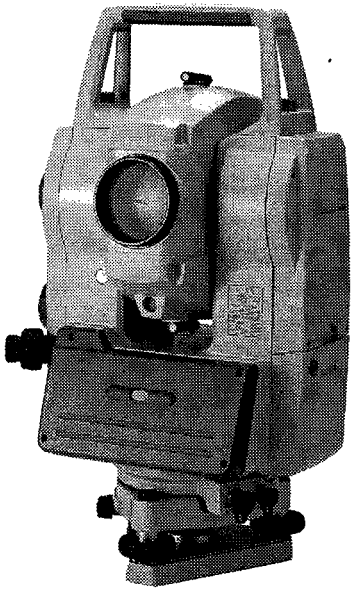
SOKKIA

Series230RM

SET3230RM

SET4230RM

Auto Pointing Reflectorless Total Station



Class 3R Laser Product

Class 1 LED Product

OPERATOR'S MANUAL

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1. PRECAUTIONS FOR SAFE OPERATION

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

Definition of Indication

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

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

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

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

General

⚠Warning

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

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

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

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

⚠Caution

- Do not use the carrying case as a footstool. The case is slippery and unstable so a person could slip and fall off it.
- Do not place the instrument in a case with a damaged catch, belt or handle. The case or instrument could be dropped and cause injury.
- Do not wield or throw the plumb bob. A person could be injured if struck.
- Do not touch the instrument or look through the telescope eyepiece during automatic target searching. Hands could be caught in moving parts or an eye could be struck by the telescope and cause injury.
- Secure handle to main unit with locking screws. Failure to properly secure the handle could result in the unit falling off while being carried, causing injury.
- Tighten the adjustment tribrach clamp securely. Failure to properly secure the clamp could result in the tribrach falling off while being carried, causing injury.
- 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.

Power Supply

⚠Warning

- Do not disassemble, rebuild, mutilate, incinerate, heat or short circuit the battery and charger. Fire, electric shock, burns or an explosion could result.
- Do not use voltage other than the specified power supply voltage. Fire or electrical shock could result.
- Do not use damaged power cords, plugs or loose outlets. Fire or electric shock could result.
- Do not use power cords other than those designated. Fire could result.
- Do not place articles such as clothing on the battery charger while charging batteries. Sparks could be induced, leading to fire.
- Use only the specified battery charger to recharge batteries. Other chargers may be of different voltage rating or polarity, causing sparking which could lead to fire or burns.
- Do not heat or throw batteries into fire. An explosion could occur, resulting in injury.
- To prevent shorting of the battery in storage, apply insulating tape or equivalent to the terminals. Otherwise shorting could occur resulting in fire or burns.
- Do not use batteries or the battery charger if wet. Resultant shorting could lead to fire or burns.
- Do not connect or disconnect power supply plugs with wet hands. Electric shock could result.
- Do not use the battery, charger or AC (power) cable for any other equipment or purpose. Fire or burns caused by ignition could result.
- Do not short circuit the battery. Fire or burns caused by heat or ignition could result.

⚠Caution

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

Tripod

⚠Caution

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

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

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

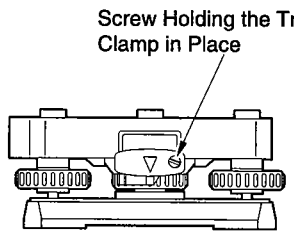
Keep hands and feet away from the tripod shoes when fixing the tripod in the ground. A hand or foot stab wound could result.

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

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 refasten it on the levelling base.



The Lithium Battery

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

Levelling base

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

Other precautions

- Never place the SET directly on the ground. Sand or dust may cause damage to the screw holes or the centering screw on the base plate.
- Do not automatically rotate the telescope when using the lens hood.
- Protect the SET from heavy shocks or vibration.
- Protect the SET from rain or drizzle with an umbrella or waterproof cover.
- When the operator leaves the SET attached to the tripod, the vinyl cover should be placed on the instrument.
- Never carry the SET on the tripod to another site.
- Turn the power off before removing the battery.
- When placing the SET in its case, first remove its battery and place it in the case in accordance with the layout plan.
- Consult your Sokkia agent before using the instrument under special conditions such as long periods of continuous use or high levels of humidity. In general, special conditions are treated as being outside the scope of the product warranty.

Maintenance

- Periodically wipe clean the terminals of the instrument and the battery with the cleaning cloth to keep them free of dirt.
- Always clean the instrument before returning it to the case. The lens requires special care. First, dust it off with the lens brush to remove minute particles. Then, after breathing on the lens, wipe it with a soft clean cloth or lens tissue.
- 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 parts, screws or optical parts (e.g. lens), contact your Sokkia agent.
- When the instrument is not used for a long time, check it at least once every 3 months.

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

3. LASER • LED SAFETY INFORMATION

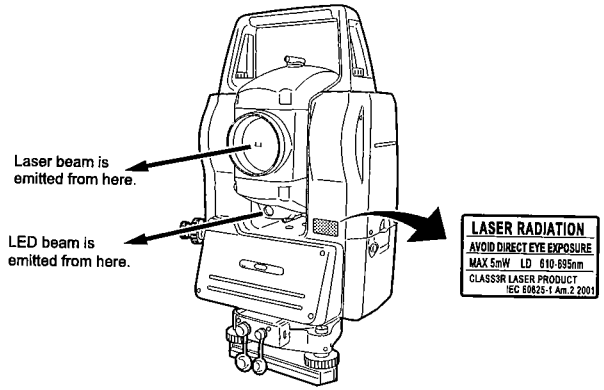
SET 230RM is classified as a Class 3R Laser Product and Class 1 LED Product according to IEC Standard Publication 60825-1 Amd. 2: 2001 and United States Government Code of Federal Regulation FDA CDRH 21CFR Part 1040.10 and 1040.11 (Complies with FDA performance standards for laser products except for deviations pursuant to Laser Notice No.50, dated July 26, 2001.)

- EDM device in objective lens: Class 3R Laser Product (Class 1 Laser Product when prism or reflective sheet is selected in Config mode as target)
- Auto pointing device in objective lens: Class 1 Laser Product
- Guide light: Class 1 LED product (For all countries except USA)

EDM device is classified as Class 3R Laser Product 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.

⚠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.



⚠CAUTION

- 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.

●Sight the targets so that laser beam does not stray from them.

⚠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.

●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.

- 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.

●①Full Absorption type YL-331 (for He-Ne laser radiation) or ② Maintenance type YL-331M (for visible semiconductor laser radiation)

●Areas in which the lasers are used should be posted with laser warning notices.

●When **[SRCH]** or **[DIST]** are pressed, the laser beam is emitted from the objective lens until the center of the prism is sighted or distance measurement begins.

●The LED beam is emitted when the guide light is set to ON and the power is turned ON. Before turning ON the power check that there are no persons in the LED beam path. Alternatively, always set the guide light to OFF when you have finished measurement.

☞ Guide light settings for tasks other than setting-out: "12.2 Using the Guide Light"

☞ Guide light settings for setting-out: "15.1 Using the Guide Light"

4. 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.
Note	:	Indicates supplementary explanation.
	:	Indicates an explanation for a particular term or operation.
[DIST] etc.	:	Indicates softkeys on the display.
{ESC} etc.	:	Indicates operation keys on SET.
<S-O> etc.	:	Indicates screen titles.

Screens and illustrations

- Except where stated, SET means SET3230RM/4230RM in this manual.
- Screens and illustrations appearing in this manual are of SET3230RM.
- Location of softkeys in screens used in procedures is based on the factory setting. It is possible to change the allocation of softkeys in Meas Mode, Shift Mode etc.

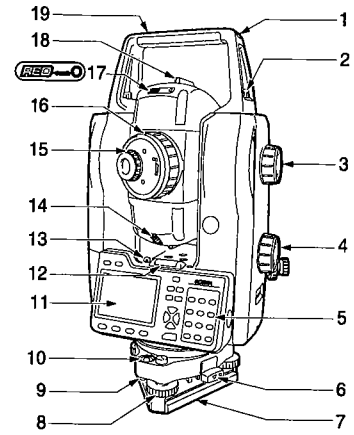
☞ For details of softkeys: "5.1 Parts of the Instrument". Softkey allocation: "21.3 Allocating Key Functions".

Operation procedure

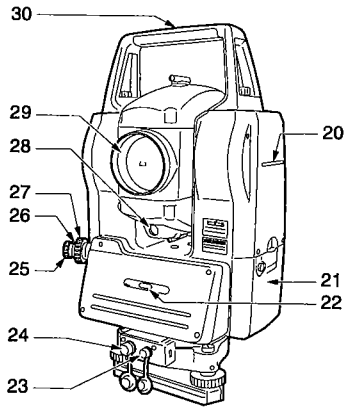
- Learn basic key operations in "5. SET FUNCTIONS" and "6. BASIC OPERATION" before you read each measurement procedure. See " "5.3 Functions"" for an overview of the SET's functions and "6.1 Basic Key Operation" for details on how to select options and input figures.
- Measurement procedures are based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

5. SET FUNCTIONS

5.1 Parts of the Instrument



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



20 Instrument height mark
21 Battery
22 Trigger key
23 Data input/output connector
24 External power source connector
25 Optical plummet eyepiece
26 Optical plummet reticle cover
27 Optical plummet focussing ring
28 Guide light
29 Objective lens (Includes laser-pointer function)
30 Instrument center mark

Vertical and Horizontal jogging knobs
The instrument and telescope can be rotated manually by hand or, for more precise adjustments, by turning the vertical and horizontal jogging knobs. The faster the jogging knobs are turned, the faster the instrument and telescope rotate.
The rotation speed setting can be changed by switching the JOG Mode setting.
☞ For JOG Mode settings, see "21.1 Configuration ● Motor Settings"

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

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

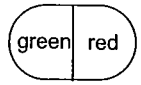
Trigger key
When the Trigger key is pressed SET carries out the operation indicated by the softkey with a white background on the screen. You do not have to always operate SET from the keyboard side. Rotating the SET 180° or starting measurement can be done smoothly from the opposite side of the instrument to the keyboard.
☞ Softkey with white background: "5.3 Functions"

● The status of the trigger key light and meaning

Light status	Meaning
Slow flashing	Rotating
	Searching
	Measuring
Fast flashing	Error

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

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.



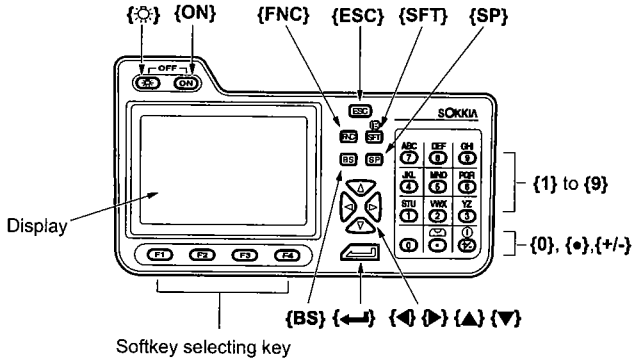
Guide light status

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 or flashes depending on the status of the guide light.

Keyboard

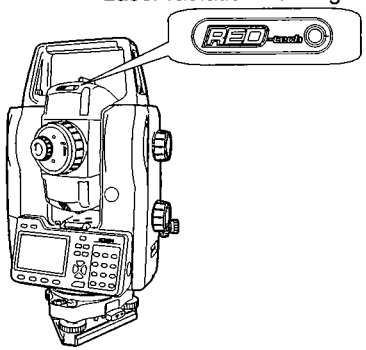
☞ "6.1 Basic Key Operation"



Laser radiation warning indicator

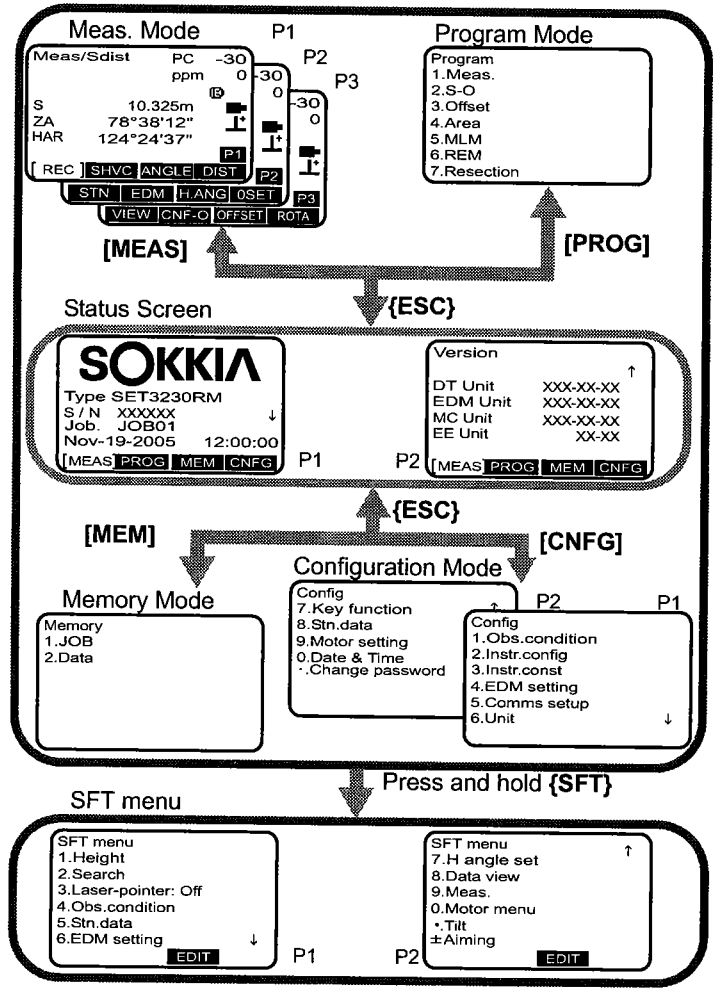
Laser radiation warning indicator is red when laser beam is emitted or laser-pointer is used, and laser beam status can be known from the telescope eyepiece side.

Laser radiation warning indicator



5.2 Mode Diagram

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



5.3 Functions

SET has the following features to make operation more efficient.

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

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

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

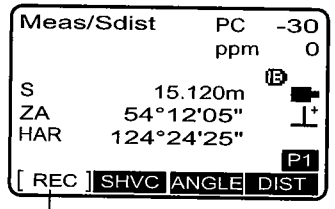
3. **Distance measurement**
   After **[DIST]** is pressed, the instrument searches for the prism and automatically measures the distance. The search range can be set beforehand. ☞ "12.3 Distance and Angle Measurement"". Setting the Search range: "21.1 Configuration ●EDM/●Motor Settings"

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

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

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

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



Softkeys with white background

When the Trigger key on the other side of the keyboard is pressed SET carries out the operation indicated by the softkey with a white background on the screen. You do not have to always operate SET from the keyboard side. Rotating the SET 180 or starting measurement can be done smoothly from the opposite side of the instrument to the keyboard. Trigger key light informs the user the current status of the SET.
☞ "5.1 Parts of the Instrument"

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

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

6. BASIC OPERATION

6.1 Basic Key Operation

Learn basic key operations here before you read each measurement procedure.
☞ Location of keys on the keyboard: "5.1 Parts of the Instrument"

● Power ON/OFF

{ON}	Power On
{ON} (while pressing)+ **{☼}**	Power Off

● Lighting up the display
{☼}: Switches the screen backlight on/off

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

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

☞ For displaying the target symbol (ex. ⓔ), see "6.2 Display functions". For switching the target type in Config mode, see "21.1 Configuration ● EDM Settings"

● Turning the laser-pointer/guide light ON/OFF

{☼} (Press and hold until a beep sounds)	To turn the laser-pointer/guide light ON/OFF
[LASER]/[G.LIGHT]	
"Guide light" then **{↵}** in Shift Mode	

☞ For displaying the laser-pointer/guide light symbol, see "6.2 Display functions". For switching the "Illum. hold" function, see "21.1 Configuration ● EDM Settings"

Note

- After turning ON the laser-pointer, the laser beam is emitted for 5 minutes, and then automatically switches OFF. However, the laser beam is not automatically turned off in the screens displayed during search and distance measurement.

● Softkey operation
Softkeys are displayed on the bottom line of the screen.

{F1} to **{F4}**	Selects the function matching the softkey
{FNC}	Toggles between MEAS Mode screen pages (when more than 4 softkeys are allocated)

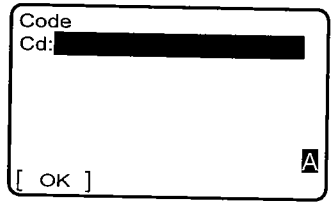
● Inputting letters/figures

{SFT}	Switch between numerals and alphabetic characters
{0} to **{9}**	During numeric input, input number of the key. During alphabetic input, input the characters displayed above the key in the order they are listed.
{●}	Input a decimal point during numeric input
{+/-}	Input plus or minus sign during numeric input
{SP}	Input a blank space
{◀}/{▶}	right and left cursor/select other option
{BS}	Delete a character on the left
{ESC}	Cancel the input data
{↵}	Select/accept input word/value

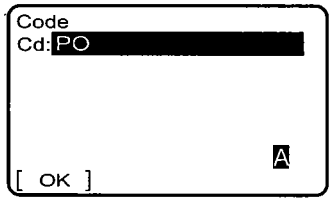
EXAMPLE 1:Entering "Pole" in the Code field

1. Press **{SFT}** to enter the alphabet input mode
   Alphabet input mode is indicated by an "**A**"on the right of the screen.

2. Press **{6}**.
   "P" is displayed.



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



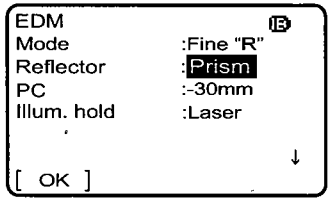
4. Press {4} three times.
   "L" is displayed.
5. Press {8} two times.
   "E" is displayed. Press {↵} to complete inputting.

● Selecting items

{▲}/{▼}	Up and down cursor
{◀}/{▶}	Right and left cursor/Select other option
{↵}	Accept the option Softkeys with clear background perform the same function as the enter key.

Example: Selecting a target type

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



● Switching modes
☞"5.2 Mode Diagram"

[MEAS]	From Status Screen to Meas Mode (Measure Mode)
[PROG]	From Status Screen to Program Mode
[MEM]	From Status Screen to Memory Mode
[CNFG]	From Status Screen to Config Mode (Configuration Mode)
Press and hold {SFT}	From each mode to Shift Mode (multiple beeps)
{ESC}	From each mode to Status Mode (may require being pressed multiple times to work back through previous screens to the Status mode)

● Rotating SET for Horizontal and Vertical angle
In the horizontal and vertical angle screens, the following keys can be used to perform the same operations as the horizontal and vertical jogging dials.

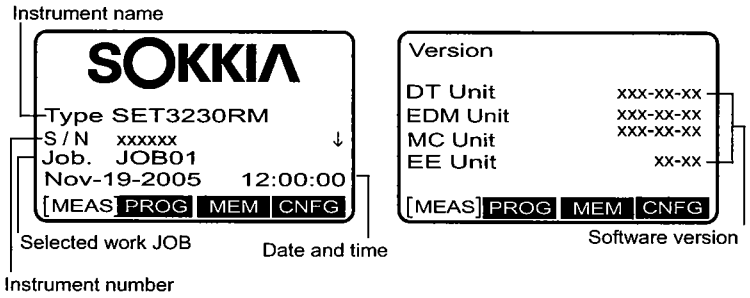
{◀}/{▶}	Horizontal angle rotation (Press {▶} to rotate SET in clockwise direction. Each time {▶} is pressed, rotating speed increases. Six speed settings are available, displayed on the screen: 1 to 6. Press {◀} to stop rotation.) Press {◀} to rotate SET in counterclockwise direction. Press {▶} to stop.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

● Other operation

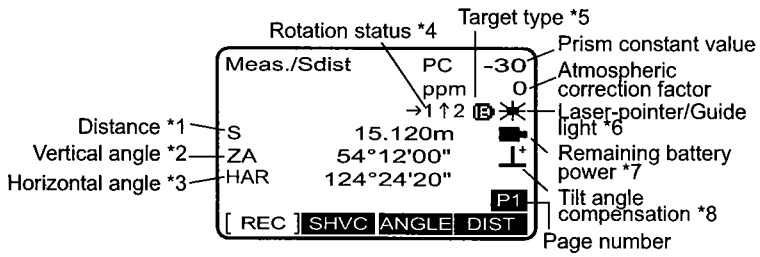
{ESC}	Return to previous screen

6.2 Display functions

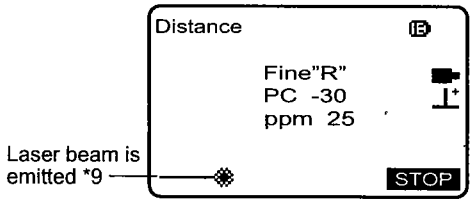
Status screen



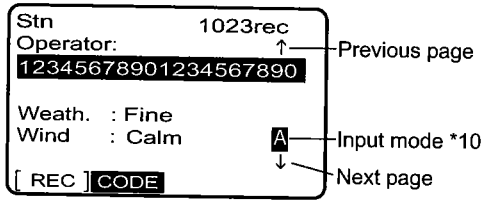
● Meas Mode screen



● Measuring screen



Data input screen



* 1: Distance
  Switching distance display status by pressing **[SHVC]**
  S: Slope distance
  H: Horizontal distance
  V: Height difference
  NEZ: Coordinates

* 2: Vertical angle
  Switching vertical angle display status: "21.1 Configuration●Observation conditions"
  ZA: Zenith angle (Z=0)
  VA: Vertical angle (H=0/H=±90)
  To switch vertical angle/slope in %, press **[ZA/%]**

* 3: Horizontal angle
  Press **[R/L]** to switch the display status.
  HAR: Horizontal angle right
  HAL: Horizontal angle left

* 4: Rotation status
  Displayed when horizontal angle or vertical angle is rotating using{◀}/{▶}/{▲}/{▼}.
  1 to 6 : Horizontal angle is rotating at speed 1 to 6.
  1 to 6 : Vertical angle is rotating at speed 1 to 6.
  ☞ "6.1 Basic Key Operation"

* 5: Target type
  The selected target type is displayed.
  :prism
  :reflective sheet
  :reflectorless

* 6: Laser-pointer/guide light
Displayed when laser-pointer/guide light ON or the guide light is selected.
☞ For switching the laser-pointer/guide light (optional function) ON/OFF, see "6.1 Basic Key Operation"

✳ (flashing) :Laser-pointer is selected and ON
(flashing) :Guide light is selected and ON
:Guide light is selected and OFF

* 7: Remaining battery power (BDC45, Temperature=25°C, EDM on)
The remaining battery power may differ during distance measurement and when measurement is stopped.

