SOKKIA

SET2100
SET3100
SET3100S
SET4100
SET4100S

Electronic Total Station

OPERATOR'S MANUAL

Ni-Cd

- **[English]** CONTAINS NICKEL-CADMIUM BATTERY.
  MUST BE RECYCLED OR DISPOSED OF PROPERLY.

- **[Deutsch]** MIT NiCd AKKU. EFORDERT RECYCLING ODER
  FACHGERECHTE ENTSORGUNG.

- **[Français]** CONTIENT UNE BATTERIE AU CADMIUM NICKEL.
  DOIT ÊTRE RECYCLÉE OU DONNÉE A UN ORGANISME
  DE RETRAITEMENT.

- **[Italiano]** CONTIENE NiCd BATTERIA. DEVE QUINDI ESSERE
  RICICLATA O ELIMINATA IN MODO APPROPRIATO.

- **[Nederlands]** BEVAT EEN NiCd BATTERIJ. DIENT GERECYCLEERD TE
  WORDEN OF OP EEN CORRECTE MANIER VERNIETIGD
  TE WORDEN.

- **[Español]** CONTIENE UNA NiCd BATERÍA. DEBE RECICLARSE O
  ELIMINARSE ADECUADAMENTE.

- **[Português]** CONTEM BATERIA DE NÍQUEL CÁDMIO. DEVERÁ SER
  RECICLADA OU DECARTADA CONVENIENTEMENTE.

- **[Svensk]** INNEHÅLLER NiCd BATTERI. BÖR ÅTERVINNAS ELLER
  FÖRSTÖRAS PÅ ETT SÄKERT SÄTT.

- **[Suomi]** SISÄLTÄÄ NIKKELI-KADMIUM AKUN.
  HÄVITETTÄESSÄ KÄSITELTÄVÄ ONGELMAJÄTTEENÄ.

- **[Norsk]** NiCd BATTERIER MÅ RESIRKULERES ELLER KASTES PÅ
  EN FORSVARLIG MÅTE.

- **[Dansk]** INDEHOLDER NiCd BATTERI. SKAL GENVINDES ELLER
  KASSERES PÅ FORSVARLIG MÅDE.

- **[Ελληνικα]** ΠΕΡΙΕΧΕΙ ΜΠΑΤΑΡΙΑ ΝΙΚΕΛΙΟΥ–ΚΑΔΜΙΟΥ.
  ΠΡΕΠΕΙ ΝΑ ΑΝΑΚΥΚΛΩΝΕΤΑΙ Η ΝΑ ΚΑΤΑΣΤΡΕΦΕΤΑΙ ΜΕ
  ΤΟΝ ΚΑΤΑΛΛΗΛΟ ΤΡΟΠΟ.

For U.S.A. ATTENTION:
The product that you have purchased contains a rechargeable battery.
The battery is recyclable. At the end of it's useful life, under various state and
local laws, it may be illegal to dispose of this battery into the municipal waste
stream. Check with your local solid waste officials for details in your area for
recycling options or proper disposal. Use the standard battery charger.

Die Schweiz: Nach Gebrauch der Verkaufsstelle zurückgeben.
La Suisse: Après usage à rapporter au point de vente.
Swizzera: Ritornare la pila usate al negozio.

SET2100
SET3100
SET3100S
SET4100
SET4100S

Electronic Total Station

OPERATOR'S MANUAL

- Thank you for selecting the **SET2100, SET3100, SET3100S, SET4100, or SET4100S.**

- Please read this manual carefully before starting to use the instrument. Keep this manual near the instrument for easy reference.

- Verify that all equipment is included by referring to "28. Standard Equipment".

- Sokkia is continuously conducting research and development in order to make its products easier to use and enhance their precision. The specifications and general appearance of the instrument may be altered without prior notification.

- Sokkia bears absolutely no responsibility for any profits or losses created through the use of this system.

- Some of the diagrams and screen displays shown in this manual are simplified for easier understanding.
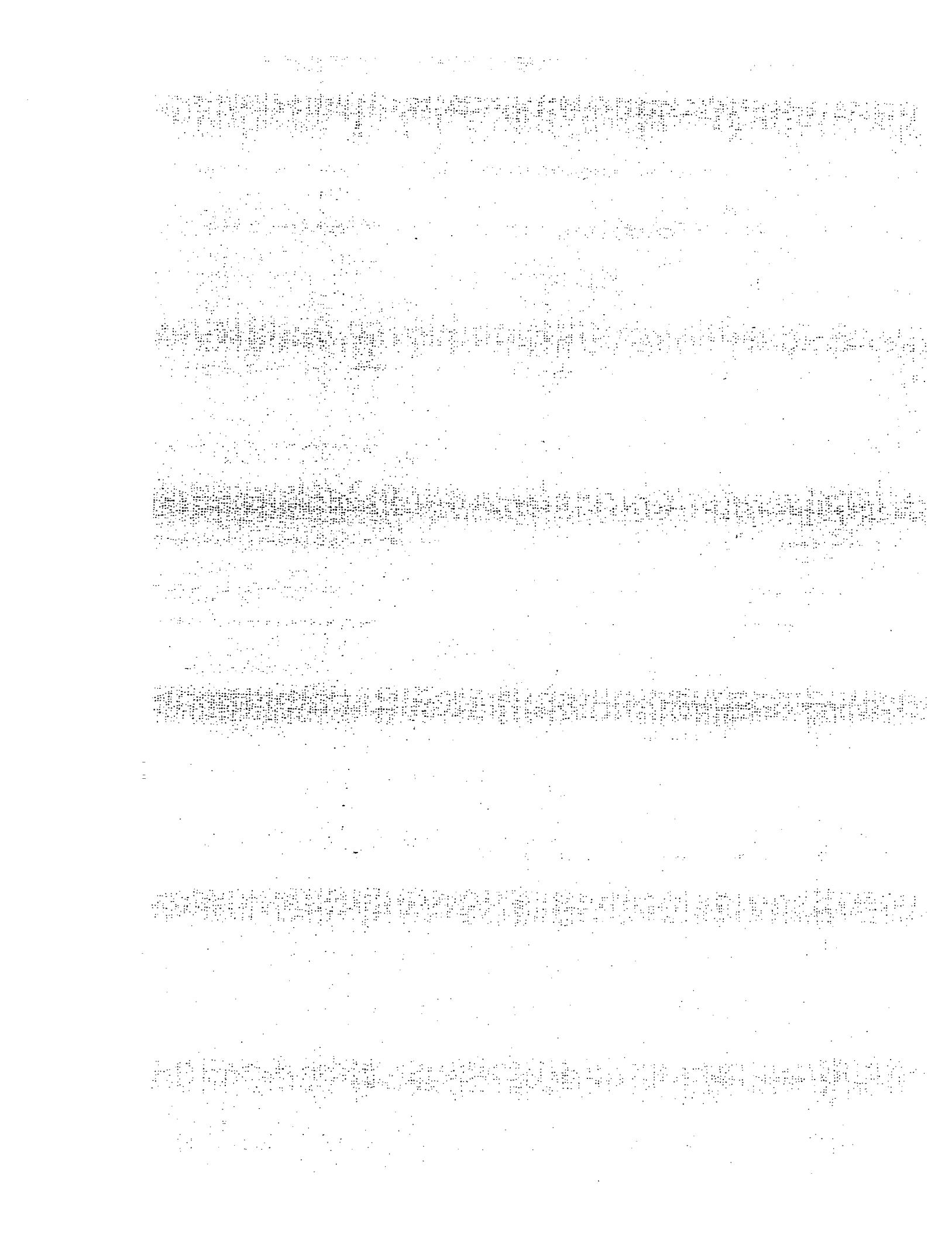
Always Follow Precautions for Safe Operation

- For the safe use of the product and prevention of injury to operators and other persons as well as prevention of property damage, items which should be observed are indicated by an exclamation point within a triangle used with WARNING and CAUTION statements in this operator's manual.
  The definitions of the indications are listed below.
  Be sure you understand them before reading the manual's main text.

Definition of Indication

⚠ **WARNING**   Ignoring this indication and making an operation error could possibly result in death or serious injury to the operator.

⚠ **CAUTION**   Ignoring this indication and making an operation error could possibly result in personal injury or property damage.

General

⚠ WARNING

- Do not use the unit in areas exposed to high amounts of dust or ash, in areas where there is inadequate ventilation, or near combustible materials. An explosion could occur.

- Do not perform disassembly or rebuilding. Fire, electric shock or burns could result.

- Never look at the sun through the telescope. Loss of eyesight could result.

- Do not look at reflected sunlight from a prism or other reflecting object through the telescope. Loss of eyesight could result.

- Direct viewing of the sun during sun observation will cause loss of eyesight. Use solar filter (option) for sun observation.

⚠ CAUTION

- Secure handle to main unit with locking screws. Failure to properly secure the handle could result in the unit falling off while being carried, causing injury.

- Tighten the adjustment tribrach clamp securely. Failure to properly secure the clamp could result in the tribrach falling off while being carried, causing injury.

- Do not use the carrying case as a footstool. The case is slippery and unstable so a person could slip and fall off it.

- Do not place the instrument in a case with a damaged catch, belt or handle. The case or instrument could be dropped and cause injury.

- Do not wield or throw the plumb bob. A person could be injured if struck.

Tripod

⚠ CAUTION

- When mounting the instrument to the tripod, tighten the centering screw securely. Failure to tighten the screw properly could result in the instrument falling off the tripod, causing injury.

- Tighten securely the leg fixing screws of the tripod on which the instrument is mounted. Failure to tighten the screws could result in the tripod collapsing, causing injury.

- Do not carry the tripod with the tripod shoes pointed at other persons. A person could be injured if struck by the tripod shoes.

- Keep hands and feet away from the tripod shoes when fixing the tripod in the ground. A hand or foot stab wound could result.

- Tighten the leg fixing screws securely before carrying the tripod. Failure to tighten the screws could lead to the tripod legs extending, causing injury.

Power Supply

⚠ WARNING

- Do not use voltage other than the specified power supply voltage. Fire or electric shock could result.

- Use only the specified battery charger to recharge batteries. Other chargers may be of different voltage rating or polarity, causing sparking which could lead to fire or burns.

- Do not place articles such as clothing on the battery charger while charging batteries. Sparks could be induced leading to fire.

- Do not use damaged power cords, plugs or loose outlets. Fire or electric shock could result.

- Do not use batteries or the battery charger if wet. Resultant shorting could lead to fire or burns.

- Do not use power cords other than those designated. Fire could result.

- To prevent shorting of the battery in storage, apply insulating tape or equivalent to the terminals. Otherwise shorting could occur, resulting in fire or burns.

- Do not heat or throw batteries into fire. An explosion could occur, resulting in injury.

⚠ CAUTION

- Do not touch liquid leaking from batteries. Harmful chemicals could cause burns or blisters.

- Do not connect or disconnect power supply plugs with wet hands. Electric shock could result.

Before Using the Instrument

- The Lithium Battery

  The lithium battery, a backup battery which retains data in the internal memory of the **SET**, can back up data for approximately 5 years of normal use, but its lifetime may be shorter depending on circumstances. <u>Therefore be sure to replace the lithium battery after the instrument has been used for 4 years.</u> Ask your Sokkia service center to replace the battery for you. <u>When the lithium battery is replaced all stored data is cleared.</u> If the voltage supplied by the lithium battery either declines or is completely discharged, the message "Exchange sub bat." is displayed. <u>If the lithium battery completely fails, the data is entirely cleared.</u> We recommend that you store data you must retain to your computer.

- Battery

  The battery (nickel hydrogen storage battery) is not charged when the instrument is shipped. Before using it, read the battery and charger operating manual and be sure to fully charge the battery.

- Loosening the Locking Screw on the Tribrach Shifting Clamp

  Screw Holding the Tribrach
  Shifting Clamp in Place
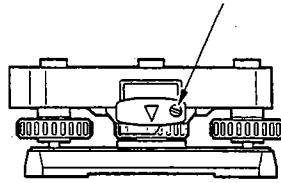
  When the instrument is shipped, the tribrach shifting clamp is held firmly in place with a locking screw to prevent the instrument from shifting on the levelling base. Before using the instrument the first time, loosen this screw with a screw-driver. And before transporting it, tighten the locking screw to fasten the tribrach shifting clamp in place so that it will not shift on the levelling base.

How to Read the Manual

- This operating manual contains all information concerning your **SET**.
  Read it in the following sequence when you use the instrument the first time.

  STEP 1 : Read "Introduction" and "Measurement Preparation."

  STEP 2 : Read "Basic Measurements" as you actually operate the instrument to become accustomed to the operating method.

  STEP 3 : Before performing measurements, try to perform the series of operations: external observation, data recording, etc.

  STEP 4 : Read "Applied Measurements" as necessary.

- Using this instrument, it is possible to freely assign the functions using the soft key in MEAS Mode. It is, therefore, not possible to specify which function is displayed at which location on which page of the screen. The operations explained in this manual are basically the settings at the time the instrument leaves the factory.

- Functions corresponding to softkeys **F1** to **F4** are enclosed by brackets [ ] in this manual.

- See "Input Range of Data Categories" for the input range of various data categories.

Special Features

- Your SET instrument displays easily understood measurement data, operating messages, and error indicators using numerals and letters of the alphabet.

- The internal memory can store 3,000 data items.

- The data stored in the internal memory can be transmitted to a computer.

- In addition to a reflective prism, it is possible to also use a reflective sheet as the target during measurements.

- Because the telescope is extremely compact, it is possible to easily collimate the target.

CONTENTS

BASIC MEASUREMENTS

DATA RECORDING

TROUBLESHOOTING

MEASUREMENT OPTIONS SELECTION

ADDITIONAL DETAILS

APPENDIX

INTRODUCTION

- This section of the manual explains precautions and the names of the parts of your **SET**. Please read this carefully before using the instrument.

1. PRECAUTIONS

- Never place the **SET** directly on the ground.
  Sand or dust may cause damage to the screw holes or the centering screw on the base plate.

- Do not aim the telescope at the sun.
  Doing so may damage the interior of the instrument.

- Protect the **SET** from direct sunlight, rain, or mist with an umbrella.
  Exposure could affect the precision of the instrument or cause corrosion and other damage.

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

- The **SET** is a precision instrument; it must be handled carefully. Protect it from heavy shocks or vibration.

- When the adaptor leaves the **SET**, the vinyl cover should be placed on the instrument.
  Dust or rain might cause an instrument malfunction.

- Turn the power off before removing the battery.
  If you do not, the internal circuits of the **SET** could be damaged.

- When placing the **SET** in its case, first remove its battery and place it in the case in accordance with the layout plan.
  If it is stored with its battery still in place, the power could come on, causing improper operation and completely discharging the battery.

- Before closing the cover on the case, make sure that the interior of the case and the **SET** are both completely dry. If any moisture remains inside the case, the instrument could rust.

2. PARTS OF THE INSTRUMENT
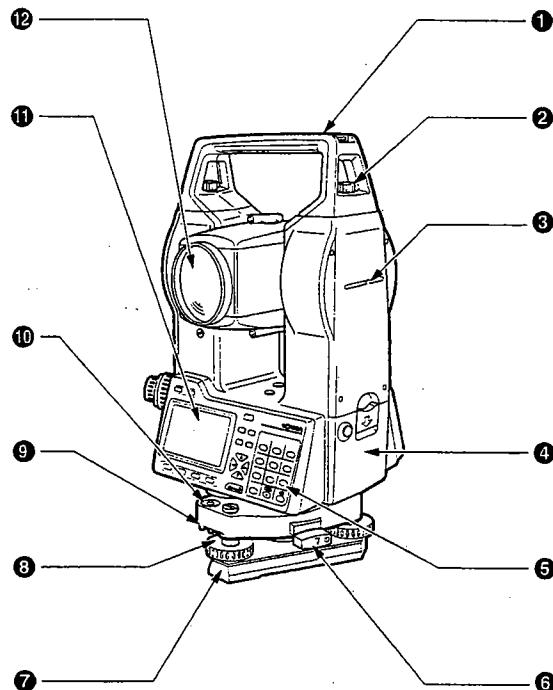
❶ Handle
❷ Handle securing screw
❸ Instrument height mark
❹ Battery
❺ Keyboard
❻ Tribrach shifting clamp
(**SET4100S/3100S**: Shifting clamp)
❼ Base Plate
❽ Levelling foot screw
❾ Circular level adjusting screws
❿ Circular level
⓫ Display
⓬ Objective lens
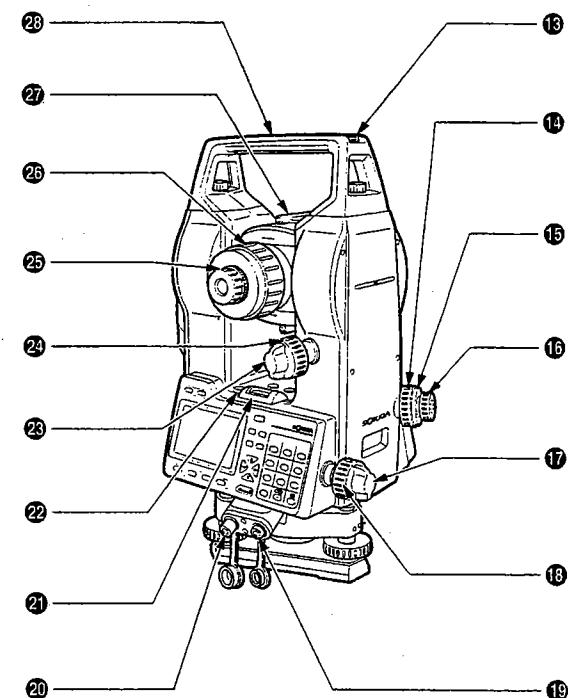
⓭ Tubular compass slot
⓮ Optical plummet focussing ring
⓯ Optical plummet reticle cover
⓰ Optical plummet eyepiece
⓱ Horizontal clamp
⓲ Horizontal fine motion screw
⓳ Data output connector
⓴ External power source connector
㉑ Plate level
㉒ Plate level adjusting screw
㉓ Vertical clamp
㉔ Vertical fine motion screw
㉕ Telescope eyepiece
㉖ Telescope focussing ring
㉗ Peep sight
㉘ Instrument center mark

3. KEY FUNCTIONS

* The **SET** has a 28-key keyboard. The keys are a power switch key, an illumination key, 4 softkeys, 10 operating keys, and 12 alphanumeric keys.

Illumination key

Power switch key

Operating keys

Softkeys

Alphanumeric keys
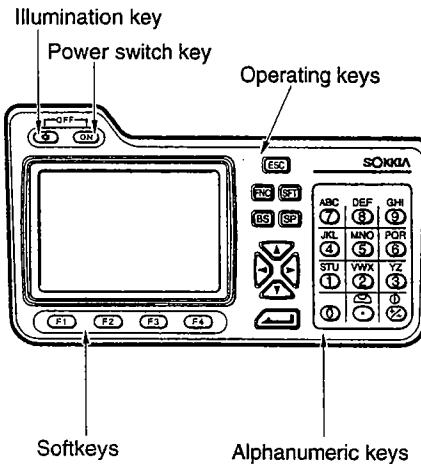
Power switch key

> To switch the power on, press **ON** .
> To switch the power off, press **:Ö:** while pressing **ON** .

Illumination key

> To switch the display and the telescope reticle image illumination on/off, press **:Ö:** .

Softkeys

> The bottom line of the **SET** display lists softkeys which vary depending on the screen. Use the keys **F1** to **F4** at the bottom left of the keyboard to select the corresponding softkey on the display. To view softkeys displayed on pages 2 and 3, press **FNC** .

> As an example, the following shows the settings of the softkeys displayed in MEAS Mode when the instrument is shipped from the factory.

Page 1

[SDIST]	:	Start distance measurement
[∡SHV]	:	Change distance measurement category
[H.ANG]	:	Set the horizontal circle to a required value
[EDM]	:	Set the EDM

Page 2

[OSET]	:	Set horizontal angle to 0
[COORD]	:	Find coordinate values of the target
[S-O]	:	Start setting-out measurement
[REC]	:	Record observed data

Page 3

[MLM]	:	Start missing line measurement
[RESEC]	:	Start resection measurement
[MENU]	:	Display measurement menu
[HT]	:	Set the height of instrument station and the target

Operating keys

ESC	:	Cancel previous operation and transfer from MEAS Mode to status screen
FNC	:	Change softkey display page
SFT	:	Turn shift mode on or off
BS	:	Delete character/left
SP	:	Input a space
▼	:	Move cursor/selected option up
▲	:	Move cursor/selected option down
▷	:	Move cursor to the left/select other options
◁	:	Move cursor to the right/select other options
⌐━━━┘	:	Confirm entry or store data on that line and move the cursor to the next line
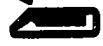
Alphanumerical keys with shift mode off

0 to **9**	:	Numerical input/selection of menu item
·	:	Input decimal point
+/−	:	Change symbol

Alphanumeric keys with shift mode on

STU **1** to GHI **9**	:	Alphabet input (a letter above each key is input when that key is pressed.)
⌒ **·**	:	Start up the circular level display function (See "9.9 Explanations: Levelling Using the Tilt Angle Display")
·① **+/−**	:	Start up the return signal check function (See "11.2 Returned Signal checking")

Read the following section for detailed alphanumeric input instructions.

4. CHARACTER ENTRY

- Job names, data numbers, codes, etc. are entered to the **SET** using letters of the alphabet and numerals.
- Change between alphabetic and numerical entry by pressing **SFT** .
  An **S** is displayed on the right side of the screen when the **SET** is in alphabet entry mode.

> Alphabet entry mode ← **SFT** → Numeral entry mode

Entry in alphabet and numeral mode is performed as follows.

▶ **PROCEDURE** Character entry

```
Mem. / JOB
JOB   : JOBM1

                              S
```
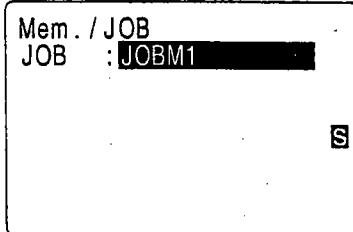
- Three letters are assigned to each key.
  Each time a key is pressed, one of the three letters is displayed successively at the cursor position.

- When the letter which must be entered is displayed, press ◀ to move the cursor to the position where the next letter will be entered.

- Press **SFT** to switch to numeral entry mode.

- When the entry is completed, press ◀▬▬ .
  The original screen is restored.

5. DISPLAY SYMBOLS

- A number of symbols are used in MEAS Mode.
  Their meanings are presented below.

PC	:	Prism constant
ppm	:	Atmospheric correction
S	:	Slope distance
H	:	Horizontal distance
V	:	Height difference
ZA	:	Zenith angle (zenith 0°)
VA	:	Vertical angle (Horizontal 0°/Horizontal 0° ± 90°)
V/%	:	Slope in %
HAR	:	Horizontal angle right
HAL	:	Horizontal angle left
HAh	:	Horizontal angle hold
$\cancel{r}$	:	Tilt angle compensation on

Remaining battery power (BDC35, Temp. = 25 °C, EDM on)

3	:	90 to 100%
2	:	50 to 90%
1	:	10 to 50%
0	:	0 to 10%

6. MODE CONFIGURATION

- The **SET** operates in a number of modes depending on your measurement needs. This section explains the relationship between the various **SET** modes and presents tables of the menus for each mode.

6.1 Mode Diagram

MEAS Mode

```
Meas.        PC    -30
             ppm     0
                    ▮3
S      1111.3625m   r
ZA      92°28'10"
HAR    120°30'10"
                    P1
SDIST ∡SHV H.ANG EDM
  OSET COORD S-O REC
   MLM RESEC MENU  HT
```

REC Mode

```
REC              123rec
 1.Dist data
 2.Angle data
 3.Coord data
 4.Stn data
 5.Note
 6.View
```

Menu Mode

```
Menu
 1.Coordinate
 2.S-O
 3.Offset
 4.Repetition
 5.MLM
 6.REM
 7.Resection
```

Status Screen

```
Apr-17-97    13:55:44

SET2100
No.123456
Ver.139-00-00
    139-00-00
Job.JOB01
 MEAS      MEM CNFG
```
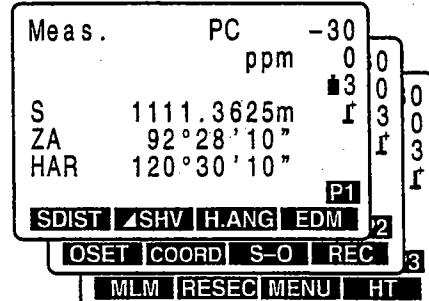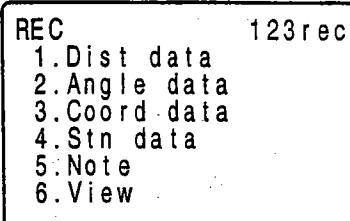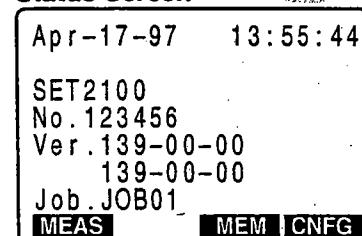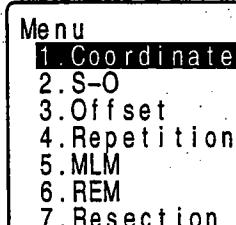
→ Instrument name
→ Instrument number
→ Application software version
→ Job name

Memory Mode

```
Memory
 1.JOB
 2.Known data
 3.Code
```

Setting Mode

```
Config.
 1.Obs.condition
 2.Instr.const.
 3.Date&time
 4.Comms setup
 5.Unit
 6.Key function
```

[MEAS] [ESC] [REC] [MENU] [MEM] [CNFG]

6.2 Menu Table

● **Status Screen**
  [MEAS]   :   To MEAS Mode
  [MEM]   :   To Memory Mode
  [CNFG]   :   To Setting Mode

● **MEAS Mode**
  [_DIST]   :   Distance measurement
  [◢ SHV] :   Select distance mode (S=Slope distance/H=Horizontal distance/V=Height difference)
  [0SET]   :   Set horizontal angle to 0
  [H.ANG]   :   Set required horizontal angle
  [R/L]   :   Select horizontal angle right/left
  [REP]   :   Repetition measurement
  [HOLD]   :   Hold horizontal angle/release horizontal angle
  [ZA/%]   :   Switch between zenith angle/slope in %
  [HT]   :   Set the instrument station height and target height
  [REC]   :   Data recording
  [REM]   :   REM measurement
  [MLM]   :   Missing line measurement
  [RCL]   :   Display final measurement data
  [VIEW]   :   Display observation data for the selected JOB
  [EDM]   :   Setting EDM (atmospheric correction and target, distance measurement method setting)
  [COORD]   :   Coordinates measurement
  [S-O]   :   Setting-out measurement
  [OFFSET] :   Offset measurement
  [MENU]   :   To Menu Mode
  [RESEC]   :   Resection measurement
  [F/M]   :   Switch between meters/feet
  [D-OUT]   :   Output measurement results to external instrument

● **Memory Mode**
  1. JOB .... To "JOB Management Screen"
  2. Known data .... To "Known Point Menu Screen"
  3. Code .... To "Code Setting Screen"

● **Setting Mode**
  1. Obs. condition .... Observation condition setting
  2. Instr. const. .... Instrument constant setting
  3. Date & time .... Date & time setting
  4. Comms setup .... Communication conditions setting
  5. Unit .... Unit setting
  6. Key function .... Key setting

<REC Mode>

1. Dist data .... Distance measurement data recording
2. Angle data .... Angle measurement data recording
3. Coord data .... Coordinates data recording
4. Stn data .... Instrument station data recording
5. Note .... Note data recording
6. View .... Review

<Menu Mode>

1. Coordinate .... Coordinates measurement
2. S–O............................. Setting-out measurement
3. Offset .... Offset measurement
4. Repetition .... Repetition measurement
5. MLM .... Missing line measurement
6. REM .... REM measurement
7. Resection.................... Resection measurement

PREPARATION FOR MEASUREMENT

7. MOUNTING THE BATTERY

- Fully charge the battery before measurement. See the battery operating manual and "24. Power Supplies" for details concerning the battery.

NOTE: Switch off power to the **SET** before removing the battery.

▶ PROCEDURE Mounting the battery

1. Insert the battery by aligning the battery guide with the guide hole in the instrument.

2. Press the top of the battery until you hear a click.

▶ PROCEDURE Removing the battery
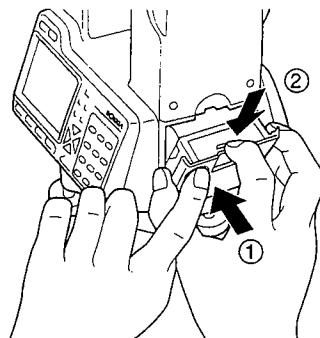
1. While pressing the round button ①, press the release button ② downward.

2. Remove the battery by pulling it towards yourself.

- To turn on the power immediately after this step, see "9. Power On and Preparation for Measurement".

8. SETTING UP THE INSTRUMENT

- If the battery is mounted after the instrument is set up, the instrument will tilt. First mount the battery, then do this operation.

8.1 Centering

▶ PROCEDURE Setting up the tripod

Level

Firmly fixed

Equal spacing
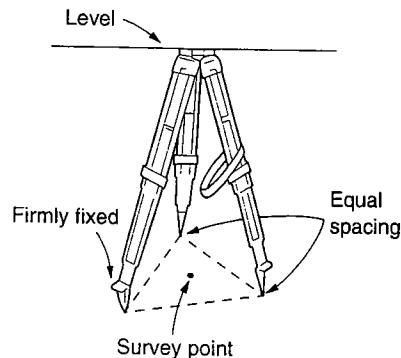
Survey point

1. Make sure the legs are spaced at equal intervals and the head is approximately level.

2. Set the tripod so the center of the head is directly over the surveying point.

3. Step on the tripod shoes to make sure the tripod is firmly fixed in the ground.

Installing the instrument on the tripod
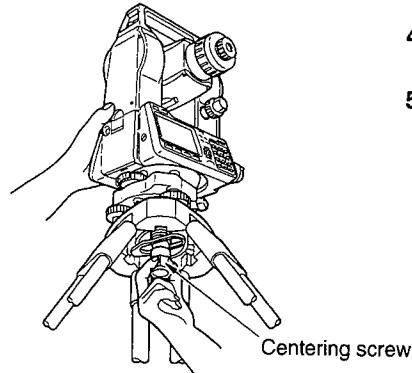
Centering screw

4. Place the instrument on the tripod head.

5. Supporting the instrument with one hand, tighten the centering screw to fix it to the female screw on the base plate of the instrument.

Focussing on the survey point

Focussing on the survey point

Focussing on the reticle
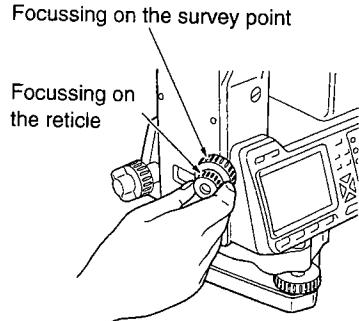
6. Looking through the optical plummet, turn the optical plummet eyepiece to focus on the concentric rings on the reticle.

7. Turn the optical plummet focussing ring to focus on the surveying point.

8.2 Levelling

- If you require higher precision levelling after completing the following procedure, please refer to "9.9 Explanations: Leveling using the tilt angle display".

▶ **PROCEDURE** **Centering the survey point in the reticle**
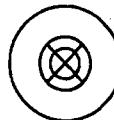
1. Adjust the levelling foot screws to center the surveying point in the optical plummet reticle.

Centering the bubble in the circular level

Tripod legs adjustment
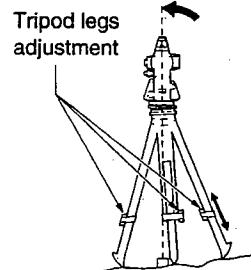
2. Center the bubble in the circular level by either shortening the tripod leg closest to the off center direction of the bubble or by lengthening the tripod leg farthest from the off center direction of the bubble.

3. Adjust one more tripod leg to center the bubble.

Centering the bubble in the plate level
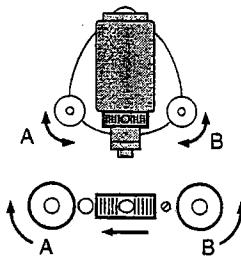
4. Loosen the horizontal clamp to turn the upper part of the instrument until the plate level is parallel to a line between levelling foot screws A and B.

5. Use levelling foot screws A and B to center the bubble.
   NOTE: The bubble moves towards a clockwise rotated levelling foot screw.

Turn 90° and center the bubble
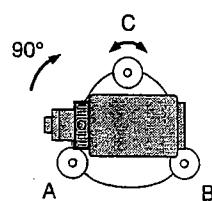
6. Turn the upper part of the instrument through 90°.
   The plate level is now perpendicular to a line between levelling foot screws A and B.

7. Use levelling foot screw C to center the bubble.

Turn another 90° and check bubble position.
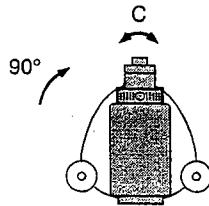
8. Turn the upper part of the instrument a further 90° and check to see if the bubble is still in the center of the plate level.

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

   a. Turn levelling foot screws A and B equally in opposite directions to remove half of the bubble displacement.

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

   Or perform the plate level adjustment described in "21.1 Plate Level".

Confirm that the bubble is in the same position in all directions

9. Turn the instrument and check to see if the bubble is in the same position in all directions. If it is not, repeat the levelling procedure.

Recentering the SET on the surveying point: removable type (SET2100, SET3100, SET4100)

10. Loosen the centering screw slightly.

11. Looking through the optical plummet eyepiece, slide the instrument over the tripod head until the surveying point is exactly centered in the reticle.

12. Retighten the centering screw securely.

13. Confirm that the bubble in the plate level is centered. If not, repeat the procedures starting from step 4.

Recentering the SET on the surveying point: shifting type (SET3100S, SET4100S)

10. Loosen the shifting clamp.
    The instrument moves horizontally up to ± 8 mm.

11. Looking at the surveying point through the optical plummet eyepiece, move the instrument to center the surveying point on the reticle.

