Canon

Service Manual

ENGLISH EDITION

EF 28-135mm 1:3.5-5.6 IS C21-9931 (ULTRASONIC)

CY8-1200-173

Canon

EF 28-135mm 1:3.5-5.6 IS USM

REF.NO.C21-9931

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.

Part 4 Parts Catalog

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Part 4: Parts Catalog

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Part 1

General Information

1. DEVELOPMENT OBJECTIVES

The EF 28-135mm f/3.5-5.6 IS USM is Canon's third lens to feature an Image Stabilizer.
While the previous two IS lenses were telephotos, this is the first standard zoom lens to have an Image Stabilizer. With this lens, even more picture-taking situations can benefit from the Image Stabilizer technology. Despite a high 5× zoom ratio, the lens is still light and compact. This can be attributed to the newly developed, compact image stabilizer unit and a compact optical system with multiple moving groups.

2. FEATURES

- Standard zoom lens with Image Stabilizer.
- Approx. 5× zoom ratio (28-135mm).
- The Image Stabilizer gives the equivalent effect of a shutter speed two stops faster.
- G14 is a molded glass (GMo) aspherical lens to give high image quality throughout the focal length range.
- Ring USM for silent AF.
- Manual focusing possible in the AF mode (full-time mechanical manual focusing).
- With inner focusing, the front of the lens does not rotate during focusing. A polarizing filter therefore need not be readjusted after focusing.
- Wide, rubber zoom ring for easy rotation.
- Dedicated Scalloped EW-78B hood effective at wide focal lengths.

3. SPECIFICATIONS

1. Format — 24 mm × 36 mm

2. Focal Length and Aperture — 28-135mm *f*/3.5-5.6

3. Optical Construction
   - 3-1 Lens construction — 16 elements in 12 groups (GMo aspherical lens: G14; R2 is aspherical)
   - 3-2 Coating — Super Spectra coating

4. Angle of View at Infinity

Diagonal (43.2 mm)	75°—18°
Vertical (24 mm)	46°—10°
Horizontal (36 mm)	65°—15°

5. AF Feature
   - 5-1 Drive system — Ring USM
   - 5-2 Drive speed — H/0.30 to L/1.00 sec. or shorter (from infinity to min. focusing distance)
   - 5-3 Drive noise — 40 dB or lower (Based on Canon's measuring standards.)
   - 5-4 Manual focusing — Enabled with focus mode switch and focusing ring (full-time mechanical manual focusing provided).

6. Focusing
   - 6-1 Extension mechanism — Inner focusing with focus cam
   - 6-2 Macro feature — None
   - 6-3 Focusing range — 0.5 m to infinity
   - 6-4 Rotating angle — 55.5°
   - 6-5 Distance scale — (MACRO: Yellow, ft: Green)

(m: Metallic gray)

   - 6-6 Maximum magnification and picture field

Min. focusing distance	Magnification (×)		Picture field(mm)	
	WIDE	TELE	WIDE	TELE
0.5 m/1.75 ft	0.07	0.19	355 × 551	125 × 188

7. Zoom Feature	
7-1 Type	6-group helical zoom (rotational angle: 60°) Front group moves.
7-2 Focal length scale	28 35 50 70 100 135
8. Mount	
8-1 Type	Canon EF mount
8-2 Signal transmission	5 items of EOS-dedicated information (absolute distance information included): (1) Lens mode (2) Lens type (3) Metering information (4) Focal length (5) AF drive information
9. Aperture Mechanism	
9-1 Aperture control	Pulse control with EMD (enabled simultaneously during autofocusing)
9-2 Aperture setting and markings	Max. aperture: *f*/3.5-5.6 (marked on lens barrel), Min. aperture: *f*/22-36 (also applicable to cameras with 1/3-stop intervals)
9-3 Aperture blades	6
9-4 Depth-of-field scale	None
9-5 Infrared mark	Provided
10. Filter Size	72 mm, P = 0.75 mm (1 filter attachable)
11. Dimensions and Weight	96.8 dia. × 78.4 mm, 540 g
12. Accessories	
12-1 Hood	EW-78B (Dedicated Scalloped, two-lug bayonet hood, attachable in reverse)
12-2 Lens cap	E-72U
12-3 Lens case	Soft case: LP1116 Hard case: None (Accommodates the lens with one filter, both lens caps, and hood attached reversed.)
12-4 Rear lens cap	Len Dust Cap E

13. Miscellaneous

13-1	Usable extenders	None
13-2	Extension Tube EF 12	Compatible
13-2	Extension Tube EF 25	Compatible

Setting		Min. focusing distance (mm)		Magnification (×)		Picture field (mm)	
EF12	Near distance	180	336	0.53	0.37	45 × 68	66 × 99
	Far distance	196	1624	0.42	0.09	57 × 85	255 × 383
EF25	Near distance	169	280	1.09	0.58	22 × 33	42 × 62
	Far distance	174	876	0.94	0.21	26 × 38	115 × 173

14. Image Stabilizer

14-1	Image stabilizer mechanism	Parallel shifting of Image Stabilizer lens group
14-2	Max. eccentricity	±1.0mm
14-3	Max. correctable angle	±0.65° (At infinity)
14-4	Shake detection	Via gyro sensors (1 sensor each for yaw and pitch)
14-5	Image stabilizer activation	Turned on with the IS ON/OFF sliding switch and activated by pressing the shutter button halfway.
14-6	Centering/locking	While the Image Stabilizer is unused, the image-stabilizing lens group is centered and locked in position.
14-7	Mode Selection	None

4. EXTERNAL DIMENSION/CROSS SECTION

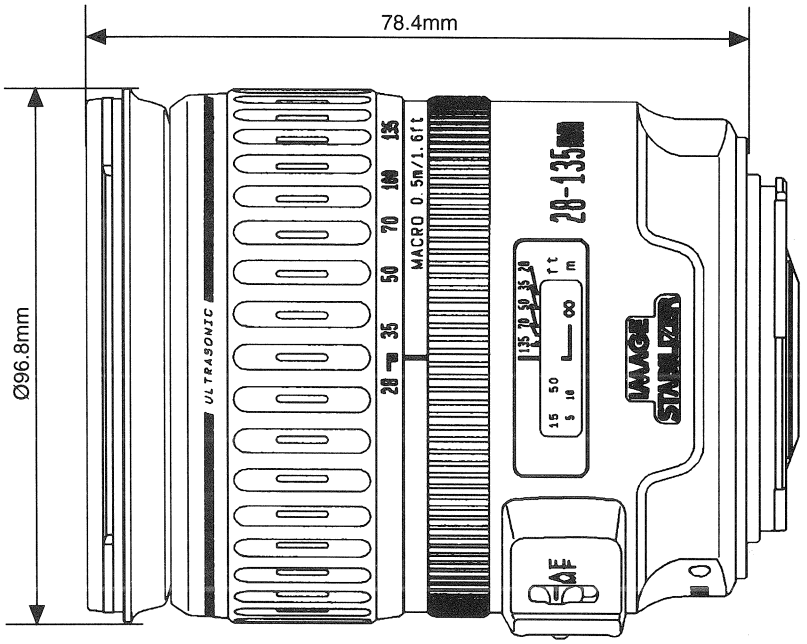


Fig. 1-1 External Dimension

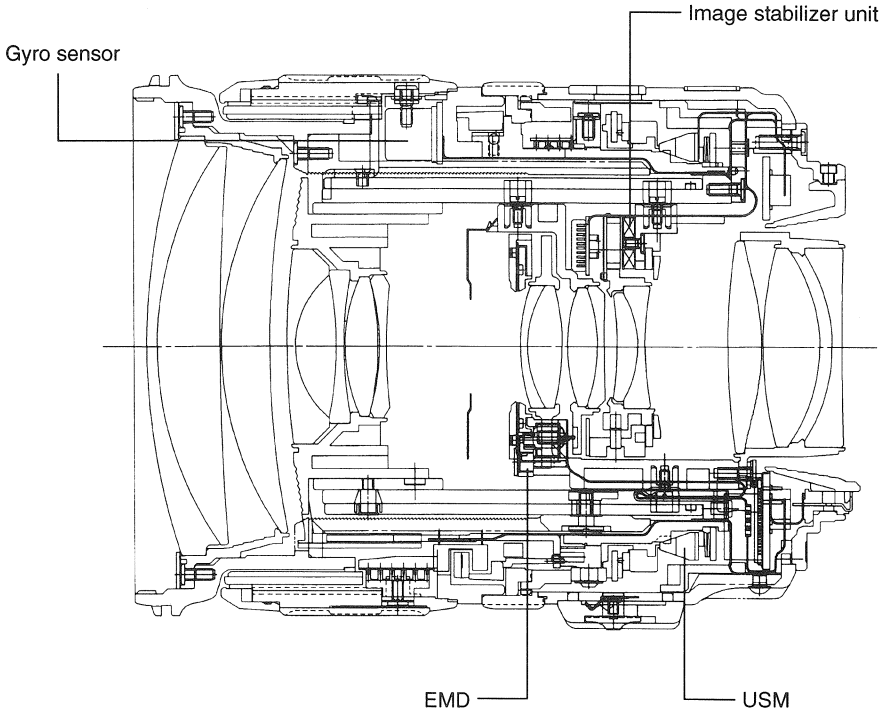


Fig. 1-2 Cross Section

5. EXTERIOR DESIGN

The EF 28-135mm f/3.5-5.6 IS USM lens's basic shape is based on the EF 24-85mm f/3.5-4.5 USM lens' design concept. It is distinguishable with the metallic "IMAGE STABILIZER" logo on the rear of the barrel to identify it as an IS lens and to give it a luxury touch.
Also, the IS switch slides in parallel with the optical axis (like the EF 300mm f/4L USM lens).

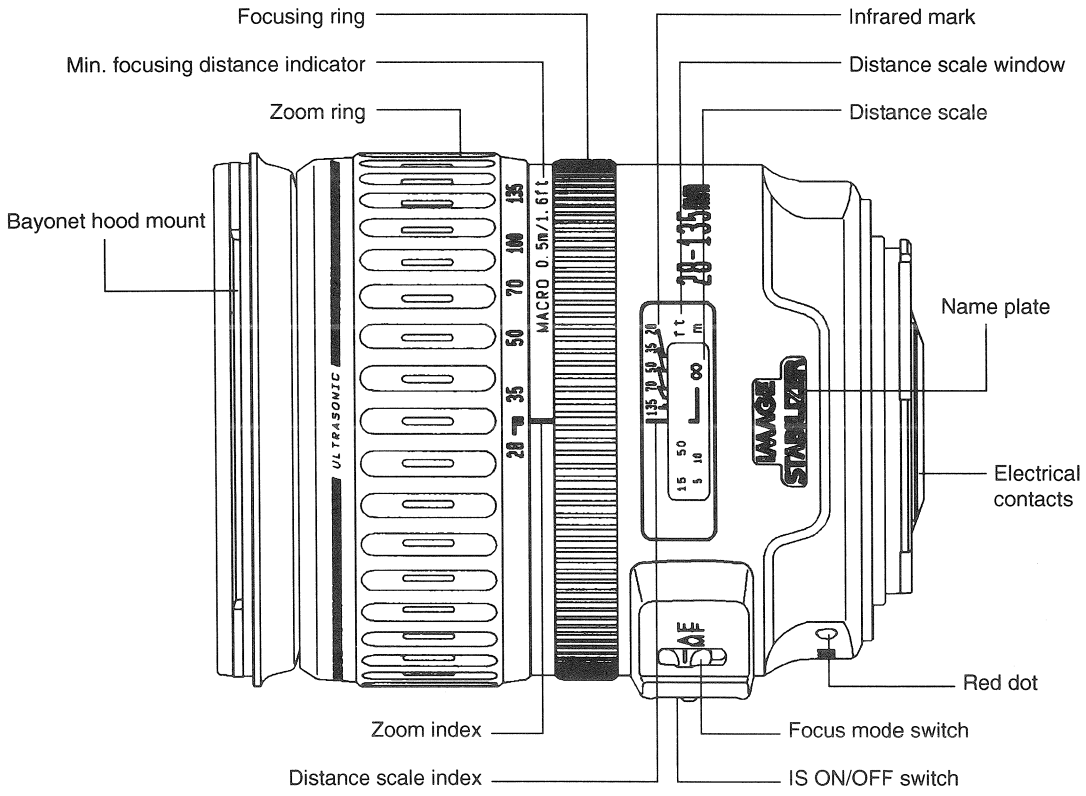


Fig. 1-3 Nomenclature

6. CAUTIONS

6.1 During Normal Use

- If the lens is used with the camera's built-in flash, flash vignetting will occur in the 28-50mm focal length range. Therefore, an external flash should be used.

- If this lens is used with the EOS Rebel II / 1000N, under low light levels the AF search may cease to function before focus is achieved. To restart, turn SW1 on again.

6.2 During Image Stabilizer Operation

- When the camera is mounted on a tripod, do not turn on the Image Stabilizer. If the Image Stabilizer is on while the camera is on a tripod, the gyro sensor output's offset during slow shutter speeds may cause Image Stabilizer misoperation. Also, at medium or fast shutter speeds, camera shake while the camera is on a tripod may cause Image Stabilizer misoperation.

- Note that after the IS ON/OFF switch is turned on, it takes about one second before the Image Stabilizer starts operating. Therefore, before pressing the shutter button, look through the viewfinder and check that the image shake is being corrected.

- After a shot is taken, the image in the viewfinder may shake a lot. This has no effect on the picture taken.

- While the camera's built-in flash recharges immediately after the flash fires, the image in the viewfinder may shake depending on the camera model. This has no effect on the picture.

- Do not use the Image Stabilizer during bulb exposures. (During bulb exposures with certain cameras, effective Image Stabilizer effects will not be attained or the Image Stabilizer will not function.)

- The Image Stabilizer will not operate with the lens mounted on the EF-M camera. Although it has the EF mount, the EF-M camera is a manual focus camera so it does not generate the signal which is necessary to activate the IS circuitry.

- With the EOS 50E/Elan II (E)/IX, the Image Stabilizer does not work with the self-timer. (The camera system turns off the Image Stabilizer if the self-timer is used.)

- If the lens is detached while the Image Stabilizer is operating, the image-stabilizing lens group will not be locked. Therefore, the lens will rattle if shaken. This does not indicate a malfunction and it will not cause any problem. However, to eliminate the rattle, re-attach the lens to the camera to lock the image-stabilizing lens group. With some cameras, the main switch must also be turned on after the lens in attached.

Part 2

Technical Information

1. COMPONENTS AND FUNCTIONS

Symbol	Spec./Mgf. #	Function
IC1	HD6433031SV06X	Overall lens control
IC2	BH2203KV	Lens control
IC3	LB1836M	EMD drive
IC4	MB3864PNF	USM drive
IC5	XC62AP4002MR	VD1 (4 V) output
IC6	S-29130AFJA	Lens adjustment data setting
IC7	NJM062V	Shift system position output amplification
IC8	MPC1731VM	Shift system drive
IC9	LB1837M	Mechanical lock drive
IC10	XC62SPR452MR	VD3 (4.5 V) output
IC11	S-80727SN-DQ-T1	Reset control
IC12	TC7S08FU	Voltage step-up circuit control
PS	P4035	Focus pulse detection
PI	RPI-121	Maximum aperture detection
PR1	TLP910	Shift system position detection
PR2	TLP910	Shift system position detection
CF	FAR-C4CG 8MHz	Microcomputer system clock supply
Q1	2SK2788VY	Voltage step-up circuit control
Q2	2SA1745	VD3 input power control
Q3	FP1J3P	VD2 output control
Q4	2SK1824	Camera communication busy control
D1	MA736	USM DC/DC rectification
D2	MA724	Shift system drive IC8 protection
D3	MA724	Shift system drive IC8 protection
D4	RB706F-40	USM S phase detection protection
ZD1	UDZ7.5B	LCLK pin protection
ZD2	UDZ7.5B	DLC pin protection
ZD3	UDZ7.5B	DCL pin protection
L1	12μH	USM voltage step-up drive
L2	1.5mH	USM drive
L3	1.5mH	USM drive

Symbol	Spec./Mgf. #	Function
C1	22µF/10V	VBAT filter
C2	1.5µF/50V	VB filter
C3	3.3µF/10V	VDD filter
C4	6.8µF/7V	VD1 filter
C5	1.0µF/10V	VD2 filter
C6	0.1µF/16V	VD3 filter
C7	0.1µF/16V	IC1 power filter
C8	0.1µF/16V	IC1 power filter
C9	0.1µF/16V	IC2 power filter
C10	0.1µF/16V	Low-voltage detection delay
C11	150pF/50V	USM DC/DC output stabilization
C12	680pF/50V	USM DC/DC oscillation frequency setting
C13	0.047µF/16V	USM DC/DC phase compensation setting
C14	3300pF/50V	USM B phase input
C15	0.01µF/50V	USM S phase bias voltage noise elimination
C16	3900pF/200V	USM B phase bias voltage noise elimination
C17	3900pF/200V	USM A phase bias voltage noise elimination
C18	330pF/50V	USM VCO frequency setting
C19	0.22µF/16V	Gyro-sensor power filter
C20	4.7µF/4V	Gyro-sensor reference voltage filter
C21	4.7µF/4V	Gyro-sensor reference voltage filter
C22	22µF/4V	Gyro-sensor output high-pass setting
C23	22µF/4V	Gyro-sensor output high-pass setting
C24	22µF/4V	Gyro-sensor output high-pass setting
C25	22µF/4V	Gyro-sensor output high-pass setting
C26	3300pF/50V	Gyro-sensor output low-pass setting
C27	3300pF/50V	Gyro-sensor output low-pass setting
C28	4700pF/50V	Gyro-sensor output low-pass setting
C29	4700pF/50V	Gyro-sensor output low-pass setting
C30	0.1µF/16V	Shift system position detection power filter
C33	0.022µF/25V	Shift system position detection output low-pass setting
C34	0.022µF/25V	Shift system position detection output low-pass setting
C35	0.022µF/25V	Shift system position detection output low-pass setting
C36	0.022µF/25V	Shift system position detection output low-pass setting
C37	0.022µF/25V	Shift system driver step-up voltage setting
C38	0.022µF/25V	Shift system driver step-up voltage setting
C39	0.022µF/25V	Shift system driver step-up voltage setting

Symbol	Spec./Mgf. #	Function
C40	0.1μF/16V	VBAT (IC8) filter
C41	0.047μF/16V	VB detection voltage filter
C42	0.1μF/16V	VD2 (IC8) filter
C43	100pF/50V	Voltage step-up circuit oscillation
C44	0.1μF/16V	VDD (IC2) filter
C45	0.047μF/16V	VBAT detection voltage filter
C46	0.1μF/16V	VC (IC2) filter
C47	0.1μF/16V	VD1-DGND (IC1) filter
C48	0.1μF/16V	VDD-PGND (IC2) filter
C50	0.01μF/50V	Phase detection reference voltage filter
C51	1200pF/50V	Pulse detection low-pass setting
C52	3300pF/50V	USM B phase
C53	0.1μF/16V	IC12 power filter
C54	0.01μF/50V	Shift system position detection output low-pass setting
C55	0.01μF/50V	Shift system position detection output low-pass setting
C56	0.01μF/50V	Shift system position detection output low-pass setting
C57	0.01μF/50V	Shift system position detection output low-pass setting
C58	0.22μF/25V	Voltage step-up circuit operation delay
C59	1μF/16V	VD2 (IC2) filter
JP1		Eliminated when IC12 and C53 are added
JP2		Eliminated when IC10 is added
GR1	CG-16CL0	Movement detection
GR2	CG-16CL1	Movement detection
R1	39kΩ/0.1W	USM voltage step-up circuit voltage setting
R2	1.8kΩ/0.063W	USM voltage step-up circuit voltage setting
R3	7.5kΩ/0.063W	USM voltage step-up circuit phase compensation setting
R4	430kΩ/0.125W	USM B phase detection voltage setting
R5	10kΩ/0.063W	USM B phase detection voltage setting
R6	27kΩ/0.063W	VB detection voltage setting
R7	2kΩ/0.063W	VB detection voltage setting
R8	7.5kΩ/0.063W	USM VCO frequency setting
R9	9.1kΩ/0.063W	USM VCO frequency setting
R10	51kΩ/0.063W	EEPROM-CS control pulldown

Symbol	Spec./Mgf. #	Function
R11	51kΩ/0.063W	EEPROM-DATA control pull-up
R12	51kΩ/0.063W	Busy control pulldown
R13	30kΩ/0.063W	Shift system position detection reference voltage setting
R14	30kΩ/0.063W	Shift system position detection reference voltage setting
R15	1kΩ/0.063W	Gryo output high-pass setting
R16	1kΩ/0.063W	Gryo output high-pass setting
R17	680kΩ/0.063W	Gryo output high-pass setting
R18	680kΩ/0.063W	Gryo output high-pass setting
R19	7.5kΩ/0.063W	Shift system position detection output low-pass setting
R20	7.5kΩ/0.063W	Shift system position detection output low-pass setting
R21	7.5kΩ/0.063W	Shift system position detection output low-pass setting
R22	7.5kΩ/0.063W	Shift system position detection output low-pass setting
R23	100kΩ/0.063W	Shift system position detection output amplification setting
R24	100kΩ/0.063W	Shift system position detection output amplification setting
R25	11kΩ/0.063W	Shift system position detection reference voltage setting
R26	24kΩ/0.063W	Shift system position detection reference voltage setting
R27	1MΩ/0.063W	Shift system driver step-up voltage limiting
R28	56kΩ/0.063W	Mechanical lock driver constant voltage setting
R29	24kΩ/0.063W	Mechanical lock driver constant voltage setting
R30	51kΩ/0.063W	AF/MF switch pull-up
R31	51kΩ/0.063W	Reset output pull-up
R32	30kΩ/0.063W	VBAT detection voltage setting
R33	30kΩ/0.063W	VBAT detection voltage setting
R34	120kΩ/0.063W	Voltage step-up circuit oscillation
R35	56kΩ/0.063W	Open switch detection current setting
R36	1kΩ/0.063W	Pulse detection low-pass setting
R37	7.5kΩ/0.063W	Shift system position detection output low-pass setting
R38	7.5kΩ/0.063W	Shift system position detection output low-pass setting
R39	7.5kΩ/0.063W	Shift system position detection output low-pass setting
R40	7.5kΩ/0.063W	Shift system position detection output low-pass setting
R41	2kΩ/0.063W	Voltage step-up circuit operation delay
R42	10kΩ/0.063W	Low-voltage detection delay
R43	120kΩ/0.063W	Voltage step-up circuit gate control detection voltage setting
R44	200kΩ/0.063W	Voltage step-up circuit gate control detection voltage setting

2. IC PIN TABLE

IC1

No.	Symbol	I/O	A/D	Voltage	Function
1	PB0	O	D	0/4V	USM DC/DC control
2	TIOCB3	I	D	0/4V	Focus pulse signal input
3	TIOCA4	I	D	0/4V	USM B phase pulse input
4	TIOCB4	I	D	0/4V	USM S phase pulse input
5	TP12	O	D	0/4V	EMD A phase forward direction drive control
6	TP13	O	D	0/4V	EMD A phase reverse direction drive control
7	TP14	O	D	0/4V	EMD B phase forward direction drive control
8	TP15	O	D	0/4V	EMD B phase reverse direction drive control
9	TXD	O	D	0/4V	DLC transmission data output
10	RXD	I	D	0/4V	DCL reception data input
11	SCK	I	D	0/4V	LCLK input
12	VSS			0	Logic power supply (–)
13	MANU	O	D	0/4V	AF/MF change switch control
14	AUTO	O	D	0/4V	AF/MF change switch control
15	P32	O	D	0/4V	Shift system (yaw) position detection switching control
16	P33	O	D	0/4V	Shift system (pitch) position detection switching control
17	P34	O	D	0/4V	Gyro high-pass filter time constant switching control
18	P35	O	D	0/4V	VD2 power control
19	P36	O	D	0/4V	Camera communication busy control
20	P37	O	D	0/4V	Camera communication busy/IC2 disable control
21	VCC			4V	Logic power supply (+)
22	P10	O	D	0/4V	IC2 serial communication control (CS)
23	P11	O	D	0/4V	IC2 serial communication control (CLK)
24	P12	O	D	0/4V	IC2 serial communication control (DATA)
25	P13	O	D	0V	Unused
26	P14	O	D	0V	Unused
27	P15	O	D	0V	Unused
28	P16	O	D	0V	Unused
29	P17	O	D	0/4V	Focusing ring/zoom/IS switch detection common
30	VSS			0	Logic power supply (–)
31	P20	I	D	0/4V	Zoom position detection
32	P21	I	D	0/4V	Zoom position detection
33	P22	I	D	0/4V	Zoom position detection
34	P23	I	D	0/4V	Zoom position detection
35	P24	I	D	0/4V	Zoom position detection
36	P25	I	D	4V	Unused
37	P26	I	D	0/4V	IS ON/OFF change switch detection
38	P27	I	D	4V	Unused
39	P50	I	D	0/4V	Focusing ring position detection

No.	Symbol	I/O	A/D	Voltage	Function
40	P51	I	D	0/4V	Focusing ring position detection
41	P52	I	D	0/4V	Focusing ring position detection
42	P53	I	D	0/4V	Focusing ring position detection
43	P60	I	D	0/4V	EEPROM data input
44	MD0	I	D	0V	Microcomputer operation mode setting
45	MD1	I	D	4V	Microcomputer operation mode setting
46	Φ	O	D	0/4V	Microcomputer system clock output
47	/STBY	I	D	4V	Standby control input
48	/RES	I	D	0/4V	Reset input
49	NMI	I	D	4V	Interrupt input
50	VSS			0V	Logic power supply (–)
51	EXTAL	I			Oscillator input
52	XTAL	I			Oscillator input
53	VCC			4V	Logic power supply (+)
54	P63	O	D	0/4V	EEPROM data output
55	P64	O	D	0/4V	EEPROM SK control
56	P65	O	D	0/4V	EEPROM CS control
57	/RES0	O	D	0/4V	Reset output
58	AVSS			0V	A/D signal power supply
59	GYROY	I	A	0-4V	Gryo (yaw) A/D conversion input
60	SHIFTY	I	A	0-4V	Shift system (yaw) center A/D conversion input
61	SHIFTYE	I	A	0-4V	Shift system (yaw) end A/D conversion input
62	VBATH	I	A	0-4V	VBAT A/D conversion input
63	GYROP	I	A	0-4V	Gyro (pitch) A/D conversion input
64	SHIFTP	I	A	0-4V	Shift system (pitch) center conversion input
65	SHIFTPE	I	A	0-4V	Shift system (pitch) end conversion input
66	VBH	I	A	0-4V	VB A/D conversion input
67	AVCC			4V	A/D signal power supply (+)
68	Vref	I	A	4V	A/D reference power supply (+)
69	/IRQ0	I	D	0/4V	AF/MANU change switch input
70	/IRQ1	I	D	0/4V	LCLK input
71	P82	I	D	4V	Unused
72	P83	I	D	0/4V	Maximum aperture signal detection
73	TP0	O	D	0/4V	Mechanical lock/unlock A phase forward direction drive control
74	TP1	O	D	0/4V	Mechanical lock/unlock A phase reverse direction drive control
75	TP2	O	D	0/4V	Mechanical lock/unlock B phase forward direction drive control
76	TP3	O	D	0/4V	Mechanical lock/unlock B phase reverse direction drive control
77	TIOCA1	O	D	0/4V	Shift system (yaw) PWM drive control
78	PA5	O	D	0/4V	Shift system (yaw) drive direction control
79	TIOCA2	O	D	0/4V	Shift system (pitch) PWM drive control
80	PA7	O	D	0/4V	Shift system (pitch) drive direction control

