

**SOKKIA**

**Series 110M**

**SET3110M**

**SET4110M**

**Auto Pointing Total Station**



Class 1 Laser Product  
Class I Laser Product

Class 1 LED Product  
Class I LED Product

**OPERATOR'S MANUAL**



Ni

- [English] CONTAIN NI-MH BATTERY. CADMIUM-FREE. MUST BE RECYCLED OR DISPOSED OF PROPERLY.
- [Deutsch] MIT NiMH AKKU. ENTHALT KEIN KADMIUM. EFORBERT RECYCLING ODER FACHGERECHTE ENTSORGUNG.
- [Français] CONTIENT UNE BATTERIE AU NI-MH. SANS CADMIUM. DOIT ÊTRE RECYCLÉE OU DONNÉE A UN ORGANISME DE RETRAITEMENT.
- [Italiano] CONTIENE NiMH BATTERIA. NON CONTIENE CADMIO. DEVE QUINDI ESSERE RICICLATA O ELIMINATA IN MODO APPROPRIATO.
- [Nederlands] BEVAT EEN NiMH BATTERIJ. BEVAT GEEN CADMIUM. DIENT GERECYCLEERD OF OP EEN CORRECTE MANIER VERNIETIGD TE WORDEN.
- [Español] CONTIENE UNA NiMH BATERÍA. NO CONTENE CADMIO. DEBE RECICLARSE O ELIMINARSE ADECUADAMENTE.
- [Portugulês] CONTEM BATERIA DE NiMH. SEM CÁDMIO. DEVERÁ SER RECICLADA OU DECARTEADA CONVENIENTEMENTE.
- [Svensk] INNEHÅLLER NiMH BATTERI. KÄDMIUMFRITT. BÖR ÅTERVINNAS ELLER FÖRSTÖRAS PÅ ETT SAKERT SÄTT.
- [Suomi] SISÄLTÄÄ NiMH AKUN. HÄVITETTÄESSÄ KÄSITELTÄVÄ ONGELMAJÄTTEENÄ.
- [Norsk] NiMH BATTERIER. INNEHOLDER IKKE KADMIUM. MÅ RESIRKULERES ELLER KASTES PÅ EN FORSVARLIG MÅTE.
- [Dansk] INDEHOLDER NiMH BATTERI. KADMIUMFRIT. SKAL GENVINDES ELLER KASSERES PÅ FORSVARLIG MÅDE.
- [Ελληνικά] ΠΕΡΙΕΧΕΙ ΜΠΑΤΑΡΙΑ ΝΙΚΕΛΙΟΥ-ΜΕΤΑΛΛΟΥ ΥΔΡΙΔΙΟΥ. ΔΕΝ ΠΕΡΙΕΧΕΙ ΚΑΔΜΙΟ. 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 its 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.



: This is the mark of the Japan Surveying Instruments Manufacturers Association.

**SOKKIA**

**Series 110M**

**SET3110M**


**SET4110M**

**Auto Pointing Total Station**

Class 1 Laser Product  
Class I Laser Product

Class 1 LED Product  
Class I LED Product

**OPERATOR'S MANUAL**

- Thank you for selecting the SET3110M/4110M.
- Before using the instrument, please read this operator's manual carefully.
- Verify that all equipment is included."  25.1 Standard Equipment"
- Data saved in the SET can be sent to a connected host computer. Commands operations from a host computer can also be performed. For details, refer to "Interfacing with the SOKKIA SDR Electronic Field Book" and "Command Explanations" manuals and ask your Sokkia agent.
- The specifications and general appearance of the instrument may be altered at any time and may differ from those appearing in brochures and this manual.
- Some of the diagrams shown in this manual may be simplified for easier understanding.

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# 1. 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.



This symbol indicates items for which caution (hazard warnings inclusive) is urged. Specific details are printed in or near the symbol.



This symbol indicates items which are prohibited. Specific details are printed in or near the symbol.



This symbol indicates items which must always be performed. Specific details are printed in or near the symbol.

## 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.

## 1. PRECAUTIONS FOR SAFE OPERATION

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### **Caution**

-  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.
-  Do not touch the instrument or look through the telescope eyepiece during automatic target searching. Hands could be caught in moving parts or an eye could be struck by the telescope and cause injury.
-  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.

### Power Supply

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#### **Warning**

-  Do not disassemble, rebuild, mutilate, incinerate, heat or short circuit the battery and charger. Fire, electric shock, burns or an explosion could result.
-  Do not use voltage other than the specified power supply voltage. Fire or electrical shock could result.
-  Do not use damaged power cords, plugs or loose outlets. Fire or electric shock could result.
-  Do not use power cords other than those designated. Fire could result.
-  Do not place articles such as clothing on the battery charger while charging batteries. Sparks could be induced, leading to fire.
-  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 heat or throw batteries into fire. An explosion could occur, resulting in injury.
-  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 use batteries or the battery charger if wet. Resultant shorting could lead to fire or burns.
-  Do not connect or disconnect power supply plugs with wet hands. Electric shock could result.
-  Do not use the battery, charger or AC (power) cable for any other equipment or purpose. Fire or burns caused by ignition could result.
-  Do not short circuit the battery. Fire or burns caused by heat or ignition could result.

## 1. PRECAUTIONS FOR SAFE OPERATION

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### **Caution**

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

### **Tripod**

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### **Caution**

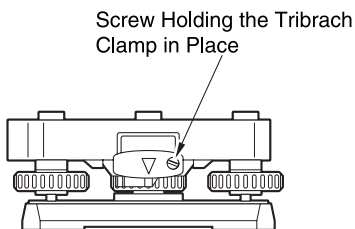
-  When mounting the instrument to the tripod, tighten the centering screw securely. Failure to tighten the screw properly could result in the instrument falling off the tripod, causing injury.
-  Tighten securely the leg fixing screws of the tripod on which the instrument is mounted. Failure to tighten 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.

## 2. PRECAUTIONS

### Tribrach Clamp

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- When the instrument is shipped, the tribrach 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 screwdriver. And before transporting it, tighten the locking screw to refasten it on the levelling base.



### The Lithium Battery

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The lithium battery is used for Calendar & Clock function. It can back up data for approximately 5 years of normal use, but its lifetime may be shorter depending on circumstances. If the voltage supplied by the lithium battery either declines or is completely discharged, the message "Clock error" is displayed. Ask your Sokkia agent to replace the battery for you.

### Levelling base

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Be sure to use levelling base WA100. Other levelling base cannot be used.

### Other precautions

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- 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 automatically rotate the telescope when using the lens hood.
- Protect the SET from heavy shocks or vibration.
- Protect the SET from rain or drizzle with an umbrella or waterproof cover.
- When the operator leaves the SET attached to the tripod, the vinyl cover should be placed on the instrument.
- Never carry the SET on the tripod to another site.
- Turn the power off before removing the battery.
- When placing the SET in its case, first remove its battery and place it in the case in accordance with the layout plan.

## 2. PRECAUTIONS

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### Maintenance

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- Periodically wipe clean the terminals of the instrument and the battery with the cleaning cloth to keep them free of dirt.
- Always clean the instrument before returning it to the case. The lens requires special care. First, dust it off with the lens brush to remove minute particles. Then, after breathing on the lens, wipe it with a soft clean cloth or lens tissue.
- Do not use organic solvents to clean the display, keyboard or carrying case.
- Store the SET in a dry room where the temperature remains fairly constant.
- Check the tripod for loose fit and loose screws.
- If any trouble is found on the rotatable parts, screws or optical parts (e.g. lens), contact your Sokkia agent.
- When the instrument is not used for a long time, check it at least once every 3 months.

#### "24. CHECKS AND ADJUSTMENTS"

- When removing the SET from the carrying case, never pull it out by force. The empty carrying case should be closed to protect it from moisture.
- To maintain the high accuracy of the instrument, we recommend that a Sokkia engineer check the SET for proper adjustment at least once a year. Please contact your Sokkia agent for details.

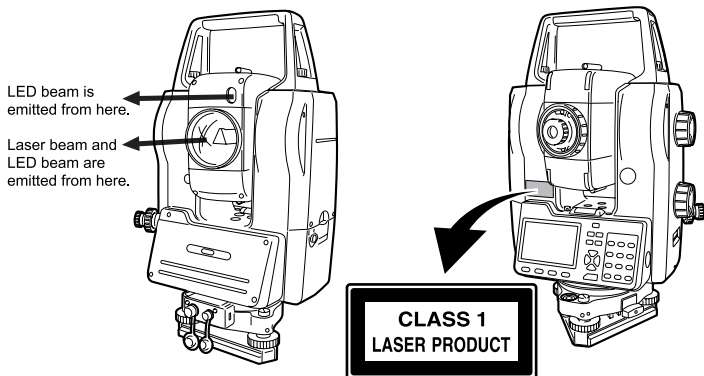


### 3. LASER • LED SAFETY INFORMATION

SET 3110M/4110M is classified as a Class 1 Laser Product and Class 1 LED Product according to IEC Standard Publication 825-1 and as a Class I Laser Product according to the United States Government Code of Federal Regulation CFR21.

- Auto pointing device in objective lens: Class 1/Class I Laser Product
- EDM device in objective lens • Guide light: Class 1 LED product (For all countries except USA)

Follow the safety instructions on the labels attached to the instrument as well as in this manual to ensure safe use of this laser and LED product.



#### **⚠ CAUTION**





- Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.
- Do not look directly into the laser beam source or LED source.
- The laser beam path and LED path should be located well above or below eye level wherever practicable.
- When **[SRCH]** or **[DIST]** are pressed, the laser beam is emitted from the objective lens until the center of the prism is sighted or distance measurement begins.
- Persons located in the path of the LED beam must be at least 5 meters away from the guide light source.

# 4. HOW TO READ THIS MANUAL

## Symbols


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The following conventions are used in this manual.

-  : Indicates precautions and important items which should be read before operations.
-  : Indicates the chapter title to refer to for additional information.
-  : Indicates supplementary explanation.
-  : Indicates an explanation for a particular term or operation.
- [DIST]** etc. : Indicates softkeys on the display.
- {ESC}** etc. : Indicates operation keys on SET.
- <S-O> etc. : Indicates screen titles.


## Screens and illustrations

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- Except where stated, SET means SET3110M/4110M in this manual.
  - Screens and illustrations appearing in this manual are of SET3110M.
  - Location of softkeys in screens used in procedures is based on the factory setting. It is possible to change the allocation of softkeys in Meas Mode, Shift Mode etc.
-  For details of softkeys: "5.1 Parts of the Instrument". Softkey allocation: "21.3 Allocating Key Functions".

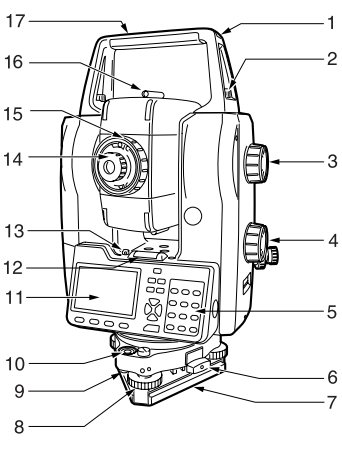
## Operation procedure

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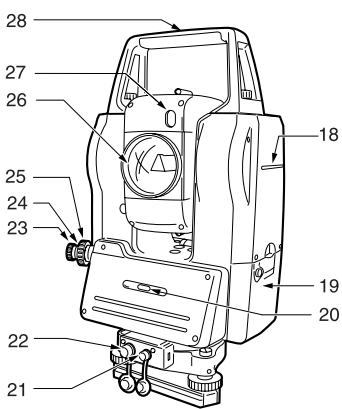
- Learn basic key operations in "5. SET FUNCTIONS" and "6. BASIC OPERATION" before you read each measurement procedure. See "5.3 Functions" for an overview of the SET's functions and "6.1 Basic Key Operation" for details on how to select options and input figures.
- Measurement procedures are based on continuous measurement. Some information about procedures when other measurement options are selected can be found in .

# 5. SET FUNCTIONS

## 5.1 Parts of the Instrument



- 1 Tubular compass slot
- 2 Handle securing screw
- 3 Vertical jogging knob
- 4 Horizontal jogging knob
- 5 Keyboard
- 6 Tribrach clamp
- 7 Base plate
- 8 Levelling foot screw
- 9 Circular level adjusting screws
- 10 Circular level
- 11 Display
- 12 Plate level
- 13 Plate level adjusting screw
- 14 Telescope eyepiece
- 15 Telescope focussing ring
- 16 Peep sight
- 17 Handle



- 18 Instrument height mark
- 19 Battery
- 20 Trigger key
- 21 Data input/output connector
- 22 External power source connector
- 23 Optical plummet eyepiece
- 24 Optical plummet reticle cover
- 25 Optical plummet focussing ring
- 26 Objective lens
- 27 Guide light
- 28 Instrument center mark

## 5. SET FUNCTIONS

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### Vertical and Horizontal jogging knobs

The instrument and telescope can be rotated manually by hand or, for more precise adjustments, by turning the vertical and horizontal jogging knobs. The faster the jogging knobs are turned, the faster the instrument and telescope rotate.



### Peep sight

Use peep sight to aim the SET in the direction of the measurement point. Turn the instrument until the triangle in the peep sight is aligned with the target.




### Instrument height mark

The height of the SET is 245mm (from tribrach dish to this mark). "Instrument height" is input when setting instrument station data and is the height from the measuring point (where SET is mounted) to this mark.



### Trigger key

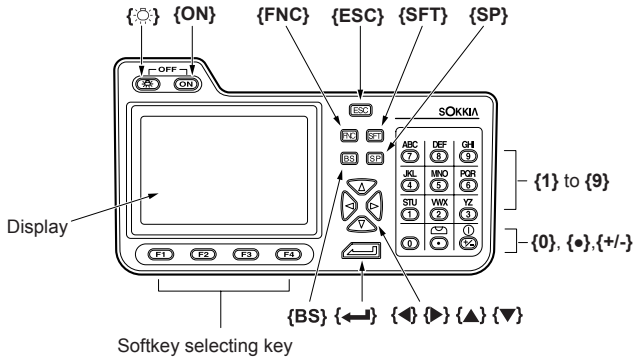
When the Trigger key is pressed SET acts the same way when a softkey with white background on the screen. You do not have to always operate SET from the keyboard side. Rotating the SET 180° or starting measurement can be done smoothly from the other side of the keyboard.  
 Softkey with white background: "5.3 Functions"

### ● The status of the trigger key light and meaning

Light status	Meaning
Slow flashing	Rotating
	Searching
	Measuring
Fast flashing	Error

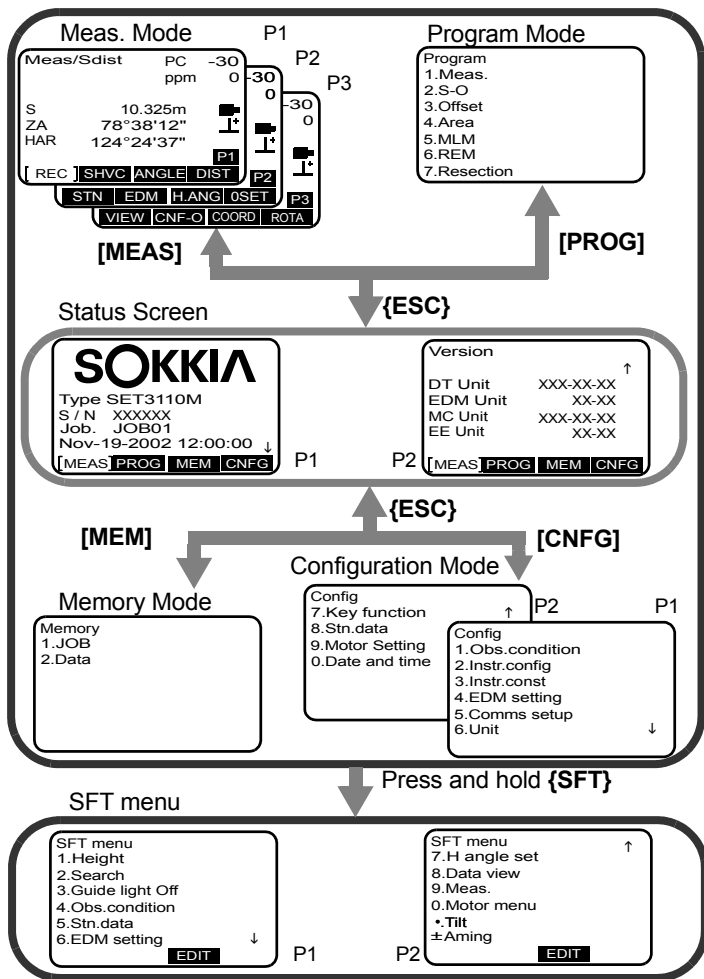
## Keyboard

### ☞ "6.1 Basic Key Operation"



## 5.2 Mode Diagram


This flow diagram shows the various modes and the key operations required to move between modes.



## 5.3 Functions


SET has the following features to make operation more efficient.

### 1. Horizontal and Vertical circle indexing


When **[ROTA]** is pressed, the instrument and telescope rotate to perform automatic horizontal and vertical circle indexing.  9. POWER ON


### 2. Sighting the target

The target can be sighted by moving the instrument and telescope manually by hand. For precise sighting, adjust the instrument and telescope using the vertical and horizontal jogging knobs.


Use the peep sight to bring the target roughly into the field of view. Then, press **[SRCH]** to automatically sight the center of the target.  "10.1 Auto-search function for target sighting"

### 3. Distance measurement


After **[DIST]** is pressed, the instrument searches for the prism and automatically measures the distance. The search range can be set beforehand.  "12.3 Distance and Angle Measurement". Setting the Search range: "21.1 Configuration ●EDM/ ●Motor Settings"

The speed of the flashing guide light informs the user at a distance of the current status of the instrument. During setting-out measurement, the speed and color of the flashing guide light instructs the person holding the pole in which direction to move.  "12.2 Turning ON the Guide Light", "15.1 Turning ON the Guide Light"

### 4. Reading-in registered coordinates

Previously registered known point coordinates can be read in and used for measurements. Coordinates can be read in from Work JOB or Control JOB.  Selecting a JOB: "19.1 JOB selection". Reading in coordinates data: "20.3 Setting Instrument Station Data".

### 5. Recording Measurement Results

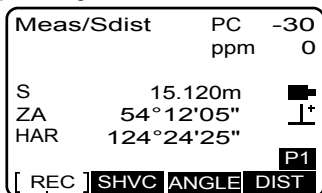
When **[AUTO]** is pressed, the instrument carries out distance measurement and automatically records the results. Measurement points are automatically counted sequentially in increments of 1. This function is convenient for fast, sequential, multi-point measurements.  Allocating the **[AUTO]** softkey: "21.3 Allocating Key Functions"

## 5. SET FUNCTIONS


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
### 6. Efficient measurement


Pressing the softkey with a white background in measurement screens leads you to the next step in the general measurement flow.



Softkeys with white background

When the Trigger key on the other side of the keyboard is pressed SET acts the same way when a softkey with white background on the screen. You do not have to always operate SET from the keyboard side. Rotating the SET 180 or starting measurement can be done smoothly from the other side of the keyboard. Trigger key light informs the user the current status of the SET.  "5.1 Parts of the instrument"

Settings etc. can be changed during measurement by pressing the **{SFT}** key. After changing the settings you can return to the same screen displayed before **{SFT}** was pressed.  Entering Shift **{SFT}** Mode: "6.1 Basic Key Operation"


The shift Mode menu and setting-out measurement, Two-distance offset measurement, missing line measurement, and REM measurement menus, as well as the Measurement Mode softkeys can be customized to meet the requirements of individual users.  "21.2 Allocating Key Functions in SFT Mode".



# 6. BASIC OPERATION


## 6.1 Basic Key Operation

Learn basic key operations here before you read each measurement procedure.

 Location of keys on the keyboard: "5.1 Parts of the Instrument"

### ● Power ON / OFF

{ON}: Power On

{ON} (while pressing) + : Power Off

### ● Lighting up the display

: Switch the screen backlight on / off

### ● Softkey operation

Softkeys are displayed on the bottom line of the screen.

{F1} to {F4}: Select the function matching the softkey

{FNC} : Toggle between MEAS Mode screen pages (when more than 4 softkeys are allocated)

### ● Inputting letters / figures

{SFT} : Switch between numerals and alphabetic characters

{0} to {9} : During numeric input, input number of the key  
During alphabetic input, input the characters displayed above the key in the order they are listed.

{●} : Input a decimal point during numeric input

{+/-} : Input plus or minus sign during numeric input

{SP} : Input a blank space

{◀}/{▶} : right and left cursor/select other option

{BS} : Delete a character on the left

{ESC} : Cancel the input data

{←} : Select / accept input word / value

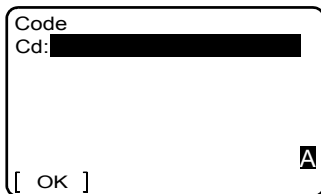
### EXAMPLE 1: Entering "Pole" in the Code field

1. Press {SFT} to enter the alphabet input mode

Alphabet input mode is indicated by an "A" on the right of the screen.

2. Press {6}.

"P" is displayed.



## 6. BASIC OPERATION

3. Press **{5}** three times.  
"O" is displayed.



4. Press **{4}** three times.  
"L" is displayed.
5. Press **{8}** two times.  
"E" is displayed. Press **{←}** to complete inputting.

### ● Selecting items

**{▲}** / **{▼}** : Up and down cursor

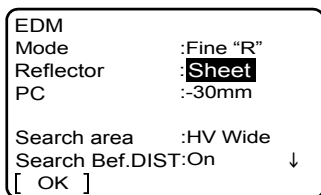
**{◀}** / **{▶}** : Right and left cursor / Select other option

**{←}** : Accept the option

Softkeys with clear background perform the same function as the enter key.

### Example: Selecting a target type

1. Select EDM setting in the Config. Mode
2. Use **{▲}** / **{▼}** to select the "Reflector" field.
3. Use **{◀}** / **{▶}** to select the required option.
4. Press **{←}** or **{▼}** to accept the option. The cursor moves to the next option.



### ● Switching modes

**[MEAS]** : From Status Screen to Meas Mode (Measure Mode)

**[PROG]** : From Status Screen to Program Mode


**[MEM]** : From Status Screen to Memory Mode

**[CNFG]** : From Status Screen to Config Mode (Configuration Mode)


Press and hold **{SFT}**:

From each mode to Shift Mode (multiple beeps)

**{ESC}** : From each mode to Status Mode (may require being pressed multiple times to work back through previous screens to the Status mode)

 "5.2 Mode Diagram"

### ● Guide light ON/OFF

 "12.2 Turning ON the Guide Light". "15.1 Turning ON the Guide Light".

### ● Rotating SET for Horizontal and Vertical angle

In the horizontal and vertical angle screens, the following keys can be used to perform the same operations as the horizontal and vertical jogging dials.

**{◀} / {▶}**: Horizontal angle rotation (Press **{▶}**) to rotate SET in clockwise direction. Each time **{▶}** is pressed, rotating speed increases. Six speed settings are available, displayed on the screen: 1 to 6. Press **{◀}** to stop rotation. ) Press **{◀}** to rotate SET in anticlockwise direction. Press **{▶}** to stop.

