Canon

Service Manual

ENGLISH EDITION

EF 70-200mm 1:2.8L (ULTRASONIC)

C21-9792

CY8-1200-122

Canon

EF 70-200mm 1:2.8L(ULTRASONIC)

REF.NO.C21-9792

SERVICE MANUAL

Application

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CANON INC.
Photo Products Quality Advancement Div.
30-2 Shimomaruko 3-Chome, Ohta-ku,
Tokyo 146, Japan

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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 product's 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 for disassembly, reassembly, and adjustment of the product, about the tools required, and about the adhesives and lubricants required, and their application.

Part 4 Parts Catalog

Part 5 Electrical Diagrams

CONTENTS

Part 1. General Information

Part 2. Technical Information

Part 3. Repair Information

Part 1

General Information

1. DEVELOPMENT OBJECTIVES

The **EF 70-200 mm *f*/2.8L USM** is a high quality "L" series telephoto zoom lens developed as a successor to the **EF 80- 200 mm *f*/2.8L USM** lens.

This high performance zoom lens is designed to meet the needs of professional and advanced amateur users with such features as an expanded zoom range and improved optical performance that are the outcomes of innovations including the adoption of a ring type USM and upgrading of the optical design.

2. FEATURES

- Telephoto zoom lens covering focal lengths from 70 mm to 200 mm.
- Secondary spectrum improved through the use of four UD glass elements.
- High resolution, high contrast and high picture quality.
- Marginal illumination greater than EF 80-200 mm *f*/2.8L achived by innovative optical design.
- The first EF zoom lens that allows the use of an extender.
- Quick, silent autofocusing using a ring type USM and inner focusing.
- Focuses down to 1.5 m giving a maximum magnification of 0.16X at Telephoto.
- Filter ring does not rotate during focusing, enabling the effective use of polarizing and other position-sensitive filters.
- Wide, easy to use. rubber manual focus ring and rotary zoom ring.
- Manual focusing possible even in autofocus mode. (full-time mechanical manual focusing system incorporated).
- Specially designed scalloped hood ET-83 optimizes hood efficiency at all focal lengths.
- High-grade appearance in light gray color similar to our ultratelephoto L lens.

3. SPECIFICATIONS

1. Format — 24 × 36 mm

2. Focal length/Aperture — 70-200mm *f*/2.8

3. Optical system construction
   - 3-1 Lens construction — 18 elements in 15 groups (UD glass used in G2, G3, G11 and G14)
   - 3-2 Coating — Super Spectra Coating

4. Angle of view (at infinity)

Diagonal (43.2mm)	34° ~ 12°
Vertical (24mm)	19° 30' ~ 7°
Horizontal (36mm)	29° ~ 10°

5. AF function
   - 5-1 Drive system — Driven by ring USM
   - 5-2 Drive speed — 0.63 sec. (from ∞ to closest distance; drive speed for lens alone
   - 5-3 Drive noise — Below 40 dB
   - 5-4 Manual focusing — AF-M switch is provided, but manual focusing in AF is possible (mechanical manual focusing).
   - 5-5 Distance measuring range selection — Switch selection between: 1) 1.5 m to ∞ and, 2) 3 m to ∞

6. Focus adjustment
   - 6-1 Extension system — Inner focusing driven by a focusing cam
   - 6-2 Macro — None
   - 6-3 Shooting distance range — 1.5 m to ∞
   - 6-4 Rotation angle/ Extention amount

Condition	Rotation angle	Extension amount
1.5 m to ∞	65° 53'	9.07 mm
Infinity overrun	1° 45'	0.27 mm

   - 6-5 Distance scale

5 7 10 15 30 (ft: green)
1.5 2 3 5 10 ∞ (m: metallic gray)

6-6 Maximum magnification and field of view

Condition	Magnification		Field of view(mm)	
	WIDE	TELE	WIDE	TELE
Closest Distance: 1.5 m	0.06	0.16	409 × 617	152 × 226

7. Zoom
   - 7-1 System: 5-group zoom, rotating system (60° rotation) First group does not move.
   - 7-2 Focal length indications: 70 100 135 200 (mm)

8. Lense mount
   - 8-1 Type: Canon EF mount
   - 8-2 Signal transmission function: EOS system (five signals, not including absolute distance data) 1) Lens Condition 2) Lens Type 3) Metering Data 4) Focal Length 5) AF Drive Data

9. Diaphragm
   - 9-1 Diaphragm control: Pulse control using Electro Magnetic Diaphragm (EMD) (Simultaneous operation of AF lens drive possible)
   - 9-2 Aperture values/ indications: Maximum Aperture: *f*/2.8 (indicated on lens barrel) Minimum Aperture: *f*/32 (not indicated: (with 1/3 stop control cameras: *f*/32)
   - 9-3 Diaphragm blades: Eight
   - 9-4 Depth-of-field scale: Provided (F16, F32)
   - 9-5 Infrared focusing index: Provided

10. Filter diameter/ Acceptable number of filters: ø77mm, P = 0.75mm Only one

11. Dimensions/Weight: ø84.6 mm × 193.6 mm 1275 g (weight of lens alone)

12. Related Products
   - 12-1 Hood: ET-83 (Scalloped two-prong bayonet, reverse mounting possible)
   - 12-2 Lens cap: E-77U
   - 12-3 Lens case: Soft Case: None Hard Case: LH-D24B Storable Items: Lens + tripod + 1 filter + reversely mounted hood + lens cap + dust cap
   - 12-4 Dust cap: Lens dust cap E
   - 12-5 Standard accessory: Tripod (weight: 150 g)

13. Other

13-1 Applicable extenders: EXT 1.4X and EXT 2X Applicable

		With EXT 1.4X mounted	With EXT 2X mounted
Focal length		98 ~ 280 mm	140 ~ 400 mm
Angle of view	Diagonal	25° 20' ~ 9° 20'	16° 20' ~ 6° 10'
	Vertical	13° 50' ~ 5° 10'	9° 10' ~ 3° 10'
	Horizontal	20° 50' ~ 7° 40'	13° 39' ~ 5° 10'
Maximum magnification		0.233	0.327
Focus		AF possible	
Aperture value		*f*/4 ~ *f*/45	*f*/5.6 ~ *f*/64

13-2 Extension tube EF25: Applicable

Condition	Shooting range(m)		Magnification		Field of view(mm)	
	WIDE	TELE	WIDE	TELE	WIDE	TELE
At closest distance	0.400	0.96	0.41	0.30	59 × 90	79 × 118
At infinity	0.405	1.73	0.38	0.14	64 × 97	171 × 256

13-3 Extension tube EF12: Applicable

Condition	Shooting range(m)		Magnification		Field of view(mm)	
	WIDE	TELE	WIDE	TELE	WIDE	TELE
At closest distance	0.55	1.16	0.22	0.22	111 × 169	107 × 160
At infinity	0.62	3.39	0.17	0.06	142 × 216	378 × 564

4. EXTERNAL DIMENSIONS/CROSS SECTION

Unit: mm

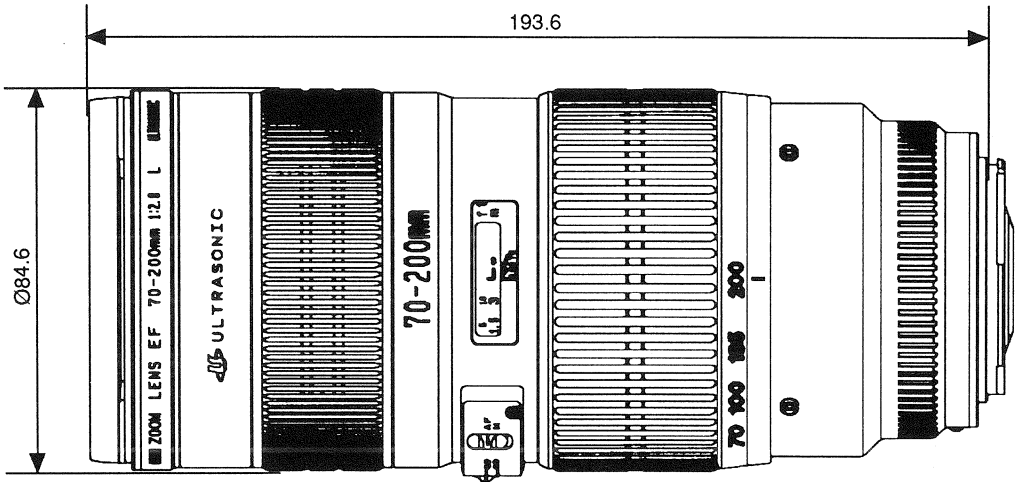


Fig. 1-1 External Dimensions

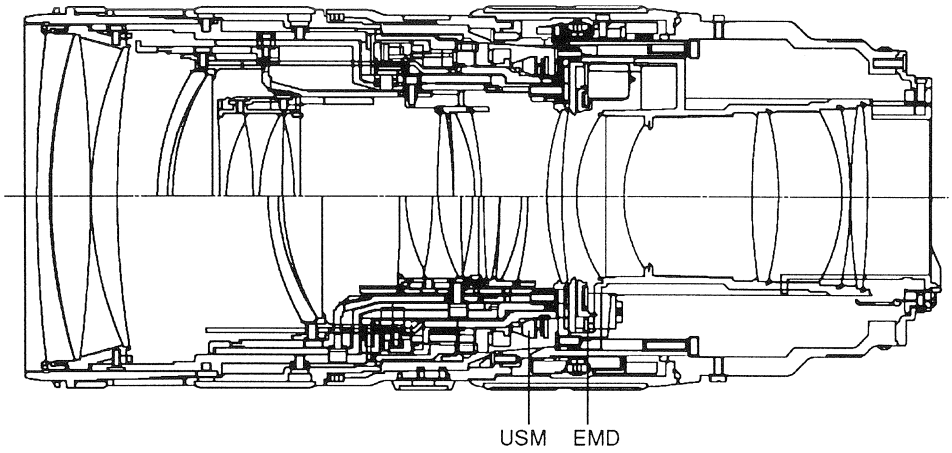


Fig. 1-2 Cross Section

5. LENS MOVEMENT

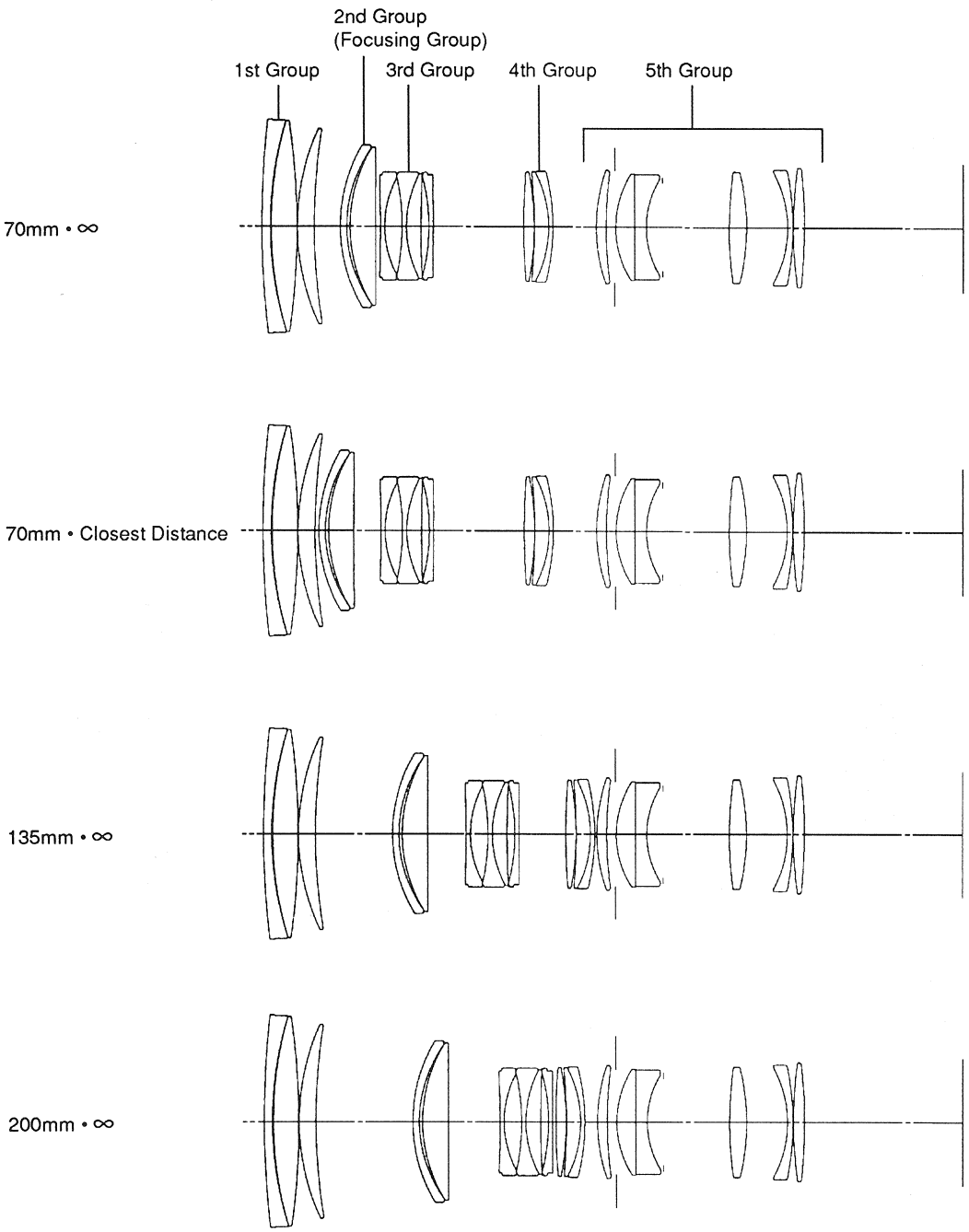


Fig. 1-3 Zooming Lens Movement

6. OTHER

6.1 Design

The design of this lens follows the EF 28-70 mm *f*/2.8L USM design concept to comply with the design specifications of *f*2.8L type zoom lens series.
The salient points of the design intended for higher operating efficiency and higher-grade appearance are:

- A powerful external image is achieved by judicious use of radiuses for edges.
- Wide manual focusing and zoom rings improve the operating efficiency.
- External appearance in light gray color similar to ultratelephoto L lens series, insures coherent appearance when equipped with an extender and underscores the quality of this high performance L-type lens.

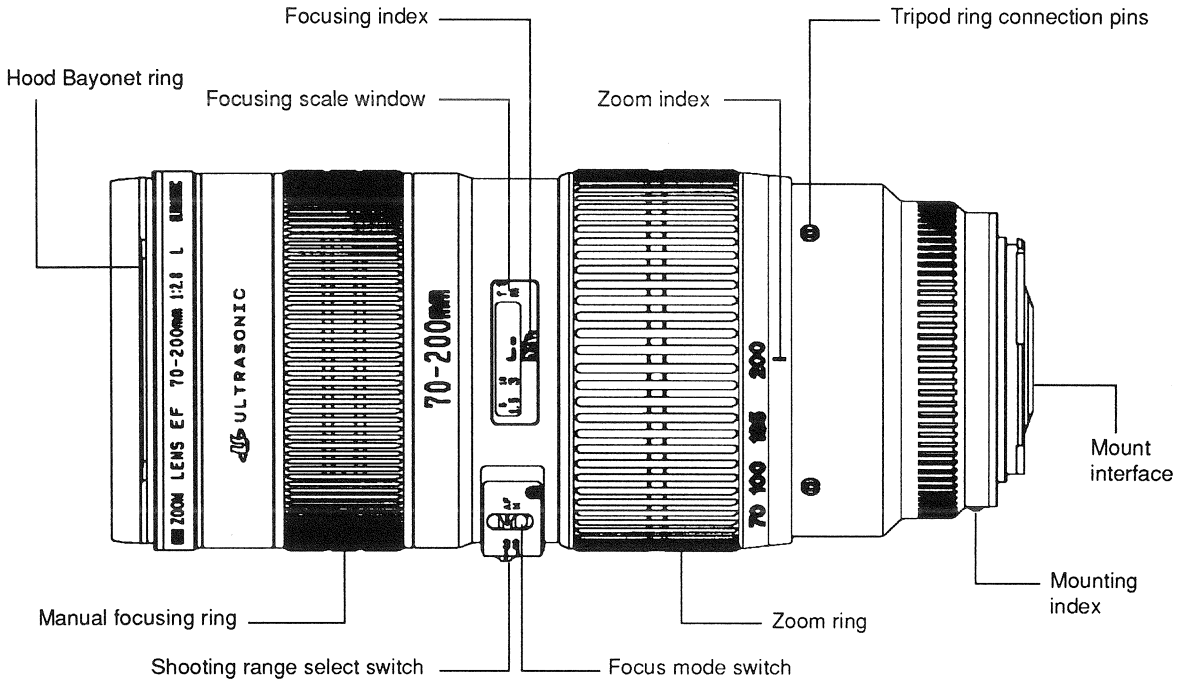


Fig. 1-4 Nomenclature

6.2 Technical Description
(1) Zoom Lens Optical System

The emphasis in this lens, as in all "L" lenses, is to achieve the best possible resolution. This is accomplished by using a design with five groups, three of which move during zooming and focusing, an independent variator, and an inner focusing system.

1) The breakdown by group is:

Group 1: Fixed positive lens group.
Group 2: Positive lens group responsible for image compensation and focusing.
Group 3: Negative lens group used for varying the focal length (zooming) (Zooming is undertaken by this group alone.).
Group 4: Positive lens group for image compensation.
Group 5: Positive lens group with diaphragm and image forming relay lens (fixed group).

2) Four UD Glass elements (G2, G3, G11, and G14), which have ultra low and anomalous dispersion, are used to reduce secondary spectrum. Through the use of the multiple moving group zoom system with independent variator and inner focusing, the following optical specifications are achieved:

- High resolution, high contrast and high picture quality.
- Large constant maximum aperture of *f*/2.8.
- Wide zoom range starting at 70 mm.
- Focuses down to 1.5 m giving a maximum magnification of 0.16X at Telephoto.
- First EF zoom lens with optical system allowing the use of an extender (Use of an extender 1.4X or 2X enables automatic focusing at any focal lengths.)
- Unlike the EF 80-200 mm *f*/2.8L, there is no lack of marginal illumination around 100 to 135 mm.

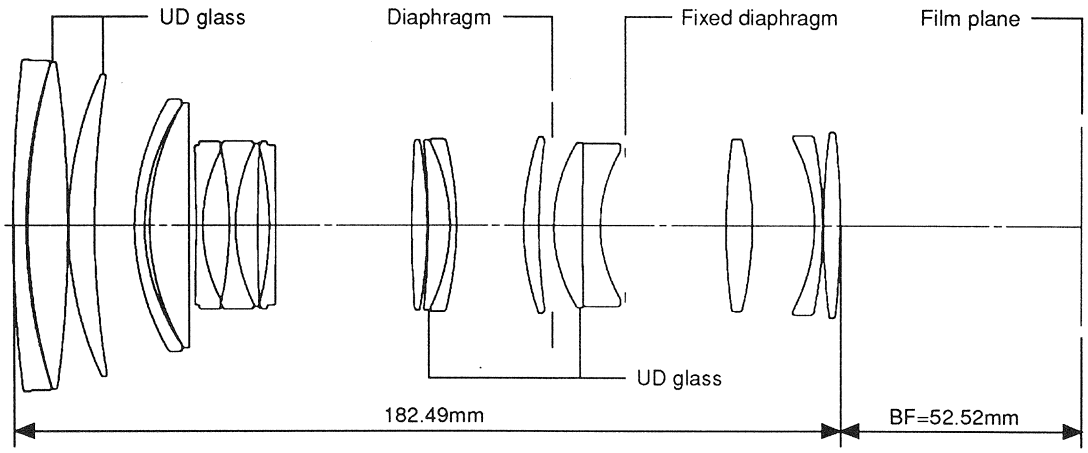


Fig. 1-5 Optical Schematic

(2) Mechanical

Mechanically, this lens has the following features.