: level 3 Full power.

: level 2 Plenty of power remains.

: level 1 Half or less power remains.

: level 0 Little power remains. Charge the battery.

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

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

* 8: Tilt angle compensation
When this symbol is displayed, the vertical and horizontal angles are automatically compensated for small tilt errors using 2-axis tilt sensor.
☞ Tilt compensation setting: "21.1 Configuration ●Observation conditions"

* 9: Appears when laser beam emitted for distance measurement.

* 10: Input mode
The current Input mode is displayed.
☞ Switching Input mode: "6.1 Basic Key Operation"

No display: numeric input
A : alphabetic input

Note
Softkeys that were not allocated in the Meas. Mode when the SET left the factory, but that are required by the user to perform measurements will have to be allocated.
☞ Allocating softkeys **[R/L]** and **[ZA/%]**: "21.3 Allocating Key Functions"

7. USING THE BATTERY

☞ Types of power supply: "25.4 Power Supply System"

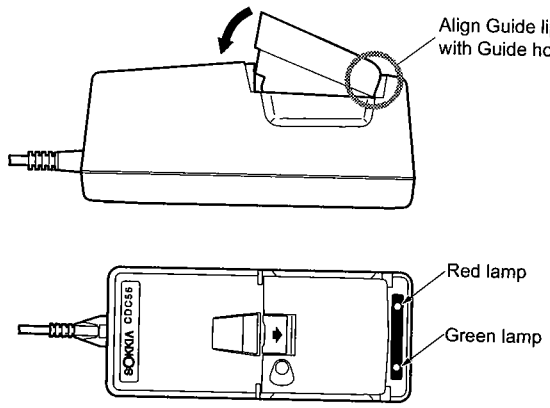
7.1 Battery Charging

The battery has not been charged at the factory.

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

▶PROCEDURE

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



When charging starts, the green lamp starts blinking.

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

● Errors during charging

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

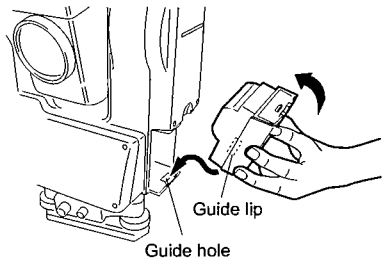
7.2 Installing/Removing the Battery

Mount charged battery (BDC45)

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

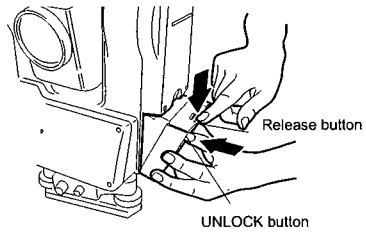
▶PROCEDURE Mounting the battery

1. Insert the battery by aligning the battery guide with the guide hole in the instrument.
2. Press the top of the battery until you hear a click.



▶PROCEDURE Removing the battery

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



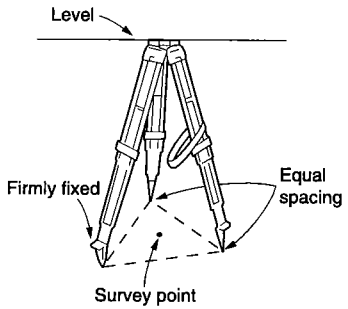
8. SETTING UP THE INSTRUMENT

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

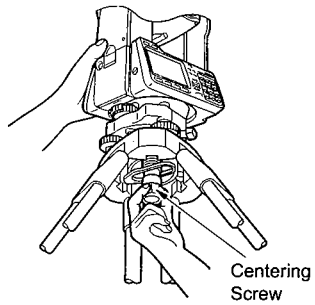
8.1 Centering

▶PROCEDURE

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

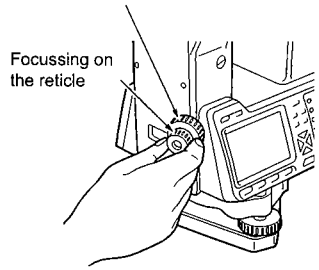


2. **Install the instrument**
   Place the instrument on the tripod head.
   Supporting it with one hand, tighten the centering screw on the bottom of the unit to make sure it is secured to the tripod.



3. **Focus on the surveying point**
   Looking through the optical plummet eyepiece, turn the optical plummet eyepiece to focus on the reticle.
   Turn the optical plummet focusing ring to focus on the surveying point.

Focussing on the survey point

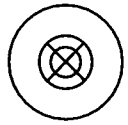


8.2 Levelling

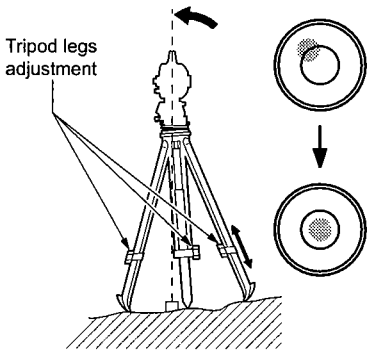
Instrument can be levelled using the screen.
☞ "Procedure Levelling on the screen"

▶PROCEDURE

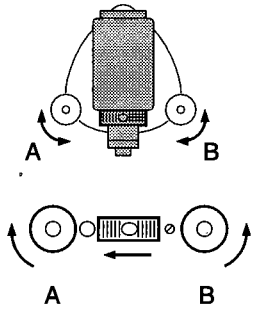
1. **Center the surveying point in the reticle**
   Adjust the levelling foot screws to center the surveying point in the optical plummet reticle.



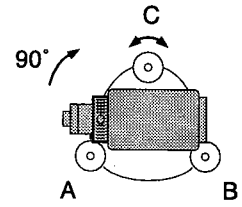
2. **Center the bubble in the circular level**
   Center the bubble in the circular level by either shorting the tripod leg closest to the off-center direction of the bubble or by lengthening the tripod leg farthest from the off-center direction of the bubble. Adjust one more tripod leg to center the bubble.



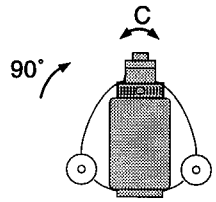
3. **Center the bubble in the plate level**
   Turn the upper part of the instrument until the plate level is parallel to a line between levelling foot screws A and B.
   Center the air bubble using levelling foot screws A and B.
   The bubble moves towards a clockwise rotated levelling foot screw.



4. **Turn 90° and center the bubble**
   Turn the upper part of the instrument though 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.
   ☞ "24.1 Plate Level"



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

Ni

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

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

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

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

SURVEYING INSTRUMENTS

SOKKIA

Series230RM

SET3230RM
SET4230RM

Auto Pointing Reflectorless Total Station

Class 3R Laser Product

Class 1 LED Product

OPERATOR'S MANUAL

- Thank you for selecting the SET3230RM/4230RM.
- Before using the instrument, please read this operator's manual carefully.
- Verify that all equipment is included. ☞"25.1 Standard Equipment"
- Data saved in the SET can be sent to a connected host computer. Commands operations from a host computer can also be performed. For details, refer to "Interfacing with the SOKKIA SDR Electronic Field Book" and "Command Explanations" manuals and ask your Sokkia agent.
- The specifications and general appearance of the instrument may be altered at any time and may differ from those appearing in brochures and this manual.
- Some of the diagrams shown in this manual may be simplified for easier understanding.

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

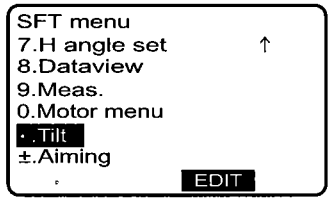
8. **Check again to make sure the bubble in the plate level is centered**
   If not, repeat the procedure starting from step 3.

▶Procedure Levelling on the screen

1. **Press {ON} to power on**
   ☞ "9. POWER ON"

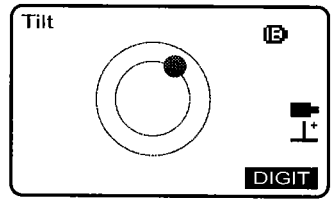
2. **Enter Shift [SFT] Mode**
   Press and hold the **{SFT}** until a series of beep tones sound and the SFT Mode menu is displayed.

3. **Select "TILT" to display the circular level on the screen.**
   ⌈●⌋ indicates bubble in circular level. The range of the inside circle is ±3' and the range of the outside circle is ±4.5'.

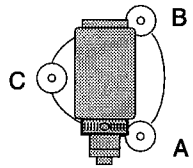


4. **Center ⌈●⌋ in the circular level**
   ☞ "8.2 Levelling"" steps 1 to 2

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



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



6. **Set the tilt angle to 0° using foot screws A and B for the X direction and levelling screw C for the Y direction.**

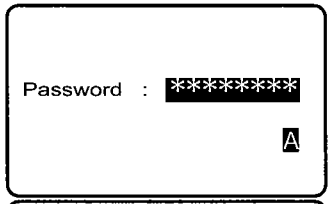
7. **Screen levelling is completed.**
   Press **{ESC}** to return to Meas Mode.

☞ Setting "H index"/"V index": "21.1 Configuration" ●Observation Conditions, Setting / changing password: "21.4 Changing password"

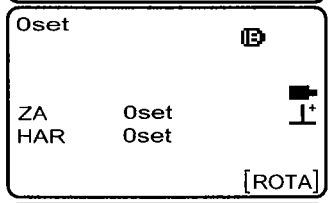
▶PROCEDURE

1. 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 **{↵}**.

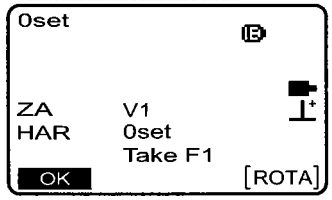


After that, the display indicates that the instrument is ready for vertical and horizontal circle indexing.



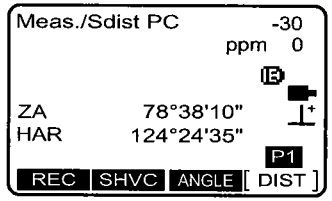
- When "H index" is set to "Manual", "HAR 0 Set" does not appear.
- When "V index" is set to "Manual" the display appears as at right.

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



2. Horizontal and Vertical circle indexing
   Press **[ROTA]** to rotate the top the instrument and the telescope.

When horizontal indexing and vertical indexing have been completed, Meas Mode screen appears.
If "Out of range" is displayed, the instrument tilt sensor is indicating that the instrument is out of level. Level the instrument once again and the horizontal and vertical angles will be displayed.



Note

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

☞ "21.1 Configuration ●Observation Conditions"

10. TARGET SIGHTING

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

10.1 Auto-search function for target sighting

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

- The search range can be set.

☞"21.1 Configuration ● EDM Settings/● Motor Settings"

⚠ Caution

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

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

☞"10.2 Manually Sighting the Target"

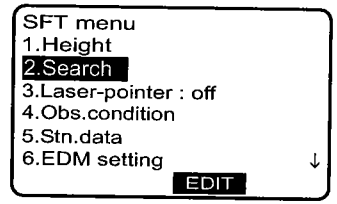
- If more than one prism is located in the field of sight during auto-search, an operation error will occur and the SET will not be able to find the target.
- The prism beyond the glass can not be searched because measurement error occurs.
- If an obstacle blocks the laser beam path between the SET and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

▶PROCEDURE

1. Aim the objective lens at the target.
   Use the peep sight to aim the objective lens in the general direction of the target. (The vertical and horizontal jogging knobs can be used for precise adjustments of the instrument and telescope.)

2. Enter Shift (SFT) Mode
   Press and hold the **{SFT}** button until a series of beep tones sound and the SFT Mode menu is displayed.

3. Search for the target
   Select "Search". The telescope and top half of the instrument rotate and target auto-search begins. When the target is found, the instrument sights the center of the prism and stops.



Note

- Press **[SRCH]** in Meas Mode to perform an auto search for the prism.

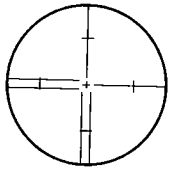
☞Allocating the **[SRCH]** softkey: "21.3 Allocating Key Functions"

10.2 Manually Sighting the Target

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

▶PROCEDURE

1. Focus on the reticle
   Look through the telescope eyepiece at a bright and featureless background.
   Turn the eyepiece clockwise, then counterclockwise little by little until just before the reticle image becomes focussed.
   Using these procedures, frequent reticle refocussing is not necessary, since your eye is focussed at infinity.



2. Sight the target
   Use the peep sight to bring the target into the field of view. Turn the vertical and horizontal jogging knobs for fine sighting adjustments.

3. Focus on the target
   Turn the telescope focussing ring to focus on the target.
   Turn the vertical and horizontal fine motion screws to align the target with the reticle.
   The last adjustment of each fine motion screw should be in the clockwise direction.

4. Readjust the focus until there is no parallax
   Readjust the focus with the focussing ring until there is no parallax between the target image and the reticle.

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

11. ANGLE MEASUREMENT

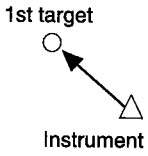
This section explains the procedures for basic angle measurement.

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

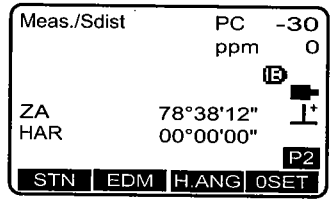
Use the "0SET" function to measure the included angle between two points. The horizontal angle can be set to 0 at any direction.

▶PROCEDURE

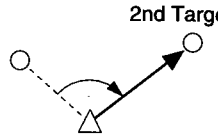
1. Sight the first target.
   ☞ "10. TARGET SIGHTING"



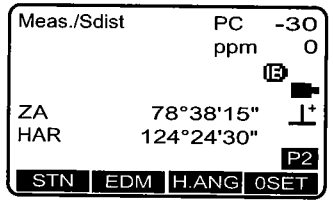
2. In the second page of the Meas Mode screen, press **[0SET]**. **[0SET]** will flash, so press **[0SET]** again.
   The horizontal angle at the first target becomes 0°.



3. Sight the second target.



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



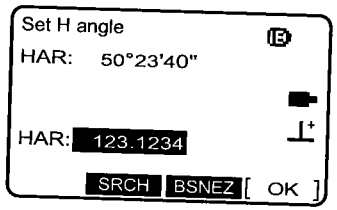
11.2 Setting the Horizontal Angle to a Required Value (Horizontal Angle Hold)

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

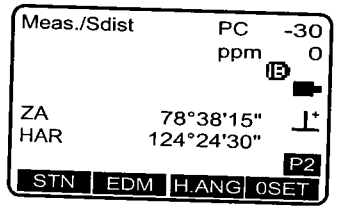
▶PROCEDURE

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

   ☞"13.2 Azimuth Angle Setting"



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



Note

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

☞Allocating **[HOLD]**: "21.3 Allocating Key Functions"

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

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

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

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

▶PROCEDURE

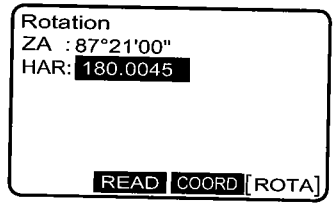
1. Sight the point you will use as the reference angle and set it as the reference angle. Sight the reference point and press **[0SET]**, or input the reference point angle.

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

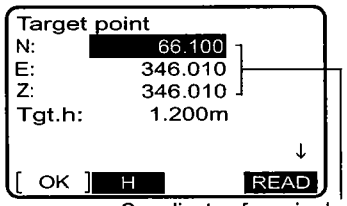
2. In the third page of the Meas mode screen, press **[ROTA]**.
3. Input the specified angle. In <Rotation>, enter the vertical and horizontal angles.

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

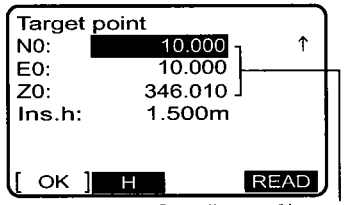
   ☞"20.3 Setting Instrument Station Data""



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



Coordinate of required pt.



Coordinate of instr pt.

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

11.4 Angle measurement and Outputting the Data

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

☞ Communication cables: "25.2 Optional Accessories"
Output format and command operations: "Interfacing with the SOKKIA SDR Electronic Field Book" and "Command Explanations" manuals. To set RS232C: "21.1 Configuration ● Communication Setup"

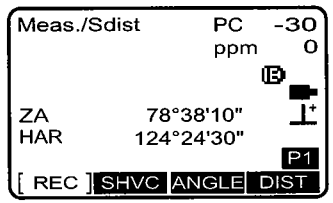
▶PROCEDURE

1. Connect SET and peripheral equipment.

2. Select "Comms setup in the configuration menu and set "D-OUT" to "On".
   ☞ "21.1 Configuration ● Communication Setup"

3. Sight the target point.

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



12. DISTANCE MEASUREMENT

Perform the following settings as preparation for distance measurement.

- Distance measurement mode
- Target type
- Prism constant correction value
- Atmospheric correction factor
- Search range
- Search before distance measurement

☞"21.1 Configuration ●EDM Settings"

⚠ 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.)

- 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 measurement results. Should this occur, repeat measurement several times and use the averaged value of the obtained results.

12.1 Returned Signal Checking

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

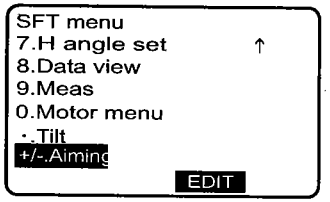
- Manually sight the target when checking the returned signal.
- When the light intensity is sufficient even though the center of the reflective prism and the reticle are slightly misaligned (short distance etc.), "*" will be displayed in some cases, but in fact accurate measurement is impossible. Therefore, make sure that the target center is sighted correctly.

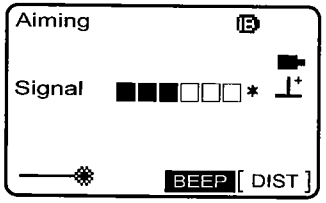
▶PROCEDURE

1. Using the manual sighting method, accurately sight the target.
   ☞"10.2 Manually Sighting the Target"

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

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





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

Note

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

☞ Allocating the **[AIM]** softkey: "21.3 Allocating Key Functions"

12.2 Using the Guide Light

The flashing speed of the guide light indicates the status of the SET and can be known when the user is located at a distance from the instrument.
☞ Switching the guide light ON/OFF "6.1 Basic Key Operation"

- Brightness of the guide light can be changed.

☞ "21.1 Configuration ●Instrument configurations"

- The guide light will turn off, even when set to ON, during distance measurement and returned signal checking.

● Guide light status and meaning

Status of SET

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

12.3 Distance and Angle Measurement

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

- The search range can be set.

☞ "21.1 Configuration ●EDM settings/●Motor settings"

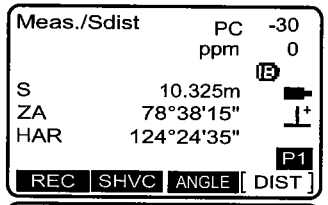
⚠CAUTION

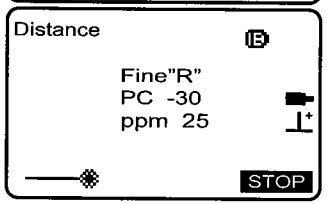
- After **[DIST]** is pressed, the laser beam is emitted until the center of the prism is automatically sighted and distance measurement begins.

▶PROCEDURE

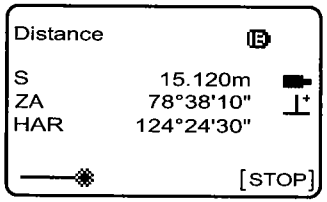
1. Face the SET in the direction of the target
   Use the peep sight to aim the SET and telescope toward the target.
   ☞ "10. TARGET SIGHTING"

2. Start measurement
   Press **[DIST]** in the first page of the Meas. Mode to start target search. When the target is found, measurement automatically starts. When measurement starts, EDM information (Distance Mode, prism constant correction value, atmospheric correction factor) is represented by a flashing light.





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

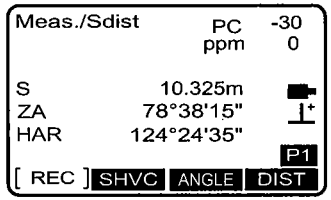


3. Stop measurement
   Press **[STOP]** to quit distance measurement.

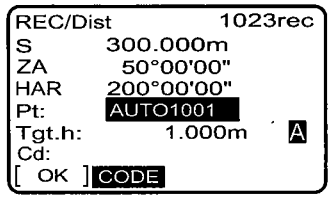
   - Each time **[SHVC]** is pressed "Meas./Sdist", "Meas./Hdist", "Meas./Vdist" and "Meas./Coord" are displayed alternately. The measurement value is calculated as S (slope distance)/H (horizontal distance)/V (height difference)/NEZ (coordinates).

4. Register the measurement results
   Press **[REC]** and input the point name and height of sight line.

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



5. Confirm input value and finish
   Press **[OK]** to register the measurement results in the current JOB and return to the main menu.