**{▲} / {▼}**: Vertical angle rotation (Press **{▲}**) to rotate telescope. Each time **{▲}** is pressed, rotating speed increases. Six speed settings are available, displayed on the screen: 1 to 6. Press **{▼}** to stop rotation. ) Press **{▼}** to rotate telescope in opposite direction. Press **{▲}** to stop.

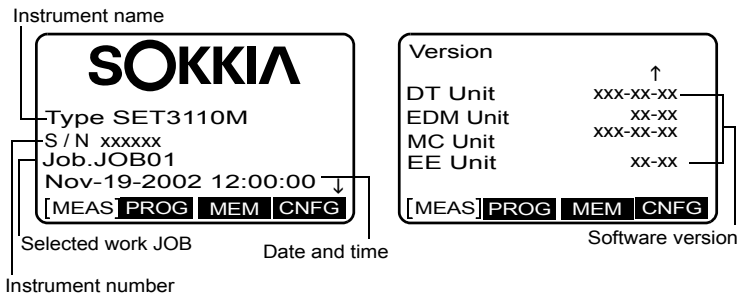
**{ESC}**: Cancels horizontal and vertical angle rotation.

### ● Other operation

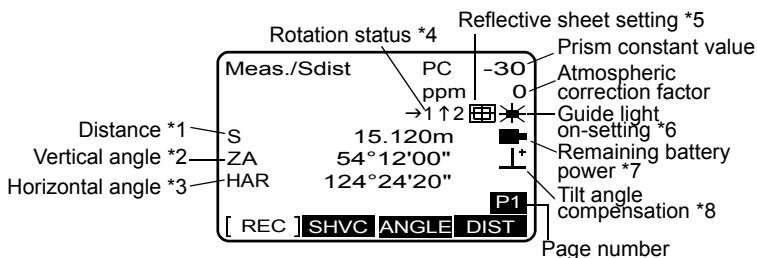
**{ESC}**: Return to previous screen

## 6.2 Display Functions

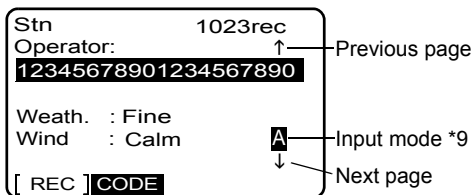
### Status screen











### ● Meas Mode screen



### Data input screen





- \* 1: Distance  
 Switching distance display status by pressing **[SHVC]**  
 S: Slope distance  
 H: Horizontal distance  
 V: Height difference  
 NEZ: Coordinates
  
- \* 2: Vertical angle  
 Switching vertical angle display status: "21.1 Configuration●Observation conditions"  
 ZA: Zenith angle (Z=0)  
 VA: Vertical angle (H=0 / H=±90)  
 To switch vertical angle/slope in %, press **[ZA/%]**
  
- \* 3: Horizontal angle  
 Press **[R/L]** to switch the display status.  
 HAR: Horizontal angle right  
 HAL: Horizontal angle left
  
- \* 4: Rotation status  
 Displayed when horizontal angle or vertical angle is rotating using **{◀}/▶/▲/▼}**.  
 1 to 6 : Horizontal angle is rotating at speed 1 to 6.  
 1 to 6 : Vertical angle is rotating at speed 1 to 6.  
 "6.1 Basic Key Operation"
  
- \* 5: Displayed when "sheet" is set as reflector in EDM setting of SFT Mode  
 "21.1 Configuration●EDM Settings"
  
- \* 6: Displayed when Guide light is set to ON  
 "12.2 Turning ON the Guide Light". "15.1 Turning ON the Guide Light".
  
- \* 7: Remaining battery power (BDC45, Temperature=25°C, EDM on)  
 The displayed battery power remaining may differ during distance measurement and when measurement is stopped.
  -  : level 3 Full power.
  
  -  : level 2 Plenty of power remains.
  
  -  : level 1 Half or less power remains.
  
  -  : level 0 Little power remains. Charge the battery.
  
  -  : (This symbol is displayed every 3 seconds): No power remains.

## 6. BASIC OPERATION

---


Stop the measurement and charge the battery.

 "7.1 Battery Charging"

 : Displayed when AC Adaptor EDC20/77 (optional accessory) is connected.


\* 8: Tilt angle compensation

When this symbol is displayed, the vertical and horizontal angles are automatically compensated for small tilt errors using 2-axis tilt sensor.

 Tilt compensation setting: "21.1 Configuration ● Observation conditions"

\* 9: Input mode

No display: numeric input


 : alphabetic input



Softkeys that were not allocated in the Meas. Mode when the SET left the factory, but that are required by the user to perform measurements will have to be allocated.

 Allocating softkeys [R/L] and [ZA/%]: "21.3 Allocating Key Functions"

# 7. USING THE BATTERY

 Types of power supply: "25.4 Power Supply System"

## 7.1 Battery Charging

The battery has not been charged at the factory.

### Caution

- Initially, or when the battery is not in use for over a month, charging will stop prior to completion. Use the battery until the power is depleted before recharging. The battery working duration will return to normal after charging a second time. This is a normal occurrence and the battery is fine.
- Do not charge a fully charged battery more than three times in succession as it will cause damage to the battery.
- The battery and charger will become rather hot during use. This is normal.
- Periodically wipe clean the terminals on the charger and battery with the cleaning cloth to keep them free of dirt.
- If you allow the battery power level to get too low, the battery may not be rechargeable or operating time may decline. Keep the battery always charged.
- If the nickel-cadmium battery is exposed to cold temperatures, the working duration of the battery may decrease.
- The battery can be recharged about 300 times under ordinary use.  
(Temperature = 25°C, Humidity = 65%)

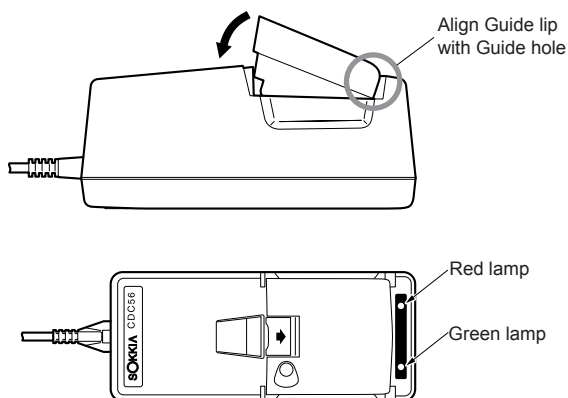
### ► PROCEDURE

---

1. Attach cable (EDC34/35) to Charger (CDC56).
2. Plug the AC cable into the wall outlet
3. Mount the battery (BDC45) in the charger by matching the guides on the battery with the guide holes on the charger.

## 7. USING THE BATTERY

---



When charging starts, the green lamp starts blinking.

4. Charging takes approximately 130 minutes.  
The lamp lights steadily when charging is finished.
5. Remove the battery and unplug the charger.

### ● Errors during charging

Green	Red	Meaning
Steady	Flashig	Battery is damaged. Please contact your Sokkia agent.
Steady	Steady	Charging stops automatically to avoid overheating. Remove the battery. Recharge the battery when it is cool enough. If the lamp status does not change, contact your Sokkia agent.
Off	Steady	Initially, the battery temperature is out of range and charging has not started. When the battery temperature becomes normal, the red light will turn off and the green light will start flashing to indicate charging has begun.



## 7.2 Installing / Removing the Battery

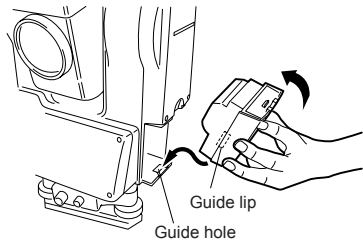
Mount charged battery (BDC45)

### Caution

- Remove the battery when the instrument is not being used.
- Before removing the battery, turn off the power to the instrument.
- When installing / removing the battery, make sure that moisture or dust particles do not come in contact with the inside of the instrument.
- Periodically wipe clean the terminals on the SET with the cleaning cloth to keep them free of dirt.

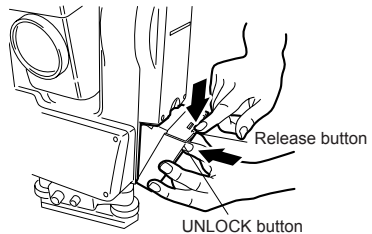
### ►PROCEDURE Mounting the battery

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 UNLOCK button, press the release button downward.
2. Remove the battery by pulling it toward you.



# 8. SETTING UP THE INSTRUMENT

## Caution

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

## 8.1 Centering

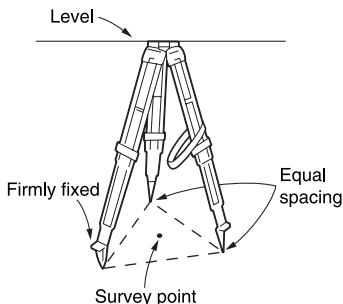
### ► PROCEDURE

#### 1. Set up the tripod

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

Set the tripod so that the head is positioned over the surveying point.

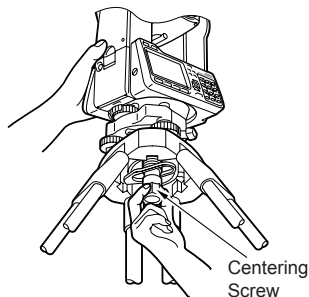
Make sure the tripod shoes are firmly fixed in the ground.



#### 2. Install the instrument

Place the instrument on the tripod head.

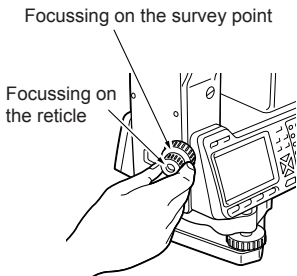
Supporting it with one hand, tighten the centering screw on the bottom of the unit to make sure it is secured to the tripod.



#### 3. Focus on the surveying point

Looking through the optical plummet eyepiece, turn the optical plummet eyepiece to focus on the reticle.

Turn the optical plummet focusing ring to focus on the surveying point.



## 8.2

## Levelling

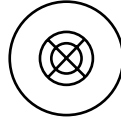
Instrument can be levelled using the screen.

 "PROCEDURE Levelling on the screen"

### ► PROCEDURE

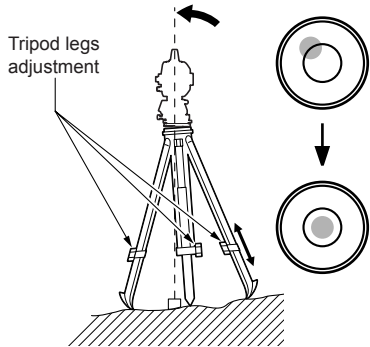
#### 1. Center the surveying point in the reticle

Adjust the levelling foot screws to center the surveying point in the optical plummet reticle.



#### 2. Center the bubble in the circular level

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. Adjust one more tripod leg to center the bubble.

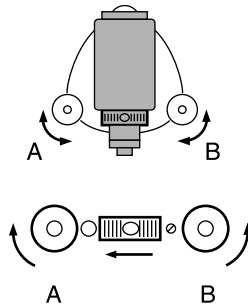


#### 3. Center the bubble in the plate level

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 air bubble using levelling foot screws A and B.

The bubble moves towards a clockwise rotated levelling foot screw.

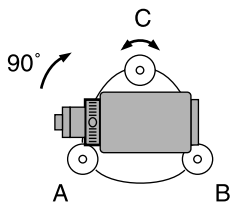


## 8. SETTING UP THE INSTRUMENT

---

### 4. Turn 90° and center the bubble

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. Center the air bubble using levelling foot screw C.




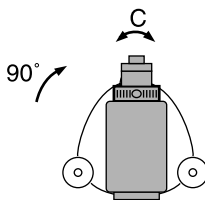
### 5. Turn another 90° and check bubble position

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:

- Turn levelling foot screws A and B equally in opposite directions to remove half of the bubble displacement.
- Turn the upper part a further 90°, and use levelling foot screw C to remove half of the displacement in this direction.

Or adjust the plate level.

 "24.1 Plate Level"



### 6. Check to see if bubble is in same position in any direction

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

### 7. Center the SET over the Surveying point

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

Retighten the centering screw securely.

### 8. Check again to make sure the bubble in the plate level is centered

If not, repeat the procedure starting from step 3.

## ► Procedure Levelling on the screen

---


### 1. Press {ON} to power on

 "9. POWER ON"

### 2. Enter Shift [SFT] Mode

Press and hold the {SFT} until a series of beep tones sound and the SFT Mode menu is displayed.

### 3. Select "TILT" to display the circular level on the screen.

 indicates bubble in circular level. The range of the inside circle is  $\pm 3'$  and the range of the outside circle is  $\pm 4.5'$ .

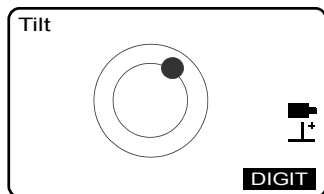


## 8. SETTING UP THE INSTRUMENT

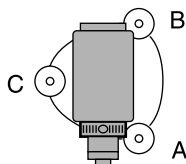
---

4. Center [●] in the circular level  
☞ "8.2 Levelling" steps 1 to 2

- Press [DIGIT] to display tilt angle values X and Y. Press [GRAPH] to return to the circular level screen.



5. Turn the instrument until the telescope is parallel to a line between levelling foot screws A and B, then tighten the horizontal clamp.



6. Set the tilt angle to  $0^\circ$  using foot screws A and B for the X direction and levelling screw C for the Y direction.

7. Screen levelling is completed.  
Press {ESC} to return to Meas Mode.

## 9. POWER ON

☞ Setting "H index"/ "V index": "21.1 Configuration ● Observation Conditions

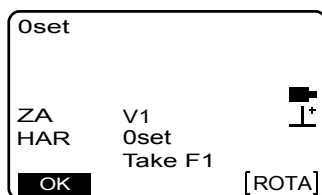
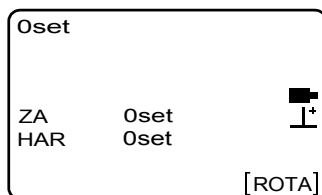
### ► PROCEDURE

#### 1. Press {ON}.

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

- When "H index" is set to "Manual", "HAR 0 Set" does not appear.
- When "V index" is set to "Manual" the display appears as at right.

☞ "27. Manually Indexing the Vertical Circle by Face 1, Face 2 Measurement"

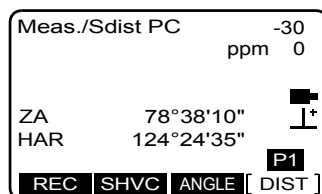


#### 2. Horizontal and Vertical circle indexing

Press [ROTA] to rotate the top the instrument and the telescope.

When horizontal indexing and vertical indexing have been completed, Meas Mode screen appears.

If "Out of range" is displayed, the instrument tilt sensor is indicating that the instrument is out of level. Level the instrument once again and the horizontal and vertical angles will be displayed.




## 9. POWER ON

---



- Rotate the instrument on the base plate until the SET beeps for horizontal indexing. Then transit the telescope until a beep sounds. Indexing occurs when the objective lens crosses the horizontal plane in face 1.
- "Tilt crn." in "Obs. Condition" should be set to "No" if the display is unsteady due to vibration or strong wind.

 "21.1 Configuration ●Observation Conditions"



# 10. TARGET SIGHTING

The target can be automatically sighted using the auto-search function or manually sighted by the operator using the peep sight and telescope.

## 10.1 Auto-search function for target sighting

The auto-search function automatically sights the target and does not require you to focus the telescope.

- The search range can be set.


 "21.1 Configuration ● EDM Settings/ ● Motor Settings"

### **Caution**

- When the [SRCH] key is pressed, the instrument emits a laser beam until the center of the prism is sighted.

#### Caution

- Use reflective prisms from Sokkia for higher precision measurement.
- Auto search can only be performed when a prism is used as the target.
- Auto search cannot be performed if the prism is located at the zenith. In this case, manually sight the target.

 "10.2 Manually Sighting the Target"

- If more than one prism is located in the field of sight during auto-search, an operation error will occur and the SET will not be able to find the target.
- The prism beyond the glass can not be searched because measurement error occurs.
- If an obstacle blocks the laser beam path between the SET and the prism, SET cannot find the target correctly.
- If strong light shines directly into the objective lens, measurement cannot be performed correctly.
- Position the prism in alignment with the objective lens. In short distance measurement especially, make sure to align the prism with the objective lens (within 10 to 15°) to obtain the correct result. A prism with a prism constant of -40mm can eliminate the error caused by tilted prism.

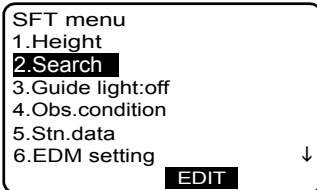
## 10. TARGET SIGHTING

---

### ►PROCEDURE

---

1. Aim the objective lens at the target.  
Use the peep sight to aim the objective lens in the general direction of the target. (The vertical and horizontal jogging knobs can be used for precise adjustments of the instrument and telescope.)
2. Enter Shift (SFT) Mode  
Press and hold the **{SFT}** button until a series of beep tones sound and the SFT Mode menu is displayed.
3. Search for the target  
Select "Search". The telescope and top half of the instrument rotate and target auto-search begins. When the target is found, the instrument sights the center of the prism and stops.



#### Note

- Press **[SRCH]** in Meas Mode to perform an auto search for the prism.
- Allocating the **[SRCH]** softkey: "21.3 Allocating Key Functions"

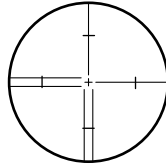
## 10.2 Manually Sighting the Target

#### Caution

- When sighting the target, strong light shining directly into the objective lens may cause the instrument to malfunction. Protect the objective lens from direct light by attaching the lens hood.

**►PROCEDURE**

1. Focus on the reticle  
Look through the telescope eyepiece at a bright and featureless background.  
Turn the eyepiece clockwise, then counterclockwise little by little until just before the reticle image becomes focussed.  
Using these procedures, frequent reticle refocussing is not necessary, since your eye is focussed at infinity.
2. Sight the target  
Use the peep sight to bring the target into the field of view. Turn the vertical and horizontal jogging knobs for fine sighting adjustments.
3. Focus on the target  
Turn the telescope focussing ring to focus on the target.  
Turn the vertical and horizontal fine motion screws to align the target with the reticle.  
The last adjustment of each fine motion screw should be in the clockwise direction.
4. Readjust the focus until there is no parallax  
Readjust the focus with the focussing ring until there is no parallax between the target image and the reticle.

**Eliminating parallax**

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

# 11. ANGLE MEASUREMENT

This section explains the procedures for basic angle measurement.

## 11.1 Measuring the Horizontal Angle between Two Points (Horizontal Angle 0°)

Use the "0SET" function to measure the included angle between two points. The horizontal angle can be set to 0 at any direction.



### ► PROCEDURE

1. Sight the first target.  
 "10. TARGET SIGHTING"

1st target

Instrument Station



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 becomes 0°.

Meas./Sdist	PC	-30
	ppm	0
ZA	78°38'12"	
HAR	00°00'00"	
<b>P2</b>		
<b>STN</b>	<b>EDM</b>	<b>H.ANG 0SET</b>

3. Sight the second target.

2nd Target

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


Meas./Sdist	PC	-30
	ppm	0
ZA	78°38'15"	
HAR	124°24'30"	
<b>P2</b>		
<b>STN</b>	<b>EDM</b>	<b>H.ANG 0SET</b>

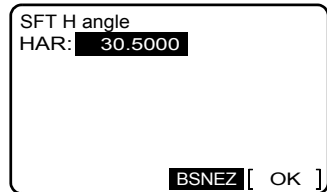
## 11.2 Setting the Horizontal Angle to a Required Value (Horizontal Angle Hold)

You can set the horizontal angle in a certain direction to any required value and then measure the angle from the direction.

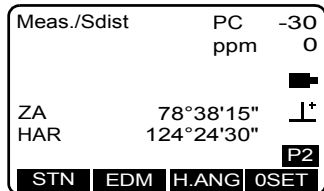
### ► PROCEDURE

1. Sight the first target.
2. In the second page of the Meas Mode screen, press **[H.ANG]**.  
<Set H angle> is displayed.
3. Enter the angle you wish to set.
  - The azimuth angle can be calculated by pressing **[BSNEZ]** and inputting the backsight point coordinates.


 "13.2 Azimuth Angle Setting"



4. Press **[OK]** to display the value input as the horizontal angle.
5. Sight the second target.  
The horizontal angle from the second target to the value set as the horizontal angle is displayed.



### Note

- Pressing **[HOLD]** performs the same function as above.
  - Press **[HOLD]** in Meas Mode to set the displayed horizontal angle. Then, set the angle that is in hold status to the direction you require.
-  Allocating **[HOLD]**: "21.3 Allocating Key Functions"

### 11.3 Turning the Instrument from the Reference Angle to a Specified Angle

The SET automatically turns from the reference direction to the specified angle (target).

- SET also turns to the target coordinates when reference angle is omitted.

#### Caution


- When "Tilt crn (tilt collection)" or "Coll. crn (collimation collection)" is set to "Yes" and inputting angle near the zenith or nadir, rotation may not be done correctly.

### ► PROCEDURE

---

1. Sight the point you will use as the reference angle and set it as the reference angle.

Sight the reference point and press **[OSET]**, or input the reference point angle.

 "11.1 Measuring the Horizontal Angle between Two Points (Horizontal Angle 0°)" / "11.2 Setting the Horizontal Angle to a Required Value (Horizontal Angle Hold)"

2. In the third page of the Meas mode screen, press **[ROTA]**.
3. Input the specified angle.  
In <Rotation>, enter the vertical and horizontal angles.

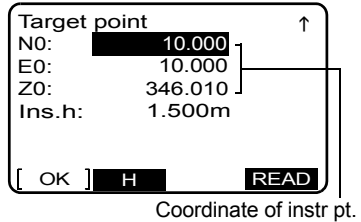
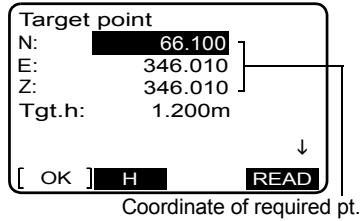
- Pressing **[READ]** displays the recorded coordinates data and allows you to set it.

 "20.3 Setting Instrument Station Data"

Rotation  
ZA : 87°21'00"  
HAR: 180.0045

**[READ]** **[COORD]** **[ROTA]**

- Pressing **[COORD]** obtains the target angle from the entered instrument station and target coordinates. Instrument station data is entered on the second page. Press **[H]** to calculate only the horizontal angle from the coordinates and return to <Rotation>
- Press **[OK]** to calculate both the horizontal and vertical angle from the coordinates.



4. After confirming the coordinates, press **[ROTA]**. The SET moves to the point (target) entered in step 3.

### 11.4 Angle measurement and Outputting the Data

The following explains angle measurement and the features used to output measurement data to a computer or peripheral equipment.

Communication cables: "25.2 Optional Accessories"

Output format and command operations: "Interfacing with the SOKKIA SDR Electronic Field Book" and "Command Explanations" manuals. To set RS232C: 21.1 Configuration ● Communication Setup"



#### ► PROCEDURE

1. Connect SET and peripheral equipment.
2. Select "Comms setup in the configuration menu and set "D-OUT" to "On".  
 "21.1 Configuration ● Communication Setup"
3. Sight the target point.

## 11. ANGLE MEASUREMENT

---


4. Angle data is output.  
Press **[ANGLE]** in the first page of the Meas. Mode screen. Target measurement results are output to peripheral equipment.

