

**ELECTRONIC TOTAL STATION**

# **SET3**

**OPERATOR'S MANUAL**

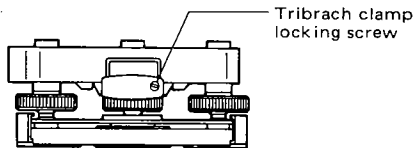


**LIETZ/SOKKISHA**

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**IMPORTANT**

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

# 1. PARTS OF THE INSTRUMENT

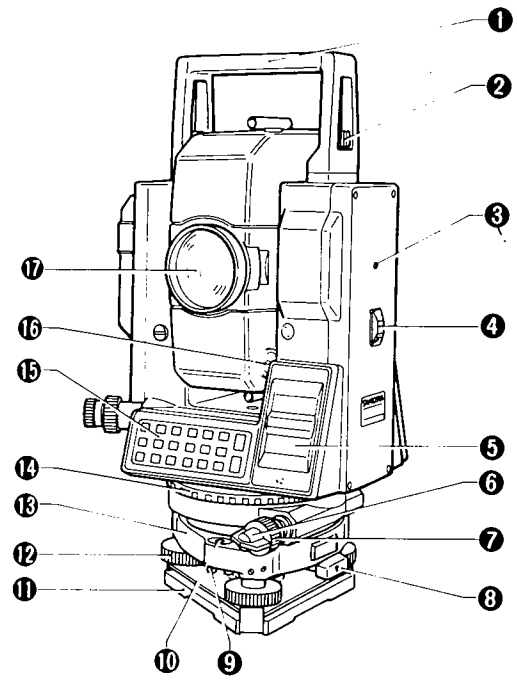


Fig. 1.1

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

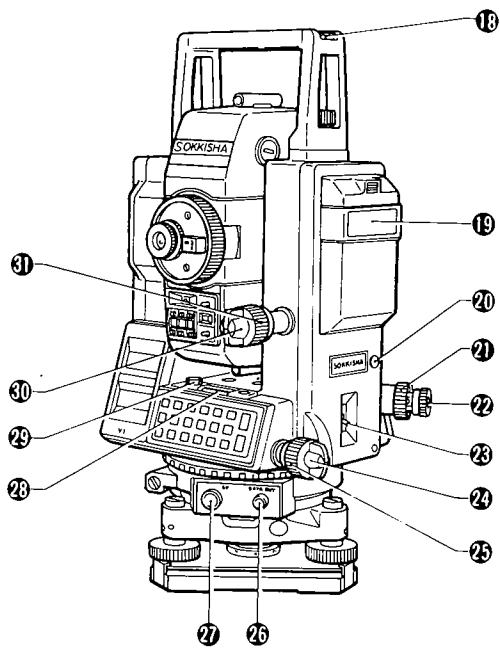


Fig. 1.2

- |                                  |                                    |
|----------------------------------|------------------------------------|
| 18 Tubular compass slot          | 25 Horizontal fine motion screw    |
| 19 Battery                       | 26 Data output connector           |
| 20 Sensor index adjustment cover | 27 External power source connector |
| 21 Optical plummet focusing 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      |

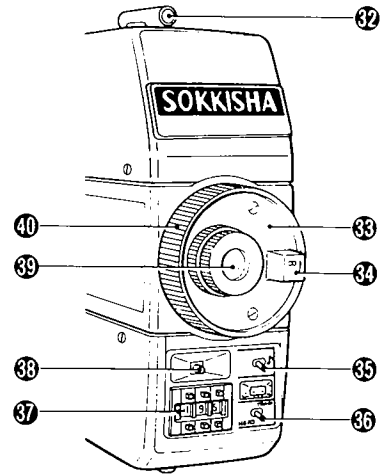


Fig. 1.3

- |                                       |                            |
|---------------------------------------|----------------------------|
| ③② Peep sight                         | ③⑤ 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      |
|                                       | ④① Telescope focusing 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 bearing and 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" or 5".
- 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 leveled. 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.
- A RS-232C data-out connector is standard.

### 3. SPECIFICATIONS

#### Distance measurement

Range:

Average conditions: (Slight haze, visibility about 12.5 miles, sunny periods, weak scintillation)

1-prism 3,300 ft (1,000 m)

3-prism 5,300 ft (1,600 m)

Good conditions: (No haze, visibility about 25 miles, overcast, no scintillation)

1-prism 4,300 ft (1,300 m)

3-prism 6,900 ft (2,100 m)

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

6,561.67 ft (1,999.999 m)

Minimum display: Successive 0.01 ft (1 mm)

Tracking 0.1 ft (10 mm)

Measuring time:

	Mode	
	Successive	Tracking
Slope distance	6 s + every 4 s	6 s + every 0.4 s
Horizontal distance		6 s + every 0.7 s
Height difference		6 s + every 1 s
Coordinates		
Remote elevation	1 s + every 0.5 s	
Horizontal distance between two points	7 s + every 4 s	7 s + every 1 s

Atmospheric correction: -99 ppm to +199 ppm (1 ppm per step)

Prism constant correction: 0 to -9 cm (1 cm 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: 6.7 inch (170 mm)  
Aperture: 1.8 inch (45 mm)  
Magnification: 30x  
Resolving power: 3"  
Image: Erect  
Field of view: 1°30' (26 ft/1,000 ft)  
Minimum focus: 4.3 ft (1.3 m)

**Horizontal circle**

Type: Incremental  
Minimum display: 1"

**Vertical circle**

Type: Incremental with 0 index  
Minimum display: 1"

**Accuracy**

Standard deviation of mean of measurement taken in positions V1 and V2

H: 4"  
V: 5"

**Automatic compensator**

Selectable ON/OFF

Type: Liquid

Minimum display: 1"

