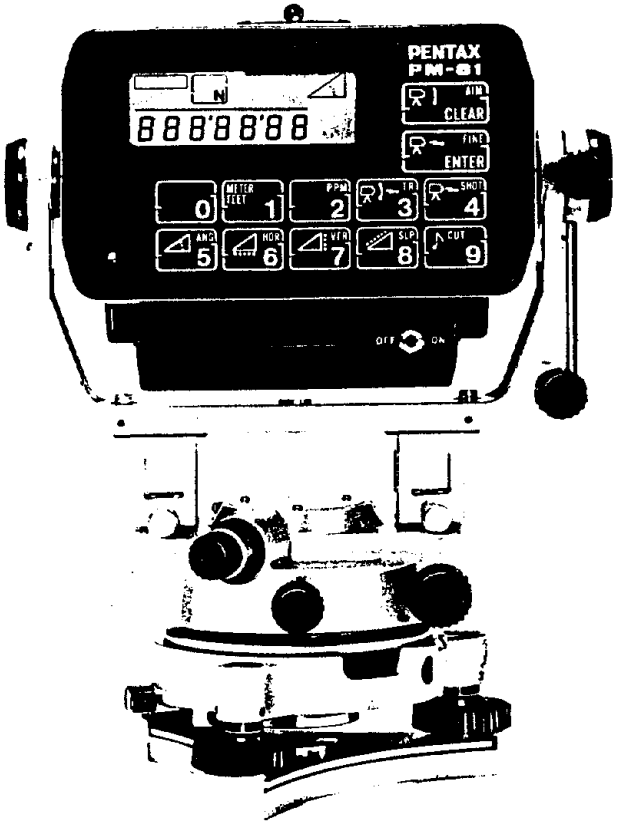
PENTAX

ELECTRONIC DISTANCE METER

PM-81

INSTRUCTION MANUAL



ASAHI PRECISION CO.,LTD.

he PENTAX PM-81 Electronic Distance Meter (EDM) is of the highest quality and design. We ould, therefore, recommend that you read the instruction manual very carefully so that you will ppreciate the full capabilities of your PENTAX precision instrument and ensure years of trouble-ee operation.

o prevent accidental damage to your PENTAX PM-81, please adhere to the following notes which ave been constructed to help you in maintaining your instrument in a precise functioning condi-on.

ironmental Conditions

Avoid leaving it at high temperatures for a long time. High internal temperatures may cause deterioration nd affect its distance measuring performance.

Avoid using it on rainy days because it contains ele-trical parts, or keep it shielded from the rain as much s possible.

Avoid subjecting it to rapid changes of temperature, .e. don't suddenly carry it to the cold open air from a warm place. This causes distortion or generates con-densation inside. This will cause temporary deterior-ation of distance measuring performance.

n poor weather conditions, distance measurement equires more time and an increase in the quantity of risms.

ming

The accuracy of aiming has an important effect on distance measuring accuracy.

If there is any delay or fluctuation of response to the return signal reception because of e.g. heat haze or large distance involved, aim using a return signal buzzer using method explained on page 12. Thereby, exact aiming can be done with ease.

ism Constant

The offset adjustment of the instrument has been made at the factory with prism constant set to −30 mm. If another prism is used, make the appropriate adjustment. See page 22 for offset adjustments.

se of An External Power Source

When using the external battery (include among opt-ional accessories) or a car battery, be sure to remove the on-board battery, otherwise, the external power ource will not be connected.

Battery Charging

- When charging the on-board batteries (MB 11) or the external battery (MB 21), be sure to use the PENTAX on-board battery charger (MC 11 or MC 12) or the PENTAX external battery charger (MC 21 or MC 22) respectively.
- Charge on-board batteries at the room temperatures of +10~+45°C (external battery: 0~+45°C). Otherwise, normal charge may not be possible.
- Upon charging, be sure to set the switch of the battery to ON and see that pilot lamp of the charger lights up.
- Charge on-board batteries for 4~6 hours. Charge external battery: 14~16 hours. **CAUTION** Do not charge on-board battery longer than 18 hours or external battery longer than 24 hours.

Shutdown

- After use, clean away dust and moisture and store in a dry place not subject to considerable temperature change.
- When putting it in the case, be sure to remove the battery.
- When not in use for extended periods, take it 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 packaging material.
- Transport in carrying case supplied.

Attaching to Tripod

- When attaching or detaching it to or from azimuth base or instrument, be sure to hold it in position until secured.
- The quality of tripod used is very important for measuring accuracy.

Other Points

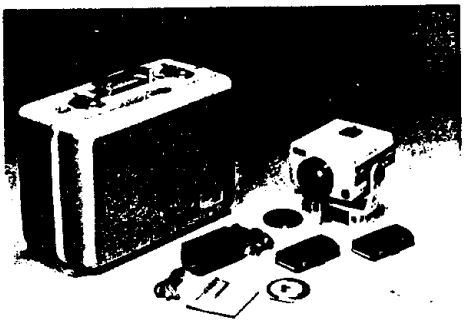
- Don't aim the objective lens directly at the sun. Direct sunlight, focused through the objective lens, may overheat internal components if exposure is continuous.
- If repair is necessary, contact your dealer. Do not attempt to repair it yourself.

CONTENTS

1. Equipment

[1] Standard Equipment

Body (PM-81) (w. yoke and objective lens cap) 1
On-board batteries (MB 11) 2
On-board battery charger (MC 11): 100V 1
(MC 12): 110V~220V
Atmospheric calculator (MU 11) 1
Set of tools (w. case) 1
(cleaning brush, hexagonal wrench×2, screw driver, adjusting pin×2)
Silicon cloth 1
Rain cover 1
Case 1



[2] Optional Accessories

- Various types of prism sets
- Tribrach
- Tribrach adaptor
- Supplementary target plate
- Mini pole
- External battery
- External battery charger
- Car battery cord
- Car battery charger
- Azimuth base
- Barometer
- Various types of tripods

2. Specifications

[1] Body (PM-81)

Measurement range:
1 prism: 1,400 m (4,590 ft.)
3 prism: 2,000 m (6,560 ft.)
Measurement accuracy: ±(5 mm +5 ppm) m.s.e.
Resolution:
FINE-measurement: 1 mm-1/1000 ft.
SHOT-measurement: 1 mm-1/1000 ft.
TR-measurement: 10 mm-1/100 ft.
Measuring time:
FINE-measurement: 5 sec. (automatic repeat measuring)
SHOT-measurement: 5 sec. (one-shot measuring)
TR-measurement: 1 sec. (automatic repeat measuring)
Indication:
Liquid-crystal, 7-digit numeric indication (up to 1999.999m)
Monitor indication:
Distance modes (slope distance, horizontal distance, vertical distance)
Measurement modes (FINE, SHOT, TR)
Operation indication (key function, vertical angle input, aiming)
Unit of measurement (ppm, meter, feet)
Atmospheric correction input: 000~999ppm (1~ppm step)
Vertical angle input: 0~360° (1~sec. step)
0~400 g (1 cc. step)
Offset constant compensation: −79 to +30 mm (1 mm step)
Selection function:
Mode of input vertical angle (zenith - 0°/horizontal -0°)
Unit of input vertical angle (DEG/GRD)
Units of distance measurement (meter/feet)
Calculation function:
Conversion of slope distance, horizontal distance and vertical distance
Aiming telescope:
Magnification: 6X
Field of view: 6.5 % (65 m/1,000 m)
Tilting angle: ±40° (±45 g)
Working temperature range: −20~+50°C
Dimensions: 184 (H)×212 (W)×191 (L) mm
Weight: 2.7kgs/5.9 lbs.