12. Gently tighten the shifting clamp.

9. POWER ON AND PREPARATION FOR MEASUREMENT

- This section explains preparations which must be performed after the power is turned on and before measurement begins.

9.1 Power on/off
9.2 Indexing the Horizontal and Vertical Circles
9.3 Focussing and Target Sighting
9.4 Display and Reticle Illumination
9.5 Setting the Instrument Options
9.6 Setting Date and Time
9.7 Restoring Set Items to Initial Settings
9.8 Initializing the Data
9.9 Explanations

9.1 Power on/off

▶ PROCEDURE Power on

Press **ON**

```
┌─────────────────────┐
│                     │
│                     │
│     Checking        │
│                     │
│                     │
└─────────────────────┘
```

```
┌─────────────────────┐
│ O SET               │
│                     │
│                     │
│ ZA        0 set     │
│ HAR       0 set     │
│                     │
└─────────────────────┘
```

```
┌─────────────────────┐
│ Meas.               │
│                     │
│                     │
│ ZA      V1          │
│ HAR      0°00'00"   │
│        Take F1      │
│               O K   │
└─────────────────────┘
```

- Press **ON** .
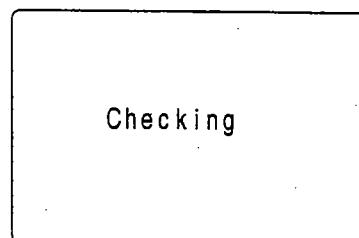
  When the power is turned on, the display on the left appears and the self-check is performed.
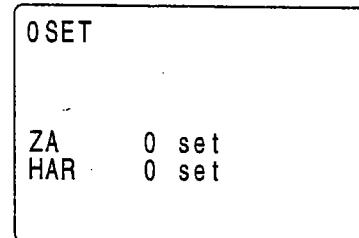
  If the instrument is operating normally, it is ready for horizontal circle and vertical circle indexing.
  When the measurement condition parameter "Horizontal circle indexing" is set to "Manual (0° at power on), the horizontal angle is displayed in [HAR].
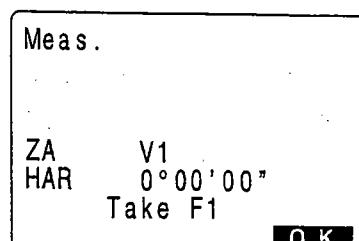
- When the measurement condition parameter "Vertical circle indexing" is set to Manual (by sighting both faces), the screen on the left appears.

  For the indexing method, refer to "26. Manually Indexing the Vertical Circle".

- **Horizontal angle of 0° when power is on**
  - It is possible to switch the horizontal circle indexing method from "indexing by rotating the top of the instrument" to "0° when power is on."

- **Indexing the vertical circle based on face left/face right measurement**
  - It is possible to switch the vertical circle indexing method from "indexing by rotating the telescope" to "indexing based on face left/face right measurement." For the indexing method based on face left/face right measurement, refer to "26. Manually Indexing the Vertical Circle".

▶ **PROCEDURE** Power off

While pressing (ON), press
(☼)

- While pressing (ON), press (☼).

NOTE: If the battery has reached the level where it should be replaced, the symbol shown on the left is displayed every 3 seconds.
When it appears, stop all work as quickly as possible, shut off the power, and charge the battery.

9.2 Indexing the Horizontal and Vertical Circles

- Either the horizontal circle indexing or the vertical circle indexing may be performed first.

▶ PROCEDURE Horizontal circle indexing
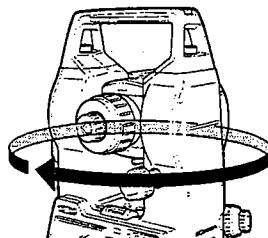
- Loosen the horizontal clamp and rotate the upper part of the instrument until the **SET** beeps.
  The horizontal circle is indexed.

▶ PROCEDURE Vertical circle indexing
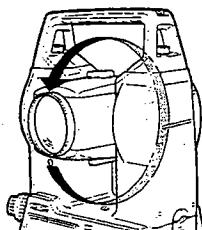
- Loosen the vertical clamp and transit the tele-scope.

- When the objective lens crosses the horizontal plane in face left, the **SET** emits a beeping sound, and the vertical circle is indexed.

```
Meas.        PC  -30
             ppm    0
                   ■3
                    ↲
ZA     78°45'59"
HAR   120°31'31"
                   P1
 SDIST  ⊿SHV  H.ANG  EDM
```

- When the horizontal circle and vertical circle have been indexed, the screen on the left is displayed.

```
Meas.        PC  -30
             ppm    0
                   ■3
                    ↲
ZA     Out of range
HAR
                   P1
 OSET  COORD  S-O  REC
```

- If the error message on the left is displayed, the instrument tilt has exceeded the tilt angle compensation range. Level the instrument again, then display the horizontal and vertical angles again.

NOTE: Be sure to index the horizontal and vertical circles every time the instrument power is turned on.

• No automatic tilt angle compensation/only vertical angle compensation

When the display is unstable because of vibration or strong wind, setting parameter can switch to either "no automatic tilt angle compensation" or "only vertical angle compensation."

Backup horizontal angle → "9.9 Explanations: Horizontal angle back-up"
Tilt angle compensation → "9.9 Explanations: Automatic tilt angle compensation mechanism"
Relevelling method → "9.9 Explanations: Levelling using the tilt angle display"

9.3 Focussing and Target Sighting

▶PROCEDURE **Focussing on the telescope's reticle image**
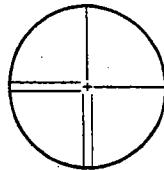
1. Direct the telescope at a bright and feature-less background.

2. Looking through the telescope eyepiece, turn the eyepiece completely to the right, then gradually to the left until just before the reticle image becomes focussed.

   This procedure reduces the load on your eyes and eliminates the need for frequent refocussing.

Sighting the target

3. Loosen the vertical clamp and the horizontal clamp, look through the peep sight to bring the target into your field of vision, then tighten both clamps.

Focussing the center of the reticle image on the target

4. Turn the focussing ring to focus on the target.

5. Turn the vertical fine motion screw and the horizontal fine motion screw to accurately align the reticle image and the center of the target.

   Perform the levelling with both fine motion screws so that in both cases the last turn is to the right.
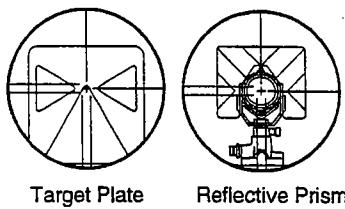
Target Plate   Reflective Prism

Readjusting the focus to eliminate parallax

6. Use the focussing ring to readjust the focus until there is no parallax between the target and the reticle image.

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

Eliminating parallax → "9.9 Explanations: Eliminating of parallax"

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9.4	Display and Reticle Illumination

- In dark places, it is possible to illuminate the display and the telescope's reticle image so that they are easy to see.

▶ PROCEDURE Display and telescope reticle illumination on/off

Press ⬭☼⬭

1. Press ⬭☼⬭ to turn the display and telescope reticle image illumination on.

2. Press ⬭☼⬭ again to turn the illumination off.

- Changing the reticle image illumination brightness
  - The brightness of the reticle image illumination can be changed from bright to dark by setting parameter.

9.5 Setting the Instrument Options

- In Setting Mode, make sure that the parameters concerning measurement are set in accordance with measurement conditions.

- To confirm or change the parameter options, see "22. Changing Instrument Parameters".

Screen Setting	Parameter		Options (* : Factory Setting)
OBSERVATION CONDITION	Atmospheric correction		Temperature, air pressure *
			Temperature, air pressure, humidity
	Earth curvature and refraction correction		None *
			K = 0.142
			K = 0.20
	Vertical angle format		Zenith 0° *
			Horizontal 0°
			Horizontal 0° ±90°
	Tilt correction		Yes (horizontal and vertical angles) *
			Yes (vertical angle only)
			No
	Collimation correction		Yes *
			No
	Reticle illumination		Bright *
			Dim
	Vertical circle indexing		Auto: Transit telescope *
			Manual: By sighting both faces
	Horizontal circle indexing		Auto: Rotate upper part *
			Manual: 0° at power on
	Automatic power cut off		Auto power cut off after 30 minutes *
			Switch on/off by key
	Angle resolution	SET2100	1" *
			0.5"
		SET3100/S	1" *
			5"
		SET4100/S	1" *
			5"
	Coordinates format		N–E–Z *
			E–N–Z
	Distance mode initial display		Slope distance (Sdist) *
			Horizontal distance (Hdist)
			Height difference (Vdist)
	Minimum distance display (only the SET2100)		1 mm *
			0.1 mm
	Read-in JOB		Enter the read-in JOB

Screen Setting	Parameter	Options (* : Factory Setting)
COMMS SETUP	Communication speed (baud rate)	1,200 bps *
		2,400 bps
		4,800 bps
		9,600 bps
		19,200 bps
		38,400 bps
	Data length	8 bits *
		7 bits
	Parity	Not set *
		Even
		Odd
	Stop bit	1 bit *
		2 bits
	Check sum	No *
		Yes
	Xon/Xoff	Yes *
		No
UNIT	Temperature	°C *
		°F
	Air pressure	hPa *
		mmHg
		inchHg
	Angle	degree *
		gon
		mil
	Distance	metres *
		feet

Concerning parameter "Collimation Correction" → 9.9 Explanations: Collimation correction"

9.6 Setting Date and Time

• It is possible to set or revise the date and time displayed in the "Status Screen".

▶ **PROCEDURE** Setting date and time

Press **[CNFG]**
Setting Mode Screen

```
Config.
 1.Obs.condition
 2.Instr.const.
 3.Date&time
 4.Comms setup
 5.Unit
 6.Key function
```

1. Press **[CNFG]** in the "Status Screen".
   The "Setting Mode Screen" is displayed.

Select "3. Date & Time",
press ◢◣
Date & Time Setting Screen

```
Date&time
 Date :Jul-20-97
 Time :143517



              O K
```

2. Select "3. Date & Time" and press ◢◣ .
   The "Date & Time Setting Screen" is displayed.
   It is possible to move the entry point between
   date and time by pressing ▼ and ▲ .

Entering date and time

3. Enter the date and time using the numerical
   keys.
   The year, month, day, hour, minute, and sec-
   ond are all two digit numbers.

   Entry example: July 20, 1997 → 072097
                  2:35:17 p.m. → 143517

Press **[OK]**

Setting Mode Screen

4. When setting is completed, press **[OK]**.

   The date and time are checked and the "Set-
   ting Mode Screen" is restored.

9.7 Restoring Set Items to Initial Settings

● Restore the following items to the initial settings when the **SET** was shipped.

Observation Conditions:
Atmospheric correction factor setting, earth curvature and refraction correction, vertical angle format, tilt correction, collimation correction, reticle illumination, vertical circle indexing, horizontal circle indexing, automatic power cut off, distance mode initial display, angle resolution, coordinate format, minimum distance display (**SET2100** only).

Communication Settings:
Transmission speed, data length, parity, stop bit, check sum, flow control (Xon/Xoff).

Units:
Temperature, air pressure, angle, distance

EDM Settings:
Temperature, air pressure, humidity, atmospheric correction factor, target, prism constant correction value, distance measurement method, average measurement frequency.

Key Array:
Key array when the **SET** was shipped

▶ **PROCEDURE** Restoring set items to initial settings and turning power on

While pressing **+/−**, press and hold **ON**

● While pressing **+/−**, press and hold **ON** with the power turned off.
When the **SET** is turned on and is in normal vertical circle and horizontal circle indexing stand-by status, release the **ON** and **+/−** buttons.

9.8 Initializing of the Data

● Initialize the data. The following data is initialized.

● Data within all jobs.
● Coordinate data within memory
● Code data within memory

▶ **PROCEDURE** Initializing the data and turning the power on.

While pressing [+/-], [6] and
[F4], press and hold [ON]

- With the power shut off, continuously press [ON] while pressing [+/-], [6] and [F4]. Turn the power on, and when the instrument is in stand by for normal vertical circle and horizontal circle indexing, lift your fingers from the keys.

9.9 | Explanations

▶ **EXPLANATION** Horizontal angle back-up

- When measurement observation parameter "Horizontal circle indexing" is set to default, the position of the horizontal angle of 0° set just before the power was turned off and the horizontal right and left is stored in the internal memory until the backup lithium battery runs down. If horizontal circle indexing is performed after power on, the angle from the position of the stored 0° is displayed.
  This function is a useful way to reproduce the original display when the battery must be replaced during measurement or after the automatic power off function has activated.

▶ **EXPLANATION** Automatic tilt angle compensation mechanism

- When the $\mathcal{I}$ symbol is shown on the display, the vertical and horizontal angles are automatically compensated for small tilt errors using the 2-axis tilt sensor.

```
Meas.          PC  -30
               ppm  DO
                     ▮3
                     (Ĩ)
ZA    89°59'54"
HAR  117°32'21"
                     P2
OSET COORD S-O REC
```
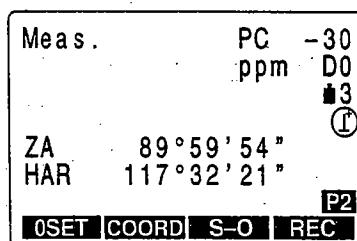
- Read the automatically compensated angles when the display has stabilized.

  The horizontal angle error (vertical axis error) fluctuates according to the vertical axis, so when the instrument is not completely levelled, changing the vertical angle by rotating the telescope will cause the displayed horizontal angle value to change. The displayed horizontal angle value will not change during telescope rotation when the instrument is correctly levelled.

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

- When the telescope is directed close to the zenith or nadir angle, tilt compensation is not applied to the horizontal angle.

▶ EXPLANATION **Eliminating parallax**

- Parallax is the relative displacement of the target image with respect to the reticle when the observer's head is moved slightly up and down or to the sides while looking through the telescope. Parallax will introduce reading errors and must be eliminated before observations are taken. Parallax can be removed by refocussing the reticle.

▶ EXPLANATION **Power-saving automatic cut-off**

- To save power, power to the **SET** is automatically cut off if it is not operated for 30 minutes. It is possible to turn the automatic power cut-off function on or off using the observation condition setting screen. For the setting method, see "22. Changing Instrument Parameters".

▶ EXPLANATION **Collimation correction**

- The **SET** has a collimation correction function which automatically corrects horizontal angle errors caused by horizontal axis and levelling axis errors. The collimation of the angles displayed are automatically corrected.

▶ EXPLANATION **Levelling using the tilt angle display**

- It is possible to display the state of tilt of the instrument graphically or numerically and level the instrument. The tilt angle correction range is ±3'.

▶ PROCEDURE **Graphically displaying the tilt of the instrument**

Press **SFT**, then press **●**

```
 Tilt


        ◉              S

 DIGIT
```
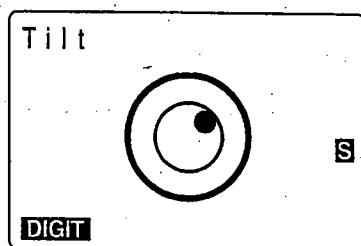
1. After pressing **SFT** with any screen displayed to set shift mode, press **●** .
   The circular level is graphically displayed.
   " ● " represents the bubble in the circular level.
   The range of the inside circle is ±3' and the range of the outside circle is ±4'.

2. Move the " ● " to the center as instructed in "8.2 Levelling".

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Levelling by displaying the tilt angle numerically
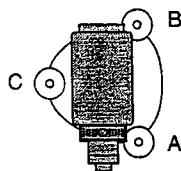
3. Turn the instrument until the telescope is parallel to a line between levelling foot screws A and B, then tighten the horizontal clamp.

Press **[DIGIT]**

```
Tilt



X      -0°00'12"      S
Y       0°00'43"

GRAPH
```
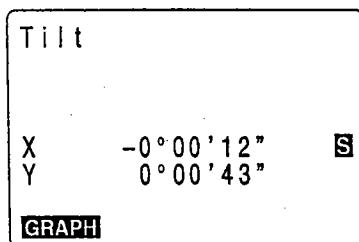
4. Press **[DIGIT]**.
   The X (horizontal) direction and the Y (vertical) direction tilt angles are displayed.

Setting the tilt angle to 0° with levelling screws.

Press **[GRAPH]**

5. Set the tilt angle to 0° using levelling foot screws A and B for the X (horizontal) direction and levelling screw C for the Y (vertical) direction. Press **[GRAPH]** to return to graphic display.

Restoring the original screen

Press **ESC**

6. Press **ESC** .
   The original screen is restored.

BASIC MEASUREMENTS

- This section of the manual explains the angle measurement, distance measurement, and coordinate measurement: three measurements which can be performed in MEAS Mode.

- Measurement data can be recorded in the instrument's internal memory.
  For the recording method, see "19. Recording in Record Mode".

MEAS Mode Screen

```
Meas.          PC  -30
               ppm   0
                     ▮3
S       1234.567m    ɾ
ZA      78°45'59"
HAR    120°31'31"
                    P1
 SDIST  ⊿SHV  H.ANG  EDM
```
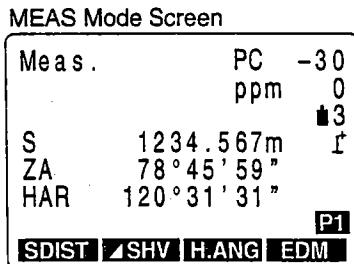
- When the preparations for measurement 7 to 9 are completed, the instrument is in MEAS mode.

10. ANGLE MEASUREMENT

- This section on angle measurement explains the following procedures.
  - 10.1 Measuring the Horizontal Angle Between Two Points (Horizontal Angle 0)
  - 10.2 Setting the Horizontal Circle to a Required value (Horizontal Angle Hold)
  - 10.3 Horizontal Angle Display Selection <Right/Left>
  - 10.4 Horizontal Angle Repetition
  - 10.5 Slope in %

- When recording the measurement data, refer to "19.2 Recording Angle Measurement Data".

Check the following one more time before measurement

1. The instrument is precisely above the survey point.
2. The battery is sufficiently charged.
3. The horizontal circle and vertical circle indexing have been completed.
4. The parameters are set in conformity with measurement conditions.

10.1 Measuring the Horizontal Angle Between Two Points (Horizontal Angle 0)

- To measure the included angle between two points, the horizontal angle can be set to 0 at any direction.

▶ **PROCEDURE** Horizontal angle 0 set

Press [FNC]
MEAS Mode Screen (Page 2)

```
Meas.          PC  -30
                ppm   0
                      ▮3
                       ƒ
ZA      89°59'54"
HAR    117°32'21"
                      P2
 OSET COORD  S-O  REC
```

1. Press [FNC] on the first page of the "MEAS Mode Screen".

   Softkey Page 2 is displayed.

Press [OSET] [OSET]

```
Meas.          PC  -30
                ppm   0
                      ▮3
                       ƒ
ZA      89°59'54"
HAR     0°00'00"
                      P2
 OSET COORD  S-O  REC
```

2. Press [OSET].

   [OSET] flashes on and off.

3. Press [OSET] again.

   The horizontal angle of the collimation direction is 0°.

▶ EXAMPLE   Measuring the horizontal angle between two points

1st target

O◀

△

Instrument Station
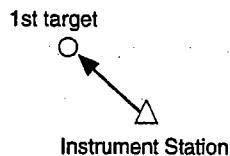
1. Using the horizontal clamp and the horizontal fine motion screw, sight the first target.

Press [0SET] [0SET]

```
Meas.          PC   -30
               ppm    0
                     ▮3
                      ↕
ZA       89°59'54"
HAR       0°00'00"
                     P2
 0SET COORD  S-O  REC
```

2. In the second page of the "MEAS Mode screen," press [0SET].

   [0SET] will flash, so press [0SET] again.

   The horizontal angle at the first target is 0°.

2nd Target
O   O◀

△
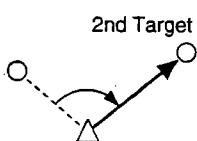
3. Sight the 2nd target.

```
Meas.          PC   -30
               ppm    0
                     ▮3
                      ↕
ZA       89°59'54"
HAR     117°32'21"
                     P2
 0SET COORD  S-O  REC
```

The displayed horizontal angle (HAR) is the included angle between the two points.

10.2 Setting the Horizontal Circle to a Required value (Horizontal Angle Hold)

- You can set the horizontal angle in the sighted direction to any required value.

▶ **PROCEDURE** Setting the horizontal circle to a required value

Press [H.ANG]
Required Angle Setting Screen

```
Set H angle
HAR:▊▊▊▊▊
```

```
 B S
```

1. In the first page of the "MEAS Mode Screen," press [H.ANG].

The "Required Angle Setting Screen" appears.

When turning the horizontal angle to the right, [HAR] is displayed, when turning it to the left, [HAL] is displayed.
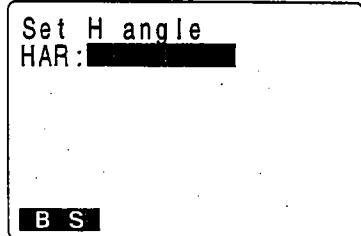
Enter the Angle, press ▟▅▅▅▟
MEAS Mode Screen (First Page)

```
Meas.        PC  -30
             ppm    0
                   ▮3
                     ⊺
ZA       89°59'54"
HAR       0°01'00"
                   P1
 SDIST  ▟SHV  H.ANG  EDM
```

2. Enter the angle you wish to set from the keyboard, then press ▟▅▅▅▟ .

The "MEAS Mode Screen" is restored and the value which is set as the horizontal angle is displayed.

- Entry Rules
  - When you wish to enter 90° 30′ 20″, input "90.3020."
  - Correct 1 letter/numeral of the entered value : **BS** (erases the letter/numeral to the left of the cursor.)
  - Erase the entered value : **ESC**
  - Stop the entry in progress : **ESC** **ESC** **ESC**

- Direction angle calculation: [BS] (See "12.2 Azimuth Angle Setting")

▶ REFERENCE Setting a required angle using [HOLD]

- It is possible to use the horizonal angle hold function to set the horizontal angle of the sighting direction to a required angle.

- In advance allocate the function keys to display **[HOLD]**. For the allocation method, see "23. Key Function Allocation".

▶ PROCEDURE Setting the horizontal angle to the required angle

Measurement Mode Screen
Display the desired angle of the horizontal angle.

```
Meas.          PC  -30
               ppm   0
                    ▪3
                     ɾ
ZA      89°59'54"
HAR     90°00'00"
                   P1
SDIST  ∕SHV  HOLD  EDM
```
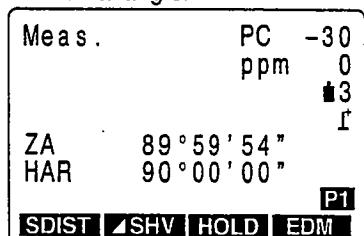
1. In MEAS Mode, display the screen which in **[HOLD]** is registered.

2. Use the horizontal clamp and the fine motion screw to display the desired angle of the horizontal angle.

Press **[HOLD]** **[HOLD]**

```
Meas.          PC  -30
               ppm   0
                    ▪3
                     ɾ
ZA      89°59'54"
HAh     90°00'00"
                   P1
SDIST  ∕SHV  HOLD  EDM
```
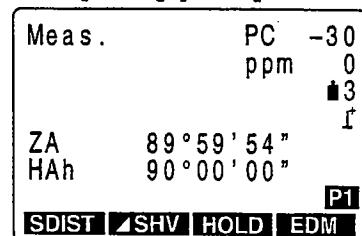
3. Press **[HOLD]** twice.

   The horizontal angle is in the hold status.

   The horizontal angle display is [HAh].

After sight the target
Press **[HOLD]**

```
Meas.          PC  -30
               ppm   0
                    ▪3
                     ɾ
ZA      89°59'54"
HAR     90°00'00"
                   P1
SDIST  ∕SHV  HOLD  EDM
```

4. Sight the target and press **[HOLD]** once.

   Horizontal angle [HOLD] is canceled and the desired angle is set for the target.
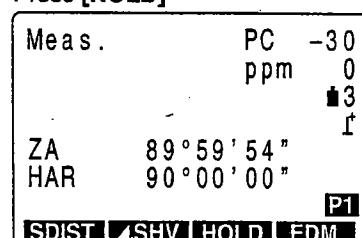
10.3 Horizontal Angle Display Selection <Right/Left>

- It is possible to switch between horizontal angle clockwise display and horizontal angle counterclockwise display.

- In advance allocate the functions keys to display **[R/L]**. For the allocation method, see "23. Key Function Allocation".

▶ **PROCEDURE** Selecting horizontal angle <right/left>

MEAS Mode Screen

```
Meas.          PC  -30
               ppm   0
                     ▮3
                      ↿
ZA      89°59'54"
HAR    117°31'21"
                     P1
 R/L  ◢SHV  H.ANG  EDM
```

1. In MEAS Mode, display the screen in which [R/L] is registered.

   Horizontal angle display becomes clockwise (HAR).

Press [R/L]

```
Meas.          PC  -30
               ppm   0
                     ▮3
                      ↿
ZA      89°59'54"
HAR    242°28'39"
                     P1
 R/L  ◢SHV  H.ANG  EDM
```

2. Press [R/L].

   Horizontal angle display switches from clockwise (HAR) to counterclockwise (HAL).

   HAL = 360° − HAR

   Press [R/L] once more to return to clockwise.

10.4 Horizontal Angle Repetition

- To find the horizontal angle with greater precision, perform repetition measurement.

- In advance allocate the function key to display [REP]. For the allocation method, see "23. Key Function Allocation".

- It is also possible to perform repetition measurement when [MENU] on page 3 of the MEAS Mode Screen is pressed to enter Menu Mode, then "4. Repetition" is selected without allocating the function keys.

```
1st Target (BS)        2nd Target (FS)
       O                      O

3rd meas. Starts                3rd meas. end (average of three measurements is displayed)
2nd meas. Starts                2nd meas. end (average of two measurements is displayed)
1st meas. Starts                1st meas. end (the angle between 2 points is displayed)

              Station
```
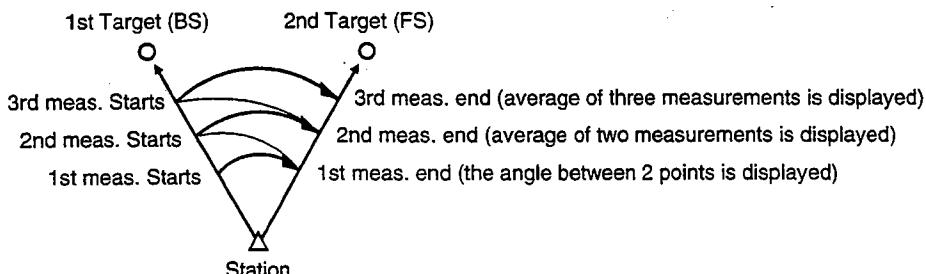
▶ PROCEDURE Horizontal angle repetition

Press [REP]
Repetition BS Sighting Screen
(First Time)

```
Repetition
HAh        0°00'00"
Reps.  0
Ave.   0°00'00"
ZA     89°59'54"
HAh    0°00'00"
 Take BS
 C E              O K
```

1. In MEAS Mode, press [REP].

Repetition BS Sighting Screen is displayed.

The horizontal angle is 0°.

Sighting First Target, press [OK]
Repetition FS Sighting Screen is
displayed (First Time)

```
Repetition
HARp       0°00'00"
Reps.  0
Ave.   0°00'00"
ZA     89°59'54"
HAR    0°00'00"
 Take FS
 C E              O K
```

2. Sighting 1st target, press [OK].

The repetition FS Sighting Screen is displayed.

Sighting 2nd Target, press [OK]
Repetition BS Sighting Screen
(Second Time)

```
Repetition
HAh      40°00'00"
Reps.    1
Ave.    40°00'00"
ZA      91°59'54"
HAh     40°00'00"
 Take BS
 C E              O K
```

3. Sighting 2nd target, press [OK].

    The Repetition BS Sighting Screen is displayed
    a second time.

* Return to the measurement of 1 st target the first time and redo it: [CE]
  (Effective when the display shows "Take BS")

Sighting 1st Target, press [OK]
Repetition FS Sighting Screen
(Second Time)

```
Repetition
HARp    40°00'00"
Reps.    1
Ave.    40°00'00"
ZA      89°59'54"
HAR      0°00'00"
 Take FS
 C E              O K
```

4. Sighting 1st target the second time, press [OK].

    The Repetition FS Sighting Screen is displayed
    a second time.

Sighting 2nd Target, press [OK]
Repetition BS Sighting Screen
(Third Time)

```
Repetition
HAh      80°00'00"
Reps.    2
Ave.    40°00'00"
ZA      91°59'54"
HAh     40°00'00"
 Take BS
 C E              O K
```

5. Sighting 2nd target, press [OK].

    The Repetition BS Sighting Screen is displayed
    a third time.

    The cumulative value of the horizontal angle is
    displayed on the second line (HAh), and the
    average value of the horizontal angle is dis-
    played on the fourth line (Ave.).

6. When continuing the repetition measurement,
    repeat procedures 4 to 5.

Repetition measurement com-
pleted, press [ESC]

7. When the repetition measurement is com-
    pleted, press [ESC] .

- In repetition measurement mode, even if "Automatic Tilt Compensation On" is selected, horizontal angle compensation will not occur.

- Maximum measurement frequency: 10 times

- Repetition display range : SET2$_{100}$ ±3559° 59' 59.5"
                       SET3$_{100}$ ±3559° 59' 59"
                       SET4$_{100}$ ±3559° 59' 55"

10.5 Slope in %

- It is possible to display the gradient as a %.

- In advance allocate the function key to display [ZA/%]. For the allocation method, see "23. Key Function Allocation".
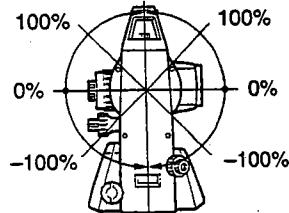
▶ **PROCEDURE** Slope in %

MEAS Mode Screen

```
Meas.          PC   -30
               ppm    0
                      ▮3
                       ⅼ
ZA      89°59'54"
HAR    117°32'21"
                     P1
 ZA/%  ⊿SHV  H.ANG  EDM
```

1. In MEAS Mode, display the screen in which [ZA/%] is registered.

Press [ZA/%]

```
Meas.          PC   -30
               ppm    0
                      ▮3
                       ⅼ
V%      -0.402 %
HAR    117°32'21"
                     P1
 ZA/%  ⊿SHV  H.ANG  EDM
```

2. Press [ZA/%].

The vertical angle (ZA) is displayed as a gradient (V%).

Press [ZA/%] again to return to the original vertical angle display.

- Display Range : Within ±1,000

- When parameter "Vertical angle format" is set to [horizontal 0°] or to [horizontal ±90°], [VA] is displayed instead of [ZA].

11. DISTANCE MEASUREMENT

- This section explains the following distance measurement items.
  First complete the preparations in 11.1 to 11.2 in order to perform distance measurements.

  11.1 Settings for Distance Measurements
  11.2 Returned Signal Checking
  11.3 Distance and Angle Measurement
  11.4 Review of Measured Data
  11.5 Measuring Distance and Outputting the Data to a Computer

11.1 Settings for Distance Measurements

- Perform the following four settings as preparation for distance measurements.
  - Atmospheric correction factor
  - Target type
  - Prism constant correction value
  - Distance measurement mode

▶ **EXPLANATION** Atmospheric correction

- The atmospheric correction is necessary for accurate distance measurement because the velocity of light in air is affected by the temperature and air pressure.

  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. See "27. Atmospheric Correction for High Precision Distance Measurements".

- The **SET** is designed so that the correction factor is 0 ppm at an air pressure of 1,013 hPa and a temperature of 15°C.

- By inputting the temperature and air pressure values, the correction value is caluculated and set into the memory.

  Calculate the atmospheric correction factor as shown in the following formula.

  $$ppm = 278.96 - \frac{0.2904 \times air\ pressure\ (hPa)}{1 + 0.003661 \times air\ temperature\ (°C)}$$

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

- It is also possible to enter the atmospheric correction factor by directly entering the ppm value. To input ppm value, read the correction factor from the "Atmospheric Correction Chart".

- For more precise measurements, account for atmospheric corrections related to humidity. See "27 Atmospheric Correction for High Precision Distance Measurements". When a **SET** is shipped from the factory, it is set so that only the corrections to temperature and to air pressure are performed. When you wish to set humidity, first change the atmospheric correction factor setting of parameter No. 1 to [+humidity], then set the atmospheric correction factor. For details, see "9.5 Setting Measurement Conditions Parameters".

▶ **EXAMPLE**   Finding the atmospheric correction factor from the atmospheric correction chart when the temperature = +25°C and the air pressure = 1,000 Pa.
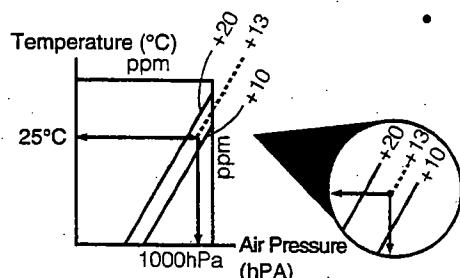
- The atmospheric correction factor from the table on the left is 13 ppm.

Temperature (°C) ppm

25°C

1000hPa Air Pressure (hPA)

▶**EXPLANATION**   Prism constant correction

- Reflective prisms each have their prism constant.
  Set the prism constant correction value of the reflective prism you are using.

- The prism constant correction values of reflective prisms from Sokkia are as shown below.

AP01S+AP01 (Constant = 30 mm)   AP01 (Constant = 40 mm)   CP01 (Constant = 0 mm)
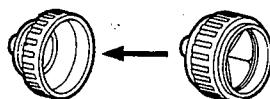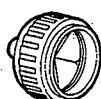
Correction Value = –30   Correction Value = –40   Correction Value = 0

▶ **EXPLANATION** Distance measurement mode

- The following are the measurement times and measurement methods and the smallest distance displayed for each measurement method when a reflective prism is used.