Range of compensation:  $\pm 3'$

**Display**

LCD 8-digit: Four display windows, two each face

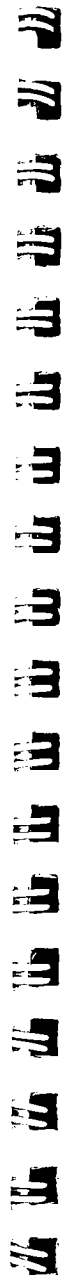
Range:  $-1,999^{\circ}59'59''$  to  $1,999^{\circ}59'59''$

**Measuring mode**

Horizontal angle: Right/Left/Repetition of angles

Vertical angle: Zenith  $0^{\circ}$  or Horizontal  $0^{\circ}$  or Horizontal  $0^{\circ} \pm 90^{\circ}$

Measuring time: Less than 0.5 s



Sensitivity of levels  
Plate level: 30"/2 mm  
Circular level: 10'/2 mm

Optical plummet  
Image: Erect  
Magnification: 3x  
Minimum focus: 0.3 ft (0.1 m)

Data output: Asynchronous serial, RS-232C compatible

Self-diagnostic function: Provided

Power saving cut off: 30 minutes after operation

Operating temperature: -4°F to +122°F (-20°C to +50°C)

Power source: Ni-Cd battery, No. 6651-01 (6V)  
Working duration: About 600 measurements at 77°F, distance and angle measurement; 13 hours at 77°F, angle measurement only.  
(About 4,000 measurements, distance and angle measurement; 90 hours at 77°F, angle measurement only, with optional battery No. 6661-02.)

Charging time: 12 hours, standard charger No. 6855-01  
(1 hour, optional charger No. 6855-02, No. 6855-03)

Size (without handle): 6.6 (W) x 6.7 (D) x 12.9 (H) inch  
(168 x 170 x 327 mm)

Weight: 16.7 lbs (7.6 kg) (w/internal battery)

#### 4. STANDARD EQUIPMENT

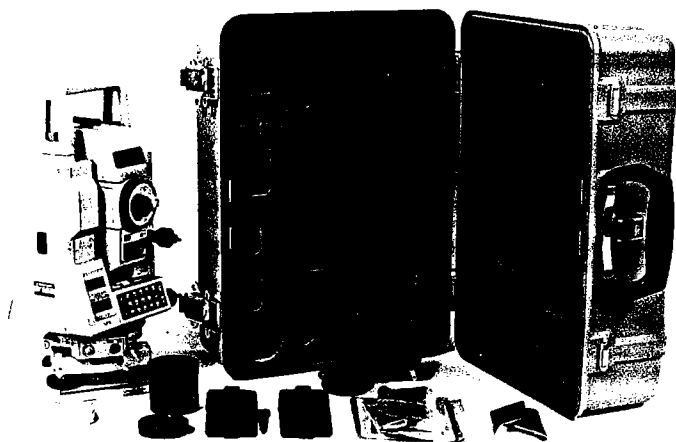


Fig. 4.1

SET3 main unit . . . . .	1	Plumb bob . . . . .	1
Internal battery, No. 6651-01 . . . . .	2	Tool pouch . . . . .	1
Battery charger, No. 6855-01 . . . . .	1	Screwdriver . . . . .	1
Battery charging adaptor, No. 6660-00 . . . . .	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
		Field guide . . . . .	1
		Carrying case, SC46 . . . . .	1

## 5. ROUND OUT YOUR LIETZ EDM SYSTEM WITH THESE ACCESSORIES

### POLYCARBONATE RETRO PRISMS

For use with all EDM systems recommending round retro prisms. Mounting system allows choice of -30mm or 0 offset. Prisms hermetically sealed to prevent contamination of reflective surfaces. Prisms interchangeable on all mounts.

### TRIPLE NON-TILTING PRISM ASSEMBLY

w/lens cover  
No. 7265-31



### TRIPLE TILTING PRISM ASSEMBLY

w/lens cover, similar to 7265-31, prism mount rotates 360°  
No. 7266-31

### SINGLE TILTING PRISM ASSEMBLY

w/lens cover, rotates 360°  
No. 7266-32



PRISM ONLY IN MOUNTING CAN  
w/lens cover, hermetically sealed  
No. 7266-35

### ACCESSORIES FOR PRISMS

NINE PRISM ADAPTOR  
Joins 7266-31 and two 7265-31.

### PEEP SIGHT

Fits on 7265 and 7266 mounts for easier aiming.  
No. 7266-30

### TARGET

Fits 7266-31 triple prism assembly, ideal for coaxial total stations.  
No. 7266-41

### TARGET

Fits 7266-32 single prism assembly.  
No. 7266-46

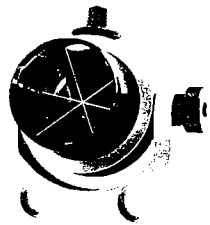
### RETRO PRISM CARRYING CASES

Vinyl plastic carrying case w/full zipper for easy access and storage. Inside padded. Exterior is bright international orange color. Sizes for single or triple retro prisms.  
No. 7270-50 Triple retro prisms  
No. 7270-52 Single retro prisms

**LIETZ SIGHTING TARGET SET**

No. 7311-45 contains one each of the following:

- 7269-34 Single Round Tilting Prism Mount
- 7270-35 Round Prism w/container
- 7270-29 Sighting Target for Retro Prism
- 7311-38 Tribrach Adaptor w/removable, rotatable center
- 7311-35 Optical Plummets Tribrach

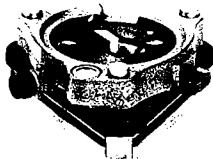


**TRIBRACHS AND ADAPTORS**

**OPTICAL PLUMMET TRIBRACH**

For precision plumbing. Has circular level vial with sensitivity of 10 minutes per 2 mm.

