SOKKIA

Series120

SET1120
SET2120
SET3120
SET4120

Electronic Total Station

Class 1 LED Product

OPERATOR'S MANUAL

Ni

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

SOKKIA

Series120

SET1120
SET2120
SET3120
SET4120

Electronic Total Station

Class 1 LED Product

OPERATOR'S MANUAL

- Thank you for selecting the SET1120/2120/3120/4120.
- Before using the instrument, please read this operator's manual carefully.
- Verify that all equipment is included." ☞24.1" Standard Equipment"
- Data saved in the SET can be sent to a connected host computer. Commands operations from a host computer can also be performed. For details, refer to "Interfacing with the SOKKIA SDR Electronic Field Book" and "Command Explanations" manuals and ask your Sokkia agent.
- The specifications and general appearance of the instrument may be altered at any time and may differ from those appearing in brochures and this manual.
- Some of the diagrams shown in this manual may be simplified for easier understanding.

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1. PRECAUTIONS FOR SAFE OPERATION

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

Definition of Indication

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

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

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

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

General

⚠Warning

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

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

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

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

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

☞ "24.2 Optional Accessories"

⚠Caution

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

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

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

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

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

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.

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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 (SET 1120/2120/3120/4120)

• 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.

Screw Holding the Tribrach Clamp in Place
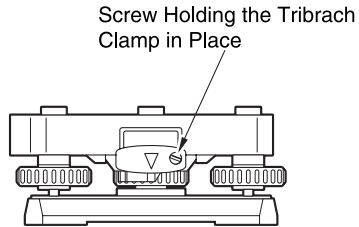
The Lithium Battery

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

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.
• 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.

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.
  ☞ "23. 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. HOW TO READ THIS MANUAL

Symbols

The following conventions are used in this manual.

Caution	:	Indicates precautions.
☞	:	Indicates the chapter title to refer to for additional information.
Note	:	Indicates supplementary explanation.
📖	:	Indicates an explanation for a particular term or operation.
[SDIST] 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 SET1120/2120/3120/4120 in this manual.
- 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.

☞ For details of softkeys: "4.1 Parts of the Instrument". Softkey allocation: "20.3 Allocating Key Functions -Config. Mode-".

Operation procedure

- Learn basic key operations in "4. SET FUNCTIONS" and "5. BASIC OPERATION" before you read each measurement procedure. See "5.1 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.

4. SET FUNCTIONS

4.1 Parts of the Instrument

1 Handle
2 Handle securing screw
3 Instrument height mark
4 Battery
5 Keyboard
6 Tribrach clamp
7 Base Plate
8 Levelling foot screw
9 Circular level adjusting screws
10 Circular level
11 Display
12 Objective lens

13 Tubular compass slot
14 Optical plummet focussing ring
15 Optical plummet reticle cover
16 Optical plummet eyepiece
17 Horizontal clamp
18 Horizontal fine motion screw
19 Data output connector
20 External power source connector
21 Plate level
22 Plate level adjusting screw
23 Vertical clamp
24 Vertical fine motion screw
25 Telescope eyepiece
26 Telescope focussing ring
27 Peep sight
28 Instrument center mark

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

Instrument height mark
The height of the SET is 236mm (from tribrach dish to this mark).
"Instrument height" is input when setting instrument station data and is the height from the measuring point (where SET is mounted) to this mark

Keyboard

☞ "5.1 Basic Key Operation".

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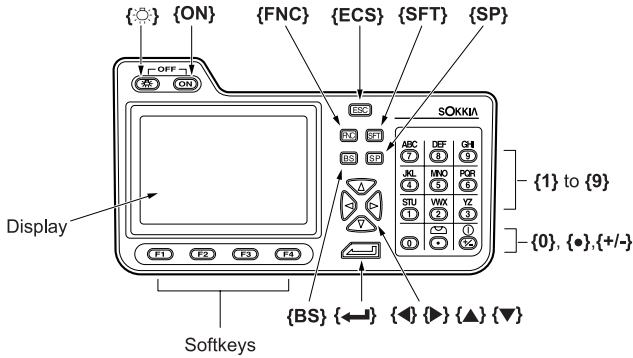
4.2 Mode Diagram

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

Measurement mode

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

REC screen

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

[REC]

{ESC}

Menu screen

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

[MENU]

{ESC}

[MEAS]

Status screen

```
Apr-17-01  13:55:44

SET2120
No.123456
Ver.XXX-XX-XX
    XXX-XX-XX
Job.JOB01
MEAS      MEM  CNFG
```

{ESC}

[MEM]   [CNFG]

Memory mode   Configuration mode

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

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

{ESC}

{ • }   (When "S" is displayed on the screen)   { +/- }

Tilt screen   Aiming screen

```
Tilt




DIGIT
```

```
Aiming


Signal ████▌▐▐▐▐ *


    BEEP        SDIST
```

5. BASIC OPERATION

5.1 Basic Key Operation

Learn basic key operations here before you read each measurement procedure.
☞ Location of keys on the keyboard: "4.1 Parts of the Instrument"

● Power ON / OFF
{ON}: Power On
{ON} (while pressing) + **{☼}**: Power Off

● Softkey operation
Softkeys are displayed on the bottom line of the screen.
{F1} to **{F4}**: Select the function matching the softkey
{FNC} : Toggle between MEAS Mode screen pages (when more than 4 softkeys are allocated)

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

EXAMPLE 1:Entering "JOB M" in the JOB name field
1. Press **{SFT}** to enter the alphabet input mode
   Alphabet input mode is indicated by an "**S**"on the right of the screen.

2. Press **{4}**.
   "J" is displayed.

```
Mem./JOB
 JOB  :▉▉▉▉▉▉▉▉▉▉▉


                       S

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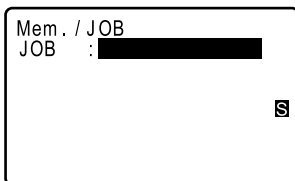
3. Press **{5}** three times.
   "O" is displayed.

```
Mem./JOB
JOB  : JO
                              S
```
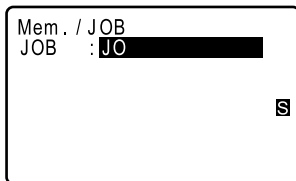
4. Press **{7}** twice.
   "L" is displayed.

5. Press **{5}** once.
   "M" 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. Press **[EDM]** in the first page of
   Meas. 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.

```
EDM
Temp      :15 C°
Press     :1013hPa
Humid     :  0%
ppm       :   0
Reflector:Sheet
PC        :-30         ↓
0PPM
```
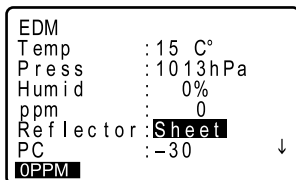
● Switching modes
[MEAS] : From Status Screen to Meas Mode (Measure Mode)
[MEM] : From Status Screen to Memory Mode
[CNFG] : From Status Screen to Config Mode (Configuration Mode)
(Press **{SFT}** to display "S") **{●}**:
              From any screen to tilt screen
(Press **{SFT}** to display "S") **{+/-}**:
              From any screen to aming screen

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

📖 "4.2 Mode Diagram"

● Other operation
{ESC}: Return to previous screen

5.2 Display Functions

Status screen

Date and time   Instrument name

```
A p r – 1 7 – 0 1    1 3 :  5 5 : 4 4
S E T 2 1 2 0
N o . 1 2 3 4 5 6
V e r . X X X – X X – X X
        X X X – X X – X X
J o b . J O B 0 1
MEAS              MEM  CNFG
```

Application software version

Instrument number   JOB name

● Meas Mode screen

```
Me a s .        PC   – 3 0
                p p m    0
                        3
S      1 1 1 1 . 3 6 2 5 m
Z A       9 2°  2 8 ' 1 0 "
H A R   1 2 0° 3 0 ' 1 0 "
                        P1
EDM  SHV  H.ANG  SDIST
```

Prism constant value

Atmospheric correction factor

Distance *1

Remaining battery power *4

Vertical angle *2

Horizontal angle *3

Tilt angle compensation *5

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Data input screen


```
REC/Stn        1200rec
Operator:              ↑  ──── Previous page
▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓
Date  :Oct-14-01
Time  :10:14:52       S  ──── Input mode *6
Weath.:Fine
Wind  :Calm            ↓  ──── Next page
 OK
```

* 1: Distance
   Switching distance display status by pressing **[◢SHV]**.
   S: Slope distance
   H: Horizontal distance
   V: Height difference

* 2: Vertical angle
   Switching vertical angle display status: "20.2 Configuration -Config.Mode-
   ●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: Remaining battery power (BDC35A, Temperature=25°C, EDM on)
   The displayed battery power remaining may differ during distance
   measurement and when measurement is stopped.
▌ 3:   90 to 100%
▌ 2:   50 to 90%
▌ 1:   10 to 50%
▌ 0:   0 to 10%

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

* 5: 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.

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 Tilt compensation setting: "20.2   Configuration -Config. Mode-
● Observation conditions"

* 6: Input mode
No display: numeric input
S : 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/%]**: "20.3 Allocating Key Functions -Config. Mode-"

6. USING THE BATTERY

Mount charged battery (BDC35A)

☞ About charging, see battery operator's manual

Caution

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

▶PROCEDURE Mounting the battery

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

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

Guide lip

Guide hole
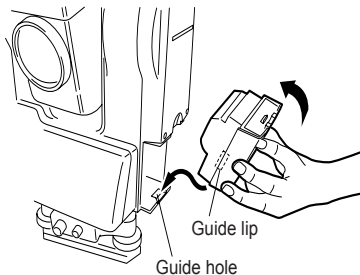
▶PROCEDURE Removing the battery

1. While pressing the UNLOCK button, press the release button downward.

2. Remove the battery by pulling it toward you.

Release button

UNLOCK button
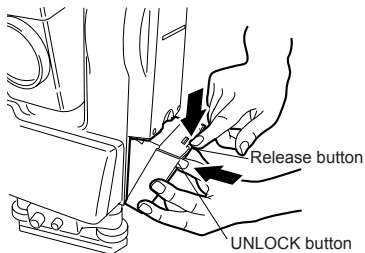
7. SETTING UP THE INSTRUMENT

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

7.1 Centering

▶**PROCEDURE**

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

Level

Firmly fixed

Equal spacing
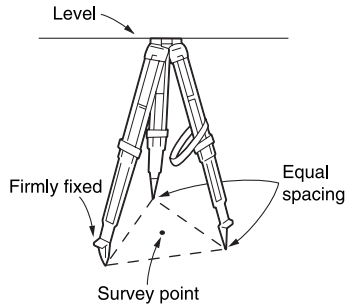
Survey point

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.

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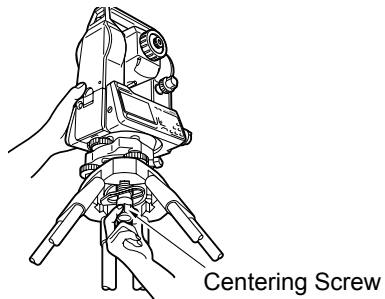
3. Focus on the surveying point
   Looking through the optical plummet eyepiece, turn the optical plummet eyepiece to focus on the reticle.
   Turn the optical plummet focusing ring to focus on the surveying point.

Focussing on the survey point

Focussing on the reticle

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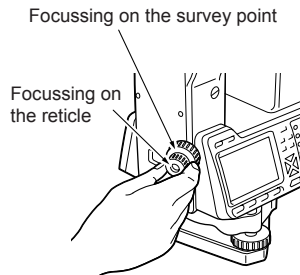
7.2   Levelling

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

▶PROCEDURE

1. Center the surveying point in the
    reticle
    Adjust the levelling foot screws to
    center the surveying point in the
    optical plummet reticle.
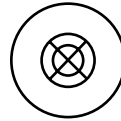
2. Center the bubble in the circular
    level
    Center the bubble in the circular
    level by either shortening the tripod
    leg closest to the off-center
    direction of the bubble or by
    lengthening the tripod leg farthest
    from the off-center direction of the
    bubble. Adjust one more tripod leg
    to center the bubble.

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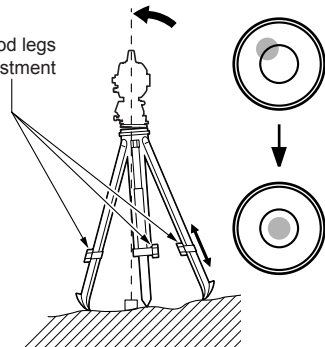
3. Center the bubble in the plate level
    Turn the upper part of the
    instrument until the plate level is
    parallel to a line between levelling
    foot screws A and B.
    Center the air bubble using
    levelling foot screws A and B.
    The bubble moves towards a
    clockwise rotated levelling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

    A   B

    A   B

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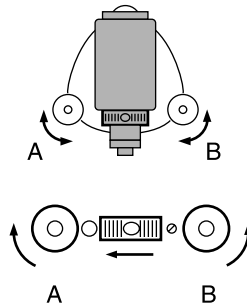
4. Turn 90° and center the bubble
   Turn the upper part of the
   instrument though 90°.
   The plate level is now
   perpendicular to a line between
   levelling foot screws A and B.
   Center the air bubble using
   levelling foot screw C.
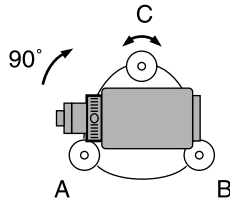
5. Turn another 90° and check
   bubble position
   Turn the upper part of the
   instrument a further 90° and check
   to see if the bubble is still in the
   center of the plate level. If the
   bubble is off-center, perform the
   following:
   a. Turn levelling foot screws A and
      B equally in 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.
   ☞ "23.1 Plate Level"
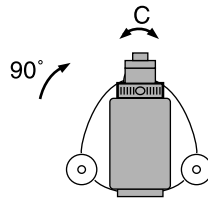
6. Check to see if bubble is in same
   position in any direction
   Turn the instrument and check to
   see if the air bubble is in the same
   position in all directions.
   If it is not, repeat the levelling
   procedure.

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

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

▶Procedure Levelling on the screen

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

2. Display the circular level screen.
   After pressing **{SFT}** in any screen
   to display "S ", press **{●}**.
   ⌈●⌋ indicates bubble in circular
   level. The range of the inside circle
   is ±3' and the range of the outside
   circle is ±4'.

```
Meas.          PC   −30
               ppm    0
                    ▮3
                     Ｉ
ZA      78°45'59"    Ｓ
HAR    120°31'31"
                    P1
 EDM  ∡S−O H.ANG SDIST
```
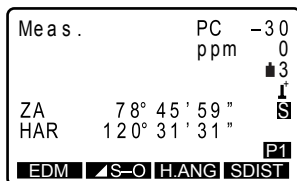
3. Center ⌈●⌋ in the circular level
   ☞ "7.2 Levelling" steps 1 to 2

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

```
Tilt



 DIGIT
```

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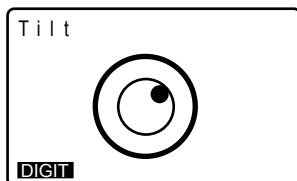
4. Turn the instrument until the telescope is parallel to a line between levelling foot screws A and B, then tighten the horizontal clamp.

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

6. Screen levelling is completed. Press **{ESC}** to return to Meas Mode.
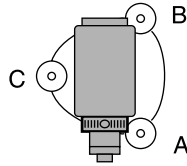
8. FOCUSSING AND TARGET SIGHTING

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

3. Focus on the target
   Turn the telescope focusing 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.

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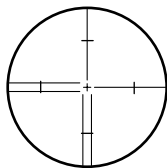
Eliminating parallax
This is the relative displacement of the target image with respect to the reticle when the observer's head is moved slightly before the eyepiece. Parallax will introduce reading errors and must be removed before observations are taken. Parallax can be removed by refocussing the reticle.

9. POWER ON

CF Setting "H index"/ "V index": "20. Configuration -Config. Mode-
  ● Observation Conditions

▶PROCEDURE

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

```
0 SET


ZA      0 set
HAR     0 set
```
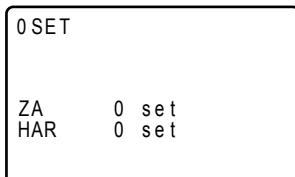
• When "H index" is set to "Manual",
  "HAR 0 Set" does not appear.
• When "V index" is set to "Manual"
  the display appears as at right.
  CF "26. Manually Indexing the
      Vertical Circle by Face 1, Face 2
      Measurement"

```
Meas.


