Canon

Service Manual

ENGLISH EDITION

CANON LENS
EF200mm 1:1.8L
EF600mm 1:4.0L
EXTENDER EF 1.4X
ELECTRICAL DIAGRAMS

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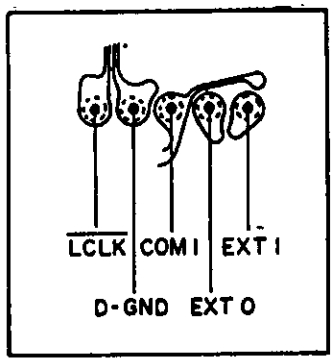
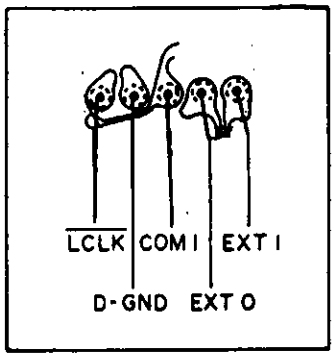
CY8–1200–047

EF200/1.8L, EF600/4.0L Service Manual Corrections

Page	Incorrect	Correct
EF200/1.8L IV-5 -27- ELECTRICAL DIAGRAMS	Red circled numberd indicate text numberd 	Red circled numbers indicate text numbers 

EF200mm 1:1.8L

REF. NO. C21-8272

REPAIR INSTRUCTIONS

Canon SERVICE MANUAL

REPAIR INSTRUCTIONS

No.

Camera Technical Service Department, Canon Inc.

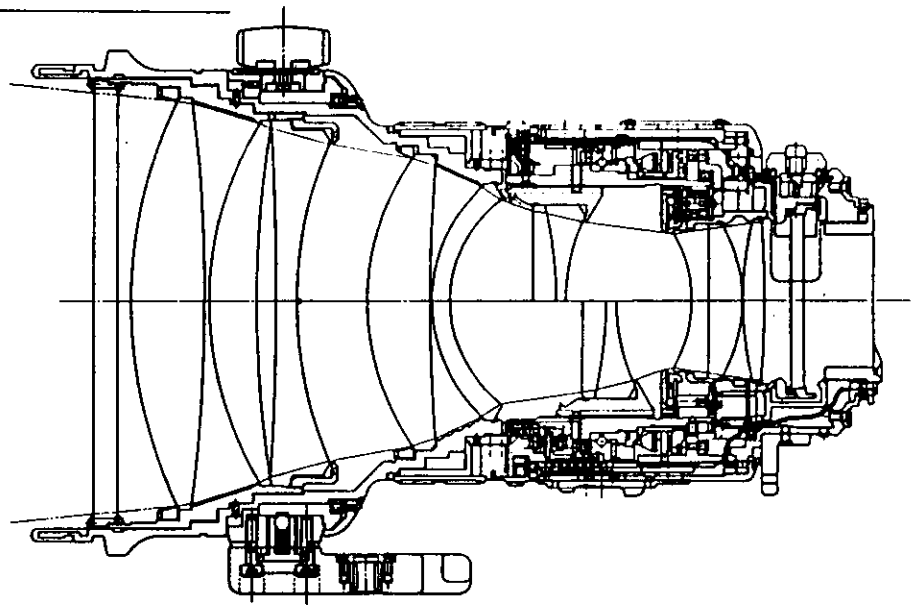
Date

CANON LENS EF200mm 1:1.8L

Ref. No. C21-5301

Special Optical Adjustments:

Centering.	Yes	No
Tilt	Yes	No



<!!> If optical components are disturbed, perform focus adjustments.

<!!> When the USM is replaced, the pulse adjustment is necessary. The EMD unit does not require adjustment when replaced.

<!!> When the main flex is replaced, the pulse adjustment must be done and the "best focus" and USM frequency checked.

<!!> Threaded parts are staked during assembly. When disassembling them be careful not to mar the screw heads or spanner points.

<!!> Lead wires and main flex are held with Acetate Cloth Tape, (CY4-9102). Replace it in exactly the same position.

<!!> Some inner areas of external parts are coated with oil retardant. Try not to touch these parts. The retardant must be renewed if touched (Pg. 14).

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EF 200mm f/1.8L

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Part Number	Name	Remarks	Plastic Safe?
-ADHESIVES-			
CY4-9102-000	Acetate Cloth Tape 570F	Holding leads and flex, replaces double-stick tape	YES
CY9-8002-000	Bond G103	General purpose bond	NO
CY9-8008-000	Arontite L	For staking screws	NO
CY9-8011-000	Screw-lock	For staking screws	YES
- LUBRICANTS -			
CY9-8044-000	GE-X8	Zoom Helicoid mix (metal OK)	YES
CY9-8045-000	GE-C4	Helicoid & cam (metal OK)	YES
CY9-8067-000	MoS_2 Grease	Tripod socket ring knob	NO
- MISCELLANEOUS -			
CY9-8078-000	Lacquer (L. Gray)	Touch-up paint	N/A
CY9-8090-000	NF-33	Moisture barrier	YES

I. Introduction:

The EF 200mm f/1.8L is the fastest 200mm photographic lens in the world. This extraordinary lens is designed to fill the needs of professional photographers.

Features

1. Three ultra-low desperation (UD) elements are used to almost completely eliminate secondary color.

2. The long focal length and large aperture allow very good separation of the subject from the blurred background. This lens gives very natural and pleasing blur.

3. The ultrasonic focusing motor coupled to lightweight internal focusing cell equals high speed autofocus.

4. The powered "manual" focusing ring is positioned for best balance in hand-held shooting.

5. The ability to limit the focusing range with the "focus preset" allows rapid shifts of focus between predetermined points.

6. The controls of all three long EF lenses have been standardized for users who use more than one lens.

7. The EF 1.4X increases the focal length to 280mm while retaining a fast f/2.5 maximum aperture. With the EF 2X extender, you get 400mm at a very respectable f/3.5 maximum aperture.

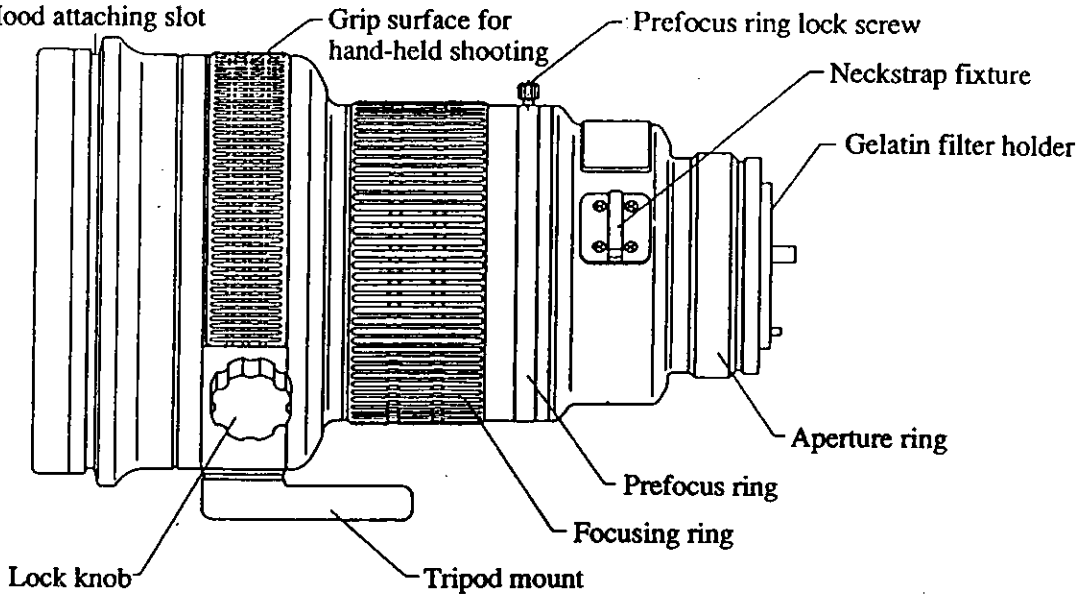
---------- Color Code

To save space on drawings, it has been necessary to uses a color code. The code is:

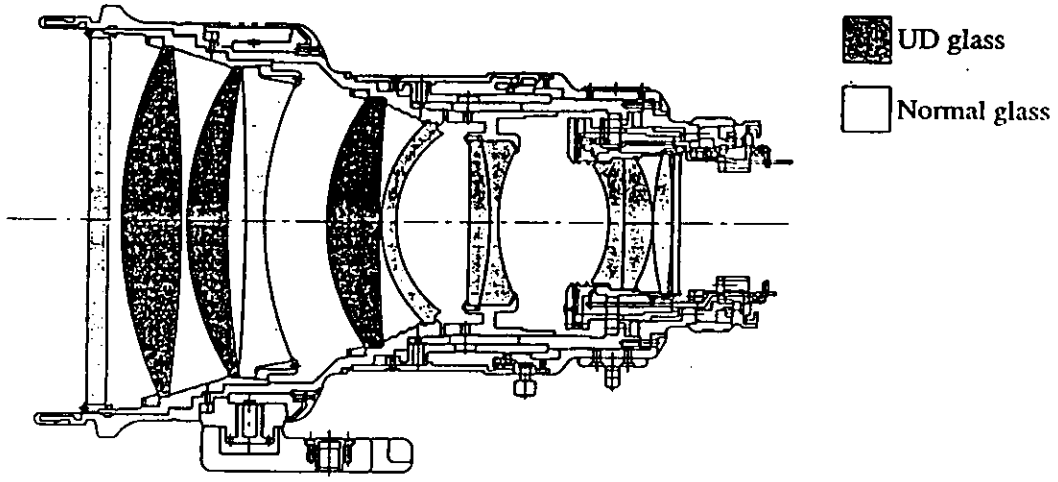
Color	Code	Color	Code	Color	Code
Black	BL	Blue	BU	Gold	GL
Brown	BR	Violet	V	Tan	T
Red	R	Purple	PR	Pink	PK
Orange	O	Gray	GY	Sky Blue	SB
Yellow	Y	White	W	Yellowish Green	YG
Green	GN	Silver	S		

External Appearance/Structural Cross-section/Optical System

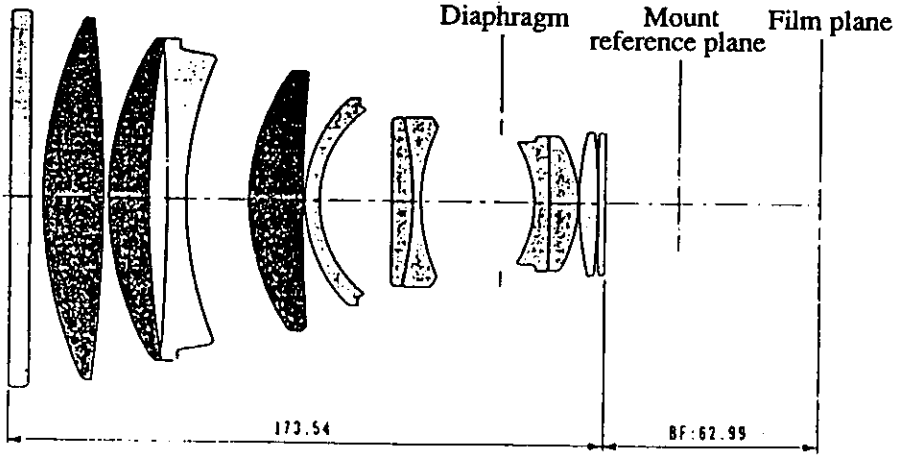
External appearance



Structual cross-section



Optical system



SPECIFICATIONS

1. Format: 24 x 36 mm

2. Focal length/aperture: 200mm , f/1.8

3. Optical structure: 10 groups*, 12 elements* (Super Spectra Coating)
G-2, G-3, & G5: UD Glass

*: Including front protective window and drop-in filter

4. Angle of view (at infinity):

Diagonally (43.2 mm)	12°
Vertically (24 mm)	7°
Horizontally (36 mm)	10°

5. Autofocus (AF)

5-1 Drive system: USM

5-2 Drive speed: 0.6 seconds (Actual operation between infinity and closest focus(3.0m), not including AF ranging)

5-3 Manual: Three speed powered manual focusing

5-4 Ranges: Switchable: 2.5m to infinity,
2.5m to 5m, or
5m to infinity

6. Focusing:

6-1 System: Internal Focusing

6-2 Range: 2.5m to infinity

6-3 Rotation angle, amount of extension

Condition	Rotationangle	Extension
2.5m to infinity	72°	12.8mm
Infinity overrun	2°42'	0.48mm

6-4 Distance scale:

9 10 12 15 20 30 60 ft (fluorescent green)

2.5 3 4 5 7 10 20 m (gray)

6-5 Maximum magnification, field of view

Condition	Magnification (power)	Field of view (mm)
Close focus	0.088X	272 x 408mm

7. Mount

7-1	Type:	Canon EF mount
7-2	Signal transfer:	EOS system, with 5 signals as follows : A) Lens condition B) Lens type C) Photometry signal D) Focal length E) AF drive information

8. Aperture mechanism

8-1	Diaphragm control:	Pulse control using EMD
8-2	Aperture range:	f/1.8 - f/22 (not indicated)
8-3	Diaphragm blades:	8
8-4	Depth-of-field scale:	f/8, 16, and 22
8-5	Infrared index:	Not necessary

9.	Filter:	48mm, 0.75mm pitch fitted in drop-in holder at rear of lens
10.	Dimensions & weight:	130.0 mm diameter x 208.0 mm length / 3Kg

11. Related products

11-1	Hood:	ET-123 (removable & reversible)
11-2	Lens cap:	E-162 bag type with draw string
11-3	Lens case:	Exclusive carrying case (Lens stores with caps on, hood reversed.
11-4	Dust cap:	Common to all EF lenses (new)

12. Miscellaneous:

12-1	Tripod mounting:	¼ x 20 tripod socket located on revolving tripod ring located well forward to assure best balance with and EOS camera body.
12-2	Tripod Ring:	360° rotation with detents at 90°, lockable with knob.

External Design

The external design concept of this lens is the same as the EF 300mm f/2.8L and EF 600mm f/4.0L and follows the concepts laid down for long lenses in the FD series. USM powered manual focusing and preset focus functions make this a quite flexible long telephoto lens.

The overall shape is one of curves, with few angles. Finish is in a slightly pebble-grained light gray lacquer to keep the lens as cool as possible. The red ring is the mark of an L series lens.

Technical Information

1. Optical Performance

1-1 Chromatic Aberration

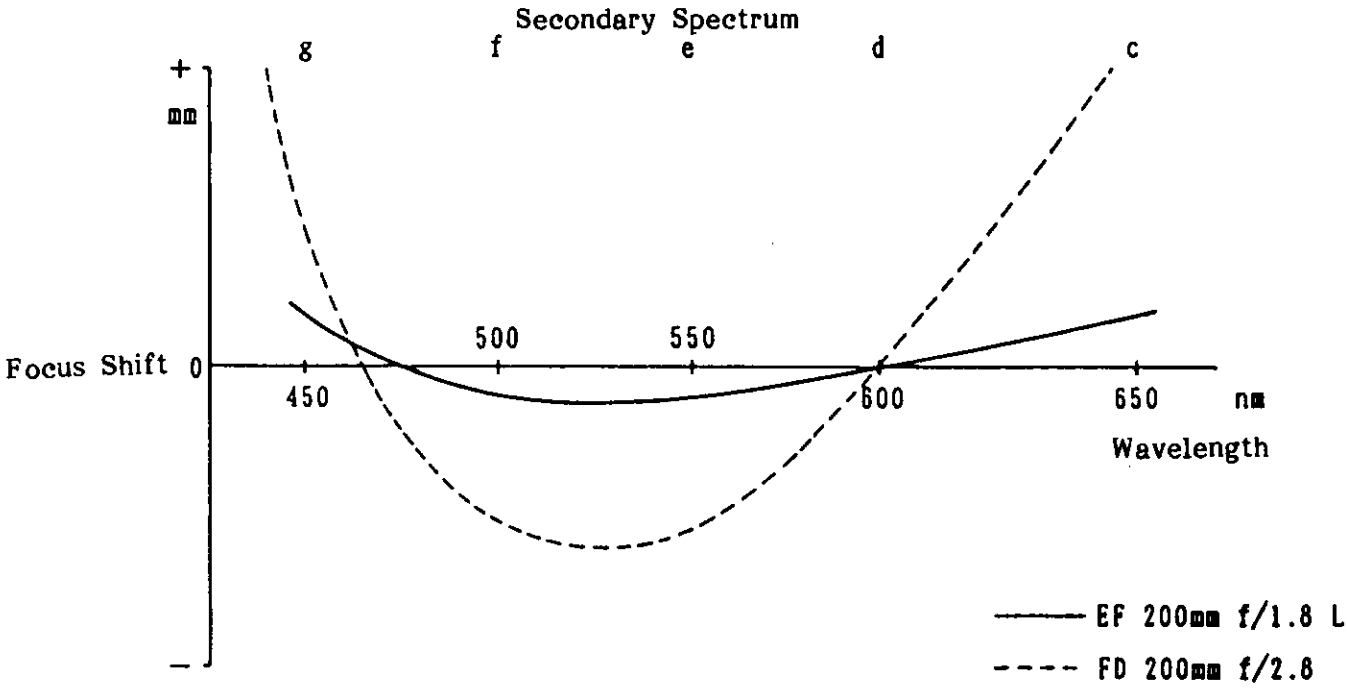
Longitudinal Chromatic Aberration is caused by the variations in the refraction index of glass by wavelength (color) of light, which is called dispersion. This aberration is most evident in large aperture, long focal length lenses. The remaining longitudinal chromatic aberration is known as secondary spectrum.

Certain optical glasses have very low dispersion, and some also have dispersion characteristics which different considerably from the characteristics of normal optical glasses. This is called anomalous dispersion. Canon calls these glasses "UD" glass. Using UD elements is expensive, but far better control of chromatic aberrations is possible with them. This lens uses UD glass for G2, G3, and G5 to achieve excellent quality.

In-focus areas give high contrast, accurate color reproduction and separation, no color fringing due to good lateral color control.

Out-of-focus areas give very pleasant blur without any color caste.

The viewfinder image is bright, clear, and neutral.



1-2 Aberration Corrections

1. The lens is designed with a four element front group (positive, positive, negative, positive) that eliminates the need for any one very strong positive element. This helps keep the peripheral aberrations, which can ruin a large aperture lens, under control.

2. The negative meniscus (G6), just in front of the focusing group corrects distance-dependent spherical aberration.

3. The rear group is effectively the rear half of a Gauss lens. It is particularly useful for controlling coma.

2. Mechanical

2-1 Internal focusing, combined with the USM, gives full-range focusing in about a second. Three speed powered manual focusing gives the advantage of power with the feel of manual focusing.

2-2 Control position and operation has been standardized, so that the photographer can switch between the 600, 300, and 200mm lenses and always feel at ease with the controls. Great balance and the powered manual focusing should make this lens eminently hand-holdable for experienced photographers.

2-3 Extenders

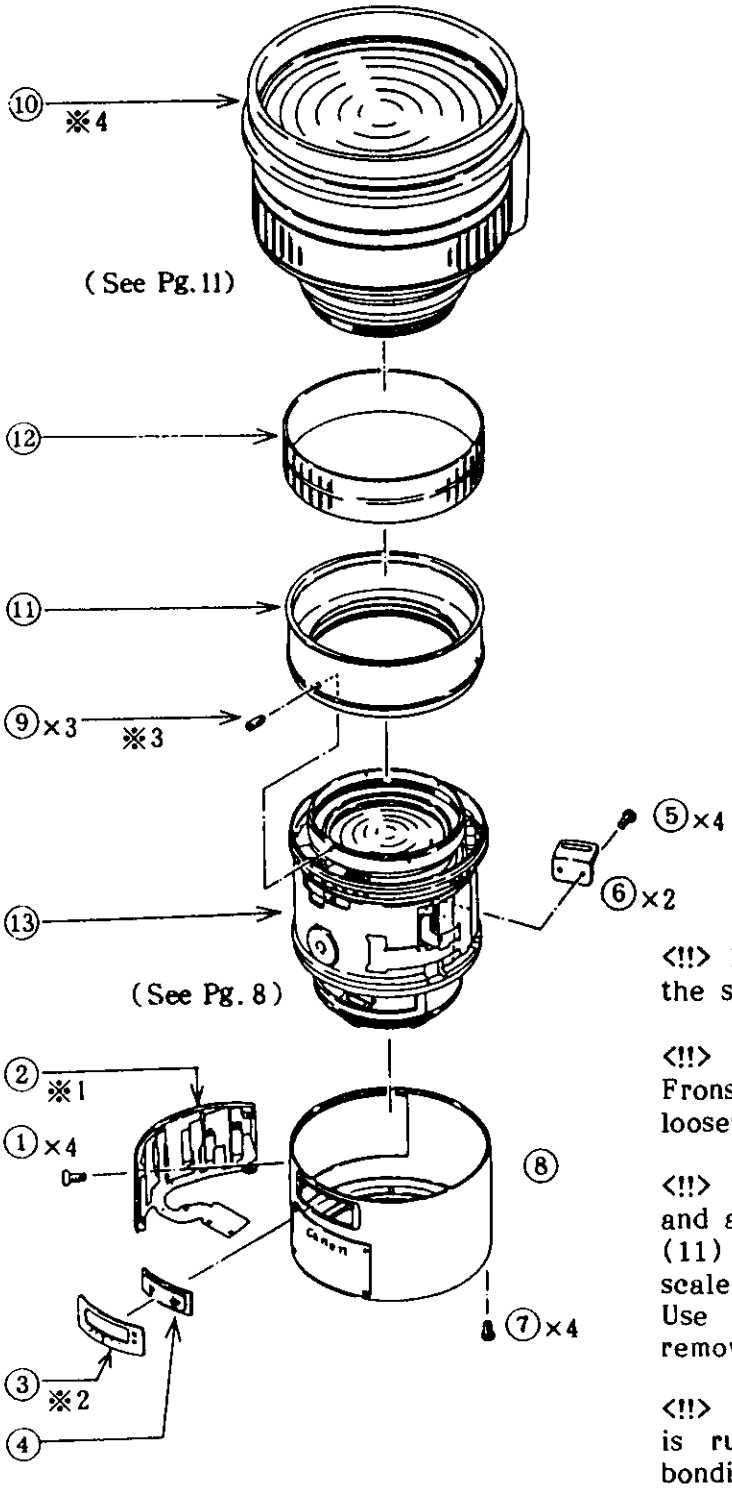
Either EF extender can be used automatically. Autofocusing speed is intentionally decreased, as with the EF 300mm f/2.8 + EF 2X.

SPECIFICATIONS with Extenders EF 1.4X and EF 2X

Focal length/aperture*	280mm f/2.5 - f/32	400mm f/3.5 - f/45
Angle of view (at infinity):		
Diagonally (43.2 mm)	8° 50'	6° 10'
Vertically (24 mm)	4° 55'	3° 30'
Horizontally (36 mm)	7° 20'	5° 10'
Drive speed:	Approx. 2/3 master lens	about 1/3 master lens
Dimensions & weight:	130 x 235.3mm 3.2 Kg	130 x 258.5mm 3.24 Kg

*: Minimum aperture depends on body in use.

1. Preliminary Disassembly



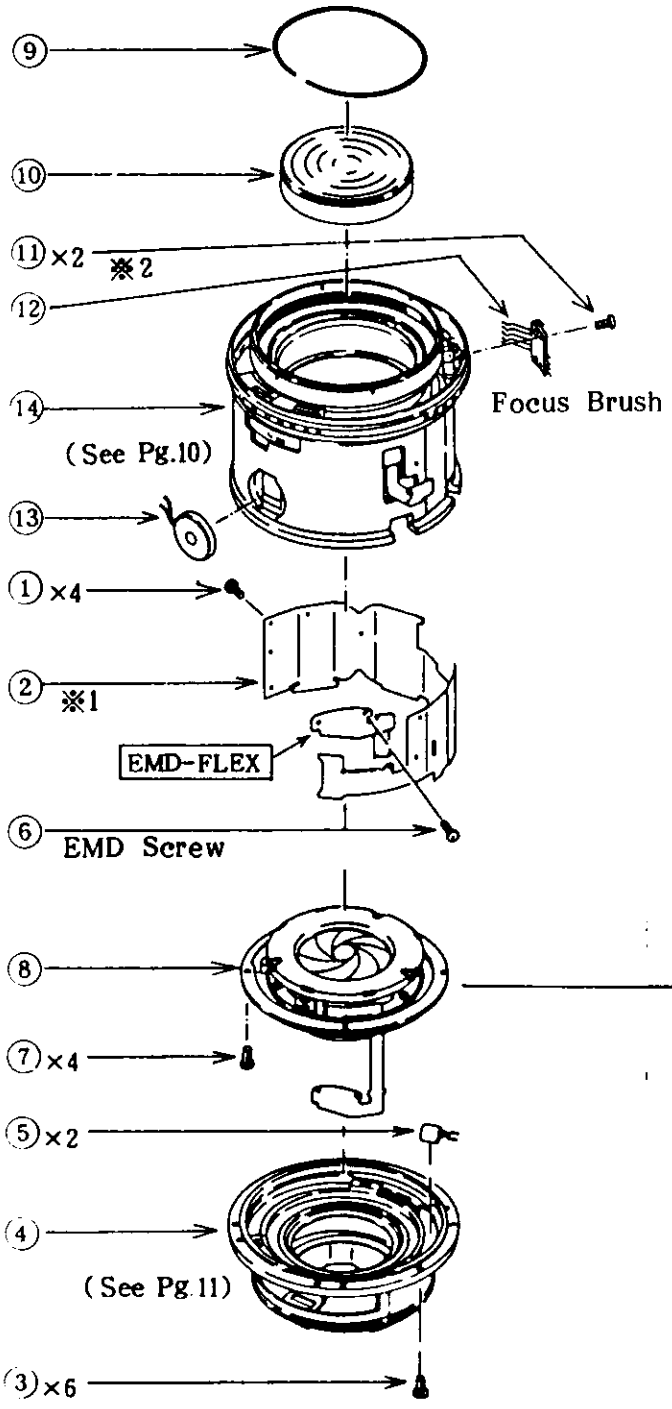
<!!> 1: Unsolder the main flex from the switch flex.

<!!> 2: (3) is bonded to (8). Run Fronsolve AE under the ends to loosen to avoid scratching (8).

<!!> 3: Lift the rear edge of (12) and align the setscrew access hole in (11) with the center of the focusing scale window to gain access to (9). Use a flat blade screwdriver to remove setscrew (9).

<!!> 4: During assembly screw-lock is run through the setscrew holes bonding (13) to (18). This makes it difficult for one person to unscrew (13). Get help.

2. Main Flex and EMD Unit Removal

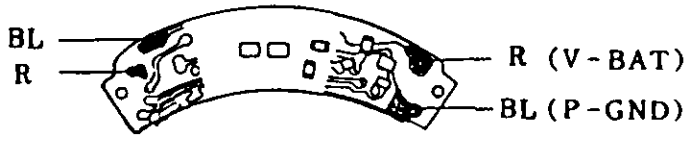


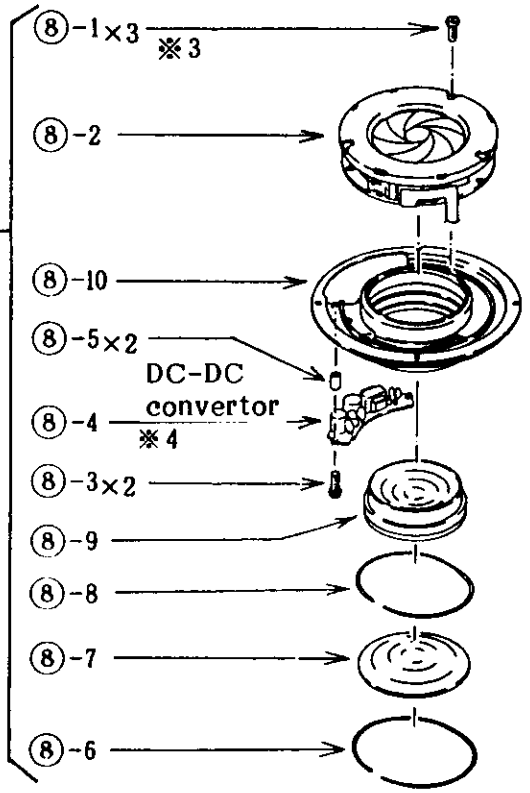
<!!> 1: Check lead routing and dress before unsoldering, then unsolder leads and flex connections. See next page for wiring.

