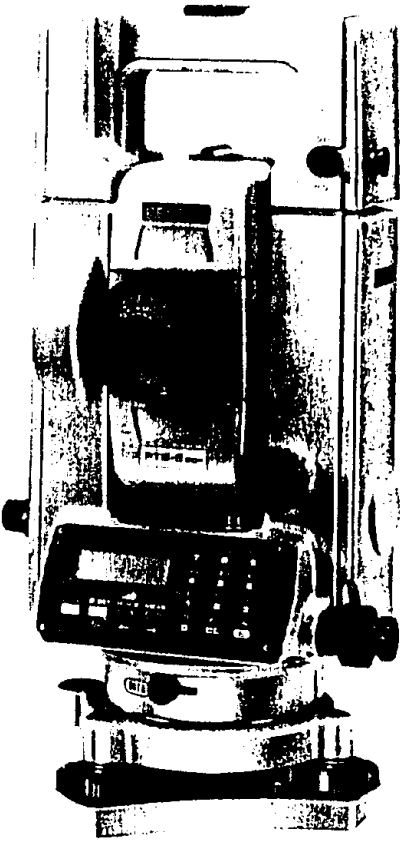
PENTAX®

ELECTRONIC TOTAL STATION

PTS-II 20F/20C

INSTRUCTION MANUAL



The PENTAX Total Station is of the highest quality and design. We therefore, recommend that you read the instruction manual very carefully so that you will appreciate the capabilities of your PENTAX precision instrument and ensure years of trouble-free operation.

To prevent accidental damage to your instrument, please adhere to the following notes which have been constructed to help you in maintaining your instrument in a precise functioning condition.

Solar Survey

- Avoid to aim the objective lens directly at the sun. Direct sunlight, focused through the objective lens, may cause the damage to internal components. When making solar suverying, attach the sun filter MU-55 to the objective lens.

Environmental Conditions

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

Shutdown

- After use, clean away dust and moisture and store in a 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.

Transport

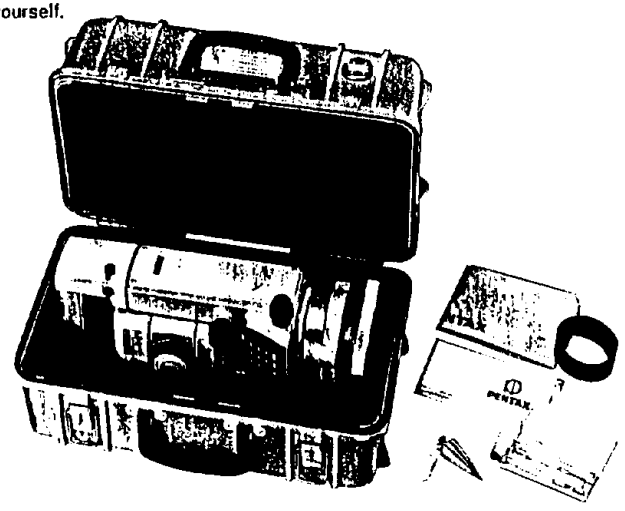
- Be careful not to subject it to impact or vibration during transport by a contractor, and use a good packaging material.
- Transport in carrying case supplied.

Attaching to Tripod

- When attaching or detaching 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 Point

- If repair is necessary, contact your dealer. Do not attempt to repair it yourself.

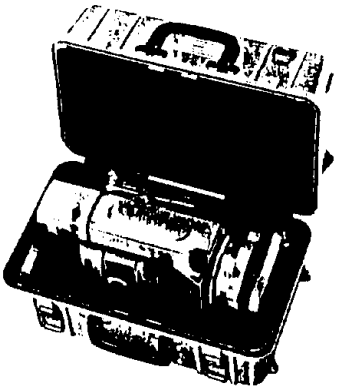


Contents

1. Equipment

[1] Standard Equipment

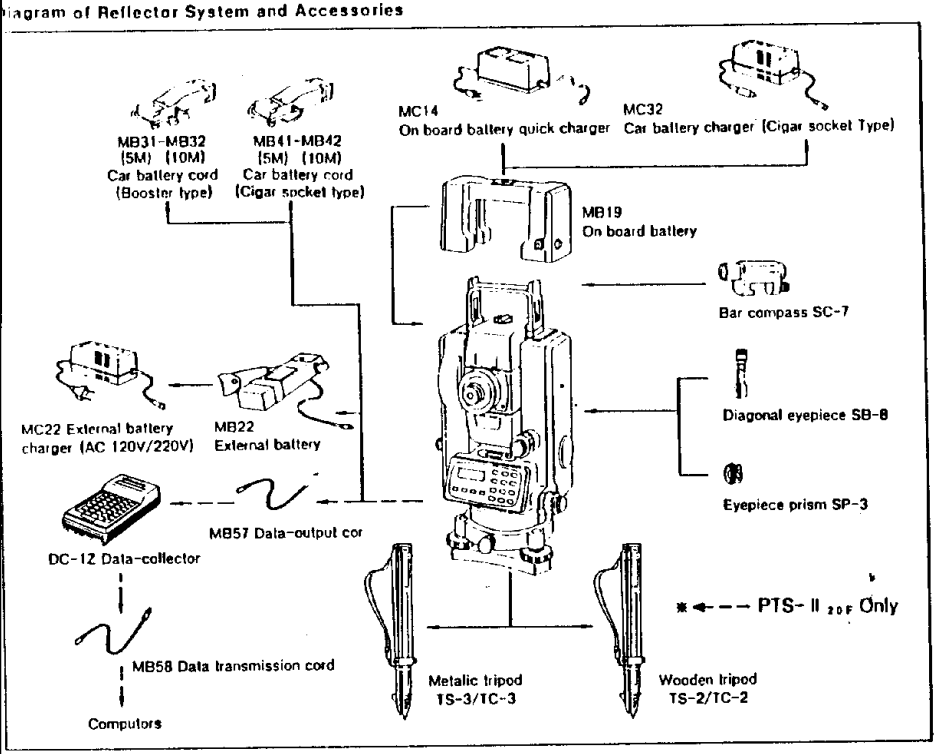
- Body (with hood and objective cap) ····· 1
- A Set of Plum Bob ····· 1
- A Set of Tool (with case) ····· 1
  (cleaning brush, 2 drivers, hexagonal wrench,2 adjusting pins)
- Silicon Cloth ····· 1
- Rain Cover ····· 1
- Carrying Case ····· 1
- On-Board Battery Quick Charger (MC14) ····· 1
  (with soft case)

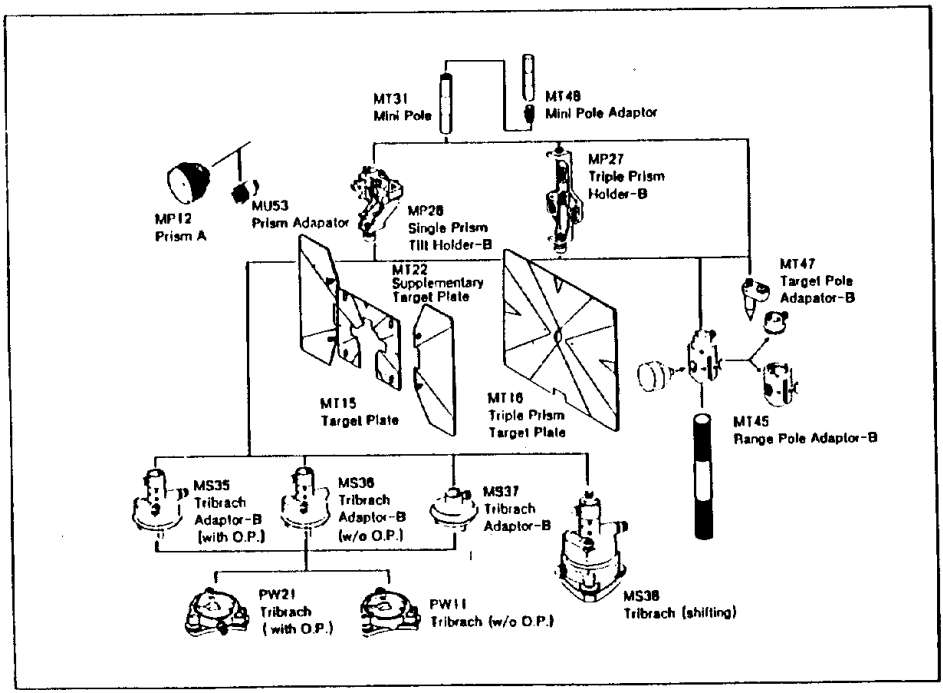


[2] Optional Accessories

- Data Collector
- Prism Unit
- External Battery
- Supplementary Target Plate
- Coaxial Type Target for Triple Prism
- Tribraches
- Tripods
- Pole Adaptor
- External Battery Charger
- Diagonal Eyepiece
- Eyepiece Prism
- Car-battery Cord
- Car-battery Charger
- Compass
- Solar Filter

iagram of Reflector System and Accessories





2. SPECIFICATIONS

Telescope Section

Image ····· Erecting
Magnification ····· 30X
Effective aperture ··· 45mm (EDM54mm)
Resolving power ····· 3"
Field of view ····· 2.3% (2.3m at 100m)
Minimum focus ····· 1.4m

Distance Measurement Section

Measuring range

1P ·····	Normal	800m/2,500ft.
	Good	1,000m/3,300ft.
3P ·····	Normal	1,200m/3,800ft.
	Good	1,400m/4,400ft.

* Definition of atmospheric conditions
··· Normal 15km visibility with slight haze.
··· Good 30km visibility, overcast, no heat haze and moderate wind.

Accuracy ····· ± (5mm + 3ppm) m.s.e.
Minimum count ····· Fine mode: 1mm/.003ft.
TR mode: 10mm/.01ft.
Measuring time ····· Fine mode: 5 sec.
TR mode: 1 sec.
Measuring system ··· Automatically repeated measurement
Display of maximum slope distance ····· 7,999.999m
Atmospheric correction (w/memory function) ····· Temperature: 1°C/1°F step
Pressure: 1 mmHg/0.1 inHg step (simultaneous display of PPM)
Prism constant correction ····· −99~ +99mm in 1mm step
Calculation function ··· Slope reduction
Stake out
Remote elevation
Missing line
Averaging(of 5measurements)
Option function ····· Distance unit: Meter/Feet (Conversion rate: 1m: 3.2808330ft)
Atmospheric refraction and earth curvature correction: ON/OFF
Refraction coefficient: 0.14/0.2

Angle Measurement Section

Method ····· Incremental rotary encoder
Detection ····· Single reading
Minimum count ·····
20"/50cc (10"/20cc Selectable)
Accuracy ····· 10"
(DIN18723)
Measuring time ····· less than 0.2 sec. (continuous)
Circle diameter ····· 79mm
Measuring mode ····· Horizontal: Right, Left, Pre-set
Vertical: Zenith 0 (or Horizontal 0)

Display Section

Type ····· 2 lines (w/illumination)
Display combination ····· V.Angle/H.Angle
H.Distance/H.Angle
S.Distance/V.Angle
V.Distance/Z coordinate
N/E
V.Distance/V.Angle in REM
Difference in height/ H.Distance in RDM

Sensitivity of Vials

Plate vial ····· 30"/2mm
Circular vial ····· 8'/2mm

Optical plummet

Image ····· Erecting
Magnification ····· 3X
Focusing range ····· 0.5m ~ ∞

Thread

$\frac{5}{8}$" ····· Shifting (range: 16mm)
$\frac{5}{8}$"F ····· Fixing

Reticle illumination (Built-in)

Light source ····· Green LED
Type ····· Intensity adjustable in 3 step

Data Output (II 20F only)

Interface ····· RS-232C
Baud rate ····· 1200/2400 selectable
Data bit ····· 8bit/7bit selectable
Parity ····· OFF/EVEN
Stop bit ····· 1/2 Selectable

Auto Power Off Function (effective with on-board battery only)

Time setting ····· 10 minutes
(ON/OFF selectable)

Ambient Temperature Range

Range ····· -20°C ~ +50°C/
-4°F ~ +122°F

Tripod Thread

II 20C ····· 1-3/8" × 13
II 20F ····· 5/8" × 11

Dimensions and Weights

Instrument ····· 162 (W) × 365 (H) ×
162 (L) mm/6.9kgs.
Carrying case ····· 260 (W) × 250 (H) ×
440 (L) mm/4.7kgs.