Optical plummet focus by push-pull side. Range: 1.5 to 50 ft. No. 7311-35

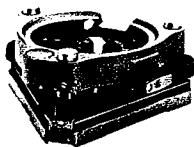


**TRIBRACH LEVELING BASE**

Same as above but without optical plummet.

For use with Azimuth Base (7150-41).

No. 7311-34



**TRIBRACH ADAPTOR**

Allows installation of retro prism or other accessories into tribrach. 5/8 x 11 thread. No. 7311-37



**TRIBRACH ADAPTOR**

Similar to above except with removable, rotatable center. No. 7311-38



**TRIBRACH ADAPTOR**

Allows easy mounting of 7266-31 and other prism with bayonet type mount in tribrachs. No. 7311-40

**OPTICAL PLUMMET TRIBRACH ADAPTOR**

Similar to above but with rotating vertical axis and optical plummet for precise positioning of prisms in tribrachs without optical plummet. No. 7311-41

**TRAVERSE SET**

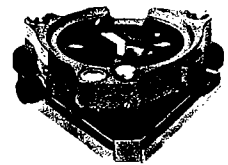
WITH CARRYING CASE. For precise triangulation surveys, day or night.

No. 7312-45 Set contains two each of the following:

- 7311-35 Optical Plummet Tribrachs
- 7311-37 Tribrach adaptors
- 7312-39 Illumination units
- 7312-40 Rotatable sighting targets mounted on a base



Exploded view



**LARGE TARGET**

Large target 8-1/4" x 11-3/4" attaches to regular target (No. 7312-40) to provide increased sighting range. No. 7312-42

### RANGE PLUMBING POLE

Aluminum tubing and brass fittings with hardened steel point. Height adjusts from 54" to 100". Upper section mounting stud accepts single or triple retro prisms; locking disc prevents prism rotation. Includes replaceable rod level (No. 8071-90). No. 7270-48



### TELESCOPING RANGE PLUMBING POLE

Ideal for EDM and traverse work. Made of quality aluminum tubing with brass fittings and hardened steel point. Positive chuck style twist lock permits height adjustment from 54" to 100". Replaceable rod level (No. 8071-90) and point (No. 8078-50). Upper section has 5/8 x 11 mounting stud to accept single or triple retro prisms. No. 7270-46



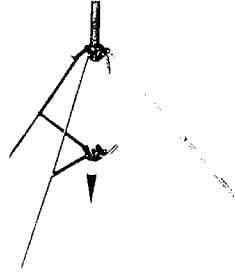
### TRIPODS

Tripods recommended for use with these accessories (not included in price):

- No. 7512-52 Wide Frame, Extension Leg (wood)
- No. 7536-75 Wide Frame, Extension Leg (aluminum)

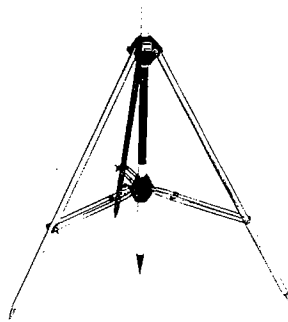
### RANGE POLE SUPPORT

Made with metal center castings, rustproof steel legs w/one adjustable (hinged) leg for uneven ground. No. 8078-90



### RANGE POLE TRIPOD

Heavy-duty. Made with metal center castings. Rustproof steel legs, adjustable for uneven ground. No. 8078-95



**POCKET THERMOMETER**

Refillable metal case. Mercury filled. Range: -30° to 120°F in 2° increments.  
No. 8006-12



**BAROMETER/ALTIMETER**  
with watch-type case.

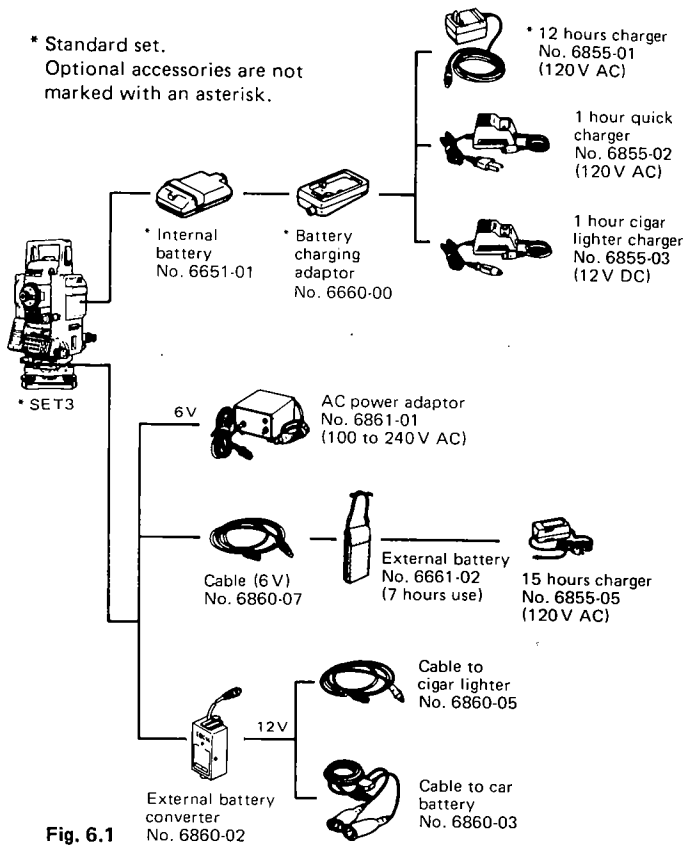
English-Range 0 to 15,000 ft.  
No. 8001-70





## 6. 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 No. 6651-01 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 50°F to 104°F (10°C to 40°C).
- 3) Before using No. 6861-01, set the voltage selector to the proper voltage.
- 4) No. 6860-02 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 32°F to 104°F (0°C to 40°C).
- 11) Battery operating life is shortened at extreme temperatures.