Fine Measurement
Accuracy: ± (2+2 ppm x D) mm (D is the measurement distance, the unit is mm)
Measuring time: First time 4.2 sec., with measurements every 2.0 seconds afterwards.
Minimum display: 1 mm (SET2100: 0.1 mm)

Rapid Measurement
Accuracy: ± (5+5 ppm x D) mm (D is the measurement distance, the unit is mm)
Measuring time: First time 2.9 sec., with measurements every 0.7 seconds afterwards.
Minimum display: 1 mm

Tracking measurement
Measuring time: First time 2.9 sec., with measurements every 0.5 seconds afterwards.
Minimum display: 10 mm

▶ **PROCEDURE** Settings for distance measurements

Press **[EDM]**
EDM Setting Screen (Page 1)

```
EDM
Temp      :15°C          1
Press     :1013hPa       2
Humid     :  0%          3
ppm       :   0          4
Reflector:Prism          5
PC        :-30      ↓    6
0PPM
```

```
              (Page 2)
Mode        :Fine"r"     7
```

1. Press **[EDM]** in Page 1 of MEAS Mode.

The "EDM Setting Screen" is displayed.

2. Set the following items

1 Temperature
2 Air pressure
3 Humidity
4 Atmospheric correction factor
5 Target type
6 Prism constant correction value
7 Distance measurement method

After setting these, press ◢◣.

- Setting method and content
1 to 4: Temp., Press., Humid., ppm
  It is possible to set the atmospheric correction factor in the following two ways.
  ① Entering the air temperature, pressure, and humidity (Temp., Press., Humid)
    After they are entered, the atmospheric correction factor is automatically calculated, and [ppm] in 4 is displayed. When parameter "Atmospheric Correction" is set to "temperature and air pressure," item (3) humidity can not be displayed.
  ② Directly entering the atmospheric correction factor (ppm).
    After entry, the values for [Temp.], [Press.] and [Humid.] are erased

5. Reflector: Select it with ▶ ◀ . (selection: prism, sheet)
6. PC: Enter the prism constant correction value suited to the reflector used.
7. Mode: Select it with ▶ ◀ .
   (Selection: Fine"r", Fine AVG"n=", Fine"S", Rapid"r", Rapid"S", Traking)

* Setting the atmospheric correction factor to 0 ppm: [0ppm]

After setting complete, on mode line
press ◢▬▬◣
Measurement Mode Screen

3. After all setting is completed, press ◢▬▬◣
   on the Mode line.

   "MEAS Mode Screen" is restored.

11.2 | Returned Signal Checking

- Check to make sure that sufficient reflected light is returned by the reflective prism sighted by the telescope. Checking the returned signal is particularly useful when performing long distance measurements.

- The instrument can be switched to returned signal checking at any time except the following times:
  - During distance measurement
  - During resection calculation
  - During circular level display

▶ PROCEDURE   Returned signal checking

Sight Target, press
SFT and **+/-**
Returned Signal Check Screen

```
Aiming


Signal   ▮▮▮▐ ┊┊┊┃ *S


SDIST  BEEP
```

Press **ESC** : Check completed
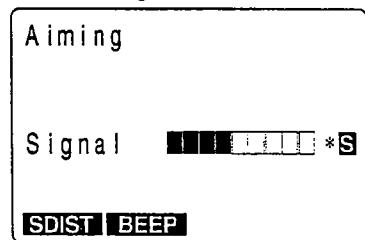
Press **[SDIST]**

1. Accurately sight the reflecting target, and press **SFT** and **+/-** in any screen.

   The "Returned Signal Check Screen" is displayed.

   The intensity of the light of the returned signal is displayed by a gauge.
   - ⬚⬚⬚⬚⬚⬚⬚ : No light
   - ⬚⬚⬚⬚⬚⬚▮ : Too much light
   - ▮⬚⬚⬚⬚⬚⬚ : Distance measurement possible
   - ▮▮▮▮⬚⬚⬚ : Distance measurement possible
   - ▮▮▮▮▮▮⬚ : Distance measurement possible

- The more [▮] displayed, the greater the quantity of reflected light.
- If [*] is displayed, only enough light for the measurement is returned.
- It is possible to make a buzzer sound at the same time the [*] appears when distance measurement is possible by pressing **[BEEP]**. Press **[OFF]** to shut off the buzzer.

2. Press **ESC** to end the check and return to the original screen.

   And if no key operations are performed for 2 minutes, the display automatically returns to "MEAS Mode Screen."

   Press **[SDIST]** to start distance measurement.

- When [*] is not displayed, either resight the target, or in the case of long distance measurement, increase the number of reflective prisms.
- When ⬚⬚⬚⬚⬚⬚▮ is displayed persistently, contact our service center.

NOTE: When the light intensity is sufficient even though the center of the reflective prism and the reticle are slightly misaligned (short distance etc.), [*] will be displayed in some cases, but in fact, accurate measurement is impossible. Therefore make sure that the target center is sighted correctly.

11.3 Distance and Angle Measurement

- An angle can be measured at the same time as the distance.

- When recording measurement data, see "19.1 Recording Distance Measurement Data".

• Check the following once more before measuring a distance

1. The **SET** is set up correctly over the surveying point.
2. The battery is sufficiently charged.
3. The horizontal circle and vertical circle indexing have been completed.
4. The parameters are set in conformity with measurement conditions.
5. The atmospheric correction factor has been set, the target type has been selected, the prism constant correction value has been set, and the distance measurement method has been selected.
6. The center of the target is correctly sighted and the light intensity of the returned signal is sufficiently high.

▶ **PROCEDURE** S/H/V selection and distance measurement

Press [◢ SHV] : MEAS Mode
Selection
MEAS Mode Screen (Page 1)

```
Meas.           PC   -30
                ppm    0
                      ♦3
                       r
ZA      89°59'54"
HAR    117°32'21"
                      P1
SDIST  ◢SHV  H.ANG  EDM
```
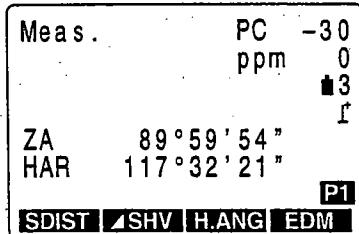
1. In the first page of MEAS Mode, press [◢ SHV] to select the desired distance mode.

   Each time [◢ SHV] is pressed, the distance measurement mode changes.

   [SDIST] : Slope distance
   [HDIST] : Horizontal distance
   [VDIST] : Height difference

Press [SDIST]
Distance Measurement Start
Screen

```
Dist

   Dist  PC  = -30
         ppm =   0
         Fine"r"


STOP
```
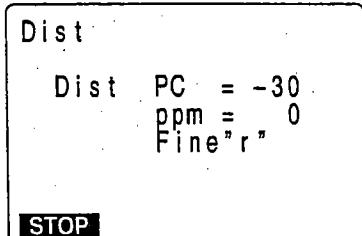
2. Press [SDIST]

   When measurement starts, EDM information (distance mode, prism constant correction value, atmospheric correction factor, distance measurement method) is represented by a flashing display.

Distance Measurement in Progress Screen
(During Repeat Measurement)

```
Dist          PC  -30
              ppm    0
                    ▮3
S     1234.567m      ┌
ZA      78°45'59"
HAR    120°31'31"

 STOP
```

When distance measurement is completed, a short beep sounds, and the measured distance data (s), vertical angle (ZA), and horizontal angle (HAR) are displayed.

Distance Measurement in Progress Screen
(During Average Measurement)

```
Dist          PC  -30
              ppm    0
                    ▮3
S     1234.567m      ┌
ZA      78°45'59"
HAR    120°31'31"

 STOP
```

During average measurement, the distance data is displayed as S-1, S-2,.... to S- 9.

Distance Measurement Results Screen
(During Average Measurement)

```
Dist          PC  -30
              ppm    0
                    ▮3
S-A  1234.5678m      ┌
ZA      78°45'59"
HAR    120°31'31"
                    P1
 SDIST  ◢SHV  H.ANG  EDM
```

3. When repeat measurement is performed, press [STOP] after displaying the measurement values to conclude distance measurement and display the final results of the measurement.

During average measurement, the average value of the distance is displayed when the designated number of measurements has been completed.

S-A : Average value of the slope distance measurements. (AVERAGE)

• The distance and angle which are most recently measured remain stored in the memory until the power is turned off. It is possible to display the measured values converted into the horizontal distance, height difference, and the slope distance by pressing [◢ SHV]. And because the distance measurement value, vertical angle, horizontal angle, and the XYZ coordinates can be displayed, it is possible to display the distance measurement values converted into the horizontal distance, elevation difference, and the slope distance.
For the display method, see "11.4 Review of Measured Data".

• If the single measurement mode is selected, measurement automatically stops after a single measurement

11.4 Review of Measured Data

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

  And because the distance measurement value, vertical angle, horizontal angle, and the XYZ coordinates can be displayed, it is possible to display the distance measurement values converted into the horizontal distance, elevation difference, and the slope distance.

- In advance, allocate the function key to display **[RCL]**. For the allocation method, see "23. Key Function Allocation".

▶ **PROCEDURE** Data recall

Press **[RCL]**
Recall Mode Screen

```
RCL
S        1234.567m
ZA        30°58'59"
HAR      126°31'17"
N      -1234567.789
E         34567.123
Z       1234567.123
 ◢SHV
```

1. In MEAS Mode, display the screen in which [RCL] is registered, and press [RCL].

   The stored data which is most recently measured is displayed.

[◢ SHV] : Switches between slope distance, horizontal distance, height difference.

2. To alternately display the horizontal distance, height difference, and the slope distance, press [◢ SHV].

   Each time [◢ SHV] is pressed, S, H, and V are displayed alternately.

   S : Slope distance
   H : Horizontal distance
   V : Height difference

Press **ESC** : To measurement mode

3. Press **ESC** to return to measurement mode.

11.5 Measuring Distance and Outputting the Data to a Computer

- Distance measurement can be performed and the data is quickly output to a computer.
- In advance allocate the function key to display **[D-OUT]**. For the allocation method, see "23. Key Function Allocation".

▶ **PROCEDURE** Measuring distance and outputting the data to a computer

1. In MEAS Mode, display the screen in which **[D-OUT]** is registered.

Press **[D-OUT]**
Measurement Selection Screen

```
D-OUT
 1.Dist data
 2.Angle data
```
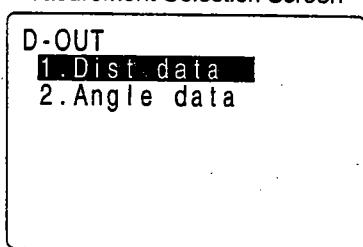
2. Press **[D-OUT]**
"Measurement Selection Screen" is displayed.

Select "1. Dist data", press ◢▬▬◣
Distance Measurement Start Screen

```
Dist

   Dist  PC  = -30
         ppm =   0
         Fine"r"


 STOP
```
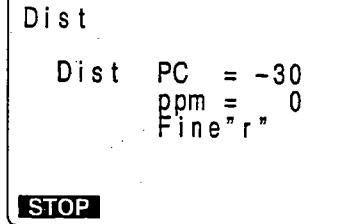
3. Select "1. Dist data", and press ◢▬▬◣ .
When measurement starts, EDM information (distance mode, prism constant correction value, atmospheric correction factor, distance measurement method) is represented by a flashing display.

Distance Measurement in Progress
Screen
(During Repeat Measurement)

```
Dist          PC  -30
              ppm   0
                    ▮3
S      1234.567m     ↰
ZA      78°45'59"
HAR    120°31'31"

 STOP
```
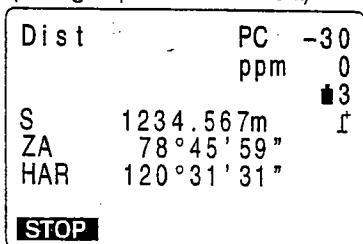
When distance measurement is completed, a short beep sounds, and the measured distance data(s), vertical angle (ZA), and horizontal angle (HAR) are displayed.

Then the measured data bigins being output. When repeat measurement is performed, press **[STOP]** to stop the output.

When "2. Angle data" is selected in step 2, the angle data which is displayed on the screen can be output. (Be sure that angle measurement can not be performed.) Turn the instrument untill the required angle is displayed and select "2. Angle data" to output the data.

12. COORDINATE MEASUREMENT

- By performing coordinate measurements it is possible to find the 3-dimensional coordinates for the target based on station point coordinates, instrument height, and target height which are entered in advance.
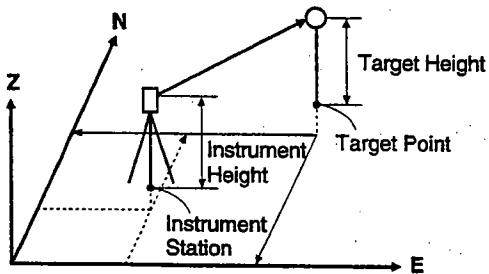
- It is possible to set the azimuth angle of a backsight station by entering the coordinates of the instrument station and a known point (backsight station) and then sighting the backsight station to be measured.

- The following preparations are required for coordinate measurement.
  - Station point coordinates setting
  - Azimuth angle setting

- For the coordinate measurement method, follow the method described in "9.5 Setting the Instrument Options".

12.1 Entering Instrument Station Data

- Before coordinate measurement, enter instrument station coordinates, the instrument height, and target height.

- First measure the instrument height and target height with a tape measure,etc.

- It is possible to set coordinate data registered in advance.

- It is possible to record the set instrument station data in the JOB which has been selected. For the JOB selection method, see "18.1 JOB Selection".

- It is also possible to perform coordinate measurement when **[MENU]** on the third page of the MEAS Mode is pressed to enter Menu Mode, then "1. Coordinate" is selected.

▶ **PROCEDURE** Entering instrument station data

Press **[COORD]**
Coordinate Measurement
Menu Screen

```
Coord.
 1.Observation
 2.Stn data
 3.Set h angle
```

1. Press **[COORD]** in the second page of the "MEAS Mode Screen."

   The Coordinate Measurement Menu Screen is displayed.

Select "2. Stn Data" and press

Instrument Station Data Setting Screen

```
Coord./Stn
NO:        0.000    1
EO:        0.000    2
ZO:        0.000    3
Inst.h.:   0.000m   4
Tgt.h. :   0.000m   5

 READ  REC        O K
```

2. Select "2. Stn Data" and press.

   The Instrument Station Data Setting Screen is displayed.

3. Set the following items.

   1 to 3 : Instrument station coordinates
   4   : Instrument height
   5   : Target height

   Each time you set an item, press.

4. Press **[REC]** to record instrument station data.

The "Instrument Station Data Recording Screen" is displayed.

For the method of setting each item, see "19.4 Recording Instrument Station Data".

Then press **[OK]** to record in JOB and restore the "Instrument Station Data Setting Screen."

Press **[OK]** : Setting Complete
Coordinate Measurement
Menu Screen

5. Press **[OK]** to end the instrument station data setting.

The "Coordinate Measurement Menu Screen" is restored.

* Stop entry in progress: **ESC** (Return to the "Coordinate Measurement Menu Screen").
* Reading in the coordinate data: **[READ]** See the following "REFERENCE Reading in Registered Data."
* Saving Instrument Station Data: **[REC]** See "19.4 Recording Instrument Station Data".

▶ REFERENCE Reading in Registered Coordinate Data

* When you wish to read in and set coordinate data from memory, press **[READ]** in the "Instrument Station Setting Screen." It is possible to search for the registered data.
* Both coordinate data saved in the memory and that saved in the JOB which has been selected.

Press **[READ]**
Coordinate Data Point Number
Display Screen

```
Coord./Stn
Pt.  POINT200000005↑
Pt.                    1
Crd.                   2
Crd.           12345678
Stn            12345679
Stn                1234↓
[↑↓-P]  TOP  LAST  SRCH
```

1. Press **[READ]** in the "Instrument Station Setting Screen."

The "Coordinate Data Point Number Display Screen" is displayed.

Known   : Coordinate data saved in the memory.

Crd./Stn : Coordinate data saved in the JOB which has been selected.

Press ▼ or ▲ : Aligning the cursor
with the required point number or
press [SRCH]
Coordinate Data Search Screen

```
Coord./Stn
Pt:POINT200000005
```

2. Align the cursor with the required point num-
    ber which was read in using ▼ or ▲ .

    To use the point number to search for coordi-
    nate data, press [SRCH].

    The "Coordinate Data Search Screen" is dis-
    played.

    Enter the point number to the [Pt.:] line.

    Note: Numerical characters of the point num-
    ber are the object of the search. Key en-
    try can not be accepted in Shift Mode
    On status.

- Changing the cursor movement method: [↑↓–P]
- When ↑↓–P is displayed, the cursor moves one line at a time.
- When ↑↓–P is displayed, the cursor moves one page at a time.

Press ◢▬▬◣ to display data
Instrument Station Data Setting Screen

```
Coord./Stn
N0: -1234567.789
E0:        56.789
Z0:         0.123
Inst.h.:    1.234m
Tgt.h. :    2.123m

READ  REC          O K
```

3. Press ◢▬▬◣ .

    The "Instrument Station Data Setting Screen"
    is restored.

    The coordinates which have been found are
    displayed.

Press [OK]
Coordinate Measurement Menu
Screen

4. Check the data and press [OK].

    The "Coordinate Measurement Menu Screen"
    is restored.

12.2 Azimuth Angle Setting

- After the instrument station coordinate data has been completely set, calculate and set the azimuth angles of the backsight station whose coordinates are already known.

- Based on the instrument station coordinates and backsight station coordinates which have already been set, sight the backsight station and perform a key operation to automatically set the azimuth angle of the backsight station.
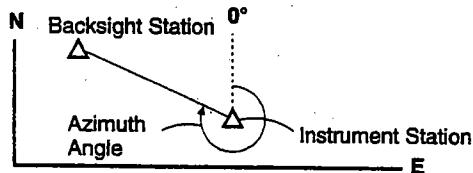
▶ **PROCEDURE** Azimuth angle setting

Select "3. Set h angle" and Press ◢◼◼.

Required Angle Setting Screen

```
Coord/Ang.
HAR:▉▉▉▉▉

▉ B S ▉
```

1. Select "3. Set h angle" in "Coordinate Measurement Menu Screen," and press ◢◼◼.

   The "Required Angle Setting Screen" is displayed.

Press [BS]

Azimuth Angle Setting Screen

```
Coord/Ang.
NO :▉-1234567.789▉  1
EO :         56.789   2
ZO :          1.234   3
NBS:         56.789   4
EBS: -1234567.789     5
ZBS:          1.234    6
READ              O K
```

2. Press [BS].

   "Azimuth Angle Setting Screen" is displayed.

   For 1 to 3, the coordinate values set in "12.1 Entering Instrument Station Data" are displayed.

3. Set the following items.

   4 to 6 Backsight station coordinates

   When setting each item, press ◢◼◼.

   It is possible to reset 1 to 3.

• Stopping entry in progress: [ESC] (return to the "Required Angle Setting Screen")

• Reading in data: To read in instrument station data, align the cursor at either NO, EO, of ZO and press [READ]. To read in instrument station data, align the cursor at either NBS, EBS, or ZBS, and press [READ].
The subsequent procedure is identical to that in "REFERENCE Reading in Registered Coordinate Data".

Press [OK]
Backsight Station Sighting Screen

```
Coord/Ang.

 Take BS

ZA        89°52'54"
HAR      150°16'15"

               NO    YES
```

4. Press [OK].

The "Backsight Station Sighting Screen" is displayed.

Sight the Backsight Station, Press [YES]
Azimuth Angle Setting Screen

```
Coord/Ang.
HAR:45.000




 BS
```

5. Sight the backsight station then press [YES].

The "Azimuth Angle Setting Screen" is restored, and the azimuth angle of the backsight station is displayed.

At this time, if the difference between the values of N and E of the instrument station coordinates and the backsight station coordinates is greater than 2,000,000, the azimuth angle cannot be set, so repeat the procedure from 2.

Press ◢▬▬◣ : To the
Coordinate Menu Screen

6. Press ◢▬▬◣ . The "Coordinate Menu Screen" is restored.

12.3 3-D Coordinate Measurement

- The coordinate values of the target can be found by measuring the distance and angle to the target based on the settings in 12.1 and 12.2.

The coordinate values of the target are calculated and displayed using the following formulae.

$$N_1 \text{ Coordinate} = N_0 + S \times \sin\theta z \times \cos\theta h$$
$$E_1 \text{ Coordinate} = E_0 + S \times \sin\theta z \times \cos\theta h$$
$$Z_1 \text{ Coordinate} = Z_0 + Mh + S \times \cos\theta z - Ph$$

No: Station point N coordinate   S: Slope distance   ih: Instrument height
Eo: Station point E coordinate   θ: Zenith angle   fh: Target height
Zo: Station point Z coordinate   Az: Direction angle
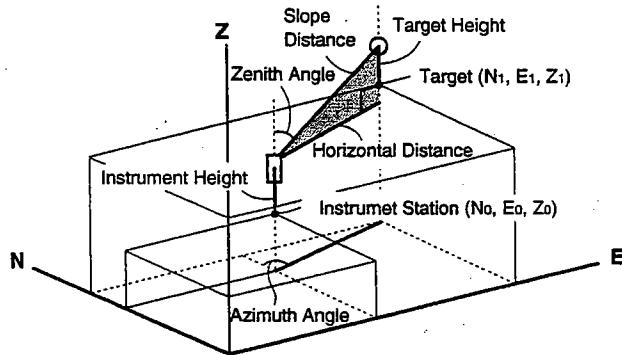
- Measurement data can be recorded in the JOB which has been selected.
  For the JOB selection method, see "18.1 JOB Selection".

• Check the following once more before measuring

1. The **SET** is set up correctly over the surveying point.
2. The battery is sufficiently charged.
3. The horizontal circle and vertical circle indexing have been completed.
4. The parameters are set in conformity with measurement conditions.
5. The atmospheric correction factor has been set, the target type has been selected, the prism constant correction value has been set, and the distance measurement method has been selected.
6. The center of the target is correctly sighted and the light intensity of the returned signal is sufficiently high.
7. The coordinate measurement preparations in 12.1 and 12.2 are completed.

▶ PROCEDURE Coordinate measurement

Sight the target at the target point.

1. Sight the target at the target point.

Select "1. Observation",press
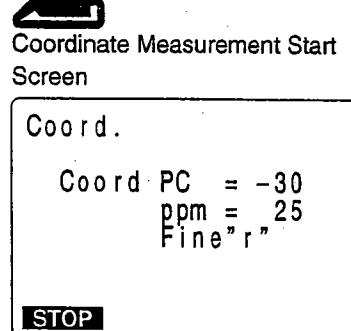
2. Select "1. Observation" in the "Coordinate Measurement Menu Screen" then press ◢▬▬◣.

Coordinate Measurement Start Screen

The "Coordinate Measurement Start Screen" is displayed.

```
Coord.

   Coord PC  = -30
          ppm =  25
          Fine"r"


   STOP
```

```
Coord.
N          34567.123
E       -1234567.789
Z             12.789
S        1234.567m
ZA        37°51'50"
HAR      120°37'52"
   STOP
```
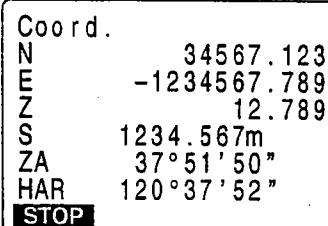
When measurement is completed, the coordinate value and the distance of the target, the vertical angle, and the horizontal angle are displayed.

```
Coord.
N          34567.123
E       -1234567.789
Z             12.789
S        1234.567m
ZA        37°51'50"
HAR      120°37'52"
   REC    H T       OBS
```

3. During repeat measurement, press [STOP] after the measured values are displayed to conclude measurement and display the final measurement results.
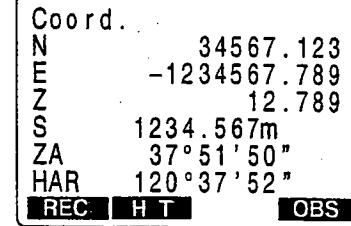
Press [REC]: Recording Observation Values
Coordinate Data Recording Screen
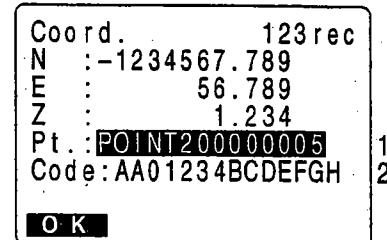
4. To record the coordinate data in the JOB, press [REC].
The "Coordinate Data Recording Screen" is displayed.

```
Coord.          123rec
N  :-1234567.789
E  :       56.789
Z  :        1.234
Pt.:POINT200000005    1
Code:AA01234BCDEFGH    2

   O K
```

5. Set the following items.

   1. Point number
   2. Code (memo etc.)

   Press ◢▬▬◣ after setting each item.

```
Coord.          123rec
N  :-1234567.789
E  :      56.789
Z  :       1.234
Pt.:POINT200000005
Code:AA01234BCDEFGH

 OK      ↑      ↓
```

By pressing [↑] or [↓] it is possible to successively display the codes registered in the memory and select codes from among them.

- Maximum point number size: 14 alphanumeric
- Maximum code size: 16 characters (alphabetic or numerical)
- For the method of registering the codes in the memory, see "18.6 Inputting codes".

Press [OK] : Recording

6. Press [OK] to store the data and restore the "Coordinate Measurement Screen".

7. Sight the next target and press [OBS].

    The next coordinate measurement begins.

[HT] : The "Instrument Station Setting Screen" is displayed, and the instrument station data can be reset.
The set values are reflected from the following observations.
When the target height of the next target is different, reenter the target height before beginning the observation.

Press ESC : To the Coordinate Measurement Menu Screen

8. When coordinate measurement is completed, press ESC on the "Coordinate Measurement Screen."

    The "Coordinate Measurement Menu Screen" is restored.

ADVANCED MEASUREMENT

- This section explains resections, setting-out measurements, offset measurements, missing line measurements, REM measurements and others which can be performed in MEAS Mode.

MEAS Mode Screen

```
Meas.          PC  -30
               ppm   0
                     ■3
S       1234.567m    𝚛
ZA      78°45'59"
HAR    120°31'31"
                     P1
 SDIST ◢SHV H.ANG EDM
```

13. RESECTION MEASUREMENT

- Resection is used to determine the coordinates of a instrument station by performing multiple measurements of points whose coordinate values are known.

Entry
Coordinates of known point : (N_i, E_i, Z_i)
Observed horizontal angle : H_i
Observed vertical angle : V_i
Observed distance : D_i

Output
Station point coordinates : (N_0, E_0, Z_0)

P1

P2

Instrument Station
(P0)

P4

P3
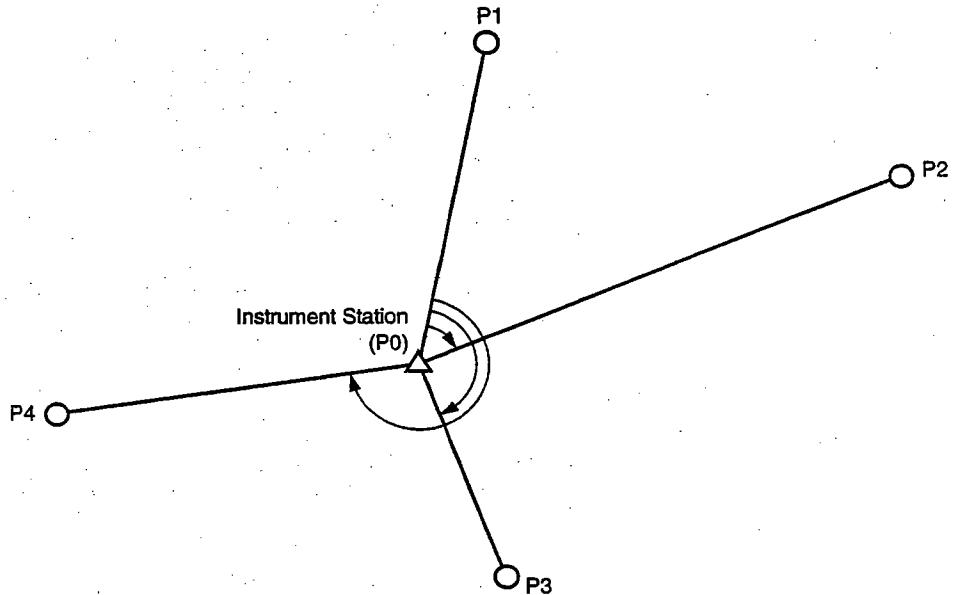
- **SET** can caluculate the instrument station coordinates by observing 2 to 10 known points.
  ① When the distance can be measured, at least 2 points.
  ② When there is even one point which can not be measured, at least 3 points.
  But the more known points there are and the more points there are whose distance can be measured, the higher the precision of the coordinate value calculation.

• **SET** calculation process
The NE coordinates are found using angle and distance observation equations, and the instrument station coordinates are found using the method of least squares.
The Z coordinate is found by treating the average value as the instrument station coordinate.

```
┌────────────────────────────────────────────────┐
│              Calculation begins.                │
└────────────────────────────────────────────────┘
                      ▼
┌────────────────────────────────────────────────┐
│        Hypothetical coordinates are found.      │
└────────────────────────────────────────────────┘
                      ▼ ◄──────────────────────┐
┌────────────────────────────────────────────────┐  │
│   The observation equation for the angle is prepared. │
└────────────────────────────────────────────────┘  │
                      ▼                             │
┌────────────────────────────────────────────────┐  │
│  The observation equation for the distance is prepared. │  Repeated
└────────────────────────────────────────────────┘  │  three times
                      ▼                             │
┌────────────────────────────────────────────────┐  │
│          The normal equation is prepared        │  │
└────────────────────────────────────────────────┘  │
                      ▼                             │
┌────────────────────────────────────────────────┐  │
│     Instrument station coordinates are calculated. │
└────────────────────────────────────────────────┘  │
                      ▼                             │
┌────────────────────────────────────────────────┐ No │
│ Difference from the hypothetical coordinates less than 0.5 mm ├──┘
└────────────────────────────────────────────────┘
                      ▼ Yes
┌────────────────────────────────────────────────┐
│          Calculation of the Z coordinate        │
└────────────────────────────────────────────────┘
                      ▼
┌────────────────────────────────────────────────┐
│               Calculation ends.                 │
└────────────────────────────────────────────────┘
```
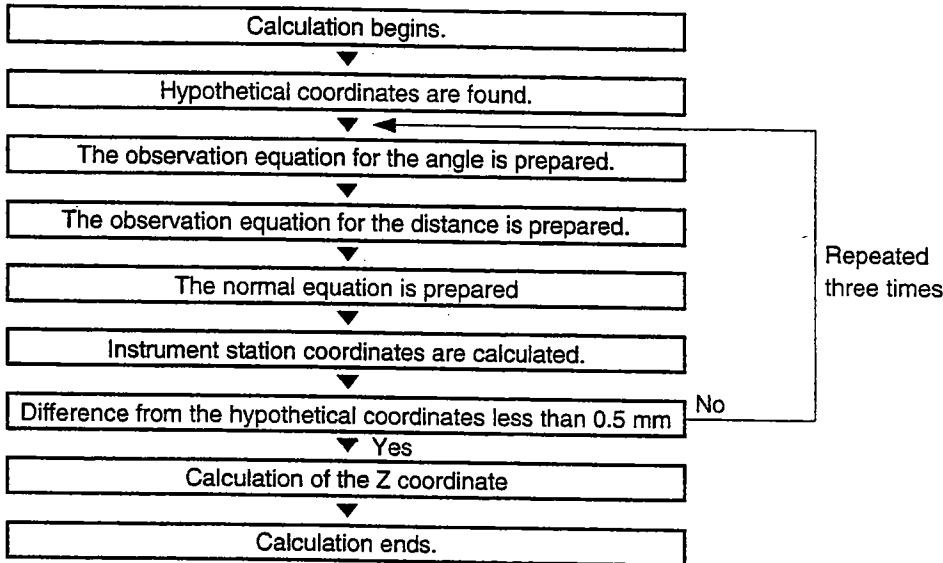
• It is also possible to perform resection measurement when [MENU] on the third page of the MEAS Mode is pressed to enter Menu Mode, then 7. Resection is selected.

• It is possible to read in a coordinate data registered in advance.

• It is possible to record set known point coordinate data or calculated instrument station data in the JOB which has been selected. For the JOB selection method, see "18.1 JOB Selection".

• The target height set here returns to its previously set value after the resection process is completed.

▶ **PROCEDURE Resection measurement**

Press [RESEC]
Known Point Setting Screen

```
┌─────────────────────────┐
│ Resection               │
│  Pt.1                   │
│ N ▌    234.000▐         │
│ E        10.000         │
│ Z         1.500         │
│                         │
│                         │
│  ▐READ▌ REC ▌ O K▌      │
└─────────────────────────┘
```

1. Press [RESEC] in the third page of MEAS Mode.
Resection Mode begins and the "Known Point Setting Screen" is displayed.

2. Enter coordinate values for the 1st known point

   After setting the coordinates, press ◢◣.

Press [OK]

3. When coordinate entry for the 1st point has been completed, press [OK].

   The "2nd Point Setting Screen" is displayed.

```
Resection
 Pt.2
N      234.000
E       10.000
Z        1.500


MEAS  READ  REC  O K
```

4. Repeat operations 2 to 3 and set the coordinates for the required number of points.

Press [MEAS]
Measurement Start Screen

```
Resection
 Pt.1
N      234.000
E       10.000
Z        1.500

SDIST ANGLE
```

5. When all required known points have been set, press [MEAS].

Sight 1st Point, press [MEAS]
Observation Start Screen
(There is Distance)

```
Dist

  Dist  PC  = -30
        ppm =  25
        Fine"r"


STOP
```

6. Sight the 1st known point and press [SDIST] for distance measurements and press [ANGLE] for angle measurements only.

   When [SDIST] has been selected, the "Observation Begins Screen" is displayed.

Press [STOP]

Observation Results Screen

```
Resection
 Pt.1

S          10.160m
ZA    156°14'50"
HAR    84°22'13"
Tgt.h. :     1.200m
             N O   YES
```

Press [YES]

• Discard the results: [NO]

Observation Results Screen

```
Resection
 Pt.3

S          10.160m
ZA    156°14'50"
HAR    84°22'13"
Tgt.h. :     1.200m
 CALC        N O   YES
```

7. When the measurements are completed, or when [STOP] is pressed after the measurement values are displayed during repeat measurement with [SDIST], the "Observation Results Screen" is displayed.