IC2

No.	Symbol	I/O	A/D	Voltage	Function
1	SAPCOP	O	A	0-4V	Shift system (pitch) center amplifier output
2	SAPEOP	O	A	0-4V	Shift system (pitch) end amplifier output
3	GAP2OY	O	A	0-4V	Gryo system (yaw) second stage amplifier output
4	GAP2NY	I	A	2.2-2.6V	Gryo system (yaw) second stage amplifier input (–)
5	GAP1OY	O	A	0-4V	Gryo system (yaw) first stage amplifier output
6	GAP1NY	I	A	2.2-2.6V	Gryo system (yaw) first stage amplifier input (–)
7	GAP1PY	I	A	2.2-2.6V	Gryo system (yaw) first stage amplifier input (+)
8	GAPRY	I	A	2.2-2.6V	Gryo system (yaw) reference power input
9	GAPRP	I	A	2.2-2.6V	Gryo system (pitch) reference power input
10	GAP1PP	I	A	2.2-2.6V	Gyro system (pitch) first stage amplifier input (+)
11	GAP1NP	I	A	2.2-2.6V	Gyro system (pitch) first stage amplifier input (–)
12	GAP1OP	O	A	0-4V	Gyro system (pitch) first stage amplifier output
13	GAP2NP	I	A	2.2-2.6V	Gyro system (pitch) second stage amplifier input (–)
14	GAP2OP	O	A	0-4V	Gyro system (pitch) second stage amplifier output
15	GINIT	I	D	0/4V	Gyro system initialization input
16	SGND			0V	Signal power supply (–)
17	DGND			0V	Logic power supply (–)
18	TH	I	A	0-4V	VCO oscillation time constant setting input
19	DIS	O	A	0-4V	VCO oscillation time constant setting output
20	VD2			4V	Signal power supply (+)
21	FPIN	I	A	0-4V	Focus pulse light receiving end input
22	FPLED	I	A	0-4V	Focus pulse light emitting end input
23	VD1			4V	Signal power supply (+)
24	VD3			4.5V	Gyro system signal power supply (+)
25	VD3CT	O	A	0-4.5V	VD3 stabilization amplifier output
26	VDD			4.5-6.5V	Signal power supply (+)
27	E	I	D	0/4V	Logic operation reference clock input
28	RESB	O	A	0-4V	Low-voltage detector reset output
29	SLCP	I	D	0/4V	Shift system (pitch) position detection switching
30	SLCY	I	D	0/4V	Shift system (yaw) position detection switching
31	UPC2O	O	D	0/4V	USM phase detection S phase output
32	UPC1O	O	D	0/4V	USM phase detection B phase output
33	FPOUT	O	D	0/4V	Focus pulse output
34	CS	I	D	0/4V	Serial communication control input (CS)
35	CLK	I	D	0/4V	Serial communication control input (CLK)
36	DATA	I	D	0/4V	Serial communication control input (DATA)
37	DCLO	O	D	0/4V	DCL output
38	DLCI	I	D	0/4V	DLC input
39	LCLKO	O	D	0/4V	LCLK output
40	DCLI	I	D	0/4V	DCL input

No.	Symbol	I/O	A/D	Voltage	Function
41	DLCO	O	D	0/4V	DLC output
42	LCLKI	I	D	0/4V	LCLK input
43	CRS	I	D	0/4V	Logic disable input
44	UPC2I	I	A	0-6.5V	USM phase detection S phase input
45	UPC1I	I	A	0-6.5V	USM phase detection B phase input
46	UPCREF			2.5V	Phase detector reference voltage
47	OSCR	I	A	2.1-1.3V	Voltage step-up circuit oscillation frequency setting
48	OSCC	I	A	2.1-1.3V	Voltage step-up circuit oscillation frequency setting
49	IN	I	A	0-1.3V	Voltage step-up circuit voltage detection input setting
50	FB	I	A	0-6.5V	Voltage step-up circuit phase compensation feedback input (–)
51	VS	I	A	0-1.3V	Voltage step-up circuit phase compensation amplifier input (+)
52	DCDCO	O	D	0-6.5V	Voltage step-up circuit gate control output
53	PGND			0V	Power system signal power supply (–)
54	AOUT	O	D	0-6.5V	USM A phase noninverting output
55	AOUTB	O	D	0-6.5V	USM A phase inverting output
56	BOUT	O	D	0-6.5V	USM B phase noninverting output
57	BOUTB	O	D	0-6.5V	USM B phase inverting output
58	SLEDY	I	A	0-4V	Shift system (yaw) position detection light emitting end input
59	SAPIY	I	A	0-4V	Shift system (yaw) position detection light receiving end input
60	SLEDP	I	A	0-4V	Shift system (pitch) position detection light emitting end input
61	SAPIP	I	A	0-4V	Shift system (pitch) position detection light receiving end input
62	VC	I	A	2V	Shift system reference voltage input
63	SAPCOY	O	A	0-4V	Shift system (yaw) center amplifier output
64	SAPEOY	O	A	0-4V	Shift system (yaw) end amplifier output

IC3

No.	Symbol	I/O	A/D	Voltage	Function
1	VCC			0-7V	Logic system power supply (+)
2	IN1	I	D	0/4V	EMD A phase forward direction drive control input
3	OUT1	O		0-7V	EMD A phase coil forward direction drive output
4	VS1			0-7V	Power system power supply (+)
5	OUT2	O		0-7V	EMD A phase coil reverse direction drive output
6	IN2	I	D	0/4V	EMD A phase reverse direction drive control input
7	GND			0V	Power system power supply (–)
8	VCONT			1.93V	Current-limiting terminal
9	IN4	I	D	0/4V	EMD B phase reverse direction drive control input
10	OUT4	O		0-7V	EMD B phase coil reverse direction drive output
11	VS2			0-7V	Power system power supply (+)
12	OUT3			0-7V	EMD B phase coil forward direction drive output
13	IN3	I	D	0/4V	EMD B phase forward direction drive control input
14	GND			0V	Power system power supply (–)

IC4

No.	Symbol	I/O	A/D	Voltage	Function
1	1A	I	D	0/4V	USM A phase drive control input
2	VCC			40V	DC/DC voltage step-up power supply (+)
3	1Y	O		0/40V	USM A phase drive output
4	GND			0V	Power system power supply (–)
5	GND			0V	Power system power supply (–)
6	2Y	O		0/40V	USM B phase drive output
7	VCC			40V	DC/DC voltage step-up power supply (+)
8	2A	I	D	0/4V	USM B phase drive control input

IC6

No.	Symbol	I/O	A/D	Voltage	Function
1	NC				Unused
2	VCC			4V	Logic power supply (+)
3	CS	I	D	0/4V	Serial communication chip selection
4	SK	I	D	0/4V	Serial communication clock
5	DI	I	D	0/4V	Serial communication data input
6	DO	O	D	0/4V	Serial communication data output
7	GND			0V	Logic power supply (–)
8	TEST				Unused

IC7

No.	Symbol	I/O	A/D	Voltage	Function
1	AOUT	O	A		Shift system (yaw) initial stage amplification output
2	A-IN	I	A		Shift system (yaw) light receptor input
3	A+IN	I	A	2.4V	Shift system (yaw) reference power supply
4	GND			0V	Signal power supply (-)
5	B+IN	I	A	2.4V	Shift system (pitch) reference power supply
6	B-IN	I	A		Shift system (pitch) light receptor input
7	BOUT	O	A		Shift system (pitch) initial stage amplification output
8	V+			4V	Signal power supply (+)

IC8

No.	Symbol	I/O	A/D	Voltage	Function
1	1A	O		3-7V	Shift system (yaw) coil forward direction drive output
2	C1L	I			Charge pump capacitor connection
3	C1H	I			Charge pump capacitor connection
4	C2L	I			Charge pump capacitor connection
5	C2H	I			Charge pump capacitor connection
6	VD1			3-7V	Power system power supply (+)
7	VG			11V	Charge pump capacitor connection
8	VC			4V	Logic power supply
9	1B	O		3-7V	Shift system (yaw) coil reverse direction drive output
10	GND			0	Logic/power system power supply (–)
11	2B	O		3-7V	Shift system (pitch) coil reverse direction drive output
12	OC2	I		4V	Shift system (pitch) drive control input
13	DIR2	I		0/4V	Shift system (pitch) drive direction control input
14	EN2	I		0/4V	Shift system (pitch) PWM drive control input
15	VD2			3-7V	Power system power supply (+)
16	EN1	I		0/4V	Shift system (yaw) PWM drive control input
17	DIR1	I		0/4V	Shift system (yaw) drive direction control input
18	OC1	I		4V	Shift system (yaw) drive control input
19	2A	O		3-7V	Shift system (pitch) coil forward direction drive output
20	GND			0	Logic/power system power supply (–)

IC9

No.	Symbol	I/O	A/D	Voltage	Function
1	IN2	I	D	0/4V	Mechanical lock system A phase reverse direction drive control input
2	IN1	I	D	0/4V	Mechanical lock system A phase forward direction drive control input
3	VREF	O		2V	Reference voltage output
4	VC1	I	A	1.2V	Constant voltage control input
5	VC2	I	A	1.2V	Constant voltage control input
6	IN3	I	D	0/4V	Mechanical lock system B phase forward direction drive control input
7	IN4	I	D	0/4V	Mechanical lock system B phase reverse direction drive control input
8	OUT4	O		0-7V	Mechanical lock system B phase coil reverse direction drive output
9	GND			0	Power system power supply (–)
10	OUT3	O		0-7V	Mechanical lock system B phase coil forward direction drive output
11	OUT1	O		0-7V	Mechanical lock system A phase coil forward direction drive output
12	GND			0	Power system power supply (–)
13	OUT2	O		0-7V	Mechanical lock system A phase coil reverse direction drive output
14	VCC			0-7V	Power system power supply (+)

IC10

No.	Symbol	I/O	A/D	Voltage	Function
1	NC				
2	VDD			5-7V	Signal power supply (+)
3	NC				
4	VSS			0V	Signal power supply (–)
5	VOUT	O	A	4.5V	Constant voltage output

IC11

No.	Symbol	I/O	A/D	Voltage	Function
1	OUT	O	D	0/4V	Microcomputer reset control output
2	VDD			4V	Logic power supply (+)
3	VSS			0V	Logic power supply (–)
4	NC				
5	NC				

IC12

No.	Symbol	I/O	A/D	Voltage	Function
1	A	I	D	0/4V	Voltage step-up circuit gate control input
2	B	I	D	0/4V	Voltage step-up circuit gate control input
3	GND			0V	Logic power supply (–)
4	Y	O	D	0/4V	Voltage step-up circuit gate control output
5	VCC			5-7V	Logic power supply (+)

3. CIRCUIT DESCRIPTION

3.1 Lens Mounted on Camera

1) When the lens is mounted, the power is supplied to each IC in the lens through VDD at the mount contact pin. Each logic circuit operates on VD1 (4 V) that is produced by regulating the VDD voltage with IC5.

2) When the CPU (IC1) receives power from VD1, internal oscillation starts at a frequency (8 MHz) set by the ceramic oscillator (CF). When the reset signal is received from the voltage detection circuit (IC11), the program execution begins.

3) The CPU places the LCLK communication line to the camera at the "Lo" level, outputs a busy signal to the camera, stores the contents of the EEPROM (IC6), including lens adjustment data, in the RAM, and initializes the internal registers and RAM.

4) After completion of the above initialization process, the CPU cancels the busy signal, sets both the LCLK and DLC pins to the "Lo" level, and outputs the communication request signal to the camera to place the CPU in the HALT state (the CPU stops).

5) When the camera sends a response to the request signal, the CPU immediately leaves the HALT state and starts operation according to the response form the camera.

6) When VD2 (4 V) turns ON, a locking operation is performed via the mechanical lock driver (IC9).

7) A current flows to the shift system position detection photo-reflector (PR1/PR2) via the lens controller IC (IC2). In accordance with the resulting position detection output, the value of the current flow to the photo-reflector is changed to effect sensitivity calibration.

8) When the prescribed time elapses after the above operation, the HALT command from the camera places the CPU to in HALT state again.

3.2 AF/MF Switch Operation

1) When the lens AF/MF switch is operated, the CPU recovers from the HALT state, outputs a request signal to the camera, and returns to the HALT state.

2) When the camera sends a response to the above communication request signal, the CPU leaves the HALT state immediately, and starts operation according to the response from the camera.

3.3 Focusing Ring (USM) Drive

1) When SW1 on the camera turns ON, the lens CPU leaves the HALT state immediately, and turns ON VD2 (4 V) to start operation.

2) When the focusing ring drive command is received from the camera with the lens AF/MF switch in the AUTO position, the CPU enters the USM drive sequence, and activates the USM drive DC/DC converter (consisting of IC2 and other components).

3) The VCO circuit (in IC2) determines the USM drive frequency, divides it to produce two signals AOUT and BOUT, whose phases differ 90 degrees, and outputs these signals to drive the USM via the USM driver (IC4).

4) The A and B phase signals from the USM are detected by the comparator (in IC2), and fed back to the AOUT and BOUT drive signals according to the relationships between the detected phase signals to maintain the optimum drive characteristics.

5) As the focusing ring moves, the pulse signals from the photointerrupter (PS) are counted, and a check is made to see whether the count matches the drive amount from the camera. When they match, the USM drive stops.

6) The USM drive DC/DC converter stops.

3.4 Diaphragm (EMD) Drive

1) When the diaphragm setting of the camera is not for the maximum aperture and SW2 or the diaphragm switch turns ON, the lens CPU leaves the HALT state immediately according to the signal from the camera, and turns ON VD2 (4 V) to start operation.

2) When the diaphragm drive command is received from the camera, LCLK is set to the "Lo" level to output a busy signal to the camera.

3) The diaphragm is driven by the EMD driver (IC3) by the number of diaphragm steps corresponding to the diaphragm drive amount from the camera. When the control for the specified number of steps is completed, the drive stops and the busy signal is canceled.

4) When the diaphragm drive stop command is received from the camera, the diaphragm is de-energized.

5) When SW2 or the diaphragm switch turns OFF, the diaphragm open command is received from the camera so that a busy signal is outputted to the camera in the same manner as for the above diaphragm operation.

6) The diaphragm is opened by the EMD driver. When the diaphragm is open, as detected by the diaphragm open detection switch, the drive stops and the busy signal is canceled.

3.5 IS Drive

1) When SW1 on the camera turns ON, the lens CPU leaves the HALT state immediately according to the signal from the camera, and turns ON VD2 (4 V) and VD3 (4.5 V) to supply power to the shift system and gyro processing circuits.

2) When the SW1 ON signal is received from the camera with the lens IS ON/OFF switch in the ON position, the CPU drives the stepping motor by the specified number of steps via the mechanical lock driver (IC9) to open the mechanical lock.

3) When the above mechanical unlock operation is carried out, the shift system is Pulse Width Modulation (PWM) driven by the shift system driver. The resulting position output is received by the A/D converter in the CPU at 1-kHz sampling intervals to exercise shift system feedback control.

4) Unwanted noise components are eliminated from the gyro-sensor movement signal output by the gryo signal processing circuit (in IC2). The resulting output is amplified, received by the A/D converter in the CPU at 1-kHz sampling intervals, and calculated by the CPU. The shift system is them driven according to the calculation results.

5) If the zoom/focus position changes in the above situation, the shift system is corrected according to the sensitivity for correction.

6) If a panning or other large movement signal is entered in the above situation, the shift system is controlled so that it does not exceed the prescribed stroke.

7) When SW2 on the camera turns ON and the SW2 ON signal is received from the camera, shift system drive characteristics changeover is effected according to the preselected shutter speed.

8) To properly compensate for camera shutter movement, the specified correction signal is added to the movement signal input from the gyro-sensor immediately before the shutter exposure sequence. The shift system is then driven according to the result of such a signal addition.

9) When the SW2 OFF signal is received from the camera, the shutter release mode reverts to the previous characteristics.

10) When the prescribed time (approx. 1.5 seconds) elapses after SW1 OFF signal reception from the camera, which occurs when SW1 on the camera turns OFF, the mechanical lock driver drives the stepping motor by the specified number of steps to set the mechanical lock.

4. DESCRIPTION

4.1 Zoom Lens Optical System

For high image quality and compactness, the optical system features a new design for this first EF lens featuring a 28-135mm zoom range. The optical system has the following features:

- The 6 lens groups which all move enable shift-system image stabilization. Even with a 5x zoom ratio, the overall length of the optical system is still compact.
- Inner focusing with group 2 made the following possible: Short focal length of 28mm, smaller lens diameter, and minimum focusing distance of 0.5 m at all focal lengths.
- Using aspherical GMo (molded glass) for G14 improved image quality throughout the zoom range.
- Filter size is held to 72mm even with these optical specifications.

4.2 Mechanical Features

The lens' optical system has a different lens extension depending on the focal length. SIC (Super Inner Cam) is therefore used. The lens extension is controlled mechanically for each lens focal length. At the same time, the focusing rotation angle is fixed for all focal lengths.

Other mechanical features are as follows:

- With the image stabilizing unit's new construction, compact optical system, and compact EMD, the lens length and maximum diameter could be made compact.
- Inner focusing and ring USM for silent AF.
- Since the front lens element does not rotate during focusing, a polarizing filter can be used without any readjustment.
- The petal-type EW-78B hood is highly effective at wide angles.

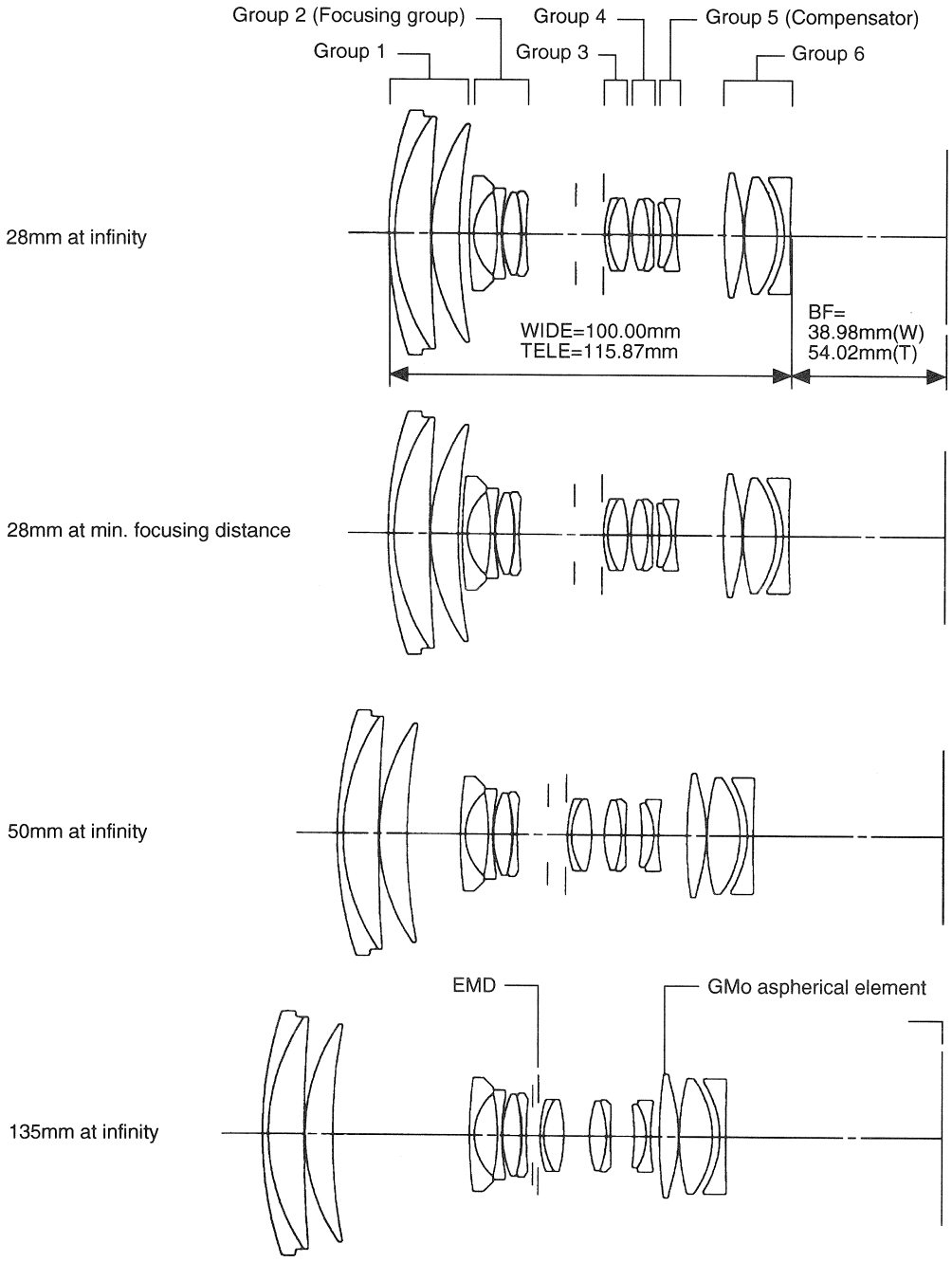


Fig. 2-1 Lens Movement during Zooming

5. IMAGE STABILIZER

5.1 Principle

The EF 28-135mm f/3.5-5.6 IS USM lens' Image Stabilizer (group 5: G12, G13) is moved laterally by the shift system. (This system is explained in the Service Manual for the EF 75-300mm f/4-5.6 IS USM.)

5.2 Image Stabilizer Control

The EF 28-135mm f/3.5-5.6 IS USM lens' Image Stabilizer is controlled in almost the same way as with the EF 75-300mm f/4-5.6 IS USM. Since the optical system's sensitivity is different between both lenses, the image stabilizing characteristics have been optimized for the lens.

5.3 Image Stabilizer Effects

As with the EF 75-300mm f/4-5.6 IS USM, this lens' Image Stabilizer gives the equivalent effect of having a shutter speed two stops faster. At the wide angle end, the Image Stabilizer gives the equivalent effect of a shutter speed 1.5 stops faster.

5.4 Image Stabilizer Unit

The EF 28-135mm f/3.5-5.6 IS USM lens uses an image-stabilizing unit newly developed just for this lens. The image-stabilizing unit's drive section has a new construction, made smaller to suit the smaller optical system. Compared to the EF 75-300mm f/4-5.6 IS USM lens' image-stabilizing unit, it is much smaller and lighter. Camera shake detection is executed by gyros.

5.5 Image Stabilizer Sequence

The EF 28-135mm f/3.5-5.6 IS USM lens' image-stabilizing sequence is the same as with the EF 75-300mm f/4-5.6 IS USM lens.

5.6 Operational Differences with Different Cameras

Depending on the EOS camera the lens is used with, image shake may be seen in the viewfinder under the following conditions:

1) After the shutter is released.
2) While the built-in flash is recharging.
3) When the DEP mode is used.

Also, during bulb exposures, Image Stabilizer operation differs depending on the camera model. See the table below.

Table 2-1 Operational Differences with Different Cameras

EOS Model	After Shutter Release	During Built-in Flash Recharging	After DEP Mode	During Bulb Exposure
630	▲	—	▲	Image Stabilizer stops immediately after exposure starts
650	▲	—	▲	Image Stabilizer stops immediately after exposure starts
RT	▲	—	▲	Image Stabilizer stops immediately after exposure starts
620	▲	—	—	Image Stabilizer stops immediately after exposure starts
700	○	▲	○	Image stabilization continues
750	○	▲	○	—
850	○	—	○	—
1	○	—	▲	Image Stabilizer stops immediately after exposure starts
1N	○	—	▲	No image stabilization
1NRS	○	—	—	No image stabilization
5	○	○	△	Image stabilization continues
10	▲	▲	▲	Image Stabilizer stops immediately after exposure starts
55	○	○	○	No image stabilization
100/100P	▲	▲	▲	Image Stabilizer stops immediately after exposure starts
1000/1000S	○	▲	○	Image stabilization continues
KISS	○	△	○	Image stabilization continues
New KISS	○	△	○	No image stabilization
888	○	○	—	No image stabilization
IXE	○	△	○	No image stabilization

* ○: No shaky image. ▲: Very shaky image. △: Slightly shaky image.

Part 3

Repair Information

1. PRELIMINARY INSTRUCTIONS

1.1 Disassembly, Reassembly, and Adjustment Notes

1) Disassembly and reassembly

- This lens requires tilt adjustment.
- Before the collars are removed, remember their locations and directions.

