

harman/kardon

# Model FL8300

5 Disc Compact Disc Changer

## SERVICE MANUAL

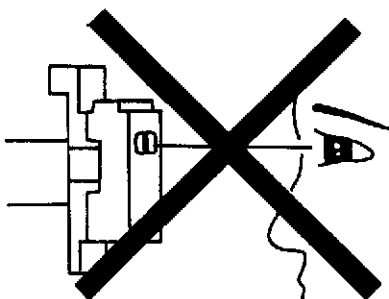


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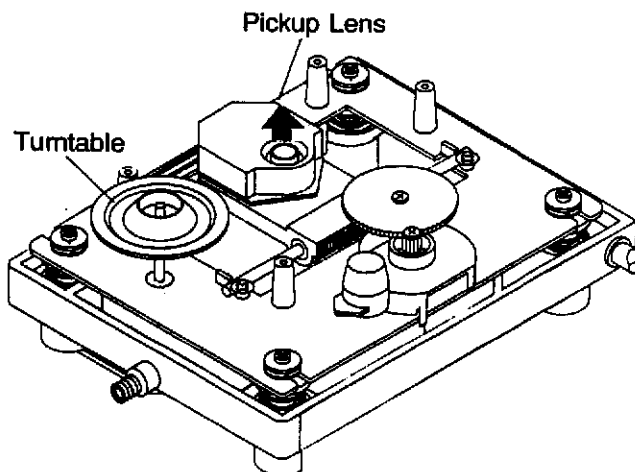
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**LASER BEAM SAFETY PRECAUTIONS****CLASS 1 LASER PRODUCT****CLASS 1  
LASER PRODUCT****CAUTION****Invisible laser radiation when the unit is open. DO not stare into beam.****CAUTION: USE OF ANY CONTROLS, ADJUSTMENT, OR PROCEDURES OTHER THAN THOSE SPECIFIED HEREIN MAY RESULT IN HAZARDOUS RADIATION EXPOSURE.****Do not look directly at the laser beam coming from the pickup or allow it to strike against your skin.**

This compact disc player uses a pickup that emits a laser beam. The laser beam is emitted from the location shown in the figure. When checking the laser diode, be sure to keep your eyes at least 1 foot away from the pickup lens when the diode is turned on. Do not look directly at the laser beam.

**CAUTION:**

Using controls and adjustment, or doing procedures other than those specified herein, may result in hazardous radiation exposure.

## SAFETY PRECAUTIONS



### WARNING

To prevent fire or shock hazard, do not expose the unit to rain or moisture.



This symbol is intended to alert the user to the presence of uninsulated "dangerous voltage" within the product's enclosure that may be of sufficient magnitude to constitute a risk of electric shock to persons.



This symbol is intended to alert the user to the presence of important operating and maintenance (servicing) instructions in the literature accompanying the appliance.

**Caution:** To prevent electric shock do not use this (polarized) plug with an extension cord, receptacle or other outlet unless the blades can be fully inserted to prevent blade exposure.

**Attention:** Pour prévenir les chocs électriques ne pas utiliser cette fiche polarisée avec un prolongateur, une prise de courant ou une autre sortie de courant, sauf si les lames peuvent être insérées à fond sans en laisser aucune partie à découvert.

### HANDLING LASER PICKUP

The laser diode in the optical system of this player can be damaged by electrostatic discharge from your clothes or your body. Proper electrostatic grounding for service personal is required during servicing.

## BEFORE REPAIRING THE COMPACT DISC PLAYER

### Preparation

#### • Human Body Grounding:

Many of the components used in this compact disc player, including the laser pickup, are sensitive to electrostatic discharge. Service personal should be grounded with an electrostatic armband (1 Mohm).

#### • Caution:

Static charge on clothing does not escape through a body grounding wrist band. Be careful not to contact the pickup or electrical components with your clothing.

#### • Workbench and Tool Grounding:

A properly-grounded electroconductive plate (1 Mohm) or metal sheet should be fitted to the workbench surface. Tools and instruments (such as soldering irons and scopes) should be grounded to prevent AC leakage.

Incorrect



Fig. 1

Correct

Grounded Conductive Wrist for Body

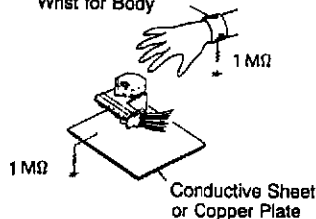


Fig. 2

**Note:** Laser diodes are so susceptible to damage from static electricity that, even if a static discharge does not ruin a diode, it can shorten its life or cause it to work improperly.

## LEAKAGE TEST

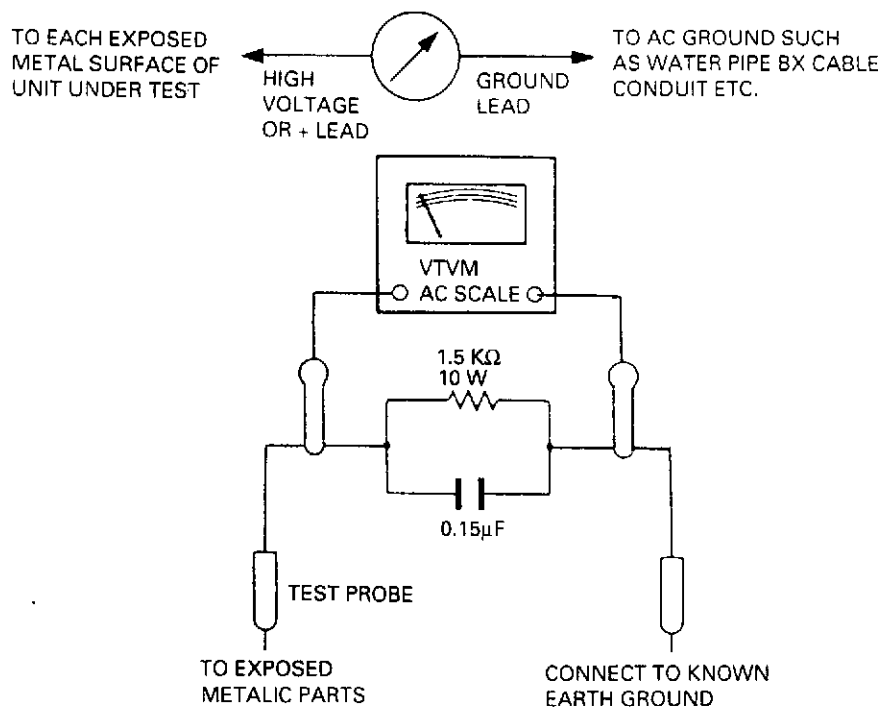
Before returning the unit to the user, perform the following safety checks:

1. Inspect all lead dress to make certain that leads are not pinched or that hardware is not lodged between the chassis and other metallic parts in the unit.
2. Be sure that any protective devices such as nonmetallic control knobs, insulating fishpapers, cabinet backs, adjustment and compartment covers or shields, isolation resistor-capacity networks, mechanical insulators, etc. Which were removed for servicing are properly reinstalled.
3. Be sure that no shock hazard exists; check for leakage current using Simpson Model 229 Leakage Tester, standard equipment item no. 21641, RCA model WT540A or use alternate method as follows: plug the power cord directly into a 120-volt AC receptacle (do not use an Isolation transformer for this test).

Using two clip leads, connects a 1500 ohm, 10-watt resistor paralleled by a  $0.15\mu\text{F}$  capacitor, in series with all exposed metal cabinet parts and a known earth ground, such as a water pipe or conduit. Use a VTVM or VOM with 1000 ohms per volt, or higher sensitivity to measure the AC voltage drop across the resistor. (see diagram) Move the resistor connection to each exposed metal part having a return path to the chassis (antenna, metal cabinet, screw heads, knobs and control shafts, escutcheon, etc.) and measure the AC voltage drop across the resistor. (This test should be performed with the power switch in both the on and off positions.)

A reading of 0.35 volt RMS or more is excessive and indicates a potential shock hazard which must be corrected before returning the unit to the owner.

### SIMPSON MODEL 229 ETC. FOR LEAKAGE TEST



## SPECIFICATIONS

### General

|                       |                               |
|-----------------------|-------------------------------|
| Transmission bit rate | 4.3218 Mbit/sec               |
| Transmission on clock | 16:9344 MHz                   |
| Error correction      | CIRC C1, C2 Double correction |

### Pickup

|                          |                                       |
|--------------------------|---------------------------------------|
| System                   | Object lens drive type optical pickup |
| Object lens drive system | 2 Dimensional parallel drive type     |
| Optical source           | Semiconductor laser                   |
| Wave length              | 760-800 nm                            |
| Tracking system          | 3 Beam tracking servo type            |

### Others

|                    |                                                                            |
|--------------------|----------------------------------------------------------------------------|
| D/A converter      | 1 bit (Bitstream Conversion)                                               |
| Power requirements | USA and Canada Version: 120 V AC, 60 Hz<br>Europe Version: 230 V AC, 50 Hz |
| Power consumption  | 12 W                                                                       |
| Dimensions (HxWxD) | 95 × 440 × 300 mm                                                          |
| Weight             | 6.08 kg                                                                    |

### Electrical

#### \* Preparations

- measuring methods in conformity with EIAJ CP-307, CCIR 468-3.
- Reference level: 0 dB (LINE OUT 2 V).
- Test disc: SONY CD3 YEDS 7, A.BEX TCD 725.

| Description                                          |             | Signal        | Track   | Unit | Normal      | Limit       | Test Disc             |
|------------------------------------------------------|-------------|---------------|---------|------|-------------|-------------|-----------------------|
| Frequency Response                                   |             | 20 ~ 20000 Hz | 2 ~ 13  | dB   | ± 0.5       | ± 1         | SONY<br>CD3<br>YEDS 7 |
| Signal to Noise Ratio (Weighted JIS A)               |             | 1 kHz         | 23      | dB   | > 95        | > 90        |                       |
| Dynamic Range (Weighted JIS A)                       |             | 1 kHz, 60 dB  | 20      | dB   | > 90        | > 85        |                       |
| Total Harmonic Distortion at 0 dB<br>(Filter 30 kHz) |             | 100 Hz        | 4       | %    | ≤ 0.08      | ≤ 0.1       |                       |
|                                                      |             | 1 kHz         | 7       | %    | ≤ 0.04      | ≤ 0.05      |                       |
|                                                      |             | 20 kHz        | 13      | %    | ≤ 0.1       | ≤ 0.15      |                       |
| Channel Separation<br>(Filter 30 kHz)                |             | 100 Hz        | 29, 33  | dB   | ≥ 82        | ≥ 80        |                       |
|                                                      |             | 1 kHz         | 30, 34  | dB   | ≥ 82        | ≥ 80        |                       |
|                                                      |             | 10 kHz        | 31, 35  | dB   | ≥ 80        | ≥ 78        |                       |
|                                                      |             | 20 kHz        | 32, 36  | dB   | ≥ 76        | ≥ 73        |                       |
| Channel Unbalance                                    |             | 1 kHz         | 7       | dB   | ± 0.2       | ± 0.5       |                       |
| Output Voltage                                       |             | 1 kHz         | 7       | V    | 2 ± 0.3     | 2 ± 0.5     |                       |
| De-emphasis                                          |             | 1 kHz         | 39      | dB   | -0.37 ± 0.2 | -0.37 ± 0.3 | A.BEX<br>TCD 725      |
|                                                      |             | 5 kHz         | 40      | dB   | -4.53 ± 0.3 | -4.53 ± 0.5 |                       |
|                                                      |             | 16 kHz        | 41      | dB   | -9.04 ± 0.5 | -9.04 ± 1.0 |                       |
| Disc Defect                                          | Back Dot    |               | 10 ~ 15 | μm   | ≥ 700       | ≥ 600       |                       |
|                                                      | Inerrupt    |               | 3 ~ 9   | μm   | ≥ 800       | ≥ 700       |                       |
|                                                      | Fingerprint |               | 17 ~ 19 | μm   | ALL         | ALL         |                       |

**Environmental****Test to specification**

Temperature between 59°F (15°C) and 95°F (35°C) and relative humidity between 45% and 75%, with power supply voltage of 10% the normal supply voltage.

**Operation**

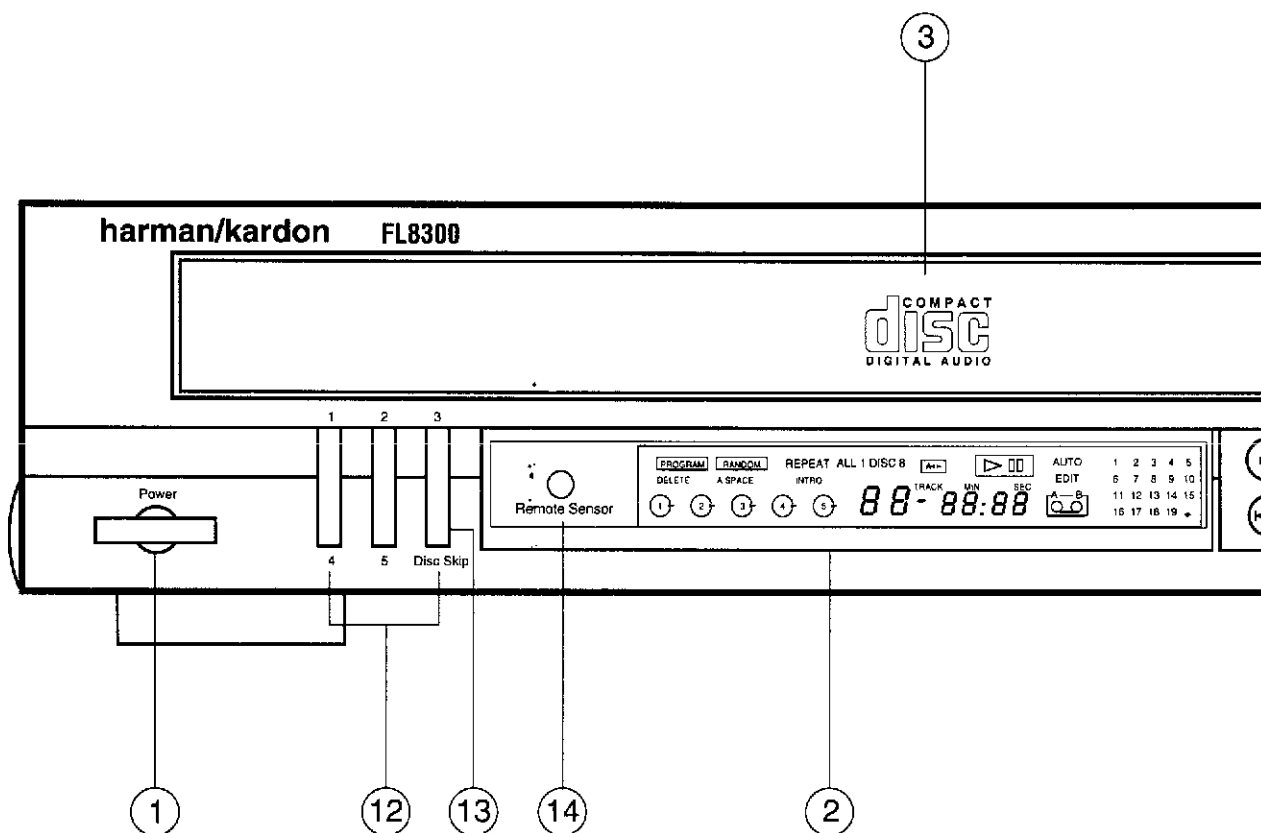
Unit must work properly and correctly at the temperature range from 32°F (0°C) to 113°F (45°C) and the relative humidity from 40% to 80%, and with the supply voltage.

**Storage**

Temperature test : 48 hours each at -40° F (-40° C) and 149° F (65° C).

Humidity test : 40° C, 95% relative humidity.

# CONTROL AND FUNCTIONS



## 1. POWER SWITCH

Press the POWER switch to turn this unit on and press it again to turn it off. For system operation, plug the AC input cord into the switched AC outlet, keep the power switch ON and control power ON/OFF with the main POWER switch on the amplifier or receiver.

## 2. MULTI-FUNCTION DISPLAY

This display shows the corresponding information according to each mode.

## 3. DISC TRAYS (1 - 5)

One disc per tray can be loaded with the labelled side up.

## 4. PLAY/PAUSE BUTTON (▶||)

This button is used for starting play, pausing play at the beginning of a track or interrupting play.

## 5. STOP/CLEAR BUTTON (■)

This button is used for stopping play, clearing programmed selections or recovering the deleted selections.

## 6. BACKWARD SKIP/SEARCH BUTTON (◀◀)

This button is used for replaying from the beginning of the current track, returning to a previous track or searching for a particular passage in fast reverse.