<!!> 2: Scribe the position of the focus brush (12) before removing it to facilitate infinity adjustment. To adjust the index, see the focus adjustment.

<!!> 3: Stop down the diaphragm to gain access to the mounting screws for the EMD unit.

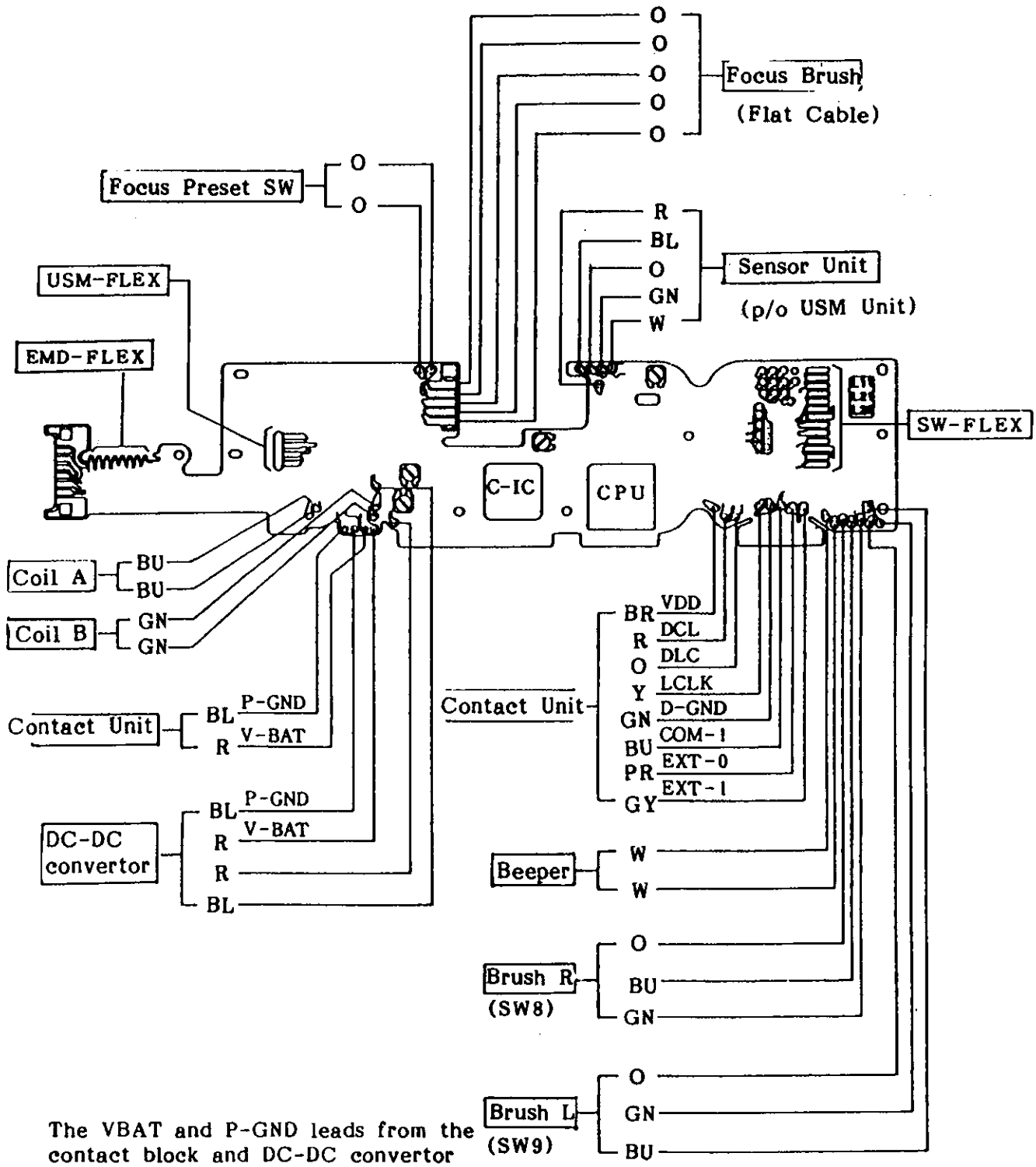
<!!> 4. Lead Connections





3. Main Flex Wiring

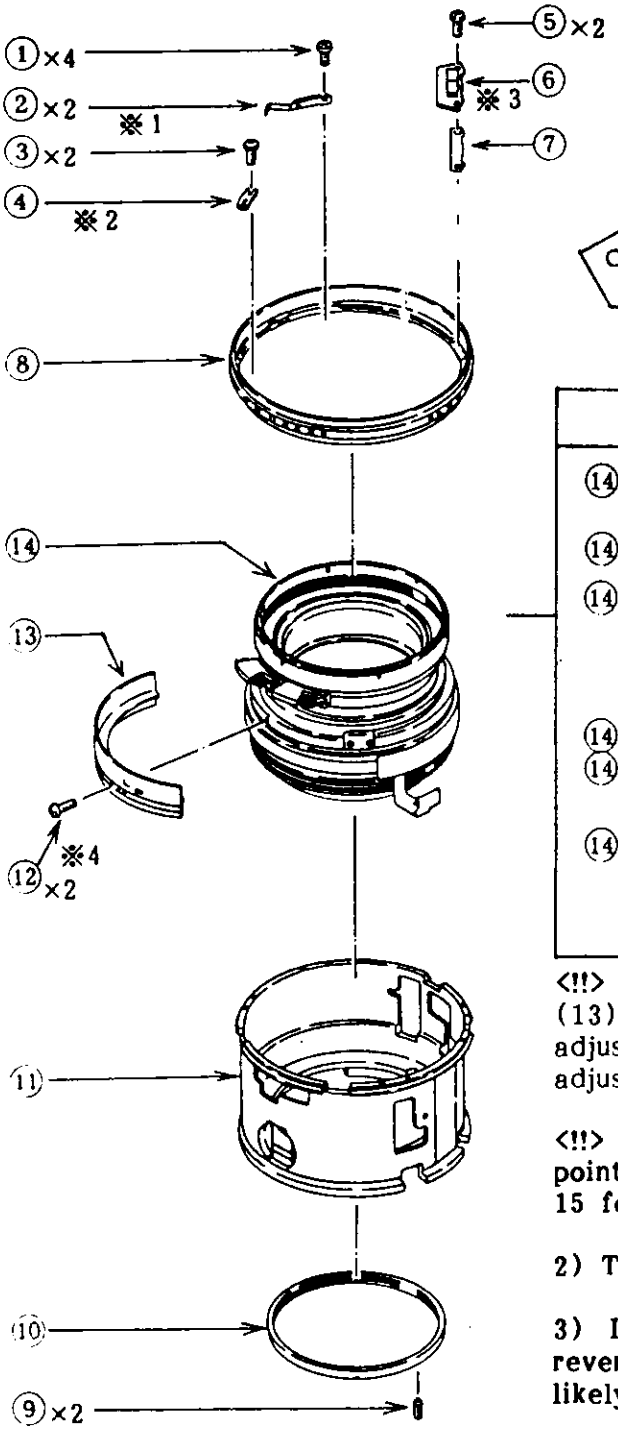
Check lead colors and lead dress before unsoldering.

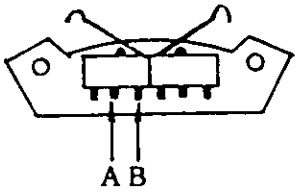


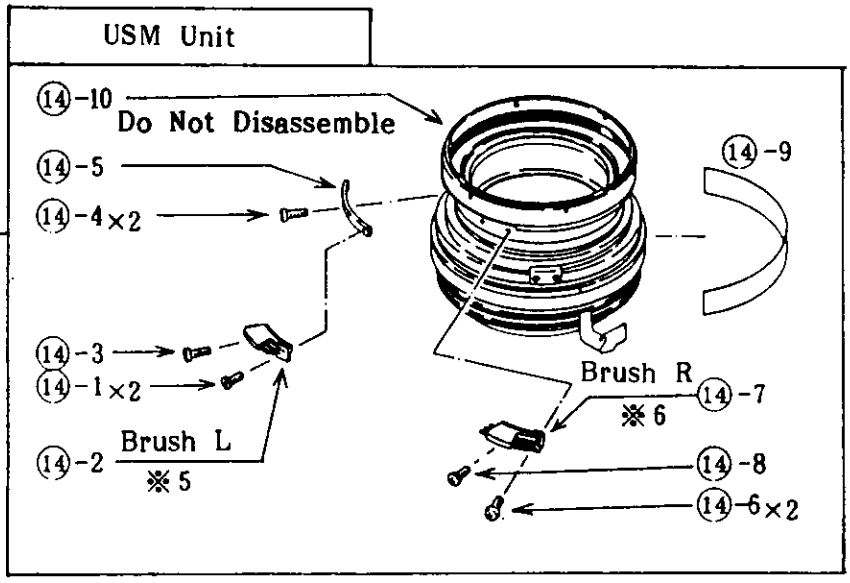
The VBAT and P-GND leads from the contact block and DC-DC convertor are heavier gage than the other leads.

Coil A and B leads are interchangeable.

4. USM Unit Removal







<!!> 1: After installing (2) turn ring (8) to both ends and insure that it returns to mid-point.

<!!> 2, 3: After installing (4), rotate ring (8) to both ends and check that A to B resistance of (6) drops to zero before the ends are reached, and that overrun is about equal at both ends.

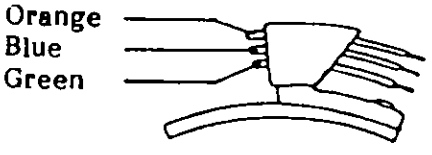
<!!> 4: Scribe the position of the focusing scale (13) before removing it to facilitate infinity adjustment. To adjust the index, see the focus adjustment.

<!!> 5, 6: 1) Adjustment is not possible at this point, so set the brushes temporarily. See pg. 15 for the adjustment.

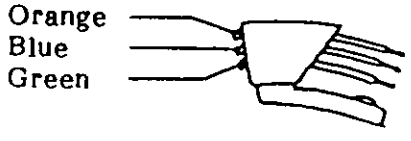
2) The USM Unit is pre-adjusted.

3) If these brushes are not properly adjusted, reverse focusing or excessive hunting are the most likely results.

4. Brush Wiring

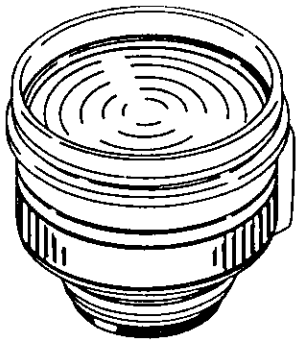


Brush L



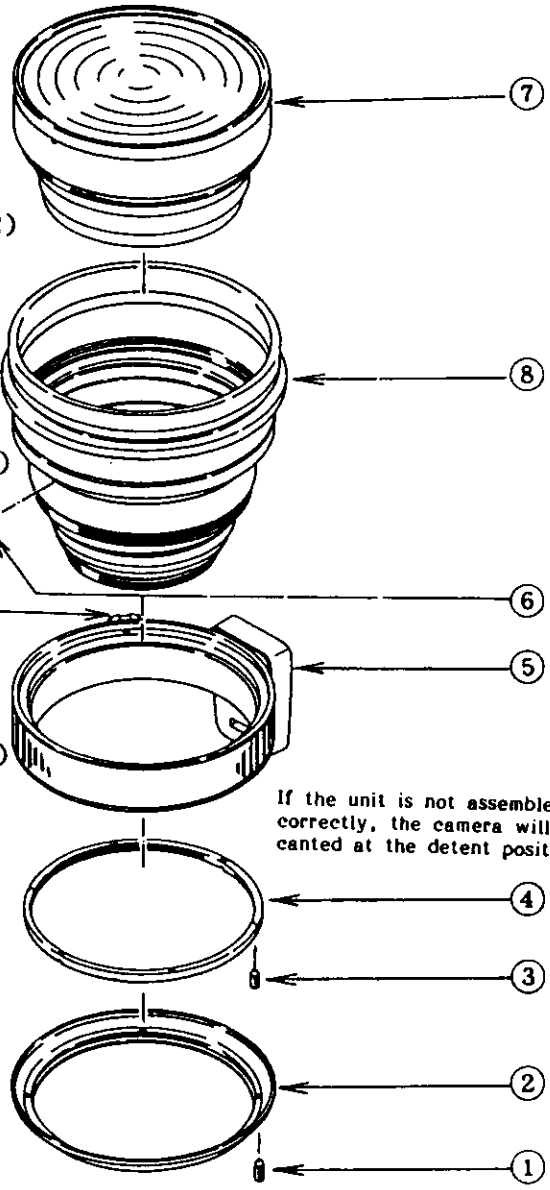
Brush R

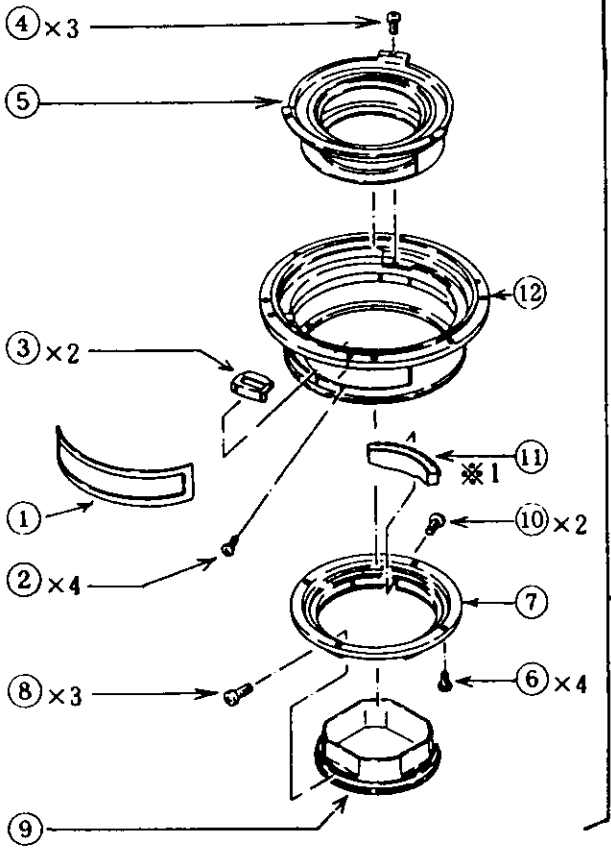
5. Tripod Ring Removal and Fixed Barrel Disassembly

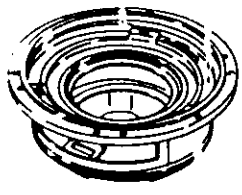


Tripod Lock Nut

<!!> Before removing tripod ring, tighten the lock knob to keep unit together.

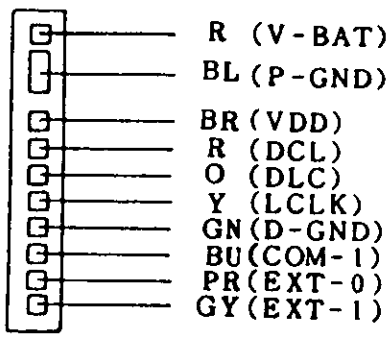






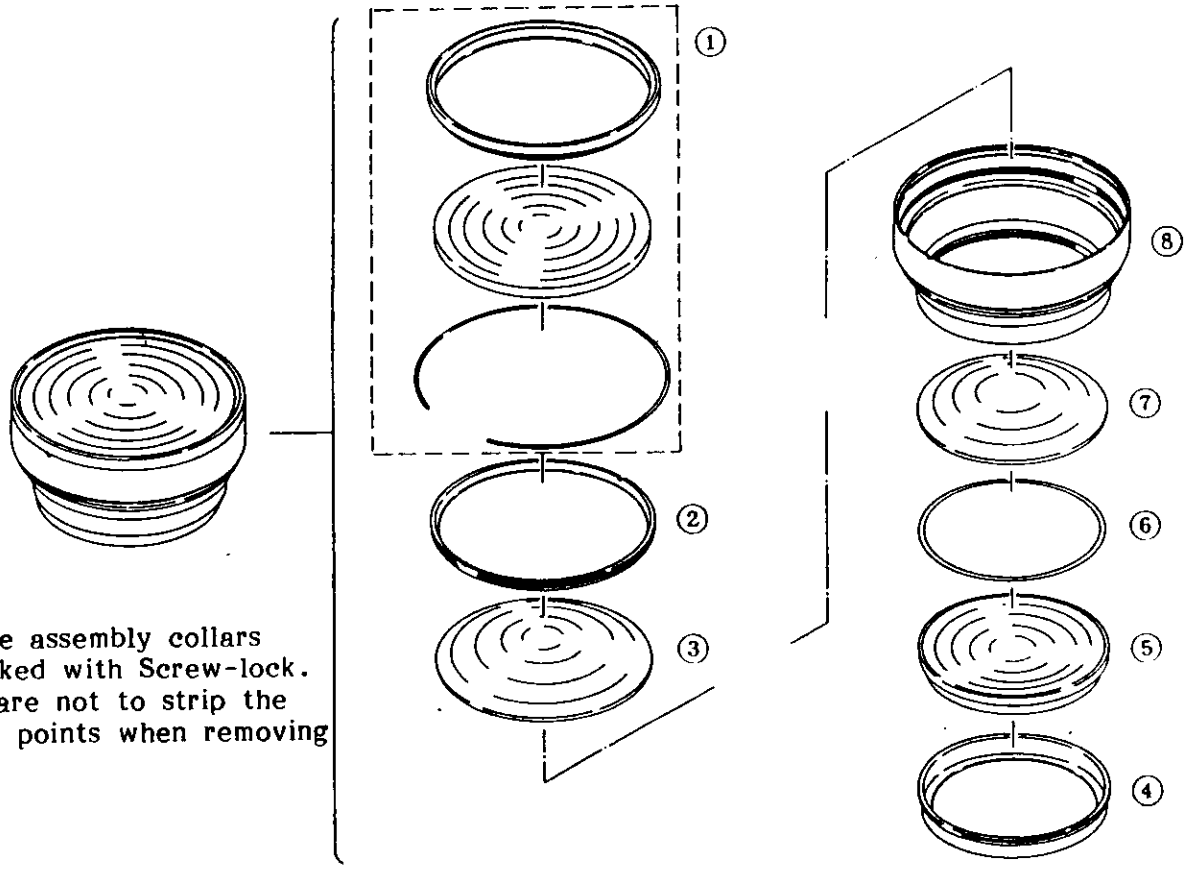
Fixed Barrel

※1 Lead Connections

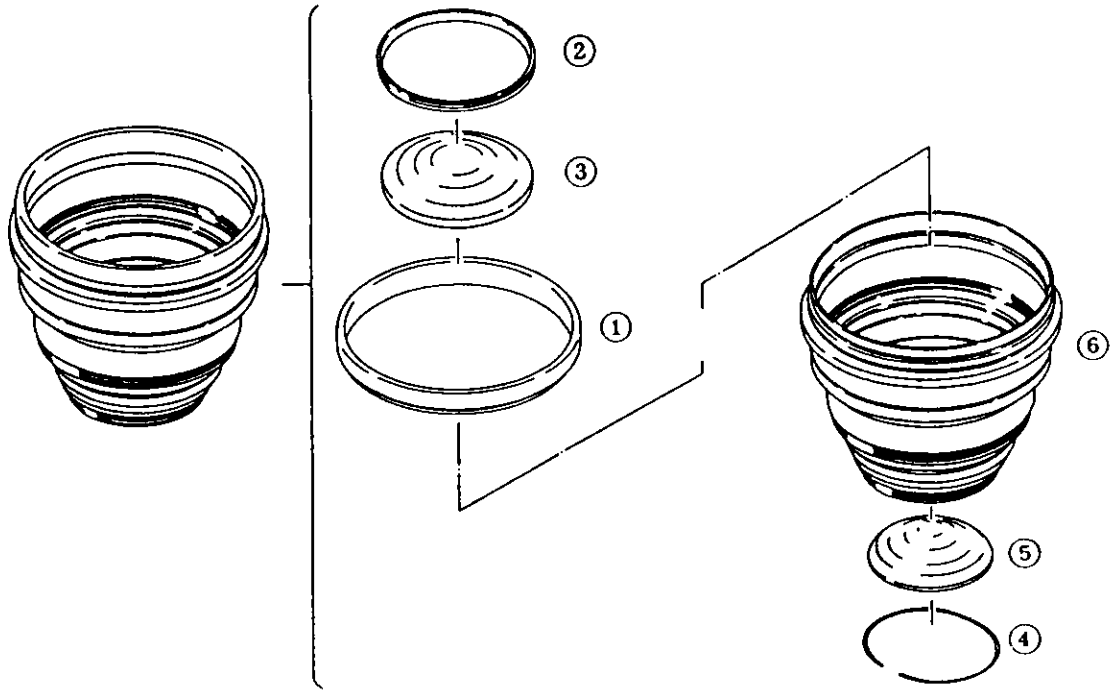


II. DISASSEMBLY & ASSEMBLY EF200mm f/1.8L

6. Front Lens Unit Disassembly

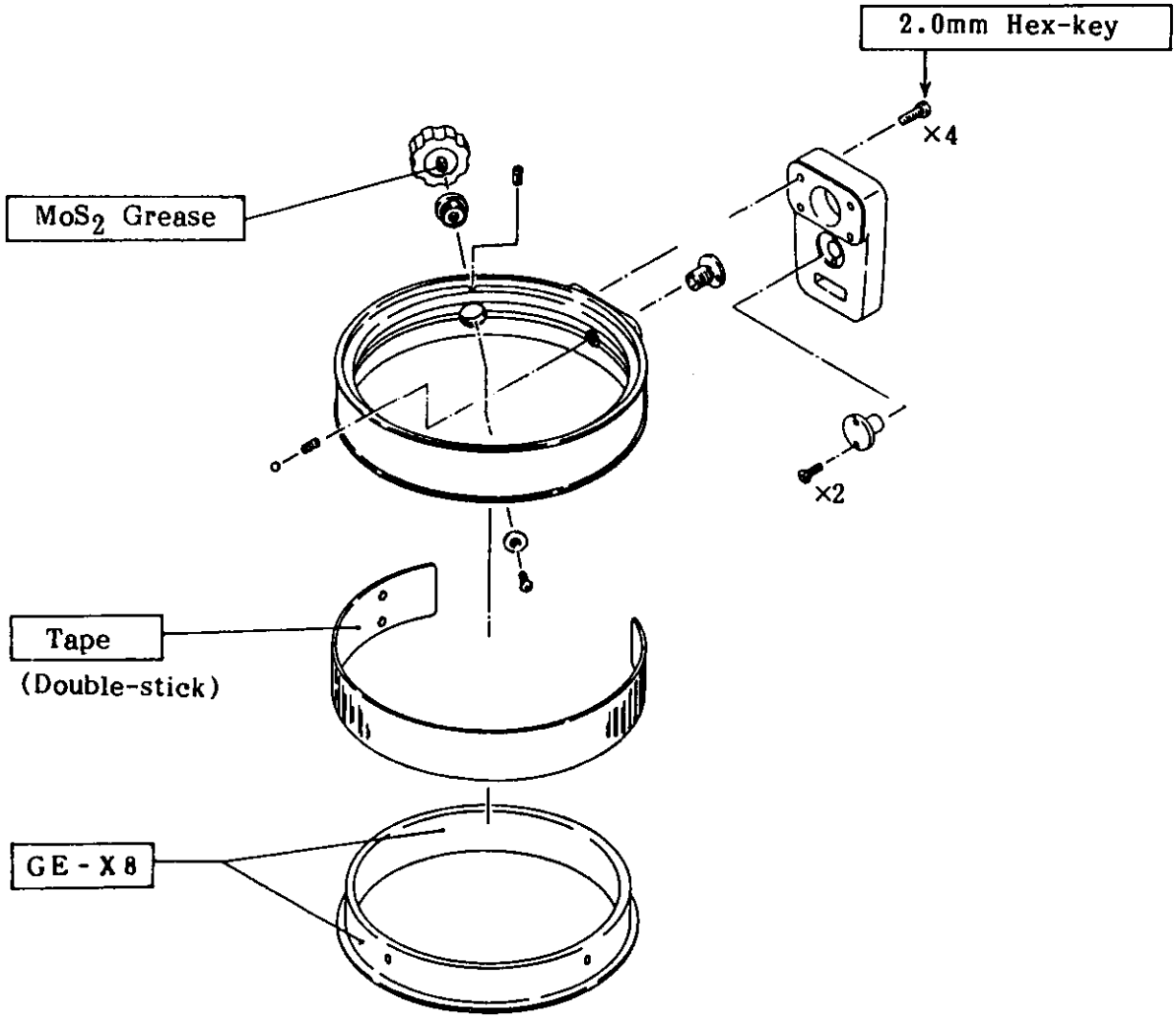


<!!> The assembly collars are staked with Screw-lock. Take care not to strip the spanner points when removing them.



II. DISASSEMBLY & ASSEMBLY EF200mm f/1.8L

7. Tripod Ring Disassembly

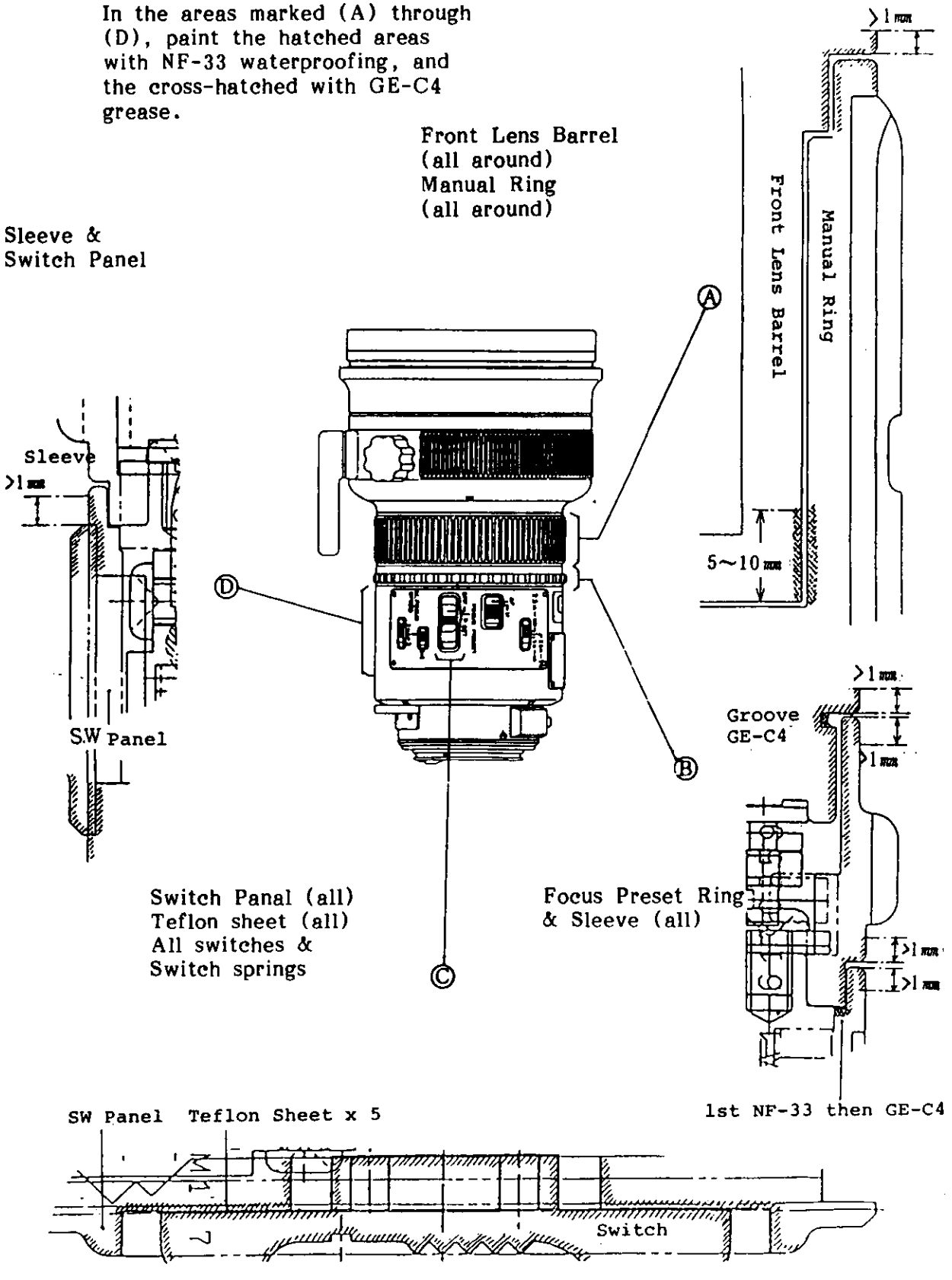


<!!> : All screws are staked with Arontite L. Take care not to strip the heads when removing them.

