PIONEER
The Art of Entertainment

Service Manual

ORDER NO.
CRT2216

CD MECHANISM MODULE

CX-680

- **This Service Manual outlines operations of the CD mechanism module used in the models listed blow.**
- **For repair, use this Service Manual and the Service Manual of the model used in the system.**

Model	Service manual	CD mechanism module	CD mechanism unit
DEX-P1R/UC DEH-P946/ES DEX-P1/ES	CRT2206	CXK5101	CXB1699
DEH-P945R/EW DEX-P99R/EW	CRT2207	CXK5101	CXB1699

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1. CIRCUIT DESCRIPTIONS

1.1 Preamplifier (UPC2572GS: IC101)

The preamplifier processes pickup output signals to generate signals to be sent to the servo, demodulator, and controller. The preamplifier with built-in photodetector converts signals from the pickup into intermediate voltage in the pickup. Then, addition is made in the RF amplifier (IC101) to obtain RF, FE, TE, and TE zero cross signals. The system consists of the UPC2572GS and other components explained below. The system uses a single power source (+5 V). Therefore, the reference voltage of IC101 and the reference voltage of the power unit and servo circuit are REFO (+2.5 V). REFO is obtained from REFOUT of servo LSI (IC201: UPD63702GF) via a buffer, and is output from Pin 19 of IC101. This REFO is used as reference for all measurements.

Note: Do NOT short-circuit REFO and GND during measurement.

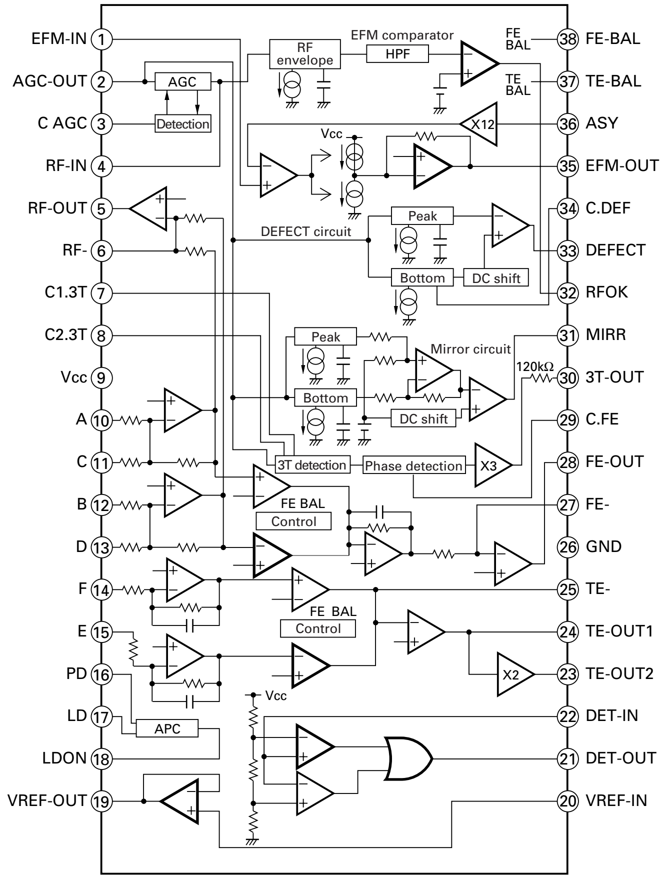


Fig. 1 Block Diagram of UPC2572GS

1) Automatic Power Control (APC) circuit

Laser diode has negative temperature characteristics with great optical output when the diode is driven with constant current. Therefore, current must be controlled by a monitor diode to ensure constant output. Thus functions the APC circuit. LD current can be obtained by measuring the voltage between LD1 and GND. The current value is approximately 35 mA.

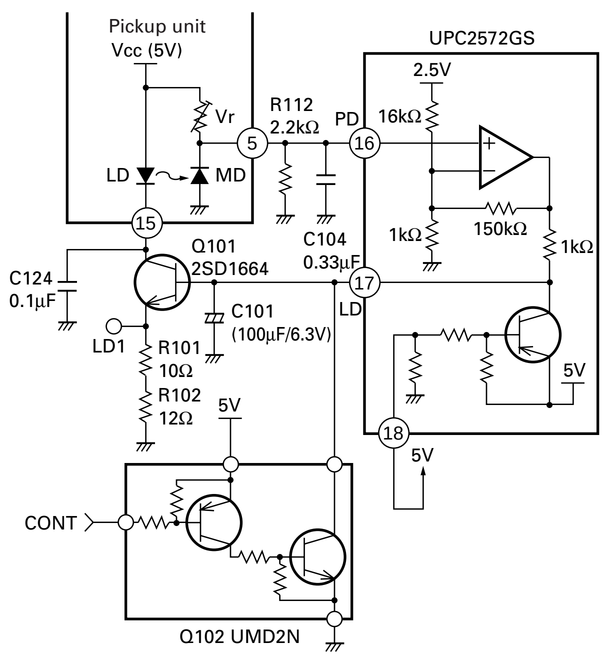


Fig. 2 APC Circuit

2) RF amplifier and RF AGC amplifier

Photodetector outputs (A+C and B+D) are added, amplified and equalized in IC101, and output to the RFI terminal as RF signal. (Eye pattern can be checked at this terminal.)
Low-frequency components of voltage RFI is:

RFI = (A + B + C + D) x 3.22

where R111 is offset resistor to keep RFI signal within the output range of the preamplifier. RFI signal is goes under AC coupling, and is input to Pin 4 (RFIN terminal).
IC101 contains an RF AGC circuit. RFO output from Pin 2 is maintained to a constant level (1.2 ±0.2 Vp-p). The RFO signal is used in the EFM, DFCT, and MIRR circuits.

3) EFM circuit

The EFM circuit converts RF signal into digital signals of “0” and “1.” RFO signal after AC coupling is input to Pin 1, and supplied to the EFM circuit.
Asymmetry caused during manufacturing of discs cannot be eliminated solely by AC coupling. Therefore, the system controls the reference voltage ASY of the EFM comparator by using the fact that probability to generate “0” and “1” is 50% in EFM signal. This reference voltage ASY is generated by output from the EFM comparator through L.P.F. EFM signal is output from Pin 35. As signal level, amplification is 2.5 Vp-p around REFO.

4) DFCT (defect) circuit

DFCT signal detects mirror defect in discs, and is output from Pin 33. The system outputs “H” when a mirror defect is detected.

If disc is soiled, the system determines it as lack of mirror. Therefore, the system inputs the DFCT signal output to the HOLD terminal of servo LSI. Focus and tracking servo drives change to Hold status only when DFCT output is in “H” so that performance of the system upon detection of defect can be improved.

5) RFOK circuit

The RFOK circuit outputs signal to show the timing of focus closing servo, as well as the status of focus closing during playback. The signal is output from Pin 32. The system inputs the RFOK signal output to the RFOK terminal of servo LSI. The servo LSI issues Focus Close command. The system outputs signal in “H” during focus closing and playback.