## 7. FORWARD SKIP/SEARCH BUTTON (▶▶)

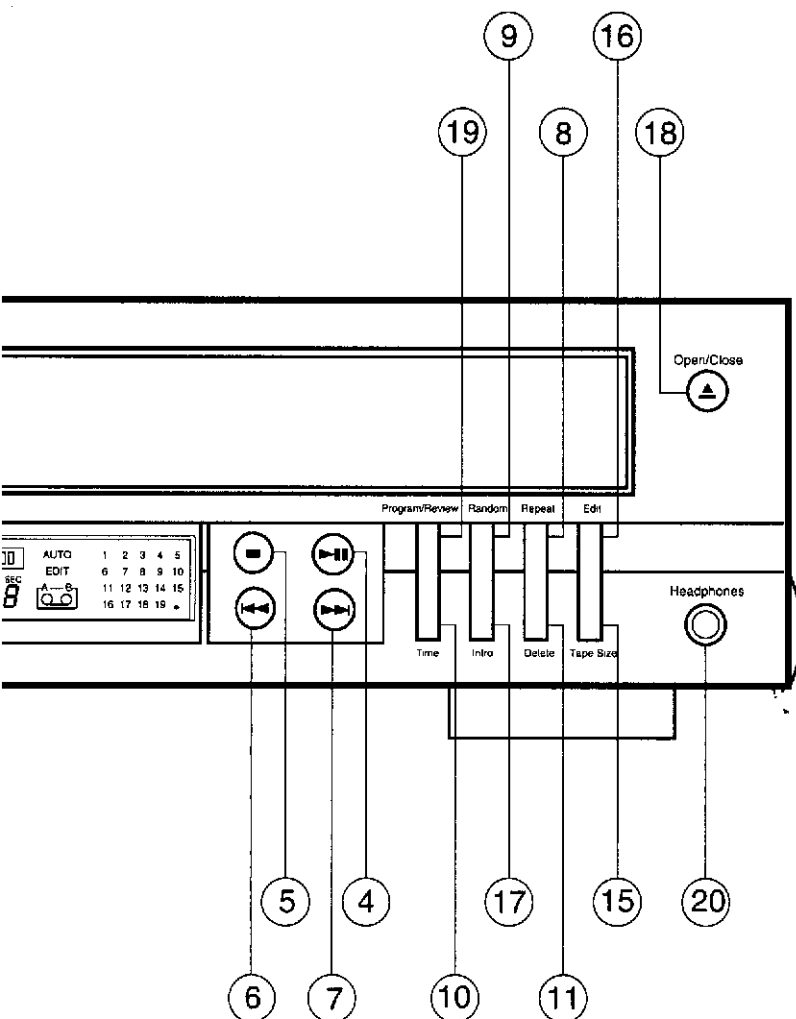
This button is used for moving to the next track or searching for a particular passage in fast forward.

## 8. REPEAT BUTTON

This button is used for repeating track, one disc or all discs.

## 9. RANDOM PLAY BUTTON

This button is used to let the unit automatically select and play randomly on each CD or track between discs and tracks.



### FORWARD SKIP/ SEARCH BUTTON (▶▶)

This button is used for moving on to the next track or searching for a particular passage in fast forward.

### REPEAT BUTTON

This button is used for repeating one track, one disc or all discs.

### RANDOM PLAY BUTTON

This button is used to let the unit automatically select and play tracks randomly on each CD or randomly between discs and tracks.

### 10. TIME BUTTON

This button is used for checking the elapsed playing time from the beginning of the current track, remaining playing time of the current track or remaining playing time of the disc.

### 11. DELETE BUTTON

This button is used for deleting the undesired tracks or discs.

### 12. DISC SELECTOR BUTTONS

These buttons are used for selecting the disc to be played.

### 13. DISC SKIP BUTTON

Each time this button is pressed to load or unload the disc, the carousel will rotate to the next tray position clockwise.

### 14. INFRARED RECEIVER WINDOW

This receives the infrared signals transmitted by the remote control and converts it into the electrical signal to control this unit.

### 15. TAPE SIZE BUTTON

This button is used for selecting the tape length.

### 16. EDIT BUTTON

This button is used for editing the tracks to be recorded onto the cassette tape.

### 17. DISC INTRO BUTTON

This button is used for playing the first 10 seconds of each track or the first track on CDs.

### 18. OPEN/CLOSE BUTTON

This button is used for opening and closing the tray.

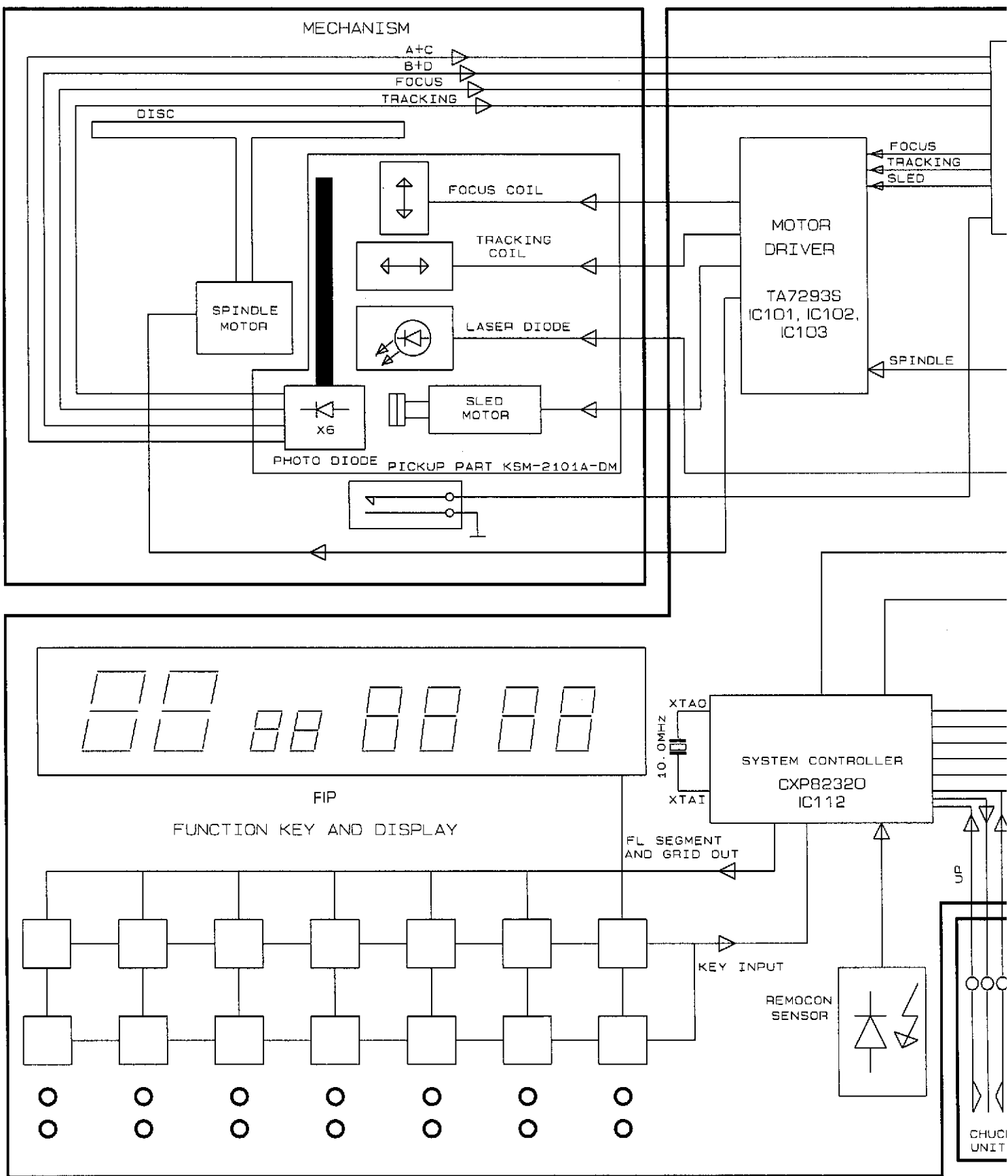
### 19. PROGRAM/REVIEW BUTTON

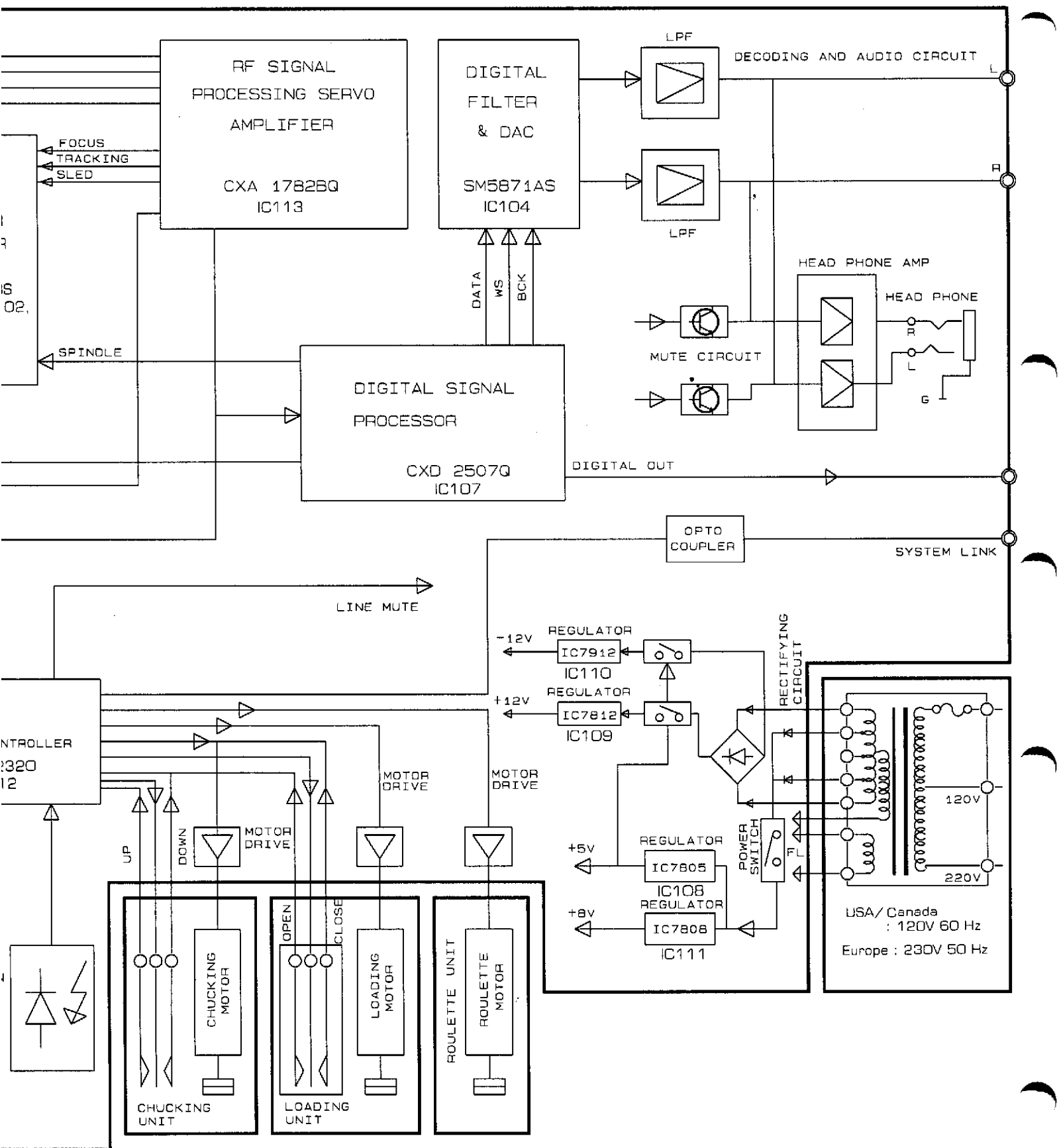
This button is used for programming your favorite tracks or discs or reviewing the programmed selections.

### 20. HEADPHONE JACK

This is used for listening with headphones.

BLOCK DIAGRAM





## PICKUP REPLACEMENT

### Caution:

Laser diodes are extremely susceptible to damage from static electricity. Even if a static discharge does not ruin the diode, it can shorten its life or cause it to work improperly. When replacing the pickup, take appropriate measures, such as using a conductive mat and a grounded soldering iron, to protect the laser diode from static damage.

