Canon

Service Manual

ENGLISH EDITION

EF 35-350mm 1:3.5-5.6 L (ULTRASONIC) C21-9642

CY8-1200-103

Canon

EF 35-350mm 1:3.5-5.6 L (ULTRASONIC)

REF.NO.C21-9642

SERVICE MANUAL

Application

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PREFACE

This manual contains information on servicing the product. It has the following sections.

Part 1 General Information

Provides the basic information needed to understand the product.
(Operating instructions are not included. Refer to the products instruction book if necessary.)

Part 2 Technical Information

Provides technical information about the mechanism and electronics of the product.

Part 3 Repair Information

Provides information about the tools and expendables required for disassembly, reassembly, adjustment and measurement of the product, and their locations and method of use.

Part 4 Parts Catalog

Part 5 Electrical Diagrams

CONTENTS

Part 1

General Information

1. DEVELOPMENT OBJECTIVES

The EF 35-350mm 1:3.5-5.6 L Ultrasonic was developed to provide the highest zoom magnification available for an SLR-use interchangeable lens.

By providing a super-high-power zoom ratio of 35mm-350mm in a hand-holdable package, this versatile zoom lens is targeted at a wide spectrum of users as an all-purpose zoom lens taking the place of several fixed focal length lenses.

2. FEATURES

- Zoom lens offering the highest zoom ratio of any interchangeable lens for SLR use. (35mm wide angle-350mm telephoto)
- Offers super-high magnification while providing dimensions similar to the 80-200mm f/2.8L. (ø85 × 167.4mm, 1385gr)
- Use of UD glass elements suppresses axial chromatic aberrations at telephoto focal lengths and provides excellent optical performance.
- Focusing possible from infinity to the closest shooting distance of 0.6m without switching. (135mm)
- Incorporates USM and rear focus design for silent, high-speed autofocusing.
- Manual focusing possible in AF mode.
- Employs wide, rubber push-pull zoom ring for superior operability.
- Adjustment ring allows adjustment of the zooming friction.
- Deluxe external styling appropriate for a zoom lens with the highest zoom magnification available.
- Specially designed lens hood effective at all zoom positions.
- Dual-bayonet lens hood attachment for error-free attachment.
- Standard tripod socket with mounting system.

3. SPECIFICATIONS

1. Format — 24 × 36mm

2. Focal length/Aperture ratio — 35-350mm; 1:3.5-5.6

3. Optical system construction
   - 3-1 Lens construction — 21 elements in 15groups (including two UD glass elements)
   - 3-2 Coating — Super Spectra Coating

4. Angle of view(∞)

Diagonal(43.2mm)	63°~3°30'
Vertical(24mm)	38°~2°
Horizontal(36mm)	54°~3°

5. AF function
   - 5-1 Drive system — Ring USM
   - 5-2 Drive speed — H:0.37-L:0.57 sec (lens drive speed between infinity and closest shooting distance)
   - 5-3 Manual focusing — Inprinciple, by switching the focusing mode switch to "M" and operating the manual focusing ring.(Manual operation at AF position is also possible)

6. Focus adjustment
   - 6-1 Extension system — USM-driven rear-focus cam
   - 6-2 Macro switching function — None
   - 6-3 Shooting distance range — TELE: 2.20m to infinity WIDE: 0.67m to infinity
   - 6-4 Rotation angle/ Extension amount

Condition	Rotation angle	Extension
Closest distance~∞	56°36'	8.55mm
∞ Infinity overrun	2°06'	0.5mm

   - 6-5 Distance scale

2 3 5 10 20 50 (ft: Fluorescent green)
0.6 1 1.5 3 5 10 └─∞(m: Light metallic gray)

   - 6-6 Maximum magnification and field of view

Condition	Closest shooting distance (m)	Magnification (times)	Field of view (mm)
WIDE(f=35mm)	0.67	0.07	330 × 495
MIDDLE(f=135mm)	0.6	0.25	96 × 144
TELE(f=350mm)	2.2	0.15	165 × 247

7. Zoom
   - 7-1 System — 6-group zoom, linear extension system (front lens barrel extends forward 75mm)
   - 7-2 Focal length indications — 35 50 70 100 135 160 200 250 300 350

8. Mount	
8-1 Type	Canon EF mount
8-2 Signal transmission function	EOS system, using the following five signals (absolute distance data provided) 1. Lens condition 2. Lens type 3. Metering data 4. Focal length 5. AF drive data
9. Diaphragm mechanism	
9-1 Diaphragm control	Pulse control system using EMD (*Simultaneous control of AF lens drive possible.)
9-2 Aperture/indication	Maximum aperture: f/3.5-5.6 (indicated on lens barrel); Minimum aperture: f/22-34 (no indication)
9-3 Number of diaphragm blades	Eight
9-4 Depth-of-field scale	None
9-5 Infrared focusing index	Provided
10. Filter	
10-1 Diameter	ø72mm; P=0.75mm
10-2 Maximum number of filters	1
11. Dimensions/Weight	ø85 × 167.4mm; 1385gr (lens only)
12.Related products	
12-1 Hood	EW-78 (detachable, specially-designed dual bayonet hood; reverse mounting possible)
12-2 Lens cap	E-78U
12-3 Lens case	Hard case: LH-D22 Housable items: Lens + tripod mount + 1 filter + reverse-mounted hood+ lens cap + dust cap
12-4 Dust cap	Lens Dust Cap E
12-5 Standard accessory	Tripod mount
13. Other	
13-1 Extenders	Cannot be used
13-2 Extension Tube EF25	Can be used Shooting distance range: WIDE 0.25-0.24m TELE 4.95-1.49m Magnification: WIDE 0.75-0.82x TELE 0.08-0.25x

4. EXTERNAL DIMENSIONS/CROSS SECTION

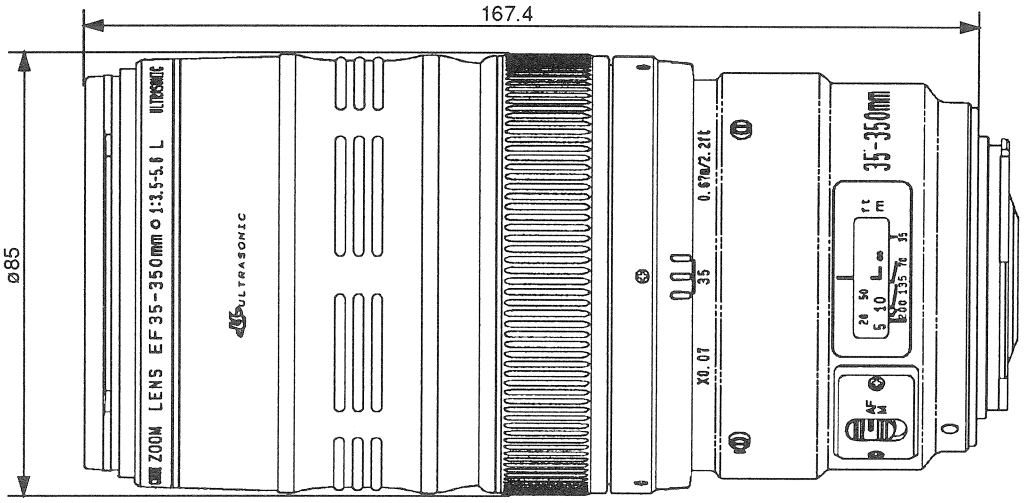


Fig. 1-1 External Dimension

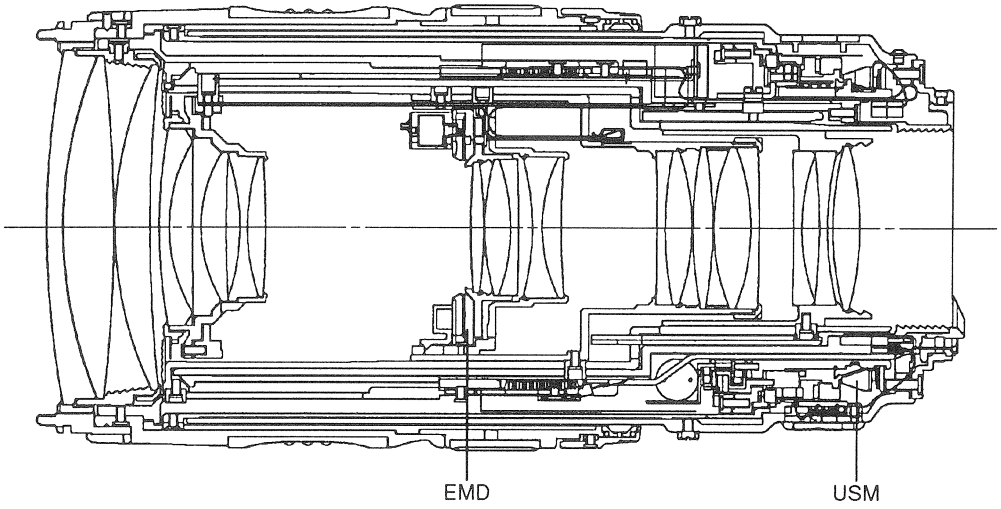


Fig. 1-2 Cross Section

5. LENS MOVEMENT

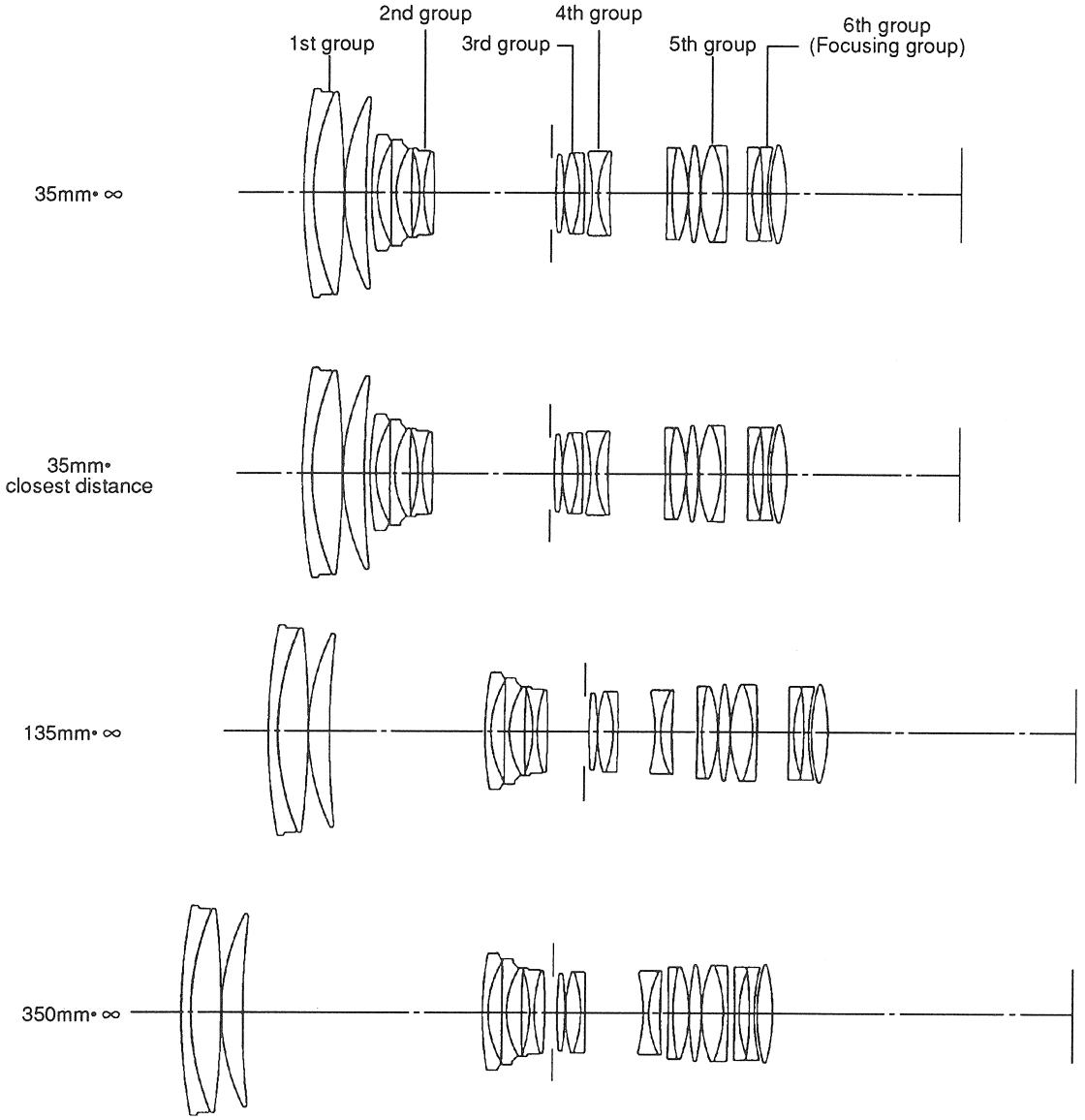


Fig. 1-3 Lens Movement During Zooming

6. OTHER

6.1 Design

- The EF 35-350mm 1:3.5-5.6 L USM is designed not only to express high quality and originality as Canon's top zoom lens, but also to provide superior functionality and operability for both advanced amateur and professional users.

1. The manual focusing ring position is balanced with the zoom ring so that manual focusing has the same feel throughout the zoom range. Moreover, the width of the manual focusing ring knurling is quite wide.
2. The shape of the rubber zoom ring is slightly depressed in the center to ensure a sure grip, and a ribbed pattern is provided around the circumference of the ring to improve zooming operability and visually emphasize the linear movement of the zoom ring.

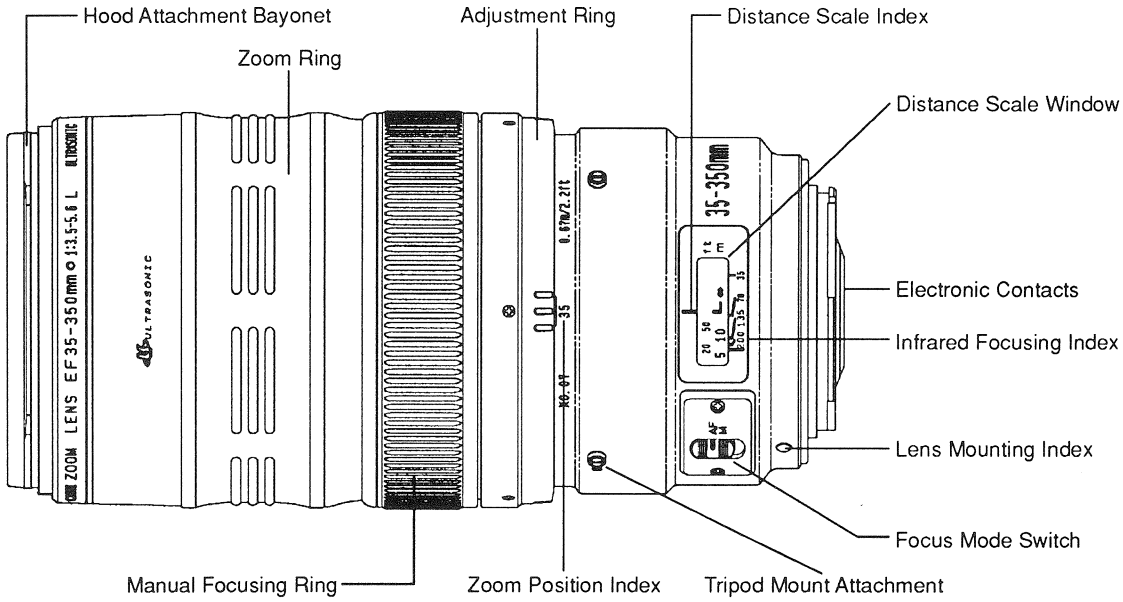


Fig. 1-4 Nomenclature

6.2 Technical Description

6.2.1 Zoom Lens Optical System

- The optical system of the EF 35-350mm 1:3.5-5.6 L USM is designed to provide the highest zoom ratio available for an SLR zoom lens.

1. Six-group lens construction with five-moving-lens groups for zooming and a sixth-lens group in the rear for focusing achieves a great zoom ratio while providing compact size and high picture quality.
2. Rear focusing system enables use of a small-diameter, lightweight focusing lens, realizing silent, high-speed autofocusing.
3. Two ultra-low dispersion (UD) glass elements employed in the first lens group greatly reduce axial chromatic aberrations at telephoto focal lengths.

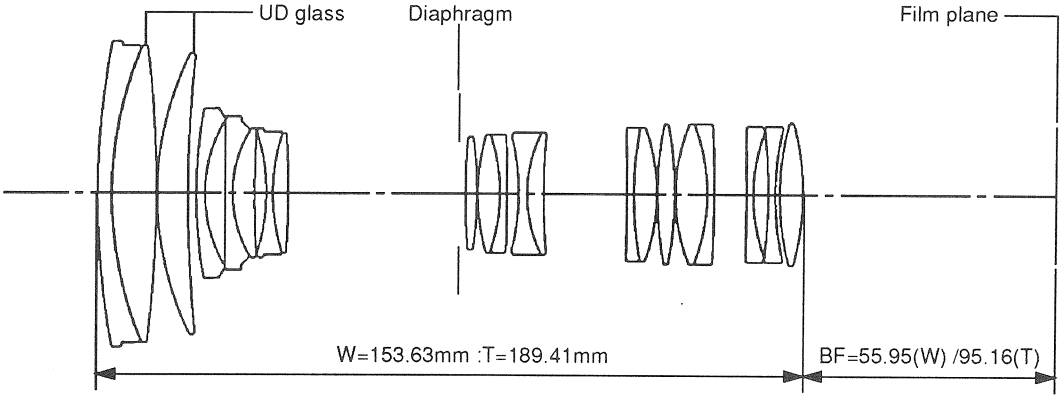


Fig. 1-5 Optical Schematic

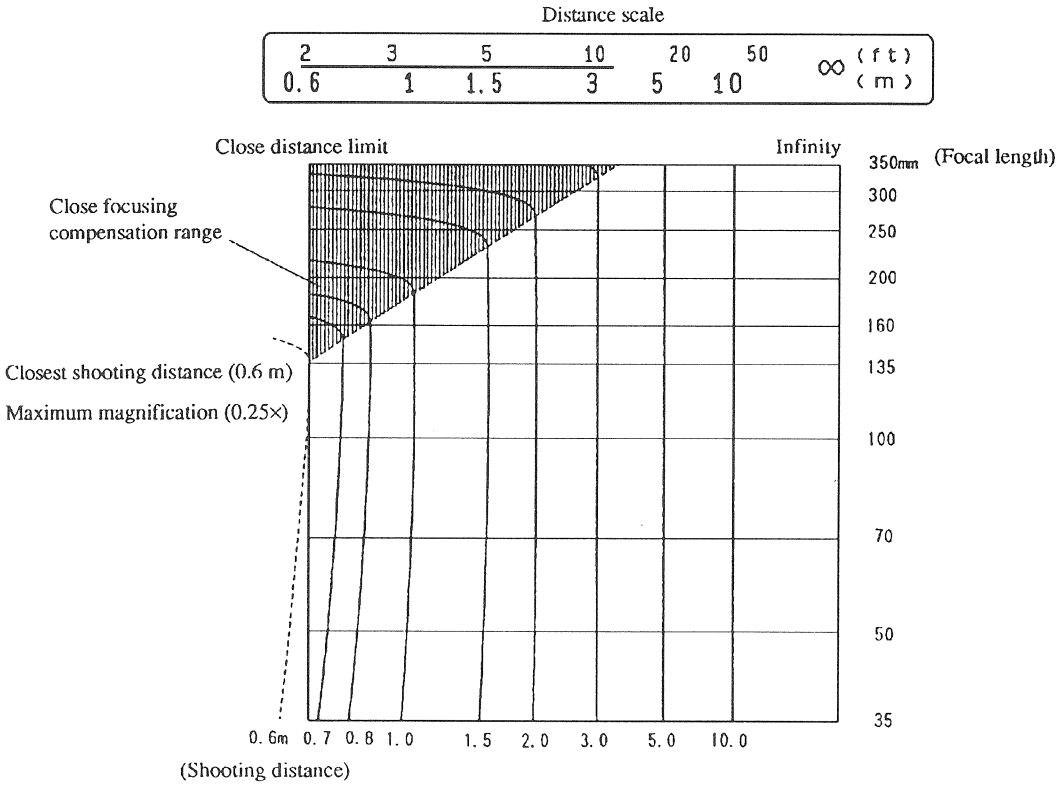
6.2.2 Adjustment Ring

The EF 35-350mm 1:3.5-5.6 L USM is newly equipped with an adjustment ring which allows the user to adjust the zoom operation force as desired, enabling fine adjustment or holding of the zoom position.
The zoom operation force is adjusted by holding the manual focusing ring still and turning the adjustment ring clockwise (looking from the camera side) to increase the force required to operate the zoom ring, thus restraining movement of the zoom position. Even when the zoom operation force is increased, however, there is no effect on operation of the manual focusing ring.

6.2.3 Closest Shooting Distance

To achieve the EF 35-350mm 1:3.5-5.6 L USM's closest shooting distance of 0.6m (0.25× magnification), the focus movement amount is compensated when the focusing distance nears the close distance limit.
The compensation range and compensation amount are shown below in Table 1.
The horizontal axis of the graph indicates the rotational position of the lens' distance scale, and the vertical axis indicates the focal length. The close focusing compensation range, indicated by a line between the feet and meter numbers on the distance scale, is the range in which the relationship between the distance scale rotation amount and actual shooting distance changes.
Through use of this close focusing compensation mechanism, continuous focusing is possible from infinity to the closest shooting distance of 0.6m (0.25× magnification) at the 135mm position.

Table1-1 Relationship Between Closest Shooting Distance and Focal Length



6.3 Tripod Mount

The tripod mount supplied with the EF 35-350mm 1:3.5-5.6 L USM has a user-friendly design matching the design of the lens and allows handheld shooting when attached to the lens.

Use of a new fastening system realizes both a compact, lightweight design and smooth mounting.

Attachment and removal of the tripod mount is carried out with the lens removed from the camera. The tripod mount ring can be removed by loosening its knob and rotating the ring to the position 45° to the right of top center (looking from the rear of the lens) and pulling it to the rear.

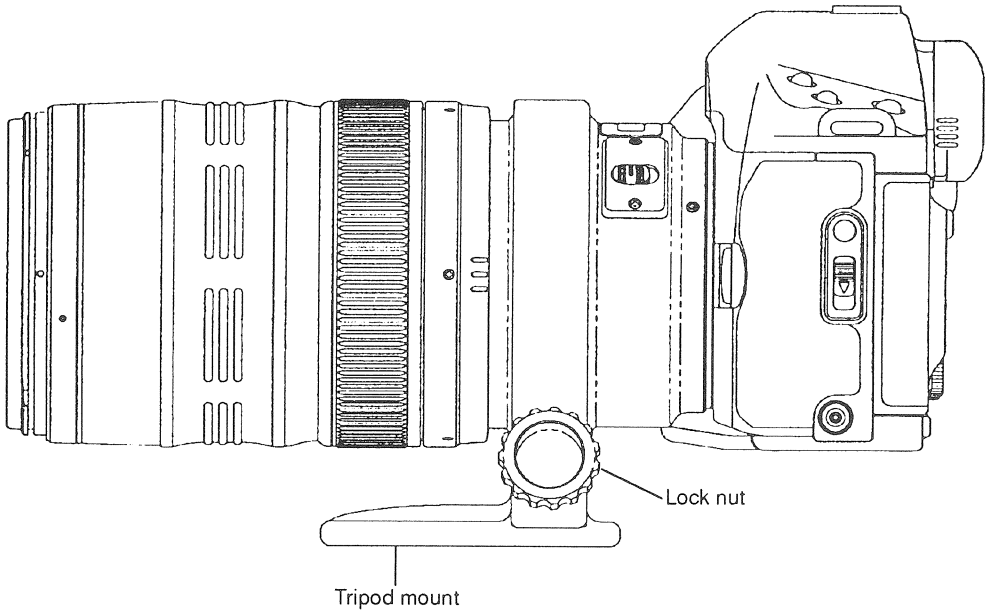


Fig. 1-6 With the Tripod Mount

6.4 Dedicated Hood EW-78

The lens hood is differentially scalloped to prevent vignetting in the corners of the frame at wide angle focal lengths. Moreover, a baffle ring inside the hood serves the dual purposes of cutting externeous flare-causing light rays, and providing a mounting lip to hold the two-piece hood together.
The dual bayonet insures proper orientation of the long edge and short edge scallops.

