

PENTAX[®]
CERTIFIED ISO 9001

ADVANCED TOTAL STATION

ATS-SERIES

ATS-101/ATS-102/ATS-102C/ATS-105

INSTRUCTION MANUAL(Hardware)

(Remote Control Keyboard Version)

ASAHI PRECISION CO., LTD.

DR DOS™ is a registered trade Mark of Novell corporation.
MS DOS™ is a registered trade Mark of Micro Soft corporation.

PRECAUTIONS REGARDING SAFETY

The following safety precautions should be observed when using this equipment. Pentax cannot accept any responsibility for problems which may result if the precautions noted here, or other precautions listed for individual items, are not observed.

WARNING

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

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

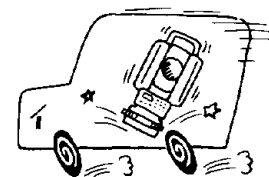
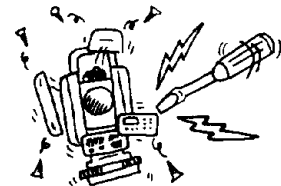
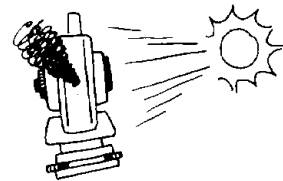
CAUTION

- ⦿ The hand grip should never be removed unless there is a good reason for doing so. If it has been removed, be sure to reattach it carefully and securely. If the instrument is carried without making sure the hand grip is securely attached, it may detach from the hand grip during transport, causing bodily injury or serious damage to the instrument.
- ⦿ Never short circuit the battery terminals. Shorting these terminals produces a strong electrical current which can not only damage the battery, but cause fire as well.

PRECAUTIONS REGARDING SAFETY

CAUTION

- ⊙ Never aim the telescope towards the sun without attaching a filter to the objective lens. If the sun's rays are allowed to enter the telescope directly, the energy from the sun can damage internal electronic components.
- ⊙ Never disassemble the equipment or the battery, as this can cause a breakdown. If there are any problems with the equipment, please contact the dealer where it was purchased.
- ⊙ Using any battery charger other than the dedicated charger designed for this instrument can cause a breakdown.
- ⊙ To avoid damaging the IC memory card, be careful never to bend it, drop it, immerse it in water, or disassemble it. Also, the IC memory card should not be stored in locations where it is exposed to high temperatures or humidity, or direct sunlight.
- ⊙ If the instrument, the battery, or the IC memory card happens to get wet, immediately wipe off the water, and place it in a dry place to allow it to dry thoroughly. To avoid breakdowns, do not replace the instrument, battery, or IC card in its case until they are completely dry.
- ⊙ When taking the battery out of the instrument, the power supply must first be turned off. Leaving the power supply on when the battery is taken out can cause a breakdown.
- ⊙ Before taking the IC memory card out of the instrument, check to make sure data is not in the process of being read. Taking out the card while data is being read can cause the data to be lost.
- ⊙ When transporting or moving the equipment, avoid shock and excessive vibration. These can adversely affect the precision of the instrument. Always handle the instrument gently and carefully.



[Other Precautions]

- ⊙ If the IC memory card is not to be used for a long period of time, any data stored on the card should be transferred to a computer or another storage device. This is necessary in order to protect valuable data.
- ⊙ The backup battery which retains data on the CA-14 /15 memory card should be charged periodically (at least once a month).

A fully-charged backup battery can retain data for approximately 4.5 months (based on an ambient temperature of 20°C), but because this may vary depending on the surrounding temperature and the card itself, the battery should be charged at more frequent intervals. (When the memory card is installed in the equipment, the backup battery is charged automatically.)

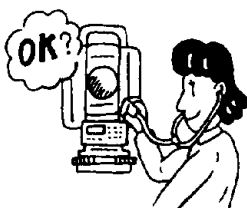
- ⊙ In order to maintain accuracy when surveying, the instrument should be left for at least one hour at the ambient temperature, to allow it to adjust to the surrounding temperature, before surveying is started. If the work is being done in strong direct sunlight, make sure the equipment is protected from the sun. These precautions are especially important if the automatic weather measurement function is being used.

PRECAUTIONS REGARDING SAFETY

- ⊙ For extremely precise surveying the temperature and atmospheric pressure should be measured separately, without using the automatic weather measurement function, and the values input manually.
- ⊙ The battery icon displayed on this instrument indicates the amount of battery power remaining, but should be used as a guide, not a precise reading. The length of the time that the battery can be used varies depending on elements such as the usage conditions, the ambient temperature, and the measurement conditions of the instrument, so the battery should be replaced in plenty of time before it runs out.
- ⊙ The time, indicated by the internal clock, on this instrument may be off by a slight amount; this should not be considered a problem unless it causes problems with surveying (for example, when the offset affects astronomical observations or the date). This would be because the date and time are used as time stamps to verify time series for observations in applications where the surveying data is recorded, such as the data collector. In order to assure the integrity of the system, the time and date must be adjusted only by Pentax or by an authorized representative of Pentax.

[Precautions Regarding Inspections]

- ⊙ The equipment should always be inspected before beginning work, to confirm that the correct precision is maintained. Pentax cannot accept any responsibility for surveying results which are adversely affected because the equipment was not inspected.



- ⊙ All other precautions noted in this manual should be followed and measurement carried out carefully and correctly.



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1 INTRODUCTION

The Pentax ATS Series is an intelligent total station incorporating a computer system. The measurement systems such as the distance and angle measurement units and the weather -sensor are functionally integrated with the computer system through the application software programs.

This instruction manual covers the features of the instrument and configuration of the hardware, as well as operation methods.

For descriptions pertaining to software, please refer to the manual entitled "ATS Series Instruction Manual: TS Kernel Program Version" and the instruction manual that comes with the application software package.

2 FEATURES AND CONFIGURATION

2.1 Features

1. Top of the line Pentax Total Station series
2. Displays ranging from 1" to 10", dual axis compensation (tri-axis correction)
3. Includes a completely new EDM system with high-level functions
4. A built-in weather sensor inputs the temperature and atmospheric pressure automatically.
5. Graphic LED display
6. IBM-PC compatible system based on MS-DOS™ Compatible OS
7. JEIDA V4.0 (PCMCIA V2.0) Type 1 IC memory cards can be installed
8. Application software programs can be interchanged (Cards can be used, or the instrument can be connected to a computer.)
9. Remote operation and efficient alphabetical character input is possible by the optional Remote Keyboard (MU72).

2.2 Configuration

(1) Standard components

Instrument	x 1
Carrying case	x 1
Tool set	x 1
Instruction manuals (2 volumes)	x 1
Battery charger MC-04	x 1

(2) Peripheral equipment and optional accessories

Application programs	
Measurement package	PK-01
Brief Measurement package	PK-11
Off Set Measurement package	PK-21
Data card 1MB	CA-14
Data card 2MB	CA-15
External battery	MB-22
External battery charger	MC-22
Computer cable MB-64A PC9801 (25-pin)	
Computer cable MB-64B PC9801 (14-pin)	
Remote keyboard (32 keys) MU72	

3 SPECIFICATIONS

3.1 Specifications of the Instrument

Telescope Section

1) Image	Erect
2) Magnification	32X
3) Effective aperture	45mm (EDM 54 mm)
4) Resolving power	2.5"
5) Field of view	1° 30' (2.6%)
6) Minimum focus	1.3m
7) Reticle illumination	Green, continuously variable

Distance Measurement Section

1) Measurement range	At visibility of 20km At visibility of 40km	
ATS-101 / 102(C)		
1prism	2400m	2700m
3prism	3100m	3600m
ATS-105		
1prism	2000m	2300m
3prism	2600m	3100m
2) Accuracy		
Normal		
ATS-101 / 102(C)	+ / - (2 + 2 ppm x D) mm	
ATS-105	+ / - (3 + 3 ppm x D) mm	
With automatic Atmospheric Correction		
ATS-101 / 102(C)	+ / - (2 + 10 ppm x D) mm	
ATS-105	+ / - (3 + 10 ppm x D) mm	
3) Minimum readings		
Fine mode	0.1mm (Factory setting)	
Normal mode	1mm	
High-speed mode	1mm	
TR mode	1cm (10mm)	
4) Measurement time (depending on atmospheric condition)		
	Initial	Continuous
Fine mode	5 seconds typical	3 seconds typical
Normal mode	4 seconds	2 seconds
High-speed mode	4 seconds	0.8 seconds
TR mode	3 seconds	0.4 seconds

5) Measurement method	Shot (Max. 99times, Average Yes / No selectable) / Continuous Fine, Normal, High-speed, TR mode (selectable)	
6) Maximum distance display	4999.9999m	
7) Display of signal return	YES	
8) Atmospheric correction	Atmospheric correction: (ON / OFF selectable) ON: PPM Correction is executed on EDM measurement value. OFF: PPM Correction is not executed on EDM measurement value. Automatic measurement of Atmosphere: (ON / OFF selectable) ON: Incorporated sensor measures the Temperature and Atmospheric pressure. OFF: The Temperature and Atmospheric pressure are inputted manually from key-board.	
9) Prism constant correction	Prism constant is entered by means of key input.	
10) Refraction and curvature correction	YES / NO (selectable) (atmospheric refraction coefficient = 0.14 / 0.2)	
11) Distance unit	Meter / Feet (selectable)	

Angle measurement section

1) Angle detection method	180-opposite detection (for both Horizontal / Vertical)		
2) Minimum display	ATS-101	ATS-102(C)	ATS-105
	0.5" / 1"	1" / 5"	5" / 10"
3) Accuracy (DIN18723)	1"	2"	5"

3 SPECIFICATIONS

Compensator

- 1) Method Dual-axis
- 2) Correction range $+ / - 3'$

Sensitivity of vials

- 1) Plate vial
 - ATS-101 ATS-102(C) ATS-105
 - 20" / 2mm 30" / 2mm 30" / 2mm
- 2) Circular vial
 - ATS-101 ATS-102(C) ATS-105
 - 8' / 2mm 8' / 2mm 8' / 2mm
- 3) Electronic vial
Displayed in 1" step (range: $+ / - 3'$)

Optical plummet

- 1) Magnification 3 X
- 2) Field of view $3^{\circ} 30'$
- 3) Focus range 0.5m ~ ∞

Tribrach type

ATS-101 / 102 / 105 Detachable
ATS-102C Shift

Display section

- 1) Display unit
 - Graphic LCD (20 characters x 8 lines, 160 x 64 dots)
 - Program function keys display on bottom line.
 - Illuminated display
- 2) Number of keys on key board
 - Power key 1
 - Program function keys 5
 - Function keys 2
 - Numeric keys 10
 - Illumination key 1

Main computer section

- 1) CPU V40 (8MHz)
- 2) Memory configuration
 - ROM 128KB (BIOS, OS) --- D drive
 - Main memory 768KB --- C drive
(Including RAM drive 193KB)
 - E2PROM 1MB --- A drive
- 3) OS MS-DOS™ compatible
- 4) IC memory card drive --- B drive
1 drive (for supplying application programs or recording data)
Accommodates to JEIDA V4.2 (PCMCIA V2.0) type 1
Recognition of whether protective cover is open or closed, recognition of card device
- 5) Calendar / clock
Built-in, rechargeable backup battery operates for approximately 1 month

