PENTAX®

ELECTRONIC TOTAL STATION

PCS-200 SERIES

PCS-225/PCS-215

INSTRUCTION MANUAL

ASAHI PRECISION CO., LTD.

Safety Precautions

Before using this instrument, be sure to read the following precautions carefully. Pentax cannot be held responsible for problems which result from failure to observe these precautions.

⚠ WARNING!!

The following items could cause severe bodily injury and should be observed at all times.

◎ Looking directly at the sun without attaching a filter to the telescope can result in a loss of eyesight. Always use an objective filter when observing the sun. (When observing the sun, always attach the solar filter, designed especially for this purpose by Pentax, to the objective lens.)

⚠ CAUTION

The following actions could cause serious damage to the instrument.

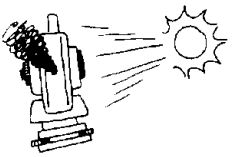
◎ Never remove the hand grip carelessly. If it is detached, reattach it securely.If the grip is loosely or incompletely attached, the instrument could fall and cause a serious injury to occur.

◎ Make sure not to short the battery terminals. If these are shorted, the resulting high current would not only damage the battery, but could also start a fire.

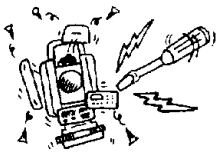
Safety Precautions

Warning!!

◎ If the telescope is pointed directly at the sun without an objective lens filter attached, the internal electronic components could be damaged by the concentrated energy of the sun. Do not aim the telescope at the sun without protecting it. (When making solar observations, always use the objective lens filter.)



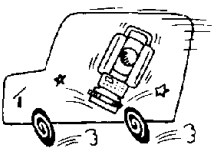
◎ Never disassemble the instrument or the battery. If you find a problem, please contact the dealer where the instrument was purchased, or get in touch with Pentax.



◎ If the instrument or the battery comes in contact with water, wipe it off as quickly as possible and set it in a dry place for a while. When it is completely dry, put it back in the case.

◎ Always turn off the power when removing the battery from the instrument. If the battery is removed with the power left on, the instrument could be damaged.

◎ Avoid storing the instrument in locations where the temperature or humidity is high, or places which are exposed to direct sunlight.



Precautions for inspection

When inspecting the instrument, make sure to read and observe the "Inspection and Adjustment" items on pages 73~80 before beginning the work.

This company is not responsible for damages due to surveying results obtained from an instrument which has not been inspected.

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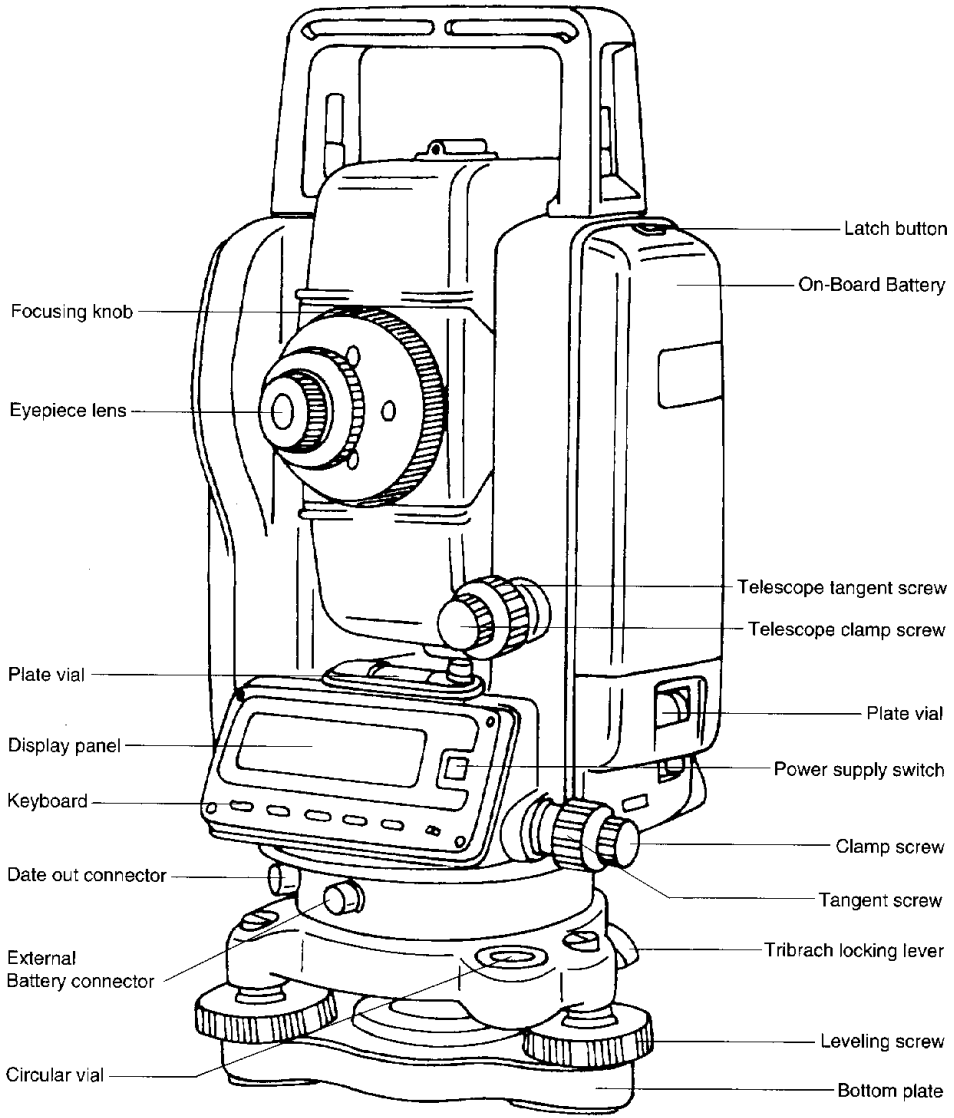
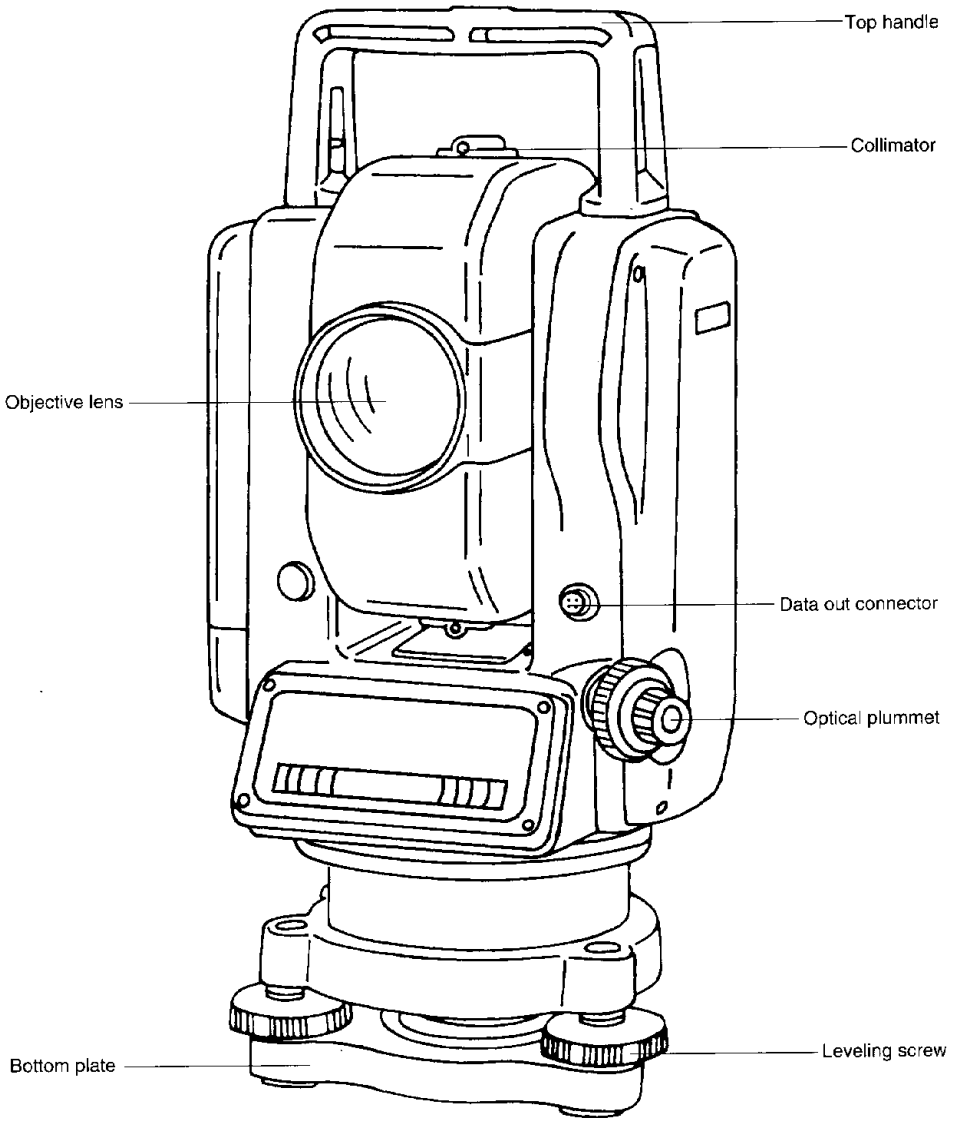
1. Before Using Your Instrument

1-1. Names and Functions of Parts



PCS-225 (Tribrach Detachable/Display:Dual)



PCS-215 (Tribrach Fixed/Display:Single)

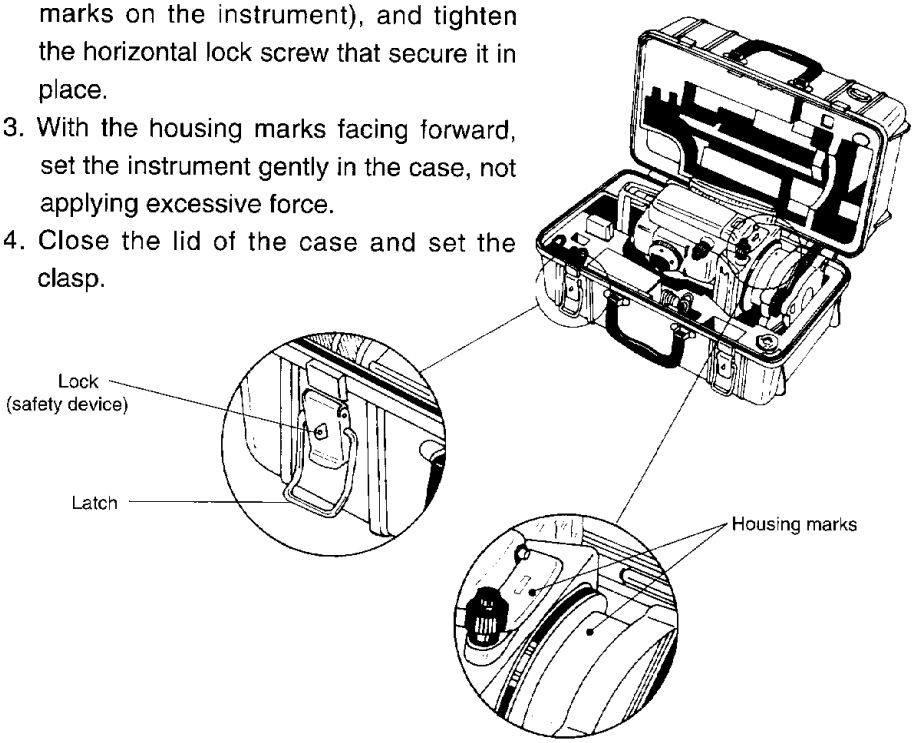
1-2. Taking the Instrument Out and Putting it Back in the Case

Taking the Instrument Out of the Case

1. Set the case down gently, with the lid facing upwards.
2. Remove the latch while pressing down on the lock (this is a safety device), and open the lid of the case.
3. Take the instrument out of the case.

Storing the Instrument in the Case

1. Make sure the telescope is fairly level, and lightly tighten the lock screw that secure it in place.
2. Line up the housing marks (round yellow marks on the instrument), and tighten the horizontal lock screw that secure it in place.
3. With the housing marks facing forward, set the instrument gently in the case, not applying excessive force.
4. Close the lid of the case and set the clasp.

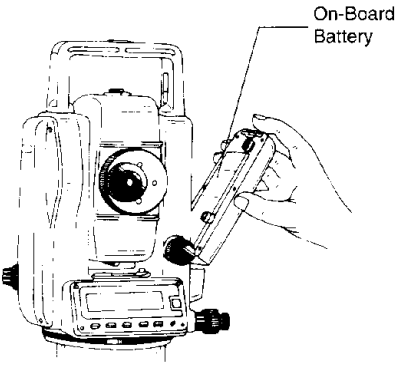


1-3. Installing and Charging the Battery

Removing the battery

Caution!! Always turn off the power when removing the battery from the instrument. If the battery is removed with the power left on, the instrument could be damaged.

Pressing down on the latch button at the top of the battery, remove the battery from the instrument.



Installing the battery

Insert the lower end of the battery in the groove of the side cover and push the top of the battery into the side cover until you hear a click.

Amount of charge left in battery

When the power to the instrument is turned on, a battery icon " 🔋 " is displayed at the right of the display panel so that the amount of charge left in the battery can be checked.


..... The instrument can be used for quite a while before the battery runs down.

..... A spare battery should be prepared.

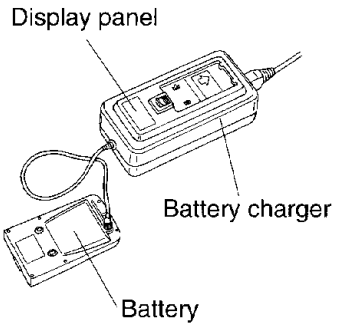
..... The battery should be replaced very soon.

Change the battery The "Change battery" display will turn off about 5 seconds after it is displayed. Replace the battery with a spare, or charge the battery.

Before Using Your Instrument

Charging

1. Insert the quick charger (MC04) plug into an ordinary wall socket.
2. When the charger is connected to the battery which has been removed from the instrument(using the connectors provided for the charger and the battery), the pilot lamp on the charger blinks and charging begins.
3. About 1.5 hours later the pilot lamp will stop blinking, indicating that the battery is completely charged.
4. After charging, remove the charger plug from the AC power supply and disconnect the charger from the battery.



Precautions when charging

- ○Even though a protective circuit to prevent overcharging is built into the quick charger (MC04), do not leave the charger plugged into the outlet for a long time after charging is complete.
- ○The battery should be charged at room temperature, within a range of +0℃ to +45℃. If charging is done outside of this regulation range, problems could occur.
- ○If the pilot lamp does not blink even though the charger is connected to the battery, there may be something wrong with either the charger or the battery.

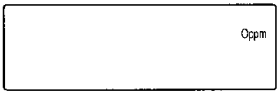
Precautions regarding storage

The battery should be charged at least once a month!

- ○A rechargeable battery can normally be charged repeatedly, from 300 to 500 times. However, if a battery is stored in fully discharged condition, the useful life of the battery could be considerably shortened.
- ○In order to ensure that a battery can be used for a long time, it should be charged at least once a month. The battery should always be charged just before it is used.
- ○If the battery capacity has dropped considerably because it has not been used for a long time, it has been affected by the storage temperature, or for other reasons, one charging might not be sufficient to fully charge it.If this happens,the battery should be alternately charged and discharged 3 or 4 times before being used.

2. Displays and Keybord

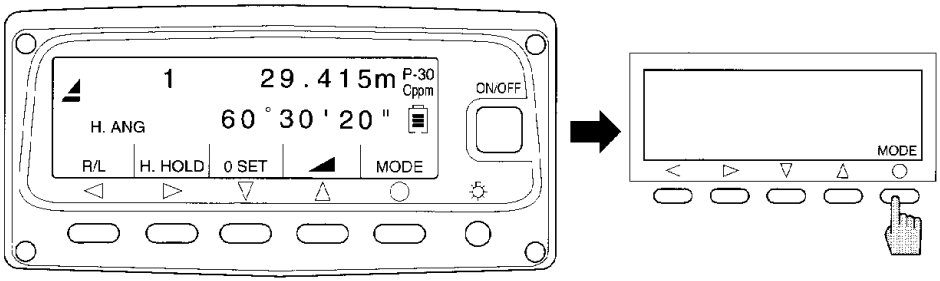
2-1. Displayed Characters and Marks

Character/Mark	Description
	**✳ mark (asterisk)** This is displayed during measurement, while the instrument is receiving reflected beam from the prism.
	**Shot** This shows that shot measurement (one time or several times) is being used rather than the normal continuous distance measurement.
	**Dot matrix** This displays distance or angle data and guide messages in a dot matrix of two rows of 12 characters.
	**P-30** When the prism constant is set to "−30mm", [P-30] is displayed; when the prism constant is "0", [P-0] is displayed.
	**0ppm** This is displayed when the standard temperature of 15°C and air pressure of 1013 hPa have been set, or when "no correction" has been selected. When changed to anything other than the standard temperature or air pressure setting, the display disappears.
	**mark** This indicates how much charge is left in the battery. The black area changes to white in three stages as the battery capacity decreases (see page 9).
	**◢mark** During measurement, a ◢mark indicates the horizontal distance, ◢indicates the slope distance, and ◢shows the height differential (or the height).

2-2. Sample Illustrations

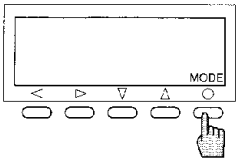
The keyboard illustrations provided in this manual have been simplified so that they include only those portions which illustrate the point currently being discussed.

Actual diagram **Simplified diagram**

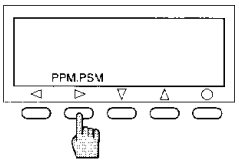


In these illustrations, the finger shows which key should be pressed.

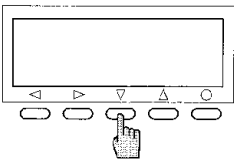
This means to press the MODE key

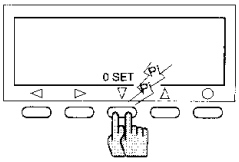


This means to press the PPM.PSM key



This means to press the ▼key



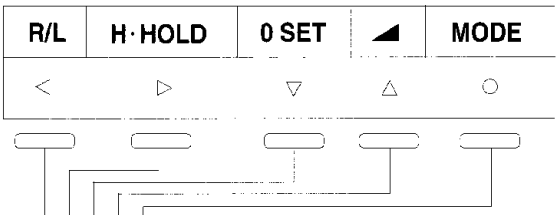


A picture of two fingers means to press the same key twice. Also, the picture means that if the key is pressed only once a buzzer will sound, and the key should be pressed again while the buzzer is still sounding.

Displays and Keyboard

2-3. What the Keys do

The various keys have several functions, as shown below.



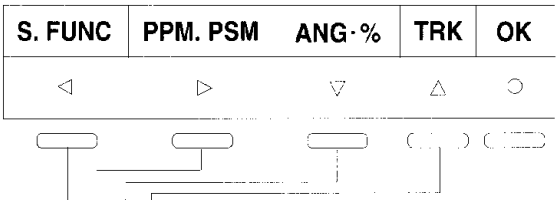
MODE key: This selects the desired mode.

◢ key: This changes the display in sequential order from horizontal distance to slope distance to height differential.

0 SET key: This sets the horizontal angle to 0.

H·HOLDkey: This key holds the horizontal angle shown on the display.

R/L key: This switches between left and right rotation of the horizontal angle.



OK key: This initiates the measurement.

