Canon

Service Manual

ENGLISH EDITION

EF 24-85mm 1:3.5-4.5 (ULTRASONIC) C21-9921

EF 24-85mm 1:3.5-4.5 MS (ULTRASONIC) C21-9922

CY8-1200-152

Canon

EF 24-85mm 1:3.5-4.5 USM
EF 24-85mm 1:3.5-4.5 USM MS

REF.NO.C21-9921
REF.NO.C21-9922

SERVICE MANUAL

Application

This manual has been issued by Canon Inc. for qualified persons to learn technical theory, and repair of products. This manual covers all localities where the products are sold. For this reason, there may be information in this manual that does not apply to your locality.

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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.

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Part 1. General Information

Part 2. Technical Information

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Part 1

General Information

1. DEVELOPMENT OBJECTIVES

The EF24-85mm f/3.5-4.5 USM has been developed to join the standard zoom lens line-up, and the EF24-85mm f/3.5-4.5 USM MS has been developed as the best lens for selling with the SLR/EO S IX E kits for the advanced photo system. It has a high zoom ratio of approximately 3.5 times, and the optical system is made compact by using zooming with several moveable lens groups to implement compact and lightweight cameras.

These lenses differ only in the external coating (EF24-85mm f/3.5-4.5 USM: Black; EF24-85mm f/3.5-4.5 USM MS: Metallic silver). They have the same mechanical, optical and electrical systems. When the lens is installed on the EOS IX E, the zoom range covers a focal length of 30 to 106 mm by 135 conversion.

2. FEATURES

- Compact and lightweight standard zoom lens
- Aspherical replica lens for G4 to provide high picture quality in the entire zoom range
- Internal focusing and the ring-type USM enable silent and high-speed AF operation
- Since the filter element does not rotate during focusing, the effect of circular polarizing filters, etc., attached to the lens is not affected by focusing operations.
- Wide rubber revolving zooming ring for easy operation.
- Manual touch-up focus (full-time mechanical manual focus) enabled even during AF.
- Dedicated petal-type hood (EW-73) effective for the entire focal length range.
- Linear and sharp external design
- The first 67mm filter for the EF lens
- The EF24-85mm f/3.5-4.5 USM MS is coated in metallic silver.

3. SPECIFICATIONS

1. Picture Size — 24 mm × 36 mm

2. Focal Length and Aperture — 24-85 mm *f*/3.5-4.5

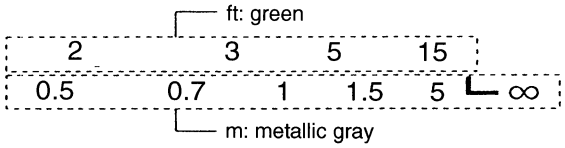
3. Optical Construction
   - 3-1 Lens construction — 15 elements in 12 groups (aspherical replica lens for G4R1)
   - 3-2 Coating — Super Spectra coating

4. Angle of View at Infinity

Diagonal (43.2mm)	84° - 28° 30'
Vertical (24mm)	53° - 16°
Horizontal (36mm)	74° - 24°

5. AF Feature
   - 5-1 Drive system — Ring-type USM
   - 5-2 Drive speed — 0.80 sec. or less (lens drive speed from infinity to minimum focusing distance)
   - 5-3 Drive noise — 40 dB or lower (According to Canon's measuring standards.)
   - 5-4 Manual focusing — Enabled with focus mode switch and focusing ring

6. Focusing
   - 6-1 Extension mechanism — Internal focusing with focusing cam
   - 6-2 Macro feature — None
   - 6-3 Focusing range — 0.5 m to infinity
   - 6-4 Rotation angle and lens extension — 42° 12'/W=1.09 T=3.65mm
   - 6-5 Distance scale



   - 6-6 Maximum magnification and picture field

Min. focusing distance	Magnification (×)		Picture field (mm)	
	Wide-angle end	Telephoto end	Wide-angle end	Telephoto end
0.5 m/1.75ft	0.06	0.16	434 × 672	157× 234

7. Zoom Feature
   - 7-1 Type — 5-group rotating zoom (rotational angle: 50°) Front group movement
   - 7-2 Focal length scale — 24 •(28) 35 50 70 85

8. Mount
   - 8-1 Type: Canon EF mount
   - 8-2 Signal transmission: 5 items of EOS-dedicated information (including absolute distanceinformation):
     (1) Lens mode (2) Lens type
     (3) Metering information (4) Focal length
     (5) AF drive information

9. Aperture Mechanism
   - 9-1 Aperture control: 5 items of EOS-dedicated information (including absolute distanceinformation)
   - 9-2 Aperture value and indications: Max. aperture: f/3.5-4.5 (indicated on lens barrel), Min. aperture: f/22-32 (same for the lens model with 1/3-step aperture indications)
   - 9-3 Aperture blades: 6
   - 9-4 Depth-of-field scale: None
   - 9-5 Infrared mark: Provided

10. Filter Size: 67 mm, P = 0.75 mm per filter

11. Dimensions and weight: 73 dia x 69.5 mm 380 g (Product weight)

12. Accessories
   - 12-1 Hood: EW-73 (Dedicated petal-shaped bayonet-type hood attachable in reverse)
   - 12-2 Lens cap: E-67U
   - 12-3 Lens case: Soft case: ES-C13
     Hard case: LH-C13
     Accommodates the lens with one filter, front and rear lens caps, and reversed hood attached.
   - 12-4 Rear lens cap: Lens Dust Cap E

13. Miscellaneous
   - 13-1 Attachable extenders: None
   - 13-2 Extension tube EF 12: Attachable
   - 13-3 Extension tube EF25: Attachable

Setting		Min. focusing distance (mm)		Magnification (×)		Picture field (mm)	
		Wide	Tele	Wide	Tele	Wide	Tele
EF12	Near distance	148	287	0.59	0.36	42 × 66	67 × 100
	Far distance	157	697	0.50	0.15	50 × 78	159 × 237
EF25	Near distance	142	234	1.23	0.61	20 × 31	39 × 59
	Far distance	145	412	1.10	0.33	22 × 35	72 × 108

Specifications for installing the lens on the EOS IX E

1. Focal length 30-106 mm (135 conversion)

2. Angle of view at infinity

Diagonal (43.2mm)	71° 25'	–	22° 58'
Vertical (24mm)	38° 22'	–	11° 13'
Horizontal (36mm)	64° 21'	–	20° 08'

* The angles were calculated based on the shooting screen size (16.7 x 30.2 mm).

3. Maximum magnification and picture field

Minimum focusing distance	Magnification (X)		Picture field(mm)	
	Wide	Tele	Wide	Tele
0.5m/1.75ft	0.06	0.16	296×556	109×197

4. Attachable extenders None

5. Extension tube EF12/25 Attachable

Setting		Min. focusing distance (mm)		Magnification (×)		Picture field (mm)	
		Wide	Tele	Wide	Tele	Wide	Tele
EF12	Near distance	148	287	0.59	0.36	29 × 54	46 × 84
	Far distance	157	697	0.50	0.15	34 × 64	111 × 200
EF25	Near distance	142	234	1.23	0.61	14 × 26	27 × 50
	Far distance	145	412	1.10	0.33	15 × 29	50 × 90

* The other specifications are the same as those when using an EOS camera.

Unusable

4. EXTERNAL DIMENSION/CROSS SECTION

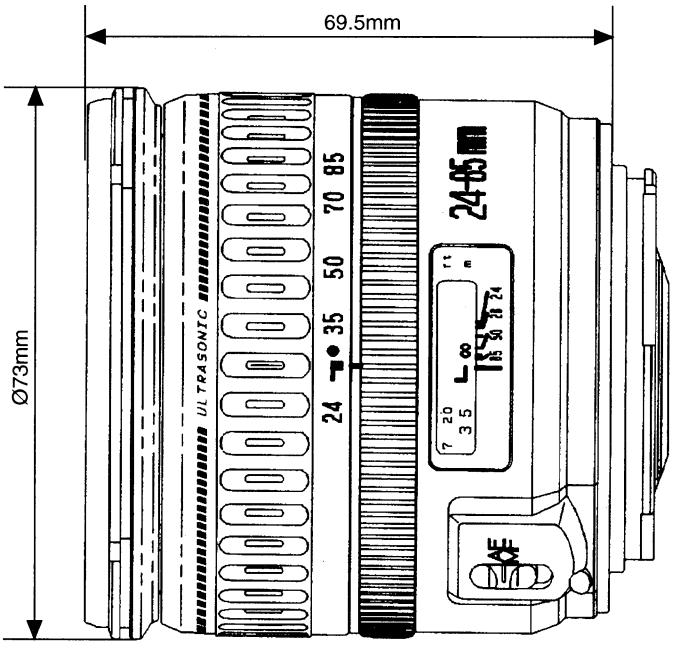


Fig. 1-1 External Dimension

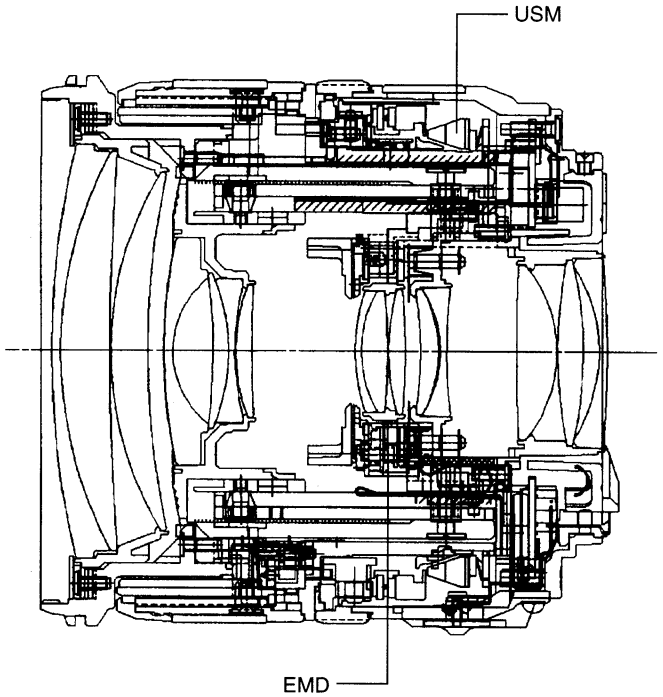


Fig. 1-2 Cross Section

5. OTHER

5.1 Exterior Design

The external form of the EF24-85mm f/3.5-4.5 USM is based on the design of the EF28-105mm f/3.5-4.5 USM and others. The details are designed to be linear and sharp to make it a new member of the standard zoom lens line-up.

The EF24-85mm f/3.5-4.5 USM MS is designed to be used with an EOS IX E kit. This lens has the same mechanical, optical and electrical systems as the EF24-85mm f/3.5-4.5 USM. It is coated in metallic silver to match the external color of the EOS IX E and emphasize the futuristic image.

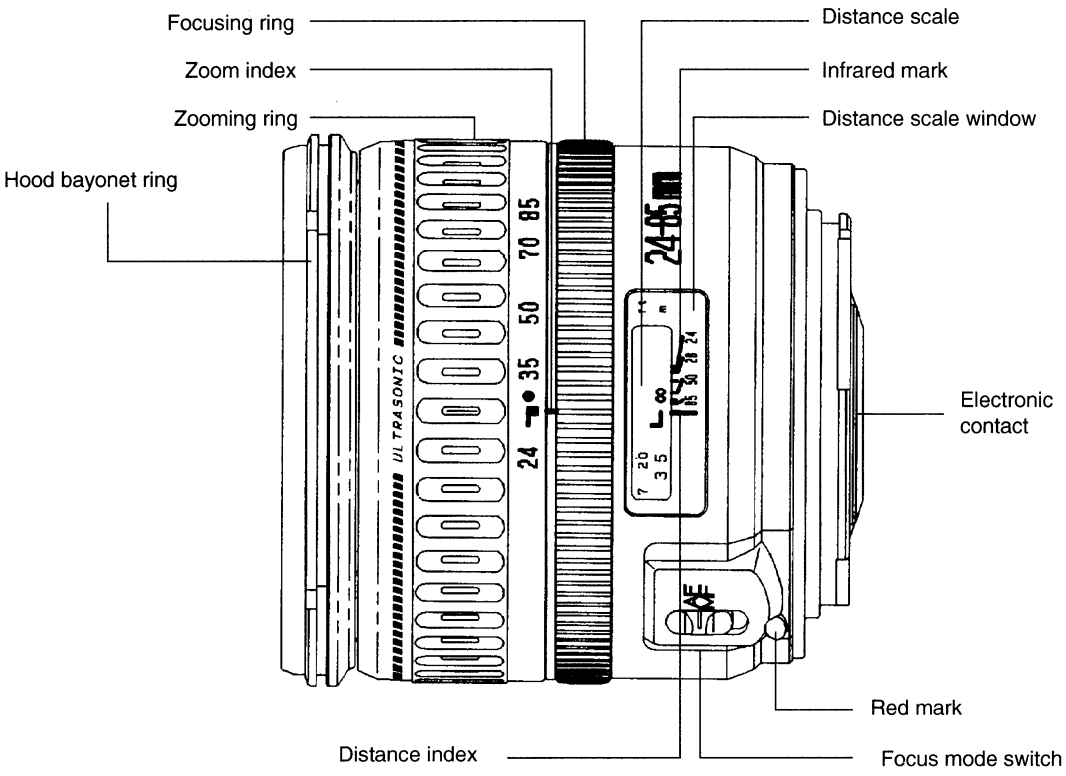


Fig. 1-3 Nomenclature

5.2 Caution

The hood must be detached when using the built-in flash.

Part 2

Technical Information

1. COMPONENTS AND FUNCTIONS

Symbol	Spec./Mgf. #	Function
IC1	MN158499L89A	Single-Chip 4-bit MPU
IC2	MPC17A33SVM	EMD driver (8 power transistors)
IC3	S80727-SN-DQ	Voltage detector (Resets MPU if VDD < 2.7V)
IC4	BU2207FV	Oscillator IC (USM control clock oscillator)
IC5	AN1393S	Comparator (USM control phase signal)
IC6	S-81237SG-QE	3.7V voltage regulator (LED current regulator)
IC7	MB3776APNF	Voltage step-up control
IC8	MB3864PNF	USM driver
IC9	TA75S393F	Comparator
PI	RPI-121	Photo-interrupter (For EMD opening detection)
PS	P4035	Photo-interrupter (Generates a signal corresponding to focusing unit movement)
Tr1	2SD1624	Power (E1) on/off transistor
Tr2	DTA-143XU	Power (E1) on/off transistor
Tr3	DTC-143TU	Focus pulse signal output transistor
C1	22µF/10V	VDD capacitor
C2	1µF/25V	VBAT capacitor
C3	1µF/25V	E1capacitor
C4	0.1µF/25V	Reset pin noise prevention
C5	1.5µF/50V	VB filter
C6	150pF/50V	IC7 oscillation stabilizer
C7	4700pF/50V	USM S phase signal divider
C8	330pF/50V	IC4 oscillation frequency set
C9, 10	3900pF/200V	USM characteristics compensation
C11	0.22µF/25V	IC6 output noise prevention
C12	4700pF/50V	IC7 oscillation frequency set
C13	0.047µF/25V	IC7 oscillation stabilizer
C14	3300pF/25V	IC5 input signal noise prevention
C15	2700pF/25V	IC9 input signal noise prevention
D1	DAP202U	For switching the zoom signal, focus signal and the best focus
D2	IMP10	For switching the zoom signal, focus signal and the best focus
D3	IMP10	For switching the zoom signal, focus signal and the best focus
D4	MA736	IC7 protector
D5	1SS302	IC5 protector
D6	SB01-05CP	IC5 protector
D7	DAP202U	For switching the zoom signal and the best focus

