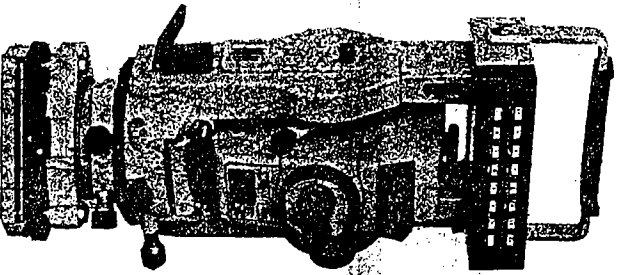


SOKKIA

SDM3E

ELECTRONIC TACHEOMETER

OPERATION MANUAL



Exclusive U.S. Distributor

SOKKIA

9111 Barton, Box 2934
Overland Park, Kansas 66201
(913) 492-4990

CONTENTS

I	FEATURES	2
II	SPECIFICATIONS	2
	1. Distance measuring	2
	2. Angle measuring	4
III	EXPLANATION OF PARTS	5
IV	STANDARD SET	11
V	OPERATION	17
	1. Setting up the SDM3E	17
	(1) Setting up the tripod	17
	(2) Center the SDM3E by adjusting leg length	18
	(3) Centering with the plumb bob	20
	(4) Focusing of the telescope	20
	(5) Sighting	21
	(6) Swivel lever	22
	2. Measuring angles	23
	(1) Horizontal and vertical circle reading	23
	(2) Horizontal angle measurement	25
	(3) Zenith angle measurement	28
	(4) Vertical angle	29
	3. Distance measurement	30
	(1) Preparation	30
	(2) Measuring the slope distance	33
	(3) Keyboard operation	34
	(4) Mode of measurement	42
	(5) To recall data	59
VI	CORRECTIONS	60
	1. Prism constant	60
	2. Earth-curvature and refraction correction	60
	3. Atmospheric correction	61
VII	INTERNAL BATTERY No.6850-01	63
	1. Specifications	63
	2. Handling	63
	3. Precautions	64

VIII	BATTERY CHARGER No.6855-01 FOR THE INTERNAL BATTERY	65
1.	Specifications	65
2.	Handling	65
3.	Precautions	66
IX	OPTIONAL ACCESSORIES	67
1.	Power source system for the SDM3E	67
(1)	1 hour quick charger No.6855-02	68
(2)	1 hour car battery charger No.6855-03	69
(3)	External battery converter No.6860-01	71
(4)	AC power adaptor No.6861-01	72
(5)	Cable to cigar lighter No.6860-05	73
(6)	Cable to car battery No.6860-03	74
2.	Diagonal eyepiece	75
X	CHECKS AND ADJUSTMENTS	76
1.	Angle measuring function	76
(1)	Plate level	76
(2)	Circular level	78
(3)	Inclination of the reticle	78
(4)	Vertical reticle line	79
(5)	Horizontal reticle line	81
(6)	Coincidence of the distance measuring axis with the reticle	82
(7)	Optical plummet	83
2.	Distance measuring function	84
(1)	Self-diagnosis	84
(2)	Check flow chart	86
XI	CONFIRMATION OF DISTANCE CONSTANT	87
XII	PRECAUTIONS AND MAINTENANCE	88
1.	Precautions	88
2.	Maintenance	89
	ATMOSPHERIC CORRECTION TABLE(English)	90
	ATMOSPHERIC CORRECTION TABLE(Metric)	91

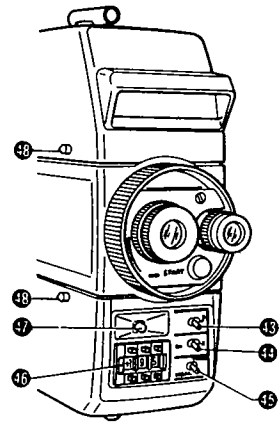
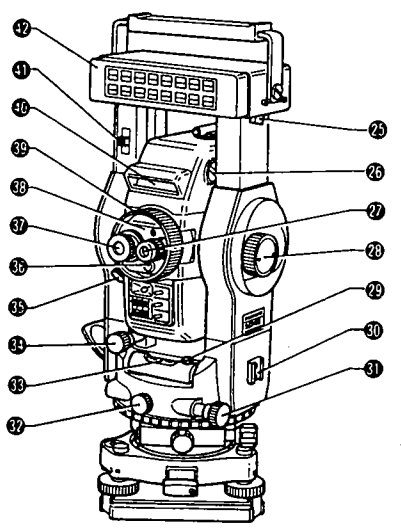
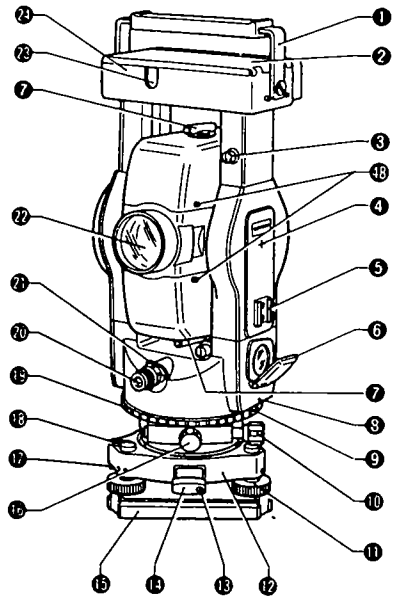


Fig. 1

I FEATURES

- Distance and angle measuring functions are synthesized in the SDM3E. Accurate and rapid operation can be executed with the SDM3E.
- Horizontal distance, height difference and coordinate are computed and displayed by keying in angle.
- Successive and tracking measurement as well as stake-out can be selected.
- The telescope can be plunged to either direction, enabling the user to observe both faces, easily.
- Adjustment of light intensity is not necessary.
- Incoming reflection from prism(s) is confirmed by light value lamp or buzzing sound.
- All the necessary information is displayed.
- Function to output the measured data is provided.
- Corrections for earth-curvature and refraction are carried out automatically.
- The SDM3E's power source is cut off two minutes after its last operation. This saves battery capacity.
- A convenient handle is provided for easy transportation.