On-board Battery (MB19)

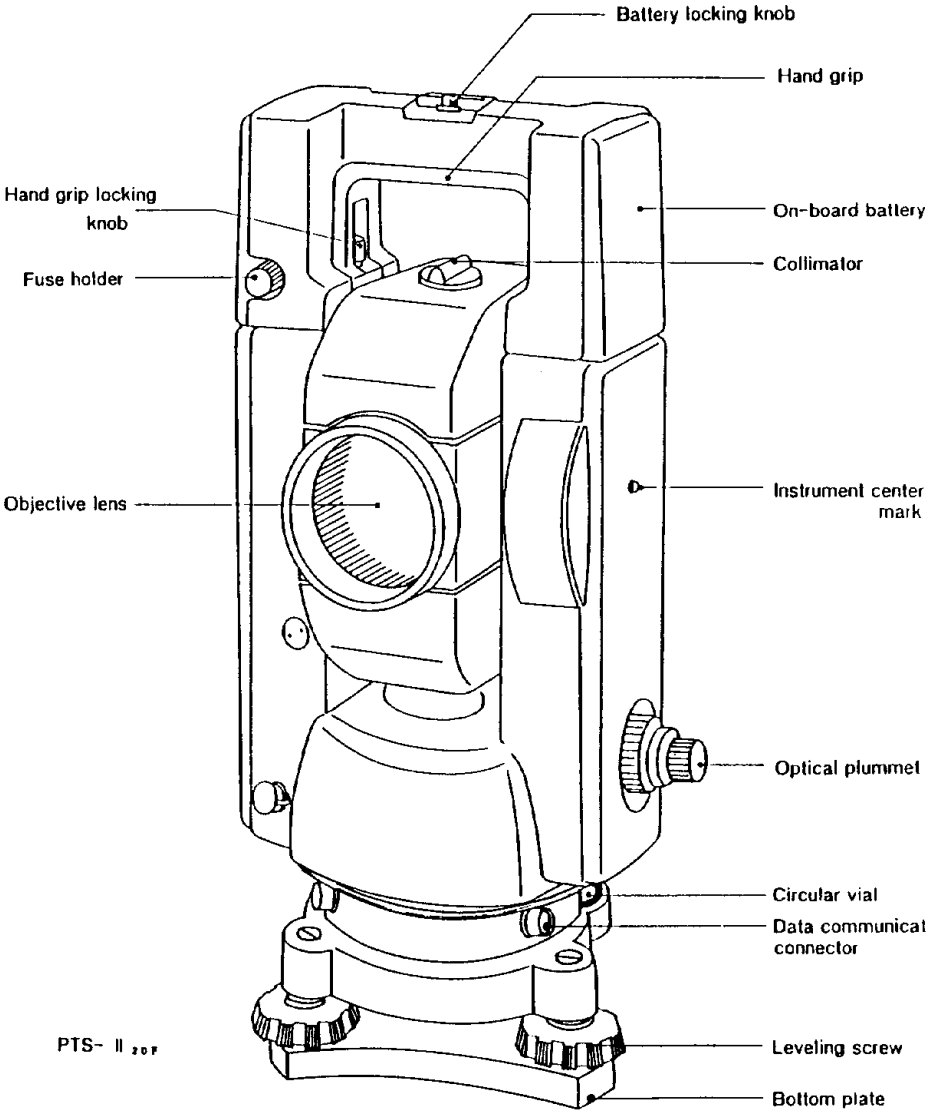
Power source ····· NiCd battery (rechargeable)
Output voltage ····· DC8.4V
Operation time ····· 3hrs. (continuous for angle
per charging ····· and distance measurements)
10 hrs. (continuous for angle
measurement only)
Weight ····· 0.7kgs.

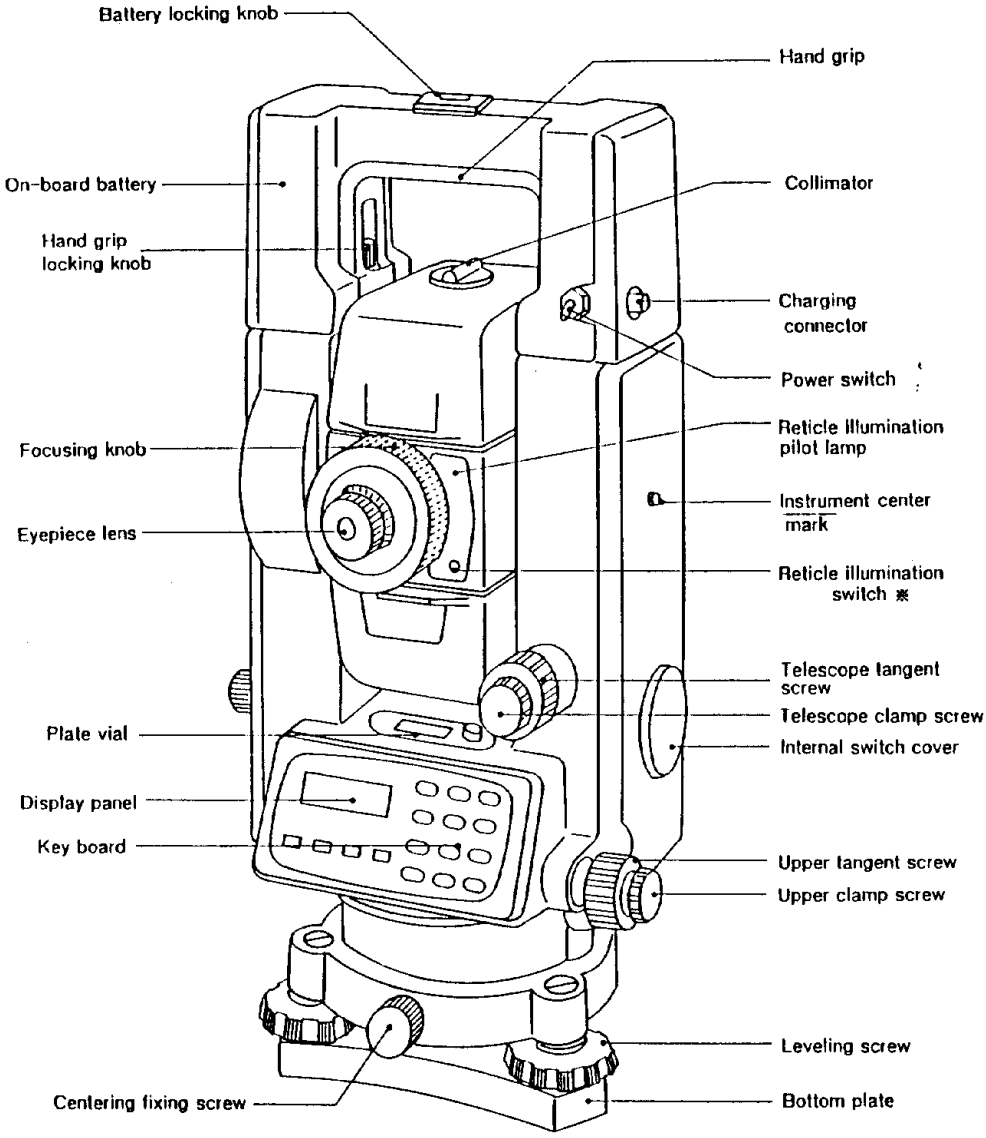
On-board Battery Quick Charger (MC14)

Input voltage ····· AC120/220/240V (variable)
Input frequency ····· 50/60Hz
Charging time ····· 1 hr.
Working tempe- ····· +10°C ~ +40°C/
rature range +50°F ~ +104°F
Weight ····· 1.5kgs.

3. Description

1. Nomenclature of parts

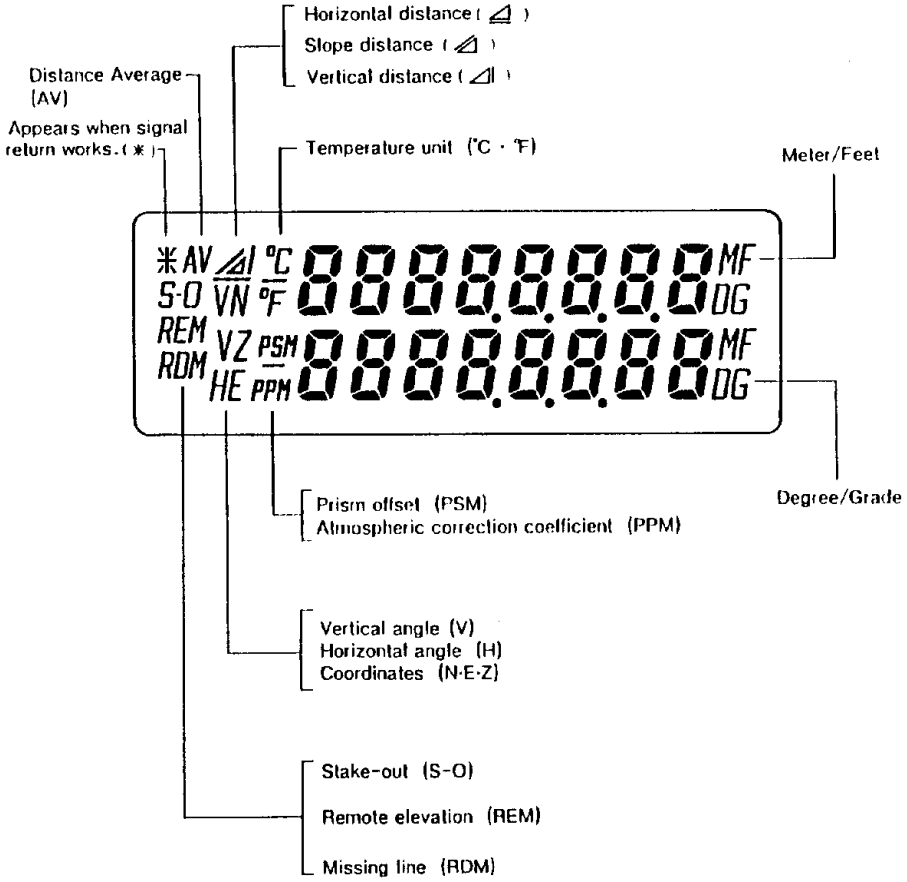




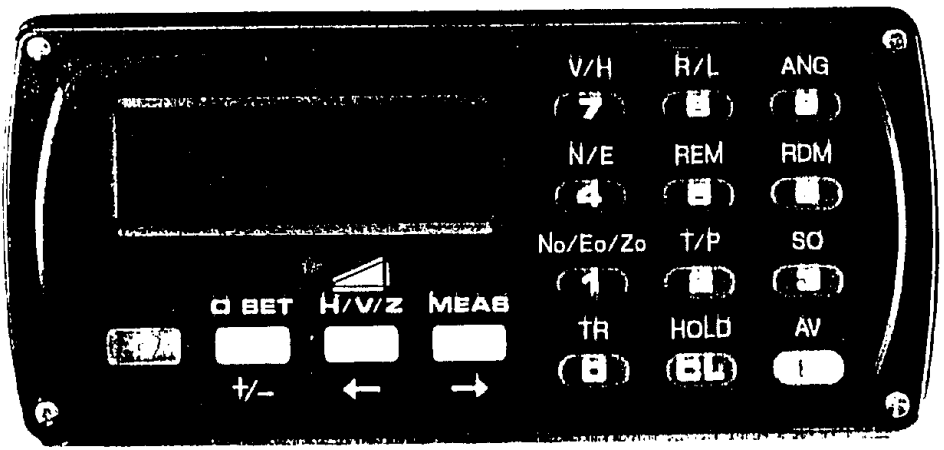
※ Reticle Illumination Switch
Whenever pressing the Reticle Illumination switch, the illumination changes to High→Middle→Low and Off.