Data input/output

- 1) Interface RS-232C compatible x 1port
- 2) Baud rate 115200 – 300 baud
- 3) Data bits 7 or 8 (selectable)
- 4) Parity bit Odd / Even / None (selectable)
- 5) Stop bits 1 or 2 (selectable)
- 6) Input / Output items
Depends on application software (see TS kernel program instruction manual and instruction manuals for various software programs) TS operation from external PC is also possible using TTY

3 SPECIFICATIONS

Batteries

- 1) Internal battery (MB05)
Rechargeable Ni-Cd (standard accessory)
1700 mAh / 7.2V
Continuous usage time: approx. 3 hours
- 2) External battery (MB22)
Rechargeable Ni-Cd (standard accessory)
4000 mAh / 8.4V
Continuous usage time: approx. 8 hours

Battery charger's

- 1) For internal battery (MC04)
Charging time: approx. 1.5 hours (standard accessory with refresh function)
- 2) For external battery (MC22)
Charging time: approx. 15 hours (optional accessory)

NOTE:

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

General specifications

- 1) Ambient operating temperature
-20°C to + 50°C
- 2) Size
343mm (H) x 189mm (W) x 185mm (L)
- 3) Instrument height
223mm (height to the center of Telescope)
- 4) Weight
7.0kg (including 0.5kg battery)

Other specifications

IC memory card [Option]
CA14 Built-in SRAM 1MB rechargeable backup battery
CA15 Built-in SRAM 2MB rechargeable backup battery
(Backup time: approx. 4.5 months (typical) at 20°C)
(Can be used for 10 years if used periodically)
Measurement functions
Noted in TS kernel program and application instruction manuals

3 SPECIFICATIONS

3.2 Compatibility

1) IC memory card

IC memory cards used in the ATS Series correspond to Type I JEIDA V4.2 (or PCMCIA V2.0) IC memory cards.

2) Application programs

Application programs manufactured for IBM-PC computers can be run on the ATS Series, but the display is smaller, and there are fewer types of keys. Therefore, it may not be possible to use some application programs without adjustment.

3) Transferring data between the IC memory card and the computer

(1) Computers with JEIDA standard drives

If the computer has an IC memory card drive that conforms to JEIDA (or PCMCIA) standards, IC memory cards for the ATS Series can be read directly. Because the format of the data on the IC memory card varies depending on the application, however, please refer to the application instruction manual for specific details.

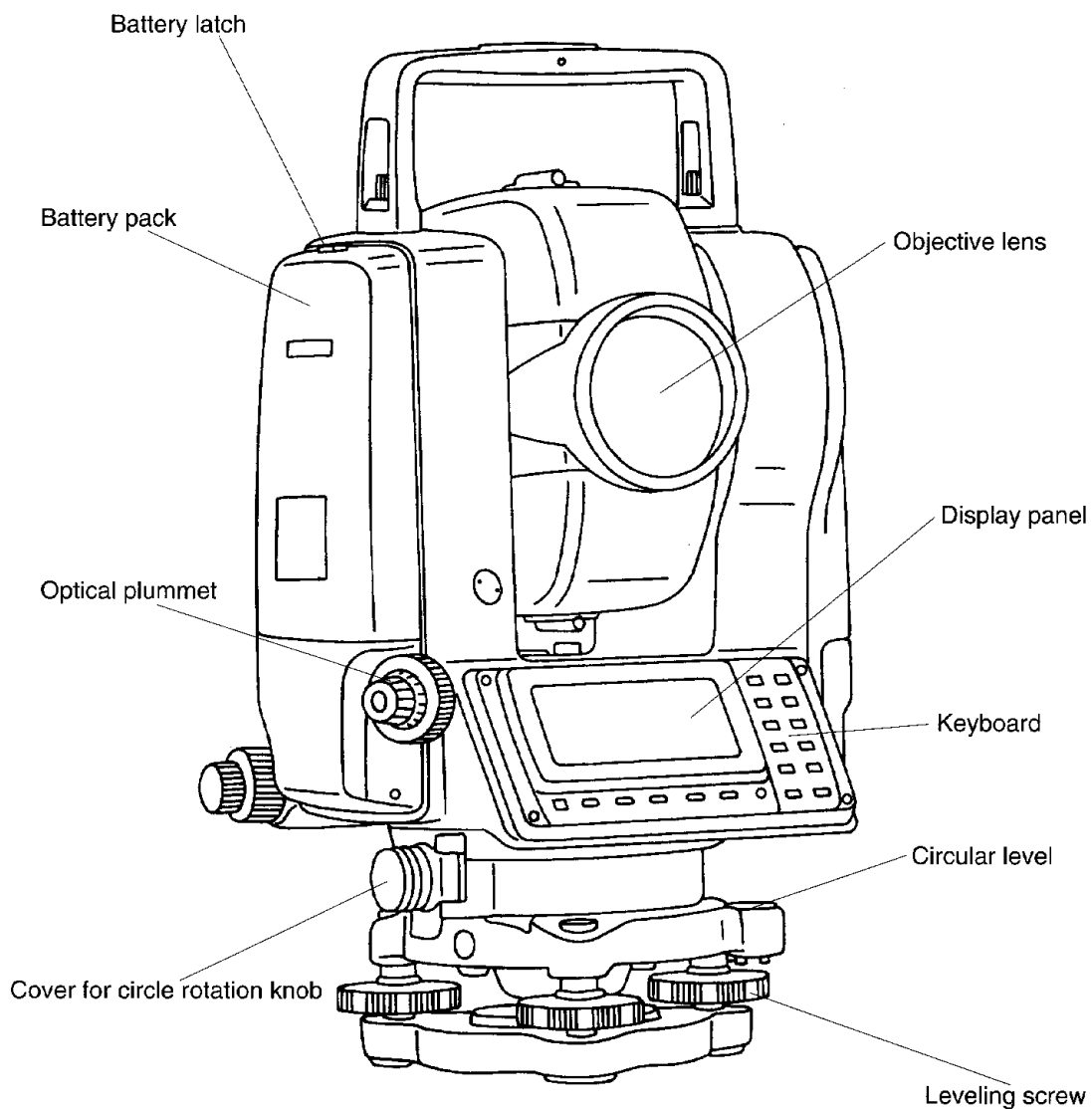
(2) Other computers

If the computer is not designed to accommodate IC memory cards, an external drive can be used or the ATS Series can be connected to the RS-232C port on the computer in order to transfer data from one to the other.

