Canon

Service Manual

ENGLISH EDITION

CANON ZOOM LENS
EF28-80mm 1:2.8~4.0L
(C21-9482)

CY8-1200-050

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TECHNICAL INFORMATION

I. PRODUCT OUTLINE

1. Development Brief

Compact "standard" zoom lenses with modest apertures have become common in recent years, and they are quite popular with many users; but there is also a demand for a faster zoom that provides high image quality in the wide-angle to short telephoto range. The 28-80mm f/2.8-4.0L was developed to meet this need. In spite of its large aperture, it provides optical performance equal to a single focal length lens even at close distances.

2. Features

2-1 Use of two aspherical surfaces gives high image quality in spite of the long (3X) zoom ratio.

2-2 Two of the three functional groups move during zooming. This suppresses distortion over the entire zoom range, and helps compensate for curvature of field and lateral color at the telephoto end.

2-3 The ultrasonic motor provides quick, smooth, and almost completely silent autofocusing and powered manual focusing.

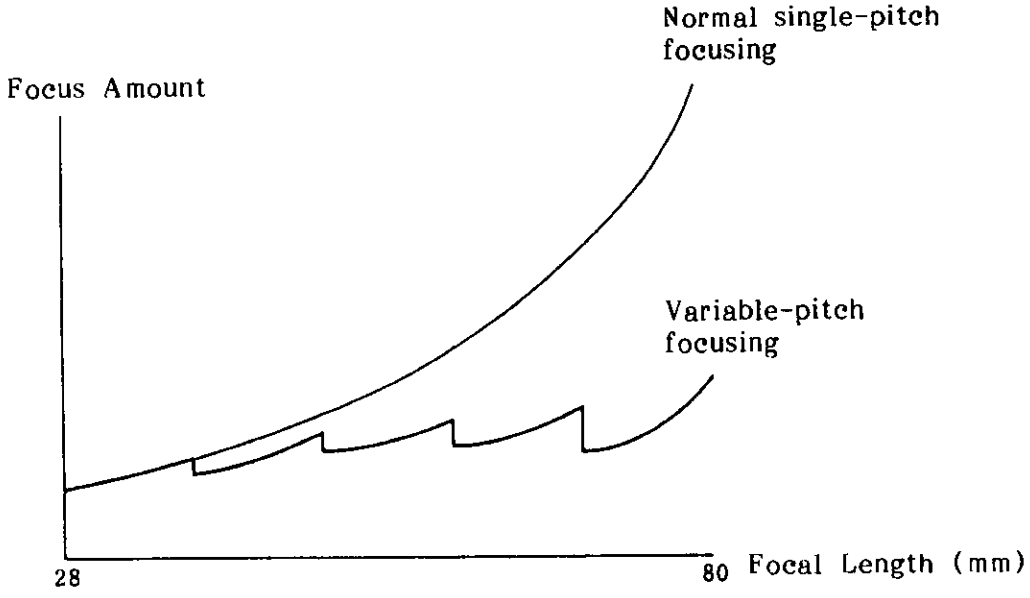
2-4 The USM unit used in this lens is slightly smaller (73mm vs. 77mm diameter) than the one used in the EF300mm f/2.8L; but basic operation is the same. This lens does contain an energy-saving intermittent DC-DC convertor similar to the ones used in the AFD equipped lenses.

2-5 A moving flare suppressing aperture (flare stop) is included between groups two and three to improve peripheral image quality.

2-6 Full range "macro" with a maximum photographic magnification of 0.2X with macro close focus at 0.5 m).

2-7 "Electronic variable-pitch" powered manual focusing automatically adjust the focusing pitch (the ratio focus point movement to focusing ring movement) in five steps depending on the focal length in use at the time. The pitch is inversely proportional to focal length so that a certain amount of manual focusing ring movement generates the same amount of focus point movement at all focal lengths. This gives a very natural "feel" to the focusing.

Electronic Variable-pitch Focusing Schematic Diagram



MF : USM	1 : 6	1 : 5	1 : 4	1 : 3	1 : 2
Focal length	28~34	35~42	44~50	52~60	62~80

Fig. 1

The ratio indicates the amount of manual focusing ring movement compared to the actual focusing movement by the USM. The lower numbers indicate the focal length range within which this ratio is used.

3. SPECIFICATIONS

3-1 Format: 24 x 36mm

3-2 Focal length/aperture: 28mm f/2.8 to 80mm f/4.0

3-3 Optical structure: 11 groups, 15 elements; G1R1 and G15R2 are aspheric surfaces (Super Spectra Coating)

3-4 Angle of view (at infinity):

Diagonally	(43.2 mm)	30° to 75°
Vertically	(24 mm)	17° to 46°
Horizontally	(36 mm)	25° to 60°

3-5 Focusing:

System: Autofocus: Ultrasonic motor (USM)
Manual: "Powered manual focus" using USM

Focusing Element: Front lens group, single helicoid

Range: 0.5m (MACRO); 0.75m to infinity

Drive speed: 0.72 seconds (Actual operation between infinity and closest focus, not including AF ranging)

Rotation angle, amount of extension

Condition	Rotation angle	Extension
0.5m to infinity	82.3°	7.32mm
0.75m to infinity	51°	4.54mm
Infinity overrun	2°	0.18mm

Maximum magnification, field of view

Condition	Magnification (power)		Field of view (mm)	
	Wide	Tele	Wide	Tele
0.75m	0.045	0.12	529x793	201x301
"MACRO" 0.5m	0.075	0.20	320x480	123x184

3-6 Zoom

Type: 3 group zoom, two ring type

Zoom Ring Rotation: 75°

Focal Length Marks: 28, 35, 50, 70, & 80mm

3-7 Mount

Type: Canon EF mount

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

3-8 Aperture mechanism

Diaphragm control: Automatic only using EMD, no manual ring

Aperture range: f/2.8 (indicated on lens) - f/22 (not indicated on lens)

Diaphragm blades: 8

D-O-F Scale: None

IR Focusing Index: For 28, 35, 50 and 80mm focal lengths

3-9 Filter: 72mm, 0.75mm pitch, (Usable: only one)

3-10 Dimensions & weight: 84.0mm diameter x 119.5 mm length / 945g

3-11 Related products

Hood: EW-79

Lens cap: E-72

Lens case: LD-D16 (hard case)
(Lens stores with one filter and caps on)

Dust cap: Common to all EF lenses

4. CONTROLS and OPTICAL SCHEMATIC

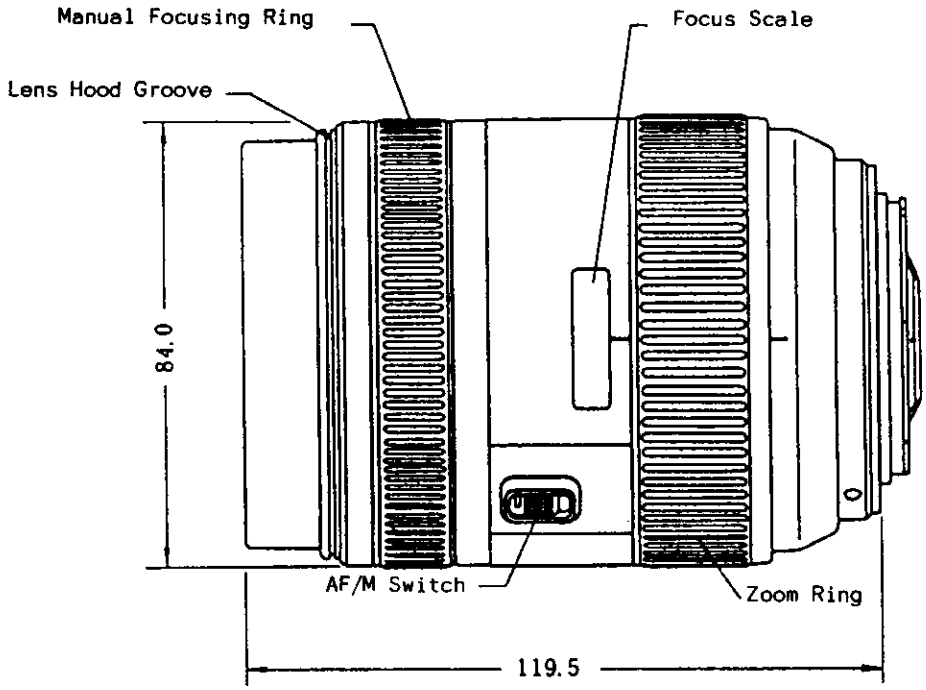


Fig. 2

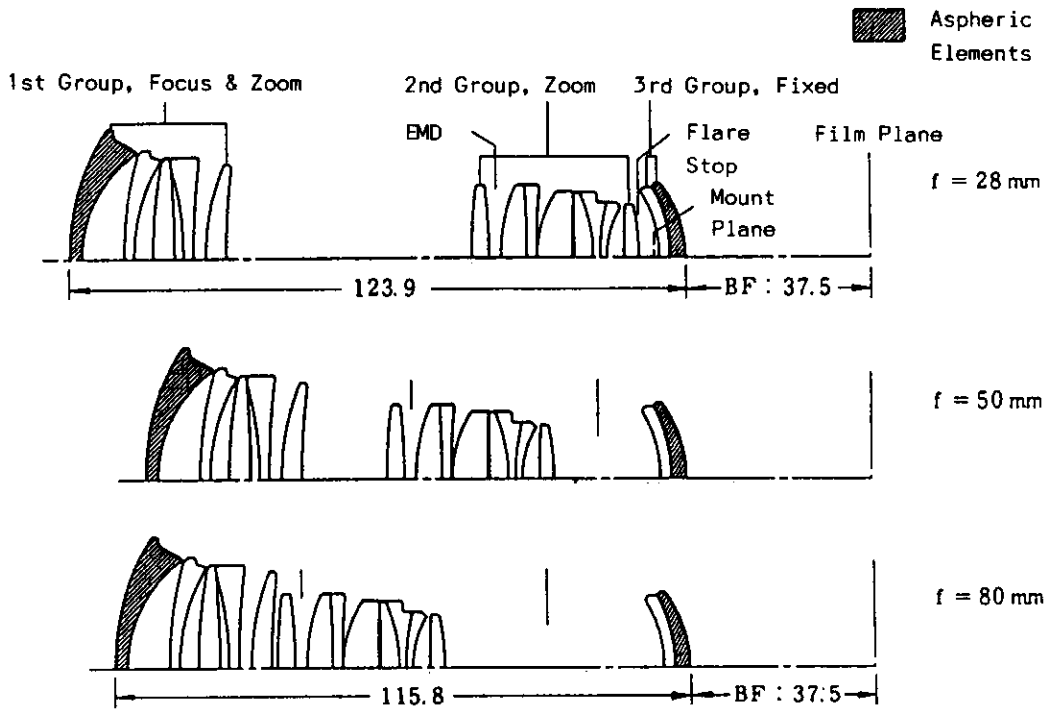


Fig. 3

5. Precautions

Mechanical vignetting: If the lens is set to 28mm and macro and a filter is mounted, there is a slight amount of vignetting. This only happens when all three are present. With a normal filter, the vignetting is so slight that it is covered by a slide mount. With a polarizing filter a slight amount may be noticeable within the slide mount.