Meas./Sdist	PC	-30
	ppm	0
ZA	78°38'10"	
HAR	124°24'30"	
		<b>P1</b>
[ REC ]	SHVC	ANGLE DIST



## 12. DISTANCE MEASUREMENT

Perform the following settings as preparation for distance measurement.

- Distance measurement mode
  - Target type
  - Prism constant correction value
  - Atmospheric correction factor
  - Search range
  - Search before distance measurement
-  "21.1 Configuration ●EDM Settings"

### 12.1 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.

#### Caution


- Manually sight the target when checking the returned signal.
- 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.

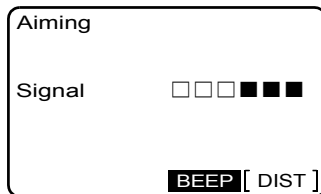
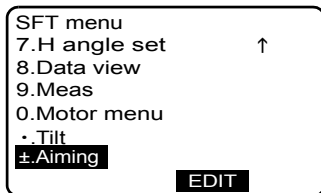
### ►PROCEDURE

---

1. Using the manual sighting method, accurately sight the target.  
 "10.2 Manually Sighting the Target"
2. Press and hold the **{SFT}** button until a series of beep tones sound and the SFT Mode menu is displayed.



## 12. DISTANCE MEASUREMENT

3. Scroll to page two of the SFT menu and select "Aiming". The intensity of the light of the returned signal is displayed by a gauge.
- The more  displayed, the greater the quantity of reflected light.
  - If "\*\*\*" is displayed; only enough light for the measurement is returned.
  - When "\*\*\*" is not displayed, accurately resight the target.
  - Press **[BEEP]** to make a buzzer sound when measurement is possible. Press **[OFF]** to shut off the buzzer.
  - Press **[DIST]** to start distance measurement.




4. Finish signal check  
Press **{ESC}** to finish signal check and return to the screen where you enter SFT menu.

### Note

-  is displayed when the returned signal is too bright. If this indicator is displayed persistently, contact your Sokkia agent.
  - If no key operations are performed for two minutes, the display automatically returns to the Meas Mode screen.
  - <Aiming> can be displayed in Meas Mode by pressing **[AIM]**.
-  Allocating the **[AIM]** softkey: "21.3 Allocating Key Functions"

## 12.2 Turning ON the Guide Light

The flashing speed of the guide light indicates the status of the SET and can be known when the user is located at a distance from the instrument.

- Brightness of the guide light can be changed.
-  "21.1 Configuration ● Instrument Configurations"

**⚠ CAUTION**

- Persons located in the path of the LED beam must be at least 5 meters away from the guide light source.

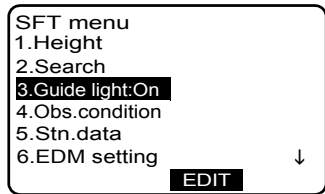
**● Guide light status and meaning**

Status of SET

Light status	Meaning
Slow flashing	Waiting
Fast flashing	Searching
	Measuring
Green and red alternate flashing	Search error (error screen only)
	Distance measurement error (no signal, sighting error)

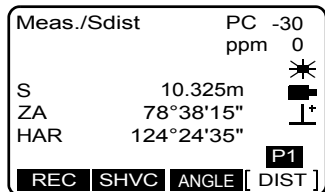
**▶ PROCEDURE Setting the guide light to ON.**

1. Press the **{SFT}** button to enter Shift Mode.
2. Align the cursor with "Guide light."



3. Set the guide light to "On."  
**{◀} / {▶}** (or **{←}**) toggles between "On" and "Off."

4. Return to Measurement Mode  
 Press **{ESC}** to return to Meas. Mode. The Guide light symbol is displayed in the screen.



## 12. DISTANCE MEASUREMENT



- Guide light can be set On and Off by pressing [**G.LIGHT**] in Meas mode.
- Allocating the [**G.LIGHT**] softkey: "21.3 Allocating Key Functions"

### 12.3 Distance and Angle Measurement

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

- The search range can be set.  
 "21.1 Configuration ●EDM Settings●Motor settings"

#### CAUTION

- After [DIST] is pressed, the laser beam is emitted until the center of the prism is automatically sighted and distance measurement begins.

#### ►PROCEDURE

1. Face the SET in the direction of the target  
Use the peep sight to aim the SET and telescope toward the target.  
 "10. TARGET SIGHTING".
2. Start measurement  
Press [**DIST**] in the first page of the Meas. Mode to start target search. When the target is found, measurement automatically starts. When measurement starts, EDM information (Distance Mode, prism constant correction value, atmospheric correction factor) is represented by a flashing light.

Meas./Sdist	PC -30	
	ppm 0	
S	10.325m	
ZA	78°38'15"	
HAR	124°24'35"	
<b>P1</b>		
<b>REC</b>	<b>SHVC</b>	<b>ANGLE [ DIST ]</b>

Distance
Fine"R"
PC -30
ppm 25
<b>STOP</b>

## 12. DISTANCE MEASUREMENT

The measured distance data (S), vertical angle (ZA), and horizontal angle (HAR) are displayed.

Distance	
S	15.120m
ZA	78°38'10"
HAR	124°24'30"
[STOP]	

### 3. Stop measurement

Press **[STOP]** to quit distance measurement.

- Each time **[SHVC]** is pressed "Meas./Sdist", "Meas./Hdist", "Meas./Vdist" and "Meas./Coord" are displayed alternately. The measurement value is calculated as S (slope distance) / H (horizontal distance) / V (height difference) /NEZ (coordinates).

### 4. Register the measurement results

Press **[REC]** and input the point name and height of sight line.

- Press **[CODE]** to select and input the previously registered code.

Meas./Sdist	PC -30	
	ppm 0	
S	10.325m	
ZA	78°38'15"	
HAR	124°24'35"	
		P1
[ REC ]	SHVC	ANGLE DIST

### 5. Confirm input value and finish

Press **[OK]** to register the measurement results in the current JOB and return to the main menu.

REC/Dist	1023rec	
S	300.000m	
ZA	50°00'00"	
HAR	200°00'00"	
Pt:	AUTO1001	
Tgt.h:	1.000m	A
Cd:		
[ OK ]	CODE	


#### Note

- If the single measurement mode is selected, measurement automatically stops after a single measurement.
- During fine average measurement, the distance data is displayed as S-1, S-2,... to S-9. When the designated number of measurements has been completed, the average value of the distance is displayed in the "S-A" line.

## 12. DISTANCE MEASUREMENT

---

- The distance and angle that are most recently measured remain stored in the memory until the power is off and can be displayed at any time by pressing **[RCL]**.
- When **[AUTO]** is pressed, the instrument carries out distance measurement and automatically records the result. Measurement points are automatically counted sequentially in increments of 1. (Incremented only when final character of point name is a numeral.)


 Allocating **[RCL]** and **[AUTO]**: "21.3 Allocating Key Functions"

Number of characters per measurement item and range of selected item is as follows:

- Maximum point number size: 16 (alphanumeric) When the point name is not entered, SET automatically increments the last input number by 1. (Incremented only when final character of point name is a numeral)
- Input range of target height: -9999.999 to 9999.999 m

### 12.4 Distance measurement and Outputting the Data


The following explains distance measurement and the features used to output measurement data to a computer or peripheral equipment.

 Communication cables: "25.2 Optional Accessories". Output format and command operations: "Interfacing with the SOKKIA SDR Electronic Field Book" and "Command Explanations" manuals. Setting RS232C: "21.1 Configuration ● RS232C (communication)"

#### ►PROCEDURE

---

1. Connect SET and peripheral equipment.
2. Select "Comms setup" in the configuration mode and set "D-OUT" to "On".

 "21.1 Configuration ● communication Setup"
3. Sight the target point.

## 12. DISTANCE MEASUREMENT

4. Press **[DIST]** in the first page of the Meas.Mode to start distance measurement. Target measurement results are output to peripheral equipment.

Meas./Sdist	PC -30	
	ppm 0	
S	10.325m	
ZA	78°38'15"	
HAR	124°24'35"	
		<b>P1</b>
<b>REC</b>	<b>SHVC</b>	<b>ANGLE [ DIST ]</b>

5. Press **[STOP]** to finish data output and return to the Meas. mode.

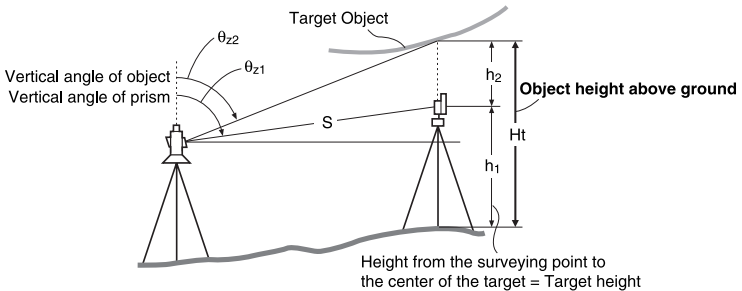
### 12.5 REM Measurement

An REM measurement is a function used to measure the height to a point where a target cannot be directly installed such as power lines, overhead cables and bridges, etc.

The height of the target is calculated using the following formula.

$$Ht = h_1 + h_2$$

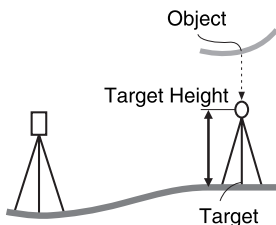
$$h_2 = S \sin \theta_{z1} \times \cot \theta_{z2} - S \cos \theta_{z1}$$



## 12. DISTANCE MEASUREMENT

### ►PROCEDURE

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



2. Enter Shift (SFT) Mode and select "Height." Then, input the target height.

SFT menu
1. Height
2. Search
3. Guide light:off
4. Obs.condition
5. Stn.data
6. EDM setting
↓
<b>EDIT</b>

Height
Tgt.h: 10.235 m
[ OK ]

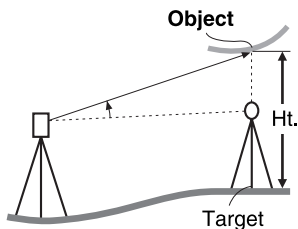
3. Press **[DIST]** in page one of the Meas. Mode to carry out target measurement.  
The measured distance data, vertical angle and horizontal angle are displayed.  
Press **[STOP]** to stop the measurement.

Meas./Sdist	PC -30	
	ppm 0	
S	10.325m	■
ZA	78°38'15"	↑↓
HAR	124°24'35"	
		<b>P1</b>
<b>REC</b>	<b>SHVC</b>	<b>ANGLE</b> [ <b>DIST</b> ]



## 12. DISTANCE MEASUREMENT

4. Sight the object, then select "REM" in Program Mode. The REM measurement is started and the height from the ground to the object is displayed in "Ht.".





Program
1.Meas.
2.S-O
3.Offset
4.Area
5.MLM
<b>6. REM</b>
7.Resection

Press **[STOP]** to stop the measurement.

REM
Ht.            -1234.123m
S                123.123m
ZA             78°38'10"
HAR            124°24'35"
<b>[STOP]</b>


Object height above ground

- To continue REM measurement, press **[REM]**.
- To re-observe the target, sight the target then press **[DIST]**.

REM
Ht.            -1234.123m
S                123.123m
ZA             78°38'10" 
HAR            124°24'30" 
<b>P1</b>
<b>[DIST] [REM]</b>

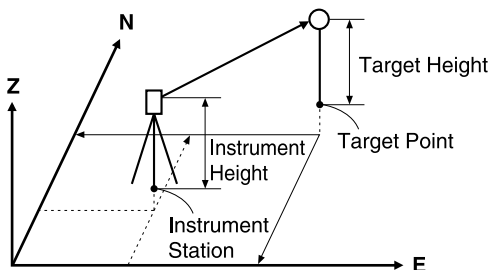
5. Press **{ESC}** to finish REM measurement and return to the Program Mode screen.

### Note

- It is also possible to perform REM measurement by pressing **[REM]** in Meas. Mode.
  - Target height can also be entered by pressing **[HT]**.
-  Allocating **[REM]** / **[HT]**: "21.3 Allocating Key Functions"

# 13. COORDINATE MEASUREMENT


By performing coordinate measurements it is possible to find the 3-dimensional coordinates of the target based on station point coordinates, instrument height, target height, and azimuth angles of the backsight station that are entered in advance. Perform procedures sequentially from "13. Entering Instrument Station Data" to "13.3 3-D Coordinate Measurement."



## 13.1 Entering Instrument Station Data

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

### ► PROCEDURE

1. First measure the target height and instrument height with a tape measure, etc.
2. Set the instrument station point  
Press **[STN]** in the second page of the Meas Mode screen.  
Set the Instrument station coordinates, Instrument height (Ins.h) and target height.  
 "20.3 Setting Instrument Station Data"

(Page1)

Stn	1023rec
NO:	66.100
E0:	346.010
Z0:	23.000
Pt:	AUTO1001
Ins.h:	0.000m
Cd:	123456789ABCDEF
[ REC ]	[ CODE ]

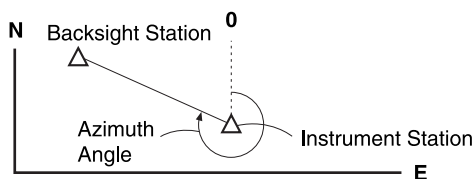
- Pressing **[READ]** displays the recorded coordinates data and allows you to set it as the instrument station coordinates.

☞ "20.3 PROCEDURE Reading in Registered Coordinate Data"

- Pressing **[CODE]** displays recorded codes, which you can select and input.
  - Pressing **[OPPM]** in the third page of Station Mode sets the atmospheric correction factor to 0 and sets the temperature and air pressure to their default values.
3. Check the input data and press **[REC]** to record the instrument station data.

## 13.2 Azimuth Angle Setting

Based on the instrument station coordinates and backsight station coordinates which have already been set, the azimuth angle of the backsight station is calculated.



### ►PROCEDURE

1. In the second page of the Meas Mode screen, press **[H.ANG]**.  
<Set H angle> is displayed.


### 13. COORDINATE MEASUREMENT

- Press **[BSNEZ]** and enter the backsight station coordinates.

Set H angle  
HAR: 0.0000

**[BSNEZ]** **[ OK ]**

- When the cursor is on the backsight coordinate, pressing **[READ]** reads out the previously registered coordinate data and sets it as the backsight station coordinates.

 "20.3 PROCEDURE Reading in Registered Coordinate Data."

Set H angle  
NB: 66.100 ]  
EB: 66.100 ]  
NO: [ 10.000  
EO: [ 10.000


**[ OK ]** **[READ]**

Coordinates of the back sight pt.  
Already set coordinates of the Instr. Stn.

- Check the input value and press **[OK]**.
- Sight the backsight station and press **[ANGLE]**. The azimuth angle of the backsight station is displayed.

Set H angle

Take BS

ZA	78°38'15"	
HAR	0°00'00"	⊥ <sup>+</sup>

**[ANGLE]**

Set H angle  
HAR: 30.5000

**[BSNEZ]** **[ OK ]**

- Press **[OK]** to set the azimuth angle. The main screen is displayed.

### 13.3 3-D Coordinate Measurement

The coordinate values of the target can be found by measuring the target based on the settings of the instrument station and backsight station.

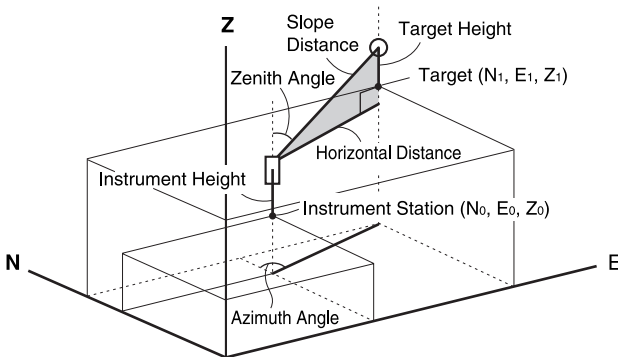
The coordinate values of the target are calculated using the following formulae.

$$N1 \text{ Coordinate} = N0 + S \times \sin Z \times \cos AZ$$


$$E1 \text{ Coordinate} = E0 + S \times \sin Z \times \sin AZ$$

$$Z1 \text{ Coordinate} = Z0 + S \times \cos Z + ih - fh$$

- $N0$  : Station point N coordinate     $S$  : Slope distance     $ih$  : Instrument height  
 $E0$  : Station point E coordinate     $Z$  : Zenith angle     $fh$  : Target height  
 $Z0$  : Station point Z coordinate     $Az$  : Azimuth angle



#### ► PROCEDURE

1. Sight the target at the target point.  
 "10. TARGET SIGHTING"

### 13. COORDINATE MEASUREMENT

---

2. In page 1 of Meas Mode, press **[SHVC]** three times to display the coordinate screen.

3. Press **[DIST]** in page 1 of the Meas. Mode screen to start measurement.  
Target coordinates, distance data (S), vertical angle (ZA) and Horizontal angle (HAR) are displayed.

Meas./Coord	
N	25.215
E	54.245
Z	8.689
S	10.325m
ZA	78°38'10"
HAR	124°24'30"
[ REC ] [ SHVC ] [ ANGLE ] [ DIST ]	

4. Press **[STOP]** to finish distance measurement.

Coord	
N	25.215
E	54.245
Z	8.689
S	10.325m
ZA	78°38'10"
HAR	124°24'30"
[ STOP ]	

5. Press **[REC]** to record the point name and target height.

REC/Coord	1023rec
N	66.100
E	346.010
Z	23.000
Pt:	AUTO1001
Tgt.h:	1.000m
Cd:	123456789ABCDEF
[ OK ] [ CODE ]	

6. Check the input value and press **[OK]** to record the measurement results and return to the main screen.

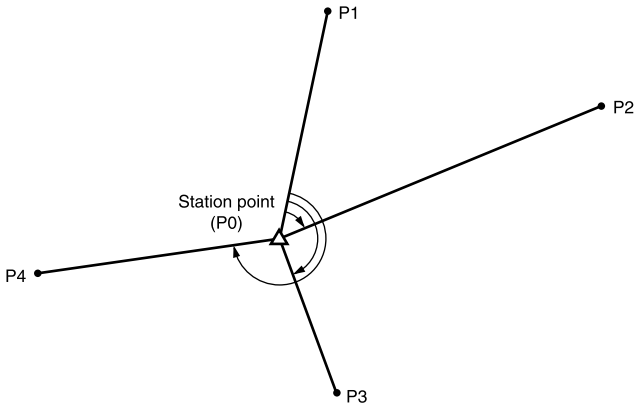


The sighting height of the target can be entered beforehand in Shift Mode. Select "Height."

# 14. RESECTION MEASUREMENT

Resection is used to determine the coordinates of an instrument station by performing multiple measurements of points whose coordinate values are known. Registered coordinate data can be recalled and set as known point data. Residual of each point can be checked, if necessary

Entry	Output
Coordinates of known point : $(N_i, E_i, Z_i)$	Station point coordinates : $(N_0, E_0, Z_0)$
Observed horizontal angle : $H_i$	
Observed vertical angle : $V_i$	
Observed distance : $D_i$	



- Between 2 and 10 known points can be measured by distance measurement, and between 3 and 10 known points by angle measurement.
- 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.

## 14. RESECTION MEASUREMENT

### ►PROCEDURE


1. Select "Resection" in the Program Mode.

```
Program
1.Meas.
2.S-O
3.Offset
4.Area
5.MLM
6.REM
7.Resection
```

2. Enter the coordinates and target height of the first known point. After setting the first point, press **[OK]** to move to the second point. When all required known points have been set, press **[MEAS]**.

```
Resection
Pt.1
N: 66.100
E: 346.010
Z: 10.000
Tgt.h: 1.500m
[ READ ] [ REC ] [ OK ]
```

- When **[READ]** is pressed, registered coordinates can be recalled and used.

 "20.3 PROCEDURE Reading in Registered Coordinate Data"

- When **[REC]** is pressed, the known point can be recorded to the current Work JOB.

```
Resection
Pt.5
N: 66.100
E: 256.000
Z: 15.000
Tgt.h: 1.500m
[ MEAS ] [ READ ] [ REC ] [ OK ]
```

3. Sight the first known point and press **[DIST]** to begin measurement. The measurement results are displayed on the screen.

- When **[ANGLE]** has been selected, the distance cannot be measured.

```
Resection
Pt.1
N 66.100
E 346.010
Z 10.000
Tgt.h: 1.500m
[ ANGLE ] [ DIST ]
```

```
Resection
Pt.1
S 12.345m
ZA 76°49'00"
HAR 123°34'10"
Tgt.h: 1.500m
[ YES ] [ NO ]
```



4. Press **[YES]** to use the measurement results of the first known point.
  - You can also input target height here.
  
5. Repeat procedures 3 to 4 in the same way from the second point. When the minimum quantity of observation data required for the calculation is present, **[CALC]** is displayed.
  
6. Press **[CALC]** or **[YES]** to automatically start calculations after observations of all known points are completed. Instrument station coordinate and standard deviation, which describes the measurement accuracy, are displayed. Press **[OK]** to go to step 10.

Resection Pt.4	
S	12.345m
ZA	76°49'00"
HAR	123°34'10"
Tgt.h:	1.500m
[ CALC ]	[ YES ] [ NO ]

Resection	
N0	55.905
E0	11.939
Z0	5.245
σN	1.2mm
σE	0.5mm
[ OK ]	[ ADD ] [ VIEW ]

("No solution" screen)

Resection	
No solution	
N0	68.905
E0	11.160
Z0	8.245
σN	5.2mm
σE	3.5mm
[ OK ]	[ ADD ] [ VIEW ]

If "No solution" is displayed, go to step 7.

- Press **[ADD]** when there is a known point that has not been measured or when a new known point is added.

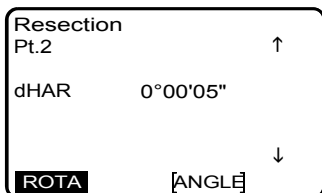
## 14. RESECTION MEASUREMENT

---

7. Press **[VIEW]** to check the result.  
Press **[▲]** / **[▼]** to check the contents of the previous and next points.


8. Press **[▲]** / **[▼]** to display a point with a problem. Align the cursor with that point and press **[DIST]** or **[ANGLE]** to measure the point again.

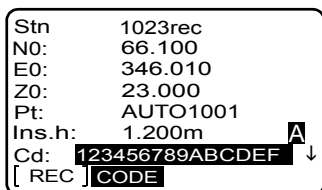
- If **[ROTA]** is pressed, SET rotates automatically to the direction of the previous measurement point.



9. After measurement, press **[CALC]** again. If there are no problems with the result, press **[OK]**.

10. Input the Instrument station data and press **[REC]** to record the results.

 Selecting instrument station data items: "20.3 Setting Instrument Station Data"

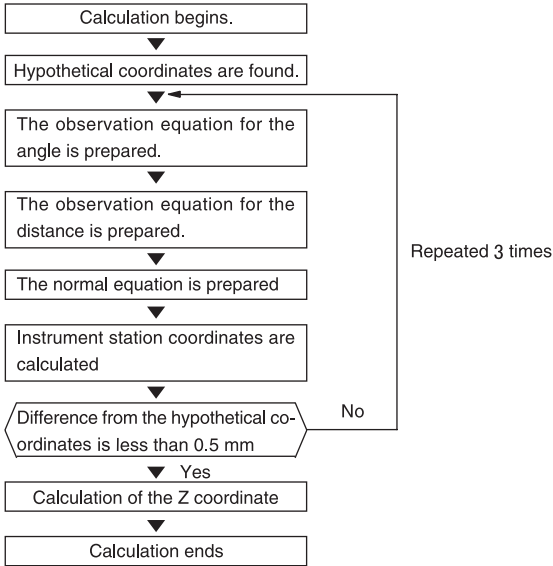


11. Press **[YES]** when you want to set the azimuth angle of the first known point as the backsight point. <Program> is restored.