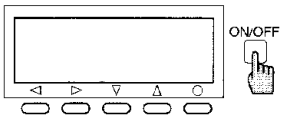
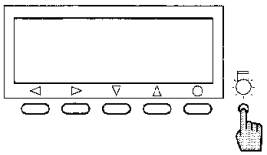
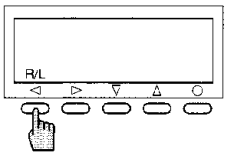
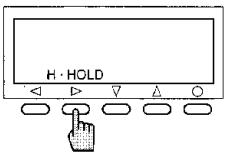
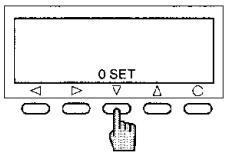
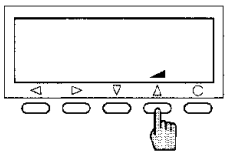
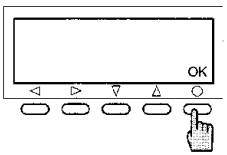
TRK key: This initiates rapid measurement.

ANG·% key: This switches to angle mode.

PPM.PSM key: This switches between the temperature, pressure, and prism constant input screens.

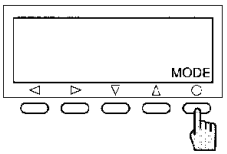
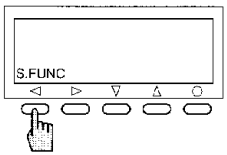
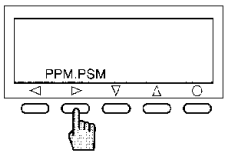
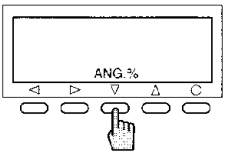
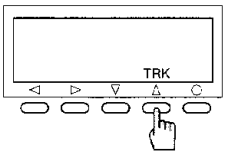
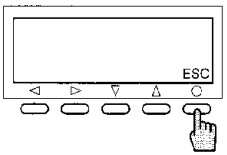
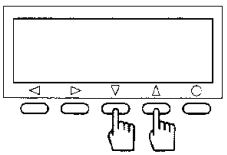
S.FUNC key: This switches to the special measurement modes.

Key Functions During Measuring Operation

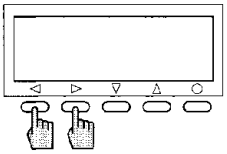
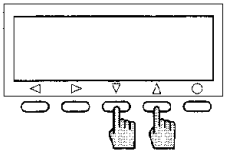
Key	Function
	**ON/OFF key:**This turns the power on and off alternately.
	**ILLUMINATION key:**This turns the lighting on and off for the LCD panel and the telescope reticle.
	**R/L key:**Pressing this key switches between left and right rotation of the horizontal angle.
	**H·HOLD key:**Pressing this key twice retains (holds) the horizontal angle shown on the display.
	**0 SET key:**Pressing this key twice sets the horizontal angle to 0°00'00".
	**◢ key:**Each press of this key changes the distance display in sequential order from slope distance to height differential to horizontal distance. In angle mode, pressing the key changes to distance mode.
	**OK key:**Pressing this key terminates the numeric or selection input and advances to the next screen.

Displays and Keyboard

Key Functions During Measuring Operation

Key	Function
	**MODE key:**Pressing this key selects modes such as a special mode or a correction mode.
	**S. FUNC key:**This is used to select the special function modes (distance stake out, lot staking, offset point, remote elevation, remote distance, coordinates, resection, traverse,and coordinate stake out measurements).
	**PPM·PSM key:**This enters the mode where the temperature, pressure, and prism constant can be corrected.
	**ANG ·% key:**This switches between distance and angle modes. In angle mode, the vertical angle is displayed as a percentage.
	**TRK key:**This switches between normal measurement (a measurement time of approximately 2.0 seconds, with display in mm) and rapid measurement (a measurement time of approximately 0.5 seconds in centimeters or 0.8 seconds in millimeters).
	**ESC key:**This returns from the various modes to the normal measurement mode.
	When a special measurement mode has been accessed, pressing the ▼ or ▲ key displays the items pertinent to that mode in sequential order.

Key Functions During figure input

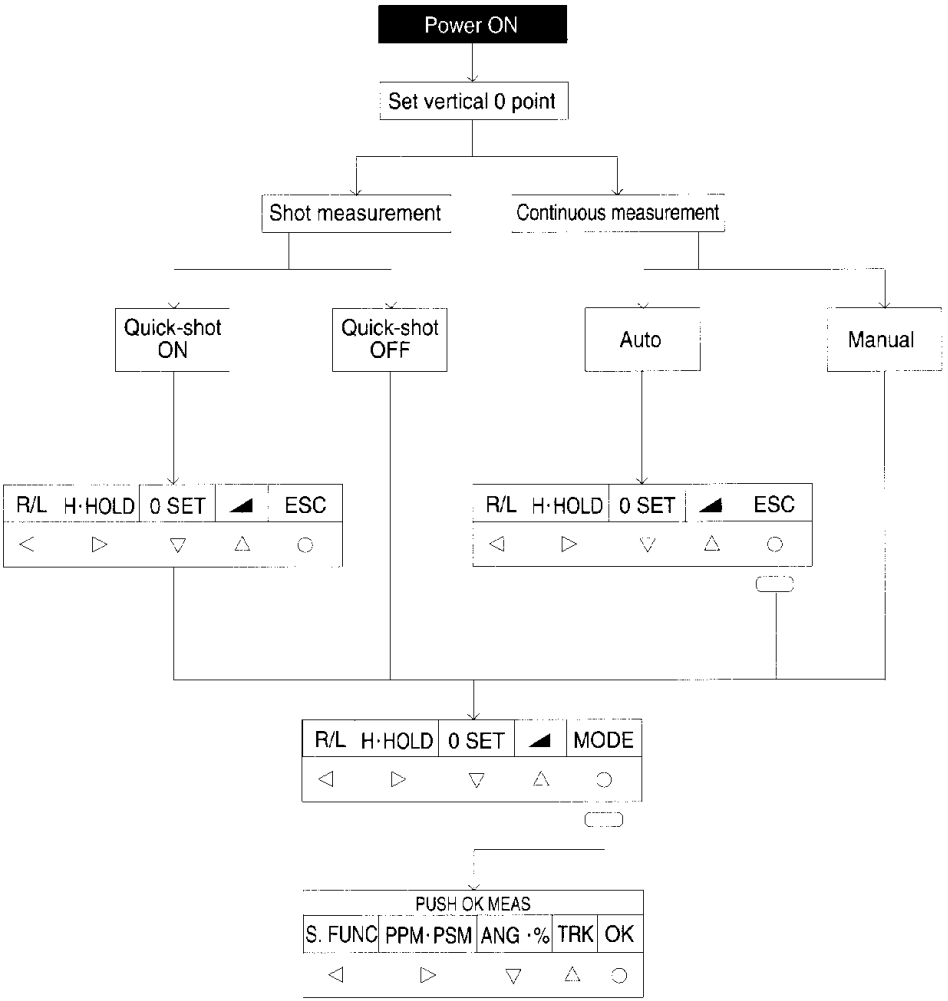
Key	Function
	Pressing the ◀ key moves the blinking cursor to the left., and pressing the ▶ key moves the blinking cursor to the right.
	Each time the ▼ key is pressed, the blinking numeric value decreases by 1. Each time the ▲ key is pressed, the value increases by 1.

3. Setting Measurement Conditions

With this instrument, a number of conditions such as the prism constant and atmospheric correction method can be specified in advance. The user can change the original settings, entered when the instrument is shipped, which are referred to as "initial settings". Please see the section on page 61 entitled "Initial Settings" for more information on these settings.

4. Operation Flowchart

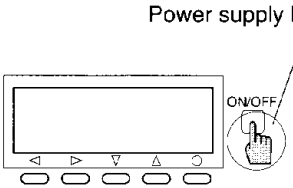
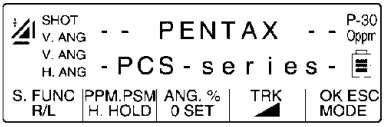
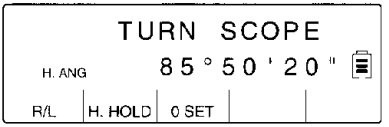
The illustration on this page shows the general flow of operations with this instrument.



※When the instrument is shipped from the factory, the quick-shot measurement function is set to ON (the number of measurements is 1). This can be changed in the initial settings if desired.

5. Turning On the Power

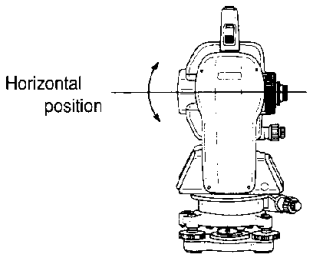
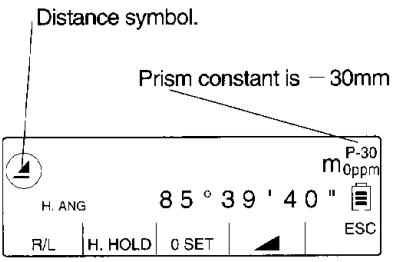
5-1. Turning the Power On and Off

Operation Procedure	Display
Power ON  Pressing the ON/OFF key causes all display segments to light. After approximately 2 seconds,horizontal angle measurement is initiated. (To turn off the power,press the on/off key once again)	 After approx. 2 seconds ⬇  Horizontal angle (right rotation angle) can be initiated. ⬇ Proceed with setting of Vertical 0 point. (Right page)

- For any measurement other than horizontal angle measurement, the vertical angle index point should be specified.
- When the power is turned off, the horizontal angle displayed at that point is retained, so that when the power is turned on again, that horizontal angle is displayed. If the previous horizontal angle is no longer necessary, set it back to 0.
- With the auto power off function, the power is turned off automatically if a period of approximately 10 minutes elapses without any operation.

To change to left rotation angle of the horizontal angle ..... **See page 22**
To retain (hold) the horizontal angle ..... **See page 23**
To set the horizontal angle to 0 ..... **See page 22**
For information on the auto power off function ..... **See page 64**

5-2. Setting the Vertical 0 Point

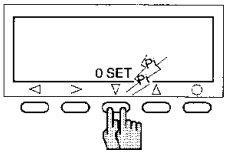
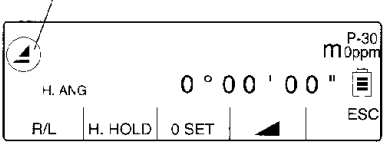
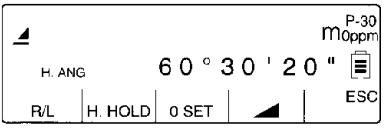
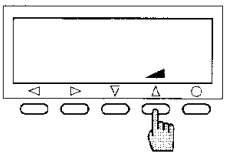
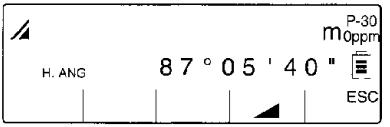
Operation Procedure	Display
 After the power is turned on, turning the telescope up and down and passing through the horizontal position sets the 0 point for the vertical angle and displays a distance mark ◢ in the display section. The vertical angle and distance can now be measured.	

- Horizontal angle measurement can be done even if the 0 point for the vertical angle has not been set.
- The horizontal angle displayed, when the power is turned on, is that which was displayed when the power was last turned off. If the previous horizontal angle is no longer necessary, set it back to 0.
- In some cases, distance measurement can be carried out even if the 0 point for the vertical angle has not been set. (This occurs when the telescope passes through the origin point as the horizontal angle is being measured.)

To change to left rotation angle of the horizontal angle ..... **See page 22**
To set the horizontal angle to 0 ..... **See page 22**
To measure the vertical angle ..... **See pages 20 and 21**
To measure a distance ..... **See page 26**

6. Angle Measurements

6-1. Measuring the Angle (in Distance Mode)

Operation Procedure	Display
1 (This step should be carried out after the 0 point of the vertical angle has been specified.)  After sighting the first target, press [0 SET] twice and set the horizontal angle.	Mark for Distance mode 
2 Sight the second target and read the horizontal angle.	
3  Press the ◢key to disply the vertical angle.	

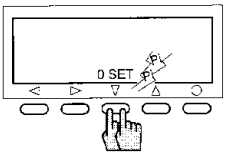
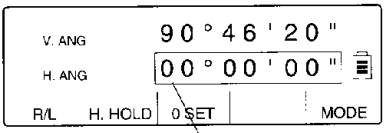
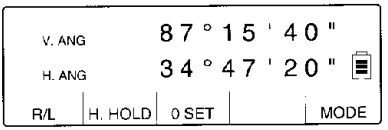
- If only the horizontal angle is being measured, the vertical angle 0 point does not have to be specified.
- The [0 SET] key cannot be used to set the vertical angle to 0.
- If the power is turned off during a measurement, the horizontal angle effective at that point is retained, so that when the power is turned on again, that horizontal angle is restored.
- If the restored horizontal angle is no longer necessary, set it back to 0.

To set the vertical angle index point ..... **See page 19**
To set the horizontal angle to 0 ..... **See page 20**

Angle Measurement

6-2. Measuring the Angle (in Angle Mode)

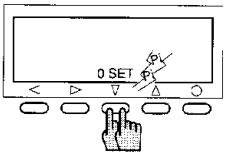
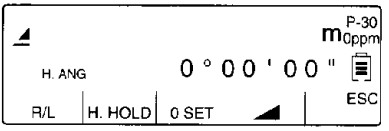
This is done after the mode has been changed from the distance mode to the angle mode, as described on page 29.

Operation Procedure	Display
1  After sighting the first target, press [0 SET] twice to set the horizontal angle.	 0 set for H.angle
2 Sight the second target, and read the vertical angle and the horizontal angle.	

- The [0 SET] key cannot be used to set the vertical angle to 0.
- If the power is turned off during a measurement, the horizontal angle effective at that point is retained, so that when the power is turned on again, that horizontal angle is restored.
- If the restored horizontal angle is no longer necessary, set it back to 0.
- In angle mode, the vertical and horizontal angles are displayed at the same time.

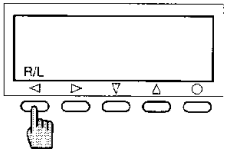
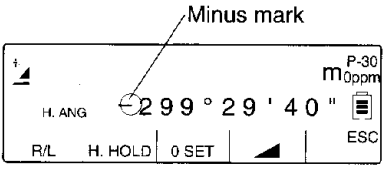
To set the horizontal angle to 0 ..... **See page 22**

6-3. Setting the 0 Point for the Horizontal Angle

Operation Procedure	Display
 Press the [0 SET] key twice to set the horizontal angle to 0°00'00".	

- Only the horizontal angle can be set using the [0 SET] key.
- The horizontal angle can be set to 0 at any point except when a hold is in effect.
- If the [0 SET] key is pressed by mistake during a measurement, the angle will not be reset to 0 unless the key is pressed twice. The only thing that happens is that a buzzer sounds, and when the buzzer stops, operation advances to the next step.

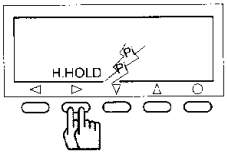
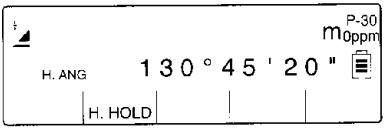
6-4. Changing the Horizontal Angle to Left Rotation

Operation Procedure	Display
 Pressing the [R/L] key sets the horizontal angle to the opposite rotation of its current setting.	

- The [R/L] key can only be used to switch the horizontal angle.
- To return from a left rotation to a right rotation angle, press the [R/L] key.
- When the rotation is switched to the left rotation, the order in which targets are sighted also switches to the opposite order of that for right rotation (sighting moves from the righth and target to the lefthand target).

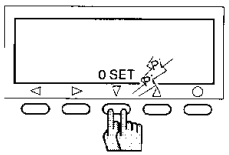
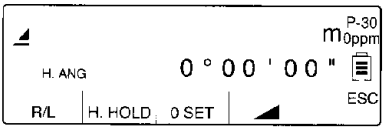
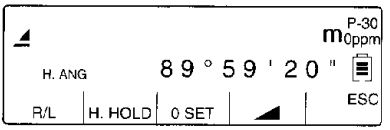
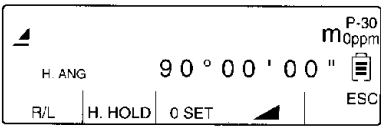
Angle Measurement

6-5. Retaining the Horizontal Angle (Hold)

Operation Procedure	Display
 To hold the displayed value (the horizontal angle), press the [H·HOLD] key twice in succession. The horizontal angle is fixed at the present value.	

- The [H·HOLD] key cannot be used to hold the vertical angle or the distance.
- To cancel a hold, press the [H·HOLD] key once.
- If the [H·HOLD] key is pressed by mistake during a measurement, the hold will not be initiated unless the key is pressed twice. The only thing that happens is that a buzzer sounds, and when the buzzer stops, operation advances to the next step.

6-6. Setting a Horizontal Angle of 90°

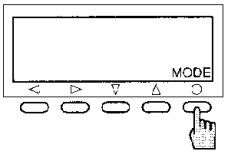
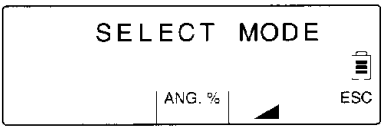
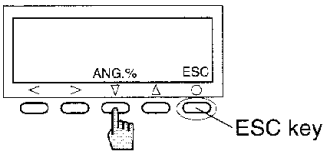
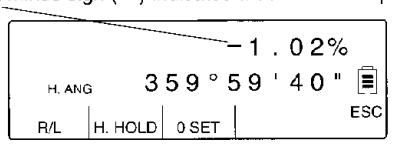
Operation Procedure	Display
1  After the first target has been sighted, press the [0 SET] key twice to set the horizontal angle to 0.	
2 Rotate the instrument in the 90° setting direction and stop when the 90° buzzer sounds.	
3 Use the horizontal tangent screw to set the angle to 90°00'00" and then mark the point, sighted with the telescope, as the setting point.	

- The 90° buzzer sounds each time the horizontal angle is within 1' on either side of the 0°, 90°, 180° and 270° points and stops when the angle reaches 20" before or after that point.
- The initial setting for the 90° buzzer can be set to "OFF".

To turn the 90° buzzer on and off ..... **See page 64**

6-7. Percentage Display (Grade) for the Vertical Angle

The vertical angle percentage (grade) can be displayed after the mode has been changed from the distance mode to the angle mode, as described on page 29.

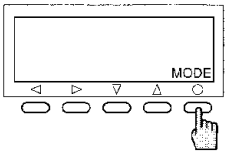
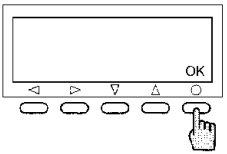
Operation Procedure	Display
1  Use the [MODE] key to select the mode.	
2  Use the [ANG·%] key to display the percentage for the vertical angle. a downward slope.	A minus sign (−) indicates a downward slope. 

- With the percentage display, the horizon is indicated by 0%, and 45° upward and downward of the horizon is indicated as 100%.
- To return from a percentage display to a 360° scale, press the [ENT] key.
- If the percentage display exceeds ±100% (±45°), the message "EXCESS ANG." is displayed, and measurement is not possible.
- The "EXCESS ANG" message disappears automatically when the telescope returns within the100% range.