4 INFORMATION ABOUT OPERATION

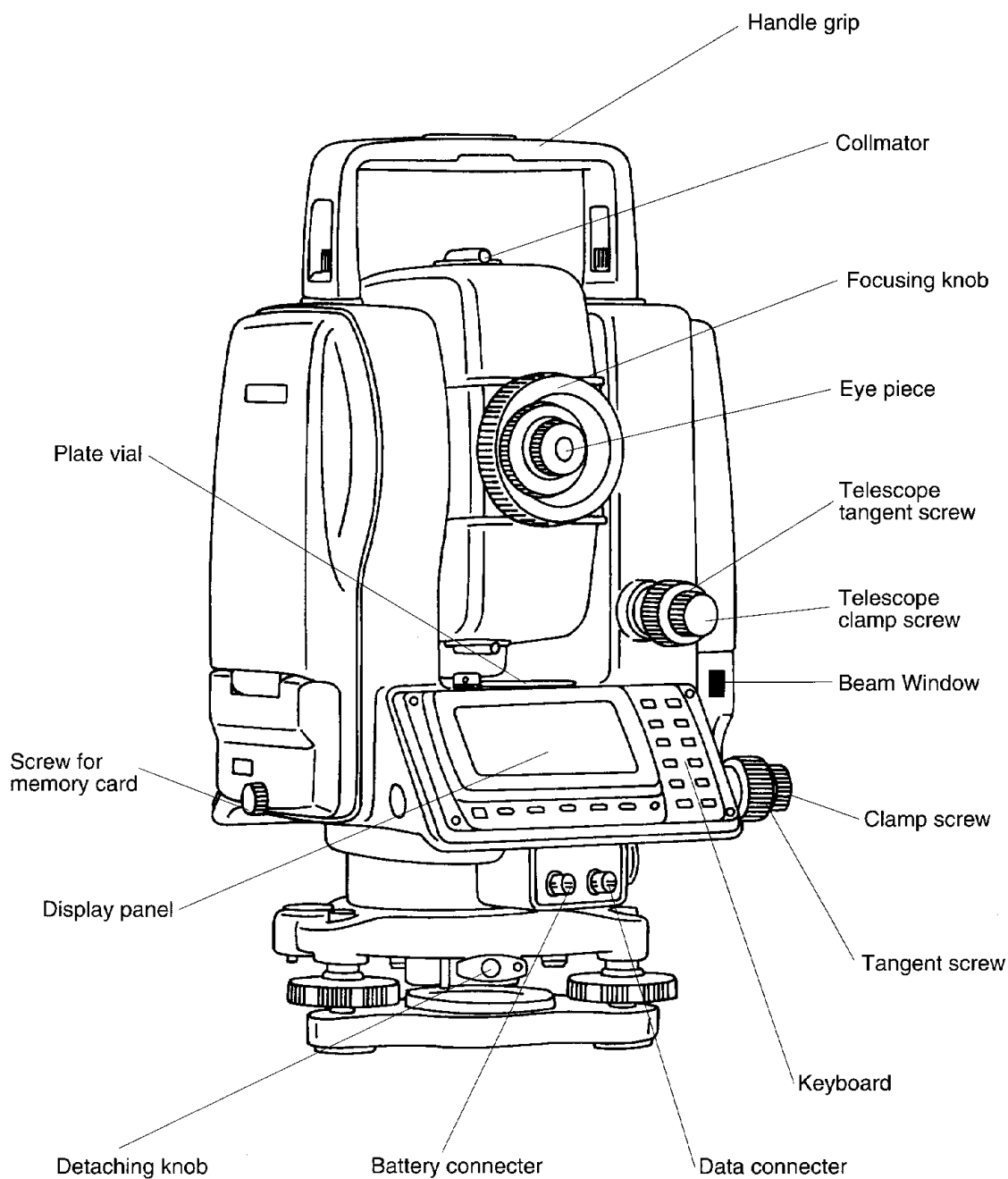
4.1 Names and Functions of Parts

4.1.1 Names of Parts



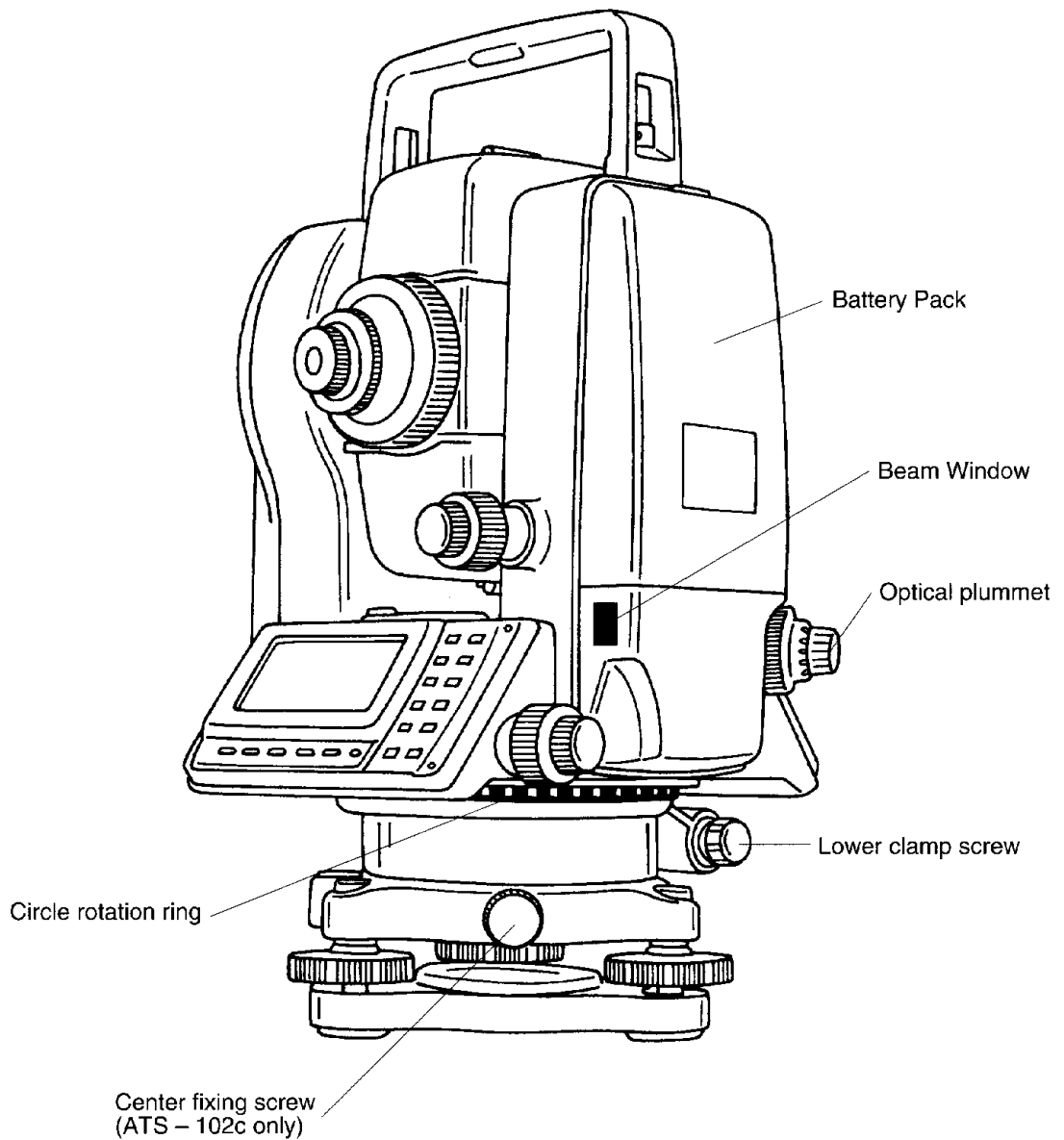
ATS - 101

4 INFORMATION ABOUT OPERATION



ATS – 101 (Tribrach Detachable)

4 INFORMATION ABOUT OPERATION



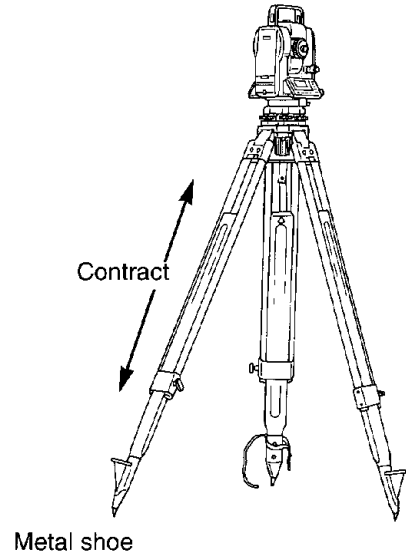
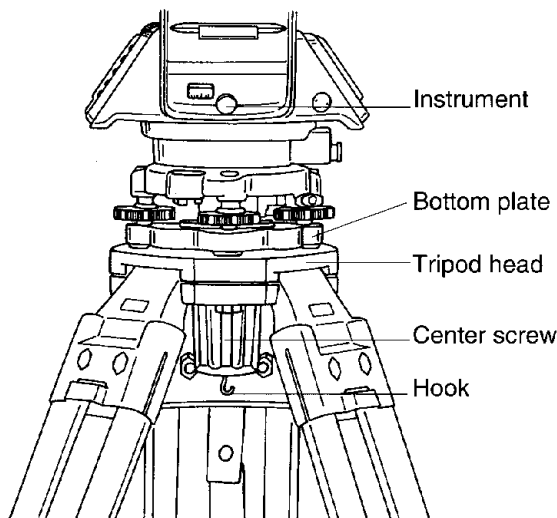
ATS - 102 / 105 (Tribrach Detachable), ATS -102c (Shifting Base)

4 INFORMATION ABOUT OPERATION

4.1.2 Centering and Leveling of the Instrument

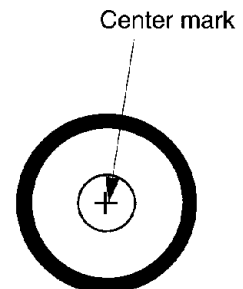
Setting up the instrument and the tripod

- 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 center 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 level as possible, and the plumb bob coincides with the station on the ground.
- ③ 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.



Centering and leveling with the optical plummet

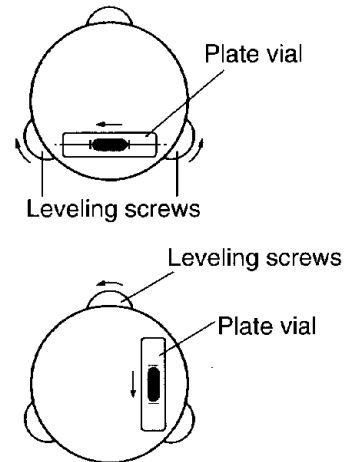
- ① Look through the optical plummet eyepiece, and rotate the eyepiece knob until the center mark can be seen clearly.
- ② Rotate the focusing knob of the optical plummet and adjust the focus to the station on the ground.
- ③ Loosen the center screw of the tripod. Look through the optical plummet, and shift the instrument base on the tripod head, taking care to avoid rotating the instrument, until the center mark coincides with the station.
- ④ Adjust the tripod legs to position the bubble of the circular vial to the center. (Be sure not to put your foot on the metal shoe, which may disturb the position of the metal shoes.)



4 INFORMATION ABOUT OPERATION

Leveling with plate vial

- ① Place a plate vial in parallel with a line joining any two of leveling screws. Adjust the two leveling screws. And position the bubble in the center of the vial. To adjust the screws at the same time, turn them in opposite directions.
- ② Adjust the remaining leveling screw so that the bubble is positioned in the center.
- ③ Repeat ① and ② by rotating the plate vial through 90° so that the bubble is positioned in the center when the plate vial is moved in any direction.



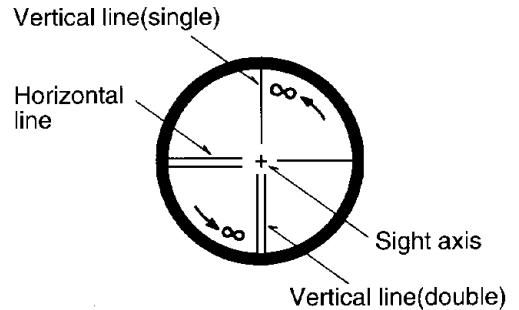
- See arrows in Fig. above for the relation between the direction of leveling screw rotation and the bubble shifting direction.
- If the bubble does not remain centered in ③, "Adjustment of plate vial" is necessary. Refer to page 80.

4 INFORMATION ABOUT OPERATION

4.1.3 Operating the Telescope

Eyepiece adjustment

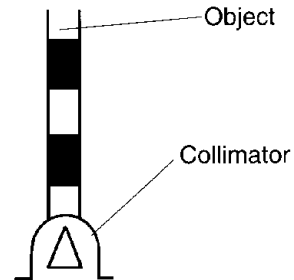
- ① Remove the telescope lens cap.
- ② Point the telescope at a bright object, and rotate the eyepiece ring full counterclockwise.
- ③ Look through the eyepiece, and rotate the eyepiece ring clockwise until the reticle appears as its maximum sharpness.



- 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 (※) to illuminate it. For adjusting intensity of brightness, refer to page 19.

Object sighting

- ① Point the telescope at the object using the collimator sight.
- ② Look through the telescope eyepiece and finely adjust the focusing knob until the object is perfectly focused. If focusing is correct, the reticle will not move, in relation to the object, even when you move your eye slightly left and right.
- ③ Accurately align the reticle with the object, using each tangent screw.



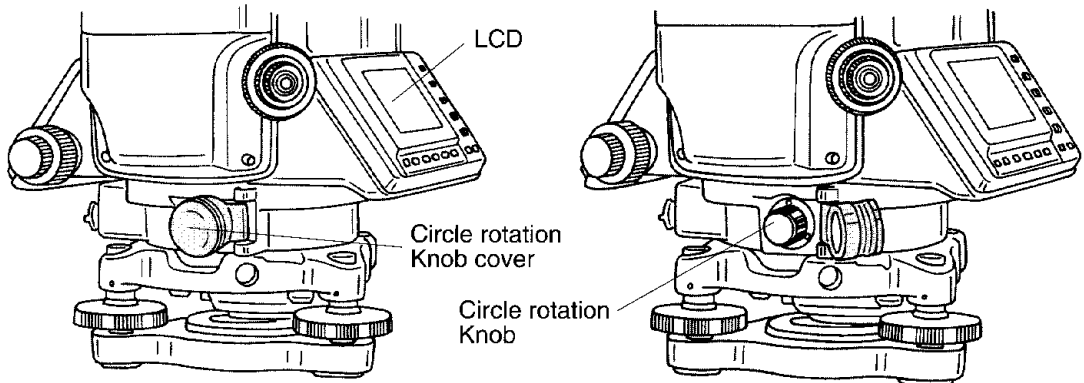
- Turn the focusing knob clockwise to focus on a near object. Turn the knob counterclockwise to focus on a far object.
- In ②, parallax may ruin the relation between the object and reticle, resulting in observation error.
- When aligning to an object using the tangent screw, always align by rotating the screw clockwise. If the screw is turned past the object, turn it back to the original position and then turn the screw clockwise to align the reticle on the object.
- Even when vertical angle measurement is not required, it is recommended that the object be placed close to the center of the reticle.