Symbol	Spec./Mgf. #	Function
ZD1	DTZ7.5	IC1 protector
ZD2	DTZ7.5	IC1 protector
ZD3	DTZ7.5	IC1 protector
ZD4	DTZ7.5	IC1 protector
ZD5	DTZ7.5	IC1 protector
ZD6	DTZ7.5	IC1 protector
ZD7	DTZ7.5	IC1 protector
ZD8	MA3075WA	IC1 protector
RA2	RCB8C123J	Resistor for high level IC2 input signal
RA3	RCB4C123J	Resistor for high level IC1 input signal
RA5	RCB4C183J	Resistor array for IC5 reference level determination
R1	12kΩ/0.063W	Resistor for high level focus pulse signal
R2	240Ω/0.063W	PI LED current limiter
R3	15kΩ/0.063W	PI LED current limiter
R4	10kΩ/0.063W	PI LED current limiter
R5	15kΩ/0.063W	Time constant resistor for oscillator IC4
R7	42.2kΩ/0.1W	Output voltage clamp resistor
R8	750Ω/0.063W	Output voltage clamp resistor
R9	27kΩ/0.063W	IC2 gate voltage divider
R10	24kΩ/0.063W	IC2 gate voltage divider
R11	820Ω/0.063W	Tr6 base current limiter
R12	1.8kΩ/0.063W	Time constant resistor for oscillator IC7
R13	15kΩ/0.063W	Tr3 base current limiter
R14	10kΩ/0.063W	Tr4 base current limiter
R15	20kΩ/0.125W	Voltage stabilizer for phase detection circuit
R17	3kΩ/0.063W	PI output signal resistor
R18	20kΩ/0.063W	PI output signal resistor
R19	2kΩ/0.063W	PI output signal resistor
R20	100kΩ/0.063W	PI output signal resistor
R21	390Ω/0.063W	PI output signal resistor
OSC	FAR-C4CB 8MHz	IC1 clock oscillator
VR1	2kΩ	PI LED current adjustment
VR2	10kΩ	IC4 frequency adjustment
L1, 2	1.5mH	USM drive coil
L3	12μH/2.3A	Step-up coil

2. IC PIN TABLE

IC1

No.	Symbol	I/O	A/D	Voltage	Function
1	RESET	I	D	0-VDD	CPU 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	SB0	I	D	0-VDD	Communications port
7	/SBT	O	D	0-VDD	Communications port
8	VSS	I/O	D	0-VDD	Communications port
9	/SIN	I	D		USM A phase input
10	/AIN	I	D		USM S phase input
11	BOUT	O	D		USM drive B phase output
12	AOUT	O	D		USM drive A phase output
13	FIN	I	D		USM drive frequency input
14	DAC0	O	D	0-VDD	IC4 capacitor charging current decision
15	DAC1	O	D	0-VDD	IC4 capacitor charging current decision
16	DAC2	O	D	0-VDD	IC4 capacitor charging current decision
17	DAC3	O	D	0-VDD	IC4 capacitor charging current decision
18	DAC4	O	D	0-VDD	IC4 capacitor charging current decision
19	DAC5	O	D	0-VDD	IC4 capacitor charging current decision
20	DAC6	O	D	0-VDD	IC4 capacitor charging current decision
21	DAC7	O	D	0-VDD	IC4 capacitor charging current decision
22	E1ON	O	D	0-VDD	Tr5 on and off
23	DC/DC	O	D		DC/DC convertor on and off
24	COM2	O	D		Zoom signal detection common
25	COM3	O	D		Focasing ring position detection common
26	ZOOM0/ZONE0/	I	D		Zoom signal detection/focusing ring position detection
	AFADJ0	I	D		Best focus adjustment
27	ZOOM1/ZONE1/	I	D		Best focus adjustment
	AFADJ1	I	D		Best focus adjustment
28	ZOOM2/ZONE2/	I	D		Zoom signal detection/focusing ring position detection
29	ZOOM3/	I	D		Zoom signal detection/focusing ring position detection
	ZONE3				Best focus adjustment
30	ZOOM4				Zoom signal detection
31	VB COMP	I	D		VBAT voltage detection pin
32	COMP	I	D		VBAT voltage detection pin
33	IRIS	I	D		Diaphragm open switch on/off pin

No.	Symbol	I/O	A/D	Voltage	Function
34	A/M	I	D		Focus mode SW common
35	MANUAL	O	D		Focus mode SW manual components
36	AUTO	O	D		Focus mode SW auto focus components
37	COM6	O	D		Production error correction signal detection common
38					Not used
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		PI pulse signal input
44	P2			0	D-GND

IC2

No.	Symbol	I/O	A/D	Voltage	Function
1	BOUT	O		0-VDD	EMD B phase current
2	VBAT				EMD power supply
3	BIN1	I	D	0-VDD	EMD B phase reverse current control
4	/BIN1	I	D	0-VDD	EMD B phase forward current control
5	E1				IC control power supply
6	DGND	I	D	0	IC3 output control
7	DGND			0	D-GND
8	/BOUT	O		0-VDD	EMD B' phase current
9	PGND			0	P-GND
10	/AOUT	O		0-VDD	EMD A' phase current
11	VBAT				EMD power supply
12	VG	I	D		IC control power supply
13	/AIN	I	D	0-VDD	EMD A phase reverse current control
14	AIN	I	D	0-VDD	EMD A phase forward current control
15	AOUT	O		0-VDD	EMD A phase current
16	PGND			0	P-GND

IC3

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

IC4

No.	Symbol	I/O	A/D	Voltage	Function
1	D7	I	D		Data input
2	D6	I	D		Data input
3	D5	I	D		Data input
4	D4	I	D		Data input
5	D3	I	D		Data input
6	D2	I	D		Data input
7	GND			0	GND
8	D0	I	D		Data input
9	D1	I	D		Data input
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

IC5

No.	Symbol	I/O	A/D	Voltage	Function
1	AOUT	O	D		USM S phase output
2	A-IN	I	A		USM S phase input
3	A+IN	I	A		USM S phase signal convertor
4	GND			0	GND
5	B+IN	I	A		USM B phase convertor
6	B-IN	I	A		USM B phase input
7	BOUT	O	D		USM B phase output
8	VB			VB	Power supply

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	PS power supply

IC7

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

IC8

No.	Symbol	I/O	A/D	Voltage	Function
1	B1	I	D		USM B phase input
2	VB			VB	Power supply
3	BOUT	O	D		USM B phase output
4	UGND			0	U-GND
5	UGND			0	U-GND
6	AOUT	O	D		USM A phase output
7	VB			VB	Power supply
8	A1	I	D		USM A phase input

IC9

No.	Symbol	I/O	A/D	Voltage	Function
1	AOUT	I	A		Output pin
2	A-IN	O	A		Input pin
3	A+IN	I	A		Output pin
4	GND				GND
5	B+IN	I	A		Input pin
6	B-IN	O	A		Output pin
7	BOUT	O	D		Comparison output pin
8	V+			V_B	Power supply

3. CIRCUIT DESCRIPTION

3.1 Lens Mounted on Camera

1) When the lens is mounted, the power is supplied from the camera to the lens CPU through the VDD mount contact pin. The CPU activates the oscillator (OSC). The CPU is then reset by capacitor C4 and voltage detection IC IC3. After the initialization, the CPU goes into HALT mode.

2) When the camera communicates with the lens, the CPU sets the E1ON pin low, turns Tr5 on, and supplies power E1 to the concerned circuits.

3) The camera sends a lens data request to the lens through the DCL line.

4) The lens sends the requested data through the DLC line. The data includes information about whether the diaphragm is fully open when the lens is mounted. If the diaphragm is not open, the camera sends a diaphragm (EMD) drive command to the lens.

5) This command causes the current flow through IC2 AO, /AO, BO, and /BO, and drives the EMD to open the diaphragm.

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

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

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

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

3.2 Switch Operation

When the Focus mode SW (A/M SW) is operated, the lens CPU turns DLC to low regardless of LCLK, and sends WAKE UP request to activate the camera DC/DC converter. The subsequent procedure is the same as step 2 and later.

3.3 Camera SW1 ON

10) When camera SW1 turns on, the camera DC/DC converter goes on, so the lens CPU receives VDD, and VBAT (for DC/DC converter and EMD drive IC2) from the camera. The lens CPU sets the E1ON pin on, turning Tr5 on and supplies power E1 to the concerned circuits.

Focusing (USM) Drive

11) When the camera sends the drive signal to the lens, the lens MPU starts the USM drive sequence.

12) The DC/DC pin goes low to activate the lens DC/DC converter.

13) If the camera sends both the drive command and focus data, the MPU drives the USM with this data (number of pulses). If the command is received without data, the MPU uses the previous focusing data.

14) When the MPU receives the drive direction signal, it issues square wave signals with different phases from the MPU AOUT and BOUT pins. The phases of the signals determine the USM rotation direction and change the combination of IC8 transistors that are turned on.

15) The square wave signals are input to the UA and UB phases according to combinations of IC8 transistors which are turned on.

16) As the USM turns, photocoupler phototransistor receives light from the LED. Tr9 converts the amount of light received to pulses and sends it to the MPU.

17) The MPU counts the pulses and drives the USM until the specified drive amount (number of pulses) is reached.

18) When the specified number of pulses is counted, the MPU sends a USM stop signal to the MPU to stop the USM drive.

19) The MPU outputs a high signal from the DC/DC pin to stop the DC/DC converter.

Diaphragm (EMD) Drive

20) The camera sends the aperture drive command to the lens through DCL. The MPU makes the LCLK line low and sends a busy signal.

21) When the aperture drive command and amount data request command are simultaneously received, the diaphragm is driven in accordance with the data.

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

23) The drive control signal changes the current flowing from the AO, /AO, BO, and /BO to the EMD coils (A, A', B, and B'), determines the EMD coil current direction, and drives the EMD.

24) After the MPU sends the control signal for the given EMD drive to IC2, it stops the "BUSY" signal the LCLK communication line to the camera.

25) After finishing the EMD drive, the camera sends a diaphragm current stop signal to the lens through the DCL. The MPU sets EMD A, A', B, and B' to low and stops the current from the IC2 AO, /AO, BO, and /BO pins to the EMD.

4. DESCRIPTION

4.1 Zoom Lens Optical System

The optical system of this lens was newly designed to be very compact and provide high picture quality in the zoom range of 24 to 85 mm, which was not implemented by the conventional EF lenses. The optical system has the following characteristics:

- A high zoom ratio of approximately 3.5 times and a compact optical system have been achieved by developing an optical system that consists of five groups of lenses, four of which are moveable.
- The inner-focusing group 2 lens is used to achieve a wide-end focal length of 24 mm, a small lens diameter, and minimum focusing distance of 0.5 m over the entire zoom range.
- An aspherical replica lens is used for G4 to improve picture quality at the periphery of the screen in the wide to middle ranges and correct distortion aberration.
- A flare-cut diaphragm that moves independently is installed between the group 3 and 4 lenses to eliminate unwanted light at the periphery and improve the contrast.
- The filter diameter of 67 mm is used for the first time to satisfy the specifications of the optical system.

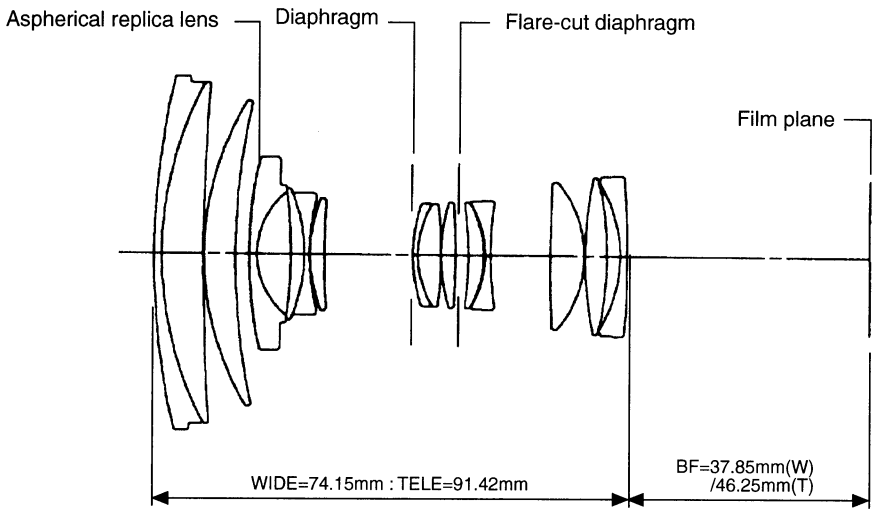


Fig. 2-1 Optical System Diagram

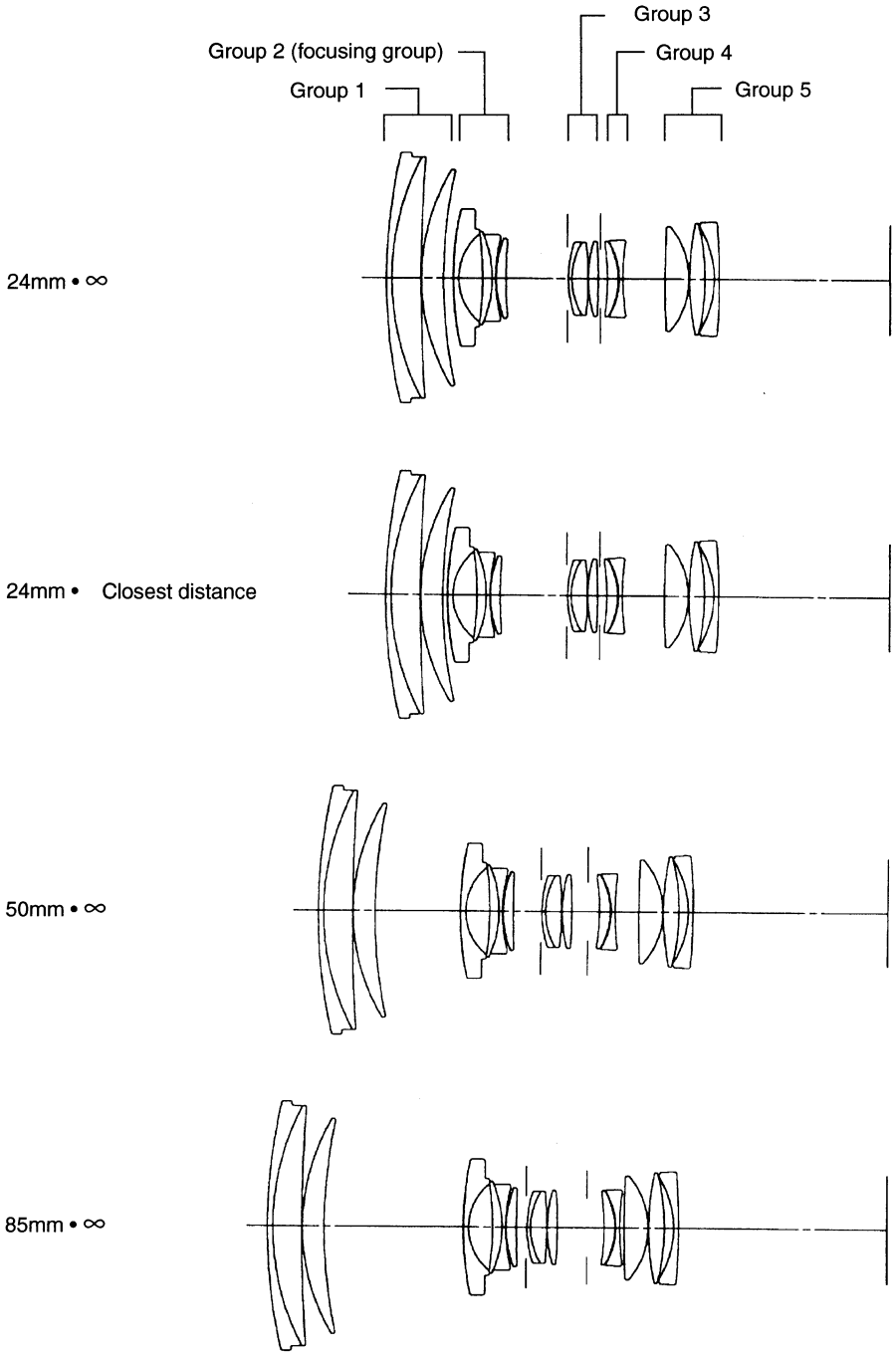


Fig. 2-2 Movement of Lenses for Zooming

4.2 Mechanical Features

This lens uses an optical system in which the focus drive changes according to the focal length. It uses the SIC (Super Inner Cam) to control the focus drive for each focal length and keep the focus rotation angle at any focal length constant.

The lens has the following mechanical features:

- Inner focusing and the ring-type USM enable silent and high-speed AF operation.
- The circular polarizing filter can be used because the front lens does not turn during zooming and focusing.
- A petal-type hood (EW-73) is provided to give a high hooding effect at Wide end.

Part 3

Repair Information

1. PRELIMINARY INSTRUCTIONS

1.1 Disassembly, Reassembly, and Adjustment Notes

1) Disassembly and reassembly

- Centering adjustment and optical tilt adjustment are required for this lens.
- Before the collars are removed, remember their locations and directions.