PTS- II 20C

[2] DISPLAY PANEL



3. KEY BOARD



O SET +/-
- To set horizontal angle 0
- To enter the plus (+) and minus (−) sign for numerical input.

H/V/Z ←
- To set distance measurement modes. Horizontal distance (◢) /Horizontal angle (H), slope distance (◢) /Vertical angle (V), and vertical. Distance (◢) /Z coordinate (Z) are displayed in order with each key operation.
- To shift the cursor left

MEAS →
- To measure the distance in Fine mode (unit: mm)
- To shift the cursol right

AV E
- To obtain the average of multiple (5) distance measurement (unit: mm)
- To enter temperature, atmospheric values, stake-out data and station point coordinate.

HOLD CL
- To suspend the automatic light volume adjusting function when the level of light volume is unstable in MEAS, AV, or TR mode.
- To clear the entered values.

TR 0
- To measure the distance in TR mode (unit: cm)
- To enter "0"

$N_0/E_0/Z_0$ 1
- To enter coordinates values of instruments point or to recall the values entered for confirmation.
- To enter "1"

T/P 2
- To recall stored temperature and pressure for confirmation or alteration.
- To confirm the remaining battery capacity.
- To enter "2".

SO 3
- To enter set distance or to recall the set distance in store for confirmation
- To enter "3"

· To set N(X)/E(Y) mode.
· To enter "4"

· To measure Remote elevation.
· To enter "5".

· To measure Missing line.
· To enter "6".

· To set vertical(V)/Horizontal(H) angles mode.
(this mode is automatically initiated when power is turned on.)
· To enter "7".

· To select horizontal left or right.
· To enter "8".

· To pre-set horizontal angle.
· To enter "9".

· To illuminate display panel
(The illumination automatically turns off about one minute after.)

4. Operating Instructions

[1] Preparation for Surveying

1] Leveling and centering of the instrument

i) Setting up the instrument and the tripod

(1) Adjust the tripod legs so that a height suitable for surveying is obtained when the instrument is set on the tripod. Carry out coarse centering to the station and fix the metal shoes firmly into the ground.

(2) Set the instrument on the tripod and lightly screw the center screw of the tripod into the thread of the foot plate. (For model Ⅱ $_{20C}$, place the shifting device at almost the center of its moving range and fasten the centering clamp screw.)

2) Centering and levelling with the optical plummet

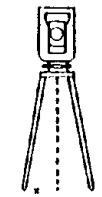
(1) Look through the optical plummet eyepiece, and rotate the eyepiece knob until the center mark can be seen clearly.

(2) Rotate the focusing knob of the optical plummet and adjust the focus to the station on the ground.

(3) Looking through the optical plummet, turn the any of levelling screws for tiling the instrument until the center mark coincides with the station.

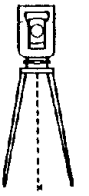
(4) Adjust the tripod legs to place the bubble in the center of a circular vial. (Be sure not to put your foot on the metal shoe to avoid the metal shoe moving.

■ The optical plummet permits focusing from 0.5m to ∞ with the focusing device.

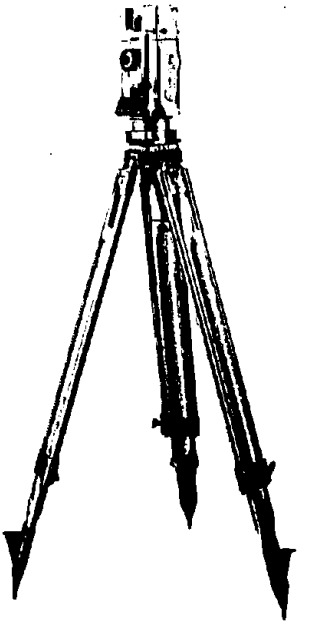


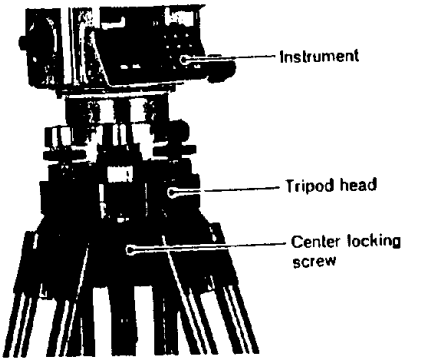
(1) Set the tripod and mount the instrument on it.

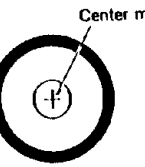
(2) Coincide the center mark with the station by using the leveling screw.



(3) Adjust the tripod legs to position the bubble of the circular in the center of circle.







[3] Leveling with the plate vial

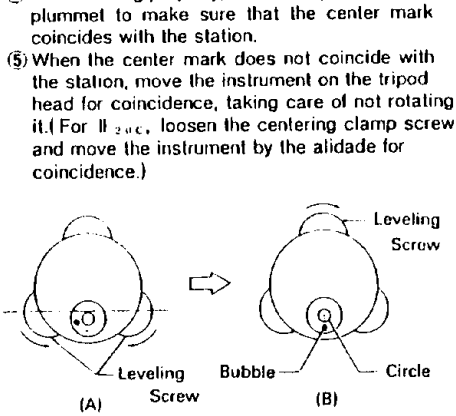
(1) Place the plate vial in parallel with a line joining any two of the leveling screws. Adjust the two screws, and position the bubble in the center of the level (A). (To adjust the screws at the same time,turn them in opposite directions.)

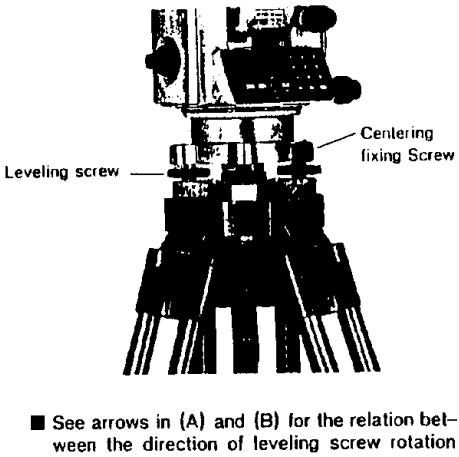
(2) Rotate the plate vial through 90° around the vertical axis. Adjust the remaining leveling screw so that the bubble comes to the center of the plate vial ((B)).

(3) Repeat 1 and 2 by rotating the plate vial through 90° so that the bubble is positioned in the center when the plate vial is moved in any direction.

(4) After leveling properly, look through the optical plummet to make sure that the center mark coincides with the station.

(5) When the center mark does not coincide with the station, move the instrument on the tripod head for coincidence, taking care of not rotating it.(For II [illegible], loosen the centering clamp screw and move the instrument by the alidade for coincidence.)





■ See arrows in (A) and (B) for the relation between the direction of leveling screw rotation and the bubble shifing direction.

■ If the bubble is not positioned stable in the center in (3) even after repeating (1) and (2), "adjustment of the plate vial" is necessary (see Page 35 "Perpendicularity of Plate Vial to Vertical Axis")

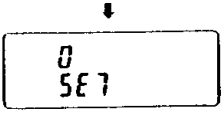
(2) Turning the power on

(1) Turn the battery switch on.

All segments light.

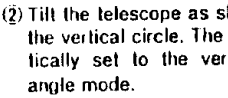
SELF CHECK

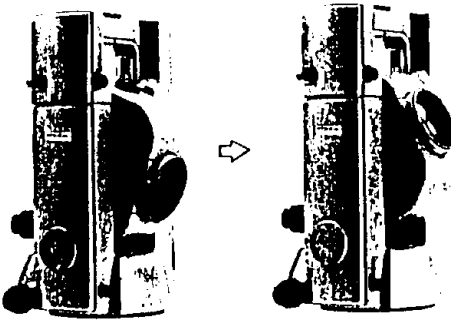
■ If the battery is low, the display will blink E-01 will be displayed if the instrument further operated while the display is blinking making the operation unavailable. Either charg or replace the battery.



Standing by for vertic circle indexing.

(2) Tilt the telescope as shown in Fig. A to ind the vertical circle. The display will be autom tically set to the vertical (V) /horizontal angle mode.





Turn the telescope upward from downward

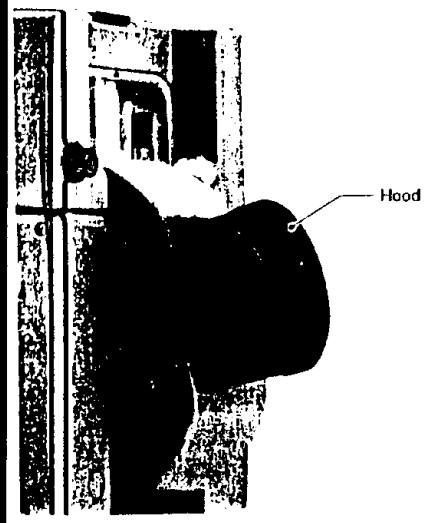
■ When indexing the vertical circle, the z point is detected as the telescpoe is rotatec elevation from slightly depressed.

■ If the vertical circle 0 is not indexed, no input, including numeric entry, will be possit

2. Surveying

1) Eyepiece adjustment

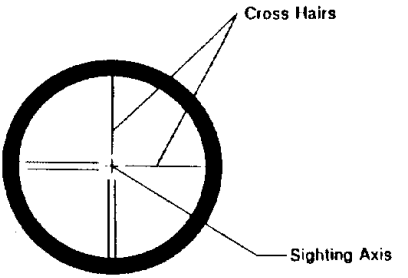
(1) Remove the telescope lens cap, and attach the lens hood, if necessary.



(2) Point the telescope at a bright object, and rotate the eyepiece fully counterclockwise.

(3) Look through the eyepiece, and rotate the eyepiece ring clockwise until the reticle appears at its maximum sharpness.

■ When looking into the eyepiece, avoid a intense look to prevent the parallax and eye fatigue.



2) Object sighting

(1) Point the telescope at the object using the aiming collimator. Tighten all clamp screws.

(2) Look through the telescope eyepiece and finely adjust the focusing konb until the object is perfectly focussed. If focusing is correct, the cross hairs will not move in relationship to the object when you move your eye slightly left and right while looking through the eyepiece.