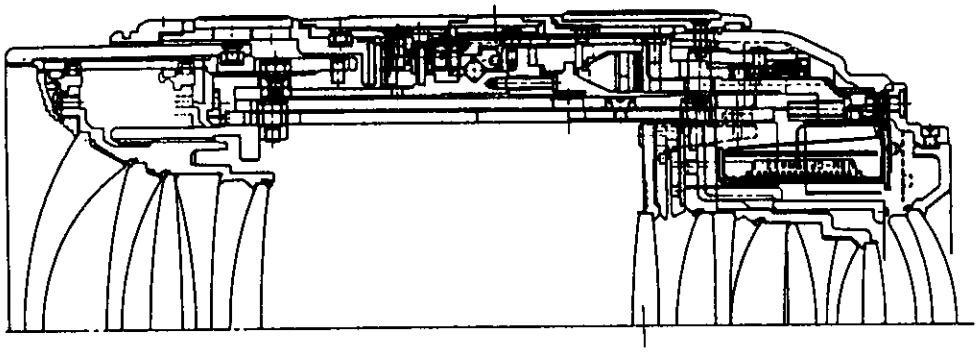
Set the lens to infinity prior to removing it from the camera. It cannot be focused when not mounted because of the powered manual focusing, and it will not fit in the case except at infinity.

REPAIR INSTRUCTIONS

Special Optical Adjustments:			Remarks
Centering	(Yes)	(No)	Not necessary when factory unit is used
Tilt	Yes	(No)	

If EMD Unit is disassembled, optical centering is necessary.

This lens uses USM autofocusing like the EF200mm f/1.8L, EF300mm f/2.8L and the EF600mm f/4.0L. The complete, pre-adjusted unit (CY1-2302) is stocked, but many of the individual parts of the unit are also stocked. These parts can be changed without affecting the adjustment. When a unit is replaced, these parts should be retained and used.



Centering Adjustment (G6)
If the screws holding this lens element are disturbed, the centering adjustment is necessary.

Part No.	Name	Remarks	Plastic Safe?
- ADHESIVES -			
CY4-9102	Acetate Cloth Tape	For holding flex	Yes
CY4-9303	Double-faced tape	For holding flex	Yes
CY9-8002	Bond G-103	For manual focus rubber ring	Yes
CY9-8008	Arontite L	For staking screws in metal	No
CY9-8009	Arontite R	For staking mount stopper screws	No
CY9-8011	Screw-lock	For staking screws in plastic, etc.	Yes
CY9-8015	Water-soluble Bond	For flare stop, ring staking	Yes
CY9-8076	Vinylole 2200	For back cover clips	Yes
- LUBRICANTS -			
CY9-8044	GE-X8	Cam and Guide Barrel grooves, helicoid	Yes
CY9-8082	GC-X5	w/GE-X8: Cam and Guide mating surfaces	Yes
CY9-8087	Lozoid 6308/31-F	Zoom Ring	Yes
CY9-8089	Electroil 190	Zoom Flex Contact Pattern	Yes

1. FRONT DISASSEMBLY

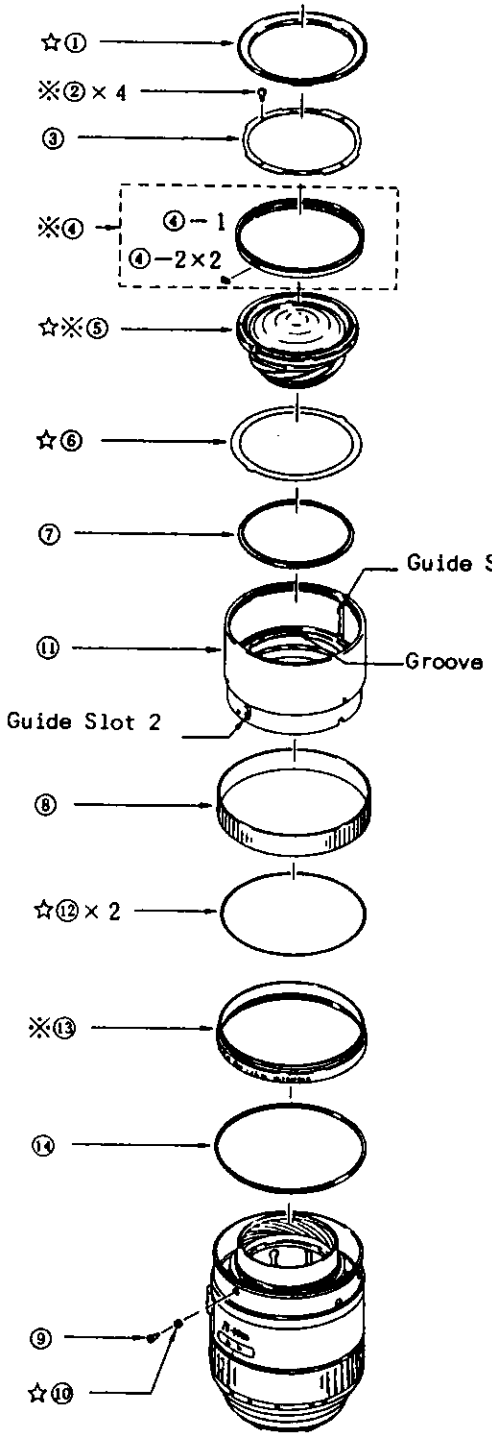
※ DISASSEMBLY

Before removing (2), mark the positions of (3) (4) and (5). These positions determine Tele focus.

Lift and tilt (4) to free it from Guide Slot 1 in (11).

Before removing (5), mark its position in relation to the focusing index. (If not adjusted, Tele focus must be readjusted.)

(13) is threaded into the Manual Ring and is difficult to remove. Run a little Fronsolve AE into the groove for (12) to loosen it.



☆ ASSEMBLY

Apply water-soluble bond to (1) before pressing into place.

Apply a little GE-X8 to the threads of (5).

Install (6) in the groove above the threads in (11).

Place the gaps in the two (12)'s opposite (180°) each other.

Choose the correct size of collar (10) to eliminate play in (11). (If there is very much play, focusing accuracy suffers.)

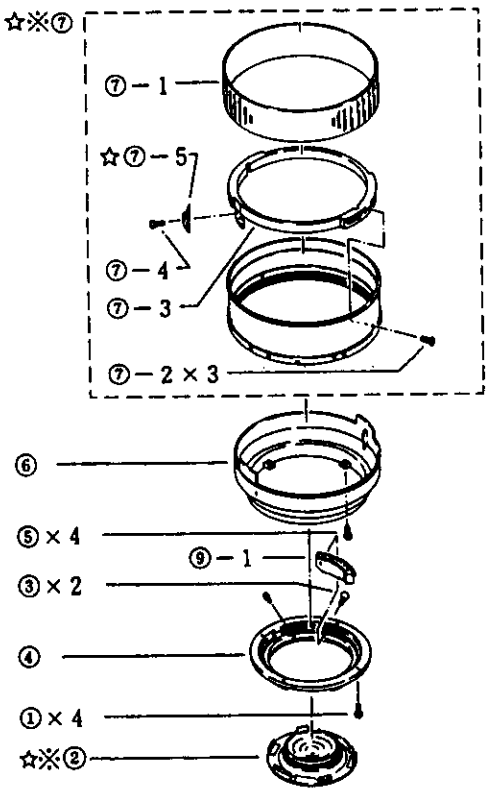
2. REAR DISASSEMBLY (1)

(continued on next page)

※DISASSEMBLY

☆ASSEMBLY

Caution: Do not bend contact brush (7)-5 when removing (7).

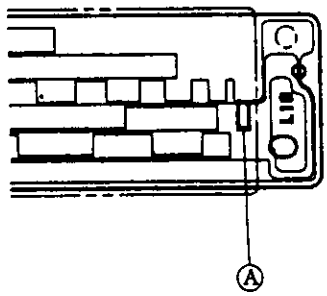


Push from inside to remove (2).

Apply Lozoid #6308/31F between (7) and (15)*.

*: Next page.

Set contact brush (7)-5 so that it falls within (A) at the Tele end.

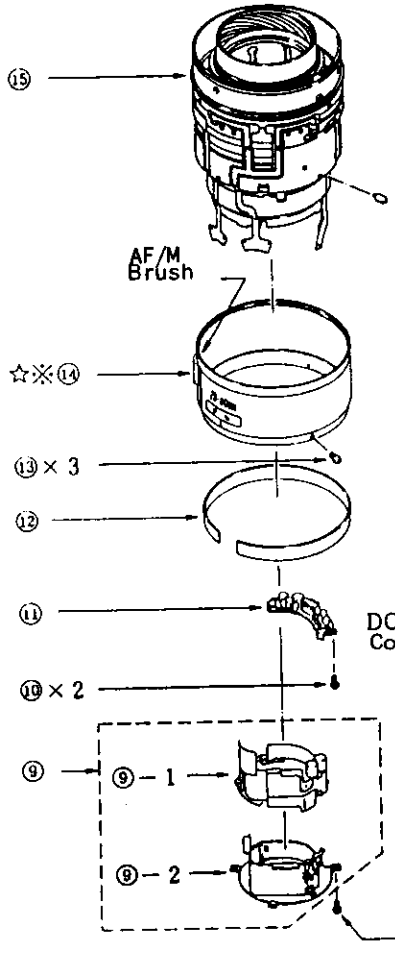


After installing (2), stake the tabs with a little Vinylole.