**Resection calculation process**

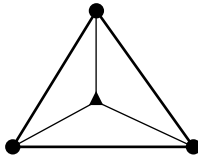
The NE coordinates are found using angle and distance observation equations, and the instrument station coordinates are found by the method of least squares. The Z coordinate is found by treating the average value as the instrument station coordinates.



**Precaution when performing resection**

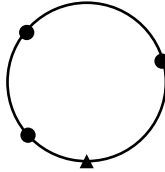
In some cases it is impossible to calculate the coordinates of an unknown point (instrument station) if the unknown point and three or more known points are arranged on the edge of a single circle.

- An arrangement such as that shown below is desirable.



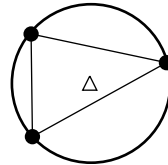
## 14. RESECTION MEASUREMENT

It is sometimes impossible to perform a correct calculation in a case such as the one below.

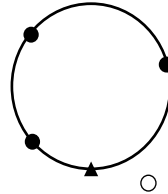


- When they are on the edge of a single circle, take one of the following measures.

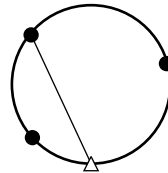
- (1) Move the instrument station as close as possible to the center of the triangle.



- (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.



### Caution

- 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.

# 15. SETTING-OUT MEASUREMENT

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.

The horizontal angle difference and distance difference are calculated and displayed using the following formulae.

Horizontal difference

Displayed value (angle) = Horizontal angle of setting-out data - measured horizontal angle

Displayed value (distance) = measured horizontal distance x tan (horizontal angle of setting out data - measured horizontal angle)

Slope distance difference

Displayed value (slope distance) \* = measured slope distance - slope distance setting-out data

\* Horizontal distance or height difference can be input in the above formula.

Coordinate difference

Displayed value (coordinates)\* measured N setting-out coordinates - N coordinates of setting-out data

\* E or Z coordinates can be input in the above formula

Height difference (REM setting out measurement)

Displayed value (height) = measured REM data - REM data of setting out data


- Setting out data can be input in various modes: slope distance, horizontal distance, height difference, coordinates and REM measurement.
- The distance value and direction of movement to the setting-out point are indicated on the screen by an arrow.

 "21.3 Allocating Key Functions

## 15.1 Turning ON the Guide Light

When the guide light is set to ON, the flashing speed of the light indicates the status of the Set and can be known when the user is located at a distance from the instrument. Also, the flashing colors relative to the target indicate the direction of the instrument and allow the user to reposition the target.

- Brightness of the guide light can be changed.

 "21.1 Configuration ● Instrument configurations"

## 15. SETTING-OUT MEASUREMENT

---

### CAUTION

- Persons located in the path of the LED beam must be at least 5 meters away from the guide light source.

### ● Guide light status and meaning

Status of SET

Light status	Meaning
Slow flashing	Waiting
Fast flashing	Searching Measuring (repeated measurement)
Green and red alternate flashing	Search error (error screen only) Distance measurement error (no signal, sighting error)

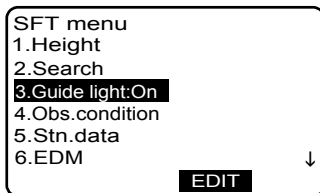
Indication for positioning target during setting-out measurement

Light status	Meaning
Increased flashing speed	(From position of poleman) Move target toward SET
Decreased flashing speed	(From position of poleman) Move target away from SET
Fast flashing	Target is at correct distance
Red	(From position of poleman) Move target left
Green	(From position of poleman) Move target right
Red and Green	Target is at correct horizontal position




### ► PROCEDURE Setting the guide light to ON.

---


1. Press and hold **{SFT}** to enter Shift Mode.
2. Align the cursor with "Guide light"
3. Set the Guide light to "On." **{◀▶}**  
(or **{←→}**) to switch On/Off.



- Press **{ESC}** to return to Meas Mode. The Guide light symbol is displayed in the screen.

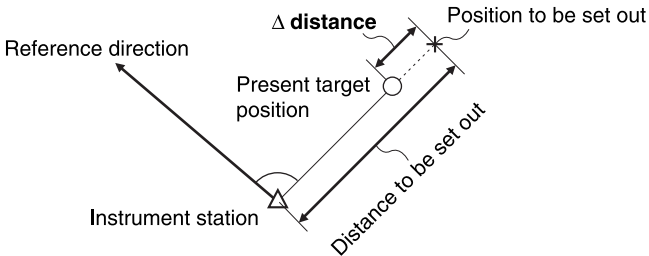
Meas./Sdist	PC -30	
	ppm 0	
S	10.325m	
ZA	78°38'15"	
HAR	124°24'35"	
		<b>P1</b>
<b>REC</b>	<b>SHVC</b>	<b>ANGLE [ DIST ]</b>

**Note**


- [Guide light]** can be displayed in Meas Mode.
-  Allocating the **[G. light]** softkey: "21.3 Allocating Key Functions."

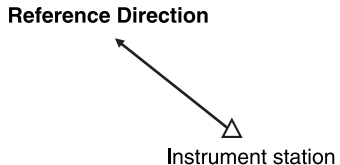
**15.2 Distance Setting-out Measurement**

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



**►PROCEDURE**

- Sight the reference point and press **[OSET]** twice or set the horizontal angle of the reference point and input the value.
  -  "11.1 Measuring the Horizontal Angle between Two Points (Horizontal Angle 0°)" / "11.2 Setting the Horizontal Angle to a Required Value (Horizontal Angle Hold)"



## 15. SETTING-OUT MEASUREMENT

- Press **[S-O]** in the Program Mode screen to display <S-O>. Then, select "Set out."

Program  
1.Meas.  
**2.S-O**  
3.Offset  
4.Area  
5.MLM  
6.REM  
7.Resection

S-O  
**1.Set out**  
2.Set out coord.  
3.Set out REM

- In <S-O config.>, enter the included angle between the reference point and the setting-out point and the distance from the instrument station to the position to be set out (slope distance, horizontal distance or height difference). Enter the value in the Distance Mode that conforms to your measurement requirements.

Angle to the setting-out pt.

S-O config.


SO HAR: 124°24'35" ———

Sdist: **10.234**m ———

**OK** **READ** **SHV**[ROTA]

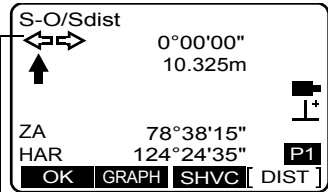
Distance to the setting-out pt.

- Each time **[SHV]** is pressed, the distance input mode changes to "Sdist" (slope distance), "Hdist" (horizontal distance) and "Vdist" (height difference).
- When **[READ]** is pressed, registered coordinates can be recalled and used. S (slope distance), H (horizontal distance) and V (height difference) are calculated using the coordinate value.

 20.3 "PROCEDURE Reading in Registered Coordinate Data"



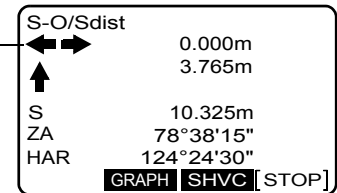
4. Enter values and press **[ROTA]** in the screen of step 3. The SET automatically turns toward the horizontal angle entered in step 3 and the angle to the setting out point reads 0°.



- Press **[OK]** to go to step 6 without automatically rotating the SET. Manually rotate the top of the instrument until the angle to the setting out point is 0°.

White arrows indicate angle to move

5. Position the target on the line of sight and press **[DIST]** to begin distance measurement. The distance and direction to move the target until the setting out point is located is displayed on the SET. The sighting point measurement results (currently installed position of the target) are displayed.



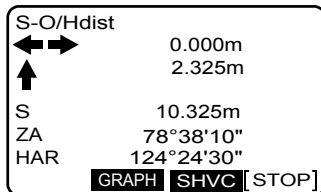
Black arrows indicate distance to move

**• Movement indicator**

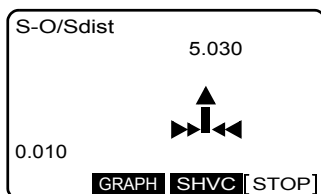
- ← : (Viewed from SET)  
Move target to the left
- : (Viewed from SET)  
Move target to the right
- ↔ : (Viewed from SET)  
Target position is correct
- ↕ : Target position is correct
- ↓ : (Viewed from SET)  
Move target closer
- ↑ : (Viewed from SET)  
Move target away
- ▲ : (Viewed from SET)  
Move target upward
- ▼ : Move target downward
- ▲▼ : Target position is correct

## 15. SETTING-OUT MEASUREMENT

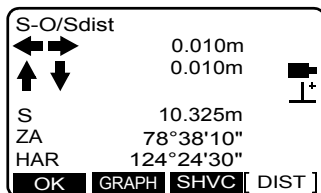
- Press **[SHVC]** to switch the distance mode: Sdist (slope distance), Hdist (horizontal distance), V distance (height difference).



- Press **[GRAPH]** to display only the direction and distance to the target.



- Move the target until the distance to the setting-out point reads 0m. When the target is moved within the allowed range, all distance and position arrows are displayed.



- Press **[OK]** to return to the <S-O config.> menu. Set the next setting-out point to continue setting-out measurement.

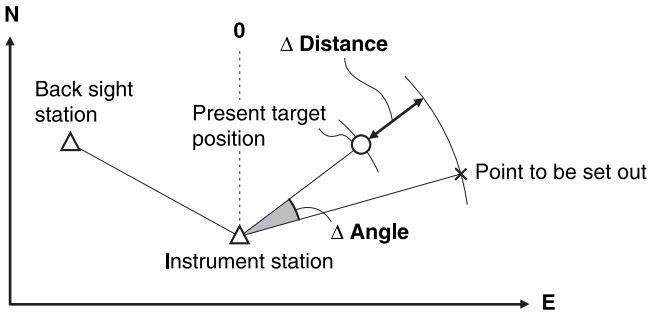
### Note

- The same procedure as that described above can be performed by selecting **[S-O]** in the Meas. Mode.

Allocating the **[S-O]** softkey: "21.3 Allocating Key Functions"

## 15.3 Coordinates Setting-out Measurement

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



- Previously recorded setting-out points can be placed in order. Up to 30 points can be recorded.
- Registered setting-out point data is saved until the power is turned OFF, so you can return to the setting out screen you were working on after you enter another mode.
- To continue setting-out measurements, press **[SKIP]** and then **[YES]**. If **[NO]** is pressed, the recorded setting-out data is canceled.

S-O regist

Continue?

YES
NO

- To find the Z coordinate, attach the target to a pole etc. with the same target height.


## 15. SETTING-OUT MEASUREMENT

### ►PROCEDURE

1. Press **[S-O]** in the Program Mode screen to display <S-O>. Then, select "Set out coord."


```
S-O/Sdist
1.Set out
2.Set out coord.
3.Set out REM
```

2. Enter the instrument station data in the <Stn> menu. Press **[REC]** to record the data.

 "13.1 Entering Instrument Station Data"

- Press **[SKIP]** to go to step 4 without recording the instrument station data.

```
Stn      1023rec
NO:      66.100
E0:      346.010
Z0:      23.000
Pt:      AUTO1001
Ins.h:   0.000m
Cd:      123456789ABCDEF
[ REC ] [ CODE ] [ SKIP ]
```

3. Set the azimuth angle of the backsight point.  
 "13.2 Azimuth Angle Setting," steps 3 to 6.

```
Set H angle
HAR:     30.5000
Tgt.h:   1.500m

BSNEZ [ OK ]
```

4. Record all the setting-out points (includes setting-out points you will measure from now).  
Press **[READ]** to display recorded angle data or press **[NEW]** to record new data.

S-O regist.			
01:AUTO1000			
02:AUTO1001			
03:			
04:			
05:			
06:			
			↓
			P1
OK	READ	NEW	[ROTA]



- Pressing **[DIST]** relists the recorded setting-out points, starting in order of the points at the shortest distance from the instrument station. If measurement has already begun, the order of the list is reorganized and starts with the points at the shortest distance from the last measured point. Press **[DIST]** again to reverse the sequence.
- Pressing **[H]** (horizontal angle right/follows counterclockwise setting) relists the recorded setting-out points in order starting from horizontal angle 0°. If measurement has already begun, the order of the list is reorganized and starts from the last measured point. Press **[H]** again to reverse the sequence.

S-O regist.			
01:AUTO1000			
02:AUTO1001			
03:			
04:			
05:			
06:			
			↓
			P2
DEL	AREA	H	DIST

- Pressing **[AREA]** allocates the range of the setting-out point using the read-in point name of the current JOB or control JOB.
  - Pressing **[DEL]** deletes the registered setting-out point that is selected.
5. Select the setting-out point and press **[ROTA]** in the screen of step 4. The SET automatically rotates until the angle of the setting-out point reads 0°.


## 15. SETTING-OUT MEASUREMENT

6. Position the target on the line of sight and press **[DIST]** to start distance measurement.  
The distance and direction to move the target until the setting out point is located is displayed on the SET.  
The sighting point measurement results (currently installed position of the target) are displayed.

S-O/Sdist	
	0.000m
	3.765m
S	10.325m
ZA	78°38'15"
HAR	124°24'30"
<b>2D-3D</b>	<b>GRAPH</b> <b>SHVC</b> [STOP]

- Press **[SHVC]** to switch items in the distance mode: Sdist (slope distance), Hdist (horizontal distance), V distance (height difference) or 2D or 3D (coordinates). When items are switched, the distance to the setting-out point in the same mode is displayed
- Pressing **[2D-3D]** changes the coordinates that are displayed: NE or NEZ

Move the target closer/further away and upward/downward to find the correct distance (0 is displayed) to the setting-out point

 Movement indicators: "15.2 Distance Setting-out Measurement," step 5

S-O/Coord2D	
SO-N	3.765m
SO-E	0.000m
S	10.325m
ZA	78°38'10"
HAR	124°24'30"
<b>2D-3D</b>	<b>GRAPH</b> <b>SHVC</b> [STOP]

S-O/Coord3D	
SO-N	-5.032m
SO-E	-2.325m
SO-Z	8.486m
S	10.325m
ZA	78°38'10"
HAR	124°24'30"
<b>2D-3D</b>	<b>GRAPH</b> <b>SHVC</b> [STOP]

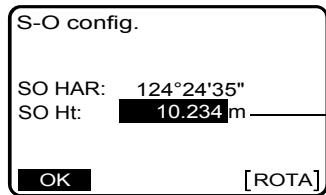
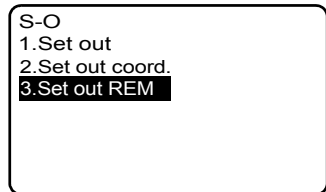
### 15.4 REM Setting-out Measurement

To find a point where a target cannot be directly installed, perform REM setting-out measurement.

 "12.5 REM Measurement"

## ►PROCEDURE

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).
2. Enter Shift Mode and select "Height." Then, enter the height.
3. Select "S-O" in Program mode. Then select "Set out REM".
4. Input height from the surveying point to the position to be set out in "SO ht".
  - Input height from the surveying point to the position to be set out in "SO dist".
  - If necessary, input the angle to the point to be set out.
5. Press **[ROTA]** in the screen of step 4. The SET automatically rotates until the horizontal angle of the setting-out point reads 0°.
6. Sight the target and press **[DIST]**. Measurement begins and the measurement results are displayed. Press **[STOP]** to stop measuring.

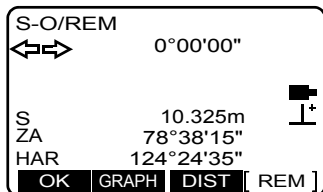


Height to be set out

## 15. SETTING-OUT MEASUREMENT

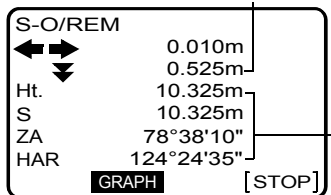
7. Press **[REM]** to begin REM setting-out measurement.

The distance and direction to move the target until the setting out point is located is indicated by arrows on the SET screen. The sighting point measurement results (currently installed position of the target) are displayed.



Height difference to the setting out point

Find the setting-out point by moving the telescope until the distance to the setting-out point reads 0m.



Measurement result of the sighting pt.

### ● Movement indicator

▲ : Move the telescope near the zenith

▼ : Move the telescope near the nadir

☞ For details of other movement indicators: "15.2 Distance Setting-out Measurement", step 5

8. Press **[OK]** to return to the <S-O config.> menu.



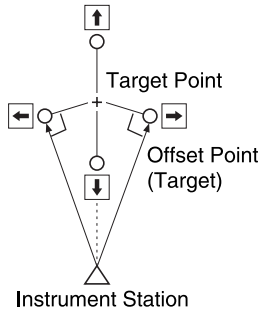
# 16. OFFSET MEASUREMENT

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.

## 16.1 Single-distance Offset Measurement

Finding it by entering the horizontal distance from the target point to the offset point.



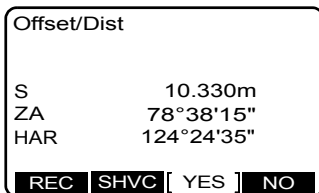
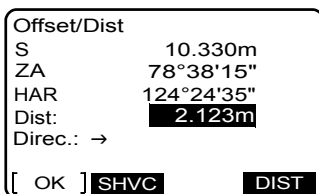
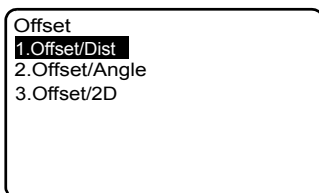
- When the offset point is positioned to the left or right of the target point, make sure the angle formed by lines connecting the offset point to the target point and to the instrument station is almost  $90^\circ$ .
- When the offset point is positioned in front of or behind the target point, install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

### ►PROCEDURE

1. Set the offset point close to the target point and measure the distance between them, then set up a prism on the offset point.

## 16. OFFSET MEASUREMENT

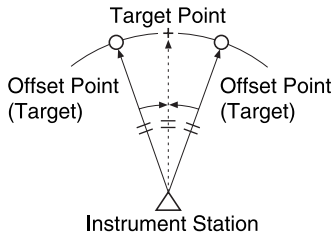
- Sight the offset point and press **[DIST]** in the first page of the Meas Mode screen to begin measurement.  
The measurement results are displayed. Press **[STOP]** to stop the measurement.
- Press **[OFFSET]** in page three of Meas Mode and select "Offset/ Dist".
- Enter the instrument station data. Input the following items.
  - Horizontal distance from the target point to the offset point.
  - Direction of the offset point
- Press **[OK]** in the screen of step 4 to calculate and display the distance and angle of the target point.
  - Press **[DIST]** to re-observe the offset point.
- Press **[YES]** in the screen of step 5 to return to <Offset>.
  - Press **[NO]** to return to setting the distance and direction.
  - To record the calculation result, press **[REC]**.



- Direction of offset point ←: On the left of the target point / →: On the right of the target point / ↓: Closer than the target point / ↑: Beyond the target point

## 16.2 Angle Offset Measurement

Sighting the direction of the target point to find it from the included angle. Install offset points for the target point on the right and left sides of and as close as possible to the target point and measure the distance to the offset points and the horizontal angle of the target point.



### ►PROCEDURE

1. Set the offset points close to the target point (making sure the distance from the instrument station to the target point and the height of the offset points and the target point are the same), then use the offset points as the target.
2. Sight the offset point and press **[DIST]** in the first page of the Meas Mode screen to begin measurement. The measurement results are displayed.
3. Press **[OFFSET]** in page three of Meas Mode and select <Offset/angle>.

Offset

1.Offset/Dist

2.Offset/Angle

3.Offset/2D

## 16. OFFSET MEASUREMENT

4. Sight the direction of the target point and press **[H]**.  
The horizontal angle is measured.

Offset/Angle		
S	10.254m	■
ZA	78°38'10"	⊥+
HAR	124°24'30"	
OK SHVC DIST [ H ]		

5. Confirm the measured value and find the target point value  
Press **[OK]** in the screen of step 4 to confirm the measured value and display the target point value.

Offset/Angle		
S	10.330m	■
ZA	78°38'10"	⊥+
HAR	124°24'30"	
REC SHVC YES NO		

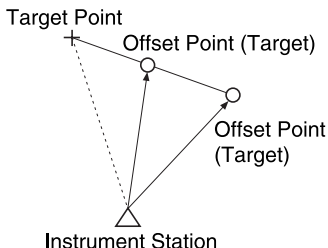
6. After finishing measurement, press **[YES]** to return to <Offset>.

### 16.3 Two-distance Offset Measurement

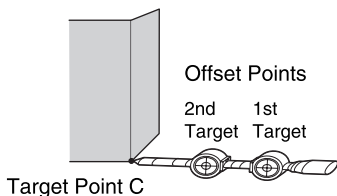
By measuring the distances between the target point and the two offset points. Install two offset points (1st target and 2nd target) on a straight line from the target point. Observe the 1st target and 2nd target, then enter the distance between the 2nd target and the target point to find the target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

- The target and PC prism factor can be set in 2-point offset menu.
- Softkeys can be customized to meet the requirements of individual users in the offset measurement.
- It is possible to make this measurement easily using the optional equipment: the 2-point target (2RT500-K).

📖 "25.3 Target System"



### How to use 2-point target (2RT500-K)



- 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.
- Set the prism factor to "0mm"

### ►PROCEDURE

1. Install two offset points (1st target, 2nd target) on a straight line from the target point and use the offset points as the target.

2. Press **[OFFSET]** in page three of Meas Mode and select "Offset/2D".

```
Offset
1.Offset/Dist
2.Offset/Angle
3.Offset/2D
```

3. Enter the distance from offset point B to the target point in "B-C". Then, set the "Reflector" and "PC" (prism constant). Press **[OK]**. (This screen is only displayed once when you enter the 2-distance offset measurement menu.)



```
Offset/2D
B-C: 10.000m
Reflector: Prism
PC : -30mm
```

```
[ OK ]
```



## 16. OFFSET MEASUREMENT

4. Sight target A and press **[DIST]** to start measurement. Measurement results of offset point A are displayed. Press **[YES]**.

- Press **[CNFG]** to change the settings entered in step 3.