2) Optical adjustment

Centering adjustment	(Necessary) / Unnecessary Move the group 4 lens unit radially.	800-mm general-purpose lens focus checker
Optical tilt adjustment	(Necessary) / Unnecessary Move the group 5 lens unit radially.	Lens projector

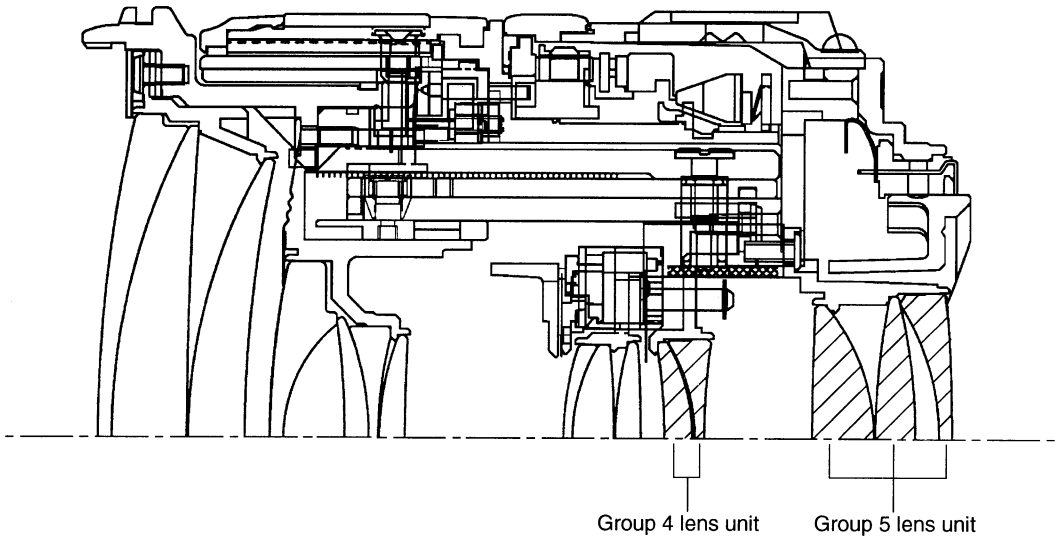
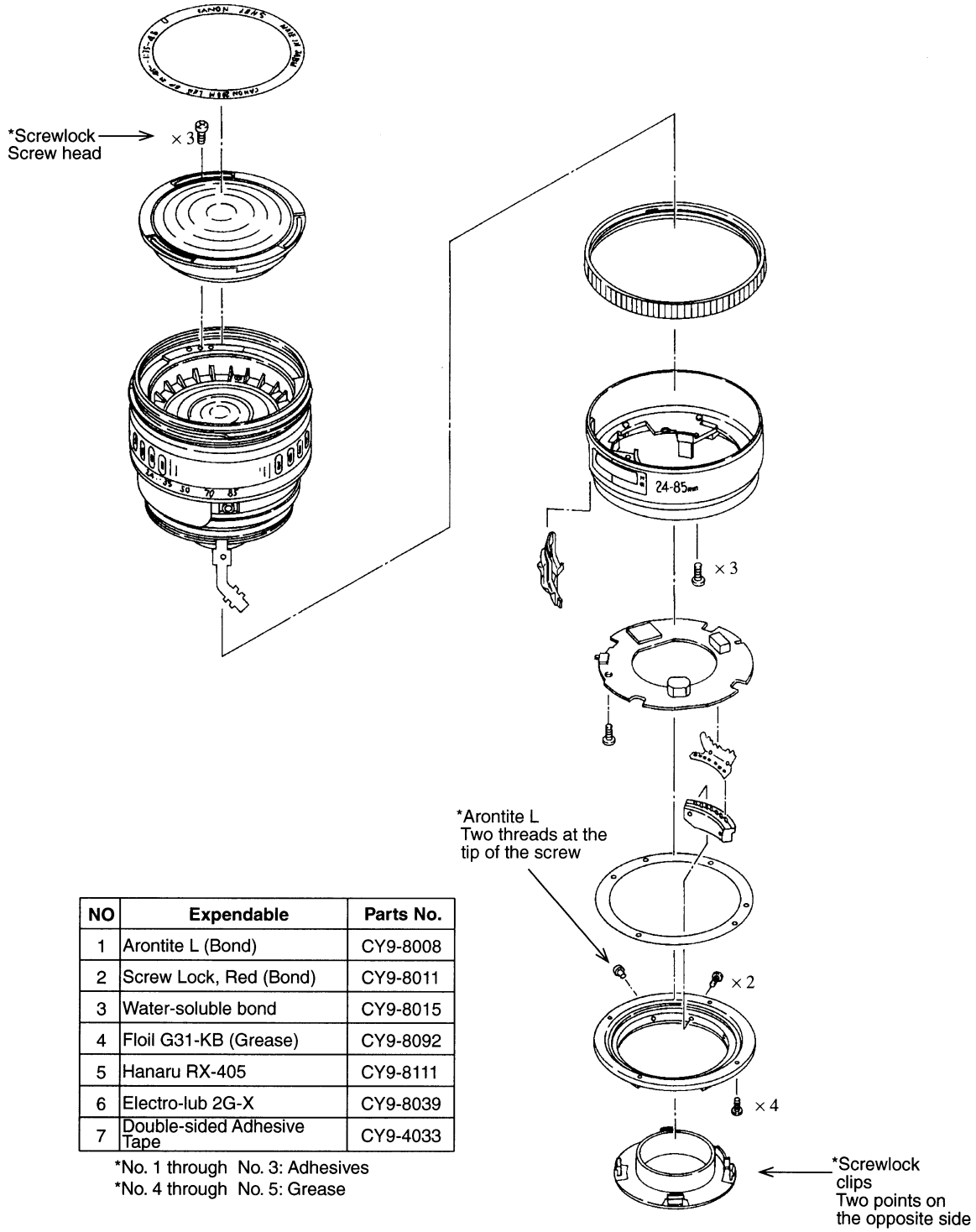


Fig. 3-1 Adjustment Points

1.2 Locations of Application of Expendables



NO	Expendable	Parts No.
1	Arontite L (Bond)	CY9-8008
2	Screw Lock, Red (Bond)	CY9-8011
3	Water-soluble bond	CY9-8015
4	Floil G31-KB (Grease)	CY9-8092
5	Hanaru RX-405	CY9-8111
6	Electro-lub 2G-X	CY9-8039
7	Double-sided Adhesive Tape	CY9-4033

*No. 1 through No. 3: Adhesives
*No. 4 through No. 5: Grease

Fig. 3-2 Locations of Application of Expendables (I)

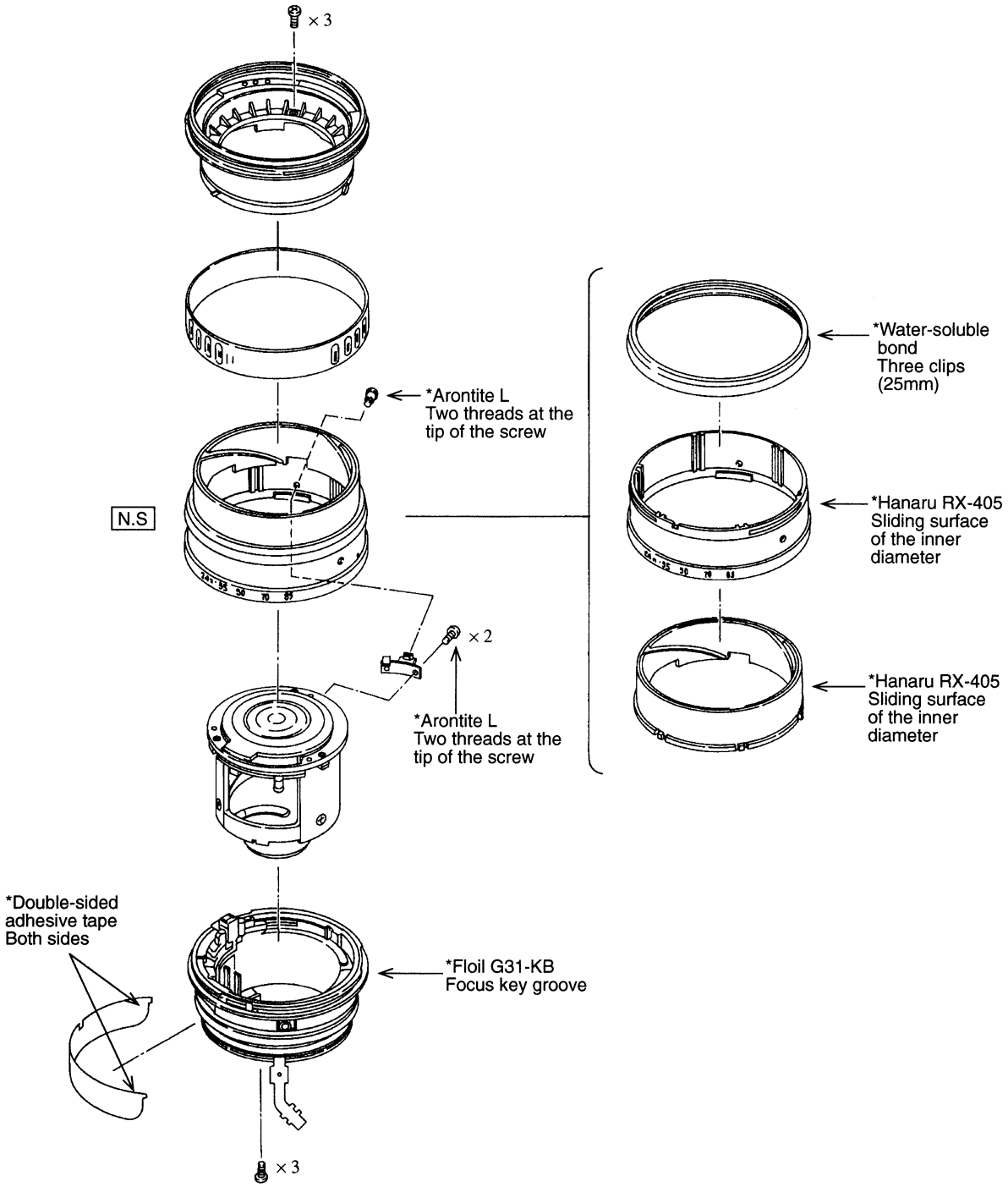


Fig. 3-3 Locations of Application of Expendables (II)

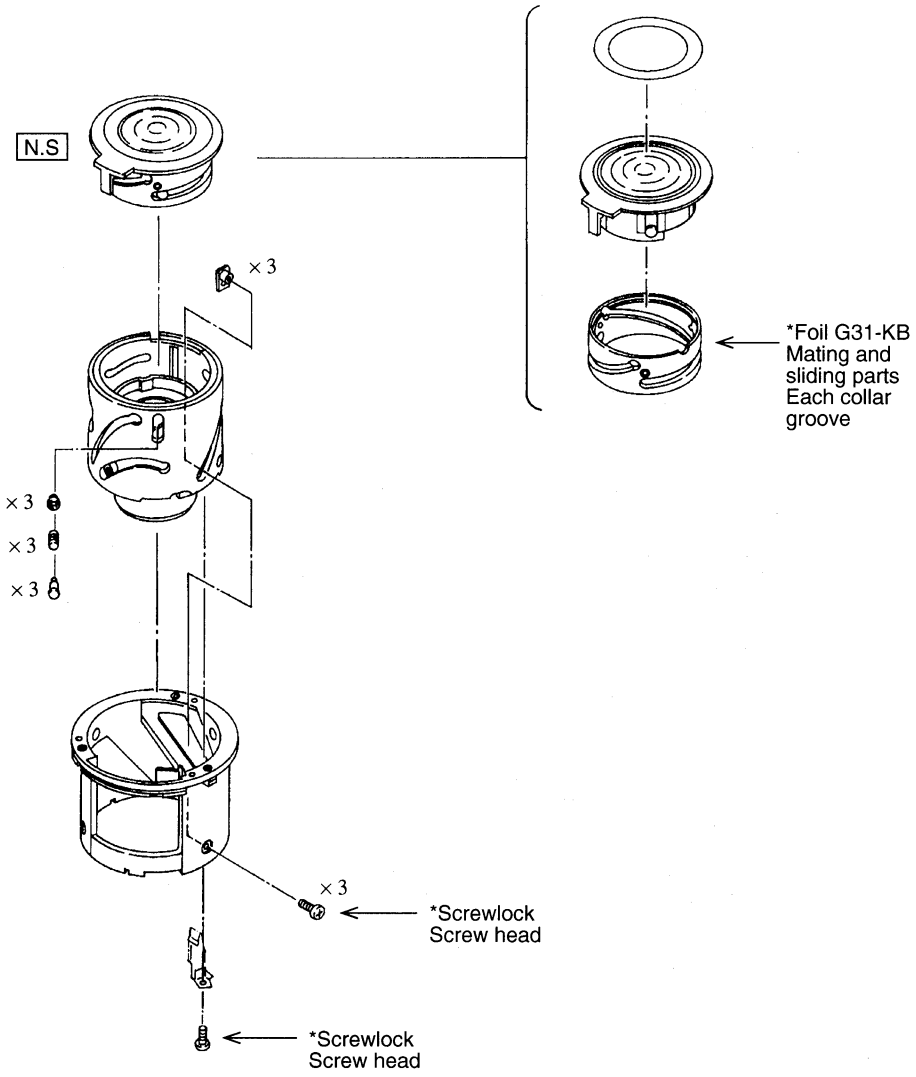


Fig. 3-4 Locations of Application of Expendables (III)

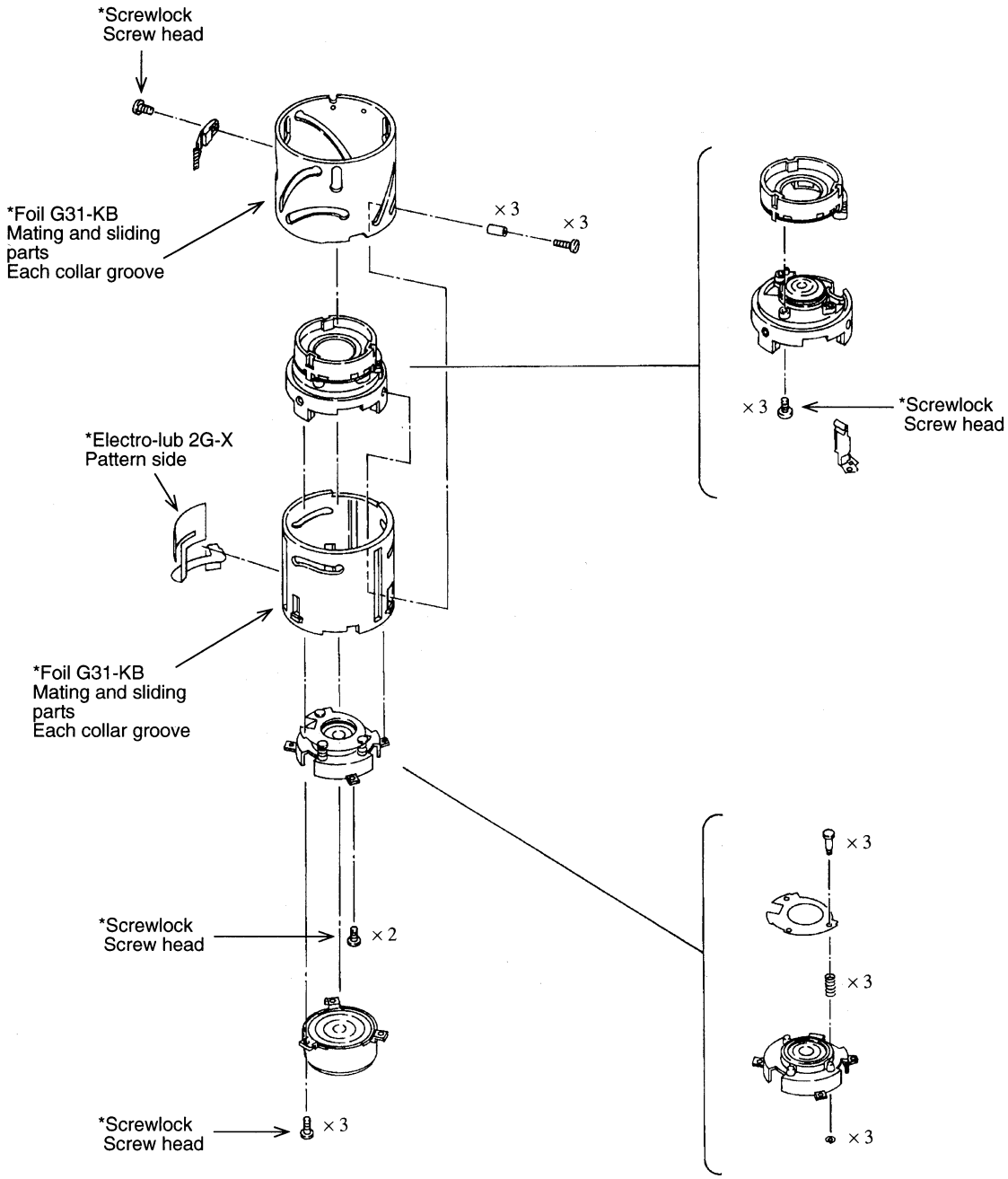


Fig. 3-5 Locations of Application of Expendables (IV)

1.3 Adjustment

Adjustment item	Purpose	Description	Page
Centering	Make resolution at the center of the field uniform.	Make this adjustment when an optical component is disassembled or replaced.	3-18
Optical tilt	Make resolution at the periphery of the field uniform.	Make this adjustment when an optical component is disassembled or replaced.	3-20
Focus	Achieve infinity focus.	Check and adjust the focusing when an optical part is disassembled or replaced.	3-22
Pulse	Achieve accurate USM drive data.	Make this adjustment when the focusing unit or main board unit is replaced.	3-24
Focus compensation	Achieve the best focusing when shooting at AF maximum aperture.	Check and adjust the focusing when an optical part is disassembled or replaced. Adjust the focusing when the main board is replaced.	3-26
USM reference frequency	Achieve reference frequency.	No adjustment is required since the service part is mounted on the main board.	3-28
Zoom brush position	Gain zoom information accurately.	Make this adjustment when the zoom brush or Z-FLX is disassembled or replaced.	3-30

* USM reference frequency adjustment is given above for reference because the USM reference frequency may need to be checked or readjusted after repair.