ZA      V1
HAR      0°00'00"
       Take F1
                    O K
```
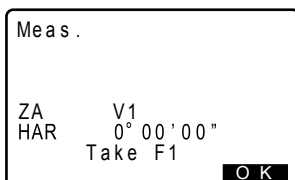
2. Either the horizontal circle
   indexing or the vertical circle
   indexing may be performed first.

```
Meas.          PC   −30
               ppm    0
                     ▮3
                      ↧
ZA      78°45'59"
HAR    120°31'31"
                    P1
 EDM  ◢S−O H.ANG SDIST
```
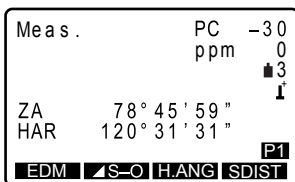
   Loosen the horizontal clamp and
   rotate the upper part of the
   instrument until the SET beeps.
   The horizontal circle is indexed.
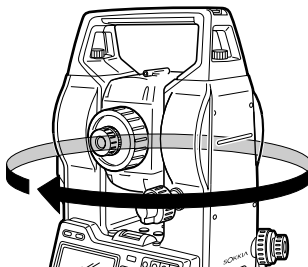
Loosen the vertical clamp and transit the telescope.
When the objective lens crosses the horizontal plane in face left, the SET emits a beeping sound, and the vertical circle is indexed.
When horizontal indexing and vertical indexing have been completed, Meas Mode screen appears.

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.
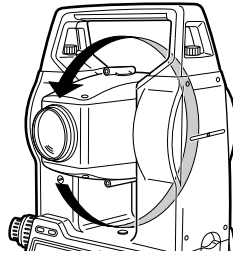
Note

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

☞ "20.2 Configuration -Config. Mode- ●Observation Conditions"

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10. ANGLE MEASUREMENT

This section explains the procedures for basic angle measurement.

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

Use the "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.
   ☞ "8. FOCUSSING AND TARGET SIGHTING"

   1st target

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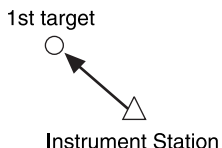
2. In the second page of the Meas Mode screen, press **[0SET]**. **[0SET]** will flash, so press **[0SET]** again.
   The horizontal angle at the first target becomes 0˚.

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

3. Sight the second target.

   2nd Target
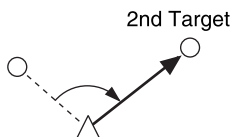
   The displayed horizontal angle (HAR) is the included angle between two points.

   ```
   Meas.              PC   -30
                      ppm    0
                            ▮3
                             ⌐
   ZA        92°28'10"
   HAR      117°32'21"
                            P2
   REC  COORD  S-O  0SET
   ```

10.2 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 Setting the horizontal circle to a required value**

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 **[BS]** and inputting the backsight point coordinates.
 ⌁ "12.2 Azimuth Angle Setting"

```
Set H angle
HAR :▮


  BS
```

4. Press **{◀━┛}** 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.

```
Meas.           PC   −30
                ppm    0
                      ▮3
                       ⊥
ZA      92°28'10"
HAR    117°32'21"
                        P2
 REC  COORD  S-O  0SET
```
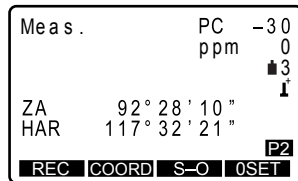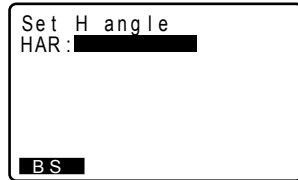
Note

• 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]**: "20.3 Allocating Key Functions -Config. Mode-"

10.3 Horizontal Angle Repetition

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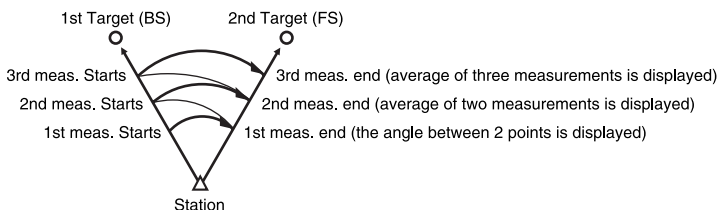
▶**PROCEDURE**

1. Allocate the **[REP]** softkey to the Meas mode screen.
☞"20.3 Allocating Key Functions - Config. Mode-"

2. Press **[REP]**.
The horizontal angle becomes 0°

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

```
Repetition
HAh      0°00'00"
Reps.   0
Ave.    0°00'00"
ZA     89°59'54"
HAh      0°00'00"
 Take BS
CE                OK
```

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

```
Repetition
HARp     0°00'00"
Reps.   0
Ave.    0°00'00"
ZA     89°59'54"
HAR      0°00'00"
 Take FS
CE                OK
```

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

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

```
Repetition
HAh    40°00'00"
Reps.   1
Ave.   40°00'00"
ZA     91°59'54"
HAh    40°00'00"
 Take BS
 CE              OK
```

• Return to the previous measurement
  of the first target and redo it:
  [CE].(Effective when the display
  shows "Take BS")

7. When continuing the repetition
   measurement, repeat steps 5 to 6

8. When the repetition measurement is
   completed, press **{ESC}**.

Note

• It is also possible to perform repetition measurement when **[MENU]** on page 3
  of the Meas mode screen is pressed to enter <Menu>, then "Repetition" is
  selected without allocating the function key.

10.4 Angle Measurement and Outputting the Data

The following explains angle measurement and the features used to output
measurement data to a computer or peripheral equipment.
☞ Commnication cables: "24.2 Optional Accessories"
  Output format and command operations: "Interfacing with the SOKKIA SDR
  Electronic Field Book" and "Command Explanations" manuals. To set
  RS232C: 20.2 Configuration -Config. Mode- ● Communication Setup"

►**PROCEDURE**

1. Connect SET and peripheral
   equipment.

2. Allozate the **[D-OUT]** softkey to
   the Meas mode screen.

    ☞ "20.2 Configuration -Config.
       Mode- ● Communication
       Setup"

3. Sight the target point.

4. Angle data is output.
    Press **[D-OUT]** and select "Angle
    Data". Measurement results are
    output to peripheral equipment.

```
D-OUT
 1.Dist data
 2.Angle data
```

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11. DISTANCE MEASUREMENT

Perform the following settings as preparation for distance measurement.
• Atmospheric correction factor
• Target type
• Prism constant correction value
• Distance measurement mode
☞ "20.1 EDM Settings"

11.1   Returned Signal Checking

Check to make sure that sufficient reflected light is returned by the reflective prism sighted by the telescope. Checking the returned signal is particularly useful when performing long distance measurements.
• The instrument can be switched to returned signal checking at any time except the following times.
   During distance measurement
   During resection calculation
   During circular level display

Caution

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

▶PROCEDURE

1. Accurately sight the target.

2. Press **{SFT}** and **{+/-}** in any screen. The "Returned Signal Check Screen" is displayed. The intensity of the light of the returned signal is displayed by a gauge.

```
A i m i n g

S i g n a l   ■■■■□□□□ *

            BEEP        SDIST
```
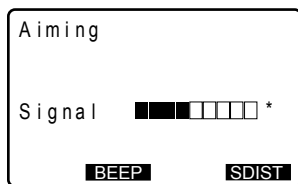
• The more ▇▇▇▇ displayed, the greater the quantity of reflected light.
• If "*" is displayed; only enough light for the measurement is returned.
• When "*" is not displayed, accurately resight the target.

- Press **[BEEP]** to make a buzzer sound when measurement is possible. Press **[OFF]** to shut off the buzzer.
- Press **[SDIST]** to start distance measurement.

3. Finish signal check
   Press **{ESC}** to finish signal check and return to the Main screen.

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.
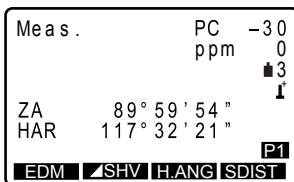
11.2 Distance and Angle Measurement

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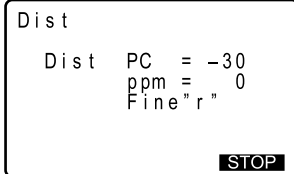
▶PROCEDURE

1. Sight the target.

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

```
Meas.           PC    −30
                ppm     0
                       ▮3
                        ↲
ZA      89°59'54"
HAR    117°32'21"
                       P1
 EDM  ∡SHV H.ANG SDIST
```

```
Dist

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



                    STOP
```

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

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

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

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

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]**.

☞ Allocating **[RCL]**: "20.3 Allocating Key Functions -Config. Mode-"

11.3 Recalling the Measured Data

The distance and angle that are most recently measured remain stored in the memory until the power is off and can be displayed at any time.
The distance measurement value, vertical angle, horizontal angle, and the coordinates can be displayed. Distance measurement values converted into the horizontal distance, elevation difference, and the slope distance can also be displayed.

▶PROCEDURE

1. Allocate the **[RCL]** softkey to the Meas mode screen.
☞ 20.3 Allocating Key Functions - Config. Mode-"

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

• If you press **[◢SHV]**, the distance values are converted into the horizontal distance, elevation difference, and the slope distance alternately.

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

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

11.4 Distance measurement and Outputting the Data

The following explains distance measurement and the features used to output measurement data to a computer or peripheral equipment.
☞ Communication cables: "24.2 Optional Accessories". Output format and command operations: "Interfacing with the SOKKIA SDR Electronic Field Book" and "Command Explanations" manuals. Setting RS232C: "20.2 Configuration -Config. Mode- ● Communication setup"

▶**PROCEDURE**

1. Connect SET and peripheral equipment.

2. Allocate the **[D-OUT]** softkey to the Meas mode screen.
   ☞ "20.3 Configuration -Config. Mode-"

3. Sight the target point.

4. Press **[D-OUT]**, and select "Dist data" to measure the distance and output the data to peripheral equipment.

```
D-OUT
 1.Dist data
 2.Angle data
```

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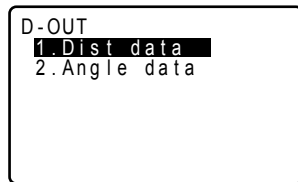
11.5 REM Measurement

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

$Ht = h_1 + h_2$
$h2 = S \sin\theta_{z1} \times \cot\theta_{z2} - S \cos\theta z_1$
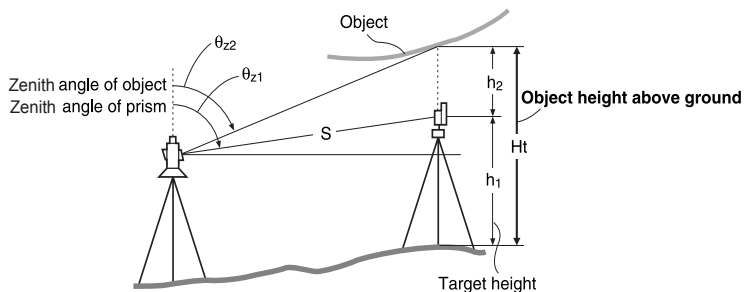
▶PROCEDURE

1. Set the target directly under or directly over the object and measure the target height with a tape measure etc.
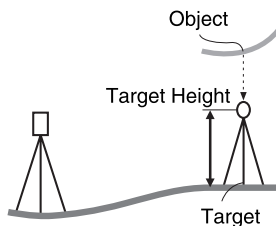
2. Press **[HT]** in page three of Meas. Mode. Then, input the target height.

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



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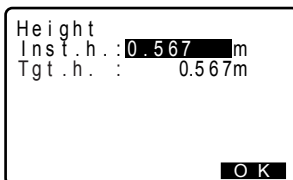
3. Press **[SDIST]** in page one of the Meas. Mode to carry out target measurement.
   The measured distance data, vertical angle and horizontal angle are displayed.
   Press **[STOP]** to stop the measurement.

```
Meas.         PC   -30
              ppm    0
                    ▪3
                     ▪
ZA      89°59'54"
HAR    117°32'21"
                    P1
 EDM   SHV   H.ANG SDIST
```

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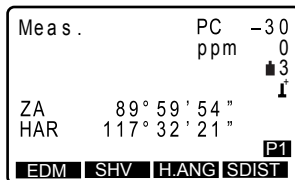
4. Sight the object, then press **[MENU]** in page three of Meas. Mode. Then select "REM". The REM measurement is started and the height from the ground to the object is displayed in "Ht.".
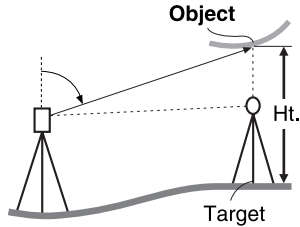
```
Me n u
  1 . Co o r d i n a t e
  2 . SñO
  3 . O f f s e t
  4 . Re p e t i t i o n
  5 . MLM
  6 . REM
  7 . R e s e c t i o n
```

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

```
REM

H t .          0 . 0 5 2m
S            1 3 . 1 2 3m
ZA         8 9 ° 5 9 ' 5 4 "
HAR      1 1 7 ° 3 2 ' 2 1 "

                        STOP
```

Object height above the ground

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

```
REM

H t .          0 . 0 5 2m
S            1 3 . 1 2 3m
ZA         8 9 ° 5 9 ' 5 4 "
HAR      1 1 7 ° 3 2 ' 2 1 "

            REM          OBS
```

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.

☞ Allocating **[REM]**: "20.3 Allocating Key Functions -Config. Mode-"

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12. COORDINATE MEASUREMENT

By performing coordinate measurements it is possible to find the 3-dimensional coordinates of the target based on station point coordinates, instrument height, target height, and azimuth angles of the backsight station that are entered in advance. Perform procedures sequentially from "12.1 Entering Instrument Station Data" to "12.3 3-D Coordinate Measurement".
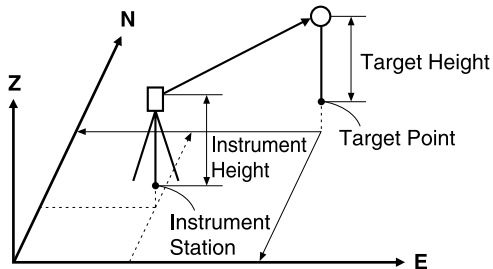
12.1 Entering Instrument Station Data

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. Press **[COORD]** in the second page of the Meas Mode.

3. Select "Stn data."

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

Input the instrument station coordinates, instrument height and target height.

