

**ELECTRONIC TOTAL STATION**

**SET3**

**OPERATOR'S MANUAL**

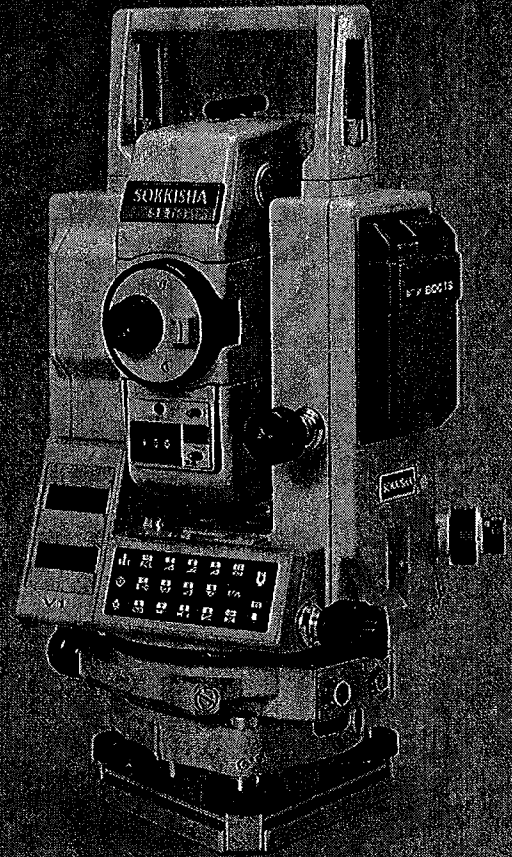


**LIETZ/SOKKISHA**

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OPERATOR'S MANUAL



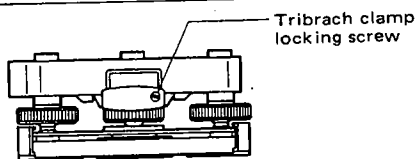
**SOKKIA**

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**IMPORTANT**

When the new SET3 is shipped, the tribrach clamp is fixed with a screw. Loosen it and leave it loose.

# 1. PARTS OF THE INSTRUMENT

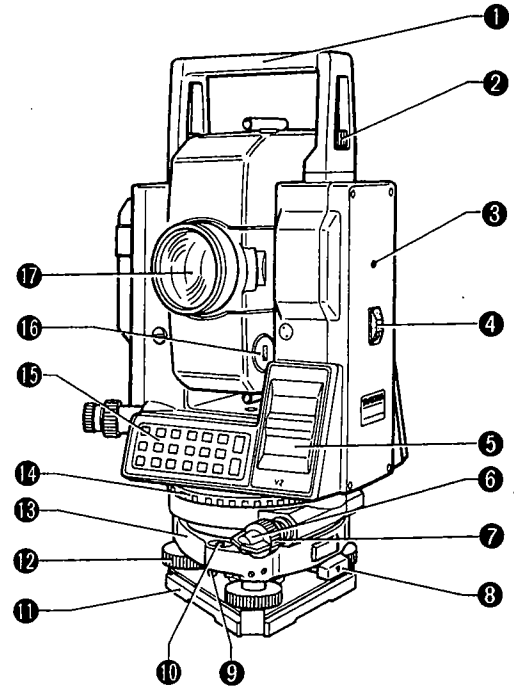


Fig. 1.1

- |                                  |                                      |
|----------------------------------|--------------------------------------|
| ① Handle                         | ⑩ Circular level                     |
| ② Handle securing screw          | ⑪ Base plate                         |
| ③ Instrument height mark         | ⑫ Levelling foot screw               |
| ④ Internal switch cover          | ⑬ Tribrach                           |
| ⑤ Display                        | ⑭ Horizontal circle positioning ring |
| ⑥ Lower clamp                    | ⑮ Keyboard                           |
| ⑦ Lower fine motion screw        | ⑯ Prism constant switch cover        |
| ⑧ Tribrach clamp                 | ⑰ Objective lens                     |
| ⑨ Circular level adjusting screw |                                      |