II SPECIFICATIONS

1. Distance measuring

Range:	1-prism 35 to 3,900ft (10 to 1,200m) 3-prism 35 to 5,900ft (10 to 1,800m) (under good atmospheric conditions)
Standard deviation:	$\pm (5\text{mm} + 5\text{ppm} \cdot D)$
Display:	LED 8-digit Maximum slope distance 6.561.66ft (1,999.999m)
Minimum count:	Successive 0.01ft (1mm) Tracking 0.1ft (10mm)

Measurement time:

	Mode	
	Succesive	Tracking
Slope distance		4s + every 0.3s
Horizontal distance		
Height difference	4s	4s + every 0.4s
X coordinate		
Y coordinate		4s + every 0.5s

Atmospheric correction: - 99 to +199ppm (1ppm step)
Reflecting prism constant: 0 to -9cm (1cm step)
Audio target acquisition: Continuous sound; measurement OK
Intermittent sound; to confirm input
and display measurement
Signal source: LED
Output of data: RS-232-C
Light intensity control: Automatic
Self-diagnostic function: Provided
Battery check: Provided
Power saving cut off: 2 minutes after operation
Earth-curvature and
refraction correction: Provided
Temperature: -4 to +122°F (-20 to +50°C)
Power source: NiCd battery, 6V, detachable
Working duration: 1 hour at 77°F (25°C)
Charging time: 12 hours, standard charger
No. 6855-01
(1 hour, optional charger No.6855-02)

2. Angle measuring

Telescope:

Length	6.7 inches (170mm)
Aperture	1.8 inches (45mm)
Magnification	X 25
Resolving power	3.5"
Image	Erect
Field of view (1,000 ft)	1°30' (26 ft)
Minimum focusing distance	4.3 ft (1.3m)

Horizontal circle:

Diameter	3.15 inches (80mm)
Digital reading	10"

Vertical circle:

Diameter	2.75 inches (70mm)
Digital reading	10"

Compensator, zenith angle:

Accuracy	± 0.5"
Range of compensation	± 5'

Sensitivity of levels:

Plate level	30"/2mm
Circular level	10"/2mm

Optical plummet:

Erect image, X2, more than 1.5 ft

Size:

6.5(W)X6.7(D)X15.2(H) inches (166 X 170 X 385 mm)

Weight:

16.8 lbs (7.6 kg), w/internal battery

III EXPLANATION OF PARTS


Refer to Fig. 1, page 1.

- ① **Handle**
- ② **Battery case cover**
- ③ **Connector**
Used for data output.
- ④ **Instrument height mark**
- ⑤ **Illumination slot**
- ⑥ **Reflector**
- ⑦ **Peep sight**
- ⑧ **0° index**
When the circle positioning ring ⑨ is turned until the 0° button on the ring comes directly below the 0° index, 0° graduation is seen through the micrometer eyepiece.
- ⑨ **0° button**
This shows the location of 0° graduation of the horizontal circle.
- ⑩ **Lower fine motion**
- ⑪ **Leveling screw**
- ⑫ **Tribrach**
- ⑬ **Clamp screw of swivel lever**
Loosen the clamp screw immediately after you receive the instrument.
- ⑭ **Swivel lever**
When this is given half a turn in an anticlockwise direction, it is possible to lift the main body from the tribrach.
- ⑮ **Base plate**
- ⑯ **Lower clamp**
- ⑰ **Circular level adjusting screw**
The circular level adjusting screws can be turned with the adjusting pin to center the circular level bubble.
- ⑱ **Circular level**
- ⑲ **Circle positioning ring**
When the lower clamp ⑯ and horizontal clamp ⑳ are loosened, the horizontal circle can be turned with the ring.
- ⑳ **Eyepiece for optical plummet**
Turn the eyepiece to focus on the reticle.

- ① Adjusting screw for the reticle
- ② Objective lens
- ③ Opening for external battery converter No. 6860-01
- ④ Battery case
- ⑤ Battery cover clamp
 - Used to mount or dismount battery No. 6850-01 or external battery converter No. 6860-01.
- ⑥ Prism constant cover
 - When the cover is removed with a coin, prism constant setter and earth-curvature refraction switch are accessible. See page 60.
- ⑦ Micrometer eyepiece
 - Numbers on the both circles are focused by turning the eyepiece. See page 23.
- ⑧ Micrometer knob
 - See page 23.
- ⑨ Plate level adjusting screw
 - See page 77.
- ⑩ Tubular compass slot
- ⑪ Horizontal fine motion
- ⑫ Horizontal clamp
- ⑬ Plate level
- ⑭ Vertical fine motion
- ⑮ Vertical clamp
- ⑯ Start-stop switch
 - A push of the switch starts or stops distance measurement.
- ⑰ Telescope eyepiece
 - The reticle is focused by turning the eyepiece, see page 20.
- ⑱ Reticle adjustment cover
 - See page 79.
- ⑲ Focusing ring
 - To focus on a target.
- ⑳ Display
 - Measured value is displayed.
 - Keyed-in numbers (i.e. angle or stake-out data) are displayed.
 - Unit of measurement, prism constant and atmospheric correction factor are displayed.

Example:

F	-3	45
---	----	----

 is displayed when  key is pressed.
: atmospheric correction factor; + 45 ppm
: prism constant; - 3cm
: unit of measurement; feet

- Necessary information is displayed:

00000000

 : Shows display function and microcomputer works normally.

S DIST

 : Before slope distance is measured.

H DIST

 : Before horizontal distance is measured.

V DIST

 : Before height difference is measured.


X/N DIST

 : Before X coordinate is measured.

Y/E DIST

 : Before Y coordinate is measured.

S-O ****

 : When the  key is pressed.

S-O S

 : Before slope distance for stake-out is measured.

S-O H

 : Before horizontal distance for stake-out is measured.

S-O V

 : Before height difference for stake-out is measured.


S-O X/N

 : Before X coordinate for stake-out is measured.

S-O Y/E

 : Before Y coordinate for stake-out is measured.

RCL ****




 : When the  key is pressed.

RCL S

 : Before stored slope distance is recalled.

RCL H

 : Before stored horizontal distance is recalled.

RCL V	: Before stored height difference is recalled.
RCL X/N	: Before stored X coordinate is recalled.
RCL Y/E	: Before stored Y coordinate is recalled.
Z ANG	: When the  key is pressed.
H ANG	: When the  key is pressed.
S-O DIST	: When the  key is pressed.
/	: When the operation to display horizontal, zenith angle and stake-out data is discontinued or finished.
-	: When no operation was done for more than 10 seconds.
-----	: When no light comes back from the reflecting prism, before distance measuring.
SIG DOWN	: When the reflected light from the prism was interrupted for more than 5 seconds.
BAT LOW	: When the battery voltage is too low.
BAD COND	: When atmospheric conditions are not suitable for distance measuring.
E 02	: When distance measuring function is not working properly.
E 03	

① Power switch

⑫ Keyboard

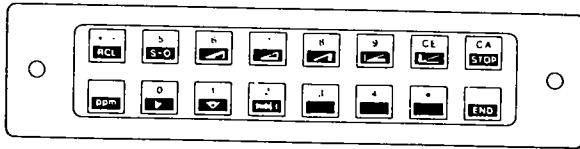


Fig. 2

Two functions are provided for the keys.

