JVC

VIDEO TECHNICAL GUIDE

VHS VIDEO MOVIE

GR-AX2/AX5 PAL

VHS C
PAL

HQ
High Quality

CCD
Charge Coupled Device

AF
FULL RANGE AF

videomovie

– GR-AX2 –

– GR-AX5 –

No. VTG86030
September 1991

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SECTION 1
INTRODUCTION

1.1 FEATURES

1.1.1 GR-AX5 features

1) Fits in the palm of the hand; comfortable with the grip point set at the center of gravity.
2) Electronic viewfinder rotates 180 degrees.
3) 1/3-inch CCD image sensor with 320,000 pixels delivers clear pictures.
4) F1.4 lens and high sensitivity; minimum illumination 3 lux (with Gain up).
5) Auto head cleaning mechanism.
6) Compact lightweight 8X power zoom lens.
7) Gain up function.
8) Full range auto focus from 1.5 cm to infinity; manual adjustment also provided.
9) 4 steps variable electronic shutter (1/50, 1/160, 1/500, 1/4000 second).
10) Automatic flicker corrector for fluorescent lighting.
11) Trigger operated AV fader (black fader).
12) Age insert function for childer's scenes.
13) Lower power consumption.

1.1.2 GR-AX2 features

The GR-AX2 use the 6X power zoom lens. These are the main difference with respect to the GR-AX5.

1.2 INTERNAL SECTIONS

1.2.1 Camera

1. Optical black

The newly designed 8X or 6X zoom lens consists of 11 groups and 13 elements

Full range auto focus

Iris sensor for increased focus accuracy

1/3-inch CCD image sensor with 320,000 pixels and 1/50 to 1/4000 electronic shutter

2. CCD board

IC1: CCD image sensor
IC2: CCD driver

3. SSG & VIDEO board

IC1: CCD drive and sync signal generator
IC2: Produces YH, YL, R and B signals from the CCD image sensor output, also includes AGC and iris sensitivity circuits
IC3: Produces luminance and color signals from YH, YL, R and B signals supplied from the IC2, also contains luminance signal enhancer
IC4: 1H delay CCD for YH vertical enhancer
IC5: Simultaneous conversion for line sequential color difference signals, plus two 1H delay CCD circuits for CNR
IC6: White balance corrector
IC7: 4.43 MHz subcarrier generator
IC9: Gain up switcher

4. AF board

IC1: Power on reset pulse generator
IC2: AF motor driver
IC3: Camera control CPU, data transfer with deck mechacon, operation switch and mode data, white balance control, focus control
IC4: Video contrast signal processor
IC5: Zoom motor driver
IC7: 5V regulator for AF motor driver
IC8: EEPROM for camera control CPU data
IC10: Iris driver, low light detector, 4V regulator

5. DC/DC converter

Power supply for camera section 5V, 15V and –8V.

1.2.2 Deck section circuits

1. Mechacon circuit

IC301: System control CPU
IC302: Mode control motor driver
IC304: Power on reset pulse generator
IC305: 5V regulator
IC306: AC power adapter and battery detector
IC307: Litium battery detector, dew sensor detector, battery indicate level detector, battery down detector
IC308: 5V regulator for IC307

2. Servo circuit

IC101: Main digital servo IC, contains video head switching pulse generator

3. Regulator & MDA circuit

DC/DC converter for deck section 5V and 8V
IC1: Short detector for DC/DC converter
IC2: Switching pulse generator for drum and capstan motor drives
IC201: Drum motor drive amplifier
IC221: Capstan motor drive amplifier

4. Y/C circuit

IC501: Luminance and color VHS REC/PB processor
IC502: Amplifier for video output
IC503: 1H delay CCD for playback DOC and line noise canceller

5. Audio circuit

IC401: Audio signal REC/PB processor
IC402: Mic amplifier and Fh trap

1.3 SERIAL DATA TRANSFER

Fig. 1-3-1 indicate the serial data transfer lines.

1. Mechacon to servo
   - a) PB/REC etc. mode data
   - b) Tracking data
2. Mechacon to AF cpu
   - a) AF on mode data
   - b) Zoom sw data
   - c) Shutter mode data
   - d) Fader mode data
3. AF cpu to mechacon
   - a) Low contrast indicate data
   - b) AF off indicate data
   - c) Flicker data
   - d) Gain up mode data
4. Remocon to mechacon (GR-AX5)
   Remote controller operation data (only when remote controller is used)
5. AF cpu to/from EEPROM
   White balance data
6. AF cpu to AF processor
   - a) Contrast signal gain control data
   - b) Contrast signal select data
7. AF cpu to/from EVR JIG
   Adjustment address and data (on when EVR JIG is used)

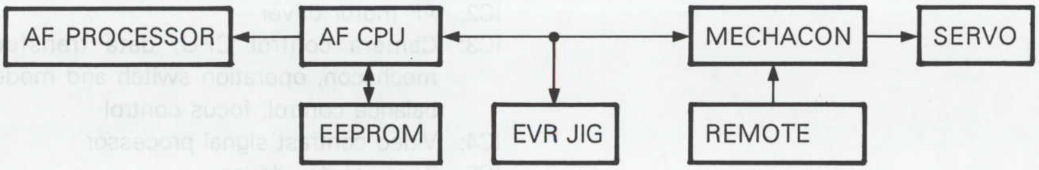


Fig. 1-3-1

SECTION 2
CAMERA SECTION CIRCUIT DESCRIPTION

2.1 CCD IMAGE SENSOR

Fig.2-2-1 indicates the picture element arrangement of the CCD image sensor. Pixel quantity is approximately 320,000 (542 horizontal × 584 vertical = 316,528). Of these, 2 pixels at the beginning and 28 pixels at the end in the horizontal direction, and a pixel at the beginning and end in the vertical direction are masked for optical black use. Therefore the effective pixel quantity is about 300,000 (512 horizontal × 582 vertical = 297,984).

The effective pixels correspond to the 1/3-inch optical size of 4.82 mm(H) × 3.62 mm(V).

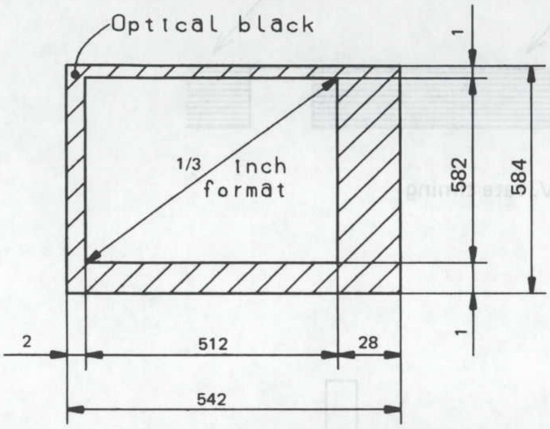


Fig. 2-1-1 Pixel arrangement

Refer to Fig. 2-1-2.

The CCD image sensor uses the interline transfer system. Light receptor and transfer elements are separated. Photosensors and VCCDs are arranged alternately in the vertical direction. Each photosensor is connected to the VCCD via a transfer gate (G).

The final VCCD stages are connected to the HCCDs, and the final HCCD to the output.

When light strikes a photosensor, an electrical charge is produced according to the intensity. The transfer gate opens during the vertical retrace period and the signal charge proceeds to the VCCD. Since this resets the photosensor, the signal storage time is normally one field.

The signal charges stored in the VCCDs are transferred one scanning line at a time to the HCCDs during the horizontal retrace period. The video signal output is then obtained during the video period.

In Fig. 2-1-2, (1) indicates the signal charge potential transferred to the VCCD. The case of extremely strong incident light is shown by (2). The excess charge produced by the photosensor is discarded to the lower portion of the chip (overflow drain). This vertical overflow construction serves to suppress blooming effects. The threshold between the photosensor and overflow drain can be adjusted with the Vsub.

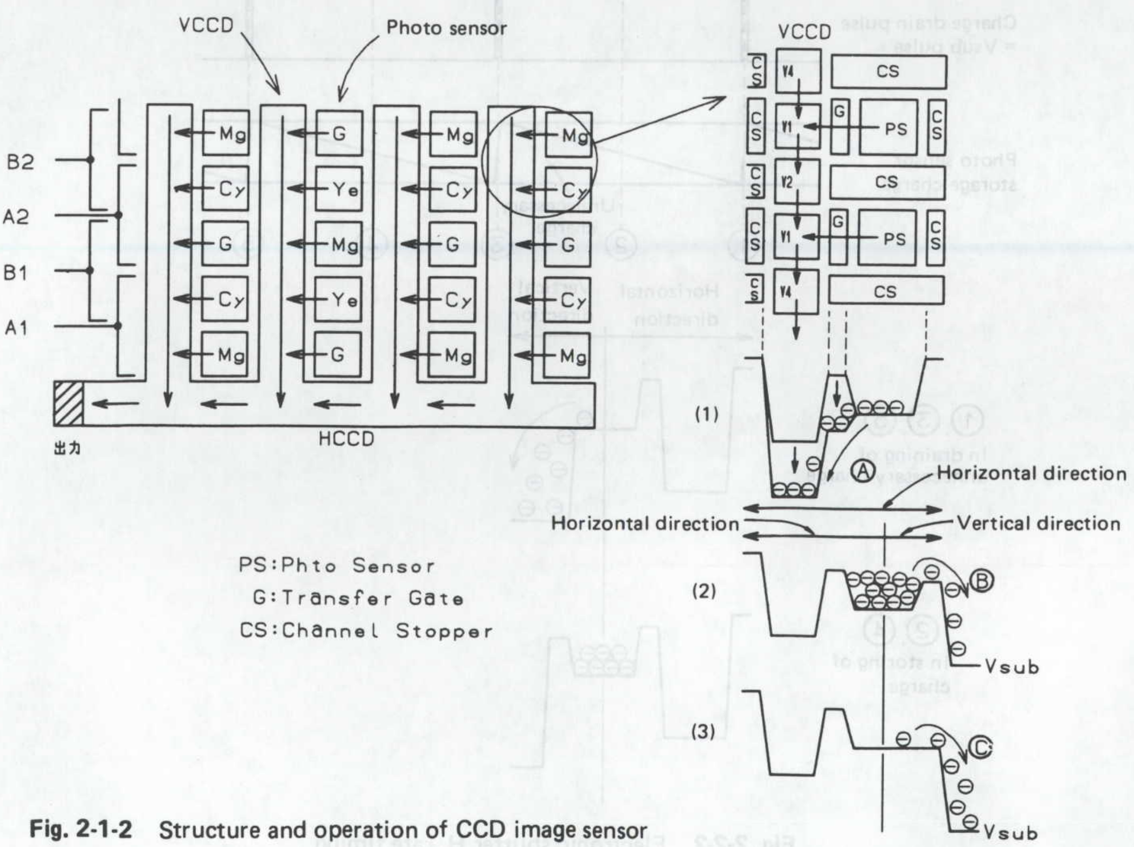


Fig. 2-1-2 Structure and operation of CCD image sensor

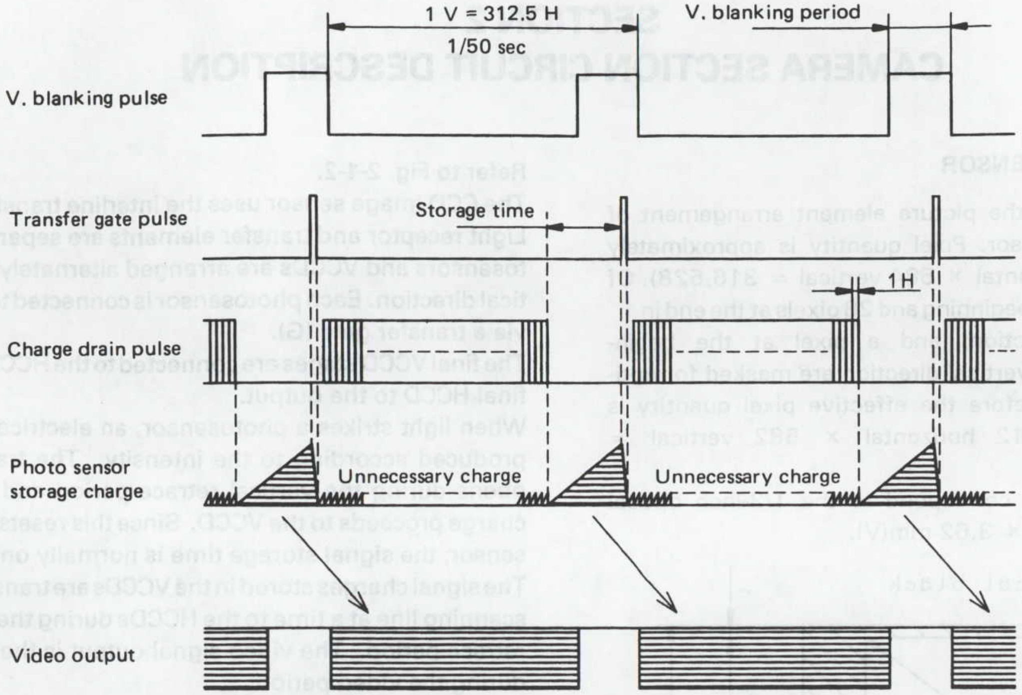


Fig. 2-2-1 Electronic shutter V. rate timing

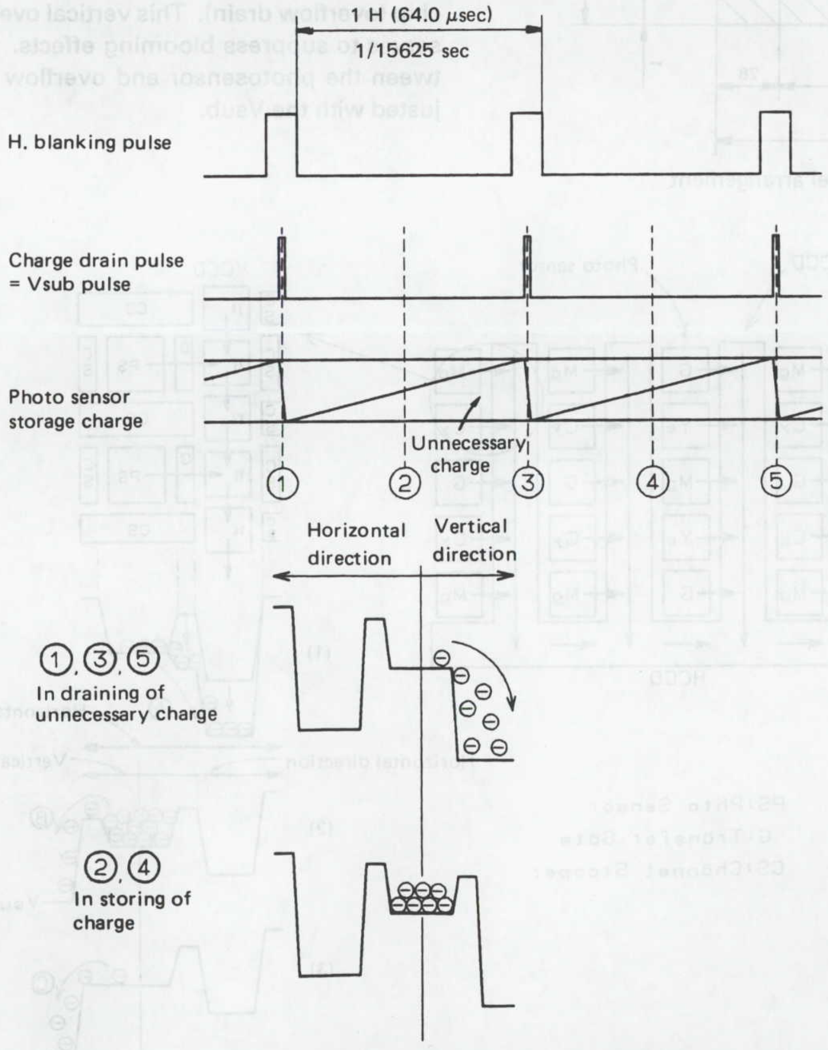


Fig. 2-2-2 Electronic shutter H. rate timing

2.2 ELECTRONIC SHUTTER

The electronic shutter functions by controlling this photosensor storage capacity. Within the normal signal charge storage time of 1 field (1/50 second), the signal charge is stored for only the period of time corresponding to the shutter speed. The unnecessary charge outside of this time is discarded.

Refer to Figs. 2-2-1 and 2-2-2.

The charge deletion pulse is overlapped on the Vsub DC bias for deleting the unnecessary charge every 1 H. This operation occurs during the horizontal retrace period and repeats at the timing which corresponds to the shutter setting.

When the timing is reached, the charge deletion pulse overlap to Vsub stops and signal charging begins.

Theoretically, this control system is capable of varying the shutter speed from 1 V (1/50 second) to 1 H (1/15,625 second). However, the shutter speed of this model is selectable in 7 steps for 1/50, 1/60, 1/125, 1/250, 1/500, 1/1000 and 1/4000 second.

2.3 FLUORESCENT FLICKER COMPENSATION

In areas with 60 Hz power line frequency, fluorescent light intensity varies at a 120 Hz cycle. At the same time, the CCD image sensor signal charge storage time is 1/50 second. As indicated in Fig.2-3-1, when used under fluorescent lighting, the signal charge amount varies with time, returning to normal 1/10 of a second later. This results in 10 Hz flicker.

This model detects 120 Hz fluorescent lighting and automatically selects the 1/60 second electronic shutter speed in order to minimize flicker.

The 1/60 shutter mode signal charge state is indicated in Fig.2-3-2. Under the normal charge storage of Fig.2-3-1, the integrated light intensity value for each field varies as A-B-C-D-E-A-B... In the Fig.2-3-2 1/60 shutter mode, the integrated points with respect to light volume differ as A-B-C-D-E-F-G... However, since the charge accumulation varies in the same cycle as the fluorescent light variation, flicker can be reduced.

The white balance G signal is used for detecting fluorescent flicker. Under fluorescent light, a 120 Hz component is included in the G signal. This is separated by the active bandpass filter, shaped and supplied to the CPU. The CPU computes the frequency and if 120 Hz, sets the SSG circuit mode for 1/60 electronic shutter speed.

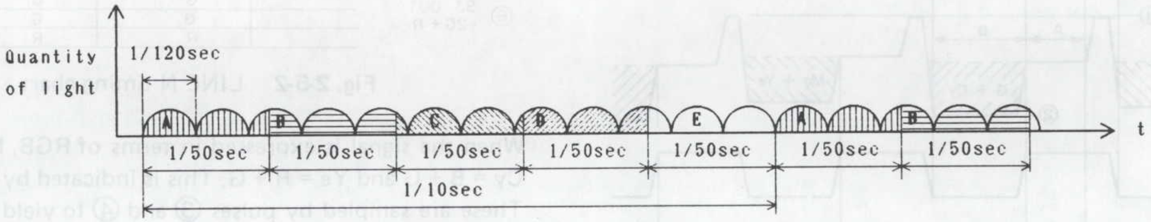


Fig. 2-3-1 Normal charge storage under fluorescent light

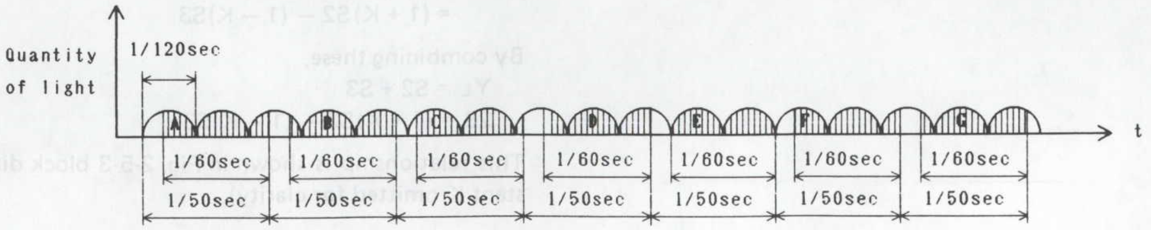


Fig. 2-3-2 Charge storage at 1/60 shutter speed under fluorescent light

2.4 CORRELATED DOUBLE SAMPLING

As shown by V. OUT in Fig. 2-6-1, charge detector gate reset pulse ϕR is overlapped on the signal voltage from the CCD image sensor. This is for neutralizing residual charge. $\phi R1$ is synchronized to $\phi H1$ and is applied directly after the signal output component.

Therefore the output signal from the CCD image sensor is intermittent, rather than continuous. Ordinarily, it would be adequate to take component ① of V. OUT as reference and sample potential ② for producing a continuous signal.

In considering noise with a frequency lower than the 104 ns (9.66 MHz) of V. OUT, correlation can be inferred between from the falling edges of ϕR and S/H1. After clamping, the signal voltage is sampled by S/H1.

In considering noise with a frequency lower than the 104 ns (9.66 MHz) of V. OUT, correlation can be inferred between the noise in periods A and B. Thus, by taking potential A as reference and sampling potential ②, the strongly correlated noise component can be removed.

This process constitutes the correlated doulbe sampling technique.

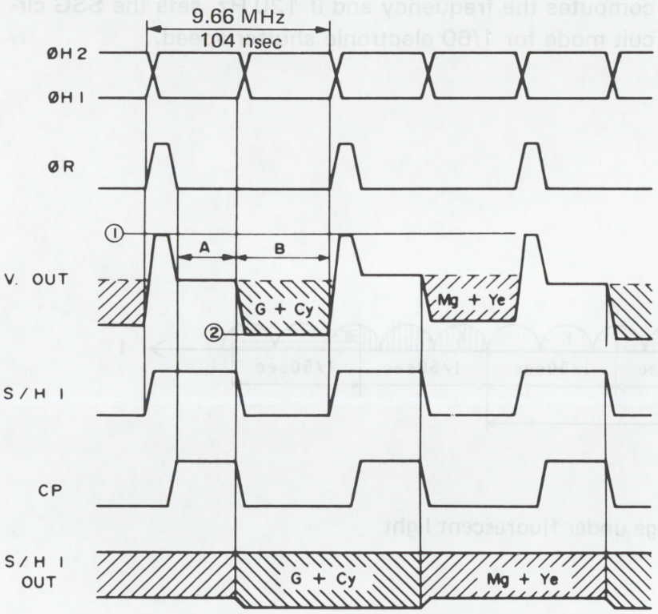


Fig. 2-4-1 Correlated double sampling

2.5 COLOR DEMODULATION

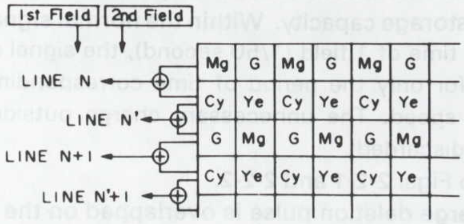


Fig. 2-5-1 Color filter

Fig. 2-5-1 shows the color filter arrangement for the CCD image sensor. In the field storage mode, the signal charge stored in each pixel is combined with those of the vertically adjacent pixels for producing the video output. Thus, the LINE N signal of Fig. 2-5-1 corresponds to signal ① of Fig. 2-5-2.

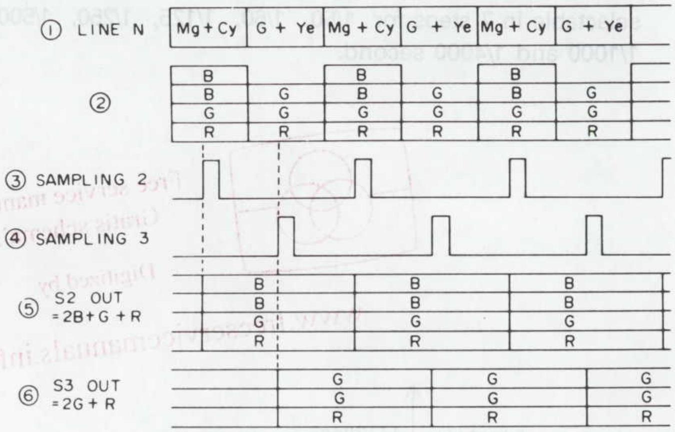


Fig. 2-5-2 LINE N timing chart

When the signal is expressed in terms of RGB, Mg = B + R, Cy = B + G and Ye = R + G. This is indicated by ②.

These are sampled by pulses ③ and ④ to yield signals ⑤ : S2 = 2B + G + R and ⑥ : S3 = 2G + R. The following formulas can be expressed.

$$S2 + S3 = (2B + G + R) + (2G + R) = 2R + 3G + 2B = Y_L$$
$$S2 - S3 = (2B + G + R) - (2G + R) = 2B - G$$

Since G = approx. $K * Y_L$

$$\begin{aligned} 2B &= 2B - G + K * Y_L \\ &= (S2 - S3) + K(S2 + S3) \\ &= (1 + K)S2 - (1 - K)S3 \end{aligned}$$

By combining these,

$$Y_L = S2 + S3$$
$$2B = (1 + K)S2 - (1 - K)S3$$

This relationship is shown in Fig. 2-5-3 block diagram (constant K omitted for clarity).

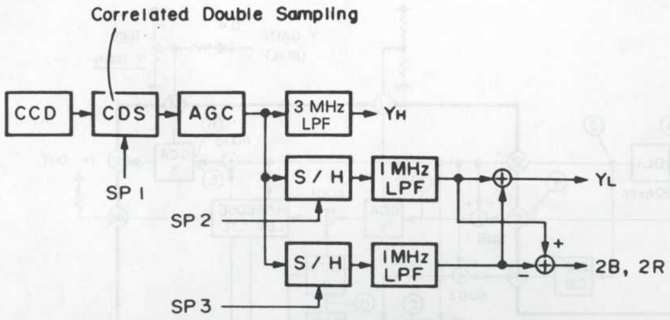


Fig. 2-5-3 Color demodulation block

In the same manner as LINE N, LINE N + 1 can be obtained from Y_L and 2R. Refer to Fig. 2-5-4.

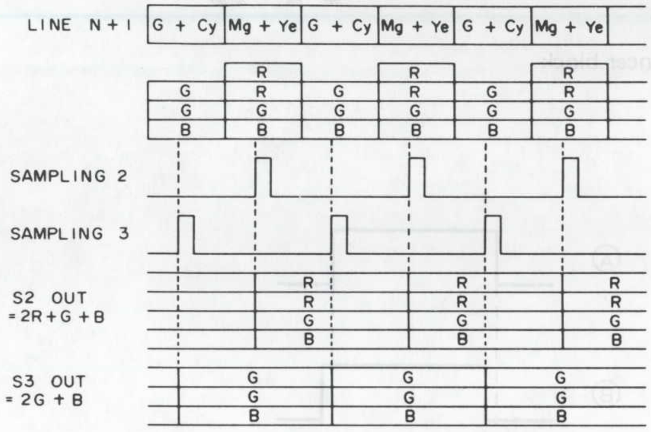


Fig. 2-5-4 LINE N + 1 timing chart

sampling S2 yields 2R + G + B, while sampling S3 produces 2G + B. The following formulas can be composed.

$$S2 + S3 = (2R + G + B) + (2G + B) = 2R + 3G + 2B = Y_L$$
$$S2 - S3 = (2R + G + B) - (2G + B) = 2R - G$$

Since G = approx. $K * Y_L$,

$$\begin{aligned} 2R &= 2R - G + K * Y_L \\ &= (S2 - S3) + K(S2 + S3) \\ &= (1 + K)S2 - (1 - K)S3 \end{aligned}$$

These formulas yield the following relationships.

$$Y_L = S2 + S3$$
$$2R = (1 + K)S2 - (1 - K)S3$$

As indicated in Fig. 2-5-3 block diagram, LINE N + 1 yields the Y_L and 2R signals.

Although Y_L is produced by both LINE N and LINE N + 1, the color components become 2B and 2R respectively.

In this manner, 2 color signals alternate each scanning line, thus forming the line sequential color signal. Refer to Fig. 2-5-5.

The line sequential color signals (2R and 2B) are sent in two lines. After white balance and gamma adjustments, pulse 1/2 Fh joins them into a single signal.

The Y_L signal is then subtracted to yield the line sequential color difference signals (R-Y and B-Y). A circuit comprised of a 1H delay CCD and 1/2H pulse converts the signals from line sequential to simultaneous color difference signals.

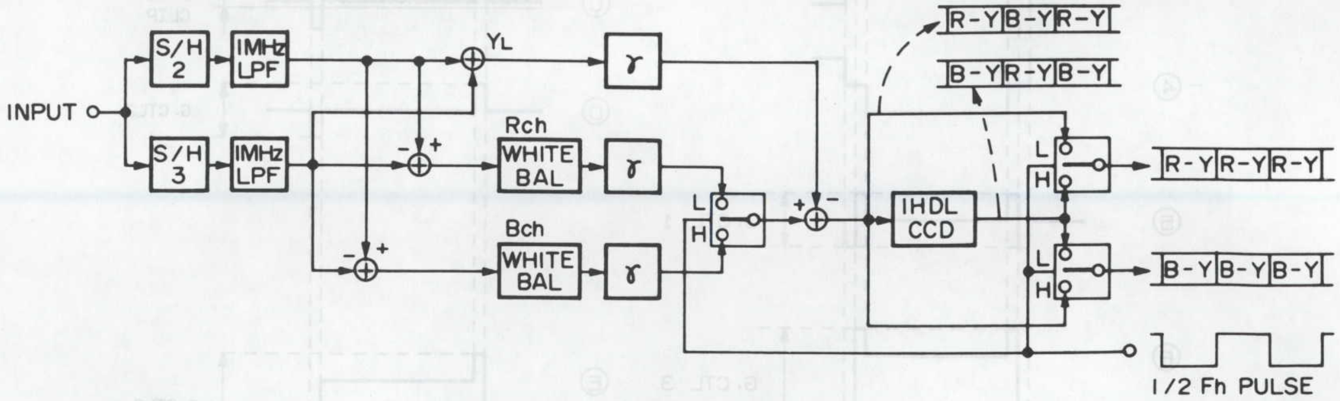


Fig. 2-5-5 Color signal system block

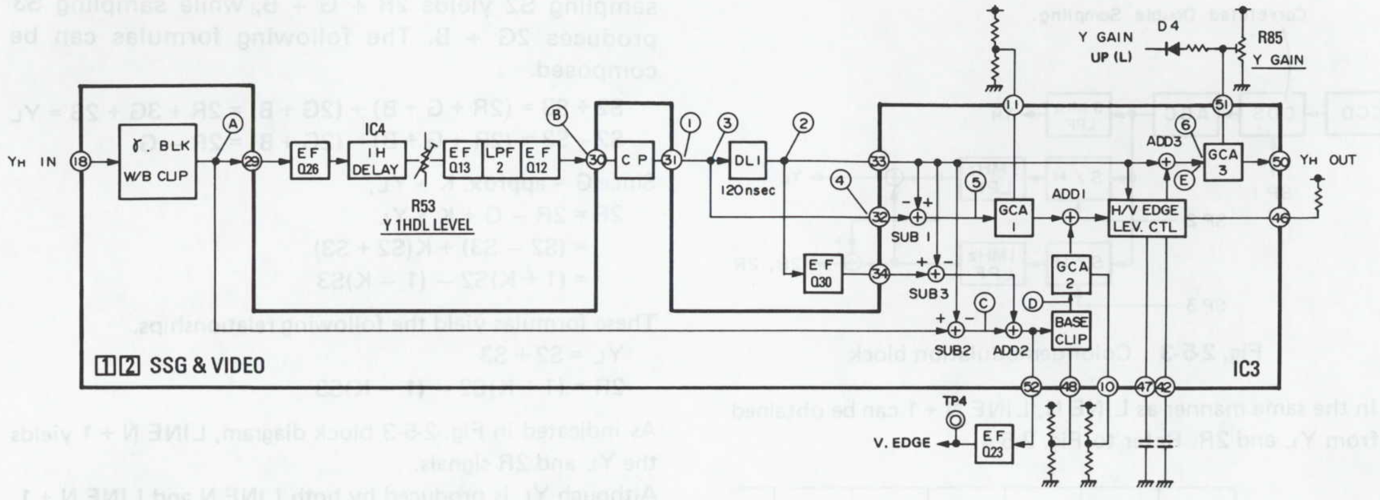


Fig. 2-6-1 Enhancer block

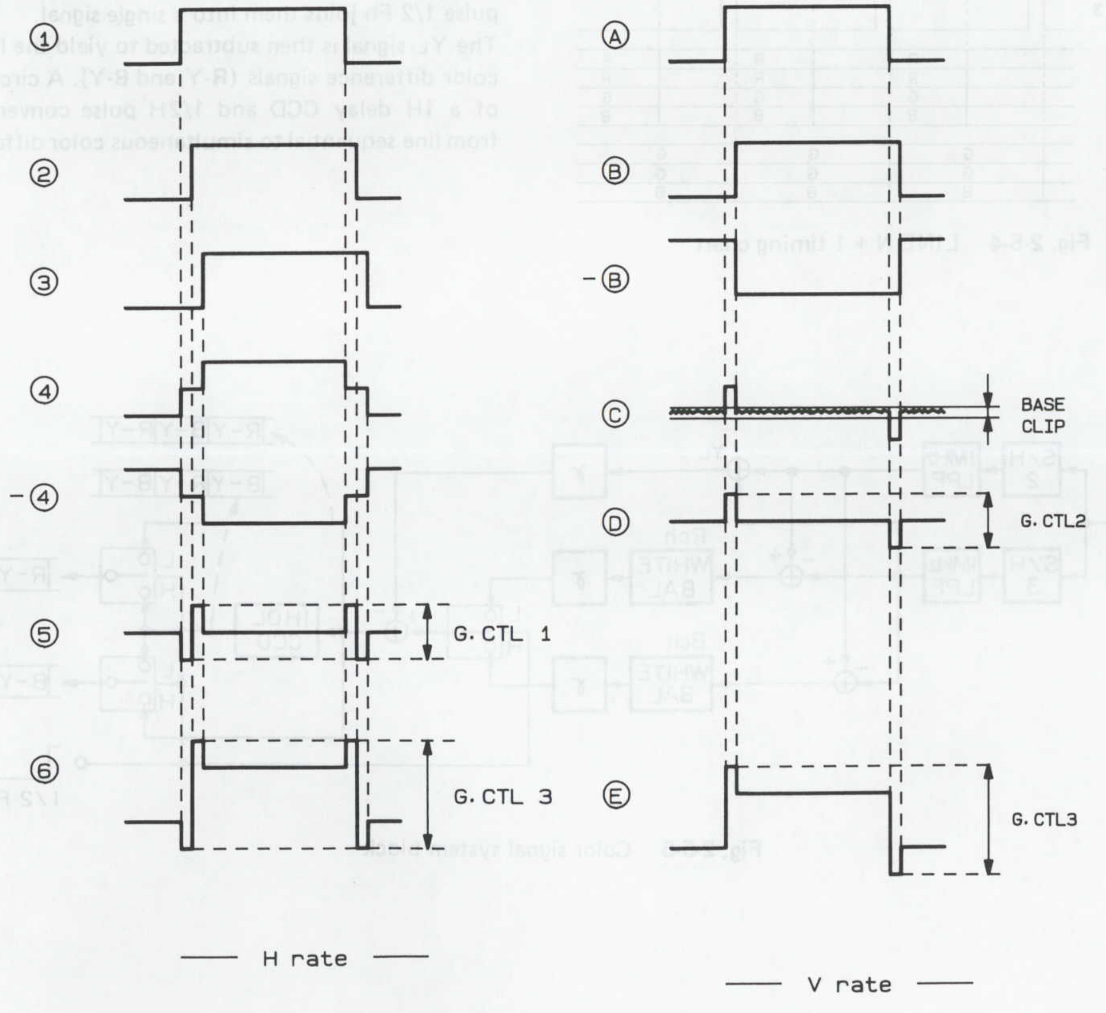


Fig. 2-6-2 Enhancer operation timing

2.6 ENHANCERS

These circuits enhance the picture edges to improve clarity and sharpness. The block diagram is shown in Fig. 2-6-1 and timing in Fig. 2-6-2.

Horizontal enhancer

The Y signal via IC3 pin 31 is supplied to 120 ns delay line DL1. Since DL1 termination impedance is not matched, the delayed signal ② is reflected and delayed 240 ns ③ . This is added to signal ① to produce signal ④ , which goes to IC3 pin 32.
Subtractor SUB1 subtracts signal ④ from signal ② to yield the horizontal edge correction signal ⑤ . This is sent via gain control amplifier GCA1 to adder ADD1, where it is added to the vertical edge correction signal.

Vertical enhancer

Y signal Ⓐ at IC3 pin 29 goes through the 1H delay CCD of IC4, lowpass filter LPF2 and DL1 to result in Y signal Ⓑ , which is delayed 1H + 120 ns. From IC3 pin 33, this is sent in one line as the main signal to ADD3 for adding with the horizontal and vertical edge correction signals.
In another line, the signal is subtracted from Ⓐ at SUB2 to yield signal Ⓒ , which is supplied to ADD2. The result from subtracting the pin 33 from pin 34 (i.e., no signal) is also supplied to ADD2. The ADD2 output thus remains as the SUB2 signal Ⓒ .
Signal Ⓒ goes via the base clip circuit, which clips low level noise, to GCA2.
The vertical edge correction signal is then added to the horizontal edge correction signal at ADD1.

The H/V edge level control circuit functions by detecting the Y signal level. If the Y signal level is low, the edge correction signal is gradually attenuated in order to avoid affecting the S/N. The edge correction signal is added to Y at ADD3. The result is sent via Y gain control amplifier GCA3 to IC3 pin 50.

2.7 COLOR NOISE REDUCTION (CNR)

Correlation is high between vertically adjacent color difference signals. Noise is reduced by sampling and subtracting the noise from the original signal.
A line sequential signal is obtained from the image sensor in which red and blue components alternate every horizontal line. Thus, a 2H delay line is required by the comb filter circuit.
For converting the line sequential signal into simultaneous form, a 1H delay line is used. By passing this further through a 1H delay line, a 2H delay line can be composed.
Fig. 2-9-1 shows a block diagram of the color noise reduction circuit. The signal delayed 2H by passing through two 1H delay lines is subtracted from the original signal, thus yielding the noise component. If this were subtracted directly from the original signal, rainbow noise would occur in the non-correlated portions.
In order to suppress this, the amplitude is limited and the edge component removed. The noise component obtained with the non-correlated signal muted is then subtracted from the original signal.
Although S/N in this circuit improves to the degree of feedback, excess can cause rainbow noise in the non-correlation portions. Therefore feedback is set for about 4 dB noise reduction for this model.

