

SURVEYING INSTRUMENTS

**SOKKIA**

**Series30R**

**SET230R/R3**

**SET330R/R3**

**SET530R/R3**

**SET630R**

**Reflectorless Total Station**

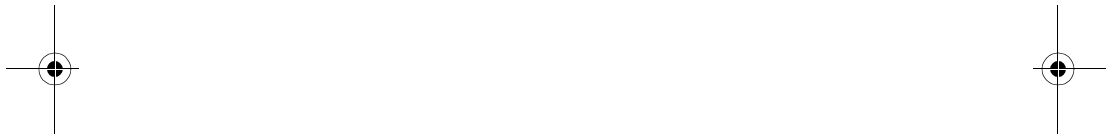


SET230R3/330R3/530R3:  
Class 3R Laser Product

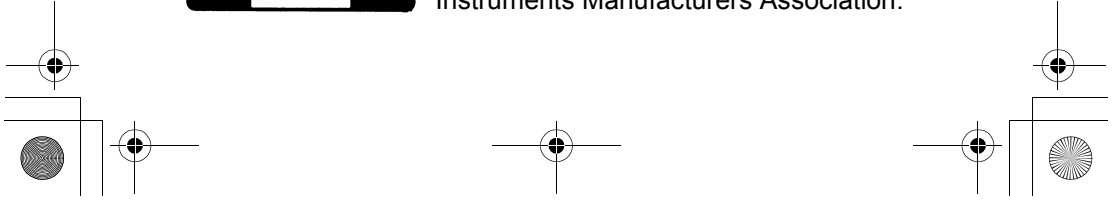
SET230R/330R/530R/630R:  
Class 2 Laser Product

Class 1 LED Product

**OPERATOR'S MANUAL**



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



## SURVEYING INSTRUMENTS

# SOKKIA

## Series30R

### SET230R/R3

### SET330R/R3

### SET530R/R3

### SET630R

### Reflectorless Total Station

SET230R3/330R3/530R3:  
Class 3R Laser Product

SET230R/330R/530R/630R:  
Class 2 Laser Product

Class 1 LED Product





### OPERATOR'S MANUAL

- Thank you for selecting the SET230R/230R3/330R/330R3/530R/530R3/630R.
- Before using the instrument, please read this operator's manual carefully.
- Verify that all equipment is included.  
☞ "27.1 Standard Equipment"
- SET has a function to output data saved in the SET to a connected host computer. Command 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.

## HOW TO READ THIS MANUAL

### Symbols

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 the SET or wireless keyboard.

<S-O> etc. : Indicates screen titles.

### Screens and illustrations

- Except where stated, "SET230R" means "SET230R/230R3", "SET330R" means "SET330R/330R3" and "SET530R" means "SET530R/530R3" in this manual.
- Screens and illustrations appearing in this manual are of SET530R.
- 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.
-  What are softkeys: "4.1 Parts of the Instrument", Softkeys allocation: "24.2 Allocating Key Functions"
- Kodak Gray Card: **KODAK** is a registered trademark of Eastman Kodak Company.

### Operation procedure

- Learn basic key operations in "5. BASIC OPERATION" before you read each measurement procedure.
- Measurement procedures are based on continuous measurement. Some information about procedures when other measurement options are selected can be found in "Note" (.
- For selecting options and inputting figures, see "5.1 Basic Key Operation".

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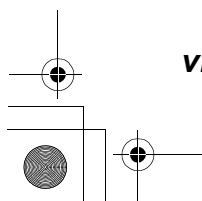
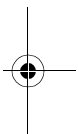
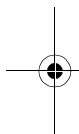
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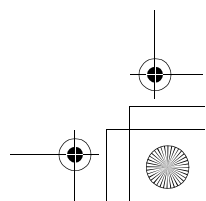
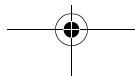
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## 1. PRECAUTIONS FOR SAFE OPERATION


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

 <b>WARNING</b>	Ignoring this indication and making an operation error could possibly result in death or serious injury to the operator.
 <b>CAUTION</b>	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.

## 1. PRECAUTIONS FOR SAFE OPERATION






### 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, burns, or hazardous radiation exposure could result.
-  Never look at the sun through the telescope. Loss of eyesight could result.
-  Do not look at reflected sunlight from a prism or other reflecting object through the telescope. Loss of eyesight could result.
-  Direct viewing of the sun during sun observation will cause loss of eyesight. Use solar filter (option) for sun observation.  
 "27.2 Optional Accessories"

-  When securing the instrument in the carrying case make sure that all catches, including the side catches, are closed. Failure to do so could result in the instrument falling out while being carried, causing injury.










#### 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.
-  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.


## 1. PRECAUTIONS FOR SAFE OPERATION

### Power Supply

#### **Warning**

-  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.






#### **Caution**

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

## 1. PRECAUTIONS FOR SAFE OPERATION




### Tripod

#### Warning

-  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.

### Wireless Keyboard

#### Caution

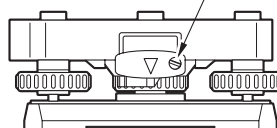
-  Do not perform disassembly or rebuilding. Fire, electric shock or burns could result.
-  Do not use batteries if wet and do not touch batteries with wet hands. Resultant shorting could lead to fire or burns.
-  When changing batteries, follow the procedure described below. If you try to open the battery cover the wrong way or try to force it open, you might injure yourself.

## 2. PRECAUTIONS

### Tribrach Clamp

- 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 fasten the tribrach clamp in place so that it will not shift on the levelling base.

Screw Holding the Tribrach Clamp in Place



### Precautions concerning water and dust resistance

SET conforms to IP66 specifications for waterproofing and dust resistance when the battery cover is closed and connector caps are attached correctly.

- Be sure to close the battery cover and correctly attach the connector caps to protect the SET from moisture and dust particles.
- Make sure that moisture or dust particles do not come in contact with the inside of the battery cover, terminal or connectors. Contact with these parts may cause damage to the instrument.
- Make sure that the inside of the carrying case and the instrument are dry before closing the case. If moisture is trapped inside the case, it may cause the instrument to rust.

### Other precautions

- If the SET is moved from a warm place to an extremely cold place, internal parts may contract and make the keys difficult to operate. This is caused by cold air trapped inside the hermetically sealed casing. If the keys do not depress, open the battery cover to resume normal functionality. To prevent the keys from becoming stiff, remove the connector caps before moving the SET to a cold place.
- Never place the SET directly on the ground. Sand or dust may cause damage to the screw holes or the centering screw on the base plate.
- Do not aim the telescope at the sun. Use the Solar filter to avoid causing internal damage to the instrument when observing the sun.

☞ "27.2 Optional Accessories"

- Protect the SET from heavy shocks or vibration.
- Never carry the SET on the tripod to another site.
- Turn the power off before removing the battery.

## 2. PRECAUTIONS

- When placing the SET in its case, first remove its battery and place it in the case in accordance with the layout plan.

### Maintenance

- 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 tiny particles. Then, after providing a little condensation by breathing on the lens, wipe it with the wiping cloth.
- If the display is dirty, carefully wipe it with a soft, dry cloth. To clean other parts of the instrument or the carrying case, lightly moisten a soft cloth in a mild detergent solution. Wring out excess water until the cloth is slightly damp, then carefully wipe the surface of the unit. Do not use any organic solvents or alkaline cleaning solutions.
- 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 portion, 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.

#### "26. 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.
- Check the SET for proper adjustment periodically to maintain the instrument accuracy.

### 3. LASER SAFETY INFORMATION

Series 30R is classified as the following class of Laser Product and LED Product according to IEC Standard Publication 60825-1 Amd. 2: 2001 and United States Government Code of Federal Regulation FDA CDRH 21CFR Part1040.10 and 1040.11 (Complies with FDA performance standards for laser products except for deviations pursuant to Laser Notice No.50, dated July 26, 2001.)

#### SET230R3/330R3/530R3

- EDM device in objective lens: Class 3R Laser Product (Class 1 Laser Product when prism or reflective sheet in Config mode as target)
- Guide light (optional function): Class 1 LED Product

#### SET230R/330R/530R/630R

- EDM device in objective lens: Class2 Laser Product (Class 1 Laser Product when prism or reflective sheet is selected in Config mode as target)
- Guide light (optional function): Class 1 LED Product

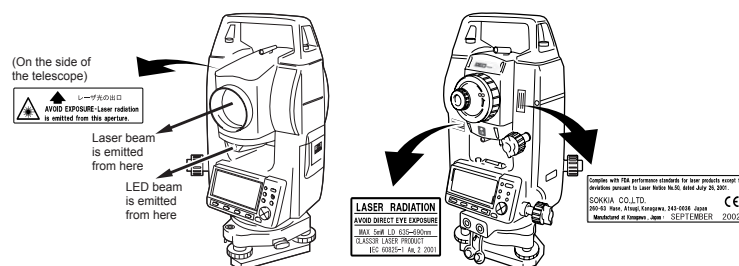
#### Caution

- EDM device is classified as Class 3R Laser Product (SET230R3/330R3/530R3)/Class 2 Laser Product (SET230R/330R/530R/630R) when reflectorless measurement is selected. When the prism or reflective sheet is selected in Config mode as target, the output is equivalent to the safer class 1.
  - The guide light is an optional function.
- ☞ "27.2 Optional Accessories"

#### Warning

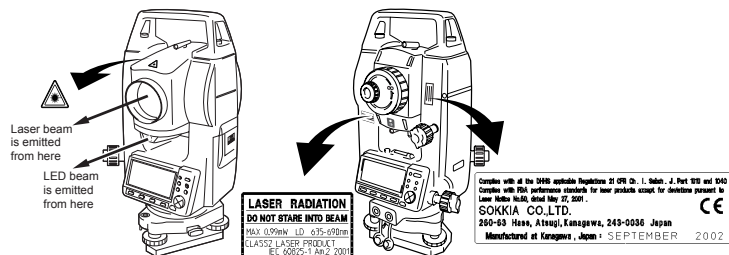
- Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.
- Follow the safety instructions on the labels attached to the instrument as well as in this manual to ensure safe use of this laser and LED product.

#### SET230R3/330R3/530R3



### 3. LASER SAFETY INFORMATION

SET230R/330R/530R/630R




- Never point the laser beam at another person. If the laser beam strikes skin or an eye, it could cause serious injury.
- Do not look directly into the laser beam source. Doing so could cause permanent eye damage.
- Do not stare at the laser beam. Doing so could cause permanent eye damage.
- If an eye injury is caused by exposure to the laser beam, seek immediate medical attention from a licensed ophthalmologist.
- Never look at the laser beam through a telescope, binoculars or other optical instruments. Doing so could cause permanent eye damage. (SET230R3/330R3/530R3 only)
- Sight the targets so that laser beam does not stray from them. (SET230R3/330R3/530R3 only)

#### **Caution**

- Perform checks at start of work and periodic checks and adjustments with the laser beam emitted under normal conditions.
- When the instrument is not being used, turn off the power.
- When disposing of the instrument, destroy the battery connector so that the laser beam cannot be emitted.
- Operate the instrument with due caution to avoid injuries that may be caused by the laser beam unintentionally striking a person in the eye. Avoid setting the instrument at heights at which the path of the laser beam may strike pedestrians or drivers at head height.
- Never point the laser beam at mirrors, windows or surfaces that are highly reflective. The reflected laser beam could cause serious injury.

