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You can read the recommendations in the user guide, the technical guide or the installation guide for PENTAX V-325N. You'll find the answers to all your questions on the PENTAX V-325N in the user manual (information, specifications, safety advice, size, accessories, etc.). Detailed instructions for use are in the User's Guide.

**User manual PENTAX V-325N**  
**User guide PENTAX V-325N**  
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**Instruction manual PENTAX V-325N**

## **TOTAL STATION** **V-300** SERIES

V-325 | V-325N | V-335N | V-323N

INSTRUCTION  
MANUAL  
V-300 SERIES  
Basic Procedures



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**Manual abstract:**

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. @@@@Basic Procedures, 2. @@@@Do not disassemble, modify or repair this product as there 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. @@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 . . . . 4 . . . . 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 item 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 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. Be 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. 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. 5 Usage precautions Surveying instruments are high-precision instruments. In order to assure that the Electronic Total Station V-300 series product which you have purchased will provide long-lasting maximum performance, the precautions in this manual must be followed.

Be 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.

V-300 is a class-II Laser product. (The reflectorless type is a Class IIIa (3R) laser product.) [EDM axis] The V-300 series EDM is the 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 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 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 and white wall, etc.

) or under too strong sun light. In a situation high accuracy may not be expected, perform the measurement by Reflector sheet or Prism.



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· When using reflector sheet, set the reflector sheet to have its surface 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. 6 In the following environments, the distance might not be able to be measured. There is a reflection things (mirror, stainless board and white wall, etc.) in the direction of the target and under too strong sun light [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 iring it.

Close the lid to the case and secure the latches. 1.

Basic Operation 1.1 Removing the Battery 1 2 (1) Rotate the knob above the battery pack counterclockwise. (2) Lift up the battery pack and remove it from the instrument. 1.2 Attaching the Battery 2 1 1 (1) Place the channel on the bottom of the battery pack, onto the protrusion of the instrument and push the battery pack down into place.

(2) Turn the knob clockwise. 9 1.3 Standard equipment . . . . . Instrument Carrying case Battery Charger Plumb bob Hexagonal wrench Rain cover Quick Reference Guide CD 1.4 How to charge the battery [Charging the battery] · The battery BP02 is not charged at our factory shipment. It must be changed before use. · For BP02 charge, use the special BC03 charger. [Connection of code] (1) Insert the output plug of the power supply code in Jack of the AC adaptor. (2) Insert the output plug of the AC adaptor in 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. 10 [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 normally 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 so that visual confirmation is possible. 1 When the [Laser] key is pressed, the Laser pointerfunction 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 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 out doors. · 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 center. Confirm the alignment (horizontal and vertical ) before measuring when performing accurate work like stake out when using the Laser pointer function. Also refer to 11.8 The EDM beam axis. · Please do not look at the laser source of beam directly. 15 3.

### PREPARATION FOR SURVEYING 3.

1 Centring and levelling of the instrument [Setting up the instrument and the tripod] Adjust the tripod legs so that a height suitable for observation is obtained when the instrument is set on the tripod. 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. If the tripod head is mis-leveled by the action of fixing the metal shoes into the ground, correct the level by extending or retracting each leg of the tripod. 3.

2 Optical plummet Look through the optical plummet eyepiece, and rotate the eyepiece knob until the centre mark can be seen clearly. Rotate the focusing knob of the optical plummet and adjust the focus on the ground mark. Loosen the centring clamp screw and push the upper plate by finger and stay the centre mark on the ground mark. Tighten the centring clamp screw. Loosen the horizontal clamp screw and rotate the instrument every 90° and confirm the Circular vial is centred correctly.

If the bubble is not centred, it can be properly set using the levelling screws. 16 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.



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· 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. 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°. - Use the remaining screw to centre the bubble in the plate vial. - Rotate the instrument by 90° and 180° 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. 3.5 Eyepiece adjustment [Eyepiece adjustment] The eyepiece adjustment is performed before target sighting. Remove the telescope lens cap. Point the telescope at a bright object, and rotate the eyepiece ring full counterclockwise. 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.