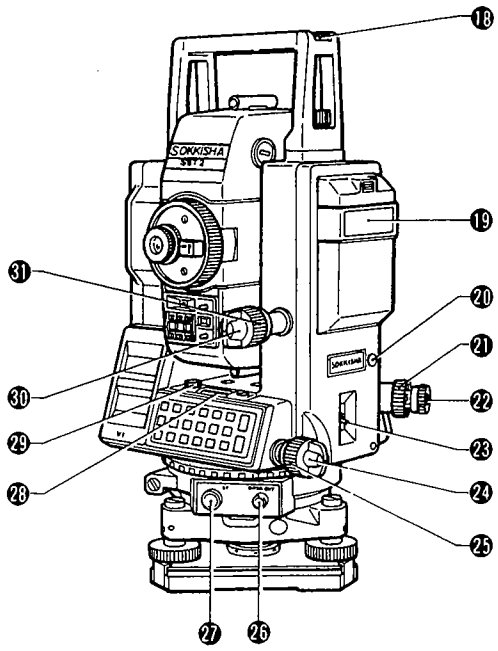


Fig. 1.2

- |                                   |                                    |
|-----------------------------------|------------------------------------|
| 18 Tubular compass slot           | 25 Horizontal fine motion screw    |
| 19 Battery, BDC18                 | 26 Data output connector           |
| 20 Sensor index adjustment cover  | 27 External power source connector |
| 21 Optical plummet focussing ring | 28 Plate level                     |
| 22 Optical plummet eyepiece       | 29 Plate level adjusting screw     |
| 23 Power switch                   | 30 Vertical clamp                  |
| 24 Horizontal clamp               | 31 Vertical fine motion screw      |

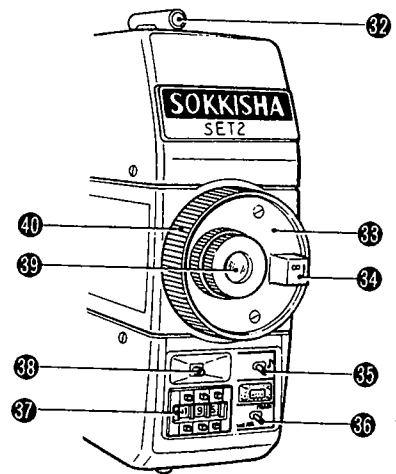


Fig. 1.3

- |                                       |                             |
|---------------------------------------|-----------------------------|
| 32 Peep sight                         | 36 Measure/track switch     |
| 33 Telescope reticle adjustment cover | 37 ppm switch               |
| 34 Telescope plunging knob            | 38 Return signal lamp       |
| 35 Return signal audio switch         | 39 Telescope eyepiece       |
|                                       | 40 Telescope focussing ring |

## 2. FEATURES

- Horizontal angle, zenith angle, slope distance, horizontal distance, height difference, N- and E-coordinates are displayed by key operation.
- Horizontal distance between two prism points and remote measurement of objects above and below a prism point are automatically calculated. A stake-out function by distance and N- and E-coordinates is standard.
- Self-diagnostic function. If, for any reason, the SET3 is not functioning correctly during use, an error code is displayed.
- Angle resolution can be set to 1" (0.2 mgon) or 5" (1 mgon).
- The tilt angle of the vertical axis can be measured by the internal sensor and displayed. By referring to the display, the SET3 can be levelled. The zenith angle is automatically compensated by the tilt sensor and the compensated angle displayed.
- Horizontal circle can be set to zero in any direction.
- The SET3 automatically switches off 30 minutes after the last operation to save battery power.
- An RS-232C data-out connector is standard.



### 3. SPECIFICATIONS

#### Distance measurement

Range: (When using Sokkisha standard reflecting prisms)  
 Average conditions: (Slight haze, visibility about 20 km, sunny periods, weak scintillation)  
 1-prism 1,900 m (6,300 ft)  
 3-prism 2,600 m (8,600 ft)  
 Good conditions: (No haze, visibility about 40 km, overcast, no scintillation)  
 1-prism 2,200 m (7,300 ft)  
 3-prism 3,000 m (9,900 ft)  
 Standard deviation  $\pm(5 \text{ mm} + 3 \text{ ppm} \cdot D)$   
 Display: LCD 8-digit Four display windows, two on each face  
 Maximum slope distance 9,999.999 m (19,999.99 ft)  
 Minimum display: MEAS. 1 mm (0.01 ft)  
 TRACK. 10 mm (0.1 ft)  
 Measuring time:

	Mode	
	MEAS.	TRACK.
Slope distance	7 s + every 5 s	7 s + every 0.4 s
Horizontal distance		7 s + every 0.7 s
Height difference		7 s + every 1 s
Coordinates		
Remote elevation	1 s + every 0.5 s	
Horizontal distance between two points	8 s + every 5 s	8 s + every 1 s

Atmospheric correction: -99 ppm to +199 ppm (1 ppm per step)  
 Prism constant correction: -99 mm to +59 mm (1 mm per step)  
 Earth-curvature and refraction correction: Selectable ON/OFF  
 Audio target acquisition: Selectable ON/OFF  
 Signal source: Infrared LED  
 Light intensity control: Automatic