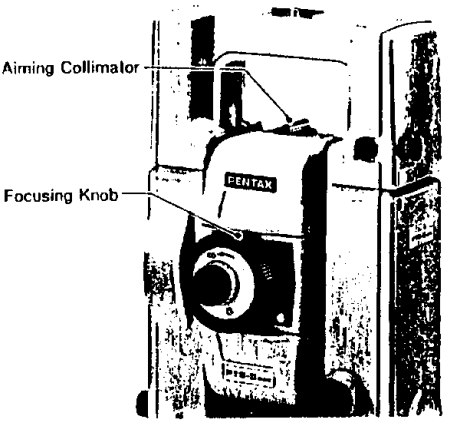
(3) Turn each tangent screw to correctly align the cross hairs on the object.

■ Turn the focusing knob clockwise to focus on a short object and counterclockwise on a far object. (∞ is markd for easy recongition of rotating direction)

■ In (2), parallax may ruin the relation between the object and the cross hairs, resulting in the survey error.

■ When aligning to an object using the tangent screw, always align by rotating the screw clockwise. If the screw is turned past the object, turn it to the original position and then turn the screw clockwise to align the corss hairs to the object.

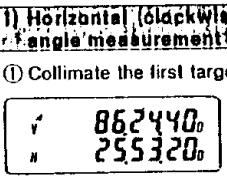
■ Even when vertical angle measurement is not required, it is recommended that the object be placed as close as to the center of the reticle pattern and that the bold object be placed between two vertical lines on the reticle pattern.



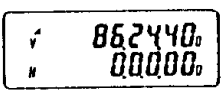
[3] Angle Measurement

(1) Horizontal (clockwise) and vertical angle measurement

① Collimate the first target.



② Press [O SET]. The buzzer will sound for approximately 3 seconds. Press [O SET] again while the buzzer is sounding to set the horizontal angle to 0°00'00".

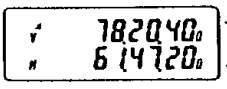


Caution) Press [O SET] gently. Excessively pressing may move the instrument, preventing to set the angle to 0°00'00".

■ [O SET] key is not valid to set the vertical angle to 0°00'00".

■ The horizontal angle will not be reset to 0°00'00" even if [O SET] is accidentally pressed during measurement unless [O SET] is pressed second time while the buzzer is sounding.

③ Collimate the second object using the upper clamp konb, upper tangent screw, telescope clamp konb, and telescope tangent screw. The vertical angle and horizontal angle will be simultaneously displayed.



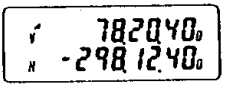
← Vertical angle (V) of second object
← Horizontal angle (H) of second object

■ The "D" in the display indicates degrees (DEG) on a 360° scale. When the 400G (GRAD) scale is used, the displayed units will be G.

(2) Horizontal (counter clockwise) angle measurement

① Press [R/L 8]

(Horizontal angle measurement will switch from horizontal right to horizontal left; values will be indicated with a minus (−) sign.)



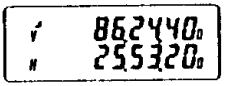
② Subsequent operation is done as in ((1) Horizontal (clockwise) and vertical angle measurement) above, except that the order of collimation is reversed.

■ Press [R/L 8] again to revert to the horizontal (clockwise) angle measurement mode

(3) Measurement from pre-set angle

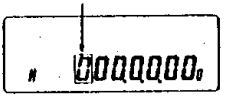
Measurement is possible from any horizontal angle by pre-setting it.

① Collimate the first object.



② Press [ANG 9] twice to initiate the horizontal angle input mode while the buzzer is sounding

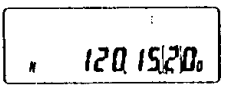
Blinks



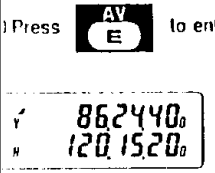
Stand-by for horizontal angle input

③ Enter the desired horizontal angle with the numeric keys.
EX: Inputting 120° 15'20".

[N./E./Z. 1] [T/P 2] [TR 0] [N./E./Z. 1] [REM 5] [T/P 2]



) Press AV E to enter.



Setting completes.

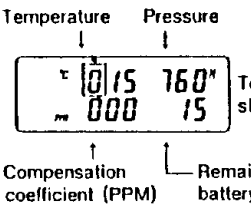
The pre-set of angle is valid only for such angles as less than 360°(400G) or the multiple of the least count unit.

[4] Distance Measurement

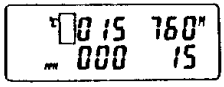
(1) Temperature and pressure input

The temperature and pressure are intially set to a standard 15℃, 760mmHg (59℉, 29.9inHg) or 0ppm. If these settings are applicable to the current conditions, the follwing procedure may be skipped. Ex1: Set temperaure to -10 ℃ ,pressure to 740 mmHg.

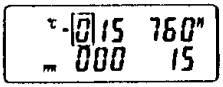
(1) Press T/P E to set the temperature, pressure input mode.



(2) Press ← to shift the blinking cursor one digit left.

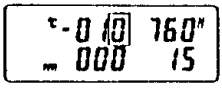


(3) Press +/- to enter the minus (−) symbol.

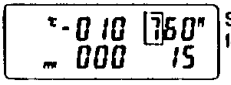


(4) Press TR 0 N/E/Z 1 TR 0 to input (0)(1)(0).

→ can also be pressed to shift the cursor right to change only that dight which differs from the one displayed.

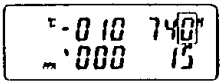


(5) Press E



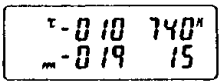
⑥ Enter the pressure similarly to the temperature.

In this example, press V/H 7 N/E 4 TR 0

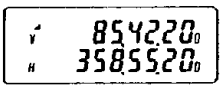


⑦ Press E

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



⑧ Press E to terminate temperature and pressure entry.



Returns to previous display mode.

Note that displayed values will be those entered during set-up. The values but above may be displayed.

■ Temperature and pressure input is not available when the atomsphreic compensation switch on the internal switch panel is OFF.

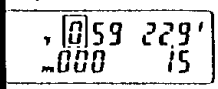
■ Press T/P 2 to recall and confirm the temperature and pressure settings. Be sure to press E three times after confirming the values to re-enter them before resuming the previous operation.

■ Temperature and pressure settings will be retained after the power is shut off.

Ex2: Set temperature to -10°F, pressure to 29.0 inHg

① Press T/P 2 to set the temperaure, pressure input mode.

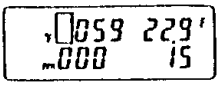
emperature Pressure



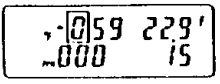
Temperature input standby

ompensation coefficient (PPM)
emaining battery capacity

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

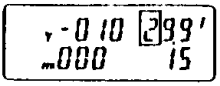


③ Press +/− to enter the minus (−) symbol.



④ Press TR 0 N₀/E₀/Z₀ 1 TR 0 to input (0)(1)(0).

⑤ Press AV E

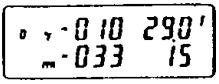


Standby for pressure input.

⑥ Enter the pressure similarly to the temperature.

In this example, press T/P 2 REP 8 TR 0

⑦ Press AV E



⑧ Press AV E

[2] Prism constant input

The prism constant is set to a standard -30mm. If a different prism is used, reset the prism constant to that of the prism in use. Use an internal switch and keys on the panel.

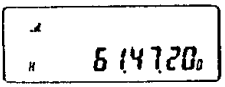
Refer to 「[8] Internal Switches」 on page 25 for prism constant input.

3) Distance measurement

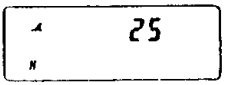
Fine mode measurement (unit: mm or foot equivalent)

(1) Aim the telescope at the center of the prism.

(2) Press  to set the distance meaure-ment mode.



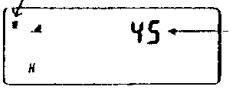
Press  for distance measurement.



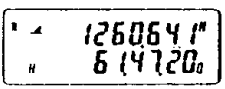
The buzzer sounds when the precise collimation on the prism (receiving the reflected beam), is attained and then 2 digit value to indicate the signal level of beam, which incremented, is displayed at the top right on the display panel. Then, the value stays at a certain level and * mark is displayed to show that distance measurement is ready. Measured value is displayed in several seconds.

■ The value to indicate the signal level of the beam may vary depending on the atmospheric condition and distance to be measured. However, the distance measurement is initiated regardless of the level of value when the value is at its maximum under the specific condition and * mark is displayed.

Indicates maximum level



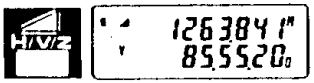
Level of beam



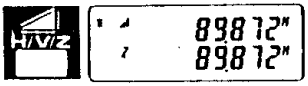
Horizontal distance value (displayed simultaneously with horizontal angle)

Under the normal atmospheric condition, measurment is automatically repeated. With the buzzer briefly sounding, measured value is displayed in a unit of millimeters.

※ Press  to measure the slope (◢) and vertical (◢) distance.

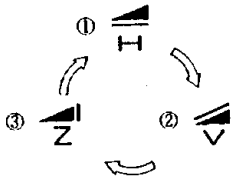


Slope distancevalue (displayed simultaneously with vertical angle)



Vertical distance value (displayed simultaneously with Z coordinate)

Provides the sequential selection of three different modes as illustrated below.



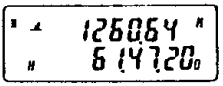
Tracking measurement (unit: cm)

(1) Aim the telescope at the center of prism.

(2) Press  to set the distance display mode.

(3) Press  for distance measurement.

Measured value is displayed in a unit of cm with the interval of 1 second.



Dispalyed in a unit of cm.

Averaging distance measurement

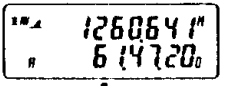
5 measurements can be taken to obtain an average.

(1) Aim the telescope at the center of prism.

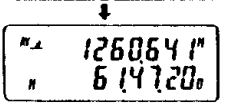
(2) Press  to set the distance display mode.

(3) Press  for the distance measure-ment.

After the specified number of measurement are automatically done, averaged value is displayed along with a long beep and the display stays.



Repetition of 5 measurements



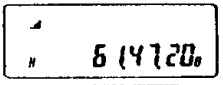
Averaged value is displayed and measurement stops.

■ Press AV E again to repeat and obtain another average.

4) Stake-out measurement

The difference between the measured distnace and the set distance can be displayed by first enterning the set distance.
The displayed value is (measured distance) − (set value).

(1) Press H/V/Z to set the distance display mode.



When obtaining the horizontal distance

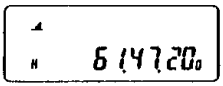
(2) Press SO 3 to set the stake-out mode.

Stand by for set distance input

(3) Enter the numbers of set value.
Ex: Set the horizontal distance to 85,000m.

MEAS → MEAS → R/L 8 REM 5

(4) Press AV E to terminate the entry.

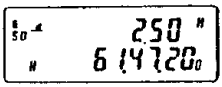


Distance display mode is again displayed.

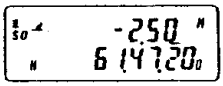
(5) Aim the telescope at the center of prism.

(6) Press TR 0 to measure the distance.

The difference with the set distance is displayed.



indicates measured distance (87.50m) is 2.50m longer than set distance.