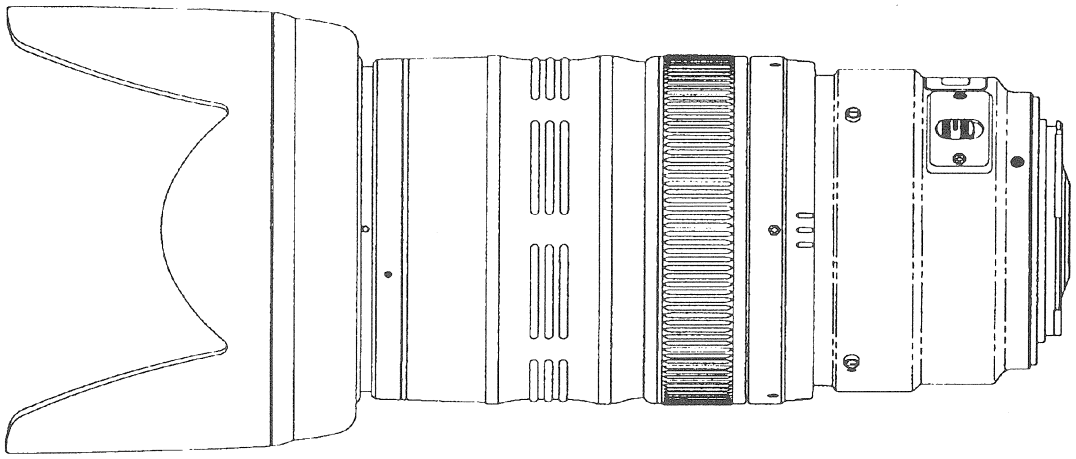


Fig. 1-7 With the Hood Mounted

6.5 Precautions

- The lens should be removed from the camera before attaching the tripod mount.
- The manual focusing ring should be held motionless while operating the adjustment ring.

Part 2

Technical Information

1. COMPONENTS AND FUNCTIONS

Symbol	Spec./Mgf. #	Function
IC1(CPU)	MN17481-AX90A	Central microprocessor
2(C-IC)	AN8329	EMD,USM control IC
3	MN12821	Voltage detect IC
Tr1	UN212Y	C-IC E1 power supply
2,3	UN206	EMD drive
4,6	2SD1511R	USM drive
5,7	2SB766AR	USM drive
8	UN2223	DC/DC convertor on and off
C1,2	4.7μF/10V	Noise filter
3	1.0μF/16V	Noise prevention
4	1.0μF/16V	Noise filter
5	10μF/50V	(US) C-IC
7	680pF/50V	(CF) C-IC
8	3.3μF/50V	(F) C-IC
9	220pF/50V	(C32) C-IC
10	10μF/50V	(F32) C-IC
13,17	1.0μF/16V	Noise filter
14	15μF/50V	Noise filter
18	3.3μF/35V	Noise filter
20,21	3.9μF/200V	USM drive
D2	RLZ7.5B 7.5V	IC1 protector
3	MA3075WA	IC1 protector
4	SB01-05CP	Protector
5	MA-157A	Tr4,Tr5 protector
6	MA-157A	Tr6,Tr7 Protector
7	SB01-05CP	Protector
8	SB01-05CP	Protector

Symbol	Spec./Mgf. #	Function
R1	10kΩ	(UAIN) C-IC
3	40kΩ	USM reference frequency adjustment
4	100kΩ	(FV) C-IC
5	8.2kΩ	(F) C-IC time constant
7	2.4kΩ	(F32) C-IC time constant
8	20kΩ	PR1 output adjustment
10	16kΩ	(DAC) C-IC
11	2.4kΩ	Tr5 base resistor
12	2.4kΩ	Tr7 base resistor
13	6.8kΩ	LCLK stabilizer
14	2.7MΩ	Frequency adjustment
15	300Ω	LED current adjustment
OSC	C4CB 8MHz	IC1 clock oscillator
L1,2	1.5mH	USM drive coil

2. IC PIN TABLE

IC1 (CPU)

No.	Symbol	I/O	A/D	Voltage	Function
1	D1	I/O	D	0-VDD	Parallel communications port
2	D2	I/O	D	0-VDD	Parallel communications port
3	D3	I/O	D	0-VDD	Parallel communications port
4	$\overline{AD}$	O	D	0-VDD	Address/Data switching signal
5	$\overline{WR}$	O	D	0-VDD	Read/Write switching signal
6	$\overline{SYNC}$	O	D	0-VDD	Synchronizing signal
7	P2	I	D	0-VDD	Photo Interruptor signal
8	P1	I	D	0-VDD	Photo Interruptor signal
9	$\overline{RST}$	I	D		CPU reset signal
10	NC				
11	NC				
12	RSV2				
13	RSV1				
14	RSV0				
15	NC				
16	NC				
17	ZOOM0	I	D	0-VDD	Zoom signal detect
18	ZOOM1	I	D	0-VDD	Zoom signal detect
19	ZOOM2	I	D	0-VDD	Zoom signal detect
20	ZOOM3	I	D	0-VDD	Zoom signal detect
21	ZOOM4	I	D	0-VDD	Zoom signal detect
22	AFADJ0	I	D	0-VDD	Best focus adjustment
23	AFADJ1	I	D	0-VDD	Best focus adjustment
24	NC				
25	ZONE0	I	D	0-VDD	Focusing Ring position
26	ZONE1	I	D	0-VDD	Focusing Ring position
27	ZONE2	I	D	0-VDD	Focusing Ring position
28	ZONE3	I	D	0-VDD	Focusing Ring position
29	ZONE4	I	D	0-VDD	Focusing Ring position
30	NC				
31	NC				
32	NC				
33	COM1	O	D	0-VDD	Common pin

No.	Symbol	I/O	A/D	Voltage	Function
34	COM2	O	D	0-VDD	Focus mode SW auto focus components
35	COM3	O	D	0-VDD	Focus mode SW manual components
36	COM8	O	D	0-VDD	Common pin
37	OPEN	I	D	0-VDD	Maximum aperture SW common
38	NC				
39	NC				
40	AF/MANU	I	D		Focus mode SW common
41	NC				
42	NC				
43	NC				
44	NC				
45	SW24				Noise filter
46	NC				
47	NC				
48	NC				
49	NC				
50	NC				
51	NC				
52	COM9				
53	BZ	O	D	0-VDD	DC/DC convertor on and off
54	NC				
55	$\overline{\text{LCLK}}$	I/O	D	0-VDD	Communication clock pulse
56	DLC	O	D	0-VDD	Lens to camera data line
57	DCL	I	D	0-VDD	Camera to lens data line
58	GND	V		0	CPU power supply device ground
59	OSC2	V			Oscillator crystal
60	OSC1	V			Oscillator crystal
61	VDD	V			CPU power supply
62	E1ON	O	D		Power switch for C-IC
63	PSM	O	D	0-VDD	Pulse to C-IC to control EMD
64	D0	I/O	D	0-VDD	Parallel communications port

IC2 (C-IC)

No.	Symbol	I/O	A/D	Voltage	Function
1	VBAT	V			Battery input from camera
2	SM4	O	D	0-VBAT	Control pin for the EMD transistor
3	SM1	O	D	0-VBAT	Control pin for the EMD transistor
4	SM2	O	D	0-VBAT	Control pin for the EMD transistor
5	SM3	O	D	0-VBAT	Control pin for the EMD transistor
6	SM8	O	D	0-VBAT	Control pin for the EMD transistor
7	SM5	O	D	0-VBAT	Control pin for the EMD transistor
8	SM6	O	D	0-VBAT	Control pin for the EMD transistor
9	SM7	O	D	0-VBAT	Control pin for the EMD transistor
10	NC				
11	BOUT	O	A	0-VBAT	USM "B" phase drive signal
12	US	I	A		Input USM S phase
13	UGND	V		0	USM device ground
14	AIN	I	A		Input USM A phase
15	AOUT	I	A	0-VB	USM "A" phase drive signal
16	VB	V	A		Input DC/DC output voltage
17	KVC1	V			Check IC
18	AGND	V		0	Analog device ground
19	NC				
20	CF	I/O	A		USM reference frequency oscillator cap
21	LR	O	A		Adjust USM reference frequency
22	FV	O	A		Connected to USM oscillator resistor
23	F	I/O	A		Connected to USM oscillator R/C network
24	NC				
25	NC				
26	NC				
27	NC				
28	VC	V			Check C-IC reference voltage
29	C32	I/O	A		Connected to USM oscillator capacitor
30	F32	I/O	A		Connected to USM oscillator R/C network

No.	Symbol	I/O	A/D	Voltage	Function
31	PR1ADJ	I	A		Threshold level adjustment
32	NC				
33	DAC	O	A		Reads voltage of CF capacitor
34	LED	I	A		Connected to photointerrupter LED
35	NC				
36	PR1	I	A		Input from focusing photointerrupter
37	GND1	V		0	C-IC digital device ground
38	P1	O	D	0-E1	Output photointerrupter signal
39	NC				
40	$\overline{\text{SYNC}}$	I	D	0-E1	Input syncronizing signal
41	$\overline{\text{WR}}$	I	D	0-E1	Input Write/Read changeover signal
42	$\overline{\text{AD}}$	I	D	0-E1	Input Address/Data changeover signal
43	D3	I	D	0-E1	Parallel communications port
44	D2	I	D	0-E1	Parallel communications port
45	D1	I	D	0-E1	Parallel communications port
46	D0	I	D	0-E1	Parallel communications port
47	PSM	I	D	0-E1	EMD contol pulse from the lens CPU
48	E1	V			C-IC power supply, controlled from CPU

3. CIRCUIT EXPLANATION

3.1 Lens Mounted on Camera

1) When the lens is mounted, VDD is applied to the lens CPU activating clock oscillator (OSC). The CPU is reset by C3 and voltage sensor IC3. After initial communications, the CPU goes into HALT mode.

2) When the camera and lens communicate, the CPU makes the $\overline{\text{E1ON}}$ pin low, turns Tr1 on, and applies E1 to the relevant circuits.

3) The camera requests lens data from the lens over the DCL line.

4) The lens sends the data over the DLC line. The camera determines whether the diaphragm is fully open. If it is not, the camera sends a diaphragm (EMD) drive command to the lens.

5) When the lens receives the EMD drive command, current flows through SM1-SM8 terminals of C-IC turning the transistor (Tr2,Tr3) on to drive the EMD.

6) If the diaphragm is fully open, the CPU senses it by the OPEN switch.

7) As in steps 3 and 4 above, the camera requests lens data again, and the lens sends the diaphragm open data to the camera.

8) After the CPU determines the diaphragm is open, it sends the EMD stop signal to C-IC.

9) If the camera determines the diaphragm is still not fully open, it decides that the diaphragm is inoperative and turns on the BC warning signal when camera SW2 is activated.

3.2 Switch Operation

When the Focus mode switch (A/M switch) is operated, the lens CPU makes DLC low regardless of $\overline{\text{LCLK}}$, and sends a WAKE UP request, activating the camera DC/DC converter. After this, the procedure is the same as from step 2, above.

3.3 Camera SW1 ON

10) When the camera SW1 is turned on, the camera DC/DC converter is activated, and lens CPU receives VDD, and VBAT (for the DC/DC converter). The lens CPU applies a low to $\overline{\text{E1ON}}$ turning Tr1 on which supplies E1 to the C-IC.

Focusing (USM) drive

11) When the focus drive signal is received from the camera, the lens CPU starts the USM drive sequence.

12) When the camera sends both the focusing command and focus data, the CPU drives the USM with this data; but if the command is received without the data, the CPU uses the previous focusing data.

13) The lens CPU sends the $\overline{\text{SYNC}}$, $\overline{\text{WR}}$, and $\overline{\text{AD}}$ signals on exclusive lines and focusing direction data on the 4-bit data lines D0 through D3. Also the LED on data is sent.

14) When C-IC receives the focus direction signal, it issues out-of-phase square wave signals AOUT and BOUT signals which cause transistor Tr4-5 and Tr6-7 to generate out-of-phase signals.

15) Square wave signals are sent to UA and UB, according to the combination of Tr4, Tr5, Tr6, and Tr7 that are on, to drive the USM.

16) As the USM turns, light from LED is "chopped" so pulses are flet by PR1, received by C-IC and sent to the CPU by line P1. These pulses contain both position and direction data.

17) The CPU counts the pulses to determine when correct focus has been reached. Focusing continues until the correct focus is reached.

18) When it is reached, the USM stop signal is sent to stop the focusing.

Diaphragm (EMD) drive

19) When the lens gets the EMD drive signal from the camera CPU, the lens sends a "busy" ($\overline{\text{LCLK}}$=low) signal.

20) When the diaphragm drive command and amount data are received, the diaphragm is driven according to the data.

21) The CPU then sends the diaphragm drive command to C-IC via the $\overline{\text{SYNC}}$, $\overline{\text{WR}}$, $\overline{\text{AD}}$ and D0-D3 lines, instructing C-IC to drive the diaphragm.

22) The CPU sends the amount data at the clock rate on the PSM line to the C-IC.

23) The C-IC uses this data to send an 8-bit signal over lines SM1-SM8 which energize the transistor Tr2,Tr3. The output of the transistor establish the current directions in coils LA and LB to stop down the diaphragm.

24) After the last pulse is sent from the CPU to the C-IC, the busy signal is removed from the $\overline{\text{LCLK}}$ line.

25) The camera sends the diaphragm stop signal through DCL to the lens CPU which sends it on over the $\overline{\text{SYNC}}$, $\overline{\text{WR}}$, $\overline{\text{AD}}$ and D0-D3 lines to remove the power from SM1-SM8.

Part 3

Repair Information

1. BEFORE REPAIR

1.1 Disassembly, Reassembly, and Adjustment Notes

1.1.1 Disassembly and Reassembly

- Tilt adjustment is necessary for this lens.
- Focus must be adjusted at three different focal lengths: Wide, Middle, and Tele.
- The degree of tightening of adjustment rings affects the adjustment.
- This lens contains very complicated optics. Do not disassemble further than necessary.
- There are also many different collars used, including some which are eccentric. Be sure to note position and orientation when removing collars.
- Always reinstall cam follower collars in the original position. If they are not, optical performance will be greatly affected.
- If screws, especially collar screws are not tightened correctly, focus variations during zooming will be unacceptable. Be sure to tighten all screws correctly.

1.1.2 Adjustments

Tilt Adjustment	(Yes) /No	Adjust by turning the eccentric collars (2) holding the 2nd lens group.	Lens projector
Centering Adjustment	Yes/ (No)		

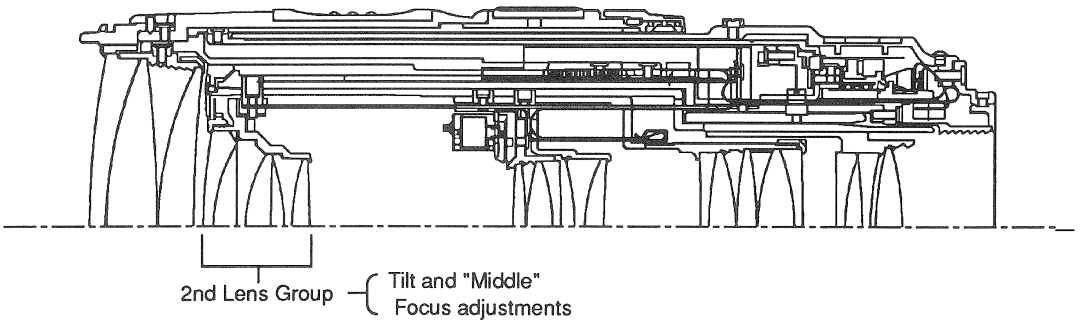
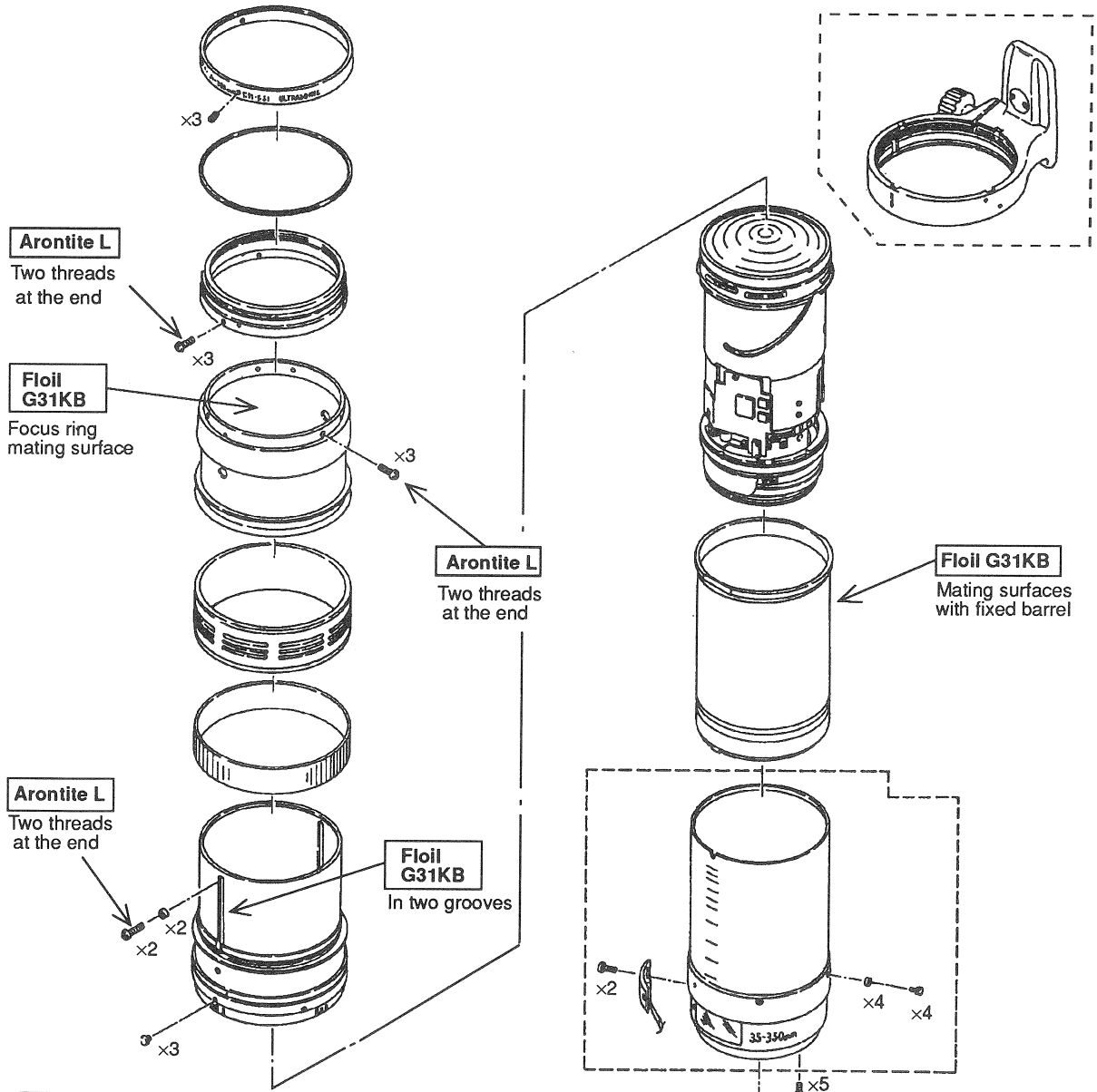


Fig. 3-1 Adjustment Points

1.2 Expendables Table



NO	Name of expendable	Part No.
1	Screw-lock	CY9-8011
2	Aron Tite L	CY9-8008
3	Water Base Adhesive Bond7	CY9-8015
4	FLOIL G31KB	CY9-8092
5	Electro-lub 2G-x	CY9-8039
6	MM-010	CY9-8101
7	Double-sided Adhesive Tape	CY4-9303
8	Acetate Cloth Tape	CY4-9102

*No. 1to 3:Glue
*No. 4: Grease

Fig. 3-2 Expendables Table (I)

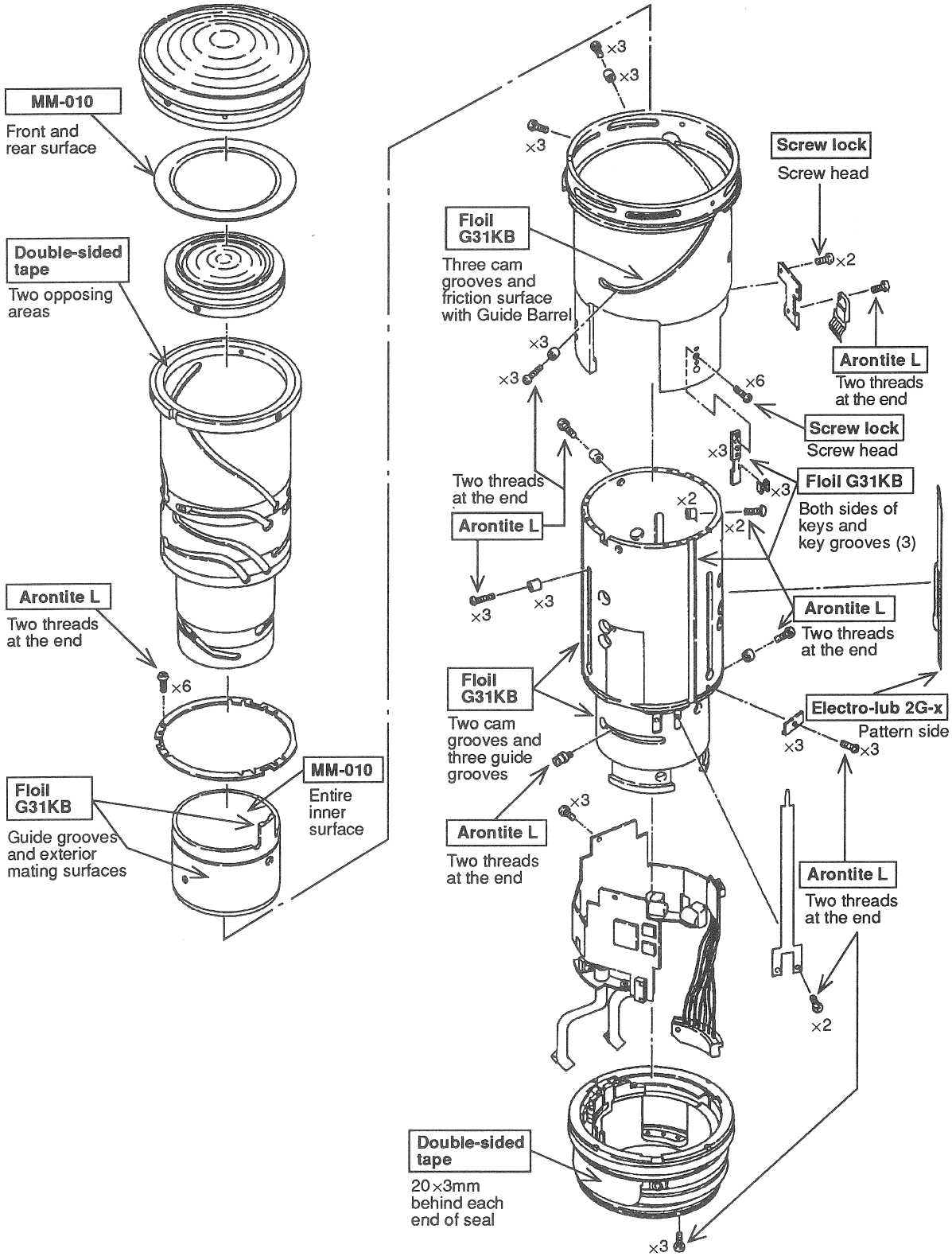


Fig. 3-3 Expendables Table (II)

