PIONEER
The Art of Entertainment

Service Manual

ORDER NO.
CRT1829

CD MECHANISM MODULE

CX-597

- This service manual describes the operation of the CD mechanism incorporated in models listed in the table below.
- When performing repairs use this manual together with the specific manual for model under repair.

Model	Service Manual	CD Mechanism Module	CD Mechanism Unit
DEH-P825R/EW, DEH-P825/UC DEH-P823/ES, DEX-P99/UC	CRT1805	CXK5011	CXA8880
DEH-P725R/EW, DEH-P725R-W/EW DEH-P725/UC, DEH-P725-W/UC DEH-P723/ES, DEH-P625/UC DEX-P88/UC, DEX-P77R/EW	CRT1812	CXK5001	CXA8870
DEH-625R/EW, DEH-624R/EW DEH-525R/EW, DEH-524R/EW DEH-424R/GR, DEH-424/EW DEH-425/IT	CRT1808	CXK5001	CXA8870
DEH-59/UC, DEH-52/UC DEH-525/UC, DEH-49/UC DEH-42/UC, DEH-425/UC DEH-225/UC, DEH-523/ES DEH-323/ES, DEH-223/ES	CRT1809	CXK5001	CXA8870

CONTENTS

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K-GFA. FEB. 1996 Printed in Japan

1. THE SUMMARY OF CIRCUITS

1.1 PRE-AMP SECTION (UPC2572GS: IC101)

This section processes the pickup output signals to create the signals for the servo, demodulator & control.

The pickup output signals are I-V converted by the pre-amp with built in photo-detector in the pickup, and added by the RF amp (IC101) to obtain the RF, FE, TE, TE zero cross, and other signals.

The main component is the UPC2572GS and each section is explained below. Because this system has a single power supply (+5V), the reference voltage for this IC, the PU and the servo circuit is the voltage REFO (+2.5V). The REFO signal is obtained by buffering REFOUT from the servo LSI (IC201: UPD63702GF) and is available from Pin 19 of IC101. All measurements should be done using this REFO as reference.

Note: During measurement, do not short REFO and GND.

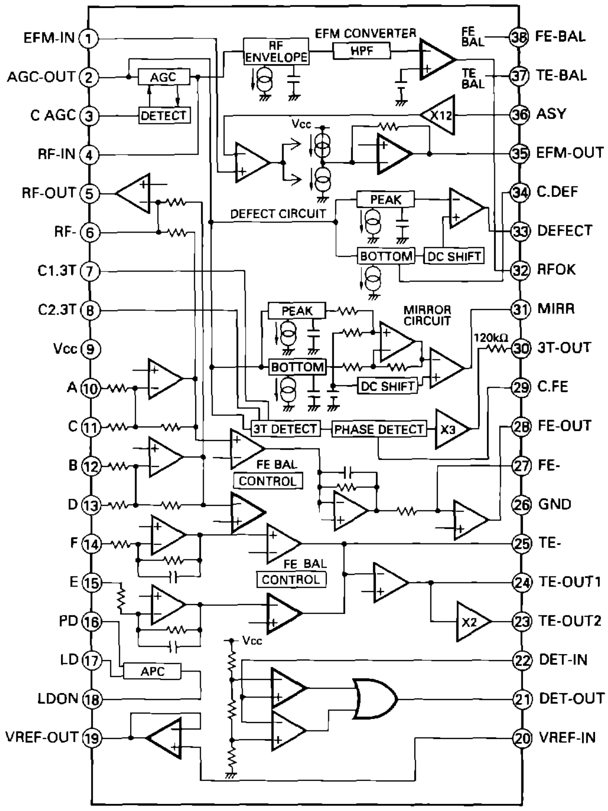


Fig.1 : UPC2572GS BLOCK DIAGRAM

1) APC Circuit (Automatic Power Control)

When the laser diode is driven with constant current, the optical output has large negative temperature characteristics. So the current must be controlled to hold the output constant with the monitor diode. The circuit that carries out this function is the APC circuit. The LD current is obtained by measuring the voltage between LD1 and ground and the value of this current is about 35mA.

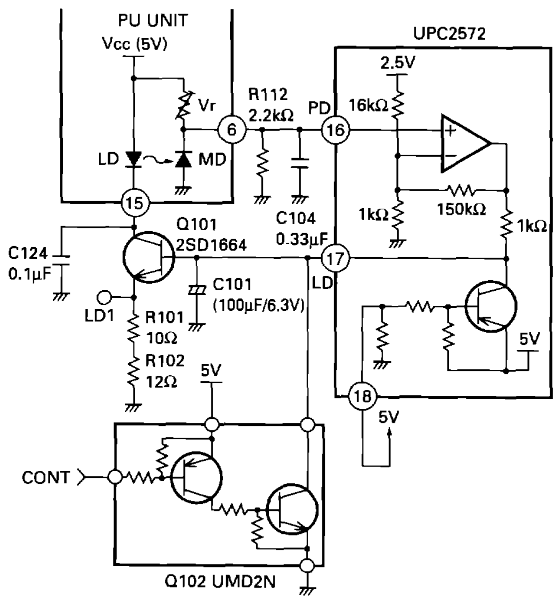


Fig.2 : APC CIRCUIT

2) RF Amp, RF AGC Amp

The photo-detector outputs (A+C) and (B+D) are added, amplified, and equalized in IC101 and output to the RFI pin. (The eye pattern can be checked at this pin.)

The RFI voltage low-frequency component is:

RFI = (A+B+C+D) × 3.22

R111 is the offset resistor for holding the RFI signal in the pre-amp's output range. The RFI signal is AC coupled and input to Pin 4 (RFIN pin).

This IC contains an RF AGC circuit, which holds the RFO output at Pin 2 at a fixed level (1.2 ± 0.2Vp-p). This RFO signal is used in the EFM, DFCT, and MIRR circuits.

3) EFM Circuit

This circuit, "squares" up the analog RF signal into a digital EFM signal. In order to ensure minimum errors it is necessary to use a feedback circuit to match the DC level of the threshold to the center of the RF waveform.

This circuit uses the fact that the EFM signal should have no DC component. By feeding back the EFM signal's DC level the threshold level changes until the DC level is zero and the threshold, by definition, is at the exact center of the RFO waveform. The filtering in the feedback has been adjusted to ensure minimum error. The EFM signal is output from Pin 35. The signal is a 2.5Vp-p amplitude signal centering on REFO.

4) DFCT (Defect) Circuit

The DFCT circuit detects defects on the disc surface, and outputs a "H" signal from Pin 33.

If there is dirt on the disc, drop outs may appear. The DFCT signal output is input to the servo LSI HOLD pin and the focus and tracking servo drives are held while the DFCT output is "H" in order to improve playability.

5) RFOK Circuit

This circuit produces the signal indicating the focus close state during play and the timing for closing the focus servo. This signal is output from Pin 32. This RFOK signal output is input to the servo LSI RFOK pin and the focus close command is issued by the servo LSI. This signal is high during play when the focus is closed.