2) Optical adjustment

Centering adjustment	Necessary / (Unnecessary)		
Tilt adjustment	(Necessary) / Unnecessary	Move lens group 6 assembly radially.	Lens projector

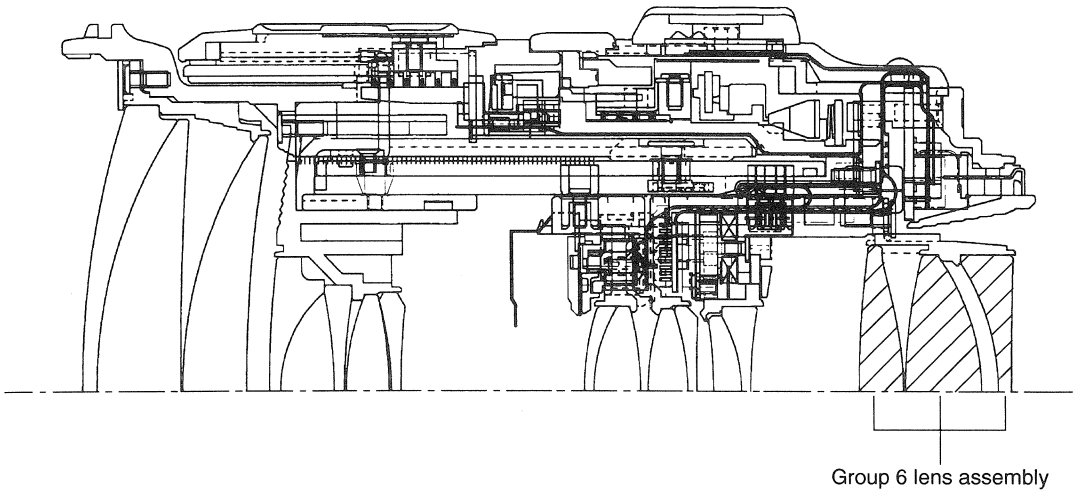
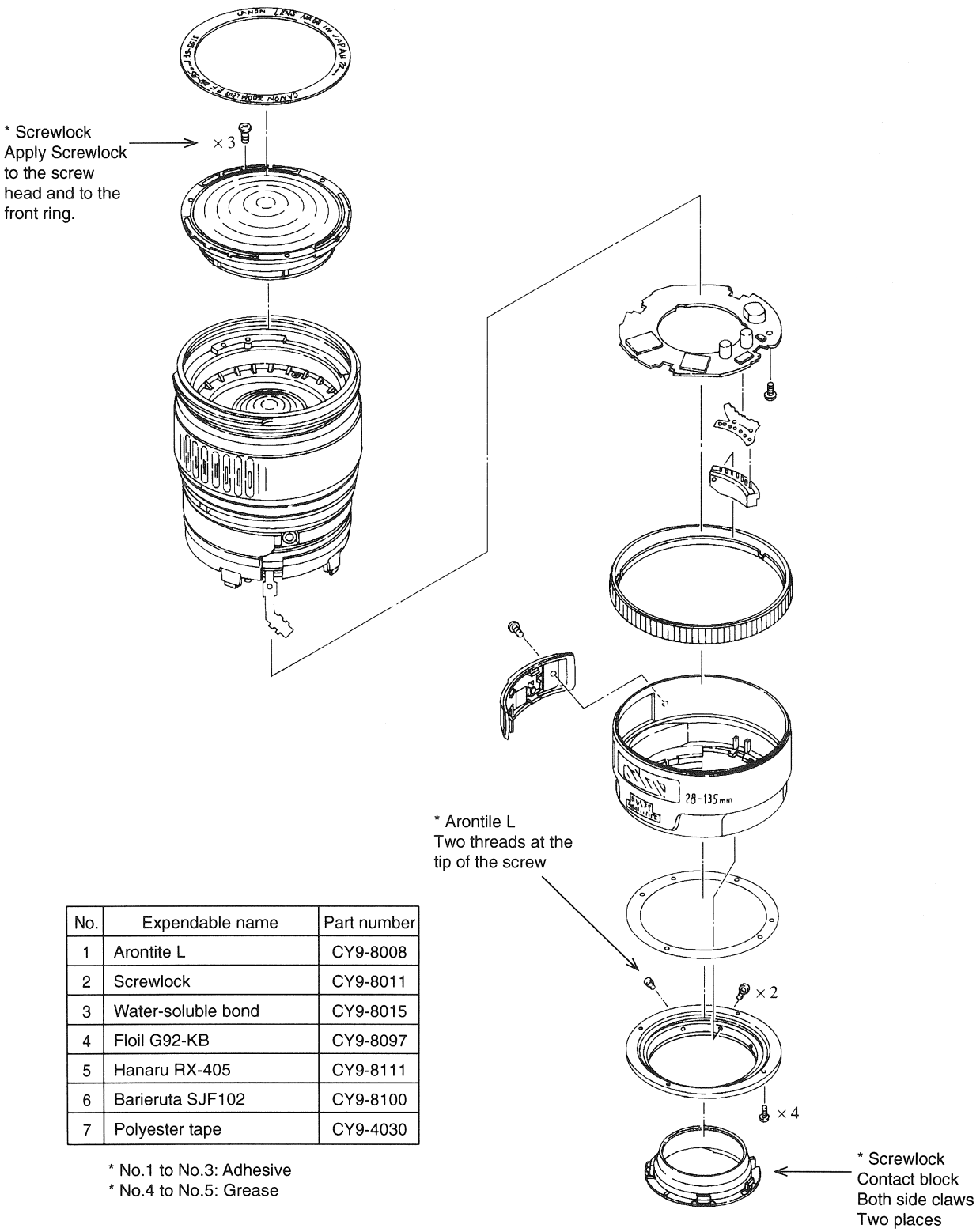


Fig. 3-1 Adjustment Points

1.2 Locations of Application of Expendables



No.	Expendable name	Part number
1	Arontite L	CY9-8008
2	Screwlock	CY9-8011
3	Water-soluble bond	CY9-8015
4	Floil G92-KB	CY9-8097
5	Hanaru RX-405	CY9-8111
6	Barieruta SJF102	CY9-8100
7	Polyester tape	CY9-4030

* No.1 to No.3: Adhesive
* No.4 to No.5: Grease

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

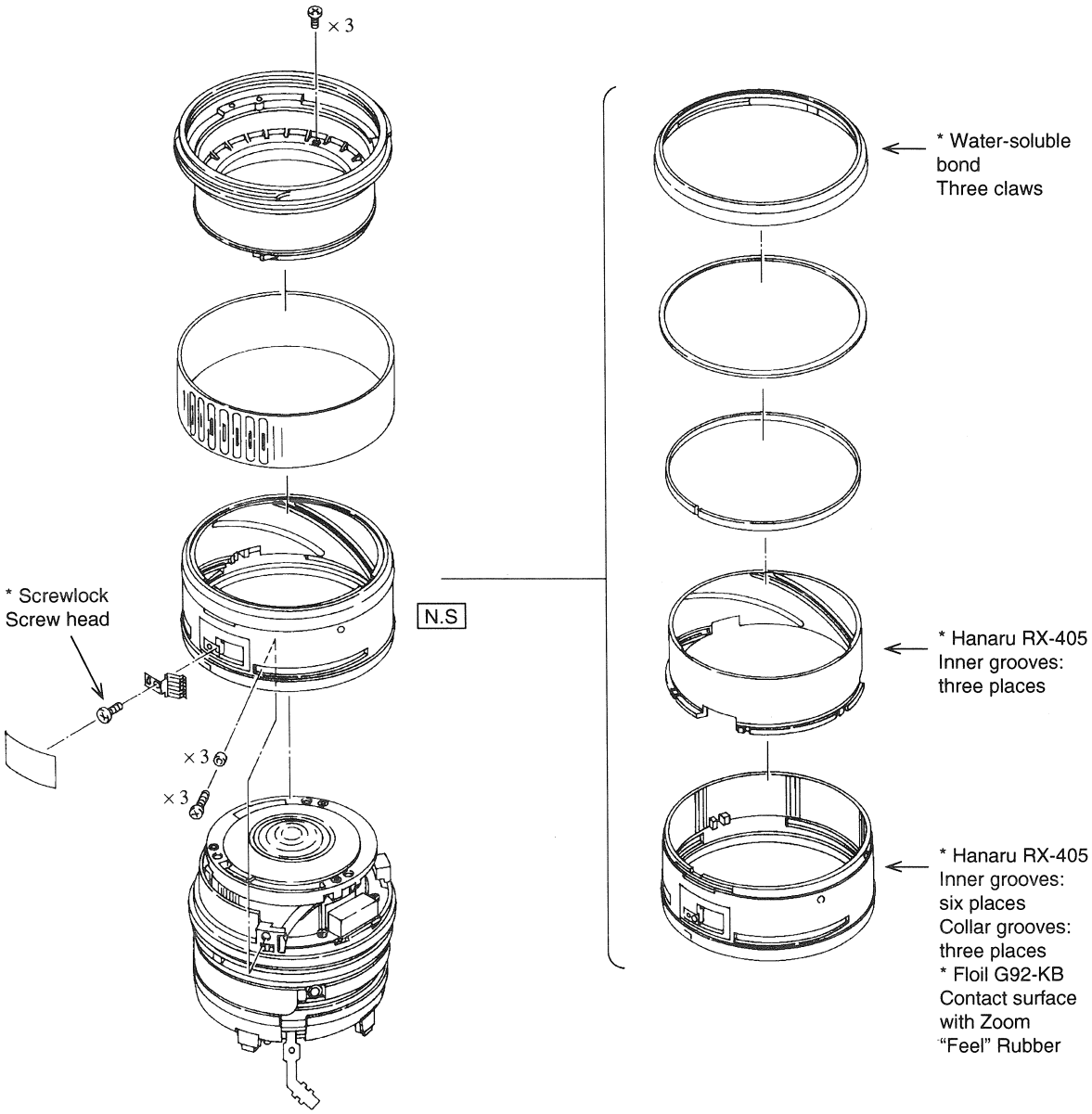


Fig. 3-3 Locations of Application of Expendables (II)

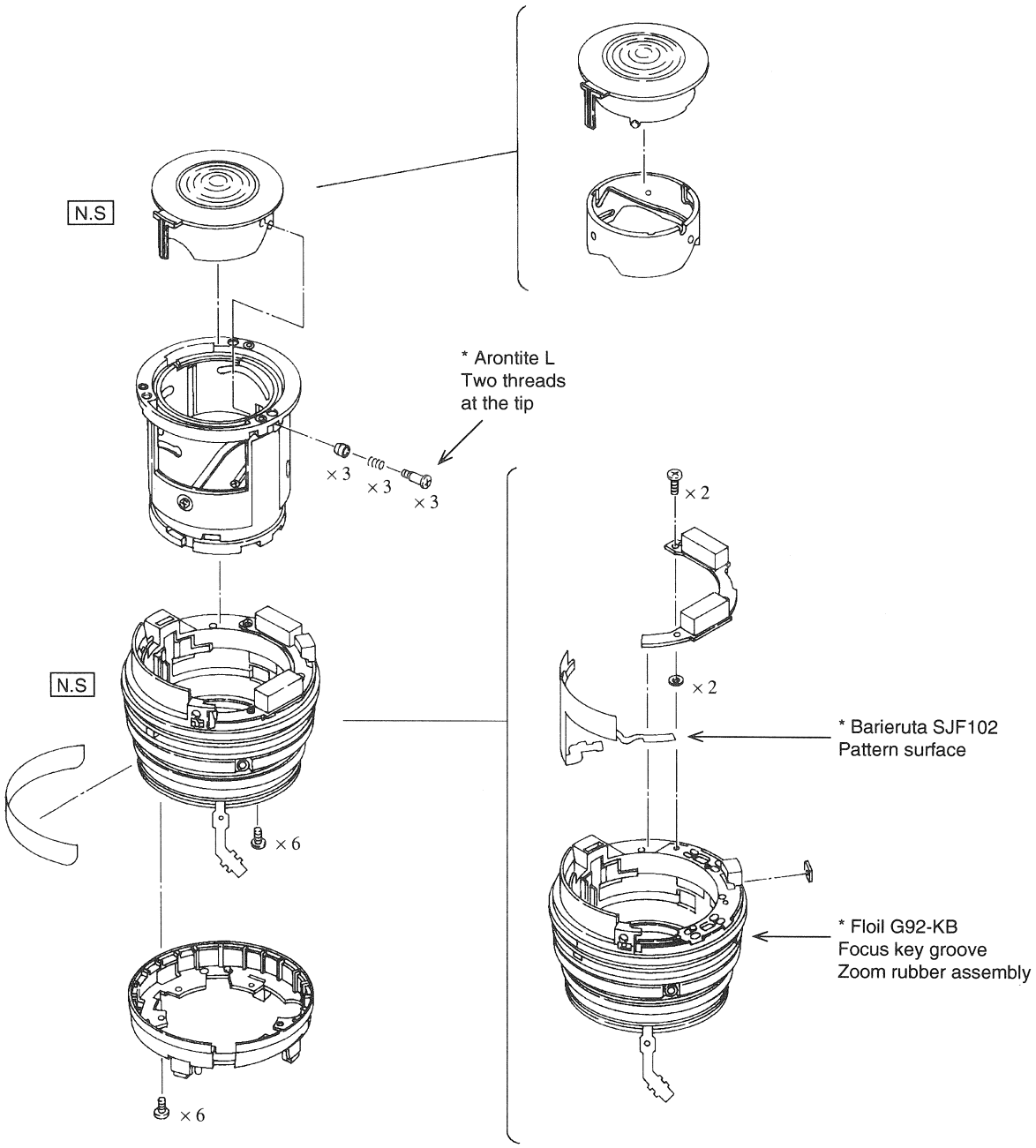


Fig. 3-4 Locations of Application of Expendables (III)

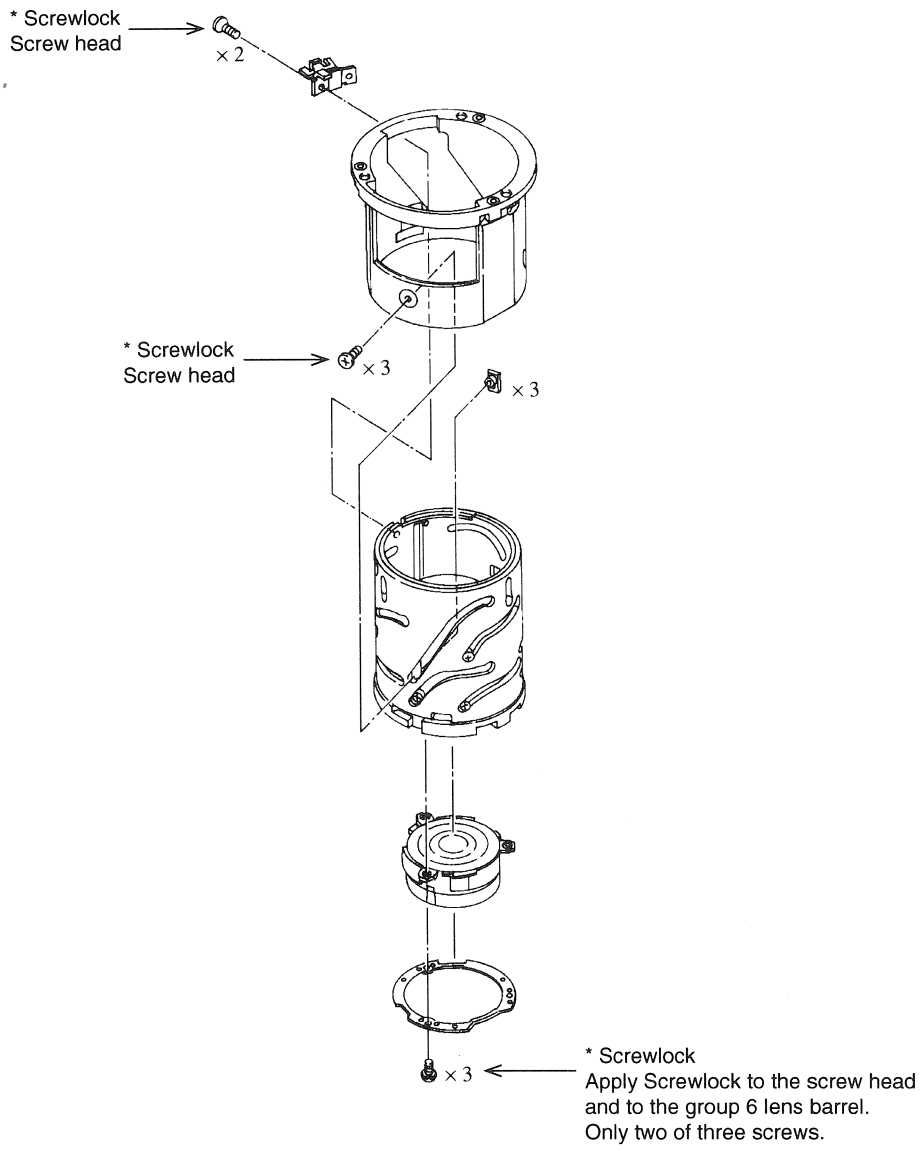


Fig. 3-5 Locations of Application of Expendables (IV)

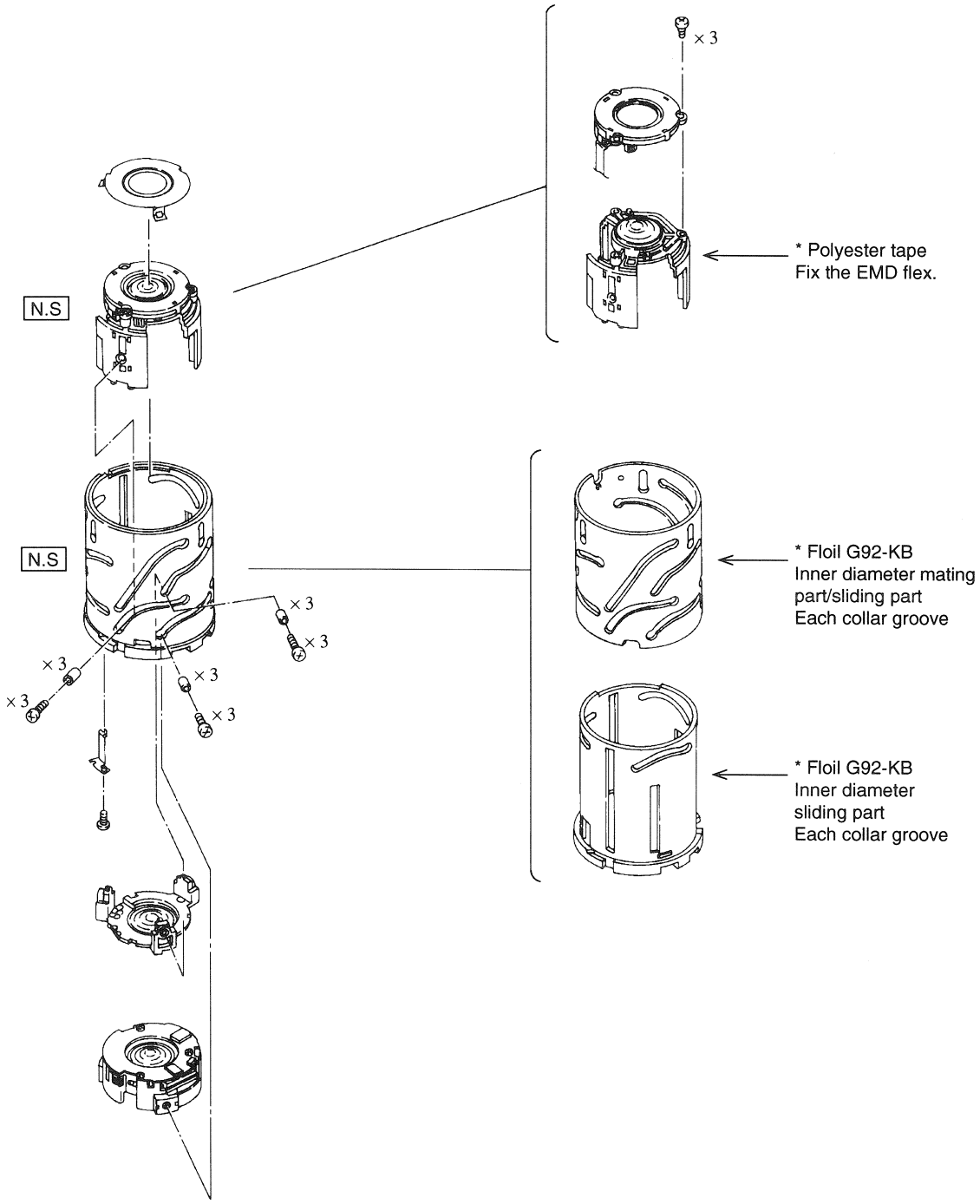


Fig. 3-6 Locations of Application of Expendables (V)

1.3 Service Tools

New	Tool name	Part number	Adjustment item
	Lens projector		Tilt ajustment
	EOS camera (with B type focusing screen)		Focus
	Magnifier		
	General-purpose 600mm collimator		
	Tester		Zoom brush position adjustment
	EOS camera (EOS REBEL X / 500 or EOS-IN)		Electrical adjustment
	HS/IF unit	CY9-7082-000	
	Frequency counter		USM frequency adjustment
	EF lens electronic ring mount adapter	CY9-2001-004	USM frequency adjustment Focus pulse adjustment Mechanical lock centering
	Lens communication tool		
	Oscilloscope		Pulse adjustment
	AF reference chart		Focus compensation
	3D chart		
	Vibration table	CY9-2030-000	Gyro sensitivity adjustment
	Penlight		

1.4 Adjustment Items

Adjustment item	Purpose	Description	Page
Tilt	Make resolution at the periphery of the field uniform.	Make this adjustment when an optical component is disassembled or replaced.	3-24
Focus	Achieve infinity focus.	Make this adjustment when an optical component is disassembled or replaced.	3-26
Zoom brush position	Correctly read zoom information.	Check and adjust when you disassemble and replace the zoom brush and GZ-FLX.	3-28
USM frequency	Set reference frequency.	Perform when you replace the main board unit (without data) and the focus unit.	3-34
Focus pulse	Achieve accurate USM drive data.	Perform when you replace the main board unit (without data) and the focus unit.	3-36
Focus compensation	Achieve the best auto-focus at very large apertures.	Perform when you replace the main board unit (without data). Check and adjust when you disassemble and replace the optical parts.	3-38
LED current data input	Enter the LED current data of the IS lens unit.	Perform when you replace the main board unit (without data) and the IS lens unit.	3-40
Mechanical lock centering	Center the meachanical lock.	Perform when you replace the main board unit and the IS lens unit.	3-41
Gyro rank data	Enter gyro-sensor rank.	Perform when you replace the main board unit (without data) and the gyro sensor unit.	3-42
Gyro sensitivity	Achieve the best vibration insulating effect.	Perform when you replace the main board unit, the gyro sensor unit, and the IS lens unit.	3-44

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2. DISASSEMBLY AND REASSEMBLY

2.1 Lens Mount Removal

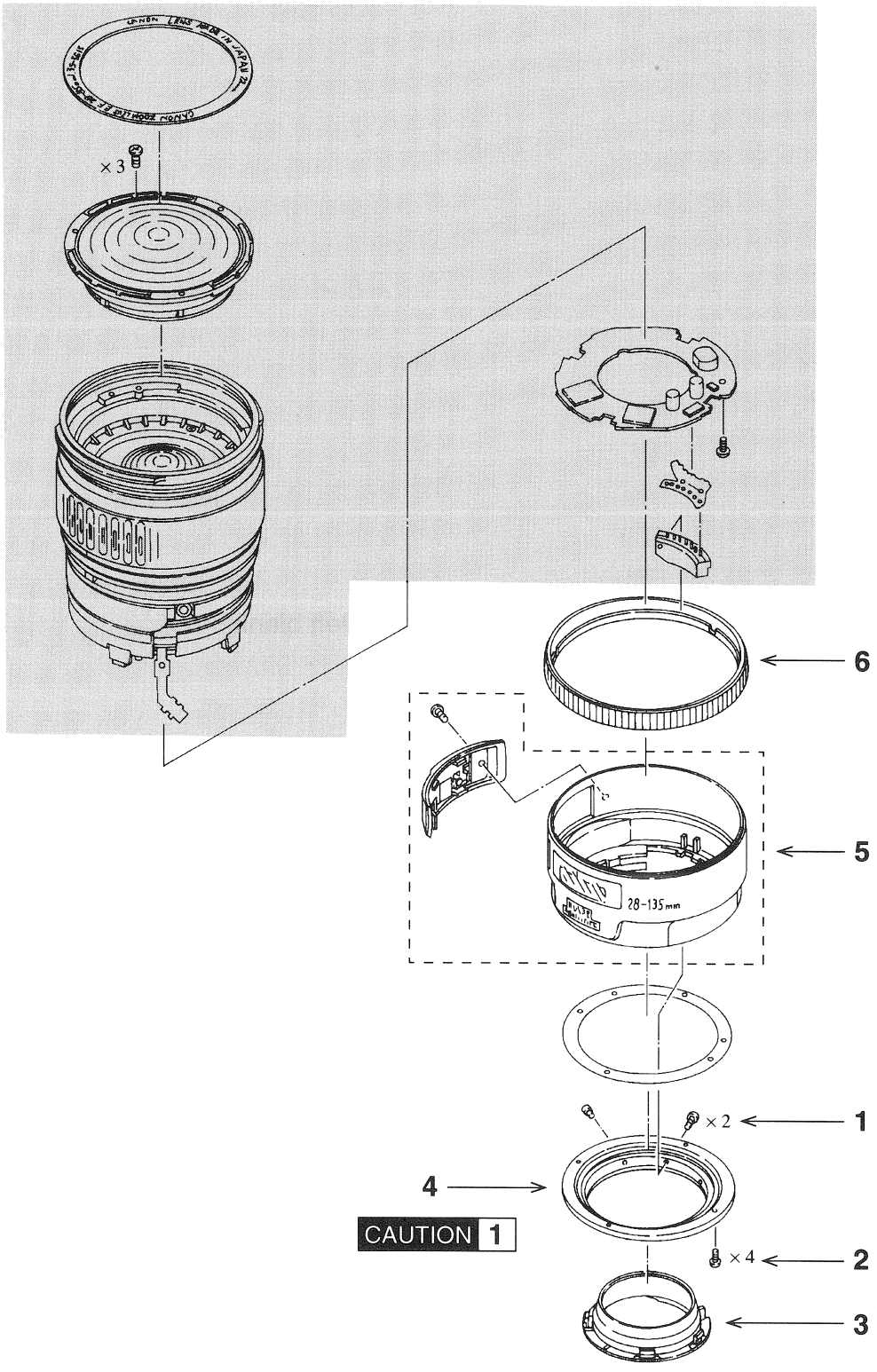

Fig. 3-7 Lens Mount Removal

1. Contact assembly screws (two)

2. Mount screws (four)

3. Back cover (bonded)

- Lift the lens mount and remove the back cover by pushing it from the inside.
- Install the lens mount, then push in the back cover.

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. Fixed barrel assembly: A/M switch assembly

- The A/M switch needs not be removed.

6. Manual distance ring

2.2 Main Circuit Unit Removal

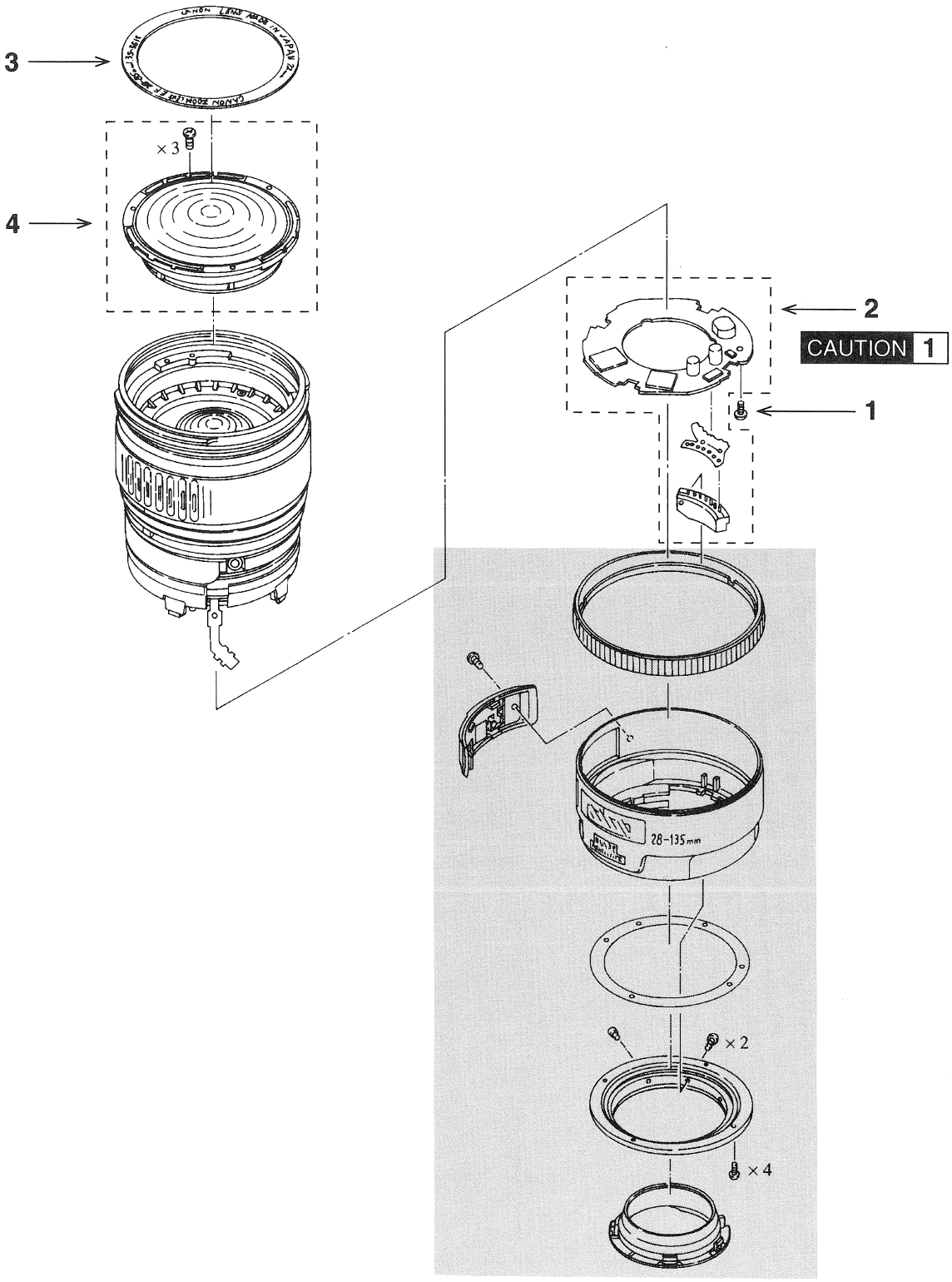

Fig. 3-8 Main Circuit Unit Removal

1. Main PCB screw (one)

2. Main PCB assembly: M-FLX: Contact assembly

- When removing the main PCB assembly, remove the three flexes.