## 7. DISPLAY SYMBOLS

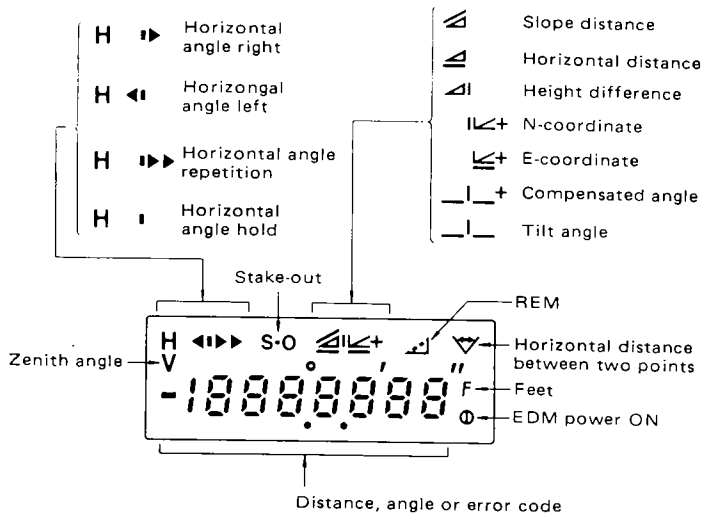


Fig. 7.1

## 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.

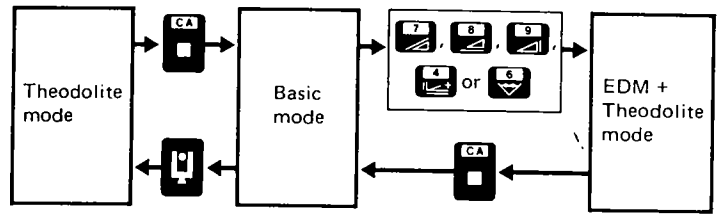


Fig. 8.1

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.

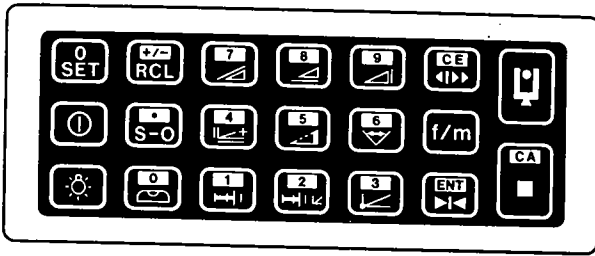

















Fig. 8.2

-  • 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).

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

## 9. INTERNAL SWITCHES

Switches are located under internal switch cover ④.

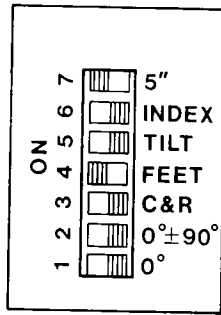


Fig. 9.1

Switch	Function
7	* ON Angle resolution 5" OFF Angle resolution 1"
6	ON Manually index vertical circle by V1, V2 * 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° horizontal ±90° * OFF Vertical angle display controlled by switch 1
1	ON Display vertical angle with 0° horizontal on face V1 * OFF Display zenith angle

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

- Before changing switch settings, turn power switch OFF.

## 10. OPERATION

### 10.1 PREPARATION FOR ANGLE MEASUREMENT

#### 10.1.1 Battery, No. 6651-01: Mounting and check

- 1) Confirm that the power switch  $\text{Ⓢ}$  is OFF.
- 2) Mount the battery No. 6651-01 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.

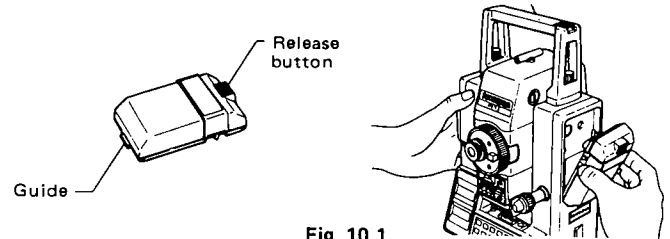


Fig. 10.1

(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.

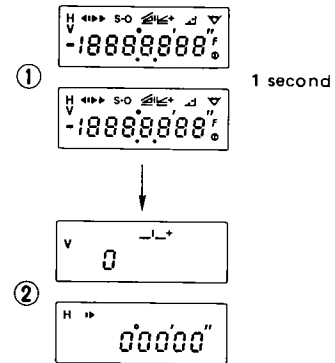


Fig. 10.2



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.

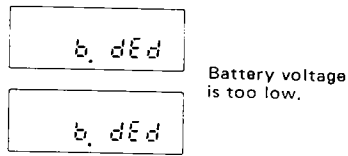
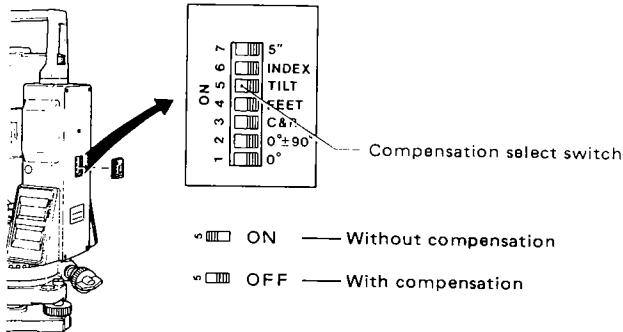


Fig. 10.3

### 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.



This mark appears when the internal switch 5 is set to OFF. When this mark appears, the angle is compensated automatically.

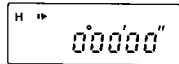


Fig. 10.4

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 Centering 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 centering screw.
- 3) Focus on the surveying point:
  - a. Turn the optical plummet eyepiece ⑳ to focus on the reticle.
  - b. Turn the optical plummet focusing ring ㉑ to focus on the surveying point.
- 4) Turn the leveling screws ㉒ to center the surveying point in the reticle.
- 5) Observe the off-center direction of the bubble in the circular level ㉓. Shorten the leg nearest that direction, or extend the leg farthest from that direction.