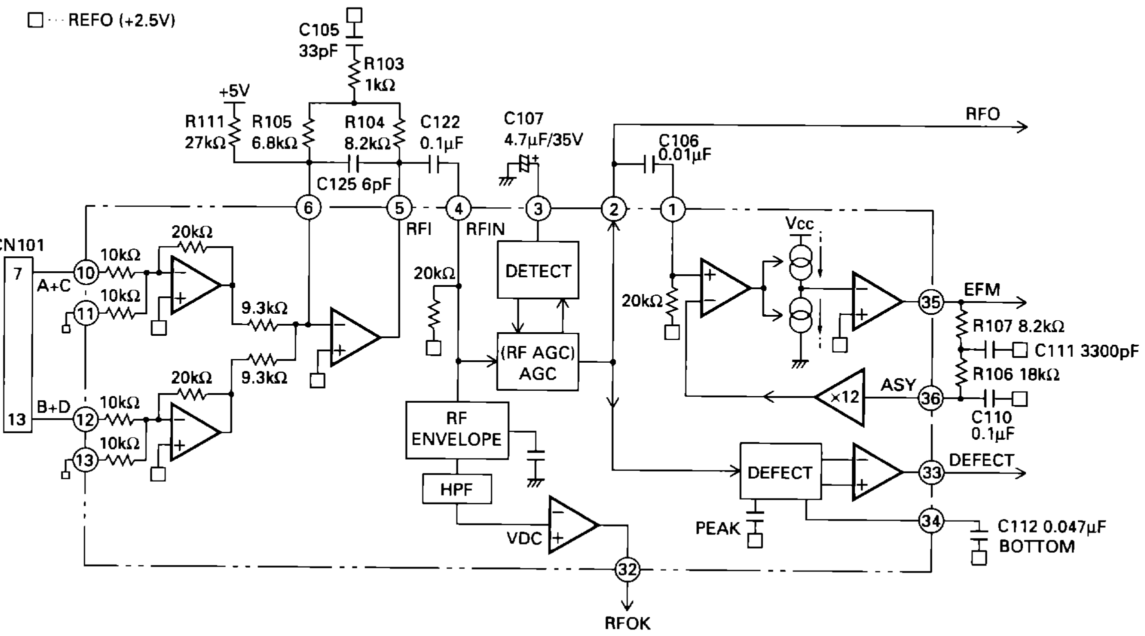


Fig.3 : RF AMP, RF AGC, EFM, DFCT, RFOK CIRCUIT

6) Focus Error Amp

The photo-detector outputs (A+C) and (B+D) are passed through a differential amp, and an error amp and (A+C-B-D) is output from Pin 28 as the FE signal.
The FEY voltage low-frequency component is:

$$FEY = (A+C-B-D) \times \frac{20k\Omega}{10k\Omega} \times \frac{90k\Omega}{68.8k\Omega} \times \frac{R108}{17.2k\Omega}$$

: (PU FE level × 5.02)

An S curve of about 1.6Vp-p is obtained with REFO as the reference. The final-stage amp cutoff frequency is 12.4kHz.

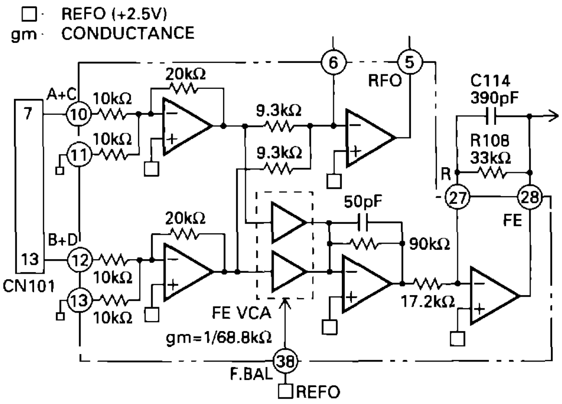


Fig.4 : FOCUS ERROR AMPLIFIER

7) Tracking Error Amp

The photo-detector E and F outputs are passed through a differential amp and an error amp and (E-F) is output from Pin 24 as the TE signal.
The TEY voltage low-frequency component is:

$$TEY = (E-F) \times \frac{63k\Omega}{(31k\Omega+16k\Omega)} \times \frac{R109}{17k\Omega}$$

: (PU TE output level × 5.36)

The TE waveform of about 1.5Vp-p with REFO as the reference is obtained as the TE output (Pin 24). The final-stage amp cutoff frequency is 19.5kHz.

8) Tracking Zero Crossing Amp

The tracking zero crossing signal (below, TEC signal) is the TE waveform (Pin 24 voltage) amplified four times and is used to find the zero crossing points of the tracking error with the UPD63702GF servo LSI. This zero crossing point is found for the following two reasons.

(1) To count tracks for carriage moves and track jumps
(2) To detect the direction in which the lens is moving for tracking closing (This is used in the tracking brake circuit, described Page 9 b).)

The TEC signal frequency range is 500Hz - 19.5kHz.
TEC voltage = TE level × 4

In other words, the TEC signal level is calculated at 6Vp-p. This level exceeds the op-amp's output range and the signal is clipped, but this can be ignored because this signal is used by the servo LSI only at the zero crossing point.

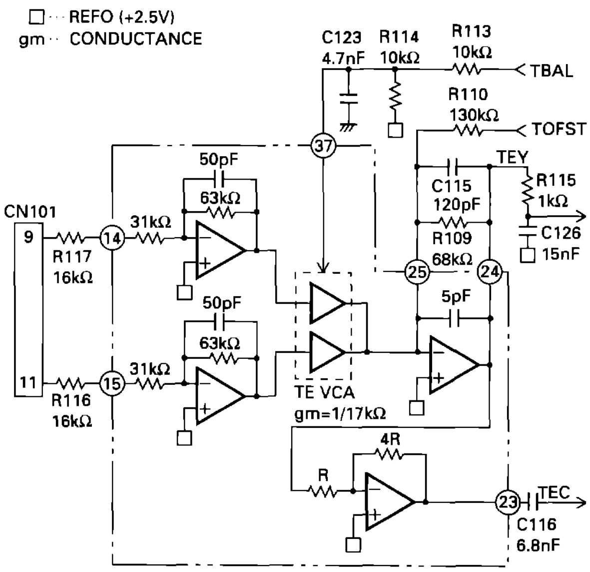


Fig.5 : TRACKING ERROR AMPLIFIER & TRACKING ZERO CROSSING AMPLIFIER

9) MIRR (Mirror) Circuit

The MIRR signal shows the on track and off track data and is output from Pin 31.

When the laser beam is

On track: MIRR = "L"

Off track: MIRR = "H"

This signal is used in the brake circuit, described Page 9 b).

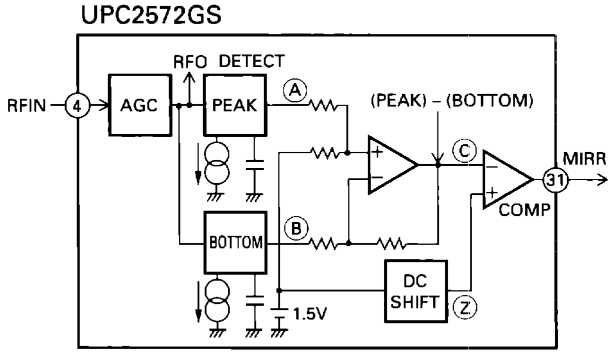


Fig.6 : MIRR CIRCUIT

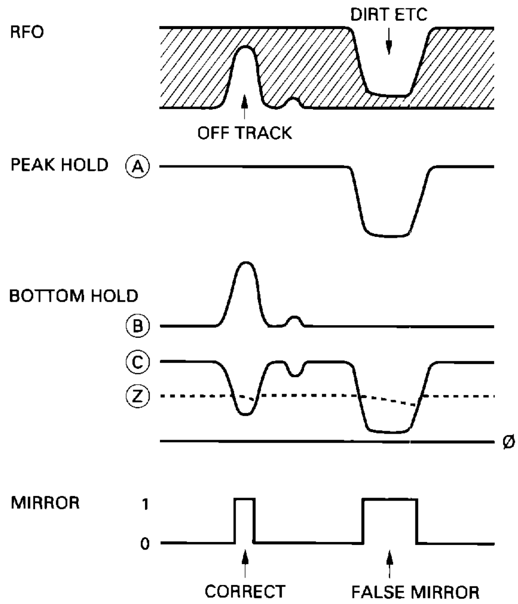


Fig.7 : MIRR CIRCUIT & SIGNAL DIAGRAM

10) 3TOUT Circuit

This circuit detects variations of the RF signal when an external interference is input into the focus servo loop and outputs the phase difference between the FE signal and the RF level variation signal from Pin 30. The signal has been passed through a low-pass filter (fc = 40Hz). This signal is used for the FE bias automatic adjustment, described Page 12 4).

