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AF-S DX Zoom-Nikkor  
ED 18-70mm f/3.5-4.5G IF

JAA79051

REPAIR MANUAL

**Nikon** | NIKON CORPORATION  
Tokyo, Japan

# SPECIFICATIONS

This lens can be used for Nikon digital SLR camera only.

Type of lens	G-type AF DX Zoom- Nikkor lens having built-in CPU and Nikon bayonet mount
Focal length	18mm-70mm
Maximum aperture	f/3.5-4.5
Lens construction	15 elements in 13 groups (1 aspherical lens and 3 ED lens elements)
Picture angle	76°-22°50'with Nikon Digital Camera D1/D1H/D1X/D2H/D100)
Focal length scale	18,24,35,50,70mm
Distance information	Output to camera body
Zoom control	Manually via separate zoom ring
Focusing	Nikon Internal Focusing (IF) system (utilizing an internal Silent Wave Motor); manually via separate focus ring
Shooting distance scale	Graduated in meters and feet from 0.38m (2ft.) to infinity ( $\infty$ )
Closest focus distance	0.38m (1.2ft.) at all zoom settings
Diaphragm	Fully automatic
Aperture range	f/3.5 to f/22 (at 18mm), f/4.5 to f/29 (at 70mm)
Exposure measurement	Via full-aperture method with cameras having CPU interface system
Attachment size	67mm (P = 0.75mm)
Dimensions	Approx. 73mm dia. ×75.5mm extension from the camera's lens mount flange (min. length at 18mm focal length)
Weight	Approx.420g (14.8 oz)

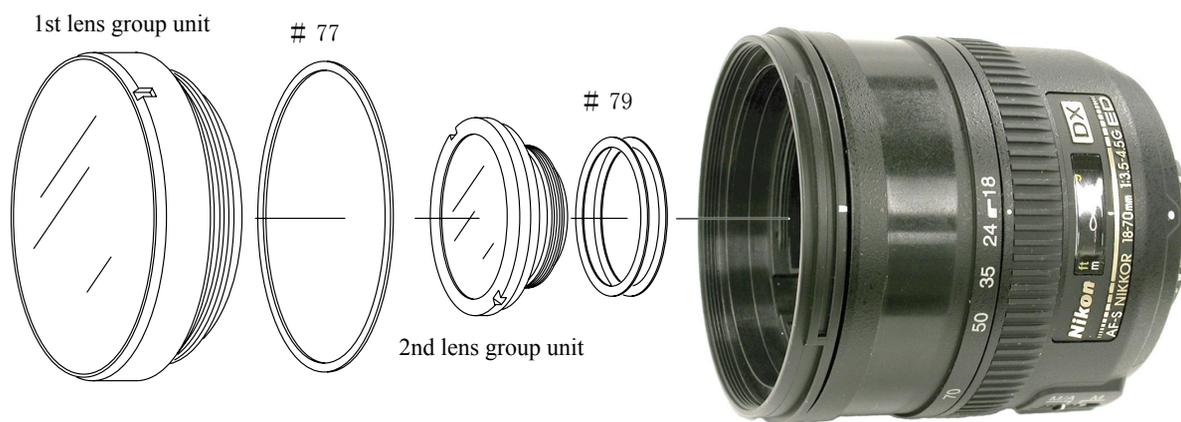
# DISASSEMBLY/ASSEMBLY/ADJUSTMENT

## 1. DISASSEMBLY

RUBBER RING, SHEET



1st AND 2nd LENS GROUP



FILTER RING



- Remove 3 screws (#96) and remove the filter ring (#25) while rotating it in the arrow direction.

ZOOM RING



- ① Remove the screw (#61).



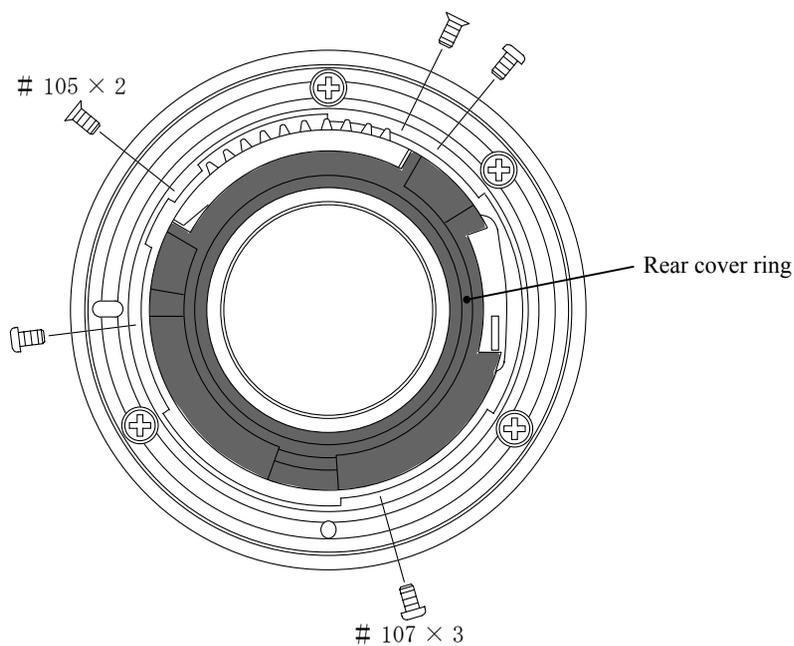
② Remove the zoom ring.

Note :

The three convex sections on the inner diameter of zoom ring are put into the groove of #22.

When removing the zoom ring, rotate it until the convex sections can be removed from the groove and then remove it.

**REAR COVER RING**



## BAYONET MOUNT



- ① Remove 3 screws (#98) and the screw (#116), and detach the bayonet mount.
- ② Remove the washers (#78).

## INDEX RING, FOCUS RING



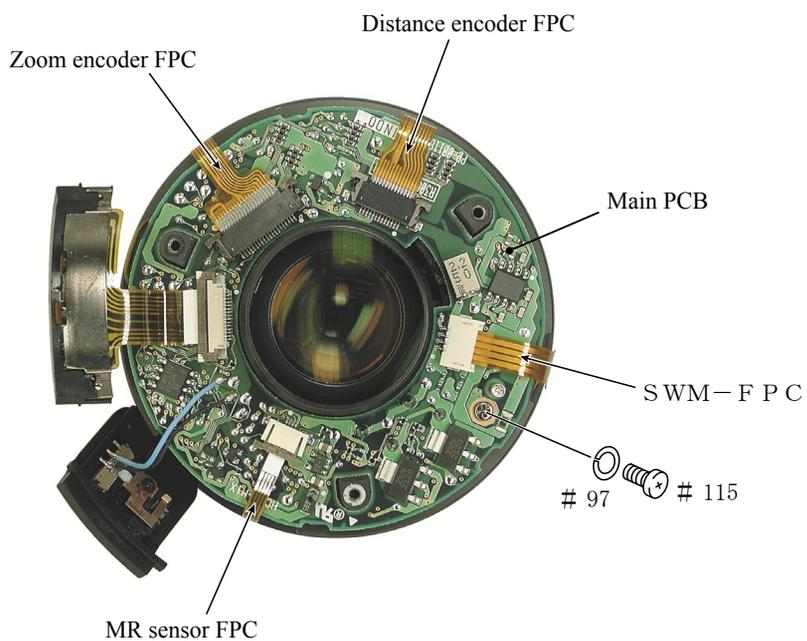
- ① Slide the M/A selector switch unit in the arrow direction as shown in the left picture.



② Remove the index ring first then the focus ring.

※ As shown in the left picture, pass the M/A selector switch unit through the index ring.

**MAIN PCB**



① Remove each FPC from the connectors as shown in the left .

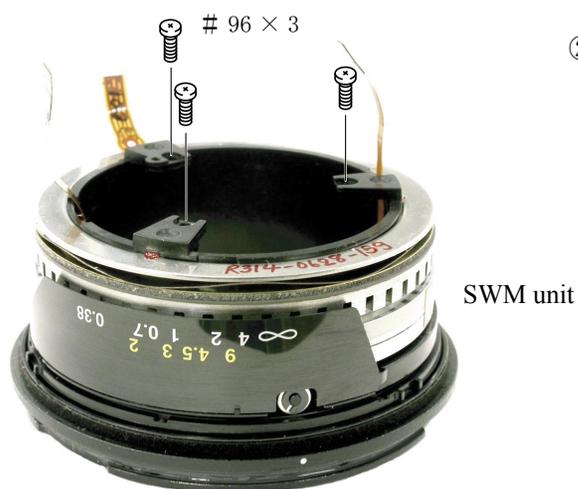
② Remove the screw (#115).

③ Remove the main PCB.

SWM UNIT



- ① Remove 3 screws (#96), and detach the Rear fixed ring (#29).

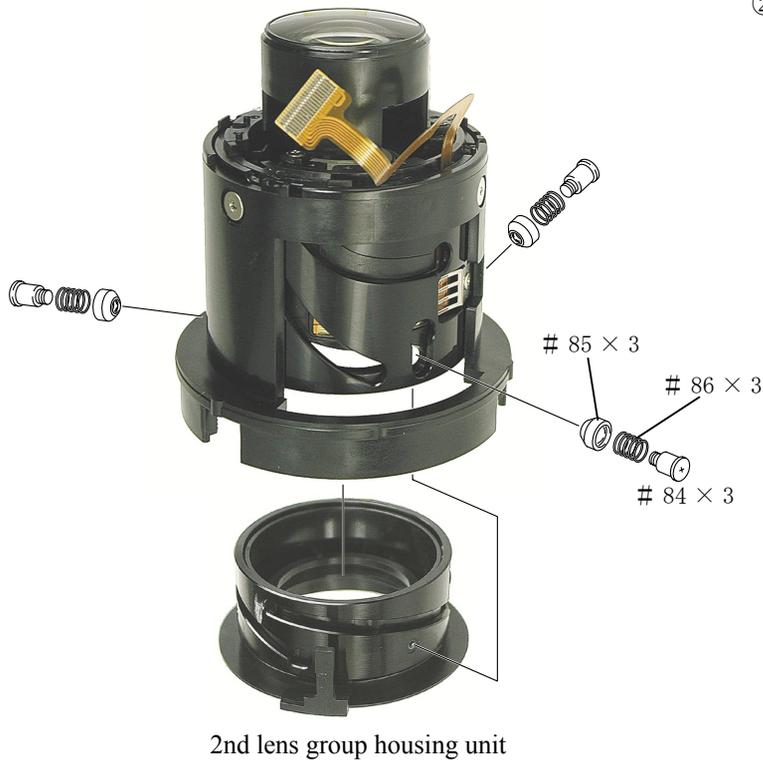


- ② Remove 3 screws (#96), and detach the SWM unit.



## 2nd LENS GROUP HOUSING UNIT

- ② Remove 3 screws (#84), 3 springs (#86) and 3 rollers #85).



**Note :**

After the above, the 5th and 4th lens groups should be removed.

When the 5th and 4th lens groups are removed, lens alignment should be performed after assembly.

If the alignment is impossible in the service office, do not carry out further disassembly work, but the zoom encoder brush and zoom key can be replaced.

## 4th AND 5th LENS GROUP



- ① Remove 3 screws (#96) and detach the 5th lens group.
- ② Remove 3 screws (#96) and detach the 4th lens group.

## 3rd LENS GROUP



## APERTURE BLADE HOUSING UNIT

① Remove 3 screws (#80), 3 rollers (#83), and detach the Aperture blade housing unit.



## ZOOM ENCODER BRUSH

① Remove 3 screws (#75) and detach the zoom encoder brush (#74).



## ZOOM KEY



- ① Remove the screws (#60 and #62) and detach the zoom key (#59).

## 1st LENS GROUP SLIDING RING



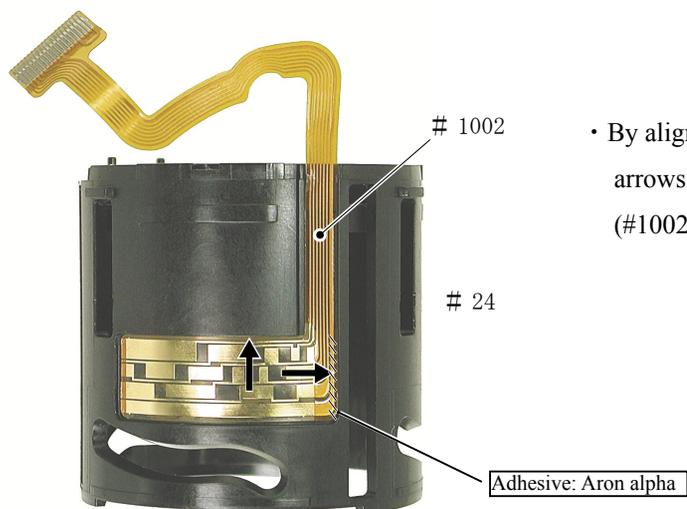
- ① Remove 3 screws (#51), the three zoom keys (B7) and detach the 1st lens group sliding ring (#51).
- ② Remove the 1st sliding ring (#51).

CAM RING



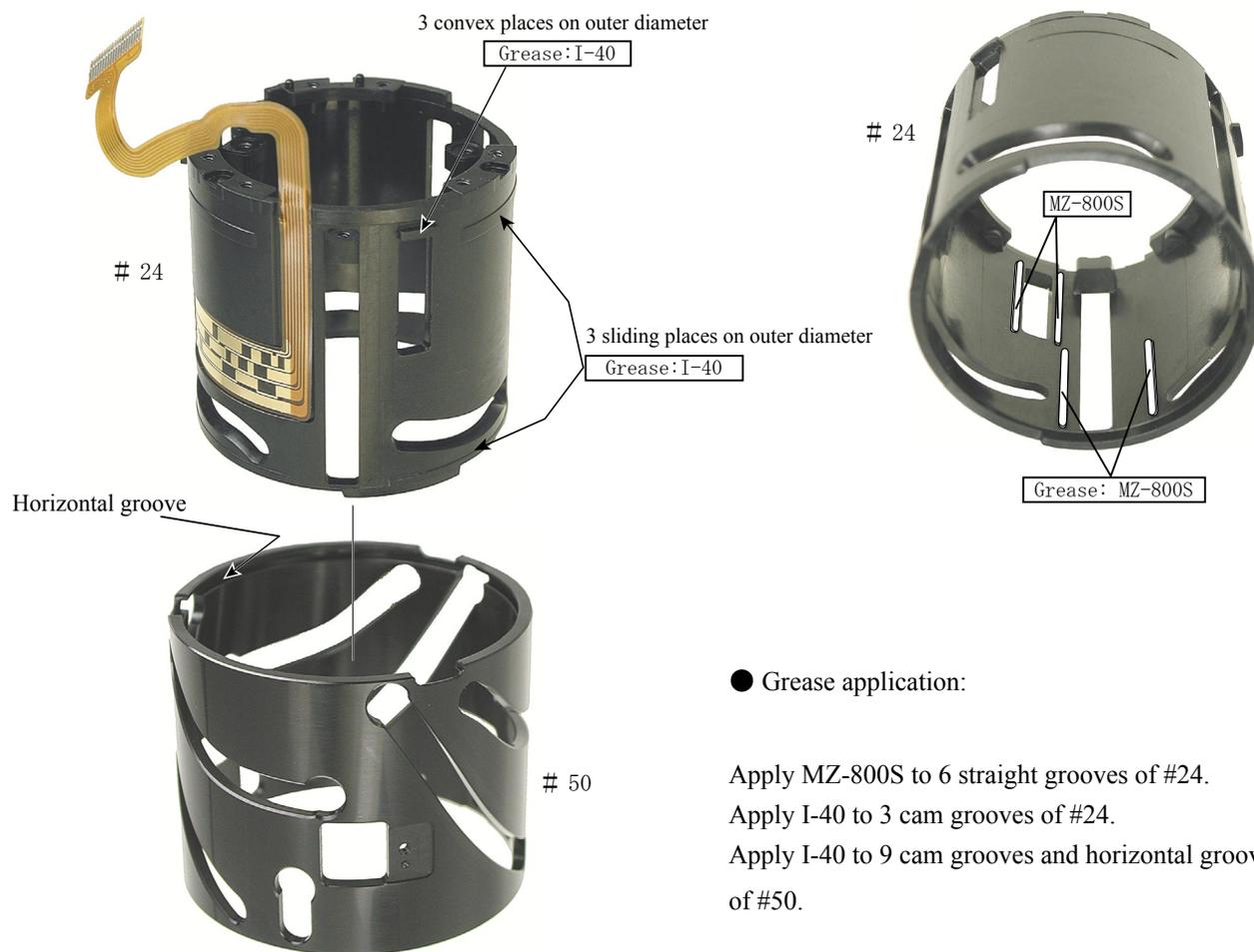
## 2. ASSEMBLY/ADJUSTMENT

### ZOOM ENCODER FPC



- By aligning the edges as shown by the left arrows, adhere the zoom encoder FPC (#1002) to #24.

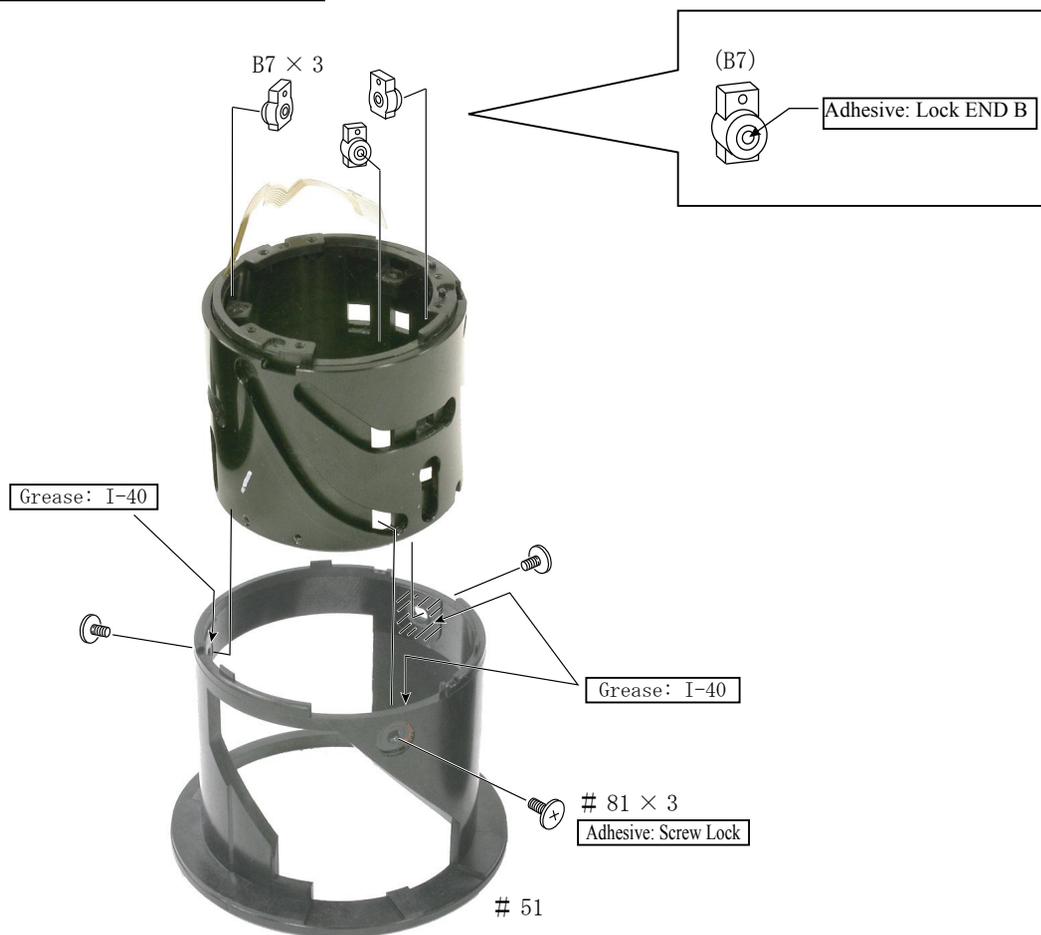
### CAM RING GROUP



● Grease application:

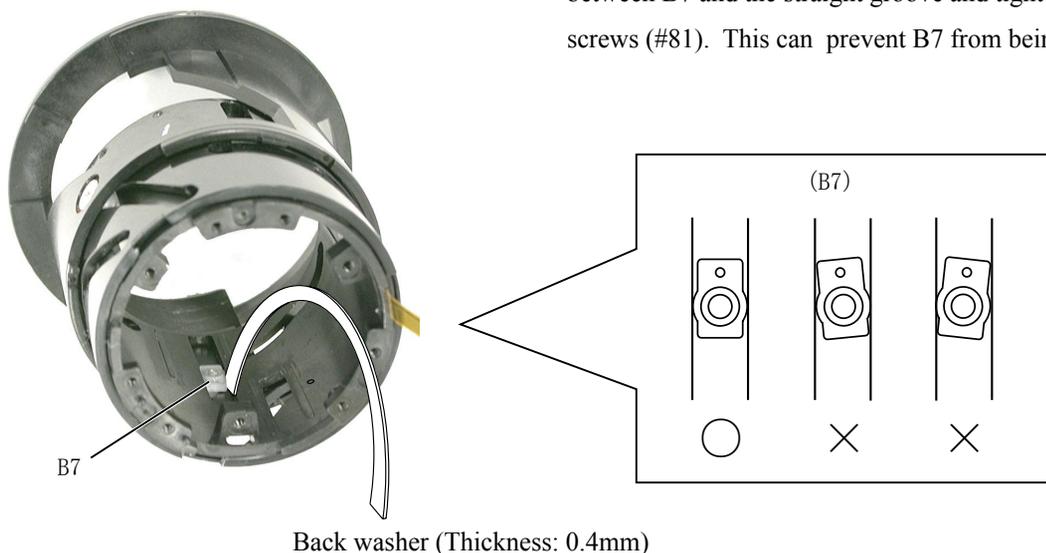
- Apply MZ-800S to 6 straight grooves of #24.
- Apply I-40 to 3 cam grooves of #24.
- Apply I-40 to 9 cam grooves and horizontal groove of #50.