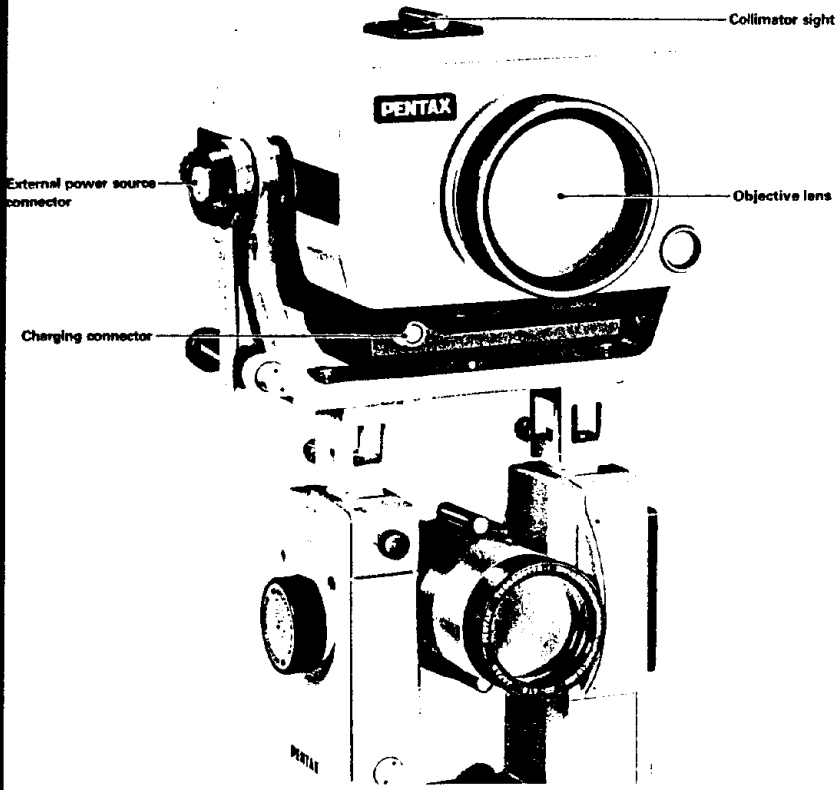
[2] On-Board Batteries (MB 11)

Power supply: NiCd batteries (rechargeable)
Output voltage: DC 8.4V
Operation time per charging: 50 min.
Weight: 0.3 kgs/10 oz.

[3] On-Board Battery Charger (MC 11 or MC 12)

In put voltage: AC 100~220V
Input frequency: 50/60 Hz
Charging time: 4~6 hrs.
Working temperature range: +10~+45°C
Weight: 0.5kgs/1 lb.

3. Parts

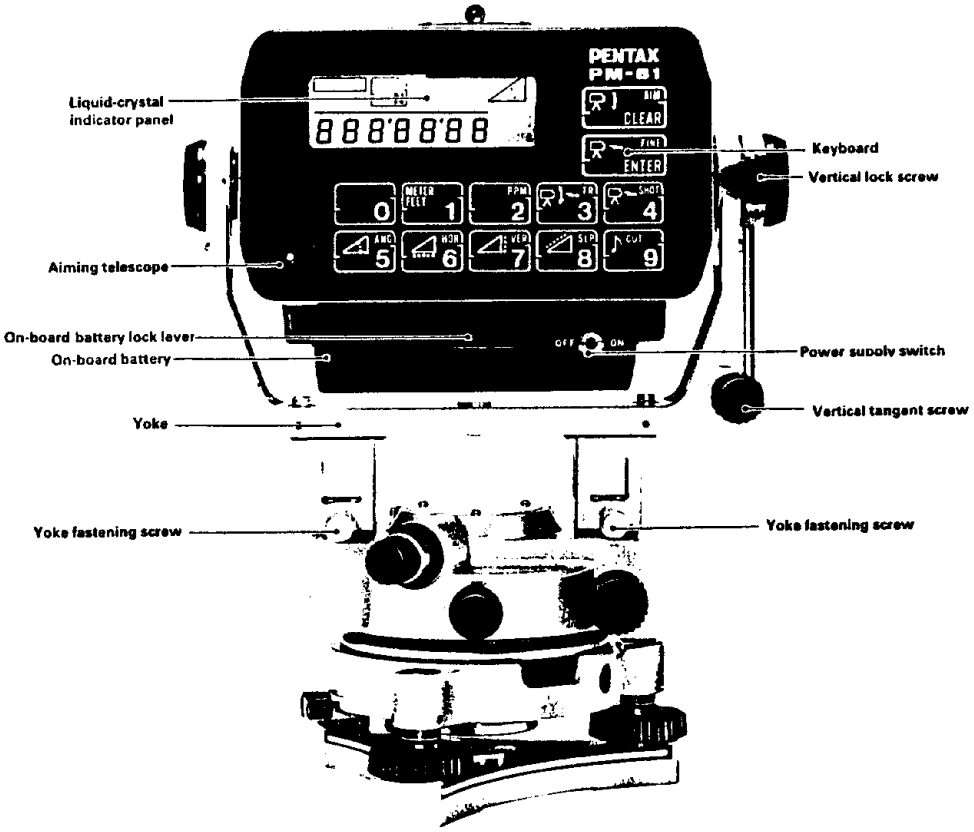


(Example of the combination use with theodolite)

Collimator Sight
For sighting, the collimator should be used for coarsely turning the meter toward a target (prism). The triangle seen inside should be used for alignment.

Charging Connector
This should be used to charge the on-board batteries.

External Power Source Connector
This should be used to connect the power supply cord with the external battery (MB 21) or a car battery cord (MB 31).
Note: When using an external power source, remove the on-board battery. Otherwise, the external power source will not be connected.



(Example of the use of azimuth base)

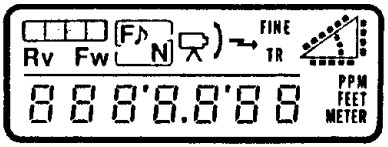
- **Aiming Telescope**
  Should be used for fine sighting, i.e. for properly receiving the reflected light from a target (prism). Fine sighting should be done in combination with electronic peaking.

- **Vertical Tangent Screw**
  This should be used for fine adjustment of vertical motion. It will operate after locking vertical lock screw.
  Note: The horizontal tangent screw of the theodolite or azimuth base should be used for horizontal fine adjustment.

- **Yoke Fastening Screw**
  This should be used to fasten the meter to the theodolite or azimuth base.

Liquid-Crystal Display

ndicates measured distance value, light receiving ondition, the turning direction of the tangent screw, ey function, light receiving buzzer, collimation, me- suring mode, distance mode, the unit of measured va- ues, offset constant setting, atmospheric correction ultiplier or vertical angle.