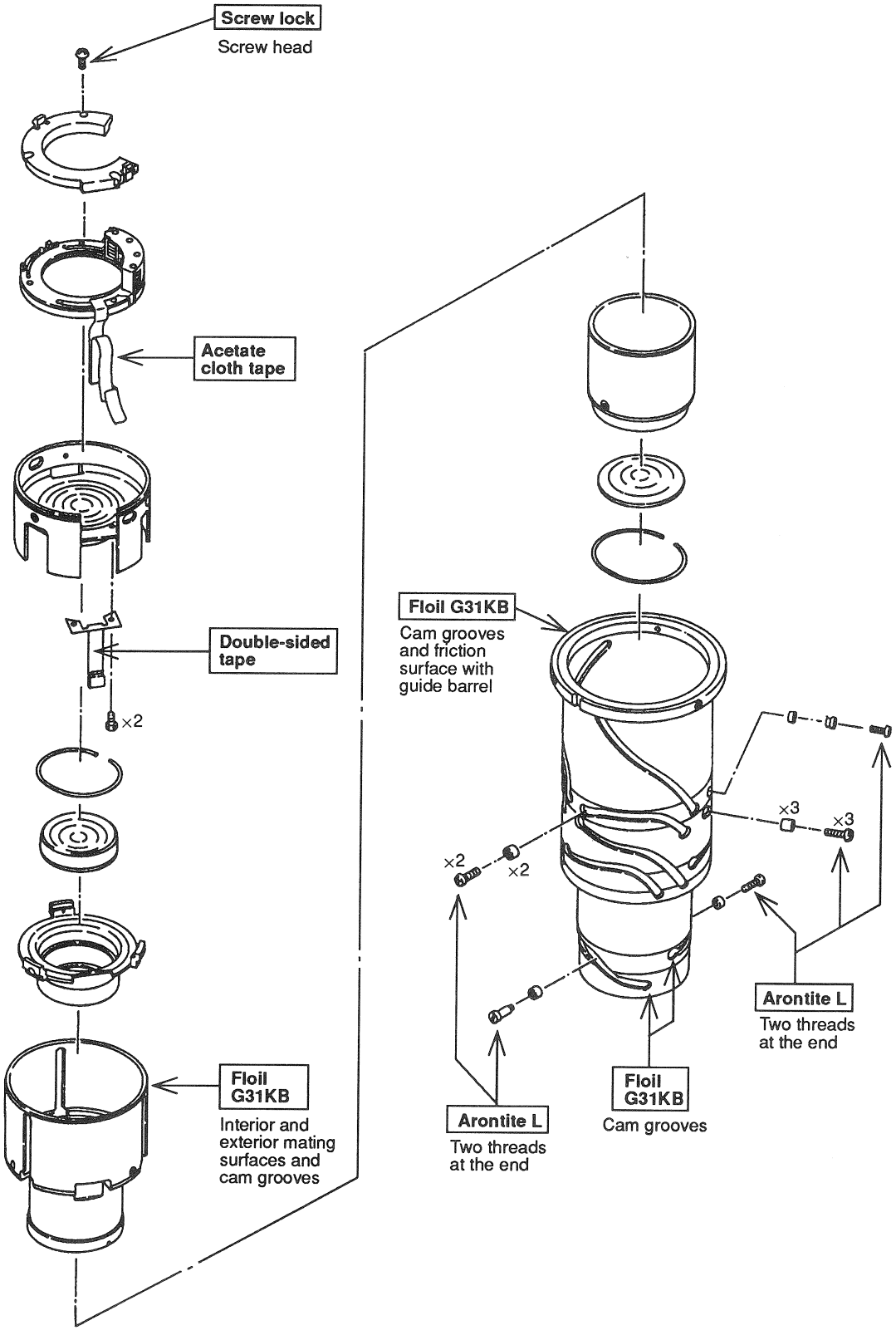


Fig. 3-4 Expendables Table (III)

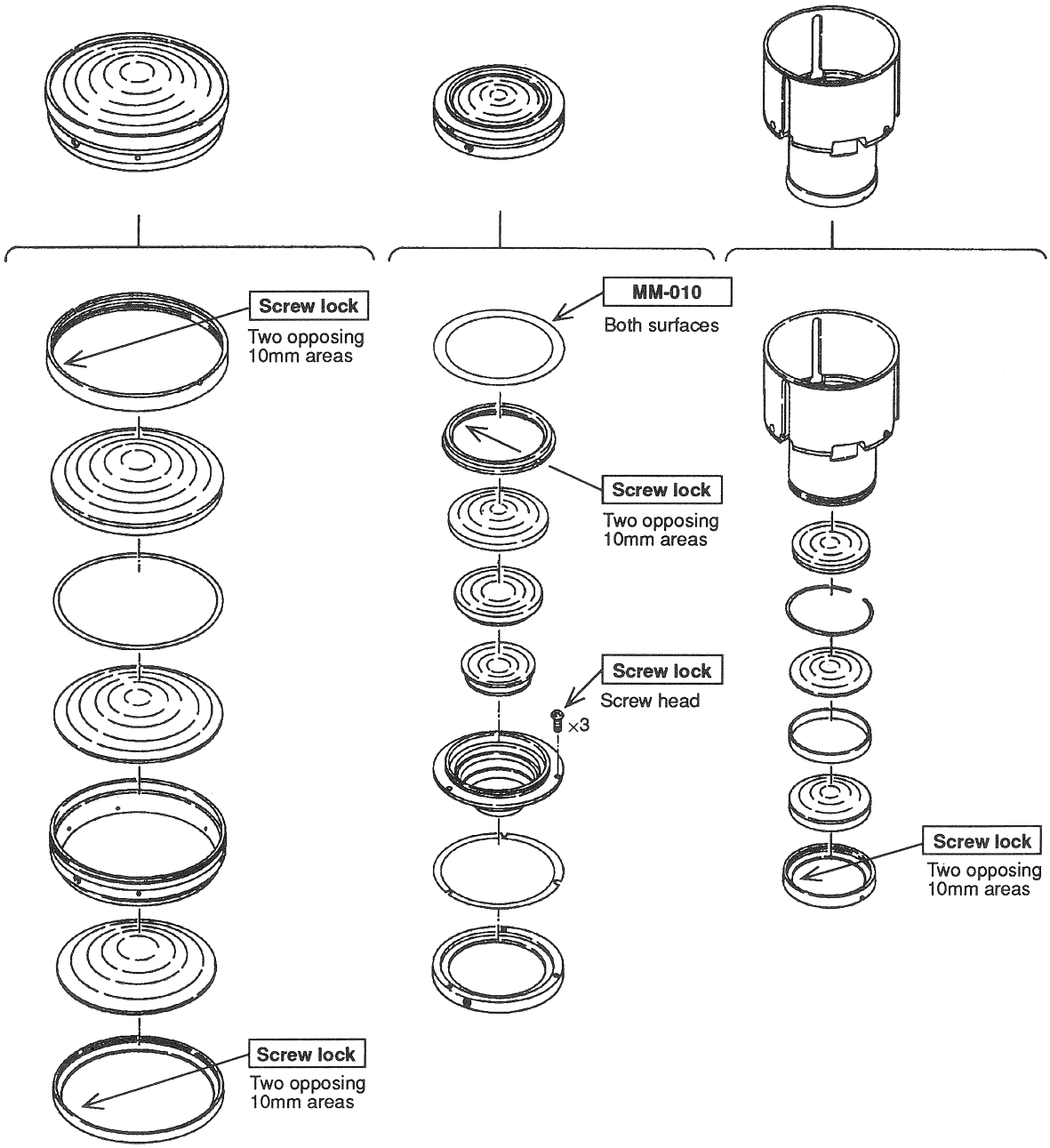


Fig. 3-5 Expendables Table (IV)

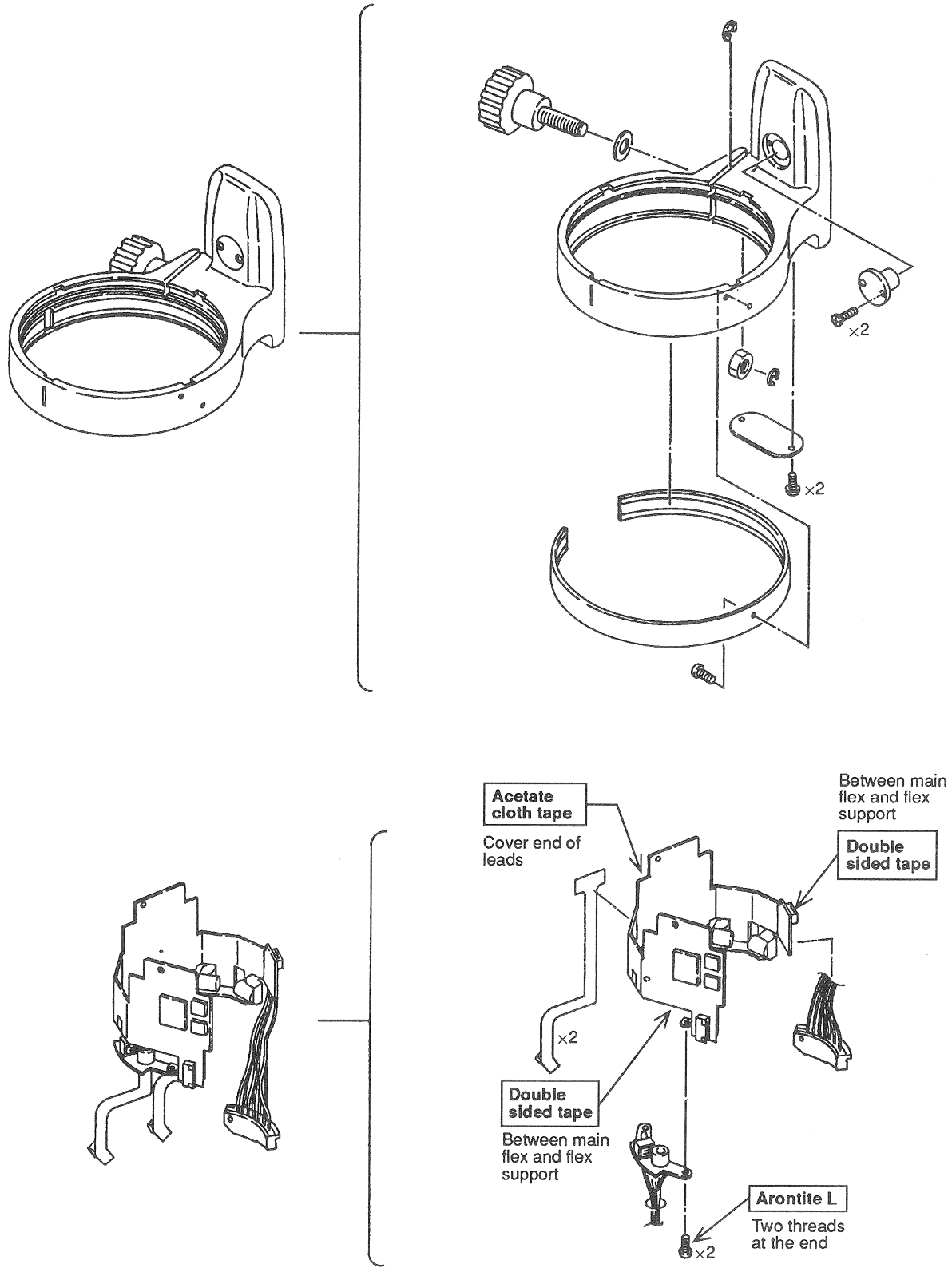


Fig. 3-6 Expendables Table (V)

1.3 Adjustments Table

Adjustment Item	Purpose	Description	Page
Tilt	Make resolution at the periphery of the field uniform.	Make this adjustment when the 2nd lens unit or any optical component is changed, or disturbed.	3-34
Focus	Achieve infinity focus.	Check and adjust when the lens is disassembled, and particularly when the lens barrel is disturbed.	3-36
Pulse	Achieve accurate USM drive data.	Make adjustment when the focusing unit or main flex unit is replaced.	3-38
Focus compensation	Achieve the best autofocus at very large apertures.	When main flex is replaced, set the adjustments pads as the replaced parts.	3-40
USM Reference frequency*	Set reference frequency.	Adjustment is not normally required since service parts are preadjusted.	3-42
Zoom brush position	Correctly read zoom information.	Make the adjustment if the zoom brush or Z-Flex (zoom flex) is disturbed.	3-43
Focus Ting Unit Adjustment	Adjust the tightening of the ring.	Make the adjustment if the ring or Fixed Barrel is changed.	3-44

* USM Reference Frequency is given because it may need to be adjusted in certain rare instances.

2. DISASSEMBLY AND REASSEMBLY

2.1 Front Disassembly

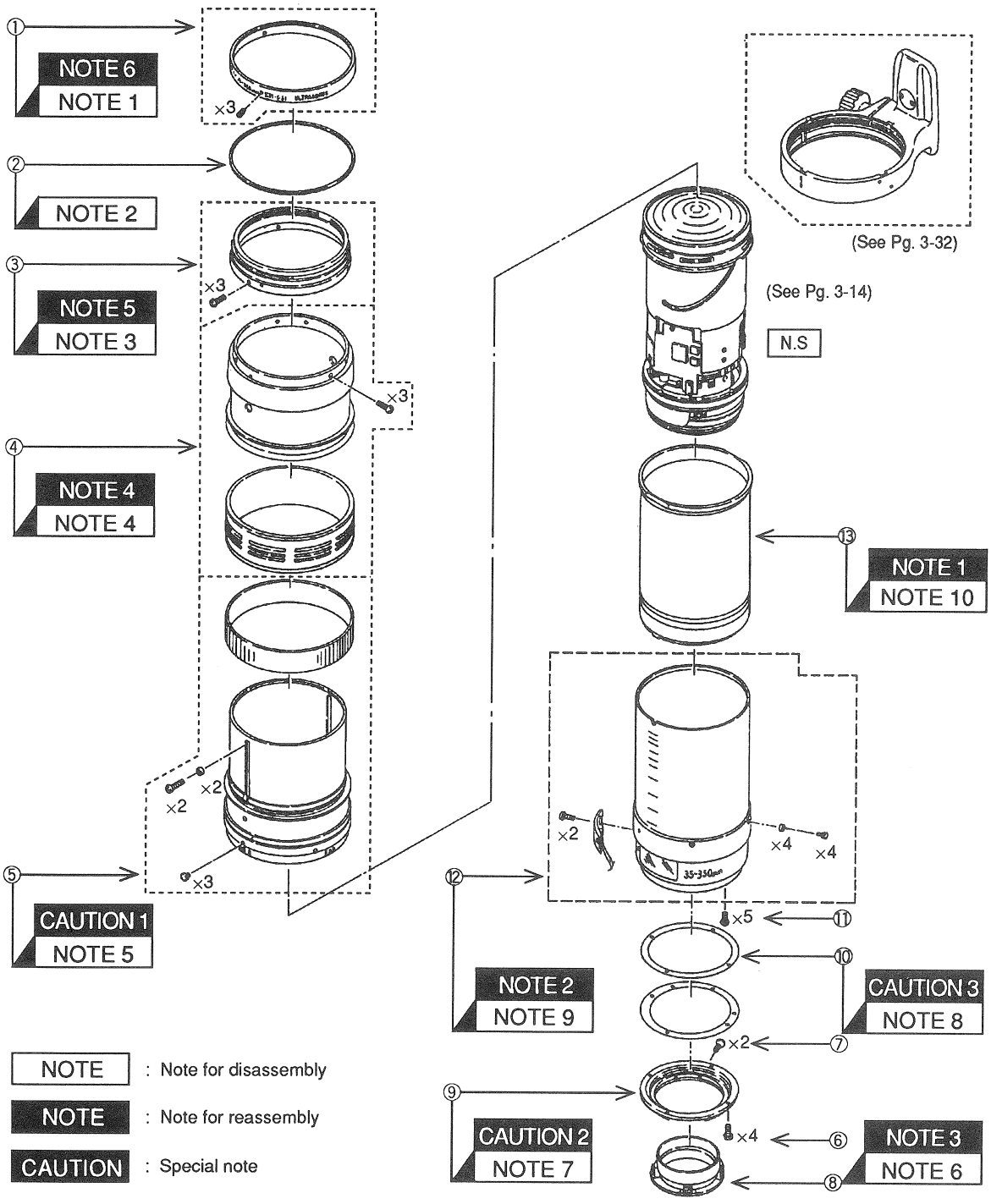


Fig. 3-7 Front Disassembly

2.1.1 Disassembly Notes

Disassembly Procedure

1) Name Ring (3 screws)
↓
2) "L" (Red) Ring
↓
3) Front Ring (3 screws) (Staked)
↓
4) Zooming Ring and Rubber Ring
↓
5) Focusing Ring Unit (Remove collar, screws) Rubber Ring
↓
6) Mount Screws (4 ea.) (Staked)
↓
7) MIF Contact (2 Screws)
↓
8) Back Cover (Staked)
↓
9) Lens Mount
↓
10) Mount Spacer
↓
11) 5 Fixed Barrel Screws
↓
12) Fixed Barrel Unit
↓
13) Focus Extension Guide

NOTE 1 **Name Ring Removal**
- Remember positioning when removing the ring.

NOTE 2 **"L" Ring Removal**
- Be careful not to scratch the ring. The red paint scratches fairly easily.

NOTE 3 **Front Ring Removal**
- The ring must be reinstalled in the same position as removed. Mark its position before taking it off.

NOTE 4 **Zooming Ring**
- Mark position before removing (The rubber ring need not be removed).

NOTE 5 **Focusing Ring Unit Removal**

- Mark position before removing. (Mark position of focus extension guide also.) The rubber ring need not be removed.
- Bearing balls within the focus torque ring are not stocked separately. Do not disassemble this unit unless necessary.

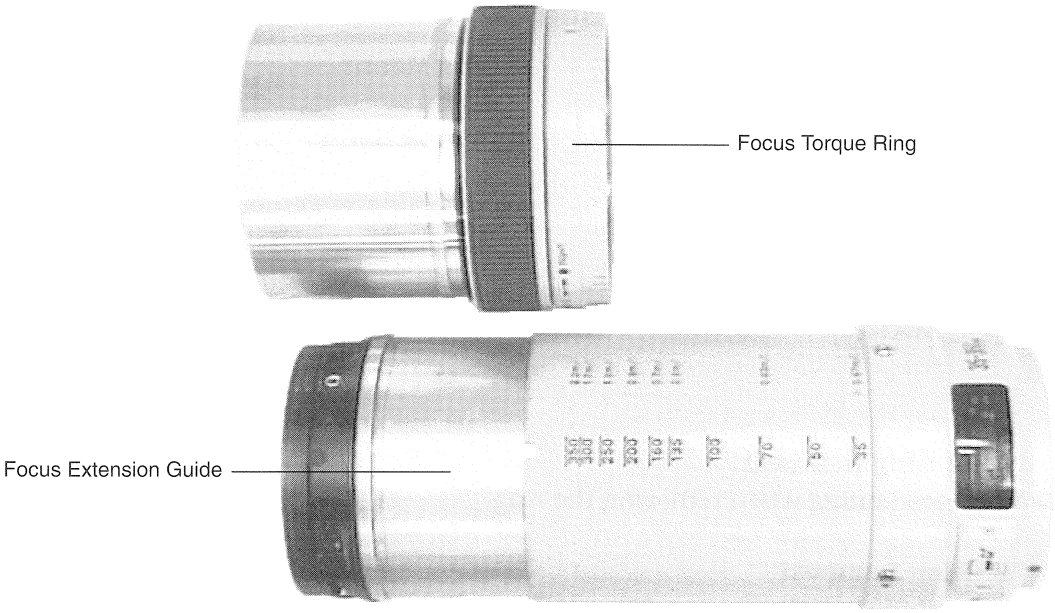


Fig. 3-8 Focusing Ring Unit Removal

NOTE 6 **Back Cover Removal**

- After removing the back cover screws push the back cover from the inside to remove. To reassemble, attach the lens mount first and then push the back cover in.

NOTE 7 **Lens Mount Removal**

- The mount is easier to remove if the zoom is set to about the 70mm position.

NOTE 8 **Mount Spacer Removal**

- If spacers are installed, determine and record their quantity.

NOTE 9 **Fixed Barrel Unit Removal**

- Disconnect the flex before removing.

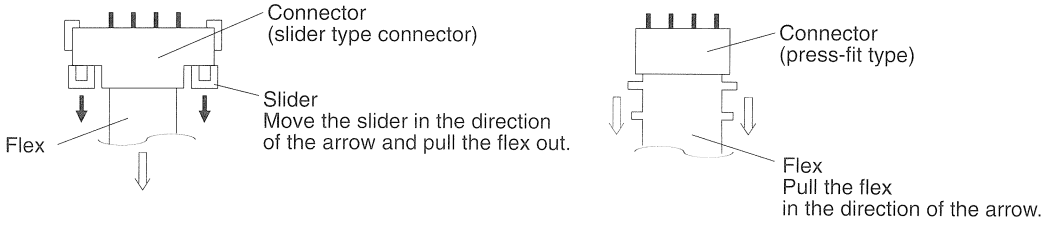


Fig 3-9 Flex Removal

NOTE 10 **Focusing Extension Guide**

- Mark position before removing.

2.1.2 Reassembly Notes

CAUTION 1 **Focusing Ring Unit or Collar Replacement**

- If the focusing ring unit is replaced, the focus torque ring must be adjusted. See Section 3.7 for details.
- If the collars must be replaced, measure the follower diameter of the replaced collars and install the same size replacements, or try each of the four sizes to determine which fits best, working smoothly, but with as little slop as possible.

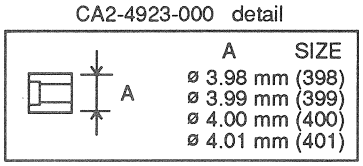


Fig. 3-10 Adjustment Collars

CAUTION 2 **Lens Mount Unit Replacement**

- The factory mount is shaved to achieve correct focus. When replacing it, measure its thickness and use the service mount and service focus shims to achieve the same thickness. See Section 3.2 for details.

CAUTION 3 **Mount Spacers Replacement**

- Use the same number of spacers as were removed.

NOTE 1 **Focus Extension Guide Installation**

- Be careful not to mar the finish of the focusing scale seal when installing the guide, to which the seal is attached.

NOTE 2 **Fixed Barrel Installation**

- Be careful to not pinch the flex when installing the fixed barrel.

NOTE 3 **Back Cover Installation**

- When installing the back cover, take care not to pinch the connector or any of the leads. The cam barrel groove may be deformed causing improper focus operation.
- Bend the flex correctly before installing the back cover, and check that it does not stick out anywhere after the cover is installed.

NOTE 4 **Zooming Ring Installation**

- When installing the zooming ring, install it so the "R" in Ultrasonic is at top dead center (aligned with the focusing index).

NOTE 5 **Front Ring Installation**

- When installing the Front Ring, position it so the red dot is 90 degrees clockwise from the index at TDC (viewed from the front of the lens).

NOTE 6 **Name Ring Installation**

- When installing the name ring the "5" in 350 should be at TDC, aligned with the focusing index.

