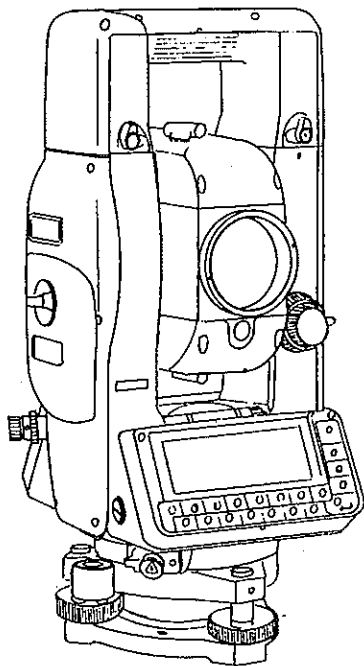


***Nikon***

**Field Station**

**DTM-801 series**

**REPAIR MANUAL**



**NIKON GEOTECS CO., LTD.**

02.02.90

# REV. RECORD

RH-0024	REV. NUMBER : 0
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3	0		38	A	
4	A		39	A	
5	A		40	A	
6	A		41	A	
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10	A		45	A	
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## 1. Introduction

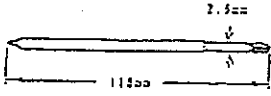
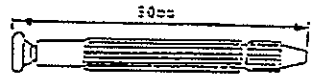




- This repair manual describes the product disassembly, reassembly, adjustment, and electrical adjustment procedures, in sequence.
- The electrical adjustment procedure for the encoder section is the same as that for the DTM-800-series Field Station, and the electrical adjustment procedure for the EDM section is the same as that for the DTM-500-series Total Station. However, some changes have been made. Be sure to read the repair manual and follow the instructions for adjustment.
- The manual is intended to facilitate your understanding of the configuration of mechanical and optical components, and necessary adjustments by describing all procedures in sequence from start to finish.
- When using an oscilloscope to monitor the detector signal, be sure to place a dark cover over the unit to prevent external light from entering the detector section.
- The manual is also organized so that each section can be referred to independently.
- The manual can be used as training TEXT in repair courses.
- Regarding parts, refer to the RH-0013A Parts List for the DTM-800-series Field Station.

## 2. Repair Information

Always remove the battery before disassembling the product.

- ★ To prevent losing the customer's data, be sure to copy and save the data in memory before starting repair work.
- Wear an anti-static wristband and perform work on an anti-static mat.
- When reassembling glass components, be sure to blow off surface dust and wipe the components using a lens tissue or clean cotton cloth moistened in lens cleaner or an alcohol-ether mixture.
- Use only the specified adhesives and lubricants.
- Using organic solvents (e.g. alcohol, acetone, thinner) to clean plastic or rubber parts may cause discoloration or deformation. To clean plastic and rubber parts, use an eraser or wash with a neutral detergent.
- Adhesive (#350) is applied to machine screws to prevent loosening. If screws are too tight to unscrew, use alcohol to dissolve the adhesive.
- Use the appropriate screwdriver to loosen and tighten screws.
- ★ In this manual, important information is indicated by "★." Be sure to read the sections marked "★" and follow the instructions given.

### 3. General Tools and Required Items

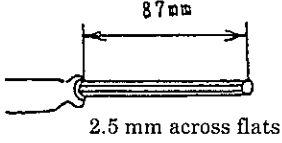
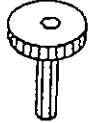
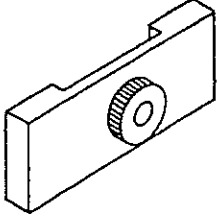

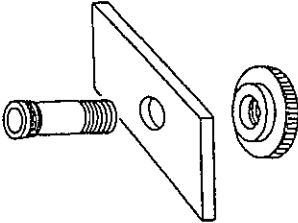
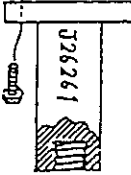
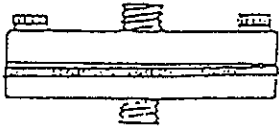
Tool No	Name	Outline
T91000	Screwdriver set (6-piece set)	
T91204	Screwdriver with wooden handle, 6-mm diameter	
T91102	Standard screwdriver with wooden handle, 5.5-mm width	
T91035	Screwdriver bit	
T91320	Screwdriver-bit holder	
T92041	Tweezers AA	
T92162	Compass wrench A	
T92163	Compass wrench B	
J5001	Hand lap (alcohol container)	
J21076	Allen wrench	Ballpoint

**Required items**

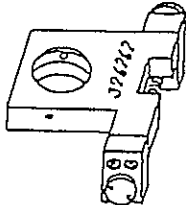
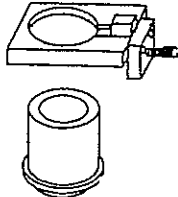

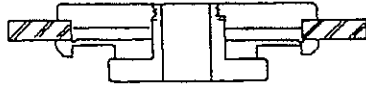
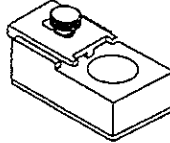
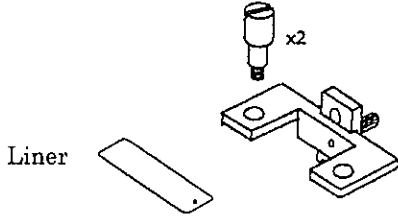
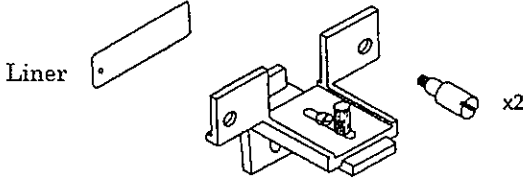
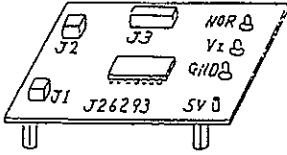
Storage oscilloscope, anti-static mat, lens tissue (E703), low-temperature solder, low-temperature soldering iron, lens cleaner (or alcohol-ether mixture), gasoline for cleaning, eraser (for cleaning support covers and other parts), neutral detergent, adhesive, lubricant (specified type)



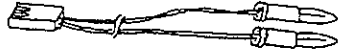


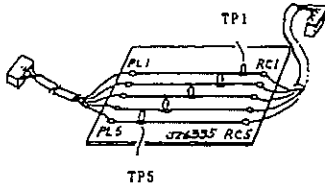
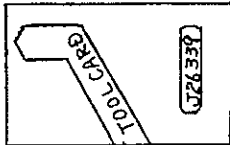
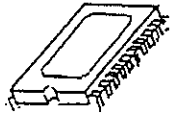
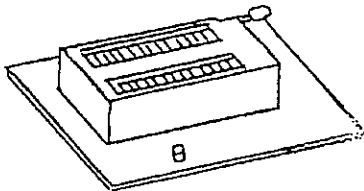
### 4. Tools for Exclusive use

Tool No	Name	Outline
J21995A	Hexagonal Bar screwdriver	
J26273	Special hex-key	
J26212A	Trunnion removing tool	
J26292	Trunnion-removing bolt (Male threads)	
J26270	Trunnion-removing tool for clamp tangent screw side	
J26261	H-encoder centering adjustment stand	
J26261A	J26261 centering adapter	

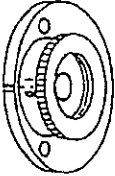


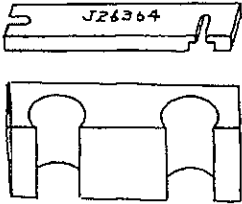

### 4. Tools for Exclusive use

Tool No	Name	Outline
J26262	H-encoder centering adjustment adapter	
J26338	H-encoder centering-adjustment-adapter guide	
J26309	H-encoder gluing tool	
J26334	V-encoder gluing tool	
J26336	Index gluing tool	
J26337H	H-index-gap adjuster	
J26337V	V-index-gap adjuster	
J26293	Zero-signal checker	

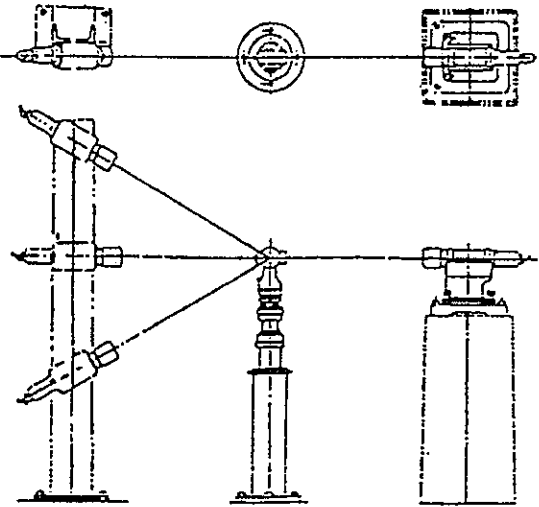
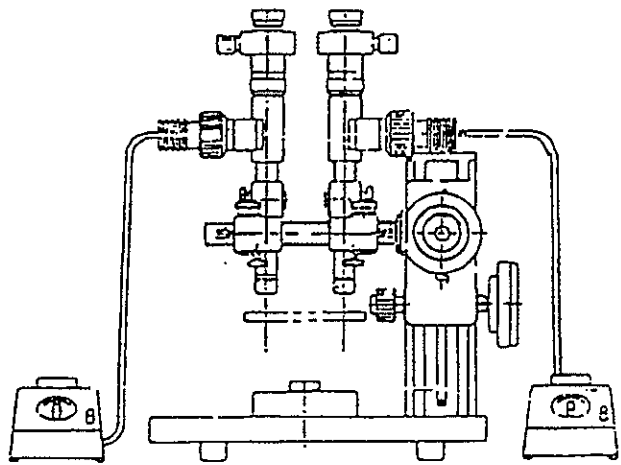
### 4. Tools for Exclusive use

Tool No	Name	Outline
J26293D	Power cable D	
J26293G	Power cable G	
J26317	Signal cable	
J26335	Signal checker	
J26339	Tool card	 <p data-bbox="734 1003 1377 1100">The tool card for the DTM-800 series can be used for the DTM0-801 series, and NPL-820/NPL-821 by updating the version.</p>
J26344E	DTM-801-series program master	 <p data-bbox="734 1302 1299 1335">J26344 for DTM-800 series cannot be used.</p>
J26355	Program installer 1	

### 4. Tools for Exclusive use

Tool No	Name	Outline
J26359	Fiber F adjuster	
J26360	EDM CPU board holder	
J26363	Fiber adjustment spacer	 Same as 2K146-250
J26364	Sector attachment tool	
J26365	Allen wrench	 0.89mm across flats
J26196H	J26196 modification kit	
J26196IJ	J26196NEW modification kit	DTM-350/330 can also be used. When J261961 is installed, this kit is not required for the product.

### 4. Tools for Exclusive use

Tool No	Name	Outline
HLB000AB	Collimator for surveying instrument	 <p>The configuration and specifications are subject to change without prior notice. The secondary/upward/downward collimator support and main collimator base are not included.</p> <p>Refer to the product manual for installation and operation instructions.</p>
HXA20307	Scale centering tool	 <p>The configuration and performance are subject to change without prior notice. Refer to the product manual for operation instructions.</p>

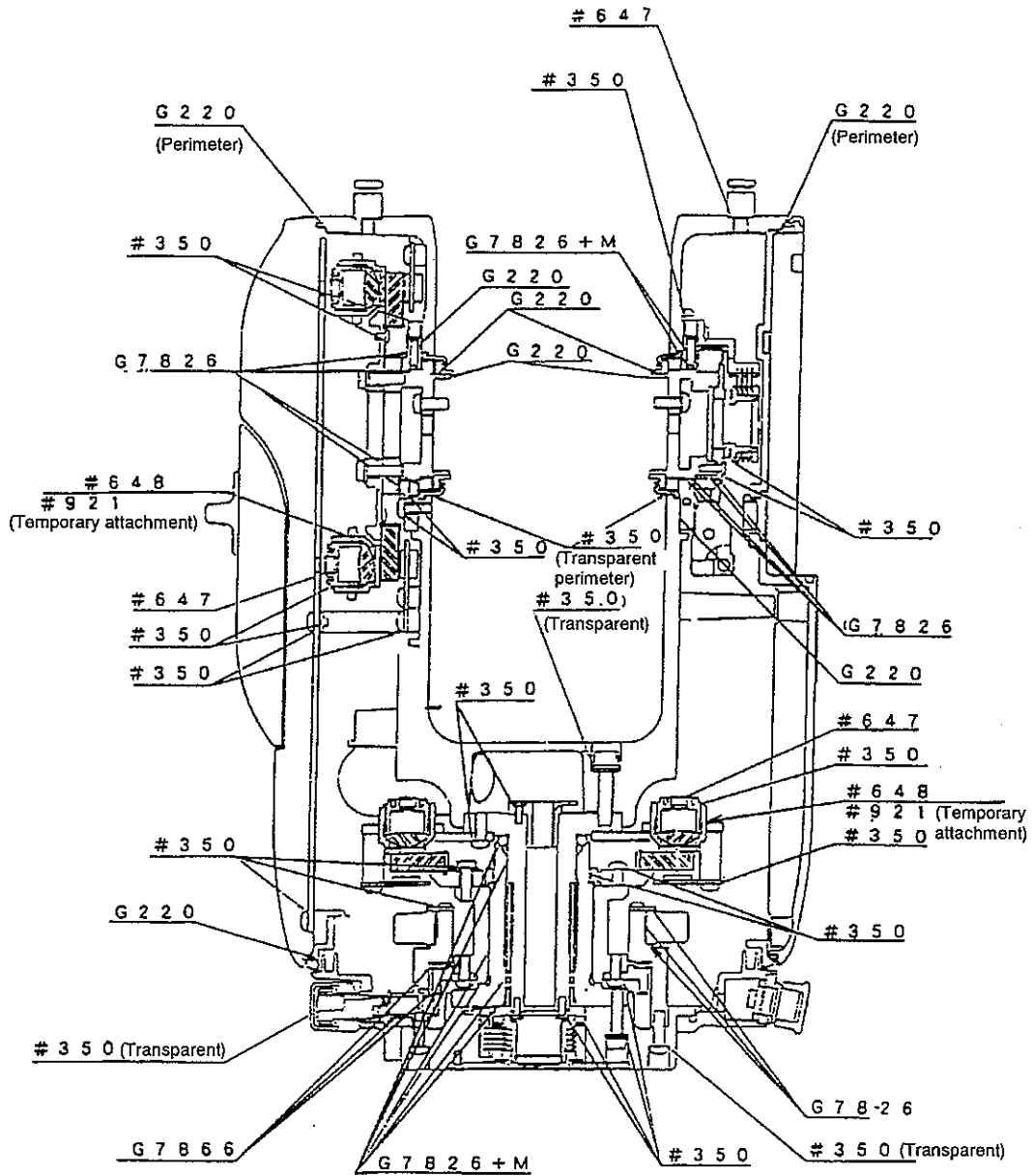
# 5. Lubricants and Adhesives

## Theodolite unit

The following reference diagram shows the theodolite fitted with a detachable leveling base. This diagram also applies to the lubricating system for the operating mechanisms of the theodolite fitted with a shift-type leveling base.

G or L: Lubricant

#: Adhesive



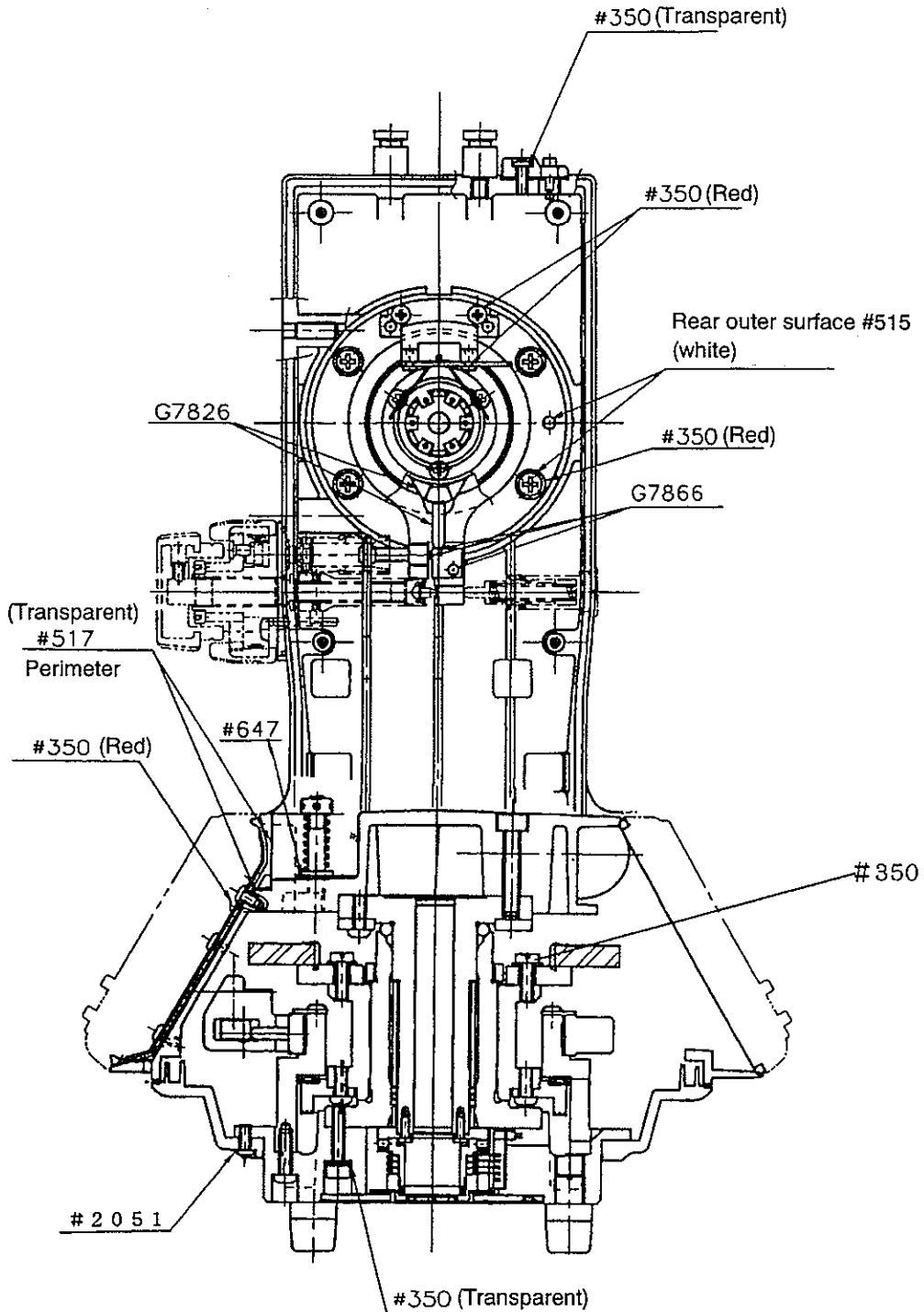
# 5. Lubricants and Adhesives

## Theodolite unit

The following reference diagram shows the theodolite fitted with a detachable leveling base. This diagram also applies to the lubricating system for the operating mechanisms of the theodolite fitted with a shift-type leveling base.

G or L: Lubricant

#: Adhesive

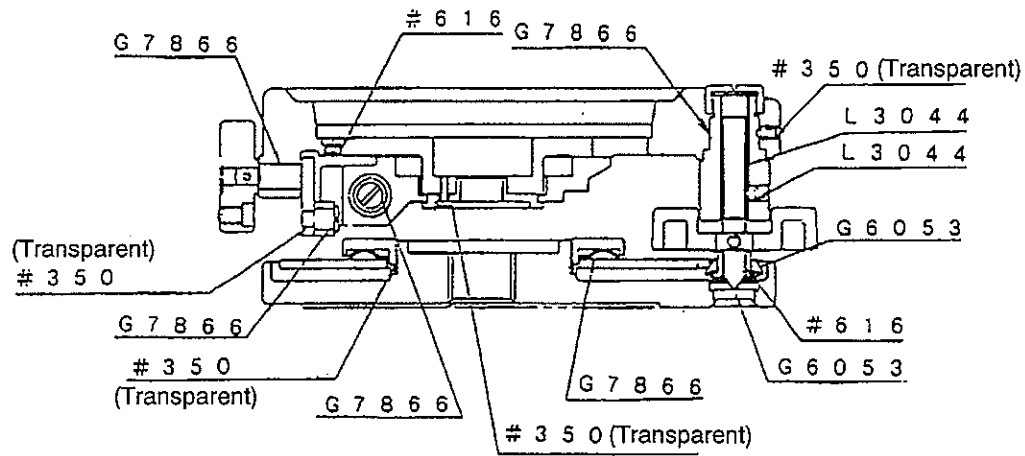


# 5. Lubricants and Adhesives

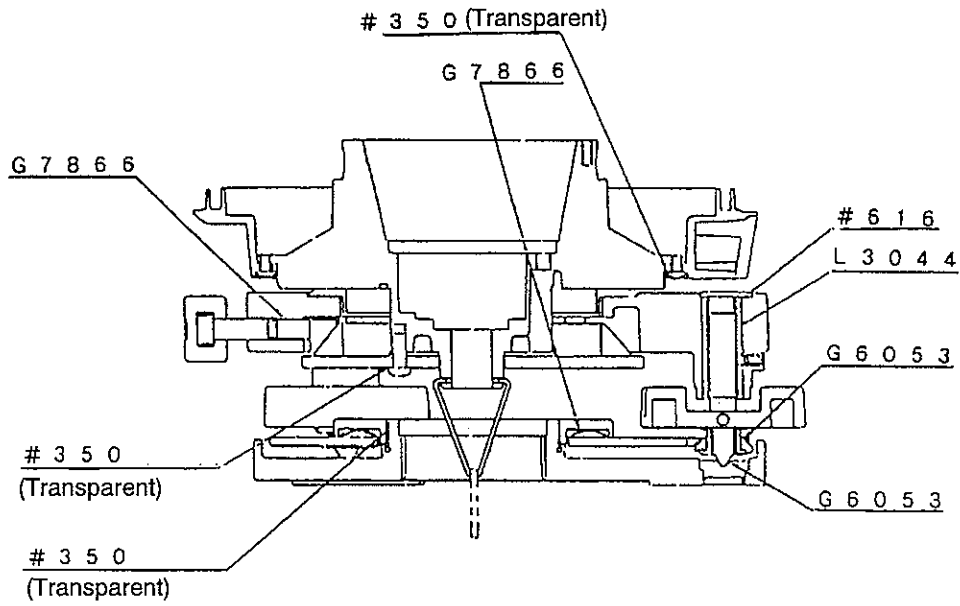
## Detachable leveling base

G or L: Lubricant

#: Adhesive



## Leveling base with shift device





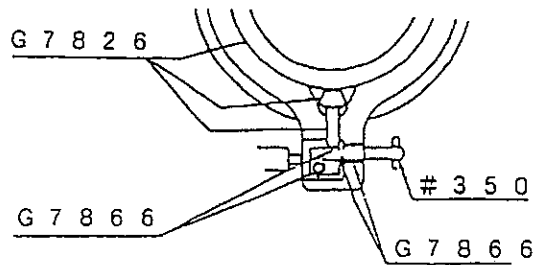
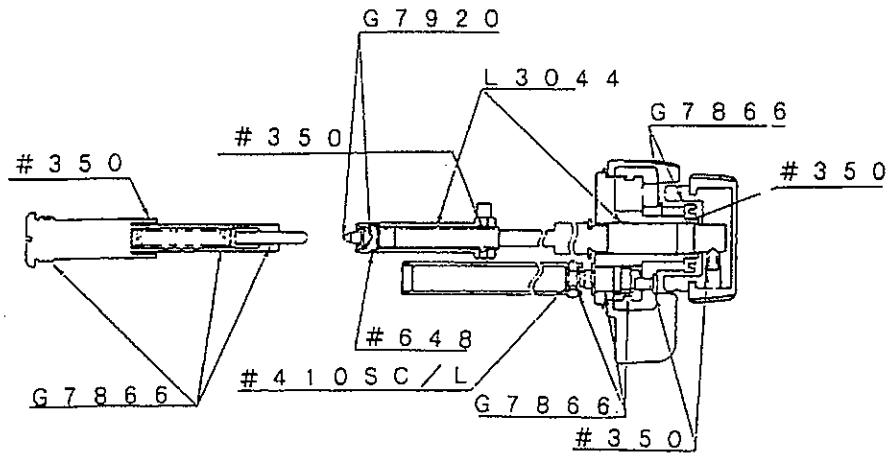
## 5. Lubricants and Adhesives

### Clamp and Tangent Screw

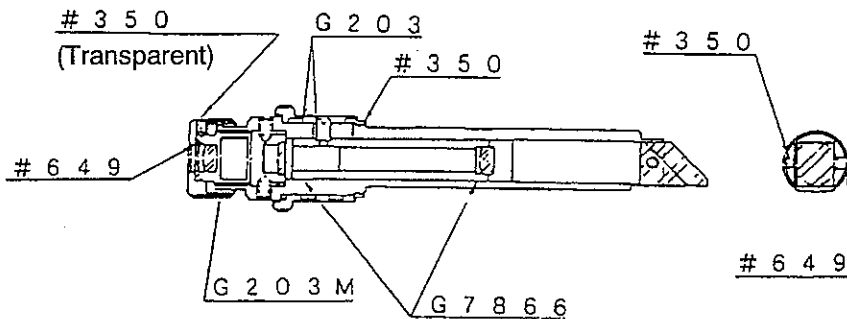
The following reference diagram shows the horizontal clamp and tangent screw. This diagram also applies to the lubricating system for the operating mechanisms of the vertical clamp and tangent screw.

G or L: Lubricant

#: Adhesive



### Optical plummet

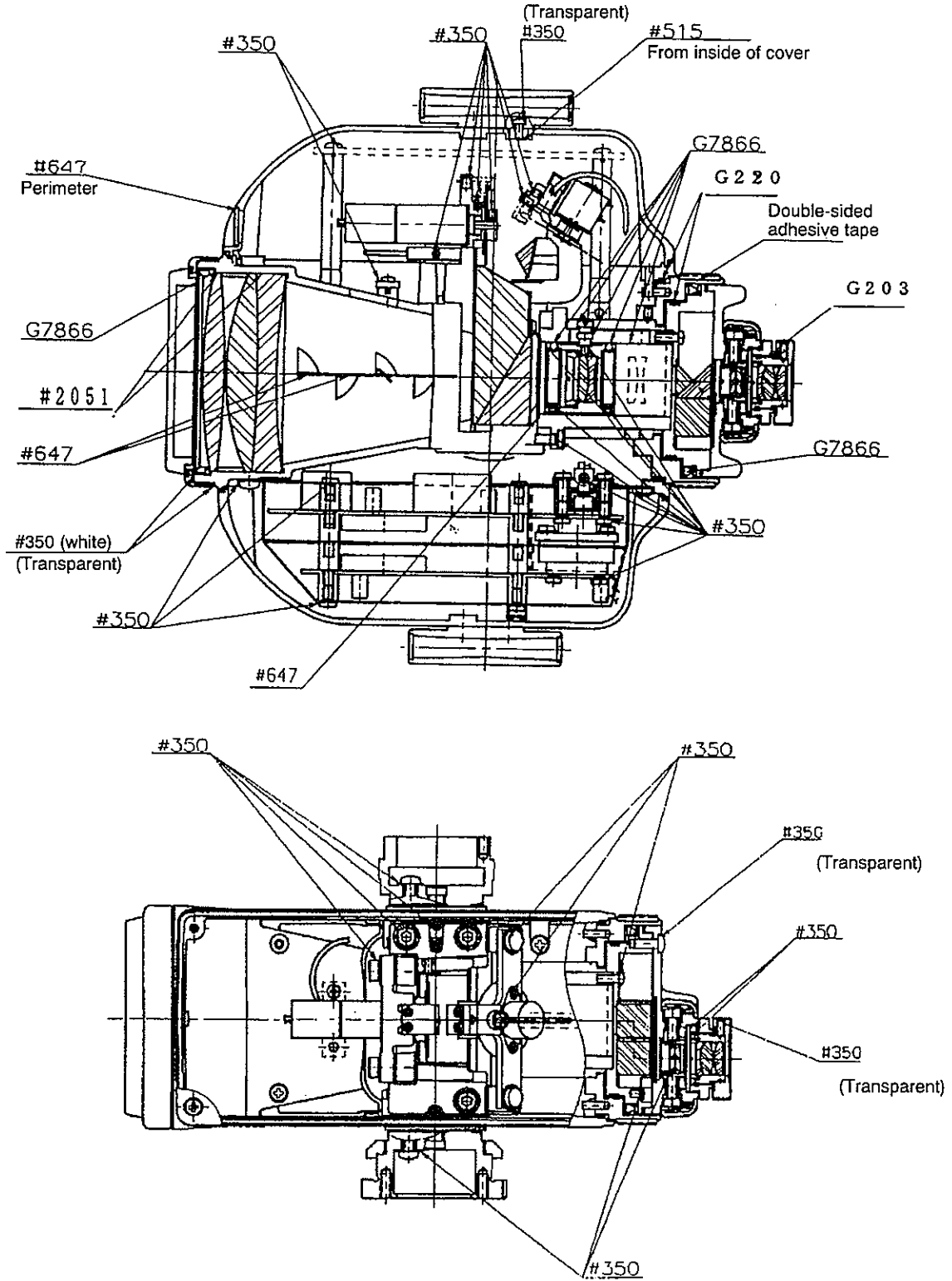


# 5. Lubricants and Adhesives

## Telescope

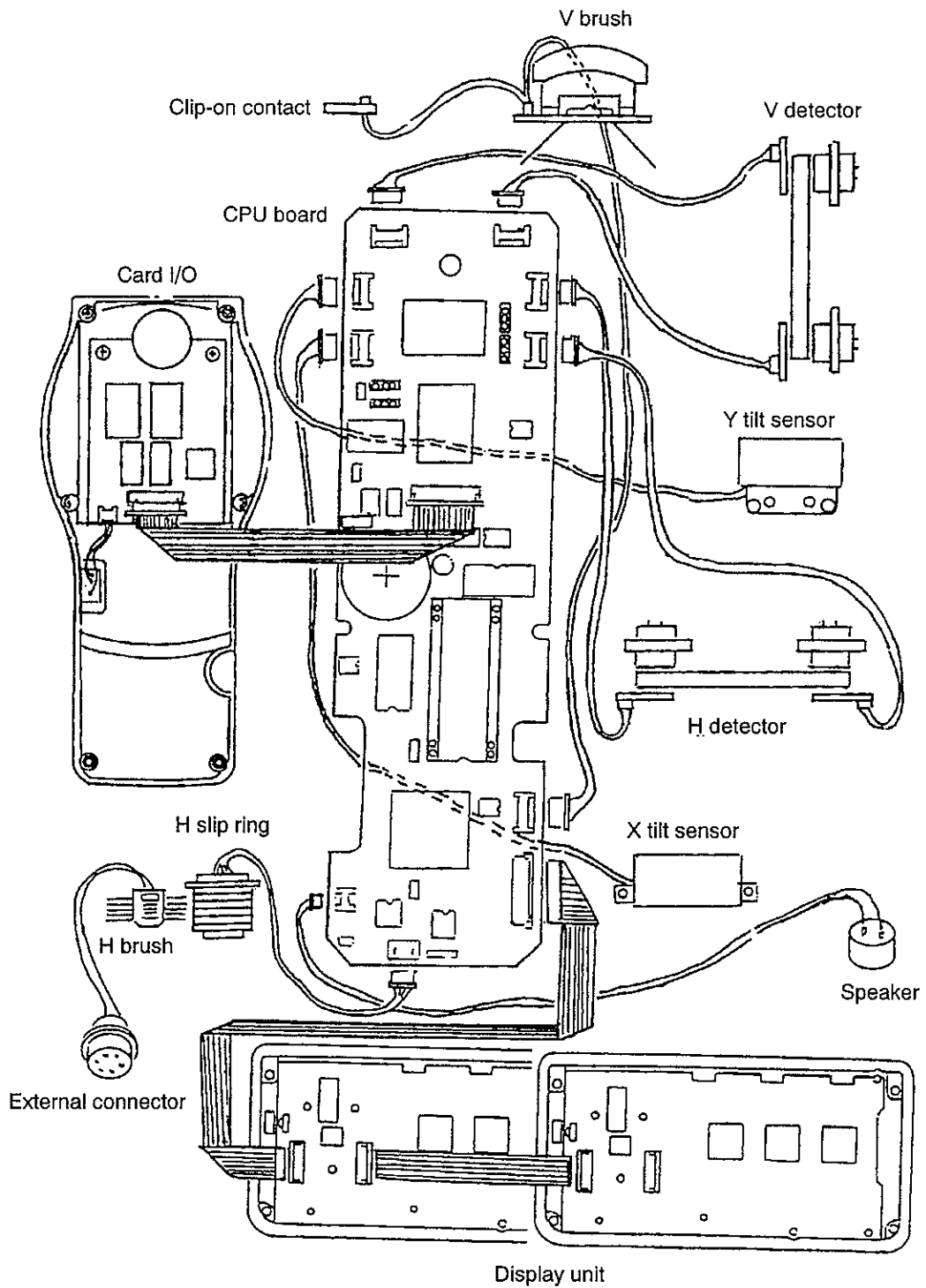
G or L: Lubricant

#: Adhesive



# 6. Connection Diagram

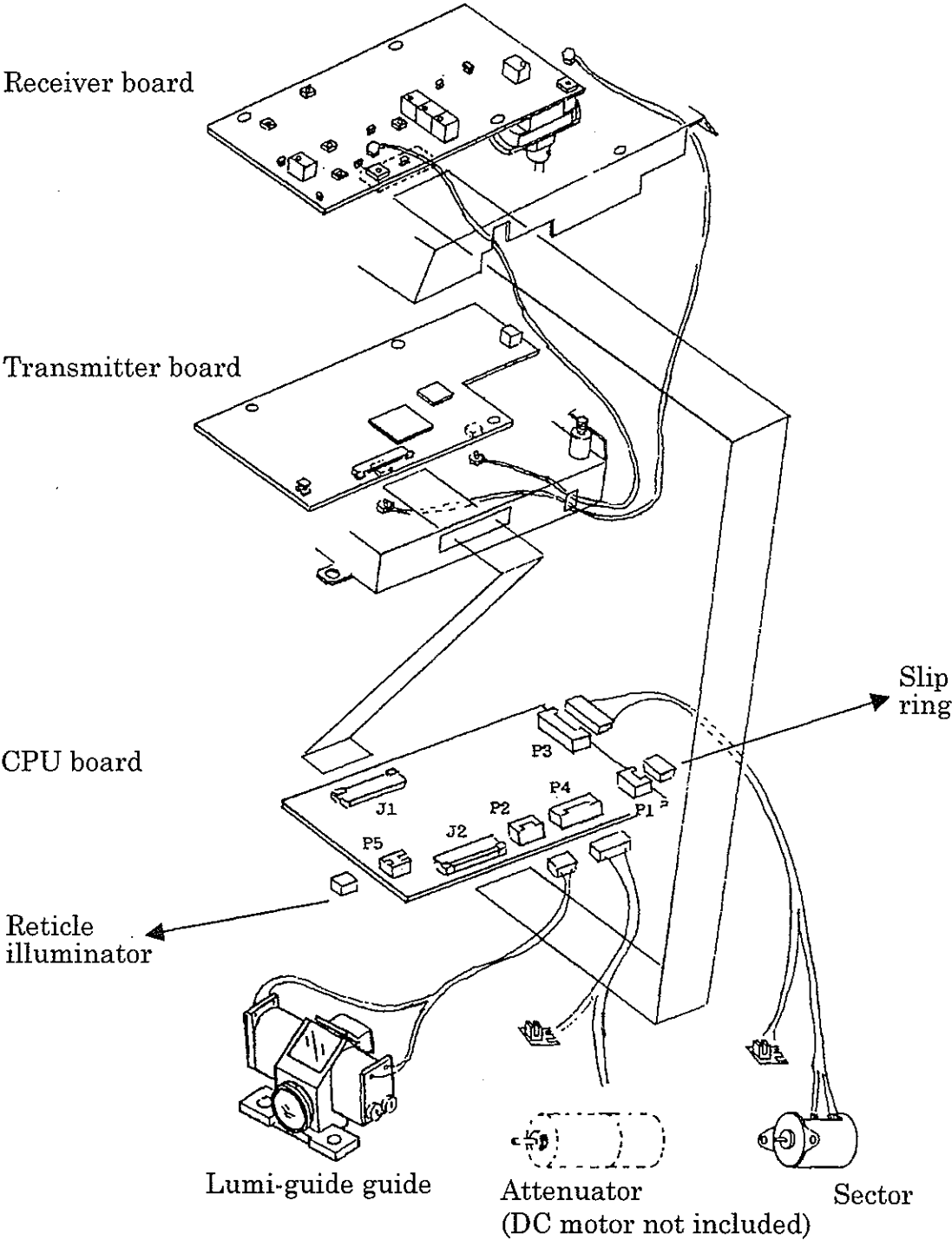
## Theodolite unit



# 6. Connection Diagram

EDM unit

★ Carefully route cables to prevent pinching by the shield plate.



## 7. Disassembly

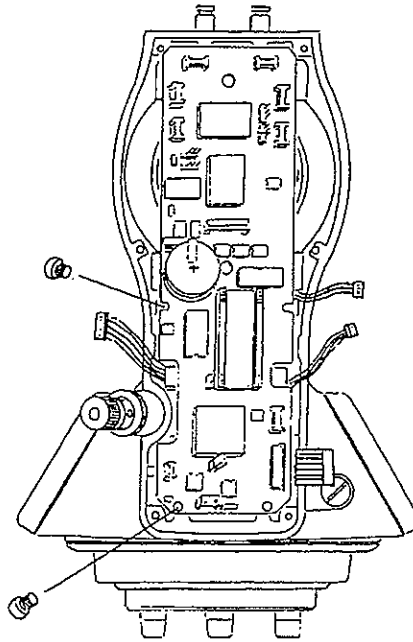
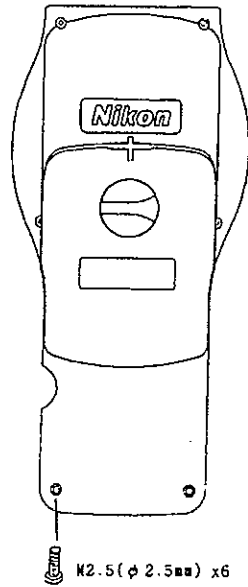
The following describes the procedure for disassembling the theodolite unit. The procedure for disassembling the EDM unit is described separately, as the EDM unit should be disassembled after the theodolite unit is completely repaired.

Copy and save necessary parameters and compensation values from the CPU-board to memory area on the tool card (J26339) for easy data restoration following completion of the repair procedures.

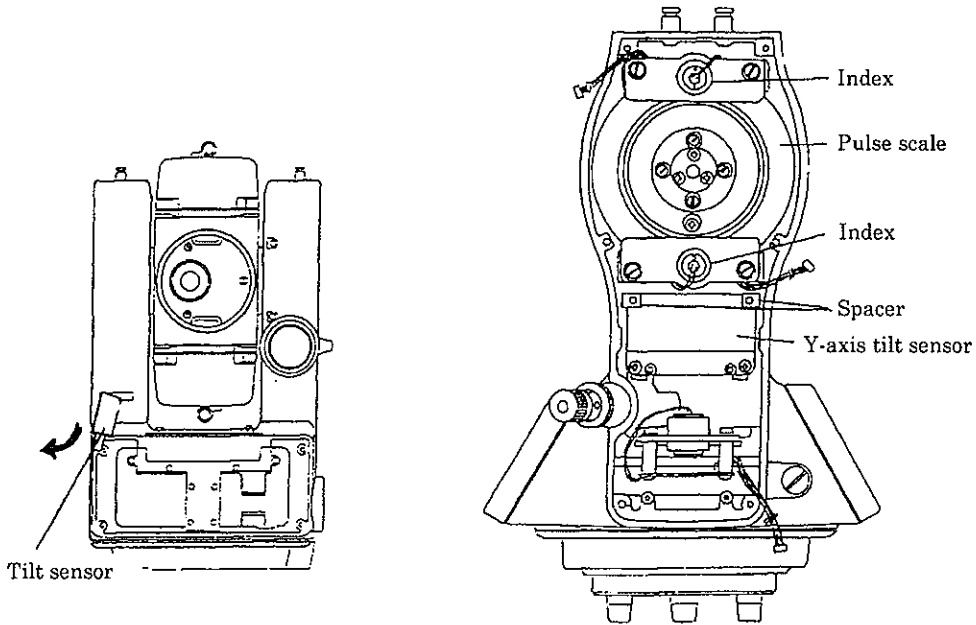
- ⊙ The disassembly procedures are divided into separate blocks in the manual, but are organized so that the entire unit can be disassembled by following all procedures in sequence.
- ⊙ In this manual, disassembly is omitted where considered unnecessary.
- ⊙ Be sure to read the notes marked "★." These notes describe important points and precautions on disassembly and reassembly.

## 7-1. Disassembling the Left Column

1. Removing the left side cover  
Carefully remove the left side cover, as a flat cable is connected between the CPU board and interface board located behind the cover.
2. Detaching the CPU board  
Disconnect all connectors from the CPU board, then remove the board-mounting screws to detach the CPU board.



3. Removing the Y-axis tilt sensor  
Pull the lower section of the tilt sensor forward and remove the sensor at an angle.

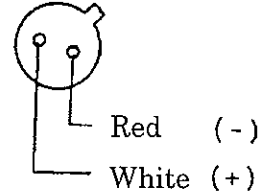


# 7-1. Disassembling the Left Column

- 4. Removing lead wires of LED on index section from cable at soldered sections
  - ★ The LED on the index section is connected to the cable from the detector board installed in the main body. The procedure described below protects the pulse scale against damage due to contact with the index section during removal.

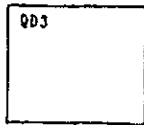
- ★ When the pulse scale is not removed, it is not necessary to conduct the following procedure.

- ★ When reinstalling the LED, carefully check the polarities.

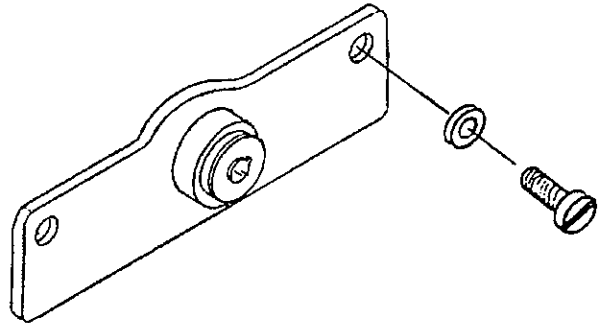


- 5. Removing the V upper/ lower indexes
 

The upper and lower indexes can be distinguished by the following indications:  
 Upper index: QD4 stamped on index glass  
 Lower index: QD3 stamped on index glass



Index glass



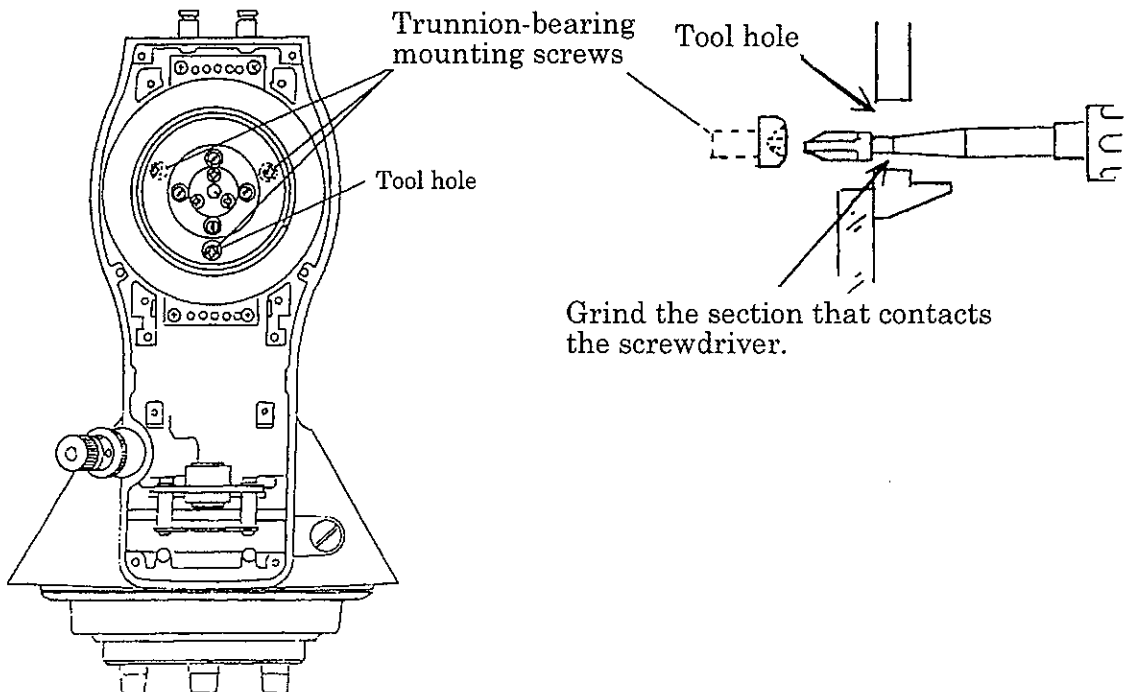
- 6. Removing the trunnion

- 1) Rotate the telescope and remove the three mounting screws through the tool hole in the pulse scale holder.
  - ⊙ Rotating the telescope one turn will expose the three trunnion-mounting screws via the tool hole in the pulse scale holder.
 