When [ANGLE] has been selected, the distance cannot be displayed.

To use the results, enter the target height of the 1st known point and press [YES].

The "Observation Point Display Screen" for the next known point is displayed.

8. Repeat procedures 6 to 7 in the same way from 2nd point.

When the minimum quantity of observation data required for the calculation is all present, [CALC] is displayed on the "Observation Results Screen."

Press [YES] to automatically start calculations after observations of all known points are completed.

• Repeat observations: [NO] ("Observation Start Screen" is restored.)
• Continue observations: [YES] (Go to "Observation Start Screen" for the next point)
• Perform calculation during observations: [CALC]

Calculation in Progress Screen

```
Resection



Busy... -


```

Calculation of the instrument station coordinates begins and the "Calculation in Progress Screen" is displayed.

Resection Results Display Screen

```
Resection

N0          22.230
E0          14.124
Z0           5.56
σN           0.3mm
σE           1.2mm
 RE-OBS  ADD   REC   O K
```

When calculation is completed, the "Resection Results Display Screen" is displayed.

The standard differential (σN, σE) which indicates the precision of the observations is displayed.

Press [OK]: Use calculation results

9. Press [OK] to use the calculation results.

The results are recorded as the instrument station coordinates and "Azimuth Angle Setting Screen" is displayed.

• Discard results and stop observations: [ESC]
• Discard results and re-observe: [RE-OBS] (See "PROCEDURE Re-observation")
• Discard results and perform supplementary observations of other points: [ADD] (See "PROCEDURE Supplementary Observation")
• Use the results and record in JOB: [REC] (Refer "19. Recording Distance Measurement Data".)
(When setting the direction angle later, press [OK], and when not doing so, press [ESC].

10. To set azimuth angle, press [YES] and set it. When not setting it, press [NO].

Returns to the screen prior to entering Resection Mode.

▶ PROCEDURE Re-observation

• It is possible to re-observe a known point from the 1st point or to re-observe only the final known point.

Press [RE-OBS]
Re-Observe Menu Screen

```
Resection
 1.Start point      1
 2.Last point       2
```
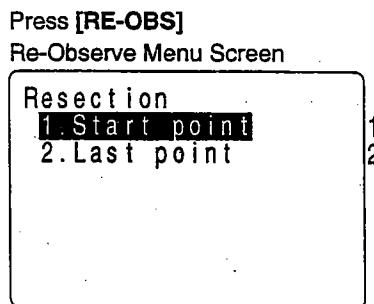
1. Press [RE-OBS] in the "Resection Results Display Screen."

The "Re-observe Menu Screen" is displayed.

1. Re-observe from the 1st known point.
2. Re-observe only the final known point.

Select item, press ◀▬▬▮
Measurement Start Screen

```
Resection
 Pt.1
N         234.000
E          10.000
Z           1.500

SDIST ANGLE
```
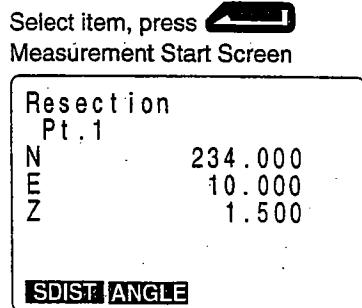
2. Align the cursor with "1. Start point" or with "2. Last point" and press ◀▬▬▮.

The "Measurement Start Screen" is displayed.

• The above procedure is identical to procedure 6 to 7 in "PROCEDURE Resection measurement".

▶ **PROCEDURE** Supplementary observation

Press **[ADD]**
Measurement Start Screen
(When there are points not yet measured)

```
Resection
 Pt.4
N        234.000
E         10.000
Z          1.500

SDIST ANGLE
```

Known Point Setting Screen
(When adding a known point)

```
Resection
 Pt.5
N        234.000
E         10.000
Z          1.500

MEAS  READ  REC  O K
```

1. Press **[ADD]** in the "Resection Results Display Screen."

   When there is a known point which has not been measured, the "Measurement Start Screen" is displayed, and when a new known point is added, the "Known Point Setting Screen" is displayed.

2. When there is a point not yet measured, perform measurement using the same procedure beginning with step 5 in "PROCEDURE Resection measurement".

   When a known point is to be added, perform supplementary measurement using the same procedure beginning with step 3 in "PROCEDURE Resection measurement".

▶ EXPLANATION Precaution when performing resection

- In some cases it is impossible to calculate the coordinates of an unknown point (instrument station) if the unknown point and three or more known points are arranged on the edge of a single circle.
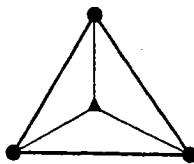
- An arrangement such as that shown on the left is desirable.

  △▲: Unknown point
  ○●: Known point
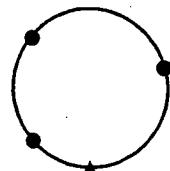
- It is sometimes impossible to perform a correct calculation in a case such as that on the left.

①
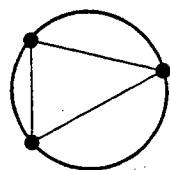
- When they are on the edge of a single circle, take one of the following measures.
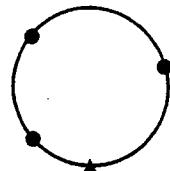
  ① Move the instrument station as close as possible to the center of the triangle.
  ② Observe one more known point which is not on the circle.
  ③ Perform a distance measurement on at least one of the three points.
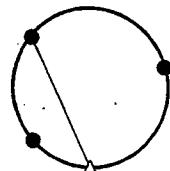
②

③

- In some cases it is impossible to calculate the coordinates of the instrument station if the included angle between the known points is too small. It is difficult to imagine that the longer the distance between the instrument station and the known points, the narrower the included angle between the known points. Be careful because the points can easily be aligned on the edge of a single circle.

14. SETTING-OUT MEASUREMENT

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

* For setting-out measurement, perform observations in face left.

14.1 Distance Setting-out Measurement

* The point can be found based on the horizontal angle from the reference direction and the distance from the instrument station.

Reference direction
△ distance
Position to be set out
Present target position
Distance to be set out
Instrument station
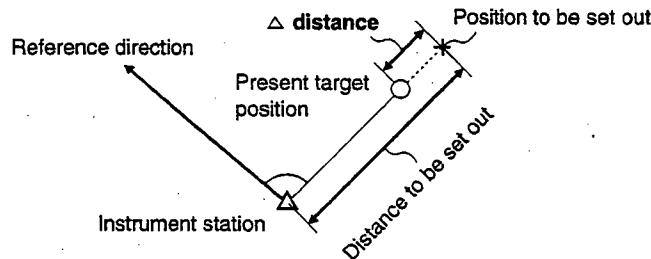
* It is also possible to perform setting-out measurement when **[MENU]** on the third page of MEAS Mode is pressed to enter Menu Mode and "2. S-O" is selected.

▶ **PROCEDURE** Distance setting-out measurement

Reference Direction

Instrument station

Press **[0SET] [0SET]**

```
Meas.          PC  -30
               ppm   0
                     ▮3
                      ┌
ZA      89°59'54"
HAR      0°00'00"
                    P2
 0SET COORD  S-O  REC
```

1. Sight the reference direction.

2. Press **[0SET]** twice in the second page of MEAS Mode.

   The horizontal angle of the sighting direction is 0°.

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Press [S-O]
Setting-out Measurement Menu
Screen

```
S-O
1.Observation
2.S-O data
3.Stn data
4.Set h angle
```

3. Press [S-O] in the second page of "MEAS Mode Screen."

The "Setting-out Measurement Menu Screen" is displayed.

Select "2. S-O data" ◢▬▬◣
Setting-out Data Setting Screen

```
S-O
Np:        0.000
Ep:        0.000
Zp:        0.000
Tgt.h. :   0.000m
SO dist:   0.000m       1
SO Hang: 0°06'00"       2
READ  REC          O K
```

4. Select "2. S-O data" and press ◢▬▬◣ .

The "Setting-out Data Setting Screen" is displayed.

5. Set the following items.

1. Distance from the instrument station to the position to be set out.
2. Included angle between the direction of the reference and the position to be set out of the point to be set out.

After entering each item, press ◢▬▬◣ .

Press [OK]
Setting-out Observation Screen

```
S-O

S-O S
S
ZA      89°52'54"
HAR    150°16'15"
dHA     -0°00'02"
SDIST ◢S-O ← → EDM
```

6. Press [OK].

The "Setting-out Observation Screen" is displayed.

S-O S : After observation, displays the distance to the point to be set out.
dHA : Displays the horizontal angle to the position to be set out.

• Stopping entry in progress: ESC

Press [← →]
Guidance Screen

```
S-O
←        15°00'00"
↑


ZA       90°00'00"
HAR      30°00'00"
SDIST  ⊿S-O  ←  →  EDM
```
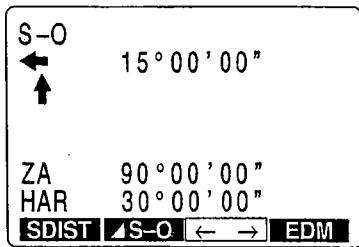
7.   Press [← →].

The "Guidance Screen" is displayed.
The angle to the point to be set out is displayed on the second line, and an arrow pointing to the left or right displays which direction the target should be moved.

8.   Rotate the top of the instrument until the angle in the second line is 0°.

When the angle is within a range of ±30°, both arrows are displayed.

• Meaning of the arrows
    ⬅ : Move the target to the left looking from the instrument station.
    ➡ : Move the target to the right looking from the instrument station.
• Restore the "Setting-out Observation Screen" ← →

Direction of
the Reference   Point to be Set Out

                        Target

Instrument Station
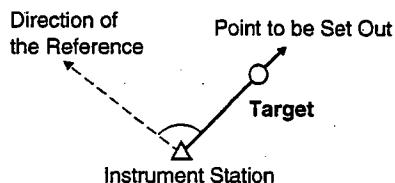
9.   Set the target on the sight-line and sight it.

Press [⊿ S-O]
Measurement Mode Selection

10.   Press [⊿ S-O] to select the measurement mode.

• Each time [⊿ S-O] is pressed: [SDIST] → [HDIST] → [VDIST] → [COORD] → [HT].
  • [SDIST]: Setting-out measurement of the slope distance
  • [HDIST]: Setting-out measurement of the horizontal distance
  • [VDIST]: Setting-out measurement of the height difference (height difference between instrument height mark and the center of the target)
  • [COORD]: Setting-out measurement of the coordinates (See "14.3 Coordinates Setting-out Measurement".)
  • [HT]: Setting-out measurement of the REM measurement (See "14.2 REM Setting-out Measurement".)

Press [SDIST] ([HDIST], [VDIST])
Setting-out Observation Start Screen

```
S-O

Dist   PC  = -30
       ppm =  25
       Fine"r"



STOP
```
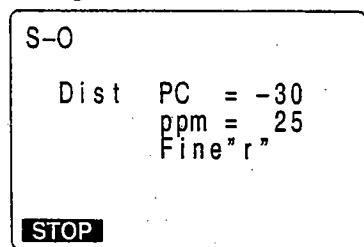
11.   Press [SDIST].

"Setting-out Observation Start Screen" is displayed and observation begins.

Guidance Screen

```
S-O
←→        0°00'01"
↑             2.345

S         100.123m
ZA         89°52'54"
HAR       150°16'15"
 SDIST  ⦜S-O  ←   →  EDM
```

```
S-O
←→        0°00'01"
↑↓          -0.002m

S          12.554
ZA         90°00'00"
HAR        45°00'00"
 SDIST  ⦜S-O  ←   →  EDM
```
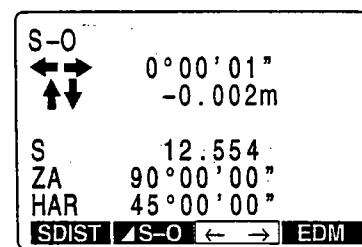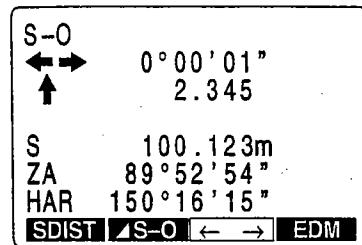
When the observation is completed, the "Guidance Screen" is displayed.

The distance to the point to be set out is displayed on line 3.

And the movement direction of the target is indicated by the arrows pointing upwards and downwards.

12. Move the reflective prism forward and backward until distance on line 3 is 0 m, then press **[SDIST]**, (**[HDIST]**, **[VDIST]**) to perform the observation again.

When it is within a range of ±1 cm, both arrows are displayed.

If repeat measurement or tracking measurement is performed at this time, it is possible to display the measurement results without any key operations while sighting the target which was moved.

• Meaning of the arrows
  ↓ : Move the target towards yourself.
  ↑ : Move the target away from yourself.

13. Find the place where the distance is 0 m.

Press **ESC**
Setting-out Measurement Menu Screen

14. Press **ESC** .
The "Setting-out Measurement Menu Screen" is restored.

• To EDM setting : **[EDM]**

14.2 REM Setting-out Measurement

- To find a point where a target can not be directly installed, perform REM setting-out measurement. For details about REM measurement, see "17. REM Measurement".

▶ **PROCEDURE** REM setting-out measurement
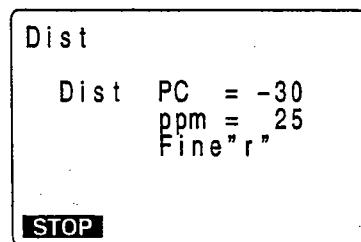
1. Install a target directly below or directly above the point to be found, then use a measuring tape etc. to measure the target height (height from the surveying point to the target).

Sight the target and press **[OBS]**
Observation Start Screen

```
Dist

  Dist   PC  = -30
         ppm =  25
         Fine"r"



 STOP
```

2. Sight the target of the offset point then press **[SDIST]** in MEAS Mode.
The "Observation Start Screen" is displayed.

Press **[STOP]**
MEAS Mode Screen

```
 Meas.          PC  -30
                ppm   0
                      ▮3
 S        10.234m     r
 ZA       89°58'50"
 HAR     111°20'31"
                     P1
 SDIST ∠SHV H.ANG EDM
```
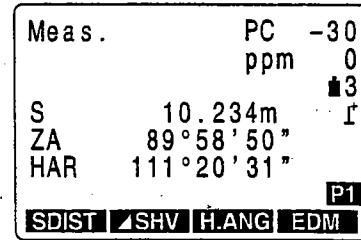
3. When the observation is completed, or during repeat measurement, press **[STOP]** after the measured values are displayed to restore the "MEAS Mode Screen."
The slope distances, vertical angles, and horizontal angles of the instrument station and the offset point are displayed.

Press **[S-O]**
Setting-out Measurement Menu Screen
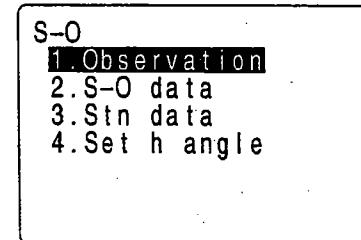
```
S-O
 1.Observation
 2.S-O data
 3.Stn data
 4.Set h angle
```

4. Press **[S-O]** in the second page of "MEAS Mode Screen."

The "Setting-out Measurement Menu Screen" is displayed.

Select "2. S-O data", press ▰▰▰▰
Setting-out Data Setting Screen

```
S-O
Np:        0.000
Ep:        0.000
Zp:        0.000
Tgt.h. :   0.000m    1
SO dist:   0.000m    2
SO Hang: 0°06'00"
 READ   REC        O K
```

5. Select "2. S-O data" and press ▰▰▰▰.

The "Setting-out Data Setting Screen" is displayed.

6. Set the following items.

1. Target height.
2. Height from the surveying point to the position to be set out.

When each item is entered, press ▰▰▰▰.

• Stopping entry in progress: ESC

Press [OK]
Setting-out Observation Screen

```
S-O

S-O S
S
ZA     89°52'54"
HAR  150°16'15"
dHA   -0°00'02"
 SDIST  ∠S-O  ←  →  EDM
```

7. Press [OK].

The "Setting-out Observation Screen" is displayed.

Press [∠ S-O]

```
S-O


S      80.123m
ZA     89°52'54"
HAR  150°16'15"
dHA    0°00'00"
 H T  ∠S-O  ←  →  EDM
```

8. Press [∠ S-O] to display [HT].

Press [HT]

```
S-O

S-O Ht.  -0.002m
S     1234.567m
ZA     89°52'54"
HAR  150°16'15"
dHA   -0°00'02"
 H T  ∠S-O  ←  →  EDM
```

9. Press [HT].

Setting-out measurement begins, and after 0.7 seconds, the difference between the setting-out data and the measured distance is displayed on the third line (S-O Ht.).

Afterwards, measurement results are displayed every 0.5 seconds.

Press [← →], then press [HT]
Guidance Screen

```
S-0
←              1°00'00"

▲              -0.002
S
ZA      90°00'00"
HAR     30°00'00"
  HT  |⊿S-0|←  →| EDM
```
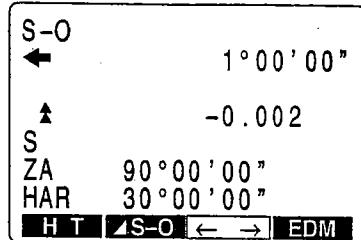
When pressing [← →] and then [HT], the "Guidance Screen" is displayed.
The discrepancy from the target to the point to be set out is displayed by triangular arrows and by numerals.

• Meaning of the arrows.
  ▲ Move the telescope near the zenith.
  ▼ Move the telescope near the nadir.

10. Jiggle the telescope up and down until it is 0 m.

As it nears 0 m, both ▲ and ▼ are displayed.

The point to be set out is now the center of the reticle of the telescope.

Press **ESC** : Measurement ends.

11. When the measurement is completed, press **ESC**.

The "Setting-out Measurement Menu Screen" is restored.

14.3 Coordinates Setting-out Measurement

- This measurement is used to set out the point of a certain coordinate away from the reference point (station point).
- After setting the coordinates for the point to be set out, the **SET** 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.
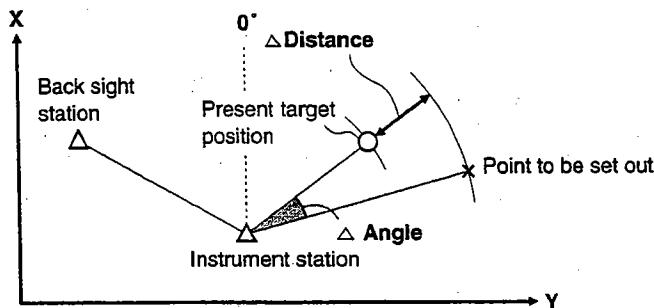
- It is also possible to perform coordinates setting out measurement when **[MENU]** on the third page of MEAS Mode is pressed to enter Menu Mode and "2. S-O" is selected.
- It is possible to output the coordinate data previously registered and set it as the setting-out coordinates.
- To find the Z coordinate, attach the target to a pole etc. with the same target height.

▶ **PROCEDURE** Coordinates setting-out measurement

Press **[S-O]**
Setting-out Measurement Menu Screen

```
S-O
1.Observation
2.S-O data
3.Stn data
4.Set h angle
–
```

1. Press **[S-O]** on the second page of the "MEAS Mode Screen."

   The "Setting-out Measurement Menu Screen" is displayed.

Select "3. Stn Data", press

Instrument Station Setting Screen

```
S-O/Stn
NO:            0.000
EO:            0.000
ZO:            0.000
Inst.h.:       0.000m
Tgt.h. :       0.000m

READ  REC        O K
```

2. Select "3. Stn data" and press ⬛.

   The "Instrument Station Setting Screen" is displayed.

3. Enter instrument station data while referring to "12.1 Entering Instrument Station Data".

   Enter the target height by measuring from the center of the target to the tip of the pole supporting the target.

Press **[OK]**
Setting-out Measurement Menu Screen

4. Press **[OK]** after the instrument station has been set.

   The "Setting-out Measurement Menu Screen" is restored.

Select "4. Set h angle", press
◄──◙
Required Angle Setting Screen

5. Select "4. Set h angle" and press **◄──◙**.

   The "Required Angle Setting Screen" is displayed.

Setting Azimuth Angle

6. Set the azimuth angle while referring to "12.2 Azimuth Angle Setting".

Setting-out Measurement Menu Screen

   After the azimuth angle has been set, the "Setting-out Measurement Menu Screen" is restored.

Select "2. S-O data", press **◄──◙**
Setting-out Data Setting Screen

```
S-O
Np:  ▐     0.000      1
Ep:        0.000      2
Zp:        0.000      3
Tgt.h. :   1.234m
SO dist:   0.000m
SO Hang: 0°00'00"
 READ  REC        O K
```

• Stopping entry in progress: **ESC**
• Reading in data: **[READ]**
• Recording data: **[REC]**

7. Select "2. S-O data" then press **◄──◙**.

   The "Setting-out Data Setting Screen" is displayed.

8. Set the following items.

   1 to 3. Coordinates of the point to be set out.

   After entering each item, press **◄──◙** .

   After entry, the distance and horizontal angle setting-out data is calculated and [SO dist] and [So hang] are displayed.

   If the distance setting-out data which has been calculated exceeds 9999.999 m, the [SO dist] displayed is 0.000 m and [SO Hang] is 0°, 00' 00", so be careful.

Press **[OK]**
Setting-out Observation Screen

```
S-O

S-O S
S
ZA      89°52'54"
HAR    150°16'15"
dHA    -0°00'02"
SDIST  ◢S-O  ←  →  EDM
```

9. Press **[OK]**.

    The "Setting-out Observation Screen" is displayed.

10. Perform the procedure from step 7 to step 13 in "14.1 Distance Setting-out Measurement" to find the point to be set out.

11. To find the height direction, press **[◢ S-O]** to display **[COORD]**.

Press **[COORD]**
Setting-out Observation Start Screen

```
S-O
S-O N      0.001
    E     -0.002
    Z      5.321
ZA      89°52'54"
HAR    150°16'54"
dAR     0°00'02"
COORD  ◢S-O  ←  →  EDM
```

12. Press **[COORD]**.

    The "Setting-out Observation Start Screen" is displayed and observation begins.

Setting-out Observation Screen
Press [← →], then press **[COORD]**

Guidance Screen

```
S-O
←          0°00'00"
↑          0.000
↥          0.300

ZA      90°00'00"
HAR     30°00'00"
COORD  ◢S-O  ←  →  EDM
```

When the measurement is completed, the "Setting-out Observation Screen" is displayed.

When pressing [← →] and then **[COORD]**, the "Guidance Screen" is displayed.
The difference in the height to the point to be set out is displayed as a triangular arrow and as numerals.

If you want the difference to the point displayed as the coordinate values, press [← →] again after measurement is completed.

Press **[COORD]**

```
S-O
←→              0°00'00"
↑↓                 0.000
↕↕                 3.123
S           12.554
ZA      90°00'00"
HAR     45°00'00"
COORD  /S-O  ←  →  EDM
```

```
S-O
←→              0°00'00"
↑↓                 0.000
↕↕                 0.000
S           12.554
ZA      90°00'00"
HAR     45°00'00"
COORD  /S-O  ←  →  EDM
```

- Meaning of the arrows
  - ↑ : Moving the target upwards.
  - ↓ : Moving the target downwards.

Press **ESC**
Setting-out Measurement Menu Selection
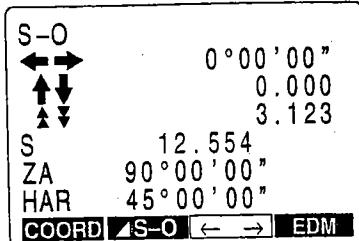
13. Move the target up and down to display 0 m.

When it is near 0 m, both the ↑ and ↓ triangular arrows are displayed.

When all three value become 0, the bottom tip of the pole is found. The bottom tip of the pole is the point to be set out.

14. Press **ESC**.

The "Setting-out Measurement Menu Screen" is restored.

To find the next point to be set out, repeat the procedure from step 7.

15. OFFSET MEASUREMENT

- Offset measurements are performed in order to find a point where a target cannot be installed directly or to find the distance and angle to a point which cannot be sighted.

- It is possible to find the distance and angle to a point you wish to measure (target point) by installing the target at a location (offset point) a little distance from the target point and measuring the distance and angle from the surveying point to the offset point.

- The target point can be found in the three ways explained below.
  ① Finding it by entering the horizontal distance from the target point to the offset point.
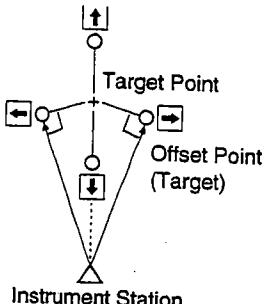
Target Point

Offset Point
(Target)

Instrument Station

- When the offset point is positioned to the left or right of the target point, make sure the angle formed by lines connecting the offset point to the target point and to the instrument station is approxiamately 90°.
- When the offset point is positioned in front of or behind the target point, install the offset point on a line linking the instrument station with the target point.

② Sighting the direction of the target point to find it from the included angle.

Target Point

Offset Point
(Target)

Offset Point
(Target)

Instrument Station
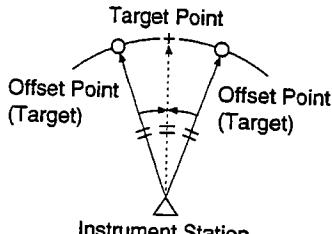
- Install the offset point as close as possible to the target point to its left or right.

③ By measuring the distances between the target point and two offset points.

Target Point

Offset Point (Target)

Offset Point
(Target)

Instrument Station
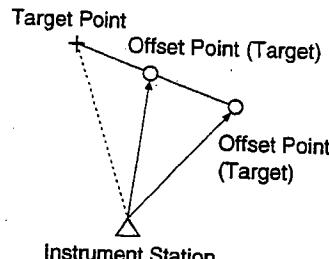
- Install offset points A and B on a line extending from the target point, measure A and B, then enter the distance between B and the target point to find the target point.

- In advance, allocate the function keys to display [OFFSET]. For the allocation method see "23. Key Function Allocation".

- It is also possible to perform offset measurement when [MENU] on the third page of MEAS Mode is pressed to enter Menu Mode and "3. Offset" is selected.

- Offset measurement is performed using the measurement method (distance measurement or coordinates measurement) used before you started up the offset measurement.

15.1 Single-distance Offset Measurement

- When the offset point is positioned to the left or right of the target point, make sure the angle formed by lines connecting the offset point to the target point and to the instrument station is almost 90°.
 When the offset point is positioned in front of or behind the target point, install the offset point on a line linking the instrument station with the target point.
  And set the target so that the target height of the target point and the offset point are identical.

```
        ↑
        ○
        | Target Point
  ←○   +   ○→
        |
        ○  Offset Point
        ↓  (Target)



        △
   Instrument Station
```
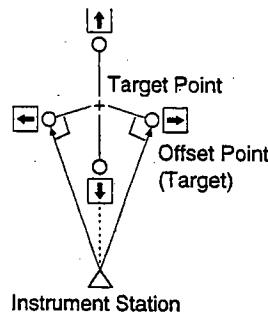
▶ **PROCEDURE** Single-distance offset measurement

Sight the target and press **[OBS]**
Observation Start Screen

```
Dist

   Dist  PC  = -30
         ppm =   25
         Fine"r"



  STOP
```

1. Sight the target of the offset point then press **[SDIST]** in the MEAS Mode Screen.
   The "Observation Start Screen" is displayed.

Press **[STOP]**
MEAS Mode Screen

```
Meas.          PC    -30
               ppm     0
                       ▮3
S         10.234m       ſ
ZA       89°58'50"
HAR     111°20'31"
                      P1
 SDIST  SHV  H.ANG  EDM
```

2. When the observation is completed, or during repeat measurement, press **[STOP]** after the measured values are displayed to restore the "MEAS Mode Screen."
   The slope distances, vertical angles, and horizontal angles of the instrument station and the offset point are displayed.

3. In MEAS Mode, display the screen in which **[OFFSET]** is registered.

Press [OFFSET]
Offset Menu Screen

```
Offset
 1.Offset/Dist
 2.Offset/Angle
 3.Offset/2D
 4.Stn data
```
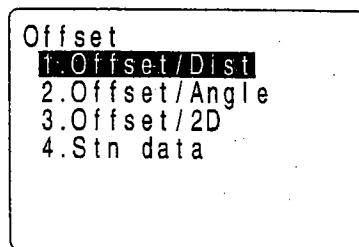
Select "1. Offset/Dist"
Press ◢◣
Offset Observation Screen
(Distance)
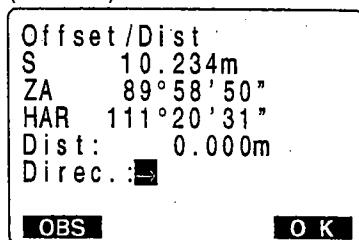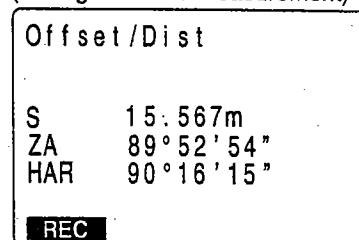
```
Offset/Dist
S         10.234m
ZA      89°58'50"
HAR    111°20'31"
Dist:       0.000m        1
Direc.:▣                   2

 OBS                    O K
```
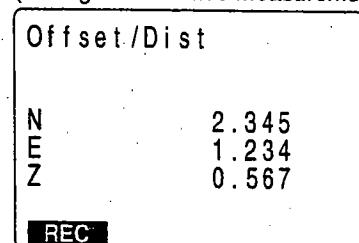
4. Press [OFFSET].

   The "Offset Menu Screen" is displayed.

5. Select "1. Offset/Dist" then press ◢◣.

   The measured values of the offset point are displayed in the "Offset Observation Screen."

6. Select the following items.

   1. Horizontal distance from the target point to the offset point.
   2. Direction of the offset point.

   After setting each item, press ◢◣.

- Horizontal distance entry range: -9999.999 to 9999.999, input unit: 0.001 m
- Direction of offset point
  - →: Offset point on the right of the target point
  - ←: Offset point on the left of the target point
  - ↑: Offset point beyond the target point
  - ↓: Offset point closer than the target point
- Re-observation of the offset point: [OBS]

Press [OK]
Offset Observation Screen
(During Distance Measurement)

```
Offset/Dist


S         15.567m
ZA      89°52'54"
HAR     90°16'15"
 REC
```

Offset Observation Screen
(During Coordinates Measurement)

```
Offset/Dist


N            2.345
E            1.234
Z            0.567
 REC
```

7. Press [OK].

   The "Offset Observation Results Screen" is displayed, and the slope distances, vertical angles, and horizontal angles of the instrument station and the target point are displayed.

   The screen during distance measurement differs from the screen during coordinates measurement.

Press [REC]

8. Press [REC] to record the results.

(During Distance Measurement)

9. Set the following items while refering to "19.1 Recording Distance Measurement data".

```
REC/Dist        1200rec
S            10.160m
ZA       76°14'50"
HAR      64°22'13"
Pt.:POINT200000005    1
Code:ABCD             2
Tgt.h. :      0.000m  3
 O K
```

1. Point number
2. Code
3. Target height

After entering each item, press ⬅.

- Maximum point number size   : 14 (alphanumeric)
- Maximum code size input   : 16 (alphanumeric)

Press [OK]

10. Press [OK].
The "Offset Menu Screen" is restored.

- Go to the "Offset Menu Screen": ESC

15.2 Angle Offset Measurement

- Install offset points for the target point on the right and left sides of and as close as possible to the target point.
  Set the target so that the target height of the target point and offset points are identical.

Target Point

Offset Point (Target)   Offset Point (Target)

Instrument Station
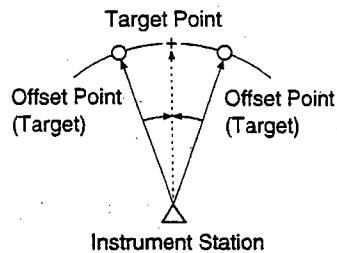
▶ **PROCEDURE** Angle offset measurement

Sight target, press **[SDIST]**
Observation Start Screen

```
Dist

   Dist   PC  = -30
          ppm =  25
          Fine"r"


 STOP
```

1. Sight the target of the offset points and press **[SDIST]** in MEAS Mode.

   The "Observation Start Screen" is displayed and observation begins.

Press **[STOP]**
MEAS Mode Screen

```
 Meas.          PC  -30
                ppm   0
                      ▮3
 S       10.234m      ř
 ZA      89°58'50"
 HAR    150°16'15"
                      P1
 SDIST ⦚SHV H.ANG EDM
```

2. When observation is completed or after the measurement values are displayed during continuous measurement, press **[STOP]** to restore the "MEAS Mode Screen."

   The slope distance, vertical angle, and horizontal angle of the instrument station and the offset points are displayed.

Press **[OFFSET]**
OFFSET Menu Screen

```
 Offset
  1.Offset/Dist
  2.Offset/Angle
  3.Offset/2D
  4.Stn data


```

3. In MEAS Mode, display the screen in which **[OFFSET]** is registered.

4. Press **[OFFSET]**.

   The "Offset Menu Screen" is displayed.

Select "2. Offset Angle", press

5.   Select "2. Offset/Angle" and press ▰▰▰.

The measured values for the offset points are displayed in the "Target Point Observation Screen".

• Re-observing the offset points: [OBS]

Target Point Observation Screen

```
Offset/Ang.

 2nd obs. OK ?
S          23.200m
ZA     76°34'20"
HAR   156°14'50"

[OBS]              [OK]
```

6.   Accurately sight the direction of the target point and press [OK].

The "Offset Observation Results Screen" is displayed.

The slope distance, vertical angle, and horizontal angle of the instrument station and the target point are displayed.

Press [OK]
Offset Observation Screen
(During Distance measurement))

```
Offset/Ang.


S          10.160m
ZA     76°14'50"
HAR    64°22'13"

[REC]
```

The screen during distance measurement differes from the screen during coordinate measurement.