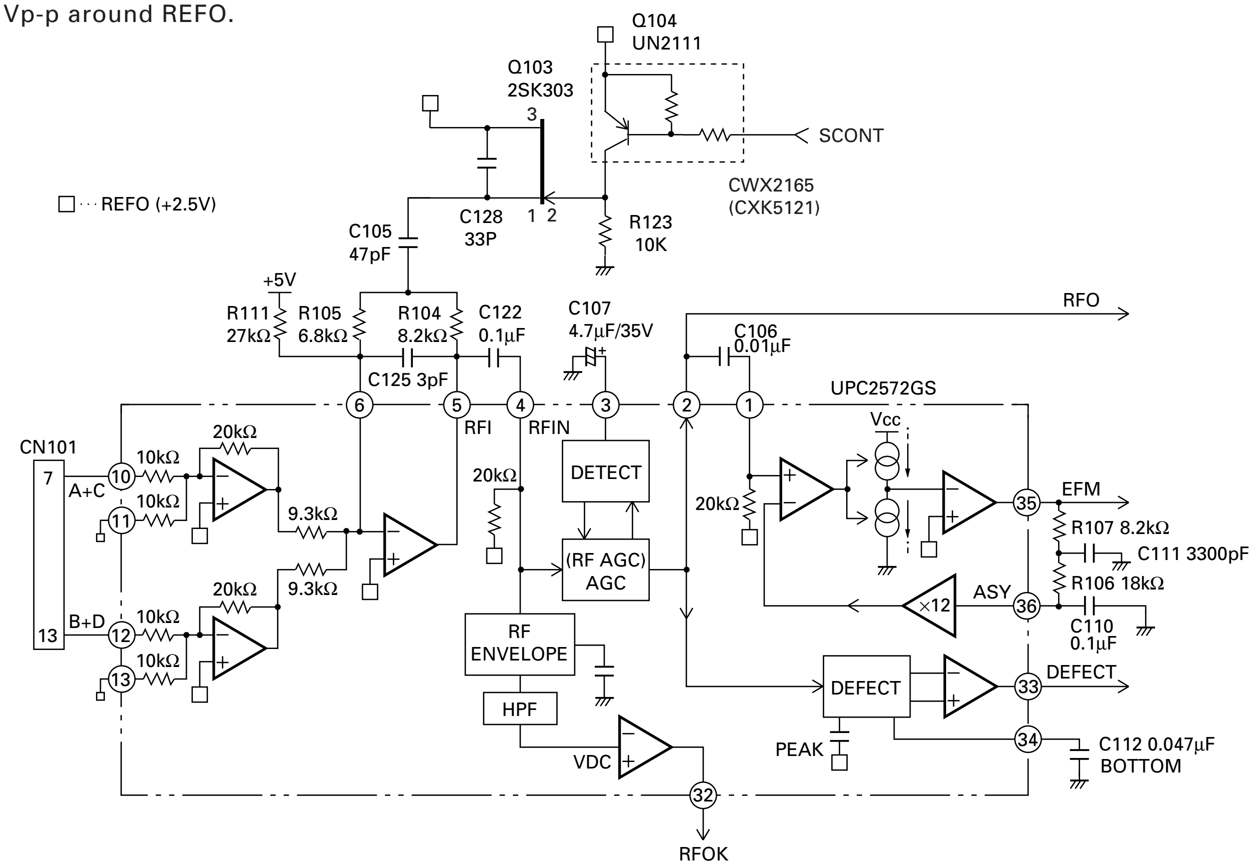


Fig. 3 RF AMP, RF AGC, EFM, DFCT, RFOK Circuit

6) Focus-error amplifier

The system outputs photodetector output (A+C and B+D) as FE signal (A+C-B-D) from Pin 28 via the difference amplifier, then via the error amplifier.

Low-frequency components of voltage FEY is:

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

: (FE level of pickup unit x 5.02)

An S curve equivalent to approximately 1.6 Vp-p is obtained at FE output (Pin 28) by using REFO as reference. The cut-off frequency of the amplifier of the last layer is 12.4 kHz.

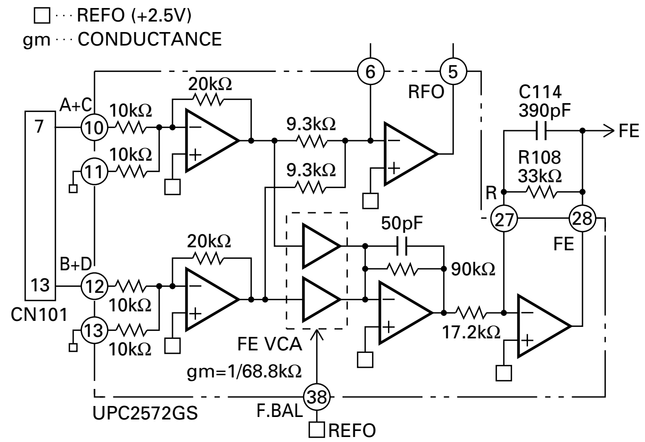


Fig. 4 Focus-error amplifier

7) Tracking-error amplifier

Outputs E and F from the photodetector are output as TE signal (E-F) from Pin 24 via the difference amplifier, then via the error amplifier.

Low-frequency components of voltage TEY is:

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

: (TE level of pickup unit x 5.36)

TE waveforms equivalent to approximately 1.5 Vp-p are obtained at TE output (Pin 24) by using REFO as reference. The cut-off frequency of the amplifier of the last layer is 19.5 kHz.

8) Tracking zero-cross amplifier

Tracking zero-cross signal (TEC signal) is generated by amplifying TE waveforms (voltage at Pin 24) by a factor of four. The signal is used for detecting the zero-cross point of tracking error in the servo LSI UPD63702GF. The purposes of detecting the zero-cross point are as follows:

(1) To be used for counting tracks for carriage move and track jump.

(2) To be used for detecting the direction of lens movement when tracking is closed. (To be used in the tracking brake circuit mentioned later.)

The frequency range of TEC signal is from 500 Hz to 19.5 kHz.

Voltage TEC = TE level x 4

In other words, the TEC signal level is calculated as 6 Vp-p. This level exceeds the D range of the operation amplifier, resulting in the signal to clip. However, there shall be no problem, since the servo LSI uses only zero-cross point.

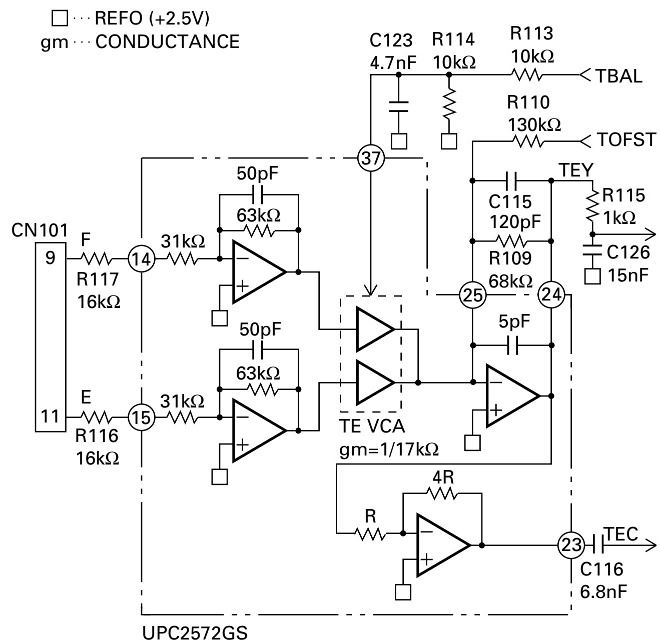


Fig. 5 Tracking-error amplifier,
Tracking zero-cross amplifier

9) MIRR (mirror) circuit

MIRR signal shows ON and OFF track information. The signal is output from Pin 31.

The status of MIRR signal is as follows:

Laser beam ON track: MIRR = “L”

Laser beam OFF track: MIRR = “H”

The signal is used in the brake circuit mentioned later.

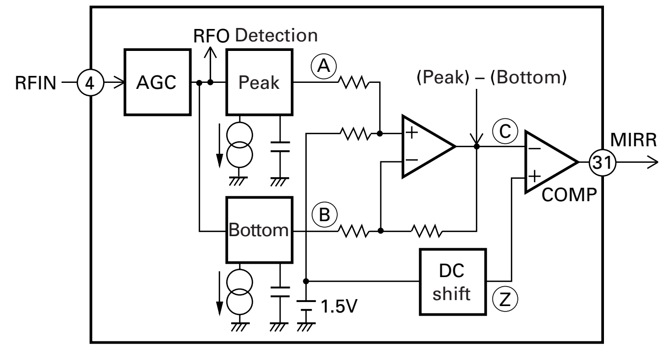


Fig.6 MIRR Circuit

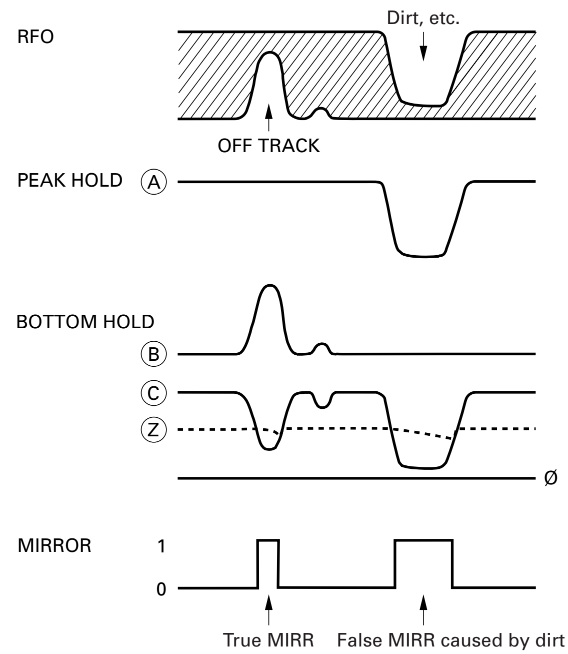


Fig. 7 MIRR Circuit

10) 3T OUT circuit

The system detects flickering of RF signal when disturbance is input to the focus servo loop, and outputs the difference of phase between FE signal and RF-level fluctuation signal from Pin 30. The resulting signal is obtained through L.P.F. with a fc of 40 Hz. This signal is used for automatic adjustment of FE bias.

