

# TOTAL STATION

# **R-400V** SERIES

## INSTRUCTION MANUAL

**BASIC PROCEDURES**  
FOR R-400V SERIES

R-422VN  
R-423VN  
R-425VN  
R-435VN



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# **PENTAX**

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<p>Before using this product, be sure that you have thoroughly read and understood this instruction manual to ensure proper operation. After reading this manual, be sure to keep in a convenient place for easy reference.</p>
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## Exemption clause

- 1) TI Asahi Co.,Ltd. (TIA) shall not be liable for damage caused by Acts of God, fire, alteration or servicing by unauthorized parties, accident, negligence, misuse, abnormal operating conditions.
- 2) TIA shall not be liable for changes or disappearance of data, loss of company profit or interruption of company operation incurred by the use of this product or malfunction of it.
- 3) TIA shall not be liable for damage caused by usage not explained in the instruction manual.
- 4) TIA shall not be liable for damage to this product caused by other equipment connected to this product.

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# PRECAUTIONS REGARDING SAFETY

## Safety precautions (Must be followed)

The following items are intended to prevent possible injury to the user or other people and/or damage to the instrument before it occurs. These safety precautions are important to the safe operation of this product and should be observed at all times.

## Distinctive displays

The following displays are used to distinguish precautions by the degree of injury or damage that may result if the precaution is ignored.



Items indicated by this sign are precautions which, if ignored, would result in serious injury.



Items indicated by this sign are precautions which if ignored may result in injury or material damage.

- Here “injury” refers to injuries such as cuts, burns or electric shock, of which treatment will not likely require hospitalization or long-term attention.
- “Material damage” refers to damage to facilities, buildings, acquired data, etc.

Before using this product, be sure that you have thoroughly read and understood this instruction manual to ensure proper operation. After reading this manual, be sure to keep it in a convenient place for easy reference.

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

Quick Reference Guide provided in your carrying case contains the following items:

1. Basic Procedures
2. PowerTopoLite Operating Procedures



- ⚠ Do not stare into the laser beam directly as this may result in damage to your eyes.
- ⚠ R-400V is a Class IIIa (3R) Laser product. Do not look into the laser radiation aperture directly as this may result in damage to your eyes.
- ⚠ Never use the telescope to view intense light such as direct sunlight or sunlight reflected through a prism as this may result in loss of sight.
- ⚠ Do not disassemble, modify or repair this product as there is a risk of laser radiation.

⚠ Do not aim the laser beam at a person as it is harmful to the eyes and body. Receive the examination treatment by the doctor when the eyesight or body trouble is doubted by any chance.

- Electro-Magnetic Compatibility (EMC):  
This instrument complies with the protection requirement for residential and commercial areas. If this instrument is used close to industrial areas or transmitters, the equipment can be influenced by electromagnetic fields.
- Do not use this product in a coal mine, in a location where there is coal dust, or near flammable material as there is a risk of explosion.
- Do not disassemble, modify or repair this product as there is a risk of fire, electric shock and burn injury. If you think the product requires repair, contact the retail outlet where you purchased it or an authorized repair site.
- Do not charge BP02 Battery with any battery charger other than BC03 as it entails a risk of fire or burn injury from the battery bursting into flames due to possible differences in voltage or polarity.
- Do not use a damaged electric cord plug or loose electric outlet when charging as there is a risk of fire or electric shock.
- Do not charge the battery while covered by clothes or similar items as there is a risk of fire if the clothes ignite.
- Do not use the battery or charger when wet as there is a risk of fire and burn injury due to short-circuit.
- To prevent making short-circuit when removing the battery and charger from the case and storing them, apply electrically resistant tape to the poles of the battery. Storing the battery and charger as it is may result in fire or burn injury due to short-circuit.
- Do not throw the battery into fire or expose it to heat as there is a risk of injury if it explodes.



## CAUTION

- ⚠ For your safety, perform the initial and periodical inspection as well as when the instrument is fixed and adjusted.
  - ⚠ When the laser beam enters eyes, an unexpected accident might be caused by blink of eyes.
  - ⚠ Do not place the laser product at a height where its laser beam may hit the eyes of car drivers and pedestrians.
  - ⚠ Do not place the laser product at a place where its laser beam may hit a reflecting object such as a mirror or a glass window. The reflection beam of the laser is also harmful to the human body.
  - ⚠ When not performing measurement, cut off the power supply or shade the objective lens with objective cap to prevent the instrument emitting the laser beam.
  - ⚠ Keep the laser product in a place where persons, who do not have the product knowledge, such as children, can not touch it by mistake.
- Before disposing of the instrument, destroy its power supply mechanism to prevent it from emitting the laser beam.
  - Do not remove the handgrip without good reason. If it does come off, be sure to attach it securely to the instrument with screws. If it is not fastened securely, the instrument may fall when you use the handgrip, leading to possible injury.

- Do not short the poles of the battery or charger as there is a risk of injury or fire.
- Do not touch any fluid which may leak from the battery as there is a risk of chemical burn injury or reaction.
- Do not insert or remove the electric plug with wet hands as there is a risk of electric shock.
- Do not use the case to stand on as it is slippery and unstable and may cause you to fall, resulting in possible injury.
- Make sure the tripod itself and the instrument on the tripod are both installed securely as insecure installation may cause the tripod to fall over or the instrument to drop, resulting in possible injury.
- Do not carry the tripod with the metal shoe pointing toward another person as it may injure him/her.



### **Ni-MH**

- The instrument contains a rechargeable battery and a battery charger.
- It may be illegal to dispose the battery at the end of its useful life.
- Check with your local solid waste officials for details for recycling.



## Usage precautions

Surveying instruments are high-precision instruments. In order to assure that the Electronic Total Station R-400V series product which you have purchased will provide long-lasting maximum performance, the precautions in this manual must be followed. Make sure to follow these instructions and use this product properly at all times.

### [Solar observation]



#### **WARNING**

Never view the sun directly using the telescope as this may result in loss of sight.  
Never point the objective lens directly at the sun as this may damage internal components.  
When using the instrument for solar observation, be sure to attach the specially designed solar filter (MU64) to the objective lens.

### [Laser beam]

Do not stare into the laser beam. R-400V is a Class IIIa (3R) Laser product.

### [EDM axis]

The R-400V series EDM is a red visible laser beam and the beam diameter is very small. The beam is emitted from the objective centre. The EDM axis is designed to coincide with the telescope sight axis (but both axes may deviate slightly because of intense temperature changes and a long time lapse).

### [Target constant]

Confirm the Target Constant of the instrument before measurement.  
If a different constant is to be used, use the correct constant of the target. The constant is stored in the instrument's memory when turned off.

### [Reflectorless and reflector sheet]

- Reflectorless (Non-Prism)  
The measurement range and accuracy of the Reflectorless mode are based on the condition that laser beam is emitted perpendicular to the white side of a Kodak Gray Card.  
The measurement range may be influenced by the shape of the target and its environment.  
There is a possibility that the range may vary when the target does not satisfy the conditions above at survey work.
- There is a possibility that correct distance measurement may not be performed by dispersion or reduction of laser beam when the laser beam comes into the target from a diagonal angle.
- There is a possibility that the instrument may not be able to correctly calculate out the distance when receiving reflected laser beam from forth and back directions in case of measuring the target on the road.
- There is a possibility that synthesized values are calculated and the distance may become longer or shorter than the actual one when the operator measures the target of slope or sphere or rugged shape.
- There is a possibility that the instrument may not be able to correctly calculate out the distance by collecting the reflected laser beam from a man or a car that comes and goes in front of the target.

- There is a possibility that the distance may not be correctly measured when measuring a target in the direction where there is a reflecting object (mirror, stainless board, white wall, etc.) or under too strong sunlight.
- In a situation where high accuracy may not be expected, perform the measurement by Reflector sheet or Prism.
- When using reflector sheet, set the reflector sheet to have its surface to be approx. vertical to the aiming line. If it is positioned not to be approx. right angle, there is a possibility that correct distance measurements may be impossible by dispersion or reduction of laser beam.

In the following environments, the distance may not be possible to be measured; there is a reflecting thing (mirror, stainless board, white wall, etc.) in the direction of the target, and under too strong sunlight

### **[Battery & charger]**

- Do not use any battery or battery charger that is not approved by Pentax as it entails a risk of damaging the instrument.
- If water should happen to splash on the instrument or the battery, wipe it off immediately and allow it to dry in a dry location. Do not put the instrument in the case until it is completely dry as this may result in damage to the instrument.
- Turn off the power when removing the battery from the instrument as removing the battery while the power is still on may result in damage to the instrument.
- The battery mark displayed on the instrument is only an estimation of remaining battery power and is not completely accurate. Replace the battery quickly when it is about to run out of power as the time a battery lasts on one full charge differs depending on conditions of ambient temperature, and the measurement mode of the instrument.
- Confirm the battery level remaining before operating.

### **[About Clock Battery (lithium)]**

- Clock battery is a backup battery used for calendar clock function.
- The battery can last about five years with regular use, but it is possible to be shorter depending on usage.
- When the voltage of the clock battery is low or runs out, the date and time display incorrectly and indication of "Clock-batt. voltage low" will appear.
- Please contact your the dealer which the purchased was mail for any exchange or return of the clock battery.

### **[LD POINT, laser pointer]**

When you make a correct direction using the “LD POINT”, aim the laser beam at the wall and mark the centre and then confirm the discrepancy between the reticle centre and the marked point beforehand.

### **[Storage and operating environment]**

- To prevent making short-circuit when removing the battery and charger from the case and storing them, apply electric resistant tape to the poles of the battery. Storing the battery and charger as it may result in fire or burn injury due to short-circuit.
- Avoid storing the instrument in places subject to extreme high, low or radically fluctuating temperature. (Ambient temperature range during use:  $-20^{\circ}\text{C}$  to  $+50^{\circ}\text{C}$ )
- Distance measurements may take longer when atmospheric conditions are poor such as when heat shimmer occurs. When storing the instrument, always put it in its case and avoid storage in dusty location or location subject to vibration or extreme heat or humidity.

- Whenever there is a sharp temperature difference between the instrument's storage and usage environment, allow the instrument to adjust to the environment for an hour or more before using it. Make sure to protect the instrument from the sun if the location is subject to intense direct sunlight.
- The battery should be charged approximately once per month if the instrument is to be stored for an extended period of time. The instrument should also be removed from its case occasionally and aired out.
- In addition to these precautions, be sure to handle the instrument properly at all times following the descriptions given in the various sections of this manual to assure safe and proper measurements.

### **[Transporting and carrying the instrument]**

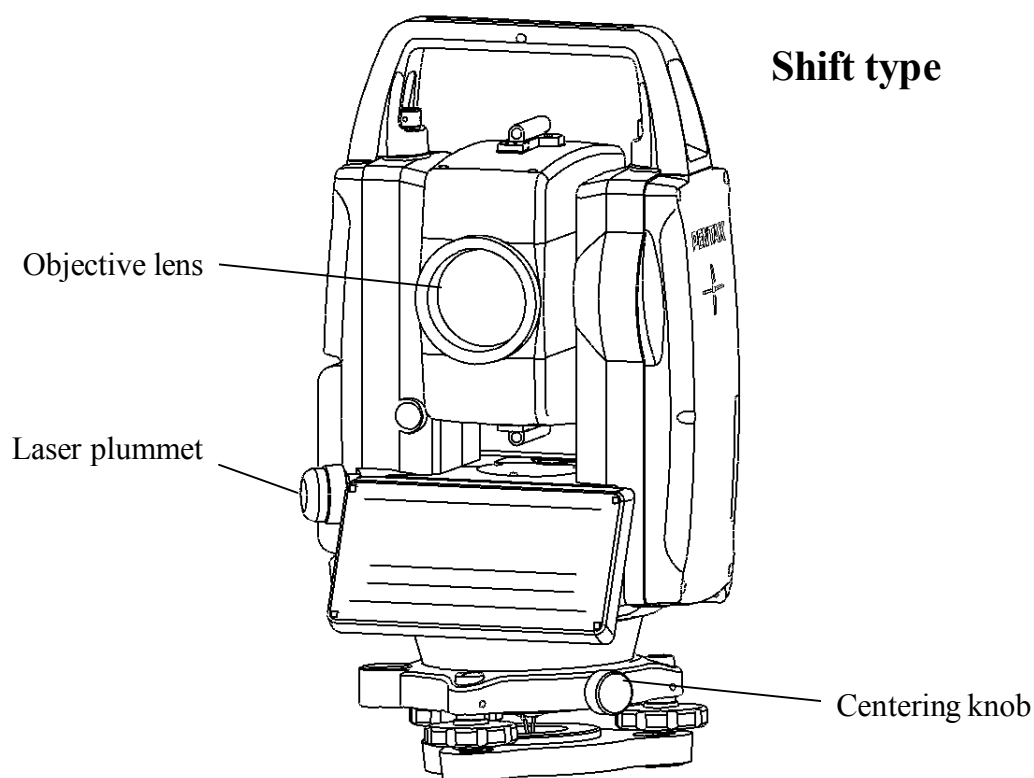
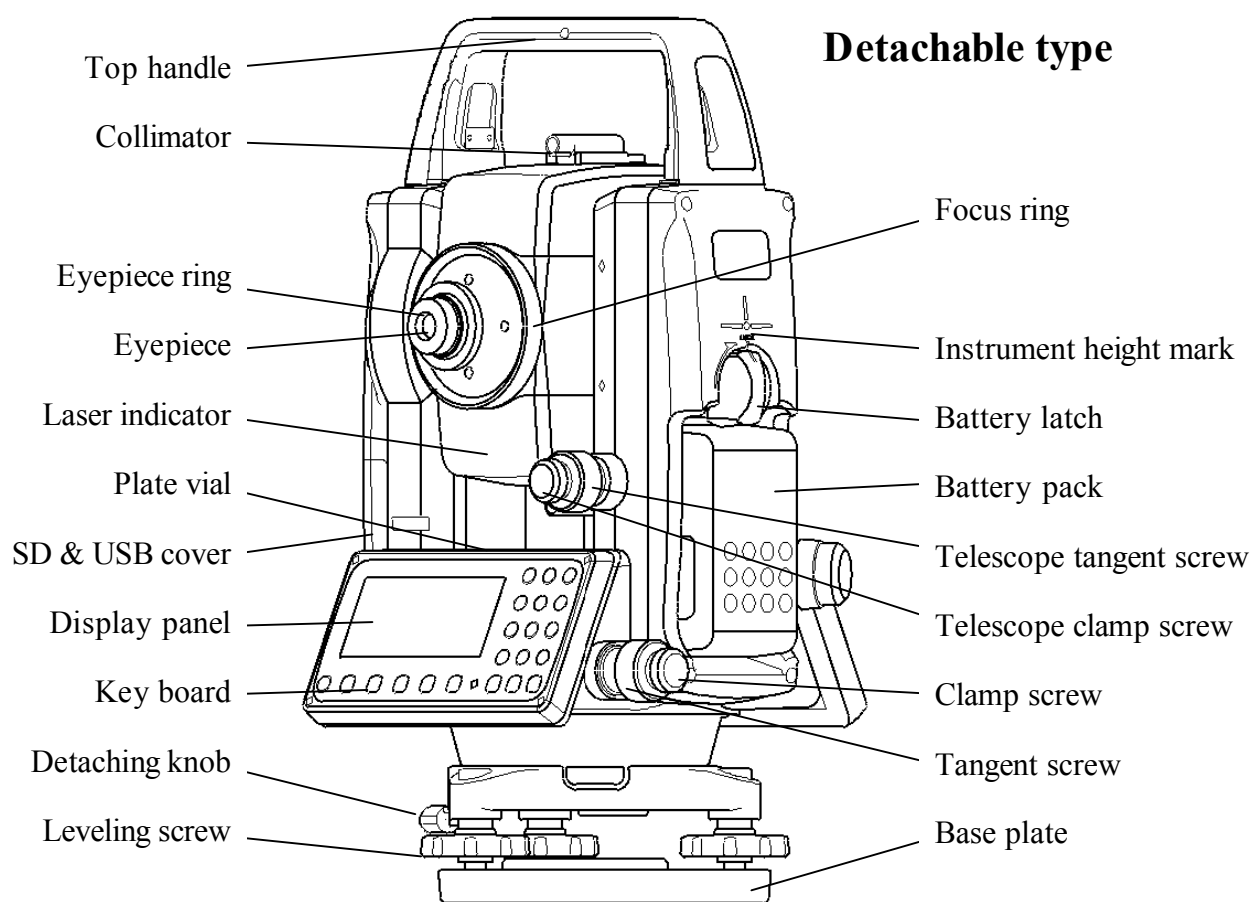
- Be careful to protect this instrument from shock of impact and excessive vibration which may result in damage during transportation and shipment.
- When transporting the instrument, always put it in the case and wrap shock absorbing material around it and be sure it is handled as "FRAGILE".