**Angle measurement****Telescope**

Length: 177 mm (7.0 inch)  
Aperture: 45 mm (1.8 inch),  
EDM: 50 mm (2.0 inch)  
Magnification: 30x  
Resolving power: 3"  
Image: Erect  
Field of view: 1°30' (26 m/1,000 m)  
Minimum focus: 1.3 m (4.3 ft)

**Horizontal circle**

Type: Incremental  
Minimum display: 1" (0.2 mgon)

**Vertical circle**

Type: Incremental with 0 index  
Minimum display: 1" (0.2 mgon)

**Accuracy**

Standard deviation of mean of  
measurement taken in positions I  
and II (DIN 18723)  
H: 3" (0.9 mgon)  
V: 3" (0.9 mgon)

**Automatic compensator**

Selectable ON/OFF  
Type: Liquid  
Minimum display: 1" (0.2 mgon)  
Range of compensation: ±3'

**Display**

Range: -1,999°59'59" to 1,999°59'59"  
(-1,999.9998gon to 1,999.9998gon)

**Measuring mode**

Horizontal angle: Right/Left/Repetition of angles  
Vertical angle: Zenith 0° (0 gon) or  
Horizontal 0° (0 gon) or  
Horizontal 0°±90° (0 gon±100 gon)  
Measuring time: Less than 0.5 s

<b>Sensitivity of levels</b>	
Plate level:	30"/2 mm
Circular level:	10'/2 mm
<b>Optical plummet</b>	
Image:	Erect
Magnification:	3x
Minimum focus:	0.1 m
<b>Data output:</b>	Asynchronous serial, RS-232C compatible
<b>Self-diagnostic function:</b>	Provided
<b>Power saving cut off:</b>	30 minutes after operation
<b>Operating temperature:</b>	-20°C to +50°C (-4°F to +122°F)
<b>Power source:</b>	Ni-Cd battery, BDC18 (6V)
Working duration:	About 600 measurement at 25°C, distance and angle measurement; 13 hours at 25°C, angle measurement only. (About 4,000 measurements, distance and angle measurement; 90 hours at 25°C, angle measurement only, with optional battery BDC12.)
<b>Charging time:</b>	12 to 15 hours, standard charger CDC11/CDC11D (depending on input voltages) (1 hour, optional charger CDC12A, CDC13, CDC15)
<b>Instrument height:</b>	236 mm (9.29 inch)
<b>Size (without handle):</b>	168 (W) x 177 (D) x 330 (H) mm (6.6 x 7.0 x 13.0 inch)
<b>Weight:</b>	7.6 kg (16.8 lbs) (w/internal battery)

4. STANDARD EQUIPMENT

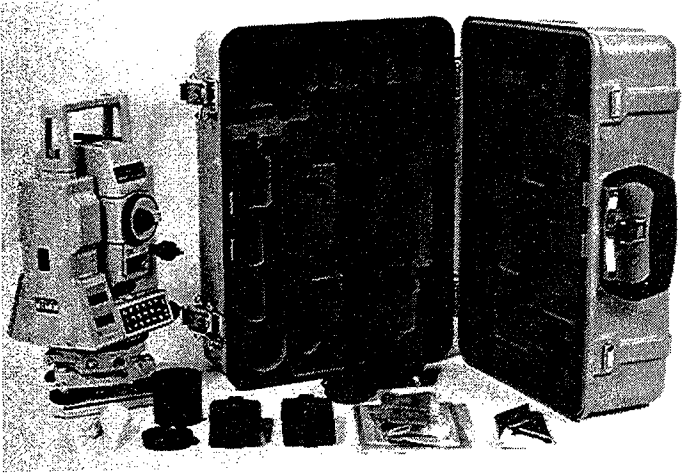
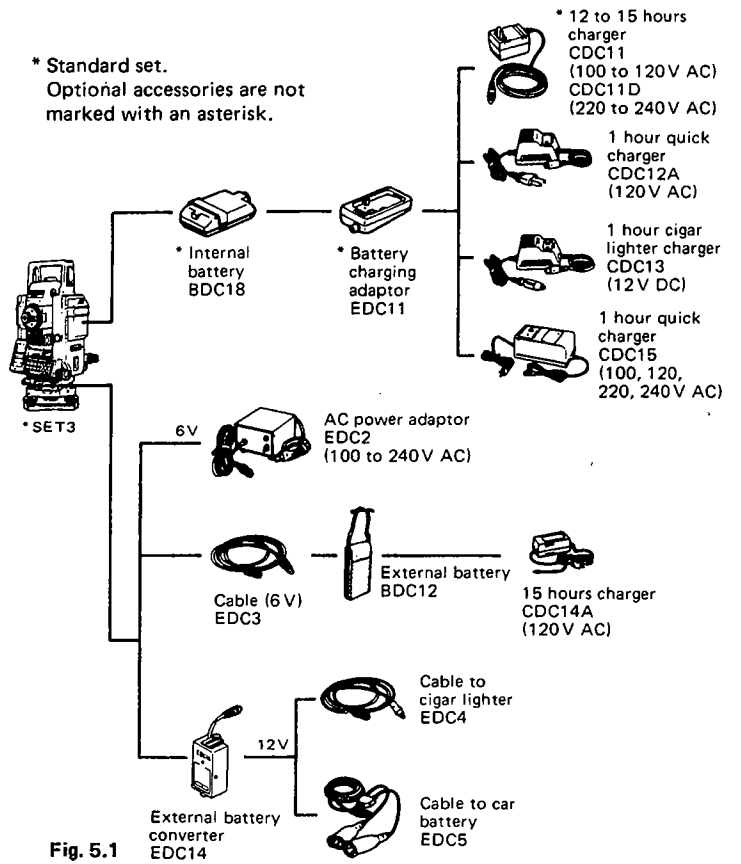