- RCL
 : ① To change the sign of keyed-in numbers.
 ② To recall distance data.
- 5

S-O
 : ① To key in "5"
 ② To measure distance for stake-out.
- 6

S
 : ① To key in "6".
 ② To measure slope distance.
- 7

H
 : ① To key in "7".
 ② To measure horizontal distance.
- 8

H
 : ① To key in "8".
 ② To measure height difference.
- 9


Y
 : ① To key in "9".
 ② To measure Y coordinate.
- CE


X
 : ① To clear keyed-in numbers.
 ② To measure X coordinate.
- CA


STOP
 : ① To discontinue recalling or keying in data.
 ② To discontinue distance measurement.
- ppm
 : ① No function
 ② To display unit of measurement, prism constant and atmospheric correction factor.
- 0


Z
 : ① To key in "0".
 ② To key in zenith angle.
- 1


H
 : ① To key in "1".
 ② To key in horizontal angle.

 : ① To key in "2".
② To key in stake-out data.

 : ① To key in "3".
② No function.

 : ① To key in "4".
② No function.

 : ① To key in decimal point.
② No function.

 : ① No function.
② Press the key when keying-in is over.

- ⑮ **Audio target acquisition switch**
ON and OFF switch for buzzer circuit.
- ⑯ **ft/m switch**
Switching between feet and meter unit of measurement.
- ⑰ **Mode switch**
Switching between successive and tracking measurement.
- ⑱ **ppm setter**
Obtain atmospheric correction (page 61), and set the value.
- ⑲ **Light value lamp**
The lamp is ON when the light value is adequate.
- ⑳ **Gun sight**
To introduce the target into the field of view.

IV STANDARD SET

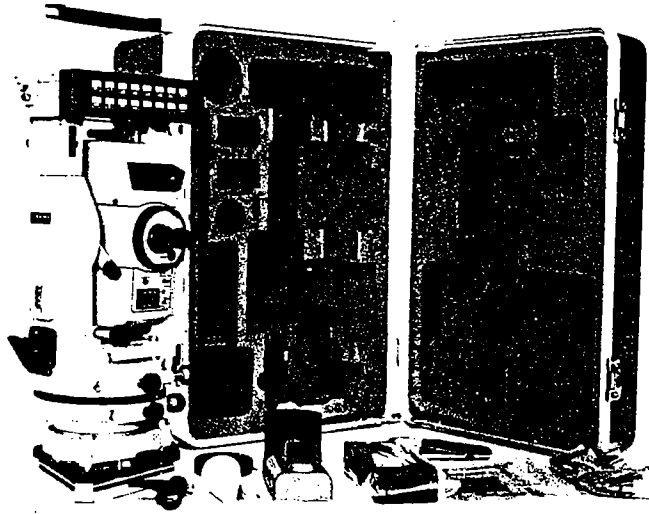


Fig. 3

SDM3E main unit	1	Screwdriver	1
Internal battery		Lens brush	1
No. 6850-01	1	Adjusting pin	2
Battery charger		Electric light bulb	1
No. 6855-01	1	Silicone cloth	1
Illumination package	1	Atmospheric correction	
Tubular compass	1	table	1
Lens cap	1	Layout	1
Lens hood	1	Operation manual	1
Vinyl cover	1	Carrying case	1
Tool bag	1		

Round Out Your Lietz EDM System with these Accessories

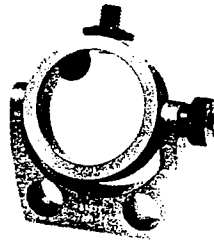
ROUND RETRO PRISMS

For use with all EDM systems recommending round retro prisms. Each prism is in a protective container which can be quickly detached from its metal mount. Lietz's standard prism offset for both triple and single assemblies is -30 mm. Triple mount sides are threaded permitting assembly of multiple mounts without any special brackets.

POCKET-SIZE RETRO PRISM
w/tilting mount
No. 7268-32



SINGLE ROUND TILTING PRISM
MOUNT only
No. 7269-34



SIGHTING TARGET FOR RETRO PRISM

Adjustable height target with 5/8 x 11 mounting stud. Black anodized aluminum.



No. 7270-29

TRIPLE PRISM assembly
with mount and sighting pole.
(Pole not illustrated)
No. 7270-31



SINGLE PRISM assembly
with mount and sighting pole.
(Pole not illustrated)
No. 7270-32



TRIPLE MOUNT only
No. 7270-33

SINGLE MOUNT only
No. 7270-34

ROUND PRISM
w/container only (shown in assemblies)
No. 7270-35

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. 7270-51 Triple retro prisms
No. 7270-52 Single retro prisms

LIETZ SIGHTING TARGET SET

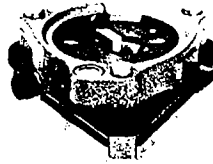
No. 7311-45 contains one each of the following:

- 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 Plummet Tribrach

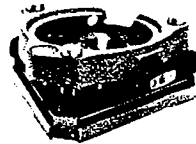


TRIBRACHS AND ADAPTORS

OPTICAL PLUMMET TRIBRACH
For precision plumbing. Has circular level vial with sensitivity of 10 minutes per 2 mm. Optical plummet focus by push-pull slide. 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

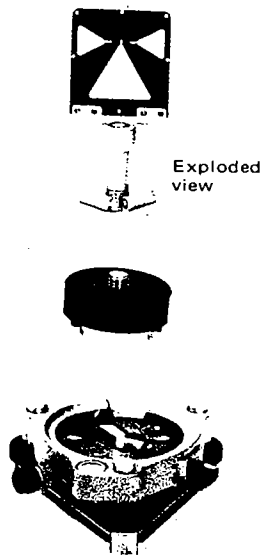


TRAVERSE SET

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



LARGE TARGET

Large target $8\frac{1}{4}'' \times 11\frac{1}{4}''$ 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 $5/8 \times 11$ mounting stud to accept single or triple retro prisms. No. 7270-46



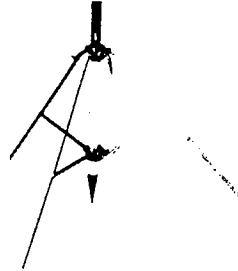
TRIPODS

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)

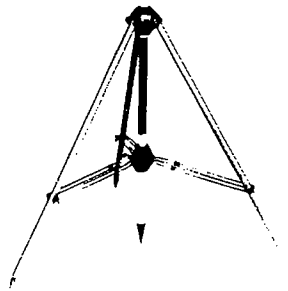
RANGE POLE SUPPORT

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 0-15,000 ft.