### **[Checks and repairs]**

- Always check the instrument before beginning work and check that the instrument is maintaining the proper level of precision. Pentax bears absolutely no responsibility for damages due to survey results obtained from surveys conducted without an initial instrument check.
- Never disassemble the instrument, battery or charger, even if you do detect an abnormality, as there is a risk of fire or electric shock due to short-circuit. If you think the product requires repair, contact the retail outlet where you purchased it or an authorized repair site.

# 1. BASIC OPERATION

## 1.1 Names of parts



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## 1.2 Standard equipment

- Instrument
- Carrying case
- BP02 battery
- BP03/AC01 charger
- Power supply cord
- Plumb bob
- Plummet hook
- Hexagonal wrench
- Adjusting pin
- Screwdriver
- Rain cover
- Quick Reference Guide
- CD-ROM (Basic operation & Special Functions manual)
- USB cable
- SD card(1GB)

---

## 1.3 Unpacking and packing

### [Unpacking the Instrument from the case]

- ① Set the case down gently with the lid facing upwards.
- ② Open the latches while pressing down on the lock (safety mechanism) and open the lid of the case.
- ③ Remove the instrument from the case.

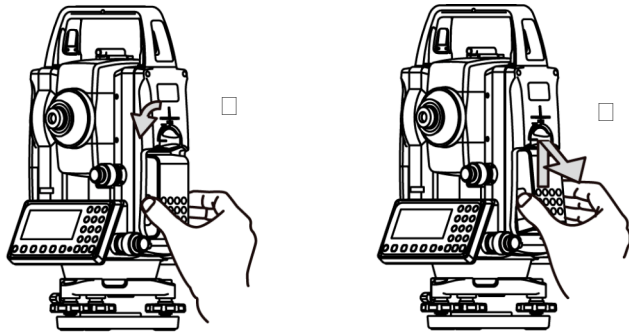
### [Packing the instrument in the case]

- ① Make sure the telescope is fairly levelled and lightly tighten the telescope clamp screw.
- ② Line up the housing marks (round yellow marks on the instrument) and tighten the upper and lower clamp screws.
- ③ With the housing marks are facing upwards, set the instrument gently in the case without forcing it. Close the lid to the case and secure the latches.

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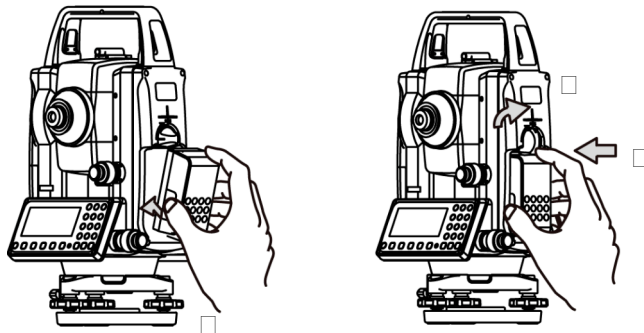
## 1.4 Removing and attaching the Battery

### [Removing the Battery]



- ① Rotate the knob above the battery pack counter clockwise.
- ② Lift up the battery pack and remove it from the instrument.

### [Attaching the Battery]



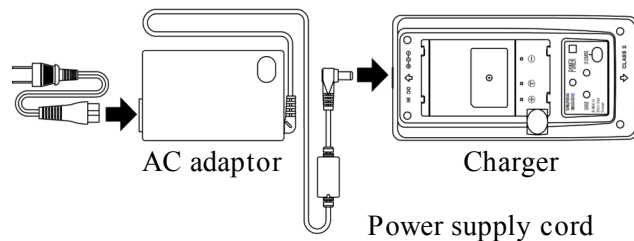
- ① Place the channel on the bottom of the battery pack.
- ② Onto the protrusion of the instrument and push the battery pack down into place.
- ③ Turn the knob clockwise.

---

## 1.5 How to charge the Battery

### [Charging the battery]

- The battery BP02 is not charged at our factory shipment. It must be charged before use.
- For BP02 charge, use the special BC03 charger.



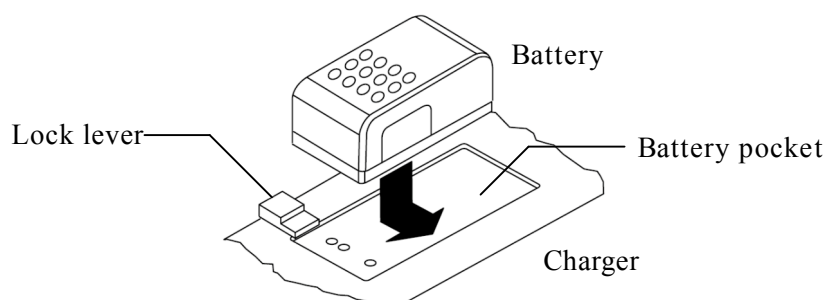
### [Connection of code]

- ① Insert the output plug of the power supply code in the jack of the AC adaptor.
- ② Insert the output plug of the AC adaptor in the jack of the charger.

- ③ Insert the power supply plug of the power supply code in the outlet of AC power supply.

### [Installation of battery]

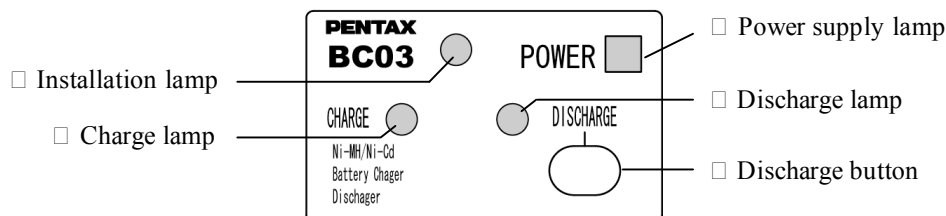
- ① Draw the battery to the lock lever side and put it on the battery pocket. The battery is firmly installed on the battery pocket.
- ② Press down the battery and then slide it to the opposite direction of the lock lever.
- ③ The lock lever goes up, and the battery is fixed.
- ④ Under such a condition, if “Connection of the code” is done, the charge with the battery is begun.



### [Detaching the battery]

- ① Press the lock lever and slide the battery to the lock lever direction.
- ② Detach the battery packing from the battery pocket.

### [Display panel]



- ① Power supply lamp (red) : Turns on when the power supply is turned on.
- ② Charge lamp (green) : Turns on while charging and turns off when the charge is completed.
- ③ Discharge lamp (yellow) : Turns on when you push the discharge button.  
Turns off when the discharge is completed.
- ④ Installation lamp (red) : Blinks or turns on when the battery packing is attached normally.  
Blinks when charge or discharge and turns on when charge is completed.  
(The charge lamp in the lower does not blink and does not turns on)

- ⑤ Discharge button : Discharge lamp lights when you push this button, and the discharge of battery begins.

### [How to charge]

- ① It begins charging automatically when you set the battery packing in the charger which beams the power supply lamp.
- ② Leave just as it is until the charge is completed.
- ③ When the charge is completed, the charge lamp is turned off.
- ④ Detach the battery packing from the charger when the charge is completed.

### [Refreshing the battery]

The use time shortens gradually by the phenomenon of “Effect of the memory” when the NiMH battery leaves capacity and repeats the charge. The voltage recovers after refreshing and the use time returns to normal in such a battery. Please refresh one degree every five times of the charge.

#### [Refreshing]

Set the battery in the charger as well as the case of the charge. Push the electrical discharge button. The electrical discharge lamp lights and the electrical discharge begins.

The electrical discharge lamp is turned off when the electrical discharge ends, the charge lamp lights, and the charge starts automatically. Leave just as it is until the charge is completed. When the charge is completed, the charge lamp is turned off. Detach the battery from the charger.

### [Time of refreshing and charge]

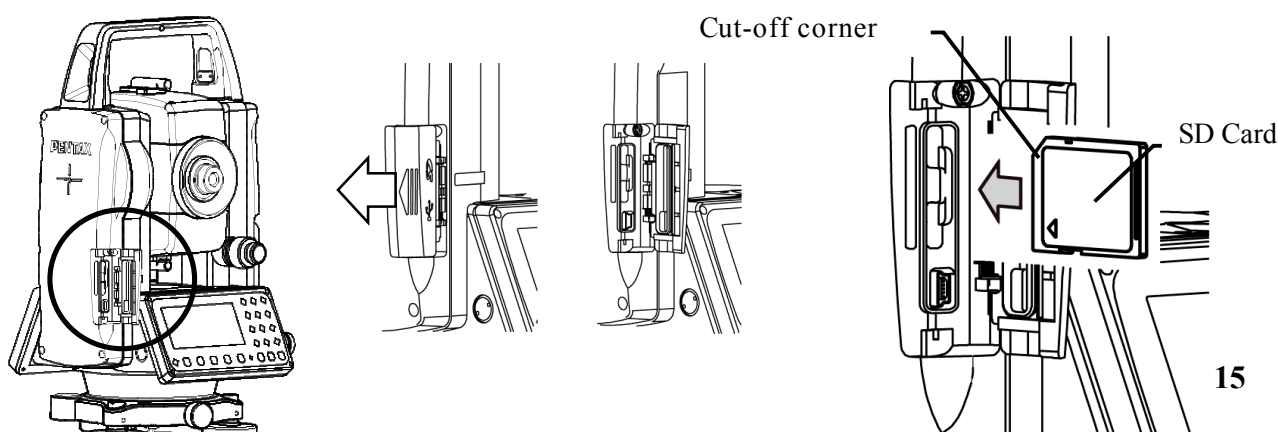
Battery BP02 is discharged from the state of a full charge at about 540 minutes and the charge is completed from the electrical discharge at about 130 minutes. However, the electrical discharge time is proportional to the remainder capacity of the battery. Moreover, the time required for refreshing might be different from the above-mentioned time according to a surrounding temperature and the state of the battery.

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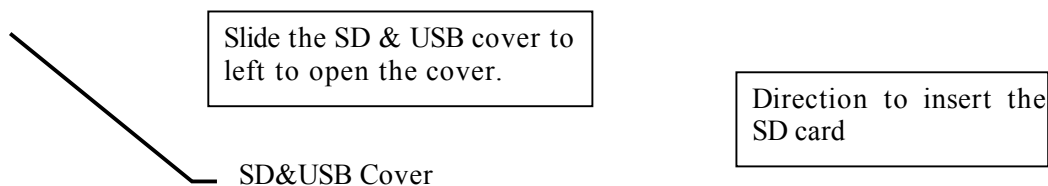
## 1.6 External connections

### [Inserting SD card]

- ① Open the SD & USB cover.
- ② Insert the SD card(The side with terminal should face the instrument and the cut-off corner should be up.)
- ③ Insert the SD card to the end. Be sure not to press the card too hard.
- ④ After the SD card is inserted, close the SD & USB cover completely.







#### [Removing SD card]

- ① Open the SD & USB cover.
- ② Lightly press the SD card slot then release yourself from there.
- ③ The SD card pops up.
- ④ After the SD card is removed, close the SD & USB cover completely.



#### CAUTION

- Be sure to turn the power off before inserting and removing the SD card.
- Be sure to close/open the SD & USB cover and insert/remove the SD card indoors.

#### [Suitability of SD card]

- The SD card that can be used with the instrument is 1GB or less.
- SD card and SD logo is registered trademark.
- The SD cards listed in the following table have been tested by us and it has been confirmed that the SD cards can be used with the R-400V series.



This test has been done with only the Pentax R-400V series Total Station, but no other Pentax Total Stations. When using with other Pentax Total Stations, please contact us to confirm if it works properly.

Also it has been confirmed that the models mentioned in the following table can be used with the R-400V series Total Station, but it has not been confirmed whether other brand SD cards, not mentioned here, can be used with the R-400V series Total Station.

Please note that the test has been done by us and it is not meant that each SD card manufacturer guarantees that the SD cards can be used with the Pentax R-400V series.

#### SD (micro SD) Card

Maker	Model	Capacity
Toshiba	SD-C01GTR	1GB
Toshiba	SD-MD001GA (microSD)	1GB
Panasonic	RP-SDM01GL1A	1GB

Be sure to use the adaptor when using a microSD.

- Regardless of the information here, be aware that all the SDHC cards can't be used with the R-400V Total Stations.
- Test item : The following has been done according to our test standard.
  - ① When data is being sent (with connecting USB), it is necessary to be able to refer to information in the SD card from PC and to operate the file.

- ② When writing / reading text, it is necessary to be able to read/write text file.

[Connecting USB cable]

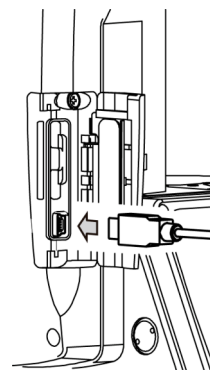
- ① Open the SD & USB cover.
- ② Insert the USB connector into the USB port in the right direction.
- ③ After the USB cable is removed, close the SD & USB cover completely.



CAUTION

**CAUTION**

- Be sure to turn the power off before inserting/removing the USB cable.
- Be sure to open/close the SD & USB cover and insert/remove the USB cable indoors.





## 2.3 Function keys

Display	F. Key	Description
<b>MODE A</b>		
[MEAS]	F1	Pressing this key one time measures the distance in normal mode. Another measurement type can be selected by InitialSetting 2. Pressing this key twice measures the distance in coarse mode. Another measurement type can be selected by initial setting 2.
[TARGET]	F2	Switches the target. REFLECTORLESS / SHEET / PRISM
[0 SET]	F3	Resets the horizontal angle to 0° 0' 0" by pressing twice.
[DISP]	F4	Switches the display composition in the order “H.angle/H.dst./V.dst.”, “H.angle/V.angle/S.dst.” and “H.angle/V.angle/H.dst./S.dst./V.dst.”.
[MODE]	F5	Switches the screen between MODE A and MODE B.
<b>MODE B</b>		
[S.FUNC]	F1	PowerTopoLite Special Functions.
[ANG SET]	F2	Brings up the angle setting screen for setting angle-related parameters. (H.ANGLE /%GRADE, H.ANGLE INPUT and L/R REVERSE)
[HOLD]	F3	Pressing this key twice retains (holds) the horizontal angle shown on the display.
[CORR]	F4	Brings up the screen for changing the target constant, temperature, pressure setting.
[MODE]	F5	Switches the screen between MODE A and MODE B.

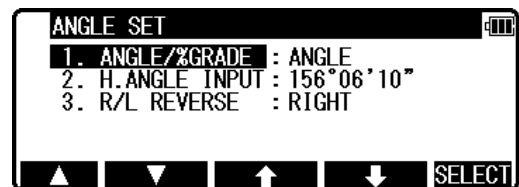
## [Other functions]

⬅	F1	Moves the cursor to the left.
➡	F2	Moves the cursor to the right.
⬆	F3	Moves the cursor up.
⬇	F4	Moves the cursor down.
⬆	F1	Goes back five items on the screen.
⬇	F2	Gose forward five items on the screen.
[RETICLE]	F3	Changing the reticle illumination when pressing illumination key.
[LCD]	F4	Changing the LCD contrast when pressing illumination key.
[ILLU]	F5	Changing the LCD illumination when pressing illumination key.
[CLEAR]	F5	Clear the figure.
[SELECT]	F5	Open the selection window.

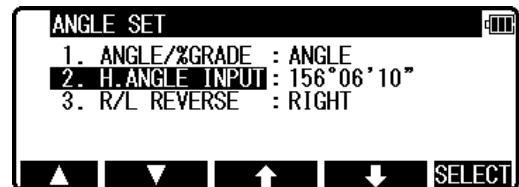
## [How to move the menu number]

Example:

The cursor is located at Menu 1.



Press the numeric key 0 and 2 to move to Menu 2 or press [F4] [⬇ ].



---

## 2.4 Alphanumeric input


The point name is input by the alphanumeric keys as following.