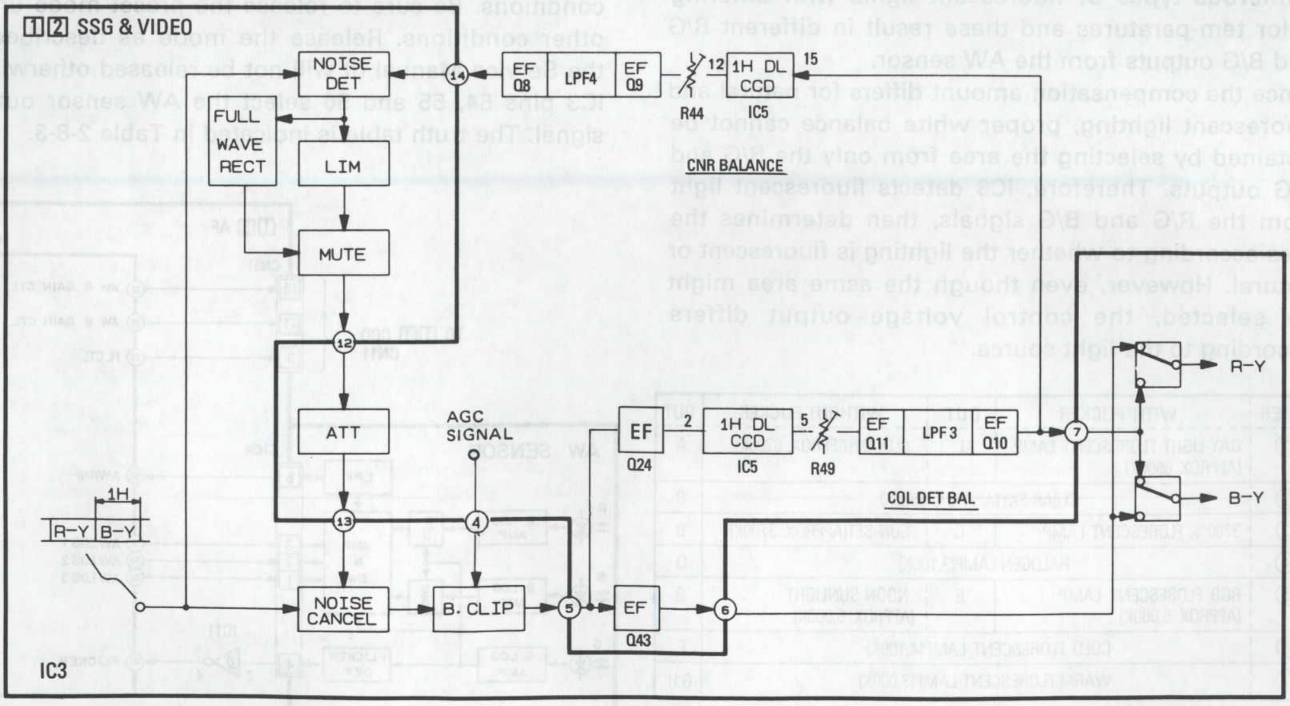


Fig. 2-7-1 Color reduction block

2.8 WHITE BALANCE CIRCUIT

An external RGB light metering system is used for white balance control. The operation is fully automatic and performed through software processing by a CPU.
Refer to Fig. 2-8-1.
Color filters separate the RGB components of the external light, which are then detected by photodiodes. Logarithmic amplifiers compress the photodiode outputs and yield voltages proportional to the amount of light.
The A/W sensors detect R/G and B/G signal from the voltages. A lowpass filter suppresses the variation component and the signals go to AW/INF CPU board IC3 pin 64.
IC3 detects the type of light source from the R/G and B/G signal levels from the auto white sensor and determines the R and G gain control voltage. The two AW signals, plus the master lens position detect signal, are applied to IC3 pin 64. Input signal selection is controlled by pin 50. (Refer to Fig. 2-8-3.)
Refer to Fig. 2-8-2.
The figure illustrates the CPU software processing of the light source distribution on the R/G and B/G axes. The system estimates the light source as indicated in Table 2-8-1.
Conditions 2 and 4 are determined by preset adjustment, while the other conditions are derived from the preset position and actual light measuring data.
The R/G and B/G signals from the auto-white sensor go to IC3. The light source type is determined according to the distribution map and the predetermined R and B gain control voltages art obtained from pons 60 and 62.
As can be noted, area 1 covers two conditions, natural lighting and fluorescent lighting. There are also numerous types of fluorescent lights with differing color tem-peratures and these result in different R/G and B/G outputs from the AW sensor.
Since the compensation amount differs for natural and fluorescent lighting, proper white balance cannot be obtained by selecting the area from only the R/G and B/G outputs. Therefore, IC3 detects fluorescent light from the R/G and B/G signals, then determines the ares according to whether the lighting is fluorescent or natural. However, even though the asme area might be selected, the control voltage output differs according to the light source.

ARER	WITH FLICKER	OUT	WITHOUT FLICKER	OUT
①	DAY-LIGHT FLORESCENT LAMP (APPROX. 6500K)	I	CLOUDY(APPROX. 6200K)	A
②	CLEAR SKY(APPROX. 5500K)			B
③	3700°K FLORESCENT LAMP	C	SUN-SET(APPROX. 3700K)	B
④	HALOGEN LAMP(3,100K)			D
⑤	RGB FLORESCENT LAMP (APPROX. 5,000K)	E	NOON SUNLIGHT (APPROX. 5,000K)	B
⑥	COLD FLORESCENT LAMP(4,100K)			F
⑦	WARM FLORESCENT LAMP(3,000K)			G,H

Table 2-8-1 White balance area

In the case of area 1, the output is A if not fluorescent and 1 if fluorescent. This mode is produced for areas 1, 3 and 5.
If the detected light source is cold fluorescent (7) or warm fluorescent (8), the IC3 pin 53 output goes High. This decreases the R-Y signal level and increases the R-Y signal to improve color reproducibility.
When the light source changes, IC3 detects if the difference light source continues for longer than 2 seconds, then changes the R and B gain control voltages. Since IC3 saturates with rapid color change, the control voltages are varied gradually. The variation speed is about two seconds from area 4 to area 1. The time is shorter when the positions are closer in Fig. 2-8-2.
If the changed light source position is in the block area, the existing R and B gain control voltages are held.
Under special lighting conditions where acceptable white balance cannot be obtained (for example, multiple light sources of different color temperature, where the scene illumination and color temperature detected by the sensor differ), the preset mode can be used for producing usable white balance. The normal white balance does not function in this mode.
The preset mode is entered as follows. Refer to Table 2-8-1. When the preset mode is entered, the R and B gain control voltages are set to A, regardless of the scene. Pressing the button afterwards changes to B, C ... G, H, I.
Area 7 is the preset mode and has two R and B gain control voltage outputs. Only the G output is obtained in the normal mode, while the output is H only in the preset mode.
The preset is used only under special lighting conditions. Be sure to release the preset mode under other conditions. Release the mode as described in the Service Manual (it will not be released otherwise).
IC3 pins 54, 55 and 56 select the AW sensor output signal. The truth table is indicated in Table 2-8-3.

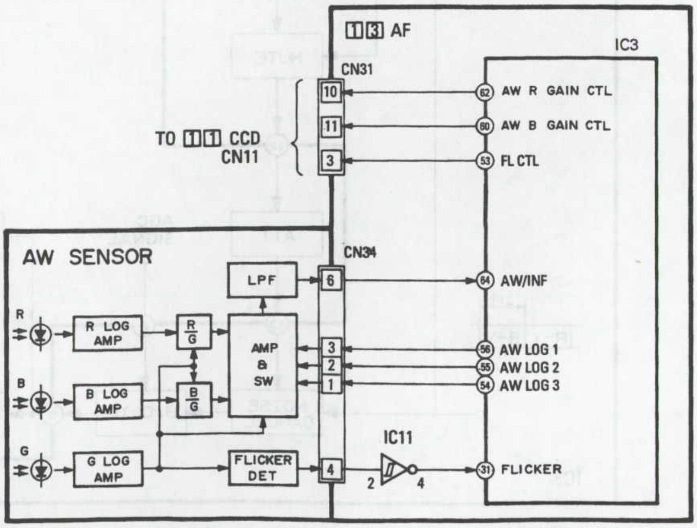


Fig. 2-8-1 White balance circuit

The AW sensor output varies accruing to manufacturing tolerances and adjustment is determined on the production line or service center. Normally, a 3 bit output selects the AW sensor output. The 3 bit output switching is obtained in synchronization with the VD pulse and within one VD pulse.

AW output G is used for detecting low light or fluorescent flicker. The signal G level declines under low light and when the level falls below 10 lax, IC3 enters the halogen mode. This is because the AW sensor output beelines under low light, which increases the significance of tolerance among elements and prevents precise white balance detection.

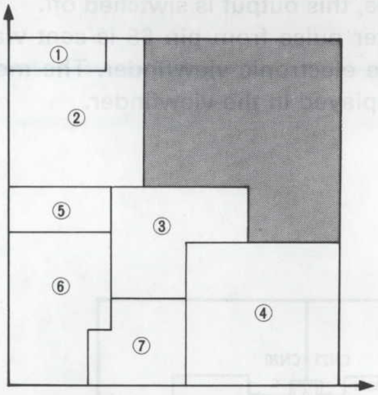


Fig. 2-8-2 Light source distribution for software processing

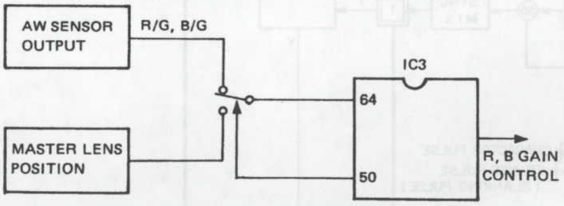


Fig. 2-8-3 Input signal select

Since the white balance circuit uses an external sensor, difference can occur between the color temperature of the actual scene and that detected by the sensor. For example, if the videomovie is used under direct sunlight, but the camera subject is in a shadow, different color temperatures will reach the optical assembly and white balance sensor. Under these conditions, correct white balance is not obtained, resulting in a bluish or yellowish image.

This model detects such conditions and functions to produce correct white balance.

See Fig. 2-8-4.

The circuit is composed of a simple closed loop. The color difference signals (R-Y and B-Y) are integrated and supplied to a comparator. The signals are compared and the result sent to the CPU.

Normally, the same color temperature data reach the optical assembly and sensor, as indicated by 3 and 4 in Table 2-8-2. The comparator output alternates between High and Low, by which the CPU detects normal compensation.

The data differ in the case of condition 1 in the table. Also see Fig. 2-8-5 condition 1. The white balance sensor detects condition 2 on the map, and if correction were only by the sensor output, a bluish picture would result. However, the comparator output goes High. When the CPU detects High potential for more than two seconds, compensation is shifted to condition 1.

The reverse is indicated by condition 2 in the table and figure. In this case, the sensor detects condition 1 and would yield a yellowish image without further compensation. The comparator output goes Low. When the CPU detects Low potential for more than two seconds, compensation is shifted to condition 2. This operation prevents bluish or yellowish image when the color temperature inputs of the optical assembly and white balance sensor differ.

The AW sensor contains a resonance circuit for detecting periodic fluorescent light flicker. This signal is shaped by IC11 and sent to IC3 pins 31. IC3 detects a periodic light source from the pin 31 signal. When this pin drops from High to Low, presence of the pulse at pin 31 is detected. If the correction pulse is present for more than 2 seconds, the command is sent to the SSG to set the electronic shutter speed for 1/60 second. Afterwards, if the correction pulse ceases, the shutter speed is returned to 1/50 second.

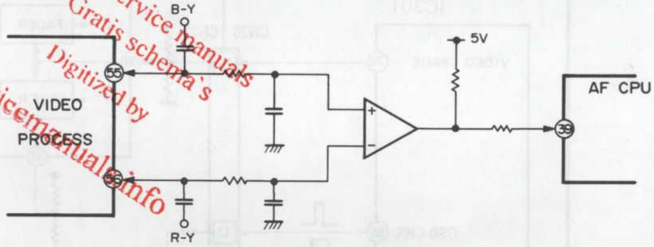


Fig. 2-8-4 Closed loop block

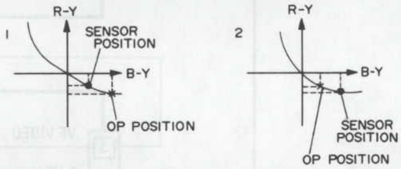


Fig. 2-8-5 Color temperature position

	OP INPUT	SENSOR INPUT	MONITOR	COMP OUT	CPU OUT
1	SHADOW	SUNLIGHT	BLUE	H	CLOUDY
2	SUNLIGHT	SHADOW	YELLOW	L	CLEAR SKY
3	SHADOW	SHADOW	OK	–	CLOUDY
4	SUNLIGHT	SUNLIGHT	OK	–	CLEAR SKY

Table 2-8-2 White balance correction circuit output signal

IC1 PIN No.			AW sensor	AW sensor
56	55	54	Output gain	Output signal
H	H	H	R/G GAIN UP	R/G signal
H	H	L	R/G GAIN STD	
H	L	L	R/G GAIN DOWN	
L	H	H	B/G GAIN UP	B/G signal
L	H	L	B/G GAIN STD	
L	L	L	B/G GAIN DOWN	
H	L	H	G GAIN STD	G signal

Table 2-8-3 Selection of AW sensor output signal

2.9 FADER AND ON-SCREEN DISPLAY

Refer to Fig. 2-9-1.

VTR board IC301 controls the fader and on-screen display. When selected by the user, the fader operates at recording start/stop. The picture is also at full fade in the stop, FF and REW modes. The video fade control signal are analog outputs from IC301 pins 78. These outputs are normally Low and decline to High as full fade is reached. The video fade signal goes to IC3 pin 38 for fading Y and C signals. The Y signal full fade level is determined by the potential at IC3 pin 37. The potential at this pin provides the black fader function. In the color signal line, full fade is at AC 0 V.

The on-screen display outputs from VTR board IC301 pins 66 and 65 are for the recording and video outputs. The normal character output pulse is for date, time and age. In the OSD mode, the pulse for electronic viewfinder display is added.

The character pulse from pin 66 is mixed with the fringe pulse from pin 65 at the video board, then supplied to video board IC3 pin 39. Prior to mixing the character pulse and Y signal, the fringe pulse blanks the Y and color signals, producing black fringes around the displayed characters.

Another OSD output from DECK board IC301 pin 68 is used for the electronic viewfinder display. Normally, this character pulse is counter and other information without date, time and age. In the OSD mode, since the pin 66 signal already includes the viewfinder display pulse, this output is siwtched off.

The character pulse from pin 68 is sent via the DECK board to the electronic viewfinder. The movie modes are then displayed in the viewfinder.

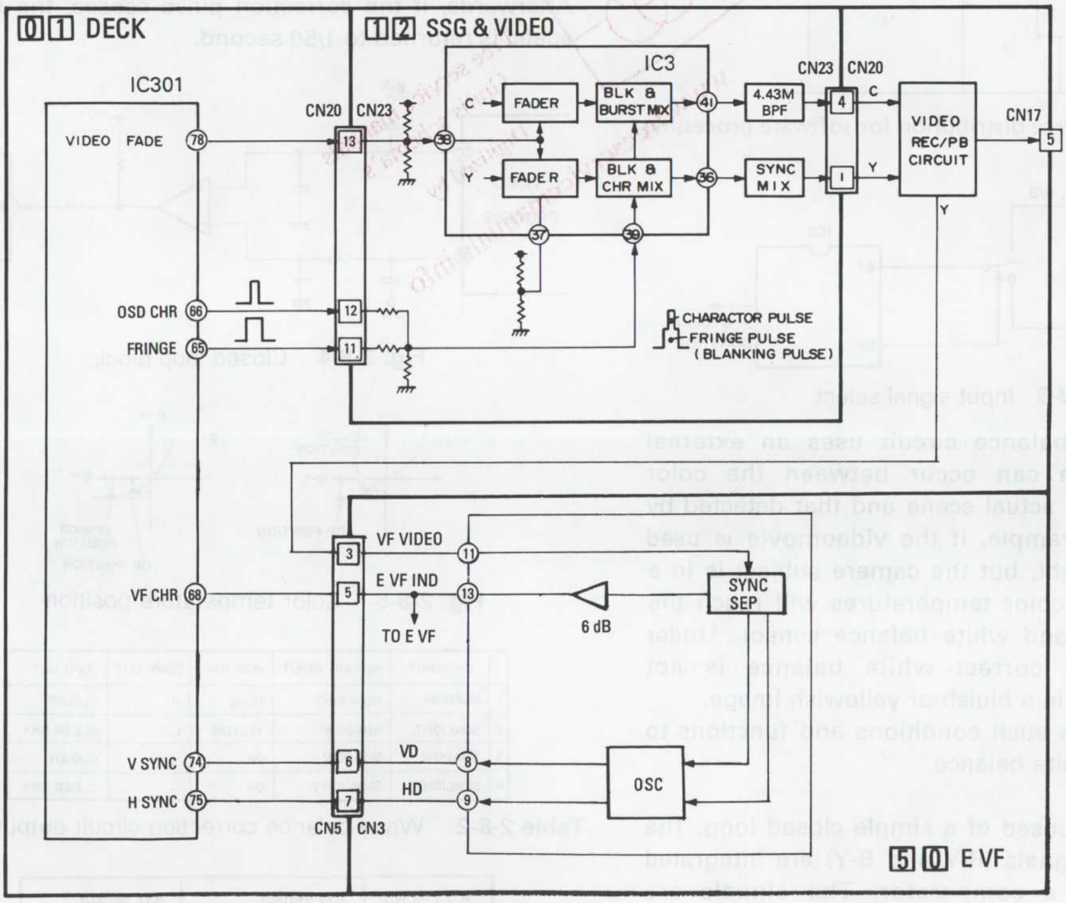


Fig. 2-9-1 Fader & OSD circuit

2.10 AF CPU PIN FUNCTION (IC3)

PIN NO.	SYMBOL	LABEL	IN/OUT	NOTE
1	ADC2	ZOOM	IN	ZOOM LENS POSITION DETECT
2	ADC1	HE	IN	IRIS SIZE DETECT
3	ADC0	AFS	IN	CONTRAST DETECT
4	VREF	REF1V	OUT	REFERENCE VOLTAGE(1V) FOR ZOOM LENS POSITION DETECT
5	S/H2	—	—	S/H CAPACITOR FOR A/D CONVERTER
6	AVSS	AVSS	—	GND
7	P67	ZOOM SP	OUT	ZOOM MOTOR ROTATION SPEED CONTROL(SPEED UP WHEN AUTO MACHRO)
8	P66	WIDE	OUT	ZOOM MOTOR DRIVE CONTROL TO IC5-7PIN
9	P65	TELE	OUT	ZOOM MOTOR DRIVE CONTROL TO IC5-8PIN
10	P64	PS	OUT	POWER SAVE CONTROL WHEN MOTOR STOP (NORMAL:L)
11	P63	FAR	OUT	AF MOTOR DRIVE TO IC2-2PIN
12	P62	NEAR	OUT	AF MOTOR DRIVE TO IC2-3PIN
13	P61	V AREA	OUT	V BLANKING PULSE OUTPUT FOR AF DETECT
14	P60	CS READY	OUT	CLOCK OUTPUT PERMISSION
15	EXI	EXI	—	GND
16	P57	JIG DATA	OUT	NORMAL:NC, NOT USED (FOR JIG UNIT)
17	P56	JIG CLK	OUT	NORMAL:NC, NOT USED (FOR JIG UNIT)
18	P55	AFS DAT	OUT	AF PROCESSOR CH SELECT & GAIN CONTROL(13BIT SERIAL DATA)
19	P54	AFS CLK	OUT	SERIAL DATA TRANSFER CLOCK
20	P53	JIG ENA	OUT	NORMAL:5V (FOR JIG UNIT)
21	P52	EEP ROM DI	OUT	EEP ROM IC WRITE DATA OUTPUT TO IC8-3PIN
22	P51	EEP ROM SK	OUT	DATA TRANSFER CLOCK TO IC8-2PIN
23	P50	EEP ROM CS	OUT	CLOCK OUTPUT PERMISSION (CHIP SELECT)
24	RST	RESET	IN	POWER ON RESET:L
25	OSC1	OSC 1	IN	MAIN SYSTEM CLOCK
26	OSC2	OSC 2	OUT	(8MHz)
27	VSS	VSS	—	VSS
28	P23	—	—	NC
29	P27	HD	IN	MAIN REFERENCE PULSE
30	P26	—	—	NC
31	P25	FLICKER	IN	FLICKER DETECT (AUTO SHUTTER SPEED SELECT)
32	P24	VD	IN	REFERENCE PULSE FOR V AREA DETECT
33	P22	H AREA	OUT	H BLANKING PULSE OUTPUT FOR AF DETECT
34	P21	—	—	NC
35	P20	HD	IN	REFERENCE PULSE FOR H AREA DETECT
36	P07	SERIAL CLOCK	OUT	SERIAL DATA TRANSFER CLOCK
37	P06	SERIAL DT I	IN	SERIAL DATA IN
38	P05	SERIAL DT O	OUT	SERIAL DATA OUT
39	P01	AW CTL	IN	AUTO WHITE DETECT CORRECTION
40	P00	—	—	NC
41	P47	FOCUS(−)	IN	SW CONDITION DETECT (SW ON:L)
42	P46	FOCUS(+)	IN	SW CONDITION DETECT (SW ON:L)
43	P45	WIDE SW	IN	SW CONDITION DETECT (SW ON:L)
44	P44	TELE SW	IN	SW CONDITION DETECT (SW ON:L)
45	P43	AF JIG MODE	IN	NORMAL:5V, NOT USED (FOR JIG MODE SELEST:L)
46	P42	AW JIG MODE	IN	NORMAL:5V, NOT USED (FOR JIG MODE SELECT:L)
47	P41	GAIN UP SW	IN	SW CONDITION DETECT (SW ON:L)
48	P40	EEP ROM DO	OUT	EEP ROM IC READ DATA INPUT FROM IC8-4PIN
49	P77	LED	OUT	LOW WHEN MASTER LENS ∞ (INFINITY) POSITION CHECK
50	P76	AW/INF SW	OUT	INPUT SIGNAL SELECT (AW DATA:L OR INF DATA:H)
51	P75	—	—	NC
52	P74	Y GAIN CTL	OUT	Y GAIN UP WHEN LOW LIGHT AND GAIN UP MODE
53	P73	FL CTL	OUT	B-Y LEVEL CORRECTION WHEN FL MODE
54	P72	AW LOG.3	OUT	WHITE BALANCE SENSOR OUTPUT SELECT
55	P71	AW LOG.2	OUT	WHITE BALANCE SENSOR OUTPUT SELECT
56	P70	AW LOG.1	OUT	WHITE BALANCE SENSOR OUTPUT SELECT
57	VDD	VDD	—	GND
58	AVDD	AVDD	—	GND
59	VREF	REV 4V	IN	REFERENCE VOLTAGE FOR SYSTEM POWER
60	DAC1	B OUT	OUT	BLUE LEVEL CONTROL FOR WB CORRECTION
61	S/H1	—	—	S/H CAPACITOR FOR A/D CONVERTER
62	DAC0	R OUT	OUT	RED LEVEL CONTROL FOR WB CORRECTION
63	S/H0	—	—	S/H CAPACITOR FOR A/D CONVERTER
64	ADC3	AW/INF	IN	AW DETECT DATA INPUT OR MASTER LENS PISITION DETECT INPUT

Table 2-10-1 CPU pin function

2.11 FULL RANGE AUTO FOCUS

The auto focus system operates by adjusting the master lens, and sometimes zoom lens, position for maximum image contrast at the CCD image sensor. A major feature of this system is the auto macro, which detects the subject position and zoom lens setting to perform automatic focusing.

1. Focus signal flow

Refer to Fig. to Fig. 2-11-1.

The Y signal obtained through the lens, CCD image sensor and video processor is supplied to a bandpass filter. This removes the DC component and sends the AC component, which indicates the video signal contrast, to the window circuit.

The window circuit blanks the region outside the AF detect area. The AF detect area signal is sent to a peak hold circuit. This holds the peak value of the AF detect area contrast signal, which is supplied as a DC voltage to the controller CPU.

The controller adjusts the master lens, and on occasion the zoom lens, for maximum DC voltage from the peak hold circuit, thereby adjusting the focus.

2. Contrast detect and focusing

See Fig. 2-11-2.

The figure illustrates the relation between the master lens position (X axis) and peak hold circuit voltage (Y axis) with the subject at a given distance.

The maximum voltage is at master lens position F, which is the precise focus point. Therefore, if the master lens is at position B, it is shifted in order to obtain maximum voltage, namely to point F.

If the master lens is moved from point B to point A, since peak hold voltage Ea is less than Eb, the master lens movement changes to direction C.

Conversely, if the master lens is moved from B to C, since voltage Ec is larger than Eb, the movement proceeds in the same direction toward point D. In this manner, the master lens position is adjusted for maximum voltage.

If the lens is moved still further, the peak hold voltage again declines and the master lens movement reverses to obtain the maximum value.

During this period, the controller monitors the iris opening to determine the depth of field. The precise focus point within the depth of field is repeatedly checked and the master lens position is adjusted within this range without changing the focus.

Finally the precise focus is determined and the master lens is adjusted midway between points F and F'.

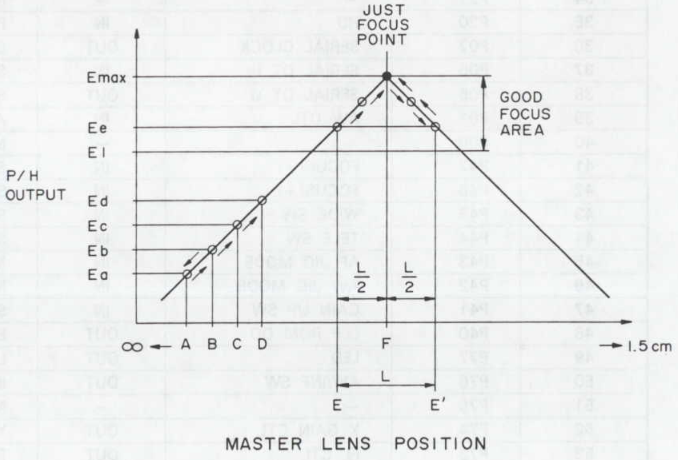
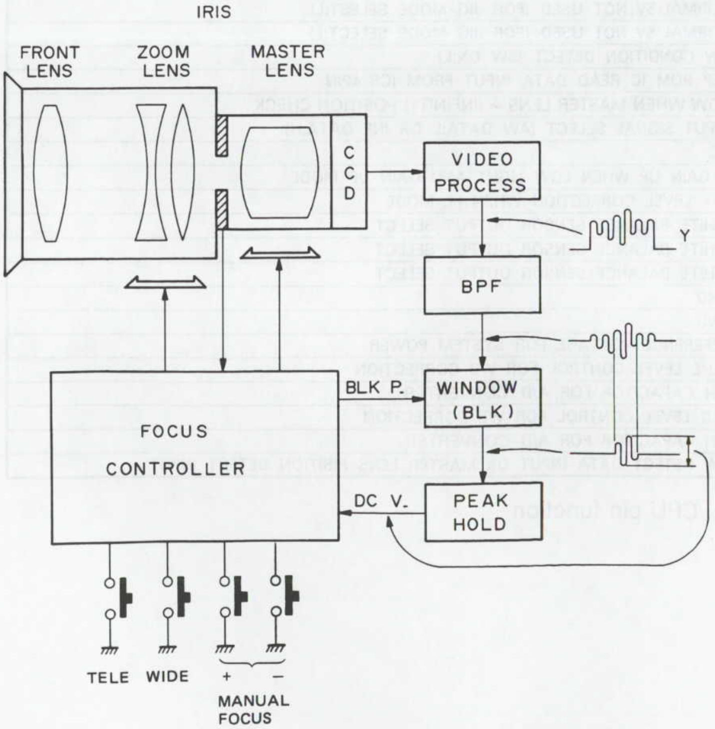


Fig. 2-11-2 Correlation between master lens position & P/H output



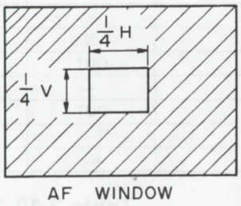


Fig. 2-11-1 Full range AF system block

3. Zoom correction

Focus is adjusted by a master lens positioned at the final stage of the zoom lens in consideration of picture angle changes and use of a conversion lens. But since the master lens position is not specific with respect to the subject distance, to include zoom lens tracking within the optical block would require complex construction. Therefore, the controller is provided with zoom curve data for adjusting the tracking.

Fig. 2-11-3 shows the zoom curve with the master lens position as the horizontal axis and the zoom lens position as the vertical axis. The master lens is driven by a pulse motor. The position can be derived from the pulse count at infinity (maximum 80).

The zoom lens is also provided with an encoder. This DC voltage output goes to an 8 bit A/D converter to produce the setting data.

The system is thus capable of storing zoom curve data consisting of 80 power horizontal and 8 bits power vertical.

As an example, assume a subject is picked up at the maximum telephoto position and the master lens is set to position A for maximum contrast.

The controller can compute the subject distance from the zoom and master lens positions, and thus determine the position of point A on the zoom curve.

When the Wide button is then pressed, the controller does not proceed with contrast detection, but instead sets the master lens according to the zoom curve determined from point A. This adjusts the zoom tracking.

Assume then the Wide button is operated for the extreme wide position at point B. Again contrast detection starts, but in this example the distance to subject does not change from point A and this becomes point B.

By again pressing the Tele button, one would assume the same zoom curve would be followed to point A. But as numerous curves are concentrated at the extreme wide position, selecting the proper one is virtually impossible.

Therefore, both contrast detection and zoom curve computation are used during the operation from wide to telephoto. This leads to some deviation during the shift from point B to point A, as indicated in the figure. However, during this period, the iris opening is monitored and contrast within the depth of field is detected. Consequently, there will not be a large deviation in the subject focus.

If focus deviations are noticed in the operation from wide to telephoto, adjust to lock the focus at the extreme telephoto position. Afterwards, the shift will follow the zoom curve.

Zoom tracking compensation does not apply to the macro range indicated by the broken line. Contrast is detected while moving the lens.

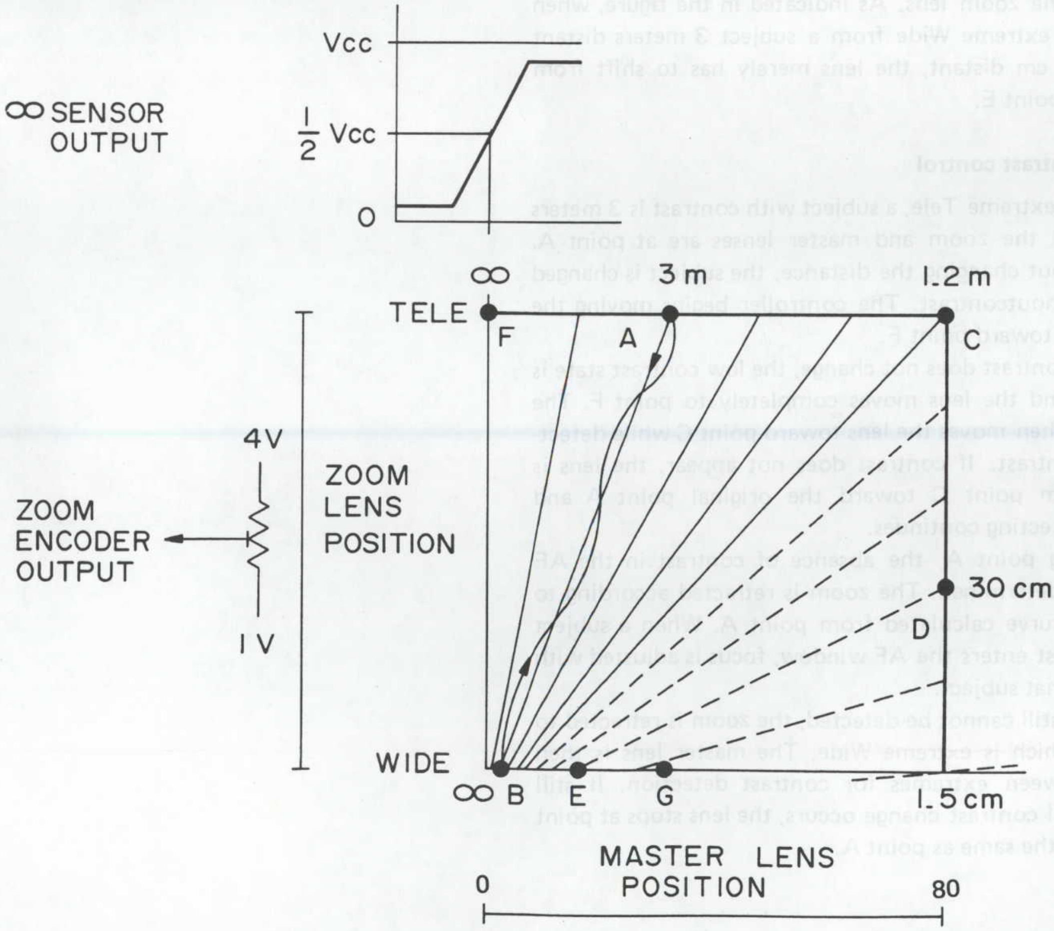


Fig. 2-11-3 Zoom tracking

4. Auto macro

Assume a subject 3 meters distant is picked up at extreme telephoto, and zoom and master lens positions are at point A. Then the camera is panned to a subject 30 cm distant.

In the full AF system, when the subject contrast declines within an area exceeding the depth of field range (F1 in Fig. 2-11-2), the master lens is first moved to obatin maximum contrast. Thus, the lens shifts from point A toward point C. Although the contrast increases as the 30 cm focal distance is approached, point C exceeds the shifting range of the master lens. Control is therefore switched to the zoom lens (auto macro).

The controller then detects the contrast while moving the zoom lens. The lens position shifts from point C to point D, where maximum contrast is obtained.

In this example, the master lens is first moved, then the zoom lens. But if the zoom lens is at extreme wide, the master lens is capable of adjusting the focus from 1.5 cm to infinity, thus shortening the time needed for adjustment.

The speed of movement differs between the master and zoom lens. The master lens uses a pulse motor, while contrast is detected at 1 V intervals. The maximum drive speed is 60 pulses per second. As the master lens shifting range is 80 pulses, a minimum of 1.3 seconds is required to shift from one extreme to the other. The zoom lens takes about 5 seconds to shift between Tele and Wide extremes.

It thus requires less time to adjust the focus with the master lens than the zoom lens. As indicated in the figure, when panning at extreme Wide from a subject 3 meters distant to one 30 cm distant, the lens merely has to shift from point B to point E.

5. Low contrast control

Assume at extreme Tele, a subject with contrast is 3 meters distant and the zoom and master lenses are at point A. Then without changing the distance, the subject is changed to one withoutcontrast. The controller begins moving the master lens toward point F.

Since the contrast does not change, the low contrast state is indicated and the lens moves completely to point F. The controller then moves the lens toward point C while detecting the contrast. If contrast does not appear, the lens is moved from point C toward the original point A and contrast detecting continues.

At reaching point A, the absence of contrast in the AF window is determined. The zoom is retracted according to the zoom curve calculated from point A. When a subject with contrast enters the AF window, focus is adjusted with respect to that subject.

If contrast still cannot be detected, the zoom is retracted to point B, which is extreme Wide. The master lens is then moved between extremes for contrast detection. If still absent, until contrast change occurs, the lens stops at point G, which is the same as point A.

6. AF motor drive

Fig. 2-11-4 indicates the AF motor drive timing. The 3 output bits from the controller are PS (power save), Far and Near. These are normally High.

To move the master lens in the Far direction, PS goes Low, then Far goes Low for the appropriate pulse count. Afterwards, both return to High. This operation is the same in the Near direction.

PS is High while the AF motor is stopped. This reduces power consumption by cutting off the AF motor coil current.

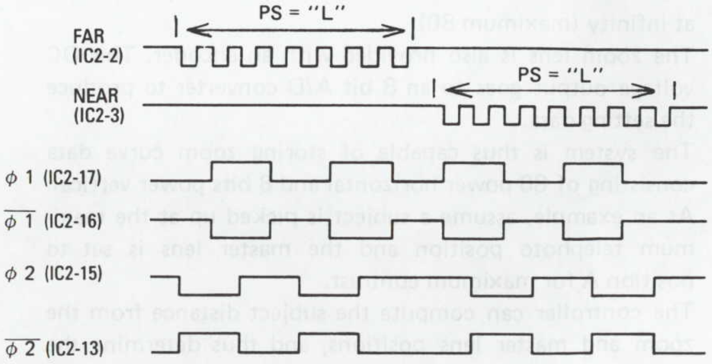


Fig. 2-11-4 AF motor drive timing

7. 8X zoom lens

Zoom compensation is a main feature of the full range auto focus. This compensation amount increases when an 8X Zoom lens is used.

Withe a 6X zoom, compensation is zero at infinity and increases as the distance shortens according to the compensation (zoom) curve. If the same curve were used for 8X, several times the maximum compensation whould be needed, resulting in inadequate compensation for close ups at telephoto range.

As indicated in Fig. 2-11-5, white an 8X zoom, nearly every compensation is applied from infinity to close up, centered on 2.4 meters. The lens is designed to reduce the maximum compensation.

When using an 8X zoom, the master lens pulse motor count goes to 120. However, the drive speed remains at 60 pulses per second.