- Quick and quiet autofocus using the inner focusing system and the world-renown ring-type USM.
- Stationary front element allows the effective use of circular polarizing filters. Use of a ø77 mm circular polarizing filter avoids a lack of marginal illumination.
- Large, scalloped hood ET-83 optimizes the hoods effect at all focal lengths.
- The tripod mount ring from the EF 35-350 mm *f*/3.5-5.6L USM lens is usable. It allows stable connection and smooth rotation.
  The lens must be removed from the camera before installing or removing the tripod mount ring. The ring can be removed by loosening its lock nut and rotating the ring to a position 45° to the right (looking from the rear of the lens) of top dead center and pulling the ring toward the rear. (Red alignment dots are provided on both the ring and the lens.)

(3) Precautions

- When using the built-in flash of certain EOS models, part of flash's light may be blocked by the lens.
- Care must be taken when using the range limiting function of the Shooting Range Select Switch:
  1) If the focusing scale is set to less than three meters and the Shooting Range Select Switch is set to 3 m to ∞, the autofocus will not operate when the shutter button is pressed.
  2) To eliviate this problem, manually move the focusing scale to above 3 m and repress the shutter button.
- Focus after zooming when using an extender. A focus shift occurs when zooming when using an extender.

Part 2

Technical Information

1. COMPONENTS AND FUNCTIONS

Symbol	Spec./Mgf. #	Function
CPU1	MN158499L84-1A	4-bit 1-chip microcomputer for communication control
CPU2	MN158499L84-2A	4-bit 1-chip microcomputer for EMD and USM control
IC1	BU2207FV	USM drive clock oscillator
IC2	MPC1732VM	EMD driver (8 power transistors)
IC3	AN1393S	Comparator (USM control phase signal)
IC4	MB3864PNF	USM driver
IC5	MB3776APNF	Step-up voltage control
IC6	S-81237SG-QE	3.7V voltage regulator (LED current regulator)
IC7	S-80727AN-DQ	Voltage detector (Resets CPUs if $V_{DD} \leq 2.7V$)
IC8	TC4W53FV	Multiplexer (communication line switching between CPU1 and CPU2)
IC9	TA75S393F	Comparator (VBAT voltage detection)
PS	P4035	Photointerrupter (generates a signal corresponding to focus unit movement)
PI	TLP810	Photointerrupter (EMD aperture detector)
Tr1	DTA-143XU	E1 current supply switch
Tr2	DTC-143TU	PI output amplifier
Tr3	2SD1624	Step-up voltage transistor
C1	1µF/25V	V_{DD} noise prevention
C2	1µF/25V	E1 noise prevention
C3	0.1µF/25V	Reset noise prevention
C4	22µF/10V	V_{BAT} noise prevention
C5	1.5µF/50V	VB filter
C6	150pF/50V	IC7 oscillation stabilizer
C7	4700pF/25V	IC7 oscillation frequency set
C8	0.047µF/25V	IC4 oscillation stabilizer
C9,10	3900pF/200V	USM drive
C11	4700pF/50V	USM phase signal voltage divider
C12	3300pF/25V	IC3 reference level voltage filter
C13	330pF/50V	IC1 oscillation frequency set
C14	0.22µF/25V	IC6 IC6 output noise prevention
D1	MA736	Set-up current limiter
D2	ISS302	IC3 protector
D3	SB01-05CP	IC3 protector
D4,5,6	IMN10	Input signal switching diode array
D7	IMN10	Input signal switching diode array
D8	MA141WA	Input signal switching diode array
D9	MA10	Input signal switching diode array
D10	MA141WA	Input signal switching diode array

Symbol	Spec./Mgf. #	Function
ZD1	MA3075WA	CPU1, CPU2 and IC8 protector
ZD2	MA3075WA	CPU1 protector
ZD3	MA3075WA	CPU1 and CPU2 protector
ZD4	MA3075WA	CPU2 protector
ZD5	7.5V/200mW	CPU1 protector
R1	27kΩ/0.063W	Resistor for communication line switching signal
R2	RCB4C123J	Resistor array for high level IC1 input signal
R3	15kΩ/0.063W	Time constant resistor for oscillator IC1
R4	42.2kΩ/0.1W	Output voltage clamp resistor
R5	750Ω/0.063W	Output voltage clamp resistor
R6	820Ω/0.063W	Tr3 base current limiter
R7	1.8kΩ/0.063W	Time constant resistor for oscillator IC5
R8	20kΩ/0.125W	Current stabilizer for phase detection circuit
R9	RCB4C104J	Input level bias for phase detection circuit
R10	RCB4C183J	IC3 reference level resistor array
R11	27kΩ/0.063W	IC2 gate voltage divider
R12	24kΩ/0.063W	IC2 gate voltage divider
R13	RCB8C123J	Resistor array for high level IC2 input signal
R14	12kΩ/0.063W	Resistor for high level focus pulse signal
R15	3kΩ/0.063W	PS output level set
R16	240Ω/0.063W	PS LED current limiter
R17	510Ω/0.063W	PI LED current limiter
R18,19	12kΩ/0.063W(1%)	VREG voltage detector
R20,21	12kΩ/0.063W(1%)	VBAT voltage detector
OSC1	FAR-C4CB 8MHz	CPU1 clock oscillator
OSC2	FAR-C4CB 8MHz	CPU2 clock oscillator
VR1	2kΩ	PS LED current adjustment
VR2	10kΩ	IC1 frequency adjustment
L1,2	1.5mH/100mA	USM drive coil
L3	12μH/2.3A	Step-up coil

2. IC PIN TABLE

CPU1

No.	Symbol	I/O	A/D	Voltage	Function
1	RESET	I	D	0-VDD	CPU1 reset
2	OSC1	I			External oscillator input (8MHz)
3	OSC2	O			External oscillator output
4	VDD			VDD	Power supply
5	DCL	I	D	0-VDD	Communications port
6	DLC	O	D	0-VDD	Communications port
7	LCLK	I/O	D	0-VDD	Communications port
8	DGND			0	D-GND (Device Ground)
9	SIN			0	D-GND
10	BIN			0	D-GND
11	BOUT				Not used
12	AOUT				Not used
13	FIN			0	D-GND
14	DAC0	O	D	0-VDD	Communications port for CPU2
15	DAC1	O	D	0-VDD	Communications port for CPU2
16	DAC2	O	D	0-VDD	Communications port for CPU2
17	DAC3				Not used
18	DAC4	O	D	0-VDD	Communications port for CPU2
19	DAC5				Not used
20	DAC6				Not used
21	DAC7				Not used
22	BUSY1	O	D	0-VDD	Communications port for CPU2
23					Not used
24	COM2	O	D		Focus ring position and limit switch detection common
25	COM3	O	D		Best focus adjustment common
26	ZM0/ZN0/ AFADJ0	I	D		Zoom signal detect, Focusing ring position Best focus adjustment
27	ZM1/ZN1/ AFADJ1	I	D		Zoom signal detect, Focusing ring position Best focus adjustment
28	ZM2/ZN2/ AFADJ2	I	D		Zoom signal detect, Focusing ring position Best focus adjustment
29	ZM3/MACRO/ AFADJ2	I	D		Zoom signal detect, Limit switch detect, Best focus adjustment
30	ZM4/EXT0/ AFADJ4/AFADJ6	I	D		Zoom signal detect, Extender detect, Best focus adjustment
31	EXT1/AFADJ5/ AFADJ7	I	D		Extender detect, Best focus adjustment
32	DATA0	I	D		Communications port for CPU2
33	DATA1	I	D		Communications port for CPU2
34	BUSY2	I	D		Communications port for CPU2
35	COM4/	O	D		Best focus adjustment common
36	COM5	O	D		Best focus adjustment common

No.	Symbol	I/O	A/D	Voltage	Function
37	COM6	O	D		Zoom signal
38	COM7	O	D		Extender
39	DLCSEL	O	D		Communication line switching signal output
40	RESOUT	O	D		CPU2 reset signal output
41					Not used
42					Not used
43	DGND		0		DGND
44	DGND		0		DGND

CPU2

No.	Symbol	I/O	A/D	Voltage	Function
1	RESET	I	D	0-VDD	CPU2 reset
2	OSC1	I			External oscillator input (8 MHz)
3	OSC2	O			External oscillator output
4	VDD			VDD	Power supply
5	DCL	I	D	0-VDD	Communications port
6	DLC	O	D	0-VDD	Communications port
7	LCLK	I/O	D	0-VDD	Communications port
8	DGND			0	D-GND
9	SIN	I	D		USM S phase input
10	BIN	I	D		USM B phase input
11	BOUT	O	D		USM drive B phase output
12	AOUT	O	D		USM drive A phase output
13	FIN	I	D	0	USM drive frequency input
14	DAC0	O	D	0-VDD	IC1 capacitor charging current decision
15	DAC1	O	D	0-VDD	IC1 capacitor charging current decision
16	DAC2	O	D	0-VDD	IC1 capacitor charging current decision
17	DAC3	O	D	0-VDD	IC1 capacitor charging current decision
18	DAC4	O	D	0-VDD	IC1 capacitor charging current decision
19	DAC5	O	D	0-VDD	IC1 capacitor charging current decision
20	DAC6	O	D	0-VDD	IC1 capacitor charging current decision
21	DAC7	O	D	0-VDD	IC1 capacitor charging current decision
22	E1ON	O	D	0-VDD	Tr1 on and off
23	DCON	O	D		DC/DC converter on and off
24	DATASEL0	O	D		Communications port for CU1
25	DATASEL1	O	D		Communications port for CU1
26	ZM2/ZN0/ EXT0	I	D		Communications port for CU1
27	ZM3/ZN1/ EXT1	I	D		Communications port for CU1
28	ZM4/ZN2/ MACRO	I	D		Communications port for CU1
29	DATA	I	D		Communications port for CU1
30	BUSY1	I	D		Communications port for CU1

No.	Symbol	I/O	A/D	Voltage	Function
31	COMP				VBAT comparator input
32	RSV	I	D		Backlash compensation common
33	IRIS	I	D		Maximum aperture SW input
34	A/M	I	D		Focus mode SW common
35	MAN	O	D		Focus mode SW manual components
36	AF	O	D		Focus mode SW auto focus components
37	BUSY2	O	D		Communications port for CPU1
38	COM	O	D		Backlash compensation common
39	EMD A	O	D		EMD A phase forward current control
40	EMD A'	O	D		EMD A' phase reverse current control
41	EMD B	O	D		EMD B phase forward current control
42	EMD B'	O	D		EMD B' phase reverse current control
43	P1	I	D		PS pulse signal input
44	DGND			0	D-GND

IC1

No.	Symbol	I/O	A/D	Voltage	Function
1	D7	I	D		VCO control data input D7 (MSB)
2	D6	I	D		VCO control data input D6 (MSB)
3	D5	I	D		VCO control data input D5 (MSB)
4	D4	I	D		VCO control data input D4 (MSB)
5	D3	I	D		VCO control data input D3 (MSB)
6	D2	I	D		VCO control data input D2 (MSB)
7	GND			0	GND (Ground)
8	D0	I	D		VCO control data input D0 (LSB)
9	D1	I	D		VCO control data input D1
10	Thresh	I	A		Oscillator input
11	Discharge	O	A		Oscillator capacity discharge output
12	Control	O	A		Control voltage output
13	Out	O	D		Oscillator output
14	VDD			E1	Power supply

IC2

No.	Symbol	I/O	A/D	Voltage	Function
1	VBAT				EMD power supply
2	OUT2	O		0-V_{DD}	EMD B' phase current
3	VG	I	D		IC control power supply
4	PGND			0	P-GND (Power Ground)
5	DGND			0	D-GND
6	E1				IC control power supply
7	OUT4	O		0-V_{DD}	EMD A' phase current
8	VBAT				EMD power supply

No.	Symbol	I/O	A/D	Voltage	Function
9	OUT3	O		0-VDD	EMD A phase current
10	IN4	I	D	0-VDD	EMD A' phase reverse current
11	IN3	I	D	0-VDD	EMD A phase forward current
12	PGND			0	P-GND
13	DGND	I	D	0	IC2 output control
14	IN1	I	D	0-VDD	EMD B phase forward current
15	IN2	I	D	0-VDD	EMD B' phase reverse current
16	OUT1	O		0-VDD	EMD B phase current

IC3

No.	Symbol	I/O	A/D	Voltage	Function
1	SOUT	O			USM S phase output
2	SIN	I			USM S phase input
3	ThresholdS	I			S phase signal converter
4	UGND			0	U-GND (USM Ground)
5	ThresholdB	I			B phase signal converter
6	BIN	I			USM B phase input
7	BOUT	O			USM B phase output
8	VB			VB	Power supply

IC4

No.	Symbol	I/O	A/D	Voltage	Function
1	1A	I	D		USM A phase input
2	VCC			VB	Power supply
3	1Y	O	D		USM A phase output
4	PGND			0	P-GND
5	PGND			0	P-GND
6	2Y	O	D		USM B phase output
7	VCC			VB	Power supply
8	2A	I	D		USM B phase input

IC5

No.	Symbol	I/O	A/D	Voltage	Function
1	-IN	I	A		Error amplifier input
2	CTL	I	A		Oscillator control
3	VCC				Power supply
4	IB		A		Output bias
5	OUT	O	A		Output
6	GND			0	GND
7	OSC		A		Oscillator

No.	Symbol	I/O	A/D	Voltage	Function
8	FB	I	A		Error amplifier output

IC6

No.	Symbol	I/O	A/D	Voltage	Function
1	DGND			0	D-GND
2	E1	I		E1	Power supply
3	VREG	O		3.7V	PI, PS power supply

IC7

No.	Symbol	I/O	A/D	Voltage	Function
1	RESET	O		0-V_{DD}	CPU reset ("L" = reset)
2	VDD			V_{DD}	Power supply
3	DGND			0	D-GND

IC8

No.	Symbol	I/O	A/D	Voltage	Function
1	COM	O	D		Communication signal output to camera
2	DGND	I	D	0	IC8 output control ("L" = permitted)
3	DGND	I		0	D-GND
4	DGND			0	D-GND
5	A	I	D		Input signal selector
6	Ch1	I	D		Communication signal input from CPU2
7	Ch2	I	D		Communication signal input from CPU1
8	VDD			V_{DD}	Power supply

IC9

No.	Symbol	I/O	A/D	Voltage	Function
1	INM	I	A		VBAT voltage input
2	GND			0	GND
3	INP	I	A		VREG voltage input
4	COMP	O	D		Comparison output
5	E1			E1	Power supply

3. CIRCUIT EXPLANATION

3.1 Lens Mounted on Camera

1) When the lens is mounted, power is supplied from the camera to the lens CPU1 and CPU2 via the VDD mount contact pin. The CPU1 and CPU2 activate the oscillator (OSC). At this time, the CPU1 is reset by capacitor C3 and voltage detector IC7. After being reset, the CPU1 resets the CPU2. After the initialization, the CPU1 and CPU2 halt.

2) When the camera and lens communicate, CPU2 makes the 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) This command causes current to flow through the IC2 OUT1 - 4 pins, and drives the EMD to open the diaphragm.

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

7) When the fully open condition has been sensed, the EMD is driven completely back the start (initial) position. When the diaphragm blades have stabilized, the EMD A, A', B and B' pins are made low, stopping the EMD drive.

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

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 CPU2 makes DLC low regardless of 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 camera SW1 goes on. the camera DC/DC converter goes on, so the lens CPUs receives VDD and VBAT (for the DC/DC converter and EMD drive IC2) from the camera. The lens CPU2 makes E1ON low, turning Tr1 on and sending E1 to the relevant circuits.

Focusing (USM) drive

11) When the focus drive signal is received from the camera, the lens CPU2 starts the USM drive sequence.

12) The DC/DC pin goes low, activating the lens DC/DC converter.

13) When the camera sends both the focusing command and focus data, CPU2 drives the USM with this data; but if the command is received without the data, CPU2 uses the previous focusing data.

14) When CPU2 receives the focus detection signal, it outputs out-of-phase square wave from AOUT and BOUT. The phase of the signal determins the rotational direction of the USM and allows IC4 to amplify the signal.

15) Signal amplified by IC4 is sent to UA and UB to drive the USM.

16) As the USM turns on, the phototransistor of the photointerrupter detects a change in the amount of light from the LED. Tr2 generates pulses corresponding to the amount of light, and sends them to CPU2.

17) CPU2 counts the pulses to determine when correct focus has been reached. Focusing continues until the correct focus is reached.

18) When the correct focus is reached, CPU2 stops the USM.

19) CPU2 issues a high signal from DC/DC, shutting off the DC/DC converter.

Diaphragm (EMD) drive

20) When the lens receives the aperture drive signal from the camera over the DCL line, the CPU2 sends a busy (LCLK=low) signal.

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

22) The CPU2 then sends the diaphragm drive command to IC2 via the EMD A, A', B and B' pins.

23) With the change of the diaphragm drive command, the current flowing through the EMD coil (A, A', B and B') from IC2 OUT1 - 4 changes, determining the direction of the current flow for the EMD coil, and with this, EMD is driven.

24) A certain time after the last pulse is sent from the CPU2 to IC2, the busy signal is removed from the LCLK line.

25) The camera sends the diaphragm stop signal through DCL to the lens CPU2, which makes the EMD A, A', B and B' pins low to remove the power from IC2 OUT1 - 4.

Part 3

Repair Information

1. PREPARATIONS FOR REPAIR

1.1 Disassembly, Assembly and Adjustment Notes

1.1.1 Disassembly and Assembly

- This lens requires tilt and centering adjustments.
- Focus is adjusted at the WIDE and TELE extremes.
- This lens has many elements. Do not disassemble this lens further than necessary for required repair.
- When removing rollers and collars, note their positions and orientations, particularly for eccentric collars.