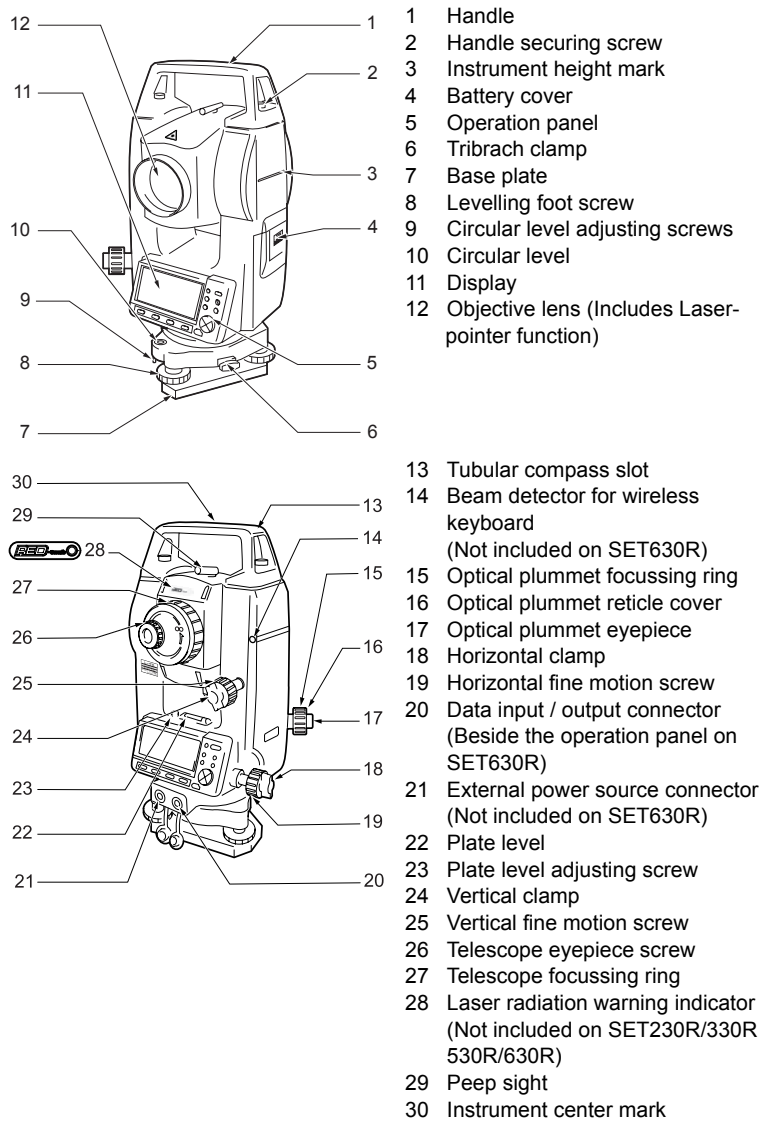


### 3. LASER SAFETY INFORMATION

- When using the Laser-pointer function, be sure to turn OFF the output laser after distance measurement is completed. Even if distance measurement is canceled, the Laser-pointer function is still operating and the laser beam continues to be emitted. (After turning ON the Laser-pointer, the laser beam is emitted for 5 minutes, and then automatically switches OFF. But in the Status screen and when target symbol (ex. ) is not displayed in the Measurement mode, the laser beam is not automatically turned off. )
- Only those who have been received training as per the following items shall use this product. (SET230R3/330R3/530R3 only)
  - Read the Operator's manual for usage procedures for this product.
  - Hazardous protection procedures (read this chapter).
  - Requisite protective gear (read this chapter).
  - Accident reporting procedures (stipulate procedures beforehand for transporting the injured and contacting physicians in case there are laser induced injuries).
- Persons working within the range of the laser beam are advised to wear eye protection for Helium Neon radiation. Recommended safety glasses from Yamamoto Optics Co., Ltd. (SET230R3/330R3/530R3 only)
- ①Full Absorption type YL-331 (for He-Ne laser radiation) or ②Maintenance type YL-331M (for visible semiconductor laser radiation)
- Areas in which the lasers are used should be posted with laser warning notices. (SET230R3/330R3/530R3 only)

## 4. SET FUNCTIONS

### 4.1 Parts of the Instrument



#### 4. SET FUNCTIONS



##### 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 236mm (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.

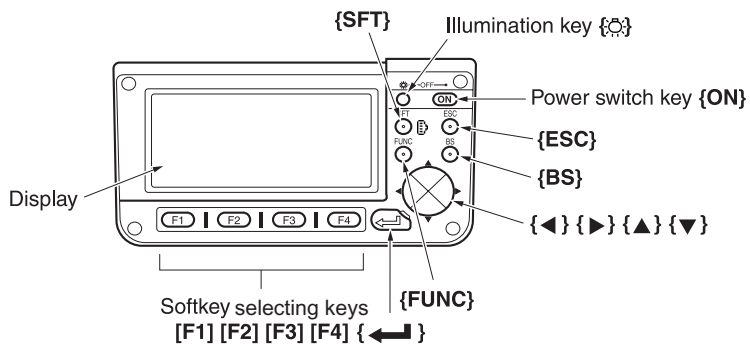


##### Laser-pointer Function

A target can be sighted with a red laser beam in dark locations without the use of the telescope.

#### Operation panel

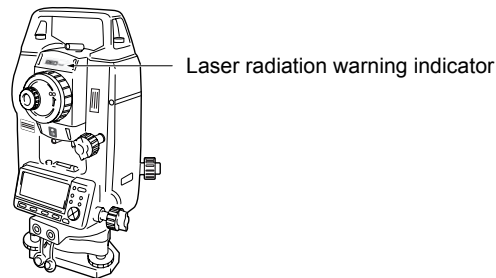
☞ "5.1 Basic Key Operation"



#### 4. SET FUNCTIONS

##### Laser-emission warning lamp (only SET230R3/330R3/530R3)

Laser-emission warning lamp is red when laser beam is emitted or laser-pointer is used, and laser beam status can be known from the telescope eyepiece side.

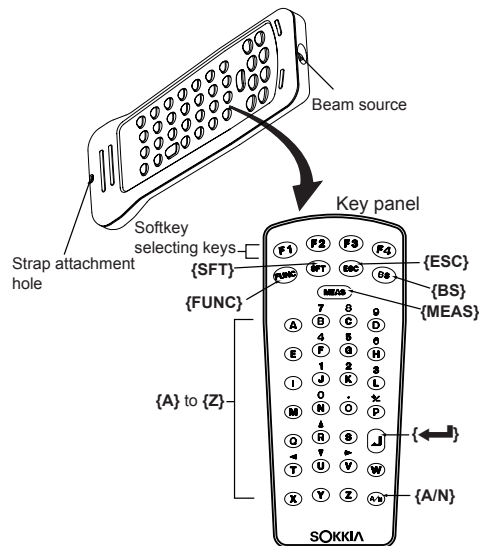


##### Wireless keyboard (Optional accessory)

☞ "5.1 Basic Key Operation" and "27.2 Optional Accessories"

##### Caution

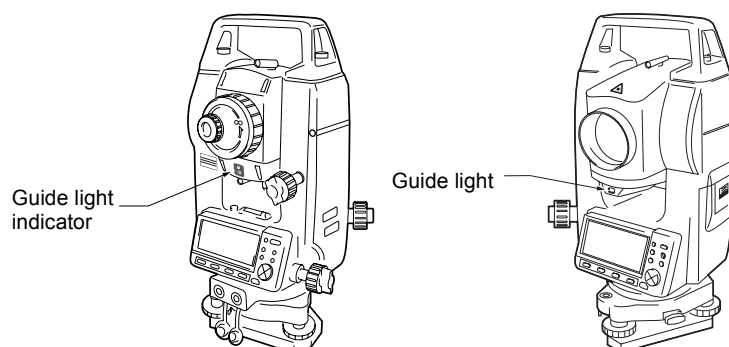
- Wireless keyboard cannot be used on SET630R.



#### 4. SET FUNCTIONS

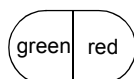
##### Guide light (Optional function)

☞ "27.2 Optional Accessories"



##### Guide light and Guide light indicator

Setting-out measurement etc. can be carried out effectively using the Guide light. The Guide light is composed of a light that is divided into a red and a green light. A poleman can ascertain the present position by checking the Guide light color.



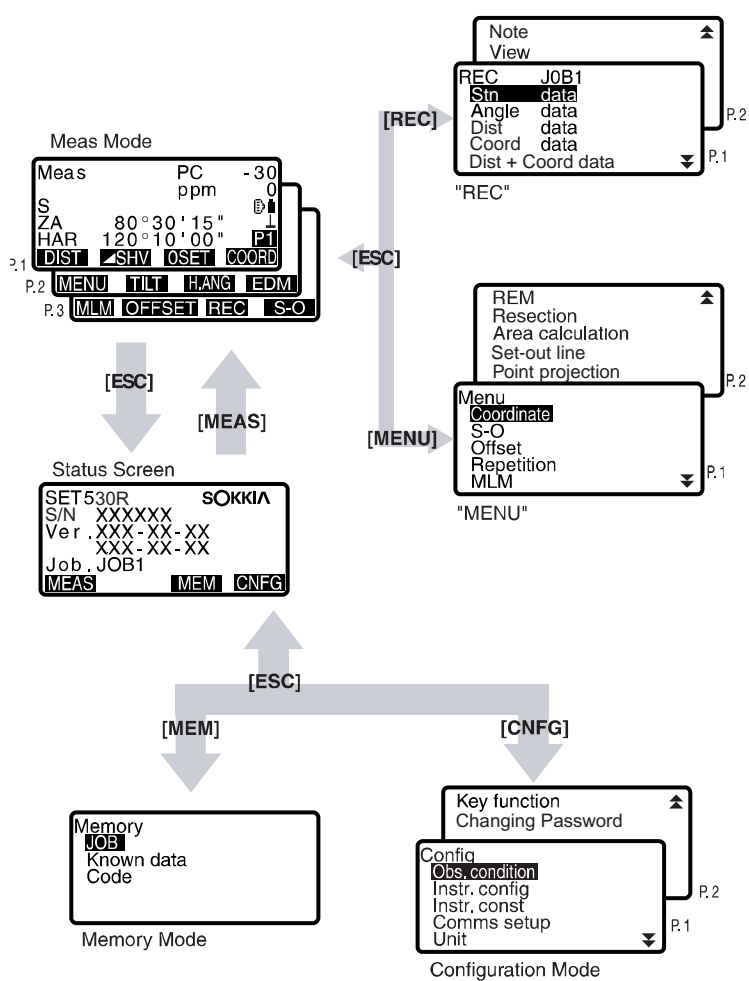
##### Guide light status

Light status	Meaning
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

The Guide light indicator is lit when the Guide light is ON.

## 4. SET FUNCTIONS


### 4.2 Mode Diagram



## 5. BASIC OPERATION

### 5.1 Basic Key Operation

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


 Location of operation keys on the panel and Location of operation keys on the wireless keyboard : "4.1 Parts of the Instrument"

- Wireless keyboard (SF14) (Optional accessory) makes key operation easier and speedier.


 Specification of the keyboard : "27.2 Optional Accessories"

#### ● Power ON / OFF


{ON} : Power On

{ON} (while pressing) +  : Power Off


#### ● Lighting up the display

 : Switch the screen backlight On / Off


#### ● Switching target type


Target type can be switched only on the screen where the target symbol (ex.  ) is displayed.

{SFT} : Switches between target types (Prism/Sheet/None(reflectorless))


 Target symbol displayed: "5.2 Display Functions", Switching the target type in Config mode: "24.1 Changing Instrument Options, ● EDM setting"

#### ● Switching the Laser-pointer / Guide light (optional function) ON / OFF

 (Press and hold ) : To turn the Laser-pointer / Guide light ON/OFF, press and hold until a beep sounds.

 Selecting of laser-pointer / guide light (optional function) : "24.1 Changing Instrument Options, ● EDM setting"

#### Note

- After turning ON the Laser-pointer / Guide light, the laser beam is emitted for 5 minutes, and then automatically switches OFF. But in the Status screen and when target symbol (ex.  ) is not displayed in the Meas mode, the laser beam is not automatically turned off.

#### ● Softkey operation

Softkeys are displayed on the bottom line of the screen.