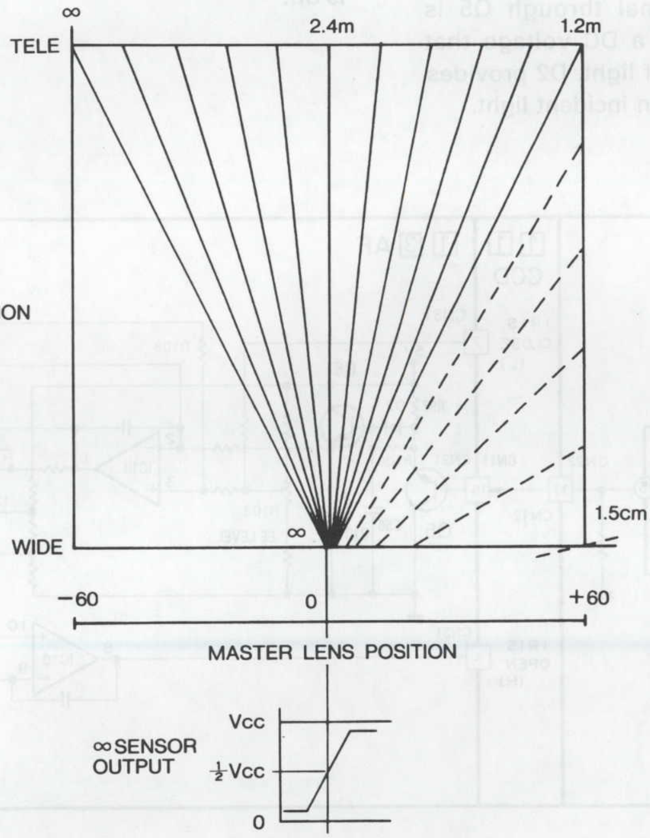


Fig. 2-11-5 Zoom correction of 8X zoom lens

2.12 IRIS CONTROL CIRCUIT

This circuit automatically adjusts the lens iris for suitable exposure. Refer to Fig. 2-12-1.

The video signal from the CCD image sensor is supplied to the sample and hold circuit at SSG & VIDEO board IC2 pin 27. The signal is then sent in one line as the main signal to the AGC amplifier. In another line, the signal goes as the iris control signal via the gamma correction amplifier to the iris sensitivity setting circuit.

The sensitivity setting pulse is supplied via IC1 pins 31 and 33. As indicated in Fig. , the three sensitivity steps are low, mid and high. At the low sensitivity range, most of the video signal at the top of the picture is cut. This is used mainly for backlighted scenes, where strong lighting at the top can produce the effect of overall picture darkening.

The mid range suppresses the video signal voltage at the perimeter of the scene, while the high setting provides maximum emphasis on the video signal level.

The video signal from IC2 pin 15 is sent via the CCD board to the AF board. The signal through Q5 is integrated by R100 and C56 into a DC voltage that varies in response to the amount of light. D2 provides fast iris response to rapid increase in incident light.

The DC voltage through Q6 controls the IC10 iris driver. For example, increased light increases the video signal level and the DC voltage rises. The voltage at IC10 pin 1 declines and current flows in the iris drive coil in the direction from CN37 pin 4 to pin 2. This closes the iris and reduces the incident light.

The damper coil of the iris driver produces a current in response to the iris operating speed. This becomes a voltage through R108 and goes to IC10 pin 3. For example, when the iris is opening, a negative voltage appears at pin 3 and retards the operation. The damper coil thus serves to stabilize the iris function.

When the video signal declines to where the iris is fully open, IC10 pin 8 goes high and the AGC circuit operates. The iris close signal at CN31 pin 7 goes low in the stop, fast forward and rewind modes to close the iris. This avoids bright incident light during these modes from affecting the white fade function.

A spring continuously applies force in the iris close direction. This closes the iris when the camera power is off.

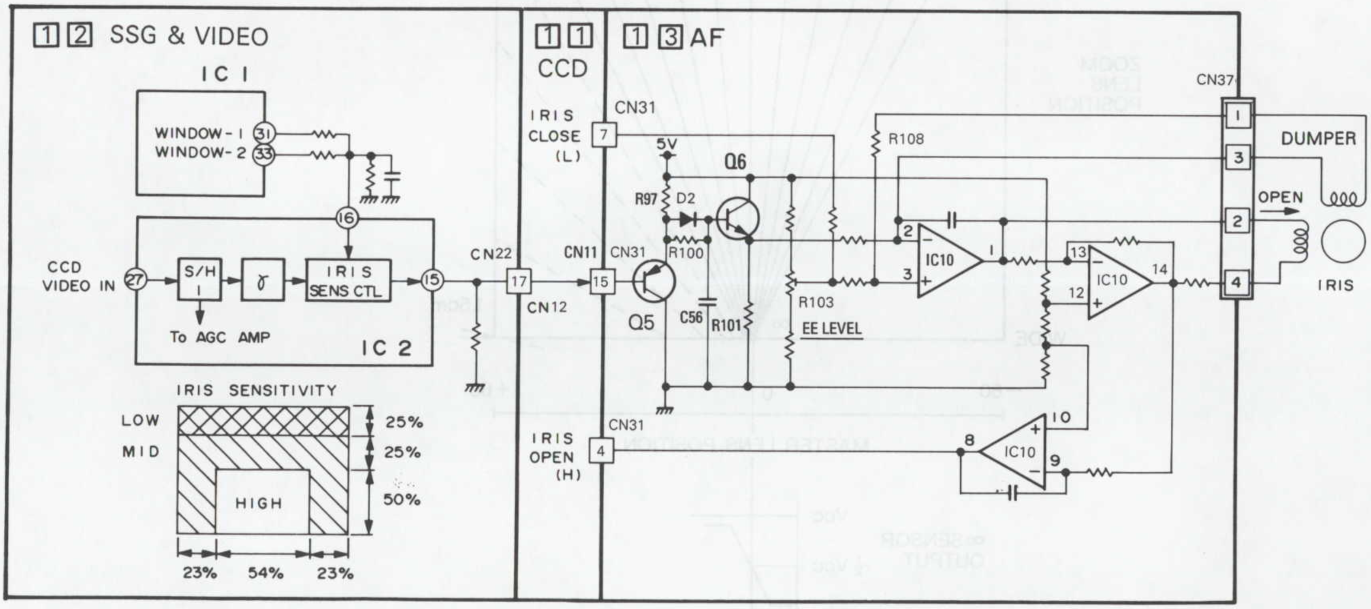


Fig. 2-12-1 Iris control circuit

2.13 GAIN ENHANCE FUNCTION

2.13.1 Outline

In previous video cameras, the iris and AGC circuits functioned to maintain a constant level with respect to changes in the light source brightness. However, under low light conditions, signal amplification by the AGC circuit tended to reduce S/N.

Recent attention has been directed toward improved videomovie performance at low light levels. Therefore, this model includes a gain enhancer for improved picture quality under low light conditions.

2.13.2 Circuit description

The illumination range for most models in the videomovie series is minimum to 100,000 lux. The minimum value varies among models, but is generally limited to around 5 to 7 lux.

As indicated in Fig. 2-13-1, the gain enhance function covers the area beyond the AGC circuit compensating range to amplify the Y signal. This circuit operates as follows.

a. Above 100 lux, the auto iris circuit controls the incident light to maintain a 100% output level.

b. In the range from 20 to 100 lux, the iris is fully open. Since the iris circuit is ineffective, the function is assumed by the AGC circuit. Although the AGC can compensate down to about 5 to 7 lux, the output level declines to about 50%. By setting the Gain Up switch to on, the Y level gain is increased to provide 100% output level compensation in the 10 – 20 lux range.

Consequently, performance is enhanced during operation at low illumination.

However, the gain enhance function is only effective with the iris fully open.

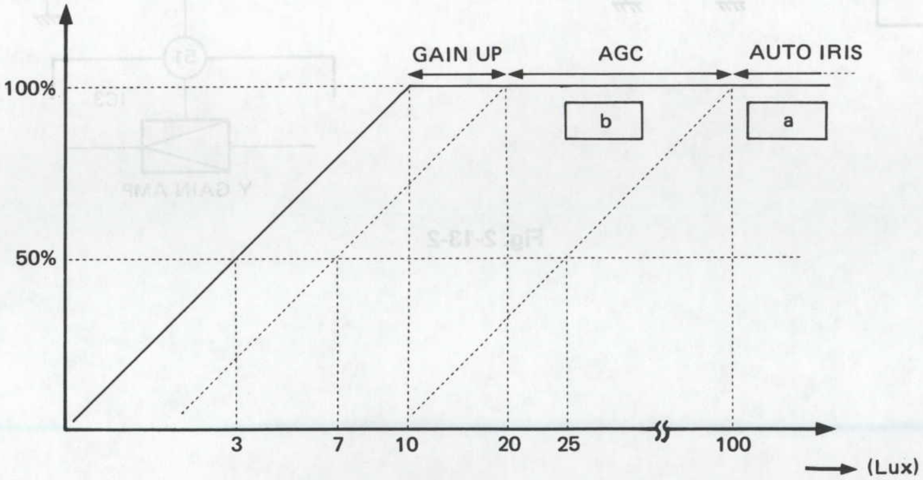


Fig. 2-13-1

2.13.3 Operation

Refer to Fig. 2-13-2.
When the Gain Up button is pressed, the AF CPU sends serial data to the syscon CPU and Gain Up is indicated in the viewfinder. High output from the AF CPU pin 52 switches on IC9.
The AGC response output appears at IC2 pin 6. This varies from about 2.8 V at AGC on to about 0.8 V at AGC maximum. The voltage goes to IC3 pin 51, decreasing the potential and raising the main signal gain.

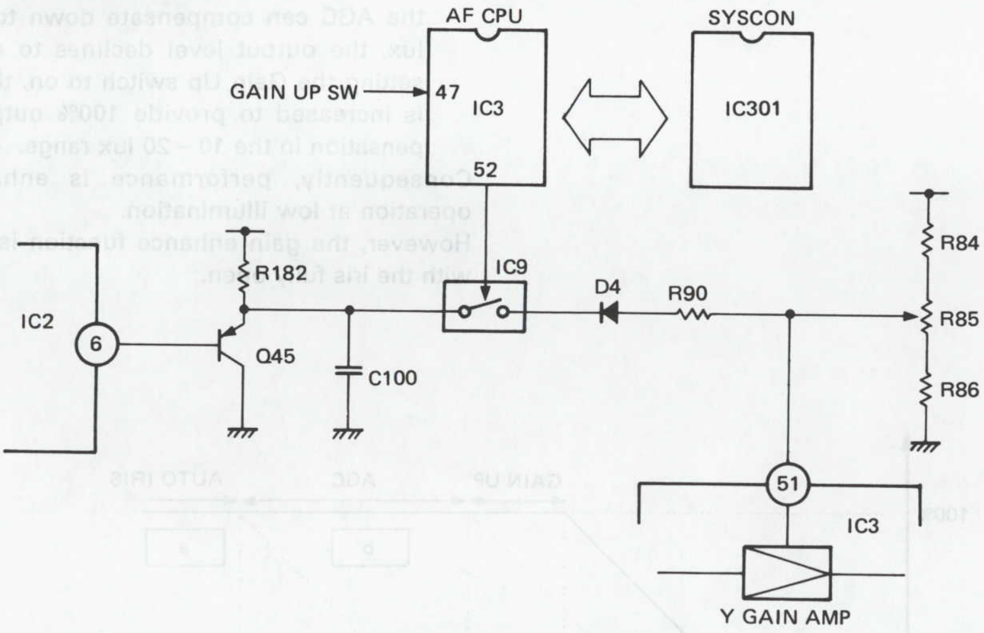


Fig. 2-13-2

SECTION 3
DECK SECTION CIRCUIT DESCRIPTION

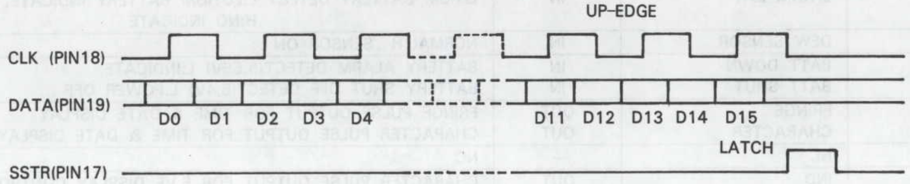
3.1 MECHANISM CONTROL (MECHACON) CIRCUIT

3.1.1 MECHACON CPU

PIN NO.	SYMBOL	LABEL	IN/OUT	NOTE
1	P67/AN3	END SENSOR	IN	TAPE END:L FOR TAPE END POSITION DETECT
2	P66/AN2	KEY SW-A	IN	SW CONDITION DETECT (STOP, REW, FF, PLAY, STILL, EDIT, TR(+))
3	P65/AN1	KEY SW-C	IN	SW CONDITION DETECT (FUUL AUTO, DISPLAY ON/OFF, SHUTTER, FADER, AGE ON/OFF, GAINUP)
4	P64/AN0	KEY SW-B	IN	SW CONDITION DETECT (DP MODE, DP SET, C.RST, C.MEMO, TR(−))

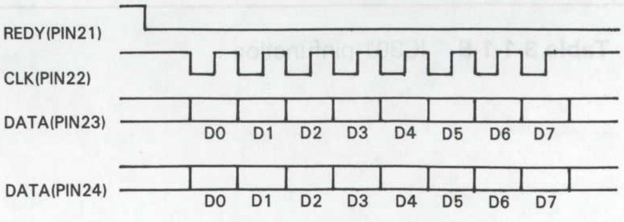
SW-A	SW-B	SW-C	DC OUT
STOP	TRIG	FULL AUTO	0V
REW	–	DISPLAY ON/OFF	0.53V
FF	DISPLAY MODE	SHUTTER	1.27V
PLAY	DISPLAY SELECT	FADER	1.89V
PAUSE	COUNTER RESET	AGE ON/OFF	2.5V
EDIT	COUNTER MEMORY		3.13V
TRACKING+	TRACKING−		3.71V

PIN NO.	SYMBOL	LABEL	IN/OUT	NOTE
5	P63/INT3	SUPPLY REEL FG	IN	REEL ROTATION DETECT, TAPE REMAIN DETECT, TAPE START POSITION DETECT
6	P62/INT2	PB CTL PULSE	IN	EDITING TIMING CONTROL, SP/EP MODE DETECT
7	P61/INT1	DRUM FF	IN	DRUM ROTATE DETECT, REC START TIMING AND END LED ON TIMING CONTROL
8	P60/INT0	BATTERY	IN	SELECT THE BATTERY OR AC ADPTOR
9	P57	C PWR CTL	OUT	CAMERA POWER CONTROL(POWER ON:H)
10	P56	D PWR CTL	OUT	DECK POWER CONTROL(POWER ON:H)
11	P55	FULL AUTO	OUT	LED CONTROL(FULL AUTO LED ON:L)
12	P54	END LED	OUT	END LED CONTROL FOR TAPE END DETECT(PULSE DRIVE FOR DRUM FF)
13	P53	VIDEO REC	OUT	VIDEO REC:L (FOR FLYING ERASE HEAD CTL, A/C HEAD CTL, Y/C CTL)
14	P52/TOUT	VIDEO EE	OUT	VIDEO EE:L(FOR Y/C CTL)
15	P51/CNTR1	CAP FG	IN	FOR TAPE REMAIN AND SP/LP MODE DETECT
16	P50/CNTR0	POWER SW	IN	POWER SW ON:H AND REMOCON DATA INPUT RISEING EDGE IS INTERRUPT MODE(POWER ON) CASSETTE SW ON→COVER SW(CAMERA)→REC ROCK→POWER OFF CASSETTE SW ON→COVER SW(PLAY)→POWER OFF
17	P47/SRDY2	SSSTRY	OUT	CLOCK OUTPUT PERMISSION
18	P46/SCLK2	SSSCLK	OUT	DATA TRANSFER CLOCK OUTPUT
19	P45/SOUT2	SSDATA	OUT	SERIAL DATA OUTPUT FOR SERVO CONTROL



- TRACKING DATA
- SERVO OPERATION MODE

PIN NO.	SYMBOL	LABEL	IN/OUT	NOTE
20	P44/SIN2	SW SCAN	OUT	INPUT DATA SELECT(L:MECHANISM MODE/H:SW CONDITION) L:CAM SW-A, CAM SW-B, REC SAEFTY SW H:COVER SW, TAPE SW, SP/LP SW POWER OFF →REC SAFETY SW ON→COVER SW DET
21	P43/SRDY1	CS REDY	IN	CLOCK OUTPUT PERMISSION
22	P42/SCLK1	CS SCLK	OUT	DATA TRANSFER CLOCK OUTPUT
23	P41/SOUT1	CS DATAO	OUT	SERIAL DATA OUTPUT
24	P40/SIN1	CS DATAI	IN	SERIAL DATA INPUT



UP(AF CPU →MECHACON)
- LOW CONTRAST INDICATE
- AF OFF INDICATE
- FLICKER
- GAIN UP MODE

DOWN(MECHACON →AF CPU)
- AF ON MODE
- ZOOM SW (WIDE/TELE)
- SHUTTER MODE
- FADER MODE

PIN NO.	SYMBOL	LABEL	IN/OUT	NOTE
25	XCIN	XCLK IN	IN	FOR TIMER CLOCK GENERATER
26	XCOUT	XCLK OUT	OUT	(32.768kHz)

Table 3-1-1-A IC301 pin function

<table>
<tr><th>PIN NO.</th><th>SYMBOL</th><th>LABEL</th><th>IN/OUT</th><th>NOTE</th></tr>
<tr><td>27</td><td>CNVSS</td><td>CNT VSS</td><td>–</td><td>GND</td></tr>
<tr><td>28</td><td>ϕ</td><td>PH</td><td>–</td><td>NC</td></tr>
<tr><td>29</td><td>RESET</td><td>RESET</td><td>IN</td><td>POWER ON RESET</td></tr>
<tr><td>30</td><td>XIN</td><td>XIN</td><td>IN</td><td>MAIN SYSTEM CLOCK (4MHz)</td></tr>
<tr><td>31</td><td>XOUT</td><td>XOUT</td><td>OUT</td><td>AND SERVO REFERENCE CLOCK OUTPUT TO IC101–13PIN</td></tr>
<tr><td>32</td><td>VSS</td><td>CPU VSS</td><td>–</td><td>GND</td></tr>
<tr><td>33</td><td>P27/DB7</td><td>EMG RQ</td><td>IN</td><td>NORMAL:H, L:REG SHORT(SWD5V, SWD8V) → POWER OFF</td></tr>
<tr><td>34</td><td>P26/DB6</td><td>SV LOCK</td><td>IN</td><td>SERVO IC CONDITION DETECT (SERVO LOCK:L)</td></tr>
<tr><td>35</td><td>P25/DB5</td><td>TU REEL FG</td><td>IN</td><td>REEL ROTATION DETECT, TAPE REMAIN DETECT</td></tr>
<tr><td>36</td><td>P24/DB4</td><td>FLY TRIG</td><td>IN</td><td>FLYING ERASE HEAD ON TIMING CONTROL (SW–D INVERTER)</td></tr>
<tr><td>37</td><td>P23/DB3</td><td>CASSETTE SW</td><td>IN</td><td>CASSETTE HOUSING LOCK DETECT (SW ON:L)</td></tr>
<tr><td>38</td><td>P22/DB2</td><td>EJECT SW</td><td>IN</td><td>SW CONDITION DETECT (SW ON:L)</td></tr>
<tr><td>39</td><td>P21/DB1</td><td>LDM PLS +</td><td>OUT</td><td>LOADING MOTOR DRIVE TO IC302 (MOTOR DRIVER)– 6PIN</td></tr>
<tr><td>40</td><td>P20/DB0</td><td>LDM MI</td><td>OUT</td><td>LOADING MOTOR DRIVE TO IC302 (MOTOR DRIVER)–11PIN</td></tr>
<tr><td>41</td><td>P17/AD15</td><td>LDM PUP</td><td>OUT</td><td>LOADING MOTOR SPEED CONTROL (SPEED UP:L)
(NORMAL:3.6V, SPEED UP:5V)
<table>
<tr><th>PIN39</th><th>PIN40</th><th>OUT2(PIN14)</th><th>OUT1(PIN3)</th><th>MODE</th></tr>
<tr><td>H</td><td>L</td><td>L</td><td>H</td><td>FWD</td></tr>
<tr><td>L</td><td>H</td><td>H</td><td>L</td><td>REV</td></tr>
<tr><td>H</td><td>H</td><td>L</td><td>L</td><td>BRAKE</td></tr>
<tr><td>L</td><td>L</td><td>OPEN</td><td>OPEN</td><td>STAND–BY</td></tr>
</table>
</td></tr>
<tr><td>42</td><td>P16/AD14</td><td>A PB</td><td>OUT</td><td>AUDIO PB:L/EE:H (AUDIO ERASE HEAD CTL, AUDIO MODE)</td></tr>
<tr><td>43</td><td>P15/AD13</td><td>A MUTE</td><td>OUT</td><td>AUDIO MUTE CONTROL(MUTE ON:H)</td></tr>
<tr><td>44</td><td>P14/AD12</td><td>BIAS ON</td><td>OUT</td><td>BIAS CONTROL(BIAS ON:H)</td></tr>
<tr><td>45</td><td>P13/AD11</td><td>TRIG OUT</td><td>OUT</td><td>REMOTE ON:H(MASTER EDIT CTL) AND EDIT MODE ON(YNR OFF)</td></tr>
<tr><td>46</td><td>P12/AD10</td><td>VIDEO PB</td><td>OUT</td><td>VIDEO PB:L/EE:H</td></tr>
<tr><td>47</td><td>P11/AD 9</td><td>FLY E ON</td><td>OUT</td><td>FLY ERASE HEAD ON:H</td></tr>
<tr><td>48</td><td>P10/AD 8</td><td>V REC MUTE</td><td>OUT</td><td>VIDEO REC MUTE CONTROL(MUTE ON:H) PRE/REC CTL</td></tr>
<tr><td>49</td><td>P07/AD 7</td><td>ALM ON</td><td>OUT</td><td>TRIGGER ALARM ON:H</td></tr>
<tr><td>50</td><td>P06/AD 6</td><td>CTL ELS</td><td>OUT</td><td>CTL ERASE HEAD ON:H</td></tr>
<tr><td>51</td><td>P05/AD 5</td><td>V SW OFF</td><td>OUT</td><td>V SW OFF:H (ASSEMBLY EDIT →SW–D TO SW–A ON)</td></tr>
<tr><td>52</td><td>P04/AD 4</td><td>SHUT–A</td><td>OUT</td><td>SHUTTLER SPEED CONTROL 1/50 1/60 1/500 1/4000</td></tr>
<tr><td>53</td><td>P03/AD 3</td><td>SHUT–B</td><td>OUT</td><td>SHUTTLER SPEED CONTROL L H H L
L H L H</td></tr>
<tr><td>54</td><td>P02/AD 2</td><td>CAP M REF</td><td>OUT</td><td>CAPSTAN MOTOR DRIVE</td></tr>
<tr><td>55</td><td>P01/AD 1</td><td>CAP M REF</td><td>OUT</td><td>& SPEED CORRECTION</td></tr>
<tr><td>56</td><td>P00/AD 0</td><td>CAP M REF</td><td>OUT</td><td>(SYSCON MODE)</td></tr>
<tr><td>57</td><td>P37/SYNC</td><td>S ENABLE</td><td>–</td><td>NORMAL:NOT USED (JIG MODE :L)</td></tr>
<tr><td>58</td><td>P36/RDB</td><td>SLD SW C</td><td>IN</td><td>SW CONDITION DETECT(CAM–A AND SP/EP SW)</td></tr>
<tr><td>59</td><td>P35/WRB</td><td>SLD SW B</td><td>IN</td><td>SW CONDITION DETECT(CAM–B AND TAPE SW)</td></tr>
<tr><td>60</td><td>P34</td><td>SLD SW A</td><td>IN</td><td>SW CONDITION DETECT(REC SF AND COVER SW)</td></tr>
<tr><td>61</td><td>P33</td><td>LITIUM BAT</td><td>IN</td><td>LITIUM BATTERY DETECT L:LUTIUM BATTERY INDICATE,
H:NO INDICATE</td></tr>
<tr><td>62</td><td>P32</td><td>DEW SENSOR</td><td>IN</td><td>NORMAL:H , SENSOR ON:L</td></tr>
<tr><td>63</td><td>P31</td><td>BATT DOWN</td><td>IN</td><td>BATTERY ALARM DETECT(5.55V) L:INDICATE</td></tr>
<tr><td>64</td><td>P30</td><td>BATT SHUT</td><td>IN</td><td>BATTERY SHUT OFF DETECT(5.4V) L:POWER OFF</td></tr>
<tr><td>65</td><td>OUT</td><td>FRINGE</td><td>OUT</td><td>FRINGE PULSE OUTPUT FOR TIME & DATE DISPLAY</td></tr>
<tr><td>66</td><td>I</td><td>CHARACTER</td><td>OUT</td><td>CHARACTER PULSE OUTPUT FOR TIME & DATE DISPLAY CONTROL</td></tr>
<tr><td>67</td><td>B</td><td>NC</td><td>–</td><td>NC</td></tr>
<tr><td>68</td><td>G</td><td>IND</td><td>OUT</td><td>CHARACTER PULSE OUTPUT FOR E.VF DISPLAY CONTROL</td></tr>
<tr><td>69</td><td>R</td><td>NC</td><td>–</td><td>NC</td></tr>
<tr><td>70</td><td>OSC1</td><td>OSC IN</td><td>IN</td><td>FOR OSD CLOCK IN/OUT</td></tr>
<tr><td>71</td><td>OSC2</td><td>OSC OUT</td><td>OUT</td><td>TO CLOCK GENERATER CIRCUIT</td></tr>
<tr><td>72</td><td>VCC</td><td>–</td><td>IN</td><td>VCC(UNREG 5V INPUT TERMINAL)</td></tr>
<tr><td>73</td><td>VSS</td><td>–</td><td>–</td><td>GND</td></tr>
<tr><td>74</td><td>VSYNC</td><td>VD</td><td>IN</td><td>VD PULSE INPUT FOR DISPLAY CONTROL</td></tr>
<tr><td>75</td><td>VSYNC</td><td>HD</td><td>IN</td><td>HD PULSE INPUT FOR DISPLAY CONTROL</td></tr>
<tr><td>76</td><td>AVCC</td><td>AVCC</td><td>IN</td><td>SYSTEM POWER FOR A/D, D/A CONVERTER</td></tr>
<tr><td>77</td><td>AVSS</td><td>AVSS</td><td>–</td><td>GND</td></tr>
<tr><td>78</td><td>D/A OUT</td><td>FADER</td><td>OUT</td><td>FADER CONTROL (FADER ON:H)</td></tr>
<tr><td>79</td><td>DAVref</td><td>DVref</td><td>IN</td><td>REFERENCE VOLTAGE FOR D/A CONVERTER</td></tr>
<tr><td>80</td><td>ADVref</td><td>AVref</td><td>IN</td><td>REFERENCE VOLTAGE FOR A/D CONVERTER</td></tr>
</table>

Table 3-1-1-B IC301 pinfunction

3.1.2 Automatic operation of mechacon

1. Tape end detection
   When the end sensor is turned on as the capstan motor is rotation in the FF direction, the mechanism is shifted to the Stop mode.
   In the FF mode, tape end is detected by the reel sensor.
2. Tape start detection
   Wen REEL FG signal does not vary for more than 2 sec as the capstan motor is rotating in the REW direction, the mechanism is shifted tot eh Stop mode.
3. Drum rotation detection
   When DRUM FF signal does not vary for more than 2 sec in a mode that the drum must be rotating, the mechanism is shifted to the Stop mode and the related emergency number is displayed in the electronic viewfinder.
4. Reel rotation detection
   When REEL FG signal does not vary for a time longer than that described below in a mode that the reel must be rotating, the mechanism is shifted to the Stop mode and the related emergency number is displayed in the electronic viewfinder.

	Supply Reel FG	Take-up Reel FG
REC/PB	10.0 sec	4.2 sec
Preroll	4.2 sec	10.0 sec
Search FF	2.2 sec	2.0 sec

5. Loading/Unloading overtime
   If loading operation does not finish with 10 sec after the Loading/Unloading operation started, the operation is stopped and the related emergency number is displayed in the electronic viewfinder.
6. Power-saving
   - When the machine is left in the Stop mode approximately for more than 5 minutes, the power is automatically turned off except in the Rehearsal mode.
   - When the machine is left in the PB Pause mode approximately for more than 5 minutes, the mechanism is shifted to the REC Lock mode and then the power is turned off.
   - When the machine is left in the REC Pause mode approximately for more than 5 minutes, the mechanism is shifted to the REC Lock mode and then the power is turned off.

3.1.4 Mechanism mode timing chart

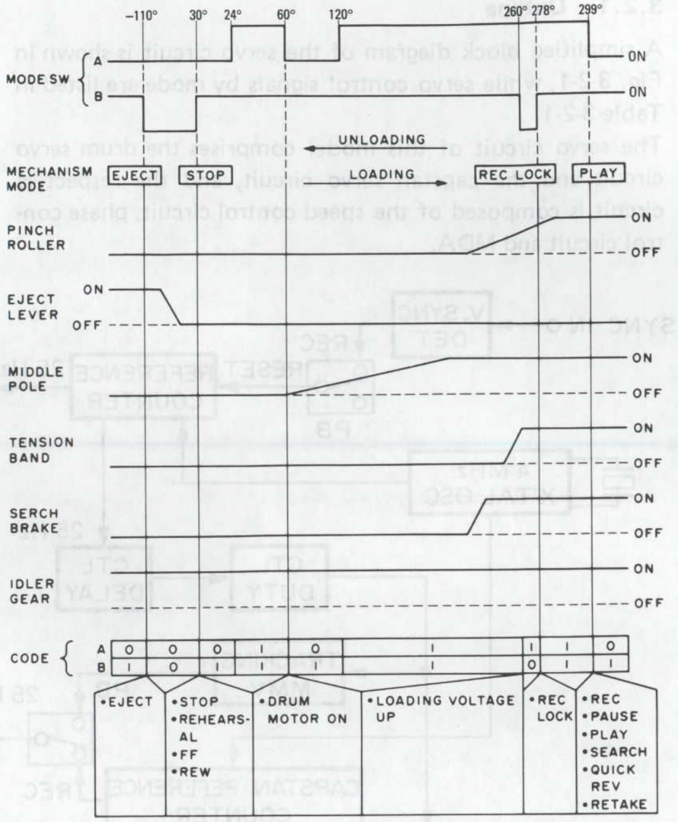


Fig. 3-1-1 Mechanism mode timing chart

3.1.3 Emergency display

Whenever some abnormal signal is supplied to mechacon CPU, the POWER LED will be flickered and an error number (EQ1, for example) displayed on the electronic view finder.

E.VF DISPLAY	Symptom	Mode when observed	Resulting mode
E04	DRUM FF input absent	DRUM rotation	STOP
E03	REEL FG input absent	REC, PLAY, SEARCH FF	STOP
E02	Mode control motor rotates for more than 10 sec. without shift to next mode.	UNLOADING	Mode continues
E01	Mode control motor rotates for more than 10 sec. without shift to next mode.	LOADING	Mode continues

Emergency mode : Indication for 5 minutes, then power OFF
Port states : Same as Stop mode
Effective key : POWER
Shifted mode : Power OFF

3.2 SERVO CIRCUIT

3.2.1 Outline

A simplified block diagram of the servo circuit is shown in Fig. 3-2-1, while servo control signals by mode are listed in Table 3-2-1.

The servo circuit of this model comprises the drum servo circuit and the capstan servo circuit, and the respective circuit is composed of the speed control circuit, phase control circuit and MDA.

Control signals used for the servo circuit are specified by mode, therefore, it is convenient for troubleshooting in finding out and specifying abnormal and faulty portions referring to those signals.

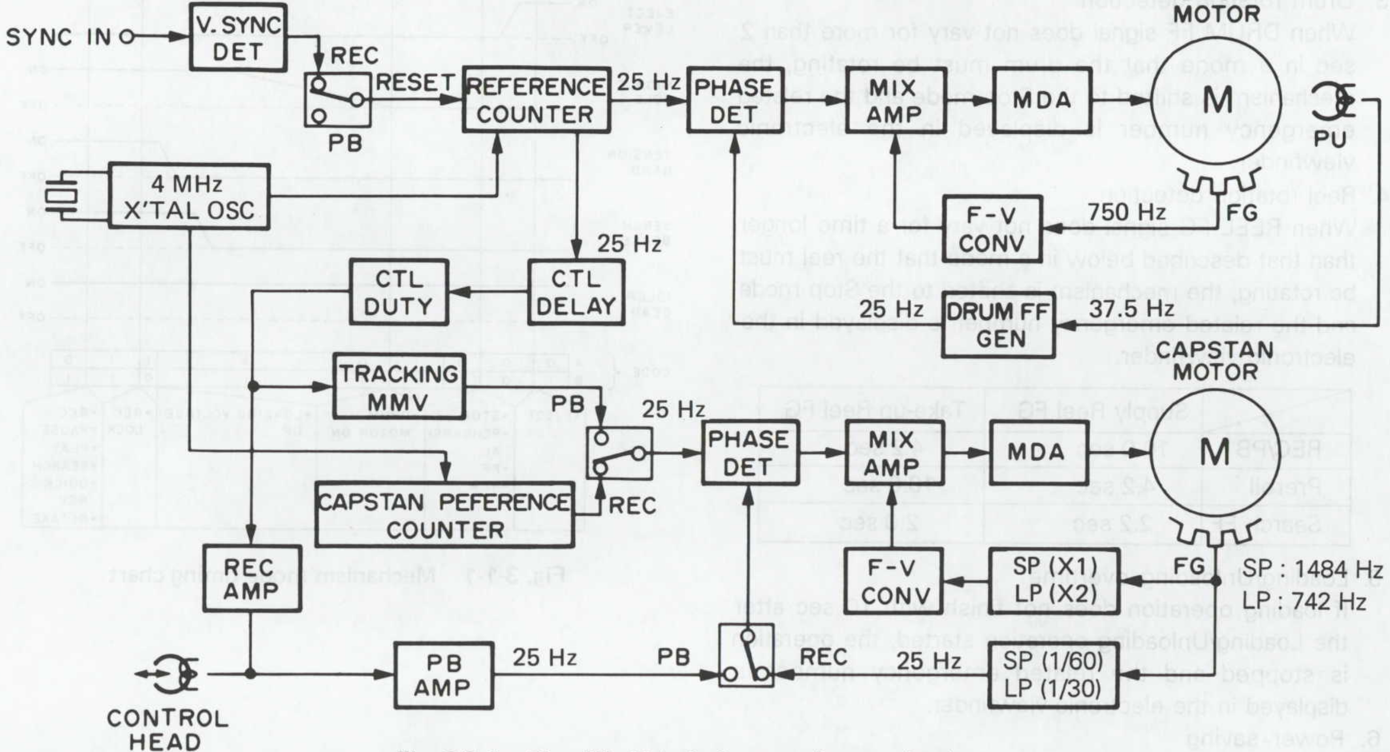


Fig. 3-2-1 Simplified block diagram of servo circuit

	DRUM SERVO			CAPSTAN SERVO		
	Phase Servo		Speed Servo	Phase Servo		Speed Servo
	Reference	Comparison		Reference	Comparison	
REC	V. SYNC 50 Hz → 25 Hz	DRUM PULSE 37.5 Hz → 25 Hz	DRUM FG 750 Hz	X'TAL 4 MHz → 25 Hz	CAPSTAN FG Counted down to 25 Hz	CAPSTAN FG SP : 1484 Hz LP : 742 Hz
PLAY	X'TAL 4 MHz → 25 Hz	DRUM PULSE 37.5 Hz → 25 Hz	DRUM FG 750 Hz	X'TAL 4 MHz → 25 Hz	CTL PULSE 25 Hz	CAPSTAN FG SP : 1484 Hz LP : 742 Hz
STILL	X'TAL 4 MHz → 25 Hz	DRUM PULSE 37.5 Hz → 25 Hz	DRUM FG About 750 Hz	—	—	—
SEARCH	X'TAL 4 MHz → 25 Hz	DRUM PULSE 37.5 Hz → 25 Hz	DRUM FG About 750 Hz	X'TAL 4 MHz → 25 Hz	CTL PULSE SP: 75 Hz → 25 Hz LP: 175 Hz → 25 Hz	CAPSTAN FG SP : About 4450 Hz LP : About 5190 Hz
ASSEMBLY EDIT	V. SYNC 50 Hz → 25 Hz	DRUM PULSE 37.5 Hz → 25 Hz	DRUM FG 750 Hz	V. SYNC 50 Hz → 25 Hz REF. COUNTER CAPSTAN FG 25 Hz RESET	CTL PULSE 25 Hz	CAPSTAN FG SP : 1484 Hz LP : 742 Hz

Table 3-2-1 Servo circuit control signals

3.2.2 Servo IC (01 VTR IC101) pin function

PIN NO.	SYMBOL	IN/OUT	NOTE
1	ADV PULSE	OUT	TRACKING CORRECTION PULSE OUTPUT (ON:H 100msec)
2	CAP CTL	OUT	SERVO MODE:L/MECHACON:H (CAPSTAN MOTOR DRIVE CONTROL)
3	SP	OUT	SP:L
4	C APC	OUT	CAPSTAN PHASE CONTROL PWM PULSE OUTPUT
5	C FV	OUT	CAPSTAN SPEED CONTROL PWM PULSE OUTPUT
6	CAP BRK	OUT	CAPSTAN BRAKE CONTROL(BRAKE ON :H)
7	CAP FWD	OUT	FWD/REV ROTATION OF CAPSTAN MOTOR(FWD MODE:L)
8	BUZZ OUT	OUT	TRIGGER ALARM CONTROL(BUZZER ON:H)
9	BUZZ CTL	IN	ALARM CONTROL(ALARM ON:H)
10	MONITOR D	OUT	DRUM PHASE MONITOR OUTPUT(TP103)
11	MONITOR C	OUT	CAPSTAN PHASE MONITOR OUTPUT(TP104)
12	TEST B	—	NC
13	REF OSC	IN	REFERENCE SIGNAL INPUT (4MHz TO SYSCON CPU)
14	V SW OFF	OUT	VIDEO HEAD SW PULSE OFF:H
15	YNR PULSE	—	NC
16	V PLS ON	OUT	V PULSE ON/OFF CONTROL(ON:H)
17	V PULSE	OUT	V PULSE OUTPUT(SPECIAL PB MODE ON)
18	C SYNC	IN	COMPOSITE SYNC INPUT
19	FRAME PLS	IN	FRAME PULSE INPUT
20	EXT/CAM	—	NOT USED
21	S LOCK OUT	OUT	SERVO LOCK DETECT(LOCK ON:L)
22	C FG OUT	OUT	CAPSTAN FG OUTPUT
23	PB CTL PLS	OUT	PB CTL PULSE OUTPUT
24	S STR	IN	CLOCK OUTPUT PERMISSION
25	S CLK	IN	DATA TRANSFER CLOCK INPUT
26	S DATA	IN	SERIAL DATA INPUT(16BIT)
27	RESET	IN	POWER ON RESET:L
28	VDD	—	SYSTEM POWER SOURCE(DIGITAL)
29	AVDD	—	SYSTEM POWER SOURCE(ANALOG)
30	C FG BIAS	IN	CAPSTAN FG BIAS TERMINAL
31	C FG IN	IN	CAPSTAN FG INPUT SP:1484Hz, EP:742
32	NC	—	NC
33	PB CTL IN	IN	PB CTL PULSE INPUT
34	CTL AMP(+)	OUT	PB CTL PULSE AMP OUTPUT
35	CTL AMP(−)	IN	PB CTL PULSE AMP INTPUT(−)
36	AVSS	—	GND(ANALOG)
37	CTL AMP(+)	IN	PB CTL PULSE AMP INTPUT(+)
38	REC CTL(+)	IN	REC CTL PULSE AMP OUTPUT(+)
39	REC CTL(−)	IN	REC CTL PULSE AMP OUTPUT(−)
40	DUTY CTL	—	CTL PULSE DUTY CONTROL
41	VSS	—	GND(DIGITAL)
42	AVSS	—	GND
43	NTSC	IN	V PULSE WIDTH CONTROL(NTSC:L)
44	DRUM ON	OUT	DRUM ON/OFF CONTROL(D ON:H)
45	ASP OUT	—	NC
46	D APC	OUT	DRUM PHASE CONTROL PWM PULSE OUTPUT
47	D FV	OUT	DRUM SPEED CONTROL PWM PULSE OUTPUT
48	SW MM	—	HEAD SWITCHING MMV TERMINAL
49	D PG/FG	IN	DRUM PG/FG INPUT
50	FLY TRIG	OUT	FLYING ERASE HEAD CONTROL TO SYSCON CPU
51	V SWD	OUT	VIDEO HEAD SWITCHING PULSE OUTPUT
52	V SWC	OUT	VIDEO HEAD SWITCHING PULSE OUTPUT
53	V SWB	OUT	VIDEO HEAD SWITCHING PULSE OUTPUT
54	V SWA	OUT	VIDEO HEAD SWITCHING PULSE OUTPUT
55	H FF	—	NC
56	V FF	OUT	VIDEO HEAD SWITCHING PULSE OUTPUT

Table 3-2-2 IC101 pin function

3.2.3 Special functions of servo IC

1. To fix DRUM PHASE OUT (pin 46)
   - When DRUM FG frequency comes off the tolerance of ±10%.
2. To fix CAPSTAN PHASE OUT (pin 4)
   - When DRUM FG frequency comes off the tolerance of ±10%.
   - When CAPSTAN FG frequency comes off the tolerance of ±10%.
   - When 2 or more PB CTL pulses drop out in playback.
   - In the Pause mode
3. SERVO LOCK OUT (pin 21)
   - To output Low potential when sampling both of the DRUM and CAPSTAN phases are performed for 4 frames in the slope period.
4. MONITOR OUT (pins 10, 11)
   - To output sampling pulses of the DRUM and CAPSTAN phases in double in the slope period of the trapezoidal waveform.