Screws: One location indicated by a solid line and two locations indicated by a dotted line in the diagram below

- ★ The tool hole and trunnion-bearing mounting screws are not located on the concentric circle. Grinding the section of the screw driver that contacts the edge of the tool hole.

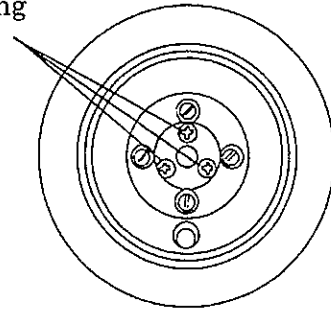
Enlarged diagram



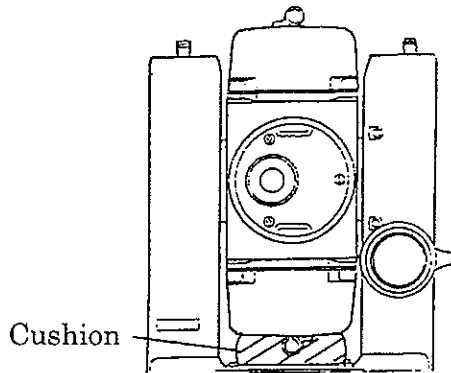
# 7-1. Disassembling the Left Column

2) Remove the trunnion mounting screws.

Trunnion mounting screws

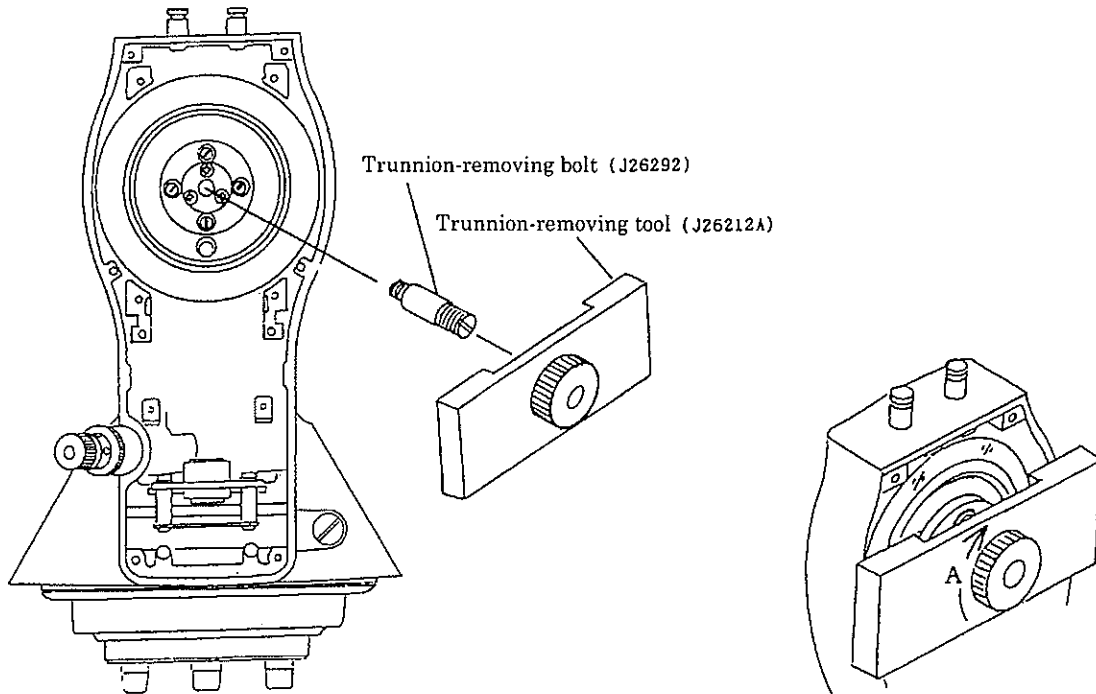


3) Detach the trunnion.  
When the trunnion is detached, the telescope section tilts downward. To prevent it from tilting, insert a sponge or other cushioning material between the main body and telescope section.



⊙ Screw the trunnion-removing bolt (J26292) into the center of the trunnion, attach the trunnion-removing tool, then turn the handle of the tool clockwise (arrow A) to remove the trunnion.

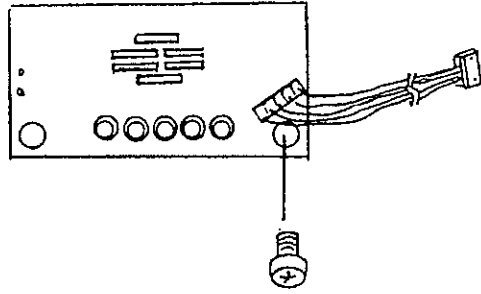
★ When the pulse-scale mounting screws are removed and the pulse scale detached from the trunnion, the pulse scale must be centered and adjusted.





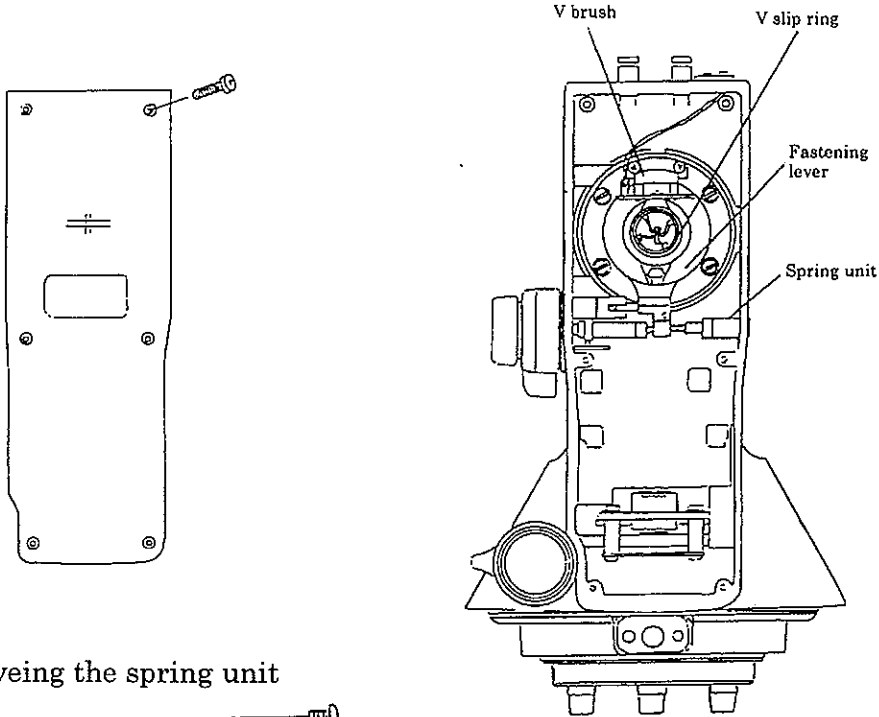
# 7-1. Disassembling the Left Column

- 7. Removing the V upper/lower detector board  
The detector board is installed directly on the main body.

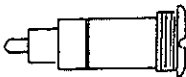


# 7-2. Disassembling the Right Column

## 1. Removing the left side cover

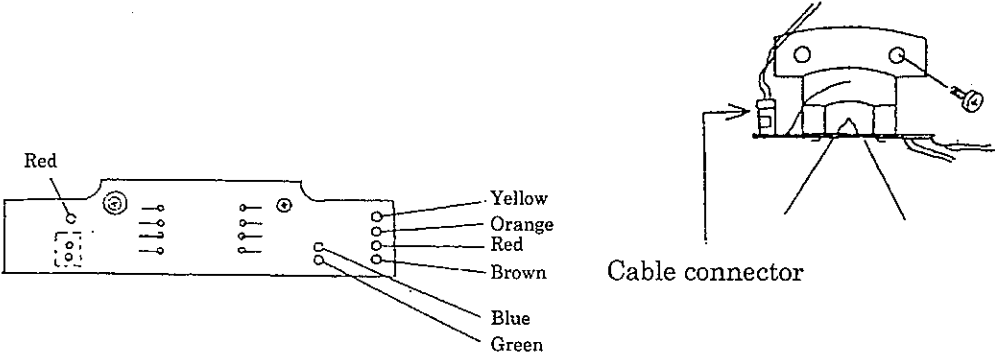


## 2. Removeing the spring unit



## 3. Removing the V brush

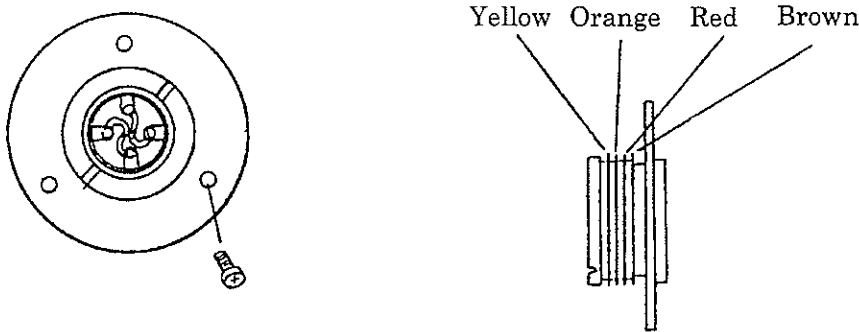
- 1) Disconnect the connector of the cable connected to the clip-on battery contact.
- 2) Remove the V-brush mounting screws.



V-brush board (viewed from the bottom)

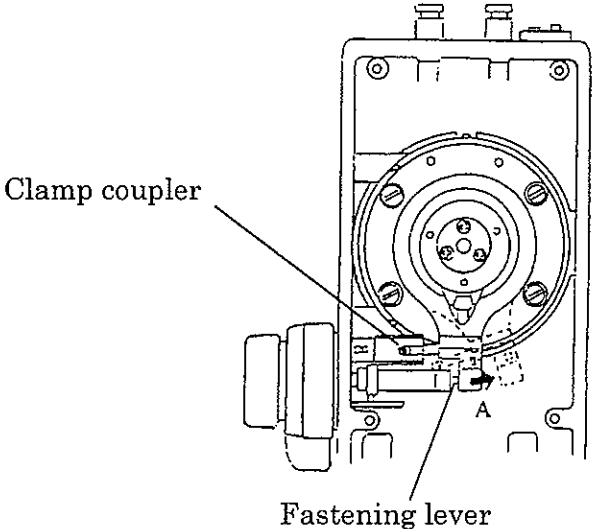
## 7-2. Disassembling the Right Column

- 4. Removing the V slip ring  
Remove solder from the slip-ring terminals, then remove the slip ring.



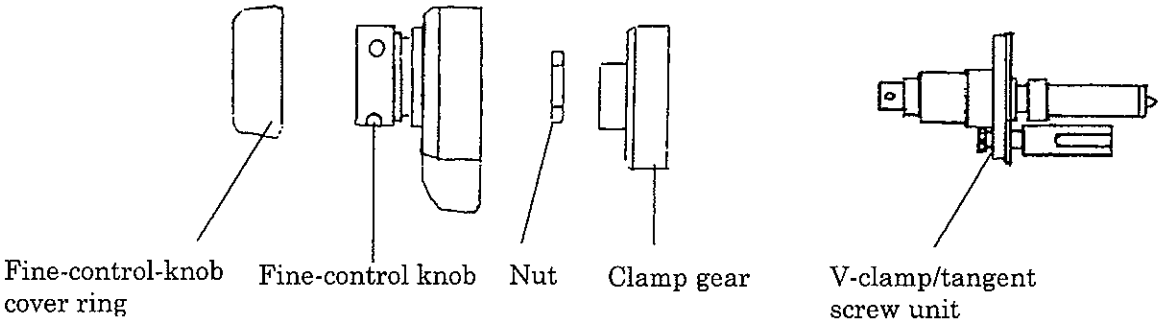
Cable connection to the slip ring  
Wires are color-coded as shown in the diagram when viewed from the exterior of the slip ring (from side-cover).

- 5. Detaching the fastening-lever unit  
Turn the fastening-lever unit counterclockwise (arrow A). When the clamp coupler detaches from the clamp joint, pull the fastening-lever unit forward to remove. Note that a washer is installed between the fastening-lever unit and trunnion.



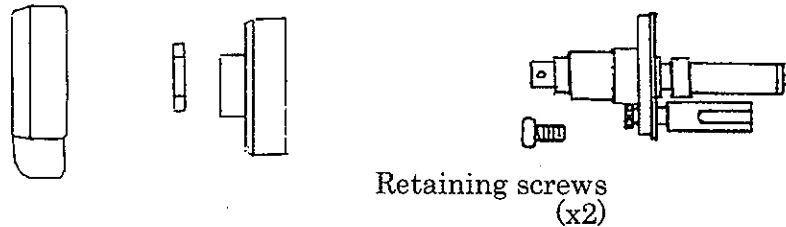
- 6. Removing the V-clamp/tangent screw

- 1) Remove the fine-control knob.  
Remove the fine-control-knob cover ring, loosen the two fine-control-knob setscrews, then detach the fine-control knob.  
© Adhesive (#350) is applied to the setscrews. Use alcohol to dissolve the adhesive before unscrewing them.



## 7-2. Disassembling the Right Column

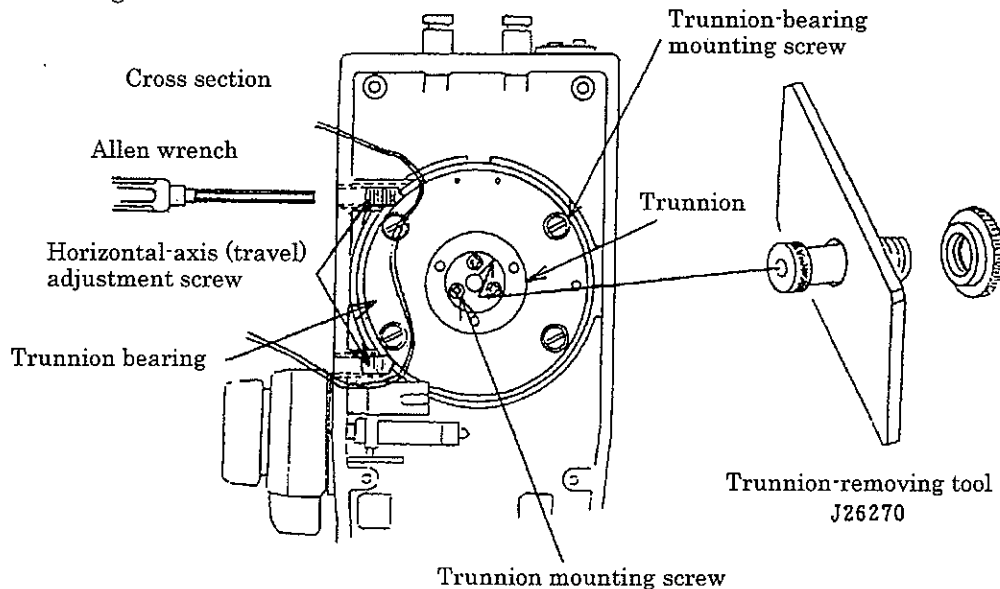
- 2) Remove the V-clamp gear  
Remove the V-clamp cover ring unscrew the clamp gear-retaining nut, then detach the V-clamp gear.



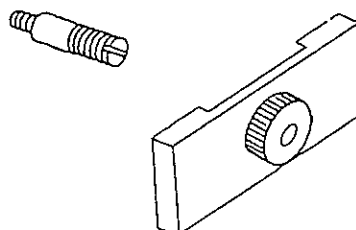
- 3) Dismount the V-clamp/tangent screw unit.  
Unscrew the two V-clamp/tangent screw unit mounting screws, then detach the V-clamp/tangent screw unit.

### 8. Detaching the trunnion and trunnion bearing

- 1) Loosen the horizontal-axis adjustment screw until it contacts the trunnion bearing.

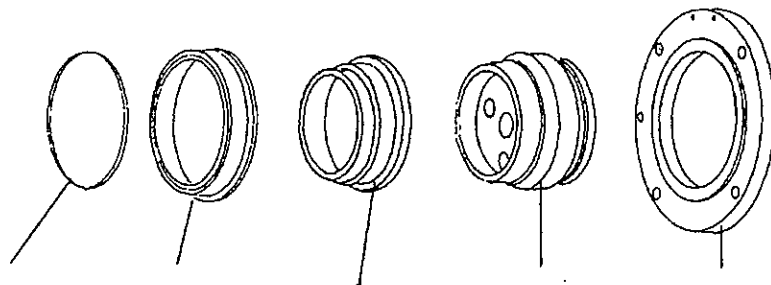


- 2) Remove the trunnion-bearing mounting screws.
  - 3) Detach the trunnion.  
Screw the trunnion-removing tool (J26270) into the hole of the trunnion, then remove the trunnion.
- © The combination of the trunnion-removing bolt (J26292) and trunnion-removing tool (J26212A) used for disassembly of the left support can also be used to remove the trunnion. Note that for such combined use, pull out the cable at the center of the trunnion toward the EDM unit before performing the removal work.



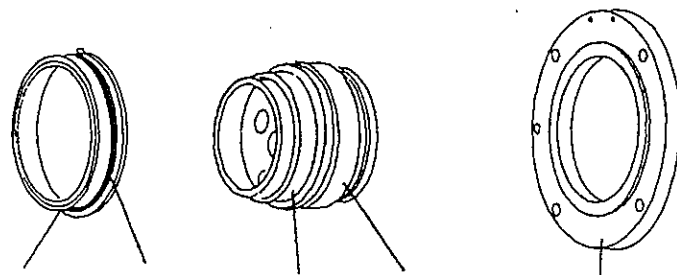
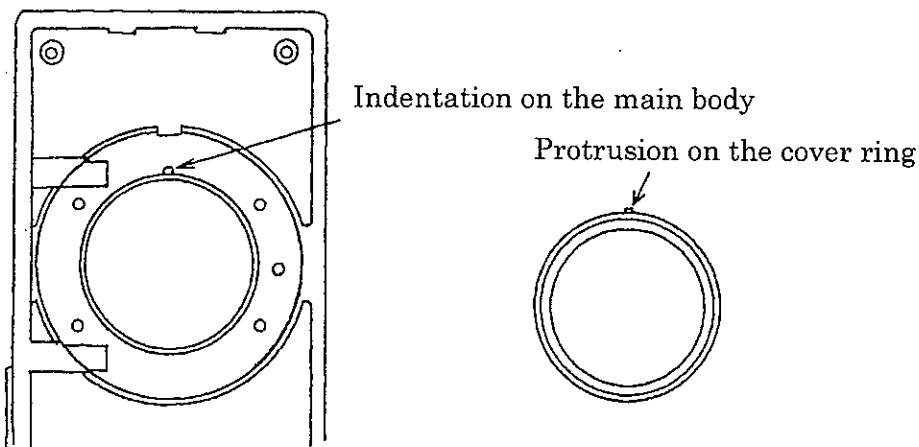
## 7-2. Disassembling the Right Column

- ⊙ The anti-splash ring, cover ring, and rubber ring cannot be removed unless the trunnion is removed.



Rubber ring    Cover ring    Anti-splash ring    Trunnion    Trunnion bearing

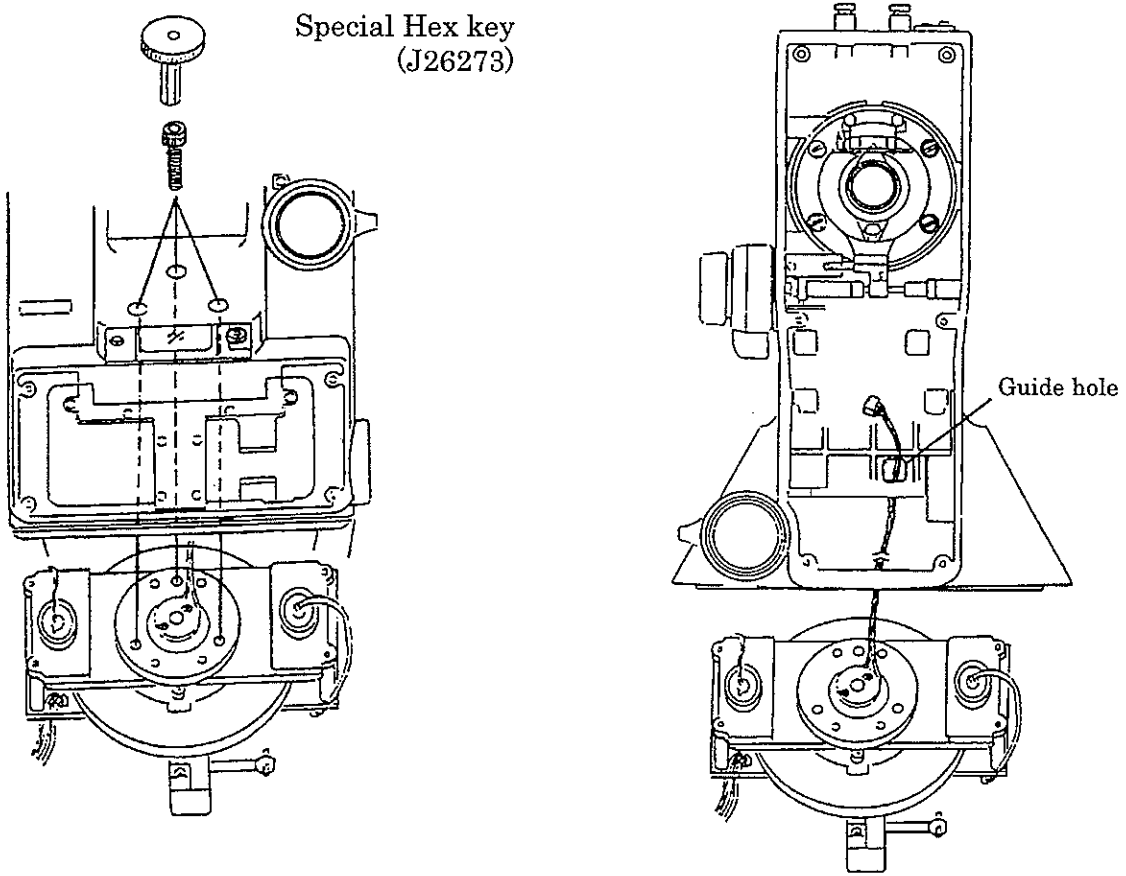
- ⊙ When reassembling the trunnion, place the rubber ring over the cover ring, align the protrusion on the cover ring with the indentation on the main-body guide, install the anti-splash ring and trunnion on the telescope, then install the trunnion bearing.



Cover ring    Rubber ring    Anti-splash ring    Trunnion    Trunnion bearing

### 7-3. Detaching the Upper Main Body from the Base

1. Detaching the main body from the base
  - 1) Use a standard Allen wrench to loosen the hexagonal socket-head bolts on the main body, then remove the bolts using the special Hex key (J26273).
  - 2) Lift the main body slightly, pull out the cable connected to the center shaft of the base through the guide hole located at the lower section of the main body, then lift the main body to detach it.

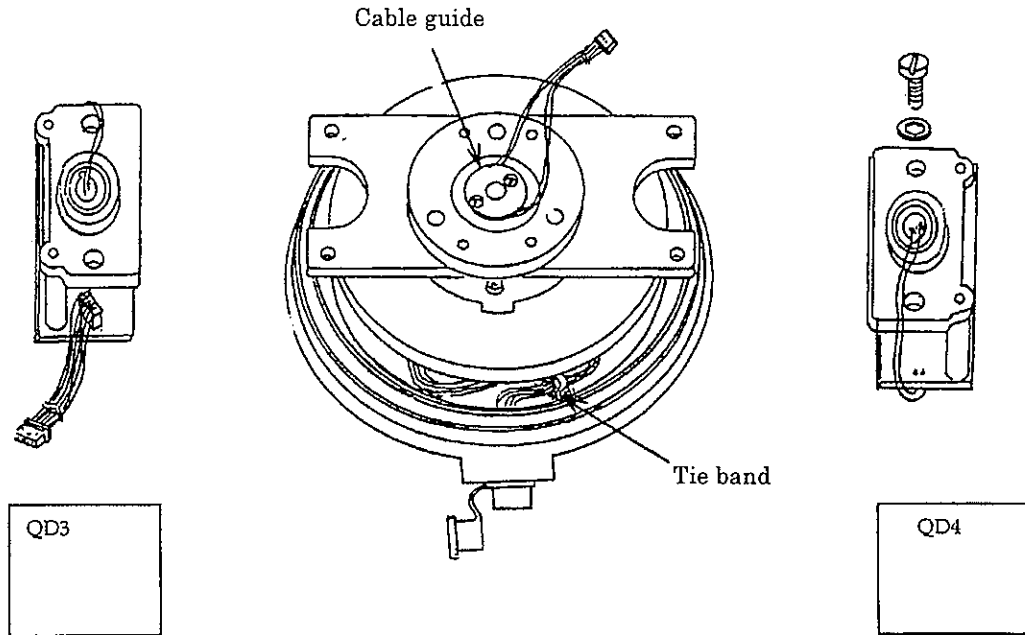


★ Caution on reinstalling the main body  
The fastening-lever clamp joint and main-body mounting screws on the center shaft must be positioned as shown in the diagram at the above left. Pull up a sufficient length of cable connected to the center shaft from the guide hole located at the lower section of the main body, then confirm that the cable is not caught between the main body and center shaft.

## 7-4. Disassembling the Vertical Axle (Leveling Base with Shift Device)

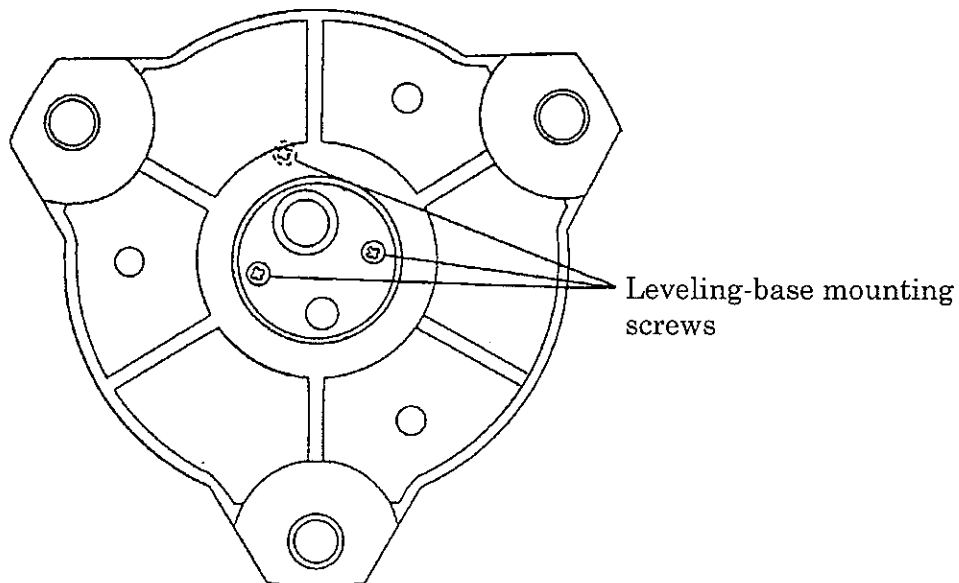
1. Removing the right and left detector units

★ To prevent cable breakage, do not detach the cable guide in this step.



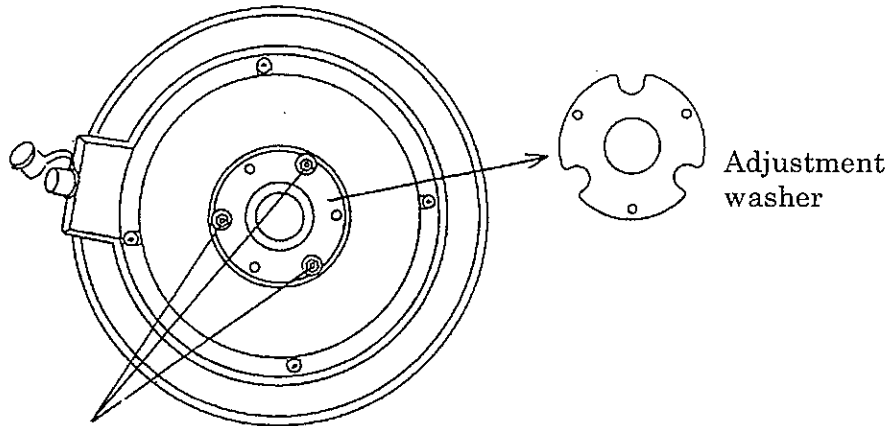
★ The right and left detector units can be distinguished by the number stamped on the index glass. The index glass for the left column is stamped "QD3." The index glass for the right column is stamped "QD4."

2. Removing the tie band
3. Removing the shift-type leveling base  
Remove the leveling-base mounting screws through the fastening-lever hole located at the center of the leveling base, then remove the leveling base.

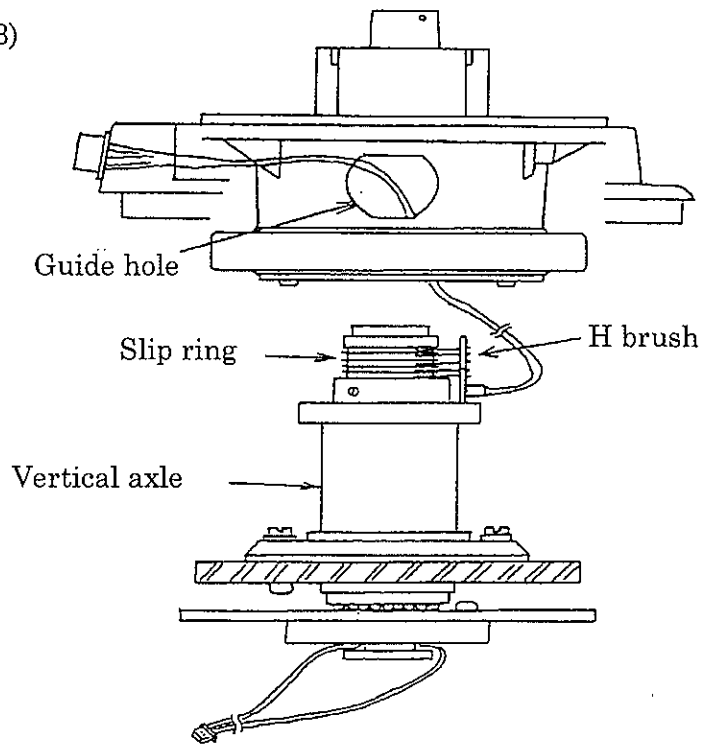


### 7-4. Disassembling the Vertical Axle (Leveling Base with Shift Device)

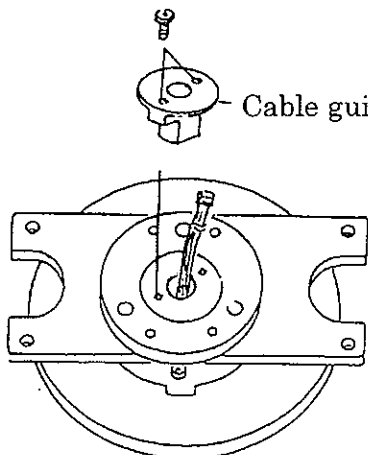
- 4. Detaching the vertical axle  
Remove the bottom-plate mounting screws, insert the cable located between the external plug and H brush into the bottom-plate cable guide hole, then lift the bottom plate while ensuring that the axle and H brush detach simultaneously.



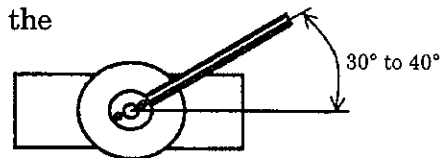
Vertical axle mounting screws (x3)



- 5. Removing the cable guide



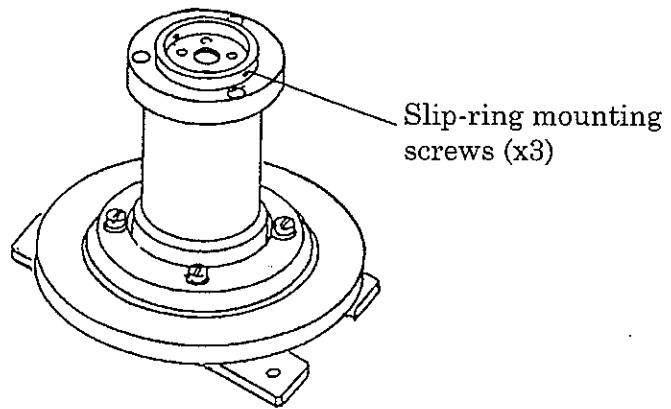
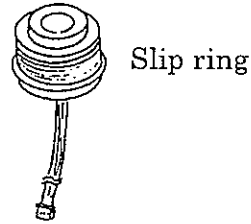
★ Caution on reassembling the cable guide  
Install the cable routed from the center shaft through the cable-guide gap at an angle of 30° to 40° from the index plate. Assembling the cable at an angle of less than 30° may result in the cable being pinched by the main body.





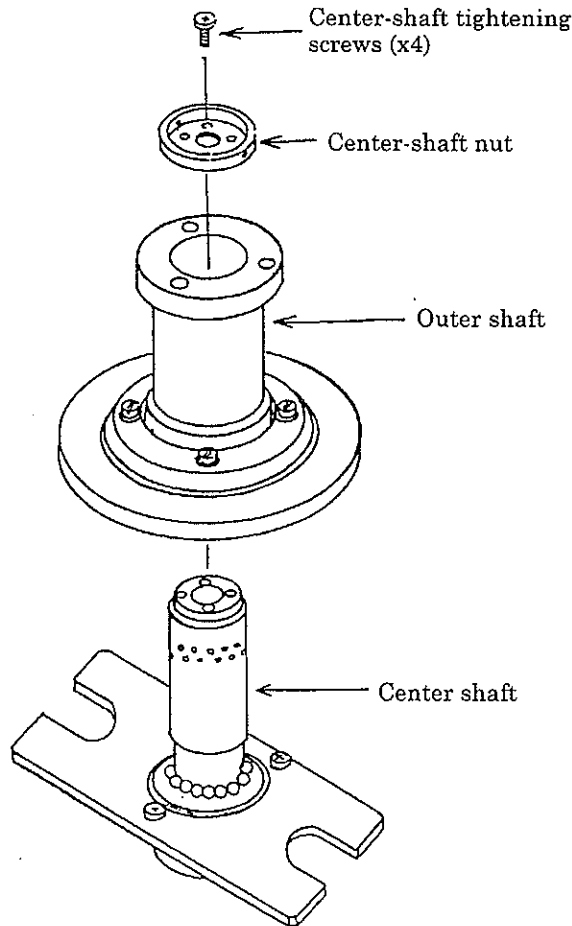
### 7-4. Disassembling the Vertical Axle (Leveling Base with Shift Device)

- 6. Removing the slip ring  
Loosen the three slip-ring mounting setscrews, then remove the slip ring.



- 7. Disassembling the vertical axle  
Remove the center-shaft nut, then lift the outer shaft to disassemble the vertical axle.

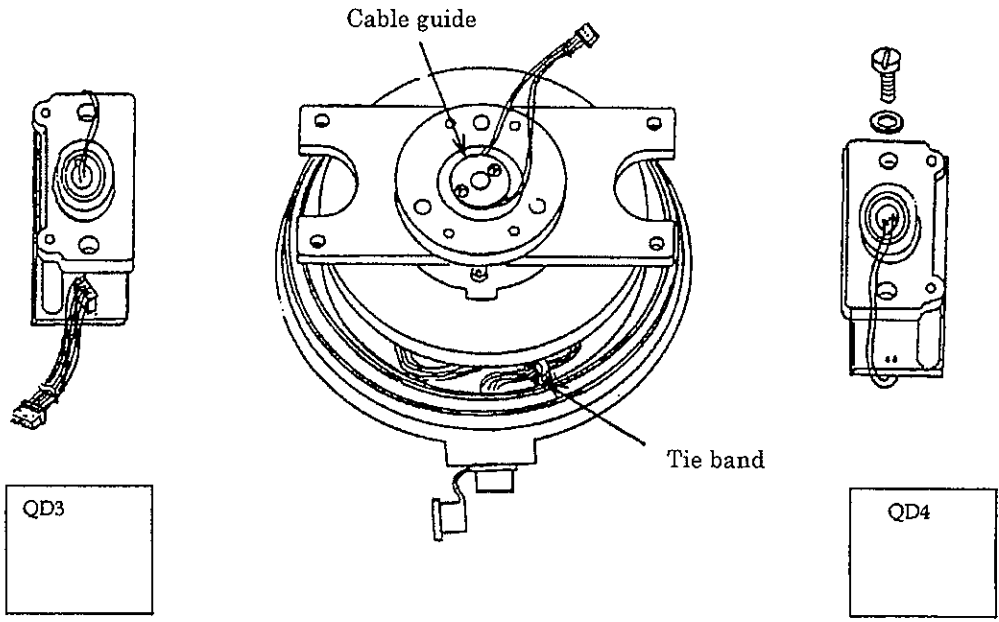
★ Be careful not to drop any steel balls.



## 7-5. Disassembling the Vertical Axle

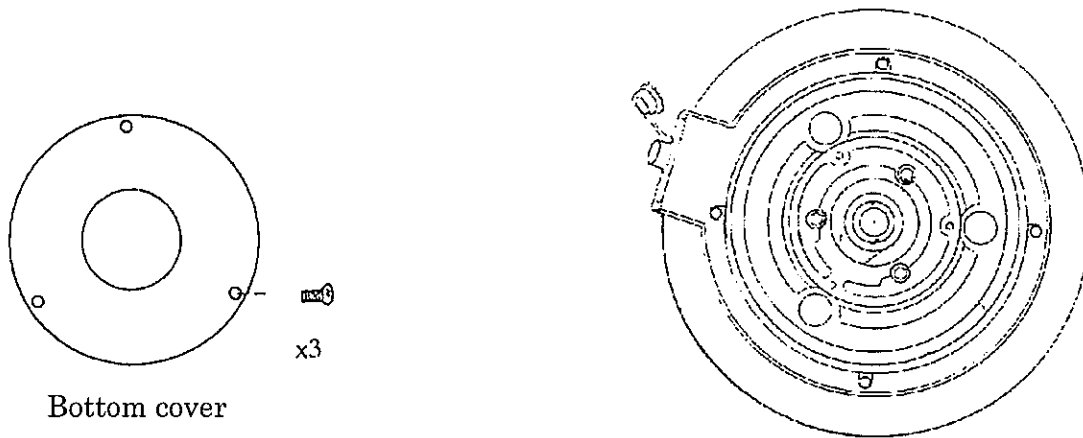
### 1. Removing the right and left detector units

★ To prevent cable breakage, do not detach the cable guide in this step.



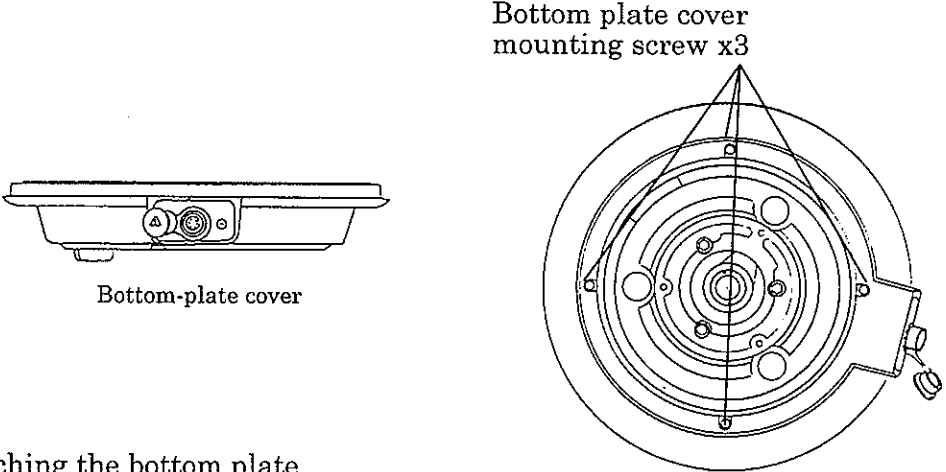
★ The right and left detector units can be distinguished by the number stamped on the index glass. The index glass for the left support is stamped "QD3." The index glass for the right support is stamped "QD4."

### 2. Detaching the bottom cover

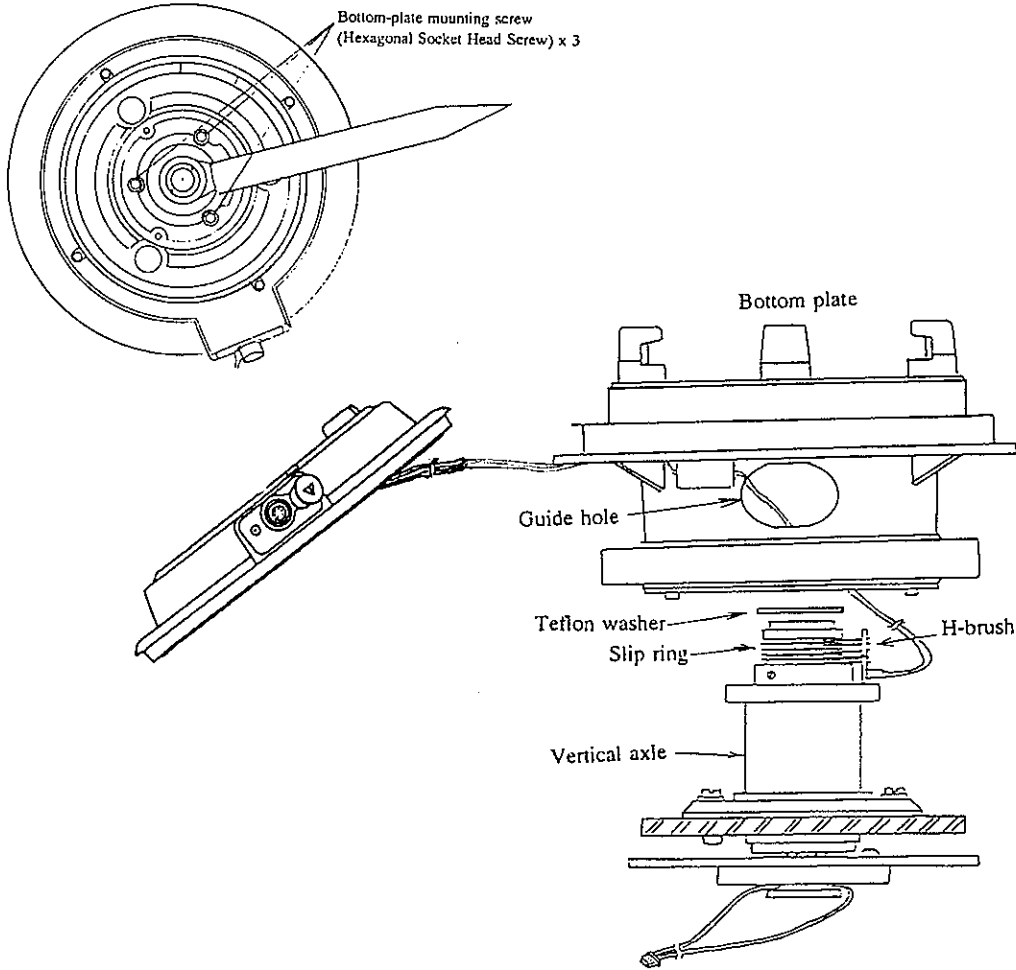


### 7-5. Disassembling the Vertical Axle

- 3. Removing the bottom-plate-cover mounting screws  
The cable routed between the brush and external plug on the bottom plate cover is secured to the bottom plate with a tie band. In this step, remove the screws, but do not detach the bottom-plate cover.

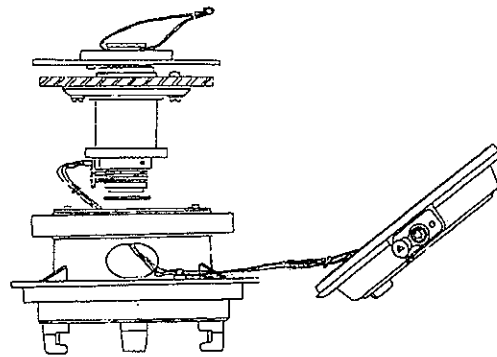


- 4. Detaching the bottom plate  
Remove the three bottom-plate mounting screws located on the outside of the bottom plate and the three inside vertical axle mounting screws. Use tweezers to gently press and hold the brush (visible from the bottom-plate side), then lift the bottom plate.



## 7-5. Disassembling the Vertical Axle

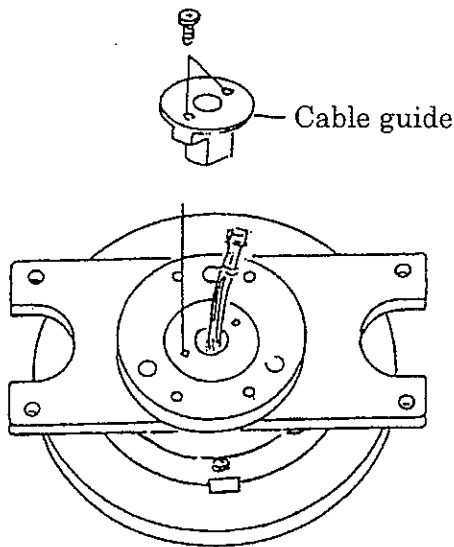
5. Removing the tie band



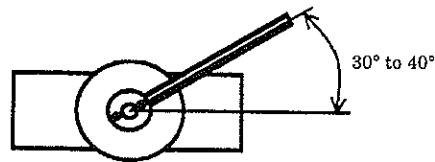
6. Removing the bottom-plate cover

The external plug and H brush are connected by a cable. This cable must be disconnected at the soldered section on either side before the bottom-plate cover can be completely detached. It is not necessary to disconnect the cable unless the bottom-plate cover must be separated.