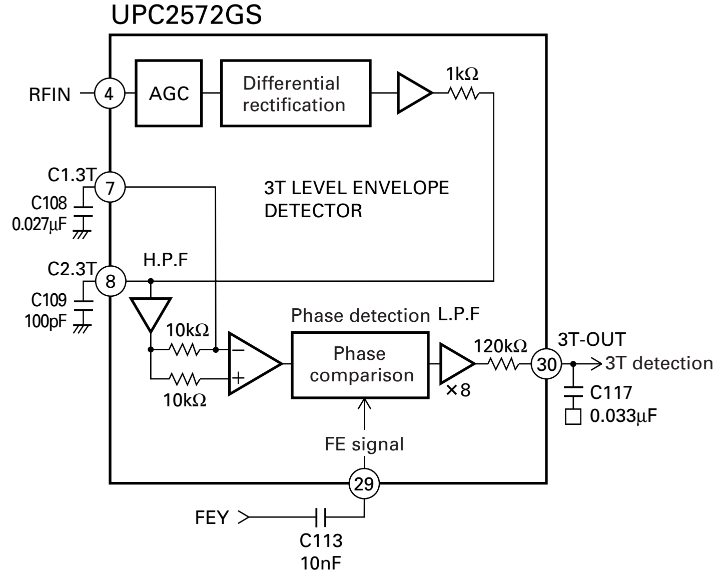


Fig. 8 3T OUT Circuit

1.2 Servo (UPD63702AGF: IC201)

The servo consists of mainly two parts. The first part is the servo processing unit to equalize error signals and control track jump, carriage move, in focus, etc. The second part is the signal processing unit to perform data decoding, error correction, and interpolation.

The system converts FE and TE signals from analog to digital in IC201, then outputs drive signals of the focus, tracking, and carriage systems via the servo block. The EFM signal input from the preamplifier is decoded by the signal processing unit, and eventually output as audio signal after conversion into analog from digital signals via the DA converter (IC201 contains audio DAC). Then, the system generates error signal for the spindle servo in the decoding process, sends the signal to the spindle servo to generate drive signal for spindle.

After that, drive signals for focus, tracking, carriage, and spindle are amplified in IC301 and BA6797FM, and supplied to respective actuators and motors.

1) Focus servo system

The main equalizer of focus servo is located in the UPD63702AGF. Fig. 9 shows block diagram of the focus servo.

For the focus servo system, the lens must be positioned within the focusing range in order to perform focus closing. To achieve this, the system moves the lens upward/downward by focus-search voltage of triangular waveform to detect the focusing point. During searching, the system kicks the SPDL motor to maintain rotation speed to set speed.

The servo LSI monitors FE and RFOK signals so that focus closing is performed automatically at an appropriate point.

Focus closing is performed when the following four conditions are satisfied:

(1) When the lens moves nearer to the disc.

(2) RFOK = “H”

(3) FZD signal (in IC) is latched to “H.”

(4) FE = 0 (REFO as reference)

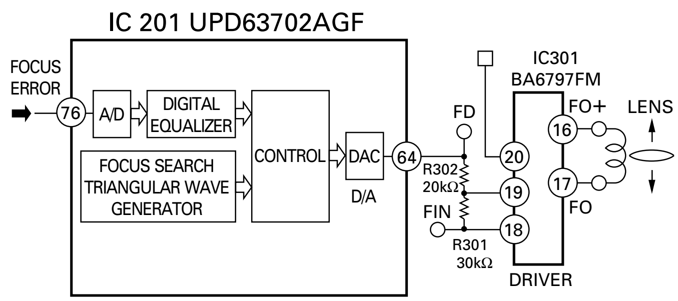


Fig. 9 Focus servo block diagram

When the conditions mentioned above are satisfied and focus is closed, the XSO terminal changes from "H" to "L." Then, the microcomputer starts monitoring RFOK signal through L.P.F after 40 ms.
If the system judges RFOK signal as "L," the microcomputer takes actions, including protection.
Fig. 10 shows operations related to focus closing. (The illustration shows when the system cannot perform focus closing.) S curve, search voltage, and actual lens behavior can be checked by pressing the Focus Close button when "01" is shown in Focus Mode Select in Test mode.

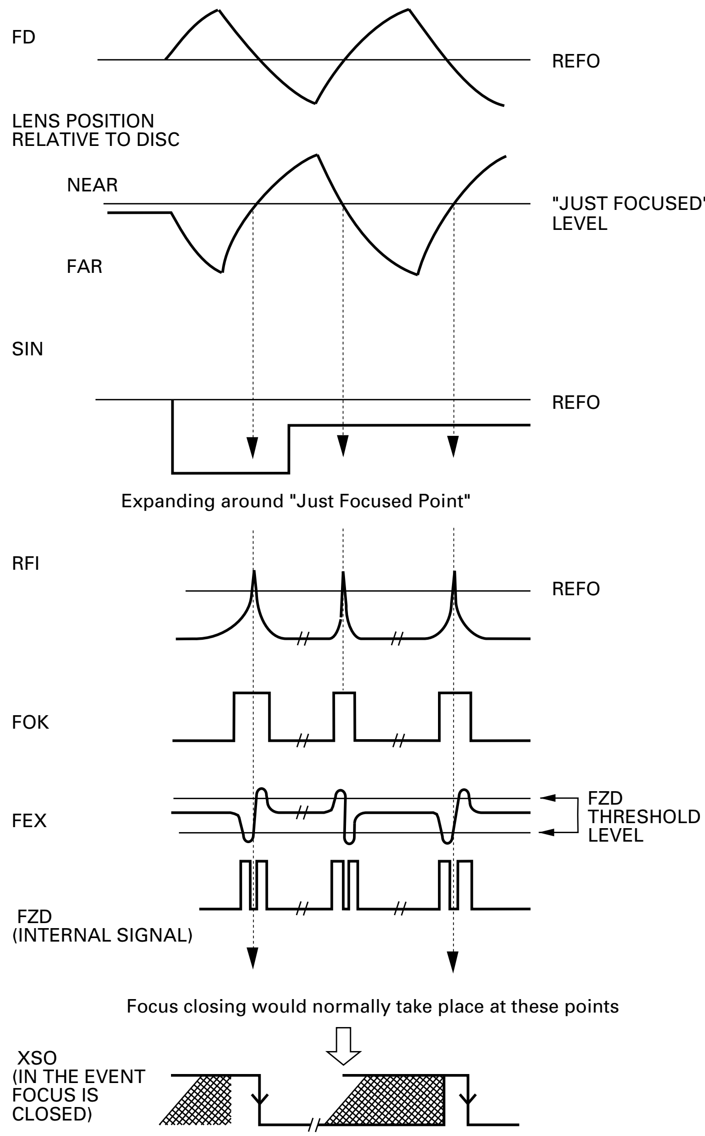


Fig. 10 Sequence of Focus Closing

2) Tracking servo system

The main equalizer of tracking servo is located in the UPD63702AGF. Fig. 11 shows block diagram of the tracking servo.