1.1.2 Adjustment

Adjustment	Adjustment Method	Tool
Tilt adjustment	Adjust the two eccentric collars holding the 1st Lens Group	Lens Projector
Centering adjustment	Adjust the lateral position of the G13 Lens Barrel	800 mm lens focus collimator

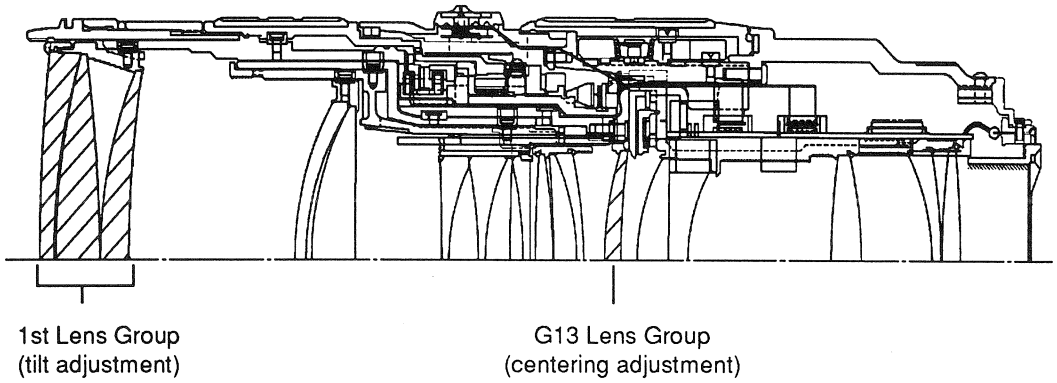


Fig. 3-1 Optical Adjustment Points

1.2 Expendables List

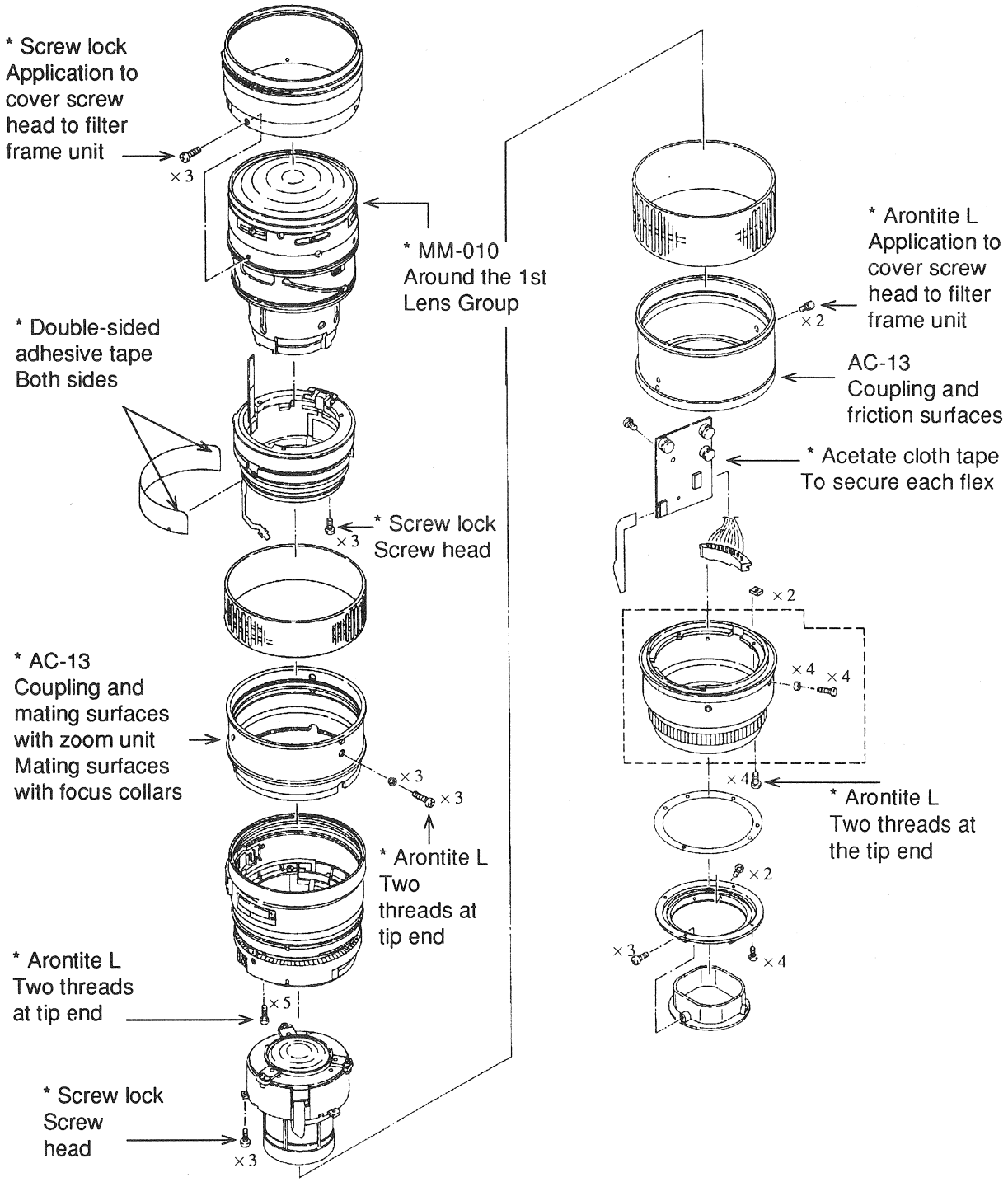


Fig. 3-2 Expendable Application (I)

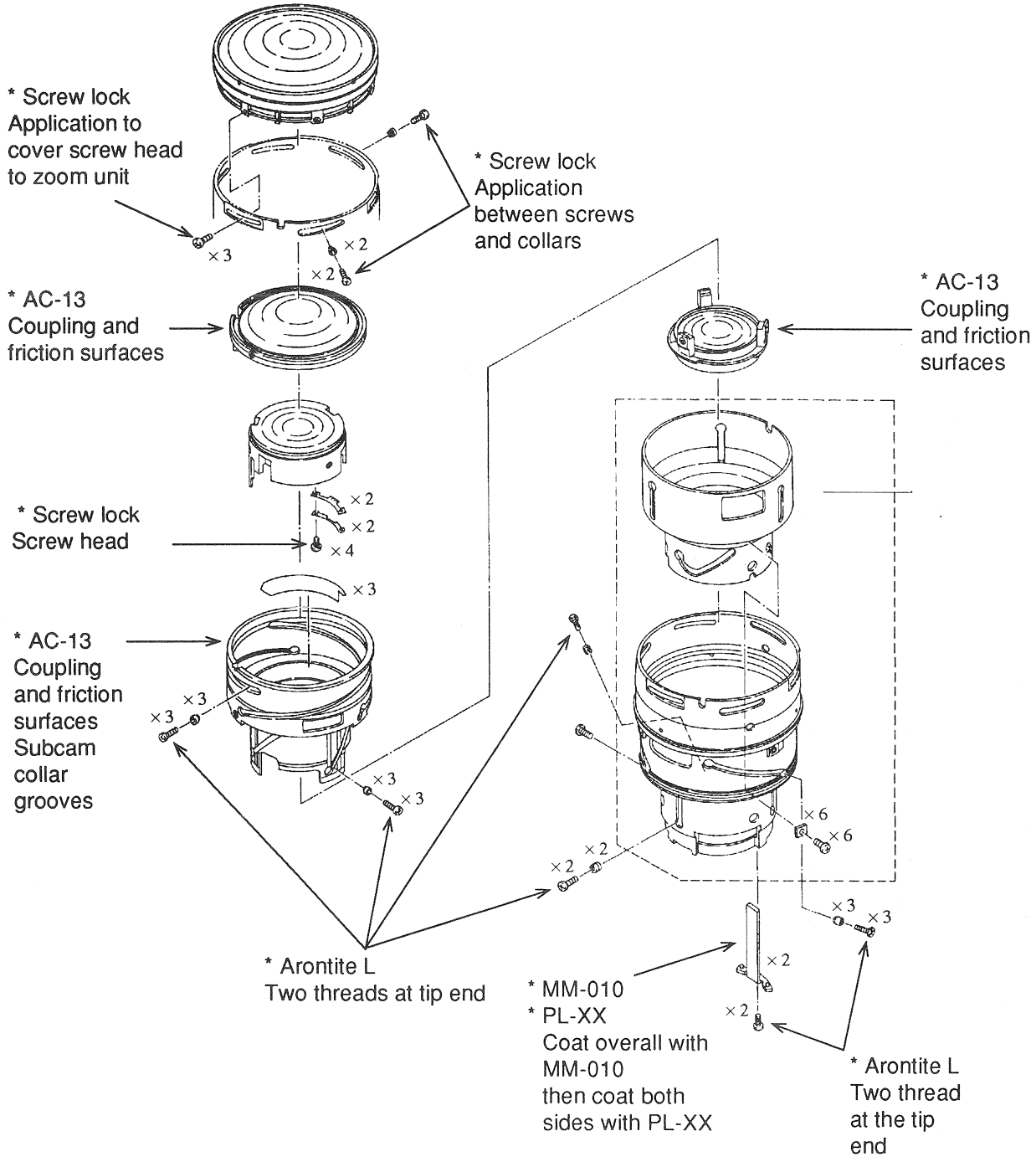


Fig. 3-3 Expendable Application (II)

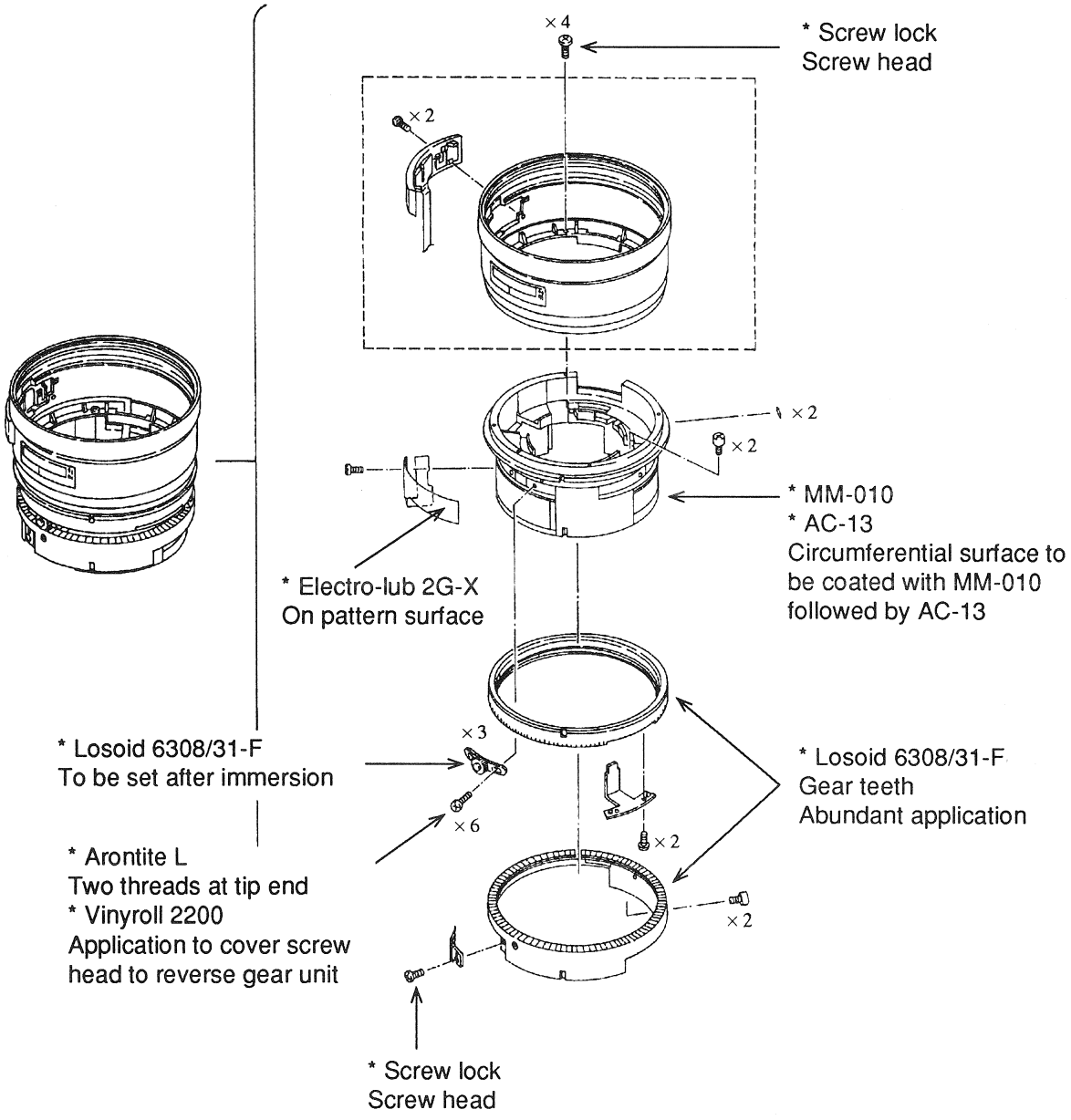
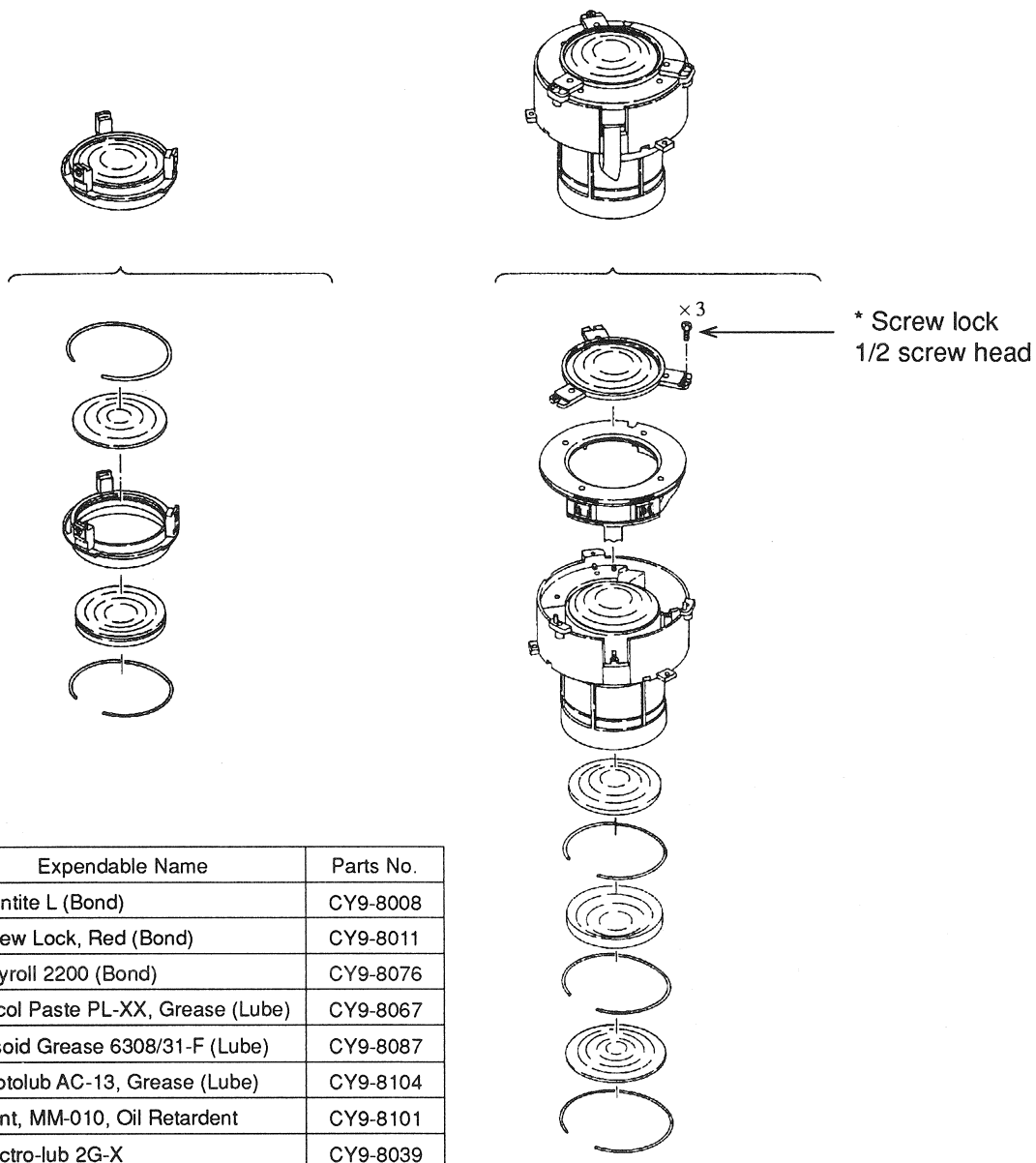


Fig. 3-4 Expendable Application (III)



NO	Expendable Name	Parts No.
1	Arontite L (Bond)	CY9-8008
2	Screw Lock, Red (Bond)	CY9-8011
3	Vinyroll 2200 (Bond)	CY9-8076
4	Rocol Paste PL-XX, Grease (Lube)	CY9-8067
5	Losoid Grease 6308/31-F (Lube)	CY9-8087
6	Photolub AC-13, Grease (Lube)	CY9-8104
7	Paint, MM-010, Oil Retardent	CY9-8101
8	Electro-lub 2G-X	CY9-8039
9	Double-sided Adhesive Tape	CY4-9303
10	Acetate Cloth Tape (No. 510 FR)	CY4-9102

Fig. 3-5 Expendable Application (IV)

1.3 Adjustments List

Item	Purpose	Description	Page
Centering	To achieve best balance of resolution on axis	Check and adjust when G13 Lens Group is replaced or removed or optical system parts are replaced or disassembled.	3-22
Tilt	To equalize resolution in the outer zones	Check and adjust when the 1st Lens Group is replaced or removed or optical system parts are replaced or disassembled.	3-24
Focus	To achieve infinity focus	Check and adjust at the time of disassembly or when parts (particularly, lens or lens barrel) are disassembled.	3-26
Pulse	To achieve more accurate USM drive data	Adjust when the focusing unit or the main circuit board is replaced.	3-28
Focus Compensation	To achieve the best focus when shooting at very large apertures	Adjust when BP-FLX is replaced. (To the same condition as it was prior to replacement)	3-30
USM Reference Frequency	To adjust the reference frequency	This adjustment is not normally required because the main flex unit is adjusted at the factory.	3-32
Zoom Brush Position	To insure correct zoom data is input into camera	Adjust when the zoom brush or the zoom flex (Z-FLX) is replaced or removed.	3-33

*: The USM Reference Frequency adjustment is included for your reference although it is not normally necessary.

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2. ASSEMBLY AND DISASSEMBLY

2.1 Main Circuit Board Unit Removal

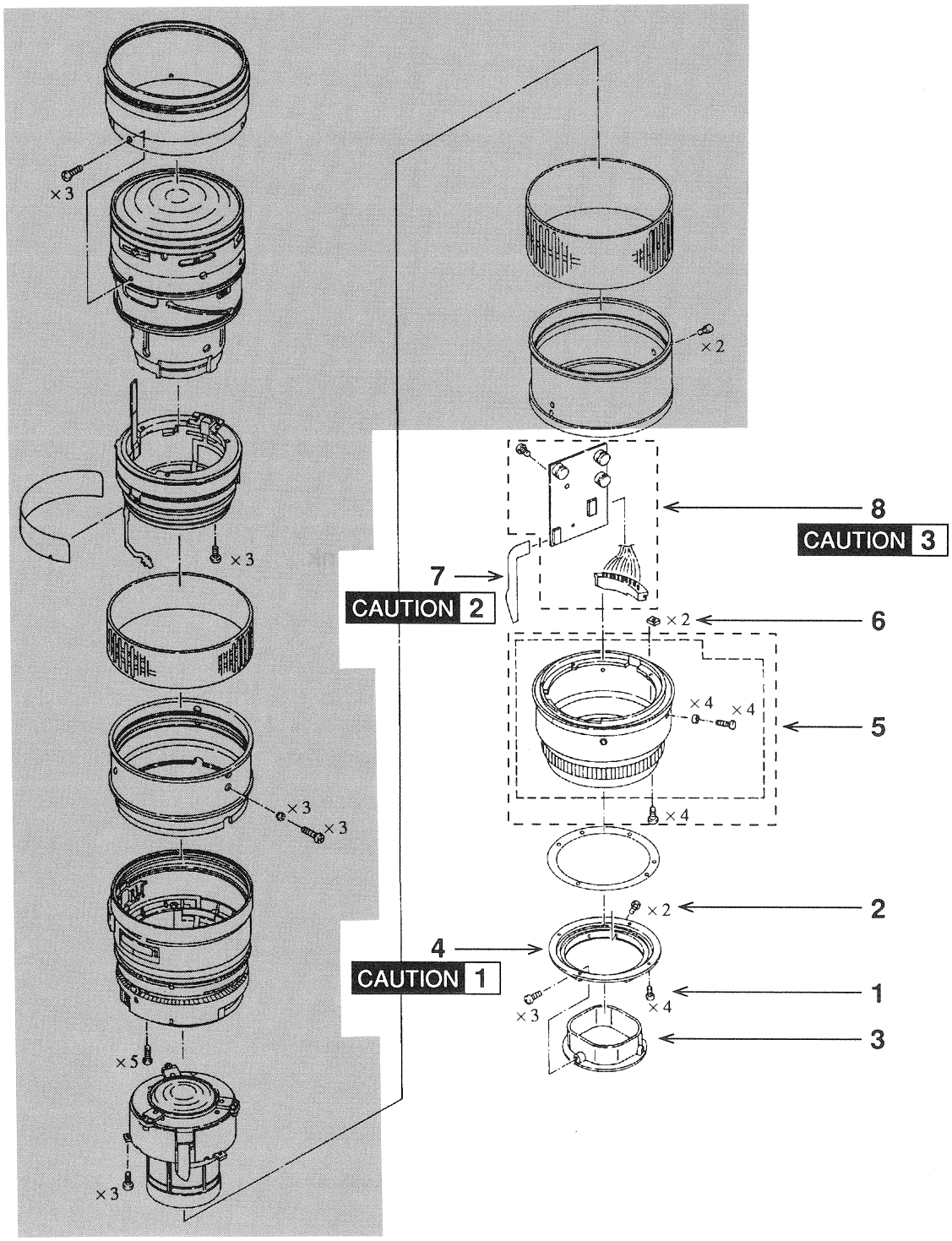


Fig. 3-6 Main Circuit Board Unit Removal

1) Lens Mount Screws (4 ea.)