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 by pressing **[RCL]**.
- When **[AUTO]** is pressed, the instrument carries out distance measurement and automatically records the result. Measurement points are automatically counted sequentially in increments of 1. (Incremented only when final character of point name is a numeral.)

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

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

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

12.4 Distance measurement and Outputting the Data

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

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

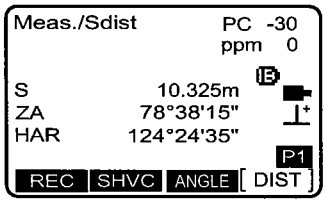
▶PROCEDURE

1. Connect SET and peripheral equipment.

2. Select "Comms setup" in the configuration mode and set "D-OUT" to "On".
   ☞ "21.1 Configuration ● Communication setup"

3. Sight the target point.

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

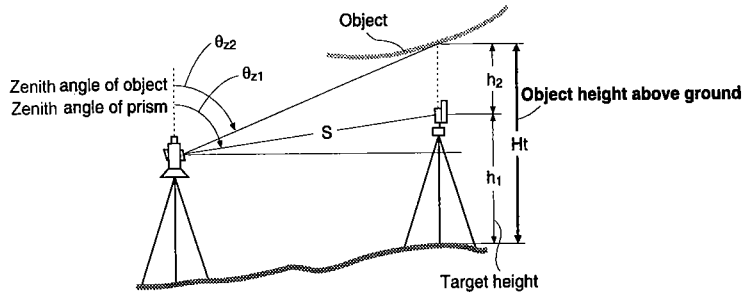


5. Press **[STOP]** to finish data output and return to the Meas. mode.

12.5 REM Measurement

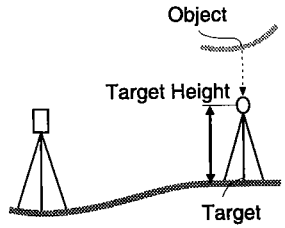
An REM measurement is a function used to measure the height to a point where a target cannot be directly installed such as power lines, overhead cables and bridges, etc.
The height of the target is calculated using the following formula.

$Ht = h_1 + h_2$
$h2 = S \sin\theta_{z1} \times \cot\theta_{z2} - S \cos\theta_{z1}$

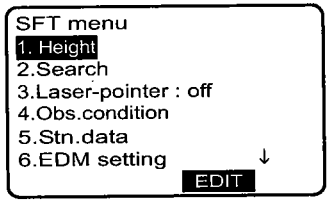


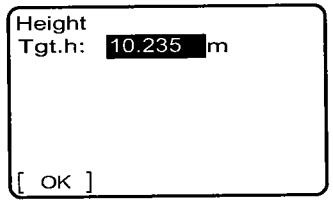
▶PROCEDURE

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

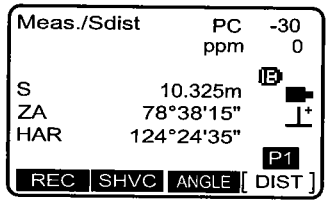


2. Enter Shift (SFT) Mode and select "Height." Then, input the target height.

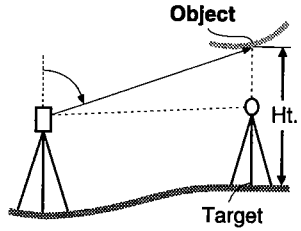


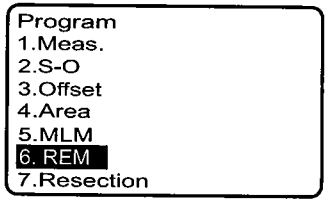


3. Press **[DIST]** in page one of the Meas. Mode to carry out target measurement.
   The measured distance data, vertical angle and horizontal angle are displayed.
   Press **[STOP]** to stop the measurement.

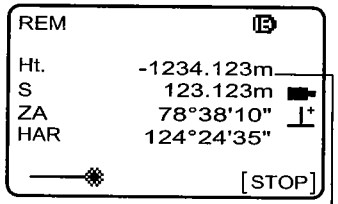


4. Sight the object, then select "REM" in Program Mode. The REM measurement is started and the height from the ground to the object is displayed in "Ht.".



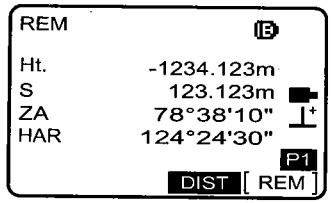


Press **[STOP]** to stop the measurement.



Object height above ground

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



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

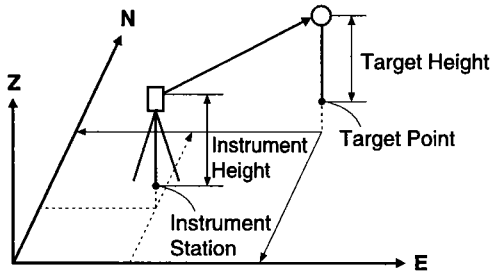
Note

- It is also possible to perform REM measurement by pressing **[REM]** in Meas. Mode.
- Target height can also be entered by pressing **[HT]**.

☞ Allocating **[REM]/[HT]**: "21.3 Allocating Key Functions""

13. COORDINATE MEASUREMENT

By performing coordinate measurements it is possible to find the 3-dimensional coordinates of the target based on station point coordinates, instrument height, target height, and azimuth angles of the backsight station that are entered in advance. Perform procedures sequentially from "13.1 Entering Instrument Station Data"" to "13.3 3-D Coordinate Measurement".



13.1 Entering Instrument Station Data

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

▶PROCEDURE

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

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

   (Page1)

Stn	1023rec
N0:	66.100
E0:	346.010
Z0:	23.000
Pt:	AUTO1001
Ins.h:	0.000m A
Cd:	123456789ABCDEF ↓
[REC]	CODE

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

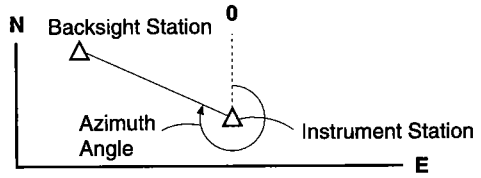
☞"20.3 PROCEDURE Reading in Registered Coordinate Data"

- Pressing **[CODE]** displays recorded codes, which you can select and input.
- Pressing **[0PPM]** in the third page of Station Mode sets the atmospheric correction factor to 0 and sets the temperature and air pressure to their default values.

3. Check the input data and press **[REC]** to record the instrument station data.

13.2 Azimuth Angle Setting

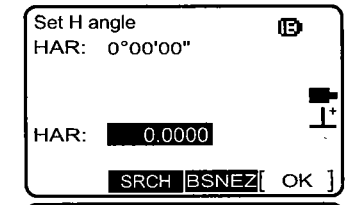
Based on the instrument station coordinates and backsight station coordinates which have already been set, the azimuth angle of the backsight station is calculated.



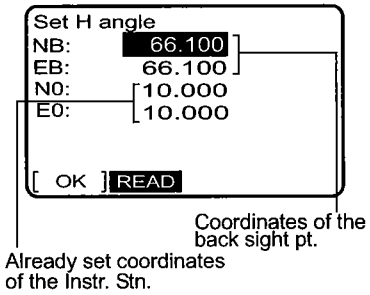
▶PROCEDURE

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

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

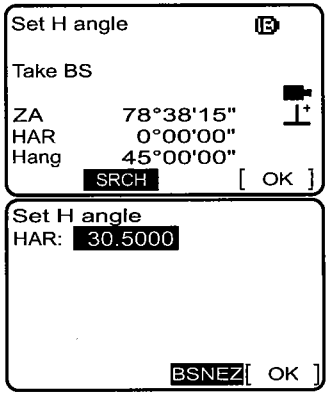


- When the cursor is on the backsight coordinate, pressing **[READ]** reads out the previously registered coordinate data and sets it as the backsight station coordinates.
  ☞"20.3 PROCEDURE Reading in Registered Coordinate Data"



3. Check the input value and press **[OK]**.

4. Sight the backsight station and press **[ANGLE]**. The azimuth angle of the backsight station is displayed.



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

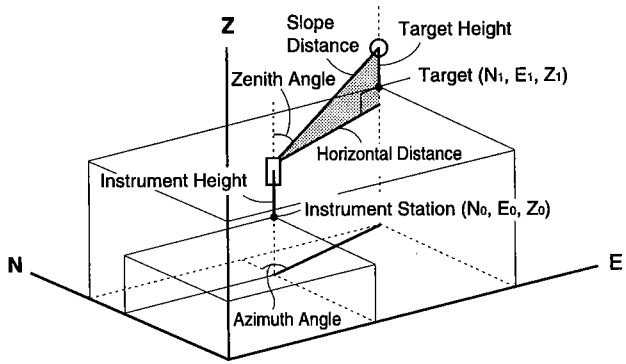
13.3 3-D Coordinate Measurement

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

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

N1 Coordinate = N0 + S x sinZ x cosAZ
E1 Coordinate = E0 + S x sinZ x sinAZ
Z1 Coordinate = Z0 + S x cosZ + ih - fh

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

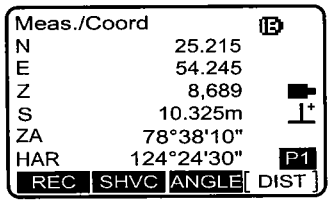


▶PROCEDURE

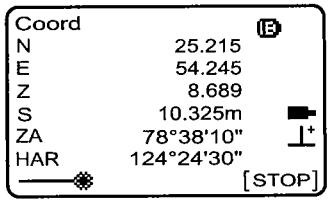
1. Sight the target at the target point.
   ☞ "10. TARGET SIGHTING"

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

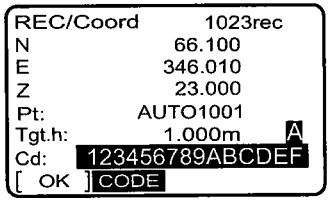
3. Press **[DIST]** in page 1 of the Meas. Mode screen to start measurement.
   Target coordinates, distance data (S), vertical angle (ZA) and Horizontal angle (HAR) are displayed.



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



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



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

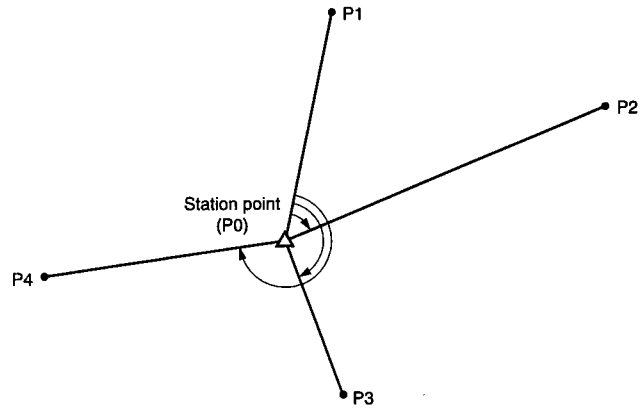
Note

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

14. RESECTION MEASUREMENT

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

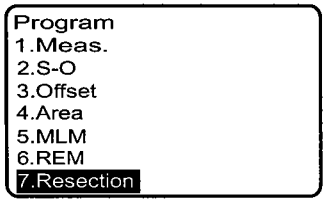
Entry		Output	
Coordinates of known point	: (Ni, Ei, Zi)	Station point coordinates	: (N0,E0, Z0)
Observed horizontal angle	: Hi		
Observed vertical angle	: Vi		
Observed distance	: Di		



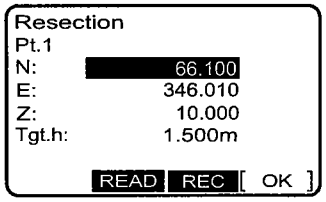
- Between 2 and 10 known points can be measured by distance measurement, and between 3 and 10 known points by angle measurement.
- The more known points there are and the more points there are whose distance can be measured, the higher the precision of the coordinate value calculation.

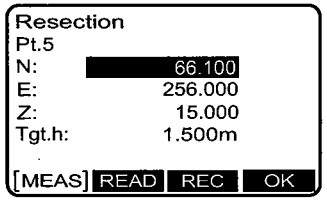
▶PROCEDURE

1. Select "Resection" in the Program Mode.



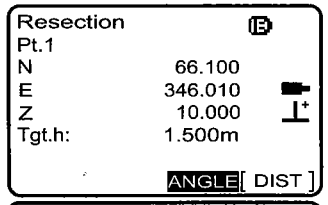
2. Enter the coordinates and target height of the first known point. After setting the first point, press **[OK]** to move to the second point. When all required known points have been set, press **[MEAS]**.

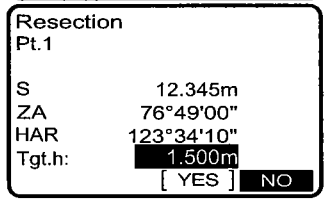




- When **[READ]** is pressed, registered coordinates can be recalled and used.
  ☞"20.3 PROCEDURE Reading in Registered Coordinate Data"
- When **[REC]** is pressed, the known point can be recorded to the current Work JOB.

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





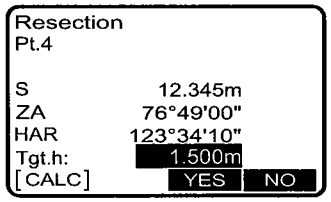
- When **[ANGLE]** has been selected, the distance cannot be measured.

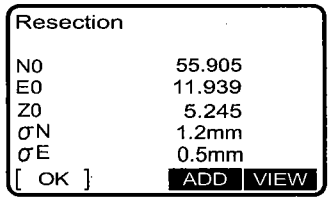
4. Press **[YES]** to use the measurement results of the first known point.

- You can also input target height here.

5. Repeat procedures 3 to 4 in the same way from the second point. When the minimum quantity of observation data required for the calculation is present, **[CALC]** is displayed.

6. Press **[CALC]** or **[YES]** to automatically start calculations after observations of all known points are completed. Instrument station coordinate and standard deviation, which describes the measurement accuracy, are displayed. Press **[OK]** to go to step 10.

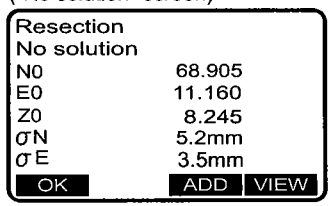




If "No solution" is displayed, go to step 7.

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

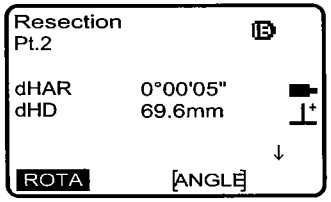
("No solution" screen)



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

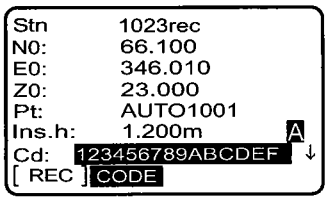
8. Press **[▲]/[▼]** to display a point with a problem. Align the cursor with that point and press **[DIST]** or **[ANGLE]** to measure the point again.

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



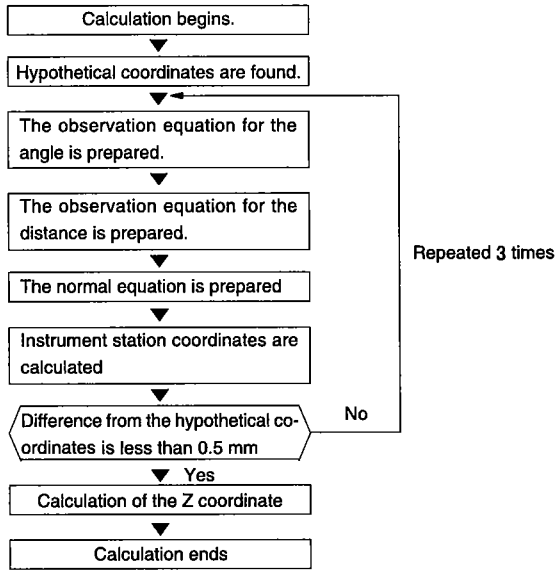
9. After measurement, press **[CALC]** again. If there are no problems with the result, press **[OK]**.

10. Input the Instrument station data and press **[REC]** to record the results.
    ☞ Selecting instrument station data items:
    "20.3 PROCEDURE Reading in Registered Coordinate Data"



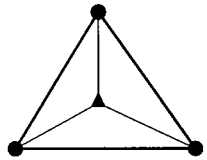
11. Press **[YES]** when you want to set the azimuth angle of the first known point as the backsight point. <Program> is restored.

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

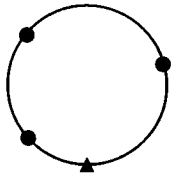


Precaution when performing resection
In some cases it is impossible to calculate the coordinates of an unknown point (instrument station) if the unknown point and three or more known points are arranged on the edge of a single circle.

- An arrangement such as that shown below is desirable.

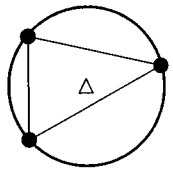


It is sometimes impossible to perform a correct calculation in a case such as the one below.

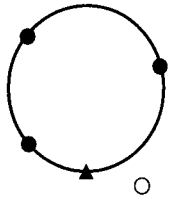


- When they are on the edge of a single circle, take one of the following measures.

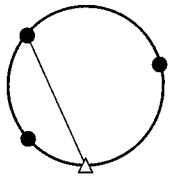
(1) Move the instrument station as close as possible to the center of the triangle.



(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.



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

15. SETTING-OUT MEASUREMENT

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

The horizontal angle difference and distance difference are calculated and displayed using the following formulae.
Horizontal difference
Displayed value (angle) = Horizontal angle of setting-out data - measured horizontal angle
Displayed value (distance) = measured horizontal distance x tan (horizontal angle of setting out data - measured horizontal angle)

Slope distance difference
Displayed value (slope distance) * = measured slope distance - slope distance setting-out data
* Horizontal distance or height difference can be input in the above formula.

Coordinate difference
Displayed value (coordinates)* measured N setting-out coordinates - N coordinates of setting-out data
* E or Z coordinates can be input in the above formula

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

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

☞ "21.3 Allocating Key Functions"

15.1 Using the Guide Light

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

☞ Turning the Guide light ON/OFF: "6.1 Basic Key Operation"

• Brightness of the guide light can be changed.
☞ 21.1 Configuration ●Instrument configurations"

The Guide light will turn off, even when set to ON, during distance measurement and returned signal checking.

● Guide light status and meaning

Status of SET

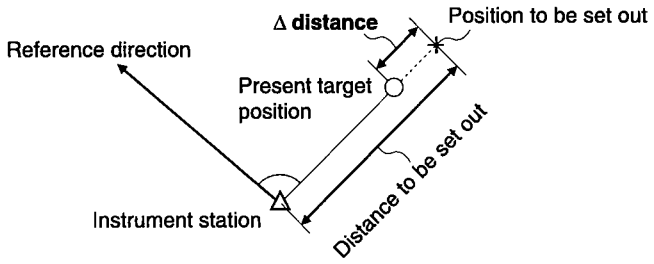
Light status	Meaning
Slow flashing	Waiting
Fast flashing	Searching Measuring (repeated measurement)
Green and red alternate flashing	Search error (error screen only) Distance measurement error (no signal, sighting error)

Indication for positioning target during setting-out measurement

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

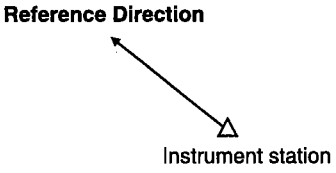
15.2 Distance Setting-out Measurement

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

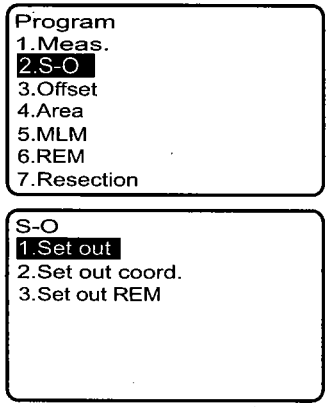


▶PROCEDURE

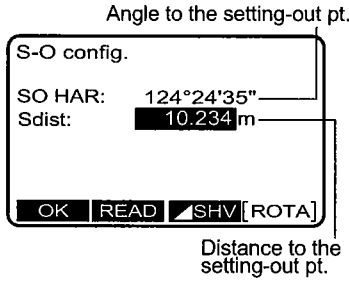
1. Sight the reference point and press **[OSET]** twice or set the horizontal angle of the reference point and input the value.
   ☞ "11.1 Measuring the Horizontal Angle between Two Points (Horizontal Angle 0°)"/"11.2 Setting the Horizontal Angle to a Required Value (Horizontal Angle Hold)"



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



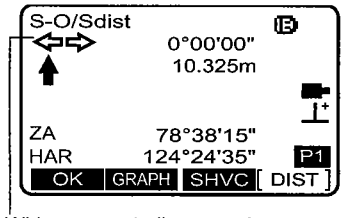
3. In <S-O config.>, enter the included angle between the reference point and the setting-out point and the distance from the instrument station to the position to be set out (slope distance, horizontal distance or height difference). Enter the value in the Distance Mode that conforms to your measurement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



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

☞ "20.3 PROCEDURE Reading in Registered Coordinate Data"

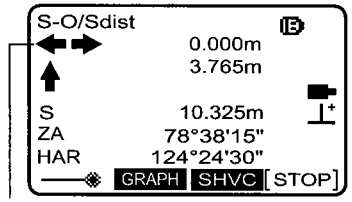
4. Enter values and press **[ROTA]** in the screen of step 3.The SET automatically turns toward the horizontal angle entered in step 3 and the angle to the setting out point reads 0°.