II. DISASSEMBLY & ASSEMBLY EF200mm f/1.8L

8. Dust and Waterproofing

In the areas marked (A) through (D), paint the hatched areas with NF-33 waterproofing, and the cross-hatched with GE-C4 grease.



III. Adjustments EF200mm f/1.8L

1. Manual Focus Brush Position Adjustment

Lenses with USM focusing use powered manual focusing. This adjustment is necessary if the manual brushes (SW8 & SW9) are disturbed, or erratic manual focusing occurs.

To disassemble, remove (1) through (7), attach test leads to the main flex at COM4 through COM7 and D-GND (Fig. 2), short the A/M and MANUAL pads once to set manual focus, attach a camera and adjust as indicated below (Fig. 1 through 4).

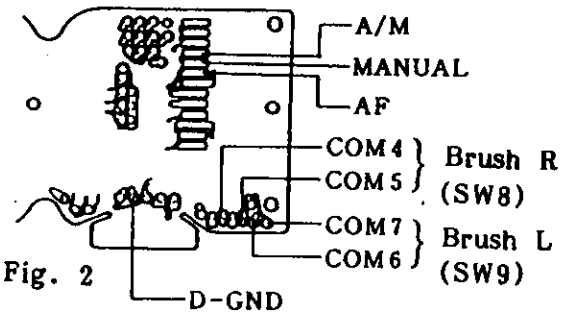


Fig. 2

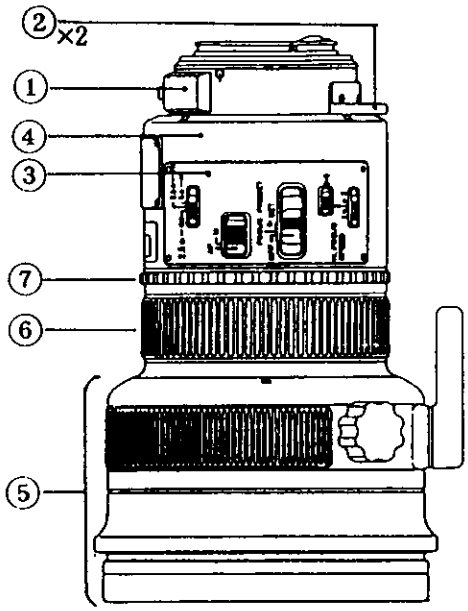


Fig. 1

Adjustment Method

1. Attach COM4 test lead to CH1 and COM5 test lead to CH2 of a dual-trace scope (Fig. 2). Turn the manual ring slowly while monitoring the scope. Adjust the screw on Brush R (SW8) until the pulses are 180° out of phase. Disconnect the leads.

2. Attach the COM6 and COM7 test leads and adjust Brush L (SW9) the same way.

3. Attach the COM4 and COM6 test leads. Turn the manual ring slowly while monitoring the scope. Adjust the adjusting base under Brush L so the pulses are 90° out of phase. This completes the adjustment.

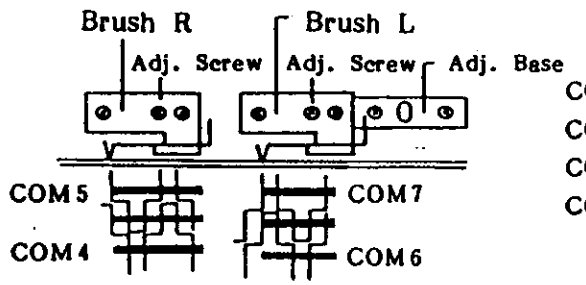


Fig. 3 ——> Pattern Movement

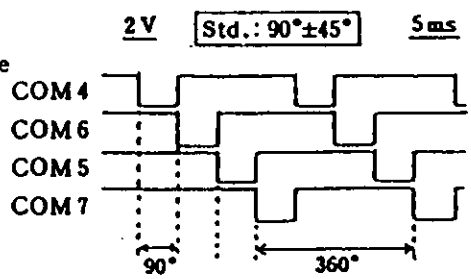


Fig. 4 (Composite View)

2. Pulse Adjustment

Adjust if main flex unit or USM unit is changed. If not adjusted, USM may work correctly at normal temperatures but fail at high or low temperatures.

Remove (1) through (8) on pg. 7, mount a camera, and attach test leads to the main flex at PR1, PR2 and D-GND (Fig. 5).

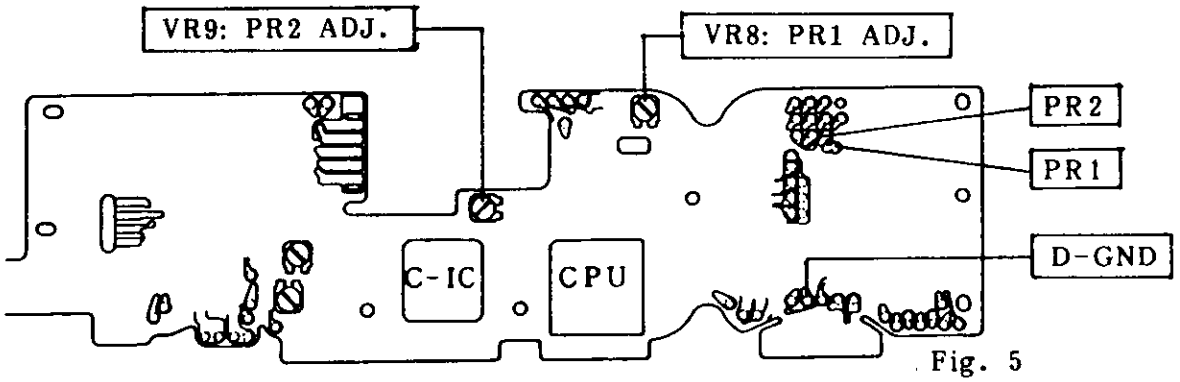


Fig. 5

Adjustment Method

1. Attach the PR1 lead and D-GND lead to the oscilloscope.
2. Press the shutter button, and adjust VR8 so the waveform matches the one shown in Fig. 6c
3. Next, repeat with the PR2 lead adjusting VR9.

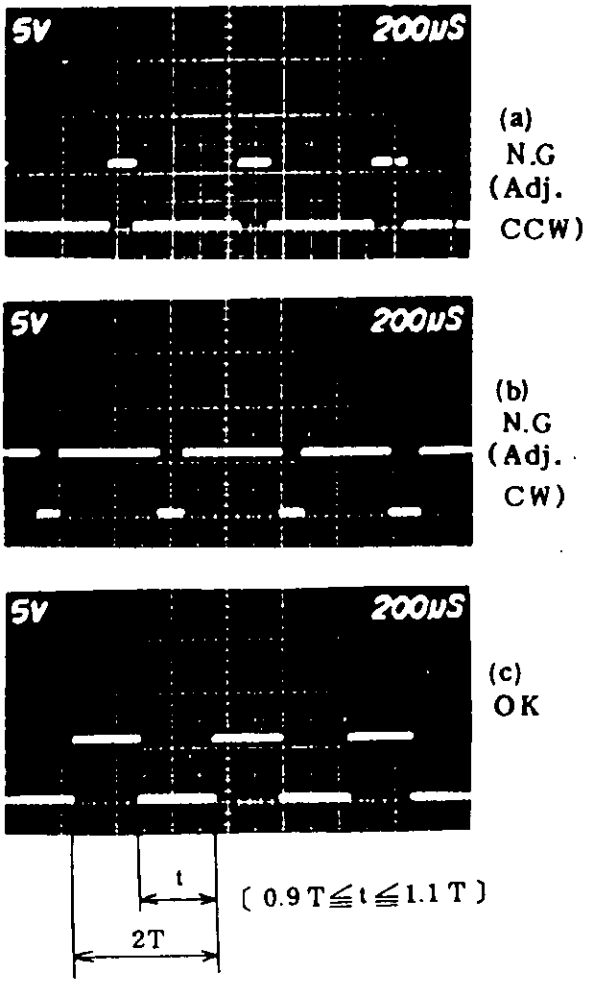


Fig. 6

3. USM Reference Frequency

This adjustment is performed at the factory, along with the inhibit adjustment, and is not normally necessary. If focusing speed is too high, too slow, or makes unusual noises, especially at extreme temperatures, check and adjust as necessary. (If an environmental chamber is available, check at low temperature.)

If adjustment is necessary, disassemble as shown in the Pulse adjustment, and install test leads at D-1 and D-GND as shown in figure 7. Mount a 6 series EOS camera.

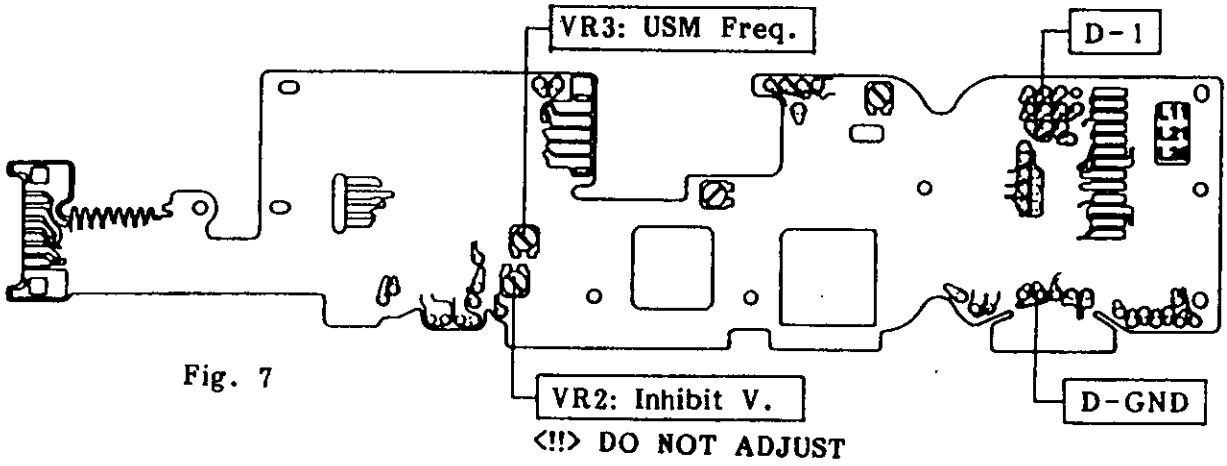


Fig. 7

<!!> : DO NOT change VR2 (Inhibit Voltage). It is factory adjusted and requires special equipment.

Adjustment:

1. Attach the D-1 and D-GND leads to a frequency counter (local purchase).

2. Press the camera's stop-down button and check the frequency counter reading. It should be 29.6 $\pm$ 0.1KHz. If not, adjust VR3.

   Note: Pressing the stop-down button activates the oscillator and gives the most stable read-out possible.

4. Focus Adjustment

This adjustment is necessary if the optics have been disturbed, or if the index doesn't align properly (Fig 10) when manually focusing at infinity.

Remove (1) through (8) on pg. 7, mount a camera and adjust as follows.

Adjustment Method

Focus Stopper Adjustment (Electrical Stop Position)

1. Manually focus on an infinity target, as distant as conditions allow ($100f^2$ is theoretically correct, but practically impossible in most situations).

2. Set the focus brush so the bottom contact fall within the width of the infinity pattern. (Note: In Fig. 8, the focusing brush is shown below the focusing pattern for clarity.)

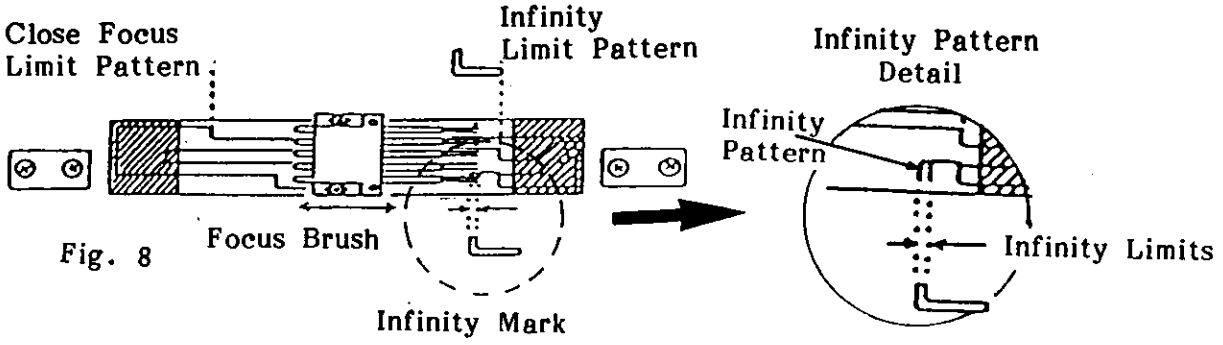


Fig. 8

3. Next, to align the upright of the infinity "L" mark with the index when it is installed later, place a 2mm diameter pin in the hole at the end of the scale and place it hard against the edge of the barrel. Tighten and stake the screw heads with screw-lock.

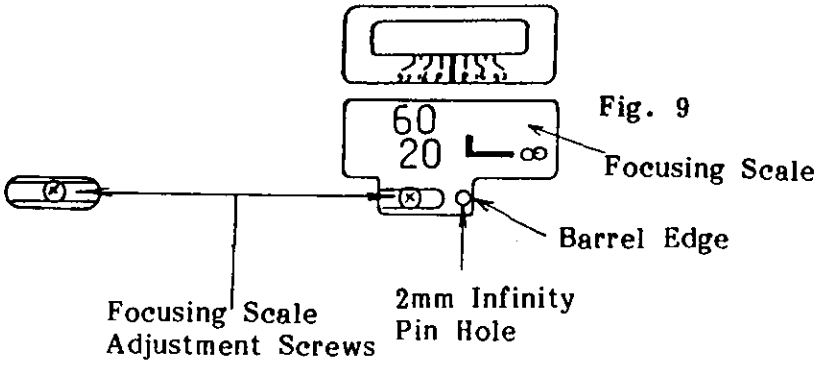


Fig. 9

Infinity Mark Limits
(at normal temperatures)

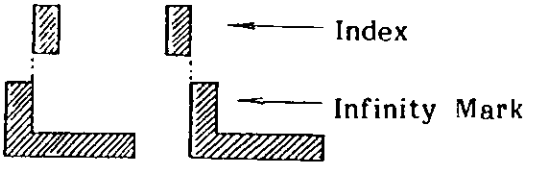


Fig. 10

4. Focus Adjustment Summary

The main points of this adjustment are:

When the lens is focused on an infinity target,
1. the bottom contact of the focus brush is on the "infinity" position of the contact flex, and
2. the edge of the 2mm hole is flush with the edge of the notch in the barrel,

the lens is correctly adjusted for infinity focus.

Table 1 : Resolution Chart

Image Height (mm)	0	4	8	12	16	20
S	100	100	100	100	100	63
Axial						
M		100	100	100	63	40

5. "Best Focus Adjustment" Service Policy

This adjustment corrects the difference between the AF focus and the actual best focus. There is always some discrepancy between the AF focus point and the actual best focus point of interchangeable lenses due to the inherent differences between the different lens types.

The difference between the two focus points has been determined for each lens type and written into the ROM so that correction is made electronically. In addition to this type difference, there are individual lenses differences, which can be noticeable. At the factory, correction is written into the individual lens' ROM with a expensive, special tool. This is called the "Best Focus Adjustment". Because of the tooling cost involved, this adjustment is not normally a part of the service procedure. In its stead, the following actions will be taken.

Service Actions:

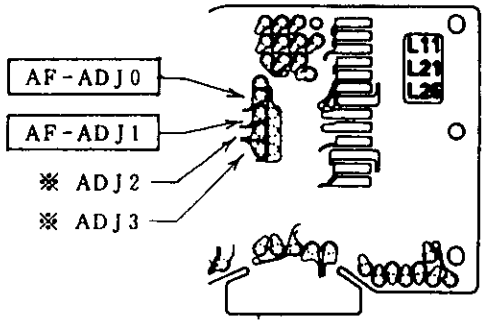
1. Main Flex Replacement
   Check the AF ADJ0 through AF ADJ3 pads on the flex being replaced and bridge the pads on the new flex in the same way.

2. If front defocus, use plus correction. If rear defocus, use negative.

Best Focus Correction (Reference)

Correction	AF ADJ0	AF ADJ1
-¾Fc	Open	Closed
-½Fc	Closed	Closed
+¼Fc	Open	Open
+¾Fc	Closed	Open

AF ADJ2 and 3 are not presently used.



3. Customer Complaints
   If a customer complains of soft focus at full aperture, you can adjust as follows:

   Photographic Test
   Make actual photographic test at a distance of 10 meters with the AF-ADJ0 and AF-ADJ1 bridges in all four possible combinations. Make five or six negatives for each combination of a flat high contrast chart or equivalent at maximum aperture using an EOS 650 / 620 in aperture priority mode. Examine the negatives closely to determine which combination is best.

   Visual Test
   Use the standard chart at a convenient distance. View through the viewfinder with a type B screen. Use a magnifier and change the pad combinations until the best combination is achieved. This test should be performed by a young person with excellent visual acuity.

IV. Electronic Circuit EF200mm f/1.8L

These circuit explanations are for the EF 600mm f/4.0L and the second type EF 300mm f/2.8L as well as the EF 200mm f/1.8L.

The power supply can be divided into three main sections.

1. VDD 5.5V (Source: camera body)
2. VBAT 6V (Source: camera body)
3. VB 40V (Source: Lens DC/DC converter)

1. Switch Functions

Symbol	Nomenclature	Remarks
SW 1	Manual Focusing Speed SW	"low" when selected
SW 2	Focus SW	"low" when contacts are On
SW 3	Focus mode SW	"low" when selected
SW 4	Beeper SW	"low" when On
SW 5	Focus Preset SW	"low" when selected
SW 6	Recall SW	"low" when On
SW 7	Range Limit Sensor SW	"low" when selected
SW 8	Manual Focusing Sensor SW	"low" when contacts are On
SW9	Manual Focusing Sensor SW	"low" when contacts are On

Notes:

1. Some IC pin names violate the common schematic reference symbol conventions, such as C32, D1, D2 etc., but these cannot be changed. Care will be taken to make clear whether D2 refers to diode # 2 or data line # 2. Please refer to the schematic when in doubt.

2. A slash (/) preceding a signal indicates an active low signal. This replaces the over-bar, which is difficult to type, in the text. You will find the over-bar on some of the drawings.

IV. Electronic Circuit EF200mm f/1.8L

2. Electronic Components

Symbol	Standard	Function or (IC Connection)
C-IC	AN 8329	EMD, USM control IC
CPU	MN17481-AX21B	Central microprocessor
OSC	C4CB-8M02	CPU Oscillator
TALY2	UN206	EMD drive IC
TALY3	UN206	EMD drive IC
VDET	MN12821	Voltage detect IC
Tr4	2SD1511R	USM drive
Tr5	2SB766AR	USM drive
Tr6	2SD1511R	USM drive
Tr7	2SB766AR	USM drive
Tr8	UN212Y	C-IC E1 power supply
C1	4.7uF	Noise filter
C2	4.7uF	Noise filter
C3	1.0uF	Filter capacitor
C4	1.0uF	Noise filter
C5	10nF	(US) C-IC
C6	220nF	Chattering prevention
C7	680pF	(CF) C-IC
C8	3.3nF	(F) C-IC
C9	220pF	(C32) C-IC
C10	10nF	(F32) C-IC
C11	100pF	Chatter prevention
C12	100pF	Chatter prevention
C13	1.0uF	Noise filter
C14	15nF	Noise filter
C15	15nF	Noise filter
C16	15nF	Noise filter
C17	1.0uF	Noise filter
C18	3.3uF	Noise filter
C19	10nF	Noise filter
D1	MA-157A	Tr4, Tr5 protection
D2	MA-157A	Tr6, Tr7 protection
R1	10KOhm	(UAIN) C-IC
R10	16KOhm	(DAC) C-IC
R11	2.4KOhm	Tr5 base resistor
R12	2.4KOhm	Tr7 base resistor
R13	6.8KOhm	/LCLK stabilizer
R4	100KOhm	(FV) C-IC
R5	8.2KOhm	(F) C-IC time constant
R7	2.4KOhm	(F32) C-IC time constant
VR2	20KOhm	Inhibit voltage adjustment
VR3	4.0KOhm	USM reference frequency adjustment
VR8	20KOhm	PR1 output adjustment
VR9	20KOhm	PR2 output adjustment
ZD1	MA3075WA	Protector
ZD2	MA3075WA	Protector
ZD3	MA3075WA	Protector
ZD4	SB01-05CP	Protector
ZD5	SB01-05CP	Protector
ZD6	SB01-05CP	Protector

3. CPU IC Pin Table

Pin	Symbol	I/O	A/D	Voltage	Function
1	D1	I/O	D	0-VDD	Parallel communications port
2	D2	I/O	D	0-VDD	Parallel communications port
3	D3	I/O	D	0-VDD	Parallel communications port
4	/AD	O	D	0-VDD	Address / Data switching signal
5	/WR	O	D	0-VBAT	Read / Write switching signal
6	/SYNC	O	D	0-VDD	Synchronizing signal
7	P2	I	D	0-VDD	Photo Interruptor PR2 signal (from C-IC)
8	P1	I	D	0-VDD	Photo Interruptor PR1 signal (from C-IC)
9	/RST	I	D		CPU reset signal
17 18	AFADJ0 AFADJ1	I	D	0-VDD	Best focus compensation. CPU contains several best focus compensations.
21	H-SPEED	I	D	0-VDD	Manual focusing speed SW - high speed
22	L-SPEED	I	D	0-VDD	Manual focusing speed SW - low-speed
23	INF	I	D	0-VDD	Detect focusing position infinity limit
24	NEAR	I	D	0-VDD	Detect focusing position near limit
25	EXT0	I	D	0-VDD	Detect extender
26	EXT1	I	D	0-VDD	Detect extender
29	Z2	I	D	0-VDD	Detect focusing position
30	Z3	I	D	0-VDD	Detect focusing position
33	COM1	O	D	0-VDD	Common pin
34	COM2	O	D		Focus mode SW - autofocus
35	COM3	O	D		Focus mode SW - manual
36	COM8	O	D		Focus Preset SW - common
39	MUTE	I	D	0-VDD	Beeper mute
40	AF/MANU	I	D		Focus mode SW - common
41	FP-SET	I	D		Focus Preset SW - memory set
42	FP-PLAY	I	D		Focus Preset Sw - set to memory position
43	PZ0	I	D		Range limit sensor SW - infinity
44	PZ1	I	D		Range limit sensor SW - near
45	/P3	I	D		Max. aperture sensor input
46	ENC0	I	D		Detect E0 brush signal
47	ENC1	I	D		Detect E0 brush signal
48	COM4	O	D		Detect E0 brush signal
49	COM5	O	D		Detect E0 brush signal
50	COM6	O	D		Detect E0 brush signal
51	COM7	O	D		Detect E0 brush signal
52	COM9	O	D		Range limit sensor - common
53	BZ	O	D		Beeper
55	/LCLK	I/O	D	0-VDD	Communication clock pulse
56	DLC	O	D	0-VDD	Lens to camera data line
57	DCL	I	D	0-VDD	Camera to lens data line
58	GND	V	-	0	CPU power supply device ground
59 60	OSC2 OSC1	V V	- -	8MHz	Oscillator crystal
61	VDD	V	-	5.5	CPU power supply
62	E1ON	O	D	0.55	Power switch for C-IC. When "low", Tr8 goes on and E1 is applied to C-IC.
63	PSM	O	D	0-VDD	Pulse to C-IC to control EMD
64	DO	I/O	D	0-VDD	Parallel communications port

Note: I/O = Input/Output, A/D = Analog/Digital
V = (voltage)- neither In or Out

4. C-IC IC Pin Table

Pin	Symbol	I/O	A/D	Voltage	Function
1	VBAT	V	-	6.0	Battery input from camera
2	SM4	O	D	0-VBAT	Control pin for the EMD transistor array. "High" turns on the transistor.
3	SM1	O	D	0-VBAT	Control pin for the EMD transistor array. "Low" turns on the transistor.
4	SM2	O	D	0-VBAT	Same as pin 3, SM1
5	SM3	O	D	0-VBAT	Same as pin 2, SM4
6	SM8	O	D	0-VBAT	Same as pin 2, SM4
7	SM5	O	D	0-VBAT	Same as pin 3, SM1
8	SM6	O	D	0-VBAT	Same as pin 3, SM1
9	SM7	O	D	0-VBAT	Same as pin 2, SM4
11	UBOUT	O	A	0-VBAT	USM "B" phase drive signal
12	US	I	A	-	Input USM S phase
13	U-GND	V	A	0	USM device ground
14	UAIN	I	A	-	Input USM A phase
15	UAOUT	O	A	0-VB	USM "A" phase drive signal
16	VB	V	-	0-4.0	Input DC/DC output voltage
17	VC	V	-	2.0	Check IC
18	A-GND	V	-	0	Analog device ground
19	INH	V	-	2.5	Adjust inhibit voltage
20	CF	I/O	A	-	USM reference frequency oscillator cap.
21	LR	O	A	-	Adjust USM reference frequency
22	FV	O	A	-	Connected to USM oscillator resistor
23	F	I/O	A	-	Connected to USM oscillator R/C network
24	LED3	I	A	-	Connected to maximum aperture sensor LED
25	/P3	O	D	0-E1	Maximum aperture sensor output to CPU
26	PR3	I	A	-	Maximum aperture sensor input to C-IC
27	PR3Adj.	I	A	-	PR3 Threshold level adjustment
28	VC1	V	-	1.25	Check C-IC reference voltage
29	C32	I/O	A	-	Connected to USM oscillator capacitor
30	F32	I/O	A	-	Connected to USM oscillator R/C network
31	PR1Adj.	I	A	-	Threshold level adjustment
32	PR2Adj.	I	A	-	Threshold level adjustment
33	DAC	O	A	-	Reads voltage of Cf capacitor
34	LED1	I	A	-	Connected to photointerrupter LED1 & LED2
35	PR2	I	A	-	Input from focusing photointerrupter 2
36	PR1	I	A	-	Input from focusing photointerrupter 1
37	GND1	V	-	0	C-IC digital device ground
38	P1	0	D	0-E1	Output photo-interrupter signal PR1
39	P2	0	D	0-E1	Output photo-interrupter signal PR2
40	/SYNC	I	D	0-E1	Input syncronizing signal
41	/WR	I	D	0-E1	Input light/lead changeover signal
42	/AD	I	D	0-E1	Input address/data changeover signal
43	D3	I	D	0-E1	Parallel 4-bit communications port
44	D2	I	D	0-E1	Parallel 4-bit communications port
45	D1	I	D	0-E1	Parallel 4-bit communications port
46	D0	I	D	0-E1	Parallel 4-bit communications port
47	PSM	I	D	0-E1	EMD control pulse from the lens CPU
48	E1	V	-	5.5	C-IC power supply, controlled from CPU

Note: I/O = Input/Output, A/D = Analog/Digital
V = A voltage, etc., neither input or output

IV. Electronic Circuit EF200mm f/1.8L

5. Schematic Explanation

Lens Mounted on Camera

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

2. When camera and lens communicate, the lens CPU applies a low to the E1ON pin turning Tr8 on, thus applying E1 to the C-IC.

3. The camera requests lens data from the lens through DCL line.

4. The lens sends the data through DLC line. With this data, the camera determines if the diaphragm fully open. If it is not fully open, the camera sends diaphragm (EMD) drive command to the lens.