Key	Letter under key	Letter & figure order to input
[0]		[@][.][_][-][:[/][0]
[1]	PQRS	[P][Q][R][S][p][q][r][s][1]
[2]	TUV	[T][U][V][t][u][v][2]
[3]	WXYZ	[W][X][Y][Z][w][x][y][z][3]
[4]	GHI	[G][H][I][g][h][i][4]
[5]	JKL	[J][K][L][j][k][l][5]
[6]	MNO	[M][N][O][m][n][o][6]
[7]		[ ][?][!][_][ ][^][ ][&][7]
[8]	ABC	[A][B][C][a][b][c][8]
[9]	DEF	[D][E][F][d][e][f][9]
[.]		[.][,][:][;][#][( )]
[+/-]		[+][-][*][/][%][=][<][>]

---

## 2.5 LD POINT, Laser pointer

The Laser pointer function turns the laser beam on continuously to become the aiming point so that visual confirmation is possible.

- ① When the [F2] [ RED MARK] key is pressed after pressing the [Laser] key, the Laser pointer function is turned on. The Laser indicator is turned on and the “” mark on the left of the screen blinks while the Laser pointer function is operating.
  - ② If the [Laser] key is pressed and the [F2] [RED MARK] key is pressed while the Laser pointer function is operating, the Laser pointer function is turned off.
- The beam of the sun is strong and visual confirmation is difficult in daytime when outdoors.
  - The laser beam is designed not to be able to observe through the telescope.
  - Please visually align the laser beam to the target and mark the centre.  
Confirm the alignment (horizontal and vertical ) before measuring when performing accurate work like stake out when using the Laser pointer function.  
Also refer to “11.9 The EDM beam axis”.
  - Please do not look at the laser source of beam directly.

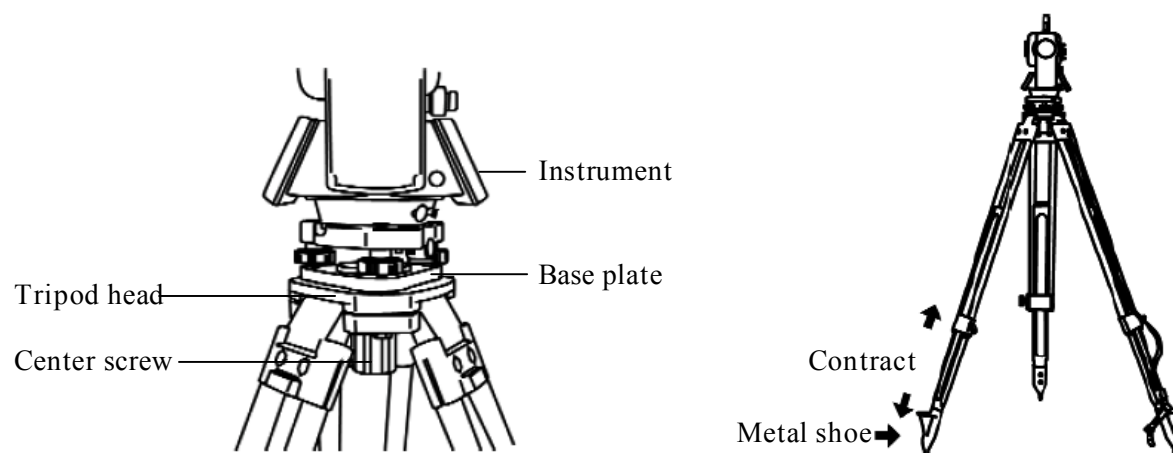
## 3. PREPARATION FOR SURVEYING

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### 3.1 Centring and Levelling of the Instrument

#### [Setting up the instrument and the tripod]

- ① Adjust the tripod legs so that a height suitable for observation is obtained when the instrument is set on the tripod.
- ② Hang the plumb bob on the hook of the tripod, and coarse centre over the station on the ground. At this time, set the tripod and fix the metal shoes firmly into the ground so that the tripod head is as levelled as possible.
- ③ If the tripod head is mis-levelled by the action of fixing the metal shoes into the ground, correct the level by extending or retracting each leg of the tripod.



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### 3.2 Laser plummet

#### [Laser plummet model]

The instrument is equipped with the laser plummet. The laser plummet is not set to be ON at factory shipping. The laser plummet operation of power supply ON can be set by command No.520, LD PLUM. For using Command number, refer to “9.2 Accessing by 007”.

#### [For the Detaching type laser plummet equipment model]

Turn on the laser plummet function by pushing the [Laser] key and [F4] [PLUM.ADJ] key. Match the position with the leveling screw so that the laser mark coincides with the ground mark.

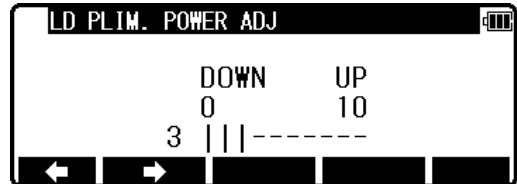
#### [For the Shift type laser plummet equipment model]

- Turn on the laser plummet function by pushing the [Laser] key and [F4] [PLUM.ADJ] key.
- Match the position by the tripod so that the laser mark coincides with the ground mark.
- The centring knob is loosened, and the upper plate is pushed by the tip of a finger, and a centre mark is matched to the ground mark.
- Tighten the centring knob.
- Loosen the horizontal clamp screw, rotate the instrument by 90°, and confirm the vial of the circular vial is at the centre position.  
Correct the vial with the leveling screw when the vial comes off from the centre position.

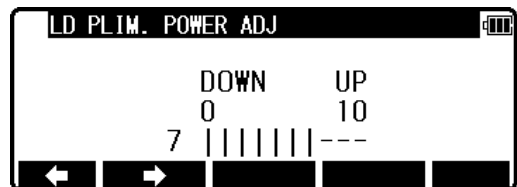
### [Brightness adjustment of laser]

Sometimes the state of the surface of the ground mark or a surrounding environmental does not allow observing the laser spot easily. Please adjust the brightness of the laser if necessary.

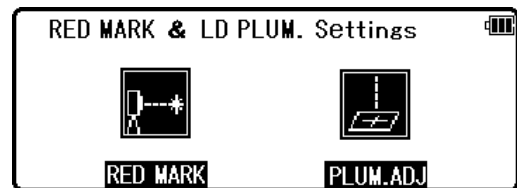
If [Laser] + [F4] [PLUM.ADJ] are pressed in due course., the brightness adjustment screen of the laser plummet device, is displayed.



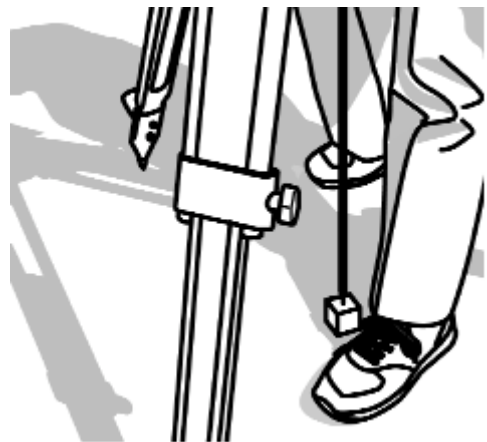
The Laser plummet becomes darker or brighter by pressing [F1] [←] / [F2] [→] key.



The adjustment is completed with the [ENT] key and it returns to RED MARK & LD PLUM. Settings screen.



- The brightness adjustment step of the laser is 10 steps.
- The laser plummet spot can become difficult to see in bright sunlight which makes it difficult to perform the occasional check. In this case, use your foot or the carrying case to make a shadow over the laser position.
- The laser plummet is adjusted to be within  $\pm 0.5\text{mm}$  at the instrument height of 1.5m at factory shipping.
- Please double check the amount of the gap (direction of X and Y direction) by laser plummet with the amount of the gap by plumb bomb etc. When working accurately you should put out a perpendicular direction using the laser plummet function.
- Please do not look at the laser source of beam directly.





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### 3.3 Levelling with circular vial

Tripod is adjusted according to the following points by extending or contracting the legs so that the bubble of the Circular vial goes to the centre of the circle.

- Shorten the leg at the side of the bubble or extend the leg opposite of the bubble to position the bubble in the centre of the vial circle.
  - All three legs are extended or contracted until the bubble is in the centre.
- During this process, the foot is not placed on the tripod leg point and the position of the tripod points do not change.

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### 3.4 Levelling with the plate vial

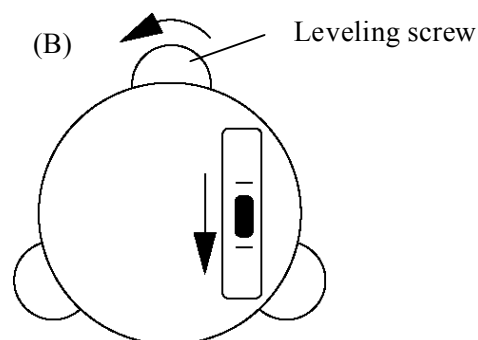
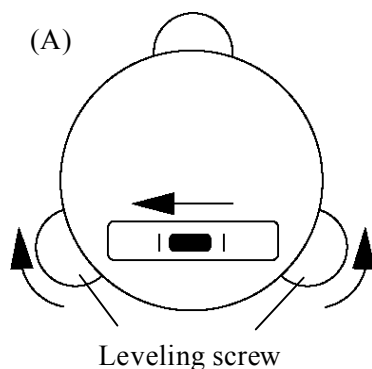
(A) Align the plate vial in parallel with a line joining any two of the levelling screws.

Then, adjust the two screws to centre the bubble in the plate vial.

- Turn two levelling screws in an opposite direction mutually in a way that the bubble moves from the side of the plate vial to the centre.

(B) Rotate the total station  $90^\circ$ .

- Use the remaining screw to centre the bubble in the plate vial.
- Rotate the instrument by  $90^\circ$  and  $180^\circ$  and confirm the position of the bubble in the plate vial. At this time, it is not necessary to adjust it if the bubble of the plate vial is in the vicinity of the centre.



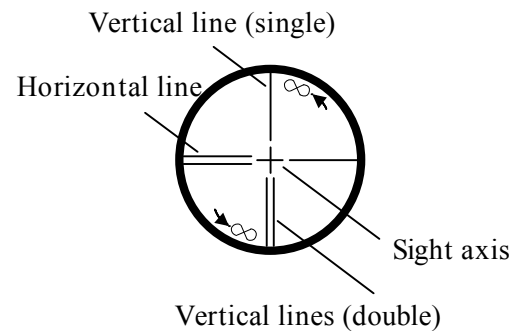
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## 3.5 Eyepiece adjustment

### [Eyepiece adjustment]

The eyepiece adjustment is performed before target sighting.

- ① Remove the telescope lens cap.
- ② Point the telescope at a bright object, and rotate the eyepiece ring full counter clockwise.
- ③ Look through the eyepiece, and rotate the eyepiece ring clockwise until the reticle appears at its maximum sharpness.
  - When looking into the eyepiece, avoid an intense look to prevent parallax and eye fatigue.
  - When it is hard to see the reticle due to poor brightness, press [ILLU] + [F3] [RETICLE] to access the RETICLE INTENSITY ADJ. screen. Use the left and right arrow to adjust the reticle intensity.

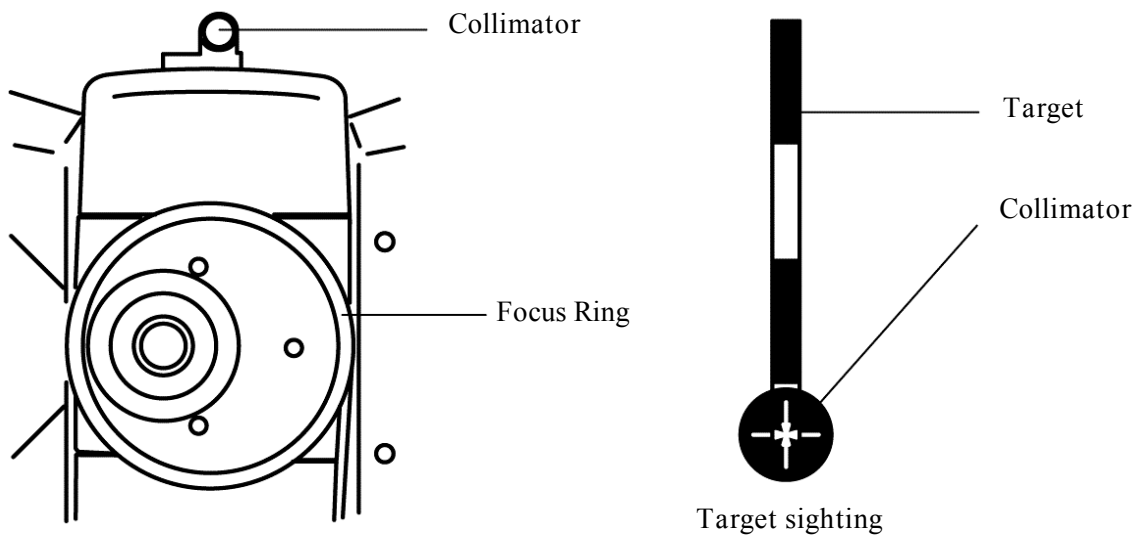


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## 3.6 Target sighting

### [Target sighting by Manual focus]

- ① Loosen the telescope clamp and horizontal clamp screws.
- ② Point the telescope at the target using a collimator.
- ③ Tighten the above two screws.
- ④ Adjust the eyepiece.
- ⑤ Look through the telescope and then rotate the Focus ring and stop it where the target can be clearly seen and the target image does not move in relation to reticle even if your eye is vertically and horizontally moved.
- ⑥ Align the reticle accurately on the target using telescope and horizontal tangent screws.



- The Focus ring rotation “clockwise” makes it possible to focus on closer objects and “counter clockwise” will focus on further objects.

---

### 3.7 Attachment and detachment of tribrach

The tribrach of R-422VN, R-423VN, and R-425VN can be detached from the instrument, if required when replacing the instrument with a prism for example.

#### [Detachment]

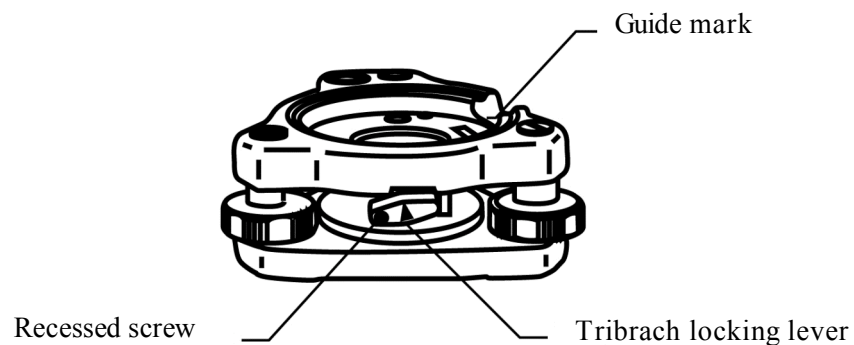
First loosen the recessed screw with a screwdriver, then rotate the locking knob until the arrow points upward, and lift the instrument up.

#### [Attachment]

Mount the instrument on the tribrach with the guide marks coinciding, and rotate the locking knob until the arrow points downwards.

The guide and guide mark must be fitted to attach the instrument.

When the tribrach does not need to be attached or detached, or the instrument is to be transported, tighten the recessed screw with a screwdriver to fix the locking knob.



## 4. TURNING THE POWER ON

### 4.1 Turning the power on and off

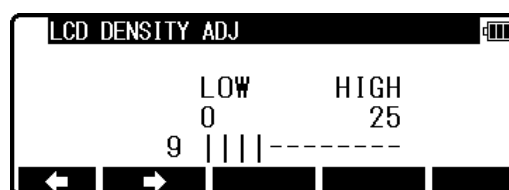
To set power on: ① To shut down: ①

To turn the power supply off, press the I/O key for more than 1 second and then release it. Power turns OFF.

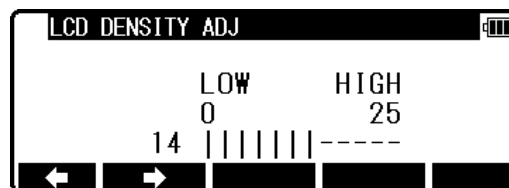
**NOTE:** The power is automatically turned off after 10 minutes of inactivity (Factory default setting).

### 4.2 Adjusting LCD contrast

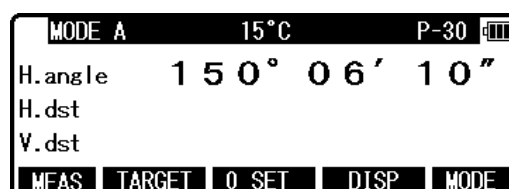
Press [F4] while holding down the Illumination key to access the screen for adjusting LCD contrast.