White arrows indicate angle to move

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

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

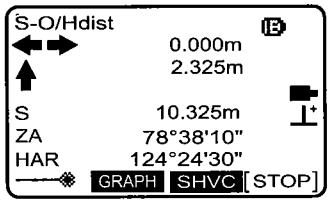


Black arrows indicate distance to move

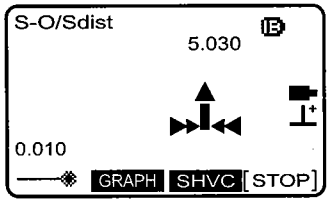
• Movement indicator

- : (Viewed from SET) Move target to the left
- : (Viewed from SET) Move target to the right
- : (Viewed from SET) Target position is correct
- : Target position is correct
- : (Viewed from SET) Move target closer
- : (Viewed from SET) Move target away
- : (Viewed from SET) Move target upward
- : Move target downward
- : Target position is correct

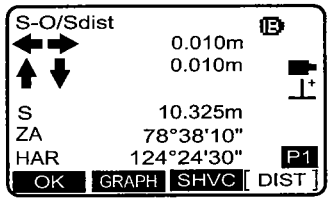
- Press **[SHVC]** to switch the distance mode: Sdist (slope distance), Hdist (horizontal distance), V distance (height difference).



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



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



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

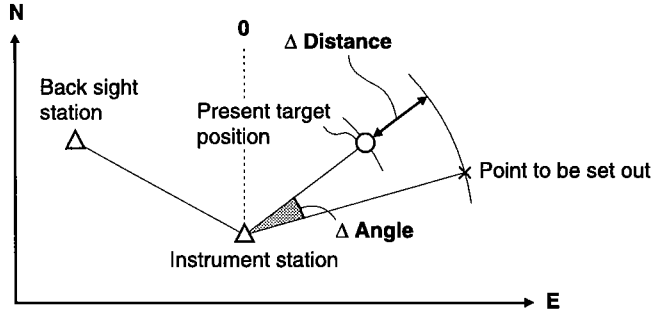
Note

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

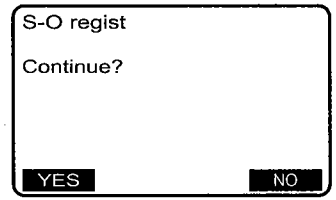
☞ Allocating the **[S-O]** softkey: "21.3 Allocating Key Functions""

15.3 Coordinates Setting-out Measurement

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



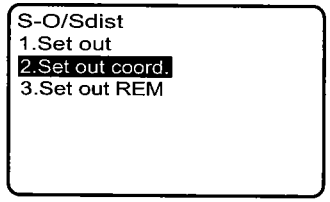
- Previously recorded setting-out points can be placed in order. Up to 30 points can be recorded.
- Registered setting-out point data is saved until the power is turned OFF, so you can return to the setting out screen you were working on after you enter another mode.
- To continue setting-out measurements,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



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

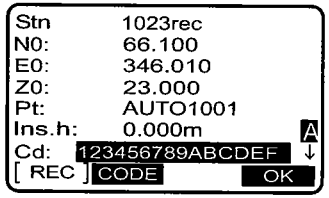
▶PROCEDURE

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

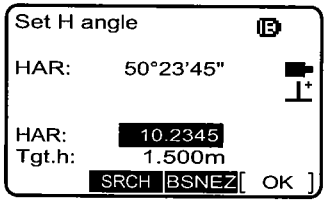


2. Enter the instrument station data in the <Stn> menu. Press **[REC]** to record the data.
   ☞"13.1 Entering Instrument Station Data""

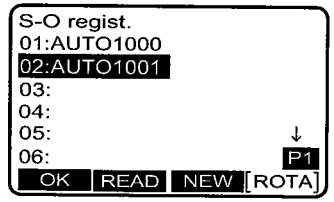
   • Press **[OK]** to go to step 4 without recording the instrument station data.

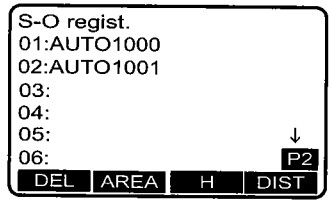


3. Set the azimuth angle of the backsight point.
   ☞"13.2 Azimuth Angle Setting"," steps 3 to 6.



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



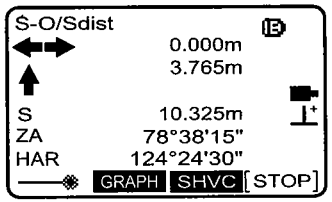


   • Pressing **[DIST]** relists the recorded setting-out points, starting in order of the points at the shortest distance from the instrument station. If measurement has already begun, the order of the list is reorganized and starts with the points at the shortest distance from the last measured point.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

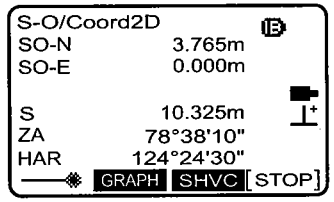
   • Pressing **[AREA]** allocates the range of the setting-out point using the read-in point name of the current JOB or control JOB.
   • Pressing **[DEL]** deletes the registered setting-out point that is selected.

5. Select the setting-out point and press **[ROTA]** in the screen of step 4. The SET automatically rotates until the angle of the setting-out point reads 0°.

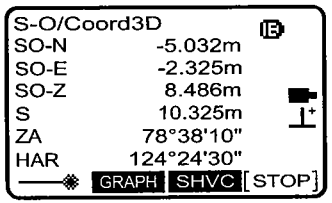
6. Position the target on the line of sight and press **[DIST]** to start distance measurement.
   The distance and direction to move the target until the setting out point is located is displayed on the SET.
   The sighting point measurement results (currently installed position of the target) are displayed.



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



   Move the target closer/further away and upward/downward to find the correct distance (0 is displayed) to the setting-out point
   ☞ Movement indicators: "15.2 Distance Setting-out Measurement" step 5



15.4 REM Setting-out Measurement

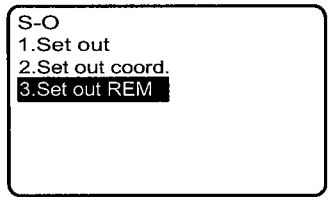
To find a point where a target cannot be directly installed, perform REM setting-out measurement.
☞ "12.5 REM Measurement"

▶PROCEDURE

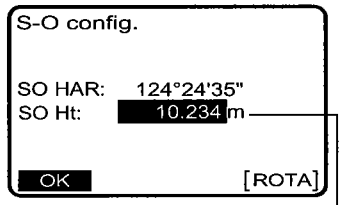
1. Install a target directly below or directly above the point to be found. Then use a measuring tape etc. to measure the target height (height from the surveying point to the target).

2. Enter Shift Mode and select "Height." Then, enter the height.

3. Select "S-O" in Program mode. Then select "Set out REM".



4. Input height from the surveying point to the position to be set out in "SO ht".
   - Input height from the surveying point to the position to be set out in "SO dist".
   - If necessary, input the angle to the point to be set out.



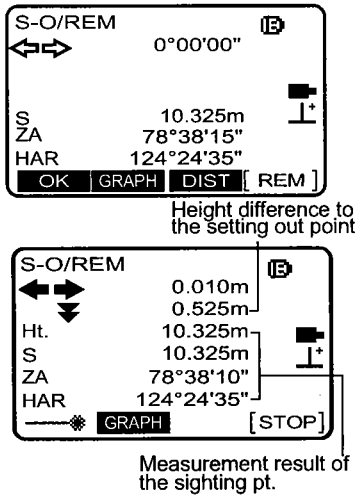
Height to be set out

5. Press **[ROTA]** in the screen of step 4. The SET automatically rotates until the horizontal angle of the setting-out point reads 0°.

6. Sight the target and press **[DIST]**. Measurement begins and the measurement results are displayed. Press **[STOP]** to stop measuring.

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

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



● Movement indicator

▲ : Move the telescope nearthe zenith

▼ : Move the telescope near the nadir

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

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

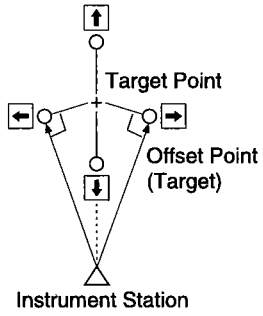
16. OFFSET MEASUREMENT

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

- It is possible to find the distance and angle to a point you wish to measure (target point) by installing the target at a location (offset point) a little distance from the target point and measuring the distance and angle from the surveying point to the offset point.
- The target point can be found in the three ways explained below.

16.1 Single-distance Offset Measurement

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



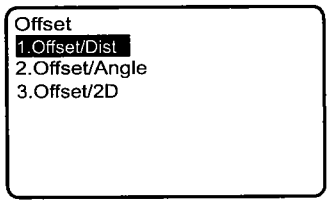
- When the offset point is positioned to the left or right of the target point, make sure the angle formed by lines connecting the offset point to the target point and to the instrument station is almost 90°.
- When the offset point is positioned in front of or behind the target point, install the offset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

▶PROCEDURE

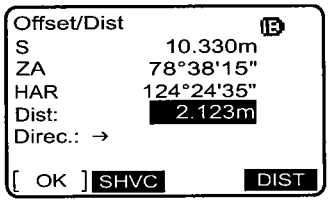
1. Set the offset point close to the target point and measure the distance between them, then set up a prism on the offset point.

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 and select "Offset/Dist".

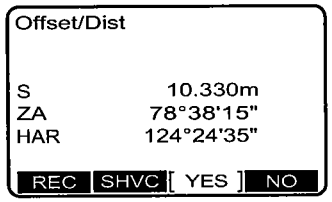


4. Enter the instrument station data.
   Input the following items.
   (1) Horizontal distance from the target point to the offset point.
   (2) Direction of the offset point



5. Press **[OK]** in the screen of step 4 to calculate and display the distance and angle of the target point.

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



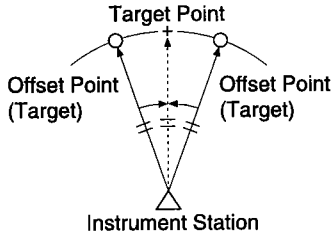
6. Press **[YES]** in the screen of step 5 to return to <Offset>.
   • Press **[NO]** to return to setting the distance and direction.
   • To record the calculation result, press **[REC]**.

Note

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

16.2 Angle Offset Measurement

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



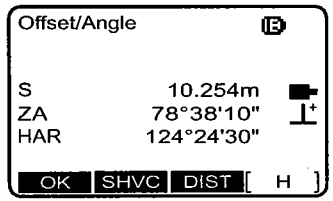
▶PROCEDURE

1. Set the offset points close to the target point (making sure the distance from the instrument station to the target point and the height of the offset points and the target point are the same), then use the offset points as the target.

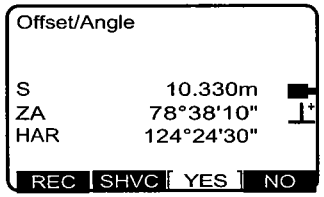
2. Sight the offset point and press **[DIST]** in the first page of the Meas Mode screen to begin measurement.
   The measurement results are displayed.

3. Press **[OFFSET]** in page three of Meas Mode and select <Offset/ Angle>.

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



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



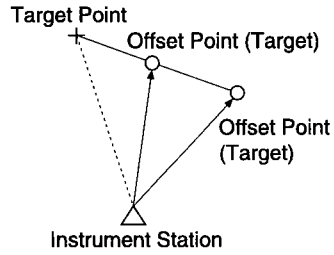
6. After finishing measurement, press **[YES]** to return to <Offset>.

16.3 Two-distance Offset Measurement

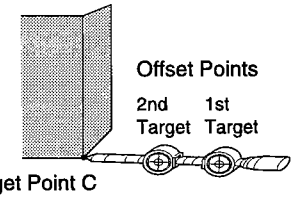
By measuring the distances between the target point and the two offset points. Install two offset points (1st target and 2nd target) on a straight line from the target point. Observe the 1st target and 2nd target, then enter the distance between the 2nd target and the target point to find the target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

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

☞ "25.3 Target System"



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



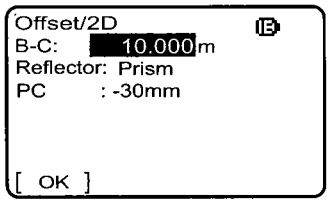
- Install the 2-point target with its tip at the target point.
- Face the targets toward the instrument.
- Measure the distance from the target point to the 2nd target.
- Set the prism factor to "0mm"

▶PROCEDURE

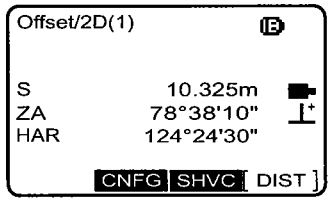
1. Install two offset points (1st target, 2nd target) on a straight line from the target point and use the offset points as the target.

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

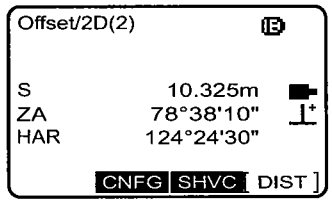
3. Enter the distance from offset point B to the target point in "B-C". Then, set the "Reflector" and "PC" (prism constant). Press **[OK]**. (This screen is only displayed once when you enter the 2-distance offset measurement menu.)



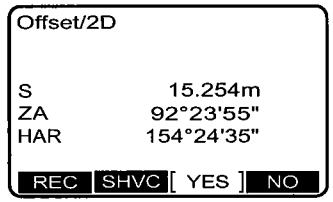
4. Sight target A and press **[DIST]** to start measurement. Measurement results of offset point A are displayed. Press **[YES]**.
   - Press **[CNFG]** to change the settings entered in step 3.



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



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



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

Note

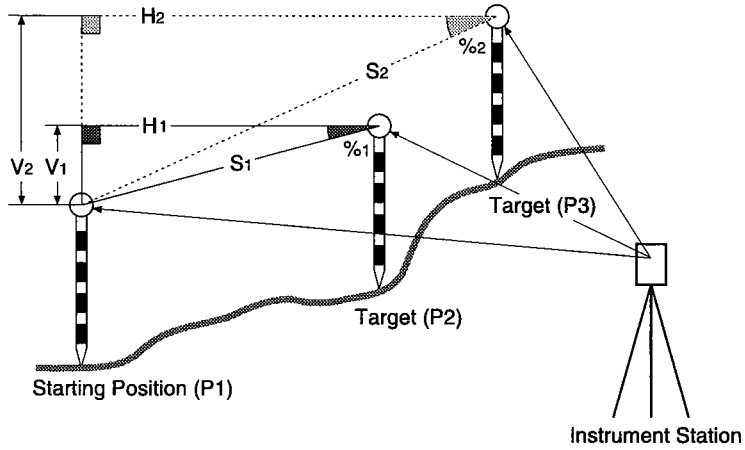
The following items and input ranges can be selected (*Factory settings)

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

17. MISSING LINE MEASUREMENT

Missing line measurement is used to measure the slope distance, horizontal distance, and horizontal angle to a target from the target which is the reference (starting point) without moving the instrument.

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



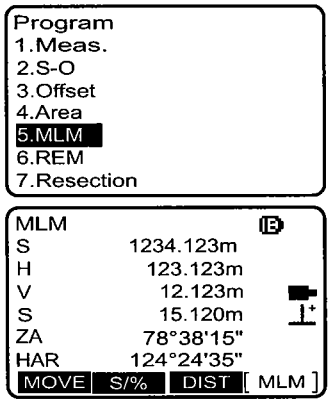
- Softkeys can be customized to meet the requirements of individual users in missing line measurement screen.

17.1 Measuring the Distance between 2 or more Points

▶PROCEDURE

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

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

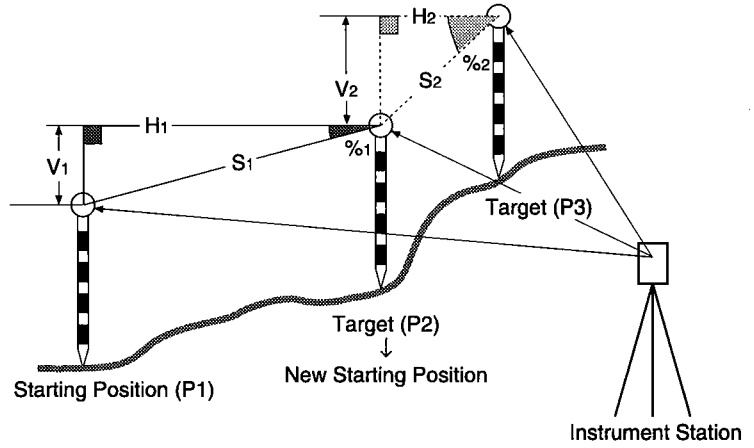


3. Sight the next target and press **[MLM]** to begin observation. Continue measuring points using starting position as backsight.
   - When **[S/%]** is pressed, the distance between two points (S) is displayed as the gradient between two points.
   - Press **[DIST]** to re-observe the starting position.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

   ☞"17.2 Changing the Starting Point"
4. Press **{ESC}** to end missing line measurement.

17.2 Changing the Starting Point

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

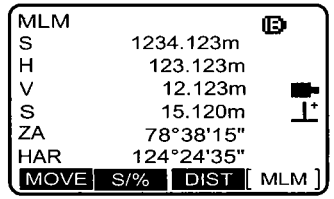


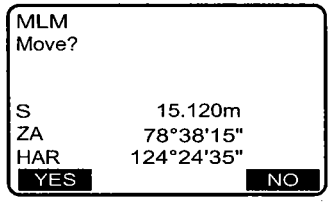
▶PROCEDURE

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

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

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



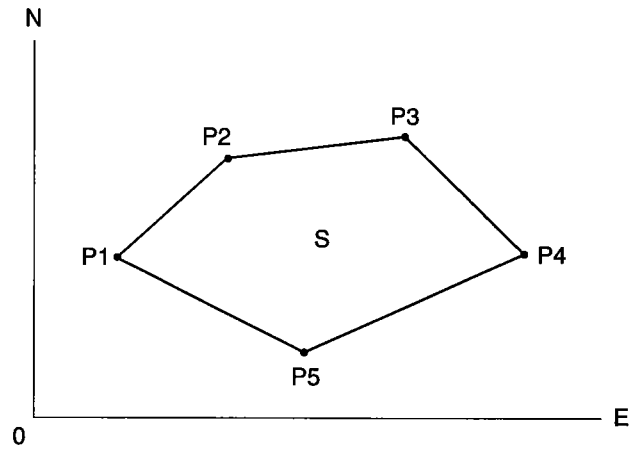


3. The last target measured is changed to the new starting position.
   Perform missing line measurement following steps 2 to 3 in "17.1 Measuring the Distance between 2 or more Points".

18. SURFACE AREA CALCULATION

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

Input		Output	
Coordinates	: P1 (N1, E1, Z1) P2 (N2, E2, Z2) P3 (N3, E3, Z3) : :	Surface area	: S (horizontal area and slope area)



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

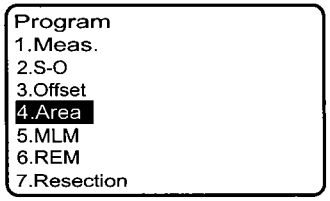
- Be sure to observe (or recall) points on an enclosed area in a clockwise or counterclockwise direction. For example, the area specified by entering (or recalling) point numbers 1, 2, 3, 4, 5 or 5, 4, 3, 2, 1 implies the same shape. However, if points are not entered in numerical order, the surface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

Slope area

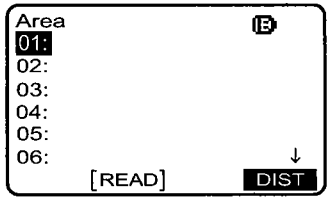
The first three points specified (measured/read-in) are used to create the surface of the slope area. Subsequent points are projected vertically onto this surface and the slope area calculated.

▶PROCEDURE Surface area calculation by measuring points

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



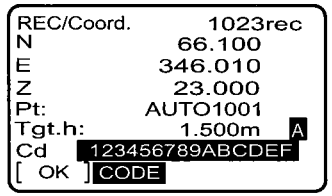
2. Sight the first point on the line enclosing the area, and press **[DIST]**.
   Measurement begins and the measured values are displayed. Press **[STOP]** to stop measuring.

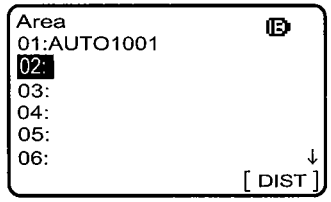


   - When **[READ]** is pressed, registered coordinates can be recalled and used in subsequent measurements.

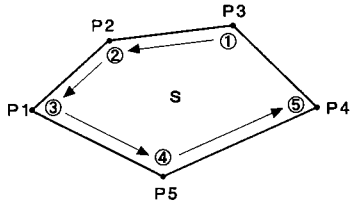
   ☞ " PROCEDURE Surface area calculation by reading in the points' coordinates"

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

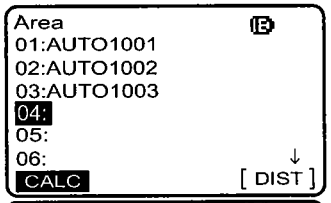


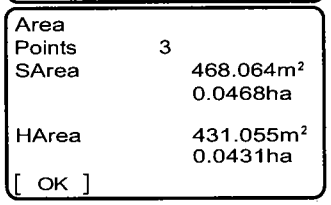


4. Repeat steps 3 to 4 until all points have been measured. Points on an enclosed area are observed in a clockwise or counterclockwise direction.
   For example, the area specified by entering point numbers 1, 2, 3, 4, 5 or 5, 4, 3, 2, 1 implies the same shape.
   After all known points necessary to calculate the surface area have been observed, **[CALC]** is displayed.



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





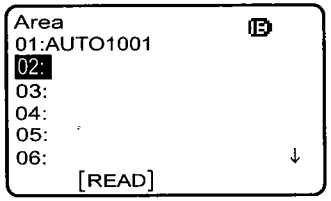
6. Press **[OK]** to quit area calculation and return to the <Program> screen. (Information for points set in procedures 2 to 4 is deleted.)