5. When the lens receives the EMD drive command, current flows through SM1-SM8 terminals of C-IC turning the transistor arrays (TALY2, TALY3) on to drive the EMD.

6. When the diaphragm is fully open, the maximum aperture sensor PR3 sends the /P3 signal to the CPU.

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

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

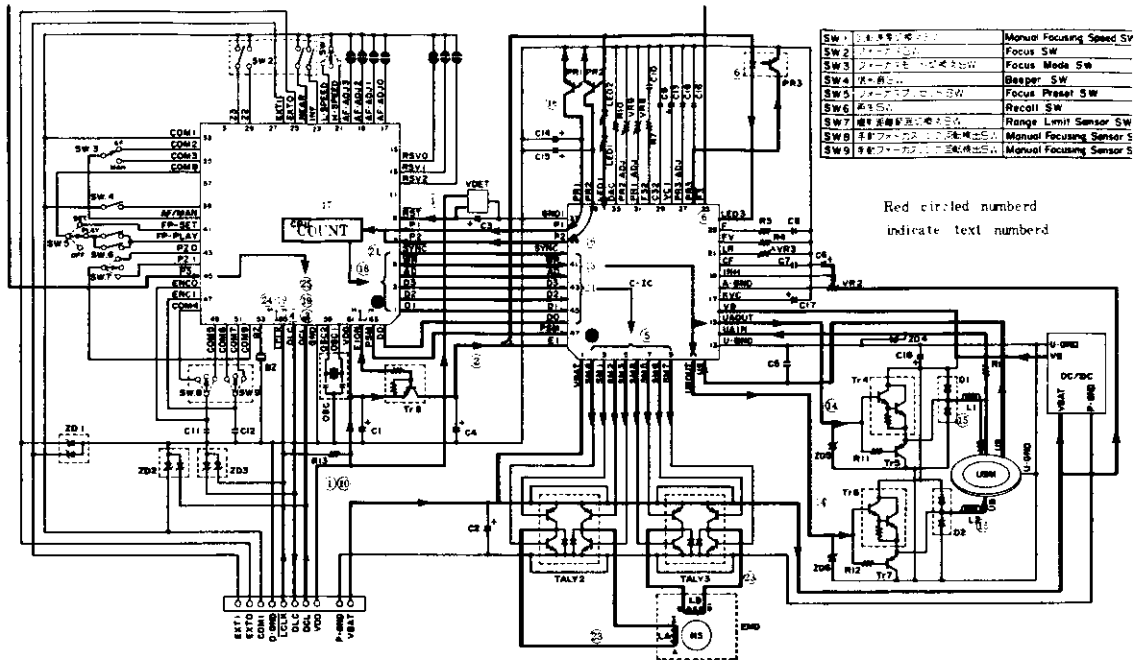
9. If the camera determines the diaphragm is still not fully open, the camera decides that the diaphragm is inoperative and initiates the BC warning signal when SW2 is closed.

Switch Operation

When Focus mode SW3, Focus preset SW5, Playback SW6, or Manual focusing sensor SW8, 9 is operated, lens CPU turns DLC to "low" regardless of /LCLK, and sends communication request (WAKE UP), activating the camera DC/DC converter. After this, procedure in the same as above from step 2.

Camera SW1 On

10. When the camera SW1 is turned on, the camera DC/DC converter is activated, and lens CPU receives VDD, and VBAT (for the DC/DC converter). The lens CPU applies a low to E1ON turning Tr8 on which supplies E1 to the C-IC.



Focusing (USM) Drive

11. When the drive signal comes from the camera, the lens CPU starts the USM Drive sequence.

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

13. The lens CPU sends the /SYNC, /WR, and /AD signals on exclusive lines and focusing direction data on the 4-bit data lines D0 through D3. Also the LED on data is sent.

14. When C-IC receives the focus direction signal, it issues out-of-phase square wave signals UAOUT and UBOUT signals which cause Tr arrays Tr4-5 and Tr6-7 to generate out-of-phase signals.

15. The outputs of the Tr arrays are applied to the USM through coils as sine waves.

16. As the USM turns, light from LEDs 1 and 2 is "chopped" so pulses are felt by PR1 and PR2, received by C-IC and sent to the CPU by lines P1 and P2. These pulses contain both position and direction data.

17. The pulses are counted by the CPU and focusing continues until the correct focus is reached.

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

Diaphragm (EMD) Drive

19. When the lens gets the EMD drive signal from the camera CPU, the lens sends a "busy" (/LCLK = L) signal.

20. When the drive command and amount data are received, the diaphragm is stopped down in accordance with the data.

21. The CPU sends the aperture
mand to C-IC via the /SYNC,
and D0-D3 lines, instructing C-
the diaphragm.

22. The CPU sends the amount d
clock rate on the PSM line to

23. The C-IC uses this data to se
signal over lines SM1-SM8 whi
the Tr arrays TALY2 and TA
output of the Tr arrays establi
rent directions in coils LA and
down the diaphragm.

24. After the last pulse is sent fr
to the C-IC, the busy signal
from the /LCLK line.

25. The camera sends the diaphrag
nal through DCL to the lens
sends it on over the /SYNC,
and D0-D3 lines to remove the
SM1-SM8.

nic Circuit EF200mm f/1.8L

tic Explanation

ed on Camera
the lens is mounted, VDD is applied to the PU activating clock oscillator (OSC). The reset by C3 and voltage sensor IC VDET. initial communications, the CPU goes into mode.

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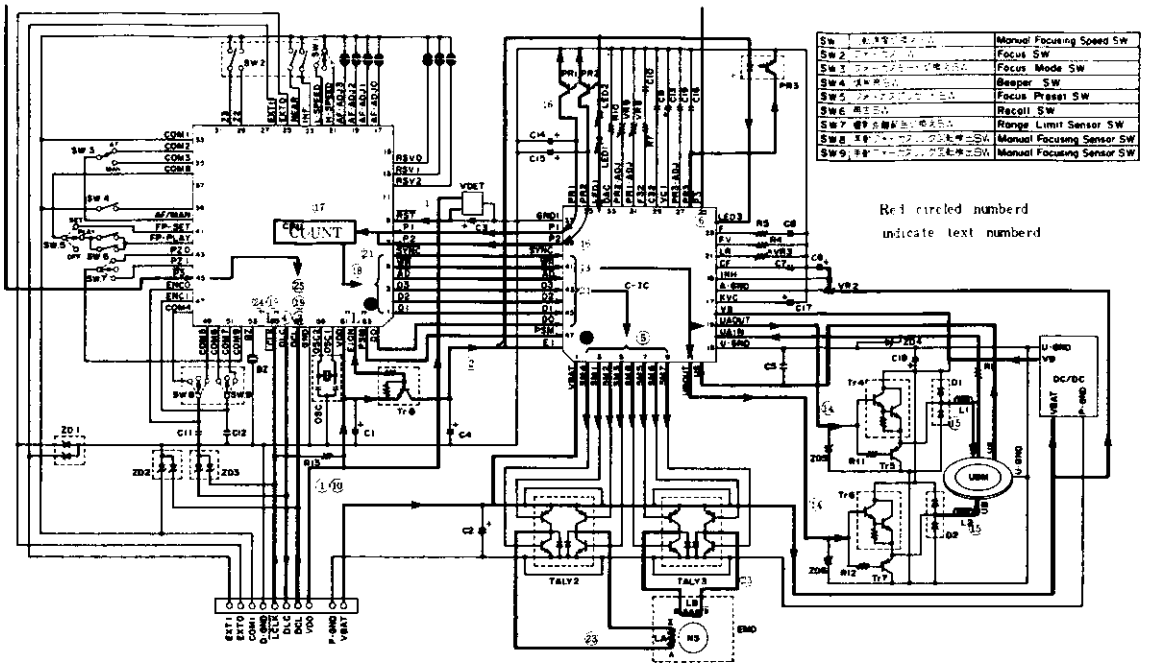

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13. The lens CPU sends the /SYNC, /WR, and /AD signals on exclusive lines and focusing direction data on the 4-bit data lines D0 through D3. Also the LED on data is sent.

14. When C-IC receives the focus direction signal, it issues out-of-phase square wave signals UAOUT and UBOUT signals which cause Tr arrays Tr4-5 and Tr6-7 to generate out-of-phase signals.

15. The outputs of the Tr arrays are applied to the USM through coils as sine waves.

16. As the USM turns, light from LEDs 1 and 2 is "chopped" so pulses are felt by PR1 and PR2, received by C-IC and sent to the CPU by lines P1 and P2. These pulses contain both position and direction data.

17. The pulses are counted by the CPU and focusing continues until the correct focus is reached.

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

Diaphragm (EMD) Drive

19. When the lens gets the EMD drive signal from the camera CPU, the lens sends a "busy" (/LCLK = L) signal.

20. When the drive command and amount data are received, the diaphragm is stopped down in accordance with the data.

21. The CPU sends the aperture drive command to C-IC via the /SYNC, /WR, /AD and D0-D3 lines, instructing C-IC to drive the diaphragm.

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

23. The C-IC uses this data to send an 8-bit signal over lines SM1-SM8 which energize the Tr arrays TALY2 and TALY3. The output of the Tr arrays establish the current directions in coils LA and LB to stop down the diaphragm.

24. After the last pulse is sent from the CPU to the C-IC, the busy signal is removed from the /LCLK line.

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

USM Operation

1. When the C-IC receives the USM drive (focus drive) command from the CPU, out-of-phase square waves are output from UAOUT and UBOUT.

2. The square wave output controls the drive transistor networks and, through them, the USM as explained below.

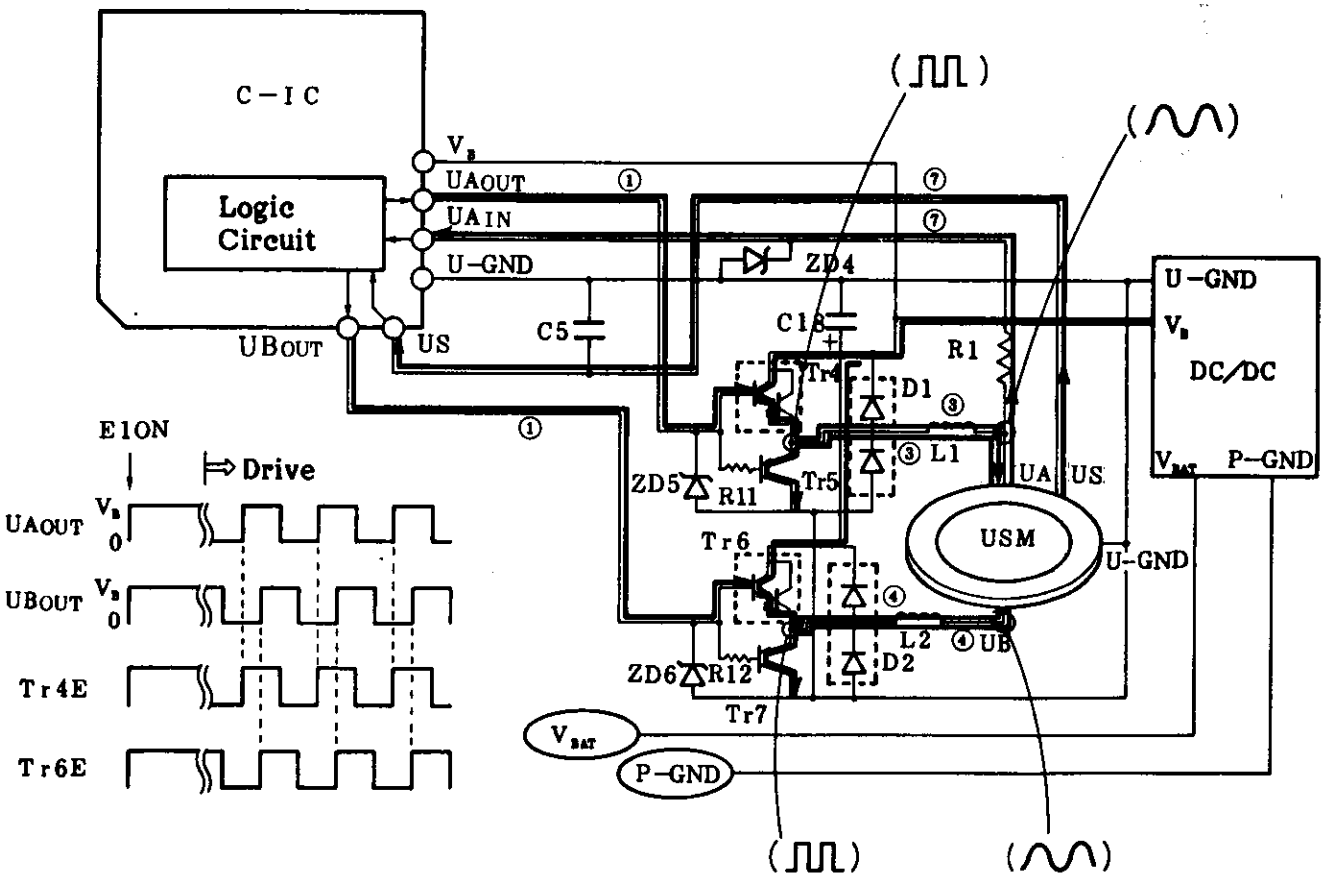
3. When UAOUT goes high, it turns on Tr4 applying VB to L1 and current flows through L1 to the USM. When UAOUT goes low, Tr4 goes off and Tr5 turns on allowing current to flow back from the USM through L1 and Tr5 to ground. Since current lags through a coil, the square wave input becomes a sine wave output.

4. The operation of the UBOUT circuit is exactly the same, Tr6 replacing Tr4, Tr7 replacing Tr5 and L2 replacing L1.

5. As operations (3) and (4) repeat the two out-of-phase sine waves cause the USM to turn.

6. When the USM is in "stand-by", both UAOUT and UBOUT are high.

7. The UAIN and US signals are fed back into the C-IC to monitor USM operation.



EMD control

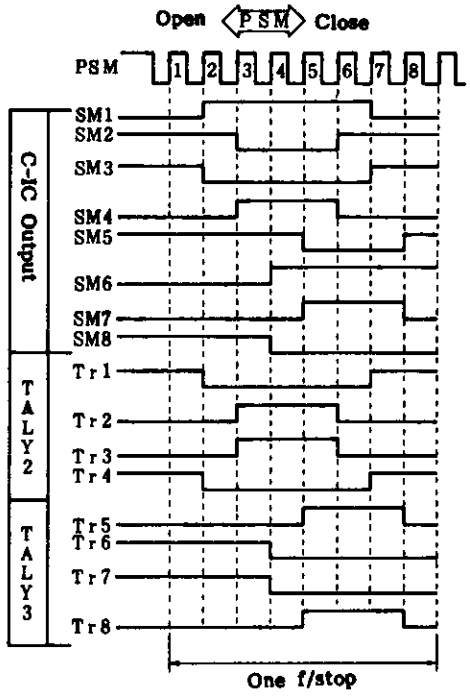
The diaphragm (EMD) drive is controlled by the stepping pulse "PSM" sent from CPU. Each pulse produces a 1/8 step change in the aperture.

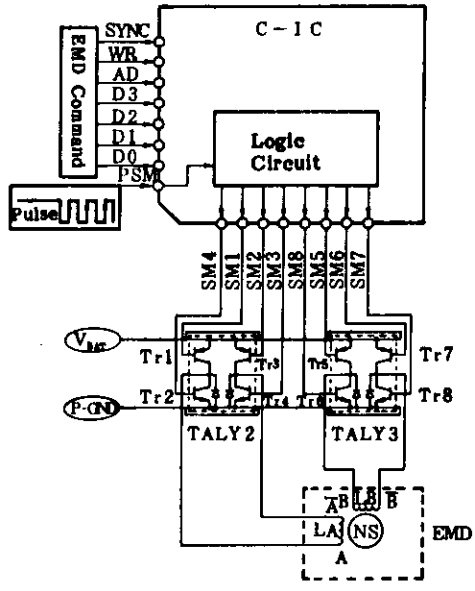
Pulse	High Signal	Current Flow*
1	SM2, SM3	A ⟶ /A
	SM5, SM8	/B ⟶ B
2	SM1, SM2	OFF
	SM5, SM8	/B ⟶ B
3	SM1, SM4	/A ⟶ A
	SM5, SM8	/B ⟶ B
4	SM1, SM4	/A ⟶ A
	SM5, SM6	OFF
5	SM1, SM4	/A ⟶ A
	SM6, SM7	B ⟶ /B
6	SM1, SM2	OFF
	SM6, SM7	B ⟶ /B
7	SM2, SM3	A ⟶ /A
	SM6, SM7	B ⟶ /B
8	SM2, SM3	A ⟶ /A
	SM5, SM6	OFF

The above sequence moves the diaphragm through one f/stop. The process is repeated until the correct aperture is reached.

To open the diaphragm after the exposure, the procedure is reversed.

*: Conventional current flow





EF600mm 1:4.0L

REF. NO. C21-8292

REPAIR INSTRUCTIONS

Canon SERVICE MANUAL

REPAIR INSTRUCTIONS No.

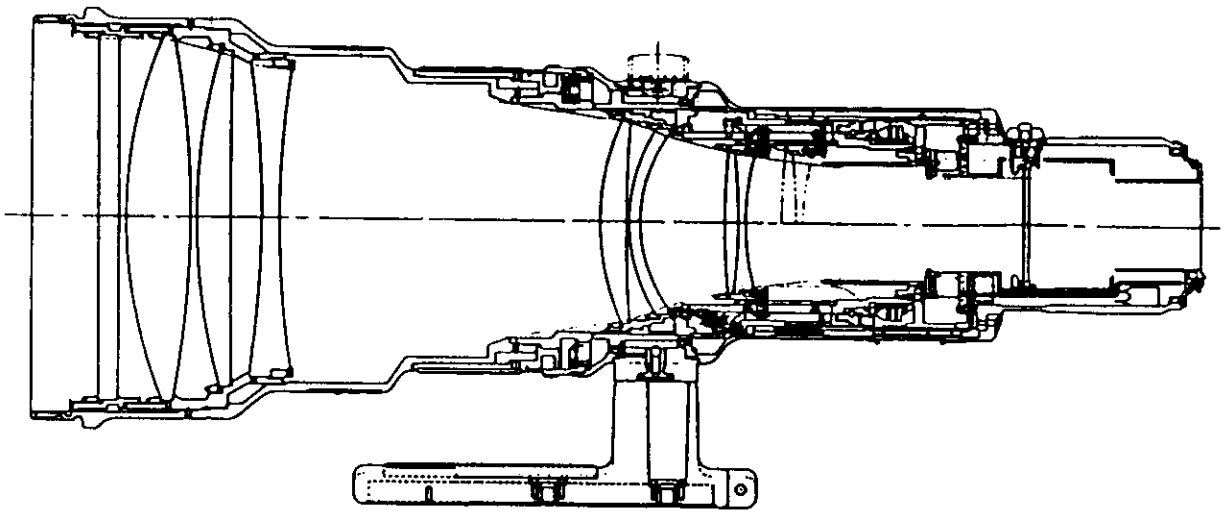
Camera Technical Service Department, Canon Inc. Date

CANON LENS EF600mm 1:4.0L

Ref. No. C21-8292

Special Optical Adjustments:

Centering.	Yes	(No)
Tilt	Yes	(No)



<!!> If optical components are disassembled or changed, perform the focus adjustments.

<!!> When the USM is replaced, the pulse adjustment is necessary. The EMD unit does not require adjustment when replaced.

<!!> When the main flex is replaced, the pulse adjustment must be done and the "best focus" and USM frequency checked.

<!!> Threaded parts are staked during assembly. When disassembling them be careful not to mar the screw heads or spanner points.

<!!> The lead wires and main flex are held in place with "Acetate Cloth Tape", (CY4-9102). When removed, be sure to replace it in exactly the same position.

<!!> Some interior portions of certain external parts are coated with oil retardant. Try not to touch these parts. The retardant loses its efficiency if touched, and must be renewed (Pg. 15).

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EF 600mm f/4.0L

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IV.	Electronic Circuit (See the EF 200 f/1.8L Service Manaul. The electrical circuits are identical).	

Part Number	Name	Remarks	Plastic Safe?
-ADHESIVES-			
CY4-9102-000	Acetate Cloth Tape 570F	Holding leads and flex, replaces double-stick tape	YES
CY9-8002-000	Bond G103	General purpose bond	NO
CY9-8008-000	Arontite L	For staking screws	NO
CY9-8011-000	Screw-lock	For staking screws	YES
- LUBRICANTS -			
CY9-8044-000	GE-X8	Zoom Helicoid mix (metal OK)	YES
CY9-8045-000	GE-C4	Helicoid & cam (metal OK)	YES
CY9-8067-000	MoS_2 Grease	Tripod socket ring knob	NO
- MISC. -			
CY9-8078-000	Lacquer (L. Gray)	Touch-up paint	N/A
CY9-8090-000	NF-33	Moisture barrier	YES

I. Introduction:

The EF 600mm f/4.0L is the first super-telephoto EF lens. It was developed, along with the EOS 850, to satisfy the needs of professional photographers.

Features

1. A fluorite and two ultra-low desperation (UD) elements are used to almost completely eliminate secondary color.

2. A telephoto lens design revision holds distance-related aberration variations to a minimum, and improved image quality close up.

3. The ultrasonic focusing motor coupled to lightweight internal focusing cell equals high speed autofocus.

4. The powered "manual" focusing ring is positioned for best balance in hand-held shooting.

5. The ability to limit the focusing range with the "focus preset" allows rapid shifts of focus between predetermined points.

6. The controls of all three long EF lenses have been standardized for users who use more than one lens.

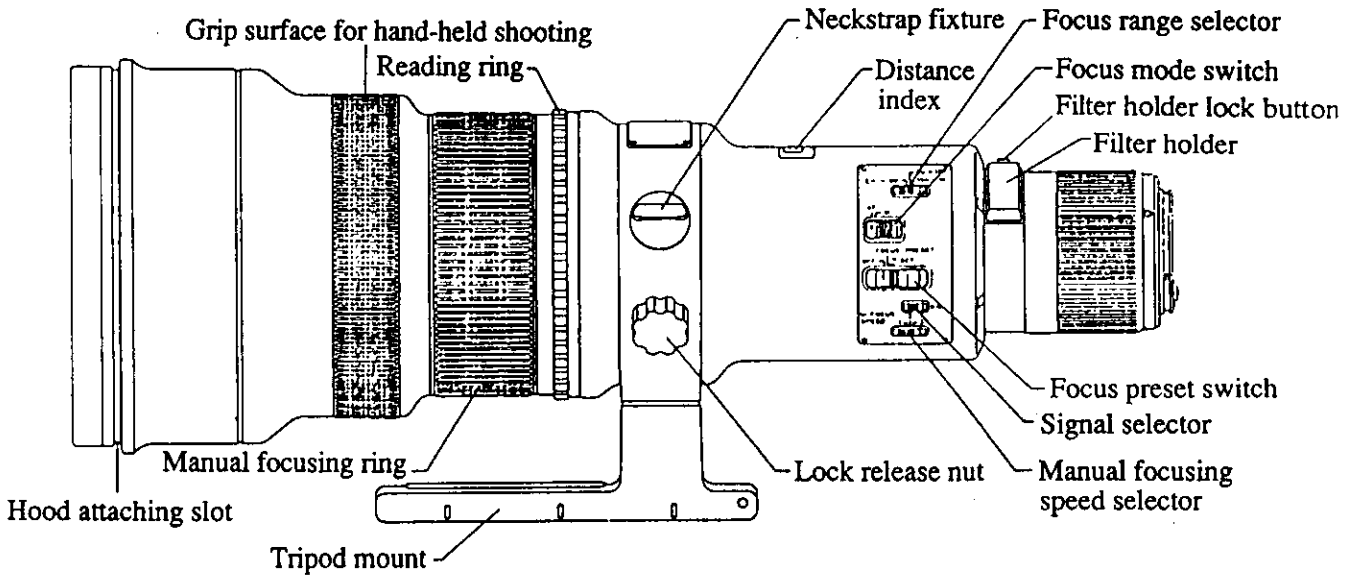
7. The EF 1.4X increases the focal length while retaining a very respectable f/5.6 maximum aperture.

---------- Color Code

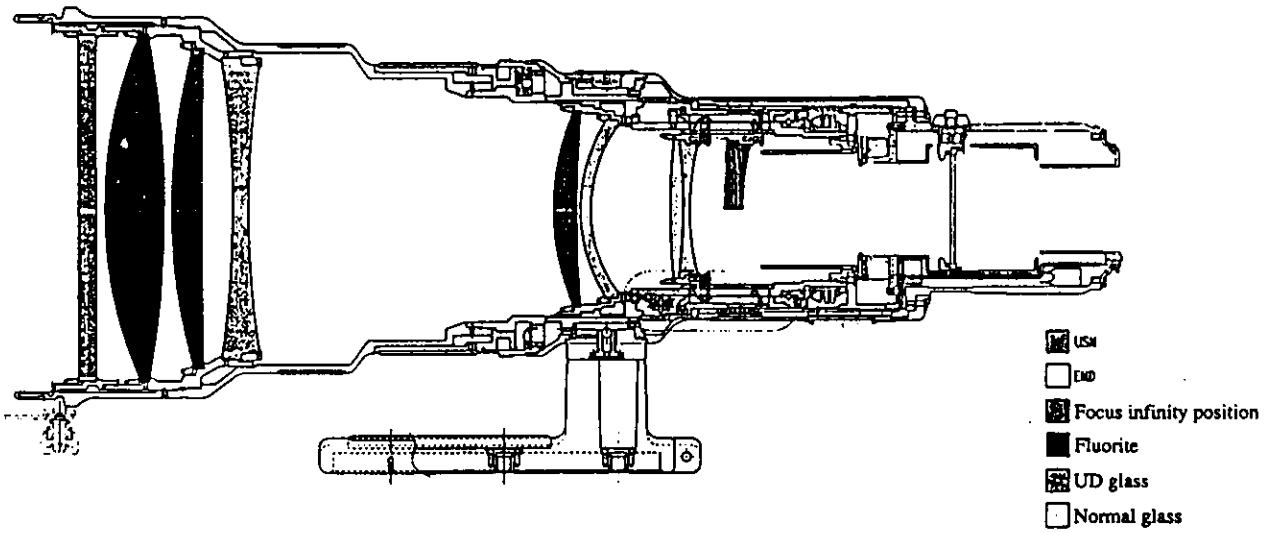
To save space on drawings, it has been necessary to uses a color code. The code is:

Color	Code	Color	Code	Color	Code
Black	BL	Blue	BU	Gold	GL
Brown	BR	Violet	V	Tan	T
Red	R	Purple	PR	Pink	PK
Orange	O	Gray	GY	Sky Blue	SB
Yellow	Y	White	W	Yellowish Green	YG
Green	GN	Silver	S		

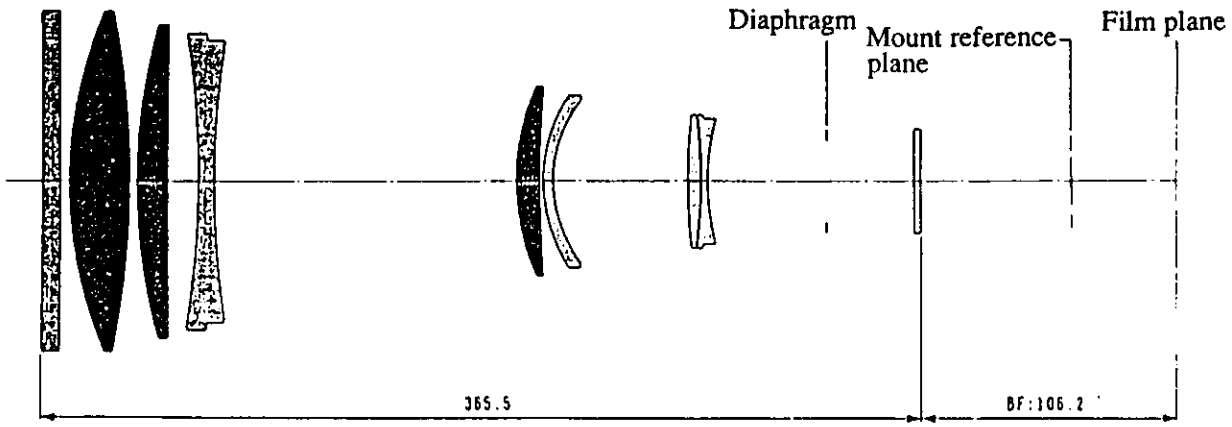
External Appearance/Structural Cross-section/Optical System



Structural cross-section



Optical system



SPECIFICATIONS

1. Format: 24 x 36 mm

2. Focal length/aperture: 600mm , f/4.0

3. Optical structure: 8 groups*, 9 elements* (Super Spectra Coating)
G-2: Fluorite, G-3 & G5: UD Glass
*: Including front window and rear filter

4. Angle of view (infinity):

Diagonally (43.2 mm)	8° 15'
Vertically (24 mm)	4° 35'
Horizontally (36 mm)	6° 50'

5. Autofocus (AF)

5-1 Drive system: USM

5-2 Drive speed: 1.03 seconds (between infinity and closest focus(3.0m), excluding AF ranging)

5-3 Manual: Three-speed, powered manual focusing

5-4 Ranges: Switchable: 6.0m to infinity,
6m to 15m, or
15m to infinity

6. Focusing:

6-1 System: Internal Focusing

6-2 Range: 6.0m to infinity

6-3 Rotation angle, extension:

Condition	Rotation angle	Extension
6.0m to infinity	116.8°	22.15mm
Infinity overrun	7°	1.24mm

6-4 Distance scale:

20 25 30 40 50 70 100 200 ft (fluorescent green)
6 7 8 10 12 12 20 30 50 m (gray)

6-5 Maximum magnification, field of view

Condition	Magnification (power)	Field of view (mm)
Close focus(6.0m)	0.105	228 x 342mm

SPECIFICATIONS

7. Mount

7-1 Type: Canon EF mount

7-2 Signal transfer function: EOS system, with 5 signals as follows :

A) Lens condition B) Lens type
C) Photometry signal D) Focal length
E) AF drive information

8. Aperture mechanism

8-1 Diaphragm control: Pulse control using EMD

8-2 Aperture range: f/4.0 - f/32 (f/32 not marked)

8-3 Diaphragm: 8 blade fully automatic diaphragm

8-4 Depth-of-field scale: @ f/16 and f/32

8-5 Infrared index: N/A

9. Filter: 48mm (P = 0.75mm) rear drop-in (One only)

10. Dimensions & weight: 167 mm diameter x 456 mm length / 6 kg

11. Related products

11-1 Hood: ET-161 (removable and reversible)

11-2 Lens cap: E-180 bag type with draw string

11-3 Lens case: Exclusive carrying case (Lens stores with caps on, but with hood removed. Space is provided for the hood.