4 INFORMATION ABOUT OPERATION

4.1.4 Rotating the Horizontal Circle

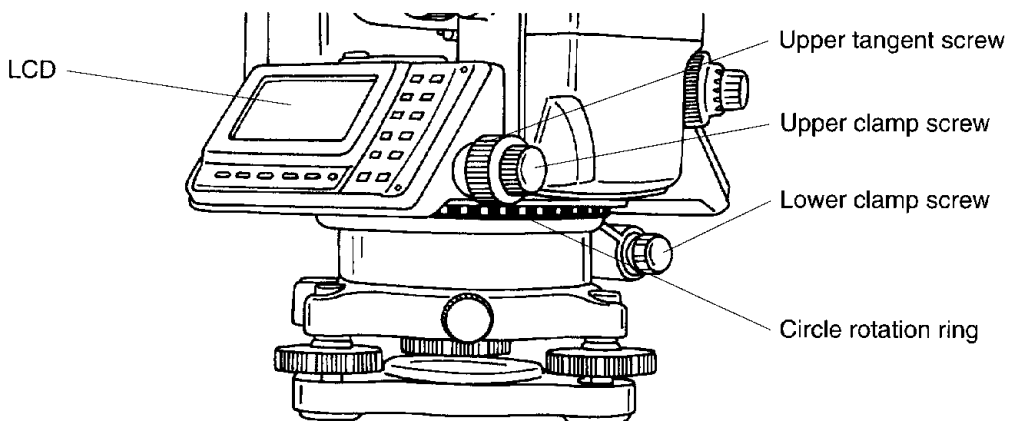
(1) With the ATS-101

- a. Open the circle rotation knob cover.
- b. While watching the LCD display, turn the circle rotation knob.
- c. Close the cover.



(2) With the ATS-102 / 102C / ATS-105

- a. Loosen the upper and lower lock screws.
- b. While watching the LCD display, turn the circle rotation ring.
- c. Tighten the upper lock screw.
- d. Using the upper tangent screw, adjust to the desired angle.
- e. Sight close to the target and tighten the lower lock screw.
- f. Using the upper tangent screw, adjust to the target.

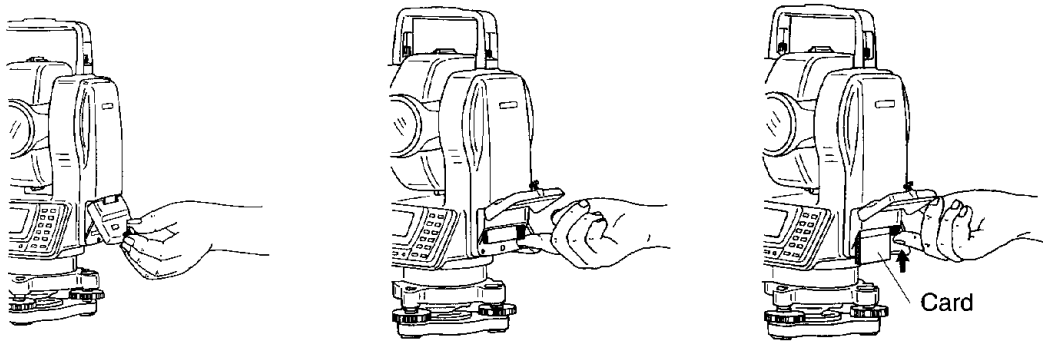


4 INFORMATION ABOUT OPERATION

4.1.5 Inserting and Removing the IC Card

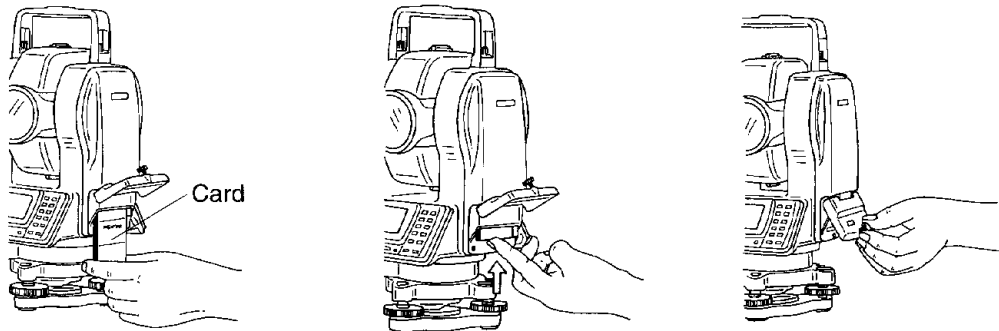
(1) Removing the card

- Check to make sure the IC memory card is not being read. (While the contents of the card are being read, an "A" or "B" will be displayed at the upper right of the LCD panel.)
- Loosen the screw securing the cover on the IC memory card drive.
- Press the button that ejects the IC memory card.
- When the IC memory card has been ejected halfway, take it out the rest of the way by hand.



(2) Installing the card

- Insert the IC memory card with the label facing out.
- Hold the Total Station with one hand, and with the other, insert the card all the way into the slot.
- Close the cover and tighten the securing screw.



⚠ CAUTION

- ⊙ When attaching and removing the card, handle it carefully and be sure not to drop it. If the card is subjected to severe impact, such as being dropped, the contents of the card may be lost or damaged, or the card may no longer function properly.
- ⊙ Ejecting the IC memory card while the equipment is reading its contents may cause the contents of the card to be lost or damaged, or the card may no longer function properly.
- ⊙ For other information on handling the IC memory card, please refer to Chapter 6.

4 INFORMATION ABOUT OPERATION

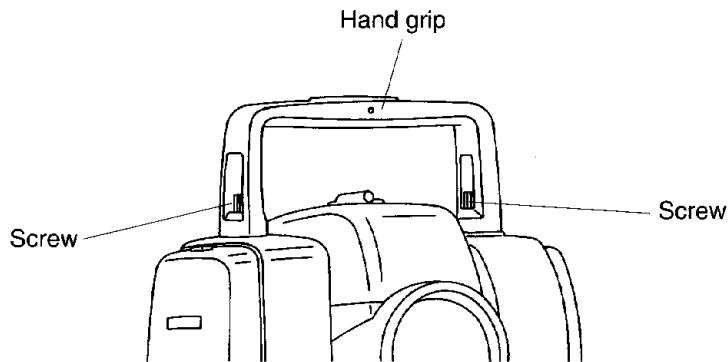
4.1.6 Attaching and Removing the Hand grip

(1) Removing the hand grip

- a. Turn both of the screws securing the hand grip in the counterclockwise direction to loosen them.
If the screws are hard to turn, insert the adjusting pin, provided as an accessory, in the pin hole and turn it.

(2) Attaching the hand grip

- a. Set the hand grip so that the side with the circular indentation is facing the objective lens side of the telescope. Fit the handle over each attachment boss.
- b. Tighten the attachment screws on both sides lightly, by hand.
- c. Using the adjusting pin, tighten the attachment screws securely.



CAUTION

- ⊙ The hand grip should never be removed unless there is a good reason for doing so. If it is removed, be sure to reattach it carefully and securely. If the instrument is carried without making sure the hand grip is securely attached, it may detach from the hand grip during transport, causing bodily injury or serious damage to the instrument.

4 INFORMATION ABOUT OPERATION

4.1.7 Attaching and Removing the Tribrach

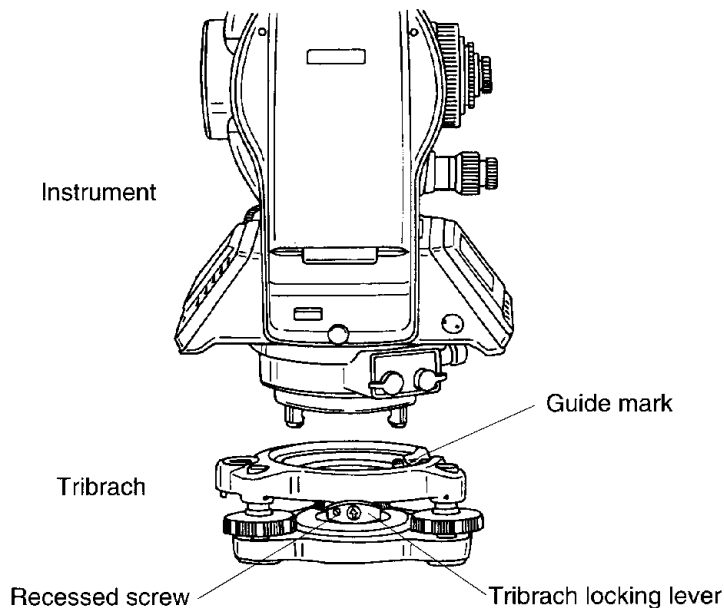
(1) Detachment

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

(2) Attachment

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

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



4 INFORMATION ABOUT OPERATION

4.1.8 Handling the Battery

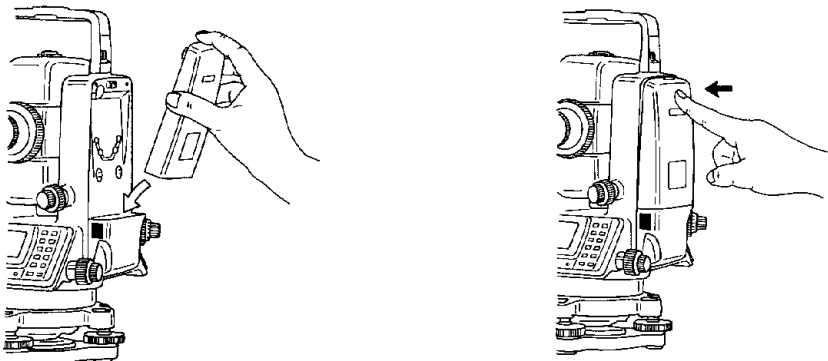
(1) Removing the battery

Pressing on the latch, remove the battery from the instrument.



(2) Attaching the battery

Lining up the guide on the bottom of the battery with the guide slots in the instrument, press the battery into position until you hear it click.



CAUTION

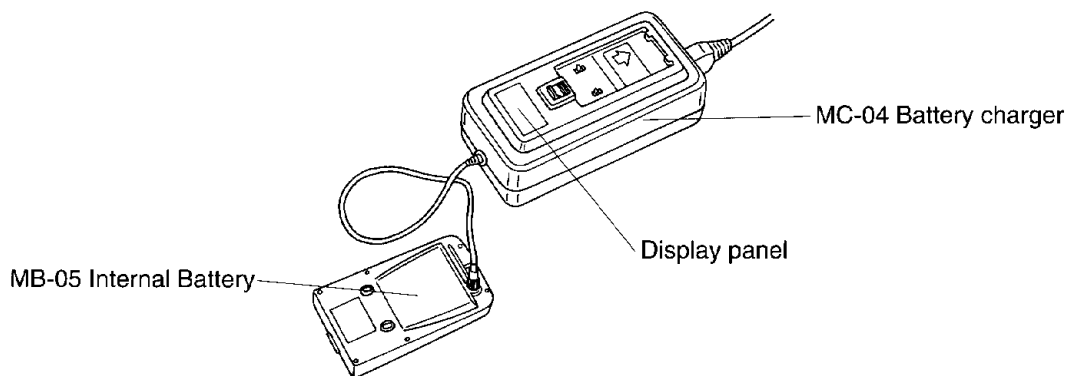
- ⊙ When taking the battery out of the instrument, the power supply must first be turned off. Leaving the power supply on when the battery is taken out can cause a breakdown.
- ⊙ Never short the battery terminals.
Shorting these terminals produces a strong electrical current which can not only damage the battery, but cause fire as well.
- ⊙ Using any battery charger other than the dedicated charger designed for this instrument can cause a breakdown.
- ⊙ To avoid damaging the battery, be careful never to drop it, immerse it in water, or disassemble it. Also, the battery should not be stored in locations where it is exposed to high temperatures or humidity, or direct sunlight.
- ⊙ If the battery happens to get wet, immediately wipe off the water, and place it in a dry place to allow it to dry thoroughly. To avoid breakdowns, do not install it in the equipment until it is completely dry.