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

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

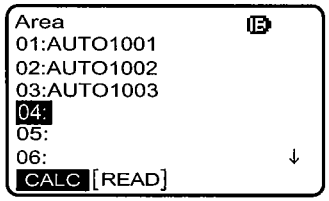
2. Press **[READ]** to display the list of coordinate data.

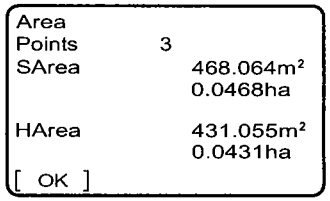
3. Select the first point in the list and press **[OK]**.
   The coordinates of the first point are set as "01".



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

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





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

19. MANAGING A JOB

Data is managed by JOB unit.

- Instrument station data, observation data (distance, angle, coordinates), known point data and notes can be recorded in a JOB.
- A total of 10,000 data items can be stored inside the instrument.

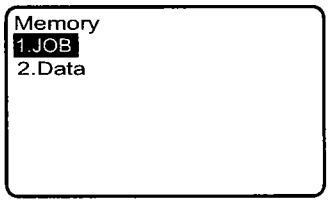
19.1 JOB selection

Select Control JOB and Work JOB before performing measurement.

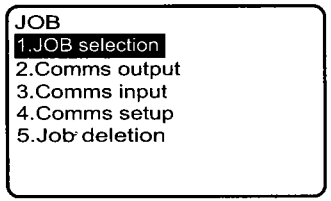
- Instrument station data, observation data and known point data are recorded in the Work JOB.
- Data in the Control JOB can be read into the Work JOB.
- A total of 24 JOBs have been prepared, and JOB01 was selected as the Work JOB and Control JOB when your SET was shipped from the factory.
- The names of the JOBs have been preset as JOB01 to JOB24; you can change them to any names you wish.

▶PROCEDURE Selecting a Work JOB and Control JOB

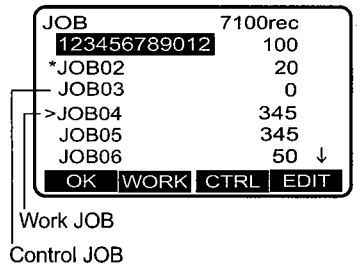
1. Select "JOB" in the Memory Mode.



2. Select "JOB selection".



3. Align the cursor with the desired Work JOB and press **[WORK]**. "*" appears to the left of the selected JOB.



- The numbers on the right represent the number of data items in each JOB.

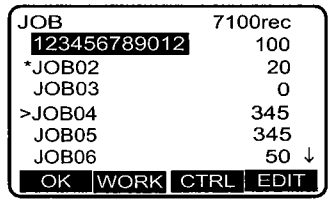
4. Align the cursor with the desired Control JOB and press **[CTRL]**. ">" appears to the left of the Control JOB.

   - If the same JOB is selected as the Work JOB and Control JOB, only "*" is displayed.

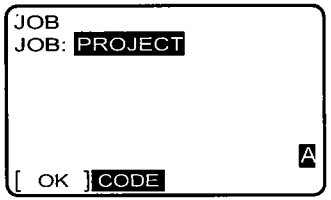
5. Press **[OK]** to finish JOB selection and return to the <JOB> management screen.

▶ PROCEDURE Enter a JOB name

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



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



Note

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

19.2 Outputting JOB data to the Host Computer

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

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

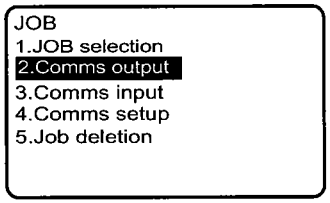
☞ Instrument settings: "21.1 Configuration ● Communication Setup".
Types of connecting cable: "25.2 Optional Accessories", details of Communications format: Command Explanations manual.

▶PROCEDURE

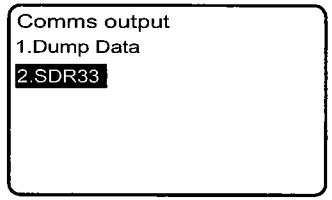
1. Use a cable to connect the SET and external equipment.

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

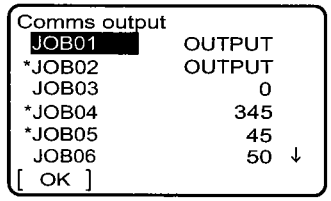
3. Select "Comms output".



4. Select the correct output format.

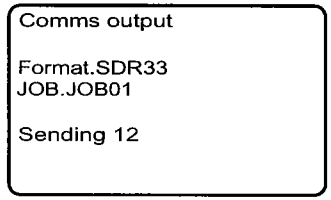


5. Press **{↵}** to select the JOB to be output. "OUTPUT" appears on the right of the JOB selected. Multiple JOBs can be selected.



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

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



Note

The following items can be selected.

- Output format: dump data/SDR33

19.3 Inputting Known Point Data

It is possible to input coordinate data of known points from a host computer or auxiliary equipment to the SET and store it as a Work JOB.
Recorded coordinates can be read in as an instrument station point, backsight point, known point, and setting-out point during point setting.

- Key input method is required to register known points.

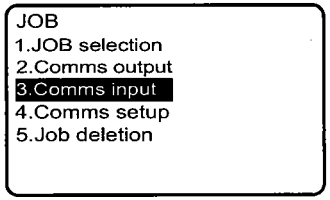
☞ "20.2 Using the Key Entry Method to register Known Point Coordinate Data"

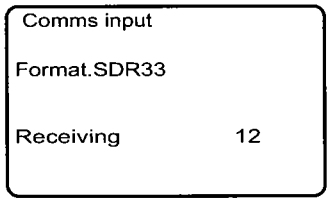
• RS232C can be set in the JOB management menu.

☞ Instrument settings: "21.1 Configuration ● Communication setup". Types of connecting cable: "25.2 Optional Accessories", details of Communications format: Command Explanations manual.

▶PROCEDURE Entering known point coordinate data from an external instrument

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





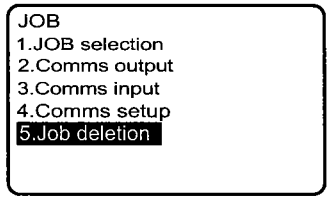
4. When data input is completed, the message "Complete" is displayed. Press any key to return to the JOB management screen.

19.4 Deleting a designated JOB

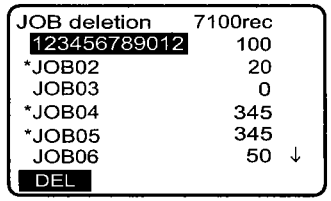
A designated JOB can be deleted. After the data is deleted, the JOB name changes to the JOB name allocated when the SET was shipped.

▶PROCEDURE

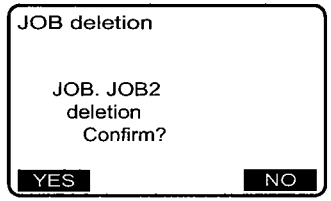
1. Enter the "JOB" management screen
   Select "JOB" in the Memory Mode.
2. Select "JOB deletion".



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



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



20. MANAGING DATA IN A JOB

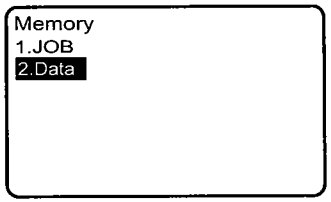
20.1 Displaying data in a JOB

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

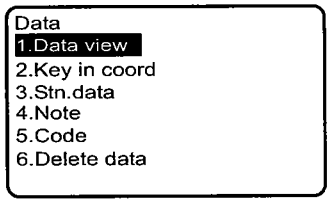
- Data is stored in ordered records in the JOB.
- Observation data is displayed in each instrument station point.
- Data in a JOB is displayed in the following sequence (1) Instrument station data (2) Observation data which was measured at the designated instrument station→ (3) Details of observation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

▶PROCEDURE

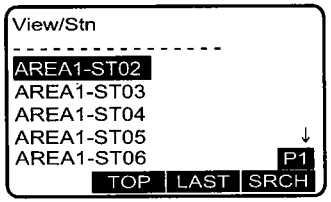
1. Select "Data" in the Memory Mode.



2. Select "Data view".



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

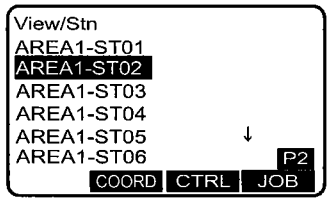


   - If the first data in the JOB is not instrument station data, "- - - -" is displayed. Select "- - - -" to display all data entered before the position of the first instrument station data.

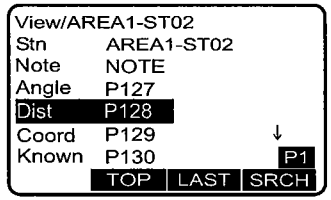
   - Press **[TOP]** to display first data.
   - Press **[LAST]** to display last data.

   ☞ How to search:
   "20.3 PROCEDURE Reading in Registered Coordinate Data"

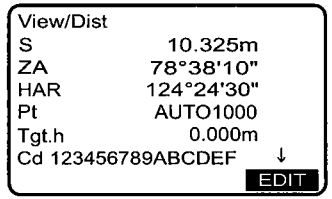
   - Press **[COORD]** in the second page to display coordinate data only.
   - Press **[CTRL]** in the second page to display a list of point names in the Control JOB. Press **[WORK]** to restore and display the Work JOB data.
   - Press **[JOB]** in the second page to display JOB selection. You can change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



4. Select data from the list of data measured with the instrument station data selected in step 3 and press {↵}.
   Details of the selected data are displayed. This screen contains distance measurement data.



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



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

It is possible to use the key entry method to enter known point coordinate data and register it in the Work JOB.
The coordinate data that has been registered can be output during setting for use as instrument station, backsight station, known point and setting-out point coordinate data.

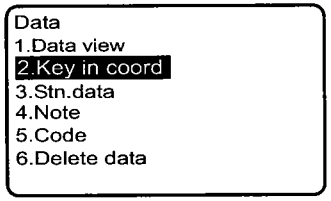
- There are two registration methods: key entry and entry from an external instrument.

☞ "19.3 Inputting Known Point Data".

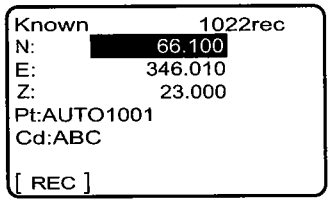
▶PROCEDURE

1. Select "Data" in the Memory mode.

2. Select "Key in coord".



3. Enter known point coordinates and the point name.



4. Press **[REC]** to record the known point data. You can record other known points as required.

   - Press **{ESC}** to return to the <Data> screen.

20.3 Setting Instrument Station Data

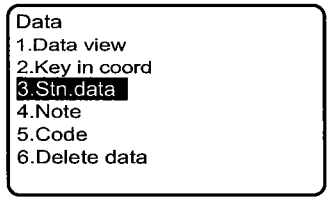
It is possible to use the key entry method to input instrument station data and register it in a Work JOB.

Date and time are not automatically renewed on the SET230RM. They must be input before measurement is started.

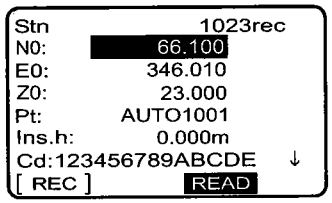
▶PROCEDURE Entering settings for instrument station points

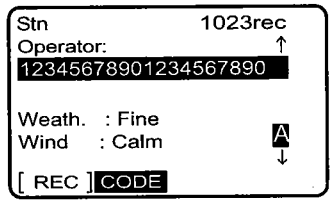
1. Enter the Data management screen
   Select "Data" in the Memory Mode.

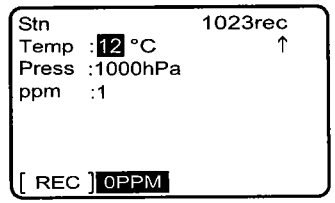
2. Select "Stn. data".



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







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

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

Note

Maximum number of characters per field and options:

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

- Wind selection: calm*, gentle, light, strong, very strong
- Temperature range: -30 to 60 (°C)
- Air pressure range: 500 to 1400 (hPa), 375 to 1050 (mmHg)
- Atmospheric correction factor range (ppm): -499 to 499

☞ "21.1 Configuration ● Observation Conditions"

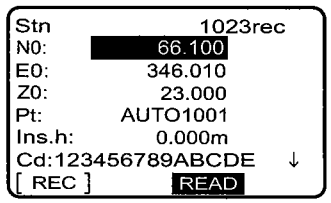
- Date: Examle: August 1, 2005 → 08012005
- Time: Example: 2:25:17 p.m. → 142517

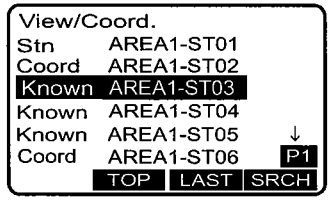
(*: Factory setting)

▶PROCEDURE Reading in Registered Coordinate Data

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

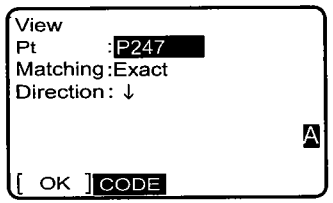
1. Press **[READ]** when setting instrument station. The list of registered coordinates in the Work JOB is displayed.
   Find the coordinates you will read in. Align the cursor with the point name and press **{↵}**.
   Go to step 3.
   To find a point name, perform step 2.
   - Press **[TOP]** to move to the first point number.
   - Press **[LAST]** to move to the last point number.
   - Press **[CTRL]** in second page to view a list of coordinate data for control JOBs

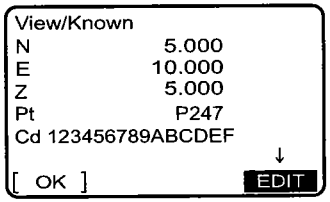




   - Press **[JOB]** to display the JOB selection screen. The status of the current Work JOB and Control JOB can be switched.

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





3. Press **[OK]**. Returns to the instrument station point setting.

   • Press **[EDIT]** to edit part of the coordinates read in.

Searching for the point name

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

Note

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

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

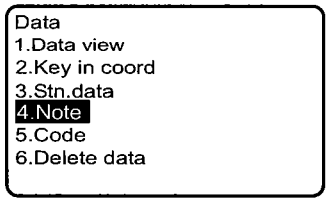
20.4 Recording Notes

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

▶PROCEDURE

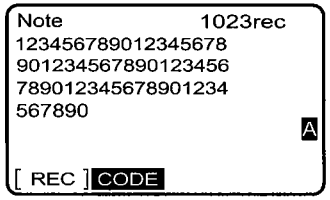
1. Select "Data" in the Memory Mode.

2. Select "Note". A list of instrument station point names is displayed.



3. Enter the note data.

   • Press **[CODE]** to go to the code entry screen.
   ☞"20.5 Registering Codes""



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

Note

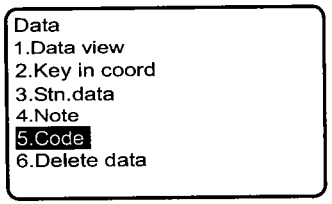
- Maximum note length: 60 characters (alphanumeric)

20.5 Registering Codes

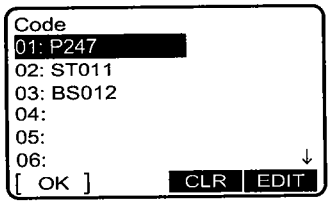
It is possible to save codes in memory. You can also read in codes registered in memory when recording instrument station data or observation data.

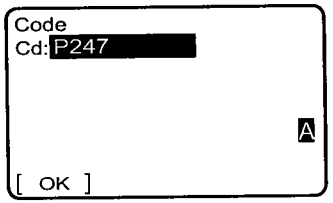
▶PROCEDURE

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



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





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

Note

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

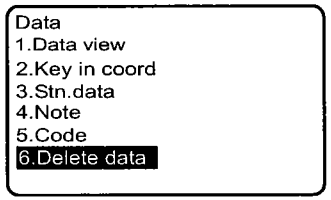
20.6 Deleting data in a JOB

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

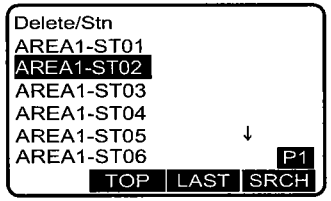
- Data deletion is performed in the following sequence: (1) Instrument station data (2) Observation data which was measured at the designated instrument station (3) Point name of point selected to be deleted.

▶PROCEDURE

1. Select "Data" in the Memory Mode.
2. Select "Delete data".



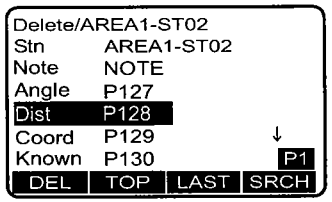
3. In the list of instrument station names, align the cursor with the data you wish to display and press {↵}.

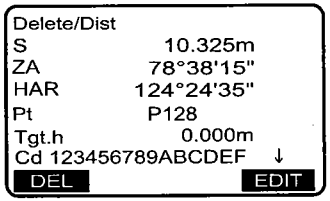


4. Select data from the list of data measured with the instrument station data selected in step 3 and press {↵} to display the details of the data selected in the list.

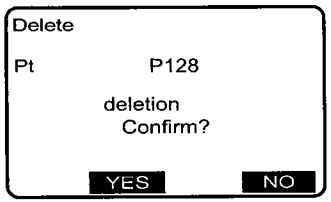
   • Data can be deleted without checking the details of the data by pressing **[DEL]** here.

   Then press **[DEL]**.





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



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

21. CHANGING THE SETTINGS -CONFIGURATION-

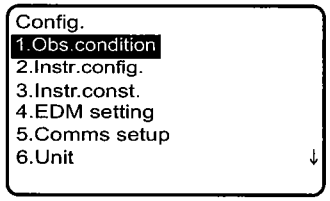
This section explains the contents of parameter settings, and how to change settings in Configuration Mode.

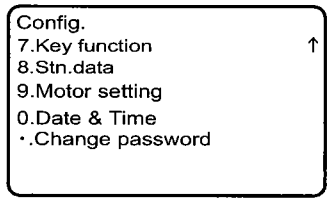
The following chapters provide details of items in the Configuration Mode.

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

21.1 Configuration

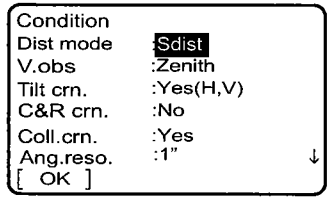
This section explains the settings in the Configuration Mode.
Each item can be changed to meet your measurement requirements.

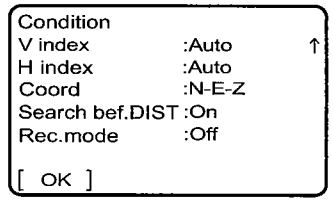




- "*": Factory setting

• Observation conditions





Items set and options

Distance mode	: Sdist (slope distance) *, Hdist (horizontal distance), Vdist (height difference), coord (coordinate)
V.obs (vertical angle display method)	: Zenith*, Horiz, Horiz 90° (Horizontal ±90°)
Tilt crn (tilt correction)	: Yes (H,V) *, Yes (V), No
C&R crn.	: No*, K=0.142, K=0.20
Coll.crn. (collimation correction)	: Yes*, No
Ang. reso. (Angle resolution)	: 1"*, 5"
V index	: Auto*, Manual

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

Automatic tilt angle compensation mechanism

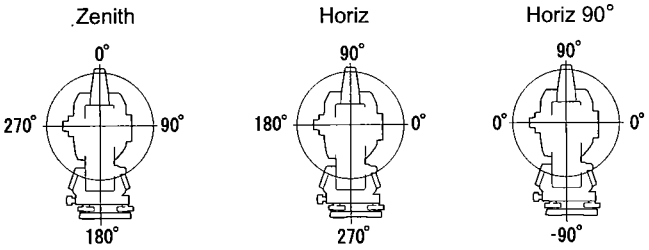
The vertical and horizontal angles are automatically compensated for small tilt errors using the 2-axis tilt sensor.

- Read the automatically compensated angles when the display has stabilized.
- The horizontal angle error (vertical axis error) fluctuates according to the vertical axis, so when the instrument is not completely leveled, changing the vertical angle by rotating the telescope will cause the displayed horizontal angle value to change.
- Compensated horizontal angle = Measured horizontal angle + Tilt in angle / tan (Vertical angle)
- When the telescope is directed close to the zenith or nadir angle, tilt compensation is not applied to the horizontal angle.

Collimation correction

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

V mode (vertical angle display method)

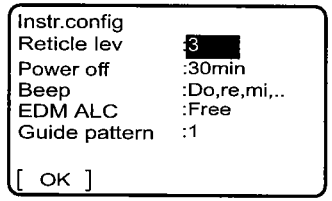


Search before DIST (distance measurement)

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

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

● Instrument configurations



Items set and options

Reticle lev (reticle level)	: 0 to 5 (3*)
Power off	: 30 min*, Off
Beep	: Do, re, mi...*, Monotone
EDM ALC	: Hold, Free*
Guide pattern	: 1* (simultaneous), 2 (alternating)

EDM ALC

Set the light receiving status of the EDM. While carrying out continuous measurement, set this item according to the measurement conditions.

- When EDM ALC is set to "Free," the instrument's ALC will be automatically adjusted if an error occurs as a result of the amount of light received. Set to "Free" when the target is moved during measurement or different targets are used.
- When "Hold" is set, the amount of light received will not be adjusted until continuous measurement is completed.
- If an obstacle intermittently obstructs the light beam during continuous measurement and the "Signal off" error occurs, each time the obstruction occurs it takes some time for the amount of light received to be adjusted and the measurement value displayed. Set to "Hold" when the light beam used for measurement is stable but is frequently obstructed by obstacles such as people, cars, or tree branches etc.