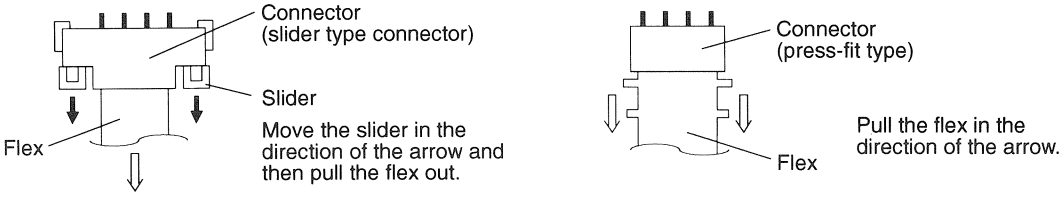

Fig. 3-9 Flex Removal

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

CAUTION 1 **Main PCB assembly replacement**

- Before replacement, save the EEPROM data and transfer the data to the new board. (See **3.4, Electrical Adjustment.**)

3. Filter ring cover

4. Group 1 lens assembly (Three screws: bonded)

2.3 Zoom Brush Removal

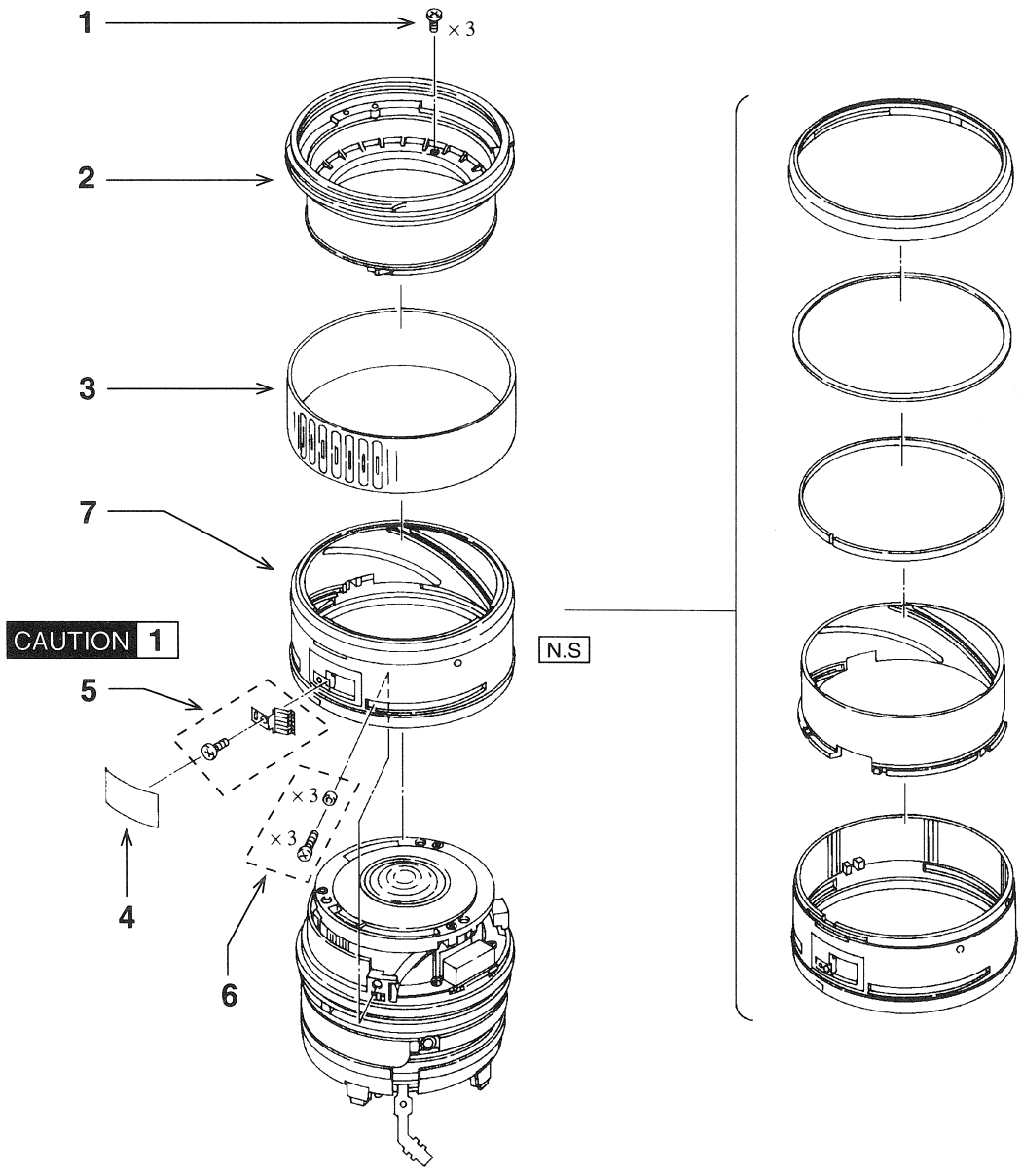

Fig. 3-10 Zoom Brush Removal

1. **Front ring ass'y screws (three)**

2. **Front ring ass'y**

3. **Zoom ring rubber**

4. **Dust shield sheet**

5. **Zoom brush (One screw: bonded)**
   - Remember the position of the zoom brush because it must be adjusted during reinstallation.

   CAUTION 1 **Zoom brush replacement**
   - Temporarily fix the zoom brush and adjust the position. (See page 3-28.)

6. **Zoom collars (three) (Three screws)**

7. **Zoom operation ring unit**

2.4 Removing Focusing Unit

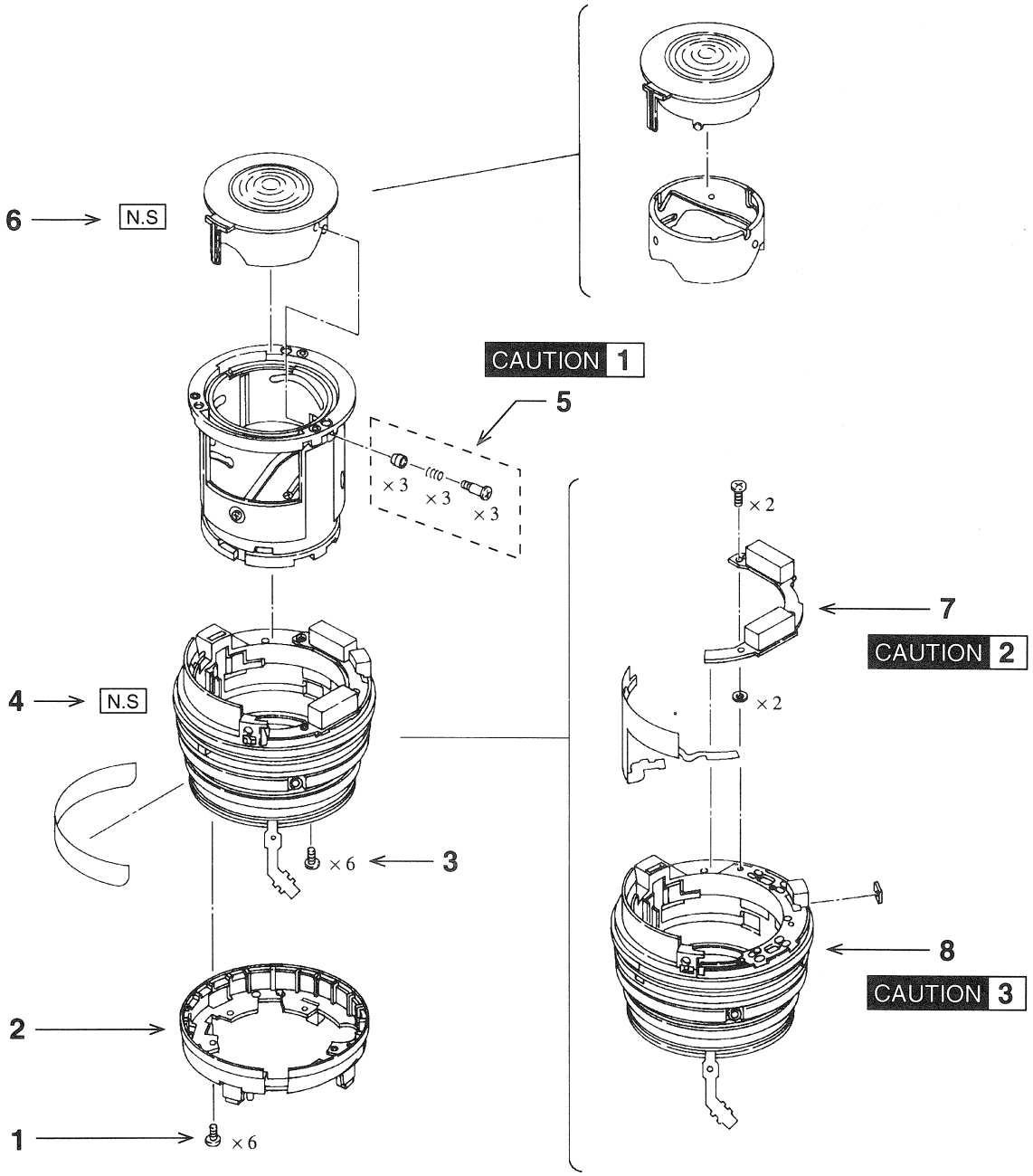

Fig. 3-11 Remomving Focusing Unit

1. Fixed ring screws (Six)

2. Fixed ring

3. Focusing assembly screws (Six)

4. Gyro focus unit

5. Three group 2 collars; three group 2 collar springs; three group 2 collar screws

- Before removing the collars, remember their locations and directions.

CAUTION 1 **Group 2 collar replacement**

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

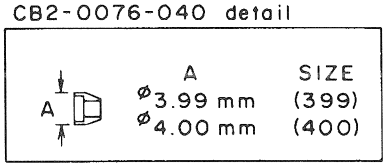

Fig. 3-12 Group 2 Eccentric Collar Size

6. Group 2 unit

7. Gyro-sensor unit

- Do not drop or impact the gyro sensor unit.

CAUTION 2 **Gyro sensor unit replacement**

- Enter rank data. (See page 3-42.)
- Perform the gyro sensitivity adjustment. (See page 3-44.)

8. Focusing assembly

- Do not touch the startor or rotor with bare hands.

CAUTION 3 **Focusing assembly replacement**

- Perform the USM frequency adjustment. (See page 3-34.)
- Perform the focus pulse adjustment. (See page 3-36.)

2.5 Lens Unit Removal (I)

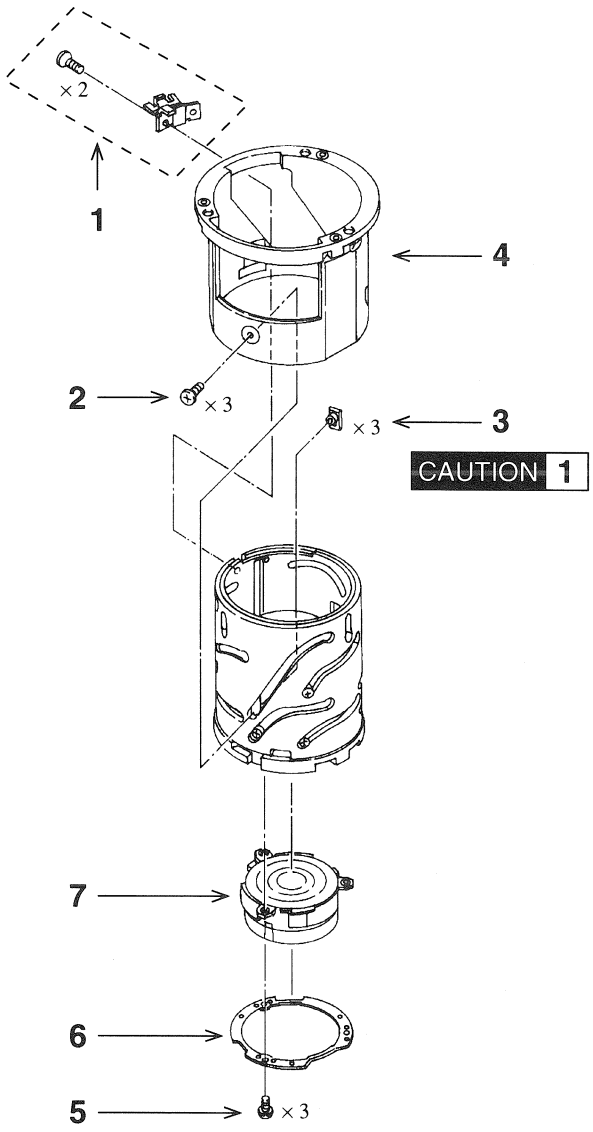

Fig. 3-13 Lens barrel unit removal (1)

1. Zooming guide base (Two screws: bonded)

2. Guide barrel screws (three)

3. Straight keys (three)

- Before removing the collars, remember their locations and directions.

CAUTION 1 **Straight key replacement**

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

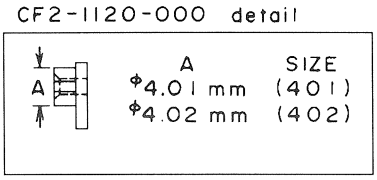

Fig. 3-14 Straight key dimensions

4. Guide barrel

5. Group 6 screws (three) (bonded)

6. Group 3 reinforcing ring

7. Group 6 lens barrel unit

2.6 Lens Unit Removal (II)

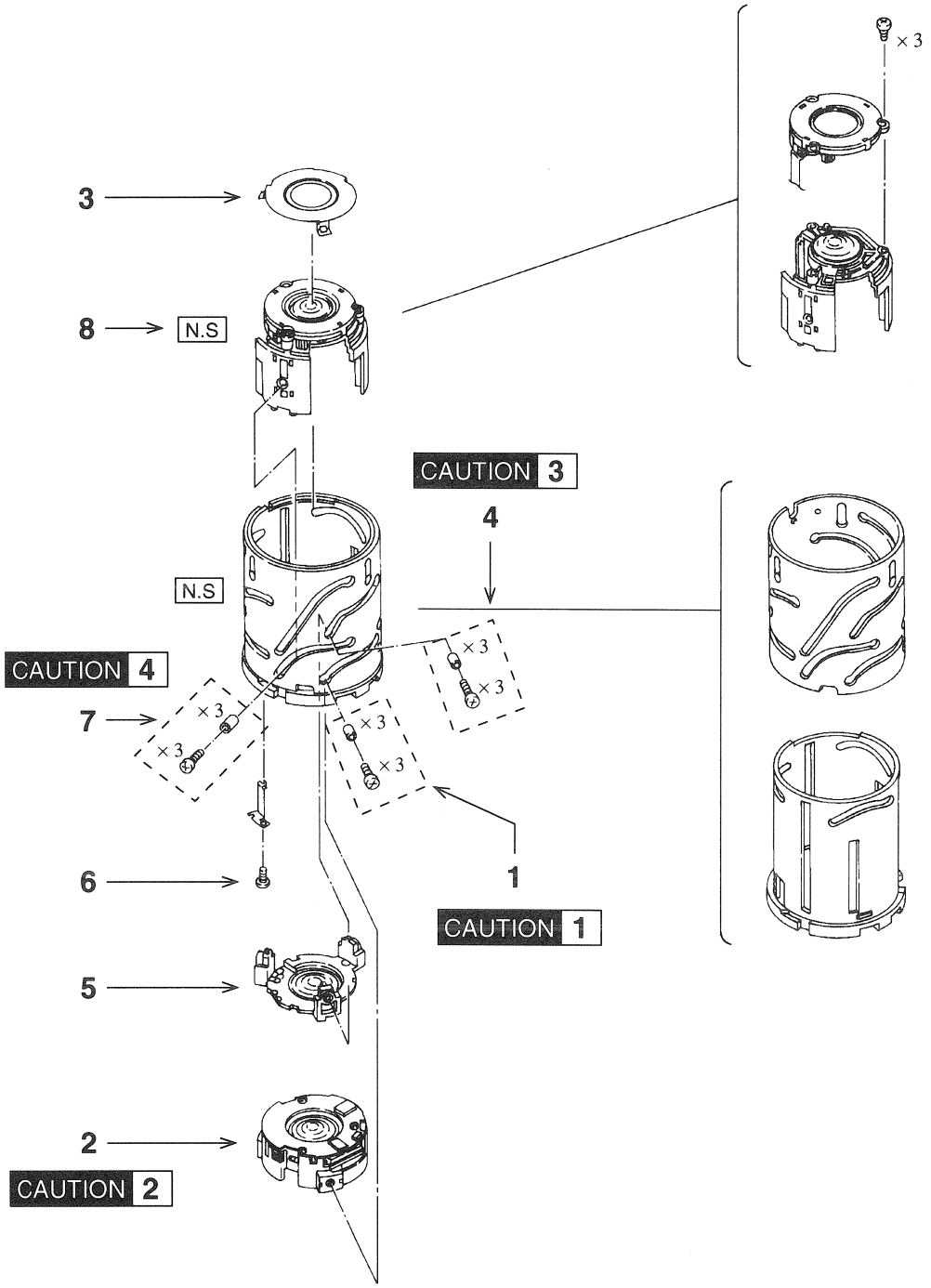

Fig. 3-15 Lens Unit Removal

1. Group 5 collars (three) (Three screws)

- Before removing the collars, remember their locations and directions.

CAUTION 1 **Group 5 collar replacement**

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

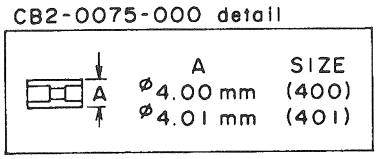

Fig. 3-16 Group 5 collar dimensions

2. IS lens unit

CAUTION 2 **IS lens unit replacement**

- Enter the LED current data shown on the service parts into the EEPROM when you replace the IS lens unit. (See page 3-40.)
- Perform the mechanical lock centering. (See page 3-41.)
- Perform the gyro sensitivity adjustment. (See page 3-44.)

3. Flare ring

4. Group 4 collars (three) (three screws)

CAUTION 3 **Group 4 collar replacement**

- See the CAUTION for the group 5 collars and dimensions.

5. Group 4 lens barrel unit

6. E-FLX holder screw (one)

7. Group 3 collars (three) (three screws)

CAUTION 4 **Group 3 collar replacement**

- See the CAUTION for the group 5 collars and dimensions.

8. Group 3 unit

3. ADJUSTMENT

3.1 Before Adjustment

- This lens uses an EEPROM for adjustment.
- The adjustment items for the lens are described in "Section 1.4, Adjustment Items."
  Items 1–3 are mechanical adjustments. The adjustment software is not used.
  Items 4–10 are electrical adjustments and require a personal computer and the adjustment software.

3.2 Adjustment Procedure

The adjustment items and steps are listed below.

Table 3-1 Flow of Adjustments

Adjustment type	Mechanical Adjustment			Electrical Adjustment						
Adjustment order→	1	2	3	4	5	6	7	8	9	10
Adjustment item / Main replacement parts	Tilt	Focus	Zoom brush position adjustment	USM frequency adjustment	Focus pulse adjustment	Focus compen-sation	LED current data input	Mechan-ical lock centering	Gyro rank data input	Gyro sensitivity adjustment
Optical parts replacement (including disassemble)	○	○	○	—	—	○	—	—	—	—
Main board unit replacement (Data can be read.)	—	—	—	—	—	—	—	○	—	○
Main board unit replacement (Data cannot be read.)	—	—	—	○	○	○	★	○	○	○
IS lens unit replacement (Group 5 lens assembly)	○	○	○	—	—	○	○	○	—	○
Gyro sensor unit replacement	—	—	○	—	—	—	—	—	○	○
USM unit replacement (focusing unit)	—	—	○	○	○	—	—	—	—	—
EMD replacement (aperture unit)	○	○	○	—	—	○	—	—	—	—

★: If you cannot read the data of the old board when replacing the main board unit, you must replace the IS lens unit, too.

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3.3 Mechanical Adjustment

1) Tilt adjustment

* Check and adjust when you disassemble and replace the optical parts.

Purpose:

- Make the resolution at the edges of the field uniform.

Tools:

- Lens projector

Standard:

The projection resolution standard is following:

Table 3-2 Projection Resolution Standard

(Unit: lines/mm)

Image height		0mm	4mm	8mm	12mm	16mm	20mm
Tele-position	S	100	100	100	100*	63*	40*
	M		100	63	63*	40	40*

*: The resolution may be one level lower in two adjacent quadrants only, providing that the center resolution is good.

Preparation:

1. Remove the back cover (CY1-2807).
2. Loosen three screws (YA2-3155) holding Group 6 lens assembly.

Adjustment method:

1. Set the chart to screen distance to 6.75 meters.
2. Mount the lens and set the zoom at tele-position (135mm).
3. Adjust the focus to the projected image.
4. Observe the projected image and determine whether it meets the projection resolution standard.
5. In case it does not, turn the group 6 lens assembly to radial direction and adjust it to satisfy the standard.
6. After adjustment, apply Screwlock to the area extending from the screw head to the group 6 lens barrel.

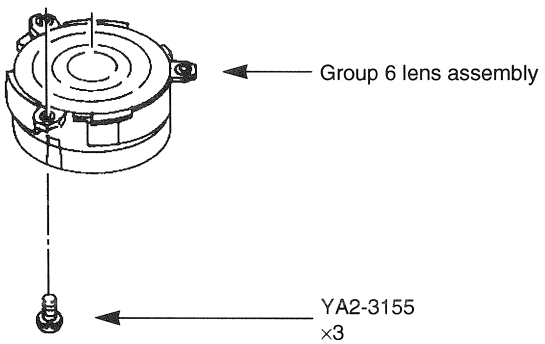


Fig. 3-17 Tilt Adjustment Locations

2) Focus adjustment

* Check and adjust when you disassemble and replace the optical parts.

Purpose:

- Achieve infinity focus.

Standard:

- The center of the index line must meet the A standard.

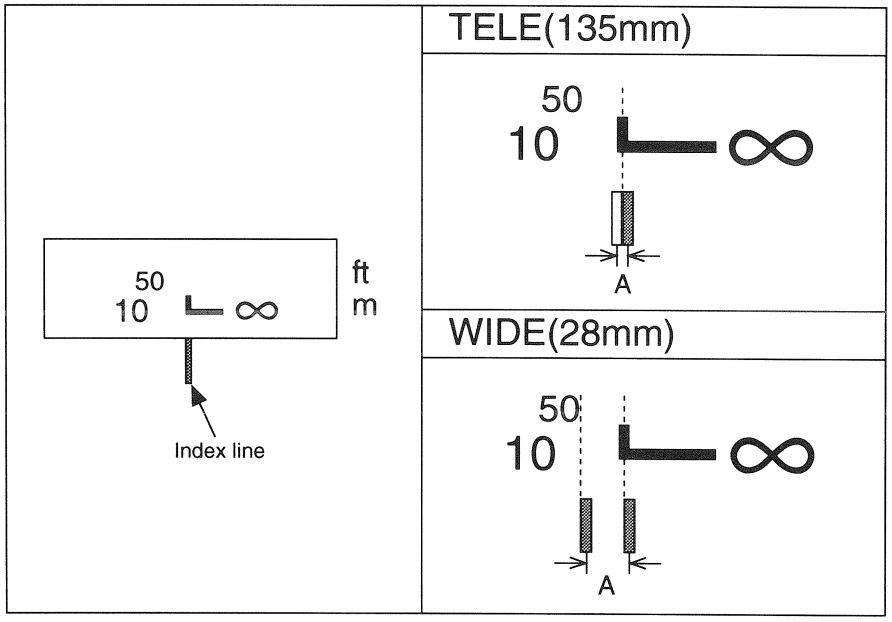


Fig. 3-18 Focus Adjustment Standard

Tools:

- EOS camera with B type focusing screen.
- Magnifier
- General-purpose 600mm collimator (or a distant sharp-edged structure).

Adjustment method:

1. Mount the lens on the camera.
2. Set the focus to infinity focal length.
3. Adjust to meet the standard at tele-position
4. Adjust to meet the standard at wide-position
5. Repeat 3. and 4. until it satisfies the standard at both positions.

Focus adjustment at tele-position

1. Remove filter ring cover (YA2-3147).
2. Undo three screws (CB2-0082) of the group 1 lens assembly.
3. Adjust the group 1 lens assembly by rotating.
4. Put screw lock glue on head of the screws when the adjustment is completed.

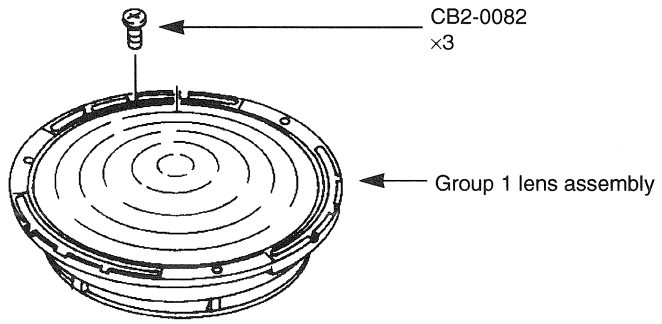


Fig. 3-19 Focus Adjustment at Tele-position

Focus adjustment at wide-position

- Adjust by changing the mount thickness using lens mount and focus washers for service.
  If many focus washers are used, the clearance between the fixed barrel unit and the lens mount increases. The maximum thickness of focus washers must be 0.07mm.

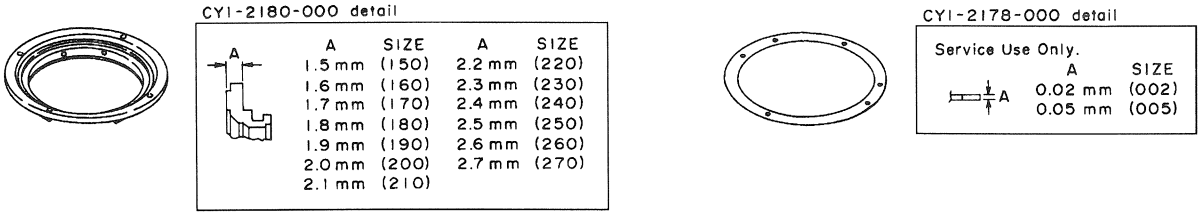


Fig. 3-20 Focus Adjustment at Wide-position

3) Zoom brush position adjustment

Purpose:

- Read zoom pattern correctly.