17 · When it is hard to see the reticle due to poor brightness, press + to access the RETICLE INTENSITY ADJ. screen. Use the left and right arrow to adjust the reticle intensity. 3.6 Target sighting Loosen the telescope clamp and horizontal clamp screws.

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

· Rotating the focusing ring "clockwise" makes it possible to focus on closer objects and "counterclockwise" will focus on further objects. 18 3.7 Attachment and detachment of tribrach The tribrach V-300 is detachable 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 downward. The guide and guide mark must be fitted to attach the instrument. When the tribrach does not need to be attached or detached or instrument is to be transported, tighten the recessed screw with a screwdriver to fix the locking knob. 19 4. TURNING THE POWER ON 4.1 Turning the power on and off To set power on: To shut down: 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 LCD DENSITY ADJ Press [F4] while holding down the Illumination key to access the screen for adjusting LCD contrast. 7 LOW 0 HIGH 25 LCD DENSITY ADJ Pressing [F1] [ ] will lighten the contrast, while pressing the [F2] [ ] will darken the contrast. 7 LOW 0 HIGH 25 MODE A 15°C P0 Press [ENT] to exit adjustment mode and return to the previous screen. H.angle H.dst. V.

dst. 85° 39' 40" MEAS TARGET 0 SET DISP MODE · · · 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. 20 4.3 Adjusting illumination brightness ILLU INTENSITY ADJ Press [F5] while holding down the Illumination key to access the screen for adjusting illumination brightness. DOWN 0 5 UP 10 ILLU INTENSITY ADJ Pressing the [F1] [ ] will decrease brightness, while pressing the [F2] [ ] will increase brightness. DOWN 0 10 UP 10 MODE A 15°C P0 Press [ENT] to exit adjustment mode and return to the previous screen.

H.angle H.dst. V.dst. 85° 39' 40" MEAS TARGET 0 SET DISP MODE · 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. 21 5. ANGLE MEASUREMENT 5.1 Measuring an angle MODE A 15°C P0 Aim at the first target, then press [F3] [0 SET] twice in succession to reset the horizontal angle to 0. H.angle H.dst. V.

dst. 0° 00' 00" MEAS TARGET 0 SET MODE A 15°C DISP MODE P0 Aim at the second target, then read the horizontal angle. H.angle H.dst.

V.dst. 60° 30' 20" MEAS TARGET 0 SET MODE A H.angle 15°C DISP MODE P0 Pressing [F4] [DISP] displays the vertical angle. H.

dst. V.dst. 60° 30' 20" 87° 05' 40" DISP MODE MEAS TARGET 0 SET · The [0 SET] key cannot reset the vertical angle to 0. · Pressing the [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 H.angle H.dst. V.dst.

MEAS TARGET 0 SET DISP MODE 15°C P0 0° 00' 00" · 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. 22 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.



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PRISM CONST : 2. SHEET CONST : 3. TEMP \* 4. PRESS \* 5. ppm \* -30mm 0mm 15°C 1013hPa 0 ppm Press the [F5] [SELECT] to enable the Prism Constant to be changed.

Clear the exiting values by pressing [CLEAR] key. Input 25 by pressing the numeric keys. CORRECTION 1. PRISM CONST : 2. SHEET CONST : 3. TEMP \* 4. PRESS \* 5.ppm \* -25mm 0mm 15°C 1013hPa 0 ppm SELECT Press the [ENT] key to accept the Prism Constant to -25mm. MODE A H.angle 15°C P0 Pressing the [ENT] key returns the instrument to mode A. 92° 30' 20" H.dst. V.dst. MEAS TARGET 0 SET DISP MODE 28 · 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 remains 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 CORRECTION 1. PRISM CONST 2. SHEET CONST 3. TEMP 4. PRESS 5.ppm \* \* : : \* 0mm 0mm +15°C 1013hPa 0 ppm SELECT Press [F4] [CORR] in mode B. @@PRISM CONST 2. SHEET CONST 3. TEMP 4. PRESS 5.ppm \* \* : : \* 0mm 0mm +15 °C 1013hPa 0 ppm CLEAR Press [F4] [ ] to move the cursor to "3.TEMP" and press the [F5] [SELECT] to enable the temperature to be changed. CORRECTION 1. PRISM CONST : 2. SHEET CONST 3. TEMP 4. PRESS 5. ppm \* \* : : \* 0mm 0mm + 2 2°C 1013hPa 0 ppm CLEAR Clear the exiting values by pressing [CLEAR] key. Input 22 by pressing the numeric keys. CORRECTION 1. PRISM CONST 2.SHEET CONT 3. TEMP 4. PRESS 5.ppm \* \* : : \* 0mm 0mm +22°C 1013hPa 0 ppm SELECT Press the [ENT] key to accept the temperature to +22°C. MODE A H.angle H.dst.