2. REAR DISASSEMBLY(2) (continued from previous page)

·※ DISASSEMBLY

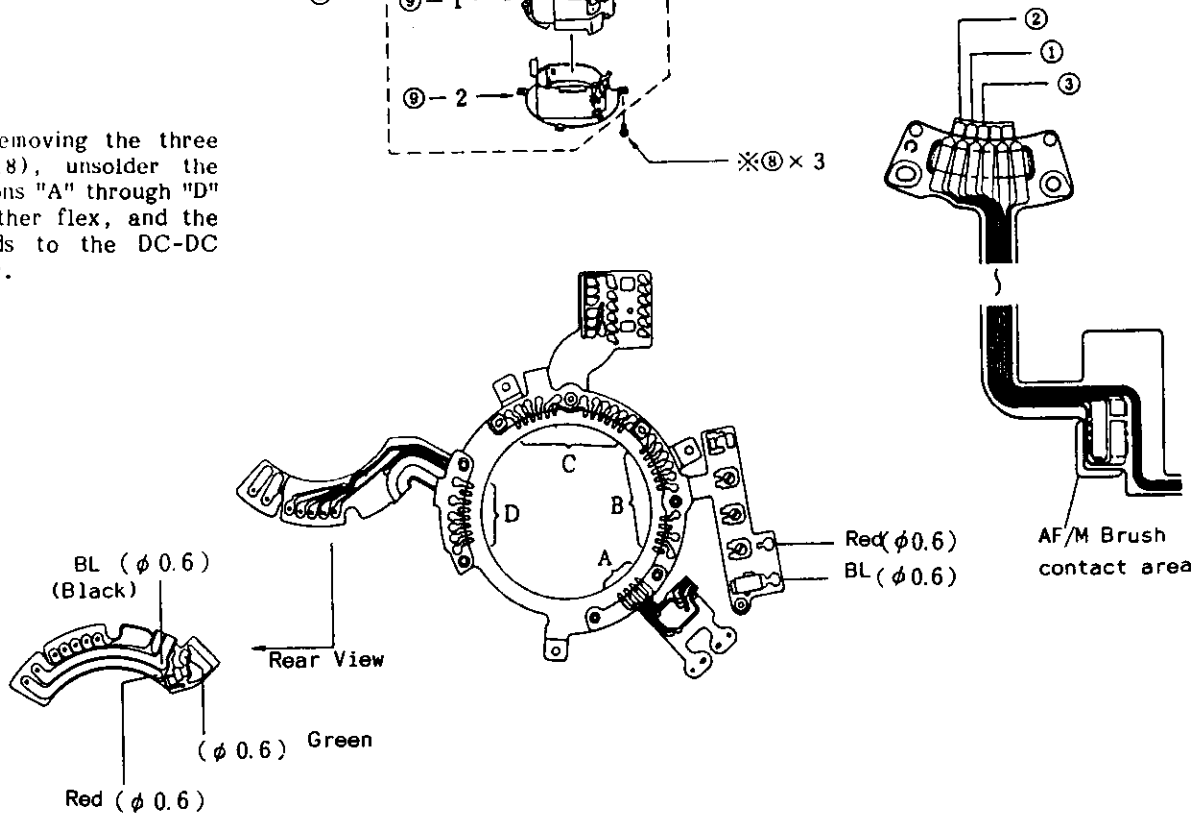
☆ ASSEMBLY



Pull (14) straight out to remove it. DO NOT turn it. Turning can bend the AF/M contact brush and tear the flexible circuit board.

When installing (14), use a piece of mylar sheet (cut from CA1-8124 - a Multi Tele spare part) to protect the contact brush. After (14) is in place, slip the mylar out and check the operation of the AF/M switch. There should be contact between (1) and (2) in one position and (1) and (3) in the other.

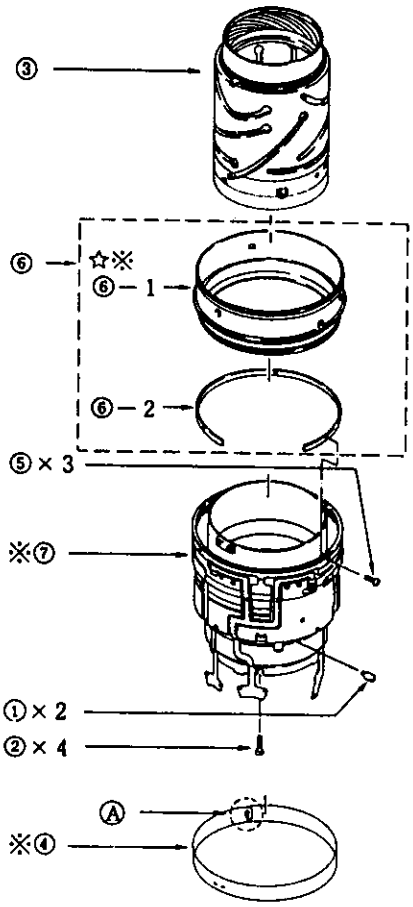
Before removing the three screws (8), unsolder the connections "A" through "D" to the other flex, and the five leads to the DC-DC convertor.



3. USM / HELICOID UNIT

※DISASSEMBLY

☆ASSEMBLY



To remove (6)-1, push (6)-2 in through the screw holes for (5).

Apply GE-X8 to the external groove in (6)-1.

(7) is a factory-adjusted unit.
DO NOT DISASSEMBLE!

The "button screw" holding (4) need not be removed. Just move the end of (4) up or down to remove it.

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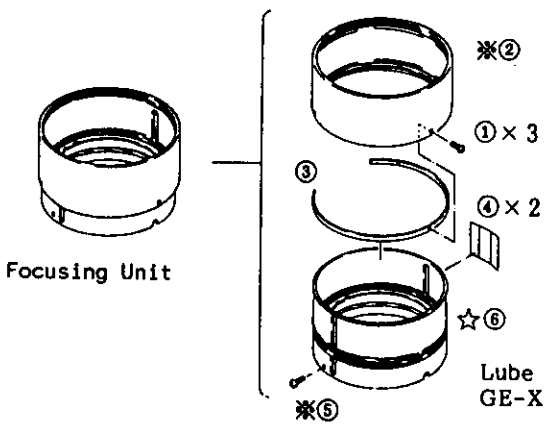
4. FOCUSING UNIT



Focusing Unit

To remove (2), push (3) in through the screw holes for (1).

Screw (5) is only used to prevent the inner helicoid from coming loose during assembly.

Lube grooves in (6) with GE-X8.

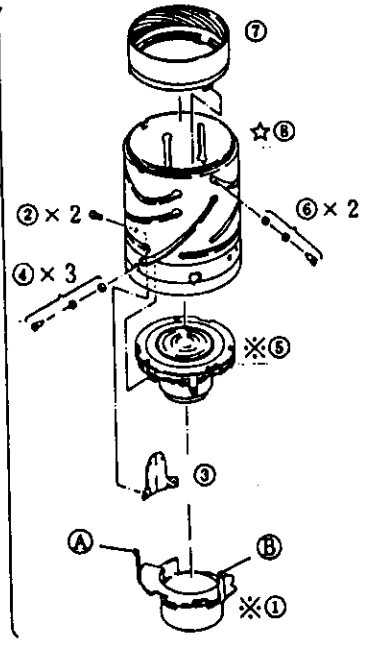
5. CAM BARREL

※ DISASSEMBLY

☆ ASSEMBLY

DO NOT DISASSEMBLE (5) if you do not have the 800mm lens focus collimator.

Cam Barrel Unit



Lubrication:

Cam Barrel and Guide Barrel coupling surfaces

GE-X8 : GC-X5

7 : 3

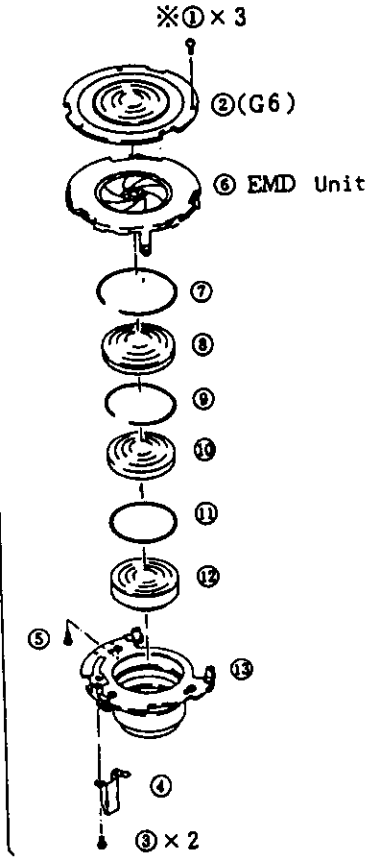
Cam Grooves: GE-X8

Set (1) in the Tele position and press in on (A) and (B) to remove.

6. REAR LENS UNIT

The position of (2) determines optical centering. Do not disturb the three screws (1) .

2nd Lens Unit



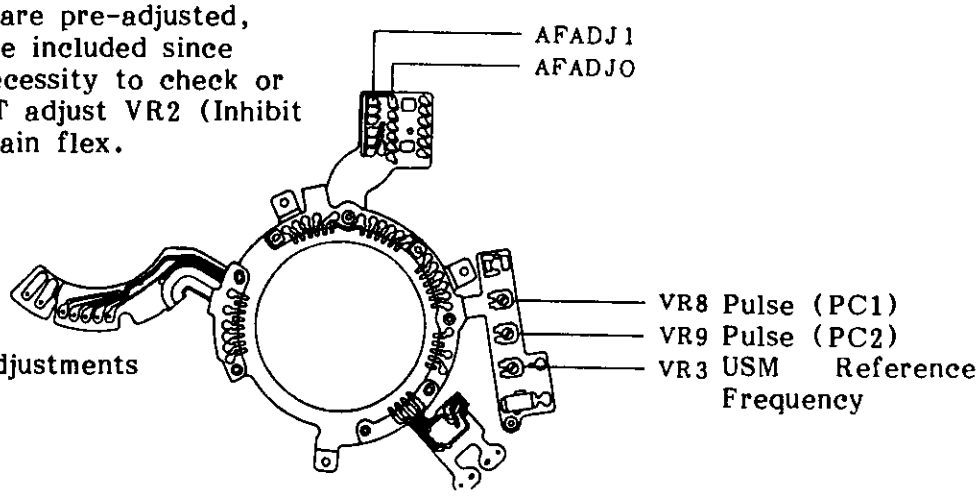
Mechanical and Optical Adjustments (excluding adjusting "SIZE" adjustments)

Adjustment	Objective	Test Equipment	Location	Page
Zoom Brush	Zoom Position Info.	————	Zoom Brush	9
AF/M Brush	AF-Manual switching	Ohmmeter	AM Brush	10
Optical Centering	Lens Axis Alignment	800mm Lens Focus Collimator(800LFC)	Lens G6	14
Focus (Wide)	Infinity Focus Setting	800LFC or 600mm Collimator& Camera	Lens mount & Focus Washers	15
Focus (Tele)	as above	as above	Front Lens	15
* Focus Limit	Set limits	————	Limit SW	16
* Manual Focus Phase	True manual focus position reading	Oscilloscope	Brush "L"	17

Electrical Adjustments

Adjustment	Objective	Test Equipment	Location	Page
Pulse	Optimize USM Drive Pulse Output	Oscilloscope & Camera	VR8, VR9	18
Best Focus	Align sensor focus with lens focus	————	AF ADJ0, AF ADJ1	19
* USM Reference Frequency	Set USM reference frequency	Frequency Counter	(VR3)	20

* USM Unit or Main Flex Adjustments: The service parts are pre-adjusted, but adjustments are included since there may be a necessity to check or readjust. **DO NOT** adjust VR2 (Inhibit Voltage) on the main flex.