Note

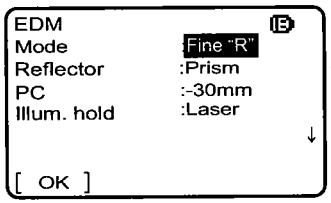
The EDM ALC setting will automatically be switched to "Free", even when set to "Hold", when the distance measurement mode is set to "Tracking" (target is moved during distance measurement).

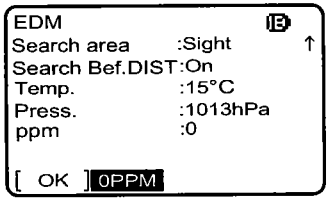
Power-saving automatic cut-off
To save power, power to the SET is automatically cut off if it is not operated for 30 minutes.

Note

- The screen will be displayed only when "Illum. hold" is set to "Guide" and the cursor is on "Guide".

● EDM settings





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

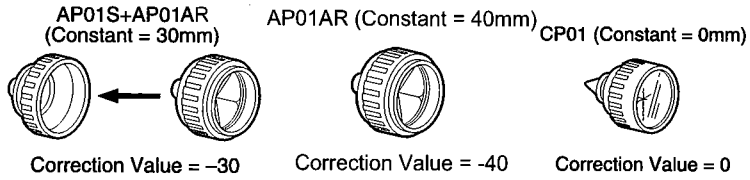
Items set, options, and input range

Mode (Distance measurement Mode) : Fine "R"*, Fine AVG"n=2" (Setting: 2 to 9 times), Fine "S", Rapid "S", Tracking
Reflector : Prism*, Sheet, Reflectorless
PC (Prism constant) -99 to 99 (Prism:-30*, sheet:0*) (in step 1mm)
Illum. Hold ({☼} function) : Laser (Laser-pointer)*, Guide (Guide light)
Search area : Sight (in field of view)*, HV wide (horizontal and vertical wide), V wide (vertical wide) H wide (horizontal wide) (Can also be set in Motor setting)

Search bef.DIST : (Can also be set in "● Observation conditions" and "● Motor setting")
Temp. (Temperature) : -30 to 60°C (15*) (in step 1°C)
Air pressure : 500 to 1400hPa (1013*) (in step 1hpa), 375 to 1050mmHg (760*) (in step 1mmHg)
ppm (Atmospheric correction factor) : -499 to 499 (0*)

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

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



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

Atmospheric correction factor
The SET measures the distance with a beam of light, but the velocity of this light varies according to the index of refraction of light in the atmosphere. This index of refraction varies according to the temperature and air pressure.

- To precisely determine the atmospheric correction factor, the average temperature and air pressure along the measurement beam route must be taken. Take care when calculating the correction factor in mountainous terrain as the difference in height will result in differences in atmospheric conditions between two points.
- The SET is designed so that the correction factor is 0 ppm at an air pressure of 1013 hPa and a temperature of 15°C.

- By inputting the temperature and air pressure (and humidity) values, the atmospheric correction value is calculated and set into the memory. Calculate the atmospheric correction factor as shown in the following formula.

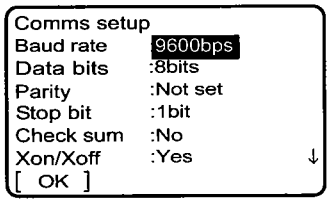
Atmospheric Correction Factor (ppm)=

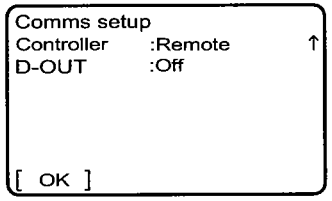
$$\left(282.324 - \frac{0.294362 \times p}{1 + 0.003661 \times t} + \frac{0.0004127 \times 50 \times ew}{1 + 0.003661 \times t}\right) \times 10^{-6}$$

t: Temperature (°C)
p: Pressure (hPa)
ew: Saturated water vapor pressure

- If the weather correction is not required, set the ppm value to 0.
  ☞ "27.2 Atmospheric Correction for High Precision Distance Measurement"

● Communication setup





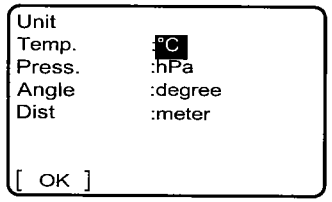
Items set and options

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

Controller
Select "Remote" to use a motor drive command (But, some of the 2-way commands cannnot be used.)
Select "2way" to use all commands other than motor drive commands.

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

● Unit



Items set and options

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

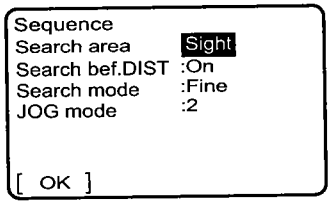
Inch (Fraction of an inch)
"Fraction of an inch" is the unit used in the United States and expressed like the following example.

10.875 feet → **10**-**10**-**1/2** inch
① ② ③

① **10**.000 feet
② 0.875 feet x 12=**10**.5 inch
③ 0.5 inch=**1/2** inch

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

● Motor Settings



Items set and options

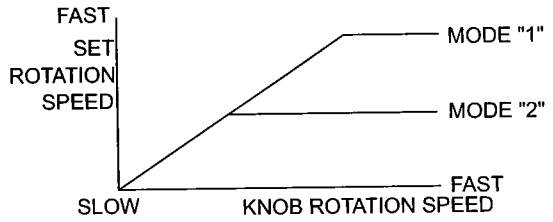
Search area : (Can also be set in "● Observation conditions" and "● EDM settings")
Search bef.DIST : (Can also be set in Configuration ● Observation conditions)
Search mode : Fine*, Rapid
JOG mode : 1, 2*

Search mode

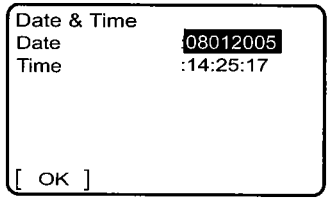
This item allows you to select the Auto-search mode. In Auto-search, the SET analyses the image of the prism in the field of view and moves the telescope to sight the center of this prism.
Compared to "Rapid" mode, the analysis of the prism image in "Fine" mode is finer and the criteria for completing sighting are more stringent.
Rapid" mode should be used when supporting the pole by hand if "Time out" is displayed before the SET completes sighting as a result of vibration, or, completing Auto-search takes too long.

JOG mode

This item allows you to select the speed at which the SET can be rotated using the vertical and horizontal jogging knobs.
When JOG mode is set to "1", the faster the jogging knobs are turned, the faster the SET rotates.
When JOG mode is set to "2" the SET rotates as in mode "1" but the maximum rotation speed is slower.



● Date and time (only SET3230M)



- On SET3230RM input date and time as instrument station data.

☞ "20.3 Setting Instrument Station Data"

Set items

Date : Example: August 1, 2005 → 08012005
Time : Example: 2:25:17 p.m. → 142517

Date and time

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

21.2 Allocating Key Functions in SFT Mode

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

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

• Shift menu configuration when SET was shipped from the factory

Page 1 : Height
Search
Laser-pointer (Guide light)
Obs. Condition
Stn. Data
EDM setting

Page 2 : H angle set
Data view
Meas.
Memory menu
Tilt
Aiming

• Allocating functions and menus

Menus	Functions
Motor menu	Search, Face change, Rotation, Laser-pointer (Guide light), Motor setting
Memory menu	JOB selection, Comms output, Comms input, Comms setup, JOB deletion
Data menu	Data view, Key in coord, Stn. Data, Note, Code, Delete data
Config menu	Obs.condition, Instr.config., Instr.const., EDM setting, Comms setup, Unit, Key function, Stn.data, Motor setting, Date and time (only SET3230RM)
Meas fnc menu	H 0set, H angle set, Stn.data, Disp.dist, H angle, V angle, Height
Etc. menu	Tilt, Aiming, Meas, S-O

• Contents of functions that can be allocated

Search : Automatically sights center of prism
Face change : Rotates the SET
Rotation : Automatically rotates the SET to the entered horizontal angle and vertical angle
Laser-pointer : Turns laser-pointer ON/OFF
Guide light : Turns guide light ON/OFF

Motor setting : Sets motor drive operation functions (search area, search before DIST, search mode, JOG mode)
JOB selection : Selects JOB
Comms output : Outputs JOB contents to external instrument
Comms input : Inputs Known point data from an external instrument
Comms setup : Sets communication parameters
JOB deletion : Deletes a JOB
Data view : Displays data in a JOB
Key in coord : Records known point data
Stn.data : Sets instrument station point data
Note : Records notes
Code : Records codes
Delete data : Deletes selected data
Obs.condition : Sets observation conditions
Instr.config. : Sets instrument configuration
Instr.const.* : Instrument constant menu
EDM setting : Sets EDM
Unit : Sets units
Key function : Allocates, registers and reads in softkeys
Date & time : Sets date and time (only SET3230RM)
H 0set : Sets horizontal angle to 0°
H angle set : Sets the horizontal angle of the sighting direction to your required angle
Disp.dist : switches distance display mode (slope distance/horizontal distance/height difference/coordinates)
H angle : Switch between horizontal angle right/left
V angle : Switch between zenith angle/slope in %
Height : Sets height of sighting point
Tilt : Display tilt angle
Aiming : Checks received laser signal
Meas* : Meas. mode
S-O : Setting-out measurement menu

Note

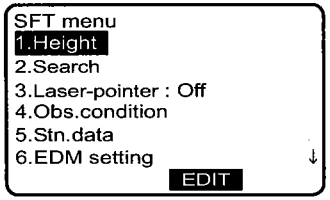
- After the function indicated with "*" is completed, the main menu (menu before **{SFT}** was pressed) is not restored.

- Only one function, "Laser-pointer" or "Guide light", can be set as the Illum. Hold setting in "EDM".
  ☞ "21.1 Configuration ● Observation conditions"

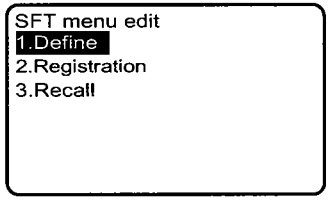
▶PROCEDURE Allocating menus

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

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

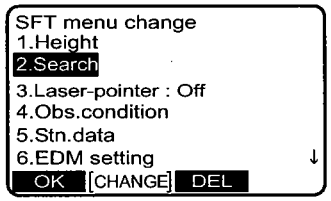


3. Select "Define".

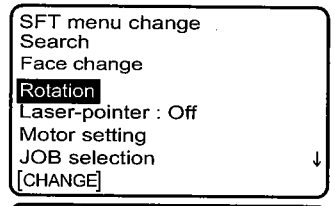


4. Align the cursor with the menu/ function you wish to change and press **[CHANGE]**.

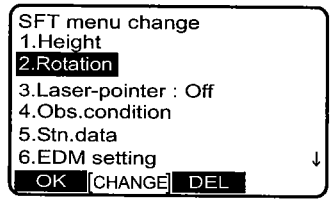
   - Press **[DEL]** to delete an item from the menu.



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



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



6. Repeat steps 4 and 5 until all new allocations are set.

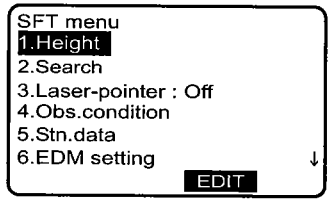
7. Press **[OK]** to finish allocating items. The allocated items are stored in memory and SFT menu edit screen is restored. The newly allocated items appear in the SFT menu.

▶PROCEDURE Registering an allocation

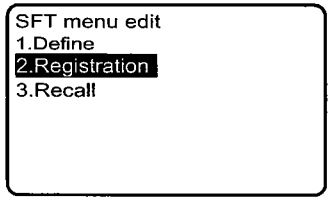
1. First register the settings you want to appear in the SFT Mode menu.
   ☞ "21.2 PROCEDURE Allocating menus"

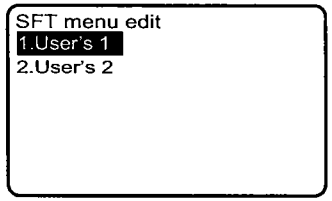
2. Press and hold **{SFT}** to enter the Shift Mode.

3. Press **[EDIT]** to enter SFT menu edit.



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





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

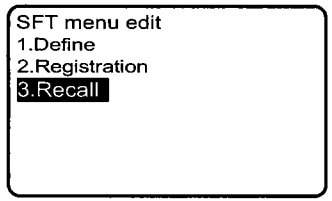
▶PROCEDURE Recalling an allocation

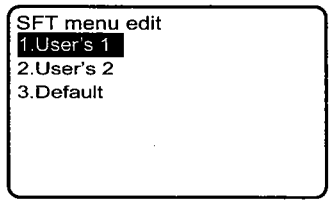
1. Press and hold **{SFT}** to enter the Shift Mode.

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

3. Select "Recall" to enter SFT menu edit. Select either "User 1", "User 2", or "Default" (factory setting) and press {↵}.

   This displays the registered array in the SFT Mode menu.





21.3 Allocating Key Functions

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

Softkeys can be allocated in the following modes and menus

- Measurement Mode
- Setting-out menu
- Offset/2D menu
- Missing line measurement menu
- REM menu

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

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

- The following are the softkey allocations when the SET was shipped.

Page 1: **[REC] [SHVC] [ANGLE] [DIST]**
Page 2: **[STN] [EDM] [H.ANG] [0SET]**
Page 3: **[VIEW] [CNF-O] [OFFSET] [ROT]**

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

[---] : No functions set
[DIST] : Distance measurement (When **[D-OUT]** in "Comms setup" is set to "On", distance data is output at the same time)
[S-DST] : Automatic sighting and distance measurement
[REC] : Data recording
[SHVC] : Select Distance Mode (Sdist (slope distance/Hdist (horizontal distance)/ Vdist (height difference)/Coord (coordinates)
[0SET] : Set horizontal angle to 0
[H.ANG] : Sets required horizontal angle
[R/L] : Select horizontal angle right/left
[RCL] : Display final measurement data
[ZA / %] : Switch between zenith angle/slope in %
[HOLD] : Hold horizontal angle/release horizontal angle
[STN] : Sets instrument points
[EDM] : Setting EDM
[CNF-M] : Sets motor drive operation functions (search area, search before DIST, search mode, JOG mode)
[RS232C] : Sets communication parameters
[CNF-O] : Sets observation conditions
[SFTKEY] : Softkey user allocation menu
[PROG] : Program mode
[OFFSET] : Offset menu
[A-OFS] : Angle offset menu
[D-OFS] : Distance offset menu
[2D-OFS] : Offset/2D menu
[AREA] : Area calculation menu
[REM] : REM measurement
[MLM] : Missing line measurement
[S-O] : Setting out measurement
[RESEC] : Resection measurement
[VIEW] : Display data in JOB
[KNOWN] : Records known point data
[NOTE] : Records notes
[MOTOR] : Motor menu
[FACE] : Turns SET 180°
[SRCH] : Automatically sights the center of the prism

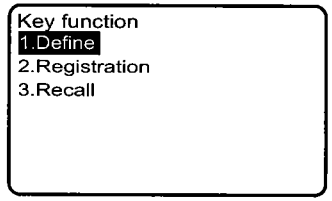
[ROTA] : SET rotates to the entered horizontal and vertical angle
[LASER] : Laser-pointer ON/OFF
[G.LIGHT] : Guide light ON/OFF
[TILT] : Displays circular level
[AIM] : Checks strength of returned signal
[F/M] : Switches feet and meter
[HT] : Sets the sighting height

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

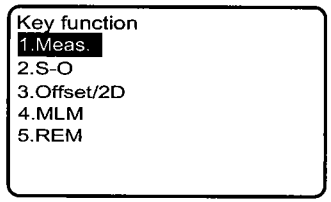
[ANGLE] : angle measurement (When **[D-OUT]** is set to "ON", angle data is output at the same time)
[AUTO] : Performs distance measurement and records results automatically
[12DST] : Face 1/2 combination

▶PROCEDURE Allocating softkeys

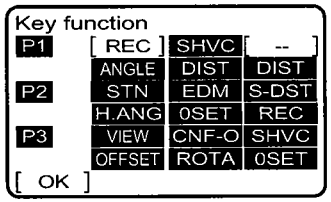
1. Select "Key function" in the Config. Mode
2. Select "Define".



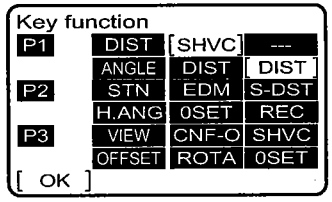
3. Select "Meas".



4. The softkey array in each page of Meas Mode is displayed.
   Align the cursor with the softkeys whose allocation you want to change using {◀}/{▶}. Selected softkey is displayed with white background.



5. Change the softkey using {▲}/{▼}. The key to be swapped in is displayed in the list on the right of the screen. Scroll up/down to select the required softkey and press {↵}.
   The softkey selected in step 4 is changed to the softkey selected in step 5.



6. Repeat steps 4 to 5 as many times as necessary.

7. Press **[OK]** to record the allocations and return to the Key Function Mode. The newly allocated softkeys are displayed in the Meas. Mode screen.

Note

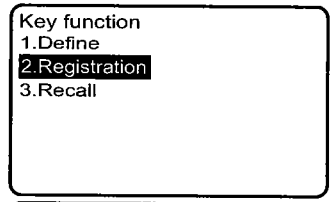
- To allocate softkeys of the Setting-out menu, Offset/2D menu, missing-line measurement menu, and REM measurement menu, select the required softkey and carry out the above procedure starting from step 3.
- Only one function, **[LASER]** or **[G.LIGHT]**, can be set as the Illum. Hold setting in "Observation conditions".
  ☞ "21.1 Configuration ● Observation conditions"

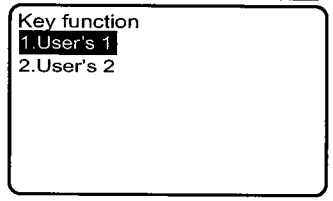
▶PROCEDURE Registering an allocation

1. Allocate functions to the softkeys.
   ☞ "21.2 Allocating Key Functions in SFT Mode"

2. Select "key function" in Config Mode.

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





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

▶PROCEDURE Recalling an allocation

1. Select "key function" in Config Mode.

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

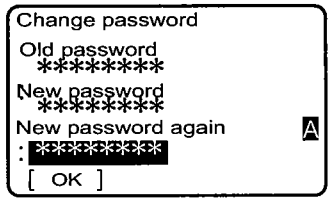
21.4 Changing password

Set password can be changed.

- No password was set when the SET was shipped.

▶PROCEDURE Changing password

1. Select "Change Password" in Config Mode.
2. Input old password and press {↵}.
3. Input new password twice and press {↵}. The password is changed and <Config> is restored.



- If no password was input as new password and {↵} was pressed, no password is set.

Note

Input range of password: 3 or more characters and 8 or fewer characters

22. RESTORING SET ITEMS TO INITIAL SETTINGS

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

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

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

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

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

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

▶PROCEDURE Initializing the data and turning the power on

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

23. WARNING AND ERROR MESSAGES

The following is a list of the error messages displayed by the SET and the meaning of each message. If the same error message is repeated or if any message not shown below appears, the instrument has malfunctioned. Contact your Sokkia agent.

Bad condition

The air is shimmering a lot, etc., measuring conditions are poor.

The center of the target cannot be sighted.
Resight the target.

Unsuitable distance measurement conditions when reflectorless measurement is set. When reflectorless measurement is set, distance cannot be measured because the laser beam is striking at least two surfaces at the same time.
Choose a single surface target for distance measurement.
☞ Precautions for setting prism: "10. TARGET SIGHTING"

Calculation error

During resection measurement the same point is registered multiple times.
Set another known point so that the known point coordinates do not coincide.

Clock error

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

EXXX Motor error X

A problem has occurred with the motor drive and operation stops.
Turn the power to the SET OFF and ON to correct the problem.
If this error message appears frequently, contact your Sokkia agent.

Flash memory error

Data cannot be read in.
Back up the required data; then turn the instrument OFF. Reinitialize the memory and start the instrument again.
☞ "22. RESTORING SET ITEMS TO INITIAL SETTINGS"
If the error message appears again, contact your Sokkia agent.

Memory is full

There is no more room to enter data.
Record the data again after deleting unnecessary data from the JOB or coordinate data.

Motor error

A problem has occurred with the motor drive and operation stops.
Turn the power to the SET OFF and ON to correct the problem.
If this error message appears frequently, contact your Sokkia agent.

Need 1st obs

During missing line measurement, the observation of the starting position was not completed normally.
Sight the starting position accurately and perform the measurement again.

Need 2nd obs

During missing line measurement, the observation of the target was not completed normally.
Sight the target accurately and perform the measurement again.

Need base pt. obs

During REM measurement, the observation of the target was not completed normally.
Reset and sight the prism and perform measurement again.

Need offset H. obs

Observation of the offset point during angle offset measurement was not completed normally.
Sight the point accurately and perform the measurement again

Need offset pt. obs

Observation of the offset point during angle offset measurement or distance offset measurement was not completed normally.
Sight the point accurately and perform the measurement again.

No coord. data

When reading in coordinate values during instrument station registration etc., there is no coordinates data registered in the memory and in the selected JOB.

Non prism not supported

Automatic sighting cannot be performed with in reflectorless mode.
Use the prism to carry out automatic sighting.

No solution

The calculation of the instrument station coordinates during resection does not converge.
Access the results and if necessary, perform the observations again.

Offset out of range
Results of CCD reticle check and inspection exceed the allowed range.
Contact your Sokkia agent.