Signal Return Indication

4 squares turn on or off to indicate the receiving condition of the reflected light from a target (prism). Note: The quantity of received light is automatically adjusted to a proper value by the automatic light attenuator.

- ➡ Return signal is not received.
- Fw ➡ Instruction for turning the tangent screw in the same direction.
- Rv ➡ Instruction for turning the tangent screw in the reverse direction.
- or ➡ Aiming is good. (See page 13.)

Key Function Indicator

Some keys have 2 functions.

- F ➡ Yellow -F- mode selecting
- N ➡ White -N- input keys

Signal Return Buzzer Indication

The signal return buzzer actuates when reflected light is received from a target (prism). It can be silenced by touching the 9 key (only when collimation or TR mode is used).

- F♪ ➡ The signal return buzzer actuates.
- F ➡ The light receiving buzzer is stopped.

Aiming Mode Indicator

The flashing arrow indicates that the aiming mode is operational.

Measuring Mode Indicator

Indicates selected measuring mode (measuring method).

- FINE ➡ Fine distance is being measured using FINE or SHOT mode. (Horizontal arrow and FINE is displayed.)
- Distance is being measured using TR (tracking) mode. (Vertical arrow flashes and TR is displayed.)

Note: When SHOT mode is used, the above indications disappear upon the completion of measuring (result indication).

- **Distance Mode Indication**

Indicates selected distance mode (the distance to be measured).

- **(Flashes)** Slope distance is being measured or conversion indication is given.
- **(Flashes)** Horizontal distance is being measured or conversion indication is given.
- **(Flashes)** Vertical distance is being measured or conversion indication is given.

- **Vertical Angle Indicator**

- **(Flashes)** Vertical angle input is being processed.

- **Value Unit Indicator**

Indicates the unit of measurement or value.
PPM: Indication numeral represents an atmospheric correction multiplier in the unit of 1×10^{-6}.
METER: Indication represents a measured distance value in metric.
FEET: Indication represents a distance value in feet.

- **Indication Numbers**

Indicates value of offset constant (2 digits), input atmospheric correction multiplier (3 digits), vertical angle (7 digits) and measured distance value (main part—up to 4 digits, decimal part—up to 3 digits).

- -38 (Example) ➡ Offset constant: −38mm
- 278 (Example) ➡ Atmospheric correction multiplier: 278 PPM
- 078°19'36 (Example) ➡ Vertical angle: 78°19'36"
- 1234.567 (Example) ➡ Measured distance value: 1234.567m

[2] Keyboard

The keys of the keyboard have two functions—F—function (yellow characters) and N—function (white characters). "F" function is used to select various modes (aiming, measuring, distance), recall the input values of atmospheric correction multiplier and vertical angle, feet, meter conversion and buzzer shut off. "N" function is used to input the values of atmospheric correction multiplier and vertical angle.
Key input can be confirmed by electronic beep. Either "F" or "N" will appear on the LCD display.

- **AIM/CLEAR Key**

F—function: Should be pressed for aiming.
N—function: Should be used to clear the indication of atmospheric correction multiplier or vertical angle for change.

- **FINE/ENTER Key**

F—function: Should be pressed for fine-measurement (automatic repeat).

N—function: Should be used for input of the indicated values of atmospheric correction multiplier or vertical angle.

- **0-Key**

N—function: Should be used to enter '0'.
Note: It does not function when the indication (F) is given.

- **Unit Conversion Key**

F—function: The conversion of measured distance value into feet and meters is made alternately each time when this key is pressed.
N—function: Should be used to enter '1'.

- **Atmospheric Correction Key**

F—function: Should be used to call up the input values of atomspheric correction multiplier for confirmation or change.
N—function: Should be used to enter '2'.

- **TR (tracking) Key**

F—function: Should be pressed for tracking measurement (automatic repeat).
N—function: Should be used to enter '3'.

- **SHOT (one-shot) Key**

F—function: Should be pressed when SHOT (one-shot, fine) measurement is carried out.
N—function: Should be used to enter '4'.

- **Vertical Angle Key**

F—function: Should be used to recall the vertical angle for change or confirmation.
N—function: Should be used to enter '5'.

- **Horizontal Distance Key**

F—function: Should be used for converting slope distance and vertical angle to horizontal distance.
N—function: Should be used to enter '6'.

- **Vertical Distance Key**

F—function: Should be used for converting slope distance and vertical angle to vertical distance.
N—function: Should be used to enter '7'.

- **Slope Distance Key**

F—function: Should be used for measuring slope distance value.
N—function: Should be used to enter '8'.

- **Buzzer Stop Key**

F—function: Should be used to stop signal return buzzer upon collimation and TR measurement.
N—function: Should be used to enter '9'.

4. Handling and Operation

[1] Mounting

[1] Combination use with theodolite

1. Attach the theodolite on a tripod, level the theodolite and plumb over the point.
2. Loosen the yoke fastening screws and set the yoke on the theodolite studs.
3. Tighten the yoke fastening screws.

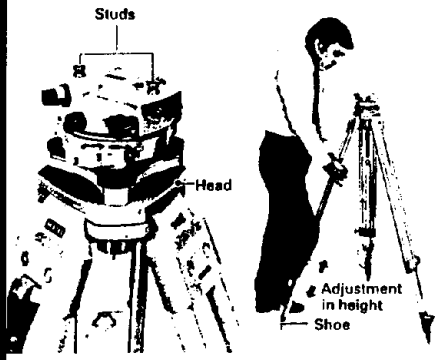
[2] Use of azimuth base (optional accessory)

1) Mounting

1. Attach a tribrach on the tripod, level the tribrach and plumb over the point.
2. Insert the azimuth base into the tribrach and secure with the fastening lever.

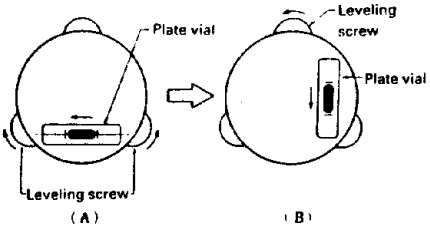
2) Plumbing and leveling by optical plummet

1. While looking through the optical plummet, turn the eyepiece until the reticle becomes clearly focused.
2. Turn the focusing knob of the optical plummet until it is focused on the set up point.
3. Looking through the optical plummet, turn the three leveling screws until the reticle coincides with set up point. The meter will be out of level.
4. Adjust the legs of the tripod in height so that the bubble in the circular vial comes to the center of the circle.



3) Leveling by plate vial

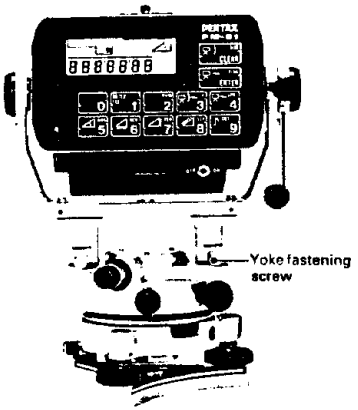
1. Place the plate vial parallel to the line connecting two voluntarily-selected leveling screws and turn the screws until the bubble comes to the center (Fig.A). (When handled at a time, the leveling screws should be turned in opposite directions to each other.)
2. Turn the plate vial round the vertical axis through 90° and turn the remaining leveling screw until the bubble of the bubble tube comes to the center (Fig.B).
3. Turn the plate vial round the vertical axis 90° at a time and repeat steps 1 and 2 until the bubble is stabilized at the center of the tube whatever the direction of the bubble tube.