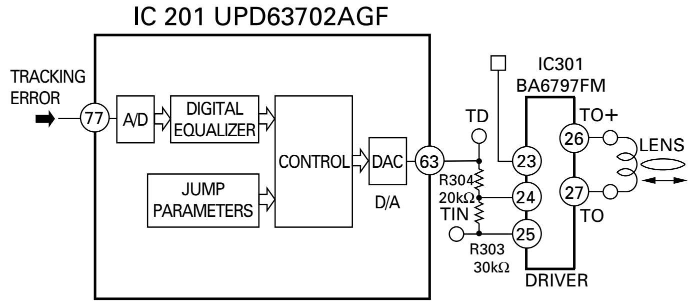


Fig. 11 Tracking servo block diagram

a) Track jump

Track jump is automatically performed by the auto sequence function in LSI when the LSI accepts command. The system has six types of jump (1, 4, 10, 32, 32x2, and 32x3) for truck jump during searching. In Test mode, the system can select and check these jump types and CRG move by selecting a mode. The microcomputer sets half of the total number of track jumps (two tracks if the total number of tracks are four), and counts the set number of tracks by using TEC signal. The system outputs brake pulse for a specified time (set by the microcomputer) from the point of time when the set number is counted, and stops the lens. Thus, tracking is closed, and the system can continue normal playback.
To improve servo withdrawal during track jump, the system sets the brake circuit to ON for 60 ms after brake pulse so that gain of the tracking servo can be increased.
FF/REV in normal mode is made by continuously performing single jump approximately ten times faster than in normal playback.

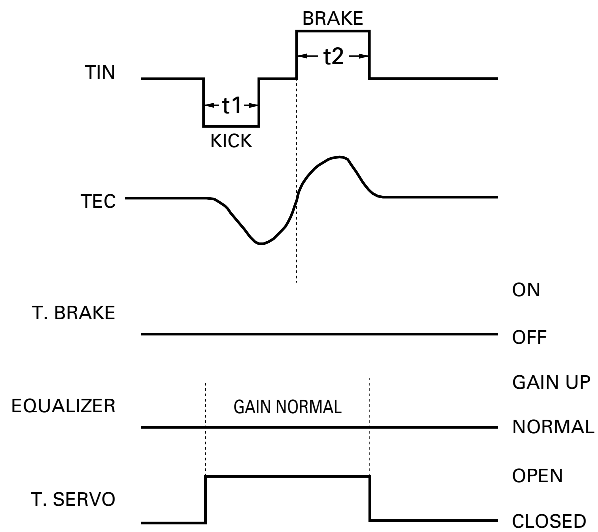


Fig. 12 Single track jump

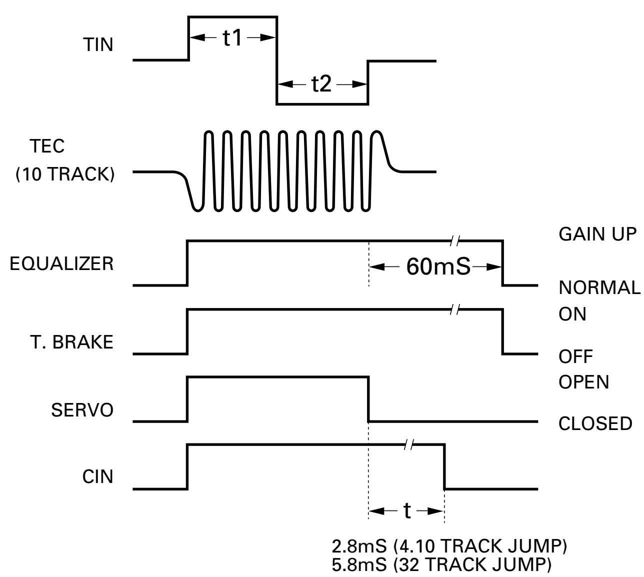


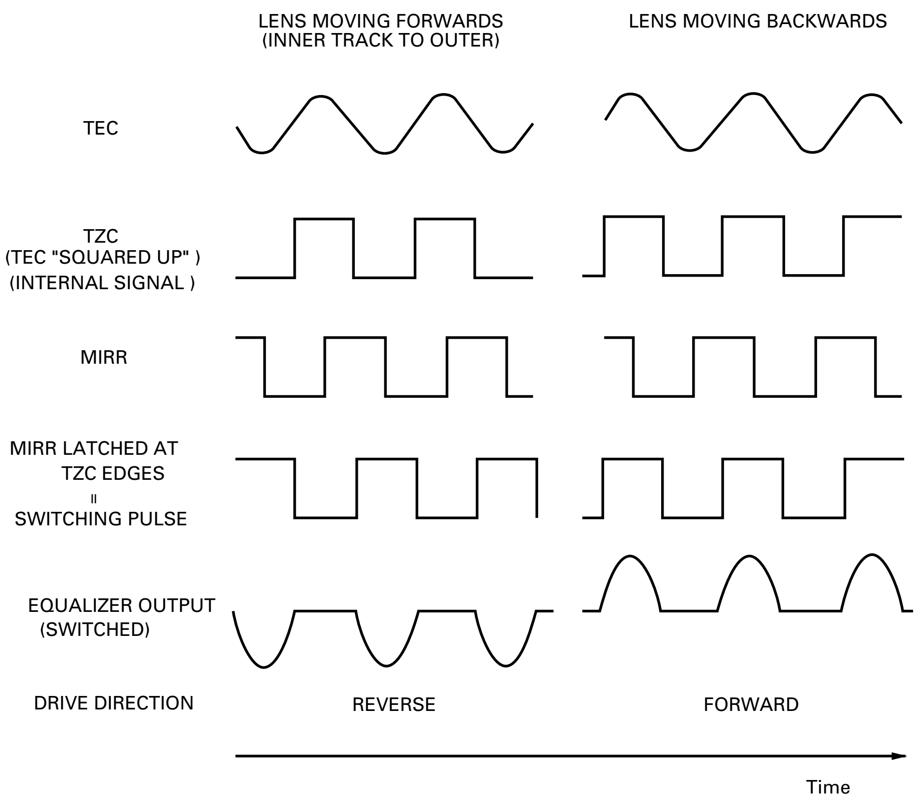
Fig. 13 Multi track jump

b) Brake circuit

Servo withdrawal will deteriorate during setting and track jump. Thus, the system uses the brake circuit to provide stable withdrawal to servo loop.

The brake circuit detects the direction of lens movement, and outputs only drive signal in the opposite direction from the lens movement. Thus, the system delays the speed of the lens movement to stabilize withdrawal of the tracking servo.

The system judges sliding direction of track from TEC and MIRR signals, as well as the relationship of their phase.



Note: In the illustration, the phase of equalizer output is shown as the same as with that of TEC.

Fig. 14 Tracking Brake Circuit

3) Carriage servo system

Output from low-frequency components (lens position information) of the tracking equalizer is input to the carriage equalizer by the carriage servo. After obtaining a certain gain, the system outputs drive signal from the servo LSI. The signal is then applied to the carriage motor via the driver IC. More specifically, the pickup unit as a whole must be moved forward when lens offset during playback reaches a specified level. Therefore, gain of equalizer is set so that voltage higher than the activation voltage of the carriage motor is output. As actual operation, a certain threshold level is set for equalizer output in the servo LSI, and drive voltage is output from the servo LSI only when the equalizer output level exceeds that level. Thus, power consumption is reduced. Depending on eccentricity, etc. of disc, the equalizer output voltage may cross the threshold level several times before the pickup unit as a whole starts operation. At this time, waveforms of drive voltage from LSI are output as pulse.