1. Remove the CD mechanism assembly by referring to the "EXPLODED VIEW II" on page 31 (See Fig. 3).

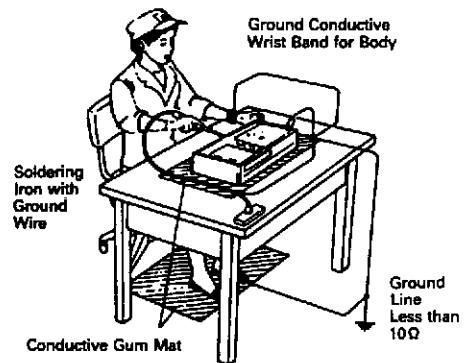


Fig. 3

2. Remove four screws S12 (See Fig. 4).

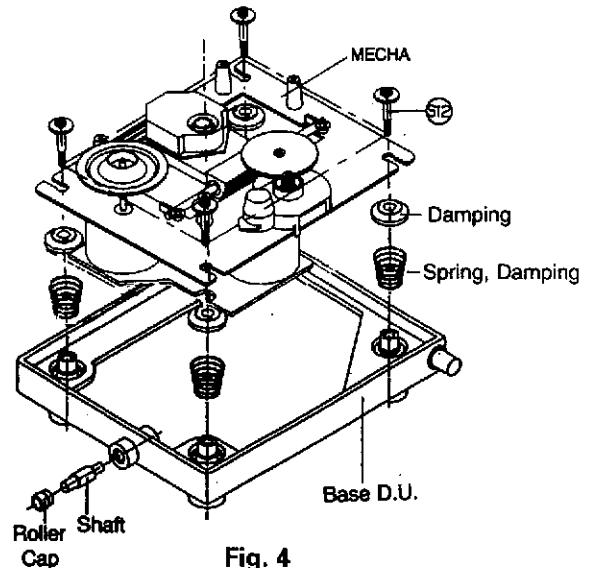


Fig. 4

3. Remove the gear A (See Fig. 5).
4. Pull out the slide shaft.

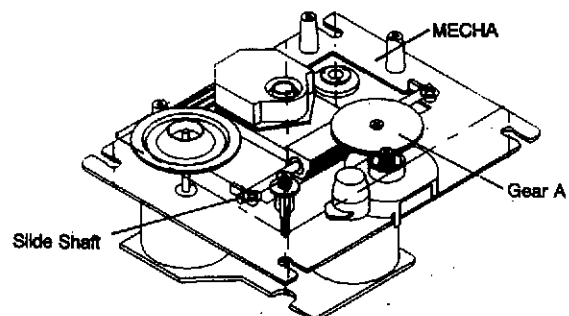


Fig. 5

5. Remove the pickup (See Fig. 6).

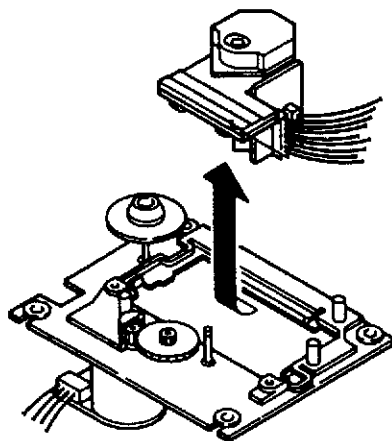


Fig. 6

6. After you connect the wire connector, desolder and remove the shorting tab (See Fig.7).

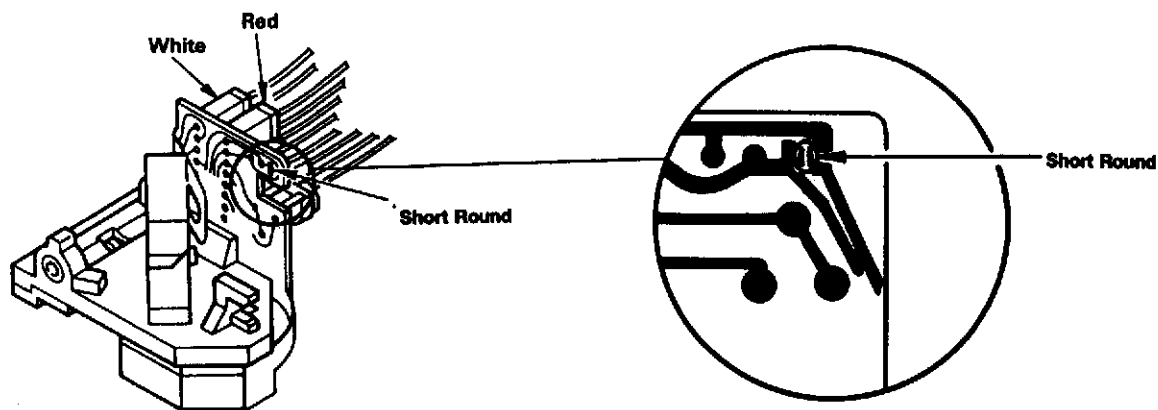


Fig. 7

7. Refer to the "EXPLODED VIEW II" of the compact disc mechanism on page 31 for detailed illustrations.

## OPERATION CHECK

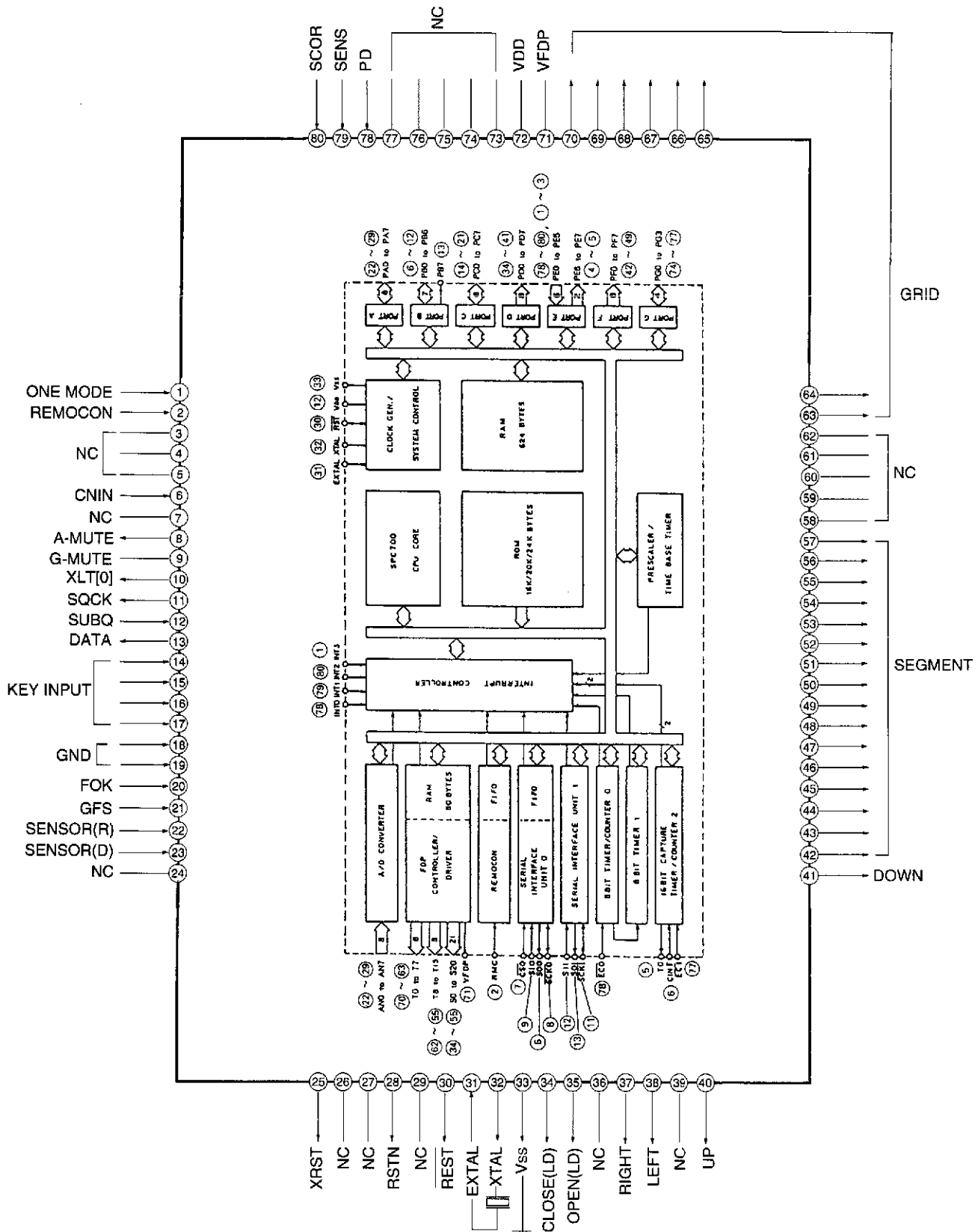
When the power switch is turned on after the chucking arm is removed, observe the objective lens and check the following. (The optical system block should be at the lead-in position when it is checked.)

1. The disc table should be at the innermost position after the chucking arm is removed.
2. The diffused light of the laser beam can be seen when the power switch is turned on.
3. Vertical (up and down) movement of the objective lens take place (2 or 3 times).

# CIRCUIT DESCRIPTION

## 1. CPU(IC112 : CXP82320-322) EXPLANATION

### 1-1. Pin Description & Block Diagram



## 1-2. Pin Functions

| Pin No. | Symbol    | Description                                                  |
|---------|-----------|--------------------------------------------------------------|
| 1       | ONE MODE  | Test mode for production.                                    |
| 2       | REMOCON   | Input for remocon data.                                      |
| 3 - 5   | NC        | Not used ! (It should be left to open.)                      |
| 6       | CNIN      | Signal input for automatic tracking adjustment from CXD2507. |
| 7       | NC        | Not used ! (It should be left to open.)                      |
| 8       | A-MUTE    | Output for audio mute.                                       |
| 9       | G-MUTE    | Not used ! (It should be left to open.)                      |
| 10      | XLT-0     | Serial latch data output to CXD2507.                         |
| 11      | SQCK      | Clock data output for subcode-Q readout to CXD2507.          |
| 12      | SUBQ      | Subcode-Q data input from CXD2507.                           |
| 13      | DATA      | Serial data output to CXD2507.                               |
| 14 - 17 | KEY INPUT | Data input for key scan.                                     |
| 18 - 19 | GND       | Ground.                                                      |
| 20      | FOK       | FOK data from CXA1782BQ.                                     |
| 21      | GFS       | GFS data from CXA1782BQ.                                     |
| 22      | SENSOR-R  | Roulette sensor data input from mecha.                       |
| 23      | SENSOR-D  | Disc sensor data input from mecha.                           |
| 24      | NC        | Not used ! (It should be left open.)                         |
| 25      | XRST      | Output for resetting CXD2507.                                |
| 26 - 27 | NC        | Not used ! (It should be left open.)                         |
| 28      | RSTN      | Output for resetting SM5871AS.                               |
| 29      | NC        | Not used ! (It should be left open.)                         |
| 30      | RST       | Input for resetting CPU.                                     |
| 31      | EXTAL     | Input of 10 MHz oscillator crystal.                          |
| 32      | XTAL      | output of 10 MHz oscillator crystal.                         |
| 33      | VSS       | Ground                                                       |
| 34      | CLOSE-LD  | Output for driving motor to close the tray.                  |
| 35      | OPEN-LD   | Output for driving motor to open the tray.                   |
| 36      | NC        | Not used ! (It should be left open.)                         |
| 37      | RIGHT     | Output for roulette motor to rotate the disc platter right.  |
| 38      | LEFT      | Output for roulette motor to rotate the disc platter left.   |
| 39      | NC        | Not used ! (It should be left open.)                         |
| 40      | UP        | Output for chucking motor.                                   |
| 41      | DOWN      | Output for chucking motor.                                   |
| 42 - 57 | SEGMENT   | Segment signal output.                                       |
| 58 - 62 | NC        | Not used ! (It should be left open.)                         |
| 63 - 70 | GRID      | Grid signal output.                                          |
| 71      | VFDP      | -35 V power supply for F1 controller.                        |
| 72      | VDD       | +5 V power supply for CPU.                                   |
| 73~77   | NC        | Not used ! (It should be left open.)                         |
| 78      | PD        | Input signal for power down.                                 |
| 79      | SENS      | Sens signal input from CXD2507.                              |
| 80      | SCOR      | Subcode-Q readout timing input from CXD2507.                 |

## 2. APC CIRCUIT

A semiconductor laser is used as the light source for the optical pickup. As the laser diode has large negative temperature characteristics in its optical output when driven with a constant current, a circuit must be provided to stabilize this output. For this purpose, a monitor diode which detects the optical output of the laser diode is used in the semiconductor laser.

As the laser diode emits light from its bonded surface, light is emitted both in front and behind. The light emitted behind is monitored with the monitor diode installed on its rear surface, and the optical output is thus controlled. The light emitted in front becomes the light source for the pickup.

Fig. 8 shows the APC circuit.

When the temperature rises and the optical output decreases, the monitor diode current ( $I_s$ ) decreases, the electric potential of IC113 pin 33 rises, the base current of the driving transistor increases, and the laser diode current increases. This causes the reduced optical output to return to its former level.

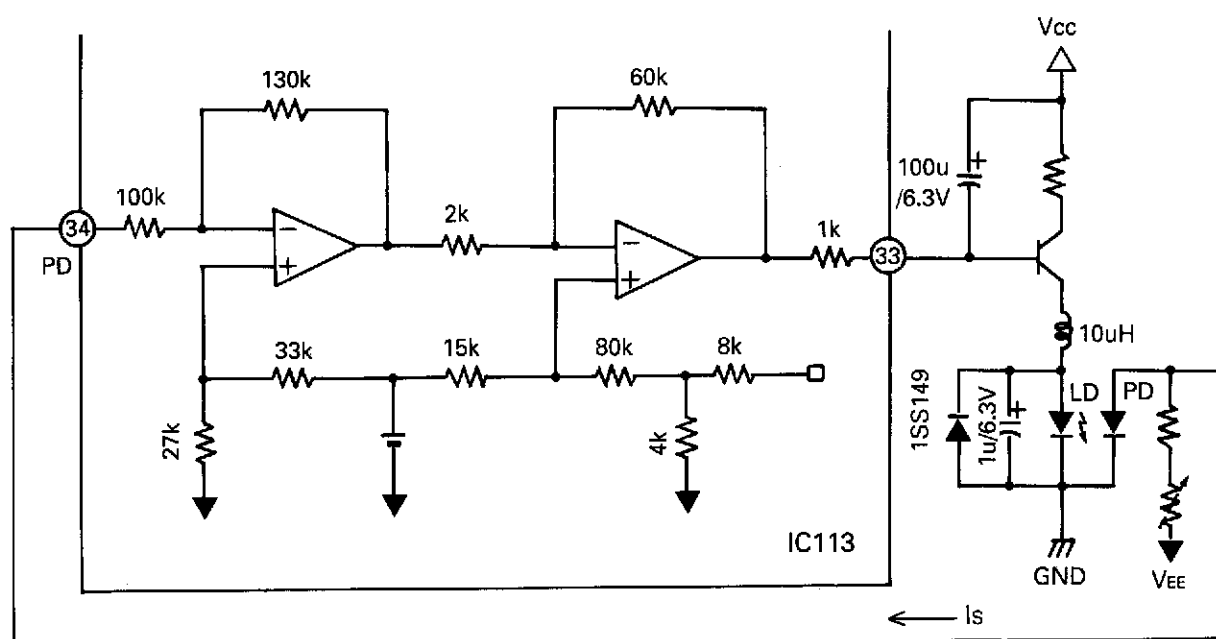


Fig. 8

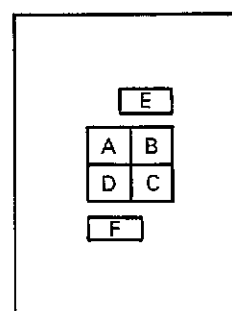
## 3. FOCUS SERVO

### 3-1. Optical pickup (Fig. 9)

This set employs a three-beam optical pickup comprised of six division photodiodes, A through F as shown in Fig. 9. The four photodiodes (A through D) at the center provide focus error detection by using their property to allow the beam to focus into a round image only at a certain point.

The sums of outputs from diagonal two elements of four division photodiodes (A+C and B+D) are compared by the differential amplifier in IC113 to detect the shape of the beam image.

The remaining two diodes (E and F) provide tracking error detection by means of sub-beam spots.



Three spotted (six-division) photo diodes

Fig. 9

### 3-2. Focus error detecting operation (Fig. 10)

The reflected laser beam from a disc is polarized 90° with the beam-splitter and sent to the cylindrical lens. The beam passed through this cylindrical lens is then sent to the four division photodiodes and focuses into an image whose shape varies with the distance between the disc and the objective lens. Such change in the beam shape causes the current flowing from the photodiodes to vary.

Shown in Fig. 10 is the principle of the focus error detection.

The currents from the photodiodes (A+C and B+D) are applied to pins 35 and 36 of IC113 and converted to voltage by RF I-V amplifiers (1) and (2) included in IC113.

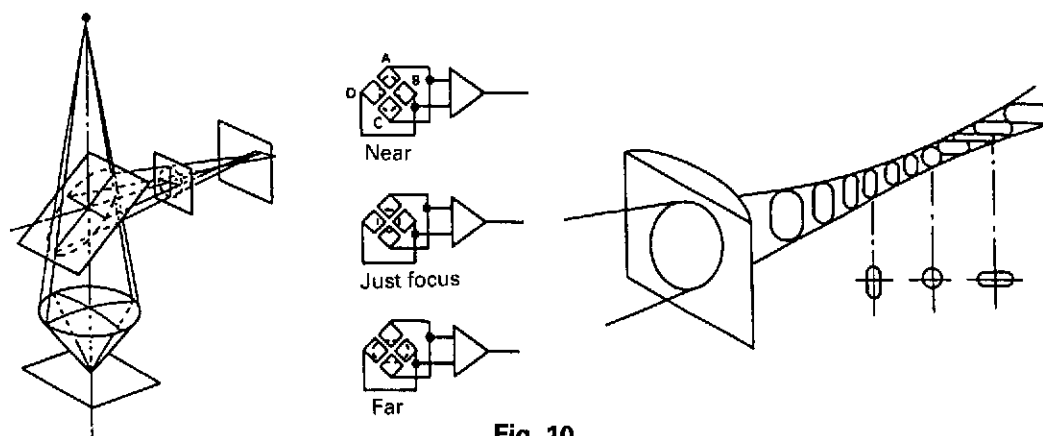


Fig. 10

### 3-3. Focus servo control operation (Fig. 11)

The focus error signal, after being converted to voltage by the RF I-V amplifier, is transmitted to the operation amplifier in the IC113 and output from pin 1.

When the disc to objective lens distance is in focus, the beam forms a true round. In this state, the beams applied to four elements of four division photodiodes become equal and thus the output provided then is 0(zero). When the disc to objective lens distance is too close (near focus), the beam is reflected divergently to form an oval in crosswise direction. In this state, the outputs provided from photodiodes A and C are higher than those from B and D, resulting in negative (-) output voltage. On the other hand, when the distance is too far (far focus), the beam is reflected convergently to form an oval in longitudinal direction. Then the outputs from photodiodes B and D are higher, resulting in positive (+) output.

The focus error amplifier calculates the difference between output VA and VB of the RF I-V amplifier, and output current-voltage converted voltage of the photo diode (A+C-B-D). Fig. 11

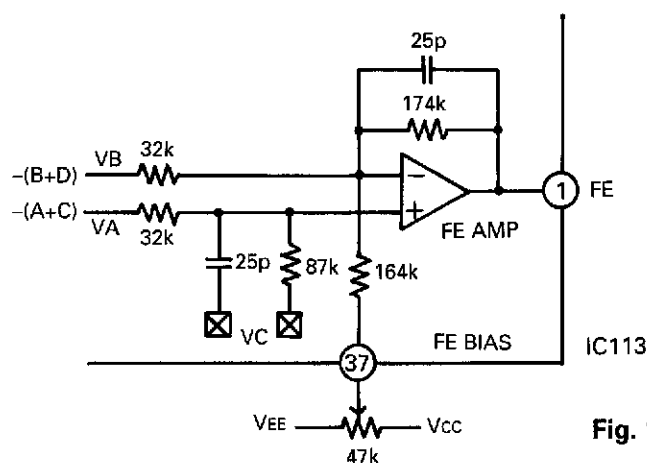


Fig. 11

The FE output voltage (low frequency) is  $V_{FE} = 5.4 \times (V_A - V_B) = (i_{PD2} - i_{PD1}) \times 315 \text{ k}\Omega$ .

Be aware that the rotation of the focus bias volume has reversed for the usual CD RF IC.

### 3-4. Tracking error detection system (Fig. 12)

Fig. 12 shows the principle of the tracking error detection system which employs the three beam system.

The laser beam is divided into the main beam and two sub-beams by diffraction grating and they are arranged on one line. The center line connecting these three beams has a slight offset angle against the main beam. The main beam is received by photodiodes A, B, C and D and two sub-beams by E and F respectively.

Fig. 12-A shows the on-track state. As both auxiliary beams 1 and 2 are slightly on the track in this state, the outputs of photodiodes E and F are equal and the tracking signal is 0(zero). When the track is shifted to the left (Fig. 12-B), the auxiliary beam 1 is off the pit. This allows more light to be received by the photodiode E, resulting in positive (+) tracking signal output. On the other hand, when the track is shifted to the right (Fig. 12-C), the amount of light received by the photodiode F increases, resulting in negative (-) tracking signal output. And these extreme signals are detected as tracking error signals.