Offset/2D(1)		
S	10.325m	
ZA	78°38'10"	
HAR	124°24'30"	
<b>CNFG</b>   <b>SHVC</b>   <b>[ DIST ]</b>		

5. Sight target B and press **[DIST]** to start measurement. Measurement results of offset point B are displayed.

Offset/2D(2)		
S	10.325m	
ZA	78°38'10"	
HAR	124°24'30"	
<b>CNFG</b>   <b>SHVC</b>   <b>[ DIST ]</b>		

6. Confirm the measurement results and press **[YES]** to display the target point value.

Offset/2D		
S	15.254m	
ZA	92°23'55"	
HAR	154°24'35"	
<b>REC</b>   <b>SHVC</b>   <b>[ YES ]</b>   <b>NO</b>		

7. After finishing measurement, press **[YES]** to return to <Offset>.

### Note

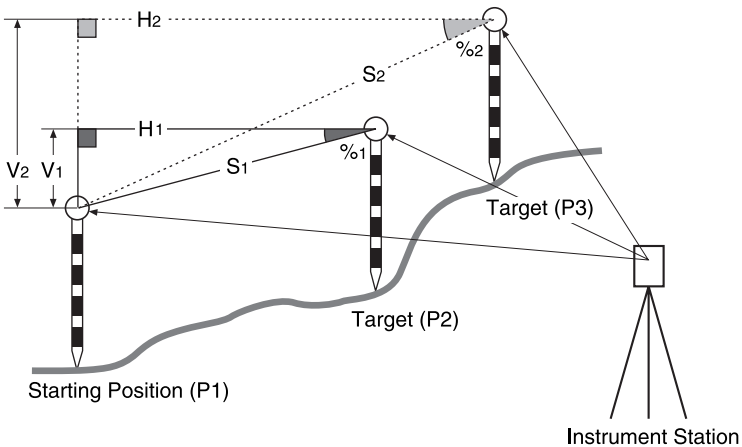
The following items and input ranges can be selected (\*Factory settings)

- Target: prism/sheet\*
- PC (prism constant): -99 to 99 (Prism:-30\*/sheet:0\*)

# 17. 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 point) without moving the instrument.

- It is possible to change the last measured point to the next starting position.
- Measurement result can be displayed as the gradient between two points.



- Softkeys can be customized to meet the requirements of individual users in missing line measurement screen.

## 17.1 Measuring the Distance between 2 or more Points

### ►PROCEDURE

1. Sight the target of the starting position, and press **[DIST]** in the first page of Meas Mode to begin measurement.  
The measured values are displayed. Press **[STOP]** to stop measurement.


## 17. MISSING LINE MEASUREMENT

- Sight the target point and select "MLM" in the Program Mode to begin observation.  
S : Slope distance of the starting position and 2nd target.  
H : Horizontal distance of the starting position and 2nd position.  
V : Height difference of the starting position and 2nd target.

```
Program
1.Meas.
2.S-O
3.Offset
4.Area
5.MLM
6.REM
7.Resection
```

```
MLM
S      -1234.123m
H      123.123m
V      12.123m
S      15.120m
ZA     78°38'15"
HAR    124°24'35"
MOVE | S/% | DIST [ MLM ]
```

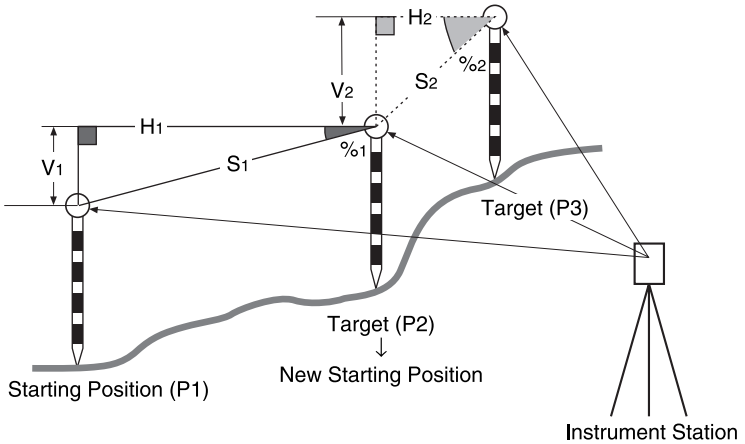
- Sight the next target and press **[MLM]** to begin observation. Continue measuring points using starting position as backsight.
  - When **[S/%]** is pressed, the distance between two points (S) is displayed as the gradient between two points.
  - Press **[DIST]** to re-observe the starting position. Sight the starting position and press **[DIST]**.
  - When **[MOVE]** is pressed, the last target measured becomes the new starting position to perform missing line measurement of the next target.
- Press **{ESC}** to end missing line measurement.

 "17.2 Changing the Starting Point"



## 17.2 Changing the Starting Point

It is possible to change the last measured point to the next starting position.



### ►PROCEDURE


1. Observe the starting position and target following steps 1 to 3 in "17.1 Measuring the Distance between 2 or more Points."

## 17. MISSING LINE MEASUREMENT

---

2. After measuring the targets, press **[MOVE]**.  
Press **[YES]**.

- Press **[NO]** to cancel measurement.

MLM		
S	-1234.123m	
H	123.123m	
V	12.123m	
S	15.120m	I <sup>+</sup>
ZA	78°38'15"	
HAR	124°24'35"	
<b>MOVE</b>	<b>S/%</b>	<b>DIST [ MLM ]</b>

MLM		
Move?		
S	15.120m	
ZA	78°38'15"	
HAR	124°24'35"	
<b>YES</b>		<b>NO</b>

3. The last target measured is changed to the new starting position.  
Perform missing line measurement following steps 2 to 3 in "17.1 Measuring the Distance between 2 or more Points."

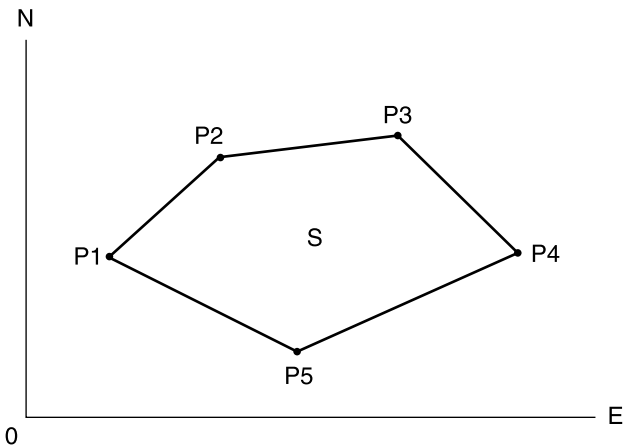
# 18. SURFACE AREA CALCULATION

You can calculate the area of land enclosed by three or more known points on a line by inputting the coordinates of the points.

Input

Output

Coordinates : P1 (N1, E1) Surface area : S  
              P2 (N2, E2)  
              P3 (N3, E3)  
              :  
              :



- Number of specified coordinate points: 3 or more, 30 or less
- Surface area is calculated by observing in order the points on a line enclosing an area or by reading in the previously registered coordinates and using it as known point data.

### Caution

- Be sure to observe (or recall) points on an enclosed area in a clockwise or anticlockwise direction. For example, the area specified by entering (or recalling) point numbers 1, 2, 3, 4, 5 or 5, 4, 3, 2, 1 implies the same shape. However, if points are not entered in numerical order, the surface area will not be calculated correctly.

## 18. SURFACE AREA CALCULATION

### ►PROCEDURE Surface area calculation by measuring points


1. Select "Area" in the Program Mode. The area configuration list is displayed.

```
Program
1.Meas.
2.S-O
3.Offset
4.Area
5.MLM
6.REM
7.Resection
```

2. Sight the first point on the line enclosing the area, and press **[DIST]**. Measurement begins and the measured values are displayed. Press **[STOP]** to stop measuring.

```
Area
01:
02:
03:
04:
05:
06:
[ READ ] [ DIST ]
```

- When **[READ]** is pressed, registered coordinates can be recalled and used in subsequent measurements.

 "PROCEDURE Surface area calculation by reading in the points' coordinates"

3. Enter the point name and target height and press **[OK]** to record the measurement. The value of point 1 is set in "01".

```
REC/Coord.      1023rec
N                66.100
E                346.010
Z                23.000
Pt:             AUTO1001
Tgt.h:          1.500m  A
Cd              123456789ABCDEF
[ OK ] [ CODE ]
```

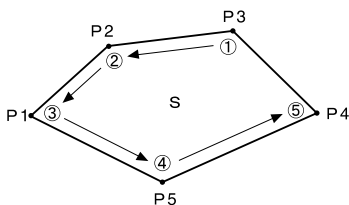
```
Area
01:AUTO1001
02:
03:
04:
05:
06:
[ DIST ]
```

## 18. SURFACE AREA CALCULATION

4. Repeat steps 3 to 4 until all points have been measured. Points on an enclosed area are observed in a clockwise or anticlockwise direction.

For example, the area specified by entering point numbers 1, 2, 3, 4, 5 or 5, 4, 3, 2, 1 implies the same shape.

After all known points necessary to calculate the surface area have been observed, **[CALC]** is displayed.



5. Press **[CALC]** to display the calculated area.

Area	
01:AUTO1001	
02:AUTO1002	
03:AUTO1003	
<b>04:</b>	
05:	
06:	
<b>[CALC]</b>	[ DIST ] ↓

Area	
Points	3
Area	468.064m <sup>2</sup>
	0.0468ha
[ OK ]	

6. Press **[OK]** to quit area calculation and return to the <Program> screen. (Information for points set in procedures 2 to 4 is deleted.)

### ► PROCEDURE Surface area calculation by reading in the points' coordinates

1. Select "Area" in the Program Mode. The area configuration list is displayed.
2. Press **[READ]** to display the list of coordinate data.

## 18. SURFACE AREA CALCULATION

---

3. Select the first point in the list and press **[OK]**.  
The coordinates of the first point are set as "01".

Area	
01:AUTO1001	
<b>02:</b>	
03:	
04:	
05:	
06:	
[READ]	↓

4. Read in coordinates of point 2 and onward  
Repeat steps 2 to 3 until all points have been read in.  
Points on an enclosed area are read in a clockwise or anticlockwise direction.  
After all known points necessary to calculate the surface area have been observed, **[CALC]** is displayed.

5. Press **[CALC]** to display the calculated area.

Area	
01:AUTO1001	
02:AUTO1002	
03:AUTO1003	
<b>04:</b>	
05:	
06:	
<b>[CALC]</b> [READ]	↓

Area	
Points	3
Area	468.064m <sup>2</sup>
	0.0468ha
[ OK ]	

6. Press **[OK]** to quit area calculation and return to the <Program> screen.  
(Information for points set in procedures 2 to 4 is deleted.)

# 19. MANAGING A JOB

Data is managed by JOB unit.

- Instrument station data, observation data (distance, angle, coordinates), known point data and notes can be recorded in a JOB.
- A total of 20,000 data items can be stored inside the instrument.

## 19.1 JOB selection

Select Control JOB and Work JOB before performing measurement.

- Instrument station data, observation data and known point data are recorded in the Work JOB.
- Data in the Control JOB can be read into the Work JOB.
- A total of 24 JOBS have been prepared, and JOB01 was selected as the Work JOB and Control JOB 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.

### ►PROCEDURE Selecting a Work JOB and Control JOB

1. Select "JOB" in the Memory Mode.

Memory  
1.JOB  
2.Data

2. Select "JOB selection".

JOB  
1.JOB selection  
2.Comms output  
3.Comms input  
4.Comms setup  
5.Job deletion

## 19. MANAGING A JOB

---

- Align the cursor with the desired Work JOB and press **[WORK]**.  
"\*\*\*" appears to the left of the selected JOB.
- The numbers on the right represent the number of data items in each JOB.
- Align the cursor with the desired Control JOB and press **[CTRL]**.  
">" appears to the left of the Control JOB.
- If the same JOB is selected as the Work JOB and Control JOB, only "\*\*\*" is displayed.
- Press **[OK]** to finish JOB selection and return to the <JOB> management screen.

JOB	7100rec		
<b>123456789012</b>	100		
*JOB02	20		
JOB03	0		
>JOB04	345		
JOB05	345		
JOB06	50 ↓		
<b>OK</b>	<b>WORK</b>	<b>CTRL</b>	<b>EDIT</b>

Work JOB

Control JOB

### ► PROCEDURE Enter a JOB name

---

- Select "JOB" in the Memory mode
- Select "JOB selection".
- Align the cursor with the JOB to be changed and press **[EDIT]**.

JOB	7100rec		
<b>123456789012</b>	100		
*JOB02	20		
JOB03	0		
>JOB04	345		
JOB05	345		
JOB06	50 ↓		
<b>OK</b>	<b>WORK</b>	<b>CTRL</b>	<b>EDIT</b>



4. Enter the new JOB name and press **[OK]**. The JOB name list is restored.

JOB  
JOB: **PROJECT**

[ OK ] **CODE** **A**

**Note**

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

## 19.2 Outputting JOB data to the Host Computer

It is possible to output the data within a JOB to the host computer in JOB units.

- Make sure communication settings are completed correctly. RS232C can be set in the JOB menu.



Instrument settings: "21.1 Configuration ● Communication Setup".

Types of connecting cable: "25.2 Optional Accessories", details of Communications format: Command Explanations manual.

### ►PROCEDURE

1. Use a cable to connect the SET and external equipment.
2. Enter the "JOB" management screen  
Select "JOB" in the Memory Mode.
3. Select "Comms output".

JOB  
1.JOB selection  
**2.Comms output**  
3.Comms input  
4.Comms setup  
5.Job deletion

## 19. MANAGING A JOB

4. Select the correct output format.

```
Comms output
1.Dump Data
2.SDR33
```

5. Press **{←}** to select the JOB to be output. "OUTPUT" appears on the right of the JOB selected. Multiple JOBS can be selected.

```
Comms output
JOB01      OUTPUT
*JOB02      OUTPUT
JOB03              0
*JOB04              345
*JOB05              45
JOB06              50 ↓
[ OK ]
```

6. Select all the JOBS you wish to output and press **[OK]** to begin JOB output. When outputting is completed, the <JOB> management screen is restored.

- Press **{ESC}** to cancel JOB output.

```
Comms output

Format.SDR33
JOB.JOB01

Sending 12
```



The following items can be selected.


- Output format: dump data / SDR33

### 19.3 Inputting Known Point Data

It is possible to input coordinate data of known points from a host computer or auxiliary equipment to the SET and store it as a Work JOB.

Recorded coordinates can be read in as an instrument station point, backsight point, known point, and setting-out point during point setting.

- Key input method is required to register known points.

 "20.2 Using the Key Entry Method to register Known Point Coordinate Data"

- RS232C can be set in the JOB management menu.
- ☞ Instrument settings: "21.1 Configuration ● Communication setup".  
Types of connecting cable: "25.2 Optional Accessories", details of Communications format: Command Explanations manual.

### ► PROCEDURE Entering known point coordinate data from an external instrument

1. Connect SET and external equipmet.
2. Select "JOB" in the Memory Mode.
3. Select "Comms input".  
Known point coordinate data starts to be entered from an external instrument.

- Press **{ESC}** to cancel data input.

```
JOB
1.JOB selection
2.Comms output
3.Comms input
4.Comms setup
5.Job deletion
```

```
Format.SDR33

Receiving 12
```

4. When data input is completed, the message "Complete" is displayed. Press any key to return to the JOB management screen.

### 19.4 Deleting a designated JOB

A designated JOB can be deleted. After the data is deleted, the JOB name changes to the JOB name allocated when the SET was shipped.

#### ►PROCEDURE

1. Enter the "JOB" management screen  
Select "JOB" in the Memory Mode.
2. Select "JOB deletion".

```
JOB
1.JOB selection
2.Comms output
3.Comms input
4.Comms setup
5.Job deletion
```

3. In the JOB list align the cursor with the JOB to be deleted and press **[DEL]**.

```
JOB deletion      7100rec
123456789012      100
*JOB02              20
JOB03                0
*JOB04              345
*JOB05              345
JOB06                50 ↓
DEL
```

4. Press **[YES]**. The selected JOB is deleted. You can continue to delete other JOBS in this screen.

```
JOB deletion

JOB. JOB2
deletion
Confirm?

YES                NO
```

## 20. MANAGING DATA IN A JOB

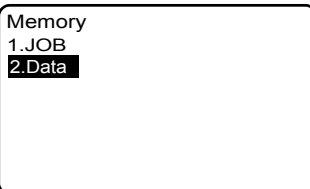
### 20.1 Displaying data in a JOB

Instrument station data, observation data, (distance, angle, coordinates), known point data and notes are displayed in the Work JOB and Control JOB.

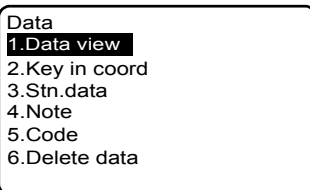
- Data is stored in ordered records in the JOB.
- Observation data is displayed in each instrument station point.
- Data in a JOB is displayed in the following sequence (1) Instrument station data(2) Observation data which was measured at the designated instrument station→ (3) Details of observation data.
- It is possible to search for data within the JOB by point name or keyword.

#### ►PROCEDURE

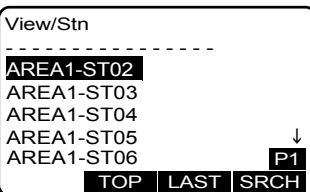
1. Select "Data" in the Memory Mode.



2. Select "Data view".



3. In the list of instrument station names, align the cursor with the data to be displayed and press {←}.  
↓



- If the first data in the JOB is not instrument station data, "----" is displayed. Select "----" to display all data entered before the position of the first instrument station data.

## 20. MANAGING DATA IN A JOB

- Press **[TOP]** to display first data.
- Press **[Last]** to display last data.
- ☞ How to search: "20.3  
PROCEDURE Reading in  
Registered Coordinate Data"

- Press **[COORD]** in the second page to display coordinate data only.
- Press **[CTRL]** in the second page to display a list of point names in the Control JOB. Press **[WORK]** to restore and display the Work JOB data.
- Press **[JOB]** in the second page to display JOB selection. You can change the selection of Control Job and Work Job.

View/Stn	
AREA1-ST01	
<b>AREA1-ST02</b>	
AREA1-ST03	
AREA1-ST04	
AREA1-ST05	
AREA1-ST06	
	↓
<b>COORD</b>	<b>CTRL</b> <b>P2</b> <b>JOB</b>

4. Select data from the list of data measured with the instrument station data selected in step 3 and press **{←}**.

Details of the selected data are displayed. This screen contains distance measurement data.

View/AREA1-ST02	
Stn	AREA1-ST02
Note	NOTE
Angle	P127
<b>Dist</b>	<b>P128</b>
Coord	P129
Known	P130
	↓
<b>TOP</b>	<b>LAST</b> <b>P1</b> <b>SRCH</b>

- Press **[EDIT]** to edit a part of the displayed data.

View/Dist	
S	10.325m
ZA	78°38'10"
HAR	124°24'30"
Pt	AUTO1000
Tgt.h	0.000m
Cd	123456789ABCDEF
	↓
	<b>EDIT</b>


## 20.2

## Using the Key Entry Method to register Known Point Coordinate Data

It is possible to use the key entry method to enter known point coordinate data and register it in the Work JOB.

The coordinate data that has been registered can be output during setting for use as instrument station, backsight station, known point and setting-out point coordinate data.

- There are two registration methods: key entry and entry from an external instrument.

 "19.3 Inputting Known Point Data".

### ►PROCEDURE

1. Select "Data" in the Memory mode.
2. Select "Key in coord".
3. Enter known point coordinates and the point name.
4. Press **[REC]** to record the known point data. You can record other known points as required.
  - Press **{ESC}** to return to the <Data> screen.

```
Data
1.Data view
2.Key in coord
3.Stn.data
4.Note
5.Code
6.Delete data
```

```
Known          1022rec
N:             66.100
E:             346.010
Z:             23.000
Pt:AUTO1001
Cd:ABC
[ REC ]
```

### 20.3 Setting Instrument Station Data

It is possible to use the key entry method to input instrument station data and register it in a Work JOB.

**Caution**

Date and time are not automatically renewed on the SET4110M. They must be input before measurement is started.

#### ► PROCEDURE Entering settings for instrument station points

---

1. Enter the Data management screen  
Select "Data" in the Memory Mode.
2. Select "Stn. data".

Data  
1.Data view  
2.Key in coord  
**3.Stn.data**  
4.Note  
5.Code  
6.Delete data



3. Set the following items.

- (1) Instrument station coordinates
- (2) Point name (Pt)
- (3) Instrument height (Ins.h)
- (4) Code (Cd)
- (5) Operator
- (6) Weather (Weath)
- (7) Wind
- (8) Temperature (TEMP)
- (9) Air pressure (Press)
- (10) Atmospheric correction factor (PPM)

- Pressing **[READ]** in the first page displays the recorded station data and allows you to set it as the instrument station coordinates.
- ☞ "PROCEDURE Reading in Registered Coordinate Data"
- Pressing **[CODE]** displays recorded codes, which you can select and input.
- Pressing **[0ppm]** in the third page sets the atmospheric correction factor to 0 and sets the temperature and air pressure to their default values.

Stn	1023rec
NO:	66.100
EO:	346.010
ZO:	23.000
Pt:	AUTO1001
Ins.h:	0.000m
Cd:	123456789ABCDE ↓
[ REC ]	<b>READ</b>

Stn	1023rec
Operator:	↑
	12345678901234567890
Weath :	Fine
Wind :	Calm
	ⓐ ↓
[ REC ]	<b>CODE</b>

Stn	1023rec
Temp :	12 °C ↑
Press :	1000hPa
ppm :	1
[ REC ]	<b>0ppm</b>

4. Press **[REC]** to record the input data. The <Data> screen is restored.



Maximum number of characters per field and options:

- Point name (Pt): 16
- Instrument height: -9999.999 to 9999.999 m
- Code (Cd): 16
- Operator: 20
- Weather selection: fine\*, cloudy, light rain, rain, snow
- Wind selection: calm\*, gentle, light, strong, very strong

## 20. MANAGING DATA IN A JOB

- Temperature range: -30 to 60 (°C)
- Air pressure range: 500 to 1400 (hPa), 375 to 1050 (mmHg)
- Atmospheric correction factor range (ppm): -499 to 499
- Humidity: 0 to 100% (Humidity is only displayed when "&Humid" is selected in the "PPM mode" field of the "Obs. Condition" menu.

 "21.1 Configuration • Observation Conditions"

- Date: Example: August 1, 2002 → 08012002
  - Time: Example: 2:25:17 p.m. → 142517
- (\*: Factory setting)

### ►PROCEDURE Reading in Registered Coordinate Data

Coordinate data in either the current Work JOB (**[WORK]**) or Control JOB (**[CTRL]**) can be read in and used as the station data.

1. Press **[READ]** when setting instrument station. The list of registered coordinates in the Work JOB is displayed. Find the coordinates you will read in. Align the cursor with the point name and press **{←}**.

Go to step 3.

To find a point name, perform step 2.

- Press **[TOP]** to move to the first point number.
  - Press **[LAST]** to move to the last point number.
  - Press **[CTRL]** in second page to view a list of coordinate data for control JOBS
- 
- Press **[JOB]** to display the JOB selection screen. The status of the current Work JOB and Control JOB can be switched.

Stn	1023rec
NO:	66.100
E0:	346.010
Z0:	23.000
Pt:	AUTO1001
Ins.h:	0.000m
Cd:	123456789ABCDE ↓
[ REC ]	<b>READ</b>

View/Coord.	
Stn	AREA1-ST01
Coord	AREA1-ST02
<b>Known</b>	<b>AREA1-ST03</b>
Known	AREA1-ST04
Known	AREA1-ST05 ↓
Coord	AREA1-ST06 <b>P1</b>
<b>TOP</b>	<b>LAST</b> <b>SRCH</b>

2. Press **[SRCH]** to display "View" menu. Set the following items
- (1) Point name or keyword
  - (2) Search conditions ("Exact" or "Partial" point name)
  - (3) Search direction
- Press **[OK]** to search for the point name and display the point coordinates.