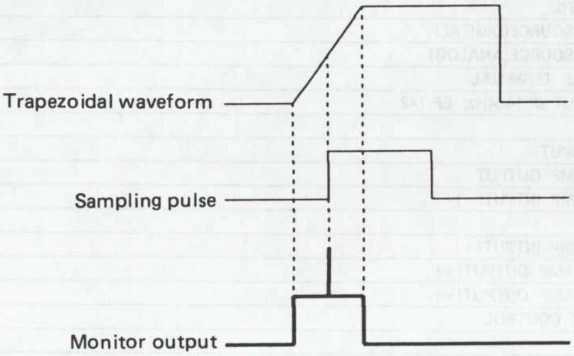


Fig. 3-2-2 Monitor output

3.2.4 Head switching

Head switching pulses are generated by the counter and the SW LOGIC circuit inside IC101.

The counter inside IC101 is composed of the 1/3 down-counter, Drum FG counter, PB SW MMV, Overlap counter 1 and Overlap counter 2.

The SW LOGIC circuit inside IC101 generates video head switching pulses A, B, C, D, DRUM FF, etc.

IC101 includes the sync. separator, too.

The following describes about the 1/3 PG, Overlap-1 and Overlap-2 which generate head switching pulses.

See Fig. 3-2-3.

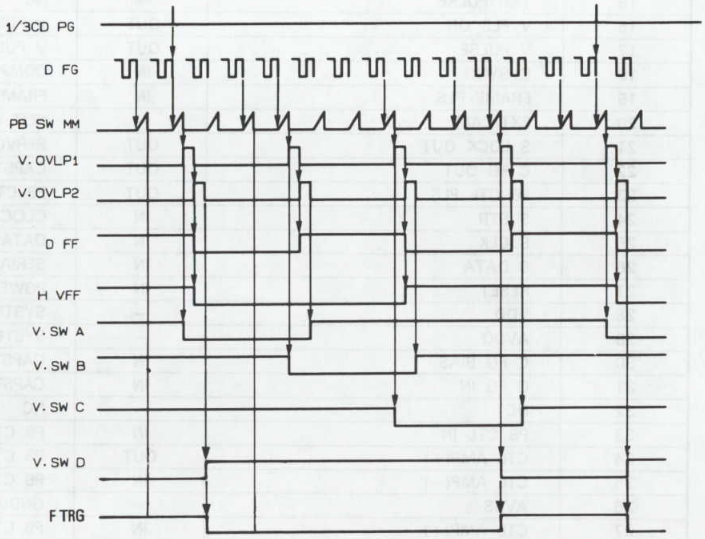


Fig. 3-2-3 Head switching pulse timing chart

The reference signal is the drum pickup pulse.

37.5 Hz drum pickup pulse supplied to pin 49 of IC101 is counted down by the 1/3 count-down circuit inside IC101 and becomes 12.5 Hz pulse.

This 12.5 Hz pulse is supplied to the drum FG counter inside the IC to be used as a trigger signal.

Being triggered by this signal, the drum FG counter starts counting for 900 Hz.

If the phase of the DRUM FG always coincides with the phase of DRUM PG, the PB SW MMV is triggered every 15 pulses (750/37.5 x 3/4) to produce SERVO FF25.

This signal is D.FF signal outputted from pin 56, however, it is not synchronized with the H. sync signal.

The overlap counter 1 and the overlap counter 2 are determine overlap period of signal to record on the tape.

The overlap counter 1 generates High pulse for 8 H period synchronizing with the fall of the PB SW MMV.

The overlap counter 2 generates High pulse for 8 H period synchronizing with the fall of the pulse of the overlap counter 1.

The DRUM FF 25 is generated synchronously with the fall of the OVERLAP 1 pulse.

By the way, it takes a certain time that the overlap counter 1 generates DRUM FF 25 after the PB SW MMV is triggered by DRUM PG. This period is prepared to absorb time lag between pulse generated by the DRUM PG and V. sync signal since the magnet to detect the rotational position of the video head and the drum PG head are set 25° of ahead the video head.

Video head switching pulses are generated referring to the PB SW MMV pulse after they are reset by the 1/3 PG.

3.2.5 Reverse tracking correction system

This model incorporates the small size head drum (41 mm diameter). Two heads are used for each of the two video tracks (designated channel 1 and channel 2). Although an output could still be obtained if the channel 1 heads traced the channel 2 tracks, best results are obtained in playback when the tracks are traced by the same heads that performed the recording. Therefore, this model includes a circuit that prevents tracing by the opposite channel heads.

This circuit is activated in the following five conditions.

1) When the mode is shifted from Stop to Play.
2) When the mode is shifted from Search or Still to Play.
3) At mode shift between SP and LP in the Play.
4) When 3 or more control pulses drop out.
5) In Assembly Edit mode.

Fig. 3-2-4 illustrates relation between the duty ratio of the control pulse and head switching pulse in the REC mode.

As mentioned previously, control pulse whose duty ratio is 55/45 % is recorded on CH-1 and CH-2 while control pulse whose duty ratio is 60/ 40 % is recorded on CH-3 and CH-4. Therefore, the proper playback manner (by the reverse tracking or normal tracking) can be determined by detecting the duty ratio of the recorded control pulse.

The reverse tracking correction circuit is built in IC101 of the DECK board, and the reverse tracking correction is performed in the following manner.

The reverse tracking is detected referring to the correct pulse and the control pulse generated inside IC101.

The correct pulse is what D. FF synchronized with 1/3 PG pulse is divided half, and it has specific delay time for each mode.

When the duty ratio of the control pulse inputted to pin 33 of IC101 is 55 % as the correct pulse is High while the duty ratio is 60 % with Low potential of the correct pulse, the frame is recorded in the normal tracking.

Contrarily, when the duty ratio is 60 % as the correct pulse is High while it is 55 % as the pulse is Low, the frame is recorded in the reverse tracking.

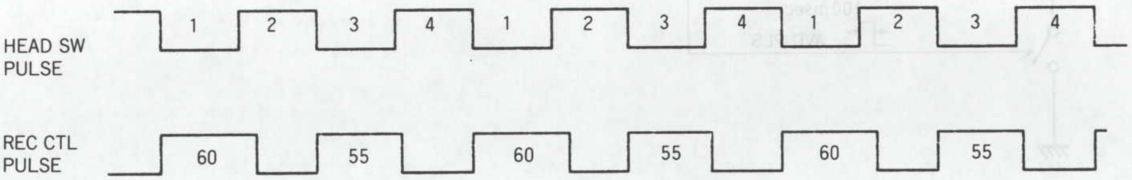


Fig. 3-2-4 REC CTL DUTY timing

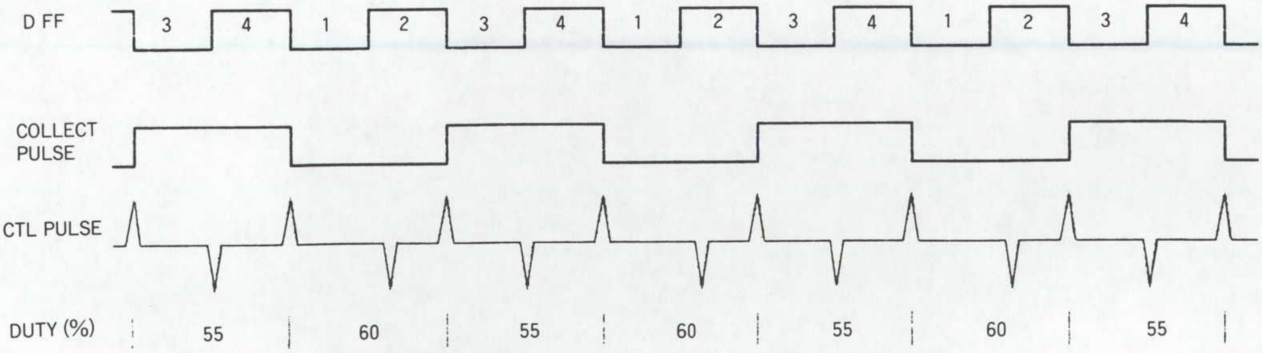


Fig. 3-2-5 PB CTL DUTY timing

Therefore, when the reverse tracking continues for 4 frames, it is judged the reverse tracking and IC101 pin 1 outputs TRACK SHIFT pulse (reverse tracking correction pulse) for 100 msec. In order to apply external minus disturbance to the speed error in a range not to saturate the F/V converter.

As a result, the rotation of the capstan motor is accelerated and the phase of the control pulse is advanced for one frame to invert the frame into the normal tracking.

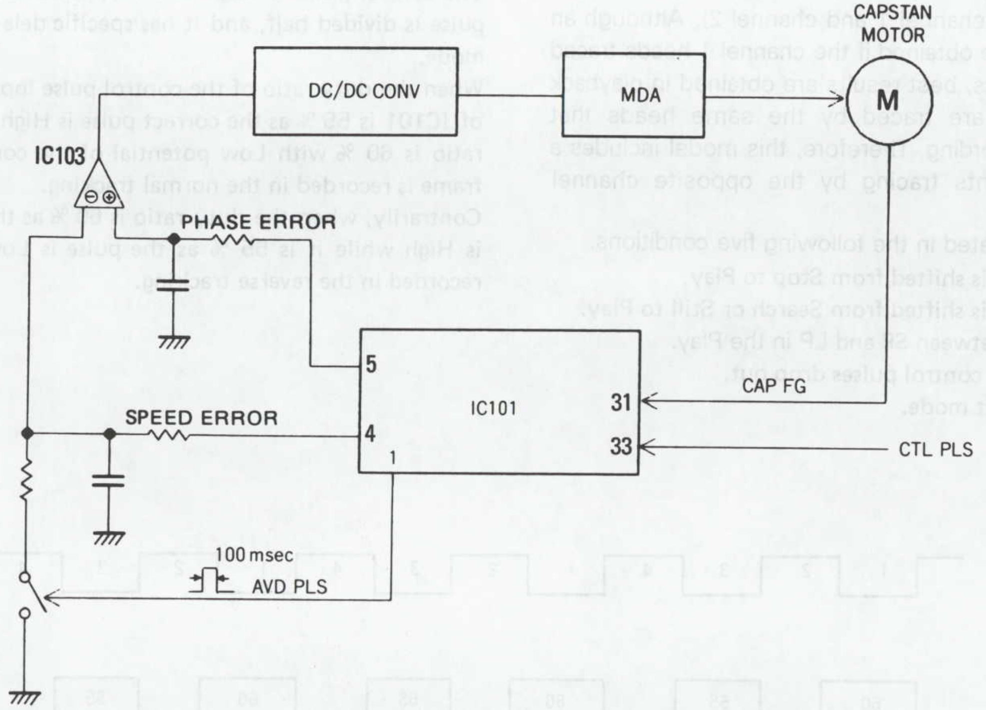


Fig. 3-2-6 Block diagram of reverse tracking correction system

3.3 DRUM MOTOR/CAPSTAN MOTOR

3.3.1 DRUM MOTOR drive circuit

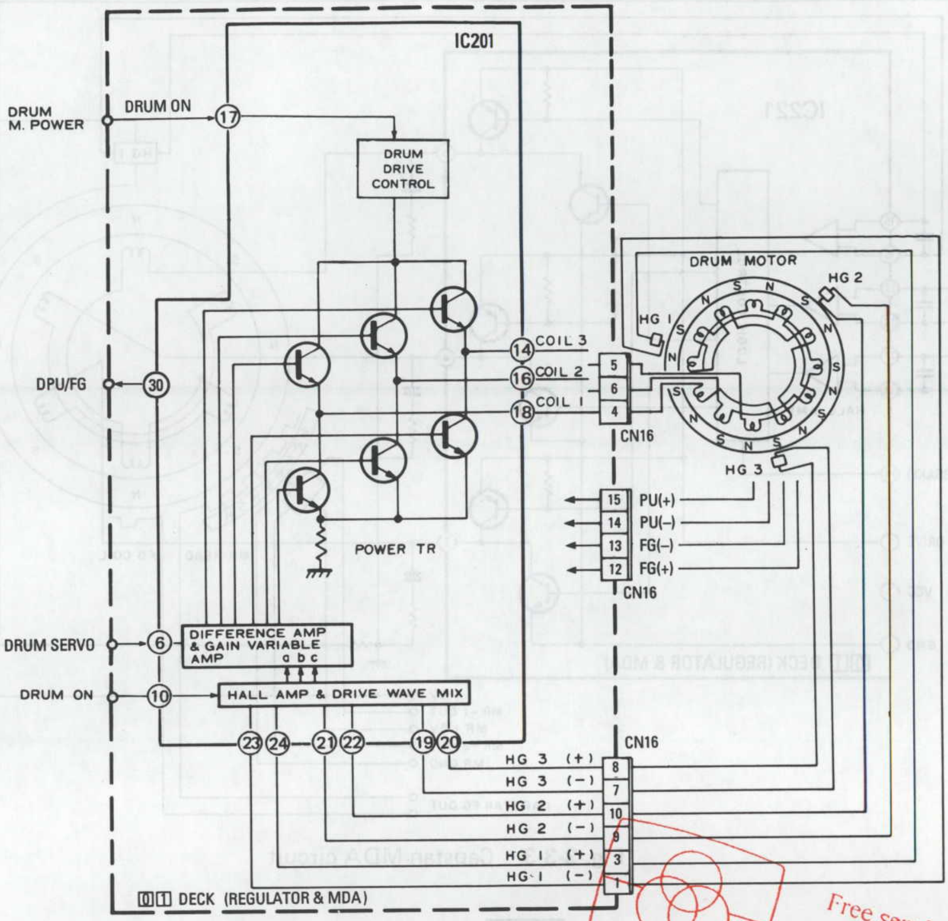


Fig. 3-3-1 Drum motor drive circuit

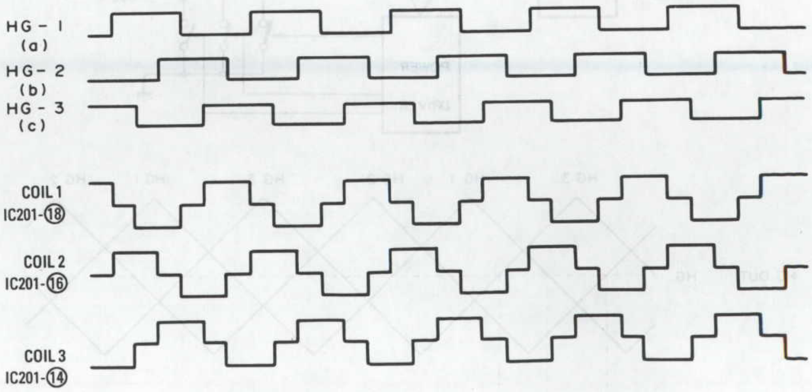


Fig. 3-3-2 Drum motor drive circuit timing chart

3.3.2 Capstan motor drive circuit

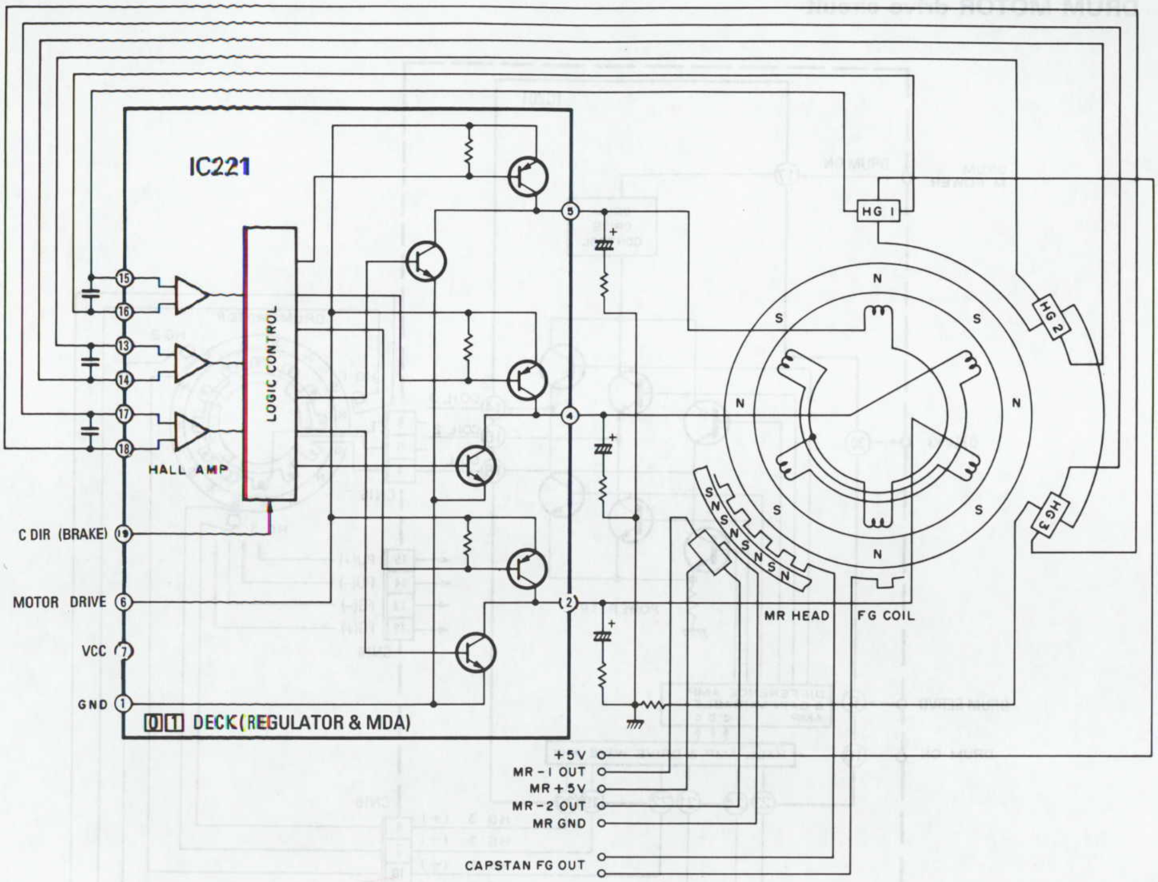


Fig. 3-3-3 Capstan MDA circuit

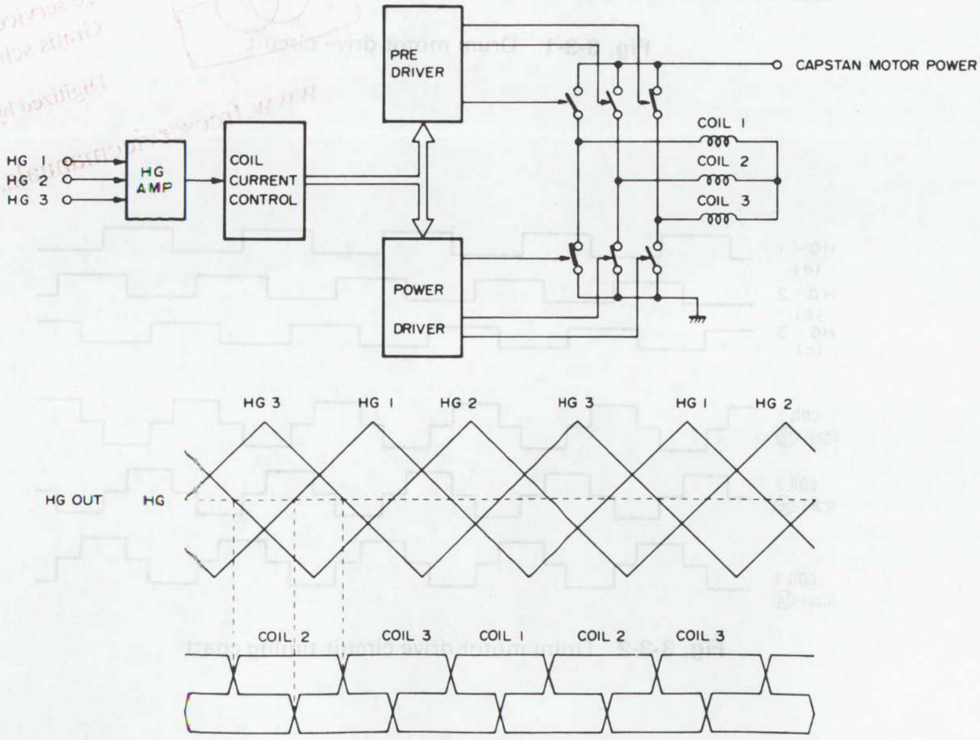


Fig. 3-3-4 Capstan motor drive block

3.3.3 IC2 function

This IC consists of triangular waveform oscillator, error amplifier short protector, low voltage error prevention, PWM comparator and output drive circuits.

1) Triangular waveform oscillator
A triangular waveform with a desired frequency between 1 – 500 kHz and 1.3 – 1.9 V can be produced by connecting a resistance and capacitance to pins 1 and 2.

2) Error amplifier
Amplifier for detecting the switching regulator output voltage. Phase is maintained by a capacitor connected to pins 5 and 12.

3) PWM comparator
Voltage comparator with 2 inverting and 1 non-inverting inputs. The voltage to pulse width converter produces an output pulse with period controlled according to the input voltage.
The oscillator triangular waveform output is High when the error amplifier voltage is higher than either of the voltages determined by pins 6 and 11.
Resistance and capacitance set the internal voltages at pins 6 and 11 to between 1.3 and 1.9 V, and thus determine the output pulse duty ratio. The normal setting is 1.5 V.

4) Short protector
The error amplifier output are detected and if either or both decline below approximately 1.1 V, Low potential is supplied to the drive circuit, cutting off the output pulse.

5) Low voltage error prevention circuit
Surge at power on or sudden decline in power line voltage can produce output error. At power on, a fixed wait period prevents output voltage error. In event of sudden drop in power line voltage, Low potential is supplied to the drive circuit, cutting off the output pulse.

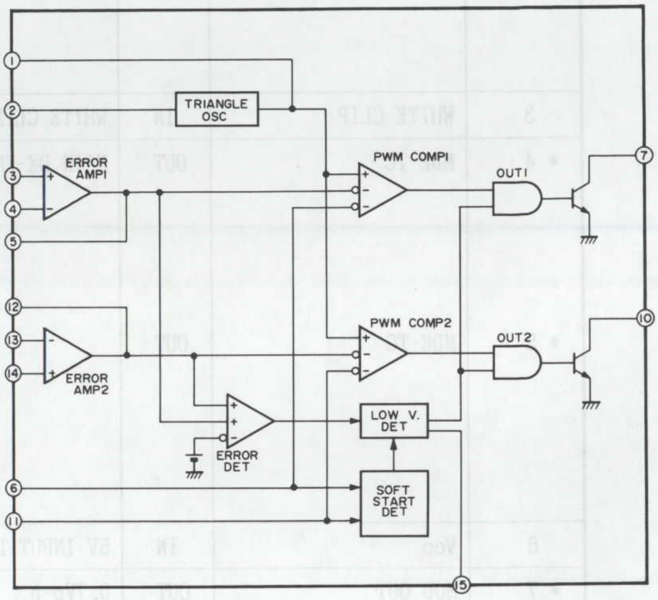


Fig. 3-3-5 IC2 block diagram

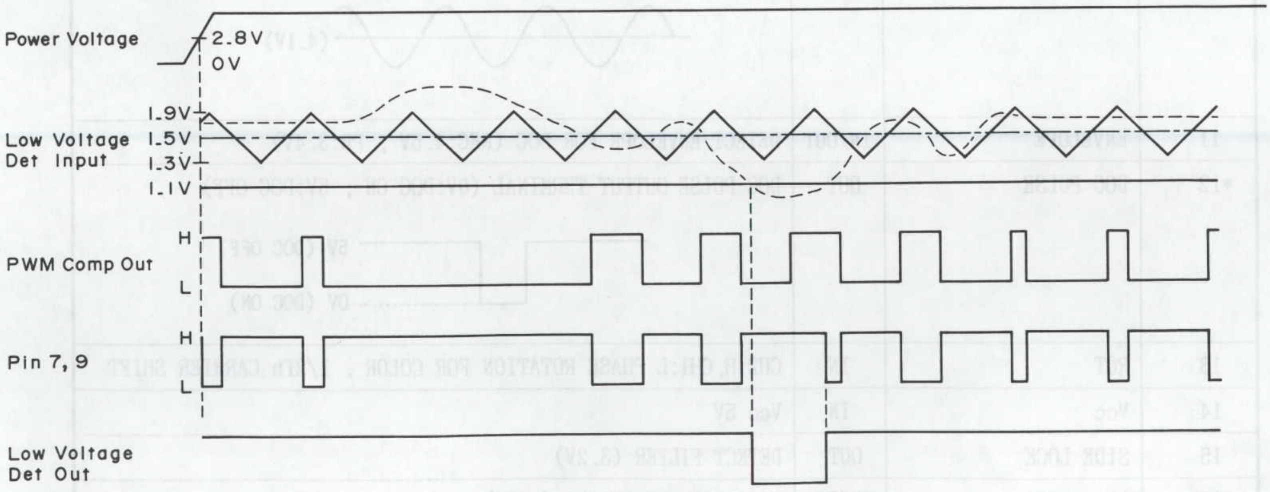
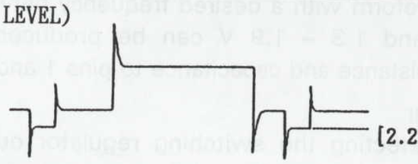
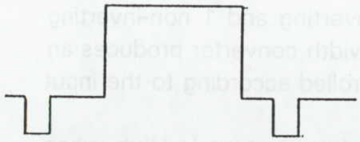
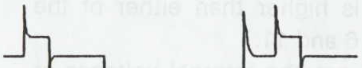
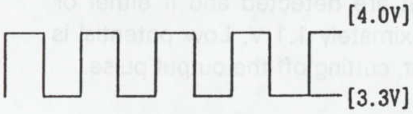
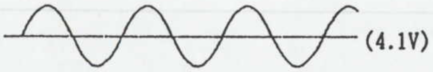
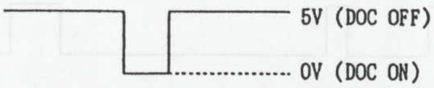
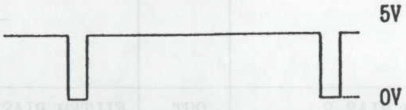
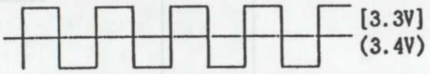
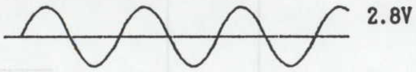
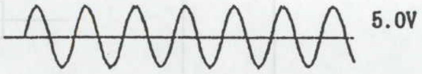
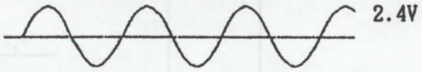
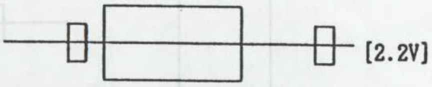
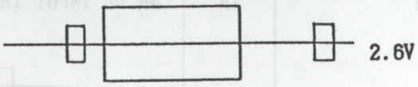
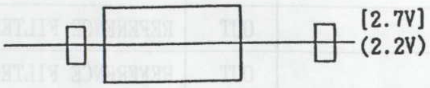


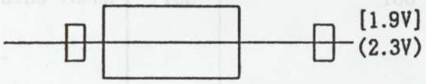
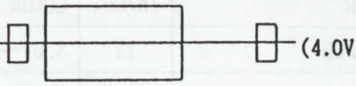
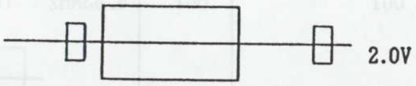
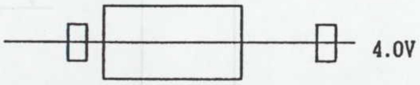
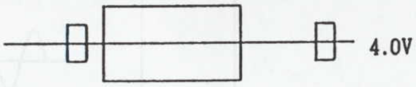
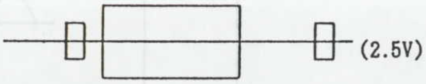
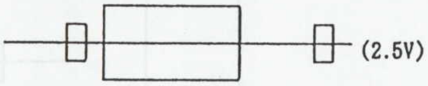
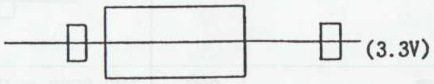
Fig. 3-3-6 IC2 timing chart

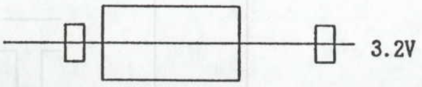
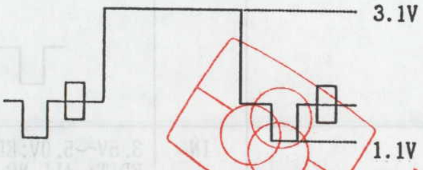
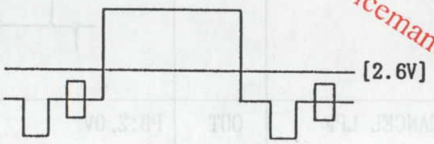
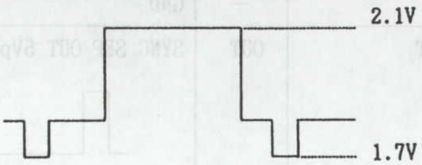
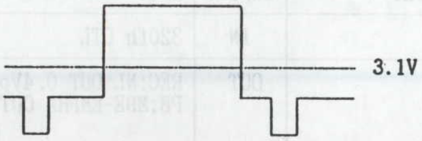
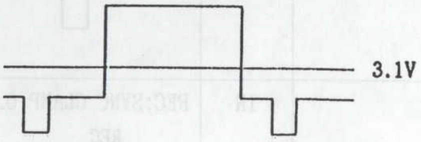
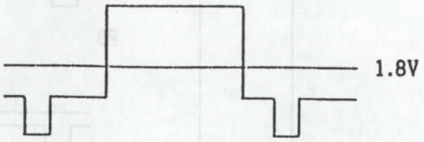
3.4 Y/C CIRCUIT

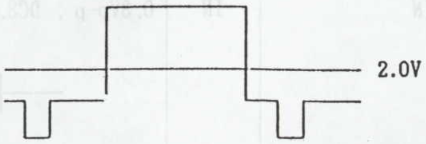
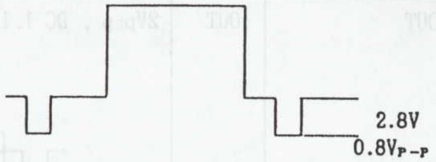
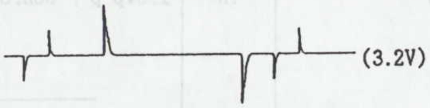
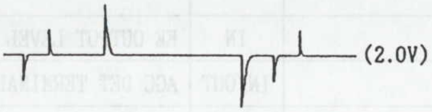
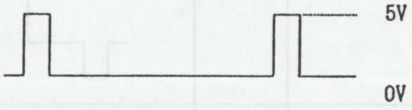
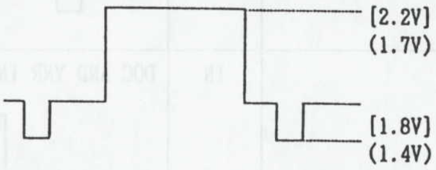
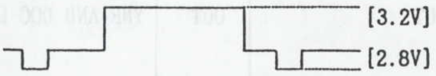
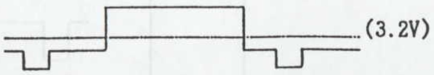
3.4.1 Y/C IC pin function

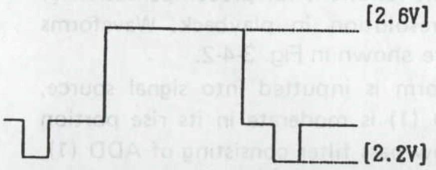
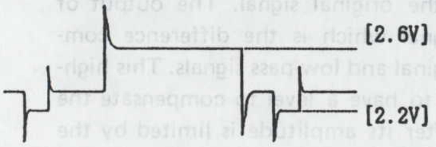
PIN NO.	LABEL	IN/OUT	NOTE
1	SECAM/PAL/NTSC	IN	3.4V~5.0V:SECAM , 1.3V ~2.8V:PAL , 0V ~0.7V:NTSC
* 2	Y MOD IN	IN	REC:2.2V (SYNC TIP LEVEL) 
3	WHITE CLIP	IN	WHITE CLIP ADJUSTMENT TERMINL
* 4	MDE-TC	OUT	MAIN DE-EMPHASIS TIMING CONTROL 
* 5	MDE-TC	OUT	
6	Vcc	IN	5V INPUT TERMINAL FOR Y-MOD
* 7	MOD OUT	OUT	0.7Vp-p 
8	DEMOD OUT	OUT	CHECK TERMINAL(3.2V)
9	PB ADJ	IN	PB OUTPUT LEVEL ADJUSTMENT(NORMAL:3.5V)
*10	PB FM	IN	DC4.1V , 350mVp-p 
11	ENVELOPE	IN/OUT	DETECT ENVELOPE FOR DOC (REC:4.5V , PB:3.4V)
*12	DOC PULSE	OUT	DOC PULSE OUTPUT TERMINAL (0V:DOC ON , 5V:DOC OFF) 
13	ROT	IN	CH2:H, CH1:L PHASE ROTATION FOR COLOR , 1/2fh CARRIER SHIFT
14	Vcc	IN	Vcc 5V
15	SIDE LOCK	OUT	DETECT FILTER (3.2V)
16	PB FILTER	IN/OUT	PB COLOR APC FILTER (3.2V)
17	Vdd	OUT	3V
18	AFC FILTER	IN/OUT	REC COLOR AFC FILTER (3.2V)
19	FILTER BIAS 1	OUT	FILTER BIAS (1.2V)
20	EP-LP-SP	IN	3.5V~5.0V:EP , 1.5V~3.0V:LP , 0V~1.0V:SP