```
Coord./Stn
N0:            0.000
E0:            0.000
Z0:            0.000
Inst.h.:       0.000m
Tgt.h. :       0.000m

READ   REC            O K
```

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

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

```
REC/Coord      1200rec
N             10.000
E            234.000
Z              1.500
Pt.:POINT200000005
Code:ABCD
Tgt.h. :       0.000m
 O K
```

• When **[REC]** is pressed, instrument station data is saved.
☞ "17. RECORDING DATA - REC Menu -"

▶PROCEDURE Reading in Registered Coordinate Data

Known point data, coordinate data and instrument station data in the current JOB can be read in.
☞ "19.1 Registering/Deleting Known Point Data"

• Both coordinate data saved in the Known Data Memory and the coordinates in the JOB selected in "Coordinate Search JOB" can be read in. Confirm that the correct JOB containing the coordinates you want to read in is already selected in "Coordinate Search JOB" in the Setting Mode.

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

Pt.   Known point date saved in the Known Data Memory or in the Coordinate Search JOB.
☞ "20.2 Configuration -Config. Mode- ●Observation Conditions"
Known: Coordinate data saved in the Known Data Memory.

```
Coord./Stn
N0:            0.000
E0:            0.000
Z0:            0.000
Inst.h.:       0.000m
Tgt.h. :       0.000m

READ   REC            O K
```

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

Crd./ Stn   Coordinate data saved in
the JOB which has been selected in
"Coordinate Search JOB."
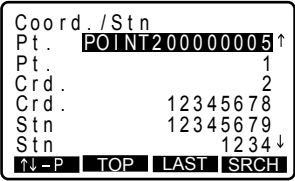
2. Align the cursor with the required
   point number and press **{◄─┛}**.
   The point number that was read in
   and its coordinate is displayed.

• Changing the cursor movement
  method: **[↑↓-P]**
     When **[↑↓-P]** is displayed, the
     cursor moves one line at a time.
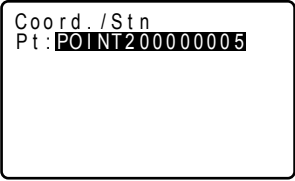
     When **[↑↓-P]** (inverted characters
     on black background) is displayed,
     the cursor moves one page at a
     time.

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

• Press **[TOP]** to move to the first point
  number on the first page.
• Press **[LAST]** to move to the last
  point number on the last page.
• Press **[SRCH]** to move to the
  "Coordinate Data Search Screen."
  Input the point number you want to
  search in "Pt. no."

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

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

12.2 Azimuth Angle Setting

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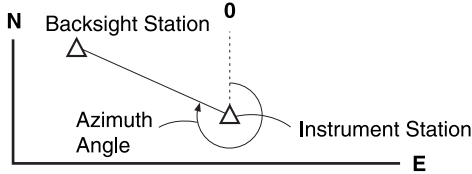
▶**PROCEDURE**

1. Select the "Set h angle" in <Coord.>

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

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

```
Coord/Ang.
HAR:

 B S
```

• When the corsor is on the backsight coordinate, pressing **[READ]** reads out the previously registered coordinate data and sets it as the backsight station coordinates.
  ☞ "12.1 PROCEDURE Recording in Registered Coordinate Data."

```
Coord/Ang.
N0  : -1234567.789
E0  :       56.789
Z0  :        1.234
NBS :       56.789
EBS : -1234567.789
ZBS :        1.234
 READ            O K
```

Coordinates of the back sight pt.

Already set coordinates of the Instr. Stn.

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

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

```
Coord/Ang.

 Take BS

ZA      89°52'54"
HAR    150°16'15"
                  NO   YES
```

```
Coord/Ang.
HAR:45.000




 BS
```

5. Press **{⏎}** to set the azimuth
   angle. The main screen is
   displayed.

12.3   3-D Coordinate Measurement

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

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

$N1$ Coordinate = $N0 + S \times \sin z \times \cos Az$

$E1$ Coordinate = $E0 + S \times \sin z \times \sin Az$

$Z1$ Coordinate = $Z0 + ih + S \times \cos z - fh$
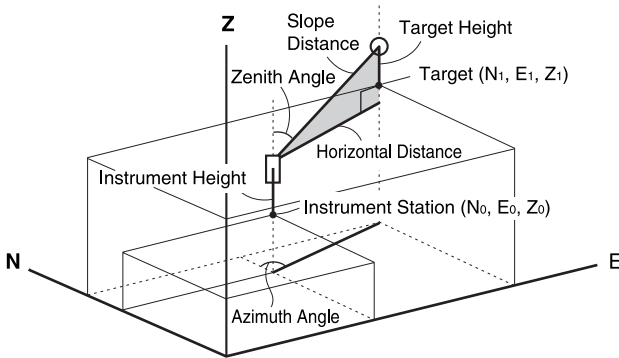
$N0$: Station point N coordinate

$E0$: Station point E coordinate

$Z0$: Station point Z coordinate

S : Slope distance

Z : Zenith angle

Az : Azimuth angle

ih : Instrument height

fh : Target height

▶PROCEDURE

1. Sight the target at the target point.

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

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

```
Coord.
N            34567.123
E          −1234567.789
Z               12.789
S         1234.567m
ZA     37°51'50"
HAR   120°37'52"
                    STOP
```

3. Sight the next target and press **[OBS]** to begin measurement.
Continue until all targets have been measured.

```
Coord.
N            34567.123
E          −1234567.789
Z               12.789
S         1234.567m
ZA     37°51'50"
HAR   120°37'52"
 REC    HT          OBS
```

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

• **[REC]**: records measurement results
Set point number and code (memo etc.) and press **[OK]** after setting each item.

```
Coord.            123rec
N  :−1234567.789
E  :        56.789
Z  :         1.234
Pt.:POINT20000005
Code:AA01234BCDEFGH
 OK
```

4. When coordinate measurement is completed, press **{ESC}** to return to <Coord>.

13. RESECTION MEASUREMENT

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

Entry			Output		
Coordinates of known point	:	(N_i, E_i, Z_i)	Station point coordinates	:	(N_0, E_0, Z_0)
Observed horizontal angle	:	H_i			
Observed vertical angle	:	V_i			
Observed distance	:	D_i			
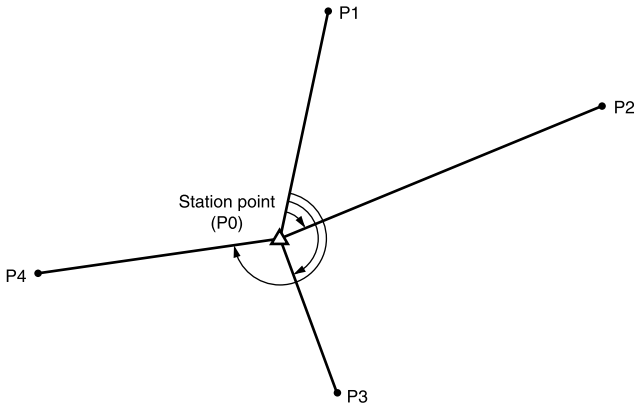
- Between 2 and 10 known points can be measured by distance measurement, and between 3 and 10 known points by angle measurement.
- The more known points there are and the more points there are whose distance can be measured, the higher the precision of the coordinate value calculation.

▶PROCEDURE

1. Press **[RESEC]** in the third page of Meas Mode.

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

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


 READ   REC   O K
```

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

```
Resection
 Pt.5
N          567.000
E           20.000
Z            3.500


 MEAS  READ   REC   O K
```

3. Sight the first known point and press **[SDIST]** for distance measurements and press **[ANGLE]** for angle measurements only.
   The measurement results are displayed on the screen.

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


 ANGLE         SDIST
```

4. Enter the target height of the first point, then press **[YES]** to use the measurement results of the first known point.

```
Resection
 Pt.1

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

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

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

```
Resection
 Pt.3

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

• Press **[RE_OBS]** to display
  <Resection>. You can select the
  following observations.
    (1) Re-observe from the first
        known point.
    (2) Re-observe only the final
        known point.

```
Resection

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

• Press **[ADD]** when there is a known
  point that has not been measured or
  when a new known point is added.
• **[REC]**: records measurement results
    ☞ Recording method:
        "17. RECORDING DATA -
        REC Menu -"

7. Press **[YES]** when you want to set
    the azimuth angle of the first
    known point as the backsight
    point. Main screen 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.

```
┌─────────────────────────────────┐
│       Calculation begins.        │
└─────────────────────────────────┘
                 ▼
┌─────────────────────────────────┐
│ Hypothetical coordinates are found. │
└─────────────────────────────────┘
                 ▼ ◄──────────────────┐
┌─────────────────────────────────┐  │
│ The observation equation for the │  │
│ angle is prepared.               │  │
└─────────────────────────────────┘  │
                 ▼                    │
┌─────────────────────────────────┐  │
│ The observation equation for the │  │    Repeated 3 times
│ distance is prepared.            │  │
└─────────────────────────────────┘  │
                 ▼                    │
┌─────────────────────────────────┐  │
│ The normal equation is prepared  │  │
└─────────────────────────────────┘  │
                 ▼                    │
┌─────────────────────────────────┐  │
│ Instrument station coordinates are │ │
│ calculated                       │  │
└─────────────────────────────────┘  │
                 ▼                    │
  ╱Difference from the hypothetical co-╲  No
  ╲ordinates is less than 0.5 mm      ╱──┘
                 ▼ Yes
┌─────────────────────────────────┐
│  Calculation of the Z coordinate │
└─────────────────────────────────┘
                 ▼
┌─────────────────────────────────┐
│        Calculation ends          │
└─────────────────────────────────┘
```
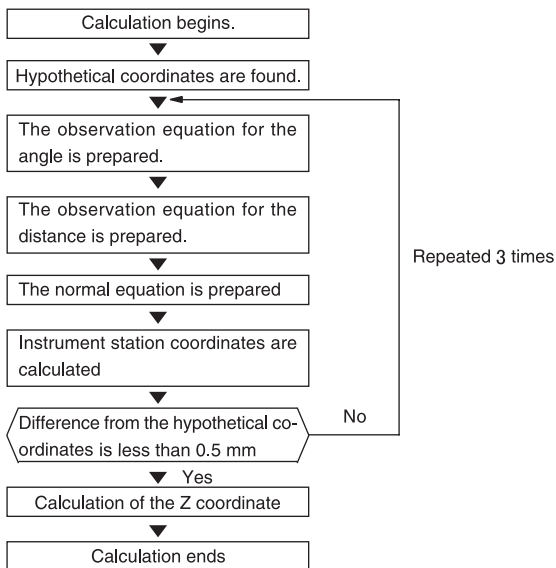
Precaution when performing resection

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.
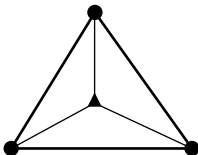
It is sometimes impossible to perform a correct calculation in a case such as the one below.
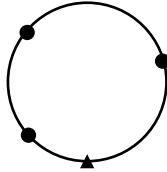
• When they are on the edge of a single circle, take one of the following measures.

(1) Move the instrument station as close as possible to the center of the triangle.
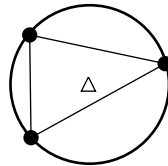
(2) Observe one more known point which is not on the circle.
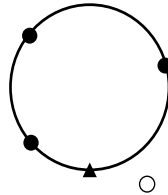
(3) Perform a distance measurement on at least one of the three points.
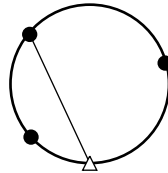
Caution

• In some cases it is impossible to calculate the coordinates of the instrument station if the included angle between the known points is too small. The SET cannot recognize that the longer the distance between the instrument station and the known points, the narrower the included angle between the known points. Be careful because the points can easily be aligned on the edge of a single circle.

14. SETTING-OUT MEASUREMENT

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

The horizontal angle difference and distance difference are calculated and displayed using the following formulae.
Horizontal difference
Displayed value (angle) = 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.

☞ "20.3 Configuration -Config. Mode-

Caution

- Set the same values for the display mode distance obtained during setting out measurement and the entered distance value (slope distance/horizontal distance/height difference/height of REM measurement) set in setting-out data. Pressing [◢S-O] switches the display mode. If the set distance and the distance in the display mode are different, correct results cannot be obtained.
- If the coordinates of the setting-out data are entered or the instrument station coordinates are renewed, the horizontal distance and horizontal angle are calculated and set using the instrument station coordinates and entered coordinates.

  At this time, the display mode consists of 2 modes: horizontal distance mode and coordinates mode. To perform slope distance setting-out measurement, height difference setting-out measurement or REM setting-out measurement, you must manually enter the slope distance, height difference or REM measurement height.

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14.1 Distance Setting-out Measurement

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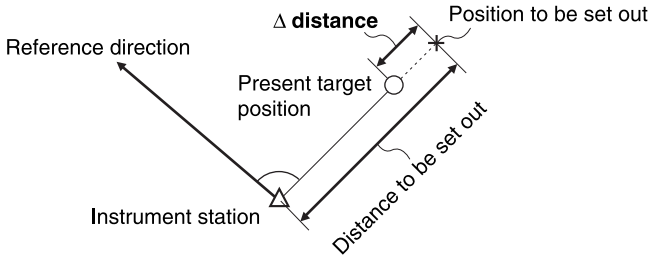
▶PROCEDURE

1. Sight the reference point and press **[0SET]** twice or set the horizontal angle of the reference point and input the value.
   ☞ "10.1 Measuring the Horizontal Angle between Two Points (Horizontal Angle 0°)" / "10.2 Setting the Horizontal Angle to a Required Value (Horizontal Angle Hold)"

2. Press **[S-O]** in the second page of Meas Mode and select the "S-O data".
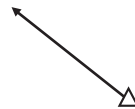
3. Enter the included angle between the reference point and the setting-out point and the distance from the instrument station to the position to be set out (slope distance, horizontal distance or height difference).

• When **[READ]** is pressed, registered coordinates can be recalled and used. Horizontal distance and the included angle between the reference point and the setting-out point calculated using the coordinate value.

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

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

5. Rotate the top of the instrument until "dHA" (the horizontal angle to the point to be set out) is 0°.

• By pressing **[←→]**, an arrow pointing to the left or right displays which direction the targets should be moved.

6. Press **[◢S-O]** to select the display mode with the same distance value set in step 3. Each time **[◢S-O]** is pressed: **[SDIST]** (slope distance), **[HDIST]** (horizontal distance), **[VDIST]** (height difference), **[COORD]** (coordinates), **[HT]** (REM measurement).

  ℒ͟ℱ "14.2 Coordinates Setting-out Measurement", "14.3 REM Setting-out Measurement"

Distance to the setting-out pt.

```
S-O
Np:              5.000
Ep:              0.000
Zp:              0.000
Tgt.h.:          1.200m
SO dist:         0.000m
SO Hang:    0° 06'00"
 READ    REC            O K
```

Angle to the setting-out pt.

```
S-O

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

7. Position the target on the line of sight and press **[SDIST]** to begin distance measurement.

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

S      100.123m
ZA     89° 52'54"
HAR   150° 16'15"
                STOP
```
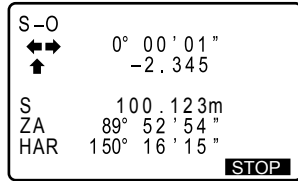
● Movement indicator

←	: (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

8. 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.

```
S-O
←→      0° 00'01"
↑↓      0.001m

S       12.554m
ZA     90° 00'00"
HAR    45° 00'00"
 EDM  /S-O ←  → SDIST
```
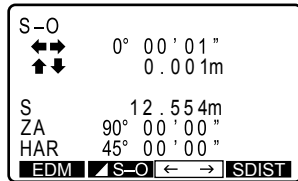
9. After completing setting-out measurment, press **{ESC}** to return to <S-O>.