- See the arrows in Figs. A and B for the relationship between the movement directions of the leveling screws and the bubble leveling device.
- The adjustment of the plate vial is necessary if the bubble is not stabilized at the center of the bubble tube despite repeating steps 1 and 2 in 3.

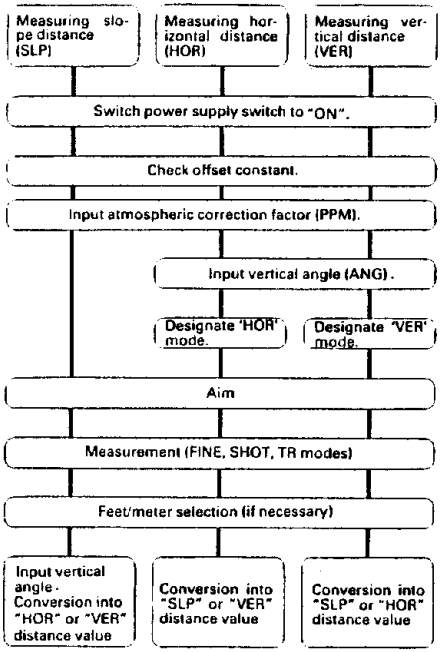
4) Installation of meter

1. Loosen the yoke fastening screws and set the yoke on the azimuth base studs.
2. Tighten the yoke fastening screws.



2 Measurement

[1] Operating procedure

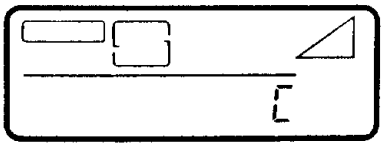


- Measuring mode
  FINE: automatic repeat measuring (mm)
  SHOT: one-shot measuring (mm)
  TR: automatic repeat measuring (cm)

[2] Operation and indication

1) Insert on-board battery or connect external battery.

1. Turn on the battery switch.

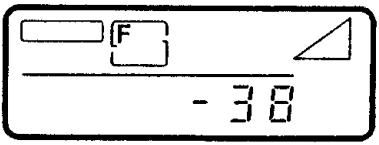


Indication of 'self-check is underway'

- When the power supply is turned on, the self-check is made to automatically determine whether there is any abnormality.
  C-indication: trouble check of electronic circuit is underway.
  EO-indication: low battery power (charging is necessary.)
  E1-indication: trouble in keyboard (repair is necessary.)

2) Check offset constant.

Unless error code is indicated at the self-check, preset value of offset constant is indicated.
(Each unit has a different offset constant.)



Example of indication: offset constant = −38mm

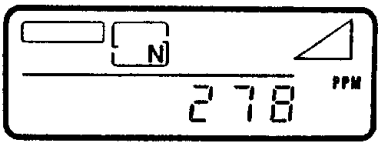
1. Confirm offset constant.

- When changing offset constant, see 'Offset Adjustment' on page 22.

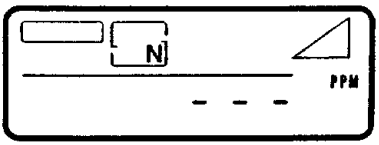
3) Input of atmospheric correction multiplier (PPM)

Initially, atmospheric correction multiplier (PPM) is set to standard value '278 ppm' (15°C, 760 mm Hg-hr.).
No operation is needed if this value is used. Otherwise, use the following procedure for input.

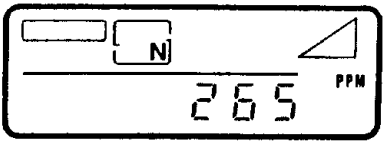
1. Press **2** key to call up the preset value of atmospheric correction multiplier.



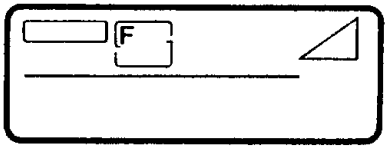
2. Press **CLEAR** key to clear.



3. Press the keys for the input of numbers.
Example: Input of 265 ppm
Press [2] [6] and [5] keys.



4. Press [ENTER] key for input.



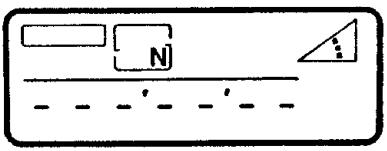
- Atmospheric correction multiplier (PPM) values should be calculated using the atmospheric correction calculator (MU 11).
See 'Atmospheric Correction' on page 15.
- If any error is made in handling the numeral keys, press [CLEAR] key to clear and start again.
- The input value of atmospheric correction multiplier (PPM) can be called up for confirmation using [2] key, provided F is displayed.

After confirmation, be sure to re-enter the data using [ENTER] key.

4) Input of vertical angle
When horizontal and vertical distances are measured, the input of vertical angle is necessary. For this purpose, use the following procedure.

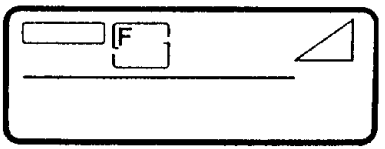
1. Press [5] key.

2. Press [CLEAR] key for clear.



3. Press the keys for the input of the numbers.
Example: Input of 78°19'36"
[0] [7] [8] [1] [9] [3] [6]

4. Press [ENTER] key for input.



- Vertical angle should be measured by the theodolite used in combination with the meter.
See 'Measuring Vertical Angle' on page 16.
- Vertical angle should be entered in 7 digits.
- If any error is made in entering the number keys, press [CLEAR] key to clear and re-enter.
- Neither the mode (zenith 0° or horizontal 0°) nor the unit (DEG or GRD) of the vertical angle to be inputted is indicated. Therefore, confirm them in advance.
- Vertical angle input can be called up for confirmation using the [5] key, provided F is displayed.

After confirmation, be sure to re-enter the data using [ENTER] key.

5) Designation of the distance mode

When measuring horizontal or vertical distance, designate the distance mode. Then, the conversion value will be indicated automatically.

- When the slope distance is initially measured, the designation of distance mode is not needed.
- The following is possible: the slope distance is measured and the vertical angle is input for obtaining its conversion into horizontal or vertical distance.

(Measuring horizontal distance)

Press [6] key.

(Measuring vertical distance)

Press [7] key.

(Measuring slope distance after designating an alternative distance mode)

Press [8] key.

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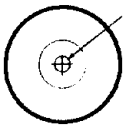
6) Aiming

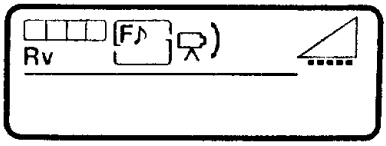
The following aiming methods, i.e. the methods of properly receiving the reflected light from a target (prism), should be selected depending on the weather conditions at time of measurement.

(Aiming by return signal buzzer)

1. Turn the meter in the direction of a target (prism) using the collimator sight.
2. Aim using the telescope. Keeping in mind to sight 6.5 mm (2 1/2 inches) left and 4.0 mm (1 1/4 inches) low at short distances.