Pressing the [F1] [↵] will lighten the contrast, while pressing the [F2] [⇒] will darken the contrast.



Press [ENT] to exit adjustment mode and return to the previous screen.

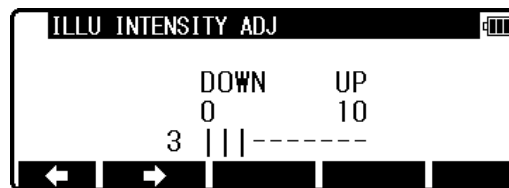


- Pressing the Illumination key views the [F3] [RETICLE], [F4] [LCD] and [F5] [ILLU].
- LCD contrast may be adjusted as necessary at any time.
- The contrast may be adjusted to any one of 25 levels.
- LCD contrast may be unappealing under certain environmental conditions such as high temperature. Adjust the LCD contrast as described above in such situations.

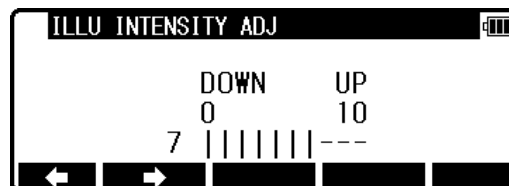
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## 4.3 Adjusting illumination brightness

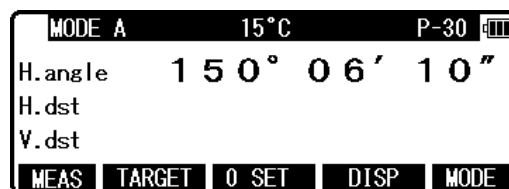
Press [F5] while holding down the Illumination key to access the screen for adjusting illumination brightness.



Pressing the [F1] [↵] will decrease brightness, while pressing the [F2] [⇒] will increase brightness.



Press [ENT] to exit adjustment mode and return to the previous screen.



- Pressing the Illumination key views the [F3] [RETICLE], [F4] [LCD] and [F5] [ILLU].
- Illumination brightness of the LCD screen and telescope reticle may be adjusted as necessary at any time.
- Illumination brightness may be adjusted to any one of 10 levels.

---

## 4.4 Adjusting reticle illumination

Press [F3] while holding down the Illumination key to access the screen for adjusting reticle illumination. The procedure to adjust the reticle illumination is the same way as 4.3.

- Pressing the Illumination key views the [F3] [RETICLE], [F4] [LCD] and [F5] [ILLU].

## 5. ANGLE MEASUREMENT

### 5.1 Measuring an angle

Aim at the first target, then press [F3] [0 SET] twice in succession to reset the horizontal angle to 0.

MODE A	15°C	P-30	
H. angle	0°	00'	00"
H. dst			
V. dst			
MEAS	TARGET	0 SET	DISP MODE

Aim at the second target, then read the horizontal angle.

MODE A	15°C	P-30	
H. angle	60°	30'	20"
H. dst			
V. dst			
MEAS	TARGET	0 SET	DISP MODE

Pressing [F4] [DISP] displays the vertical angle.

MODE A	15°C	P-30	
H. angle	60°	30'	20"
V. angle	87°	05'	40"
S. dst			
MEAS	TARGET	0 SET	DISP MODE

- The [F3] [0 SET] key cannot reset the vertical angle to 0.
- Pressing the [F4] [DISP] key cycles through the sets of display items :  
“H.angle/H.dst/V.dst.”, “H.angle/V.angle/S.dst.”, and  
“H.angle/V.angle/H.dst./S.dst./V.dst.”.
- Even though you turn the power off during a survey, the horizontal angle displayed last time is saved, so that it is restored when the power is turned on next time.
- When the restored horizontal angle is not necessary, reset it to 0.

### 5.2 Resetting the horizontal angle to 0

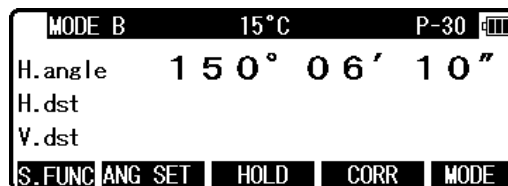
Pressing [F3] [0 SET] twice in succession resets the horizontal angle to 0° 0' 0".

MODE A	15°C	P-30	
H. angle	0°	00'	00"
H. dst			
V. dst			
MEAS	TARGET	0 SET	DISP MODE

- The [F3] [0 SET] cannot reset the vertical angle to 0.
- Pressing the [F3] [0 SET] accidentally during measurement does not reset the horizontal angle to 0 unless you press it again. Once the buzzer stops sounding, you can go to the next step.
- You can reset the horizontal angle to 0 any time except when it has been held.

## 5.3 Holding the horizontal angle

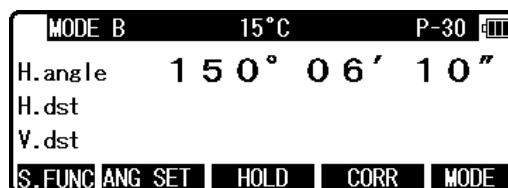
To hold the horizontal angle currently being displayed, press [F3] [HOLD] twice in succession. The horizontal angle value is displayed in reverse video when being held.



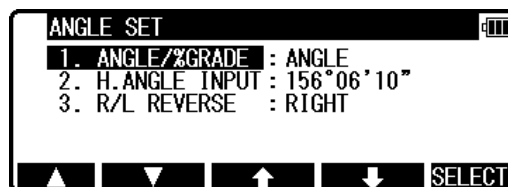
- If you want to hold the horizontal angle when you are in MODE A, press [F5] [MODE] first to switch to MODE B, then press [F3] [HOLD].
- The [F3] [HOLD] cannot hold the vertical angle or distance.
- To release the horizontal angle from being held, press [F3] [HOLD] once.
- Pressing [F3] [HOLD] accidentally during measurement does not hold the horizontal angle unless you press it again. Once the buzzer stops sounding you can go to the next step.

## 5.4 Inputting an arbitrary horizontal angle

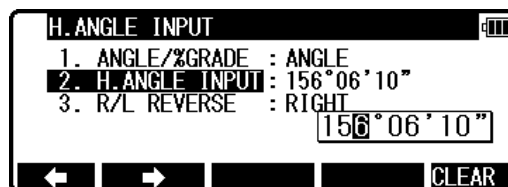
In case of Horizontal angle 123° 45' 20" input.  
Press [F5] [MODE] to enter MODE B.



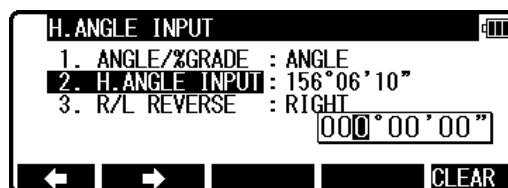
Press [F2] [ANG SET] to display the ANGLE SET screen, then press [F4] [↓] to move the cursor to "2. H.ANGLE INPUT".



Press [F5] [SELECT] to open the horizontal angle input window.

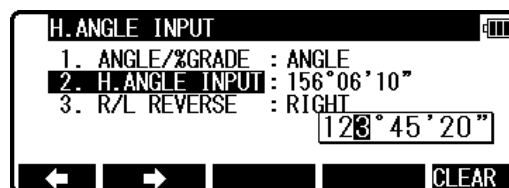


[F5] [CLEAR] is used to clear the values.





Press the numeric key as 123.4520.



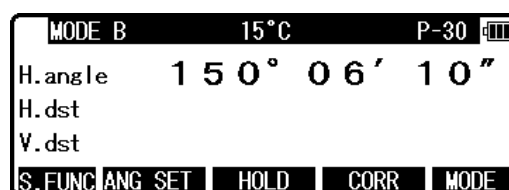
Press the [ENT] key to accept the horizontal angle set to 123° 45' 20" and change the screen to MODE A.

- The former data is called by pressing the [CLEAR] key again.

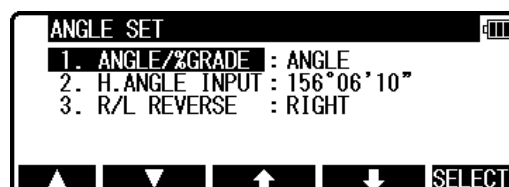


## 5.5 Displaying the slope % of the vertical angle

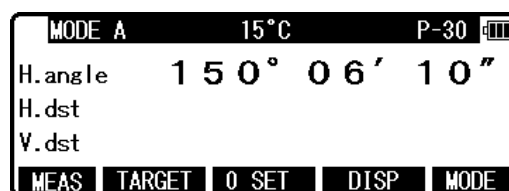
Press [F5] [MODE] to enter MODE B.



Press [F2] [ANG SET] to display the ANGLE SET screen.



Press the [F5] [SELECT] to change the screen to display the slope % of Vertical angle.



Press [F4] [DISP] to display the slope value in %.

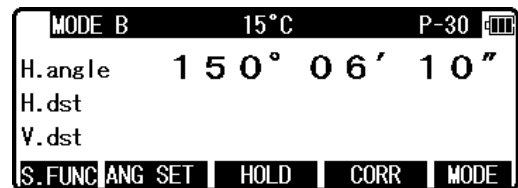


- The 0% represents the horizontal 0, and +100% and -100% represent 45° up and down slopes respectively.

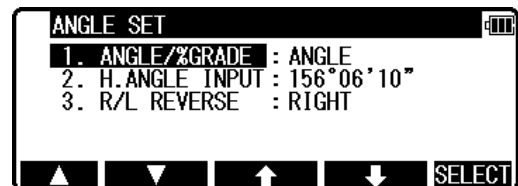
- To return the screen from the slope (%) display to the 360° scale, also take above same steps by entering MODE B.
- If the slope (%) exceeds [+/-] 1000%, “Out of grade range” is displayed, indicating that the current vertical angle cannot be measured.
- When the telescope returns to a slope within slope [+/-] 1000%, the slope (%) display returns automatically from the “Out of grade range” message to the numeric value.

## 5.6 Changing the horizontal angle from clockwise to counter clockwise

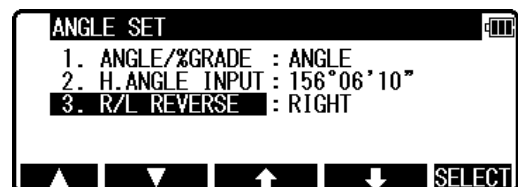
Press [F5] [MODE] to enter MODE B.



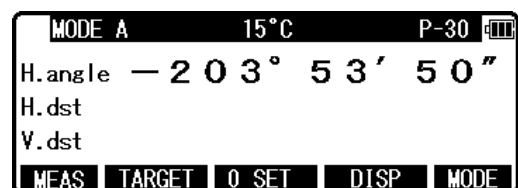
Press [F2] [ANG SET] to display the ANGLE SET screen.



Press [F4] [↓] to move the cursor to “3. R/L REVERSE”.



Press [F5] [SELECT] to add a minus sign (-) to the horizontal angle value as a counter clockwise angle.

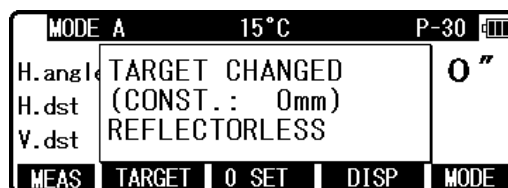


- To return the horizontal angle from counter clockwise to clockwise, also take the above same procedures, press [F5] [SELECT] to select the clockwise angle.
- When the counter clockwise horizontal angle is selected, the order of aiming at the targets becomes the reverse (the right one first, then the left one) of the order for the clockwise angle.

## 6. DISTANCE MEASUREMENT

### 6.1 Target setting

The target mode and its Constant of current setting are shown at the left of the battery mark. For example in case of each Constant 0, Reflectorless (Non-Prism); N 0, Prism; P 0



Pressing [F2] [TARGET] changes the target mode.

- The target mode is changed sequentially as follows.  
Reflector sheet - Prism - Reflectorless
- The selected target mode is stored in the memory even if the power is turned off.  
So, next time you can use the same mode after turning on.
- The target Constant differs according to the selected target mode. So, confirm the target mode and its Constant shown at the top screen after changing the target.

#### [Distance measurement by reflectorless (Non-Prism) mode]

- The measurement range and accuracy of Reflectorless are based on the condition that laser beam is emitted perpendicular to the white side of the Kodak Gray Card. The measurement range may be influenced by the shape of the target and its environment. There is a possibility that the range may vary when the target does not satisfy the conditions above at survey work.
  - Pay attention to the following in case of distance measurement by Reflectorless.  
In case of resulting in low accuracy, perform the distance measurement by Prism.
  - The CODE number 521 [LONG RANGE MES.] shows ON/OFF.
  - The WARNING (Laser Power) screen is displayed when Message ON is selected, and then [F1] [MEAS] key is pressed.
  - Pressing [F1] [MEAS] one time selects "Second MEAS setting" and twice selects "QUIT".
- ① There is a possibility that correct distance measurement may be impossible by dispersion or reduction of laser beam when the laser beam comes into the target from diagonal angle.
  - ② There is a possibility that the instrument cannot calculate correctly when receiving reflected laser beam from forth and back directions in case of measuring the target on the road.
  - ③ There is a possibility that synthesized values are calculated and the distance may become longer or shorter than the actual one when the operator measures the target of slope or sphere or rugged shape.
  - ④ There is a possibility that the instrument cannot calculate correctly collecting the reflected laser beam from a man or a car that comes and goes in front of the target.

#### [Distance measurement by reflector sheet mode]

Position the Reflector sheet whose reflecting surface faces the aiming line to be approx. right angle when the distance is measured by it. If it is positioned not to be approx.

right angle, there is a possibility that correct distance measurement may be impossible by dispersion or reduction of laser beam.

### [Applied measurement range by each target mode]

- When a wrong target mode is selected, a correct distance cannot be measured.  
Please select a correct target mode and measure.
- It is sometimes possible to measure without prism under special conditions like in the close distance, targeting on a wall surface. However, there is a possibility including some errors in this case, so be sure to select the reflectorless mode.
- The target constant should be correctly selected and confirmed in case that the reflector sheet is used at the prism mode and the prism is used at the reflector sheet mode.

## 6.2 Distance measurement

The R-400V series has two distance measurement modes of primary MEAS and second MEAS. Pressing the [F1] [MEAS] one time goes to primary MEAS and twice goes to second MEAS.

You can freely select and allocate your desired measurement mode in primary MEAS and second MEAS by the initial setting 2. The “MEASURE SHOT” is set at primary MEAS and “TRACK CONT” is set at second MEAS as a factory default setting.

- MEASURE SHOT means the distance measurement by the shot mode.
- MEASURE CONT means the distance measurement by the continuous mode.
- TRACK SHOT means the fast distance measurement by the shot mode.
- TRACK CONT means the fast distance measurement by the continuous mode.

Confirm the target constant before beginning the distance measurement.

### Example: “MEASURE SHOT” at primary MEAS (Factory default setting)

Collimate the telescope at a target and press the [F1] [MEAS] once to start measuring the distance. Once distance measurement has been started, the distance measurement mark remains displayed. Upon reception of a reflected light from the target, the instrument beeps and displays the mark to start the shot measurement automatically.

* MODE A	15°C	P-30	
H. angle	150°	06'	10"
H. dst			
V. dst	SHOT	(( (  ) ) )	
MEAS	TARGET	0 SET	DISP MODE

- If the instrument is in MODE B, press the [F5] [MODE] to switch to MODE A and press [F1] [MEAS].
- Pressing the [F1] [MEAS] after collimating the telescope at the prism starts shot distance measurement with the “MEAS” text blinking. Distance measurement is completed and the “MEAS” text stops blinking the moment the distance measured by shot measurement is displayed. During continuous measurement, the “MEAS” text keeps on blinking. Pressing the [F1] [MEAS] again terminates both distance measurement and blinking of the “MEAS” text.
- Pressing [F4] [DISP] cycles through the sets of display items: “H. angle/H. dst./V. dst.”, “H. angle/V. angle/S. dst.”, and “H. angle/V. angle/H. dst./S. dst./V. dst.”
- Pressing the [ESC] or [F2] [TARGET] or [F5] [MODE] during distance measurement stops it.