11-4 Dust cap: Common to all EF lenses (new)

12. Miscellaneous:

12-1 Tripod mounting: Three $\frac{1}{4}$ x 20 sockets located on the revolving tripod ring located well forward to assure best balance with and EOS camera body.

12-2 Tripod Ring: Revolving ring, 360° rotation with detentes every 90°, lockable with knob.

External Design

The external design concept of this lens is the same as the EF 300mm f/2.8L and EF 200mm f/1.8L and follows the concepts laid down for long lenses in the FD series. USM powered manual focusing and preset focus functions make this a quite flexible long telephoto lens.

The overall shape is one of curves, with few angles. Finish is in a slightly pebble-grained light gray lacquer to keep the lens as cool as possible. The red ring is the mark of an L series lens.

Technical Information

1. Optical Performance

1-1 Chromatic Aberration

Longitudinal Chromatic Aberration is caused by the variations in the refraction index of glass by wavelength (color) of light, which is called dispersion. This aberration is most evident in large aperture, long focal length lenses. The remaining longitudinal chromatic aberration is known as secondary spectrum.

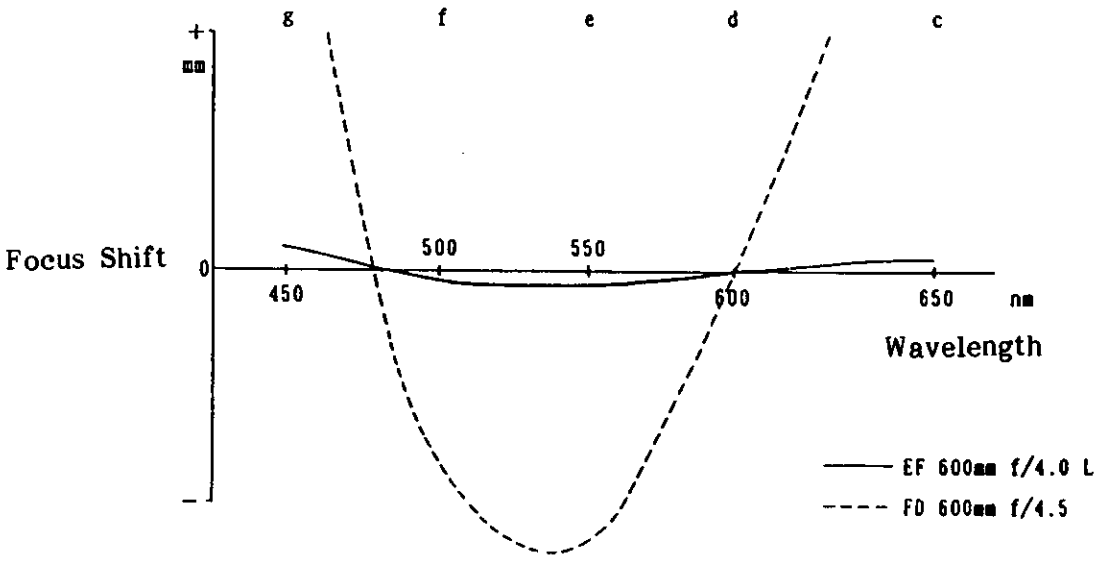
Certain optical crystals, like fluorite (CF_2), and certain optical glasses have very low dispersion, and some also have dispersion characteristics which different considerably from the characteristics of normal optical glasses. This is called anomalous dispersion. Canon calls these optical glasses "UD" glass. Using fluorite and UD elements is expensive, but far better control of longitudinal and lateral chromatic aberrations is possible with them. This lens uses fluorite for G2 and UD glass for G3 and G5 to achieve excellent quality.

In-focus areas give high contrast, accurate color reproduction and separation, no color fringing due to good lateral color control.

Out-of-focus areas give very pleasant blur without any color caste.

The viewfinder image is bright, clear, and neutral.

Secondary Spectrum



1-2 Aberration Variations with Focusing Distance

A positive element (G5) has been added to the middle group, allowing the power of the inner focusing group to be reduced. Since any group that moves in relation to the other groups tends to cause variations, and the greater its power, the greater the variations are, reducing the power of this group reduces the variations with focusing distance allowing closer focusing and stable image quality from closest focus to infinity. (As an example, the FL 600mm was an f/5.6 and focused only to 10 meters. The FD 600mm was a f/4.5 and focused to 8 meters. This lens is an f/4.0 and focuses to 6 meters and gives better image quality than the older lenses.

2. Mechanical

2-1 Internal focusing, combined with the USM, gives full-range focusing in about a second. Three speed powered manual focusing gives the advantage of power with the feel of manual focusing.

2-2 Control position and operation has been standardized, so that the photographer can switch between the 600, 300, and 200mm lenses and always feel at ease with the controls. Naturally, a 600mm lens is designed primarily for use on a tripod, but the balance and the powered manual focusing should make this lens eminently hand-holdable for experienced photographers.

2-3 Extenders

EF 2X: Since this combination gives 1000mm at f/8 and the light cone necessary for the autofocus sensor is f/7.6, autofocus cannot be used. Manual focus is possible with the switch in the AF position. AE operation is not affected.

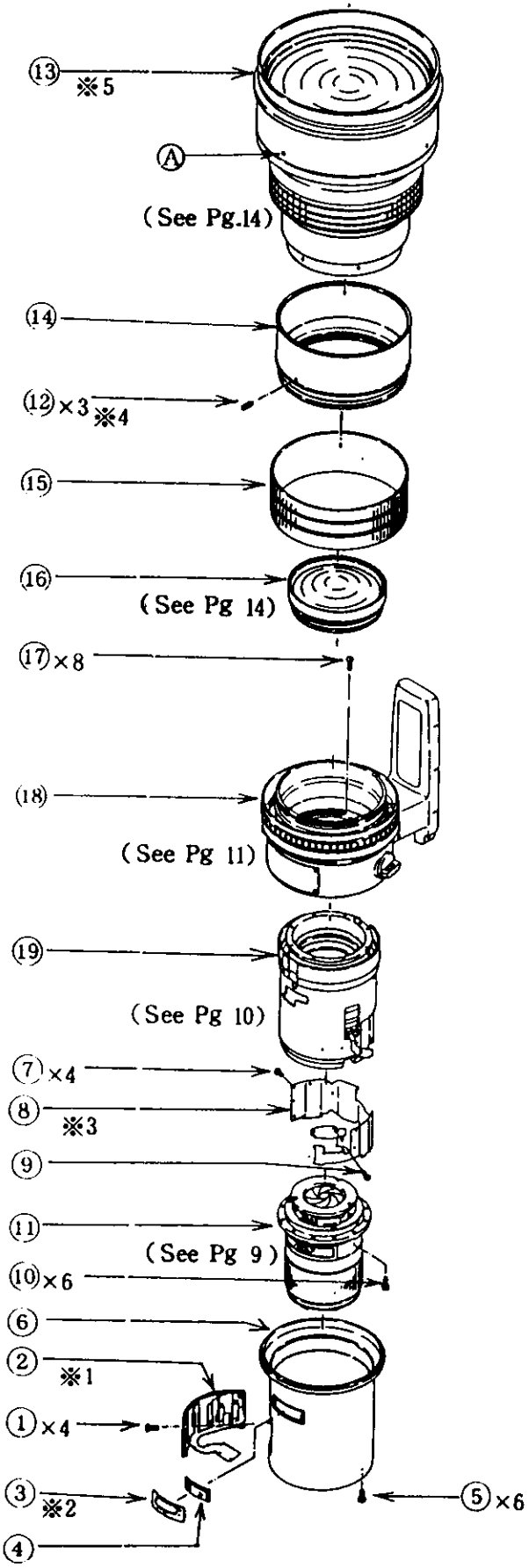
EF 1.4X: Both AF and AE operate, although AF speed is intentionally decreased, as with the EF 300mm f/2.8 + EF 2X, but to a lesser extent than with the 2X extender.

SPECIFICATIONS with Extenders EF 1.4X and EF 2X

Focal length/aperture*	840mm f/5.6 - f/45	1200mm f/8.0 - f/64
Angle of view (at infinity):		
Diagonally (43.2 mm)	3° 00'	2° 05'
Vertically (24 mm)	1° 40'	1° 10'
Horizontally (36 mm)	2° 30'	1° 40'
Autofocus (AF)	Usable	Switches to manual automatically
Drive speed:	Approx. ½ master lens.	N/A
Dimensions & weight:	167 x 483.3mm 6.2 Kg	167 x 506.5mm 6.24 Kg

*: Minimum aperture depends on body in use.

1. Preliminary Disassembly



The entire front lens unit can be removed after only loosening the setscrews (12) (See notes 4 and 5).

<!!> 1: Unsolder the main flex from the switch flex.

<!!> 2: (3) is bonded to (6). Run Fronsolve AE under the ends to loosen to avoid scratching (6).

<!!> 3: Unsolder leads and peripheral flex connections.

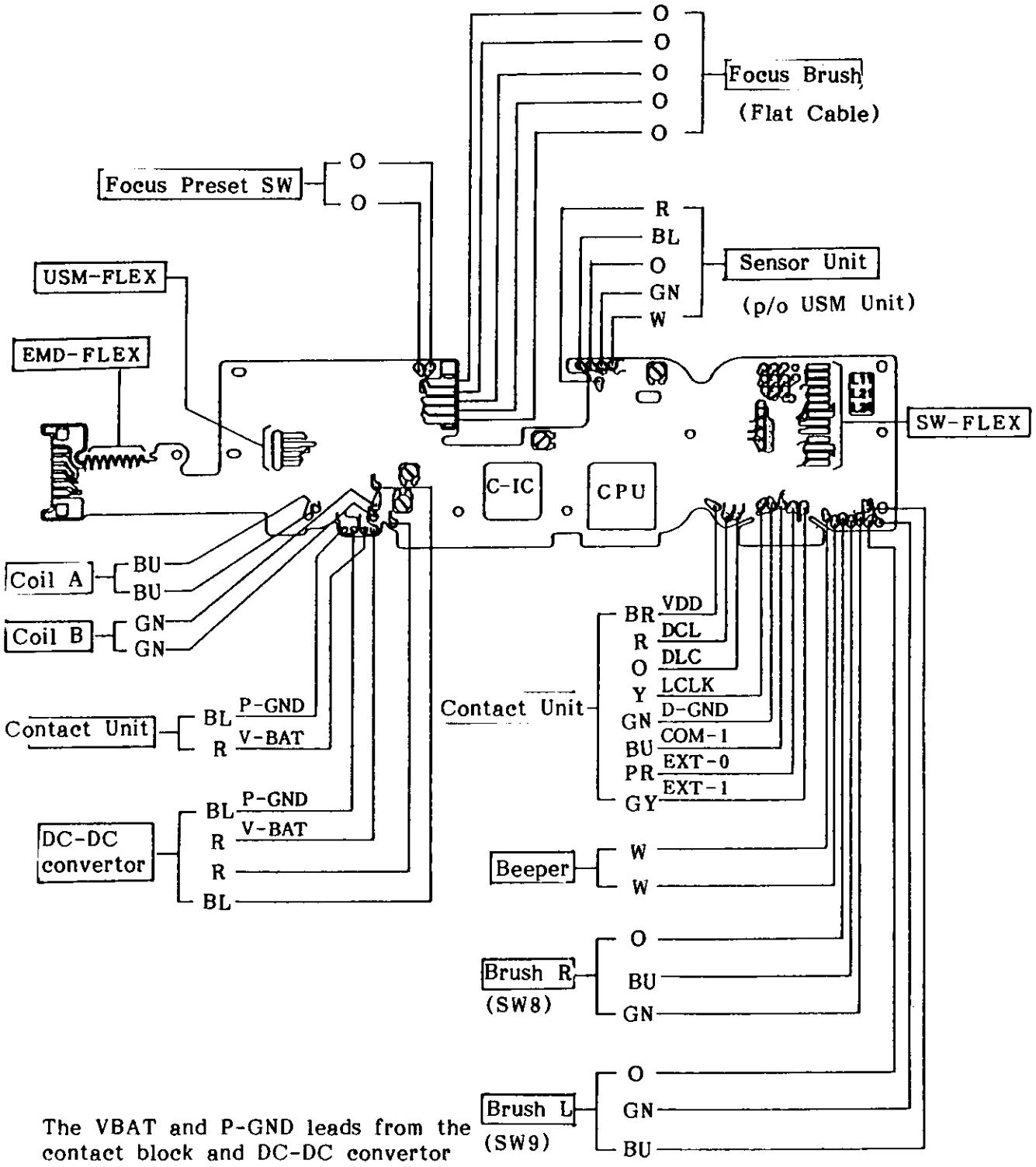
<!!> 4: Lift the rear edge of (15) and align the setscrew access hole in (14) with the setscrew hole (A) in (13). Use a 1.5mm hex key to loosen setscrew (12) three to four turns. [The setscrew is actually in the rear of (13), not (14) as shown in the drawing.]

<!!> 5: During assembly screw-lock is run through the setscrew holes bonding (13) to (18). This makes it difficult for one person to unscrew (13). Get help.

II. DISASSEMBLY & ASSEMBLY EF600mm f/4.0L

2. Main Flex Removal

Check lead colors and lead dress before unsoldering.

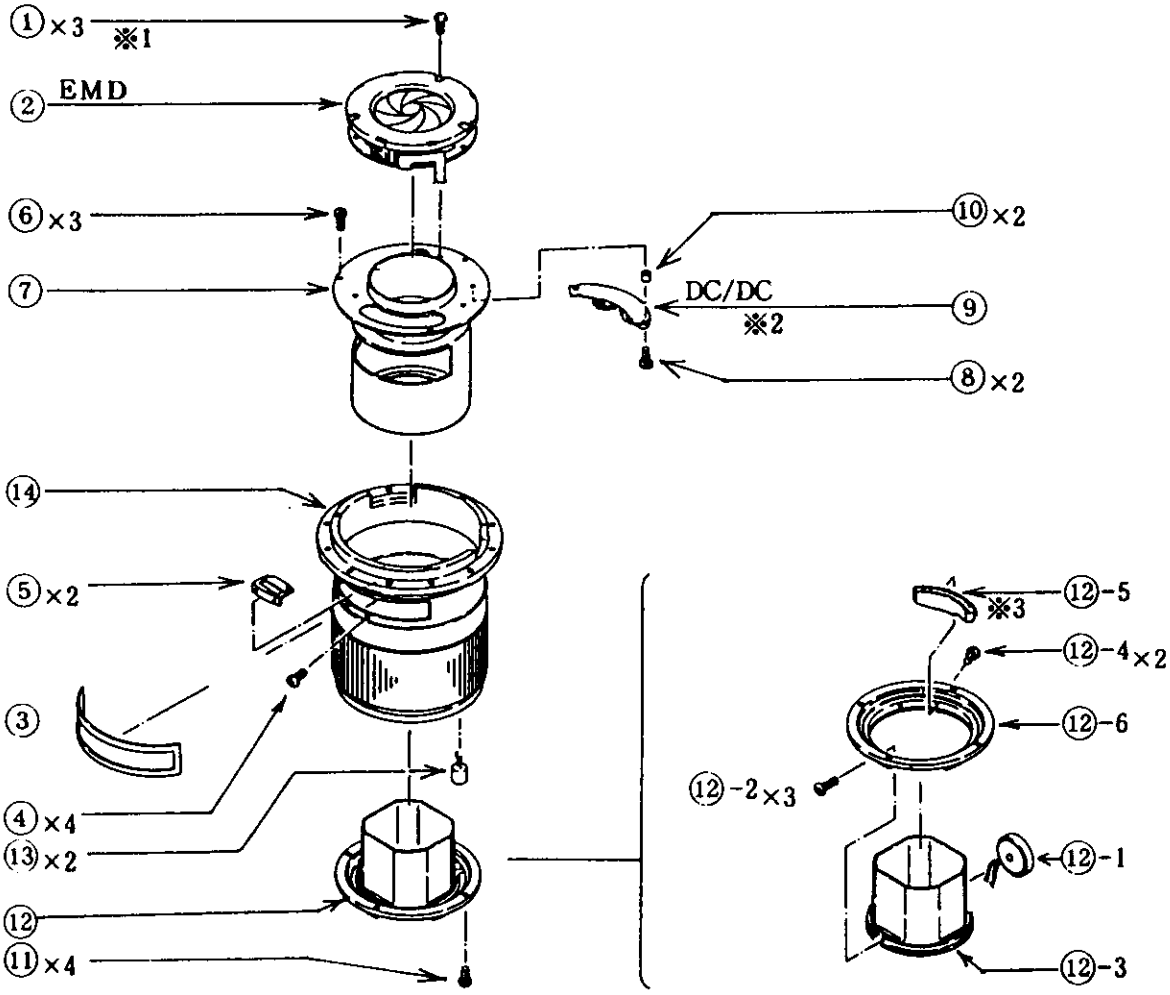


The VBAT and P-GND leads from the contact block and DC-DC convertor are heavier gage than the other leads.

Coil A and B leads are interchangeable.

3. EMD Unit, DC-DC Convertor Removal and Fixed Barrel Disassembly

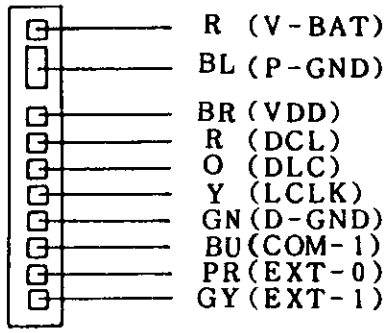
Check lead routing and dress before unsoldering.



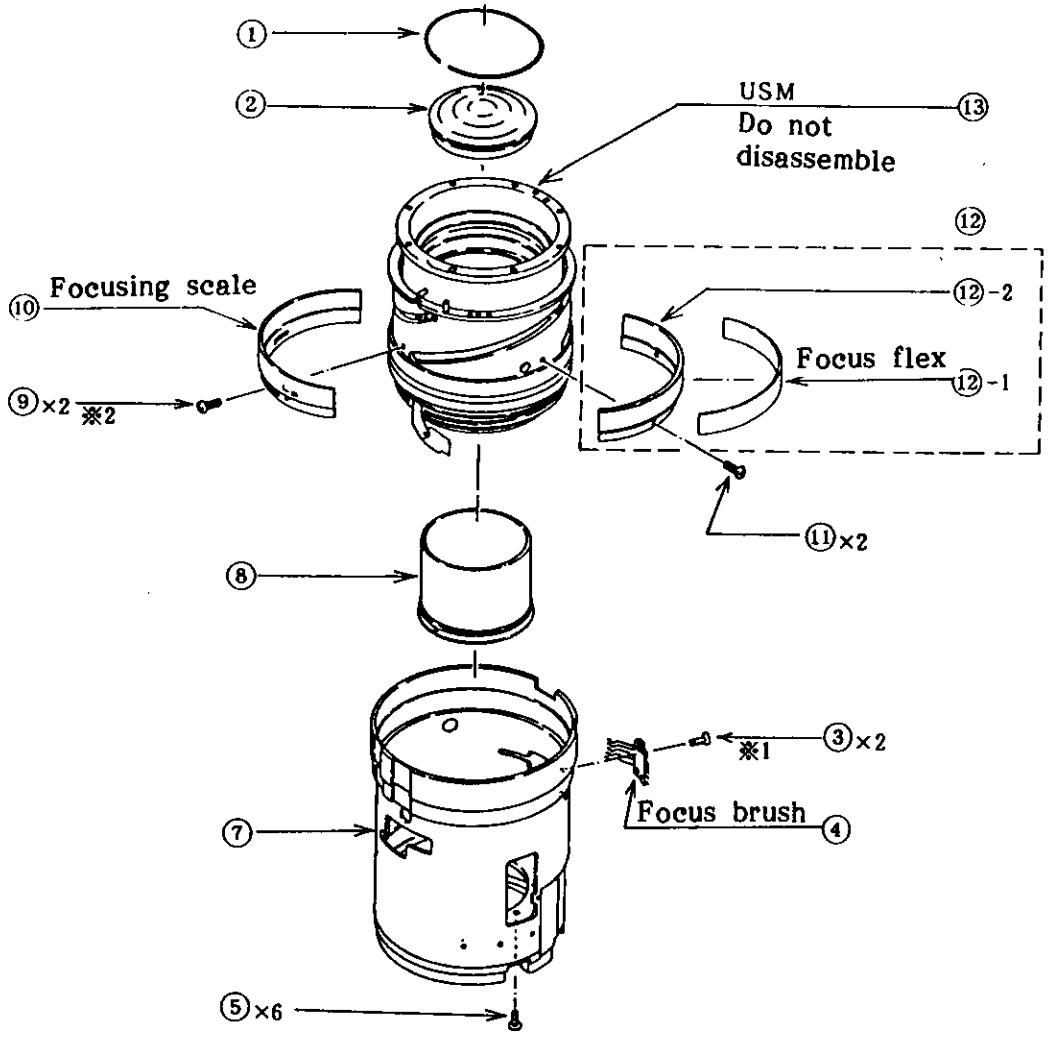
<!!> 1: Scribe alignment marks on (2) and (7) to facilitate reassembly. (The position is adjusted to center the mechanical aperture on the optical axis. This is not critical for optical performance.)

<!!> 2. Lead Connections

<!!> 3: Lead Connections



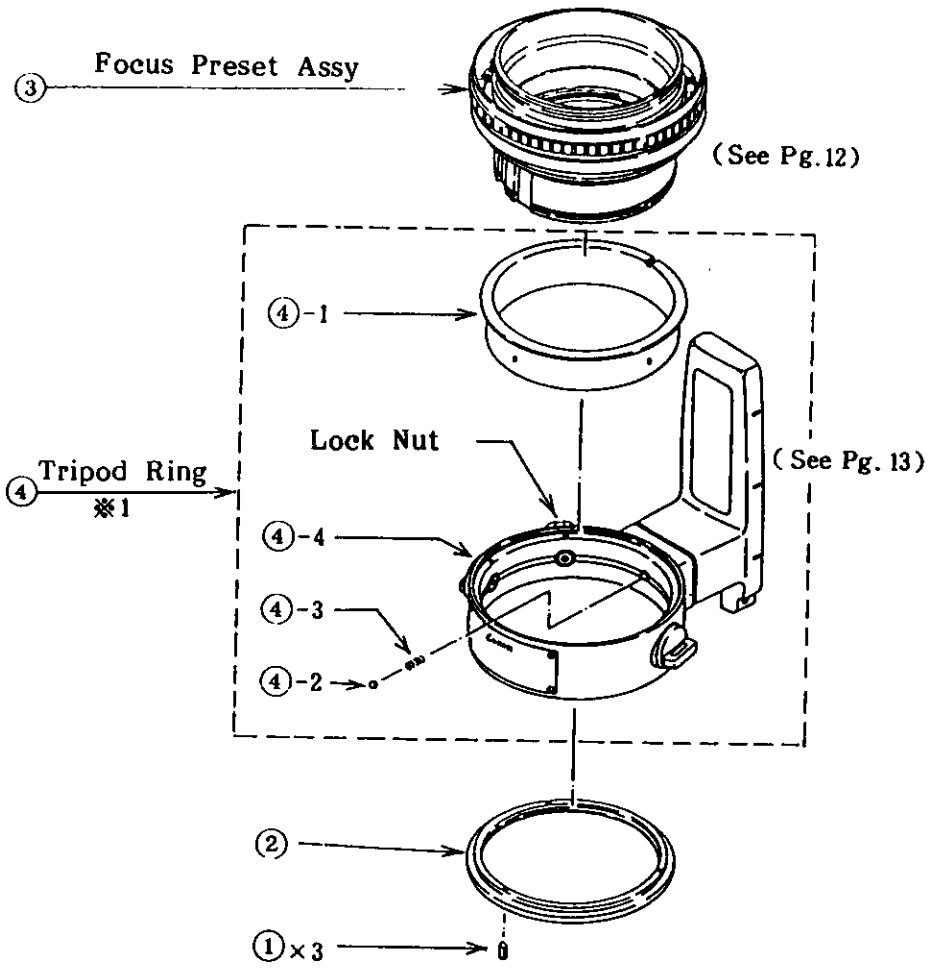
4. USM Unit Removal



<!!> 1: Scribe the position of the focus brush (4) before removing it to facilitate infinity adjustment. To adjust the index, see the focus adjustment.