1st LENS GROUP SLIDING RING

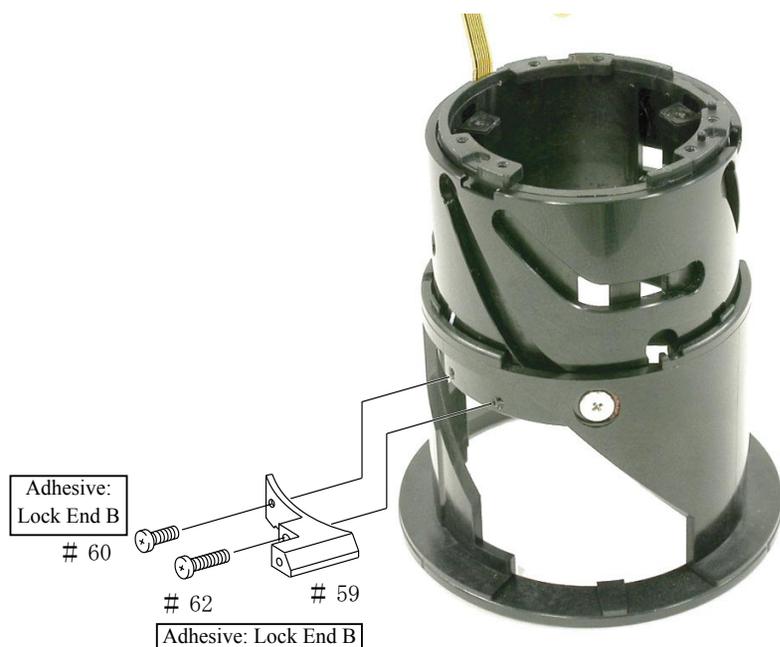


《Reference》

Tightening the screws (#81) causes inclination of B7, and it becomes heavy in operating the cam ring. Therefore, as shown below, put a back washer, etc. in between B7 and the straight groove and tighten the screws (#81). This can prevent B7 from being inclined.



## ZOOM KEY

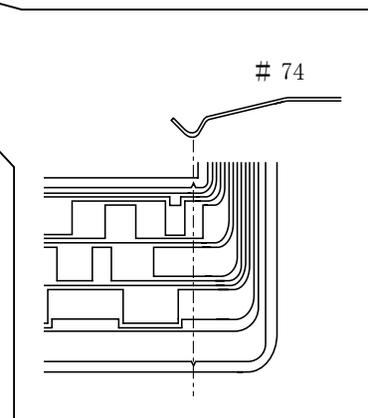


- ① Attach the zoom key #59 with the screws (#60 and #62).

## ADJUSTMENT OF ZOOM ENCODER BRUSH POSITION

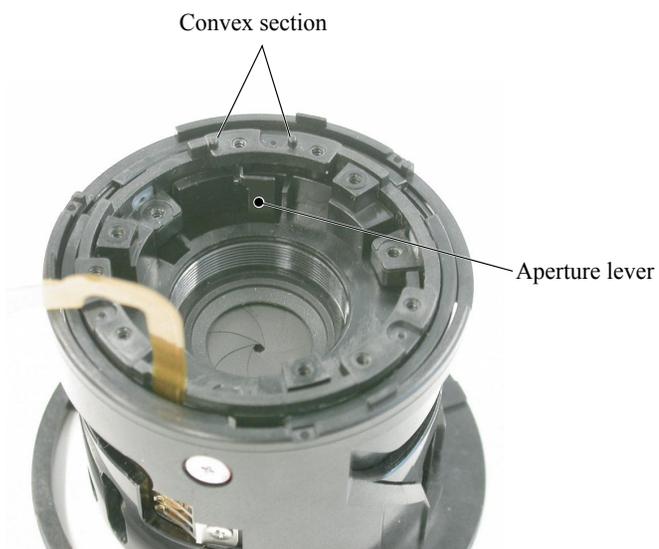


- ① Set the zoom encoder brush #74. Tighten the screw #75 temporarily.
- ② Set the cam ring to the W side as shown in the above picture.
- ③ Adjust the brush position so that the edge of the brush are positioned as shown right.
- ④ Tighten the screw (#75) securely and fix it with the screw lock.



APERTURE BLADE HOUSING UNIT

① Assemble the zoom Aperture blade housing unit with 3 screws (#80) and 3 rollers (#83).



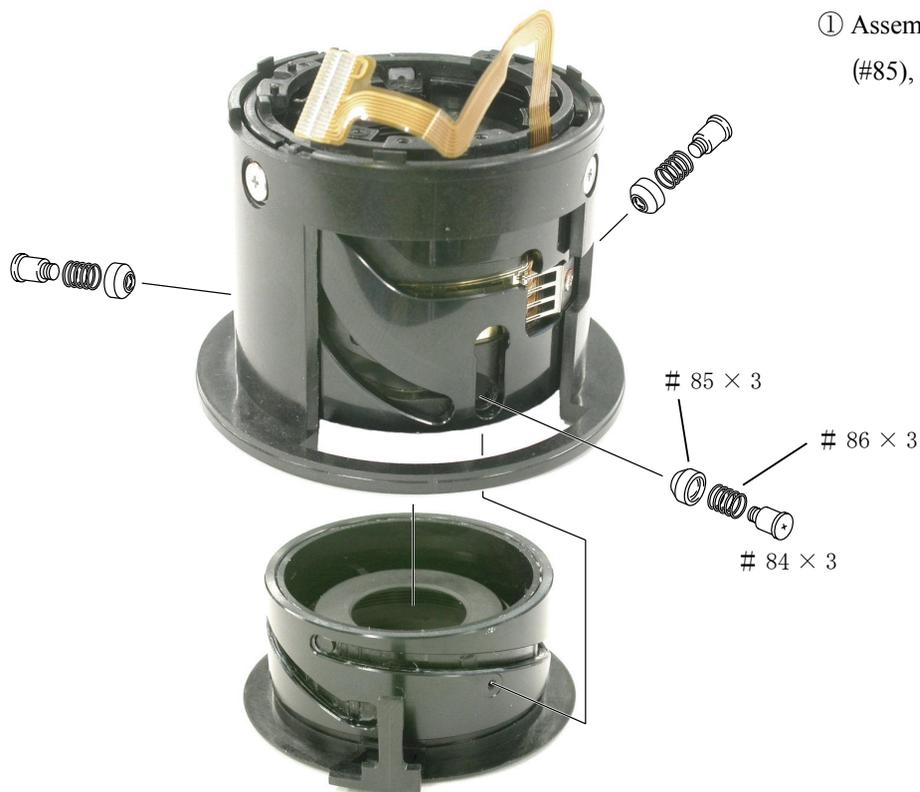
Check : When mounting the aperture blade chamber unit, the aperture lever must be positioned as shown left.

2nd LENS GROUP HOUSING UNIT



● Apply G92KA to the 3 cam grooves of #52.

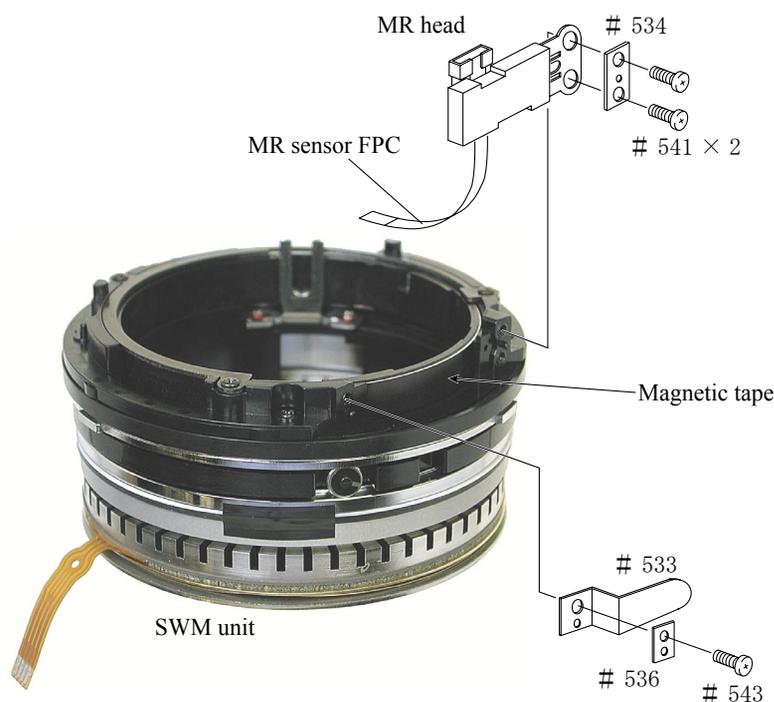
Apply to 2 convexities on outer diameter



① Assemble the 2nd lens group with 3 rollers (#85), 3 springs #86 and 3 screws (#84).

2nd lens group housing unit

## MR HEAD



① Set the MR head to be parallel with the magnetic tape.

② Adhere the MR sensor FPC to the inside of the SWM unit.

Note : Adhere the MR sensor FPC not to be largely slack.

## INSPECTION AND ADJUSTMENT FOR THE WAVEFORM OUTPUT FROM MR ENCODER

● In case of disassembling or replacing the MR head, be sure to conduct adjustment.

### 1 . Equipment and tools required

- Single output rated voltage power supply: 1 unit With 5.0V and 100mA, applicable to the self-made tool
- Oscilloscope: 1 unit
- Self-made tool: 1 unit

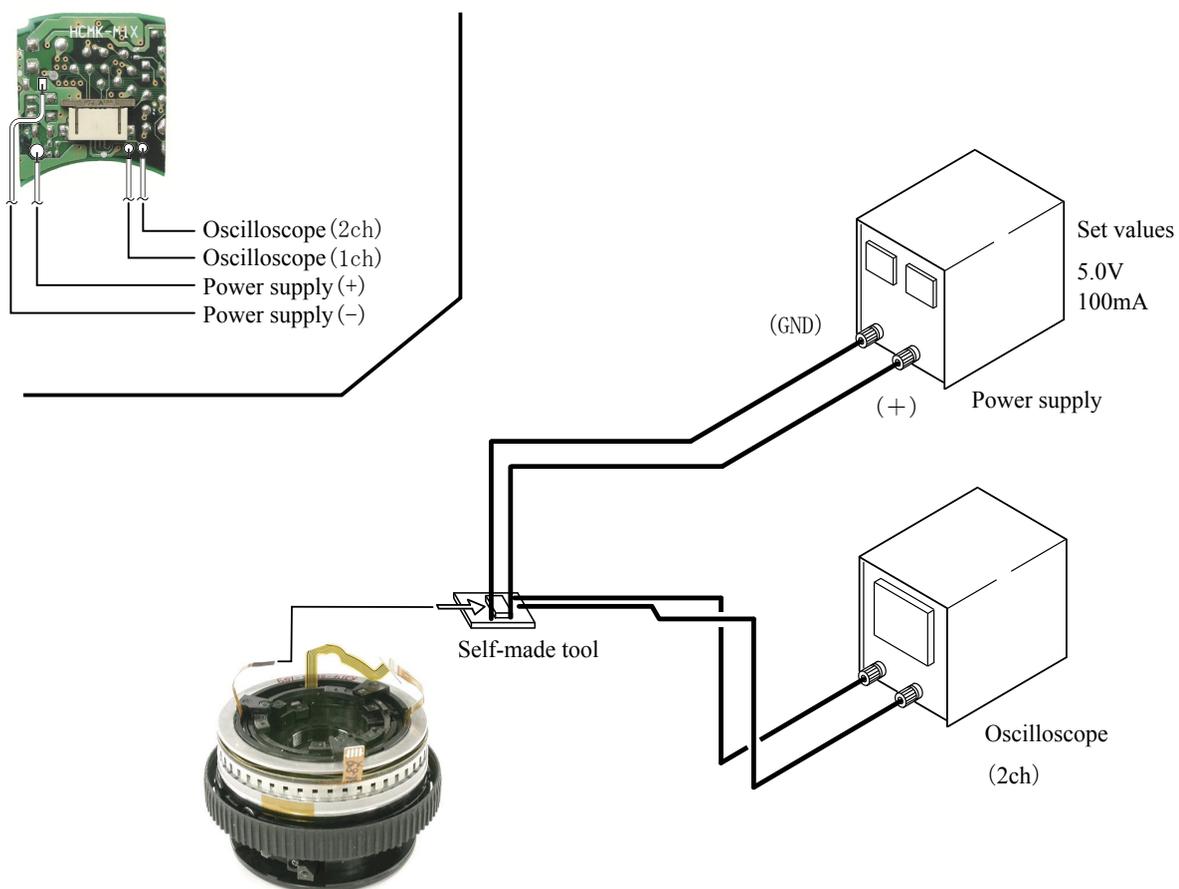
Note : In case of any trouble in continuity between the self-made tool and the contacts of relay FPC, there may be dust, corrosion or oxidation on the contact surface of relay FPC. Be sure to polish the contact surface prior to getting connected with the self-made tool.

### 2 . Preparation for measuring lens

- Assemble the SWM unit, on which the MR head is already attached, and the MF ring into the cam ring unit. Then, connect to the measuring devices. (Refer to the next page.)



• Connection diagram



• How to conduct inspection and adjustment

- ① Make sure that the current and voltage of the connected rated voltage power supply are set values.  
Then, turn on the power.

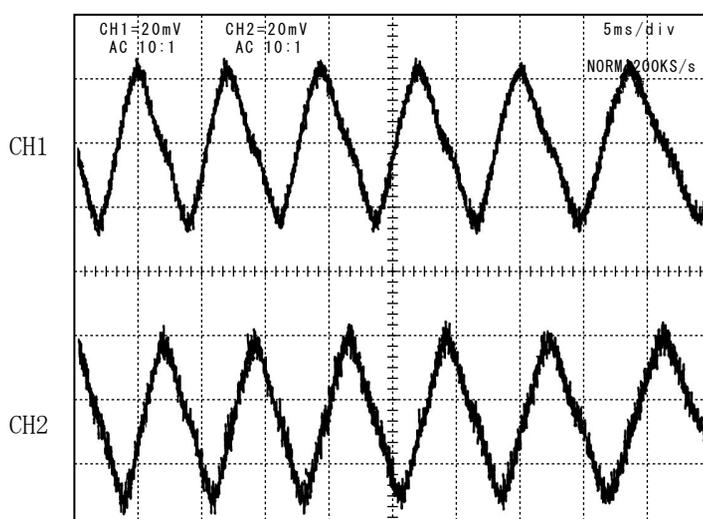
- ② Set the oscilloscope and turn the focus ring by hand.

Note : Because the shape of waveform varies according to the driving speed of focus ring, set Time/Div accordingly.

- ③ In case of detecting any wide waveform noise, use the filter function.

How to set the filter function by Yokogawa-manufactured DL1540

- 1 . Press the filter button.
- 2 . Select "Smooth" in the menu on the PC screen.



●Setting of oscilloscope

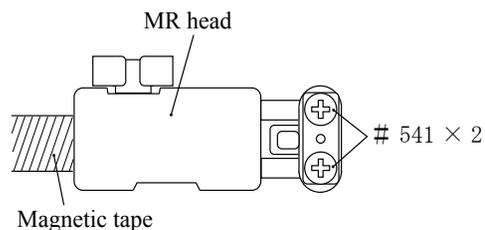
V/Div (CH1)	: 2 0 m V
V/Div (CH2)	: 2 0 m V
Coupling	: A C
Time/Div	: 5 m Sec
Trigger Mode	: NORMAL
Trigger Coupling	: A C
Trigger Source	: C H 1
Trigger Position	: + 4 div
Trigger Type	: EDGE
Trigger Level	: 0 V

Standard : The amplitude of every pulse/waveform should be 50mV or more.

Note : Check the waveform by letting the focus ring to travel from the infinity-end to the near distance end and vice versa.

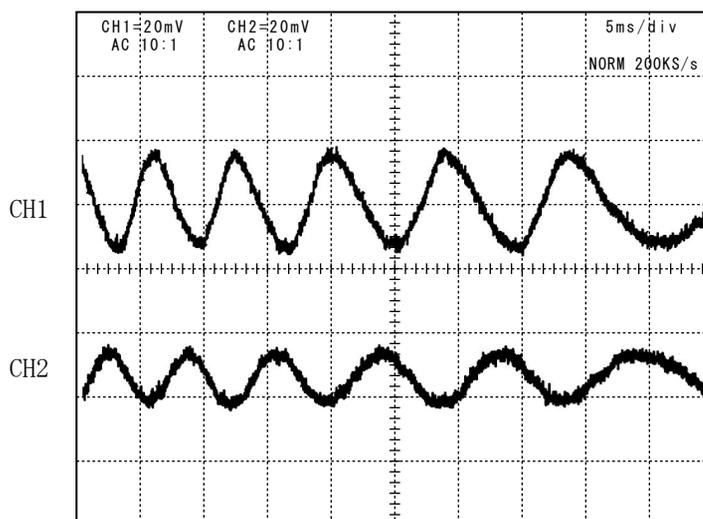
- ④ In the case of small amplitude, make an adjustment by loosen 2 screws #541 to shift the MR head position as shown right.

Note :  
During adjustment, prevent the magnetic tape and MR head from touching the magnetized driver bit, or the magnetic data may be damaged.

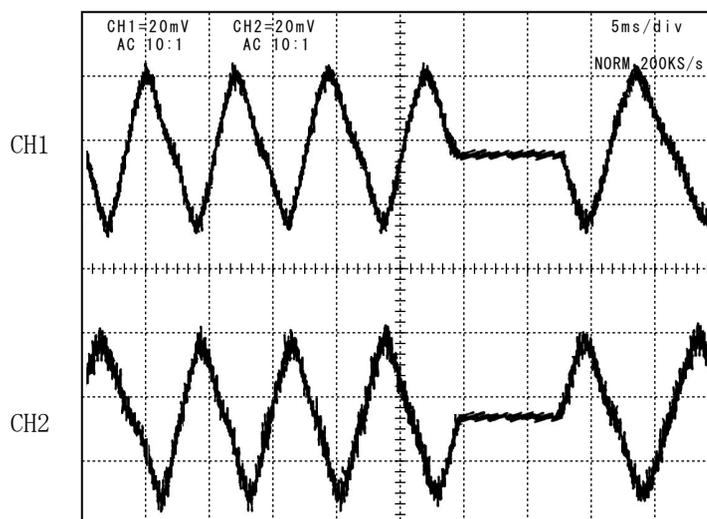


《Reference》

- In case the amplitude of either CH1 or CH2 is smaller, one of 2 screws #541 may be loosened, so check for it. But if this is not the case, the MR head is regarded as malfunctioning. Be sure to replace the MR head unit (B15) and adjust it again.



- In case there is a partial drop in the amplitude between the infinity and the near distance, the magnetic data of magnetic tape may be damaged. Then, replace the magnetic tape and adjust it again.



- ⑦ Turn off the rated voltage power supply and remove the SWM unit.

## ZOOM RING FIXING RING

Note : When mounting #22, do NOT allow it to touch the MR head. If external pressure is applied to the MR head, it causes misalignment and changes the accuracy.



- Adhere #67 to the zoom ring fixing ring (#22) and apply the oil barrier to the whole #67.

## INSTALLATION OF THE SWM UNIT

- ① Assemble the SWM unit with 3 screws (#93).





① Set the rear fixed ring (#29) with 3 screws (#96).

## 3rd LENS GROUP

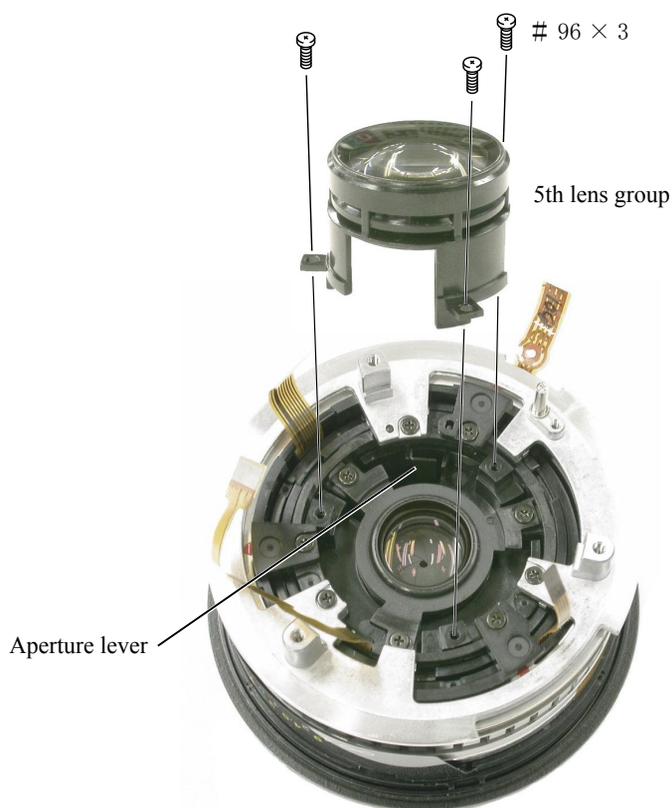


## 4th LENS GROUP



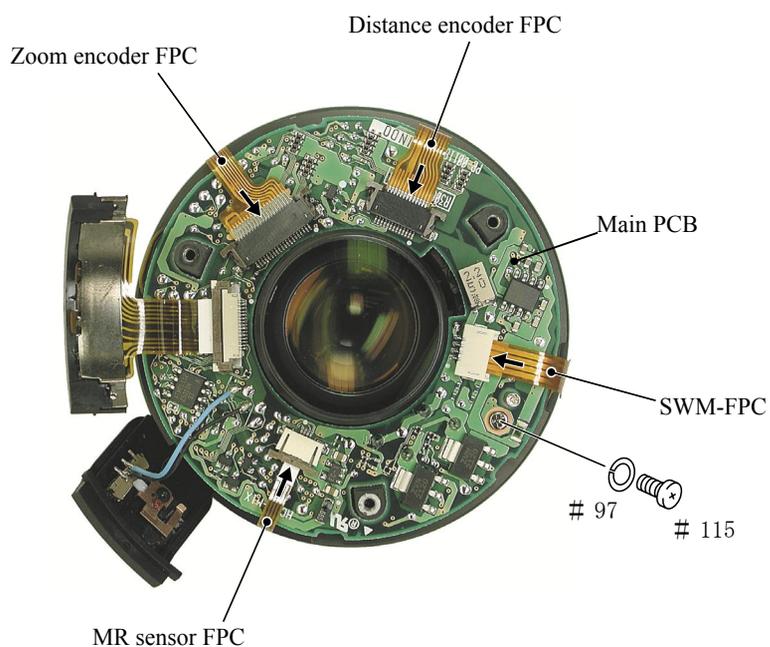
① Set the 4th lens group with 3 screws (#96).

## 5th LENS GROUP



① Set the 5th lens group with 3 screws (#96).

## MAIN PCB



- ① Assemble the main PCB, and fix it with the washer (#97) and the screw (#115).
- ② Connect each FPC as shown in the left to the connectors.