Indicates measured distance (82.50m) is 2.5m shorter than set distance.

■ Stake-out (SO) measurements are valid for MEAS measrement or AV measurement, but TR measurement is usualy used for stake driving.

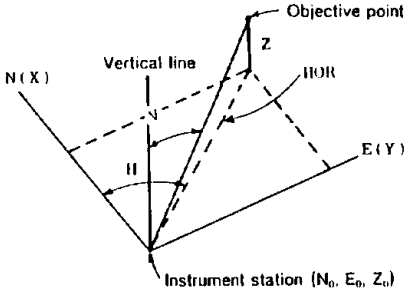
■ Stake-out measurements are taken the same for slope (◢) and vertical distance (◢|). This mode can also be used in coordinate measurements.

■ To clear the set distance, press SO 3 to recall the set distance, press HOLD CL to clear the display, and then press AV E

The set distance is also automatically cleared when the power is turned off.

15. Coordinate Measurements

The coordinate values for any desired objects can be obtained with reference to the instrument station.



■ If the instrument station 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 N_0, E_0, Z_0.
Ex: N: 15,000m E: 85,500m Z: 23,000m

(1) Press [N₀/E₀/Z₀ 1] to set the coordinate measurements mode.

N 0.000.000"	Stand by for N coordinate input

(2) Press numeric keys to enter the N coordinate of the instrument station.

[TR 0] [TR 0] [N₀/E₀/Z₀ 1] [REM 5]

N 00 15.000"	The station N coordinate

(3) Press [AV E]

E 0.000.000"	Stand by for E coordinate input

(4) Press numeric keys to enter the E coordinate for the instrument staiton.

[TR 0] [TR 0] [R/L 8] [REM 5] [REM 5]

E 0085.500"	The station E coordinate

(5) Press [AV E]

Z 0.000.000"	Stand by for Z coordinate input.

(6) Press numeric keys for Z coordinate input.

[TR 0] [TR 0] [T/P 2] [SO 3]

Z 0023.000"	The station Z coordinate

(7) Press [AV E] to complete station coordinates entry.

V 85.42.20₀	
H 358.55.20₀	

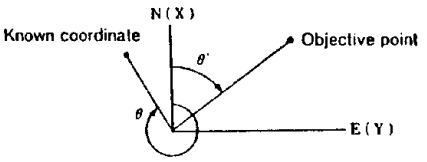
The previously displayed mode before the coordinate mode is resumed.

■ Entered coorinates can be recalled and confirmed by pressing [N₀/E₀/Z₀ 1] Be sure to press [AV E] again after recalling each coordinate to re-enter the value.

■ To clear any coordinate setting, press [N₀/E₀/Z₀ 1] to recall the desired coordinate, press [HOLD CL] to clear each value, and then press [AV E]

Coordinates are automatically cleared when the power is turned off.

2] Coordinate measurements



① Use the upper clamp and tangent screws as well as the telescope clamp and tangent screws to collimate the known coordinate.

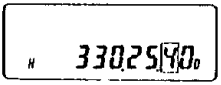
② Press ANG 9 to set horizontal angle input mode.
(Refer to 3) on p.16 Measurement from preset angle)

Blinks

③ Use numeric keys to input the bearing to the known coordnate.
EX: Bearing to known coordinate.....330°25'40"

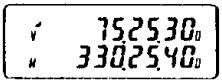
SO 3 SO 3 TR 0 T/P 2

REM 5 N/E 4

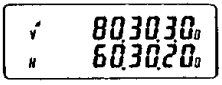


← Bearing to known coordinate (θ)

④ Press AV E to enter.



⑤ Use the upper clamp and tangent screws as well as the telescope clamp and tangent screws to collimate the object.

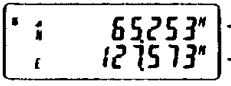


← Bearing to the object (θ')

⑥ Press N/E 4 to set N/E disply mode.

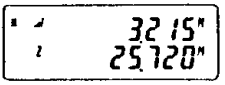
⑦ Press MEAS to measure the distance

N(X) and E(Y) coordinates of the object p
are simultaneously displayed.



← N(X) coordinate
← E(Y) coordinate

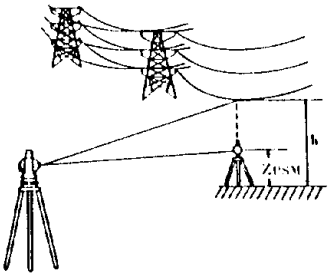
⑧ Press H/V/Z to set Z mo



← Z coordinate

REM (Remote Elevation Measurement)

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

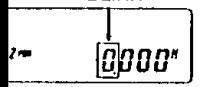


Set the reflecting prism directly below the target object, and measure the distance from the ground to the reflecting prism center with a tape.

Ex: A ground to prism height (Z_{PSM}) of 1.453m

Press REM 5 to set the REM mode after performing the vertical index 0 point setting.

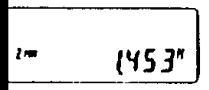
BLINK



The ground to target height (Z_{PSM}) will be requested.

Enter the height with the numeric keys

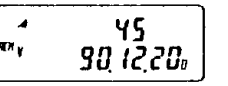
...M/E/Z... 1 | N/E 4 | REM 5 | SO 3



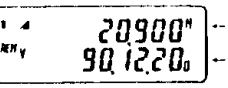
Press AV E to enter.

Slope distance (◢) measurement is requested.

Aim the prism and press MEAS → to measure the distance. (REM measurement is valid in TR mode, too.)

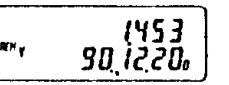


⬇

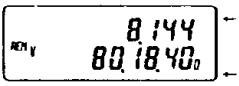


← Slope distance
← Vertical angle to the prism.

⑥ Press AV E to enter the slope distance.



⑦ Aim the telescope at the object to obtain the difference in height (h) from the ground to the object.

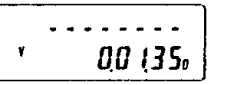


← Difference in height from the ground to the object.
← Vertical angle to the object

■ Earth curvature and atmospheric refraction correction is not available for REM measurement.

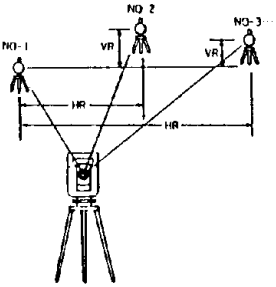
■ Press REM 5 to release REM measurement.

■ REM measurement is impossible when the vertical angle is at the visinity of 0°0'0". Together with a beep., follwing display appears to indicate it. Press REM 5 to release REM measurement.



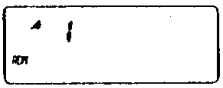
(7) RDM: Missing Line Measurement

The RDM mode can be used to measure the horizontal distance (HR) as well as difference in height between two target points.



① Set the prisms P1 and P2 at the two points, respectively, where the measurement is required.

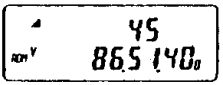
② Press [RDM B] to set RDM mode.

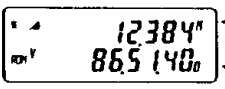


The distance to the first object (P1) is requested.

③ Aim the first object (P1).

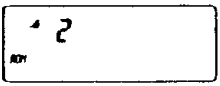
Press [MEAS] to measure the slope distance to the first object.





← The slope distance to the first object.
← The vertical angle to the first object.

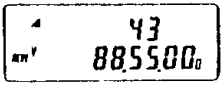
④ Press [AV E] to enter the distance and vertical angle to the first object.

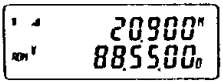


The distance to the second object (P2) is requested.

⑤ Aim the second object (P2).

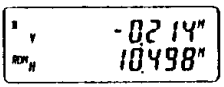
⑥ Press [MEAS] to measure the distance to the second object.





← Brief display of slope distance to P2

0.5 second later



Difference in height between two points (VR) ←
Horizontal distance between two points (HR) ←

⑦ If there are additional objects, aim the third object or the one concerned.

Then, press [MEAS] to obtain the slope distance to the object. (This procedure is equivalent to procedure ⑥. The horizontal distance and difference in height between the first object, being as a basic point, and the object concerned.) are displayed.
RDM measurement between the first object and any number of additional object can be taken.

■ Press [RDM B] to release RDM mode.

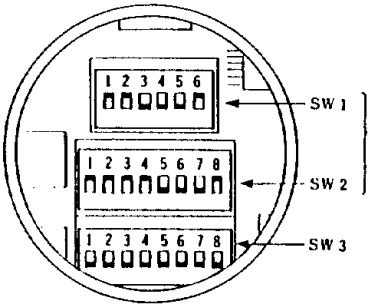
18. Internal Switches

Internal switches operation

(1) Turn counterclockwise the internal switch cover on the right side of instrument to remove.

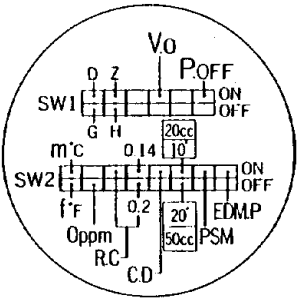
(2) Use a tip of small screw driver or similar to reset the switches.

- Make use of a rubber or similar for easily turning the cover.
- Be sure to turn the power off when resetting the switch.
- Factory settings may differ according to market destination.



- Refrain from operating a group of switches on SW3 unless needed. They are for checking at factory and selection of data-out format.

NOTE: Be sure that switches No.1 ~ No.4 on SW3 are always set to OFF(lower side). For specifying the function of each switch, following label is attached to the rear of the internal switch cover.



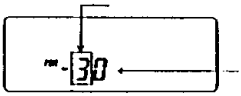
(1) Prism constant setting

PSM (No.7 switch on SW2)

The prism constant can be set between -99~+99mm.

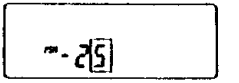
EX: Reset the prism constant to -25mm.

(1) After turning the power off, set the No.7 switch (PSM) on SW2 to ON. Then, turn the power on.

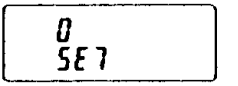


The stored value is displayed

(2) Press T/P 2 REM 5 to set the new value.



(3) Press AV E to enter the new value.



(4) Reset the PMS switch to OFF.

- The prism constant is factory set to -30mm.

(2) Auto power off setting

P.OFF (No.6 switch on SW1)

No operation on the instrument for about 10 minutes makes the power automatically turn off to prevent unnecessary battery drainage.

Setting the No.6 switch (P OFF) on SW-1 works to suspend the Auto power off function.

☆ With the auto power off being effective, the power automatically turns off when neither key operation nor turning the angles horizontally and vertically more than 1° is done for about 10 minutes.

- When the power turns off due to the auto power off function, turn the power switch off before turning the power on again.
- The auto power off function does not work with an external power source.

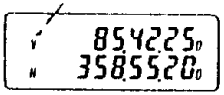
[3] EDM power cancel

EDM.P (No.8 switch on SW 2)

To measure angles without measuring the distance, the EDM power supply can be turned off. The on-board battery will last for approximately 10 hrs., and the external battery pack will last for approximately 26 hrs when the EDM power is off.
Set the No.8 switch (EDM .P) on SW2 to OFF for cancellation.

■ When the EDM power is in cancellation, no "◿" mark on the left top of the display apperars.

A mark to indicate that EDM power is ON.