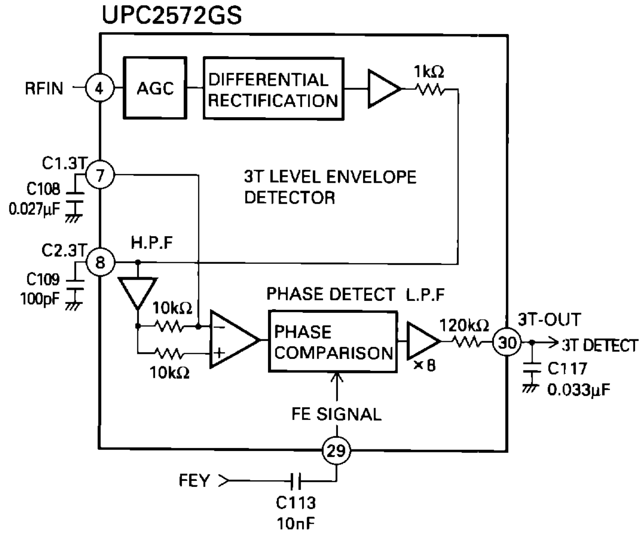


Fig.8 : 3T OUT CIRCUIT

1.2 SERVO SECTION (UPD63702GF: IC201)

This section can be divided into two parts.
One is the servo processing section, which handles such servo controls as error signal equalizing, in focus, track jump, and carriage move. The other is the signal processing section, which handles data decoding, error correction, and interpolation processing.
This IC converts the FE and TE signals from analog to digital and outputs the focus, tracking, and carriage drive signals via the servo block. Also, the EFM signal from the pre-amp is decoded in the signal processing section and finally output as audio signals after D/A conversion. (This IC has a built in audio digital-analog converter.) The decoding process also creates the spindle servo error signals, which is fed to the spindle servo block to create the spindle drive signal.
The focus, tracking, carriage, and spindle drive signals are then amplified by IC301, XLA6997FP and fed to their respective actuators and motors.

1) Focus Servo System

The main focus servo equalizer is in the UPD63702GF. Figure 9 is the focus servo block diagram.
In the focus servo system, the lens must be brought within the in-focus range for focus closing. Therefore, the lens is raised and lowered according to the triangular focus search voltage to find the focus point. During this time the spindle motor is kicked and kept rotating at a set speed.
The servo LSI monitors the FE signal and the RFOK signal and automatically carries out the focus close operation at the appropriate point.
Focus closing is carried out when the following four conditions are all met.
(1) The lens is moving from far to near toward the disc surface.
(2) RFOK = H
(3) The FZD signal (within the IC) is latched at high.
(4) FE = 0 (REFO reference)

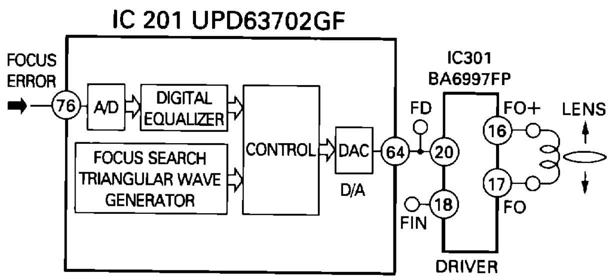


Fig.9 : FOCUS SERVO BLOCK DIAGRAM

When the above conditions are all met and the focus is closed, the XSO signal is shifted from high to low, then 40ms later, the microcomputer begins to monitor the RFOK signal that is passed through the low pass filter.
When the RFOK signal is judged to be low, the microcomputer carries out various actions such as protection.
Figure 10 shows the series of operations for focus closing (for the case where focus cannot be closed.)
Also, in focus-mode-selection during test mode when the display is 01, if the focus close button is pressed, the S curve, search voltage, and actual lens movements can be checked.

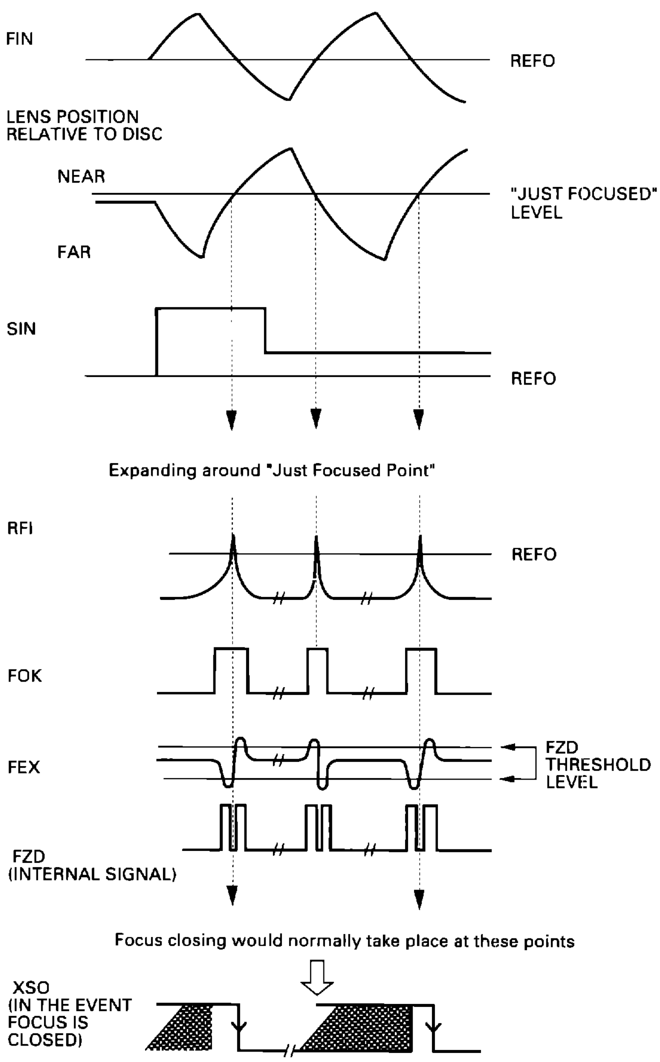


Fig.10 : FOCUS CLOSING SEQUENCE

2) Tracking Servo System

The main tracking servo equalizer is in the UPD63702GF. Figure 11 is the tracking servo block diagram.

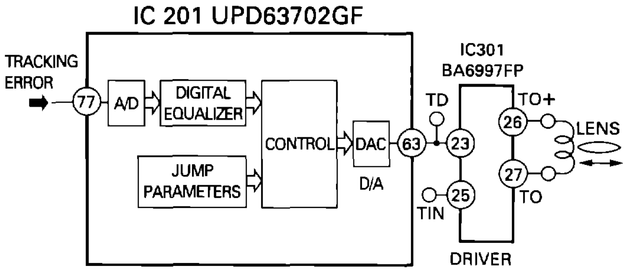


Fig.11 : TRACKING SERVO BLOCK DIAGRAM

a) Track Jump

When the LSI receives the track jump command from the microcomputer, the track jump is carried out automatically by the auto sequence function within the LSI. This system has six types of track jumps used for searches: 1, 4, 10, 32, 32 × 2, and 32 × 3. In test mode, in addition to these jumps, CRG moves can be executed and checked by mode selection. For track jumps, the microcomputer sets half of the total number of jumps (2 tracks for a 4 track jump) and counts the set number of tracks using the TEC signals. From the point when it has counted the set number of tracks, it outputs the brake pulse for a fixed period of time (set by the microcomputer) to stop the lens. In this way, it can close the tracking and continue normal play.