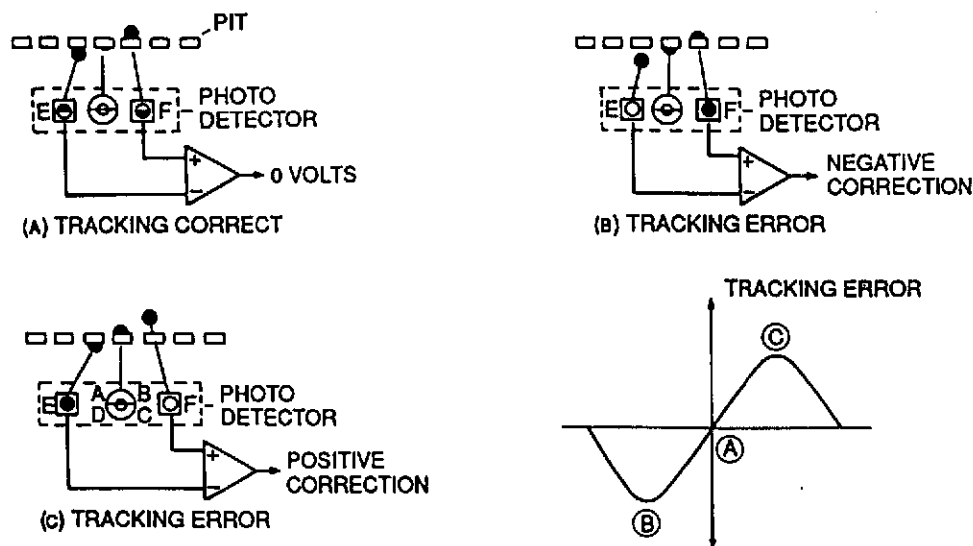


Fig. 12



### 3-6. Tracking automatic adjustment for gain/balance (Fig. 14)

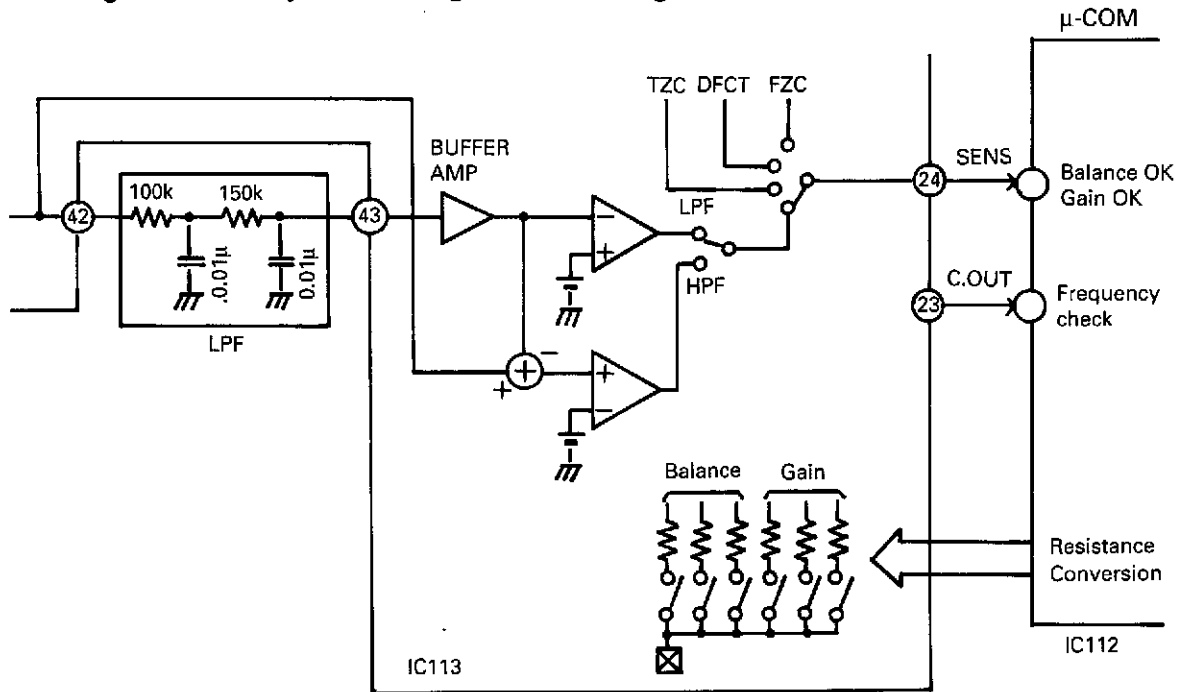


Fig. 14

IC113 has Balance control, Gain control, and comparator circuit required to perform tracking automatic adjustment. LPF is set externally at approximately 100 Hz.

## 4. Regenerative Circuit

### 4-1. RF circuit (Fig. 15)

The currents from photodiodes (A, B, C and D) are fed to IC113 through pins 35 and 36 and converted to voltage by RF I-V amplifiers (1) and (2) respectively there, added by the RF summing amplifier and output from pin 31 as a signal. It can be checked at the test point (RF T.P.) provided on its way by means of the eye pattern check.

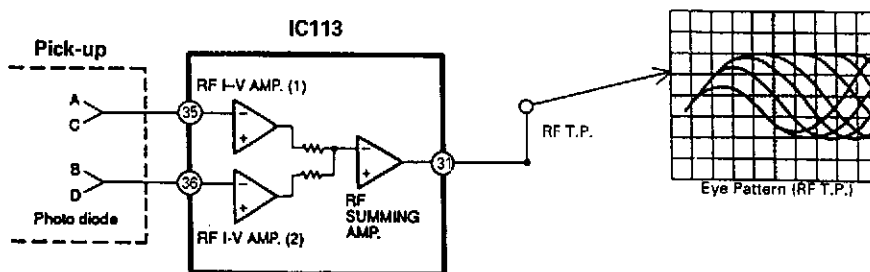


Fig. 15

#### 4-2. Digital Signal Processor (Fig. 16)

The EFM signals from pin 31 of IC113 are sent to pin 14 of IC107, then demodulated from 14 bits to 8 bits by EFM readjustment. At the same time any error, if found, is corrected (CIRC) and the signals are sent to the D/A converter interface. After that they are output as 16-bit digital signals from pins 20, 21 and 22 of IC104. In this case, EFM demodulation, error correction and serial/parallel conversion are performed by the internal circuitry of IC107.

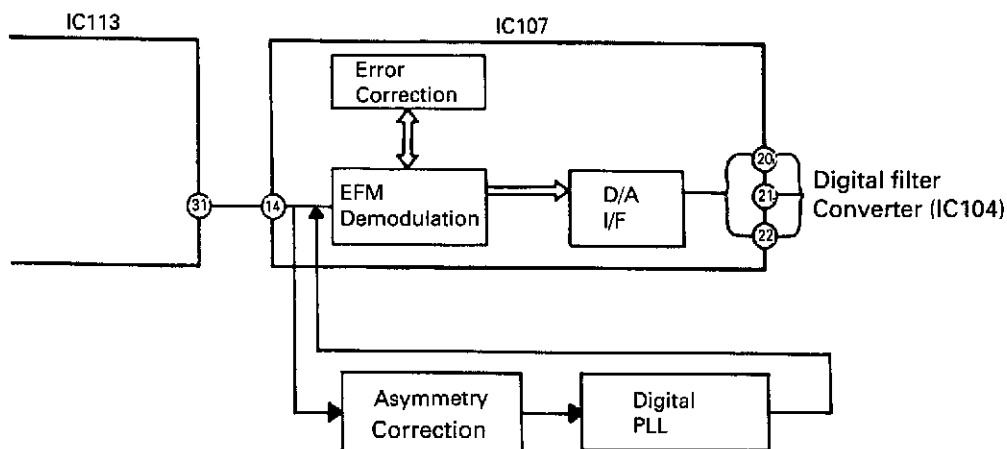


Fig. 16

### 5. Audio Circuit

#### 5-1. Configuration of SM5871AS

Fig. 17 shows the configuration of the SM5871AS.

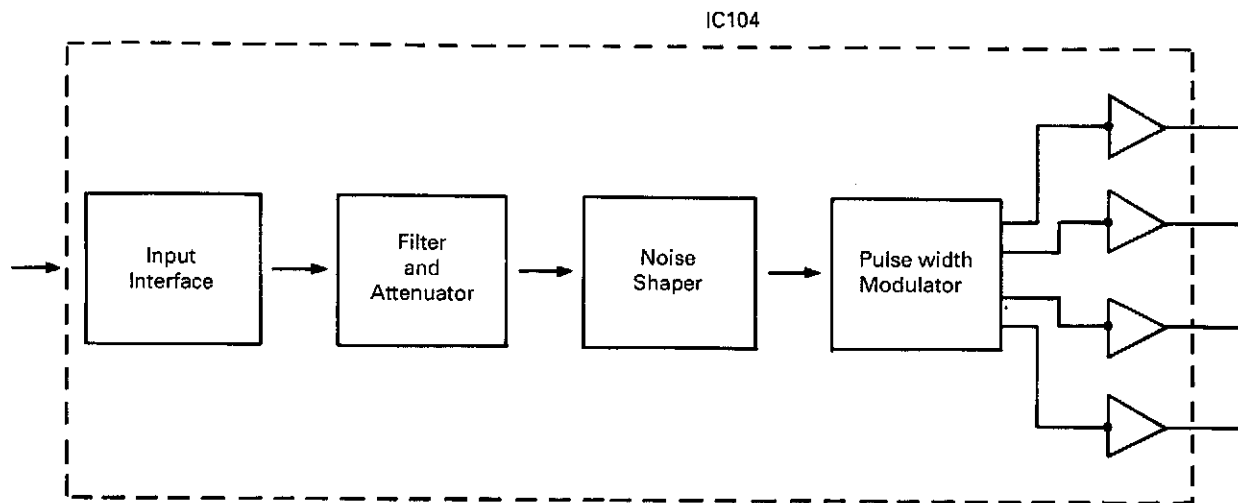


Fig. 17

IC104 is a highspeed converter for digital audio systems fabricated using NPC's molybdenum-gate CMOS process. It incorporates a two-channel, 16-bit D/A converter and a four-times digital oversampling filter.

IC104 can operate at three different sampling frequencies and incorporates deemphasis, attenuation and soft mute functions.

Double-speed dubbing is supported without any change in clock frequency.

IC104 linearly interpolates the input signal at a high multiple of the original sampling frequency, and then requantizes the resulting signal. A third-order noise shaper is used to remove most of the quantizing noise before the signal is output as a pulsewidth-modulated (PWM) waveform.



Service bulletin # 9604 rev1 - October 1998

This is considered a Minor Repair

To: All harman/kardon Service Centers

Models: FL8300

Subject: Digital Output Level

The Digital Interface Standard recommends D/A converters have a minimum Input sensitivity of 200 mV. In early FL8300 production units, the Digital Output level was 240 mV  $\pm 10\%$  peak to peak. Based on our research, we found that some D/A converters require more than 240 mV for intermittent free operation.

**In the event you receive a FL8300 from a consumer with the a complaint “Intermittent Sound from External D/A converter”, check the serial number in the table below.**

If the FL8300 has a serial number *higher* than indicated in the table below, connect a properly working D/A converter to the Digital Output and verify interruption free operation. Also confirm the Digital Output level of the FL8300 is 500 mV  $\pm 10\%$  Peak to Peak. If the FL8300 passes these two tests, advise the customer to have their external D/A converter and connecting cables checked.

**If the FL8300 has a serial number *lower* than indicated in the table below, perform the following modification:**

- 1) With the unit plugged in and turned on, push the “open/close” button to extend the drawer fully; then turn the unit off and unplug it.
- 2) Open the top cover (6 screws).
- 3) Remove output board PCB3 from the rear panel (4 screws). This board can be pulled back and modified without completely removing it from the chassis.
- 4) Locate resistor R901, it may be a 680 ohm resistor or a jumper wire; replace in either case with a 0.47 uf capacitor h/k part# 5354-474593.
- 5) Locate R903 and change from 680 $\Omega$  to a 4.7k $\Omega$  resistor – h/k part # 3029472970. Re-attach output PCB3 to the unit.
- 6) Connect a 75 Ohms cable to the digital output jack. Terminate this cable with a 75 Ohm load; connect an oscilloscope to the 75 Ohm termination resistor. While playing a CD, confirm the output of the signal is now 500 mV  $\pm 10\%$  peak to peak.
- 7) Reassemble the FL8300 and test all functions.

| Model  | Serial number<br>120V              | Serial number<br>230V              | Status                                                  | Action                                                                                                                            |
|--------|------------------------------------|------------------------------------|---------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|
| FL8300 | IN0019-01001<br>to<br>IN0019-19393 | IN0020-01001<br>to<br>IN0020-04500 | May have low digital<br>output for some<br>applications | Replace R901 with 0.47 uf mylar<br>capacitor h/k part# 5354-474593<br>Replace R903 with 4.7k ohm resistor<br>h/k part# 3029472970 |
| FL8300 | IN0019-19394                       | IN0020-04501                       | Factory Installed *                                     | NONE REQUIRED                                                                                                                     |

\* Factory modification of the FL8300 starting with the serial numbers indicated in the above table consisted of:

R236: 1k Ohm

R901: Jumper or 680 Ohm

R903: Changed from 680 Ohm to 4.7k Ohm.

**Digital output level into 75 Ohms: 500 mV  $\pm 10\%$  peak to peak.**

Service bulletin # 9607-January 97

This is considered a Major Repair

To: All harman/kardon Service Centers

Models: FL8300 Compact disc changer

Subject: Failure to play Multi-media CDs or skip data tracks

---

Early FL8300 CD Players used a micro-computer which could not read the table of contents (TOC) of certain multimedia CD's or skip data tracks on multimedia CD's. During two running production changes, new Microprocessor were installed which performs as shown in the table below:

| Description<br>IC112     | Part Number | Serial number<br>Range120V            | Serial number<br>Range230V            | Processor action                            | Year/Month<br>first used |
|--------------------------|-------------|---------------------------------------|---------------------------------------|---------------------------------------------|--------------------------|
| CXP21320-322<br>DWP325   | 2138322197  | IN0019-01001 to<br>IN0019-29000       | IN0020-01001 to<br>IN0020-05500       | Does not play Multimedia CD                 | 95 October               |
| CXP82320-352Q<br>DWP325A | 2139322710  | IN0019-29001 to<br>IN0019-53790       | IN0020-05501 to<br>IN0020-08510       | Plays Multimedia CD,<br>Mutes at data track | 96 July                  |
| CXP82320-367Q<br>DWP325B | 2139322722  | IN0019-53791 to<br>present production | IN0020-08511 to<br>present production | Plays Multimedia CD, Skips<br>data tracks   | 96 November              |

In the event you receive a FL8300 from a consumer with a complaint "Player will not read or, loudspeakers make strange noise while playing multimedia CDs", replace IC112 with H/K Part number 2139322722.

The IC can be identified by CXP82320-367Q DPW 325B printed on its case.

Service bulletin # 9703 June 1997

This is considered a Major Repair

To: All harman/kardon Service Centers

Models: FL8300

Subject: Dead unit, no display; Service upgrade

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**In the event you receive an FL8300 that is dead, and upon inspection R701 is damaged or an otherwise open circuit, perform the necessary steps listed below:**

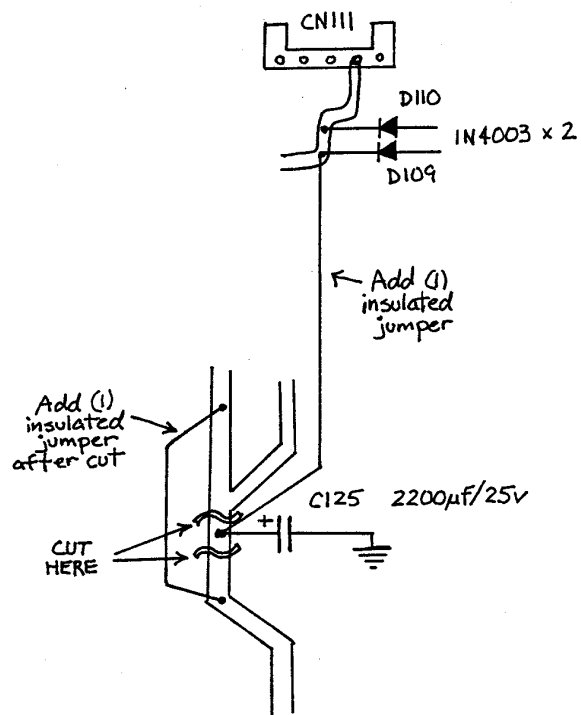
Due to current surges, early models of the FL8300 could repeatedly damage R701 (either a 1 ohm resistor or 1.5A micro fuse depending on version). Along with the replacement of R701, the positive lead should be relocated on C125 to suppress any future current surges.

Additionally, two capacitors, now designated as C907 & C908, (1uf/50v) should be added to the power supply output pins on regulator IC108 & IC111 on a unit serviced for any reason; these will add stability to help prevent oscillation.