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2. DISASSEMBLY AND REASSEMBLY

2.1 Main Board Unit Removal

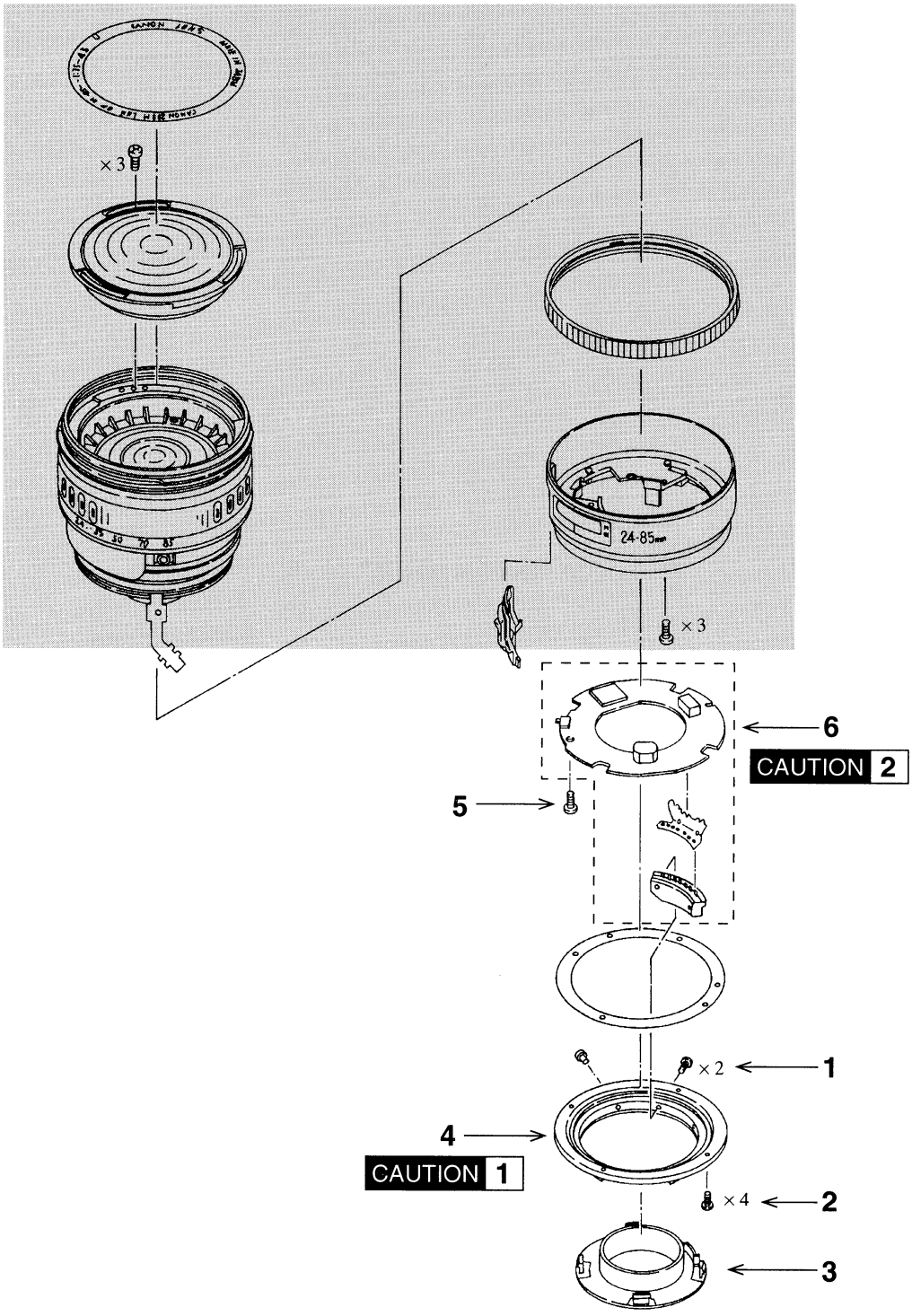


Fig. 3-6 Main Board Unit Removal

1. Two screws holding the contact block

2. Four screws holding the mount

3. Back cover (Glued)

- Lift the lens mount, and push the back out from inside.
- To reinstall the back cover, install the lens mount, then push the back in.

4. Lens mount

CAUTION 1

Replacing the lens mount

- The focus is adjusted in the factory by machining the mount. Measure the mount thickness with a micrometer, vernier caliper, etc., and combine a adjusting lens mount and a focus washer for service use so that the thickness is the same as before replacement.

5. One screw holding the main board unit

6. Main board unit: M-FLX: Contact block

- Disconnect the four flexes from the connectors, then remove the main board unit.

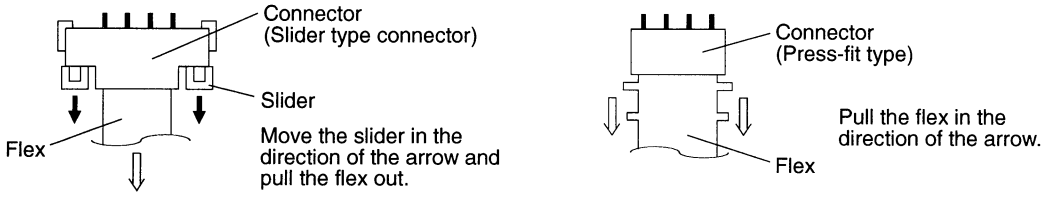


Fig. 3-7 Removing Flexes

- The contact block does not need to be removed unless the main board unit is replaced.
- Before inserting each flex into the connector, wipe the pattern side with a dry cloth. (To prevent shorting)

CAUTION 2

Replacing the main board unit

- Solder AF-ADJ0 to AF-ADJ1 in the same way as before replacement. (See 3.5 Focus Compensation.)
- Adjust the pulse. (See 3.4 Pulse Adjustment.)

2.2 Lens Unit Removal (I)

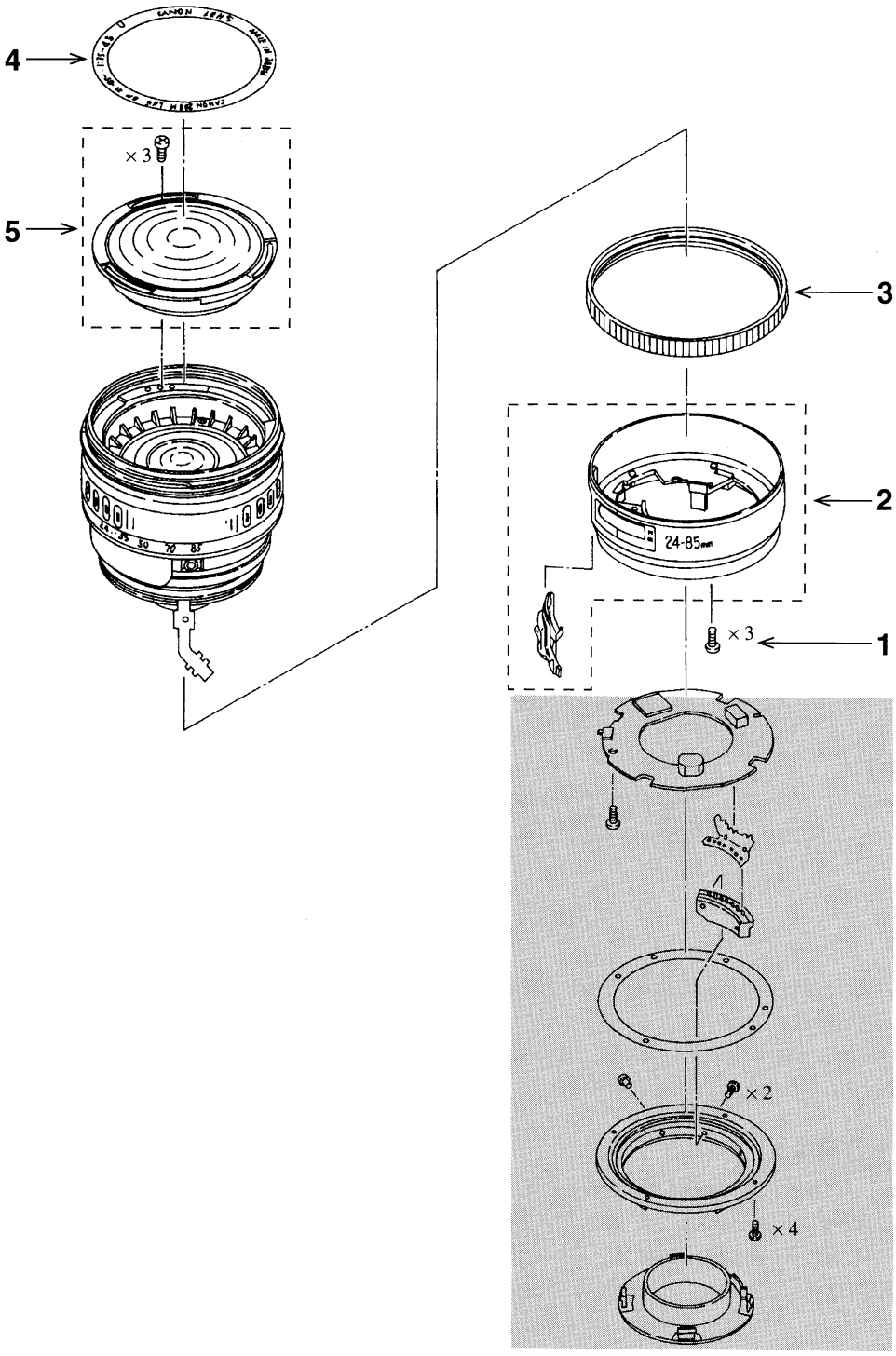


Fig. 3-8 Lens Unit Removal (1)

1. Three screws holding the fixed barrel

2. Fixed barrel unit: A/M switch unit

- Normally, the A/M switch unit does not need to be removed.

3. Manual distance ring

4. Face ring

5. Group 1 lens unit (Three screws; glued)

2.3 Focusing Unit Removal

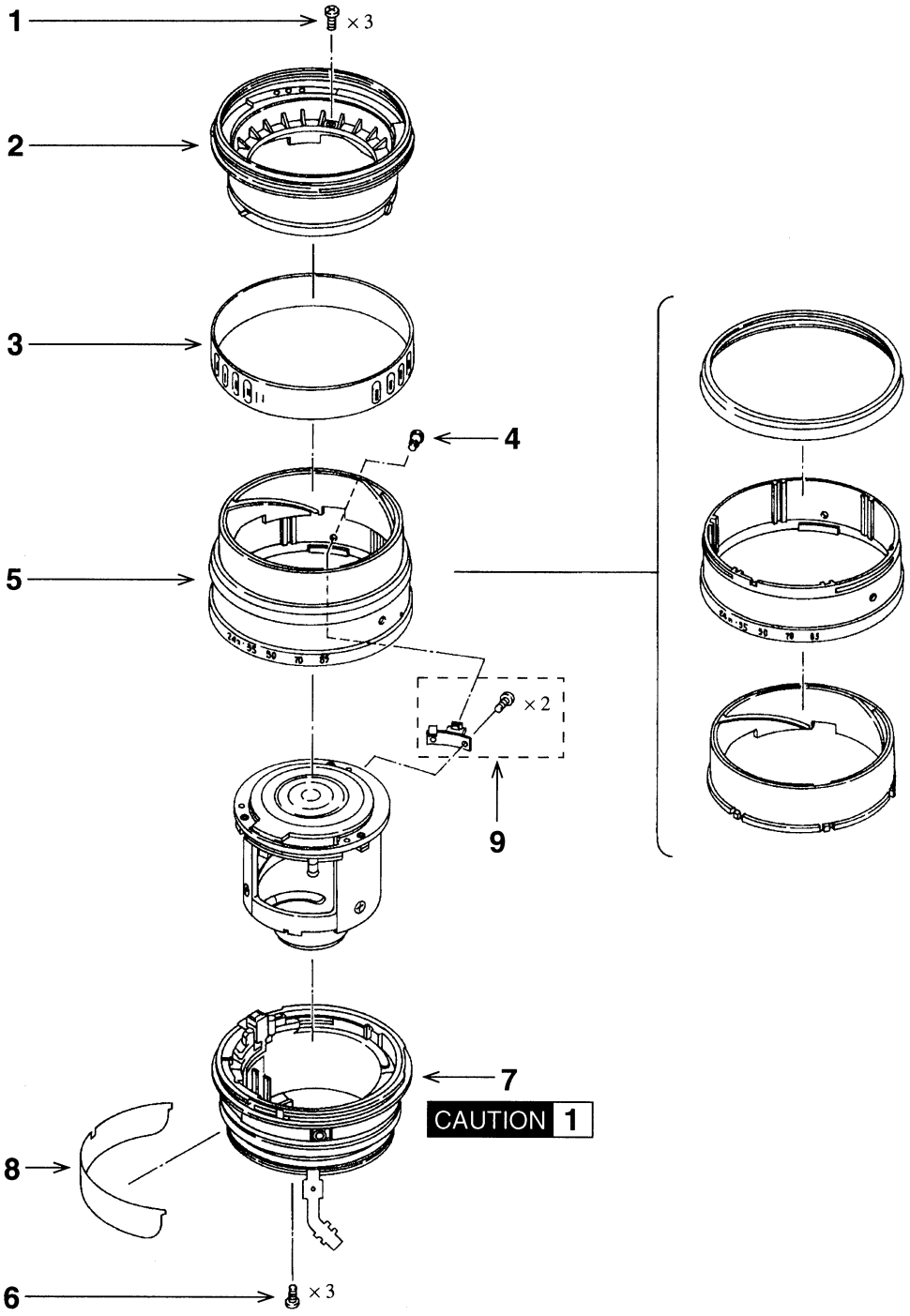


Fig. 3-9 Focusing Unit Removal

1. Filter frame holding screws (Three)

2. Filter frame unit

3. Zoom ring rubber

4. Zoom operation ring holding screw (Glued)

5. Zoom operation ring unit

6. Focus unit holding screws (Three)

7. Focus unit

- Do not touch the stator and rotor.

CAUTION 1 Replacing the focus unit

- Perform pulse adjustment. (See 3.4, Pulse Adjustment.)

8. Distance scale seal (Double-sided adhesive tape)

- Normally, this seal does not need to be removed.
- Do not shift the reference notch position or avoid slackening or twisting when placing the seal.