To improve the servo loop re-closing performance just after track jump, the brake circuit comes on for 60ms after the end of the brake pulse and the tracking servo gain is increased.

Fast forward and reverse operations in normal mode are realized by executing consecutive single track jumps. The speed is about 10 times as high as in normal play.

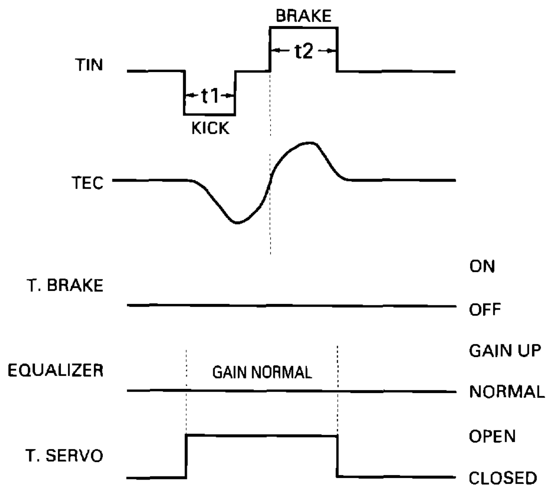


Fig.12 : SINGLE TRACK JUMP

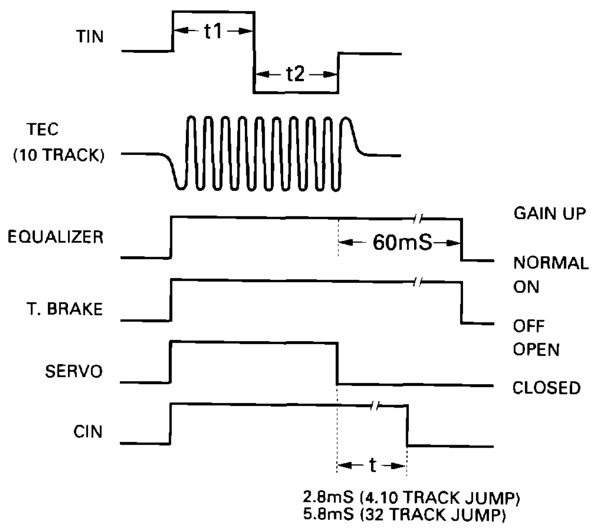
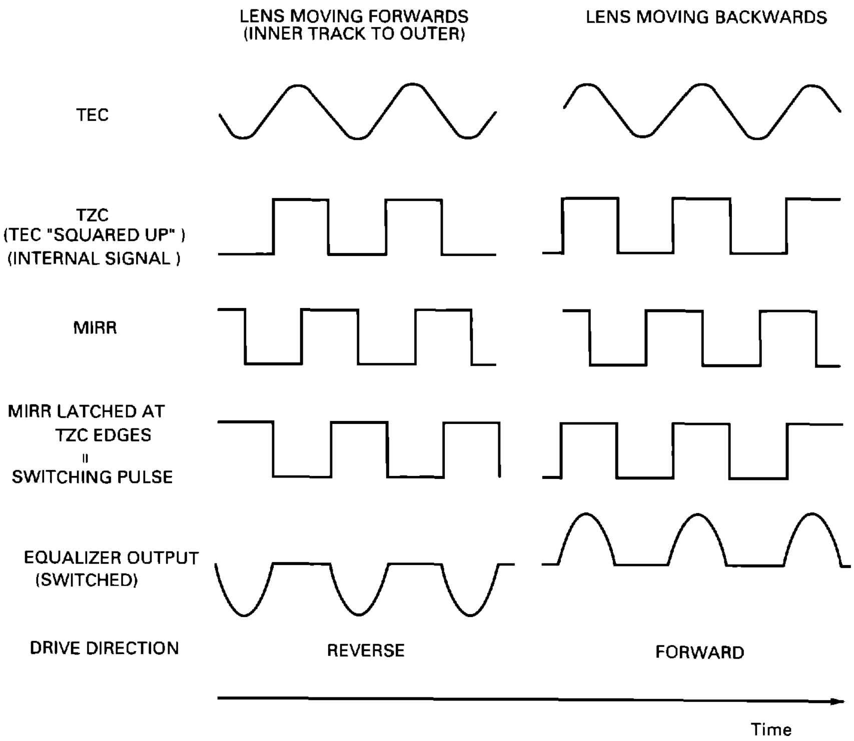


Fig.13 : MULTI-TRACK JUMP

b) Brake Circuit

This relies on determining which direction the lens is moving and only outputting the portion of the drive waveform which acts to oppose this motion. Direction of motion is deduced from TEC and the MIRR signal and knowledge of their phase relation.



Note: Equalizer output assumed to hava same phase as TEC.

Fig.14 : TRACKING BRAKE CIRCUIT

3) Carriage Servo System

The carriage servo supplies the tracking equalizer's low-frequency component (lens position information) output to the carriage equalizer and after applying a fixed amount of gain, outputs the drive signal from the servo LSI. This signal is applied to the carriage motor through the driver IC.

When the lens offset reaches a certain level during play, the entire PU must be moved in the forward direction. Therefore, the equalizer gain is adjusted to output a voltage higher than the carriage motor starting voltage. In actual operations, a certain threshold level is set for the equalizer output within the servo LSI and the drive voltage is output from the servo LSI only when the equalizer output level exceeds that threshold level. This reduces power consumption. Also, due to disc eccentricity and other factors, the equalizer output voltage may cross the threshold level a number of times before the entire PU starts to move. In this case, the drive voltage waveform, (which is applied) from the LSI, becomes pulsative.

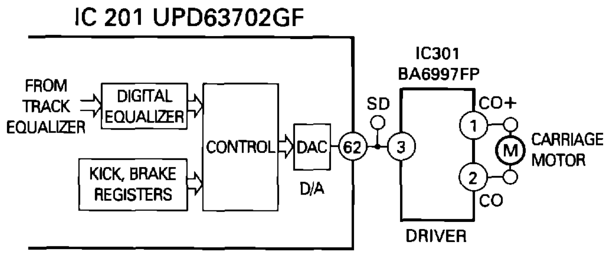


Fig.15 : CARRIAGE SERVO CIRCUIT

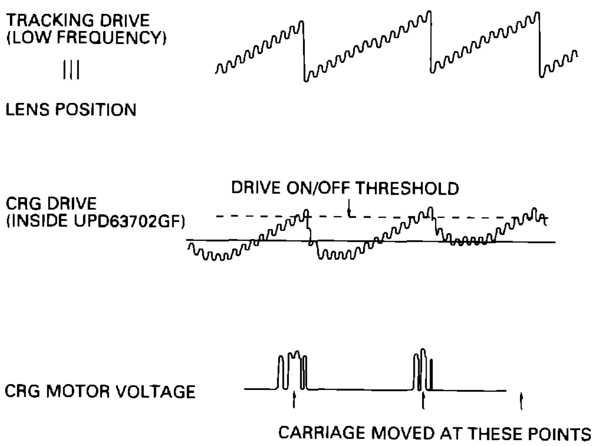


Fig.16 : CARRIAGE WAVEFORM

4) Spindle Servo System

The spindle servo has the following modes.

(1) Kick: The mode used for disc rotation acceleration during setup

(2) Offset:

a) Used during setup from the end of kick until the AGC end

b) Used during play when the focus is unlocked until it is recovered

Both of these are for holding the disc rotation rate near the normal rotation rate.

(3) Adaptive servo: CLV servo mode for normal operation

In the EFM demodulation block, the frame sync signal and internal frame counter output signal are sampled each WFCK/16 and a signal is produced indicating whether or not they match. Only after this signal is in non-match mode eight consecutive times, is the system treated as out of sync, at other times it is treated as in sync. In this adaptive servo mode, a servo mode for pulling the system into sync is automatically selected when the system is out of sync and the regular servo is automatically selected when the system is in sync.