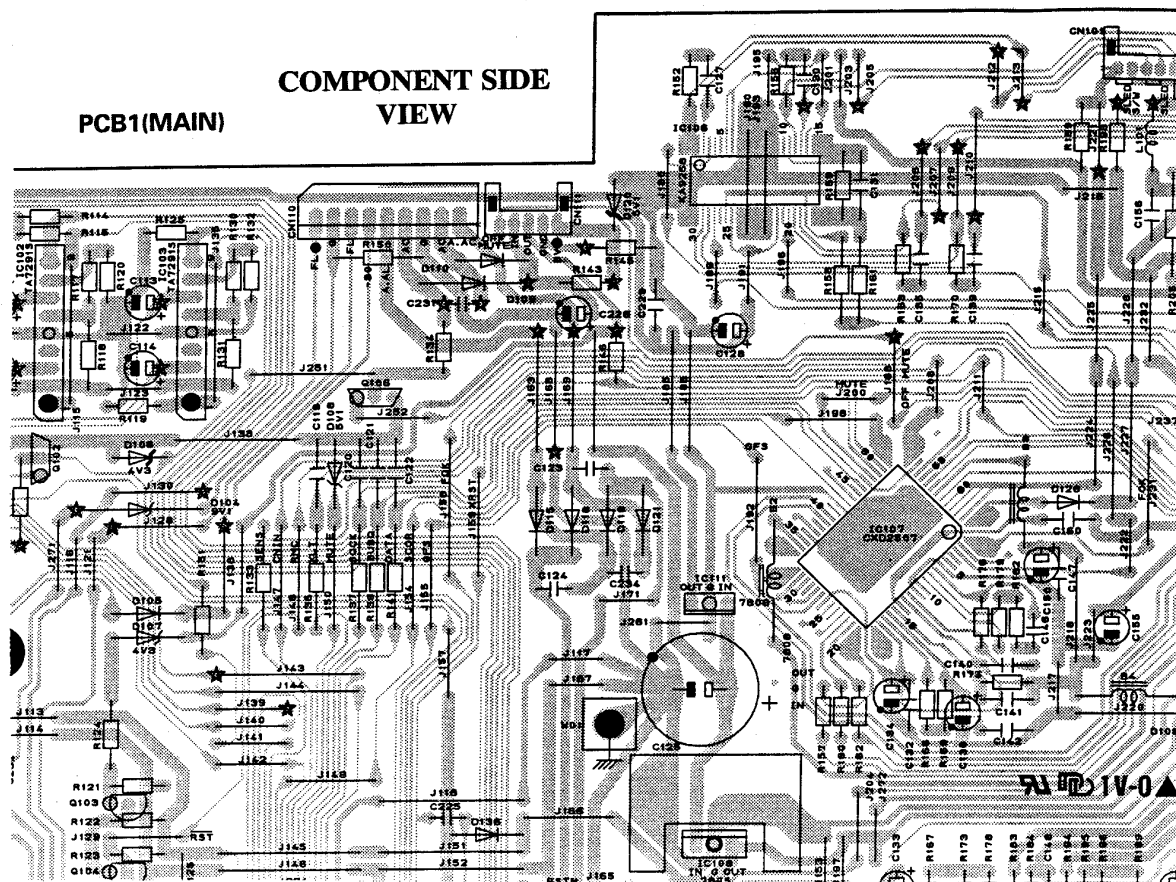
**PROCEDURE:**

- 1) Replace R701 with micro-fuse H/K # 5508722221, this component is on PCB7.
- 2) A PCB trace should be cut on the C125 (2200 uf/25v) positive lead on the main circuit board and an insulated jumper wire attached from that lead to the junction of D109/110. Additionally another insulated jumper will need to replace the trace that was cut. (see drawing)
- 3) Add C907 & 908, 1uf/50v , H/K/ # 3479310971, one on each output pin to ground on regulators IC108 and IC111. This is most easily accomplished by:  
Soldering one 1uf cap to the jumpers 153 & 197. Observe polarity; J153 is ground.  
Soldering one 1uf cap to the jumpers 185 & 186. Observe polarity; J186 is ground.

| Model  | Serial number<br>120V     | Serial number<br>230V | Action                                | Correction                                                                |
|--------|---------------------------|-----------------------|---------------------------------------|---------------------------------------------------------------------------|
| FL8300 | IN0019-72213<br>and below | NOT REQUIRED          | R701 is damaged or<br>an open circuit | Replace R701,<br>re-route positive connection<br>on C125,<br>Add C907/908 |
| FL8300 | IN0019-72214<br>and above | NOT REQUIRED          | Modified by factory                   | NONE REQUIRED                                                             |



### COMPONENT SIDE VIEW



**Troubleshooting tips and solutions to common service problems****For models: FL8300****TIP# HKTT2003-02**

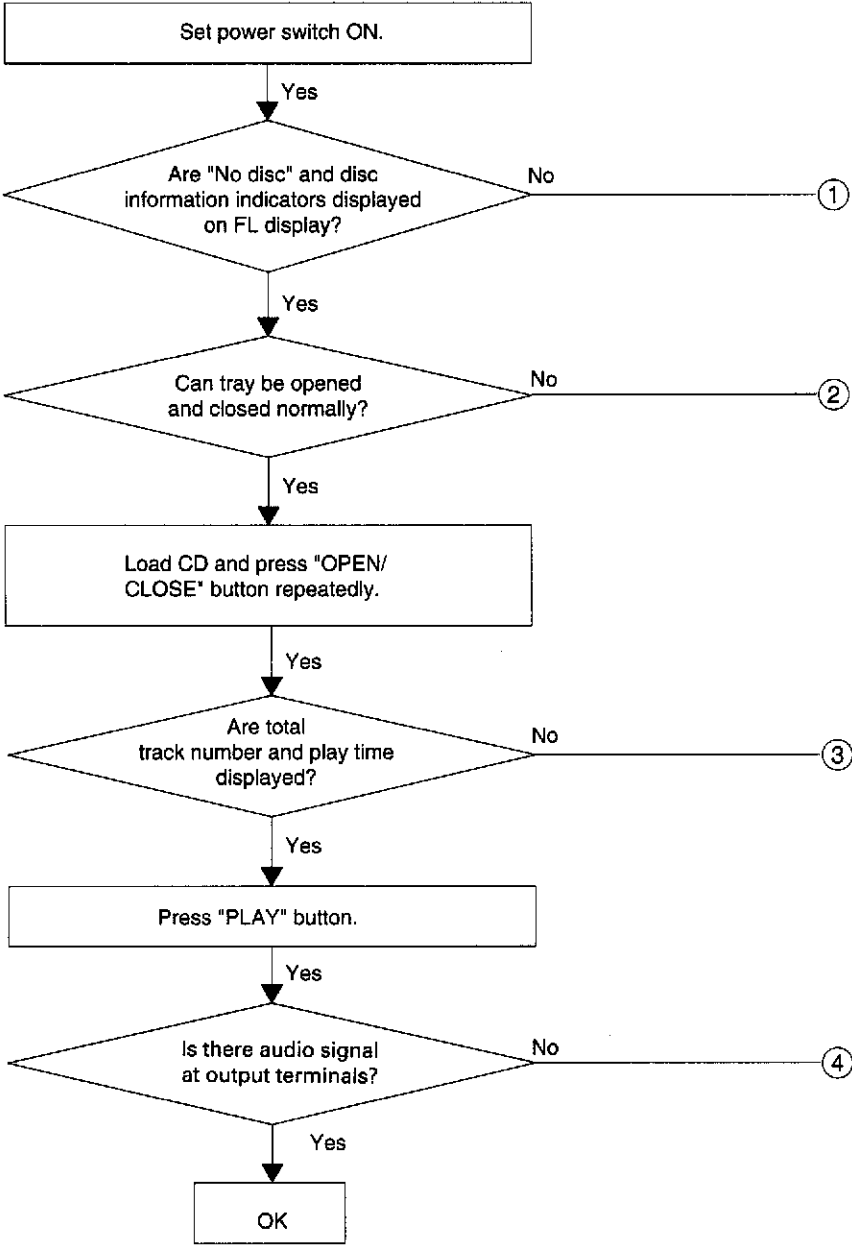
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**Problem:** "Carousel not stopping in the correct position, so disc can be clamped correctly".

**Check:**

- 1) 6-conductor Ribbon cable connection to sensor board - check cable; clean, re-seat at both ends.
- 2) There is a post/standoff underneath the single center screw in the center of the carousel (under the plastic 1,2,3,4,5 cap). If that post/standoff is too long, it can cause the symptom. If the part is higher than the surface of the carousel in that area, the part needs to be shaved down so it's shorter.
- 3) Defective Roulette sensor (part# 2408001111) or Disc sensor (part# 2408210001).

TROUBLESHOOTING



[ Repair item 1] At power on, "No disc" and some parts are not displayed.

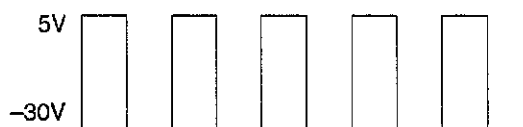
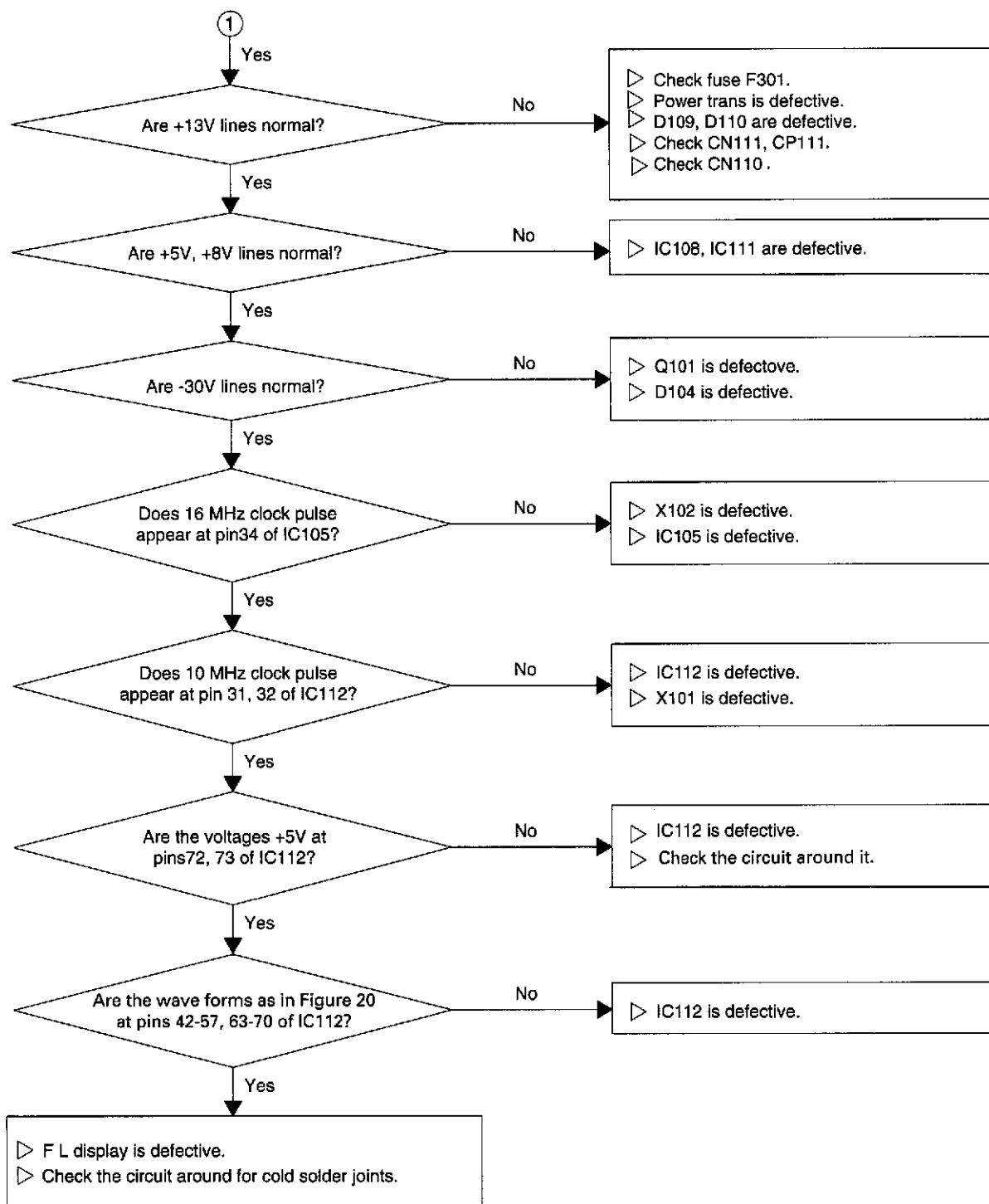
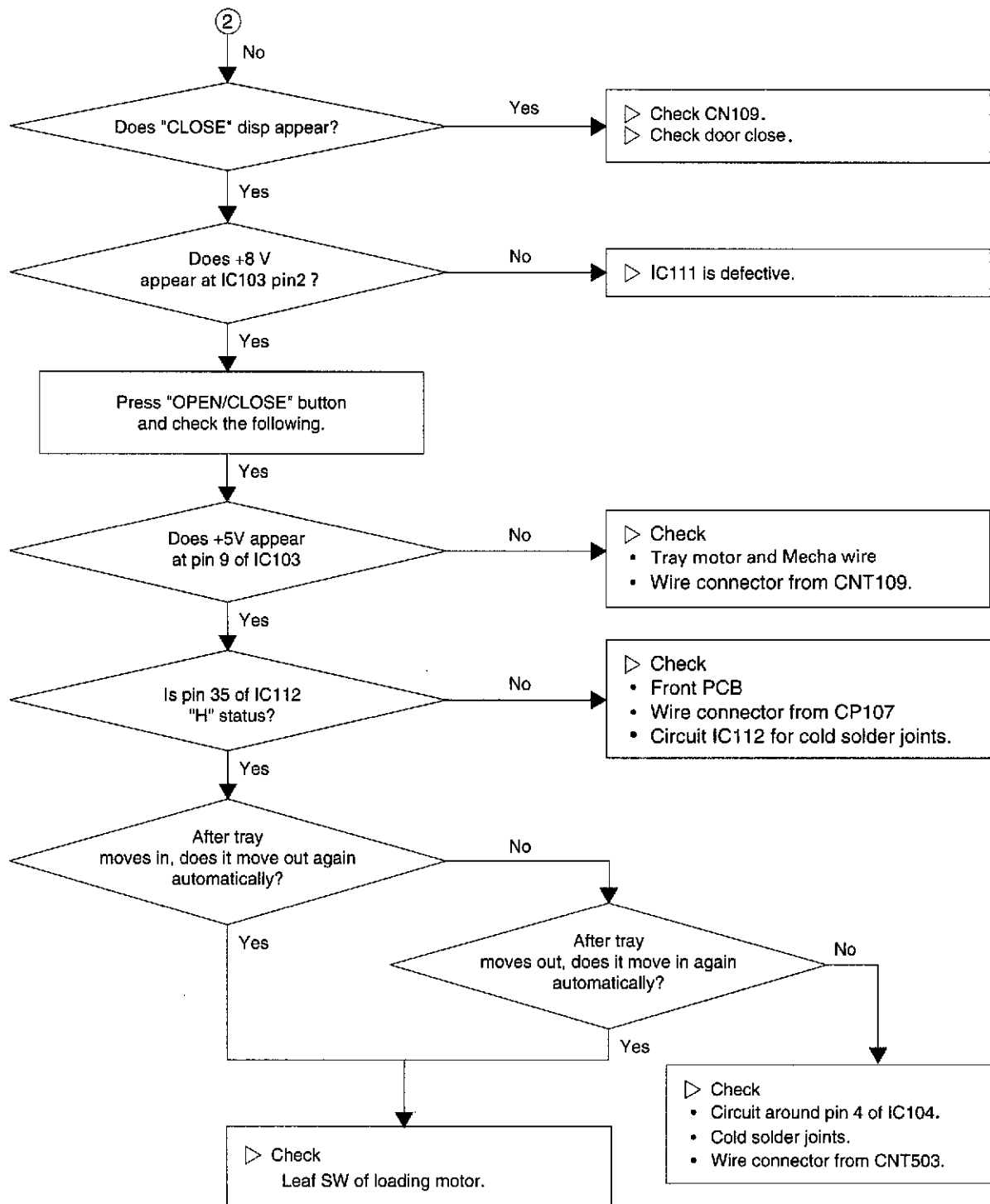
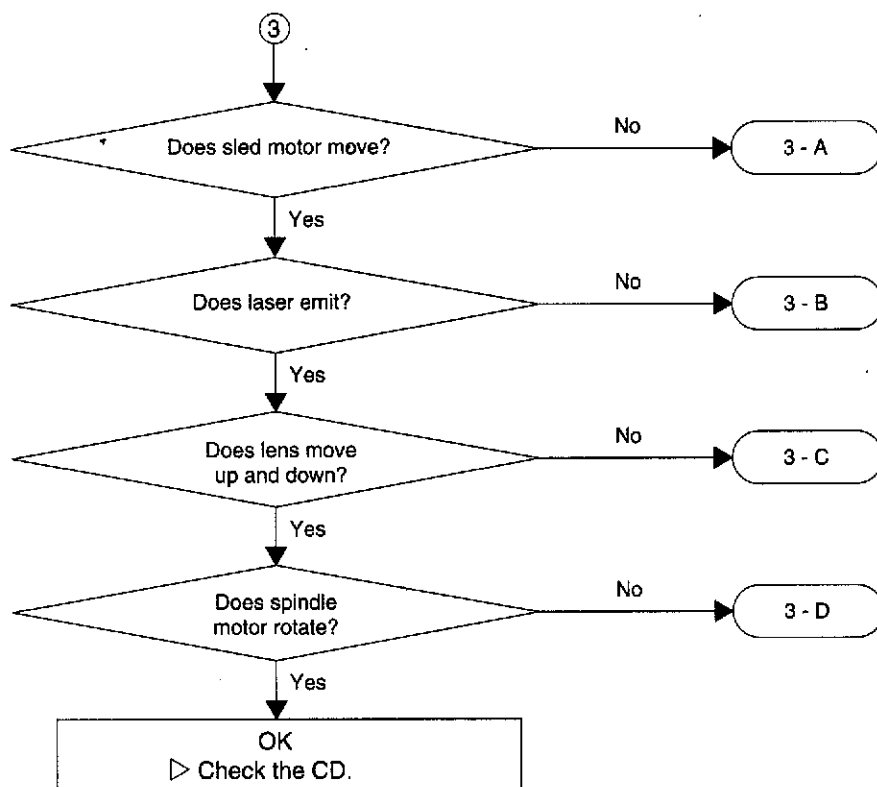