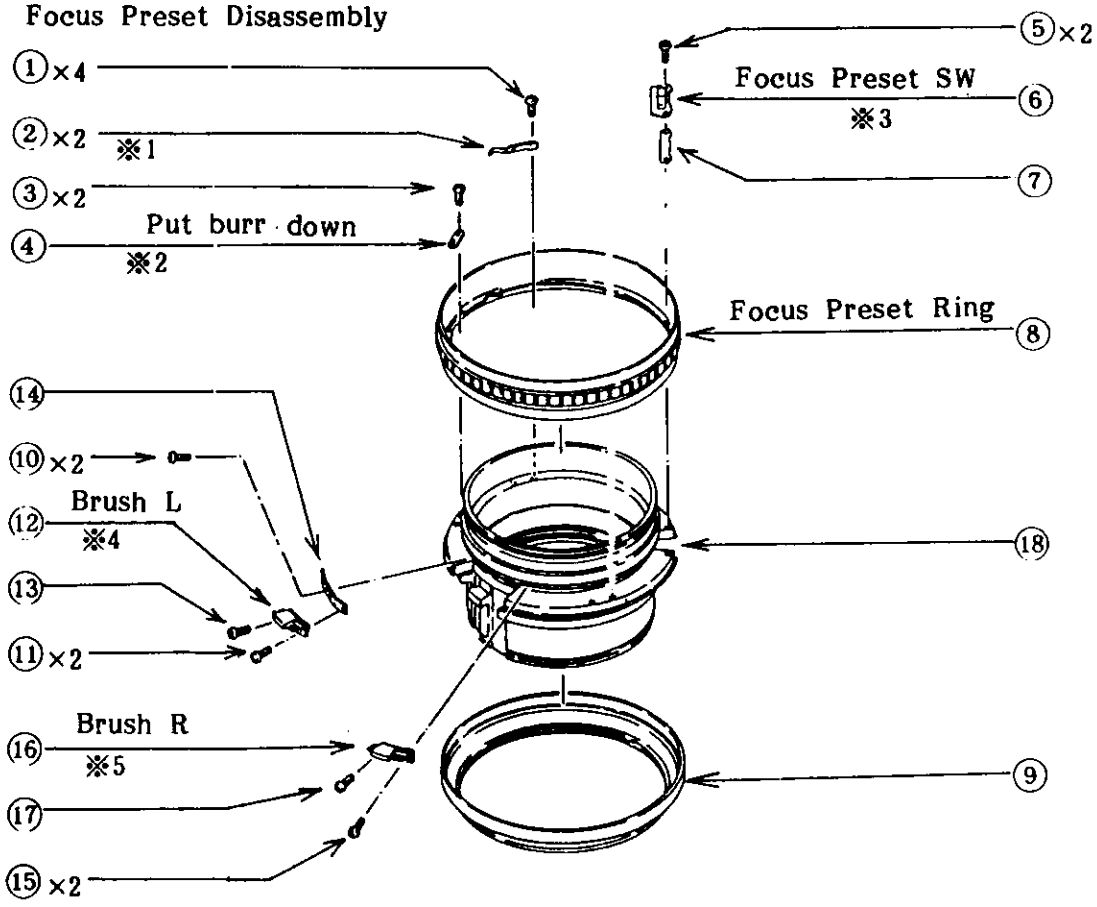
<!!> 2: Scribe the position of the focusing scale (10) before removing it to facilitate infinity adjustment. To adjust the index, see the focus adjustment.

5. Focus Preset Assembly and Tripod Ring Removal



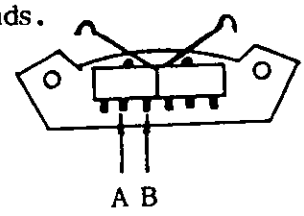
<!!> : Before removing the tripod ring, tighten down the lock knob to keep (4)-1 and (4)-4 together. This prevents detent ball and spring (4)-2 & 3 from flying out. If (4) is not assembled correctly, the camera will be canted at the detent positions.

6. Focus Preset Disassembly



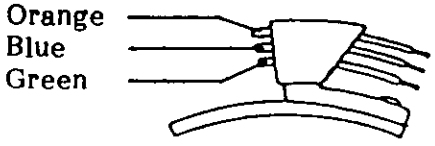
<!!> 1: After installing (2) rotate ring (8) to both extremes and insure that it returns to mid-point under its own power.

<!!> 2, 3: After installing (4), rotate ring (8) to both extremes and check that the resistance between A and B of (6) drops to zero before the mechanical extremes are reached, and that the overrun is about equal at both ends.

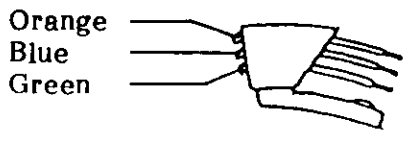


<!!> 4, 5: Adjustment is not possible at this point, so set the brushes visually and snug the screws just to hold the limit brushes temporarily.

If these brushes are not properly adjusted, reverse focusing or excessive hunting are the most likely results.

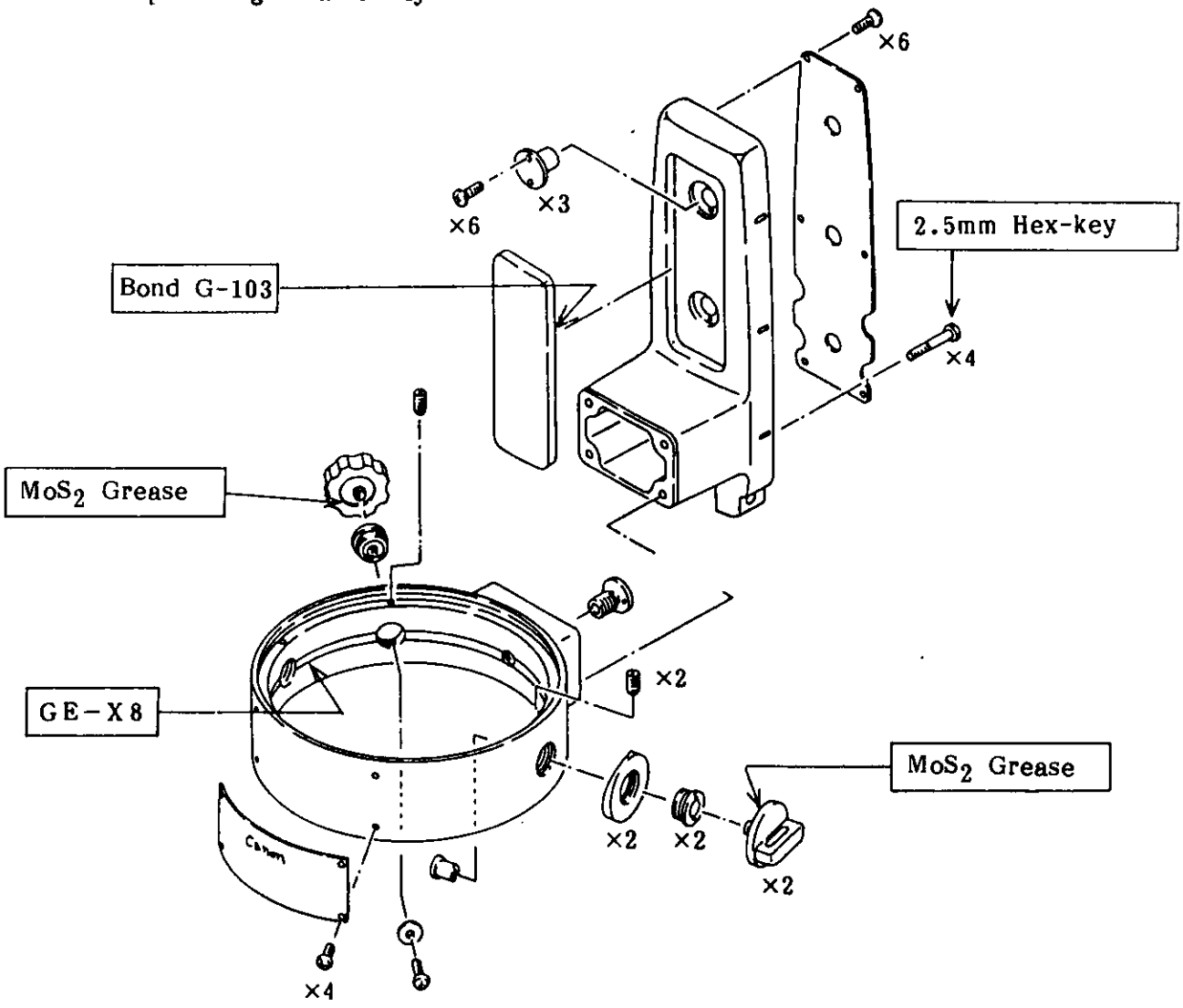


Brush L



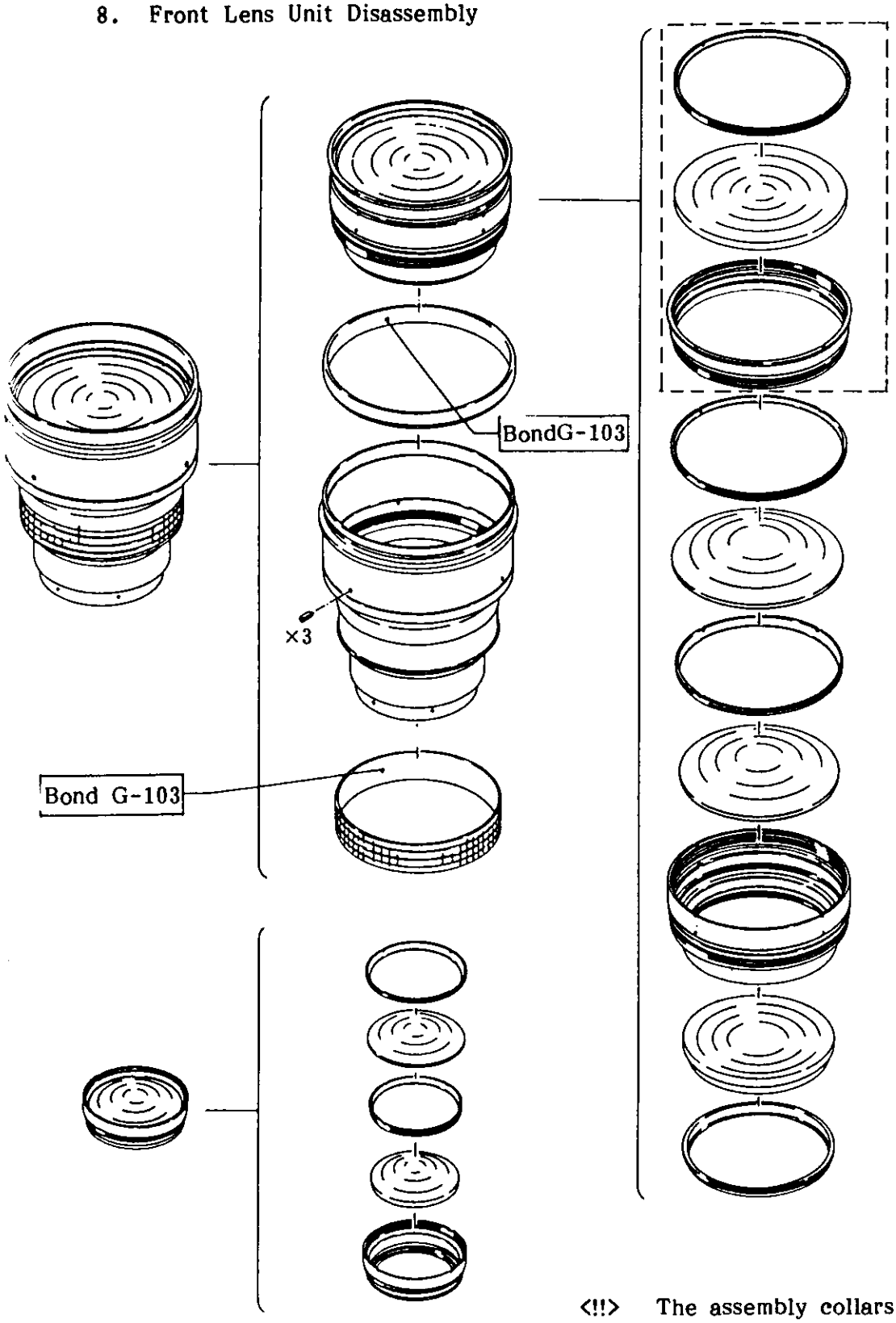
Brush R

7. Tripod Ring Disassembly



<!!> : All screws are staked with Arontite L. Take care not to strip the heads when removing them.

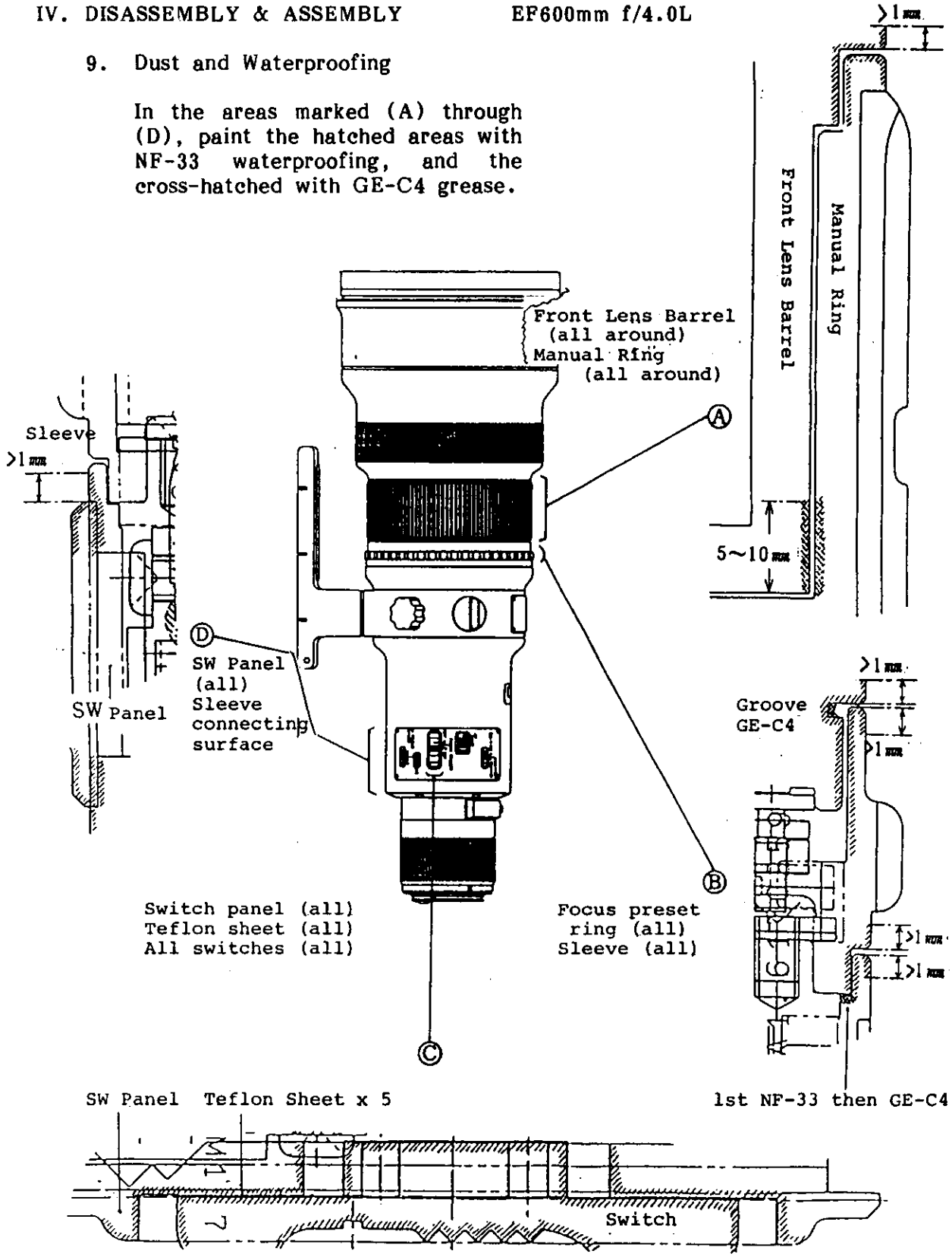
8. Front Lens Unit Disassembly



<!!> The assembly collars are staked with Screw-lock. Take care not to strip the heads when removing them.

9. Dust and Waterproofing

In the areas marked (A) through (D), paint the hatched areas with NF-33 waterproofing, and the cross-hatched with GE-C4 grease.



III. Adjustments EF600mm f/4.0L

1. Manual Focus Brush Position Adjustment

Lenses with USM focusing use powered manual focusing. This adjustment is necessary if the manual brushes (SW8 & SW9) are disturbed, or erratic manual focusing occurs.

To disassemble, remove (1) through (5), attach test leads to the main flex at COM4 through COM7 and D-GND (Fig. 2), short the A/M and MANUAL pads once to set manual focus, attach a camera and adjust as indicated below (Fig. 1 through 4).

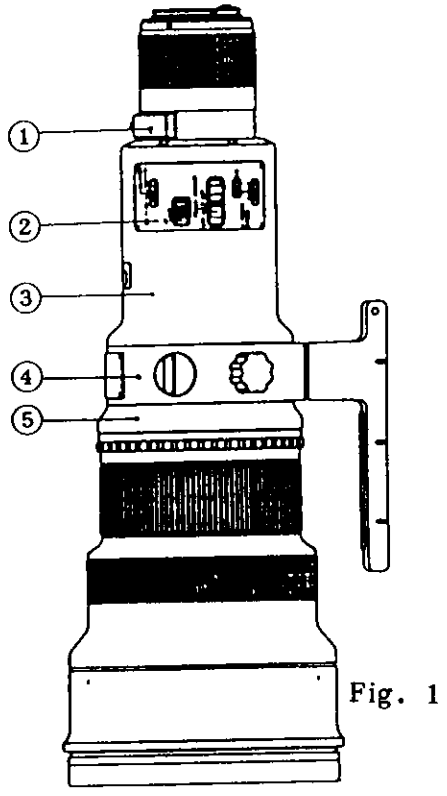


Fig. 1

Remove: (1) Focus Holder
(2) Switch Panel [Pg. 7 (1) & (2)]
(3) Indicator Sleeve [Pg. 7 (3)-(6)
(4) Tripod Ring [Pg. 11 (1) & (2)]
(5) Retaining Ring [Pg. 12 (9)]

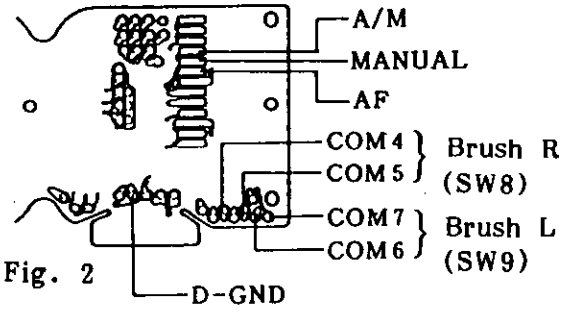


Fig. 2

Adjustment Method

1. Attach COM4 test lead to CH1 and COM5 test lead to CH2 of a dual-trace scope (Fig. 2). Turn the manual ring slowly while monitoring the scope. Adjust the screw on Brush R (SW8) until the pulses are 180° out of phase. Disconnect the leads.

2. Attach the COM6 and COM7 test leads and adjust Brush L (SW9) the same way.

3. Attach the COM4 and COM6 test leads. Turn the manual ring slowly while monitoring the scope. Adjust the adjusting base under Brush L so the pulses are 90° out of phase. This completes the adjustment.

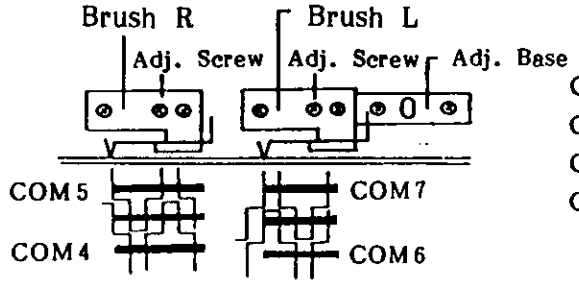


Fig. 3 ——> Pattern Movement

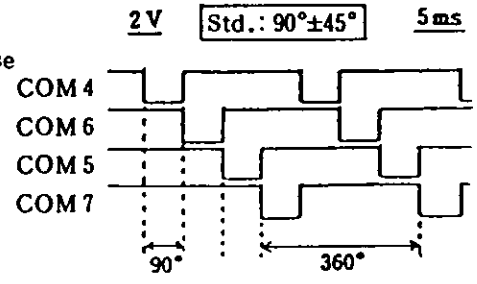


Fig. 4 (Composite View)

2. Pulse Adjustment

Adjust if main flex unit or USM unit is changed. If not adjusted, USM may work correctly at normal temperatures but fail at high or low temperatures.

Remove (1) through (3) in the previous section (III.1), mount a camera, and attach test leads to the main flex at PR1, PR2 and D-GND (Fig. 5).

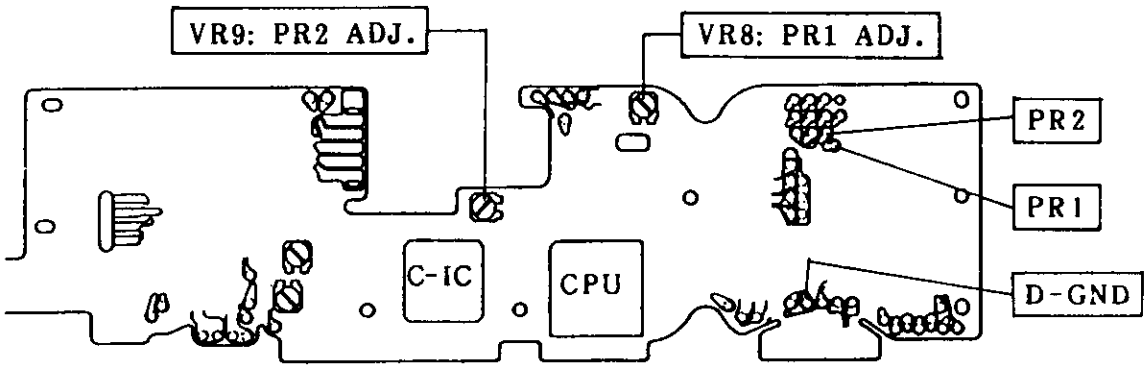
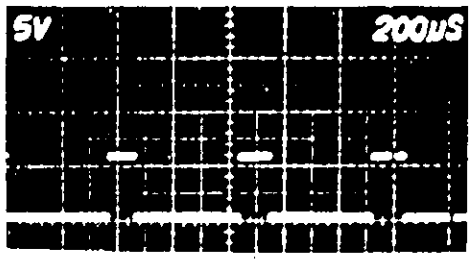


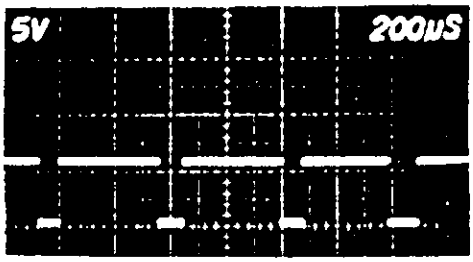
Fig. 5

Adjustment Method

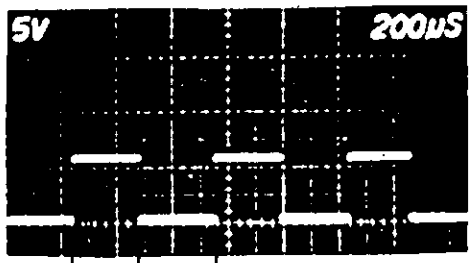
1. Attach the PR1 lead and D-GND lead to the oscilloscope.
2. Press the shutter button, and adjust VR8 so the waveform matches the one shown in Fig. 6c
3. Next, repeat with the PR2 lead adjusting VR9.



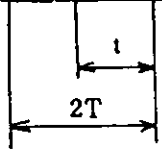
(a) N.G (Adj. CCW)



(b) N.G (Adj. CW)



(c) OK



(0.9 T ≦ t ≦ 1.1 T)

Fig. 6

3. USM Reference Frequency

This adjustment is performed at the factory, along with the inhibit adjustment, and is not normally necessary. If focusing speed is too high, too slow, or makes unusual noises, especially at extreme temperatures, check and adjust as necessary. (If an environmental chamber is available, check at low temperature.)

If adjustment is necessary, disassemble as shown in the Pulse adjustment, and install test leads at D-1 and D-GND as shown in figure 7. Mount a 6 series EOS camera.

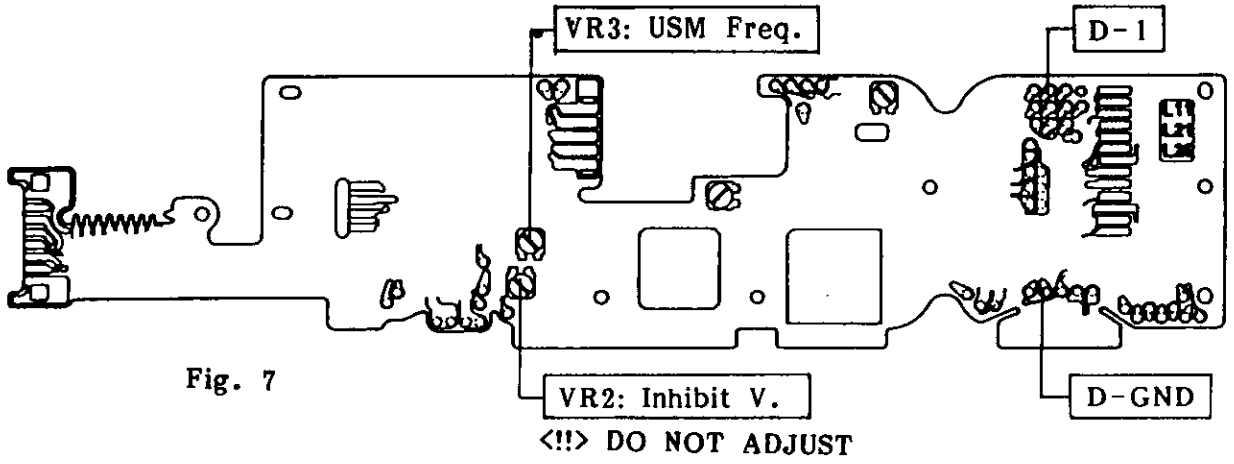


Fig. 7

<!!> : DO NOT change VR2 (Inhibit Voltage). It is factory adjusted and requires special equipment.

Adjustment:

1. Attach the D-1 and D-GND leads to a frequency counter (local purchase).

2. Press the camera's stop-down button and check the frequency counter reading. It should be 29.6 $\pm$ 0.1KHz. If not, adjust VR3.

   Note: Pressing the stop-down button activates the oscillator and gives the most stable read-out possible.

4. Focus Adjustment

This adjustment is necessary if the optics have been disturbed, or if the index doesn't align properly (Fig 10) when manually focusing at infinity.

Remove (1) through (3) in section III.1, mount a camera and adjust as follows.

Adjustment Method

Focus Stopper Adjustment (Electrical Stop Position)

1. Manually focus on an infinity target, as distant as conditions allow ($100f^2$ is theoretically correct, but practically impossible in most situations).

2. Set the focus brush so the bottom contact fall within the width of the infinity pattern. (Note: In Fig. 8, the focusing brush is shown below the focusing pattern for clarity.)

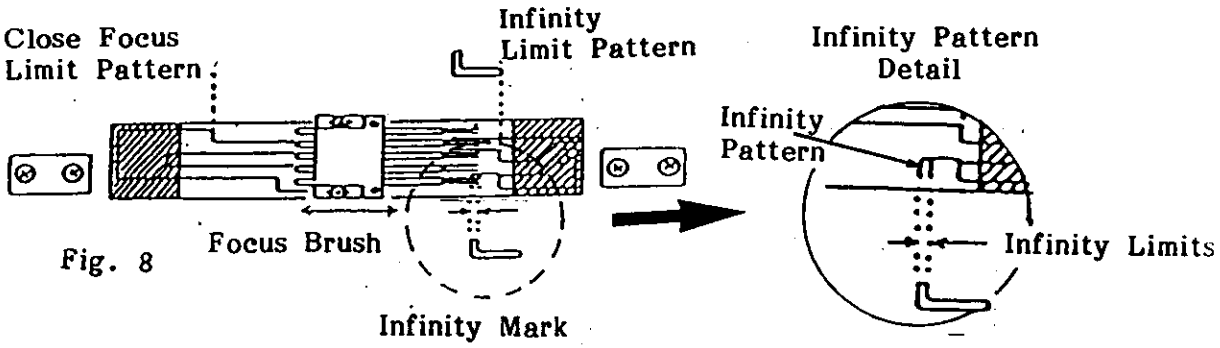


Fig. 8

3. Next, to align the upright of the infinity "L" mark with the index when it is installed later, place a 2mm diameter pin in the hole at the end of the scale and place it hard against the edge of the barrel. Tighten and stake the screw heads with screw-lock.