4 INFORMATION ABOUT OPERATION

(3) Charging the battery

The "General-Purpose Charging Unit MC-04" provided as an accessory should be used to charge the battery. Before charging the battery, please read the instruction manual that comes with the MC-04.

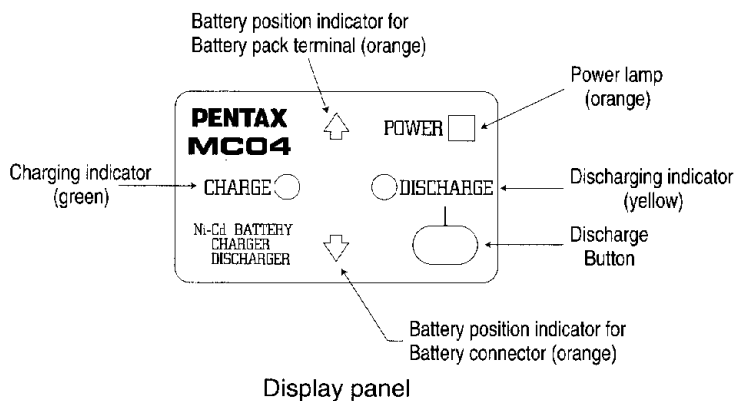
- Insert the AC plug on the charging unit into an AC power outlet.
- Plug the "EXT" cable on the charging unit into the battery connector. The "↑ or ↓" lamp blinks and the "CHG" (Charge) lamp on the charging unit turns on.
- The charging lamp goes out, indicating that the battery is fully recharged.



(4) Refreshing the battery

One of the characteristics of Ni-Cd batteries is that, if the battery is repeatedly recharged before it has completely run down, a "memory effect" causes the amount of time that the battery can be used to be shortened, even though the battery has been fully charged. The battery voltage can be recovered, and the full operating time restored, by discharging the battery completely and then charging it.

- Press the "DISCHG" (Discharge) button in the procedure of above (3) b.
- When the battery has been fully discharged, the "CHG" (Charge) lamp lights, and the charging process begins automatically.

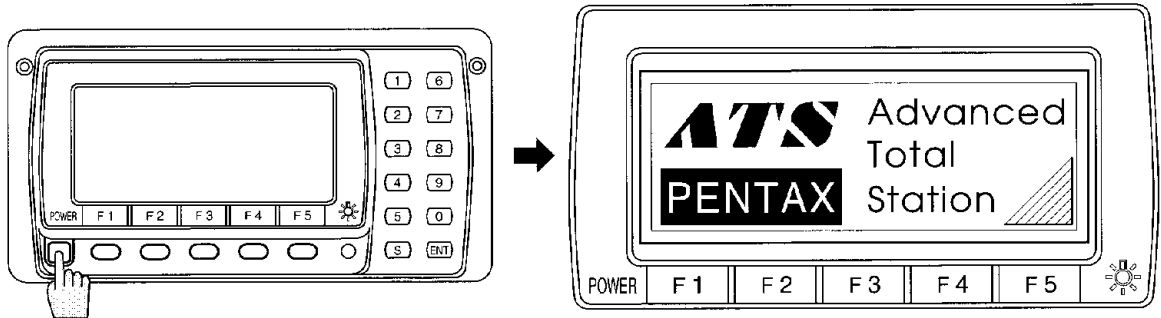


4 INFORMATION ABOUT OPERATION

4.1.9 Turning the Power On and Off

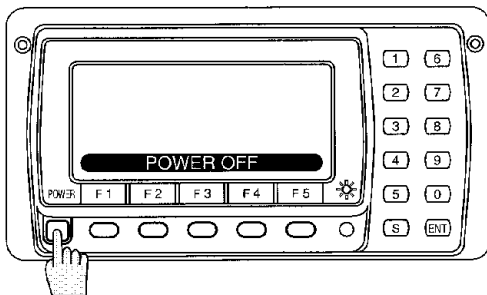
(1) Turning the power on

Pressing the “Power” key turns on the power and displays the following on the LCD panel:



(2) Turning the power off

In order to avoid erroneous operation, this instrument is designed so that, while the main unit is in operation, the program itself controls the “Power” key, and pressing the key will not turn off the power. The “Power” key is effective only when the power can safely be turned off.



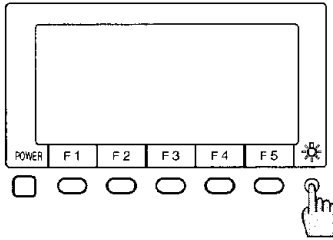
The “POWER OFF” is displayed and blinks when “Power” key is pressed for about 2 seconds and Power is turned off sounding a buzzer.

4 INFORMATION ABOUT OPERATION

4.1.10 Operating the “Illumination” Key

The “Illumination” key is used to light up the main LCD display panels, dual sides, and the telescope reticule.

(1) Turning the illumination on and off

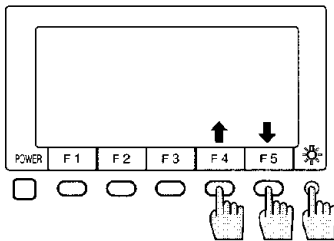


- Pressing the “Illumination” key turns on the illumination.
- Pressing the “Illumination” key once again turns off the illumination.

(2) Automatic cancelling of the illumination

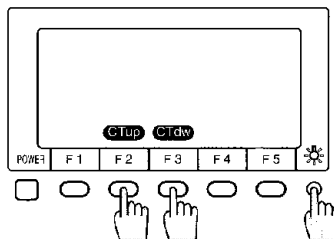
After the illumination has been turned on, it goes off automatically after three minutes. The user can specify the amount of elapsed time before the illumination is turned off. (For information on this procedure, please see Section 9.9 of the ATS Series instruction manual, TS kernel program version.)

(3) Adjusting the brightness of the illumination



- Holding down the “Illumination” key and pressing the “F4” key brightens the lighting
- Holding down the “Illumination” key and pressing the “F5” key dims it.

(4) Adjusting the LCD contrast



- Holding down the “Illumination” key and pressing the “F2” (CTup) key increases the contrast
- Holding down the “Illumination” key and pressing the “F3” (CTdw) key decreases the contrast

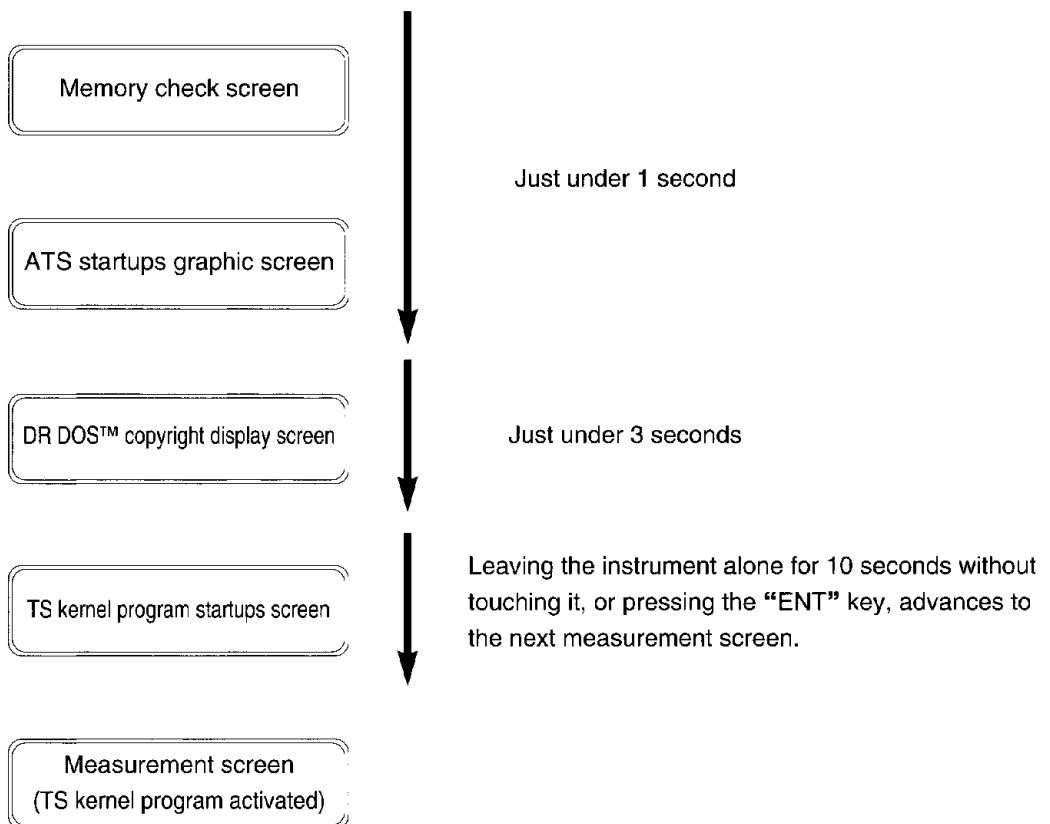
4 INFORMATION ABOUT OPERATION

4.2 Preparation before using the Equipment

4.2.1 Inspection before starting work

Before setting out for the work site, always inspect the following points and make sure that there are no problems.

- (1) The perpendicular axis, telescope, fine adjustment screws, securing knobs, and all other rotating or moving parts function smoothly.
- (2) There is no extreme error in the level vials or the optical plummet.
For information on inspecting these, please see Chapter 5, "Inspection and Adjustment"
- (3) Make sure spare batteries, a spare plumb bob, extra tools, and any other necessary items have been put in the case.
- (4) Make sure that, when the power is turned on, the initial screen is displayed on the LCD panel and the computer system starts up with no problems.



CAUTION

- ⊙ The equipment should always be inspected before beginning work, to confirm that the correct precision is maintained. Pentax cannot accept any responsibility for surveying results which are adversely affected because the equipment was not inspected.

4 INFORMATION ABOUT OPERATION

(5) Checking the calendar/clock

To check the calendar/clock (date and time) settings, please refer to Section 8.3, "Date and Time Display" of the instruction manual (TS kernel program version).

If the set time is widely off from the actual time, or the date is off, please take the instrument back to the place where it was purchased and have it adjusted.

(6) Make sure the battery is sufficiently charged.

The remaining battery capacity can be seen by looking at the battery mark displayed at the upper right of the LCD panel. The battery mark changes depending on the battery capacity, as shown below:



--- Battery is fully charged (7.6 V or more)



--- Battery is sufficiently charged (7.4 - 7.6 V)



--- Battery can still be used (7.2 - 7.4 V)



--- Battery can be used for a short time (7.0 - 7.2 V)



--- Battery should be replaced soon (6.8 - 7.0 V)



--- Battery must be replaced immediately (6.6 - 6.8 V)

Display is flashing

--- Power supply will be turned off (6.6 V or less)

Power shut off

(6.0 V)Buzzer sound

(Note) The power is turned off after 2 or 3 seconds of blinking.