For the height differential (percentage display) of the distance ..... See page 28

7. Distance Measurements

7-1. Millimeter Unit Measurements (Normal Measurement)

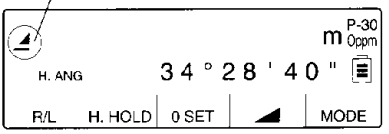
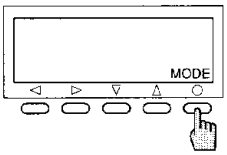
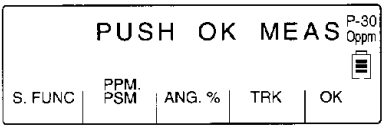
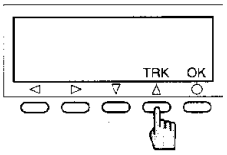
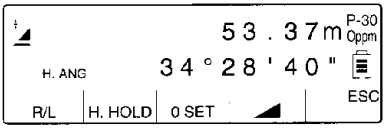
Operation Procedure	Display
1 If the display is in the angle mode, change it to the distance mode. (For instructions on changing to the distance mode, see page 30.)	Mark for Distance mode m P-30 Oppm 34°28'40" R/L | H. HOLD | 0 SET | ◢ | MODE
2  Sight the prism with the telescope, and press the [MODE] key.	PUSH OK MEAS P-30 Oppm S. FUNC | PPM. PSM | ANG. % | TRK | OK
3  Press [OK]key to start the distance measurement. When the beam reflected from the prism reaches the instrument, a buzzer sounds, and the [÷] mark is displayed. Shot measurement begins automatically.(For information on slope distance and height differential displays, see Horizontal distance: see page 28.)	Receiving mark of reflected beam P-30 Oppm 34°28'40" ESC R/L | H. HOLD | 0 SET | ◢ ⬇ Shot Number 1 53.378m P-30 Oppm H. ANG 34°28'40" R/L | H. HOLD | 0 SET | ◢ | MODE

- If the Quick Shot function is set to "YES", the distance will be displayed for the first measurement simply by sighting the prism. (Starting with the second measurement, the [MODE] key has to be pressed.)
- If "Continuous Measurement" has been specified in the initial settings, the distance will be displayed simply by sighting the prism.
- To measure distances, the 0 point of the vertical angle has to be specified after the power has been turned on.
- Always confirm the constant for the prism being used (see page 38 for instructions on changing the prism constant).
- The following marks are displayed in the distance mode: horizontal distance ◢, slope distance ◢, and height differential ◢.

Distance Measurements

7-2. Centimeter or Millimeter Unit Measurements

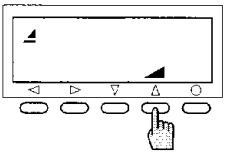
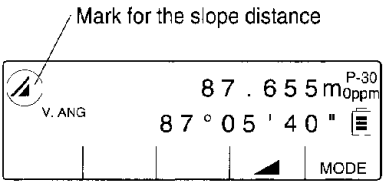
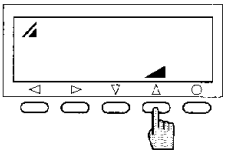
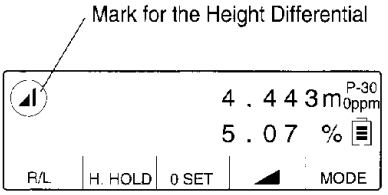
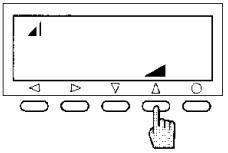
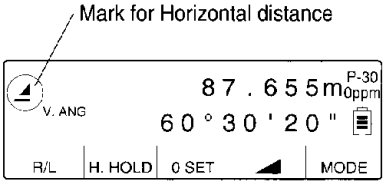
(Rapid Measurement)

Operation Procedure	Display
1 Change the display to the distance mode. (For instructions on changing to the distance mode, see page 30.)	Mark for distance mode 
2  Select the mode by pressing the [MODE] key.	 Waiting for mode selection.
3  Use the [TRK] key to initiate rapid measurement. Following this,measurement will be repeated approximately every 0.5 seconds for centimeter distances and every 0.8 seconds for millimeter distances.	

- The slope distance and the height differential can be displayed during rapid measurement by pressing the ◢ key.
- To return to the normal measurement mode, press the [ENTER] key.
- For information on selecting the minimum distance display unit for rapid measurement, see "Initial Settings Mode B" on page 62.

Distance Measurement

7-3. Displaying the Slope Distance and Height Differential

Operation Procedure	Display
1  Press the ◢ key while the horizontal distance is displayed to change the display to the slope distance.	 Displaying the slope distance and vertical angle
2  Press the ◢ key while the slope distance is displayed to change the display to the height differential.	 Displaying the height and differential and percentage
3  Press the ◢ key while the height differential is displayed to change back to the horizontal distance display.	 Displaying the horizontal distance and horizontal angle

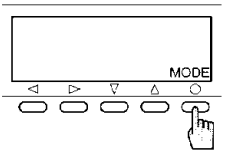
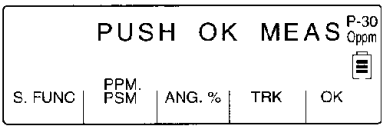
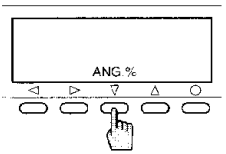
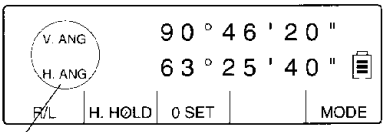
- Each time the ◢ key is pressed, the display changes sequentially in the following order: [horizontal distance] → [slope distance] → [height differential] → [horizontal distance]. (The sequence can be changed to the following in the initial settings: [horizontal distance] → [height differential] → [slope distance] → [horizontal distance]. See page 63 for instructions.)
- Displays are shown in combination, as follows: horizontal distance + horizontal angle, slope distance − vertical angle, height differential + % grade. (The combinations can be changed using the initial settings.See page 63 for instructions.)

Combinations

Slope distance	Horizontal angle	Horizontal distance	Horizontal angle	Height differential	Horizontal angle
	Vertical angle		Vertical angle		Vertical angle
	Grade (%)		Grade (%)		Grade (%)

8. Changing the Measurement Mode

8-1. Changing From Distance to Angle Mode

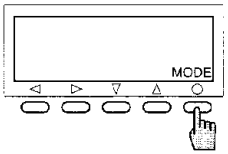
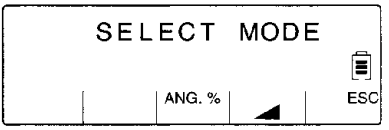
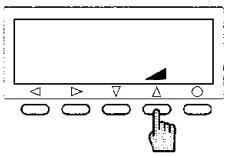
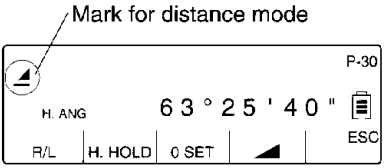
Operation Procedure	Display
1  Press the [MODE] key to select the mode.	 Waiting for mode selection.
2  Press the [ANG·%] key to change to the angle mode.	 V.Angle and H.Angle are displayed at a same time in Angle mode.

- The angle can be measured in the distance mode, but the distance cannot be measured in the angle mode.
- When the power is turned on, the mode will always be that selected in the initial settings.

To measure an angle ..... **See pages 20 and 21**
To measure a distance ..... **See page 26**
For initial settings ..... **See page 61**

Changing the Measurement Mode

8-2. Changing From Angle to Distance Mode

Operation Procedure	Display
1  Press the [MODE] key to select the mode.	 Waiting for mode selection
2  Press the ◢ key to change to the distance mode.	

●The angle can be measured in the distance mode, but the distance cannot be measured in the angle mode.

●When the power is turned on, the mode will always be that selected in the initial settings.

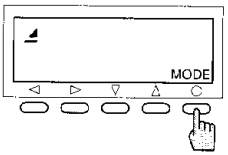
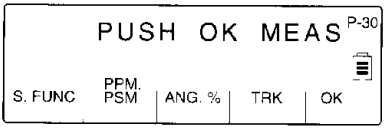
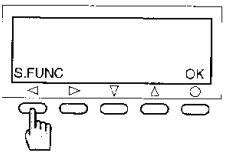
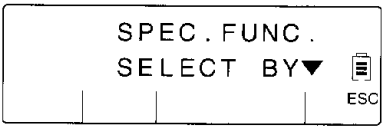
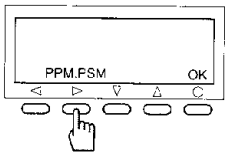
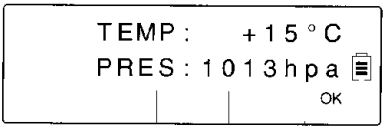
To measure an angle ..... **See pages 20 and 21**
To measure a distance ..... **See page 26**
For initial settings ..... **See page 61**

9. Selecting the Mode

9-1. Pressing the [MODE] Key (in Distance Mode)

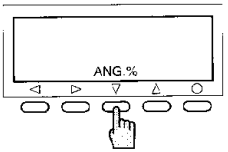
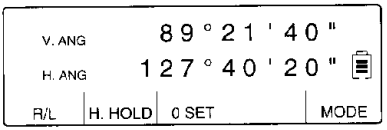
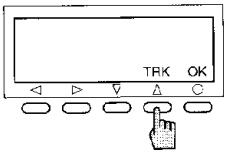
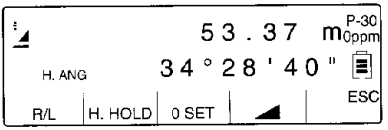
In distance mode, the following four modes can be selected:

1. Special function mode --- Measurement can be carried out using the nine types of special surveying software noted on page 40.
2. Correction mode ---------- The temperature, atmospheric pressure,and prism constant can be confirmed, and settings entered or changed.
3. Angle measurement / % mode --- This changes to the angle mode.
4. Rapid measurement mode --- Measurement is carried out at a fast speed of approximately 0.5 seconds in centimeter and 0.8 second in millimeter units.

Operation Procedure	Display
1  Press the [MODE] key to select the mode.	
2  Press the [S. FUNC] key to access the special measurement selection mode.(For information on the special measurement modes, see page 41.)	
 Press the [PPM·PSM] key to display the temperature, atmospheric pressure, and prism constant. (For information on changing the temperature, atmospheric pressure, and prism constant, please see pages 34 to 39.)	 The temperature and atmospheric pressure which were previously entered are displayed.

(Cont. on next page)

Selecting the Mode

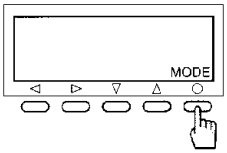
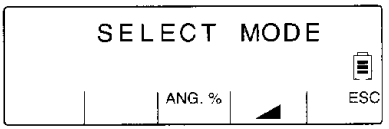
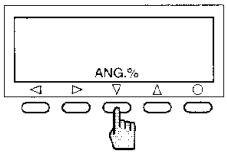
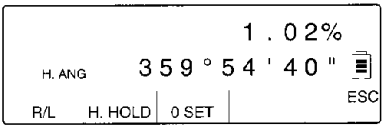
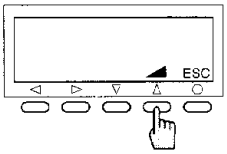
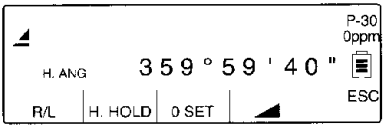
Operation Procedure	Display
 Press the [ANG·%] key to change to the angle mode. (For information on changing to the angle mode, see page 29.)	
 Use the [TRK] key to switch to the rapid measurement mode, in which measurement is carried out at a fast sreed of approximately 0.8 seconds in millimeter units. (For information on the rapid mode, see page 27.)	

●Pressing the [ESC] key returns the screen to the status it was in before the mode was entered.

Selecting the Mode

9-2. Pressing the [MODE] Key (in Angle Mode)

This is done after switching from the distance mode to the angle mode, as described on page 29.

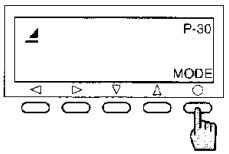
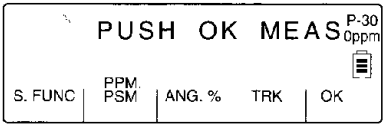
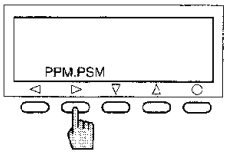
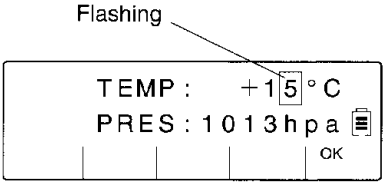
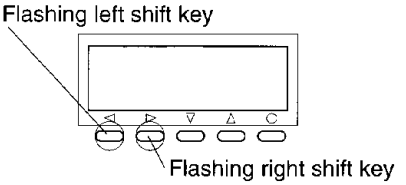
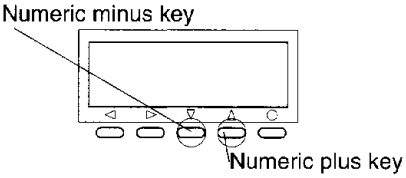
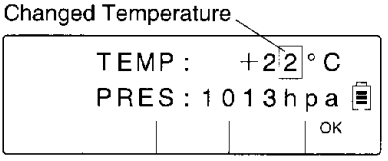
Operation Procedure	Display
1  Press the [MODE] key to select the mode.	
2  Using the [ANG·%] key, display the percentage of the vertical angle.	
3  Use the [◢] key to change to the distance mode.	

Pressing the [ESC] key returns the screen to the status it was in before the [MODE] key was pressed.

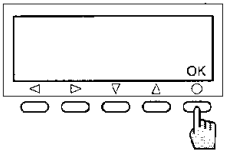
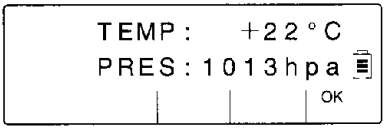
10. Correction Mode

10-1. Changing the Temperature

The temperature can only be changed when "Enter" is selected under"PPM CORR" of "Initial Settings A".

Operation Procedure	Display
1  Press the [MODE] key to select the mode.	 Waiting for mode selection
2  Press the [PPM·PSM] key to display the temperature and atmospheric pressure which have already been entered. (The temperature is flashing.)	
3 ○The numeric value for the temperature which is flashing can be changed. ○Press the right [SHIFT] key to move the flashing numeral to the right, and the left [SHIFT] key to move it to the left.	
4 To change the flashing value, use the [+] and [−] keys to increase or decrease the value. Each time the key is pressed once, the value changes by 1 in the corresponding direction.	
5 Use the [SHIFT] key to move the flashing display to the value to be changed, and press the [+] or [−] key to change to the desired value.	

Correction Mode

Operation Procedure	Display
6  Press the [OK] key to input the updated temperature. The flashing display moves to the atmospheric pressure value.	 Waiting for new pressure input (See page 36 for instructions on changing the pressure)

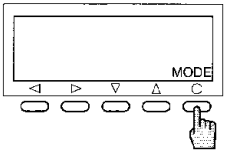
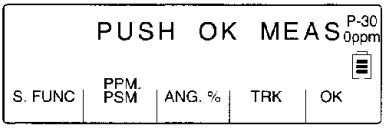
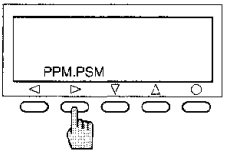
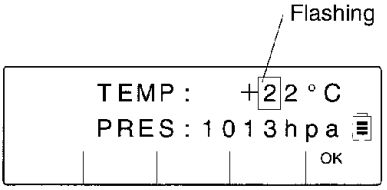
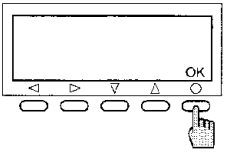
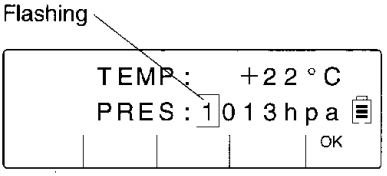
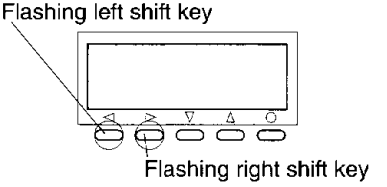
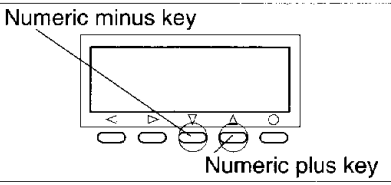
- The range of values which can be input for the temperature is from −30°C to +60°C.
- If the atmospheric pressure does not need to be changed, press the [OK] button to move to the prism constant. If no change is necessary here, either, press the [OK] key again to move back to the measurement mode.
- The input temperature is retained when the power is turned off.
- The standard temperature correction is 15°C.
- If "PPM FIXED" is displayed, the atmospheric correction function has been turned off in the initial settings,and the temperature and pressure cannot be changed.

If the instrument is used without correcting the temperature, the error will be approximately −0.1 mm per 100 m for each +1°C that the temperature is off from the standard value of 15°C, and will be approximately 0.1 mm per 100 m at −1°C. (For precise figures, see page 84.)

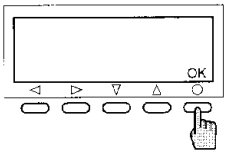
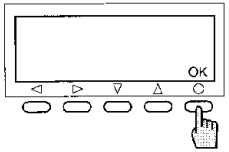
Correction Mode

10-2. Changing the Pressure

The atmospheric pressure should be changed after the temperature has been changed.

Operation Procedure	Display
1  Press the [MODE] key to select the mode.	 Waiting for mode selection
2  Press the [PPM· PSM] key to display the temperature and atmospheric pressure which have already been entered. (The temperature is flashing.)	
3  Press the [OK] key to move the flashing display to the pressure value.	
4 The numeric value for the pressure which is flashing can be changed. ●Press the right [SHIFT] key to move the flashing numeral to the right, and the left [SHIFT] key to move it to the left.	
5 To change the flashing value, use the [+] and [−] keys to increase or decrease the value. Each time the key is pressed once, the value changes by 1 in the corresponding direction.	

Correction Mode

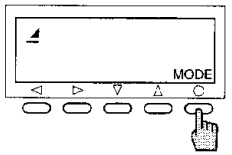
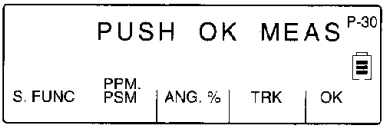
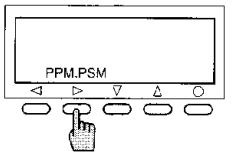
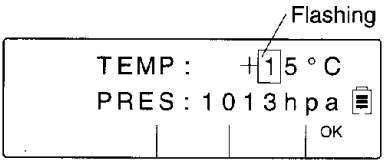
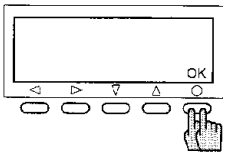
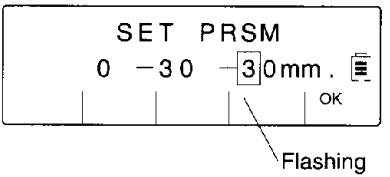
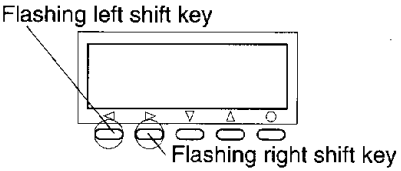
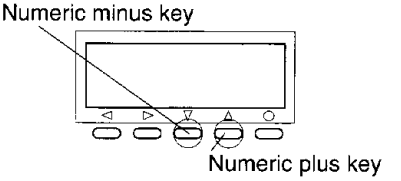
Operation Procedure	Display
6 Use the [SHIFT] key to move the flashing display to the value to be changed, and press the [+] or [−] key to change to the desired value.	TEMP : +22°C PRES : 985hpa OK
7  Press the [OK] key to enter the new value and display the "ppm value".	PPM 14ppm OK
8  Press the [OK] key to change the "Prism Setting" screen.	SET PRSM 0 −30 −30mm. OK Waiting for prism constant to be changed (see page 38 for instructions)

- The input range for the atmospheric pressure is from 600 hPa to 1120 hPa (420 mmHg to 840 mmHg).
- If the prism constant does not need to be changed, press the [OK] key to return to the normal measurement mode.
- The input pressure value is retained when the power is turned off.
- The standard value for the atmospheric pressure correction is 1013 hPa.