Fig. 4.1

SET3 main unit .....	1	Plumb bob .....	1
Internal battery, BDC18 ..	2	Tool pouch .....	1
Battery charger, CDC11/CDC11D .....	1	Screwdriver .....	1
Battery charging adaptor, EDC11 .....	1	Lens brush .....	1
Tubular compass, CP7 (accuracy: $\pm 1^\circ$ ) .....	1	Adjusting pin .....	2
Lens cap .....	1	Cleaning cloth .....	1
Lens hood .....	1	Atmospheric correction chart .....	1
Vinyl cover .....	1	Operator's manual .....	1
		Carrying case, SC46 .....	1

## 5. POWER SUPPLIES

The SET3 can be operated with the following combinations:



Use the SET3 only with the combinations shown here.

**Note:** When using the SET3 with external power supplies, it is recommended that for the most accurate angle measurements, the BDC18 battery be left in place to balance the weight on the axes.

## Battery charging precautions

To charge the battery, use only the recommended charger.

- 1) Charge the battery at least once a month if it is not used for a long time.
- 2) Charge the battery at a temperature between 10°C and 40°C.
- 3) Before using EDC2 or CDC15, set the voltage selector to the proper voltage.
- 4) EDC14 has a breaker switch. Normally the red mark appears on the breaker. If not, set the red mark in place.
- 5) When using a car battery, make sure that the polarity is correct.
- 6) Make sure that the cigar lighter has 12V output and that the negative terminal is grounded.
- 7) When charging the battery, first connect it to the battery charger and then connect the charger to the power supply. Check that the battery charger light is on. If not switch power supply off and on again until the light comes on.
- 8) The battery charger may become warm while charging. This is normal.
- 9) Do not charge the battery for any longer than specified.
- 10) Store the battery in a place where the temperature is between 0°C and 40°C.
- 11) Battery operating life is shortened at extreme temperatures.

## 6. REFLECTING PRISMS AND ACCESSORIES

All Sokkisha reflecting prisms and their accessories have standardized screws (5/8" x 11 thread) for easy compatibility.

