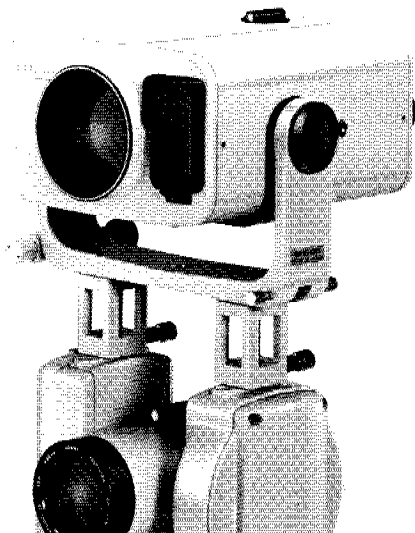


PENTAX[®]

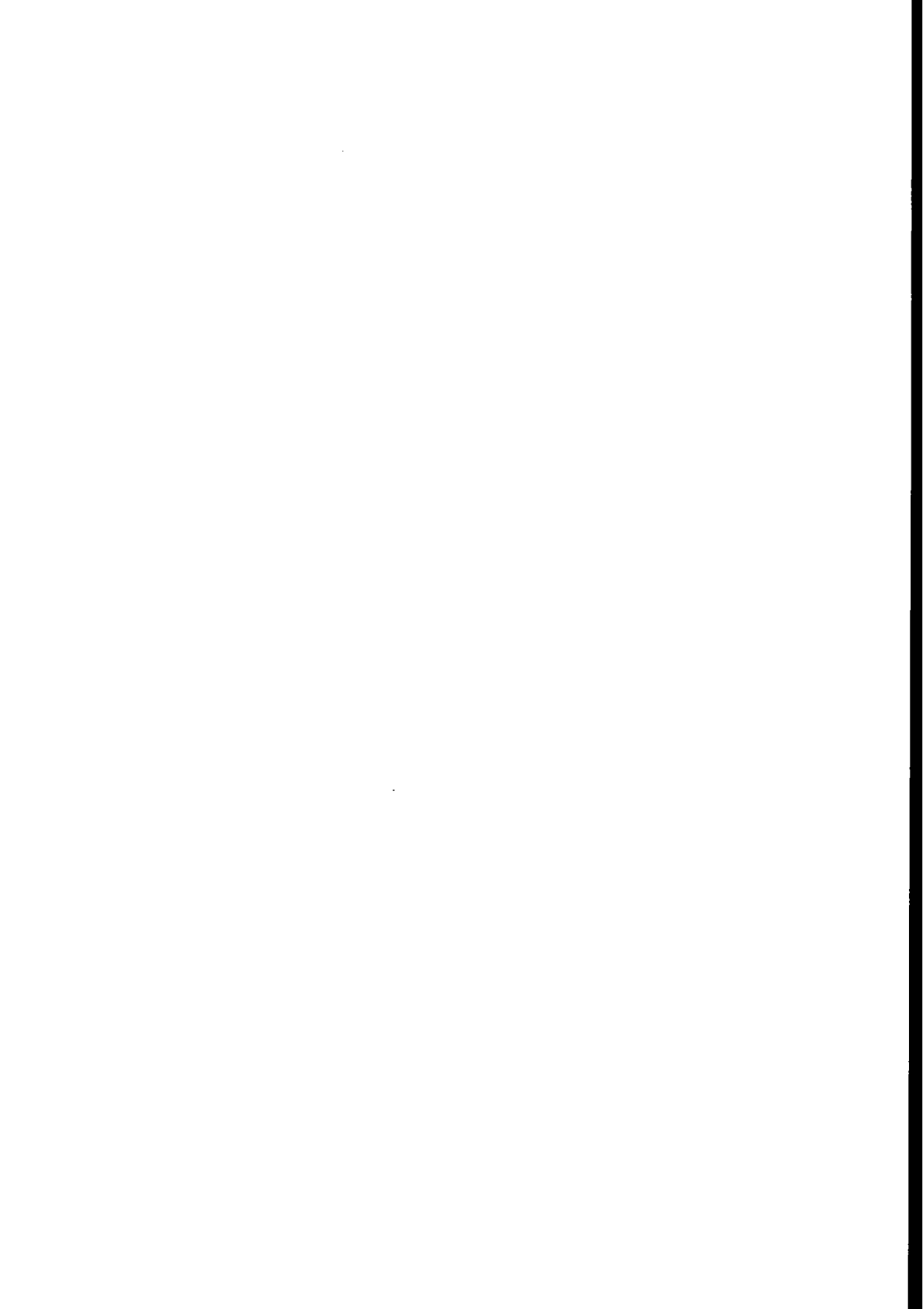
ELECTRONIC DISTANCE METER

MD-14 MD-20

INSTRUCTION MANUAL



ASAHI PRECISION CO., LTD.



The PENTAX Electronic Distameter MD-14/MD-20 are of the highest quality and design. We therefore, recommend that you read the instruction manual very carefully so that you will appreciate the full capabilities of your PENTAX precision instrument.

and ensure years of trouble-free operation. To prevent accidental damage to your PENTAX EDM, please adhere to the following notes which have been constructed to help you in maintaining your instrument in a precise functioning condition.

Environmental Conditions

- Avoid to aim the objective lens directly at the sun. Direct sunlight, focused through the objective lens, may cause the damage to internal components.
- Avoid leaving it at high temperatures for a long time. High internal temperatures may cause deterioration and affect its distance measuring performance.
- Avoid using it on rainy days because it contains electrical parts, or keep it shielded from the rain as much as possible.

- Avoid subjecting it to rapid changes of temperature, i.e. do not suddenly carry it to the cold open air from a warm place. This causes distortion or generates condensation inside. This will cause temporary deterioration of distance measuring performance.
- In poor weather conditions, distance measurement requires more time and an increase in the quantity of prisms.

Battery Charging

- When charging the on-board battery MB18 or the external battery (MB22), be sure to use the PENTAX on-board battery charger (MC-17, MC-16) or the PENTAX external battery charger (MC-22) respectively.

- Charge on-board battery at the room temperatures of +10~40°C / 50~+104°F (external battery 0~+45°C / +32~113°F.) Otherwise, normal charge may not be possible.

Shutdown

- After use, clean away dust and moisture and store in dry place not subject to considerable temperature change.
- When not in use for extended periods, take it out of the case occasionally and expose it to the fresh air.

- When not in use for extended periods, be sure to remove the on-board battery from the instrument and store it separately. Also, take the instrument out of the case occasionally and expose it to the fresh air.

Transport

- Be careful not to subject it to impact or vibration during transport by a contractor, and use a good packing material.

- Transport in carrying case supplied.

Attaching Tripod

- When attaching or detaching the instrument to or from the tripod, be sure to hold it with one hand.

The quality of tripod used is very important for measuring accuracy.

Other Points

- If repair is necessary, contact your dealer. Do not attempt to repair it yourself.
- It is recommended that the instrument be checked before going to field work, particularly in case that the instrument is not in use for an extended period.

- Avoid to disassemble the instrument by yourself even if the defect is found.