7. Removing the cable guide

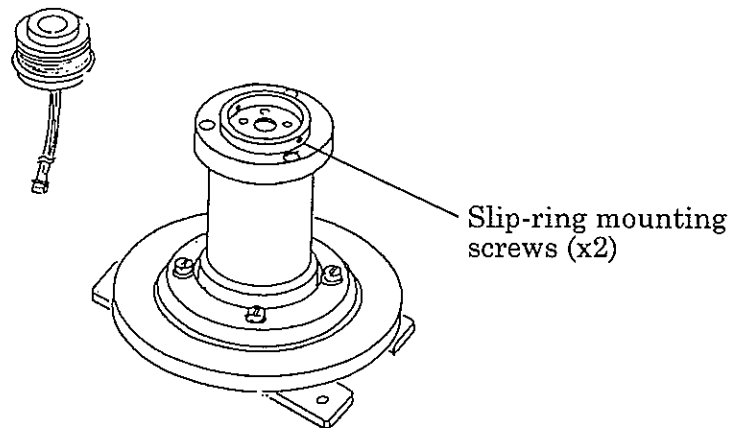


- ★ Caution on reassembling the cable guide  
Install the cable routed from the center shaft through the cable-guide gap at an angle of 30° to 40° from the index plate.  
Installing the cable at an angle of less than 30° may result in the cable being pinched by the main body.



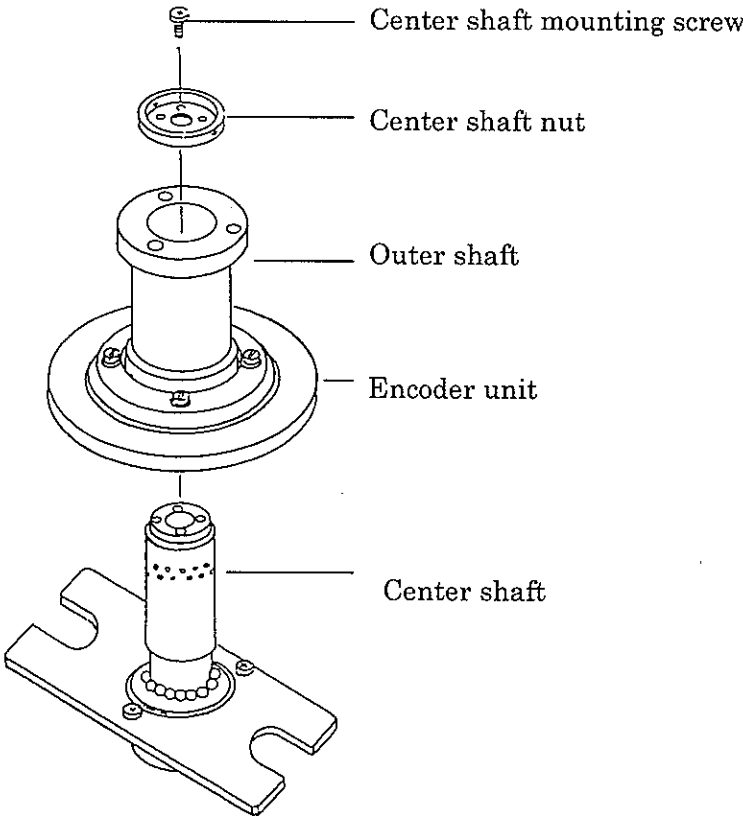
8. Removing the slip ring

Loosen the two slip-ring mounting screws, then remove the slip ring.



### 7-5. Disassembling the Vertical Axle

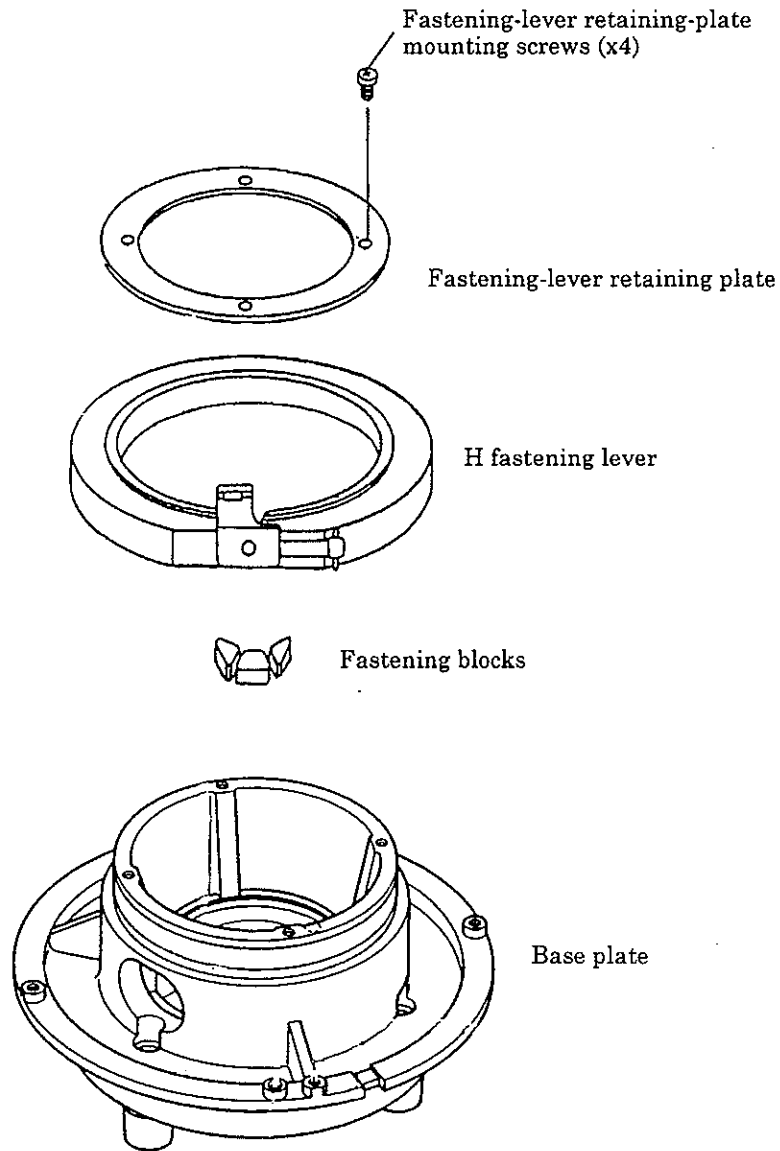
- 9. Disassembling the vertical axle  
Remove the three center-shaft mounting screws, then lift the outer shaft and encoder unit to remove the center shaft.



## 7-5. Disassembling the Vertical Axle

### 10. Detaching the fastening lever

Remove the fastening-lever retaining plate, then detach the fastening lever and fastening blocks.

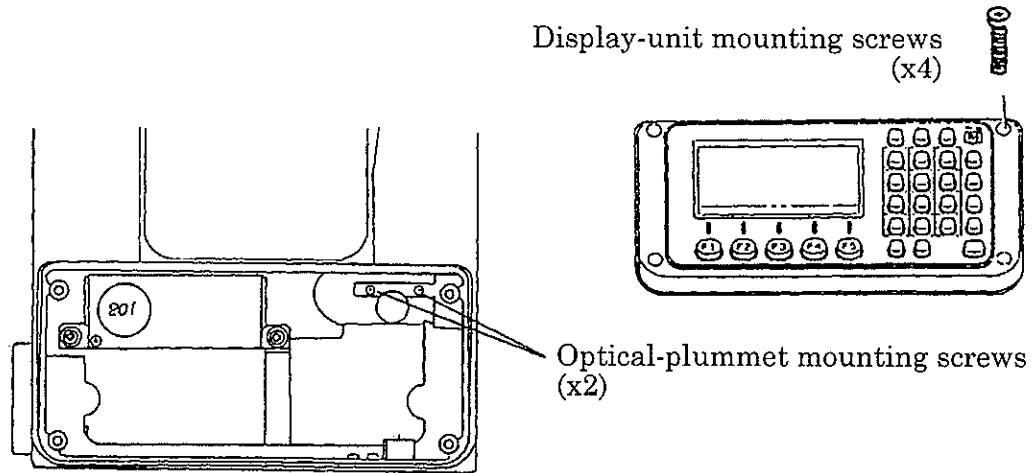


★ Use only the specified oil to lubricate the fastening lever. Using other oil may result in clamp malfunction.

## 7-6. Disassembling the Optical Plummet

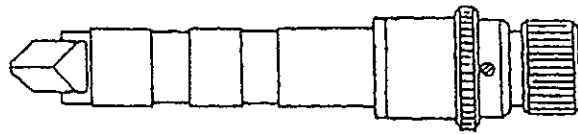
When disassembling the optical plummet immediately after 7-5, start from step 2.

### 1. Removing the subdisplay unit



### 2. Detaching the optical plummet

From the subdisplay-unit section, remove the optical-plummet mounting screws from the main body, then pull out the optical plummet.



- ★ The optical plummet must be adjusted after it is reassembling. Disassembly of the optical plummet is omitted in this manual. Refer to the repair parts chart when disassembling the optical plummet or when necessary to study its structure.

## 8. Reassembly and Adjustment

- ⊙ The structure is relatively simple, and the product can be reassembled by reversing the disassembly procedure. Therefore, an explanation of the reassembly procedure is omitted.
- ⊙ The following primarily describes the reassembly and adjustment procedures that require tools, for exclusive use.
- ⊙ Some parts may not function if reassembly and adjustment procedures have not been completed. All procedures must be performed in the sequence described.

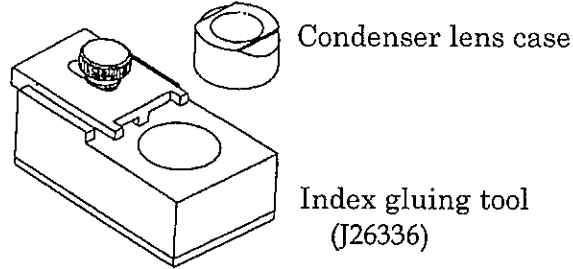


## 8-1. Gluing the Index

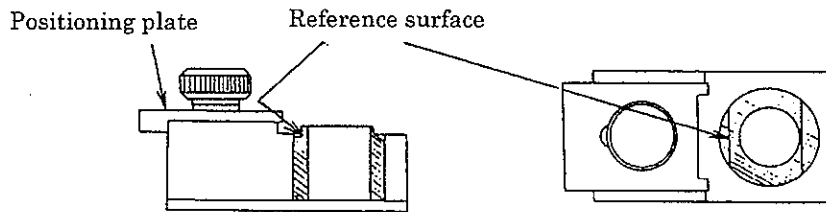
★ Only when the index glass is detached is it necessary to glue the index using the index gluing tool (J26336) as shown below.

### 1. Gluing the index glass

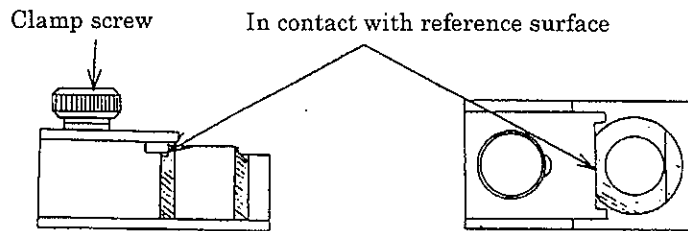
1) Insert the condenser lens case into the hole of the index gluing tool (J26336).



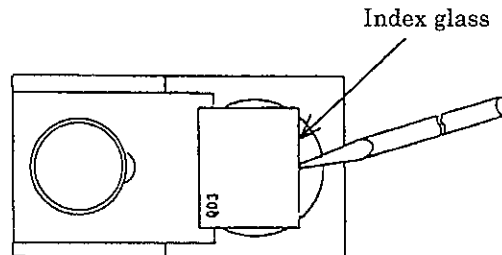
2) Face the condenser lens case toward the attachment reference surface (i.e. toward the positioning plate of the index adjustment tool).



3) Set the index positioning plate firmly against the reference surface of the condenser lens case, then tighten the clamp screw.

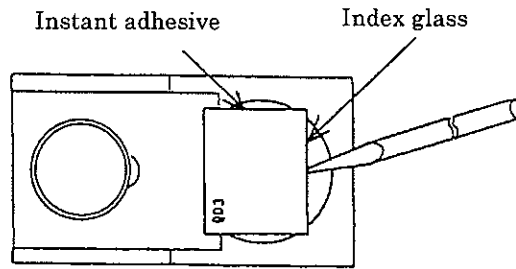


4) With the deposition surface facing up, place the index glass on the condenser lens case, then press the side marked "QD3" or "QD4" against the index positioning plate.



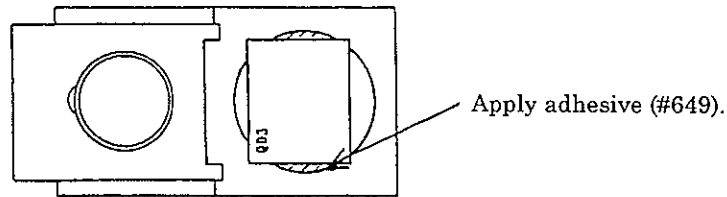
## 8-1. Gluing the Index

- 5) Apply a small amount of instant adhesive (#921) to the contacting surfaces of the condenser lens case and index glass, then press down for about one minute.



- 6) Apply adhesive (#648) to the contacting surfaces (shaded area) of the condenser lens case and index glass.

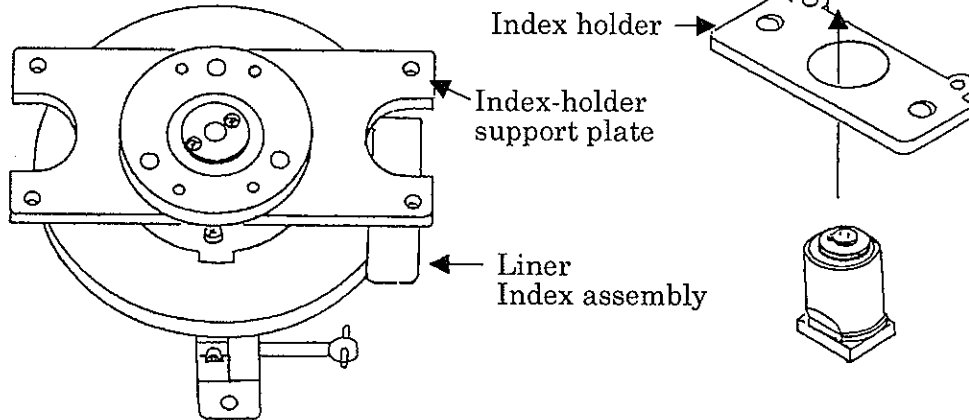
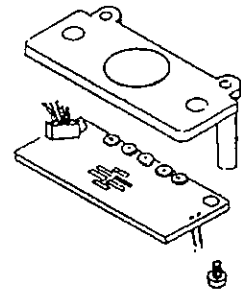
★ Do not apply adhesive to the reference surface of the condenser lens case in this step. The reference surface is used for positional adjustment of the H/V index.



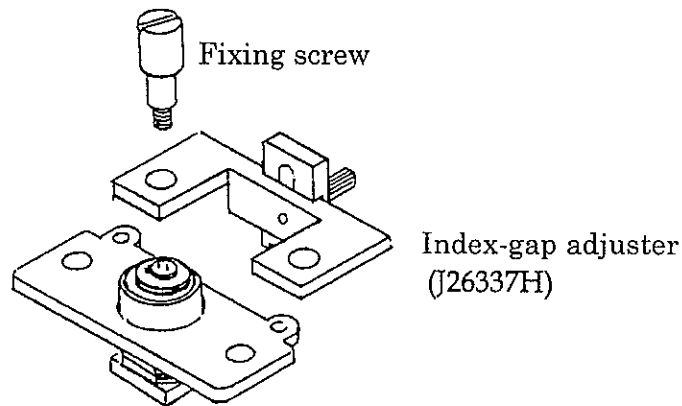
- 7) Leave the index assembly (condenser lens case and index glass) at room temperature for 24 hours to allow the adhesive to harden.

## 8-2. Positioning the H Index

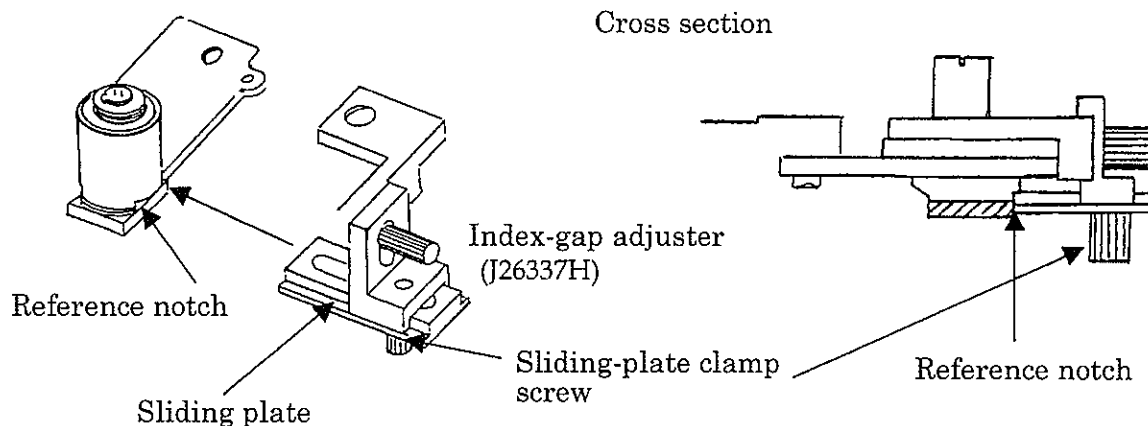
1. Detach the detector board from the board-mounting support of the index holder.
2. Place the gap-adjusting liner (t = 0.24 ± 0.04 mm) on the encoder pulse scale.
3. Insert the index assembly into the index holder, then place it on the index-holder support plate.



4. Place the index-gap adjuster (J26337H) on the index holder, and secure it to the index support plate using the fixing screws.
- ★ Use a screwdriver with a wooden handle to tighten the two fixing screws.

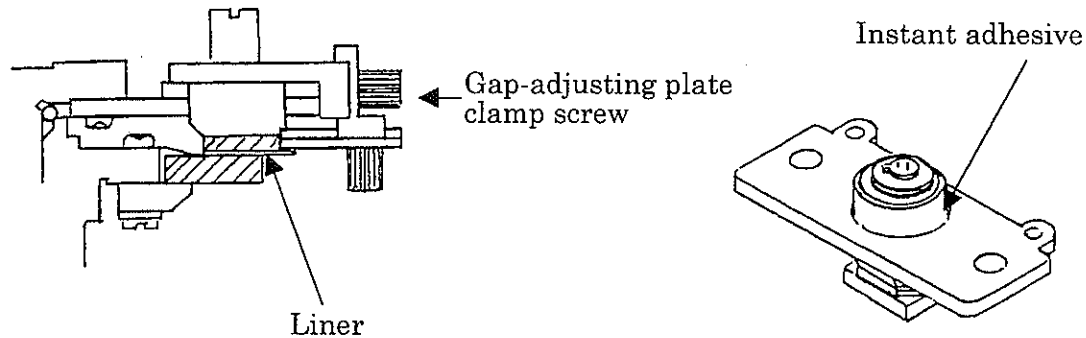


5. Push the sliding plate of the index-gap adjuster against the inclination-adjustment reference notch on the condenser lens case, then tighten the sliding-plate clamp screw.

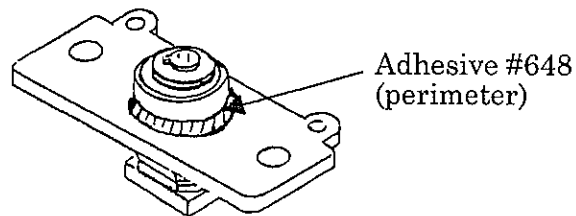


## 8-2. Positioning the H Index

6. Confirm that the index gap-adjusting liner is located between the encoder pulse scale and index glass. Move the gap-adjusting plate up and down to press the index assembly firmly against the liner, then tighten the clamp screw. Apply a small amount of instant adhesive to several locations on the contacting surfaces of the index holder and index assembly.  
★ Make sure the sliding plate is not tilted by contacting the pulse scale.



7. Apply adhesive #648 along the entire contacting edges of the index holder and index assembly.

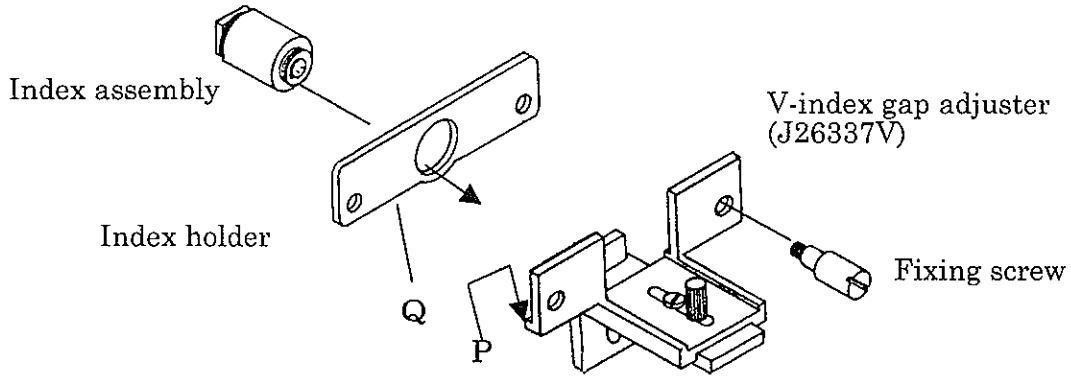


8. Remove the index-gap adjuster (J26337H) and gap-adjusting liner, then leave the index holder and index assembly at room temperature for 24 hours to allow the adhesive to fix.

### 8-3. Positioning the V Index

Ⓢ The V-index gas adjuster (J26337V) cannot be used to adjust the gap at the upper index position. If the upper index gap requires adjustment, move the index holder and index assembly to the lower index mounting position, and then adjust the gap.

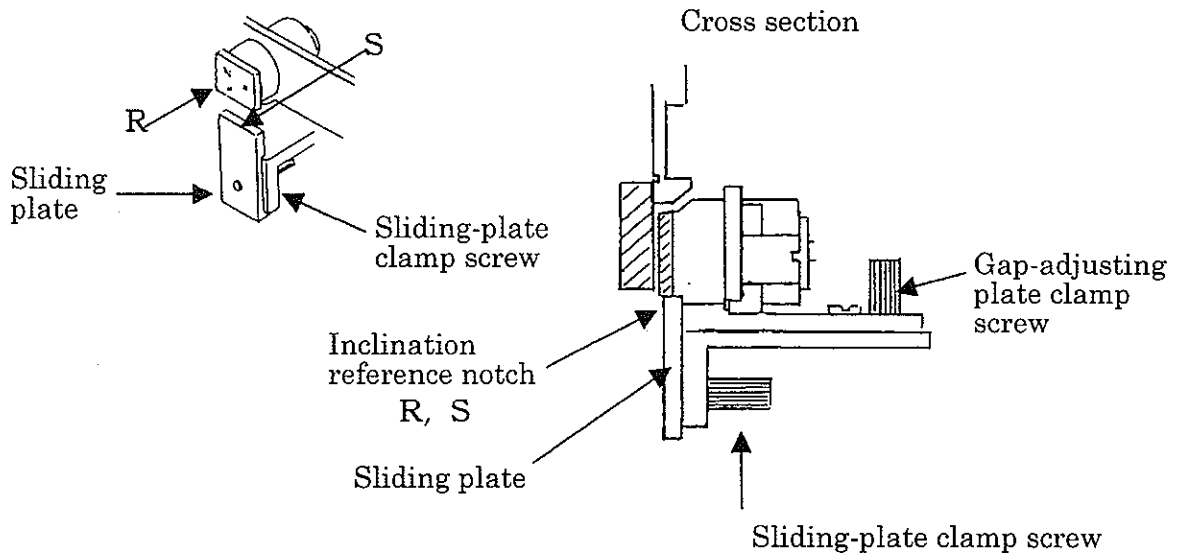
1. Insert the condenser lens case into the index holder.



2. Install the index holder to the V-index gap adjuster (J26337V) so that the index-holder bottom side (Q) firmly contacts the V-index-gap adjuster's reference surface (P), and then use the fixing screws to secure the index holder to the left column of the main body.

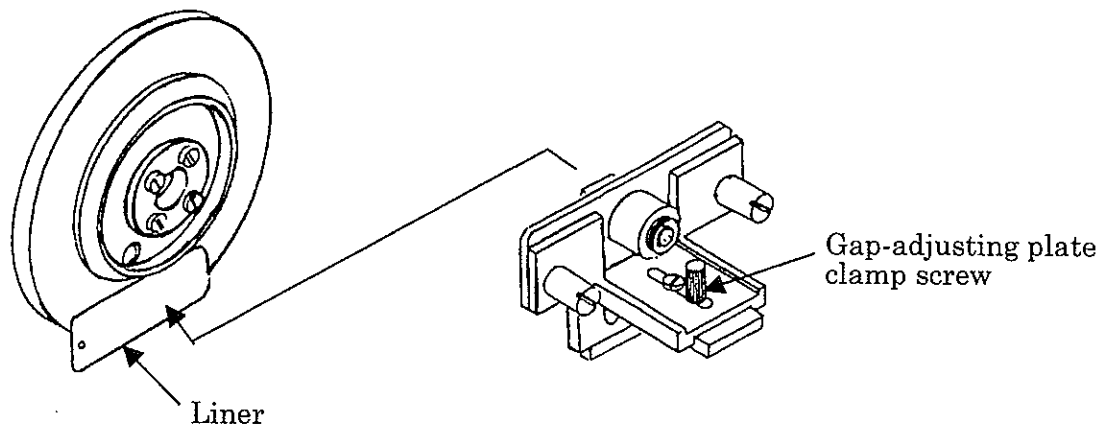
★ Use a screwdriver with a wooden handle to tighten the two fixing screws.

3. Set the sliding plate (S) of the index gas adjuster firmly on the reference notch (R) of the index assembly, and then tighten the sliding-plate clamp screw.

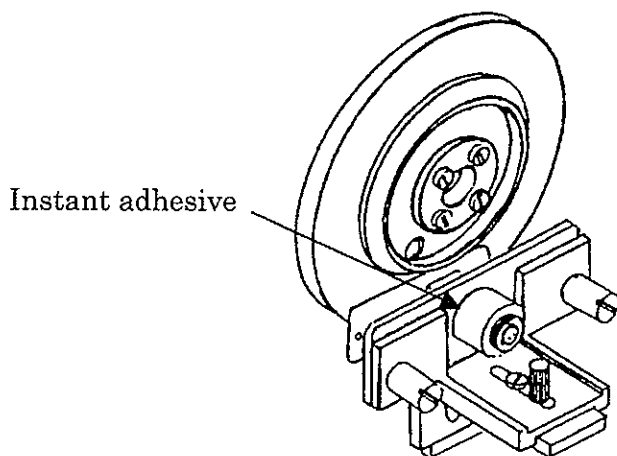


### 8-3. Positioning the V Index

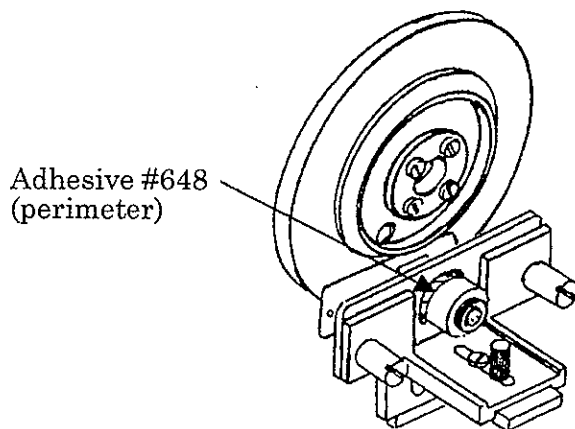
- Place the gap-adjusting liner ( $t = 0.24 \pm 0.04$  mm) on top of the V pulse scale, move the gap-adjusting plate back and forth to press the index assembly firmly against the gap-adjusting liner, and then tighten the clamp screws.



- Apply a small amount of instant adhesive to several locations on the contact surfaces of the index holder and index assembly. Allow to stand for one minute.
  - ★ If the pressing force of the gap-adjusting plate is too weak to hold the liner in place, hold the index assembly with your fingers until the instant adhesive hardens.



- Apply adhesive #648 to the entire contact perimeter of the index holder and index assembly.



- Remove the index-gap adjuster (J26337V) and liner, then leave the index holder and index assembly at room temperature for 24 hours to allow the adhesive to fix.

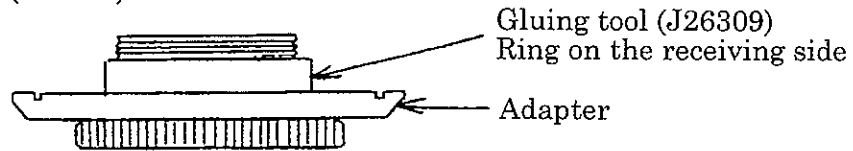
### 8-4. Gluing the H Pulse Scale

★ When the H pulse scale has detached from the pulse-scale adapter, use the pulse-scale gluing tool (J26309) and glue the parts as shown below.

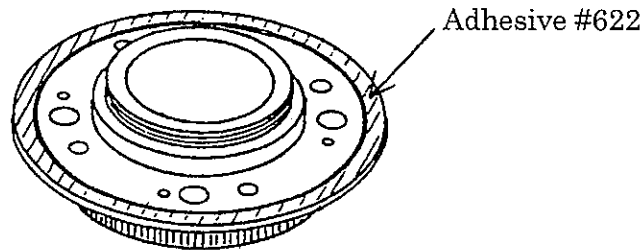
★ Preheating

Thoroughly clean the pulse scale, pulse-scale adapter, and pulse-scale gluing tool (J26309), then place them on a hot plate and heat at a temperature of approximately 40°C for 30 to 60 minutes. The following procedure must be performed while the parts are heated on the hot plate.

1. Place the pulse-scale adapter on top of the ring on the receiving side of the H pulse-scale gluing tool (J26309).

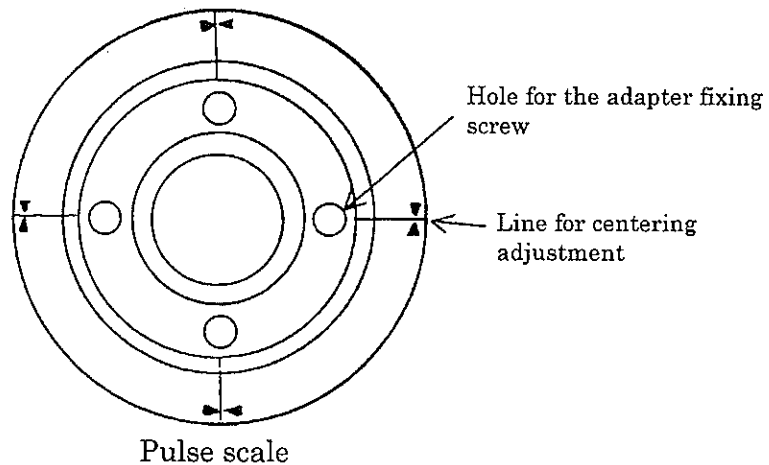


2. Apply a thin coat of adhesive (#622) to the section (shaded area) outside the groove on the perimeter of the pulse-scale adapter.



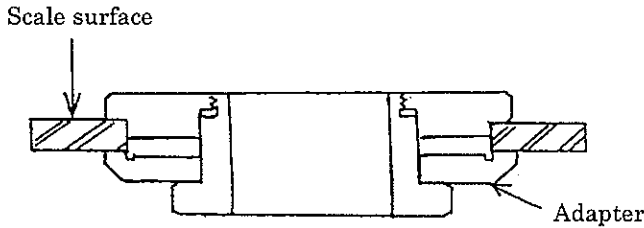
3. With the scale surface facing up, position the pulse scale so that the centering adjustment lines align with the holes for the pulse-scale adapter fixing screws. Then tighten the retaining ring of the pulse-scale gluing tool.

★ It is not necessary to precisely align the adjustment lines on the pulse scale with the centers of the holes in the adapter. This procedure matches the pulse-scale adapter fixing screws with the direction of motion of the adapter for easier centering adjustment.



### 8-4. Gluing the H Pulse Scale

- 4. Leave the pulse-scale assembly (pulse scale and pulse-scale adapter) at room temperature for 24 hours to allow the adhesive to harden.  
★ After bonding, centering must be performed.



H pulse-scale gluing tool  
(J26309)



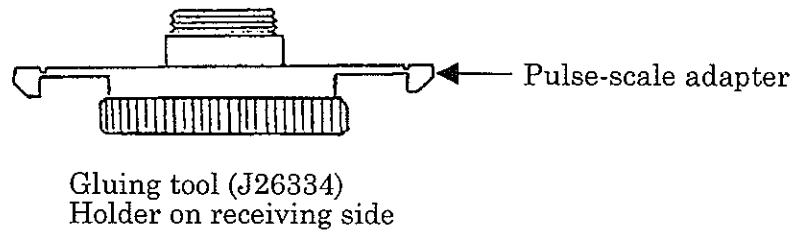
## 8-5. Gluing the V Pulse Scale

★ When the V pulse scale is detached from the pulse-scale adapter, use the pulse-scale gluing tool (J26334) and glue the parts as shown below.

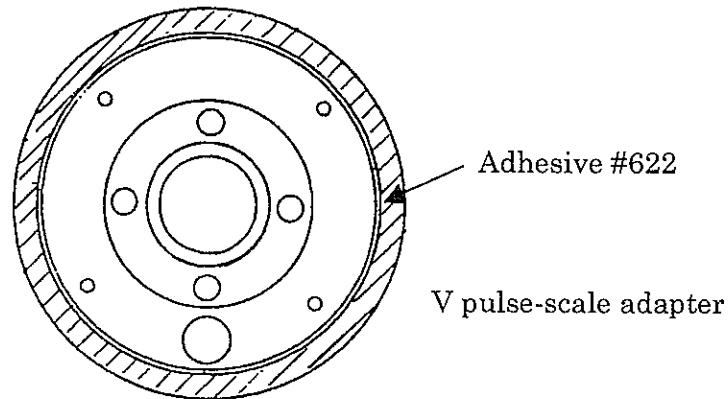
★ Preheating

Thoroughly clean the pulse scale, pulse-scale adapter, and pulse-scale gluing tool (J26334), then place them on a hot plate and heat them at a temperature of approximately 40°C for 30 to 60 minutes. The following procedure must be performed while the parts are being heated on the hot plate.

1. Place the pulse-scale adapter on top of the ring on the receiving side of the V pulse-scale gluing tool (J26334).

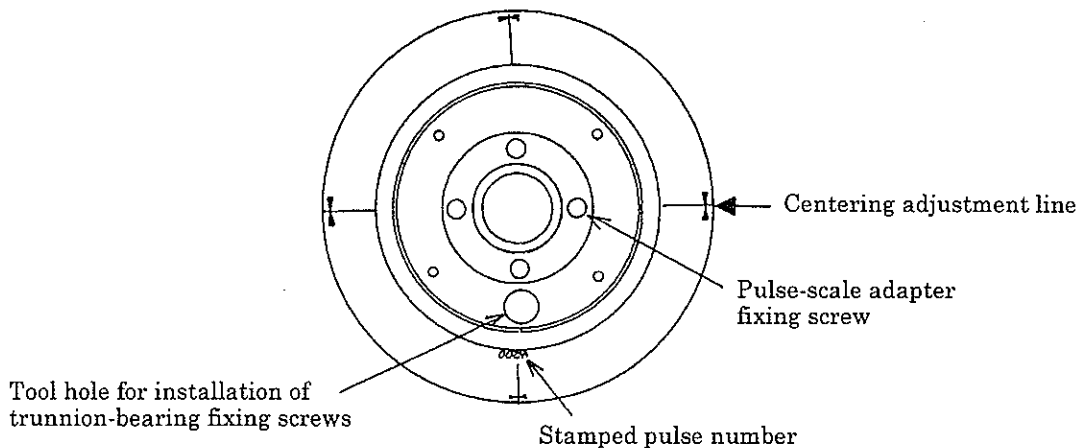


2. Apply a thin coat of adhesive (#622) to the section (shaded area) outside the groove on the perimeter of the pulse-scale adapter.



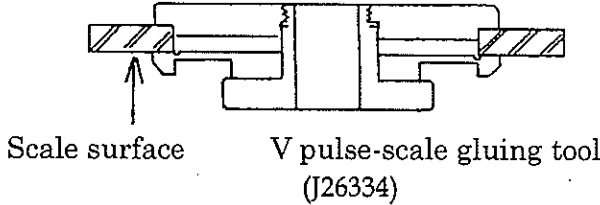
3. With the scale surface facing down, position the pulse scale so that the tool hole for assembling of the trunnion-bearing fixing screws is aligned with the center of the stamped pulse-scale number, and that the centering adjustment lines and adapter fixing screws are aligned in a straight line, then tighten the retaining ring of the pulse-scale gluing tool.

★ If the pulse scale is installed upside down, zero-signal adjustment cannot be performed.



### 8-5. Gluing the V Pulse Scale

- 4. Leave the pulse-scale assembly (pulse scale and pulse-scale adapter) at room temperature for 24 hours to allow the adhesive to harden.  
★ After bonding, centering must be performed.



### 8-6. Centering the H Pulse Scale

The following describes the procedure for installing the tool necessary to adjust the pulse scale.

⊙ Single-axis type: Vertical axle that has its pulse scale fixed on the bottom plate and cannot rotate on its own.

1. Install the centering adjustment stand (J26261) on top of the vertical axle (the vertical axle is shown upside down in the diagram to the right).

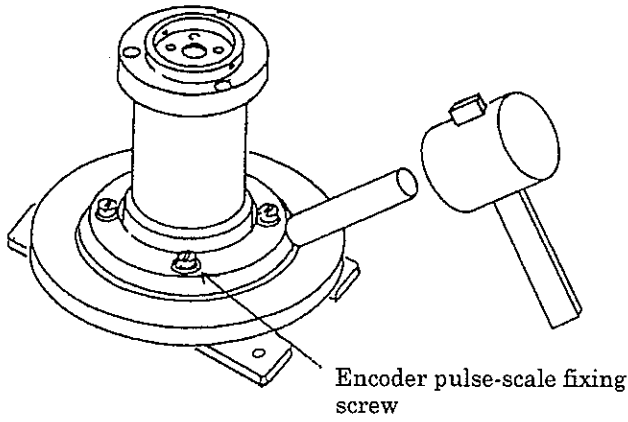
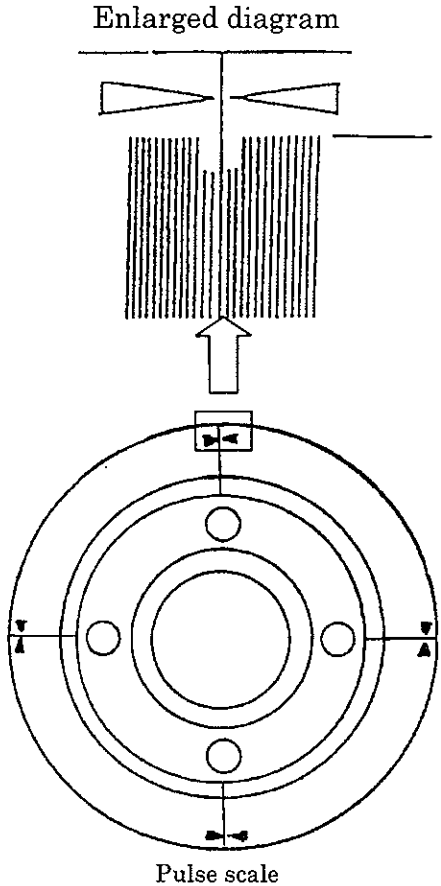
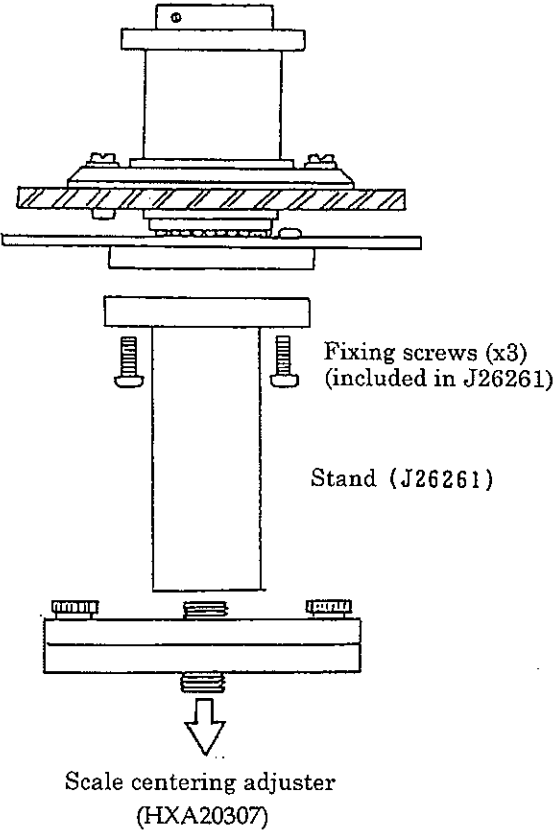
2. Attach the centering adapter (J26261A) to the scale centering tool (HXA20307) and mount the centering adapter on the centering adjustment stand (J26261).

Position the centering adapter so that the two microscopes of the scale centering tool (HXA20307) are aligned in a straight line with the stamped line on the pulse scale.

3. Using the four centering-adjustment lines, center the pulse scale.

Slightly loosen the pulse-scale adapter fixing screws. Place a plastic dowel against the adapter and tap it using a wooden hammer to adjust the centering of the pulse scale.

⊙ Ensure accurate centering by confirming that the outer diameter (C) of the pulse scale does not fluctuate.

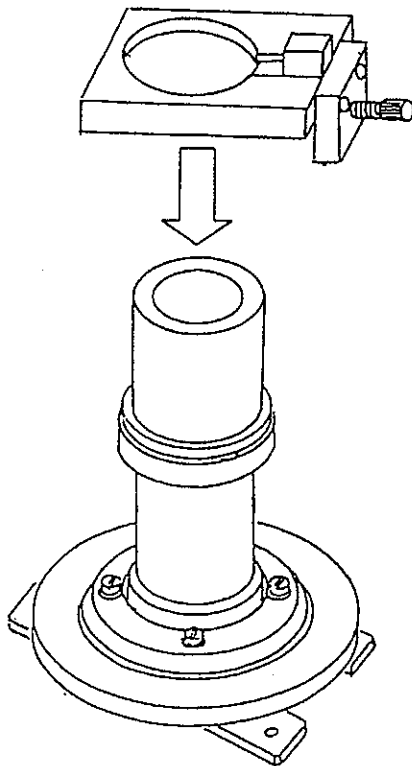


## 8-6. Centering the H Pulse Scale

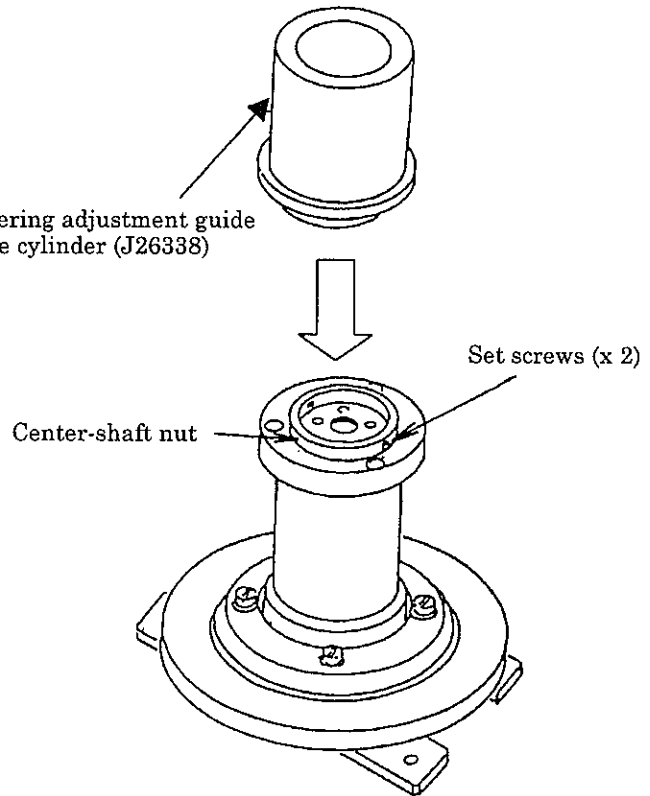
If the work is difficult to perform due to the absence of the clamp fine-control mechanism on the vertical axle, attach the centering adjustment adapter (J26262) and centering-adjustment adapter guide (J26338). This makes it easier to align the centering adjustment lines on the pulse scale with the eyepiece scale on the centering adjustment tool (HAX20307). Tighten the clamp screw on the centering-adjustment adapter guide. When the fine-adjustment screw on the centering adjustment adapter is turned, the pulse scale rotates very slowly within the preset range.