2) Mount Interface (MIF) Unit Screws (2 ea.)

3) Back Cover (3 screws)

4) Lens Mount

CAUTION 1 Lens Mount Replacement

- At the factory, the lens mount is shaved to the correct thickness. When replacing the mount, measure the original thickness (using a micrometer, calipers, etc.) and replace with the special service mount and washers in a manner to achieve the original thickness.

5) Fixed Barrel (4 screws, staked)

6) Friction Rubber

- Note that turning the fixed barrel downward, may cause this friction rubber to fall off.
- This rubber is required at two points only. Confirm where to insert.

7) BP-FLX

- Normally, removal is unnecessary.
- Before reinserting the flex connectors, wipe the pattern surface with dry cloth to prevent electrical shorts.

CAUTION 2 BP-FLX Replacement

- Bridge the AF-ADJ0 through AF-ADJ7 pads as they were prior to replacement. **(See 3.5 Focus Compensation for details.)**

8) Main Circuit Board (1 screw)/MIF unit

- When removing the main circuit board, disconnect all five flexes.

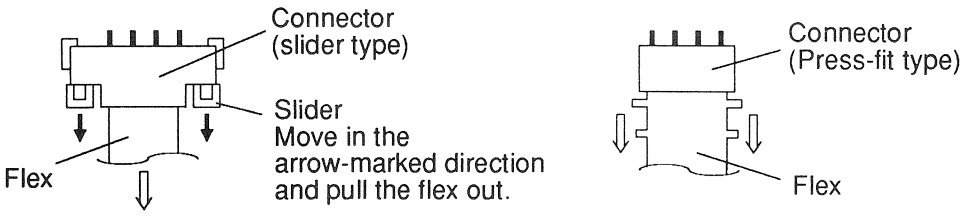


Fig. 3-7 Flex (Dis)connection

- The MIF unit needs to be removed only when replacing the main circuit board.
- Before reinserting the flex connectors, wipe the pattern surface with dry cloth to prevent electrical shorts.

CAUTION 3 Main Circuit Board Replacement

- Pulse adjustment is required. **(See 3.4 Pulse Adjustment for details.)**

2.2 Focusing Unit Removal

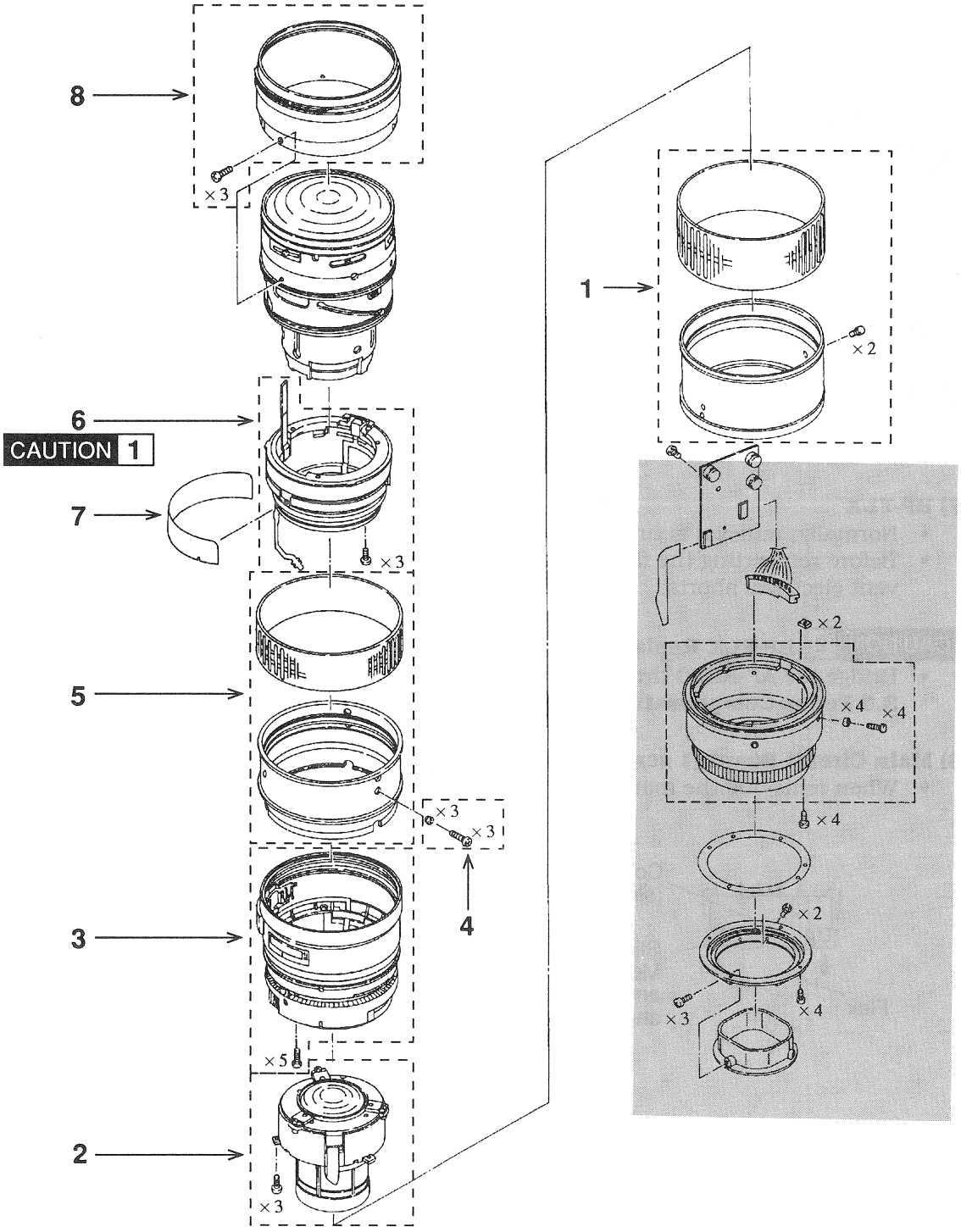


Fig. 3-8 Focusing Unit Removal

1. Zoom Ring (2 screws, staked)/Rubber Grip
- Lift the back edge of the rubber grip to remove the screws. The rubber grip need not be removed.

2. 5th Lens Group (3 screws, staked)

3. Focus Index & Reverse Gear Unit (5 screws, staked)
- Be careful not to pinch or tear any of the flexes.
- When reinstalling, align the zoom key of the focus index & reverse gear unit with the zoom key groove in the zoom unit.

4. Focusing Collar (3 screws, staked)
- When removing, turn over the lower half of the rubber grip.

5. Focusing Ring/Rubber Grip
- Normally, rubber grip needs not be removed.

6. Focusing Unit (3 screws, staked)
- Check the holes containing screws before removing this unit.
- Do not touch the stator and rotor with the bare hands.
- When reinstalling, align the focusign key of the focusing unit with the focusing key groove in the 2nd Lens Group barrel.

CAUTION 1 Focusing Unit Replacement
- Pulse adjustment is required. **(See 3.4 Pulse Adjustment for details.)**

7. Distance Scale Seal (double-sided tape)
- It is not normally necessary to remove the distance scale seal.
- When affixing the scale, make sure the cut-out is on the positioning pin and that the scale is properly aligned.

8. Front Ring Unit (3 screws, staked)

2.3 Lens Barrel Unit Removal (I)

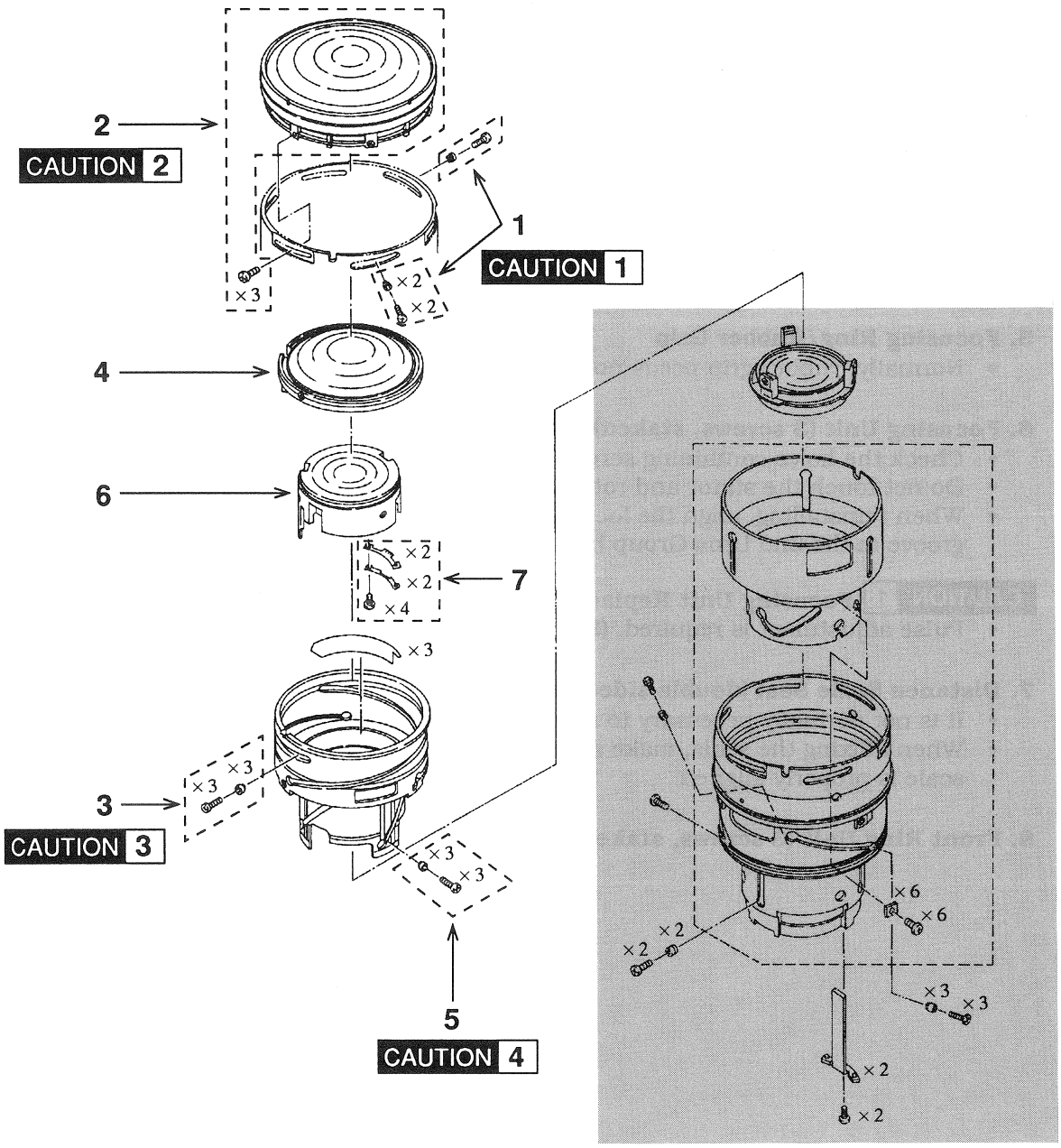


Fig. 3-9 Lens Barrel Unit Removal (1)

1. First Group Collars (2 eccentric collars, 1 concentric collar, 3 screws; staked)

- Before removing the collars, check the placement and positioning of the collars. Particulary, eccentricity of eccentric collars must be confirmed.

CAUTION 1 First Group Collar Replacement

- Place the concentric collar in the round hole and the eccentric collars in the oblong holes.
- Carry out tilt adjustment. **(See 3.2 Tilt Adjustment for details.)**

2. First Lens Group (3 screws, staked)

- During focus adjustment, the 1st Lens Group is adjusted to achieve best balance between tele and wide focus.
- Check the position with respect to the zoom unit before removing.

CAUTION 2 First Lens Group Replacement

- Focus adjustment is necessary. **(See 3.3 Focus Adjustment.)**

3. Second Group Collars (3 collars and 3 screws, staked)

- Before removing the collars, check the placement and positioning of the collars.

CAUTION 3 Second Group Collar Replacement

- When replacing the collars, check collar diameter and replace with the same diameter collars or try each collar size and use the size that allows smooth movement without excess slop.

YA2-2062-000 detail

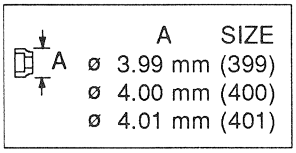


Fig. 3-10 2nd Lens Group Collar Adjustment

4. Second Lens Group

- When installing, make sure that the lens barrel moves by its own dead load.

5. Third Group Collars (3 collars and 3 screws, staked)

- Before removing the collars, check the placement and positioning of the collars.

CAUTION 4 Third Group Collar Replacement

- See the above CAUTION for the second group collars.
- For adjustment, refer to Fig. 3-10 2nd Lens Group Collar Adjustment.

6. Third Lens Group

- When installing, make sure that the lens barrel moves by its own dead load.

7. Two Key Masks/Two Mask Holders (4 screws, staked)

- Removal is not normally necessary.

2.4 Lens Barrel Unit Removal (II)

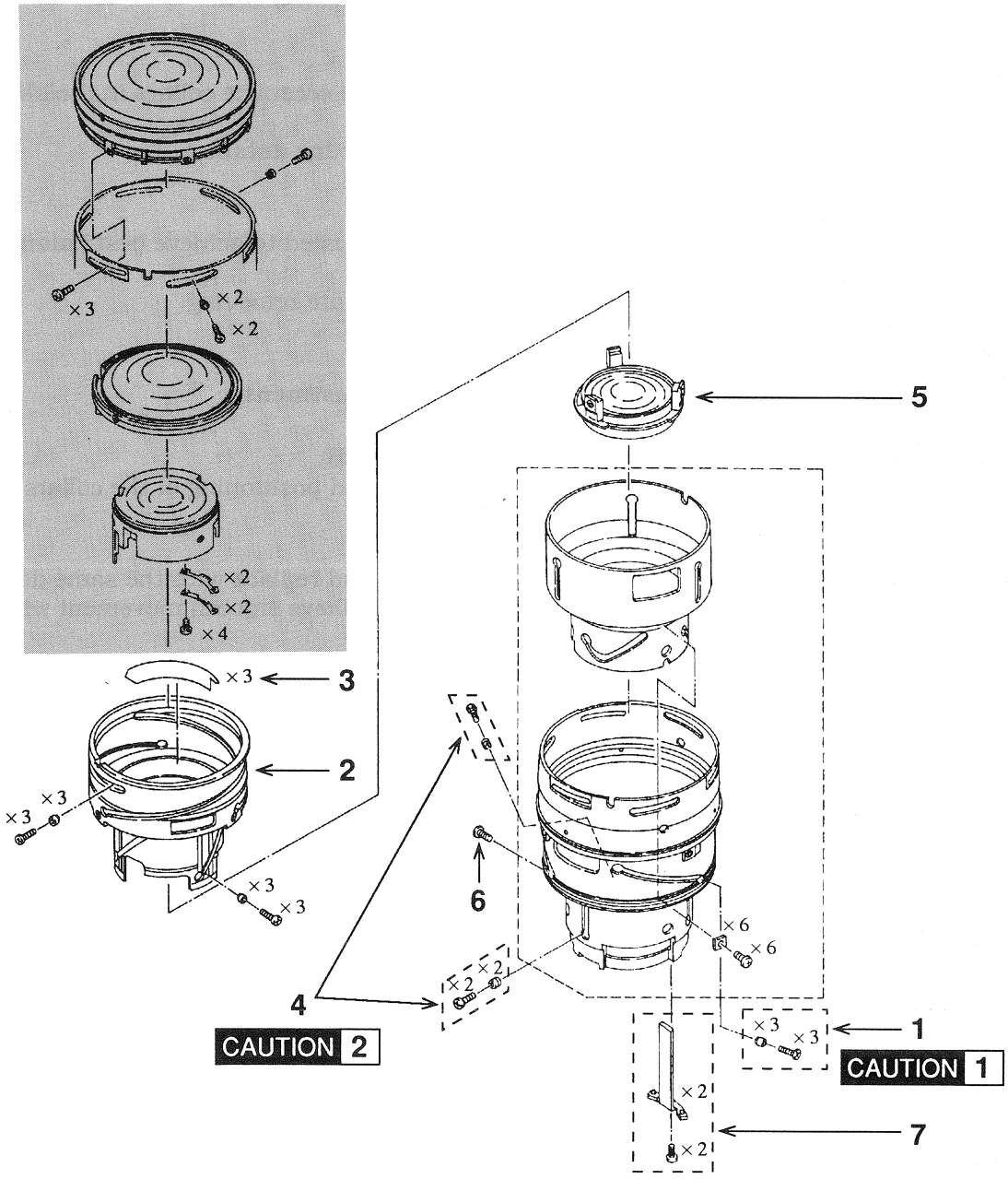


Fig. 3-11 Lens Barrel Unit Removal (II)

1. Subcam Collars (3 collars and 3 screws, staked)

- Before removing the collars, check the placement and positioning of the collars.

CAUTION 1 Subcam Collar Replacement

- When replacing the collars, check collar diameter and replace with the same diameter collars, or try each collar size and use the size thta allows smooth movement without excess slop.

YA2-2063-000 detail

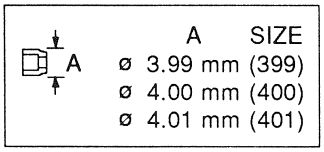


Fig. 3-12 Subcam Collar Adjustment

2. Subcam Barrel

- When installing subcam barrel, align the zoom unit with the focus key groove.

3. Subcam Flock Paper

- Removal is normally unnecessary.
- When affixing this paper, avoid bends, slack, twists and overlaps.

4. Fourth Group Collars (2 eccentric collars, 1 concentric collar and 3 screws, staked)

- Before removing the collars, check the placement and positioning of the collars.