Fig. 20

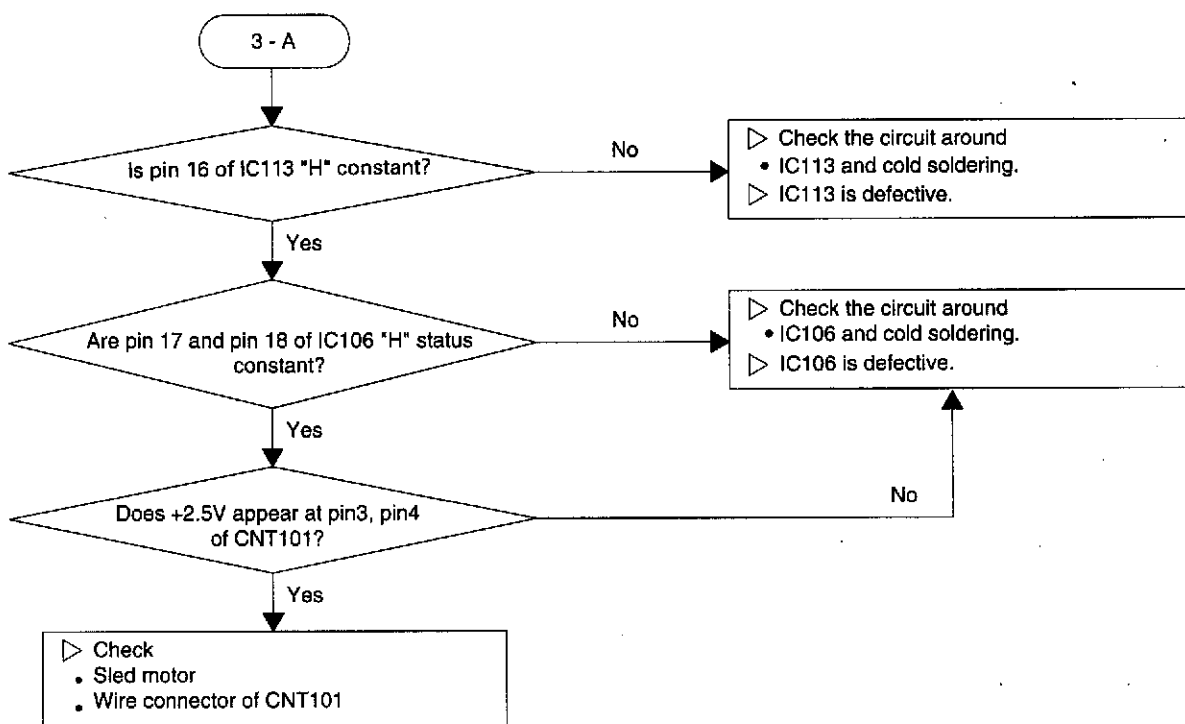
[ Repair item 2 ] Tray cannot opened and closed by pressing "OPEN/CLOSE" button.



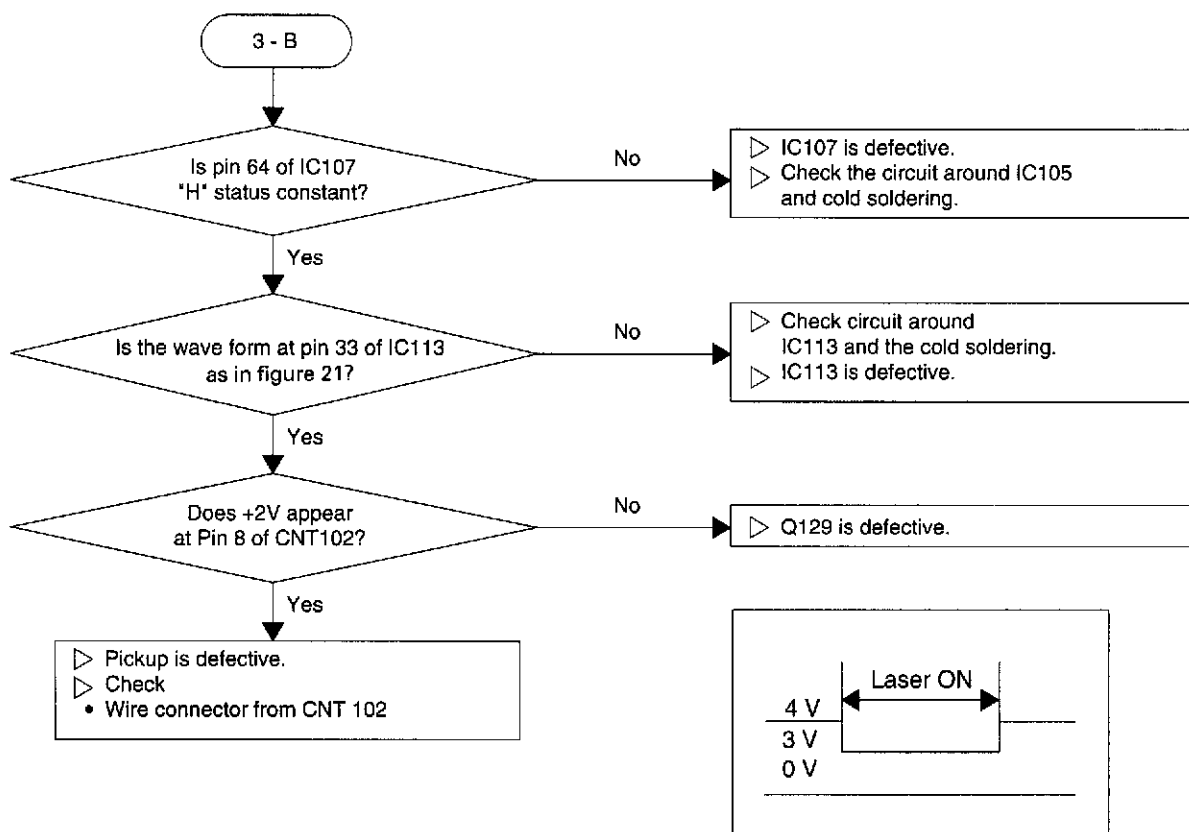
[ Repair item 3 ] " 8 " is displayed instead of total playing time and track number.



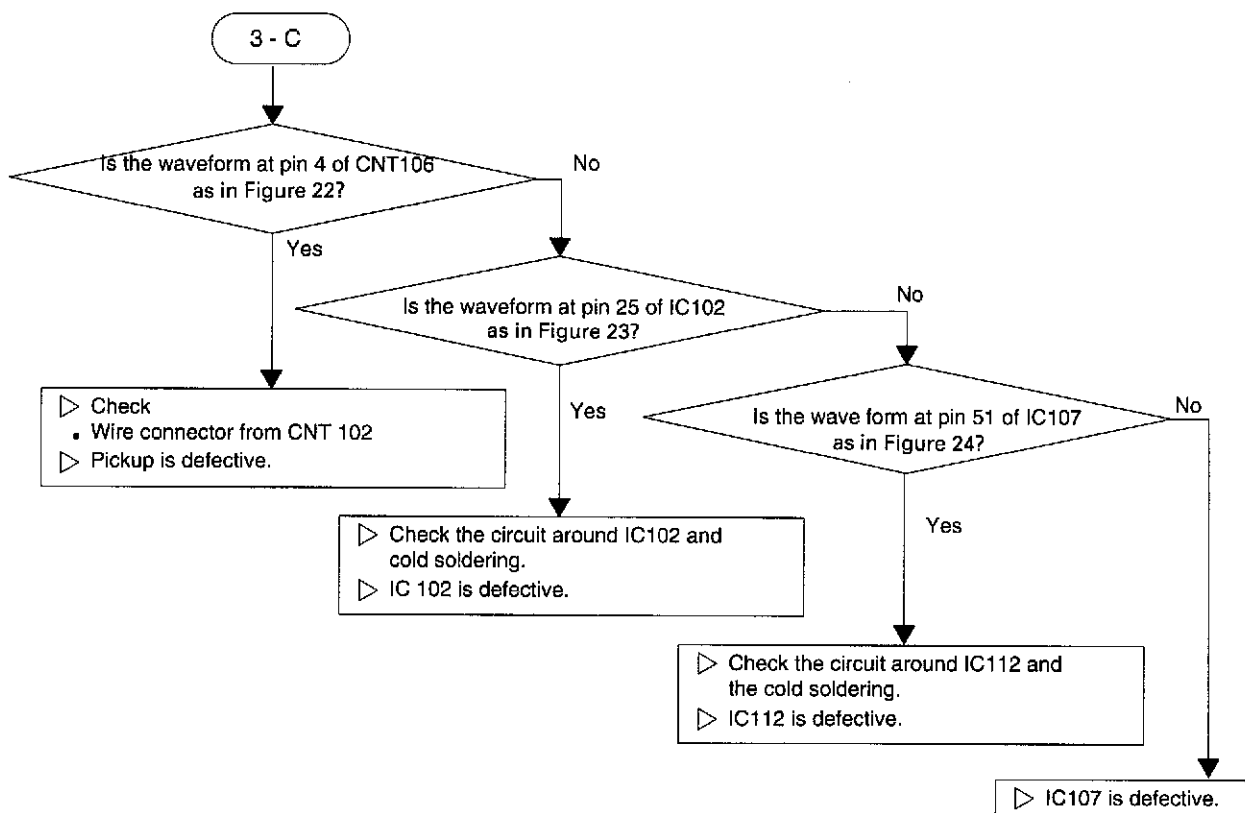
[ Repair item 3-A ] Sled motor does not move.



[ Repair item 3-B] Laser does not emit.



[ Repair item 3-C] Object lens of pickup unit does not move up and down.



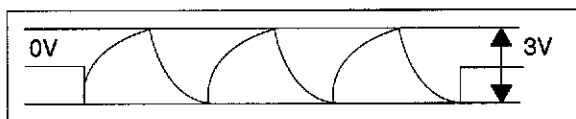


Fig. 22

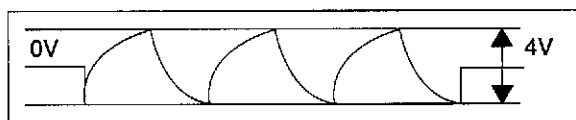


Fig. 23



Fig. 24

[ Repair item 3-D] Spindle motor does not rotate.

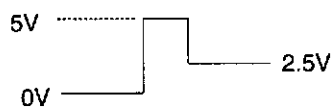
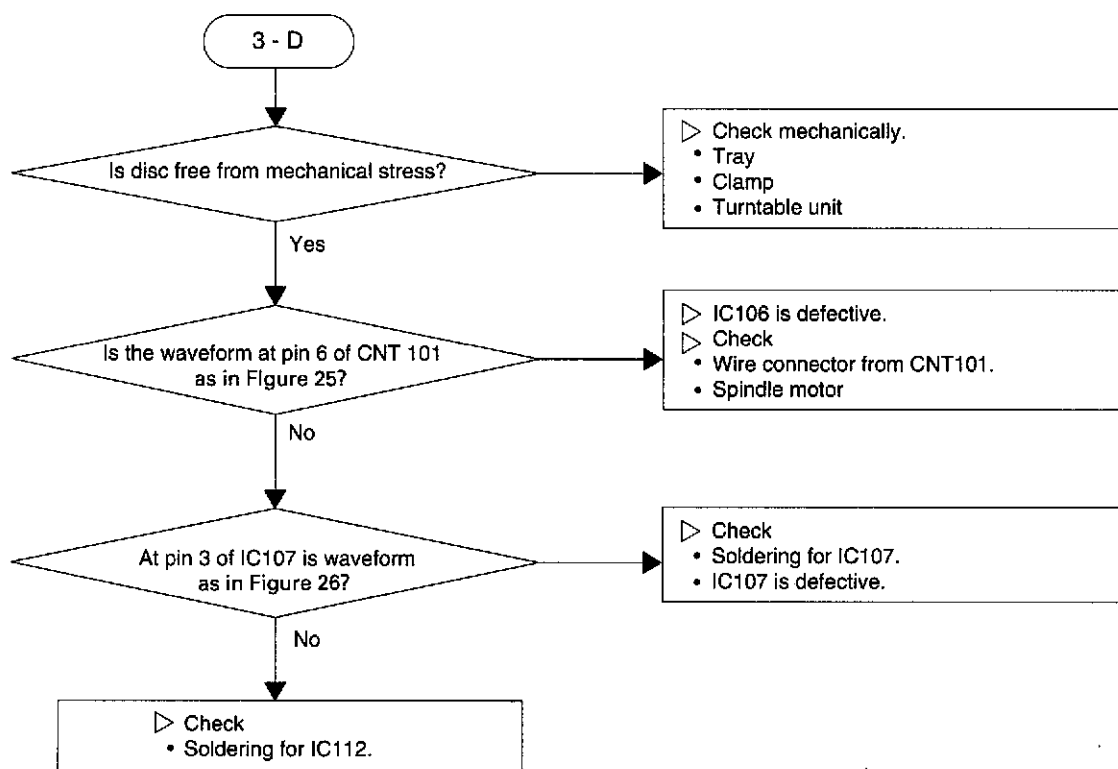


Fig. 25

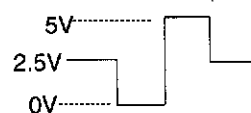
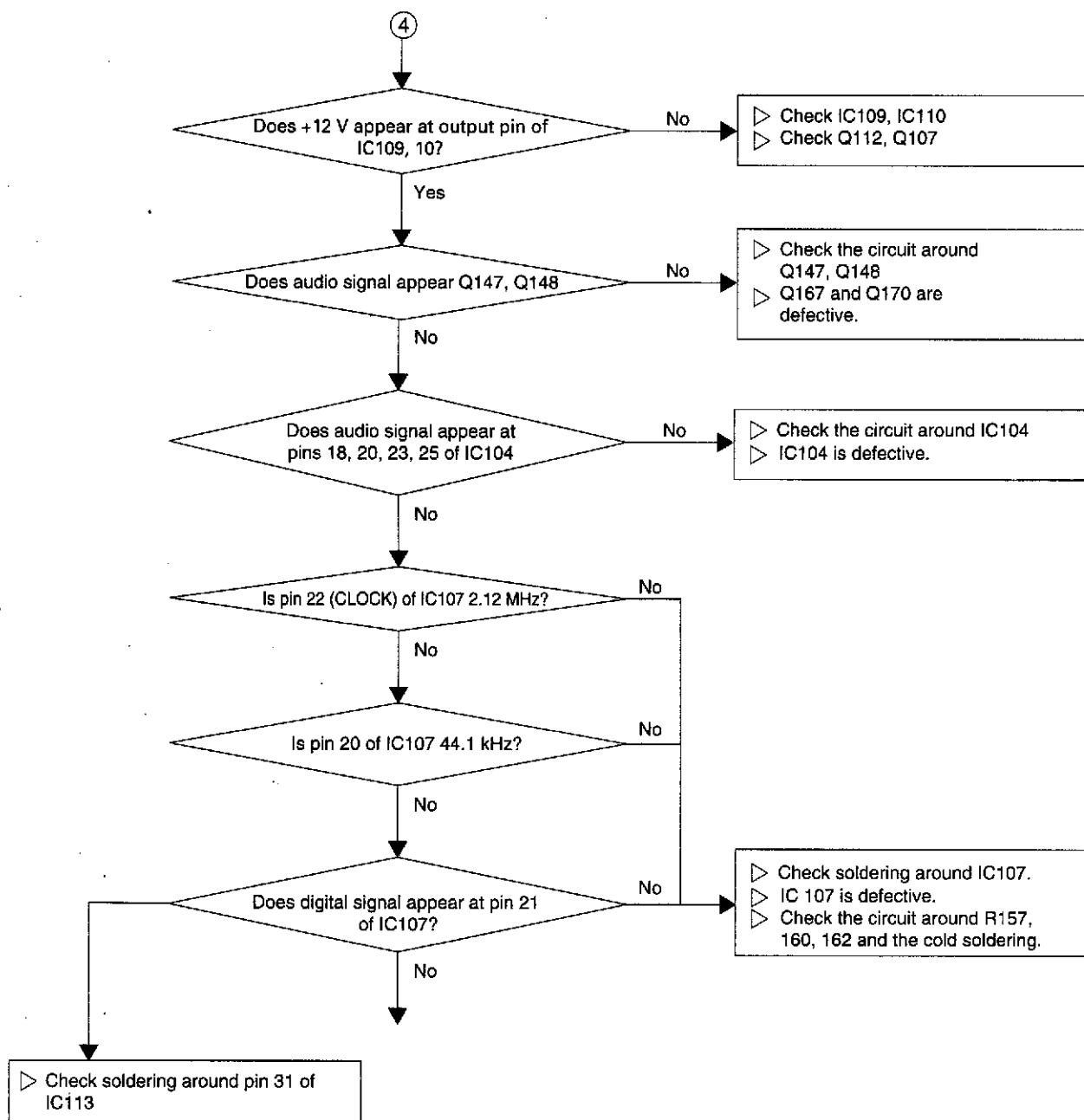
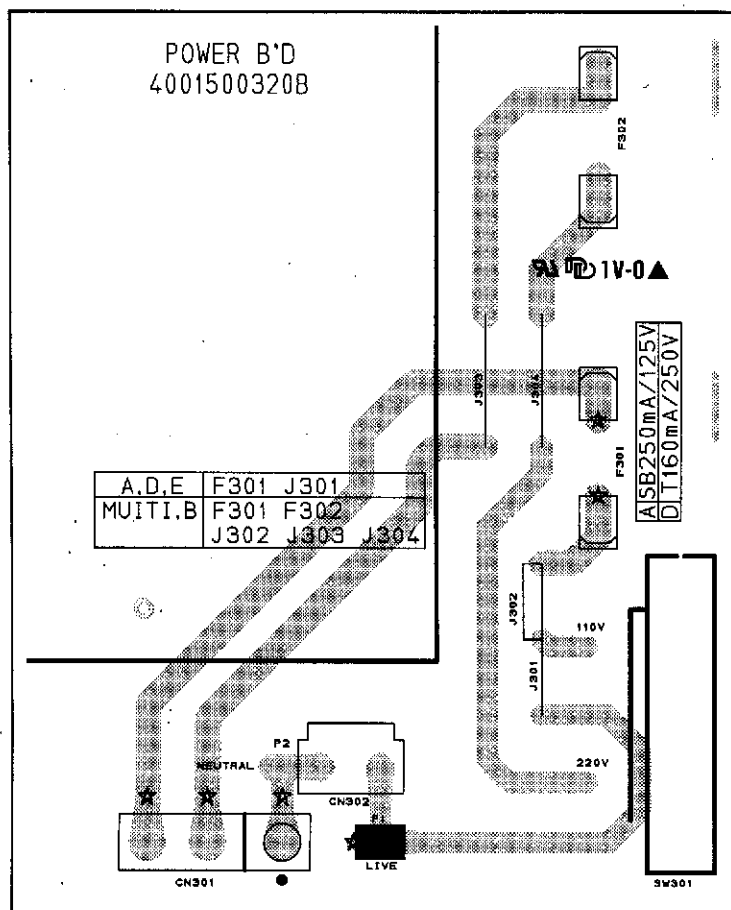