Offset Observation Screen
(During Coordinate Measurement)

```
Offset/Ang.


N   -1234567.789
E    1234567.789
Z         67.002

[REC]
```

Press [REC]

7.   Press [REC] to record the results.

For the recording method, refer to "19.1 Recording Distance Measurement".

Press [OK]

8.   Press [OK].

The "Offset Menu Screen" is restored.

15.3 Two-distance Offset Measurement

- Install two offset points (1st target and 2nd target) on a straight line from the target point, observe the 1st target and 2nd target, then enter the distance between the 2nd target and the target point to find the target point.

Target Point
+ Offset Point
2nd Target
Offset Point
1st Target
Instrument Station
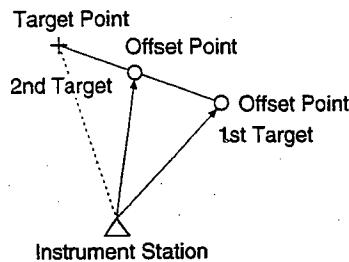
Σ It is possible to make this measurement easily using the optional equipment: the 2-point target (2RT500). When using this 2-point target, be sure to set prism constant to 0.

Offset Points

2nd   1st
Target   Target
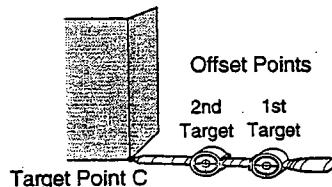
Target Point C

Install the 2-point target with its tip at the target point.
Face the targets toward the instrument.
Measure the distance from the target point to the 2nd target.

▶ PROCEDURE   Two-distance offset measurement

1. In MEAS Mode, display the screen in which [OFFSET] is registered.

Press [OFFSET]
Offset Menu Screen

```
Offset
 1.Offset/Dist
 2.Offset/Angle
 3.Offset/2D
 4.Stn data
```

2. Press [OFFSET].

The "Offset Menu Screen" is displayed.

Select "3. Offset/2D", press

1st Target Observation Screen
(2 points)

```
Offset/2D

 Take 1st o/s read

ZA    89°52'54"
HAR  150°16'15"

              O K
```

3. Select "3. Offset/2D" and press ▰▰▰.

The "1st Target Observation Screen" is displayed.

Sight the 1st target, press **[OK]**
1st Target Observation Start Screen

```
Offset/2D

  Coord PC  =    0
        ppm =    0
        Fine"r"


 STOP
```

4. Sight the 1st target and press **[OK]**.

The "1st Target Observation Start Screen" is displayed and observation begins.

Press **[STOP]**
1st Target Observation Results
Screen

```
Offset/2D


 N        10.567
 E         1.234
 Z         1.890
  Confirm ?
            NO   YES
```

5. When observation has been completed or after the measurement values are displayed during repeat measurement, press **[STOP]** to display the "1st Target Observation Results Screen."

The coordinates of the 1st target are displayed.

Press **[YES]**
2nd Target Observation Screen
(2 points)

```
Offset/2D

  Take 2nd o/s read

 ZA     89°52'54"
 HAR   150°16'15"

                 OK
```

6. Press **[YES]**.

The "2nd Target Observation Screen" is displayed.

• Discard the data and observe the 1st target again: **[NO]**

Sight the 2nd target, press **[OK]**
2nd Target Observation Start Screen

```
Offset/2D

  Coord PC  =    0
        ppm =    0
        Fine"r"


 STOP
```

7. Sight the 2nd target and press **[OK]**.

The "2nd Target Observation Start Screen" is displayed, and observation begins.

Press [STOP]
2nd Target Observation Results
Screen

```
Offset/2D


N          10.567
E           1.789
Z           1.890
 Confirm ?
            N O   YES
```

Press [YES]
Offset distance Entry Screen

```
Offset/2D
B-C: 0.000 m



```

8. When observation has been completed or af-
    ter the measurement values are displayed dur-
    ing repeat measurement, press [STOP] to dis-
    play the "2nd Target Observation Results
    Screen."

    The coordinates of the 2nd target are displayed.

9. Press [YES].

    The "Offset Distance Entry Screen" is dis-
    played.

• Discard the data and observe the 2nd target again: [NO]

Entering distance from 2nd target
to target point
Press ◄▬▬▬◗
Offset Observation Results Screen

```
Offset/2D


N           7.890
E           3.456
Z           0.123
 REC         N O   YES
```

10. Enter the distance from the 2nd target to the
    target point and press ◄▬▬▬◗.

    The "Offset Observation Results Screen" is dis-
    played.
    The coordinates of the target point are dis-
    played.

11. Press [YES].

    The "Offset Menu Screen" is restored.

• Offset distance entry range: –9999.999 to 9999.999 m, Entry unit: 0.001 m
• Discard the data and observe 1st target again: [NO]
• Record displayed values in JOB: [REC] Refer to "19.1 Recording Distance Measure-
  ment Data".

16. MISSING LINE MEASUREMENT

- Missing line measurement is used to measure the slope distance, horizontal distance, and horizontal angle to a target from the target which is the reference (starting position) without moving the instrument.
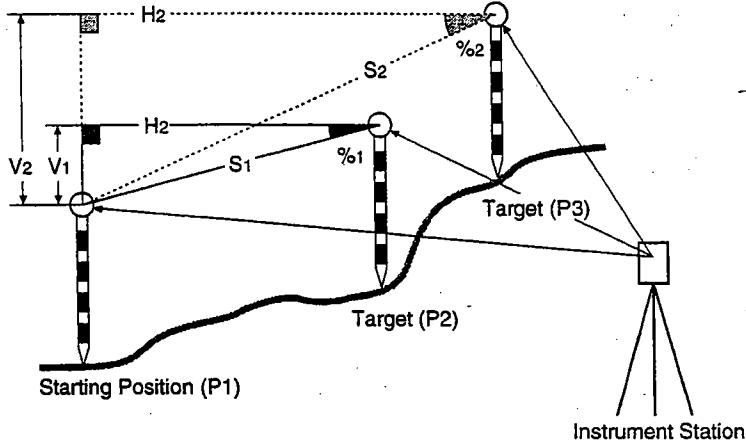
- To find the height difference (V) between 2 points, use a pole etc. to make the target height of all the targets identical.

Measuring the Distance Between Multiple Targets

- It is also possible to perform missing line measurement when **[MENU]** on the third page of MEAS Mode is pressed to enter MEAS Mode and "5. MLM" is selected.

▶ **PROCEDURE** Measuring the distance between multiple targets

Starting Position (P1)

Instrument Station

MEAS Mode Screen

```
Meas.           PC  -30
                ppm   0
                     ↕3
 S        10.567m     ɪ
 ZA     70°11'57"
 HAR   135°31'27"
                     P1
 SDIST ↙SHV H.ANG EDM
```

2nd Target (P2)

Press **[MLM]**
Missing Line Measurement Start
Screen

```
MLM

   MLM    PC  = -30
          ppm =  25
          Fine"r"

 STOP
```

1. Sight the target of the starting position (P1), then press **[SDIST]** in MEAS Mode.

   The "Observation Start Screen" is displayed and observation begins.

2. When the observation is completed, or during repeat measurement, press **[STOP]** after the measured values are displayed to restore the "MEAS Mode Screen".

3. Sight the 2nd target (P2) then press **[MLM]** in the third page of the "MEAS Mode Screen."

   The "Missing Line Measurement Start Screen" is displayed and observation begins.
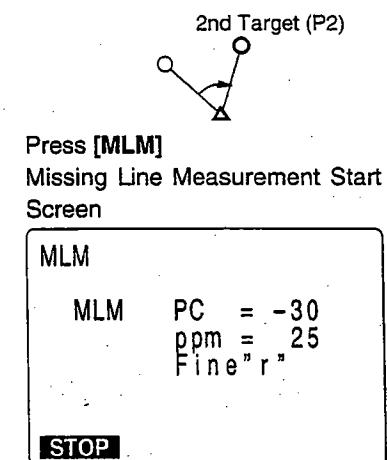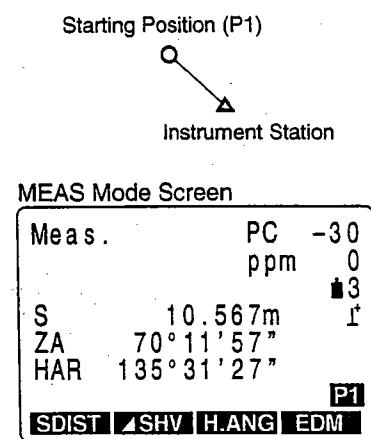
Press **[STOP]**
Missing Line Measurement Results
Screen

```
MLM
MLM  S        20.757m
     H        27.354m
     V         1.012m
S          15.483m
ZA      70°11'57"
HAR    135°31'27"
 MLM  MOVE  S/%  OBS
```

3rd Target (P3)

Press **ESC**: Observation completed
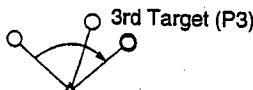
4. When the measurement is completed, the "Missing Line Measurement Results Screen" is displayed.

MLM   S : Slope distance of the starting position and 2nd target

H : Horizontal distance of the starting position and 2nd target

V : Height difference of the starting position and 2nd target

S   : Slope distance of the instrument station and 2nd target

ZA   : Vertical angle of the instrument station and 2nd target

HAR   : Horizontal angle of the instrument station and 2nd target

5. Sight on the 3rd target and press **[MLM]**.

When the observation is completed, the "Missing Line Measurement Results Screen" is displayed.

The values displayed are the slope distance, horizontal distance, and the height difference between starting position and 3rd target.

It is possible to measure 4th or more targets using the same procedure.

• Re-observe the starting position: **[OBS]**

6. To end the observation, press **ESC**.

▶ PROCEDURE Slope in between 2 points

• It is possible to display the gradient of the starting position and target as a %.

With the measured values
displayed: **[S/%]**

```
MLM
MLM  S        48.755%
     H        20.757m
     V         1.012m
S          15.483m
ZA      79°20'00"
HAR     89°53'20"
 MLM  MOVE  S/%  OBS
```

1. Press **[S/%]** with the measured values displayed.

The gradient of the two points is displayed as a % on the second line.

2. Press **[S/%]** once more to return to the original screen.

16.2 Changing the Starting Position

- It is possible to change the last measured point to the next starting position.
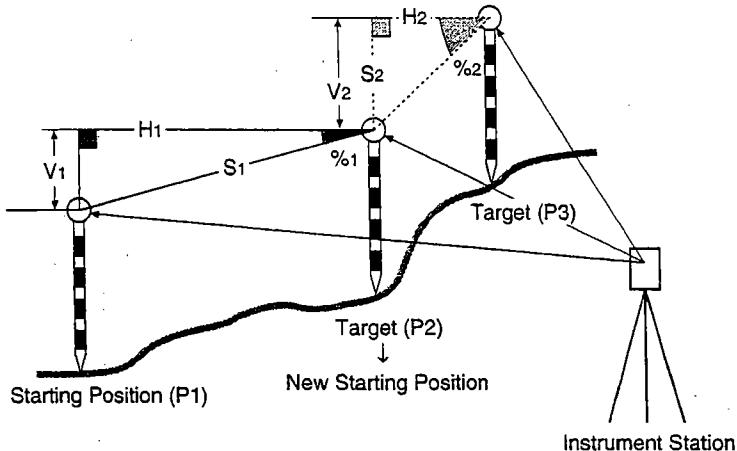
► PROCEDURE Changing the starting position

Missing Line Measurement Results Screen

```
MLM
MLM S        1.234m
    H        2.345m
    V        0.678m
S         15.483m
ZA      70°11'57"
HAR    135°31'27"
  MLM  MOVE  S/%  OBS
```

[MOVE]: Make the last surveying point the new starting position

Starting Position Transfer Screen

```
MLM

 Move ?

S         15.483m
ZA      70°11'57"
HAR    135°31'27"
              NO  YES
```

1. Observe the starting position and target following the steps 1 to 4 in "PROCEDURE Measuring the distance between multiple targets".

   Press **[MOVE]** with the "Missing Line Measurement Results Screen" displayed.

   The "Starting Position Transfer Screen" is displayed.

Press [YES]: Confirmation
Missing Line Measurement
Screen

```
MLM
MLM   S
      H
      V
S         15.483m
ZA      70°11'57"
HAR    135°31'27"
 MLM  MOVE  S/%  OBS
```
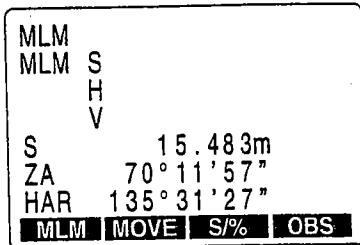
2. Press [YES].

The "Missing Line Measurement Screen" is displayed.

The last target measured becomes the new starting position.

3. To perform missing line measurement of the next target, perform the same operation beginning with the observation of the target in step 3 of "PROCEDURE Measuring the Distance Between Multiple Targets".

17. REM MEASUREMENT

- An REM measurement is a function used to measure the height to a point where a target cannot be directly installed power cables, bridges, bridge supports, etc.

Target Object

θ_{z2}

Vertical angle of object
Vertical angle of prism

θ_{z1}

S

h_2

Object height above ground

Ht

h_1

Height from the surveying point to
the center of the target = Target height
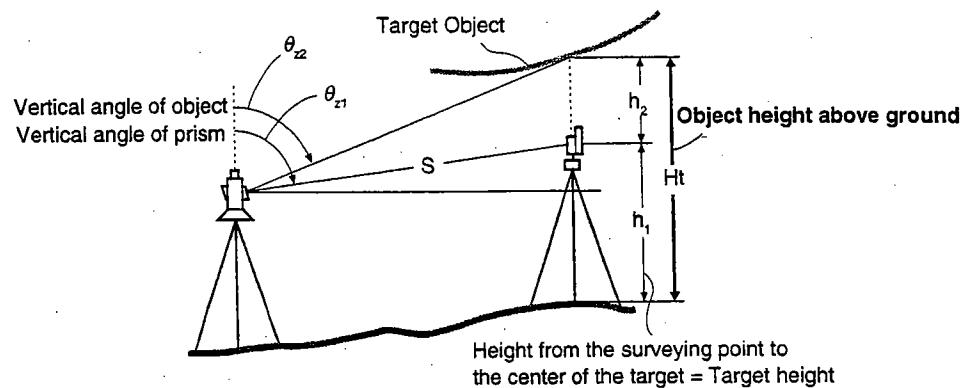
- The height of the target is calculated using the following formula.

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

- When an REM measurement is performed, the initial measurement is performed after 0.7 seconds and later measurements are performed at 0.5 second intervals no matter which distance measurement method is selected.

- In advance allocate the function keys to display **[REM]**. For the allocation method see "23. Key Functions Allocation".

- It is also possible to perform REM measurement when **[MENU]** on the third page of MEAS Mode is pressed to enter MEAS Mode and "6. REM" is selected.

▶ PROCEDURE REM measurement

Object

Target Height
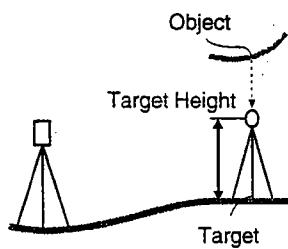
Target

1. Set the target directly under or directly over the object and measure the target height with a tape measure etc.

Press **[HT]**
Height Setting Screen

```
Height
Inst.h.:0.567   m
Tgt.h. :    0.567m



                  OK
```

2. Press **[HT]** on the third page of "MEAS Mode Screen."

   The "Height Setting Screen" is displayed.

Enter the target height,press **[OK]**
MEAS Mode Screen

3. Enter the target height and press **[OK]**.

   The "MEAS Mode Screen" is restored.

Sighting the target

Object
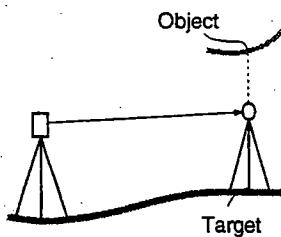
Target

4. Sight the target.

Press **[SDIST]**

```
Dist

   Dist  PC  = -30
         ppm =  25
         Rapid"r"


 STOP
```

5. Press **[SDIST]** on the first page of the "MEAS Mode Screen."
   Distance measurement begins.
   The distance measurement mode at this time may be either S, H, or V mode.

6. When the observation is completed, the distance measurement result is displayed.

7. Sight the object.
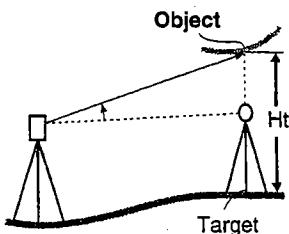
Object

Ht.

Target

8. In MEAS Mode, display the screen in which [REM] is registered

Press **[REM]**
REM Measurement In Progress
Screen

9. Press **[REM]**.

REM measurement begins.

```
REM

Ht.        0.052m
S         13.123m
ZA     89°59'54"
HAR  117°32'21"

STOP
```

The "REM Measurement Screen" is displayed, and 0.7 seconds later, the height from the surveying point to the object is displayed in [Ht.].

Afterwards, the measurement values are completed every 0.5 seconds.

Press **[STOP]**
REM Measurement Screen

10. Press **[STOP]** to terminate the measurement operation.

```
REM

Ht.        0.052m
S         13.123m
ZA     89°59'54"
HAR  117°32'21"

      REM        OBS
```

* Re-observe the target (distance measurement): **[OBS]** (Afterwards returns to step 7.)
* Start REM measurement   : **[REM]**

Press **ESC**
MEAS Mode Screen

11. Press **ESC** to restore the "MEAS Mode Screen."

* Maximum angle of measurement possible: Horizontal ±89°
  (Max. measurement distance (Ht.): ±9999.999 m)

DATA RECORDING

* This section explains JOB or memory settings which can be performed in Memory Mode and data recording methods which can be performed in Record Mode.

Press [MEM]
Memory Mode Screen

```
Memory
 1.JOB
 2.Known data
 3.Code
```

Press [REC]
Record Mode Screen

```
REC
 1.Dist data
 2.Angle data
 3.Coord data
 4.Stn data
 5.Note
 6.View
```

* To enter Memory Mode, press **[MEM]** in the "Status Screen."

* To enter Record Mode, press **[REC]** in "MEAS Mode Screen."

* To return to the original screen, press **ESC**.

18. SETTINGS IN MEMORY MODE

Press **[MEM]**
Memory Mode Screen

```
Memory
1.JOB
2.Known data
3.Code
```

- To enter Memory Mode, press **[MEM]** in the "Status Screen."

- In Memory Mode, it is possible to perform settings concerning JOB and memory.

  - JOB Selection
  - Deleting a JOB
  - Registering Coordinate Data in Memory
  - Clearing Coordinate Data from Memory
  - Reviewing Coordinate Data
  - Inputting Codes
  - Deleting Codes
  - Reviewing Codes
  - Outputting JOB Data to Host Computer
  - Outputting JOB Data to a Printer

18.1 JOB Selection

- Before recording data, select the JOB in which it is to be recorded. The following data can be recorded in JOB.
  - Measurement results
  - Instrument station data
  - Notes

- A total of 24 JOBs have been prepared, and JOB01 was selected when your SET was shipped from the factory.
  The names of the JOBs have been preset as JOB01 to JOB24; you can change them to any names you wish.

- A total of 3,000 data items, which includes data stored in all JOBs and the coordinate data in the memory, can be stored inside the instrument.
  However, storage space for 2 items is required to store 1 item of instrument station data.

▶ PROCEDURE JOB selection

Select "1. JOB", press ▰▰▰
JOB Management Screen

```
Mem. / JOB
 1.JOB selection
 2.JOB deletion
 3.Comms output
```

1. Select "1. JOB" in the Memory Mode Screen and press ▰▰▰.

   The "JOB Management Screen" is displayed.

Select "1. JOB Selection", press

▰▰▰

JOB Selection Screen

```
Mem. / JOB
 JOB01          0
 JOB02          0
 JOB03          0
 JOB04          0
 JOB05          0
 JOB06          0↓
 ↓↑→P  TOP  LAST  EDIT
```

2. Select "1. JOB Selection" and press ▰▰▰.

   The "JOB Selection Screen" is displayed.
   The JOB name is displayed. The 24 JOBs are divided among four pages.
   The numbers to the right represent the number of data items in each JOB.

3. Align the cursor with the desired JOB and press

The JOB is determined and the "JOB Management Screen" is restored.

- Move item : ▼ or ▲
- Changing the cursor motion unit : [↑ ↓ −P]
  - When ↑↓−P is displayed, the cursor moves from line to line.
  - When ↑↓−P is displayed, the cursor moves from page to page.
- Display top of JOB list : [TOP]
- Display end of JOB list : [LAST]

▶ PROCEDURE Changing JOB name

JOB Selection Menu

```
Mem. / JOB
  JOB01        46
  JOB02         0
  JOB03       254
  JOB04         0
  JOB05         0
  JOB06         0↓
 ↓↑−P  TOP  LAST  EDIT
```

1. Perform steps 1 and 2 in "JOB Selection" on P. 106 to display the "JOB Selection Screen."

Press [EDIT]
JOB Name Change Screen

```
Mem. / JOB
 JOB  :JOB01

                      S
```

2. Align the cursor with the JOB to be changed then press [EDIT].

    The current name is displayed on the "JOB Name Change Screen."

Enter new JOB name,
JOB Selection Screen

3. Enter the new JOB name with the alphanumeric keys, then press .

    The "Job Selection Screen" is restored.

- Maximum size of JOB name : 12 (letters of the alphabet and numerals)

18.2 Deleting a JOB

- It is possible to clear the data within a designated JOB.

- It is not possible to clear a JOB until external output (transmission to the host computer or output to printer) has been completed. An [*] beside a JOB name indicates that the data in that JOB has not been output.

- After the data has been cleared, the JOB name returns to the name allocated when the **SET** was shipped.

▶ **PROCEDURE Deleting a JOB**

Select "1. JOB", press ▰▰▰▰
JOB Management Screen

```
Mem./JOB
 1.JOB selection
 2.JOB deletion
 3.Comms output
```

1. Select "1. JOB" in the "Memory Mode Screen," and press ▰▰▰▰ .
The "Job Management Screen" is displayed.

Select "2. JOB Deletion", press
▰▰▰▰
Job Clearing Screen

```
Mem./JOB
 JOB01          0
 JOB02          0
 JOB03          0
 JOB04          0
 JOB05          0
 JOB06          0↓
 ↓↑_P  TOP  LAST
```

2. Select "2. Job deletion" and press ▰▰▰▰ .
The "JOB Clearing Screen" is displayed.

The JOB names are displayed in a table.

Select JOB to be deleted, press
▰▰▰▰
Job Deletion Confirmation Screen

```
Mem./JOB


 JOB.JOB01
   deletion
     Confirm ?

            NO  YES
```

3. Select the JOB whose data is to be deleted and press ▰▰▰▰ .

The "JOB Deletion Confirmation Screen" is displayed.

Press [YES] : Confirmation
JOB Management Screen

4. Press [YES].
   The data within the JOB which is displayed is deleted and the "JOB Management Screen" is restored.

Press **ESC** : To Memory
   Mode Screen

5. Press **ESC** to restore the "Memory Mode Screen."

18.3 Registering Coordinate Data in Memory

- It is possible to register coordinate data in memory in advance. The coordinate data which has been registered can be output during setting for use as instrument station, backsight station, known point, and setting-out point coordinate data.

- Coordinate data is stored in a part of the memory separated from JOB data.

- It is possible to register 3000 items of coordinate data, including the data inside the JOBs.

- There are two registration methods: key entry and entry from an external instrument.

▶ **PROCEDURE** Using the key entry method to register coordinate data

Select "2. Known data", press
▱◣

Known Point Menu Screen

```
Mem./Known
 1.Key in coord
 2.Comms input
 3.Deletion
 4.View
 5.Clear
```

1. Select "2. Known data" in "Memory Mode Screen" and press ▱◣.

   The "Known Point Menu Screen" is displayed.

Select "1. Key in coord", press
▱◣

Coordinate Data Entry Screen

```
Mem./Known  (3000rec)
N        0.000        1
E        0.000        2
Z        0.000        3
Pt.:POINT200000005    4

 REC
```

2. Select "1. Key in coord" and press ▱◣.

   The "Coordinate Data Entry Screen" is displayed.

   Item Registration Capacity

3. Set the following items.
   1 to 3 Coordinate values
   4   Point number

Entry of coordinate values and number, press ▱◣

After setting each item, press ▱◣.

Press **[REC]**: Recording Coordinate Data
Recording Complete Screen

```
Mem./Known    2999rec
N   -1234567.890
E    1234567.890
Z          1.123
Pt.:POINT200000005


 REC
```

4. Press **[REC]**.
   The coordinate data is recorded in the memory and the "Recording Complete Screen" is displayed.

   Next it is possible to enter other coordinate data.

After Registration Completed, press **ESC**
Known Point Menu Screen

5. After the registration of all the coordinate data has been completed, press **ESC**.

   The "Known Point Menu Screen" is restored.

• Maximum point number size : 14 characters (alphanumeric)

▶ PROCEDURE Entering coordinate data from an external instrument

- The format of the coordinate data is the SDR33 format.

- The communication conditions conform to the set communication conditions represented by parameters.

Select "2. Known data", press

◢▬▬◣

Known Point Menu Screen

```
Mem. / Known
 1.Key in coord
 2.Comms input
 3.Deletion
 4.View
 5.Clear
```

1. Select "2. Known data" in the "Memory Mode Screen" and press ◢▬▬◣ .

   The "Known Point Menu Screen" is displayed.

Select "2. Comms input", press

◢▬▬◣

Coordinate Data Reception Screen

```
Mem. / Known

 Format.SDR33


 Receiving    12
```

2. Select "2. Comms input" and press ◢▬▬◣ .

   The "Data Format Display Screen" is displayed.

   The format SDR33 is displayed.
   Press ◢▬▬◣ .

   The "Coordinate Data Reception Screen" is displayed. Enter coordinate data from an external instrument in this condition. The figure represents the number of items received.

   When data reception is completed, the "Data Format Display Screen" is restored.

- Stopping data reception in progress : ESC

18.4 Clearing Coordinate Data from Memory

- It is possible to clear coordinate data from memory.
  There are two methods: initialization which clears all coordinate data at once and clearing of designated data items one at a time.

▶ **PROCEDURE** Clearing all coordinate data at once (initialization)

- This procedure clears all registered coordinate data from memory at once.

Select "2. Known data", press
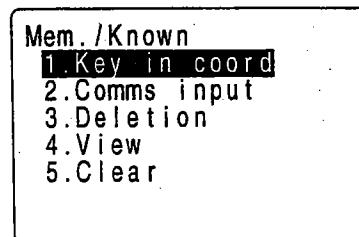
Known Point Menu Screen

```
Mem. / Known
 1.Key in coord
 2.Comms input
 3.Deletion
 4.View
 5.Clear
```

1. Select "2. Known data" in the "Memory Mode Screen" and press .

The "Known Point Menu Screen" is displayed.

Select "5. Clear", press
Data Initialization Screen

```
Mem. / Known


 Clear
   Confirm ?


              N O   YES
```
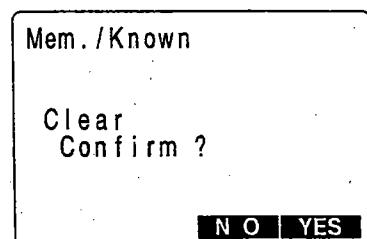
2. Select "5. Clear" and press .

The "Data Initialization Screen" is displayed.

Press [YES]: Clearing all data
Known Point Menu Screen

3. Press [YES].

Coordinate data is completely cleared and the "Known Point Menu Screen" is restored.

- Cancel of clearing: [NO]

► PROCEDURE   Deleting designated coordinate data

• Select the point number of the coordinate data to delete data one item at a time.

Select "2. Known data", press

![button]

Known Point Menu Screen

```
Mem./Known
1.Key in coord
2.Comms input
3.Deletion
4.View
5.Clear
```

1. Select "2. Known data" in the "Memory Mode Screen" and press ![button].

   The "Known Point Menu Screen" is displayed.

Select "3. Deletion", press

![button]

Point Number Display Screen

```
Mem./Known
Pt.   101           ↑
Pt.   POINT200000005
Pt.   102
Pt.   103
Pt.   104
Pt.   105           ↓
↓↑–P  TOP  LAST  SRCH
```

2. Select "3. Deletion" and press ![button].

   The "Point Number Display Screen" is displayed.

Select the point number to be deleted, press ![button]

Data Clearing Screen

```
Mem./Known
N          22.230
E         123.450
Z           6.330
Pt.:POINT200000005
 Deletion
  Confirm ?
           NO  YES
```

3. Select the point number to be deleted and press ![button].
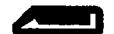
   The "Data Clearing Screen" is displayed.

• Move item   : ▼ or ▲

• Changing the cursor motion unit : [↑ ↓ –P]

   • When ↑↓–P is displayed, the cursor moves from line to line.

   • When ↑↓–P is displayed, the cursor moves from page to page.

• Display top of point number list : [TOP]
• Display end of point number list : [LAST]
• Searching for coordinate data   : [SRCH] (See "REFERENCE Searching for
                                                Coordinate Data")
• Display next data   : [NEXT]
• Display previous data   : [PREV]

Press **[YES]** : Clearing data
Point Number Display Screen

4. Press **[YES]**.

The displayed coordinate data is cleared and
the "Point Number Display Screen" is restored.

Press **ESC** : Clearing com-
pleted
Known Point Menu Screen

5. After clearing is completed, press **ESC** to re-
store the "Known Point Menu Screen."

▶ **REFERENCE** Searching for coordinate data

* When it is necessary to search for a point number to be cleared using the second proce-
dure "PROCEDURE Deleting Designated Coordinate Data", search as explained below.

Point Number Display Screen

```
Mem./Known
Pt.   101            ↑
Pt.   POINT200000005
Pt.   102
Pt.   103
Pt.   104
Pt.   105            ↓
↓↑_P  TOP  LAST  SRCH
```

1. Align the cursor with the top point number and
press **[SRCH]** in the "Point Number Display
Screen."

NOTE : The point number following the point
number indicated by the cursor be-
comes the object of the search.

The "Data Search Screen" is displayed.

Press **[SRCH]**
Data Search Screen

```
Mem./Known
Pt.:POINT200000005
```

Entering the point number, press

Data Clearing Screen

```
Mem./Known
N          22.230
E         123.450
Z           6.330
Pt.:POINT200000005
 Deletion
  Confirm?
            N O   YES
```

2. Enter the point number and press ⬤.

When searching is completed, the "Data Clear-
ing Screen" is displayed.

When no point number has been searched,
"Not found" is displayed on line 7.

Press **[YES]** : Clearing data
Point Number Display Screen

3. Press **[YES]**.

The displayed coordinate data is cleared and
the "Point Number Display Screen" is restored.

18.5 Reviewing Coordinate Data

- It is possible to display the coordinate data within the memory.

▶ **PROCEDURE** Reviewing coordinate data

Select "2. Known data", press

Known Point Menu Screen

```
Mem./Known
 1.Key in coord
 2.Comms input
 3.Deletion
 4.View
 5.Clear
```

1. Select "2. Known data" on the "Memory Mode Screen" and press ◢▬◣ .

   The "Known Point Menu Screen" is displayed.
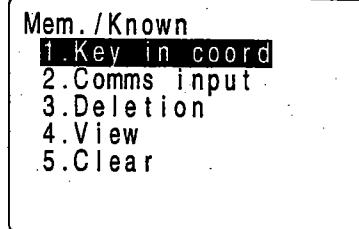
Select "4. View", press

Point Number Display Screen

```
Mem./Known
Pt.  POINT200000005 ↑
Pt.  1
Pt.  2
Pt.  12345678
Pt.  12345679
Pt.  3            ↓
 ↓↑-P  TOP  LAST  SRCH
```

2. Select "4. View" and press ◢▬◣ .

   The "Point Number Display Screen" is displayed.
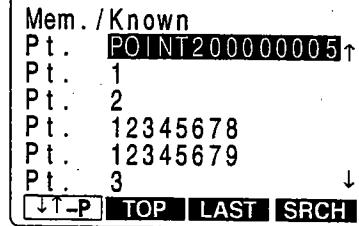
Select point number to be displayed, press

Coordinate Data Display Screen

```
Mem./Known
N        1234.567
E        8901.234
Z           0.567
Pt.:POINT200000005


 NEXT  PREV
```

3. Select the point number to be displayed and press ◢▬◣ .

   "Coordinate Data Display Screen" is displayed.

- Move item : ▼ or ▲
- Changing the cursor motion unit : [↑ ↓ –P]

  - When ↑↓–P is displayed, the cursor moves from line to line.

  - When ↑↓–P is displayed the cursor moves from page to page.
- Display first point number list : [TOP]
- Display last point number list : [LAST]
- Search for Coordinates data : [SRCH]
- Display next data : [NEXT]
- Display previous data : [PREV]

Press ESC : To Point Number Display Screen

4. Press ESC to restore the "Point Number Display Screen".

Press ESC : To Known Point Menu Screen

5. Press ESC again to restore the "Known Point Menu Screen".

18.6 Inputting Codes

- It is possible to save codes in memory.

- It is possible to read in codes registered in memory when recording instrument station data or observation data.

▶ **PROCEDURE** Inputting codes

Select "3. Code", press ◢▆▆▆▋
Code Menu Screen

```
Mem. /Code
 1.Key in code
 2.Deletion
 3.Code view
 4.Clear list


```

1. Select "3. Code" in the "Memory Mode Screen" and press ◢▆▆▆▋ .

   The "Code Menu Screen" is displayed.

Select "1. Key in code", press
◢▆▆▆▋
Code Entry Screen

```
Mem. /Code
Code:▆▆▆▆▆▆▆▆


                        S
```

2. Select "1. Key in code" and press ◢▆▆▆▋ .
   The "Code Entry Screen" is displayed.

◀

Entering codes, press ◢▆▆▆▋
Code Menu Screen

3. Enter the code and press ◢▆▆▆▋ .

   The code is registered and the "Code Menu Screen" is restored.