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1. Equipment

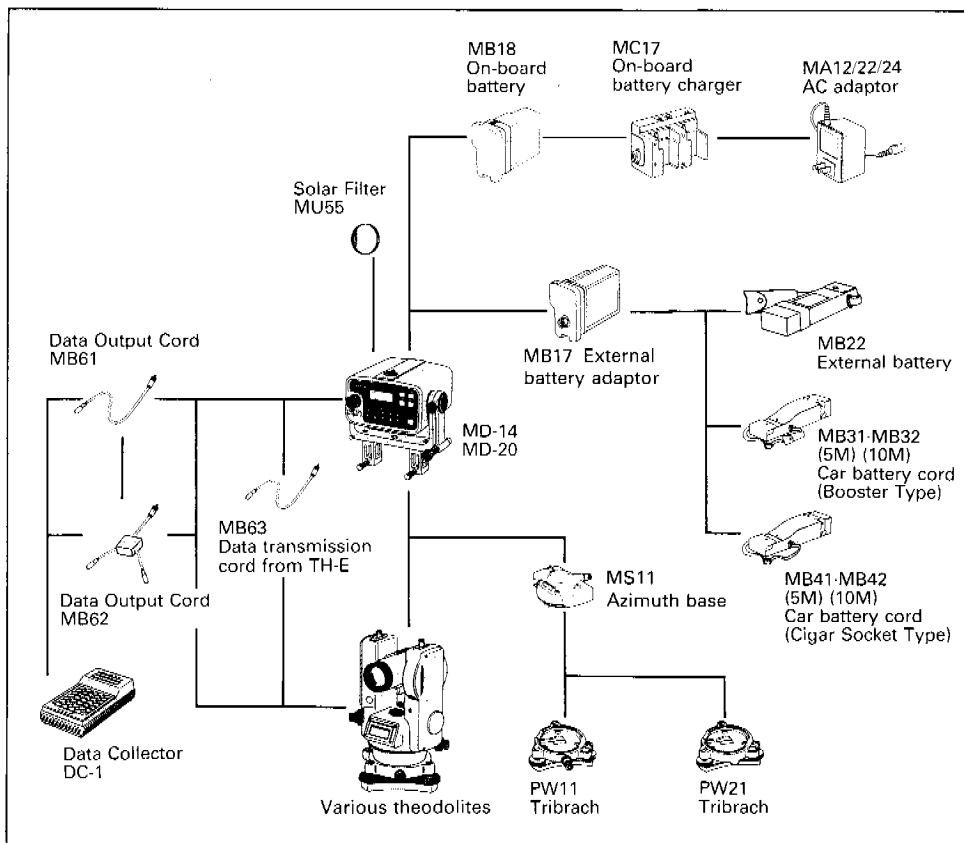
1 Standard equipment

Instrument (w/objective cap)	1
Sunshade	1
On-board battery (MB-18)	2
On-board battery charger (MC-17)	1
AC adaptor (MA 10)	1
Tool kits	1
(Cleaning brush, Hexagonal wrench	
Driver, Adjusting pin)	
Silicone cloth	1
Rain cover	1
Carrying case	1

2 Optional accessories

Data collector (DC-1)	
External battery adaptor (MB17)	
External battery (MB22)	
External battery charger (MC-22)	
Prism reflector system	
Pole adaptor	
Azimuth base	
Tribrach	
Solar filter	
Barometer	
Tripod	
Mount adaptor base (for TH-E/TH-D)	(MU-61)
Mount adaptor base (for TH-01W)	(MU-62)
Mount adaptor base	(MU-63)
(for TH-20WA/10WA)	

Diagram of standard combination of accessories



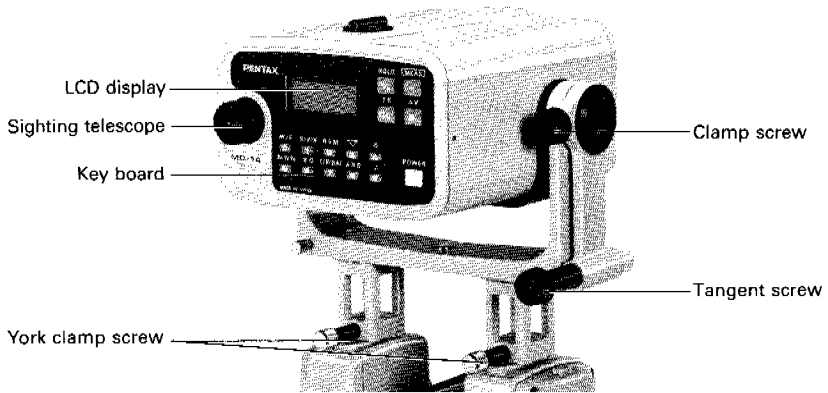
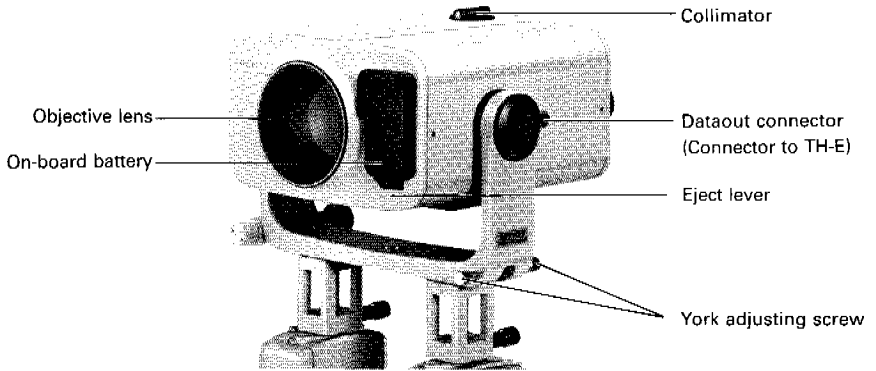
2. Specifications

1 Instrument (MD-14, MD-20)

Measuring range		Display	LCD Dot Matrix 2 lines (w/back-up illumination)
MD-14	1 prism : 1,000m/3,300ft. 3 prisms: 1,400m/4,600ft.	Combination of display	SLP/HOR, VER/Z, N/E,
MD-20	1 prism : 1,400m/4,600ft. 3 prisms: 2,000m/6,600ft.	Telescope	Coaxial with beam axis Magnification: 11 ×
Accuracy	+ (5mm + 5ppm) m.s.e.	Tilting range	± 40°
Least count	Fine mode: 1mm/0.003ft Tracking mode: 10mm/0.01ft.	Data-out function	RS-232C standard Baud rate: 1200/2400 Data length: 7 bit/8 bit Parity: ON (even)/OFF Stop bit: 1 bit/2bit (Selectable with internal switch)
Measuring time	Fine mode: 5 sec. Tracking mode: 1 sec.	Automatic -power-off function	Power-off 10 minutes after suspension of key operation ON/OFF selectable with internal switch
Measuring method	Repeat measurement	Ambient temperature range	-20°C ~ +50°C / -4°F ~ +122°F
Display	up to 7999.999m	Dimensions	172(H) × 185(W) × 178(D)mm/ 6.8(H) × 7.3(W) × 7.0(D)inch 2.2 Kgs./4.9 lbs.
Atmospheric correction (w/memory function)	Temperature: 1°C or 1°F step Pressure: 1mmHG or 0.1inHg step	Weight	
Prism offset correction (w/memory function)	1mm step (-99 ~ +99mm)	2 On-board battery (MB18)	
Averaging function	Display of averaged value of distance (3 or 5 times selected by internal switch)	Power source	Ni-Cd battery (rechargeable)
Stake-out function	Display of (measured value - setting value) ON/OFF selectable with internal switch	Output voltage	DC 8.4V
Earth curvature and refraction correction	ON/OFF selectable with internal switch	Operation time	60 minutes (continuous use)
Atmospheric correction coefficient	0.14 or 0.2 selectable with internal switch	Weight	180g/0.4 lbs.
Measuring unit	Meter/Feet switcheable with panel key/priority of Meter or Feet selectable with internal switch (Conversion rate: 1m=3.280833ft.)	3 On-board battery charger (MC17)	
Remote elevation Function	Measurement of object height above the earth.	Input voltage	DC 9V
Missing line measurement Function	Measurement of horizontal distance and difference in height between two target points.	Charging time	8 hrs.
Instrument point compensation (For telescope mount type)	Compensation with vertical angle input (ON/OFF selectable with internal switch)	Working temperature range	+10 ~ +40°C / +50 ~ +104°F
Angle input	Vertical angle: 0-360° (1° step) or 0-399.999g (1cc step) Horizontal angle: ±999°59'59" (1" step) or +999.999g * Automatic angle input from TH-E10 (D)	Weight	100gs./0.2 lbs.
Vertical angle mode	Zenith 0/Horizontal 0 (selectable with internal switch)	4 AC adaptor (MA12/22/24)	
Coordinate Measurement Function	Determination of coordinate values of any desired points	Used in combination with on-board battery charger (MC17)	
Slope Reduction Function	Measurements of slope distance, horizontal distance and height in difference	Input voltage	AC120/220/240V
Angle unit	360°/400g (selectable with internal switch)	Input frequency	50/60Hz
		Output voltage	14V 300mA

3. Description

1 Nomenclature of Parts



2 Key board



Function of each panel key



To be used for Fine measurement (unit: mm)
(For numerical input, to be used to shift the cursor right.)



To be used to suspend the automatic light volume adjusting function when the level of light volume is unstable in MEAS, AV, or TR mode. (For numerical input, to be used to input () sign or to shift the cursor left.)



To be used for Tracking measurement. (unit: cm)
(For numerical input, to be used to clear the entered value.)



To be used to average the measured distance of 3 or 5 times. (Unit: mm)
(For numerical input, to be used to enter the value of temperature, atmospheric pressure, stake-out setting and instrument coordinates.)



To be used to convert display in the unit of meter into feet, or vice versa. The conversion is made alternately each time the key is pressed.
(For numerical input, to be used to enter "0".)



To be used to select display mode. Slope distance (SLP)/Horizontal distance (HOR), Vertical distance (VER)/Elevation in height(Z) and N coordinate(N)/E coordinate (E) are displayed in turn.
(For numerical input, to be used to enter "1".)