PIN NO.	LABEL	IN/OUT	NOTE
21	REC-SPE-PB	IN	3.5V~5.0V:REC , 1.5V ~3.0V:SPE , 0V ~1.0V:PB
*22	BGP OUT	OUT	BURST GATE PULSE OUTPUT TERMINAL 
23	GND	—	GND
24	KILLER	IN/OUT	COLOR KILL DETECT TERMINAL (3.9V:ON , 3.1V:OFF)
25	COLOR/WB	IN	3.5V~5.0V:COLOR , 1.5V ~3.0V:W/B
26	FILTER BIAS 2	OUT	FILTER BIAS (1.1V)
27	DIFF. PHASE COLOR	OUT	DIFFERENCE PHASE DETECT TERMINAL (3.4V)
*28	X'TAL OUT	OUT	4.43MHz (0.3Vp-p REC:DC3.3V , PB:DC3.4V) 
*29	X'TAL IN	IN	(0.2Vp-p DC2.8V) 
30	GND	—	COLOR GND
*31	2Fsc	OUT	FOR 1H DL (0.3Vp-p , DC5V) 
*32	Fsc	OUT	DC2.4V , 600mVp-p 
33	MAIN CONV.	IN	MAIN CONVERTER DET (3.3V)
*34	REC COLOR OUT	OUT	REC:0.7Vp-p , DC2.2V , PB:2.4V (KILL ON:L) 
35	ACC DET	OUT	COLOR ACC DET (ONLY NTSC) 2.4V
*36	ACC IN	IN	200mVp-p , DC2.6V 
*37	SW OUT	OUT	REC:COMB DRIVE OUT (0.2Vp-p , DC2.7V) PB:627K BPF OUT (0.2Vp-p , DC2.2V) 

PIN NO.	LABEL	IN/OUT	N O T E
*38	ACC OUT	OUT	ACC OUTPUT MONITOR(0.5Vp-p , DC1.9V) 
39	FILTER BIAS 3	OUT	FILTER BIAS TERMINAL (1.2V)
*40	PB COLOR IN	IN	100mVp-p 4.0V 
*41	COMB	OUT	COMB DRIVE TERMINAL (1.0Vp-p , DC2.0V) 
42	Vcc	IN	5V
*43	COMB-IN2	IN	COMB THOUGH INPUT TERMINAL (0.36Vp-p , DC4.0V) 
*44	COMB-IN1	IN	COMB INPUT TERMINAL (0.12Vp-p , DC4.0V) 
45	EE-PB-TRICK	IN	3.5V~5.0V:EE , 1.5V~3.0V:PB , 0V~1.0V:TRICK
*46	PB COLOR OUT	OUT	REC:4.3V , PB:0.5Vp-p , DC2.5V 
*47	CNR DL	OUT	REC:3.8V , PB:0.8Vp-p , DC2.5V 
48	NR BIAS	IN/OUT	YNR/CNR BIAS TERMINAL
49	NR TP	OUT	REC:YNR TP(1.8V) , PB:CNR TP(2.4V)
*50	CNR DL IN	IN	CNR DL INPUT TERMINAL(0.05Vp-p , DC3.3V) 
51	Vcc	IN	5V
52	FILTER	OUT	REFERENCE FILTER (2V)
53	FILTER	OUT	REFERENCE FILTER (2.9V)

PIN NO.	LABEL	IN/OUT	NOTE
54	Vreg	OUT	3.8V OUT PUT TERMINAL
*55	COLOR IN	IN	0.3Vp-p , DC3.2V 
56	Vcc	IN	5V
*57	VIDEO OUT	OUT	2Vp-p , DC 1.1V(SYNC TIP LEVEL) 
58	VP	IN	SYNC TIP LEVEL:3.5V ~5.0V ,
59	SUB CLAMP	IN/OUT	SUB-CLAMP DET TERMINAL (1.5V)
*60	VIDEO IN	IN	1.0Vp-p , DC2.6V 
61	AGC ADJ	IN	EE OUTPUT LEVEL ADJUSTMENT (NORMAL:2.05V)
62	AGC DET	IN/OUT	AGC DET TERMINAL (REC:1.9V , PB:1.5V)
*63	Y OUT	OUT	MAIN LPF OUTPUT TERMINAL 0.4Vp-p , DC1.7V (SYNC TIP LEVEL) 
*64	YNR IN	IN	YNR INPUT TERMINAL 0.4Vp-p, DC3.1V 
*65	DOC IN	IN	DOC AND YNR INPUT TERMINAL 0.4Vp-p, DC3.1V 
*66	DOC OUT	OUT	YNR AND DOC DRIVE TERMINAL 0.4Vp-p , DC1.8V 

PIN NO.	LABEL	IN/OUT	N O T E
*67	YNR OUT	OUT	0.8Vp-p , DC2.0V 
*68	CLAMP 1	IN	CLAMP INPUT TERMINAL 0.8Vp-p , DC2.8V (SYNC TIP LEVEL) 
69	EDIT	IN	3.5V~5.0V:EDIT , 1.5V~3.0V:YNR OFF , 0V ~1.0V:NORMAL EDIT: ALL NR OFF
70	PICTURE CTL	IN	HORIZONTAL ENHANCER CONTROL
*71	ANR IN	IN	HIGH FREQUENCY INPUT TERMINAL FOR ANR (PB:3.2V) 
*72	NOISE CANCEL LPF	OUT	PB:2.0V 
73	GND	—	GND
*74	C SYNC OUT	OUT	SYNC SEP OUT 5Vp-p 
75	SYNC SEP DET	IN/OUT	2.6V
76	VCO ADJ	IN	320fh CTL
*77	NL OUT	OUT	REC:NL OUT 0.4Vp-p , DC1.8V (SYNC TIP LEVEL) PB:MDE-EMPHA OUT 0.3Vp-p , DC1.4V(SYNC TIP LEVEL) 
*78	CLAMP 3	IN	REC:SYNC CLAMP 0.4Vp-p, DC2.8V (SYNC TIP) , PB:DC BIAS (3.2V) REC  PB 

PIN NO.	LABEL	IN/OUT	N O T E
*79	ME TC	IN	MAIN EMPHA TIMING CONTROL 0.4Vp-p , DC2.2V (SYNC TIP LEVEL) 
*80	ME OUT	OUT	MAIN EMPHA OUTPUT TERMINAL 2.2V (SYNC TIP LEVEL) 

3.4.2 Y. NR

Fig. 3-4-1 shows a circuit of the recording system.
In recording, this circuit functions for precompensation of decrease in vertical resolution in playback. Waveforms observed at V. rate are shown in Fig. 3-4-2.
When a square waveform is inputted into signal source, the output from ADD (1) is moderate in its rise portion owing to the cyclic low pass filter consisting of ADD (1), 1H DELAY and ATT(1). As this output is larger in amplitude than the original one, ATT(2) corrects it to have the same level as that of the original signal. The output of SUB(1) is high-pass signal which is the difference component between the original and low-pass signals. This high-pass signal is amplified to have a level to compensate the playback signal, and, after its amplitude is limited by the limiter to secure the changeability, it is mixed with the original signal by ADD(2) to be sent as the REC signal.

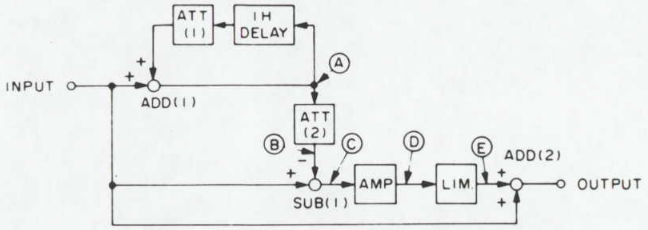


Fig. 3-4-1 YNR block diagram (REC)

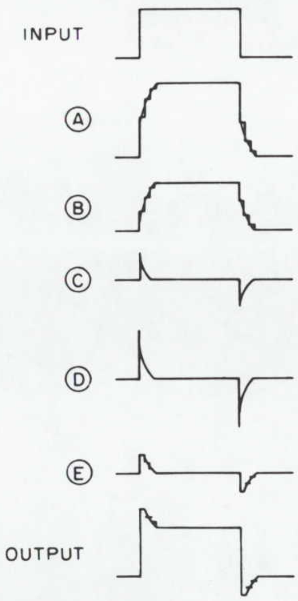


Fig. 3-4-2 YNR timing chart (REC)

Fig. 3-4-3 shows a playback circuit.
This circuit functions to remove noise generated in recording and playback. When P.B. signal containing noise is inputted to the input terminal, the cyclic low-pass filter composed of ADD(1), 1H DELAY and ATT(1) removes the noise, and ADD(1) outputs noiseless signal. If this signal is sent to ADD(2) in the same manner as in recording, output of SUB(1) is high-pass signal containing noise.
Therefore, the circuit is designed so that the signal passes ATT(3) which decrease noise effectively, the limiter to secure changeability, and SUB(2) which adds noise in reversed polarity. Through the above processes, the same output signal, without noise, as the original one can be obtained.

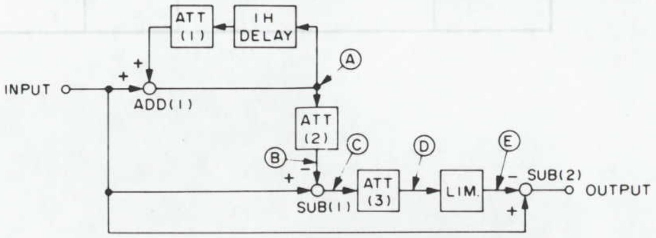


Fig. 3-4-3 YNR block diagram (PB)

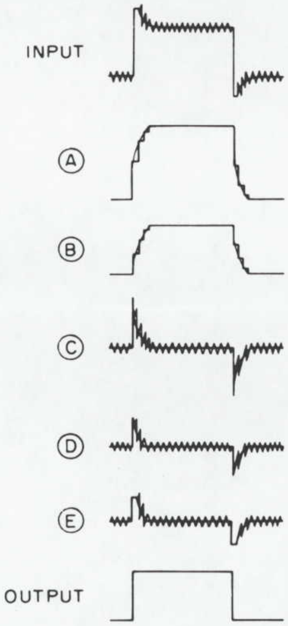


Fig. 3-4-4 YNR timing chart (PB)

3.4.3 Advanced noise reduction (ANR)

This is a newly introduced system for improving picture quality in the luminance system. It is contained in the Y module and is comprised of TNR (twin noise reduction) and LPA (linear phase aperture) circuits. The system is able to improve S/N without sacrificing playback signal pulse response.

The noise canceller type system used with earlier equipment subtracted the separated noise component from the playback signal to perform noise reduction. The highpass filter for separating the noise component also separated some of the high frequency signal component, which was removed by a limiter. Subtraction then reduced definition in the picture edges.

The ANR system offers significant improvement in edge response and S/N. Noise reducers NR1 and NR2 are positioned before and after the LPA, thus providing clear and lifelike picture reproduction.

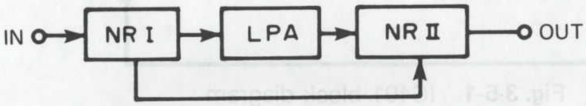


Fig. 3-4-5 ANR Circuit

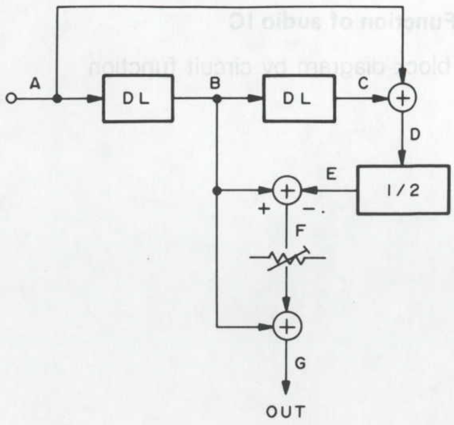


Fig. 3-4-6 LPA block diagram

3.4.4 Linear phase aperture (LPA)

The LPA circuit stresses an outline of images, and is effective for improving clearness.

Fig. 3-4-6 indicates the block diagram and Fig. 3-4-7 indicates the timing of each action.

LPA Circuit is composed of two DLs and the subtraction and addition circuits. At first, the input signal A is delayed by means of a DL and becomes signal B, which is further delayed by means of another DL and becomes signal C. Signal C becomes signal D by adding to signal A. Signal D is reduced to 1/2 level and becomes signal E, which is supplied to the subtraction circuit.

In the subtraction circuit, signal B has already been supplied and the contour correcting signal F can be obtained by subtracting signal E from signal B.

After the level of the contour correcting signal F is adjusted, signal F is added to the reference signal and becomes signal G that stresses edge portions.

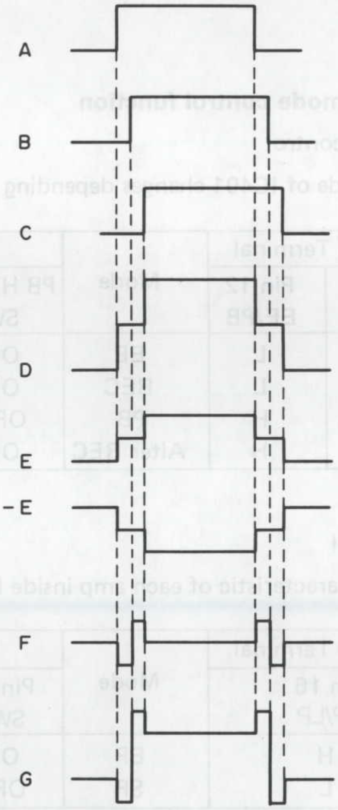


Fig. 3-4-7 LPA timing chart

3.5 AUDIO CIRCUIT

3.5.1 Function of audio IC

1. IC401 block diagram by circuit function

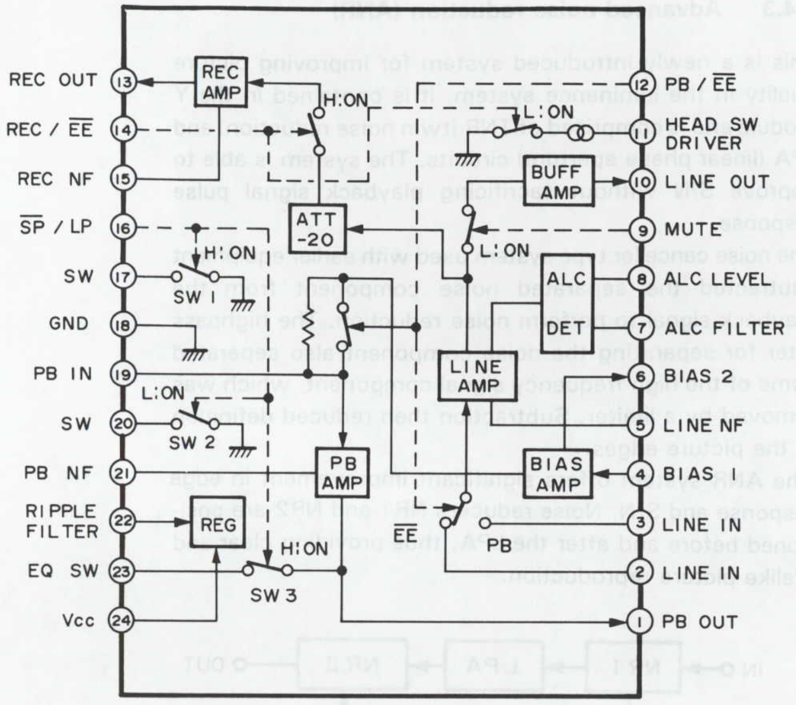


Fig. 3-5-1 IC401 block diagram

3.5.2 IC401 mode control function

1. REC/EE/PB control

The internal mode of IC401 changes depending on the respective potentials of pin 12 and pin 14.

Control Terminal		Mode	Function			
Pin 14 EE/REC	Pin 12 EE/PB		PB HEAD SW	REC HEAD SW D.R.	LINE SW	REC AMP
L	L	EE	ON	ON	EE	OFF
H	L	REC	ON	OFF	EE	ON
L	H	PB	OFF	ON	PB	OFF
H	H	Alter REC	ON	OFF	EE	ON

2. EP/SP control

The equalizer characteristic of each amp inside IC401 is switched by mode (LP/SP) according to the potential of pin 16.

Control Terminal	Mode	Function		
Pin 16 SP/LP		Pin 17 SW1	Pin 20 SW2	Pin 23 SW3
H	EP	ON	OFF	ON
L	SP	OFF	ON	OFF

3. Muting control

Muting applies to the monitor amp depending on the potential of pin 9 of IC401.

Control Terminal	Mode	Function
Pin 9 MUTE		LINE SW
H	LINE	OFF
L	MUTE	ON

SECTION 4
MECHANISM DESCRIPTION

4.1 TAPE TRANSPORTATION

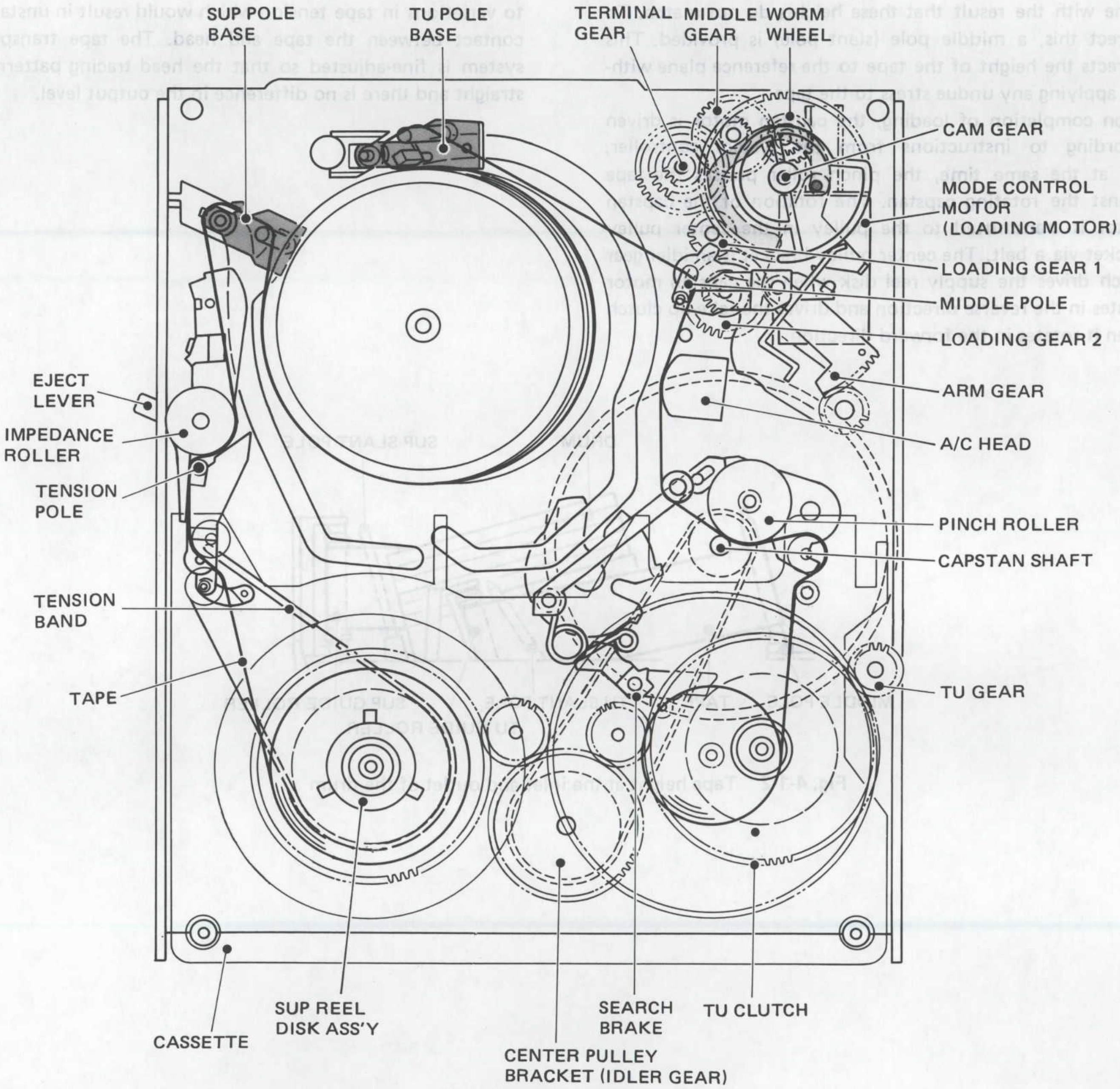


Fig. 4-1-1 Tape transportation system

When a cassette is inserted into the cassette housing and the cassette housing is moved into the main deck, the cassette sensor switch turns on. If the PLAY or RECORD switch is pressed in this condition, the mode control motor is driven and the loading mechanism is actuated via the worm gear.

In this loading mechanism, the slant pole which corresponds to the angle of inclination of the head drum, the supply pole base on which the vertical guide roller is mounted to permit stable tape travel and the take-up pole base are driven so that the tape is pulled out of the cassette, and loading is performed so that the tape is wrapped around the head drum.

So that the tape travels stably after loading, the tape at the inlet and outlet of the head drum must have the same height with respect to the reference plane (assumed to be the center line of the tape), and the tape at the outlet of the cassette and the inlet of the supply pole base and the tape at the outlet of the take-up pole base and the inlet of the cassette should be parallel to the reference plane.

In the VHS-C system, the tape is wrapped around the head drum by 270° in order to maintain compatibility with the VHS system. For this reason, the supply pole base at the inlet of the head drum is the same height above the reference plane and is perpendicular to the plane so as to be parallel to the head drum. However, the take-up pole base at the outlet of the head drum is lower than the reference plane with the result that these heights do not match. To correct this, a middle pole (slant pole) is provided. This corrects the height of the tape to the reference plane without applying any undue stress to the tape.

Upon completion of loading, the capstan motor is driven according to instructions from the system controller, and at the same time, the pinch roller presses the tape against the rotating capstan. The rotation of the capstan motor is transmitted to the pulley in the center pulley bracket via a belt. The center pulley bracket is an idler gear which drives the supply reel disk when the capstan motor rotates in the reverse direction and drives the take-up clutch when it rotates in the forward direction.

The rotation of the take-up clutch drives the take-up reel via the take-up gear to take up the tape, allowing the tape to travel from the supply side to the take-up side as shown in Fig. 4-1-1.

So that the tape travels stably, it is fed via the tension pole, impedance roller, take-up guide pole, and pinch roller, etc. The tape is controlled so that it does not become slack due to variations in tape tension which would result in unstable contact between the tape and head. The tape transport system is fine-adjusted so that the head tracing pattern is straight and there is no difference in the output level.

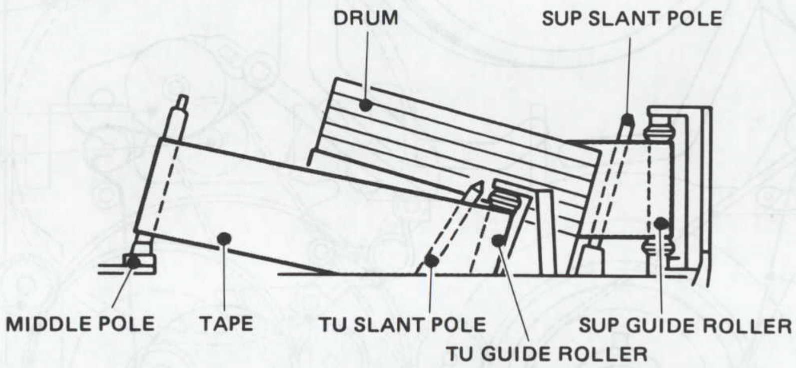


Fig. 4-1-2 Tape height at the inlet and outlet of the drum

4.2 PRIMARY COMPONENTS

1. Drum motor (direct drive)

This motor drives the upper drum on which the rotary head is mounted.

Motor switching is controlled by the system controller and the speed and phase are controlled by the servo mechanism.

Mechanism action table:

DRUM MOTOR $\xrightarrow{\text{DIRECT DRIVE}}$ ROTARY HEAD

2. Capstan motor (direct drive)

Together with the pinch roller, this feeds the tape after the completion of loading.

Motor switching and the direction of rotation are controlled by the system controller and the speed and phase are controlled by the servo mechanism.

The motor drive force is transferred by the belt to the center pulley bracket to also perform tape take-up.

Mechanism action table:

CAPSTAN MOTOR = CAPSTAN SHAFT
↓
REEL BELT
↓
CENTER PULLEY

3. Center pulley bracket (idler gear)

The center pulley bracket consists of the center pulley and idler gear. The center pulley is driven in the same direction as the capstan motor via the belt and presses the idler gear against the take-up clutch or supply reel disk in order to transmit the rotation. It also transmits the rotation of the capstan motor to the idler gear.

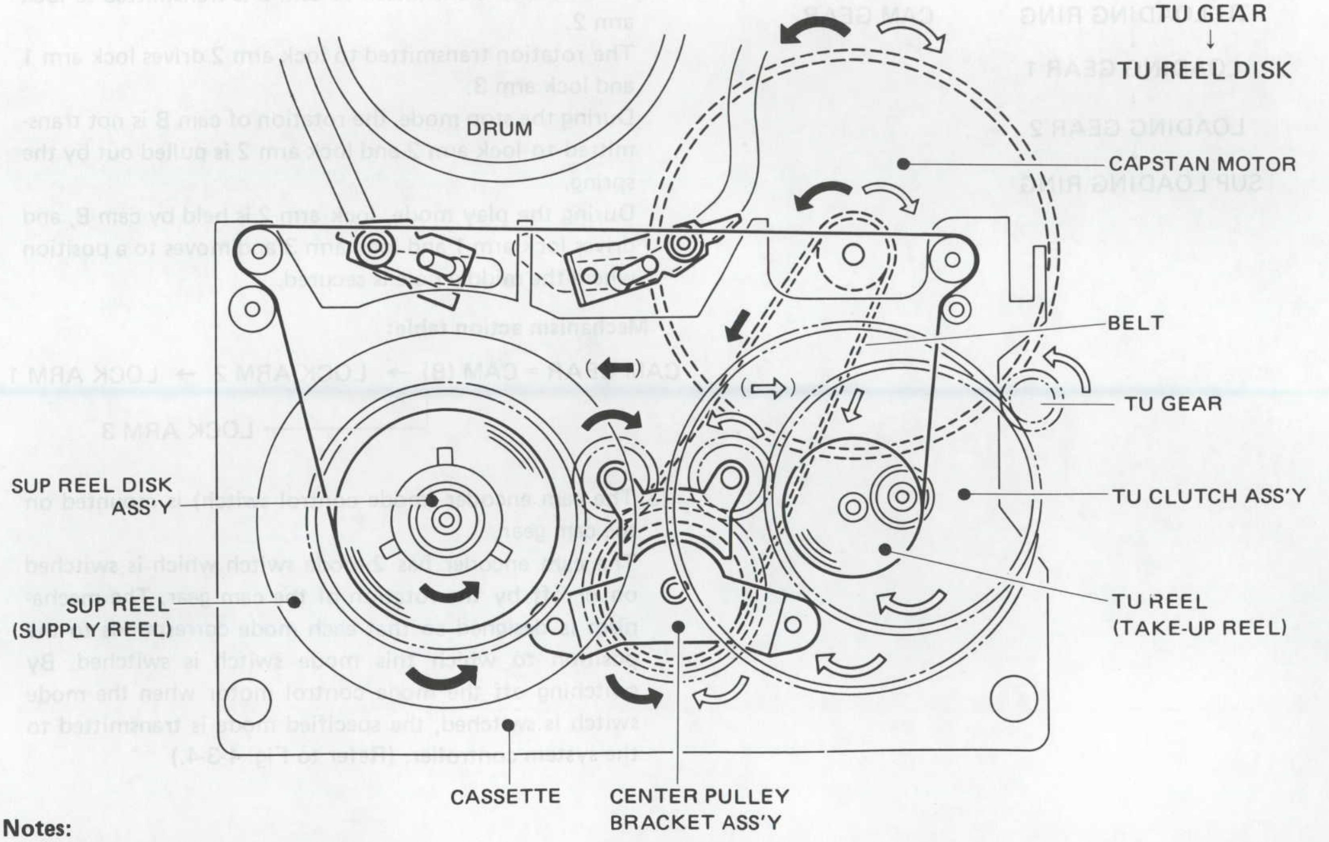
During the Play and FF modes, the idler gear is moved to the take-up side by the clockwise rotation of the center pulley and drives the take-up clutch.

During the REW mode, the idler gear is moved to the supply side by the counterclockwise rotation of the center pulley and drives the supply reel disk.

During the FF and REW modes, the tape speed varies depending on the diameter of the tape wound on the reels; however, due to the reel servo, the rotation of the take-up reel gear is varied in steps, reducing variations in the tape speed.

Mechanism action table:

CENTER PULLEY
↓
IDLER GEAR
(REW) (FF)
SUP IDLER GEAR → SUP REEL DISK
TU IDLER GEAR → TU CLUTCH GEAR → TU GEAR → TU REEL DISK



Notes:

1. ⇨ : Direction of rotation when the capstan motor rotates in the forward direction. (REC, PLAY, FF, SEARCH FF)
2. ➡ : Direction of rotation when the capstan motor rotates in the reverse direction. (REW, SEARCH REW)
3. Arrows (⬅) and (⇨) indicate the directions of rotation of the idler gear.

Fig. 4-2-1 Center pulley bracket

4. Mode control motor

This motor switches between loading and unloading operations and switches mechanism modes.

The switching of this motor and its direction of rotation are controlled by the system controller. The rotation of the mode control motor is transmitted to the worm wheel via the worm gear.

The rotation of the worm wheel drives the terminal gear via the middle gear.

The terminal gear incorporates two gears; one drives the cam gear and the other drives the take-up loading ring directly. The take-up loading ring is driven by the terminal gear and drives the supply loading ring via loading gear 1 and loading gear 2. Loading gear 1 and loading gear 2 turn the supply loading ring in the reverse direction to that of the take-up loading ring.

Mechanism action table:

MODE CONTROL MOTOR
↓
WORM GEAR
↓
WORM WHEEL
↓
MIDDLE GEAR
↓
TERMINAL GEAR
↓ → CAM GEAR
TU LOADING RING
↓
LOADING GEAR 1
↓
LOADING GEAR 2
↓
SUP LOADING RING

5. Cam gear (control cam)

The rotation of the mode control motor is transmitted to the cam gear via the worm wheel, middle gear and terminal gear as shown.

The cam gear contains grooves at the top and bottom. These operate as follows (A is bottom and B is top). The cam gear also controls the head cleaning operation druing loading and unloading.

(1) The rotation transmitted to cam A is transmitted to the middle pole via the arm gear.

As shown in Fig. 4-2-3(A), during the stop mode, pin (1) is positioned on the outer side and the arm gear is positioned when the mechanism is assembled.

At this time, the middle pole is in phase with the arm gear. During the play mode, as shown in Fig. 4-2-3(B), pin (1) is positioned near the center of cam A and the arm gear moves in the counterclockwise direction from the stop mode position, turns the middle pole in the clockwise direction and is set to the play mode position.

Mechanism action table:

CAM GEAR = CAM (A)
↓
PIN (1) = ARM GEAR
↓
MIDDLE POLE

(2) The rotation transmitted to cam B is transmitted to lock arm 2.

The rotation transmitted to lock arm 2 drives lock arm 1 and lock arm 3.

During the stop mode, the rotation of cam B is not transmitted to lock arm 2 and lock arm 2 is pulled out by the spring.

During the play mode, lock arm 2 is held by cam B, and drives lock arm 1 and lock arm 3 and moves to a position where the middle pole is secured.

Mechanism action table:

CAM GEAR = CAM (B) → LOCK ARM 2 → LOCK ARM 1
→ LOCK ARM 3

(3) The cam encoder (mode control switch) is mounted on the cam gear.

The cam encoder has 2-mode switch which is switched on or off by the rotation of the cam gear. The mechanism is designed so that each mode corresponds to the position to which this mode switch is switched. By switching off the mode control motor when the mode switch is switched, the specified mode is transmitted to the system controller. (Refer to Fig. 4-3-4.)

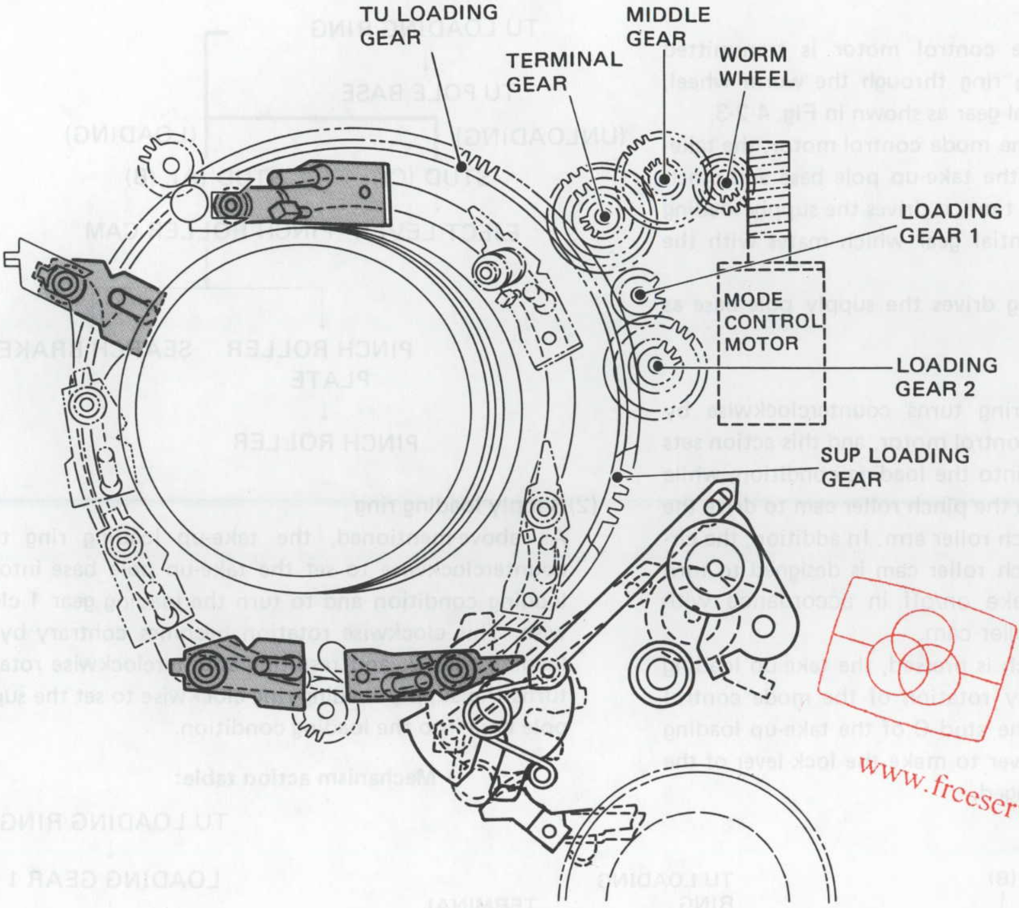
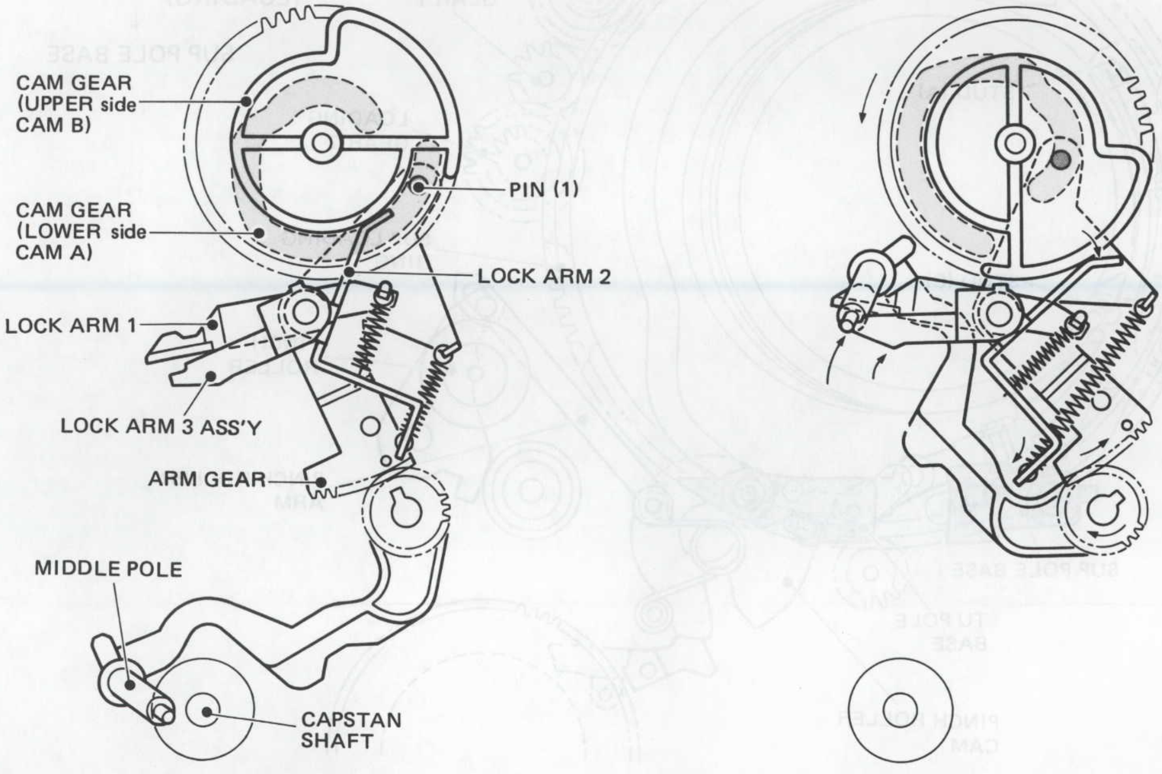


Fig. 4-2-2 Mode control motor



(A) Stop mode

(B) Tape play mode

Fig. 4-2-3 Cam gear

6. Loading ring

Rotation of the mode control motor is transmitted to the take-up loading ring through the worm wheel, middle gear and terminal gear as shown in Fig. 4-2-3.

Owing to rotation of the mode control motor, the take-up loading ring drives the take-up pole base and pinch roller cam. At the same time, it drives the supply loading ring by its circumferential gear which mates with the loading gears 1 and 2.

The supply loading ring drives the supply pole base as well as the eject lever.

(1) Take-up loading ring

The take-up loading ring turns counterclockwise by rotation of the mode control motor, and this action sets the take-up pole base into the loading condition, while its studs A and B rotate the pinch roller cam to drive the pinch roller via the pinch roller arm. In addition, the circumference of the pinch roller cam is designed to turn on/off the search brake on/off in accordance with rotation of the pinch roller cam.