No. 8001-70



V OPERATION

1. Setting up the SDM3E

- (1) Setting up the tripod
 - 1) Loosen wing nuts A.

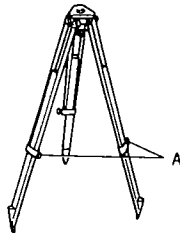


Fig. 4

- 2) Keep tripod closed and raise the tripod head to about chin level. Tighten wing nuts A.
- 3) Spread the tripod legs so that the three shoes form an equilateral triangle and the tripod head is positioned directly over the surveying point.
- 4) Make sure that:
 1. the tripod head is approximately level,
 2. the tripod shoes are firmly fixed in the ground.

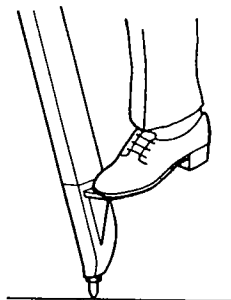


Fig. 5

If the ground is not solid enough, drive wooden stakes on which shoes are set.

(2) Center the SDM3E by adjusting leg length

- 1) Set the SDM3E on the tripod head. Support the instrument with one hand and screw the centering screw into the tribrach female thread. Tighten the centering screw.

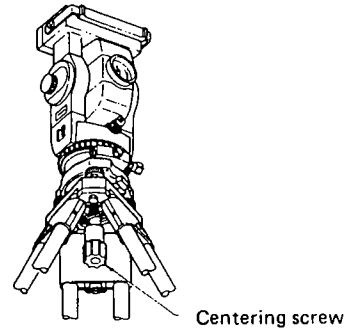


Fig. 6

- 2) Turn the optical plummet eyepiece \odot to focus on the reticle. Then push or pull the eyepiece to focus on the surveying point.

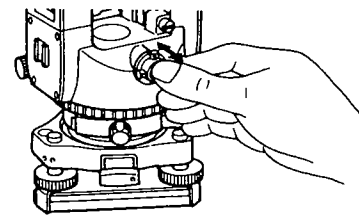
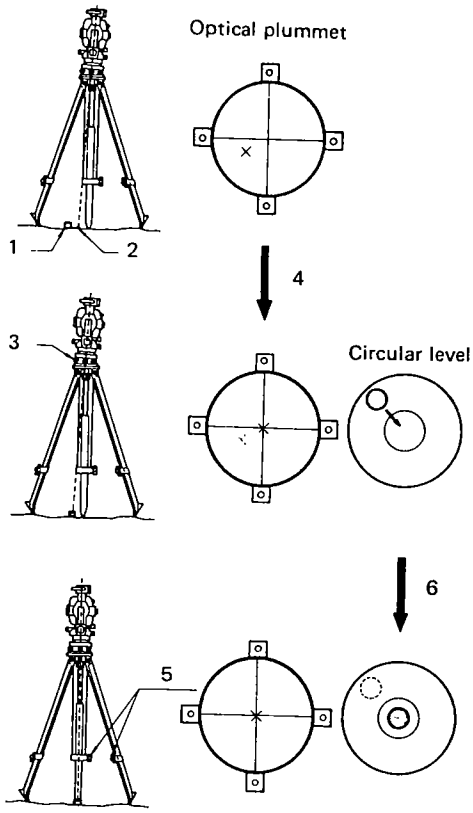


Fig. 7

- 3) Turn the leveling screws ① to center the surveying point in the reticle.



- 1 Surveying point
 2 Sighting position
 3 Leveling screw
 4 Look through the optical plummet and center the surveying point by turning the leveling screws.
 5 Extend the legs.
 6 The bubble should be centered by extending or shortening any of the three tripod legs.

Fig. 8

- 4) Now look at the circular level ③. Observe the off center direction of the bubble. Shorten a leg nearest to the direction, or extend a leg farthest from the direction. Generally, two legs have to be adjusted to center the bubble.
- 5) When centering of the circular level is completed, turn the leveling screws to center the plate level ④ bubble.

- 6) 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.

(3) Centering with the plumb bob

If the weather is calm, it is possible to use the plumb bob for centering. Unwind the plumb bob cord and attach it to the hook inside the centering screw. Use the cord grip piece to adjust cord length.

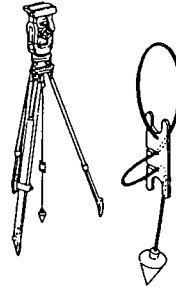


Fig. 9

(4) Focusing of the telescope

- 1) Loosen the vertical clamp ⑤ and horizontal clamp ⑥. Bring the target into the field of view with the peep sight ⑦. Tighten both clamps.
- 2) Looking through the telescope, turn the telescope eyepiece ⑧ anticlockwise and stop turning just before the image of reticle becomes blurred. In this way, frequent refocusing can be dispensed with, since your eye is focused at infinity.
- 3) Turn the focusing ring ⑨ and focus on the target. Sight the target with the vertical ④ and horizontal fine motion ⑩. 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 somewhat before the eyepiece.

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

(5) Sighting

1) Shift the target until it coincides with the central part of a reticle line or bisects a double line reticle by turning the fine motions clockwise. If the fine motion is turned too much, give one complete anticlockwise turn, then repeat another sighting with clockwise fine motion.

2) Position of target on the reticle line(s)

Horizontal angle: at a point close to the center of the vertical reticle.

Zenith angle: at a point close to the center of the horizontal reticle.

N.B. Use the same point of the reticle when the telescope face is changed.

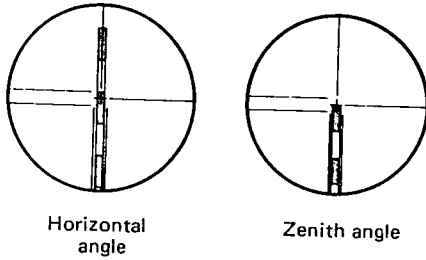


Fig. 10

For one reflecting prism with target, see N.B. on page 32.

(6) Swivel lever

Main unit of SDM3E is detachable from the tribrach. Give a 180° anticlockwise turn to the swivel lever ①. The main unit can be removed and replaced by other instruments such as a target, reflecting prism, etc.

To mount the instrument on the empty tribrach, open the swivel lever (180° anticlockwise turn), put the instrument in the tribrach, and turn the swivel lever clockwise until a click is heard.