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

{FUNC} : Toggle between Meas mode screen pages (when more than 4 softkeys are allocated)

## 5. BASIC OPERATION

### ● Inputting letters / figures

- {F1} to {F4}**: Input a letter or a figure allocated to the softkey  
**{FUNC}**: Go to the next softkey page (search for the letter or figure you want to input)  
**{FUNC}** (hold for a moment): Go back one softkey page  
**{FUNC}** (continue to hold): Go to previous softkey pages  
**{BS}**: Delete a character on the left  
**{ESC}**: Cancel the input data  
**{SFT}**: Switch between upper and lower case  
**{←}**: Select / accept input word / value

Example: Input of angle 125° 30' 00" (Input "125.3000")

1. Press **[H.ANG]** in page 2 of Meas mode.
2. Press **{←}** to select "H angle."
3. Press **[1]**. "1" is input and the cursor moves to next input position.
4. Press **[2]**.
5. Press **{FUNC}** to display the page in which **[5]** is allocated.
6. Press **[5]**.
7. Press **{FUNC}** to display the page in which **[.]** is allocated.
8. Input the remaining figures. When input is complete, press **{←}** to accept the value.

HAR: 125.			
1	2	3	4

### Note

- When inputting alphabetic characters, press **{FUNC}** until the page in which letters are allocated is displayed, and input using the same procedure used for inputting figures.

### ● Selecting options

- {▲} / {▼}**: Up and down cursor  
**{▶} / {◀}**: Right and left cursor / Select other option  
**{←}**: Accept the option

Example: Select a reflector type

1. Press **[EDM]** in page 2 of Meas mode.
2. Move to "Reflector" using **{▲} / {▼}**.
3. Display the option you want to select using **{▶} / {◀}**.  
Switches between "Sheet", "Prism" and "None."

EDM	
Mode	: Fine "r"
Reflector	: Prism
PC	: -30
Illum.hold	: Laser



## 5. BASIC OPERATION

4. Press {←} or {▼} to move to the next option.  
The selection is set and you can set the next item.

### ●Switching modes

[CNFG] : From Status mode to Config Mode (Configuration Mode)  
 [MEAS] : From Status mode to Meas Mode (Measurement Mode)  
 [MEM] : From Status mode to Memory Mode  
 {ESC} : Return to the Status mode from each Mode  
 ☐ "4.2 Mode Diagram"

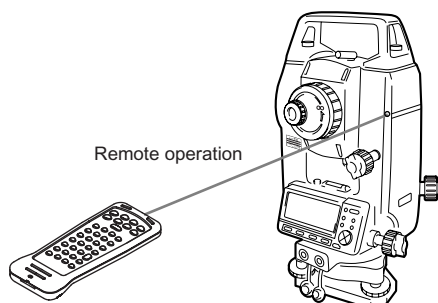
### ●Other operation

{ESC} : Return to the previous screen

## 5. BASIC OPERATION

### Key operation for Wireless Keyboard (SF14)

The SET is operated from the Wireless Keyboard by pointing the Wireless Keyboard beam at the Beam Detector on the SET and pressing the required operation keys.



#### Caution

- When sunlight shines directly into the Beam Detector on the SET, the Wireless Keyboard may not work correctly.
- If other SETs are turned ON and placed within the operating range of the Wireless Keyboard, they may be unintentionally operated at the same time.
- Do not place the keyboard under heavy objects or in a tight space. A key may be continuously depressed and deplete battery power.
- Ni-Cd batteries are recommended when operating the Wireless Keyboard under low temperatures.
- In temperatures around -20°C, the SET may function erratically if the Wireless Keyboard is operated too close to the SET. Hold the Wireless Keyboard further away from the SET and at various angles to the Beam Detector until normal operation is resumed.

#### • Measuring distance

**{MEAS}** : Start distance measurement (same as pressing **[DIST]** or **[OBS]** on the screen / same as pressing **[MLM]** in missing line measurement) / Stop distance measurement

#### • Inputting letters / figures

**{A/N}** : Switch between numerals and alphabetic characters  
**{A} to {Z}** : During numeric input, input numeral or symbol (+/- and .) printed above the key  
 During alphabetic input, input the character of the key

## 5. BASIC OPERATION

- {E} : Enter letters and figures editing mode (same as pressing [EDIT] on the screen)
- {BS} : Delete a character on the left
- {ESC} : Cancel the input data
- {SFT} : Switch between upper and lower case
- {←/→} : Select / accept input word / value

### • Selecting options

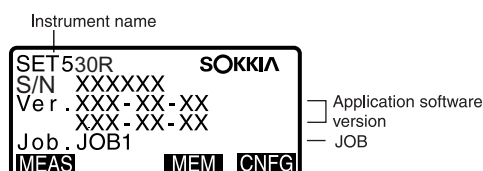
- {R} / {U} (▲/▼ is printed above the key)  
: Up and down cursor (numeric input mode)
- {V} / {T} (▶/◀ is printed above the key)  
: Right and left cursor / Select other option (numeric input mode)
- {←/→} : Accept the option

### Note

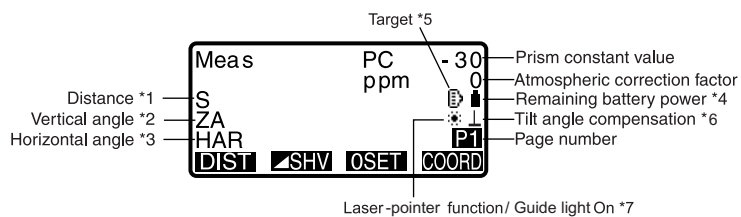
- Other operations (softkey operations and switching modes) are the same for the operation panel on the SET.
- Power On/Off, lighting up the display, Laser-pointer and Guide light (optional function) On/Off cannot be done on the Wireless Keyboard.

## 5.2 Display Functions

### Status screen

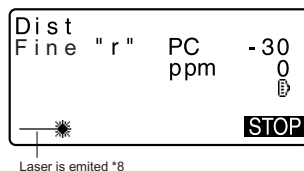


### Meas Mode screen



## 5. BASIC OPERATION

### Measuring screen



### Input screen



#### \* 1 Distance

- ☞ Switching distance display status: "24.1 Changing Instrument Options ● Settings in Config Mode"
- S : Slope distance
- H : Horizontal distance
- V : Height difference

#### \* 2 Vertical angle

- ☞ Switching vertical angle display status: "24.1 Changing Instrument Options ● Settings in Config Mode"
- 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


#### \* 1,2,3


To switch usual "S, ZA, H" display to "S, H, V", press [▲ SHV].

#### \* 4 Remaining battery power (BDC46A, Temperature=25°C, EDM on)

- 🔋 : 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.




## 5. BASIC OPERATION

 (This symbol is displayed every 3 seconds): No power remains.  
Stop the measurement and charge the battery.

 "6.1 Battery Charging"


### \*5 Target display

Press **{SFT}** to switch the selected target. This key function can be used only on the screens on which the target symbol is displayed.


-  :prism
-  :reflective sheet
-  :reflectorless



### \*6 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: "24.1 Changing Instrument Options ● Settings in Config Mode"



### \*7 Laser-pointer/Guide light (optional function) display

 Selecting Laser-pointer/Guide light: "24.1 Changing Instrument Options ● EDM settings", Switching Laser-pointer/Guide light ON/OFF : "5.1 Basic Key Operation"

-  :Laser-pointer is selected and ON
-  :Guide light is selected and ON

### \*8 Appears when laser beam is emitted for distance measurement

### \*9 Input mode

-  :Inputting capital letters and figures.
-  :Inputting small letters and figures.

## 6. USING THE BATTERY

### 6.1 Battery Charging

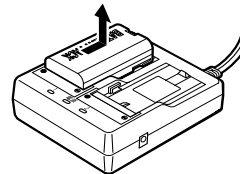
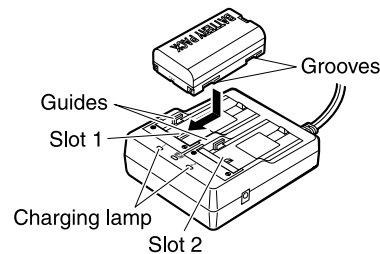
The battery has not been charged at the factory.

#### Caution

- Do not short circuit. Heat or ignition could result.
- Batteries cannot be charged, even when the charging lamp is flashing, when the temperature is outside the charging temperature range. Do charge batteries within the charging temperature range.
- Do not leave the battery in places exposed to high temperatures (more than 35°C). Doing so may reduce the life of the battery.
- Charge the battery once a month to maintain its quality when not in use for long periods.
- Do not charge the battery just after charging is completed. Battery performance may decline.
- Do not use to charge batteries other than those specified.
- If you allow the battery level to get too low, the battery may not be rechargeable or operating time may decline. Keep the battery always charged.
- The charger will become rather hot during use. This is normal.

#### ►PROCEDURE

1. Connect the power cable to the CDC68 charger and plug the charger into the wall outlet.
2. Mount the battery (BDC46A) in the charger (CDC68) by matching the grooves on the battery with the guides on the charger. When charging starts, the lamp starts blinking.
3. Charging takes approximately 2 hours (25°C). The lamp lights when charging is finished.
4. Remove the battery and unplug the charger.



## 6. USING THE BATTERY

### Note

- Slots 1 and 2: The charger starts charging the battery mounted first. If you place two batteries in the charger, the battery in slot 1 is charged first, and then the battery in slot 2. (step 2)
- Charging lamp: The charging lamp is off when the charger is outside the charging temperature range or when the battery is mounted incorrectly. If the lamp is still off after the charger falls within its charging temperature range and the battery is mounted again, contact your Sokkia agent. (steps 2 and 3)
- Charging time : Charging can take more than 2 hours when temperatures are either especially high or low.

### 6.2 Installing / Removing the Battery

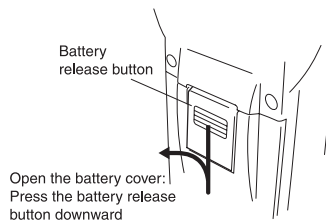
Mount the charged battery.

#### Caution

- When removing the battery, turn the power off.
- When installing / removing the battery, make sure that moisture or dust particles do not come in contact with the inside of the instrument.

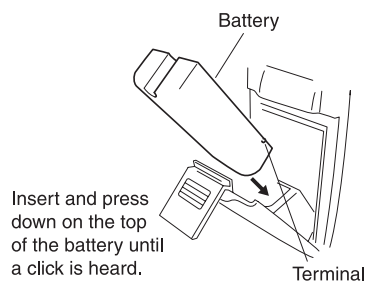
### ►PROCEDURE

1.

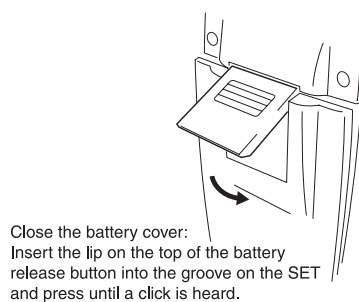


## 6. USING THE BATTERY

2.



3.

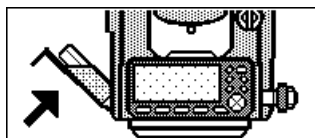


### Note

- Battery cover

If the battery cover is open during power on, SET notifies you by displaying the screen below and beeping.

When the battery cover is closed, the previous screen is restored.





## 7. SETTING UP THE INSTRUMENT

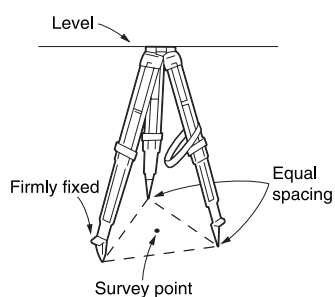
### Caution

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

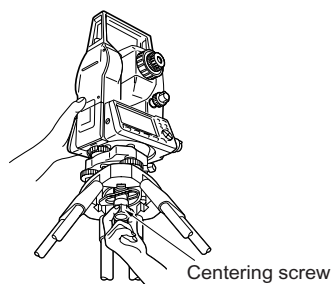
### 7.1 Centering

#### ►PROCEDURE

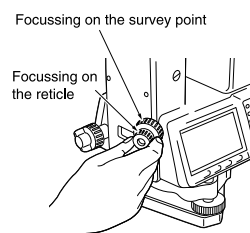
1. Set up the tripod  
Make sure the legs are spaced at equal intervals and the head is approximately level.  
Set the tripod so that the head is positioned over the surveying point.  
Make sure the tripod shoes are firmly fixed in the ground.