When the EJECT switch is pressed, the take-up loading ring turns clockwise by rotation of the mode control motor. At this time, the stud C of the take-up loading ring pushes the eject lever to make the lock lever of the cassette housing disengaged.

Mechanism action table:

TU LOADING RING
↓
TU POLE BASE
(UNLOADING) (LOADING)
STUD (C) STUD (A), (B)
↓ ↓
EJECT LEVER PINCH ROLLER CAM
PINCH ROLLER PLATE SEARCH BRAKE
↓
PINCH ROLLER

(2) Supply loading ring

As above-mentioned, the take-up loading ring turns counterclockwise to set the take-up pole base into the loading condition and to turn the loading gear 1 clockwise. This clockwise rotation becomes contrary by the loading gear 2, and resulting counterclockwise rotation turns the supply loading ring clockwise to set the supply pole base into the loading condition.

Mechanism action table:

TU LOADING RING
↓
LOADING GEAR 1
↓
LOADING GEAR 2
↓
SUP LOADING RING
(LOADING) ↓
↓
SUP POLE BASE

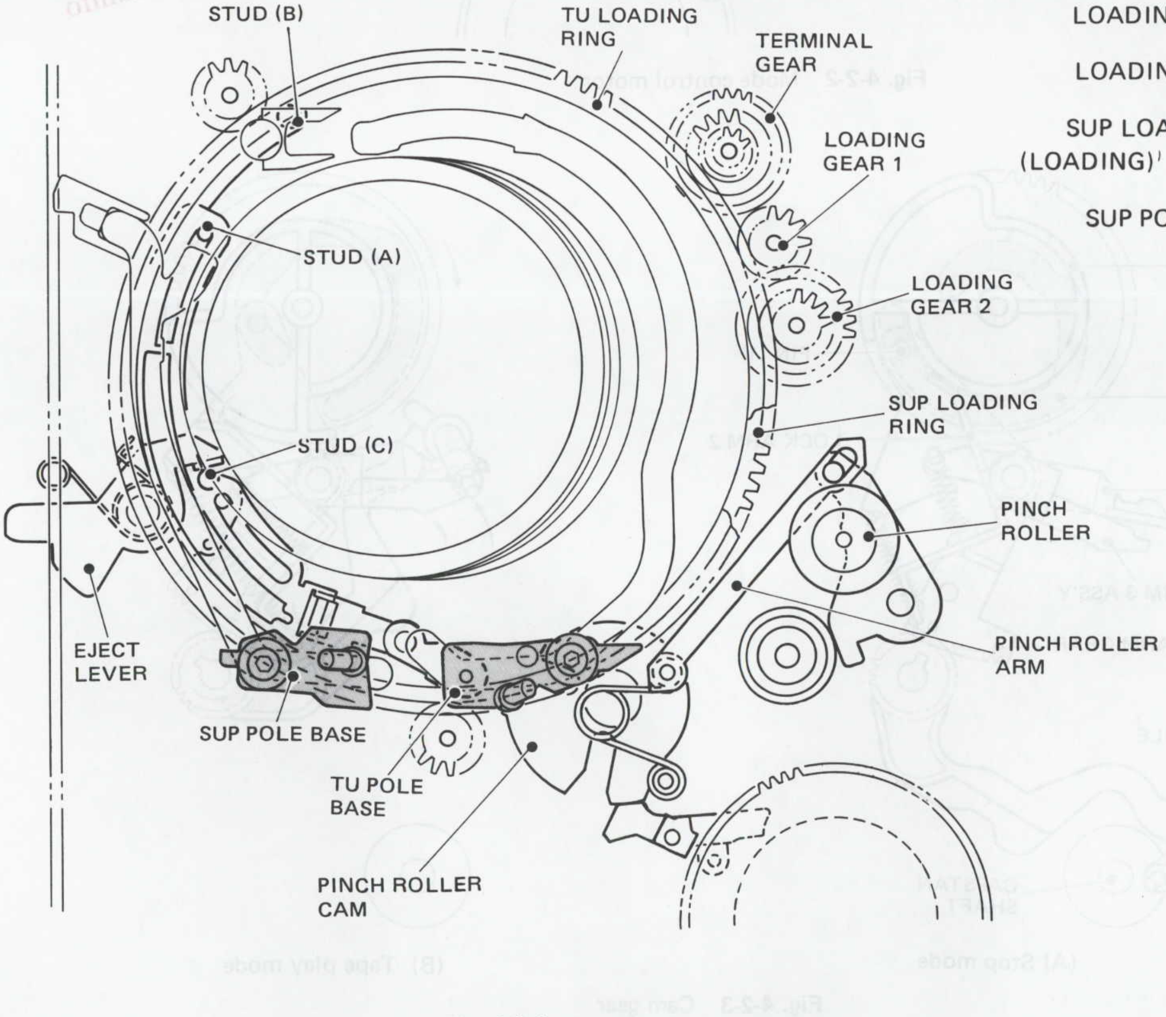


Fig. 4-2-4 Loading ring

7. Tension arm

The tension arm applies back tension to the tape when loading is complete in order to remove any slack from the tape and to provide back tension to the supply reel disk via the tension band.

During the stop mode, the tension arm is restricted by being pressed by the supply pole base; when loading starts, the tension arm is rotated counterclockwise by the force of the spring force as the supply pole base moves.

Fig. 4-2-5(A) shows the loading start condition.

When loading has started, as the tension arm is held by the supply pole base, it does not apply back tension to the tape. The tension band is also in the free state so it does not apply back tension to the supply reel disk which facilitates the supply of tape from the supply reel at the time of loading.

Mechanism action table:

TENSION POLE
↓
×←SUP POLE BASE
↓
BACK TENSION TENSION BAND

Fig. 4-2-5(B) shows the loading condition. The tension arm is freed from the supply pole base and the supply pole base causes the FE head arm to move out in the counterclockwise direction. As a result, as the cancel lever of the FE head arm moves the tension arm in the clockwise direction the tension arm and tension band are free from the tape and supply reel disk.

Mechanism action table:

TENSION POLE
↓
×←CANCEL LEVER = FE HEAD ARM
↑
SUP POLE BASE
BACK TENSION TENSION BAND

Fig. 2-4-5(C) shows a state immediately before loading is complete.

The FE head arm becomes free immediately before loading and is turned clockwise by the force of the torsion spring and the cancel lever is released. The tension arm opens fully to apply tension to the tape and, at the same time, presses the tension band against the supply reel disk.

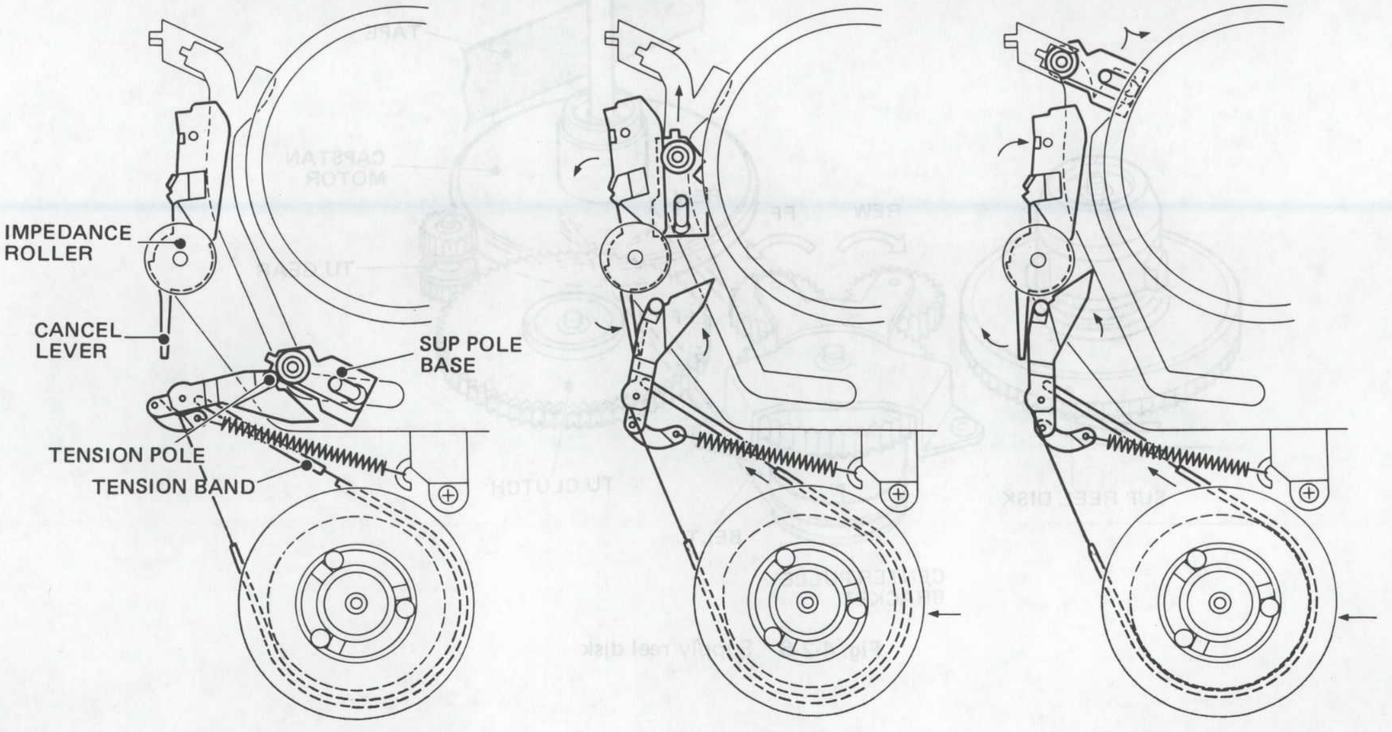
The tension band now applies a load to the supply reel disk, which serves as a loading brake, preventing tape from becoming slack due to the inertia of loading.

During the play mode, tension servo is applied to the tape by the tension arm and tension band.

The tension servo mechanism makes the tape tension which varies at the take-up reel constant at the drum inlet.

Mechanism action table:

TENSION POLE
BACK TENSION TENSION BAND
↓ ↓
TAPE LOADING BRAKE
↓
SUP REEL DISK



(A) Loading starts. (B) During loading (C) Loading complete

Fig. 4-2-5 Tension arm

8. Supply reel disk

The supply reel disk supplies tape during loading and in the play mode and takes up tape during unloading and in the rewind mode.

During loading, the supply reel disk is completely free and tape supply is controlled by the supply reel.

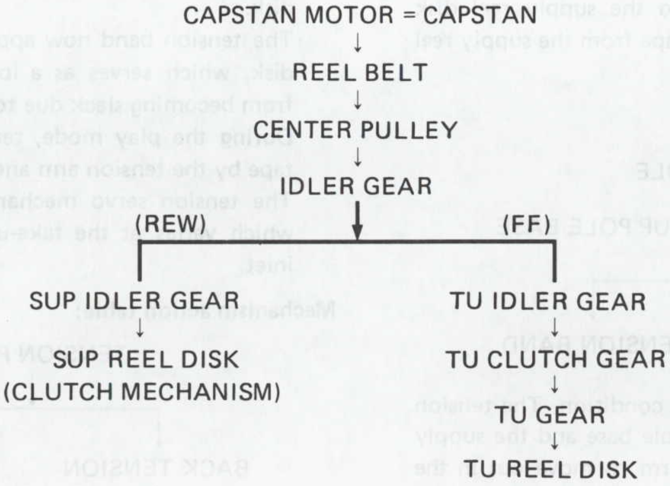
During the play mode, the tension servo acts on the supply reel disk from the tension band, permitting stable tape supply.

At this time, the tape travels due to the rotation of the capstan and is taken up (wound) by the take-up gear to which the rotation of the capstan motor is transmitted.

During unloading, the rotation of the capstan motor is transmitted to the supply reel disk via the center pulley which drives the supply reel to take up the tape.

During the rewind mode, the tape is wound at high speed onto the supply reel. When the end of tape is reached, the load applied to the tape increases. To alleviate this load, the supply reel disk incorporates a clutch mechanism.

Mechanism action table:



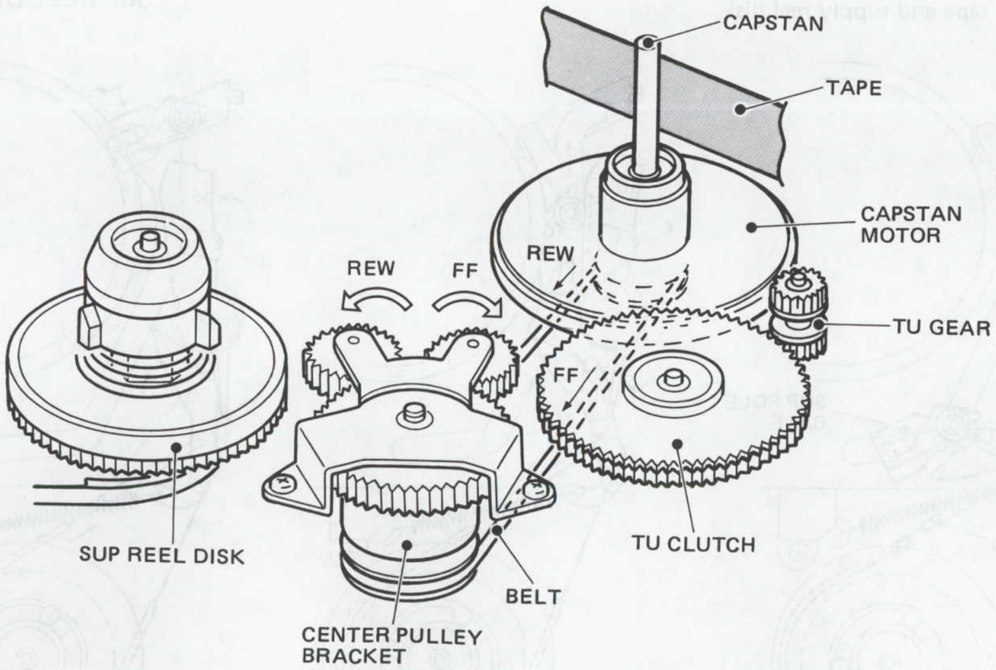


Fig. 4-2-6 Supply reel disk

9. Tape guides

The tape travels along the poles and rollers as shown in Fig. 4-2-7.

The impedance roller serves as a height reference for the cassette outlet and supply side (tape inlet), permitting tape to be supplied stably. This also alleviates vertical vibrations which could cause jitter in the picture and wow & flutter in the sound.

The supply guide roller and take-up guide roller play an important role in making the beginning and end of the FM waveform linear.

The angle of the A/C head is adjusted so that the tape travels smoothly along the flange of the take-up guide pole, thereby playing an important role in tape compatibility.

The take-up guide pole serves as a height reference at the take-up side (tape outlet) and cassette inlet.

10. A/C head and FE (flying erase) head

In the course of tape running on the FE head, rotary head drum and A/C head one after another in recording, such the proceeding as 2-frame erasure, video signal recording, audio signal recording and control signal recording take place.

Since the FE head is installed at 135° delayed to CH1 of the rotary drum head, it erases signals for 2 frames in SP mode while it does the same for 6 frames in EP mode.

By wrapping the tape around the rotary head drum by 270°, exactly the same video signal as in the conventional VHS system is recorded on the same track.

The A/C head consists of the erase head, audio head and control head. With the video signal recorded over the entire width of the tape, the audio track and control track are erased by the erase head when the audio signal and control signal are recorded using the audio head and control head.

If the position of the audio/control head is not correct and a tape recorded on one deck is played back by another, the audio output may drop, the S/N ratio may deteriorate or the control signal may not be picked up, thereby losing compatibility.

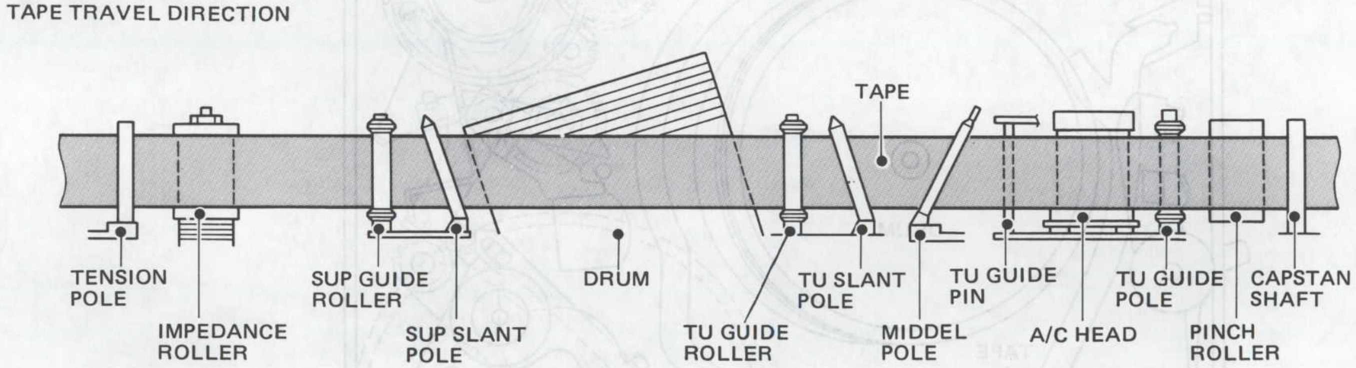


Fig. 4-2-7 Tape guide

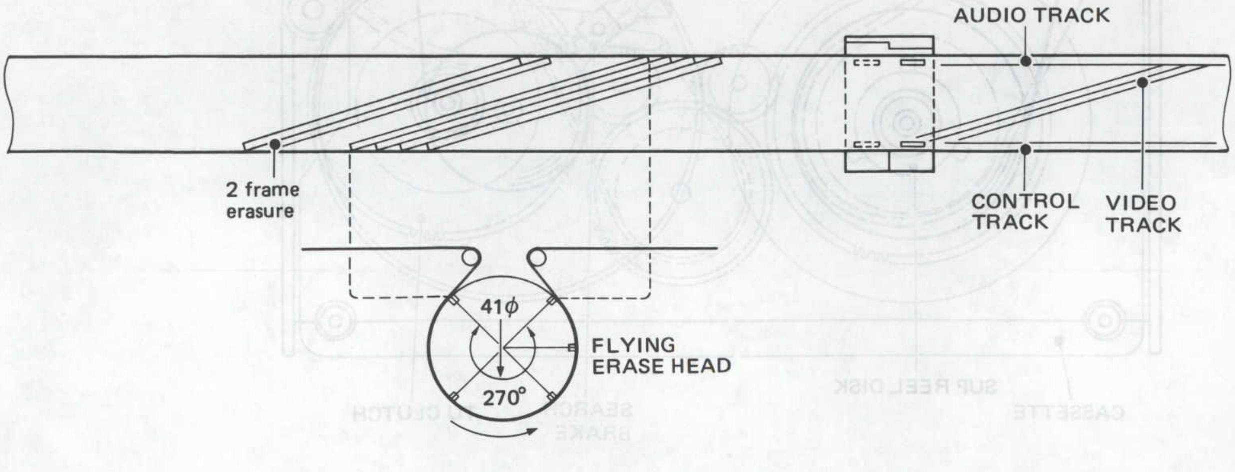


Fig. 4-2-8 A/C head and flying erase head

4.3 DESCRIPTION OF MECHANISM MODE OPERATIONS

4.3.1 Stop mode

When the power is switched on, if a tape is loaded, it is slightly rewound to pull in the slack of the tape. The still state after the short rewind is called Stop mode.

In this state, the drum, capstan, and mode control motor are stopped, while the take-up brake presses against the take-up clutch to avoid unreasonable turning of the reel inside the cassette because this causes slackening in the tape.

Supply pole base, take-up pole base, tension pole and middle pole are positioned to permit the tape to be pulled out from the cassette, that is, they are positioned so that they are inside the cassette when a cassette is loaded. The pinch roller is moved away from the capstan to a position where it cannot interfere with the loading and unloading of the cassette.

The cassette switch is switched on and off by the cassette housing moving up and down.

Mode shift table:

POWER SW : ON
↓
SHORT REW
↓
STOP MODE

Mechanism action table:

DRUM MOTOR : STOP
CAPSTAN MOTOR : STOP
MODE CONTROL MOTOR : STOP
TU CLUTCH←TU BRAKE : ON

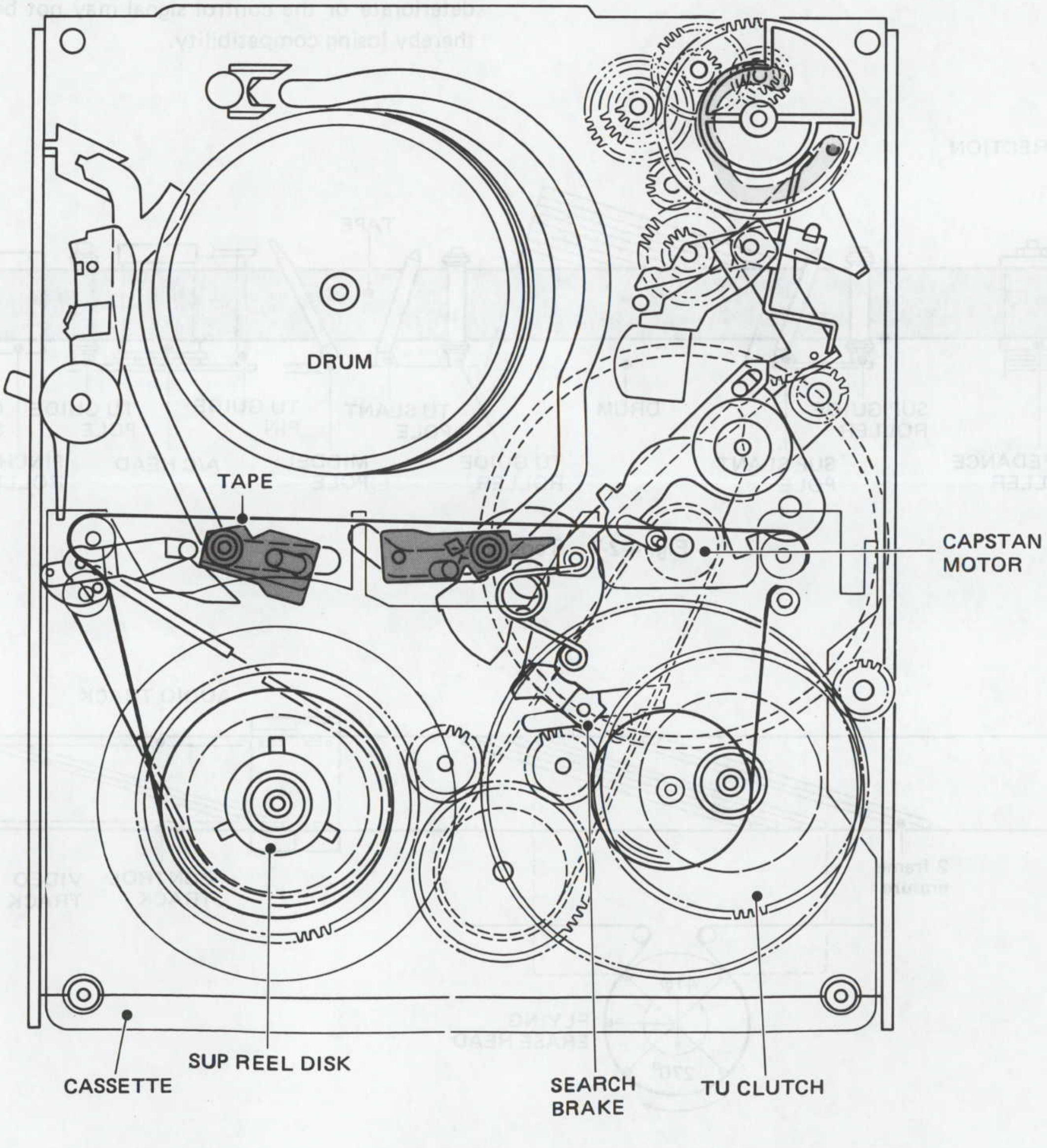


Fig. 4-3-1 Stop mode

4.3.2 Eject mode

When the EJECT button is pressed in the Stop mode, the loading ring starts unloading operation and it pushes the eject lever to release the cassette housing lock lever from the engagement.

Mode shift table:

STOP MODE
↓ EJECT SW : ON
UNLOADING
↓
EJECT MODE

As the EJECT button is pressed in the Stop mode, the syscon directs the mode control motor to start rotation. By the rotation, the mode control motor drives the loading ring to start additional unloading at the position of the Stop mode and the eject lever is pushed by the stud C of the take-up loading ring (see Fig. 4-3-2). Then, the eject lever pushes the cassette housing lock lever to release the housing arm stud from the lock lever. As a result, the Eject operation takes place.

Mechanism action table:

EJECT SW : ON
↓
MODE CONTROL MOTOR : ON
↓
WORM GEAR
↓
WORM WHEEL
↓
MIDDLE GEAR
↓
TERMINAL GEAR
↓
TU LOADING RING
| (UNLOADING)
STUD (C)
↓
EJECT LEVER
↓
HOUSING LOCK LEVER

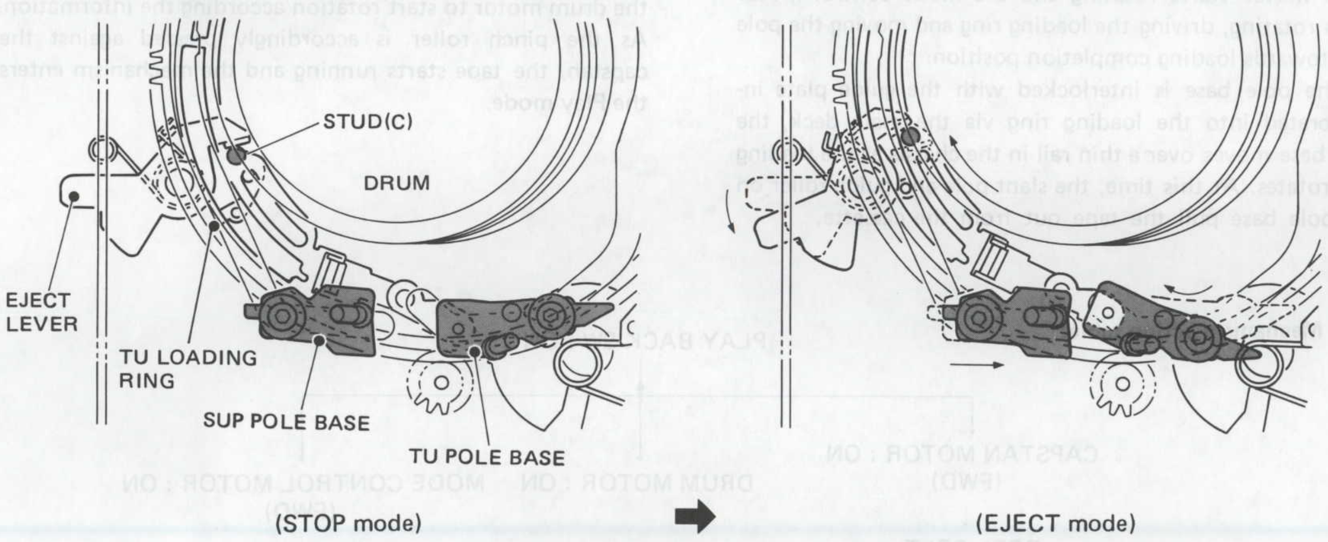


Fig. 4-3-2(A) EJECT mode

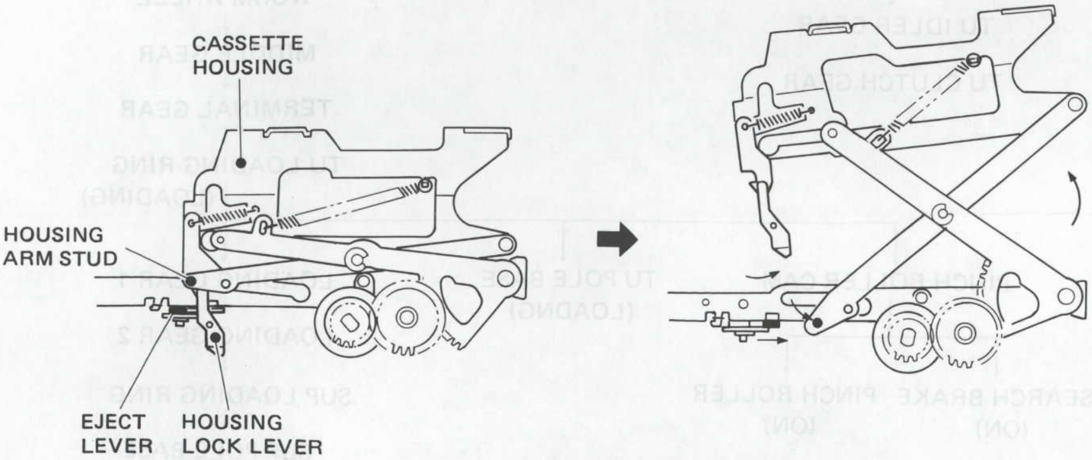


Fig. 4-3-2(B) EJECT mode

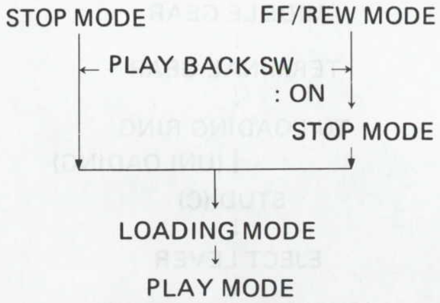
4.3.3 Loading mode

The mode in which the tape is pulled out of the cassette and set to the travel system (mechanism) is called the loading mode.

When the PLAY switch is pressed in the stop mode, the capstan motor rotates in the counterclockwise direction following an instruction from the system controller.

When the PLAY switch is pressed in the FF or rewind mode, the loading mode is entered after transferring to the stop mode.

Mode shift table:



The center pulley bracket is pressed against the take-up clutch by the rotation of the capstan motor. After this, the drum motor starts rotating and the mode control motor starts rotating, driving the loading ring and moving the pole base towards loading completion position.

As the pole base is interlocked with the guide plate incorporated into the loading ring via the main deck, the pole base moves over a thin rail in the chassis as the loading ring rotates. At this time, the slant pole and guide roller on the pole base pull the tape out from the cassette.

The supply reel disk is completely free, the supply of tape druing loading is performed under the control of the supply reel.

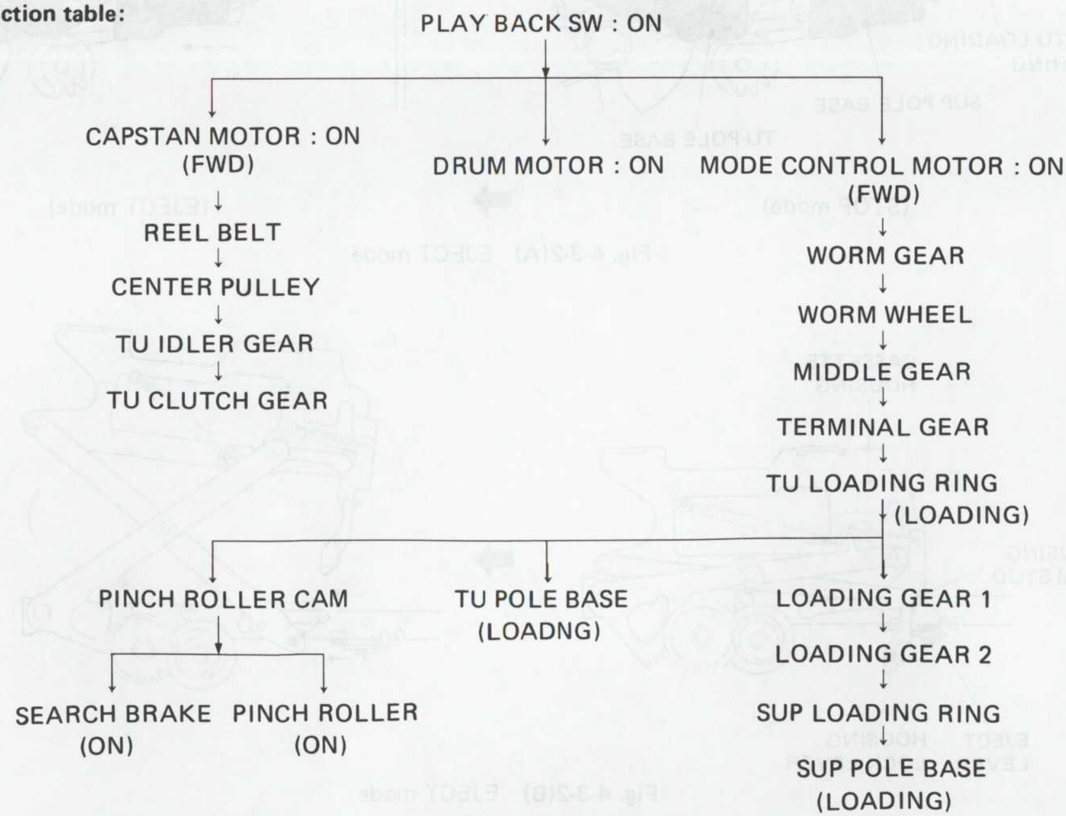
When the take-up pole base advances to approach the loading completion position, the pinch roller arm starts rotating by the action of the pinch roller cam which is engaged with the studs A, B of the take-up loading ring. As the pinch roller arm is interlocked with the pinch roller, the movement of the loading ring is transmitted to the pinch roller. For this reason, as the loading ring rotates, the studs A, B traces the groove in the pinch roller cam, transmitting the clockwise rotation. The clockwise rotation is transmitted to the pinch roller as counterclockwise rotation due to the pinch roller arm and the pinch roller moves towards the capstan spindle.

At the same time, rotation of the pinch roller cam is transmitted to the search brake. When the loading ring approaches the loading finish position, the search brake, which has been pressed by the pinch roller cam's circumference, becomes free. Accordingly, the search brake is pulled by the spring and pressed on the take-up clutch.

The mode control switch also comes into operation by rotation of the cam gear, therefore information about the current mode is transmitted to the mechacon, which directs the drum motor to start rotation according the information.

As the pinch roller is accordingly pressed against the capstan, the tape starts running and the mechanism enters the Play mode.