To be used to measure remote elevation.
(For numerical input, to be used to enter "2".)



To be used to measure the horizontal distance and height difference between two target points.
(For numerical key, to be used to enter "3".)



To be used to illuminate the display panel and the reticle.
(For numerical input, to be used to enter "4".)



To be used to enter coordinate values of instrument point or to recall the values entered for confirmation.
(For numerical input, to be used to enter "5".)



To be used to set the specified distance or to recall the specified distance entered.
(For numerical input to be used to enter "6".)



To be used to recall temperature, atmospheric pressure entered for alteration of value or confirmation and to check the remaining battery capacity.
(For numerical input, to be used to enter "7".)



To be used to recall the vertical and horizontal angles entered for alteration or confirmation. The function of this key does not work when the angle is automatically input from TH-E10 series
(For numerical input, to be used to enter "8".)



To be used to cut off the buzzer when MEAS or TR mode is in operation.
(For numerical input, to be used to enter "9".)

4. Operating instructions

1 Mounting

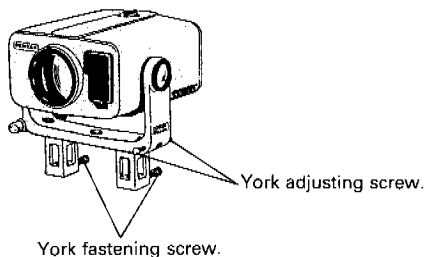
[1] Combination use with theodolite

- ① Mount the theodolite on the tripod, level and center in over the point.
- ② Loosen the york fastening screws and set the yorks on the mounting studs of the theodolite.
- ③ Tighten the york fastening screws.

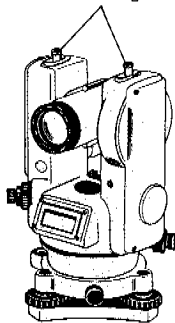
* The theodolite having the EDM mounting studs is required.

* For leveling and centering the theodolite, refer to the instruction manual for theodolite.

* Azimuth base (optional accessory) is available for setting EDM.



EDM mounting studs.



2 Distance measurement

[1] Power on

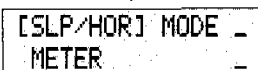
- ① Turn the power switch on the keyboard on.



All display segments light.



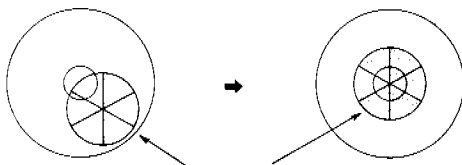
Self-check mode



No internal problem

[2] Prism Collimation

- ① Look through the collimator and roughly sight the instrument at the target.
- ② Look through the telescope and collimate on the center of the reflecting prism.



Prism, or where the prism is believed to be.

* The appropriate distance measurement mode should be chosen according to the objective and required precision.

[Fine measurement] (mm units)

① Press



```
-SLP      25  -
-HOR      -   -
```

If the scope is properly collimated at this time (i.e., reflected light is received), a buzzer will sound and a two-digit number will appear at the top right of the display. The number will gradually increase according to the amount of light received. When the number stops rising and holds steady, an asterisk (*) will appear to indicate that preparation is completed. The distance will be displayed several seconds later.

```
*SLP      45  -
*HOR      -   -
```

“■” : A Pentax TH-E Electronic Theodolite is connected.

“-” : A Pentax TH-E Electronic Theodolite is not connected.



```
*SLP 1261.631M□
*HOR 1120.201M_
```

SLP 1261.631M- Slope distance (in mm units)
 HOR 1120.201M- Horizontal distance (in mm units)

- In this example, the vertical angle has been entered.
- Measurement will be repeated at five second intervals and the distance is displayed when the buzzer sounds briefly.
- The light level reading will change with the different distance and weather conditions. Automatic measurement is possible, however, after the maximum value is obtained and the asterisk (*) displayed. Depending on the distance, the asterisk (*) may be displayed after the light level reading drops slightly from the maximum.
- The hyphen (-) on the right end of the top row is displayed until a sufficient light level is received as determined by the automatic light level sensor. The asterisk (*) is displayed when this light level is obtained.

[Tracking Measurements] (cm units)

① Press the



key.

```
*SLP 1261.63 M_
*HOR 1120.20 M_
```

SLP 1261.63 M- Slope distance (in cm units)
 HOR 1120.20 M- Horizontal distance (in cm units)

- In this example, the vertical angle has been entered.
- Measurement will be repeated at each one second interval and the value displayed when the buzzer stops.

[Average Distance Measurements]

Each distance measurements (in mm units) and the number of measurements made will be displayed, the average of all measurements will be displayed, and stay on the display.

Either three or five readings can be taken for average distance measurements. Selection is made with an internal switch. (See page 19 for internal switch descriptions.)

① Press



For an average of 3 readings

```
*SLP1 1260.641M_
*HOR1 1120.201M_
```

1st measurement



```
*SLP2 1260.642M_
*HOR2 1120.203M_
```

2nd measurement




```
*SLP3 1260.640M_
*HOR3 1120.200M_
```

3rd measurement



```
A-SLP 1260.641M_
A-HOR 1120.201M_
```


Average of 3 measurements

- The average is displayed when the buzzer stops.
- Press the  key again to repeat the averaging sequence.

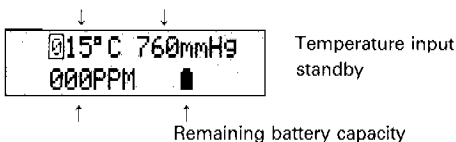
[3] Temperature and pressure input

The temperature and pressure are initially set to a standard 15°C, 760 mmHg (59°F, 29.9 inHg). If these settings are applicable to the current conditions, the following procedure may be skipped.


Ex.1: Set temperature to -10°C, pressure to 740 mmHg.

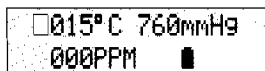
- ① Press  to set the temperature, pressure input mode.


Temperature pressure

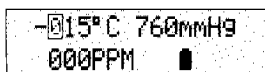


Compensation coefficient (PPM)

- ② Press  to shift the blinking cursor one digit left.




- ③ Press  to enter the minus [-] symbol.

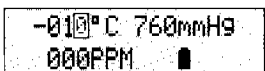


- ④ Press   

to input [0] [1] [0].

 can also be pressed to shift the cursor

right to change only that digit which differs from the one displayed.

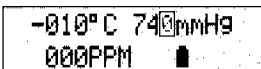


- ⑤ Press 



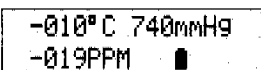
Standby for pressure input.


- ⑥ Enter the pressure similarly to the temperature. In this example, press

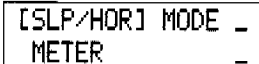


- ⑦ Press 


The atmospheric constant will be calculated from the temperature and pressure values just entered and displayed in ppm (parts per million) units.




- ⑧ Press  to terminate temperature and pressure input.

Ex.: 

Returns to previous display mode
Note that displayed values will be those entered during set-up. The values but above may be displayed.

- Press  to recall and confirm the temperature and pressure settings. Be sure to press

 three times after confirming the values to re-enter them before resuming the previous operation.

- Temperature and pressure settings will be retained after the power is turned off.

- With the internal switch for atmospheric correction off, temperature and pressure can not be input. Only the remaining battery capacity is displayed. To return the previous display mode,

press 

Ex.2: Set temperature to -10°F , pressure to 29.0 inHg

- ① Press **T/P/BAT** **7** to set the temperature, pressure input mode.

Temperature Pressure

59°F 29.9 inHg Temperature
000PPM 15 input standby

↑ Compensation coefficient (PPM) ↑ Remaining battery capacity

- ② Press **HOLD** **←/→** to shift the blinking cursor one digit left.

059°F 29.9 inHg
000PPM 15

- ③ Press **HOLD** **←/→** to enter the minus (-) symbol.

-059°F 29.9 inHg
000PPM 15

- ④ Press **M/F** **0** **S/V/N** **1** **M/F** **0** to input(0)(1)(0).

⑤ Press **AV** **E**

-010°F 29.9 inHg Standby
000PPM 15 for pressure input.

- ⑥ Enter the pressure similarly to the temperature.

In this example, press **REM** **2** **9** **M/F** **0**

-010°F 29.0 inHg
000PPM 15

⑦ Press **AV** **E**

-010°F 29.0 inHg
-033PPM 15

[4] Prism constant input

The prism constant is set to a standard -30 mm. If a different prism is used, reset the prism constant to that of the prism in use.

The prism constant is set with an internal switch. Refer to page 21 [6], **Internal switches**, for prism constant entry.

- Note that the prism constant for all Pentax prisms is -30 mm.