- Maximum code size : 16 (alphanumeric)
  When the code can not be completely displayed, use ◀ to display the remainder.
- Maximum number of codes registered : 40

18.7 Deleting Codes

- It is possible to clear codes from memory.

▶ **PROCEDURE** Deleting codes

Select "3. Code", press ⬛
Code Menu Screen

```
Mem./Code
 1.Key in code
 2.Deletion
 3.Code view
 4.Clear list
```

1. Select "3. Code" in the "Memory Mode Screen" and press ⬛ .

   The "Code Menu Screen" is displayed.

Select "2. Deletion", press

⬛

Code Display Screen

```
Mem./Code
  ABCDEFGHIJKLMNO  ↑
  A001
  TREE01LEFT
  POINT1
  POINT2
  POINT3        ↓
 ↓↑-P  TOP   LAST  DEL
```

2. Select "2. Deletion" and press ⬛ .

   The "Code Display Screen" is displayed.

Press [DEL]: Clears code data.

3. Align the cursor with the code to be cleared and press [DEL] .

   The selected code data is cleared.

- Move item : ▼ or ▲
- Changing the cursor motion unit : [↑ ↓ –P]
  - When ↑↓–P is displayed, the cursor moves from line to line.
  - When ↑↓–P is displayed, the cursor moves from page to page.
- Display top of code list : [TOP]
- Display end of code list : [LAST]

Press ESC : To Code Menu Screen

4. After the code data has been completely cleared, press ESC .

   The "Code Menu Screen" is restored.

18.8 Reviewing Codes

- It is possible to display a list of codes in memory.

▶ **PROCEDURE** Reviewing codes

Select "3. Code", press ◢◣◣◣
Code Menu Screen

```
Mem./Code
 1.Key in code
 2.Deletion
 3.Code view
 4.Clear list
```

1. Select "3. Code" in the "Memory Mode Screen" and press ◢◣◣◣ .

   The "Code Menu Screen" is displayed.

Select "3. Code view", press

◢◣◣◣

Code Data Display Screen

```
Mem./Code
  ABCDEFGHIJKLMNO   ↑
  A001
  TREE01LEFT
  POINT1
  POINT2
  POINT3            ↓
 ↓↑-P  TOP   LAST
```

2. Select "3. Code view" and press ◢◣◣◣ .

   The "Code Data Display Screen" is displayed.

- Move item : ▼ or ▲
- Changing the cursor motion unit : [↑ ↓ –P]
  - When ↑↓–P is displayed, the cursor moves from line to line.
  - When ↑↓–P is displayed, the cursor moves from page to page.
- Display top of code list : [TOP]
- Display end of code list : [LAST]

Press ESC : To the Code Menu Screen

3. Press ESC to return to the "Code Menu Screen."

18.9 Outputting JOB Data to Host Computer

- It is possible to output the data within the JOB to a host computer in JOB units.

▶ PROCEDURE Outputting JOB data to host computer

Select "1. JOB", press ◢▰▰▰▰◣
JOB Management Screen
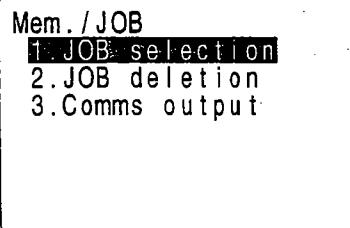
```
Mem./JOB
 1.JOB selection
 2.JOB deletion
 3.Comms output
```

1. Select "1. JOB" on the "Memory Mode Menu Screen" and press ◢▰▰▰▰◣ .

The "JOB Management Screen" is displayed.

Select "3. Comms output", press
◢▰▰▰▰◣
Output Format Selection Screen

```
Mem./JOB
 1.SDR
 2.Printed output
```
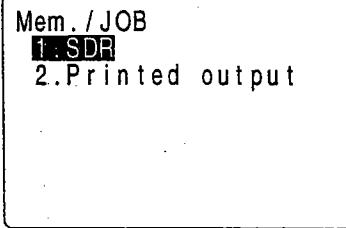
2. Select "3. Comms output" and press ◢▰▰▰▰◣ .

The "Output Format Selection Screen" is displayed.

Select "1. SDR", press ◢▰▰▰▰◣
Output JOB Selection Screen
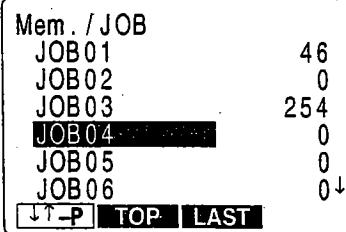
```
Mem./JOB
 JOB01          46
 JOB02           0
 JOB03         254
 JOB04           0
 JOB05           0
 JOB06          0↓
 ↓↑-P  TOP  LAST
```

3. Select "1. SDR" and press ◢▰▰▰▰◣ .

The "Output JOB Selection Screen" is displayed.

- Move item : ▼ or ▲
- Changing the cursor motion unit : [↑↓ –P]
  - When [↑↓ –P] is displayed, the cursor moves from line to line.
  - When [↑↓ –P] is displayed, the cursor moves from page to page.
- Display top of JOB list : [TOP]
- Display end of JOB list : [LAST]

Select JOB, press ◢▬▬◣
Output in Progress Screen

```
Mem. / JOB

 Format.SDR33
 JOB.JOB01

 Sending
```

After output is complete, moves to
the Output JOB Selection Screen

4. Select the JOB to be output to the printer, and
    press ◢▬▬◣ .
    Printer output starts and the "Output in Progress
    Screen" is displayed.

When the output to the printer is completed,
the "Output JOB Selection Screen" is restored.
It is possible to continue printer output of the
next JOB.

- Stopping output : ESC

18.10 Outputting JOB Data to a Printer

- It is possible to output data within a JOB to a parallel printer in JOB units.

- Switch off the power to the printer and the **SET** and connect them with printer cable DOC46 (sold separately).

▶ **PROCEDURE** Outputting JOB data to a printer

Select "1. JOB", press ◢▬▬◣
JOB Management Screen

```
Mem. / JOB
1.JOB selection
2.JOB deletion
3.Comms output
```

1. Select "1. JOB" on the "Memory Mode Menu Screen" and press ◢▬▬◣.

   The "JOB Management Screen" is displayed.

Select "3. Comms output", press
◢▬▬◣
Output Format Selection Screen

```
Mem. / JOB
1.SDR
2.Printed output
```

2. Select "3. Comms output" and press ◢▬▬◣.

   The "Output Format Selection Screen" is displayed.

Select "2. Printed output", press
◢▬▬◣
Output JOB Selection Screen

```
Mem. / JOB
 JOB01           46
 JOB02            0
 JOB03          254
 JOB04            0
 JOB05            0
 JOB06            0↓
 ↓↑−P   TOP  LAST
```

3. Select "2. Printed output" and press ◢▬▬◣.

   The "Output JOB Selection Screen" is displayed.

- Move item : ▼ or ▲
- Changing the cursor motion unit : [↑ ↓ −P]
  - When ↑↓ −P is displayed, the cursor moves from line to line.
  - When ↑↓−P is displayed, the cursor moves from page to page.
- Display top of JOB list : [TOP]
- Display end of JOB list : [LAST]

Select JOB, press ⬛
Output in Progress Screen

```
Mem. / JOB

Print
JOB . JOB01

Sending
```

4. Select the JOB to be output to the printer, and press ⬛ .
Printer output starts and the "Output in Progress Screen" is displayed.

After output is complete, moves to the Output JOB Selection Screen

When the output to the printer is completed, the "Output JOB Selection Screen" is restored. It is possible to continue printer output of the next JOB.

- Stopping output : ESC

19. RECORDING IN RECORD MODE

| Press [REC] | • To enter Record Mode, press **[REC]** in the "MEAS Mode Screen." |
| Record Mode Screen | |

```
REC
 1.Dist data
 2.Angle data
 3.Coord data
 4.Stn data
 5.Note
 6.View
```

• Operations concerning the recording of data can be performed in Record Mode.

• Recording Distance Measurement Data
• Recording Angle Measurement Data
• Recording Coordinates Data
• Recording Station Point Data
• Recording Notes
• Reviewing JOB Data

19.1 Recording Distance Measurement Data

• It is possible to record the most recently measured distance measurement data in a JOB. And it is possible to perform and record distance measurements, offset measurements, etc. after entering Record Mode.

• Once the data has been recorded, [REC] cannot be displayed in order to prevent double recording.

• It is convenient to use **[AUTO]** to perform automatic operation from distance measurement to recording.

• The items recorded are slope distance, vertical angle, horizontal angle, point number, codes, and target height.

▶ **PROCEDURE** Recording distance measurement data

MEAS Mode Screen

```
Meas.         PC  -30
              ppm   0
                    ▮3
S      1234.567m    r
ZA     78°45'59"
HAR   120°31'31"
                   P1
 SDIST  ⊿SHV  H.ANG  EDM
```

1. Perform distance measurement in MEAS Mode.

Press **[REC]**
Record Mode Screen

```
REC
 1.Dist data
 2.Angle data
 3.Coord data
 4.Stn data
 5.Note
 6.View
```
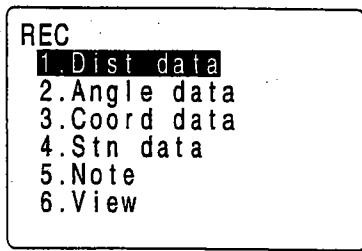
Select "1. Dist data", press ◢▬▬◣
Measurement Data Display Screen

```
REC/Dist      1200rec
*S          10.160m
*ZA      76°14'50"
*HAR     64°22'13"
Pt.:POINT200000005
ZA       84°22'13"
HAR     156°14'50"
 AUTO  SDIST  OFFSET  REC
```

Press **[REC]**
Measurement Data Setting Screen

```
REC/Dist      1200rec
S           10.160m
ZA       76°14'50"
HAR      64°22'13"
Pt.:POINT200000005    1
Code:ABCD             2
Tgt.h. :     0.000m   3
 O K
```
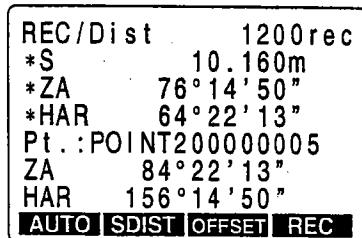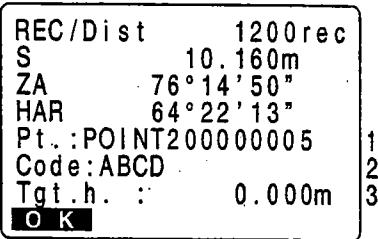
2. Press **[REC]** on the second page of MEAS Mode.

   The "Record Mode Screen" is displayed.

3. Select "1. Dist. data" and press ◢▬▬◣ .

   The measurement results are displayed on lines 2 to 4 (lines indicated by [*]) of the "Measurement Data Display Screen".

4. Press **[REC]** to record the measurement data indicated by the [*].

   The "Measurement Data Setting Screen" is displayed.

5. Set the following items.

   1 Point number
   2 Code
   3 Target height

   After entering each item, press ◢▬▬◣ .

   SET automatically increments the last input number by 1 and displays it. This point number can be used to record data in the memory or can be changed.

• Maximum point number size: 14 (alphanumeric)

```
REC/Dist      1200rec
S           10.160m
ZA       76°14'50"
HAR      64°22'13"
Pt.:POINT200000005    1
Code:ABCD             2
Tgt.h. :     0.000m   3
 O K
```
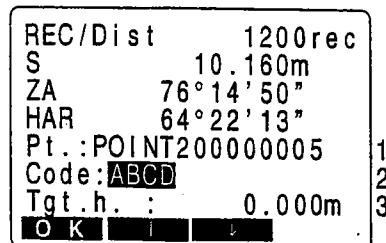
Codes registered in advance can be read in by pressing [↑] or [↓]. Position the cosur at the point you want to read in a code.

> • Maximum code size : 16 (alphanumeric)
> When the code cannot be completely displayed, use ◄ to display the remainder.

Press [OK]

Measurement Data Display Screen

```
REC/Dist        1199rec
*S           10.160m
*ZA       76°14'50"
*HAR      64°22'13"
Pt.:POINT200000005
 ZA       84°22'13"
 HAR     156°14'50"
[AUTO] [SDIST] [OFFSET]
```

Press [SDIST] : Measure distance again

Press [ESC] : To the Record Mode Screen

6. Check the data and press [OK].

The data is recorded and the "Measurement Data Display Screen" is restored.

The number of registrations possible declines by 1.

Because the same data can not be recorded a second time, [REC] is not displayed after recording.

7. Press [SDIST] to measure the distance again in Record Mode.

8. Press [ESC] to restore the "Record Mode Screen."

> • Perform distance measurement to record automatically by pressing a single key : [AUTO]
> When this key is used, it is unnecessary to perform distance measurement in MEAS mode. Press [AUTO] on the "Record Mode Screen" to perform distance measurement and automatically record the results. When this is done, the point number automatically increases from that displayed when the SET entered Record Mode and the code that was displayed is used unchanged. After measurement has been completed, the results are displayed for 2 seconds and the screen displayed before [AUTO] was pressed is restored.
> • Offset measurement in Record Mode: [OFFSET]
> It is possible to advance through "Offset/Dist" and "Offset/Angle" by pressing [OFFSET]. See "15. Offset Measurement" for the procedure.

19.2 Recording Angle Measurement Data

- It is possible to record angle measurement data only in a JOB after entering Record Mode.

- Once the data has been recorded, [REC] can not be displayed in order to prevent double recording.

- It is convenient to use [AUTO] to perform automatic operation from angle measurement to recording.

- The items which can be recorded are the vertical angle, horizontal angle, point number, code, and target height.

▶ **PROCEDURE** Recording angle measurement data

Record Mode Screen

```
REC
 1.Dist data
 2.Angle data
 3.Coord data
 4.Stn data
 5.Note
 6.View
```
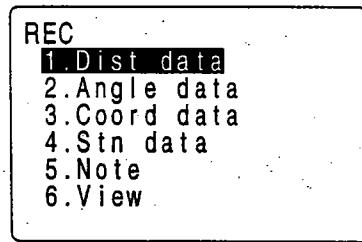
1. Press on the second page of the "MEAS Mode Screen".

   The "Record Mode Screen" is displayed.

Select "2. Angle data", press

Measurement Data Display Screen

```
REC/Angle      1200rec

*ZA
*HAR
Pt.:POINT200000005
ZA        84°22'13"
HAR    156°14'50"
 AUTO  ANGLE
```
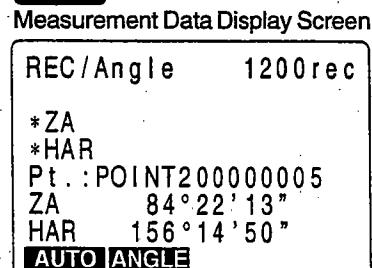
2. Select "2. Angle data" and press ▱.

   The "Angle Measurement Data Recording Screen" is displayed.

Sight the point to be recorded, press [ANGLE]

Measurement Data Display Screen

```
REC/Angle      1200rec

*ZA        76°14'50"
*HAR       64°22'13"
Pt.:POINT200000005
ZA        84°22'13"
HAR    156°14'50"
 AUTO  ANGLE        REC
```
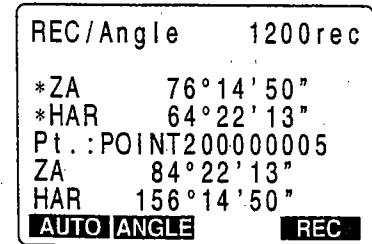
3. Sight the point to be recorded and press [ANGLE].

   The measurement results are displayed on lines 3 and 4 (lines indicated by [*]) of the "Measurement Data Display Screen". Values with no [*] are the angle measurement values displayed in real time.

Press **[REC]**
Measurement Data Setting Screen

```
┌─────────────────────────────┐
│ REC/Angle      1200rec      │
│                             │
│ ZA        76°14'50"         │
│ HAR       64°22'13"         │
│ Pt.:POINT200000005          │
│ Code:ABCD                   │
│ Tgt.h. :      0.000m        │
│ ▐O K▌                       │
└─────────────────────────────┘
```

4. Press **[REC]** to record the angle measurement data indicated by the [*].

   The "Measurement Data Setting Screen" is displayed.

5. Set the following items while refering to "19.1 Recording Distance Measurement data".

   1. Point number
   2. Code
   3. Target height

   After entering each item press ◢▬▬▬◣ .

- Maximum point number size   : 14 (alphanumeric)
- Maximum code size   : 16 (alphanumeric)

Press **[OK]**: Record angle measurement data

6. Press **[OK]** to confirm the data.

   The data is recorded and the "Measurement Data Display Screen" is restored.

   Because the same data can not be recorded a second time, **[REC]** is not displayed after recording.

Measure the angle again : **[ANGLE]**

7. Press **[ANGLE]** to measure the angle again.

Press **ESC** : To the "Record Mode Screen"

8. Press **ESC** to restore the "Record Mode Screen".

- Perform angle measurement to recording automatically by pressing a single key : **[AUTO]**
  When this key is used, it is unnecessary to perform distance measurement in MEAS mode. Press **[AUTO]** on the "Record Mode Screen" to perform distance measurement and automatically record the results. When this is done, the point number automatically increases from that displayed when the **SET** entered Record Mode and the code that was displayed is used unchanged. After measurement has been completed, the results are displayed for 2 seconds and the screen displayed before **[AUTO]** was pressed is restored.

19.3 Recording Coordinates Data

- It is possible to record the measured coordinates data in a JOB. And it is possible to perform and record coordinates measurements, offset measurements, etc. after entering Record Mode.

- Once the data has been recorded, **[REC]** is not displayed in order to prevent double recording.

- It is convenient to use **[AUTO]** to perform automatic operation from coordinates measurement to recording.

- The items which can be recorded are the coordinate values, point number, codes, and target heights.

▶ PROCEDURE **Recording coordinates data**

MEAS Mode Screen

```
Meas.          PC   -30
               ppm    0
                      ■3
S       1234.567m     ┌
ZA       78°45'59"
HAR     120°31'31"
                     P2
 OSET  COORD   S-O   REC
```

1. Perform coordinates measurement in the "MEAS Mode Screen".

Press **[REC]**
Record Mode Screen

```
REC
 1.Dist data
 2.Angle data
 3.Coord data
 4.Stn data
 5.Note
 6.View _
```

2. Press **[REC]** in the second page of the "MEAS Mode Screen".

   The "Record Mode Screen" is displayed.

Select "3. Coord data", press

◢◣

Measurement Data Display Screen

```
REC/Coord      1200rec
*N          10.000
*E         234.000
*Z           1.500
Pt. POINT200000005
ZA      156°14'50"
HAR      84°22'13"
 AUTO   OBS  OFFSET  REC
```

3. Select "3. Coord data" and press ◢◣.

   The measurement results are displayed on lines 2 to 4 (lines indicated by [*]) of the "Measurement Data Screen".

Measurement Data Setting Screen

```
REC/Coord      1200rec
N           10.000
E          234.000
Z            1.500
Pt.:POINT200000005
Code:ABCD
Tgt.h. :    0.000m
O K
```

4. Press [REC] to record the measurement data indicated by [*].
The "Measurement Data Setting Screen" is displayed.

5. Set the following items while refering to "19.1 Recording Distance Measurement data".

   1. Point number
   2. Code
   3. Target height

After entering each item, press ◢▬▬◣ .

• Maximum point number size   : 14 (alphanumeric)
• Maximum code size input   : 16 (alphanumeric)

Press [OK]
Measurement Data Display Screen

```
REC/Coord      1199rec
*N          10.000
*E         234.000
*Z           1.500
Pt. POINT200000005
ZA   156°14'50"
HAR   84°22'13"
AUTO  OBS  OFFSET
```

6. Press [OK] to confirm the data.

The data is recorded and the "Measurement Data Display Screen" is restored.

The number of registrations possible declines by 1 and the point number increases by 1.

Because the same data can not be recorded a second time, [REC] is not displayed after recording.

Measure the angle again: [OBS]

7. Press [OBS] to measure the coordinates again in Record Mode.

Press [ESC] : To the "Record Mode Screen"

8. Press [ESC] to restore the "Record Mode Screen".

• Perform coordinate measurement to record automatically by pressing a single key: [AUTO]
When this key is used, it is unnecessary to perform distance measurement in MEAS mode. Press [AUTO] on the "Record Mode Screen" to perform distance measurement and automatically record the results. When this is done, the point number automatically increases from that displayed when the SET entered Record Mode and the code that was displayed is used unchanged. After measurement has been completed, the results are displayed for 2 seconds and the screen displayed before [AUTO] was pressed is restored.
• Offset measurement in Record Mode: [OFFSET]
It is possible to advance through "Offset/Dist" and "Offset/Angle" by pressing [OFFSET]. See "15. Offset Measurement" for the procedure

19.4 Recording Instrument Station Data

- It is possible to record instrument station data in a JOB.

- The items which can be recorded are the instrument station coordinates, point number, codes, instrument height, operator, date, time, weather, wind, temperature, air pressure, atmospheric correction factor, target type, prism constant correction value, and distance measurement method.

- There are items which can be set even using **[EDM]** in MEAS mode.

▶ **PROCEDURE** Recording instrument station data

Record Mode Screen

```
REC
1.Dist data
2.Angle data
3.Coord data
4.Stn data
5.Note
6.View
```
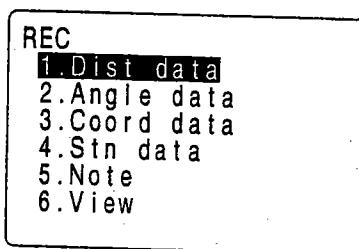
1. Press **[REC]** in the second page of MEAS Mode. The "Record Mode Screen" is displayed.

Select "4. Stn. data", press ◢▬▬◣

Instrument Station Data Setting Screen

```
REC/Stn        1200rec
NO :        10.000
EO :       234.000
ZO :         1.500
Pt.:POINT200000005
Code:TREE
Inst.h.:      1.500m ↓

Operator:              ↑

Date  :Oct-14-96
Time  :10:14:52
Weath.:Fine
Wind  :Calm            ↓

Temp.    : 15°C        ↑
Press.   :1013hPa

ppm       :0.000m
Reflector:Prism
PC        :-30         ↓

Mode  :Rapid"r"        ↑
OK
```

2. Select "4. Stn data" and press ◢▬▬◣ .

   The "Instrument Station Data Setting Screen" (first page) is displayed, and the present instrument station data is displayed.
   There are a total of 4 pages.

3. Set the following data items.

   - Instrument station coordinates
   - Point number
   - Code
   - Instrument height
   - Operator
   - Date
   - Time
   - Weather
   - Wind
   - Temperature
   - Air pressure
   - Humidity
   - Atmospheric correction factor
   - Target type
   - Prism constant correction value
   - Distance measurement method

• Movement of the cursor between items: ▼ ▲

• Entry rules
  Pt.   : 14 numerals and letters of the alphabet
          Coordinate data read-in: **[READ]**
  Code : 16 numerals and letters of the alphabet
          Selection from the code list: ▼ ▲
  Date : To enter July 20, 1997, enter 072097.
  Time : To enter 3:33:37 p.m., enter 153337.

• Setting methods and content
  Weather : Select with ◄ ► (Selection: clear, cloudy, light rain, rain, snow)
  Wind   : Select with ◄ ►
            (Selection: calm, gentle, light, strong, very strong)
  Target : Select with ◄ ► (Selection: prism, sheet)
            Choose the prism constant value set to memory for the reflecting prism
            or reflecting sheet.
  Mode   : Select with ◄ ►
            (Selection: Fine"r",FineAVG"n=", Fine"s", Rapid"r", Rapid"s", Tracking)
            When selecting "precision average measurement," designate the num-
            ber of measurements.

• To set the atmospheric correction factor to 0 ppm   : **[0ppm]**

Press **[OK]**: Recording instru-
ment station data
Record Mode Screen

4.   When the setting is completed, press **[OK]**.

      Instrument station data is recorded and the
      "Record Mode Screen" is restored.

19.5 Recording Notes

- This procedure prepares note data and records it in the JOB which is selected.

▶ **PROCEDURE** Recording of notes

Record Mode Screen

```
REC
 1.Dist data
 2.Angle data
 3.Coord data
 4.Stn data.
 5.Note
 6.View
```
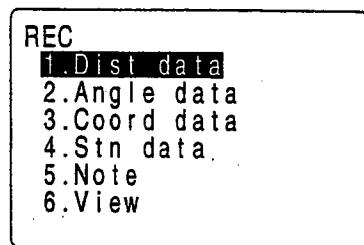
1. Press **[REC]** on the second page of MEAS Mode.

    The "Record Mode Screen" is displayed.

Select "5. Note", press ◢◣█
Note Entry Screen

```
REC/Note      1200rec
ABCDEFGHIJKLMNOPQR
STU

 OK
```
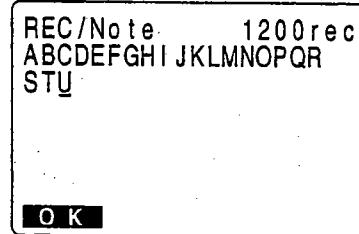
2. Select "5. Note" and press ◢◣█ .

    The "Note Entry Screen" is displayed and the final note data prepared is displayed.

Entry of Notes
Press **[OK]**
Record Mode Screen

3. Enter the note and press **[OK]**.

    The "Record Mode Screen" is restored.

- Maximum note length : 60 characters (alphanumeric)

19.6 Reviewing JOB Data

- It is possible to display the data within the JOB which is selected.

- In advance allocate the function key to display **[VIEW]**.
  For the allocation method, see "23. Key Function Allocation".

- It is possible to search for data within the JOB to be displayed by point number. But the note data cannot be searched.

▶ PROCEDURE Reviewing JOB data

Press **[REC]**
Record Mode Screen

```
REC
 1.Dist data
 2.Angle data
 3.Coord data
 4.Stn data
 5.Note
 6.View
```
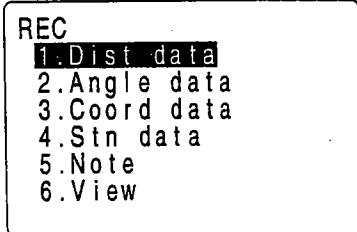
1. Press **[REC]** on the second page of MEAS Mode.

    The "Record Mode Screen" is displayed.

Select "6. View", press ◢▬▬◖

Point Number Display Screen

```
REC/View
Stn   1001
Dist  101
Dist  102
Ang.  103
Crd.  104
Note  ABCDEFGHI        ↓
 ↓↑-P   TOP   LAST   SRCH
```
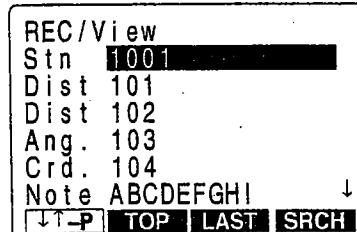
2. Select "6. View" and press ◢▬▬◖ .

    The "Point Number Display Screen" is displayed.

- Item motion   : ▼ or ▲
- Changing the cursor motion unit : [↑ ↓ -P]

  - When ↑↓-P is displayed, the cursor moves from line to line.

  - When ↑↓-P is displayed the cursor moves from page to page.
- Display first data   : **[TOP]**
- Display last data   : **[LAST]**
- Search for point number   : **[SRCH]**

Select point number, press

![button]

Details Display Screen
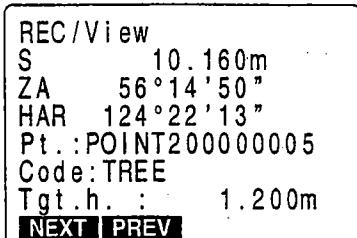
```
REC/View
S         10.160m
ZA     56°14'50"
HAR   124°22'13"
Pt.:POINT200000005
Code:TREE
Tgt.h. :    1.200m
 NEXT   PREV
```

- Display next data   : [NEXT]
- Display previous data item : [PREV]

Press **ESC**: Conclude details display
Point Number Display Screen

Press **ESC**: To Record Mode Screen

3. Select the point number to be displayed in detail and press ![button] .

    "Details Display Screen" is displayed.
    All data for the designated point number is displayed.

4. Press **ESC** to conclude detailed display.

    The "Point Number Display Screen" is restored.

5. Press **ESC** to restore the "Record Mode Screen".

TROUBLESHOOTING

- This section explains the meaning of error messages and checking and adjustment methods.

20. ERROR MESSAGES

- The following is a list of the error messages displayed by the **SET** and the meaning of each message. If the same error message is repeated or if any message not shown below appears, the instrument has malfunctioned. Contact your Sokkia agent.

Bad condition

Distance measurement conditions are poor.
Either sight the target again, or when using a reflective prism, increase the number of reflective prisms.

Calculation error

Coordinates identical to the known point coordinates observed during resection exist.
Set another known point so that the known point coordinates do not coincide.

Code area full

There is no space in the area where the code is to be read in.
Clear unnecessary codes and record the code again.

Code file checksum err. All cleared

An error may have occurred in the code memory.
Forcefully clear codes from the memory. If it appears to occur frequently, contact your Sokkia agent.

Data checksum err. Delete all data OK?

It is possible that an error has occurred in the data.
After selecting **[NO]** to back up all data, select **[YES]** the next time the power is turned on. Be careful when pressing **[YES]**, because this clears all data within the JOB and coordinate data from memory. If it appears to occur frequently, contact your Sokkia agent.

Data write err

It is impossible to read in data.
Contact your Sokkia agent.

Exchange sub bat.

The lithium battery used for backup is either weak or dead.
When data remains, perform an emergency backup of the data and replace the backup battery at your Sokkia service center.

Invalid data

You have pressed **[REC]**, but no data is recorded. The data is already recorded or else there is an error in the data. (In a case where parameter "Recording Mode" is "auto," even if **[REC]** is not pressed, the message is displayed under the above conditions.)

Perform the observations again.

Memory is full

There is no more room to enter data.

Record the data again after deleting unnecessary data from the JOB or coordinate data from the memory.

No code data

When clearing or displaying code data in memory, there is no code data registered in memory.

No coord. data

When reading in coordinate values during instrument station registration etc., there is no coordinates data registered in the memory and in the selected JOB.

No known data

When clearing or displaying coordinates data in memory, there is no coordinates data registered in memory.

No obs. data

When deleting data from within a JOB, there is no data registered in the JOB now selected.

No solution

The calculation of the instrument station coordinates during resection does not converge.

Assess the results and if necessary, perform the observations again.

Not found

During a data search, the search stopped either because the item in question does not exist or the data volume is large.

Out of range

The tilt of the instrument exceeds the tilt angle compensation range during measurement.

Sight again within ±3'.

Out of value

- During gradient % display, the display range (less than. ±1,000%) has been exceeded.
- During REM measurement, either the vertical angle has exceeded horizontal ±89° or the measured distance is greater than 9999.999 m.
  Install a instrument station far from the target.
- The instrument station coordinates calculated during resection are too high.
  Perform the observation again.

Print or send first

JOB data output (transmission to the host computer or output to the printer) is not completed before JOB is cleared.
Either transmit the JOB to be cleared to the host computer or output it to the printer.

RAM cleared

It is possible there is a nonconformity in a setting area.
Forcefully initialize all set values. If it appears to occur frequently, contact your Sokkia agent.

Re 0 Set

The telescope or top of the instrument was rotated too rapidly.
Index the horizontal circle and vertical circle once again. (The readout speed of the horizontal angle and vertical angle of the **SET** is about 4 rotations/second.)

Receive data err.

A reception error has occurred in coordinate data from an external instrument.
Check the settings of parameters 16 to 21 concerning communication conditions.

Signal off

The reflected light is not observed when distance measurement begins. Or during measurement, the reflected light has weakened or is blocked.
Either sight the target again, or when using a reflective prism, increase the number of reflective prisms.

Need 1st o/s obs

When finding a target point from two offset points during offset measurement, the 1st target observation is not completed normally.
Sight the 1st target accurately and press **[OBS]** to perform the observation again.

Need 2nd o/s obs

When finding a target point from two offset points during offset measurement, the 2nd target observation is not completed normally.
Sight the 2nd target accurately and press **[OBS]** to perform the observation again.

Need offset pt. obs

Observation of the offset point during offset measurement was not completed normally.
Sight the offset point accurately and press **[OBS]** to perform the measurement again.

Need base pt. obs

During REM measurement, the observation of the target was not completed normally.
Sight the target accurately and press **[OBS]** to perform the measurement again.

Need 1st obs

During missing line measurement, the observation of the starting position was not completed normally.

Sight the starting position accurately and press [OBS] to perform the measurement again.

Need 2nd obs

During missing line measurement, the observation of the target was not completed normally.

Sight the target accurately and press [MLM] to perform the measurement again.

Too few points

The known point observations necessary for calculation during resection are not completed or the calculation conditions are not all satisfied.

Check the calculation conditions in "13. Resection," and perform supplementary known point observations.

21. CHECKING AND ADJUSTMENTS

- A **SET** is a precision instrument which requires fine adjustments. It must be inspected and adjusted before use so that it always performs accurate measurements.
- Always perform checking and adjustment in the proper sequence beginning with "21.1 Plate level".
- In addition, the instrument should be inspected with special care after it has been stored a long time, transported, or when it may have been damaged by a strong shock.

21.1 Plate Level

- The bubble tube is made of glass, so it is sensitive to temperature changes or to shock. Check and adjust it as outlined below.

▶ **PROCEDURE** Checking
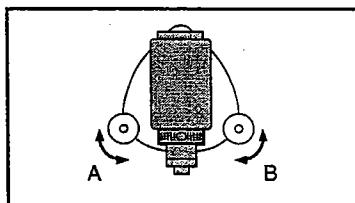
1. Turn the upper part of the instrument until the plate level is parallel to a line between levelling foot screws A and B.
   Center the plate level bubble using levelling foot screws A and B.
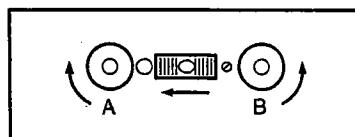
   The bubble moves towards a clockwise rotated levelling foot screw.
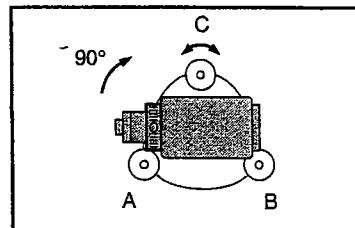
2. Loosen the horizontal clamp and turn the upper part 90°.
   The plate level is perpendicular to a line between levelling foot screws A and B.