N.B. For the new SDM3E just received, the swivel lever is fixed with a screws ②. Loosen it and keep it loosened.

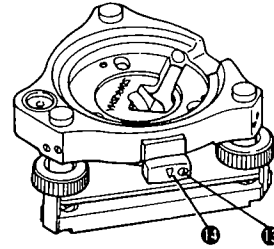


Fig. 11

2. Measuring angles

Before measuring angles, make sure that you have carried out the CHECKS AND ADJUSTMENTS of the SDM3E indicated on page 76.

Even for angle measurement, be sure the internal battery is mounted.

(1) Horizontal and vertical circle reading

Open the reflector ⑥. Turn the micrometer eyepiece ⑦ to focus on the graduations. Three windows are seen. See Fig. 12. The upper window marked V is for a degree of zenith angle. The lower window marked H is for a degree of horizontal angle. The small window on the right is for minutes and seconds of the both angles, and is thus known as MS window.

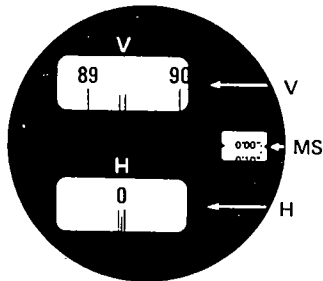


Fig. 12

1) Reading horizontal angle

Fig. 13 shows the appearance of the windows after the sighting. H and MS windows are used. In the H window, 128° and 129° graduations are seen on the both sides of the index line. Turn the micrometer knob ⑧ until the index line bisects the double line of either 128° or 129° graduation as in Fig. 14. The MS window shows $46'00''$. The horizontal reading is then $128^\circ 46'00''$.

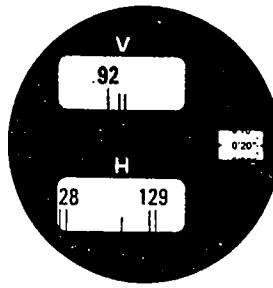


Fig. 13

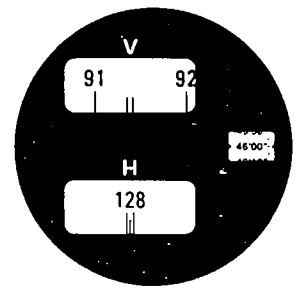


Fig. 14

2) Reading zenith angle

After the target is sighted, look at the V and MS windows. Two graduations are seen on the both sides of the double index line (Fig. 14). Turn the micrometer knob until either degree is centered in the double line as in Fig. 15. The zenith angle reading is then $92^{\circ}5'50''$.

N.B. Two displays of minutes and seconds may be seen in the MS window under certain circumstances. Read the figures lying closer to the arrow indices.

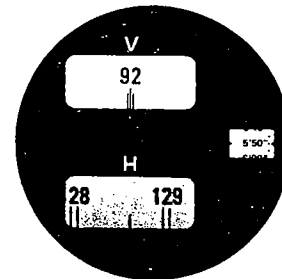


Fig. 15

(2) Horizontal angle measurement

1) Conventional (clockwise) measurement

- a. Sight the first target A. (Fig. 16)
- b. Turn the micrometer knob ② to read the horizontal circle.

Example: $44^{\circ}21'40''$ (Fig. 17)

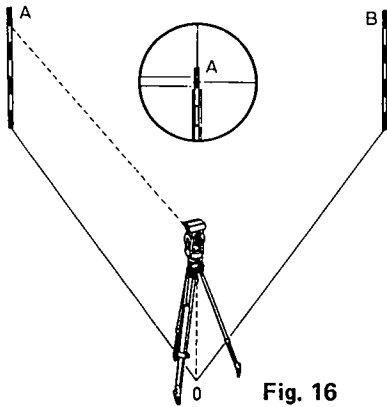


Fig. 16

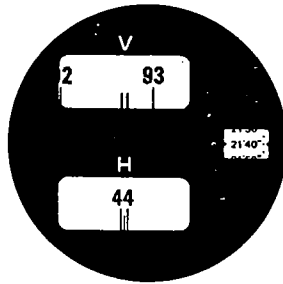


Fig. 17

- c. Use the horizontal clamp ⑦ and horizontal fine motion ④ to sight the second target B. (Fig. 18)
- d. Turn the micrometer knob and read the horizontal circle. Example: $125^{\circ}42'40''$ (Fig. 19)
- e. Subtract the 1st from the 2nd reading to obtain the angle AOB.

Example: $125^{\circ}42'40'' - 44^{\circ}21'40'' = 81^{\circ}21'00''$

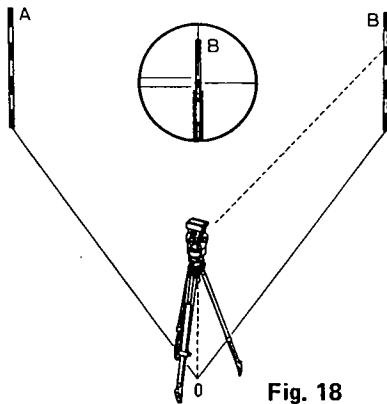


Fig. 18

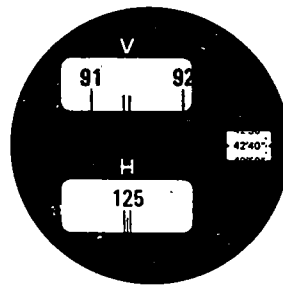


Fig. 19

2) Horizontal angle from $0^{\circ}00'00''$

- a. Turn the micrometer knob until $0'00''$ coincides with the arrow indices in the MS window.

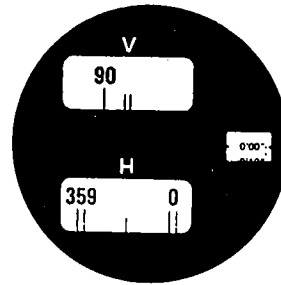


Fig. 20

- b. Loosen the horizontal clamp ⑫ and the lower clamp ⑬ and hold the upper alidade lightly. Turn the circle positioning ring ⑩ until the 0° button ④ is aligned with the 0° index ⑥. Graduation 0° appears in the H window.
- c. Tighten the horizontal clamp ⑫ and turn the horizontal fine motion ⑪ until the index line bisects the 0° double line, Fig. 21.
- d. Guide the target A into the field of view. Tighten the lower clamp ⑬. Sight the target A with the lower fine motion ⑩. The target A is now in the direction of $0^{\circ}0'00''$, Fig. 22.