Mechanism action table:



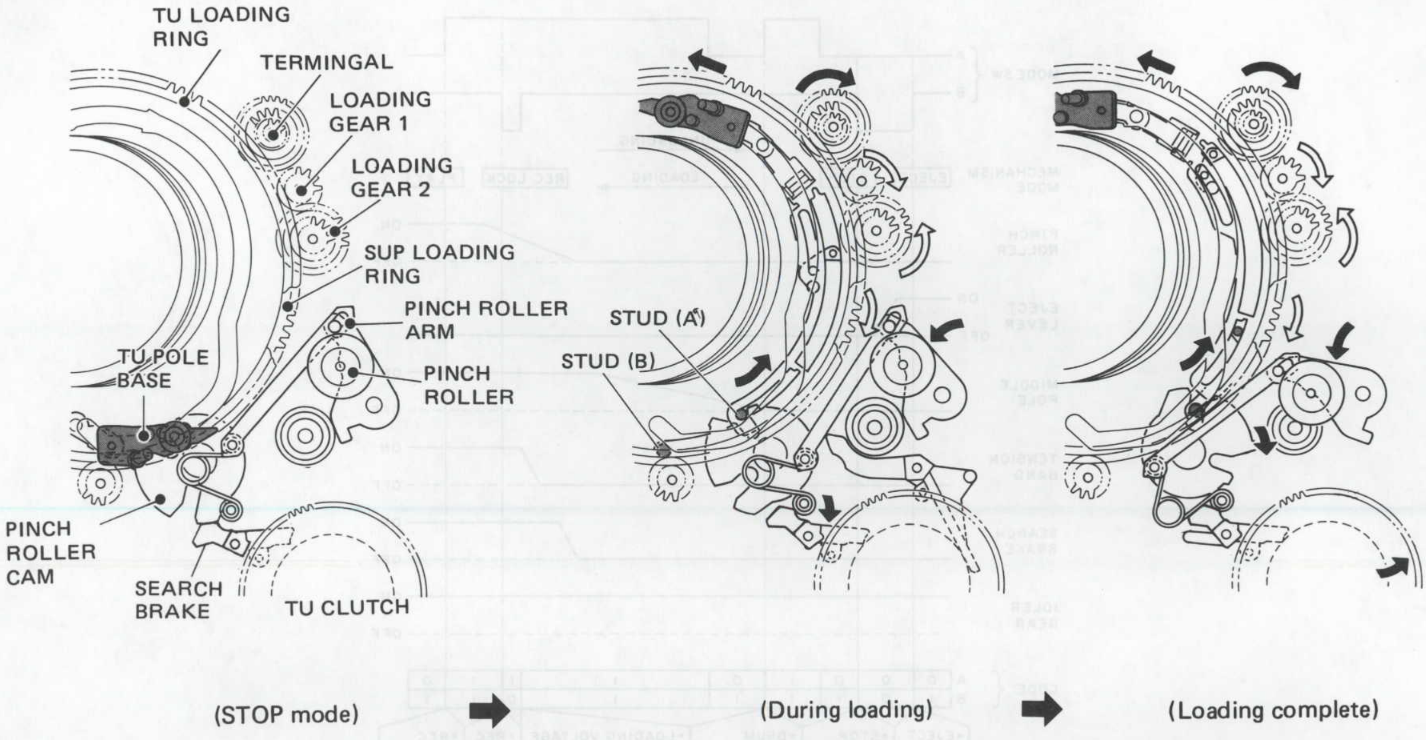


Fig. 4-3-3(A) Loading mode

Direction (➡) in take-up loading
Direction (⇨) in supply loading

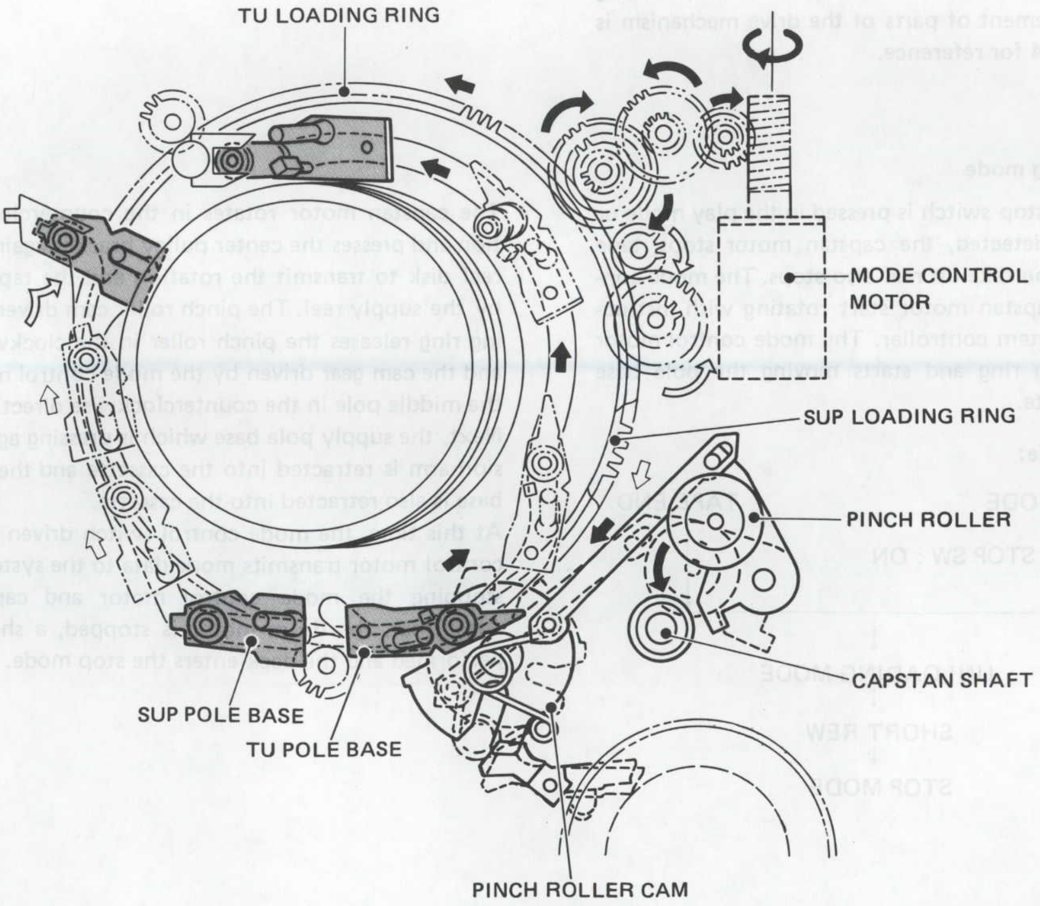


Fig. 4-3-3(B) Loading mode

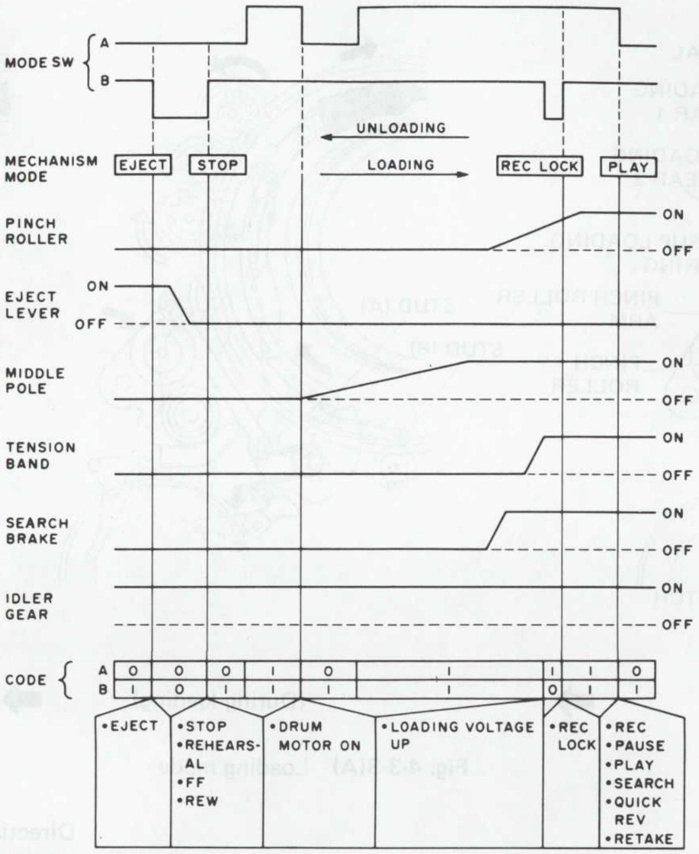


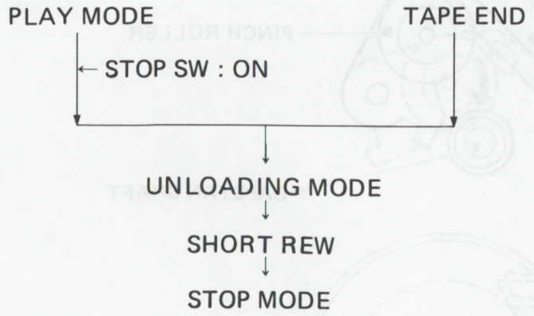
Fig. 4-3-4 Mechanism mode timing chart

The relation between the movement of the take-up loading ring and the movement of parts of the drive mechanism is shown in Fig. 4-3-4 for reference.

4.3.4 Unloading mode

The moment the stop switch is pressed in the play mode or the tape end is detected, the capstan motor stops, tape travel stops and the take-up reel also stops. The mode control motor and capstan motor start rotating with instructions from the system controller. The mode control motor drives the loading ring and starts moving the pole base towards the cassette.

Mode shift table:

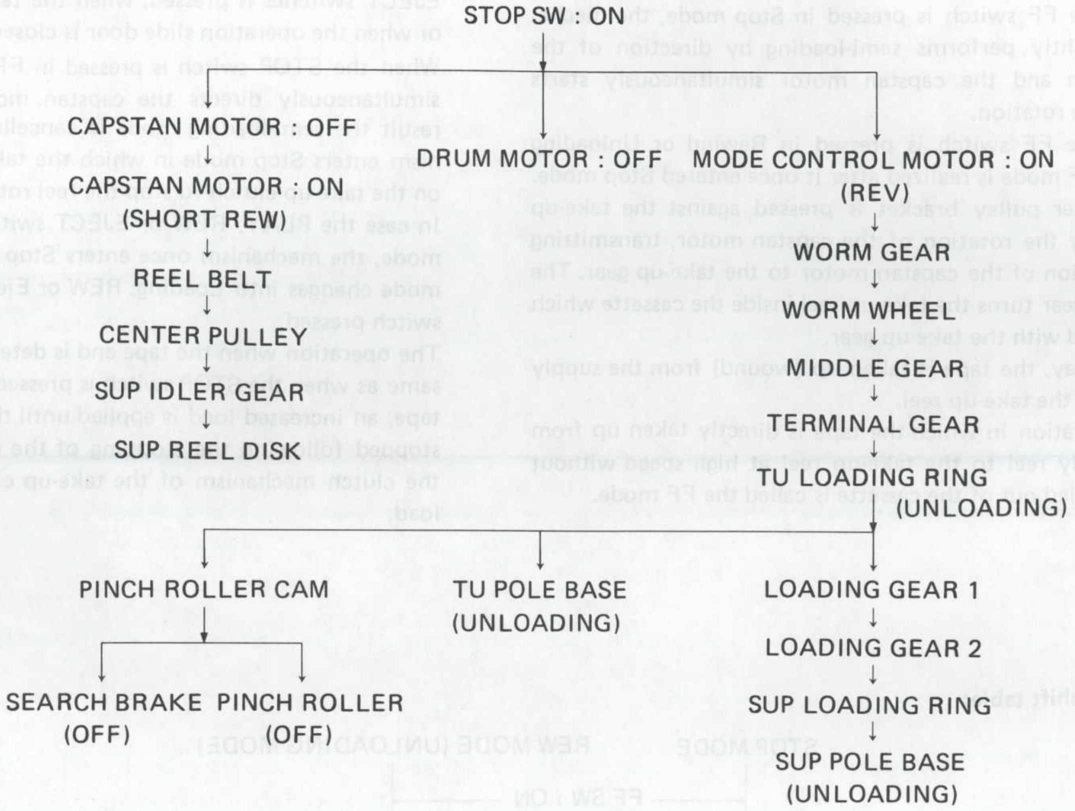


The capstan motor rotates in the counterclockwise direction and presses the center pulley bracket against the supply reel disk to transmit the rotation and the tape is taken up by the supply reel. The pinch roller cam driven by the loading ring releases the pinch roller in the clockwise direction and the cam gear driven by the mode control motor releases the middle pole in the counterclockwise direction.

Next, the supply pole base which is pressing against the tension arm is retracted into the cassette and the take-up pole base is also retracted into the cassette.

At this time, the mode control switch driven by the mode control motor transmits mode data to the system controller, stopping the mode control motor and capstan motor. After that, the drum motor is stopped, a short rewind is performed and the deck enters the stop mode.

Mechanism action table:



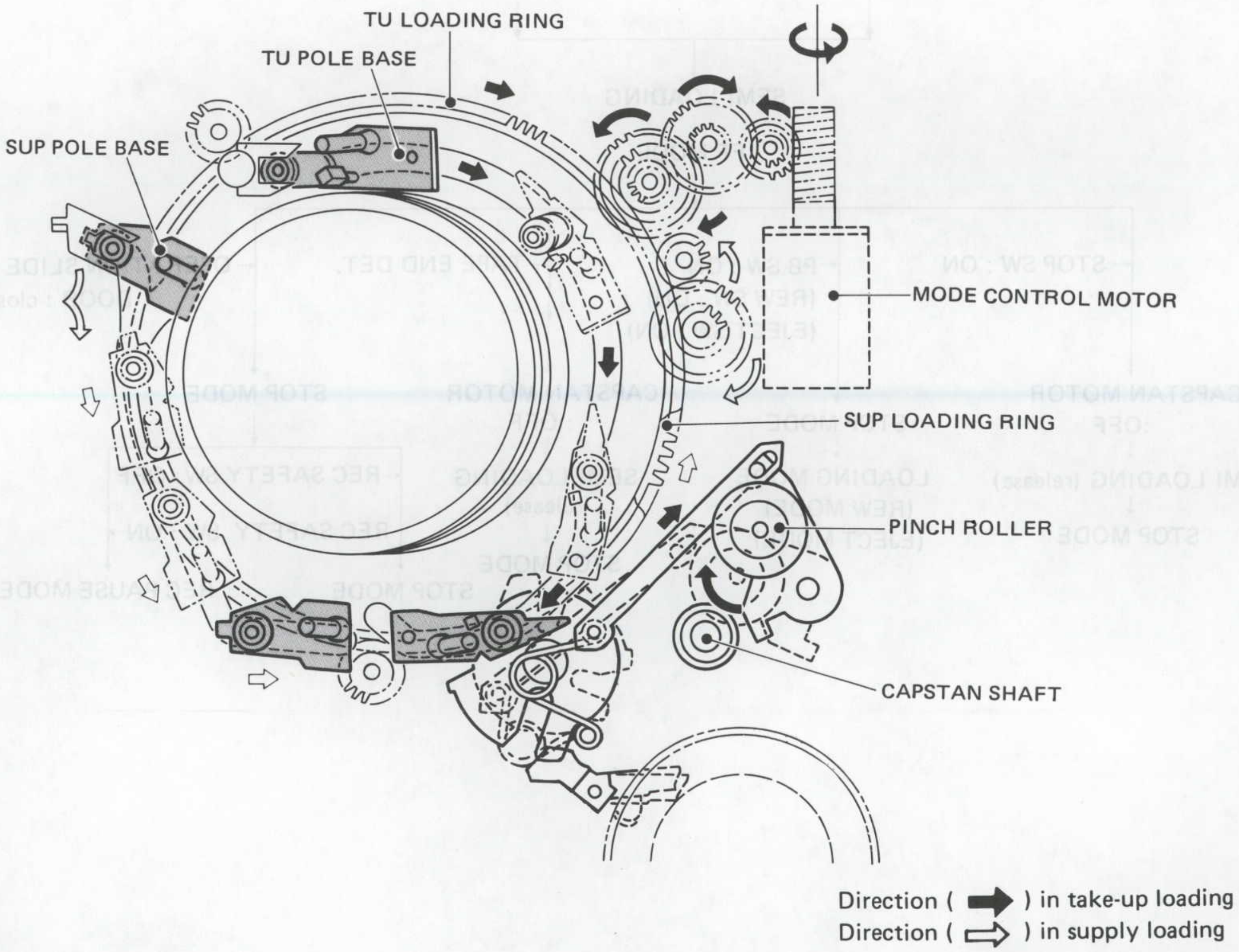


Fig. 4-3-5 Unloading mode

4.3.5 FF mode

When the FF switch is pressed in Stop mode, the mechanism slightly performs semi-loading by direction of the mechacon and the capstan motor simultaneously starts clockwise rotation.

When the FF switch is pressed in Rewind or Unloading mode, FF mode is realized after it once entered Stop mode.

The center pulley bracket is pressed against the take-up clutch by the rotation of the capstan motor, transmitting the rotation of the capstan motor to the take-up gear. The take-up gear turns the take-up reel inside the cassette which is engaged with the take-up gear.

In this way, the tape is taken up (wound) from the supply reel onto the take-up reel.

The operation in which the tape is directly taken up from the supply reel to the take-up reel at high speed without being pulled out of the cassette is called the FF mode.

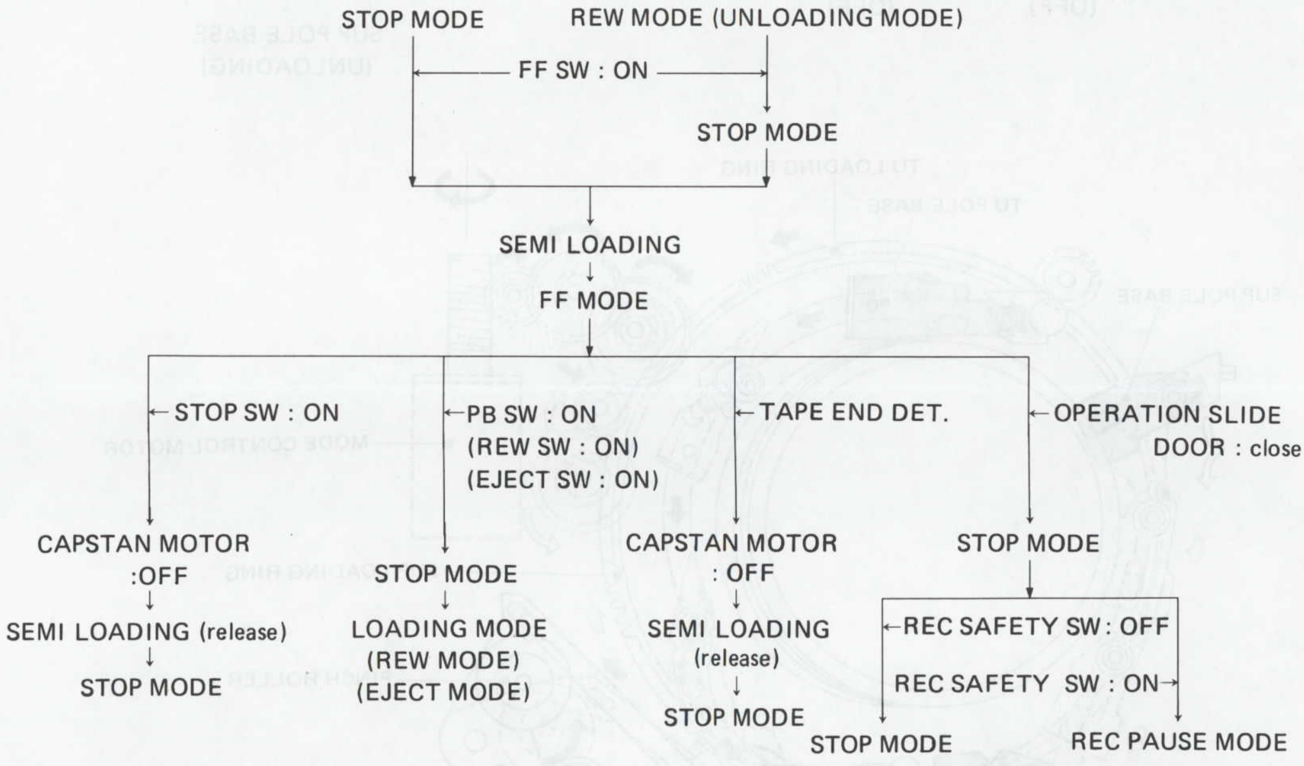
FF mode ends when any of the STOP, PLAY, REW and EJECT switches is pressed, when the tape end is detected, or when the operation slide door is closed.

When the STOP switch is pressed in FF mode, the syscon simultaneously directs the capstan motor to stop. As a result the semi-loading mode is cancelled and the mechanism enters Stop mode in which the take-up brake presses on the take-up clutch to stop the reel rotation.

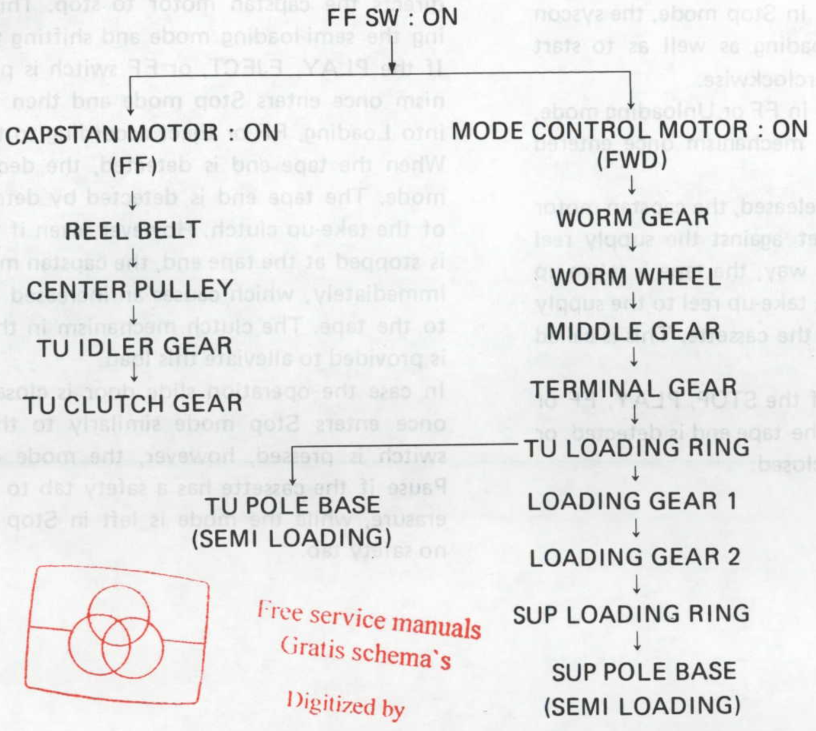
In case the PLAY, REW or EJECT switch is pressed in FF mode, the mechanism once enters Stop mode and then the mode changes into Loading, REW or Eject according to the switch pressed.

The operation when the tape end is detected is virtually the same as when the STOP switch is pressed. At the end of the tape, an increased load is applied until the capstan motor is stopped following the stopping of the reel disk. However, the clutch mechanism of the take-up clutch alleviates this load.

Mode shift table:



Mechanism action table:



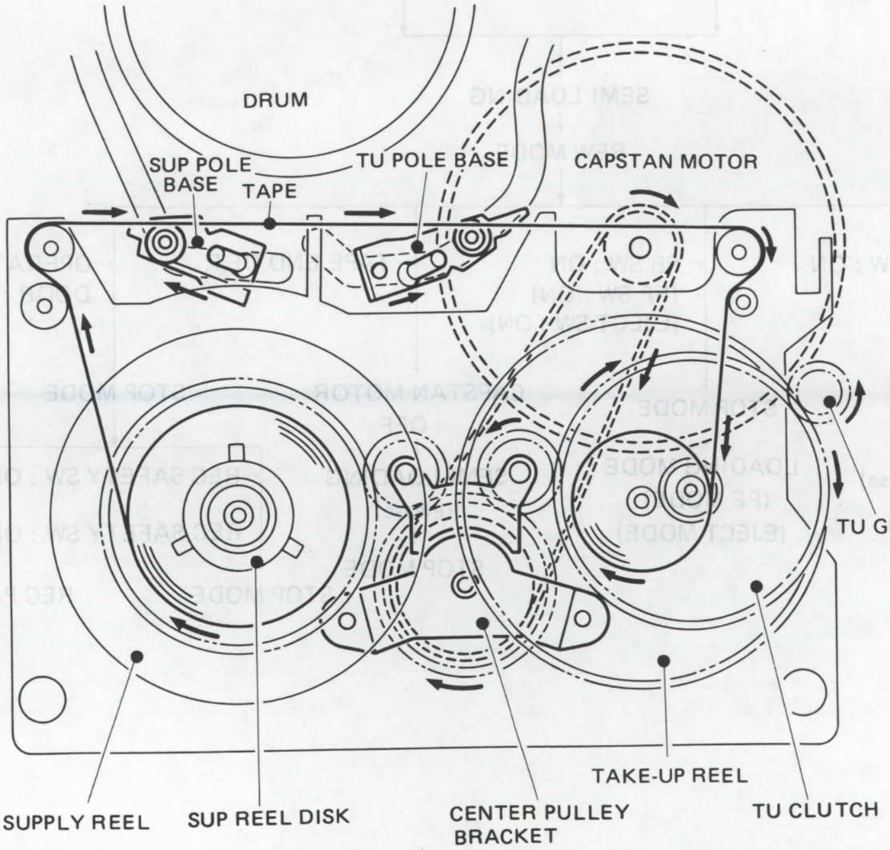


Fig. 4-3-6 FF mode

4.3.6 REW mode

When the REW switch is pressed in Stop mode, the syscon directs to operate slight semi-loading as well as to start the capstan motor to turn counterclockwise.

In case the REW switch is pressed in FF or Unloading mode, REW mode is realized after the mechanism once entered Stop mode.

The moment the main brake is released, the capstan motor presses the center pulley bracket against the supply reel disk to transmit rotation. In this way, the tape is taken up (rewound) at high speed from the take-up reel to the supply reel without being pulled out of the cassette. This is called the Rewind mode.

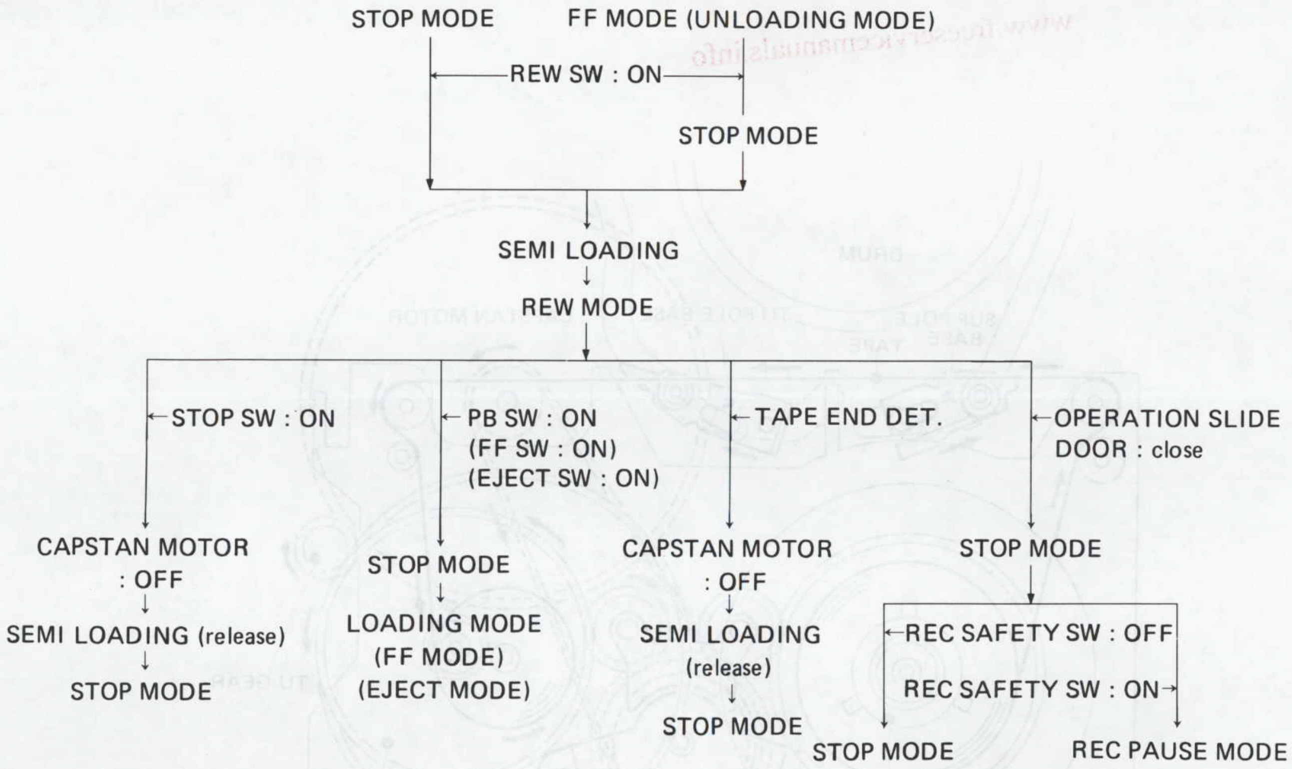
Rewind mode ends when any of the STOP, PLAY, FF or EJECT switch is pressed, when the tape end is detected, or when the operation slide door is closed.

Immediately after the STOP switch is pressed, the syscon directs the capstan motor to stop. This results in releasing the semi-loading mode and shifting the mode to Stop. If the PLAY, EJECT, or FF switch is pressed, the mechanism once enters Stop mode and then the mode changes into Loading, FF or Eject according to the switch pressed.

When the tape end is detected, the deck enters the Stop mode. The tape end is detected by detecting the rotation of the take-up clutch. However, even if the take-up clutch is stopped at the tape end, the capstan motor does not stop immediately, which causes an increased load to be applied to the tape. The clutch mechanism in the supply reel disk is provided to alleviate this load.

In case the operation slide door is closed, the mechanism once enters Stop mode similarly to the case the STOP switch is pressed, however, the mode is shifted to REC Pause if the cassette has a safety tab to prevent erroneous erasure, while the mode is left in Stop if the cassette has no safety tab.

Mode shift table:



Mechanism action table:

REW SW : ON

CAPSTAN MOTOR : ON (REW)
↓
REEL BELT
↓
CENTER PULLEY
↓
SUP IDLER GEAR
↓
SUP CLUTCH GEAR

MODE CONTROL MOTOR : ON (FWD)
↓
WORM GEAR
↓
WORM WHEEL
↓
MIDDLE GEAR
↓
TERMINAL GEAR
↓
TU LOADING RING → TU POLE BASE (SEMI LOADING)
↓
LOADING GEAR 1
↓
LOADING GEAR 2
↓
SUP LOADING RING
↓
SUP POLE BASE (SEMI LOADING)

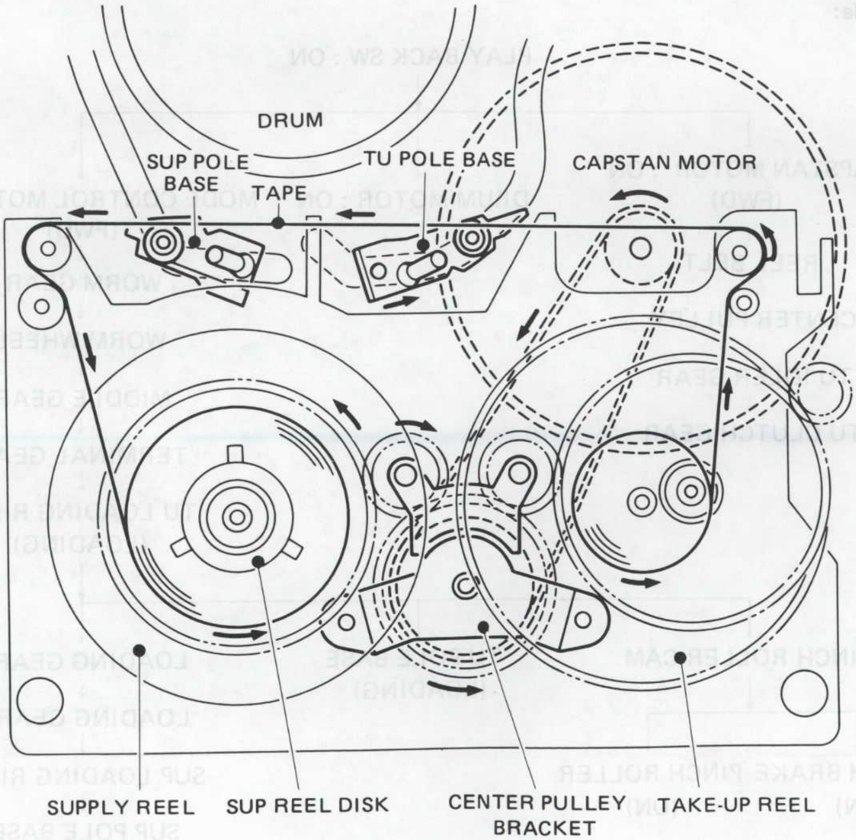


Fig. 4-3-7 Rewind mode

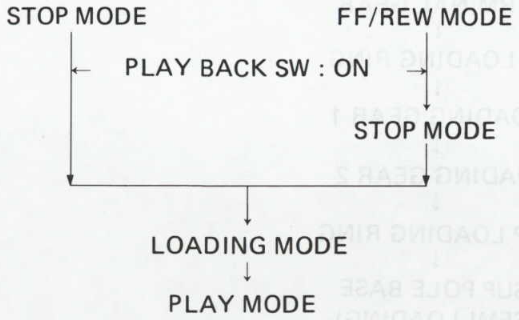
4.3.7 Play mode

Even during loading, the mode control motor continues to rotate slightly. However, mode control switch soon transmits the mode data to the system controller and stops the mode control motor which drives the loading ring.

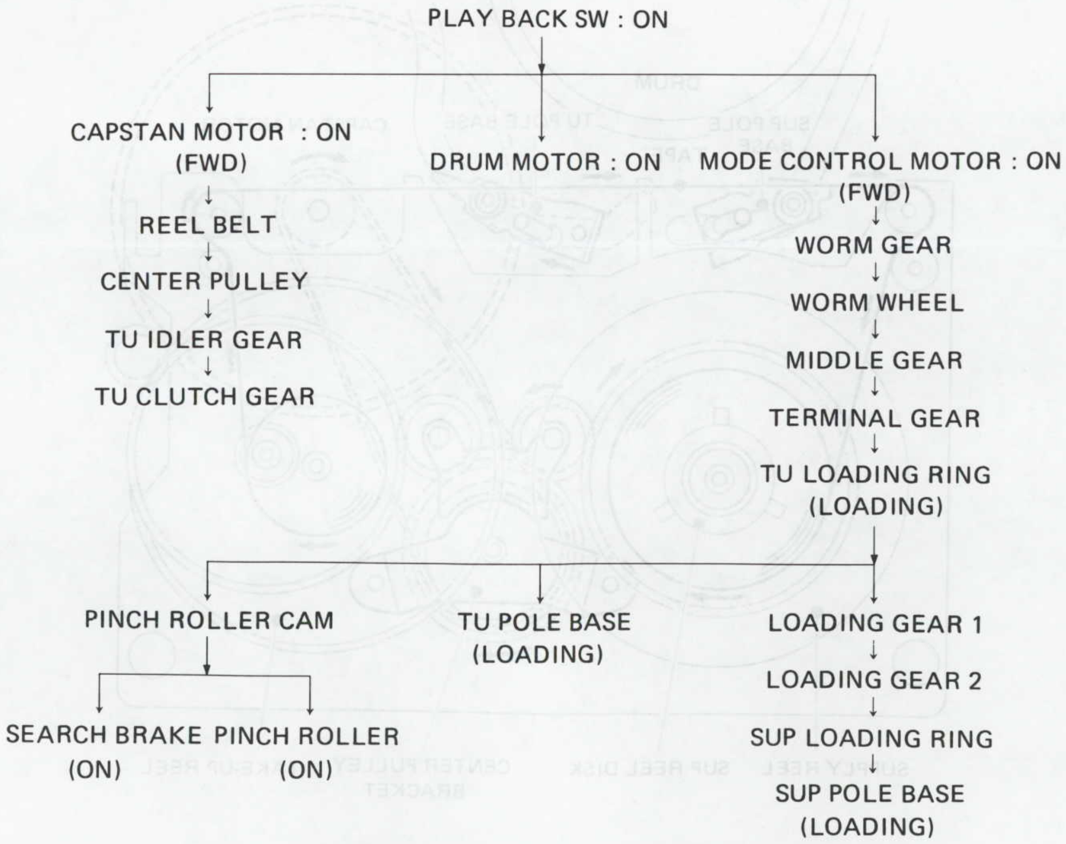
In the play mode, the tape travels due to the rotation of the capstan and is taken up (wound) onto the take-up reel by the take-up gear to which the rotation of the capstan motor is transmitted. Although the amount of tape supplied by the capstan is constant, the speed of rotation of the take-up reel varies depending on the amount of tape taken up. However, the clutch mechanism of the take-up clutch operates to correct this.

Tension servo is applied to the tape by the tension arm and tension band. Tension servo is a mechanical servo system provided to make the tape tension which varies as the diameter of the tape wound on the reels changes constant at the drum inlet.

Mode shift table:



Mechanism action table:



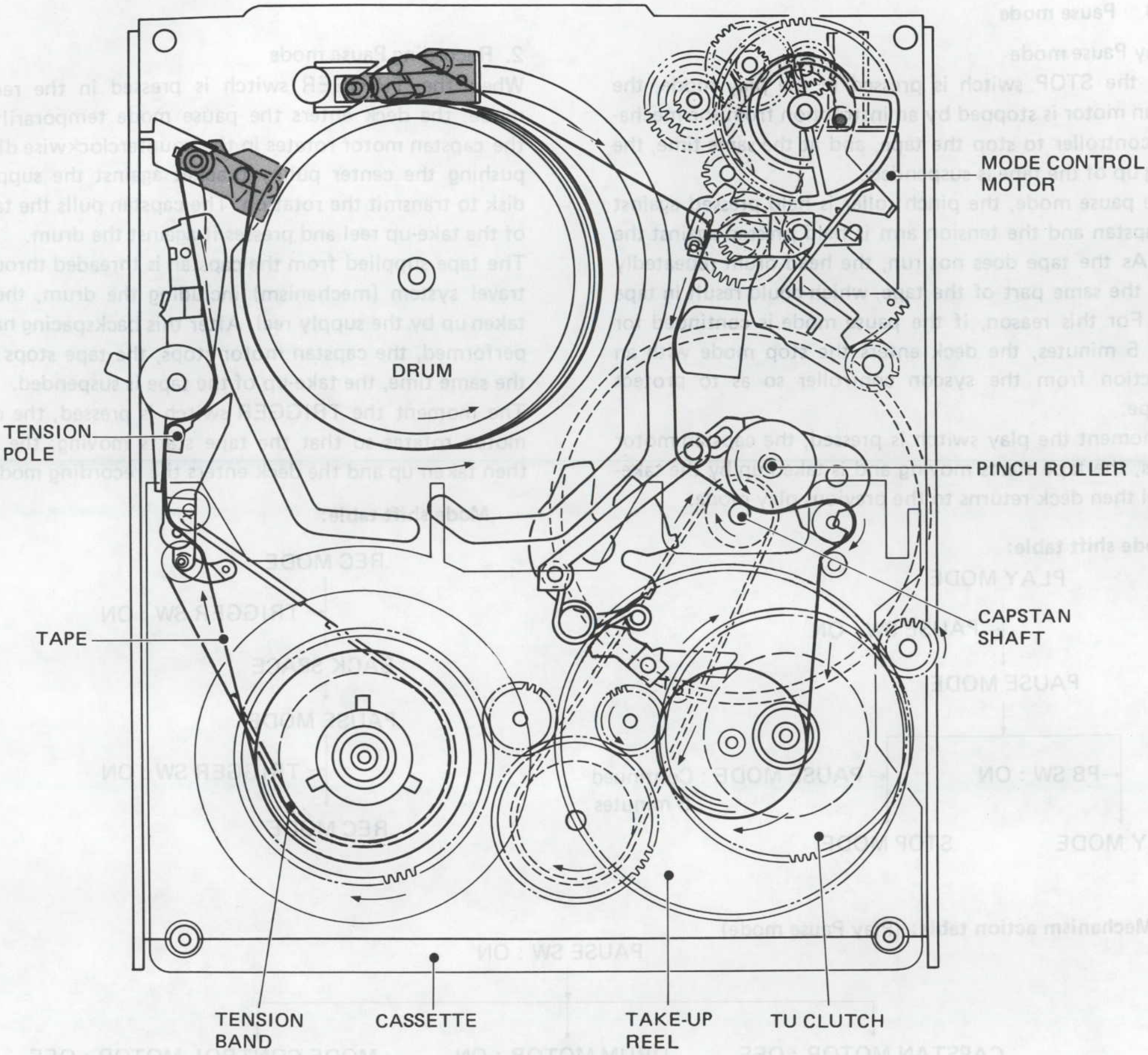


Fig. 4-3-8 Play mode

4.3.8 Pause mode

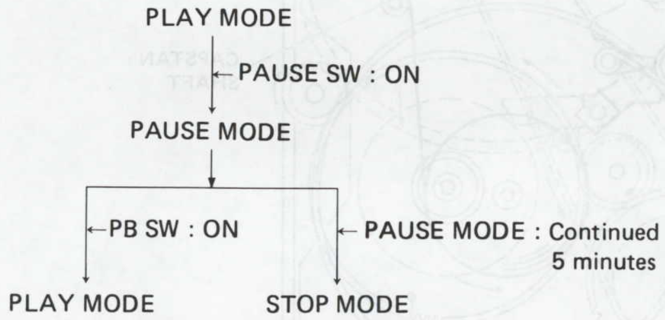
1. Play Pause mode

When the STOP switch is pressed in the play mode, the capstan motor is stopped by an instruction from the mechanism controller to stop the tape, and at the same time, the taking up of the tape is suspended.