15°C P0 92° 30' 20" Pressing the [ENT] key returns the instrument to mode A. V.dst. MEAS TARGET 0 SET DISP MODE 29 · The valid range of Temperature input is from -30°C to +60°C. · When "ATM CORR" in "Initial Setting 1" has been set to "3. 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. @@@@ @@@@ · Temperature correction is based on 15°C. @@@@ (For more accurate values, See "12. @@@@ @@@@PRISM CONST 2. SHEET CONST 3.TEMP 4. PRESS 5. @@PRISM CONST 2. SHEET CONST 3.

TEMP 4. PRESS 5. ppm \* \* : : \* 0mm 0mm +15°C 1013hPa 0ppm SELECT Clear the exiting values by pressing [CLEAR] key. Input 900 by pressing the numeric keys. CORRECTION 1. PRISM CONST 2. SHEET CONST 3. TEMP 4. PRESS 5. ppm \* \* : : \* 0mm 0mm +15°C 090 0 hPa 0ppm CLEAR 30 Press the [ENT] key to accept the PRESS to 900hPa. CORRECTION 1. PRISM CONST 2. TEMP 3. PRESS 4. ppm \* : : \* 0mm +15°C 090 0 hPa 0ppm SELECT MODE A 900hPa S0 Pressing the [ENT] key returns the instrument to mode A.

H.angle H.dst. V.dst. 92° 30' 20" MEAS TARGET 0 SET DISP MODE · 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. ppm INPUT", no pressure is displayed on the correction menu screen. · Once set, the pressure is displayed at the center 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. 3 Calculation Formula" .) 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 CORRECTION Press [F4] [CORR] in mode B. (If the instrument is in mode A, press [F5] [MODE] to enter mode B.) 1. PRISM CONST \* 2. SHEET CONST \* 3. ppm : 0mm 0mm +12ppm SELECT 31 Press [F4] [ ] to move the cursor to "3. ppm" and press the [F5] [SELECT] to enable the temperature to be changed. Press the [CLEAR] key. CORRECTION 1.

PRISM CONST \* 2. SHEET CONST \* 3. ppm : 0mm 0mm +000ppm CLEAR CORRECTION Input 31 by pressing numeric keys. 1. PRISM CONST \* 2. TEMP \* 3. ppm : 0mm 0mm +0 31ppm CLEAR MODE A 15°C P0 Pressing the [ESC] key returns the instrument to mode A. H.angle H.dst. V.dst. 92° 30' 20" MEAS TARGET 0 SET DISP MODE · The valid range of ppm values is from -199 to +199. · Once set, the ppm value is displayed at the center 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. 32 8. INITIAL SETTING 8.1 Overview For the V-300 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 4" "Initial Setting 5" and "Setting of Date and Time " 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 on "8.2" and the operating procedures for changing an Initial Setting on "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. SET 1 1. ATM CORR 2. PRISM CONST 3.



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#### SHEET CONST 4.

CRV/REF CORR 5. COMPENSATOR : : : : ATM INPUT -30mm 0mm 0.14 ON SELECT Press [F3] [ ] or [F4] [ ] to position the cursor at the item of interest. SET 1 1. ATM CORR 2. PRISM CONST 3. SHEET CONST 4. CRV/REF CORR 5. COMPENSATOR : : : : ATM INPUT -30mm 0mm 0.14 ON SELECT 8.