## INDEX RING, FOCUS RING



- ② Set the focus ring first then the index ring.

※ As shown in left, pass the M/A selector switch unit through the index ring.



- Slide the M/A selector switch in the arrow direction and assemble it into the index ring.

## BAYONET MOUNT

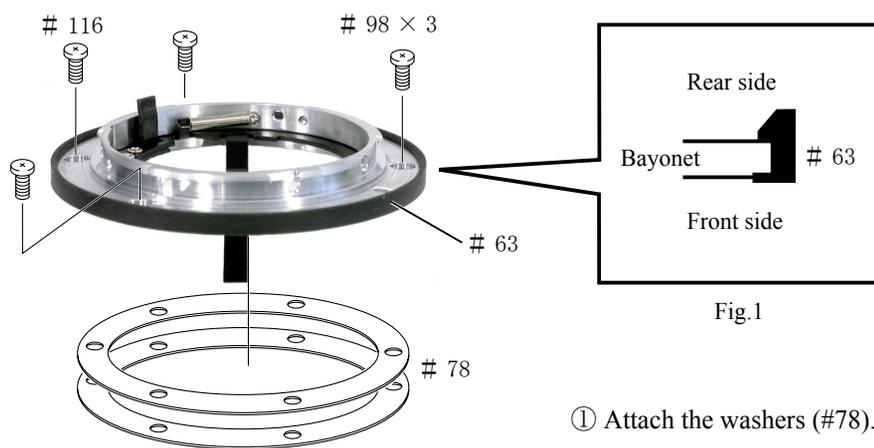


Fig.1

- ① Attach the washers (#78).
  - ② Set the bayonet mount with 3 screws (#98) and the screw (#116).
- Attach the rubber ring (#63) to the bayonet mount at the position as shown in Fig.1.



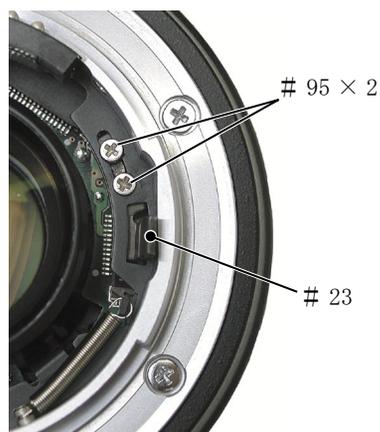
## ADJUSTMENT OF APERTURE DIAMETER



① Set the tool J18004-1 and check the aperture diameter.

Standard: Full aperture

② If it is out of the standard, adjust the position of the aperture lever (#23) by loosening 2 screws (#95).



## ZOOM RING



● Adhere #68 to B32 and apply the oil barrier to the whole #68.



- Apply I-40 to the 6 convex places on the outer circumference of #38.



- As shown left, rotate the zoom ring B32 to align the hole position of B32 with the zoom key position, then tighten the screw (#61).



# 61

Adhesive: Lock End B

## FILTER RING



Fig.1

① Adhere #65 to the filter ring (#25) and apply the oil barrier to the whole #65.

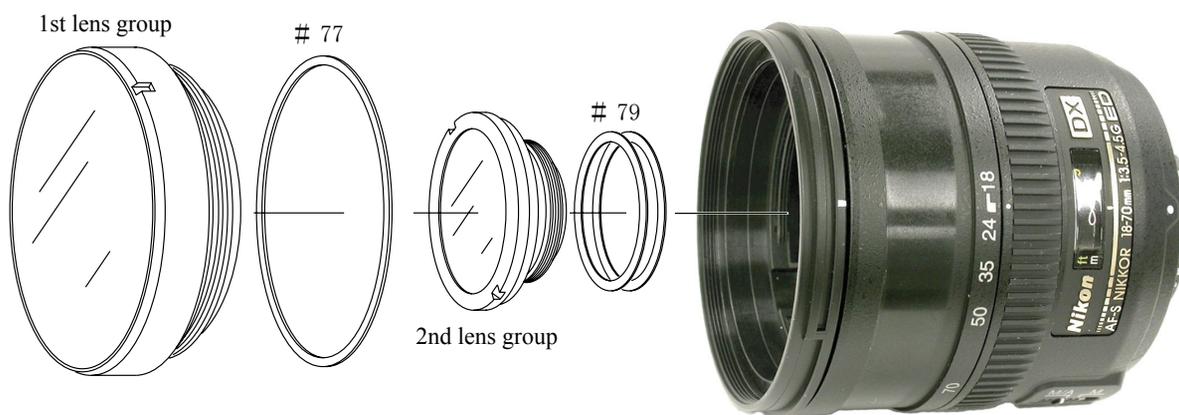
Apply MZ-800S to the 3 convex places on the outer circumference of the filter ring (#25).

② By aligning the index of the filter ring and the M/A selector switch, assemble the filter ring #25 into #38.



Fig.2

## 1st AND 2nd LENS GROUP



Note : 1st lens group washer (#77) is not for adjustment. Its dimension is fixed at 0.2mm.

Lens alignment
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**Note: This adjustment is required when the 4th and/or 5th lens groups is removed.**

(1) Preparation of Lens to be examined

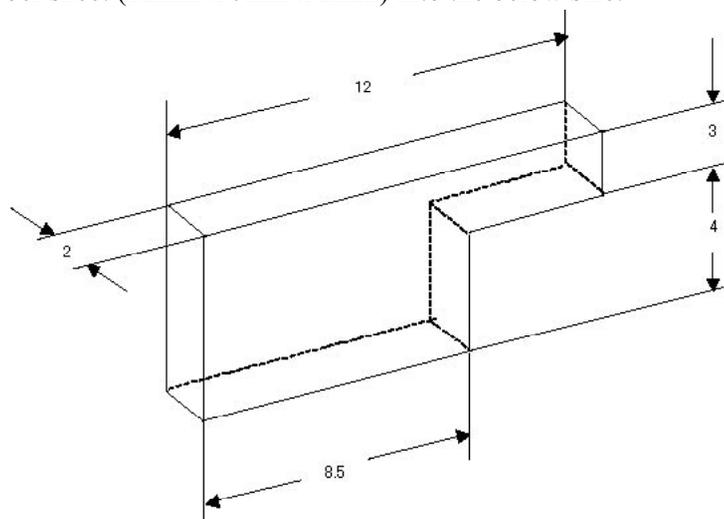
- Remove the main PCB on Page L24.
- Remove the aperture lever of the bayonet mount on Page L25.
- Create Aperture opening tool (Common with AF-S 24-85/3.5-4.5G).

Procedure

- ① Prepare one piece of rubber (12mm x 7mm x 2mm).

(Note) Choose relatively flexible material of rubber that can be easily cut, because it is used for putting in the clearance between the lens aperture lever and lens chamber.

- ② Cut the rubber sheet (12mm x 7mm x 2mm) into the below size.



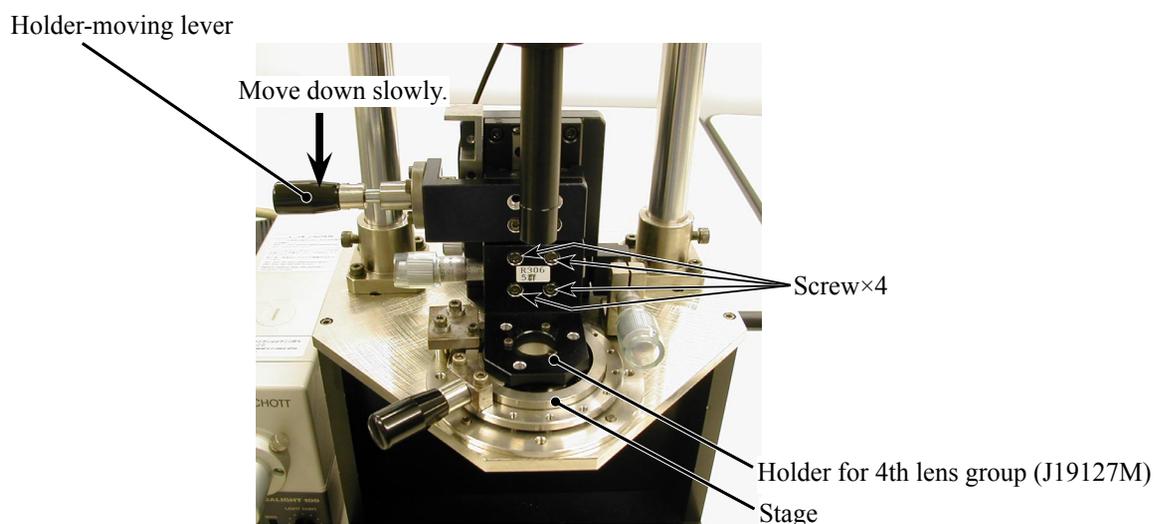
- By using the above created tool, set the lens to full aperture opening.



## (2) Preparation of Lens optical alignment equipment

- Fix the attachment holder for 4th lens group (J19127M) in the lens equipment for center alignment.

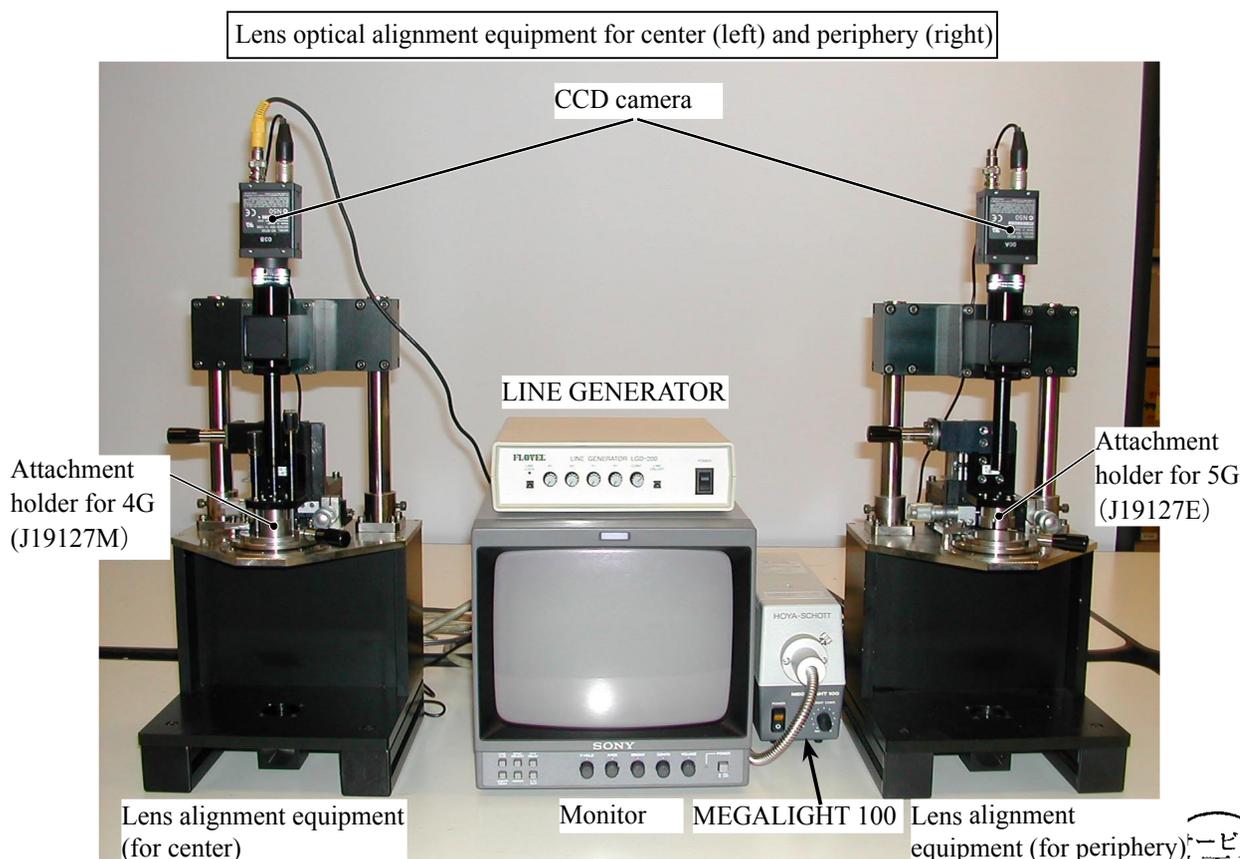
How to fix: Move down the holder-moving lever slowly so that the holder touches the stage. Then tighten 4 screws to fix it.



- Fix the attachment holder for 5th lens group (J19127E) in the lens equipment for periphery alignment.

How to fix: Same as the above 4th-lens-group holder.

- Create the center positioning tool (ref. Page28-17 for how to create it).
- Create cardboards in which "Lens alignment chart" and "Viewers" are fit. (ref. Page 28-19 for how to create them.)



Back view of Lens optical alignment equipment for center and periphery

- Connect each cable to the appropriate equipment with the same number. (e.g. Connect up ① to ①.)

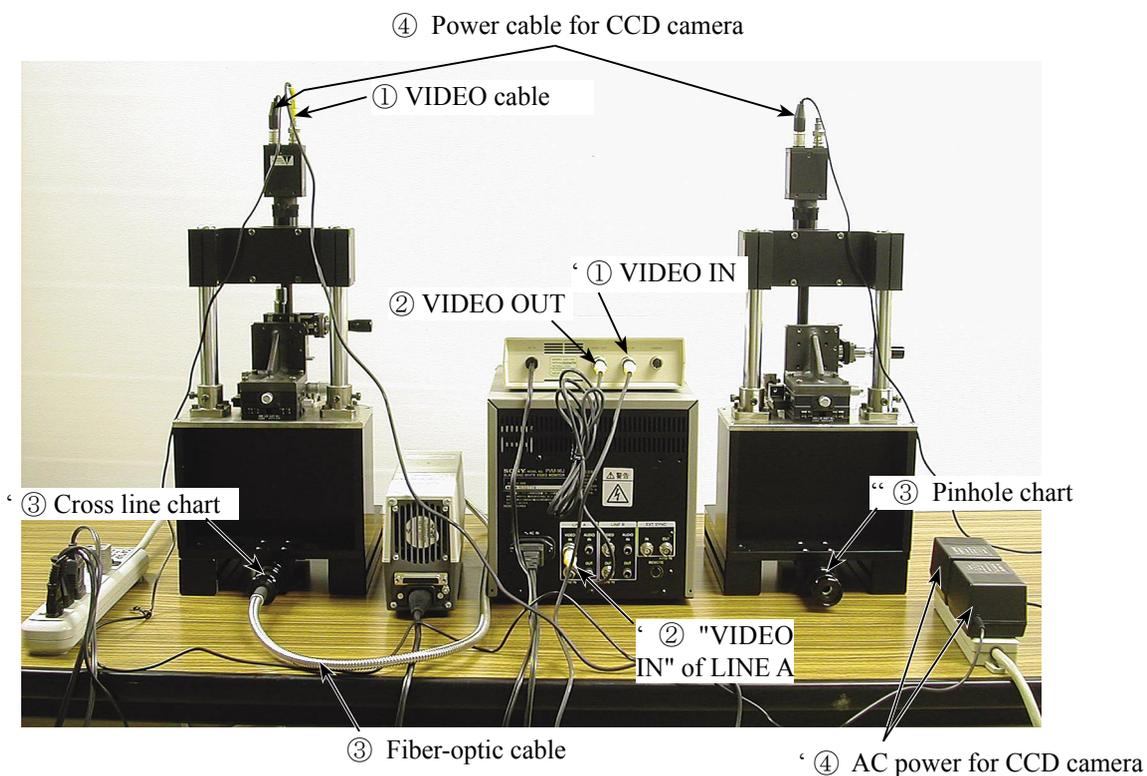
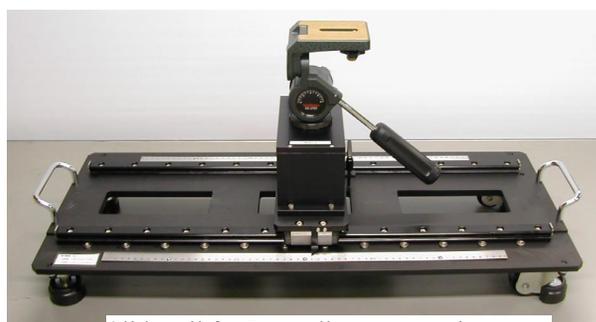
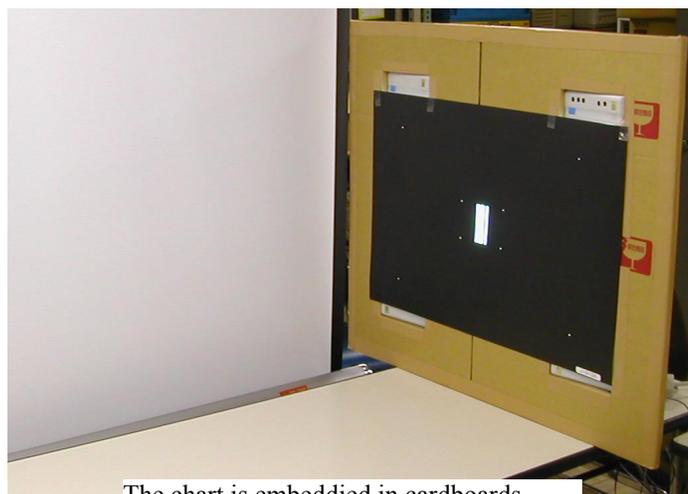


Chart shooting equipment for 5th lens group alignment



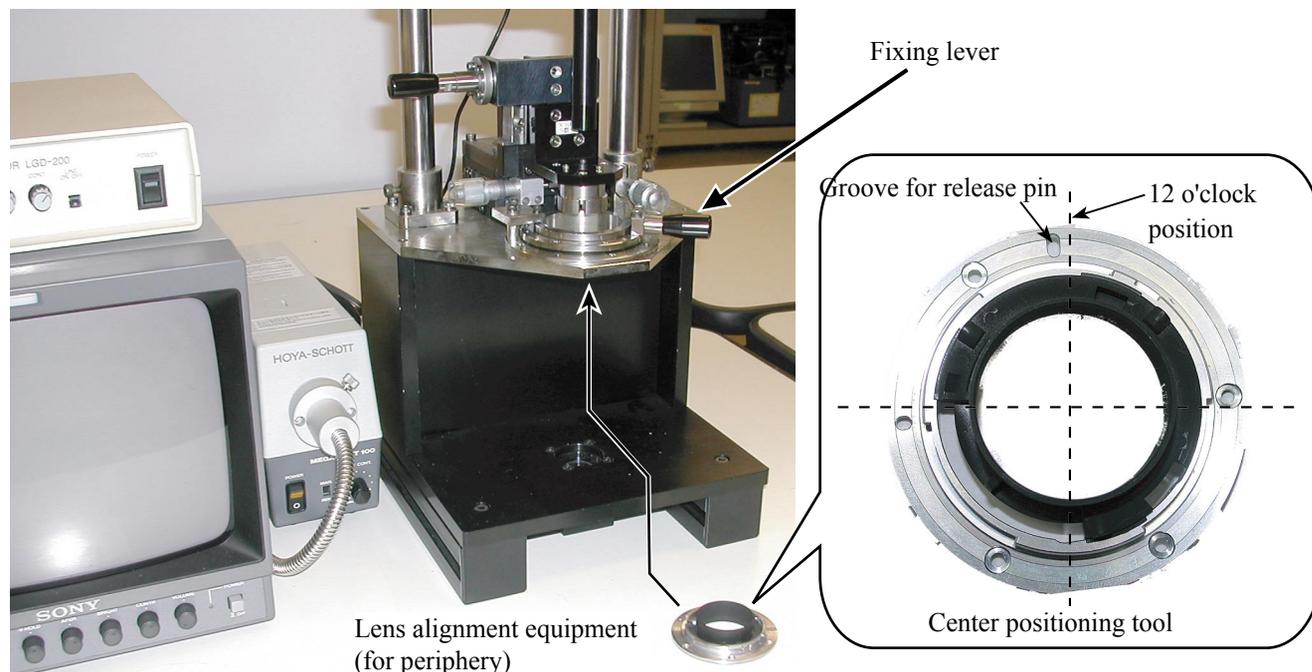
Slide rail for Lens alignment equipment



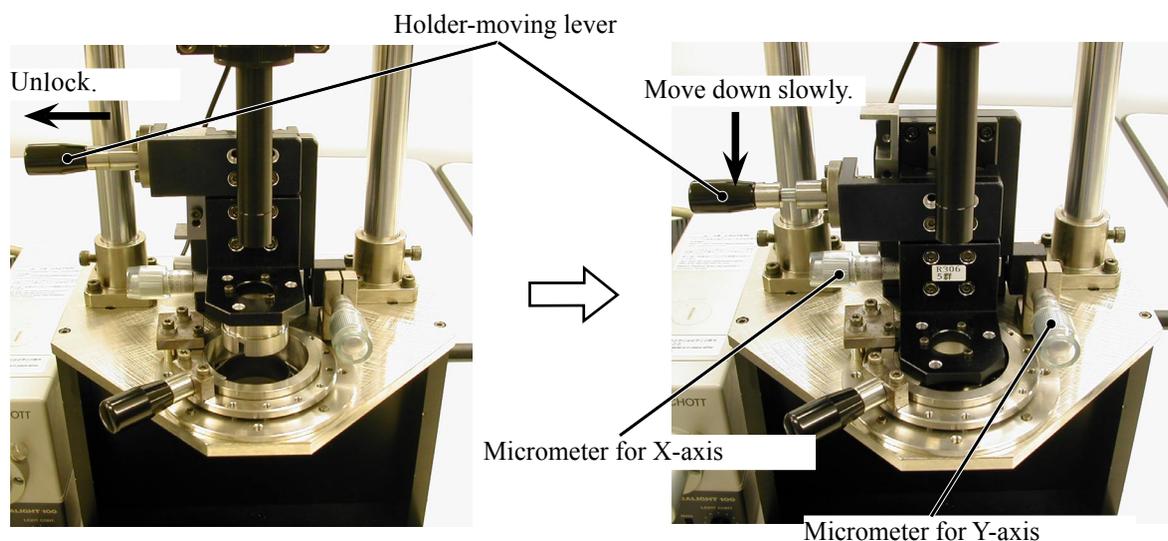
The chart is embedded in cardboards.