9. Zoom connection block (Two screws: glued)

2.4 Lens Unit Removal (II)

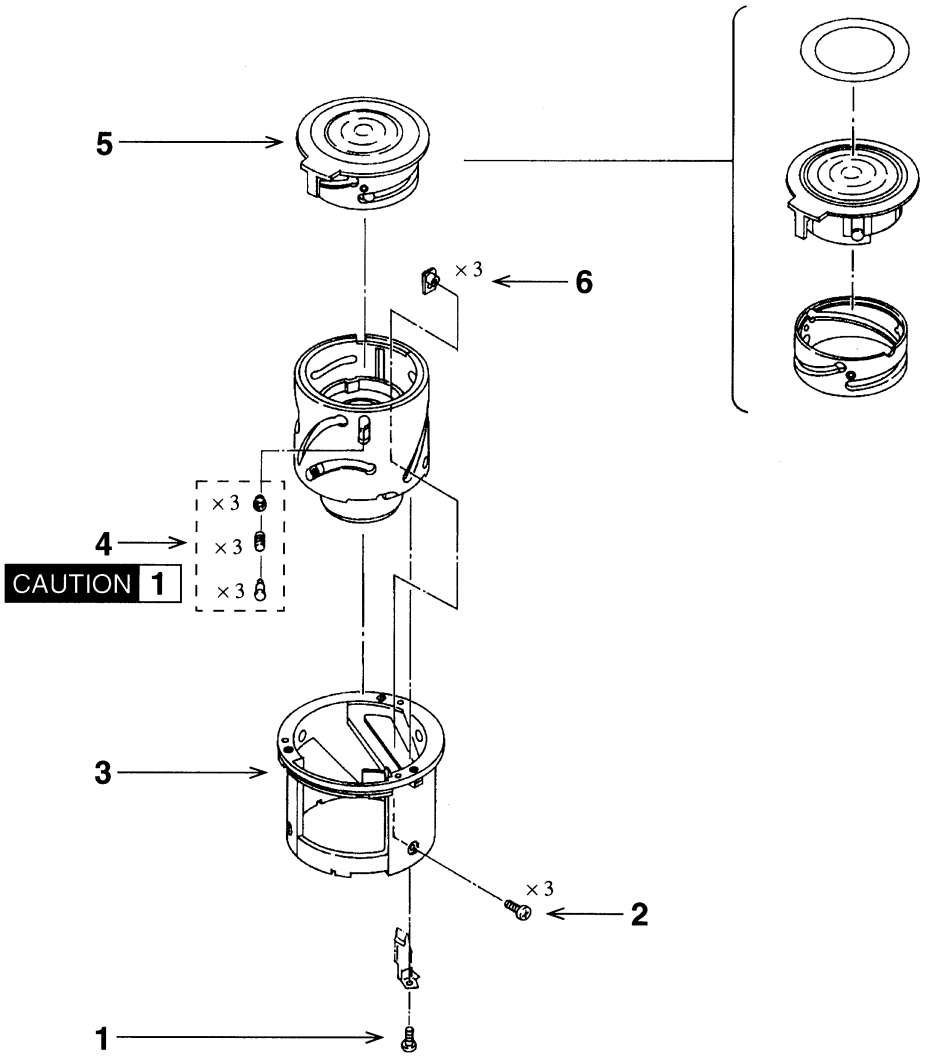


Fig. 3-10 Lens Unit Removal

1. Group 4 lens barrel (E-FLX holder) holding screw (One) (Glued)

2. Straight barrel holding screws (Three) (Glued)

3. Straight barrel

4. Group 2 collars (three); group 2 collar springs (three); group 2 collar holding screws (three)

- Before the collars are removed, remember their locations and directions.

CAUTION 1 Replacing the group 2 collars

- Measure the diameter of the collars with a micrometer, and use a new collar with the same size. Alternatively, fit each kind of collar into the cam groove, and select one of them that has no play and moves smoothly.

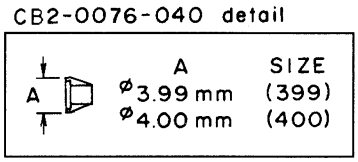


Fig. 3-11 Group 2 Collar Adjustment Size

5. Group 2 unit

6. Straight keys (Three)

2.5 Lens Unit Removal (III)

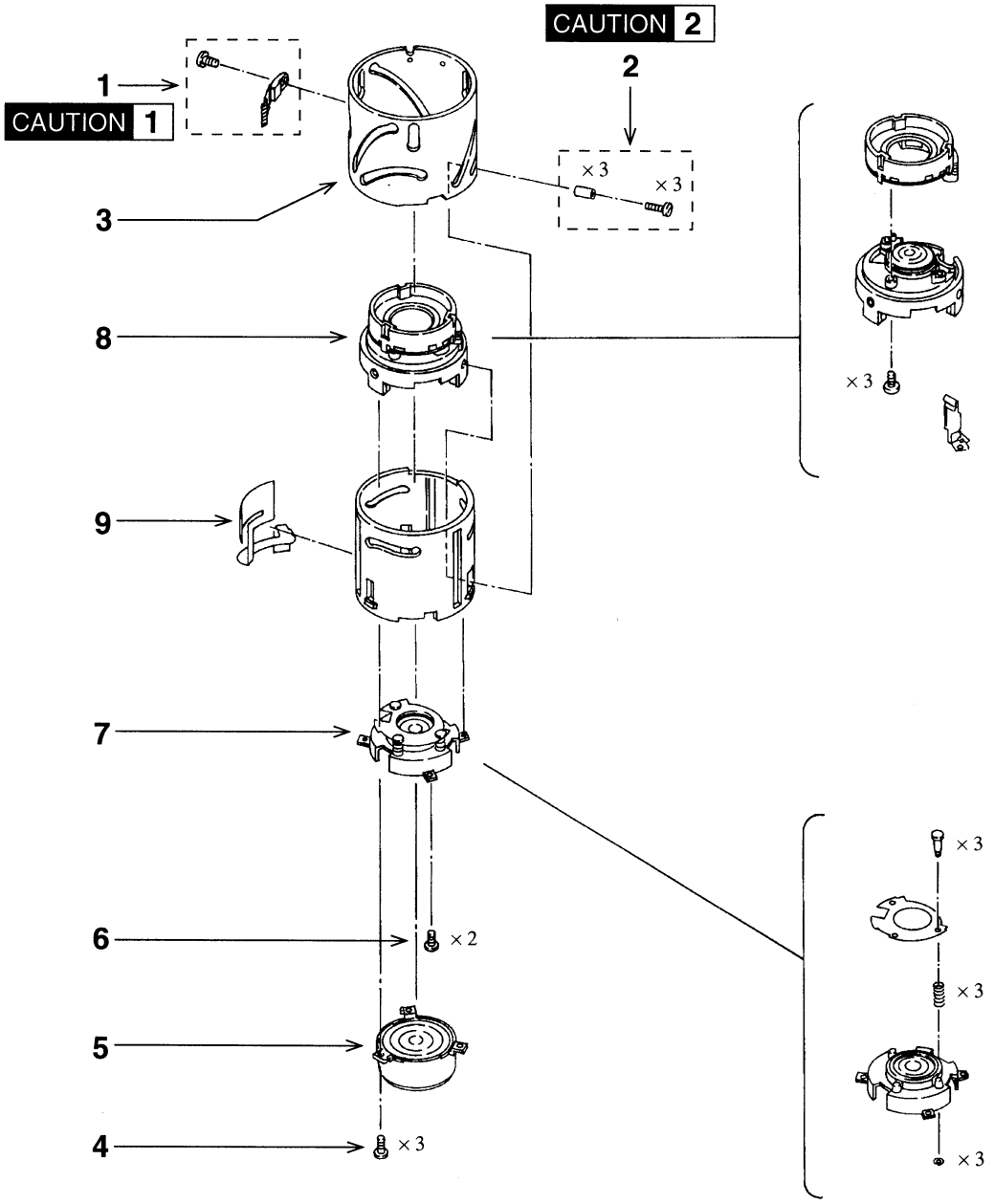


Fig. 3-12 Removing the Lens Unit (III)

1. Zoom brush (One screw: glued)

- Mark the position because it must be adjusted when reinstalling the brush.

CAUTION 1 **Replacing the zoom brush**

- Temporarily fix the zoom brush, and adjust its position.
  (See 3.7 Zoom Brush Position Adjustment.)

2. Group 3 collars (Three screws: glued)

- Before the collars are removed, remember their locations and directions.

CAUTION 2 **Replacing the group 3 collars**

- Measure the diameter of the collars with a micrometer, and use a new collar with the same size. Alternatively, fit each kind of collar into the cam groove, and select one of them that has no play and moves smoothly.

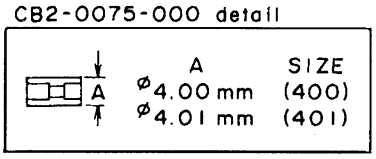


Fig. 3-13 Group 3 Collar Adjustment Size

3. Cam barrel

4. Group 5 holding screws (Three: glued)

5. Group 5 lens unit

6. Group 4 holding screws (Two: glued)

7. Group 4 unit

8. Group 3 unit

9. Z-FLX

- Normally, the Z-FLX does not need to be removed.

3. ADJUSTMENT

3.1 Centering Adjustment

Note: Adjust the centering when you disassemble or replace optical system components.

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

Tool: 800-mm general-purpose lens focus checker

Standard

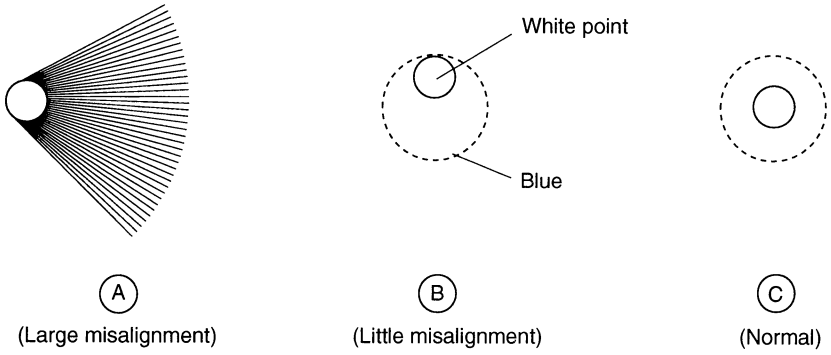


Fig. 3-14 Centering Adjustment Standard

Preparation:

1. Perform steps 1 to 6 in 2.1, Main Board Unit Removal, in the Disassembly and Reassembly section.
2. Assemble the mount only.
3. Loosen the three screws (YA2-1513) holding the group 4 lens unit.

Adjustment method:

1. Mount the lens on the checker and set the focus to infinity.
2. Observe the star image. Check whether it meets the standard.
3. If it does not meet the standard, move the group 4 lens unit radially and adjust it to the standard.
4. After adjustment, apply Screwlock to the screw head.

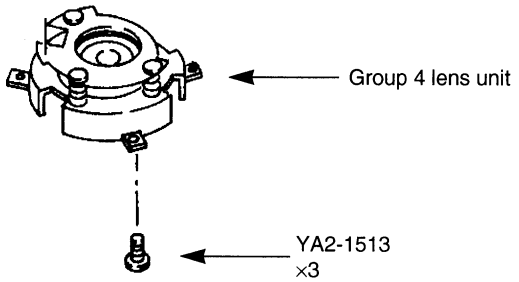


Fig. 3-15 Centering Adjustment Point

3.2 Optical Tilt Adjustment

* Make this adjustment when an optical component is disassembled or replaced.

Purpose: Make resolutions at the periphery of the screen uniform.

Tool: Lens projector

Standard: The projection resolution standard is shown below.

Table 3-1 Projection Resolution Standard

Image height		0mm	4mm	8mm	12mm	16mm	20mm
Wide end	S	100 lines/ mm	*100	*100	*100	* 63	40
	M		* 63	40	40	25	16
Intermediate (f=50mm)	S	100 lines/ mm	100	63	40	* 63	25
	M		100	63	* 63	* 40	25
Tele end	S	100 lines/ mm	100	*100	* 40	* 40	*25
	M		*100	63	40	* 40	*25

*: Can be one level lower in the two adjacent direction only.

Preparation:

1. 1. Perform steps 1 to 6 in **2.1, Main Board Unit Removal,** in the Disassembly and Reassembly section.
2. Assemble the mount only.
3. Loosen the three screws (YA2-1513) holding the group 5 lens unit.

Adjustment method:

1. Set the distance between the projector chart surface and the projected image to about 4.25 m.
2. Mount the lens on the projector, and focus the projected image.

3. Observe the projected image and check whether the projection resolution meets the standard.
4. If the resolution is not within the standard, move the group 5 lens unit radially to adjust the resolution.
5. After adjustment, apply Screwlock to the heads of the screws.

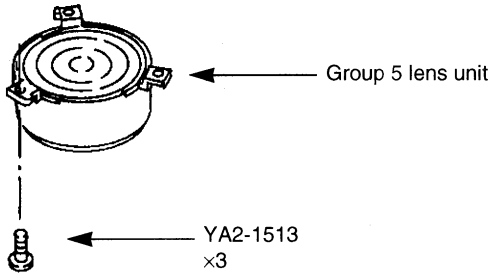


Fig. 3-16 Tilt Adjustment PointTilt

3.3 Focus Adjustment

* Check and adjust the focus when an optical part is disassembled or replaced.

Purpose: Gain infinity focus.

Standard:

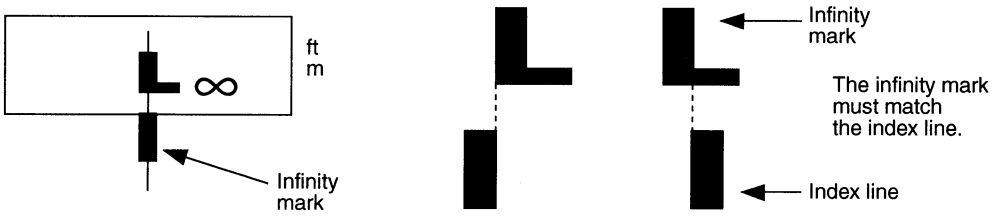


Table 3-17 Focus Adjustment Standard

Tools:

- EOS camera with B type focusing screen
- Magnifier
- General 600mm collimator (infinity object)

Adjustment method:

1. Mount a lens on the camera.
2. Set the focus to infinity.
3. Adjust the focus so that it meets the standard at Tele end.
4. Adjust the focus so that it meets the standard at Wide end.
5. Repeat steps 3 and 4 until the focus meets the standard at Tele and Wide ends.

Tele end focus adjustment method

1. Remove the face ring (YA2-2843).
2. Loosen three group 1 lens holding screws (X91-1737-300).
3. Adjust the focus by rotating the group 1 lens unit clockwise or clockwise.
4. After adjustment, apply Screwlock to the screw head.

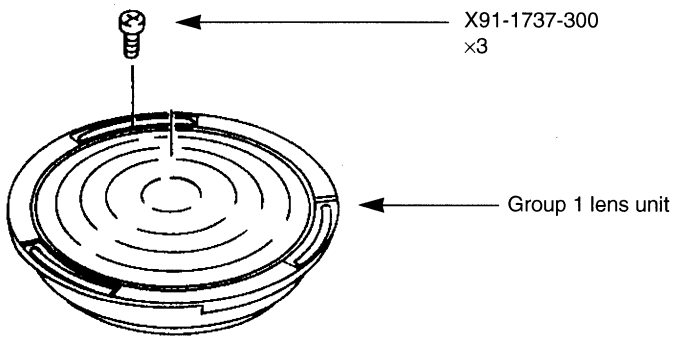


Table 3-18 Focus Adjustment at Tele End

Focus adjustment at Wide end:

- Adjust the total mount thickness by combining a service lens mount and a focus washer for service use.
  If many focus washers are used, the gap between the fixed barrel and lens mount becomes noticeable, so the total thickness of the focusing washers should be limited to 0.07mm.

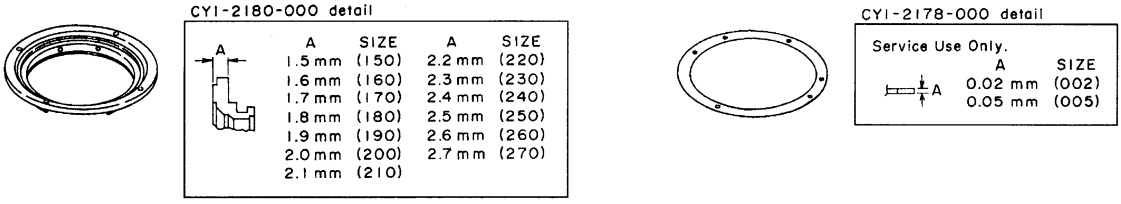


Fig. 3-19 Focus Adjustment at Wide End

3.4 Pulse Adjustment

* Make pulse adjustment when the focusing unit or main board unit is replaced.

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

Tools:
- Oscilloscope
- EOS camera
- EF lens electronic ring mount adapter (CY9-2001-004) or lens communication tool (See page 3-57 of EF75-300/4.0-5.6 IS Service Manual.)

Standard: 0.9T < t < 1.1T

Preparation:
1. Remove the parts as instructed in **2.1 Lens Mount Disassembly**, Disassembly and Reassembly.
2. Solder a lead to each land of P1 and DGND shown below.
3. Assemble the components, other than the back cover.
4. Install the adapter or communication tool and draw the lead from the inside.
5. Install them on the camera.