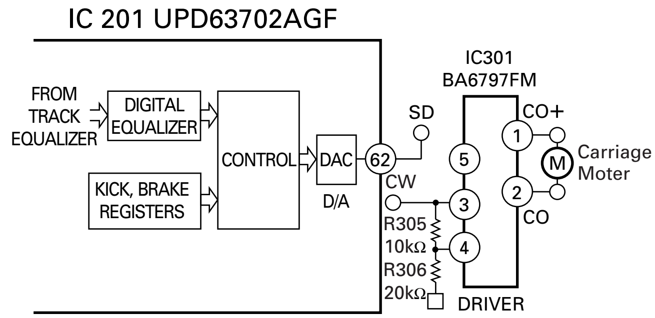


Fig. 15 Carriage Servo Circuit

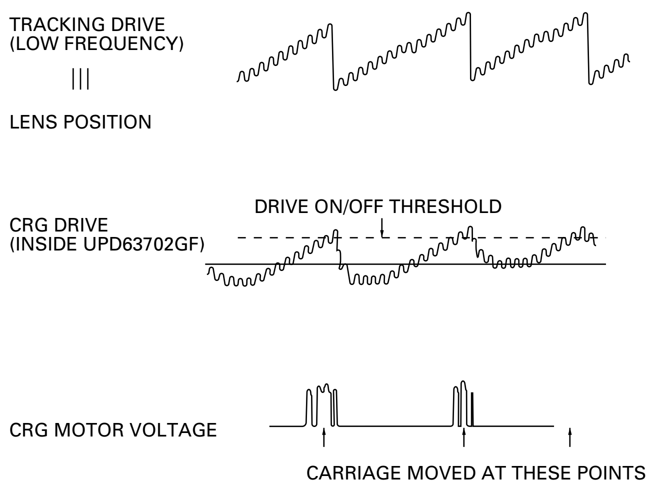


Fig. 16 Carriage Signal Waveforms

4) Spindle servo system

The spindle servo has the following modes:

(1) Kick mode: To be used for accelerating disc rotation during setting.

(2) Offset mode:

a) To be used after completion of kick until completion of spindle lock during setting.

b) If focus is out of range during playback, this mode is used until focus is recovered. In both cases, Offset mode is used for maintaining disc rotation to the speed close to specified rotation.

(3) Adaptive Servo mode: CLV servo mode during normal operation. The system samples every WFCK in 16 cycles whether frame synchronous signal matches output from the internal frame counter in EFM demodulation block, and generates signal that shows matching/unmatching status. If signal showing unmatching status continues for 8 times, the system deems it as asynchronous status. Except this case, the system judges as synchronous. In Adaptive Servo mode, the system automatically selects withdrawal servo for asynchronous status, and steady-state servo for synchronous status.

(4) Brake mode: Mode to stop the spindle motor.
The microcomputer outputs brake voltage from the servo LSI. Waveforms of EFM are monitored inside the LSI. If the longest pattern of EFM exceeds specified intervals (if the rotation speed adequately slowed down), flag is activated in the LSI, and the microcomputer turns brake voltage to OFF. If no flag is activated after a specified time, the microcomputer changes from Brake to Stop mode. This status continues for a specified time. If the system changes to Stop mode during ejection, disc is ejected after the specified time mentioned above.

(5) Stop mode: To be used when the power is turned to ON, and during ejection. In Stop mode, the end-to-end voltage of the spindle motor is 0 V.

(6) Rough Servo mode: To be used when returning carriage (carriage move during long search, etc.). The system calculates linear speed from waveforms of EFM, and inputs either "H" or "L" level to the spindle equalizer. This mode is also used for confirmation of grating in Test mode.

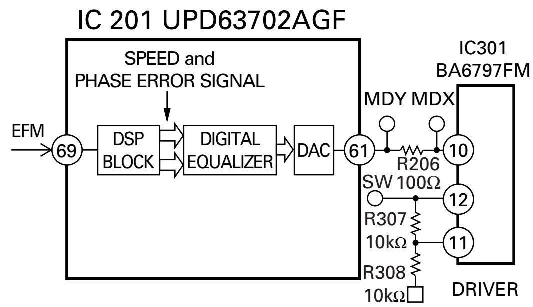


Fig. 17 Spindle servo block diagram

1.3 Automatic Adjustment Function

With this system, all circuit adjustments are automatically performed by using the preamplifier (UPC2572GS) and servo LSI (UPD63702AGF). All adjustments are automatically performed whenever disc is inserted or CD mode is selected by the Source key. Details of automatic adjustments are as follows:

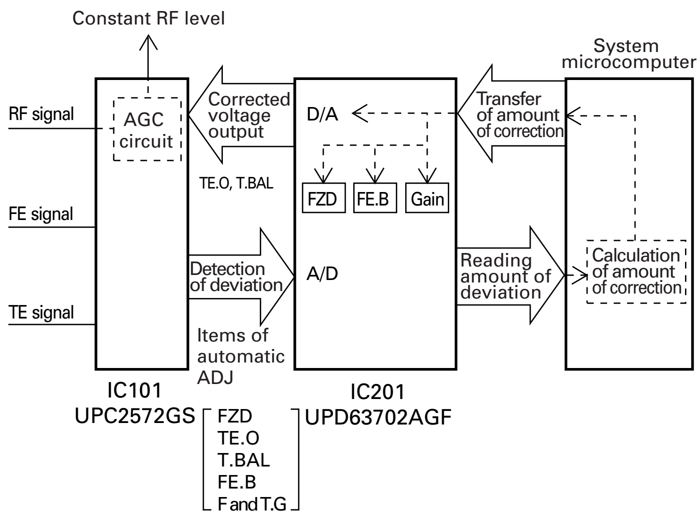


Fig. 18 Outline of Automatic Adjustment

1) Setting of FZD cancellation

This setting ensures focus closing. The system reads the FE offset level when the power is turned to ON, then writes the inverse voltage of offset value of that level to CRAM inside IC to cancel offset. Thus, the threshold level of FZD can be set to a constant value (+150 mV). As a result, "Latching FZD signal to H," which is one of the conditions required for focus closing in IC, is ensured.

2) TE offset automatic adjustment

Adjusts TE amplifier offset of the preamplifier to 0 V when the power is turned to ON.
Adjustment is made as follows:

(1) The microcomputer reads TE offset in LD OFF status via the servo LSI (TE1).
(2) The microcomputer calculates the voltage to be corrected using the TE1 value, and outputs from Pin 65 (pin name: TOFST) of the servo LSI. More specifically, calculation is made as follows:
TOFST2 = TOFST1 + TE1 x R110 / R109

3) Tracking balance (T.BAL) automatic adjustment

To make the sensitivity of Ech of TE output equal to that of Fch. In fact, adjustment is made so that the upper and lower portions of TE waveforms are symmetric to REFO.
Adjustment is made in the following steps:

(1) After focus close, the system kicks the lens in the radial direction to ensure TE waveforms to be generated.
(2) The microcomputer reads the peak bottom of TE waveforms via the servo LSI.
(3) The microcomputer calculates the amount of offset, then calculates the voltage to be corrected based on that offset. The system outputs the result from Pin 66 (pin name: TBAL) of the servo LSI.
(4) The voltage output from the servo LSI is input to Pin 37 of the preamplifier (IC101: UPC2572GS). Pin 37 is a control-voltage terminal of the TEVCA amplifier. According to voltage input, the system changes gain of Ech and Fch in the preamplifier, and adjusts the tracking balance to make the upper and lower portions of TE waveforms symmetric to REFO.

4) FE bias automatic adjustment

Maximizes the RFI level by optimizing focus point during playback. Adjustment is made by using 3T level waveforms of RF waveforms and the phase difference generated by input of disturbance of focus error. Since adjustment is made by inputting disturbance to focus loop, the system uses the same timing as with auto gain control (mentioned later~) for adjustment.
Adjustment is made in the following steps:

(1) Disturbance is input to focus loop by the command from the microcomputer (inside the servo LSI).
(2) The system detects flickering of 3T components of RF signal in the preamplifier.
(3) The system checks the phase difference between 3T components mentioned above and FE signal caused by input of disturbance to detect the direction of focus deviation. The result is output as DC voltage from Pin 30 (3TOUT) of the preamplifier.
(4) The 3TOUT voltage is input to Pin 75 (A/D port) of the servo LSI. The microcomputer reads this 3TOUT voltage via the servo LSI.
(5) The microcomputer calculates the amount of correction required. The results are transferred to offset of focus loop in the servo LSI.

As with auto gain control, the system repeats the same adjustment process several times to improve adjustment precision.

5) Auto gain control (AGC)

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

Adjustment is made in the following steps:

(1) Disturbance is input to servo loop.

(2) The system extracts error signals (FE and TE) upon input of disturbance via the B.P.F. and obtains signals of G1 and G2.

(3) The microcomputer reads G1 and G2 signals via the servo LSI.

(4) The microcomputer calculates required amount of correction to adjust loop gain in the servo LSI.