[5] Angle input

The vertical angle and horizontal angle must be entered to measure the horizontal distance, vertical distance, coordinates, REM, and distance between points. These angles can be entered either manually or automatically.

- ① **Manual angle input**

Ex.: Vertical angle $78^{\circ} 19' 35''$

Horizontal angle $112^{\circ} 23' 45''$

- ② Press the **ANG** **8** key to select the angle input mode.

V **00.00.00.D**
H **0000.00.00.D**

- ③ Press the appropriate number keys to enter the angle.

M/F **0** **T/P/BAT** **7** **ANG** **8** **S/V/N** **1** **9**

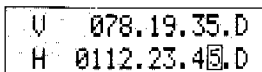
↔ **3** **NaEoZo** **5**

V **078.19.35.D**
H **0000.00.00.D**

- ④ Press **AV** **E** to enter the vertical angle.

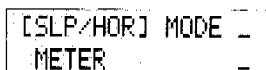
V **078.19.35.D**
H **0000.00.00.D**

④ Now enter the horizontal angle.



⑤ Press **AV** **E** to enter the horizontal angle.

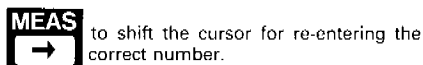
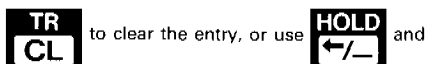
The current mode display will now appear.



■ The horizontal and vertical angles are obtained with the theodolite.

■ Enter the vertical angle as a seven digit number, the horizontal angle as an eight digit number.

■ If the incorrect number key is pressed, press



■ The vertical angle mode (zenith 0° or horizontal 0°) must be confirmed before entering the angle.

■ Press **ANG** **8** to recall and check the angle. Be

sure to press **AV** **E** twice after recalling an angle value to re-enter the value.

② Automatic angle entry

① Use a Pentax Theodolite model TH-E10 series to automatically enter the angle.

■ Function mode of **ANG** **8** does not work when the automatic input is in use.

■ If the theodolite power switches on or off during MD is in operation, the distance measurement will be interrupted and the display mode resumed.

■ If the 0 point of TH-E is not indexed, distance measurement is impossible.

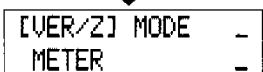
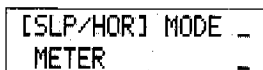
■ Do not connect or disconnect the data transfer cord to the MD or TH-E while the power is on.

■ Coincidence of the vertical angle mode (zenith or horizontal 0°) and the TH-E Electronic Theodolite mode is necessary. When the theodolite is connected, the vertical angle mode of the theodolite takes precedence.

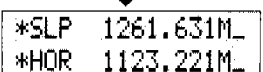
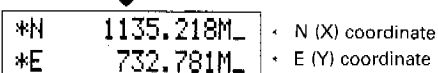
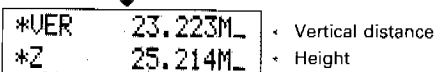
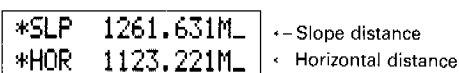
■ Adjust the D-G internal switch to transfer angles measured by the theodolite as either Degree or Grade.

[6] Conversion to another display mode

① At the initial display mode, press **S/V/N** **1** to change the mode display as shown below.



② Pressing **S/V/N** **1** during measuring will shift the display as shown below. Displayed values will be automatically converted and displayed.



- Press **MEAS** **→** , **TR** **CL** , or **AV** **E** to

select the desired measuring mode.

- The angles (horizontal and vertical) are assumed to be entered except when measuring the slope distance. The default angle is 0° 0' 0". Be sure to reset as required.
- The vertical and horizontal angles are automatically entered when a Pentax TH-E Theodolite is connected.

[7] Stake-out Measurements

The difference between the measured distance and the set distance can be displayed by first entering the set distance before measurement. This displayed value is: (the measured value-the set value).

Measuring with the Slope Distance

[SLP/HOR] MODE _
METER _

- ① Press **SO** **6** to set the stake-out mode.

S SLP 0000.000M
S HOR 0000.000M

- ② Press the number keys to enter the set distance. Ex.: If the slope is set for 85.000 meters. Enter the slope as described for entering the temperature and pressure.

M/F **0** **M/F** **0** **ANG** **8** **NoEoZo** **5**

S SLP 0085.000M
S HOR 0000.000M

- ③ Press **AV** **E** to set and terminate the slope entry.

S SLP 0085.000M
S HOR 0000.000M

- ④ Skip the horizontal distance measurement. Press

AV **E** to terminate entry.

[SLP/HOR] MODE _
METER _

- The display returns to the initial display mode.

⑤ Press **TR** **CL**

(Either the MEAS or AV measurement mode can be used, but the tracking (TR) mode is preferable for regular stake-out work.)

The difference between measured and set values will be displayed.

*SLP +2.50 M_
*HOR 0.00 M_

Indicates a measured distance is 2.5 m longer than a set distance.

*SLP -2.50 M_
*HOR 0.00 M_

Indicates a measured distance is 2.5 m shorter than a set distance.

- If a set value is entered, a lower case m will be displayed (normally an upper case M).
- The stake-out mode is available for any of horizontal distance, vertical distance, or coordinates measurement.
- The vertical angle is 0° 00' 00" in this example (horizontal 0° mode). This mode can also be used for coordinate measurements.

- To clear the set distance, press **SO** **6** , press

TR **CL** after the set distance is recalled and

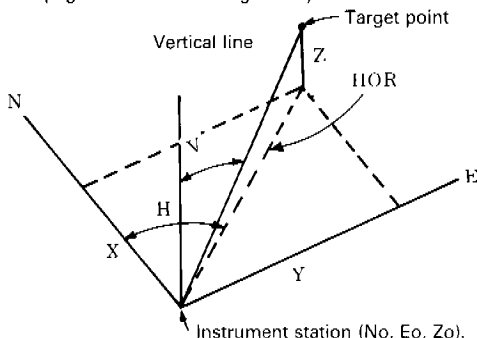
displayed, and then press **AV** **E** twice. Turning the power off will also automatically clear the set distance.

- When used with TH-E theodolite, horizontal distance is displayed in ⑤. But, this value has nothing to do with a set distance.

3 Coordinate Measurements

The coordinate values of any desired points can be determined using the position of the instrument as the No, Eo, Zo base point.

- The angle is entered automatically with Pentax Electronic Theodolite TH-E10 series.
- If the Electronic Theodolite is not used, refer to page 11 for manual angle entry.

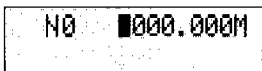


- If the instrument station coordinates are not [0,0,0], first enter the station coordinates to obtain the objective coordinates measured from the station.

[1] Instrument coordinates input

This procedure is not required if the instrument coordinates are No, Eo, Zo.

- ① Press **AV**
E



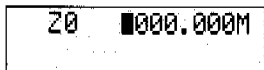
- ② Press the numeric key for the coordinate value to be entered. [Enter the N coordinate for the instrument.]

- ③ Press **AV**
E



- ④ Press the numeric key for the coordinate value to be entered. [Enter the E coordinate for the instrument.]

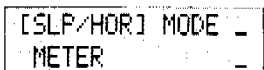
- ⑤ Press **AV**
E



- ⑥ Press the numeric key for the coordinate value to be entered. [Enter the Z coordinate for the instrument.]

- ⑦ Press **AV**
E

This completes station coordinate entry. The initial display mode will be resumed.



- Numbers are entered as are the temperature and pressure settings. (See page 16, [4] 1) Temperature and pressure input.)
- Entered coordinates can be recalled and con-

firmed by pressing **NoEoZo**
5. Be sure to press

AV
E again after recalling each coordinate to re-enter the value.

- To clear any coordinate setting, press **NoEoZo**
5 to

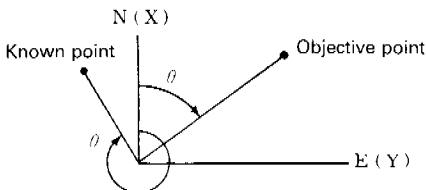
recall the values, and press **TR**
CL to

clear each value, and then press **AV**
E. Coordinates are automatically cleared when the power is turned off.

[2] Coordinate measurement

(Using the TH-E Electronic Theodolite Series)

- ① Loosen all clamp knobs, turn the horizontal rotation ring so the horizontal angle near the directional angle of the known coordinate is displayed, and then tighten the clamp knobs.



- ② Use the upper tangent screw to set the display to the precise directional angle of the known coordinate.