3 Entering the mode for initial setting 2 SET 2 1. SHOT COUNT 2. SHOT INPUT 3. QUICK MEASURE 4. LONG.

RANGE MES. 5. MIN UNIT ANG. Press the [POWER] key while holding [F2] key down to access the screen for Initial setting 2. : 1 TIMES : 01 TIMES : OFF : ON : COARSE SELECT · Select the item of interest in the same way as in the mode for Initial setting 2.

· Pressing [F2] [ ] scrolls the screen down five items; pressing [F1] [ ] scrolls it up five items. 3.3 8.4 Entering the mode for initial setting 4 SET 4 1. TEMP UNIT 2. PRESS. UNIT 3. DIST. UNIT 4. ANG. UNIT Press the [POWER] key while holding [F4] key down to access the screen for Initial setting 4.

: : : : °C hPa m DEG SELECT · Select the item of interest in the same way as in the mode for Initial setting 4. 8.5 Entering the mode for initial setting 5 SET 5 1. BAUD RATE : 1200 2. DATA LENGHT : 8 3. PARITY BITS : NIL 4. STOP BITS : 1 5. SIGNAL CONTROL : Press the [POWER] key while holding [F5] key down to access the screen for Initial setting 5. ON SELECT · Select the item of interest in the same way as in the mode for Initial setting 5. · Pressing [F2] [ ] scrolls the screen down five items; pressing [F1] [ ] scrolls it up five items.

3.4 8.6 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". SET 1 1. ATM CORR 2. PRISM CONST 3. SHEET CONST 4.

CRV/REF CORR 5. COMPENSATOR : : : : ATM INPUT -30mm 0mm 0.14 ON SELECT Press [F5] [SELECT] to open the screen for selecting the atmospheric correction. SET 1 1. ATM CORR 2. PRISM CONST 3. SHEET CONST 4. CRV/REF CORR 5. COMPENSATOR : : : : 1. ATM INPUT 2.

ppm INPUT 3. NIL 0.14 ON SELECT Press [F3] [ ] or [F4] [ ] to position the cursor at the desired item, then press [ENT] key to select that item. Pressing the [ENT] key settles the change of selected item. Pressing the [ESC] key invalidates the change of selected item. SET 1 1. ATM CORR 2. PRISM CONST 3. SHEET CONST 4. CRV/REF CORR 5.

COMPENSATOR : : : : 1. ATM INPUT 2. ppm INPUT 3. NIL 0.14 ON SELECT Pressing again the [ESC] key or [ENT] key quits the initial setting screen and usual start screen appears.

SET 1 1. ATM CORR 2. PRISM CONST 3. SHEET CONST 4. CRV/REF CORR 5.

COMPENSATOR : : : : ppm INPUT -30mm 0mm 0.14 ON SELECT 8.7 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 measured with a thermometer and barometer, by entering ppm value, or by fixing the ppm value to 0 (NIL) not to perform Atmospheric Correction. 1. ATM INPUT 2. ppm INPUT 3. NIL 35 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. 1.

-30mm 2. 0mm 3. INPUT 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. 1. 0mm 2. INPUT 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. 1. 0.14 2.

0.2 3. NIL 5. Selection of Tilt Compensation: [COMPENSATOR] Select whether Tilt Compensation is to be single-axis (ON) or disabled (OFF) 1. ON 2.

OFF 6. Selection of ATM CORR DISP: [ATM CORR DISP] Turn the display of the atmospheric corrections ON or OFF. When they are turned on, the atmospheric corrections are displayed in the title bar of the measure screens. 1. OFF 2. ON · The factory default for each instrument condition is marked by . 8.8 Initial setting 2 1. 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. 2.

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" . 3. Selection of Quick measure: [QUICK MEASURE] Select whether to enable or disable the quick mode at measurement. 1. 2. 3.

4. 1 TIME 3 TIMES 5 TIMES INPUT 01 TIMES 1. OFF 2. ON 4. Selection of Long range message: [LONG RANGE MES.

] If you need the long range message. (not applicable on V-325) 1. ON 2. OFF 36 5. 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)" .

1. COARSE 2. FINE 6. 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 7. Selection for 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. 2. 3. 4. 10 MIN 20 MIN 30 MIN 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.