3. Center the plate level bubble using levelling foot screw C.
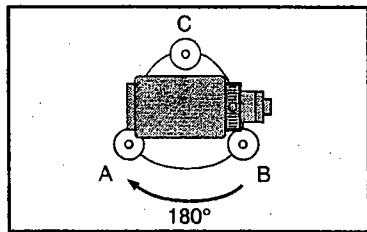
4. Turn the upper part through 180° and check the bubble position.
If the bubble is still centered, no adjustment is necessary.

If the bubble is off-center, adjust as follows.

Adjustment

Using levelling foot screws
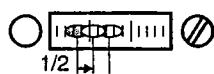
5. Correct half of the bubble displacement using levelling foot screw C.

Bubble motion

The bubble moves in the clockwise direction: the adjustment screw rotation direction.

Using adjusting pin
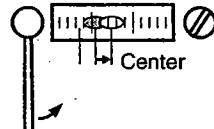
6. Correct the remaining half of the displacement by using the adjustment pin to rotate the plate level adjustment screw.

When the plate level adjustment screw is tightened in the clockwise direction, the bubble moves in the same direction.

7. Rotate the top of the instrument and repeat checking and adjustment steps 1 to 6 to adjust it so the bubble remains centered for any position of the upper part.

• When the bubble does not move to the center even when the adjustment has been repeated, ask your Sokkia service center to adjust it.

21.2 Circular Level

▶ PROCEDURE Checking
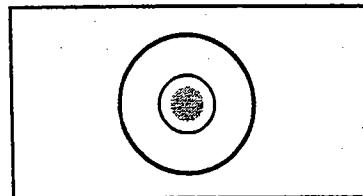
1. Perform the plate level inspection and adjustment or carefully use the plate level to level the instrument.

2. Check the position of the bubble of the circular level.

   If the bubble is not off-center, no adjustment is necessary.

   If the bubble is off-center, perform the following adjustment.
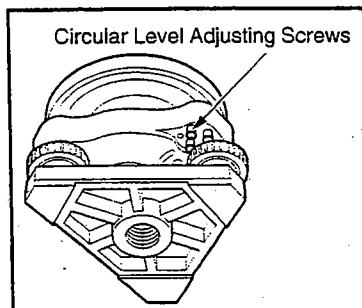
Adjustment

3. First confirm the off-center direction.

4. Use the adjusting pin to loosen the circular level adjustment screw on the side opposite to the direction the bubble is displaced to move the bubble to the center.

5. Adjust the adjusting screws until the tightening tension of the three screws are the same to align the bubble in the middle of the circle.

Circular Level Adjusting Screws

NOTE: Be careful that the tightening tension is identical for all the adjusting screws. Also, do not over-tighten the adjusting screws as this may damage the circular level.

21.3 Tilt Offset Setting

- With the "Tilt offset" option you can measure tilt zero point error. To measure the error, make tilt angular observations using both faces.

▶ **PROCEDURE** Setting the tilt offset

Setting Mode Screen

```
Config.
1.Obs.condition
2.Instr.const.
3.Date&Time
4.Comms setup
5.Unit
6.Key function
```

1. Select "2. Instr. const." in the "Setting Mode Screen" and press ▰▰▰ .

Select "2. Instr. const.", press
▰▰▰
Instrument Constant Selection Screen

```
Instr.const.
1.Tilt:X 396 Y  411
2.Collimation
```

The "Instrument Constant Selection Screen" is displayed.

Select "1. Tilt", press ▰▰▰
Tilt Offset Screen

```
Tilt offset
       X  396Y  411

X      -0°01'50"
Y      -0°00'30"
HAR   184°14'50"
 Take F1
              N O   YES
```

2. Select "1. Tilt" and press ▰▰▰ .

Sight, press **[YES]**

```
Tilt offset
       X  396Y  411

X      -0°01'50"
Y      -0°00'30"
HAR   184°14'50"
 Take F2
              N O   YES
```

3. Sight one point which is the reference. Press **[YES]** to record the value.

   "Take F2" is displayed.

- To discard the data and return to the "Instrument Constant Selection Screen": **[NO]**

Sight in face right, press **[YES]**

```
Tilt offset
Current  X 396  Y 411
NEW      X 402  Y 398



              N O | YES
```

4. Set the telescope in face right and sight the same point.
   Press **[YES]** to record the value.

   The constant now set and the newly set constant are displayed.

• To discard the data and return to the "Face Left Observation Screen": **[NO]**

5. Press **[YES]**.

   After the new constant is set, the "Instrument Constant Selection Screen" is restored.

• To discard the data and return to the "Face Left Observation Screen": **[NO]**
• To return to the "Instrument Constant Selection Screen": **ESC**

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21.4 Setting the Collimation Line Error Correction Constant

- With the "Collimation" option you can measure collimation error in your instrument so that the **SET** can correct subsequent single face observations. To measure the error, make angular observations using both faces.

▶ **PROCEDURE** Setting the collimation line error correction constant

Setting Mode Screen

```
Config.
 1.Obs.condition
 2.Instr.const.
 3.Date&Time
 4.Comms setup
 5.Unit
 6.Key function
```

1. Select "2. Instr. const" in the "Setting Mode Screen" and press ◢▬▬◣ .

Select "2. Instr. const", press

◢▬▬◣

Instrument Constant Selection Screen

```
Instr.const.
 1.Tilt:X 396 Y 411
 2.Collimation
```

The "Instrument Constant Selection Screen" is displayed.

Select "2. Collimation", press

◢▬▬◣

Collimation Screen

```
Collimation


ZA      0 set
HAR   184°14'50"
 Take F1
           N O | YES
```

2. Select "2. Collimation" and press ◢▬▬◣ .

```
Collimation


ZA    60°00'30"
HAR  184°14'50"
 Take F1
           N O | YES
```

3. Rotate the telescope to index the vertical circle.

- Return to "Instrument Constant Selection Screen": [NO]

Sight one point, press [YES]

```
Collimation


ZA    259°59'30"
HAR     0°14'30"
 Take F2
              N O   YES
```

4. Sight one point and press [YES] to record the value.

   "Take F2" is displayed.

Sight the same point in face right, press [YES]

```
Collimation
EL        -0°00'08"
V off.     0°00'10"




              N O   YES
```

5. In face right sight the same point.
   Press [YES] to record the value.

   The correction constant is displayed.

- To discard the data and return to the "Face Left Observation Screen": [NO]

6. Press [YES].
   After the constant is set, the "Instrument Constant Selection Screen" is restored.

- To discard the data and return to the "Face Left Observation Screen": [NO]
- To return to the "Instrument Constant Selection Screen": ESC

21.5 Reticle

▶ **PROCEDURE** **Check 1: Perpendicularity of the reticle to the horizontal axis**

1. Carefully level the instrument.

2. Align a clearly visible target (the edge of a roof for example) on point A of the reticle line.
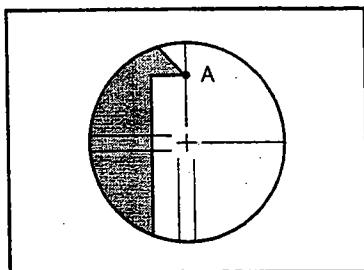
3. Use the telescope fine motion screw to align the target to point B on a vertical line.
   If the target moves parallel to the vertical line, adjustment is unnecessary.
   If its movement deviates from the vertical line, have your Sokkia service representative adjust it.
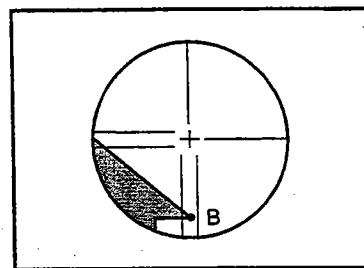
▶ **PROCEDURE** **Check 2: Vertical and horizontal reticle line positions**

1. Install a target at a point about 100 m in the horizontal direction from the **SET**.
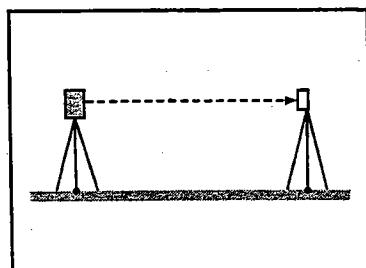
2. Level the instrument carefully, turn on the instrument's power, and index the vertical and horizontal circles.

Measurement Item Display Screen

```
Meas.        PC   -30
             ppm    0
                   ▪3
                    ℾ
ZA    90°30'20"
HAR   18°34'00"
                   P1
SDIST ▰SHV H.ANG EDM
```
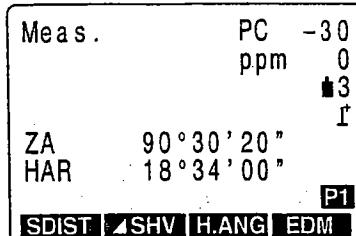
Read the horizontal and vertical angles with the telescope in face left.

Read the horizontal and vertical angles with the telescope in face right.

Calculation A2–A1 and B2+B1

Example: A2–A1 (Horizontal angle)
= 198° 34' 20"–18° 34' 00"
= 180° 00' 20"
B2+B1 (Vertical angle)
= 269° 30' 00"+90° 30' 20"
= 360° 00' 20"

3. While the "Measurement Item Display Screen" is displayed and the telescope is in face left, sight the center of the target and read out the horizontal angle A1 and the vertical angle B1.

Example: Horizontal angle A1 = 18° 34' 00".
Vertical angle   B1 = 90° 30' 20"

4. While the telescope is in face right, sight the center of the target and read out the horizontal angle A2 and the vertical angle B2.

Example: Horizontal angle A2 = 198° 34' 20"
Vertical angle   B2 = 269° 30' 00"

5. Do the calculations: A2–A1 and B2+B1
If A2–A1 is within 180° ±20" and B2 + B1 is within 360° ±20", adjustment is unnecessary.

• If the difference is large even after repeating the check 2 or 3 times, have your Sokkia service representative perform the adjustment.

21.6 | Optical plummet

▶ PROCEDURE **Checking**

1. Carefully level the **SET** and center a surveying point precisely in the reticle of the optical plummet.

2. Turn the upper part through 180° and check the position of the surveying point in the reticle. If the surveying point is still centered, no adjustment is necessary.
   If the surveying point is no longer centered in the optical plummet, perform the following adjustment.
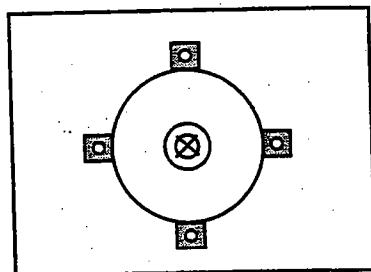
Adjustment

3. Correct half the deviation with the levelling foot screw.

4. Remove the optical plummet reticle cover.

5. Use the 4 adjusting screws of the optical plummet to adjust the remaining half of the deviation as shown below.
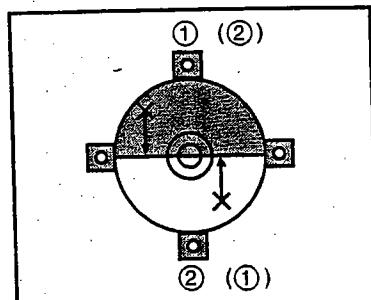
   When the surveying point is on the part shown as ▽ (△):
   ① Loosen the upper (lower) adjusting screw slightly and,
   ② Tighten the upper (lower) adjusting screw the same amount, to move the surveying point to a point directly under the center of the optical plummet.
   (It will move to the line in the figure on the left.)
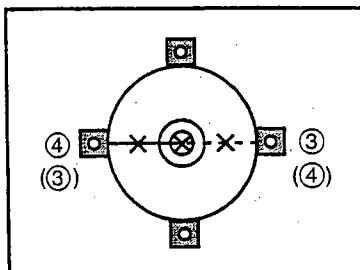
6. If the surveying point is on the solid line (dotted line):
   ③ Loosen the right (left) adjusting screw slightly and,
   ④ Tighten the left (right) adjusting screw by the same amount to move the surveying point to a point in the center of the optical plummet.

NOTE: Be extremely careful to adjust all the adjustment screws by the same amount so that none will be over-tightened.
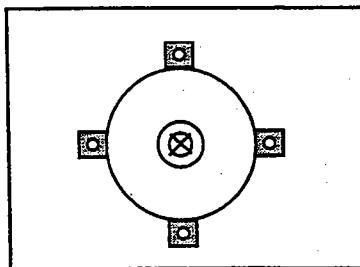
7. Check to make sure that the surveying point remains centered on the reticle even if the upper part of the instrument is rotated. If necessary, perform the adjustment again.

8. Replace the optical plummet reticle cover.

21.7 Distance Measurement Check Flow Chart

- Make sure that the distance measurement function is operating normally by performing the procedure in the following flowchart.
  When performing this check, set the distance measurement method to the "fine, repeat measurement mode" (factory setting). ("11.1 Settings for Distance Measurements")

▶ **PROCEDURE** Check

```
                    ( Start )
                        │
            ┌───────────────────────┐
            │   Level and power on  │
            └───────────────────────┘
                        │
            < Audio tone heard? >──── No ──────────┐
                      │ Yes                        │
    < "HAR 0set" and "ZA0set" displayed? >── No ───┤
                      │ Yes                        │
            ┌───────────────────────┐              │
            │ Indexing H and V circles │           │
            └───────────────────────┘              │
                        │                          │
 A < Battery symbol appears every 3 seconds? >─ Yes ┤
                      │ No                         │
      ┌───────────────────────────────┐    ┌──────────────┐
      │ Sight target and press SFT and +/- │  │ Power switch off │
      └───────────────────────────────┘    └──────────────┘
                        │                          │
        < Signal strength adequate? >── No ──┐  ┌──────────────────┐
                      │ Yes                  │  │ Recharge battery  │
            ┌───────────────────────┐        │  │ or replace it with│
            │ Cover the objective lens │     │  │ a charged one     │
            └───────────────────────┘        │  └──────────────────┘
                        │                     │         │
            < "*" Disappeared? >── No ─────┐  │  ┌──────────────┐
                      │ Yes               │  │  │ Power switch on │
            ┌───────────────────────┐      │  │  └──────────────┘
            │ Uncover objective lens │     │  │         │
            └───────────────────────┘      │  No < Audio tone heard? >
                        │                   │         │
            ┌───────────────────────┐       │  No < "HAR 0set" and
            │    Press [Sdist]       │      │     "ZA0set" displayed? >
            └───────────────────────┘       │         │
                        │                    │  ┌──────────────────────┐
  < Distance displayed in about 5 seconds? >─ No │ Indexing H and V circles │
                      │ Yes                   │  └──────────────────────┘
            ┌───────────────────────┐         │         │
            │     Press [STOP]       │        │  Yes < Battery
            └───────────────────────┘         │      symbol appears? >
                        │                      │         │
            ┌───────────────────────┐          │        A
            │    Power switch off    │          │
            └───────────────────────┘          │
                        │                       │
            ( Check is finished )               │
                                        ┌──────────────┐
                                        │ Power switch off │
                                        └──────────────┘
                                                │
                                        ┌──────────────┐
                                        │ Contact your  │
                                        │ Sokkia agent  │
                                        └──────────────┘
```

21.8 Additive Distance Constant

- The additive distance constant K of the **SET** is adjusted to 0 before delivery. Although it almost never deviates, use a baseline with a known distance precision to check that the additive distance constant K is close to 0 several times a year and whenever the values measured by the instrument begin to deviate by a consistent amount. Perform these checks as follows.

NOTE: Errors in setting up the instrument and reflective prism or in sighting the target will influence the additive distance constant. Be extremely careful to prevent such errors when performing these procedures.

Set up so that the instrument height and the target height are identical. If a flat place is not available, use an automatic level to make sure the heights are identical.

▶ PROCEDURE   Check
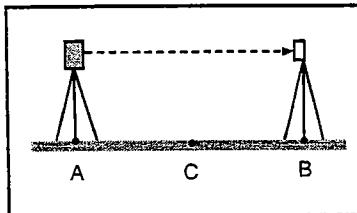
Fine measurement of the horizontal distance AB 10 times and calculation of the average value
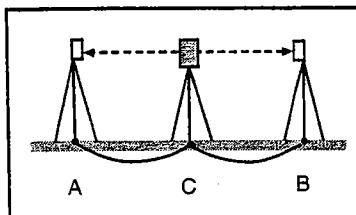
Fine measurement of the horizontal distances CA and CB 10 times each and calculation of the average values

1. Find an area of flat ground where two points 100 m apart can be selected, set up the instrument at point A and the reflective prism at point B. Establish a point C half way between points A and B.

2. Precisely measure the horizontal distance between point A and point B 10 times and calculate the average value.

3. Place the **SET** at point C directly between points A and B and set up the reflective prism at point A.

4. Precisely measure the horizontal distances CA and CB 10 times each and calculate the average value for each distance.

5. Calculate the additive distance constant K as follows.
    K = AB–(CA+CB)

6. Repeat steps 1 to 5 two or three times.
    If the additive distance constant K is **within ± 2 mm even once**, adjustment is unnecessary. If it always exceeds this range, have your Sokkia service representative perform an adjustment.

MEASUREMENT
OPTIONS SELECTION

- This section explains the setting of the parameters of the instrument's functions, allocating the function keys, the power system, and the reflective prism system.

22. CHANGING INSTRUMENT PARAMETERS

- This section explains the parameters which are set in Setting Mode.
- The set parameters are recorded until they are revised.

- The following are the items set and their parameters.

Screen Setting	Parameter		Options (* : Factory Setting)
OBSERVATION CONDITION	Atmospheric correction		Temperature, air pressure *
			Temperature, air pressure, humidity
	Earth curvature and refraction correction		None *
			K = 0.142
			K = 0.20
	Vertical angle format		Zenith 0° *
			Horizontal 0°
			Horizontal 0° ±90°
	Tilt correction		Yes (horizontal and vertical angles) *
			Yes (vertical angle only)
			No
	Collimation correction		Yes *
			No
	Reticle illumination		Bright *
			Dim
	Vertical circle indexing		Auto: Transit telescope *
			Manual: By sighting both faces
	Horizontal circle indexing		Auto: Rotate upper part *
			Manual: 0° at power on
	Automatic power cut off		Auto power cut off after 30 minutes *
			Switch on/off by key
	Angle resolution	SET2100	1" *
			0.5"
		SET3100/S	1" *
			5"
		SET4100/S	1" *
			5"
	Coordinates format		N–E–Z *
			E–N–Z
	Distance mode initial display		Slope distance (Sdist) *
			Horizontal distance (Hdist)
			Height difference (Vdist)
	Minimum distance display (only the SET2100)		1 mm *
			0.1 mm
	Read-in JOB		Enter the read-in JOB

Screen Setting	Parameter	Options (∗ : Factory Setting)
COMMS SETUP	Communication speed (baud rate)	1,200 bps ∗
		2,400 bps
		4,800 bps
		9,600 bps
		19,200 bps
		38,400 bps
	Data length	8 bits ∗
		7 bits
	Parity	Not set ∗
		Even
		Odd
	Stop bit	1 bit ∗
		2 bits
	Check sum	No ∗
		Yes
	Xon/Xoff	Yes ∗
		No
UNIT	Temperature	°C ∗
		°F
	Air pressure	hPa ∗
		mmHg
		inchHg
	Angle	degree ∗
		gon
		mil
	Distance	metres ∗
		feet

▶ **PROCEDURE** Setting parameters

Status Screen

```
Oct-08-96    13:41:58

SET4100
No.050621
Ver.139-00-01
     139-88-50
Job.JOB01
 MEAS        MEM  CNFG
```

- First display the "Status Screen."

Press **[CNFG]**

Setting Mode Screen

```
Config.
 1.Obs. condition
 2.Instr.const.
 3.Date&time
 4.Comms setup
 5.Unit
 6.Key function
```

1. Press **[CNFG]**.

   The "Setting Mode Screen" is displayed.

Select "1. Obs. condition", press

Observation Condition Setting Screen

```
Condition
ppm mode  :Pres/Tmp
C&C crn.  :No
V.obs     :Zenith
Tilt crn. :Yes(H,V)
Coll.crn  :Yes
Reticle   :Bright   ↓

V index   :Auto      ↑
H index   :Auto
Power off :On(30min)
Ang.reso. :1"
Coord.    :E-N-Z
Dist mode :Sdist    ↓

Dist. reso:1mm       ↑
Coord. search JOB:
JOB01
```

2. Select "1. Obs. condition" and press ◢▬▬◣.

   The "Observation Condition Setting Screen" is displayed.

   It is possible to check and change the parameter settings.

   When ↑ or ↓ is displayed, there are items above or below. Use ▼ ▲ to scroll the screen.

   The following are the selected conditions. (Those marked by an [*] are values set at the factory.)

ppm mode		Pres/Tmp *
		&Humid
C&C crn.		No *
		K=0.142
		0.20
V. obs		Zenith *
		Vertical
		Vert+/-90
Tilt crn.		Yes (H, V) *
		Yes (V)
		No
Coll. crn		Yes *
		No
Reticle		Bright *
		Dim
V index		Auto *
		Manual
H index		Auto *
		Manual
Power off		On (30min) *
		Off
Ang. reso.	SET2100	1" *
		0.5"
	SET3100/S	1" *
		5"
	SET4100/S	1" *
		5"
Coord.		E–N–Z *
		N–E–Z
Dist mode		Sdist *
		Hdist
		Vdist
Dist. reso (only the SET2100)		1 mm *
		0.1 mm
Coord. search JOB		Coord. search JOB:

After setting is completed:
Align the cursor with the final item,
press ◢▬▬▬◣
Setting Mode Screen

3. Align the cursor with the final item after setting
is complete and press ◢▬▬▬◣ .

"Setting Mode Screen" is restored.

Select "4. Comms setup", press

Communication Condition Setting Screen

```
Comms setup
Baud rate: 1200bps
Data bits:8bits
Parity    :Not set
Stop bit :1bit
Check sum:No
Xon/Xoff :Yes
```

4. Select "4. Comms setup" and press .

The "Communication Conditions Setting Screen" is displayed.

It is possible to check and change the parameter settings.
The following are the selected conditions.
(Those marked by an [*] are values set at the factory.)

Baud rate	1200bps *, 2400bps, 4800bps, 9600bps, 19200bps, 38400bps
Data bits	8bits *
	7bits
Parity	Not set *
	Even
	Odd
Stop bit	1bit *
	2bits
Check sum	No *
	Yes
Xon/Xoff	Yes *
	No

After setting is complete,
Align cursor with final item,
press
Setting Mode Screen

5. Align the cursor with the final item after setting is completed and press .

"Setting Mode Screen" is restored.

Select "5. Unit", press

```
Unit
Temp. :°C
Press.:hPa
Angle :mil
Dist :m
```

6. Select "5. Unit" and press

It is possible to check and revise the parameter settings.
The following are the selected conditions.
(Those marked by an [*] are values set at the factory.)

| Temp. | °C * |
	°F
Press.	hPa *
	mmHg
	inchHg
Angle	deg *
	gon
	mil
Dist	m *
	feet

After setting is completed, press
Setting Mode Screen

7. Press after setting is completed.

The "Setting Mode Screen" is restored.

▶ **EXPLANATION** Vertical angle display method

• Nadir 0°
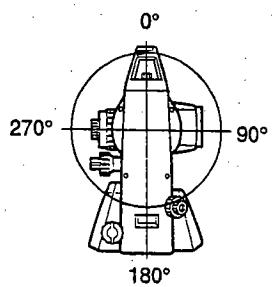
• Horizontal 0°
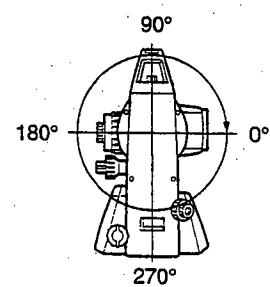
• Horizontal 0° ±90°
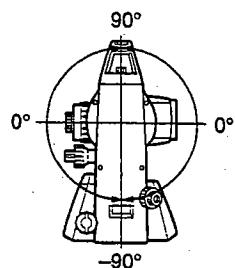
23. KEY FUNCTION ALLOCATION

- With the **SET**, it is possible to allocate the softkeys in MEAS Mode to suit measurement conditions. The current softkey allocations are retained until they are revised again, even when the power is cut off. It is also possible to register two sets of key function allocations: user setting 1 and user setting 2.

  It is possible to operate the **SET** efficiently because unique softkey allocations can be preset to suit various applications and the ways that different operators handle the instrument.

Press **[CNFG]**
Setting Mode Screen

- Press **[CNFG]** in the "Status Screen."

  The "Setting Mode Screen" is displayed.

Select "6. Key Function", press
⬛ or ⑥
Key Setting Screen

Select "6. Key Function" and press either
⬛ or ⑥.

```
Key func.
1.Define
2.Registration
3.Recall
```

The "Key Setting Screen" is displayed.

- The following operations can be performed in the "Key Allocation Mode".
  - Key allocation
  - Registration of the allocation
  - Recalling the allocation

Existing Key Allocations

1. Setting

Set new allocations in Key Allocation Mode.

RECORDING

2. Registration

REGISTRATION

Display new key allocations

User setting 1

User setting 2

Factory setting

Call Out

3. Read In
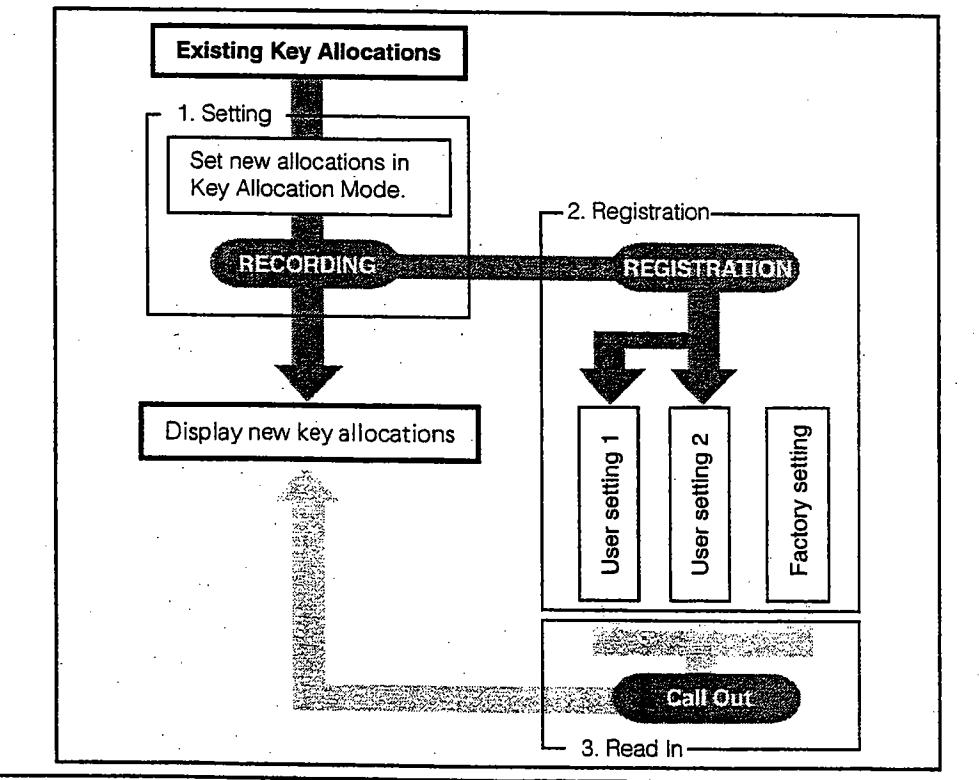
23.1 Allocation and Registration

- It is possible to set new key allocations in the "Key Allocation Screen."
  When new key allocations are set, the content of the function keys in MEAS Mode are displayed. This allocation is recorded in the instrument until they are set again.
  It is possible to register two kinds of allocations: User Setting 1 and User Setting 2.

NOTE: When softkey allocations are recorded and registered, the previously recorded key settings are cleared.

- It is possible to allocate the functions displayed in the "Setting Mode Screen" to the softkeys. The following functions can be allocated to the softkeys.

  1) [_DIST]   : Distance measurement
  2) [⊿SHV]   : Select distance mode (S=Slope distance/H=Horizontal distance/ V=Height difference)
  3) [0SET]   : Set horizontal angle to 0
  4) [H.ANG]   : Set required horizontal angle
  5) [R/L]   : Select horizontal angle right/left
  6) [REP]   : Repetition measurement
  7) [HOLD]   : Hold horizontal angle/release horizontal angle
  8) [ZA/%]   : Switch between zenith angle/slope in %
  9) [HT]   : Set the instrument station height and target height
  10) [REC]   : Data recording
  11) [REM]   : REM measurement
  12) [MLM]   : Missing line measurement
  13) [RCL]   : Display final measurement data
  14) [VIEW]   : Display observation data for the selected JOB
  15) [EDM]   : Setting EDM (atmospheric correction and target, distance measurement method setting)
  16) [COORD] : Coordinates measurement
  17) [S-O]   : Setting-out measurement
  18) [OFFSET] : Offset measurement
  19) [MENU]   : To Menu Mode
  20) [RESEC] : Resection measurement
  21) [F/M]   : Switch between meters/feet
  22) [D-OUT]   : Output measurement results to external instrument
  23) [– – –]   : No functions set

- The following are the softkey allocations when the SET was shipped.
  Page 1   [_DIST] [⊿SHV] [H.ANG] [EDM]
  Page 2   [0SET] [COORD] [S-O] [REC]
  Page 3   [MLM] [RESEC] [MENU] [HT]

23.1.1 Allocating Functions

- It is possible to freely allocate up to 12 kinds of functions to the softkeys. The allocated key array is saved until it is revised again, even when the power is cut off.
  It is possible to allocate the same keys on each page (example 1). The same function can be allocated to more than one key on the same page (example 2). And it is also possible to allocate a function to only one key (example 3).

Allocation example 1:

       P1 [DIST] [SHV] [H.ANG] [EDM]

       P2 [DIST] [SHV] [H.ANG] [EDM]

Allocation example 2:

   P1 [DIST] [DIST] [SHV] [SHV]

· · · · · · · · · · · · · · · · · ·

Allocation example 3:

       P1 [DIST] [SHV] [– – –] [– – –]

· · · · · · · · · · · · · · · · · ·

▶ PROCEDURE **Allocating functions**

Setting Mode Screen
Select "6. Key Function", press
[▬▬].
Key Setting Screen

```
Key func.
 1.Define
 2.Registration
 3.Recall
```

Select "1. Define", press [▬▬].
Allocation Screen

```
Key func.
P1 DIST  SHV  HOLD   ↑
   H.ANG EDM  ZA/%
P2 OSET  HOLD H T
   S-O   REC  REC
P3 MLM   RESEC REM
   MENU  H T   MLM   ↓
              O K
```

1. Select "6. Key function" in Setting Mode and press [▬▬].

    The "Key Setting Menu Screen" is displayed.

2. Select "1. Define" and press [▬▬].

    The "Allocation Screen" is displayed.

```
Key func.
P1 DIST  SHV  HOLD  ↑
   H.ANG EDM   ZA/%
P2 0SET  HOLD  HT
   S-O   REC   REC
P3 MLM   RESEC REM
   MENU  HT    MLM   ↓
               O K
```
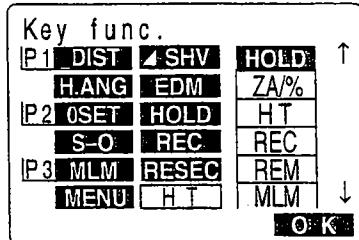
3. Align the cursor with the keys on the left half of the screen whose allocation is changed using

▷ ◁ .

```
Key func.
P1 DIST  SHV  HOLD  ↑
   H.ANG EDM   ZA/%
P2 0SET  HOLD  HT
   S-O   REC   REC
P3 MLM   RESEC REM
   MENU  HT    MLM   ↓
               O K
```
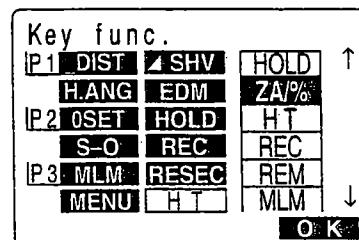
4. Align the cursor with the functions on the right half of the screen which are to be allocated using ▼ ▲.

```
Key func.
P1 DIST  SHV  HOLD  ↑
   H.ANG EDM   ZA/%
P2 0SET  HOLD  HT
   S-O   REC   REC
P3 MLM   RESEC REM
   MENU  ZA/%  MLM   ↓
               O K
```
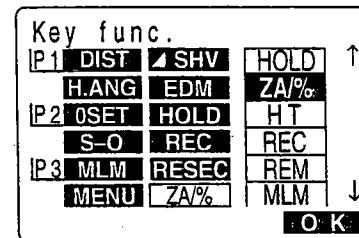
5. Press ⬤ to allocate the functions designated in step 4 to the positions designated in step 3.

6. Repeat steps 3 to 5 only as many times as necessary.

Press **[OK]**: Allocation Recording
Key Setting Screen

7. Press **[OK]** to record the allocations and to restore the "Key Setting Screen".

This displays the functions with their new allocations in the "Setting Mode Screen".

23.1.2 Registering an Allocation

- It is possible to register two softkey arrays allocated in the "Allocation Screen" as User Registration 1 and User Registration 2.
- The registered softkey arrays can be called and used as needed (See "23.2 Recalling Allocation".) Softkey registration is performed as follows.