View  
 Pt : P247  
 Matching: Exact  
 Direction: ↓

**A**

[ OK ] **CODE**

View/Known

N	5.000
E	10.000
Z	5.000
Pt	AUTO1000
Cd	123456789ABCDEF

↓

[ OK ] **EDIT**

3. Press **[OK]**. Returns to the instrument station point setting.
- Press **[EDIT]** to edit part of the coordinates read in.



**Searching for the point name**

Data is stored in the JOB in the order that the data was stored. When searching, if there is more than one point with the same name, the closest searched point to the currently selected point is found. See note below for details of the search conditions and search direction.



Setting items for searching (\*Setting when power is turned ON)

- Matching: "Exact" match\* / Partial match
- Direction: ↓ (Searches down from the currently selected point name)\* / ↑ (Searches up from the currently selected point name)

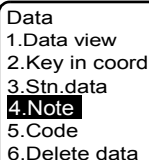
### 20.4 Recording Notes

This procedure prepares notes data and records it in the JOB which is selected.

#### ►PROCEDURE

---

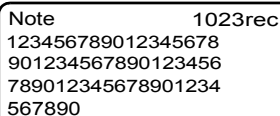
1. Select "Data" in the Memory Mode.
2. Select "Note". A list of instrument station point names is displayed.



Data  
1.Data view  
2.Key in coord  
3.Stn.data  
**4.Note**  
5.Code  
6.Delete data

3. Enter the note data.
  - Press **[CODE]** to go to the code entry screen.

 "20.5 Registering Codes"



Note 1023rec  
123456789012345678  
901234567890123456  
789012345678901234  
567890

4. After inputting the note data, press **[REC]**. <Data> screen is restored.

[ REC ] **CODE** 

#### Note

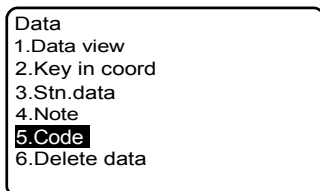
- Maximum note length: 60 characters (alphanumeric)

## 20.5 Registering Codes

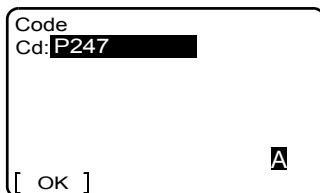
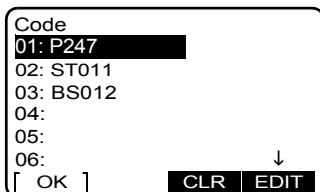
It is possible to save codes in memory. You can also read in codes registered in memory when recording instrument station data or observation data.

### ► PROCEDURE

1. Select "Data" in the Memory Mode.
2. Select "Code".



3. Press **[EDIT]** and enter a code.
  - Press **[CLR]** to delete all the codes.



4. Press **[OK]** to store the code.  
 <Data> screen is restored.



- Maximum code length: 16 characters (alphanumeric)
- Maximum number of codes: 40

### 20.6 Deleting data in a JOB


---

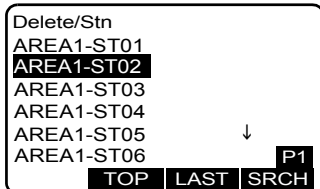
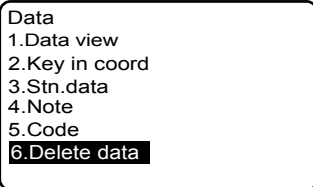
It is possible to delete individual data items in a JOB.

- Data deletion is performed in the following sequence: (1) Instrument station data (2) Observation data which was measured at the designated instrument station (3) Point name of point selected to be deleted.

#### ►PROCEDURE

---

1. Select "Data" in the Memory Mode.
2. Select "Delete data".
3. In the list of instrument station names, align the cursor with the data you wish to display and press {←}.  




4. Select data from the list of data measured with the instrument station data selected in Step 3 and press {←} to display the details of the data selected in the list.

- Data can be deleted without checking the details of the data by pressing [DEL] here.

Delete/AREA1-ST02			
Stn	AREA1-ST02		
Note	NOTE		
Angle	P127		
Dist	P128		
Coord	P129		↓
Known	P130		P1
DEL	TOP	LAST	SRCH

Then press [DEL].

5. Press [YES] to delete the selected data.

Delete/Dist	
S	10.325m
ZA	78°38'15"
HAR	124°24'35"
Pt	P128
Tgt.h	0.000m
Cd	123456789ABCDEF ↓
DEL	EDIT



6. Press {ESC} twice to restore the <Data> screen.

Delete	
Pt	P128
deletion	
Confirm?	
YES	NO

# 21. CHANGING THE SETTINGS -CONFIGURATION-

This section explains the contents of parameter settings, and how to change settings in Configuration Mode.

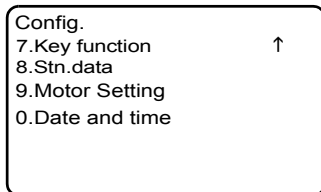
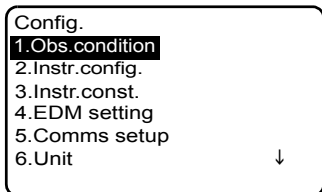
The following chapters provide details of items in the Configuration Mode.

- Instrument station settings  "20.3 Setting Instrument Station Data"
- Instrument constant  "24.3 Tilt Sensor"

## 21.1 Configuration

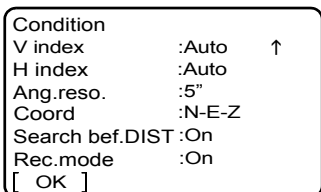
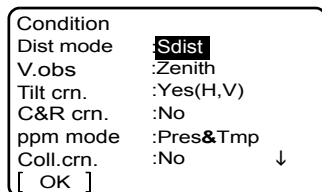
This section explains the settings in the Configuration Mode.

Each item can be changed to meet your measurement requirements.



- "": Factory setting

### • Observation conditions



### Items set and options

- Distance mode : Sdist (slope distance) \* / Hdist (horizontal distance) / Vdist (height difference) / coord (coordinate)
- V.obs (vertical angle display method) : Zenith\* / Vertical (vertical 0°) \* / Vert +/-90
- Tilt crn (tilt correction) : Yes (H,V) \* / Yes (V) / No
- C&R crn. : No\*/K=0.142/K=0.20
- ppm mode : Pres/Tmp\*/&Humid
- Coll.crn. (collimation correction) : Yes\*/No
- V index : Auto\*/ Manual



## 21. CHANGING THE SETTINGS -CONFIGURATION-

H index	: Auto*/ Manual (horizontal angle is 0° at power on)
Ang. reso. (Angle resolution)	: 1"/ 5"
Coord.	: N-E-Z*/ E-N-Z
Search bef. DIST	: On*/Off (can also be set in "● EDM Settings", "● Motor Settings")
Rec. mode	: On* (returns to original screen after distance measurement is completed)/Off (goes to record screen after distance measurement is completed)



### Automatic tilt angle compensation mechanism

The vertical and horizontal angles are automatically compensated for small tilt errors using the 2-axis tilt sensor.

- 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 leveled, changing the vertical angle by rotating the telescope will cause the displayed horizontal angle value to change.
- Compensated horizontal angle = Measured horizontal angle + Tilt in angle / tan (Vertical angle)
- When the telescope is directed close to the zenith or nadir angle, tilt compensation is not applied to the horizontal angle.

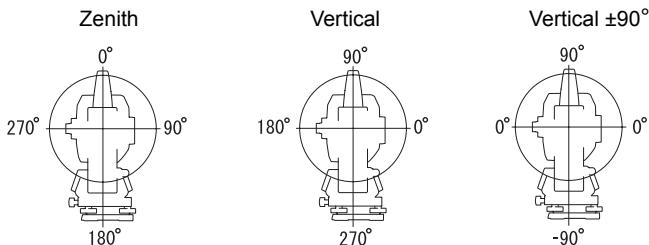


### Collimation correction

The SET has a collimation correction function that automatically corrects horizontal angle errors caused by horizontal axis and leveling axis errors.



### V mode (vertical angle display method)



## 21. CHANGING THE SETTINGS -CONFIGURATION-



### Search before DIST (distance measurement)

When this function is set to "On" and **[DIST]** is pressed in Meas. Mode, the prism is automatically sighted and distance measurement is carried out. Pressing **[S-DST]** in Meas. Mode, regardless of the Search before DIST setting will carry out automatic sighting and distance measurement.

Allocating the **[S-DST]** softkey: "21.3 Allocating Key Functions"

### ● Instrument configurations

Instr.Config	
Reticle lev	:Bright
Guide light	:2
Power off	:30min
Beep	:Do,re,mi,..
[ OK ]	

### Items set and options

Reticle lev (reticle level): Bright\*/Dim

Guide light : 1 (Dim)/2 (Normal)\*/3 (Bright)

Power off : 30 min\*/Off

Beep : Do, re, mi...\*/Monotone



### Power-saving automatic cut-off

To save power, power to the SET is automatically cut off if it is not operated for 30 minutes.

### ● EDM settings

EDM	
Mode	:Fine "R"
Reflector	:Prism
PC	:-30mm
Search area	:HV Wide
Search Bef.DIST:	On ↓
[ OK ]	

EDM	
Temp.	:30°C ↑
Press.	:1034hPa
Humid.	:50%
ppm	:-30
[ OK ] <b>0PPM</b>	

- **[0PPM]**: Atmospheric correction factor returns to 0 and temperature, air pressure (and humidity) are set to the default values.
- Atmospheric correction factor is calculated and set using the entered values of the temperature and air pressure. Atmospheric correction factor can also be entered directly.

## 21. CHANGING THE SETTINGS -CONFIGURATION-

### Items set, options, and input range

Mode (Distance measurement Mode)	: Fine "R"/Fine AVG"n=2" (Setting: 2 to 9 times), Fine "S"/ Rapid "R"/Rapid "S"/ Tracking
Reflector	: Prism* / Sheet
PC (Prism constant)	-99 to 99 (Prism:-30*/sheet:0*) (in step 1mm)
Search area	: Sight (in field of view)*/HV wide (horizontaland vertical wide)/ V wide (vertical wide) H wide (horizontal wide) (Can also be set in Motor setting)
Search bef.DIST	: (Can also be set in "Configuration ● Motor setting")
Temp. (Temperature)	: -30 to 60°C (15*) (in step 1°C)
Air pressure	: 500 to 1400hPa (1013*) (in step 1hpa), 375 to 1050mmHg (760*) (in step 1mmHg)
Humidity	: 0 to 100% (0*) (in step 1%)
ppm (Atmospheric correction factor)	: -499 to 499 (0*)



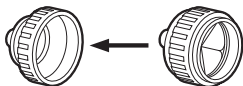
### Prism constant correction

Reflective prisms each have their prism constant.

Set the prism constant correction value of the reflective prism or reflective sheet you are using. (SET allows you to enter separate values for a prism and sheet.)

- The following are samples of the prism constant correction values of reflective prisms from Sokkia.

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



Correction Value = -30



Correction Value = -40



Correction Value = 0



### Search area

"Sight (in field of view)" means the area range viewed from the telescope.



### Atmospheric correction factor and Humidity

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 air pressure.

- To precisely determine the atmospheric correction factor, the average temperature and air pressure along the measurement beam route must be taken. Take care when calculating the correction factor in mountainous terrain as the difference in height will result in differences in atmospheric conditions between two points.
- The SET is designed so that the correction factor is 0 ppm at an air pressure of 1013 hPa and a temperature of 15°C.
- By inputting the temperature and air pressure (and humidity) values, the atmospheric correction value is calculated and set into the memory. Calculate the atmospheric correction factor as shown in the following formula.

Atmospheric Correction Factor

$$= 278.96 - (0.2904 \times P - 0.044735 \times e) / (1 + 0.003661 \times T)$$

$$e = H \times e_w / 100$$

$$e_w = a_0 T^4 + a_1 T^3 + a_2 T^2 + a_3 T + a_4$$

T: Temperature (°C)

P: Pressure (hPa)

E: Water vapor pressure (hPa)

H: Relative humidity (%)

E<sub>w</sub>: Saturated water vapor pressure

$$a_0 = 0.0000491539$$

$$a_1 = 0.00026202374$$

$$a_2 = 0.01251534557$$

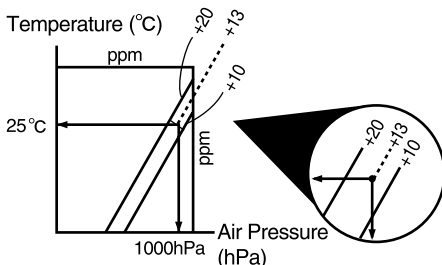
$$a_3 = 0.45183196592$$

$$a_4 = 6.32672468457$$

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

## 21. CHANGING THE SETTINGS -CONFIGURATION-

- The atmospheric correction factor from the table below is 13ppm.



- If "&Humid" is set in the ppm mode of the Obs. Condition screen, humidity can also be set. The effect of humidity on the results of short distance measurements is negligible, but for high accuracy measurement of long distances and in humid conditions, humidity should be set.

### ● Communication setup

Comms setup	
Baud rate	:1200bps
Data bits	:8bit
Parity	:Not set
Stop bit	:1bit
Check sum	:No
Xon/Xoff	:No
↓	
[ OK ]	

Comms setup	
Controller	:Remote ↑
D-OUT	:Off
[ OK ]	

### Items set and options

Baud rate	: 1200bps*/2400bps/4800bps/9600bps /19200bps/38400bps
Data bits	: 8bit*/ 7bit
Parity	: Not set*/ Odd/ Even
Stop bit	: 1bit*/ 2bit
Check sum	: Yes/ No*
Xon/Xoff	: Yes*/ No
Controller	: Remote */ 2way
D-OUT	: Off*/On



#### Controller

Select "Remote" to use a motor drive command (But, some of the 2-way commands cannot be used.)


Select "2way" to use all commands other than motor drive commands.



#### D-OUT

When "D-OUT" is set to "On", pressing [ANGLE] or [DIST] in Meas. Mode outputs the measurement results to an external instrument.

## 21. CHANGING THE SETTINGS -CONFIGURATION-

 Output format and command operations: "Interfacing with the SOKKIA SDR Electronic Field Book" and "Command Operations" manuals.

### ● Unit

Unit	
Temp.	: <b>C</b>
Press.	:hPa
Angle	:degree
Dist	:meter
[ OK ]	

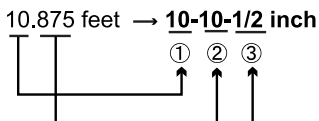
### Items set and options

Temp. (Temperature) : °C\*/ °F  
Press. : hPa\*/ mmHg/ inchHg  
Angle : degree\*/ gon/ mil  
Dist : meter\*/ feet/ inch



### Inch (Fraction of an inch)

"Fraction of an inch" is the unit used in the United States and expressed like the following example.



- ① 10.000 feet
- ② 0.875 feet x 12=10.5 inch
- ③ 0.5 inch=1/2 inch

#### Caution

- Even if "inch" is selected in this setting, all the data including the result of area calculation are output in "feet" and all the distance values must be input in "feet". In addition, when the "inch" display exceeds the range, it is displayed in "feet".

## ● Motor Settings

Sequence	
Search area	Sight
Search bef.DIST	:On
[ OK ]	

### Items set and options

- Search area : (Can also be set in "Configuration ● EDM settings")  
 Search bef.DIST : (Can also be set in Configuration ● Observation conditions)

## ● Date and time (only SET3110M)

Date and time	
Date	08012002
Time	:14:25:17
[ OK ]	

### Caution

- On SET4110M input date and time as instrument station data.

 "20.3 Setting Instrument Station Data"

### Set items

- Date : Example: August 1, 2002 → 08012002  
 Time : Example: 2:25:17 p.m. → 142517



### Date and time

SET has Calendar & Clock function. Date and time set here are displayed on the status screen.

## 21.2 Allocating Key Functions in SFT Mode

It is possible to allocate functions and menus in the Shift Mode to suit the measurement conditions. It is possible to operate the SET efficiently because unique menu and function allocations can be preset to suit various applications and the ways that different operators handle the instrument.

## 21. CHANGING THE SETTINGS -CONFIGURATION-

---

- 12 Functions and menus can be allocated from the SFT menu.
- In the following description, "menu" means a screen containing other menus or functions. (Example: Motor menu.)
- In the following description, "function" means an item that when selected starts an automatic operation. (Example: guide light)
- The content of the "menu" cannot be changed. But functions in "menu" can be individually selected to be displayed in the Shift Mode screen.

### ● Shift menu configuration when SET was shipped from the factory

Page 1	: Height Search Guide light Obs. Condition Stn. Data EDM setting
Page 2	: H angle set Data view Meas. Memory menu Tilt Aiming

### ● Allocating functions and menus

Menus	Functions
Motor menu	Search, Face change, Rotation, Guide light, Motor setting
Memory menu	JOB selection, Comms output, Comms input, Comms setup, JOB deletion
Data menu	Data view, Key in coord, Stn. Data, Note, Code, Delete data
Config menu	Obs.condition, Instr.config., Instr.const., EDM setting, Comms setup, Unit, Key function, Stn.data, Motor setting, Date and time (only SET3110M)
Meas fnc menu	H 0set, H angle set, Stn.data, Disp.dist, H angle, V angle, Height
Etc. menu	Tilt, Aiming, Meas, S-O



### ● Contents of functions that can be allocated

Search	: Automatically sights center of prism
Face change	: Rotates the SET
Rotation	: Automatically rotates the SET to the entered horizontal angle and vertical angle
Guide light	: Turns guide light ON/OFF
Motor setting	: Sets functions related to the motor drive (Search, Face change, Rotation, Guide light)
JOB selection	: Selects JOB
Comms output	: Outputs JOB contents to external instrument
Comms input	: Inputs Known point data from an external instrument
Comms setup	: Sets communication parameters
JOB deletion	: Deletes a JOB
Data view	: Displays data in a JOB
Key in coord	: Records known point data
Stn.data	: Sets instrument station point data
Note	: Records notes
Code	: Records codes
Delete data	: Deletes selected data
Obs.condition	: Sets observation conditions
Instr.config.	: Sets instrument configuration
Instr.const.*	: Instrument constant menu
EDM setting	: Sets EDM
Unit	: Sets units
Key function	: Allocates, registers and reads in softkeys
Date & time	: Sets date and time (only SET3110M)
H 0set	: Sets horizontal angle to 0°
H angle set	: Sets the horizontal angle of the sighting direction to your required angle
Disp.dist	: switches distance display mode (slope distance/horizontal distance/height difference/coordinates)
H angle	: Switch between horizontal angle right/left
V angle	: Switch between zenith angle/ slope in %
Height	: Sets height of sighting point
Tilt	: Display tilt angle
Aiming	: Checks received laser signal
Meas*	: Meas. mode

## 21. CHANGING THE SETTINGS -CONFIGURATION-

---

S-O : Setting-out measurement menu



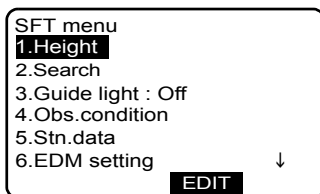
- After the function indicated with "\*" is completed, the main menu (menu before {SFT} was pressed) is not restored.

### ►PROCEDURE Allocating menus

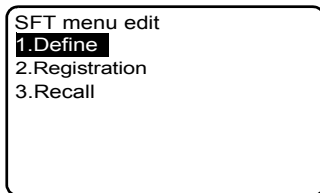
---

1. Press and hold {SFT} to enter the Shift Mode

2. Press [EDIT] to enter SFT menu edit.

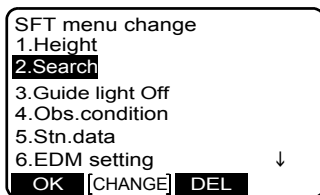


3. Select "Define".

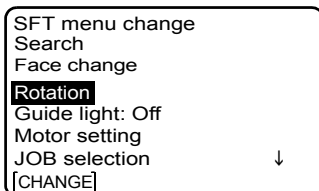


4. Align the cursor with the menu/function you wish to change and press [CHANGE].

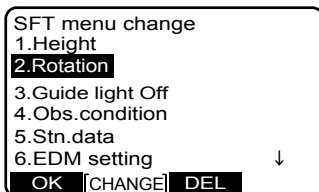
- Press [DEL] to delete an item from the menu.



- Align the cursor with the menu or function whose allocation you want to swap in and press **[CHANGE]**.




The item selected in this step is allocated to the item selected in step 4.

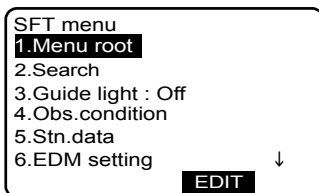


- Repeat steps 4 and 5 until all new allocations are set.
- Press **[OK]** to finish allocating items. The allocated items are stored in memory and SFT menu edit screen is restored. The newly allocated items appear in the SFT menu.

### ►PROCEDURE Registering an allocation

---

- First register the settings you want to appear in the SFT Mode menu.  
 "PROCEDURE Allocating menus"
- Press and hold **{SFT}** to enter the Shift Mode.
- Press **[EDIT]** to enter SFT menu edit.



## 21. CHANGING THE SETTINGS -CONFIGURATION-

---

4. Select "Registration" to enter SFT menu edit. Select either "User 1" or "User 2".

SFT menu edit  
1.Define  
2.Registration  
3.Recall

SFT menu edit  
1.User's 1  
2.User's 2

5. Press {←} to register the SFT menu array to the user selected in step 4. Press any key to return to the SFT menu.

### ►PROCEDURE Recalling an allocation

---

1. Press and hold {SFT} to enter the Shift Mode.
2. Press [EDIT] to enter SFT menu edit.
3. Select "Recall" to enter SFT menu edit. Select either "User 1", "User 2", or "Default" (factory setting) and press {←}.

This displays the registered array in the SFT Mode menu.

SFT menu edit  
1.Define  
2.Registration  
3.Recall

SFT menu edit  
1.User's 1  
2.User's 2  
3.Default

### 21.3 Allocating Key Functions

It is possible to allocate the softkeys to suit the measurement conditions. It is possible to operate the SET efficiently because unique softkey allocations can be preset to suit various applications and the ways that different operator's handle the instrument.

Softkeys can be allocated in the following modes and menus

- Measurement Mode
  - Setting-out menu
  - Offset/2D menu
  - Missing line measurement menu
  - REM menu
- It is possible to allocate the same key to each page. The same function can be allocated to more than one key on the same page. And it is also possible to allocate a function to only one key.
  - The current softkey allocations are retained until they are revised again, even when the power is cut off.
  - It is possible to register two sets of key function allocations: user setting 1 and user setting 2.
  - It is possible to recall the softkey arrays registered for User 1 and User 2 as necessary.

#### Caution

- When softkey allocations are recorded and registered, the previously recorded key settings are cleared. When a softkey array is recalled, the key array is changed to the key array that has been recalled, clearing the previous key array. Be sure to remember this.
- The following are the softkey allocations when the SET was shipped.