U 85.42.25.D ■
H 330.25.40.D_ ← Directional angle (θ)

- ③ Collimate the known coordinate using the lower clamp knob and tangent screw, and the telescope clamp knob and tangent screw.

U 75.25.30.D ■
H 330.25.40.D_

- ④ Collimate the objective point (prism) using the upper clamp knob and tangent screw, and the telescope clamp knob and tangent screw.

* U 80.30.30.D ■ ← Directional angles (θ) of objective point
* H 60.30.20.D_

- Enter the angle marked with * manually when using an optical theodolite.

- ⑤ Press **S/V/N** **1** to set the display mode.

[N/E] MODE ■
METER _

- ⑥ Press **MEAS** **→** to measure.

Then N coordinate and E coordinate of the objective point will be simultaneously displayed.

*N 65.253M ■ ← N coordinate
*E 127.573M_ ← E coordinate

- ⑦ Press **S/V/N** **1** twice to change the display mode.

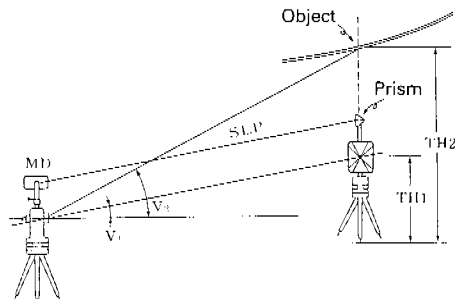
The Z coordinate of the objective point will be displayed.

*UER 3.215M ■ ← Z coordinate
*Z 25.720M_

④ REM: Remote Elevation Measurement

The REM mode can be used to quickly measure the height (h) of power transmission lines, bridge cables, and other targets on which the reflecting prism cannot be easily set.

- Earth curvature and atmospheric refraction correction is not possible during REM measurements.



- ① Set the reflecting prism directly below the target object, and measure the distance from the ground to the reflecting prism center with a tape.
Ex.: A ground to prism height of 1.453 m

- ② Press the **REM** **2** key to set the REM mode.

TARGET1 HEIGHT
TH1 0.000M

- The ground to target height will be requested.

- ③ Enter the height with the number keys

S/V/X **1** **4** **NoEoZo** **5** **←→** **3**

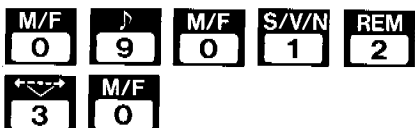
TARGET1 HEIGHT
TH1 1.453M

- ④ Press **AV** **E** to enter.

TARGET1 V-ANG.
V1 000.00.00.D

- The vertical angle to the target will be requested.
Ex.: A vertical angle of 90° 12' 30"

⑤ Enter the vertical angle with the number keys.



TARGET1 V-ANG.
U1 090.12.30.D

⑥ Press **AV E**

PLEASE MEASURE
SLP

■ You will be instructed to measure the slope distance (SLP).

⑦ Press the **MEAS** key.

-SLP 45
U1 90.12.30.D

*SLP 20.900M
U1 90.12.30.D

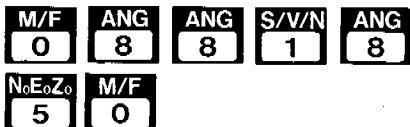
■ The slope distance is measured.

⑧ Press **AV E** to confirm and store the slope distance.

TARGET2 V-ANG. ← The V1 angle display will remain.
U2 090.12.30.D

■ The vertical angle to the object will be requested.

⑨ Collimate on the object with the theodolite. Enter the vertical angle with the number keys.
Ex.: Vertical angle of 88° 18' 50"



⑩ Press **AV E** The height from the ground to the object will be displayed.

TH2 2.144M ← Height of object from ground
U2 88.18.50.D

⑪ If there are a second, third, and successive objects, enter the vertical angle of the objects

with the **ANG 8** key. The height of the objects will be displayed.

⑫ To cancel the REM mode, press **REM 2** again.

[SLP/HOR] MODE, -
METER

■ The display mode will return and the REM mode will be cancelled.

Working with Electronic Theodolite TH-E10 series

Angle measurement and entry is automated with TH-E Electronic Theodolites, making operation easier and quicker.

① Press **REM 2**

TARGET1 HEIGHT ← The ground to prism height will be requested.
TH1 0.000M

Ex.: A ground to prism height of 1.453 m

② Enter the height with the number keys.



TARGET1 HEIGHT
TH1 1.453M

③ Press **AV E**

PLEASE MEASURE
SLP

↙ Displayed while data is being exchanged with TH-E10. Slope distance (SLP) measurement is requested.

④ Press **MEAS**

-SLP 45
U1 90.12.30.D

The vertical angle to the target will be automatically entered.

↓

*SLP	20.900M
V1	90.12.30.D

The slope distance is measured.

- ⑤ Press **AV**
E to confirm and store the slope distance.

TH2	1.453M
V2	90.12.30.D

■ TH2 and V2 will be displayed according to the vertical angle of Electronic Theodolite TH-E10.

- ④ When the theodolite is sighted at the object, the height of the object from the ground will be displayed.

TH2	2.144M
V2	88.18.50.D

- ⑦ To cancel the REM mode, press **REM**
2 again.

[SLP/HOR] MODE	■
METER	-

The display mode returns.

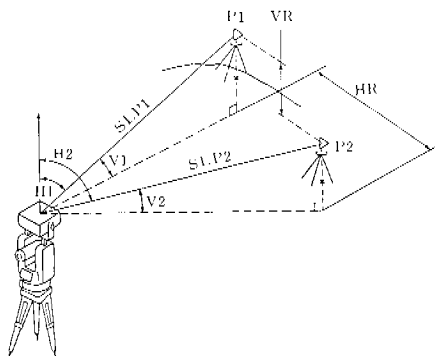
■ Measurement is impossible when following display appears during the REM measurement.

To release it, press **REM**
2 to return the display mode.

OVERFLOW PUSH REM KEY

5 Missing line measurement

When measuring the distance between two points, both the horizontal distance (HR) and the difference in height (VR) between the points is measured.



- ① Set a reflecting prism P1 and P2 at the two points between which the distance is to be measured.

- ② Press **3** to enter the missing line measurement mode.

V1	000.00.00.D
H1	0000.00.00.D

- ③ Collimate on target P1.

Ex.: V1 vertical angle 88° 55' 00"
H1 horizontal angle 64° 52' 00"

- ④ Input the vertical angle with the number keys.

M/F 0	ANG 8	ANG 8	XoYoZo 5	NoEoZo 5
------------------------	------------------------	------------------------	---------------------------	---------------------------

M/F 0	M/F 0
------------------------	------------------------

- ⑤ Press **AV**
E to enter the vertical angle.


- ⑥ Input the horizontal angle with the number keys.

M/F 0	M/F 0	SO 6	⊙ 4	NoEoZo 5	REM 2
------------------------	------------------------	-----------------------	----------------------	---------------------------	------------------------

M/F 0	M/F 0
------------------------	------------------------

- ⑦ Press **AV**
E to enter the horizontal angle.

PLEASE MEASURE SLP1

- ⑧ Press **MEAS**  to measure the slope distance to target 1.

```
-SLP      45  -
V1  64.52.00.D_
```

```
*SLP     12.384M_
V1  64.52.00.D_
```

- ⑨ After the slope distance is measured, press

AV
E

The distances to target 1, V1, and H1, will be stored.

```
V2  000.00.00.D
H2  0000.00.00.D
```

- ⑩ Collimate on the second target.


Ex.: V2 vertical angle 89° 56' 40"
H2 horizontal angle 86° 51' 30"

- ⑪ Input the angles with the number keys.

M/F 0	ANG 8	↔ 9	N ₀ E ₀ Z ₀ 5	SO 6	☉ 4
M/F 0	AV E	M/F 0	M/F 0	ANG 8	SO 6
N ₀ E ₀ Z ₀ 5	S/V/N 1	↕ 3	M/F 0		

- ⑫ Press **AV**
E to enter the vertical and horizontal angles.

```
PLEASE MEASURE
SLP2
```

- ⑬ Press **MEAS**  to measure the slope distance to target 2.

```
-SLP      43  -
V2  86.51.30.D_
```

```
*SLP     20.900M_
      86.51.30.D_
```


The slope distance will be displayed.

```
*HR      10.498M_
*VR     -0.214M_
```

Repeated measurements of horizontal distance and difference in height between two points is performed.

- ⑭ If there are additional points, collimate on the third point, press **ANG**
8, and repeat the procedure from step ⑩.


- The distance measured will be the distance from P1 to the third (or successive) point. The distance can be measured from P1 to any number of additional points.

- ⑮ Press  **3** to cancel the missing line measurement mode.

```
[SLP/HOR] MODE _
METER           _
```


(Using with the Electronic Theodolite (TH-E10 series))

- The angle will be automatically entered for easier operation.