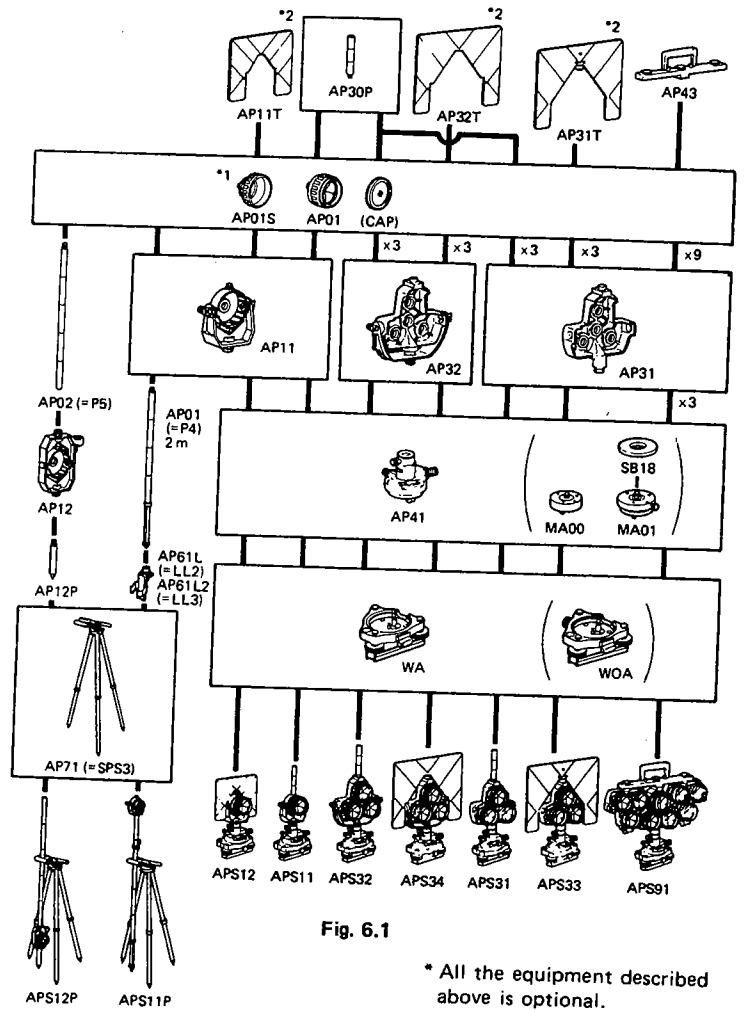


Fig. 6.1

\* All the equipment described above is optional.

\*1: See 10.3.1 Prism constant correction.

\*2: Fluorescent paint finishing allows clearer sighting in adverse observing conditions.

## Precautions

- 1) Carefully face the reflecting prism towards the instrument; sight the target centre accurately.
- 2) To use the triple prism assembly AP31 or AP32 as a single prism (e.g. for short distances), mount the single prism AP01 in the centre hole of the triple prism holder.
- 3) Check that "236" (the height of the SET3) is displayed in the window of the instrument height adaptor AP41.

The height of the AP41 can be adjusted as follows:

- ① Loosen the two fixing screws.
- ② Turn the centre part counterclockwise to unlock it.
- ③ Move it up or down until "236" appears in the window.
- ④ Turn the centre part clockwise to re-lock it.
- ⑤ Tighten the fixing screws.

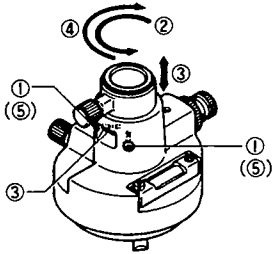


Fig. 6.2

248
245
242
239
236
233
230

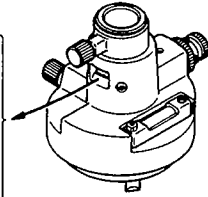


Fig. 6.3

**Note:** SET3 instruments with a serial number less than 79301 have a height of 233 mm.

- 4) Use the plate level on the AP41 to adjust the tribrach circular level as in 13.1.2.
  - 5) Check the optical plummet of the AP41 as in 13.1.7.
- After all checks and adjustments have been completed, make sure that the AP41 optical plummet sights the same point as the optical plummet of the SET3.



## 7. DISPLAY SYMBOLS

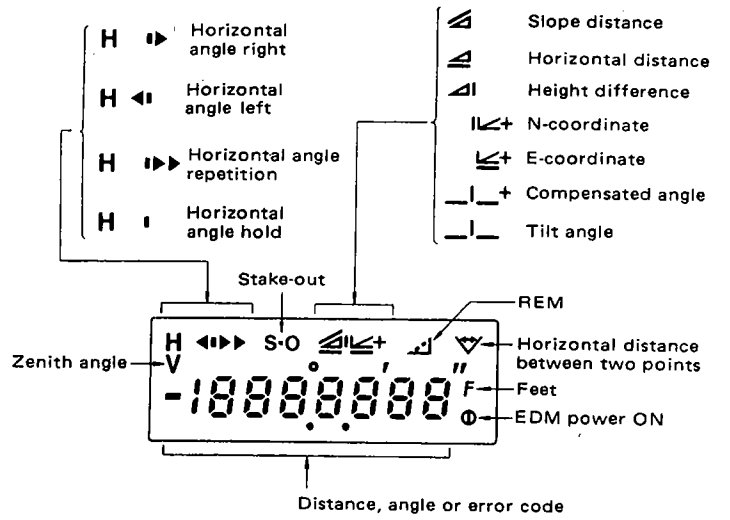


Fig. 7.1

## 8. KEY FUNCTIONS

SET3 has three measurement modes.

When it is switched on and the vertical circle is indexed by rotating the telescope, it is automatically in the theodolite mode.

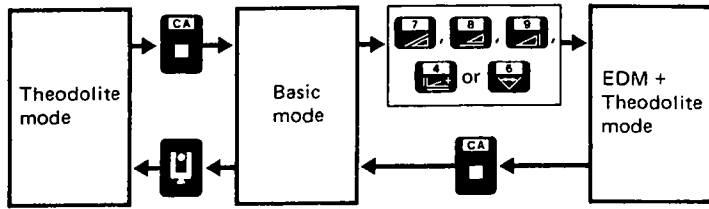


Fig. 8.1

### Theodolite mode

Angle measurement.

SET3 accepts , , , , , or keys.