Tools:

- Tester

Preparation:

1. Pull up half of the zoom ring rubber (YA2-3137) which is adjacent to the mount.
2. Lift off the dustproof sheet (YA2-3157).

Adjustment method:

1. Set the zoom at tele-position (135mm).
2. Adjust mounting position of the zoom brush so that the positioning of the contacting face of the zoom brush and the zoom pattern satisfies the A standard.
3. Confirm that there is no current between the zoom brush and the zoom pattern.
4. Put screw lock glue on head of the screws when the adjustment is completed.

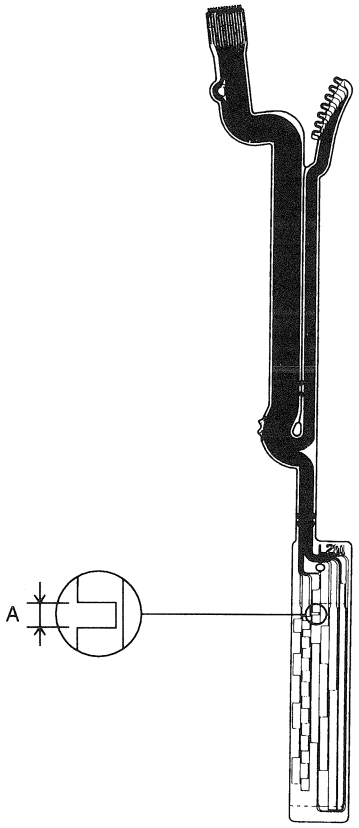


Fig. 3-21 Zoom Brush Adjustment Locations

3.4 Electrical Adjustment

1) Electrical adjustment

• USM frequency adjustment	Obtain reference frequency of USM drive.
• Focus pulse adjustment	Obtain the USM drive information for certain.
• Focus compensation	Adjust AF focusing position to be closer to the actual best focusing position.
• LED current data input	Enter the LED current data of the IS lens unit into the EEPROM. The data is shown on the IS lens unit (CY1-2809).
• Mechanical lock centering	Center the mechanical lock.
• Gyro rank data input	Enter the sensitivity rank of the gyro sensor into the EEPROM. The data is shown on the gyro sensor unit (CY1-2808).
• Gyro sensitivity adjustment	Obtain the best anti-vibration effect.
• Initialize	Write basic data.
• Data save	Save the lens EEPROM data on a disk.
• Data transfer	Transfer the EEPROM data on the disk to the lens.

3) Lens adjustment software

Starting adjustment software

- The adjustment software file is named 28135IS.EXE. If a working disk is created, the program can be executed automatically by using AUTOEXEC.BAT.

Adjustment software operations

- The adjustment software can be controlled by pressing the Return (Enter) key, space bar, and cursor keys. Follow the instructions shown on the screen.

Connecting the lens/camera with the HS-I/F

- Only an EOS KISS / Rebel X / 500 (C12-824X series), or EOS-1N can be used for this adjustment.
- If the EOS KISS is used, the HS-I/F or multiple tool II can be used for adjustment. If the EOS-1N is used, the HS-I/F must be connected for adjustment.

*: The EOS-1N cannot communicate with the multiple tool II.

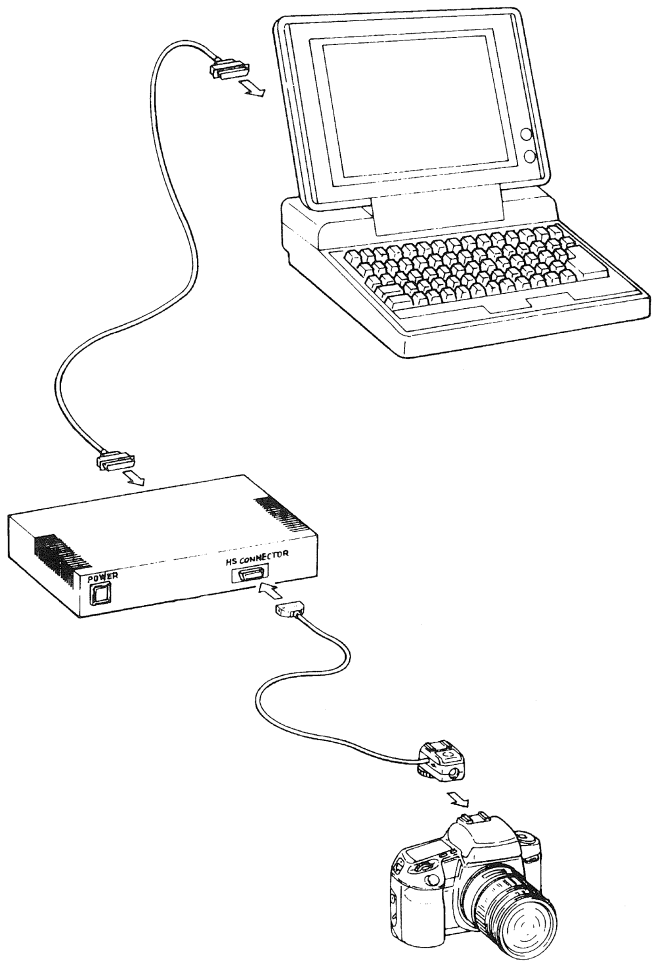
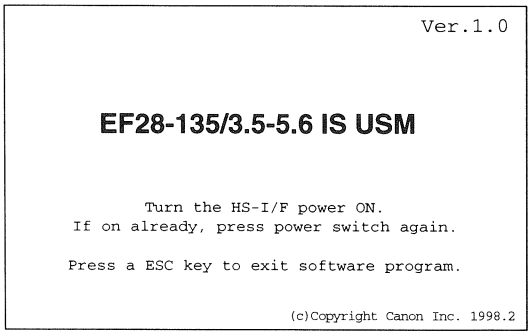


Fig. 3-22 Connecting the Lens/Camera with the Personal Computer

Start of operation

1) Insert the working disk into the disk drive of the personal computer. The screen shown at the right appears.

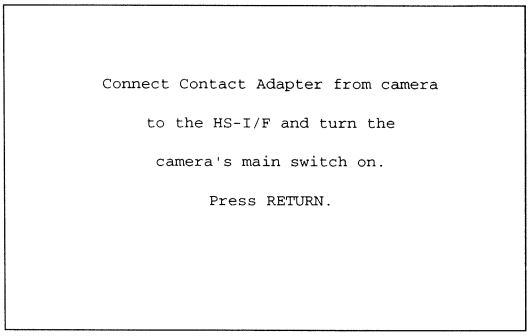
POWON



2) Turn the power to the HS-I/F according to the instructions shown on the screen. If the power is already on, turn it off and on again.

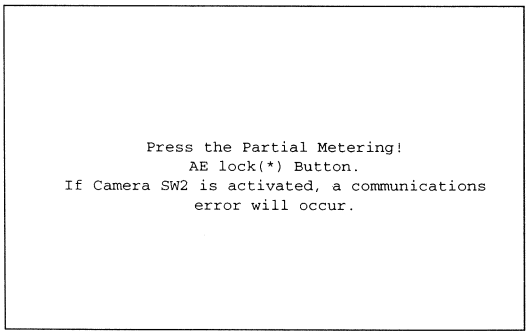
3) If the personal computer is connected with the HS-I/F, the adjustment software displays the screen shown at the right.
Connect the camera according to the instructions shown on the screen, and turn the main switch on the camera on.
After connection, press the Return key.

SET



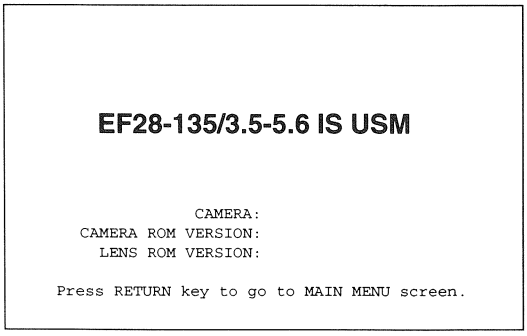
4) It may be necessary to turn the camera's AE lock button ON to communicate with the camera.
Follow the instructions given on the screen by the adjustment software.
An error occurs if the AE lock button is not pressed within about one minute.

WakeUP



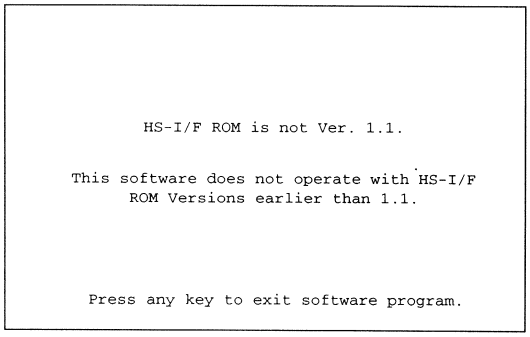
5) An error occurs if the lens is not mounted on the camera.
The adjustment software checks communication with the camera.
After communication, the lens ROM version is displayed as shown in the figure at the right.

POWON2



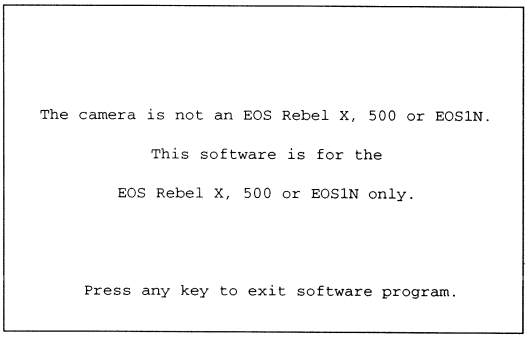
6) The HS-I/F ROM Version 1.1 or later is required to perform electrical adjustments of this lens.
If the HS/I/F ROM version is not 1.1 or later, the adjustment software shows this message.

ERRHSVER

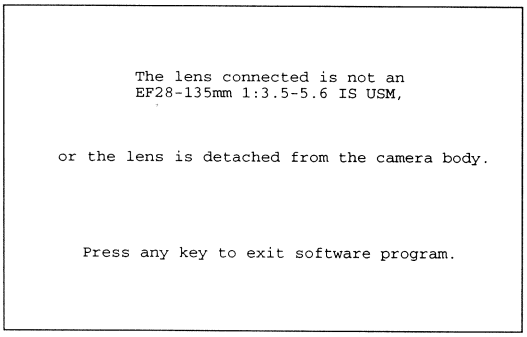


7) The adjustment software will display a message shown on the right when non-applicable camera or other lens is connected.

ERRCAM



ERRLVER



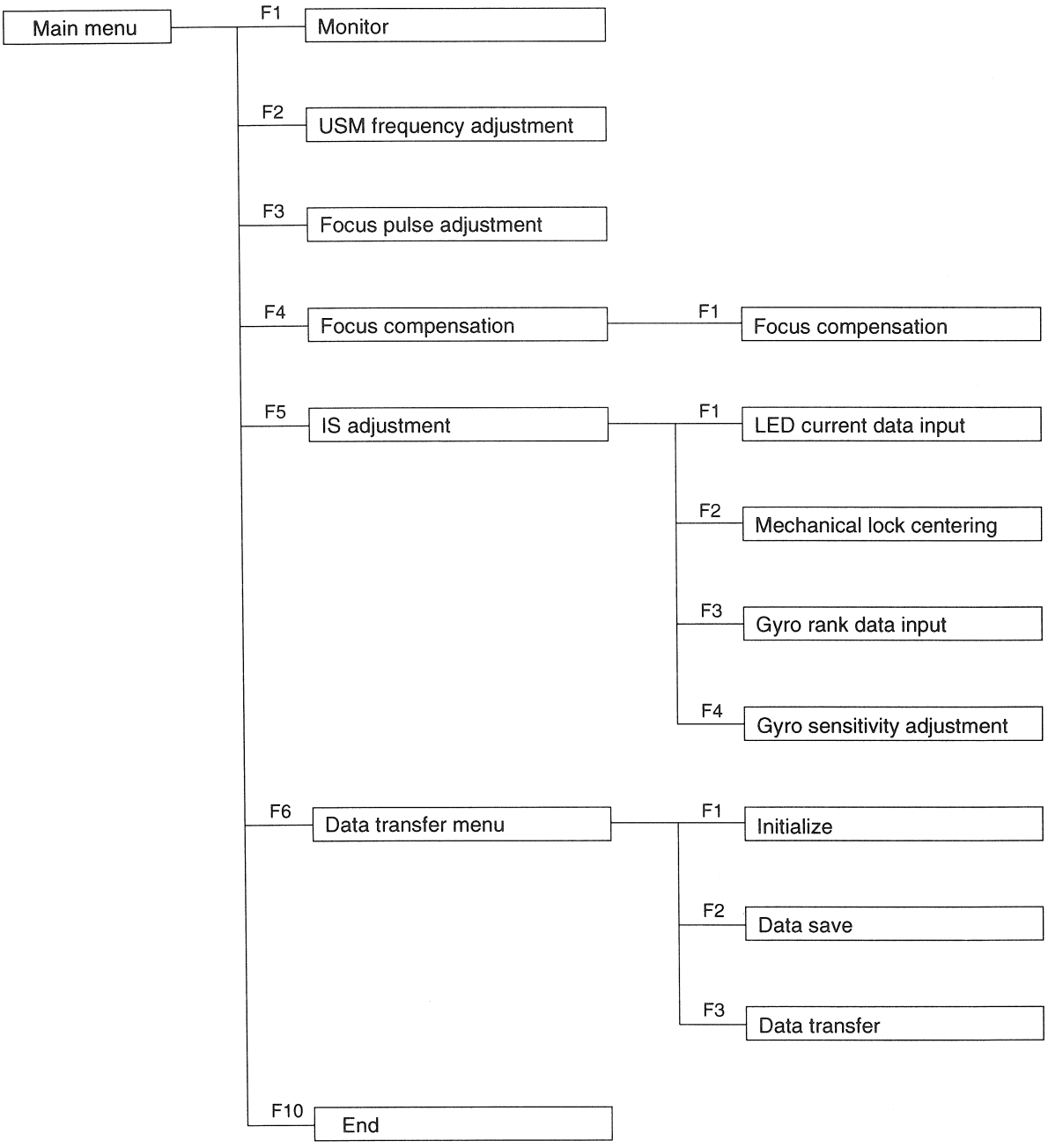


Fig. 3-23 Adjustment Software Menu Configuration

4) USM frequency adjustment

CAUTION

- Implement if you cannot save the old data when replacing the main board unit.
- Perform when you replace the USM unit.

Purpose:

- Establish the USM drive reference frequency.

Tools:

- HS-I/F
- EOS REBEL X / 500 or EOS-1N
- Adjustment software working disk
- Frequency counter
- EF lens electronic ring mount adapter or lens communication tool

Standard:

125.2 +/- 0.2 kHz

Preparation:

1. Remove the back cover, lens mount, and the fixed barrel unit.
2. Solder a lead to each of the FOUT and DGND lands shown in Fig. 3-24.
3. Reassemble except the back cover.
4. Mount the adapter and communication tool and draw the leads out through the inside.

Adjustment method:

1. Select [F2] USM Frequency Adjustment from the adjustment menu.
2. Turn the USM drive ON. (The screen shown at the right appears and indicates the reference frequency.)
3. Connect the leads to the frequency counter.
4. Measure the frequency.
5. If the frequency does not conform to the standard, adjust it referring the screen.
6. Measure the frequency, adjust, then measure the frequency again. Repeat this process until the frequency conforms to the standard.
7. When adjustment is complete, press the Return key.

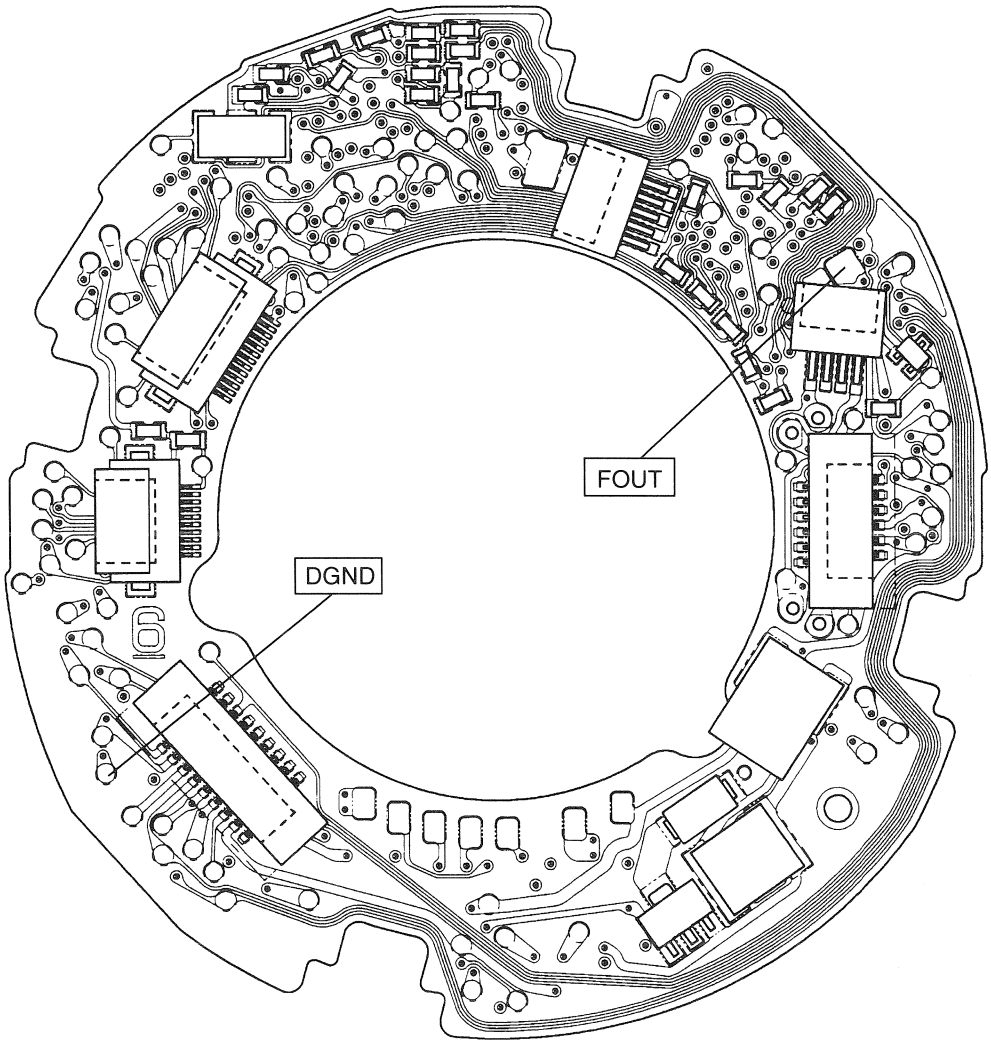


Fig. 3-24 USM Frequency Adjustment Locations

5) Focus pulse adjustment

CAUTION	• Implement if you cannot save the old data when replacing the main board unit. • Perform when you replace the USM unit.

Purpose:

- Adjust the phase to receive USM drive data accurately and efficiently.
- Perform this adjustment if the USM moves unstably (or skips).

Tools:

- HS-I/F
- EOS KISS or EOS-1N
- Adjustment software working disk
- Oscilloscope
- EF lens electronic ring mount adapter or lens communication tool

Standard:

A (high) : B (low) = 5:5 to 6:4

Preparation:

1. Remove the back cover, lens mount, and the fixed barrel unit.
2. Solder a lead to each of the PULSE and DGND lands shown in following figure.
3. Reassemble except the back cover.
4. Mount the adapter or communication tool, and draw the leads out through the inside.

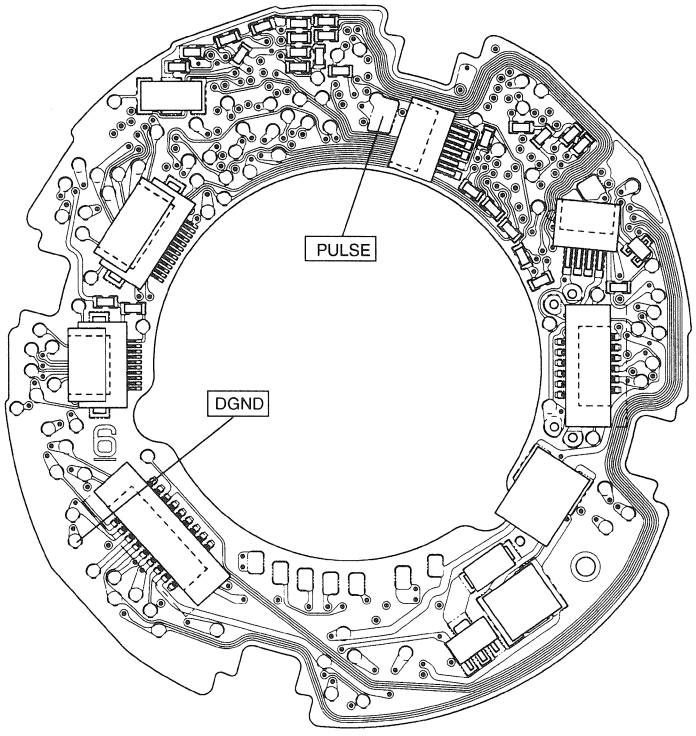
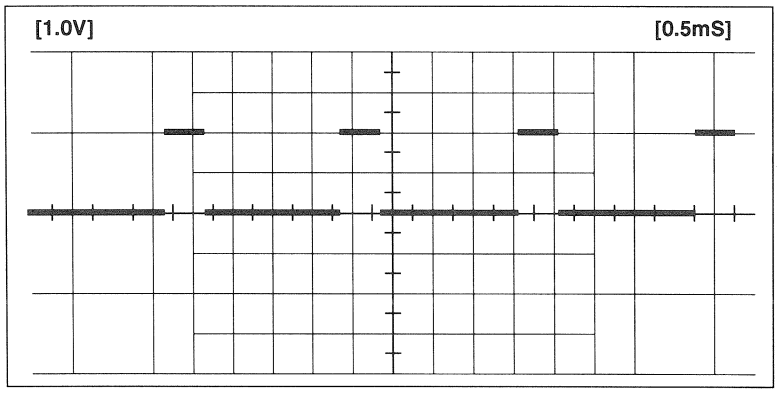


Fig. 3-25 Focus Pulse Adjustment Locations

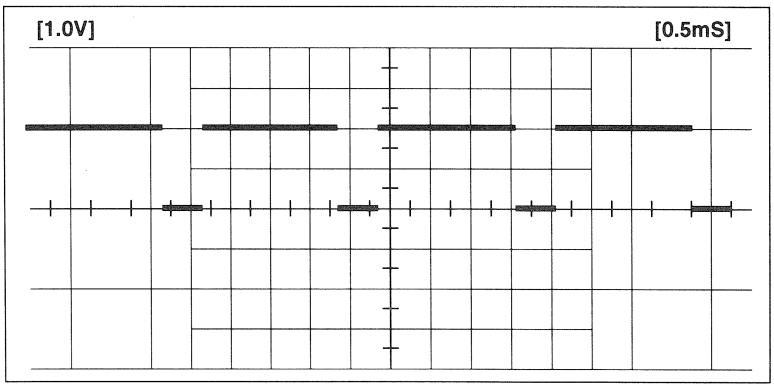
Adjustment method:

1. Select [F3] Focus pulse adjustment in the adjustment menu.
2. Turn the USM drive ON.
3. Connect the leads to the oscilloscope.
4. Press the shutter button (SW-1 only) and observe the waveform.
   (The waveform appears when the USM is driven.)
5. If the pulse does not conform to the standard, adjust it referring the screen.
6. Measure the pulse, adjust, then measure the pulse again. Repeat this process until the pulse conforms to the standard.
7. When adjustment is complete, press the Return key.

① **NG**



② **NG**



③ **OK**

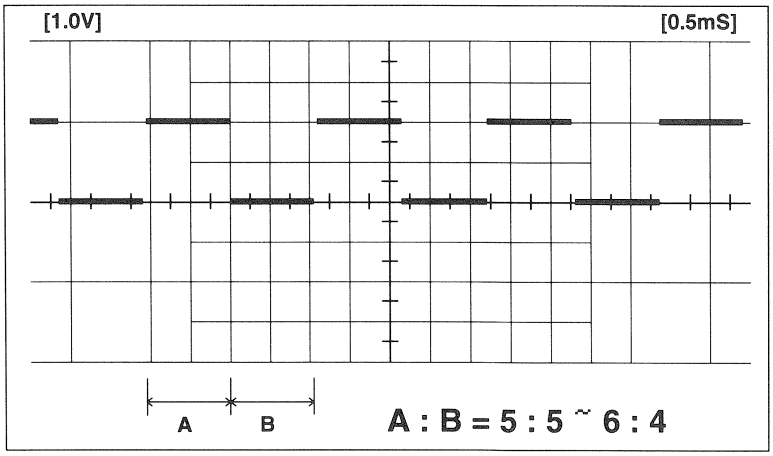


Fig. 3-26 Focus Pulse Waveforms

6) Focus compensation

CAUTION

- Do this adjustment when the optical system is replaced, or when the user requests it.
- Implement if you cannot save the old data when replacing the main board unit.

Purpose:

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

Adjustment method 1

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

Adjustment method 2

- Select [F4] Focusing Correction from the menu, set one of the eight data settings, and make two or three test exposures. Repeat at the other seven data items. Develope the monochrome negatives and determine which data setting gives the best focus.

Tools:

- HS-I/F
- EOS REBEL X / 500 or EOS-1N
  (AF and flange-back are adjusted correctly.)
- Adjustment software working disk
- AF reference chart
- 3D chart

Preparation:

1. Run the adjustment software, connect the camera with the HS-I/F, and then select [F4] Focus adjustment in the main menu.

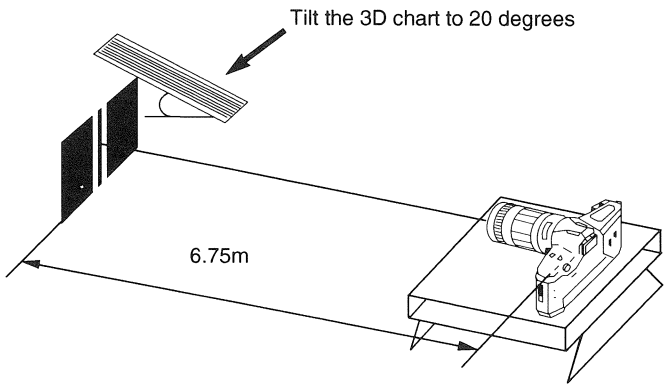
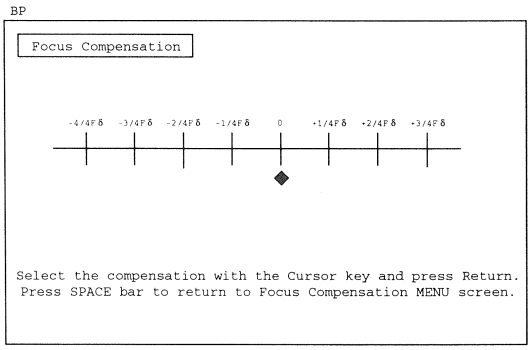


Fig. 3-27 3D Chart Shooting 1

Input:

1) Enter data using the cursor keys.