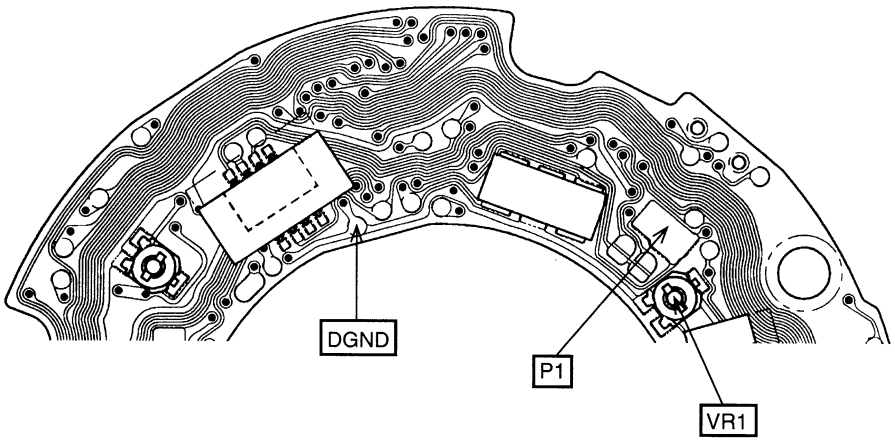


Table 3-20 Pulse Adjustment Point

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 meet the standard (for example, a), 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 c.

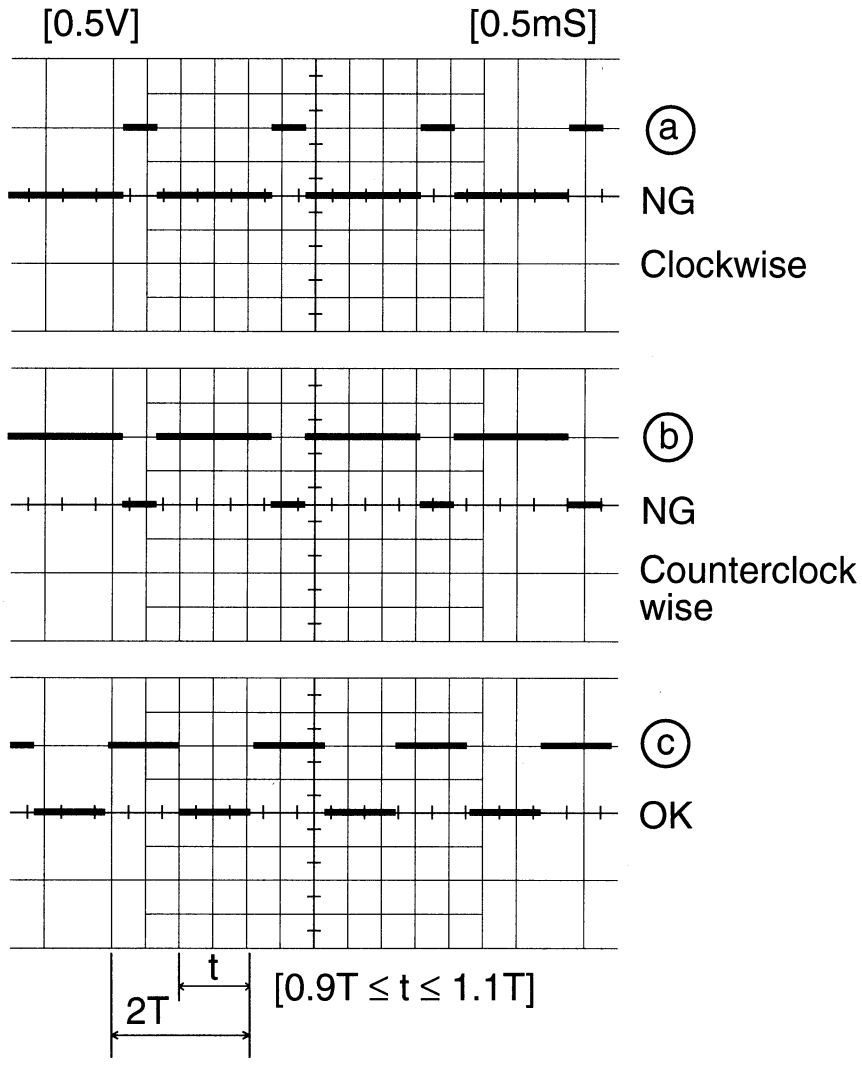


Table 3-21 Pulse Waveform

3.5 Focus Compensation

* Check and adjust the focus when an optical part is disassembled or replaced. Make this adjustment when the main board unit is replaced.

Purpose: Make the AF focus position closer to the best focus position.

Tools:
- Three-dimensional chart
- Reference chart
- EOS camera with the AV priority function

Adjustment method 1: When the main board unit is replaced, set the AF-ADJ0 to AF-ADJ1 adjusting pads to the same condition as for the old board unit.

Adjustment method 2: If front defocus, increase plus correction. If rear defocus, increase negative correction.

Adjustment method 3: Select each of four combinations of adjusting pads and perform open shooting. Select the combination of adjusting pads that give the best focus.

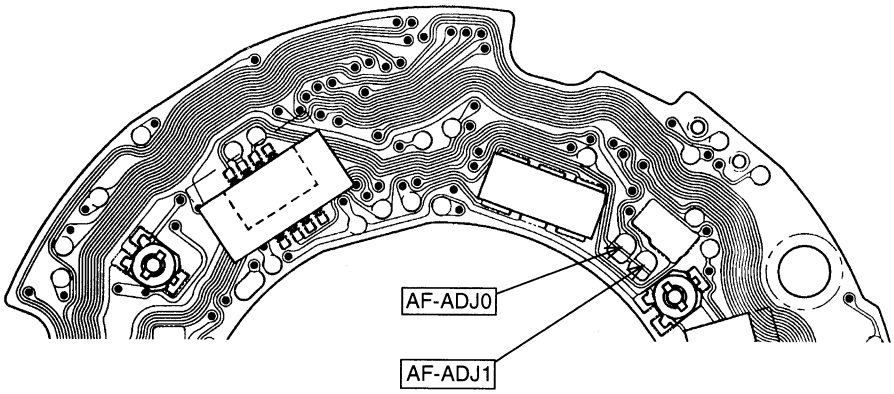


Table 3-22 AF-ADJ Points

Shooting conditions:

- Shooting distance: about 4.25 m
- Object: Three-dimensional chart, reference chart
- Aperture: AV aperture open
- Shooting method: AF shooting from infinity end (or the closest end) of each frame
- Number of shots: 5 or 6 at the same soldered bridge position

Procedure:

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

Table 3-2 AF-ADJ Correction

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

F: F No.
δ: Minimum circle of confusion

0: Closed (Soldered)
1: Open (Not soldered)

3.6 USM Reference Frequency

* This adjustment is performed when the main board unit is adjusted, but it is presented below for reference only.
* If the focus speed is different from that of other products or if abnormal sound is heard at low or high temperature, check the USM reference frequency.

Purpose: Gain the USM drive reference frequency.

Tools:

- Frequency counter
- EOS camera with aperture button (except EOS620)
- When the aperture button is pressed, a stable frequency can be measured regardless of the USM.
- If the EOS620 is used, press the EL button instead of the aperture button.
- EF lens electronic ring mount adapter (CY9-2001-004) or lens communication tool (See page 3-57 of EF75-300/4.0-5.6 IS Service Manual.)

Standard: 125.2 ± 0.2 kHz

Preparation:

1. 1. Perform steps 1 to 4 in **2.1, Main Board Unit Removal, in the Disassembly and Reassembly section.**
2. Solder a lead to each of FIN and DGND lands shown below.
3. Assemble the components, other than the back cover.
4. Install the adapter or communication tool and draw the lead from the inside.
5. Install them on the camera.

Adjustment method:

1. Connect the leads to the frequency counter.
2. Press the aperture button, and measure the frequency.
3. If it does not meet the standard, remove the lens, turn VR2, 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 frequency meets the standard.

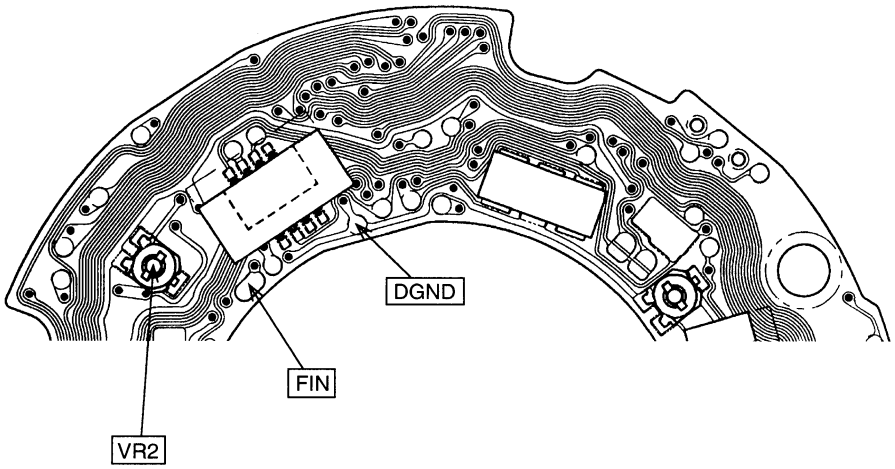


Fig. 3-23 USM Reference Frequency Adjusting Points

3.7 Zoom Brush Position Adjustment

Purpose: Read the zoom pattern accurately.

Tool: Continuity tester

Preparation: Perform the steps described in **2.3, Focus Unit Removal, in the Disassembly and Reassembly section.**

Adjustment method:

1. Set the zoom to Tele end (85 mm).
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 Screwlock to the head of the screw.

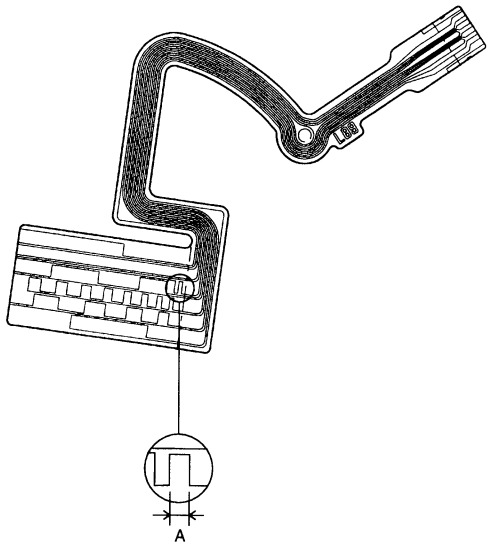


Fig. 3-24 Zoom Brush Position Adjustment Method

Part 4

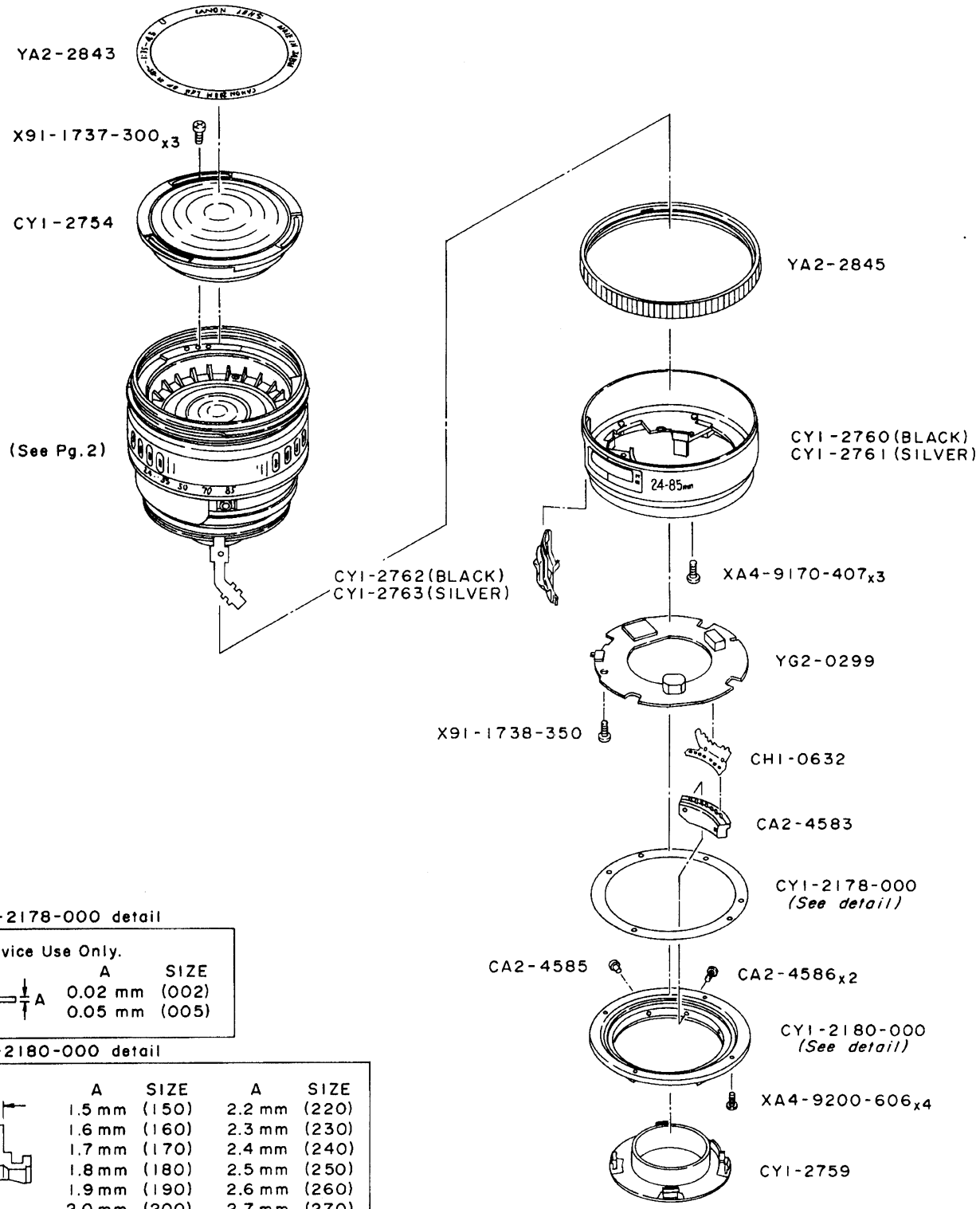
Parts Catalog

Canon

EF 24-85mm 1:3.5-4.5 USM
EF 24-85mm 1:3.5-4.5 USM MS
REF.NO.C21-9921
REF.NO.C21-9922

PARTS CATALOG

CANON LENS EF 24-85 mm 1:3.5-4.5 USM
EF 24-85 mm 1:3.5-4.5 USM MS



CY1-2178-000 detail

Service Use Only.