8. Selection for Distance measurement automatic power-off function: [EDM OFF] It chooses whether to make the auto-off function effective or to invalidate it. The distance measurement function will disappear in three minutes when the auto-off function is made effective. 1. ON 2.

OFF · The distance measurement automatic power-off function automatically poweroff distance measurement after the specified period of time when no key operation has been performed with the measured value remaining unchanged (over about 0.1m) during measurement. 9. Selection for H. angle 90° buzzer: [QUAD.

BUZ] Select whether to enable or disable the beep at every 90° during angle measurement. 1. OFF 2. ON 37 8.9 Initial setting 4 1. Selection of Temperature unit setting: [TEMP. UNIT] Select °C or °F as the unit for Temperature. 1. °C 2. °F 2.



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Selection of Pressure unit setting: [PRESS UNIT] Select hPa (hectopascal), mmHg, inchHg as the unit for pressure to be input. 1. hPa 2. mmHg 3. inchHg 3. ft+ inch 4. Selection of Angle unit setting: [ANG. UNIT] Select DEG or DEC or GRD or MIL as the unit for Angle. 1. 2. 3. 4. DEG DEC GRD MIL 8.10 Initial setting 5 1. Selection of Transfer rate (baud rate): [BAUD UNIT] Select a baud rate of 1200, 2400, 4800 or 9600. 1. 2. 3. 4. 1200 2400 4800 9600 2. Selection of Data bits: [DATA LENGTH] Select a data length of 8 bits. 1. 8 3. Selection of Parity: [PARITY BITS] Select no (NIL) parity bit, even parity or odd parity. 1. NIL 2. EVEN 3. ODD 4. Selection of Stop bit: [STOP BITS] Select the number of stop bits to be used: 1 or 2. 1. 1 2. 2 3 5. Selection of Control signal: [SIGNAL CONTROL] Select whether the control signal is effective or not. 1. ON 2. OFF 6. Selection of XON/XOFF: [XON/XOFF] Select whether to enable or disable XON/XOFF. 1. ON 2. OFF 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. 2. 3. 4. 5. 6. 7. NIL a b c d e f 39 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. HELP 1. HELP 2. 401 PRISM CONST : -30mm 3. 402 ATM CORR : ATM INPUT 4. 502 SHOT COUNT 5. 503 CRV/REF CORR : 0.14 SELECT The help menu will then be displayed. Press [F1] [ ] position the cursor to the desired item. ] [F2] [ ] or [F3] [ ] [F4] [ ] to 9.2 Accessing by 007 The V-300 allows you to enter a special code of 007 with the alphanumeric keys to display specific initial setting. MODE A 15°C P0 H.angle H.dst. V. dst. 92° 30' 20" 00 0 CLEAR MODE A 15°C P0 Press the numeric keys [0] [0] [7] in mode A or B. The screen will then change to the command input screen. H.angle H. dst. V.dst. 92° 30' 20" 41 CLEAR MEAS MIN DISP Press the numeric keys for the desired command number in the Command No. Table. (For example, press [4] [0] [1] for TARGET CONST.) 1. PRISM CONST 2. SHEET CONST : -30mm 0mm SELECT Press the [ENT] key to access the TARGET CONST. 40 10. DATA COLLECTOR The instrument can communicate directly with a computer through the RS232C 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 an "Instruction manual" of the data collector. 11.

CHECKS AND ADJUSTMENTS · 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.

Leveling screw to be adjusted. Plate vial Leveling screw to be adjusted. [Adjustments] (1) If the bubble of the plate level 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°.

(4) When the bubble moves, repeat from (1) once again. 41 Bubble adjusting screw Plate level 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 center of the circle. [Adjustments] When the bubble of the circular vial comes off from the center 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 center 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. Vertical line Line of sight axis 42 [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 loosening each screw by the same amount, and then rotate the reticle line around the sight axis and align the vertical line of the sight axis with Point A'. (3) Tighten the reticle adjustment screws again by the same amount, and repeat the check to make sure the adjustment is correct. 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. 30-50m 30-50m B A D C [Adjustments] (1) If Points B and C are not aligned, mark Point D at 1/4 the length of the BC, from Point C in the direction of Point B.