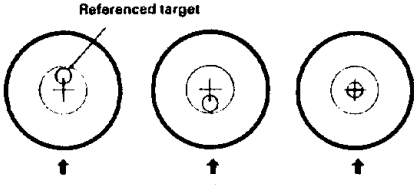


3. Press [CLEAR] key.

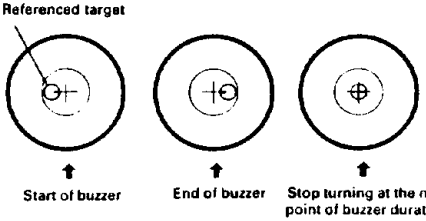


When return signal is received at this time, the return signal buzzer actuates.

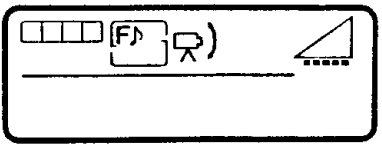
4. While looking through the sighting telescope at some referenced target, turn the vertical tangent screw until the middle point of buzzer duration.



5. Turn the horizontal tangent screw of the theodolite (or azimuth base) and stop turning at the middle point of buzzer duration.



6. Check return signal indication to check the receiving condition of return signal.

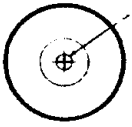


Aiming is completed when 'Rv' or 'Fw' has disappeared and any of the four dots illuminates like [□□□□].

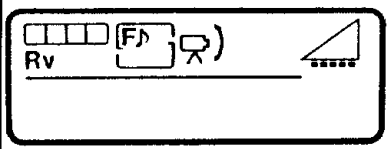
This method is suitable for aiming made when the return signal indication fluctuates due to the delay in return signal indication response at low temperatures or bad weather. It ensures easy accurate aiming.

Aiming by return signal indication)

- Coarsely turn the meter toward a target (prism) using the collimator sight.
- Coarsely aim the meter to the target using the aiming telescope.



. Press [CLEAR] key.



Vhen return signal is received at this time, the return ignal buzzer actuates.

4. While watching return signal indication, turn the vertical tangent screw. Turn the tangent screw in such a direction that return signal quantity decreases if indication [□□□□] is given.

Rv

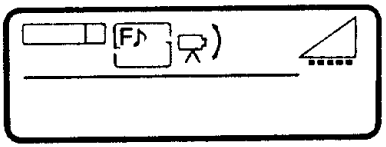
Then, reverse the movement of the tangent screw. If indication [□□□□] is given, the turning direction is

Fw

such that return signal increases. Then, turn it further in the same direction after 'Fw' disappears.

If 'Fw' is not displayed and the light receiving indication does not move to the right like [□□□□], the tangent screw has gone past the maximum light quantity position.

Therefore, it should be reversed slowly and stopped when the light of the indication squares has come to the extreme right like [□□□□].



5. The horizonal tangent screw of the theodolite (or azimuth base) should be turned and stopped when the light of the return signal indication squares has come to the extreme right.

- When stopping the return signal buzzer, press [9] key.

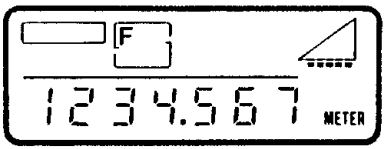
) Measurement

For measurement, select the measuring mode in accordance with the purpose and required accuracy of measurement.

- Upon measurement, make sure that light receiving 'Rv' or 'Fw' is not displayed.

FINE (automatic repeat) measurement)

. Press [ENTER] key.

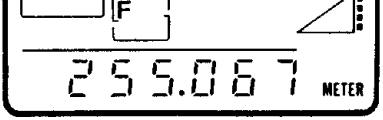


Sample reading: horizontal distance= 1234.567m

- Thereafter, measurement is repeated automatically and the measured value is indicated by short-lasting buzzer.

(SHOT (one-shot) measurement)

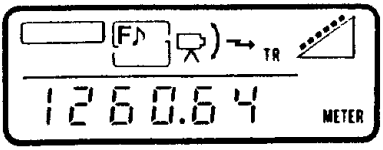
1. Press [4] key.



Sample reading: vertical distance =255.067m

(TR (automatic repeat) measurement)

1. Press [3] key.



Sample reading: slope distance =1260.64m

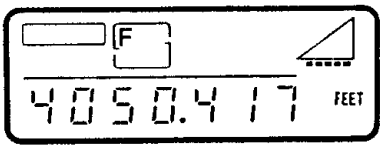
- Thereafter, measurement is repeated automatically at 1-sec. intervals and as soon as buzzer ceases measured value is indicated.
- To stop the return signal buzzer, press [9] key.

- When any distance greater than 2,000 m is measured, only the excess value is indicated.
  Example: 2,050 m—indication—50 m

---

8) Unit conversion

When converting the unit of measured value into another unit, press [1] key.



Example of reading: horizontal distance = 4050.417ft.

- To reset indication to initial unit, press [1] key again.
- When [1] key is pressed, the measurement function stops.
  If the measurement is needed again, press the measuring mode key once more.

Example of reading: horizontal distance = 1234.567m

---

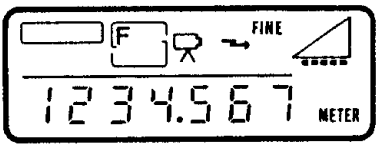
9) Conversion into alternative distance mode

When converting an indicated measured value into another distance mode, proceed as follows:

- When the following conversion operation is performed, the measurement function stops. If measurement is needed again, press the measuring mode key once more.

(Conversion into horizontal distance)

1. Press [6] key.



Sample reading: horizontal distance = 1234.567 m

(Conversion into slope distance)

Press [8] key.

Sample reading: slope distance = 1260.641m

(Conversion into vertical distance)

1. Press [7] key.

Sample reading: vertical distance = 255.067m

---

[3] Handling Power Supplies

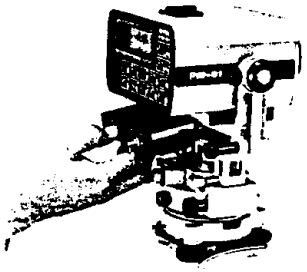
[1] On-board batteries (MB11)

1) Inserting

Align the rail of the on-board batteries with the guide groove of the meter and gently push it in until the lock-lever clicks into locked position.

2) Removal

Pull out the on-board battery while pushing down the lock-lever with your thumb.



3) Power charging

1. Remove the on-board battery from the meter and attach the connector of the on-board battery charger (MC11 or MC12) to the charging connector.
2. Insert the plug of the battery charger into a wall socket (AC 100 V, 120 V, 220 V, 50/60 Hz).
3. Turn on the power supply switch for the on-board batteries and check that the indicator light of the battery charger lights.
4. After 4~6 hours, turn off the power supply switch and take off the connector and plug.

- Charging time should be shorter than 18 hours.
- Two on-board batteries can be charged at a time.

---

[2] Use of external batteries (MB 21)

For longer continuous measurement, use the external battery (optional accessory).