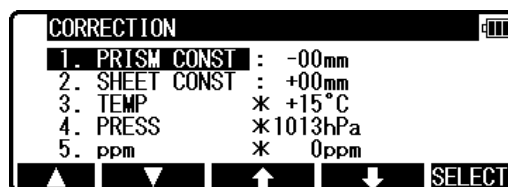
## 7. CORRECTION MODE

### 7.1 Changing the target constant

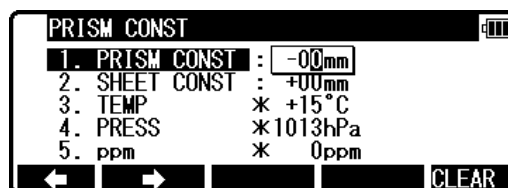
Changing the Target Constant can be performed only when the Reflector sheet and Prism Constant setting are “INPUT” in initial setting 1.

Example: Prism Constant -25mm setting

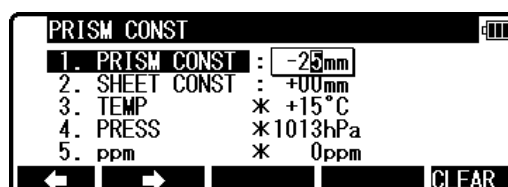
Press [F4] [CORR] in MODE B.  
(If the instrument is in MODE A,  
press [F5] [MODE] to enter MODE B.)



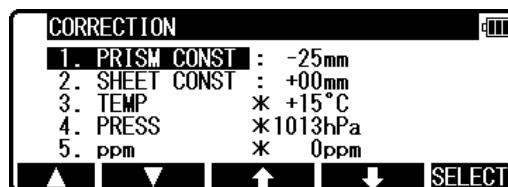
Press the [F5] [SELECT] to enable  
the Prism Constant to be changed.



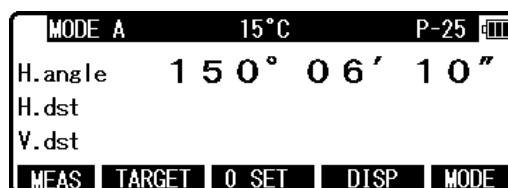
Clear the exiting values by pressing [F5] [CLEAR].  
Input -25 by pressing the numeric keys.



Press the [ENT] key to accept the Prism  
Constant to -25mm.



Pressing the [ENT] key returns the instrument  
to MODE A.



- To set the Reflector sheet constant to “0mm” select “0mm” for “SHEET CONST” in “initial setting 1”.
- To set the Prism constant to “0mm” or “-30mm” select “0mm” for “PRISM CONST” in “initial setting 1”.
- When the “Sheet Constant” has been set to “0mm” in “initial setting 1” and “PRISM CONST” has been set to “0mm” or “-30mm”, “\*” is displayed to the left of “0mm” or “30mm” on the correction menu screen. When “\*” is on the screen, the Constant cannot be changed (by entering a numeric key).
- Once set, the Reflector sheet Constant and Prism Constant remain on the measurement screen as “S 0” or “P 0”.

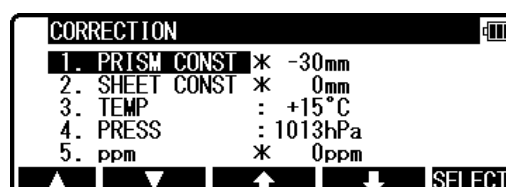
- The factory initial of Reflector sheet Constant and Prism Constant are 0.
- Once set, each Constant remains in memory even after the power is turned off.

## 7.2 Changing the temperature

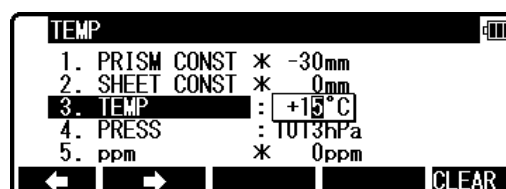
The temperature setting can be changed only when “ATM CORR” has been set to “ATM INPUT” in “initial setting 1”.

Example: Setting the temperature to +22°C

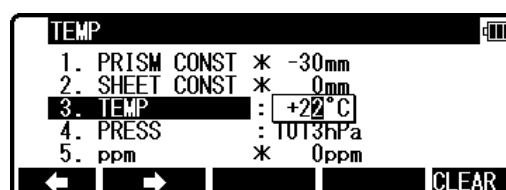
Press [F4] [CORR] in MODE B.  
(If the instrument is in MODE A,  
press [F5] [MODE] to enter MODE B.)



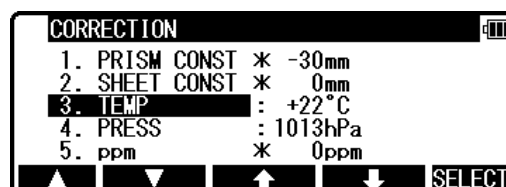
Press [F4] [↵] to move the cursor to “3.TEMP”  
and press the [F5] [SELECT] to enable the  
temperature to be changed.



Clear the exiting values by pressing [F5] [CLEAR].  
Input 22 by pressing the numeric keys.



Press the [ENT] key to accept the  
temperature to +22°C.



Pressing the [ENT] key returns the instrument to  
MODE A.



- The valid range of Temperature input is from -30°C to +60°C.
- When “ATM CORR” in “initial setting 1” has been set to “4. NIL”, “\*” is displayed to the left of the temperature value on the correction menu screen. When “\*” is on the screen, the temperature cannot be changed. If “ATM CORR” in “initial setting 1” has been set to “3. ppm INPUT”, no temperature is displayed on the correction menu screen.
- Once set, the temperature is displayed at the centre of the top of the measurement screen.
- The factory initial of temperature is “+15°C”.
- Once set, the temperature remains in memory even after the power is turned off.

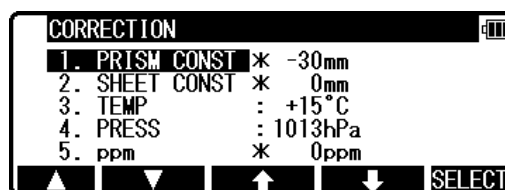
- Temperature correction is based on 15°C.  
If this instrument is used without correcting the temperature, a distance error per 100m is about -0.1mm per +1°C as a temperature difference from 15°C.  
A distance error per 100m is about 0.1mm per -1°C as a temperature difference from 15°C.  
(For more accurate values, See “12.4 Error when no atmospheric correction is made”.)

## 7.3 Changing the atmospheric pressure

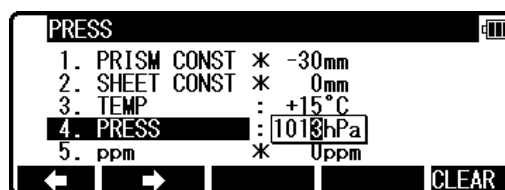
The atmospheric pressure setting can be changed only when “ATM CORR” has been set to “ATM INPUT” in “initial setting 1”.

Example: Setting the pressure to 900hPa

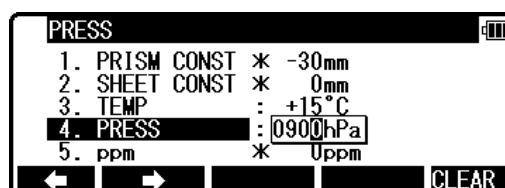
Press [F4] [CORR] in MODE B.  
(If the instrument is in MODE A,  
press [F5] [MODE] to enter MODE B.)



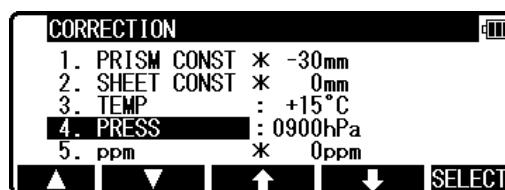
Press [F4] [↵] to move the cursor to “4.PRESS”  
and press the [F5] [SELECT] to enable  
the temperature to be changed.



Clear the exiting values by pressing [F5] [CLEAR].  
Input 900 by pressing the numeric keys.



Press the [ENT] key to accept the  
PRESS to 900hPa.



Pressing the [ENT] key returns  
the instrument to MODE A.



- The valid range of Pressure input is from 600 to 1120hPa (420 - 840mmHg) .
- When “Atmospheric Correction” in “initial setting 1” has been set to “3. NIL”, “\*” is displayed to the left of the pressure value on the correction menu screen.  
When “\*” is on the screen, the pressure cannot be changed.  
If “ATM CORR” in “initial setting 1” has been set to “2.ppm INPUT”, no pressure is displayed on the correction menu screen.



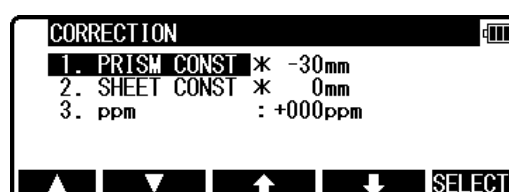
- Once set, the pressure is displayed at the centre of the top of the measurement screen.
- The factory initial of pressure is “1013hPa”.
- Once set, the pressure remains in memory even after the power is turned off.
- Pressure correction is based on 1013 hectopascals (hPa).
- If this instrument is used without correcting the pressure, a distance error per 100m is about -0.3mm per -10hPa as a pressure difference from 1013hPa.  
(For more accurate values, see “12.4 Error when no atmospheric correction is made”.)

## 7.4 Changing the ppm value

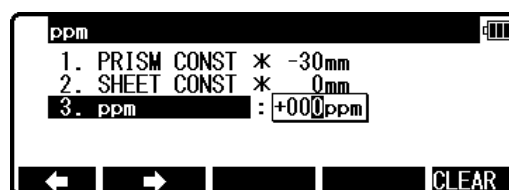
The ppm value can be changed only when “ATM CORR” has been set to “ppm INPUT” in “initial setting 1”. “TEMP” and “PRESS” are not displayed.

Example: Setting the ppm value to 31 ppm.

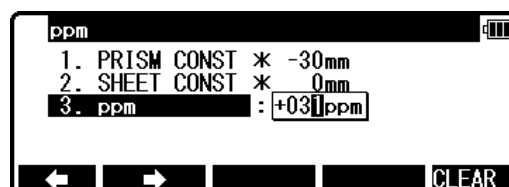
Press [F4] [CORR] in MODE B.



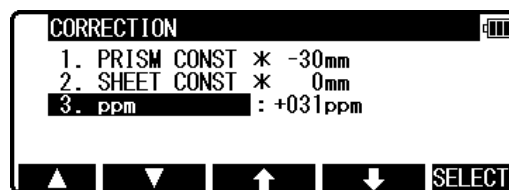
Press [F4] [↵] to move the cursor to “3. ppm” and press the [F5] [SELECT] to enable the temperature to be changed.



Clear the exiting values by pressing [F5] [CLEAR].  
Input 31 by pressing the numeric keys.



Press the [ENT] key to accept the PPM to 31ppm.



Pressing the [ENT] key returns the instrument to MODE A.



- The valid range of ppm values is from -199 to +199.
- Once set, the ppm value is displayed at the centre of the top of the measurement screen.
- The factory initial of ppm value is “0”.
- Once set, the ppm value remains in memory even after the power is turned off.

## 8. INITIAL SETTING

### 8.1 Overview

For the R-400V series, you can select and save the desired setting for a variety of prescribed instrument conditions, called initial setting.

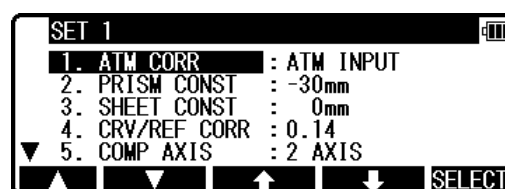
The Initial Setting is saved in five modes, “initial setting 1”, “initial setting 2”, “initial setting 3”, “initial setting 4”, and “initial setting 5” in which you can select and save the instrument conditions described below.

The factory default for each of these conditions is marked by   .

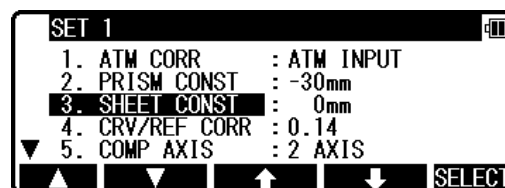
To change initial setting, follow the operating procedures for entering each initial setting mode in “8.2” and the operating procedures for changing an initial setting in “8.2”.

### 8.2 Entering the mode for initial setting 1

Press the [POWER] key while holding [F1] key down to access the screen for initial setting 1.



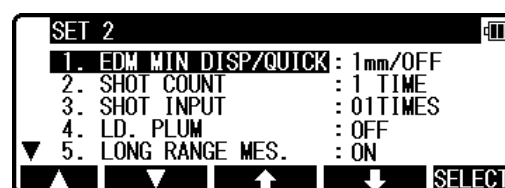
- Pressing [F1] [  $\triangle$  ] scrolls it up five items; pressing [F2] [  $\nabla$  ] scrolls the screen down five items.
- Press [F3] [  $\uparrow$  ] or [F4] [  $\downarrow$  ] to position the cursor at the item of interest.



### 8.3 Entering the mode for initial setting 2

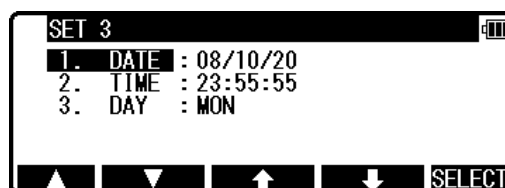
Press the [POWER] key while holding [F2] key down to access the screen for initial setting 2.

- Select the item of interest in the same way as in the mode for initial setting 2.



### 8.4 Entering the mode for initial setting 3

Press the [POWER] key while holding [F3] key down to access the screen for initial setting 3.

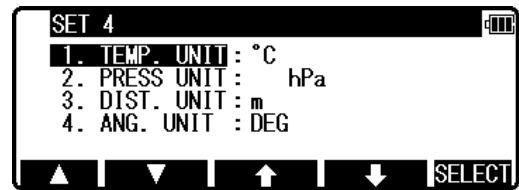


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## 8.5 Entering the mode for initial setting 4

Press the [POWER] key while holding [F4] key down to access the screen for initial setting 4.

- Select the item of interest in the same way as in the mode for initial setting 4.

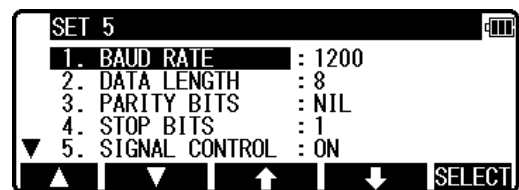


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## 8.6 Entering the mode for initial setting 5

Press the [POWER] key while holding [F5] key down to access the screen for initial setting 5.

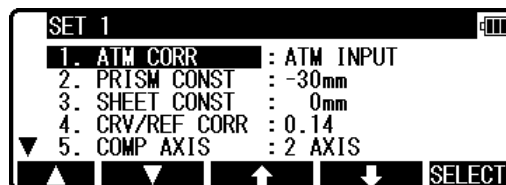
- Select the item of interest in the same way as in the mode for initial setting 5.



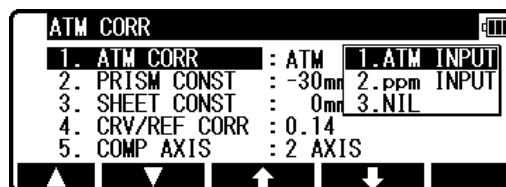
## 8.7 Example of changing an initial setting content (selection of atmospheric correction)

This section describes the operating procedures for selecting “1.ATM CORR” in initial setting 1 as an example of changing an initial setting content. Use this example as a reference when changing other items because it is also applicable to the operating procedures for changing them.

Access the screen for initial setting 1 by taking procedures “8.2 Enter the mode for initial setting 1”.

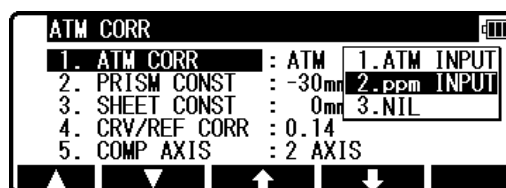


Press [F5] [SELECT] to open the screen for selecting the atmospheric correction.

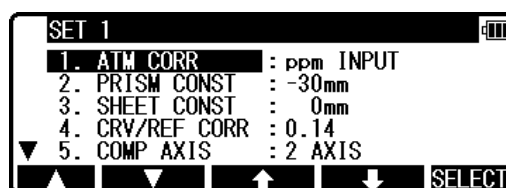


Press [F3] [↑] or [F4] [↓] to position the cursor at the desired item, then press [ENT] key to select that item.