### Basic mode

Prism sighting, data entry and recall.

SET3 accepts all keys except , , , or keys.

### EDM + Theodolite mode

Angle and distance measurement.

SET3 accepts or keys.

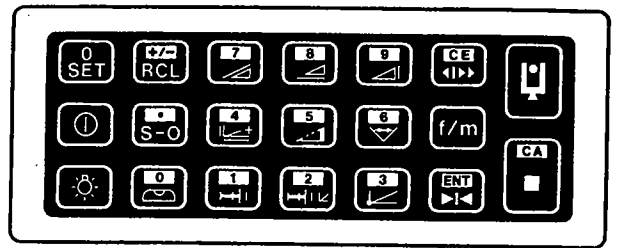






















Fig. 8.2

- 
  - Select theodolite mode.
- 
  - Stop measurement and transfer to basic mode.
  - Stop data entry or recall.
- 
  - Set horizontal angle to zero.
  - Index vertical circle when manual indexing selected.
- 
  - Change the sign of data before entry.
  - Recall data from memory.
- 
  - Enter "7".
  - Measure slope distance.
- 
  - Enter "8".
  - Measure horizontal distance.
- 
  - Enter "9".
  - Measure height difference.
- 
  - Clear entry.
  - Select horizontal angle to left, right or by repetition (accumulation).

-  ● EDM power ON/OFF for locating prism.
  
-  ● Enter decimal point.  
● Measure stake-out distance.
  
-  ● Enter "4".  
● Measure N- and E-coordinates.
  
-  ● Enter "5".  
● Measure remote elevation.
  
-  ● Enter "6".  
● Measure horizontal distance between two prism points.
  
-  ● Convert displayed distance to feet or meters for 5 seconds.
  
-  ● Illuminate display and reticle of telescope for 30 seconds.
  
-  ● Enter "0".  
● Display vertical axis tilt angle ON/OFF.
  
-  ● Enter "1".  
● Enter stake-out distance.
  
-  ● Enter "2".  
● Enter stake-out N- and E-coordinates.
  
-  ● Enter "3".  
● Enter coordinates of instrument station.
  
-  ● Transfer entered data to memory.  
● Hold/release horizontal angle.

## 9. INTERNAL SWITCHES

Switches are located under internal switch cover ④.

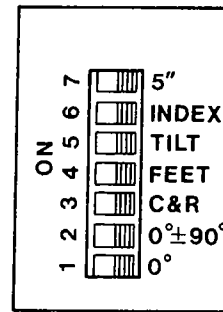


Fig. 9.1

Switch	Function
7	ON Angle resolution 5"/1 mgon * OFF Angle resolution 1"/0.2 mgon
6	ON Manually index vertical circle by $V_1, V_2$ * OFF Automatically index vertical circle by transitting telescope
5	ON Vertical circle compensator off * OFF Vertical circle compensator on
4	ON Display distance in feet * OFF Display distance in meters
3	ON Distance corrected for earth-curvature and refraction * OFF Distance not corrected for earth-curvature and refraction
2	ON Display vertical angle with $0^\circ$ (0 gon) horizontal $\pm 90^\circ$ (100 gon) * OFF Vertical angle display controlled by switch 1
1	ON Display vertical angle with $0^\circ$ (0 gon) horizontal on face $V_1$ * OFF Display zenith angle

(The asterisk indicates the position of each switch at the time of shipping from factory.)

Before changing switch settings, turn power switch OFF.

## 10. OPERATION

### 10.1 PREPARATION FOR ANGLE MEASUREMENT

#### 10.1.1 Battery, BDC18: Mounting and check

- 1) Confirm that the power switch  $\text{Ⓢ}$  is OFF.
- 2) Mount the battery BDC18 in the SET3.

Hold the left standard when inserting the battery. Push it until a click is heard to indicate correct location. Confirm that the battery is fixed securely.

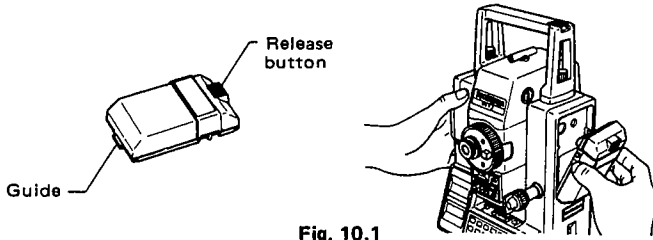


Fig. 10.1

(To remove the battery, turn the power switch OFF and push down the release button of the battery.)

- 3) Two short audio signals are heard when the power is switched ON. The display shown in ① and then ② indicate the instrument is in normal condition.