The system repeats the same adjustment process several times to improve adjustment precision.

6) Initial adjustment value

For all automatic adjustments, the system uses the previous adjustment value as initial values, except when the power of the microcomputer has been turned to OFF (backup is turned to OFF). If backup has been turned to OFF, the system uses initial set value to perform automatic adjustment.

7) Display of coefficients of adjustment results

Results of automatic adjustments can be displayed in Test mode for confirmation. Display of coefficients in each automatic adjustment is as follows:

(1) FZD cancel, TE.OFST cancel, T.BAL, and FE bias
Reference = 32 (32: No adjustment was required)
Display is made in units of approximately 40 mV.
Example: Coefficient of FZD cancel = 35
35 - 32 = 3   3 x 40 mV = 120 mV
Corrected amount is approximately +120 mV. Thus, FE offset before adjustment is -120 mV.

(2) Adjustment of F and T gain
Reference: Focus = 13, tracking = 20
The amount of reduced gain in comparison with the reference is known by looking at the coefficient displayed.
Example: AGC coefficient = 40
Amount of reduced gain = 20 log (20/40) = -6 dB

1.4 Power Supply and Loading Unit

The power supply of the system uses VD (8.3 V) supplied from the mother board, and generates power supply VM (7.6 V) for the loading motor driver and 5 V RegIC power supply (7.6 V). The system directly uses VD for power supplies for driving voltage of disc detection LED and CD driver IC. The microcomputer controls ON/OFF of the CD driver and laser diode by “CONT,” and ON/OFF of 5 V by “CD5VON.” The loading motor driver has no control terminal. However, “EJ” and “LOAD,” which are input signals, play the same role as with control terminal.

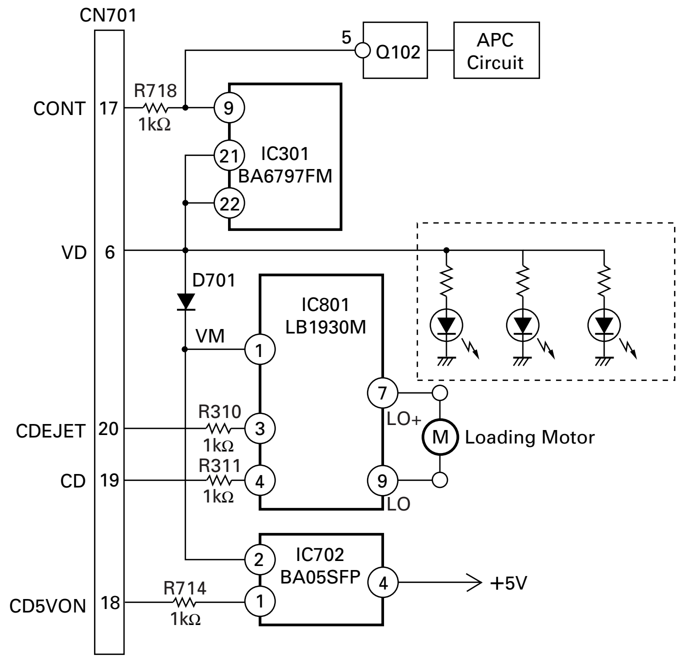


Fig. 19 Power Supply and Loading Unit

2. MECHANISM DESCRIPTIONS

● Disc loading

1. Three phototransistors are provided in front and rear of the rubber roller for disc transfer. Light is received from three LEDs corresponding the phototransistors. (Voltage of the phototransistors is "L" when receiving light.)
2. The voltage of the front phototransistor (P1) changes to "H" when disc is inserted and reaches immediately before the rubber roller. As a result, the loading motor is activated to drive.
3. The driving power of the motor is conveyed by the gear to rotate the rubber roller and transfer the disc. The rubber roller is located at an end of the loading arm, and in condition to lift the guide arm. The guide arm is driven by two springs so that the guide arm and rubber roller obtain appropriate pressure to transfer disc between them.
4. The clamper arm has the disc centering mechanism to determine disc size and clamp the disc to the center of the spindle motor. The centering arms are provided on the right and left of the clamper arm, and move around the supporting point. The end of centering arm has a lock arm (rotates around the centering pin, and is locked to the clamper arm when an 8-cm disc is inserted).
5. The lock arm is unlocked when a 12-cm disc is inserted, and moves to the position shown in Fig. 21. The position of the detection arm, having the center of rotation on the right centering arm as shown in Fig. below, is different for 8-cm and 12-cm discs. The detection arm moves clockwise according to outer diameter when disc is positioned on the spindle to move the detection lever downward as shown in the illustration.

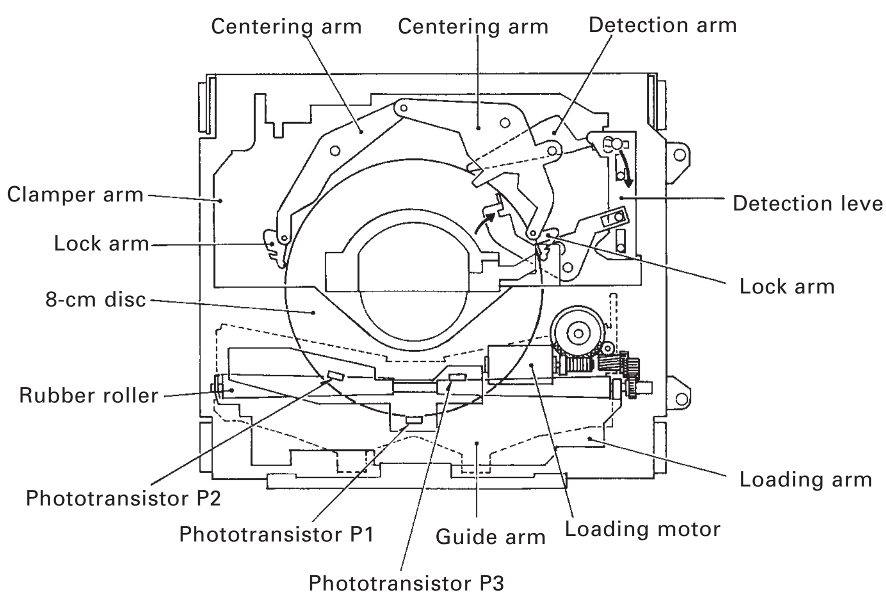
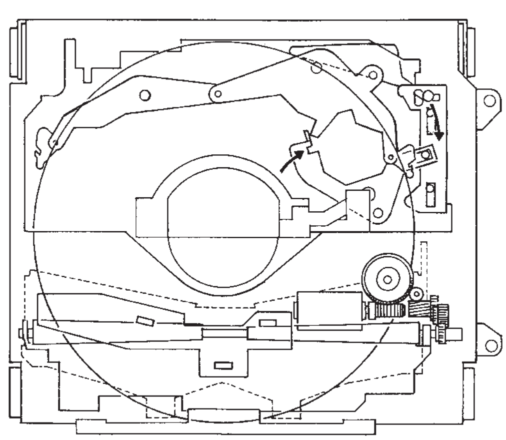


Fig. 20



When 12-cm disc is inserted

Fig. 21

● **Clamp operation**

When the rack lever in contact with the detection lever is driven by the loading motor, the rack lever engages with the gear to move the clamp UP lever, mechanical lock arm, and mechanical lock lever toward the directions indicated with arrows in Fig. 22.

The clamper arm, that was lifted by the clamp UP lever, comes down to clamp disc. The clamp UP lever and mechanical lock lever L move the loading arm apart from the disc. When the mechanical lock lever has moved to a specified position, the system turns the clamp switch to ON to stop the loading motor.

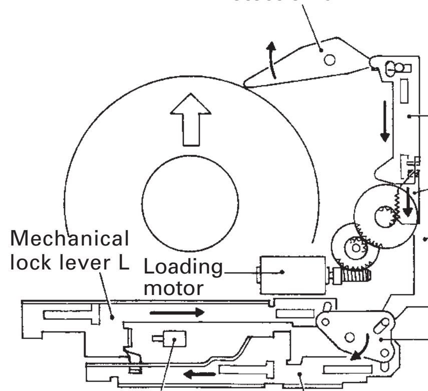


Fig. 22

● **Mechanical locking**

During ejection, two mechanical lock levers slide into the teeth of the frame to resist the mechanical spring and push down the front of floating (chassis) unit. Thus, the system detects the height of disc insertion. During playback, the floating unit is released when the mechanical lock levers move and disengage from the frame teeth.