Fig. 26

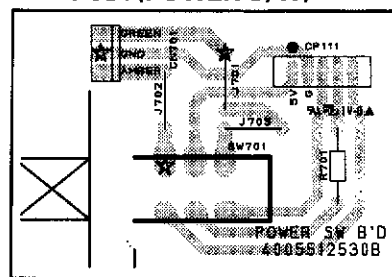


# PRINTED CIRCUIT BOARDS

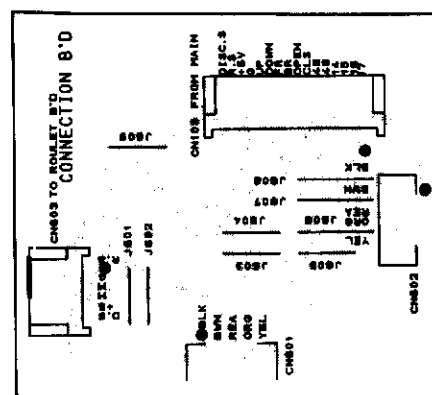
PCB2(POWER)



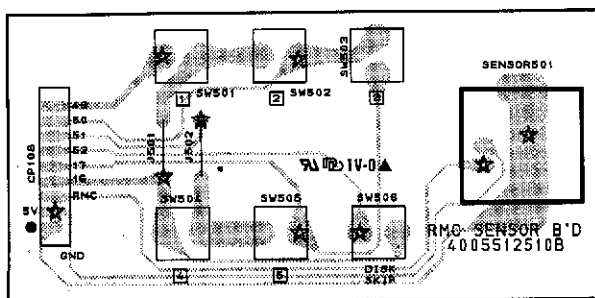
PCB7(POWER S/W)

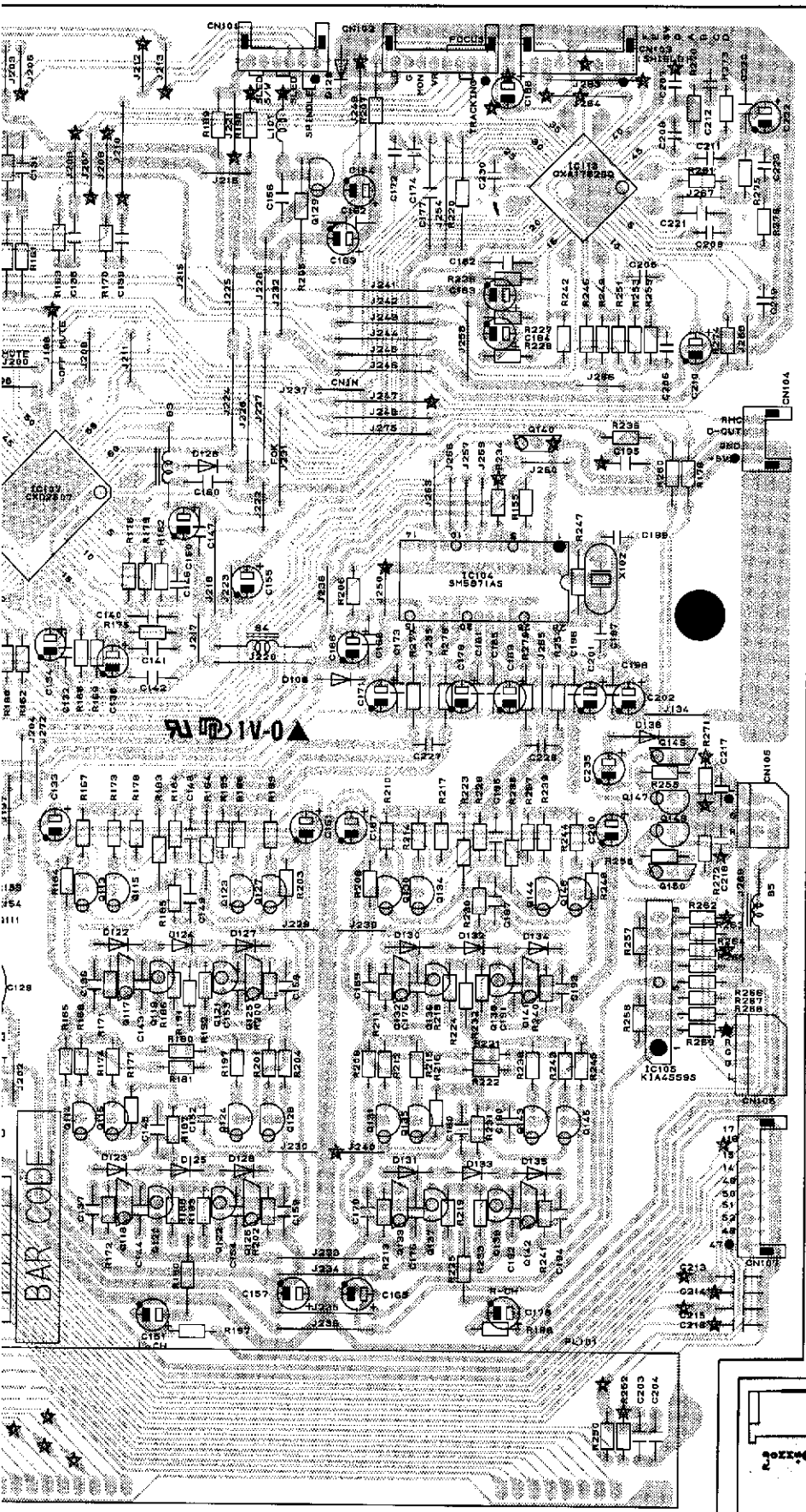


PCB9(CONNECTION)

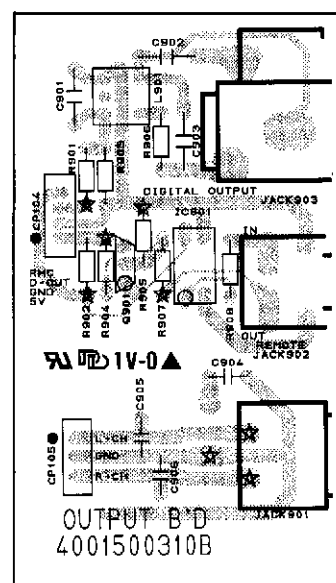


PCB5(RMC SENSOR)

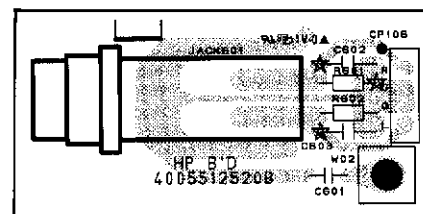




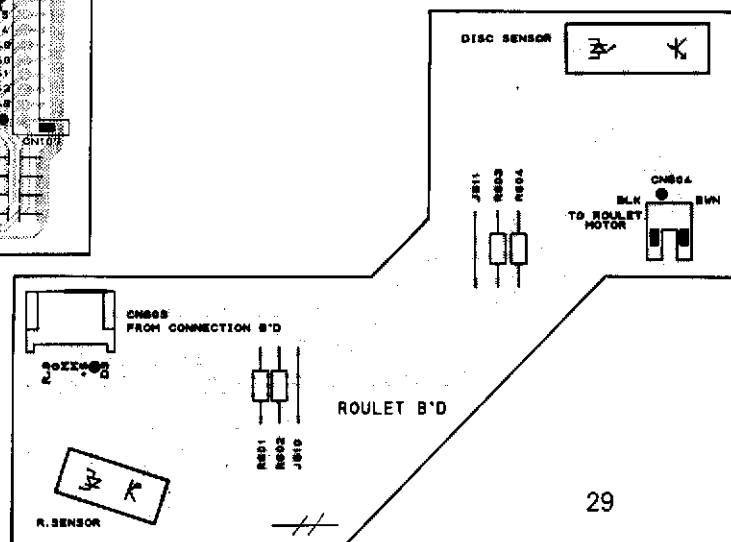
### PCB3(OUTPUT)



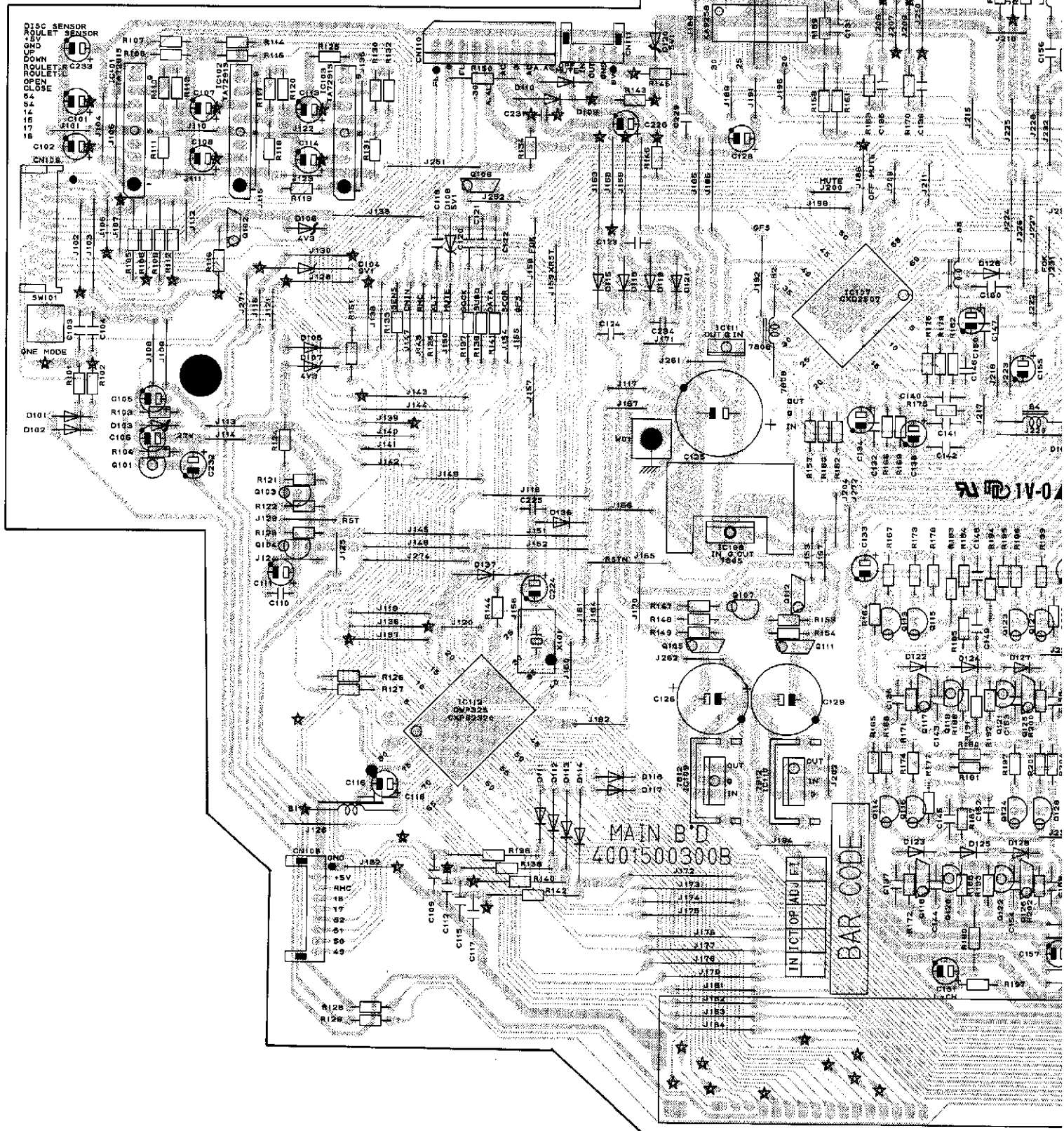
PCB6(HEADPHONE)



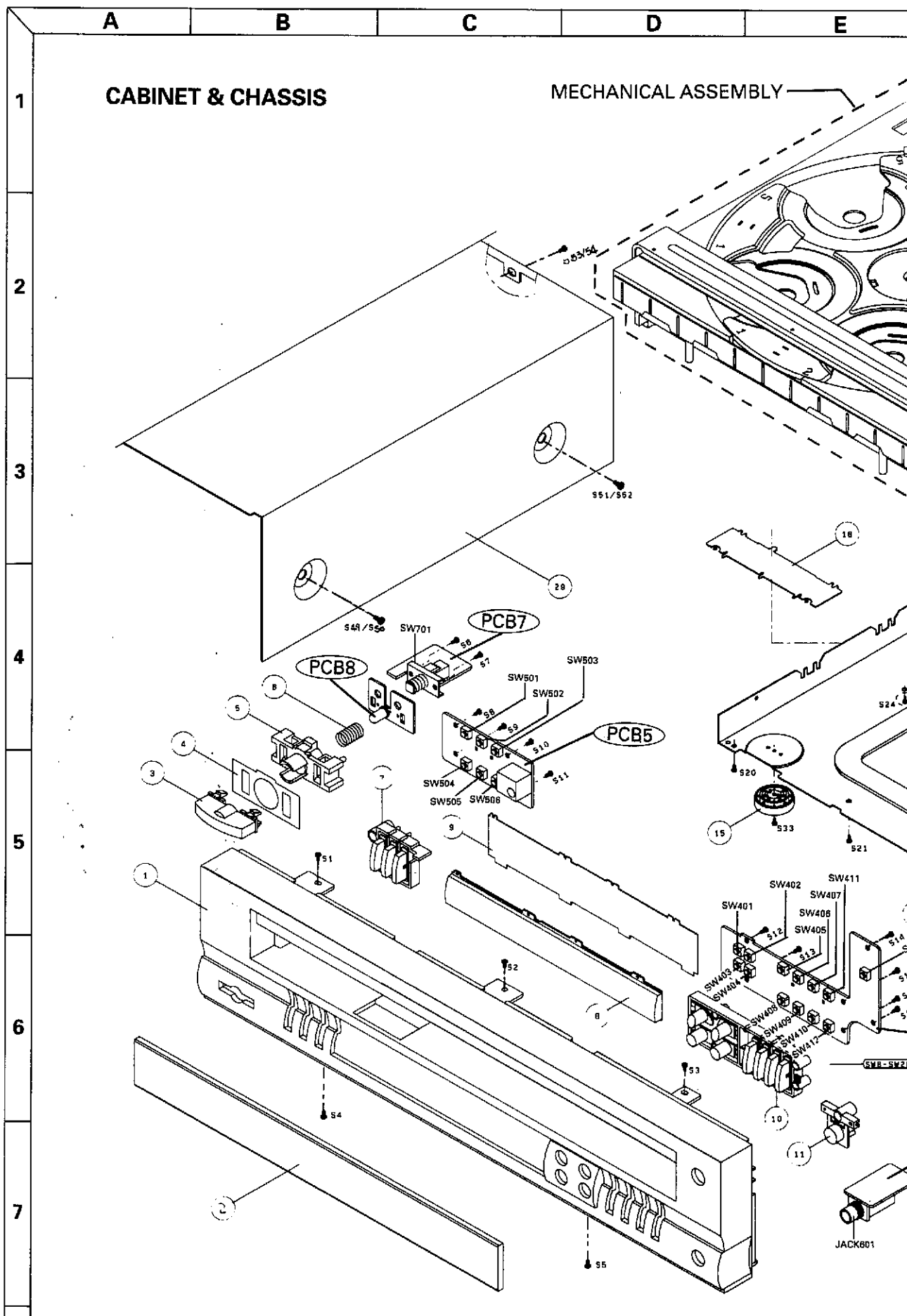
### PCB10(ROULETTE SENSOR)