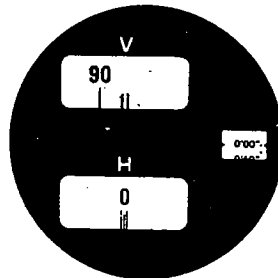


Fig. 21

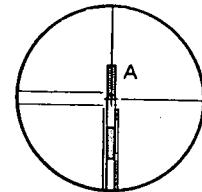


Fig. 22

- e. Loosen the horizontal clamp ② . Introduce the target B into the field of view and tighten the horizontal clamp. Sight the target B with the horizontal fine motion ④ , Fig. 23.
Important: Do not bother with the lower fine motion ⑤ .
- f. Turn the micrometer knob to read the angle AOB.
Example: $81^{\circ}21'00''$ (Fig. 24)

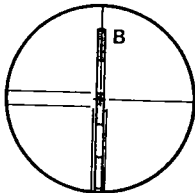


Fig. 23

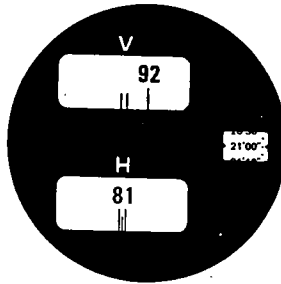


Fig. 24

- 3) Laying out a given angle
To find a point $90^{\circ}10'20''$ in a clockwise direction from the target A:
- Set the SDM3E at $0^{\circ}0'00''$ as in 2) a. to c. above, Fig. 25.
 - Sight the target A using the lower clamp ① and fine motion ④ , Fig. 26.

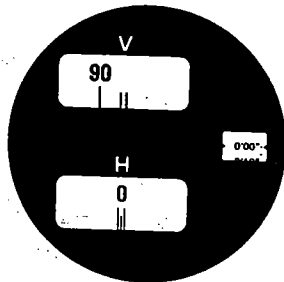


Fig. 25

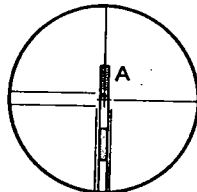


Fig. 26

- c. Turn the micrometer knob until $10'20''$ aligns with arrow indices of the MS window, Fig. 27.
- d. Loosen the horizontal clamp $\textcircled{2}$. Turn the instrument 90° clockwise. Tighten the horizontal clamp. Turn the horizontal fine motion $\textcircled{1}$ until the 90° double line is bisected by the H window index, Fig. 28.
- e. The direction sighted is $90^\circ 10'20''$ clockwise from the target A.

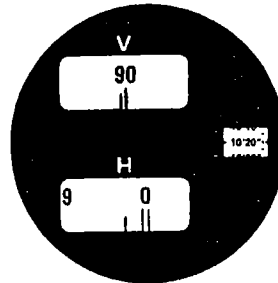


Fig. 27

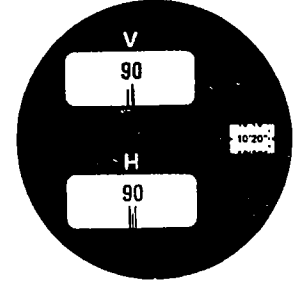


Fig. 28

(3) Zenith angle measurement

Zenith angle is 0° vertically upwards, 90° (face left), and 180° (face right) horizontally.

- 1) Sight the target in face left position and obtain the zenith angle FL. Example: $FL = 82^\circ 35'30''$, Fig. 30

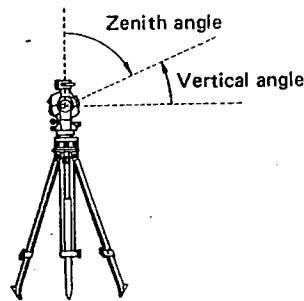


Fig. 29

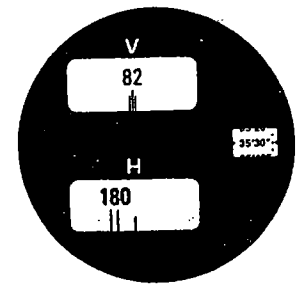


Fig. 30

- 2) Sight the target in face right and obtain the zenith angle
FR. Example: FR = 277°24'20"

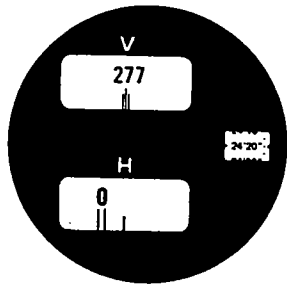


Fig. 31

- 3) Compute zenith angle by the formula:

$$\text{Zenith angle} = \frac{\text{FL} + 360^\circ - \text{FR}}{2}$$

Example:

$$\begin{aligned} \text{Zenith angle} &= \frac{82^\circ 35' 30'' + 360^\circ - 277^\circ 24' 20''}{2} \\ &= 82^\circ 35' 35'' \end{aligned}$$

- (4) Vertical angle

Obtain zenith angle as in 3) above, and subtract it from 90°.

N.B. The SDM3E has automatic zenith angle compensator. As far as the normal leveling of the instrument is done with the plate level, the compensated reading is obtained.

3. Distance measurement

(1) Preparation

- 1) Adjust the height of the reflecting prism with the four screws of the centering plummet so that the **TM 10 722C** mark is seen at the adjusting window. This is necessary to convert the slope distance to horizontal distance or to height difference.

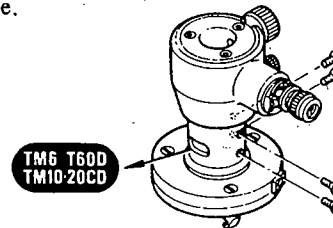


Fig. 32

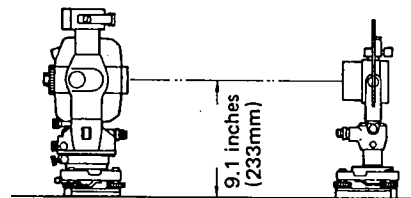
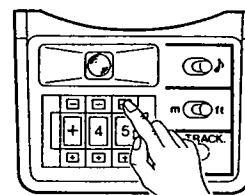


Fig. 33

- 2) Mount the internal battery No. 6850-01, see page 63.
- 3) Level the SDM3E and the reflecting prism.
- 4) Set the prism constant, earth-curvature and refraction correction, see page 60.
- 5) Set the atmospheric correction to the ppm setter

N.B. When the slope distance exceeds 6,561.66 ft (1,999.999m), see page 62.



Example: + 45 ppm

Fig. 34

- 6) Set the mode switch ⑬ to MEAS. for successive measurement, or to TRACK. for tracking.