### (3) 5th lens group temporary alignment

- ① Mount the (self-made) center positioning tool on the lens alignment equipment (for periphery) with the groove positioned slightly toward the counterclockwise direction from the below 12 o'clock position. Then turn the tool clockwise all the way to the right, and move the Fixing-lever to the left to fix it.



- ② Unlock the the holder-moving lever, and move the holder down slowly by the lever.



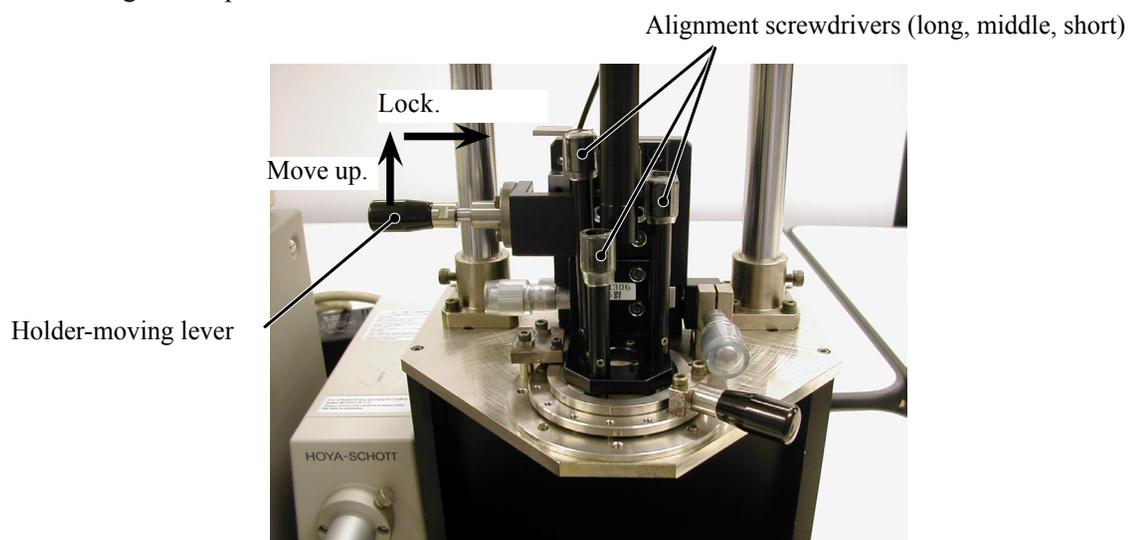
- ③ Adjust the holder's position by rotating the micrometers for X-axis or Y-axis so that the holder does not touch the protection ring of the center positioning tool.

**Note) Without this alignment, the 5th lens may be damaged by the holder.**

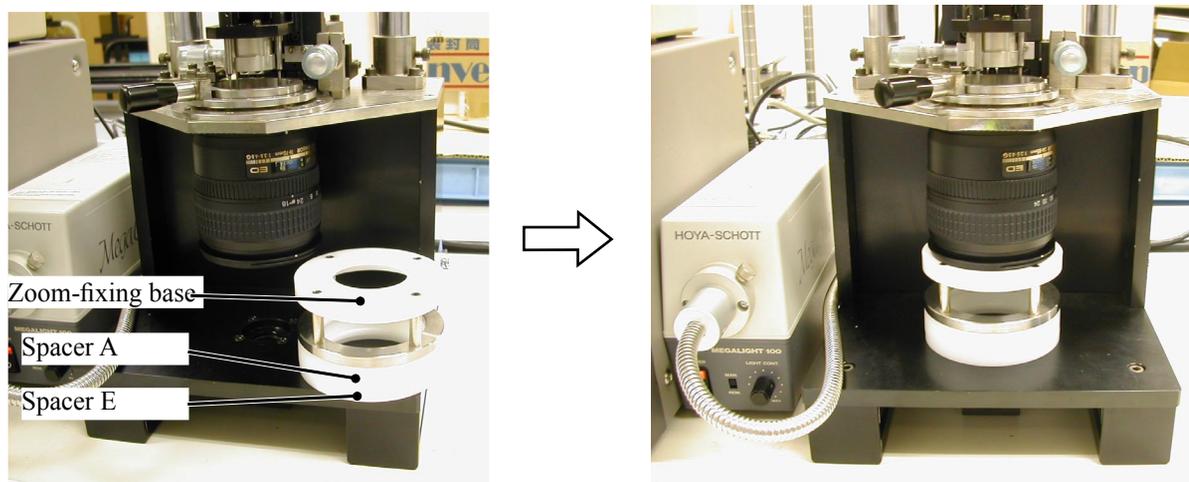
- ④ Move the fixing lever of the alignment equipment to the right, and remove the center positioning tool from the equipment.



- ⑤ Insert 3 alignment screwdrivers (long, middle, short) in the 5th lens group holder, and move the holder-moving lever up to lock the holder.

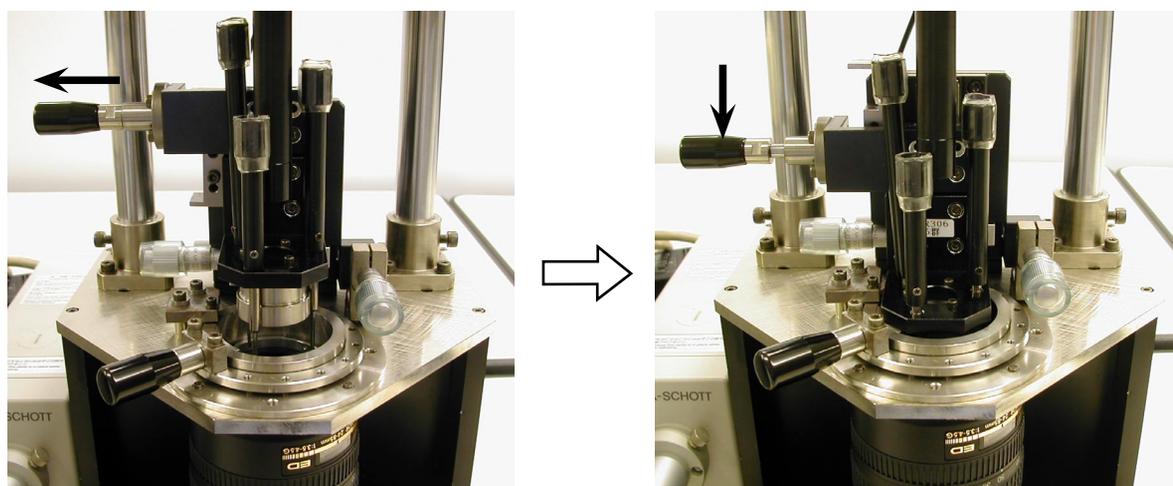


- ⑥ With the 3 screws of the 5th lens chamber being loose, mount the lens to be examined on the equipment (for periphery). (ref. ① for how to attach it.)
- ⑦ Set the lens to WIDE-end. Place the zoom-fixing base, spacer A, and spacer E in position, then turn the zoom ring until the lens touches the zoom fixing base.



- ⑧ Unlock the holder-moving lever, and move the holder down slowly by the lever. Insert 3 alignment screwdrivers (long, middle, short) in the loosened screw holes of the 5th lens chamber.

Note) Because the screws cannot be seen, when inserting the alignment screwdrivers, put them straight down in the screw holes so that the screws can be easily found.



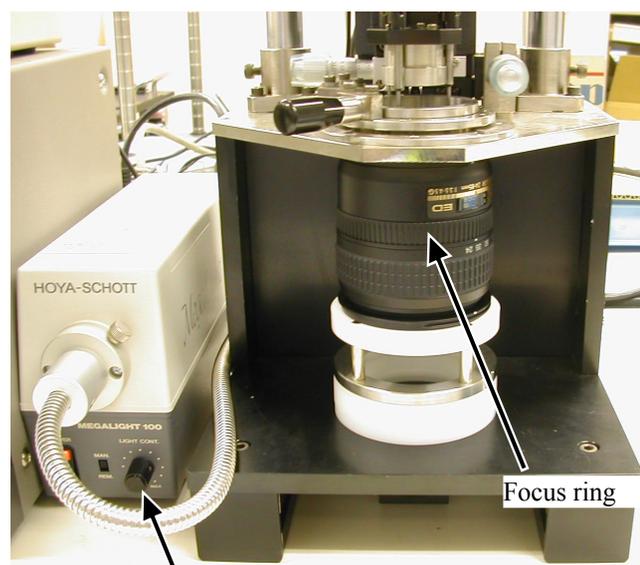
- ⑨ Turn the power of the Monitor, LINE GENERATOR, and MEGALIGHT 100 to ON. By checking the screen of the Monitor, rotate the micrometers (X and Y) so that the intersection point of the cross lines\*1 (calibrated) comes in the center of the Monitor.

\*1 Adjust the cross lines by turning the "LIGHT CONT." knob of "MEGALIGHT 100" and the focus ring until the calibration of the cross lines can be seen clearly.



Cross line

Note) In case the cross lines are tilted, adjust them by turning the chart, which is screwed in the rear tube of the equipment. (Just slight slackness of the chart poses no problems.)



LIGHT CONT. knob

Focus ring

- ⑩ When the intersection point of the cross lines comes in the center, tighten the 3 screws of the 5th lens chamber with the alignment screwdrivers.

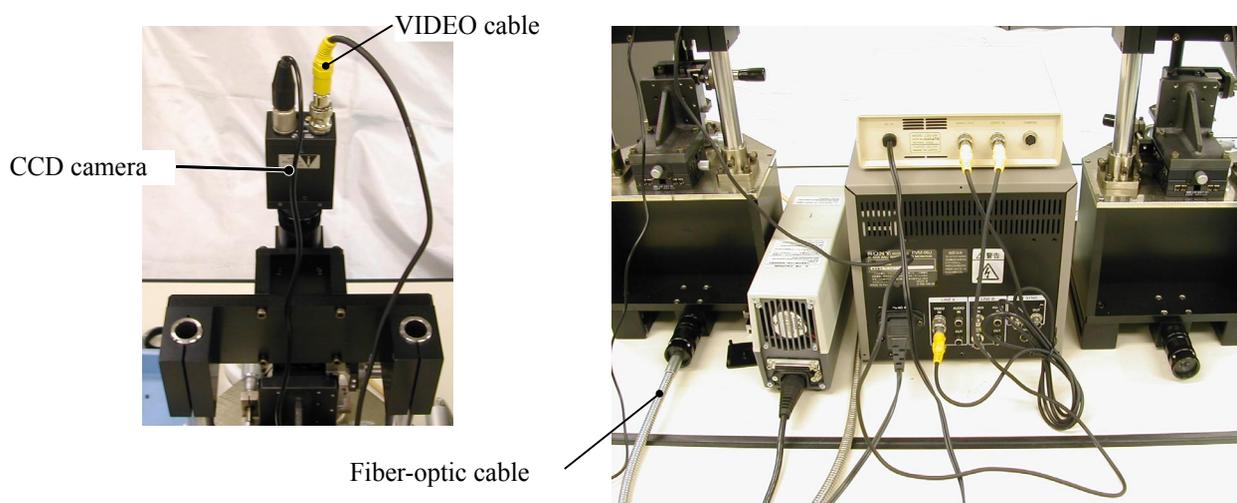
Note) When the holder is raised, the intersection point of the cross lines is misaligned. So make an adjustment by considering this.

- ⑪ Move the holder-moving lever up slowly to lock the holder, and remove the lens from the equipment (for peripheral)



## (4) 4th lens group alignment (Center alignment)

- ① Remove the alignment screwdrivers (long, middle, short) from the equipment (for periphery) and insert them into the equipment (for center). Then move the holder-moving lever up to lock the holder.
- ② Mount the lens on the equipment (for center) (ref. ① of (3) for how to fit in it.), and set the zoom ring to TELE-end (70-mm side).
- ③ Remove the both cable that connects the VIDEO terminal of the CCD camera and the fiber-optic cable that connects MEGALIGHT 100 from the equipment (for periphery), then connect them to the equipment (for center). Turn the "LIGHT CONT." knob of MEGALIGHT 100 to adjust brightness, and turn the focus ring to adjust the shape of the pinhole on the monitor. (ref. Pic.1 for the image of the pinhole.)



Pic.1

- ④ Check the pinhole shape on the monitor. In case of Fig.1-A, set the zoom ring by turning it to wide-side (35 mm and 24 mm) to confirm the shape. If it is also like Fig.1-A at wide-side, remove the lens from the equipment (for center) and go to “(5) Chart shooting for the 5th lens alignment”. In case of Fig.1-B or C, go to the next ⑤ .

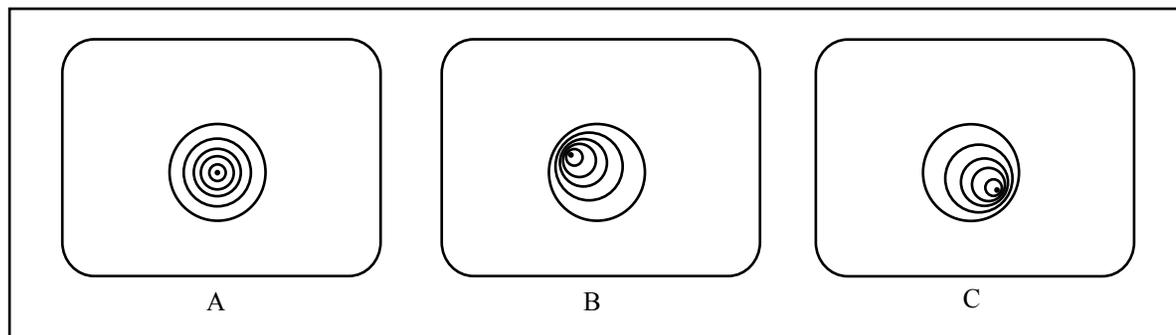
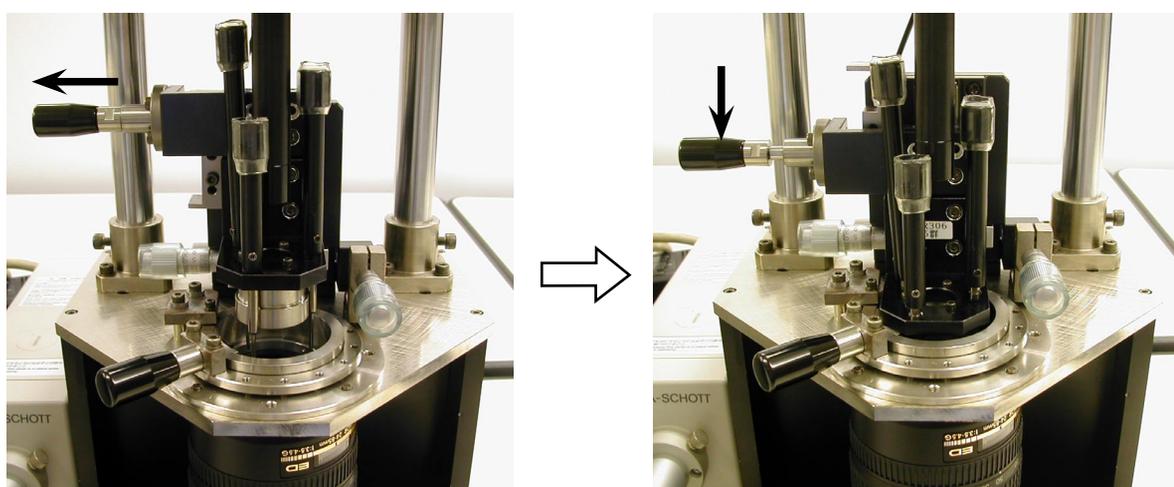
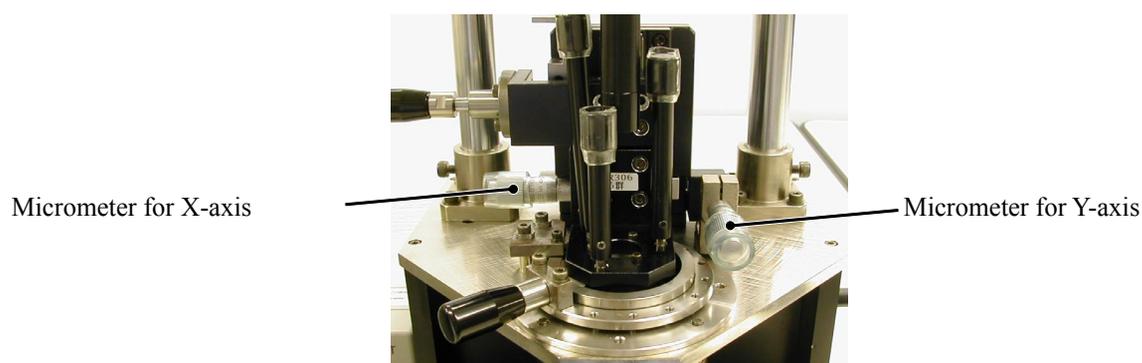


Fig.1

- ⑤ Unlock the holder-moving lever, and move the holder down slowly by the lever. Loosen the 3 screws of the 4th lens chamber with alignment screwdrivers (long, middle, short).



- ⑥ Adjust the micrometers (X and Y) by turning them so that the shape on the monitor becomes like Fig.1-A.  
 Note) When the holder is raised, the image on the monitor is changed in its shape. So make an adjustment by considering this change.

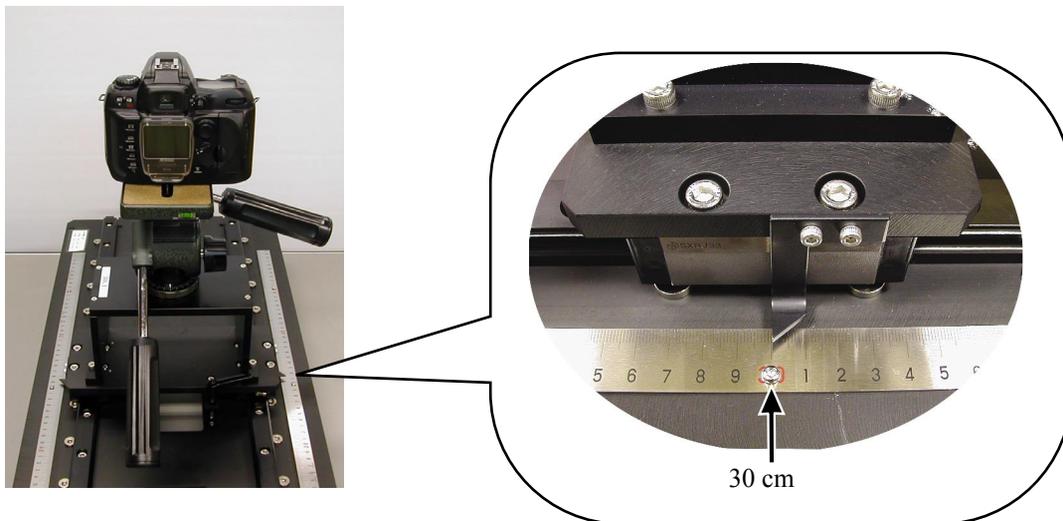


- ⑦ When the monitor image becomes like Fig.1-A, tighten the 3 screws of the 4th lens chamber. Move the holder-moving lever up slowly to lock the holder, and remove the lens from the equipment (for center).
- ⑧ Turn the power of the Monitor, LINE GENERATOR, and MEGALIGHT 100 to OFF. Remove the both fiber-optic cable and the VIDEO cable that connects the CCD camera from the equipment (for center) connect them to the equipment (for periphery).

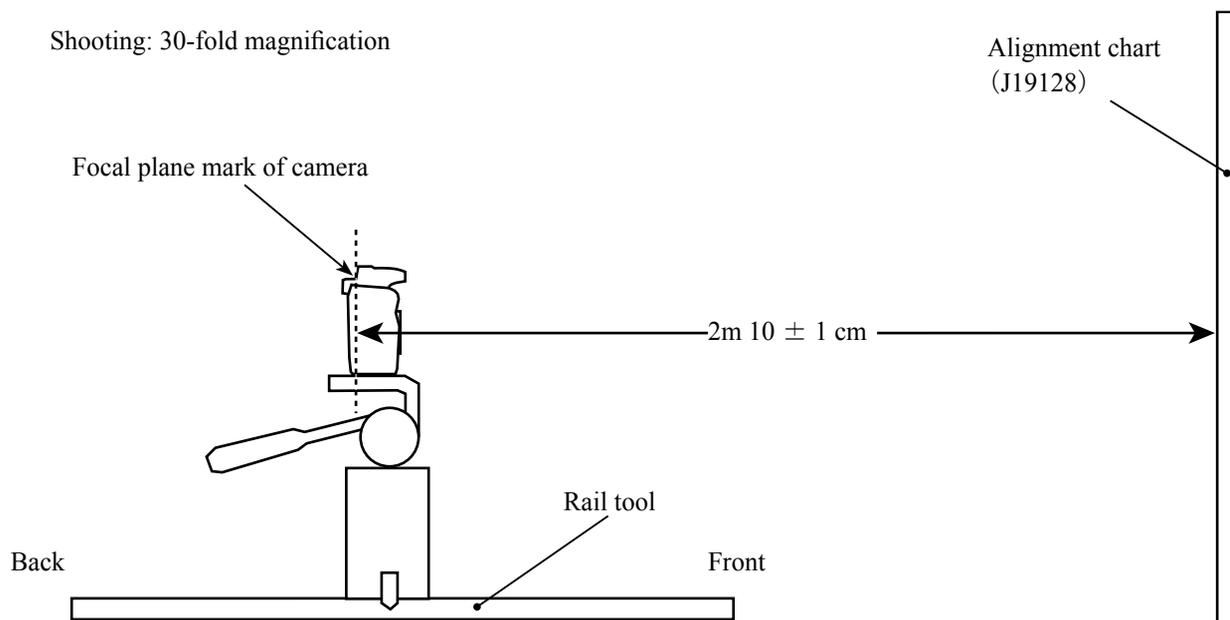


(5) Chart shooting for the 5th lens alignment

- ① Prepare a camera (D100). Set the shutter speed to “M1/80” and the focus mode to “M”. On the shooting menu, set the Image Quality mode to “RAW”, the WB to “Preset” and the ISO to “200”.
- ② Set up the camera (D100) on a tripod on the slide rail. Set the indication pointer of the tripod to 30 cm.



- ③ Set the alignment chart (J19128) as shown below.

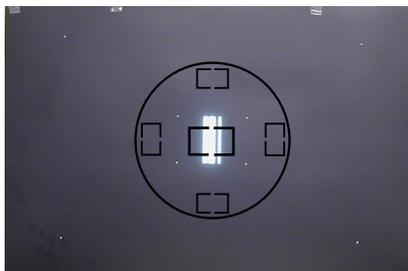


- ④ Turn the power of viewers (5 pcs.) to ON.