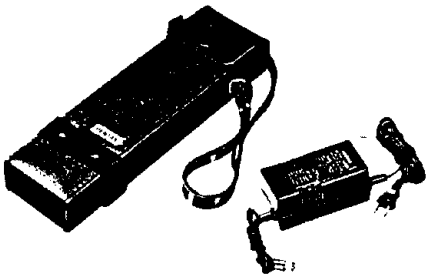
1) How to use

1. Remove the on- board battery from the meter.
2. Fit the external battery on the tripod and attach its connector and the external power source connector of the meter using the power supply cord.
3. Turn on the power supply switch of the external battery.

2) Charging

1. Attach the connector of the external battery charger (MC21 or MC22) to that of the external battery.
2. Insert the plug of the battery charger into a wall socket (AC100V, 120V, 220V, 50/60 Hz).
3. Turn on the power supply switch of the battery and check that the indicator light of the battery charger lights.
4. After 14~16 hours, turn off the power supply switch and remove the connector and plug.

- Charging time should be shorter than 24 hours.



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4 Atmospheric Correction

The velocity of light in the atmosphere depends on atmospheric temperature and pressure. Therefore, accurate measurement requires atmospheric correction. The meter will indicate an automatically-corrected distance for an input atmospheric correction factor. The correction factor is obtained using the following procedure and the atmospheric correction calculator (MU11).

1. Measure the atmospheric temperature and pressure.
2. Adjust the blue indicator line of the calculator to the measured value of temperature.
3. Adjust the measured value of atmospheric pressure to the black indicator line of the calculator.
4. Read the ppm value using blue indicator line.
   Example: Atmospheric temperature: +25°C
   Atmospheric pressure: 760 mm Hg
   Weather compensation multiplier:
   269 ppm

- During measurement, protect the thermometer and barometer from direct sunlight.
- The values obtained from the atmospheric correction multiplier (PPM) should be entered using the keyboard.
  See 'Input of Atmospheric Correction Multiplier (PPM)' on page 10.
- If measurement is conducted without entering the atmospheric correction multiplier (PPM), the value compensated using '278 ppm' (15°C, 760 mm Hg-hr.) is indicated.
- The atmospheric correction calculator (MU11) is designed on the basis of the following equation.

$$\text{Atmospheric correction multiplier (PPM)} = \frac{293.6\ p}{760 + 2.78236t}$$

p: atmospheric pressure (mm Hg)
t: atmospheric temperature (°C)

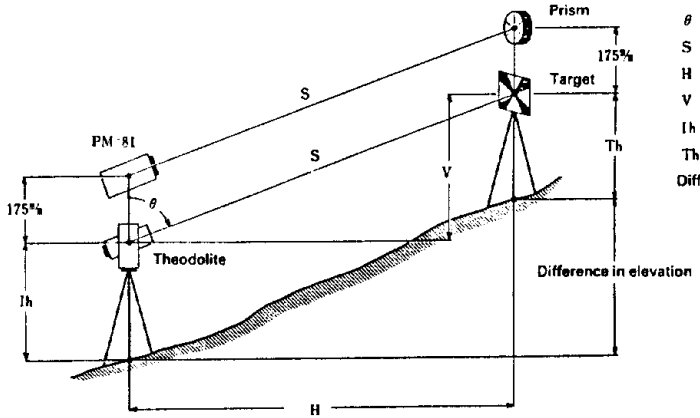
[5] Conversion into Horizontal or Vertical Distance Values

Provided a vertical angle is fed in and a distance mode is designated, the meter is capable of directly indicating the horizontal or vertical distance obtained through automatic conversion.
The vertical angle value to be fed in can be obtained as illustrated below.

[1] Measuring vertical angle

1. Sight to the target, combined with the prism, using the telescope of the theodolite.
2. Read vertical angle (θ) using the theodolite.

- The vertical angle (θ) value thus obtained should be entered into the keyboard.
  See 'Input of Vertical Angle' on page 11.
- The vertical angle read using the theodolite should coincide with the internal switch positions (zenith 0° or horizontal 0°) and (DEG or GRD).
  Refer to page 23 if change is required.

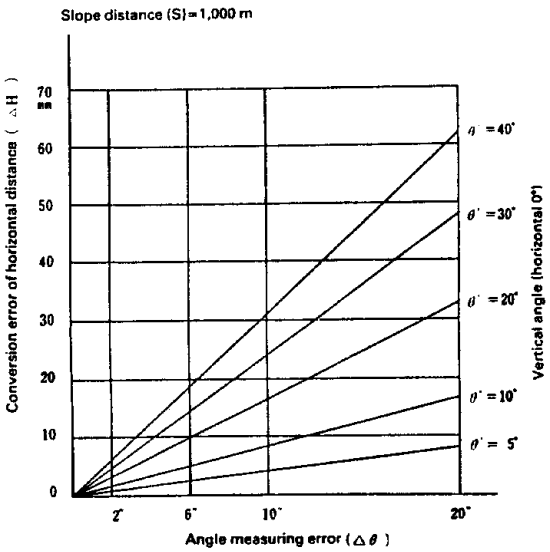


θ : vertical angle
S : slope distance
H : horizontal distance
V : vertical distance
Ih : height of instrument
Th : height of target
Difference in elevation = V + Ih − Th

nfluence of vertical angle on measurement error

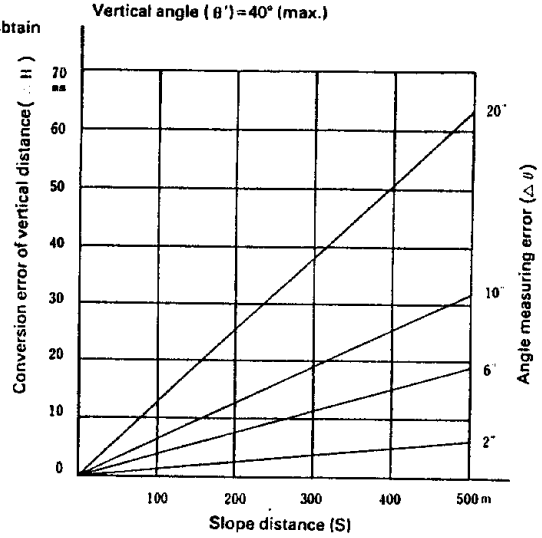
he conversion error originates from the measurement error of the vertical angle. This error fluences the calculated value of the horizontal stance or difference in elevation.
herefore, to calculate the required accuracy of vertical angle, necessary to correspond to the distance easuring accuracy.

nversion error of horizontal distance
e the proportional graph inserted right to obtain e conversion error of horizontal distance.