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.



## 7. SETTING UP THE INSTRUMENT

### 7.2 Levelling

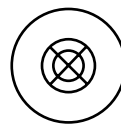
Instrument can be levelled using the screen.

 **Note** Levelling on the screen

#### ►PROCEDURE

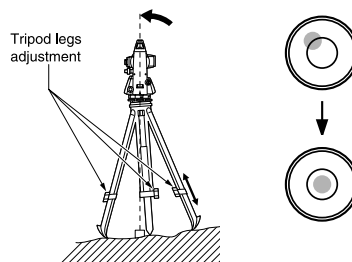
1. Center the surveying point in the reticle

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



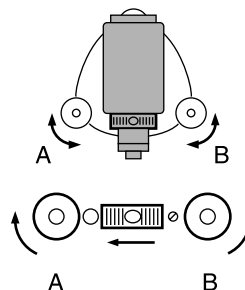
2. Center the bubble in the circular level

Center the bubble in the circular level by either shortening the tripod leg closest to the offcenter direction of the bubble or by lengthening the tripod leg farthest from the offcenter direction of the bubble. Adjust one more tripod leg to center the bubble.



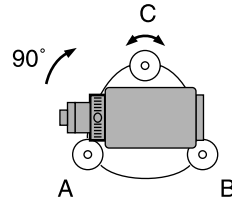
3. Center the bubble in the plate level  
Loosen the horizontal clamp to turn the upper part of the instrument until the plate level is parallel to a line between levelling foot screws A and B.

Center the air bubble using levelling foot screws A and B. The bubble moves towards a clockwise rotated levelling foot screw.

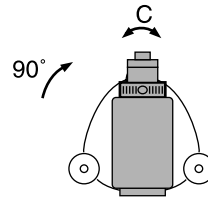


## 7. SETTING UP THE INSTRUMENT

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:

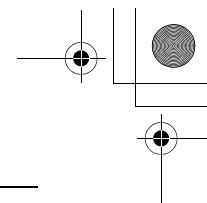
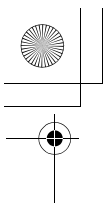


- a. Turn levelling foot screws A and B equally in opposite directions to remove half of the bubble displacement.  
b. Turn the upper part a further 90°, and use levelling foot screw C to remove half of the displacement in this direction.

Or adjust the plate level.

 "26.1 Plate Level"

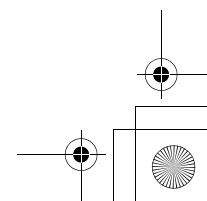
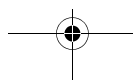
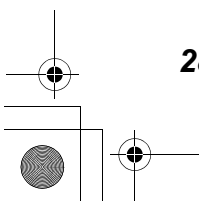
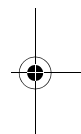
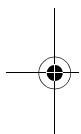
6. Check to see if the bubble is in the same position in any direction  
Turn the instrument and check to see if the air bubble is in the same position in all directions. If it is not, repeat the levelling procedure.



## 7. SETTING UP THE INSTRUMENT

---

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.

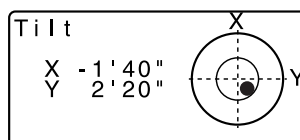


## 7. SETTING UP THE INSTRUMENT

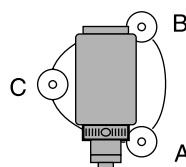
### ►PROCEDURE Levelling on the screen

1. Press **{ON}** to power on
2. Press **[TILT]** in the second page of Meas Mode 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  $\pm 6'$ .  
 Tilt angle values X and Y are also displayed on the screen.

3. Center “●” in the circular level  
 ☞ “7.2 Levelling” steps 1 to 2



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



5. 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.
6. Press **{ESC}** to return to Meas Mode.

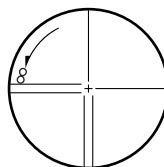
## 8. FOCUSING AND TARGET SIGHTING

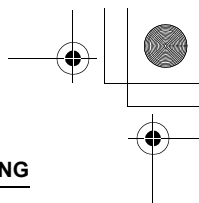
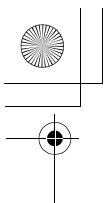
### Caution

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

### ►PROCEDURE

- Focus on the reticle**  
 Look through the telescope eyepiece at a bright and featureless background. Turn the eyepiece screw 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.
- Sight the target**  
 Loosen the vertical and horizontal clamps, then use the peep sight to bring the target into the field of view. Tighten both clamps.
- 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.





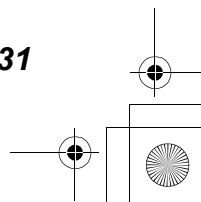
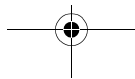
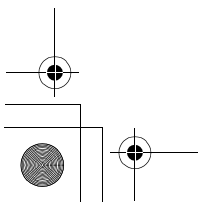
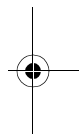
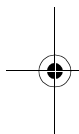
## 8. FOCUSING AND TARGET SIGHTING

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.



## 9. POWER ON

☞ Setting "V manual": "24.1 Changing Instrument Options ● Settings in Config Mode", Setting / changing password: "24.3 Changing Password"

### ►PROCEDURE

#### 1. Power on

Press **{ON}**.

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

- When password is set, the display appears as at right. Input password and press **{←}**.

- When "V manual" is set to "Yes", the display appears as at right.

☞ Manually indexing the vertical circle by face left, face right measurements:  
"30. EXPLANATION"

After that, 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.

### Note

- When "Resume" in "Instr. config" is set to "On", the screen previous to power off is displayed.

☞ "24.1 Changing Instrument Options ● Settings in Config Mode"

- "Tilt crn" in "Obs. condition" should be set to "No" if the display is unsteady due to vibration or strong wind.

☞ "24.1 Changing Instrument Options ● Settings in Config Mode"



## 10. ANGLE MEASUREMENT

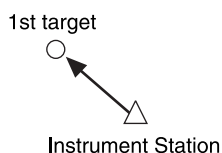
This section explains the procedures for basic angle measurement.

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

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

#### ►PROCEDURE

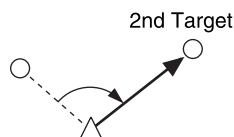
1. Sight the first target as at right.



2. In the first page of the Meas mode screen, press **[OSET]**.  
**[OSET]** will flash, so press **[OSET]** again.  
The horizontal angle at the first target becomes 0°.

Meas	PC	-30
	ppm	0
ZA	89°59'50"	
HAR	0°00'00"	P1
<b>[DIST]</b>	<b>[SHV]</b>	<b>[OSET]</b> <b>[COORD]</b>

3. Sight the second target.



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

Meas	PC	-30
	ppm	0
ZA	89°59'50"	
HAR	117°32'20"	P1
<b>[DIST]</b>	<b>[SHV]</b>	<b>[OSET]</b> <b>[COORD]</b>

## 10. ANGLE MEASUREMENT

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

You can reset the horizontal angle to a required value and use this value to find the horizontal angle of a new target.

#### ►PROCEDURE

1. Sight the first target.
2. In the second page of the Meas mode screen, press **[H.ANG]**.  
Select "H angle."
3. Enter the angle you wish to set, then press **[←]**.  
The value that is input as the horizontal angle is displayed.
4. Sight the second target.  
The horizontal angle from the second target to the value set as the horizontal angle is displayed.

HAR: 125.3220			
1	2	3	4

Meas	PC	-30
	ppm	0
ZA	89°59'50"	
HAR	125°32'20"	P1
DIST	SHV	OSET
		COORD

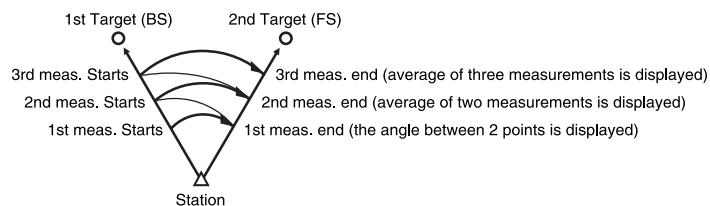
#### Note

- Pressing **[HOLD]** performs the same function as above.
- Press **[HOLD]** to set the displayed horizontal angle. Then, set the angle that is in hold status to the direction you require.  
☞ Allocating **[HOLD]**: "24.2 Allocating Key Functions"

## 10. ANGLE MEASUREMENT

### 10.3 Horizontal Angle Repetition

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



- The maximum number of angle measurements that can be made is 10.

#### ►PROCEDURE

1. In the second page of Meas mode screen, press **[MENU]**, then select "Repetition".

Menu
Coordinate
S-O
Offset
<b>Repetition</b>
MLM

2. Sighting the first target, press **[OK]**.

Repetition	
HARp	0°00'00"
Reps.	0
Ave.	0°00'00"
Take	BS
<b>CE</b>	<b>OK</b>

3. Sighting the second target, press **[OK]**.

4. Sighting the first target a second time, press **[OK]**.


5. Sighting the second target a second time, press **[OK]**.  
The added value of the horizontal angle is displayed on the second line "HARp" and the average value of the horizontal angle is displayed on the fourth line "Ave."

Repetition	
HARp	110°16'20"
Reps.	2
Ave.	50°38'10"
Take	BS
<b>CE</b>	<b>OK</b>

## 10. ANGLE MEASUREMENT


- Return to the previous measurement of the first target and redo it: **[CE]**.  
(Effective when the display shows "Take BS")
- 6. When continuing the repetition measurement, repeat steps 4 to 5.
- 7. When the repetition measurement is completed, press **{ESC}**.

### Note


- It is also possible to perform repetition measurement when **[REP]** on Meas mode screen.  
 Allocating **[REP]**: "24.2 Allocating Key Functions"

### 10.4 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: "27.2 Optional Accessories"
- Output format and command operations: "Interfacing with the SOKKIA SDR Electronic Field Book" and "Command Explanations" manuals.


#### ►PROCEDURE

1. Connect SET and host computer.
2. Allocate the **[D-OUT]** softkey to the Meas mode screen.  
 "24.2 Allocating Key Functions"
3. Sight the target point.
4. Press **[D-OUT]** and select "Angle Data."  
Output measurement data to peripheral equipment.


## 11. DISTANCE MEASUREMENT

Perform the following settings as preparation for distance measurement.

- Distance measurement mode
- Target type
- Prism constant correction value
- Atmospheric correction factor
- EDM ALC

 "24.1 Changing Instrument Options • EDM Settings / • Settings in Config Mode"

### CAUTION

- When using the Laser-pointer function, be sure to turn OFF the output laser after distance measurement is completed. Even if distance measurement is canceled, the Laser-pointer function is still operating and the laser beam continues to be emitted. (After turning ON the Laser-pointer, the laser beam is emitted for 5 minutes, and then automatically switches OFF. But in the Status screen and when target symbol (ex. ) is not displayed in the Meas mode, the laser beam is not automatically turned off. )

#### Caution

- Make sure that the target setting on the instrument matches the type of target used. SET automatically adjusts the intensity of the laser beam and switches the distance measurement display range to match the type of target used. If the target does not correspond to the target settings, accurate measurement results cannot be obtained.
- Accurate measurement results cannot be obtained if the objective lens is dirty. Dust it off with the lens brush first, to remove minute particles. Then, after providing a little condensation by breathing on the lens, wipe it off with the wiping cloth.
- During reflectorless measurement, if an object with a high reflective factor (metal or white surface) is positioned between the SET and the target, accurate measurement results may not be received.
- Scintillation may affect the accuracy of distance of measurement results. Should this occur, repeat measurement several times and use the averaged value of the obtained results.

## 11. DISTANCE MEASUREMENT


### 11.1 Returned Signal Checking

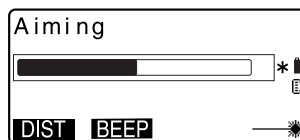
- Check to make sure that sufficient reflected light is returned by the reflective prism sighted by the telescope. Checking the returned signal is particularly useful when performing long distance measurements.