CAUTION 2 Fourth Group Collar Replacement

- When replacing the collars, check collar diameter and replace with the same diameter collars, or try each collar size and use the size that allows smooth movement without excess slop.

YA2-2051-000 detail

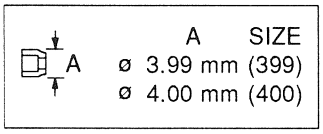


Fig. 3-13 Fourth Lens Group Collar Adjustment

5. Fourth Lens Group

6. Stopper Screw

- Normally, this screw needs not be removed.

7. Third Group Guide Keys (2 keys and 2 screws, staked)

- Normally, removal is not necessary.

2.5 Reverse Gear Disassembly (I)

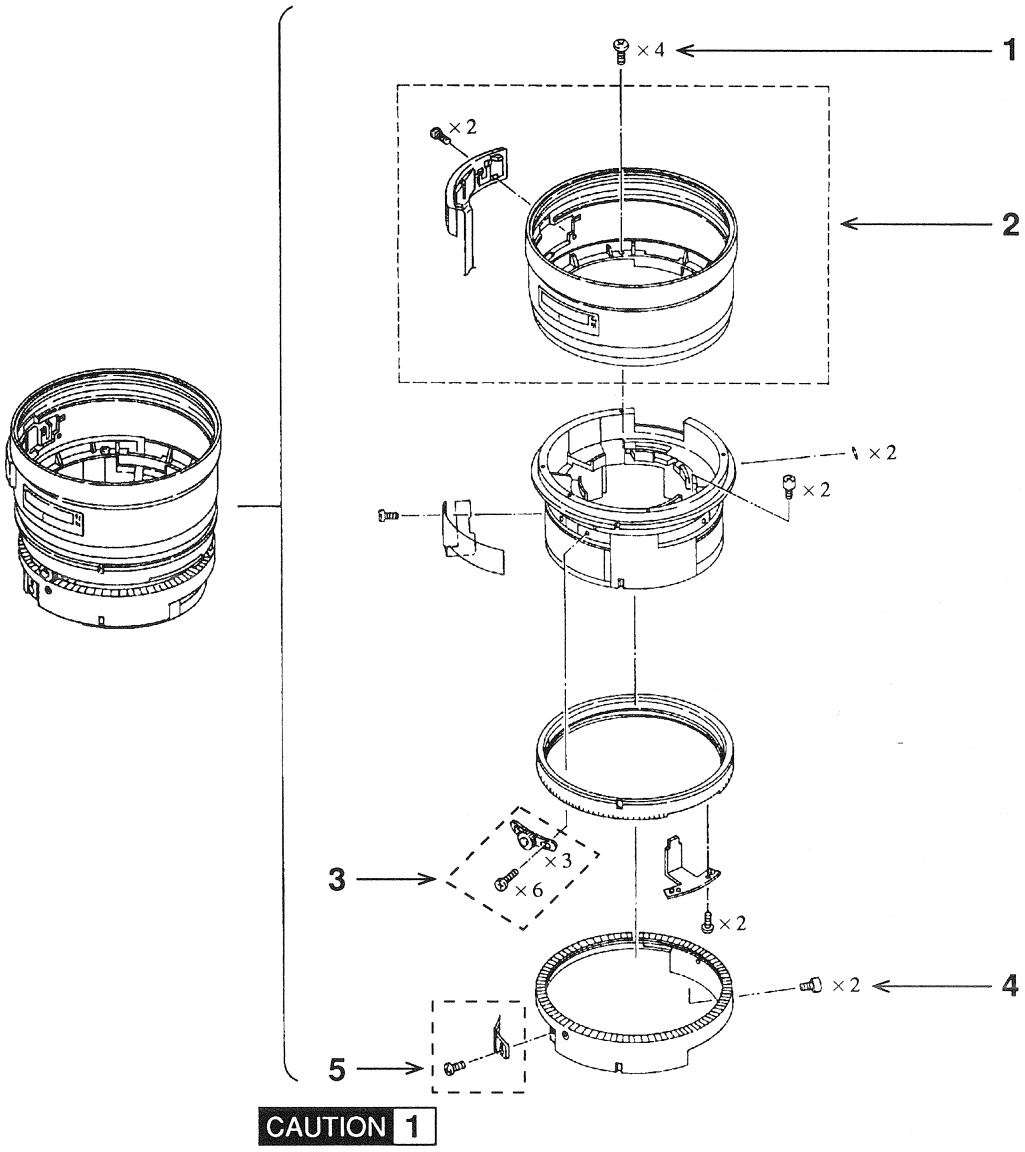


Fig. 3-14 Reverse Gear Disassembly (I)

1. Four Set Screws for Focus Index Unit, staked.

2. Focus Index Unit

3. Reverse Gear Unit (6 screws, staked)

- When installing, be sure that the positioning slots in intermediate barrel are in alignment with those in each gear ring.

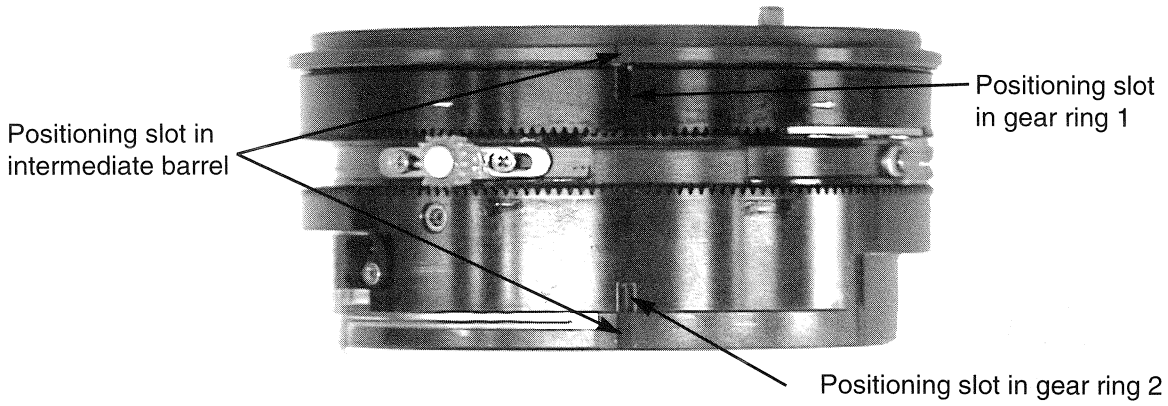


Fig. 3-15 Reverse Gear Unit Positioning

4. Two Stopper Screws

5. Zoom Brush (1 screw, staked)

- Adjustment is necessary when installing. Check its position in advance.

CAUTION 1 Zoom Brush Replacement

- Temporarily fix the brush. It must be adjusted later. **(See 3.7 Zoom Brush Adjustment for details.)**

2.6 Reverse Gear Disassembly (II)

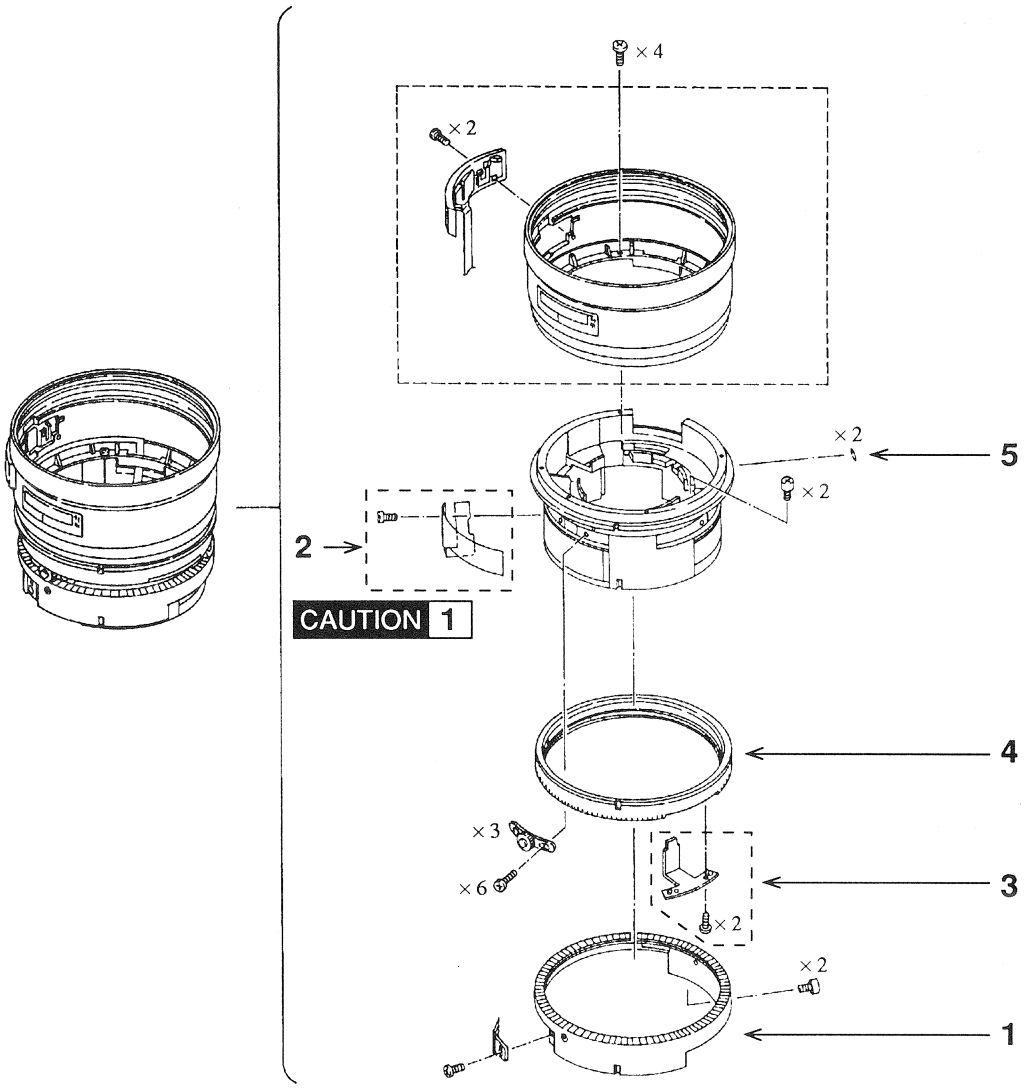


Fig. 3-16 Reverse Gear Disassembly (II)

1. Gear Ring 2

- When installing, be sure that the positioning slots in gear rings are located as follows with respect to the positioning slots in the intermediate barrel.

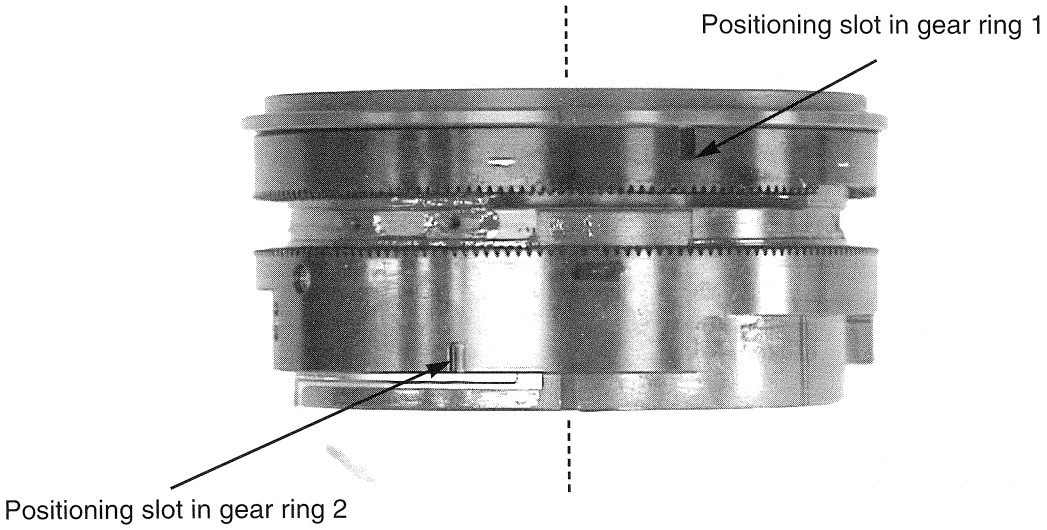


Fig. 3-17 Gear Ring Installation Position

2. Z-FLX

- Removal of Z-FLX is normally unnecessary.

CAUTION 1 **Z-FLX Replacement**

- The zoom brush position must be adjusted if the Z-FLX is replaced. **(See 3.7 Zoom Brush Adjustment for details.)**

3. Zoom Key (2 screws)

4. Gear Ring 1

- Refer to Fig. 3-17 Gear Ring Installation Position for details.

5. Friction Rubber

2.7 Lens Unit Disassembly

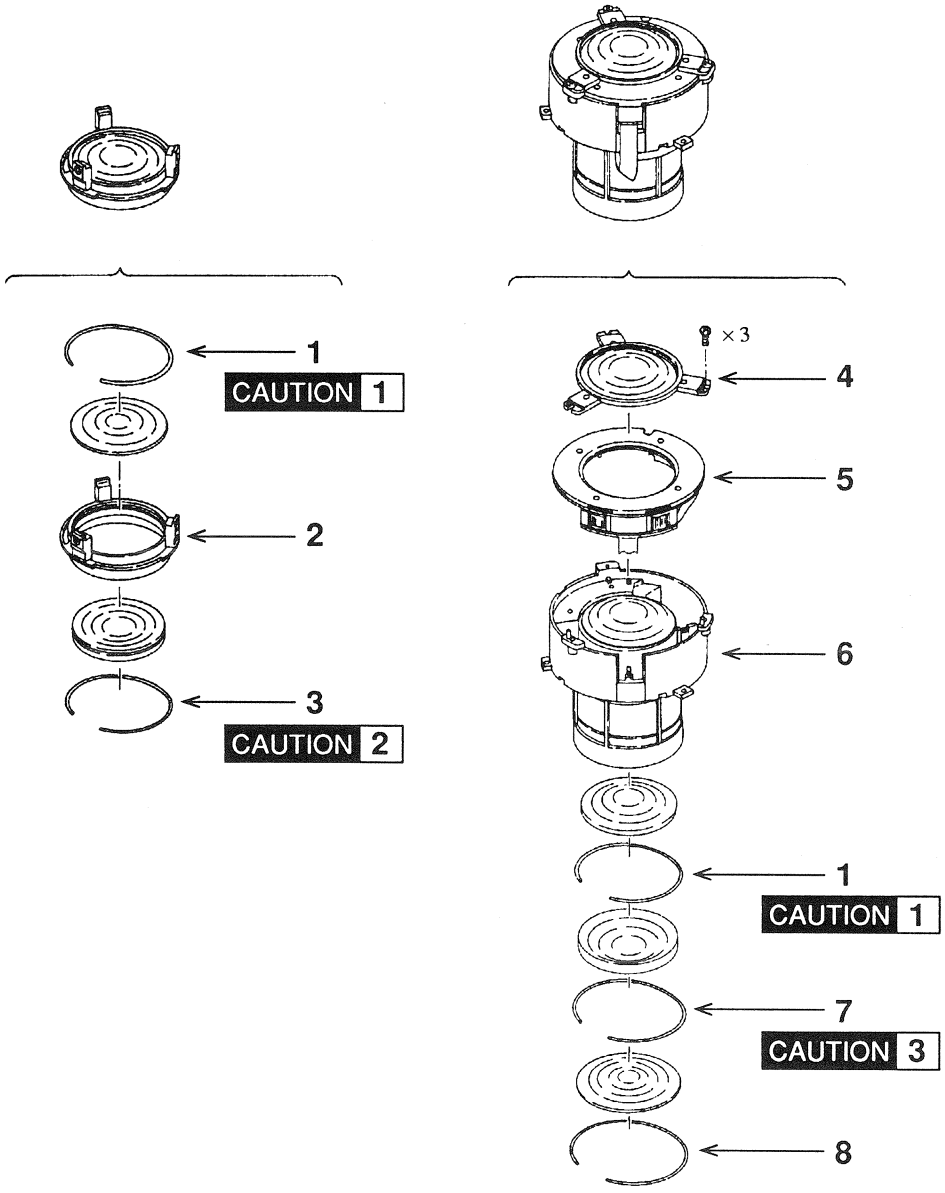


Fig. 3-18 Lens Unit Disassembly

Note: As far as this page is concerned, numbers in the illustration have nothing to do with disassembly sequence.

1. G10/16 Snap Ring

CAUTION 1 G10/16 Snap Ring Replacement

- Check the wire diameter of the old ring with vernier calipers or a micrometer and install a new ring of the same diameter.
- After installation, lightly tap the unit to insure that there is no play in the fitting of the lens elements. Check that the ends of the ring are separated by some space.

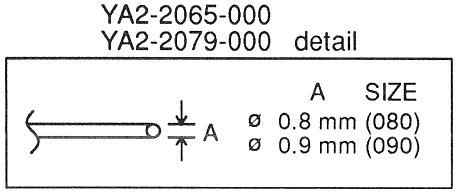


Fig. 3-19 G10/16 Snap Ring Adjustment Sizes

2. Fourth Lens Group

3. G11/12 Snap Ring

CAUTION 2 G11/12 Snap Ring Replacement

- Refer to the above CAUTION for G10/16 snap ring.
- Refer to Fig. 3-19 G10/16 Snap Ring Adjustment Sizes for details.

4. G13 Lens Group Unit (3 screws, staked)

5. EMD Unit

6. Fifth Lens Group Unit

7. G17 Snap Ring

CAUTION 3 G17 Snap Ring Replacement

- Refer to the above CAUTION for G10/16 snap ring.

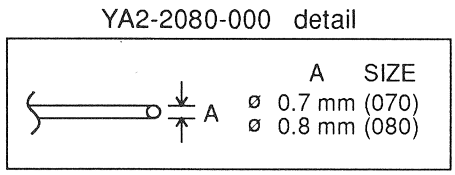


Fig. 3-20 G17 Snap Ring Adjustment Sizes

8. G18 Snap Ring

3. ADJUSTMENTS

3.1 Centering Adjustment

* This adjustment is necessary when G13 Lens Group is replaced or removed or any optical components are replaced.

Purpose:
- To achieve best balance of resolution in the center.

Tool:
- 800 mm lens focus collimator

Standards:

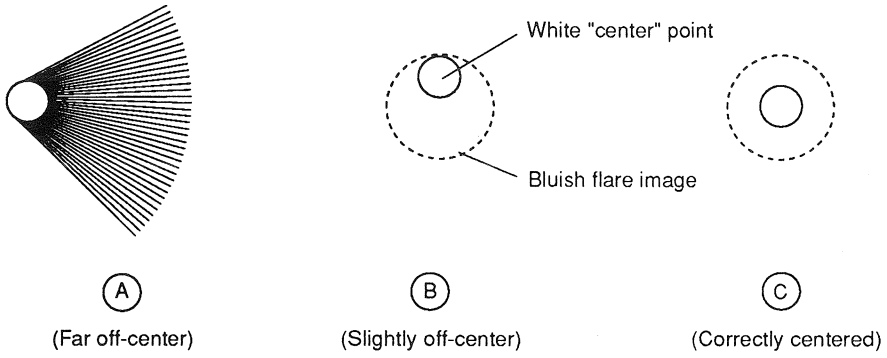


Fig. 3-21 Centering Adjustment Method

Preparation:

1. Complete up to step 2 specified in "2.2 Focusing Unit Removal."
2. Loosen screws (CB2-0304) from G13 Lens Group.
3. Install other components except a back cover and a main circuit board.