Pressing the [ENT] key selects the change of selected item. Pressing the [ESC] key invalidates the change of selected item.



Pressing again the [ESC] key or [ENT] key quits the initial setting screen and usual start screen appears.

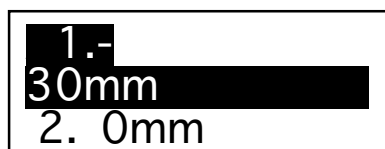


## 8.8 Initial setting 1

1. Selection of **Atmospheric Correction**: [ATM CORR]  
Select whether Atmospheric Correction is to be performed by entering the atmospheric temperature and pressure, by entering ppm value, or by fixing the ppm value to 0 (NIL) not to perform Atmospheric Correction.



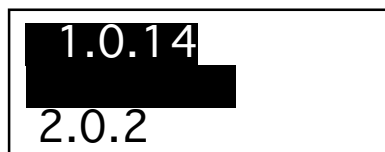
2. Selection of **Prism Constant**: [PRISM CONST.]  
Select whether the Prism Constant to be input is set to 0mm, -30mm or to an arbitrary value to be entered from the keyboard.



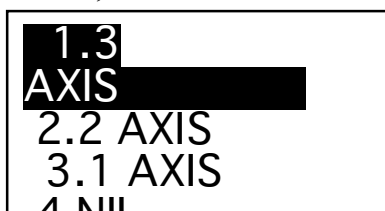
3. Selection for **Reflector sheet Constant**: [SHEET CONST]  
Select whether the target constant to be input is set to 0mm, or to an arbitrary value to be entered from the keyboard.



4. Selection for **Refraction & Curvature Corrections**: [CRV/REF CORR]  
Select whether the correction factor to be input for both differences (Refraction, Curvature) is set to 0.14, 0.2 or none (NIL). Selecting "3. NIL" results in no correction of both values.



5. Selection of **Tilt Compensation**: [COMP AXIS]  
Select whether Tilt Compensation is to be single-axis compensation, dual-axis compensation or disabled (NIL).  
R-422VN is selectable up to 3 AXIS.  
R-423VN, R-425VN, R-435VN are selectable up to 2 AXIS.  
The figure on the right shows that 3 AXIS is selected on R-422VN.



6. Selection of **Atmospheric corrections display**: [ATM CORR DISP]  
Select whether to display the atmospheric corrections in the title bar of the measure screens or not.

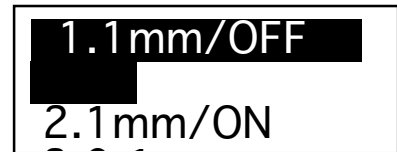


- The factory default for each instrument condition is marked by ☐ .

## 8.9 Initial setting 2

1. Selection of the **Minimum Distance measurement unit and Quick Mode** : [EDM MIN DISP/QUICK]

More fine angle view is necessary, select 0.1mm,  
Besides that, select 1mm/OFF.  
When using Quick Mode, select 1mm/ON.



2. Selection of the **Shot count**: [SHOT COUNT]  
Select whether the shot count for Shot distance measurement is to be 1, 3, 5 or an arbitrary count to be entered.



3. Setting the **Shot input**: [SHOT INPUT]  
Set the shot number for Shot distance measurement.



- The valid range of values for the shot number is from 1 to 99.
- This setting is enabled only when the shot number (Above 2.) has been set to “4. INPUT”.

4. Selection of **Laser plummet** : [LD PLUM.]  
Laser plumb ON/OFF is selected.



5. Selection of **Long range message** : [LONG RANGE MES.]  
If you need the long range message.



6. Selection of **primary MEAS setting** : [PRIM. MEAS KEY]  
Select whether the primary distance measurement is MEAS SHOT or MEAS CONT or TRACK SHOT or TRACK CONT.



7. Selection of **second MEAS setting** : [SEC. MEAS KEY]  
Select whether the second distance measurement is TRACK CONT or TRACK SHOT or MEAS CONT or MEAS SHOT.



8. Selection of **Minimum angle display**: [MIN UNIT ANG.]  
Select whether to set the minimum angle display mode to “COARSE (5 seconds)” or “FINE (1 second)”.



9. Selection of **Vertical angle style**: [V.ANG. STYLE]  
Select whether the 0 point for vertical angle is set to be “Z.0”, “H.0” or “COMPAS”.

1.Z.0  
2.H.0  
3.COMPAS

10. Selection of **Automatic power-off function**  
: [AUTO OFF]  
Select the time interval (10, 20 or 30 minutes) for activating the automatic power-off function, or select NIL, disabling the function.

1.10 MIN  
2.20 MIN  
3.30 MIN  
4.NIL

- The automatic power-off function automatically turns the power supply off after the specified period of time (in minutes) when no operation for distance measurement or for key entry has been performed with the angle remaining unchanged.

11. Selection of **Distance measurement automatic power-off function**: [EDM OFF]  
Select the time interval (3, 5, or 10 minutes) for activating the distance measurement automatic power-off function, or select NIL, disabling the function.

1.3 MIN  
2.5 MIN  
3.10 MIN  
4.NIL

12. Selection of **Automatic illumination power-off function**  
: [ILLU. OFF]  
Select the time interval (3, 5, or 10 minutes) for activating the automatic illumination power-off function, or select NIL, disabling the function.

1.3 MIN  
2.5 MIN  
3.10 MIN  
4.NIL

13. Selection of **Distance measurement buzzer**  
: [DIST. BUZ]  
Select whether to enable or disable the beep when the prism receives a light during distance measurement or during repeated distance measurement.

1.ON

14. Selection for **H.angle 90° buzzer**: [QUAD. BUZ]  
Select whether to enable or disable the beep at every 90° during angle measurement.

1.OFF

15. Selection of **Distance measurement signal**  
: [MEAS. SIGNAL]  
Select whether to display a signal indicator or AIM value to be displayed from when distance measurement is

1.MARK

started to when measured data is displayed.

16. Selection of **Priority Display**: [PRIORITY DISP.]

Select the display order of the sets of display items which pressing the [DISP] key cycles through. The set of display items selected here appears first after the power is turned on.

1.HA	VA	VD
2.HA	VA	SD
3.HA	VA	HD SD

---

## 8.10 Initial setting 3

1. Input of date

Set date using [numeric keys].  
Year / month / date

08/12/24
----------

2. Input of time

Set time using [numeric keys].  
Time : minute : second

00:00:01
----------

3. Selection of week day

Select week day.

1.SUN
2.MON
3.TUE
4.WED
5.THU
6.FRI

- The date clock is powered by the built-in lithium battery. The lithium battery needs to be replaced in five years. When the message “Li-batt.voltage is low.” is shown on the display screen, have the lithium battery replaced by the dealer from whom the instrument was purchased. The timing of battery replacement varies depending on the frequency of use and the environment where the instrument is stored while not in use.



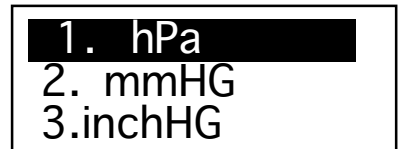
---

## 8.11 Initial setting 4

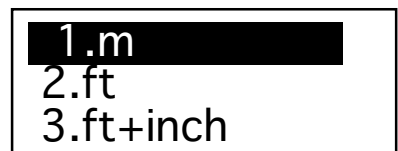
1. Selection of **Temperature unit setting**: [TEMP. UNIT]  
Select °C or °F as the unit for Temperature.

A screen showing a selection menu for temperature units. The first option, '1. °C', is highlighted with a black bar. Below it, '2. °F' is visible. At the bottom, there are small icons for a thermometer and a degree symbol.

2. Selection of **Pressure unit setting**: [PRESS UNIT]  
Select hPa (hectopascal), mmHg, inchHg as the unit for pressure to be input.

A screen showing a selection menu for pressure units. The first option, '1. hPa', is highlighted with a black bar. Below it, '2. mmHG' and '3. inchHG' are listed.

3. Selection of **Distance unit setting**: [DIST. UNIT]  
Select m or ft or ft+inch as the unit for Distance.

A screen showing a selection menu for distance units. The first option, '1. m', is highlighted with a black bar. Below it, '2. ft' and '3. ft+inch' are listed.

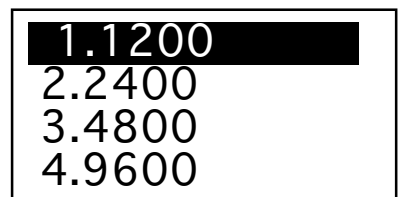
4. Selection of **Angle unit setting**: [ANG. UNIT]  
Select DEG or DEC or GRD or MIL as the unit for Angle.

A screen showing a selection menu for angle units. The first option, '1. DEG', is highlighted with a black bar. Below it, '2. DEC', '3. GRD', and '4. MIL' are listed.

---

## 8.12 Initial setting 5

1. Selection of **Transfer rate** (baud rate): [BAUD UNIT]  
Select a baud rate of 1200, 2400, 4800 or 9600.

A screen showing a selection menu for transfer rates. The first option, '1. 1200', is highlighted with a black bar. Below it, '2. 2400', '3. 4800', and '4. 9600' are listed.

2. Selection of **Data bits**: [DATA LENGTH]  
Select a data length of 8 bits.

A screen showing a selection menu for data bits. The first option, '1. 8', is highlighted with a black bar.

3. Selection of **Parity**: [PARITY BITS]  
Select no (NIL) parity bit, even parity or odd parity.

A screen showing a selection menu for parity. The first option, '1. NIL', is highlighted with a black bar. Below it, '2. EVEN' and '3. ODD' are listed.

4. Selection of **Stop bits**: [STOP BITS]  
Select the number of stop bits to be used: 1 or 2.

A screen showing a selection menu for stop bits. The first option, '1. 1', is highlighted with a black bar. Below it, '2. 2' is visible.

5. Selection of **Control signal**: [SIGNAL CONTROL]  
Select whether the control signal is effective or not.

1.ON
------

6. Selection of **XON/XOFF**: [XON/XOFF]  
Select whether to enable or disable XON/XOFF.

1.ON
------

7. Selection of **Through command**  
: [THROUGH COMMAND]  
Select whether to disable data output  
without receiving any data request command  
or enable the “a” to “f” command data output.

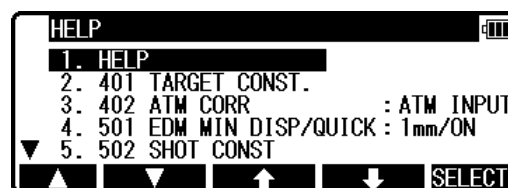
1.NIL
2.a
3.b
4.c
5.d
6.e

## 9. ACCESSING THE FUNCTIONS

### 9.1 Accessing by help key

You can use the [HELP] key to display specific initial setting (such as the prism constant and priority mode).

Press the [ILLU]+[ESC] key in MODE A or B.

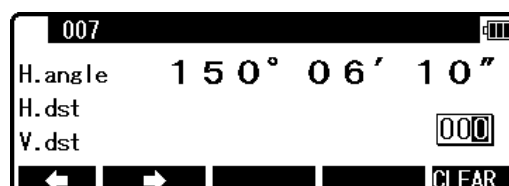


The help menu will then be displayed. Press [F1] [△] [F2] [▽] or [F3] [↑] [F4] [↓] to position the cursor to the desired item.

### 9.2 Accessing by 007

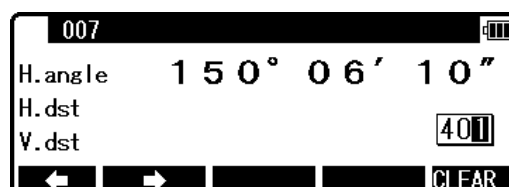
The R-400V allows you to enter a special code of 007 with the alphanumeric keys to display specific initial setting.

Press the numeric keys [0] [0] [7] in MODE A or B. The screen will then change to the command input screen.

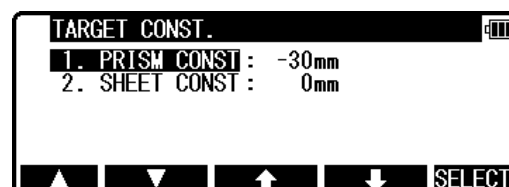


Press the numeric keys for the desired command number in the Command No. Table.

(For example, press [4] [0] [1] for TARGET CONST.)



Press the [ENT] key to access the TARGET CONST.



## [Instrument setting items]

007	HELP menu list		Default	Other options
401	TARGET CONST	PRISM CONST	-30mm	0mm, INPUT
		SHEET CONST	0mm	INPUT
402	ATM CORR		ATM INPUT	ppm INPUT, NIL
403	ATM CORR DISP		OFF	ON
501	EDM MIN DISP/QUICK		1mm/OFF	1mm/ON, 0.1mm
502	SHOT COUNT	SHOT COUNT	1TIME	3TIMES, 5TIMES, INPUT
		SHOT INPUT	01TIMES	(input)
503	CRV/REF CORR.		0.14	0.2, NIL
504	MIN UNIT ANG.		FINE	COARSE
505	V.ANG. STYLE		Z.0	H.0, COMPAS
508	DIST. BUZ.		ON	OFF
509	QUAD BUZ.		OFF	ON
510	AUTO OFF		10 MIN	20 MIN, 30 MIN, NIL
511	EDM OFF		3 MIN	5 MIN, 10 MIN, NIL
512	ILL. OFF		3 MIN	5 MIN, 10 MIN, NIL
514	MEAS. SIGNAL		MARK	VALUE
515	PRIORITY SELECT	PRIM. MEAS KEY	MEAS. SHOT	MEAS. CONT, TRACK SHOT, TRACK CONT
		SEC. MEAS KEY	TRACK CONT	TRACK SHOT, MEAS. CONT, MEAS. SHOT
		PRIORITY DISP.	HA/HD/VD	HA/VA/SD, HA/VA/HD/SD/VD
517	COMP AXIS		3 AXIS (R-422VN)	2 AXIS, 1AXIS, NIL
			2 AXIS (R-423VN, R- 425VN, R-435VN)	1 AXIS, NIL
520	LD. PLUM.		OFF	ON
521	LONG RANGE MES.		ON (when target is Ref.less)	OFF
701	ATM UNIT	TEMP. UNIT	<input type="checkbox"/> C	<input type="checkbox"/> F
		PRESS UNIT	hPa	mmHg, inchHg
702	DIST. UNIT		m	ft, ft+inch
703	ANG. UNIT		DEG	DEC, GRD, MIL
801	SETUP COM.	BAUD RATE	1200	2400, 4800, 9600
		DATA LENGTH	8	
		PARITY BITS	NIL	EVEN, ODD
		STOP BITS	1	2
		SIGNAL CONTROL	ON	OFF
		XON / XOFF	ON	OFF
		THROUGH COMMAND	NIL	a, b, c, d, e, f

## 10. DATA COLLECTOR

---

The instrument can communicate directly with a computer through the RS-232c interface. By use of a data collector you can automate data entry, from the collection of survey data to the transfer of the data to a computer. This is useful in saving time and protecting data integrity. For instructions about the connection with a data collector and the handling, please refer to the “Instruction manual” of the data collector.

## 11. CHECKS AND ADJUSTMENTS

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- Checks and adjustments should be performed before and during measurement.
- The instrument should be checked after long storage and transportation.
- The checks should be performed in the following order.

### [Cautions on CHECKS AND ADJUSTMENTS]

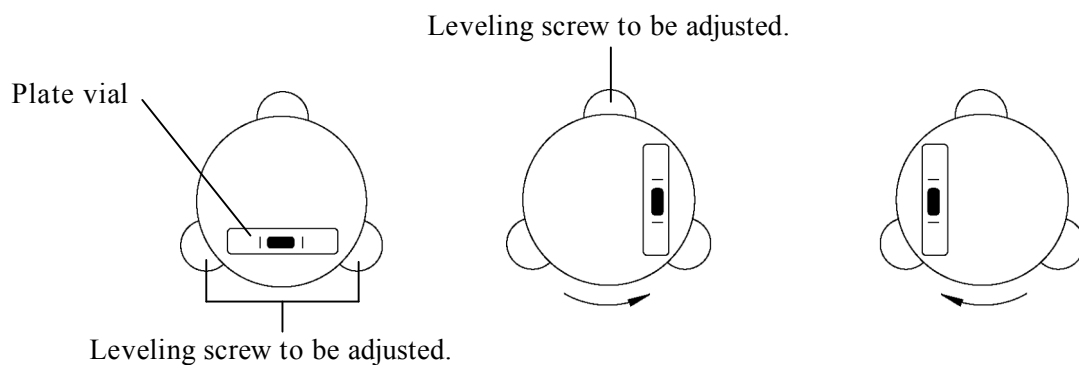
- When adjustment is completed, be sure that adjusting screws are completely tightened. When finishing turning adjusting screws, be sure that screws are turned in a direction for tightening.
- Repeat check after adjustment, and check if the instrument has been adjusted properly.
- When adjustment is completed, be sure that adjusting screws are completely tightened. When finishing turning adjusting screws, be sure that screws are turned in a direction for tightening.
- Repeat check after adjustment, and check if the instrument has been adjusted properly.