Note

• The same procedure as that described above can be performed by selecting **[MENU]** in the third page of the Meas. Mode and select "S-O".

14.2   Coordinates Setting-out Measurement

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

N

0   Δ **Distance**

Back sight
station

Present target
position

Point to be set out

Δ **Angle**
Instrument station

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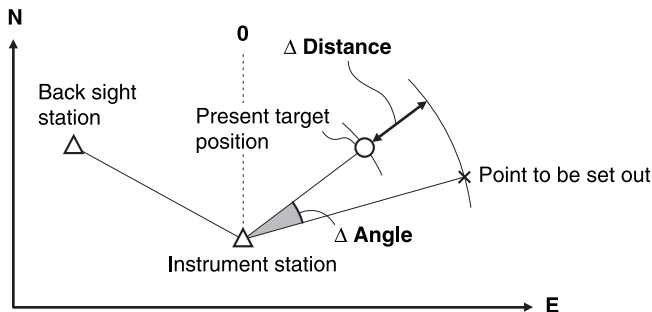
• To find the Z coordinate, attach the target to a pole etc. with the same target height.

▶PROCEDURE

1. Press **[S-O]** in the second page of Meas. Mode.

2. Select "Stn data". Enter the instrument station data in the <S-0/Stn>. And press **[OK]** to record the data.
    ☞ "12.1 Entering Instrument Station Data"

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

```
S-O/Stn
N0:        8.000
E0:        3.000
Z0:        0.000
Inst.h.:   1.500m
Tgt.h. :   0.800m

 READ   REC        O K
```

3. Select "Set h angle" in the <S-O>
   menu. Set the azimuth angle in
   the backsight point and press
   {◄┘}
   ☞ "12.2 Azimuth Angle Setting"
      steps 3 to 6.

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

```
Set H angle
HAR:█████████


 BS
```

4. Select "S-O data" in <S-O> and
   enter the coordinates of the target.
   Target distance (horizontal
   distance) and horizontal angle
   setting-out data are calculated and
   displayed.

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

```
S-O
Np:█████████1.000
Ep:        3.000
Zp:        0.000
Tgt.h. :   1.234m
SO dist:   3.162m
SO Hang:71° 30'00"
READ  REC         OK
```

5. After entering the data, press **[OK]**.

6. Press **[◢S-O]** to display
   [COORD].

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

• By pressing **[←→]**, an arrow pointing to the left or right displays which direction the targets should be moved.

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

Move the prism forward or backward, up or down until the angle is 0° and the setting-out distance is 0m.

 Movement indicators: "14.1 Distance Setting-out Measurement" step 7.

```
S-O
←         -40°00'00"
↑          -5.000
↑          -0.300
S       100.123m
ZA      90°00'00"
HAR     30°00'00"
                STOP
```

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

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

14.3 REM Setting-out Measurement

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

▶PROCEDURE

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

2. Sight the target and press **[SDIST]** in the first page of the Meas.Mode.

3. Press **[S-O]** in the second page of the Meas. Mode.

4. Select "S-O data" in the <S-O>. Input target height from the surveying point to the position to be set out in "SO dist" and target height.

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

•   If necessary, input the angle to the point to be set out.

Target height

```
S-O
Np:              5.000
Ep:              0.000
Zp:              0.000
Tgt.h. :         1.200m
SO dist:         0.000m
SO Hang:   0° 06'00"
 READ   REC           OK
```
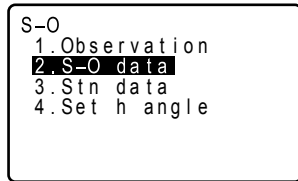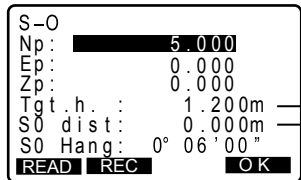
Height to be set out

5. After entering the data press **[OK]**.

6. Press **[◢S-O]** to display **[HT]**.

7. Press **[HT]** to begin REM setting-out measurement. The height difference between the target and the setting out point is displayed on the SET screen. The sighting point measurement results (currently installed position of the target) are displayed.

```
S-O

S-O Ht.  -0.002m
S    1234.567m
ZA    89° 52'54"
HAR   150° 16'15"
dHA   -0° 00'02"
 EDM  ◢S-O  ←  →  HT
```
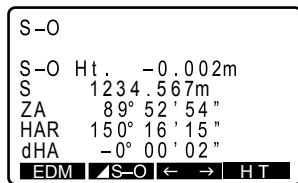
Height difference
to the setting out point

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

```
S-O
←              -1° 00'00"

▲               -0.002m
S    100.123m
ZA    90° 00'00"
HAR   30° 00'00"
                 STOP
```
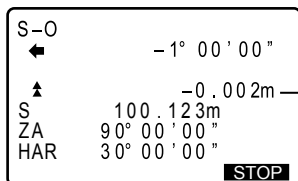
● Movement indicator

    ♦   : Move the telescope near the
           zenith

    ♦   : Move the telescope near the
           nadir

    ☞ For details of other movement
       indicators: "14.1 Distance
       Setting-out Measurement",
       step 7

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

15. OFFSET MEASUREMENT

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

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

15.1 Single-distance Offset Measurement

Finding it by entering the horizontal distance from the target point to the offset point.
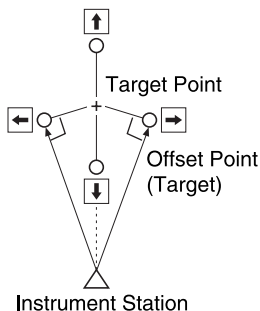
- When the offset point is positioned to the left or right of the target point, make sure the angle formed by lines connecting the offset point to the target point and to the instrument station is almost 90˚.
- When the offset point is positioned in front of or behind the target point, install the offset 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
   [SDIST] 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 **[MENU]** in page three of
   Meas Mode and select "Offset".

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

4. Select "Offset/Dist" and 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

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

```
Offset/Dist
S        10.234m
ZA      89°58'50"
HAR    111°20'31"
Dist:     0.000m
Direc.:→

 OK                OBS
```

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

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

```
Offset/Dist


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

 REC
```

6. Press **[REC]** in the screen of step 5 to record the calculation result. Enter point name, code, and target height and press **[OK]**. <Offset> is restored.

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

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

15.2   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.

Target Point

Offset Point (Target)   Offset Point (Target)

Instrument Station
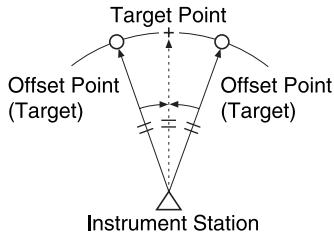
▶PROCEDURE

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 **[SDIST]** in the first page of the Meas Mode screen to begin measurement. The measurement results are displayed.

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3. Press **[MENU]** in page three of
   Meas Mode and select <Offset>.
   Select "Offset Angle".

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

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

4. Sight the direction of the target
   point and press **[OK]**.

```
Offset/Ang.

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

 OK             OBS
```

   The target point value is displayed.

```
Offset/Ang.


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

 REC
```

5. Press **[REC]** in the screen of
   step4.
   Press **[OK]** to finish recording the
   result. <Offset> is restored.

15.3 Two-distance Offset Measurement

By measuring the distances between the target point and the two offset points.
Install two offset points (1st target and 2nd target) on a straight line from the target
point. Observe the 1st target and 2nd target, then enter the distance between the
2nd target and the target point to find the target point.
• It is possible to make this measurement easily using the optional equipment:
  the 2-point target (2RT500-K).
☞ "24.3 Target System"

Target Point
Offset Point (Target)
Offset Point
(Target)
Instrument Station
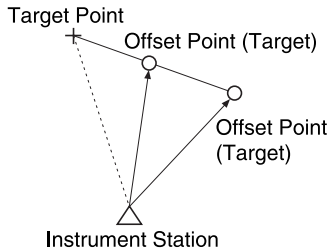
How to use 2-point target (2RT500-K)

Offset Points
2nd   1st
Target   Target
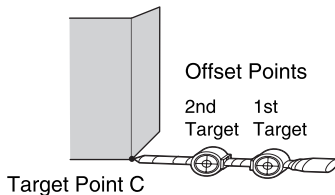
Target Point C

• Install the 2-point target with its tip at the target point.
• Face the targets toward the instrument.
• Measure the distance from the target point to the 2nd target.
• Select "Sheet" and set prism constant to 0mm in the setting mode.
☞ "20.2 Configuration -Config. Mode- ●Observation conditions"

▶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 **[MENU]** in page three of
   Meas Mode and select "Offset".
   Select "Offset/2D".

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

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

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

```
Offset/2D

 Take 1st o/s read

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

```
Offset/2D


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

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

```
Offset/2D

 Take 2nd o/s read

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

5. Confirm the measurement results
   and press **[YES]**.

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6. Enter the distance from the 2nd target to the target point and press **{◄━}**. The measurement results are displayed.

```
O f f s e t / 2D
B – C :    0 . 000   m
```

```
O f f s e t / 2D


N              7 . 890
E              3 . 456
Z              0 . 123
  REC        N O   YES
```

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

• Press **[REC]** to record the measurement result.

16. MISSING LINE MEASUREMENT

Missing line measurement is used to measure the slope distance, horizontal distance, and horizontal angle to a target from the target which is the reference (starting 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.

Target (P3)

Target (P2)

Starting Position (P1)

Instrument Station
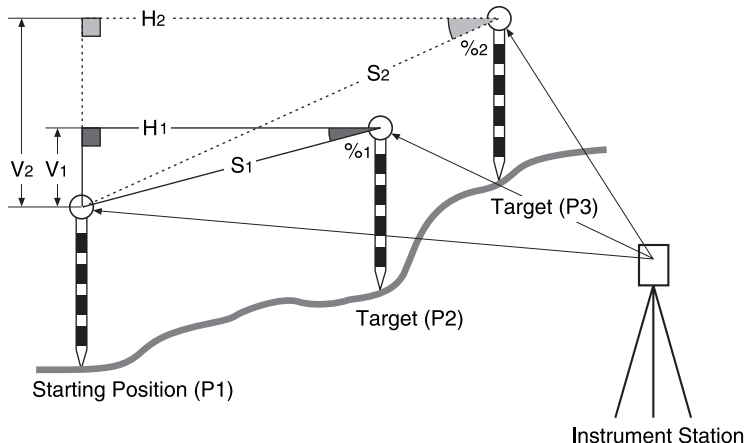
16.1   Measuring the Distance between 2 or more Points

▶PROCEDURE

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

2. Sight the next target and press
   [MLM] in the third page of Meas.
   Mode to begin observation.
   Continue measuring points using
   starting position as backsight.

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

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

   MLM H: Horizontal distance of the
   starting position and 2nd
   position.

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

• When **[S/%]** is pressed, the distance
  between two points (S) is displayed
  as the gradient between two points.

• Press **[OBS]** to re-observe the
  starting position. Sight the starting
  position and press **[OBS]**.

• When **[MOVE]** is pressed, the last
  target measured becomes the new
  starting position to perform missing
  line measurement of the next target.
  ☞ "16.2 Changing the Starting
     Point"

3. Press **{ESC}** to end missing line
   measurement.

16.2   Changing the Starting Point

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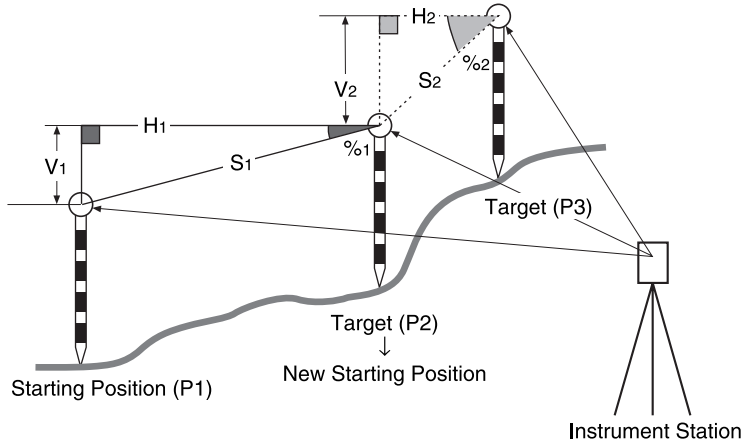
▶PROCEDURE

1. Observe the starting position and target following steps 1 to 2 in "16.1 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 "16.1 Measuring the Distance between 2 or more Points"

17. RECORDING DATA - REC MENU -

In the REC Menu, distance measurement data, angle measurement data, station point data, and notes can be recorded in a JOB. It is also possible to display or delete recorded data.

☞ "18. SELECTING/DELETING A JOB"

• Measurements can be carried out and results recorded in the REC Menu.
• 3000 items of known point data, including data inside the JOBs, can be registered.

17.1 Recording Distance Measurement Data

• Distance measurement data can be registered in the currently selected JOB.
• It is convenient to use [AUTO] to perform automatic operation from distance measurement to recording.

▶PROCEDURE Recording distance measurement data

1. Press **[SDIST]** in the first page of Meas Mode to perform distance measurement.
   ☞ "11.2 Distance and Angle Measurement"

2. Press **[REC]** on the second page of Meas Mode.

3. Select "Dist. data" and press {◀━━】.
   The measurement results of step 1 are displayed in lines indicated by "*".

Current JOB is displayed

```
REC       JOB05
 1.Dist data
 2.Angle data
 3.Coord data
 4.Stn data
 5.Note
 6.View
```

```
REC/Dist      1200rec
*S          10.160m
*ZA      76°14'50"
*HAR     64°22'13"
Pt.:POINT200000005
ZA        84°22'13"
HAR      156°14'50"
 REC  SDIST OFFSET AUTO
```

4. Press **[REC]** and set the point
   number, code and target height.
   After entering each item, press
   {←⏎}.

```
REC/Dist        1200rec
S          10.160m
ZA         76°14'50"
HAR        64°22'13"
Pt.:POINT200000005
Code:ABCD
Tgt.h.:     1.200m
 OK
```

5. Check the data and press **[OK]**.

6. To continue measurements, sight
   the next measurement point and
   press **[SDIST]**. Repeat steps 4
   and 5.

7. Press **{ESC}** to restore the
   <REC>.

Note

- Point number is incremented automatically.
- Once the data has been recorded, **[REC]** cannot be displayed in order to
  prevent double recording.
- Perform distance measurement to record automatically by pressing a single key
  : **[AUTO]**
  When this key is used, it is unnecessary to perform distance measurement in
  MEAS Mode. Press **[AUTO]** on the <REC/Dist> to perform distance
  measurement and automatically record the results. When this is done, the point
  number automatically increases from that displayed when the SET entered
  REC Menu and the code that was displayed is used unchanged. After
  measurement has been completed, the results are displayed for 2 seconds and
  the screen displayed before **[AUTO]** was pressed is restored.

- Maximum point name size: 14 (alphanumeric)
- Maximum target height: -9999.999 to 9999.999m
- Maximum code size: 16 (alphanumeric)

17.2 Recording Angle Measurement Data

Angle measurement data can be stored in the current JOB.

• It is convenient to use **[AUTO]** to perform automatic operation from angle measurement to recording.

▶PROCEDURE

1. Press **[REC]** on the second page of the Meas Mode to display the <REC>.

2. Select " Angle data," sight the point to be recorded and press **[ANGLE]**.
   Angle measurement values are displayed in real time.