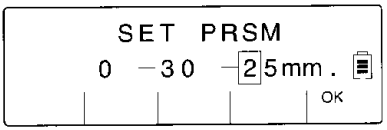
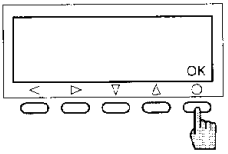
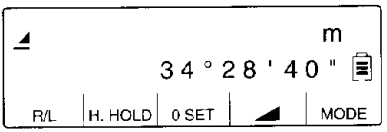
If the instrument is used without correcting the pressure, the error will be approximately −0.3 mm per 100 m for each −10 hPa that the pressure is off from the standard value of 1013 hPa. (For precise figures, see page 84.)

10-3. Changing the Prism Constant (Numeric Key Input)

Changes to the prism constant can be made only when "Enter" has been specified in the initial settings.

Operation Procedure	Display
1  Press the [MODE] key to select the mode selection.	 Waiting for mode selection.
2  Press the [PPM·PSM] key to display the temperature and atmospheric pressure which have already been entered.	
3  Press the [OK] key twice to move the flashing display to the pressure value ("Prism Setting").	
4 The numeric value for the prism constant which is flashing can be changed. Press the right [SHIFT] key to move the flashing numeral to the right, and the left [SHIFT] key to move it to the left.	
5 To change the flashing value, use the [+] and [−] keys to increase or decrease the value. Each time the key is pressed once, the value changes by 1 in the corresponding direction.	

Correction Mode

Operation Procedure	Display
6 Use the [SHIFT] key to move the flashing display to the value to be changed, and press the [+] or [−] key to change to the desired value.	
7  Press the [OK] key to enter the new value and return to the measurement mode.	

- To set the prism constant to "0" or "−30", the "−30" and "0" values displayed in the display section, in addition to the other settings entered using the above keys, can be set to flashing and the "OK" button pressed to select those constants.
- If "−30" or "0" has been selected for the prism constant, or "−30" or "0" has been entered using key input, the indication "P-30" or "P-0" is displayed at the right end of the display.
- If any setting other than "−30" or "0" has been entered for the prism constant using key input, nothing will appear in the display section.
- When the instrument is shipped from the factory, "−30" has been entered using key input.
- The input value for the prism constant is retained when the power is turned off.
- If "Prism Fixed" is displayed, a fixed prism constant has been selected in the initial settings, and the value cannot be changed using key input. Change the parameter in the initial settings to "Enter" to change the value.

11. Special Functions

11-1. About the Special Functions

This instrument is equipped with nine types of special surveying programs, making it extremely simple to carry out the various types of measurement.

◎Distance Stake Out measurement

By inputting the distance to be determined by the machine, thedifference between that distance and the actual measured value is displayed, for extremely fast distance measurements.

◎Lot Staking measurement

The input distances from the designs, or the measured distance, can be divided into N equal sections, and the separate sections measured.

◎Offset Point measurement

This function enables the widths to the right and left of a center line to be measured easily, by setting an PCS on the center line. (This can only be used for linear measurements, not on curves.)

◎Remote Elevation measurement (REM)

A prism (base point) positioned almost directly underneath the desired location is measured, to determine the height to the target object.This makes it easy to determine the heights of objects such as power cables, bridge suspension cables and large construction objects.

◎Remote Distance measurement (RDM)

This function is used to measure the horizontal distance, height differential, slope distance, and percentage grade between two prisms set at the base point and the various measurement points.

◎Coordinates measurement

This enables the coordinates of a target point to be determined, using the instrument point as an origin point. Even without using the instrument point as an origin point, the coordinates of the instrument point can be input and used to determine the coordinate values of the target point.

◎Resection measurement

Two known points (A and B) can be measured to determine the instrument point coordinates.

◎Traverse measurement

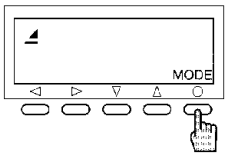
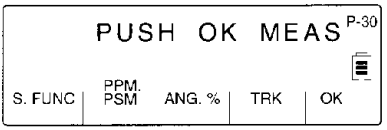
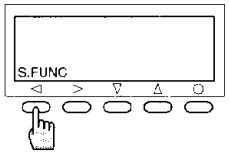
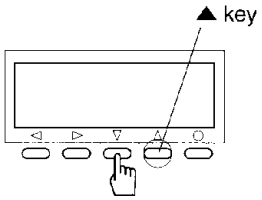
Based on given "instrument point coordinates and backsight coordinates" or on "instrument point coordinates and directional angle", the coordinates of a new point can be determined.

Special Functions

◎Coordinate stake out

Based on given "instrument point coordinates, backsight coordinates, and measurement point coordinates" or on "instrument point coordinates, directional angle of the backsight point, and measurement point coordinates", three-dimensional coordinate stake out can be carried out.

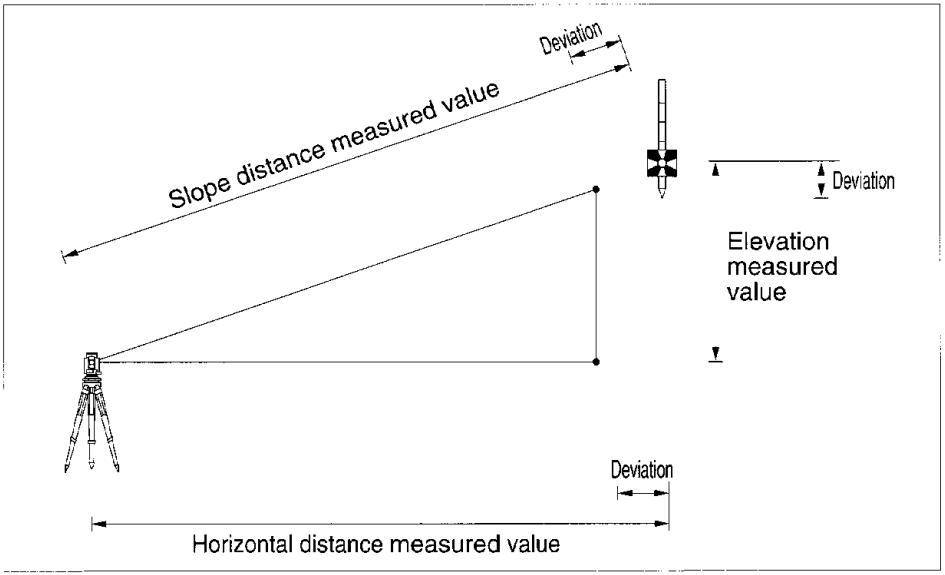
11-2. Changing to Special Measurements

Operation Procedure	Display
1  In distance mode, use the [MODE] key to select the mode.	 Waiting for the mode key to select the mode.
2  Press the [S. FUNC] key to select a special function.	 Waiting for a special function to be selected
3  Press the ▼ or ▲ key to display the desired measurement item.	**Display Sequence** STAKE OUT LOT STAKING OFFSET STA. R.E.M R.D.M COORD MEAS RESEC MEAS TRAV MEAS COORD STAKE

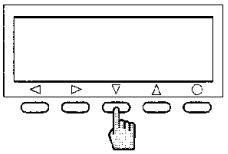
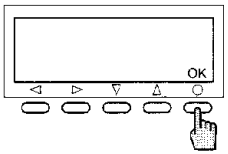
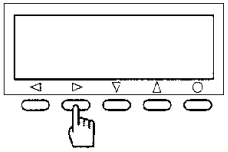
11-3. Distance Stake Out Measurement

By inputting the distance to be determined in advance, the difference between that distance and the actual measured distance can be displayed. (The input range for the distance is 0.85 mm ~ 1999.999 mm, and for the height differential is −1999.999 m ~ 1999.999 m.)

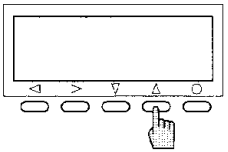
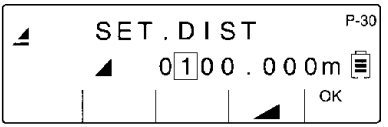
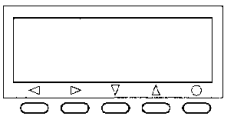
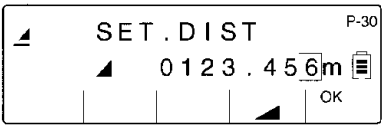
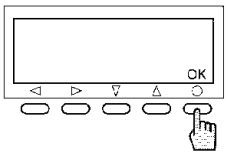
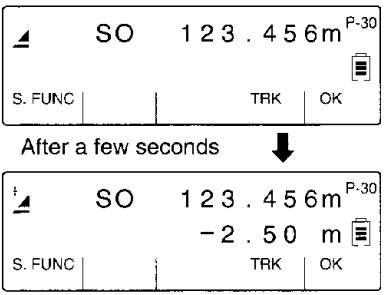
Comparison with design



Special Functions

Operation Procedure	Display
1 Select the special function, using the procedure described on page 41.	SPEC. FUNC. SELECT BY▼ S. FUNC ESC
2  Pressing the ▼ key displays the"Distance Stake Out" item.	STAKE OUT S. FUNC OK
3  Press the [OK] key. The system waits for the distance to be input.	SET. DISTANCE P-30 0000.000m OK Flashing
4 **EX: Set distance = 123.456m**  Press the ▶ key to move the flashing display to the right.(Pressing the ◀ key moves the flashing display to the left.)	SET. DISTANCE P-30 0000.000m OK Flashing ◢ mark, press the ▼ key and then mark ◢ changes to be ◢, ◢ and ◢ in sequence.

Special Functions

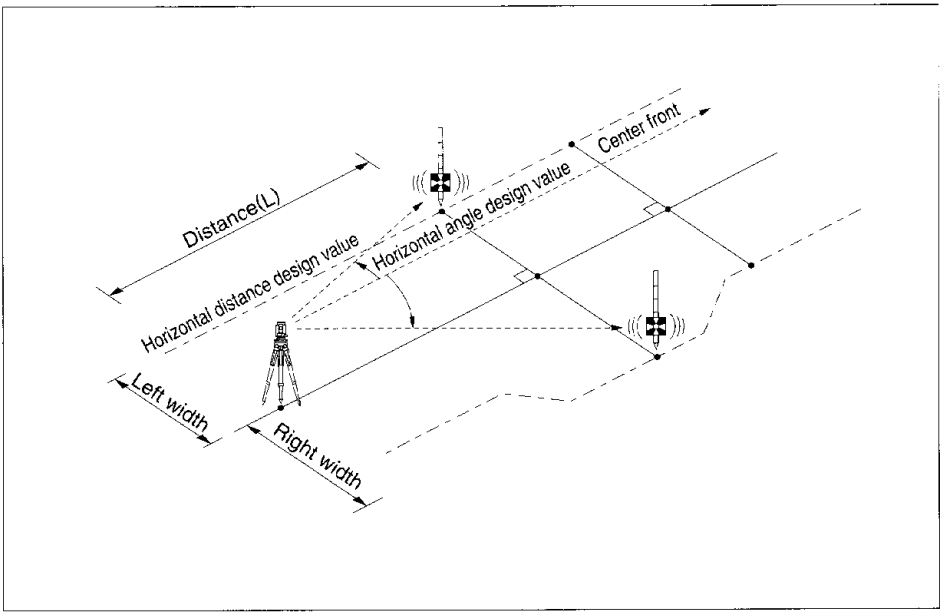
Operation Procedure	Display
5  Pressing the ▲ key increases the flashing digit by one each time the key is pressed. (Pressing the ▼ key decreases the flashing digit by one.)	
6  In the same way, use the ▶ key to move the flashing display and the ▲ key to change the value, until the desired distance has been set. (The ◀ and ▼ keys can also be used.)	
7  When the desired distance has been input, press the [OK] key to terminate the setting process. When the prism is sighted, rapid measurement begins (in centimeter units). Move the prism until the value reads 0.00 m.	

- The distance displayed with the distance stake out function is the difference between the distance to be determined (the set distance) and the actual measured distance. (A negative value is displayed if the actual distance is shorter than the set distance.)
- With the distance stake out function, measurement is carried out automatically at high speed. Pressing the [TRK] key switches alternately between normal and rapid measurement speed each time the key is pressed.
- Pressing the [OK] key cancels the distance stake out measurement and returns to the previous measurement mode.

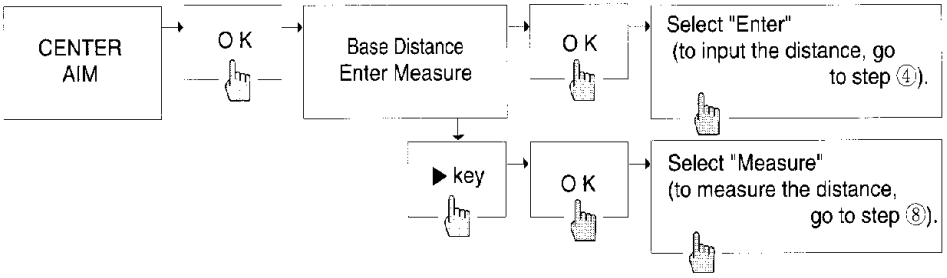
11-4. Offset Station Measurement

The [OFFSET STA.] program is used for easy determination of the widths to the right and left of a center line, by setting the instrument on the center line.

Overall flow diagram



①Select the special function, using the procedure described on page 41.
②Use the key to enter the Offset Station mode, and the [OK] key to switch to the center aim screen.
③Following the guide messages, sight the center stake, and select whether the distance tothe center stake is to be input or measured.

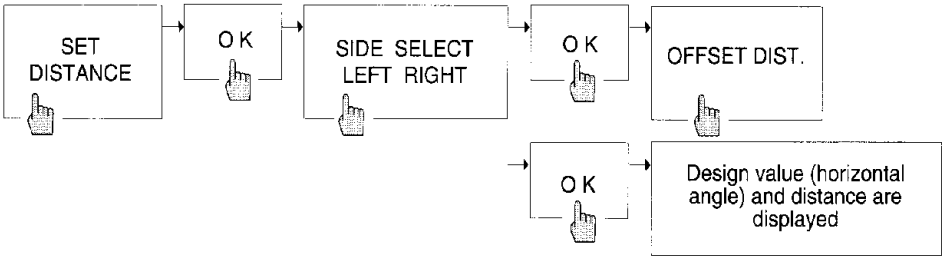


Special Functions

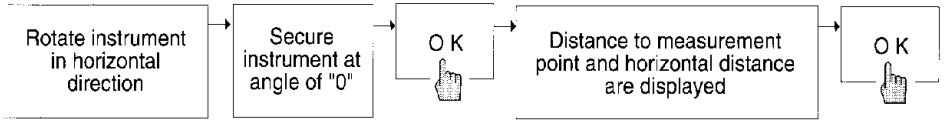
To input the distance

If "Enter" is selected, the measurement points of the widths can be determined by inputting the distance and the width to the center stake as specified by the design.

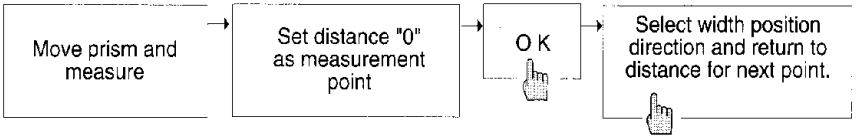
④Input the distance to the center stake, select the direction in which the width stake is to be set (left or right), and input the width. The design value (horizontal angle) and the distance are displayed.(For instructions on specifying the values, see steps 4, 5, and 6 on pages 43 and 44, "Distance Stake Out Measurement".)



⑤Rotate the instrument in the horizontal direction, set the angle to 0-00'00", and secure the horizontal rotation of the instrument.



⑥Moving the prism, measure the distance, and set the point at which the distance becomes "0" as the width.



⑦Repeat the above procedure starting from ④ until all of the necessary points on the left and right, or the 2nd and 3rd points, have been determined.

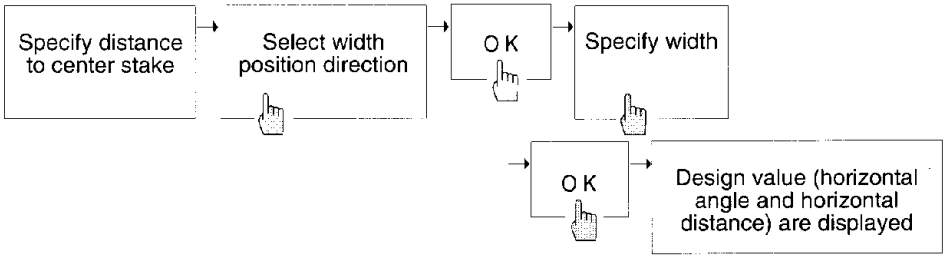
●Pressing the [S. FUNC] key during measurement returns to the beginning of the offset station measurement function. Pressing the [S. FUNC] key once more at this point exits the special functions mode and returns to the normal measurement mode.

Special Functions

To measure the distance

Selecting "Measure" enables the measurement points of the width to be determined by measuring the distance to the center stake and then inputting the width.

⑧Measure the distance to the center stake, select the direction in which the width stake has been set (left or right), and input the width. The design value (horizontal angle and thehorizontal distance) are displayed.(For instructions on specifying the values, see steps 4, 5, and6 on pages 43 and 44, "Distance Stake Out Measurement".)



⑨Continue repeating steps ⑤ to ⑦ until all of the necessary measurement points have been determined.

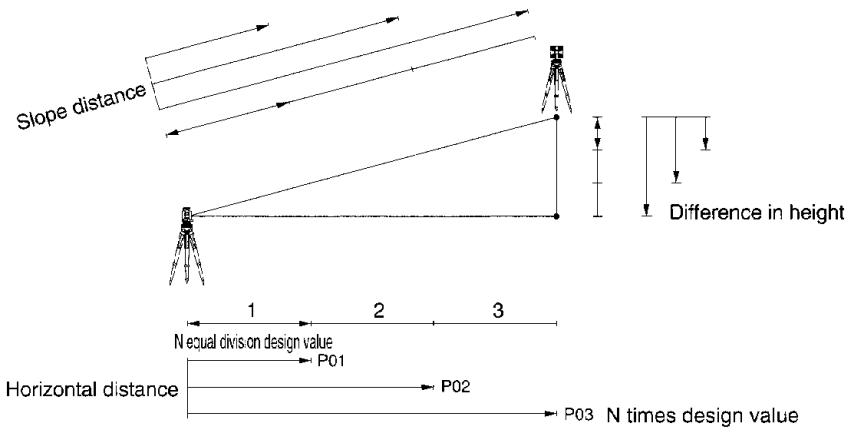
●Pressing the [S. FUNC] key during measurement returns to the beginning of the offset point measurement function. Pressing the [S. FUNC] key once more at this point exits the special functions mode and returns to the normal measurement mode.

Special Functions

11-5. Lot Staking Measurement

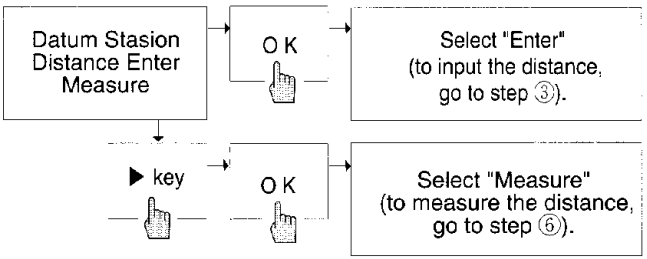
With the lot staking function, the input datum station distance (the linear distance on the design or the measured linear distance) can be divided into N equal segments and measured.

Overall flow diagram



①Select the special function, using the procedure described on page 41.

②Use the key to enter the lot staking mode, and the [OK] key to select whether the datum station distance is to be input or measured.