Adjustment Method:

1. Place the lens on the colimator and set to TELE and infinity.
2. Check the star image. If it appears as "A" or "B" in Fig. 3-24, disassemble up to the above preparation step 1 and adjust the 5th Lens Group radially to reach the mode "C" in Fig. 3-24.
3. After adjustment, apply screw lock to the screw head.

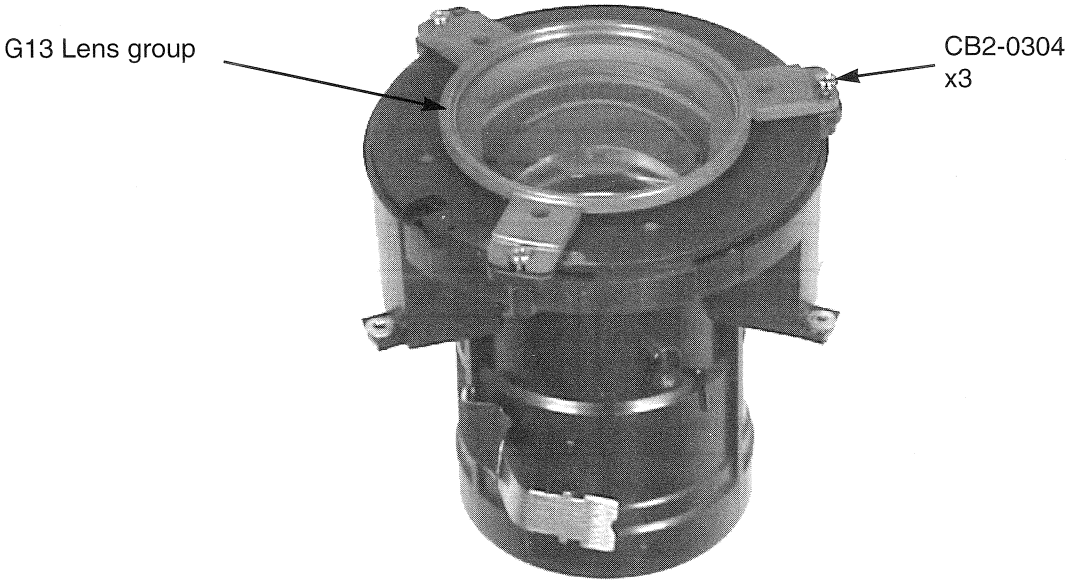


Fig. 3-22 Centering Adjustment Point

3.2 Tilt Adjustment

* This adjustment is necessary when the 1st Lens Group is replaced or removed or any optical components are replaced.

Purpose:

- To equalize resolution in the center.

Tool:

- Projector

Standards:

- Projection resolution standards are shown below:

Table 3-1 Projection Resolution Standards

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

* Down one step in two adjacent zones, permissible if center is good.

Preparation:

- Turn over the front half of the focus ring rubber grip and remove the three screws (XA1-7170-307) from the front ring unit.
- Dismount the front ring unit.

Adjustment Method:

1. Place the lens on the projector and set to TELE and infinity.
2. Set the focal plane to chart wall distance to about 10 m.
3. Check the projected image to see if it meets the projection resolution standards.
4. If not, adjust it to meet the standards by turning the two eccentric collars.
5. After adjustment, apply screw lock between the collars and set screws.

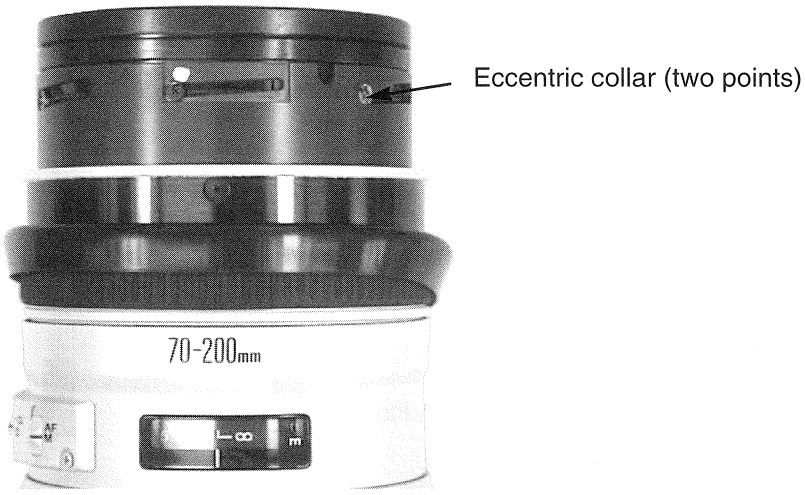


Fig. 3-23 Tilt Adjustment Point

3.3 Focus Adjustment

* Check and adjust after disassembly or replacement of optical system parts.
* If your facility has the 800mm Lens Focus Collimator, check several new lenses from stock and establish the collimator average for this type lens. Use this average as the standard for lenses you repair.
* If your facility does not have the 800mm Lens Focus Collimator, mount the lens on a camera with a B-type (split-image) focusing screen and a magnifier and focus on a distant straight line target.

Purpose:
To obtain infinity focus over the entire zoom range.

Standards:

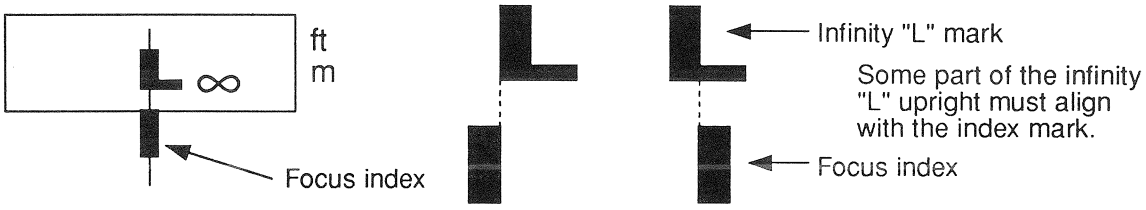


Fig. 3-24 Focus Adjustment Standards

Tools:
- Camera with B-type focusing screen
- Magnifier
- General 600 mm collimator (or infinity object)
- General 800 mm lens focus tester

Adjustment Method:

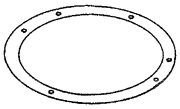
Check the following prior to adjustment:

1. Turn the manual ring and focus on the infinity target and check if the focus is within limits at both TELE ad WIDE.
2. If it is not within limits at TELE, turn the front lens group.
3. If it is not within limits at the WIDE end, change the lens mount thickness to bring it within tolerances.

WIDE Adjustment:

1. Set zoom to WIDE and mount the lens on a camera.
2. Check the infinity focus.
3. Check the alignment between the focus index and the upright of infinity "L".
4. If not within tolerances, change the mount thickness using the special service mount and focus shims (washers). Limit the maximum washer thickness to 0.07 mm to prevent an unsightly gap between the fixed barrel and the lens mount.

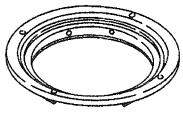
Service focusing washer (for fine adjustment)
CY1-2178-000(XXX)



Service Use Only.

A	SIZE
0.02mm	(002)
0.05mm	(005)

Service lens mount (for coarse adjustment)
CY1-2497-000(XXX)



A	SIZE	A	SIZE
1.5mm	(150)	2.2mm	(220)
1.6mm	(160)	2.3mm	(230)
1.7mm	(170)	2.4mm	(240)
1.8mm	(180)	2.5mm	(250)
1.9mm	(190)	2.6mm	(260)
2.0mm	(200)	2.7mm	(270)
2.1mm	(210)	2.8mm	(280)

Fig. 3-25 WIDE Focus Adjustment Method

TELE adjustment (focus balance)

1. Turn over the front half of the focusing ring rubber grip and remove the three set screws (XA1-7170-307) from the front ring unit.
2. Dismount the front ring unit.
3. Loosen the three screws (X91-1737-300) from the first lens group unit.
4. Make adjustment by turning the first lens group unit clockwise or counterclockwise.
5. After adjustment, apply screw lock to the screw head to the zoom unit.

X91-1737-300
X3

Fig. 3-26 TELE Focus Adjustment Method

3.4 Pulse Adjustment

* Carry out this adjustment after replacing the focus unit or the main circuit board unit.

Purpose:
- To obtain more accurate USM drive information and adjust the phase to ensure more efficient phase generation.

Tool:
- Oscilloscope
- EOS camera

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

Preparation:
1. Follow steps 1) to 5) in section **2.1 Main Circuit Board Unit Removal.**
2. Temporarily solder test leads to lands P1 and DGND shown in the figure below.
3. Reinstall all parts except for the back cover.
4. Attach the lens to the camera.

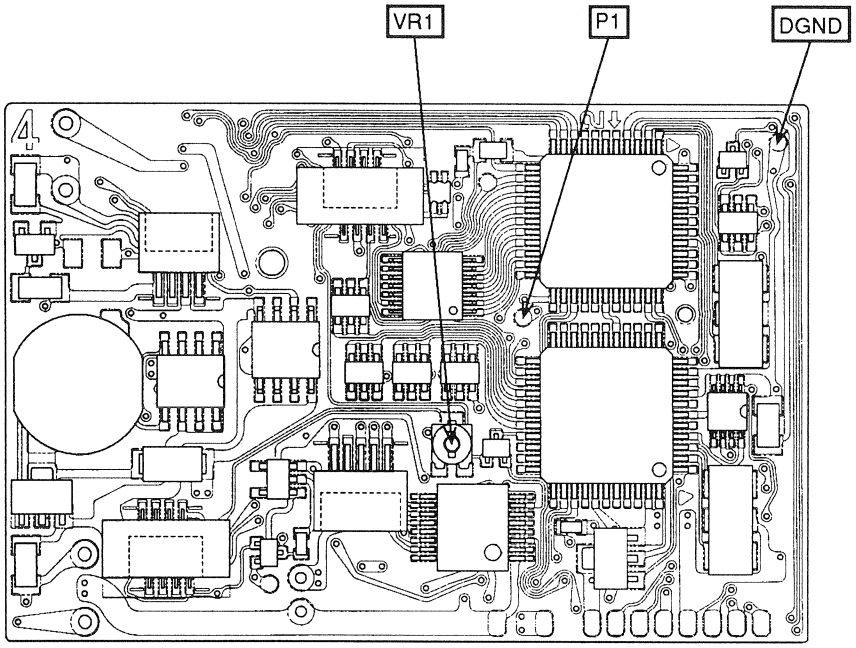


Fig. 3-27 Pulse Adjustment

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, (a)), remove the lens, turn VR1 clockwise, and measure the waveform again.
4. Measure the waveform, remove the lens, adjust, mount the lens, then measure the waveform again. Repeat this process until the waveform conforms to the standard (c).

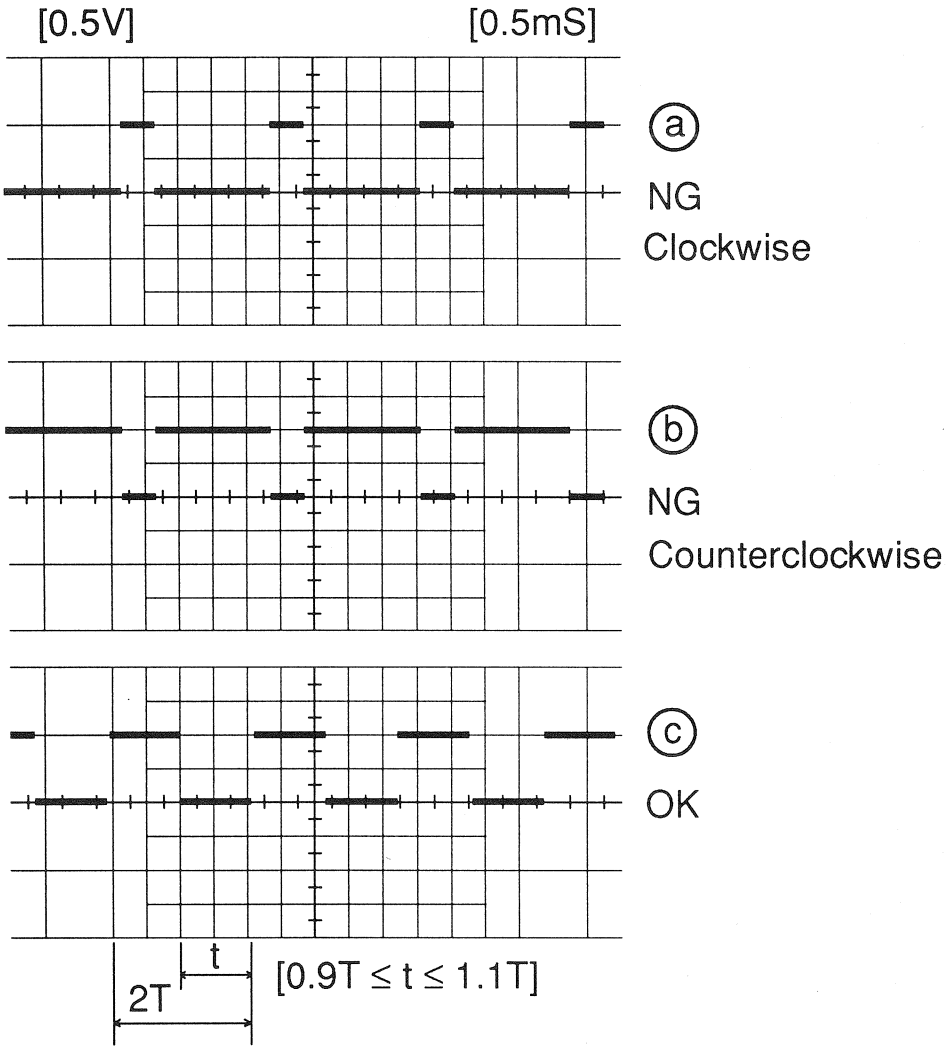


Fig. 3-28 Pulse Waveform

3.5 Focus Compensation

* This procedure is required when BP-FLX is replaced.
* Adjustment must also be made for the lens alone and for the lens equipped with an extender 1.4 X or 2 X.

Purpose:

- To obtain optimum focus position during autofocus at maximum aperture.

Notes:

At the factory, this correction value is written into each individual lens' ROM with an exclusive tool. This tool is too costly for field use, so service engineers will follow the procedure below instead.

1. When the BP-FLX is replaced, set AF-ADJ0 to 7 adjusting pads to the same state as they were with the old flexes.
2. When a component other than the main circuit board unit is replaced, this adjustment is not necessary.
3. For customer complaints, undertake the following adjustment method 1 or 2. It is also necessary to confirm which camera model the user is using (due to difference in focusing sensors.)

Horizontal vs Vertical Sensors:

- Even the earliest EOS cameras had a single, horizontal BASIS sensor. All EOS camera available today incorporates horizontal sensors.
- EOS1 is the first to incorporate a vertical sensor which operates when the horizontal sensor cannot determine focus for lenses of $f/2.8$ or brighter. The amount of day focus is determined based on focus compensation data for vertical sensors.

Adjustment Method 1

1:If front defocuses, make corretion in the positive direction. If rear defocuses, make correction in the negative direction.

Adjustment Method 2

2:Make photographic tests with the horizontal AF-ADJ adjustment pads bridged in each combination at Tele, and examine the negatives closely to determine which combination is best. Repeat the procedure with the vertical sensor pads and extender EF1.4X and EF2X pads as well.

Use a reference bar chart in AF mode. For vertical sensor adjustment, lay the chart on its side or lay the camera upright.

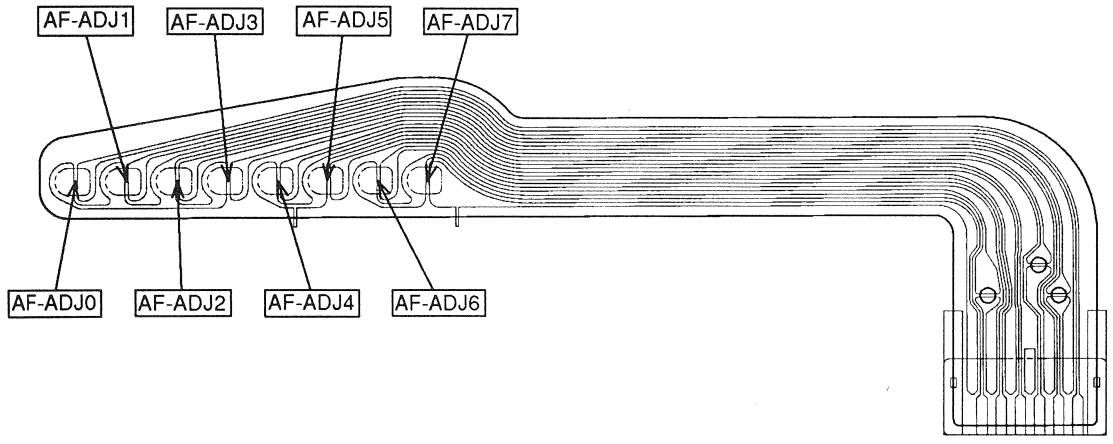


Fig. 3-29 AF-ADJ Pad Positions

Test Exposure Conditions:
- Zoom position: TELE (200 mm)
- Distance: Lens alone: About 10 m

Lens with EXT. 1.4 x: About 14 m

Lens with EXT. 2 x: About 20 m
- Target: Casual Resolution Chart*1 with AF Standard Bar*2 Chart in Center
- Mode/Aperture: Aperture priority/Maximum aperture
- Focusing: Return lens to infinity after each exposure and autofocus on bar chart
- Number of shots: 5 or 6 at each AF-ADJ position

Procedure:
1. Assemble the lens except for the back cover.
2. Set correction to - Fδ .
3. Shoot five or six frames.
4. Change the correction to - 1/2Fδ + OFδ and + 1/2Fδ and shoot.

Table 3-2 Focus Compensation Table

Correction	Horizontal sensor (inner)		Vertical sensor (outer)		Extender EF1.4x		Extender EF2x	
	AF – ADJ0	AF – ADJ1	AF – ADJ2	AF – ADJ3	AF – ADJ4	AF – ADJ5	AF – ADJ6	AF – ADJ7
-Fδ	1	0	1	0	1	0	1	0
-1 / 2Fδ	0	0	0	0	0	0	0	0
0	1	1	1	1	1	1	1	1
+1 / 2Fδ	0	1	0	1	0	1	0	1

F : FNO
δ : Minimum circle of confusion

0: Close (soldered)
1: Open (not soldered)

*1 : A 'casual resolution chart' is a flat chart made of newsprint, photographs, etc. Most service facilities have such a chart.
*2 : Rotate chart or EOS-1 camera 90° for vertical sensor chack.

3.6 USM Reference Frequency

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

Purpose:
- To obtain the standard reference frequency.

Tools:
- Frequency counter
- EOS camera with stop-down aperture button (except EOS620)
  * Pressing this button permits measurement of a stable frequency regardless of the USM.
  * When the EOS620 is used, press the EL button instead of the stop-down button.

Standard:
125.2 ± 0.2 kHz

Preparation:
1. Follow steps 1) to 5) in section **2.1 Main Circuit Board Unit Removal.**
2. Temporarily solder test leads to check pads FIN and DGND shown in the figure below.
3. Assemble the lens except for the back cover.
4. Attach the lens to the camera.

Adjustment Method:
1. Connect the leads to the frequency counter.
2. Press the aperture button and measure the frequency.
3. If the frequency does not conform to the standards, remove the lens, turn VR2, and measure the frequency again.
4. Measure the frequency, remove the lens, adjust, mount the lens and then measure the frequency again. Repeat this procedure until the frequency conforms to the standards.