```
REC        JOB05
 1.Dist  data
 2.Angle data
 3.Coord  data
 4.Stn  data
 5.Note
 6.View
```

```
REC/Angle      1200rec

*ZA
*HAR
Pt.:POINT200000005
ZA      84° 22'13"
HAR    156° 14'50"
      ANGLE          AUTO
```

3. Press **[REC]** and set the point number, target height, and code.

```
REC/Angle      1200rec

*ZA      76° 14'50"
*HAR     64° 22'13"
Pt.:POINT200000005
ZA      84° 22'13"
HAR    156° 14'50"
  REC  ANGLE          AUTO
```

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4. Check the input data and then press **[OK]**.

```
REC/Angle      1200rec

ZA         76°14'50"
HAR        64°22'13"
Pt.:POINT200000005
Code:ABCD
Tgt.h. :      1.200m
 O K
```

5. Press **{ESC}** to quit measurement and restore <REC>.

17.3   Recording Coordinate Data

• Coordinate measurement data can be registered in the currently selected JOB.
• It is convenient to use **[AUTO]** to perform automatic operation from measurement to recording.

▶PROCEDURE

1. Press **[COORD]** in the first page of Meas Mode to perform coordinate measurement.
   📖 "11.2 Distance and Angle Measurement"

2. Press **[REC]** on the second page of Meas Mode.

3. Select "Coord data" and press **{◀━━}**.
   The measurement results of step 1 are displayed in lines indicated by "*".

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

```
REC/Coord     1200rec
*N          10.000
*E         234.000
*Z           1.500
Pt. POINT200000005
ZA     156°14'50"
HAR     84°22'13"
 REC   OBS  OFFSET AUTO
```

4. Press **[REC]** and set the point number, code and target height. After entering each item, press **{◄┘}**.

```
REC/Coord    1200rec
N          10.000
E         234.000
Z           1.500
Pt.:POINT200000005
Code:ABCD
Tgt.h. :    1.200m
 OK
```

5. Check the data and press **[OK]**.

6. To continue measurements, sight the next measurement point and press **[OBS]**. Repeat steps 4 and 5.

7. Press **{ESC}** to restore <REC>.

17.4   Recording Instrument Station Data

Instrument station data can be stored in the current JOB.

▶Procedure

1. Press **[REC]** in the second page of Meas mode to display <REC>.

2. Select "Stn data".

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

Set the following data items.
    (1) Instrument station
         coordinates
    (2) Point number
    (3) Codes
    (4) Instrument height
    (5) Operator
    (6) Date
    (7) Time
    (8) Weather
    (9) Wind
    (10) Temperature
    (11) Air pressure
    (12) Humidity
    (13) Atmospheric correction factor
    (14) Target type
    (15) PC (Prism constant
         correction value)
    (16) Distance measurement mode

```
REC/Stn          1200rec
N0  :        10.000
E0  :       234.000
Z0  :         1.500
Pt.:POINT200000005
Code:TREE
Inst.h.:      1.500m  ↓

Operator:              ↑

Date  :Oct-14-01
Time  :10:14:52
Weath.:Fine
Wind  :Calm           ↓

Temp.     :  15°C     ↑
Press.    :1013hPa

ppm       : 0.000m
Reflector:Prism
PC        :-30        ↓

Mode  :Rapid"r"       ↑
 OK
```

• Align the cursor where you want to
read the coordinate data and press
[READ].
   ☞"12.1 Entering Instrument
      Station Data PROCEDURE
      Reading in Registered
      Coordinate Data"

• When inputting code, press **{▲}**/**{▼}**
to align the cursor where you want to
input the registered code.
• To set the atmospheric correction
factor to 0ppm, press **[0ppm]**. The
temperature and air pressure are set
to the default setting.

3.   Check the input data, then press
     [OK].

4.   Press **{ESC}** to quit measurement
     and restore <REC>.

Note
- Maximum point number size: 14 (alphanumeric)
- Weather selection: clear, cloudy, light rain, heavy 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)
- Humidity: 0 to 100%
- Atmospheric correction factor range (ppm): -499 to 499
- Target type: Prism/sheet
- PPC (Prism constant correction value): -99 to 99mm
- Distance measurement mode: (Selection:Fine"r", FineAVG"n=", Fine"s", Rapid"r", Rapid"s", Tracking) When selecting "precision average measurement," designate the number of measurements.

- The SET includes clock and calendar functions.
☞ "20.2 Configuration -Config. Mode- ●Date/Time"
- The temperature, air pressure, humidity, ppm (atmospheric correction factor), target type, PPC prism constant correction value and distance measurement mode can be set by pressing **[EDM]** in page one of the Meas Mode.
☞ "20.1 EDM Settings"

17.5 Recording Notes

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

▶PROCEDURE

1. Press **[REC]** in the second page of Meas Mode.

2. Select "Note" and enter the note data.

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

```
REC/Note      1200rec
ABCDEFGHIJKLMNOPQR
STU

                       S


  OK
```

3. After inputting the note data, press **[OK]** to return to <REC>.

Note
• Maximum note length: 60 characters (alphanumeric)

17.6 Reviewing Job Data

It is possible to display the data within the current JOB that is selected.

• It is possible to search for data within the JOB to be displayed or deleted by point number. But the note data cannot be searched.

▶PROCEDURE

1. Press **[REC]** in the second page of Meas Mode to display <REC>.

2. Select "View" to display the list of recorded points.

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

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3. Select the point number to be displayed in detail and press **{ ◄┘ }**.
   Details of the data is displayed. This screen contains distance measurement data.
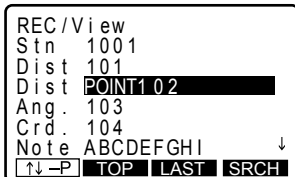
```
REC/View
Stn   1001
Dist  101
Dist  POINT1 0 2
Ang.  103
Crd.  104
Note ABCDEFGHI        ↓
↑↓-P   TOP   LAST   SRCH
```

• Item motion: **{▲}** or **{▼}**
• Changing the cursor motion unit : **[↑↓...P]**

   When **[↑↓...P]** (no background color) is displayed, the cursor moves from line to line.
   When **[↑↓...P]** (black background, inverted text) is displayed, the cursor moves from page to page.
• Press **[TOP]** to display first data.
• Press **[LAST]** to display last data.
• Press **[SRCH]** to search for point number. Input the point number after "Pt. No."

4. Press **{ESC}** to conclude detailed display and restore the list of points.
   Press **{ESC}** again to restore <REC>.

18. SELECTING/DELETING A JOB

18.1   Selecting a JOB

Before recording data, select the JOB in which it is to be recorded. The following data can be recorded in a JOB.

• Measurement results
• Instrument station data
• Notes

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

▶PROCEDURE JOB selection

1. Select "JOB" in Memory Mode.

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

2. Select "JOB selection" and press
    {◀━█}.

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

3. Align the cursor with the desired JOB and press {◀━█}.
    The JOB is determined and <Mem./JOB> is restored.

• The numbers to the right represent the number of data items in each JOB.
• The list of JOB names is divided among four pages.

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

▶PROCEDURE Inputting a JOB name

1. Select "JOB" in Memory mode.

2. Select "JOB selection."

3. Align the cursor with the JOB to be changed and press **[EDIT]**.

```
Mem . / J OB
 J OB 0 1              0
 J OB 0 2              0
 JOB03                 0
 J OB 0 4              0
 J OB 0 5              0
 J OB 0 6              0↓
 ↑↓−P   TOP   LAST   EDIT
```

4. Input the new JOB name and press **{◀━】**.
   <Mem./JOB> is restored.

```
Mem . / J OB
 JOB   : JOB03

                          S
```

Note
• Maximum size of JOB name: 12 (alphanumeric)

18.2   Deleting a JOB

It is possible to clear the data within a designated JOB. After the data has been cleared, the JOB name returns to the name allocated when the SET was shipped.

• A JOB that has not been output to an external device (displayed with*) cannot be deleted.

▶PROCEDURE

1. Select "JOB" in Memory Mode and press **{◀━】**.

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2. Select "JOB deletion" and press
   {◄┛}.
   The JOB names are displayed in a
   table.

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

3. Align the cursor with the JOB
   whose data is to be deleted and
   press {◄┛}.

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

4. Press **[YES]**. The data within the
   JOB that is selected is deleted
   and <Mem./JOB> is restored.

```
Mem./JOB

 JOB.JOB03
   deletion
      Confirm ?
                NO   YES
```

18.3 Outputting JOB Data to a Host Computer

It is possible to output the data within the JOB to the host computer or printer in
JOB units.
☞ Communication cables: "24.2 Optional Accessories"
Output format and command operations: "Interfacing with the SOKKIA SDR
Electronic Field Book" and "Command Explanations" manuals.

▶PROCEDURE Outputting JOB data to the host computer

1. Connect SET and host computer.

2. Select "JOB" in the Memory Mode and press {◄┘}.

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

3. Select "Comms output" and press {◄┘}.

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

4. Select "SDR" and press {◄┘}.

```
Mem./JOB
 1.SDR
 2.Printed output
```

• Item motion: **[▲]** or **[▼]**
• Changing the cursor motion unit: **[↑↓...P]**
  When **[↑↓...P]** (no background color) is displayed, the cursor moves from line to line.
  When **[↑↓...P]** (black background, inverted text) is displayed, the cursor moves from page to page.

• Press **[TOP]** to display first data.
• Press **[LAST]** to display last data.
• Press **[SRCH]** to search for point number. Input the point number after "Pt. No."

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5. Select the JOB to be output to the printer, and press **{◄┛}**.

• "*" means that the JOB has not been output to an external device yet.

Output starts. When the output is completed, the JOB list is restored. It is possible to continue output of the next JOB.

• Stopping output: **{ESC}**.

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

```
Mem . / JOB

 Format . SDR33
 JOB . JOB03

 Sending
```

Note
• If "Printed output" is selected in step 4, the data is output to a printer.

19. REGISTERING/DELETING DATA

19.1 Registering/Deleting Known Point Data

It is possible to register or delete coordinate data of the known points in the known point memory. The known point memory is a part of the memory separated from JOB data.

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

• Registered known point data can be used in any JOB.
• It is possible to register 3000 items of coordinate data, including the data inside the JOBs.
• There are two registration methods: key entry and entry from an external instrument.

☞ Communication cables: "24.2 Optional Accessories"
Output format and command operations: "Interfacing with the SOKKIA SDR Electronic Field Book" and "Command Explanations" manuals.

▶PROCEDURE Using the key entry method to register coordinate data

1. Select "Known data" in Memory Mode and press {◀━■}.

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

2. Select "Key in coord" and press {◀━■}.

```
Mem./Known
 1.Key in coord
 2.Comms input
 3.Deletion
 4.View
 5.Clear
```

3. Set the coordinate values, and
   point number. After setting each
   item, press **{◄█}**.

Item registration capacity

```
Mem. / Known     3000 rec
N              5.000
E             10.000
Z              8.000
Pt.:POINT200000005

 REC
```

4. Press **[REC]**. The coordinate data
   is recorded in the memory.
   Next it is possible to enter other
   coordinate data.

```
Mem. / Known     2999 rec
N      -1234567.890
E       1234567.890
Z             1.123
Pt.:POINT200000005

 REC
```

5. After the registration of all the
   coordinate data has been
   completed, press **{ESC}**.
   The <Mem./Known> is restored.

▶**PROCEDURE Entering known point coordinate data from an external instrument**

---

1. Connect SET and host computer.

2. Select "Known data" in the
   Memory Mode and press **{◄█}**.

3. Select "Comms input" and press
   {◄█}.
   Enter coordinate data from an
   external instrument in this
   condition.
   Data receiving begins.

```
Mem. / Known
1.Key in coord
2.Comms input
3.Deletion
4.View
5.Clear
```

• The figure represents the number of
  items received.
• Stopping data reception in progress:
  {ESC}.
    When data reception is completed,
    the "Data Format Display Screen"
    is restored.

```
Mem. / Known

 Format.SDR33


 Receiving    12
```

▶PROCEDURE Deleting designated coordinate data

1. Select "Known data" in the
   Memory Mode and press **{◄━▐}**.

2. Select "Deletion" and press **{◄━▐}**.

```
Mem./Known
 1.Key in coord
 2.Comms input
 3.Deletion
 4.View
 5.Clear
```
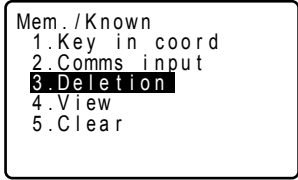
3. Select the point number to be
   deleted and press **{◄━▐}**.
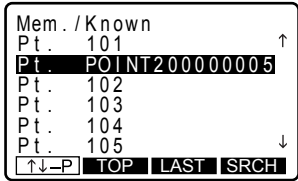
• Item motion: **[▲]** or **[▼]**
• Changing the cursor motion unit:
  [↑↓...P]
  When **[↑↓...P]** (no background color)
  is displayed, the cursor moves from
  line to line.
  When **[↑↓...P]** (black background,
  inverted text) is displayed, the cursor
  moves from page to page.

```
Mem./Known
Pt.  101              ↑
Pt.  POINT200000005
Pt.  102
Pt.  103
Pt.  104
Pt.  105              ↓
↑↓─P  TOP  LAST  SRCH
```

• Press **[TOP]** to display first data.
• Press **[LAST]** to display last data.
• Press **[SRCH]** to search for point
  number. Input the point number after
  "Pt. No."

4. Press **[YES]**.
   The displayed coordinate data is
   cleared and the point number list is
   restored.

```
Mem./Known
N           22.230
E          123.450
Z            6.330
Pt.:POINT200000005
 Deletion
  Confirm ?
 NEXT       NO   YES
```
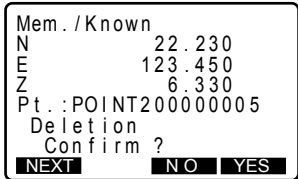
• Press **[NEXT]** to display next data.
• Press **[PREV]** to display previous
  data.

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5. After clearing is completed, press
   {ESC} to restore the <Mem./
   Known>.

▶**PROCEDURE Clearing all coordinate data at once (initialization)**

1. Select "Known data" in the
   Memory Mode and press **{◄━┛}**.

2. Select "Clear" and press **{◄━┛}**.

```
Mem./Known
 1.Key in coord
 2.Comms input
 3.Deletion
 4.View
 5.Clear
```

3. Press **[YES]**.
   Coordinate data is completely
   cleared and the <Mem./Known> is
   restored.

```
Mem./Known


 Clear
  Confirm ?


            NO   YES
```

19.2   Reviewing Known Point Data

It is possible to display all the coordinate data within the known data memory.

▶**PROCEDURE**

1. Select "Known data" in Memory
   Mode.

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

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2. Select "View." .

```
Mem./Known
 1.Key in coord
 2.Comms input
 3.Deletion
 4.View
 5.Clear
```

3. Select the point number to be displayed and press **{◄─┘}**.

```
Mem./Known
Pt.  POINT200000005↓
Pt.  1
Pt.  2
Pt.  12345678
Pt.  12345679
Pt.  3          ↓
↑↓−P  TOP  LAST  SRCH
```

The coordinates of the selected point number are displayed.

```
Mem./Known
N        1234.567
E        8901.234
Z           0.567
Pt.:POINT200000005

NEXT  PREV
```

4. Press **{ESC}** to restore the point number list.
   Press **{ESC}** again to restore <Mem./Known>.

19.3 Registering / Deleting Codes

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

▶PROCEDURE Inputting Codes

1. Select "Code" in Memory Mode.

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

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2. Select "Key in code."