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2.2 USM Unit Removal

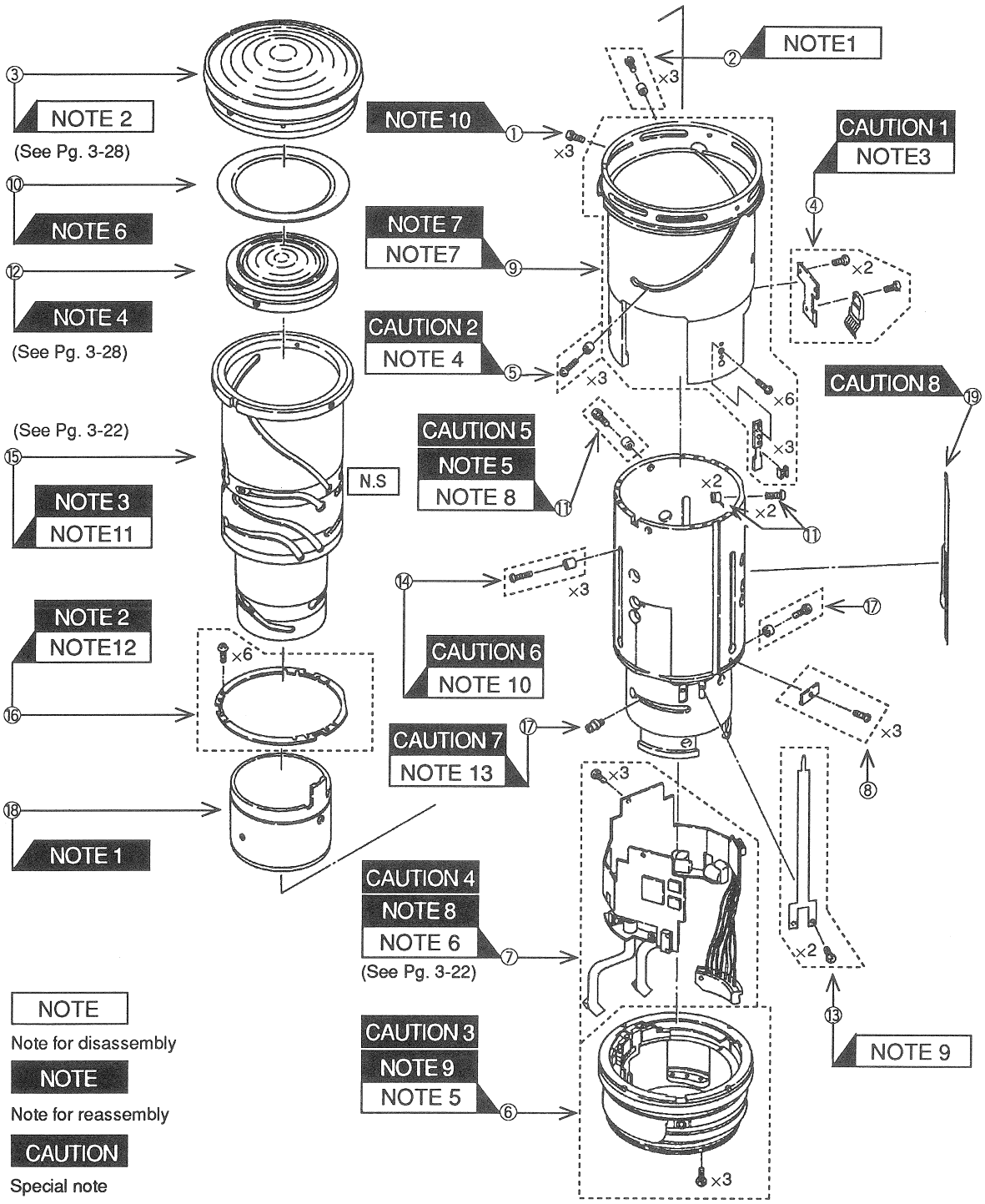

Fig. 3-11 USM Unit Removal

Disassembly Notes

- By setting at WIDE and nearest focus, all collar screws are visible.
- Study the collar coupling and individual collar orientation before removing any of them. Several of the collars are eccentrics. If they are not reinstalled as removed, extra adjustment is required.

Disassembly Procedure

1) Front Lens Unit screws (3 ea.)
↓
2) FLU Collars
(Remove with screws)
↓
3) Front Lens Unit
↓
4) Zooming Brush and brush holder
(Remove screws) (Staked)
↓
5) Collar 1' ×3 (Staked)
(Remove with screw)
↓
6) Focus Unit
(3 screws) (Staked)
↓
7) Main Flex Unit
(3 Screws)
↓
8) Zoom Stopper Plates
(3 screws) (Staked)
↓
9) Guide Barrel
(Compensation keys and plates)
↓
10) Flare Stop
↓
11) 2nd Lens Group Collars
(3 screws) (Staked)
↓
12) 2nd Lens Group Unit
↓
13) Holder
(2 screws) (Staked)
↓
14) Collar 2' ×3
(Remove with screws) (Staked)
↓
15) Cam Barrel Unit
↓
16) Zoom Stopper
(6 screws) (Staked)
↓
17) Focus pin,
collar with screw (Staked)
↓
18) Focus Barrel
↓
19) Z-Flex (Zoom Flex)

NOTE 1 **FLU Collars Removal**

- Check positioning collars and FLU before removing the collars.

NOTE 2 **Front Lens Unit Removal**

- Don't scratch the lens elements, and mark unit position for reinstallation.

NOTE 3 **Zoom Brush Removal**

- When reinstalled, the zoom brush must be adjusted. Marking its position before removing makes the adjustment simpler.

NOTE 4 **Collar 1 (Guide barrel coupling collars) Removal**

- Washers are sometimes used between the collars and lens cell.
- If so, note position and number and reinstall as removed.

NOTE 5 **Focus Unit Removal**

- Disconnect the two flex connectors to remove the focus unit.

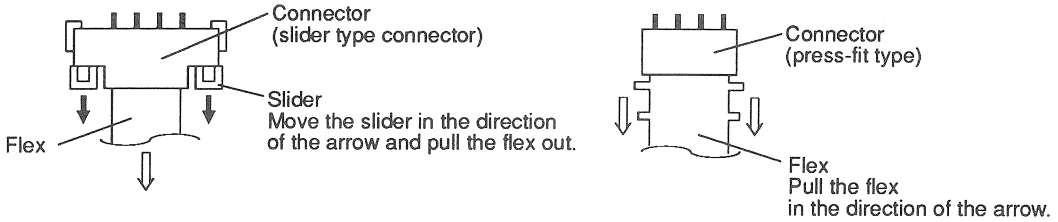

Fig. 3-12 Flex Disconnection

NOTE 6 **Main Flex Removal**

- Disconnect two flex connectors to remove the main flex.

NOTE 7 **Guide Barrel Removal**

- The guide barrel can be removed without removing the compensation key or plate.

NOTE 8 **2nd Lens Group Collar Removal**

- These collars hold the 2nd Lens Group. If they are disturbed the tilt adjustment is necessary, but the lens elements and lens barrel (YA2-0877) can be removed without disturbing theses collars.

NOTE 9 **Flex Holder Removal**

- Be careful to not tear the EMD flex when removing this holder.

NOTE 10 **Collar 2 (5th Group coupling collars) Removal**

- These collars hold the 5th lens group. (No. 5 on page 3-22)

NOTE 11 **Cam Barrel Unit Removal**

- This part must only be installed one way. Check positioning before removal.

NOTE 12 **Zoom Stopper Removal**

- The stopper should only be removed when it is being replaced.
- The cam barrel can be removed without removing the stopper, but take care not to scratch the barrel.

NOTE 13 **Focus Pin, Collars (Focus barrel coupling) Removal**

- When removing the focus pin, the opposing collar and its screw must also be removed. They couple with the focus barrel (18).
- The focus barrel must be reinstalled in the same position, so check its position before removing it.

2.2.2 Assembly Notes

- Always reinstall cam follower collars in the original position. If they are not, optical performance will be adversely affected.
- If screws, especially collar screws are not tightened correctly, focus variations during zooming will be unacceptable. Be sure to tighten all screws correctly.

CAUTION 1 **Zoom Brush Replacement**

- The zoom brush must be adjusted whenever it is disturbed. Set it as indicated in the adjustment (3.6 Zoom Brush Position Adjustment), zoom through the entire range and check that no brush touches the adjacent pattern.

CAUTION 2 **Collar 1 (Guide barrel coupling collars) Replacement**

- If the collars must be replaced, measure the follower diameter of the replaced collars and install the same size replacements, or try each of the four sizes to determine which fits best, working smoothly, but with as little slop as possible.

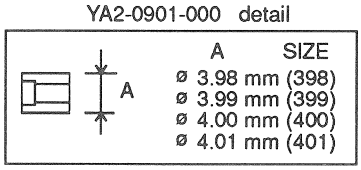

Fig. 3-13 Adjustment Collars

CAUTION 3 **Focus Unit Replacement**

- If the focus unit is replaced, the pulse adjustment (3.3 Pulse Adjustment) is necessary.
- Before reconnecting the flex, wipe the connector pattern to prevent shorts.

CAUTION 4 Main Flex Unit Replacement

- Solder the AF-ADJ0,1 pads as they were soldered on the removed flex unit. (See 3.4 Focus Compensation.)
- The pulse alignment must be performed. (See 3.3 Pulse Adjustment)
- Before reconnecting the flex, wipe the connector pattern to prevent shorts.

CAUTION 5 2nd Lens Group Collar Replacement

- If the collars must be replaced, measure the follower diameter of the replaced collars and install the same size replacements, or try each of the four sizes to determine which fits best, working smoothly, but with as little slop as possible.

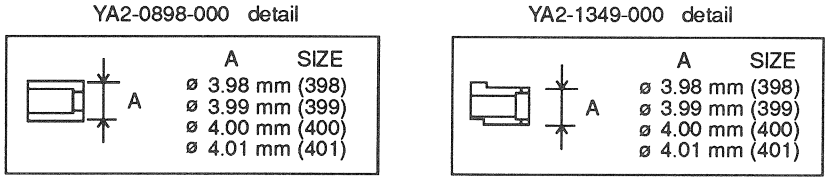

Fig. 3-14 Collar 2 Adjustment Sizes

CAUTION 6 Collar 2 (5th Group coupling collars) Replacement

- These collars hold the 5th lens group. CAUTION 5 also applies.

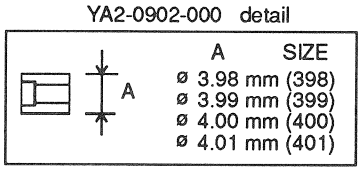

Fig. 3-15 5th Group Coupling Collar Replacement

CAUTION 7 Focus collars (Focus barrel coupling) Replacement

- When replacing the focus collar, CAUTION 5 also applies.

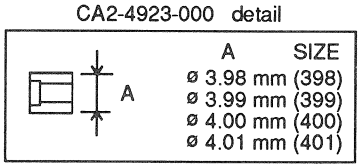

Fig. 3-16 Focus Collar Replacement

CAUTION 8 Z-FLX (Zoom Flex) Replacement

- The zoom brush must be adjusted when the Z-FLX is replaced.
- Align the hole in the zoom flex with the pin on the guide barrel. (3.6 Zoom Brush Position Adjustment)

NOTE 1 Focus Barrel Installation

- Align the extension arm on the focus barrel within the Z-FLX position on the cam barrel as shown.

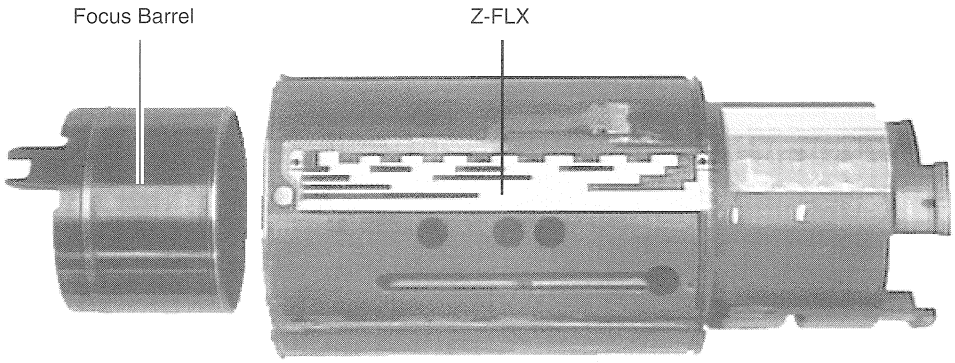

Fig. 3-17 Focus Barrel Installation

NOTE 2 Zoom Stopper Installation

- If the zoom stopper is not correctly installed, it will scrape against the cam barrel during zooming causing a scratching noise.

NOTE 3 Cam Barrel Installation

- Pull the EMD unit's flex through the hole for the "U-turn" Flex holder (13), and place the protruding collar in the straight groove.
- When assembling the guide and cam barrels, take care not to tear the flex.

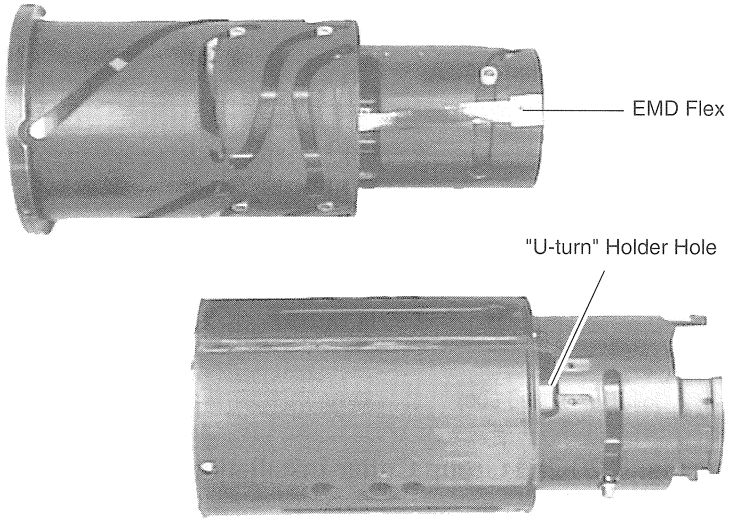

Fig. 3-18 Cam Barrel Installation

NOTE 4 **2nd Group Barrel Installation**

- Place the tip of the "U-turn" Holder in the hole in the 2nd Group barrel.

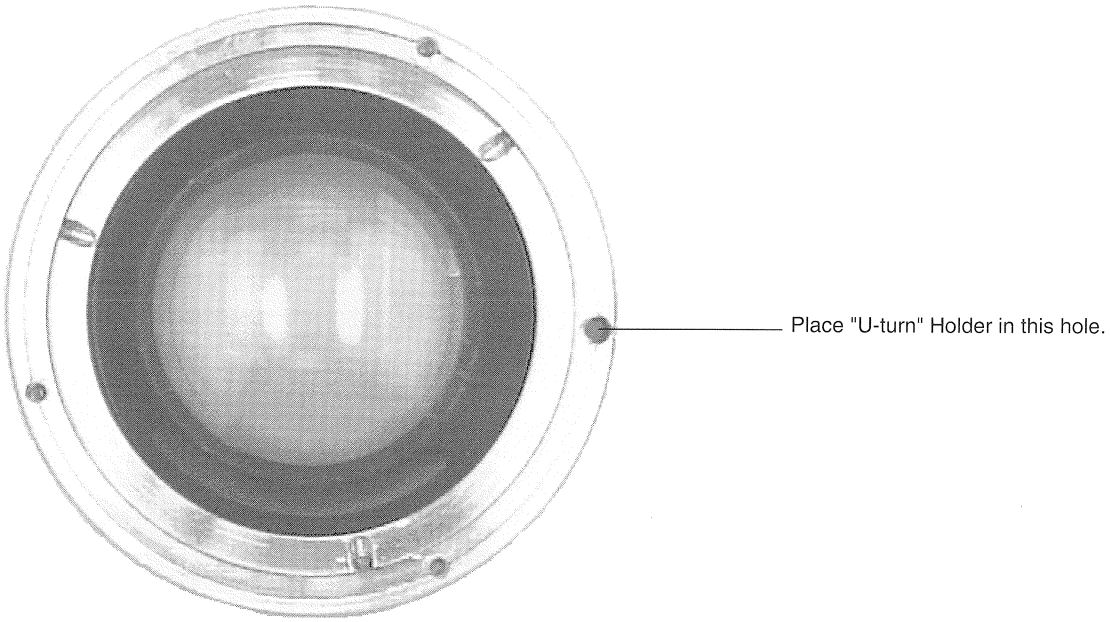

Fig. 3-19 2nd Group Barrel Installation

NOTE 5 **2nd Group Collar Installation**

- The concentric collar (YA2-0898-000) goes in the hole at the end of the zoom flex (Z-FLX). (Note that although different from the position shown in the original parts catalog, this is the correct position.)
- To prevent the collar screw from loosening during adjustment, always turn the collars clockwise during adjustment.

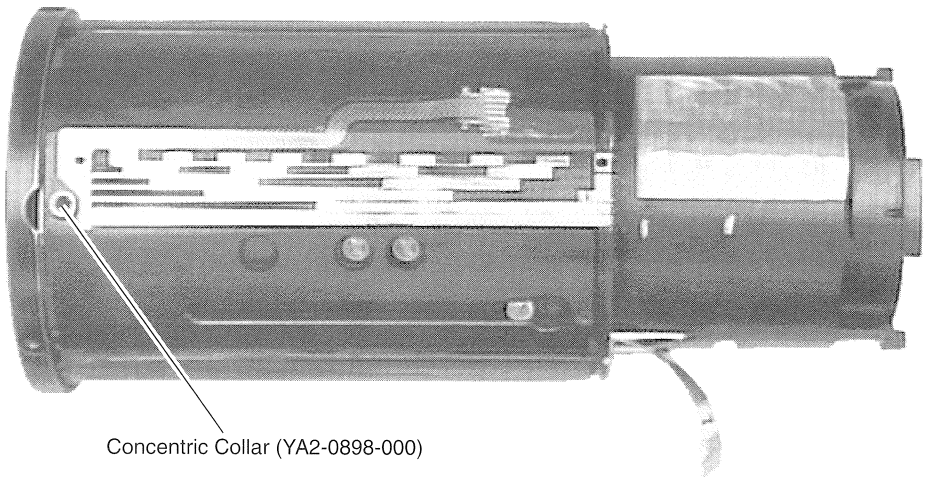

Fig. 3-20 2nd Group Collar Installation

NOTE 6 **Blind Plate Installation**

- Insure that the plate is not bent, and is properly seated when installed.

NOTE 7 **Guide Barrel Installation**

- Check that the zoom brush mounting position (mounting holes) is properly aligned with the zoom flex, and also take care with the zoom flex. The zoom flex connector gets caught easily.

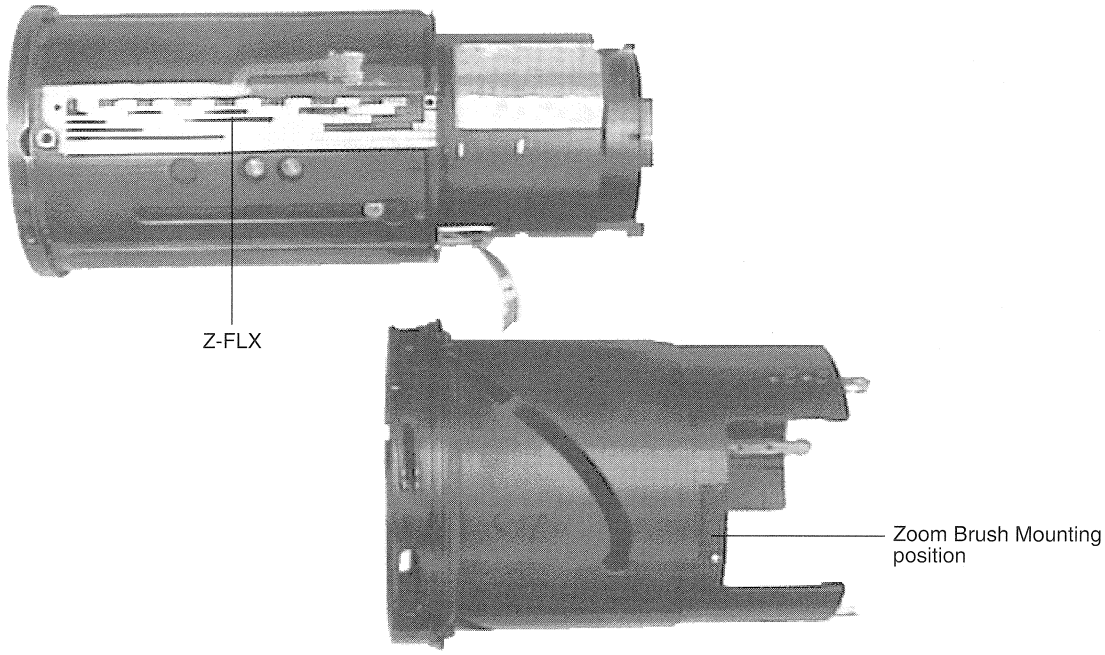

Fig. 3-21 Guide Barrel Installation

NOTE 8 **Main Flex Unit Installation**

- Insure that the SUB-FLX is not twisted and is properly seated when it is installed.
- When the leads are fixed to the guide barrel, push them into the "corner" of the guide barrel so they are not sticking out.

NOTE 9 **Focus Unit Installation**

- When the focus unit is installed, insure that neither the flex nor leads is pinched in anyway.
- When the screws are installed, insure that they are tightened evenly.

NOTE 10 **Front Lens Unit Mounting Screws**

- The holes for the mounting screws are drilled through, so any dust, etc. in the holes can get into the lens proper.

2.3 EMD Unit Removal

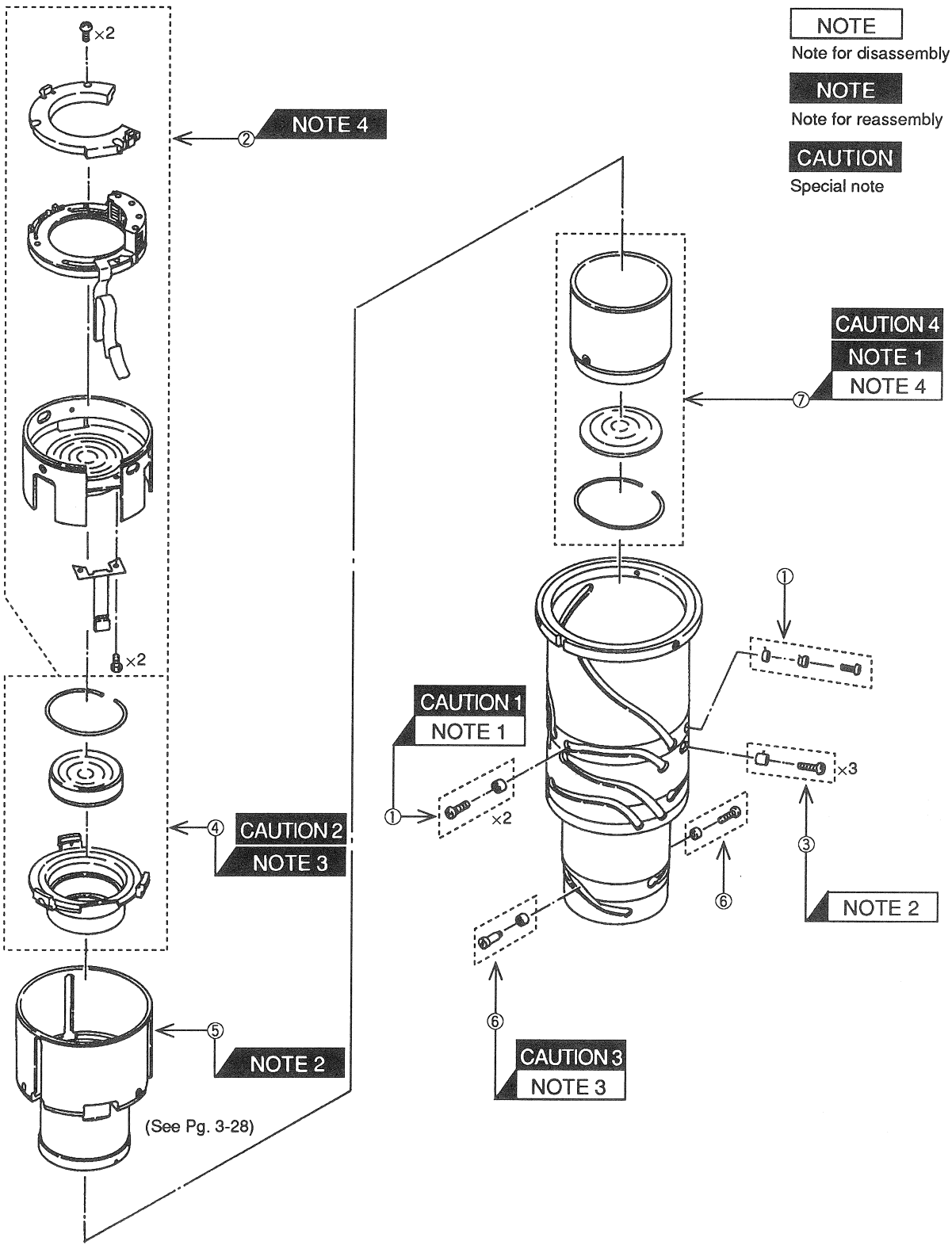

Fig. 3-22 EMD Unit Removal

2.3.1 Disassembly Notes

- Study the collar coupling and individual collar orientation before removing any of them. Several of the collars are eccentrics. If they are not reinstalled as removed, extra adjustment is required.