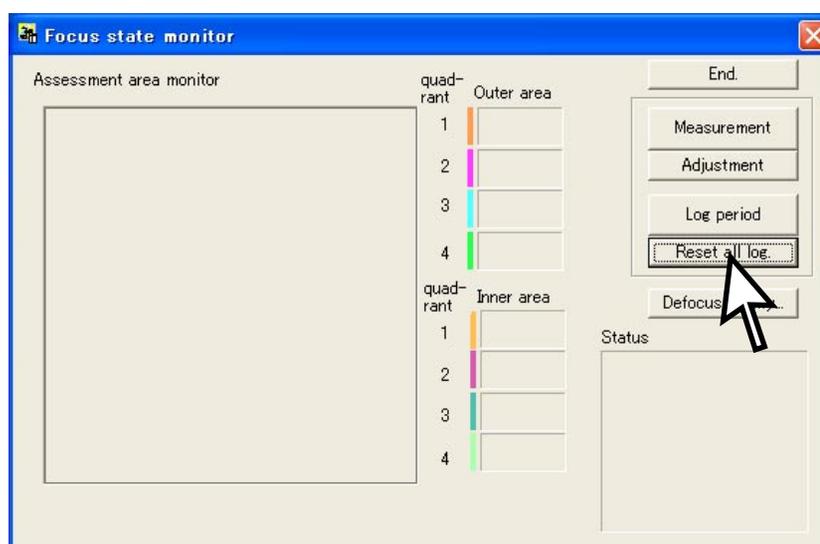
(Note: If the batteries of viewers are exhausted with decreased brightness, the shooting data cannot be obtained correctly.)



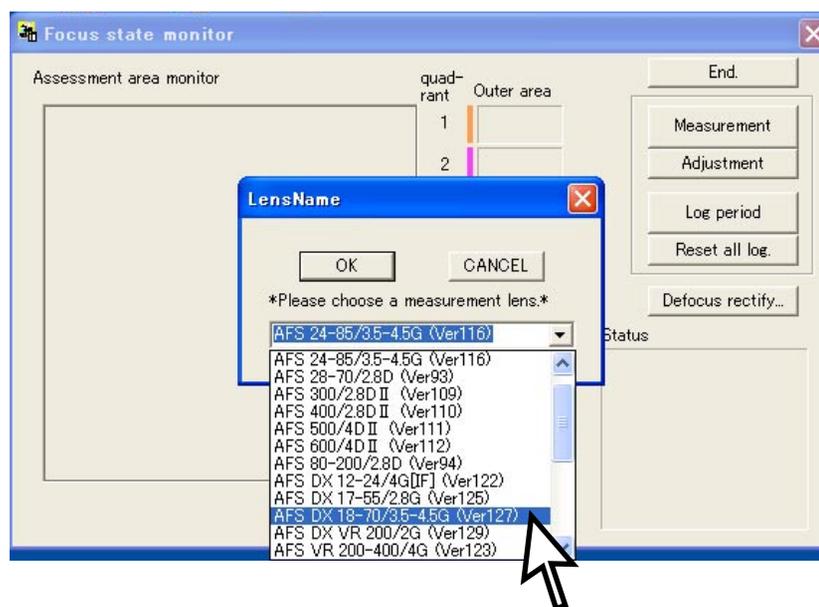
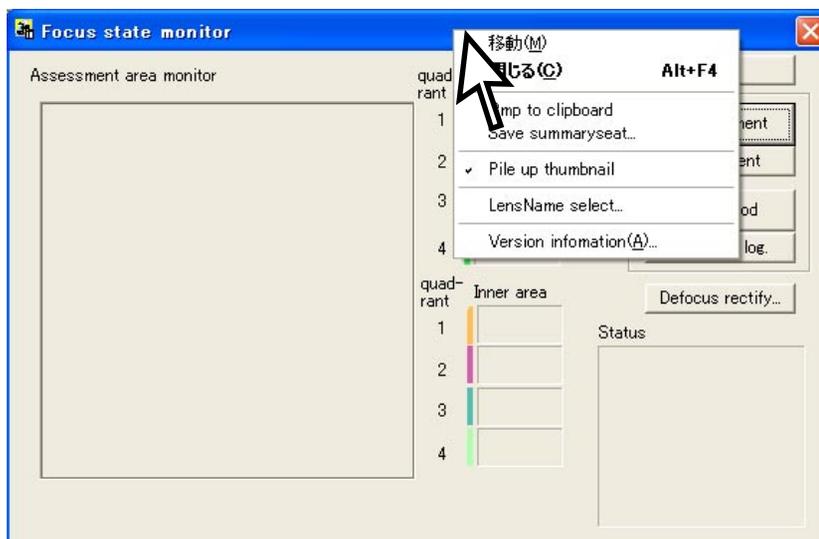
- ⑤ Fit the lens to be examined in the camera. Set the zoom to TELE (70mm).
- ⑥ By looking through the viewfinder, adjust the height and tilt to make the chart fill the entire finder field frame.
- ⑦ Adjust the tilt of the slide rail to make the 3 chart lines position in the center of the viewfinder, when the tripod is slid all the way to the front and back.



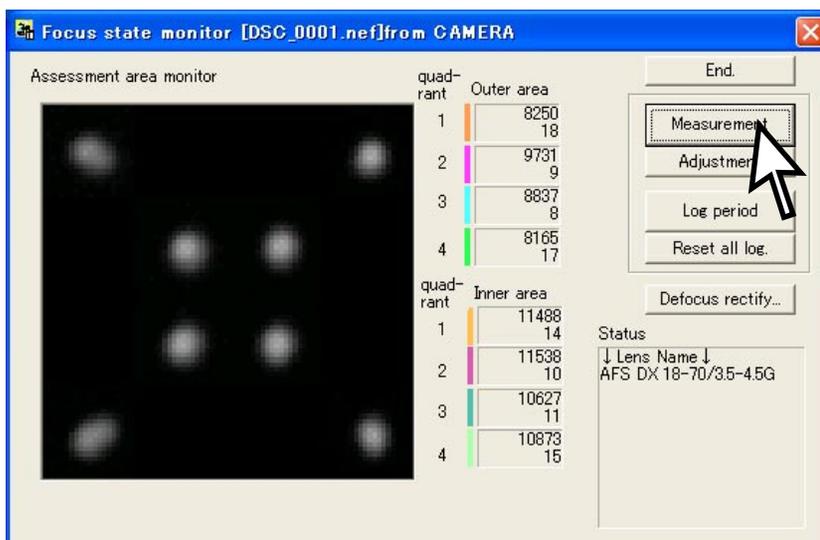
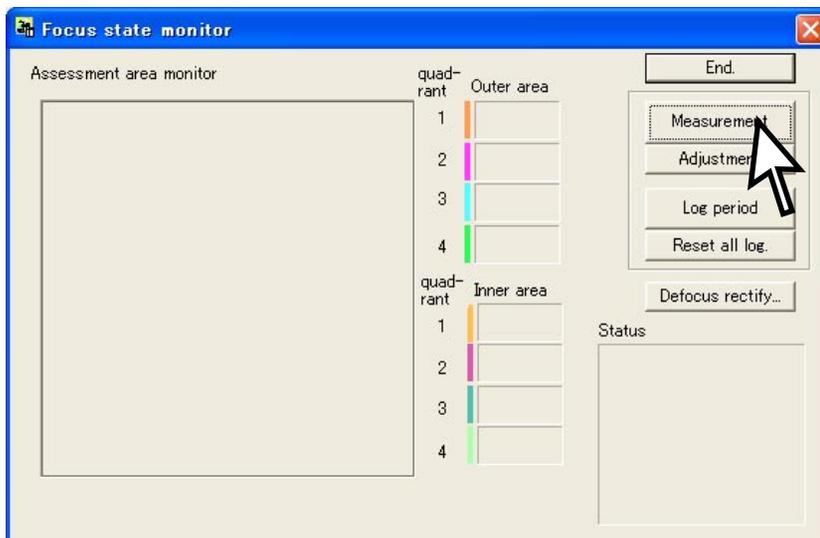
- ⑧ Back the tripod to the 30-cm position. Bring the 3 lines into focus with "Focus Aid" of the camera.
- ⑨ Connect the PC and camera via USB cable. (Camera setting: Mass Storage)
- ⑩ Start the adjustment software (LWM.exe).
- ⑪ Click the "Reset all log" button.



- ⑫ Point the cursor to the title bar of the window. Right-click on it and select "Lens Name select" to open the "Lens Name" window. Then select "AF-S DX18-70/3.5-4.5G" and click "OK".

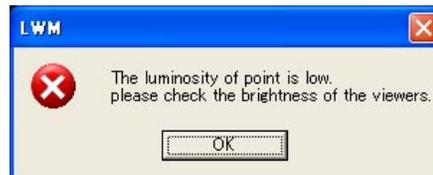


- ⑬ Slide the tripod to the front by  $18 \pm 0.1$  cm.
- ⑭ Click the "measurement" button of the adjustment software.



- ⑮ When the shutter of the camera is released, slide the tripod to the back by  $6 \pm 0.1$  cm and make a remeasurement.
- ⑯ Again, slide the tripod to the back by  $6 \pm 0.1$  cm and make a remeasurement.  
Repeat this operation 4 more times, totalling in 7 measurements. (The total sliding distance is 36 cm.)

**Note 1: When the below warning is given, there may be some defects in the brightness of the viewers and/or parallelism of the chart and camera, etc. So correct the above and make a remeasurement.**



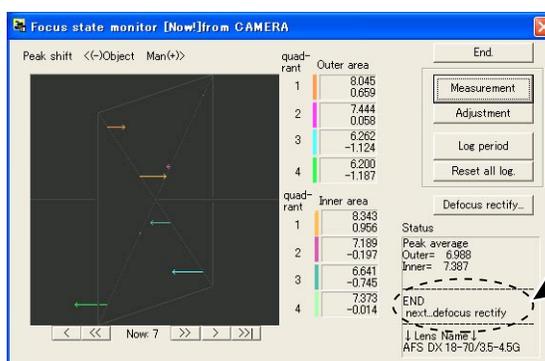
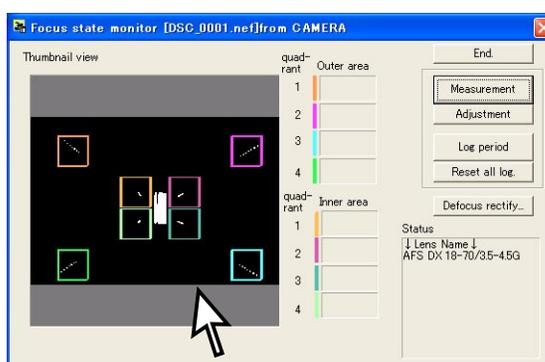
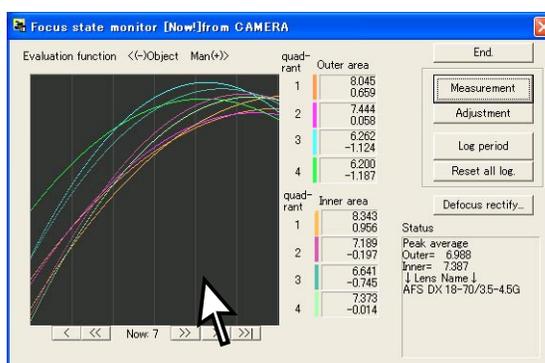
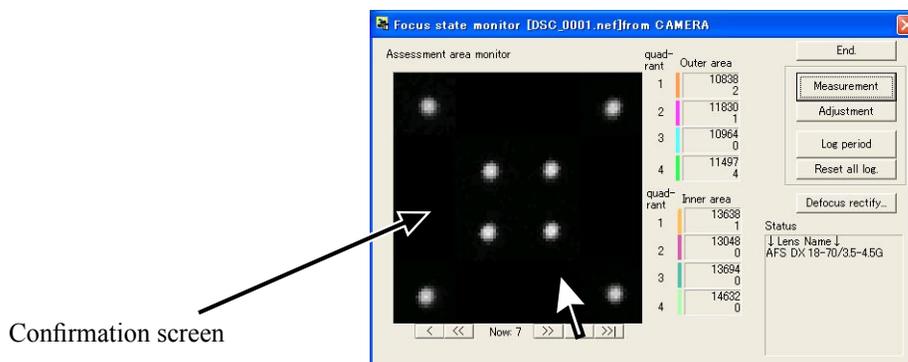
**Note 2: When the below warning is given, recheck that the Quality mode of the camera is set to RAW.**



**Note 3: When the below warning is given, recheck that the zoom ring of the lens is set to TELE-end.**



- ⑰ After the 7 measurements, point the cursor to the confirmation screen of the software. Click it 3 times, and if "END" is displayed on the Information, the lens optical alignment is completed. If "END" is NOT displayed (e.g. : X directions:+1, Y directions:-1), go to the next “(6) 5th lens group alignment (periphery alignment)”. In case “Please adjust optical axis” is indicated when "END" is NOT displayed, make readjustment starting from “(4) 4th lens group alignment (for center alignment).”



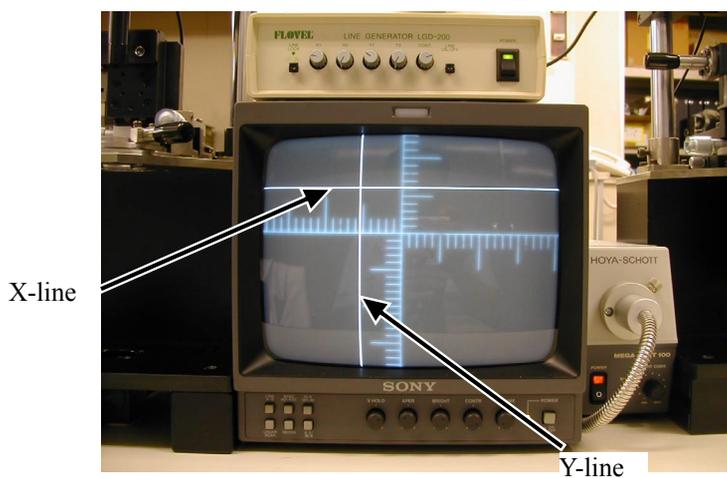
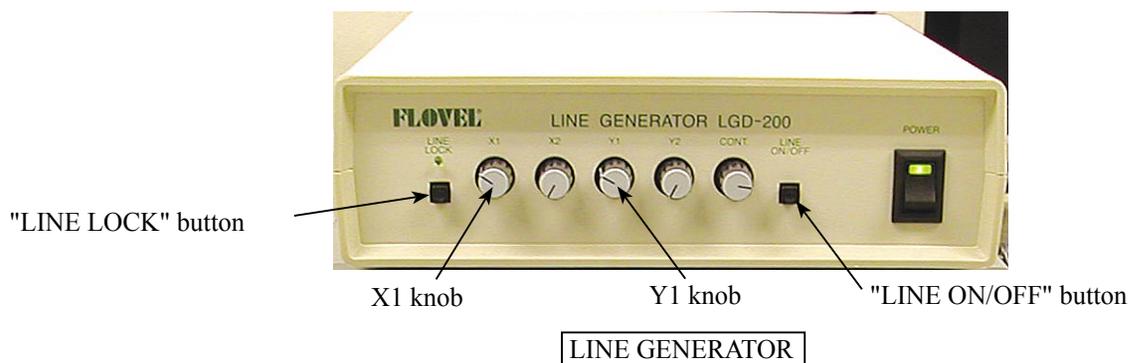
(6) 5th lens group alignment (periphery alignment)

① Mount the lens in the equipment (for center). (ref. ① of (3) for how to fit in it.)

② Turn the power of the monitor, LINE GENERATOR, and MEGALIGHT100 to ON.

③ Press the "LINE ON/OFF" button of LINE GENERATOR. Turn the knobs of "X1" and "Y1" so that X- and Y-lines are displayed on the monitor.

Superpose these X- and Y-lines on the cross lines of the CCD camera. Then press "LINE LOCK" button to fix these X- and Y-lines.



- ④ Unlock the holder-moving lever, and move the holder down slowly by the lever.
- ⑤ Insert the alignment screwdrivers (long, middle, short) into the screw holes of the 5th lens chamber, and loosen the 3 screws.
- ⑥ Rotate the micrometers (X and Y), and shift the cross lines by the scales that were results of the chart shooting of the 5th lens group alignment.  
(e.g. Refer to "Pic.2" for the case of <X directions:+1, Y directions:-1>)



Pic.2

- ⑦ Fix the 3 screws of the 5th lens chamber with the alignment screwdrivers. Move the holder-moving lever up to lock the holder.
- ⑧ Check that a shift length caused by the cross lines and the X/Y lines is equal to the scales (1 = 1 scale of the calibrated cross lines) of the results of "Chart shooting of the 5th lens group alignment". (ref. Pic.2)  
Note: After fixing the 3 screws of the 5th lens chamber, if a shift length is different from the results of the chart shooting, repeat the procedure from ④ to ⑧ until they become equal.
- ⑨ Turn each power of the monitor, LINE GENERATOR, and MEGALIGHT 100 to OFF. Remove the lens from the equipment (for periphery).  
Then go back to "(5) Chart shooting of the 5th lens group alignment" and repeat the procedure (5) and (6) until the result becomes "END".

## How to create positioning tool of 5<sup>th</sup>-lens-group holder for lens alignment (Common with AF-S ED 24-85/3.5-4.5G)

### 1: Summary

1-1: This is a positioning tool of the 5<sup>th</sup> lens group holder for lens alignment, in order to secure the position for attaching the 5<sup>th</sup> lens group temporarily.

### 2: Preparation

2-1: The following is used:

- \* Rear cover ring (1K631-287) X 1 pc.
- \* Bayonet mount (1K404-157 or 1K404-168) X 1 pc.
- \* Mount rotation stopper screw (1K120-012) X 1 pc.

### 3. Procedure

3-1: Put the bayonet mount as shown in Fig. 1.

Put with the groove, in which the lock pin of camera body enters, just upward.



Fig. 1

3-2: Mount the reversed rear cover ring on the position of Fig. 1, and attach them as shown in Fig. 2.



Put with the groove, in which the lock pin of camera body enters, just upward.

Large notch of rear cover ring.

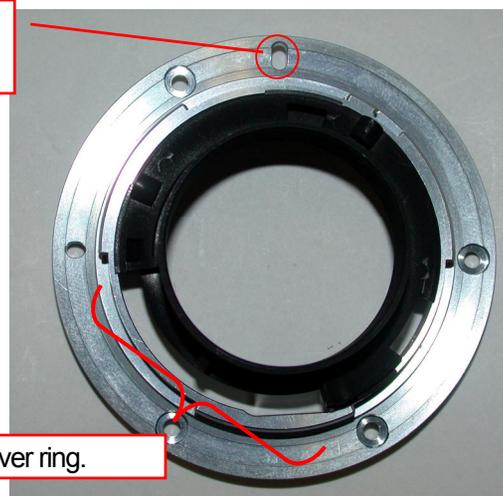


Fig. 2

3-3: Turn the rear cover ring clockwise, which was attached to the bayonet mount. Then stop at the position as shown in Fig.3-1.

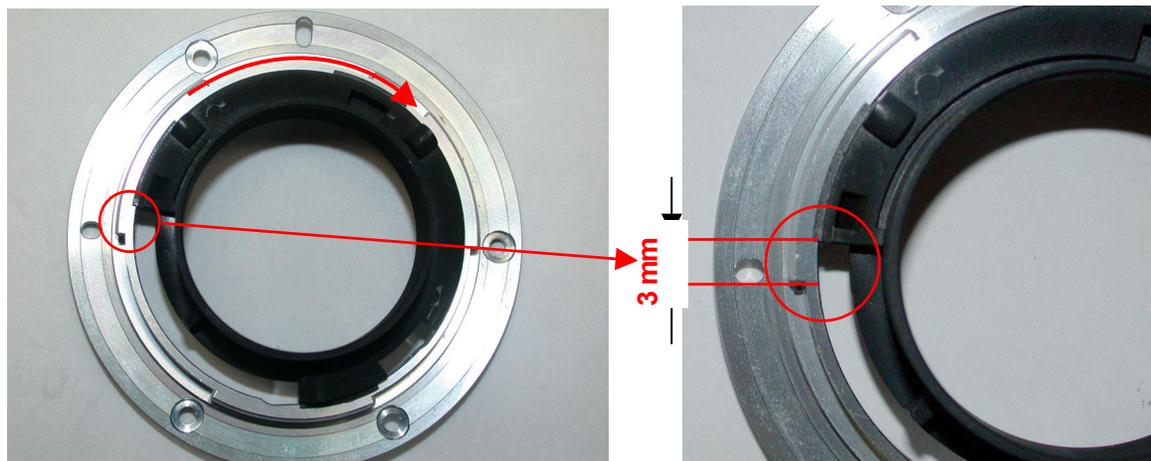


Fig. 3

Fig. 3-1

3-4: Fix the following 3 locations of the rear cover ring with the instant glue.

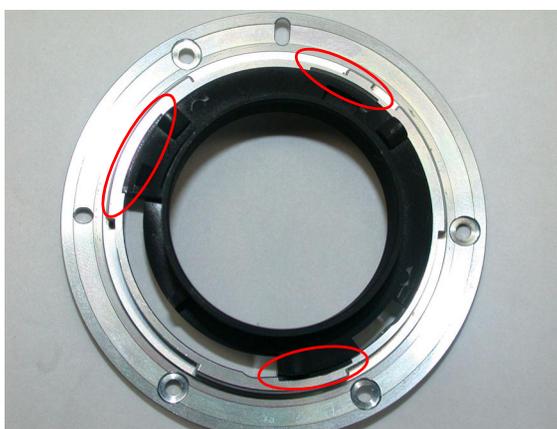
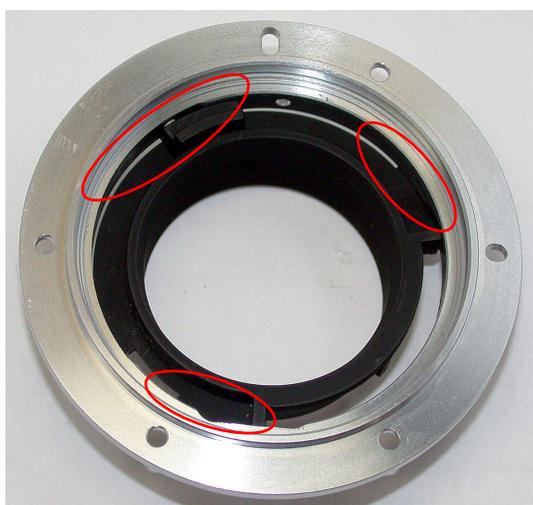


Fig. 4

3-5: Turn the bayonet mount over. Reinforce the following 3 locations with the adhesive to attach the bayonet mount and rear cover ring firmly.