Generally, two legs must be adjusted to center the bubble.
- 6) When centering of the circular level is completed, turn the leveling screws to center the plate level ㉔ bubble.
- 7) Look through the optical plummet again. If the surveying point is off-center, loosen the centering screw to center the surveying point on the reticle. Tighten the centering screw.
- 8) Repeat 6), 7) if the plate level bubble is off-center.

### 10.1.4 Focusing

- 1) Looking through the telescope, turn the eyepiece anticlockwise and stop turning just before the reticle image becomes blurred. In this way, frequent refocusing can be dispensed with, since your eye is focused at infinity.
- 2) Loosen the vertical ㉕ and horizontal clamp ㉖.

Bring the target into the field of view with the peep sight ㉗. Tighten both clamps.
- 3) Turn the focusing ring ㉘ and focus on the target.

Sight the target with the vertical ㉙ and horizontal fine motion screws ㉚. 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 on 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.

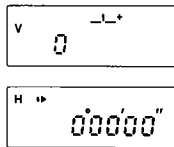


Fig. 10.5

- 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.

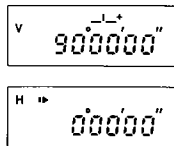


Fig. 10.6

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 **[H]**.
- 2) Select the horizontal angle right or left with **[CE/DIR]** according to measuring method.

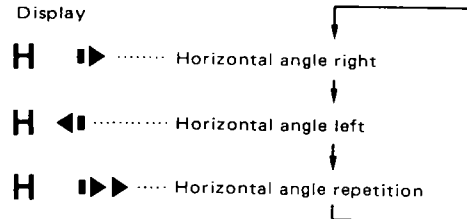


Fig. 10.7

When **[CE/DIR]** is pressed, the display changes alternately as shown in Fig. 10.7.

- 3) Sight the first target A.
- 4) Press **[0/SET]** to set the horizontal angle display to 0°.

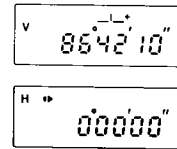


Fig. 10.8

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

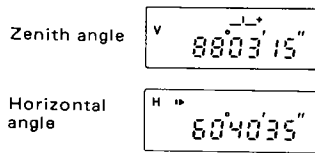


Fig. 10.9

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°10'20":

- 1) 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° and tighten both clamps. Turn the horizontal fine motion screw ⑮ until the desired angle is displayed.
- 2) Press  $\text{H}$ .

$H$  Horizontal angle hold display

Fig. 10.10

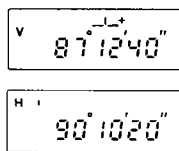



Fig. 10.11

3) Turn the instrument and sight the target.

4) Press  to release the display hold.

The required horizontal circle value is now set to the reference target.

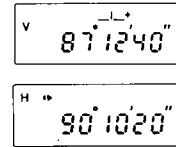



Fig. 10.12

#### 10.2.4 Repetition of angles

Repetition of angles from  $-1,999^{\circ}59'59''$  to  $1,999^{\circ}59'59''$  is displayed by using .

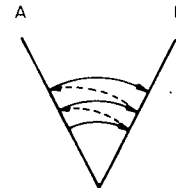


Fig. 10.13



1) Press  to select repetition of angle.



Fig. 10.14

2) Sight target A, and press .

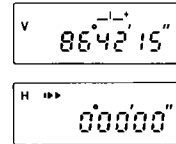


Fig. 10.15

- 3) Use the horizontal clamp ④ and the horizontal fine motion screw ⑤ to sight target B.

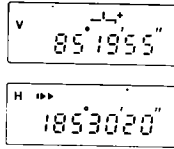


Fig. 10.16

- 4) Use the lower clamp ⑥ and the lower fine motion screw ⑦ to turn back to target A.

Important: Do not turn the horizontal clamp or fine motion screw during this procedure.

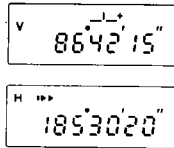
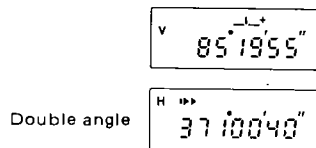


Fig. 10.17

- 5) Use the horizontal clamp and the horizontal fine motion screw to sight target B.



Double angle

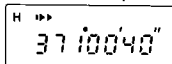



Fig. 10.18

- 6) Repeat 4), 5) steps to measure repetition of angles.  
7) To release the repetition of angle display, press .

## 10.3 PREPARATION FOR DISTANCE MEASUREMENT

### 10.3.1 Prism constant correction

- 1) Remove the prism constant cover ⑩ with a coin.
- 2) Turn the index to 3 with a screwdriver.  
The prism constant of a Lietz reflecting prism is -3 cm.
- 3) Replace the cover.

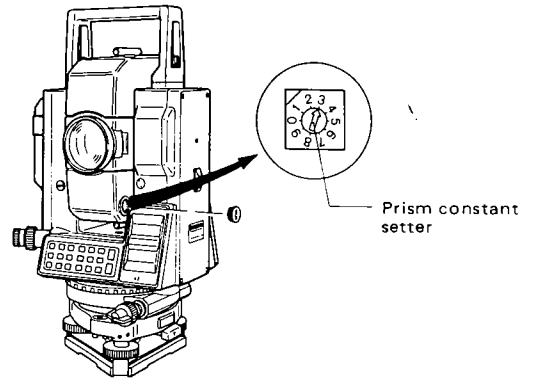


Fig. 10.19

- A prism constant of 0 to -9 cm can be set in steps of 1 cm.  
Example: When the prism constant is -2 cm, set the index to 2.