4. Attach the guide cylinder of the centering adjustment guide (J26338) to the slip-ring mounting section of the center shaft nut, then secure it in place using the two slip-ring mounting screws.
5. Mount the clamp section on the centering adjustment guide (J26338).

Centering adjustment guide (J26338)  
Clamp section

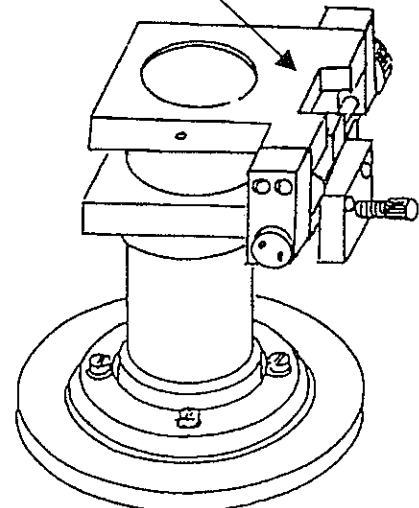


Centering adjustment guide  
Guide cylinder (J26338)



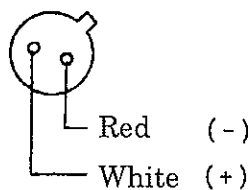
Centering adjustment  
adapter (J26262)  
Fine control

6. Attach the fine-control section to the guide cylinder of the centering adjustment adapter (J26262), and then secure it in place using the three set screws. Tighten the clamp screw on the centering adjustment guide. When the fine-adjustment screw on the centering adjustment adapter is turned, the pulse scale rotates very slowly.



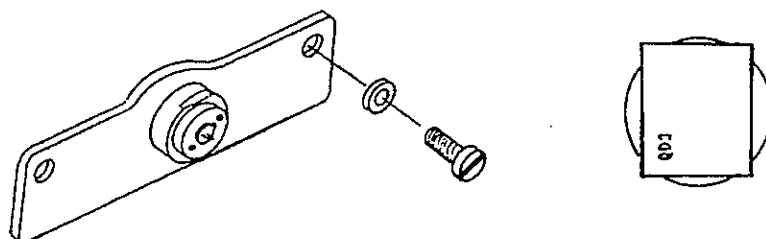
## 8-7. Centering the V Pulse Scale

1. Remove the lead wires of the LED on the V upper/lower-index sections at the soldered sections.  
Before disconnecting, record the cable color, connecting location, and polarity to facilitate reassembly.

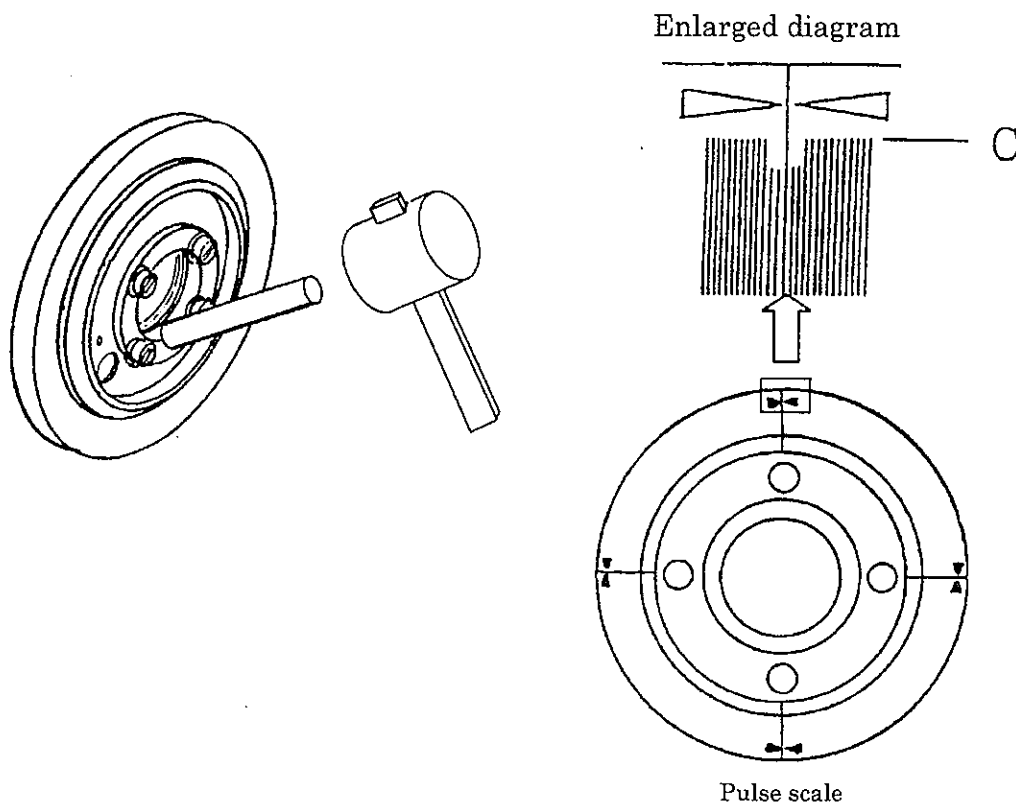


2. Detach the index holder.

The index glass for the upper index is stamped "QD4."  
The index glass for the lower index is stamped "QD3."

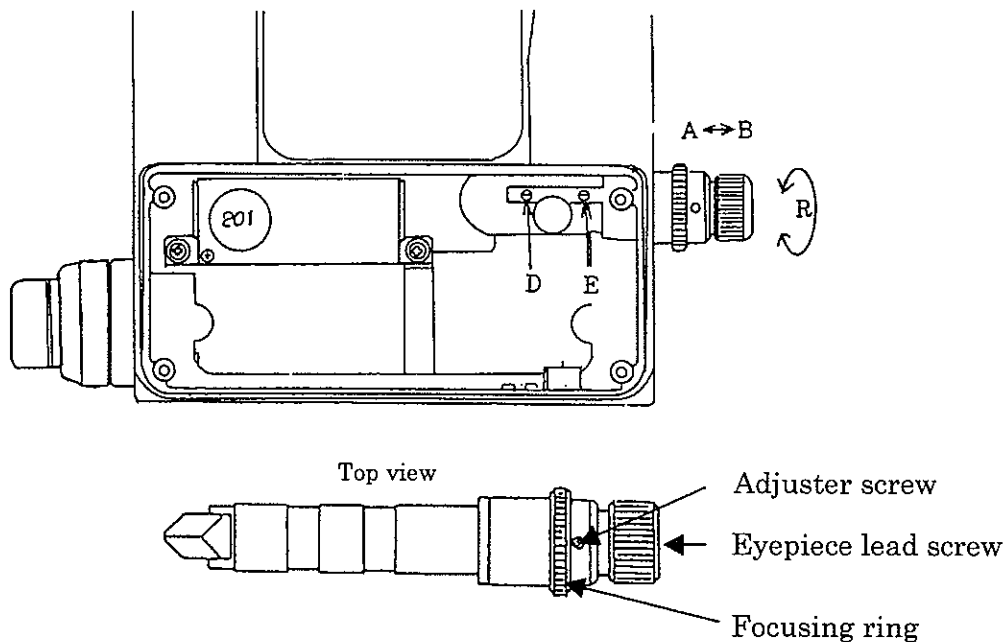


3. Adjust the pulse-scale centering using the four centering-adjustment lines.  
Slightly loosen the pulse-scale fixing screws. Place a plastic dowel against the adapter and tap it using a wooden hammer to adjust the centering of the pulse scale.  
⊙ Ensure accurate centering by confirming that the outer diameter (C) of the pulse scale does not fluctuate.

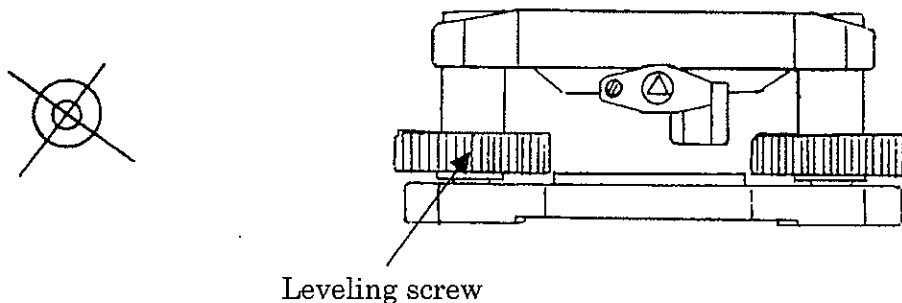


## 8-8. Adjusting the Optical Plummet

1. Position the main body on the collimator stand.
2. Mount the optical plummet on the main body.  
Insert the optical plummet so that the flat surface of the front-end prism faces the base, push it in the direction indicated by arrow A until it stops, then pull back 1 mm in direction B. Position one of the adjuster screws at the top, then loosely tighten set screws D and E.



3. Rotate the eyepiece lead screw to focus on the reticle of the optical plummet.
4. Rotate the focusing ring to focus on the infinite-distance crosshairs of the plummet collimator.
5. Rotate the leveling screw to align the center of the plummet-collimator crosshairs with the center of the optical-plummet reticle.

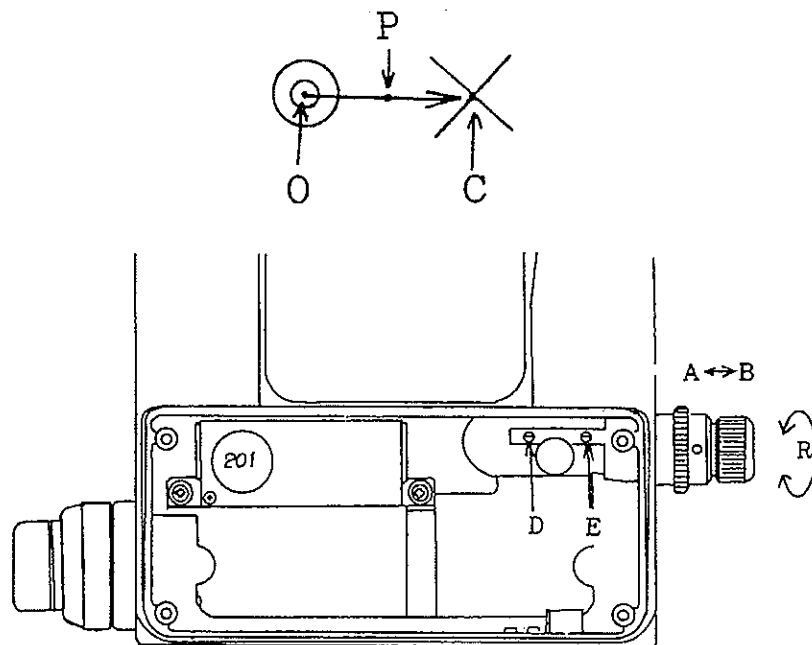


## 8-8. Adjusting the Optical Plummet

6. Rotate the main body by a half-turn.

If the center (C) of the collimator crosshairs is offset from the reticle center (O) of the optical plummet, correct it by the following way. First, using the leveling screw, align point C with point P, which is half the offset distance. Then, align point P, which is now aligned with point C, with point O using the adjustment screw of the optical plummet.

- ★ If there is excessive sideways offset, correct it by rotating the entire optical plummet in the direction indicated by arrow R in the diagram. Lock the sideways adjustment screw of the optical plummet to the center of the adjustment range. Use this adjuster screw to perform fine adjustment.
- ★ Rotate the main body by a half-turn and repeat the procedure until point C is exactly aligned with point O.



7. Rotate the focusing ring of the optical plummet to focus on the near-distance (1.2 m or 0.3 m) crosshairs.
8. Repeat steps (4) through (6) for near-distance adjustment.
- ★ Only the vertical offset can be adjusted for the near distance. Adjust the vertical offset by moving the optical plummet in direction A or B (pulling out or pushing in).
  - ★ Be sure to tighten set screws D and E following the adjustment.

## 9. Electrical Adjustment

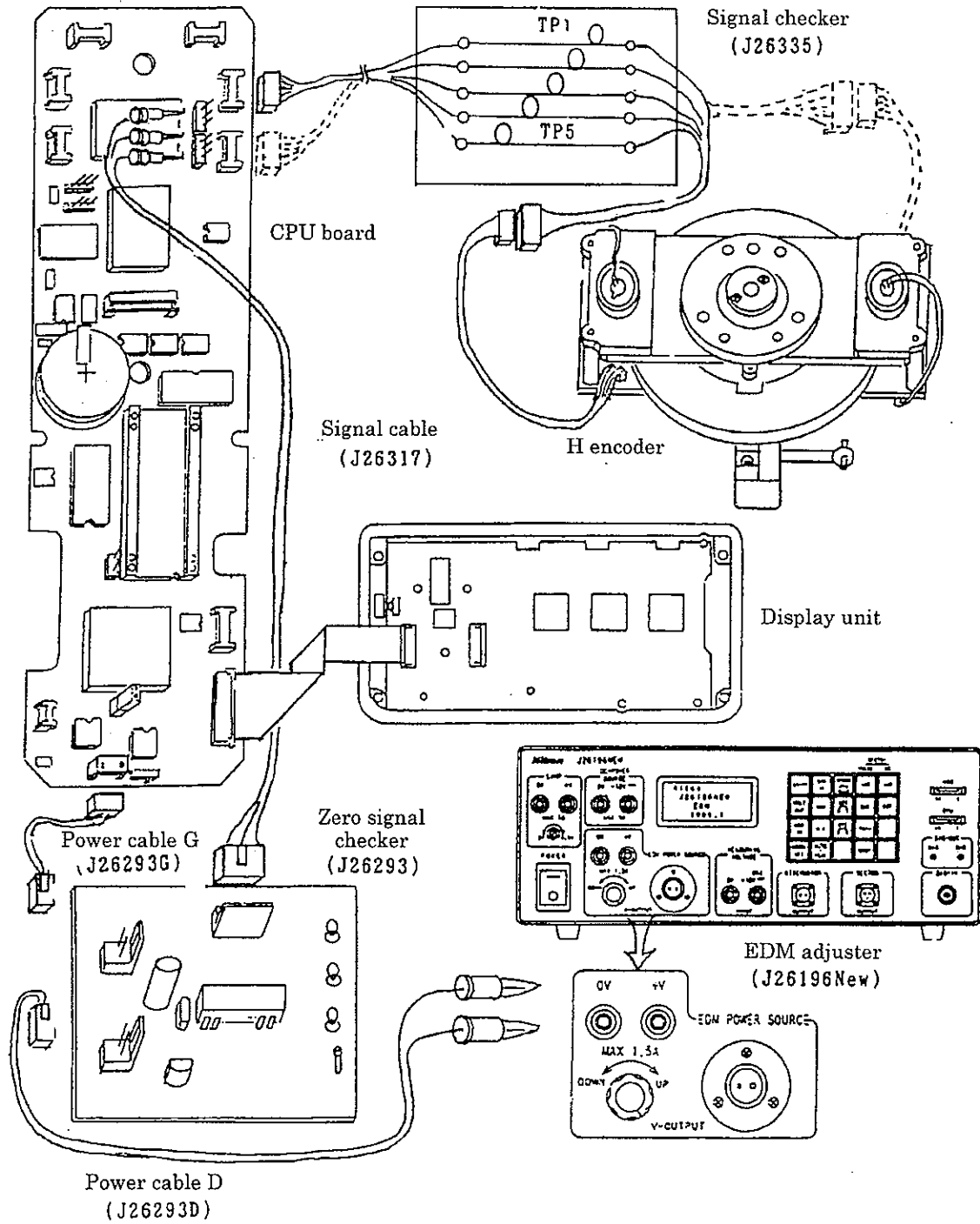
- ★ Wear an anti-static wristband and perform work on an anti-static mat.
- ★ To ensure accurate adjustment of the frequency and phase of the zero signal (Hz and Vz) for the main encoder signals (H0 and H90, V0 and V90), observation must be conducted using a stationary waveform.  
This requires the use of a storage oscilloscope.
- ★ If external light other than the light from the LED enters the detector unit, the waveform may change, resulting in inaccurate adjustment. To prevent this, place a dark cover of suitable size (e.g., black cloth) over the detector unit when making an adjustment.
- ★ Some H/V encoder adjustments require use of the tool card. Be sure to adjust all items in accordance with the instructions given in Section 10.



# 9-1. Adjusting the H Encoder

## Adjusting the H-encoder amplitude and phase

1. Connecting the circuit boards and tools  
Connect the H detector, CPU board, display unit, zero signal checker, signal checker, power cable, and EDM adjuster as shown in the diagram below.



## 9-1. Adjusting the H Encoder

★ Be sure to place a dark cover (e.g., black cloth) over the detector unit when adjusting the encoder.

2. Set the oscilloscope.

Input mode: AC (for both CH1 and CH2)

Sweep time: X-Y

Voltage range: 500 mV (for both CH1 and CH2)

Connections:

CH1 → TP2 (H0) on signal checker (J26335)

CH2 → TP3 (H90) on signal checker (J26335)

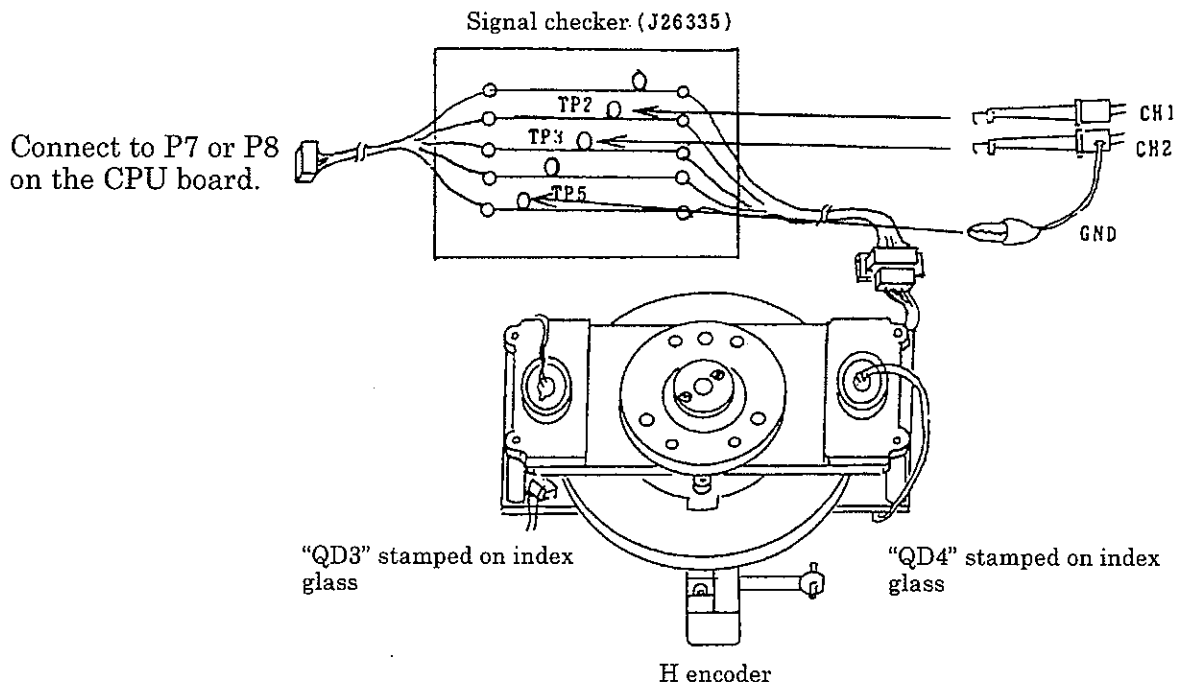
GND → TP5 (GND) on signal checker (J26335)

3. Turn on the power switch of the EDM adjuster and set the voltage between 7 V and 8 V (a DC stabilized power supply may be used).

★ Connect one connector of the signal checker (J26335) to the H detector and connect the other connector as described below.

⊙ When one connector is connected to the left detector board (for adjustment of the left index), connect the other connector to P7 (HL) on the CPU board.

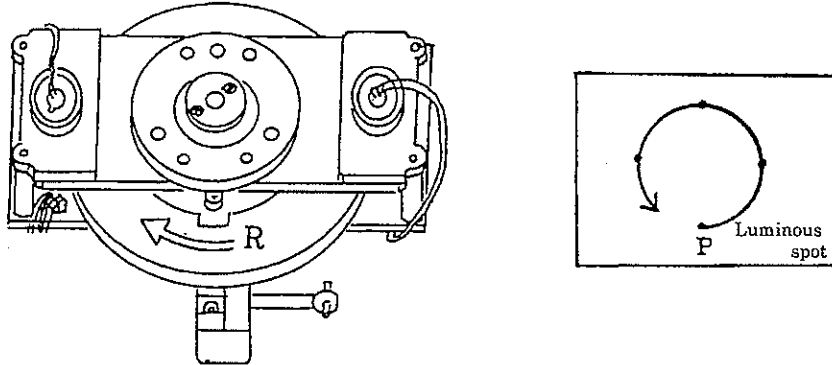
⊙ When one connector is connected to the right detector board (for adjustment of the right index), connect the other connector to P8 (HR) on the CPU board.



★ Make sure the "QD3" indication on the index glass is on the left and the "QD4" indication is on the right when the fastening-lever clamp shaft is positioned toward you.

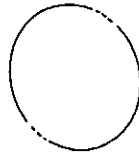
### 9-1. Adjusting the H Encoder

- 4. While rotating the center shaft, move the index holder to adjust the Lissajous waveform displayed on the oscilloscope.
  - ★ Be sure to place a dark cover (e.g., black cloth) over the detector unit when observing a waveform.
  - ★ Confirm that when the center shaft (index) is rotated slowly clockwise in the direction indicated by arrow R, the luminous spot of the signal draws a Lissajous waveform in a counterclockwise direction as shown in the diagram below.

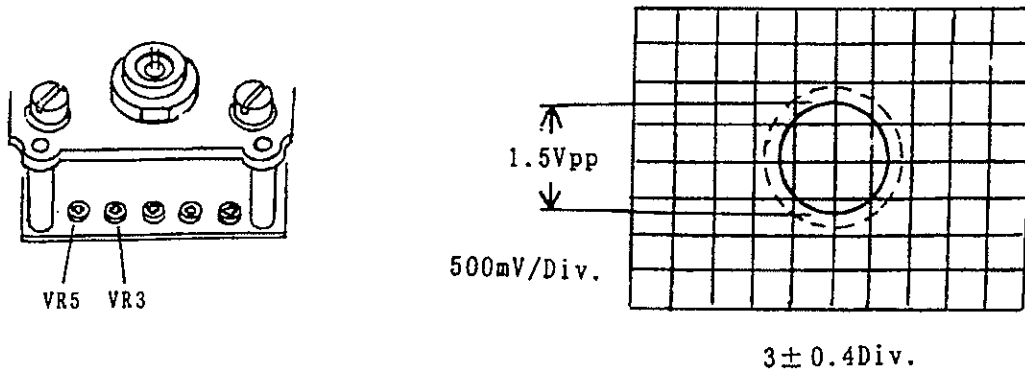


- ★ Adjust the phase shift so that the Lissajous waveform has the largest diameter and is closest to being a perfect circle. (Maximize the amplitude of the 0° and 90° signals and adjust the phase shift to as close to 90° as possible.)  
Phase standard:  $90 \pm 10^\circ$

Waveform observed when the phase is shifted by 10° from the 90° position



- 5. Adjust VR5 on the detector board so that the diameter of the Lissajous waveform is  $1.5 \pm 0.2$  V.  
Turning VR3 extends or compresses the Lissajous waveform vertically.  
Amplitude standard:  $1.5 \pm 0.2$  Vpp

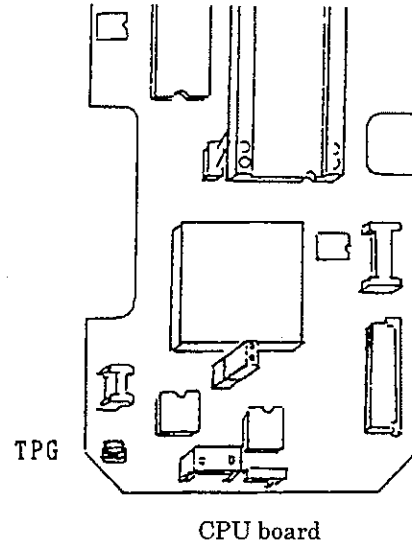


# 9-1. Adjusting the H Encoder

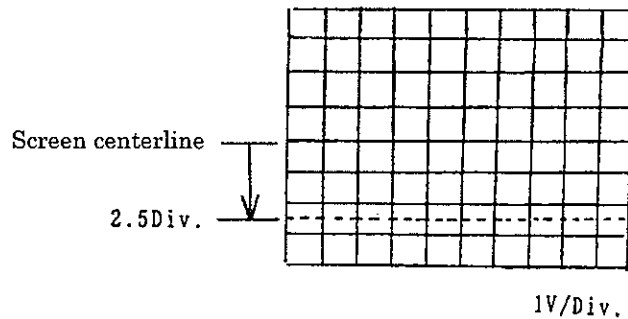
- 6. Set the oscilloscope.
  - Input mode: DC (CH1)
  - Sweep mode: CH1
  - Sweep time: 2 mV/div.
  - Voltage range: 1 V/div.

### Connections:

CH1 → TPG (GND) on the CPU board  
 CH2 → TP5 on the signal checker (J26335)  
 There is no 1/2-Vcc (2.5 V) test pin on the CPU board. Therefore, use the above connections to obtain the reference voltage.

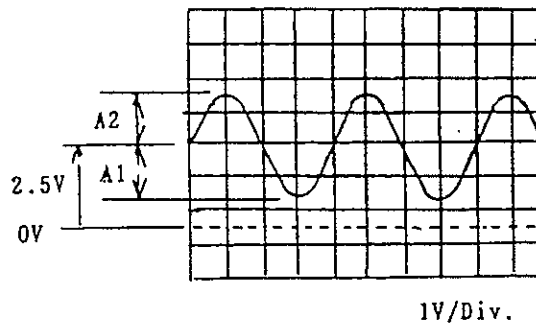
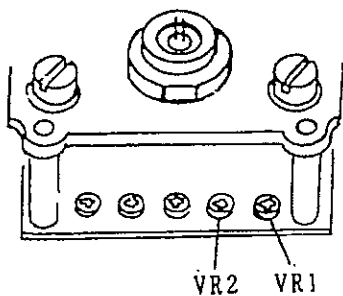


- 7. Turn the CH1 Vertical knob on the oscilloscope to bring the sweep to 2.5 V below the centerline of the oscilloscope screen.



- 8. Connect the CH1 probe to TP2 on the signal checker (J26335). Turn the center shaft (index) to display the H0 sine wave on the oscilloscope screen. Adjust V1 to divide the waveform as evenly as possible across the centerline (A1 = A2).

DC offset standard:  $2.5 \pm 0.15$  V



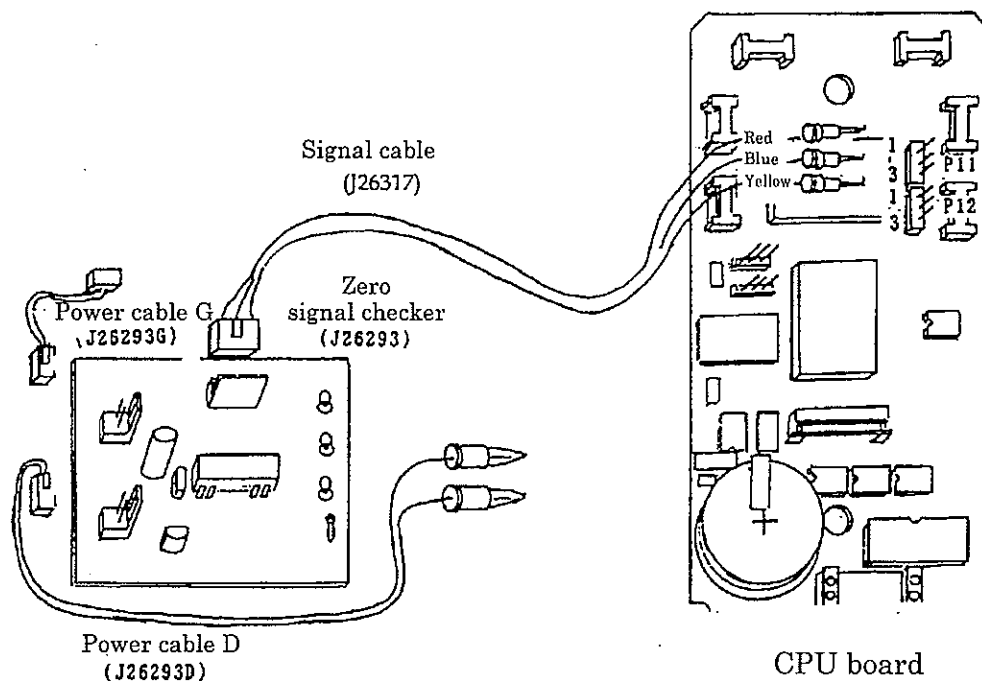
Adjust VR1 and VR2 to achieve  $A1 = A2$ .

## 9-1. Adjusting the H Encoder

9. Connect the CH1 probe to TP3 on the signal checker (J26335) and adjust the H90 sine wave using VR2 by following steps 6 through 8.
10. Upon completion of adjustment of the left (right) index, adjust the opposite index by following steps 1 through 9.

### Adjustment of the H-encoder zero signal

11. Connect the CPU board and tool
    - 1) Connect the signal cable (J26317).  
Connect one connector of the signal cable to the zero signal checker (J26293) and connect the other connector as described below.
- ★ When this adjustment is made following the previously described adjustment, keep all cables other than the signal cable (J26317) connected.



For adjustment of the left index:

- P11 on the CPU board Pin 1 → Red cable (H0) of J26317
- P11 on the CPU board Pin 2 → Blue cable (H90) of J26317
- P11 on the CPU board Pin 3 → Yellow cable (Hz) of J26317

For adjustment of the right index:

- P12 on the CPU board Pin 1 → Red cable (H0) of J26317
- P12 on the CPU board Pin 2 → Blue cable (H90) of J26317
- P12 on the CPU board Pin 3 → Yellow cable (Hz) of J26317

## 9-1. Adjusting the H Encoder

12. Set the oscilloscope.

Input mode: DC

Sweep mode: CHOP

Sweep time: 2 mSec/div.

Voltage range: 2 V/div.

⊙ Adjust the phase and frequency of the zero signal (Hz) for the main signals (H0 and H90) by storing the signals.

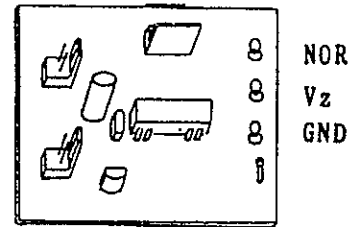
⊙ Set the oscilloscope so that the CH2 up-edge signal can be stored.

Connections:

CH1 → NOR on the zero-signal checker (J26293)

CH2 → Vz on the zero-signal checker (J26293)

GND → GND on the zero-signal checker (J26293)



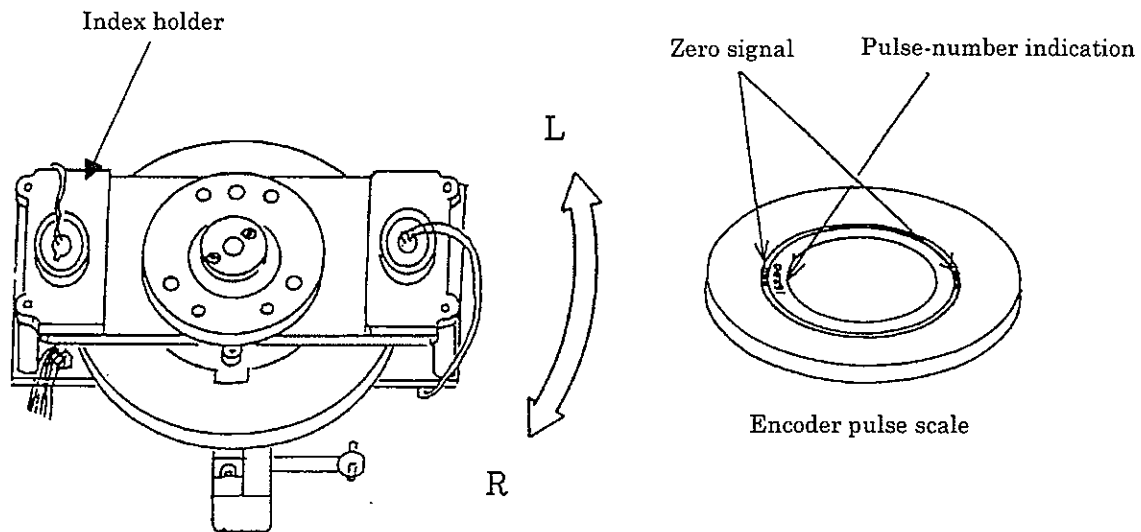
J26293

13. Adjust the zero signal.

★ When adjusting the left index (marked "QD3" on the index glass), adjust using the zero signal for the pulse scale marked with a pulse number.

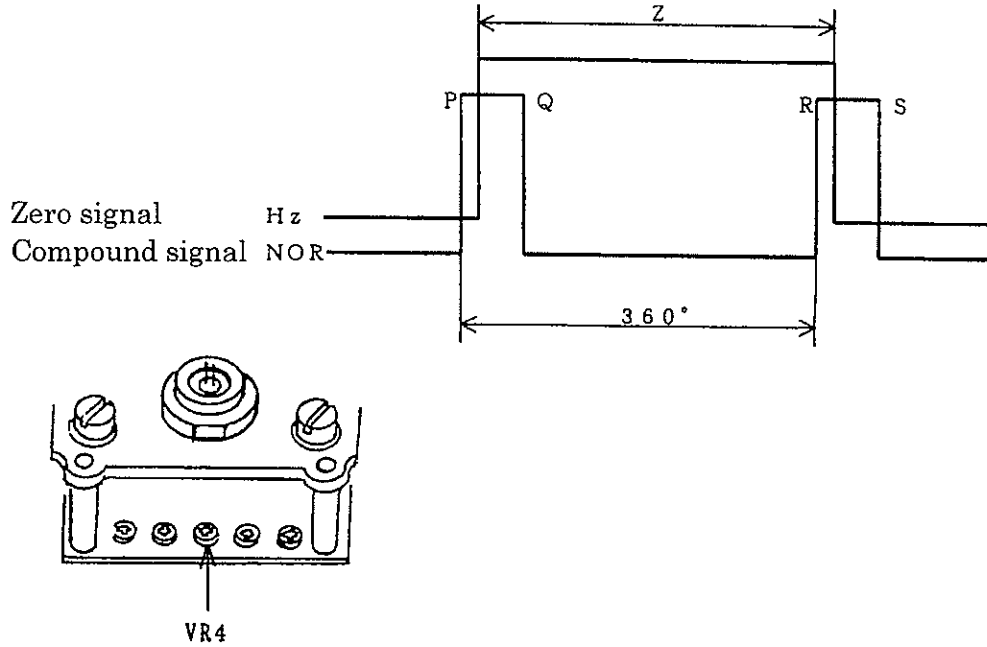
★ When adjusting the right index (marked "QD4" on the index glass), adjust using the zero signal for the pulse scale not marked with a pulse number.

1) With the index holder positioned above the H-encoder zero signal, turn the center shaft repeatedly in the R and L directions so that the zero signal can be continuously monitored on the oscilloscope.



## 9-1. Adjusting the H Encoder

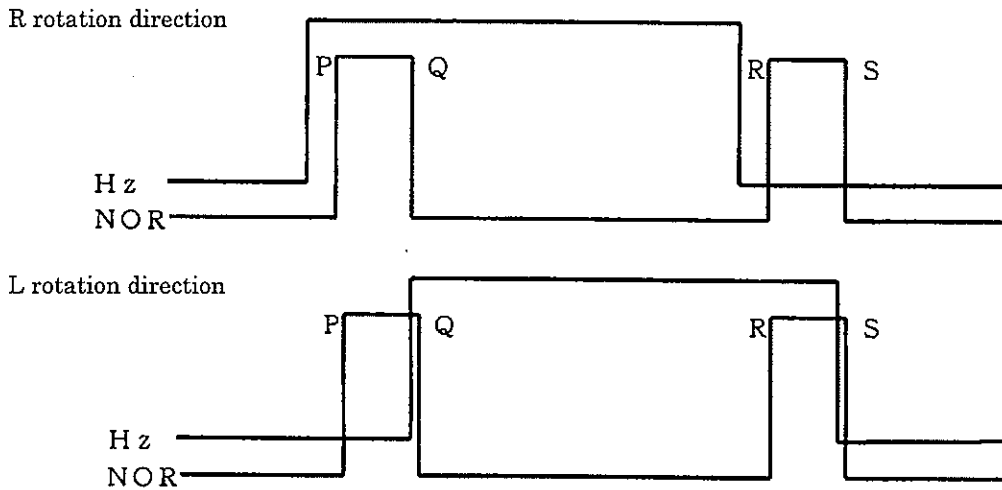
- 2) Store (record) the rectangular waveforms for the H-encoder compound signal (NOR) and zero signal (Hz). Adjust VR4 on the detector board so that the Hz-signal width (Z) matches the wavelength (360°) of the compound signal.



- ★ Adjustment is complete when the Hz up-edge signal is between P and Q on the compound signal and the down-edge signal is between R and S on the compound signal in both R and L rotation directions.

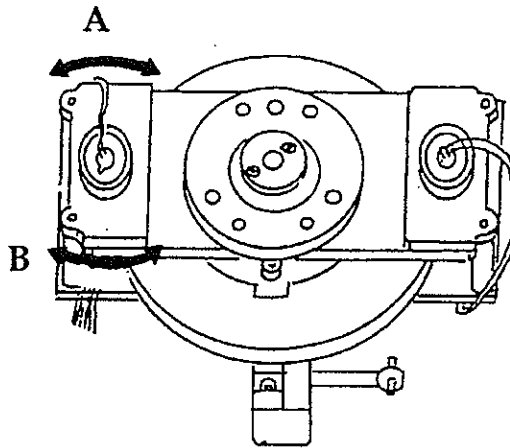
When the zero-signal (Hz) up-edge and down-edge signals are not located between P and Q and between R and S, respectively, as shown in the diagram, move the H index holder in the directions indicated by arrows A and B, a little at a time, to adjust the up-edge and down-edge signals properly.

Examples of signals requiring adjustment



## 9-1. Adjusting the H Encoder

Upon completion of adjustment of the left (right) index, adjust the opposite index by following steps 1) and 2).



- ★ As in the L rotation direction, if the zero up-edge and down-edge signals are not located between P and Q and between R and S, respectively, a measuring angle error of 80" or 40" may be generated.

If the index is moved, repeat the signal checking and adjustment procedures starting from step 4 in Section 9-1.

When J26293 is not available for use, make adjustments using the method described on the following pages.



## 9-1. Adjusting the H Encoder

★ Be sure to place a dark cover (e.g., black cloth) over the detector unit when observing a waveform. Set the oscilloscope as described in step 12, Section 9-1.

### 14. Adjusting the zero signal without using J26293

#### 1) Oscilloscope connections

For adjustment of the left index:

CH1 → P11 Pin 1 (H0) or Pin 2 (H90) on the CPU board

CH2 → P11 Pin 3 (Hz) on the CPU board

GND → TPG on the CPU board, or TP5 on J26335

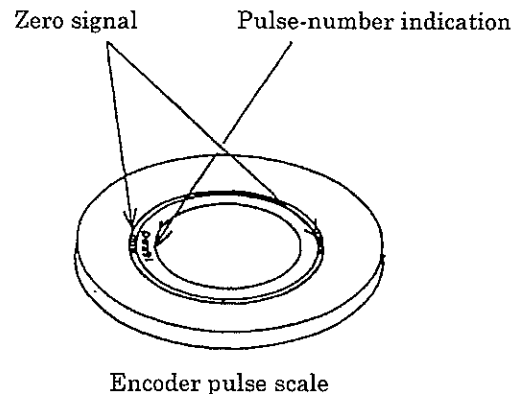
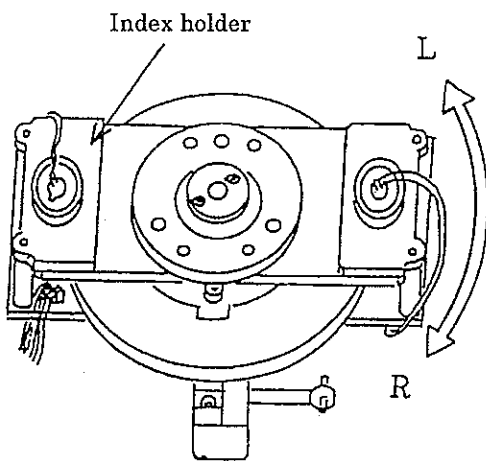
For adjustment of the right index:

CH1 → P12 Pin 1 (H0) or Pin 2 (H90) on the CPU board

CH2 → P12 Pin 3 (Hz) on the CPU board

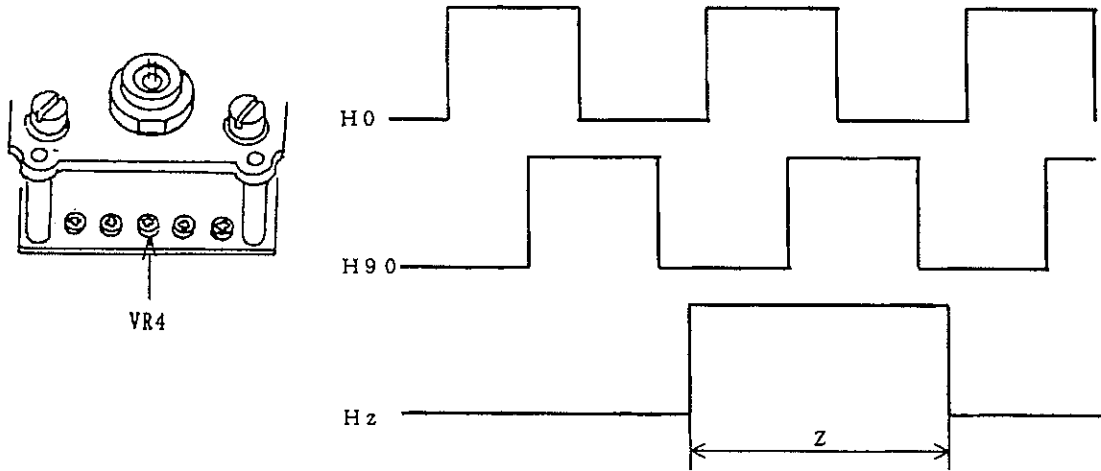
GND → TPG on the CPU board, or TP5 on J26335

- ★ When adjusting the left index (marked "QD3" on the index glass), adjust using the zero signal for the pulse scale marked with a pulse number.
  - ★ When adjusting the right index (marked "QD4" on the index glass), adjust using the zero signal for the pulse scale not marked with a pulse number.
- 2) With the index holder positioned above the H-encoder zero signal, move the index holder while turning the center shaft.  
Move the center shaft in the R and L directions so that the index holder passes over the zero-signal position repeatedly and the zero signal is continuously monitored on the oscilloscope.



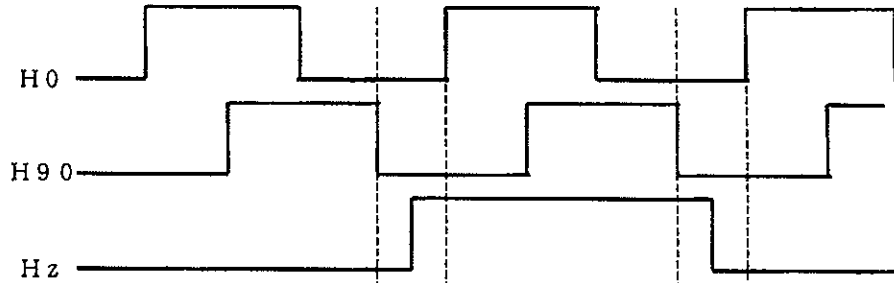
### 9-1. Adjusting the H Encoder

Adjust VR4 on the detector board so that the Hz-signal width (Z) matches the wavelength (360°) of H0.

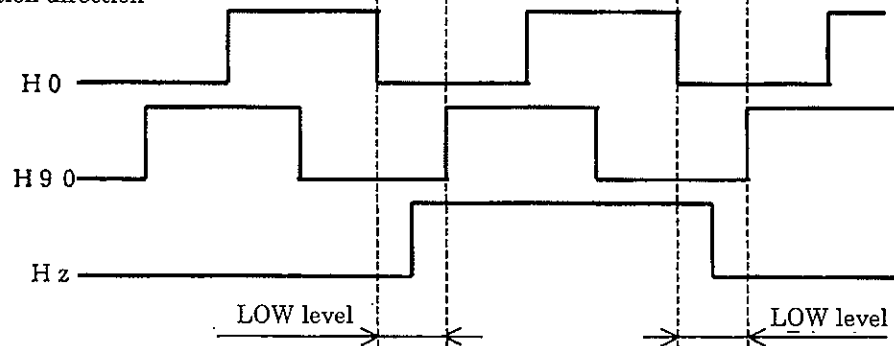


- ★ Make sure Hz rises at H0 (H90) LOW and falls at LOW in both the R and L directions of the index rotation. When the signal is checked using H0 (H90), be sure to check using H90 (H0).