(4) Brake: The mode for stopping the spindle motor rotation

The brake voltage is output by the microcomputer from the servo LSI. At this time, the EFM wave form is monitored within the LSI and if the longest EFM pattern exceeds a certain interval (when the rotation is slow enough), a flag is registered within the LSI and the microcomputer switches the brake voltage off. If the flag is not registered within a certain period of time, the microcomputer switches from brake mode to stop mode which lasts for a fixed period of time. In this case, ejection of the disc can only occur after this period of time.

(5) Stop: The mode used during power on and ejection

At this time, the voltage across the spindle motor is 0V.

(6) Rough servo: The mode used for carriage feed (carriage move during a long search)

The linear speed is calculated from the EFM wave form and a high level or low level is input to the spindle equalizer. In test mode, this mode is also used for the grating check.

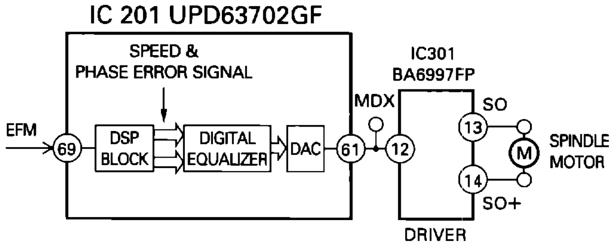


Fig.17 : SPINDLE SERVO BLOCK DIAGRAM

1.3 AUTOMATIC ADJUSTMENT FUNCTIONS

This system uses a pre-amp (UPD2572GS) and servo LSI (UPD63702GF) to automate all circuit adjustment. All adjustments are carried out automatically each time a disc is inserted or the CD mode is selected with the source key. Here is how each automatic adjustment works.

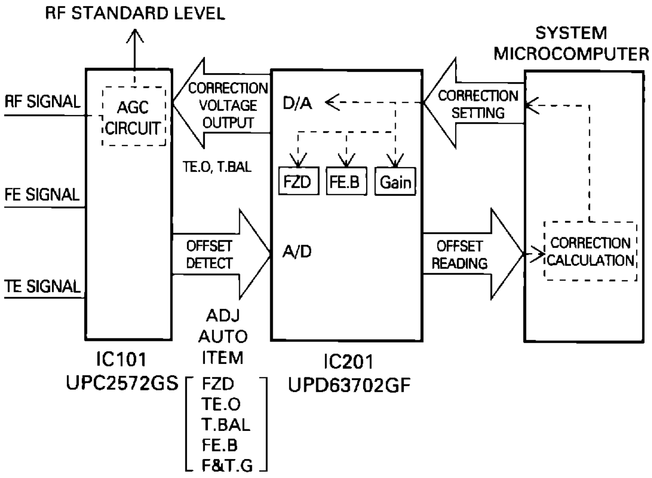


Fig.18 : AUTOMATIC GAIN CONTROL

1) FZD Cancel Setting

This setting is to make the focus closing reliable. When the power is switched on, the FE offset level is read and a voltage opposite to this offset value is written to the CRAM in the IC to cancel the offset. In this way, the FZD threshold level can be set to a constant value (+150mV) and one of the conditions within the IC for focus closing "that the FZD signal is latched at high" can be fulfilled reliably.

2) TE Offset Automatic Adjustment

This function adjusts the pre-amp TE amp offset to 0 V when the power is switched on.

The adjustment procedure is:

(1) The TE offset (LD off) is read by the microcomputer via the servo LSI (offset = TE1).

(2) The microcomputer calculates the voltage to be corrected from the value of TE1 and sets the output of Pin 65 of the servo LSI (signal name: TOFST). The concrete calculation method is as follows.

TOFST2 = TOFST1 + TE1 × R110/R109

3) Tracking Balance Automatic Adjustment

This adjustment equalizes the difference in sensitivity of the E channel and F channel of the TE output. In actual practice, the TE waveform is adjusted to be vertically symmetrical about REFO.

The adjustment procedure is:

(1) After focus closing, the lens is kicked in the radial direction to reliably generate the TE waveform.

(2) At this time, the microcomputer reads the peak and bottom of the TE waveform through the servo LSI.

(3) The microcomputer calculates the value of the offset and the correction voltage to output from Pin 66 of the servo LSI (signal name: TBAL).

(4) The voltage output from the servo LSI is input to Pin 37 of the pre-amp (IC101: UPC2572). This pin is the TEVCA amp control voltage pin. The gain for the E channel and F channel within the pre-amp is varied according to the input voltage to adjust the tracking balance and make the TE waveform vertically symmetrical about REFO.

4) FE Bias Automatic Adjustment

This adjustment is made to maximize the RFI level during play by optimizing the focus point. This adjustment utilizes the phase difference between the RF waveform 3T level signal and the focus error signal. Since an external interference is input into the focus loop, this adjustment uses the same timing as the auto gain control, explained below.

The adjustment procedure is:

(1) External interference is injected into the focus loop by command from the microcomputer (within the servo LSI).

(2) The RF signal 3T component level variation is detected within the pre-amp.

(3) The phase difference between the FE signal due to external interference input and the above 3T component is detected, to sense the focus deviation direction, and the result is output as a DC voltage from Pin 30 (3T-OUT) of the pre-amp.

(4) The 3T-OUT voltage is input to Pin 75 (A/D port) of the servo LSI and the microcomputer reads the 3T-OUT voltage through the servo LSI.
(5) The microcomputer calculates the required correction and adjusts the focus loop offset in the servo LSI.

In the same manner as the auto gain control, this adjustment is repeated a number of times to raise the adjustment precision.

5) Auto Gain Control (AGC)

This adjustment has already been used in the previous generation of CD modules. This function automatically adjusts the focus and tracking servo loop gain.

The adjustment procedure is:
(1) External interference is injected into the servo loop.
(2) The error signals (FE, TE) when the external interference is injected are passed through a band pass filter and the G1 and G2 signals are obtained.
(3) The microcomputer reads the G1 and G2 signals through the servo LSI.
(4) The microcomputer calculates the required correction and adjusts the loop gain within the servo LSI.

To raise the adjustment precision, the same adjustment procedure is repeated a number of times.

6) Initial Adjustment Values

All the automatic adjustments use the previous adjustment value as the initial value as long as the microcomputer power supply is not cut off (the backup is not cut off). If the backup is cut off, automatic adjustment does not start from the previous adjustment value, but rather from the default setting.

7) The Coefficient Display for Adjustment Result

The results of all automatic adjustments can be displayed and checked in test mode.

The coefficient displays for each automatic adjustment are as follows.

(1) FZD cancel, TE.OFST cancel, T.BAL, FE.bias
Reference value = 32 (A coefficient of 32 indicates that no adjustment was necessary).
The display is in units of about 40mV.
Example: FZD cancel coefficient = 35
35-32 = 3   3 × 40mV = 120mV
Since the corrected value is approximately + 120mV, the FE offset before adjustment was - 120mV.

(2) Focus and tracking gain adjustment
Reference value: Focus = 13, tracking = 20
The coefficient display shows the gain derease relative to the reference value.
Example: AGC coefficient = 40
Gain = 20log (20/40) = - 6dB

1.4 POWER SUPPLY AND LOADING SECTION

The power supply within the system makes the loading motor drive power supply VM (7.6V) and 5V Reg IC power (6.9V) from VD (8.3V) supplied by the mother board. The disc detection LED drive voltage and the CD driver IC power supply use VD directly.

The microcomputer switches the CD driver and laser diode on/off with "CONT" and switches the 5V power on/off with "CD5VON". There is no particular control pin for the loading motor driver, but the "EJ" and "LOAD" input signals serve the same role.