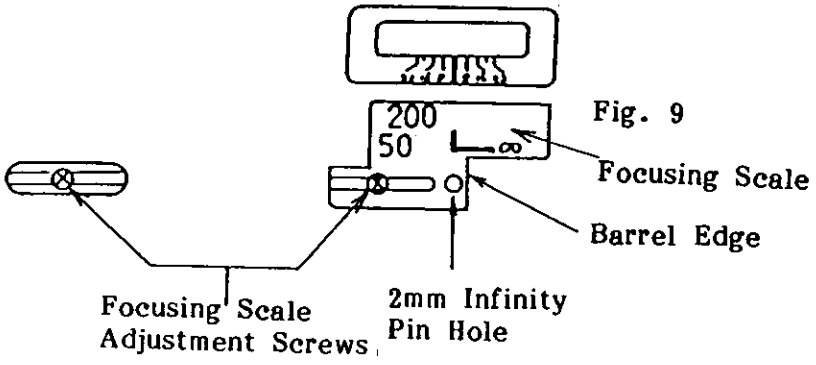


Fig. 9

Infinity Mark Limits
(at normal temperatures)

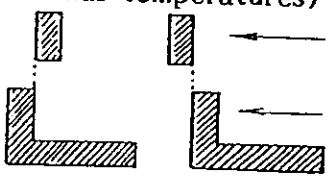


Fig. 10

4. Focus Adjustment Summary

The main points of this adjustment are:

When the lens is focused on an infinity target,
1. the bottom contact of the focus brush is on the "infinity" position of the contact flex, and
2. the edge of the 2mm hole is flush with the edge of the notch in the barrel,

the lens is correctly adjusted for infinity focus.

Table 1 : Resolution Chart

Image Height (mm)	0	4	8	12	16	20
S	100	100	100	100	100	63
Axial						
M		100	100	63	63	40

5. "Best Focus Adjustment" Service Policy

The reason for this adjustment is to correct the difference between the focus point determined by the autofocus system and the actual best focus. There will always be some discrepancy between the focus point determined by the autofocus system and the actual best focus point of the interchangeable lenses due to the inherent differences between the different lens types.

In the EOS system, the difference between the AF focus and the optical best focus has been determined for each lens type and the information written into the lens ROM so that correction for the difference at maximum aperture is made electronically. In addition to this type difference, there is a difference between individual lenses within each type, which can be noticeable if not corrected, At the factory, correction is written into the individual lens' ROM with a expensive, special tool. This is called the "Best Focus Adjustment". Because of the tooling cost involved, this adjustment is not normally a part of the service procedure. In its stead, the following actions will be taken.

Service Actions:

1. Main Flex Replacement
   Check the AF ADJ0 and AF ADJ1 pads on the flex being replaced and bridge the pads on the new flex in the same way.

2. If front defocus, use plus correction. If rear defocus, use negative.

Best Focus Correction (Reference)

Correction	AF ADJ0	AF ADJ1
$-\frac{3}{4}$Fc	Open	Closed
$-\frac{1}{4}$Fc	Closed	Closed
$+\frac{1}{4}$Fc	Open	Open
$+\frac{3}{4}$Fc	Closed	Open

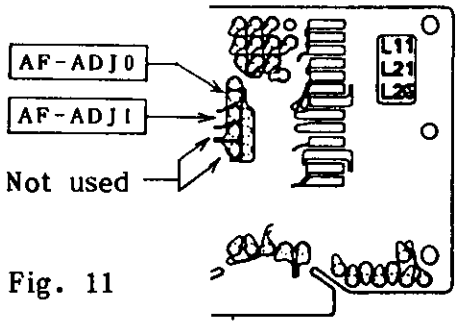


Fig. 11

3. Customer Complaints
   If a customer complains of soft focus at full aperture, you can adjust as follows:

   Photographic Test
   Make actual photographic test at a distance of 30 meters with the AF-ADJ0 and AF-ADJ1 bridges in all four possible combinations. Make five or six negatives for each combination of a flat high contrast chart or equivalent at maximum aperture using an EOS 650 / 620 in aperture priority mode. Examine the negatives closely to determine which combination is best.

   Visual Test
   Use the standard chart at a convenient distance. View through the viewfinder with a type B screen. Use a magnifier and change the pad combinations until the best combination is achieved. This test should be performed by a young person with excellent visual acuity.

EXTENDER EF 1.4X

REF. NO. C54-3801

REPAIR INSTRUCTIONS

Canon SERVICE MANUAL

REPAIR INSTRUCTIONS

No.

Camera Technical Service Department, Canon Inc.

Date

CANON EXTENDER EF 1.4X

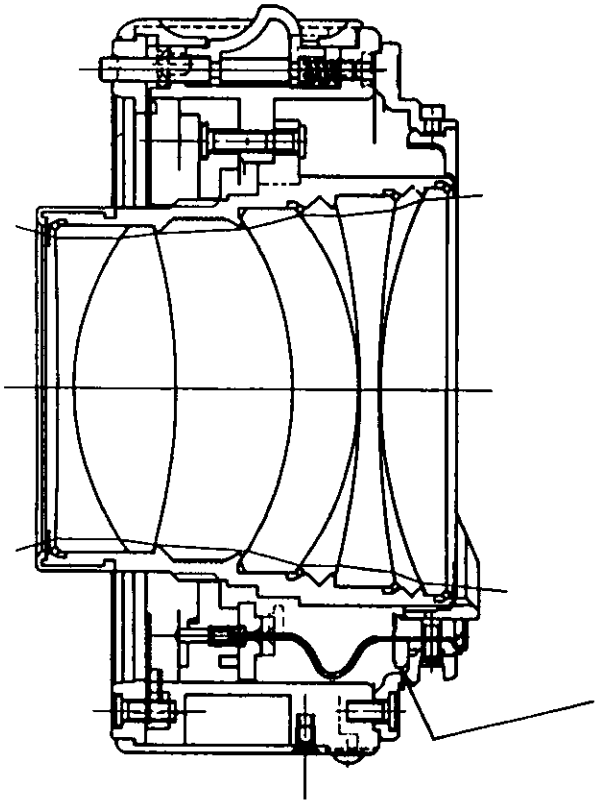
Ref. No. C54-3801

Special Optical Adjustments:

Centering.	Yes	(No)
Tilt	Yes	(No)

<!!> This extender, and the EF 2X both have a "focus" adjustment. (The adjustment should be made with the EF 300mm f/2.8L lens)

<!!> In general, construction is the same as the EF Extender 2X and the Life Size Converter EF.



Optical Length Adjustment

(Washers or Undersize mount)

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Extender EF 1.4X

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Cmpatible Lens Chart 4

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2. Main Barrel and Mount Unit Disassembly 6
3. Contact Assy and Lens Unit Disassembly 7

III. ADJUSTMENTS

"Focus" Adjustment 8

-ADHESIVES-

Part Number	Name	Remarks	Plastic Safe?
CY9-8001-000	Pliobond	Rubber seals	NO
CY9-8008-000	Arontite L	For staking screws	NO
CY9-8011-000	Screw-lock	For staking screws	YES
CY9-8076-000	Vinylole	Back cover Clasps	YES
CY9-8091-000	SO-820	Adhesive & dust shield	YES

- LUBRICANTS -

CY9-8041-000	GD-SP	Mount Spring	YES
CY9-8045-000	GE-C4	Release Button	YES

Color Code

To save space on drawings, it has been necessary to uses a color code.

Color	Code	Color	Code	Color	Code
Black	BL	Blue	BU	Gold	GL
Brown	BR	Violet	V	Tan	T
Red	R	Purple	PR	Pink	PK
Orange	O	Gray	GY	Sky Blue	SB
Yellow	Y	White	W	Yellowish Green	YG
Green	GN	Silver	S		

I. Introduction:

This focal length extender was designed to compliment the telephoto EF lenses. Combined with one of the "L" lenses, it gives results equal to a single lens of that focal length. With the Extender EF 2X, it gives the photographer a choice of three image sizes from the same spot. Being a 1.4X extender also means you only loose one stop instead of two with a 2X.

Features

1. When mounted on an "L" lens, the quality is equal to a good single lens.

2. Because the f/stop is only reduced one stop, autofocus is usable even with the EF 600mm f/4.0L.

Specifications

1. Optical Construction:

   Optical structure: 4 groups, 5 elements

   Lens Coating: Super Spectra Coating

   Magnification: 1.4 x master lens focal length

2. Master Lens:

   Compatible Lenses: EF 200mm f/1.8L, EF 300mm f/2.8L, EF 600mm f/4.0L

   Aperture Reduction: 1 f/stop

   Depth-of-Field Scale: Not reliable (D-O-F is approx. 0.707)

3. Mount:

   Front Mount: Same as EF body mount (8 contacts)

   Rear Mount: Same as EF lens mount (11 contacts)

   Signal transfer function: EOS system, with 5 signals as follows :

   A) Lens condition
   B) Lens type
   C Photometry signal
   D) Focal length
   E) AF drive information

4. Dimensions & weight: 67.6 mm diameter x 27.3 mm length / 200g

5. Related products

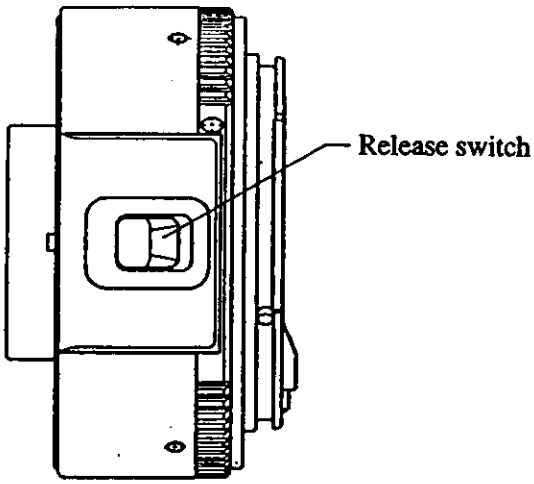
   Front cap: E

   Case: ES-C9 Soft Case or LH-B9 Rigid Case

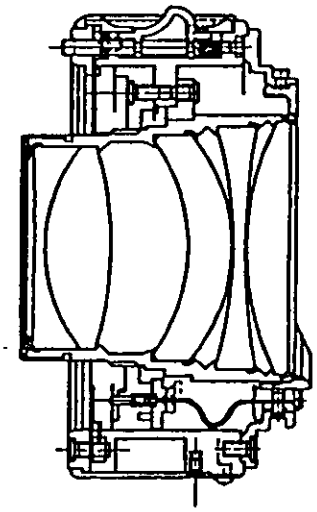
   Rear dust cap: Common to all EF lenses (new)

External and Cross-section Views, and Optical Schematic

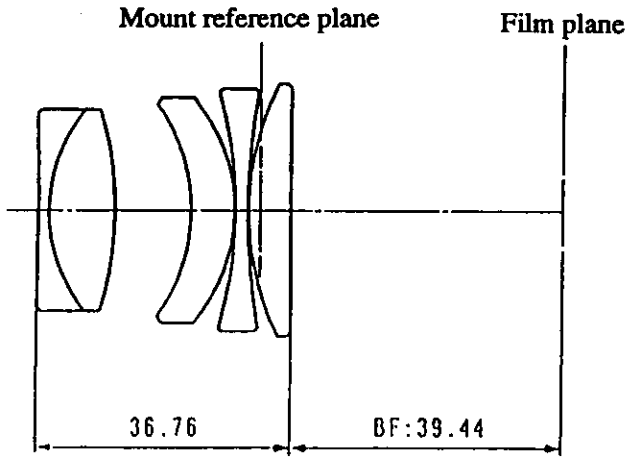
Appearance



Structural cross-section



Optical system



Technical Information

Aberration Corrections

Considerable attention was paid to aberration control to insure performance equal to a single lens when the extender is used.

1. Low index glass was used in the positive elements and high index glass was used in the negative elements. This prevents the deterioration due to astigmatism that is common in extenders. Chromatic aberrations were controlled by carefully balancing the power of the lenses in the front group.

2. Because the negative rear group is far removed from the aperture in the master lens, spherical aberration and astigmatism are easy to over-correct, but this is avoided by judicious selection of the power of the elements in the rear group, in particular by using a weak positive meniscus at the front of the rear group (G3).

2. Automatic Focusing Speed

As with the EF 2X, the focusing is intentionally decreased, but since the focal length increase is less, the speed decrease is hardly noticeable.

3. Compatible Lenses

The extenders should be used only with the EF 200mm f/1.8L, EF 300mm f/2.8L, and EF 600mm f/4.0L. There are several reasons for this.

1. These three lenses have extender-related information written into there ROMs and contacts which determine which extender is attached. Other lenses do not have this information so the camera's AF and AE circuits will not receive the properly modified information.

2. The 1.4X, and to a lesser extent the 2X, optics protrude from the front of the extender so other lenses cannot be mounted*.

*: Certain other lenses could be mounted if their back cover were removed, but they will not operate properly as stated in reason #1. As of October, 1988, lenses which fall into this category are: EF 135mm f/2.8SF, EF 50 - 200 mm f/ 3.5 - 4.5 and "L", EF 100 - 300mm f/ 5.6 and "L".

When the EF 600mm f/4.0L is used with the EF 2X extender, autofocus cannot be used. The lens automatically sets to manual focus regardless of the position of the AF - Manual switch. (This is because the maximum aperture of f/8 is smaller than the aperture necessary for autofocus (f/6.7).

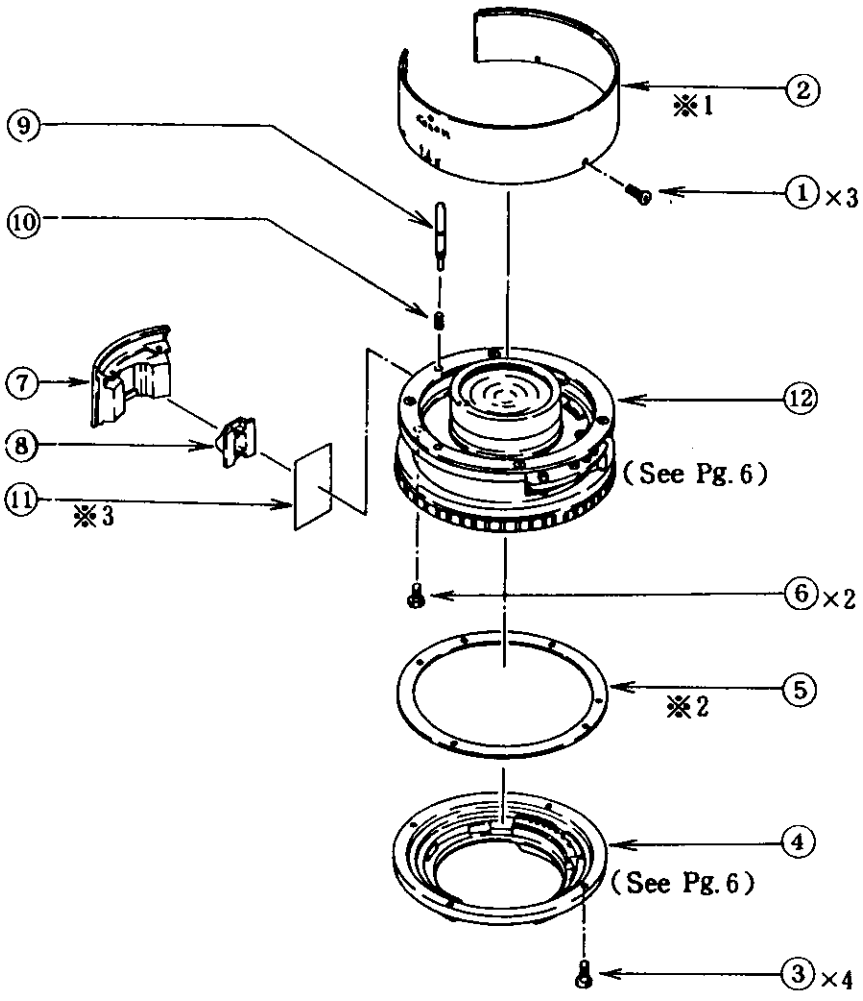
Compatible Lens Table

Lens	Compatible	Incompatible	
		Mountable (w/o back cover)	Not mountable
15mm f/2.8FE			X
24mm f/2.8			X
28mm f/2.8			X
50mm f/1.8			X
50mm f/2.8 MACRO			X
135mm f/2.8SF		X	
200mm f/1.8L	X		
300mm f/2.8L	X		
600mm f/4.0L (No AF with 2X)	X		
28-70mm f/3.5-4.5			X
35-70mm f/3.5-4.5			X
35-105mm f/3.5-4.5			X
35-135mm f/3.5-4.5			X
70-210mm f/4			X
50-200mm f/3.5-4.5		X	
50-200mm f/3.5-4.5L		X	
100-200mm f/4.5			X
100-300mm f/5.6		X	
100-300mm f/5.6L		X	

Lenses in this group can be mounted if the back cover is removed.

II. DISASSEMBLY & ASSEMBLY EF Extender 1.4X

1. Preliminary Disassembly



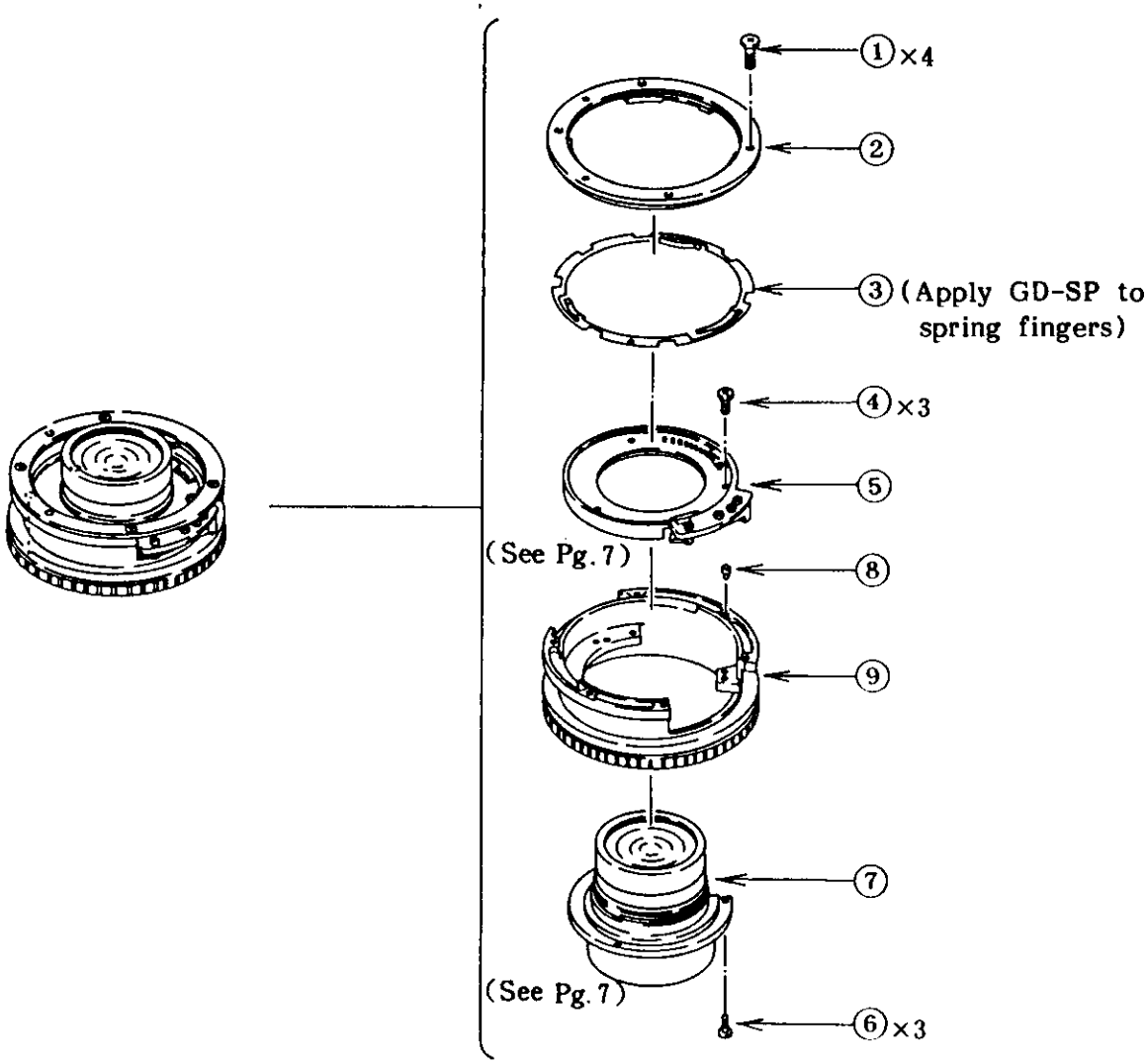
<!!> 1: Apply SO-820 to the mating surfaces between (7) and (12).

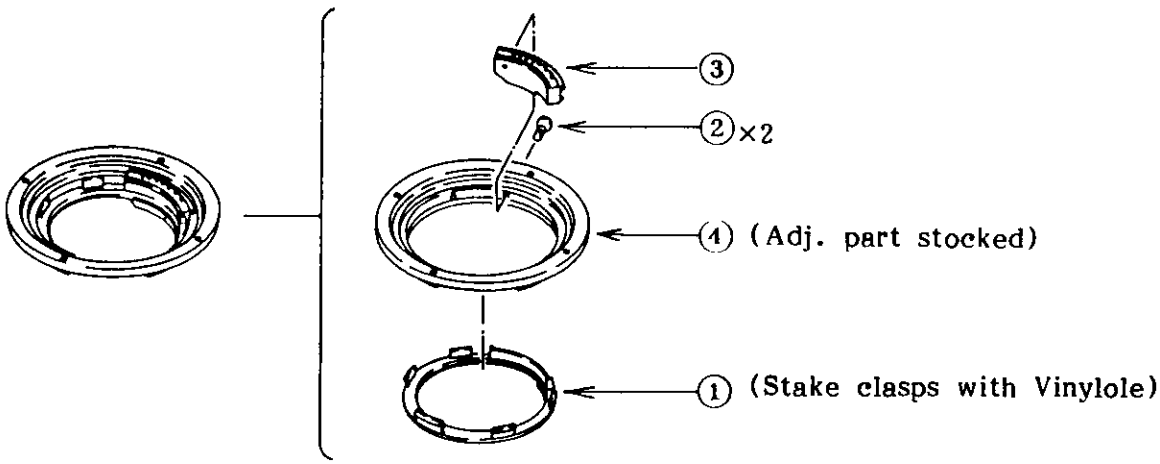
<!!> 2: Special service part. It is not installed in new units. See the optical length adjustment for details.

<!!> 3: Apply to friction surface with (8).

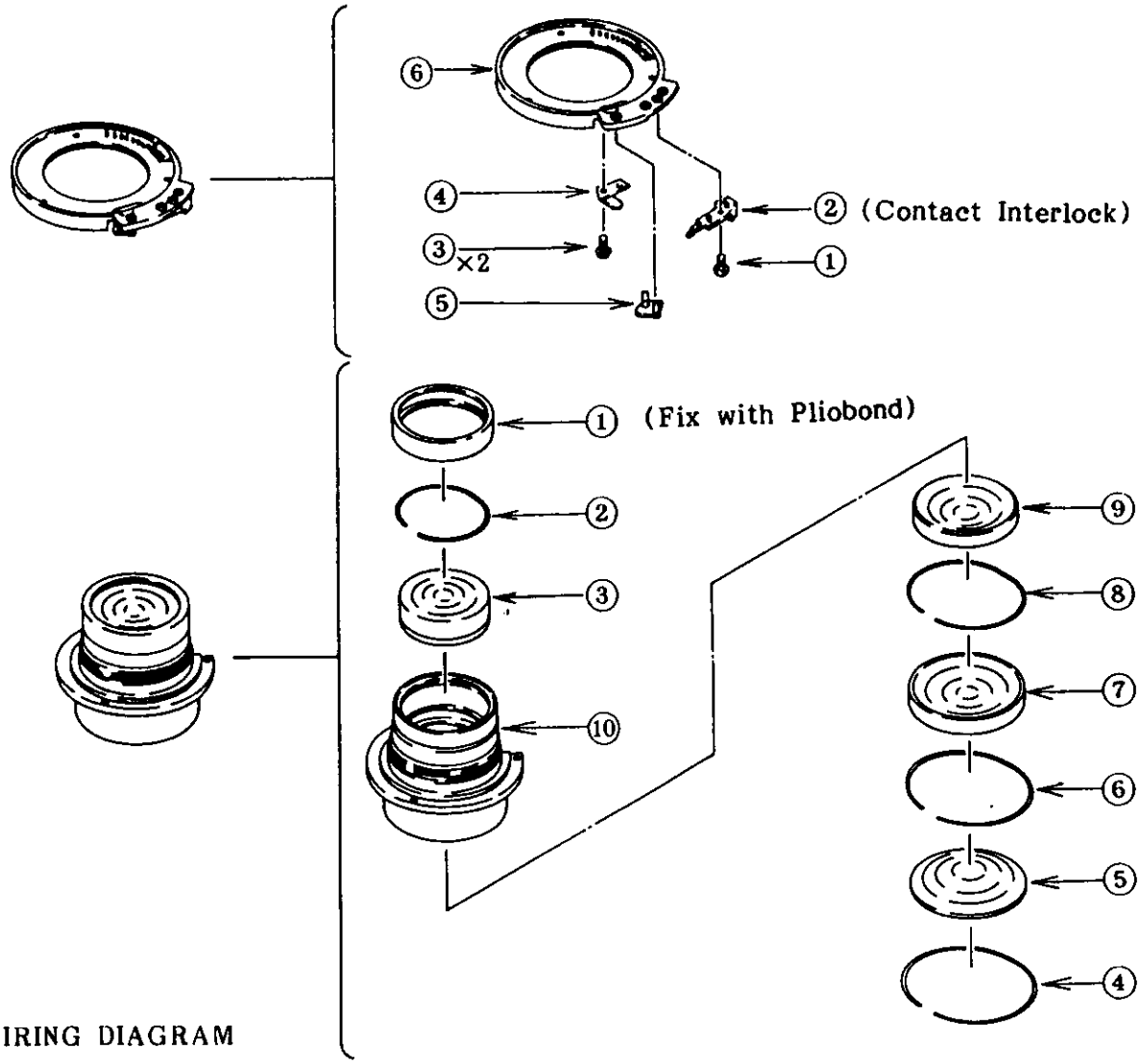
II. DISASSEMBLY & ASSEMBLY EF Extender 1.4X

2. Main Barrel and Mount Unit Disassembly

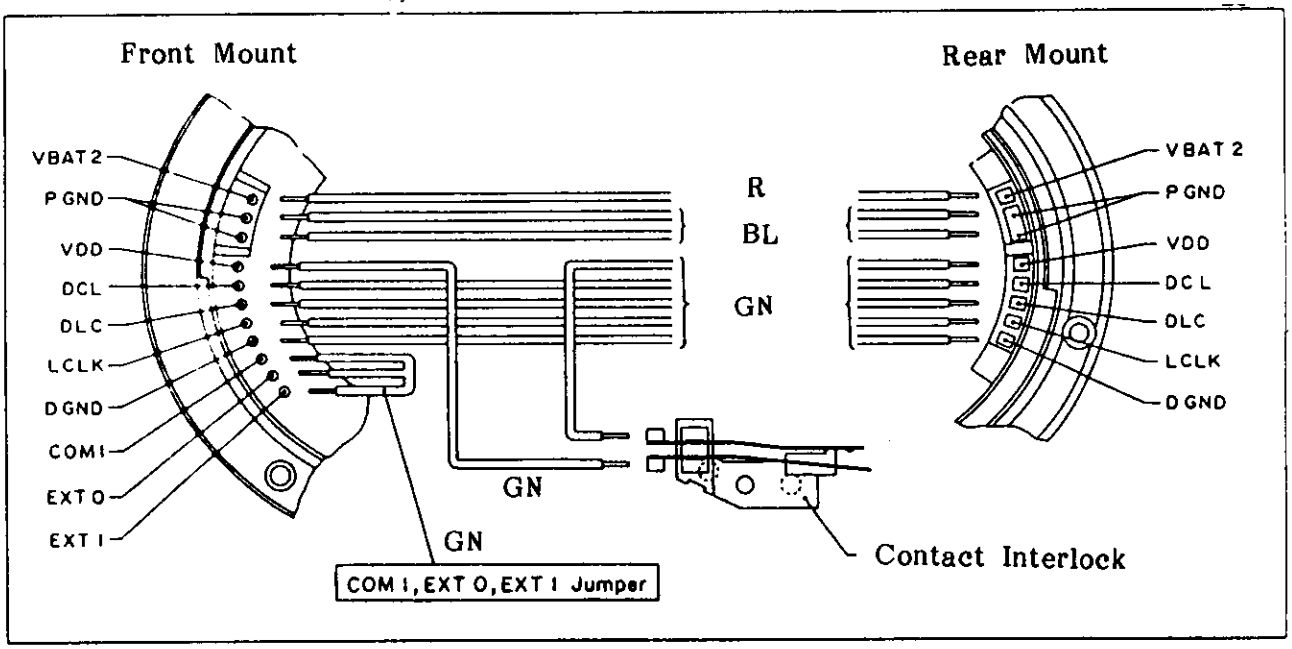




3. Contact Assy and Lens Unit Disassembly (with Wiring Diagram)



WIRING DIAGRAM

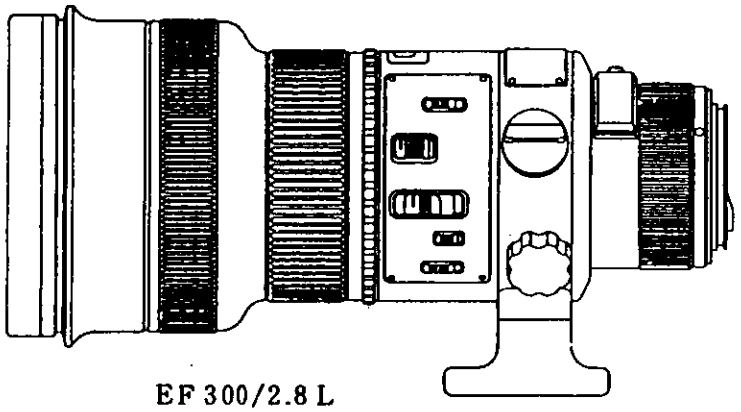


III. Adjustments EF Extender 1.4X

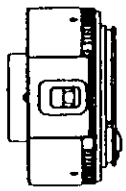
Optical Length Adjustment

This procedure is to adjust the front to rear flange distance. It is similar to a focus adjustment for a lens.