- ⑯ Press  **3** to initiate the missing line measurement mode.

```
PLEASE MEASURE
SLP1
```

- ⑰ Collimate on target P1.

- ⑱ Press **MEAS**  to measure the slope distance to target 1.

```
-SLP      45  -
V1  88.55.00.D_
```

```
*SLP     12.384M_
V1  88.55.00.D_
```

- ⑳ After the slope distance is measured, press

AV
E

PLEASE MEASURE
SLP2

⑤ Collimate on the second target. P2.

⑥ Press **MEAS** to measure the slope distance to target 2.

-SLP 43
V2 86.51.30.0

*SLP 20.900M
V2 86.51.30.0

The slope distance will be displayed.

*HR 10.498M
*VR -0.214M

--The horizontal distance between the two points
--The difference in height between the two points

⑦ If there are additional points, collimate on the third point, and press **MEAS** to measure the missing line between the first and third points.

■ The horizontal distance and difference in height measured is always those between the first point and the point concerned.

The distance between P1 and any number of additional points can be measured.

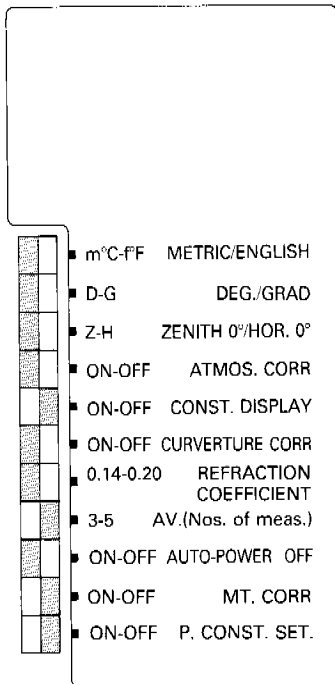
⑧ Press **3** to cancel the missing line measurement mode.

[SLP/HOR] MODE -
METER -

When the mode display returns, the missing line measurement mode is cancelled.

6 Internal Switches

The internal switches are factory-adjusted as described below. Before resetting any of the switches, be sure to first turn the power off. The internal switches can be accessed by removing the decorative plate and collimator.



- Use the tip of a fine screwdriver or similar object to reset the switches.
- Factory-adjusted switch settings may differ depending on the country to which the EDM is consigned.

[1] Setting the prism constant

The prism constant can be set anywhere from -99 to +99.

Ex.: To set a prism constant of -25 mm

- Switchover the prism constant switch to ON, and then turn the power switch on.

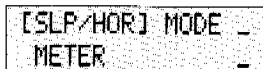


The current prism constant setting will be displayed.

- Enter the new prism constant with pressing.



- Press, **AV** **E** to enter the new setting.



- Switchover the prism constant switch OFF.
- Procedure completed.
 - The prism constant is factory set to -30 mm.

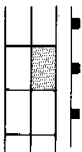
[2] Auto-power down function selection

The power is automatically turned off if there is no keyboard operation for about ten minutes in order to prevent unnecessary battery drainage. The auto-power down function can be cancelled by turning the switch to OFF if it is not needed.

- The auto-power down function is factory set to ON.

[3] Atmospheric correction cancel

The atmospheric correction settings can be ignored if the standard settings of 15°C(59°F), 760mmHg (29.9inHg), or 0 ppm are acceptable. Turning this function off will prevent accidental adjustments and resulting measurement errors.



ON-OFF ATMOS. CORR.

The standard setting of 0 ppm is fixed and the temperature and pressure settings cannot be changed when set to "OFF"

* Note on Atmospheric correction

The speed at which light passes through the atmosphere varies with temperature and pressure. Atmospheric correction is therefore required for precise measurements.

This instrument enables easy keyed entry of temperature and pressure for automatic conversion and display of the compensated value. Atmospheric correction is obtained according to the below formula.

$$K = (279.75207 - \frac{106.06631 \cdot P}{273.14941 + t}) \times 10^{-6}$$

Where K is the atmospheric correction coefficient, P is the atmospheric pressure (mmHg), and t is temperature (°C). Distance after atmospheric correction is $D = D_s(1 + K)$, where D_s is the measured distance before atmospheric correction.

[4] Constant display switch

The current temperature, pressure, prism constant, and remaining battery capacity can be automatically displayed after **SELF CHECK OK** appears.

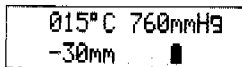


ON-OFF CONST. DISPLAY

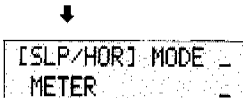
The following information is displayed when the power is turned on if the constant display switch is ON.
Power ON

↓
"SELF CHECK"

↓
Temperature Pressure




↑ ↑
Prism constant Remaining battery capacity



- The constant display switch is factory-set to OFF.

* The remaining battery capacity indicator

Press **T/P/BAT** to display  for confirming

the remaining battery capacity.



.....Enough capacity remained for about 50 minute operation.



.....About 30 minute more operation possible.



.....About 10~20 minute more operation possible.



.....The indicator will blink, indicating only 5 minute more operation possible.

* The remaining battery capacity indicator is available only when the on-board battery is in use.

[5] Atmospheric refraction and earth curvature correction switch

The effects of atmospheric refraction and earth curvature can be automatically corrected for measurement of horizontal distance and vertical distance. This atmospheric refraction and earth curvature correction can also be cancelled. The atmospheric refraction coefficient can also be set to either 0.14 or 0.2.



ON-OFF CURVERTURE CORR

0.14-0.2 REFRACTION COEFFICIENT

Atmospheric refraction correction is provided at 0.2 by setting a switch to 0.2 when the correction switch is ON.

No correction is provided when the switch is OFF.

■ Factory settings are: correction: ON, atmospheric refraction coefficient: 0.14.

* Note on Earth Curvature and Atmospheric Refraction Correction

Correction for atmospheric refraction and earth curvature is provided according to the following formula.

- If atmospheric refraction and earth curvature correction is ON:

Corrected horizontal distance

$$H = S (\cos \alpha + \sin \alpha \cdot \frac{K-2}{2Re} \cdot \alpha \cdot S \cdot \cos \alpha)$$

Corrected vertical distance

$$V = S (\sin \alpha + \cos \alpha \cdot \frac{1-K}{2Re} \cdot \alpha \cdot S \cdot \cos \alpha)$$

- If atmospheric refraction and earth curvature correction is OFF:

Horizontal distance $H' = S \cdot \cos \alpha$

Vertical distance $V' = S \cdot \sin \alpha$

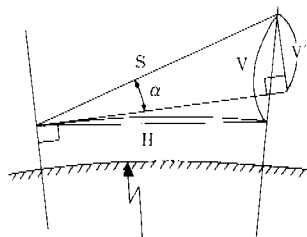
Where:

S: slope distance

K: atmospheric refraction coefficient (0.14 or 0.2)

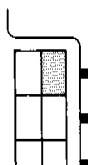
Re: radius of the earth (6,370 km)

α : vertical angle from horizontal



Re=6,370Km

[6] Units switch (meters, feet)



m°C-°F METRIC/ENGLISH

(m°C)

Measured distances are displayed in metric (m), temperature and pressure are displayed in °C and mmHg when the switch is set to m°C.

(°F)

Measured distances are displayed in English (f), temperature and pressure are displayed in °F and inHg when switch is set to °F.

[7] Number of averaged measurements

When the average mode is used, 3 or 5 measurements are automatically taken and averaged depending upon the position of this switch.

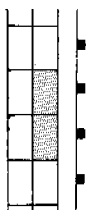


3-5 AV (Nos. of meas)

Three measurements will be averaged when the switch is set to 3.

- The factory setting is 5.

[8] Angle mode selection



D-G DEG./GRAD

Vertical angle is displayed with a 0° horizontal when set to H.

Z-H ZENITH 0°/HOR 0°

Angles are displayed in 400G when set to G.

[7] Error Message

Message	Contents	Solution
BATTERY	Battery capacity is low	Recharge the battery
ERROR 2	A keyboard problem, perhaps a short or contact in key action	Turn the power off, wait a moment, and then turn it on again. If the error message remains, repair is necessary.
ERROR 3 -- 6	A problem in the EDM section	
ERROR 8 -- 12	Some other mechanical or electrical problem	

- If a problem persists that is not due to improper operation, contact your local PENTAX dealer.