4 INFORMATION ABOUT OPERATION

- (7) Make sure that the distance measurement function is working normally.
Sight a prism which has been set at an appropriate distance, and press the "F4" (Meas) key to make sure that the distance can be measured.
- (8) Make sure that the angle measurement function is working normally.
Rotate the instrument and confirm that the Angle display is changing smoothly.
When the instrument is rotated and the compensator is working, the V. angle and H. angle blink temporarily until the compensator becomes stable and the display returns to the normal situation for a second or 2 seconds.

CAUTION

- ⊙ The battery mark displayed on this instrument indicates the amount of battery power remaining, but should be used as a guide, not a precise reading. The length of the time that the battery can be used varies depending on elements such as the usage conditions, the ambient temperature, and the measurement conditions of the instrument, so the battery should be replaced in plenty of time before it runs out.

4.2.2 Confirming the Application Program

The ATS Series is designed so that application programs can be switched as necessary, in order to match the objective. The following application programs will be available:

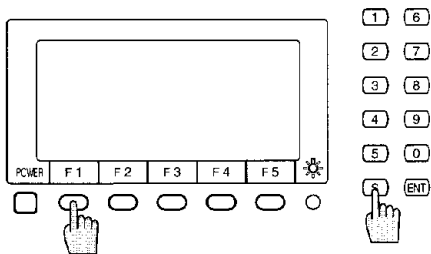
For surveying: PK-01

For other purposes:

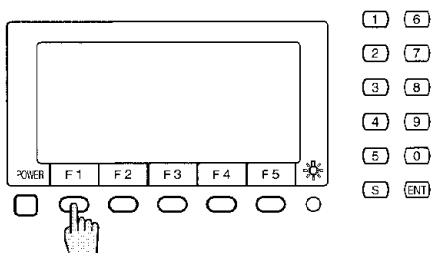
For easy surveying: PK-11

For coordinate stakeout: PK-21

Before setting out for the work site, the necessary programs should be registered in the instrument.



- a. Holding down the "S" key, press the "F1" (APPLI) key.
- b. A list of registered programs is displayed. Check to make sure it contains desired target program.



- c. Press the "F1" (ESC) key to return to the original display.
If the desired program has not been registered: Set the program to the ATS instrument according to the each instruction manual.

4 INFORMATION ABOUT OPERATION

4.2.3 IC Memory Card for Data Storage

(1) Checking the capacity

- a. The 3rd line from the bottom of the TS kernel program startups screen shown in Section 4.2.1 (4) displays the amount of memory remaining on the IC memory card which can be used for data storage. Check the remaining capacity displayed on this line. The amount of remaining memory must be larger than the amount of data to be stored on the card. The volume of data registered varies depending on the application program and the survey method, so please refer to the instruction manual for that particular application package for specific information.
- b. If there is any data which is no longer needed, delete it before storing new data. Before deleting data from the IC memory card, check to make sure it has been transferred to a computer or another storage device. For information on the procedure for deleting data, please refer to the instruction manual for the application program.

(2) Formatting a new card

IC memory cards are formatted using the "Card Format" function in the application. Cards must be formatted before they can be used. They can also be formatted using the formatting function on a computer which is equipped with an IC memory card drive.



CAUTION

◎ IC memory cards which can be used:

JEIDA V. 4.2 Type 1 card (SRAM) or PCMCIA V. 2.0 Type 1 card (SRAM)

4 INFORMATION ABOUT OPERATION

4.3 Cleaning and Storing the Equipment after Work

(1) Cleaning

- a. Wipe metallic parts clean using a silicon cloth.

Parts which are especially dirty can be cleaned by wiping them with a cloth dipped in a neutral cleaning agent.

- b. For optical components, use a lens brush to clean away dirt and dust.

(2) Storage

- a. If the instrument is not to be used for a long period of time, it should be stored out of the case.

- b. The battery should be charged periodically (about once a month) and the instrument operated.

This is necessary in order to maintain the internal battery which operates the calendar/clock.

- c. Data stored on the card should be transferred to a computer or another storage device as soon as possible.



CAUTION

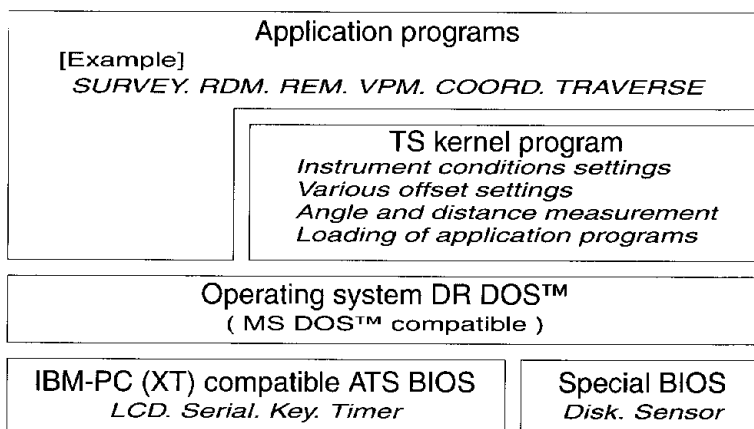
- ⊙ When cleaning plastic parts of the instrument, never use organic solvents such as gasoline, thinner, or ethyl. Organic solvents can dissolve the surface of the plastic and cause deformation.

5 INFORMATION ABOUT THE SOFTWARE

5.1 Software Configuration and Operation

(1) Configuration

Software programs for the ATS Series consist of an operating system and an application program, just like those for regular computers. The operating system, which is the MS DOS™ compatible OS (DR DOS™ system designed by Nobel Corporation), is contained in the ROM. There are two kinds of application programs: those which are common to all ATS Total Stations (TS kernel program) and those created especially for a particular application.



(2) Operation

The application software programs are housed in the various drives of the ATS main unit, and turning on the power supply starts up the program automatically. They can therefore be used without paying any particular attention to the computer.

- a. Turning on the power starts up the operating system, runs a check of the various components, and enters settings for the necessary conditions.
- b. Next, the TS kernel program is run, and the settings for the conditions specific to the Total Station are entered. Data is acquired from various sections such as the angle measurement unit, the power supply, and the weather sensor unit, and is displayed. The system is now ready for keyboard input.
- c. The application program is read from the TS kernel program and run.

5 INFORMATION ABOUT THE SOFTWARE

5.2 Application Programs

The application programs of ATS are supplied by our several package programs and they can be created according to your request.

Except for the display screens and keyboard, the ATS Series computer system is compatible with that of the IBM PC-XT. Consequently, if a few elements such as control of the various parts of the Total Station, small display screens, and special keyboard functions are taken into consideration, the user can create his or her own application programs for the ATS Series, to supplement those available through Pentax.

Technical information pertaining to application development can be obtained by contacting the sales outlet where the instrument was purchased.

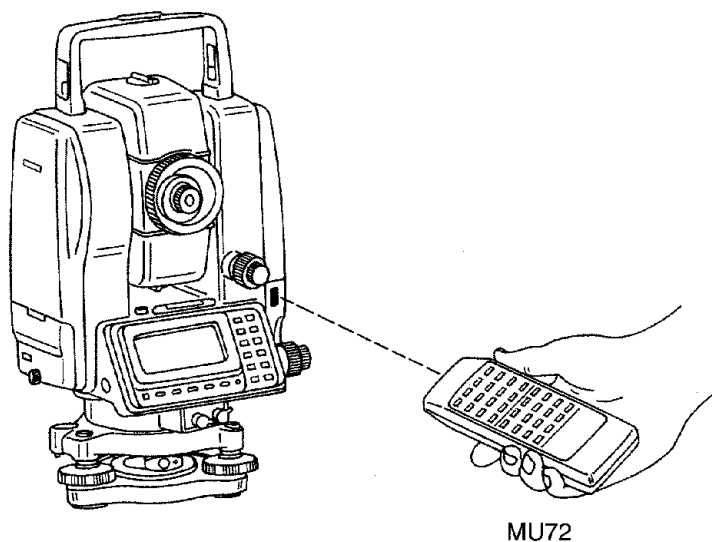
6 REMOTE CONTROL KEYBOARD [MU72]

Some application programs and some surveying operations need "Alphabetic character input" frequently. The optional MU72 can input these Alpha characters most efficiently. You can perform not only character input but also all ATS instrument operation functions.

6.1 Handling the Remote Control Keyboard

The MU72 is a Remote Control Keyboard employing an infrared beam. A signal which corresponds to the pressed key is emitted from the beam aperture located at the front end of the keyboard. The ATS instrument receives this signal at a window located on the right standard cover.

- (1) Insert the 2 x AAA batteries before using the Keyboard. The power supply of the instrument is turned on only when the key is pressed and the Infrared signal is emitted.
- (2) Operate the MU72 holding it by the angle less than 45° facing the instrument window.
- (3) MU72 is not water-proof but can be used while inside of a bag of transparent vinyl or similar.



6 REMOTE CONTROL KEYBOARD [MU72]

6.2 Operation

There are 3 types of key-modes in Remote Control Keyboard. Function, Character and Mark mode are operated according to the situation of the ATS instrument.

(1) Default mode

When the power supply of the instrument is turned on, the following keys respond.

When the character input screen of ATS is displayed, a black square cursor blinks.

4 keys at uppermost line: ALPHA, MARK, ALT and S


Function keys: F1 ~ F5

Cursor shift keys: Functions written in yellow color

Edit keys: Functions written in white color

Figure keys: Functions written in green color

(2) Alphabetic input mode

Pressing the [ALPHA] key changes into the alphabetic input mode. This mode is held until the [ALPHA] key is pressed again to return to default mode. The cursor () blinks when the Character input screen of ATS is displayed. Following keys respond.


4 keys at uppermost line: ALPHA, MARK, ALT, S

Alphabetic keys: Functions written in black color

[Bs] key

[ENT] key

(3) Mark input mode

Pressing the [MARK] key changes into MARK input mode. This mode changes to [ALPHA] mode after any mark is input. The cursor () blinks when the character input screen of ATS is displayed. Following keys respond.

4 keys at uppermost line: ALPHA, MARK, ALT, S

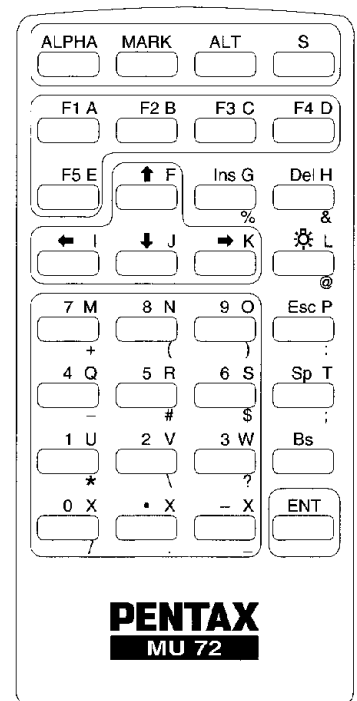
Function keys of F1`F5

Cursor shift key: Functions written in yellow color

Mark keys: Functions written in red color

[Bs] key



[ENT] key



Keyboard

(4) [ALT] key

The [ALT] key performs the equivalent function as continuing to press the [S] key of the ATS.