### 10.3.2 Atmospheric correction

The SET3 is designed so that the correction factor is 0 for a temperature of +59°F (+15°C) and an atmospheric pressure of 29.9 inchHg (760 mmHg). The correction factor is obtained from the pressure and temperature as follows.

- 1) Measure the temperature and atmospheric pressure with a thermometer and a barometer.  
Pressure can be obtained from weather station sea level data by correcting for altitude. For altitude correction see 15.2.



2) Read the correction factor from the atmospheric correction chart.

Example: Temperature +77°F (+25°C)  
 Atmospheric pressure 29.5 inchHg (750 mmHg)  
 Correction factor is +13 ppm.

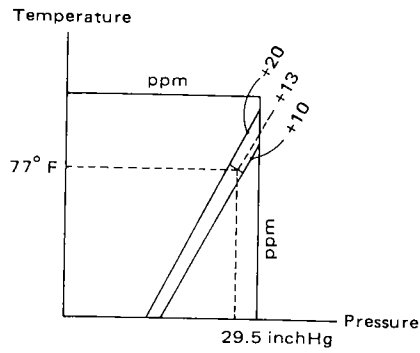


Fig. 10.20

- To convert millibars to mmHg multiply by 0.75.  
 Example: 959 millibar  
 $0.75 \times 959 \doteq 719 \text{ mmHg}$
- To convert temperature in fahrenheit to centigrades by computation.

$$^{\circ}\text{C} = \frac{5}{9} (^{\circ}\text{F} - 32)$$

3) Set the ppm switch **37** to +13.

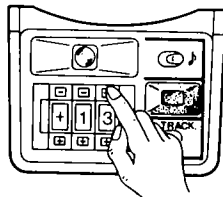


Fig. 10.21

4) To obtain the atmospheric correction factor by computation.

a. inchHg - °F system (english):

Atmospheric correction factor

$$X = 278.96 - \frac{10.5 \times P}{1 + 0.002175 \times t}$$

P: Atmospheric pressure in inchHg

t: Temperature in fahrenheit

Example: P = 29 inchHg, t = +60°F

$$\text{ppm} = 278.96 - \frac{10.5 \times 29}{1 + 0.002175 \times 60} = 9.61 \approx 10$$

Set +10 to the ppm switch.

b. mmHg - °C system (metric):

Atmospheric correction factor

$$X = 278.96 - \frac{0.3872 \times P}{1 + 0.003661 \times t}$$

P: Atmospheric pressure in mmHg

t: Temperature in centigrade

5) For slope distances equal to or more than 6,561.68 ft (2,000.000 m) (exceeding the maximum display 6,561.67 ft (1,999.999 m)), ppm switch should be set to 0 and the corrected slope distance calculated by the formula:

$$D = (6,561.68 + d) \times \left(1 + \frac{X}{1,000,000}\right)$$

D: Corrected slope distance

d: The display of slope distance when ppm is set at 0

X: Correction factor in ppm

Example: Slope distance 6,594.48 ft (displayed as 32.80 ft)

X = +5 ppm

$$\begin{aligned} D &= (6,561.68 + 32.80) \times \left(1 + \frac{5}{1,000,000}\right) \\ &= 6,594.51 \text{ ft} \end{aligned}$$

### 10.3.3 Earth-curvature and refraction correction

- 1) Remove the internal switch cover ④.
- 2) To correct horizontal distance and height difference for earth-curvature and refraction, set switch 3 to ON with a screw-driver.
- 3) Replace the cover.

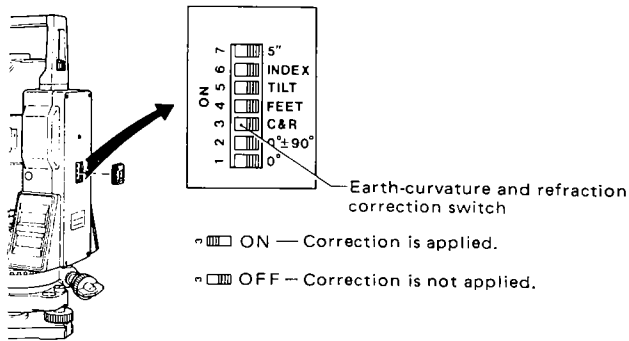


Fig. 10.22

- This correction is performed in the measurement of horizontal distance and height difference. The value displayed by the SET3 is computed by the following formula:

When the switch is ON

Horizontal distance after correction

$$H' = S \times \sin Z - \frac{1 - K}{2R} \times S^2 \times \sin Z \times \cos Z$$

Height difference after correction

$$V' = S \times \cos Z + \frac{1 - K}{2R} \times S^2 \times \sin^2 Z$$

When the switch is OFF

Horizontal distance  $H = S \times \sin Z$

Height difference  $V = S \times \cos Z$

S: Slope distance (value after atmospheric correction)

Z: Zenith angle

K: Atmospheric refraction constant (0.142)

R: Radius of the earth ( $2.09 \times 10^7$ ft)

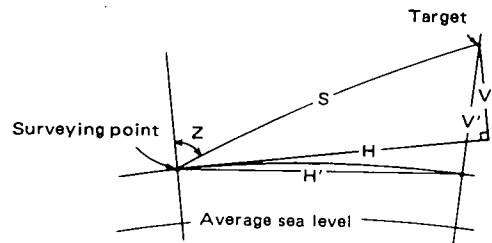


Fig. 10.23

Example: Amount of correction at a zenith angle 70°

S (ft)	500	1,500	3,000	5,000
H' - H (ft)	-0.00	-0.03	-0.13	-0.36
V' - V (ft)	0.00	0.04	0.16	0.45

Note that the horizontal distance is a distance measured at the height of the surveying point above the sea level so that to convert it to a distance above the average sea level, it is necessary to apply a projection correction additionally. Further, since the SET3 does not apply the earth-curvature and refraction and atmospheric corrections when a slope distance is more than 6,561.67 ft, such corrections should be performed by computation.