Main Flex Adjustments

1. OPTICAL CENTERING

This adjustment is necessary if the EMD Unit is changed. The 800mm lens focus collimator is required. If not available, a pre-adjusted unit is available.

Purpose: To align the optical axes of the lens elements.

Equipment: 800mm Lens Focus Collimator, Lens Projector (Resolution check)

Preparation: Remove item # (1) through (5) on pg. 8, loosen and lightly tighten the screws holding G6. Reinstall the front lens group.

Adjustment:

1. Mount the lens on the 800LFC. Set to Tele and adjust the focus for slight blue (green) flare around the white center of the star image.
2. If the image appears as (A) or (B), adjust in the direction of the arrow so the image is as (C).
3. To adjust, remove the front lens unit, adjust the position of G6 slightly, reinstall the lens unit and check. Repeat as necessary.

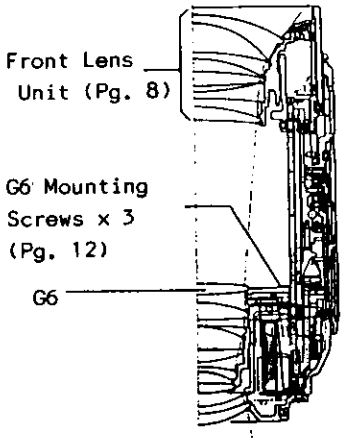


Fig. 4

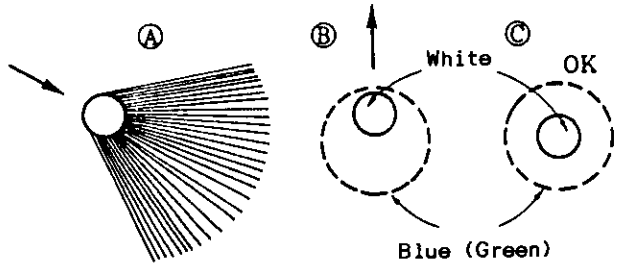


Fig. 5

Example (A): Bad de-centering

Example (B): Slight de-centering

STANDARD:

If centering is correct resolution will be good, but we recommend checking resolution as a final check.

Resolution Table

Image Height (mm)	0	4	8	12	16	20
S	100	63	63	63	63	40
28mm						
M		63	63	63	63	25
S	100	63	63	63	63	40
50mm						
M		63	63	63	63	40
S	100	63	63	63	63	40
80mm						
M		63	63	63	63	40

2. FOCUS ADJUSTMENT

A. 800mm Lens Focus Collimator Method
Install the EOS mount adaptor on the collimator and check several lenses from stock for an average. Adjust lenses to that average.

B. Camera Method
Use a known-good camera with a type B (split-image) screen and a magnifier. Check focus on a collimator or with an actual target at least $100f^2$ distant.

Standard:

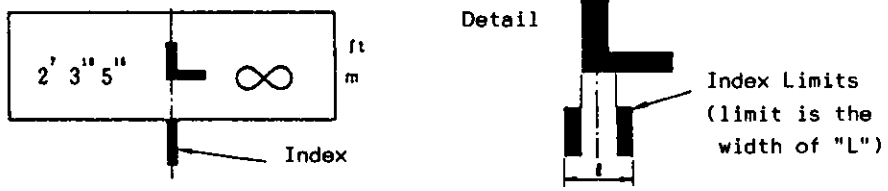


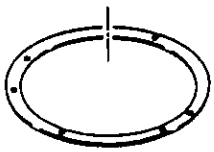
Fig. 6

Adjustment(perform wide adjustment first)

1. Wide Adjustment

At the factory, the guide rails are shaved to give the correct FFD; but this is impossible in the field. Special thin service mounts and focus washers are used. If the lens focuses past infinity (positive defocus) focusing washers of a combined thicknesses not exceeding 0.07mm can be used. (Using more may cause a visible gap.) If the defocus is greater than 0.07mm plus, or if it is negative, measure the lens mount thickness and choose the appropriate undercut lens mount and focus washers to bring the focus within limits.

Service Focus Washers



Service Use Only.

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

Service Lens Mounts

A	SIZE	A	SIZE
1.9 mm	(190)	2.4 mm	(240)
2.0 mm	(200)	2.5 mm	(250)
2.1 mm	(210)	2.6 mm	(260)
2.2 mm	(220)	2.7 mm	(270)
2.3 mm	(230)		

2. Tele Adjustment

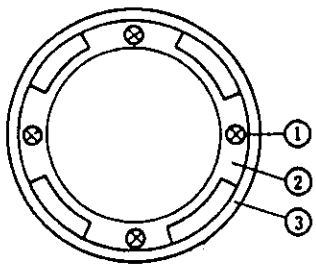


Fig. 7

a. Remove the cover ring in front of the front lens.

b. Loosen the four screws (1) in Fig. 7 and move (2). The relative positions of (2) and (3) determine Tele focus.

3. FOCUS STOPPER ADJUSTMENT
(Electrical Stop Position)

The USM / Helicoid Unit stocked as a service unit is pre-adjusted. This adjustment is included for reference purposes. The purpose of the adjustment is to align the focusing index with the end of the infinity "L" when the lens is focused at infinity at normal temperature.

Purpose: To adjust the maximum over-travel of the focusing at infinity.

Preparation:
1. Disassemble from the mount end (pg. 9, 10) all parts except (8), (9), (10), and (11), and then reinstall the mount and complete the circuits with the camera.
2. Temporarily short (1) and (3) (Fig. 8) with tweezers to set the lens in manual focusing mode.

Adjustment: The lens should stop with the end of the "L" aligned with the focusing index (which is removed at this point). The "TOP" screw is in the same position as the index. Since there is some distance between the "L" and the screw, use a straight-edge to check their alignment. If not aligned, loosen the two brush screws and move the slot slightly and check again.

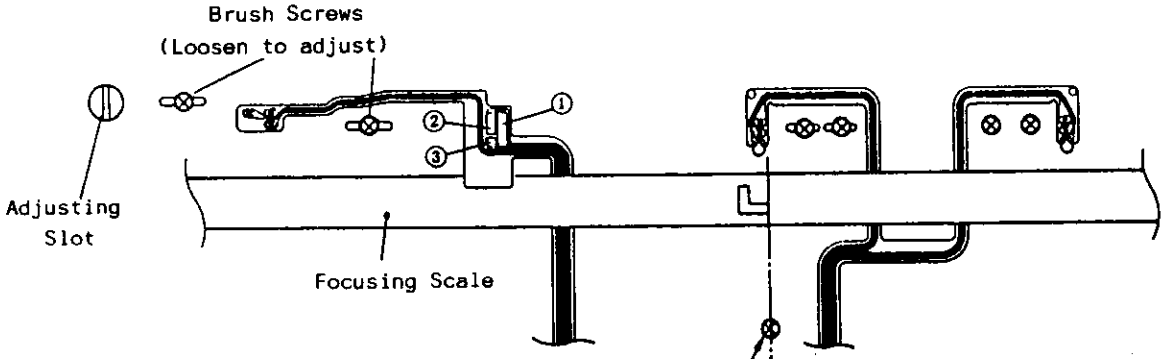


Fig. 8

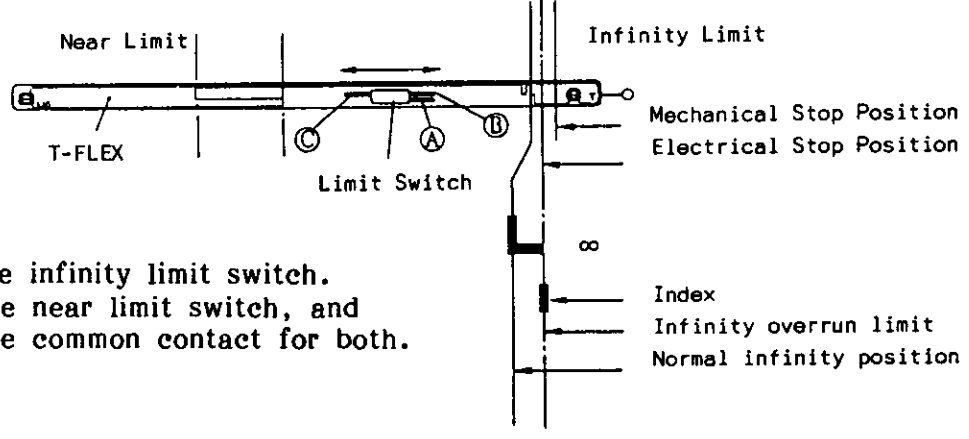


Fig. 9

(B) is the infinity limit switch.
(C) is the near limit switch, and
(A) is the common contact for both.

4. MANUAL FOCUS BRUSH POSITION
(Drive Phase Adjustment)

The USM / Helicoid Unit supplied as a service part is pre-adjusted at the factory. This adjustment is included for reference.

This adjustment is necessary if the powered manual focusing hunts or focus in the opposite direction from the direction the focusing ring is turned.

Purpose: To insure that the manual ring rotation produces the correct signal for focusing the lens.

Equipment: Dual-trace Oscilloscope

Standard: 90° ± 45°

Preparation: Disassemble as in Focus Stopper Adjustment (III-3), and attach lead wires as shown in Fig. 10.

Adjustment:

Attach test leads from COM4 and COM6 to the two channels and D-GND to both channel grounds. While watching the scope, turn the manual ring toward infinity. With the Brush L brush only lightly tightened, adjust until the phases are within the limits shown.