3-6: Attach the mount rotation stopper screw at the appropriate position.  
 (Note) Refer to Lens Repair Manual for how to handle this tool.



## [ How to create Setting board of "Lens alignment chart" and "Viewer" ]

### 1. Summary

1-1: In order to get necessary data for lens alignment, this board is created to use for setting a special chart and light viewers (for chart illumination), while taking pictures of the special chart with a digital camera.

### 2. Preparation

2-1: Prepare a board (760 x 880 x 20 mm) or 2 package cardboard boxes (size 2.33).

(Note) Because you have to cut out the shape to embed light viewers, choose package cardboard boxes (size 2.33) or material which can be easily cut. - ref. Fig. 1

### 3. Procedure (In this document, 2 package cardboards are used)

3-1: As for the 1st flattened cardboard box (size 2.33), check the positions for embedding the light viewers, and cut out the shape at 5 locations (shaded parts/size 154 x 245 mm) as shown below. - ref. Fig. 2

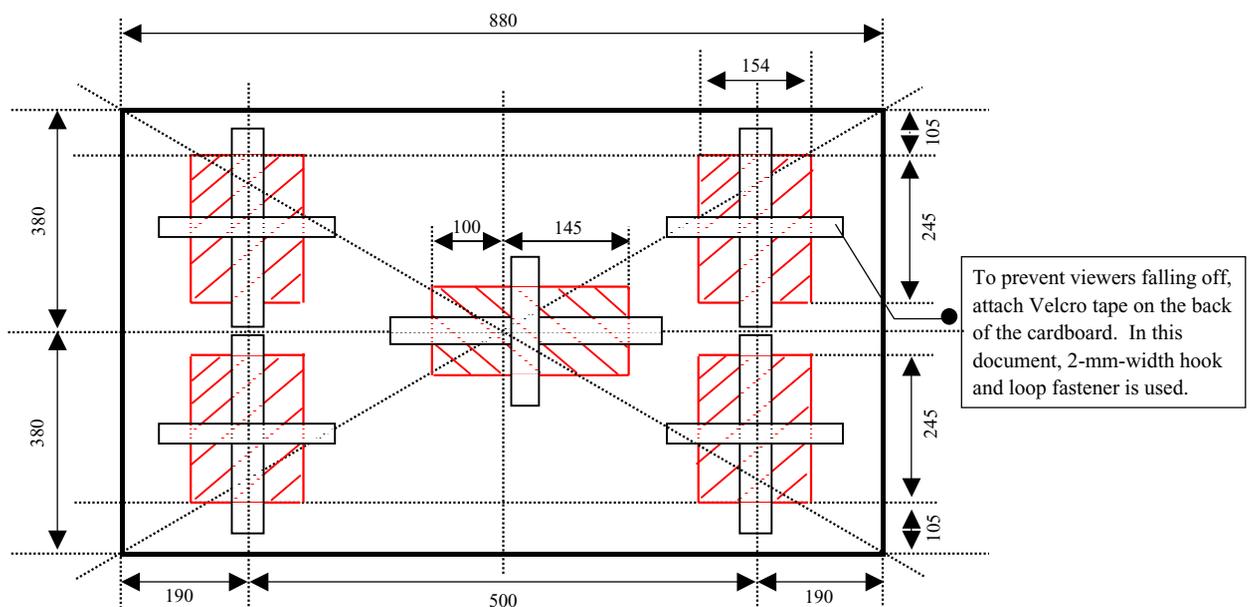
(Note) Cutting the shape slightly smaller than the light viewers.

3-2: Put the 2nd flattened cardboard box (size 2.33) and the above cut-out 1st cardboard together as one, and fix them by taping at 4 sides. - ref. Fig. 3

3-3: Then as for the 2nd flattened cardboard box, cut out the shape again by matching the cut-out size of 3-1 for each viewer. - ref. Fig. 4

3-4: Reinforce the edges of cut-out parts with tape.

(Note) To prevent viewers falling off, secure them with tape around the edges. - ref. Fig. 5



### 4. Prevent Viewers from falling off (In this document, 2-mm width Velcro tape is used.)

4-1: As shown above, when viewers are embedded, secure them with square pieces of Velcro tape (hook and loop fastener) on the back of the cardboard to prevent viewers falling off.



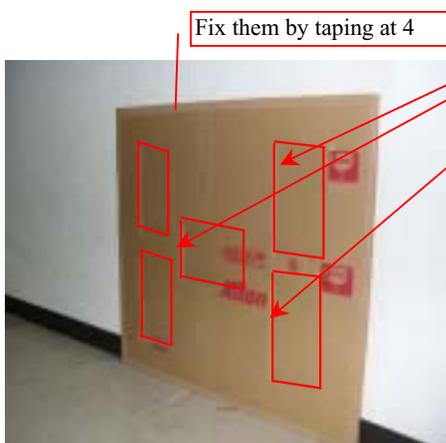
(Fig. 1 - Prepare 2 package cardboard boxes, and flatten them as below.)



(Fig. 2 - As for the 1st flattened cardboard box, cut out the <154 x 245 mm sized> shape at 5 locations.)



(Fig. 3 - Package cardboard boxes)  
Put the 2nd flattened cardboard box and the 1st cut-out cardboard together as one as shown below.



(Fig. 4 - As for the 2nd flattened cardboard box, cut out the shape in the same way as Fig.2. All cardboards are cut out as below.)



(Fig. 5- Light viewers are embedded.)



To prevent viewers falling off, secure the viewers with tape around

(Fig. 6 - Cart is attached.)



ADJUSTMENT (DIVISION) OF FOCUS MOVEMENT (T, W)
--

1. Align the infinity ( $\infty$ ) mark of the focus ring with the index.
2. Fix the aperture lever so that the aperture becomes "full".
3. Read the values of the Wide and Tele sides.
4. Carry out the following calculations.

$$A - B = C$$

A = Value of Tele side

B = Value of Wide side

C = Adjustment amount (mm) of the 2nd lens group unit washer (#79)

5. Adjust the thickness of the washer (#79) by the value of C calculated in the above. If C is positive, increase the washers to thicken. If it is negative, decrease the washers to thin. (Refer to P. L28.)

Note : When putting the washers (#79), put a thin washer between thick washers.

ADJUSTMENT OF BACK FOCUS
--------------------------

1. Align the infinity ( $\infty$ ) mark of the focus ring with the index.
2. Fix the aperture lever so that the aperture becomes "full".
3. Read the value of Wide or Tele side.
4. Remove the bayonet mount.
5. Adjust the thickness of the washer (#78) by the difference from the standard value. If the difference value is positive, increase the washers to thicken. If it is negative, decrease the washers to thin. (Refer to P. L25.)

Focal length (f)	Standard (mm)
1 8 m m	- 0 . 0 1 ~ + 0 . 0 5
3 5 m m	- 0 . 0 4 ~ + 0 . 1 5
5 0 m m	- 0 . 0 8 ~ + 0 . 2 5
7 0 m m	- 0 . 1 4 ~ + 0 . 2 0

PREPARATION FOR INSPECTION AND ADJUSTMENT OF MAIN PCB
---

● In case of replacing the main PCB, SWM unit or MR encoder unit, be sure to adjust the followings:

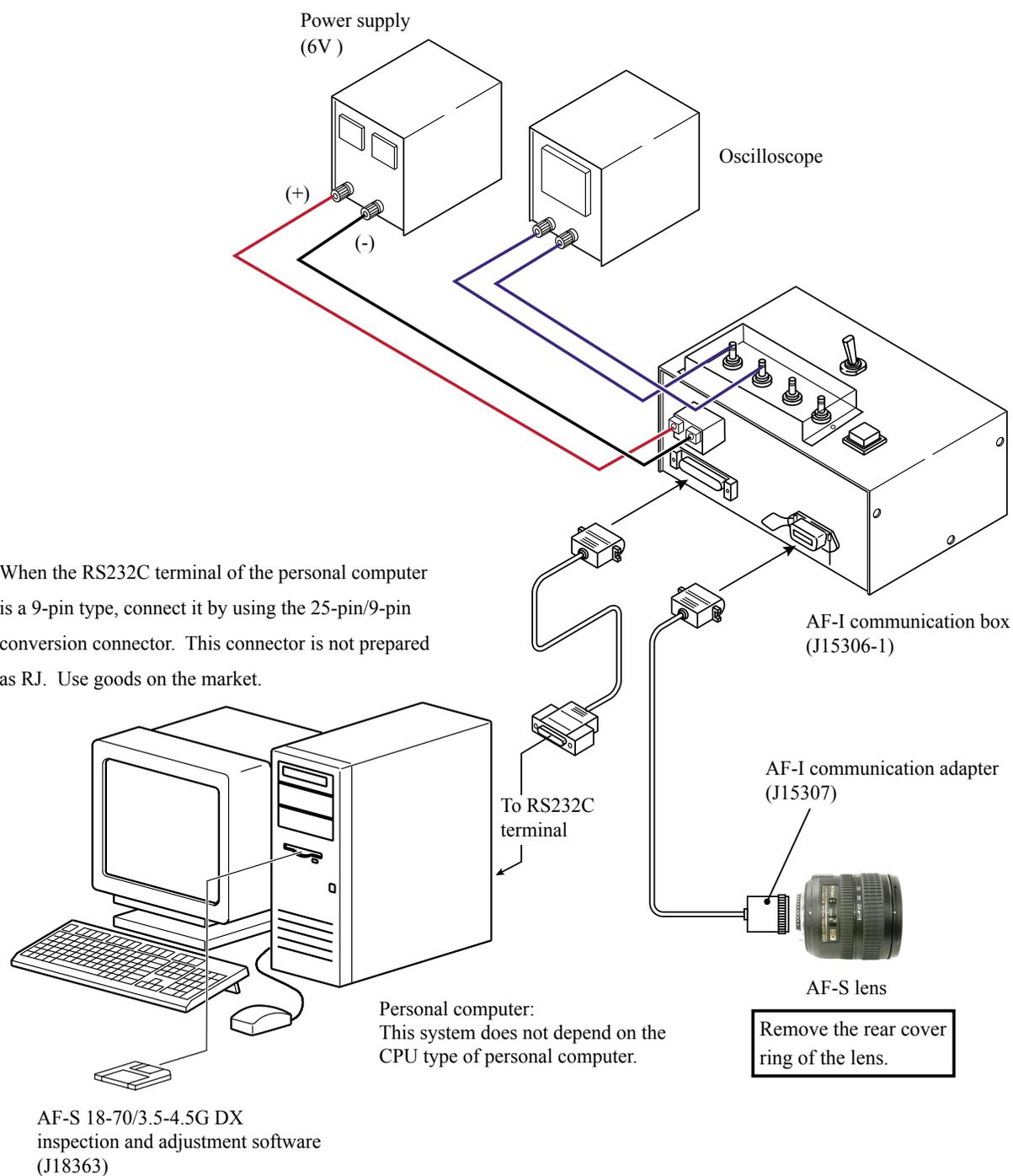
1. Adjustments

- Adjustment of MR duty
- Adjustment of driving frequency and motor control

2. Equipment and tools required

- Single output rated voltage power supply: 1 unit 6.0V 3.0A
- Oscilloscope: 1 unit for adjusting the MR duty/adjusting the driving frequency and motor control
- AF-I communication box (J15306 or J15306-1): 1 unit
- AF-I communication adapter (J15307): 1 unit

**【System configuration】**

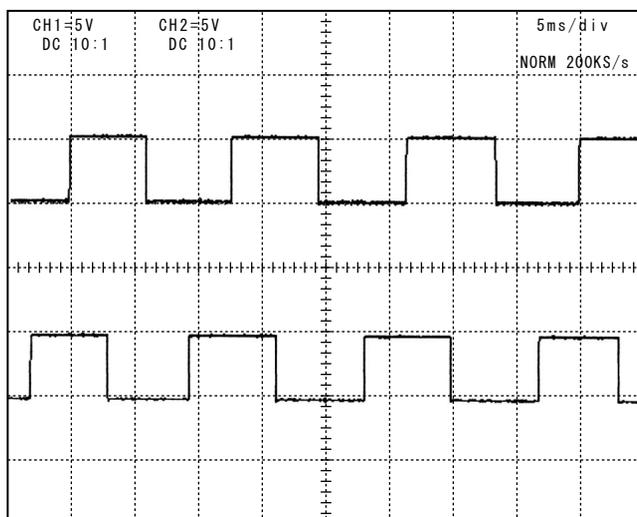


## ADJUSTMENT FOR MR DUTY

- In case of replacing the main PCB, SWM unit or MR encoder unit, be sure to make this adjustment.
- In case of replacing the main PCB, be sure to perform "READING AND REWRITING OF EEPROM DATA" then "3.WRITING THE FIXED VALUES."

How to adjust:

- ① Make sure that the current and voltage of the connected rated voltage power supply are the set values.  
Then, turn on the rated voltage power supply for the contacts A and F.
- ② Select "MR DUTY ADJUSTMENT" in the menu items of the AF-S 18-70/3.5-4.5G DX inspection program.
- ③ The display for checking whether the fixed values are written in EEPROM appears. Select a proper item.
- ④ According to the instructions on the screen, rotate the MF ring from the infinity to the near distance direction slowly by hand. Make sure that the waveform on the oscilloscope has duty 50% then stop the MF ring at the near distance end.



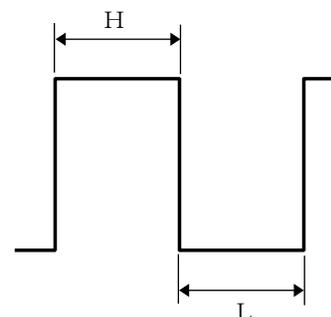
### ●Setting of oscilloscope

V/Div (CH1)	: 5 V
V/Div (CH2)	: 5 V
Coupling	: D C
Time/Div	: 5 m Sec
Trigger Mode	: NORMAL
Trigger Coupling	: D C
Trigger Source	: C H 1
Trigger Position	: + 4 div
Trigger Type	: EDGE
Trigger Level	: 2 . 5 V

- ⑤ According to the instructions on the screen, rotate the MF ring from the near distance to the infinity direction slowly by hand. Make sure that the waveform on the oscilloscope has duty 50% and then stop the MF ring at the infinity end.

Note : If the waveform from infinity to near distance and vice versa does not have duty 50%, perform again "INSPECTION AND ADJUSTMENT FOR THE WAVEFORM OUTPUT FROM MR ENCODER" in P.L17.

Standard  $H : L = 100 : 206 \sim 206 : 100$  (50%  $\pm 17.3\%$ )



**ADJUSTMENT FOR FREQUENCY AND CONTROL**

- In case of replacing the main PCB, SWM unit or MR encoder unit, be sure to make this adjustment.
- ① How to connect the rated voltage power supply and measuring tools is the same as "ADJUSTMENT FOR MR DUTY". Turn on the rated voltage power supply.
- ② Make sure that the current and voltage of the rated voltage power supply are the set values.
- ③ Turn on the rated voltage power supply.
- ④ Select "ADJUSTMENT FOR FREQUENCY & CONTROL" in the menu items of the AF-S 18-70/3.5-4.5G DX inspection program. The lens starts scanning automatically.



- ⑤ When the above display appears and the motor stops driving, select  to end the adjustment. If the motor does not stop driving, select  to make the adjustment again. If the adjustment is made again but the motor does not stop driving, readjust the MR duty and then perform "ADJUSTMENT OF DRIVING FREQUENCY AND MOTOR CONTROL" again. If the adjustment is not successful yet, the SWM unit or cam ring unit is regarded as defective.

LENS OPERATION CHECK
----------------------

Check the lens operation by using a personal computer after assembling.

○ Check by using PC

● Inspections

1. Operation of MR encoder

- Drive the lenses for scanning and check the difference in pulses between start and end.
- In case the MR encoder's MR head is not properly attached on the magnetic tape, the difference in pulses is larger.

2. Lens servo stop accuracy

- Check the overrun/underrun pulses (misalignment of the stop position against the aimed position) for the specified lens actuation.
- If there is no mechanical irregular operations of the focus ring drive unit, underrun tends to occur when the cam ring rotary weight of the MR encoder is heavy, while overrun tends to occur when it is light.

3. Lens servo time

- Check the servo time (time from servo start to stop) with an oscilloscope when the specified lens is actuated.
- If there is no mechanical irregular operations of the focus ring drive unit, the servo time tends to be long when the cam ring rotary weight of the MR encoder is heavy, while the time tends to be short when it is light.

4. Switches and lenses

- Check the ON/OFF operation of switches and the operation of the distance encoder and zoom encoder.

● After the inspections

1. When the MR encoder operation is out of standard:

Adjust the MR duty again. (Refer to P. L32.)

If the pulse is out of the standard, adjust the output pulse/waveform from the MR encoder again. (Refer to P. L17.)

If the pulse meets the standard, replace the cam ring unit.

2. When the lens servo stop accuracy is out of the standard:

Check the output pulse/waveform from the MR encoder. If it is normal, replace the cam ring unit.

3. When the lens servo time is out of the standard:

Adjust the driving frequency and motor control again.

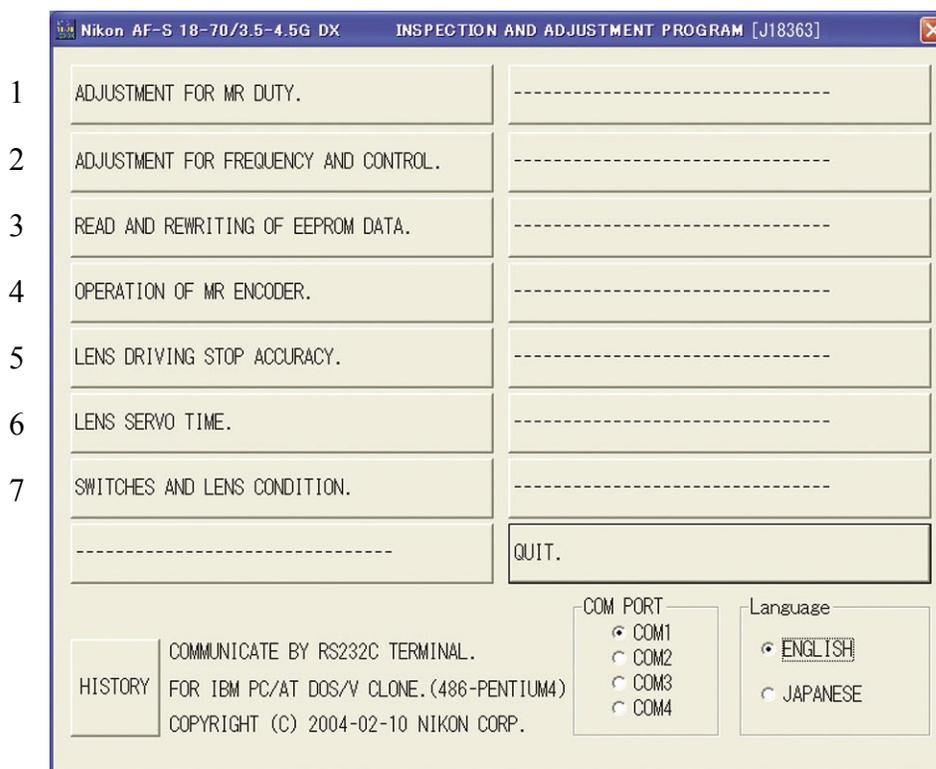
If the lens servo time is still out of the standard after the readjustment, replace the cam ring unit.

4. When switches do not operate properly:

Check the wiring arrangements of the defective switch or replace it.

● Details of the AF-S 18-70/3.5-4.5G DX inspection program

( 1 ) Menu screen



• Menu items

The items 1 and 2 are used for adjustment.

The item 3 is used for reading and writing EEPROM DATA.

The items 4~7 are used for inspection.

• Selection of item

After selecting the item, one of the screens for the lens selection, the focal length selection, the voltage setting , the inspection start, etc. appears. The displays are different depending on the items, so follow the instructions of PC.

• Operating voltage

	Power supply for AF motor in lens	Power supply for AF-I communication box
Inspection of MR encoder operation	6 . 0 ± 0 . 1 V	5 . 5 ± 0 . 2 V
Inspection of lens servo stop accuracy	6 . 5 ± 0 . 1 V	
Inspection of lens servo time	6 . 5 ± 0 . 1 V	
Inspection of switches and lenses	6 . 0 ± 0 . 1 V	

• Initial driving

When "WAIT FOR SOME SECOND" is displayed, execute the initial driving (repeat scanning five times and stop at infinity end).

( 2 ) Screen of "OPERATION OF MR ENCODER"



Note : If the MF ring is rotated during lens scanning, the number of pulses becomes abnormal value. Therefore, do NOT touch the MF ring during operation.

Make inspections by maintaining the below 5 positions.

(Lens positions at inspection)

Lens inclination	Position of index window
Horizontal	Up, right and left
Front lens group 90° upward	
Front lens group 90° downward	

When the inspection ends, the result appears in the next page.

The total number of pulses in inspecting should be within the standard.

Standard of all pulses :  $2506 \pm 94$  PLUSE(S)

---

TYPE OF LENS : AF-S 18-70mm/3.5-4.5G CPU VERSION : 21.01.00  
OPERATION OF MR ENCODER.

THE TOTAL NUMBER OF PULSE(S) AT INSPECTION. [PULSE(S)] ----- 2506  
STANDARD FOR THE NUMBER : FROM 2412 TO 2600 [PULSE(S)]  
IN STANDARD.

PUSH OK TO RETURN TO MENU.