[4] Atmosphere correction cancel

Oppm (No.2 switch on SW2)

The atmoshperic correction input function can be cancelled if the standard atmosheric correction coefficient of 15°C, 760 mmHg (59°F, 29.9InHg) or 0 PPM is OK. Compensation values cannot be input when this function cancelled, thereby preventing errant readings due to erroneous input.
Setting No.2 switch (0 ppm) on SW2 to OFF makes it unavailable to alter temperature and pressure values, whereby atmospheric correction is fixed to the standard values (0 ppm)

※ **Note on Atmospheric correction**

The speed at which light passes through the atmosphere varies with temperature and pressure. Atmospheric correction is therefore requied 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.

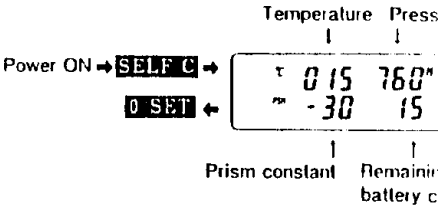
$$K = \left(279.75207 - \frac{106.06631 \cdot P}{273.14941 + t}\right) \times 10^{-6}$$

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

[5] Constant display switch

C.D (No.5 switch on SW2)

The stored temperature, pressure, prism cons and the remaining battery capacity can be played for confirmation after **SELF C** is palyed.
Following shows how the constants appear on display when setting the No.5 switch (C.D.) SW2 to ON.



* **Note on Remaining Battery Capacity**

Remaining battery capacity is numerically d played as shown below.

Remaining capacity code

16
15
14
⋮
10 } Operation possible

9
⋮
6 } Display blinks,indicating low battery capacity.

⋮ } **E-01** is displayed; operation is not possible. Replace or charge the battery.

■ Remaining battery capacity can also be d

played by pressing T/P E

However, be sure to press AV E th

times after recalling.

Atmospheric refraction and earth curvature correction switch

R.C (No.3 and 4 switches on SW2)

he effects of atmospheric refraction and earth urvature can be automatically corrected for easurement of horizontal distance and vertical istance. This atmospheric refraction and earth urvature correction can be cancelled by setting he No.3 switch (R.C.) to OFF. The atmospheric efraction coefficient can be set to either 0.14 or .2 with the No.4 switch on SW2.

■ Factory setting are: correction: ON, coefficient: 0.14.

* **Note on Earth Curvature and Atmospheric Refraction Correction**

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

○ If atmospheric refraction and earth curvature correction is ON

Corrected horizontal distance

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

Corrected vertical distance

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

○ If atmospheric refraction and earth curvature correction is OFF

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

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

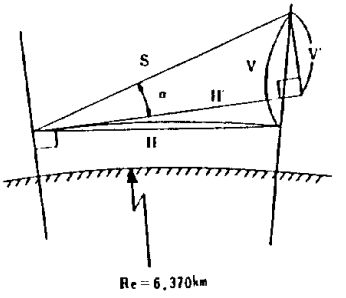
Where:

S: slope distance

K: atmospheric refraction coefficient (0.14 or 0.2)

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

α : vertical angle from horizontal



7 Unit switch (meters, feet)

m'C/f'F (No.1 switch on SW2)

When the switch is ON, distance measurement is done in the unit of meter and 'C and mmHg are to be used for temperature and atmospheric pressure, respectively For the distance measurement in the unit of feet and atmospheric correction in 'F and inHg, set the switch to OFF.

8 Angle mode selection

D/G **Z/H** (No.1 and 2 switches on SW1)

The unit of Angle (No.1 on SW1) { D (ON) : 360° / G (OFF) : 400G

The vertical angle mode (No.2 on SW1) { Z (ON) : Zenith 0° / H (OFF) : Horizontal 0°

9 Selection of least count of angle

10"(20CC) / 20"(50CC) (No.6 switch on SW2)

Set the switch to ON to change the angle unit to 10" or 20cc.

19. Error Codes

Dispalyed code	Meaning	What to do
V-OVER PUSH O	Displayed when the telescope is turned too quickly (faster than 2 revolutions/second.)	Press O SET and remeasure from the start.
H-OVER PUSH O	Displayed when the alidade is turned too quickly horizontally (faster then 2 revolutions/second.)	Press O SET and remeasure from the start.
E-01	Battery capacity is too low for continued operation.	Replace or recharge battery.
E-02	Poor contact or other problem found in keyboard operation.	Turn the power off and then on again. If the error message still appears, repair is required.
E-3 ~ E-6	Some problem found in the distance measurement circuit.	
E-07 ~ E-16	Some problem found in the angle measurement circuit.	
E-17 ~ E-21	Some other problem found.	

■ If an error message appears during proper operation, please consult your local dealer or service outlet.

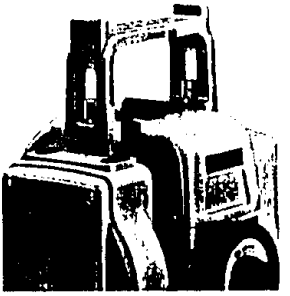
1) Battery

(1) ON BOARD BATTERY (MB19)

Attachment

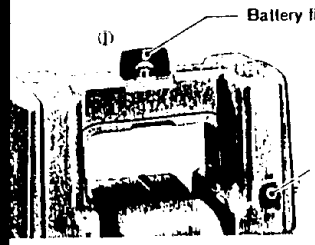
1) Attach the on board battery on the top of the instrument along with the hand grip.
2) Lightly pressing the on board battery, turn the battery fixing lever to fix the battery.

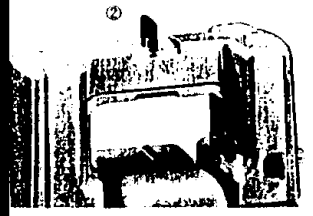
■ Place the battery in right position so that the power switch on the battery faces toward you when viewed from the normal position.



2) Detachment

(1) Lift the lever upright and turn it 90°.
(2) lift the on-board battery up.



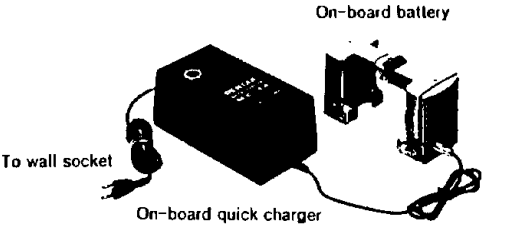


① Lift the lever.
② Turn 90°.
③ Lift the battery.

3) Charging

① Remove the on-board battery from the main body, and attach the connector of the on-board battery quick charger (MC-14) to the charging connector.
② Insert the plug of MC-14 into wall socket (AC100V, 120V, 220V, 240V, 50/60Hz), and make sure that the pilot lump illuminates. MB19 can be recharged regardless as to whether the switch is on or off.
③ After the pilot lump extinguishes (In approximately 1 hour), remove the connector and plug.

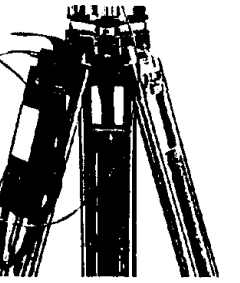
■ Do not charge MB19 while it is on the instrument.
■ Do not leave MC-14 with plug in the wall socket after recharging the on-board battery although it has the built-in circuit for protection from over-charging.
■ Be sure to charge the battery under the temperature of + 10°C ~ + 40°C. Proper charging may not be possible out of the specified temperature range.



NOTE: Rechargeable battery can be repeatedly recharged 300~500 times. However, complete discharge of the battery may shorten the service life of it. In order to ensure the usage of the battery for extended period, be sure to recharge the battery once a month.

(2) EXTERNAL BATTERY (MB22)

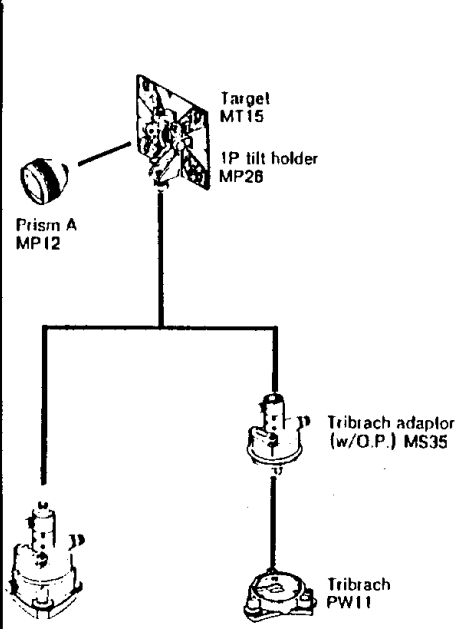
For extended continuous use, use the external battery MB22 (Optional accessory).
(For detail, refer to [2] External battery MB22 on Page 32.

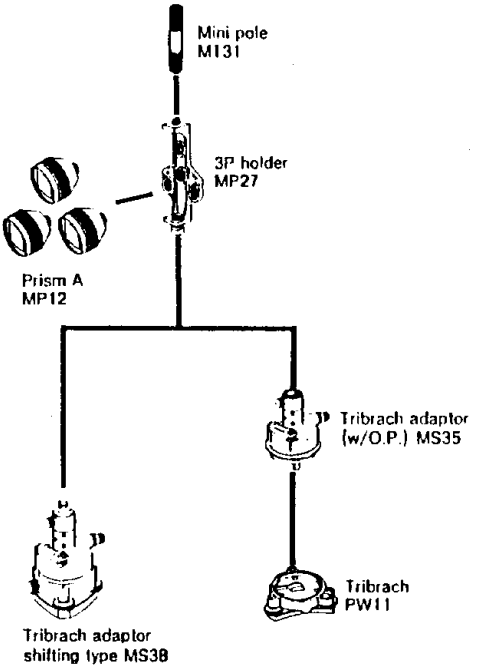


5. Optional Accessories

Standard Combination

Prism unit





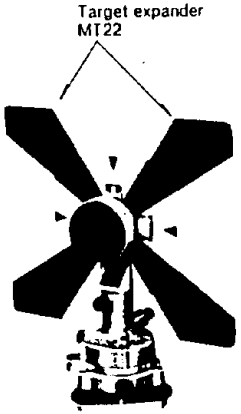
1P tilt unit
shifting type A
MPU6A

1P tilt unit A
MPU5A

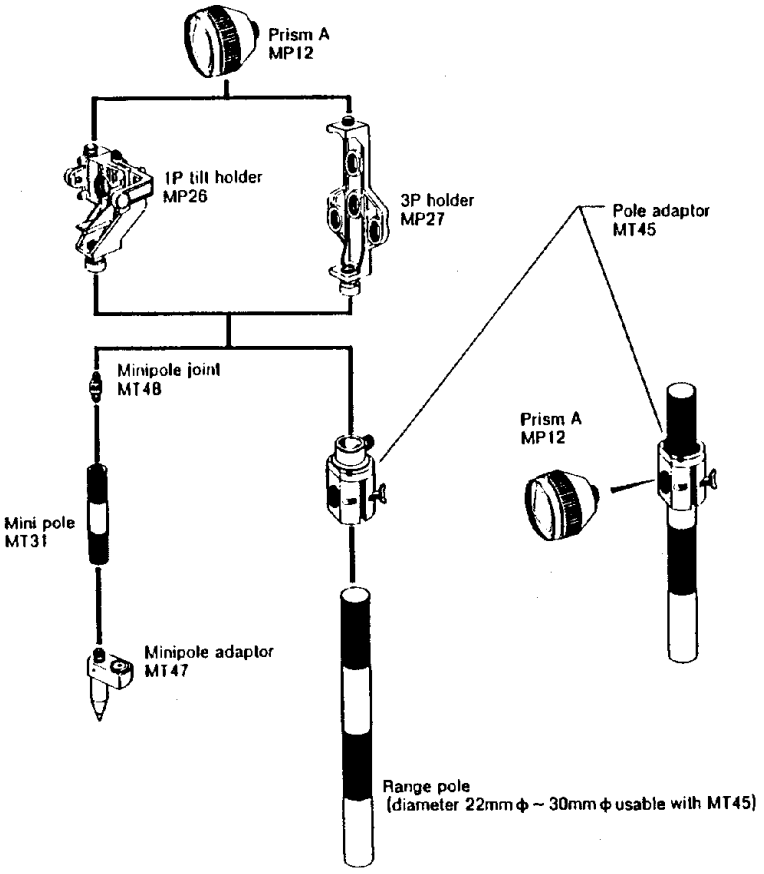
3p unit shifting
type A MPU8A

3P unit A
MPU7A

) Target



3) Pole adaptor



[2] External battery (MB22)

For longer continuous measurement, use the external battery MB22 (optional accessry).
When both the on-board battery and external battery are turned on the power supply from on-board battery is automatically cut off.