In the pause mode, the pinch roller is held pressed against the capstan and the tension arm is held pressed against the tape. As the tape does not run, the head drum repeatedly traces the same part of the tape, which could result in tape wear. For this reason, if the pause mode is continued for about 5 minutes, the deck enters the stop mode with an instruction from the syscon controller so as to protect the tape.

The moment the play switch is pressed, the capstan motor rotates, the tape starts moving and is taken up by the take-up reel then deck returns to the previous play mode.

Mode shift table:



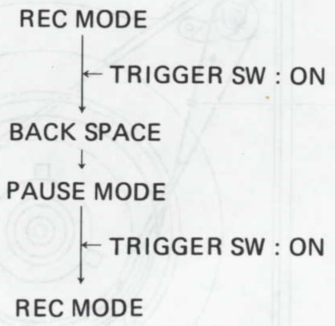
2. Recording Pause mode

When the TRIGGER switch is pressed in the recording mode, the deck enters the pause mode temporarily, then the capstan motor rotates in the counterclockwise direction, pushing the center pulley bracket against the supply reel disk to transmit the rotation. The capstan pulls the tape out of the take-up reel and presses it against the drum.

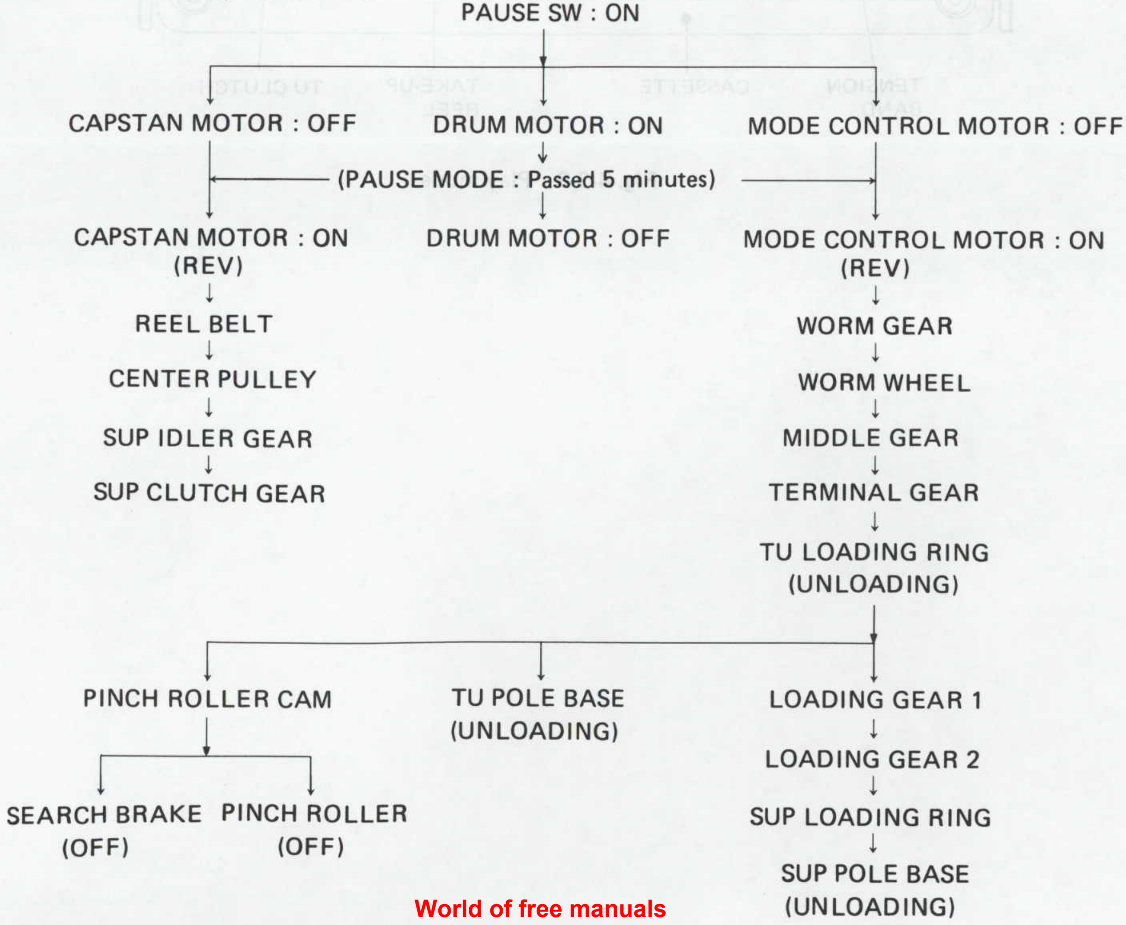
The tape supplied from the capstan is threaded through the travel system (mechanism) including the drum, then it is taken up by the supply reel. After this backspacing has been performed, the capstan motor stops, the tape stops and, at the same time, the take-up of the tape is suspended.

The moment the TRIGGER switch is pressed, the capstan motor rotates so that the tape starts moving; the tape is then taken up and the deck enters the recording mode.

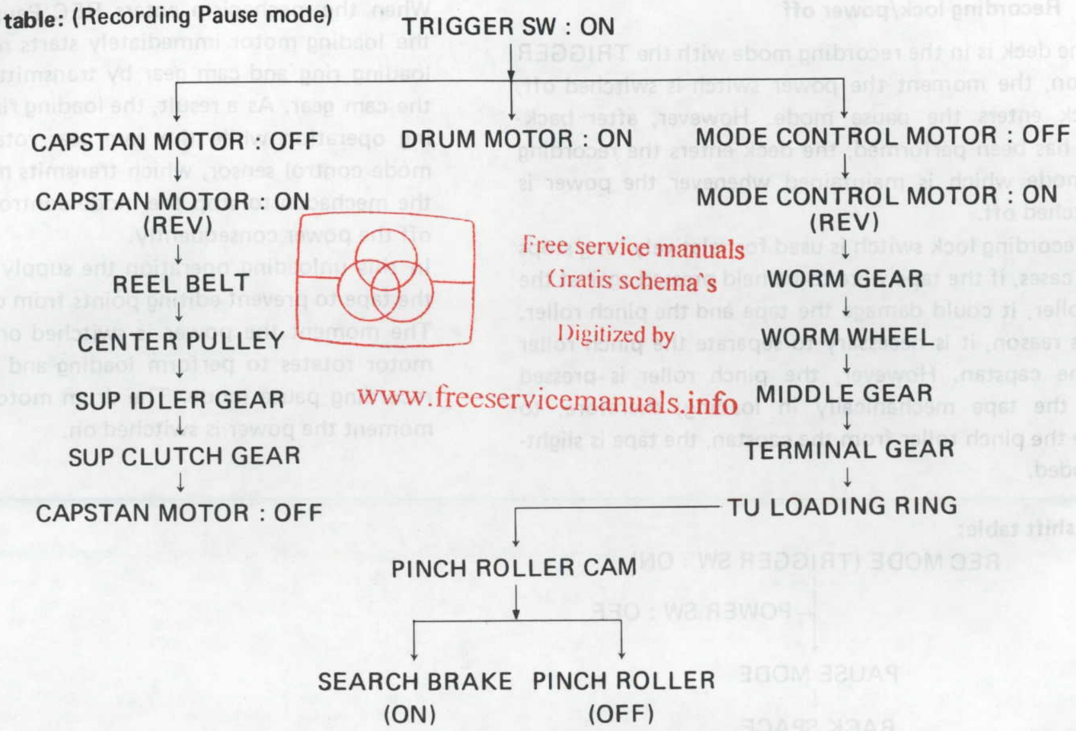
Mode shift table:



Mechanism action table: (Play Pause mode)



Mechanism action table: (Recording Pause mode)



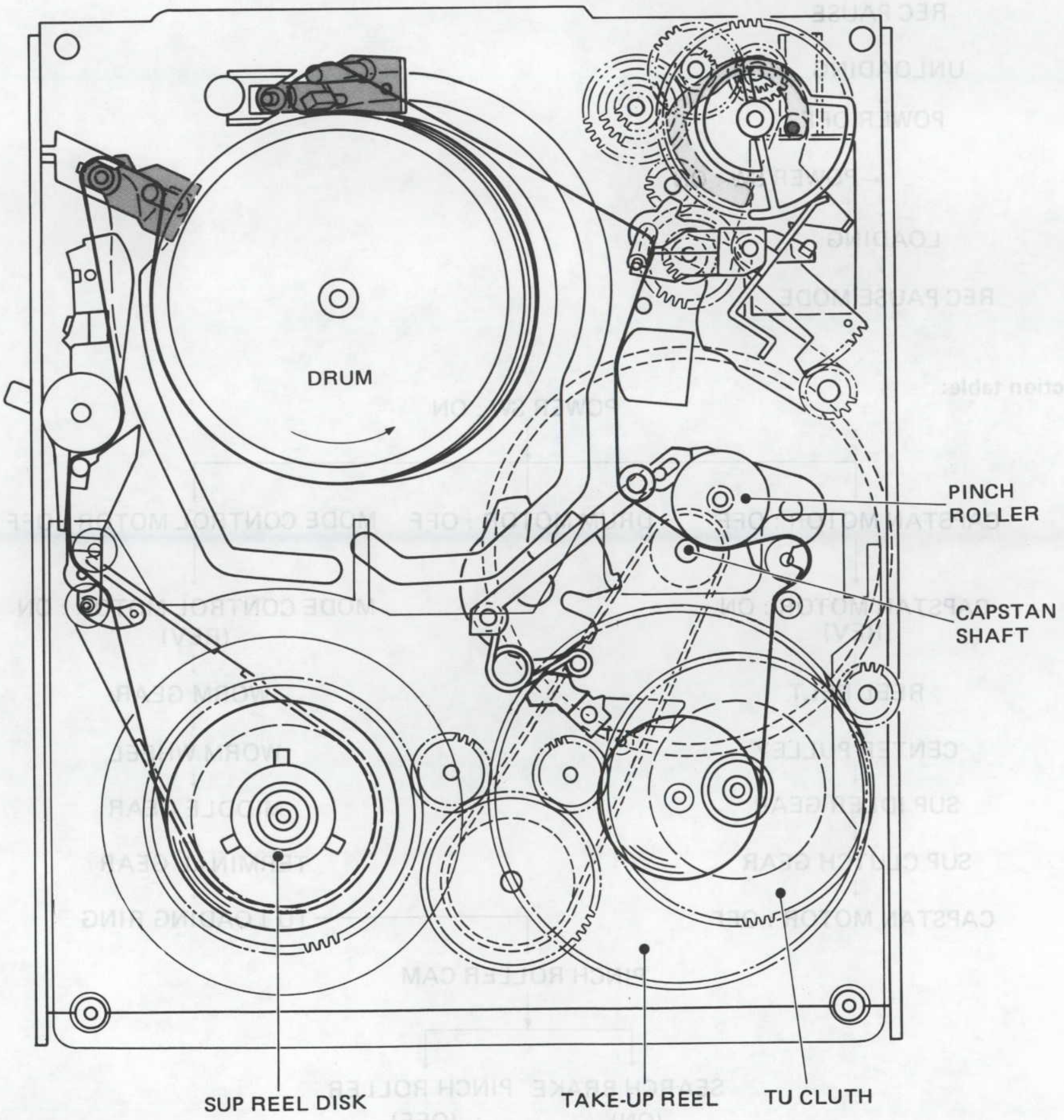


Fig. 4-3-9 Pause mode

4.3.9 Recording lock/power off

When the deck is in the recording mode with the TRIGGER switch on, the moment the power switch is switched off, the deck enters the pause mode. However, after back-spacing has been performed, the deck enters the recording pause mode which is maintained whenever the power is not switched off.

As the recording lock switch is used for relatively long stops in most cases, if the tape were to be held pressed against the pinch roller, it could damage the tape and the pinch roller. For this reason, it is necessary to separate the pinch roller from the capstan. However, the pinch roller is pressed against the tape mechanically in loading; therefore, to separate the pinch roller from the capstan, the tape is slightly unloaded.

When the mechanism enters REC Pause mode, therefore, the loading motor immediately starts rotation to drive the loading ring and cam gear by transmitting the rotation via the cam gear. As a result, the loading ring performs unloading operation while the cam gear rotates to turn on the mode control sensor, which transmits mode information to the mechacon to stop the mode control motor and to turn off the power consequently.

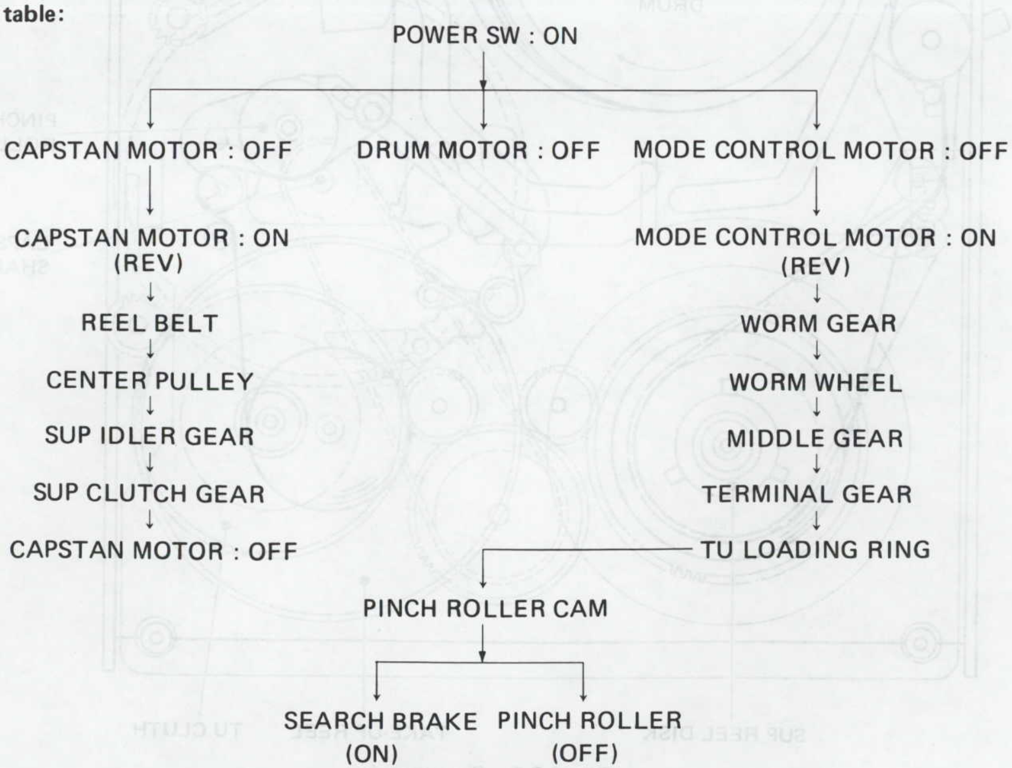
In this unloading operation the supply reel does not wind the tape to prevent editing points from drifting.

The moment the power is switched on, the mode control motor rotates to perform loading and the deck enters the recording pause mode. The drum motor starts turning the moment the power is switched on.

Mode shift table:

REC MODE (TRIGGER SW : ON)
↓ ← POWER SW : OFF
PAUSE MODE
↓
BACK SPACE
↓
REC PAUSE
↓
UNLOADING
↓
POWER OFF
↓ ← POWER SW : ON
LOADING
↓
REC PAUSE MODE

Mechanism action table:



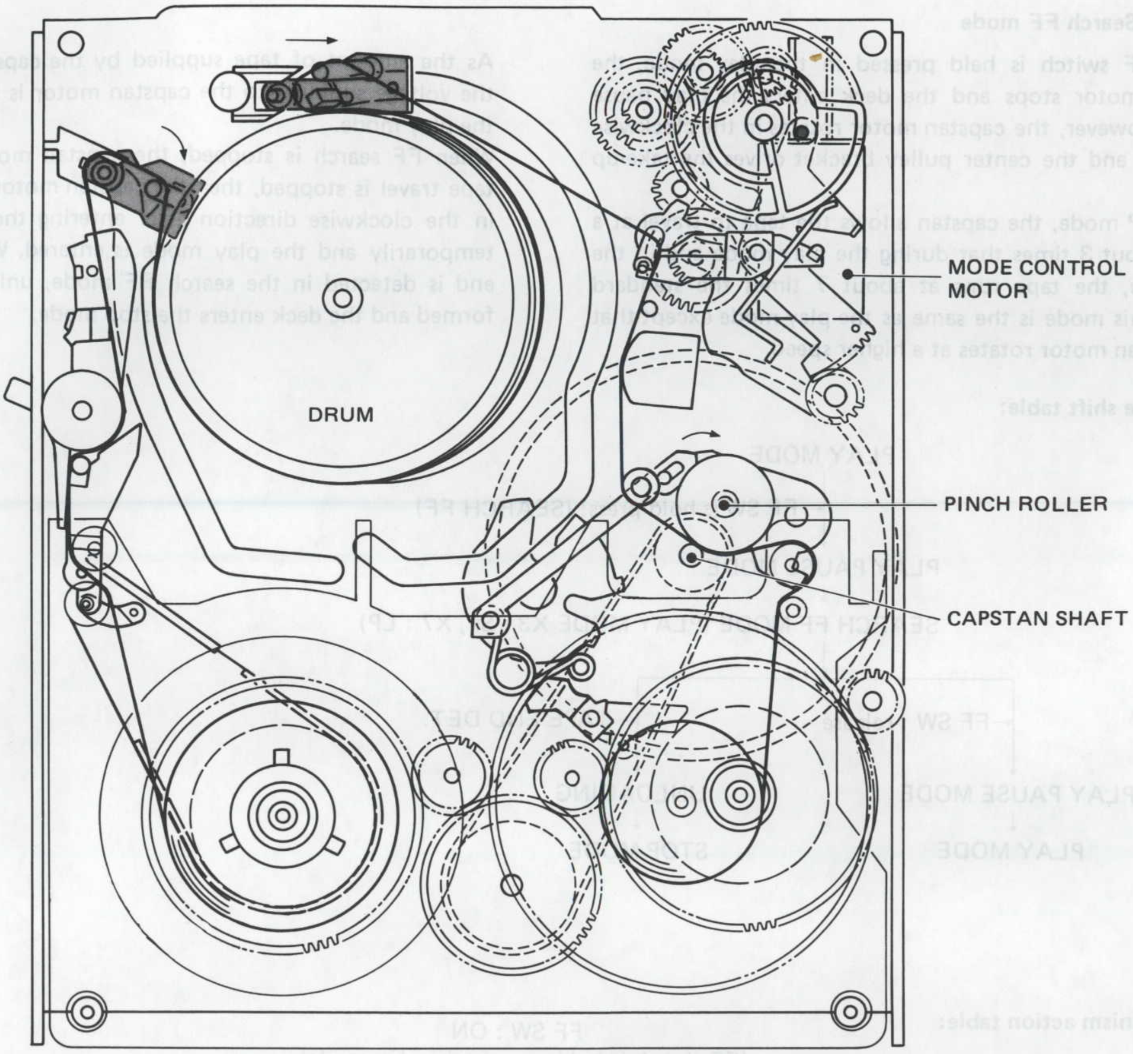


Fig. 4-3-10 Recording lock/power off

4.3.10 Search FF mode

If the FF switch is held pressed in the play mode, the capstan motor stops and the deck enters the play pause mode. However, the capstan motor rotates in the clockwise direction and the center pulley bracket drives the take-up clutch.

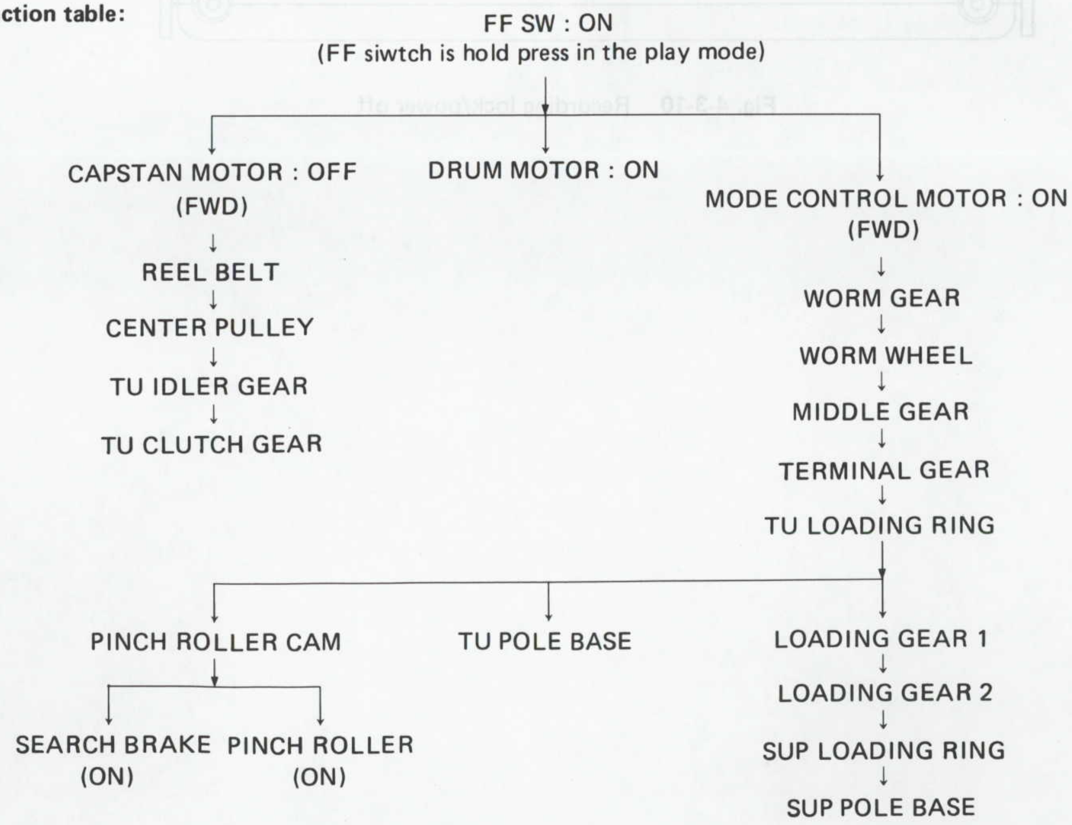
In the SP mode, the capstan allows the tape to travel at a speed about 3 times that during the play mode and in the LP mode, the tape runs at about 7 times the standard speed. This mode is the same as the play mode except that the capstan motor rotates at a higher speed.

As the amount of tape supplied by the capstan increases, the voltage supplied to the capstan motor is higher than in the play mode.

When FF search is stopped, the capstan motor stops and tape travel is stopped, then the capstan motor again rotates in the clockwise direction after entering the pause mode temporarily and the play mode is entered. When the tape end is detected in the search FF mode, unloading is performed and the deck enters the stop mode.

Mode shift table:

Mechanism action table:



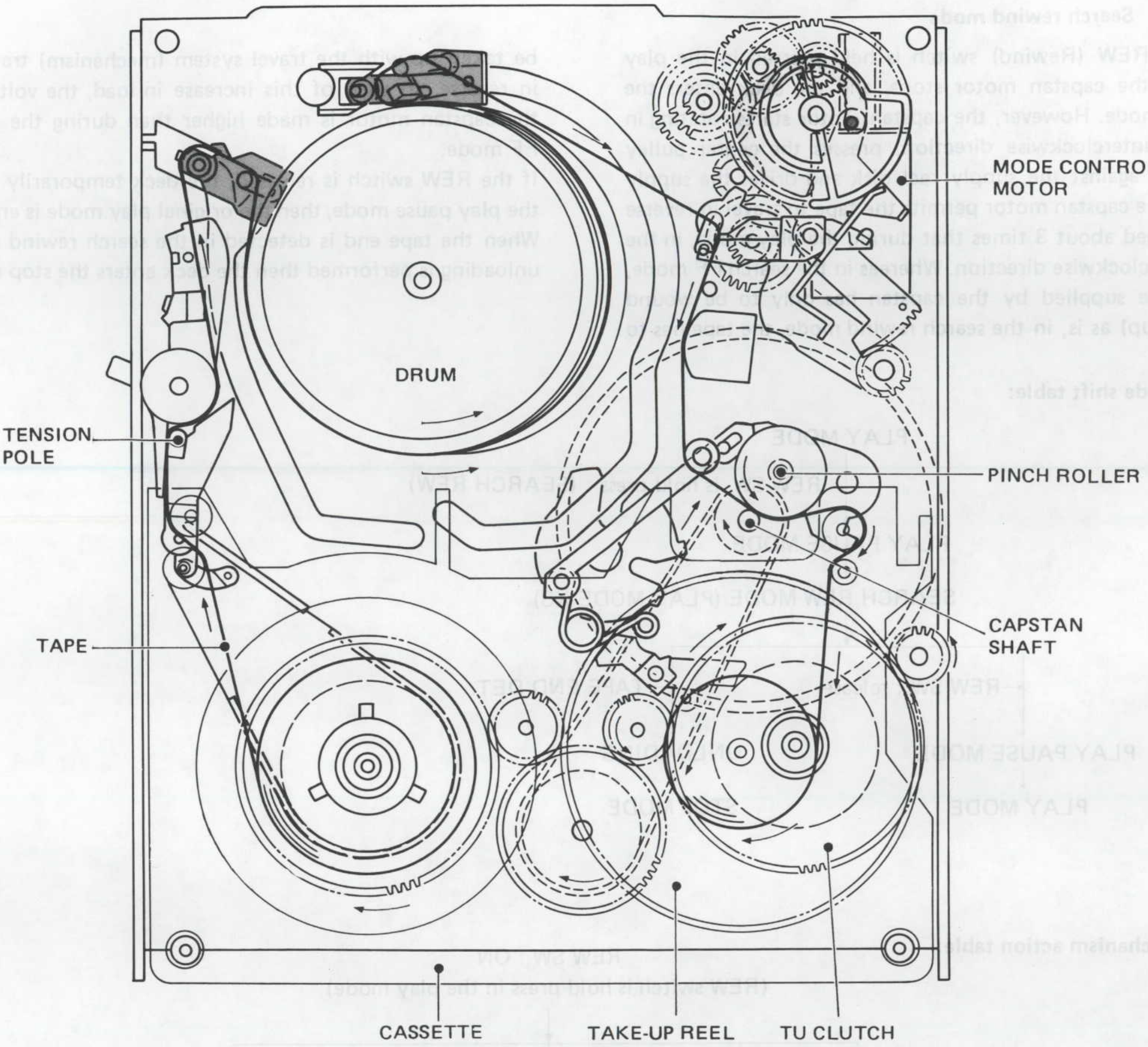


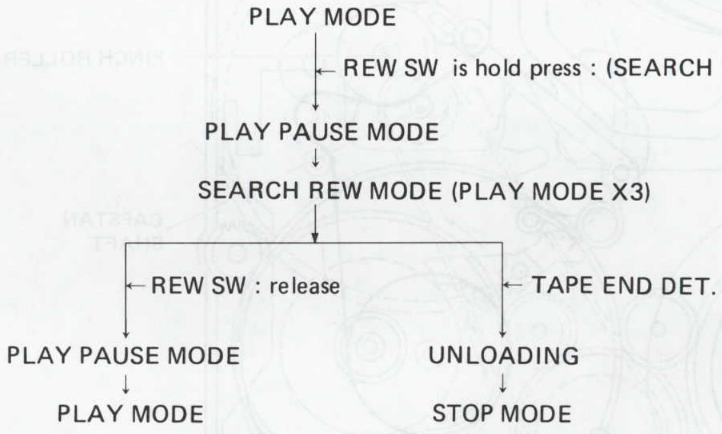
Fig. 4-3-11 Search FF mode

4.3.11 Search rewind mode

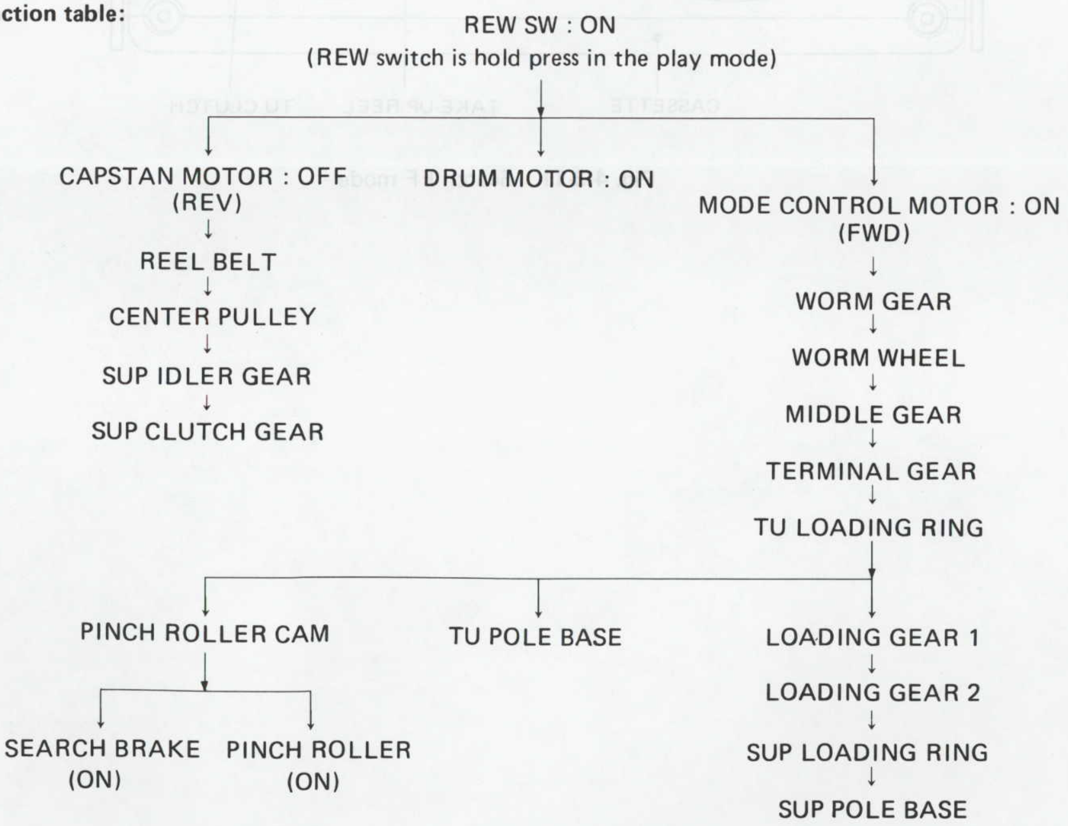
If the REW (Rewind) switch is held pressed in the play mode, the capstan motor stops, and the deck enters the pause mode. However, the capstan motor starts rotating in the counterclockwise direction, presses the center pulley bracket against the supply reel disk and drives the supply reel. The capstan motor permits the tape to travel in reverse at a speed about 3 times that during the play mode, in the counterclockwise direction. Whereas in the search FF mode, the tape supplied by the capstan has only to be wound (taken up) as is, in the search rewind mode, the tape has to be taken up with the travel system (mechanism) travelling in reverse. In view of this increase in load, the voltage of the capstan motor is made higher than during the search FF mode.

If the REW switch is released, the deck temporarily enters the play pause mode, then the original play mode is entered. When the tape end is detected in the search rewind mode, unloading is performed then the deck enters the stop mode.

Mode shift table:



Mechanism action table:



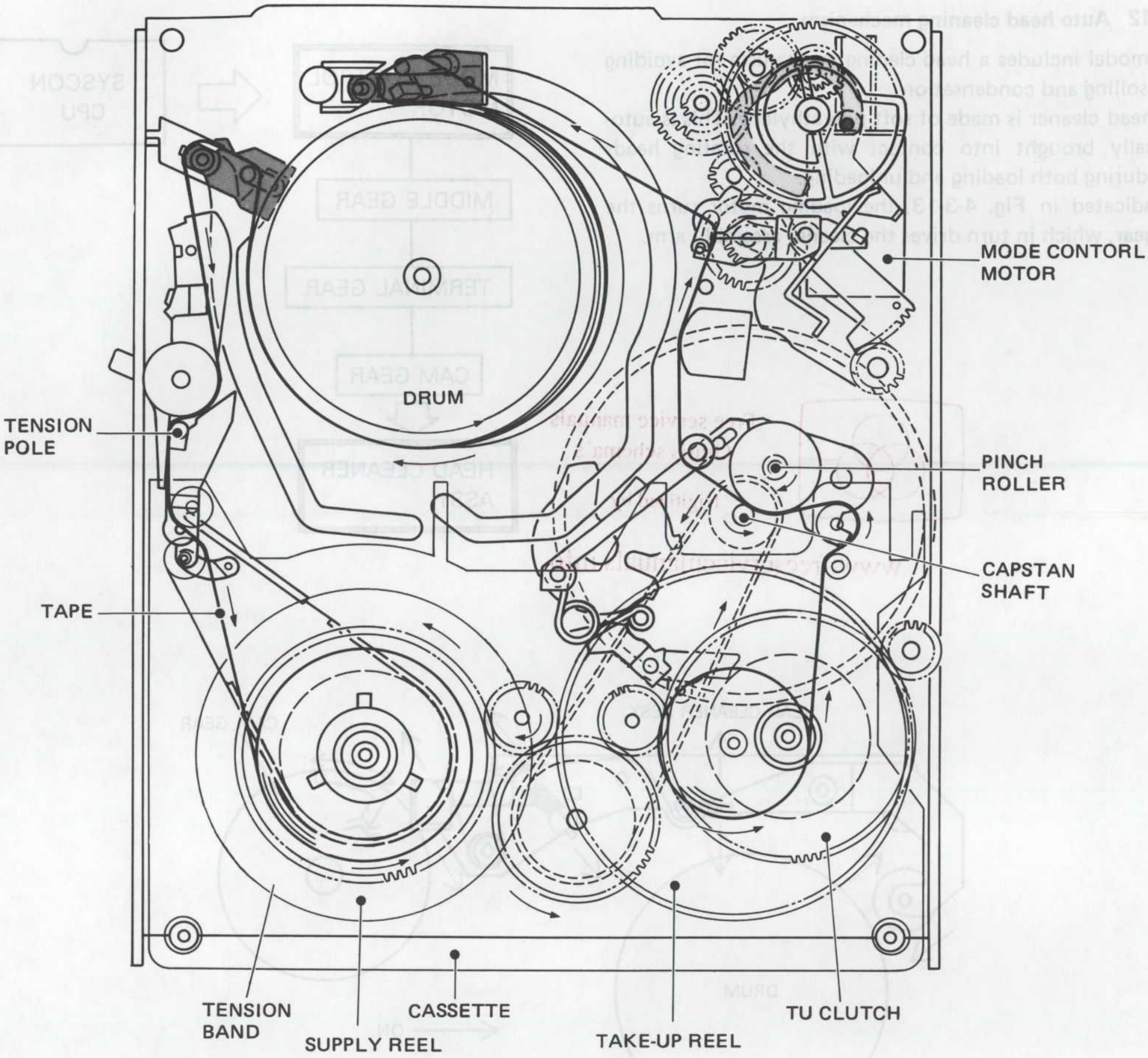


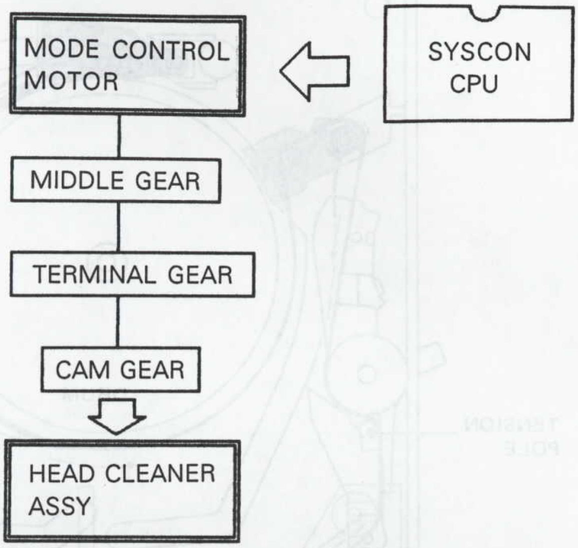
Fig. 4-3-12 Search rewind mode

4.3.12 Auto head cleaning mechanism

This model includes a head clening mechanism for avoiding head soiling and condensation.

The head cleaner is made of soft polyethylene. This is automatically brought into contact with the rotating heads once during both loading and unloading.

As indicated in Fig. 4-3-13, the loading motor turns the cam gear, which in turn drives the cleaner assembly arm.



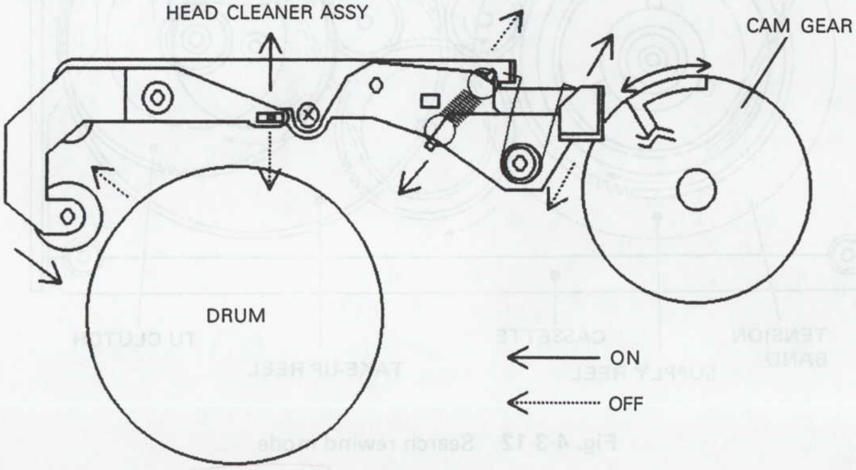


Fig. 4-3-13

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