▶ **PROCEDURE** Registering an allocation

Setting Mode Screen
Select "6. Key function", press

1. Select "6. Key function" in Setting Mode and press ▰▰▰ .

Key Setting Screen

The "Key Setting Screen" is displayed.

```
Key func.
 1.Define
 2.Registration
 3.Recall
```

Select "2. Registration", press

2. Select "2. Registration" and press ▰▰▰ .

Allocation Registration Screen

The "Allocation Registration Screen" is displayed.

```
Key func.
 1.User's 1
 2.User's 2
```

Select "1. User'1" or "2. User'2", press
Confirmation Screen

3. Select either "User'1" or "User'2" as the softkey array to be registered and press ▰▰▰ .

The "Confirmation Screen" is displayed.

```
Key func.

 Registered to 1

 Press any key
```

Press any key
Allocation Registration Screen, press ESC
Key Setting Screen

4. Press any key to restore the "Allocation Registration Screen". Press ESC to restore the "Key Setting Screen".

Recalling an Allocation

- It is possible to recall the softkey arrays registered for User 1 and User 2 as necessary.

NOTE: When an array is recalled, the key array is changed to the key array which has been recalled, clearing the previous key array. Be sure to remember this.

▶ PROCEDURE Recalling an allocation

Setting Mode Screen
Select "6. Key function", press

Key Setting Screen

```
Key func.
 1.Define
 2.Registration
 3.Recall
```

1. Select "6. Key function" in the "Setting Mode Screen" and press .

   The "Key Setting Screen" is displayed.

Select "3. Recall", press
Allocation Recall Screen

```
Key func.
 1.User's 1
 2.User's 2
 3.Default
```

2. Select "2. Recall" and press .

   The "Allocation Recall Screen" is displayed.

Select the array to be recalled, press .

Key Setting Screen

3. Select the key array for either User 1, User 2, or default (setting when the SET was shipped), and press .

   The "Key Setting Screen" is restored.
   This displays the functions in the recalled array in the "MEAS Mode Screen".

24. POWER SUPPLIES

- Operate your **SET** with the following combinations of power equipment.

- Be sure to carefully read the operating manuals for the battery and charger before operating them.

NOTE: Never use any combination other than those indicated below. If you do, the **SET** could be damaged.

* Those indicated by a single "*" are standard accessories. Others are optional accessories (sold separately).

	Battery	Charger
	BDC35* (Ni-MH) BDC40 (Ni-Cd)	CDC39* [70 min.] (90 to 132 V AC)
		CDC41 [70 min.] (11 to 16 V DC) For cigarette lighter

External battery adapter	Cable to car cigarette lighter	
EDC14**	EDC4 (12 V DC)	

AC adapter	Cable to car battery
EDC2/2A** (100 to 240 V AC)	EDC5 (12 V DC)

Cable	External battery	Charger
EDC3	BDC12** (6V DC)	CDC14 (100V AC) CDC14A (120V AC) CDC14D (220V AC to 240V AC) (15 hours)
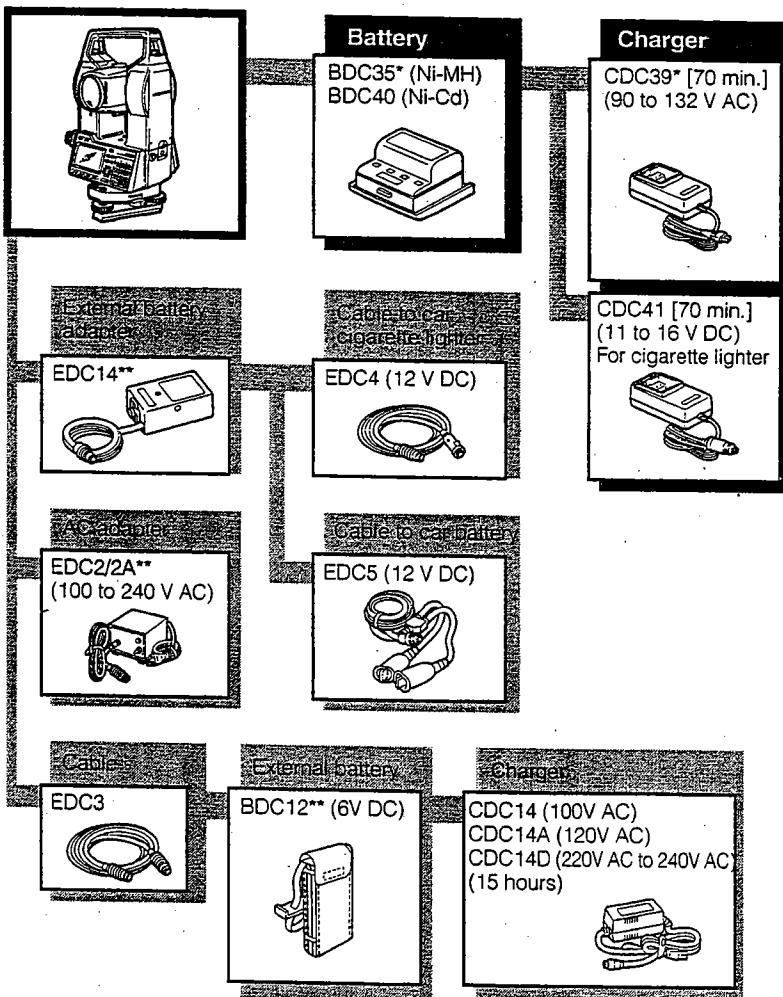
- External power supply equipment
  - When using an external battery marked with [**], with the BDC35 battery mounted in place to maintain the balance of the instrument.
  - Make sure that the car cigarette lighter is 12V DC and that its negative terminal is grounded. Use it with the car's engine running.
  - The EDC2 is equipped with an input voltage selector. Make sure that this voltage selector is set to 100 V.
  - The EDC14 has a breaker switch. Normally the red mark appears on the breaker. If it cannot be seen, set the breaker so it is visible.
    When using the car battery, the breaker will cut off if the poles are not correctly connected.

25. REFLECTING PRISMS

- Because all Sokkia reflecting prisms and accessories have standardized screws, it is possible to combine these prisms, accessories, etc. according to your objectives.

- The following are all special accessories (sold separately).
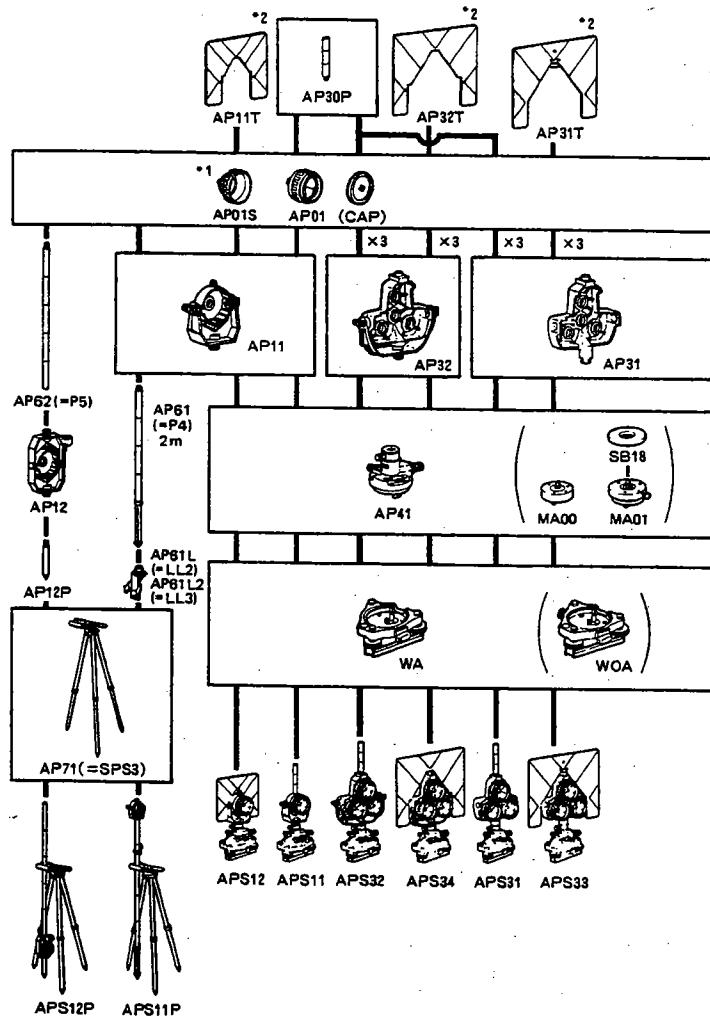
* : Each reflective prism has its own prism constant value. When changing prisms, be sure to change the prism constant correction value.

** : Because these targets are coated with fluorescent paint, they reflect when there is little light.

Precautions when using reflecting prisms

- When using a reflecting prism equipped with a target for distance and angle measurements, be sure to direct the reflective prism correctly and sight the center of the prism target accurately.

- To use the triple prism assembly AP31 or AP32 as a single prism for short distance measurements, mount the single reflective prism AP01 in the center mounting hole of the prism holder.

Precautions when using the instrument height adaptor

- Adjust the level of the AP41 instrument height adaptor following the checking and adjustment methods outlined in "21.1 Plate Level".

- Adjust the optical plummet of the AP41 instrument height adaptor following the checking and adjustment methods outlined in "21.5 Reticle".

- The height of the AP41 instrument height adaptor can be adjusted using two fixing screws. When used with the **SET**, make sure that the instrument height "236" (mm) is displayed in the instrument height adjustment window.

▶ PROCEDURE   Adjusting the height of the AP41

1. Loosen the screws.

2. Rotate it counterclockwise.

3. Move it up or down until the desired instrument height is displayed in the adjustment window.

4. Rotate it clockwise.

5. Tighten the screws.
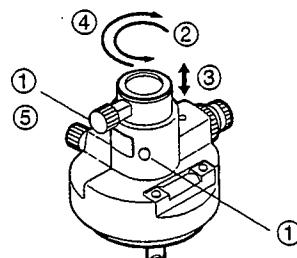
Precaution when using the levelling plate

- Adjust the circular level on the levelling plate for the reflective prism following the checking and adjustment methods outlined in "21.2 Circular Level".

ADDITIONAL DETAILS

- These sections provide further details concerning the material presented in earlier sections.

26. MANUALLY INDEXING THE VERTICAL CIRCLE

- The 0 index of the vertical circle of your **SET** is almost 100% accurate, but when it is necessary to perform particularly high precision angle measurements, you can eliminate any inaccuracy of the 0 index as follows.
- Set parameter "Vertical Circle Indexing Method" to "Manual."

▶ **PROCEDURE** Manually indexing the vertical circle

- This section explains the procedure for vertical circle indexing using face left/right sighting, which is done after parameter "Vertical Circle Indexing Method" is set to "Manual" and the "MEAS Mode Screen" is restored.

MEAS Mode Screen

```
OSET


ZA      V1
HAR     0°00'00"
        Take F1
                  OK
```

- After parameter "Vertical Circle Indexing Method" has been changed to "Manual", if you press **[MEAS]** in the "Status Screen" to enter the "MEAS Mode Screen," the vertical angle V1 is displayed in "Take F1" on line 7.

1. Carefully level the instrument.

Sighting the target with face left telescope


Reflective prism

2. Accurately sight a clear target with a distance of about 30 m in the horizontal direction with the telescope in face left.
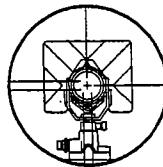
Press **[OK]**
MEAS Mode Screen

```
OSET


ZA      V2
HAR     0°00'00"
        Take F2
                  OK
```

3. Press **[OK]**.

The vertical angle "V2" is displayed as "Take F2" on line 7.

Sighting the target with the telescope in face right

Press [OK]
MEAS Mode Screen

```
┌─────────────────────────┐
│ Meas.          PC   -30 │
│                ppm    0 │
│                      ▮3 │
│                       ⊥ │
│ ZA        0°00'00"      │
│ HAR     180°00'00"      │
│                     P1  │
│ SDIST ◢SHV H.ANG EDM    │
└─────────────────────────┘
```
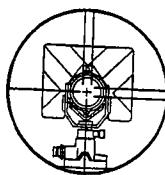
4. Loosen the horizontal clamp, turn the upper part through 180° and clamp it. Then set the telescope in the face right position and accurately sight the same target.

5. Press [OK].

   The "MEAS Mode Screen" is displayed.

   This concludes the vertical circle indexing procedure.

NOTE: If the power is cut off, the vertical circle indexing is ineffective. Do it again every time the power is turned on.

27. ATMOSPHERIC CORRECTION FOR HIGH PRECISION DISTANCE MEASUREMENTS

- Need for atmospheric correction

  The **SET** measures the distance with a beam of light, but the velocity of this light varies according to the index of refraction of light in the atmosphere. This index of refraction varies according to the temperature and pressure. Near normal temperature and pressure conditions:

  With constant pressure, a temperature change of 1°: an index change of 1 ppm

  With constant temperature, a pressure change of 3.6 hPa: an index change of 1 ppm.

  To perform high accuracy measurements, it is necessary to find the atmospheric correction factor from even more accurate temperature and pressure measurements and perform an atmospheric correction.

  Sokkia recommends that extremely precise instruments be used to monitor the air temperature and pressure.

- Finding the average temperature and pressure between two points in different atmospheric conditions

  To precisely determine the atmospheric correction factor, the average temperature and air pressure along the measurement beam route must be taken.

 Determine the temperature and pressure as follows.

  Flat terrain : Use the temperature and pressure at the midpoint of the line.

  Mountainous terrain : Use the temperature and pressure at the intermediate point (C).

  If it is not possible to measure the temperature and pressure at the midpoint, take the temperature and pressure at the instrument station (A) and the target station (B), then calculate the average value.

  Average air temperature: $(t_1 + t_2)\ /2$
  Average air pressure: $(p_1 + p_2)/2$
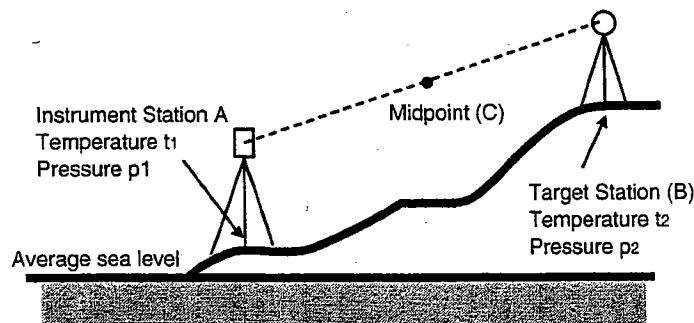
Instrument Station A
Temperature t_1
Pressure p_1

Midpoint (C)

Target Station (B)
Temperature t_2
Pressure p_2

Average sea level

* Atmospheric correction for relative humidity

The humidity has little influence, particularly on short distance measurements. The effect of humidity is considered in cases where it is very hot and humid and high precision measurements are to be performed over a particularly long distance.

With the **SET**, if the humidity is entered along with the temperature and pressure, the atmospheric correction factor set in the instrument is calculated using the following formula.

Atmospheric Correction Factor $= 278.96 - (0.2904 \times P - 0.044735 \times e)/(1 + 0.003661 \times T)$

$e = H \times ew/100$

$ew = a_0 T4 + a_1 T^3 + a_2 T^2 + a_3 T + a_4$

T : Temperature (°C)

P : Pressure (hPa)

e : Water vapor pressure (hPa)

H : Relative humidity (%)

ew : Saturated water vapor pressure

$a_0 = 0.00000491539$

$a_1 = 0.00026202374$

$a_2 = 0.01251534557$

$a_3 = 0.45183196592$

$a_4 = 6.32672468457$

APPENDIX

- This section explains standard accessories, optional accessories, maintenance, specifications, the atmospheric correction chart, and the entry range for various kinds of data.

28. STANDARD EQUIPMENT

- Please verify that all equipment is included
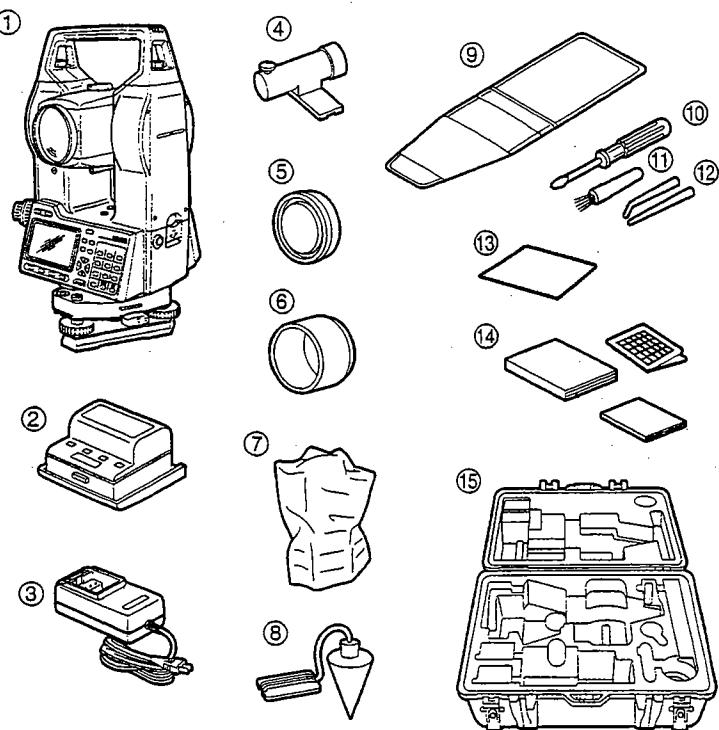
①	SET main unit..	1	⑩	Screwdriver	1
②	Internal battery (BDC35)	2	⑪	Lens brush	1
③	Battery charger (CDC39)	1	⑫	Adjusting pin	2
④	Tubular compass (CP7)	1	⑬	Cleaning cloth	1
⑤	Lens cap	1	⑭	Basic operating manual	1
⑥	Lens hood	1		Two-way communication command manual	1
⑦	Vinyl cover	1		Atmospheric correction chart	1
⑧	Plumb bob	1	⑮	Carrying case	1
⑨	Tool pouch	1	⑯	Carrying straps	1
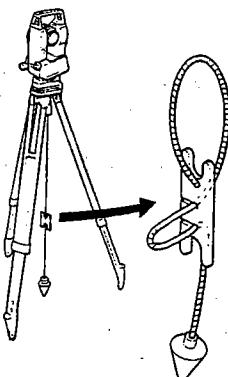
• Plumb bob

The plumb bob can be used to set up and center the instrument on days when there is little wind. To use the plumb bob, unwind its cord, pass it through the cord grip piece as shown in the figure to adjust its length, then suspend it from the hook attached to the centering screw.
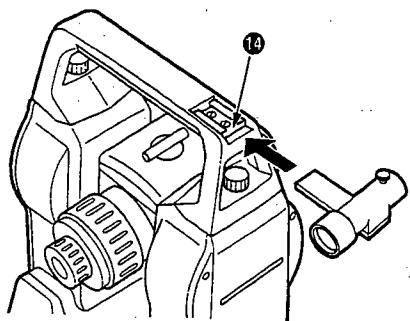
• Tubular compass (CP7)

Slide the tubular compass into the tubular compass slot (⑭), loosen the clamp screw, then rotate the top part of the instrument until the compass needle bisects the index lines. The telescope's face left sighting direction in this position will indicate magnetic north. After use, tighten the clamp and remove the compass from the slot, then place it in the specified location in the carrying case.

NOTE: The tubular compass is susceptible to the influence of nearby magnets or metal. Such influence could cause it to fail to accurately indicate magnetic north. Do not use magnetic north as indicated by this compass for base line surveying.
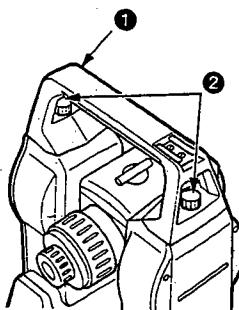
• Handle

The carrying handle (❶) can be removed from the instrument. To remove it loosen the handle securing screws (❷).

29. OPTIONAL ACCESSORIES

> • The following are optional accessories which are sold separately from the **SET**.
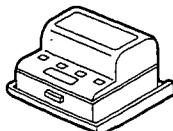
• Ni-Cd battery (BDC40)
The Ni-Cd battery (BDC40) can be used in place of the internal battery (BDC35) provided as a standard accessory.

BCD40 Specifications
Output voltage : 6 V DC
Size   : 75 x 74 x 40 mm
Weight   : 220 g

• Printer cable (DOC46)
The **SET** can be connected to a Centronics specification printer which supports ESC/PTM by the printer cable DOC46. This allows direct output of data from the **SET** to a printer.
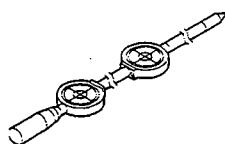
• Two-point target (2RT500)
It is used to find a target point from observations of two offset points during offset measurement.
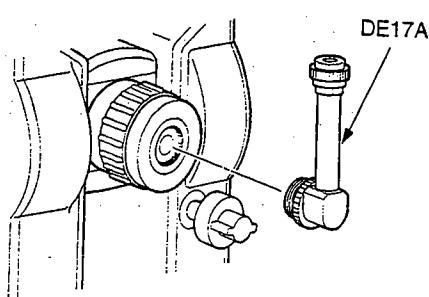
- Diagonal eyepiece (DE17A)
The diagonal eyepiece is convenient for observations near the nadir and in narrow spaces. After removing the handle from the **SET**, loosen the attachment screw to remove the telescope eyepiece. Then screw the diagonal lens into place.
See "28. Standard Equipment" for the handle removal method.
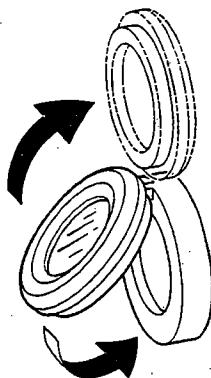
- Solar filter (OF3A)
When sighting targets where glare is present, solar observations for example, attach it to the objective lens of the **SET** to protect its interior and the eyes of its operator. The filter part can be flipped up without being removed.

30. MAINTENANCE

- Perform the following maintenance whenever you use the instrument.

1. If rain falls during surveying work, thoroughly wipe all moisture off the instrument.

2. Always clean the instrument before returning it to the case. The lens requires specia care. Dust it off with the lens brush first, to remove tiny particles. Then, after providing little cordensatior by breathing on the lens, wipe it with a soft clean cloth (cotton cut fror worn-out clothing is okay) or lens tissue.

3. Do not use organic solvents to clean the display, key board, or carrying case.

4. Store the **SET** in a dry place where the temperature is constant.

5. When the tripod is used for a long time, loose feet or damaged thumbscrews can make i unstable. Check and retighten these parts regularly.

6. If there appears to be any foreign matter in the rotating part or screws, or if any trace o moisture or mold is discovered on the telescope's internal lenses, reflective prisms, etc., contact your Sokkia agent.

7. Even when the instrument has not been used for a long time, inspect it every 3 months in accordance with "21. Checking and Adjustments".

8. When removing the **SET** from its carrying case, never pull it out by force. After removing it, close the case to prevent moisture from getting inside it.

9. Have the **SET** checked once or twice a year at your Sokkia service center to maintain its high precision.

SPECIFICATIONS

Telescope

Length:	165 mm
Aperture:	45 mm (EDM: 50 mm)
Magnification:	30x
Image:	Erect
Resolving power:	3"
Field of view:	1° 30'
Minimum focus:	1.0 m
Focussing screw:	Fine/coarse 2-speed
Reticle illumination:	Bright or dim selectable

Angle measurement

Horizontal and Vertical circles type: Increment with 0 index
(Both circles adopt diametrical detection)

Angle units: Degree/Gon/Mil (Selectable with parameter)

Display range:
SET2100 : 0˚00'00.0" to 359˚59' 59.5"
SET3100/3100S : 0˚00'00" to 359˚59'59"
SET4100/4100S : 0˚00'00" to 359˚59'59"

Minimum display:
SET2100 : 1" (0.2 mgon/0.005 mil)/
0.5" (0.1 mgon/0.002 mil)
SET3100/3100S : 1" (0.2 mgon/0.005 mil)/
5" (1 mgon/0.02 mil)
SET4100/4100S : 1" (0.2 mgon/0.005 mil)/
5" (1 mgon/0.02 mil)
(Selectable with parameter)

Accuracy: Standard deviation (DIN18723)
SET2100 : 2" (0.6 mgon)
SET3100/3100S : 3" (1 mgon)
SET4100/4100S : 5" (1.5 mgon)

Measuring time: Less than 0.5 sec

Automatic compensator: Selectable ON (V & H/V)/OFF
Type: Liquid 2-axis tilt sensor
Range of compensation: ±3'

Measuring mode:
Horizontal angle: Right/Left selectable
Vertical angle: Zenith 0°, horizontal 0°, horizontal ±90°

Distance Measurement

Measuring range:
    (Slight haze, visibility about 20 km, sunny periods, weak scintillation)

SET2100

Compact prism CP01	: 1.0 to 800 m/2600 ft
Reflective target	: 1.0 to 120 m/390 ft
Standard prism AP X 1	: 1.0 to 2,400 m/ 7,800 ft (2,700 m/8,800 ft)
Standard prism AP X 3	: 1.0 to 3,100 m/10,100 ft (3,500 m/11,400 ft)
Standard prism AP X 9	: 1.0 to 3,700 m/12,100 ft (4,200 m/13,700 ft)

SET3100/3100S

Compact prism CP01	: 1.0 to 700 m/2,200 ft
Reflective target	: 1.0 to 100 m/320 ft
Standard prism AP X 1	: 1.0 to 2,200 m/7200 ft (2,500 m/8,200 ft)
Standard prism AP X 3	: 1.0 to 2,900 m/9,500 ft (3,300 m/10,800 ft)
Standard prism AP X 9	: 1.0 to 3,500 m/11,400 ft (4,000 m/13,000 ft)

SET4100/4100S

Compact prism CP01	: 1.0 to 600 m/1,900 ft
Reflective target	: 1.0 to 80 m/260 ft
Standard prism AP X 1	: 1.0 to 1,600 m/5,200 ft (1,800 m/5,900 ft)
Standard prism AP X 3	: 1.0 to 2,100 m/6,800 ft (2,400 m/7,800 ft)
Standard prism AP X 9	: 1.0 to 2,500 m/8,200 ft (2,900 m/9,500 ft)

Minimum display:
SET2100:

Fine measurement	: 1 mm, 0.1 mm (0.01/0.001ft)
Rapid measurement	: 1 mm (0.01 ft)
Tracking measurement	: 10 mm (0.1 ft)

SET3100/3100S & SET4100/4100S

Fine measurement	: 1 mm (0.01 ft)
Rapid measurement	: 1 mm (0.01 ft)
Tracking measurement	: 10 mm (0.1 ft)

Maximum slope distance:
SET2100 : 9999.9999 m (32808.333 ft)
SET3100/3100S & SET4100/4100S : 9999.999 m (32808.33 ft)

Distance unit: meters/feet selectable

Accuracy:
Fine measurement with prism: $\pm (2 + 2$ ppm X D) mm
Rapid measurement with prism: $\pm (5 + 5$ ppm X D) mm
Fine measurement with reflective target:
    $\pm (4 + 3$ ppm X D) mm
Rapid measurement with reflective target:
    $\pm (5 + 5$ ppm X D) mm

Measurement mode:
Fine measurement (single/repeat/average)
Rapid measurement (single and repeat)
Tracking

Measuring time:

Fine measurement	: 4.2 sec. + every 2.0 sec.
Rapid measurement	: 2.9 sec. + every 0.7 sec.
Tracking measurement	: 2.9 sec. + every 0.5 sec.

Signal source: Infrared LED
Light intensity control: Automatic
Atmospheric correction:
   Temperature input range: −30 to 60 °C (in 1°C step)/−22 to 140 °F
   Pressure input range: 500 to 1,400 hPa (in 1hPa step)
                                                  375 to 1,050 mmHg (in 1mmHg step)
                                                  14.8 to 41.3 inchHg (in 0.1 inchHg step)
   ppm input range: −499 to 499 ppm (in 1 ppm step)
   Humidity input range: 0 to 100% (in 1% step)
Prism constant correction:
   Constant input range: −99 to 99 mm (in 1 mm step)
Earth curvature and refraction correction: Atmospheric refraction constant
                                                  $K=0.14$ or $K=0.2$ selectable

Power Supply

Power source: Ni-MH rechargeable battery BDC35 (6 V)
Working duration at 25°C: Distance & angle measurement
                                 (Fine & single measurement, interval = every 30 sec)
                                   BDC35: Approx. 5.5 hours (approx. 660 points)
                                   Option BDC40: Approx. 4 hours (approx. 480 points)
                                   Option BDC12: Approx 17.5 hours (approx. 1,980 points)
                                 Angle measurement only
                                   BDC35: Approx. 7 hours
                                   Option BDC40: Approx. 6 hours
   Option BDC12: Approx. 22.5 hours
Charging time: BDC 35: Approx. 70 min.

General

Display: 2LCD graphic displays on each face
                                 120 dots X 64 dots (20 characters X 8 lines)
Keyboard: 28 keys
                                 (numeric, edit, soft function, power on, light)
Sensitivity of levels: Plata level:
                                   SET2100   : 20"/2 mm
                                   SET3100/4100 : 30"/2 mm
                                 Circular level: 10'/2 mm
                                 Image: Erect
                                 Magnification: 3X
Optical plummet: Minimum focus: 0.5 m
Horizontal & Vertical motion screw: Fine/Coarse 2 speed
Automatic power cut off: Yes
Calender · Clock: Yes
Data storage: On board about 3,000 points
Data output   Asynchronous serial RS232C compatible baud rate up
                                 to 38,400 bps
                                 Centronics compatible (with DOC46)
Operating temperature: −20° to 50°C
Water protection: IPX2 (Based on IEC529/1989)
Instrument height: 236 mm (9.3 inch) from tribrach bottom
                                 193 mm (7.6 inch) from tribrach dish
Size: 177 (W) X 165 (D) X 345 (H) mm (with handle and battery)
Weight: **SET2100/SET3100/SET4100** : 5.4 kg (with handle and battery)
                                 SET3100S/SET/4100S   : 5.6 kg (with handle and battery)

ATMOSPHERIC CORRECTION CHART

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

- The following is the hPa - mmHg conversion formula.
  hPa = mmHg/0.75
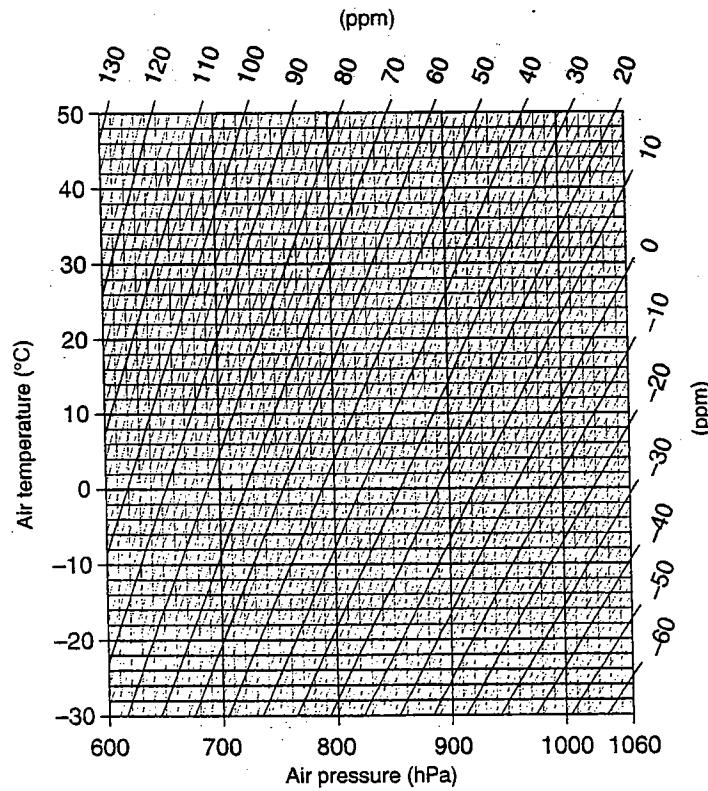
DATA ENTRY RANGES

- The following table shows the entry range for all data.

Data Name		Entry Range	Entry Unit
Temperature		−30 to 60	1°C
Air pressure	hPa	500 to 1400	1hPa
	mmHg	357 to 1050	1mmHg
Humidity		0 to 100	1%
Atmospheric correction factor		−499 to 499	1ppm
Distance measurement frequency (Fine single measurement)		1 to 9	Once
Prism constant correction value		−99 to 99	1mm
Date		000101 to 991231	
Time		000000 to 235959	
Required horizontal angle		**SET2100** : 0° to 359° 59' 59.5"	0.5"
		SET3100 : 0° to 359° 59' 59"	1"
		SET4100 : 0° to 359° 59' 55"	1"
Height		−9999.999 to 9999.999	0.001m
Distance value		−9999.999 to 9999.999	0.001m
Coordinates		−9999999.999 to 9999999.999	0.001m

REGULATIONS

Radio Frequency Interference

WARNING: Changes or modifications to this unit not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Notice for Canada
This Class A digital apparatus meets all requirements of Canadian Interference-Causing Equipment Regulations.
Get apparareil numérique de la Class A respecte toutes les exigences du Réglement sur le matériel brouilleur du Canada.

CE Conformity Declaration

CE Declaration of Conformity
in accordance with EMC Directive 89/336/EEC of the European Community

We herewith declare that the undermentioned instrument, in view of its design and type of construction, fully complies with the relevant basic radio interference requirements of the EMC Directive.

Should the instrument be modified without agreement, this declaration becomes invalid.

Instrument Description: Total Station (Surveying Instrument)

Model Name :   SET2100, SET3100, SET4100

Relevant EC Directive: EMC Directive (89/336/EEC)
                         Version: 91/263/EEC, 92/31/EEC, 93/68/EEC

Applied
Harmonized Standard: EMI   EN50081-1 1992
                               EN55022 1994-8 ClassB
                         EMS : EN50082-2 1995
   ENV50140 1993
                               ENV50141 1993
                               EN61000-4-2 1995
                               EN61000-4-4 1995

Date: .... 15/4/97 ....   **SOKKIA B.V.**
Firm: .... SOKKIA B.V. ....   Industrieterrein De Vaart
                                             Damsluisweg 1
                                             NL-1332 EA Almere

Address: ...... Industrieterrein De Vaart, Damsluisweg 1, NL-1332 EA Almere ....

Representative's Signature:

Name of Representative :   Stephen Blaikie
Representative's position : European vice President