OK

(3) Screen of "INSPECTION OF DRIVING STOP ACCURACY"

```

INSPECTION OF DRIVING STOP ACCURACY.
① → NUMBER OF LENS GO-AND-RETURN OPERATIONS.      : 5 / 5 TIME(S).
LENS DRIVING TIMES. (DF0+DF1+DF2+DF3+DF4+DF5+DF6) : 85 TIME(S).
MAXIMUM PULSE. (ABSOLUTE) (DF0+DF1+DF2+DF3+DF4+DF5+DF6) : 3 PULSE(S).
OVER ( OR UNDER ) RUN PULSE(S).                  : -1 PULSE(S).
LENS DRIVING TIMES. : DF1=15 DF2=15 DF3=15 DF4=15 DF5=10 DF6= 5
DIRECTION          : INF - ) CLOSE                CLOSE - ) INF
AMOUNT             : DF1      DF2      DF3      DF1      DF2      DF3
UNDER(-), OVER(+) : (-) (+) (-) (+) (-) (+) (-) (+) (-) (+) (-) (+)
0 - 6              : 0 10  0 10  2 8      3 2  5 0  5 0
7 - 18             : 0 0  0 0  0 0      0 0  0 0  0 0
12 - 18            : 0 0  0 0  0 0      0 0  0 0  0 0
④ → 19 -           : 0 0  0 0  0 0      0 0  0 0  0 0
DIRECTION          : INF - ) CLOSE                CLOSE - ) INF
AMOUNT             : DF4      DF5      DF6      DF4      DF5      DF6
UNDER(-), OVER(+) : (-) (+) (-) (+) (-) (+) (-) (+) (-) (+) (-) (+)
⑤ → 0 - 6          : 0 10  0 5  0 5      5 0  5 0  0 0
② → 7 - 18         : 0 0  0 0  0 0      0 0  0 0  0 0
③ → 12 - 18        : 0 0  0 0  0 0      0 0  0 0  0 0
19 -               : 0 0  0 0  0 0      0 0  0 0  0 0
RATIO(1)           (%): Df1=0.00 Df2=0.00 Df3=0.00 Df4=0.00 Df5=0.00 Df6=0.00
RATIO(2)           (%): Df1=0.00 Df2=0.00 Df3=0.00 Df4=0.00 Df5=0.00 Df6=0.00
PUSH CANCEL TO RETURN TO FOCAL DISTANCE SET-UP MENU.
    
```

CANCEL

Note : If the MF ring is rotated during lens scanning, the number of pulses becomes abnormal value. Therefore, do NOT touch the MF ring during operation.

The above display appears during lens driving. Make the inspection by maintaining the below 5 positions.

(Lens position at inspection)

Lens inclination	Position of index window
Horizontal	Up, right and left
Front lens group 90° upward	
Front lens group 90° downward	

The pulses of overrun/underrun should be within the standards after the lens drives by traveling back-and-forth five times ("5/5TIME (S)." in [1] of the display).

Standards RATIO (1) is 40% or less for Df1~Df6. ② of the display  
 (Occurrence ratio of 7~18 pulses)

RATIO (2) is 10% or less for Df1~Df6. ③ of the display  
 (Occurrence ratio of 12~18 pulses)

Occurrence of 19 or more pulses is zero for Df1~Df6. ④ and ⑤ of the display  
 (It is malfunction if there is only one occurrence.)

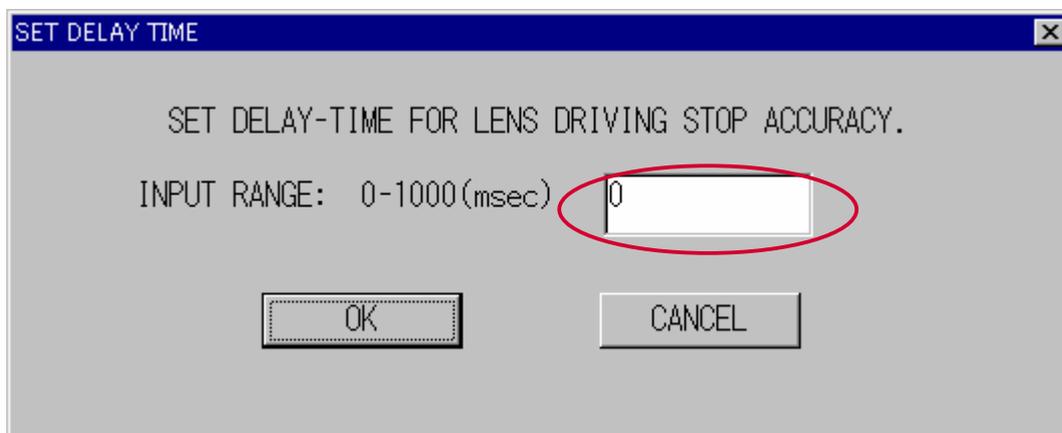
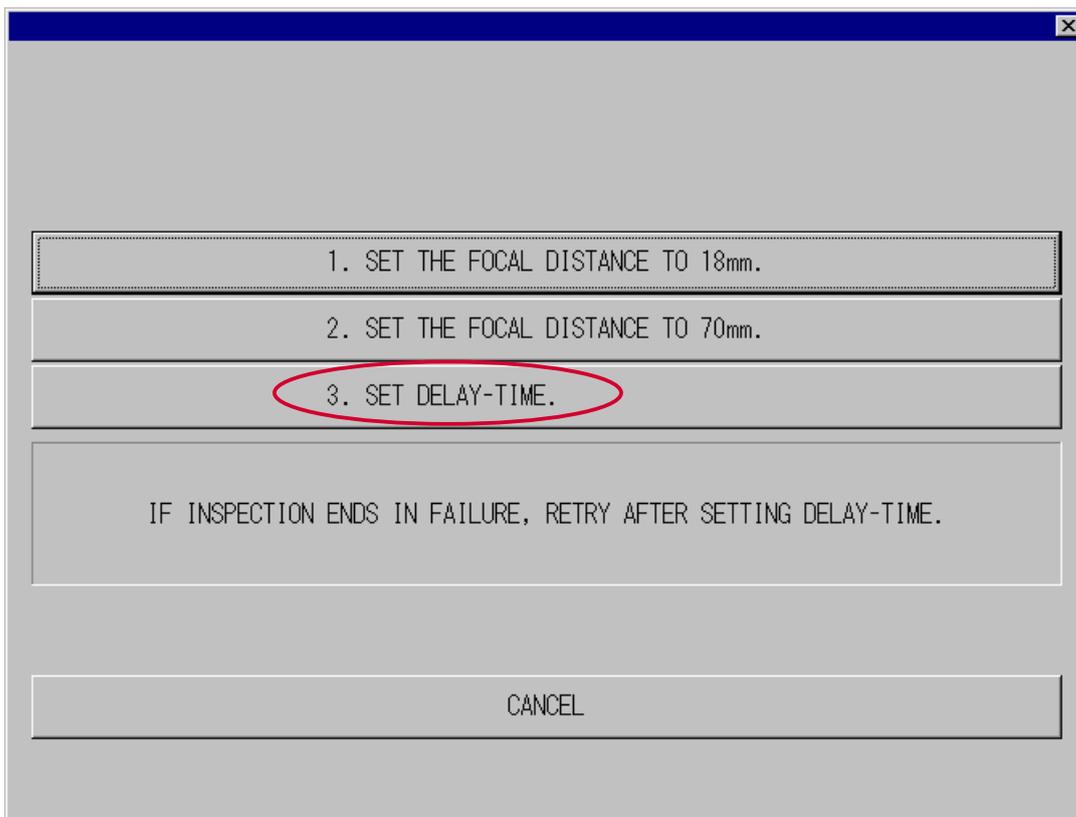
※ "Df1~Df6" shows the lens driving amount.

If the lens stops while inspecting the lens-servo stop accuracy, select "3.SET DELAY-TIME" and input a figure from 0 to 1000 for the delay time (msec: millisecond) to prevent stopping the lens into the entry field of "DELAY-TIME" of the below.

**Note:**

The value of "ADJUST DELAY-TIME" is set by the adjustment software. So, if the lens does not stop during the inspection of "LENS DRIVING STOP ACCURACY", any value can be input without problem.

However, the larger the value of "ADJUST DELAY-TIME" gets, the longer the inspection time becomes.



(4) Screen of "INSPECTION OF LENS SERVO TIME"

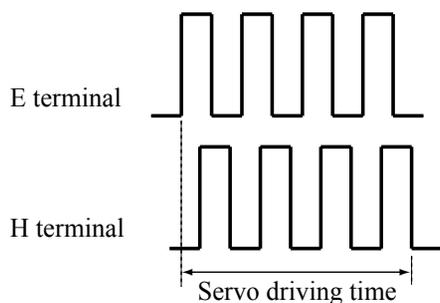
INSPECTION OF LENS SERVO TIME.	
SERVO AMOUNT.	STANDARD.
1. [ Df1 ]	93ms OR LESS.
2. [ Df2 ]	120ms OR LESS.
3. [ Df3 ]	146ms OR LESS.
4. [ Df4 ]	186ms OR LESS.
5. [ Df5 ]	219ms OR LESS.
6. [ Df6 ]	253ms OR LESS.
7. DRIVING TO INFINITY.	
8. DRIVING TO CLOSE.	
9. RETURNING TO FOCAL DISTANCE SET-UP MENU.	

Connect the probes of oscilloscope to E and H terminals of the AF-I communication box (J15306-1). Select each servo driving amount. The lens servo drive time should be within the standard respectively.

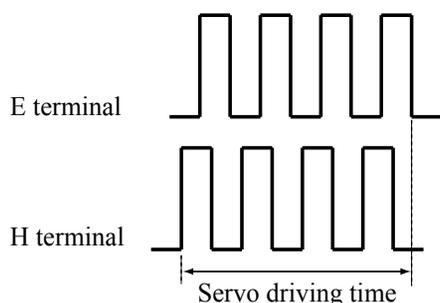
Note : If the MF ring is rotated during inspection, the waveform becomes abnormal value. Therefore, do NOT touch the MF ring during inspection. Make the inspection by maintaining the below 5 positions.

(Lens positions at inspection)

Lens inclination	Position of index window
Horizontal	Up, right and left
Front lens group 90° upward	
Front lens group 90° downward	

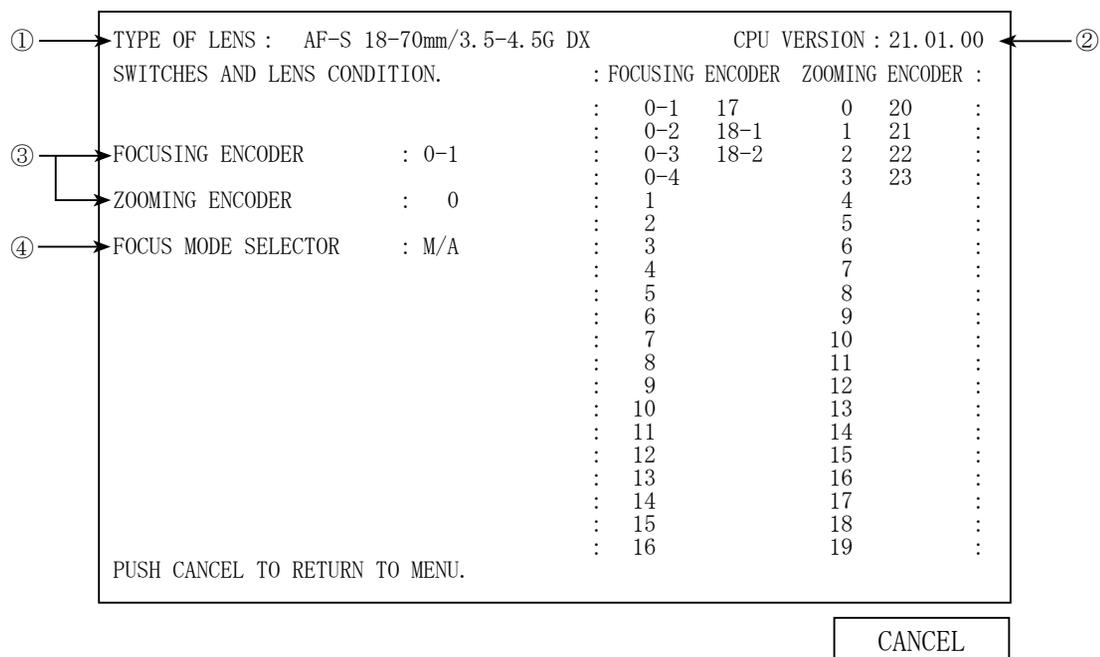


- Setting of oscilloscope
- V/Div : 5 V
- Coupling : D C
- Time/Div : 2 0 m Sec
- Trigger Mode : S G L (S)
- Trigger Coupling : D C
- Trigger Source : C H 1



※ The waveforms of E and H terminals include a start of going up and a start of going down.  
down for

(5) Screen of "SWITCHES AND LENS CONDITION"



- ① This shows the type of lens.
- ② This shows the version of CPU in the lens.
- ③ This shows the signals of the distance encoder and zoom encoder.  
This value is changed if the MF ring is rotated while the lens drive mode selector is at M or M/A.
- ④ This shows the status of switches.

### Aberration compensation data writing adjustment

- This adjustment uses the software which calculates the aberration compensation data according to the feature of lens aberration and writes in EEPROM of the lens, in order to improve the accuracy of autofocus.

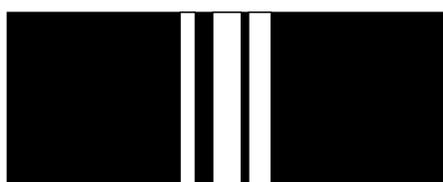
**Note: This adjustment is necessary when the main PCB and/or each lens part (glass, lens chamber) is replaced or when each lens part is disassembled. Be sure to make this adjustment after completing inspecting and adjusting the main PCB.**

#### (1) Preparation

- Test chart (Self-made tool: ref. Procedure for how to create it.)
- Tripod
- D100
- Personal computer
- USB cable (UC-E4)
- Adjustment software (LWM.exe : used for the lens optical alignment.)

#### (2) Procedure for how to create Test chart

- Photocopy the next page and cut out 1 target chart and 5 resolution charts.



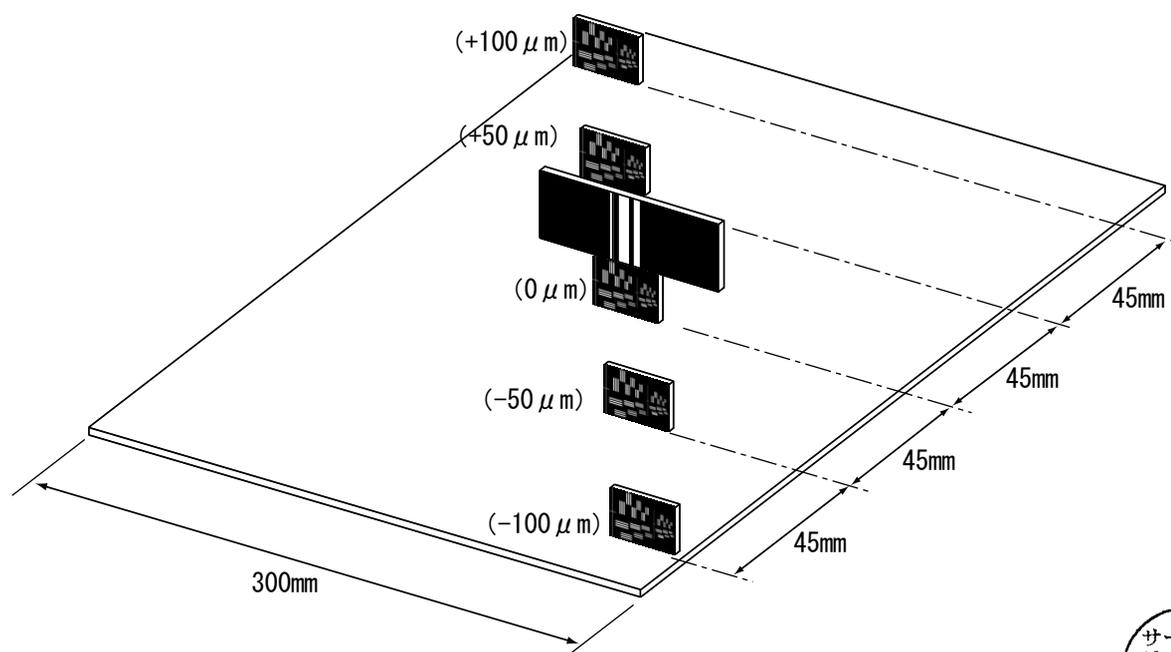
(Target chart)



(Resolution chart)

- As shown below, put each chart in position at the specified spacings.

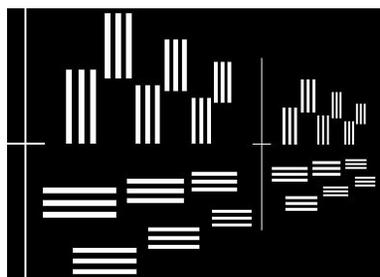
**Note: Only about the center, put the target chart on the central resolution chart.**



(Target chart)

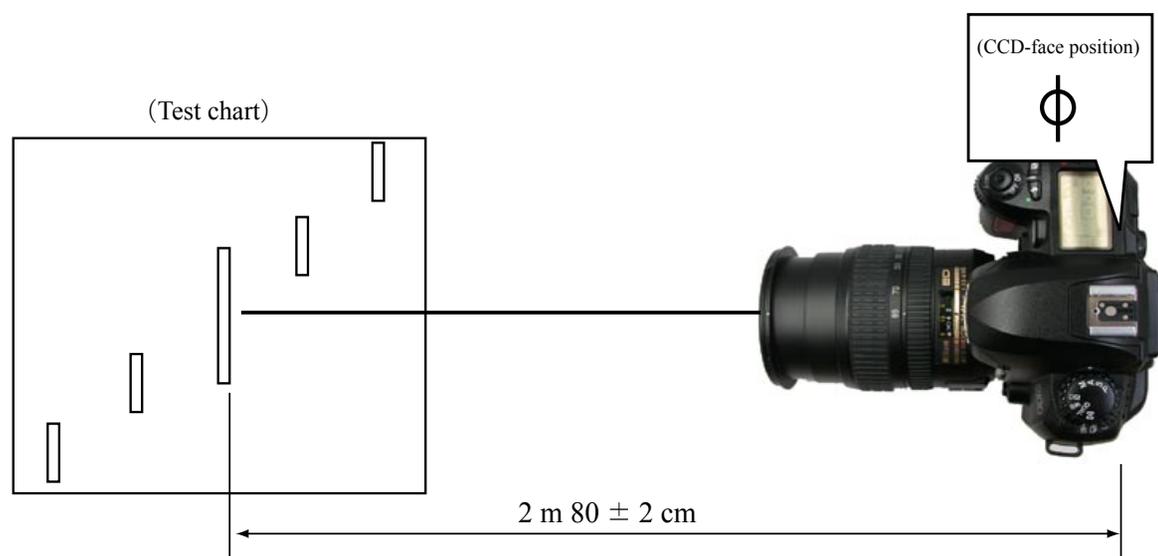


(Resolution chart)

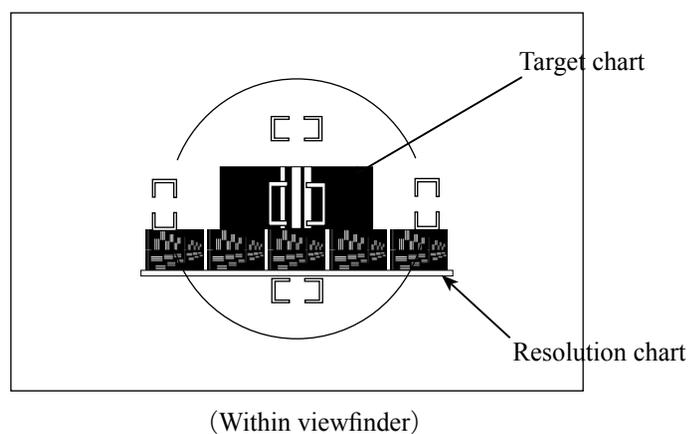


## (3) Writing aberration compensation data

- ① Prepare a camera (D100). Set the "Exposure mode" to "A" for full aperture and "Focus mode" to "S".  
On the shooting menu, set the "Image quality mode" to "FINE", "Image size" to "L", "WB" to "Preset", and "ISO" to "200".
- ② Set up the camera (D100), in which the lens to be inspected is fit, on the tripod. Set the focal length to 70 mm, and the distance between the test chart and camera (CCD face) to 2 m 80±2 cm.

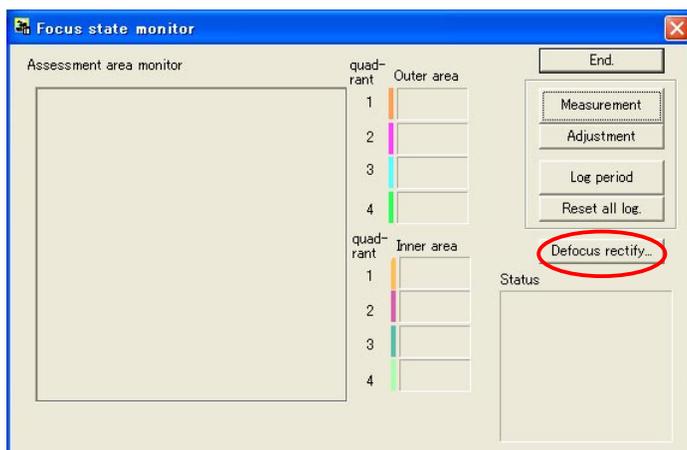


- ③ As shown below, bring the target chart in the center of focus area within viewfinder.

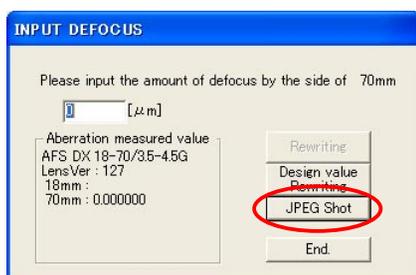


- ④ Connect the PC and camera via USB cable. (Camera setting: Mass storage)
- ⑤ Start the adjustment software (LWM.exe).

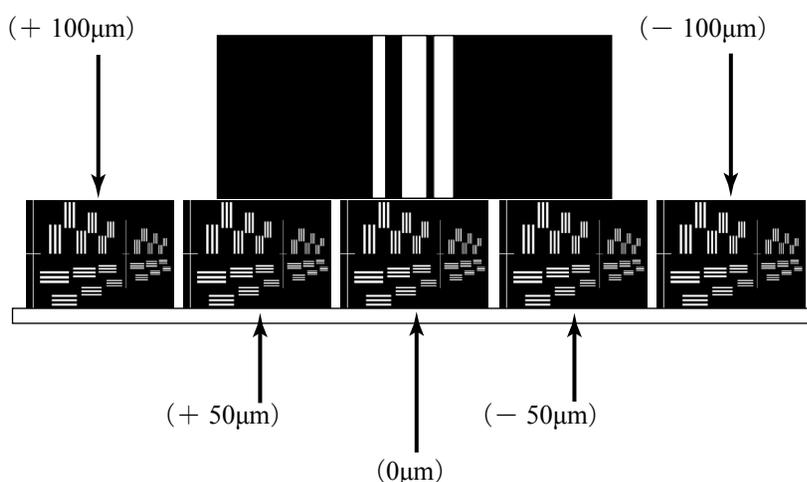
⑥ Click the "Defocus rectify..." button.