Test conditions

- Shooting distance: About 6.75 m.
- Target: AF reference chart and 3D chart
  The brightness of the AF reference chart must be about EV 12. A video light should be used. (Do not use a fluorescent lamp.)
- Aperture: Maximum aperture (Aperture Priority)
- Zoom = Tele-position (135mm)
- IS switch = OFF
- Focusing: AF metering from infinity (or closest end) after each exposure (Focus on the AF reference chart.)
- Number of shoots: 2 to 3 with four correction values. (Monochrome films should be used.)
- Check the 3D chart with a 30 to 50 x magnifier or microscope and correct the focus.
- The chart is seen as shown below through the viewfinder.

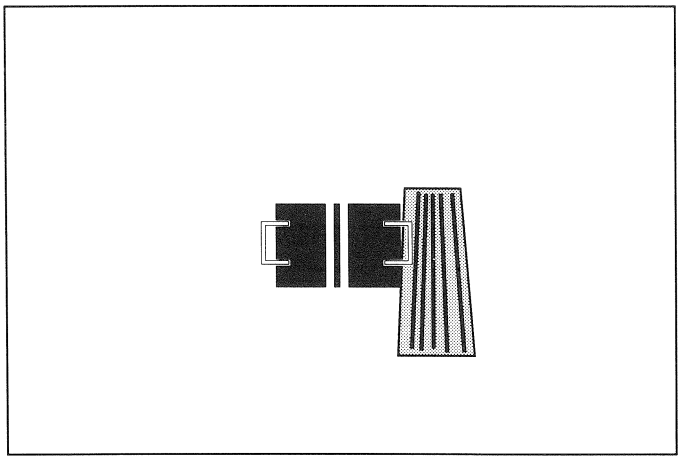


Fig. 3-28 Viewfinder when the 3D Chart is Shot

7) LED current data input

CAUTION

- Implement if you cannot save the old data when replacing the main board unit. (The IS lens unit must be replaced.)
- Perform when you replace the IS lens unit.

Purpose:

- Enter the LED current data of the IS lens unit into the EEPROM.

Tools:

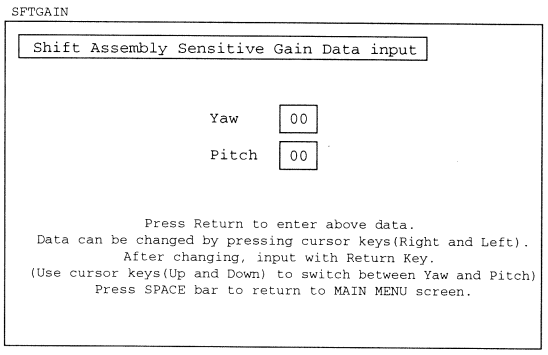
- HS-I/F
- EOS REBEL X / 500 or EOS-1N
- Adjustment software working disk

Preparation:

1. Run the adjustment software, connect the camera with the HS-I/F, then select [F5] IS adjustment in the main menu then [F1] LED current data input.
2. Check the LED current data shown on the IS lens unit (CY1-2809).

Input

1) Input data using the cursor keys. When the Return key is pressed, the computer communicates with the camera and writes data in the camera. (When the space bar is pressed, data is not input, and the main menu returns.)
2) After communication, the main menu returns.



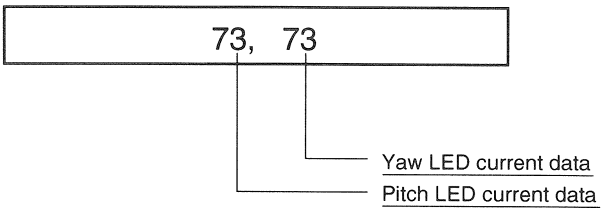


Fig. 3-29 LED Current Data

8) Mechanical lock position adjustment

CAUTION

- Implement whenever you replace the main board unit regardless of whether the old data is saved or not.
- Perform when you replace the IS lens unit.

Purpose:

- Obtain centering when the anti-vibration function turns on. When the camera is fixed on the tripod and the anti-vibration function turns on, the image does not shake if the lens is good. If the image shakes greatly, this adjustment is required.

Tools:

- HS-I/F
- EOS REBEL X / 500 or EOS-1N
- Adjustment software working disk
- EF lens electronic ring mount adapter or lens communication tool

Standard:

- Fix the lens on the tripod and look through the viewfinder. When the anti-vibration function turns on, the image must not move.

Preparation:

1. Install the mount adapter or lens communication tool on the lens.
2. Run the adjustment software, connect the camera with the HS-I/F, then select [F5] IS adjustment in the main menu then [F2] Mechanical centering.
3. Set the lens as shown below.
4. Turn the IS switch ON.

Adjustment

1) Set the lens and press the Return key. The computer carries out adjustment automatically. (It takes about one minute to complete adjustment.)
2) After adjustment, remove the lens from the camera and reinstall it to reset the lens.
The main menu returns.

MLKADJ1

Mechanical Lock Position Adjustment

Place the front of the lens upward

Then press the RETURN key

The adjustment is automatic

Press SPACE bar to return to MAIN MENU screen.

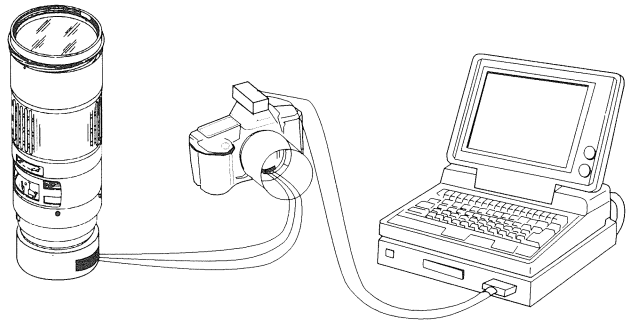


Fig. 3-30 Mechanical Lock Adjustment

9) Gyro rank data input

CAUTION

- Implement if you cannot save the old data when replacing the main board unit.
- Perform when you replace the gyro sensor unit.

Purpose:

- Enter the sensitivity rank of the gyro sensor into the EEPROM.

Tools:

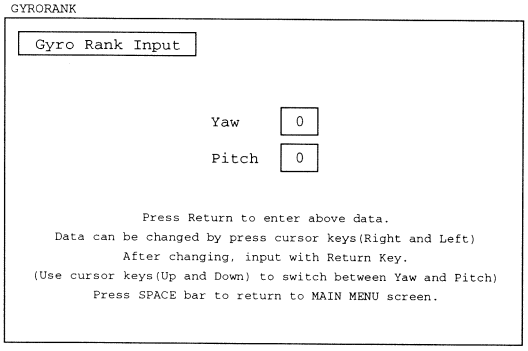
- HS-I/F
- EOS REBEL X / 500 or EOS-1N
- Adjustment software working disk

Preparation:

1. Run the adjustment software, connect the camera with the HS-I/F, and then select [F5] IS adjustment in the main menu and [F3] Gyro rank data input.
2. Check the gyro rank data shown on the gyro sensor unit (CY1-2808).

Input

1) Input data using the cursor keys. When the Return key is pressed, the computer communicates with the camera and writes data into the camera. (When the space bar is pressed, data is not input, and the main menu returns.)
2) After communication, the main menu returns.



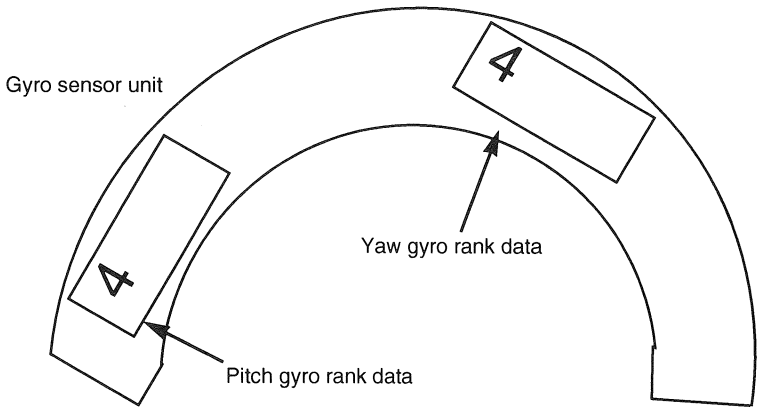


Fig. 3-31 Gyro Sensor Data Location

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10) Gyro sensitivity adjustment

CAUTION

- Implement whenever you replace the main board unit regardless of whether the old data is saved or not.
- Perform when you replace the IS lens unit or the gyro sensor unit.

Purpose:

- Find the peak anti-vibration effect to achieve the best anti-vibration effect.

Tools:

- HS-I/F
- EOS REBEL X / 500 or EOS-1N (Note that the EOS-1N cannot be mounted directly to the vibration table. Put a tripod head on the table and install the EOS-1N on it.)
- Vibration table
- Chart

Standard:

Perform adjustment so that the penlight movement is minimized (within the viewfinder frame). Reduce the shake to 1/4 or less visually when the anti-vibration function turns on.

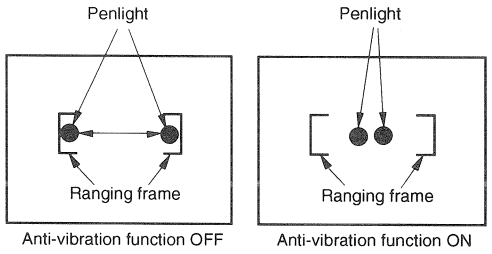


Fig. 3-32 Anti-vibration Effect

Preparation:

1. Set the lens as shown below. (Set the penlight at the center of the ranging frame.) Set the lens to TELE, the IS switch to ON, IS mode to 1 and A/M switch to MF.
   If the vibration table is not available, adjustment can be performed by shaking the camera manually.
2. Run the adjustment software, connect the camera with the HS-I/F, and then select [F5] IS adjustment in the main menu and [F4] Gyro sensitivity adjustment.

Distance to the chart: 2.5 m
Vibration angle: 0.1 degree (Adjust with the control on the vibration table.)
Frequency: 5 Hz (Apply 9 V to the vibration table.)
Final check is to be performed at 5 Hz, but initial adjustment may be easier at a lower frequency (3 Hz, 6 V).

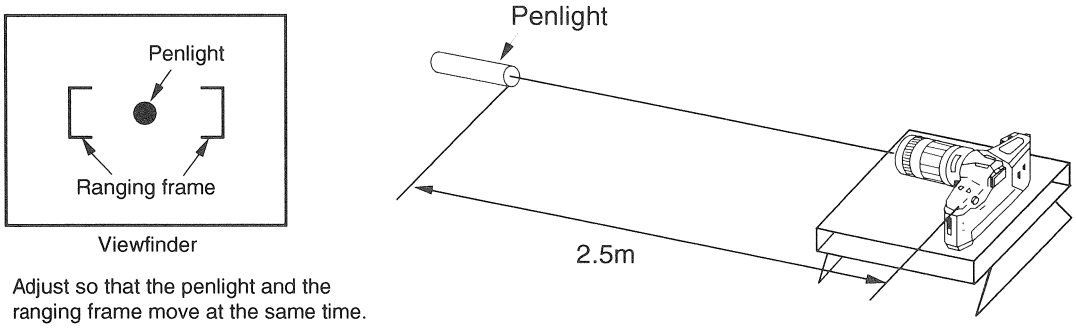
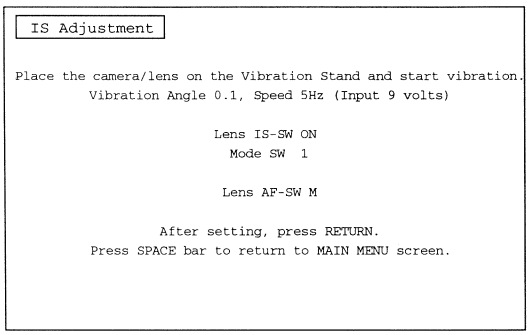


Fig. 3-33 Gyro Sensitivity Adjustment

Adjustment:

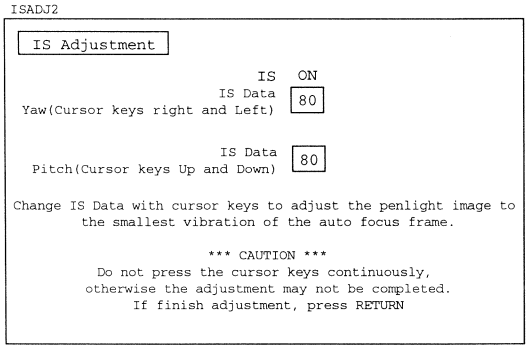
1) Supply power to the vibration table and apply vibration to the camera and lens.
Apply 9 V to the vibration table (5 Hz) and set the view angle to 0.1 degree. (Initial adjustment may be easier at a lower frequency i.e. 3 Hz.)

ISADJ1



2) When the Return key is pressed, the lens activates the shake prevention function. The gyro sensitivity can be set using the cursor keys. Maximize the shake prevention effect.
Adjust the yaw (horizontal) direction with the right and left cursor keys.
Adjust the pitch (vertical) direction with the up and down cursor keys.

ISADJ2



Note:

When the sensitivity is changed by one step, wait for two or three seconds and check the IS effect.
(If cursor keys are pressed continuously, adjustment may not be performed. Terminate the adjustment, remove and reinstall the lens while the main menu is displayed, and perform adjustment again.)

3) When the return key is pressed, the "Reset" screen appears. Remove and replace the lens. (During the gyro sensitivity adjustment the lens is in a special test mode and IS will not work until this step is performed.)

4) When the return key is pressed, you can return to the Gyro sensitivity adjustment menu.

11) Data transfer

CAUTION

- When you replace the main board unit, the data stored in it must be saved.
- After the data transfer, return to the main menu and remove and reinstall the lens.

- One of the following two options can be selected to transfer data.
  1. Initialize: Initialize the main flex.
  2. Data Save: Save camera data.
  3. Data Transfer: Transfer the saved data.

Initialize

- When you select Initialize, the screen shown in the figure at the right appears. Press the Return key to initialize the main flex. Press the space bar to return to the main menu.

INIT

```
!! Initialize !!"

Press RETURN to Initialize.

Press SPACE bar to return to Data MENU screen.
```

Note:

After the data transfer, return to the main menu and remove and reinstall the lens.

Data Save

When you select Data Save, the screen shown in the figure at the right appears. Select a file using the cursor keys, and press the Return key. Enter a comment. After entering a comment, press the Return key to save the camera data.

DATC_T

```
DATA STORAGE

Lens --> Disk

Select file number with cursor keys.
Press RETURN and type comment if
desired. Press RETURN to transfer data.

Files
 1.
 2.
 3.
 4.
 5.

Press SPACE bar to return to"
DATA TRANSFER MENU screen."
```

Data Transfer

When you select Data Transfer, the screen shown in the figure at the right appears. Select a file using the cursor keys, and press the Return key. The camera data will be transferred.

DATT_C

```
DATA TRANSFER

Disk --> Lens

Select file number with cursor key
Press RETURN to transfer

Files
 1.
 2.
 3.
 4.
 5.

Press SPACE bar to return to
DATA TRANSFER MENU screen.
```

Note:

After the data transfer, return to the main menu and remove and reinstall the lens.

4. LENS COMMUNICATION TOOL

Uses

- The lens communication tool is used in place of the service tool "EF lens electronic ring mount adapter".
- It is used to adjust the USM frequency, focus pulse, and mechanical lock centering. (This tool cannot be used for optical adjustment that requires a lens projector or collimator.)

Preparation:

- Obtain the following parts from EF 50mm 1:1.8II.
  YA2-0121-000 Contact block screws (2)
  YA2-0425-000 Body
  YA2-0442-000 Contact block

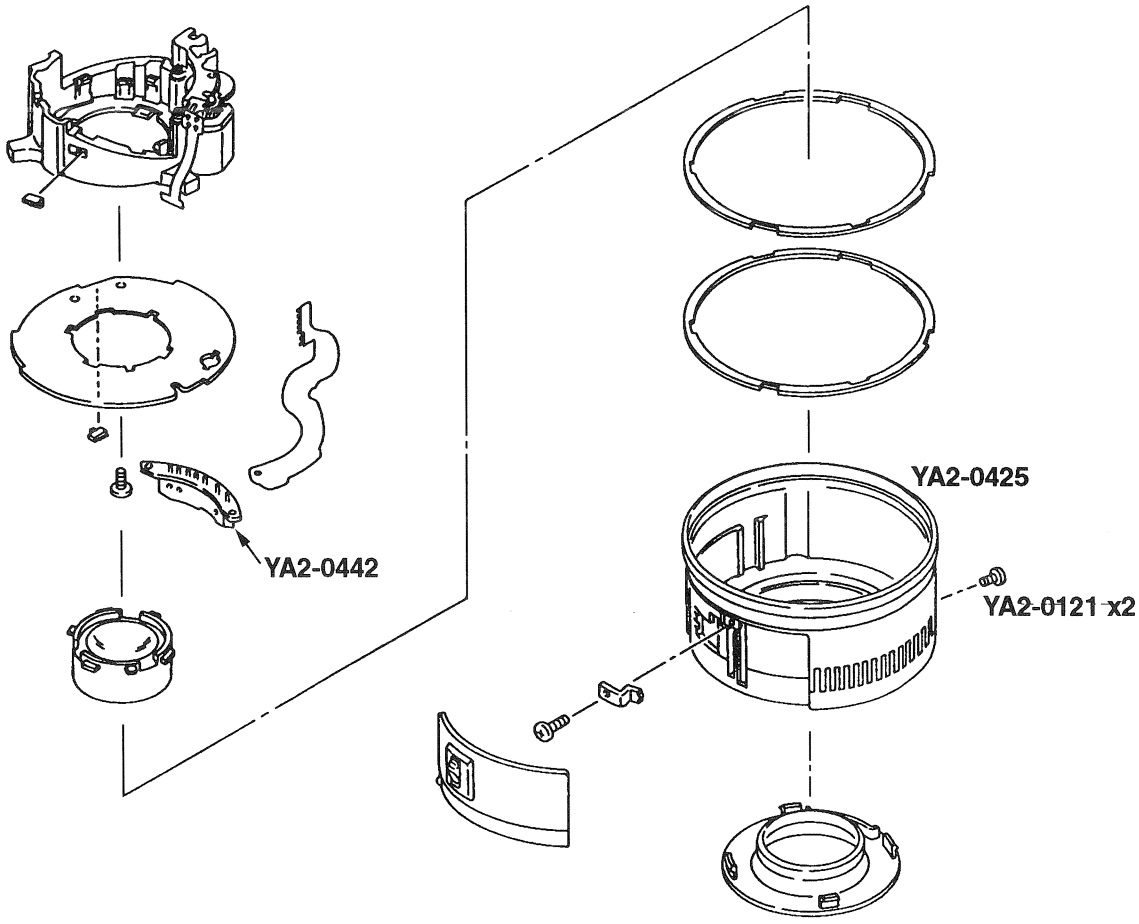


Fig. 3-34 Removing Parts from the EF 50mm 1:1.8II

- Obtain the following components from the EOS KISS (REBEL X/500).
  - CB1-1142-000 Mount screws (5)
  - CB1-3441-000 Mount
  - CB1-3442-000 MIF spring
  - CF1-1948-000 Lock pin unit
  - CG1-1381-000 Contact seat unit
  - CS2-5020-000 Lock pin spring
  - CY1-1610-000 Front panel unit
  - XA4-9170-509 Screw (2)

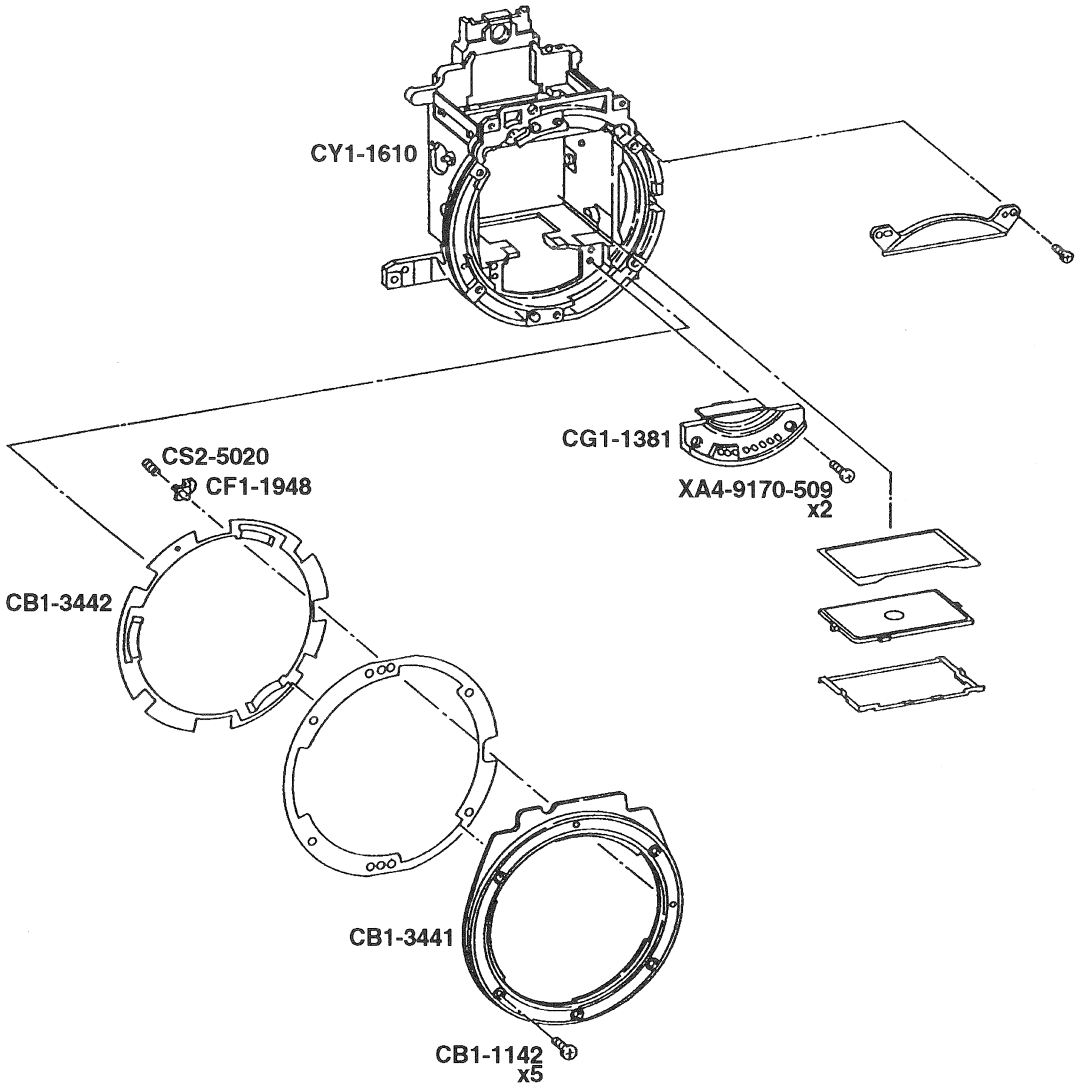


Fig. 3-35 Removing Parts from EOS KISS

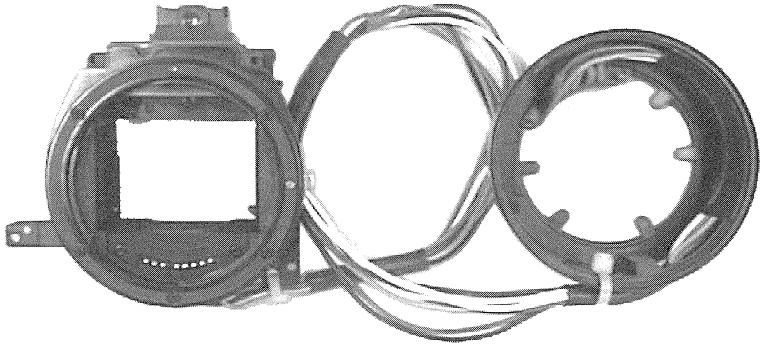


Fig. 3-36 Lens Communication Tool

Creation method

- Connect the camera contact seat with the lens contact block with leads.
- Use seven leads 30 to 40 cm long.

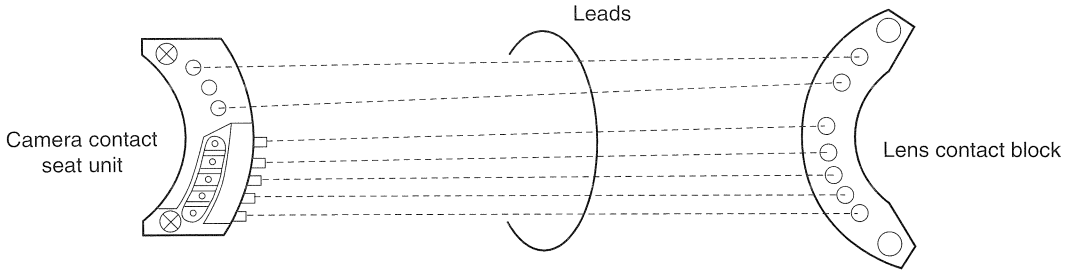


Fig. 3-37 Lead Connection

- Install the contact seat on the front panel unit and install the mount.
- Install the contact block on the main unit.
- Cut off the projection of the front panel unit so that its height is the same as the height of the shutter unit installation surface of the front panel unit. (See Fig. 3-38.)

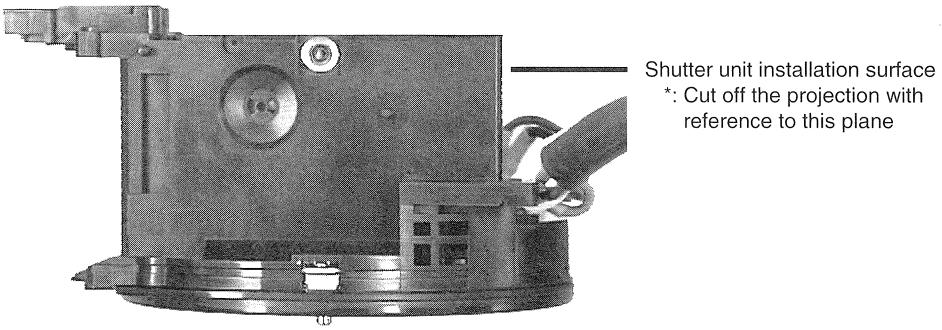


Fig. 3-38 Front Panel Unit Cutting

EF28-135mm 1:3.5-5.6 IS USM C21-9931

Service Manual Correction

Japanese Edition CY8-1100-153
English Edition CY8-1200-173

P.g. 3-7 1.3 Service Tools List:

In "1.3 Service Tools List", the adjustment item for the EF lens electronic ring mount adaptor (CY9-2001-004) and the Lens communication tool is corrected as follows:

Incorrect:
USM frequency adjustment
Focus pulse adjustment
Mechanical lock centering

Correct:
USM frequency adjustment
Focus pulse adjustment

P.g. 3-22 Table 3-1 Flow of Adjustments:

In "Table 3-1 Flow of Adjustment", the adjustment order is corrected as follows:

Incorrect Order: →

Electrical Adjustment				
6	7	8	9	10
Focus compen-sation	LED current data input	Mecha-nical lock centering	Gyro rank data input	Gyro sensitivity adjustment

Correct Order: →

Electrical Adjustment				
10	6	7	8	9
Focus compen-sation	LED current data input	Mecha-nical lock centering	Gyro rank data input	Gyro sensitivity adjustment

P.g. 3-30 3) Lens Adjustment Software:

1. The adjustment software file name is corrected as follows:

   Incorrect: 28135IS.EXE

   Correct: C21-9931.EXE

2. The description for cameras used for the adjustment is corrected as follows:

   Incorrect:

   - If the EOS KISS is used, the HS-I/F or multiple tool II can be used for adjustment. If the EOS-1N is used, the HS-I/F must be connected for adjustment.