R rotation direction



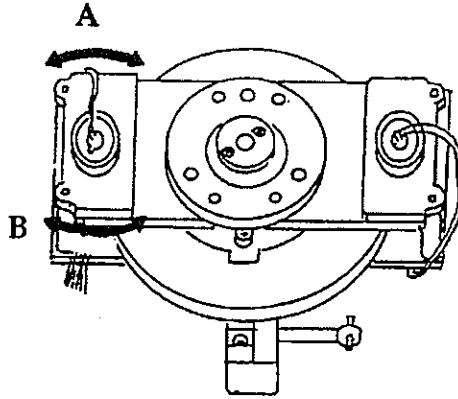
L rotation direction



### 9-1. Adjusting the H Encoder

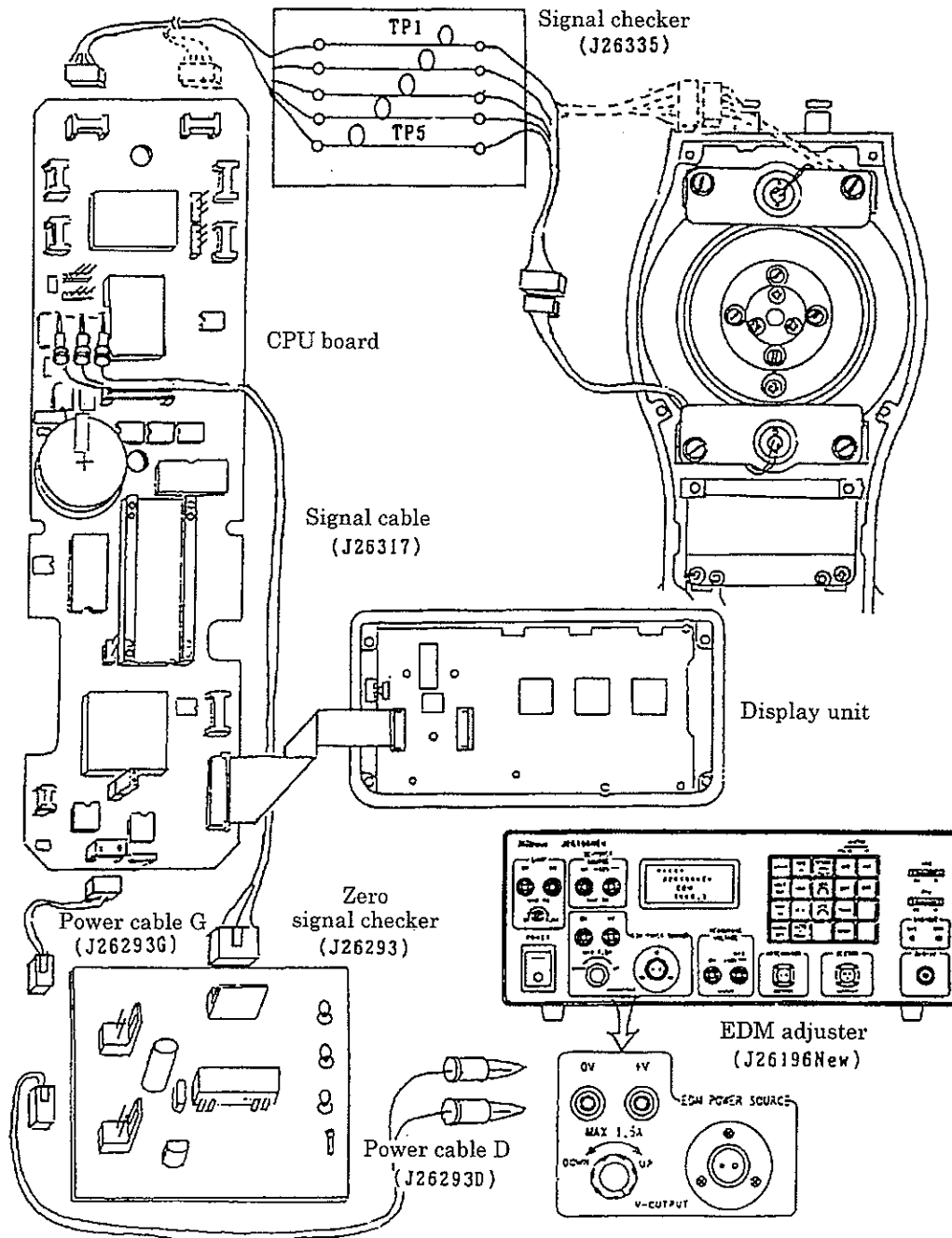
If the H0 and H90 signals rise at LOW in the first cycle and do not fall in the second cycle, move the index holder in the direction of arrow A, a little at a time, to adjust the signals within the LOW range.

If the index is moved, repeat the Lissajous waveform checking and adjustment procedures starting from step 2 in Section 9-1.



## 9-2. Adjusting the V Encoder

1. Connect the circuit boards and tools.  
Connect the V detector, CPU board, display unit, zero signal cheker, signal checker, power cable, and EDM adjuster as shown in the diagram below.



### 9-2. Adjusting the V Encoder

★ Be sure to place a dark cover (e.g., black cloth) over the detector unit when adjusting the encoder.

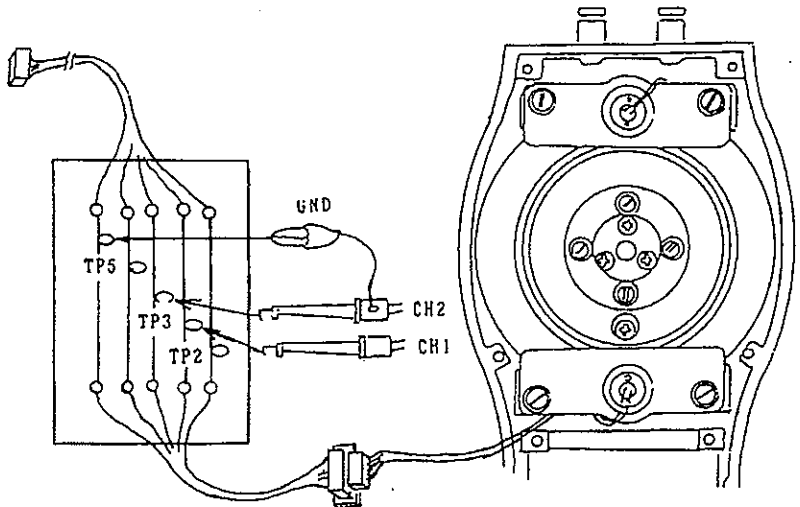
- 2. Set the oscilloscope.
  - Input mode: AC (for both CH1 and CH2)
  - Sweep time: X-Y
  - Voltage range: 500 mV (for both CH1 and CH2)

Connections:

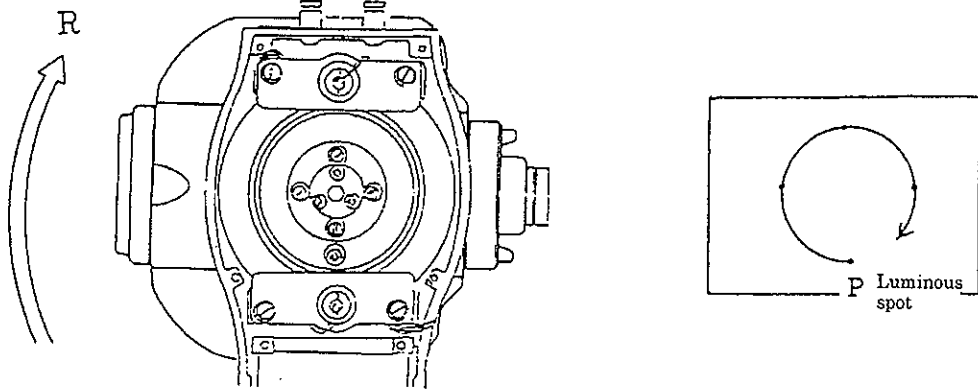
- CH1 → TP2 (V0) on signal checker (J26335)
- CH2 → TP3 (V90) on signal checker (J26335)
- GND → TP5 (Vz) on signal checker (J26335)

- 3. Turn on the power switch of the EDM adjuster and set the voltage between 7 V and 8 V (a DC stabilized power supply may be used).
  - Connect one connector of the signal checker to the V detector, and connect the other connector as described below.
  - ⊙ When one connector is connected to the lower detector board (for adjustment of the lower index), connect the other connector to P9 (VL) on the CPU board.
  - ⊙ When one connector is connected to the upper detector board (for adjustment of the upper index), connect the other connector to P10 (VR) on the CPU board.

Connect to the P9 or P10 connector on the CPU board.



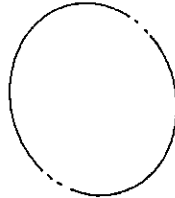
- 4. While rotating the telescope, move the index holder to adjust the Lissajous waveform displayed on the oscilloscope.
  - ★ Be sure to place a dark cover (e.g., black cloth) over the detector unit when observing a waveform.
  - ★ Confirm that when the telescope (pulse scale) is slowly rotated clockwise in the direction indicated by arrow R, the luminous spot of the signal draws a Lissajous waveform in a clockwise direction as shown in the diagram below.



## 9-2. Adjusting the V Encoder

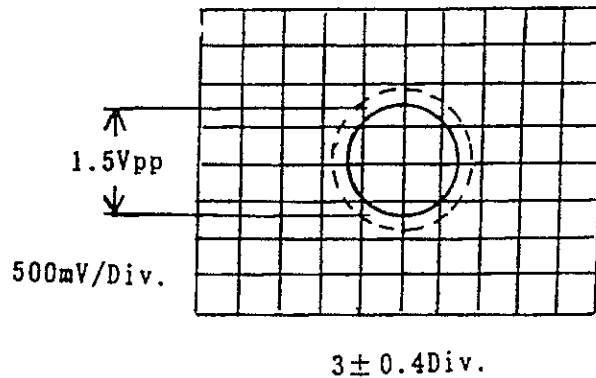
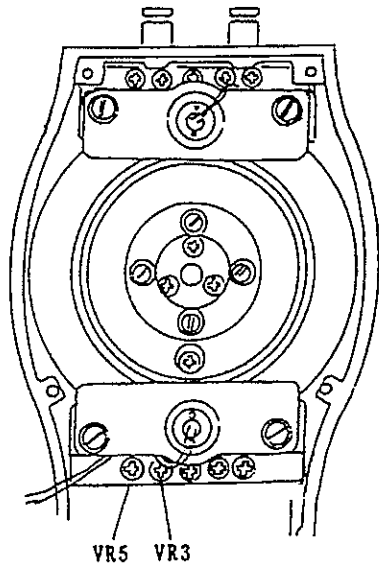
- ★ Adjust the phase shift so that the Lissajous waveform has the largest diameter and is closest to being a perfect circle.  
(Maximize the amplitude of the 0° and 90° signals, and adjust the phase shift to as close to 90° as possible.)

Phase standard:  $90 \pm 10^\circ$



Waveform observed when the phase is shifted by 10° from the 90° position

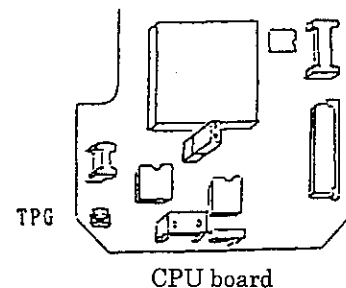
- Adjust VR5 on the detector board so that the diameter of the Lissajous waveform is  $1.5 \pm 0.2$  V. Turning VR3 extends or compresses the Lissajous waveform vertically.  
Amplitude standard:  $1.5 \pm 0.2$  Vpp



- Set the oscilloscope.  
Input mode: DC (CH1)  
Sweep mode: CH1  
Sweep time: 2 mV/div.  
Voltage range: 1 V/div.

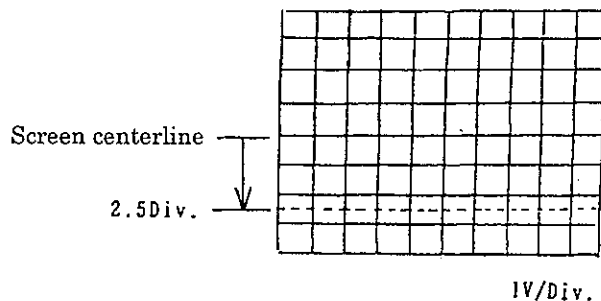
Connections:

- CH1 → TPG (GND) on CPU board
- CH2 → TP5 on signal checker (J26335)



There is no 1/2-Vcc (2.5 V) test pin on the CPU board. Therefore, use the above connections to obtain the reference voltage.

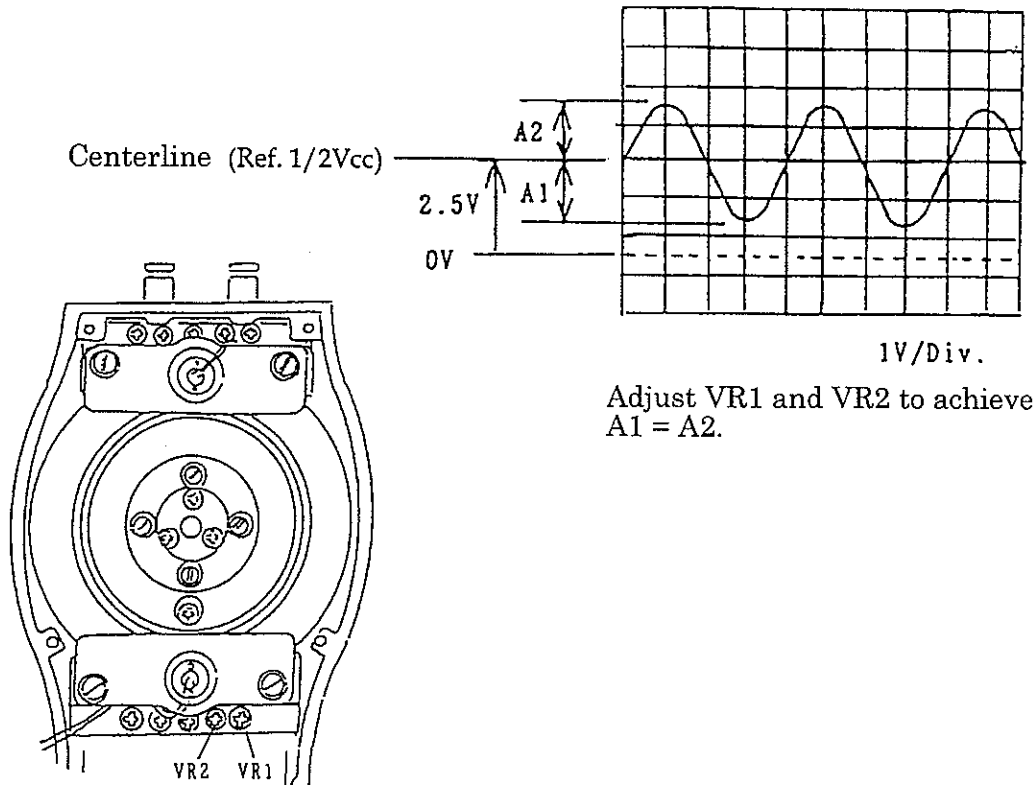
- Turn the CH1 Vertical knob on the oscilloscope to bring the sweep to 2.5 V below the centerline of the oscilloscope screen.



## 9-2. Adjusting the V Encoder

8. Connect the CH1 probe to TP2 (V0) on the signal checker (J26335). Turn the telescope (pulse scale) to display the V0 sine wave on the oscilloscope screen. Adjust V1 to divide the waveform as evenly as possible across the centerline (A1 = A2).

DC offset standard:  $2.5 \pm 0.15$  V



9. Connect the CH1 probe to TP3 (V90) on the signal checker (J26335), and adjust the V90 sine wave using VR2 in the same way as described in 7.

### Adjustment of the V-encoder zero signal

10. Connect the CPU board and tool.

- 1) Connect the signal cable (J26317).

Connect one connector of the signal cable to the signal checker (J26293), and connect the other connector as described below.

For adjustment of the lower index

- P13 on CPU board Pin 1 → Red cable (V0) of J36317
- P13 on CPU board Pin 2 → Blue cable (V90) of J36317
- P13 on CPU board Pin 3 → Yellow cable (Vz) of J36317

For adjustment of the upper index

- P14 on CPU board Pin 1 → Red cable (V0) of J36317
- P14 on CPU board Pin 2 → Blue cable (V90) of J36317
- P14 on CPU board Pin 3 → Yellow cable (Vz) of J36317

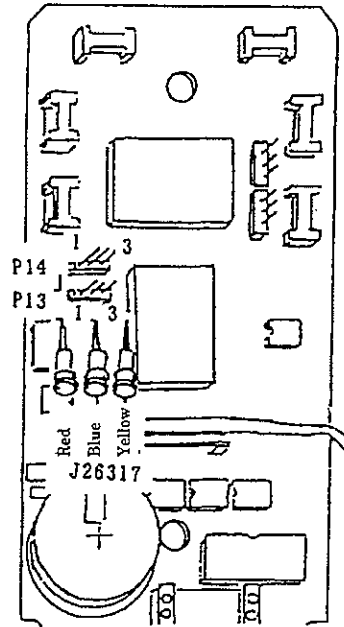
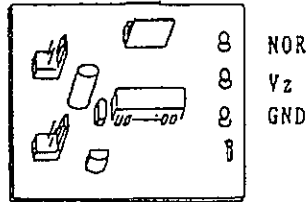
★ When this adjustment is made following the previously described adjustment, keep all cables other than the signal cable (26317) connected.

## 9-2. Adjusting the V Encoder

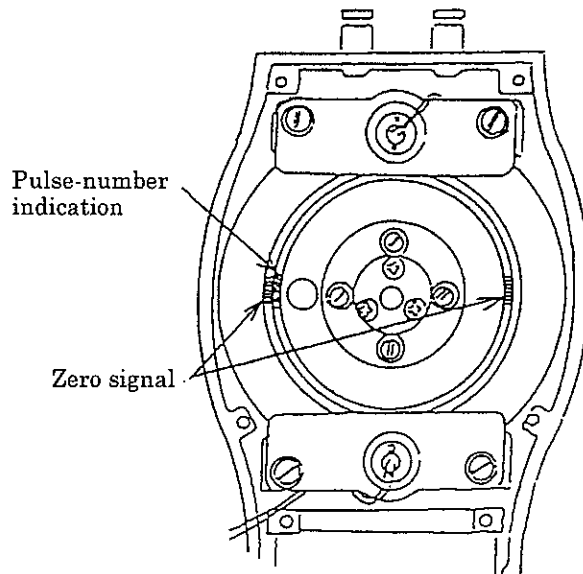
- 11. Set the oscilloscope.
  - Input mode: DC
  - Sweep mode: CHOP
  - Sweep time: 2 mSec/div.
  - Voltage range: 2 V/div.

Connections:

- CH1 → NOR on zero-signal checker (J26293)
- CH2 → Vz on zero-signal checker (J26293)
- GND → GND on zero-signal checker (J26293)



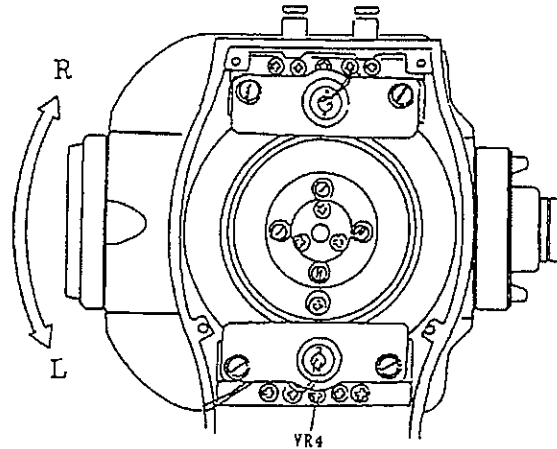
- ⊙ Adjust the phase and frequency of the zero signal (Hz) for the main signals (H0 and H90) by storing the signals.
  - ⊙ Set the oscilloscope so that the CH2 up-edge signal can be stored.
12. Adjust the zero signal.
- ★ When adjusting the lower index (marked "QD3" on the index glass), adjust using the zero signal for the pulse scale marked with a pulse number.
  - ★ When adjusting the upper index (marked "QD4" on the index glass), adjust using the zero signal for the pulse scale not marked with a pulse number.



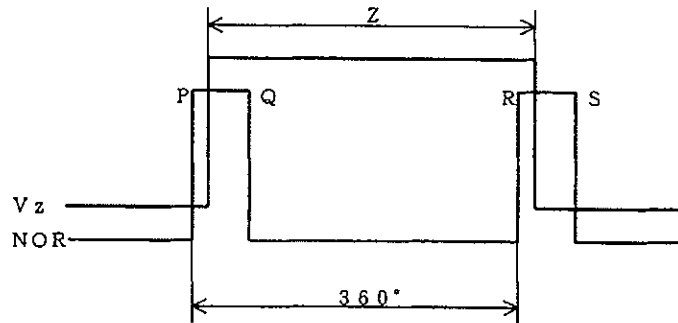


## 9-2. Adjusting the V Encoder

- 1) Rotate the telescope to position the V pulse-scale zero signal below the index, then turn the telescope repeatedly in the R and L directions so that the zero signal can be continuously monitored on the oscilloscope.

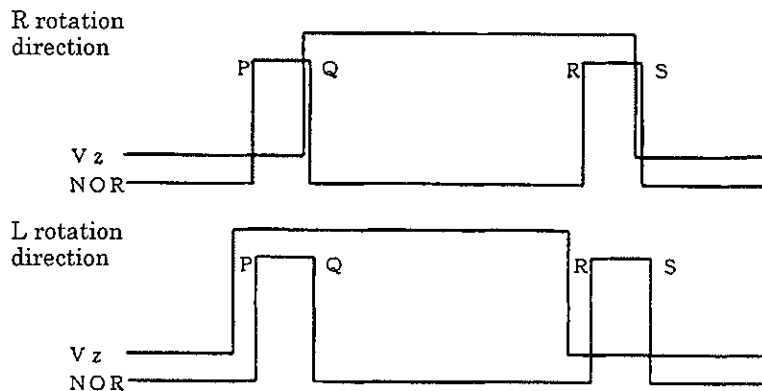


- 2) Store (record) the rectangular waveforms for the V-encoder compound signal (NOR) and zero signal (Vz). Adjust VR4 on the detector board so that the Vz-signal width (Z) matches the wavelength (360°) of the compound signal.



- ★ Adjustment is complete when the Vz up-edge signal is between P and Q on the compound signal and the down edge signal is between R and S on the compound signal in both the R and L rotation directions.

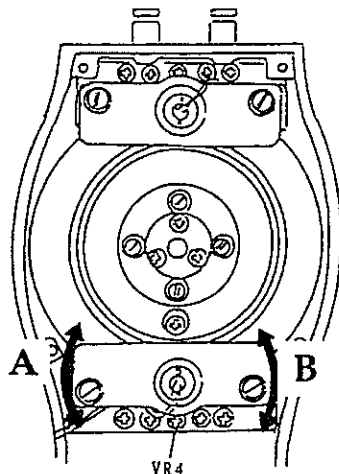
Examples of signals requiring adjustment



## 9-2. Adjusting the V Encoder

- 3) When the zero-signal ( $V_z$ ) up-edge and down-edge signals are not located between P and Q and between R and S, respectively, as shown in the diagram, move the V index holder in the directions indicated by arrows A and B, a little at a time, to properly adjust the up-edge and down-edge signals.

Upon completion of adjustment of either the lower or upper index, adjust the opposite index starting from step 1 in Section 9-2.



- ★ As in the L rotation direction shown above, if the zero signal is not located between R and S, a measuring-angle error of 80" or 40" may be generated.

If the index is moved, repeat the signal checking and adjustment procedures starting from step 2 in Section 9-2.

When J26293 is not available for use, make adjustments using the method described on the following pages.

### 13. Adjusting the zero signal without using J26335

- ★ Be sure to place a dark cover (e.g., black cloth) over the detector unit when observing a waveform. Set the oscilloscope as described in step 11, Section 9-2.

#### 1) Oscilloscope connections

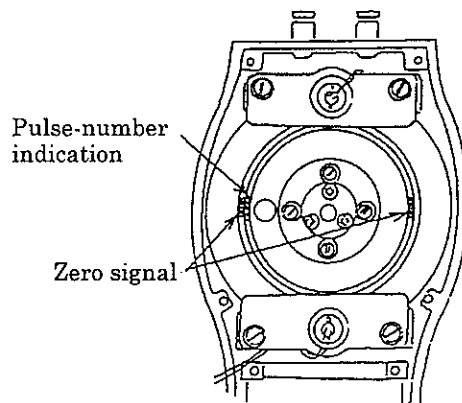
For adjustment of the lower index

CH1 → P13 Pin 1 ( $V_0$ ) or Pin 2 ( $V_{90}$ ) on CPU board

CH2 → P13 Pin 3 ( $V_z$ ) on CPU board

GND → TPG on CPU board, or TP5 on J26335

- ★ When adjusting the lower index (marked "QD3" on the index glass), adjust using the zero signal for the pulse scale marked with a pulse number.



## 9-2. Adjusting the V Encoder

For adjustment of the upper index

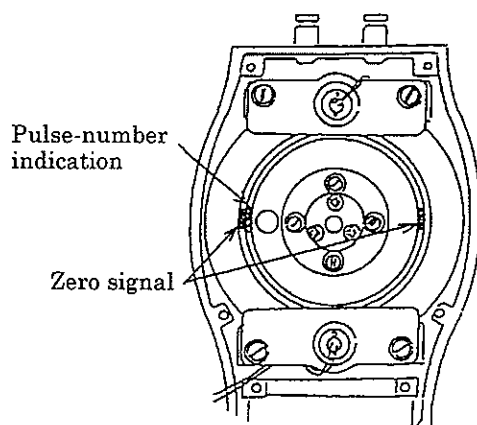
CH1 → P14 Pin 1 (V0) or Pin 2 (V90) on CPU board

CH2 → P14 Pin 3 (Vz) on CPU board

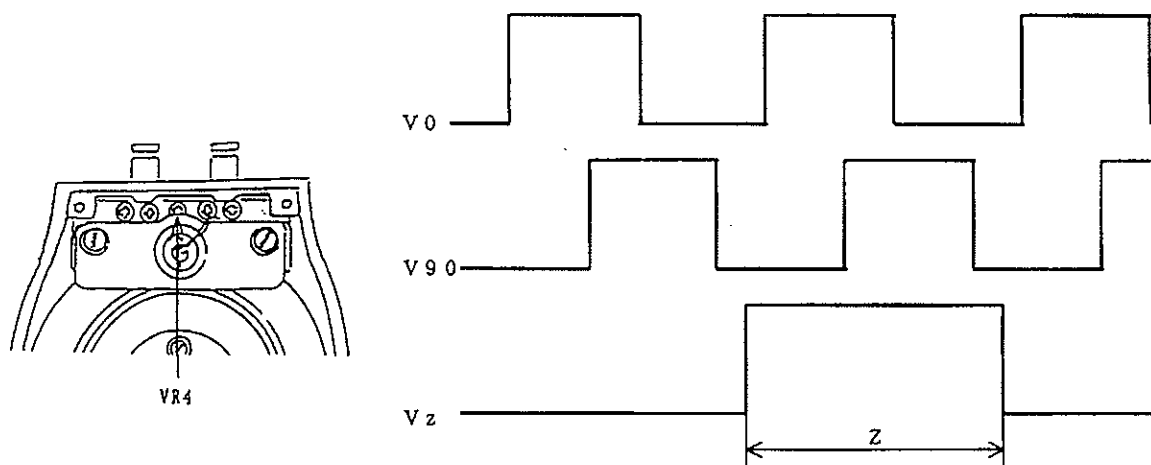
GND → TPG on CPU board, or TP5 on J26335

★ When adjusting the upper index (marked "QD4" on the index glass), adjust using the zero signal for the pulse scale not marked with a pulse number.

- 2) Rotate the telescope to position the V pulse-scale zero signal below the index, then turn the telescope repeatedly in the R and L directions so that the zero signal can be continuously monitored on the oscilloscope.



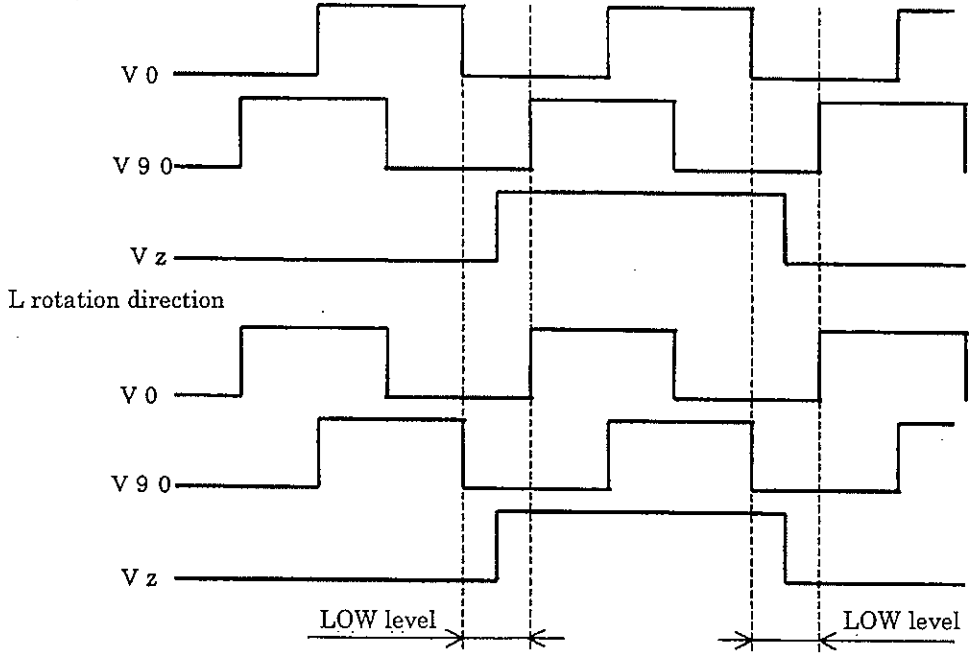
Adjust VR4 on the detector board so that the Vz-signal width (Z) matches the wavelength (360°) of V0.



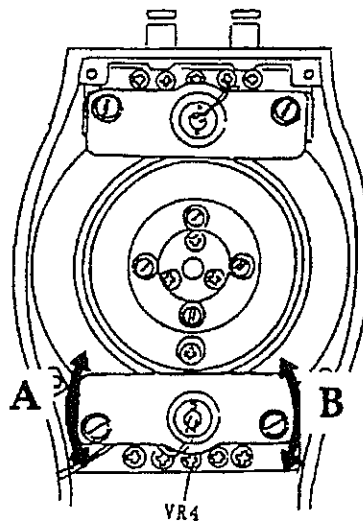
★ Make sure Vz rises at V0 (V90) LOW and falls at LOW in both the R and L directions of the index rotation. When the signal is checked using V0 (V90), be sure to check using V90 (V0).

## 9-2. Adjusting the V Encoder

R rotation direction

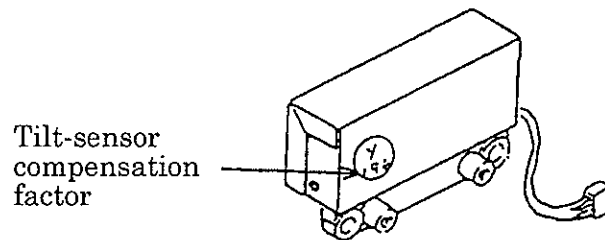


If the V0 and V90 signals rise at LOW in the first cycle and do not fall in the second cycle, move the index holder in the direction indicated by arrow A, a little at a time, to adjust the signals within the LOW range. If the index is moved, repeat the signal checking and adjustment procedures starting from step 4 in Section 9-2.



### 9-3. Adjusting the Tilt Sensors

- ⊙ The tilt sensors (automatic inclination compensation devices) are devices that automatically correct the inclination of the vertical axle within the specified angle ( $\pm 3'$ ) from the vertical position, and display the correct angle.
- ⊙ The X-axis tilt sensor automatically corrects horizontal tilt error and displays the correct horizontal angle for at least two targets with different angles of elevation when tilted to the right or left within the specified angle ( $\pm 3'$ ) in the collimating direction of the telescope.
- ⊙ The Y-axis tilt sensor automatically corrects vertical tilt error and displays the correct vertical angle when tilted in a longitudinal direction within the specified angle ( $\pm 3'$ ) in the collimating direction of the telescope.
- ⊙ Vertical and horizontal errors are corrected based on the tilt-sensor compensation factors stored in the memory of the CPU board.
- ⊙ The tilt sensors are operative when "2 axes" or "1 axis" is selected for the tilt compensation in the initial setting (see the Operation Manual).
- ⊙ The compensation factor is specific to individual tilt sensors, and is indicated on the label attached to each tilt sensor.
- ⊙ The internal operating function of the tilt sensors changes over time, and may prevent the initial compensation factors from providing proper compensation.

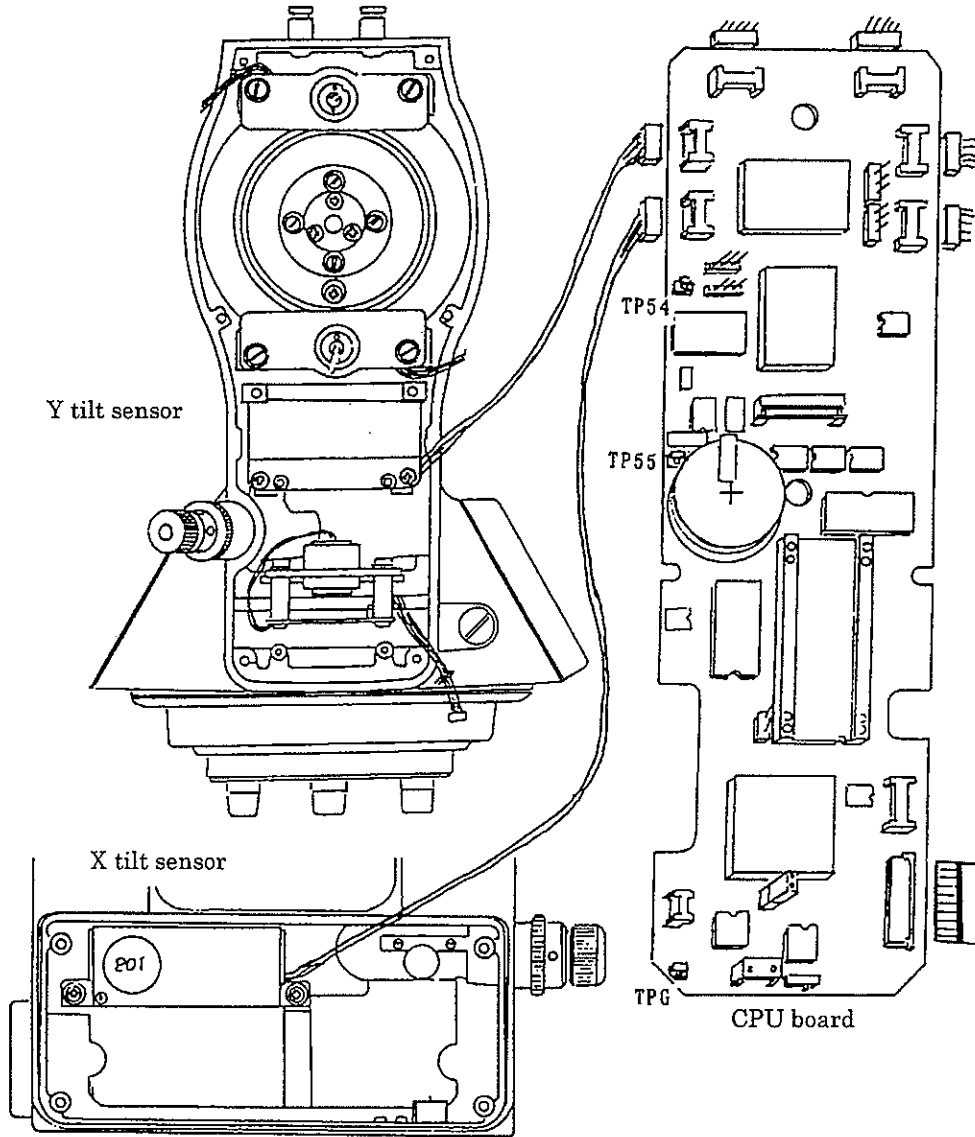


Example: Y tilt sensor

- ⊙ The compensation factors can be read from the factory-setting data through the use of the tool card (J26340). In the cases specified below, appropriate compensation factors must be written to the memory of the CPU board.
  - 1) When the tilt sensors are replaced → Write new compensation factors.
  - 2) When the internal function of the tilt sensors has changed over time and prevents proper compensation → Calculate the appropriate values and rewrite the compensation factors.
  - 3) When the CPU board is replaced → Write the compensation factors indicated on the tilt sensors to the memory.
- ⊙ For the calculation of compensation factors, refer to Section 9-4.
- ★ If the tilt sensors are not properly adjusted or if the compensation factors are not written to the memory of the CPU board, the automatic compensation function does not function properly.

### 9-3. Adjusting the Tilt Sensors

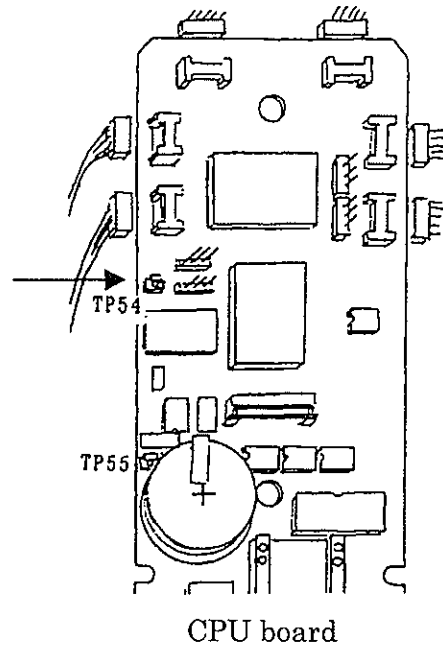
- ⊙ When the tilt sensors are moved or replaced, adjust the electrical signals as described below.
  - ⊙ Use a fully charged internal battery as the power source.
1. Connect the tilt sensors, circuit board, and tool. Cover the CPU board with a plastic bag to prevent it from contacting the main body. Mount the main display unit on the main body.



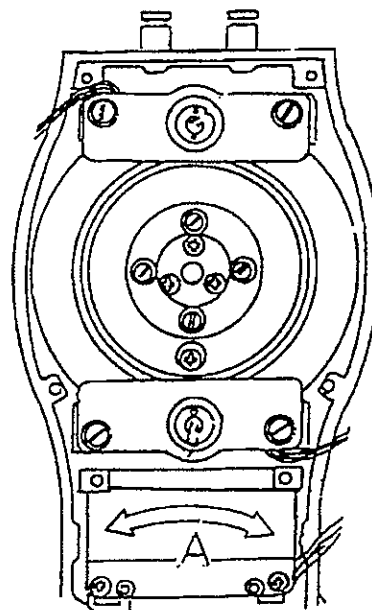
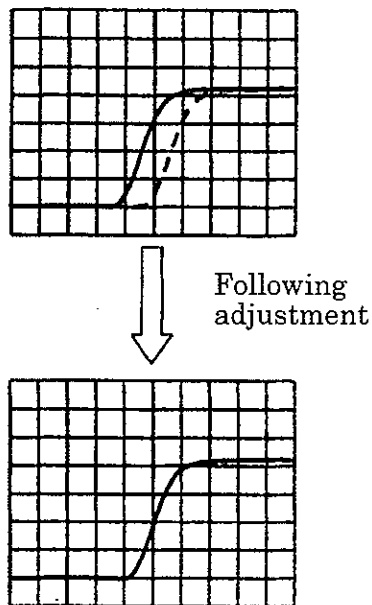
### 9-3. Adjusting the Tilt Sensors

#### Adjustment of the Y tilt sensor

2. Mount the device on the collimator stand and adjust the leveling as precisely as possible.
3. Set the oscilloscope.  
Input mode: AC or DC  
Sweep time: CHOP  
Voltage range: 1 V
4. Connect the oscilloscope.  
CH1 → TP54 on CPU board  
GND → TPG on CPU board



5. Turn on the power switch of the device.  
If the tilt sensor is inclined relative to the main-unit level, the oscilloscope screen displays two separate signals (solid line and dotted line), as shown below to the left. Loosen the tilt-sensor retaining screws and incline the tilt sensor in the direction indicated by arrow A so that the two signals overlap. Unless this adjustment is made, the tilt-sensor compensation range will not be distributed evenly for longitudinal tilt.



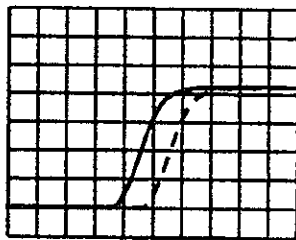
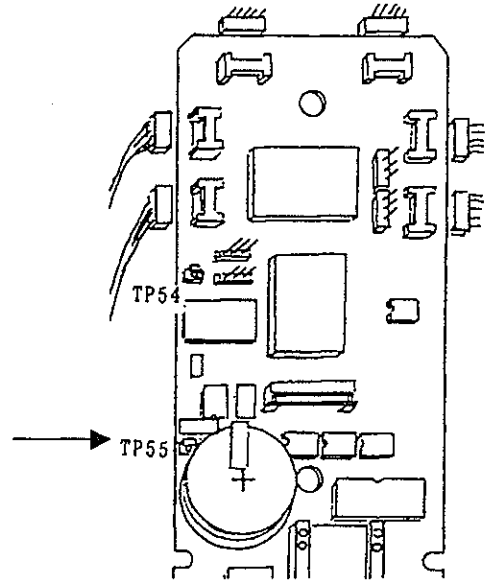
## 9-3. Adjusting the Tilt Sensors

### Adjustment of the X tilt sensor

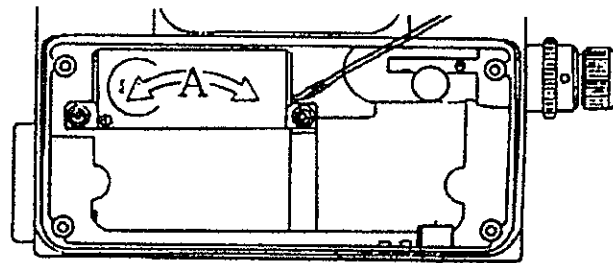
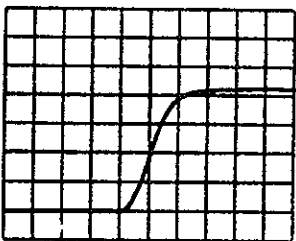
6. Mount the device on the collimator stand and adjust the leveling as precisely as possible.
7. Connect the oscilloscope.
  - CH1 → TP55 on CPU board
  - GND → TPG on CPU board
8. Turn on the power switch to the device.
 

If the tilt sensor is inclined relative to the main-unit level, the oscilloscope screen displays two separate signals (solid line and dotted line), as shown below to the left. Loosen the tilt-sensor retaining screws and incline the tilt sensor in the direction indicated by arrow A so that the two signals overlap.

Unless this adjustment is made, the tilt-sensor compensation range will not be distributed evenly for longitudinal tilt.



Following  
adjustment





## 9-4. Calculating the Tilt Sensor Compensation Factor and Correction Value

### X-axis tilt sensor

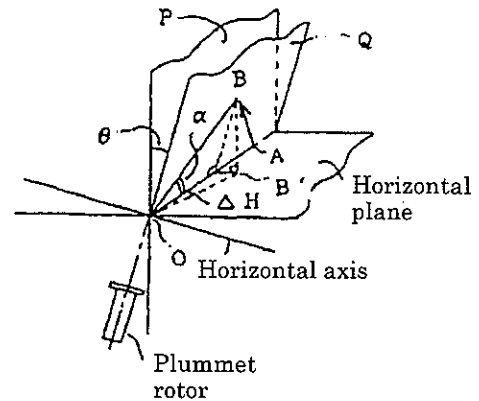
- ⊙ When the vertical axle is inclined at an angle  $\theta$  to the right of the collimating direction of the telescope

O: Center of telescope (intersection point of collimating line and horizontal axis)

OA: Collimating line with telescope positioned horizontally

OB: Located on plane Q at an angle  $\theta$  from plane P based on collimating line set by rotating telescope by an angle of  $\alpha$

B': Projection of point B on horizontal plane  
According to the above, the horizontal angle deviation of OB from OA is  $\Delta H$ .