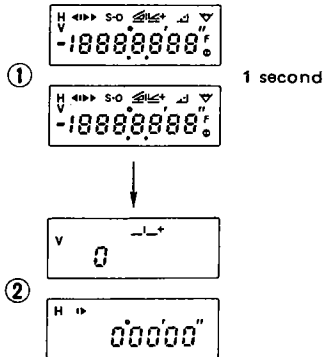


Fig. 10.2

If the battery voltage is too low, the display will appear as shown below. Set the power switch OFF and replace the battery with a charged one, or charge the battery.

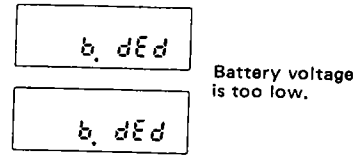


Fig. 10.3

### 10.1.2 Compensation of zenith angle

- 1) Remove the switch cover ④.
- 2) To use zenith angle with compensation, set switch 5 to OFF with a screw driver. (The factory setting is OFF.)
- 3) Replace the cover.

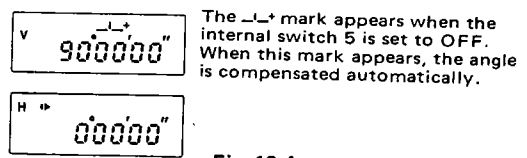
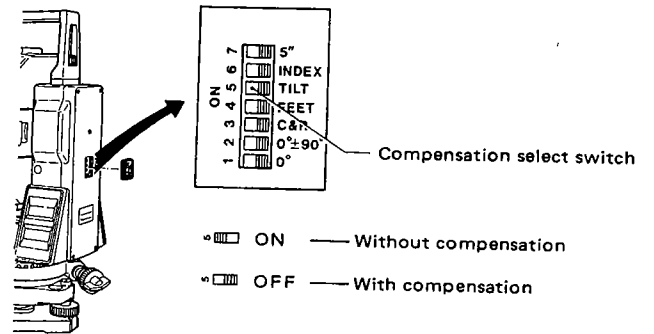


Fig. 10.4

The internal tilt sensor has a range of  $\pm 3'$  and a resolution of  $1''$ . Read the automatically compensated zenith angle when the display is steady. When the display is not steady due to vibration or strong wind, set switch 5 to ON to use the SET3 without compensation.

### 10.1.3 Centring the SET3 by adjusting tripod leg length

- 1) Make sure that:
  - a. The tripod head is approximately level.
  - b. The tripod shoes are firmly fixed in the ground.
- 2) Set the SET3 on the tripod head. Tighten the centring screw.
- 3) Focus on the surveying point:
  - a. Turn the optical plummet eyepiece ⑫ to focus on the reticle.
  - b. Turn the optical plummet focussing ring ⑪ to focus on the surveying point.
- 4) Turn the levelling foot screws ⑬ to centre the surveying point in the reticle.
- 5) Observe the off-centre direction of the bubble in the circular level ⑩. Shorten the leg nearest that direction, or extend the leg farthest from that direction.  
Generally, two legs must be adjusted to centre the bubble.
- 6) When centring of the circular level is completed, turn the levelling screws to centre the plate level ⑮ bubble.
- 7) Look through the optical plummet again. If the surveying point is off-centre, loosen the centring screw to centre the surveying point on the reticle. Tighten the centring screw.
- 8) Repeat 6), 7) if the plate level bubble is off-centre.

### 10.1.4 Focussing

- 1) Looking through the telescope, turn the eyepiece fully clockwise, then anticlockwise until just before the reticle image becomes blurred. In this way, frequent refocussing can be dispensed with, since your eye is focussed at infinity.
- 2) Loosen the vertical ⑩ and horizontal clamp ⑭.  
Bring the target into the field of view with the peep sight ⑯.  
Tighten both clamps.
- 3) Turn the focussing ring ⑪ and focus on the target.  
Sight the target with the vertical ⑩ and horizontal fine motion screws ⑮. Focus on the target until there is no parallax between the target and the reticle.



**Parallax:**

Relative displacement of target image in respect to the reticle when observer's head is moved slightly before the eyepiece.

If sighting is carried out before parallax is eliminated, this will introduce errors in reading and will impair your observations.

## 10.2 ANGLE MEASUREMENT

Make sure that: \_\_\_\_\_

- a. The SET3 is set up correctly over the surveying point.
- b. Battery voltage is adequate.

### 10.2.1 Automatically indexing vertical circle

- 1) Turn the power switch **(28)** ON.

Make sure that the display appears as shown below.

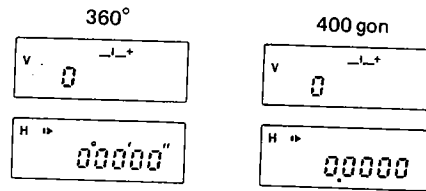


Fig. 10.5

- 2) Loosen the vertical clamp **(30)**, and use the telescope plunging knob **(34)** to rotate the telescope completely.