#### Caution

- 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. Allocate the **[AIM]** softkey to the Meas mode screen.  
 "24.2 Allocating Key Functions"
2. Accurately sight the target.
3. Press **[AIM]**.  
 <Aiming> is displayed.  
 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 shift distance measurement.

## 11. DISTANCE MEASUREMENT

- Press **{ESC}** to finish signal checking and return to Meas Mode.

### Note

- When            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.

### 11.2 Distance and Angle Measurement

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

#### ►PROCEDURE

- Sight the target.
- In the first page of Meas Mode, press **[DIST]** to start distance measurement.

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

A short beep sounds, and the measured distance data (S), vertical angle (ZA), and horizontal angle (HAR) are displayed.

Meas	PC	-30
	ppm	0
S		
ZA	80°30'15"	
HAR	120°10'00"	P1
<b>[DIST]</b>	<b>[SHV]</b>	<b>[OSET]</b> <b>[COORD]</b>

Dist	PC	-30
Fine "r"	ppm	0
		<b>[STOP]</b>

Meas	PC	-30
	ppm	0
S	525.450m	
ZA	80°30'10"	
HAR	120°10'00"	P1
		<b>[STOP]</b>


## 11. DISTANCE MEASUREMENT

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

- Each time **[SHV]** is pressed, S (Slope distance), H (Horizontal distance) and V (Height difference) are displayed alternately.

Meas	PC	-30
	ppm	0
S	525.450m	
H	518.248m	
V	86.699m	P1
<b>[DIST]</b>	<b>[SHV]</b>	<b>[OSET]</b> <b>[COORD]</b>

### 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.
- 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.  
 "11.3 Recalling the Measured Data"

## 11.3 Recalling the Measured Data

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.

The distance measurement value, vertical angle, horizontal angle, and the coordinates can be displayed. Distance measurement values converted into the horizontal distance, elevation difference, and the slope distance can also be displayed.

### ►PROCEDURE

- Allocate the **[RCL]** softkey to the Meas mode screen.  
 "24.2 Allocating Key Functions"



## 11. DISTANCE MEASUREMENT

2. Press **[RCL]**.  
The stored data that is most recently measured is displayed.


S	525.450m
ZA	80°30'10"
HAR	120°10'10"
N	-128.045
E	-226.237
Z	30.223

- If you have pressed **[SHV]** beforehand, the distance values are converted into the horizontal distance, elevation difference, and the slope distance and recalled.

3. Press **{ESC}** to return to Meas mode.


### 11.4 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: "27.2 Optional Accessories"

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

#### ►PROCEDURE

1. Connect SET and host computer.
2. Allocate the **[D-OUT]** softkey to the Meas mode screen.  
 "24.2 Allocating Key Functions"
3. Sight the target point.
4. Press **[D-OUT]**, and select "Dist data" to measure the distance and output the data to peripheral equipment.
5. Press **[STOP]** to stop outputting data and return to Meas Mode.

## 11. DISTANCE MEASUREMENT

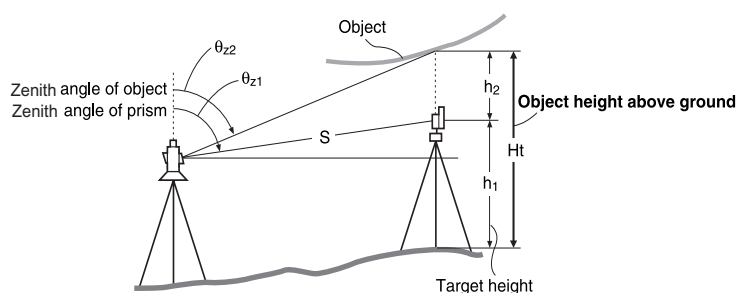
### 11.5 REM Measurement

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.

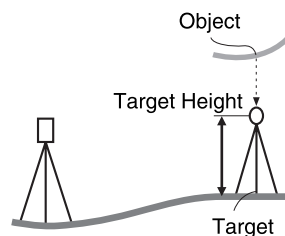
$$H_t = h_1 + h_2$$


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



#### PROCEDURE

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



2. After inputting the target height, accurately sight the target.  
 **Note**  
 Press **[DIST]** in page 1 of Meas Mode to carry out measurement.

The measured distance data (S), vertical angle (ZA), and horizontal angle (HAR) are displayed.  
 Press **[STOP]** to stop the measurement.

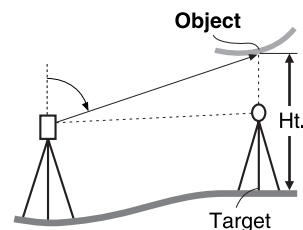
## 11. DISTANCE MEASUREMENT

3. In the second page of Meas mode screen, press **[MENU]**, then select "REM".

**REM**  
 Resection  
 Area calculation  
 Set-out line  
 Point projection

4. The REM measurement is started and the height from the ground to the object is displayed in "Ht.".

REM  
 Ht . 6.255m  
 S 13.120m  
 ZA 89°59'50"  
 HAR 117°32'20"  
**STOP**



5. Press **[STOP]** to terminate the measurement operation.
- To re-observe the target, sight the target, then press **[OBS]**.

REM  
 Ht . 6.255m  
 S 13.120m  
 ZA 89°59'50"  
 HAR 117°32'20"  
**REM** **OBS**

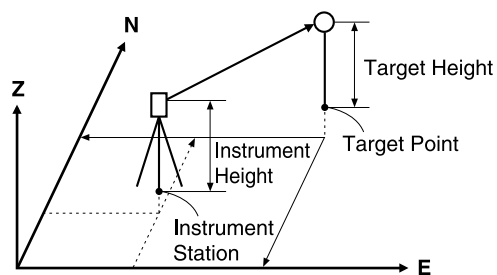
6. Press **{ESC}** to finish measurement and return to the Meas mode screen.


### Note

- It is also possible to perform REM measurement when **[REM]** on the Meas mode screen.  
 ☞ "24.2 Allocating Key Functions"
- Inputting target height (Step 3): Press **[HT]** to set target height. It can be set also in "Stn data" of coordinate measurement.  
 ☞ "12.1 Entering Instrument Station Data"

## 12. 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 which are entered in advance.



- EDM setting can be done in coordinate measurement menu.  
 Setting items: "24.1 Changing Instrument Options ● EDM settings"

### 12.1 Entering Instrument Station Data

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

#### ►PROCEDURE

1. First measure the target height and instrument height with a tape measure, etc.
2. Press **[COORD]** in the first page of the Meas mode screen to display <Coord.>

## 12. COORDINATE MEASUREMENT

3. Select "Stn Orientation," then  
"Stn coordinate."  
Press **[EDIT]**, then input the  
instrument station coordinates,  
instrument height and target  
height.

N0:	0.000
E0:	0.000
Z0:	0.000
Inst.h:	1.400m
Tgt.h:	1.200m
<b>READ REC EDIT OK</b>	

N0:	370.000
E0:	10.000
Z0:	100.000
Inst.h:	1.400m
Tgt.h:	1.200m
<b>1 2 3 4</b>	

- When you wish to read in the  
registered coordinate data,  
press **[READ]**.  
☞ "PROCEDURE Reading in  
Registered Coordinate Data"

4. Press **[OK]** to set the input values.  
<Coord> is displayed again.

- When **[REC]** is pressed,  
instrument station data is saved.  
☞ "20. RECORDING DATA -  
RECORD MENU -"

## 12. COORDINATE MEASUREMENT

### ►PROCEDURE Reading in Registered Coordinate Data

Known point data, coordinate data and instrument station data in the current JOB and Coordinate Search JOB can be read in.

Confirm that the correct JOB containing the coordinates you want to read in is already selected in Coordinate Search JOB in Memory Mode.

☞ "22.1 Registering/Deleting Known Point Data", "21.1 Selecting a JOB"

1. Press **[READ]** when setting Instrument Station.  
The list of registered coordinates is displayed.

Pt. : Known point data saved in the current JOB or in the Coordinate Search JOB.

Crd./ Stn : Coordinate data saved in the current JOB or in the Coordinate Search JOB.

Pt.	11111111
Pt.	1
Crd.	2
Stn	12345679
Stn	1234
[↑↓...P]	[TOP] [LAST] [SRCH]

2. Align the cursor with the required point number and press **[←]**.  
The point number that was read in and its coordinate is displayed.

N0:	9.876
E0:	5.432
Pt.	PNT-001
Inst.h	0.000m
Tgt.h	0.000m
[READ]	[REC] [EDIT] [OK]

- **[↑↓...P]** = Use **[▲]** / **[▼]** to move from page to page.  
**[↑↓...P]** = Use **[▲]** / **[▼]** to select individual point.
- Press **[TOP]** to move to the first point number on the first page.
- Press **[LAST]** to move to the last point number on the last page.
- Press **[SRCH]** to move to the "Coordinate Data Search Screen." Input the point number you want to search in "Pt. no." The search may take time if many data are registered.

## 12. COORDINATE MEASUREMENT

3. Press **[OK]**.  
<Instrument Station Data Setting>  
is restored.

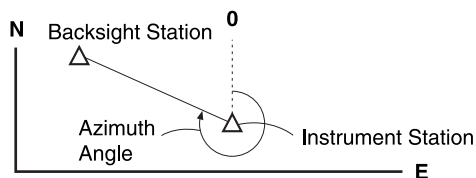
- Press **[EDIT]** to edit the coordinate data that was read in. Editing does not affect the original coordinate data. After editing, the point number is no longer displayed.

### Note

- The point number that was read in is displayed until the current JOB is changed.
- When **[SRCH]** is pressed, SET searches data in the current JOB first, then in the Coordinate Search JOB.
- If more than two points with the same point name exist in the current JOB, SET finds the newer data only.

### 12.2 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. Select "Stn.Orientation", then "Set H angle" in <Coord.>.

## 12. COORDINATE MEASUREMENT

2. Select "Back sight", press **[EDIT]**, then input the backsight station coordinates.

Set H angle/BS			
NBS:	170.000		
EBS:	470.000		
ZBS:	100.000		
1	2	3	4

- When you wish to read in and set coordinate data from memory, press **[READ]**.

 "12.1 Entering Instrument Station Data, PROCEDURE Reading in Registered Coordinate Data"

3. Press **[OK]**.  
Instrument station coordinates are displayed.

4. Press **[OK]** again to set the instrument coordinates.

Set H angle	
Take BS	
ZA	89°59'55"
HAR	117°32'20"
NO YES	

5. Sight the backsight station, then press **[YES]** to set the backsight station.  
<Coord> is restored.

- Press **[NO]** to go back to step 2.



## 12. COORDINATE MEASUREMENT

### 12.3 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.

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

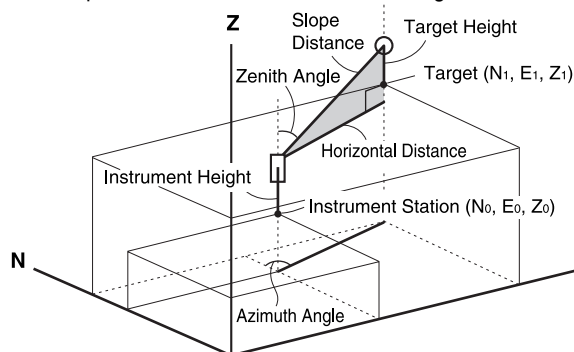
$$E1 \text{ Coordinate} = E0 + S \times \sin Z \times \sin Az$$

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

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: Direction angle



#### ►PROCEDURE

1. Sight the target at the target point.
2. In <Coord>, select "Observation" to start measurement. The coordinate value of the target is displayed. Press **[STOP]** to quit measurement.


Coord.  
Stn. Orientation  
**Observation**  
EDM

## 12. COORDINATE MEASUREMENT

- By pressing **[HT]**, the instrument station data can be reset. When the target height of the next target is different, reenter the target height before beginning the observation.