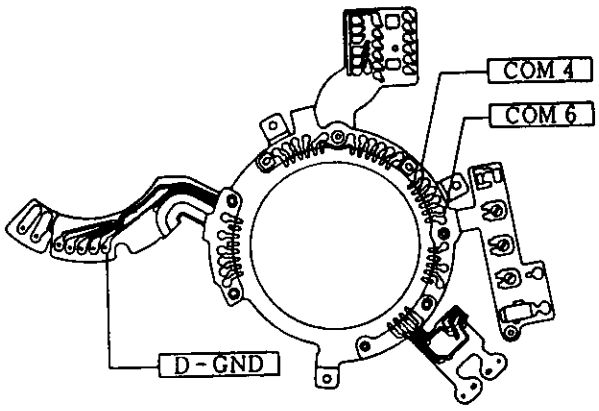


Fig. 10

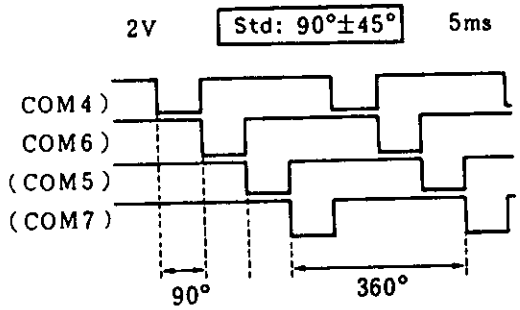


Fig. 12

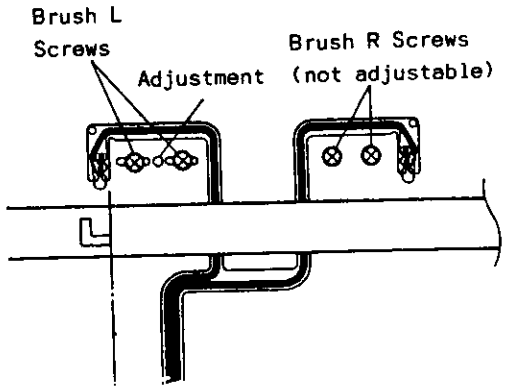


Fig. 11

The other USM lenses have adjustments for both the left and right brushes, but this lenses needs only the Brush L adjustment, because of improved production techniques and a coarser pattern on the flex. (COM5) and (COM7) and the waveforms for the non-adjustable Brush R.

5. 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.

Purpose: To adjust the duty cycle for maximum power output

Equipment: Oscilloscope, EOS camera

Standard: On(T) and off(t) times should be equal, within 10%.

$0.9T \leqq t \leqq 1.1T$

Preparation:

Remove (1) through (7) on pg. 9, mount a camera, and attach test leads to the main flex at PC1, PC2 and D-GND (Fig. 13).

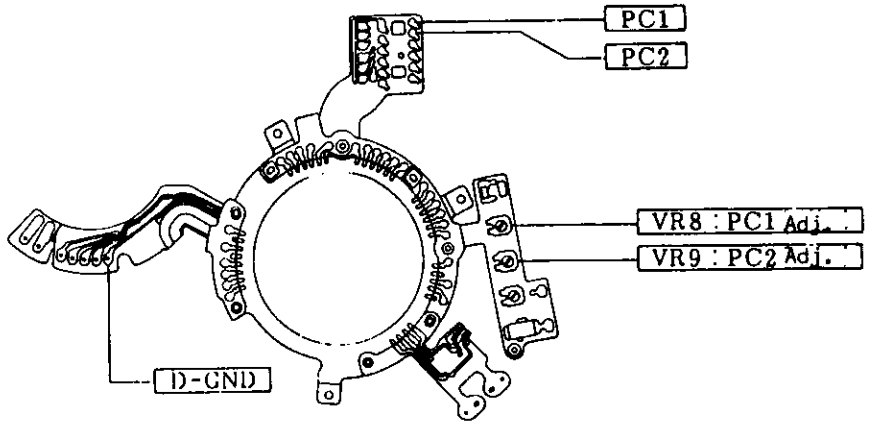


Fig. 13

Adjustment:

1. Attach the PC1 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. 14c.
3. Next, repeat with the PC2 lead adjusting VR9.

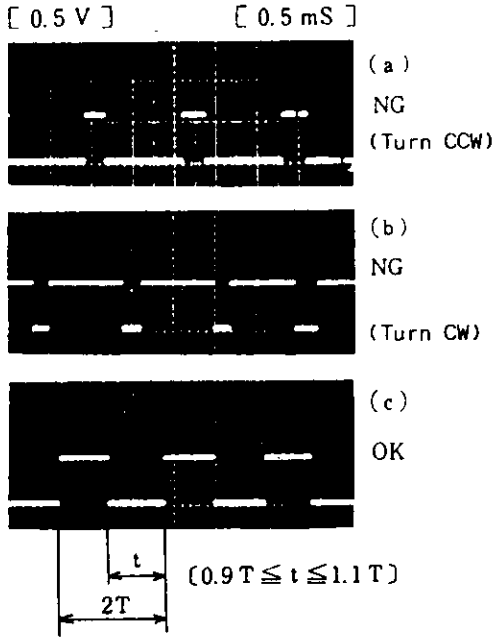


Fig. 14

6. BEST FOCUS ADJUSTMENT

Purpose: To bring the point where the lens stops when focused automatically into as close alignment as possible with the lenses actual best focus point.

Notes: 1. At the factory, this correction is written into each individual lens' ROM with a expensive tool. This tool is much too costly for field use so service will use the following procedures instead.

2. When the Main Flex is replaced, 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.

Adjustment 1: If front defocus, use plus correction. If rear defocus, use negative.

Adjustment 2. Make actual photographic test at with the AF-ADJ0 and AF-ADJ1 bridges in all four possible combinations. Make five or six negatives for each combination.

Test Conditions:

Distance:	4 meters (approx. 13 feet, 1 15/32 inches)
Target:	Flat, high contrast chart or equivalent
Aperture:	Maximum aperture
Camera:	EOS with Aperture Priority (AV) Mode

Examine the negatives closely to determine which combination is best.

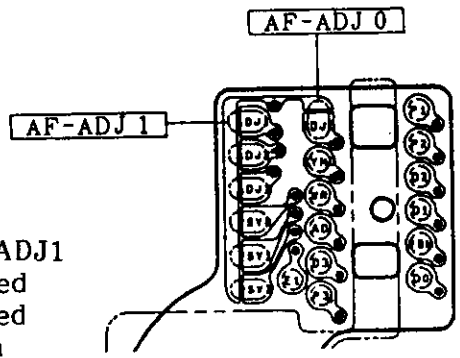


Fig. 15

Best Focus Correction

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

F: f/No.; c: circle of confusion

7. USM REFERENCE FREQUENCY

The USM / Helicoid Unit supplied as a service part is pre-adjusted at the factory. This adjustment is included for reference.

If, compared to other EF 28-80mm f/2.8-4.0L lenses, focusing speed is too high, too slow, or makes unusual noises, especially at extreme temperatures, check and adjust as necessary.

Purpose: To set the reference frequency for the ultrasonic focusing motor.

Equipment: Frequency Counter, EOS Camera with depth-of-field preview

Standard: 32.6 $\pm$ 0.5kHz

Preparation: Remove item # (1) through (7) on page 9, then reinstall the lens mount so the lens is operational. Install the lens on an EOS with depth-of-field preview button. (The frequency is not stable during actual USM operation. It is stable and can be measured with the D-O-F button pressed.)

Adjustment:

1. Install test leads at D-1 and D-GND and connect them to the frequency counter.
2. Mount the lens on an EOS, press the D-O-F button, and read the frequency.
3. It should be 32.6 $\pm$ 0.5kHz. If not, adjust VR3.

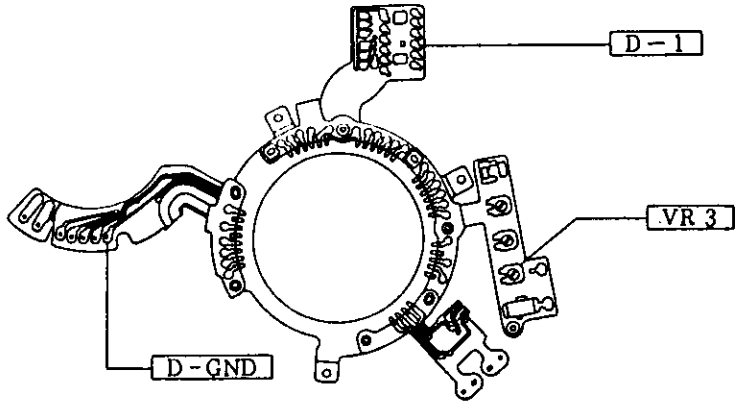


Fig. 16

The electronics in this lens are basically the same as the EF 200mm f/1.8L, EF 600mm f/4.0L and the second type EF 300mm f/2.8L, but there are certain differences which need explaining here. Variable-pitch powered manual focusing and an intermittent energy-saving DC-DC convertor are features of this lens which will be explained.

The operational sequence will be covered also, but for IC pin assignments, etc., see the EF 200mm f/1.8L Service Manual.

Variable-pitch Powered Manual Focusing

Variable-pitch powered manual focusing is similar to the three focus speeds on the other USM lenses, but instead of being manually selected by the photographer, the focusing speed in automatically controlled in five steps by the signal from the zoom encoder to give the optimum speed for the focal length in use.

Operation

(1) Set the focus mode switch (SW3) to Manual. This initiates the manual focus operational sequence.

(2) SW2 inputs the zoom encoder information to the MPU.

(3) With this zoom encoder data, the focal length sensitive five-step focusing drive program is activated.

(4) Manual focusing ring movement is sensed by switches SW4 and SW5, and the speed of movement (pitch) is input into the MPU.

(5) Within the MPU, the correct USM drive program is selected and the drive speed determined.

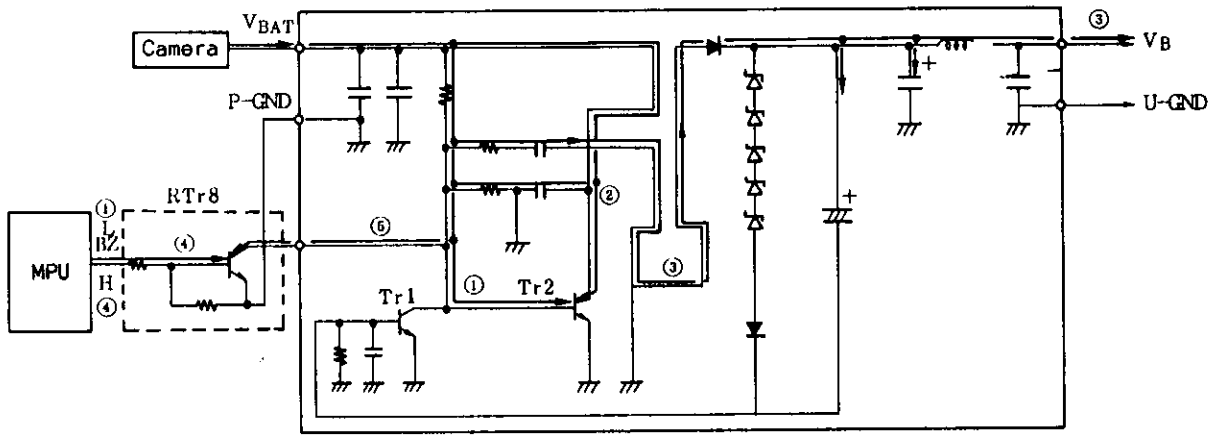
(6) The /SYNC*, /WR, and /AD signals, along with the drive amount information on data lines D0 through D3, are output from the MPU to the C-IC which translates this data into the correct number of phase pulses which are output through UAout and UBout to drive the USM.