---

### 11.1 Plate level

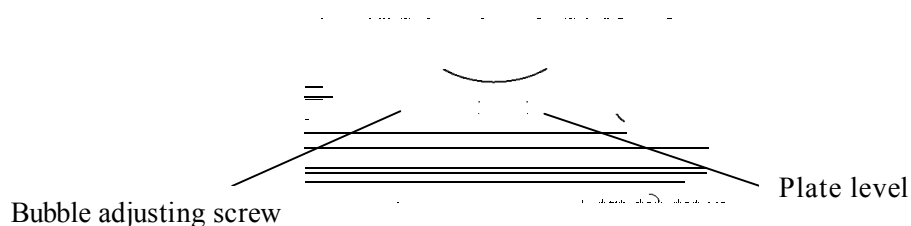
#### [Checks]

- ① Align the Plate level in parallel with a line joining any two of the leveling screws. Then, adjust the two screws to center the bubble in the vial.
- ② Rotate the instrument 90° and adjust the remaining leveling screw to center the bubble.
- ③ Loosen the upper clamp screw and rotate the instrument 180° around the vertical axis.
- ④ No adjustment is needed if the bubble stays in the center.



## [Adjustments]

- ① If the bubble of the plate lever moves from the center, bring it half way back to the center by adjusting the leveling screw(s) which is parallel to the plate level.
- ② Correct the remaining half by adjusting the bubble adjusting nuts with the adjusting pin.
- ③ Confirm that the bubble does not move from the center when the instrument is rotated by  $180^\circ$ .
- ④ When the bubble moves, repeat from (1) once again..



## 11.2 Circular vial

### [Checks]

- ① Adjust by the plate level vial beforehand.
- ② Confirm the position of the bubble of the circular vial.  
At this time, it is not necessary to adjust if the bubble is at the centre of the circle.

### [Adjustments]

When the bubble of the circular vial comes off from the centre according to check procedure

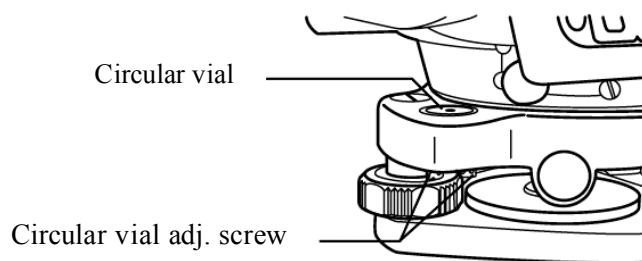
- ②, it is necessary to adjust.

Turn the bubble adjustment screws with the reticle adjustment pin and put the bubble in the centre of the circle.

### [Only the detaching type model]

Turn the bubble adjustment screws with the reticle adjustment pin and put the bubble in the centre of the circle.

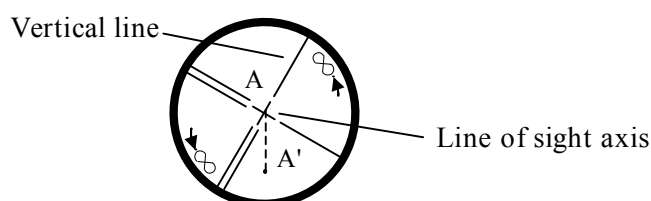
- Tighten the screws equally after the above adjustment.



## 11.3 Vertical reticle

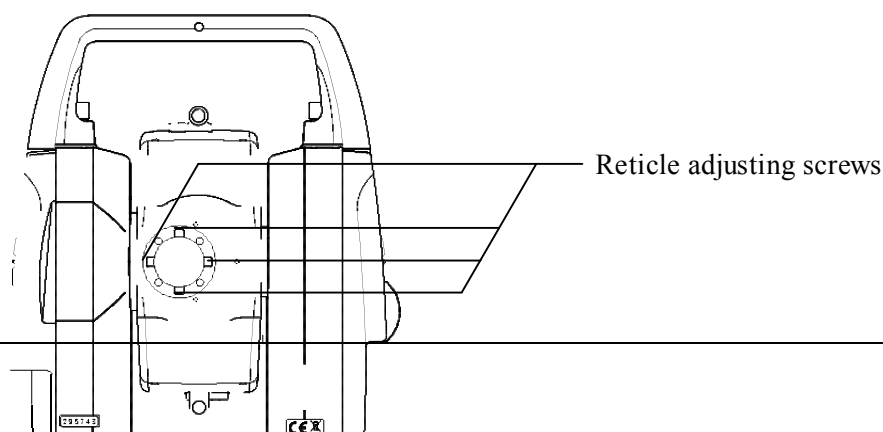
### [Checks]

- ① Set the instrument up the tripod and carefully level it.
- ② Sight the target Point A with telescope.
- ③ Using the telescope fine adjustment screws, move Point A to the edge of the field of view by screw (Point A').
- ④ No adjustment is necessary if Point A moves along the vertical line of the reticle.



### [Adjustments]

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

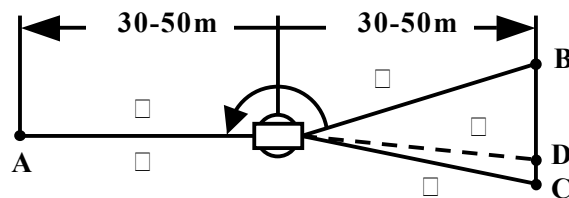


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## 11.4 Perpendicularity of line of sight to horizontal axis

### [Checks]

- ① Position a target Point A at a distance 30m - 50m away from the instrument, and sight it with the telescope.
- ② Loosen the telescope lock screw and turn the telescope until a point is sighted at a distance roughly equal to that of Point A. This is Point B.
- ③ With the telescope still reversed, loosen the horizontal lock screw and rotate the instrument around the vertical axis, and sight Point A again.
- ④ Loosen the telescope lock screw and turn the telescope until a point is sighted at a distance equal to that of Point B. This is Point C.
- ⑤ No adjustment is necessary if Point B and C are aligned.



### [Adjustments]

- ① If Points B and C are not aligned, mark Point D at  $\frac{1}{4}$  the length of the BC, from Point C in the direction of Point B.
- ② Using the adjustment pin, rotate the reticle adjustment screws horizontally opposite each other (see preceding page), and move the reticle to sight Point D.
- ③ Repeat the check and make sure the adjustment is correct.



---

## 11.5 Vertical 0 point error

Make sure to follow check procedures mentioned below after making adjustments on reticle and perpendicularity of line of sight to horizontal axis.

### [Checks]

- ① Set up the instrument and turn the power on.
- ② Sight the telescope at any reference target A at Normal state. Read the vertical angle (y).
- ③ Turn the telescope and rotate the alidade. Sight the same target A again at Back state and read the vertical angle R.  
If  $y+R = 360^\circ$ , no further adjustment is necessary.

### [Adjustments]

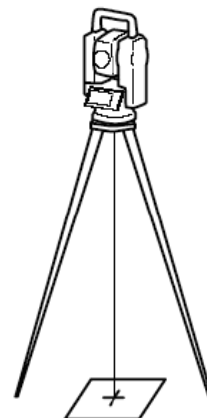
If the deviation  $d (y+ R - 360^\circ)$  is wide, contact your local dealer.

---

## 11.6 Laser plummet

### [Checks]

- ① Set the instrument on the tripod, and place a piece of white paper with a cross drawn on it right under the instrument.
- ② Press the [LASER] key and press [F4][PLUM.ADJ] key , and move the paper so that the intersecting point of the cross comes to the centre of the laser mark.
- ③ Rotate the instrument around the vertical axis, and observe the centre mark position against the intersecting point of the cross at each  $90^\circ$  rotation.
- ④ If the laser mark always coincides with the intersecting point, no adjustment is necessary.



### [Adjustments]

When a centre part where a cross intersection and the laser mark look the brightest shifts by 0.5mm or more (at the instrument height 1.5m), it is necessary to adjust it. A repair engineer does this adjustment. Please contact the PENTAX dealer.

---

## 11.7 Offset constant

The offset constant rarely changes. It is recommended, however, that checks be done once or twice a year.

The check of the offset constant can be done on a certified base line. It can also be obtained in a simple way as described below.

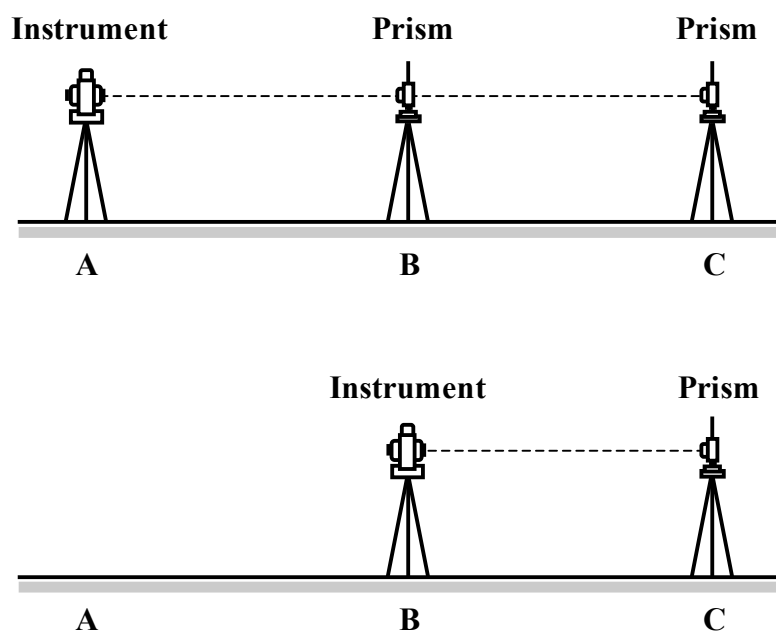
### [Checks]

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

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

### [Adjustments]

- Contact your local dealer for adjustment of the offset constant when K is not nearly 0.



---

## 11.8 Beam axis and line of sight

Be sure to check that the beam axis and line of sight are aligned when the adjustments on reticle and perpendicularity of line of sight to horizontal axis are made.

### [Checks]

- ① Set the prism at a distance greater than 50m.
- ② Accurately sight the centre of the prism through the telescope.
- ③ Turn the power on and press (MEAS) to measure.
- ④ No adjustment is necessary if beam receiving buzzer sounds immediately and measurement value is displayed in a few seconds.

### [Adjustments]

- If instrument function is not as described in ④, contact your local dealer.

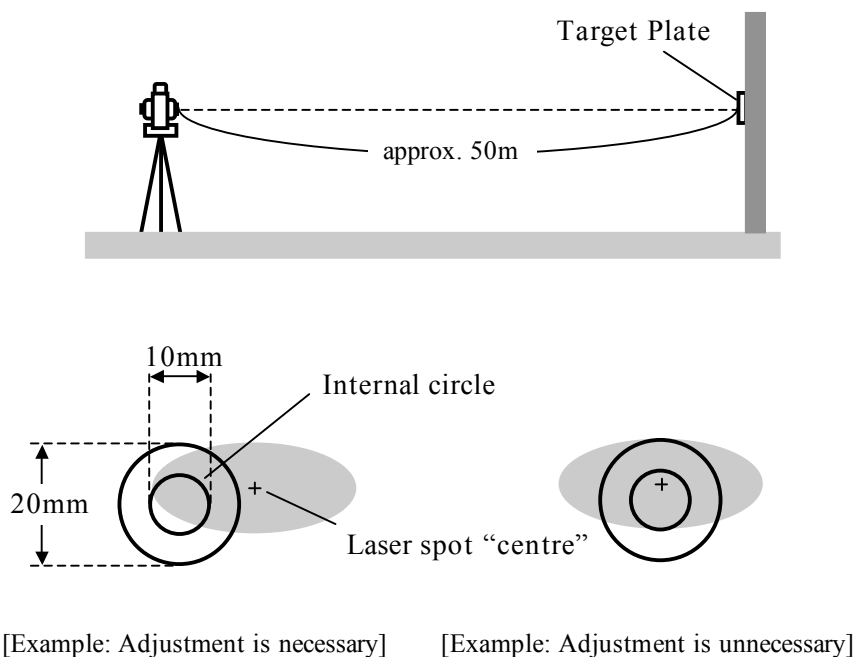
- This check should be done under good weather conditions.

## 11.9 The EDM beam axis

The distance measurement (EDM) beam axis is adjusted to be aligned to the sighting axis of the telescope, but it can be changed a little in case of rapid temperature change, shock or aging. Check your instrument by following procedures.

### [Checks]

- ① Install the instrument on the tripod and level it at the distance of approx. 50m from the wall.
  - ② Displace the target plate attached to the end of this manual. Place the target plate adjusting its centre to the centre of telescope cross line and to be about horizontal to the instrument.
  - ③ Turn the power on, and confirm the [TARGET] is set to the reflector sheet mode (“S” will be indicated at the top of display, left side of the battery remains sign when it is that.) When it is not, press [F2][TARGET] and set to reflector sheet mode (refere to “6.1 Target setting”).
  - ④ Press [F1][MEAS], then the laser spot appears on the target plate. If the “Centre” of the laser spot is within the internal circle (10mm) of the target plate at this moment, the adjustment is unnecessary.
- The laser spot disappears in approx. 20 seconds after pressing [F1][MEAS]. Press [MEAS] again, if it is necessary.



### [Adjustments]

At the procedure 4. above, if the “Centre” of laser spot is not within the internal circle (10mm) of the target plate, the adjustment is necessary. Please contact your PENTAX dealer.

## 12. APPENDIX

### 12.1 Warning and Error Messages

Warning Message	Meaning	What to do
Out of tilt range	Displayed when the instrument is tilted beyond the vertical compensation range ( $\pm 3^\circ$ ) in case automatic compensation is selected. When it is properly leveled, this message may be temporarily displayed if the instrument is turned too fast.	Re-level the instrument. Repair is needed if the message is displayed when it is properly levelled.
Excess data	The input data exceeds the allowable range.	Press the [ESC] key and enter the correct data.
Out of range □ when being lit□	This message is displayed if a long distance which is far beyond measurable distance of R-400V series is measured with a wrong target mode. Please select a correct target then measure. If a wrong target is selected, a correct distance cannot be measured.	Select the correct target mode.
Out of range (when flashing)	The measurement distance is less than 1.5m in Reflector sheet mode. The measurement distance is less than 5m in Prism mode.	Select a longer point, or use a tape measurer.
Unsuitable Condition	Under too strong sunlight. Unstable light value owing to shimmer or obstacles. Reflector sheet, Target and Prism do not face the instrument. Reflector sheet, Target and Prism are not correctly sighted. Measurement range is over in Reflectorless mode. Sufficient signal does not return by sighting sharp edge etc. at Reflectorless mode.	Change the object that has much better reflectivity or use a prism, or wait until the sun activity has weakened.
Li-batt.voltage is low.	<ul style="list-style-type: none"> <li>The Date Clock is powered by the built-in lithium battery.</li> <li>The lithium battery needs to be replaced in five years.</li> </ul>	Have the lithium battery replaced by the dealer from whom the instrument was purchased.

Error Message	Meaning	What to do
EDM ERROR 04 -05, 34-39, 50-53	Distance measurement system problem	Turn the power off, and then turn on again. Repair is needed when the message appears consistently.
ETH ERROR 70-76	Angle measurement system problem	
MEMORY ERROR 19	Memory problem	
ERROR PS DATA of EDM ERROR P DATA of EDM	Problem of the internal EDM parameters	
ERROR ETH DATA	Problem of the internal ETH parameters	

## 12.2 Atmospheric correction

The speed at which light travels through the air varies depending on the temperature and atmospheric pressure. The R-400V 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

$$K = \left( 276.26713 - \frac{78.565271 \times P}{273.14941 + t} \right) \times 10^{-4}$$

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.