```
Mem./Code
 1.Key in code
 2.Deletion
 3.Code view
 4.Clear list
```

3. Enter the code and press {◄━┫}.
   The code is registered and
   <Code> is restored.

```
Mem./Code
Code:_

                          S
```

Note
• Maximum code size: 16 (alphanumeric)
• Maximum number of codes registered: 40

▶PROCEDURE Deleting codes

1. Select "Code" in Memory Mode.

2. Select "Deletion." The registered
   code list is displayed.

```
Mem./Code
 1.Key in code
 2.Deletion
 3.Code view
 4.Clear list
```

3. Align the cursor with the code to
   be deleted and press [DEL].
   The designated code is deleted.

```
Mem./Code
 ABCDEFGHIJKLMNO  ↑
 A001
 TREE01LEFT
 POINT1
 POINT2
 POINT3           ↓
 ↑↓−P  TOP  LAST  DEL
```

4. Press {ESC} to restore <Mem./
   Code>.

Note

• If you select "Clear list" in step 2 and then press **[YES]**, all registered codes are deleted.

19.4 Reviewing Codes

▶PROCEDURE

1. Select "Code" in Memory Mode.

2. Select "Code view."
   The registered code list is
   displayed.

```
Mem./Code
 1.Key in code
 2.Deletion
 3.Code view
 4.Clear list

```

```
Mem./Code
  ABCDEFGHIJKLMNO  ↑
  A001
  TREE01LEFT
  POINT1
  POINT2
  POINT3          ↓
 ↑↓–P  TOP  LAST
```

3. Press **{ESC}** to restore <Mem./
   Code>.

20. CHANGING THE SETTINGS

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

20.1   EDM Settings

This section explains EDM settings.
Press **[EDM]** in the first page of Meas Mode.

• "*": Factory setting

```
EDM
Temp     :15 C∞
Press    :1013hPa
Humid    :  0%
ppm      :   0
Reflector:Prism
PC       :-30         ↓
0PPM
```
```
Mode     :Fine"r"
```

Temp. (Temperature)   : -30 to 60°C (15*)
Press. (Air pressure)   : 500 to 1400hPa (1013*), 375 to
                                       1050mmHg (760*)
Humid (Humidity)   : 0 to 100% (0*)
ppm (Atmospheric correction factor) : -499 to 499 (0*)
Reflector   : Prism* / Sheet
PC (Prism constant)   -99 to 99 (Prism:-30*/sheet:0*)
Mode (Distance measurement Mode)   : Fine "r"*/Fine AVG"n=2" (Setting: 2 to 9
                                       times), Fine "s"/ Rapid "r"/Rapid "s"/
                                       Tracking

• **[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.

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

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

Atmospheric Correction Factor
$$=278.96 - (0.2904 \times P - 0.044735 \times e) / (1 + 0.003661 \times T)$$
$$e = H \times ew/100$$
$$ew = a_0T^4 + a_1T^3 + a_2T^2 + a_3T + a_4$$

T: Temperature (°C)
P: Pressure (hPa)
E: Water vapor pressure (hPa)
H: Relative humidity (%)
Ew: Saturated water vapor pressure
$a_0 = 0.00000491539$
$a_1 = 0.00026202374$
$a_2 = 0.01251534557$
$a_3 = 0.45183196592$
$a_4 = 6.32672468457$

- If the weather correction is not required, set the ppm value to 0.
- The atmospheric correction factor from the table below is 13 ppm.
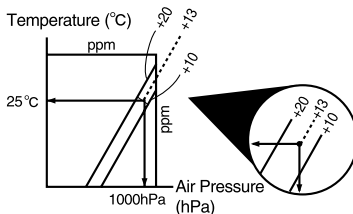
- If "&Humid" is set in the ppm mode of the Obs. Condition screen, humidity can also be set. The effect of humidity on the results of short distance measurements is negligible, but for high accuracy measurement of long distances and in humid conditions, humidity should be set.

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

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

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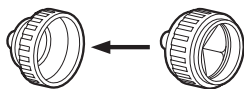
Correction Value = –30   Correction Value = -40   Correction Value = 0

20.2	Configuration -Config. Mode-

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

• Instrument station settings ☞ "17.4 Recording Instrument Station Data"
• Instrument constant ☞ "23.3 Tilt Sensor".

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

• "*": Factory setting

● **Observation conditions (items set and options)**

```
Condition
ppm mode   :Pres/Tmp
C&R crn.   :No
V.obs      :Zenith
Tilt crn.  :Yes(H,V)
Coll.crn   :Yes
Reticle    :Bright    ↓

V index    :Auto      ↑
H index    :Auto
Power off  :On(30min)
Ang.reso.  :1"
Coord.     :E-N-Z
Dist mode  :Sdist     ↓

Dist. reso :1mm       ↑
Coord. search JOB:
JOB01
```

ppm mode   : Pres/Tmp*/&Humid
C&R crn.   : No*/K=0.142/K=0.20
V.obs (vertical angle display method) : Zenith* / Vertical (vertical 0°) * /Vert±90
Tilt crn (tilt correction)   : Yes (H,V) * / Yes (V) / No
Coll.crn. (collimation correction)   : Yes*/No
Reticle   : Bright*/Dim
V index   : Auto*/ Manual
H index   : Auto*/ Manual (horizontal angle is 0° at power on)
Power off   : On (30min)*/Off
Ang. reso. (Angle resolution)   : SET1120/2120 (0.5"/1"*), SET3120 (1"*/5"),SET4120 (1"/5"*)
Coord.   : N-E-Z*/E-N-Z
Dist mode   : Sdist (slope distance) * / Hdist (horizontal distance) / Vdist (height difference)
Dist. reso (Only the SET21120)   : 1mm/0.1mm
Coord. search JOB   : JOB01 to JOB24

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

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)

| Zenith | Vertical | Vertical ±90˚ |
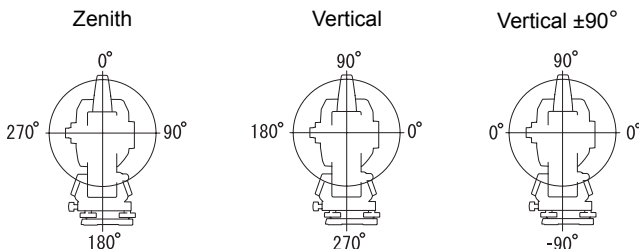
Power-saving automatic cut-off
To save power, power to the SET is automatically cut off if it is not operated for 30 minutes.

Coordinate search JOB
The registered coordinate data in the JOB selected here can be read into coordinate measurement, resection measurement, setting-out measurement, etc.

● Date and time (Items set)

```
Date&time
 Date : Jul–20–01
 Time : 143517



             OK
```

Date:Entry example: July 20, 2001 → 072097
Time:Entry example: 2:35:17 p.m. → 143517

Date and time
The SET includes clock and calendar functions and date and time input here are displayed in the Status screen. Date and time input when recording instrument station data are not linked with this function.

● **Communication setup (items set, options, and input range)**

```
Comms setup
Baud rate: 1200bps
Data bits:8bits
Parity   :Not set
Stop bit :1bit
Check sum:No
Xon/Xoff :Yes
```

Baud rate   : 1200bps*/2400bps/4800bps/9600bps /19200bps/38400bps
Data bits   : 8bit*/ 7bit
Parity   : Not set*/ Odd/ Even
Stop bit   : 1bit*/ 2bit
Check sum   : Yes/ No*
Xon/Xoff   : Yes*/ No

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

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● **Unit** (items set and options)

```
Unit
Temp. :°C
Press.:hPa
Angle :mil
Dist  :m
```

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

20.3   Allocating Key Functions -Config. Mode-

It is possible to allocate the softkeys in the Meas. Mode 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.
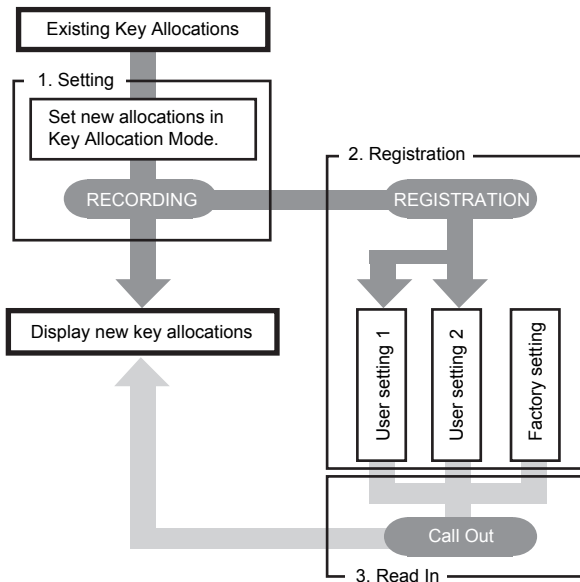
• It is possible to allocate the same key to each page. The same function can be allocated to more than one key on the same page. And it is also possible to allocate a function to only one key.
• The current softkey allocations are retained until they are revised again, even when the power is cut off.
• 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.

<div style="border:1px solid">Caution</div>

• 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 [EDM] [◢SHV] [H.ANG] [_DIST]
Page 2 [REC] [COORD] [S-O] [0SET]
Page 3 [MLM] [RESEC] [MENU] [HT]

[_DIST]	: Distance measurement
[◢ SHV]	: Select distance mode (S=Slope distance/H=Horizontal distance/ V=Height difference)
[0SET]	: Set horizontal angle to 0
[H.ANG]	: Set required horizontal angle
[R/L]	: Select horizontal angle right/left
[REP]	: Repetition measurement
[HOLD]	: Hold horizontal angle/release horizontal angle
[ZA/%]	: Switch between zenith angle/slope in %
[HT]	: Set the instrument station height and target height
[REC]	: To <REC> (data recording)
[REM]	: REM measurement
[MLM]	: Missing line measurement
[RCL]	: Display final measurement data
[VIEW]	: Display observation data for the selected JOB
[EDM]	: Setting
[COORD]	: Coordinates measurement

[S-O]		: Setting-out measurement
[OFFSET]		: Offset measurement
[MENU]		: To <Menu> (Coordinates measurement, setting-out measurement, offset measurement, repetition measurement, missing line measurement, REM measurement, and resection measurement can be selected)
[RESEC]		: Resection measurement
[D-OUT]		: Output measurement results to external instrument
[F/M]		: Switch between meters/feet
[- - -]		: No functions set

▶PROCEDURE Allocating softkeys

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

2. Select "Define".

```
Key func.
 1.Define
 2.Registration
 3.Recall
```
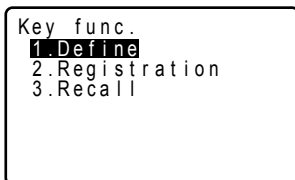
3. The softkey array in each page of Meas Mode is displayed.
   Align the cursor with the softkeys whose allocation you want to change using {◀}/{▶}. Selected softkey is displayed with white background.

```
Key func.
P1 EDM  ∕SHV  HOLD   ↑
   H.ANG _DIST  ZA/%
P2 REC  COORD  H T
   S-O   0SET   REC
P3 MLM  RESEC  REM
   MENU  H T    MLM   ↓
                O K
```
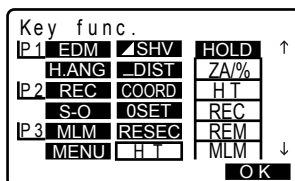
4. Change the softkey using {▲}/{▼}. The key to be swapped in is displayed in the list on the right of the screen. Scroll up/down to select the required softkey and press {◀┘}.
   The softkey selected in step 3 is changed to the softkey selected in step 5.

```
Key func.
P1 EDM  ∕SHV  HOLD   ↑
   H.ANG _DIST  ZA/%
P2 REC  COORD  H T
   S-O   0SET   REC
P3 MLM  RESEC  REM
   MENU  HOLD   MLM   ↓
                O K
```
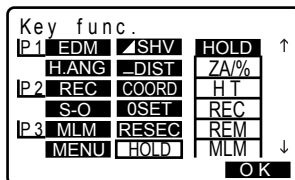
5. Repeat steps 3 to 4 as many times as necessary.

6. Press **[OK]** to record the allocations and return to the Key Function Mode. The newly allocated softkeys are displayed in the Meas. Mode screen.
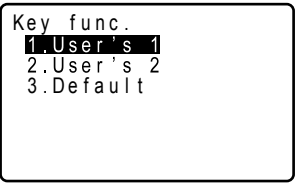
▶PROCEDURE Registering an allocation

1. Allocate functions to the softkeys.
   ☞ "20.3 Allocating Key Functions - Config. Mode-"

2. Select "key function" in Config Mode.

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