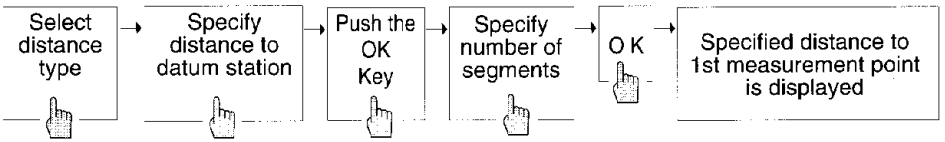
Special Functions

To input the distance

When "Enter" is selected, the distance determined by the design is input, and divided into N equal segments.

③First, use the key to select the type of distance (horizontal distance, slope distance, or height differential), and then specify and input the distance to the datum station and the number of segments.

(For instructions on specifying the values, see steps 4, 5, and 6 on pages 43 and 44,



④Measure the 1st measurement point (the first segment point).

a. Position the person holding the prism on the line and measure the distance to the prism. (The design distance and the difference between design and measured are displayed.)

b. Guide the person holding the prism to the point where the range reads 0 m. (The range changes as the prism moves.)

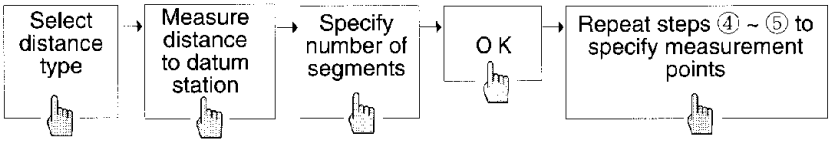
c. The point where the distance reads 0 is the 1st measurement point.

⑤When the 1st measurement point has been specified, press the [OK] key to change the screen to show the distance to the 2nd measurement point. Specify a number of segments for the 2nd point in the same way as for the 1st point, and press the [OK] key to exit the lot staking function and return to the normal measurement mode.

To measure the distance

Select "Measure" to measure the distance to be divided, and to divide it into equal segments.

⑥In the same way as for step ③, use the key to select the type of distance. Then measure the distance to the datum station, specify the number of segments, and specify the measurement point.



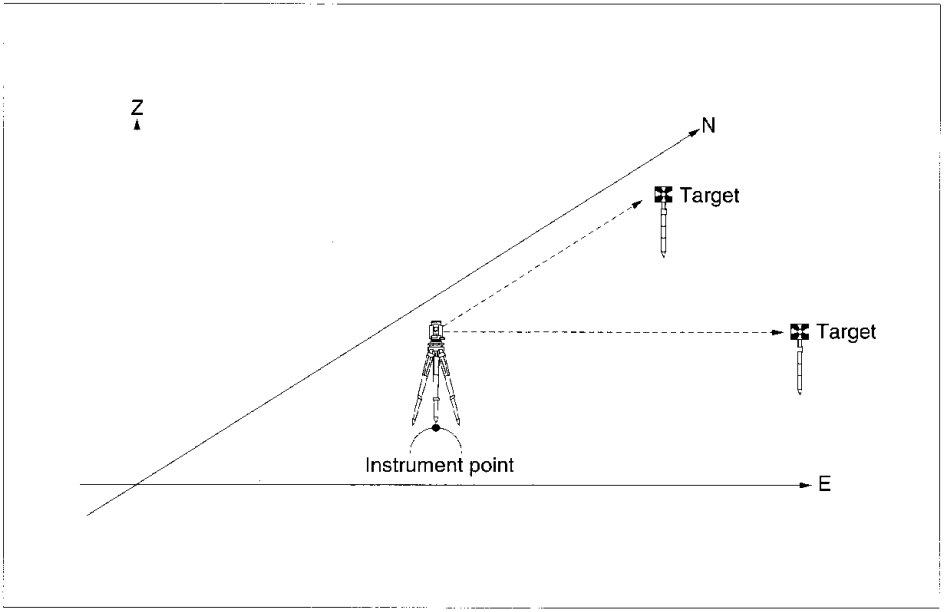
⑦When all of the segments have been measured, press the [OK] key to exit the lot staking function.

●Pressing the [S. FUNC] key during measurement returns to the beginning of the lot staking measurement function. Pressing the [S.FUNC] key once more at this point exits the special functions mode and returns to the normal measurement mode.

11-6. Coordinates Measurement

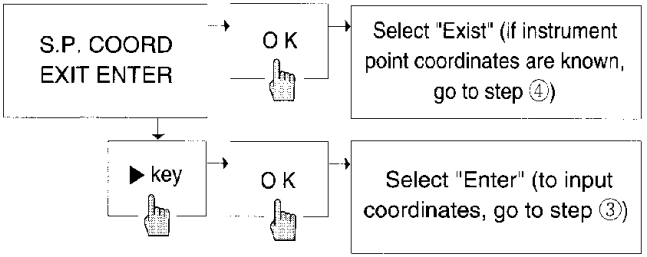
With the coordinates measurement function, the coordinates of any target point can be determined, using the instrument position as the origin point. If necessary, new instrument point coordinate values (N, E, Z) can be input, and the coordinate values for the target point can be determined from the coordinates of the origin point.

Overall flow diagram



①Select the special function, using the procedure described on page 41.

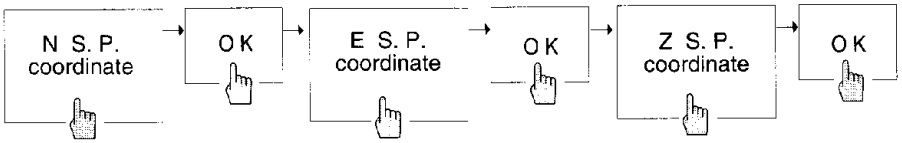
②Use the key to enter the coordinates measurement mode, and the [OK] key to select whether the instrument point coordinates which have already been input will be used as the origin point, or whether new instrument point coordinates will be input. If known instrument point coordinates are to be used as the origin point, select "Exist", and if new instrument point coordinates are to be entered, select "Enter".



Special Functions

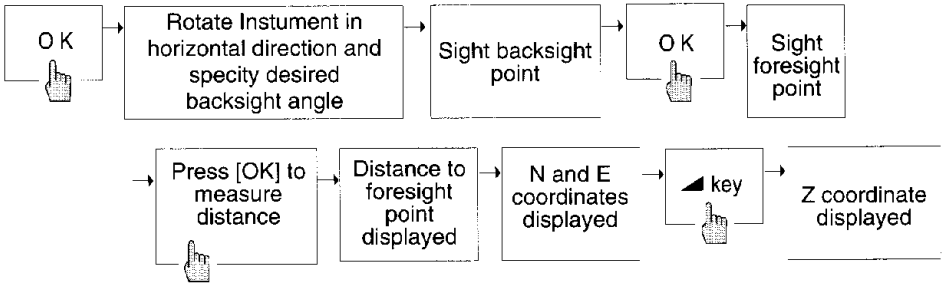
To input instrument point

③Specify and input the N, E, and Z coordinates for the instrument point.
(For instructions on specifying the values, see steps 4, 5, and 6 on pages 43 and 44, "Distance Stake Out Measurement".)



To input instrument point

④Specify and input the N, E, and Z coordinates for the instrument point.
(For instructions on specifying the values, see steps 4, 5, and 6 on pages 43 and 44, "Distance Stake Out Measurement".)



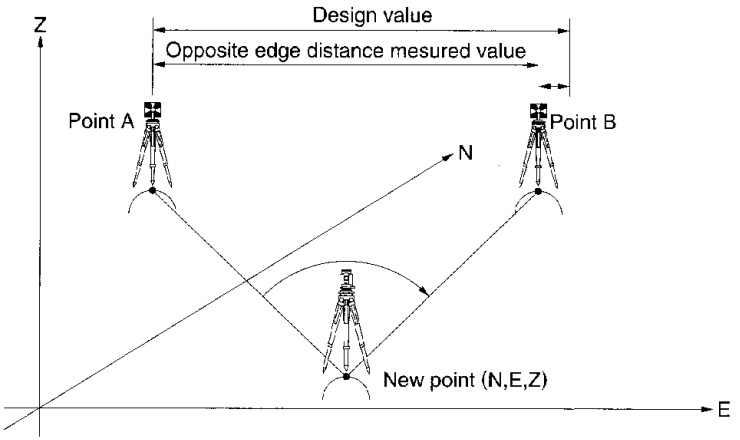
⑤Pressing the [OK] key returns to the screen showing Step 3 so that the next target point can be measured.

●Pressing the [S. FUNC] key during measurement returns to the beginning of the coordinates measurement function. Pressing the [S. FUNC] key once more at this point exits the special functions mode and returns to the normal measurement mode.

11-7. Resection Measurement

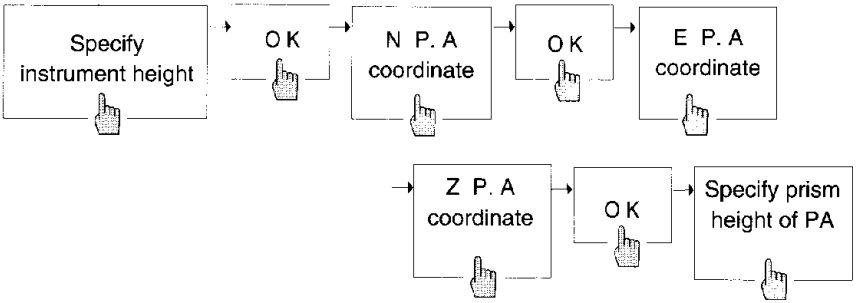
With the resection measurement, two known points (PA and PB) can be measured to find the instrument point coordinates.

Overall flow diagram



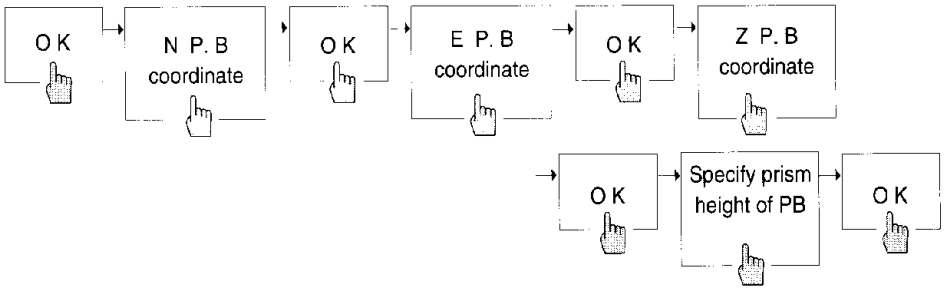
①Select the special function, using the procedure described on page 41.

②Use the key to enter the resection mode, and press the [OK] key to display the screen where the instrument height is specified. Specify and enter values for the instrument height, the NA coordinates, the EA coordinates, the ZA coordinates, and the prism height. (For instructions on specifying the values, see steps 4, 5, and 6 on pages 43 and 44, "Distance Stake Out Measurement".)

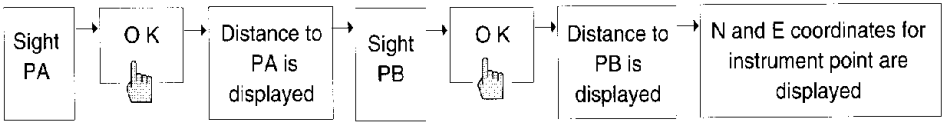


Special Functions

③In the same way, specify and enter values for the NB coordinates, the EB coordinates, the ZB coordinates, and the prism height.
(For instructions on specifying the values, see steps 4, 5, and 6 on pages 43 and 44, "Distance Stake Out Measurement".)



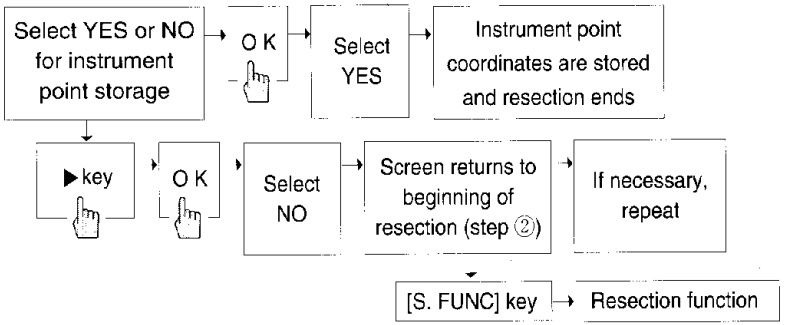
④Now measure the distance to PA and PB, to display the instrument point coordinates N and E.



Each time the ◢ key is pressed, the screen displays changes from [Zcoordinates] to [NE coordinates] and back to [Z coordinates].

⑤Pressing [OK] displays the value for the horizontal distance and height. Pressing [OK] again displays a confirmation message asking if the instrument point is to be stored.

⑥Selecting "YES" stores the instrument point coordinates and exits the resection function. Selecting "NO" returns to the beginning of the resection function, at step ②, so that the measurement can be repeated.

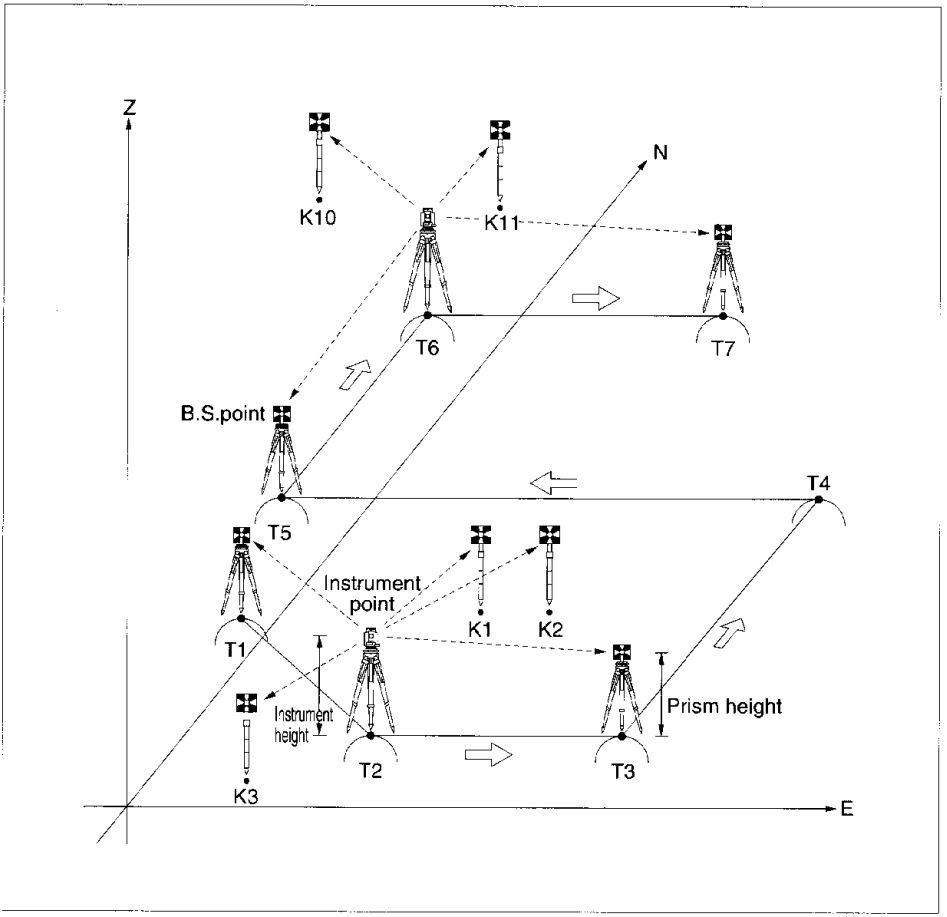


●Pressing the [S. FUNC] key during measurement returns to the beginning of the resection measurement function. Pressing the [S. FUNC] key once more at this point exits the special functions mode and returns to the normal measurement mode.

11-8. Traverse Measurement

With the traverse measurement function, the coordinates of a new point can be determined based on a known "instrument point coordinates and backsight point coordinates" or "instrument point coordinates and directional angle".

Overall flow diagram



①Select the special function, using the procedure described on page 41.

②Use the key to enter the traverse mode, and press the [OK] key to display the screen where the "New" or "Continue" measurement method is selected.

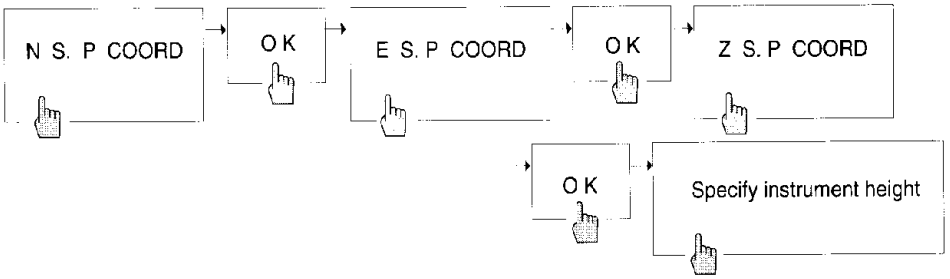
a. To begin a new traverse measurement, use the [OK] key to select "New", and go to step ③.

b. To continue a traverse measurement using a different instrument point, use the key to move the flashing point to "Continue", and press the [OK] key to select the item. The operation then begins from step ③

When "New" is selected

With a new measurement, the known instrument point coordinates, to be used, are input as the instrument point.

③Specify and input the known N instrument point coordinates,E instrument point coordinates, Z instrument coordinates, and instrument height.
(For instructions on specifying the values, see steps 4, 5, and 6 on pages 43 and 44, "Distance Stake Out Measurement".)



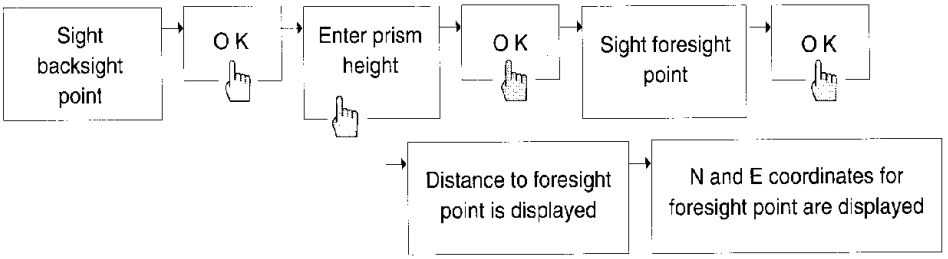
④Press [OK] to specify whether the directional angle or the coordinates are to be used as the backsight point.

a. If "Directional Angle" is selected, rotate the instrument horizontally to display a known directional angle, and press [OK] to hold the angle.

b. If "NEZ" is selected, specify the known N, E, and Z coordinates, and press [OK] to enter them.

※The selection is made in the same way as "b" of step ②.

⑤Sight the backsight point and specify the prism height. Then measure the distance to the front sight point. The X and Y coordinates for the new point are displayed.



※The key can be used to change the display to the Z coordinates.

⑥Pressing [OK] displays a confirmation message asking if the coordinates of the front sight point are to be stored.

a. Selecting "YES" stores the foresight point coordinates and exits the traverse function.