Page 1: [REC] [SHVC] [ANGLE] [DIST]

Page 2: [STN] [EDM] [H.ANG] [0SET]

Page 3: [VIEW] [CNF-O] [OFFSET] [ROT]

## 21. CHANGING THE SETTINGS -CONFIGURATION-

---

- The following functions can be allocated to the softkeys  
(Measurement Mode, Setting-out menu, Offset/2D menu, Missing line measurement menu, REM menu)

[--]	: No functions set
[DIST]	: Distance measurement (When [D-OUT] in "Comms setup" is set to "On", distance data is output at the same time)
[S-DST]	: Automatic sighting and distance measurement
[REC]	: Data recording
[SHVC]	: Select Distance Mode (Sdist (slope distance/Hdist (horizontal distance)/ Vdist (height difference)/ Coord (coordinates)
[0SET]	: Set horizontal angle to 0
[H.ANG]	: Sets required horizontal angle
[R/L]	: Select horizontal angle right/left
[RCL]	: Display final measurement data
[ZA / %]	: Switch between zenith angle/slope in %
[HOLD]	: Hold horizontal angle/release horizontal angle
[STN]	: Sets instrument points
[EDM]	: Setting EDM
[CNF-M]	: Sets functions related to the motor drive (Search, Face change, Rotation, Guide light)
[RS232C]	: Sets communication parameters
[CNF-O]	: Sets observation conditions
[SFTKEY]	: Softkey user allocation menu
[PROG]	: Program mode
[OFFSET]	: Offset menu
[A-OFS]	: Angle offset menu
[D-OFS]	: Distance offset menu
[2D-OFS]	: Offset/2D menu
[AREA]	: Area calculation menu
[REM]	: REM measurement
[MLM]	: Missing line measurement
[S-O]	: Setting out measurement
[RESEC]	: Resection measurement
[VIEW]	: Display data in JOB
[KNOWN]	: Records known point data

[NOTE]	: Records notes
[MOTOR]	: Motor menu
[FACE]	: Turns SET 180°
[SRCH]	: Automatically sights the center of the prism
[ROTA]	: SET rotates to the entered horizontal and vertical angle
[G.LIGHT]	: Guide light ON/OFF
[TILT]	: Displays circular level
[AIM]	: Checks strength of returned signal
[F/M]	: Switches feet and meter
[HT]	: Sets the sighting height

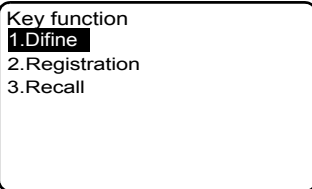
- The following lists the softkeys that can be allocated and their functions (Measurement Mode)

[ANGLE]	: angle measurement (When [D-OUT] is set to "ON", angle data is output at the same time)
[AUTO]	: Performs distance measurement and records results automatically
[12DST]	: Face 1/2 combination

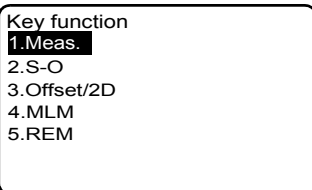
### ►PROCEDURE Allocating softkeys

---

1. Select "Key function" in the Config. Mode
2. Select "Define".



3. Select "Meas".



## 21. CHANGING THE SETTINGS -CONFIGURATION-

---

4. The softkey array in each page of Meas Mode is displayed.

Align the cursor with the softkeys whose allocation you want to change using {◀}/{▶}. Selected softkey is displayed with white background.

Key function			
P1	[ REC ]	SHVC	[ -- ]
	ANGLE	DIST	DIST
P2	STN	EDM	S-DST
	H.ANG	0SET	REC
P3	VIEW	CNF-O	SHVC
	OFFSET	ROTA	0SET
[ OK ]			

5. Change the softkey using {▲}/{▼}.

The key to be swapped in is displayed in the list on the right of the screen. Scroll up/down to select the required softkey and press {←}.

The softkey selected in step 4 is changed to the softkey selected in step 5.

Key function			
P1	DIST	[ SHVC ]	[ --- ]
	ANGLE	DIST	DIST
P2	STN	EDM	S-DST
	H.ANG	0SET	REC
P3	VIEW	CNF-O	SHVC
	OFFSET	ROTA	0SET
[ OK ]			

6. Repeat steps 4 to 5 as many times as necessary.
7. Press [OK] to record the allocations and return to the Key Function Mode. The newly allocated softkeys are displayed in the Meas. Mode screen.

### Note

- To allocate softkeys of the Setting-out menu, Offset/2D menu, missing-line measurement menu, and REM measurement menu, select the required softkey and carry out the above procedure starting from step 3.

## ►PROCEDURE Registering an allocation

---

1. Allocate functions to the softkeys.  
☞ "21.2 Allocating Key Functions in SFT Mode"
2. Select "key function" in Config Mode.



3. Select "Registration."  
Select either "User 1" or "User 2" as the softkey array to be registered.

Key function  
1.Define  
**2.Registration**  
3.Recall

4. Press {←}. The softkey array is registered as user 1 or user 2 and <Key function> is restored.

Key function  
**1.User's 1**  
2.User's 2

### ►PROCEDURE Recalling an allocation

---

1. Select "key function" in Config Mode.
2. Select "Recall." Select the key array for either User 1, User 2, or Default (setting when the SET was shipped), and press {←}. <Key function> is restored. This displays the functions in the recalled array in Meas Mode.

## 22. RESTORING SET ITEMS TO INITIAL SETTINGS

This chapter explains two methods to restore items to their default settings when the SET was shipped. The first method describes how to restore set items to their initial settings and turn the power on and the second method describes how to initialize the data and turn the power on.

- Restore the following items to the initial settings when the SET was shipped. All setting modes and setting items (includes softkeys) and the Shift Mode configuration are restored to the initial settings.

 Factory settings: "21. CHANGING THE SETTINGS -CONFIGURATION-"

- Data in all JOBS (includes known point data) and code data in memory are restored to the initial settings.

### ► PROCEDURE Restoring set items to initial settings and turning power on

---

1. Turn the power OFF.
2. Press and hold **{+/-}** and **{ON}** until "Checking... Default set" is displayed.
3. Release the keys. The normal <0set> screen will appear.

### ► PROCEDURE Initializing the data and turning the power on

---

1. Turn the power OFF
2. Press and hold **{+/-}**, **{6}**, **{F4}** and **{ON}** until "Checking.... File clear" is displayed.
3. Release the keys. The normal <0set> screen will appear.


## 23. WARNING AND 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**

Prism conditions are poor.

Reset and sight the prism and perform measurement again.

 Precautions for setting prism: "10. TARGET SIGHTING"

### **Calculation error**

During resection measurement the same point is registered multiple times.

Set another known point so that the known point coordinates do not coincide.

### **Clock error**

The voltage supplied by the lithium battery either declines or is completely discharged. Ask your Sokkia agent to replace the battery for you.

### **EXXX Motor error X**

A problem has occurred with the motor drive and operation stops.


Turn the power to the SET OFF and ON to correct the problem.

If this error message appears frequently, contact your Sokkia agent.

### **Flash memory error**

Data cannot be read in.

Back up the required data; then turn the instrument OFF. Reinitialize the memory and start the instrument again.

 "22. RESTORING SET ITEMS TO INITIAL SETTINGS"

If the error message appears again, contact your Sokkia agent.

### **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.

### **Motor error**

A problem has occurred with the motor drive and operation stops.

Turn the power to the SET OFF and ON to correct the problem.

If this error message appears frequently, contact your Sokkia agent.

### **Need 1st obs**

During missing line measurement, the observation of the starting position was not completed normally.

Sight the starting position accurately and perform the measurement again.

## 23. WARNING AND ERROR MESSAGES

---

### **Need 2nd obs**

During missing line measurement, the observation of the target was not completed normally.

Sight the target accurately and perform the measurement again.

### **Need base pt. obs**

During REM measurement, the observation of the target was not completed normally.

Reset and sight the prism and perform measurement again.

### **Need offset H. obs**

Observation of the offset point during angle offset measurement was not completed normally.

Sight the point accurately and perform the measurement again

### **Need offset pt. obs**

Observation of the offset point during angle offset measurement or distance offset measurement was not completed normally.

Sight the point accurately and perform the measurement again.

### **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 solution**

The calculation of the instrument station coordinates during resection does not converge.

Access the results and if necessary, perform the observations again.

### **Offset out of range**

Results of CCD reticle check and inspection exceed the allowed range.

Contact your Sokkia agent.

### **Out of value**

During gradient % display, the display range (less than  $\pm 1000\%$ ) has been exceeded.

During REM measurement, either the vertical angle has exceeded horizontal  $\pm 89^\circ$  or the measured distance is greater than 9999.999m.

Install the instrument station far from the target.

### **Re 0 Set**

The telescope or top of the instrument was rotated too rapidly.

Index the horizontal circle and vertical circle once again.

### **Receive data err.**

A reception error occurred during communication with an external instrument.  
Try to send (receive) data again.

A reception error occurred when receiving data from an external instrument.  
Check the settings of parameters concerning communication conditions.

### **Send first**

JOB data output (transmission to the host computer) is not completed before  
JOB is cleared.

Transmit the JOB to be cleared to the host computer.

### **Sheet not supported**

Automatic sighting cannot be performed with the sheet.  
Use the prism to carry out automatic sighting.

### **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.

### **Target not found**

The prism cannot be found within the automatic sighting range.  
Reset and sight the prism and perform measurement again.

### **Time out**

Measurement is not carried out in the allotted time.  
Reset and sight the prism and perform measurement again.

When designating the angle of rotation or automatically sighting the prism,  
there is a problem with the positioning of the prism or the operation of the  
instrument and measurement is not obtained within the fixed time.

Check the positioning of the instrument and prism and perform measurement  
again.

If observation is still not possible, sight the target manually.

### **Tilt out of range**

The tilt angle exceeds the tilt angle compensation range of the sensor.  
Sight again within  $\pm 3'$ .

### **X Motor communication err X**

A problem has occurred with the motor drive and operation stops.

Turn the power to the SET OFF and ON to correct the problem.

If this error message appears frequently, contact your Sokkia agent.

## 24. CHECKS AND ADJUSTMENTS

SET is a precision instrument that 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 from "24.1 Plate Level" to "24.8 Additive Distance Constant."
- In addition, the instrument should be inspected with special care after it has been stored for a long time, transported, or when it may have been damaged by a strong shock.

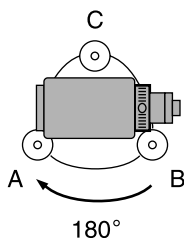
### 24.1 Plate Level

The bubble tube is made of glass, so it is sensitive to temperature changes or to shock. Check and adjust it as outlined below.

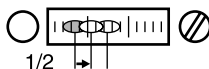
#### ►PROCEDURE Checking and adjusting

1. Level the instrument and check the position of the bubble of the plate level.  
☞ "8.2 Levelling," steps 3 to 5.

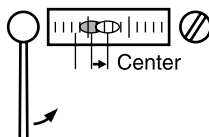
2. Turn the upper part through  $180^\circ$  and check the bubble position.  
If the bubble is still centered, no adjustment is necessary.  
If the bubble is off-center, adjust as follows.



3. Correct half of the bubble displacement using levelling foot screw C.



4. 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 turned in the counterclockwise direction, the bubble moves to the right.

5. Rotate the top of the instrument and continue adjustments until the bubble remains centered for any position of the upper part.  
If the bubble does not move to the center even when the adjustment has been repeated, ask your Sokkia agent to adjust it.



### 24.2 Circular Level

#### ►PROCEDURE Checking and adjusting

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##### Caution

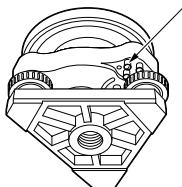
Be careful that the tightening tension is identical for all the adjusting screws. Also, do not over-tighten the adjusting screws as this may damage the circular level.

1. Perform the plate level inspection and adjustment or carefully use the plate level to level the instrument.  
 "24.1 Plate Level".
2. Check the position of the bubble in the circular level.  
 8.2 " Levelling", steps 1 and 2.  
If the bubble is not off-center, no adjustment is necessary.  
If the bubble is off-center, perform the following adjustment.

## 24. CHECKS AND ADJUSTMENTS

3. First confirm the off-center direction. 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.

Circular level  
adjusting screws



4. Adjust the adjusting screws until the tightening tension of the three screws is the same to align the bubble in the middle of the circle.

### 24.3 Tilt Sensor

If the tilt angle shown on the display shifts from tilt angle  $0^\circ$  (zero point), the instrument is not correctly levelled. This will adversely affect angle measurement. Perform the following procedure to cancel the tilt zero point error.

#### ► PROCEDURE Check

1. Carefully level the instrument. If necessary, repeat the procedures to check and adjust the bubble levels.
2. Select "Instr. const." in the Config. Mode.
3. Select "Tilt offset".

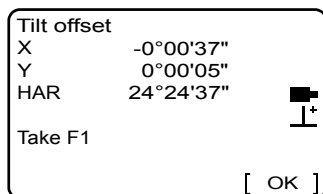
Config.  
1. Obs. condition  
2. Instr. config.  
**3. Instr. const.**  
4. EDM setting  
5. Comms setup  
6. Unit



Instr. const  
**1. Tilt offset**  
X 397  
Y 421  
2. Collimation  
3. CCD-Reticle ofs.



4. Wait a few seconds for the screen to stabilize. The tilt angle in the X (sighting) direction and Y (horizontal axis) direction are displayed.

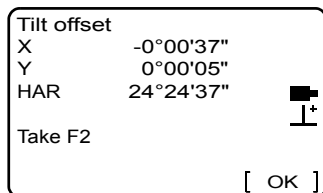


5. Press **[OK]**. The top of the instrument and telescope automatically rotate 180° and the horizontal angle is set to 0°.
6. Wait a few seconds for the screen to stabilize, then read the automatically compensated angles X2 and Y2.
7. In this state, calculate the following offset values (tilt zero point error).  
 $X_{\text{offset}} = (X1+X2)/2$   
 $Y_{\text{offset}} = (Y1+Y2)/2$

If one of the offset values (Xoffset, Yoffset) exceeds ±10", adjust the value using the following procedure. When the offset value falls within the range ±10", adjustment is not necessary.

Press **{ESC}** to return to <Instr. const>.

8. Press **[OK]** to automatically rotate the top of the instrument and telescope through 180°.



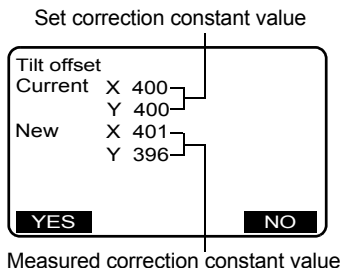
## 24. CHECKS AND ADJUSTMENTS

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9. Confirm that the values are in the adjustment range.

If both correction constants are within the range  $400 \pm 30$ , select **[YES]** to renew the correction angle. "Tilt offset" is restored. Continue to step 11.

If the values exceed the adjustment range, select **[NO]** to cancel the adjustment and restore <Instr. const>. Contact your Sokkia agent to perform the adjustment.



### ►PROCEDURE Recheck

---

10. Enter the <Tilt offset> menu.
11. Wait a few seconds for the display to stabilize, then read the automatically compensated angles X3 and Y3.
12. Press **[OK]** to automatically rotate the top of the instrument through  $180^\circ$ .
13. Wait a few seconds for the display to stabilize, then read the automatically compensated angles X4 and Y4.

14. In this state, the following offset values (tilt zero point error) are calculated.

$$X_{\text{offset}} = (X_3 + X_4) / 2$$

$$Y_{\text{offset}} = (Y_3 + Y_4) / 2$$

When both offset values fall within the range  $\pm 10''$ , adjustment is completed.

Press **{ESC}** to return to <Instr. const>.

If one of the offset values ( $X_{\text{offset}}$ ,  $Y_{\text{offset}}$ ) exceeds  $\pm 10''$ , repeat the check and adjustment procedures from the beginning. If the difference continues to exceed  $\pm 10''$  after repeating the check 2 or 3 times, have your Sokkia agent perform the adjustment.

## 24.4 Collimation

With this 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

1. Select "Instr. const." in the Config. Mode.
2. Select "Collimation".

```
Instr.const
1.Tilt offset
X 397
Y 421
2.Collimation
3.CCD-Reticle ofs.
```

## 24. CHECKS AND ADJUSTMENTS

3. Sight the reference point in Face 1 and press **[OK]**. Telescope rotates and vertical circle is indexed.

Collimation	
ZA	0°00'05"
HAR	24°24'37"
Take F1	
[ OK ]	

4. Sight the reference point in Face 2 and press **[OK]**.

Collimation	
ZA	0°00'05"
HAR	24°24'37"
Take F2	
[ OK ]	

5. Press **[YES]** to set the constant.

- Press **[NO]** to discard the data and return to <Instr.const>.

Collimation	
EL	0°00'05"
V ofs	0°00'03"
YES NO	

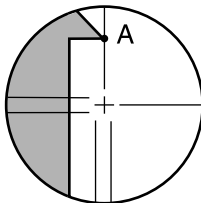
### 24.5 Reticle

#### Caution

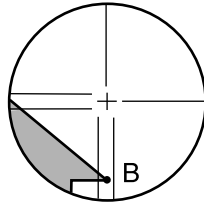
- Check the telescope reticle by manually sighting the target.

#### ►PROCEDURE Check 1: Perpendicularity of the reticle to the horizontal angle

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.



- 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

- Carefully level the instrument.
- Install a target at a point about 100m in the horizontal direction from the SET.
- Turn on the instrument's power and index the vertical and horizontal circles.
- While the Meas Mode screen is displayed and the telescope is in face 1, 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"
- While the telescope is in face 2, 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"



## 24. CHECKS AND ADJUSTMENTS

---

6. Do the calculations:

A2-A1 and B2+B1

If A2-A1 is within  $180^{\circ}\pm 20''$  and

B2+B1 is within  $360^{\circ}\pm 20''$ ,

adjustment is unnecessary.

Example:

A2-A1 (Horizontal angle)

$=198^{\circ} 34' 20'' - 18^{\circ} 34' 00''$

$=180^{\circ} 00' 20''$

B2+B1 (Vertical angle)

$=269^{\circ} 30' 00'' + 90^{\circ} 30' 20''$

$=360^{\circ} 00' 20''$

If the difference is large even after

repeating the check 2 or 3 times,

have your Sokkia service

representative perform the

adjustment.

### 24.6 CCD reticle

The internal CCD sensor is used for automatic sighting. The offset value is set to correct the position of the CCD sensor in relation to the telescope reticle, but if for whatever reason the telescope reticle and CCD camera become misaligned, automatic sighting of the center of the prism cannot be performed correctly. Check and adjust it as outlined below.

#### Note

- Perform check and adjustment in weak sunlight and no scintillation.
- It may take up to 20 seconds for the offset value to appear based on the measurement results.

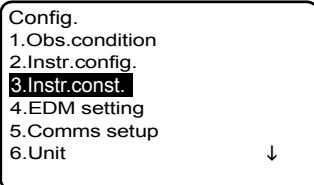
### ►PROCEDURE Checks and adjustments

---

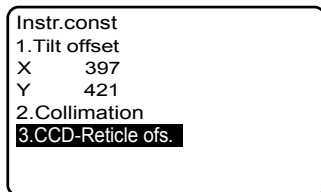
1. Carefully level the instrument.
2. Position the prism in a horizontal direction approximately 50 meters from the SET.



3. Select "Instr. const." in the Config. Mode.



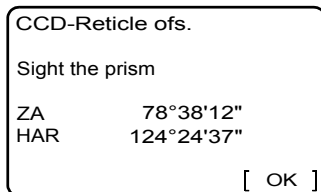
4. Select "CCD-Reticle ofs".



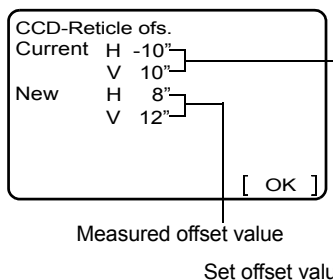
5. Use manual sighting to accurately sight the target.

"10.2 Manually Sighting the Target"

6. Press **[OK]** to sight using the CCD sensor.



7. Offset value (H, V) is obtained from the set offset value (H, V) and the measurement results. The offset value is a constant value that indicates the number of degrees of misalignment between the center of the telescope reticle and the center of the CCD sensor. If the offset value obtained from the measurement result is significantly larger than the set offset value, press **[ESC]** and resight the target.



## 24. CHECKS AND ADJUSTMENTS

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If the offset value (H, V) obtained from the measurement results continues to be significantly large after repeated checks, adjustment is necessary. Go to step 8.

If one of the offset values exceeds the range, an error message appears on the screen. Contact your Sokkia agent to perform the adjustment.

Offset out of range

Press any key

8. Press **[OK]** to renew the offset value.

- Press **[INIT]** to return to the default settings.

### 24.7 Optical plummet

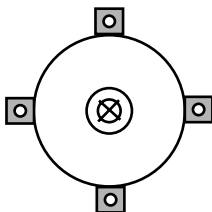
#### Caution

Be extremely careful to adjust all the adjustment screws by the same amount so that none will be over-tightened.

#### ►PROCEDURE Checking

---

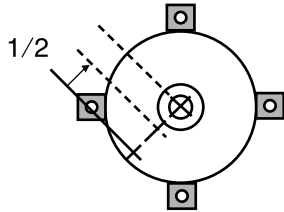
1. Carefully level the SET and center a surveying point precisely in the reticle of the optical plummet.
2. Turn the upper part through  $180^\circ$  and check the position of the surveying point in the reticle. If the surveying point is still centered, no adjustment is necessary. If the surveying point is no longer centered in the optical plummet, perform the following adjustment.





## ►PROCEDURE Adjustment

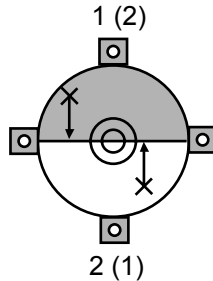
3. Correct half the deviation with the levelling foot screw.



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.

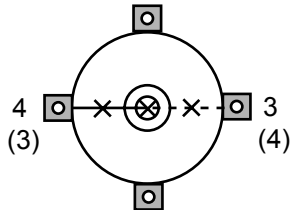
When the surveying point is on the lower (upper) part of the illustration: Loosen the upper (lower) adjusting screw slightly, and tighten the upper (lower) adjusting screw the same amount to move the surveying point to a point directly under the center of the optical plummet.

(It will move to the line in the figure on the right.)



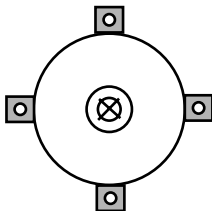
If the surveying point is on the solid line (dotted line):

Loosen the right (left) adjusting screw slightly and, 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.



## 24. CHECKS AND ADJUSTMENTS

6. 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.
7. Replace the optical plummet reticle cover.



### 24.8 Additive Distance Constant

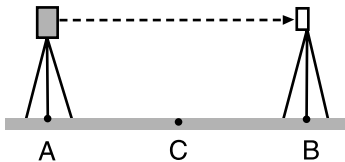
The additive distance constant  $K$  of the SET is adjusted to 0 before delivery. Although it almost never deviates, use a baseline with a known distance precision to check that the additive distance constant  $K$  is close to 0 several times a year and whenever the values measured by the instrument begin to deviate by a consistent amount. Perform these checks as follows.

#### Caution

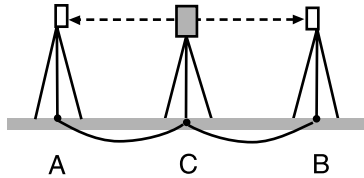
- Errors in setting up the instrument and reflective prism or in sighting the target will influence the additive distance constant. Be extremely careful to prevent such errors when performing these procedures.
- Set up so that the instrument height and the target height are identical. If a flat place is not available, use an automatic level to make sure the heights are identical.