Disassembly Procedure

1) Collar 1
   (3 ea.) (Remove screws.) (Staked)
   ↓
2) 3rd Group Unit
   EMD UNIT
   EMD Holder (2 screws)
   "U-turn" Holder 2 screws.(Staked)
   ↓
3) Collar 2
   (3 ea.) (Remove screws) (Staked)
   ↓
4) 4th Group Unit
   ↓
5) 5th Group Unit
   ↓
6) 6th Group collars (3 ea.)
   (Remove screws.) (Staked)
   ↓
7) 6th Group Unit.

NOTE 1 **Collar 1 (3rd Group Coupling Collars) Removal**

- Washers are sometimes used between the collars and lens cell. If so note position and number and reinstall as removed.
- These collars hold the 3rd lens group.

NOTE 2 **Collar 2 (4th Group Coupling Collars) Removal**

- These collars hold the 4th lens group.

NOTE 3 **6th Group Collar Removal**

- These collars hold the 6th lens group.
- Before removing the 6th group, mark its position for reassembly.

NOTE 4 **6th Group Removal**

- This group is removed from the mount end.

2.3.2 Assembly Notes

CAUTION 1 Collar 1 (3rd Group Coupling Collars) Replacement

- If the collars must be replaced, measure the follower diameter of the replaced collars and install the same size replacements, or try each of the sizes to determine which fits best, working smoothly, but with as little slop as possible.

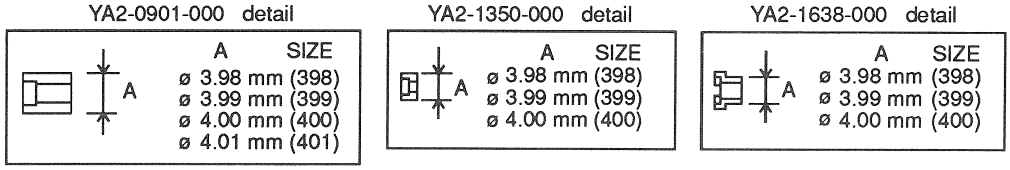

Fig. 3-23 3rd Group Adjustment Collars

CAUTION 2 G12 Retaining Ring Replacement

- Measure the diameter of the replaced ring with a micrometer and replace with one of the same diameter.
- After installing the retainer, lightly tap the lens to insure there is no looseness, and that the ring is fully seated.

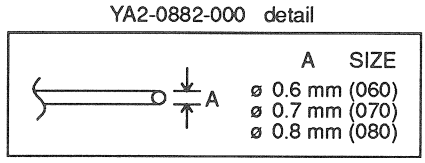

Fig. 3-24 G12 Adjustment Sizes

CAUTION 3 6th Group Coupling Collar Replacement

- These collars hold the 6th lens group. CAUTION 1 also applies.

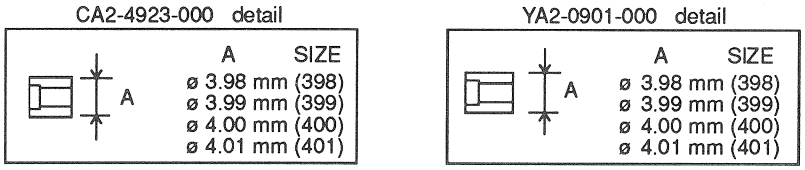

Fig. 3-25 6th Group Collar Replacement

CAUTION 4 G21 Retaining Ring Replacement

- Caution 2 also applies to this retainer.

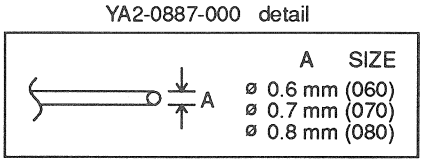

Fig. 3-26 G21 Adjustment Sizes

NOTE 1 6th Group Installation

- After installing the 6th group, turn the lens upside down. The group should move by its own weight.

NOTE 2 5th Group Installation

- Align the EMD flex reliefs in both the 5th group barrel and cam barrel as indicated in the figure.

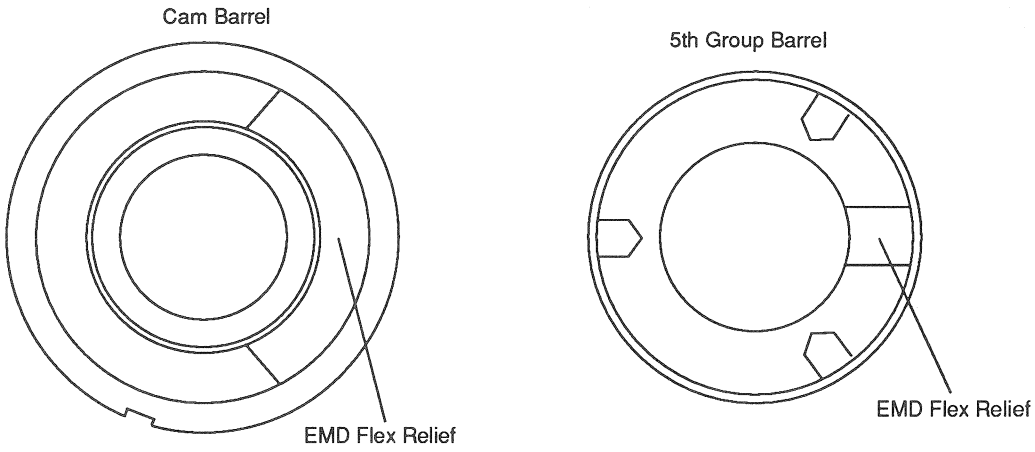

Fig. 3-27 5th Group Barrel Installation

NOTE 3 **4th Group Barrel Installation**

- Align the EMD reliefs when installing the unit.

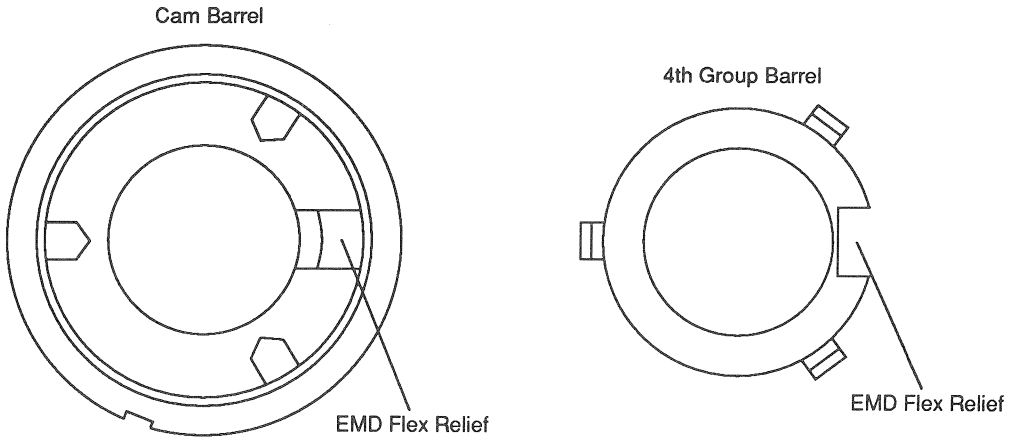

Fig. 3-28 4th Group Barrel Installation

NOTE 4 **3rd Group Installation**

- Align the EMD flex with the relief in the cam barrel as indicated in the figure.

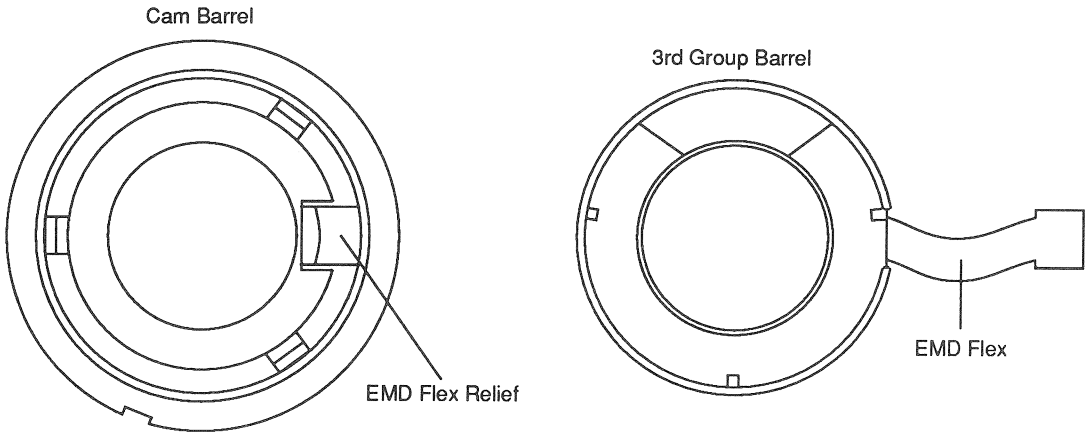

Fig. 3-29 3rd Group Barrel Installation

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2.4 Lens Unit Disassembly

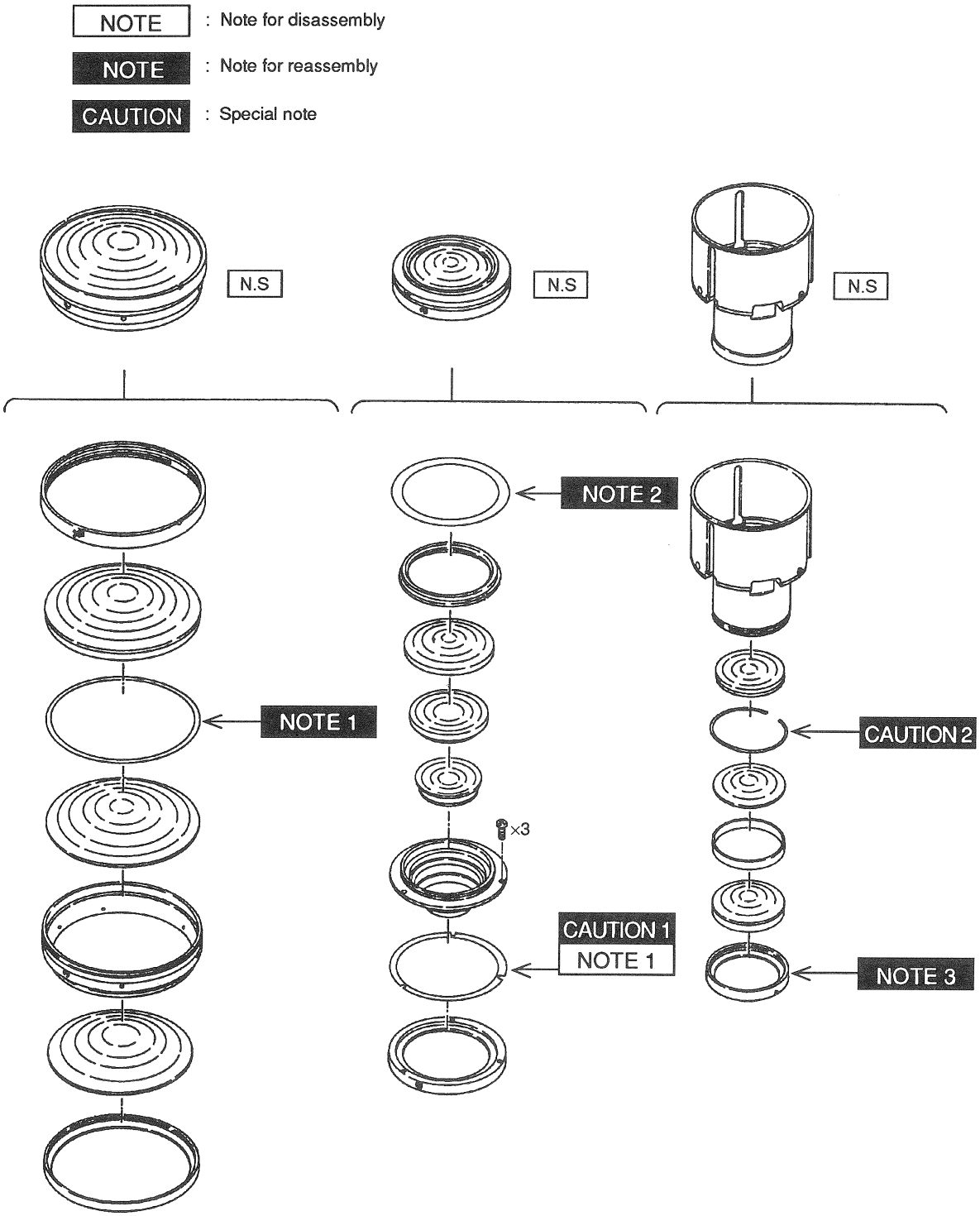

Fig. 3-30 Lens Unit Disassembly

2.4.1 Disassembly Notes

- Be careful not to soil or scratch the lens elements.
- Focus is determined by the 2nd group spacer. Do not disassemble the 2nd group unless necessary.
- See page 3-5 for adhesives used.

NOTE 1 **2nd Group Spacer Removal**

- The 2nd group spacer is used to adjust the focus in the middle area of the zoom range. Be careful not to lose, break, or bend it.

2.4.2 Assembly Notes

- The assembly collars bend easily. Be careful when tightening.

CAUTION 1 **2nd Group Spacer Replacement**

- Measure the thickness of the spacer with a micrometer and replace with one of the same thickness.

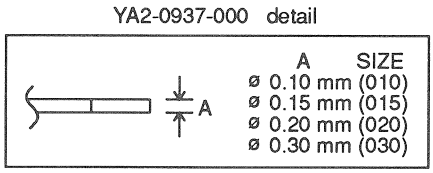

Fig. 3-31 2nd Group Spacer Adjusting Parts

CAUTION 2 **G15 Retaining Ring Replacement**

- Measure the diameter of the replaced ring with a micrometer and replace with one of the same diameter.
- After installing the retainer, lightly tap the lens to insure there is no looseness, and that the ring is fully seated.

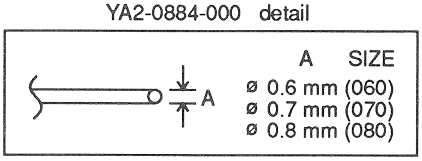

Fig. 3-32 G15 Adjusting Parts

NOTE 1 **Intra-element Washer "Luminar A" Installation**

- When G1 is installed the washer is easily deformed. Take care.

NOTE 2 **2nd Group Cover Installation**

- When attaching this cover, insure that it is clean and properly seated all around.

NOTE 3 **G18 Assembly Ring Installation**

- First tighten down the ring, then loosen it some. Retighten to where it hits the lens and back off 2 to 3mm.
- After installing the lens, lightly tap the lens to insure there is no looseness.

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2.5 Miscellaneous Disassembly

NOTE : Note for disassembly

NOTE : Note for reassembly

CAUTION : Special note

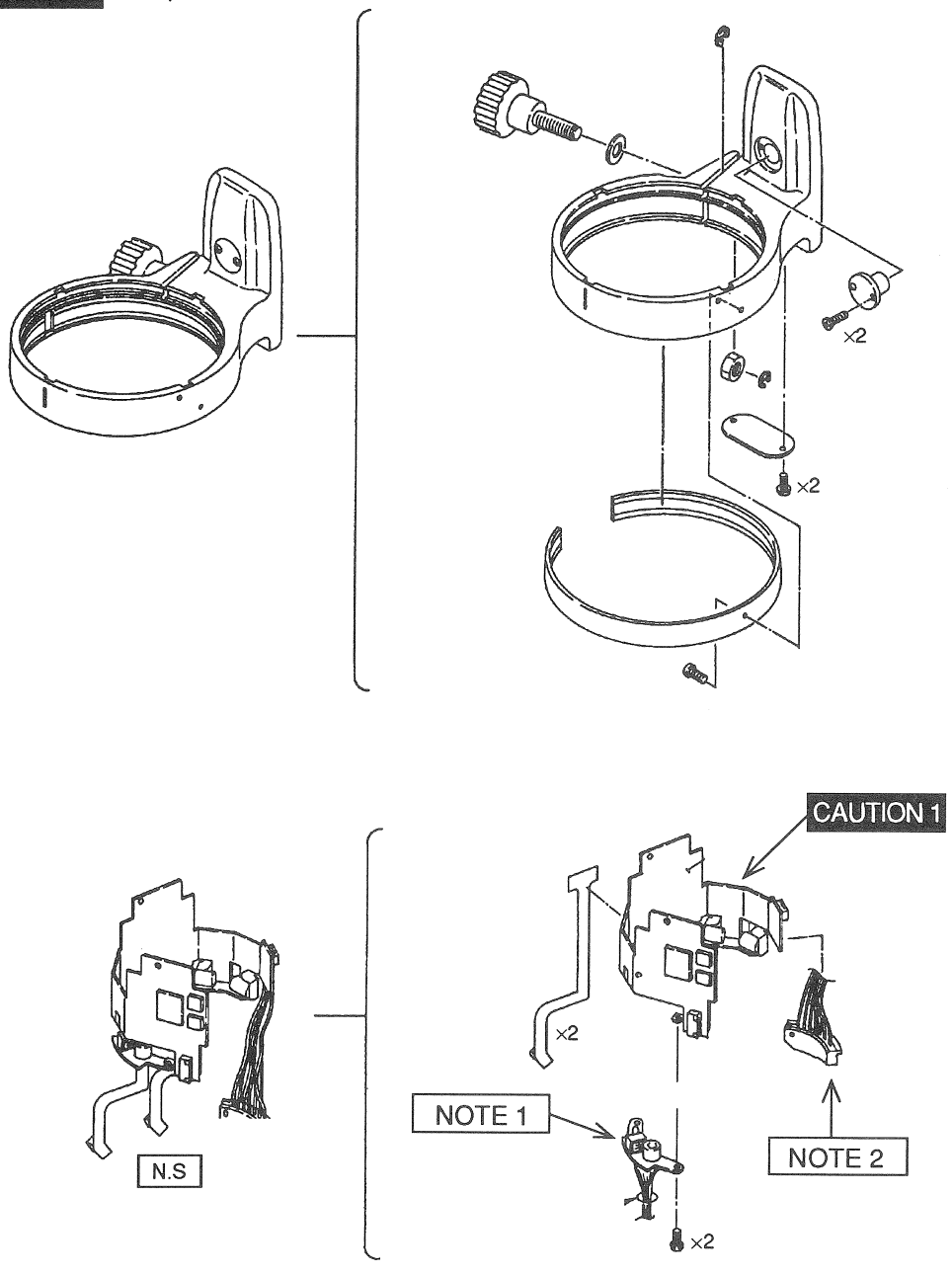


Fig. 3-33 Miscellaneous Disassembly

2.5.1 Disassembly Notes

- Be careful not to pinch, crimp, or tear any flex or lead wires during installation.

NOTE 1 **DC/DC Convertor Removal**

- The lead wiring is shown in figure 3-34.

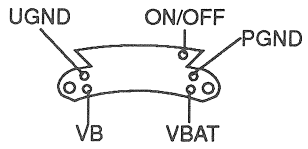


Fig. 3-34 DC/DC Convertor Wiring

NOTE 2 **Mount Interface (MIF) Contact Removal**

- The lead wiring is shown in figure 3-35.

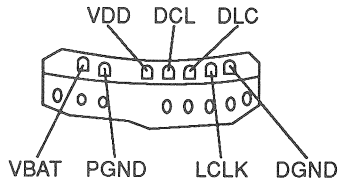


Fig. 3-35 MIF Contact Wiring

2.5.2 Assembly Notes

CAUTION 1 **Main Flex Unit Replacement**

- If the main flex unit is replaced, the pulse adjustment (3.3) and focus compensation (3.4) must be adjusted.

3. ADJUSTMENT

3.1 Tilt Adjustment

* Do this adjustment when you replace or disassemble any of the optical components.
* If a collar is replaced, measure and replace with an identical one.

Purpose: Make the resolution at the edges of the field uniform.

Tools:
- Lens projector
- Modified fixed barrel unit
  Cut a defective unit at the 250mm zoom position to gain access to the collars.

Preparation:
1. Reassemble all parts, except # 1 through 5 in 2.1 Front Disassembly.
2. Place the lens in the modified fixed barrel.

Adjustment method:
1. Mount the lens on the projector, and set the focus to infinity.
2. The distance between the lens projector and projected image must be about 15m.
3. View a projected image to check whether the projection resolution is within the standard.
4. If the resolution is not within the standard, rotate the two eccentric collars to bring it within the limits.

Standard: The projection resolution standard is shown below.

Table 3-1 Projection Resolution Standard

Image height		0mm	4mm	8mm	12mm	16mm	20mm
Wide	S	100 line/mm	100	63	63	*63	*63
	M		*100	*63	40	*40	*25
Middle (f=70mm)	S	100 line/mm	100	63	63	*63	*63
	M		100	63	*63	40	40
Middle (f=135mm)	S	100 line/mm	100	63	63	*63	*63
	M		100	63	*63	40	*40
Middle (f=200mm)	S	100 line/mm	100	100	63	*63	40
	M		100	63	*63	40	40
Tele	S	100 line/mm	*100	*100	63	*63	*63
	M		*100	*63	40	*40	25

* : Can be one level lower in two adjacent quadrants only, providing center resolution is good.

Alternative Procedure

(If a lens projector is not available, this method may be used with discretion.)

1. In the position near the Z-FLX, install the concentric collar (YA2-0898). In the other two positions, installed eccentric collars (YA2-1349).
2. Turn the two eccentrics to bring the 2nd group barrel as far forward as possible. The screwdriver slots in the collars will be parallel with the optical axis. (Remember to turn the collars clockwise only to prevent loosening of the collar screws.)
3. Turn the upper eccentric (the one that is roughly aligned with the index line) clockwise to 45 degrees.
4. Turn the other eccentric about 20 - 30 degrees clockwise.
5. Check that the screws are securely tightened.