*. 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.

Intermittent Energy-saving DC-DC convertor

In an effort to reduce the energy consumption of the USM type lens, an intermittent DC-DC convertor has been designed.

DC/DC Convertor



Operation (numbers = circled numbers in schematic)

DC-DC convertor turns on:
It draws power from VBAT, and pin BZ of the MPU goes low (L). This turns Tr2 on (1). DC/DC oscillation starts (2) and (3) VB is output.

DC-DC convertor turns off:
It draws power from VBAT, pin BZ of the MPU goes high (H), turning RTr8 (4) on, and oscillation stops (5), because RTr8 draws the current from VBAT, turning Tr2 off.

BZ Switching Timing

(1) When the camera's SW1 is turned on, the DC-DC convertor draws power from VBAT.

(2) At this point the E1 ON pin of the lens' MPU goes low (L). This turns on the E1 generator in the C-IC.

(3) The MPU sends the USM drive command to C-IC which generates the USM drive pulses. These pulses are counted by C-IC and sent to the MPU.

(4) When the count reaches to number requested by the MPU, it sends the USM stop signal to the C-IC, which stops the USM drive pulse.

(5) Pin BZ of the MPU goes high (H), turning off the DC-DC convertor.

ntermittent

③ V_B

U-GND

urns Tr2 on

r8 (4) on,
turning Tr2

power from

urns on the

USM drive

e USM stop

IV. ELECTRONIC CIRCUIT

EF 28 - 80mm f 2.8 - 4.0L

Lens Mounted on Camera

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

2. When camera and lens communicate, the lens MPU applies a low to the E1ON pin turning RTr1 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, and the camera determines if the diaphragm is fully open. If not, 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 PC3 sends the /P3 signal from pin 25 of C-IC to the MPU.

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

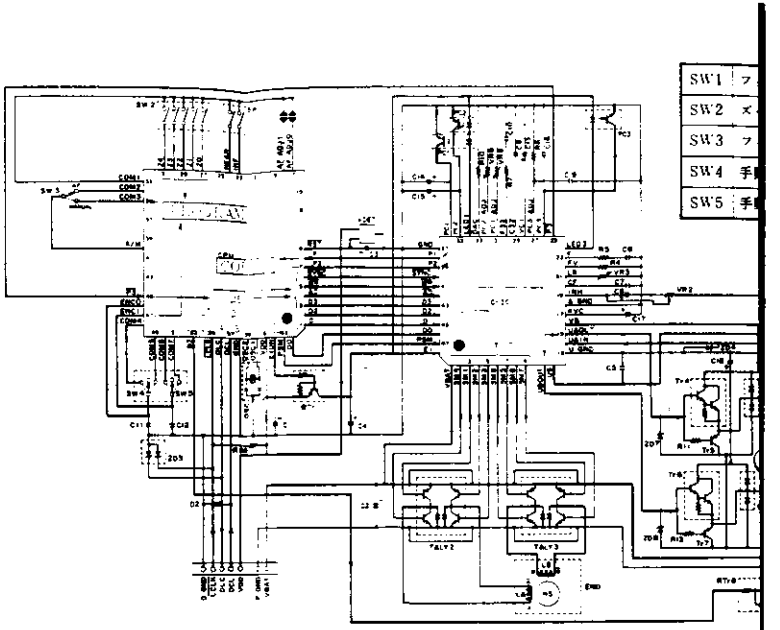
9. If the camera determines the diaphragm is still not fully open, the camera decides that the diaphragm is inoperative and initiates the BC warning signal when SW2 is closed.

Switch Operation

When Focus mode SW3, Manual focus sensor SW4 or SW5 is operated, lens MPU turns DLC to "low" regardless of /LCLK, and sends WAKE UP request, activating the camera DC/DC converter. After this, procedure in the same as above from step 2.

Camera SW1 On

10. At camera SW1 on, the camera DC/DC converter goes on so the lens MPU receives VDD, and VBAT (for DC/DC converter). The lens MPU applies a low to E1ON turning RTr1 on sending E1 to the C-IC, and a low to BZ to activate the lens' DC-DC convertor.



Focusing (USM) Drive

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

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

13. The lens MPU sends the sync (/SYNC) signal, and the Read-Write (/WR), and Address-Data (AD) switching signals on exclusive lines and focusing direction data on the 4-bit data lines D0 through D3. Also the photocoupler 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 transistor arrays Tr4-5 and Tr6-7 to generate out-of-phase signals.

15. The outputs of the transistor 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 of light are felt by PC1 and PC2. These pulses are received by C-IC and sent to the MPU by lines P1 and P2. These pulses contain both position and direction data.

17. The pulses are counted by the MPU to determine when correct focus is reached. Focusing continues until the correct focus is reached.

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

19. The MPU issues a high from pin BZ shutting off the DC-DC convertor.

Diaphragm (EMD) Drive

20. When the lens receives the aperture drive signal from the camera MPU, the lens sends a "busy" (/LCLK = L) signal.

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

EF 28 - 80mm f/2.8 - 4.0L

VDD is applied to the
oscillator (OSC). The
oltage sensor IC VDET.
ns, the MPU goes into

municate, the lens MPU
N pin turning RTr1 on,
-IC.

s data from the lens

through DLC line, and
the diaphragm is fully
sends diaphragm (EMD)

e EMD drive command,
-SM8 terminals of C-IC
ys (TALY2, TALY3) on

lly open, the maximum
the /P3 signal from pin

4), the camera again
ds the diaphragm open

the diaphragm is open,
nal to C-IC.

the diaphragm is still
e decides that the dia-
nitiates the BC warning

al focus sensor SW4 or
turns DLC to "low"
nds WAKE UP request,
converter. After this,
e from step 2.

amera DC/DC converter
eceives VDD, and VBAT
The lens MPU applies a
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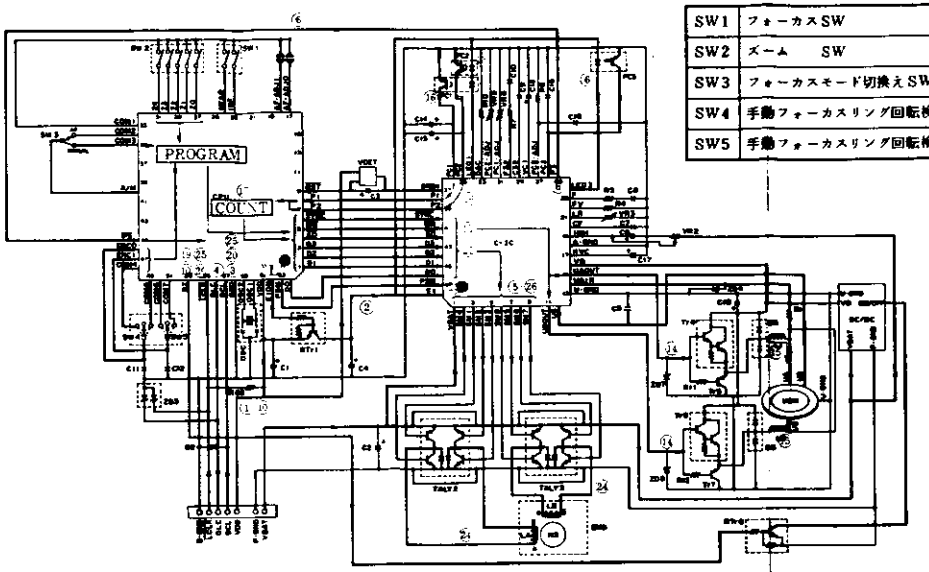
to activate the lens'



SW1	フォーカスSW	Focus SW
SW2	ズーム SW	Zoom SW
SW3	フォーカスモード切換えSW	Focus Mode SW
SW4	手動フォーカスリング回転検出SW	Manual Focusing Sensor SW
SW5	手動フォーカスリング回転検出SW	Manual Focusing Sensor SW

Red circled numbers
indicate text numbers
赤丸の数字は文中の説明の
数字に対応します。

Focusing (USM) Drive

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

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

13. The lens MPU sends the sync (/SYNC) signal, and the Read-Write (/WR), and Address-Data (/AD) switching signals on exclusive lines and focusing direction data on the 4-bit data lines D0 through D3. Also the photocoupler 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 transistor arrays Tr4-5 and Tr6-7 to generate out-of-phase signals.

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16. As the USM turns, light from LEDs 1 and 2 is "chopped" so pulses of light are felt by PC1 and PC2. These pulses are received by C-IC and sent to the MPU by lines P1 and P2. These pulses contain both position and direction data.

17. The pulses are counted by the MPU to determine when correct focus is reached. Focusing continues until the correct focus is reached.