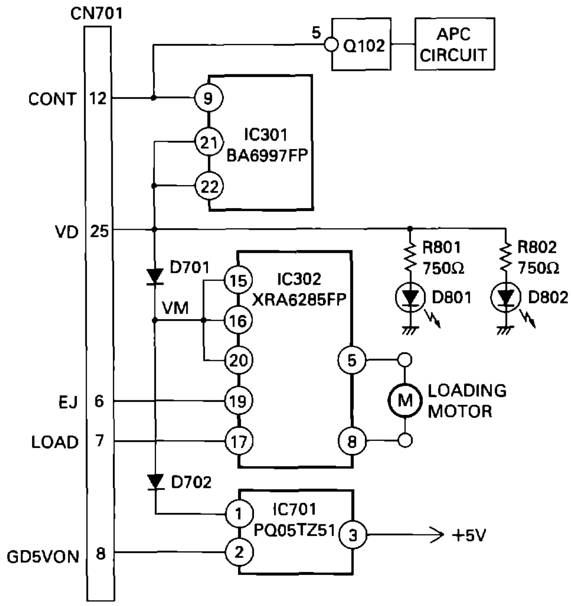


Fig.19 : POWER SUPPLY & LOADING SECTION

2. THE SUMMARY OF STRUCTURE

● Disc Loading Operations

1. There are two photo transistors before and after the rubber roller that conveys the disc. They receive light from the corresponding two LEDs. (When light is received, the photo transistor voltage is low.)
2. When a disc is inserted to just before the rubber roller, the front section photo transistor (P1) voltage goes high and the loading motor drive starts.
3. The drive power of the motor is transmitted by gear and the rubber roller rotates to transport the disc.
   The rubber roller is at one end of the loading arm and lifts up the guide arm. The guide arm is positioned by two springs. Therefore the guide arm and the rubber roller provide the appropriate pressure to feed out the disc between them.
4. The clamper arm also has a disc centering mechanism that discriminates the size of the disc and clamps the disc at the center of the spindle motor. The centering arms form a set left and right on the clamper arm and can move centering on their pivots. At the end of the centering arms are the lock arms. (The lock arms rotate about the centering pins and are locked to the clamper arm for 8cm discs.)
   For 12cm discs, the lock arms are unlocked and move to the position indicated in Figure 21.
   The detection arm, which has its center of rotation on the centering arm on the right side of the diagram, has different positions for 8cm and 12cm discs. When one of these discs is positioned on the spindle, the detection arm moves clockwise according to the external diameter of the disc and moves the detection lever to the bottom side of the figure.

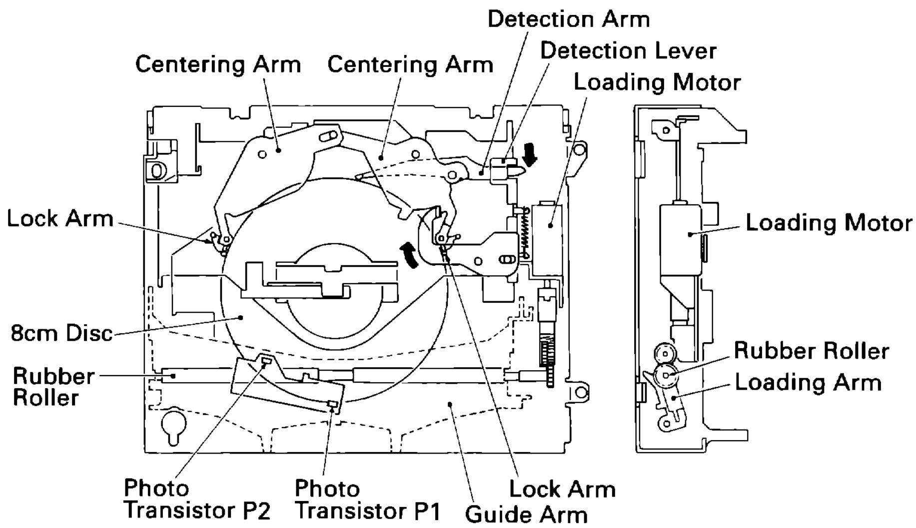


Fig.20

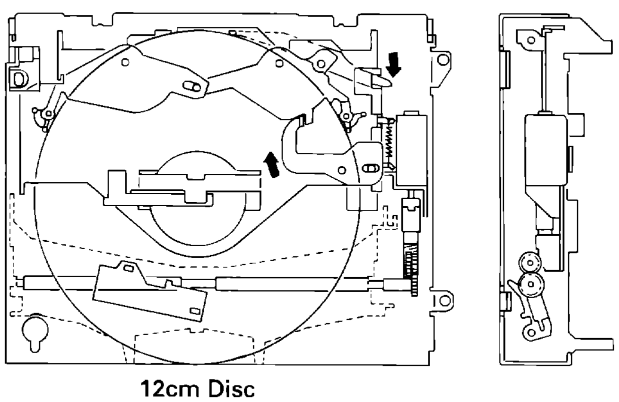


Fig.21

● **Clamp Operation**

The rack gear touching the detection lever meshes with the gear driven by the loading motor and rotates the L arm in the direction of the arrow in Figure 23. The clamper arm, lifted up by the L arm, descends and clamps the disc. Also, the lock lever linked with the L arm moves the loading arm.
Because of this, the rubber roller descends, separating from the disc. At the same time the guide arm also descends. Loading ends at the position where the lock lever switches on the clamp switch.

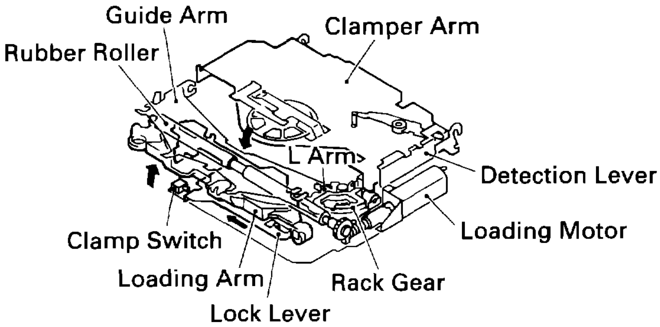


Fig.22

● **Mechanism Lock Operation**

1. In the eject state, both ends of the loading arm touch the bottom of the frame, the floating section front side is pushed down against the resistance of the mechanism suspension spring, and the disc insertion height position is found.
   For play, the loading arm rotates and the separation of the two ends from the frame bottom releases the floating section.

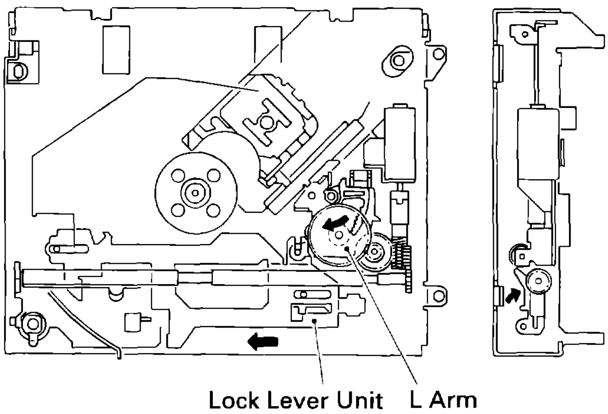


Fig.23

● **Eject**

1. The eject mechanism operates by reversing the rotation which takes place when the loading motor loads. The L arm moves and operates the mechanical lock, the clamp is released, the roller is applied, and the disc is conveyed. Loading stops when the photo transistor to the rear of the rubber roller (P1) is illuminated.
   However, in case of an 8cm disc, motor revolution stops a fixed period of time after P2 is illuminated. The disc type is recognized during play, by the voltage of the photo transistor (P1) located in front of the rubber rollers.

3. DISASSEMBLY AND ASSEMBLY

Remove in the order of the circled numbers in the disassembly diagram.