#### 10.3.4 Prism sighting

- 1) Sight the center of the reflecting prism with the telescope.
- 2) Set the return signal audio switch  $\text{ⓑ}$  to  $\text{ⓐ}$ .
- 3) Set the power switch  $\text{ⓐ}$  to ON and press  $\text{ⓐ}$ .

$\text{ⓐ}$  turns the power supplied to the EDM unit ON or OFF. Usually the power of the EDM unit turns OFF automatically after 1 second of inactivity and the power source mark disappears.

But when  $\text{ⓐ}$  is pressed, power is supplied to the EDM unit for about 2 minutes to permit prism sighting.

- a. When power is supplied to the distance measurement unit (EDM unit), the power source marking  $\text{ⓐ}$  is displayed.

- b. When the reflected light is received by the telescope, an audio signal is heard and the return signal lamp ④ lights up.

When the light intensity coming back from the prism is very high, the return signal lamp may light up, even for a slight mis-sighting. Make sure that the target center is sighted correctly.

- 4) Switch off the audio target acquisition.

### 10.3.5 Mode selection

- 1) Select the mode switch ④ to MEAS. for successive measurement, or TRACK. for tracking.

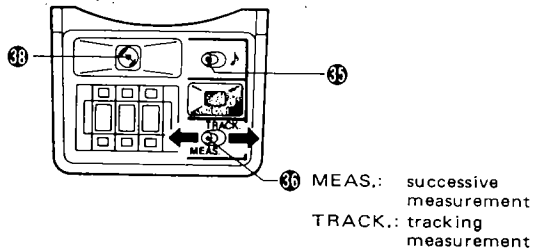


Fig. 10.24


- MEAS.: Measures in hundredths of a foot, first after 6 seconds, then every 4 seconds.
- TRACK.: Measures in tenths of a foot, first after 6 seconds, then every 0.4 to 1 second.

## 10.4 DISTANCE MEASUREMENT

Make sure that:

- The SET3 is set up correctly on the surveying point.
- The prism constant switch, the earth-curvature refraction switch, and ppm switch are set up correctly.
- Battery voltage is adequate.
- Indexing the vertical circle is complete.

### 10.4.1 Angle and distance measurement

- Press  to stop angle measurement.

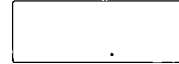


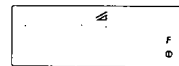
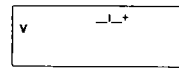


Fig. 10.25

- Press  and sight the center of the reflecting prism. (See 10.3.4)
- Press  to measure slope distance.

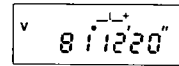
The following display appears showing that the slope distance measurement is being performed.



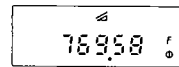
} Display flashes

Fig. 10.26

- The slope distance and the zenith angle will be displayed after about 6 seconds.




Zenith angle



Slope distance: 769.58 ft  
(Successive measurement)

Fig. 10.27

Slope distance will continue to be measured every 4 seconds.

- Maximum display for slope distance is 6,561.67 ft (1,999.999 m). For longer slope distances, see 10.3.2.
- When the following keys are pressed instead of  in step 3), the measurement corresponding to each key is performed.



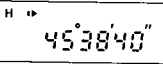
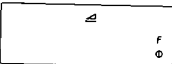
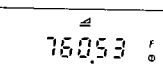

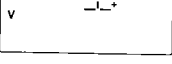
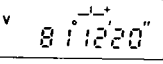
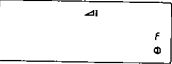
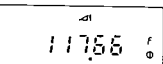

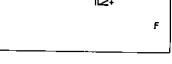
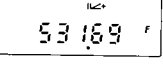
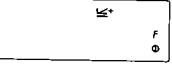
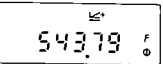


Key operation	During measurement	Measured value	
		 453840"	Horizontal angle
		 76053	Horizontal distance
		 871220"	Zenith angle
		 11756	Height difference
		 53169	N-coordinate
		 54379	E-coordinate

Fig. 10.28

5) Press  to stop measurement.

If it is necessary to convert displayed feet distance to metric, press . The metric value will be displayed for 5 seconds. If the usual measurement is in meters, the display will be changed temporarily to feet.

6) After stopping, you can recall the following observational data, which are stored in the instrument, by pressing the appropriate keys.