N	240.490	
E	340.550	
Z	305.740	
ZA	89°42'50"	
HAR	180°31'20"	
<b>OBS</b>	<b>HT</b>	<b>REC</b>

- [REC]**: records measurement results

 Recording method:  
"20. RECORDING DATA -  
RECORD MENU -"

- Sight the next target and press **[OBS]** to begin measurement. Continue until all targets have been measured.
- When coordinate measurement is completed, press **{ESC}** to return to <Coord>.

## 13. 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

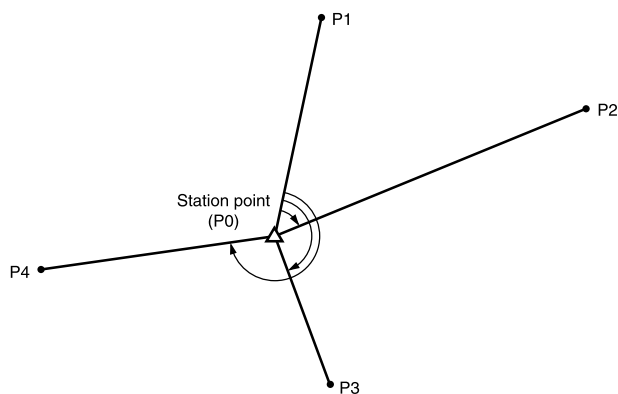
### Output

Coordinates of known point : (Xi, Yi, Zi) Station point coordinates : (X0, Y0, Z0)

Observed horizontal angle : Hi

Observed vertical angle : Vi

Observed distance : Di



- All the N, E, Z or only Z data of an instrument station is calculated by measuring the known points.
- Coordinate resection measurement overwrites the N, E and Z data of the instrument station, but height resection does not overwrite N and E. Always perform resection measurement in the sequence described in "13.1 Coordinate Resection Measurement" and "13.2 Height Resection Measurement".
- Input known coordinate data and calculated instrument station data can be recorded in the current JOB.

☞ "21. SELECTING / DELETING A JOB"

## 13. RESECTION MEASUREMENT

### 13.1 Coordinate Resection Measurement

N, E, Z of an instrument station is determined by the measurement.

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

#### ►PROCEDURE

- In the second page of Meas mode screen, press **[MENU]**, then select "Resection".

REM  
**Resection**  
 Area calculation  
 Set-out line  
 Point projection

- Select "NEZ" and press **[EDIT]** to input the known point.  
 After setting the coordinates for the first known point press **[▶]** to move to the second point.  
 When all required known points have been set, press **[MEAS]**.

Resection.  
**NEZ**  
 Elevation

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

"12.1 Entering Instrument Station Data, PROCEDURE Reading in Registered Coordinate Data"

- Press **[◀]** to return to the previous known point.

2nd Pt. ▶  
 No: 100.000  
 Ep: 100.000  
**Zp: 50.000**  
 Tgt.h: 1.400m  
**READ REC EDIT MEAS**

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

Resection 1st Pt.  
 N 100.000  
 E 100.000  
 Z 50.000  
**DIST ANGLE**

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

### 13. RESECTION MEASUREMENT

4. Press **[YES]** to use the measurement results of the first known point.

- You can also input target height here.

Resection	1st Pt.
S	525.450m
ZA	80°30'15"
HAR	120°10'00"
Tgt.h	1.400m
<div> <div>EDIT</div> <div>NO</div> <div>YES</div> </div>	

5. Repeat procedures 4 to 5 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.

Resection	3rd Pt.
S	125.450m
ZA	40°30'15"
HAR	20°10'00"
Tgt.h	1.200m
<div> <div>CALC</div> <div>EDIT</div> <div>NO</div> <div>YES</div> </div>	

7. Press **[RESULT]** to check the result.  
If there are no problems with the result, press **[ESC]** and go to step 11.

N	100.001
E	100.000
Z	9.999
σN	0.0014m
σE	0.0007m
<div> <div>RESULT</div> <div>REC</div> <div>OK</div> </div>	

- [REC]**: records measurement results

 Recording method:  
"20. RECORDING DATA -  
RECORD MENU -"

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

	σN	σE
1st	-0.001	0.001
* 2nd	0.005	0.010
3rd	-0.001	0.001
4th	-0.003	-0.002
<div> <div>BAD</div> <div>RE CALC</div> <div>RE OBS</div> <div>ADD</div> </div>		

### 13. RESECTION MEASUREMENT

8. If there are problems with the results of a point, align the cursor with that point and press **[BAD]**.  
 “\*” is displayed on the left of the point. Repeat for all results that include problems.

9. Press **[RE CALC]** to perform calculation again without the point designated in step 8. The result is displayed.  
 If there are no problems with the result, go to step 10.  
 If problems with the result occur again, perform the resection measurement from step 3.


- Press **[RE OBS]** to measure the point designated in step 9.  
 If no points are designated in step 9, all the points or only the final point can be observed again.

Resection  
 Start point  
 Last point

10. Press **[OK]** in the screen of step 6 to finish resection measurement. The instrument station coordinate is set.  
 Press **[YES]** when you want to set the azimuth angle of the first known point as the backsight point.

- Press **[NO]** to return to Meas Mode without setting the azimuth angle.

#### Note

- It is also possible to perform resection measurement when **[RESEC]** on Meas mode screen.  
 Allocating **[RESEC]**: "24.2 Allocating Key Functions"
- Even if "inch" is selected in Config mode, standard deviation is displayed in "feet."

## 13. RESECTION MEASUREMENT

### 13.2 Height Resection Measurement

Only Z (height) of an instrument station is determined by the measurement.

- Known points must be measured by distance measurement only.
- Between 1 and 10 known points can be measured.

#### ►PROCEDURE

1. In the second page of Meas mode screen, press **[MENU]**, then select "Resection".
2. Select "Elevation" and press **[EDIT]** to input the known point. After setting the elevation for the first known point, press **[▶]** to move to the second point. When all required known points have been set, press **[MEAS]**.
  - Press **[◀]** to return to the previous known point.
3. Sight the first known point and press **[OBS]** to begin measurement. The measurement results are displayed on the screen.
4. Press **[YES]** to use the measurement results of the first known point.
5. If measuring two or more known points, 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.

Resection.  
NEZ  
Elevation

◀ 10th Pt.  
Zp: 11.891  
Tgt.h: 0.100m  
READ REC EDIT MEAS

Resection 10th Pt.  
Z 11.718  
OBS

### 13. RESECTION MEASUREMENT

6. Press **[CALC]** or **[YES]** to automatically start calculations after observations of all known points are completed. Instrument station elevation and standard deviation, which describes the measurement accuracy, are displayed.
7. Press **[RESULT]** to check the result.  
If there are no problems in the result, press **{ESC}** and go to step 10.
8. If there are problems with the results of a point, align the cursor with that point and press **[BAD]**.  
“\*” is displayed on the left of the point.
9. Press **[RE CALC]** to perform calculation again without the point designated in step 8. The result is displayed.  
If there are no problems with the result, go to step 10.  
If problems with the result occur again, perform the resection measurement from step 3.
10. Press **[OK]** to finish resection measurement. Only Z (elevation) of the instrument station coordinate is set. N and E values are not overwritten.

Z	10.000
$\sigma Z$	0.0022m
<b>RESULT</b>	<b>REC</b> <b>OK</b>

	$\sigma Z$
1st	-0.003
2nd	-0.003
3rd	0.000
4th	0.002
<b>BAD</b>	<b>RE CALC</b> <b>RE OBS</b> <b>ADD</b>

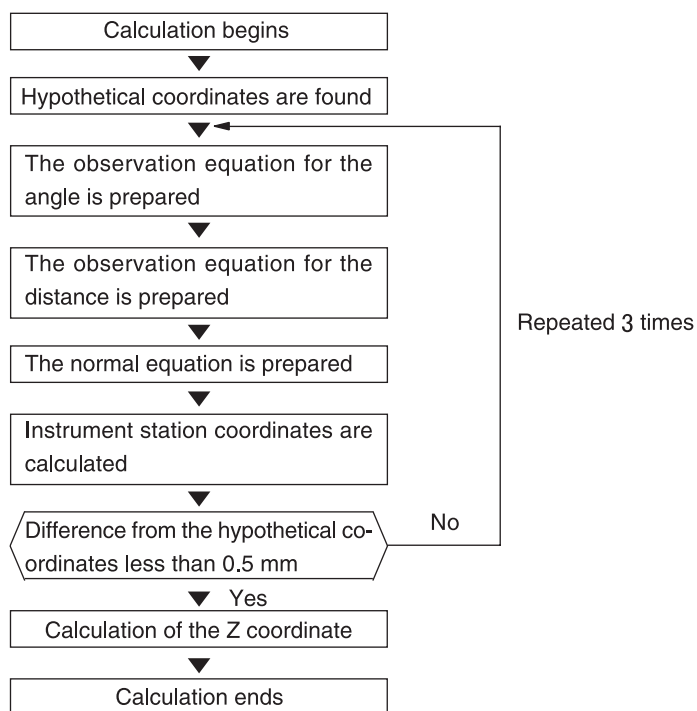


### 13. RESECTION MEASUREMENT



#### Resection calculation process

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



### 13. RESECTION MEASUREMENT



#### Precaution when performing resection

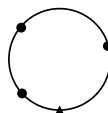
In some cases it is impossible to calculate the coordinates of an unknown point (instrument station) if the unknown point and three or more known points are arranged on the edge of a single circle.

An arrangement such as that shown below is desirable.



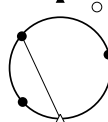
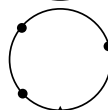
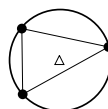
△▲ : Unknown point  
○● : Known point

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.

## 14. 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 angle difference

dHA = Horizontal angle of setting-out data - measured horizontal angle


### Distance difference

Distance      Displayed item

Sdist: S-O S = measured slope distance - slope distance of setting-out data

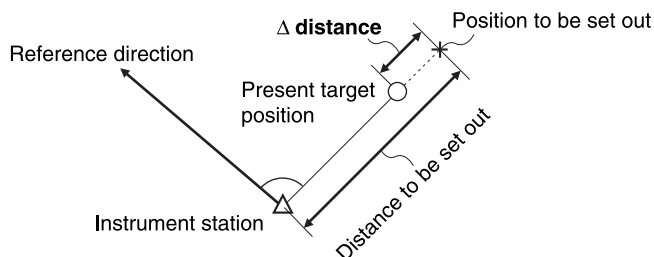
Hdist: S-O H = measured horizontal distance - horizontal distance of setting-out data

Vdist: S-O V = measured height difference - height difference of setting-out data

- Setting out data can be input in various modes: slope distance, horizontal distance, height difference, coordinates and REM measurement.
- In slope distance, horizontal distance, height difference, and coordinate mode, registered coordinates can be recalled and used as setting-out coordinates. In slope distance, horizontal distance and height difference, S/H/V distances are calculated from the read in setting-out coordinate, instrument station data, instrument height, and target height.
- Setting-out measurement can be carried out effectively using the Guide light.  
 "4.1 Parts of the Instrument", "5.1 Basic Key Operation" and "27.2 Optional Accessories"

### 14.1 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.



## 14. SETTING-OUT MEASUREMENT

### ►PROCEDURE

1. Press **[S-O]** in the third page of the Meas mode screen to display <S-O>.
2. Enter the instrument station data.  
 "12.1 Entering Instrument Station Data, PROCEDURE Reading in Registered Coordinate Data".
3. Set the azimuth angle of the backsight point.  
 "12.2 Azimuth Angle Setting" steps 2 to 6
4. Select "S-O data."