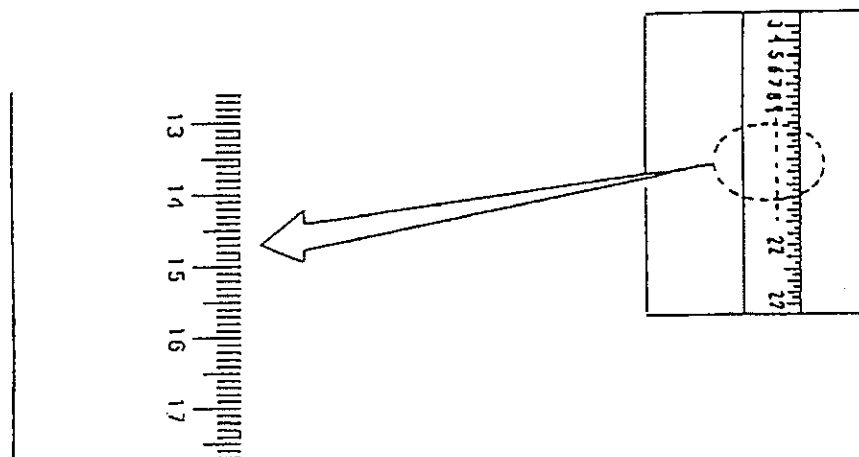


For example, when the device is collimated on A, collimating on B by rotating the telescope after the horizontal angle is zero-reset should indicate a horizontal angle  $\Delta H$ . However, the deviation in this example results in an indication of "0" (because the main body is not moved). In other words, an error  $\Delta H$  is generated in the horizontal angle. ( $\Delta H$  varies in accordance with  $\theta$  and  $\alpha$ .)

- ⊙ The following describes the procedure for checking whether the compensation factor stored in memory is appropriate and the procedure for calculating and storing the correct compensation factor if it is found to be inappropriate.

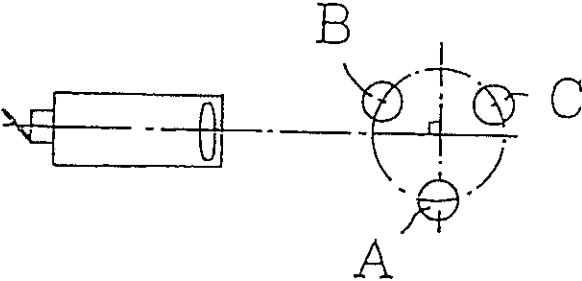
Note the following points before starting work:

- 1) Electrical adjustment of the tilt sensor must be complete.
  - 2) Tilt-sensor compensation: 2 axes
  - 3) Display resolution: Minimum display angle
  - 4) The vertical tangent screw must be positioned at the center of the movement range.
  - 5) The right and left side covers must be attached.
  - 6) Copy a transparent plastic ruler (1 mm scale) on a sheet of white paper. Place the rear side of the ruler on the photocopier when copying.
- ⊙ The scale copied onto paper will hereinafter be referred to as the "copied scale."

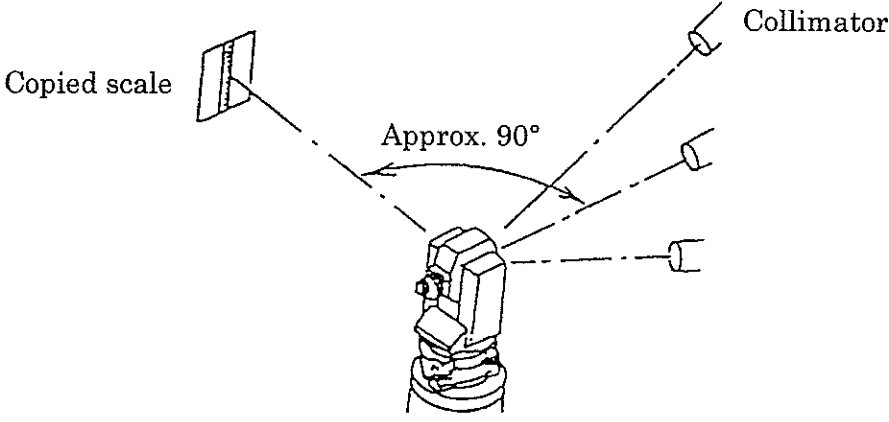


### 9-4. Calculating the Tilt Sensor Compensation Factor and Correction Value

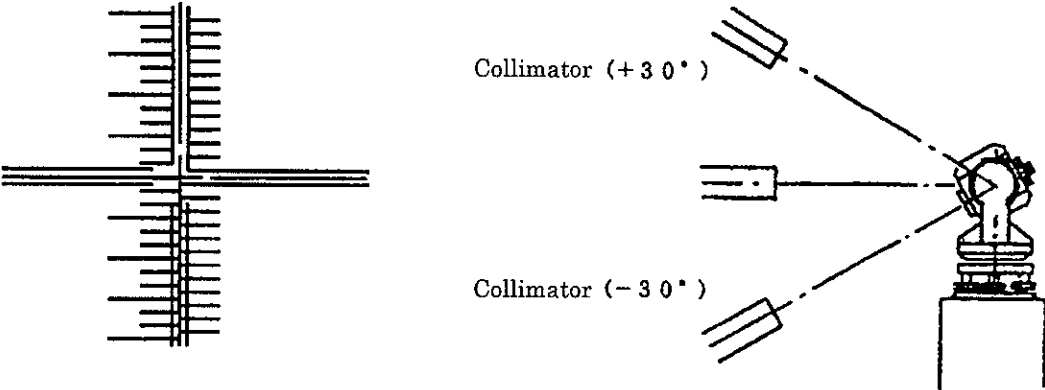
1. Mount the device on the collimator stand.  
Rotate and lock the top of the collimator stand so that one of the three leveling screws (A, B, C) is perpendicular to the optical axis of the collimator (A in the diagram below).  
If the top of the stand does not rotate, lock it by inserting a piece of paper between the bottom plate of the main body and the top of the stand.



2. Affix the copied scale to a wall to the right or left of the subcollimator using adhesive tape.
  - ⊙ The copied scale should be positioned further than the minimum focal distance from the device.
  - ⊙ Affix the scale at the same height as the telescope.
  - ⊙ Position the scale at approximately 90 degrees to the right or left of the sub collimator.



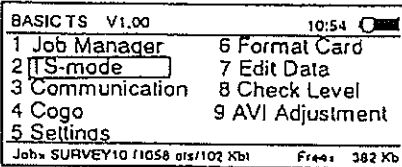
3. Level the device after adjusting the level as precisely as possible.
4. Turn on the power switch of the device.
5. Collimate the collimator (-30°) crosshairs with the telescope in the face left direction.
  - ★ Collimating precision can be improved by positioning the vertical collimating line of the telescope at the midpoint between the collimator's two lines.



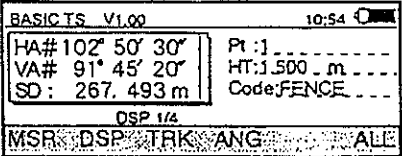
# 9-4. Calculating the Tilt Sensor Compensation Factor and Correction Value

- 6. Reset the horizontal angle to "0."  
 Press the **TS** key on the keyboard, then press the **F4** Angle key.  
 When the screen shows the TS-mode window, press the **F1** key to reset the horizontal angle.

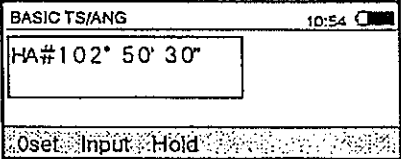
Main menu  
 Select TS-mode



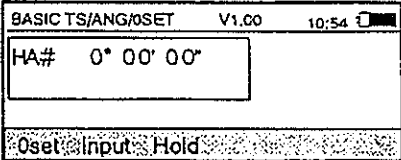
TS-mode screen  
 Press F4 ANG



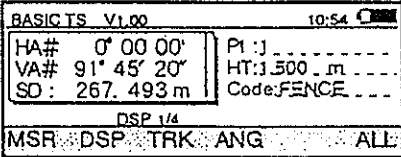
Horizontal angle setting screen  
 Press F1 0 set



Horizontal 0 set



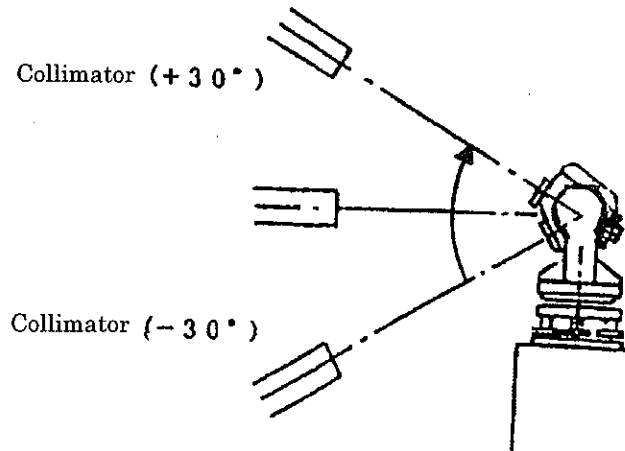
Return to TS-mode screen



## 9-4. Calculating the Tilt Sensor Compensation Factor and Correction Value

- Collimate the collimator ( $+30^\circ$ ) crosshairs, then use the horizontal tangent screw to align the telescope's collimating line with the collimator's vertical line.

Read and record the horizontal angle in this step. H0



- Collimate on the copied scale with the telescope positioned horizontally.
- Use the vertical tangent screw to align the telescope's collimating line with an appropriate scale line.  
In this description, assume alignment to the 15-cm mark.



## 9-4. Calculating the Tilt Sensor Compensation Factor and Correction Value

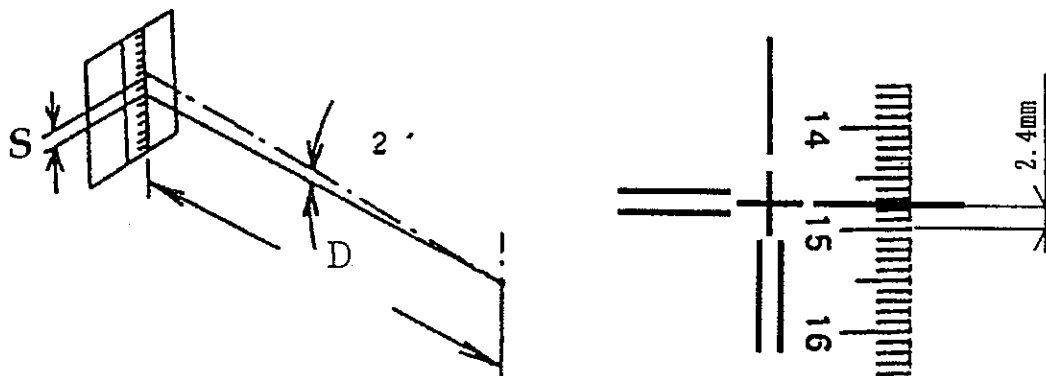
10. Turn leveling screw A to tilt the telescope by  $2'$  above the 15-cm mark.  
If the distance between the device and the copied scale is  $D$  and the distance on the copied scale corresponding to  $2'$  is  $S$ , the relationship is as shown in the table below.

D (m)	1	2	3	4	5	6
S (mm)	0.6	1.2	1.8	2.4	3.0	3.6

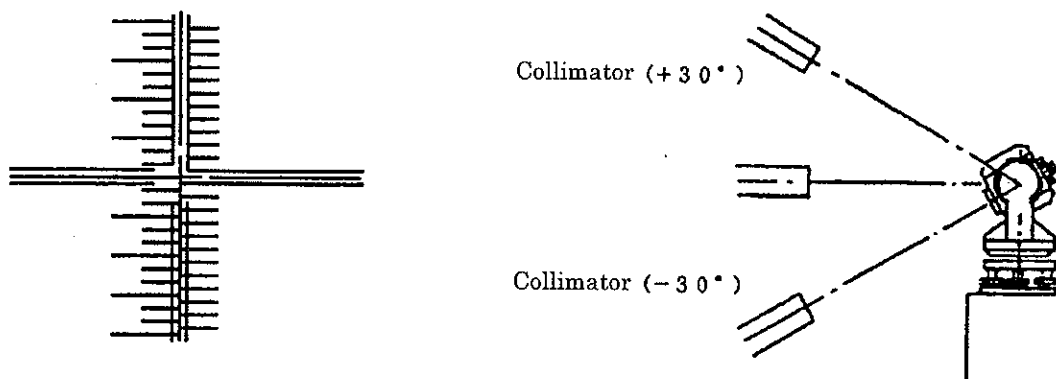
Note that 1 m is not suitable, as the minimum focal point is 1.3 m.

In this description, assume  $D = 4$  m, and thus  $S = 2.4$  mm.

The collimating line of the telescope will therefore be positioned 2.4 mm above the 15-cm mark.



11. Collimate the collimator ( $-30^\circ$ ) crosshairs with the telescope in the forward direction.  
★ Collimating precision can be improved by positioning the vertical collimating line of the telescope at the midpoint between the collimator's two lines.



11. Reset the horizontal angle to "0."  
Press the **F4** Angle key.  
When the screen shows the TS-mode window, press the **F1** key to reset the horizontal angle.

TS-mode screen

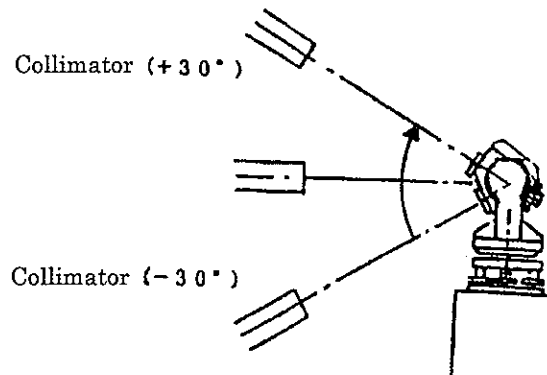
Press F4 ANG

BASICTS V1.00		10:54	
HA# 102° 50' 30"	Pt: J	HT: 1.500 m	Code: FENCE
VA# 91° 45' 20"			
SD: 267.493 m			
DSP 1/4			
MSR	DSP	TRK	ANG
			ALL

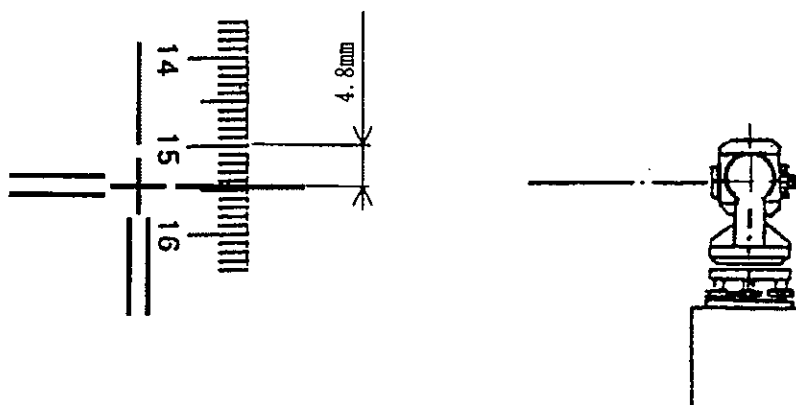
## 9-4. Calculating the Tilt Sensor Compensation Factor and Correction Value

13. Collimate the collimator (+30°) crosshairs, then use the horizontal tangent screw to align the telescope's collimating line with the collimator's vertical line.

Read and record the horizontal angle in this step. H1

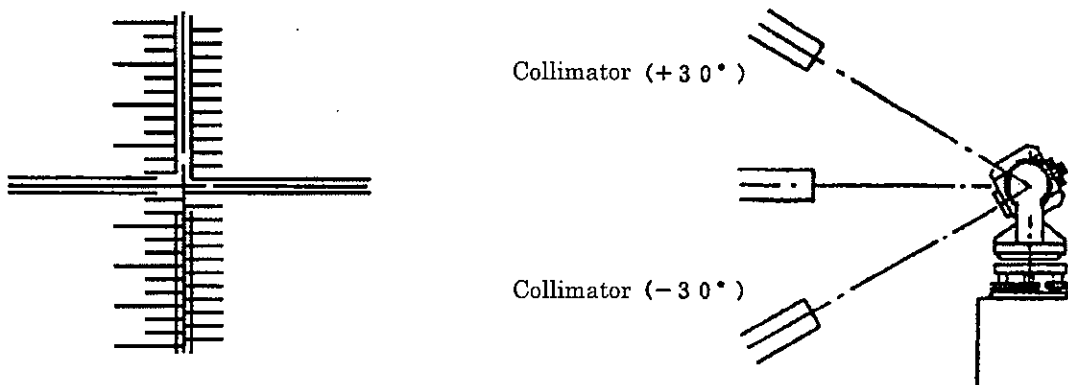


14. Collimate on the 15-cm mark with the telescope positioned horizontally. Turn leveling screw A to tilt the device down by 4' (4.8 mm down on the copied scale).



15. Collimate the collimator (-30°) crosshairs with the telescope in the forward direction.

★ Collimating precision can be improved by positioning the vertical collimating line of the telescope at the midpoint between the collimator's two lines.

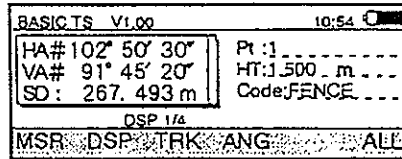


### 9-4. Calculating the Tilt Sensor Compensation Factor and Correction Value

- 16. Reset the horizontal angle to "0."  
 Press the **F4** Angle key.  
 When the screen shows the TS-mode window, press the **F1** key to reset the horizontal angle.

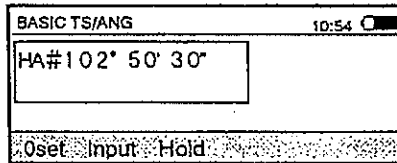
TS-mode screen

Press F4 ANG

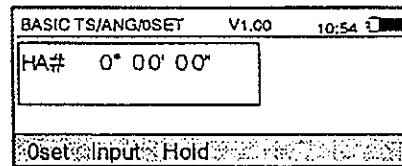


Horizontal angle setting screen

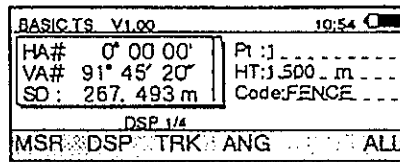
Press F1 0 set



Horizontal 0 set

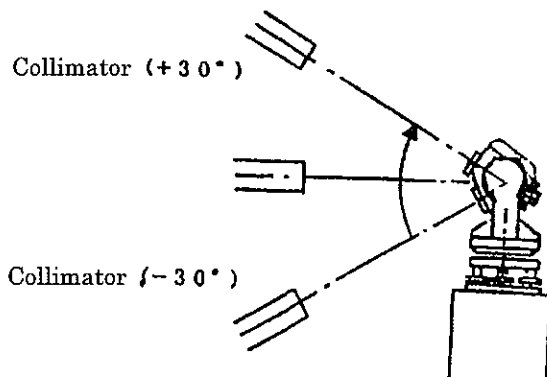


Return to TS-mode screen



- 17. Collimate the collimator (+30°) crosshairs, then use the horizontal fine-adjustment screw to align the telescope's collimating line with the collimator's vertical line.

Read and record the horizontal angle in this step. H2



## 9-4. Calculating the Tilt Sensor Compensation Factor and Correction Value

18. Calculate the correction value.

- ⊙ It is not necessary to change the factor if the difference between the maximum and minimum for H0, H1, and H2 is less than 10".
- ⊙ If the difference exceeds 10", new factor C must be calculated by applying H0, H1, and H2 in the equation shown below.

Unit: Seconds

Compensation factor:

$$e1 = H1 - H0$$

$$e2 = H2 - H0$$

★ If the copied scale affixed in step 2 is to the left when looking at the subcollimator

$$HC = \frac{240 + (e2 - e1)}{240} \times HCO$$

★ If the copied scale affixed in step 2 is to the right when looking at the subcollimator

$$HC = \frac{240 + (e1 - e2)}{240} \times HCO$$

HC: New compensation factor to be set

HCO: Compensation factor currently set

19. Level the device again and repeat steps 3 through 13.

20. Write the compensation factor to memory using the tool card (J26340).

For more information, see the section on parameter setting in "Setting Parameters and Machine Data."



# 9-4. Calculating the Tilt Sensor Compensation Factor and Correction Value

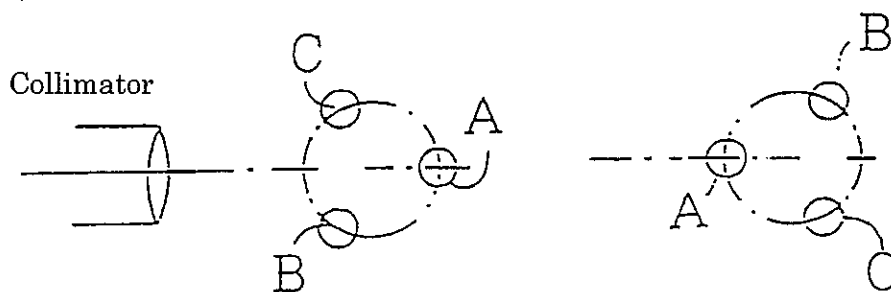
## Y-axis tilt sensor

- ⊙ The following describes the procedure for checking whether the compensation factor stored in memory is appropriate and the procedure for calculating and storing the correct compensation factor if it is found to be inappropriate.

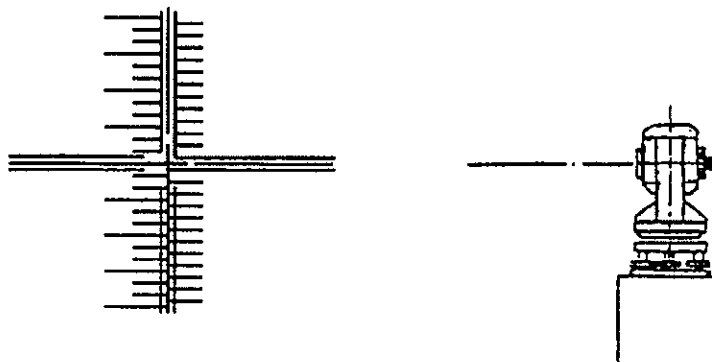
Note the following points before starting work:

- 1) Electrical adjustment of the tilt sensor must be complete.
- 2) Tilt-sensor compensation: 2 axes
- 3) Display resolution: Minimum display angle
- 4) The vertical tangent screw must be positioned at the center of the movement range.
- 5) The right and left side covers must be detached.

1. Mount the device on the collimator stand.  
 Rotate and lock the top of the stand so that one of the three leveling screws (A, B, C) is perpendicular to the optical axis of the collimator.  
 If the top of the stand does not rotate, lock it by inserting a piece of paper between the bottom plate of the main body and the top of the stand.



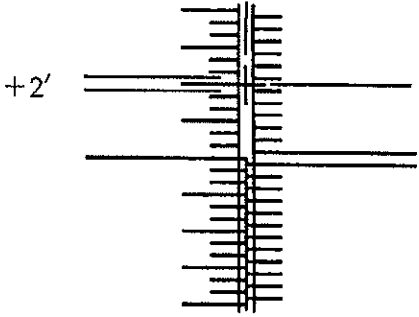
2. Level the device after adjusting the level as precisely as possible.
3. Collimate the collimator crosshairs with the telescope in the face right direction.
  - ⊙ The telescope is used in face left in order to align the horizontal lines as accurately as possible by positioning the collimator's two lines between the telescope's two lines.



★ If this is performed with the telescope in the face left direction, reverse the ± sign for the compensation factor.

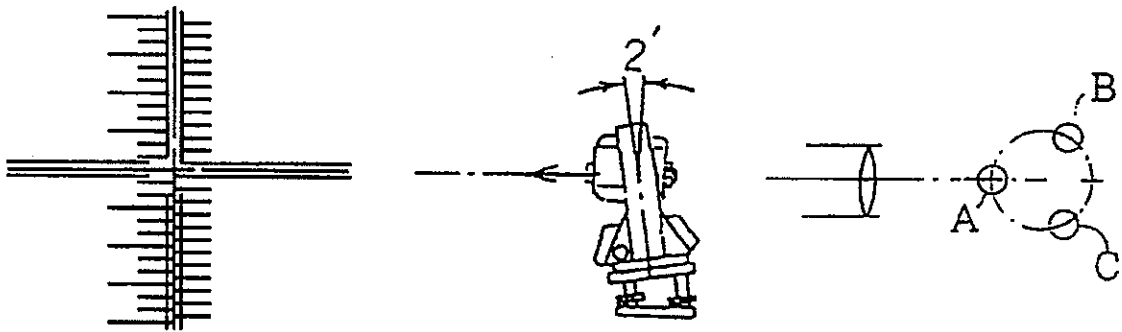
### 9-4. Calculating the Tilt Sensor Compensation Factor and Correction Value

- 4. Turn the vertical tangent screw to align the horizontal collimating line of the telescope with the +2' line on the collimator scale.

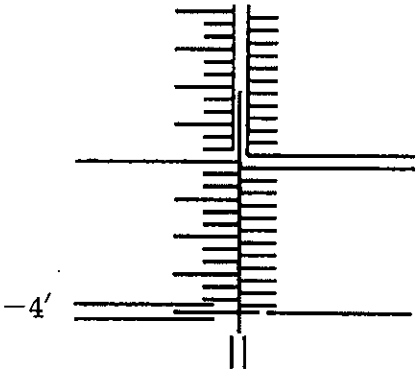


- 5. Turn leveling screw A to align the crosshairs as accurately as possible, as described in step 3.

Read and record the vertical angle in this step. V1



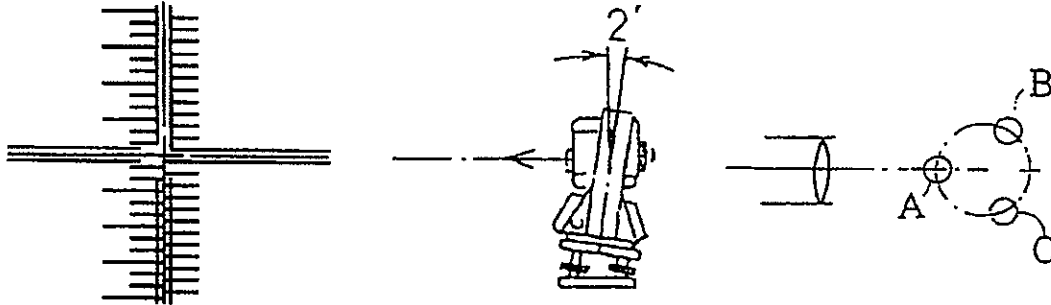
- 6. Turn the vertical tangent screw to align the horizontal collimating line of the telescope with the -4' line on the collimator scale.



### 9-4. Calculating the Tilt Sensor Compensation Factor and Correction Value

7. Turn leveling screw A to align the crosshairs as accurately as possible, as described in step 5.

Read and record the vertical angle in this step. V2



8. Calculate the correction value.
  - ⊙ It is not necessary to change the factor if the difference between the maximum and minimum for V0, V1, and V2 is less than 10'.
  - ⊙ If the difference exceeds 10', the new factor C must be calculated by applying V0, V1, and V2 in the equation shown below.

Unit: Seconds

Compensation factor Δ:

$$e1 = V1 - V0$$

$$e2 = V2 - V0$$

$$\Delta = e2 - e1$$

$$VC = \frac{240}{\Delta + 240} \times VCO$$

- ★ If this is performed with the telescope in the face left direction, reverse the ± sign for the compensation factor Δ.

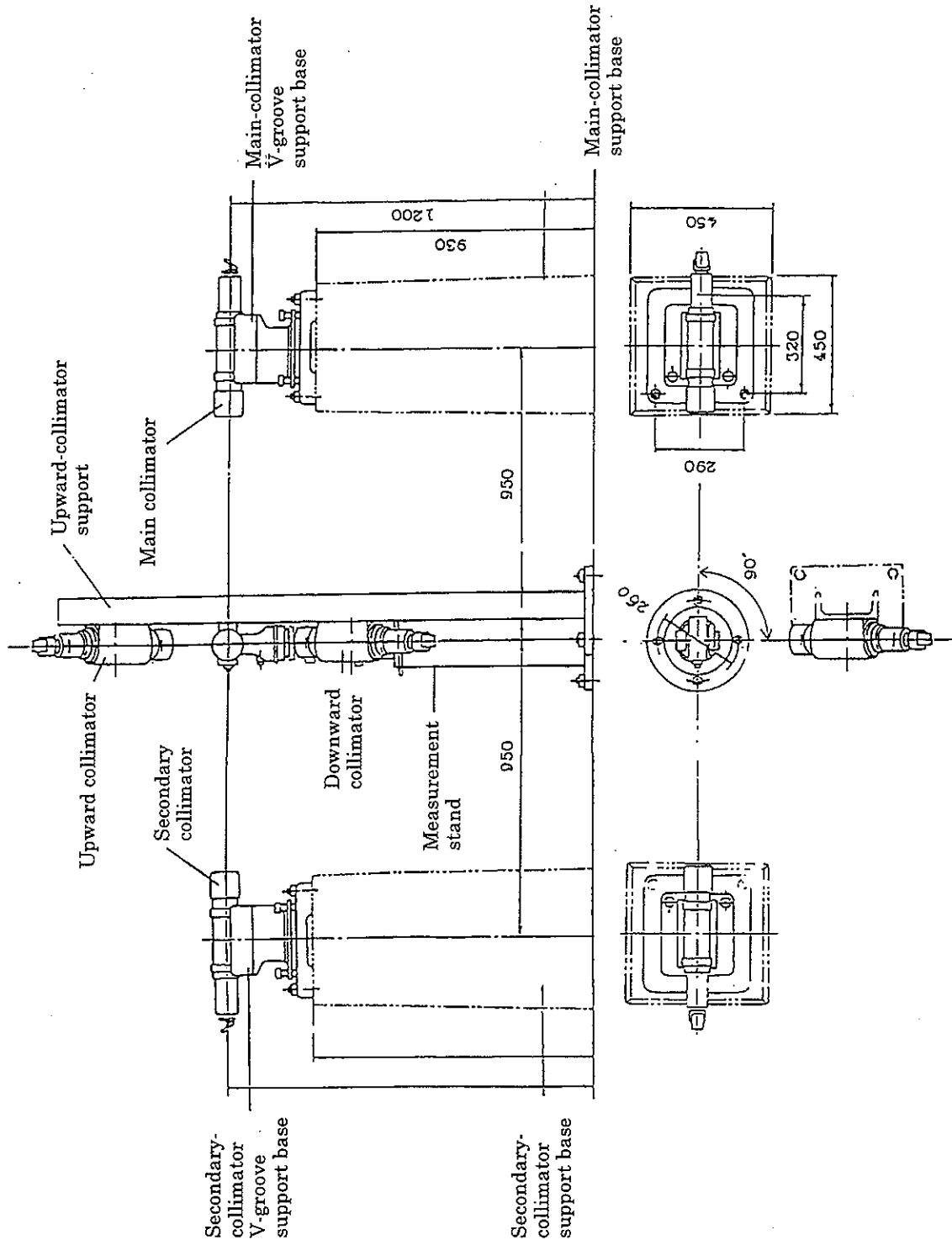
VC: New compensation factor to be set

VCO: Compensation factor currently set

- ★ If the absolute values (ignoring the ± sign) differ significantly, the tilt sensor may be improperly adjusted or faulty.
  - ★ If e1 and e2 have the same sign and their absolute values exceed the permissible accuracy (10"), the tilt sensor may be faulty.
9. Write the compensation factor to memory using the tool card (J26340).  
For more information, see the section on parameter-setting in "Setting Parameters and Machine Data."

### 9-5. Install the Collimators for 2-Axis Tilt-Sensor Adjustment

In the previous collimator setting method, a target (a copied scale is used in this manual) was positioned in the direction perpendicular to the main and subcollimators, and the device was tilted to obtain the compensation factors. In the following description, the collimators are set up as shown in the diagram below to obtain the compensation factor for the X-axis tilt sensor. Although it differs from the calibration collimator setting, the described method can achieve the same results when modified appropriately.



## 9-6. Calculating the 2-Axis Tilt-Sensor Compensation Factor Using the 2-Axis Tilt-Sensor Verification Collimator

⊙ The following describes the X-axis tilt sensor. For the Y-axis tilt sensor, refer to Section 9-4.

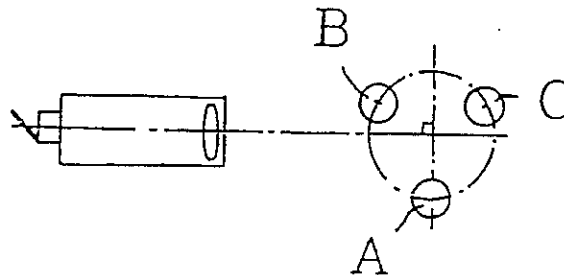
Note the following points before starting work.

- 1) Electrical adjustment of the tilt sensor must be complete.
- 2) Tilt-sensor compensation: 2 axes
- 3) Display resolution: Minimum display angle
- 4) The vertical tangent screw must be positioned at the center of the movement range.
- 5) The right and left side covers must be detached.

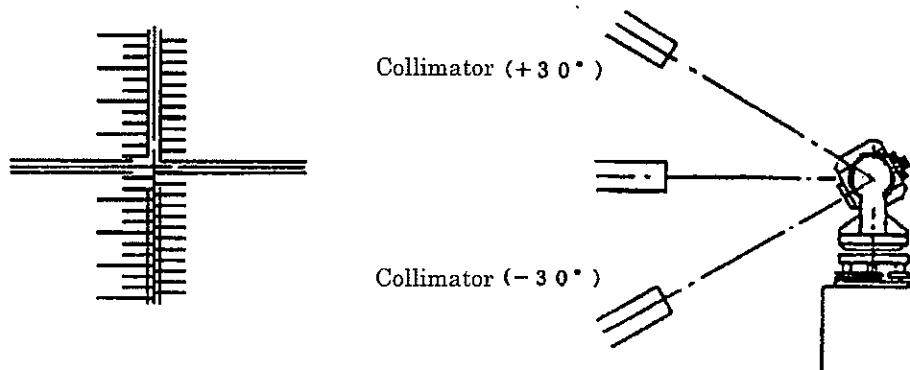
1. Mount the device on the collimator stand.

Rotate and lock the top of the stand so that one of the three leveling screws (A, B, C) is perpendicular to the optical axis of the main/subcollimator (A in the diagram below).

If the top of the stand does not rotate, lock it by inserting a piece of paper between the bottom plate and the stand.



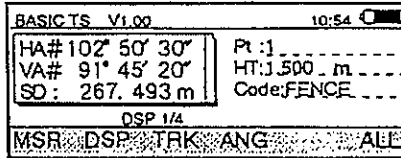
2. Level the device after adjusting the level as precisely as possible.
3. Collimate the collimator (-30°) crosshairs with the telescope in the forward direction.  
★ Collimating precision can be improved by positioning the vertical collimating line of the telescope at the midpoint between the collimator's two lines.



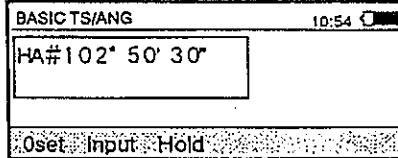
## 9-6. Calculating the Compensation Factor Using the 2-Axis Tilt-Sensor Verification Collimator

- Reset the horizontal angle to "0."  
Press the **F4** Angle key.  
When the screen shows the TS-mode window, press the **F1** key to reset the horizontal angle.

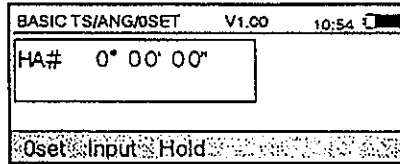
TS-mode screen  
Press F4 ANG



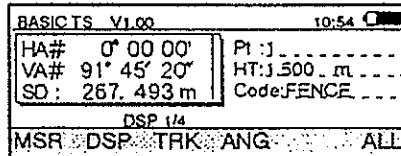
Horizontal angle setting screen  
Press F1 0 set



Horizontal 0 set

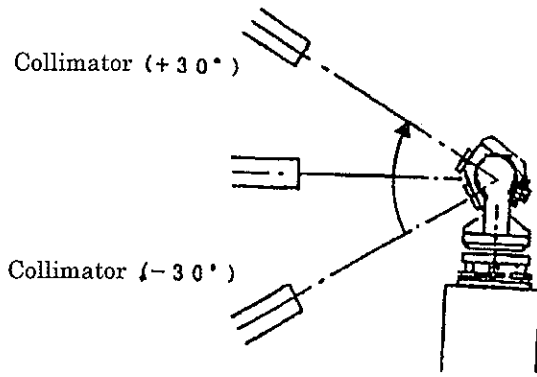


Return to TS-mode screen

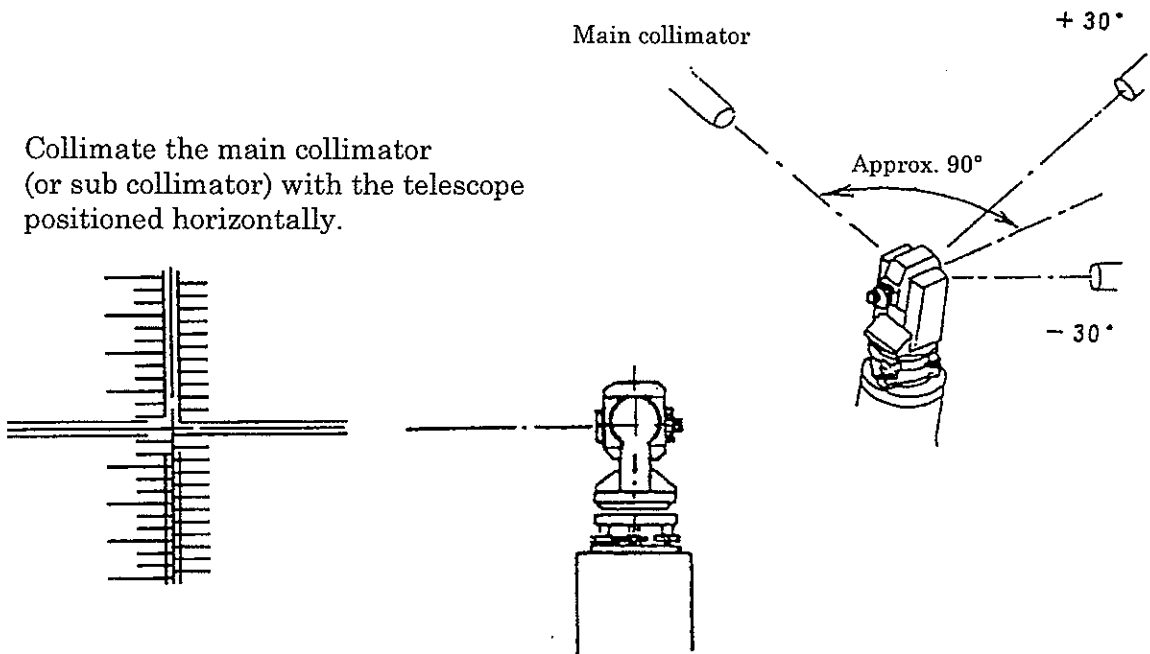


5. Collimate the collimator (+30°) crosshairs, then use the horizontal tangent screw to align the telescope's vertical collimating line with the collimator's vertical line.

Read and record the horizontal angle in this step. H0

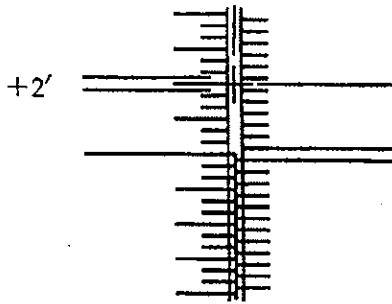


6. Collimate the main collimator (or sub collimator) with the telescope positioned horizontally.

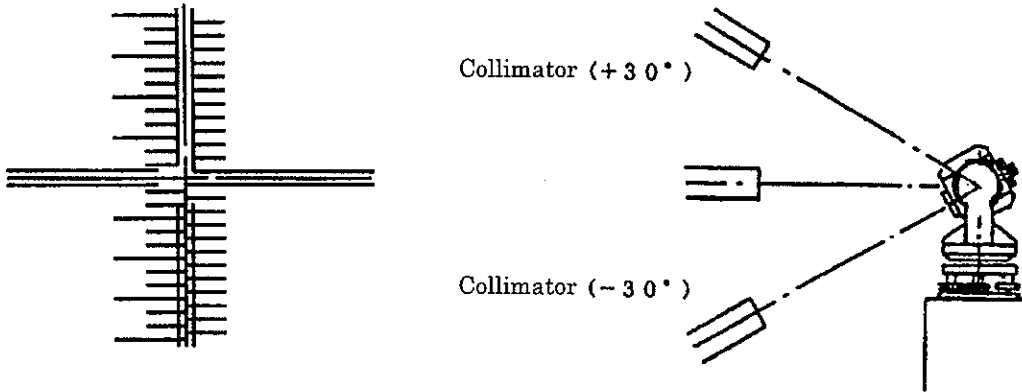


### 9-6. Calculating the Compensation Factor Using the 2-Axis Tilt-Sensor Verification Collimator

- 7. Turn leveling screw A to tilt the telescope up by 2'.



- 8. Collimate the collimator (-30°) crosshairs with the telescope in the face left direction.  
★ Collimating precision can be improved by positioning the vertical collimating line of the telescope at the midpoint between the collimator's two lines.



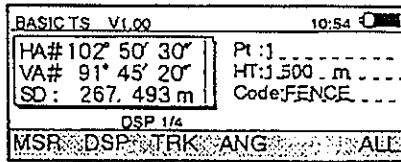


9. Reset the horizontal angle to "0."

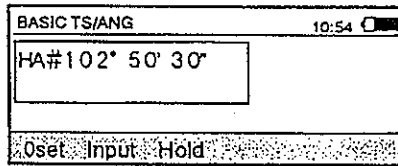
Press the **F4** Angle key.

When the screen shows the TS-mode window, press the **F1** key to reset the horizontal angle.

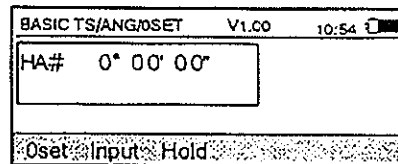
TS-mode screen  
Press F4 ANG



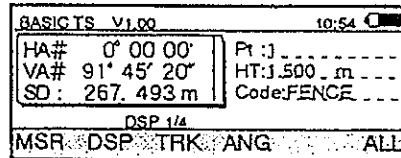
Horizontal angle setting screen  
Press F1 0 set



Horizontal 0 set

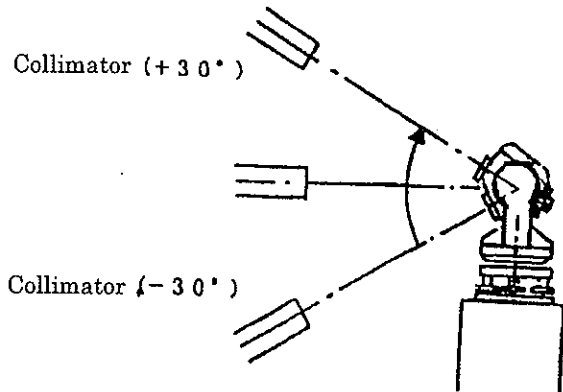


Return to TS-mode screen



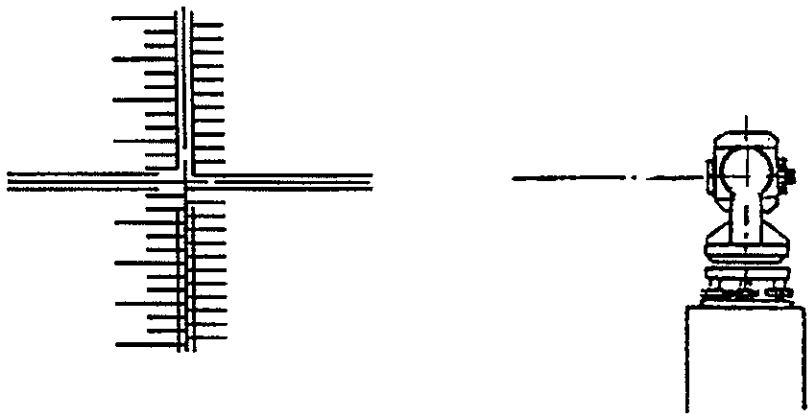
10. Collimate the collimator (+30°) crosshairs, then use the horizontal tangent screw to align the telescope's collimating line with the collimator's vertical line.

Read and record the horizontal angle in this step. H1

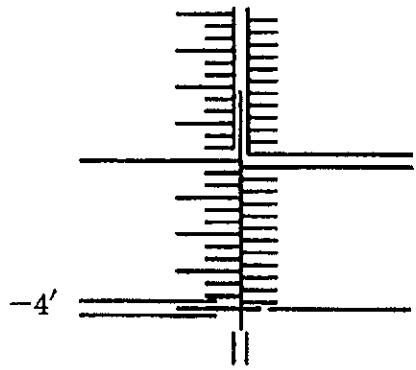


### 9-6. Calculating the Compensation Factor Using the 2-Axis Tilt-Sensor Verification Collimator

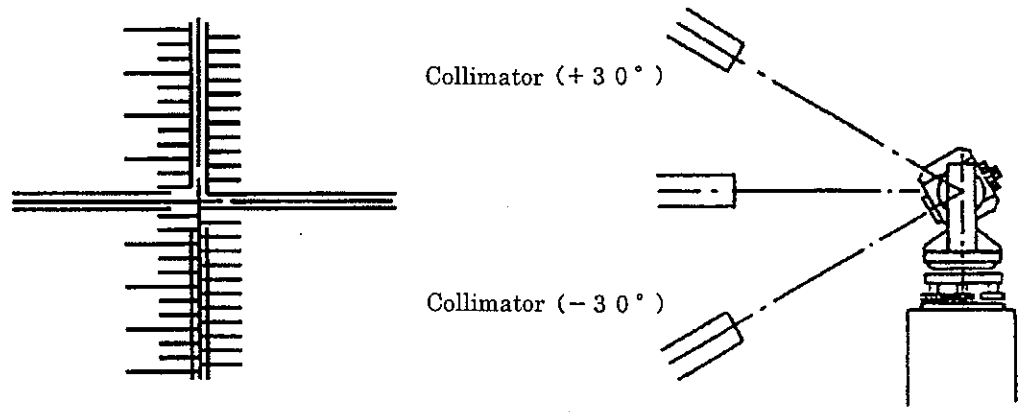
- 11. Collimate the main collimator (or secondary collimator) with the telescope positioned horizontally.