● **Ejection**

Disc is ejected by the loading motor rotating in the inverse direction from loading to activate mechanical locking, release clamping, and press the roller. The system stops the loading motor when both phototransistors P2 and P3 in the rear of the rubber roller detect. (Voltage : L)

3. DISASSEMBLY

When removing the floating unit, stop the mechanism during playback (to unlock the mechanism).

● **Removing the damper and frame**

● **Removing the floating unit**

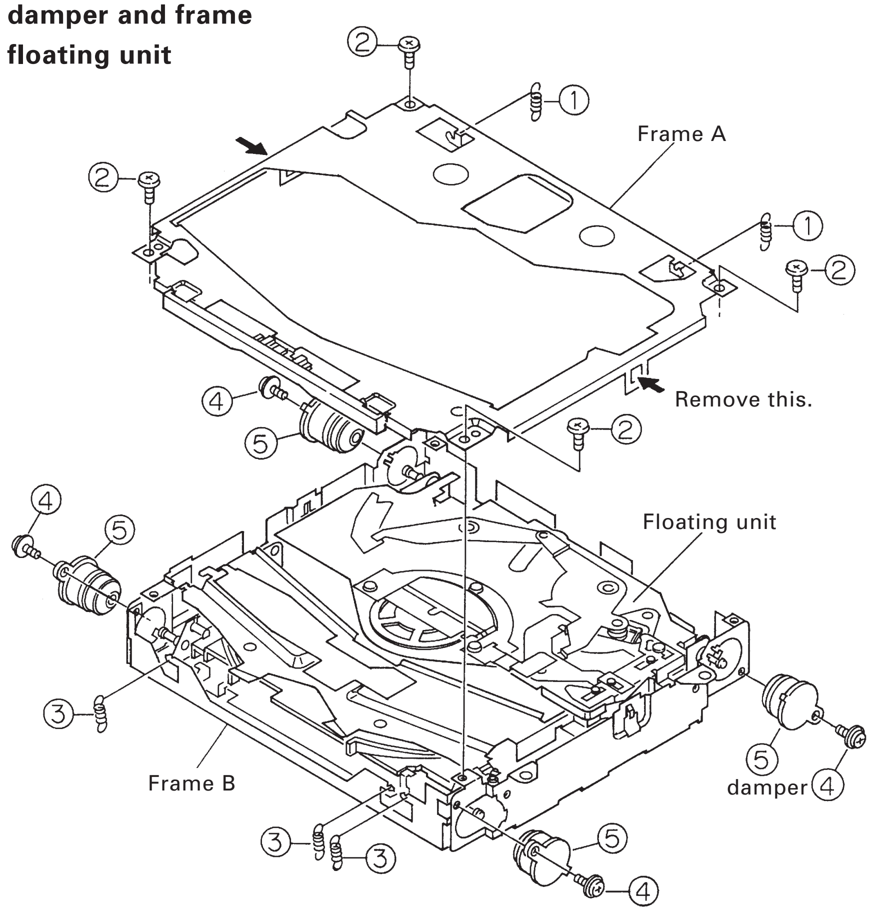


Fig. 23

● **Removing the clamper arm**

● **Removing the spindle motor**

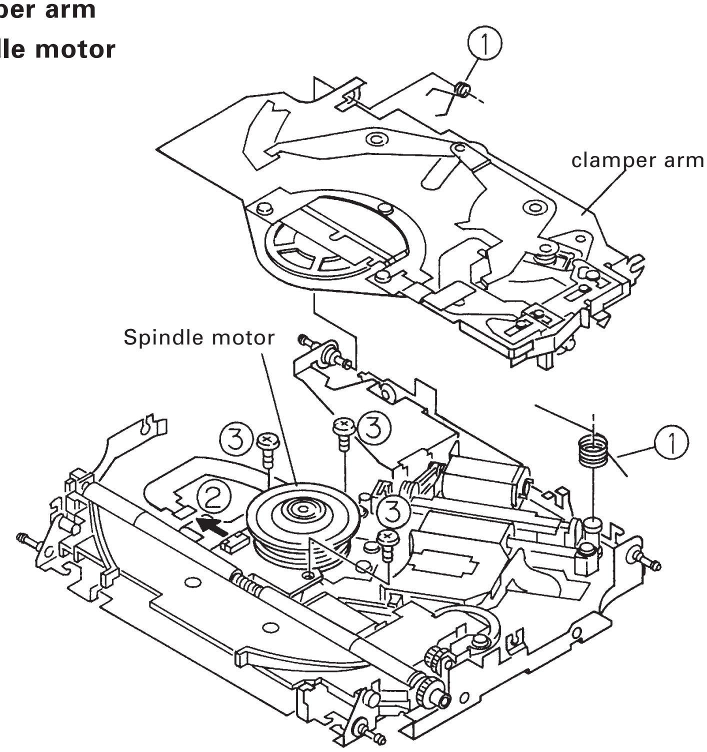