⑦ Click the "JPEG Shot" button.

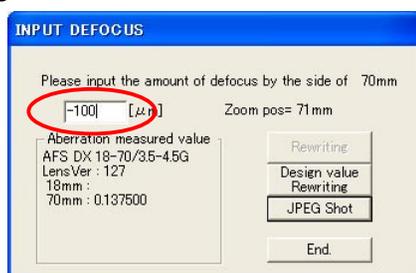


⑧ The shutter is released after the AF operation. The shot image is automatically displayed on the PC screen. Scale the image to 100% and check which chart is in focus of the 5 resolution charts.

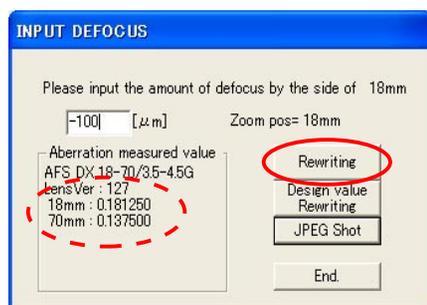


⑨ Input the value of the focused position into the entry field.

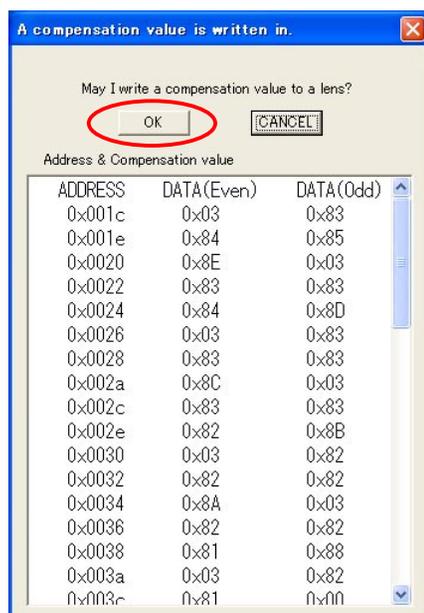
e.g. The below is the case when " − 100μm" of the front focus side is in focus.



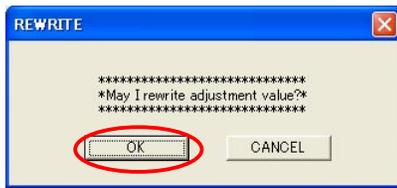
- ⑩ Set the focal length of the lens to 18 mm, and the distance between the test chart and camera (CCD face) to  $72 \pm 2$  cm.
- ⑪ Perform the operations from ⑦ to ⑨ of the previous page.
- ⑫ Check that the values of all the focal lengths are displayed within the dotted red circle. Then click on "Rewriting".



- ⑬ When "A compensation value is written in." is displayed, click "OK".



- ⑭ The reconfirmation screen is displayed. Click "OK".

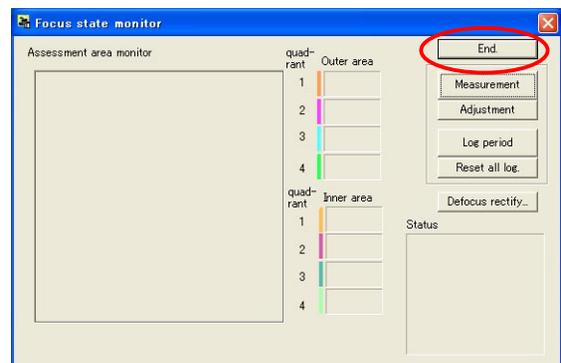
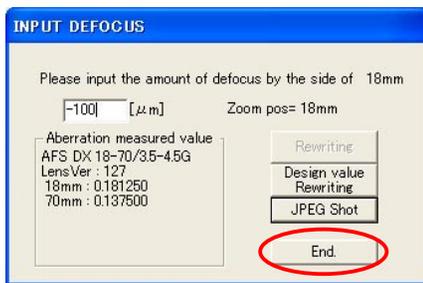
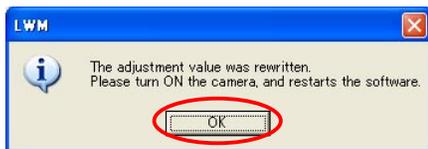


- ⑮ An hourglass is displayed on the screen, and writing starts.

The below screen is displayed after a few seconds. Turn camera OFF and turn it ON again.

Click "OK", and the adjustment software restarts.

**Note: Unless the camera is turned off once, the value that was written in EEPROM is not reflected on the results of shooting.**

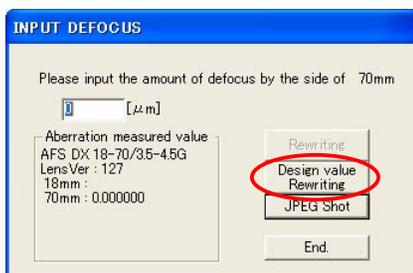


- ⑯ When the adjustment software restarts, perform the operations from ② to ⑪ again. Check that "0 $\mu$ m" of the AF position is in focus.

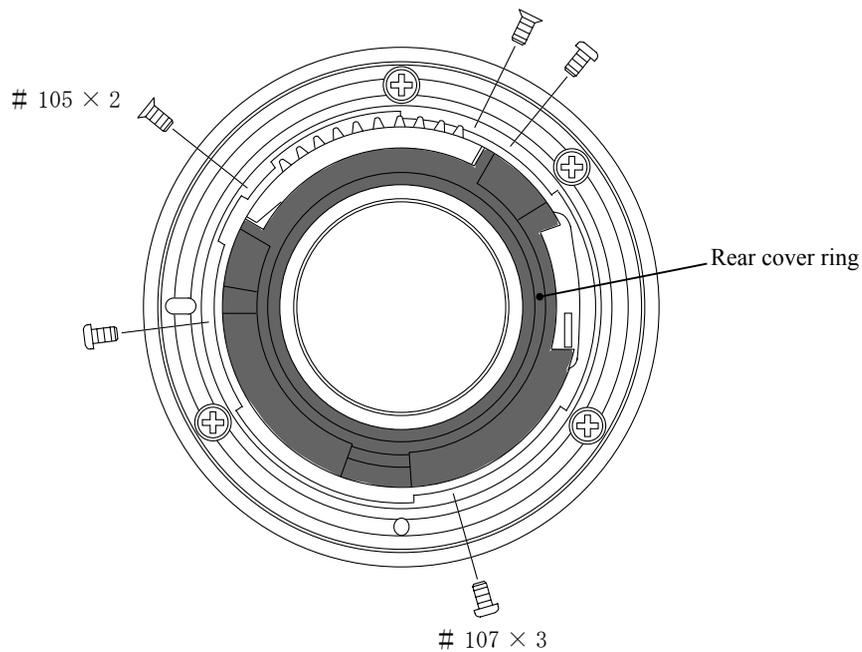
(It is also possible, after Wide-side shooting of ⑩, to take the Tele-side shooting of ②.)

If "0 $\mu$ m" is not in focus, repeat the operations from ② to ⑯.

If it is not still in focus even after repetition, the written value in EEPROM may be abnormal. So click "Design value Rewriting" to write the initial value, then proceed with the operations.



REAR COVER RING



RUBBER RING, SHEET

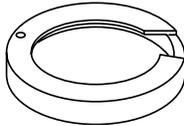
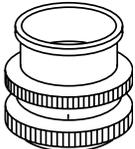
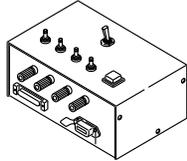
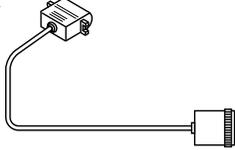
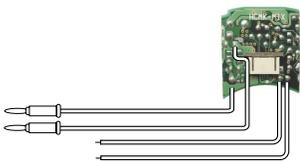


Necessary adjustments when parts are replaced

Parts Replaced \ Item of Adjustment	Adjustment for MR duty (Necessary to write fixed value) Adjustment for drive frequency/motor control	Inspection and adjustment for the waveform output from MR encoder
Main PCB	○	
SWM	○	○
MR head unit	○	○

## Tools

★ : New tool

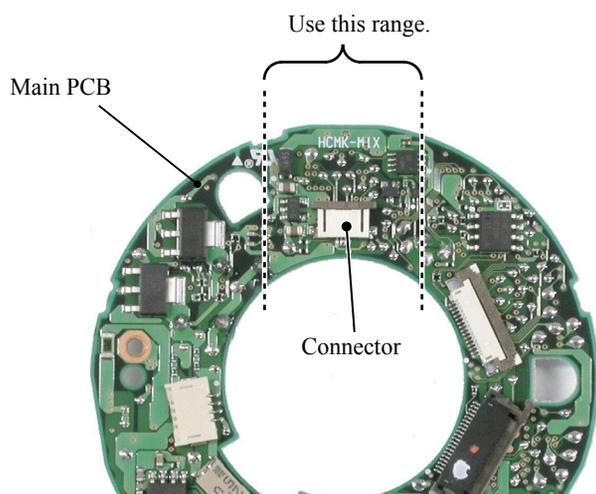
RJ No.	Name	Note
MZ-800S	DRY SURF MZ-800S	
G92KA	FLOIL G92KA	
I-40	GREASE I-40	
EDC0021	ADHESIVE	
EDB0011	SCREW LOCK 1401C	
L-241	LOCK END	
J18004-1	STANDARD GAUGE FOR J18004 	
J19002	BACK FOCUS COLLIMATER LT-500S	
J18028	LENS ADAPTER FOR FOCUS TESTER 	
★ J18363	AF-S 18-70/3.5-4.5G DX INSPECTION AND ADJUSTMENT SOFTWARE 	
J15306 or J15306-1	AF-I COMMUNICATION BOX 	
J15307	AF-I COMMUNICATION ADAPTER 	
J15399	COVER SHEET ATTACHING TOOL	For 1K110-578
	PERSONAL COMPUTER	
	POWER SUPPLY	
	OSCILLOSCOP	
	SELF-MADE TOOL 	Use the self-made tool that was created in AF-S24-85/3.5-4.5G or AF-S DX12-24/4G.

## Making of self-made tool

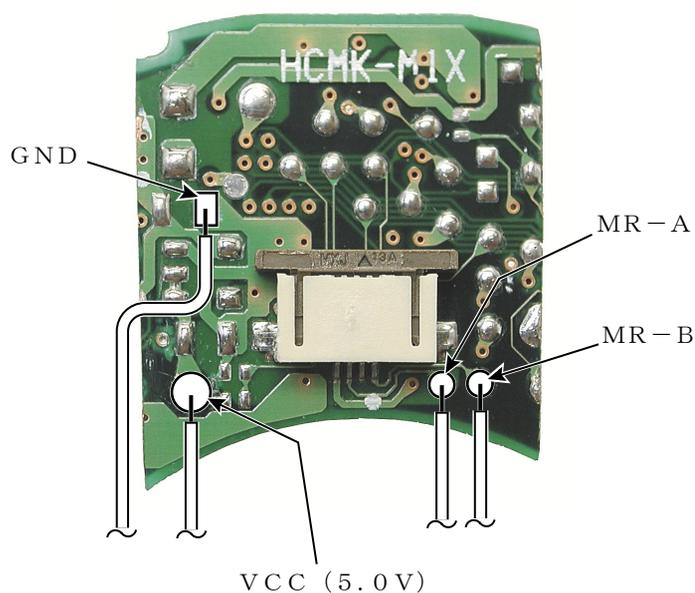
- It is necessary to make a self-made tool by using the main PCB of repair part. The self-made tool will be used for "INSPECTION AND ADJUSTMENT FOR THE WAVEFORM OUTPUT FROM MR ENCODER".

The making procedure is shown below. Make a self-made tool according to this procedure.

This tool is the same as the tool that was Self-made for AF-S24-85/3.5-4.5G or AF-S DX12-24/4G.

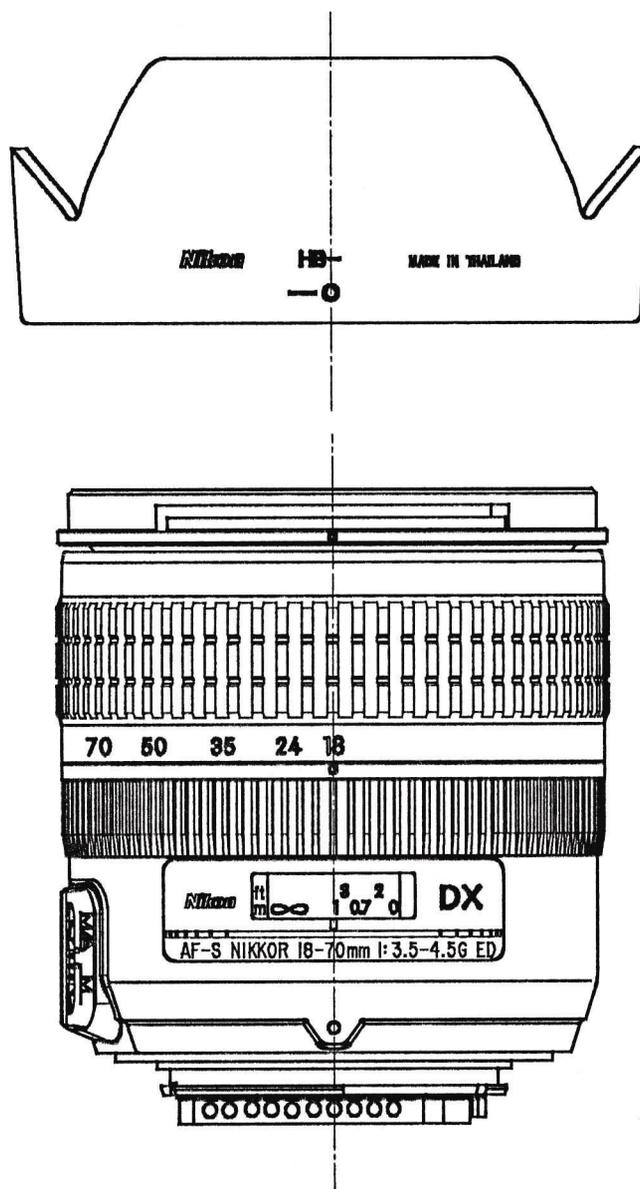


- ① Remove the elements (condenser, transistor, IC, etc.) installed within the dotted line as shown in the left from both sides of PCB. Don't remove the connector.
- ② Cut the PCB at the dotted line.

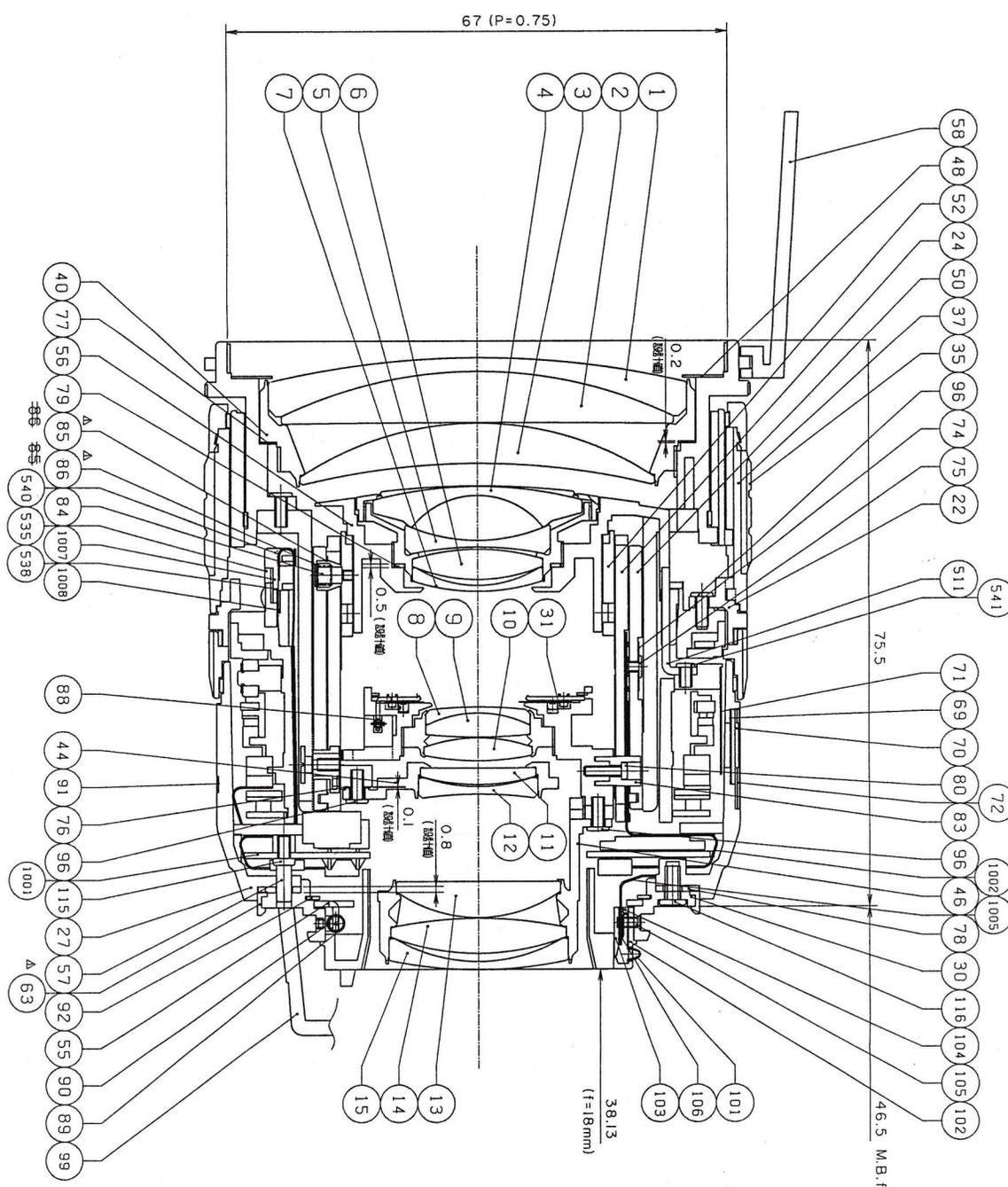


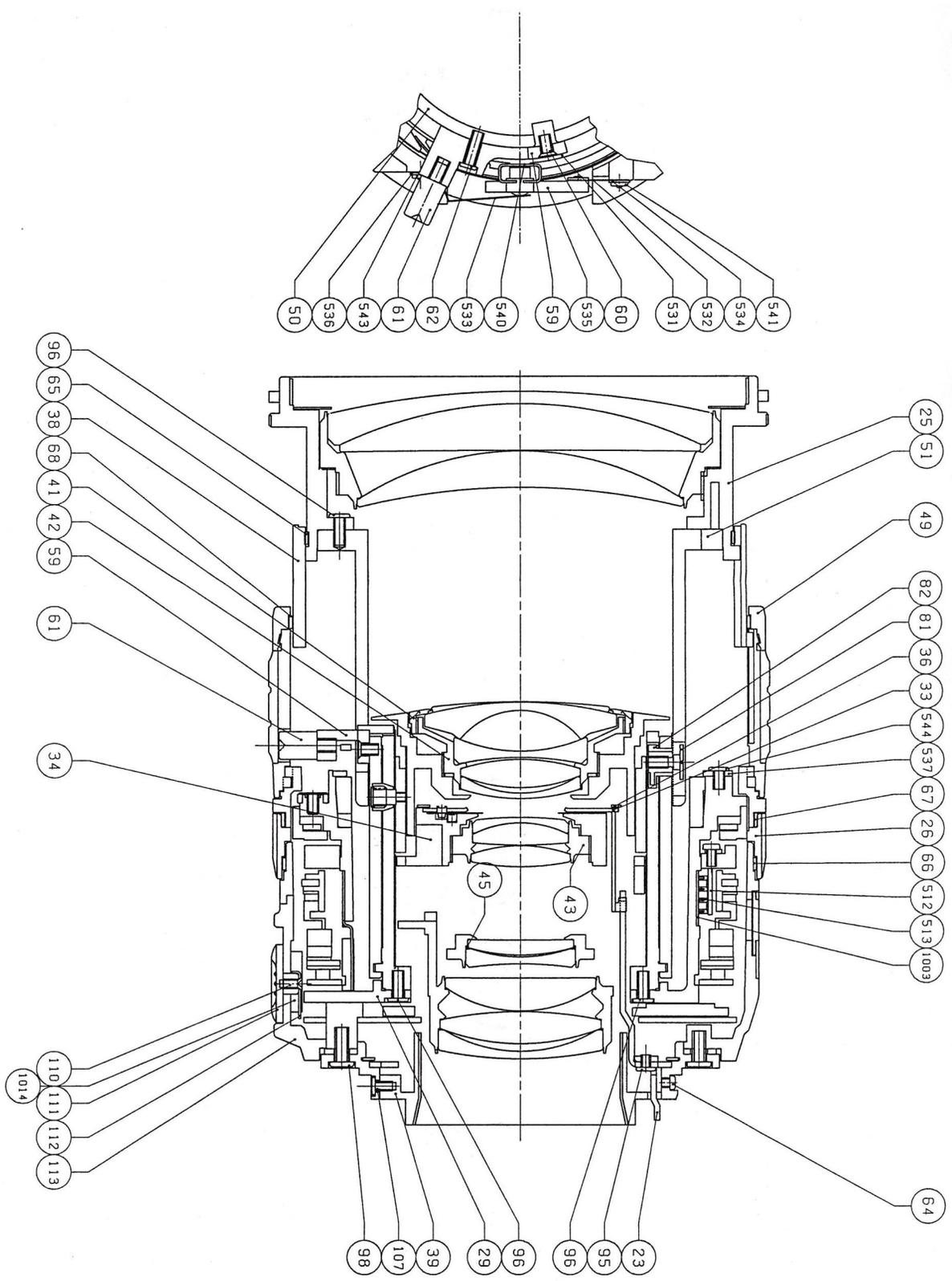
- ③ Solder the cords at 4 pattern places on the PCB as shown in the left.

外觀図 Sketch drawings



組立図 Structure of the Lens





実体配線図

WIRING DIAGRAM