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(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. 43 11.5 Vertical 0 point error Be 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 Optical 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) Look through the optical plummet, and move the paper so that the intersecting point of the cross comes to the center of the field of view. (3) Adjust the leveling screws so that the center mark of the optical plummet coincides with the intersecting point of the cross.

(4) Rotate the instrument around the vertical axis. Look through the optical plummet each  $90^\circ$  of rotation, and observe the center mark position against the intersecting point of the cross. (5) If the center mark always coincides with the intersecting point, no adjustment is necessary. Adjusting screws [Adjustments] (1) If the center mark does not coincide with the intersecting point, rotate the optical plummet focusing knob cover and remove it. (2) Mark the point set on the line of sight at each step of  $90^\circ$  on the white paper and call them A, B, C and D. (3) Join the opposed points (A, C and B, D) with a straight line, and set the intersecting point O. 44 (4) Turn the four optical plummet adjusting screws with a adjusting pin so that the center mark coincides with the intersecting point O. (5) Repeat from (4) and check that adjustment is correct. 11.7 Offset constant The offset constant rarely changes.

It is recommended, however, that check 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 off-set constant when the K is not nearly 0. Instrument Prism A B Instrument C Prism A B C 11.8 The EDM beam axis The distance measurement (EDM) beam 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. [Checks] (1) Install the instrument on the tripod and level it at the distance of approx.

50m from the prism. (2) Accurately sight the center of the prism through the telescope. (3) Turn the power on and measure the distance. (4) No adjustment is necessary if beam receiving buzzer sounds immediately and measurement value is displayed in a few seconds. If instrument functions is not as described in (4), please contact your PENTAX dealer. This Checks should be done under weather conditions. 45 12. APPENDIX 12.1 Warning and Error Messages

Warning Message Out of tilt range Meaning Displayed when the instrument is tilted beyond the vertical compensation range ( $\pm 3'$ ) in case automatic compensation is selected. This message may be temporarily displayed if the instrument is turned too fast.

What to do Re-level the instrument. Repair is needed if the message is displayed when it is properly leveled. Excess data Mismatched Target The input data exceeds the allowable Press the [ESC] key and enter the correct data. range. This message is displayed if a long dis- Select the correct target, tance which is a far beyond measurable mode. distance of V-300 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. The measurement distance is less than Select a longer point, or use a tape measure. 1.5m in Prism mode.

· Under too strong sun light. · Unstable light value owing to shimmer or obstacles. · Target, Prism do not face the instrument. · Reflector sheet, Target and Prism do not face the instrument. · Reflector sheet, Target en Prism are not correctly sighted. · Target, 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.

Target is too close Unsuitable Condition Error Message EDM ERROR 04 -05, 34-39, 50-53 ETH ERROR 70-76 MEMORY ERROR 19 ERROR PS DATA of EDM ERROR P DATA of EDM ERROR ETH DATA Meaning What to do Distance measurement system problem Turn the power off, and then turn on again.

Repair is needed when the message appears Angle measurement system problem consistently. Memory problem Problem of the internal EDM parameters Problem of the internal ETH parameters 46 12.2 Atmospheric correction The speed at which light travels through the air varies depending on the temperature and atmospheric pressure. The V-300 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. @@@@ 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. 49 12.5 Specifications V-325 V-325N V-335N V-323N Telescope Magnification 30 x Resolving power 3" Field of view 2.6% ( $1^\circ 30'$ ) Minimum focus 1.0m Distance measurement Laser Class (Visible Laser) Visible Laser: Class II Visible Laser: Class IIIR (Reflectorless), Class II (Prism) Measurement range (Good condition) Reflectorless I.



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5~300m Mini prism 1100m (1600m) IP 3400m (4500m) 3P 4500m (5600m) Accuracy Prism 1.5m~10m:  $\pm(3+2ppmxD)mm$  10m~ :  $\pm(2mm+2pmxD)mm$   
Reflectorless 1.5~200m:  $\pm(5+2ppmxD)mm$ , 200m~:  $\pm(7+10ppmxD)mm$  Measuring time (minimum count) Normal 2.0 Seconds (1mm) Track 0.4 Seconds (1cm)  
Quick Mode 1.