Out of value
During gradient % display, the display range (less than ± 1000%) has been exceeded.
During REM measurement, either the vertical angle has exceeded horizontal ±89° or the measured distance is greater than 9999.999m.
Install the instrument station far from the target.

The instrument station coordinates calculated during resection are too high.
Perform the observation again.

During area calculation, results exceeded the display range.

Re 0 Set
The telescope or top of the instrument was rotated too rapidly.
Index the horizontal circle and vertical circle once again.

Receive data err.
A reception error occurred during communication with an external instrument.
Try to send (receive) data again.
A reception error occurred when receiving data from an external instrument.
Check the settings of parameters concerning communication conditions.

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

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

Signal off
The reflected light is not observed when distance measurement begins. Or, during measurement, the reflected light has weakened or is blocked.
Either sight the target again or, when using a reflective prism, increase the number of reflective prisms.

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

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

When designating the angle of rotation or automatically sighting the prism, there is a problem with the positioning of the prism or the operation of the instrument and measurement is not obtained within the fixed time.
Check the positioning of the instrument and prism and perform measurement again.
If observation is still not possible, sight the target manually.

Tilt out of range
The tilt angle exceeds the tilt angle compensation range of the sensor.
Sight again within ±3'.

X Motor communication err X
A problem has occurred with the motor drive and operation stops.
Turn the power to the SET OFF and ON to correct the problem.
If this error message appears frequently, contact your Sokkia agent.

24. CHECKS AND ADJUSTMENTS

SET is a precision instrument that requires fine adjustments. It must be inspected and adjusted before use so that it always performs accurate measurements.

- Always perform checking and adjustment in the proper sequence beginning from "24.1 Plate Level" to "24.8 Additive Distance Constant."
- In addition, the instrument should be inspected with special care after it has been stored for a long time, transported, or when it may have been damaged by a strong shock.

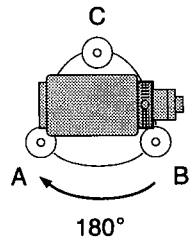
24.1 Plate Level

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

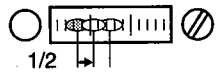
▶PROCEDURE Checking and adjusting

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

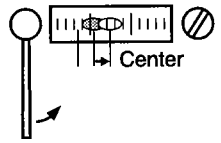
2. Turn the upper part through 180° and check the bubble position.
   If the bubble is still centered, no adjustment is necessary.
   If the bubble is off-center, adjust as follows.



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



4. Correct the remaining half of the displacement by using the adjustment pin to rotate the plate level adjustment screw.



When the plate level adjustment screw is turned in the counterclockwise direction, the bubble moves to the right.

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

24.2 Circular Level

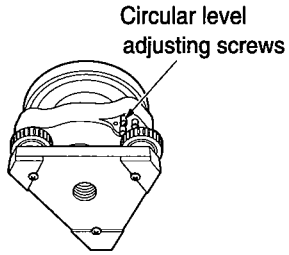
▶PROCEDURE Checking and adjusting

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

1. Perform the plate level inspection and adjustment or carefully use the plate level to level the instrument.
   ☞"24.1 Plate Level".

2. Check the position of the bubble in the circular level.
   ☞"8.2 Levelling", steps 1 and 2.
   If the bubble is not off-center, no adjustment is necessary.
   If the bubble is off-center, perform the following adjustment.

3. First confirm the off-center direction. Use the adjusting pin to loosen the circular level adjustment screw on the side opposite to the direction the bubble is displaced to move the bubble to the center.



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

24.3 Tilt Sensor

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

▶PROCEDURE Check

1. Carefully level the instrument. If necessary, repeat the procedures to check and adjust the bubble levels.

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

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

3. Select "Tilt offset".

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


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

```
Tilt offset
X          -0°00'37"
Y           0°00'05"
HAR        24°24'37"

Take F1
                [ OK ]
```

5. Press **[OK]**. The top of the instrument and telescope automatically rotate 180° and the horizontal angle is set to 0°.

6. Wait a few seconds for the screen to stabilize, then read the automatically compensated angles X2 and Y2.

7. In this state, calculate the following offset values (tilt zero point error).
   Xoffset = (X1+X2)/2
   Yoffset = (Y1+Y2)/2

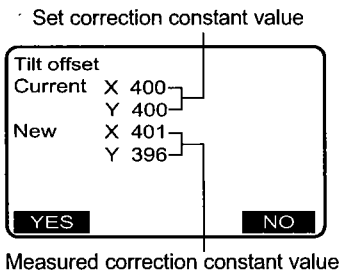
   If one of the offset values (Xoffset, Yoffset) exceeds ±10", adjust the value using the following procedure. When the offset value falls within the range ±10", adjustment is not necessary.
   Press **{ESC}** to return to <Instr. const>.

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

```
Tilt offset
X          -0°00'37"
Y           0°00'05"
HAR        24°24'37"

Take F2
                [ OK ]
```

9. Confirm that the values are in the adjustment range.
   If both correction constants are within the range 400 ±30, select **[YES]** to renew the correction angle. "Tilt offset" is restored. Continue to step 11.
   If the values exceed the adjustment range, select **[NO]** to cancel the adjustment and restore <Instr. const>. Contact your Sokkia agent to perform the adjustment.



▶PROCEDURE Recheck

10. Enter the <Tilt offset> menu.

11. Wait a few seconds for the display to stabilize, then read the automatically compensated angles X3 and Y3.

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

13. Wait a few seconds for the display to stabilize, then read the automatically compensated angles X4 and Y4.

14. In this state, the following offset values (tilt zero point error) are calculated.
    Xoffset = (X3+X4)/2
    Yoffset = (Y3+Y4)/2
    When both offset values fall within the range ±10", adjustment is completed.
    Press **{ESC}** to return to <Instr. const>.

    If one of the offset values (Xoffset, Yoffset) exceeds ±10", repeat the check and adjustment procedures from the beginning. If the difference continues to exceed ±10" after repeating the check 2 or 3 times, have your Sokkia agent perform the adjustment.

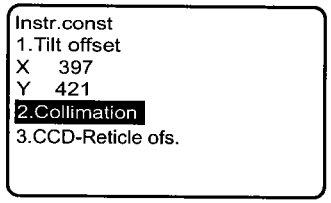
24.4 Collimation

With this option you can measure collimation error in your instrument so that the SET can correct subsequent single face observations. To measure the error, make angular observations using both faces.

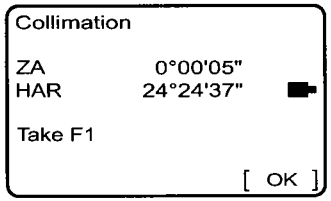
▶PROCEDURE

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

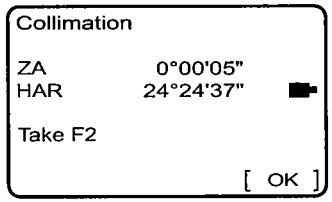
2. Select "Collimation".



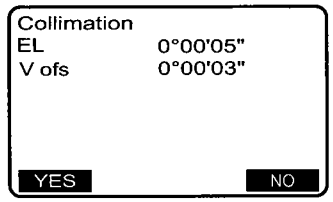
3. Sight the reference point in Face 1 and press **[OK]**. Telescope rotates and vertical circle is indexed.



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



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



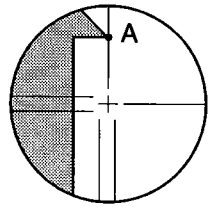
24.5 Reticle

- Check the telescope reticle by manually sighting the target.

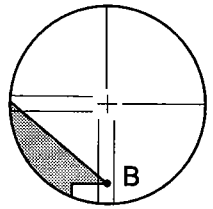
▶PROCEDURE Check 1: Perpendicularity of the reticle to the horizontal axis

1. Carefully level the instrument.

2. Align a clearly visible target (the edge of a roof for example) on point A of the reticle line.



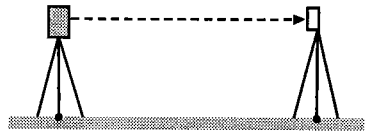
3. Use the telescope fine motion screw to align the target to point B on a vertical line.
   If the target moves parallel to the vertical line, adjustment is unnecessary. If its movement deviates from the vertical line, have your Sokkia service representative adjust it.



▶PROCEDURE Check 2: Vertical and horizontal reticle line positions

1. Carefully level the instrument.

2. Install a target at a point about 100m in the horizontal direction from the SET.



3. Turn on the instrument's power and index the vertical and horizontal circles.

4. While the Meas Mode screen is displayed and the telescope is in face 1, sight the center of the target and read out the horizontal angle A1 and the vertical angle B1.
   Example:
   Horizontal angle A1=18° 34' 00"
   Vertical angle B1=90° 30' 20"

5. While the telescope is in face 2, sight the center of the target and read out the horizontal angle A2 and the vertical angle B2.
   Example:
   Horizontal angle A2=198° 34' 20"
   Vertical angle B2=269° 30' 00"
6. Do the calculations:
   A2-A1 and B2+B1
   If A2-A1 is within 180°±20" and B2+B1 is within 360°±20", adjustment is unnecessary.
   Example:
   A2-A1 (Horizontal angle)
   =198° 34' 20" - 18° 34' 00"
   =180° 00' 20"
   B2+B1 (Vertical angle)
   =269° 30' 00" + 90° 30' 20"
   =360° 00' 20"
   If the difference is large even after repeating the check 2 or 3 times, have your Sokkia service representative perform the adjustment.

24.6 CCD reticle

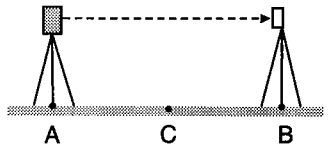
The internal CCD sensor is used for automatic sighting. The offset value is set to correct the position of the CCD sensor in relation to the telescope reticle, but if for whatever reason the telescope reticle and CCD camera become misaligned, automatic sighting of the center of the prism cannot be performed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

Note

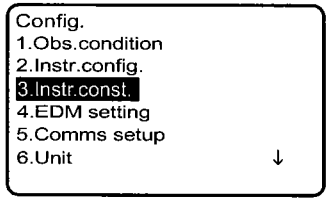
- Perform check and adjustment in weak sunlight and no scintillation.
- It may take up to 20 seconds for the offset value to appear based on the measurement results.

▶PROCEDURE Checks and adjustments

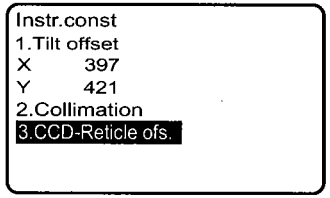
1. Carefully level the instrument.
2. Position the prism in a horizontal direction approximately 50 meters from the SET.



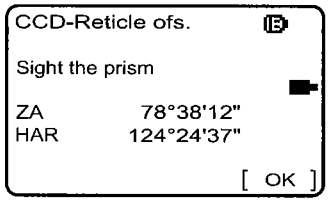
3. Select "Instr. const." in the Config. Mode.



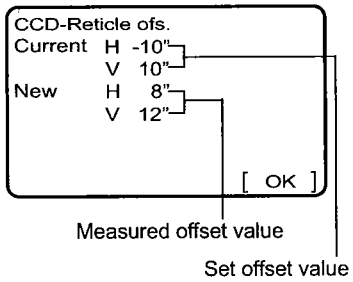
4. Select "CCD-Reticle ofs".



5. Use manual sighting to accurately sight the target.
   ☞"10.2 Manually Sighting the Target"
6. Press **[OK]** to sight using the CCD sensor.

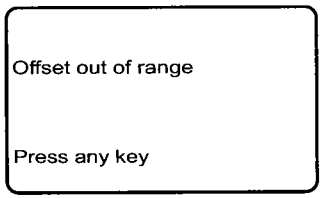


7. Offset value (H, V) is obtained from the set offset value (H, V) and the measurement results. The offset value is a constant value that indicates the number of degrees of misalignment between the center of the telescope reticle and the center of the CCD sensor. If the offset value obtained from the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



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

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



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

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

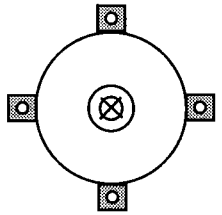
24.7 Optical plummet

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

▶PROCEDURE Checking

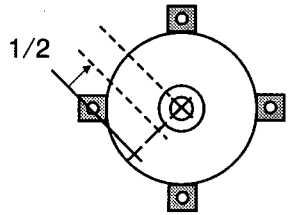
1. Carefully level the SET and center a surveying point precisely in the reticle of the optical plummet.

2. Turn the upper part through 180° and check the position of the surveying point in the reticle.
   If the surveying point is still centered, no adjustment is necessary.
   If the surveying point is no longer centered in the optical plummet, perform the following adjustment.



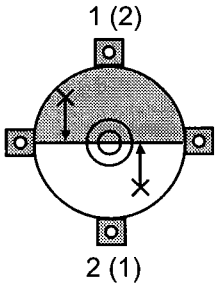
▶PROCEDURE Adjustment

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

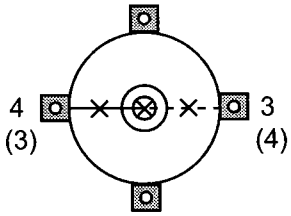


4. Remove the optical plummet reticle cover.

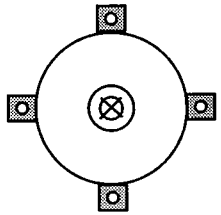
5. Use the 4 adjusting screws of the optical plummet to adjust the remaining half of the deviation as shown below.
   When the surveying point is on the lower (upper) part of the illustration: Loosen the upper (lower) adjusting screw slightly, and tighten the upper (lower) adjusting screw the same amount to move the surveying point to a point directly under the center of the optical plummet.
   (It will move to the line in the figure on the right.)



   If the surveying point is on the solid line (dotted line):
   Loosen the right (left) adjusting screw slightly and, tighten the left (right) adjusting screw by the same amount to move the surveying point to a point in the center of the optical plummet.



6. Check to make sure that the surveying point remains centered on the reticle even if the upper part of the instrument is rotated.
   If necessary, perform the adjustment again.



7. Replace the optical plummet reticle cover.

24.8 Additive Distance Constant

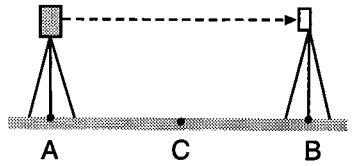
The additive distance constant K of the SET is adjusted to 0 before delivery. Although it almost never deviates, use a baseline with a known distance precision to check that the additive distance constant K is close to 0 several times a year and whenever the values measured by the instrument begin to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

consistent amount. Perform these checks as follows.

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

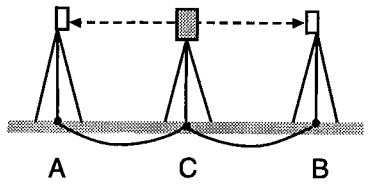
▶PROCEDURE Check

1. Find an area of flat ground where two points 100m apart can be selected.
   Set up the Instrument at point A and the reflective prism at point B.
   Establish a point C half way between points A and B.



2. Precisely measure the horizontal distance between point A and point B 10 times and calculate the average value.

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



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

6. Repeat steps 1 to 5 two or three times.
   If the additive distance constant K is within ±3mm even once, adjustment is unnecessary.
   If it always exceeds this range, have your Sokkia service representative perform an adjustment.

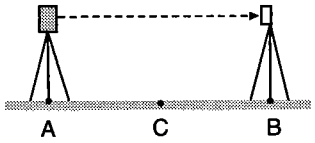
24.9 Guide light

When the dividing line (the position where it switches back and forth from red to green) for the red and green guide lights is off centered from the reticle lines, use the following procedures to make adjustments.

- Set "Illum. Hold" to "Guide" in Config. mode, Use the setting page to select, check and adjust the guide light.
  ☞"21.1 Configuration ●EDM Settings".

▶PROCEDURE Checks

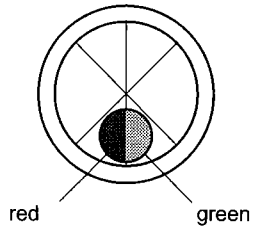
1. Install a prism at a point about 20 meters in the horizontal direction from the SET.



2. Level the instrument.
3. Sight the center of the prism with the telescope (face left).
4. Hold {☼} down to turn the guide lights on.
5. Set the horizontal angle to 0° by pressing **[0SET]** twice on the first page of the Meas mode.

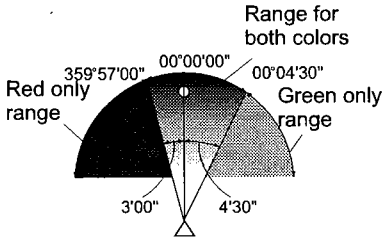
6. Look through the telescope to verify that the guide lights are being reflected in the prism.

   If both colors (red and green) are visible:proceed to procedure 7.
   If only the red or the green are visible:proceed to procedure 10.



7. Move the top of the instrument slightly while looking through the telescope, measure the horizontal angle of the position that changes only to green from both colors (red and green) of the guide light colors that are reflected in the prism.
8. Move the top of the instrument slightly while looking through the telescope, measure the horizontal angle of the position that changes only to red from both colors (red and green) of the guide light colors that are reflected in the prism.
9. Calculate the difference of the angle of the horizontal angle to search for the offset direction of the dividing line of the guide lights from the measurement values of procedures 7 and 8.

Example:
(Procedure 7) The horizontal angle 0°03' 30" = 04' 30" to the right from the reticle line (=0° set position) of the position that changes to green only from both colors (red and green) of the colors of the guide lights that are reflected in the prism.
(Procedure 8) The horizontal angle 359°57' 00" = 03' 00" to the left from the reticle line (=0° set position) of the position that changes to green only from both colors (red and green) of the colors of the guide lights that are reflected in the prism.



→ The angle difference for procedures 7 and 8 is 1' 30," with this the dividing line for the green and the red shifts to the right side (the green side).

Note

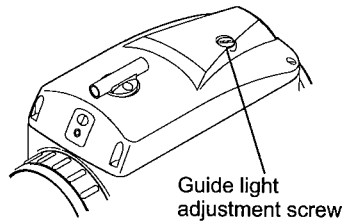
The illustration depicts how the left and right colors of the guide light are reflected in a prism and seen when viewed through the telescope.

When the angle difference is more than 1', proceed to the adjustments for procedure 10.

When the angle difference is less than 1', adjustments are unnecessary.

▶PROCEDURE Adjustments

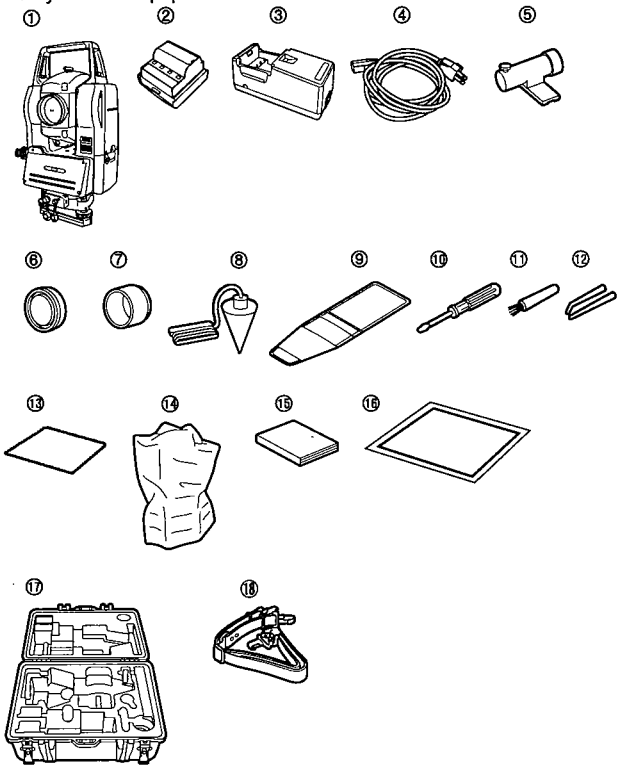
10. Adjust the dividing line for the red and green lights of the guide lights that are reflected in the prism so that it is centered in the reticle.
When only the red is visible, or if the dividing line shifts onto the red side: turn the guide light adjustment screw clockwise.
When only the green is visible, or if the dividing line shifts onto the green side: turn the guide light adjustment screw counterclockwise.



11. Carry out a check of procedures 7 to 9 once again.
When the measurement value difference for the horizontal angle is more than 1', then repeat the adjustments for procedure 10.
When the measurement value difference for the horizontal angle is less than 1', then adjustments are complete.

25.1 Standard Equipment

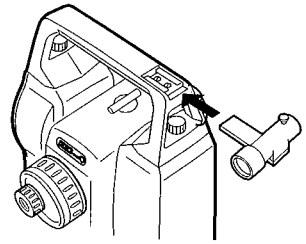
Please verify that all equipment is included.



1	SET main unit 1	10	Screwdriver 1
2	Battery (BDC45) 2	11	Lens brush 1
3	Battery charger (CDC56) 1	12	Adjusting pin. 1
4	AC cable (EDC34/35) 1	13	Cleaning cloth 1
5	Tubular compass (CP7) 1	14	Vinyl cover 1
6	Lens cap 1	15	Operator's manual 1
7	Lens hood 1	16	Laser caution sign-board 1
8	Plumb bob 1	17	Carrying case (SC193). 1
9	Tool pouch 1	18	Carrying strap 1

• Tubular compass (CP7)

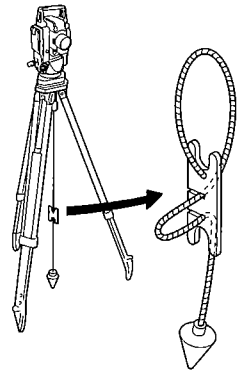
Slide the tubular compass into the tubular compass slot, loosen the clamp screw, then rotate the top part of the instrument until the compass needle bisects the index lines. The telescope's face 1 sighting direction in this position will indicate magnetic north. After use, tighten the clamp and remove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



The tubular compass is susceptible to the influence of nearby magnets or metal. Such influence could cause it to fail to accurately indicate magnetic north. Do not use magnetic north as indicated by this compass for base line surveying.