(Indexing occurs when the objective lens crosses the horizontal plane in position V1.)

When the vertical circle is indexed, an audio signal is given and the display appears as below.

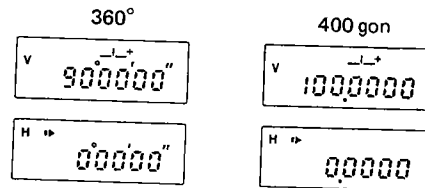




Fig. 10.6

Angle measurement can now begin.

**Note:** When the power switch is turned off for any reason, the vertical index is lost. When the power switch is turned back on, the vertical index must be redetermined.

### 10.2.2 Angle measurement

Before this procedure, index the vertical circle.

- 1) Select theodolite mode by pressing .
- 2) Select the horizontal angle right or left with  according to measuring method.

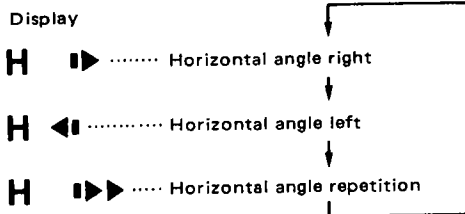



Fig. 10.7

When  is pressed, the display changes alternately as shown in Fig. 10.7.

- 3) Sight the first target A.
- 4) Press  to set the horizontal angle display to 0° (0 gon).

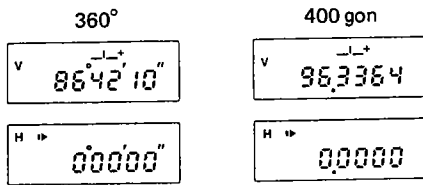


Fig. 10.8

- 5) Use the horizontal clamp ⑭ and the vertical clamp ⑩ to sight the second target B.

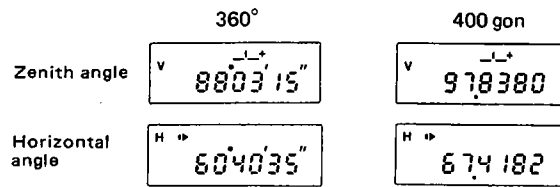


Fig. 10.9

The displayed horizontal angle is the angle between targets A and B.

### 10.2.3 Setting the horizontal circle to a required value

To set the horizontal circle to the reference target, for example  $90^{\circ}10'20''$  (100.1914 gon):

- Loosen the horizontal clamp ⑭ and the lower clamp ⑥ and hold the upper alidade lightly. Turn the circle positioning ring ⑬ until the display becomes about  $90^{\circ}$  (100 gon) and tighten both clamps. Turn the horizontal fine motion screw ⑮ until the desired angle is displayed.
- Press  $\text{ENT}$ .

**H** ..... Horizontal angle  
hold display

Fig. 10.10

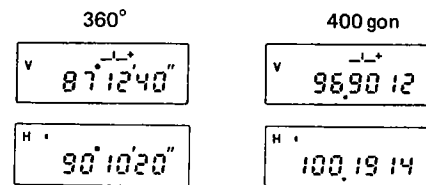


Fig. 10.11

- 3) Turn the instrument and sight the target.
- 4) Press  $\text{CE/DEL}$  to release the display hold.  
The required horizontal circle value is now set to the reference target.

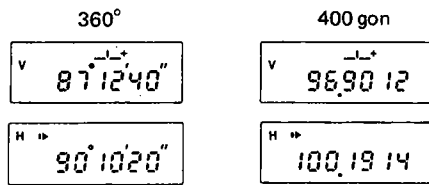


Fig. 10.12

### 10.2.4 Repetition of angles

Repetition of angles from  $-1,999^{\circ}59'59''$  to  $1,999^{\circ}59'59''$  ( $-1,999.9998$  gon to  $1,999.9998$  gon) is displayed by using  $\text{CE/DEL}$ .

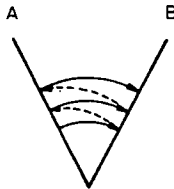


Fig. 10.13

- 1) Press  $\text{CE/DEL}$  to select repetition of angle.

**H**  $\text{▶▶}$  ..... Repetition of angle display

Fig. 10.14

- 2) Sight target A, and press  $\text{0/SET}$ .

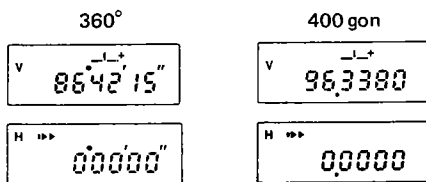


Fig. 10.15