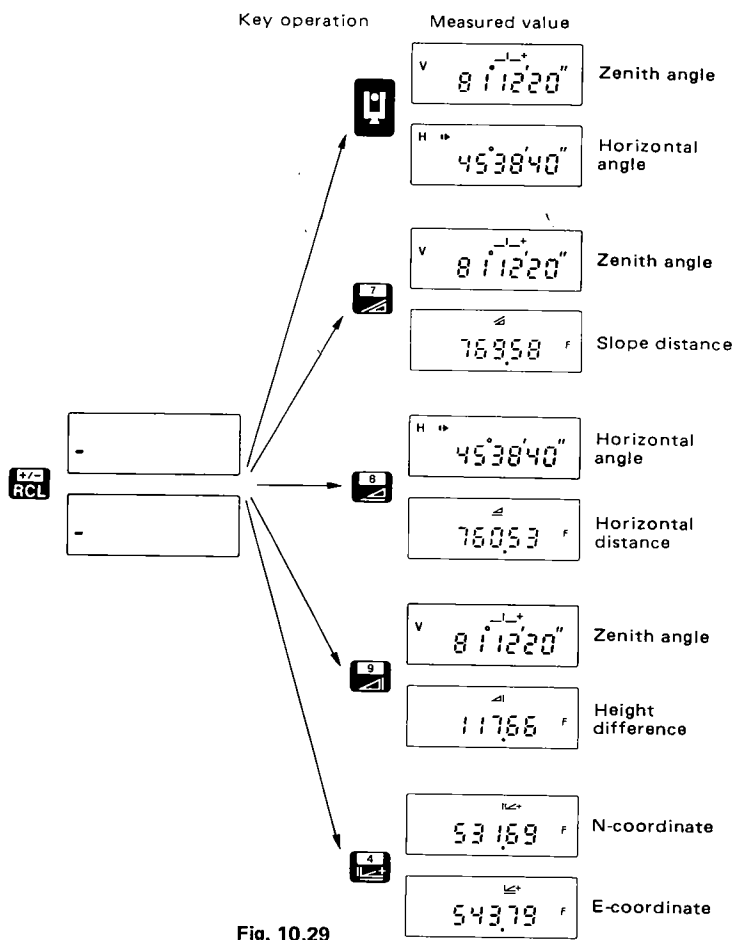


Fig. 10.29

• Each measured value displayed is the result obtained in the latest measurement.

7) To use as a theodolite after distance measurement, press then .



## 10.4.2 Measurement of coordinates

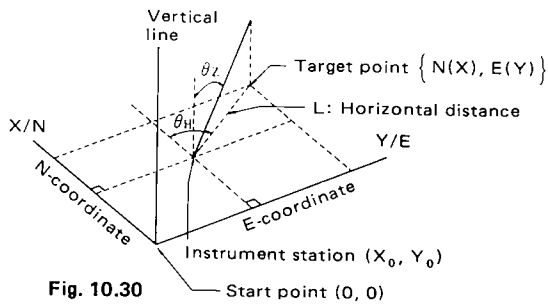


Fig. 10.30

- 1) The SET3 computes coordinates using the formulas:  

$$N(X)\text{-coordinate} = X_0 + L \cos \theta_H$$

$$E(Y)\text{-coordinate} = Y_0 + L \sin \theta_H$$
- 2) The observation procedure is the same as 10.4.1. Because the N component is positive for north and the E component is positive for east in plane rectangular coordinates, you should select the horizontal angle right and set the horizontal circle to zero on north.
- 3) For example:

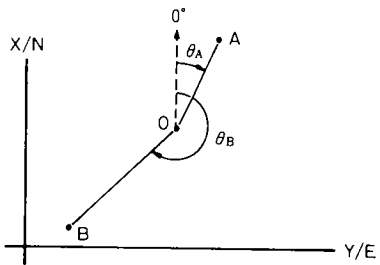

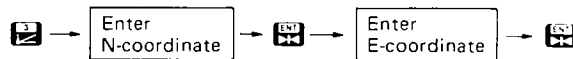




Fig. 10.31

Point No.	Horizontal distance	Horizontal angle	N-coordinate	E-coordinate
O	—	—	2,000.00	2,500.00
A	1,454.68	20°15'10"	3,364.74	3,003.56
B	2,462.11	225°32'50"	275.73	742.48

4) Press  to stop measurement. Measure coordinates as follows.

a. Entry of instrument station coordinates



- To clear the entry halfway, press .
- To stop the entry halfway, press .
- The range of coordinates is between -9,999.99 ft (-9,999.999 m) and 9,999.99 ft (9,999.999 m).
- The coordinates are retained in the memory of the SET3 for about 5 days even when the power switch is turned OFF. After that, the coordinates become (0, 0).

Example: Entering the instrument station coordinates (2,000, 2,500)

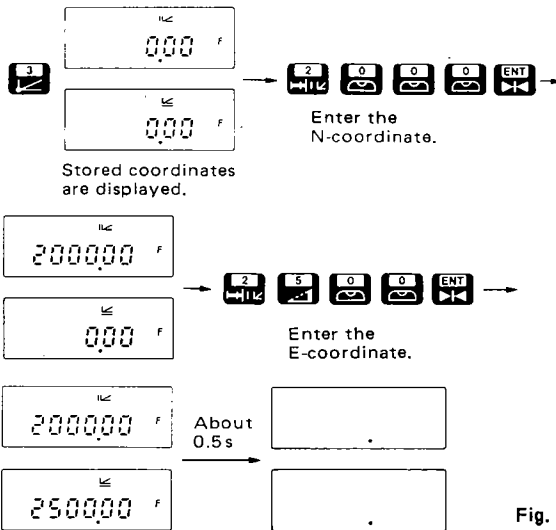
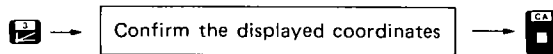


Fig. 10.32

b. Confirmation of instrument station coordinates



- To correct the stored coordinates, re-enter them.

c. Measurement of target point coordinates

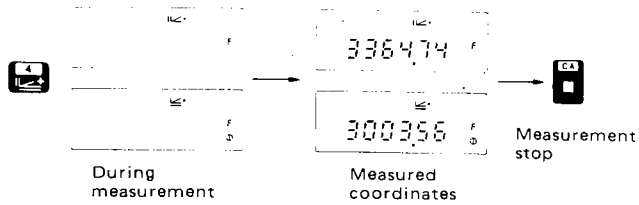
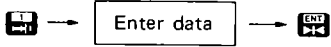


Fig. 10.33

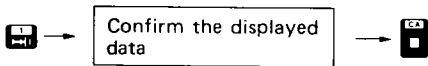
### 10.4.3 Stake-out measurement

Distance stake-out measurement.

- 1) Stake-out distance  
The SET3 displays the measured distance minus the desired (stake-out) distance.
- 2) Entry of stake-out distance data  
The stake-out distance must be entered for slope distance, horizontal distance or height difference measurements.  
Press **CA** to stop measurement. Enter as follows.



- To clear the entry halfway, press **CE**.
  - To stop the entry halfway, press **CA**.
  - The data once entered is stored until the power switch is turned OFF and then becomes 0.
- 3) Confirmation of stake-out distance data



- To correct the stored data, re-enter it.