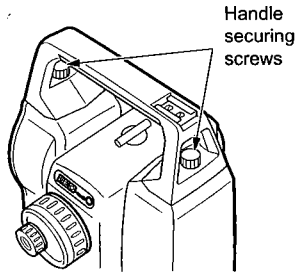
• Plumb bob

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



● Handle

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



25.2 Optional Accessories

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

● Remotocatcher remote control system

This system points the Remotocatcher-compatible SET in the direction of the prism with speed and precision. ☞ "Remotocatcher Operator's manual"

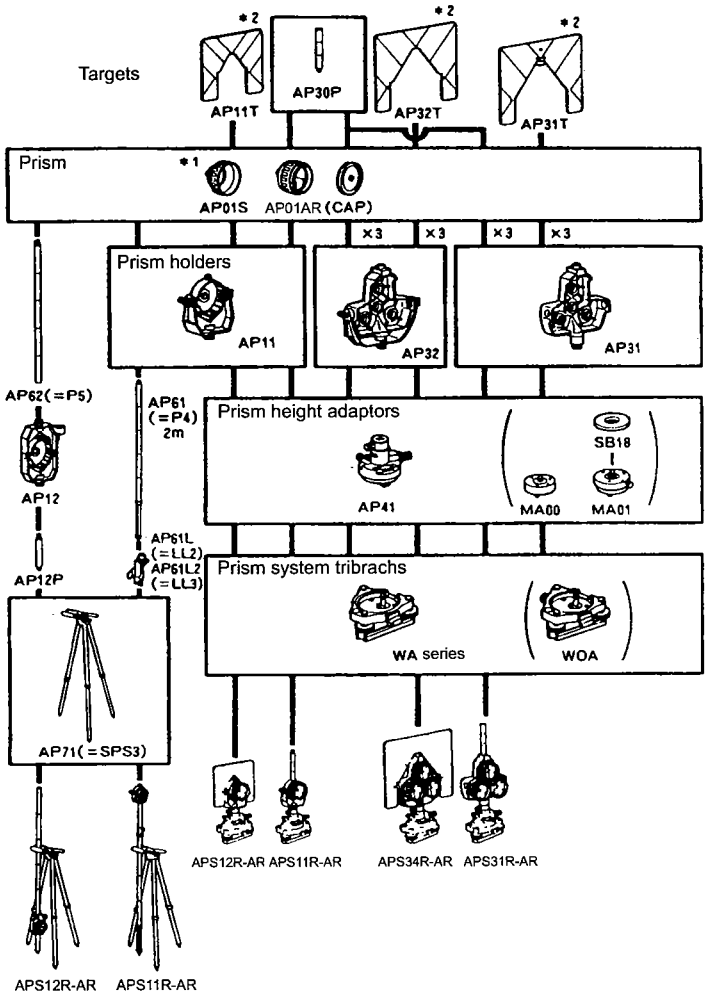
● Interface cable

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

25.3 Target System

- Because all Sokkia reflecting prisms and accessories have standardized screws, it is possible to combine these prisms, accessories, etc. according to your objectives.
- The following are all special accessories (sold separately).
- Because these targets(*2) are coated with fluorescent paint, they reflect when there is little light.

- When using a reflecting prism equipped with a target for distance and angle measurements, be sure to direct the reflective prism correctly and sight the center of the prism target accurately.
- Each reflective prism(*1) has its own prism constant value. When changing prisms, be sure to change the prism constant correction value.
- To use the triple prism assembly AP31 or AP32 as a single prism for short distance measurements, mount the single reflective prism AP01AR in the center mounting hole of the prism holder.



• 2-point target (2RT500-K)

This target is used for two-distance offset measurement.
Prism constant: 0

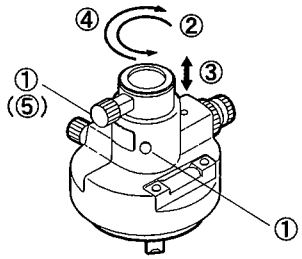
• Instrument height adaptor (AP41)

Adjust the level of the AP41 instrument height adaptor following the checking and adjustment methods of plate level.
☞ "24.1 Plate Level"

Adjust the optical plummet of the AP41 instrument height adaptor following the checking and adjustment methods of optical plummet.
☞ "24.7 Optical plummet"

The height of the AP41 instrument height adaptor can be adjusted using two fixing screws. When used with the SET, make sure that the instrument height "245" (mm) is displayed in the instrument height adjustment window.

Loosen the screws ① and rotate SET counterclockwise ②.
Move the part ③ up or down until the desired instrument height is displayed in the adjustment window ③, then rotate SET clockwise and tighten the screws ⑤.



• Adjusting plate (WA2)

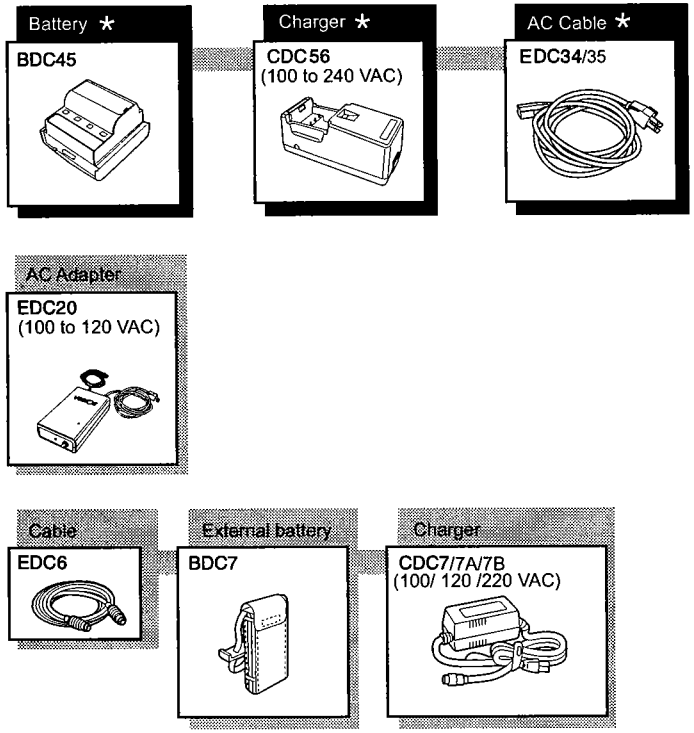
Adjust the circular level of the adjusting plate for a prism following the checking and adjustment methods of circular level.
☞ "24.2 Circular Level"

25.4 Power Supply System

Operate your SET with the following combinations of power equipment.

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

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



26. SPECIFICATIONS

Telescope

Length:	171 mm
Aperture:	45 mm (EDM: 48mm)
Magnification:	30x
Image:	Erect
Resolving power:	2.5"
Field of view:	1° 30'
Minimum focus:	1.3 m
Focussing screw:	1 speed
Reticle illumination:	5 brightness levels

Angle measurement

Horizontal and Vertical circles type:	Increment with 0 index (Both circles adopt diametrical detection)
Angle units:	Degree/Gon/Mil (selectable)
Minimum display:	1" (0.2mgon/0.005mil)/5" (1mgon/0.02mil)
Accuracy:	SET3230RM: 3" (1mgon) SET4230RM: 5" (1.5mgon) (ISO 17123-3: 2001)
Measuring time:	Less than 0.5 sec (repeated measurement)
Automatic compensator:	ON (V & H/V)/OFF (selectable) Type:Liquid 2-axis tilt sensor Minimum display: Agrees with minimum displayed measurement angle Range of compensation:±3'
Collimation correction	:Yes, No (selectable)
Measuring mode:	
Horizontal angle:	Right/Left (selectable)
Vertical angle:	Zenith 0°, Vertical 0°, Vertical ±90° (selectable)

Distance Measurement

Measuring method:	Coaxial phase-contrast measuring system
Signal source:	Red laser diode 690nm Class 3R (IEC60825-1 Amd. 2: 2001/FDA CDRH 21 CFR Part 1040.10 and 1040.11 (Complies with FDA performance standards for laser products except for deviations pursuant to Laser Notice No.50, dated July 26, 2001.))
Measuring range:	(Using Sokkia's reflective prism/reflective sheet target during normal atmospheric conditions ***1**/ ***2** is good atmospheric conditions) Reflective sheet RS90N-K: 1.3 to 500m (1,640ft)

Reflective sheet RS50N-K: 1.3 to 300m (980ft)
Reflective sheet RS10N-K: 1.3 to 100m (320ft)
Compact prism CP01: 1.3 to 800m (2,620ft)
Standard prism AP01AR X 1: 1.3 to 4,000m (13,120ft) to 5,000m (16,400ft) *2
Standard prism AP01AR X 3: to 5,000m (16,400ft) to 6,000m (19,680ft)*2
Mini pole prism OR1PA: 1.3 to 500m (1,640ft)
Reflectorless (White) *3: 0.3 to 350m (1,140ft)
Reflectorless (Gray) *4: 0.3 to 170m (550ft)

Minimum display: Fine measurement, Rapid measurement: 0.001 m
Tracking measurement: 0.01 m

Maximum slope distance: 9999.999 m

Distance unit: meter/feet/inch (selectable)

Accuracy:

(Using prism)

Fine measurement: ± (2 + 2 ppm X D) mm
Rapid measurement (single): ± (5 + 2 ppm X D) mm

(Using reflective sheet target)

Fine measurement: ± (3 + 2 ppm X D) mm
Rapid measurement (single): ± (6 + 2 ppm X D) mm

(Reflectorless (White))*3

Fine measurement:
± (3 + 2 ppm X D) mm (0.3 to 200m)
± (5 + 10 ppm X D) mm (over 200 to 350m)
Rapid measurement (single):
± (6 + 2 ppm X D) mm (0.3 to 200m)
± (8 + 10 ppm X D) mm (over 200 to 350m)

(Reflectorless (Gray))*4

Fine measurement:
± (3 + 2 ppm X D) mm (0.3 to 100m)
± (5 + 5 ppm X D) mm (over 100 to 170m)
Rapid measurement (single):
±(6 + 2 ppm X D) mm (0.3 to 100m)
±(8 + 5 ppm X D) mm (over 100 to 170m)

Measurement mode: Fine measurement (single/repeat/average)/ Rapid measurement (single)/Tracking (selectable)

Measuring time:

Fine measurement: 1.7 sec. + every 0.9 sec.
Rapid measurement (single): 1.4 sec.

Tracking measurement: 1.4 sec. + every 0.3 sec.

Atmospheric correction:

Temperature input range: - 30 to 60 °C (in 1°C step)
Pressure input range: 500 to 1,400 hPa (in 1hPa step)
375 to 1,050 mmHg (in 1mmHg step)
ppm input range: -499 to 499 ppm (in 1 ppm step)
Prism constant correction: -99 to 99 mm (in 1 mm step)
Earth curvature and refraction correction:
Atmospheric refraction constant: No/Yes K=0.142 or Yes K=0.20 (selectable)

*1: Slight haze, visibility about 20 km, sunny periods, weak scintillation.
*2: No haze, visibility about 40 km, overcast, no scintillation.
*3: Figures when using Kodak Gray Card White side (reflection factor 90%) and brightness level is less than 30000 lx (a little cloudy).
*4: Figures when using Kodak Gray Card Gray side (reflection factor 18%) and brightness level is less than 30000 lx (a little cloudy).
*3,*4: When performing reflectorless measurement, the possible measurement range and precision will change depending on the target reflection factor, weather conditions and location conditions.

Auto Pointing

Sokkia's reflective prism/reflective target
(No haze, visibility about 40 km, cloudy periods, no scintillation)

Signal source: Laser diode (785nm)
Class 1
(IEC60825-1 Amd. 2: 2001/FDA CDRH 21 CFR Part 1040.10 and 1040.11 (Complies with FDA performance standards for laser products except for deviations pursuant to Laser Notice No.50, dated July 26, 2001.))

Measuring range: Sight (in field of view)
Distance:
Standard prism AP01 X 1: 2.0 to 800 m/6.5 to 2600ft
Compact prism CP01: 2.0 to 400 m/6.5 to 1300ft
Mini pole prism OR1PA:2.0 to 300 m/6.5 to 950ft

Sighting accuracy (Standard deviation):
2.5mm (less than 100m)
5" (more than 100m)

Sighting speed: 3 to 6 sec (100m)

Motor

(No vibration and no wind)

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

Guide Light

(Slight haze, visibility about 20 km, sunny periods, weak scintillation)

Light source:	LED (red 630 nm/green 524 nm) Class 1 (IEC60825-1 Amd. 2: 2001/FDA CDRH 21 CFR Part 1040.10 and 1040.11 (Complies with FDA performance standards for laser products except for deviations pursuant to Laser Notice No.50, dated July 26, 2001.))
Distance:	1.3 to 150m
Visible range:	Right and Left/Upward and Downward: about ± 4°(about 7m/100m)
Resolving power at center area (width):	less than about 4' (about 0.12/100m)

Power Supply

Power source:	Ni-MH rechargeable battery BDC45 Battery state indicator: 4 levels
Working duration at 25°C:	BDC45:about 3.5 hours (Fine single measurement by face 1 and 2, every 30 sec., using auto-pointing function) BDC7(optional accessories):about 7 hours
Charging time:	BDC45:about 130 minutes (using CDC56)

(BDC45)

Nominal voltage:	10.8 V

(CDC56)

Input voltage:	100 to 240 VAC
Frequency:	50/60Hz
Charging temperature range:	10 to 40°C
External power input:	12.0V

General

Display:	LCD graphic display 120 dots X 64 dots 1 LCD graphic display with illuminator
Operation panel (keyboard):	28 keys + 1 key (soft function, operation, power, light) (trigger key)
Auto power-off:	On (instrument powers off if not used for 30 min.)/Off (selectable)
Calendar clock:	Provided (only SET3230RM)
Internal memory:	about 10000 points
Data output:	Asynchronous serial, RS232C compatible
Sensitivity of levels:	Plate level: 30"/2 mm Circular level: 10'/2 mm
Optical plummet:	Image: Erect Magnification: 3X Minimum focus: 0.5 m
Horizontal and vertical motion:	changeable speed using jog dial
Operating temperature:	-20 to 50 °C
Dust and water resistance:	IPX2 (IEC60529: 1989)
Instrument height:	245 mm from tribrach bottom 202 mm from tribrach dish
Size:	202 (W) X 171 (D) X 380 (H) mm (with handle)
Weight:	about 7.0 kg (with handle and battery)

27.1 Manually Indexing the Vertical Circle by Face 1, Face 2 Measurement

The 0 index of the vertical circle of your SET is almost 100% accurate, but when it is necessary to perform particularly high precision angle measurements, you can eliminate any inaccuracy of the 0 index as follows.

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

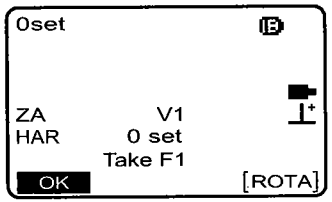
▶PROCEDURE Manually indexing the vertical circle

1. Select "Obs. condition" in Config Mode. Set "V index" (vertical circle indexing method) to "Manual."
   ☞"21.1 Configuration ● Observation conditions"

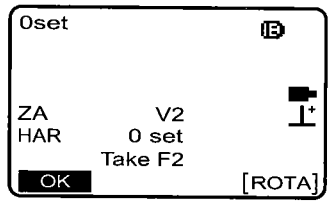
2. Press **{ESC}** and go to the Meas Mode screen.
   The vertical angle V1 is displayed above "Take F1."

3. Carefully level the instrument.

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



5. Then set the telescope in the face 2 position and accurately sight the same target.
   Press **[ROTA]**. The SET rotates 180° and the vertical and horizontal angles are displayed. This concludes the vertical circle indexing procedure.



27.2 Atmospheric Correction for High Precision Distance Measurement

- Need for atmospheric correction
  The SET measures the distance with a beam of light, but the velocity of this light varies according to the index of refraction of light in the atmosphere. This index of refraction varies according to the temperature and pressure. Near normal temperature and pressure conditions:
  With constant pressure, a temperature change of 1°: an index change of 1 ppm.
  With constant temperature, a pressure change of 3.6 hPa: an index change of 1 ppm.
  To perform high accuracy measurements, it is necessary to find the atmospheric correction factor from even more accurate temperature and pressure measurements and perform an atmospheric correction.
  Sokkia recommends that extremely precise instruments be used to monitor the air temperature and pressure.

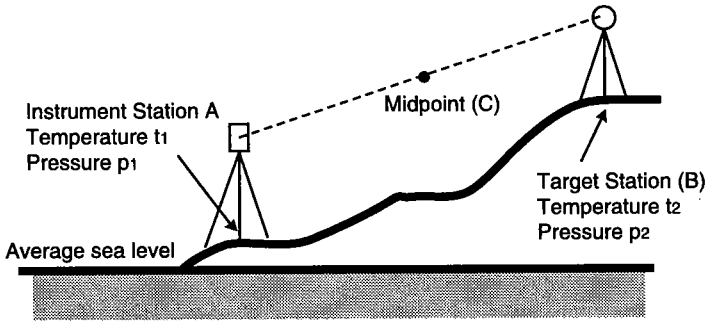
- Finding the average temperature and pressure between two points in different atmospheric conditions
  To precisely determine the atmospheric correction factor, the average temperature and air pressure along the measurement beam route must be taken.

  Determine the temperature and pressure as follows.

Flat terrain	:Use the temperature and pressure at the midpoint of the line.
Mountainous terrain	:Use the temperature and pressure at the intermediate point (C).

If it is not possible to measure the temperature and pressure at the midpoint, take the temperature and pressure at the instrument station (A) and the target station (B), then calculate the average value.

Average air temperature :(t1 + t2)/2
Average air pressure :(p1 + p2)/2



- Calculation of atmospheric correction factor allowing for humidity
  The humidity has little influence, particularly on short distance measurements. The effect of humidity should be considered in cases where it is very hot and humid and high precision measurements are to be performed over a particularly long distance.
  When taking humidity into consideration, enter the atmospheric correction factor calculated using the following formula.

Atmospheric Correction Factor (ppm)=

$$\left(282.324 - \frac{0.294362 \times p}{1 + 0.003661 \times t} + \frac{0.04127 \times e}{1 + 0.003661 \times t}\right) \times 10^{-6}$$

e (water vapor pressure) can be calculated using the following formula.

$$e = h \times \frac{ew}{100}$$

$$ew = 6.11 \times 10^{\frac{(7.5 \times t)}{(t + 237.3)}}$$

t : Air temperature (°C)
p : Pressure (hPa)
e : Water vapor pressure (hPa)
h : Relative humidity (%)
ew: Saturated water vapor pressure

28. REGULATIONS

Radio Frequency Interference

WARNING: Changes or modifications to this unit not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment

NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Notice for Canada
This Class A digital apparatus meets all requirements of Canadian Interference-Causing Equipment Regulations.
Cet appareil numérique de la Class A respecte toutes les exigences du Règlement sur le matériel brouilleur du Canada.

CE Conformity Declaration

CE Conformity Declaration
in accordance with EMC Directive 89/336/EEC of the European Community

We herewith declare that the undermentioned instrument, in view of its design and type of construction, fully complies with the relevant basic radio interference requirements of the EMC Directive.
Should the instrument be modified without agreement, this declaration becomes invalid.

Instrument Description: Reflectorless Total Station (Surveying Instruments)

Model Name : SET3230RM(with option Beem Detector(RC-TS1) and RC-PR2)
SET4230RM(with option Beem Detector(RC-TS1) and RC-PR2)

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

Applied
Harmonized Standard: EMI EN55022 1994+A1 1995+A2 1997
EN55022 1998+A2 2003
EMS EN61000-6-2 2001

Date: 12-05-2005
Firm: SOKKIA B.V.
Address: Industrieterrein De Vaart, Damsluisweg 1, NL-1332 EA Almere

Representative's Signature:

Name of Representative : Jan van der Weijden
Representative's position : Managing Director

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

We herewith declare that the under mentioned instrument, in view of its design and type of construction, fully complies with the relevant basic radio interference requirements of the EMC Directive and the relevant electrical safety requirements of the Low Voltage Directive.
Should the instrument be modified without agreement, this declaration becomes invalid.

Instrument Description: Power Supply (Battery Charger)

Model Name : CDC56

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

Applied
Harmonized Standard: EMI:EN50081-1 1992
EN55022 1998 Class B
EMS:EN50082-2 1995 EN61000-4-2 1995
EN61000-4-3 1996 EN61000-4-4 1995
EN61000-4-6 1996 EN61000-4-8 1993
ENV50204- 1995
Low Voltage:
EN 60950 1992/A1:1993/A2:1993/A3:1995/A4:1997

Date: 1 August 2001
Firm: SOKKIA B.V.
Address: Industrieterrein De Vaart, Damsluisweg 1, NL-1332 EA Almere

Representative's Signature:

Name of Representative : Hajimu Maeda
Representative's position : European President

CE Conformity Declaration

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

We herewith declare that the under mentioned instrument, in view of its design and type of construction, fully complies with the relevant basic radio interference requirements of the EMC Directive and the relevant electrical safety requirements of the Low Voltage Directive.
Should the instrument be modified without agreement, this declaration becomes invalid.

Instrument Description: Power Supply (AC Adaptor)

Model Name : EDC77

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

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

Date: 1 August 2001

Firm: SOKKIA B.V.

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

Representative's Signature:

Name of Representative : Hajimu Maeda

Representative's position : European President

SOKKIA Customer Service

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