2. Conversion error of vertical distance

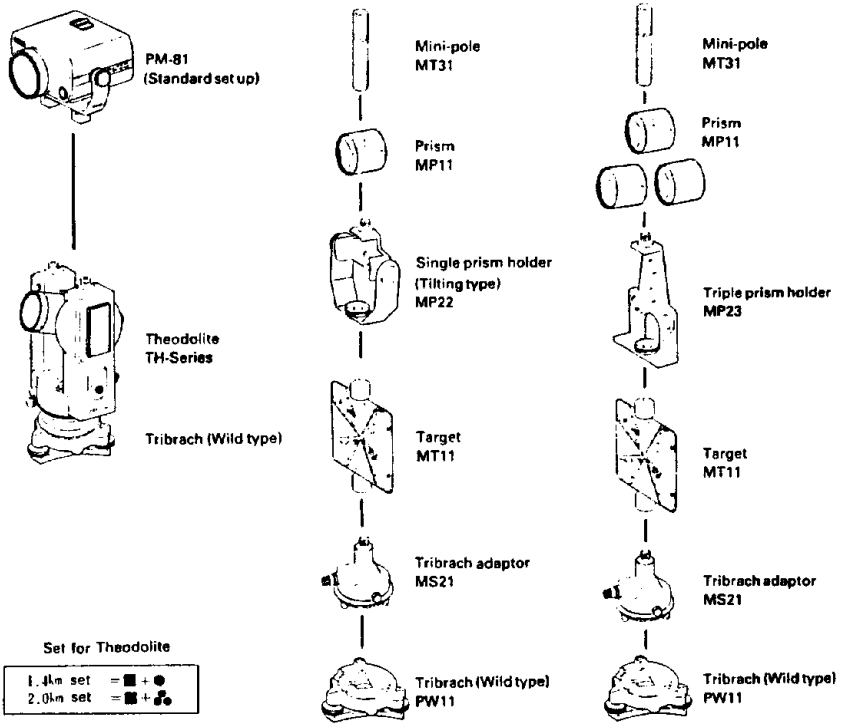
Use the proportional graph inserted right to obtain the conversion error of vertical distance.



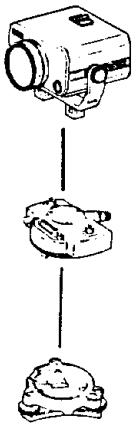
5. Optional Accessories

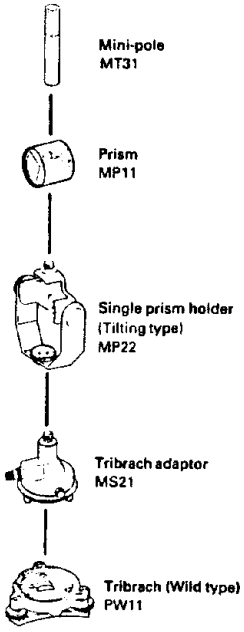
[1] Standard Combination and Measurements

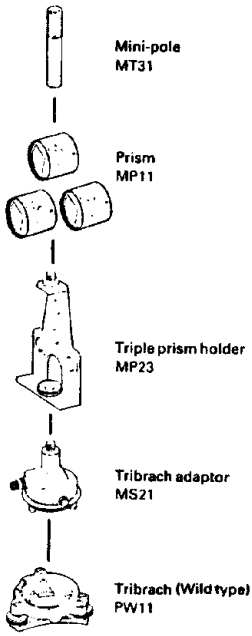
[1] Combination use with theodolite



[2] Use of azimuth base

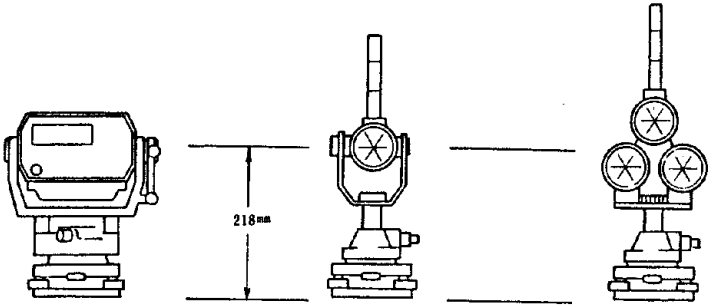






Set for azimuth base

1.4km set	= ■ + ●
2.0km set	= ■ + ♣

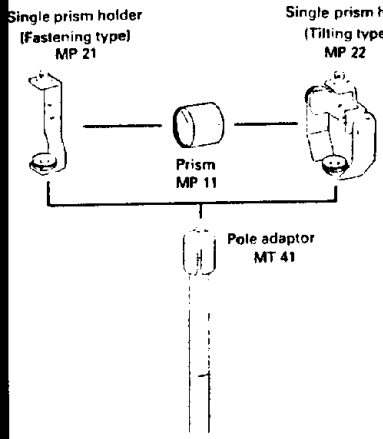


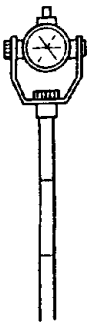
■

● Single prism set
Tilting type (without target)

♣ Triple prism set
(without target)

[3] Use of pole adaptor

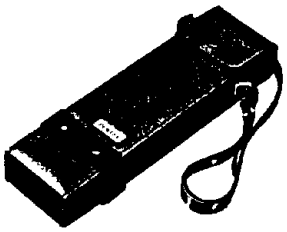


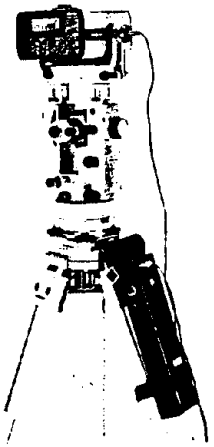


[2] External Power Supply

[1] External battery (MB 21)

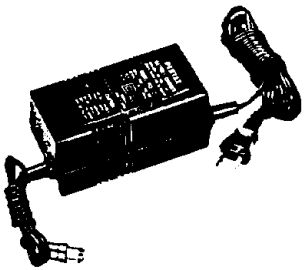
Power supply: ..... NiCd battery (rechargeable)
Output voltage: ..... DC 8.4 V
Working time per charging: ..... 6 hrs. (continuous)
Length of power supply cord: ..... 2 m





[2] External battery charger (MC 21 or MC 22)

Input voltage: ..... AC 100~220 V
Input frequency: ..... 50/60 Hz
Charging time: ..... 14~16 hrs.
Working temperature: ..... 0~+45°C

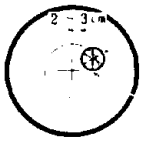


6. Inspection and Adjustment

[1] Parallelism between Optical Axis and Sighting Telescope

1) Inspection

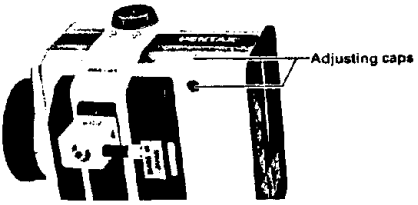
1. Set up a prism at a distance of about 50 m and (see aiming with indicator squares) align the meter to the prism as accurately as possible.
2. Observe the relative location of the prism to the reticle through the aiming telescope.
3. No further adjustment is necessary if the horizontal and vertical lines of the reticle are in the vicinity of the lower part, and 2~3 cm apart (actual distance) from the right end, respectively, of the outer circumference of the prism. (From center of prism -2 1/2 inches left and 1 1/4 inch down)



2) Adjustment

If the location of the reticle differs from the above illustration, use the following procedure to adjust it.

1. Remove the adjusting caps attached to the right and lower sides using a coin.
2. Loosen the Phillips screw and tighten the slotted screw, or vice versa, until the cross is located as illustrated above.



• Adjustment should be completed with the adjusting screw tightened.