1. Remove the CD Mechanism Module

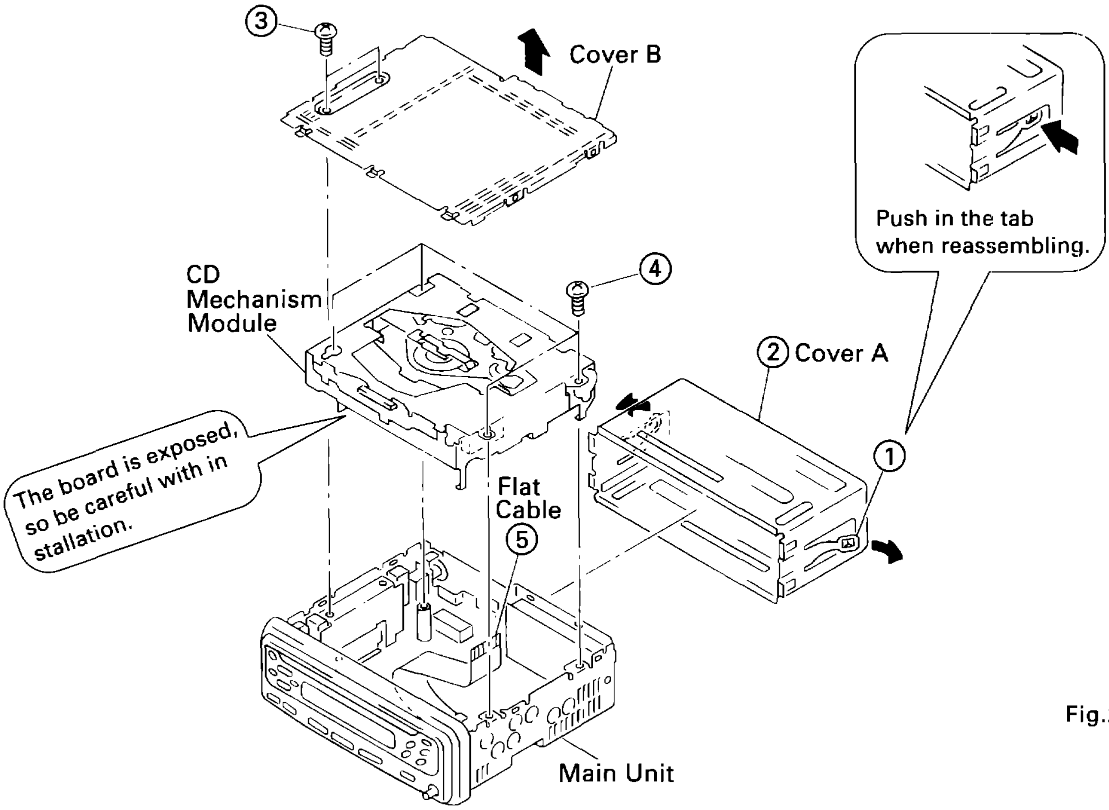


Fig.24

2. Remove the Damper and the Frame Unit

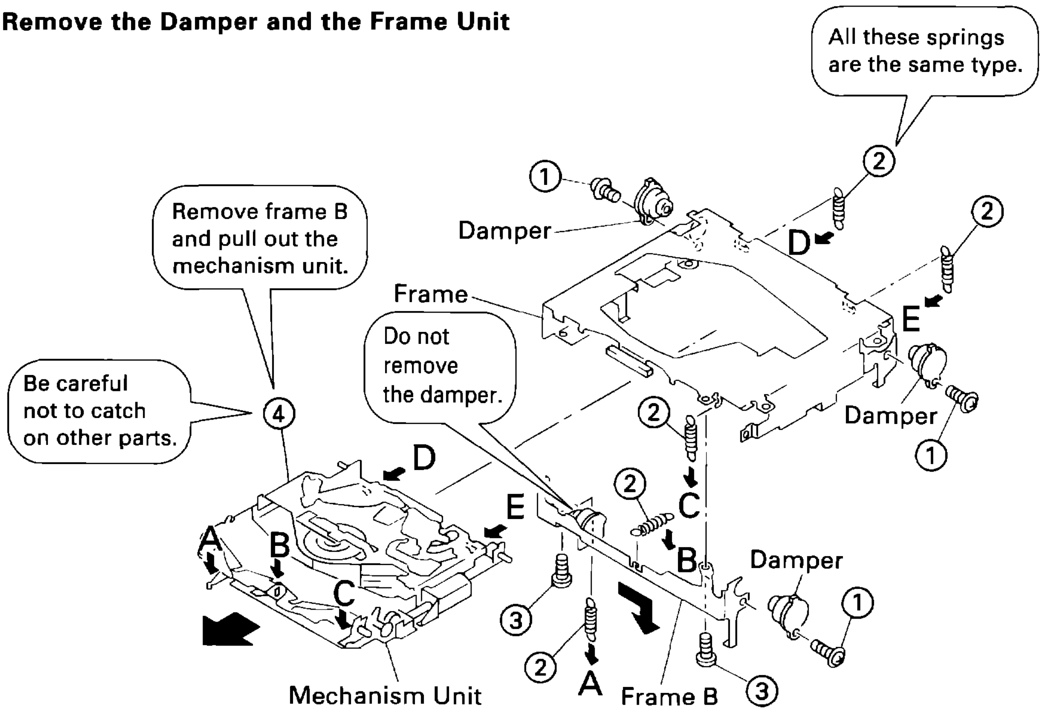


Fig.25

3. Remove the Spindle Motor