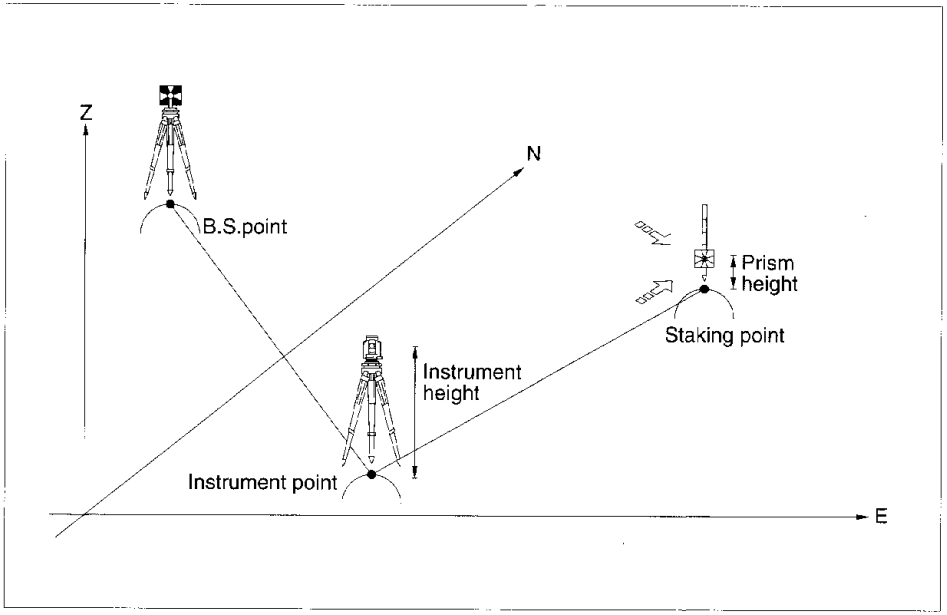
b. Selecting "NO" returns to the screen where the prism height is specified, at step ⑤, so that the measurement can be repeated.

●Pressing the [S. FUNC] key during measurement returns to the beginning of the traverse measurement function. Pressing the [S. FUNC] key once more at this point exits the special functions mode and returns to the normal measurement mode.

11-9. Coordinate Stake Out Measurement

With the coordinate stake out function, three-dimensional coordinate stake out can be done, based on known "instrument point coordinates and backsight point coordinates" or "instrument point coordinates and backsight point directional angle".

Overall flow diagram

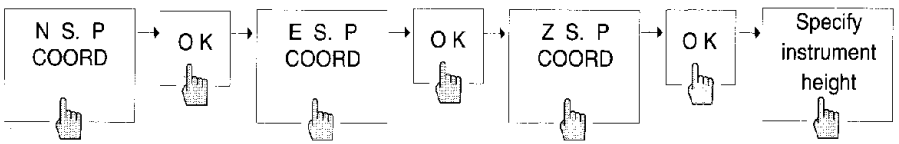


①Select the special function, using the procedure described on page 41.

②Use the ▼ key to enter the Coordinate stake out mode, and press the [OK] key to display the screen where the instrument point coordinates are entered.

③Enter the known N instrument point coordinates, E instrument point coordinates, Z instrument coordinates, and instrument height.

(For instructions on specifying the values, see steps 4, 5, and 6 on pages 43 and 44, "Distance Stake Out Measurement".)

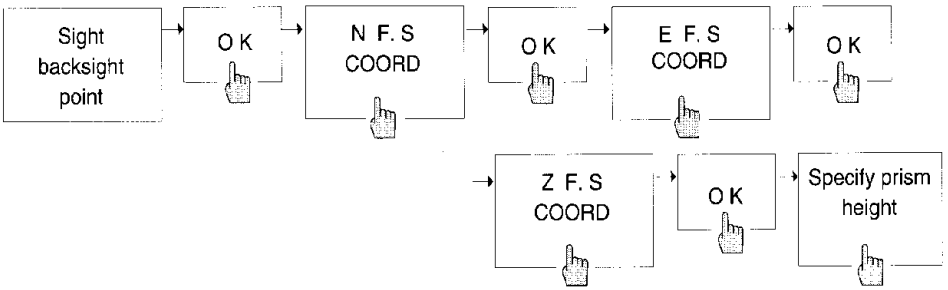


④Press [OK] to specify whether the directional angle or the coordinates are to be used as the backsight point.

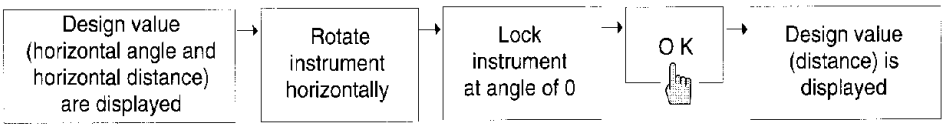
a. If "Directional Angle" is selected, rotate the instrument horizontally to display a known directional angle, and press [OK] to hold the angle.

b. If "NEZ" is selected, specify the known N, E, and Z coordinates of the backsight point, and press [OK] to enter them.
(The selection is made in the same way as "b" of step ②).

⑤Sight the backsight point and specify the known N, E, and Z coordinates of the measurement point, and the prism height.



⑥Pressing the [OK] key displays the design values calculated from the data input at steps ① to ③ (the horizontal angle and the horizontal distance). Rotate the instrument horizontally until the angle reads 0°00'00", and lock the horizontal rotation of the instrument at that point.



⑦Specify the measurement point.

a. Position the person with the prism near the measurement point within the sighting range of the telescope, and sight the prism. Measuring begins automatically, and the difference between the design value and the measured value is displayed.

b. Guide the person with the prism to a point where the distance reads 0. (The distance changes as the prism moves.)

c. The point at which the distance reads "0" serves as the measurement point.

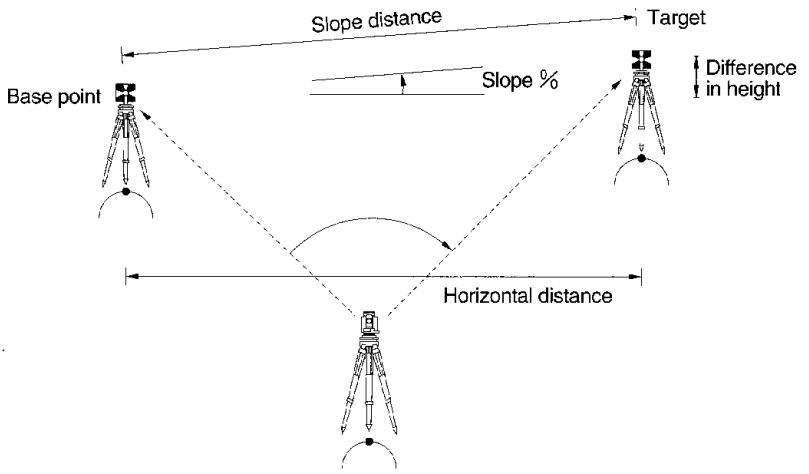
⑧When the measurement point has been stored, press the [OK] key to confirm the height, and then press it again to exit the coordinate stake out function.

●Pressing the [S. FUNC] key during measurement returns to the beginning of the coordinate stake out function. Pressing the [S. FUNC] key once more at this point exits the special functions mode and returns to the normal measurement mode.

11-10. Remote Distance Measurement

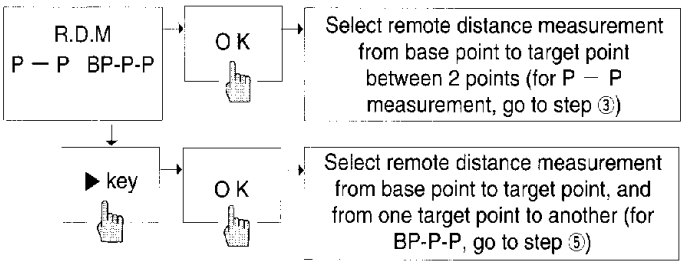
With the remote distance measurement function, the remote distances (horizontal distance, slope distance, height differential, and percentage grade) between a base point P1 and a target point Px, as well as a target point Px and another target point Px, are measured.

Overall flow diagram



①Select the special function, using the procedure described on page 41.

②Use the ▼key to enter the remote distance mode, and press the [OK] display the screen where the type of measurement can be selected. To measure the remote distance from a base point to a target point , select [P − P], and to measure the remote distances from a base point to a target point and from one target point to another, select [BP-P-P].

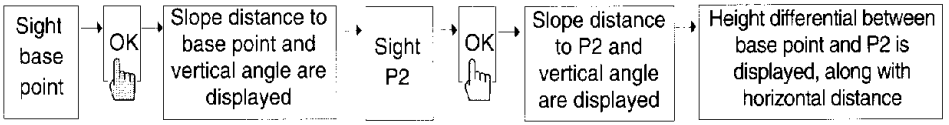


Special Functions

P - P measurement

When [P - P] is selected, the remote distances from the base point to a target point between two points are measured.

③As instructed by the message, measure the distances to the base point (P1) and the target point (P2).



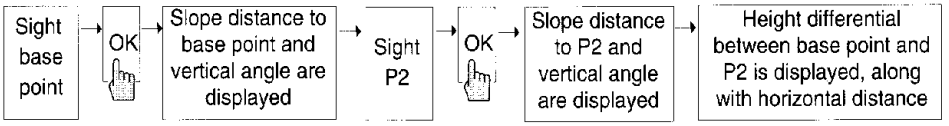
④Pressing the ◢ key displays the slope distance and percent grade.

- ●Pressing [OK] and sighting a new target point (P3) displays the remote distances from the base point (P1) to the new target point (P3). Each time the target is changed, the remote distances from the base point (P1) to the new target point (Px) are displayed.
- ●To change the base point, use the [S. FUNC] key to go back to step ② of the remote distance function, and repeat the procedure starting from step ③, "Sight the base point".
- ●Pressing the [S. FUNC] key during measurement returns to step ② of the remote distance measurement function. Pressing the [S. FUNC] key once more at this point exits the special functions mode and returns to the normal measurement mode.

BP-P-P measurement

With [BP-P-P] measurement, the remote distances from the base point to a target point, and from the target point to another target point, are measured.

⑤As instructed by the message, measure the distances to the base point (P1) and the target point (P2).



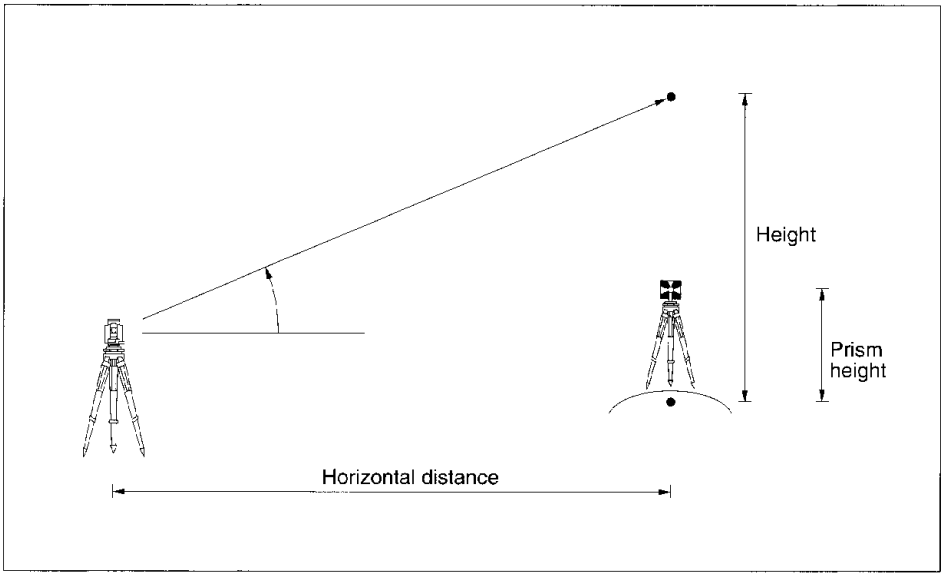
⑥Each time the ◢ key is pressed, the display changes in sequence from the height differential to the slope distance to the percent gradient.

- ●Pressing [OK] and sighting a new target point (P3) and displays the remote distances from the base point (P1) to the new target point (P3), as well as the remote distances (P — P) from the previous target point (P2) to the new target point (P3). Each time the target is changed, the remote distances (P — P) from the base point to the new target point and from the previous target point to the new target point are displayed.
- ●To change the base point, return to the ② R.D.M and use the [S.procedure starting from step ⑤ "Sight the base point".
- ●Pressing the [S. FUNC] key during measurement returns to step ② of the remote distance measurement function. Pressing the [S. FUNC] key once more at this point exits the special functions mode and returns to the normal measurement mode.

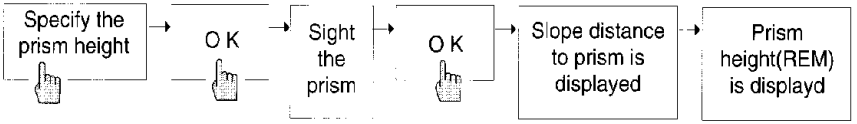
11-11. Remote Elevation Measurement

With the remote elevation measurement function, a prism can be positioned directly under a target such as a power cable, where it is impossible to position the prism directly on the target, and the distance to the target can be measured.

Overall flow diagram



①Select the special function, using the procedure described on page 41.
②Use the [v] key to enter the remote elevation mode, and press the [OK] key to display the screen where the prism height is entered.
③Following the guide messages, input the prism height. Then sight the prism and measure the distance.(For instructions on specifying the values, see steps 4, 5, and 6 on pages 43 and 44, "Distance Stake Out Measurement".)



④As the telescope is rotated in the upward direction, the perpendicular distance (REM) changes. When the target point to be measured is sighted accurately, the height (REM) from the ground to the target point is displayed.

- Check the height to the target point and then press the [ESC] key to exit the remote elevation measurement function and return to the normal measurement mode.
- Pressing the [S. FUNC] key during measurement returns to step ② of the remote elevation measurement function. Pressing the [S. FUNC] key once more at this point exits the special functions mode and returns to the normal measurement mode.

12. Initial Settings

12-1. About Initial Settings

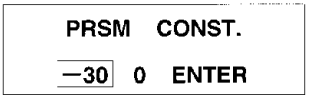
With the PCS-200 series, there are numerous usage conditions which can be selected and specified by the user. These are called "initial settings".
The initial settings are grouped into five modes, from the A Mode to the E Mode. The user can select and store the contents of each of these modes, as described below.
When the instrument is shipped from the factory, those settings (at the left end of the screen) are stored.
If a setting needs to be changed, follow the instructions on page 65, "Accessing the Initial Settings", and page 67, "Changing the Contents of Initial Settings".

12-2. Initial Settings Mode A

(Display)

■Selecting the prism constant

This selects whether the input prism constant is to be −30 mm (−30) or 0 mm (0), or whether a setting selected by the user will be entered from the keyboard.

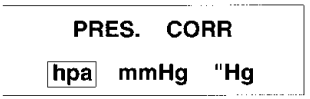


■Selecting the atmospheric correction

This selects whether the temperature and atmospheric pressure measured with the thermometer and barometer will be entered from the keyboard (Enter), or whether the atmospheric correction will normally be fixed at 0 ppm (NIL) and no atmospheric correction will be used.

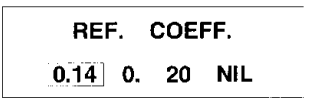
■Selecting the pressure unit

This selects whether the input pressure unit will be hPa, mmHg or "Hg (inch Hg).



■Selecting the atmospheric refraction and earth curvature correction

This selects whether the correction coefficient for the input atmospheric refraction and earth curvature will be "0.14", "0.2", or "NIL".If "None" is selected, no correction is carried out.



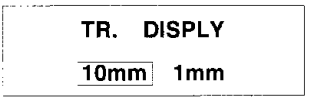
12-3. Initial Settings Mode B

■Selecting the minimum display unit for angles

This selects whether the minimum unit in which angles are displayed will be 10" (COARSE) or 05" (FINE).

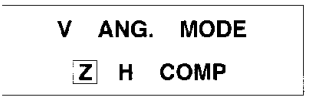
■ Selecting the minimum display unit for distances

This selects whether the minimum unit in which distances are displayed during rapid (TRK) measurement will be 0.01 m (10 mm) or 0.001 m (1 mm).



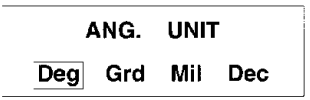
■ Selecting the vertical angle 0 reference

This selects whether the 0 reference point for the vertical angle will be the zenith 0° (Z), horizontal 0° (H) or whether the compass scale (COMP) will be used.



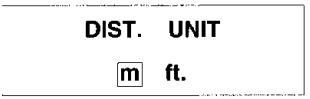
■ Selecting the angle type display

This selects whether the angles display in degrees, minutes and seconds (DEG), grads (GRD), mills (MIL) or decimal degrees (DEC).



■ Selecting the distance type display

This selects whether the distances display in meters (M) or feet (FT).



12-4. Initial Settings Mode C

■ Selecting shot/continuous measurement

(for normal measurement)

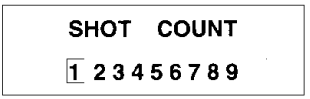
This selects whether measurement will be carried out for the specified number of shots (SHOT) or continuously (SERIES) until stopped.

■ Selecting whether quick-shot is used

This is effective only when "SHOT" is selected at the previous step (for normal measurement), and selects whether the first measurement will start automatically when the prism is sighted (ON) or when the [OK] key is pressed (OFF). If "SERIES" is selected at the previous step, this parameter is invalid.

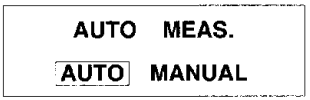
■ Selecting the number of shots

If shot measurement is selected in the Initial Settings Mode A, this selects the number of shots. A value from 1 time (1) to 9 times (9) may be selected.



■ Selecting auto measurement with continuous measurement

If "SERIES" is selected at the previous step, this selects whether measurement will start automatically when the prism is started (AUTO) or whether it will start when the [OK] key is pressed (MANUAL). (If "SHOT" is selected at the previous step, this parameter is invalid.)



Initial Settings

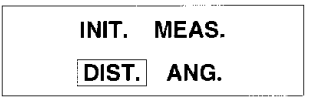
■ Selecting shot or continuous measurement

(for rapid measurement)

This selects whether high-speed measurement "TRACKING" is to be repeated continuously until stopped (SERIES), or is to be repeated for only the specified number of shots (SHOT).

■ Selecting the priority measurement mode

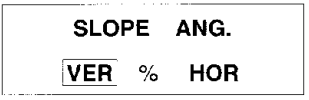
This selects whether the instrument starts from the distance mode (DIST) or the angle mode (ANG).



■ Selecting the display angle

(for slope distance displays)

This selects whether the angle displayed when a slope distance is displayed will be shown as a vertical angle (VER), as a percent grade (%) or whether a horizontal angle (HOR) will be displayed.



■ Selecting the display angle

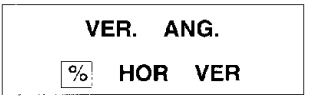
(for horizontal distance displays)

This selects whether the angle displayed when a horizontal distance is displayed will be shown as a horizontal angle (HOR), a vertical angle (VER) or whether a percent grade (%) will be displayed.

■ Selecting the angle display

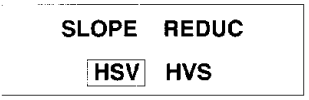
(for height differential displays)

This selects whether the angle displayed when a height differential is displayed will be shown as a percent grade (%), as a horizontal angle (HOR) or as a vertical angle (VER).



■ Selecting the order in which distances are displayed

This selects whether the display switches in the order of horizontal distance (H) → slope distance (S) → height differential (V) each time the ◢ key is pressed, or whether the order will be horizontal distance (H) → height differential (V) → slope distance (S).



12-5. Initial Settings Mode D

■Adjusting the LCD contrast

The LCD screen can be lightened by pressing the ◀key and darkened by pressing the ▶key.

■Adjusting the brightness of the illumination

The screen can be made brighter by pressing the ◀ key and darker by pressing the ▶key.

■Selecting whether or not a buzzer sounds when measuring

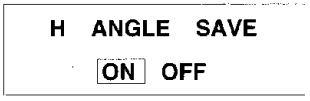
This selects whether the buzzer sounds (ON) when the beam returns from the prism, during rapid measurements, and at other times, or whether no buzzer sounds (OFF).