```
Key func.
 1.Define
 2.Registration
 3.Recall
```

```
Key func.
 1.User's 1
 2.User's 2
 3.Default
```

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. 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) configuration are restored to the initial settings.

☞ Factory settings: "20. CHANGING THE SETTINGS"

• 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}**, **{4}** and **{ON}** until "Checking.... Default set" is displayed.

3. Release the keys. The normal <0set> screen will appear.

22. WARNING AND ERROR MESSAGES

The following is a list of the error messages displayed by the SET and the meaning of each message and its respective countermeasure. 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 .

Calculation error

Coordinates identical to the known point coordinates observed during resection exist.
Set another known point so that the known point coordinates do not coincide.

Code area full

There is no space in the area where the code is to be read in.
Clear unnecessary codes and record the code again.

Code file checksum err. All cleared

An error may have occurred in the code memory.
Forcefully clear codes from the memory. If it appears to occur frequently, contact your Sokkia agent.

Data checksum err. Delete all data OK?

It is possible that an error has occurred in the data.
After selecting **[NO]** to back up all data, select **[YES]** the next time the power is turned on. Be careful when pressing **[YES]**, because this clears all data within the JOB and coordinate data from memory. If it appears to occur frequently, contact your Sokkia agent.

Data write err

It is impossible to read in data.
Contact your Sokkia agent.

Exchange sub bat.

The lithium battery used for backup is either weak or dead.
When data remains, perform an emergency backup of the data and have your local Sokkia service center replace the backup battery.

exist.

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

Invalid data

You have pressed **[REC]**, but no data is recorded. The data is already recorded or else there is an error in the data. (In a case where parameter "Recording Mode" is "auto," even if **[REC]** is not pressed, the message is displayed under the above conditions.)
Perform the observations again.

Memory is full

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

No code data

When clearing or displaying code data in memory, there is no code data registered in memory.

No coord. data

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

No known data

When clearing or displaying coordinates data in memory, there is no coordinates data registered in memory.

No obs. data

When deleting data from within a JOB, there is no data registered in the JOB now selected.

No solution

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

Not found

During a data search, the search stopped either because the item in question does not exist or the data volume is large.

Out of range

The tilt of the instrument exceeds the tilt angle compensation range during measurement.
Sight again within ±3'.

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Out of value

During gradient % display, the display range (less than. ±1,000%) has been exceeded.
During REM measurement, either the vertical angle has exceeded horizontal ±89° or the measured distance is greater than 9999.999 m.
Install a instrument station far from the target.
The instrument station coordinates calculated during resection are too high.
Perform the observation again.

Print or send first

JOB data output (transmission to the host computer or output to the printer) is not completed before JOB is cleared.
Either transmit the JOB to be cleared to the host computer or output it to the printer.

RAM cleared

It is possible there is a nonconformity in a setting area.
Forcefully initialize all set values. If it appears to occur frequently, contact your Sokkia agent.

Re 0 Set

The telescope or top of the instrument was rotated too rapidly.
Index the horizontal circle and vertical circle once again. (The readout speed of the horizontal angle and vertical angle of the SET is about 4 rotations/ second.)

Receive data err.

A reception error has occurred in coordinate data from an external instrument.
Check the settings of parameters 16 to 21 concerning communication conditions.

Need offset pt. obs

Observation of the offset point during offset measurement was not completed normally.
Sight the offset point accurately and press **[OBS]** to perform the measurement again.

Need base pt. obs

During REM measurement, the observation of the target was not completed normally.
Sight the target accurately and press **[OBS]** to perform the measurement again.

Need 1st obs

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

Sight the starting position accurately and press **[OBS]** to perform the measurement again.

Need 2nd obs

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

Sight the target accurately and press **[MLM]** to perform the measurement again.

Signal off

Measuring conditions are poor, and there is not any reflective light for measuring distances.

Resight the target. When using reflective prisms, effectiveness will be improved by increasing the number of prisms used.

Time out

Measuring conditions are poor, and due to the insufficient amount of reflective light, measuring could not be carried out within the time specified.

Resight the target. When using reflective prisms, effectiveness will be improved by increasing the number of prisms used.

Too few points

The known point observations necessary for calculation during resection are not completed or the calculation conditions are not all satisfied.

Check the calculation conditions and perform supplementary known point observations.

ⓒ�“13. RESECTION MEASUREMENT”

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23. 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 "23.1 Plate Level" to "23.7 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.

23.1 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.
   ☞ "7.2 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.
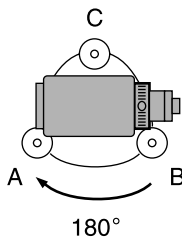
3. Correct half of the bubble displacement using levelling foot screw C.
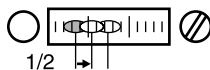
4. Correct the remaining half of the displacement by using the adjustment pin to rotate the plate level adjustment screw.
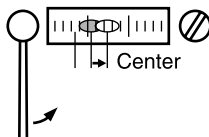
When the plate level adjustment
screw is turned in the
counterclockwise direction, the
bubble moves to the right.

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.

23.2 Circular Level

▶PROCEDURE Checking and adjusting

Caution

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

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

2. Check the position of the bubble in
    the circular level.
    ☞ "7.2 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.

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

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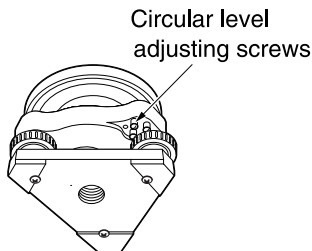
4. Adjust the adjusting screws until the
   tightening tension of the three
   screws is the same to align the
   bubble in the middle of the circle.

23.3   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. Press **[0SET]** twice in the second
   page of the Meas mode screen to
   set the horizontal angle to 0°.

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

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

4. Select "Tilt".

```
Instr.const.
 1.Tilt:X 1600 Y 1600
 2.Collimation
```

5. 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  1600 Y 1600

X        0° 01'50"
Y        0° 00'30"
HAR   0° 00'00"
  Take F1
                NO   YES
```

6. Loosen the horizontal clamp and turn the instrument 180° while referring to the displayed horizontal angle, then retighten the clamp.

```
Tilt offset
       X  1600 Y  1600

X      −0° 01'50"
Y      −0° 00'30"
HAR   180° 00'00"
  Take F2
                NO   YES
```

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

8. 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>.

▶**PROCEDURE Adjustment**

9. Press **[YES]** in the screen of step 6 to store value X2 and Y2. The horizontal angle is set to 0°.

10. Rotate the top of the instrument through 180°.

11. Wait a few seconds for the display to stabilize, then press **[YES]** to store tilt angles X1 and Y1. The new correction constant is displayed.

```
Tilt offset
        X 1600  Y 1600

X      −0° 01' 50"
Y      −0° 00' 30"
HAR   180° 00' 00"
  Take F2
                   N O   YES
```
Set correction constant value

12. Confirm that the values are in the adjustment range.
If both correction constants are within the range 1600±120 (SET1120/2120/3120) 400 ±30 (SET4120), select **[YES]** to renew the correction angle. "Tilt offset" is restored. Continue to step 12.
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.

```
Tilt offset
Current X 1600 Y 1600
NEW      X 1600 Y 1590


                   N O   YES
```
Measured correction constant value

▶**PROCEDURE Recheck**

13. Enter the <Tilt offset>.

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

15. Loosen the horizontal clamp and turn the instrument 180° while referring to the displayed horizontal angle, then retighten the clamp.

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

17. 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.

23.4   Collimation

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

▶PROCEDURE

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

2. Select "Collimation".

```
Instr.const.
 1.Tilt:X 1600 Y 1600
 2.Collimation
```

3. Rotate the telescope to index the vertical angle.

4. Sight the reference point in Face 1 and press **[YES]**.

```
Collimation


ZA      60° 00'30"
HAR   184° 14'50"
 Take F1
                 NO   YES
```

5. Rotate the SET 180°. Sight the reference point in Face 2 and press **[YES]**.

```
Collimation


ZA     259° 59'30"
HAR     0° 14'30"
 Take F2
                 NO   YES
```

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

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

```
Collimation
EL        −0° 00'08"
V off.     0° 00'10"



                 NO   YES
```

23.5   Reticle

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

1. Carefully level the instrument.

2. Align a clearly visible target (the edge of a roof for example) on point A of the reticle line.
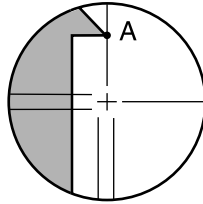
3. Use the telescope fine motion screw to align the target to point B on a vertical line.
   If the target moves parallel to the vertical line, adjustment is unnecessary. If its movement deviates from the vertical line, have your Sokkia service representative adjust it.
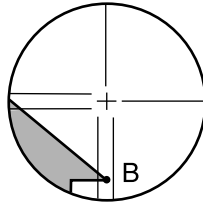
▶PROCEDURE Check 2: Vertical and horizontal reticle line positions

`Caution`

Perform the check procedure under slightly hazy and weakly scintillating conditions.

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"

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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°±40", 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.

23.6   Optical plummet

Caution

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

▶PROCEDURE Checking

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

2. Turn the upper part through 180°
   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.
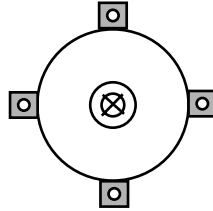
▶PROCEDURE Adjustment

3. Correct half the deviation with the
   levelling foot screw.
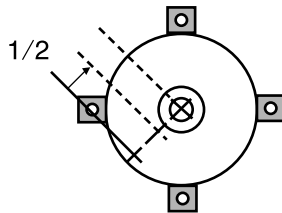
4. Remove the optical plummet reticle
   cover.

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.)

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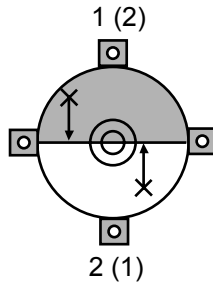
If the surveying point is on the solid line (dotted line):
Loosen the right (left) adjusting screw slightly and, tighten the left (right) adjusting screw by the same amount to move the surveying point to a point in the center of the optical plummet.

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.
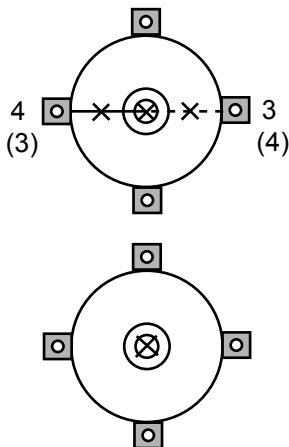
7. Replace the optical plummet reticle cover.

23.7   Additive Distance Constant

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

Caution

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

▶PROCEDURE Check

1. Find an area of flat ground where
   two points 100m apart can be
   selected.
   Set up the Instrument at point A and
   the reflective prism at point B.
   Establish a point C half way between
   points A and B.
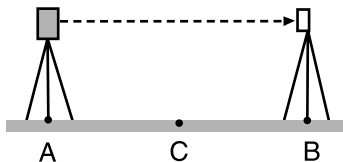
2. Precisely measure the horizontal
   distance between point A and point
   B 10 times and calculate the
   average value.

3. Place the SET at point C directly
   between points A and B and set up
   the reflective prism at point A.
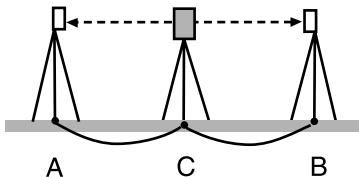
4. Precisely measure the horizontal
   distances CA and CB 10 times each
   and calculate the average value for
   each distance.

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.

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24. STANDARD EQUIPMENT AND OPTIONAL ACCESSORIES

24.1　Standard Equipment

Please verify that all equipment is included.
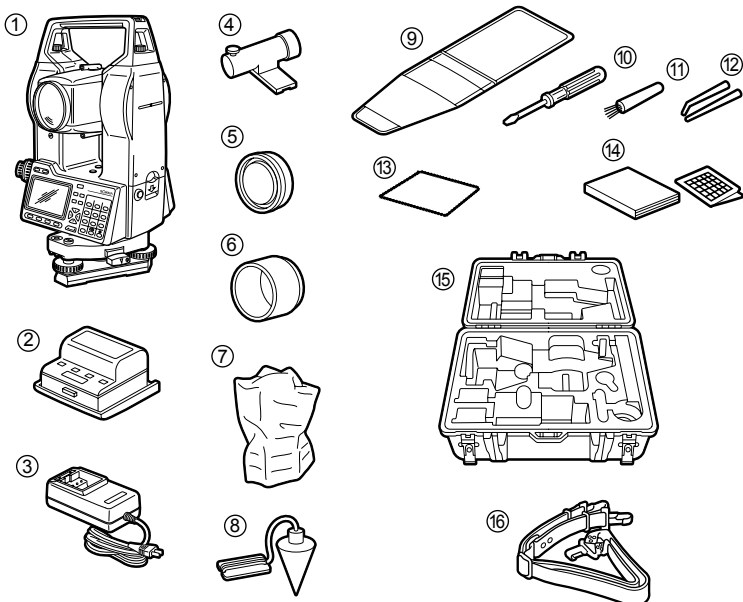
1　SET main unit 1
2　Internal battery (BDC35A) . . .2
3　Battery charger (CDC39/40/48)
　　. 1
4　Tubular compass (CP7) 1
5　Lens cap 1
6　Lens hood 1
7　Vinyl cover. 1
8　Plumb bob. 1
9　Tool pouch. 1

10　Screwdriver 1
11　Lens brush 1
12　Adjusting pin. 2
13　Cleaning cloth 1
14　Operator's manual 1
　　Atmospheric correction chart . 1
15　Carrying case (SC141A) 1
16　Carrying straps. 1

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● 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.

Tubular compass slot
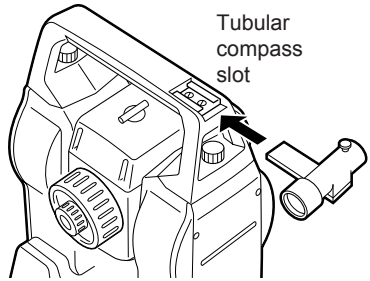
Caution

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

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

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

Handle

Handle
securing
screws
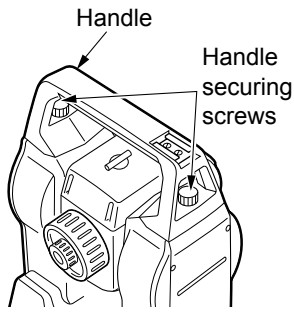
24.2 Optional Accessories

The following are optional accessories which are sold separately from the SET.
☞ Target and power supply optional accessories: "24.3 Target System, and
"24.4 Power Supply System".

● Diagonal eyepiece (DE25)
The diagonal eyepiece is convenient
for observations near the nadir and
in narrow spaces.
Magnification:30X
After removing the handle from the
SET, loosen the attachment screw to
remove the relescope eyepiece.
Then screw the diagonal lens into
place.

DE25
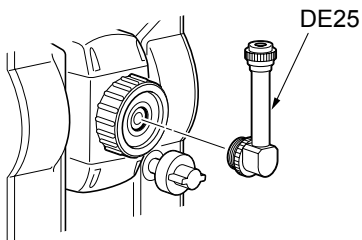
● Interface cable

Computer	Cable	Notes		
IBM PC/AT or compatible	DOC26	Length	:	2m
		Pin number and signal level	:	RS232C 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		

24.3　Target System

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

Caution

• When using a reflecting prism equipped with a target for distance and angle measurements, be sure to direct the reflective prism correctly and sight the center of the prism target accurately.
• Each reflective prism (*1) has its own prism constant value. When changing prisms, be sure to change the prism constant correction value.
• To use the triple prism assembly AP31 or AP32 as a single prism for short distance measurements, mount the single reflective prism AP01 in the center mounting hole of the prism holder.

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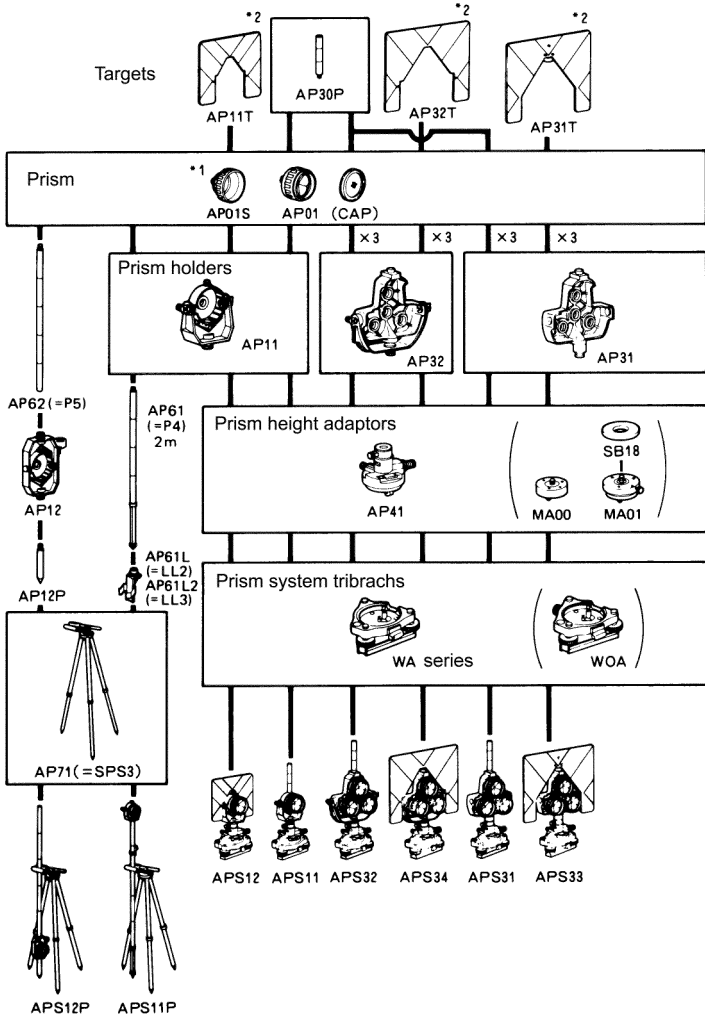
● 2-point target (2RT500-K)
This target is used for two-distance
offset measurement.
Prism constant: 0mm

● Instrument height adaptor (AP41)
Adjust the level of the AP41 instrument
height adaptor following the checking
and adjustment methods of plate level.
☞ "23.1 Plate Level"

Adjust the optical plummet of the AP41
instrument height adaptor following the
checking and adjustment methods of
optical plummet.
☞ "23.6 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 "236" (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, then rotate SET
clockwise ④ and tighten the screws
⑤.
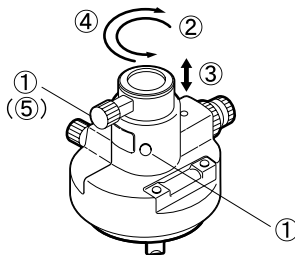
● Adjusting plate (WASeries)
Adjust the circular level of the adjusting
plate for a prism following the checking
and adjustment methods of circular
level.
☞ "23.2 Circular Level"

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24.4   Power Supply System

Operate your SET with the following combinations of power equipment.