   *: The EOS-1N cannot communicate with the multiple tool II.

   Correct:

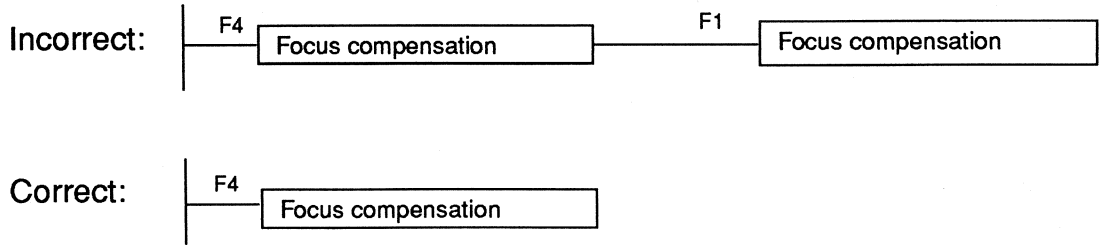
   - EOS KISS / Rebel X / 500 (C12-824X series) and EOS-1N can be used with either HS-I/F or multiple tool II.

3. The caution for use of the adaptor (communication tool) is added.

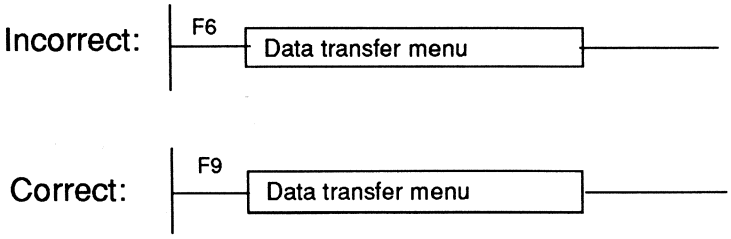
   Note:
   To reset the lens while using the EF lens electronic ring mount adaptor or the lens communication tool, remove and reattach the adapter (or communication tool) on the camera side. The lens sensor SW is on the camera mount.

P.g. 3-33 Adjustment Software Menu Configuration

1. In Fig. 3-23 Adjustment Software Menu Configuration, the item "Focus Compensation" is corrected as follows:



2. The item "Data transfer menu" is corrected as follows:



P.g. 3-34 USM Frequency Adjustment Method:

The Adjustment method of USM Frequency Adjustment is corrected as follows:

Incorrect:

2. Turn the USM drive ON. (The screen shown at the right appears and indicates the reference frequency.)

Correct:

2. USM frequency signal is output constantly.

Incorrect:

7. When adjustment is completed, press the Return key.

Correct:

7. When the frequency conforms to the standard, select "0" compensation, then press RETURN.

P.g. 3-36 Focus Pulse Adjustment Standard:

The Standard for the Focus pulse adjustment is corrected as follows:

Incorrect: A (Hi) : B (Low) = 5:5 to 6:4

Correct: A (Hi) : B (Low) = 47:53 to 53:47

P.g. 3-37 Focus Pulse Adjustment Method & Setting:

1. The adjustment method of Focus Pulse Adjustment is corrected as follows:

Deletion: 2. Turn the USM drive ON.

Incorrect:

4. Press the shutter button (SW-1 only) and observe the waveform. (The waveform appears when the USM is driven.)

Correct:

4. Press Esc key and observe the waveform. (The wave form appears when the USM is driven.)

Incorrect: 7. When adjustment is completed, press the Return key.

Correct:

7. When the waveform conforms to the standard, select "0" compensation, then press RETURN.

2. Focal Pulse Adjustment setting is corrected as follows:

Incorrect: 1.0V 0.5mS A : B = 5 : 5 ~ 6 : 4

Correct: 2.0V 0.1mS A : B = 47 : 53 ~ 53 : 47

P.g. 3-41 Mechanical Lock Position Adjustment:

1. The tools for Mechanical lock position adjustment is corrected.

   Deletion: EF lens electronic ring mount adaptor or lens communication tool

2. "Preparation" for Mechanical lock position adjustment is corrected.

   Deletion: 1. Install the mount adapter or lens communication tool on the lens.

3. "Adjustment" for Mechanical lock position adjustment is corrected.

Incorrect:	Correct:
2) After adjustment, remove the lens form the camera and reinstall it to reset the lens. The main menu returns.	2) When the adjustment is completed, the screen returns to main menu.

4. The adjustment screen for Mechanical lock position adjustment is corrected.

   Incorrect:

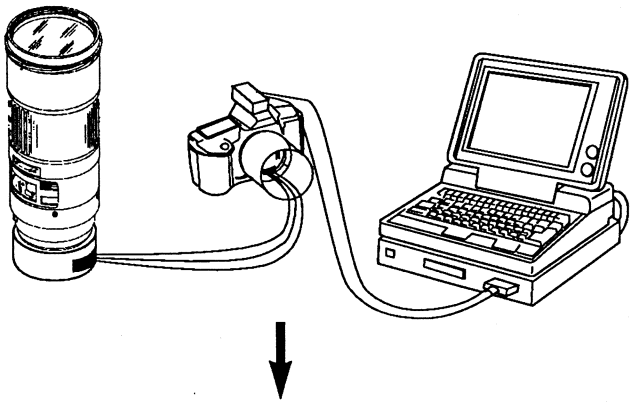
   ```
   Place the front of the lens upward
      Then press the RETURN key
   ```

   Correct:

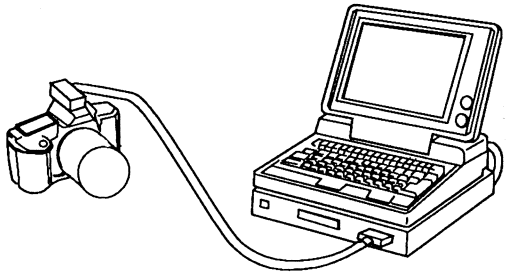
   ```
   Place the lens horizontal position
         Then press RETURN.
   ```

5. Fig. 3-30 Mechanical Lock Adjustment is corrected as shown below.

Incorrect:



Correct:



P.g. 3-44 Tools for Gyro Sensitivity Adjustment:

The tools for Gyro sensitivity adjustment is corrected.

Incorrect:

- EOS REBEL X / 500 or EOS-1N (Note that the EOS-1N cannot be mounted directly to the vibration table. Put a tripod head on the table and install the EOS-1N on it.)

Correct ("Note" in parentheses is deleted.):

- EOS KISS / Rebel X / 500 (C12-824X series) or EOS 1N

P.g. 3-45 Gyro Sensitivity Adjustment:

1. In the article 2) of "Adjustment" for Gyro sensitivity adjustment is corrected.

Incorrect:

Note:
When the sensitivity is changed by one step, wait for tow or three seconds and check the IS effect.
(If cursor keys are pressed continuously, adjustment may not be performed. Terminate the adjustment, remove and reinstall the lens while the main menu is
displayed,and perform adjustment
again.)

Correct:

Note:
When the sensitivity is changed by
one step, wait for two or three seconds
and check the IS effect. (If cursor keys
are hold down, adjustment software
may be stopped.
If stopped, reset the computer.

2. In the article 3) of "Adjustment" for Gyro sensitivity adjustment, description in parentheses is deleted.

Deletion: During the gyro sensitivity adjustment the lens is in a special test mode and IS will not work until this step is performed.

Part 4

Parts Catalog

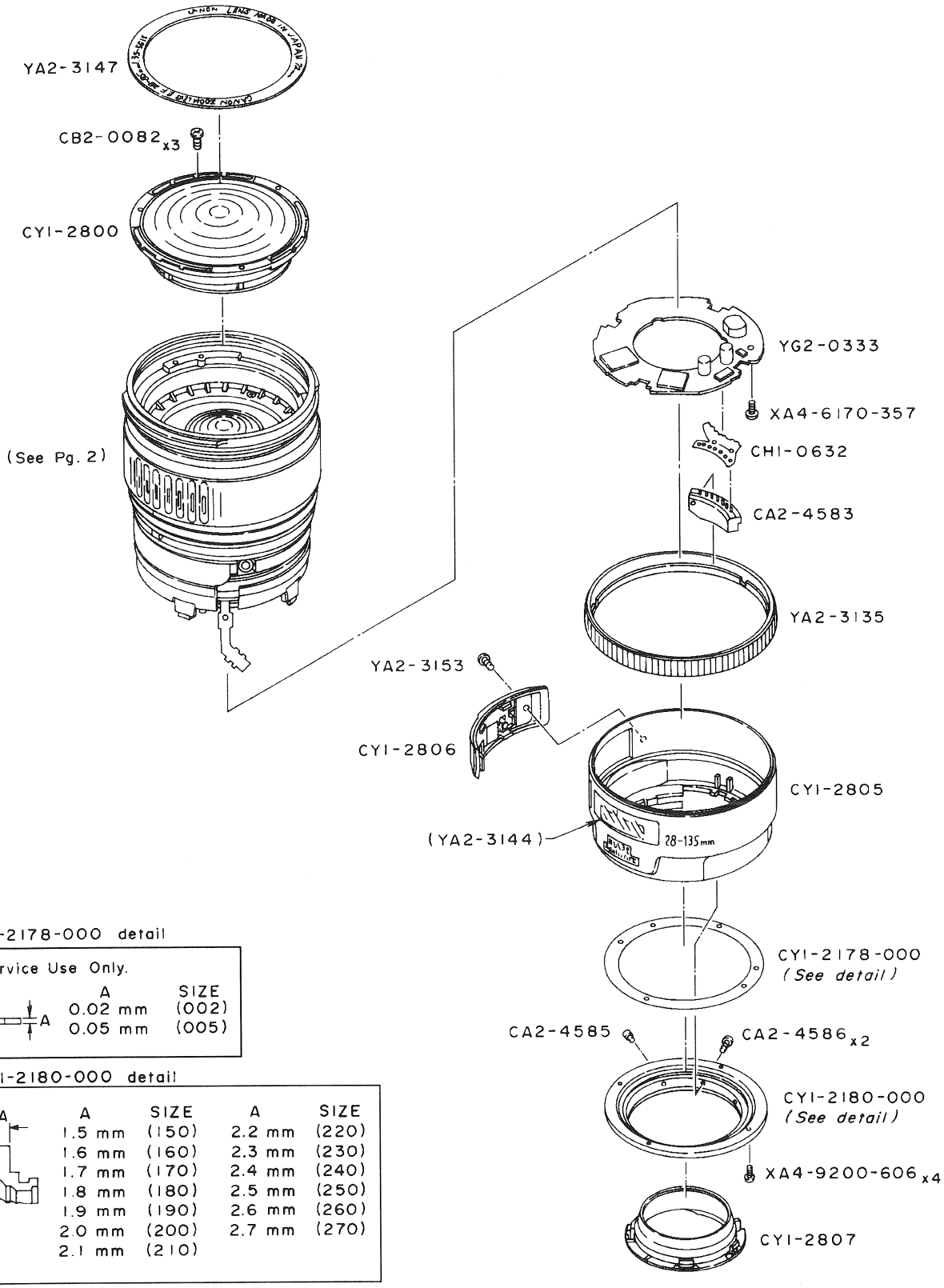
Canon

EF 28-135mm 1:3.5-5.6 IS USM

REF.NO.C21-9931

PARTS CATALOG

CANON LENS EF 28-135 mm 1:3.5-5.6 IS USM



CY1-2178-000 detail

Service Use Only.

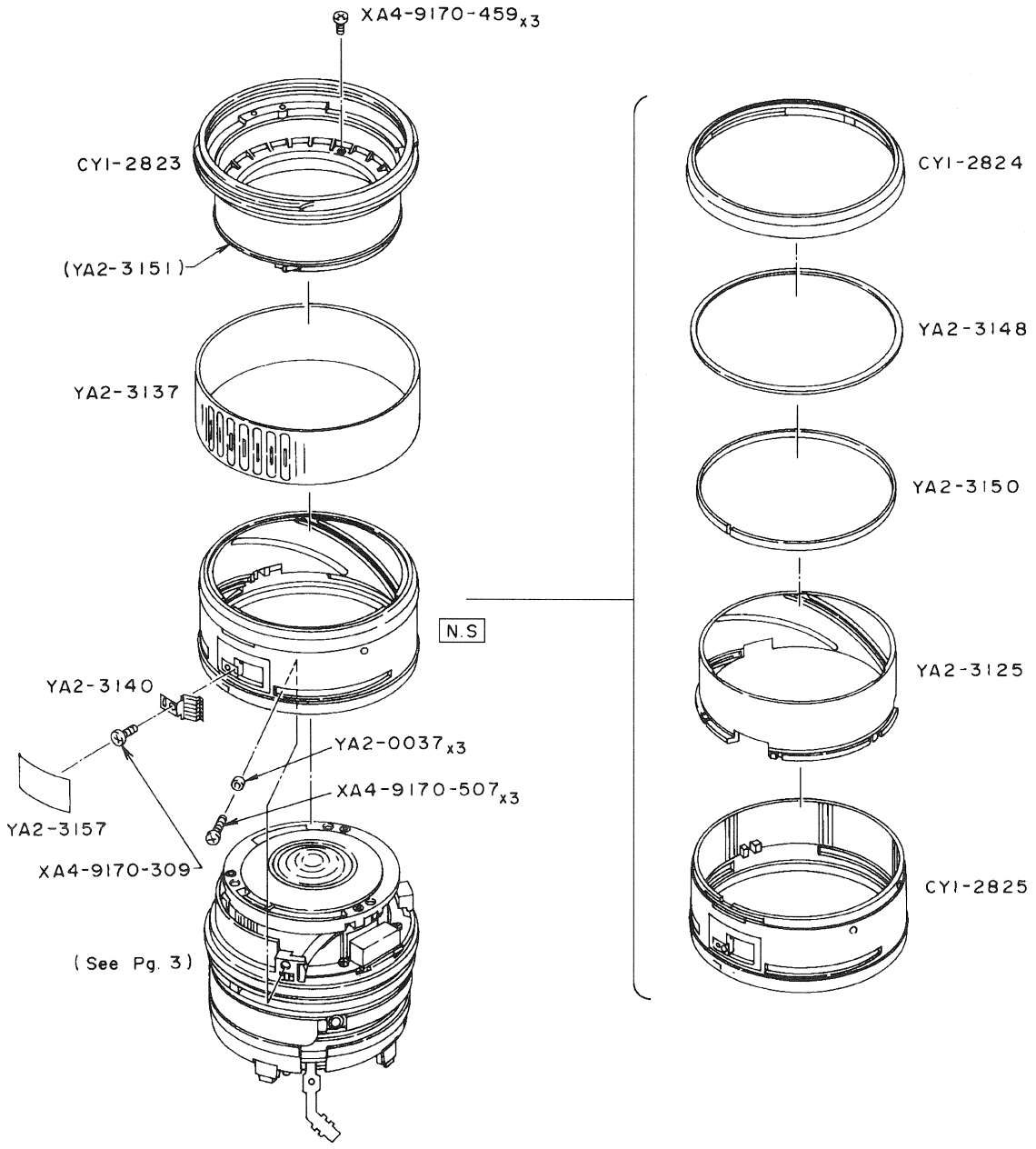
A	SIZE
0.02 mm	(002)
0.05 mm	(005)

CY1-2180-000 detail

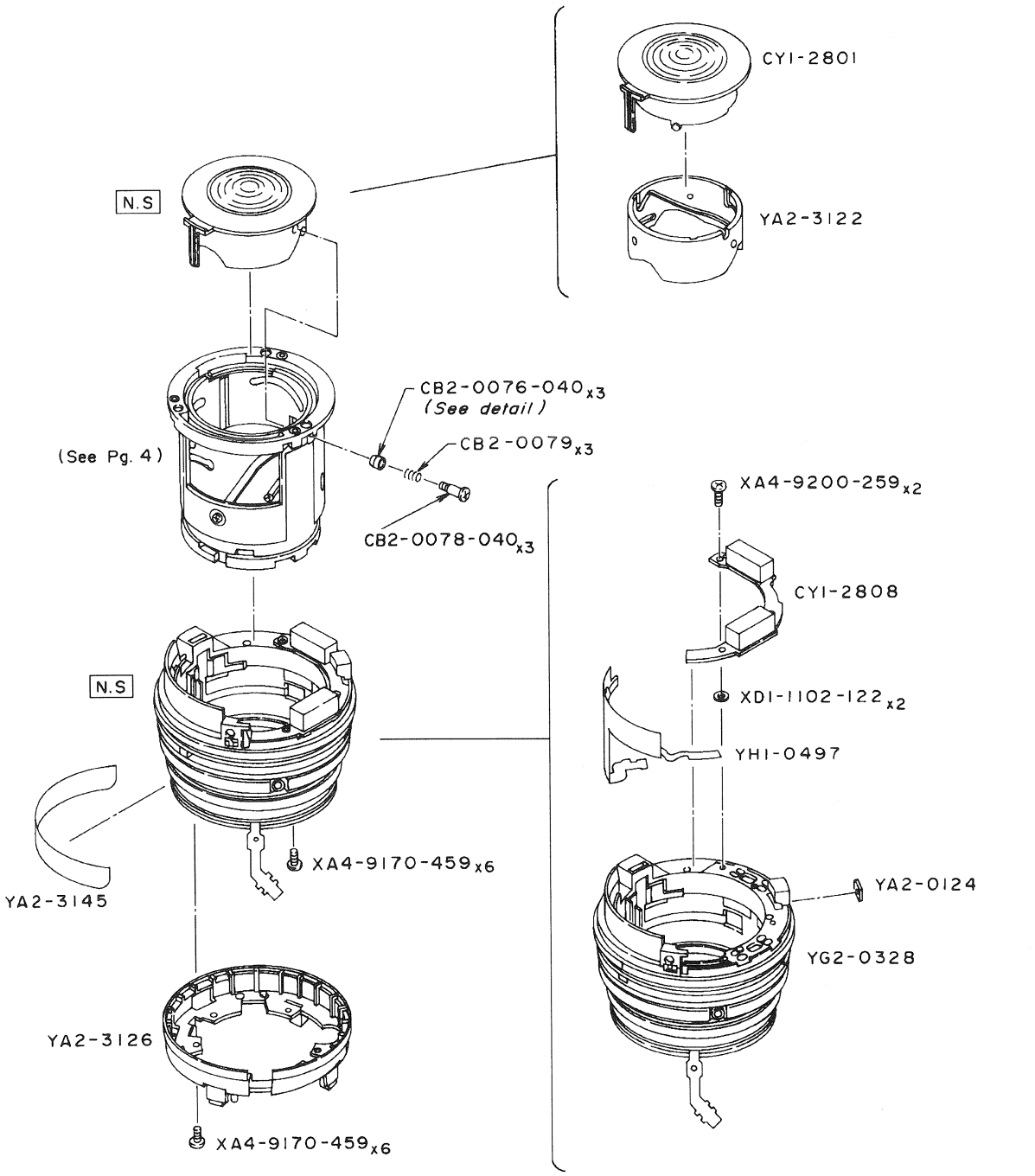
A	SIZE	A	SIZE
1.5 mm	(150)	2.2 mm	(220)
1.6 mm	(160)	2.3 mm	(230)
1.7 mm	(170)	2.4 mm	(240)
1.8 mm	(180)	2.5 mm	(250)
1.9 mm	(190)	2.6 mm	(260)
2.0 mm	(200)	2.7 mm	(270)
2.1 mm	(210)		

REF. NO. C21-9931

CANON LENS EF 28-135 mm 1:3.5-5.6 IS USM



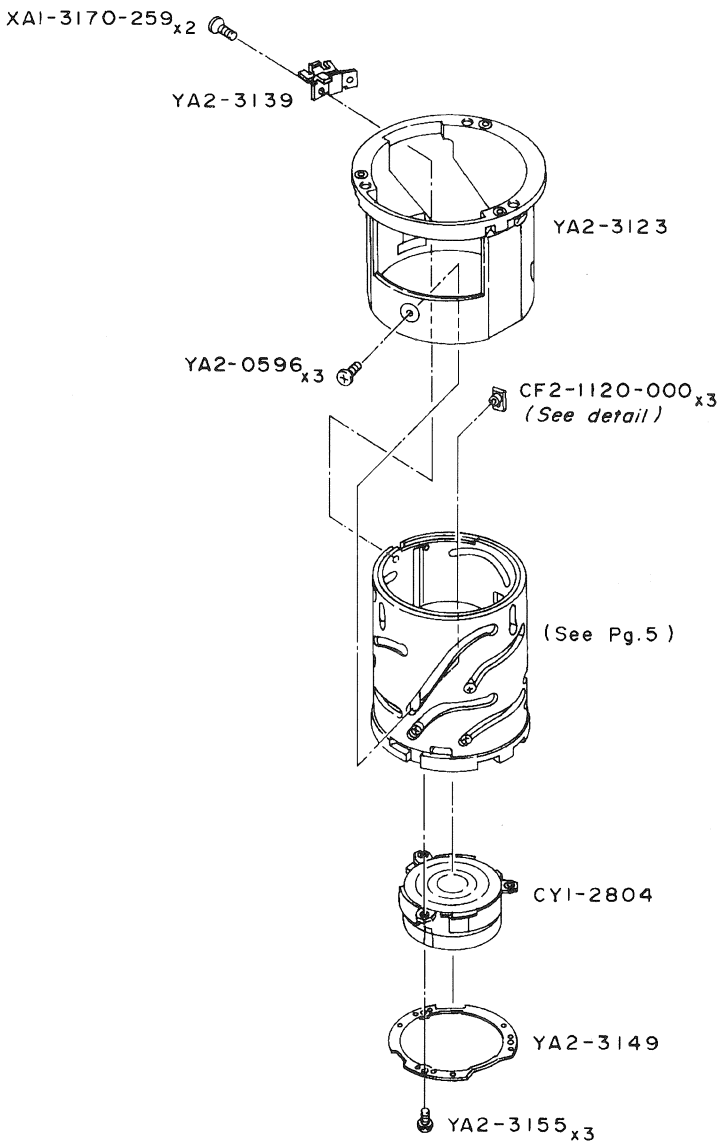
CANON LENS EF 28-135 mm 1:3.5-5.6 IS USM



CB2-0076-040 detail

A	SIZE
φ3.99 mm	(399)
φ4.00 mm	(400)

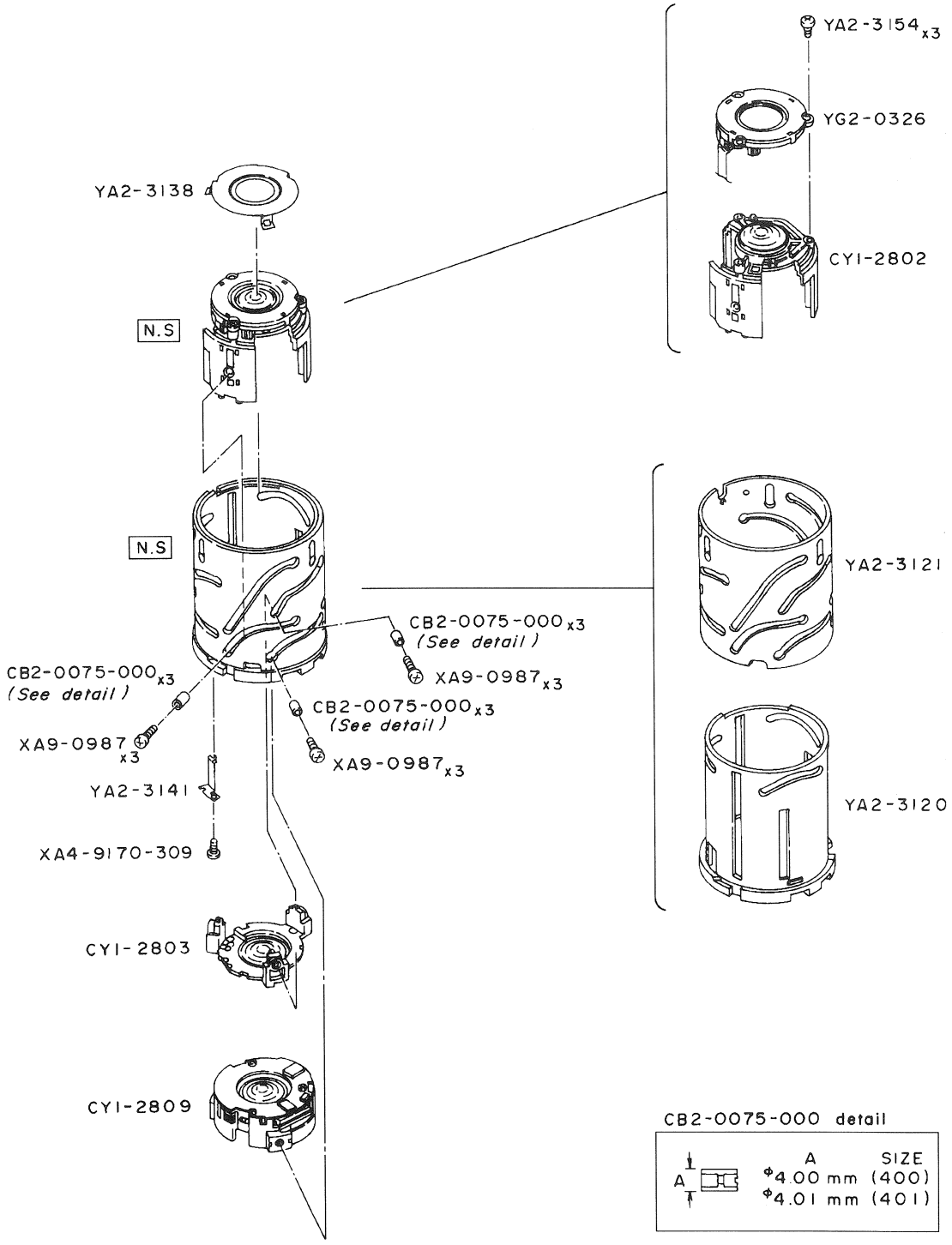
CANON LENS EF 28-135 mm 1:3.5-5.6 IS USM



CF2-1120-000 detail

A	SIZE
φ4.01 mm	(401)
φ4.02 mm	(402)