2 Seconds (1mm) Angle measurement Measuring method Absolute rotary encoder Detection 1 side 2 side Minimum count 1" / 5" selectable Accuracy  
(ISO17123-3) 5" 3" Compensator Single axis Tangent screw 1 speed Sensitivity of vials Plate level (electronic) 40"/2div. @@@@\* Normal conditions: 20km  
visibility with slight shimmer. @@@\* Reflector sheet: PENTAX genuine reflector sheet ( 5cm x 5cm). @@@\* Quick mode, which is effective only under Normal  
mode (1mm) setting, functions with Prism and Reflector Sheet. \* Reflectorless: - 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. - The measurement range at TRACK mode is over 5m. - It takes  
time, longer than usual, to measure the distance to the object that is hard to measure. - The measurement range, accuracy of distance measurement and time  
required to measure may be influenced by the shape, size of surface area and reflection rate of the target and its environment. \* The operating time becomes  
shorter under the low temperature, due to the temperature dependence of the battery performance.

12.6 Notice to the user of this product TO THE USER OF THIS 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. 1. Specifications of Laser Radiation A) The EDM module of the V-300 produces a visible light beam, which is emitted from  
the telescope objective lens and the center hole of the instrument base plate. The V-300 is designed and built to have a laser diode radiating at 620-690nm.

B) Radiant power The V-300 is designed and built to radiate a maximum average radiant power of 0.95mW from the telescope. The user may be subject to this  
radiation as a beam while operation until such time that the instrument is turned off. 2. The following labels are affixed to and must remain attached to this  
laser product. WARNING Do not stare into the laser beam directly as this may result in damage to your eyes. V-300 is a Class II Laser product. Do not look  
into the laser radiation aperture directly as this may result in damage to your eyes. (The reflectorless type is a Class IIIa (3R) laser product.) 5) 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 II 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. 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 key. E) Pressing keys can terminate the laser beam emission by the laser pointer. 12.7 Labeling AVOID  
EXPOSURE Laser radiation is emitted from this aperture Aperture label Warning label Laser beam is transmitted from this aperture Identification label 52  
Warning logotype CAUTION N TIOE DIA EY UCT CT DI R RA RESUREPROD SE D PO SER LA AVOI EX3R LA CL S AS R GE DAN Laser beam is  
transmitted from this aperture For North America Certification LED is turned on at the time of emission 007 code 401 402 502 503 504 505 509 510 511 517  
522 523 701 702 703 801 HELP menu list TARGET CONST ATM CORR SHOT COUNT CRV/REF CORR MIN UNIT ANG. V. ANG. STYLE QUAD BUZ  
AUTO OFF EDM OFF COMPENSATOR QUICK MEASURE ATM CORR DISP ATM UNIT DIST. UNIT ANG. UNIT SET UP COM.

PRISM CONST SHEET CONST SHOT CONT SHOT INPUT TEMP. UNIT PRESS UNIT BAUD RATE DATA LENGTH PARITY BITS STOP BITS SIGNAL  
CONTROL XON/XOFF THROUGHT COMMAND REF. LESS RANGE LONG RANGE MES. LONG RANGE SETUP Default -30mm 0 mm ATM INPUT 1  
time 01 times 0.14 COARSE Z.0 OFF 10 MIN ON ON OFF ON Centigrade hPa m DEG 1200 8 NIL 1 ON ON NIL NORMAL ON EACH TIME Other options  
0mm, INPUT INPUT ppm INPUT, NIL 3 times, 5 times, INPUT (input) 0.2, NIL FINE H.0, COMPASS ON 20 MIN, 30 MIN, NIL OFF OFF ON OFF  
Fahrenheit mmHg, inchHg ft+inch, ft DEC, GRD, MIL 2400 4800 9600 EVEN, ODD 2 OFF OFF a,b,c,d,e,f LONG OFF PERMANENT V-325N, V-335N,  
V-323N 521 REF. LESS RANGE 53 PENTAX Industrial Instruments Co., Ltd.

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