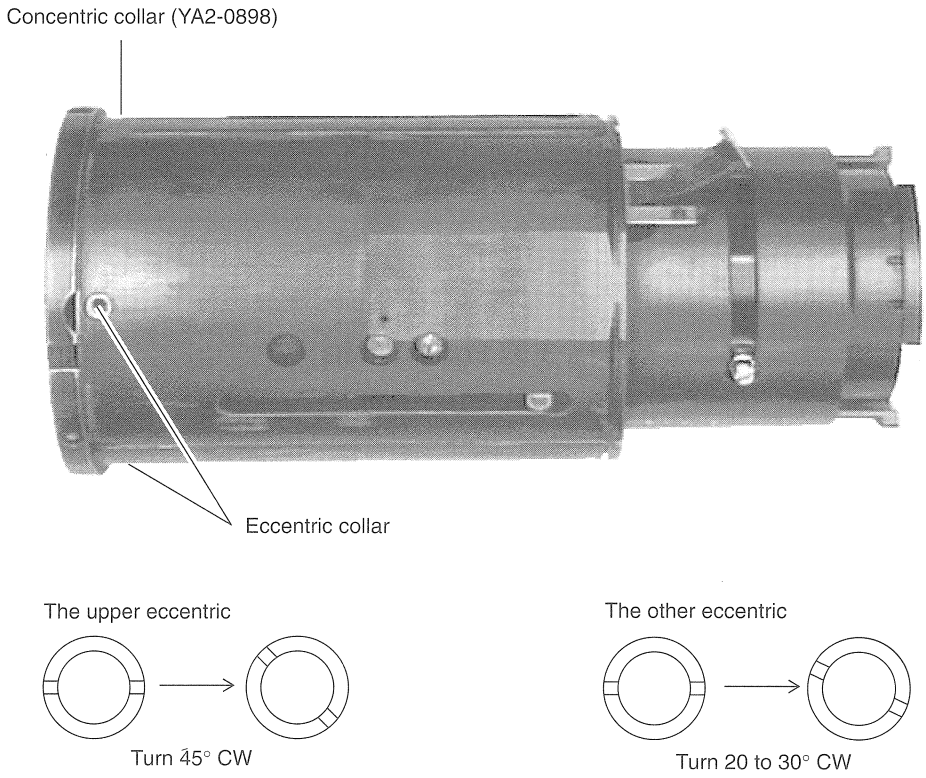


Fig. 3-36 Alternate Tilt Adjustment Procedure

3.2 Focus Adjustment

* Check and adjust the focus when an optical part is disturbed.
* Because of the very great (10X) zoom range, the focus must be adjusted at both ends and the middle of the zoom range.

Purpose: Achieve infinity focus.

Tools:
- Lens projector
- Magnifier

Standard:

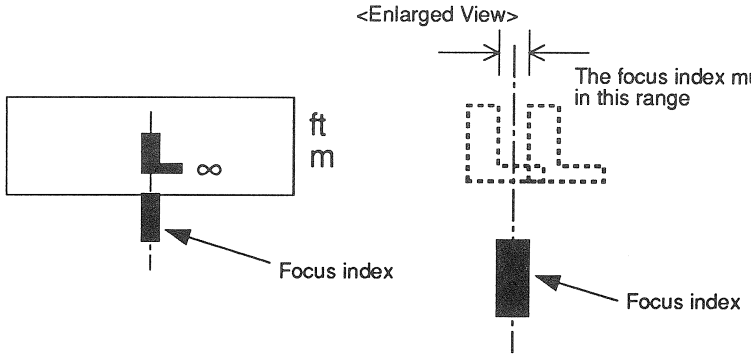


Fig. 3-37 Focus Limits

Adjustment method: <WIDE>

1. Mount the lens on the camera.
2. Set the focus to infinity.
3. Check the shift between the focusing index and the infinity mark.
4. If the shift does not conform to the standard, adjust the total mount thickness by combining a service lens mount and service focusing washers.

If many focusing washers are used, the gap between the rear sleeve assembly and lens mount becomes too large, so limit the maximum thickness of the washers to 0.07 mm.

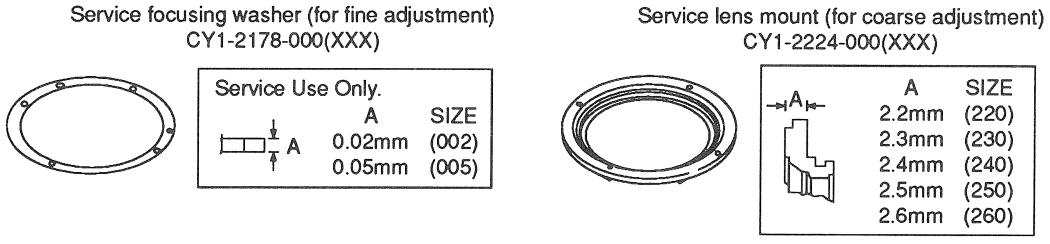


Fig. 3-38 Focus Adjustment (Wide)

<TELE>
1. Perform steps 1 to 3 above.
2. If the focus does not meet the standard, loosen the three collar (YA2-0605) screws (XA1-1170-287) and three screws (XA1-7170-357) holding the front lens unit, turn the group 1 lens barrel clockwise or counterclockwise, and adjust the focus.

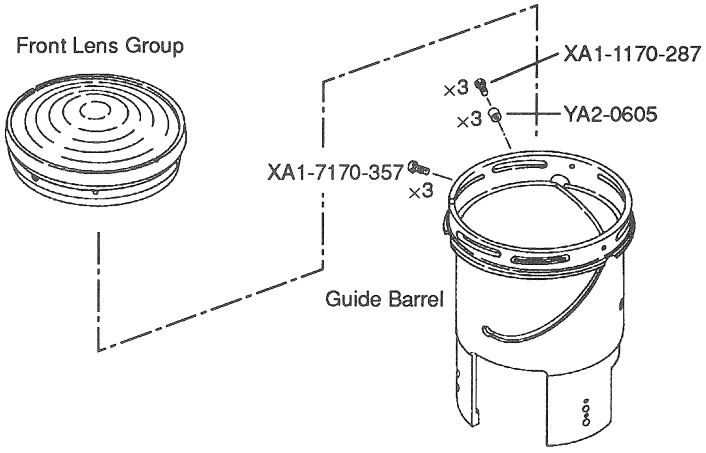


Fig. 3-39 Focus Adjustment (Tele)

<MIDDLE>
The middle range focus adjustment involves changing the thickness of the washer within the 2nd lens group.
1. Mount the lens on the camera and set the zoom to 200mm.
2. Set the focus to infinity.
3. Check the shift between the focusing index and the infinity mark.
4. If the shift does not conform to the standard, change the thickness of the 2nd group spacer.

Alternate Method

Measure the thickness of the 2nd group spacer and install a new one of the same thickness.

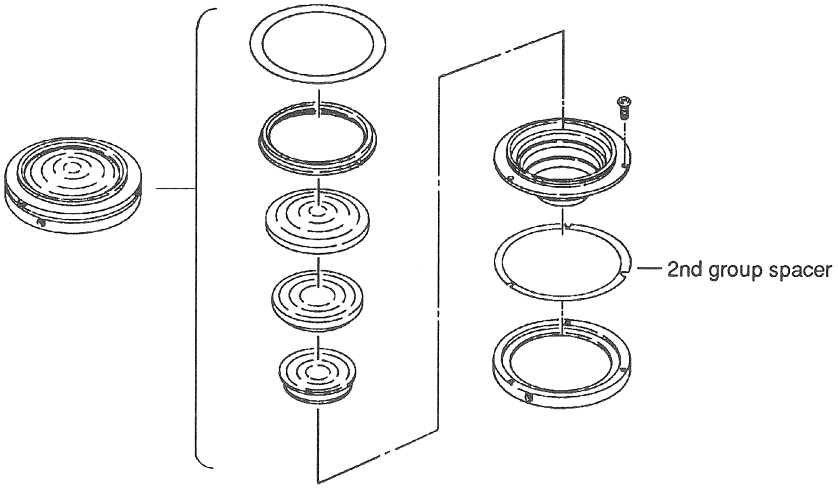


Fig. 3-40 Focus Adjustment (Middle)

3.3 Pulse Adjustment

* Adjust the pulses when the focusing unit or main flex is replaced.

Purpose: Adjust the phase to generate USM drive data accurately and efficiently.

Tools
- Oscilloscope
- EOS camera

Standard: $0.9T \leqq t \leqq 1.1T$

Preparation:

1. Remove all the parts described in "Front Disassembly" in Disassembly and Reassembly.
2. Solder a lead to the P1 and DGND lands shown below.
3. Attach the MIF contact to the lens mount.
4. Mount the lens on a camera , being careful not to pinch any leads.

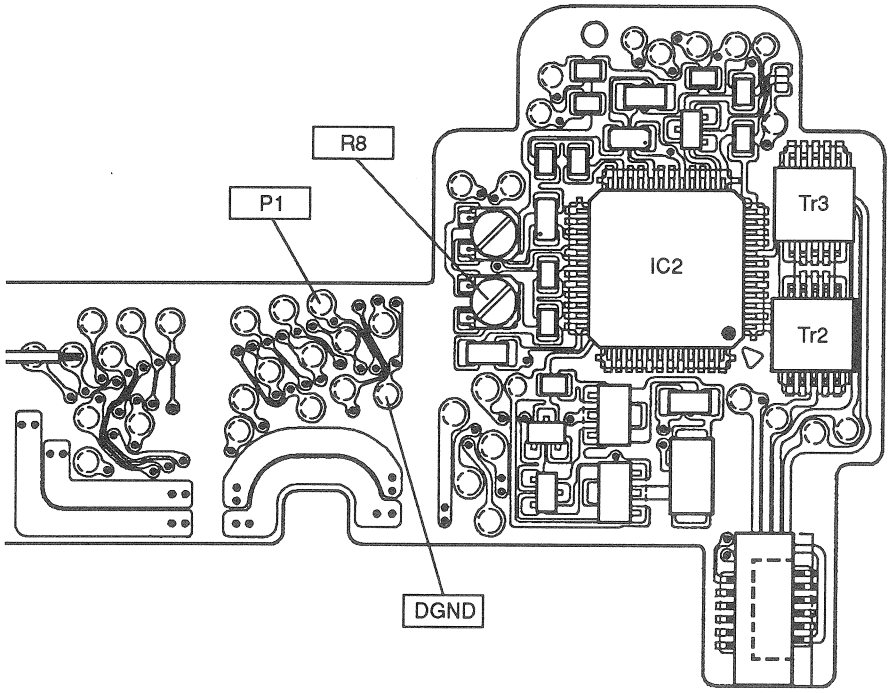


Fig. 3-41 Pulse Adjustment

Adjustment method:

1. Connect the leads to the oscilloscope.
2. Press the shutter button (SW-1 only), and observe the waveform.
3. If the waveform does not conform to the standard (for example, ⓐ), remove the lens, turn VR1 clockwise, and measure the waveform again.
4. Measure the waveform, remove the lens, adjust, install the lens, then measure the waveform again. Repeat this process until the waveform conforms to the standard ⓒ .

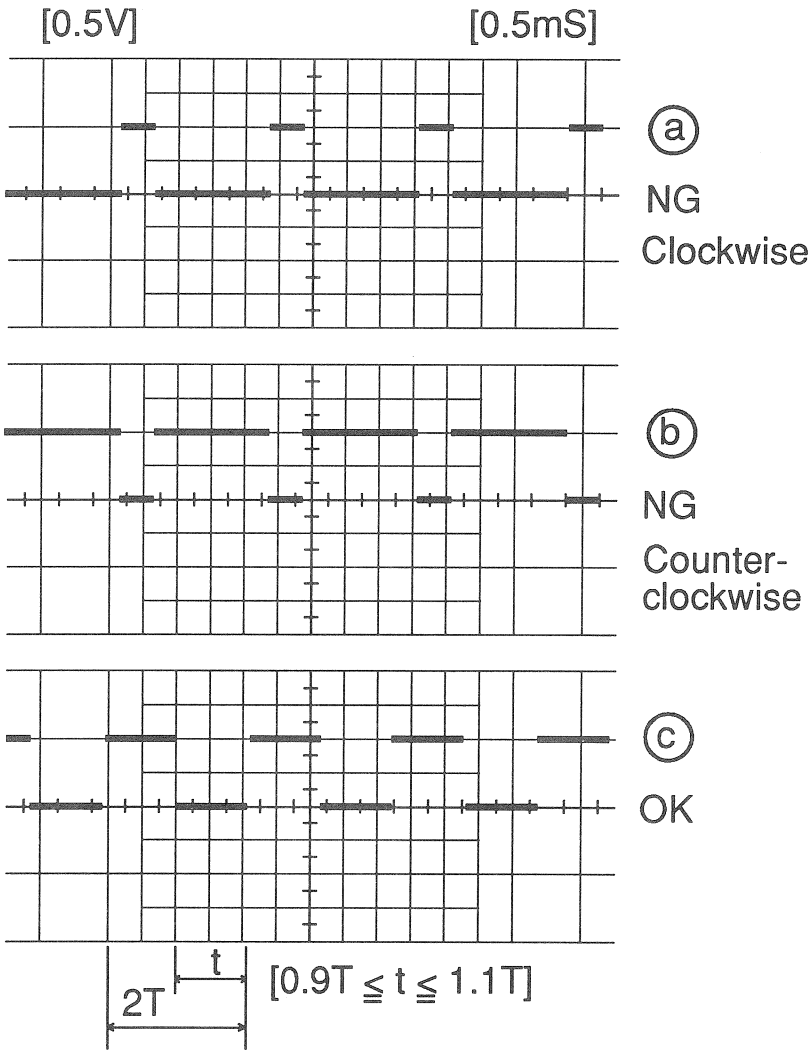


Fig. 3-42 Pulse Waveforms

3.4 Focus Compensation

* Do this adjustment when you replace the main board unit.

Purpose: To align the autofocus point as closely as possible to the lens' actual best focus point.

Notes: At the factory, this correction is written into each individual lens' ROM with a expensive tool. This tool is much too costly for field use so service will use the following procedures instead.

1. When the main flex unit is replaced, set AF-ADJ0,1 adjusting pads to the same condition as the old flex.
2. When a component other than the main flex unit is replaced, no adjustment is necessary.
3. For customer complaints, determine the model of camera being used and adjust using one of the following two methods.

Adjustment method 1

If front defocus, increase plus correction. If rear defocus, increase negative correction.

Adjustment method 2

Select a combination of four adjustment pads (AF-ADJ0,1) that gives the best focus at maximum aperture.

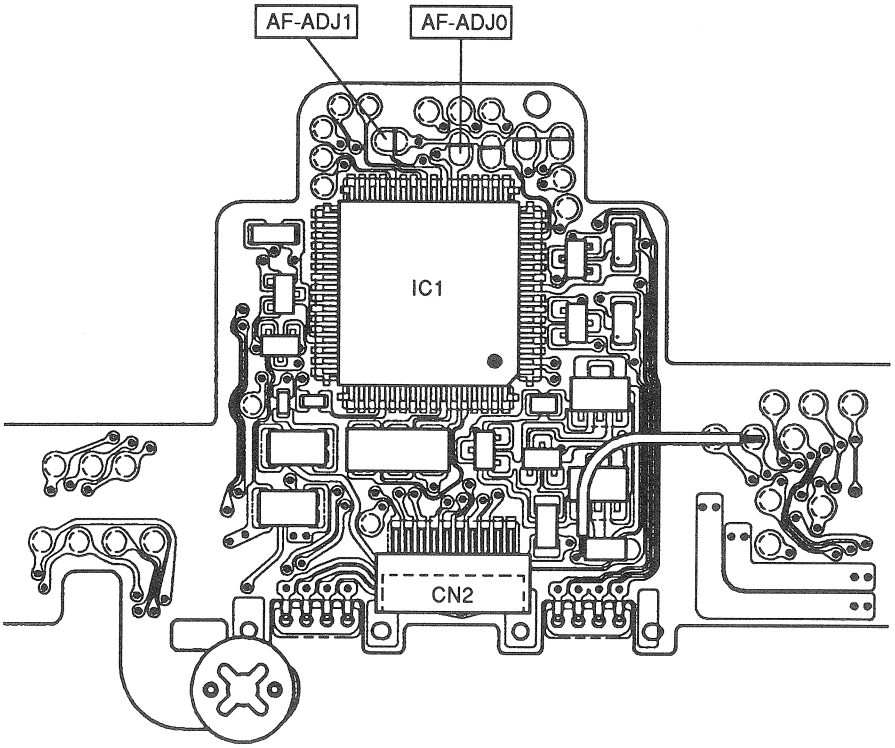


Fig. 3-43 AF-ADJ Adjusting Pads

Test conditions

- Distance: 17.5m
- Target: Casual Resolution Chart* with AF Standard Bar Chart in center.
- Aperture: Maximum aperture
- Focusing: Return lens to infinity after each exposure and autofocus on bar chart.
- Number of shoots: 5 or 6 at each solder bridge position

Procedure

1. Remove the back only.
2. Set correction to -3/4Fδ.
3. Shoot.
4. Change the correction to -1/4Fδ, +1/4Fδ, +3/4Fδ, and shoot.

Table 3-2 AF-ADJ Compensation

Correction	AF-ADJ0	AF-ADJ1
-3/4F δ	1	0
-1/4F δ	0	0
+1/4Fδ	1	1
+3/4Fδ	0	1

F: FNO
δ: Minimum circle of confusion
0: Close (Soldered)
1: Open (No soldered)

*:A 'Casual Resolution Chart' is a flat chart made up of newsprint, photographs, etc. Most service facilities have such a chart.

3.5 USM Reference Frequency

* This adjustment is carried out when the main board unit is adjusted. It is given below for reference.
* If the focus speed is different from that of other products, or if an abnormal sound is heard at low or high temperature, check the USM reference frequency.

Purpose: Achieve the USM drive reference frequency.

Tools:
- Frequency counter
- EOS camera with stop-down aperture (D-o-F) button (except EOS 620)
  * When the aperture button is pressed, a stable frequency can be measured regardless of the USM.
  * If the EOS 620 is used, press the EL button instead of the D-o-F button.

Standard: 31.1±0.05kHz

Preparation:
1. Remove all the parts described in "Front Disassembly" in Disassembly and Reassembly.
2. Solder leads to the D1 and DGND lands shown below.
3. Reattach the MIF contact to the lens mount.
4. Mount the lens on a camera body. (Take care not to break the lead wires.)

Adjustment method
1. Connect the leads to the frequency counter.
2. Press the D-o-F button, and measure the frequency.
3. If the frequency does not conform to the standard, remove the lens, turn R3, and measure the frequency again.
4. Measure the frequency, remove the lens, adjust, install the lens, then measure the frequency again. Repeat this process until the frequency conforms to the standard.

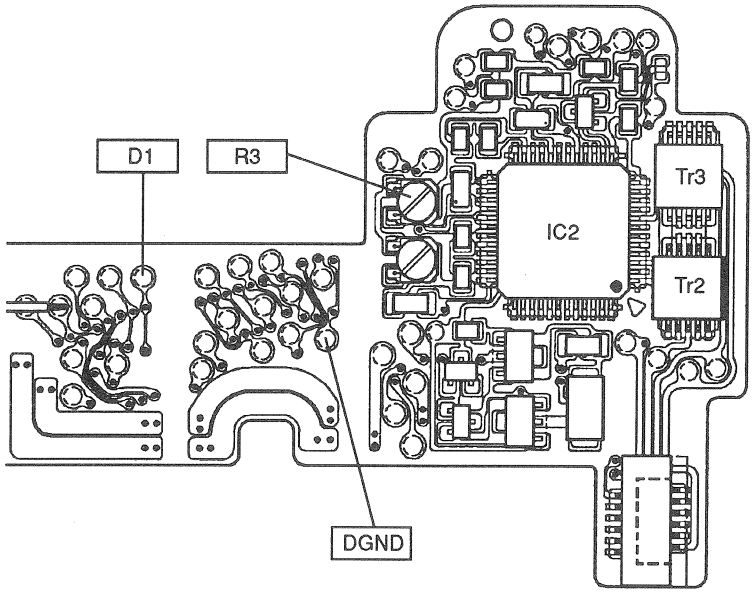


Fig. 3-44 USM Reference Frequency Adjustment Points

3.6 Zoom Brush Position Adjustment

* Check and adjust whenever either the zoom brush or Z-FLX is removed or replaced.

Purpose: Read the zoom pattern accurately.

Tools: Ohmmeter

Preparation:

Remove all the parts described in "Front Disassembly" in Disassembly and Reassembly.

Adjustment method:

1. Set the zoom to wide (35mm).
2. Change the zoom brush position so that the positional relationship between the zoom brush contact surface and zoom pattern is in the range of A.
3. Check that there is no continuity between the zoom brush and zoom pattern.
4. After adjustment, apply screw lock to the tip of the screw.

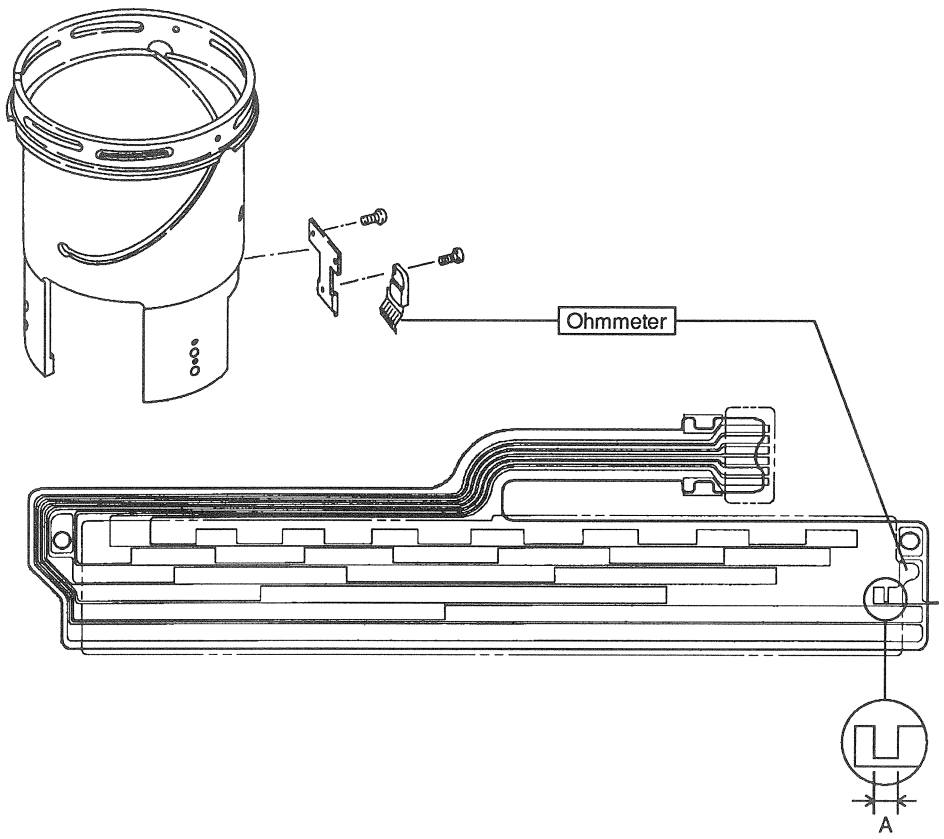


Fig. 3-45 Zoom Brush Position Adjustment

3.7 Focus Ring Unit Adjustment

* Check, and adjustment if necessary, is required whenever the focus ring unit or fixed barrel is replaced.

Purpose: To set the original position of the adjustment ring so it will operate through its entire range from quite loose to quite tight.

Adjustment method:

1. Remove parts (1) through (4) described in "Front Disassembly" in Disassembly and Reassembly.
2. Remove the focus ring unit from the fixed barrel.
3. Remove the two screws from the adjustment ring.
4. Hold the focus ring and unscrew the adjustment ring. There are loose steel balls within the adjustment ring. Be careful not to lose them. The stopper collar is also loose when the ring is separated from the focus ring. Don't lose it.
5. Push the pins out of the unused screw holes from the inside. (Remember the balls!).
6. Screw the adjustment ring back onto the focus ring, and install them on the fixed barrel.
7. Check the tightening and install the screws in the holes in the retaining collar which give the best range of operation. When screwed down tight, the zoom position should be fixed.