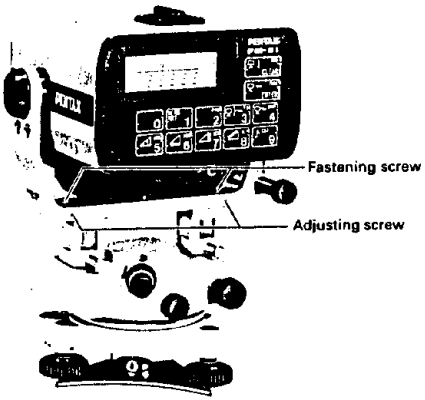
---

[2] Alignment between the Reticle of Theodolite and Optical Axis

No adjustment is necessary if the sighting for the angle measured by the theodolite and the prism aiming for the distance measured by the meter are made separately. However, the following adjustment is necessary, in advance, if the horizontal aiming for distance measuring (movement of horizontal tangent screw) is omitted for the reason that target aiming has been performed.

Adjustment

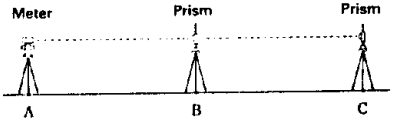
1. Set up the combination of a prism and a target at a distance of about 50 m and align the meter to the target using the theodolite.
2. Align the meter to the prism by turning the vertical tangent screw of the meter (stop turning at the middle point of the duration of return signal buzzer).
3. Loosen the right and left yoke fastening screws using the large-size hexagonal wrench.
4. Turn the two right and left yoke adjusting screws using the small-size hexagonal wrench to align the meter to the prism. Stop turning at the middle point of the duration of return signal buzzer.
5. Tighten the fastening screws.
   Tighten either of the adjusting screws after loosening the other a little. Adjustment should be completed with both tightened.



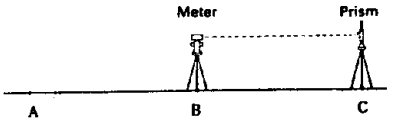
3 Checking the Accuracy

Check the accuracy of your PM-81 on a certified government E.D.M. baseline for best results. The following method can be used for a field check.

1. Locate points A, B and C at about 50 m intervals on even ground.
2. Set up the meter at point A and measure distances $\overline{AB}$ and $\overline{AC}$.



3. Set up the meter at point B and measure distance $\overline{BC}$.



4. Calculate the error (K) using the equation:
   $K=\overline{AC}-(\overline{AB}+\overline{BC})$
   If the error exceeds the specifications of the EDM, return your instrument to your dealers for calibration.

4 Prism Offset Adjustment

[1] Adjusting offset constant

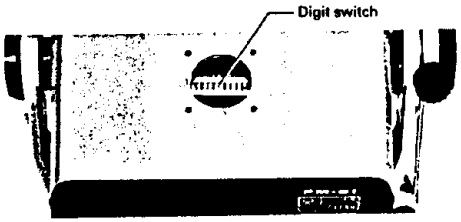
Record the offset constant displayed when the power supply switch is turned on and determine a new offset constant (K') using the equation:
(K)+30+(P)=K'(unit: mm)
where K=recorded offset constant
P=prism constant of the prism to be used
K'=new offset constant
Example: If the recorded offset constant=−38 mm and the prism constant of prism to be used=0, then the new offset constant=(−38)+30+(0)=−8 mm.

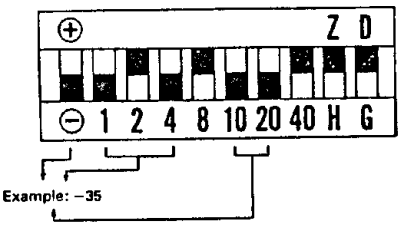
[2] Setting offset constant

Set the newly-determined offset constant on the digit switch inside the meter after turning off the power supply.

1. Remove the sighting collimator on the upper surface of the meter using the screw driver.
2. Set the digit switch seen inside to the new offset constant using the tip of the screw driver.

- Before setting the offset constant, be sure to turn off the power supply.
- The +, − and numeric indication switches of the digit switch are used for the offset constant. Its setting should be made by the indication side.

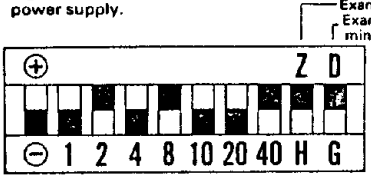




- The setting of the digit switch should be made so that the total of the numerals is equal to the offset constant.
  The total of the indication numerals of the 1-digit indicator switches should not be set to more than 10.
- If this is the case, the error indication of the offset constant is given and correct measuring is not possible.

[5] Change-over of Mode and Unit of Vertical Angle

For the change-over of the mode and unit of the vertical angle to be fed in, use the same procedure as the setting of the offset constant, i.e. move the digit switches after turning off the power supply.



Z: The vertical angle read using the theodolite with zenith 0° is fed in.
H: The vertical angle read using horizontal 0° theodolite is fed in.
D: Vertical angle is fed in degree, minute and second.
G: Vertical angle is fed in grads.

- Before the change-over of the digit switch, be sure to turn off power supply.

7. Troubleshooting

Classification	Problem	Cause	Solution
Power supply	No indication is given with the power supply switch on and with on-board battery inserted.	• Bad connection	• Re-insert battery. • Insert other battery securely.
		• Low battery voltage	• Insert the charged battery securely. • Recharge.
		• Battery trouble	• Insert other battery.
	No indication is given with power supply switch on and with external battery connected.	• On-board battery is inserted.	• Remove on-board battery.
		• Improper connection	• Reconnect connector.
		• Low battery voltage	• Recharge.
		• Fuse has blown.	• Replace fuse.
		• Breakage of power supply cord or failure of battery	• Check with on-board battery inserted.
After connecting to power supply	Indication 'C' does not disappear.	• Internal temperature of meter is too high.	• Turn power supply switch on and off several times. • Place meter in a cooler place to lower internal temperature.
	Indication 'EO' is displayed and buzzer sounds intermittently.	• Low battery voltage	• Replace with recharged battery. • Recharge.
	To check display numbers.		• Enter angle 888°88'88".
Input operation	No number is entered although numeral key is pressed after pressing 'PPM' or 'ANG' key.	• 'CLEAR' key was not pressed.	• Press number key after pressing 'CLEAR' key.
	Number keys do not work in F-function after being used to enter numbers.	• 'ENTER' key was not pressed.	• Press 'ENTER' key.

Aiming	Return signal buzzer and return signal indicator do not actuate although meter is aimed at prism.	• Cap is fitted over objective lens.	• Take off objective lens cap.
	Return signal buzzer and return signal indicator actuate although meter is not aimed at prism.	• Objective lens is aimed toward the sun.	• Switch meter and prism with each other.
	Aiming by return signal indication is difficult due to the fluctuation of return signal indication.	• Heat waves and atmospheric disturbance have occurred. • Delay in return signal indication response at low temperatures.	• Try aiming by return signal buzzer.
Measurement	Measurement requires excessive time and a stable measurement can not be obtained.	• Bad weather conditions e.g. heat waves, air disturbance, strong wind, rain and fog	• Increase number of prisms. • Avoid precision measurement.
Charge batteries	Battery can not be charged.	• Battery switch is not turned on.	• Turn on battery switch.
		• Failure of charger	• Attempt to charge another battery for verification.
		• Failure of battery	• Attempt to charge another battery for verification.

Note: Contact your distributors if there are other problems other than tabulated above or if problems can not be corrected by any measures stated above.

Memo

PENTAX

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