[8] Batteries

[1] On-board battery (MB18)

1) Attachment

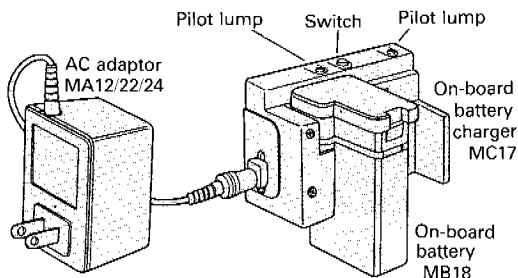
Properly align and insert the battery in the battery compartment on the objective lens side of the instrument until it clicks.

2) Removal

Press the eject lever down. The stopper will come off and the battery can be removed.

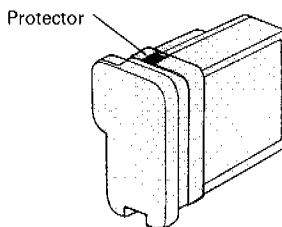
3) Recharging

- Remove the on-board battery from the instrument, and insert the battery along the guides into the MC17 battery charger.



- Plug the AC adaptor plug into the MC17 battery charger, and then plug the AC adaptor into a wall outlet.
- Turn the battery charger start switch on and make sure the pilot lamp where the battery is inserted lights.
- The battery charger is capable of accepting two batteries, and will recharge either one or two at a time.
- A second battery can be inserted after the battery charger has been started. In this case, be sure to press the start switch once again.
- The pilot lamp will go out in about 8 hrs. to indicate the battery is fully charged. Remove the battery. Additional batteries added after the battery charger has started will also be fully charged in 8 hrs. after the start button is pressed the second time.

- Each battery has a safety protector. Make sure the red mark is showing during recharging. No power can be drawn from the battery nor the battery can be recharged unless the red mark is showing.
- The MC17 battery charger is equipped with an overcharge prevention circuit. Do not, however, leave the AC adaptor plugged into the wall outlet after recharging is completed.

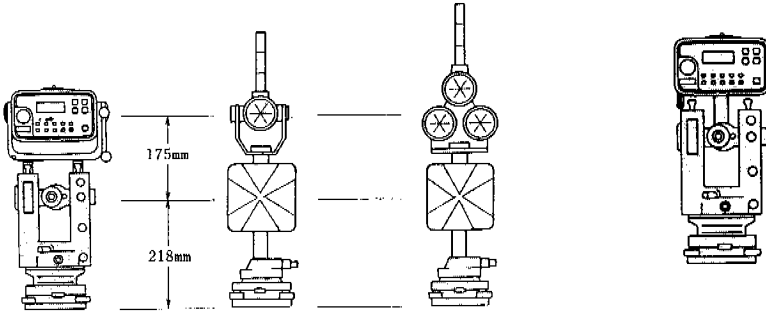


5. Optional accessories

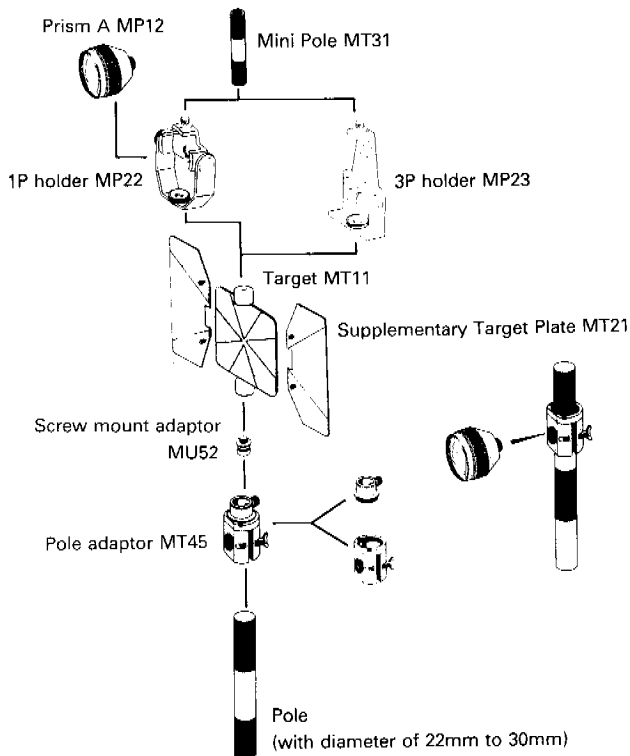
[1] Standard combination and the instrument height

[1] Use with the theodolite (standard mount type)

[2] Use with the theodolite (Telescope mount type)



[3] Pole adaptor



2 External power source

An external battery (MB22) and external battery adaptor (MB17) can be used for extended measurements.

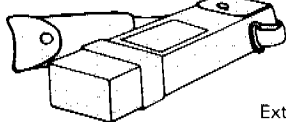
- ① Mount the external battery on a tripod, and connect the battery connector to the external battery adaptor. Now insert the adaptor into the battery compartment of the instrument.
- ② Turn the external battery power switch on.

[1] External battery (MB22)

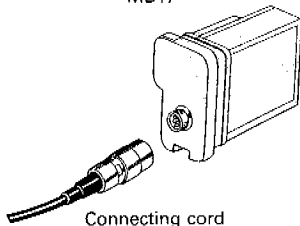
Power supply NiCd battery
(rechargeable)
Output voltage DC8.4V
Working time per charging 8 hrs.(continuous)
Length of power 2m
supply cord

[2] External battery adaptor (MB17)

External battery MB22



External battery adaptor MB17



Connecting cord

[3] External battery charger (MC22)

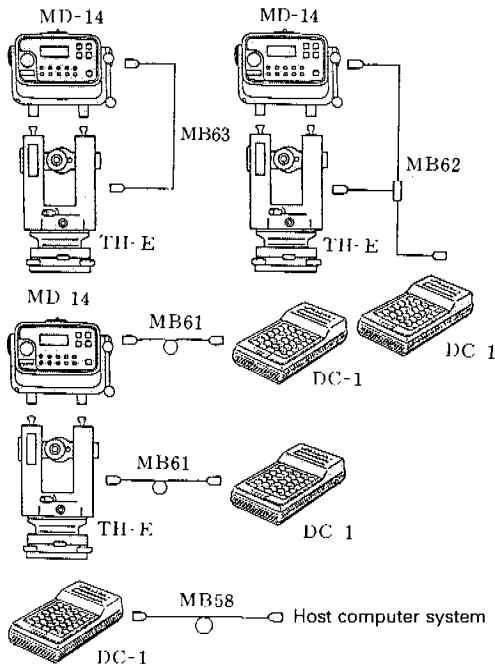
- ① Connect the external battery charger (MC22) to the external battery connector.
- ② Plug the external battery charger into a wall outlet.
- ③ Turn the external battery pack power switch on, and make sure the external battery charger pilot lamp lights.
- ④ Turn the power switch off after 14 ~ 16 hours, and disconnect the connector and plug. Recharging is completed.

* Do not recharge for more than 24 hours.

Input voltage AC120V or 220V
Input 50/60Hz
Charging time 14 ~ 16 hrs.
Working temperature 0°C ~ 45°C
(+32°F ~ 113°F)

3 Data communication with Data collector DC-1

When used with TH-E Series Electronic Theodolites, MD-14 can obtain angle data from the theodolite to measure horizontal and vertical distances without complex conversion equations (similar to a Total Station system). In addition, Data Collector DC-1 can be used to communicate data with a computer via the RS-232C interface and bidirectional communications system. Data collected in field measurements can also be stored in the DC-1 Data Collector for later transmission to a base computer, thereby automating and rationalizing a series of measurements.



- Refer to the Data Collector instruction manual for specifics on Data Collector connection and operation.
- Communications parameters between the Data Collector and host computer system will vary with the computer system. Refer to the communications protocols of the computer.

DC-1 Specifications

CPU	8 bit, C-MOS
Memory	64k bytes for programming and data storage
Display	LCD, 2 line, 16 characters/line
Power supply	Main: 4 × 1.5-V AA batteries (100 hrs. continuous operation) Lithium memory back-up battery (3 yr. service life)
Interface	Standard RS232C
Dimensions	210(H) × 100(W) × 35(D) mm
Weight	550g
Programs	Standard program built-in

6. Maintenance and Storing

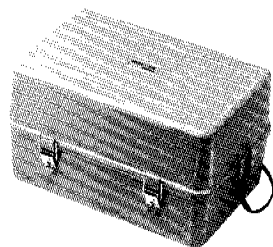
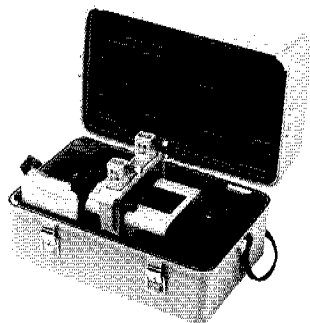
1 Maintenance

- ① After using the instrument, wipe off dust and moisture and store it in its case.
- ② When cleaning the exposed parts, first remove dust with the cleaning brush, then gently wipe with a soft cloth.
- ③ To clean the lens surfaces, first remove dust clean cotton cloth to which a small amount of alcohol has been applied. Be sure the cloth used is clean.