MEAS: Successive
TRACK: Tracking

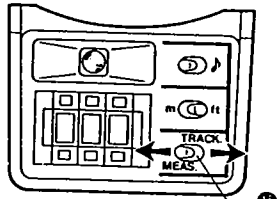


Fig. 35

- 7) Set the audio target acquisition switch ⑮ to \mathcal{A} , and the ft/m switch ⑭ to ft (feet).

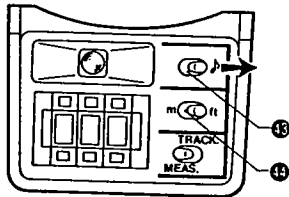


Fig. 36

- 8) Set the power switch ⑯ ON.
A short buzzing sound is heard when the power switch is ON.
Displays of Figs. 37 and then 38 show that the instrument is in normal condition.

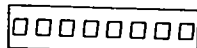


Fig. 37

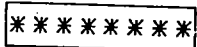


Fig. 38

1 second

- N.B. 1. If no keys were operated for more than 10 seconds after the power is ON, display of Fig. 38 is replaced by that of Fig. 39.

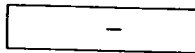


Fig. 39

N.B. 2. If Fig. 40 appears on the display after the power is ON, or while distance measurement, replace the battery with the charged one or charge the battery.

BAT LOW

Fig. 40

N.B. 3. For unusual happening, refer to "2. Distance measuring function" on page 84.

- 9) Sight the center of the target with the telescope.
 - a. When the reflected light is caught by the telescope, buzzing sound is heard.
 - b. When the received light intensity is suitable for the SDM3E, the light value lamp ● lights up.

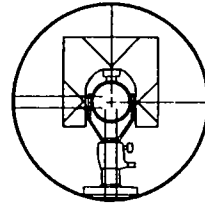


Fig. 41


N.B. 1. When the Light intensity coming back from the prism is very high, the light value lamp may light up even for a slight mis-sighting. Make sure that the target center is sighted correctly, Fig. 41.

N.B. 2. The reflecting prism w/ target plate (one prism) is designed for use at more than 10m distance. For distance less than 20m, the prism should be directed to the instrument carefully and the target center should be sighted correctly. It is recommended that the target is directed to the instrument even for the longer distance.

10) Switch off the audio target acquisition.

11) The SDM3E is now ready for slope distance measurement.

(2) Measuring the slope distance

- 1) Press the start-stop switch 

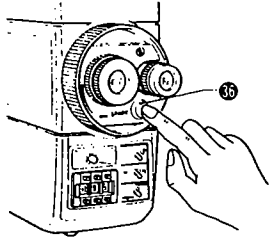


Fig. 42

- 2) For successive measurement, the slope distance is measured and displayed every 4 seconds.

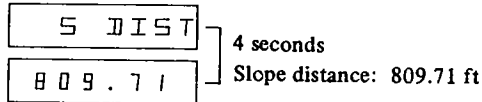
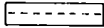



Fig. 43

When  is displayed, see page 85.

- 3) To stop measurement, give another press to the start-stop switch, or press  key.

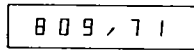



Fig. 44

- N.B. 1. Make sure a short buzzing sound is heard after every keying and measurement.
- N.B. 2. Maximum display for the slope distance is 6,561.66ft (1,999.999m).
For the longer slope distance, see page 62.
- N.B. 3. To measure other target, press the start-stop switch or  key. Then start sighting the target.
- N.B. 4. If two minutes have passed with or without any key operation after power is switched ON, the power is OFF automatically, and all the stored data are lost. OFF the power switch once, then ON.

(3) Keyboard operation

1) To input angle

a. Zenith angle (Example 1: $82^{\circ}46'30''$)

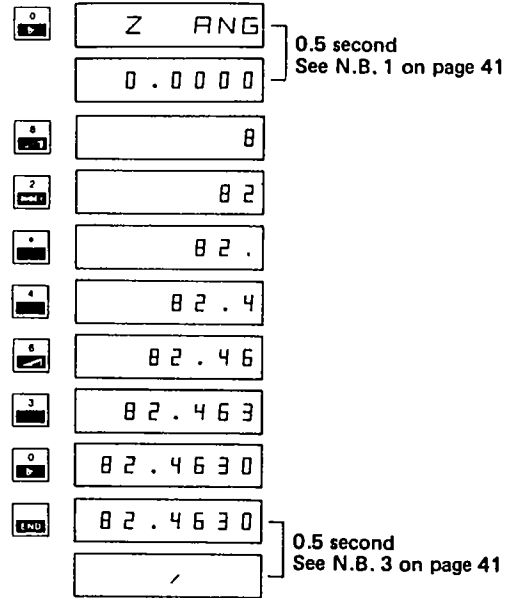
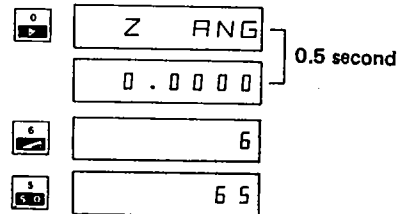


Fig. 45

Input of the keyed-in angle is done when \rightarrow key is pressed.

(Example 2: 65°)



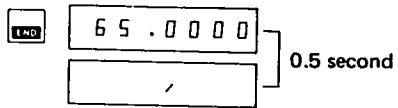


Fig. 46

When 65°00'00" is keyed in, the result is the same as above.

(Example 3: 91°28'30.5")

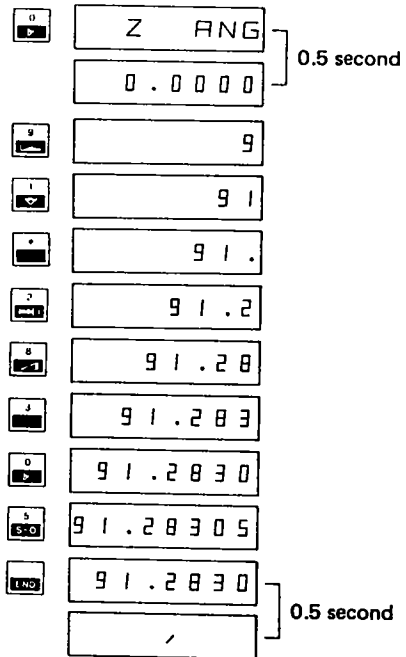


Fig. 47

Fractions of a second can not be keyed in.

b. Horizontal angle (Example: $74^{\circ}53'20''$)

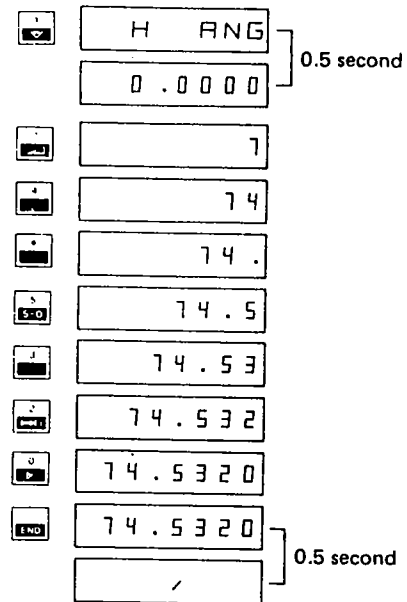


Fig. 48

The range of angle is between 0 and $999^{\circ}99'99''$. Angle less than 0° is not accepted as an input.