Fig. 24

● Removing the Carriage Motor

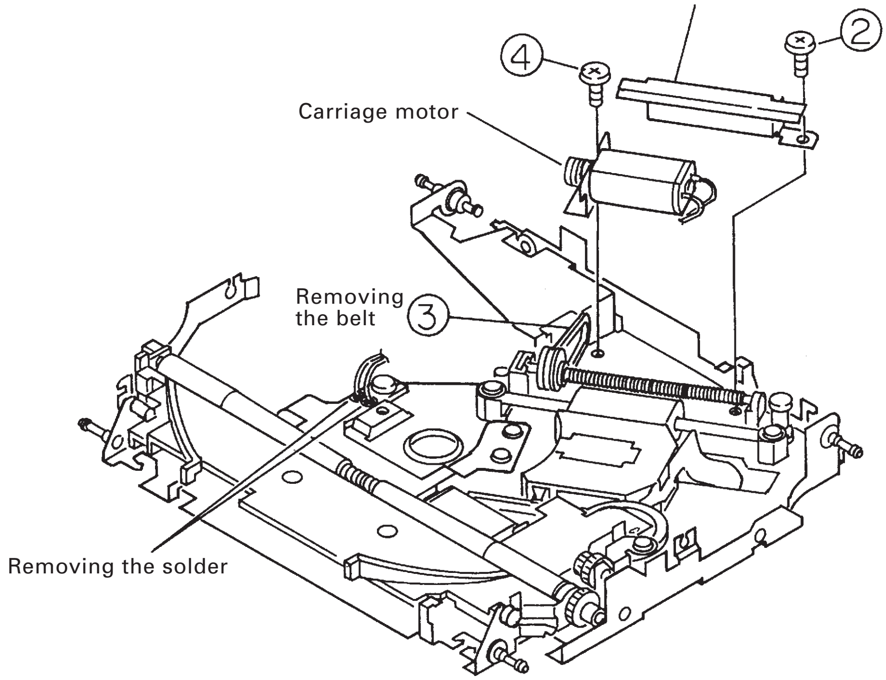


Fig. 25

● Removing the Loading motor

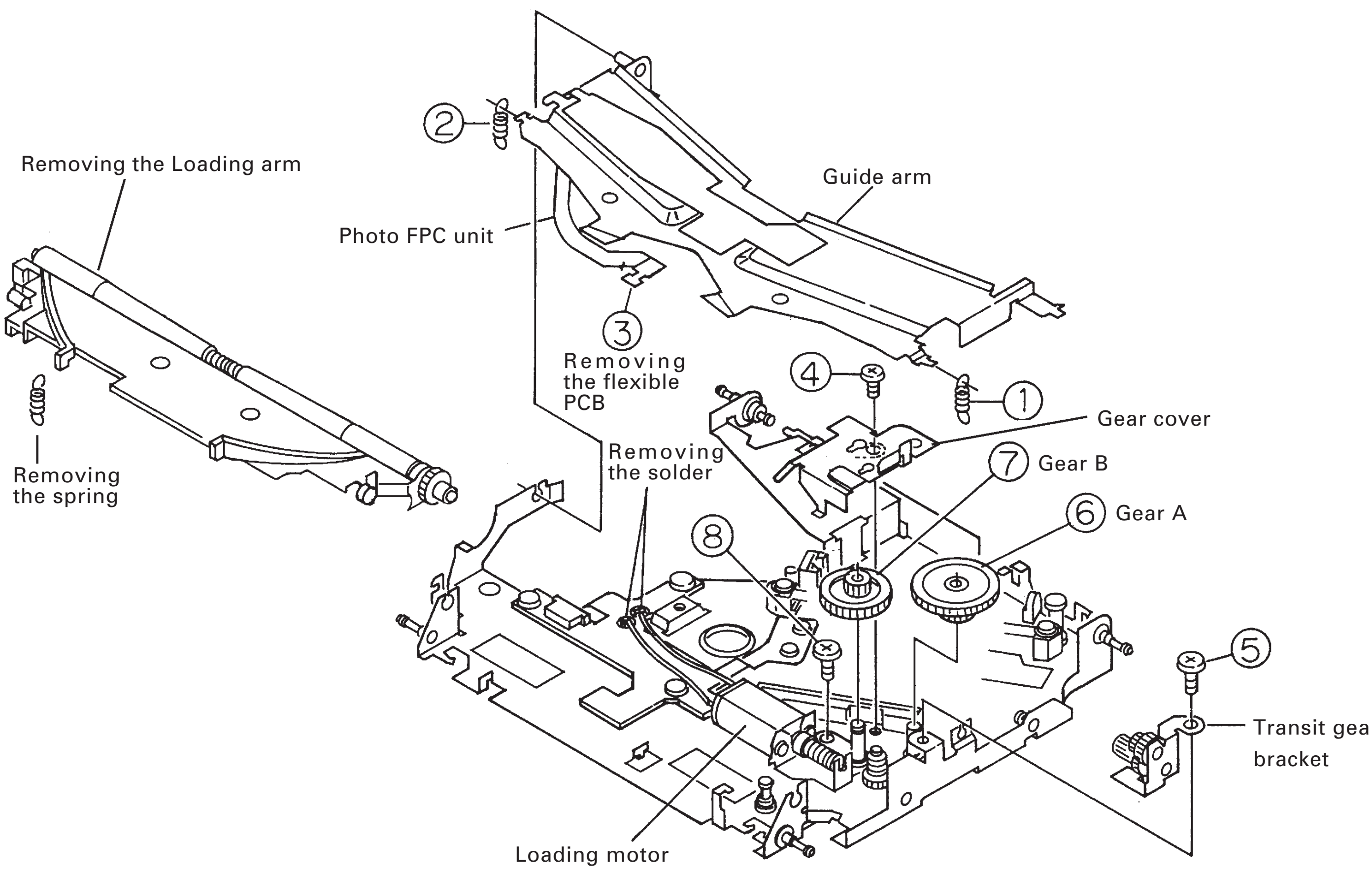
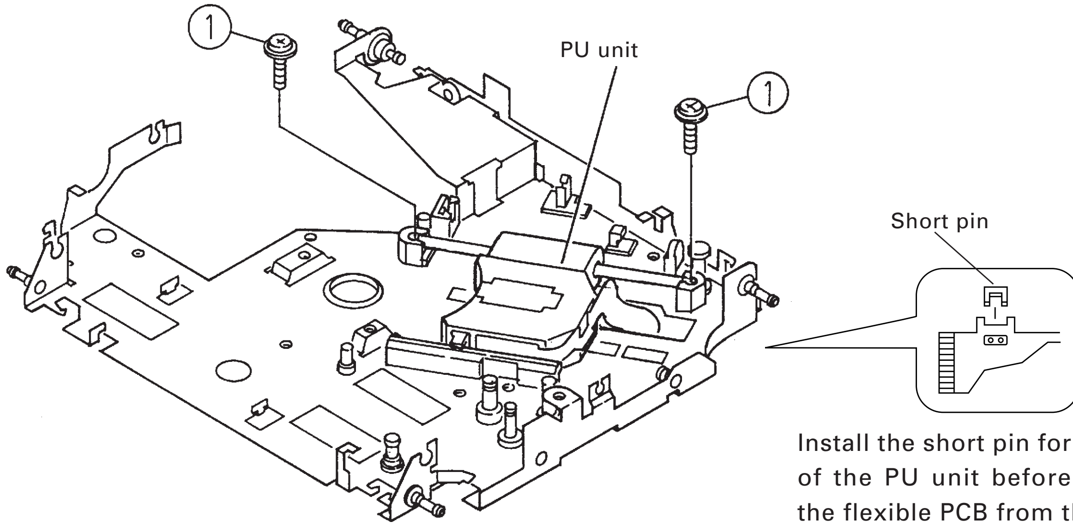


Fig. 26

● Removing the PU unit

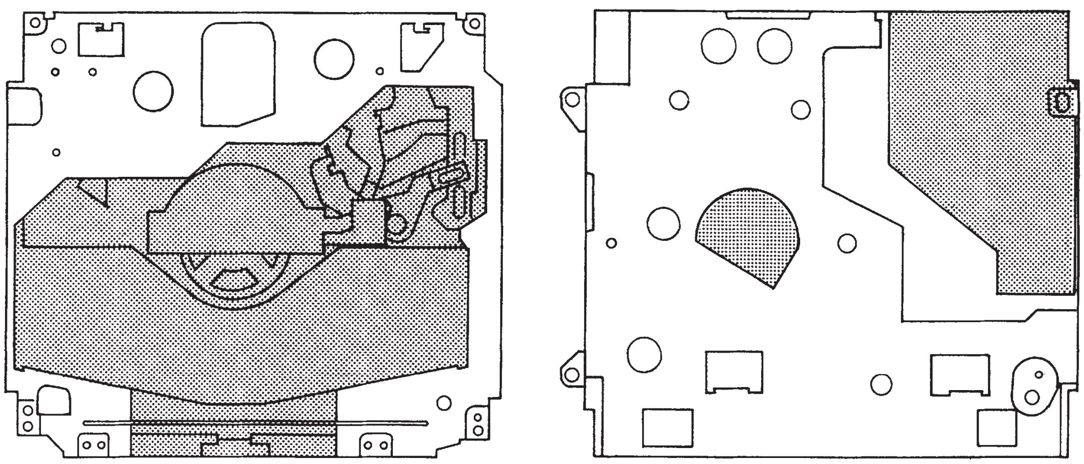
When tighten screw (1), tighten with a torque of 1.8 kg-cm.



Install the short pin for protection of the PU unit before removing the flexible PCB from the connector (CN101).

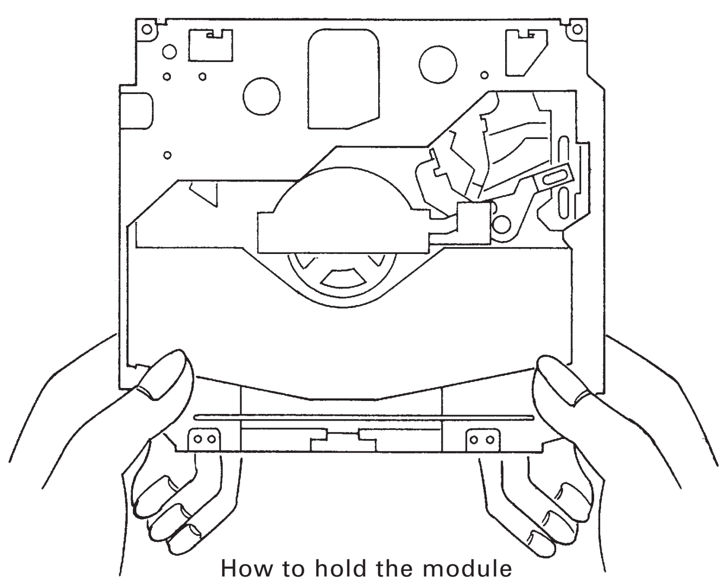
Fig. 27

● How to hold the CD mechanism module



Do NOT hold the parts indicated in dark color.

Fig. 28



How to hold the module

Fig. 29