## 12.3 hPa and mmHg conversion table

### [Converting from hPa to mmHg]

Unit:mmHg										
hPa	0	10	20	30	40	50	60	70	80	90
500	375	383	390	398	405	413	420	428	435	443
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
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### [Converting from mmHg to hPa]

Unit:hPa										
mmHg	0	10	20	30	40	50	60	70	80	90
400	533	547	560	573	587	600	613	627	640	653
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	1240	1253	1267	1280	1293	1307	1320

## 12.4 Error 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 1013hPa or 760mmHg), the error per 100 meters in temperature and pressure will be shown in the tables below.

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

### [Error table: When hPa (15°C, 1013hPa as standard)]

Unit:mm								
hPa C°	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

### [Error table: With mmHg (15°C, 760mmHg as standard)]

Unit:mm							
mmHg C°	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
-----	-----	-----	-----	-----	------	------	-------

## 12.5 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 error when the slope distance and vertical angle are caused 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)

$$H = S \left( \cos \square + \sin \square \frac{K-2}{2Re} S \cos \square \right)$$

### Corrected vertical distance (V)

$$V = S \left( \sin \square + \cos \square \frac{1-K}{2Re} S \cos \square \right)$$

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

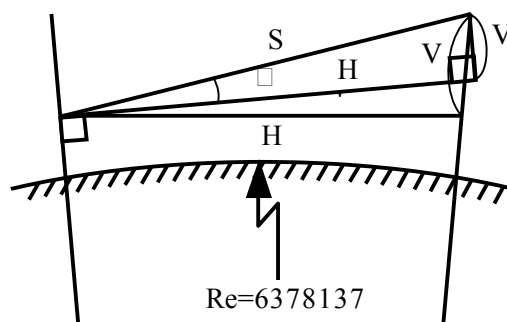
$$\begin{aligned} \text{Horizontal distance } H' &= S \cos \square \\ \text{Vertical distance } V' &= S \sin \square \end{aligned}$$

S: Slope distance

□: Vertical angle from horizontal

K: Atmospheric refraction coefficient (0.14 or 0.2)

Re: Diameter of earth (6,370 km)



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## 12.6 Distance range

Generally speaking, the maximum range which can be measured varies considerably depending on the atmospheric conditions. For this reason, the specifications illustrate the values for both good and normal weather conditions.

It is extremely difficult to judge when weather conditions are “Good” and when they are “Normal”. With this instrument, the conditions noted below are used to differentiate between the two situations (good weather conditions for surveying are different from normal weather conditions, and in surveying situations, cloudy skies are considered more favourable than sunny skies).

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

Normal : Visibility of approximately 20 km, with slight shimmer and moderate wind.

Good : Visibility of approximately 40 km, overcast, with no shimmer and moderate wind.



## 12.7 Specifications

	R-422VN	R-423VN	R-425VN	R-435VN
Telescope				
Magnification	30×			
Effective aperture	45mm (EDM45mm)			
Resolving power	3.0"			
Field of view	1°30' (2.6%)			
Minimum focus	1.0m			
Focus	Manual			
Distance measurement				
Laser class	Visible Laser : Class IIIa (3R) (Reflectorless) / Class II (2) (Prism,sheet)			
Measurement range(Good conditions) ※3				
Reflectorless ※1	1.5~400m			
Reflector sheet ※2	1.5~600m(800m)			
Mini prism	1.5~1,600m(2,000m)			
1P	1.5~5,500m(7,000m)			
3P	1.5~7,000m(9,000m)			
Accuracy				
Prism / Reflector sheet	1.5~10m : ± (3+2ppm×D) mm,10m~ : ± (2+2ppm×D) mm, Quick : ± (3+2ppm×D) mm ※5			
Reflectorless	1.5~300m : ± (5+2ppm×D) mm 300m~ : ± (7+10ppm×D) mm			
Minimum count	0.1mm(Fine mode), 1mm(Normal mode), 10mm(Track mode)			
Measuring time ※4				
Repeat meas.	Normal(1mm) : Quick(1mm) : Track(10mm) :	Prism / Ref.sheet 2.0sec. Ref.less 2.0sec. Prism / Ref.sheet 1.2sec. ※5 Prism / Ref.sheet 0.4sec. Ref.less 0.4sec.		
Initial meas.	Normal(1mm) : Quick(1mm) : Track(10mm) :	Prism / Ref.sheet 2.5sec. Ref.less 2.4sec. Prism / Ref.sheet 1.7sec. ※5 Prism / Ref.sheet 2.5sec. Ref.less 2.5sec.		
Angle measurement				
Measuring method	Absolute rotary encoder			
Detection method	Vertical / Horizontal angle : 2 sides		Vertical / Horizontal angle : 1 sides	
Minimum count	1"/5" selectable			
Accuracy (ISO 17123-3)	2"	3"	5"	
Compensator	3 AXIS	2 AXIS		
Target screw	1 speed			
Sensitivity of vials				

Plate vial	30"/1div.	
Circular level	8'/2mm	
Plummet	Visible laser : ±0.5mm (Instrument height : 1.5m)	
Base	Detachable	Shifting
Dust and Water Protection	IP56 (Instrument only)	
Ambient temperature	-20°C~+50°C/-4°F~122°F (Working range)	
Tripod thread	5/8"x11	M35 P2
Dimensions/Weight		
Dimensions	180(W)×342(H)×177(L)mm	
Weight(incl. Battery)	5.7kg	5.5kg
Carrying case	250(W) x 365(H) x 425(L)mm	
Battery pack BP02		
Power source	Ni-MH 4300mAh (Rechargeable) DC6.0V	
Operation time	Continuous approx.4.5hrs(ETH+EDM), 15hrs(ETH) with approx., 2.2hrs of charging time	
Weight	380 g	
Battery Charger BC03 and AC adapter AC01		
Input voltage(AC01)	AC 100~240V	
Output voltage(BC03)	DC7.5V	
Weight	280g	
Data Process		
Data recording method	Internal Memory	
Coordinates data ※6	45,000	
Special function	PowerTopoLite	
I/F	RS-232C, SD CARD, USB	
Display / keyboard		
Display type	Graphic LCD / 20 characters x 8 lines / 240 x 96 pixels	
Quantity	1 (2nd optional)	
Keys	22 each(12 numeric / 5 function / 5 special)	
Display back light	Intensity settings: 10 steps	
Laser Pointer	Yes	
Date clock	Yes	

**NOTE :**

- \*1 The measurement range and accuracy of reflectorless, and time required to measure may vary by the shape, size of surface area and reflection rate of the target and its environment. The measurement range of reflectorless is determined by the white side of the Kodak Gray Card.  
(KODAK is a trademark of Eastman Kodak Company)
- \*2 Reflector sheet: PENTAX genuine Reflector sheet
- \*3 The measurement range may vary by conditions of the environment.  
Normal conditions: 20km visibility with slight shimmer Good conditions: 40km visibility, overcast, no heat, no shimmer and moderate wind.
- \*4 EDM measuring time is determined in good conditions. It may takes longer than usual to measure the distance exceeding 4000m in prism mode and 300m in reflectorless mode.  
Also the measurement time in reflectorless mode is influenced by the share, size and surface area and reflection rage of the target and its environment.
- \*5 Quick mode, which functions with prism and reflector sheet, is effective only under normal mode(1mm) and up to 500m.
- \*6 Number of points to be recorded may vary by usage.  
Maximum number of point to be recorded per job site : 3000 points  
Maximum number of job file to be recorded : 50 job files  
Maximum data points to be sent from PC to the instrument: 3000 points

## 13. NOTICE TO THE USER OF THIS PRODUCT

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To assure compliance with the Safety standard 21 CFR, Chapter 1., Subchapter J., the U.S. Bureau of Radiological Health requires the following information to be provided to user.:



It can be dangerous to look into the beam with optical equipment such as binoculars and telescopes.

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### 13.1 Specifications of Laser Radiation

- A) The EDM module of the R-400V produces a visible light beam, which is emitted from the telescope objective lens and the centre hole of the instrument base plate.  
The R-400V is designed and built to have a laser diode radiating at 620-690nm.
- B) Radiant power  
The R-400V is designed and built to radiate a maximum average radiant power of 4.75mW from the telescope. The user may be subject to this radiation as the beam continues operating until such time that the instrument is turned off.




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### 13.2 The following labels are affixed to and must remain attached to this laser product.



**WARNING**

#### **WARNING**

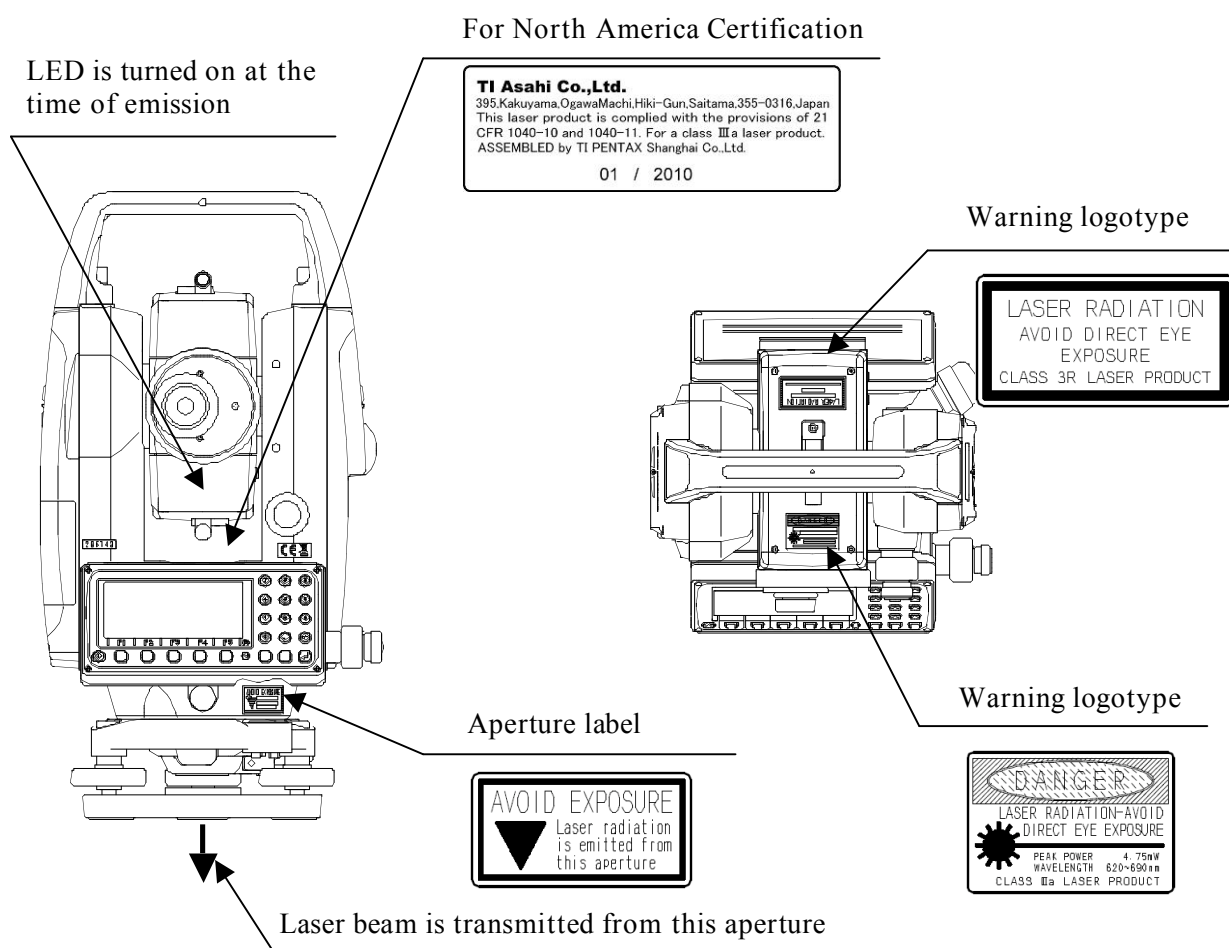
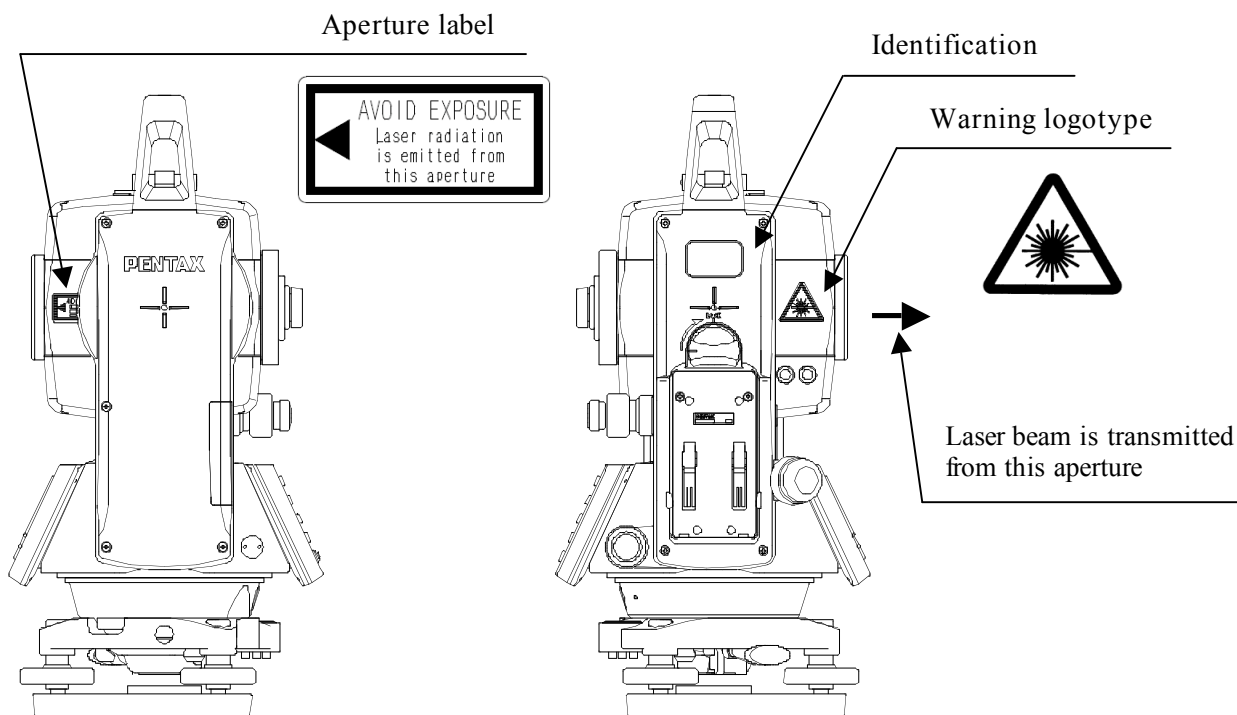
-  Do not stare into the laser beam directly as this may result in damage to your eyes.
  -  R-400V is a Class IIIa (3R) Laser product. Do not look into the laser radiation aperture directly as this may result in damage to your eyes.
  -  Never use the telescope to view intense light such as direct sunlight or sunlight reflected through a prism as this may result in loss of sight.
- A) The following Certification label is located near the Plate level: “This laser product is complied with the provisions of 21 CFR 1040. 10 and 1040.11. For a Class IIIa laser product.”
- B) Caution label is located near the exit aperture: “AVOID EXPOSURE. Laser radiation is emitted from this aperture.”
- C) Warning logotype is located on the surface of the telescope: “CAUTION LASER RADIATION DO NOT STARE INTO BEAM”
- D) Warning label is located near the exit aperture.

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### **13.3 Caution to maintain the safety in compliance with the standard**

- A) To maintain the safety standard, refrain from any operation, maintenance, or adjustment other than described in this instruction manual.
- B) Operation, maintenance or adjustment other than those specified in this instruction manual may result in hazardous radiation exposure.
- C) Maintenance and repair not covered in this manual must be done by an authorized Pentax dealer.
- D) The Laser beam emission by the Distance measurement can be terminated by Pressing [ESC] key.
- E) Pressing [Laser] key and [F2] [ RED MARK] key can terminate the laser beam emission by the laser pointer.
- F) The laser beam emission by the laser plummet can be terminated by pressing laser key and [F4] [PLUM.ADJ] key.

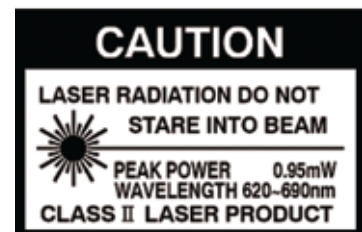
## 13.4 Labelling



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