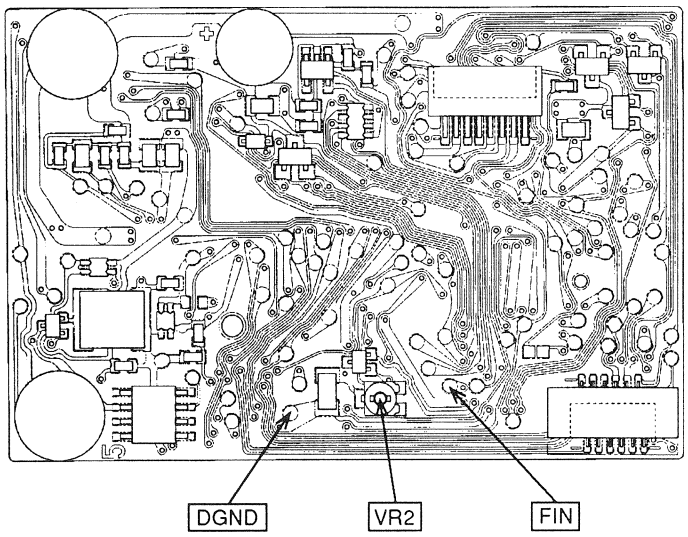


Fig. 3-30 USM Reference Frequency

3.7 Zoom Brush Adjustment

Purpose:
- To obtain accurate zoom pattern information.

Tools:
- Ohmmeter

Preparation:
Disassemble up to step 1 in **2.2 Focusing Unit Removal.**

Adjustment Method:
1. Set Zoom to Tele (200 mm).
2. Temporarily fasten the screw holding the zoom brush. Set the zoom brush on the zoom pattern as shown. The brush contacts should be within the area marked "A".
3. Connect the ohmmeter to the zoom pattern and zoom brush check pads on the main circuit board.
4. After adjustment, apply screw lock to the screw head.

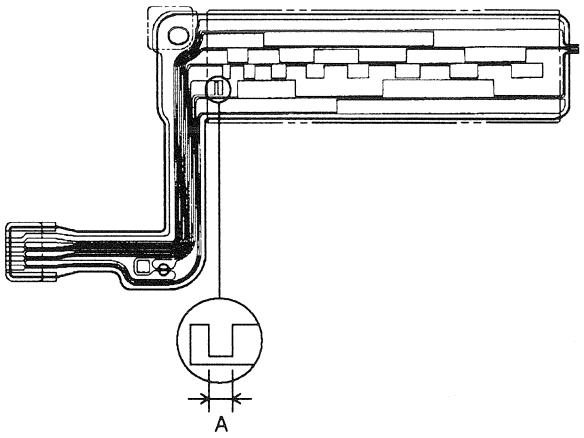


Fig. 3-31 Zoom Brush Position Adjustment

Part 4

Parts Catalog

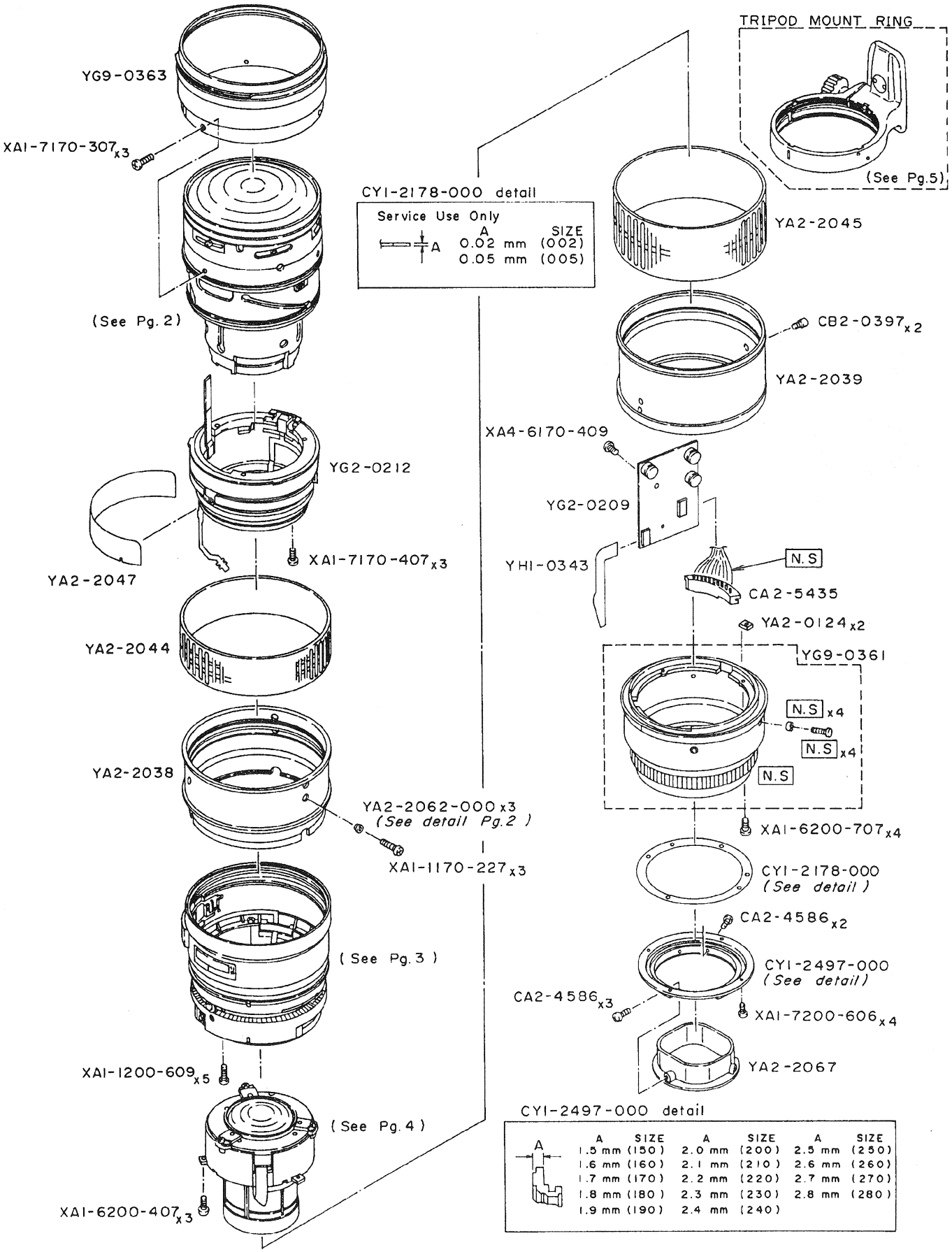
Canon

EF 70-200mm 1:2.8L(ULTRASONIC)

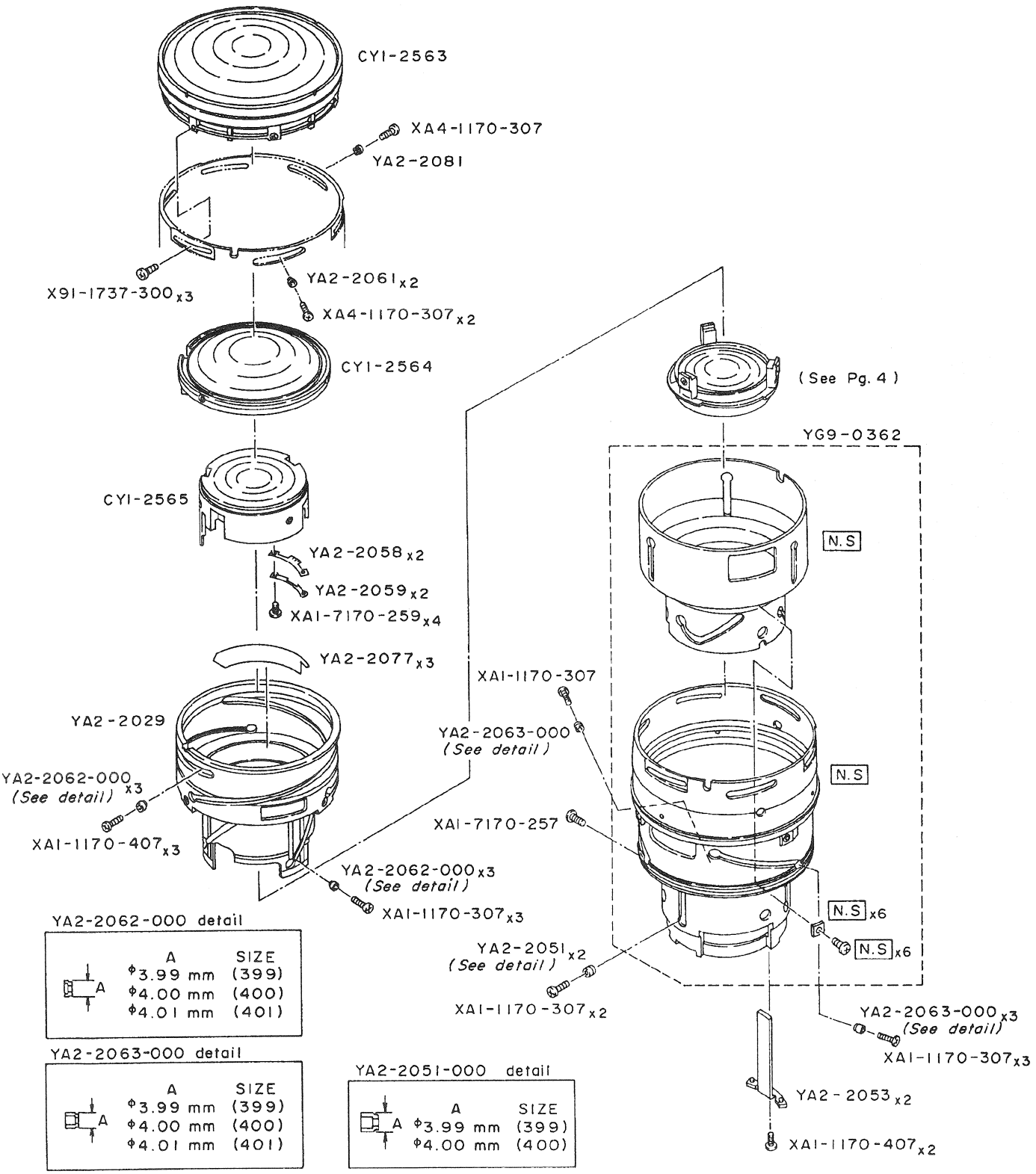
REF.NO.C21-9792

PARTS CATALOG

CANON LENS EF70-200mm 1:2.8L USM



CANON LENS EF 70-200 mm 1:2.8L USM



YA2-2062-000 detail

A	SIZE
φ3.99 mm	(399)
φ4.00 mm	(400)
φ4.01 mm	(401)

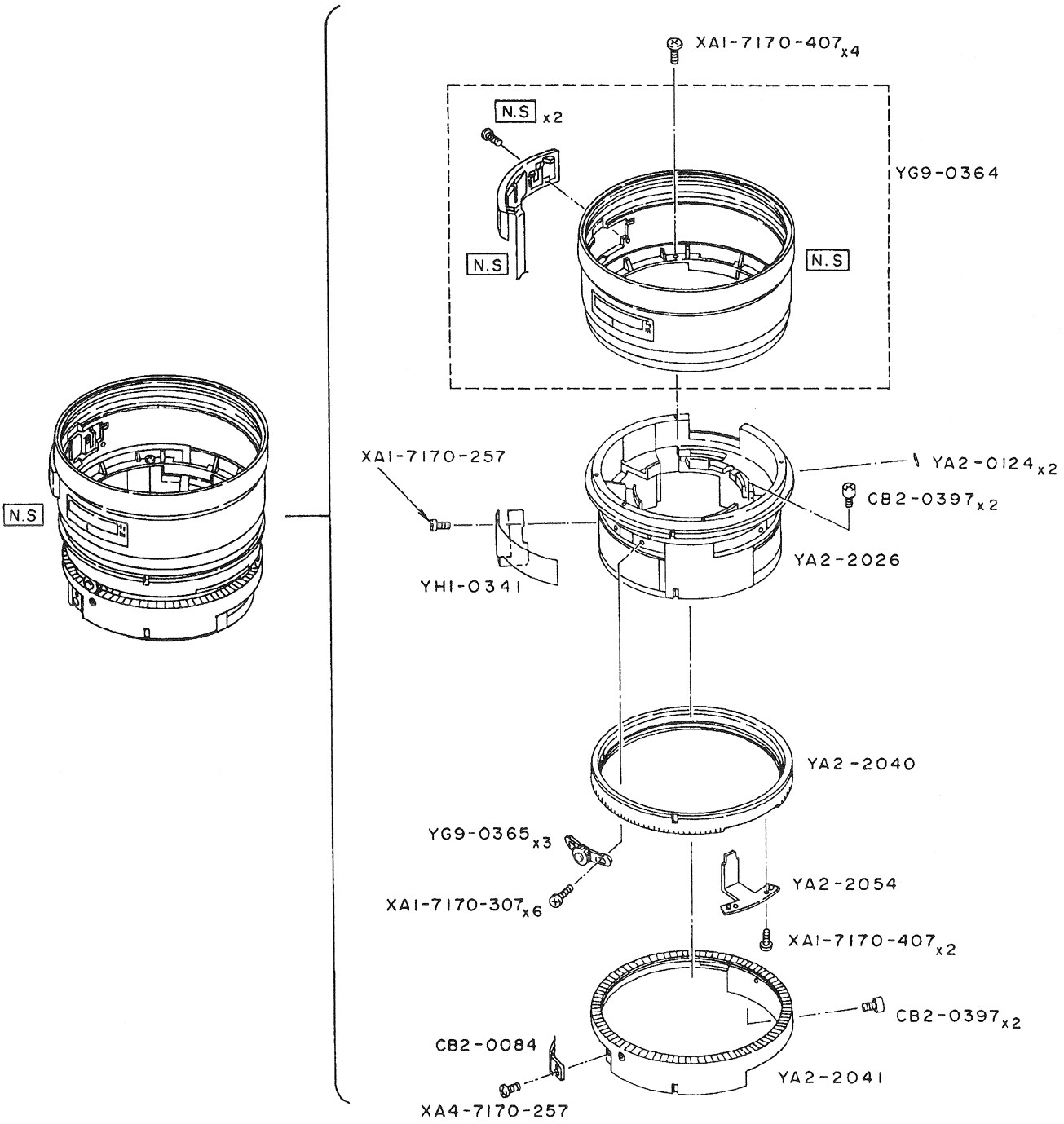
YA2-2063-000 detail

A	SIZE
φ3.99 mm	(399)
φ4.00 mm	(400)
φ4.01 mm	(401)

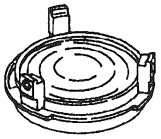
YA2-2051-000 detail

A	SIZE
φ3.99 mm	(399)
φ4.00 mm	(400)

CANON LENS EF70-200mm 1:2.8L USM



CANON LENS EF70-200mm 1:2.8L USM



N.S

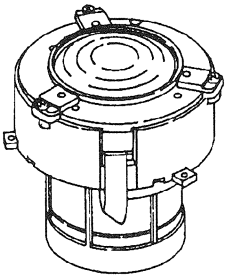
YA2-2079-000
(See detail)

YN2-0810

YA2-2033

YP2-0812

YA2-2065-000
(See detail)



N.S

CB2-0304

CY1-2566

YG2-0214

CY1-2567

YN2-0816

YA2-2079-000
(See detail)

YN2-0817

YA2-2080-000
(See detail)

YN2-0818

YA2-2052

YA2-2065-000
YA2-2079-000 detail

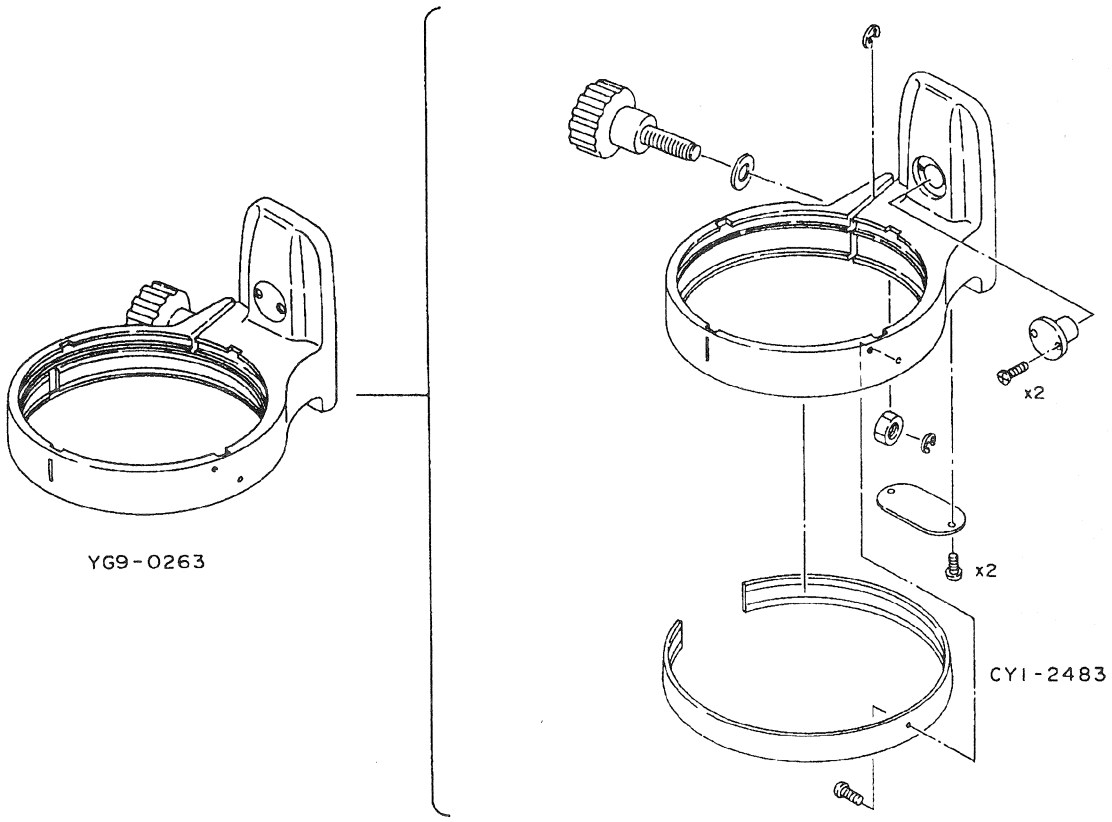
	A	SIZE
A	φ0.80 mm	(080)
	φ0.90 mm	(090)

YA2-2080-000 detail

	A	SIZE
A	φ0.70 mm	(070)
	φ0.80 mm	(080)