■Selecting whether or not the 90° buzzer sounds

This selects whether the 90° buzzer sounds (ON) or does not sound (OFF).

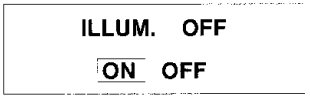
■Selecting whether or not the horizontal angle is retained when the power is turned off

This selects whether the horizontal angle is to be retained (ON) when the power is turned off, or is not to be retained (OFF).



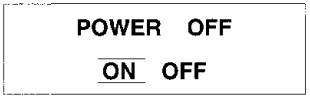
■Selecting whether the Illumination Auto Power Off function is used

This selects whether the illumination goes off automatically (ON) or not (OFF) after 10 minutes.



■Selecting whether the power is turned off automatically

This selects whether the power supply goes off automatically (ON) ornot(OFF) after 10 minutes.

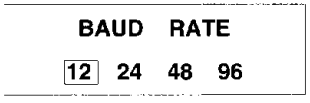


12-6. Initial Settings Mode E

This mode is used to handle communications with peripheral devices.

■Selecting the baud rate

This selects whether the baud rate is 12, 24, 48, or 96.



Initial Settings

■Selecting the data bit
This selects whether the data length is 8 bits or 7.

DATA BITS
[8] 7

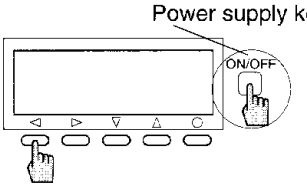
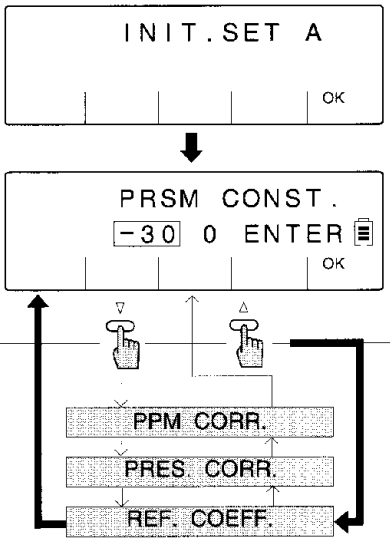
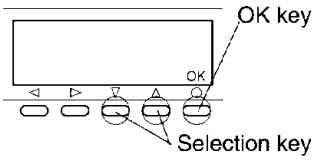
■Selecting the parity
This selects whether no parity check is used (NON), an odd parity check is used (ODD), or an even parity check is used (EVN).

PARITY
[NON] ODD EVN

■Selecting the stop bit
This selects the number of stop bits used, 1 or 2.

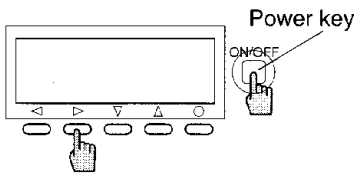
STOP BITS
[1] 2

12-7. Accessing Initial Settings A

Operation Procedure	Display
1  Holding down the ◀ key while turning on the power brings up the "Initial Settings A" screen and enters Mode A. The "PRISM CONSTANT" parameter is displayed.	
2  Use the ▼ or ▲ key the necessary number of times to bring up the desired item.	

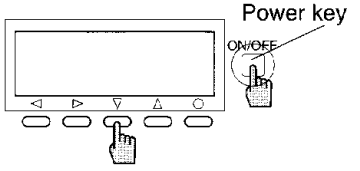
Initial Settings

12-8. Accessing Initial Settings B

Operation Procedure	Display
1  Holding down the key while turning on the power brings up the "Initial Settings B" screen and enters Mode B.	INIT.SET B OK ⬇ ANG. DISPLAY COARSE FINE OK

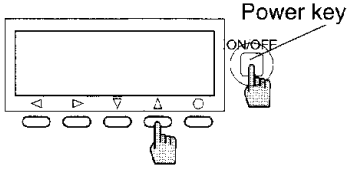
Bring up any necessary items using the same procedure as with Mode A.

12-9. Accessing Initial Settings C

Operation Procedure	Display
1  Holding down the key while turning on the power brings up the "Initial Settings C" screen and enters Mode C.	INIT.SET C OK ⬇ Flashing MEASURE SHOT SERIES OK

Bring up any necessary items using the same procedure as with Mode A.

12-10. Accessing Initial Settings D

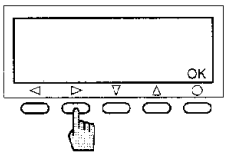
Operation Procedure	Display
1  Holding down the key while turning on the power brings up the "Initial Settings D" screen and enters Mode D.	INIT.SET D OK ⬇ LCD DENSITY ◀LOW HIGH▶ OK

Bring up any necessary items using the same procedure as with Mode A.

※To access Mode E, hold down the [●] key while turning on the power.

12-11. Example of Changing Initial Settings (Selecting Atmospheric Correction)

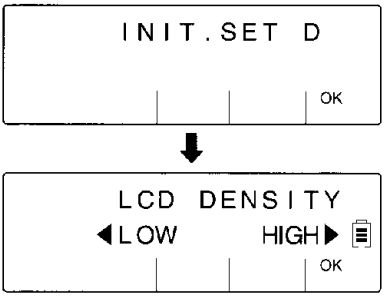
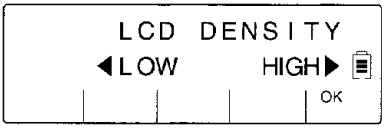
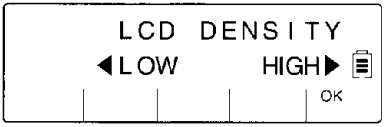
As an example of how to change initial settings, we will look at the parameter for selecting the atmospheric correction in Mode A.
Except for changing the LCD contrast and the illumination brightness in Mode D, all of the settings can be changed using the same procedure. For instructions on changing the contrast and brightness parameters in Mode D, please refer to "Adjusting the LCD contrast" on page 68.

Operation Procedure	Display
1 Use the procedure described in page 65 to access Mode A, where the "PRISM CONSTANT" screen is displayed.	INIT.SET A OK ⬇ PRSM CONST. −30 0 ENTER OK
2 Use the ▼ key to bring up "PPM CORR".	PPM CORR. ENTER NIL OK
3  Using the ▶ key, move the flashing display to the desired item, and then either press the ▼ key to move to another item, or press the [OK] key to exit the selection function. Normally,when the power supply is turned on, the "TURN SCOPE" screen is displayed.	Flashing PPM CORR. ENTER NIL OK To change this to "NIL", move the flashing display to the"NIL" item.

- If "NIL" is selected for the ppm correction function, or if values of 15°C and 1013 hPa (760 mmHg) are entered from the keyboard, "0 ppm" appears on the display.
- If "ENTER" is selected, enter the temperature and atmospheric pressure, following the instructions on page 34, under "Correction Mode".

12-12. Adjusting the LCD Contrast

The procedure is shown here for adjusting the contrast of the LCD. The same procedure can also be used to adjust the brightness of the illumination.

Operation Procedure	Display
1 When Mode D is accessed by following the instructions on page 66, the "LCD DENSITY" screen appears.	
2 Each time the ▶key is pressed, the contrast lightens.	
3 Pressing the ◀ key darkens the contrast.	

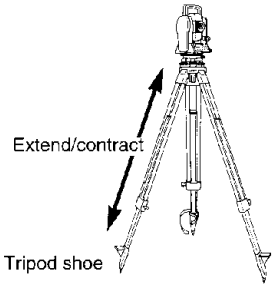
- When the appropriate contrast level has been reached, move to another item, or press the [OK] key to exit the adjustment function.
- Pressing the [OK] key returns to the initial status in effect right after the power supply is turned on with the "TURN SCOPE" message displayed.
- To move to another selection item, use the ▼ key or ▲ key.

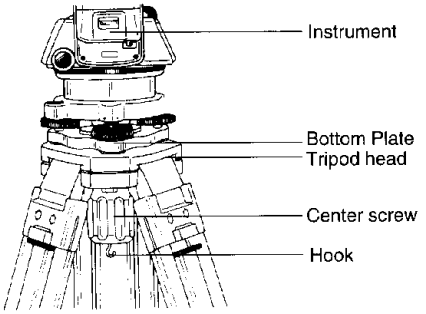
13. Preparing for Measurement

13-1. Centering and Levelling the Instrument

Setting up the instrument and the tripod

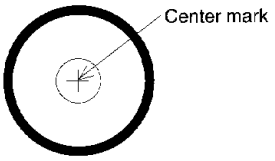
①Adjust the tripod so that the height is suitable for observation when the nstrument is set on the tripod and there is sufficient room to extend and contract the legs.
②Position the tripod so that it is approximately above the station on the ground, gauging the position visually. Position the tripod shoes firmly on the ground.
③Attach the instrument to the Tripod head.

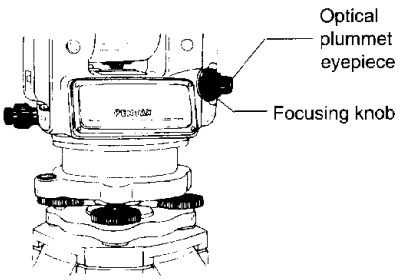




Centering and Leveling with the optical plummet

①Look through the optical plummet eyepiece, and rotate the eyepiece knob until the center mark can be seen clearly.
②Rotate the focusing knob of the optical plummet and adjust the focus to the station mark on the ground.
③Look through the optical plummet and tilt the instrument by adjusting the 3 pcs Leveling screws until the center mark coincides with the mark on the ground.
④Adjust the tripod legs to position the bubble, of the circular vial, to the center. (Be sure not to put your foot on the tripod shoe, which may disturb the position of the tripod.)





Preparing for Measurement

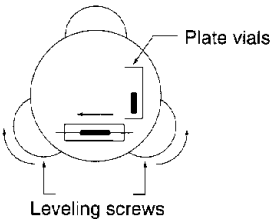
Leveling with the plate

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

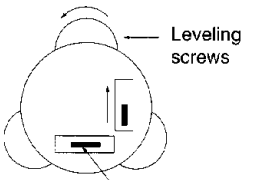
②Adjust the remaining leveling screw so that the bubble in the other plate vial is positioned in the center.

③Check to make sure the bubbles in the two plate vials are positioned in the center,and if not,repeat steps ① and ② until they are centered.

④Rotate the instrument 180° on the vertical axis, and check to make sure the bubbles stay centered.



(A)



(B)

○See the arrows in Figs. A and B to determine the relation between the directionin which the leveling screws are turned and the direction in which the bubble moves. The bubble moves in the opposite direction from that in which the left or right thumb moves.

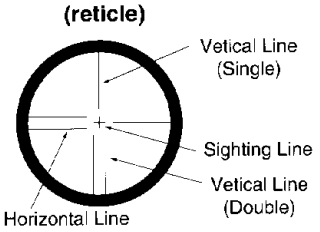
○If the bubbles do not remain centered at step ④, the plate vial needs to be adjusted. See the instructions on page 73, under section 14-1.

Preparing for Measurement

13-2. Eyepiece Adjustment and Sighting

Eyepiece adjustment

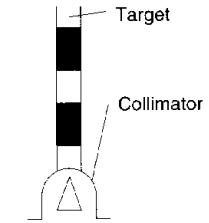
①Remove the telescope lens cap.
②Point the telescope in a bright direction, and rotate the eyepiece ring all the way in the counterclockwise direction.
③Looking through the eyepiece, rotate the eyepiece ring clockwise until the reticle appears at its maximum sharpness.



○When looking through the eyepiece in step ③, make sure you can view the target easily and comfortably, with no eye strain. Attempting to stare at the reticle can cause parallax and eye fatigue.
○If the field is dark and the reticle is hard to see, press the 🔦 key to brighten the field. For instructions on adjusting the brightness, please refer to page 64, section 12-5, "Initial Settings Mode D".

Target sighting

①Point the telescope at the target, using the collimator sight, and tighten the tangent lock knobs.
②Looking through the eyepiece, turn the focusing knob until the target is clearly visible. If the focusing is correct, the reticle will not move in relation to the object even when your eye moves slightly left and right.
③Using the tangent screws, align the reticle accurately with the target.



Sighting a target

○Turn the focusing knob to the right to focus on a nearby target, and to the left to focus on a target which is farther away.
○At step ②, parallax may interfere with the relation between the reticle and the target, preventing accurate observation.
○When using the tangent screws to sight the target, always turn the tangent screws in the clockwise direction (to the right). If the screw is turned past the target point, bring it back past the optimum position and then turn it again in the clockwise direction to find the proper position.
○The target should be placed near the vertical center (the reticle) even when vertical angle measurement is not required. If the target is large, position it accurately between the two vertical lines to sight it.

13-3. Attaching and Removing the Tribrach

With the PCS-225, the tribrach can be detached from the instrument, allowing easy replacement by a target or prism for functions such as traverse measurements.

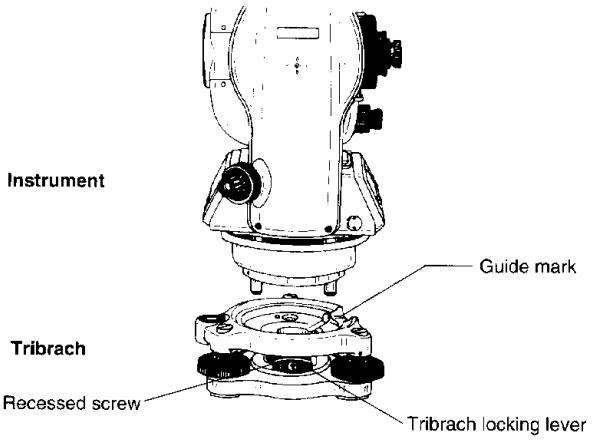
Detachment

①Using the screwdriver provided as an accessory, loosen the screws that secure the attachment lever in place.
②Turn the attachment lever so that the arrow faces upwards.
③Lift the instrument off of the tribrach.

Attachment

①Align the guide on the bottom of the instrument with the guide slot on the tribrach, and set the instrument in place on the tribrach.
②Turn the attachment lever so that that arrow faces downward. This completes the attachment procedure.

■Be careful never to turn the attachment lever unless necessary.
■To avoid turning the attachment lever by mistake when it is not necessary to detach the tribrach, or when transporting the instrument, be sure the screws securing the attachment lever are tightened with the screwdriver.
■The instrument can only be attached to the tribrach by aligning the guide with the guide slot.



14. Inspection and Adjustment

14-1. Plate Vials

Inspection

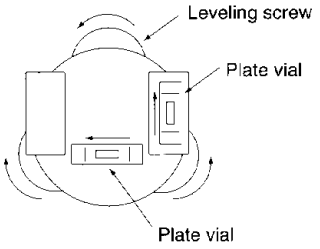
①Place the plate vial in parallel with a line joining any two leveling screws. Adjust the two leveling screws, and position the bubble in the center of the vial.

②Adjust the remaining leveling screw so that the bubble in the other plate vial is positioned in the center.

③Check to make sure the bubbles in the two plate vials are positioned in the center, and if not, repeat steps ① and ② until they are centered.

④Loosen the horizontal lock screw and rotate the instrument 180° on the vertical axis.

⑤Check to make sure the bubbles stay centered. If so, no further adjustment is needed.

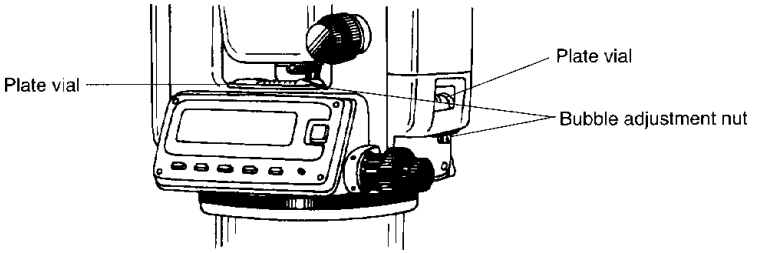


Adjustment

①If the bubble in the plate vial has moved from the center, adjust the leveling screw parallel to the plate vial, and bring the bubble back to the center by half the amount which it has moved.

②Using the adjustment pin, turn the bubble adjustment nut to bring the bubble the rest of the way back to its correct position.

③Rotate the instrument again 180° on the vertical axis, and check to make sure the bubble stays centered.



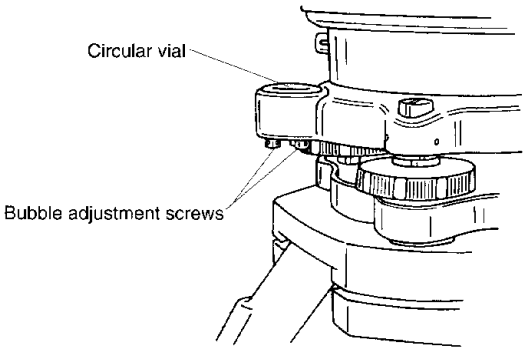
14-2. Circular Vial

Inspection

No inspection is necessary if the bubble of the circular vial is in the center after inspection and adjustment of the plate vials.

Adjustment

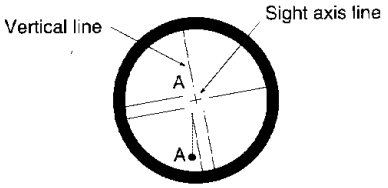
If the bubble of the circular vial is not in the center, bring the bubble to the center by turning the bubble adjusting screws with an adjustment pin.



14-3. Inclination of Reticle

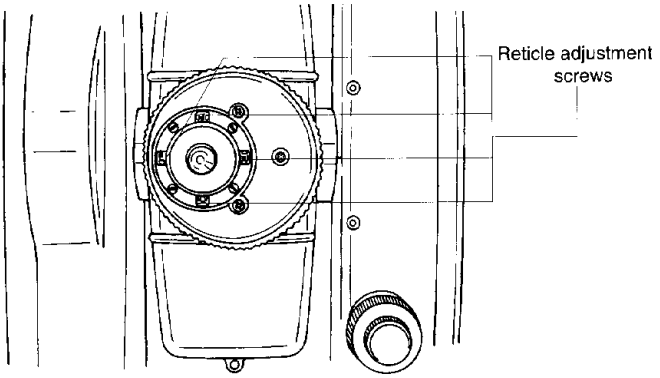
Inspection

①Secure target Point A and sight it with the telescope.
②Using the telescope fine adjustment screws, move Point A to the edge of the field of view (Point A').
③No adjustment is necessary if Point A moves along the vertical line of the reticle.



Adjustment

①If Point A is off from the vertical line of the reticle, first remove the eyepiece cover.
②Using the adjusting pin, loosen the four reticle adjustment screws slightly,loosening each screw by the same amount, and then rotate the reticle line around the sight axis and align the vertical line of the sight axis with Point A'.
③Tighten the reticle adjustment screws again by the same amount, and repeat the inspection to make sure the adjustment is correct.



14-4. Perpendicularity of Line of Sight to Horizontal Axis

Inspection

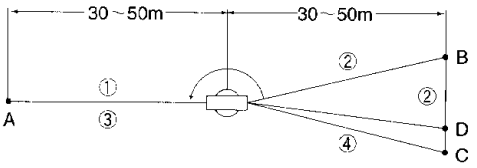
①Position a target Point A at a distance 30-50 m away from the instrument, and sight it with the telescope.

②Loosen the telescope lock screw and reverse the telescope on the vertical axis, until a point is sighted at a distance roughly equal to that of Point A. This is Point B.

③With the telescope still reversed, loosen the horizontal lock screw, rotate the instrument around the vertical axis, and sight Point A again.

④Loosen the telescope lock screw and reverse the telescope on the vertical axis, until a point is sighted at a distance equal to that of Point B. This is Point C. (Return the telescope to the normal position.)

⑤No adjustment is necessary if Points B and C are aligned.



Adjustment

①If Points B and C are not aligned, mark Point D at 1/4 the length of the line BC, from Point C in the direction of Point B.