- 12. Turn leveling screw A to tilt the telescope down by 4'.



- 13. Collimate the collimator (-30°) crosshairs with the telescope in the face left direction.  
★ Collimating precision can be improved by positioning the telescope's vertical collimating line at the midpoint between the collimator's two lines.



# 9-6. Calculating the Compensation Factor Using the 2-Axis Tilt-Sensor Verification Collimator

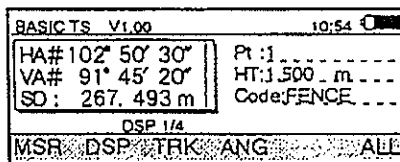
14. Reset the horizontal angle to "0."

Press the **F4** Angle key.

When the screen shows the TS-mode window, press the **F1** key to reset the horizontal angle.

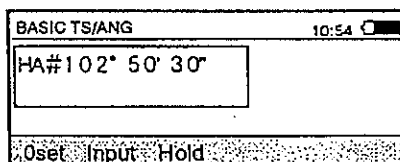
TS-mode screen

Press F4 ANG

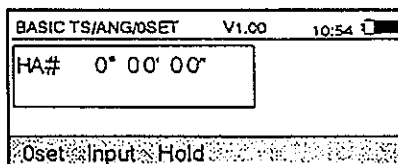


Horizontal angle setting screen

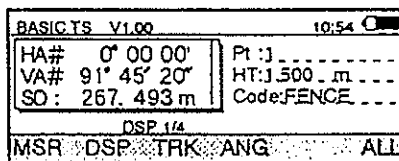
Press F1 0 set



Horizontal 0 set

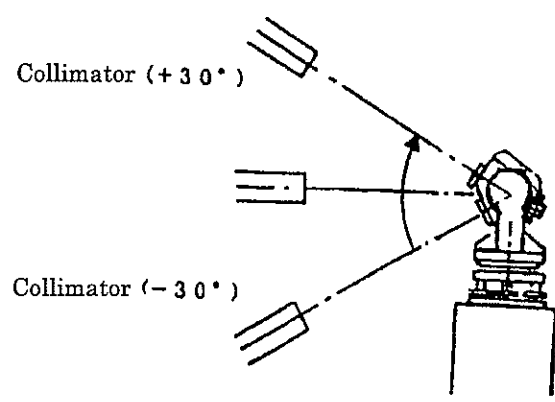


Return to TS-mode screen



15. Collimate the collimator (+30°) crosshairs, then use the horizontal tangent screw to align the telescope's collimating line with the collimator's vertical line.

Read and record the horizontal angle in this step. H2



16. Calculate the correction value.

- ⊙ It is not necessary to change the factor if the difference between the maximum and minimum for H0, H1, and H2 is less than 10".
- ⊙ If the difference exceeds 10", new factor C must be calculated using H0, H1, and H2 in the equation shown below.

Unit: Seconds

Compensation factor:  $e1 = H1 - H0$   
 $e2 = H2 - H0$

★ When the main collimator (or subcollimator) used in the procedure is to the left when looking at the upward/downward collimators:

$$HC = \frac{240 + (e2 - e1)}{240} \times HCO$$

★ When the main collimator (or subcollimator) used in the procedure is to the right when looking at the upward/downward collimators:

$$HC = \frac{240 + (e1 - e2)}{240} \times HCO$$

HC: New compensation factor to be set  
HCO: Compensation factor currently set

17. Level the device again, and repeat steps 3 through 13.

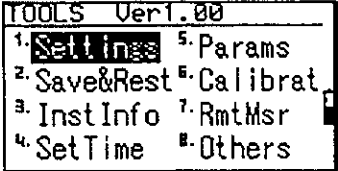
18. Write the compensation factor to the memory using the tool card (J26340). For more information, see the section on parameter setting in "Setting Parameters and Machine Data."

## 10. Setting Parameters and Machine Data

- ⊙ To set parameters in the DTM-801 series, add new programs to the tool card (J26340) for the DTM-800 series. Regarding the addition of programs, contact the nearest Nikon Geotecs office.
- ⊙ The tool card has an internal battery as a memory backup. The service life of the battery is seven years when it is stored under suitable conditions. When storing the tool card, carefully check the storage environment.
- ⊙ The contents of the tool card are subject to change without prior notice.
- ★ The intellectual property rights to the tool card belong to Nikon Geotecs Co., Ltd. Duplication of the data on the tool card is prohibited.

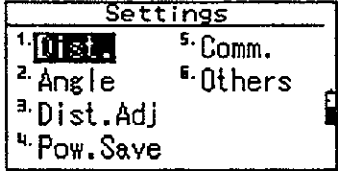
# 10. Setting Parameters and Machine Data

1. Insert the tool card (J26340) into the card slot on the device.
2. Turn on the power switch of the device.
3. Rotate the telescope and upper main body.  
The display shows the initial tool program screen.



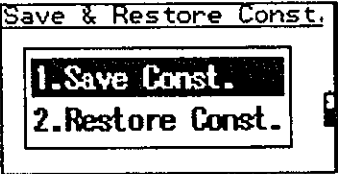
Using the numeric and arrow keys, move the cursor to an item to be set, and press the **ENT** key to select the item.

4. Selection of settings  
The condition-setting items are the same as those in the applications installed in the device, including the measurement times, tilt-sensor compensation, energy savings, and communication.  
Enter data according to the directions given in the operation manual.

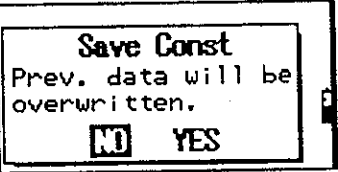


Only the menu screen is shown in this manual, and explanation of the operating methods is omitted.

5. Save and restore  
Press the **Z**. This item is used to save and reset the content ( **1** ) registered in the memory by condition setting.

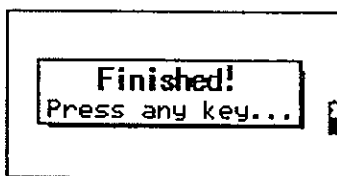


- 1) Save const.  
Press the **F4** YES key to save data in the memory on the tool card.  
Press the **F2** NO key or **ESC** key to cancel and return to the menu screen.



## 10. Setting Parameters and Machine Data

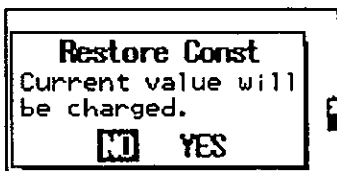
Press any key other than the POWER key to return to the menu screen.



### 2) Restore

Press the **F4** YES key to transfer the data stored in the memory on the tool card (J26340) to the memory in the device.

Press the **F2** NO key or **ESC** key to cancel and return to the menu screen.

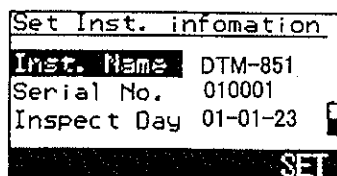


Press any key other than the POWER key to return to the menu screen.

### 6. Machine-data setting

This item is used to set the model type, serial number (manufacturing No.), and calibration date.

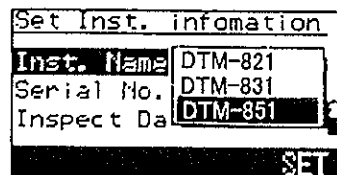
Using the arrow keys, move the cursor to the item, then press the **ENT** key to finalize the selection



#### 1) Model-type setting

Move the cursor to Inst. Name, then press the **ENT** key to display a model list.

Using the arrow keys, select the model type and press the **ENT** key to finalize the selection. Press the **ESC** key to close the model list.



#### 2) Serial-number (manufacturing No.) setting

Move the cursor to SERIAL NO., then move the cursor to the number by pressing the **ENT** key.

Using the ten keys (numeric keys from 1 to 10), enter the serial number (manufacturing No.), and press the **F5** key to finalize the input.

# 10. Setting Parameters and Machine Data

## 3) Calibration-date setting

Move the cursor to Inspect Date, then move the cursor to the year/month/day section by pressing the **ENT** key.

Using the ten keys (numeric keys from 1 to 10) and bar key (- key), enter the year, month, and day, then press the **F5** key to finalize the input.

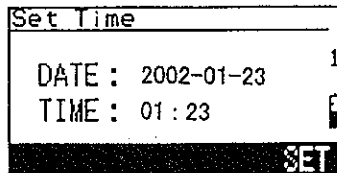
Ⓞ Press the **ESC** key to complete the setting and return to the previous screen.

## 7. Date and time setting

★ The date and time should be changed only when the CPU board is replaced due to repair or when the device is used overseas. It is prohibited to conduct the following procedure for any other purpose.

Change the date first, followed by the time. If a setting is not changed, press the **F5** key to move the cursor to the next item.

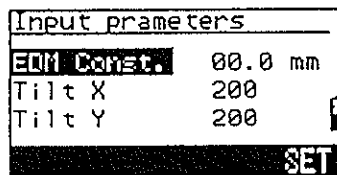
- Using the ten keys (numeric keys from 1 to 10) and bar key (- key), enter the year, month, and day, input the time and press the **±** key to conclude the input. Then press the SET **F5** key to finalize the setting. After pressing the SET **F5** key, press the **ESC** key to return to the previous screen.



Pressing the **ESC** key before finalizing the setting using the **F5** key cancels the setting and returns to the previous screen.

## 8. Parameter setting

This item is used to enter machine parameters and tilt-sensor compensation factors. Using the arrow keys, highlight an item, and press the **ENT** key to finalize the item selection.





# 10. Setting Parameters and Machine Data

## 1) EDM-constant setting

(1) Move the cursor to EDM Const., then move the cursor to the constant-input section by pressing the **ENT** key.

(2) Enter the EDM constant calculated based on the measurement baseline, then press the **F5** Set key.

If the constant is a negative value, display the negative (-) sign by pressing the **MODE** key, then enter the constant and press the **F5** Set key.

Other function keys are as follows. (·) = **±**, (-) = **MODE**  
(BACK SPACE) = **□**, SPACE **□**.

Pressing the **ESC** key before finalizing the setting using the **F5** key cancels the entered data and returns to the previous screen.

Press the **ESC** key to return to the previous screen.

## 2) Tilt-sensor compensation-factor setting

(1) Move the cursor to TILT X or TILT Y, then move it to the tilt-factor input section by pressing the **ENT** key.

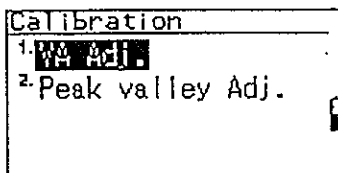
(2) Enter the compensation factor obtained through measurement, then press the **F5** Set key. Pressing the **ESC** key before finalizing the setting using the **F5** key cancels the entered data and returns to the previous screen.

Press the **ESC** key to return to the previous screen.

## 9. Measurement setting

This item is used for adjustment of the vertical-angle zero position and confirmation of the encoder signal amplitude.

### 1) Adjustment of the vertical-angle zero position



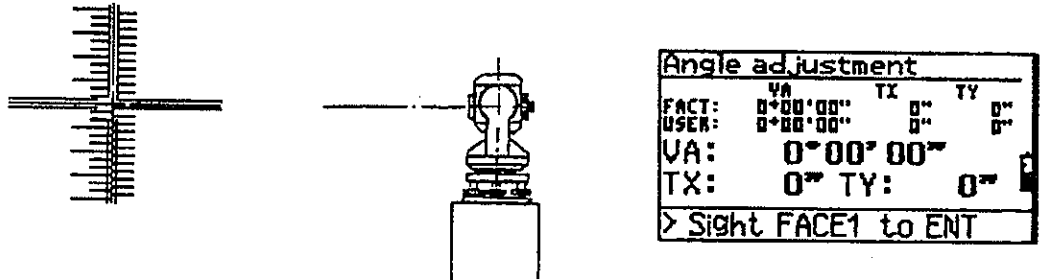
(1) Mount the device on the collimator stand, and adjust the level as precisely as possible.

(2) Move the cursor to VA Adj., and press the **ENT** key to finalize the selection.

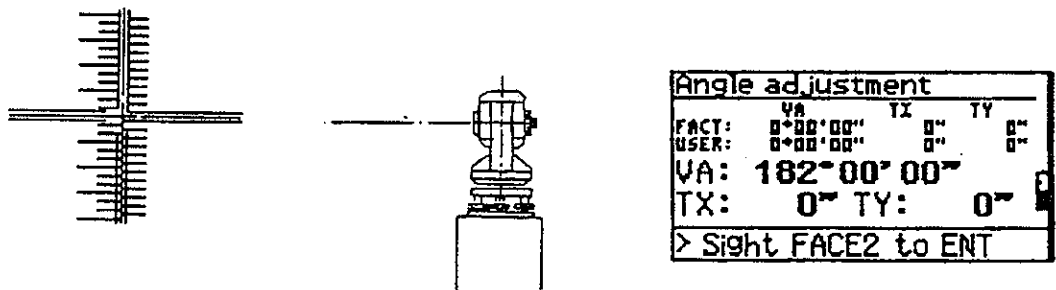
## 10. Setting Parameters and Machine Data

- (3) Set the telescope to the forward observation position and collimate the horizontal collimator.

After the vertical angle stabilizes, press the **ENT** key.



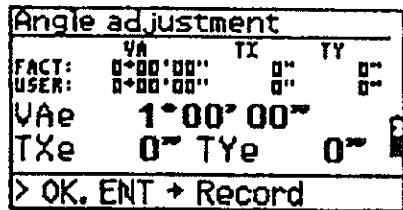
- (4) Set the telescope to the reverse observation position and collimate the same horizontal collimator. After the vertical angle stabilizes, press the **ENT** key.



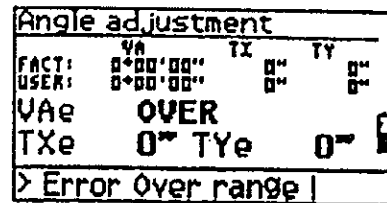
- (5) Display the vertical-constant measurement result. Press the **ENT** key to finalize the setting.

If the measurement result exceeds the allowed vertical-constant range, the display shows "OVER RANGE."

In such an event, press the **ESC** key to return to the previous screen, then repeat the steps from the vertical-angle zero-point adjustment or electrical adjustment (9-2. Adjusting the V Encoder).



Setting completion display

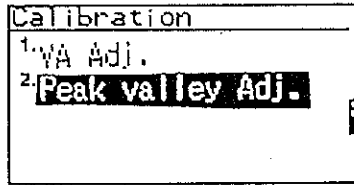


Out-of-range display  
Repeat the adjustment procedure.

# 10. Setting Parameters and Machine Data

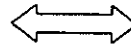
## 2) Peak-valley measurement

This item allows confirmation of the encoder signal amplitude.



- (1) Move the cursor to Peak Valley Adj., and press the **ENT** key to finalize the selection. The display shows the existing measurement values.

Peak/Valley		ver. 1.02	
		Amplitude	Average
HA a0		309	511
HA a90		309	511
HA b0		309	511
HA b90		309	511
H <> V		MsrPV	



H <> V

Peak/Valley		ver. 1.02	
		Amplitude	Average
VA a0		309	511
VA a90		309	511
VA b0		309	511
VA b90		309	511
H <> V		MsrPV	

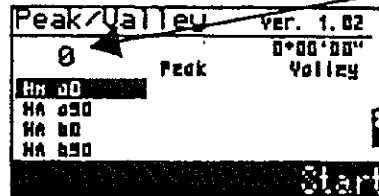
- (2) Select Horizontal or Vertical (H <> V) using the **F1** key. The H encoder is selected for the following explanation. The procedure is the same for the V encoder.

- ★ When conducting the peak-valley measurement, be sure to set the V encoder after completing the H-encoder setting.

- (3) Press the **F5** MsrPV key to start the measurement.

- ★ The tangent screw is used in this step. Make sure the horizontal clamp is tight. Take one measurement each for HA a0, HA a90, HA b0, and HA b90, in that order, at the same position. In each of these four measurements, set the peak. Pressing the **ESC** key cancels the measurement and returns to the previous screen.

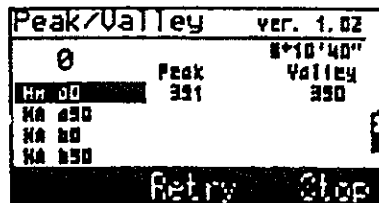
Screen before measurement operation



Angle to be measured

- (4) Press the **F5** Start key.

Turn the horizontal tangent screw to the right or left to locate the position at which the peak and valley values become the largest.

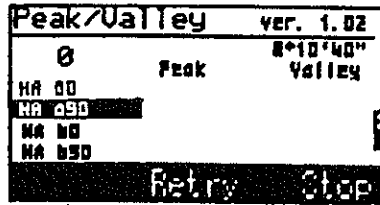


After the displayed values stabilize, press the **F5** Stop key. If the **F5** Stop key is pressed while the displayed values are unstable, press the **ESC** key to return to the previous screen, then start from step (3).

If a key other than the **F5** Stop key is pressed, press the **F3** Retry key to repeat the setting process.

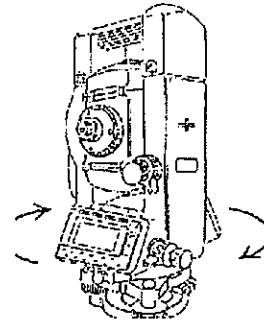
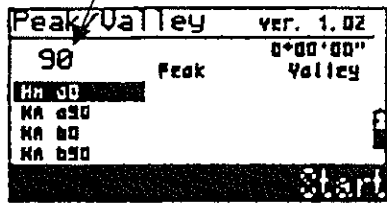
## 10. Setting Parameters and Machine Data

- (5) When the **F5** Stop key is pressed after completion of the HA a0 measurement, the cursor moves to HA a90. Repeat the measurement process from step (4) to set the peak and valley values for HA a90. Then, set HA b0 and HA b90, in sequence, by following the same procedure.

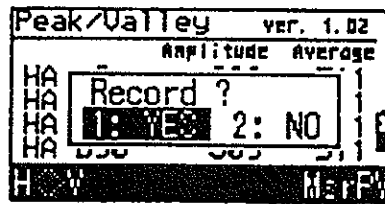


- (6) Upon completion of the HA b90 measurement, the display shows a new angle, "90," to be measured. Rotate the upper main body 90° to the right, then repeat steps (4) through (6).

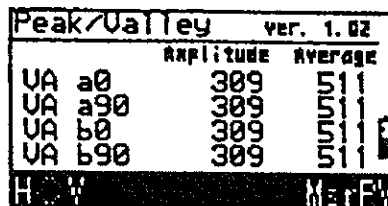
New angle to be measured



- (7) Continue the measurement process at 180 and 270.
- (8) When the peak-valley measurement is completed for all horizontal angles, the display indicates the measurement completion screen. When the **1** YES key is pressed, all measurement results are stored, and the display shows the amplitude and average value. When the **2** NO key is pressed, the measurement results are not stored, and the display returns to the screen shown prior to the measurement.



- (9) Vertical-angle peak-valley measurement  
Point the objective lens of the telescope toward the zenith, and change the Horizontal and Vertical (H <math>\leftrightarrow</math> V) setting using the **F1** key.



## 10. Setting Parameters and Machine Data

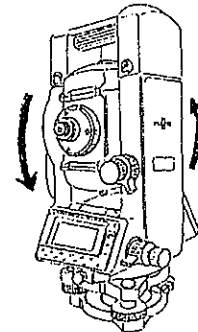
(10) Press the **F5** MsrPV key to start the measurement.

The tangent screw is used in this step. Make sure the vertical clamp is tight.

Point the telescope toward the zenith, and take one measurement each for VA a0, VA a90, VA b0, and VA b90, in that order, at the same position, and make the settings using the **F5** Stop key.

Pressing the **ESC** key cancels the measurement and returns to the previous screen.

Upon completion of the VA a0 measurement, rotate the telescope 90° and repeat the measurement process.



(11) When the peak-valley measurement is completed for all vertical angles, the display indicates the measurement completion screen. When the **1** YES key is pressed, all measurement results are stored and the display shows the amplitude and average value. When the **2** NO key is pressed, the measurement results are not stored, and the display returns to the screen shown prior to the measurement.

### 10. External observation

If a PC installed with the device operating program is used, the measurement range and angle data can be transferred using the communications function.

```

Remote                               ver. 1.00
HA : 0° 00' 00"
VA : 90° 00' 00"
SD :                               m
Mar Trk StHA
  
```

Press the **F1** Mrs key to start the measurement.

Press the **F2** Trk key to start the measurement.

Press the **F3** StHA key to input a horizontal angle.

```

Remote                               ver. 1.00
HA  Input HA
VA  >
SE  >                               m
Mar Trk StHA
  
```

Press the **ESC** key to return to the previous screen.

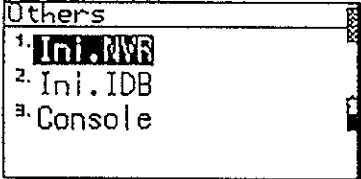
# 10. Setting Parameters and Machine Data

## 11. Others

This item is used for the deletion of data in the memory and changing of the display language.

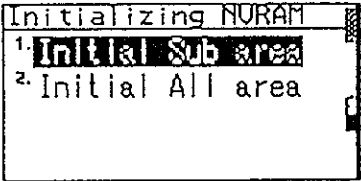
### 1) Initialization of NVR

(1) Select Ini. NVR, and press the **ENT** key to display the input screen.

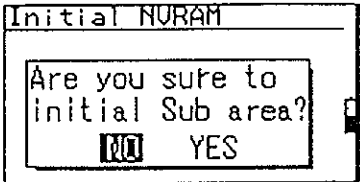


### (2) Initialization of subsystem area

The vertical- and horizontal-angle peak-valley measurement values, angle-measurement compensation ON/OFF, and tilt-sensor compensation factors are stored in the subsystem area.



Move the cursor to Initial Sub area, then press the **ENT** key.



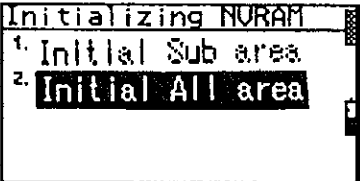
Press the **F4** YES key to delete the data in the subsystem area.

Press the **F2** NO key or **ESC** key to cancel the initialization and return to the previous screen.

### (3) Initialization of the all NVR area

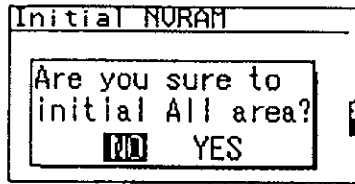
The NVR area contains the device's main-menu condition settings and machine constants, in addition to the data in the subsystem area.

Move the cursor to Initial All area, then press the **ENT** key.

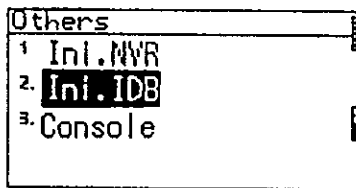


## 10. Setting Parameters and Machine Data

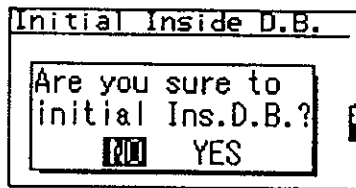
- (4) Press the **F4** YES key to delete the data in the entire NVR area.  
Press the **F2** NO key or **ESC** key to cancel the initialization and return to the previous screen.



- 2) Initialization of IDB  
The IDB area contains the internal auxiliary data on measurement results (this memory area may not be used by some applications).



Move the cursor to Ini. IDB, then press the **ENT** key.

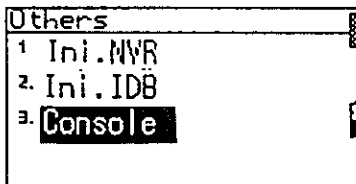


Press the **F3** YES key to delete the data in the IDB area.

Press the **F2** NO key to cancel the initialization and return to the previous screen.

Using the arrow keys, select a language, then press the **ENT** key to finalize the selection.

- 12. Console  
This item enables communication with an external device through the use of a program produced using communication commands for the device.  
No repair tool uses this function.



- 13. Finish the parameter and machine-data setting.

Press the **POWER** key, then press the **ENT** key to turn off the power.

Remove the tool card from the card slot on the device.

## 11. Replacing the CPU Board

When the CPU board installed in the theodolite unit is replaced, a software-writing program, device-operating main program, and pre-install applications must be installed in the memory on the new CPU board.

The J26345 (two EP-ROMs and one program card) contains the upgraded programs for the CPU board.

The J26345 for the DTM-800 series cannot be used to write programs to the CPU board of the DTM-801 series, but it can be upgraded to the J26345 equipped with additional functions.

The ROM for the program master (J26345) comes in two types. One is for the DTM-800 series, and the other is for the DTM-801 series. Therefore, be sure to check the model.

If the programs for the DTM-800 series are written to the CPU board of the DTM-801 series, they will not function properly.

The main program and pre-install applications are subject to change without prior notice.

Regarding the upgrade and latest program information, contact the nearest Nikon Geotecs office.

The intellectual property rights of the tool programs belong to Nikon Geotecs Co., Ltd. Unauthorized duplication of the tool-program data is prohibited.

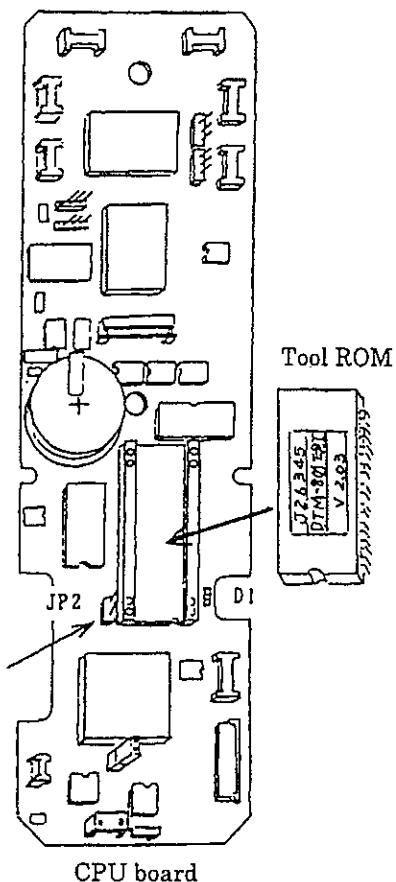
- ★ Make sure the battery has sufficient capacity before starting the program master.
- ★ Never turn off the power switch while the program master is booting up.

Keep the internal battery disconnected until battery connection is instructed.

### 1. Writing programs

When a new CPU board is installed, a program in the program master (J26345) ROM must be written to the CPU board for the writing of all programs necessary for operation of the device functions.

- 1) Detach the left side cover (on the card-slot side). Remove the left side cover carefully, as there is a flat cable connected between the CPU board and the interface board located behind the cover.
- 2) Insert the program-master (J26345) ROM into the ROM socket on the CPU board.
  - ★ Make sure "DTM-801" is indicated on the ROM.
- 3) Connect JP2 to the CPU board using an alligator clip. There are two test pins on JP2. Be sure to securely connect the pins using an alligator clip.
- 4) Install the clip-on battery to the device, and turn on the power switch. D1 (diode) on the CPU board indicates the writing operation as follows: ON → OFF → Flashing → OFF. When the LED is flashing, the light dims and it may seem that the LED is OFF. Be sure to wait until the LED turns OFF completely before proceeding to the next step.
- 5) Remove the clip-on battery.
- 6) Remove the alligator clip and tool-master ROM.





## 11. Replacing the CPU Board

- ★ Make sure the battery has sufficient capacity before starting up the program master.
- ★ Never turn off the power switch while the program master is booting up.

### 2. Writing the main program and pre-install applications

- 1) Insert the program-master (J26345) program card into the card slot on the device.
- 2) Install the clip-on battery to the device, and turn on the power switch. The display changes from the Loading screen to the Main Menu screen.

```

INSTALL TOOL V2.01          15:15
1. QL2 Main V1.05
2. QL2 Main V2.03
3. Qn2 Main V1.20N
4. Pre-Install V1.22
  
```

1. QL2 For the DTM-800 series
2. QL2 Modified  
For the DTM-801 series
3. QN For NPL-820/821
4. Pre-install applications  
For all models with a display device

- 3) From the main menu, select "2. QL2 V2."

```

*** BIOS UPDATE ***

Warning :
Do not cut the power absolutely
Between writing

End          SUM          Go
  
```

Abort: Stops the program-writing operation and turns off the power

SUM: Conducts a sum check for the existing main program, and displays the result  
(The display of the sum-check result requires approximately 30 seconds.)  
After the sum-check result is displayed, press the POWER key to turn off the power.

Start: Deletes the existing main program, then writes the main program from the program-master (J26345) memory card to the memory on the CPU board

- 4) Press the F5 Start key.  
Writing of the main program starts.  
Upon completion of the writing operation, press the POWER key to turn off the power.

## 11. Replacing the CPU Board

- ★ Make sure the battery has sufficient capacity before starting up the program master.
  - ★ Never turn off the power switch while the program master is booting up.
- 5) Turn on the power switch.  
The display changes from the Loading screen to the main-menu screen.

```

INSTALL TOOL V2.01      15:15
1. QL2 Main V1.05
2. QL2 Main V2.03
3. Qn2 Main V1.20N
4. Pre-Install V1.22
  
```

1. QL2 For the DTM-800 series
2. QL2 Modified  
For the DTM-801 series
3. QN For NPL-820/821
4. Pre-install applications  
For all models with a display device

- 6) From the main menu, select "4. Pre-install applications."

```

Program Loader V1.00
Pre-Install Software V1.22
Install Application
ESC -- Abord  ↻ -- Start
  
```

Abort: Stops the program-writing operation and turns off the power

Start: Deletes the existing applications, then writes the application programs from the program-master (J26345) memory card to the memory on the CPU board


- 7) Press the **F5** Start key.

Writing of the pre-install application programs starts.

The deletion and writing operations require approximately 2 minutes and 30 seconds. Note that the writing time varies depending on the connected external equipment.

```

Program Loader V1.00
Writing
90%
  
```



The display shows the data-transfer progress. The writing operation is complete when the display shows "100%."

```

Wait a minute
Making the verify data
  
```

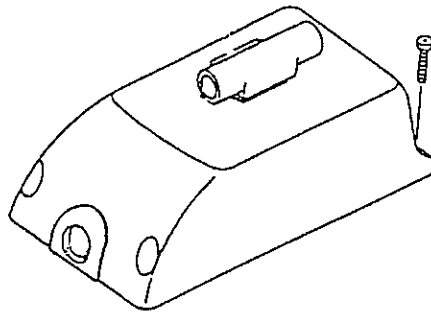
- 8) Press any key to turn off the power.

```

Finished
Remove card and press any key
  
```

## 12. Disassembling the Telescope

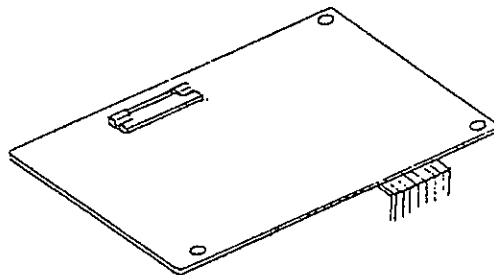
1. Remove the upper and lower telescope covers.



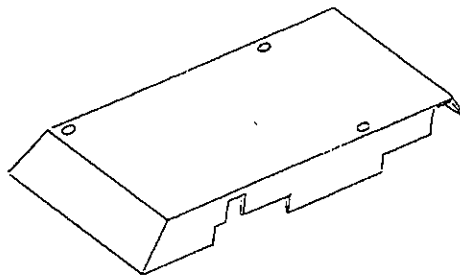
2. Remove the CPU board.

Do not forcibly lift the CPU board before disconnecting the cable from the connector on the rear side.

- ★ The flat-cable connector must be inserted in the specified direction. Connection of the connector in reverse may damage the CPU board. Be sure to position the mark on the flat cable in the specified direction.

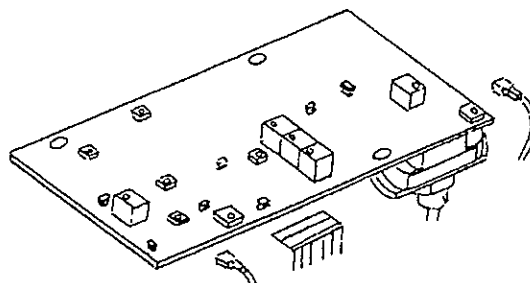


3. Detach the detector shield.



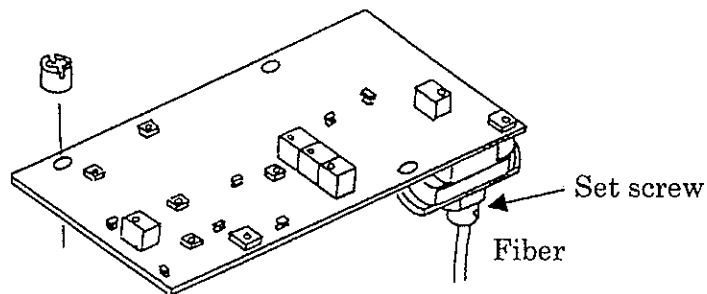
4. Remove the detector board.

- 1) Disconnect the two signal cables and one flat cable. Mark the signal cables to prevent reversed connection during reassembly.



## 12. Disassembling the Telescope

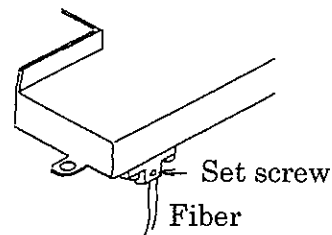
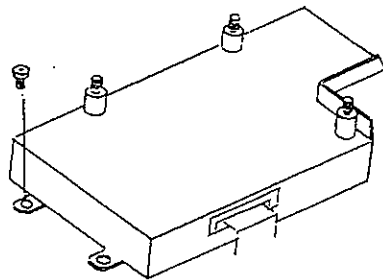
- 2) Remove the spacer and lift the board slowly, then loosen the fiber set screw and disconnect the fiber.



5. Remove the driver board.

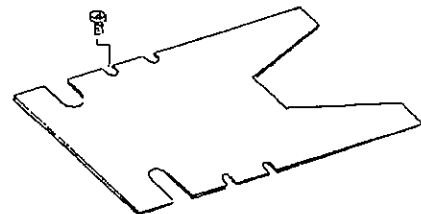
When the shield case for the driver board is lifted after the mounting screws are removed, the driver board detaches together with the shield case. Loosen the fiber set screw and disconnect the fiber.

Keep the flat cable connected to the driver board unless it must be removed.



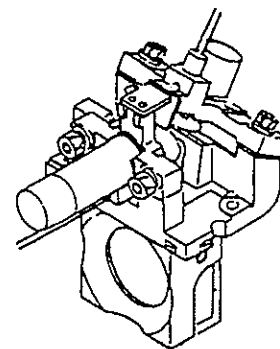
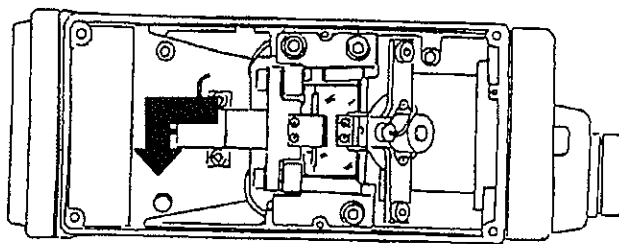
6. Detach the shield plate.

If it is not necessary to remove the shield plate, do not detach it.



7. Remove the dichroic-prism assembly.

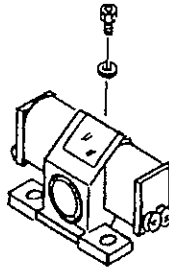
If it is not necessary to remove the dichroic-prism assembly, do not detach it.



When reinstalling the dichroic prism, press it against the reference surface in the direction indicated by the arrow in the diagram, then tighten the mounting screws.

## 12. Disassembling the Telescope

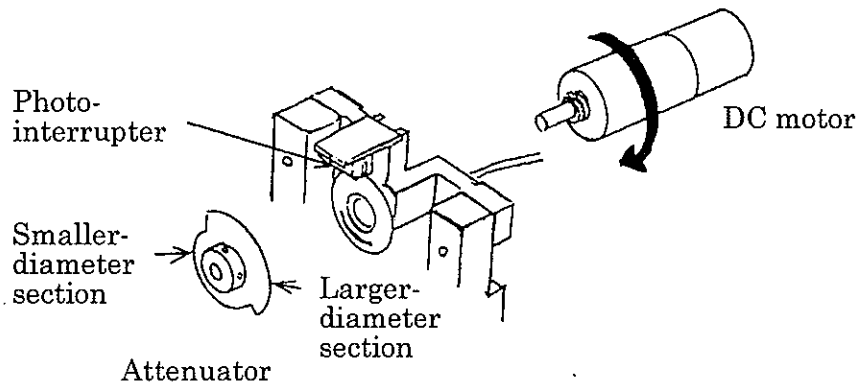
8. Remove the lumi-guide.



9. Dismount the DC motor.

The following describes a DC-motor removal method that does not require adjustment of the light intensity. When the DC mounting bracket at the receiver section is dismantled, accuracy adjustment must be made in accordance with the adjustment items.

- 1) Position the smaller-diameter section of the attenuator at the top, then loosen the attenuator set screw and remove the attenuator.
  - ★ If the larger-diameter section of the attenuator is positioned at the top, the attenuator becomes caught by the receiver photo-interrupter. Forcibly pulling out the attenuator in this position may cause deformation or peeling of adhesive.

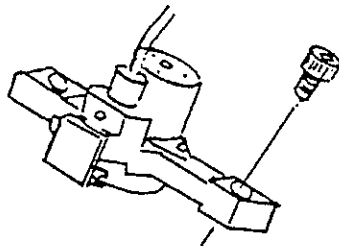


- 2) Turn the DC motor counterclockwise and remove it.

10. Detach the sector.

Remove the emitter-sector retaining plate, then dismount the pulse motor and sector.

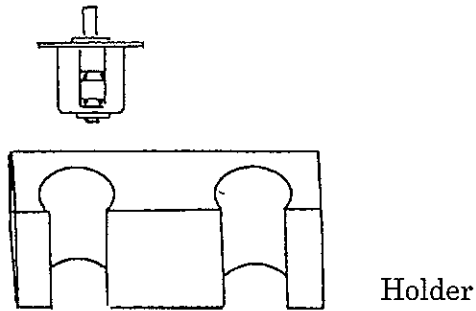
- ★ In reassembly, position the sector at the center of the notch on the photo-interrupter. Observe the cautions regarding gluing the sector to the motor spindle during reassembly.



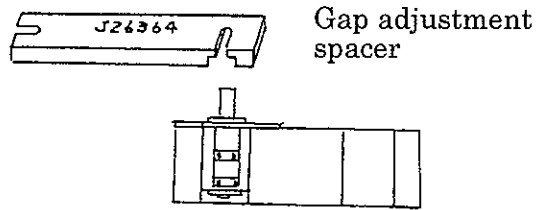
## 12. Disassembling the Telescope

★ Cautions in adhering the sector

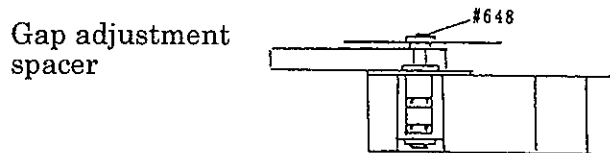
- 1) With the spindle facing up, insert the pulse motor into the holder of the sector attachment tool (J26364).



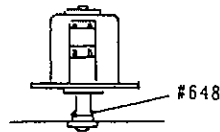
- 2) Place the gap adjustment spacer of the sector attachment tool on top of the pulse motor.



- 3) Insert the pulse-motor spindle into the sector.  
Apply #648 adhesive to the center hole in the sector, and leave it for 15 minutes.



- 4) Remove the pulse motor and sector from the attachment tool, then apply #648 adhesive to the motor spindle and the bushing on the rear side of the sector, and leave them for 15 minutes.

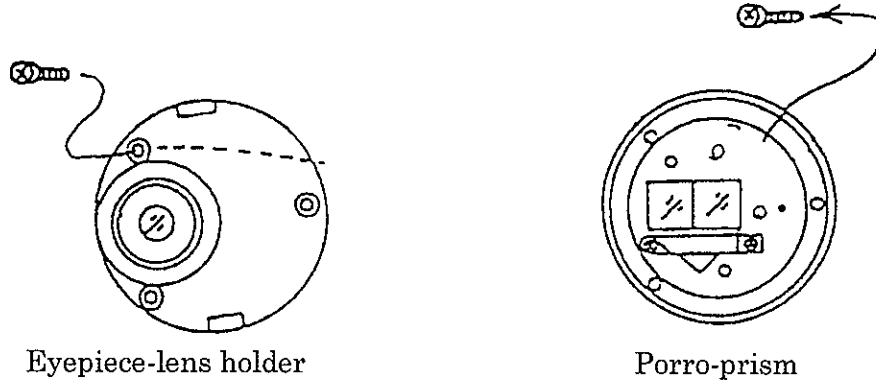


- 5) Install the pulse motor to the emitter section.

## 12. Disassembling the Telescope

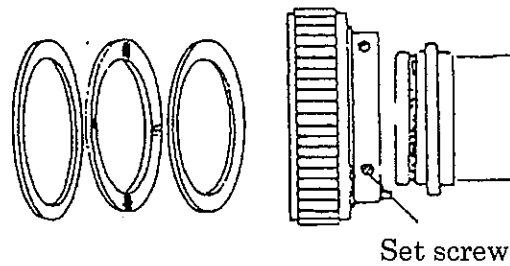
11. Remove the eyepiece-lens unit.

1) Remove the eyepiece-lens holder.

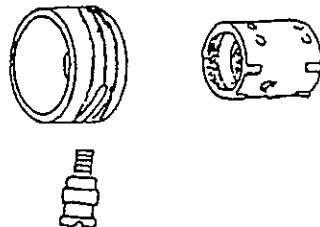


2) Remove the polo-prism unit.

3) Loosen the three focusing lens-chamber set screws, then detach the focusing ring.



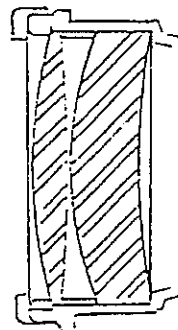
4) Remove the guide pin from the focusing ring, then detach the focusing ring.



12. Remove the objective lens.

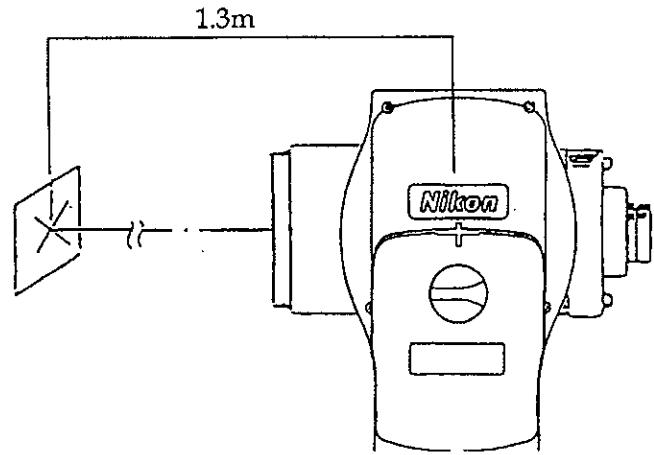
The objective lens is installed directly to the telescope tube and attached using #2051 adhesive at several locations.

To remove the objective lens, push from the rear side of the telescope tube, taking care not to damage the lens.

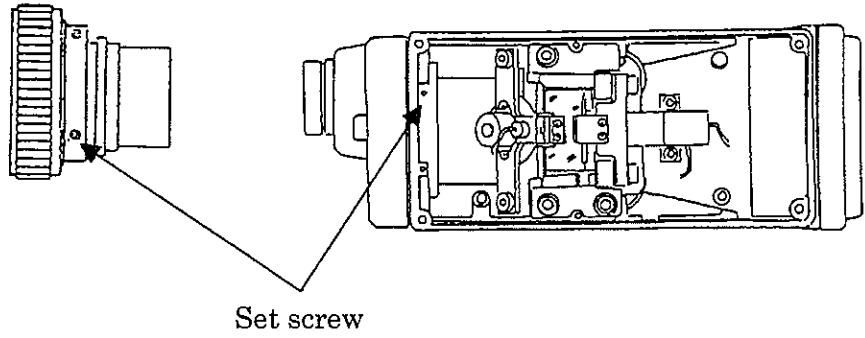


### 13. Positioning the Focusing Stopper

1. Mount the device on the collimator stand, and position a target (e.g., printed material) 1.3 m from the front center of the device.



2. Loosen two of the three set screws on the focusing-ring chamber.



3. Rotate the focusing ring clockwise to focus on the target in front of the device.
4. Loosen the one set screw securing the focusing-lens chamber, and rotate the focusing ring clockwise until it contacts the stopper.
5. Tighten the focusing-lens-chamber set screws.
6. Rotate the focusing ring counterclockwise, then make sure the collimator can be focused on the infinity scale.