5

CANON LENS EF 70-200 mm 1:2.8L USM



PARTS LIST

REF.NO. C21-9792

NEW	PARTS NO.	CLASS	QTY	DESCRIPTION		PAGE
	CA2-4586-000	E	5	SCREW, CROSS-RECESS, PH		1
	CA2-5435-000	D	1	CONTACT ASS'Y	接点ブロック	1
	CB2-0084-000	E	1	BRUSH, ZOOMING	ズームブラシ	3
	CB2-0304-000	F	3	SCREW, PH, W/LOCK WASHER	ワッシャー付きビス	4
	CB2-0397-000	F	6	SCREW, CROSS-RECESS, PH		1,3
	CY1-2178-000(XXX)	E	1	WASHER, MOUNT	マウントワッシャー	1
	CY1-2483-000	E	1	BELT	バンド	5
	CY1-2497-000(XXX)	E	1	MOUNT, LENS	レンズマウント	1
*	CY1-2563-000	D	1	1st GROUP LENS ASS'Y	1群鏡筒ユニット	2
*	CY1-2564-000	E	1	2nd GROUP LENS ASS'Y	2群鏡筒ユニット	2
*	CY1-2565-000	E	1	3rd GROUP LENS ASS'Y	3群鏡筒ユニット	2
*	CY1-2566-000	D	1	G13 LENS ASS'Y	G13鏡筒ユニット	4
*	CY1-2567-000	D	1	5th GROUP LENS ASS'Y	5群鏡筒ユニット	4
	X91-1737-300	F	3	SCREW, CROSS-RECESS, PH		2
	XA1-1170-227	F	3	SCREW, CROSS-RECESS, PH		1
	XA1-1170-307	F	9	SCREW, CROSS-RECESS, PH		2
	XA1-1170-407	F	5	SCREW, CROSS-RECESS, PH		2
	XA1-1200-609	F	5	SCREW, CROSS-RECESS, PH		1
*	XA1-6200-407	F	3	SCREW, CROSS-RECESS, PH		1
	XA1-6200-707	F	4	SCREW, CROSS-RECESS, PH		1
	XA1-7170-257	F	2	SCREW, CROSS-RECESS, PH		2,3
	XA1-7170-259	F	4	SCREW, CROSS-RECESS, PH		2
	XA1-7170-307	F	9	SCREW, CROSS-RECESS, PH		1,3
	XA1-7170-407	F	9	SCREW, CROSS-RECESS, PH		1,3
	XA1-7200-606	F	4	SCREW, CROSS-RECESS, PH		1
	XA4-1170-307	F	3	SCREW, CROSS-RECESS, PH		2
	XA4-6170-409	F	1	SCREW, CROSS-RECESS, PH		1
*	XA4-7170-257	F	1	SCREW, CROSS-RECESS, PH		3
	YA2-0124-000	D	4	RUBBER, FRICTION	フレクションゴム	1,3
*	YA2-2026-000	E	1	BARREL, INTERMEDIATE	中間筒	3
*	YA2-2029-000	E	1	BARREL, SUB CAM	サブカム筒	2
*	YA2-2033-000	E	1	BARREL, LENS	第4群鏡筒	4
*	YA2-2038-000	D	1	RING, MANUAL FOCUSING	フォーカス操作環	1
*	YA2-2039-000	D	1	RING, ZOOMING	ズーム操作環	1
*	YA2-2040-000	E	1	RING, GEAR 1	ギヤリング1	3
*	YA2-2041-000	E	1	RING, GEAR 2	ギヤリング2	3
*	YA2-2044-000	D	1	RING, MANUAL FOCUS RUBBER	フォーカスリングゴム	1
*	YA2-2045-000	D	1	RING, ZOOM RUBBER	ズーム環ゴム	1
*	YA2-2047-000	E	1	SCALE, FOCUSING	距離目盛シール	1
*	YA2-2051-000(XXX)	D	2	COLLAR	4群偏芯コロ	2

PARTS LIST

REF.NO. C21-9792

NEW	PARTS NO.	CLASS	QTY	DESCRIPTION		PAGE
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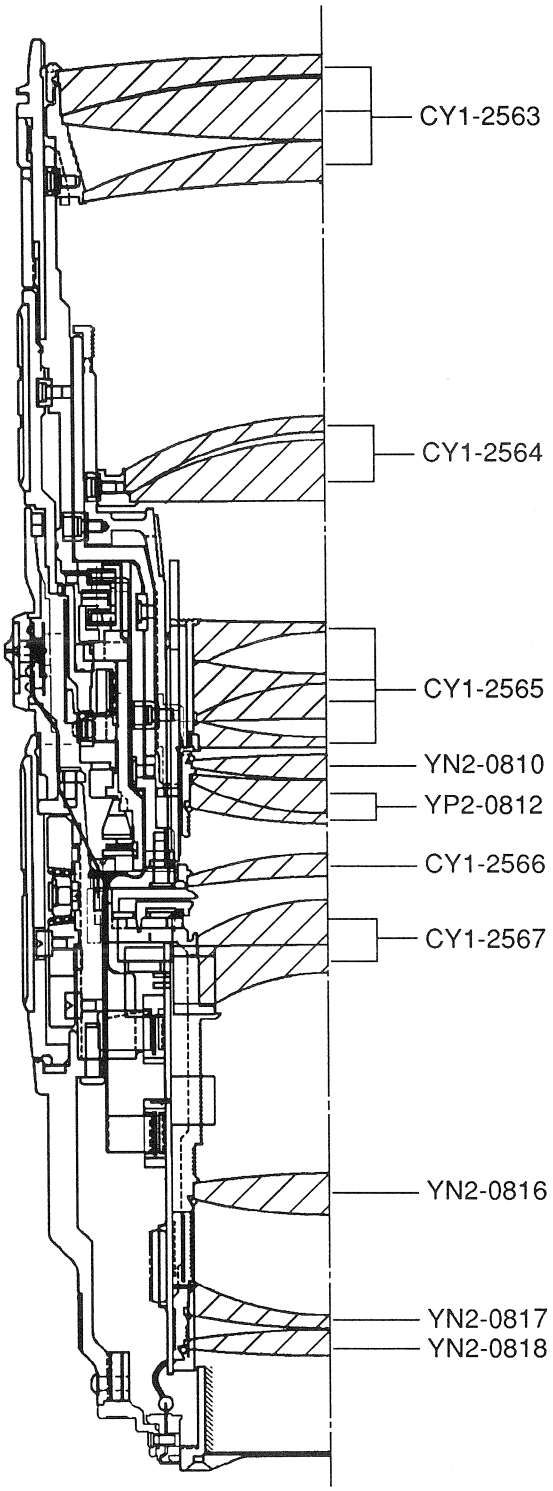
*	YA2-2053-000	E	2	KEY, GUIDE	3群ガイドキー	2
*	YA2-2054-000	E	1	KEY, ZOOMING	ズームキー	3
*	YA2-2058-000	E	2	WASHER, BLIND	キーマスク	2
*	YA2-2059-000	E	2	HOLDER, WASHER	マスク押さえ	2
*	YA2-2061-000	D	2	COLLAR	1群偏芯コロ	2
*	YA2-2062-000(XXX)	D	9	COLLAR	3群コロ	1,2
*	YA2-2063-000(XXX)	D	4	COLLAR	サブカムコロ	2
*	YA2-2065-000(XXX)	E	1	RING, SNAP	G11/12押さえ	4
*	YA2-2067-000	D	1	COVER, BACK	ウラブタ	1
*	YA2-2077-000	E	3	SHEET, LIGHT SHIELD	サブカム植毛紙	2
*	YA2-2079-000(XXX)	E	2	RING, SNAP	G10/16押さえ	4
*	YA2-2080-000(XXX)	E	1	RING, SNAP	G17押さえ	4
*	YA2-2081-000	D	1	COLLAR	1群固定コロ	2
*	YG2-0209-000	D	1	MAIN PCB ASS'Y	メイン基板ユニット	1
*	YG2-0212-000	D	1	FOCUSING UNIT	フォーカスユニット	1
*	YG2-0214-000	D	1	POWER DIAPHRAGM UNIT	EMDユニット	4
	YG9-0263-000	D	1	TRIPOD SOCKET UNIT	三脚座ユニット	5
*	YG9-0361-000	D	1	FIXED BARREL UNIT	固定筒ユニット	1
*	YG9-0362-000	E	1	ZOOM UNIT	ズームユニット	2
*	YG9-0363-000	D	1	FRONT RING UNIT	フィルター枠ユニット	1
*	YG9-0364-000	D	1	INDEX RING UNIT	指標環ユニット	3
*	YG9-0365-000	D	3	REVERSE GEAR UNIT	リバースギヤユニット	3
*	YH1-0341-000	D	1	ZOOM FLX	Z-FLX	3
*	YH1-0343-000	D	1	FOCUS FLX	BP-FLX	1
*	YN2-0810-000	D	1	LENS, G10	レンズG10	4
*	YN2-0816-000	D	1	LENS, G16	レンズG16	4
*	YN2-0817-000	D	1	LENS, G17	レンズG17	4
*	YN2-0818-000	D	1	LENS, G18	レンズG18	4
*	YP2-0812-000	D	1	LENS, G11/12	レンズG11/12	4

CANON LENS EF 70-200mm 1:2.8L USM

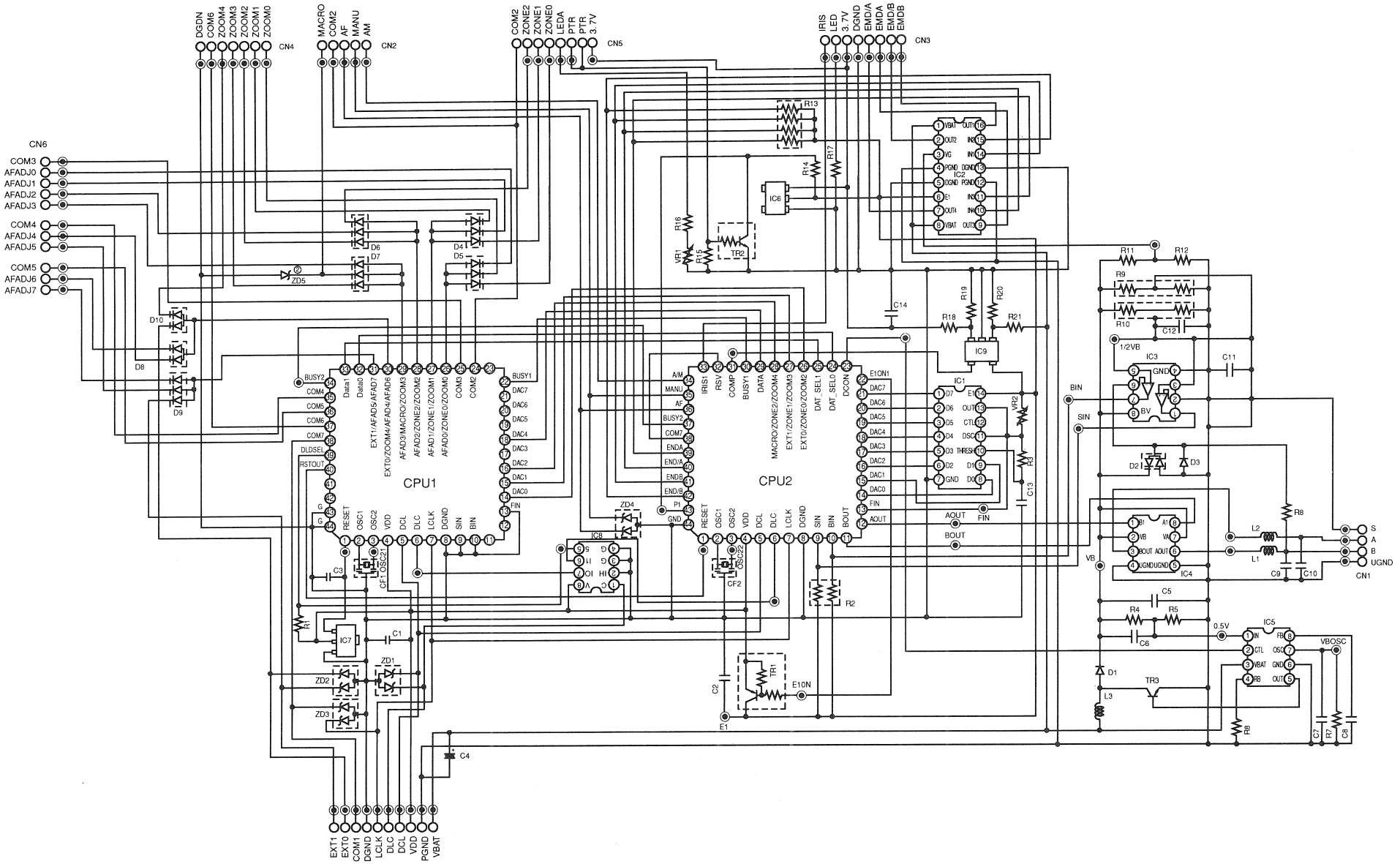


Part 5

Electrical Diagrams

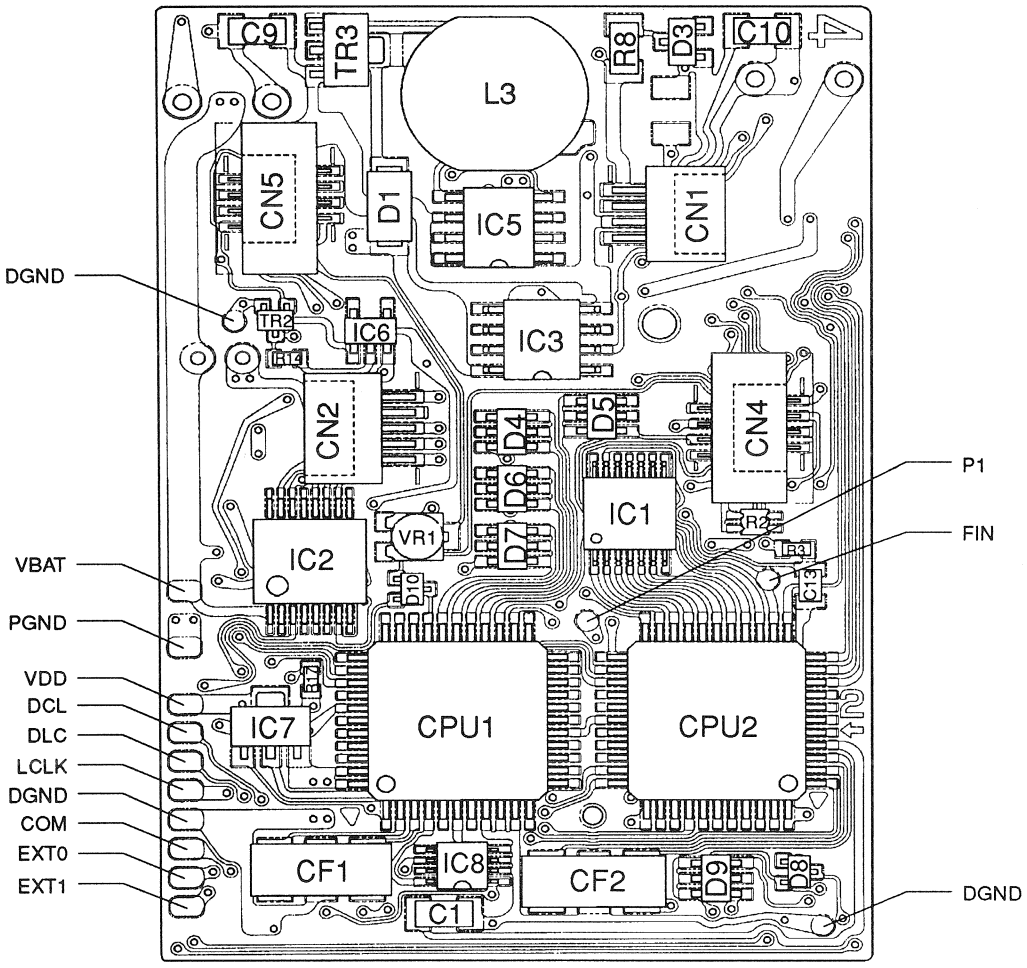
SCHEMATIC DIAGRAM

EF70 - 200mm f/2.8L ULTRASONIC
REF. NO. C21-9792



P.C.B DIAGRAM
(MAIN PCB ASS'Y - A)

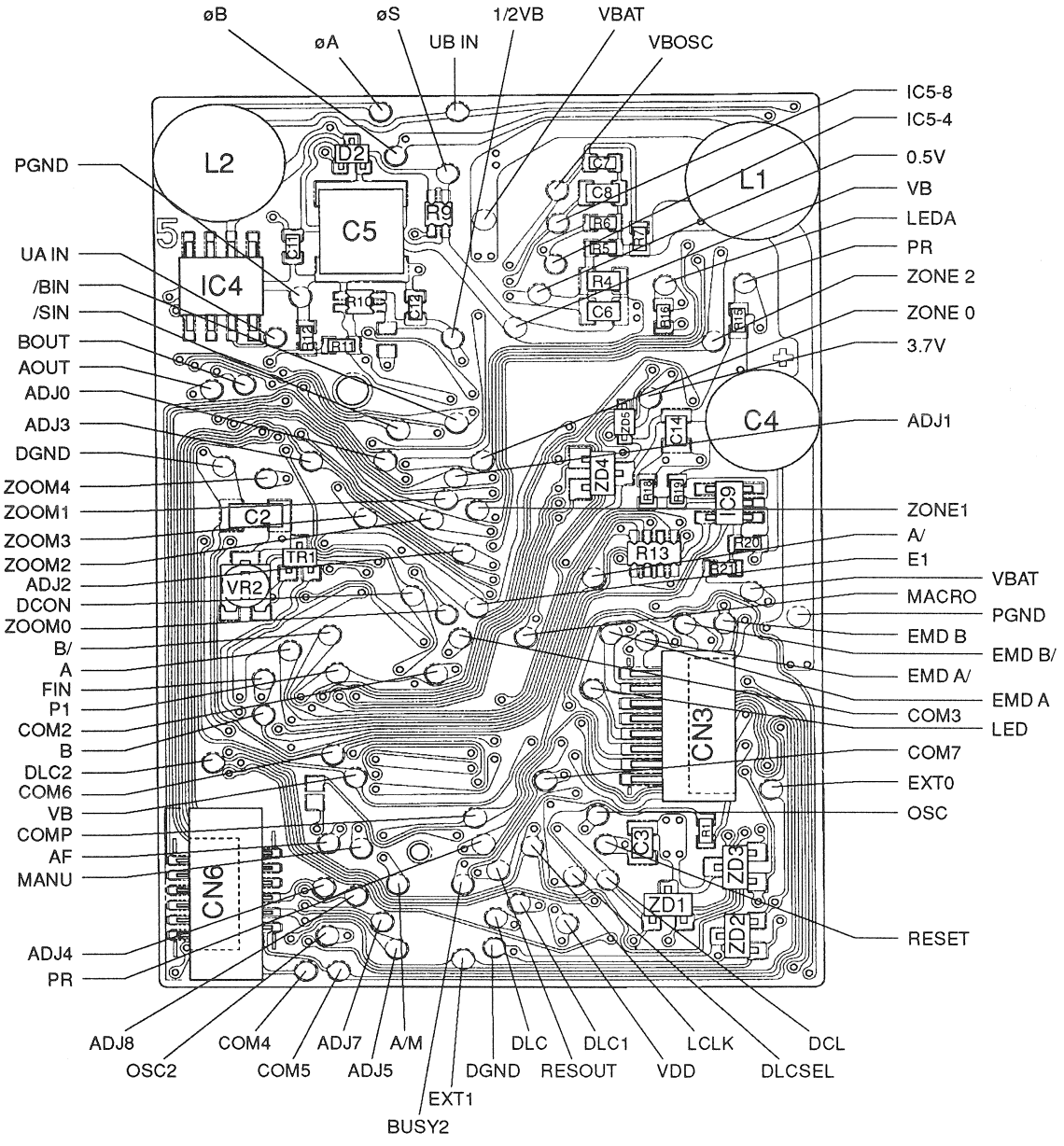
EF 70-200mm f/2.8L ULTRASONIC
REF. NO. C21-9792



01 FEB. 1995

P.C.B DIAGRAM
(MAIN PCB ASS'Y - B)

EF 70-200mm f/2.8L ULTRASONIC
REF. NO. C21-9792



01 FEB. 1995