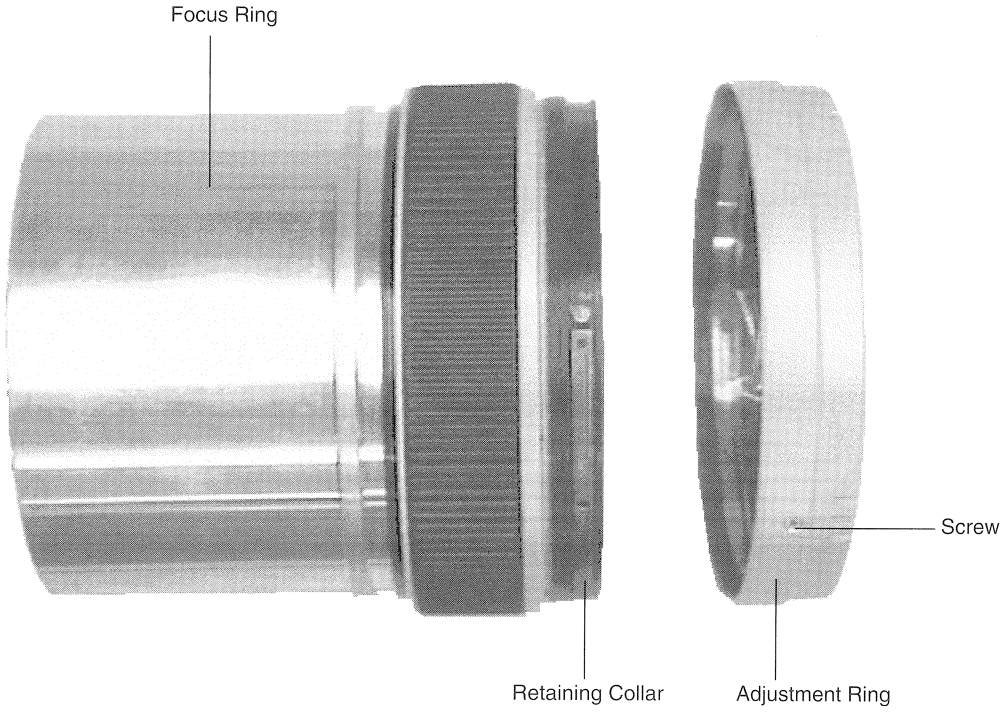


Fig. 3-46 Adjustment Ring Adjustment

Part 4

Parts Catalog

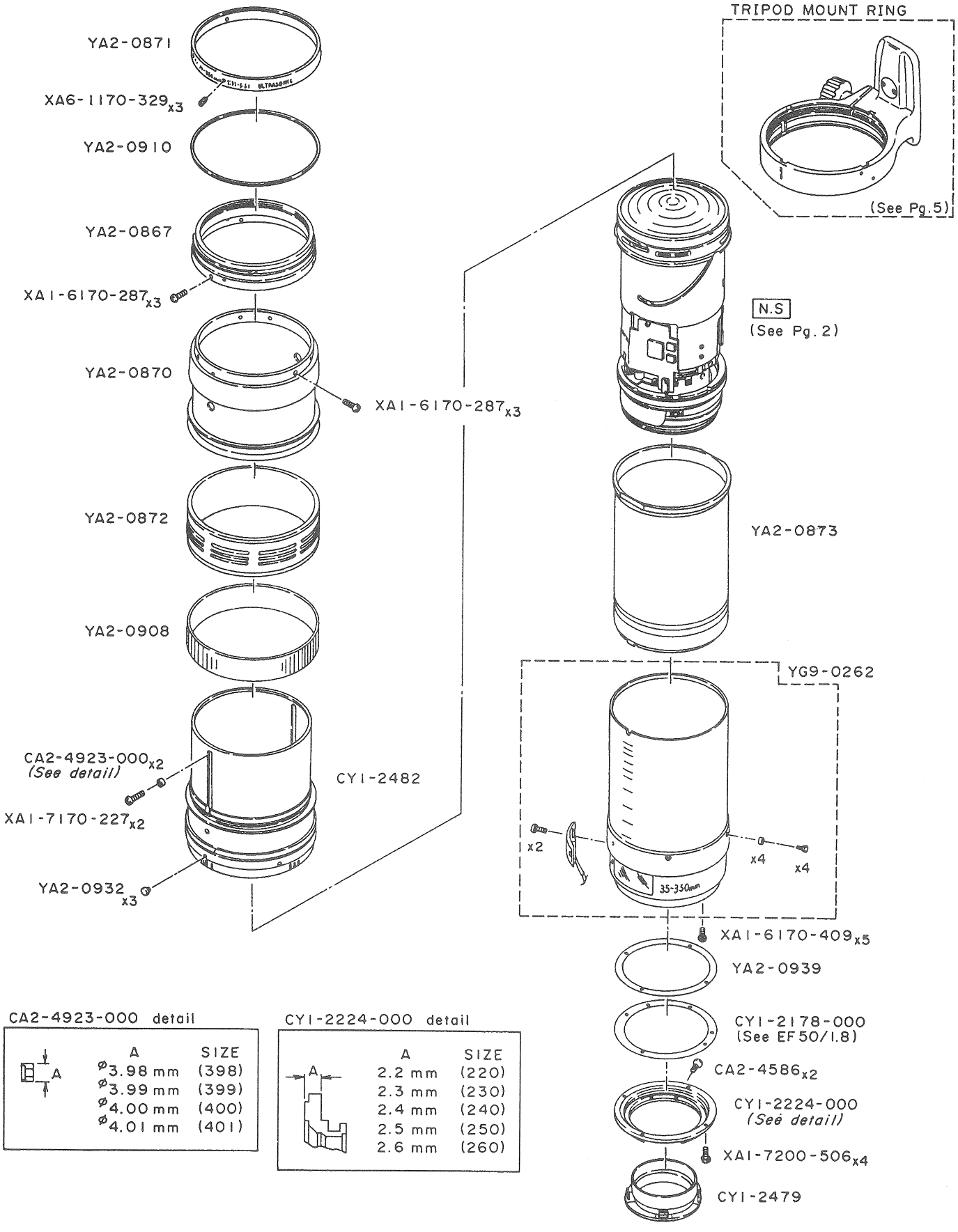
Canon

EF 35-350mm 1:3.5-5.6 L (ULTRASONIC)

REF.NO.C21-9642

PARTS CATALOG

CANON LENS EF 35-350 mm 1:3.5-5.6L USM



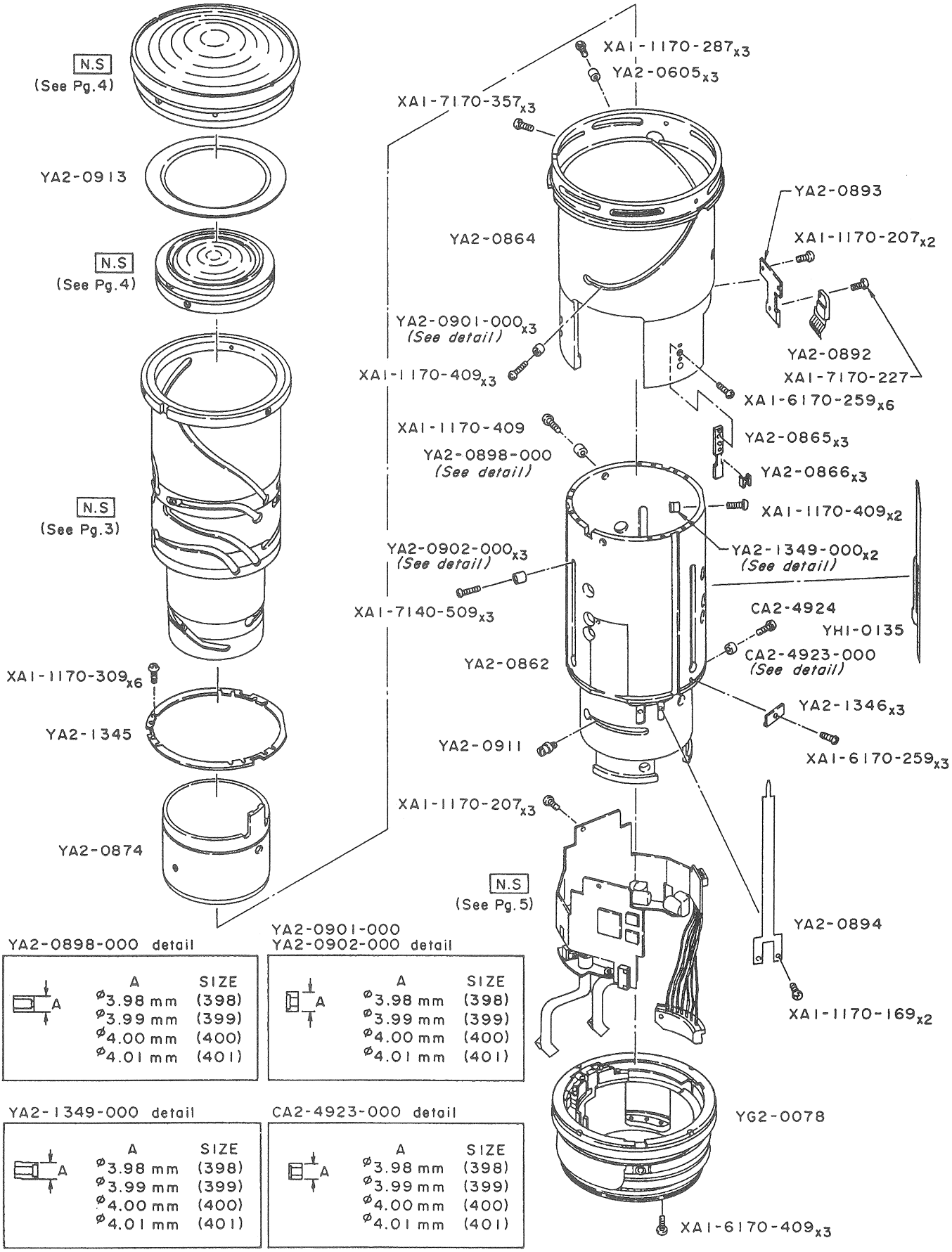
CA2-4923-000 detail

A	SIZE
ø3.98 mm	(398)
ø3.99 mm	(399)
ø4.00 mm	(400)
ø4.01 mm	(401)

CY1-2224-000 detail

A	SIZE
2.2 mm	(220)
2.3 mm	(230)
2.4 mm	(240)
2.5 mm	(250)
2.6 mm	(260)

CANON LENS EF 35-350 mm 1:3.5-5.6L USM



YA2-0898-000 detail

A	SIZE
ø3.98 mm	(398)
ø3.99 mm	(399)
ø4.00 mm	(400)
ø4.01 mm	(401)

YA2-0901-000
YA2-0902-000 detail

A	SIZE
ø3.98 mm	(398)
ø3.99 mm	(399)
ø4.00 mm	(400)
ø4.01 mm	(401)

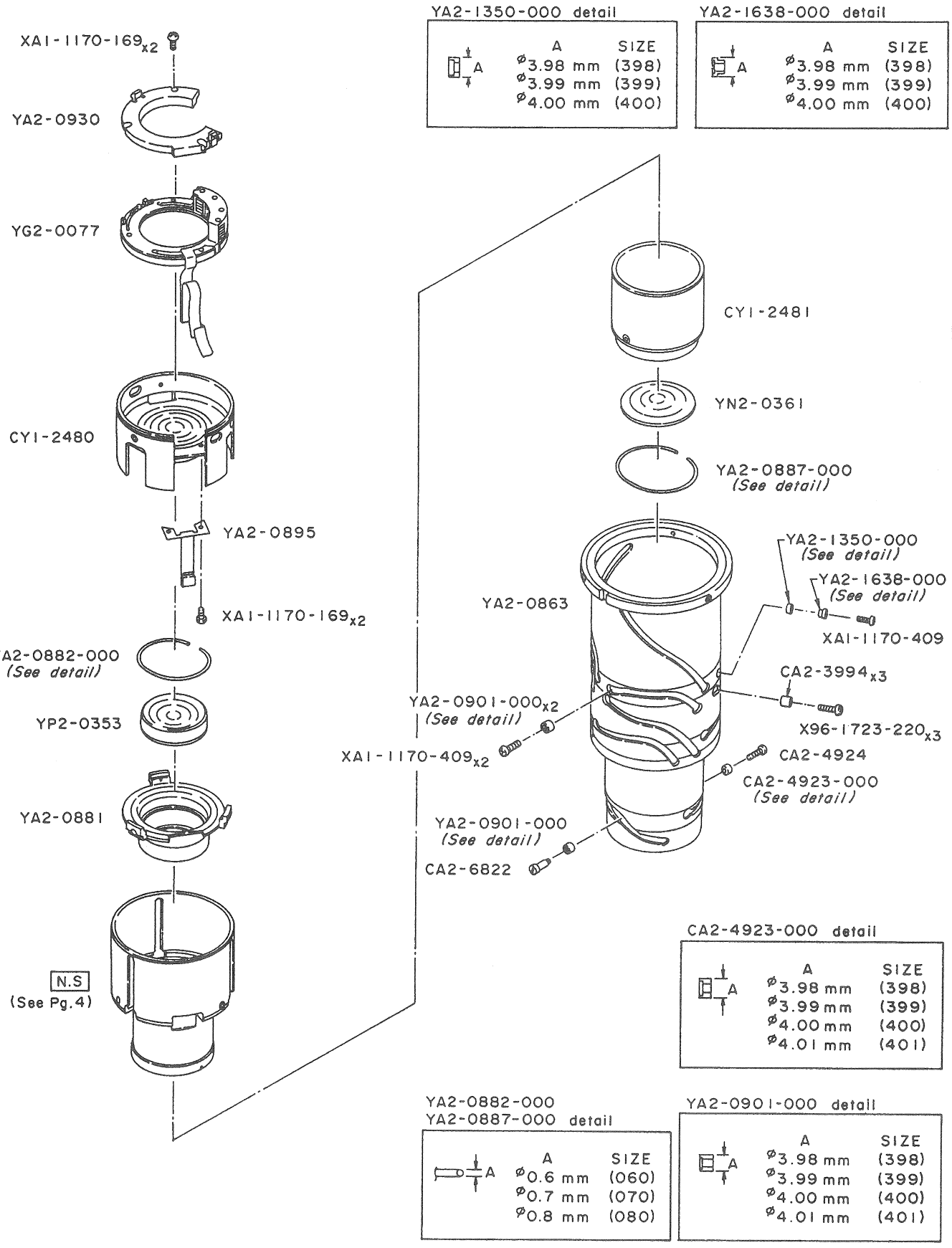
YA2-1349-000 detail

A	SIZE
ø3.98 mm	(398)
ø3.99 mm	(399)
ø4.00 mm	(400)
ø4.01 mm	(401)

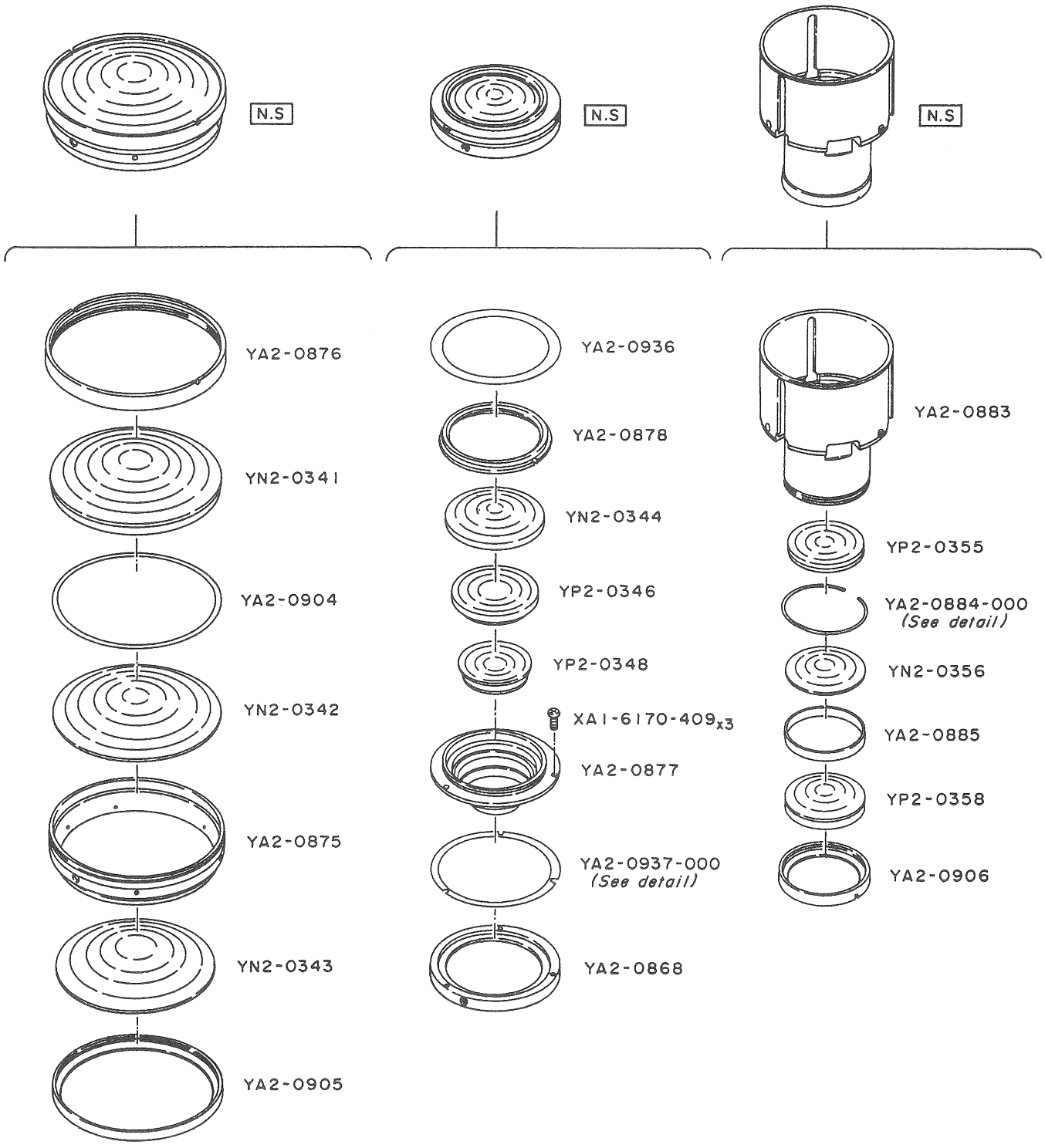
CA2-4923-000 detail

A	SIZE
ø3.98 mm	(398)
ø3.99 mm	(399)
ø4.00 mm	(400)
ø4.01 mm	(401)

CANON LENS EF 35-350 mm 1:3.5-5.6L USM



CANON LENS EF 35-350 mm 1:3.5-5.6L USM



YA2-0884-000 detail

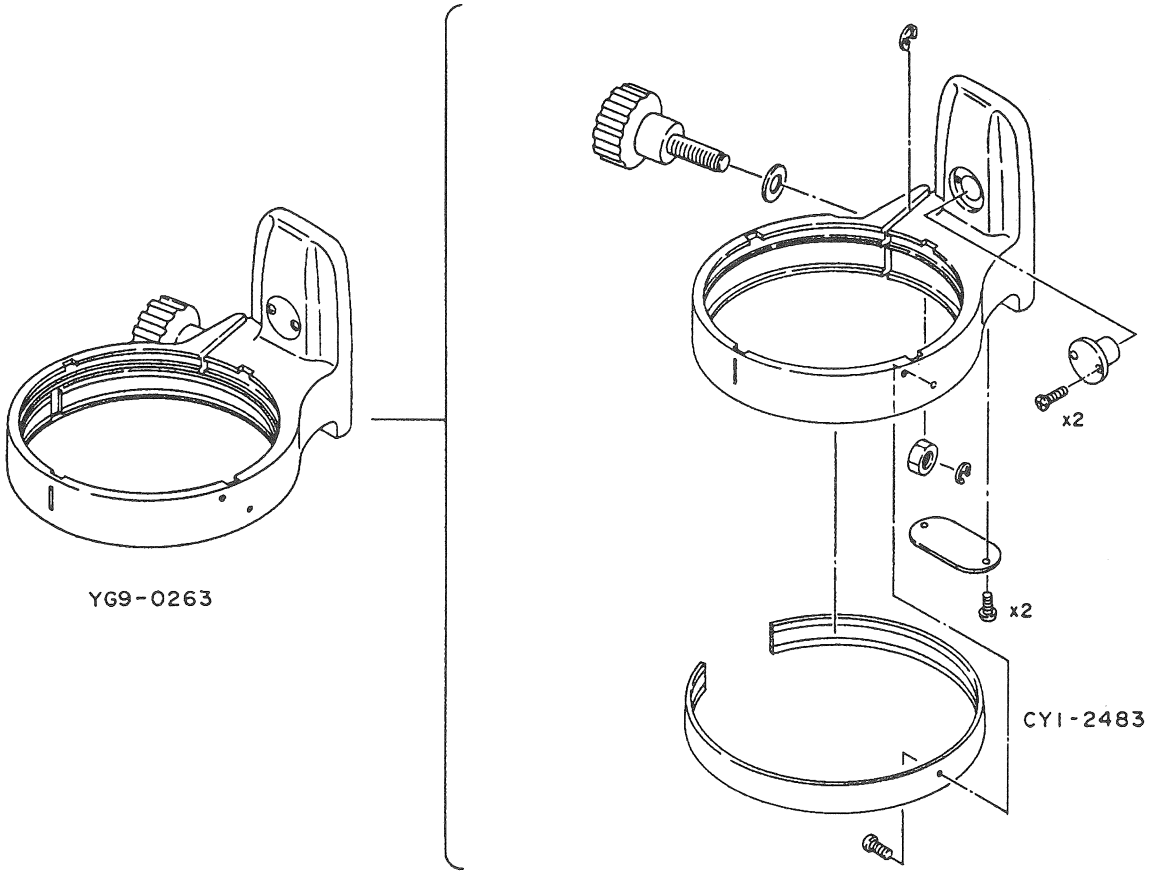
A	SIZE
ø0.6 mm	(060)
ø0.7 mm	(070)
ø0.8 mm	(080)

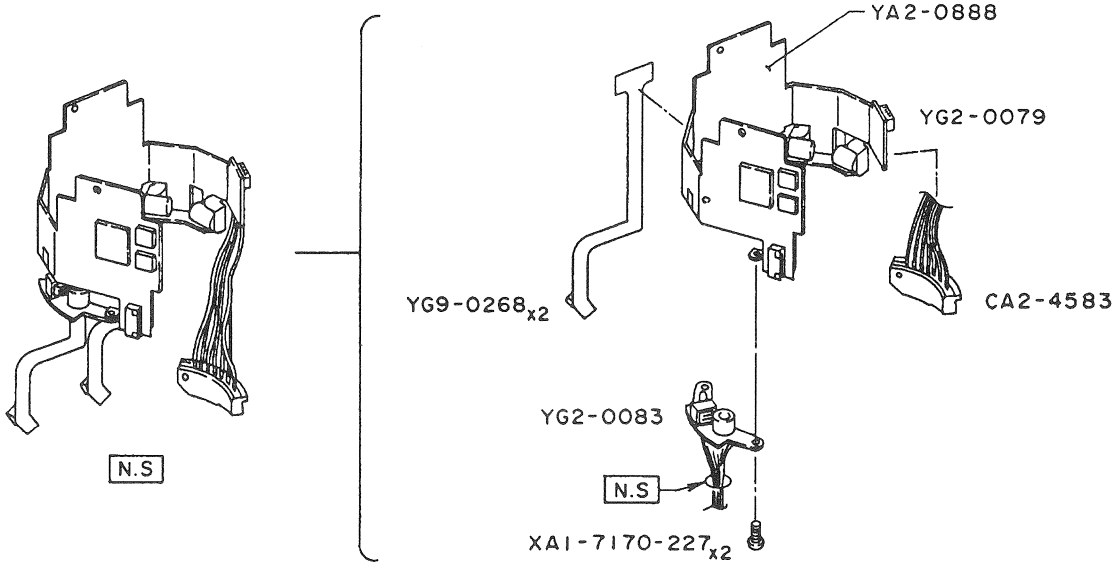
YA2-0937-000 detail

A	SIZE
0.10 mm	(010)
0.15 mm	(015)
0.20 mm	(020)
0.30 mm	(030)