CANON LENS EF 28-135 mm 1:3.5-5.6 IS USM



PARTS LIST

REF.NO. C21-9931

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	9	COLLAR	3,4,5群コロ	5
	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
	CB2-0082-000		3	SCREW, CROSS-RECESS, PH		1
	CF2-1120-000(XXX)	E	3	KEY	直進キー	4
	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
*	CY1-2800-000	E	1	LENS ASS'Y, 1st GROUP	1群鏡筒ユニット	1
*	CY1-2801-000	E	1	LENS ASS'Y, 2nd GROUP	2群鏡筒ユニット	3
*	CY1-2802-000	E	1	LENS ASS'Y, 3rd GROUP	3群鏡筒ユニット	5
*	CY1-2803-000	E	1	LENS ASS'Y, 4th GROUP	4群鏡筒ユニット	5
*	CY1-2804-000	E	1	LENS ASS'Y, 6th GROUP	6群鏡筒ユニット	4
*	CY1-2805-000	D	1	BARREL ASS'Y, FIXED	固定筒ユニット	1
*	CY1-2806-000	D	1	A/M SWITCH ASS'Y	A/Mスイッチユニット	1
*	CY1-2807-000	E	1	COVER, BACK	裏蓋	1
*	CY1-2808-000	D	1	SENSOR ASS'Y, GYRO	ジャイロセンサーユニット	3
*	CY1-2809-000	D	1	IS LENS UNIT	ISレンズユニット	5
*	CY1-2823-000	D	1	RING ASS'Y, FRONT	フィルター枠ユニット	2
*	CY1-2824-000	D	1	RING, NAME	ネームリング	2
*	CY1-2825-000	D	1	RING, ZOOM	ズーム操作環	2
	XA1-3170-259		2	SCREW, CROSS-RECESS, PH		4
	XA4-6170-357		1	SCREW, CROSS-RECESS		1
	XA4-9170-309		2	SCREW, CROSS-RECESS, PH		2,5
	XA4-9170-459		15	SCREW, CROSS-RECESS, PH		2,3
	XA4-9170-507		3	SCREW, CROSS-RECESS, PH		2
	XA4-9200-259		2	SCREW, CROSS-RECESS, PH		3
	XA4-9200-606		4	SCREW, CROSS-RECESS, PH		1
*	XA9-0987-000		9	SCREW, CROSS-RECESS, PH		5
	XD1-1102-122	F	2	WASHER		3
	YA2-0037-000	D	3	COLLAR, ZOOMING	ズームコロ	2
	YA2-0124-000	D	1	RUBBER, FRICTION	ズーム味出しゴム	3
	YA2-0596-000		3	SCREW, CROSS-RECESS, PH		4
*	YA2-3120-000	E	1	BARREL, GUIDE	案内筒	5
*	YA2-3121-000	E	1	BARREL, CAM	カム筒	5
*	YA2-3122-000	E	1	BARREL, INNER CAM	インナーカム筒	3

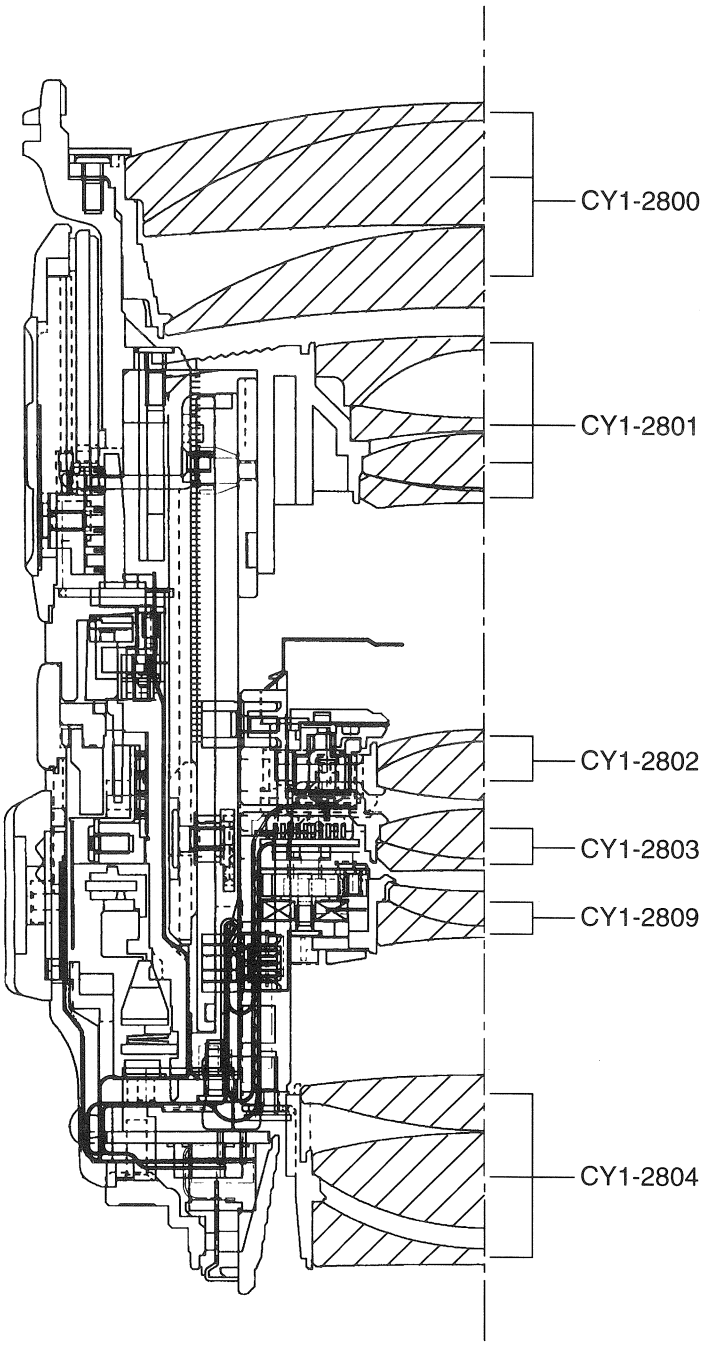
PARTS LIST

REF.NO. C21-9931

NEW	PARTS NO.	CLASS	QTY	DESCRIPTION		PAGE
*	YA2-3123-000	E	1	BARREL, HELICOID	直進筒	4
*	YA2-3125-000	D	1	BARREL, INTERMEDIATE	中間筒	2
*	YA2-3126-000	E	1	RING,FIXED	固定環	3
*	YA2-3135-000	D	1	RING, MANUAL FOCUSING	マニュアル距離リング	1
*	YA2-3137-000	D	1	RING, RUBBER	ズームリングゴム	2
*	YA2-3138-000	E	1	RING, FLARE	移動絞り板	5
*	YA2-3139-000	E	1	BASE, ZOOMING GUIDE	ズーム連結ブロック	4
*	YA2-3140-000	E	1	BRUSH, ZOOMING	ズームブラシ	2
*	YA2-3141-000	E	1	HOLDER, EMD-FLX	E-FLX押さえ板	5
*	YA2-3144-000	D	1	WINDOW, SCALE	目盛窓	1
*	YA2-3145-000	E	1	SCALE, FOCUSING	距離目盛シール	3
*	YA2-3147-000	D	1	COVER, FILTER RING	化粧環	1
*	YA2-3148-000	E	1	RING, REINFORCEMENT	補強リング	2
*	YA2-3149-000	E	1	RING, 3rd GROUP REINFORCEMENT	3群補強リング	4
*	YA2-3150-000	D	1	SHIELD, DUST 1	防塵リング1	2
*	YA2-3151-000	D	1	SHIELD, DUST 2	防塵リング2	2
*	YA2-3153-000	F	1	SCREW		1
*	YA2-3154-000	F	3	SCREW		5
*	YA2-3155-000	F	3	SCREW		4
*	YA2-3157-000	D	1	SHEET, DUST SHIELD	防塵シート	2
*	YG2-0326-000	E	1	POWER DIAPHRAGM ASS'Y	EMDユニット	5
*	YG2-0328-000	D	1	FOCUSING ASS'Y	フォーカスユニット	3
*	YG2-0333-000	E	1	PCB ASS'Y, MAIN	メイン基板ユニット	1
*	YH1-0497-000	E	1	FPC, GYRO & ZOOM	GZ-FLX	3

REF.NO. C21-9931

CANON LENS EF 28-135mm 1:3.5-5.6 IS USM

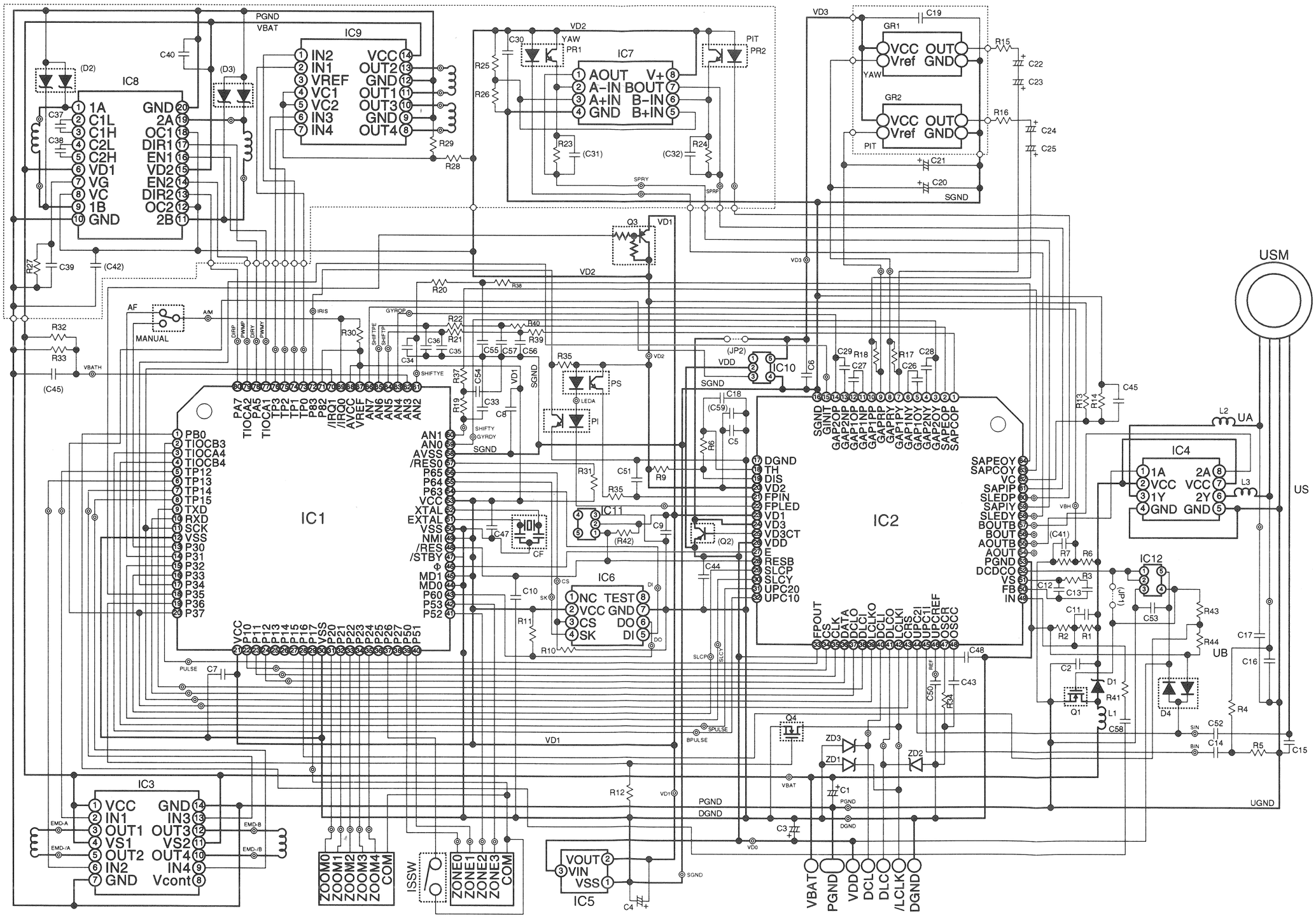


Part 5

Electrical Diagrams

SCHEMATIC DIAGRAM

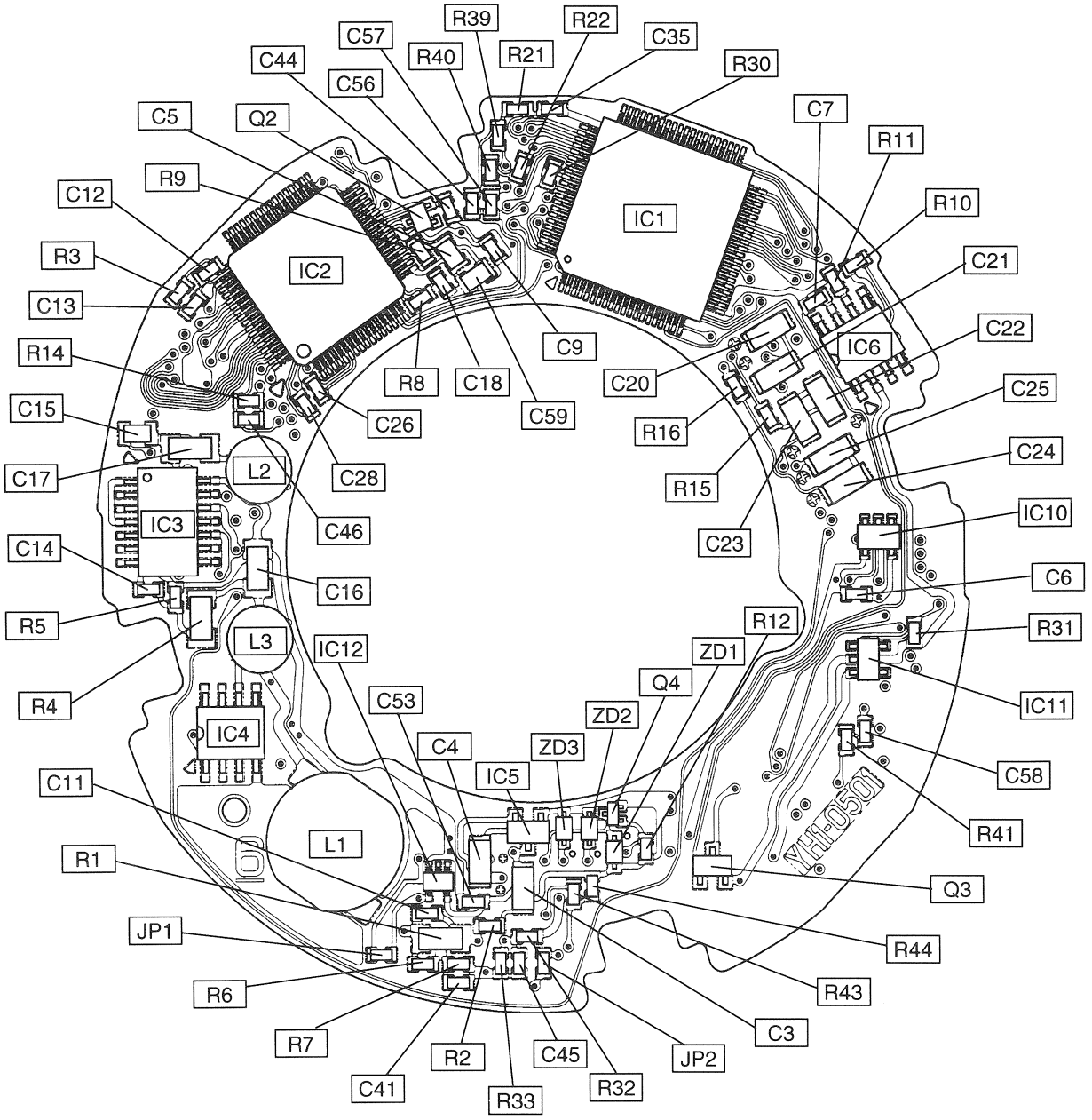
EF 28-135mm f/3.5-5.6 IS ULTRASONIC
REF.NO. C21-9931

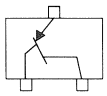
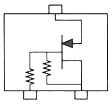
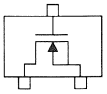


01 FEB., 1998

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

EF 28-135mm f/3.5-5.6 IS ULTRASONIC
REF. NO. C21-9931

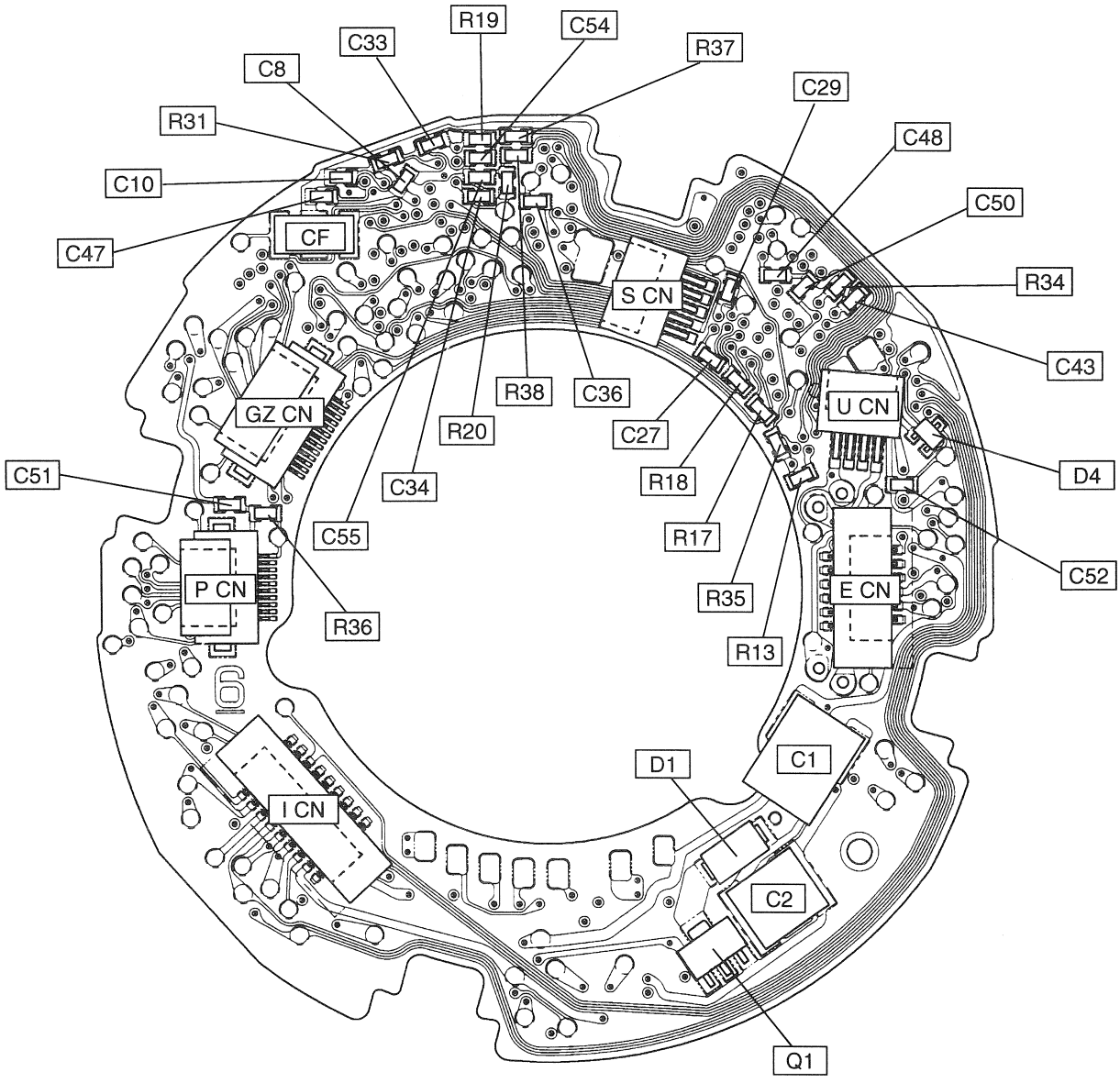


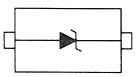
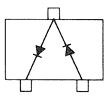
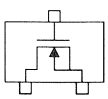
ZD1,2,3	Q2	Q3	Q4
			

01 FEB., 1998

P.C.B DIAGRAM
(MAIN PCB ASS'Y - B1)

EF 28-135mm f/3.5-5.6 IS ULTRASONIC
REF. NO. C21-9931

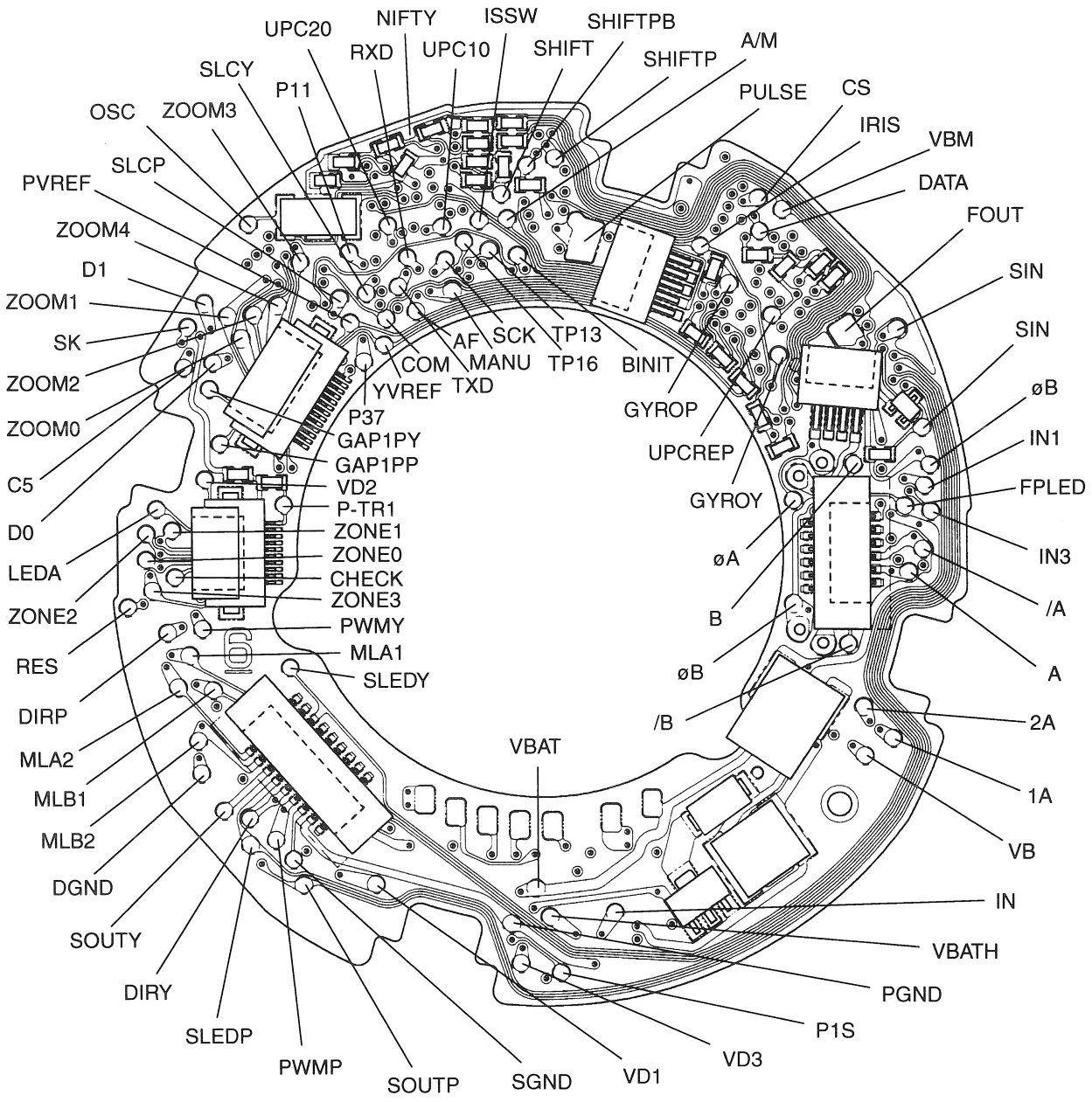


D1	D4	Q1
		

01 FEB., 1998

P.C.B DIAGRAM
(MAIN PCB ASS'Y - B2)

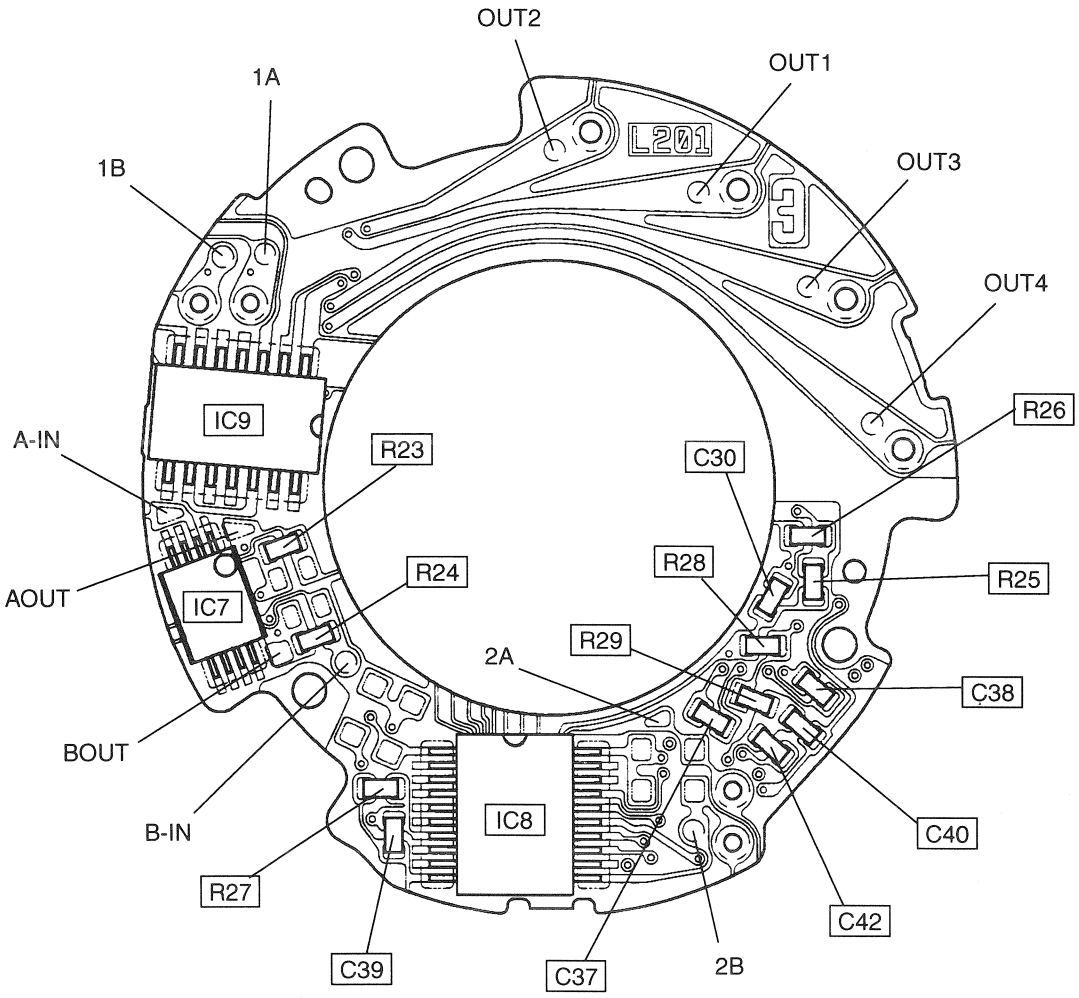
EF 28-135mm f/3.5-5.6 IS ULTRASONIC
REF. NO. C21-9931



01 FEB., 1998

P.C.B DIAGRAM
(IS PCB ASS'Y)

EF 28-135mm f/3.5-5.6 IS ULTRASONIC
REF. NO. C21-9931



01 FEB., 1998