In this process, make sure the focusing ring contacts the rotation stopper on the infinity side when it is rotated slightly in the counterclockwise direction from the point at which the focus is on the infinity scale.



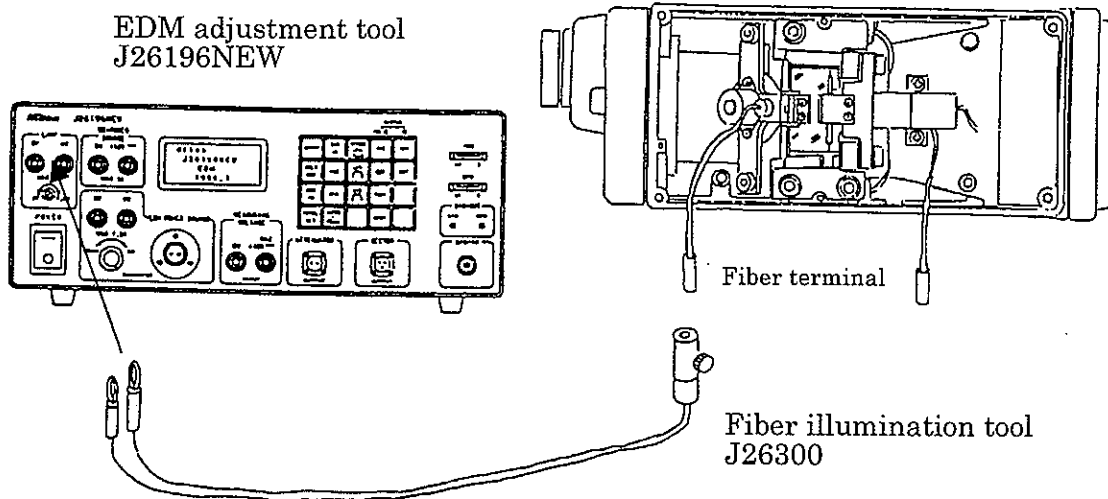
## 14. Adjusting the Fiber Focus and Optical Axis

⊙ Remove the electrical board before conducting the following procedure.

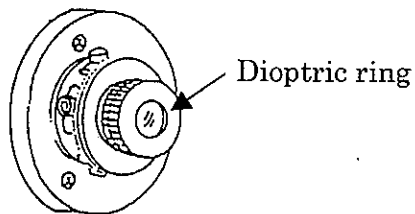
1. Mount the device on the collimator stand.
2. Insert the emitter fiber terminal into the fiber illumination tool (J26300), and tighten the clamp screw.

Connect the power supply of the fiber illumination tool to "LAMP" on the EDM adjustment tool (J26196NEW).

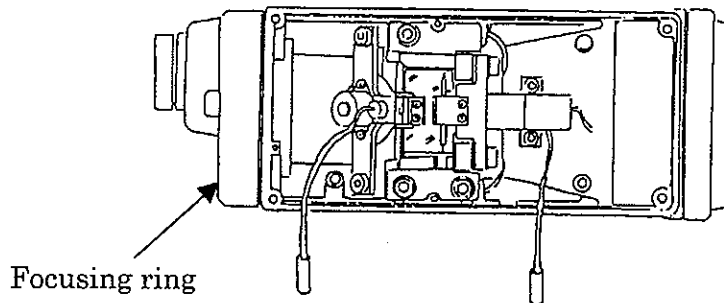
★ The illumination unit lamp is rated at 6 V, but the lamp output is set lower. Do not change the setting to prevent shortening of the lamp's service life. Note that the device's sector is normally set to the External Light side.



3. Turn the diopter ring on the telescope's eyepiece lens to focus on the collimating line.

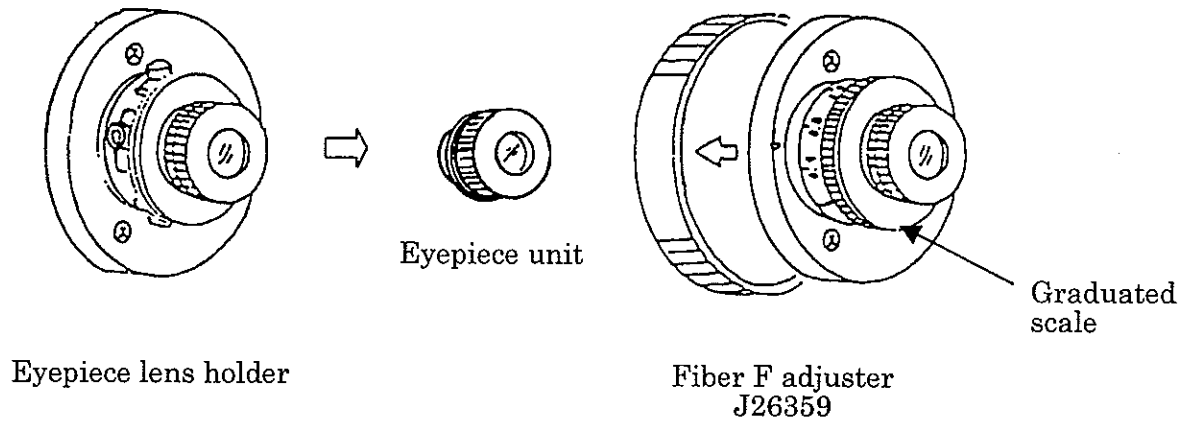


4. Rotate the focusing ring to focus on the collimator crosshair at the infinity position.
- ★ Do not touch the focusing ring until focus adjustment is complete.

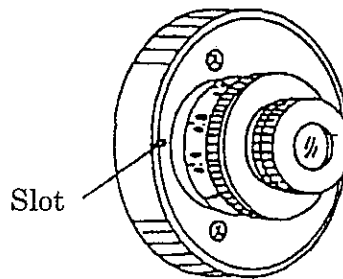


### 14. Adjusting the Fiber Focus and Combination

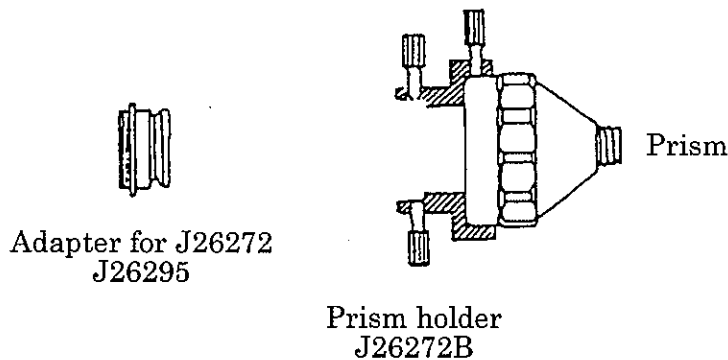
5. Install the fiber F adjuster (J26359) in place of the eyepiece unit.



6. Remove the eyepiece lens from the device, mount the fiber F adjuster (J26359), and then rotate the diopter ring to focus on the focusing-plate crosshairs.
7. Rotate the graduated scale on the fiber F adjuster (J26359) to focus on the collimator infinity crosshairs.
8. Turn the graduated scale clockwise by nine gradations, using the slot on the fiber F adjuster (J26359) as the reference point.
  - ★ Be sure to stop the ring in clockwise rotation.
  - ★ Do not touch the graduated scale or focusing ring until fiber focusing is complete.



9. Install the prism-holder adapter (J26295) to the objective lens chamber, then mount the prism holder (J26272B) and prism.



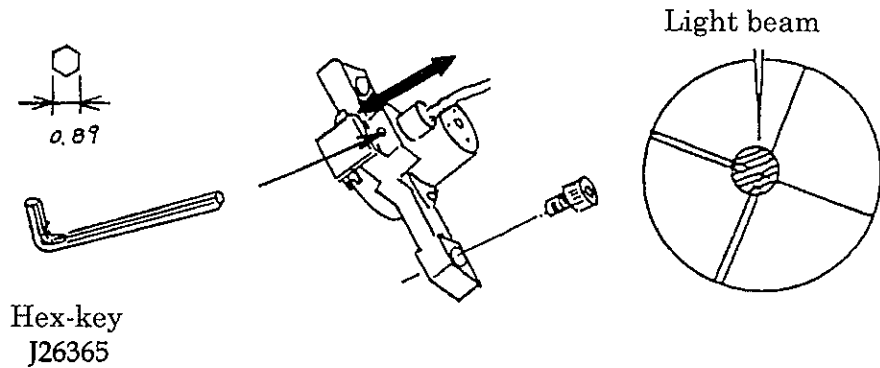
# 14. Adjusting the Fiber Focus and Combination

- 10. Turn on the power switch of the EDM adjustment tool (J26196NEW) to light the emitter fiber.

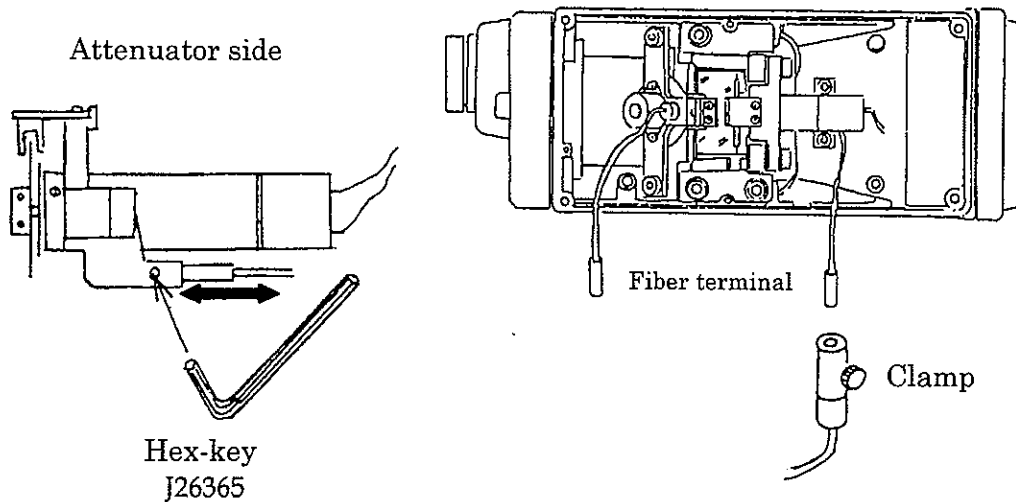
Look into the eyepiece lens and focus the light beam on the focusing-plate crosshairs.

Loosen the fiber set screw using the hex-key (J26365), then move the fiber in and out (as indicated by the arrow) to focus the light beam on the focusing plate.

★ The fiber light beam should be near the center.

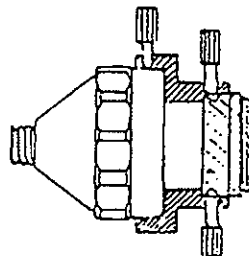


- 11. Remove the fiber illumination tool, then insert the receiver fiber terminal and clamp.



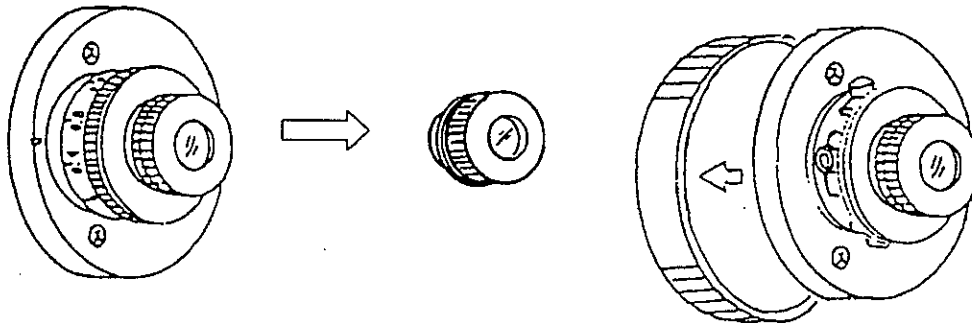
- 12. Loosen the fiber set screw, then move the fiber in and out (as indicated by the arrow) to focus the fiber light beam on the focusing plate.

- 13. Remove the prism, prism holder, and adapter.

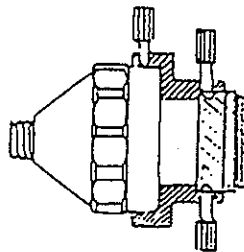


## 14. Adjusting the Fiber Focus and Combination

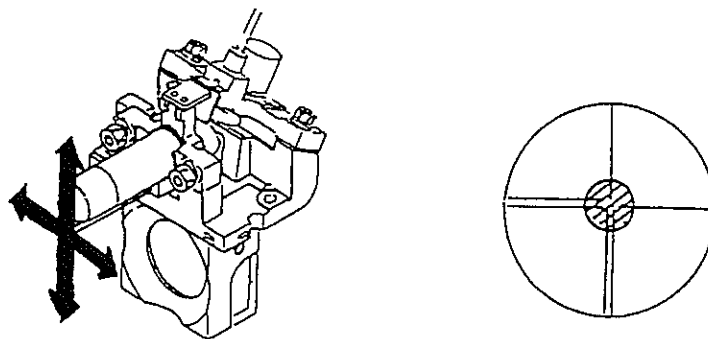
14. Remove the fiber F adjustment eyepiece (J26359), then install the device's eyepiece lens holder.



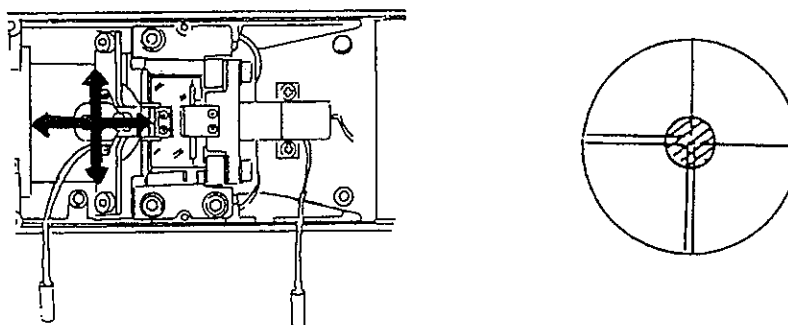
15. Level the device, and adjust the perpendicularity of the horizontal axis and the inclination of the crosshairs.
16. Install the prism, prism holder, and adapter to the objective lens chamber.



17. Look into the eyepiece lens, and move the receiver section so that the receiver fiber light beam is positioned at the center of the eyepiece crosshairs.  
Standard: Centering deviation must be less than 1/10 of the diameter of the fiber light beam.



18. In the same way, move the emitter section to position the light beam at the center of the crosshairs.



19. Install the CPU board.

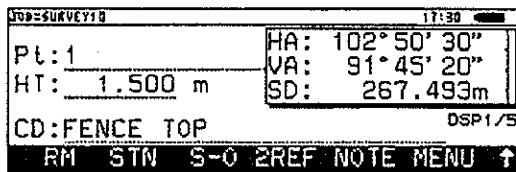
# 15. Positioning the Fiber

★ The following procedures require that the EDM adjustment tool (J26196, J26196NEW) be fitted with the modification kit (J26196H for J26196, J26196I or J26196IJ for J26196NEW). As mentioned in the DTM-500-series repair manual, a modified EDM adjustment tool must be used for the adjustment described herein. The J26196NEW units purchased in and after August 2001 are fitted with the modification kit.

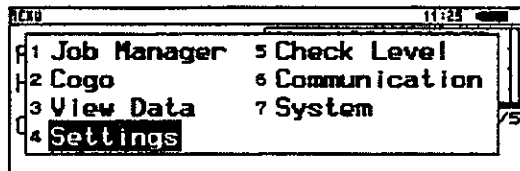
If the CPU board has not been installed when the previous procedures are completed, be sure to install the board before conducting the following steps.

## 1. Device condition setting

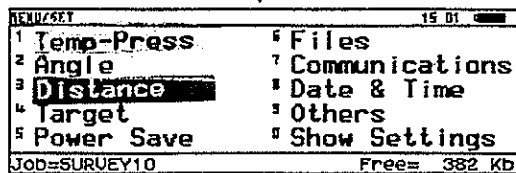
- 1) Turn on the power switch of the device and move the telescope up and down at the 90° position.
- 2) From the job = survey, select menu.



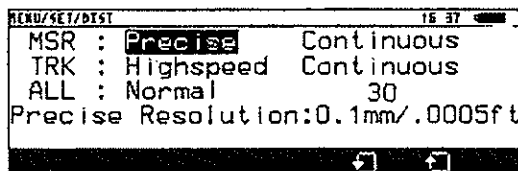
- 3) From the main menu, select setting.



- 4) From the condition-setting screen, select DISTANCE.



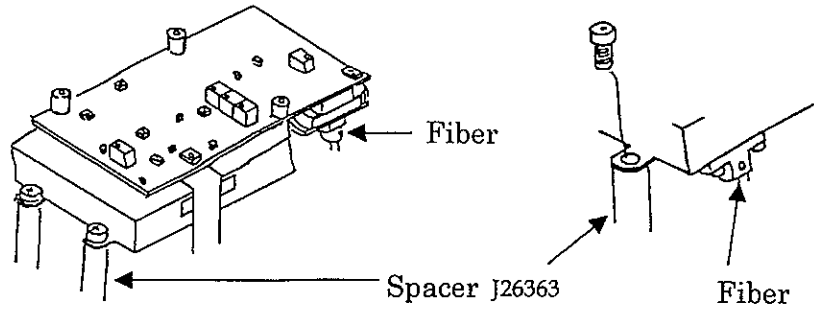
- 5) Set the distance conditions as shown below.



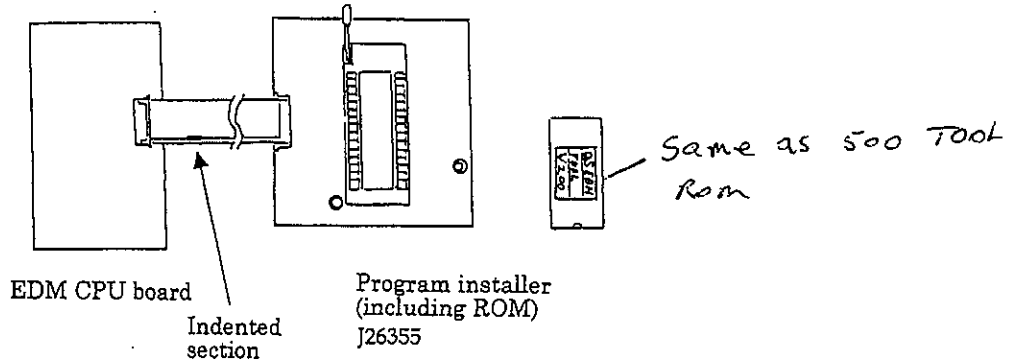
- 6) Press the **ENT** key, then turn off the power switch of the device.

### 15. Positioning the Fiber

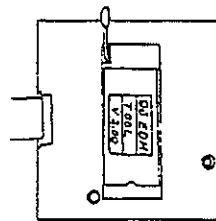
- 2. Insert the spacers (J26363) between the telescope and the shield case on the emitter side so that the fiber can be moved.



- 3. Install the provided EDM tool ROM after version v2.00 in the ROM socket on the program installer 1 (J26355), then connect the flat cable to the CPU board.



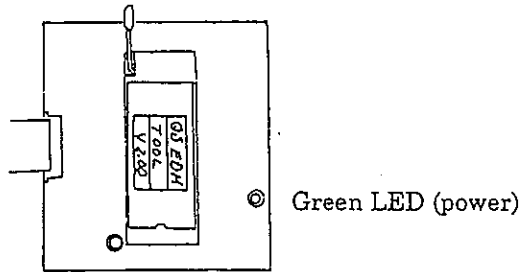
- ★ Important
  - ★ When connecting the flat cable, make sure the contact surface of the flat cable faces up and the indented section is positioned toward the center side of the board.
- Connecting the flat cable in reverse may damage the CPU board or tool.



- 4. Write the tool program.  
Copy the EDM adjustment-tool program to the EDM CPU board, then follow the adjustment steps in sequence.  
The EDM adjustment-tool program is designed to allow easy step-by-step adjustment.  
Pressing the **MRS** key moves the adjustment steps forward, and pressing the **TRK** key changes the adjustment steps in reverse.  
The attenuator must be rotated during an adjustment step. To rotate the attenuator, press the **LG** key.

# 15. Positioning the Fiber

- 1) Turn on the power switch of the device.  
The green LED (power) on the tool (J26355) lights, then the red LED (write) flashes after several seconds.

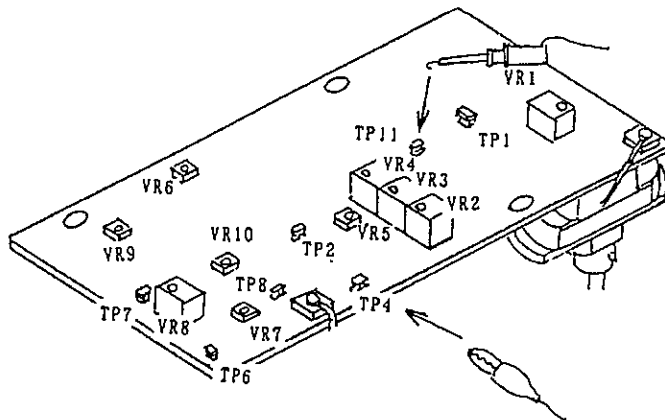


Red LED (write)

- 2) The writing operation is completed in several seconds, and the red LED turns OFF.  
Wait approximately 10 seconds until the writing program ends, then turn off the power switch of the device.
- 3) Disconnect the flat cable from the CPU board, then remove the tool (J26355).

## 5. Position the fiber.

- 1) Connect the SIG IN probe of the EDM adjustment tool to TP11 on the receiver board. Connect the GND wire to TP4 on the receiver board.



- 2) Turn on the power switch of the EDM adjustment tool.
  - ★ When using the J26196 EDM adjustment tool, set the model-type selector to DTM-A, and the sensitivity selector to H.
  - ★ When using the J26196NEW EDM adjustment tool, set the model-type selector to B.
- 3) Press the MRS key on the operation section of the device. (This activates the functions necessary for setting of the optical path, attenuator, and frequency.)  
The display shows "1.000 m" for SDx. Press the MRS key to change the SDx indication to "2.000 m."

# 15. Positioning the Fiber

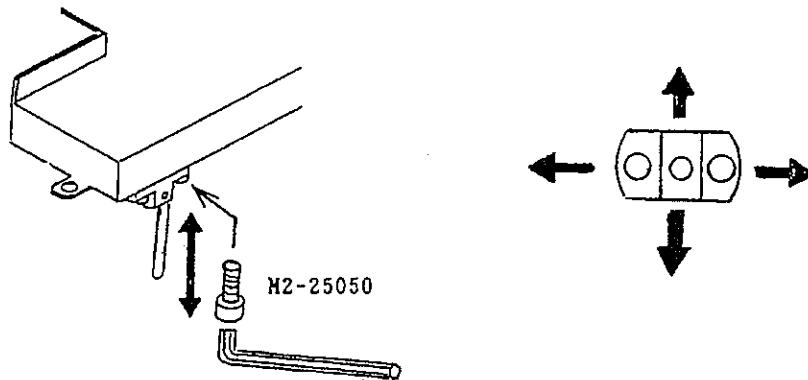
★ To return to the previous screen, press **TRK** **TRK** (press the key twice) or **MRS** **MRS** (press the key twice).

HD#	3.9289M
VD#	-0.1613M
SDx	2.000M
DSP2/4	

If the SDx indication does not show a value in the unit of 1.000, press the **DISP** key to change the indication.

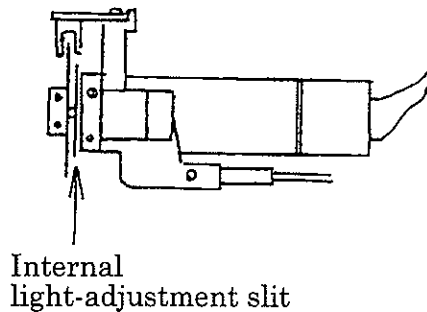
Ignore HD# and VD# in this procedure.

- 4) Loosen the emitter-fiber set screw, then move the fiber up and down to display the largest voltage value on the EDM adjustment tool.



- Ⓢ If the displayed voltage value does not increase, replace the fiber-mounting flange screw with parts M2-25050, then move the flange back and forth as well as to the right and left in order to increase the voltage to the largest value.

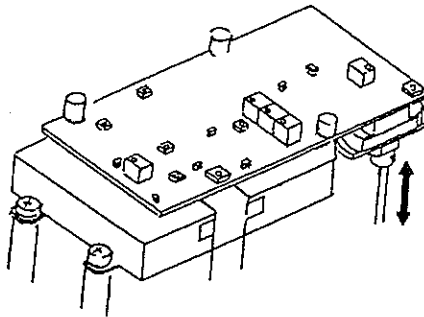
- Ⓢ If the displayed voltage value still does not increase, rotate the internal light-adjustment slit.  
If the displayed value is saturated, press the **LG** key to rotate the attenuator until the displayed value decreases. Then, move the fiber to set the largest value.





## 15. Positioning the Fiber

- 5) In the same way, adjust the receiver fiber and flange positions so that the displayed voltage value becomes the largest.



Spacer J26363

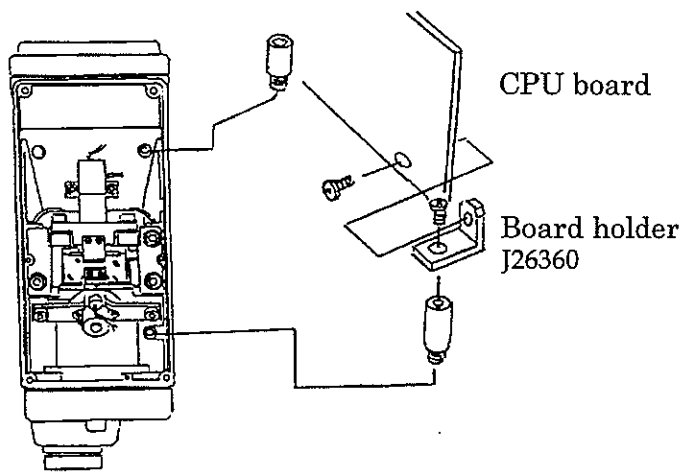
- 6) Turn off the power switch.
- 7) Remove the spacers used to raise the emitter section and EDM module, and install the board to the telescope.

# 16. Internal Light Adjustment

## 1. Adjustment of the internal light intensity

Use the CPU board holder (J26360) to position the CPU board vertically for easy rotation of the internal light-adjustment slit. If the CPU board holder is not used, place the CPU board in a plastic bag to prevent short-circuiting due to contact with the telescope.

- 1) Remove the two spacers from the telescope, and mount the CPU board holder (J26360).



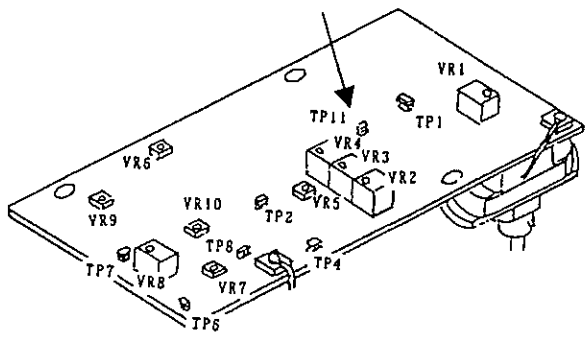
- 2) Turn on the power switch, and move the telescope up and down at the 90° position. Press the **MSR** key to display "1.000 m" on the screen, then press the **MSR** key again to display "2.000 m."

★ To return to the previous screen, press **TRK** **TRK** (press the key twice) or **MSR** **MSR** (press the key twice).

HD#	3.9289M
VD#	-0.1613M
SDx	2.000M
DSP2/4	

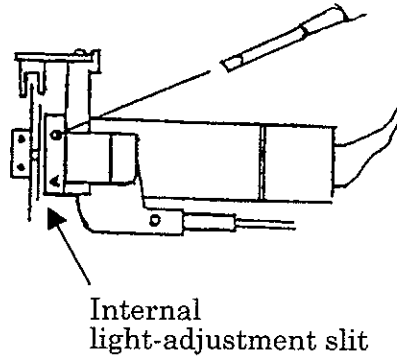
If the SDx indication does not show a value in the unit of 1.000 m, press the **DISP** key to change the indication. Ignore HD# and VD# in this procedure.

- 3) Connect the SIG IN probe of the EDM adjustment tool to TP11 on the receiver board.



## 16. Internal Light Adjustment

- 4) Move the internal light-adjustment slit to adjust the internal light intensity.
  - ⊙ Adjust the value so that the J26196 EDM adjustment tool indicates  $8 \pm 1$ .
  - ⊙ Adjust the value so that the J26196NEW EDM adjustment tool indicates  $8 \pm 1$ .



- ⊙ Loosen the set screw, insert the tip of a screwdriver into the screw hole, and then rotate the light-adjustment slit to change the indication on the EDM adjustment tool.
- ⊙ If proper adjustment cannot be achieved, slightly turn VR1 on the receiver board, then adjust it again.

## 17. Electrical Adjustment

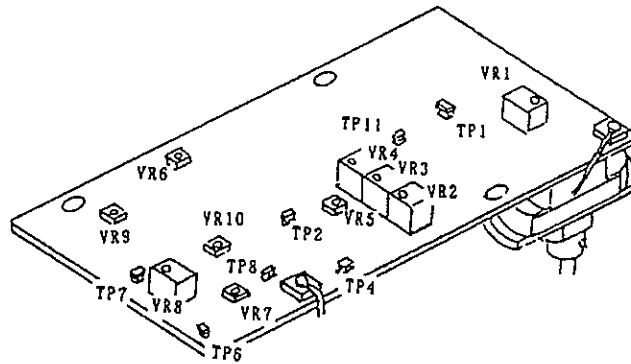
When electrical adjustment is made following the internal light adjustment, use the same EDM adjustment tool and program settings. If not, copy the tool program to the EDM CPU board using the program installer 1 (J26355) used for fiber positioning, before conducting the following procedures.

Press the **MRS** key on the operation section of the device, and confirm that "1.000 m" is displayed before making electrical adjustment.

### TI amp output adjustment

#### 1. Probe connection

Connect the SIG IN probe of the EDM adjustment tool to TP11 on the receiver board. (Connect the GND wire to TP4 on the receiver board.)



#### 2. Electrical adjustment

1) Press the **MRS** key to indicate "2.000 m" on the display.

HD#	3.9289M
VD#	-0.1613M
SDx	2.000M
DSP2/4	

Turn VR1 on the receiver board to set the displayed value on the EDM adjustment tool as follows:

- ⊙ When using J26196:  $.918 \pm .10$
- ⊙ When using J26196NEW:  $2118 \pm 200$

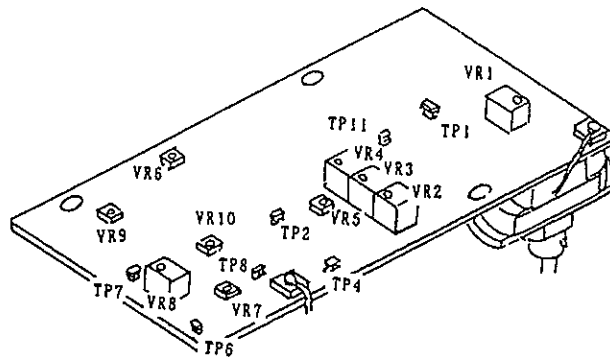
★ To return to the previous screen, press **TRK** **TRK** (press the key twice) or **MRS** **MRS** (press the key twice).

If the SDx indication does not show a value in the unit of 1.000 m (e.g. 1.2288 m), press the **DISP** key to change the indication.

Ignore HD# and VD# in this procedure.

## 17. Electrical Adjustment

- 2) Press the **MRS** key to display "3.000 m."



Turn VR4 on the receiver board to set the displayed value on the EDM adjustment tool as follows:

- ⊙ When using J26196:  $.918 \pm .10$
- ⊙ When using J26196NEW:  $2118 \pm 200$

- 3) Press the **MRS** key to display "4.000 m."

Turn VR3 on the receiver board to set the displayed value on the EDM adjustment tool as follows:

- ⊙ When using J26196:  $.918 \pm .10$
- ⊙ When using J26196NEW:  $2118 \pm 200$

- 4) Press the **MRS** key to display "5.000 m."

Turn VR2 on the receiver board to set the displayed value on the EDM adjustment tool as follows:

- ⊙ When using J26196:  $.918 \pm .10$
- ⊙ When using J26196NEW:  $2118 \pm 200$

### AGC gain adjustment

- 5) Connect the SIG IN probe of the EDM adjustment tool to TP2 on the receiver board.

When using the J26196, turn the sensitivity selector switch ON and make sure the LED on the EDM adjustment tool is ON.

- 6) Press the **MRS** key to display "6.000 m."

Turn VR5 on the receiver board to set the displayed value on the EDM adjustment tool as follows:

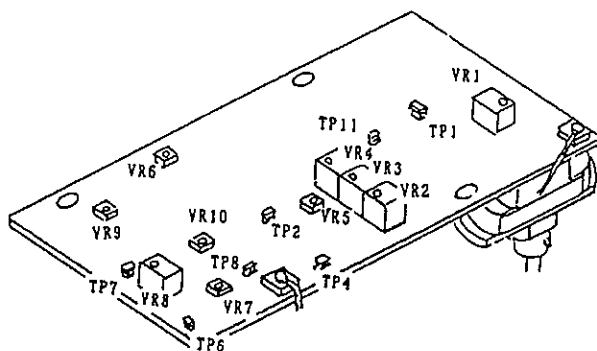
- ⊙ When using J26196:  $477.5 \pm 16.4$
- ⊙ When using J26196NEW:  $47565 \pm 1640$

- ⊙ If a high-intensity input light results in saturation of the displayed value, turn VR6 on the receiver board to set the displayed value on the EDM adjustment tool as follows, then make adjustment using VR5 again.

- ⊙ When using J26196:  $311.7$
- ⊙ When using J26196NEW:  $30986$

## 17. Electrical Adjustment

- 7) Press   (press the key twice) to display "7.000 m."



Turn VR6 on the receiver board to set the displayed value on the EDM adjustment tool as follows:

- ⊙ When using J26196:  $477.5 \pm 16.4$
- ⊙ When using J26196NEW:  $47565 \pm 1640$

- 8) Press the  key to display "8.000 m."

Turn VR5 on the receiver board to the point at which the displayed value is the largest.

- 9) Connect the SIG IN probe of the EDM adjustment tool to TP11 on the receiver board. Connect the GND wire to TP4 on the receiver board. When using the J26196, turn the sensitivity selector switch OFF and make sure the LED on the EDM adjustment tool is OFF.

Make sure the displayed value on the EDM adjustment tool is as follows:

- ⊙ When using J26196:  $.918 \pm .10$
- ⊙ When using J26196NEW:  $2118 \pm 200$

### VAD1 setting

- 10) Press the  key to display "9.000 m."

Connect a digital voltmeter to TP6 on the receiver board, and measure the voltage.

(Connect the GND wire to TP4 on the receiver board.)

Equation: Adjustment voltage = Reference voltage of 2.5 V - Measured voltage  
Divide the adjustment-voltage value between VR7 and VR8 at a ratio of 1:3, to adjust the reference voltage to  $2.5 \pm 0.05$  V.

### Example 1

When the measurement voltage is 1.7 V:

Adjustment voltage = Reference voltage of 2.5 V - Measured voltage 1.7 V = 0.8 V

Divide the adjustment voltage of 0.8 V between VR7 and VR8 at a ratio of 1:3 (VR7:VR8 = 1:3 = 0.2 V:0.6 V) in order to adjust voltage to 2.5 V.

From the measured value, increase by 0.2 V using VR7 and by 0.6 V using VR8, in order to adjust the reference voltage to  $2.5 \pm 0.05$  V.

## 17. Electrical Adjustment

11) Press the **LG** key to rotate the attenuator. Press the **LG** key again to stop the attenuator rotation at the position at which the displayed value on the EDM adjustment tool is as follows:

- ⊙ When using J26196: .033
- ⊙ When using J26196NEW: 76

To reduce the rotating speed, hold down the LIGHT key in order to display the light menu screen, then press “2: Reticle illuminator.”

Measure the voltage at TP6 on the receiver board.

Equation: Adjustment voltage = Reference voltage of 1.0 V - Measured voltage

Divide the adjustment-voltage value between VR7 and VR8 at a ratio of 1:3, in order to adjust the reference voltage to  $1.0 \pm 0.05$  V.

### Example 2

When the measurement voltage is 0.6 V:

Adjustment voltage = Reference voltage of 1.0 V - Measured voltage of 0.6 V = 0.4 V

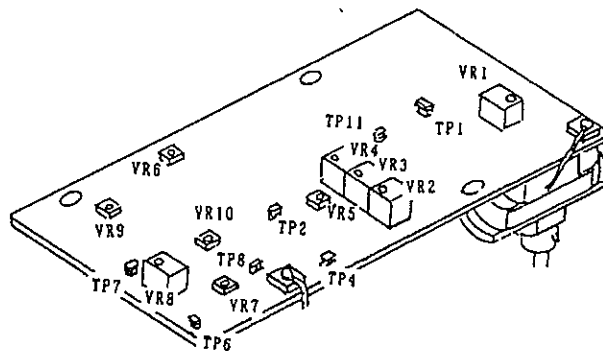
Divide the adjustment voltage of 0.4 V between VR7 and VR8 at a ratio of 1:3 (VR7:VR8 = 1:3 = 0.1 V:0.3 V), in order to adjust voltage to 1.0 V.

From the measured value, increase by 0.1 V using VR7 and by 0.3 V using VR8, in order to adjust the reference voltage to  $1.0 \pm 0.05$  V.

12) Press **TRK** **TRK** (press the key twice) to display “8.000 m.” Then, press **MRS** **MRS** (press the key twice) to display “9.000,” and confirm that the adjustment values described in steps 10) and 11) are obtained.  
If the adjustment values are not correct, repeat steps 10) and 11).

### VAD2 setting

13) Connect a digital voltmeter to TP7 on the receiver board.



Press the **MRS** key to display “10.000 m.”

Press the **MRS** key to display “11.000 m.”

Press the **MRS** key to display “12.000 m.”

Use VR9 on the receiver board to adjust voltage to  $1.5 \pm 0.1$  V.

## 17. Electrical Adjustment

### SIF comparator phase adjustment

- 14) Connect the SIG IN probe of the EDM adjustment tool to TP11 on the receiver board. Press the **MRS** key to display "13.000 m."

Make sure the displayed value on the EDM adjustment tool is as follows:

- ⊙ When using J26196: .918 ± .10
- ⊙ When using J26196NEW: 2118 ± 200

- 15) Connect a digital voltmeter to TP8 on the receiver board, and measure and record the voltage.  
Voltage: SV1

Press the **LG** key to rotate the attenuator. Press the **LG** key again to stop the attenuator rotation at the position at which the displayed value on the EDM adjustment tool is as follows:

- ⊙ When using J26196: .116
- ⊙ When using J26196NEW: 268

At this point, measure and record the voltage.

Voltage: SV2

Using VR10 on the receiver board, adjust voltage SV2 to the same value as SV1. Repeat step 15) until the voltage difference between SV1 and SV2 is less than 1 mV.

- 16) The EDM adjustment is complete. Press the **MRS** key to display "100.000 m." This ends the tool program.

Turn off the power switch of the device.

- 17) Install the device's EDM-program ROM to the ROM socket on program installer 1 (J26355), then connect the flat cable to the CPU board.

The device's EDM program is subject to change without prior notice. For the latest information, check the program information on the newest model.

★ Do not connect the flat cable in reverse.

Turn on the power switch of the device.

- 18) Confirm that the red LED on program installer 1 (J26355) turns ON, then turns OFF after approximately a half-minute. After waiting for approximately 10 seconds, turn off the power switch of the device.

Disconnect the flat cable and remove the tool.



## 18. Supplementary Information (Version Display)

The versions of the programs installed in the CPU board and EDM unit can be checked by operating the keys on the operation section.

### 1. Version display

- 1) Press **ENTER** and **→** arrow key. Then turn on the power switch.

The display shows the model name, then indicates the versions of the installed programs.

DTM-851			
MAIN	QL2	Bios	V1.05
EDM	QS	EDM	V2.03
Sensor Sub		SNS-01	V1.00
Main Disp Sub		LCD-01	V2.00
1-23-2002		15:15:30	

To end the display, turn off the power switch.

EDM adjustment-procedure service manual (for J26196NEW)

Model:  Product No.:

Accurately record displayed values.

LCD	Caution	SIG IN	Tool display	Voltage measurement	Check value	Tolerance	Adj. vol.
-	Adjust the peak using the LED and APD fiber.						
-	On J26196NEW, set the Model Type to TYPE B.						
2 m		TP11	○	ON	<input type="text"/>	Maximum	Peak adjustment using fiber

GND: TP4 → For voltage measurement using SIG IN

LCD	Caution	SIG IN	Tool display	Voltage measurement	Check value	Tolerance	Adj. vol.
-	On J26196NEW, set the Model Type to TYPE B.						
1 m		TP11	8	-	<input type="text"/>	±1	Slit adj.
2 m		↓	2115	-	<input type="text"/>	±200	VR1
3 m		↓	2115	-	<input type="text"/>	±200	VR4
4 m		↓	2115	-	<input type="text"/>	±200	VR3
5 m		↓	2115	-	<input type="text"/>	±200	VR2
6 m		TP2	47565	-	<input type="text"/>	±1640	VR5
If high-intensity input light results in saturation of the displayed value, turn VR6 on receiver board to decrease the displayed value, then make adjustments using VR5 again.							
7 m		TP2	47565	-	<input type="text"/>	±1640	VR6
8 m		↓	○	-	<input type="text"/>	Maximum	VR5
		TP11	2118	-	<input type="text"/>	±200	Check only
9 m	*1	↓	-	○TP6	<input type="text"/>	2.5 ± 0.05 V	VR7:VR8 (1:3)
	SET SIG	↓	76	Press the LG key to rotate and adjust.			
	*2	↓	-	○TP6	<input type="text"/>	1.0 ± 0.05 V	VR7:VR8 (1:3)
Display "8 m," then change to "9 m" and check 1.0 VDC.							
10 m	Skip						
11 m	Skip						
12 m		TP11	-	○TP7	<input type="text"/>	1.5 ± 0.1 V	VR9
13 m		↓	2118	-	<input type="text"/>	±200	Check only
		↓	-	○TP8	<input type="text"/>		SV1 → Record value
	SET SIG	↓	268	Press the LG key to rotate and adjust.			
		↓	-	○TP8	<input type="text"/>		SV2 → Record value
	SV1 = SV2	↓	-	○	<input type="text"/>	±1 mV	VR10
Display "8 m," then change to "13 m" and repeat adjustment until SV1 = SV2.							
100 m	Turn off the power.						

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EDM adjustment-procedure service manual (for J26196)

Model:  Product No.:

Accurately record displayed values.

LCD	Caution	SIG IN	Tool display	Voltage measurement	Check value	Tolerance	Adj. vol.
-	Adjust the peak using the LED and APD fiber.						
-	On J26196, set Model Type to DTM-A and Sensitivity to H.						
2 m		TP11	○	ON	<input type="text"/>	Maximum	Peak adjustment using fiber

GND: TP4 → For voltage measurement using SIG IN

LCD	Caution	SIG IN	Tool display	Voltage measurement	Check value	Tolerance	Adj. vol.
-	On J26196, set Model Type to DTM-A and Sensitivity to H.						
1 m		TP11	.008	-	<input type="text"/>	±.001	Slit adj.
2 m		↓	.918	-	<input type="text"/>	±.1	VR1
3 m		↓	.918	-	<input type="text"/>	±.1	VR4
4 m		↓	.918	-	<input type="text"/>	±.1	VR3
5 m		↓	.918	-	<input type="text"/>	±.1	VR2
6 m		TP2	477.5	-	<input type="text"/>	±16.4	VR5
If high-intensity input light results in saturation of the displayed value, turn VR6 on receiver board to decrease the displayed value, then make adjustments using VR5 again.							
7 m		TP2	477.5	-	<input type="text"/>	±16.4	VR6
8 m		↓	○	-	<input type="text"/>	Maximum	VR5
		TP11	.918	-	<input type="text"/>	±.1	Check only
9 m	*1	↓	-	○TP6	<input type="text"/>	2.5 ± 0.05 V	VR7:VR8 (1:3)
	SET SIG	↓	.033	Press the LG key to rotate and adjust.			
	*2	↓	-	○TP6	<input type="text"/>	1.0 ± 0.05 V	VR7:VR8 (1:3)
Display "8 m," then change to "9 m" and check 1.0 VDC.							
10 m	Skip						
11 m	Skip						
12 m		TP11	-	○TP7	<input type="text"/>	1.5 ± 0.1 V	VR9
13 m		↓	.918	-	<input type="text"/>	±.1	Check only
		↓	-	○TP8	<input type="text"/>		SV1 → Record value
	SET SIG	↓	.116	Press the LG key to rotate and adjust.			
		↓	-	○TP8	<input type="text"/>		SV2 → Record value
	SV1 = SV2	↓	-	○	<input type="text"/>	±1 mV	VR10
Display "8 m," then change to "13 m" and repeat adjustment until SV1 = SV2.							
100 m	Turn off the power.						

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