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

19. The MPU issues a high from pin BZ shutting off the DC-DC convertor.

Diaphragm (EMD) Drive

20. When the lens receives the aperture drive signal from the camera MPU, the lens sends a "busy" (/LCLK = L) signal.

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

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

23. The MPU sends the amount data at the clock pulse rate over the PSM line from the MPU to the C-IC.

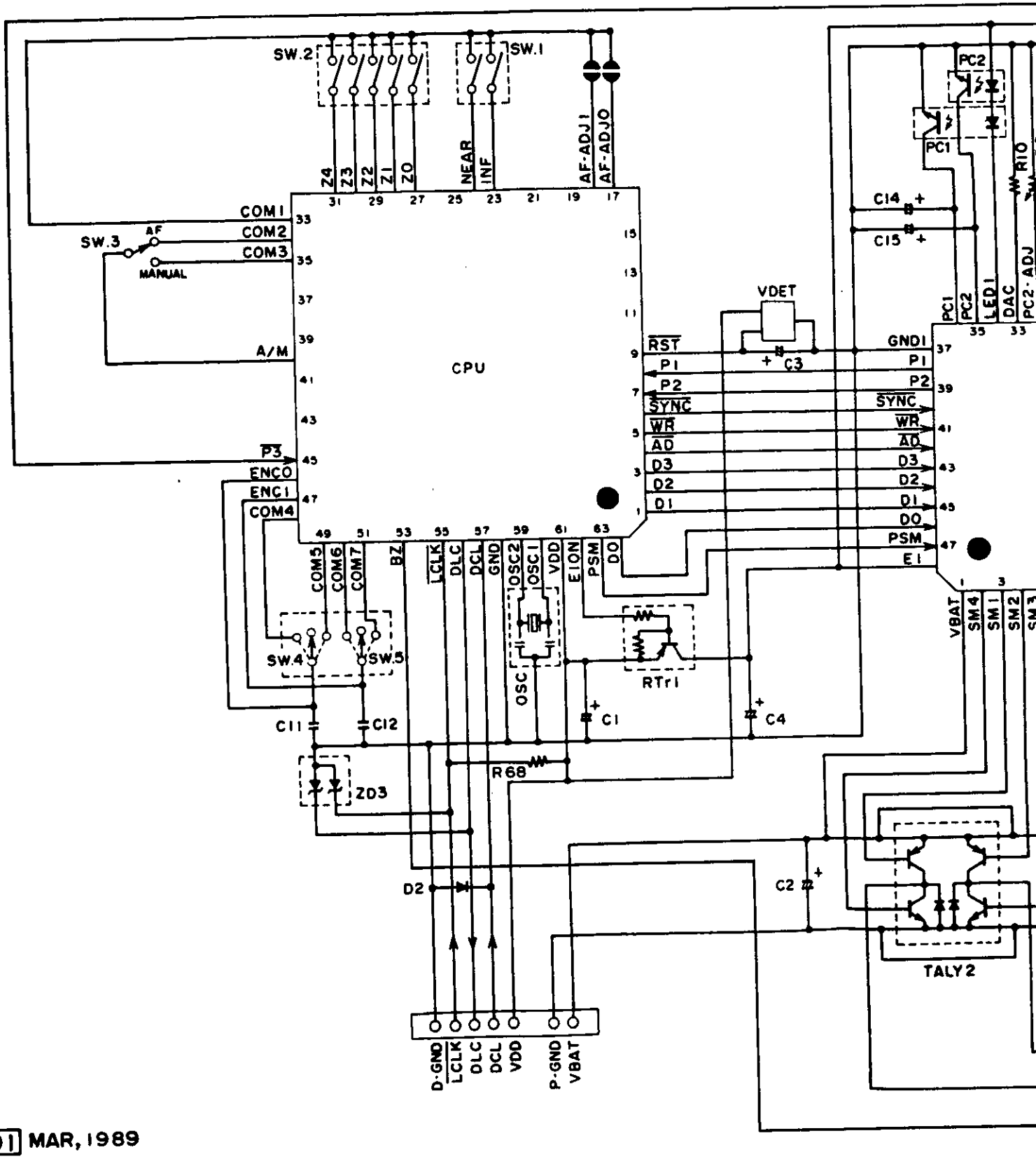
24. The C-IC uses this data to send an 8-bit signal over lines SM1 through SM8. These signals energize the transistor arrays TALY2 and TALY3. The output of the transistor arrays establish the current directions in coils LA and LB to stop down the diaphragm.

25. A certain time after the last pulse is sent from the MPU to the C-IC, the busy signal is removed from the /LCLK line.

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

CANON LENS EF 28-80 mm

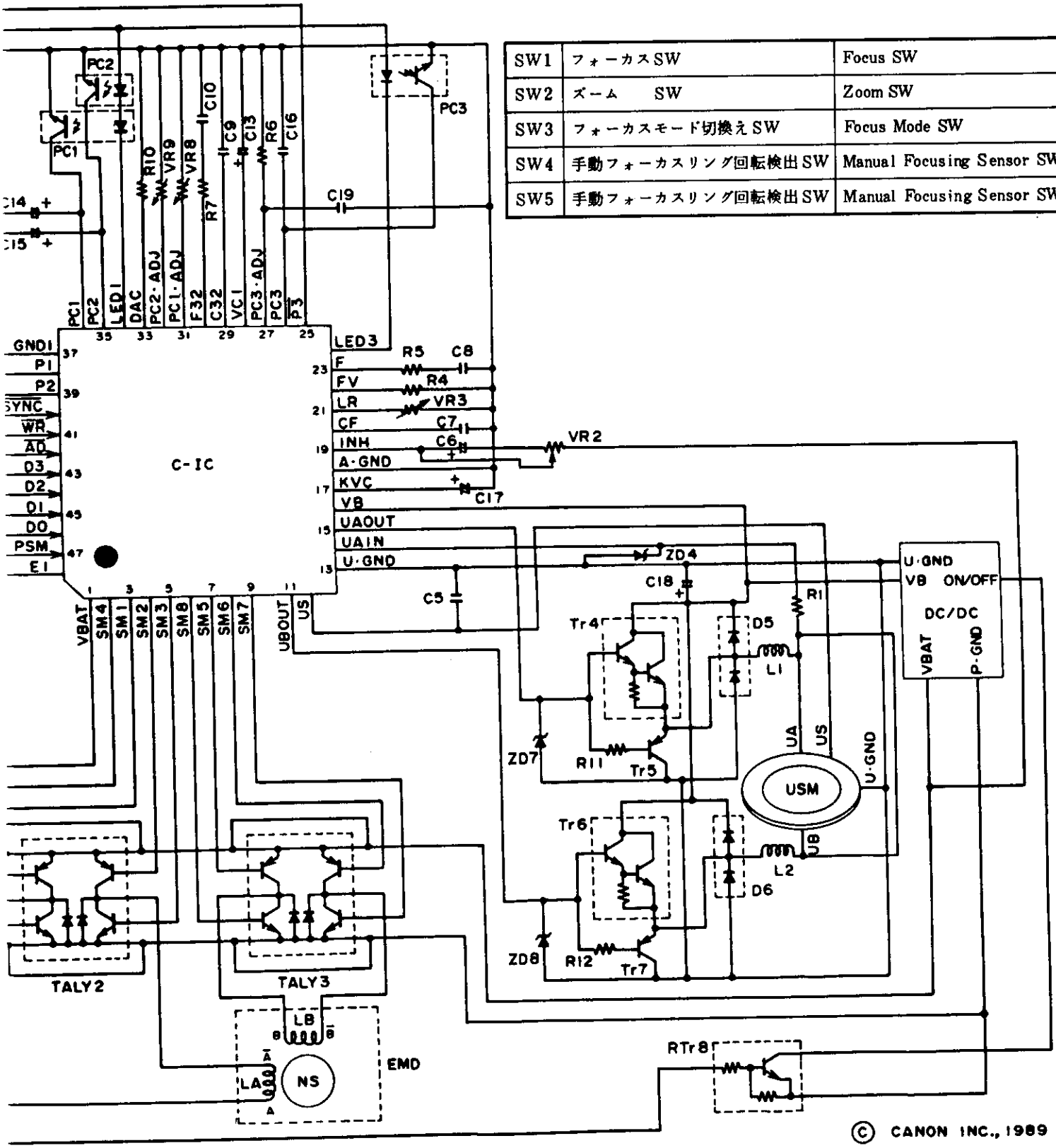
SCHEMATIC DIAGRAM



01 MAR, 1989

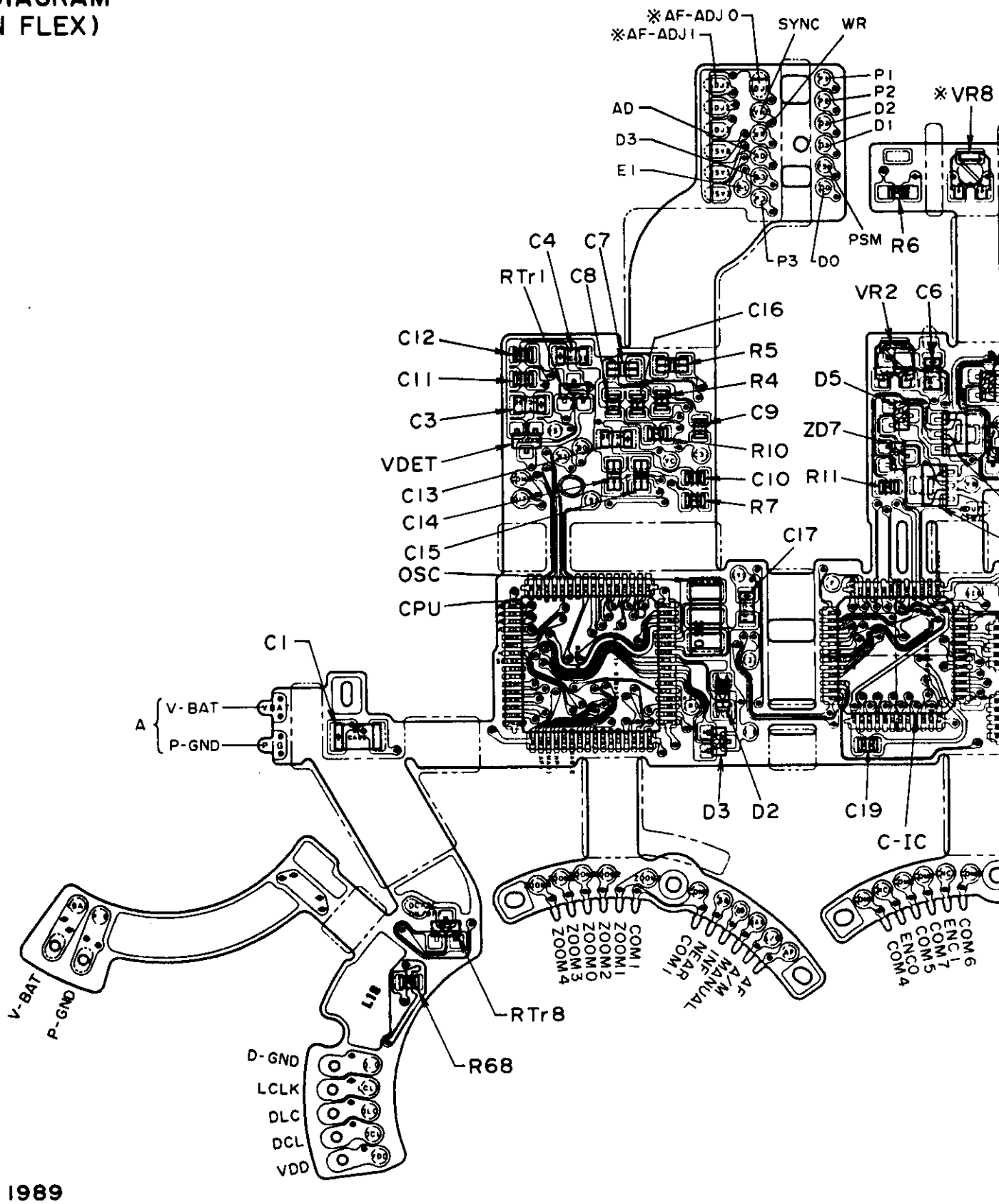
28-80 mm 1:2.8-4.0L

SW1	フォーカスSW	Focus SW
SW2	ズーム　　SW	Zoom SW
SW3	フォーカスモード切換えSW	Focus Mode SW
SW4	手動フォーカスリング回転検出SW	Manual Focusing Sensor SW
SW5	手動フォーカスリング回転検出SW	Manual Focusing Sensor SW