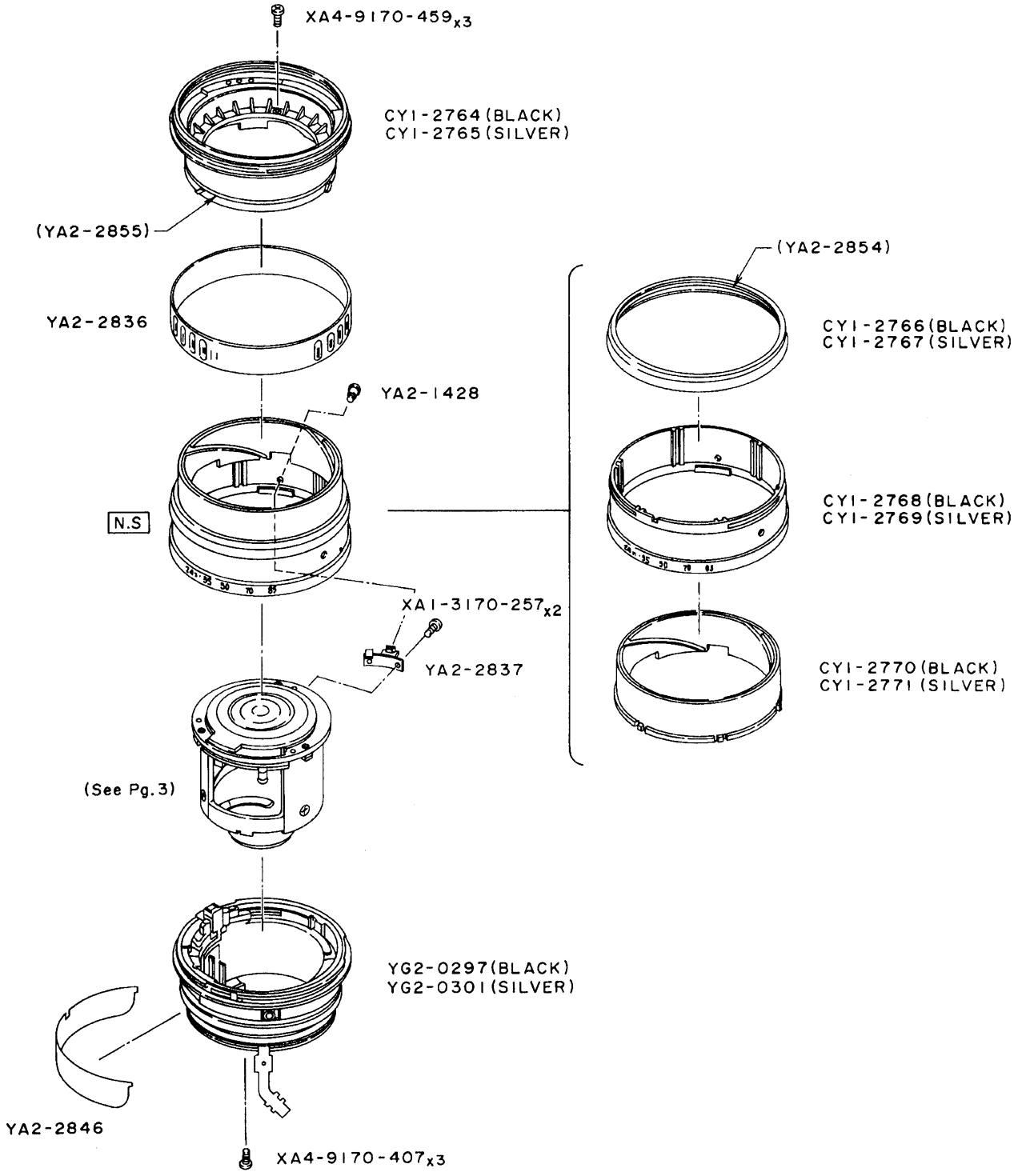
A	SIZE
0.02 mm	(002)
0.05 mm	(005)

CY1-2180-000 detail

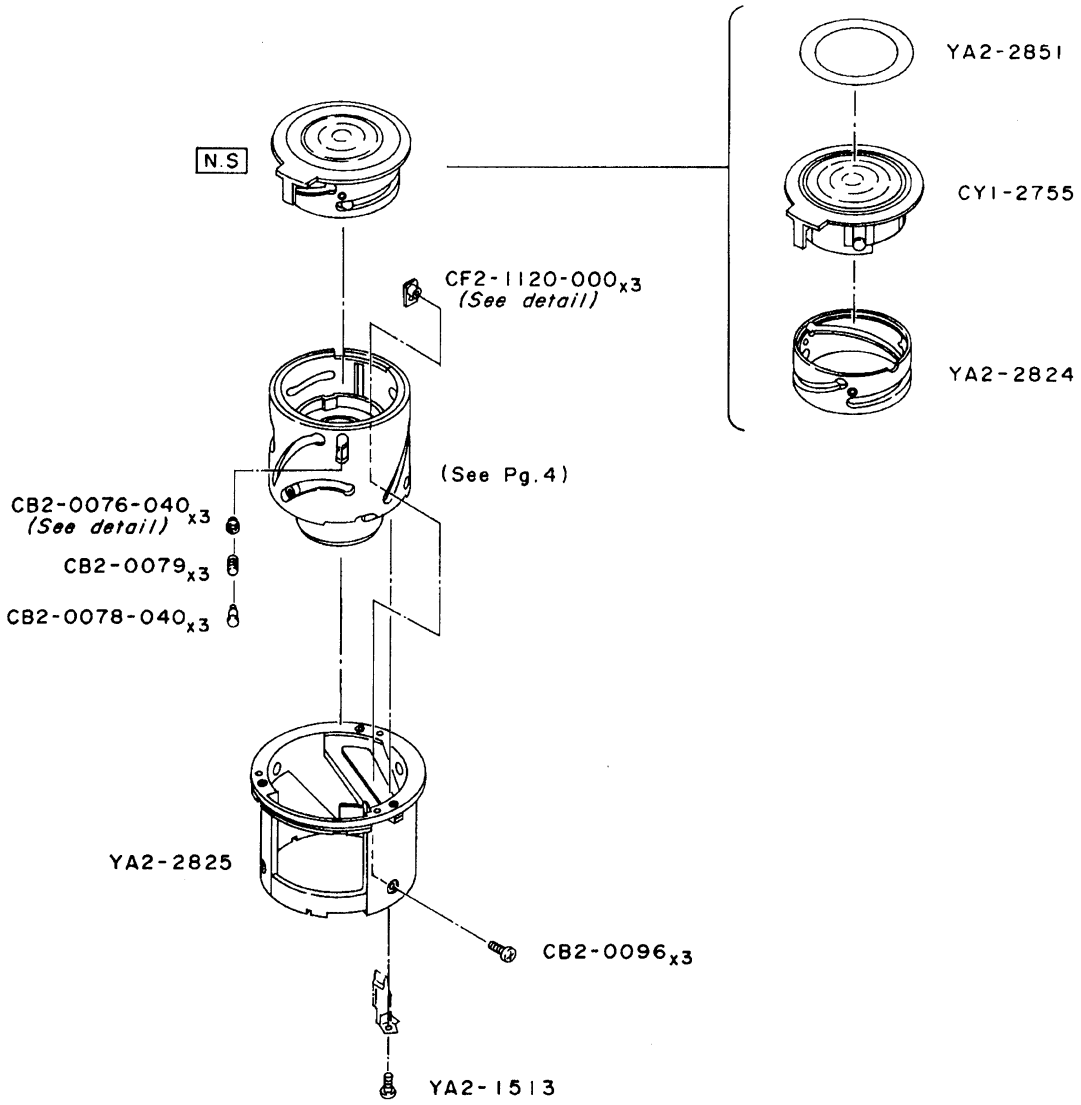
A	SIZE	A	SIZE
1.5 mm	(150)	2.2 mm	(220)
1.6 mm	(160)	2.3 mm	(230)
1.7 mm	(170)	2.4 mm	(240)
1.8 mm	(180)	2.5 mm	(250)
1.9 mm	(190)	2.6 mm	(260)
2.0 mm	(200)	2.7 mm	(270)
2.1 mm	(210)		

REF. NO. C21-9921
C21-9922

CANON LENS EF 24-85 mm 1:3.5-4.5 USM
EF 24-85 mm 1:3.5-4.5 USM MS



CANON LENS EF 24-85 mm 1:3.5-4.5 USM
EF 24-85 mm 1:3.5-4.5 USM MS



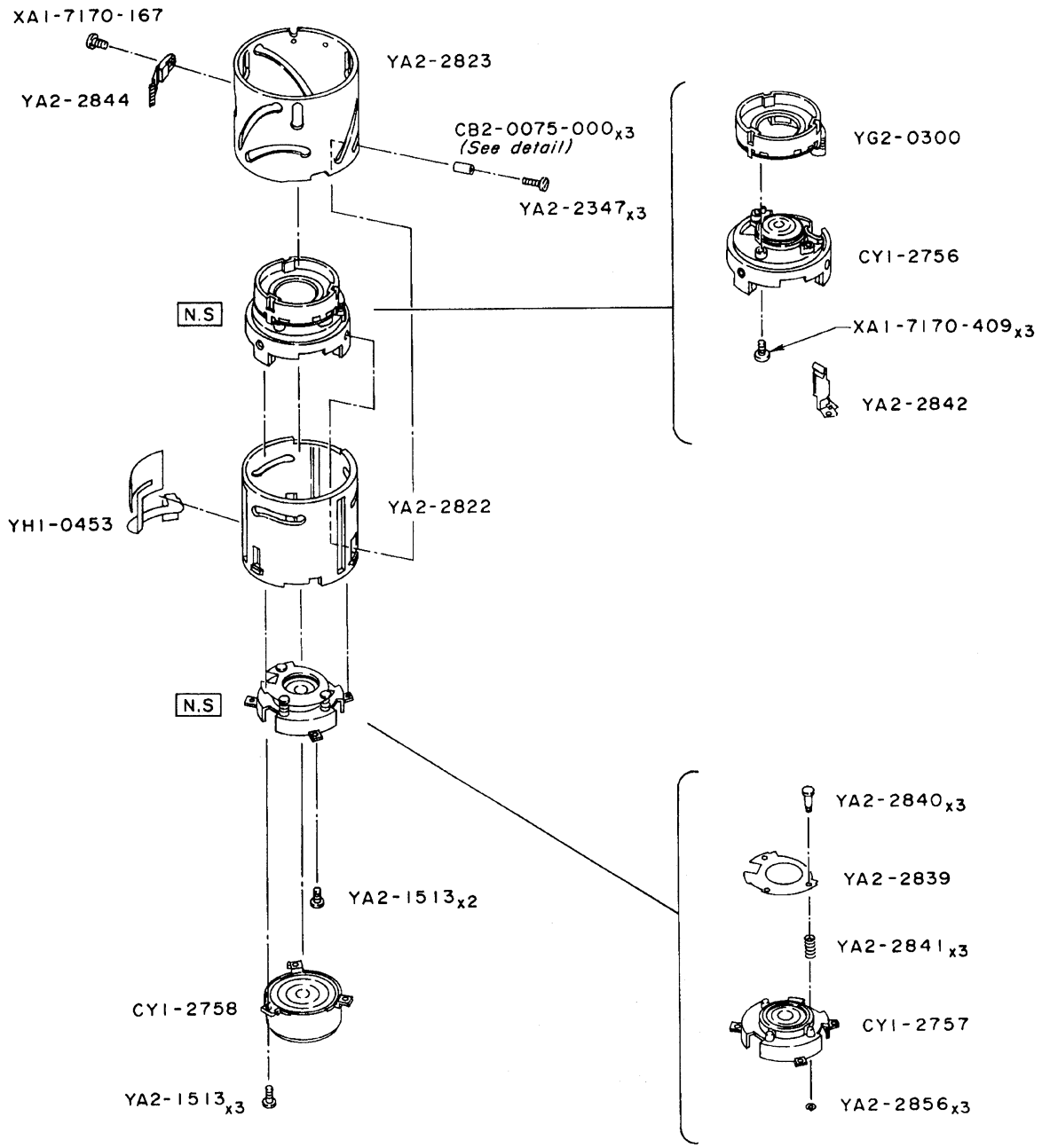
CF2-1120-000 detail

	A	SIZE
A	ø4.01 mm	(401)

CB2-0076-040 detail

	A	SIZE
A	ø3.99 mm	(399)
	ø4.00 mm	(400)

CANON LENS EF 24-85 mm 1:3.5-4.5 USM
EF 24-85 mm 1:3.5-4.5 USM MS



CB2-0075-000 detail

	A	SIZE
A	ø4.00 mm	(400)
	ø4.01 mm	(401)

PARTS LIST

REF.NO. C21-9921,2

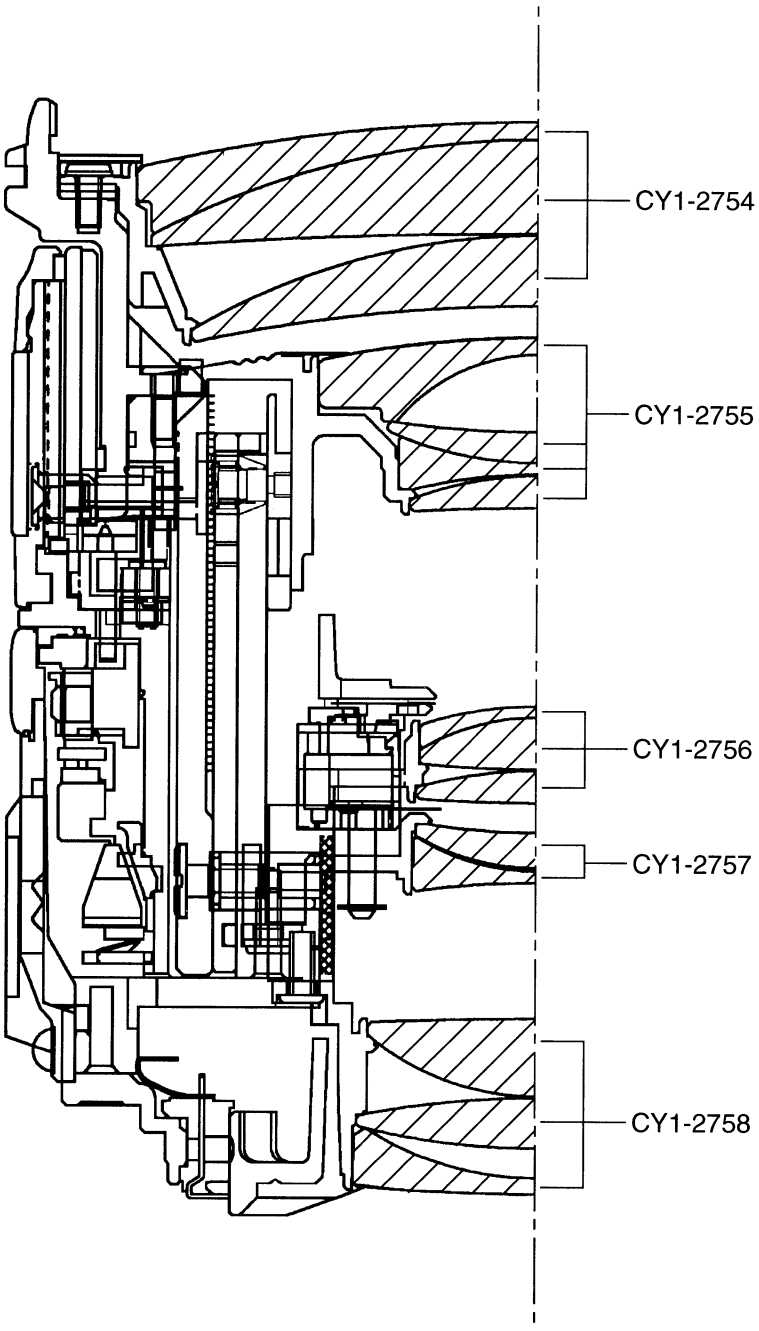
NEW	PARTS NO.	CLASS	QTY	DESCRIPTION		PAGE
	CA2-4583-000	D	1	CONTACT ASS'Y	接点ブロック	1
	CA2-4585-000	E	1	SCREW, MOUNT STOPPER	ストッパービス	1
	CA2-4586-000	E	2	SCREW	接点ブロック止めビス	1
	CB2-0075-000(XXX)	E	3	COLLAR	3群コロ	4
	CB2-0076-040(XXX)	E	3	COLLAR, TAPER	2群コロ	3
	CB2-0078-040	E	3	SCREW, STUD		3
	CB2-0079-000	E	3	SPRING, COIL	2群コロスプリング	3
	CB2-0096-000	E	3	SCREW, STUD		3
	CF2-1120-000(XXX)	E	3	KEY	直進キー	3
	CH1-0632-000	E	1	PCB ASS'Y, M-FLEX	M-FLX	1
	CY1-2178-000(XXX)	E	1	WASHER, MOUNT	マウントワッシャー	1
	CY1-2180-000(XXX)	E	1	MOUNT, LENS	レンズマウント	1
*	CY1-2754-000	E	1	LENS ASS'Y, 1st GROUP	1群鏡筒ユニット	1
*	CY1-2755-000	E	1	LENS ASS'Y, 2nd GROUP	2群鏡筒ユニット	3
*	CY1-2756-000	E	1	LENS ASS'Y, 3rd GROUP	3群鏡筒ユニット	4
*	CY1-2757-000	E	1	LENS ASS'Y, 4th GROUP	4群鏡筒ユニット	4
*	CY1-2758-000	E	1	LENS ASS'Y, 5th GROUP	5群鏡筒ユニット	4
*	CY1-2759-000	E	1	COVER, BACK	裏蓋	1
*	CY1-2760-000	D	1	BARREL ASS'Y, FIXED (BLACK)	固定筒ユニット（黒）	1
*	CY1-2761-000	D	1	BARREL ASS'Y, FIXED (SILVER)	固定筒ユニット（銀）	1
*	CY1-2762-000	D	1	A/M SWITCH ASS'Y (BLACK)	A/Mスイッチユニット（黒）	1
*	CY1-2763-000	D	1	A/M SWITCH ASS'Y (SILVER)	A/Mスイッチユニット（銀）	1
*	CY1-2764-000	D	1	RING ASS'Y, FRONT (BLACK)	フィルター枠ユニット（黒）	2
*	CY1-2765-000	D	1	RING ASS'Y, FRONT (SILVER)	フィルター枠ユニット（銀）	2
*	CY1-2766-000	D	1	RING ASS'Y, REINFORCEMENT (BLACK)	ズーム補強環ユニット（黒）	2
*	CY1-2767-000	D	1	RING ASS'Y, REINFORCEMENT (SILVER)	ズーム補強環ユニット（銀）	2
*	CY1-2768-000	D	1	RING, ZOOM (BLACK)	ズーム操作環（黒）	2
*	CY1-2769-000	D	1	RING, ZOOM (SILVER)	ズーム操作環（銀）	2
*	CY1-2770-000	D	1	BARREL, INTERMEDIATE (BLACK)	中間筒（黒）	2
*	CY1-2771-000	D	1	BARREL, INTERMEDIATE (SILVER)	中間筒（銀）	2
	X91-1737-300		3	SCREW, CROSS-RECESS, PH		1
	X91-1738-350		1	SCREW, CROSS-RECESS		1
	XA1-3170-257		2	SCREW, CROSS-RECESS, FCH		2
	XA1-7170-167		1	SCREW, CROSS-RECESS, PH		4
	XA1-7170-409		3	SCREW, CROSS-RECESS, PH		4
	XA4-9170-407		6	SCREW, CROSS-RECESS, PH		1,2
	XA4-9170-459		3	SCREW, CROSS-RECESS, PH		2
	XA4-9200-606		4	SCREW, CROSS-RECESS, PH		1
	YA2-1428-000	F	1	SCREW		2
	YA2-1513-000	F	6	SCREW, CROSS-RECESS, PH		3,4