When an angle larger than 360° is keyed in, the angle is converted to its equivalent less than 360° . However, the display is kept to the keyed-in figure.

Example: $585^{\circ}46'90''$ is converted to $225^{\circ}47'30''$.

By pressing $\left[\frac{0}{\rightarrow} \right]$ or $\left[\frac{1}{\leftarrow} \right]$ key,

$\left[585.4690 \right]$ is displayed.

- 2) To input stake-out data
 Stake-out data is a given distance or coordinate where a stake is supposed to be driven into the ground.
 The SDM3E displays the result of measured distance minus the given distance (stake-out data).
 (Example 1: 552.29 ft)

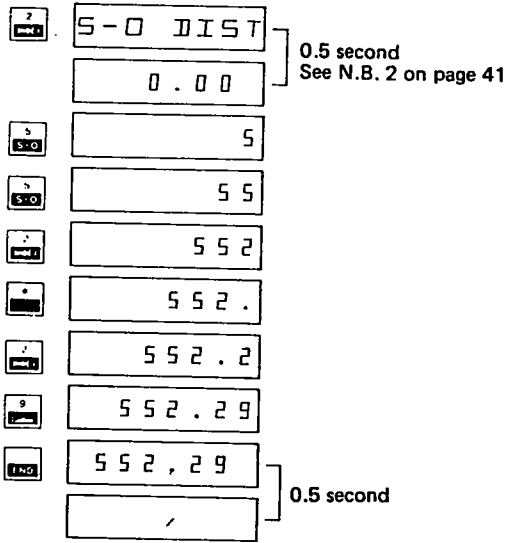
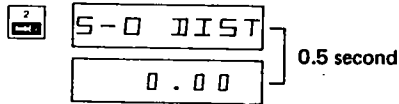


Fig. 49

(Example 2: 300ft)



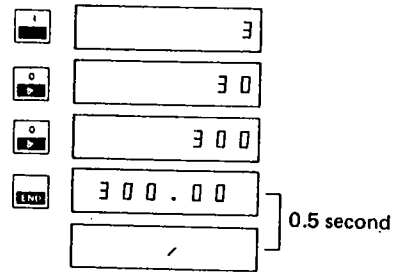


Fig. 50

The same effect results if 300.00 ft is keyed in. The range of stake-out data is between - 999.99 and 9,999.99 ft (- 999.999 and 9,999.999 m). Length less than 0.01ft (0.001m) is not accepted as an input.

3) To correct the input

a. Correction before the [END] key is pressed.

Example: to correct 1°20'40" to 81°20'00"

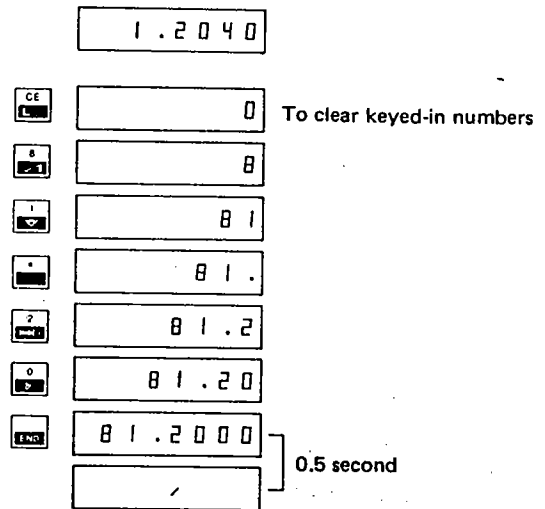



Fig. 51

- b. Correction after the  key is pressed.
 Example: to correct $1^{\circ}20'40''$ to $81^{\circ}20'00''$

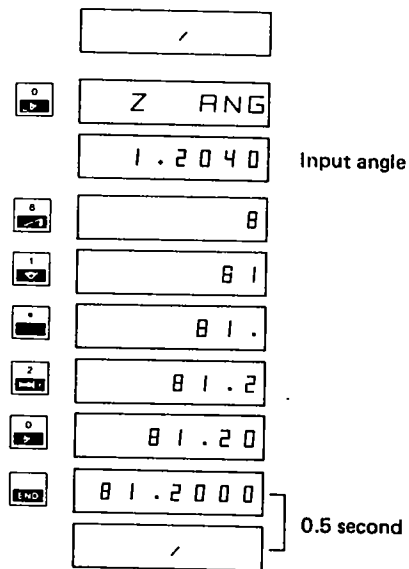



Fig. 52

- c. Correction of the stake-out data is the same as above.

- 4) To stop keying angle or stake-out data in
 Example: zenith angle $78^{\circ}56'30''$ has been keyed in. To stop storing a new angle 75° , just press  key.

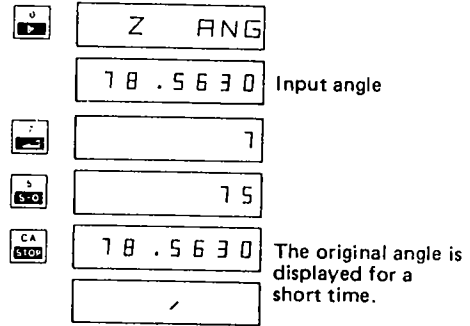







Fig. 53

The original angle $78^{\circ}56'30''$ is kept in the instrument when  key is pressed.

Press ,  or  key to input the next angle or stake-out data.

- 5) When angle over $999^{\circ}99'99''$ or stake-out data over 9,999.99 ft (9,999.999 m) or under -999.99 ft (-999.999 m) is keyed in and  key is pressed, the display flashes.

(Example 1: zenith angle $2,000^{\circ}50'$)



Fig. 54

(Example 2: stake-out data 10,001 ft)

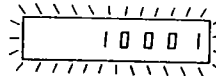



Fig. 55

To input the correct figures, press  key and key in the correct figures.