1) External battery (MB22)

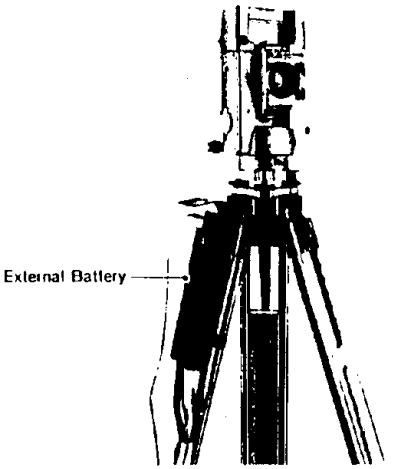
Power supply	NiCd battery (rechargeable)
Output voltage	DC8.4V
Working time per charging	8 hrs. (continuous) (Distance & Angle Measurement) 26hrs. (continuous) (Angle Measurement Only)
Length of power supply cord	2m

2) External battery charger (MC22)

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

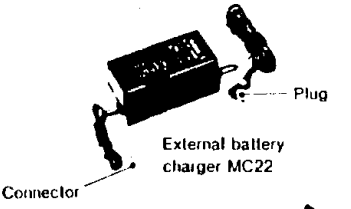
3) Usage

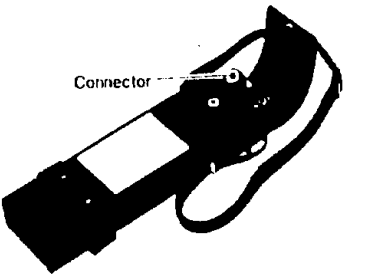
① Fit the external battery on the tripod and attach its connector and the external battery connector of the instrument using the power supply cord.
② Turn on the power supply switch of the external battery.
■ The auto power OFF function is not available when the external battery is in use.



4) Charging

① Attach the connector of the external battery charger MC22 to that of the external battery.
② Insert the plug of the battery charger into a wall socket (AC120V, 220V, 50/60Hz).
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.

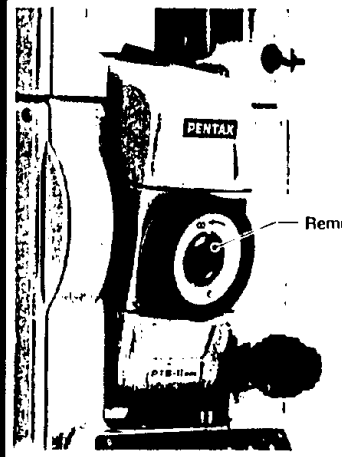


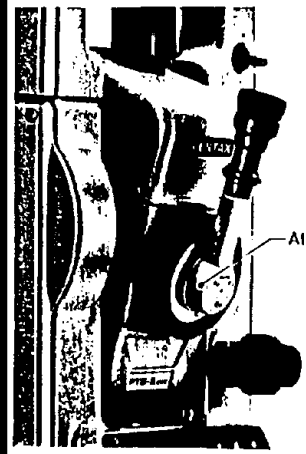


External battery MB22

[3] Diagonal Eyepiece (SB8)

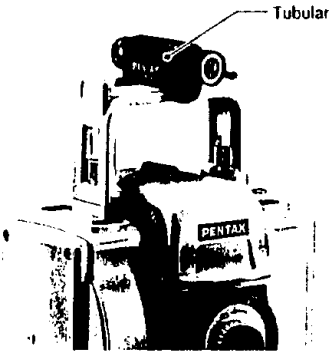
The diagonal eyepiece can be attached for convenience in observing the zenith or surveying in confined spaces. To attach the diagonal eyepiece, turn the telescope eyepiece ring counterclockwise to remove the eyepiece, and attach the diagonal eyepiece by turning its ring clockwise.
The eyepiece can be rotated through 360°
When sighting is made through the telescope with the diagonal eyepiece attached, the reticle may be seen deflected vertically or horizontally, but this has no influence upon accuracy. It can be corrected with three adjusting screw attahced to the diagonal eyepiece if necessary.





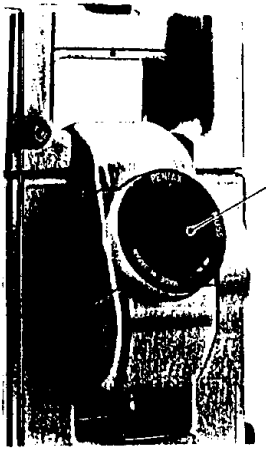
[4] Tubular Compass (SC7)

The tubular compass can be attached onto the hand grip to obtain the magnetic north.
When using it, remove the on board battery to eliminate the influence by the magnetism.



[5] Solar Filter (MU55)

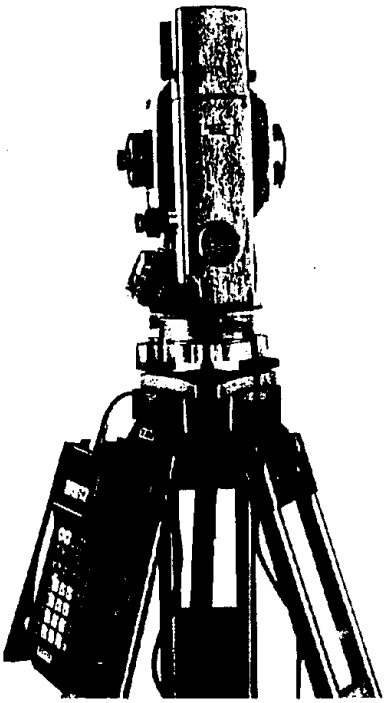
For solar survey, the solar filter needs to be attached to the objective lens. Avoid to aim the objective lens directly at the sun without attaching a solar filter. Direct sunlight, focused through the objective lens, may cause the damage to internal components.

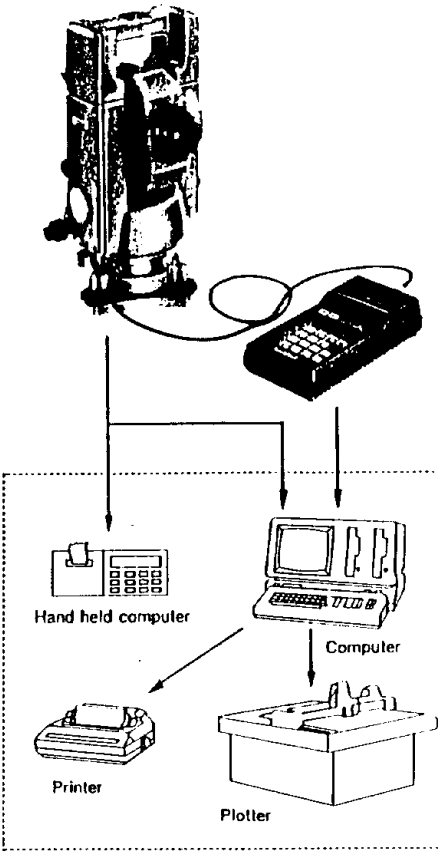


16. Data Collector DC-1Z

PTS-Ⅱ$_{20F}$ has a built-in bidirectional communications function for direct data transfer to a computer via the RS-232C interface. Data Collector DC-1Z can be used for data storage during field work and enables automatic data transmission to a desktop computer station, thereby simplifying operator work tasks and rationalizing work procedures.

- Refer to the Data Collector operation manual for connection and operation.
- Computer to Data Collector connection may vary with different computer systems. Refer to the computer operating manuals or consult your dealer for computer communications protocol specifications.





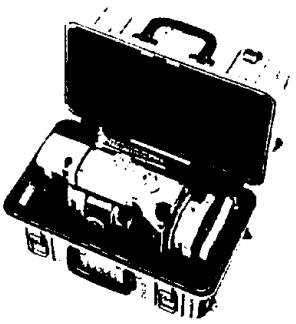
DC-1Z Specifications

CPU:	8 bit C-MOS	
Memory:	256K bites ROM: 128K bites (for program) RAM: 128K bites (for data recording) (Desired program and data bank selectable)	
Display:	LCD two line with 16 characters per line	
Key board:	Alpha-numeric 34 keys	
Interface:	RS-232C standard	
Power source:	Main power: 4XAA battery continuous 100 hrs. operation Memory back up: Lithium battery 3 years life	
Dimensions:	210 (L) × 100 (W) × 35 (H) mm	
Weight:	590 gs.	
Loaded programe	DC-SURVEY V2.2 SET OUT V1.1	
Maximum number of data points	DC-SURVEY V2.2:	1620 (points) × 3 (banks) = 4860 (points) (for recording data of point number, H. angle, V. angle and S. distance) * Maximum number of data points depends on character of each data. * User definable sequence
	SET OUT V1.1:	580 (points) × 3 (banks) = 1740 (points) (for recording data of point name, N coordinate, E coordinate and Elevation) * Maximum number of data points depends on character of each data. * SET OUT program is sub-devided into Setting out, Resection, Direct Check and Indirect Check programs.

6. Maintenance and Storing

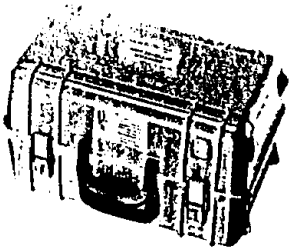
[1] Maintenance

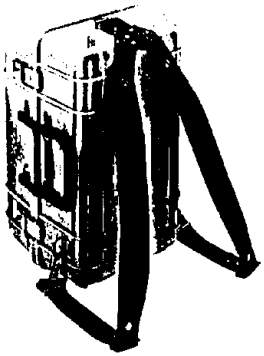
(1) After using the instrument, wipe off dust and moisture and store it in its case.
(2) When cleaning the exposed parts, first remove dust with the cleaning brush, then gently wipe with a soft cloth.
(3) To clean the lens surfaces, first remove dust with cleaning brush, then gently wipe with a clean 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 as follows.
(1) Set the telescope almost horizontal, and tighten telescope clamp screw lightly.
(2) Align the yellow dots, and tighten each clamp screw lightly.
(3) Store the instrument correctly into the case with the yellow dots towards you.
(4) Close the case lid and lock the clamp.
■ Be sure to turn off the power when storing the instrument with the on-board battery on.