PARTS LIST

REF.NO. C21-9921,2

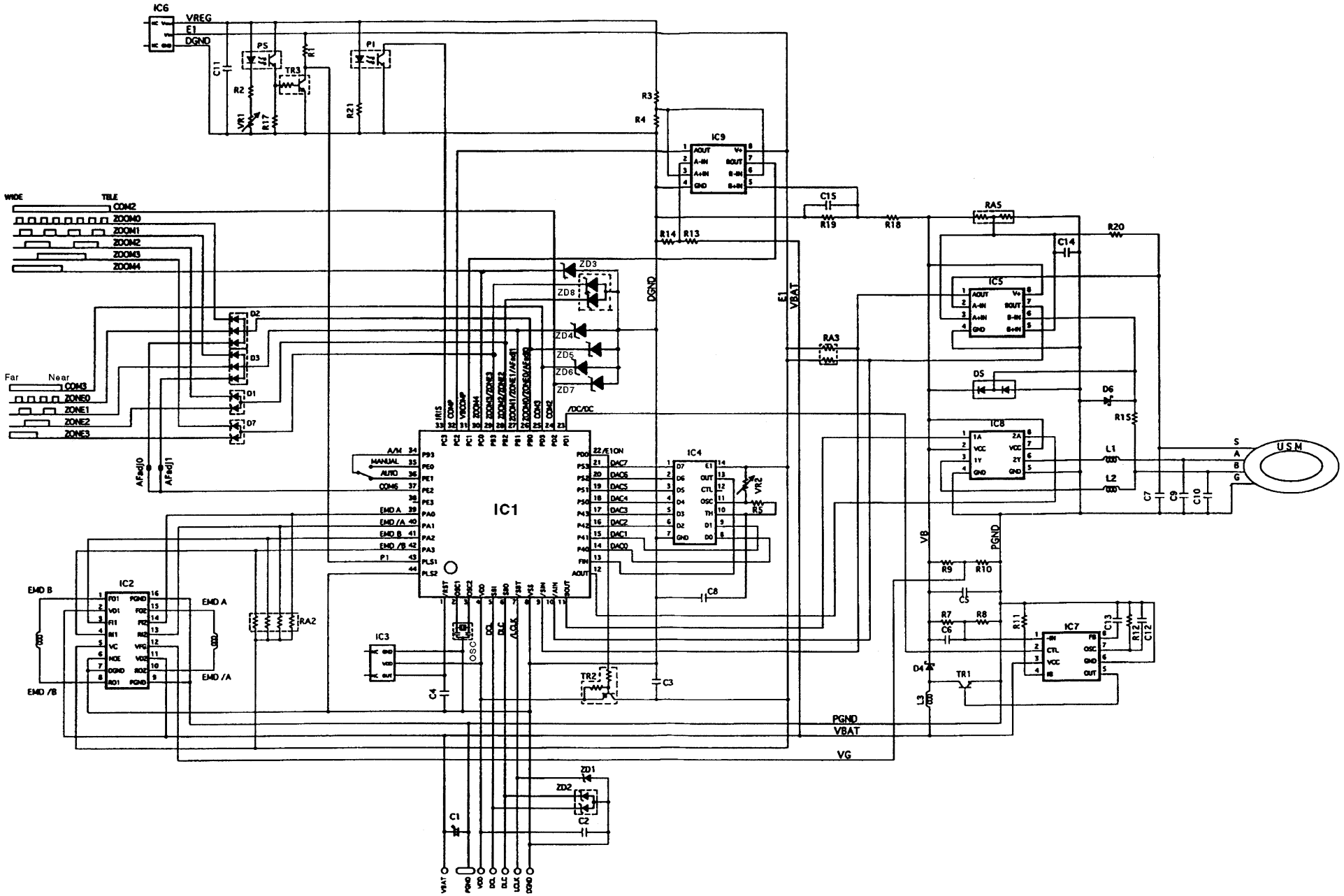
NEW	PARTS NO.	CLASS	QTY	DESCRIPTION		PAGE
	YA2-2347-000	F	3	SCREW		4
*	YA2-2822-000	E	1	BARREL, GUIDE	案内筒	4
*	YA2-2823-000	E	1	BARREL, CAM	カム筒	4
*	YA2-2824-000	E	1	BARREL, INNER CAM	インナーカム筒	3
*	YA2-2825-000	E	1	BARREL, HELICOID	直進筒	3
*	YA2-2836-000	D	1	RING, RUBBER	ズームリングゴム	2
*	YA2-2837-000	E	1	BASE, ZOOMING GUIDE	ズーム連結ブロック	2
*	YA2-2839-000	E	1	RING, FLARE	移動絞り板	4
*	YA2-2840-000	E	3	SHAFT	移動絞り軸	4
*	YA2-2841-000	E	3	SPRING, COIL	移動絞りスプリング	4
*	YA2-2842-000	E	1	HOLDER, EMD-FLX	E-FLX押さえ板	4
*	YA2-2843-000	D	1	COVER, FILTER RING	化粧環	1
*	YA2-2844-000	E	1	BRUSH, ZOOMING	ズームブラシ	4
*	YA2-2845-000	D	1	RING, MANUAL FOCUSING	マニュアル距離リング	1
*	YA2-2846-000	E	1	SCALE, FOCUSING	距離目盛シール	2
*	YA2-2851-000	D	1	RING, BLIND	G4防視板	3
*	YA2-2854-000	D	1	SHIELD, DUST 1	防塵リング1	2
*	YA2-2855-000	D	1	SHIELD, DUST 2	防塵リング2	2
*	YA2-2856-000	E	3	RING, STOPPER	移動絞りストッパー	4
*	YG2-0297-000	D	1	FOCUSING ASS'Y (BLACK)	フォーカスユニット（黒）	2
*	YG2-0299-000	E	1	PCB ASS'Y, MAIN	メイン基板ユニット	1
*	YG2-0300-000	E	1	POWER DIAPHRAGM ASS'Y	EMDユニット	4
*	YG2-0301-000	D	1	FOCUSING ASS'Y (SILVER)	フォーカスユニット（銀）	2
*	YH1-0453-000	E	1	FPC, ZOOM	Z-FLX	4

CANON LENS EF 24-85mm 1:3.5-4.5 USM
EF 24-85mm 1:3.5-4.5 USM MS



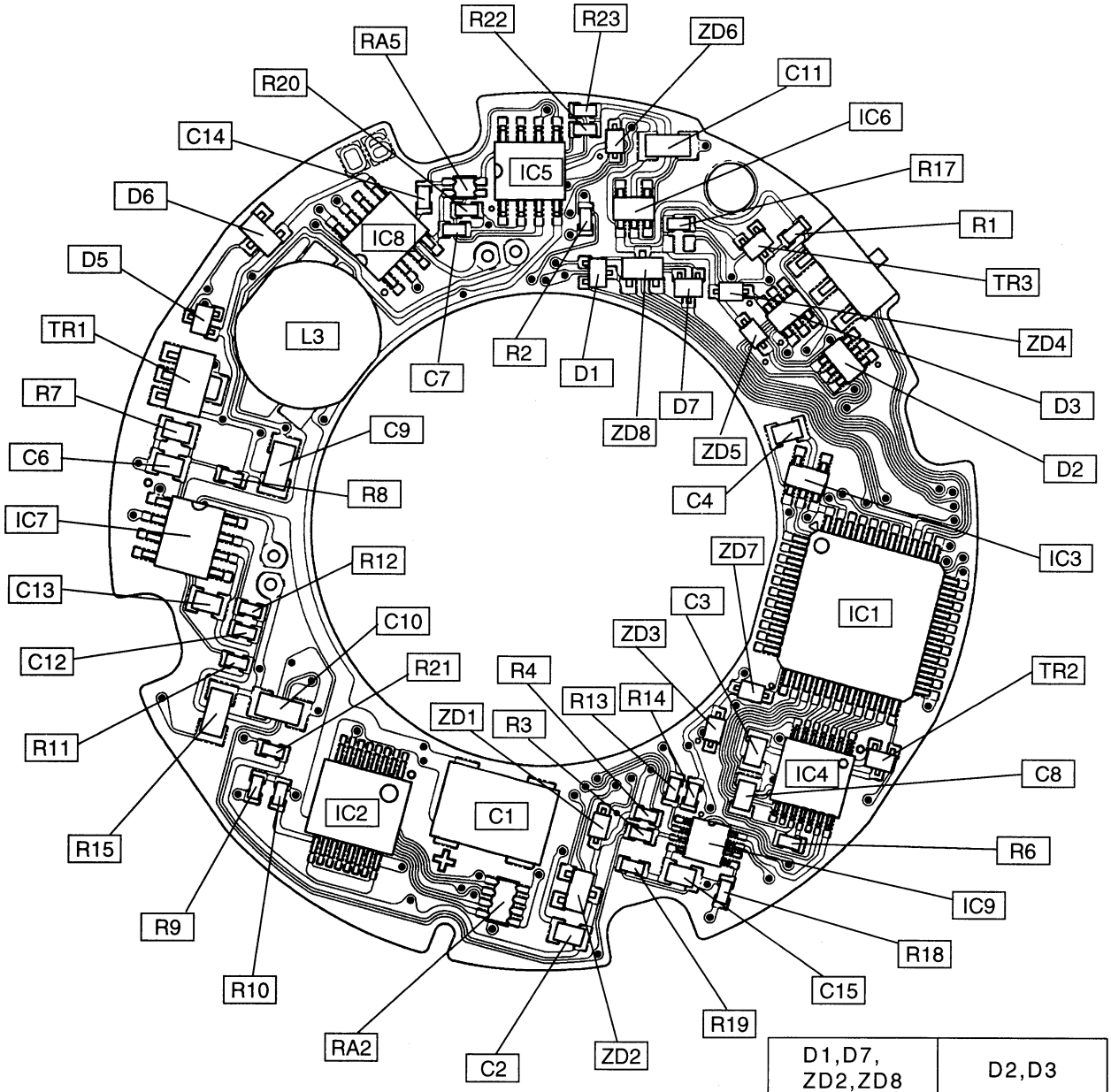
Part 5

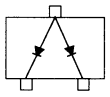
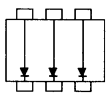
Electrical Diagrams

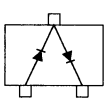
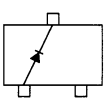
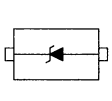
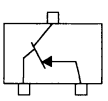

IC6
VREG
E1
DGND
PS
PI
TR3
R1
R2
R21
C11
VR1
R17
R3
R4
IC9
C15
R19
R18
RA5
R20
C14
R14
R13
IC5
WIDE
TELE
COM2
ZOOM0
ZOOM1
ZOOM2
ZOOM3
ZOOM4
ZD3
ZD8
ZD4
ZD5
ZD6
ZD7
DGND
E1
VBAT
RA3
D2
D3
D1
D7
Far
Near
COM3
ZONE0
ZONE1
ZONE2
ZONE3
AFadj0
AFadj1
/DC/DC
IC1
IC4
VR2
R5
D5
D6
R15
IC8
L1
L2
S
A
B
G
USM
C7
C9
C10
C8
VB
PGND
R9
R10
C5
R7
R8
C6
R11
IC7
C13
R12
C12
D4
TR1
L3
EMD B
EMD A
EMD /B
EMD /A
IC2
RA2
IC3
OSC
C4
TR2
C3
PGND
VBAT
VG
ZD1
ZD2
C2
C1
VBAT
PGND
VDD
SCL
DLC
LOCK
DGND

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

EF 24-85mm f/3.5-4.5 ULTRASONIC
REF. NO. C21-9921



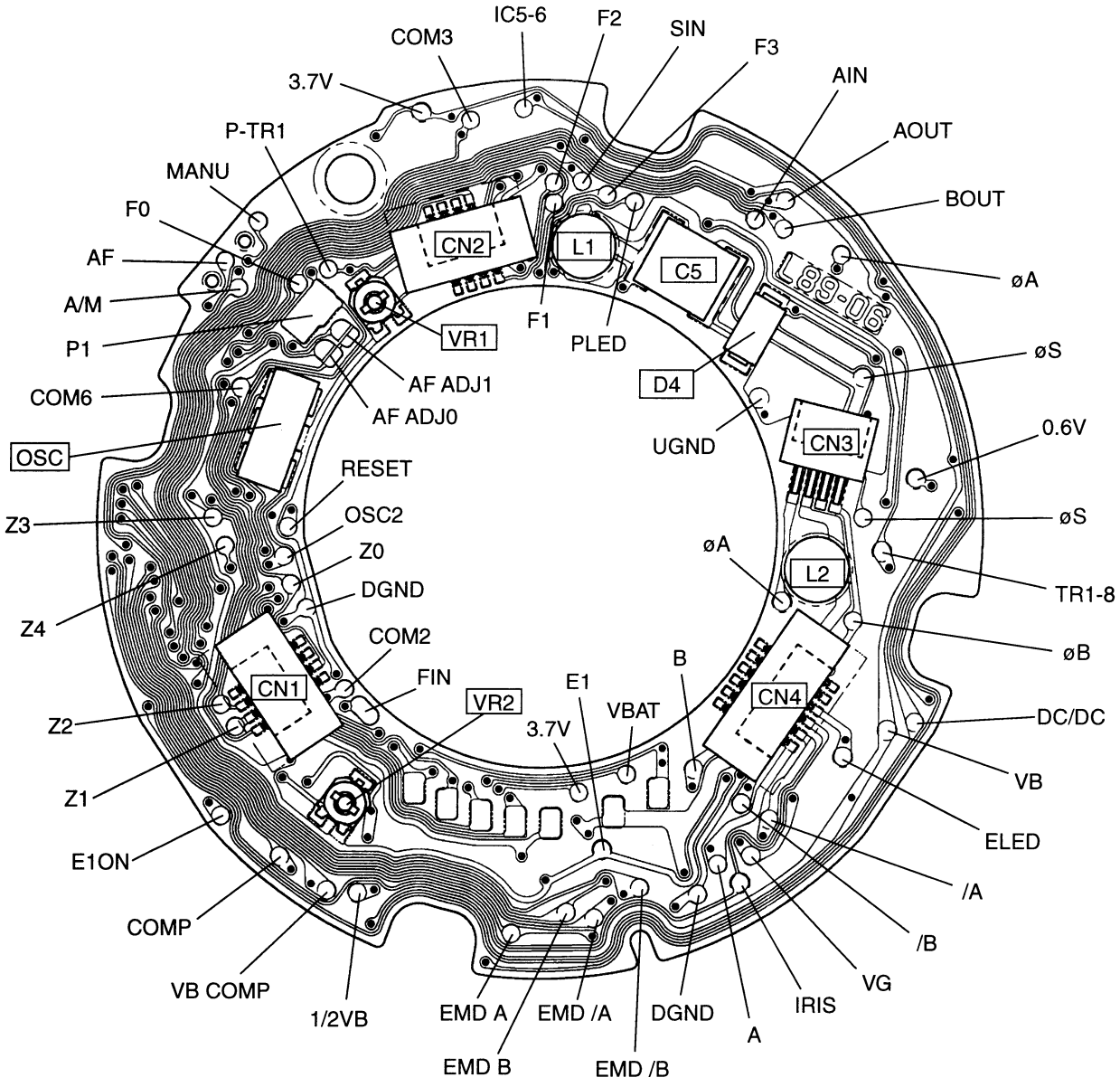
D1,D7, ZD2,ZD8	D2,D3
	

D5	D6	ZD1,ZD3,ZD4, ZD5,ZD6,ZD7	TR2
			

01 OCT., 1996

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

EF 24-85mm f/3.5-4.5 ULTRASONIC
REF. NO. C21-9921



01 OCT., 1996