S-O  
 Stn. Orientation  
**S-O data**  
 Observation  
 EDM

5. Press **[ΔS-O]** to select distance input mode.  
 Each time **[ΔS-O]** is pressed: S-O S (slope distance), S-O H (horizontal distance), S-O V (height difference), S-O Coord (coordinates), S-O Ht. (REM measurement).  
 "14.2 Coordinates Setting-out Measurement", "14.3 REM Setting-out Measurement"

S-O S  
 S dist: 0.000m  
 H ang: 0°00'00"  
 P1  
**READ** **ΔS-O** **EDIT** **OK**

- When **[READ]** is pressed, registered coordinates can be recalled and used. Distance and angle are calculated using the coordinate value.  
 "12.1 Entering Instrument Station Data, PROCEDURE Reading in Registered Coordinate Data"

## 14. SETTING-OUT MEASUREMENT

6. Press **[EDIT]** and set the following items.

- (1) Sdist/Hdist/Vdist: distance from the instrument station to the position to be set out.
- (2) H ang: included angle between the direction of the reference and the point to be set out.

- Pressing **[COORD]** in the second page allows you to enter the coordinates of the point to be set out.

S-O H  
Hdist: 3.300m  
H ang: 40°00'00"  
P1  
READ S-O EDIT OK

S-O H  
Hdist: 3.300m  
H ang: 40°00'00"  
P2  
COORD

7. Press **[OK]** to set the input values.

8. Rotate the top of the instrument until "dHA" is 0° and place the target on the sight line.

9. Press **[OBS]** to start distance measurement. The target and the distance of the point to be set out is displayed (S-O H).

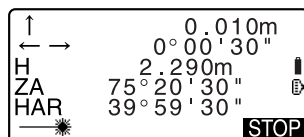
S-O H 0.820m  
dHA 0°09'40"  
H 2.480m  
ZA 75°20'30"  
HAR 39°05'20"  
OBS S-O ← → REC

S-O H 0.820m  
dHA 0°09'40"  
H 2.480m  
ZA 75°20'30"  
HAR 39°05'20"  
STOP

10. Move the prism forward and backward until the setting-out distance is 0m. If [S-O H] is "+", move the prism toward yourself, if it is "-", move the prism away from yourself.

## 14. SETTING-OUT MEASUREMENT

- By pressing [ $\leftarrow \rightarrow$ ], an arrow pointing to the left or right displays which direction the target should be moved.

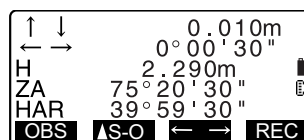


- ← : Move the prism to left.
- : Move the prism to right.
- ↓ : Move the prism forward.
- ↑ : Move the prism away.

When the target is within measurement range, all four arrows are displayed.

11. Press **{ESC}** to return to <S-O>.

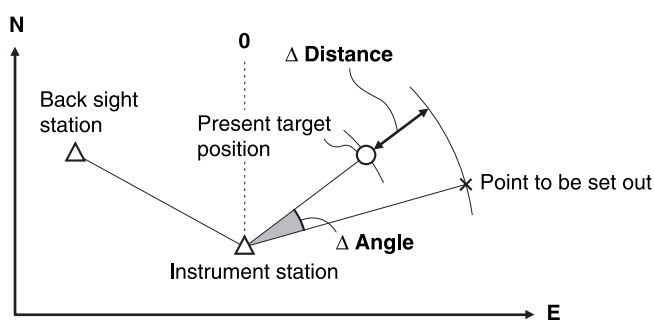
- When **[READ]** was used in step 5, the list of registered coordinates is restored. Continue setting-out measurement.
- [REC]**: records measurement results
- Recording method:  
"20. RECORDING DATA -  
RECORD MENU -"



## 14. SETTING-OUT MEASUREMENT

### 14.2 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.



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

#### ►PROCEDURE

1. Press **[S-O]** on the third page of the Meas mode screen to display <S-O>.
2. Enter the instrument station data.  
☐ "12.1 Entering Instrument Station Data PROCEDURE Reading in Registered Coordinate Data".
3. Set the azimuth angle of the backsight point.  
☐ "12.2 Azimuth Angle Setting" steps 2 to 6
4. Select "S-O data" and press **[▲ S-O]** until <S-O Coord> is displayed.

## 14. SETTING-OUT MEASUREMENT

5. Press **[EDIT]**. Enter the coordinates of the setting-out point.

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

"12.1 Entering Instrument Station Data, PROCEDURE Reading in Registered Coordinate Data"

S-O Coord	
Np:	100.000
Ep:	100.000
Zp:	50.000
Tgt. h:	1.400m P1
<div> <div>READ</div> <div>▲S-O</div> <div>EDIT</div> <div>OK</div> </div>	

6. Press **[OK]** to set the setting-out data.

7. Press **[OBS]** to begin coordinate setting-out measurement. Move the prism to find the point to be set out.

"14.1 Distance Setting-out Measurement" steps 9 to 10

- ▲ : Move the prism upward.  
▼ : Move the prism downward.

↓	1.988m	
→	2.015m	
▲	-1.051m	🔋
ZA	89°52'50"	📖
HAR	150°16'10"	
<div> <div>OBS</div> <div>▲S-O</div> <div>← →</div> <div>REC</div> </div>		

8. Press **{ESC}** to return to <S-O>. When **[READ]** was used in step 5, the list of registered coordinates is restored. Continue setting-out measurement.



## 14. SETTING-OUT MEASUREMENT

### 14.3 REM Setting-out Measurement

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


☞ "11.5 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. Press **[S-O]** in the Meas mode screen to display <S-O>.
3. Enter the instrument station data.  
☞ "12.1 Entering Instrument Station Data, PROCEDURE Reading in Registered Coordinate Data".
4. Select "S-O data" and press **[▲S-O]** until <S-O Ht.> is displayed.
5. Press **[EDIT]**.  
Input height from the surveying point to the position to be set out in "SO dist".
6. After inputting the data, press **[OK]**.

S-O Ht.	
Height:	3.300m
<b>▲S-O</b>	<b>EDIT</b> <b>OK</b>

## 14. SETTING-OUT MEASUREMENT

7. Press **[REM]** to begin REM setting-out measurement. Move the telescope to find the point to be set out.  
 "14.1 Distance Setting-out Measurement" steps 9 to 10

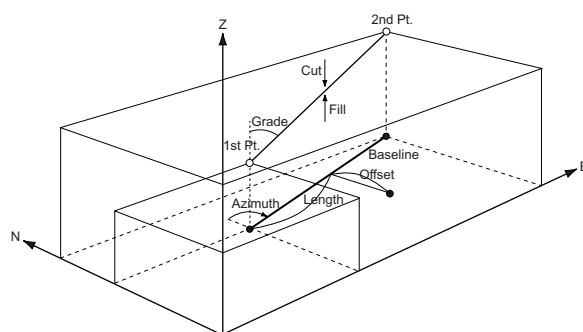
	1.051m	
S	1.051m	
ZA	89°52'55"	
HAR	150°16'10"	
REM	▲S-O	←→

- ▲ : Move the telescope near the zenith.
- ▼ : Move the telescope near the nadir.

8. When the measurement is completed, press **{ESC}** to restore <S-O>.

## 15. SETTING-OUT LINE

Setting-out line is used for setting out a required point at a designated distance from the baseline and for finding the distance from the baseline to a measured point.



### 15.1 Defining Baseline

To perform setting-out line measurement, first, define the baseline. The baseline can be defined by inputting the coordinates of the two points. The scale factor value is the difference between the input coordinates and the observed coordinates.

Scale (X, Y) =  $\frac{\text{Hdist}' (\text{horizontal distance calculated from the measured value})}{\text{Hdist} (\text{horizontal distance calculated from the input coordinates})}$

- When not observing first or second points, scale factor is set to "1".
- Defined baseline can be used in both setting-out line measurement and point projection.

#### ►PROCEDURE

1. In the second page of Meas mode screen, press **[MENU]**, then select "Set-out line."

REM  
Resection  
Area calculation  
**Set-out line**  
Point projection

## 15. SETTING-OUT LINE

2. Enter the instrument station data.

"12.1 Entering Instrument Station Data, PROCEDURE Reading in Registered Coordinate Data".

3. Select "Define baseline" in <Set-out line> and press **[EDIT]**.

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

"12.1 Entering Instrument Station Data, PROCEDURE Reading in Registered Coordinate Data"

Set-out line  
Stn. Orientation  
**Define baseline**  
Set-out line

Define 1st Pt.   
Np: **113.464**  
Ep: 91.088  
Zp: 12.122  
**READ REC EDIT**

4. Enter the first point data and press **{←}**.

5. Press **{▶}** to move to the second point.

6. Press **[EDIT]** and enter the second point data.

◀ Define 2nd Pt. ▶  
Np: **112.706**  
Ep: 104.069  
Zp: 11.775 **P1**  
**READ REC EDIT OK**

7. Press **{FUNC}**.  
**[MEAS]** is displayed.

- When not observing the first point and the second point, go to step 13.

◀ Define 2nd Pt. ▶  
Np: **112.706**  
Ep: 104.069  
Zp: 11.775 **P2**  
**MEAS**

8. Press **[MEAS]** on the screen of step 7 to move to observation of the first point.

## 15. SETTING-OUT LINE

9. Sight the first point and press **[OBS]**.

The measurement results are displayed on the screen.

- Press **[STOP]** to stop the measurement.
- You can input target height here.

Measure 1st Pt.	
N	113.464
E	91.088
Z	12.122
<b>[OBS]</b>	

10. Press **[YES]** to use the measurement results of the first point.

- Press **[NO]** to observe the first point again.

Measure 1st Pt.	
S	525.450m
ZA	80°30'15"
HAR	120°10'00"
Tgt.h	1.400m
<b>[EDIT] [NO] [YES]</b>	

11. Sight the second point and press **[OBS]**.

12. Press **[YES]** to use the measurement results of the second point.  
The distance between the two measured points, the distance calculated from inputting the coordinates of two points and the scale factors are displayed.

Azimuth 93°20'31"	
Hcalc	13.003m
Hmeas	13.004m
ScaleX	1.000091
ScaleY	1.000091
<b>[Sy=1] [Sy=Sx] [EDIT] [OK]</b>	

Grade	%-2.669
<b>[1:**] [%] [OK]</b>	

13. Press **[OK]** on the screen of step 13 to define the baseline. <Set-out line> is displayed. Move to setting-line measurement.

"15.2 Setting-out Line Point"/  
"15.3 Setting-out Line Line"

Set-out line	
<b>[Point]</b>	
Line	

- Press **[Sy=1]** to set scale factor y to "1".
- Press **[1 : \*\*]** to change the grade display mode to "1 : \*\* = elevation : horizontal distance".

## 15. SETTING-OUT LINE



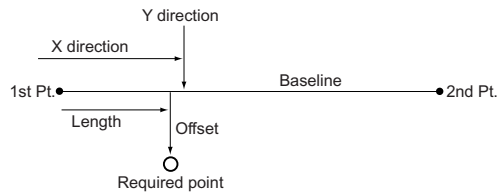
- It is also possible to perform setting-out line measurement when **[S-O LINE]** on the Meas mode screen.

Allocating **[S-O LINE]**: "24.2 Allocating Key Functions".

### 15.2 Setting-out Line Point

Setting-out line point measurement can be used to find the required point coordinate by inputting the length and offset based on the baseline.

- Before performing setting-out line point, the baseline must be defined.



#### ►PROCEDURE

- Select "Point" in <Set-out line>

Set-out line	
Point	
Line	

- Press **[EDIT]**.

Set the following items.

- Length: Distance along the baseline from the first point to the position at which a line extending from the required point intersects the baseline at right angles (X direction).
- Offset: Distance from the required point to the position at which a line extending from the required point intersects the baseline at right angles (Y direction).