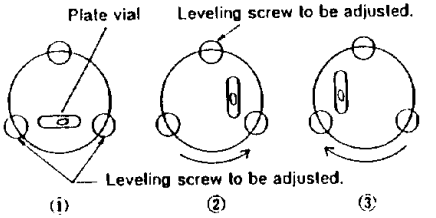


7. Inspection and Adjustment

[1] Perpendicularity of Plate Vial to Vertical Axis

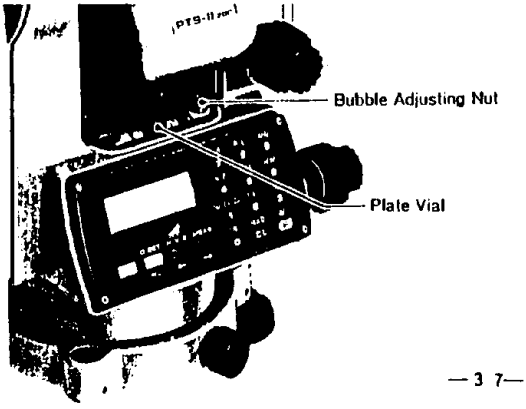
1) Inspection

(1) Align the plate vial in parallel with a line joining any two of the leveling screws. Then, adjust the two screws to center the bubble in the vial.
(2) Rotate the plate vial through 90° around the vertical axis. Adjust the remaining leveling screw to bring the bubble to the center.
(3) Rotate the plate vial through 180° around the vertical axis.
(4) No adjustment is necessary if the bubble of the plate vial is in the center.



2) Adjustment

[1] If bubble of the plate vial moves from the center, bring it half way back to the center by adjusting the leveling screw which is parallel to the plate vial. (Fig.A)
[2] Correct the remaining half by adjusting the bubble adjusting nuts with a adjusting pin. (Fig.B)
[3] Confirm that the bubble does not move from the center when the plate vial is rotated by 180°
[4] When the bubble moves, start from [1] once again.



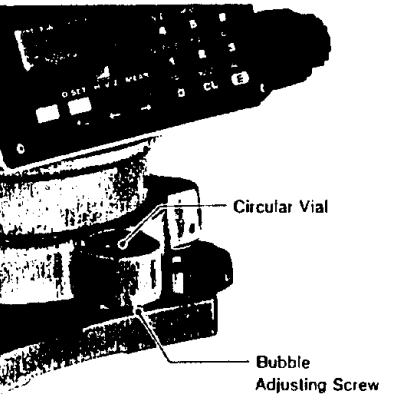
[2] Perpendicularity of Circular Vial to Vertical Axis

1) Inspection

No adjustment is necessary if the bubble of the circular vial is in the center after inspection and adjustment of "Perpendicularity of the Plate Vial to the Vertical Axis".

2) Adjustment

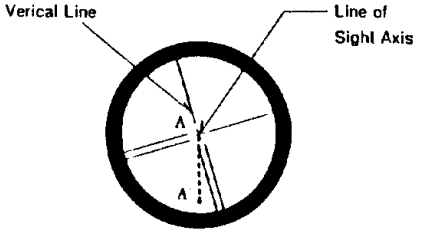
If the bubble of the circular vial is not in the center, bring the bubble to the center by turning the bubble adjusting screw with the adjusting pin.



[3] Inclination of Reticle Pattern Cross Hair

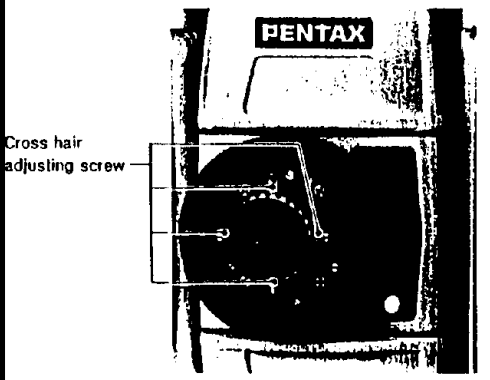
[1] Inspection

(1) Set an object point A on the line of sight through the telelscope.
(2) Move point A to the edge of the field of view by adjusting the telescope tangent screw (point A')
(3) No adjustment is necessary if point A moves along the vertical line of the reticle.



[2] Adjustment

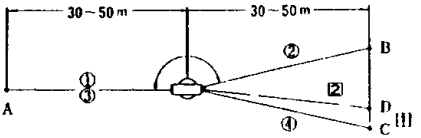
[1] If the point A does not move along the vertical line, first remove the eyepiece cover with a screwdriver.
[2] Loosen the four cross adjusting screws uniformly with the adjusting pin. Rotate the cross hair around the sight axis, and align the vertical line of the cross hairs with point A'.
[3] Tighten the cross hairs adjusting screws uniformly. Repeat the inspection and check that the adjustment is correct.
■ After adjustment, make inspections described in [4], [5] and [8]



[4] Perpendicularity of Lines of Sight to Horizontal Axis

[1] Inspection

(1) Set an object point A at a distance of 30 to 50m away from the instrument, and sight it through the telescope.
(2) Loosen the telescope clamp screw and reverse the telescope around the horizontal axis. Mark a point set ont the line of sight at about the same distance to the object point A, and call it point B.
(3) Loosen the upper clamp screw, and rotate the instrument around the vertical axis. Sight point A again.
(4) Loosen the telescope calmp screw, and reverse the telescope around the horizontal axis. Mark a point on the line of sight at about the same distance as point B, and call it mark C. (The telescope has now returned to its normal position.)
(5) No adjustment is necessary if points B and C coincide.



[2] Adjustment

[1] If points B and C do not coincide, set up a point D located 1/4 of the length BC from the point C toward B.
[2] Turn the two cross hairs adjusting screws opposed horizontally by first loosening one, then tightening the other with the adjusting pin. Move the cross hair so that point D is set on the line of sight.
[3] Repeat the inspcetion and check that the adjustment is correct.
■ After adjustment, make inspection described in [5] and [8].

[5] Inspection and Adjustment of Vertical 0 point Error

Be sure to carry out [Inspection and Adjustment of Vertical 0 point] whenever making adjustment [3] and [4].

[1] Inspection

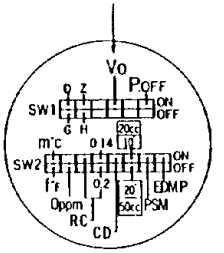
(1) Set up as usual and turn the power on.
(2) Sight the telescope at any reference target A. Obtain vertical angle (γ).
(3) Reverse the telescope and rotate the alidate. Sight again at A and obtain vertical angle (θ)
(4) If $\gamma + \theta = 360°$, no further adjustment is required.

※ If difference d ($r + \theta - 360°$) is greater than the rated value, either (or both) of the vertical scale zero offset or vertical compensation offset values is incorrect. Adjustment is required.

[2] Adjustment

(VERTICAL SCALES ZERO OFFSET ADJUSTMENT)

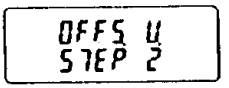
Vertical scales zero offset switch.



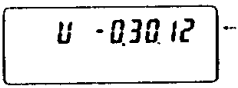
[1] Turn the power off and open the internal switch cover.
[2] Set V.O (No.4 on SW1) to ON.

[3] Turn the power on and perform the vertical angle zero set operation. (Refer to p.14 (2) Turning the power ON).

[4] Aim the object A and press SET



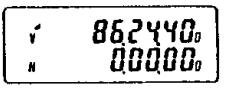
[5] Reverse the telescope and turn the instrument and sight at object A again with the telescope reversed. Press SET



← Zero offset value is displayed

[6] Reset the zero offset switch V.O OFF. Adjustment is completed.

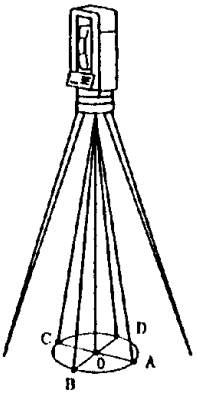
Note) Be sure not to turn the power off before resetting internal switchesto off. V/H display mode will be resumed.



[6] Coincidence of Line of Sight of Optical Plummet with Vertical Axis

(1) Inspection

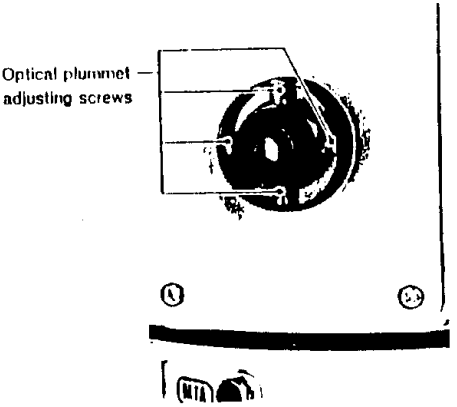
(1) Set the instrument on the tripod, and place a piece of white paper with a cross drawn on it right under the instrument.
(2) Look through the optical plummet, and move the paper so that the intersecting point of the cross comes to the center of the field of view.
(3) Adjust the leveling screw so that the center mark of the optical plummet coincides with the intersection point of the cross.
(4) Rotate the instrument around the vertical axis. Look through the optical plummet each steps of 90° rotation, and observe the center mark position against the intersection point of the cross.
(5) If the center mark always coincides with the intersecting point, no adjustment is necessary.



(2) Adjustment

[1] If the center mark does not coincide with the intersection point, rotate counter-clockwise the cap put on focussing knob of optical plummet and then remove it.
[2] Mark the point set on the line of sight at each step of 90° on the white paper and call them A,B,C and D.
[3] Join the opposed points (A,C and B,D) with a straight line, and set intersecting point 0.
[4] Turn four optical plummet adjusting screws with a adjusting pin so that the center mark coincides with the intersecting point 0.

[5] Repeat the intersection procedures starting with inspection (4), and confirm if the adjustment is correct or not.



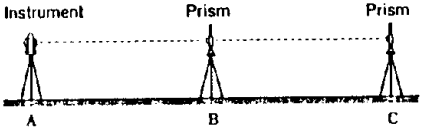
[7] Offset Constant

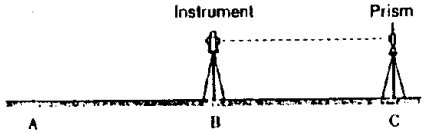
The offset constant can be obtained by checking the measuring accuracy on the certified base line. It can also be obtained in the following way.

[1] Checking

(i) 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.





[8] Checking of Alignment of Beam Axis with Line of Sight

At the time of adjustment in articles [3] and [4] confirm that the distance measuring axis and sighting axis are aligned.

[1] checking

① Set the prism at a distance greater than 50m.
② Accurately sight the center of the prism through the telescope.
③ Turn the power on. After setting the distance mode with H/V/Z press MEAS for measurement.
④ If the light receiving buzzer sounds, and the displayed value of the receiving light volume changes, there will be no problem.

■ Unless the instrument functions as described in ④, contact our authorized dealers.
■ This checking should be done under good weather condition.

[9] Caution and Precaution for Adjustment

◇ Make all checkings and adjustments in numerical order.
◇ Do not make checking and adjustment described in articale [4] prior to those in article [3]. When making adjustment described in articles [3] and [4] make inspection described in articles [5] and [8].
◇ Be sure to tighen the adjustment screws all the way when adjustments are completed. When tighening the adjustment screws stops truning. Turn the adjustment screws nearly all the way out before re-tightening them.
◇ Re-check setting after adjustments have been made.

PENTAX®

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