Caution

• When using EDC14, EDC2A, and BDC12, mount the BDC35A in place to maintain the balance of the instrument.

• Make sure that the car cigarette lighter is 12V DC and that its negative terminal is grounded. Use it with the car's engine running.

• The EDC14 has a breaker switch. Normally the red mark appears on the breaker. If it cannot be seen, set the breaker so it is visible.

• When using the car battery, the breaker will cut off if the poles are not correctly connected.

• 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

Battery	Charger
BDC35A* (Ni-MH) BDC40A (Ni-Cd)	CDC39/40/48* (90 to 132 V AC/ 180 to 264 V AC/ 180 to 264 V AC)

	CDC41 (11 to 16 V DC) For cigarette lighter

External battery adapter	Cable to car cigarette lighter
EDC14	EDC4 (12 V DC)

AC adapter	Cable to car battery
EDC2A (100 to 240 V AC)	EDC5 (12 V DC)

Cable	External battery	Charger
EDC3	BDC12(6V DC)	CDC14 (100V AC) CDC14A (120V AC) CDC14D (220V AC to 240V AC) (15 hours)

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25. SPECIFICATIONS

Telescope
Length:	170 mm
Aperture:	45 mm (EDM: 48 mm)
Magnification:	30x
Image:	Erect
Resolving power:	3"
Field of view:	1°30'
Minimum focus:	1.0 m
Focussing screw:	SET1120/2120 : 2-speed
	SET3120/4120 : 1-speed
Reticle illumination:	Bright or dim selectable

Angle measurement

Horizontal and Vertical circles type:

Increment with 0 index (Both circles adopt diametrical detection)

Angle units: Degree/Gon/Mil (Selectable with parameter)

Minimum display: SET1120/2120 : 1" (0.2 mgon/0.005 mil)/
0.5" (0.1 mgon/0.002 mil)
SET3120/4120 : 1" (0.2 mgon/0.005 mil)/
5" (1 mgon/0.02 mil)
(Selectable with parameter)

Accuracy: Standard deviation (ISO 12857-2:1997)
SET1120: 1" (0.3 mgon)
SET2120: 2" (0.6 mgon)
SET3120: 3" (1 mgon)
SET4120: 5" (1.5 mgon)

Measuring time: Less than 0.5 sec

Automatic compensator: Selectable ON (V & H/V)/OFF
Type:Liquid 2-axis tilt sensor
Range of compensation:±3'
Minimum display: Agrees with minimum displayed measurement angle

Measuring mode: Horizontal angle:Right/Left selectable
Vertical angle:Zenith 0°, horizontal 0°, horizontal ±90°

Distance Measurement

Measuring range: SET1120/2120
Compact prism CP01:1.0 to 800 m/2,600 ft
Mini pole prism OR1PA:1.0 to 500 m/1,600ft
Reflective sheet: 2.0 to 120 m/390 ft
Standard prism AP01 X 1:1.0 to 2,400 m/ 7,800 ft
Standard prism AP01 X 3:1.0 to 3,100 m/10,100 ft
Standard prism AP01 X 9:1.0 to 3,700 m/12,100 ft

	SET3120
	Compact prism CP01:1.0 to 700 m/2,200 ft
	Mini pole prism OR1PA:1.0 to 500 m/1,600ft
	Reflective sheet: 2.0 to 100 m/320 ft
	Standard prism AP01 X 1:1.0 to 2,200 m/7,200 ft
	Standard prism AP01 X 3:1.0 to 2,900 m/9,500 ft
	Standard prism AP01 X 9:1.0 to 3,500 m/11,400 ft
	SET4120
	Compact prism CP01:1.0 to 600 m/1,900 ft
	Mini pole prism OR1PA:1.0 to 400 m/1,300ft
	Reflective sheet: 2.0 to 80 m/260 ft
	Standard prism AP01 X 1:1.0 to 1,600 m/5,200 ft
	Standard prism AP01 X 3:1.0 to 2,100 m/6,800 ft
	Standard prism AP01 X 9:1.0 to 2,500 m/8,200 ft
Minimum display:	SET1120/2120:
	Fine measurement:1 mm, 0.1 mm (0.01/0.001ft)
	Rapid measurement:1 mm (0.01 ft)
	Tracking measurement:10 mm (0.1 ft)
	SET3120/4120
	Fine measurement:1 mm (0.01 ft)
	Rapid measurement:1 mm (0.01 ft)
	Tracking measurement:10 mm (0.1 ft)
Maximum slope distance:	SET1120/2120:4200.0000 m (13779.53 ft)
	SET3120/4120:4200.000 m (13779.53 ft)
Distance unit:	meters/feet selectable
Accuracy:	Fine measurement with prism:
	± (2 + 2 ppm X D) mm
	Rapid measurement with prism:
	± (5 + 5 ppm X D)mm
	Fine measurement with reflective sheet:
	± (4 + 3 ppm X D) mm
	Rapid measurement with reflective sheet:
	± (5 + 5 ppm X D) mm
Measurement mode:	Fine measurement (single/repeat/average)
	Rapid measurement (single and repeat)
	Tracking
Measuring time:	Fine measurement:3.3 sec. + every 1.6 sec.
	Rapid measurement:2.8 sec. + every 0.8 sec.
	Tracking measurement:2.3 sec. + every 0.3 sec.
Signal source:	Infrared LED (Class1 IEC825-1:1993)

Atmospheric correction:	
Temperature input range:	-30 to 60 ˚C (in 1˚C step)/-22 to 140 ˚F
Pressure input range:	500 to 1,400 hPa (in 1hPa step)375 to 1,050 mmHg (in 1mmHg step)14.8 to 41.3 inchHg (in 0.1 inchHg step)
ppm input range:	-499 to 499 ppm (in 1 ppm step)
Humidity input range:	0 to 100% (in 1% step)
Prism constant correction:	
Constant input range:	-99 to 99 mm (in 1 mm step)
Earth curvature and refraction correction:	
	Atmospheric refraction constant K=0.14 or K=0.2 selectable

Power Supply

Power source:	Ni-MH rechargeable battery BDC35A (6 V)
Working duration at 25˚C:	Distance & angle measurement (Fine & single measurement, interval = every 30 sec)
	BDC35A: Approx. 8.5 hours (approx. 900 points)
	Option BDC40A: Approx. 4 hours (approx. 480 points)
	Option BDC12: Approx. 17.5 hours (approx. 1,980 points)
	Angle measurement only BDC35A: Approx. 10.5 hours
	Option BDC40A:Approx. 6 hours
	Option BDC12:Approx. 22.5 hours
Charging time:	BDC35A: Approx. 70 min.

General

Internal memory:	448Kbyte (about 3000 points)
Display:	2LCD graphic displays (one on each face)
	120 dots X 64 dots (20 characters X 8 lines)
Keyboard:	28 keys (numeric, edit, soft function, power on, light)
Sensitivity of levels:	Plate level: SET1120/2120:20"/2 mm
	SET3120/4120:30"/2 mm
	Circular level:10'/2 mm
Optical plummet:	Image: Erect
	Magnification:3X
	Minimum focus:0.5 m
Horizontal & Vertical motion screw:	
	Fine/Coarse 2 speed
Automatic power cut off	Yes
Calendar Clock:	Yes

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Data output:	Asynchronous serial RS232C compatible baud rate up to 38,400 bps Centronics compatible (with DOC46)
Operating temperature:	-20 to 50˚C
Water protection:	IPX4 (Based on IEC 60529:1989) (only when using BDC35A)
Instrument height:	236 mm (9.3 inch) from tribrach bottom 193 mm (7.6 inch) from tribrach dish
Size:	175 (W) X 170 (D) X 345 (H) mm (with handle and battery)
Weight:	SET1120/2120/3120/4120:5.8 kg (with handle and battery)

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

Caution

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

▶PROCEDURE Manually indexing the vertical circle

1. Select "Obs. condition" in Config Mode. Set "V index" (vertical circle indexing method) to "Manual."
    ☞ "20.2 Configuration -Config. Mode- ● 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 **[OK]**.

```
0SET


ZA      V1
HAR    0°00'00"
       Take F1
                    OK
```
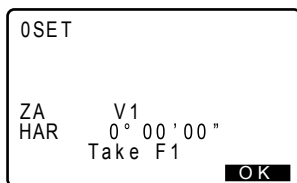
5. Rotate the upper part of the SET 180°. Then set the telescope in the face 2 position and accurately sight the same target.
    The vertical and horizontal angles are displayed.
    This concludes the vertical circle indexing procedure.

```
0SET


ZA      V2
HAR    0°00'00"
       Take F2
                    OK
```
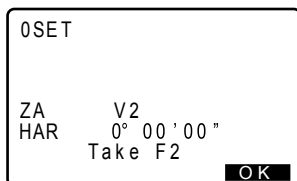
● Need for atmospheric correction

The SET measures the distance with a beam of light, but the velocity of this light varies according to the index of refraction of light in the atmosphere. This index of refraction varies according to the temperature and pressure. Near normal temperature and pressure conditions:

With constant pressure, a temperature change of 1°: an index change of 1 ppm
With constant temperature, a pressure change of 3.6 hPa: an index change of 1 ppm.

To perform high accuracy measurements, it is necessary to find the atmospheric correction factor from even more accurate temperature and pressure measurements and perform an atmospheric correction.
Sokkia recommends that extremely precise instruments be used to monitor the air temperature and pressure.

● Finding the average temperature and pressure between two points in different atmospheric conditions

To precisely determine the atmospheric correction factor, the average temperature and air pressure along the measurement beam route must be taken.

Determine the temperature and pressure as follows.
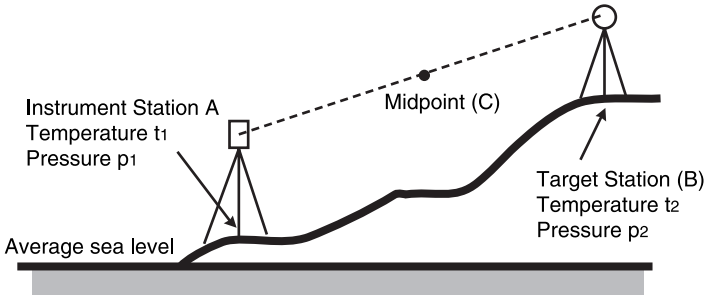
Flat terrain   : Use the temperature and pressure at the midpoint of the line.

Mountainous terrain   : Use the temperature and pressure at the intermediate point (C).

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

Average air temperature   : $(t_1 + t_2)/2$
Average air pressure   : $(p_1 + p_2)/2$

Instrument Station A
Temperature t_1
Pressure p_1

Midpoint (C)

Target Station (B)
Temperature t_2
Pressure p_2

Average sea level

- Atmospheric correction for relative humidity
  The humidity has little influence, particularly on short distance measurements.
  The effect of humidity is considered in cases where it is very hot and humid and
  high precision measurements are to be performed over a particularly long
  distance.
  With the SET, if the humidity is entered along with the temperature and
  pressure, the atmospheric correction factor set in the instrument is calculated
  using the following formula.

$$\text{Atomospheric Correction Factor} = 278.96 - \left(\frac{0.2904 \times p - 0.044735 \times e}{1 + 0.003661 \times t} \right)$$

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

$$ew = a0T4 + a1T3 + a2T2 + a3T + a4$$

T: Temperature (×C)
P: Pressure (hPa)
e: Water vapor pressure (hPa)
H: Relative humidity (%)
ew: Saturated water vapor pressure
a0= 0.00000491539
a1= 0.00026202374
a2= 0.01251534557
a3= 0.45183196592
a4= 6.32672468457

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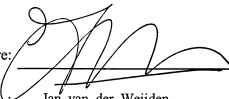
Notice for Canada
This Class A digital apparatus meets all requirements of Canadian Interference-Causing Equipment Regulations.
Cet appareil numérique de la Class A respecte toutes les exigences du Règlement sur le matériel brouilleur du Canada.
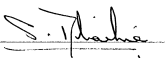
CE Conformity Declaration

SOKKIΛ

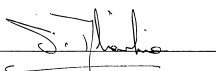### CE Conformity Declaration
in accordance with EMC Directive 89/336/EEC of the European Community

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: Total   Station (Surveying Instruments)

Model Name :   SET1120, SET1120S, SET2120, SET2120S, SET3120,
SET3120S, SET4120, SET4120S

Relevant EC Directive: EMC Directive (89/336/EEC)
Version: 91/263/EEC, 92/31/EEC, 93/68/EEC

Applied
Harmonized Standard: EMI EN55022 Class B:1994 +A1:1995+A2:1997

EMS EN61000-6-2:1999

Date: *0 - 2 - 2002*
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

SOKKIA

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: Power Supply (Battery Charger)

Model Name :   CDC40

Relevant EC Directive: EMC Directive (89/336/EEC)
                           Version: 91/263/EEC, 92/31/EEC, 93/68/EEC

Applied
Harmonized Standard: EN50081-1 1992 , and EN50082-2 1995

Date: _Dec . 95_
Firm: SOKKIA B.V.
Address: Industrieterrein De Vaart, Damsluisweg 1, NL-1332 EA Almere

Representative's Signature:

Name of Representative :   Stephen Blaikie
Representative's position : European vice President

SOKKIΛ

CE Declaration of Conformity
in accordance with Low Voltage Directive 73/23/EEC of the European Community

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We herewith declare that the undermentioned instrument, in view of its design and type of construction, fully complies with 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 Adapter)

Model Name :   CDC40

Relevant EC Directive: Low Voltage Directive (73/23/EEC)
                           Version: 93/68/EEC

Applied
Harmonized Standard: EN60950: 1992 / A1: 1993 / A2: 1993 / A3: 1995

Date: ....2.0/5/97....
Firm: SOKKIA B.V.
Address: Industrieterrein De Vaart, Damsluisweg 1, NL-1332 EA Almere

Representative's Signature:

Name of Representative :   Stephen Blaikie
Representative's position :   European vice President

SOKKIA

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: Power Supply (Battery Charger)
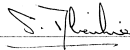
Model Name :   CDC41

Relevant EC Directive: EMC Directive (89/336/EEC)
                           Version: 91/263/EEC, 92/31/EEC, 93/68/EEC

Applied
Harmonized Standard: EN55011 1991 Group 1 class B, and EN50082-2 1995

Date: *Feb. 96*
Firm: SOKKIA B.V.
Address: Industrieterrein De Vaart, Damsluisweg 1, NL-1332 EA Almere

Representative's Signature:

Name of Representative :   Stephen Blaikie
Representative's position :   European vice President

SOKKIA Customer Service