Set-out line	
Length	3.678m
Offset	1.456m
<div>EDIT</div> <div>OK</div>	

## 15. SETTING-OUT LINE

3. Press **[OK]** on the screen of step 2. The coordinate value of the required point is calculated and displayed.

Set-out line	
N	111.796
E	94.675
Z	12.024

**REC****▲S-O**

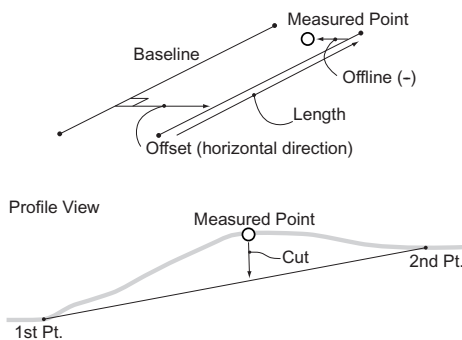
- **[REC]**: records the coordinate value as a known point data.
- ☞ Recording method:  
"22.1 Registering/Deleting  
Known Point Data"
- Press **▲S-O** to move to setting-out measurement of the required point.
- ☞ "14. SETTING-OUT  
MEASUREMENT"

4. Press **{ESC}**. Continue the measurement (repeat steps from 4).

### 15.3 Setting-out Line Line

Setting-out line line measurement tells how far horizontally the measured point is from the baseline and how far vertically the measured point is from the connected line. The baseline can be offset in a horizontal direction if necessary.

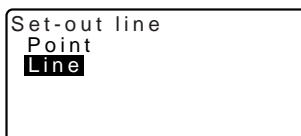
- Before performing setting-out line line, the baseline must be defined.



## 15. SETTING-OUT LINE

### ►PROCEDURE

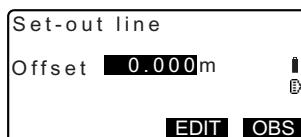
1. Select "Line" in <Set-out line>.



Set-out line  
Point  
**Line**

2. Press **[EDIT]** and enter the offset value.

- Offset: How much to move the baseline.  
Right side indicates positive value and left side indicates negative value.
- When not setting offset value, go to step 3.



Set-out line  
Offset **0.000**m  
**EDIT** **OBS**

3. Sight the target and press **[OBS]** on the screen of step 2.  
The measurement results are displayed on the screen.  
Press **[STOP]** to stop the measurement.



## 15. SETTING-OUT LINE


4. Press **[YES]** to use the measurement results.  
Displays the difference between the measured point and the baseline.

Set-out line	
S	525.450m
ZA	80°30'15"
HAR	120°10'00"
Tgt.h	1.400m
<input type="button" value="EDIT"/> <input type="button" value="NO"/> <input type="button" value="YES"/>	

- Offline: A positive value indicates the point is on the right of the baseline and a negative value indicates it is on the left.
- "Cut" indicates that the point is below the baseline.
- "Fill" indicates that the point is above the baseline.
- Length: Distance along the baseline from the first point to the measured point.
- Press **[NO]** to observe the target again.

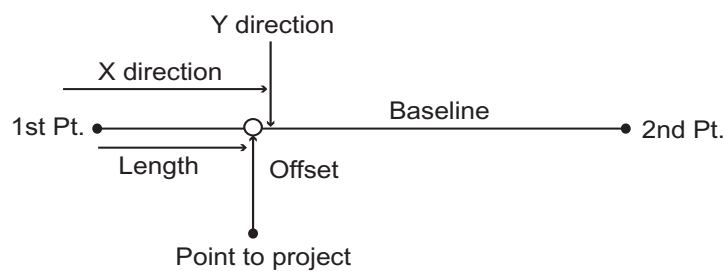
5. Sight the next target and press **[OBS]** to continue the measurement.

Set-out line	
Offline	-0.004m
Cut	0.006m
Length	12.917m
<input type="button" value="REC"/> <input type="button" value="OBS"/>	

- Press **[REC]**: records measurement results.
-  Recording method:  
"20. RECORDING DATA - RECORD MENU -"

## 16. POINT PROJECTION

Point projection is used for projecting a point onto the baseline. The point to project can be either measured or input. Displays the distances from the first point and point to project to the position at which a line extending from point to project intersects the baseline at right angles.



### 16.1 Defining Baseline

- Defined baseline can be used in both setting-out line measurement and point projection.

#### ►PROCEDURE

- In the second page of Meas mode screen, press **[MENU]**, then select "Point Projection".

```

REM
Resection
Area calculation
Set-out line
Point projection
  
```

- Enter the instrument station data then define the baseline.  
 "15.1 Defining Baseline" step 2 to 13

- Press **[OK]** to define the baseline.  
 <Point projection> is displayed.  
 Move to point projection measurement.  
 "16.2 Point Projection"

```

Point projection
Np: 103.514
Ep: 101.423
Zp: 12.152
READ OBS EDIT OK
P1
  
```

## 16. POINT PROJECTION

### Note

- It is also possible to perform setting-out line measurement when **[P-PROJ]** on the Meas mode screen.

Allocating the function key: ".24.2 Allocating Key Functions"

### 16.2 Point Projection

Before performing point projection, the baseline must be defined.

#### ►PROCEDURE

- Define the baseline.  
 "16.1 Defining Baseline"
- Select "Point Projection" in <Point Projection>.

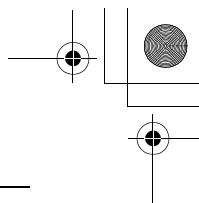
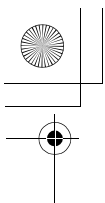
Point projection  
Stn. Orientation  
Define baseline  
**Point Projection**

- Press **[EDIT]**, enter the point coordinate.
  - Press **[OBS]** to observe the point to project.
  - When recording the data as a known point, press **{FUNC}**, and then press **[REC]** on the second page.
 Recording method:  
"22.1 Registering/Deleting Known Point Data"

Point projection  
Np: **103.514**  
Ep: 101.423  
Zp: 12.152  
**P1**  
**READ** **OBS** **EDIT** **OK**


- Press **[OK]** on the screen of step 3.  
The following items are calculated and displayed.
  - Length: Distance along the baseline from the first point to the projected point (X direction).

Point projection  
Length 10.879m  
Offset 9.340m  
d.Elev 0.321m  
**XYZ** **REC** **ΔS-O**




## 16. POINT PROJECTION

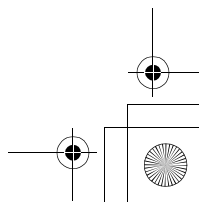
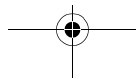
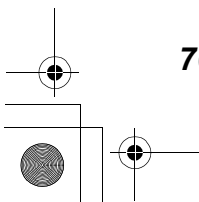
- Offset: Distance from point to project to the position at which a line extending from point of project intersects the baseline at right angles. (Y direction).
- d.Elev: Elevation between the baseline and the projected point.
- Press **[XYZ]** to switch the screen display to coordinate values.
- Press **[OFFSET]** to switch the screen display to distance values.
- Press **[REC]**: records the coordinate value as a known point data.

 Recording method:  
"22.1 Registering/Deleting  
Known Point Data"

- Press **[▲ S-O]** to move to setting-out measurement of the projected point.

 "14. SETTING-OUT  
MEASUREMENT"

5. Press **{ESC}**. Continue the measurement (repeat steps from 3).



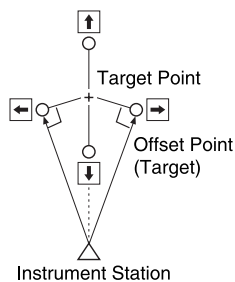
## 17. OFFSET MEASUREMENT

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.

### 17.1 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°.
- 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.

## 17. OFFSET MEASUREMENT

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

3. Press **[OFFSET]** in page three of Meas mode to display <Offset>.

4. Enter the instrument station data.  
☞ “12.1 Entering Instrument Station Data, PROCEDURE Reading in Registered Coordinate Data”.

5. Select “Offset/Dist” and press **[EDIT]**.  
Input the following items.  
(1) Horizontal distance from the target point to the offset point.  
(2) Direction of the offset point.

Offset  
Stn. Orientation  
**Offset/Dist**  
Offset/Angle  
Offset/2D

S 34.770m  
ZA 80°30'10"  
HAR 120°10'00"  
Dist: 2.000m  
Direc: →  
**OBS** **EDIT** **OK**

- 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.

- Press **[OBS]** to re-observe the offset point.

6. Press **[OK]** on the screen of step 5 to calculate and display the distance and angle of the target point.

Offset/Dist  
S 34.980m  
ZA 85°50'30"  
HAR 125°30'20"  
**REC** **XYZ** **NO** **YES**

## 17. OFFSET MEASUREMENT

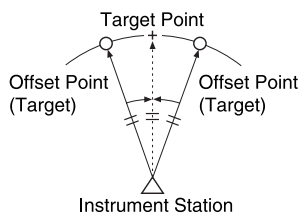
7. Press **[YES]** to return to <Offset>.

- Press **[XYZ]** to switch the screen display from distance values to coordinate values. Press **[HVD]** to return to distance values.
- Press **[No]** to return to the previous of distance and angle.
- To record the calculation result, press **[REC]**.

☞ "20. RECORDING DATA - RECORD MENU -"

### 17.2 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.

## 17. OFFSET MEASUREMENT

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. Press **[STOP]** to stop the measurement.
3. Press **[OFFSET]** in page three of Meas mode to display <Offset>.
4. Enter the instrument station data.  
☞ “12.1 Entering Instrument Station Data, PROCEDURE Reading in Registered Coordinate Data”.
5. Select “Offset/Angle” in <Offset>.
6. Accurately sight the direction of the target point and press **[OK]**.  
The distance and angle of the target point are displayed.
7. After finishing measurement, press **[YES]** to return to <Offset>.

Offset  
Stn. Orientation  
Offset/Dist  
**Offset/Angle**  
Offset/2D

S 34.770m  
ZA 80°30'10"  
HAR 120°10'00"  
2nd obs.OK?  
**OBS** **OK**

Offset/Angle  
S 34.980m  
ZA 85°50'30"  
HAR 125°30'20"  
**REC** **XYZ** **NO** **YES**



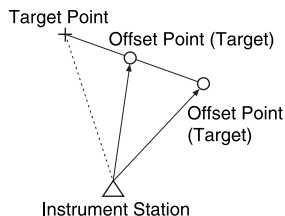
## 17. OFFSET MEASUREMENT

### 17.3 Two-distance Offset Measurement

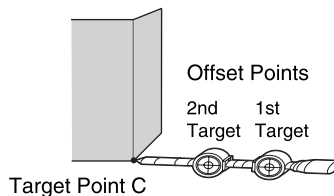
By measuring the distances between the target point and the two offset points. Install two offset points (1st target and 2nd target) on a straight line from the target point, observe the 1st target and 2nd target, then enter the distance between the 2nd target and the target point to find the target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

- It is possible to make this measurement easily using the optional equipment: the 2-point target (2RT500-K). When using this 2-point target, be sure to set prism constant to 0.

☞ “24.1 Changing Instrument Options ● EDM settings”



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 reflector type to “sheet”.

#### ►PROCEDURE

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

## 17. OFFSET MEASUREMENT

2. Press **[OFFSET]** in page three of Meas mode to display <Offset>.
3. Enter the instrument station data.  
 "12.1 Entering Instrument Station Data, PROCEDURE Reading in Registered Coordinate Data".
4. Select "Offset/2D" in <Offset>.

Offset  
 Stn. Orientation  
 Offset/Dist  
 Offset/Angle  
**Offset/2D**

5. Sight the 1st target and press **[OBS]**.  
 Observation begins and the measurement results are displayed.  
 Press **[YES]**. The "2nd Target Observation Screen" is displayed.

Observe 1st o/s  
 ZA 73°18'00"  
 HAR 250°12'00"  
**[OBS]**

6. Sight the 2nd target and press **[OBS]**.  
 The measurement results are displayed. Press **[YES]**.

N 10.480  
 E 20.693  
 Z 15.277  
 Confirm?

**[NO] [YES]**

7. Enter the distance from the 2nd target to the target point and press **[←]**. The coordinates of the target point are displayed.

B-C: 1.2000m

**[1] [2] [3] [4]**

Offset/2D  
 N 10.480  
 E 20.693  
 Z 15.277

**[REC] [HVD] [NO] [YES]**

8. Press **[YES]**. <Offset> is restored.
  - When **[HVD]** is pressed, display mode is switched from coordinates to S, ZA, HAR.