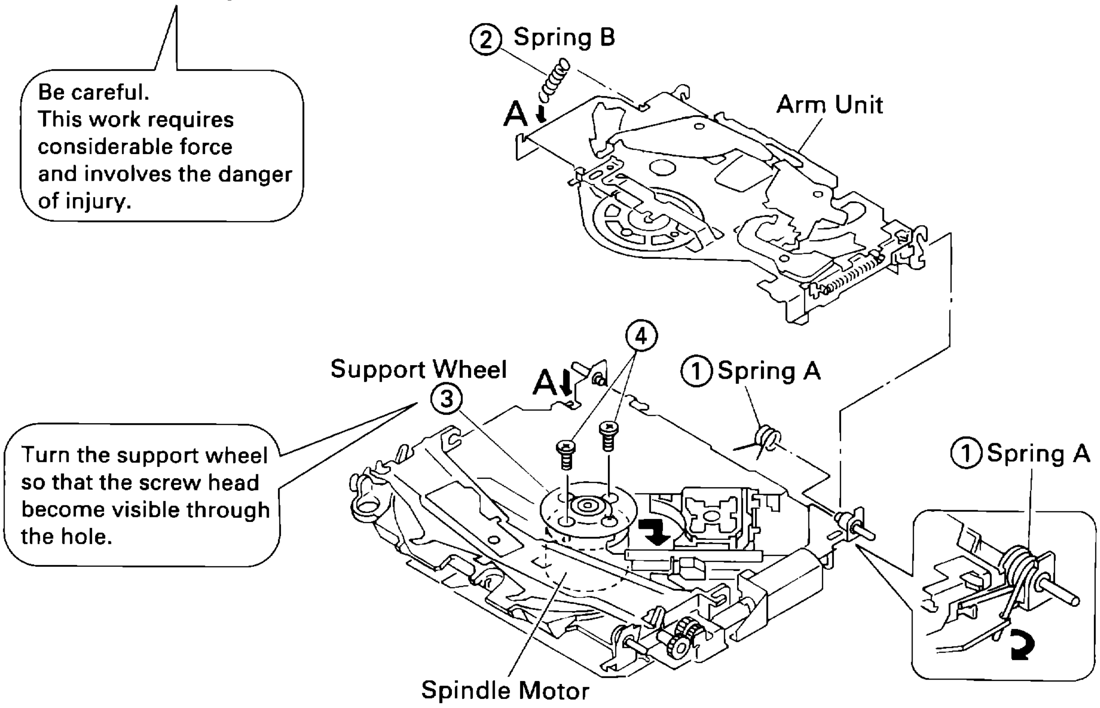


Fig.26

4. Remove the Loading Motor

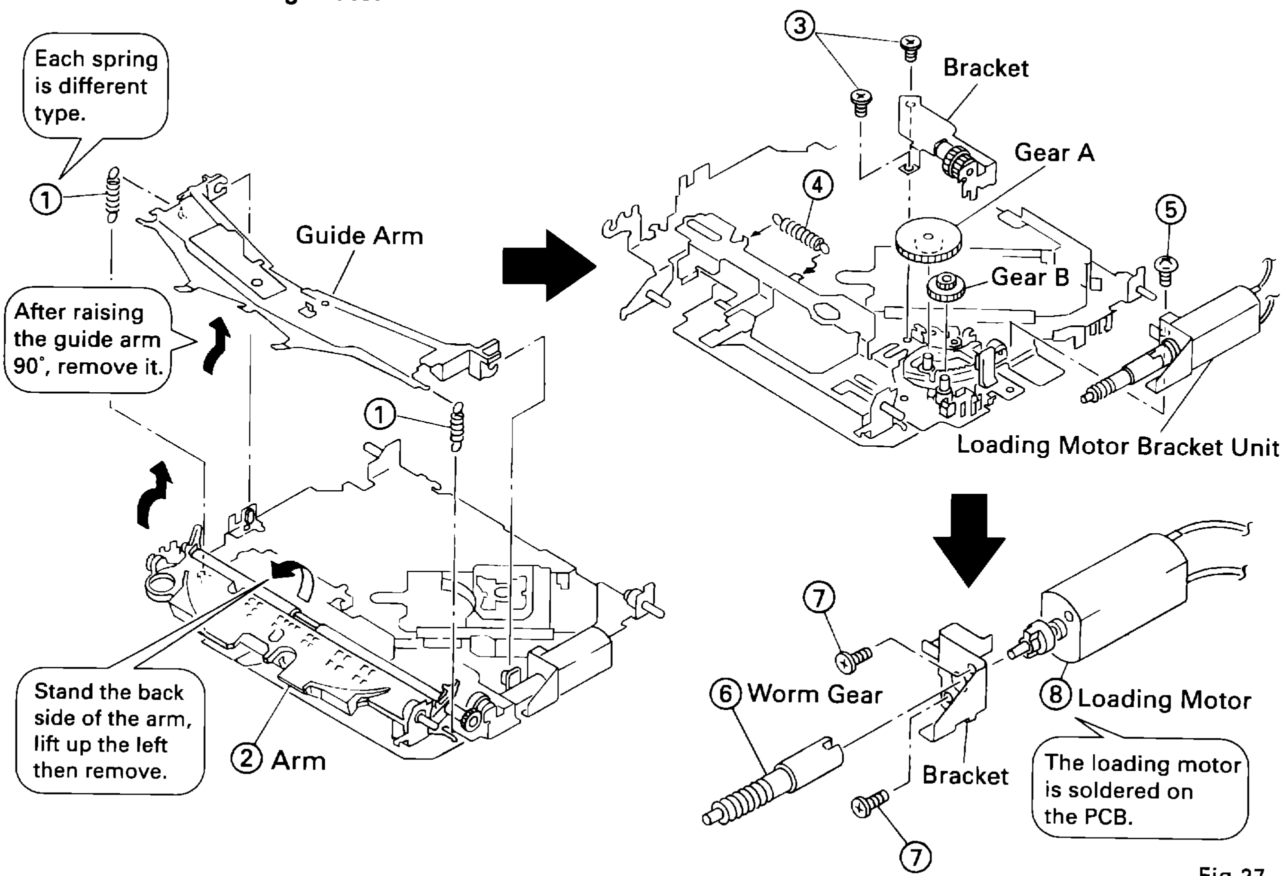


Fig.27

5. Remove the PU Unit and the Carriage Motor

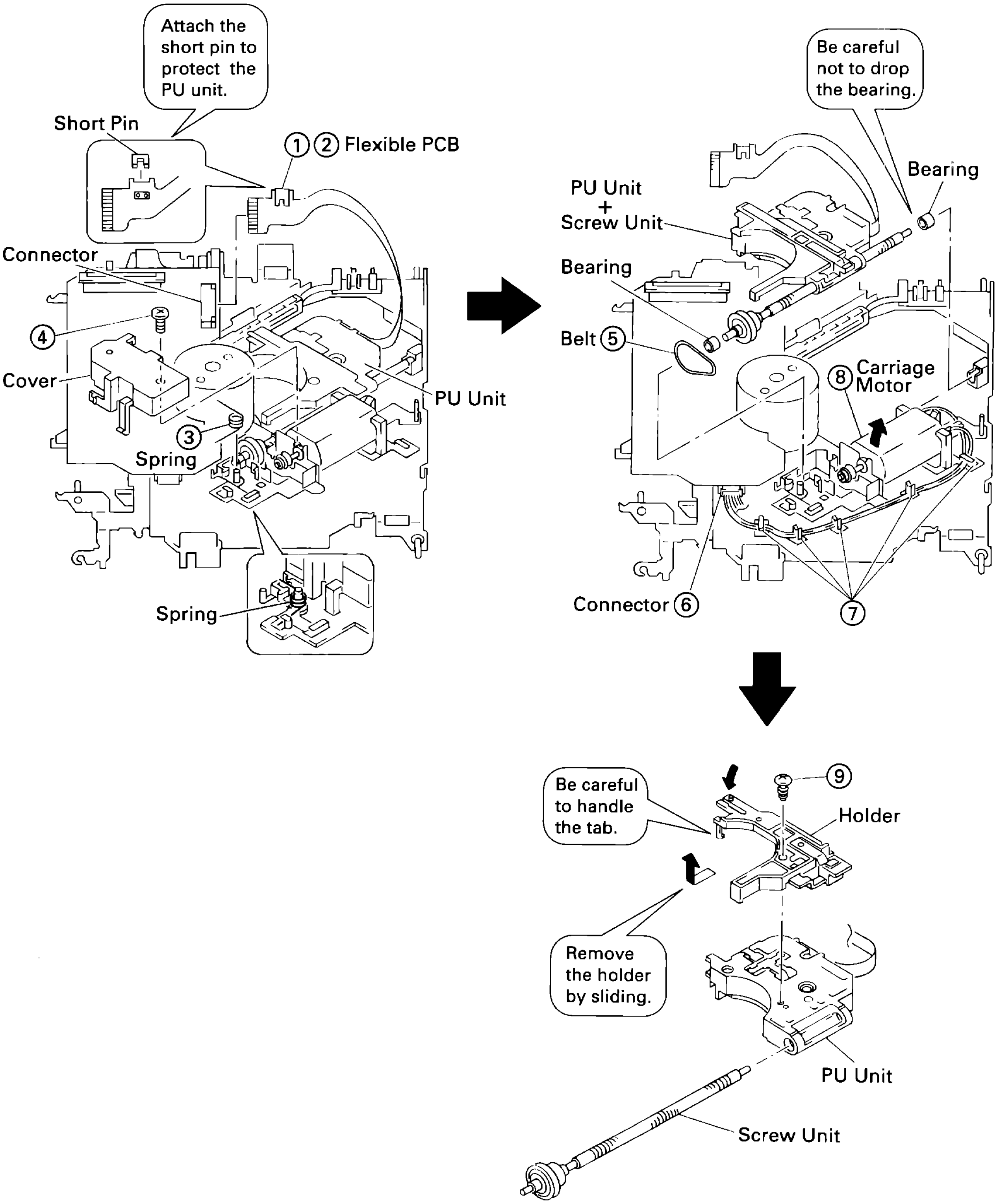


Fig.28