#### ►PROCEDURE Check

1. Find an area of flat ground where two points 100m 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.



- Place the SET at point C directly between points A and B and set up the reflective prism at point A.



- Precisely measure the horizontal distances CA and CB 10 times each and calculate the average value for each distance.
- Calculate the additive distance constant K as follows.  
$$K = AB - (CA + CB)$$

- Repeat steps 1 to 5 two or three times.

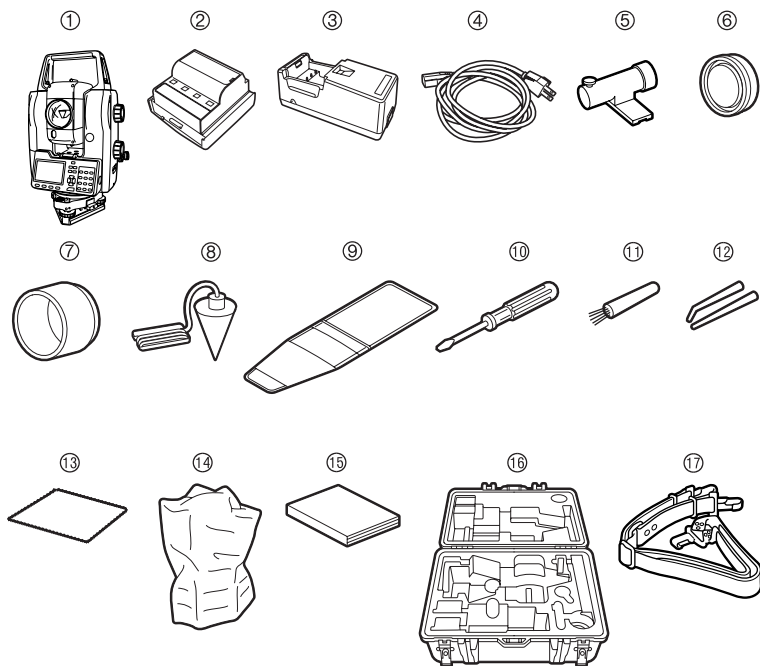
If the additive distance constant K is within  $\pm 3\text{mm}$  even once, adjustment is unnecessary.

If it always exceeds this range, have your Sokkia service representative perform an adjustment.

# 25. STANDARD EQUIPMENT AND OPTIONAL ACCESSORIES

## 25.1 Standard Equipment

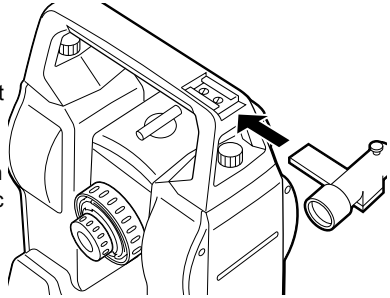
Please verify that all equipment is included.



1	SET main unit . . . . .	1	10	Screwdriver . . . . .	1
2	Battery (BDC45) . . . . .	2	11	Lens brush . . . . .	1
3	Battery charger (CDC56) . . . . .	1	12	Adjusting pin. . . . .	1
4	AC cable (EDC34/35) . . . . .	1	13	Cleaning cloth . . . . .	1
5	Tubular compass (CP7) . . . . .	1	14	Vinyl cover . . . . .	1
6	Lens cap . . . . .	1	15	Operator's manual . . . . .	1
7	Lens hood . . . . .	1	16	Carrying case . . . . .	1
8	Plumb bob . . . . .	1	17	Carrying straps (SC193) . . . . .	1
9	Tool pouch . . . . .	1			

### ● Tubular compass (CP7)

Slide the tubular compass into the tubular compass slot, loosen the clamp screw, then rotate the top part of the instrument until the compass needle bisects the index lines. The telescope's face 1 sighting direction in this position will indicate magnetic north. After use, tighten the clamp and remove the compass from the slot.

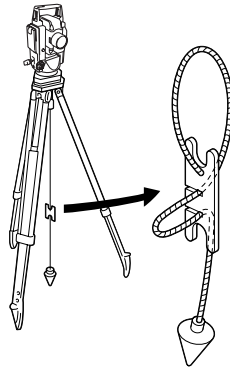


#### Caution

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.

### ● Plumb bob

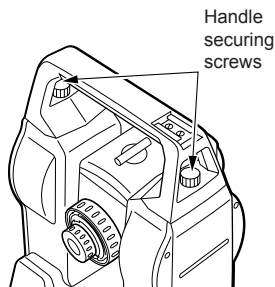
The plumb bob can be used to set up and center the instrument on days when there is little wind. To use the plumb bob, unwind its cord, pass it through the cord grip piece as shown in the figure to adjust its length, then suspend it from the hook attached to the centering screw.




## 25. STANDARD EQUIPMENT AND OPTIONAL ACCESSORIES

### ● Handle

The carrying handle can be removed from the instrument. To remove it, loosen the handle securing screw.



## 25.2 Optional Accessories

The following are optional accessories which are sold separately from the SET.  Target and power supply optional accessories: "25.3 Target System", and "25.4 Power Supply System."

### ● Interface cable

Computer	Cable	Notes
IBM PC/AT or compatible	DOC26	Length : 2m Pin number and signal level : RS-232C compatible
DOS/V	DOC 27	D-Sub connector: DOC 26 : 25 pins (female) DOC 27 : 9 pins (female)
Other computers	DOC1	No connector for attachment to a computer

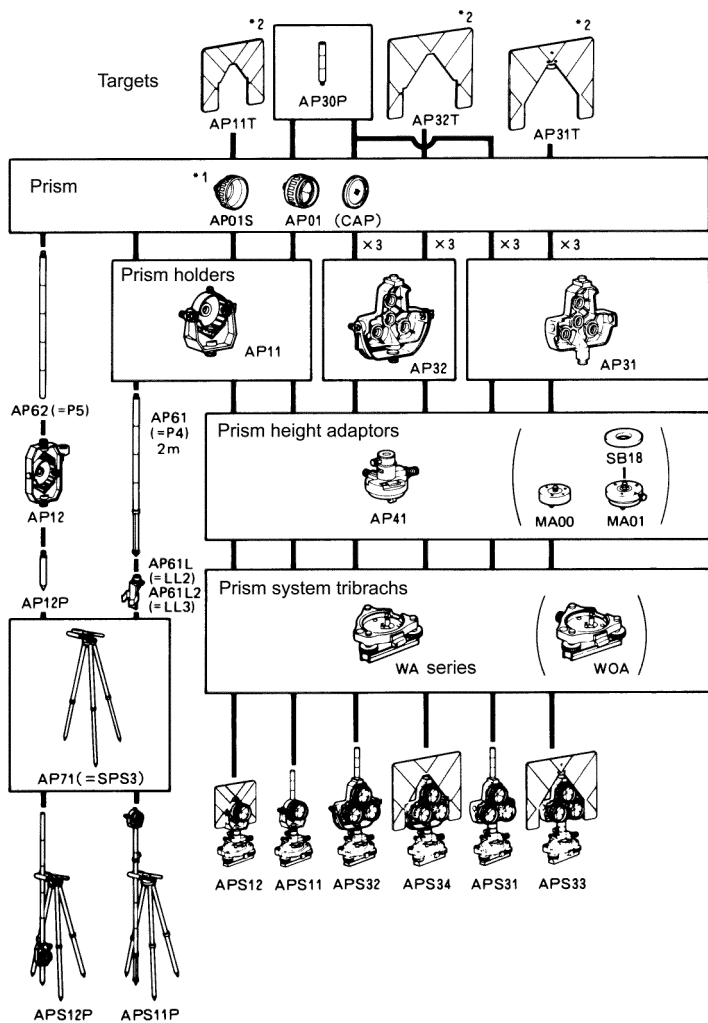
### 25.3 Target System

- 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).
- Because these targets(\*2) are coated with fluorescent paint, they reflect when there is little light.

#### Caution

- 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.
- Each reflective prism(\*1) has its own prism constant value. When changing prisms, be sure to change the prism constant correction value.
- 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.

## 25. STANDARD EQUIPMENT AND OPTIONAL ACCESSORIES





### ● 2-point target (2RT500-K)

This target is used for two-distance offset measurement.

Prism constant: 0

### ● Instrument height adaptor (AP41)

Adjust the level of the AP41 instrument height adaptor following the checking and adjustment methods of plate level.

☞ "24.1 Plate Level"

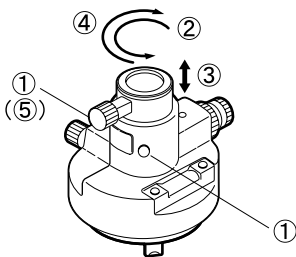
Adjust the optical plummet of the AP41 instrument height adaptor following the checking and adjustment methods of optical plummet.

☞ "24.7 Optical plummet"

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 "245" (mm) is displayed in the instrument height adjustment window.

Loosen the screws ① and rotate SET counterclockwise ②.

Move the part ③ up or down until the desired instrument height is displayed in the adjustment window ④, then rotate SET clockwise and tighten the screws ⑤.



### ● Adjusting plate (WA2)

Adjust the circular level of the adjusting plate for a prism following the checking and adjustment methods of circular level.

☞ "24.2 Circular Level"

## 25. STANDARD EQUIPMENT AND OPTIONAL ACCESSORIES

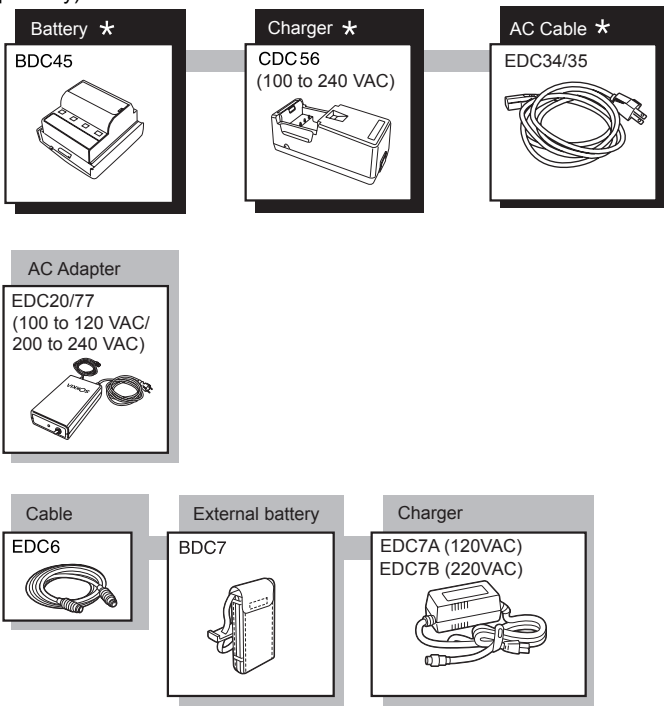
### 25.4 Power Supply System

Operate your SET with the following combinations of power equipment.

#### Caution

- When using EDC20/77 and BDC7, mount the BDC45 in place to maintain the balance of the instrument.
- Never use any combination other than those indicated below. If you do, the SET could be damaged.

Those indicated by \* are standard accessories. Others are optional accessories (sold separately).



## 26. SPECIFICATIONS

### Telescope

Length:	165 mm
Aperture:	45 mm (EDM: 50mm )
Magnification:	30x
Image:	Erect
Resolving power:	3"
Field of view:	1° 30'
Minimum focus:	1.2 m
Focussing screw:	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)

Minimum display: 1" (0.2mgon/0.005mil)/5" (1mgon/0.02mil) (selectable)

Accuracy: SET3110M: 3" (1mgon)  
SET4110M: 5" (1.5mgon)  
(ISO 12857-2 1997)

Measuring time: Less than 0.5 sec (repeated measurement)

Automatic compensator: ON (V & H/V)/OFF (selectable)

Type:Liquid 2-axis tilt sensor

Minimum display: Agrees with minimum displayed measurement angle

Range of compensation:±3'

Measuring mode:

Horizontal angle: Right/Left (selectable)

Vertical angle: Zenith 0°, Vertical 0°, Vertical ±90° (selectable)

### Distance Measurement

Measuring range: Sokkia's reflective prism/reflective target (Slight haze, visibility about 20 km, sunny periods, weak scintillation)

Standard prism AP X 1: 1.2 to 1,600 m / 5200ft

Standard prism AP X 3: 1.2 to 2,100 m / 6800ft

Standard prism AP X 9: 1.2 to 2,500 m / 8200ft

Reflective sheet RS90N-K: 3.0 to 80 m / 260ft

Compact prism CP01: 1.2 to 600 m / 1900ft

Mini pole prism OR1PA:1.2 to 300m / 950ft

Minimum display: Fine measurement, Rapid measurement:  
0.001 m

Tracking measurement: 0.01 m

## 26. SPECIFICATIONS

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Maximum slope distance:	9999.999 m
Distance unit:	meter / feet / inch (selectable)
Accuracy:	(Using prism) Fine measurement with prism: $\pm (2 + 2 \text{ ppm} \times D)$ mm Rapid measurement with prism: $\pm (5 + 2 \text{ ppm} \times D)$ mm (Using reflective sheet target) Fine measurement with reflective sheet: $\pm (4 + 2 \text{ ppm} \times D)$ mm Rapid measurement with reflective sheet: $\pm (5 + 2 \text{ ppm} \times D)$ mm (D: measurement distance; Unit: mm)
Measurement mode:	Fine measurement (single/repeat/average)/ Rapid measurement (single/repeat)/ Tracking (selectable)
Measuring time:	Fine measurement: 3.7sec. + every 2.0 sec. Rapid measurement: 2.1 sec. + every 0.9 sec. Tracking measurement: 1.9 sec. + every 0.4 sec. *( ):When EDM standby is set to ON
Signal source:	Infrared LED (860nm) (Class 1 IEC60825-1/ 2001)
Atmospheric correction:	
Temperature input range:	- 30 to 60 °C (in 1°C step)
Humid input range:	0 to 100% (in 1% step)
Pressure input range:	500 to 1,400 hPa (in 1hPa step) 375 to 1,050 mmHg (in 1mmHg step)
ppm input range:	-499 to 499 ppm (in 1 ppm step)
Prism constant correction:	-99 to 99 mm (in 1 mm step)
Earth curvature and refraction correction:	
Atmospheric refraction constant:	No/Yes K=0.142 or Yes K=0.20 (selectable)

### Auto Pointing

Sokkia's reflective prism/reflective target (No haze, visibility about 40 km, cloudy periods, no scintillation)	
Signal source:	Laser diode (785nm) (Class 1 IEC60825-1/ 2001)
Measuring range:	Sight (in field of view) Distance: Standard prism AP X 1: 2.0 to 800 m / 6.5 to 2600ft Compact prism CP01: 2.0 to 400 m / 6.5 to 1300ft

	Mini pole prism OR1PA:2.0 to 300 m / 6.5 to 950ft
Sighting accuracy (Standard deviation):	2.5mm (less than 100m) 5" (more than 100m)
Sighting speed:	3 to 6 sec (100m)

**Motor**

(No vibration and no wind)

Motion range:	360°(Vertical and horizontal)
Rotating time:	Less than 10 sec. (when rotating 180°) (25°C)

**Guide Light**

	(Slight haze, visibility about 20 km, sunny periods, weak scintillation)
Light source:	LED (red 626 nm/ green 524 nm) (Class 1 IEC60825-1/2001)
Distance:	to 170m
Visible range:	

	Right and Left: about $\pm 2.5^\circ$ , about $\pm 4m$ (100m)
	Upward and downward: about $5^\circ$ , 8m (100m)
Resolving power at center area (width):	less than about 0.12m (100m)

**Power Supply**

Power source:	Ni-MH rechargeable battery BDC45 Battery state indicator: 4 levels
Working duration at 25°C:	BDC45: about 4 hours (Fine single measurement by face 1 and 2, every 30 sec., using auto-pointing function) BDC7(optional accessories): about 7 hours
Charging time:	BDC45: about 130 minutes (using CDC56)

(BDC45)	
Nominal voltage:	10.8 V

(CDC56)	
Input voltage:	100 to 240 VAC
Frequency:	50/60Hz
Charging temperature range:	10 to 40°C

External power input:	12.0V
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## 26. SPECIFICATIONS

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### General

Display:	LCD graphic display 120 dots X 64 dots 1 LCD graphic display with illuminator
Operation panel (keyboard):	28 keys + 1 key (soft function, operation, power, light) (trigger key)
Auto power-off:	On (instrument powers off if not used for 30 min.) / Off (selectable)
Calendar clock:	Provided (only SET3110M)
Internal memory:	about 20000 points
Data output:	Asynchronous serial, RS232C compatible
Sensitivity of levels:	Plate level: 30"/2 mm Circular level: 10"/2 mm
Optical plummet:	Image: Erect Magnification: 3X Minimum focus: 0.5 m
Horizontal and vertical motion:	changeable speed using jog dial
Operating temperature:	-20 to 50 °C
Dust and water resistance:	IPX2 (IEC60529: 1989)
Instrument height:	245 mm from tribrach bottom 202 mm from tribrach dish
Size:	202 (W) X 165 (D) X 380 (H) mm (with handle)
Weight:	about 7.1 kg (with handle and battery)

## 27. MANUALLY INDEXING THE VERTICAL CIRCLE BY FACE 1, FACE 2 MEASUREMENT

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.


### Caution

- If the power is cut off, the vertical circle indexing is ineffective. Do it again every time the power is turned ON.
- When indexing the vertical circle, sight the target manually.

### ►PROCEDURE Manually indexing the vertical circle

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1. Select "Obs. condition" in Config Mode. Set "V index" (vertical circle indexing method) to "Manual."

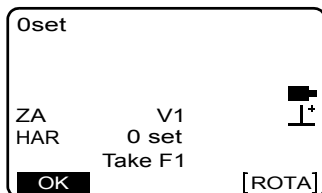
 "21.1 Configuration ●  
Observation conditions"

2. Press **{ESC}** and go to the Meas Mode screen.

The vertical angle V1 is displayed above "Take F1."

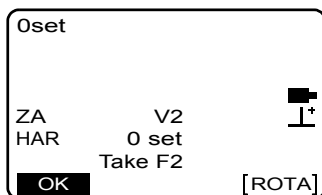
3. Carefully level the instrument.

4. Accurately sight a clear target with a distance of about 30m in the horizontal direction with the telescope in face1. Press **[ROTA]**. The SET rotates 180° and the vertical angle V2 is displayed above "Take F2."



5. Then set the telescope in the face 2 position and accurately sight the same target.

Press **[ROTA]**. The SET rotates 180° and the vertical and horizontal angles are displayed. This concludes the vertical circle indexing procedure.



## 28. REGULATIONS

### Radio Frequency Interference

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**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.

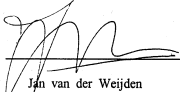
#### **Notice for Canada**


This Class A digital apparatus meets all requirements of Canadian Interference-Causing Equipment Regulations.

Cet appareil numérique de la Class A respecte toutes les exigences du Règlement sur le matériel brouilleur du Canada.



## CE Conformity Declaration

CE Conformity Declaration in accordance with EMC Directive 89/336/EEC of the European Community	
<p>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.</p>	
Instrument Description:	Total Station (Surveying Instruments)
Model Name :	SET4110M, SET4110MS, SET3110M, SET3110MS
Relevant EC Directive:	EMC Directive (89/336/EEC) Version: 92/31/EEC, 93/68/EEC
Applied	
Harmonized Standard:	EMI EN55011 <small>1998(A):1999</small> Group 1 Class A EMS EN61000-6-2 <small>1999</small>
Date:	<u>22-01-2002</u>
Firm:	<u>SOKKIA B.V.</u>
Address:	<u>Industrieterrein De Vaart, Damsluisweg 1, NL-1332 EA Almere</u>
Representative's Signature:	
Name of Representative :	Jan van der Weijden
Representative's position :	Managing Director

<p><b>CE Conformity Declaration</b>                  in accordance with EMC Directive 89/336/EEC of the European Community                  and Low Voltage Directive 73/23/ECC of the European Community</p>	
<p>We herewith declare that the under mentioned instrument, in view of its design and type of construction, fully complies with the relevant basic radio interference requirements of the EMC Directive and the relevant electrical safety requirements of the Low Voltage Directive.</p> <p>Should the instrument be modified without agreement, this declaration becomes invalid.</p>	
Instrument Description:	Power Supply (Battery Charger)
Model Name :	CDC56
Relevant EC Directive:	EMC Directive (89/336/EEC) Version: 92/31/EEC, 93/68/EEC Low Voltage Directive(73/23/EEC) Version: 93/68/EEC
Applied Harmonized Standard:	EMI:EN50081-1 <sup>1992</sup> EN55022 <sup>1998</sup> Class B EMS:EN50082-2 <sup>1995</sup> EN61000-4-2 <sup>1995</sup> EN61000-4-3 <sup>1996</sup> EN61000-4-4 <sup>1995</sup> EN61000-4-6 <sup>1996</sup> EN61000-4-8 <sup>1993</sup> ENV50204- <sup>1995</sup> Low Voltage: EN 60950 <sup>1992/A1:1993/A2:1993/A3:1995/A4:1997</sup>
Date:	<u>1 August 2001</u>
Firm:	<u>SOKKIA B.V.</u>
Address:	<u>Industrieterrein De Vaart, Damsluisweg 1, NL-1332 EA Almere</u>
Representative's Signature:	
Name of Representative :	Hajimu Maeda
Representative's position :	European President

## CE Conformity Declaration

in accordance with EMC Directive 89/336/EEC of the European Community  
and Low Voltage Directive 73/23/ECC of the European Community

We herewith declare that the under mentioned instrument, in view of its design and type of construction, fully complies with the relevant basic radio interference requirements of the EMC Directive and the relevant electrical safety requirements of the Low Voltage Directive.

Should the instrument be modified without agreement, this declaration becomes invalid.

Instrument Description: Power Supply (AC Adaptor)

Model Name : EDC77


Relevant EC Directive: EMC Directive (89/336/EEC)  
Version: 92/31/EEC, 93/68/EEC  
Low Voltage Directive(73/23/EEC)  
Version: 93/68/EEC

Applied  
Harmonized Standard: EMI:EN50081-1 1992  
EN55022 1994-8 Class B  
EMS:EN50082-2 1995  
ENV50140 1995  
ENV50204 1995  
EN61000-4-2 1995  
Low Voltage:  
EN 61010-1:93 +A2:1995

Date: 1 August 2001

Firm: SOKKIA B.V.

Address: Industrieterrein De Vaart, Damsluisweg 1, NL-1332 EA Almere

Representative's Signature: 

Name of Representative : Hajimu Maeda

Representative's position : European President



## **SOKKIA Customer Service**

### **SOKKIA CO.,LTD.**

<http://www.sokkia.co.jp/english/>

INTERNATIONAL DEPT.

20-28, ASAHICHO 3-CHOME, MACHIDA, TOKYO, 194-0023 JAPAN

PHONE +81-42-729-1848 FAX +81-42-729-1930

# SOKKIA CO.,LTD.

<http://www.sokkia.co.jp/english/>

1-1, TOMIGAYA 1-CHOME, SHIBUYAKU, TOKYO, 151-8511 JAPAN  
PHONE +81-3-3465-5211 FAX +81-3-3465-5203