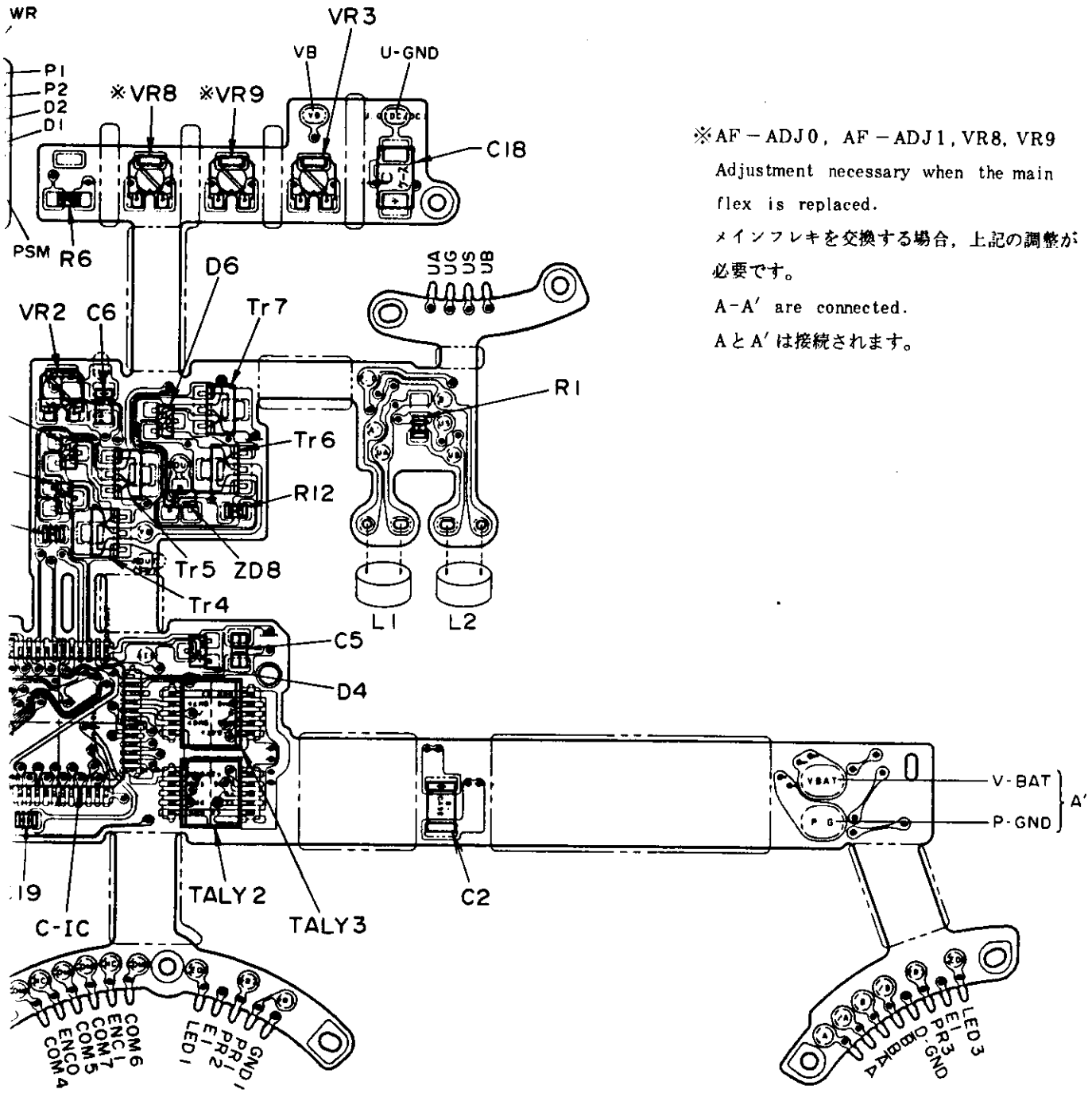
CANON LENS EF 28-80 m

P.C.B. DIAGRAM (MAIN FLEX)



01 MAR, 1989

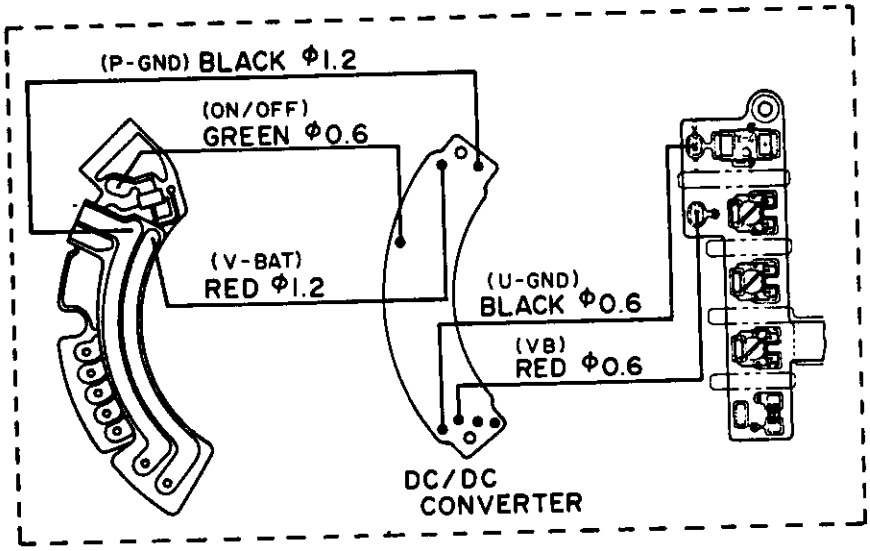
28-80 mm 1:2.8-4.0 L



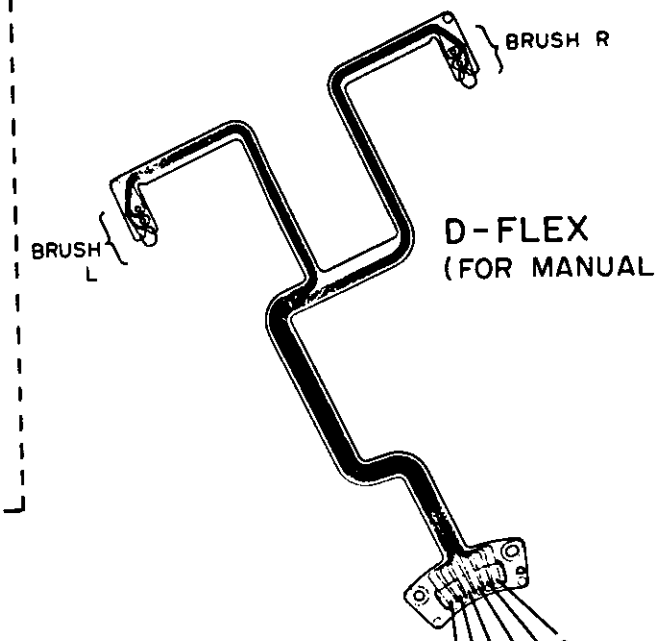
※AF－ADJ0, AF－ADJ1, VR8, VR9
Adjustment necessary when the main flex is replaced.
メインフレキを交換する場合，上記の調整が必要です。
A-A′ are connected.
AとA′は接続されます。

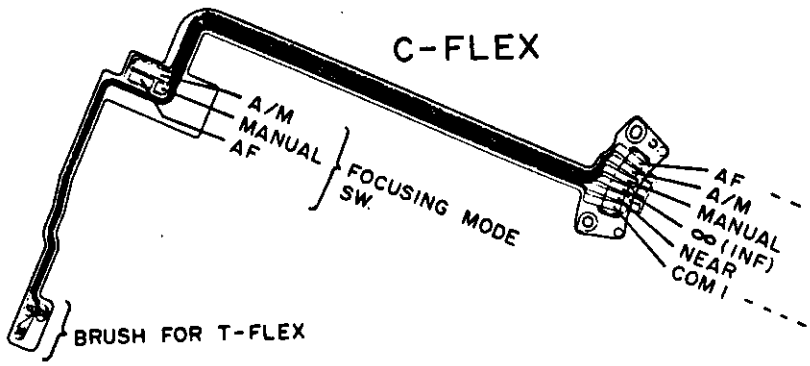
CANON LENS EF 28-80

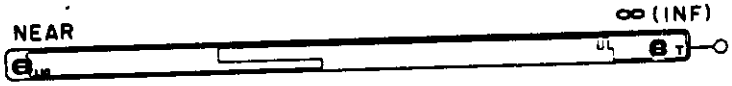
WIRING & P.C.B DIAGRAM



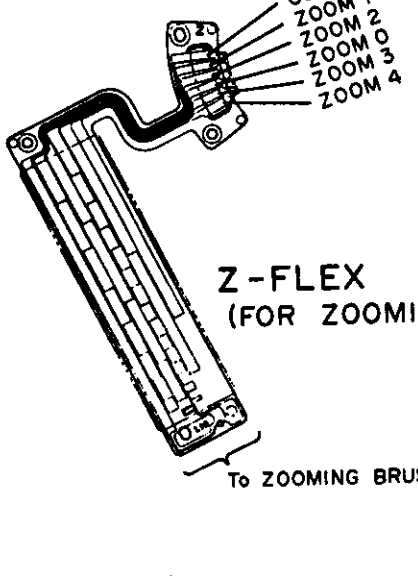
WIRING

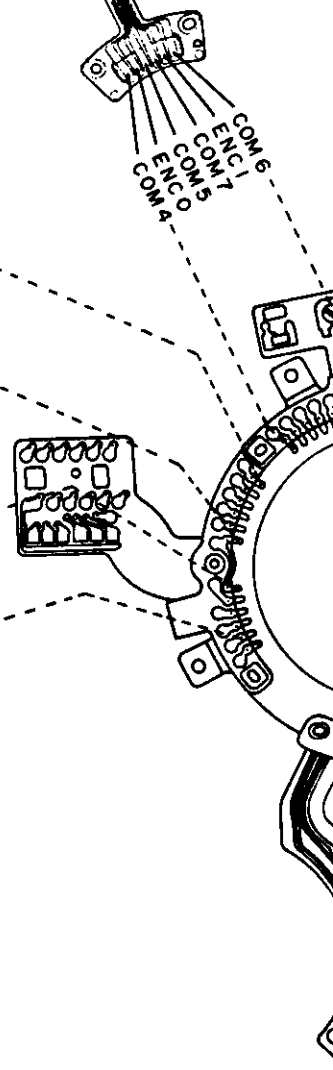






T-FLEX
(DISTANCE LIMIT INFORMATION)





01 MAR, 1989

EF 28-80 mm 1:2.8-4.0 L