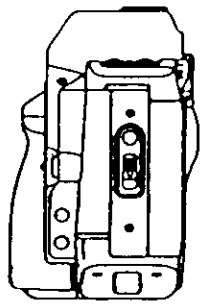
Mount the extender and a correctly adjusted EF 300mm f/2.8L lens (or EF 200mm f/1.8L) on the shop standard body (Type B screen & Magnifier).



EF 300/2.8 L



EXT. 1.4X



EOS 650/620
(W/F. SCREEN TYPE B
W/MAGNIFIER S)

Adjustment

1. Attach the lens directly to the body and manually focus on a finite target.

2. Install the extender and focus on the same target again. There should be no noticeable focus shift.

3. If there is a noticeable difference between the focus in (1) and (2), adjust by changing either the rear mount or installing focus washers.

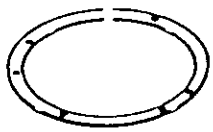
   Do not use adjusting washers with a combined thicknesses of more than 0.07mm. (If too many washers are used, a gap will be noticeable between the rear mount and the main body of the extender.

EF 300mm f/2.8L

Table 1 : Resolution Chart (line pairs)

Image Height (mm)	0	4	8	12	16	20
S	100	100	100	100	100	63
Axial						
M		100	100	100	63	63

Adjusting Washer



Service Use Only.

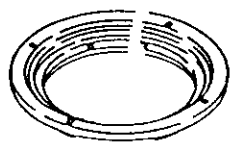
	A	SIZE
	0.02 mm	(002)
	0.05 mm	(005)

EF 300mm f/2.8L + EF Extender 1.4X

Table 2 : Resolution Chart (line pairs)

Image Height (mm)	0	4	8	12	16	20
S	100	100	100	100	100	63
Axial						
M		100	100	63	63	40

Lens Mount



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

ELECTRICAL DIAGRAMS

EF200mm 1:1.8L

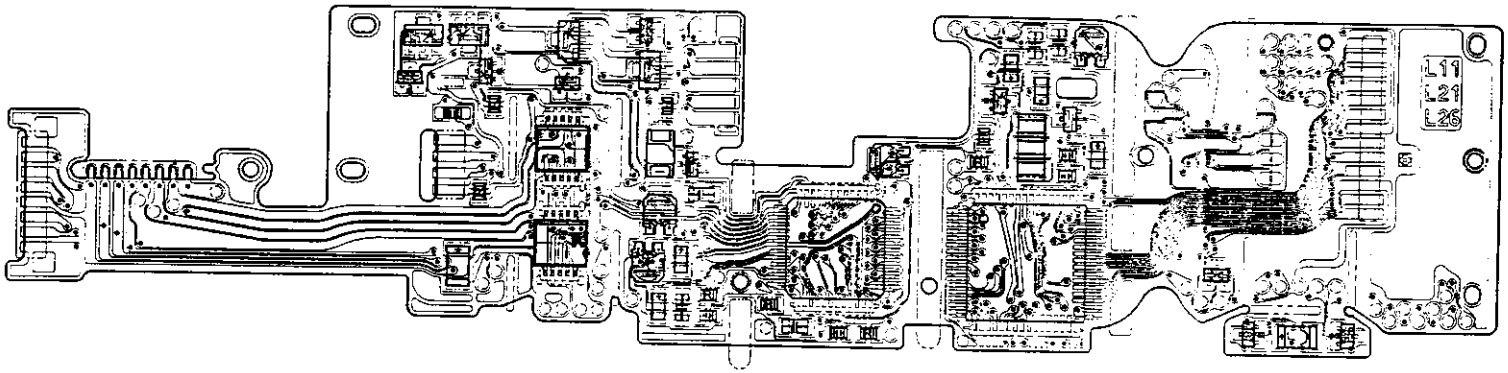
EF300mm 1:2.8L(NEW)

EF600mm 1:4.0L

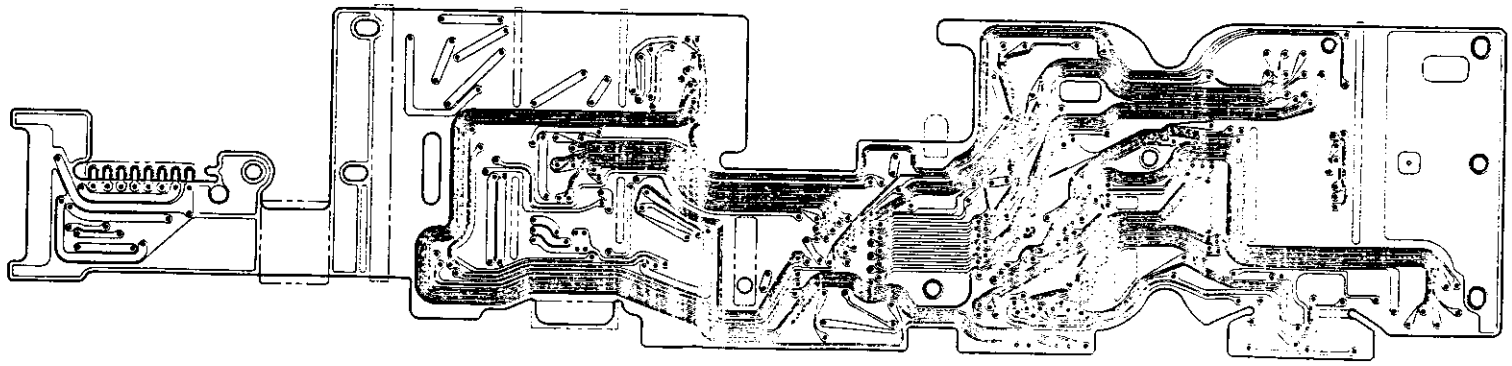
REF. NO

CANON LENS EF 200 mm 1:1.8L
EF 300 mm 1:2.8L (NEW)
EF 600 mm 1:4.0L

P.C.B. DIAGRAM
(MAIN-FLX)



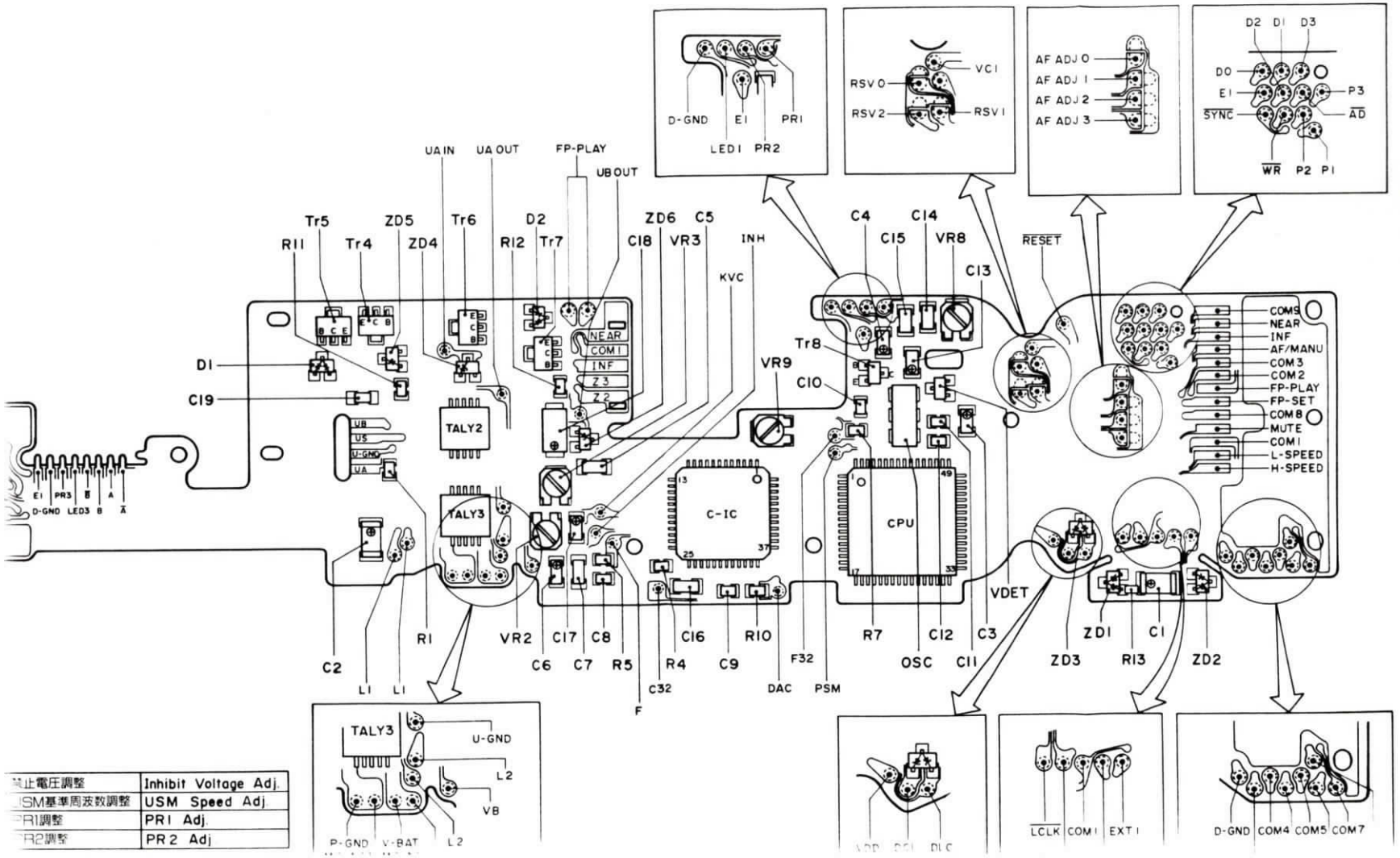
(Thru View)



REF. NO. C21-82
C21-82
C21-82

CANON LENS EF200mm 1:1.8L
EF300mm 1:2.8L (NEW)
EF600mm 1:4.0L

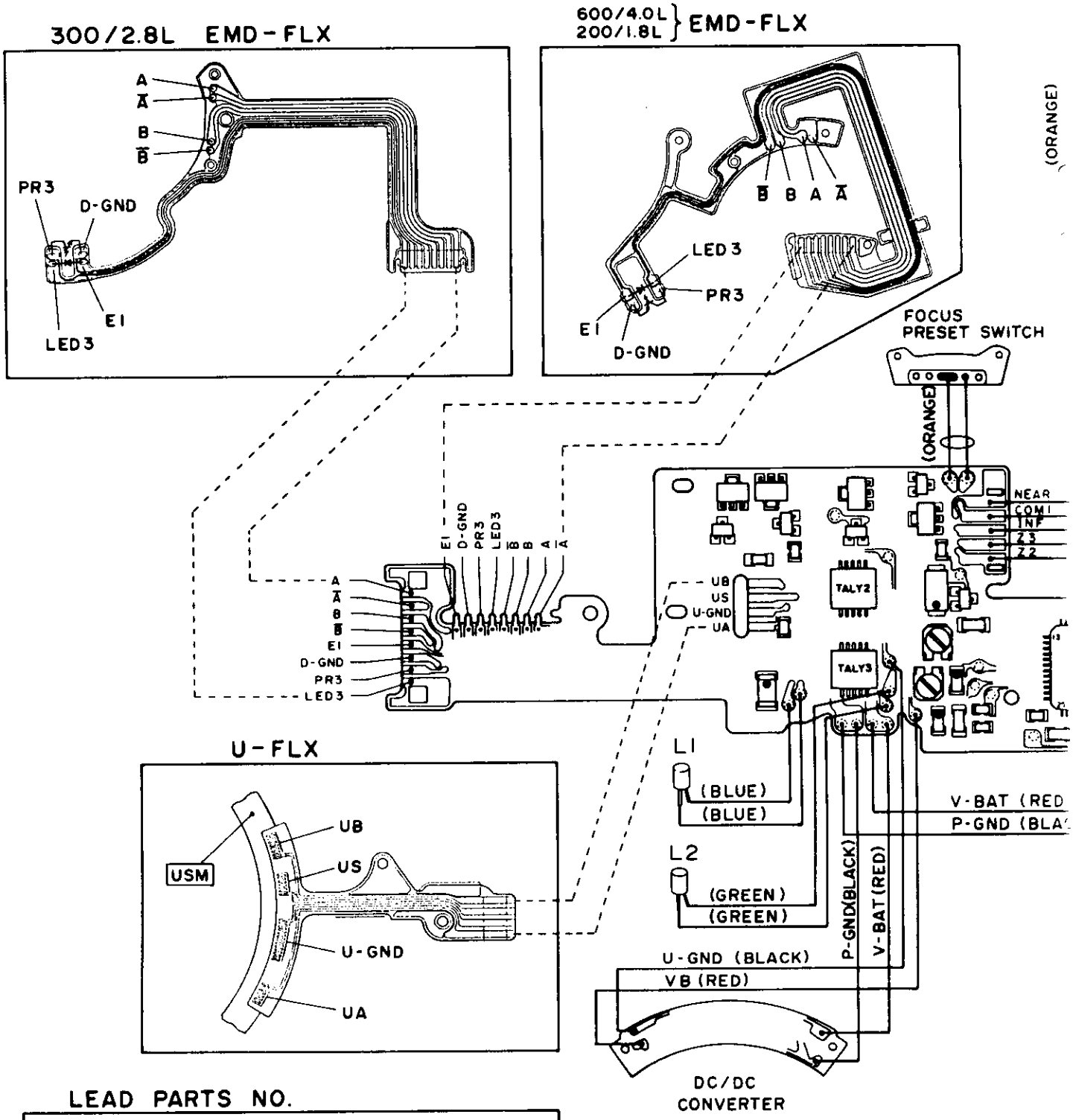
DIAGRAM



禁止電圧調整	Inhibit Voltage Adj.
USM基準周波数調整	USM Speed Adj
PR1調整	PR1 Adj.
PR2調整	PR2 Adj

VR2
3
3
9

WIRING & P.C.B. DIAGRAM



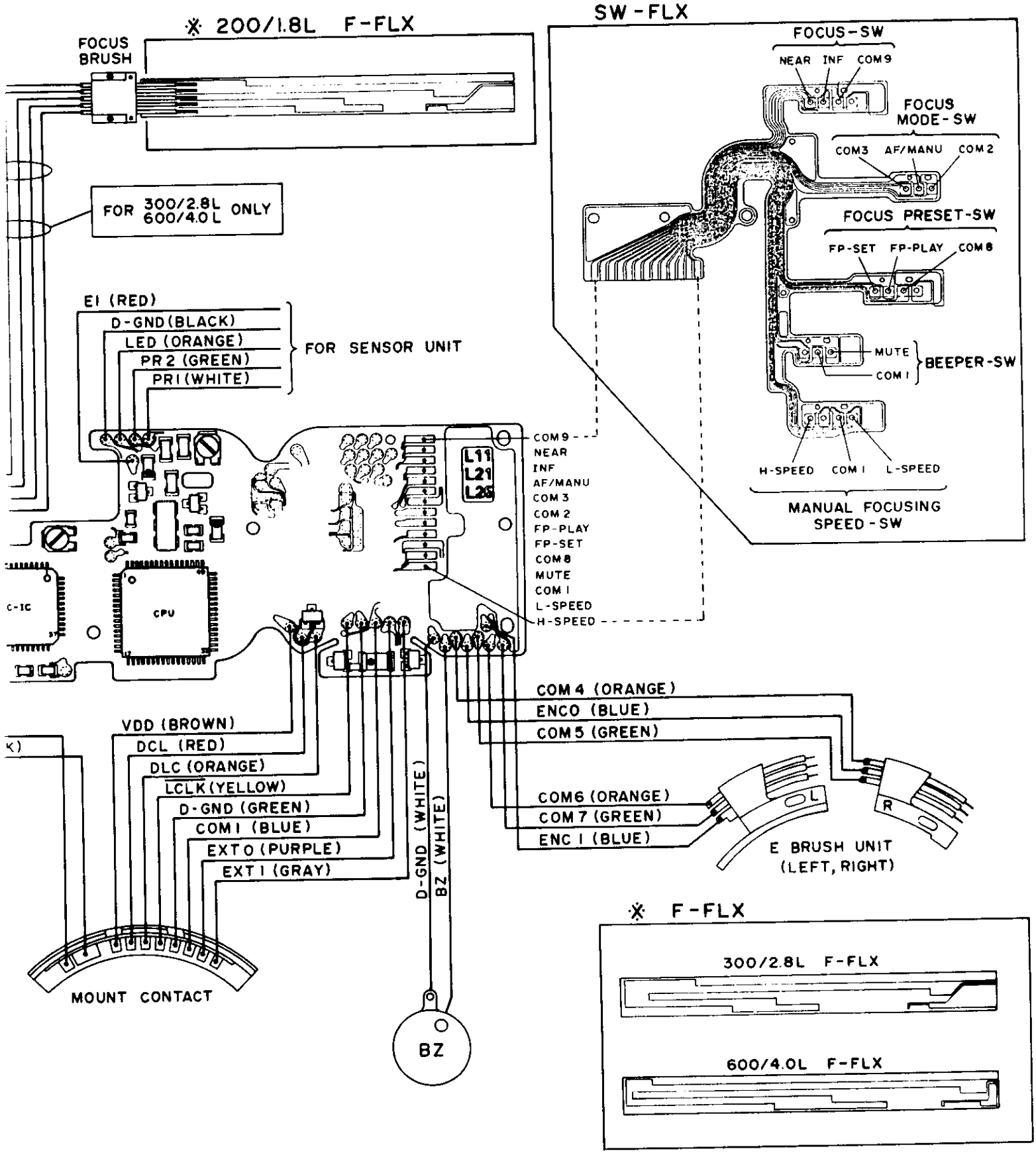
LEAD PARTS NO.

(V-BAT, P-GND ONLY)
Y11-50XX
(OTHER)
Y11-39XX — COLOR CODE

COLOR	WHITE	BLACK	RED	ORANGE	YELLOW	GREEN	BLUE	PURPLE	BROWN	GRAY
COLOR CODE	01	02	03	06	07	09	11	12	13	14

REF. NO. C21-8272
C21-8252
C21-8292

200 mm 1:1.8L
300 mm 1:2.8L (NEW)
600 mm 1:4.0L



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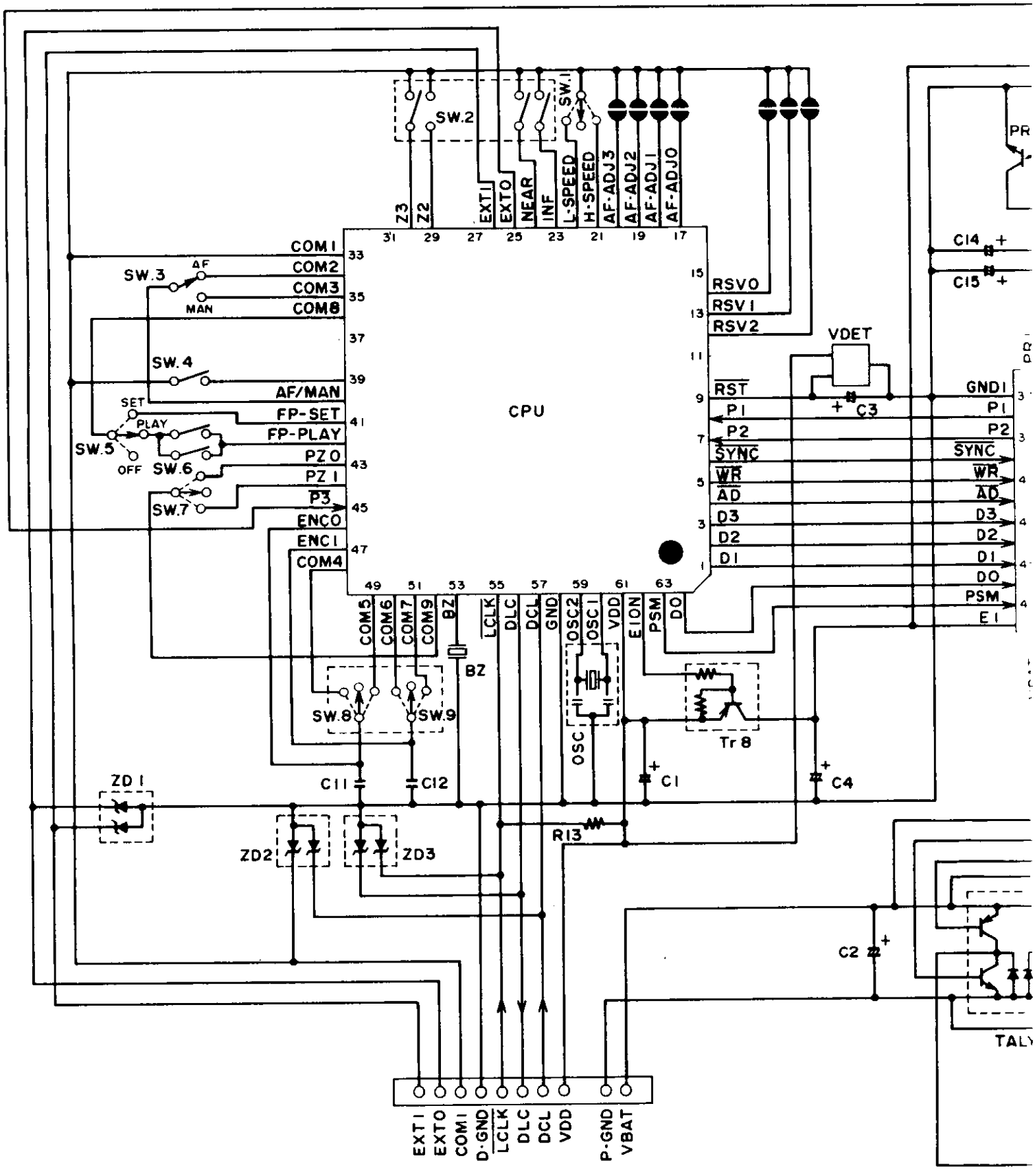
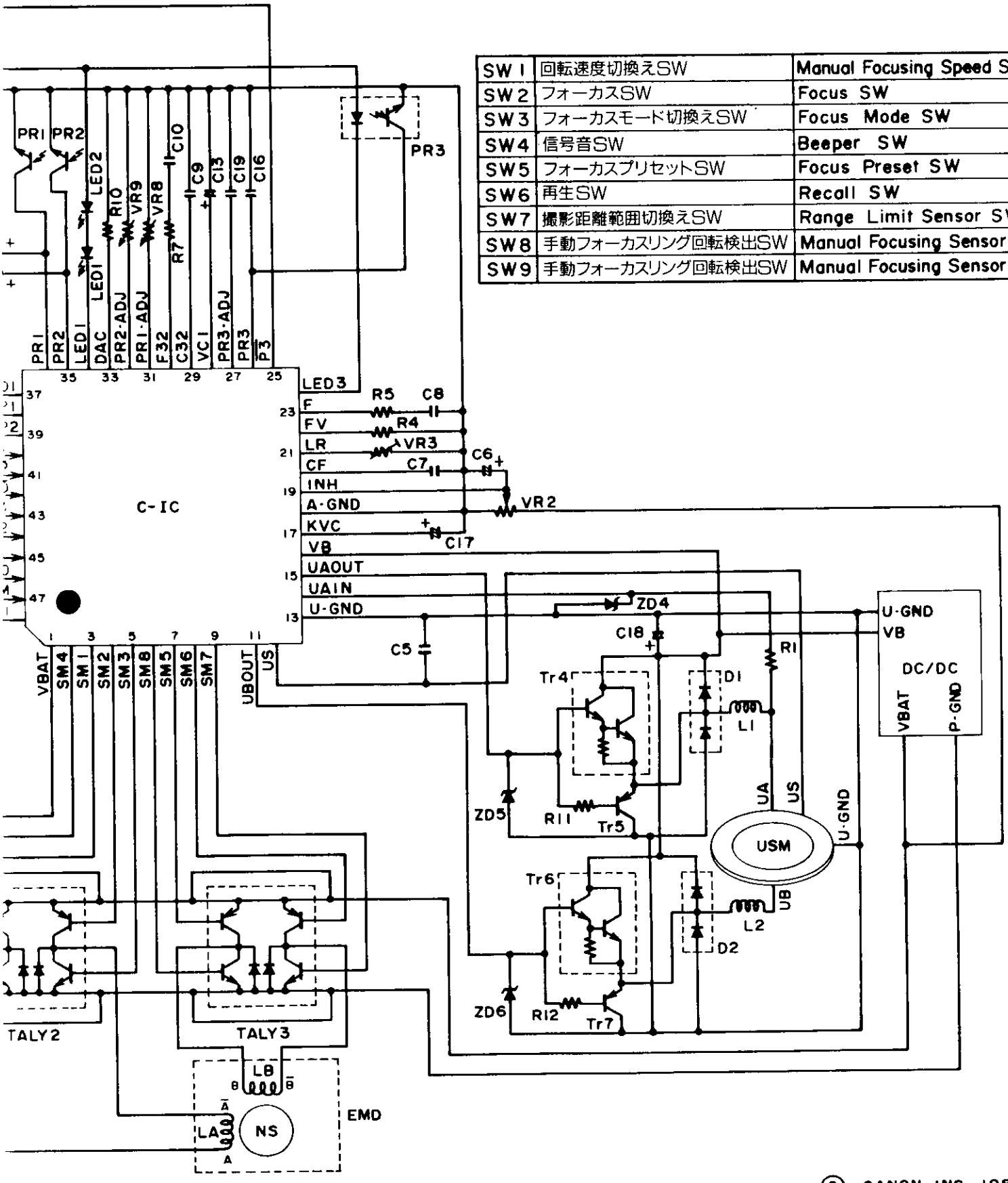
SCHEMATIC DIAGRAM



REF. NO. C21-8272
C21-8252
C21-8292

00 mm 1:1.8L
00 mm 1:2.8L (NEW)
00 mm 1:4.0L

SW 1	回転速度切換えSW	Manual Focusing Speed SW
SW 2	フォーカスSW	Focus SW
SW 3	フォーカスモード切換えSW	Focus Mode SW
SW 4	信号音SW	Beeper SW
SW 5	フォーカスプリセットSW	Focus Preset SW
SW 6	再生SW	Recall SW
SW 7	撮影距離範囲切換えSW	Range Limit Sensor SW
SW 8	手動フォーカスリング回転検出SW	Manual Focusing Sensor SW
SW 9	手動フォーカスリング回転検出SW	Manual Focusing Sensor SW



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