The cursor () blinks when the character input screen of ATS is displayed. Every key which is operated by pressing the [S] key of the ATS responds. After this operation, the mode returns to Alphabetic mode ().

(5) [S] key

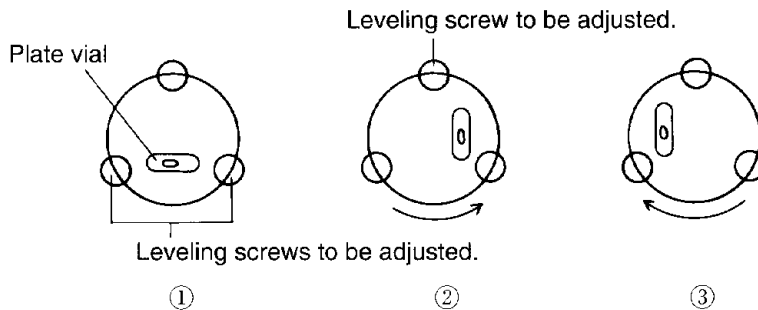
The [S] key is equivalent to the [S] key of ATS. The function displayed at the lowermost line of the screen, LCD, is changed whenever this key is pressed. The key mode is not changed.

7 INSPECTION AND ADJUSTMENT

7.1 Plate vial

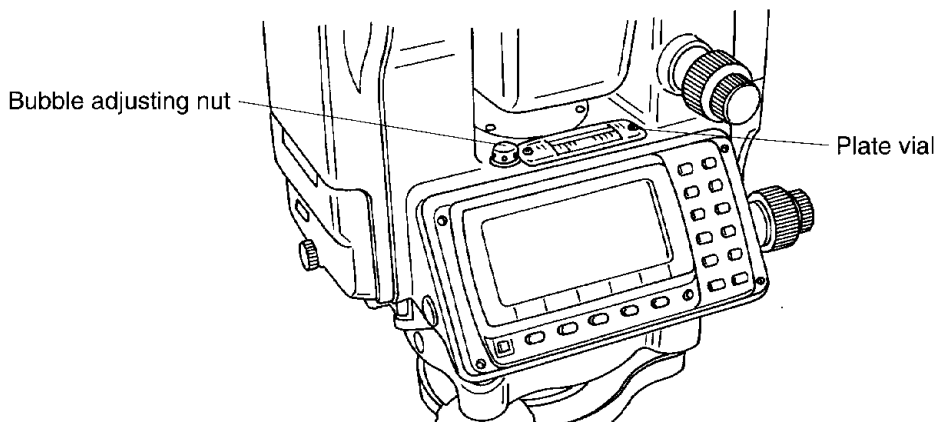
Inspection

- ① Align the plate vial in parallel with a line joining any two of the leveling screws. Then, adjust the two screws to center the bubble in the vial.
- ② Rotate the 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.



Adjustment

- ① If the bubble of the plate vial moves from the center, bring it half way back to the center by adjusting the leveling screw(s) which is parallel to the plate vial.
- 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.



7 INSPECTION AND ADJUSTMENT

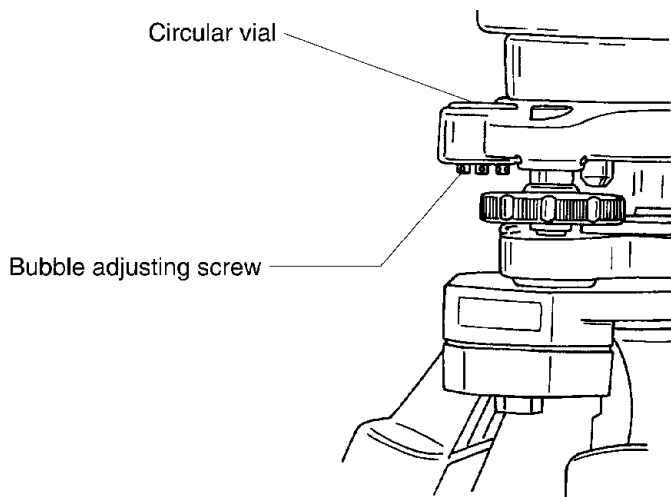
7.2 Circular vial

Inspection

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

Adjustment

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

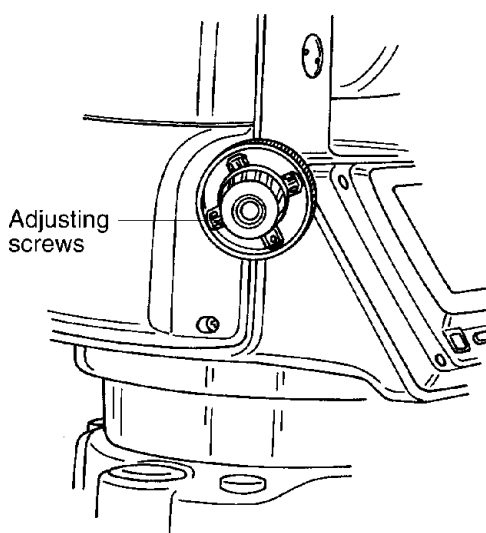
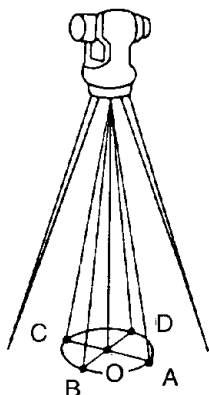


7 INSPECTION AND ADJUSTMENT

7.3 Optical plummet

Inspection

- ① Set the instrument on the tripod, and place a piece of white paper with a cross drawn on it right under the instrument.
- ② Look through the optical plummet, and move the paper so that the intersecting point of the cross comes to the center of the field of view.
- ③ Adjust the leveling 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° 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.



Adjustment

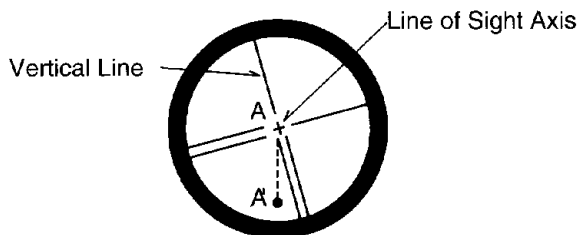
- ① If the center mark does not coincide with the intersecting point, rotate the optical plummet focusing knob cover and remove it.
- ② Mark the point set on the line of sight at each step of 90° on the white paper and call them A, B, C and D.
- ③ Join the opposed points (A,C and B,D) with a straight line, and set the intersecting point O.
- ④ Turn the four optical plummet adjusting screws with an adjusting pin so that the center mark coincides with the intersecting point O.
- ⑤ Repeat from ④, and check that adjustment is correct.

7 INSPECTION AND ADJUSTMENT

7.4 Reticle

Inspection

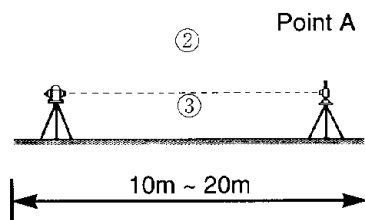
- ① Set an object A on the line of sight through the telescope.
- ② Move point A to the edge of the field of view by adjusting the telescope tangent screw (point A').
- ③ No adjustment is necessary if point A moves along the vertical line of the reticle.



If the point A is widely off the vertical line of the reticle, contact your local dealer for adjustment.

7.5 Perpendicularity of line of sight to horizontal axis

- ① Set an object point A at a distance of 10m ~ 20m away from the instrument.
Precisely level the instrument and turn the power on.
- ② Sight the telescope at point A and read the horizontal angle.
(Example) Horizontal angle $10^{\circ} 13' 10''$ – (a) (Normal position)
- ③ Reverse the telescope and loosen the upper clamp screw. Rotate the instrument to sight the point and read the horizontal angle.
(Example) Horizontal angle $190^{\circ} 13' 20''$ – (b) (Reversed position)
- ④ $b - a = 180^{\circ} 00' 10''$
- ⑤ No adjustment is necessary when the value in ④ is about $180^{\circ} \pm 20''$.



If the value $(b - a)$ is larger than $180^{\circ} \pm 20''$, contact your local dealer.

7 INSPECTION AND ADJUSTMENT

7.6 Vertical O point error

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

Inspection

- ① Set up the instrument and turn the power on.
- ② Sight the telescope at any reference target A. Obtain vertical angle (γ).
- ③ Reverse the telescope and rotate the alidade. Sight again at A and obtain vertical angle ℓ .
- ④ If $\gamma + \ell = 360^\circ$, no further adjustment is necessary.

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

7 INSPECTION AND ADJUSTMENT

7.7 Offset constant

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

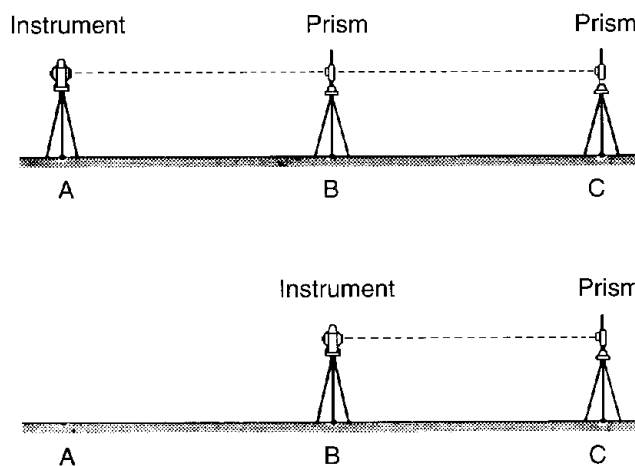
The inspection of the offset constant can be done on a certified base line. It can also be obtained in a simple way as described below.

Inspection

- 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 \overline{AB} and \overline{AC} .
- ③ Set up the instrument at point B, and measure the distance \overline{BC} .
- ④ Obtain the offset constant (K):

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

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



7 INSPECTION AND ADJUSTMENT

7.8 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.

Inspection

- ① Set the prism at a distance greater than 50m.
- ② Accurately sight the center of the prism through the telescope.
- ③ Turn the power on 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.

- If instrument function is not as described in ④, contact your local dealer.
- This inspection should be done under good weather conditions.