5

CANON LENS EF 35-350 mm 1:3.5-5.6L USM





P A R T S　L I S T

EF35-350mm 1：3.5-5.6L (USM)
REF.NO.C21-9642

NEW	PARTS NO.	CLASS	QTY	DESCRIPTION		PAGE
	CA2-3994-000	D	3	COLLAR, RUBBER	4群ゴムコロ	3
	CA2-4583-000	D	1	CONTACT ASS'Y	接点ブロック	5
	CA2-4586-000	E	2	SCREW	接点ブロック止めビス	1
	CA2-4923-000(XXX)	D	4	COLLAR, BRASS	コロ	1, 2, 3
	CA2-4924-000	E	2	SCREW	コロ止めビス	2, 3
	CA2-6822-000	E	1	SCREW, STUD	スタットビス	3
	CY1-2178-000(XXX)	E	N	WASHER, MOUNT	マウントワッシャー	1
	CY1-2224-000(XXX)	E	1	MOUNT, LENS	レンズマウント	1
*	CY1-2479-000	D	1	COVER, BACK	裏蓋	1
*	CY1-2480-000	D	1	LENS G9.10/11 BARREL ASS'Y	第3群鏡筒ユニット	3
*	CY1-2481-000	D	1	LENS G19.20 BARREL ASS'Y	第6群鏡筒ユニット	3
*	CY1-2482-000	E	1	FOCUS RING UNIT	フォーカスリングユニット	1
*	CY1-2483-000	E	1	BELT	バンド	5
*	X96-1723-220	F	3	SCREW		3
	XA1-1170-169	F	6	SCREW, CROSS-RECESS, PH		2, 3
	XA1-1170-207	F	5	SCREW, CROSS-RECESS, PH		2
	XA1-1170-287	F	3	SCREW, CROSS-RECESS, PH		2
	XA1-1170-309	F	6	SCREW, CROSS-RECESS, PH		2
	XA1-1170-409	F	9	SCREW, CROSS-RECDSS, PH		2, 3
	XA1-6170-259	F	9	SCREW, CROSS-RECESS, PH		2
	XA1-6170-287	F	6	SCREW, CROSS-RECESS, PH		1
	XA1-6170-409	F	11	SCREW, CROSS-RECESS, PH		1, 2, 4
	XA1-7140-509	F	3	SCREW, CROSS-RECESS, PH		2
	XA1-7170-227	F	5	SCREW, CROSS-RECESS, PH		1, 2, 5
	XA1-7170-357	F	3	SCREW, CROSS-RECESS, PH		2
	XA1-7200-506	F	4	SCREW, CROSS-RECESS, PH		1
	XA6-1170-329	G	3	SETSCREW, SLOTTED, HLCP		1
*	YA2-0605-000	D	3	COLLAR	1群コロ	2
*	YA2-0862-000	E	1	BARREL, GUIDE	案内筒	2
*	YA2-0863-000	E	1	BARREL, ZOOMING CAM	カム筒	3
*	YA2-0864-000	E	1	INNER, HELICOID	直進筒	2
*	YA2-0865-000	E	3	KEY	補正キー	2
*	YA2-0866-000	E	3	SPACER	補正コマ	2
*	YA2-0867-000	D	1	RING, FRONT	フィルター枠	1
*	YA2-0868-000	E	1	2nd GROUP EXTENSION GUIDE	2群継筒	4
*	YA2-0870-000	D	1	RING, ZOOMING	操作環	1
*	YA2-0871-000	E	1	RING, NAME	ネームリング	1
*	YA2-0872-000	D	1	RING, ZOOM RUBBER	ズームゴム	1
*	YA2-0873-000	E	1	EXTENSION GUIDE, FOCUS	フォーカス連絡筒	1
*	YA2-0874-000	E	1	BARREL, FOCUS	フォーカス筒	2

P A R T S　L I S T

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NEW	PARTS NO.	CLASS	QTY	DESCRIPTION		PAGE
*	YA2-0875-000	E	1	BARREL, FRONT LENS	第1群鏡筒	4
*	YA2-0876-000	E	1	COLLAR, ASSEMBLY	G1押さえ	4
*	YA2-0877-000	E	1	BARREL, LENS	第2群鏡筒	4
*	YA2-0878-000	E	1	COLLAR, ASSEMBLY	G4押さえ	4
*	YA2-0881-000	E	1	BARREL, LENS	第4群鏡筒	3
*	YA2-0882-000(XXX)	E	1	RING, SNAP	G12押さえ	3
*	YA2-0883-000	E	1	BARREL, LENS	第5群鏡筒	4
*	YA2-0884-000(XXX)	E	1	RING, SNAP	G15押さえ	4
*	YA2-0885-000	E	1	COLLAR, ASSEMBLY	G16押さえ	4
*	YA2-0887-000(XXX)	E	1	RING, SNAP	G21押さえ	3
*	YA2-0888-000	E	1	HOLDER, MAIN CBA	メインフレキ台	5
*	YA2-0892-000	D	1	BRUSH, ZOOMING	ズームブラシ	2
*	YA2-0893-000	D	1	HOLDER, ZOOMING BRUSH	ズームブラシ台	2
*	YA2-0894-000	D	1	HOLDER	Uターン押さえ板	2
*	YA2-0895-000	D	1	HOLDER, E-FLX	Uターン押さえ板2	3
*	YA2-0898-000(XXX)	D	1	COLLAR	2群コロ	2
*	YA2-0901-000(XXX)	D	6	COLLAR	コロ1	2,3
*	YA2-0902-000(XXX)	D	3	COLLAR	コロ2	2
*	YA2-0904-000	E	1	SHEET, WASHER	ルミラーA	4
*	YA2-0905-000	E	1	COLLAR, ASSEMBLY	G3押さえ	4
*	YA2-0906-000	E	1	COLLAR, ASSEMBLY	G18押さえ	4
*	YA2-0908-000	D	1	RING, MANUAL FOCUS RUBBER	フォーカスリングゴム	1
*	YA2-0910-000	D	1	RING, L INDICATOR	Lリング	1
*	YA2-0911-000	E	1	PIN, FOCUSING	フォーカスピン	2
*	YA2-0913-000	E	1	LIGHT, SHIELD	遮光板	2
*	YA2-0930-000	E	1	HOLDER, EMD UNIT	EMD押さえ	3
*	YA2-0932-000	E	3	PIN, COVER	カバーピン	1
*	YA2-0936-000	E	1	COVER, 2nd GROUP	2群カバー	4
*	YA2-0937-000(XXX)	E	1	SPACER, 2nd GROUP	2群スペーサー	4
*	YA2-0939-000	E	N	MOUNT, SPACER	マウントスペーサ	1
*	YA2-1345-000	E	1	STOPER, ZOOMING	ズームストッパー	2
*	YA2-1346-000	E	3	KEY, STOPER ZOOMING	ズームストッパーコマ	2
*	YA2-1349-000(XXX)	D	2	COLLAR, ECCENTRIC	2群偏芯コロ	2
*	YA2-1350-000(XXX)	D	1	COLLAR	3群コロ1	3
*	YA2-1638-000(XXX)	D	1	COLLAR, ECCENTRIC	3群偏芯コロ	3
*	YG2-0077-000	D	1	POWER DIAPHRAGM UNIT	EMDユニット	3
*	YG2-0078-000	D	1	FOCUSING UNIT	フォーカスユニット	2
*	YG2-0079-000	D	1	MAIN CBA ASS'Y	メインフレキユニット	5
*	YG2-0083-000	D	1	CONVERTER, DC/DC	DC/DCコンバータ	5
*	YG9-0262-000	E	1	FIXED BARREL UNIT	固定筒ユニット	1

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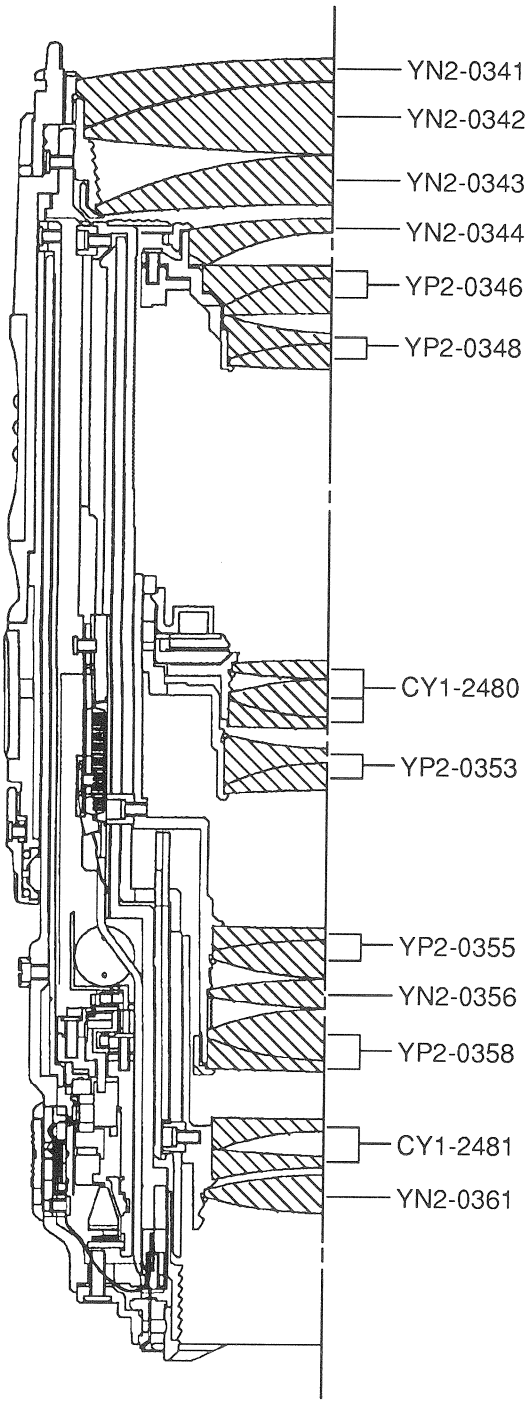
NEW	PARTS NO.	CLASS	QTY	DESCRIPTION		PAGE
*	YG9-0263-000	D	1	TRIPOD SOCKET UNIT	三脚座ユニット	5
*	YG9-0268-000	E	2	SUB-FLX	SUB-FLX	5
*	YH1-0135-000	D	1	Z-FLX	Z-FLX	2
*	YN2-0341-000	D	1	LENS, G1	レンズG1	4
*	YN2-0342-000	E	1	LENS, G2	レンズG2	4
*	YN2-0343-000	E	1	LENS, G3	レンズG3	4
*	YN2-0344-000	E	1	LENS, G4	レンズG4	4
*	YN2-0356-000	E	1	LENS, G16	レンズG16	4
*	YN2-0361-000	D	1	LENS, G21	レンズG21	3
*	YP2-0346-000	E	1	LENS, G5/6	レンズG5/6	4
*	YP2-0348-000	E	1	LENS, G7/8	レンズG7/8	4
*	YP2-0353-000	E	1	LENS, G12/13	レンズG12/13	3
*	YP2-0355-000	E	1	LENS, G14/15	レンズG14/15	4
*	YP2-0358-000	E	1	LENS, G17/18	レンズG17/18	4

CANON LENS EF 35-350mm 1:3.5-5.6 L USM

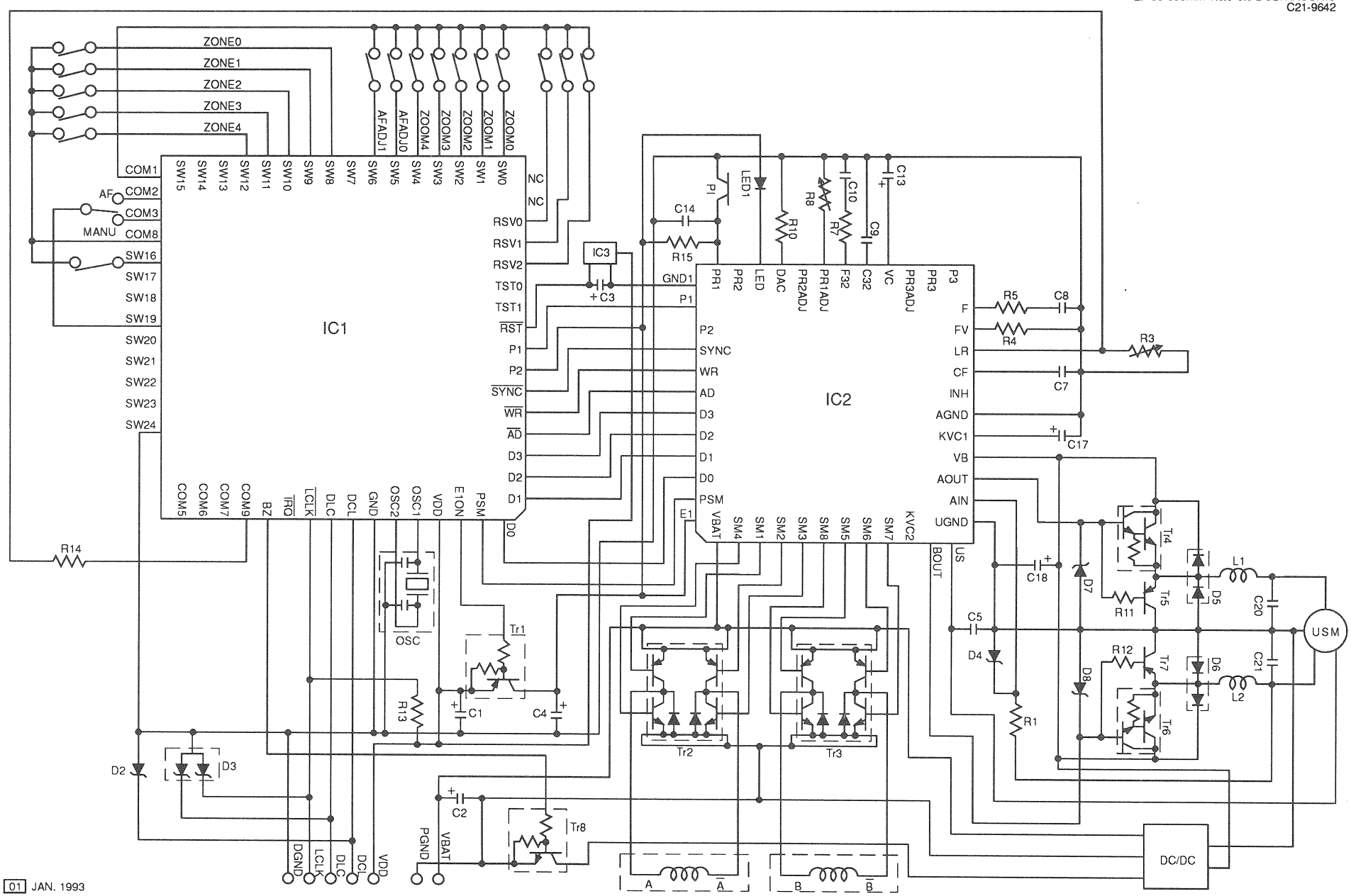


Part 5

Electrical Diagrams

SCHEMATIC DIAGRAM

EF 35-350mm 1:3.5-5.6 L ULTRASONIC
C21-9642



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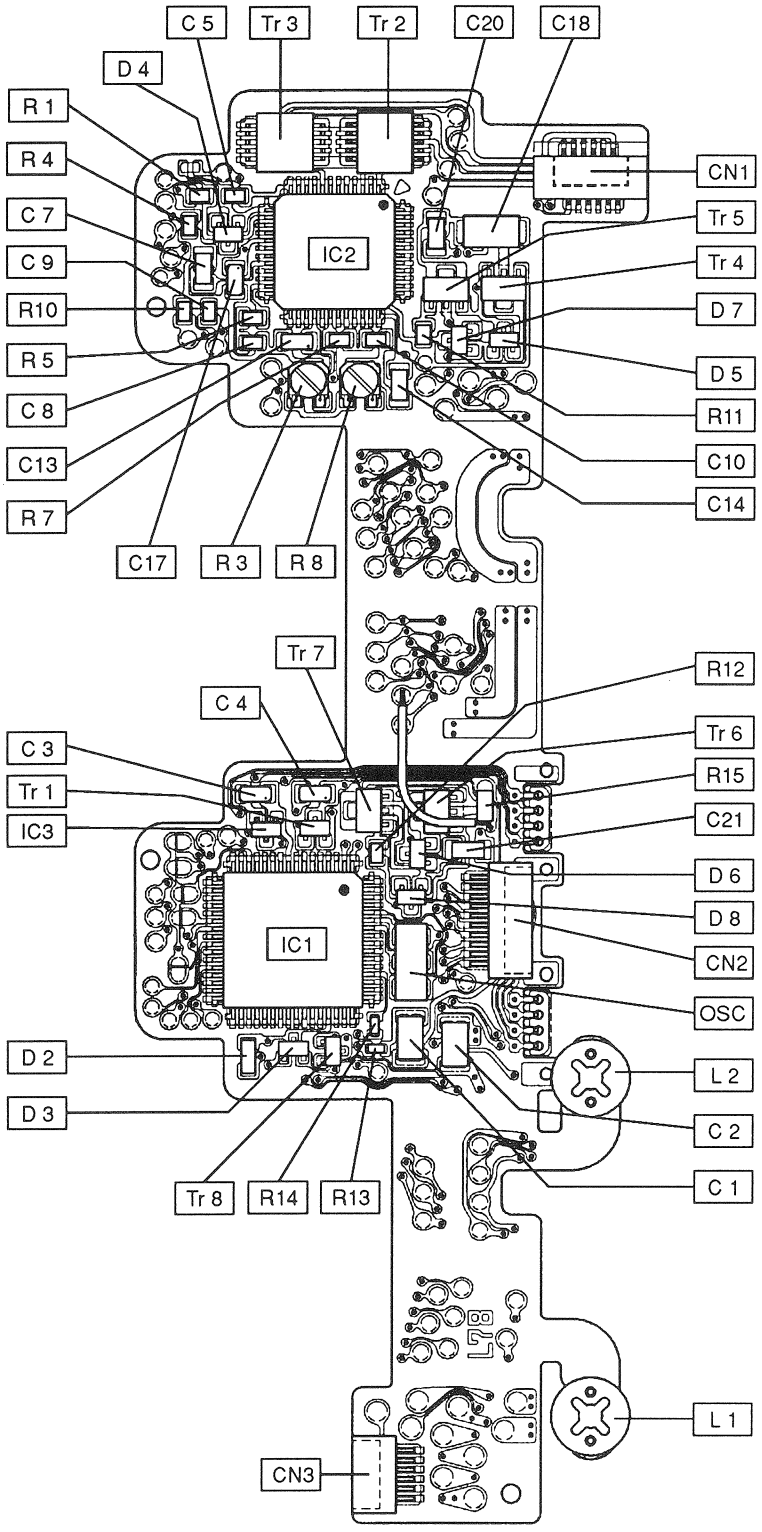
P.C.B DIAGRAM
(MAIN C.B.A)

EF 35-350mm 1:3.5-5.6 L (ULTRASONIC)
REF.NO. C21-9642

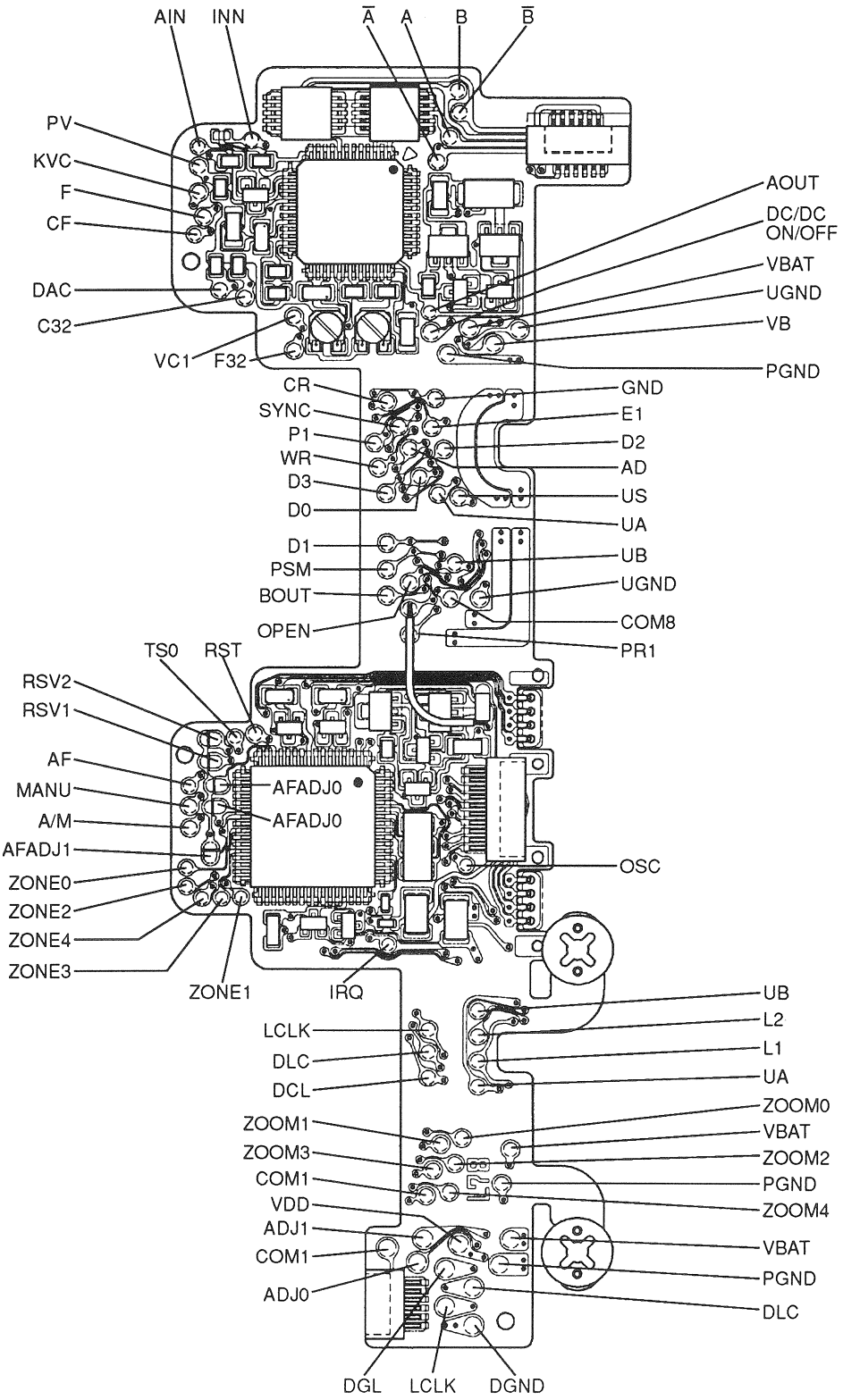


SYMBOL	SCHEMATIC
D 2	
D 3	
D 4 D 7 D 8	
D 5 D 6	
Tr 1	
Tr 2 Tr 3	
Tr 4 Tr 6	
Tr 5 Tr 7	
Tr 8	

01 JAN. 1993

P.C.B DIAGRAM
(MAIN C.B.A)

EF 35-350mm 1:3.5-5.6 L (ULTRASONIC)
REF.NO. C21-9642



01 JAN. 1993