②Using the adjustment pin, rotate the reticle adjustment screws horizontally opposite each other (see preceding page), and move the reticle to sight Point D.

③Repeat the inspection and make sure the adjustment is correct.

14-5. Vertical 0 Point Error

This item should always be inspected when the adjustments described in sections 14-3 and 14-4 have been carried out.

Inspection

①Set up the instrument and turn on the power supply.
②Secure a target Point A at any desired location, sight it with the telescope, and read the vertical angle γ.
③Reverse the telescope and rotate the instrument horizontally, sighting Point A again at the reversal position. Read the vertical angle ℓ.
④ If $\gamma + \ell = 360^{\circ}$, no adjustment is necessary.

> If there is significant deviation d ($\gamma + \ell = 360^{\circ}$), please contact your local dealer for adjustment.

14-6. Optical Plummet

Inspection

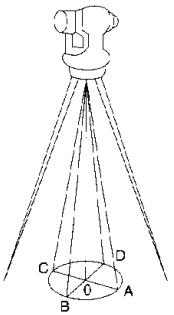
①Set the instrument on the tripod, and position a sheet of white paper underneath it with an "X" drawn on it.

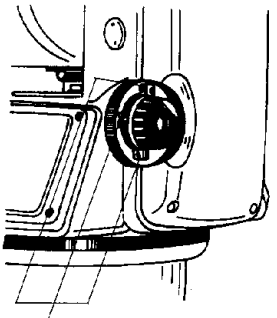
②Looking through the eyepiece, move the paper until the center of the "X" is roughly in the center of the field of view. Secure the paper in that position.

③Using the levèling screws, align the center of mark of the optical plummet telescope with the center of the "X" mark on the paper.

④Rotate the instrument around the vertical axis, and check through the eyepiece at each 90° position to see if the center mark is still aligned with the center of the "X" mark.

⑤If the center mark and the "X" are correctly aligned, no adjustment is necessary.





Optical plummet telescope adjustment screws

Adjustment

①If the "X" mark and the center mark are not aligned, first turn the cap on the focusing knob of the optical plummet telescope in the counter-clockwise direction and remove it.

②Rotate the instrument and, at each 90° position, mark the point sighted with the telescope on the sheet of paper, labelling the four points A, B, C, and D.

③Draw lines connecting the opposite points (A and C, B and D), and mark the intersecting point as 0.

④Using the adjustment pin, turn the four adjustment screws on the telescope to align the center mark of the telescope with the 0 point on the paper.

⑤Repeat the inspection starting from step (4) and check to see if the adjustment is correct.

14-7. Offset Constant

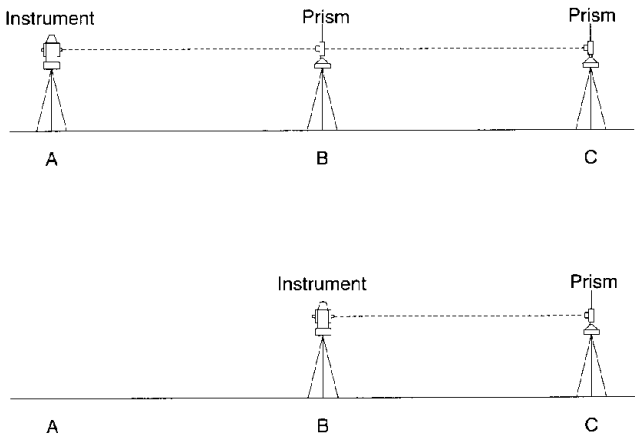
The offset constant rarely changes, but should be inspected once or twice a year to make sure that it has not changed.
It can be inspected on a certified base line, or by using the simple procedure described below.

Inspection

①Select a flat location with a linear distance of approximately 100 meters, and mark Points A, B, and C at approximately 50-meter intervals.
②Set the instrument at Point A and measure distances $\overline{AB}$ and $\overline{AC}$.
③Set the instrument at Point B, and measure distance $\overline{BC}$.
④The offset constant (K) can be determined using the following equation:

$$K = \overline{AC} - (\overline{AB} + \overline{BC}).$$

> If the constant K is not close to 0 in the above inspection, the offset constant needs to be changed. Please contact your local dealer for this adjustment.



14-8. Beam Axis and Sighting Axis

Always check to see if the beam axis and sighting axis are correctly aligned after the adjustments described in sections 14-3 and 14-4 have been carried

Inspection

①Position the prism on the ground, at a point at least 50 meters from the instrument.
②Accurately sight the center of the prism through the telescope.
③Turn on the power supply and measure the distance to the prism.
④If the light-receiving buzzer sounds immediately and the measurement value is displayed within a few seconds, no adjustment is needed.

■If the instrument does not function as described in step (4), the surveying axis and sighting axis need to be adjusted. Please contact your local dealer for this adjustment.
■Weather conditions should be as close to optimum as possible for this inspection.

Precautions regarding inspections and adjustments

◇Be sure to follow all steps in numerical sequence when carrying out inspections and adjustments.
◇With sections 14-3 and 14-4, in particular, make sure the inspection and adjustment steps are done in proper sequence. Also, when the adjustments described in sections 14-3 and 14-4 have been carried out, always do the inspections noted in sections 14-5 and 14-8, and check that the adjustments have been done correctly.
◇Always turn adjustment screws in the tightening direction and make sure they are tightened securely when an adjustment has been completed.
◇After an adjustment has been completed, always repeat the inspection and make sure the adjustment has been done correctly.

15. Appendix

15-1. Warning and Error Messages

Display	Contents	Corrective
BATT. CHANGE	The battery has run down.	Replace or charge the battery.
H OVER SPEED	The horizontal angle rotation speed is too fast.	Press the [0 SET] key and start the measurement again.
V OVER SPEED	The vertical angle rotation speed is too fast.	Turn the telescope and specify the index point again.
EXCESS DATA	The input data exceeds the allowable range.	Press the [OK] key and enter the correct data.
EXCESS ANG./DIST.	The measurement range has been exceeded.	Measurement is not possible in this range.
EDM ERROR E - XX	A problem has occurred with the distance measurement section. "XX" indicates the error number.	Try the measurement again, within the measurement range. Turn the ON/OFF switch off and then on again. If the error is still displayed, the instrument needs repair. **(Note)** This can sometimes be displayed as a result of incorrect handling.
ETH ERROR E - XX	A problem has occurred with the angle measurement system. "XX" indicates the error number.	
OTHER ERROR E - XX	Another problem has occurred inside the instrument. "XX" indicates the error number.	

15-2. Atmospheric Correction

The speed at which light travels through the air varies depending on the temperature and atmospheric pressure. The PCS-200 series is designed to measure distances at the speed of light. In order to measure accurately, atmospheric correction needs to be used. The instrument is designed to correct for weather conditions automatically if the temperature and pressure are input. Correction is then carried out based on the following formula.

Calculation formula

$$K=\left(279.75207-\frac{79.55626 \cdot P}{273.14941+t}\right)\times 10^{-6}$$

K: Atmospheric correction constant

P: Atmospheric pressure (hPa)

t: Temperature (°C)

Distance after atmospheric correction D = Ds (1 + K)

Ds: Measured distance when no atmospheric correction is used

Appendix

15-3. hPa and mmHg Conversion Tables

Converting from hPa to mmHg

hPa	0	10	20	30	40	50	60	70	80	90
500	375 mmHg	383 mmHg	390 mmHg	398 mmHg	405 mmHg	413 mmHg	420 mmHg	428 mmHg	435 mmHg	443 mmHg
600	450	458	465	473	480	488	495	503	510	518
700	525	533	540	548	555	563	570	578	585	593
800	600	608	615	623	630	638	645	653	660	668
900	675	683	690	698	705	713	720	728	735	743
1000	750	758	765	773	780	788	795	803	810	818
1100	825	833	840	848	855	863	870	878	885	893
1200	900	908	915	923	930	938	945	953	960	968

Converting from mmHg to hPa

mmHg	0	10	20	30	40	50	60	70	80	90
400	533 hPa	547 hPa	560 hPa	573 hPa	587 hPa	600 hPa	613 hPa	627 hPa	640 hPa	653 hPa
500	667	680	693	707	720	733	747	760	773	787
600	800	813	827	840	853	867	880	893	907	920
700	933	947	960	973	987	1000	1013	1027	1040	1053
800	1067	1080	1093	1107	1120	1133	1147	1160	1173	1187
900	1200	1213	1227	1140	1153	1167	1180	1193	1207	1220

Appendix

15-4. Deviation When No Atmospheric Correction Is Made

When measurement is carried out with no atmospheric correction (with the settings fixed at a temperature of 15°C and an atmospheric pressure of 1013 hPa or 760 mmHg), the deviation per 100 meters in temperature and pressure will be as shown in the tables below.

With hPa (15°C, 1013 hPa as standard)

°C \ hPa	1200	1100	1013	900	800	700	600	500
45	2.0	−0.5	−2.6	−5.5	−8.0	−10.5	−13.0	−15.5
35	3.0	0.4	−1.8	−4.7	−7.3	−9.9	−12.5	−15.1
25	4.0	1.4	−0.9	−4.0	−6.6	−9.3	−12.0	−14.6
15	5.2	2.4	−0.0	−3.1	−5.9	−8.6	−11.4	−14.2
5	6.3	3.5	1.0	−2.2	−5.1	−8.0	−10.8	−13.7
−5	7.6	4.7	2.1	−1.3	−4.2	−7.2	−10.2	−13.1
−15	9.0	5.9	3.2	−0.2	−3.3	−6.4	−9.5	−12.6

Unit = millimeter

With mmHg (15°C, 760 mmHg as standard)

°C \ mmHg	900	800	760	700	600	500	400
45	2.0	−1.3	−2.6	−4.6	−8.0	−11.3	−14.6
35	3.0	−0.4	−1.8	−3.9	−7.3	−10.8	−14.2
25	4.0	0.5	−0.9	−3.1	−6.6	−10.2	−13.7
15	5.2	1.5	0.0	−2.2	−5.9	−9.6	−13.3
5	6.3	2.5	1.0	−1.3	−5.1	−8.9	−12.7
−5	7.6	3.7	2.1	−0.3	−4.2	−8.2	−12.2
−15	9.0	4.9	3.2	0.8	−3.3	−7.4	−11.5

Unit = millimeter

※When the actual pressure is 1013 hPa (760 mmHg) and the temperature is 25°C,conducting the measurement with the temperature left at 15°C will result in the measurement being short by 0.9 mm per 100 meters.

Appendix

15-5. Atmospheric Refraction and Earth Curvature Correction

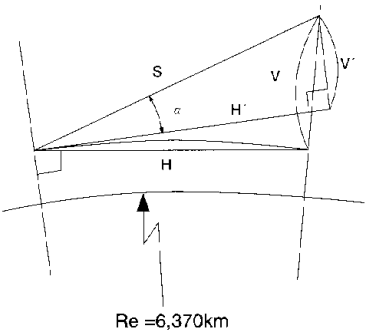
- Atmospheric refraction and earth curvature correction refers to correcting both the bending of the light beam caused by atmospheric refraction and the effect on the height differential and horizontal distance caused by the earth curvature.
- Correction called "atmospheric refraction and earth curvature correction"is initiated to correct deviation when the slope distance and vertical angle are used to determine the horizontal distance and the height differential. With this instrument, the following formula is used to correct these factors.
- Calculation formula when atmospheric refraction and earth curvature correction parameter is set to "ON":

Corrected horizontal distance (H)

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

Corrected vertical distance (V)

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



- Calculation formula when atmospheric refraction and earth curvature correction parameter is set to "OFF":

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

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

S: Slope distance

a: Vertical angle from horizontal

K: Atmospheric refraction coefficient (0.14 or 0.2)

Re: Diameter of earth (6,370 km)

15-6. Distance Range

Generally speaking, the maximum range which can be measured varies considerably depending on the atmospheric conditions. For this reason, the performance tables on the following pages illustrate the values for both optimum and ordinary weather conditions.

It is extremely difficult to judge when weather conditions are "optimum" and when they are "ordinary". With this instrument, the conditions noted below are used to differentiate between the two situations. (Optimum weather conditions for surveying are different from ordinary weather conditions, and in surveying situations, cloudy skies are considered more favorable than sunny skies.)

Weather conditions for measurement ranges are based on the following standard values:

Normal:Visibility of approximately 20 km, with slight haze
Good:Visibility of approximately 40 km, overcast, no heat haze and moderate wind

16. Specfications

Instrument

Telescope

Image ..... Erecting
Magnification ..... 30 X
Effective aperture ..... 45 mm (EDM 45 mm)
Resolving power ..... 3"
Field of view ..... 2.6% (1°30')
Minimum focus ..... 0.85 m / 2.8 ft.

Distance Measurement Section

Measuring range	Normal	Good
1 prism	800 m / 2625 ft.	(1000 m / 3280 ft.)
3 prism	1200 m / 3935 ft.	(1500 m / 4920 ft.)

Accuracy ..... ± (3 + 3 ppm x D) mm
Measurement display ... 8 digits,max. display 99999.999m
Minimum readings
Fine mode ..... 1 mm / .001 ft.
TR mode ..... 1 cm, 1 mm / .1 ft., .001 ft.
Measuring time
Fine mode ..... Approx. 2 seconds
TR mode ..... Approx. 0.8 seconds (mm)
Measuring system
Normal ..... Measurement repeated automatically
Shot ..... Selectable from 1 to 9 times
Max. slope distance display ..... 3,000 m
Atmospheric correction ... Temperature: 1°C / 1°F per step input
(On/Off selection) ... Pressure: 1 mmHg / 0.1 inHg per step input
Prism constant ... 0 mm, -30 mm, selectable numeric input
Atmospheric refraction and earth curvature ... ON / OFF
Atmospheric refraction coefficient ..... 0.14 / 0.2
Distance unit ..... Meter / Feet
Calculation functions ..... Distance Stake out
Lot staking
Offset point
Remote elevation measurement
Remote distance measurement
Coordinates
Resection
Traverse
Coordinate stake

Angle Measurement Section

Measuring system ..... Incremental rotary encoder
Detection method ..... Horizontal angle- Double
Vertical angle- Single
Minimum display ..... 10" / 5" Selectable
Accuracy (DIN18723) ... Horizontal : Standard deviation 5"
Vertical : Standard deviation 7"
Measuring time ..... Approx. 0.2 seconds (continuous measuring)
Diameter of encoder ..... 79 mm
Measuring modes ..... Horizontal angle Right, Left , Hold
Vertical angle Zenith 0°, Horizontal 0°, % , Compass

Display Section

Type ..... LCD 2 lines with illumination
PCS-225: Dual
PCS-215: Single
Display combinations ..... Vertical angle/Horizontal angle
% / Horizontal angle
Horizontal distance / Horizontal angle
Slope distance / Vertical angle
Height differential / % X
X coordinates / Y coordinates / Z coordinates
Vertical distance / Vertical angle[REM]
Height differential / Horizontal distance [RDM]
Slope distance and %

Sensitivity of Vials

Plate vial ..... 40" / 2 mm
Circular vial ..... 8" / 2 mm

Specfications

Optical Plummet

Image	Erecting
Magnification	3 X
Focal range	0.5 m ~ ∞

Types of Vertical axis and Tribrach

Vertical axis	Single axis
Tribrach type	PCS-225: Detachable
	PCS-215: Fixed

Data Communication

Interface	RS-232C standard
Baud rate	1200, 2400, 4800, 9600
Data bits	8 or 7 bits
Parity bit	None, Odd, or Even
Stop bits	1 / 2

Auto Power Off Function

Time setting	10' (On/Off selectable)

Ambient Temperature

Temperature range	-20 ~ +50°C

Tripod Thread

PCS-215/225	5/8"x 11 (JIS/Type B)

Dimensions and Weights

Instrument (w/o battery)	162(W)x 338(H)x 154(L)mm 4.7kg
Case	260(W)x 250(H)x 440(L)mm 3 kg

On-Board Battery (MB06)

Power supply	Rechargeable Ni-Cd battery
Output voltage	7.2 VDC
Opeation time per charging	Continuous : approx. 4 hours
	(Angle/Distance measurement)
	Continuous: approx. 15 hours
	(Angle measurement only)
Weight	0.3 kg

Battery Chargers

Quick Charger for Internal Use (MC04)

Input voltage	AC 120V
	(for USA)
	AC 240V
	(for Europe)
Input frequency	50/60 Hz
Charging time	Approx. 1.0 hour
Ambient usage temperature	0 ~ + 45°C
Weight	0.35 kg

17. External Battery (MB07)

In addition to the on-board battery (MB06), the PCS-215/225 can be connected to a long-term continuous external battery (MB07). If both the on-board battery (MB06) and external battery (MB07) are connected to the instrument at the same time, the power is supplied only from the external battery (MB07) without consuming the on-board battery (MB06). The MB07 can be charged by means of a MC04 charger.

17-1. MB07 Specifications

Type	Rechargeable Ni-Cd battery
Output voltage	7.2 V
Continuous usage hours per full charge	14.5 hours (Distance & Angle measurement) 54 hours (Angle measurement only)
Cable MB45	Length 2m

17-2. MC04 Specifications

Input voltage	AC 120V / 240V
Frequency	50/60 Hz
Charging time	Approx.4 hours
Ambient usage temperature	0℃~ 45℃(+32℉~ +113℉)

17-3. How to attach the MB07

Attach the MB07 to the tripod, and connect ther MB07 to the instrument connector by means of a MB45 battery cable.

17-4. How to charge the MB07 by means of MC04

① Connect the MC04 connector to the MB07 connector terminal.

② Insert the MC04 plug in a wall outlet (AC 120V/220V,50/60 Hz).

③ Disconnect the MC04 connector from the MB07 connector terminal, and unplug the MC04 plug to terminate charging after approx. 4 hours.

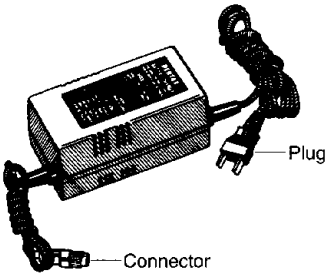
Note:

1. The "Auto power off" function can work as well when the MB07 is used.
2. Please refer to the MB07 instruction manual when the MB07 is charged.

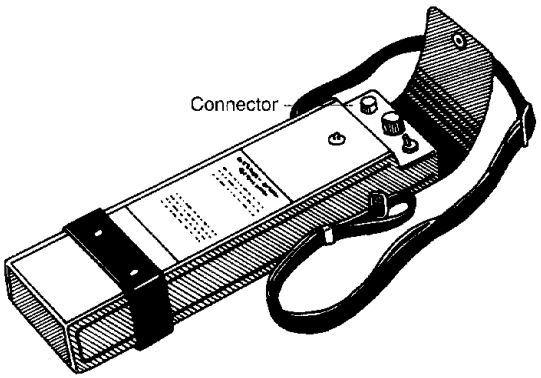
17-4. Charging the Battery

①Connect the external battery and the charger (MC22).
②Plug the charger into a household outlet (AC 120V / 220V,50/60 Hz).
③Turn on the power supply switch on the external battery and check to make sure the pilot lamp on the charger lights.
④After 14-16 hours, turn off the power supply switch, unplug the charger, and disconnect the charger and the battery.

■Do not charge batteries for longer than 24 hours, as this can damage the battery.
■If the pilot lamp on the charger does not light when the power supply switch on the external battery is turned on, either the battery or the charger may have a problem.



External battery Charger MC22



External Battery MB22

Note:
The external battery charger MC22 cannot be sold in EU countries.

This device complies with the protection requirement for residential and commercial areas. If this device is used close to industrial areas or transmitters, the equipment can be influenced by electromagnetic fields.

PENTAX®

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CE

The CE marking assures that this product complies with the requirements of the EC directive for safety.

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