Cautions on Inspection and adjustments

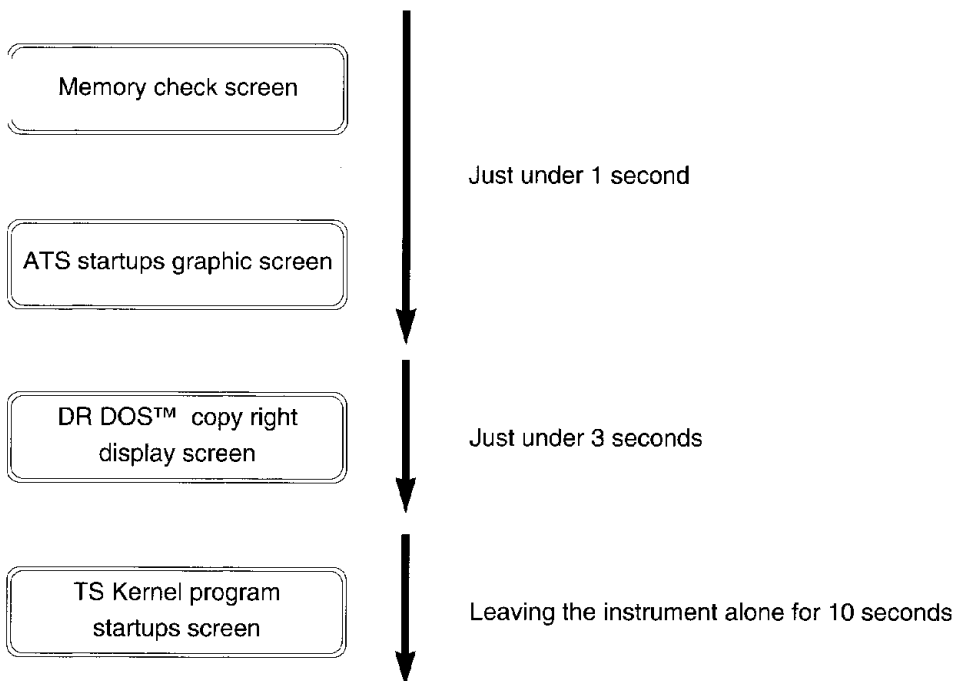
- ◇ Make all inspection and adjustments in numerical order.
- ◇ Be sure not to make inspection and adjustment on "Perpendicularity of line of sight to horizontal axis" prior to those on "Reticle".
When making adjustments on "Reticle" and "Perpendicularity of line of sight to horizontal axis", be sure to make inspection on "Vertical 0 point error" and "Beam axis and line of sight".
- ◇ 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 inspection after adjustment, and check if the instrument has been adjusted properly.

7 INSPECTION AND ADJUSTMENT

7.9 Calendar/Clock

Inspection

a. Turn on the power supply



b. For information on inspecting the calendar/clock, please see Section 8.3 of the Instruction Manual, TS Kernel Program Version, "Date and Time Display", and follow the instructions.

Adjustment

Time and date are set not to be able to adjust directly to secure the observation reliability.

Please contact dealer or our company if time or date has many discrepancy.

CAUTION

⊙ The period of time for which the calendar/clock can be operated solely by the rechargeable battery incorporated, in this instrument, is approximately 1 month. Make sure the instrument is operated at least once a month in order to keep the battery charged. (The backup battery is charged when the power supply to the instrument is turned on.)

If more than a month has passed since the instrument was last used, be sure to check the date and time.

8 EXTERNAL BATTERY

For longer continuous measurement, use the external battery MB22 (optional accessory).

When both the on-board battery and external battery are turned on, the power supply from on-board battery is automatically cut off.

8.1 External battery (MB22) specifications

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

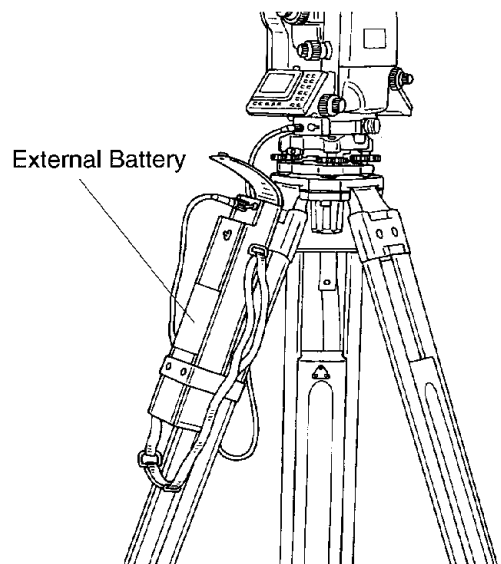
8.2 External battery charger (MC22) specifications

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

8.3 Usage

- ① Fit the external battery on the tripod and attach its connector and the external battery connector of the instrument using the power supply cord.
- ② Turn on the power supply switch of the external battery.

■ The AUTO POWER OFF function is not available when the external battery is in use.

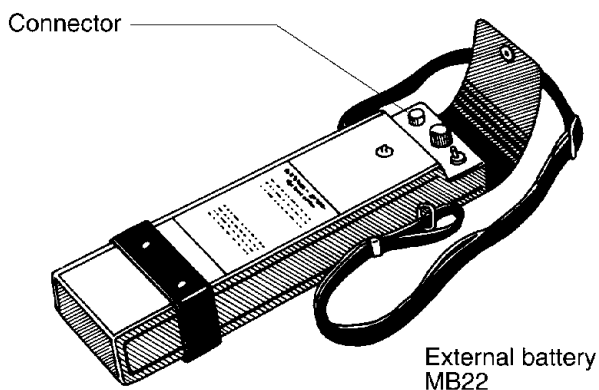
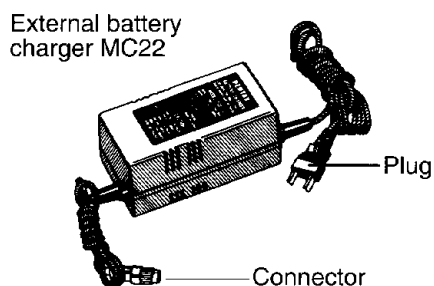


8 EXTERNAL BATTERY

8.4 Charging

- ① Attach the connector of the external battery charger MC22 to that of the external battery.
- ② Insert the plug of the battery charger into a wall socket (AC120V, 220V, 50 / 60Hz).
- ③ Turn on the power supply switch of the battery and check that the indicator light of the battery charger lights.
- ④ After 14~16 hours, turn off the power supply switch and remove the connector and plug.

■ Charging time should be shorter than 24hours.



NOTE:

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

9.1 Tri Axis Compensation (Inclination compensation)

The ATS series are capable of compensating the error caused by the inclination of the vertical axis in X and Y directions as well as the error with the line of sight due to the instrument inclination.

ON / OFF selection of the compensation is made in accordance with the necessity of it depending on the type of measurement. Furthermore, any of single, dual or tri axis compensation can be selected when the compensation is ON.

The single axis compensation makes the correction which is calculated based on the amount of mis-level in the X axis (first axis). The X axis is the one which is in line with the sighting direction of the telescope. The mis-level is measured by the compensator and the correction is applied to the vertical angle reading.

The dual axis compensation makes the correction which is calculated based on the amount of mis-level in the Y axis (second axis) in addition to the correction in X axis. The Y axis is the one which is at 90° to the sighting direction of the telescope. The mis-level is measured by the compensator and the correction is applied to the vertical angle reading.

The error caused by the inclination of the vertical axis can not be corrected even by performing a pair of angle measurement with the telescope in both normal and reversed positions. The ATS series equipped with a dual axis compensator can provide precise vertical angle measurement. The slight change of the horizontal angle is also found when moving the telescope upward or downward.

In the tri axis compensation, another correction is made in addition to the dual axis compensation. This correction is calculated based on the error in the telescope line of sight (third axis). This correction is applied to the horizontal angle reading. When applying the correction to the sight axis, the error with the line of sight is always corrected. It provides the precise measurement result as if the measurement is done with the telescope in both normal and reversed positions although it is made with the telescope in either normal or reverse position.

When setting a vertical line by sighting the upper and lower positions, for instance, the measurement with the telescope in normal and reversed positions are needed to delete the error unless correction of sight axis is made. Correction of sight axis makes it possible to obtain the same precise result even by the measurement with the telescope in either position.

Sight the ground point, and set the horizontal angle to 0. Aim the telescope upward. The horizontal angle reading slightly changes. This changed reading of the horizontal angle is the amount of errors with angle and sight axis, which should be corrected. Set the horizontal angle to 0° 00' 00" and sight again. Corrected vertical line is obtained.

9 APPENDIX

9.2 Atmospheric refraction and earth curvature

- The effects of atmospheric refraction and earth curvature can be automatically compensated for measurements of horizontal distance and difference in height.
- Compensation for atmospheric refraction and earth curvature are provided according to the following formula.
- When compensation of atmospheric refraction and earth curvature are valid:

Compensated horizontal distance (H)

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

Compensated difference in height (V)

$$V = S \left(\sin \alpha + \cos \alpha \cdot \frac{1-K}{2R_e} \cdot S \cdot \cos \alpha \right)$$

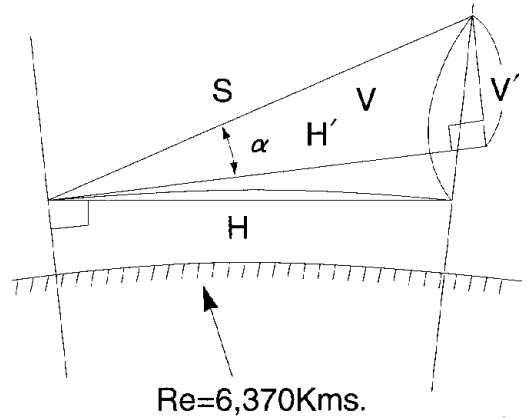
H.Distance H'	=S · Cos α
Difference in height V'	=S · Sin α

S: Slope distance

α: Vertical angle from horizontal

K: Atmospheric refraction coefficient (0.14 or 0.2)

Re: Radius of the earth (6,370kms.)



9.3 Atmospheric correction

The velocity of the EDM beam, traveling through the atmosphere varies according to the temperature and atmospheric pressure. Corrections of both factors are necessary in order to measure the distance precisely, because distance measurement is based on the velocity of the beam.

The PTS-V displays the automatically compensated value once the prevailing temperature and atmospheric pressure are entered. The formula of compensation is as follows.

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

K: Compensation coefficient

P: Atmospheric pressure (mmHg)

T: Temperature (°C)

9 APPENDIX

9.4 Deviation of distance when no atmospheric correction is made

Factory setting of values of atmospheric factors are 15°C in temperature and 760mmHg in atmospheric pressure. When the surrounding conditions differ from the factory setting, corrections of atmospheric factors are needed to avoid the measurement error. Following tables show the error per 100m or 500ft. when no corrections are made.

1) mmHg (Reference PPM value : 15°C, 760mmHg)

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	3.3	0.8	-3.3	-7.4	-11.5

Unit:Millimeter

2) InHg (Reference PPM value : 50°F 29.9InHg)

InHg \ °F	33.0	29.9	28.0	26.0	24.0	22.0	20.0	17.0
140	-.0925	-.0705	-.0570	-.0430	-.0290	-.0145	-.0010	.0200
113	0	.0130	.0210	.0295	.0380	.0465	.0550	.0680
86	-.0065	.0070	.0150	.0240	.0330	.0420	.0510	.0640
59	-.0140	0	.0090	.0180	.0275	.0370	.0460	.0605
32	-.0225	-.0070	.0015	.0115	.0215	.0315	.0410	.0560
5	-.0320	-.0160	-.0060	.0040	.0145	.0250	.0355	.0510
-22	-.0425	-.0255	-.0150	-.0040	.0070	.0180	.0290	.0455

Unit:Feet

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

10.1995 First edition
05.10.1996 Second edition
TS00402E
Printed in Japan