2 Storing

Store the instrument in the plastic case shown.

- Be sure not to store the instrument with the on-board battery



7. Inspection and Adjustment

1) Offset Constant

The offset constant can be obtained by checking the measuring accuracy on the certified base line. It can also be obtained in the following way.

■ Remember that any error in prism position, base line accuracy, collimation error, atmospheric correction, or atmospheric refraction and earth curvature will affect the precision of the inspection.

1) Checking

- 1) Locate points A, B and C at about 50m intervals on the even ground
- 2) Set up the instrument at point A, and measure distances AB and AC.
- 3) Set up the instrument at point B, and measure the distance BC.
- 4) Obtain the offset constant (K):

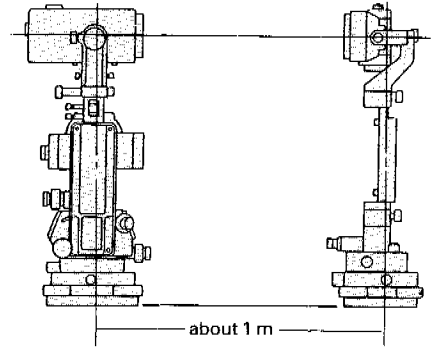
$$K = AC - (AB + BC)$$

■ After above checking is completed, please consult with your local dealer when the offset constant of nearly 0 is not obtained.

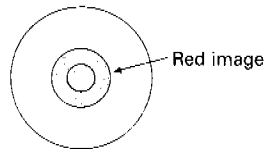
2) Checking of Alignment of Beam Axis and Line of Sight

Use the procedure below to check if the beam axis and the line of sight is aligned.

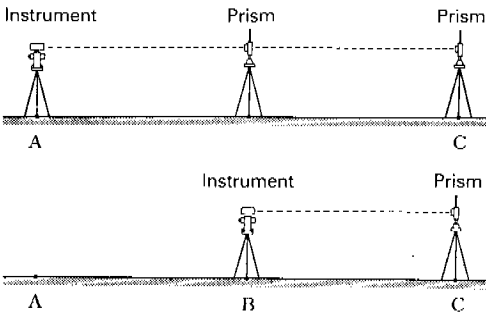
- 1) Set the instrument and a prism about 1 m apart. They should be on a straight line.



- 2) Turn the power switch on.
- 3) Measure the distance with the MEAS and TR keys.
- 4) Use the telescope and horizontal tangent screws to sight the EDM towards the point where the signal strength is maximum.
- 5) Look through the collimation scope eyepiece. A red image should be visible. There will be no problem with EDM accuracy if the red image almost overlaps the center circle of the collimation scope pattern.



If this is not the case, contact your Pentax dealer.



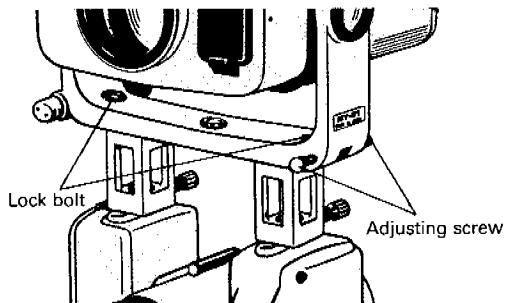
3) Parallelism of the theodolite line of sight and beam axis

1) Standard mount type (MY-01)

This adjustment is not necessary if target collimation for theodolite angle measurements and MD prism collimation for distance measurements are performed separately. This adjustment is necessary, however, if target collimation of the theodolite is used to eliminate the horizontal axis collimation (using the direction tangent screws) needed for distance measurement.

Adjustment

- ① Set the prism and target about 50 m away from the instruments, and collimate the theodolite on the target.
- ② Use the vertical tangent screw to collimate the prism (vertical).
- ③ Loosen the mount adaptor lock bolt (one each on right and left) with a hexagonal wrench (large).
- ④ Turn the mount adaptor adjustment screws to collimate the prism.
- ⑤ Tighten the lock bolts.



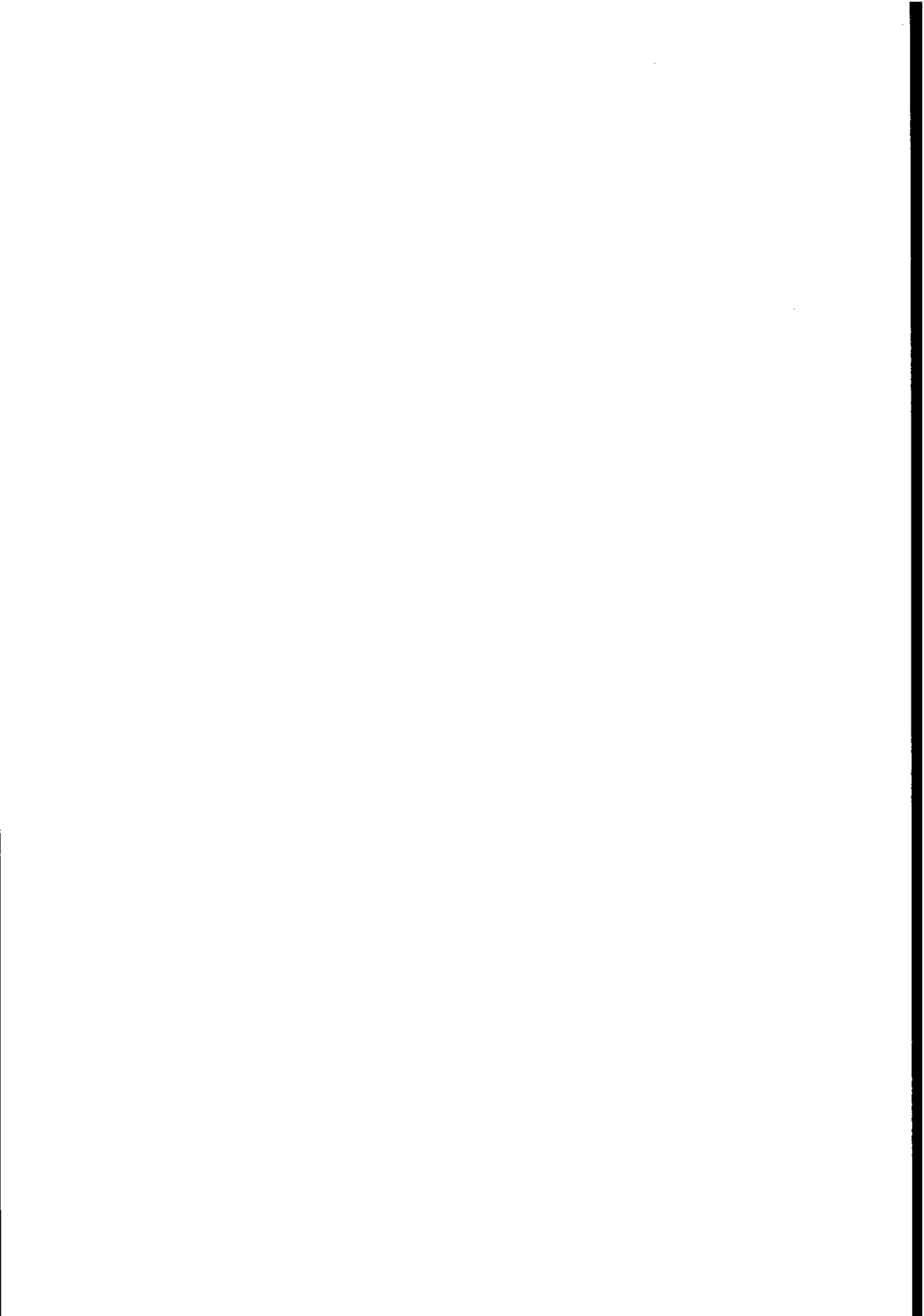
- Tighten one adjustment screw and then the other. The adjustment is completed when both are retightened.

2) Telescope mount type (MT-01)

Adjustment

- ① Set the prism and target for telescope mount type about 5 m away, and collimate the theodolite on the target.
 - ② Collimate the prism with the instrument collimation scope. Use the horizontal and vertical adjustment screws to adjust the horizontal and vertical, respectively, to compensate for prism error.
- Tighten one adjustment screw and then the other. The adjustment is completed when both are retightened.

The contents of this instruction manual may differ slightly from the specifics of the product due to on-going improvements in product specifications and performance. Please feel free to consult your dealer regarding any questions of differences you may find.



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