# PCB1(MAIN)

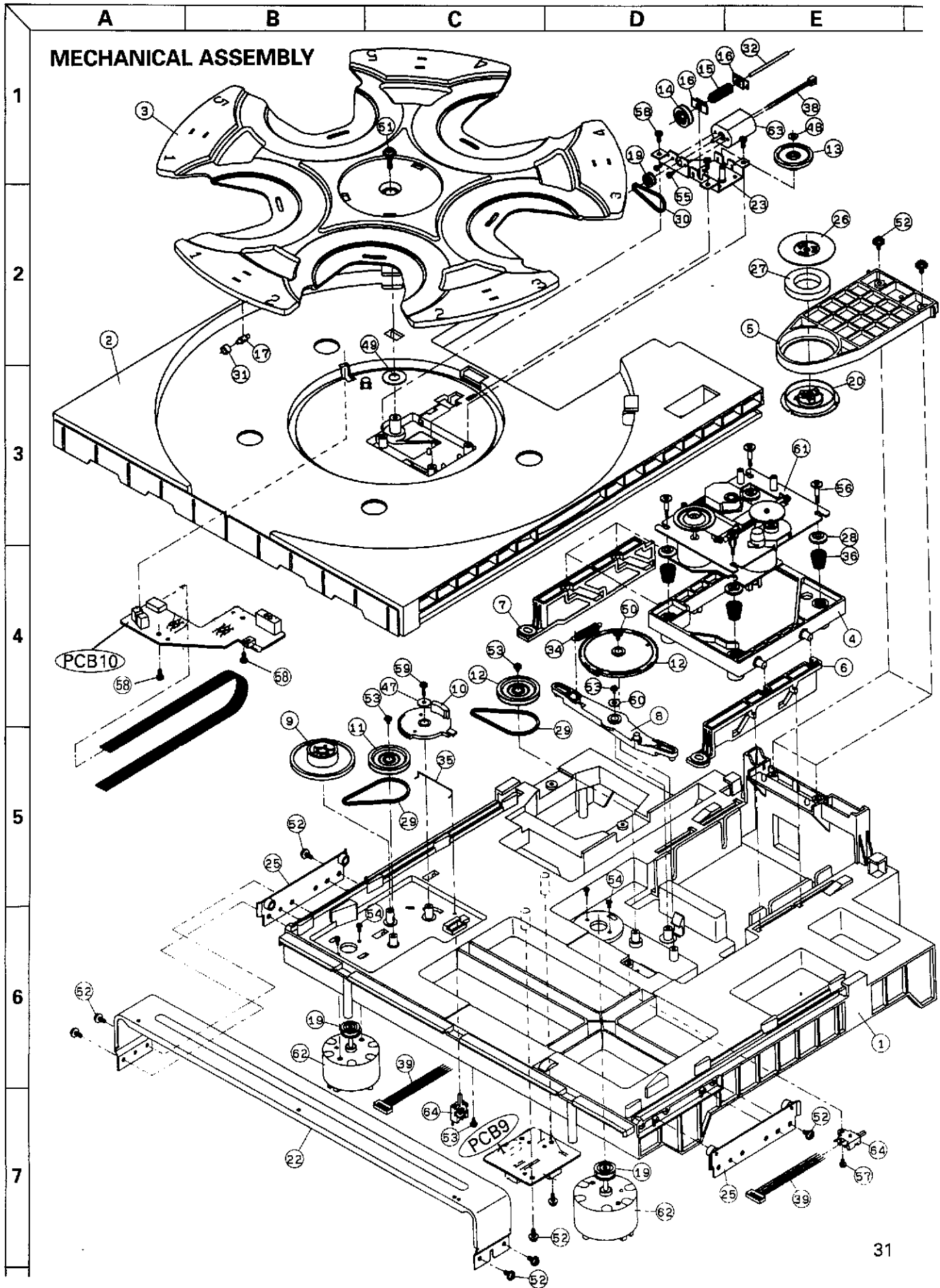


## GENERAL UNIT EXPLODED VIEW I





## GENERAL UNIT EXPLODED VIEW II



GENERAL UNIT PARTS LIST

| Ref. No.                     | Description                                     | Mfr. Part No. | Q'ty |
|------------------------------|-------------------------------------------------|---------------|------|
| <b>CABINET &amp; CHASSIS</b> |                                                 |               |      |
| 1                            | Panel, Front, ABS, Black                        | 048501036211  | 1    |
| 2                            | Door, Tray, ABS, Black                          | 048562006511  | 1    |
| 3                            | Button, Power                                   | 048545130811  | 1    |
| 4                            | Light Shield                                    | 8535046020    | 1    |
| 5                            | Indicator, Power                                | 8555052110    | 1    |
| 6                            | Spring, Button                                  | 6555010720    | 1    |
| 7                            | Button Function, 3key                           | 048543068811  | 1    |
| 8                            | Window, Display                                 | 8553022810    | 1    |
| 9                            | Filter, FL                                      | 048553022911  | 1    |
| 10                           | Button Function, 8key                           | 048543068911  | 1    |
| 11                           | Bullon, Open/Close                              | 048545130611  | 1    |
| 12                           | Bracket, Phone                                  | 6505110210    | 1    |
| 13                           | Chassis, Main                                   | 6121614510    | 1    |
| 14                           | Foot PL(H.S)                                    | 046033102511  | 1    |
| 15                           | Foot PL(H.S)                                    | 046033102511  | 1    |
| 16                           | Foot Base                                       | 046035101511  | 1    |
| 17                           | Foot Base                                       | 046035101511  | 1    |
| 18                           | Cover Chassis Fuse                              | 8123017710    | 1    |
| 19                           | Holder, FL                                      | 6513004420    | 1    |
| 20                           | Heatsink Regulator TR.                          | 7505202410    | 1    |
| 21                           | Heatsink Regulator TR.                          | 7505202410    | 1    |
| 22                           | Heatsink Regulator TR.                          | 7505206110    | 1    |
| 23                           | Jack RCA, 1P                                    | 4438111020    | 1    |
| 24                           | Jack, Multi, 2P                                 | 4438007510    | 1    |
| 25                           | Jack RCA, 2P                                    | 4438111320    | 1    |
| 26                           | Chassis, Back                                   | 046102044021  | 1    |
| 27                           | △ Cord, AC Power                                | 4308001410    | 1    |
| 28                           | Holder, Power Cord                              | 6518002310    | 1    |
| 29                           | Cover, Top                                      | 6122022030    | 1    |
| 30                           | Cover Roulette                                  | 048583005911  | 1    |
| SW701                        | Switch, Push, Power                             | 4628058310    | 1    |
| SW101                        | Switch, Tact                                    | 4658003710    | 1    |
| SW401-413                    | Switch, Tact                                    | 4658003710    | 13   |
| SW501-506                    | Switch, Tact                                    | 4658003710    | 6    |
| JACK601                      | Jack, Phone                                     | 4438005010    | 1    |
| <b>HARDWARE KIT</b>          |                                                 |               |      |
| S1-S5                        | Screw, #2BTC 3x8B                               | 8109230083    | 5    |
| S6/S7                        | Screw, #2BTC 3x10B                              | 8109230103    | 2    |
| S8-S19                       | Screw, #2BTC 3x8B                               | 8109230083    | 12   |
| S20-S29                      | Screw, #1WPTC 3x12Y                             | 8159130121    | 10   |
| S30-S40                      | Screw, #2BTC 3x8B                               | 8109230083    | 11   |
| S41-S43                      | Screw, #1WPT 3x10B                              | 8119130103    | 1    |
| S44                          | Screw, #2BTC 3x8B                               | 8109230083    | 1    |
| S45                          | Screw, Ground                                   | 8155000710    | 1    |
| S46                          | Screw, #1WPT 3x10B                              | 8119130103    | 1    |
| S47                          | Screw, Ground                                   | 8155000710    | 1    |
| S48                          | Screw, #2BTC 3x8B                               | 8109230083    | 1    |
| S49-S52                      | Screw, WSAM 4x8B                                | 8159440083    | 4    |
| S53/S54                      | Screw, #2BTC 3x8B                               | 8109230083    | 2    |
| <b>MISCELLANEOUS</b>         |                                                 |               |      |
| CP101                        | Lead Ass'y, 6P, 120mm, Mecha to Main B'D        | 435206122042  | 1    |
| CP102                        | Lead Ass'y, 8P 200mm, Mecha to Main B'D         | 4358508202    | 1    |
| CP103                        | Ass'y Wire, Shield, 8P 200mm, Mecha to Main B'D | 4358508201    | 1    |
| CP109                        | Cable FPC, 16P, 120mm, Mecha to Main B'D        | 4118616125    | 1    |
| Trans                        | △ Power Transformer, 120 V, 60 Hz               | 2828100647    | 1    |
| Label1                       | Label, DHHS                                     | 9057069130    | 1    |
| Label2                       | Label, Class1                                   | 9057067300    | 1    |
| <b>MECHANICAL ASSEMBLY</b>   |                                                 |               |      |
| 1                            | Body Mecha                                      | 6220600210    | 1    |
| 2                            | Tray                                            | 6020800110    | 1    |
| 3                            | Roulette                                        | 7121400410    | 1    |
| 4                            | Base D.U                                        | 6022604310    | 1    |
| 5                            | Clamp Chuck                                     | 7143104610    | 1    |
| 6                            | Slider Right                                    | 7143202410    | 1    |
| 7                            | Slider Left                                     | 7143202510    | 1    |
| 8                            | Lever Chuck                                     | 7143104510    | 1    |
| 9                            | Gear Loading                                    | 7103002110    | 1    |
| 10                           | Gear Stopper                                    | 7103002210    | 1    |
| 11                           | Gear Pulley                                     | 7103002310    | 2    |
| 12                           | Gear Cam                                        | 7103002410    | 1    |
| 13                           | Gear Skip                                       | 7103002510    | 1    |
| 14                           | Pulley Skip                                     | 7115003510    | 1    |
| 15                           | Worm                                            | 7105001010    | 1    |
| 16                           | Bushing Skip                                    | 7015005010    | 2    |
| 17                           | Roller Skip                                     | 7115003610    | 5    |
| 18                           | Not Used !                                      |               |      |
| 19                           | Pulley Motor                                    | 7113001310    | 3    |
| 20                           | Base Magnet                                     | 6063103010    | 1    |
| 21                           | Not Used !                                      |               |      |
| 22                           | Frame Body                                      | 6122622810    | 1    |
| 23                           | Bracket Skip Ass'y                              | 6503031710    | 1    |
| 24                           | Not Used !                                      |               |      |
| 25                           | Guide Tray Ass'y                                | 6143001310    | 2    |
| 26                           | Cover magnet                                    | 6023408610    | 1    |
| 27                           | Magnet                                          | 5125000910    | 1    |
| 28                           | Rubber Damping                                  | 6715024510    | 4    |
| 29                           | Belt Loading                                    | 7165002810    | 2    |
| 30                           | Belt Skip                                       | 7165002820    | 1    |
| 31                           | Rubber Wheel                                    | 6715026210    | 5    |
| 32                           | Shaft Skip                                      | 7005008010    | 1    |
| 33                           | Not Used !                                      |               |      |
| 34                           | Spring Chuck                                    | 6555307610    | 1    |
| 35                           | Spring Bar                                      | 6555900810    | 1    |
| 36                           | Spring Damping                                  | 6555014010    | 4    |
| 37                           | Not Used !                                      |               |      |
| 38                           | Connector, Skip Ass'y 2P                        | 5798100310    | 1    |

| Ref. No. | Description                | Mfr. Part No. | Q'ty |
|----------|----------------------------|---------------|------|
| 39       | Connector, Load Ass'y 5P   | 5798100309    | 2    |
| 40       | Wire FPC 6P                | 5798100308    | 1    |
| 41-46    | Not Used !                 |               |      |
| 47       | Washer, Poly               | 8338301210    | 1    |
| 48       | Washer, Poly               | 8338300810    | 1    |
| 49       | Washer, Plain              | 8305003810    | 1    |
| 50       | Screw, Mecha               | 8155001210    | 1    |
| 51       | Screw, # 1 WPT 3x12Y       | 8159130121    | 1    |
| 52       | Screw, # 1 WPT 3x10Y       | 8159130101    | 10   |
| 53       | Screw, # 1 WPT 2.6x8Y      | 8159126081    | 3    |
| 54       | Screw, BM 2.6x5Y           | 8009126051    | 4    |
| 55       | Screw, BM 2x3Y             | 8009120031    | 2    |
| 56       | Screw, Damping             | 8155001610    | 4    |
| 57       | Screw, # 1 BT 2.6x8Y       | 8109126081    | 1    |
| 58       | Screw, # 1 BT 3x8Y         | 8109130081    | 5    |
| 59       | Screw, # 1 WPT 2.6x14Y     | 8159126141    | 1    |
| 60       | Washer Plain               | 8305001810    | 1    |
| 61       | Drive Unit, KSM 2101 ABM   | 5728001010    | 1    |
| 62       | Motor, RF-500TB-14415      | 5558200310    | 2    |
| 63       | Motor, RF-130SH-14230      | 5558200410    | 1    |
| 64       | Switch, Lever, SSCF-21004A | 4638003410    | 2    |
| 65/66    | Not Used !                 |               |      |

1. This parts list based on American version is for European version.  
2. Each Initial In the Remark is denoted as follows.  
C: Changed, D: Deleted, A: Added

| Ref. No.                     | Description                       | Mfr. Part No. | Q't | Remark |
|------------------------------|-----------------------------------|---------------|-----|--------|
| <b>CABINET &amp; CHASSIS</b> |                                   |               |     |        |
| 28                           | Chassis Back, SECC, Black         | 046102044051  | 1   | C      |
| 27                           | △ Cord AC Power                   | 4308000430    | 1   | C      |
| <b>MISCELLANEOUS</b>         |                                   |               |     |        |
| Trans                        | △ Power Transformer, 230 V, 50 Hz | 2828100657    | 1   | C      |

PRODUCT SAFETY NOTICE

Each precaution in this manual should be followed during servicing. Components identified with the IEC symbol △ in the part list are of special significance to safety. When replacing a component identified with △, use only the replacement parts designated, or parts with the same ratings of resistance, wattage or voltage that are designated in the parts list in this manual. Leakage-current or resistance measurements must be made to determine that exposed parts are acceptably insulated from the supply circuit before returning the product to the customer.

# ELECTRICAL PARTS LIST

**PRODUCT SAFETY NOTICE :** Products marked with  $\Delta$  have special characteristics important to safety.

If you replace any of these components, read carefully the product safety notice in this manual.

Don't degrade the safety of the product through improper servicing.

Resistor/Capacitor tolerance – D : ( $\pm 0.5\%$ ), J : ( $\pm 5\%$ ), K : ( $\pm 10\%$ ), M : ( $\pm 20\%$ ), Z : +80, – 20%)

| Ref. No.                        | Description     | Mfr. Part No.    | Q'ty         | Ref. No.                   | Description                      | Mfr. Part No.    | Q'ty          |
|---------------------------------|-----------------|------------------|--------------|----------------------------|----------------------------------|------------------|---------------|
| <b>PCB1 ASSEMBLY P.C.B MAIN</b> |                 |                  |              |                            |                                  |                  |               |
| <b>CAPACITORS</b>               |                 |                  |              |                            |                                  |                  |               |
| C101/C102                       | Electrolytic SG | 100 uF 10 V M    | 3479310121 2 | C229                       | Ceramic Tubular                  | 0.022 uF 50 V K  | 3519223520 1  |
| C105                            | Electrolytic SG | 22 uF 50 V M     | 3479322071 1 | C230                       | Mylar                            | 0.033 uF 100 V J | 3679333120 1  |
| C106-C108                       | Electrolytic SG | 100 uF 10 V M    | 3479310121 3 | C231                       | Mylar                            | 0.047 uF 100 V J | 3679473120 1  |
| C110                            | Electrolytic SG | 0.47 uF 50 V M   | 3479347871 1 | C232                       | Electrolytic SG                  | 22 uF 50 V M     | 3479322071 1  |
| C111                            | Mylar           | 0.002 uF 100 V J | 3679222120 1 | C234                       | Mylar                            | 0.047 uF 100 V J | 3679473120 1  |
| C113/C114                       | Electrolytic SG | 100 uF 10 V M    | 3479310121 2 | <b>CONNECTORS</b>          |                                  |                  |               |
| C116                            | Electrolytic SG | 100 uF 10 V M    | 3479310121 1 | CN101                      | Wafer, 6P                        |                  | 4428525560 1  |
| C118                            | Ceramic Tubular | 0.022 uF 50 V J  | 3519223935 1 | CN102                      | Wafer, 8P                        |                  | 4428525580 1  |
| C119-C122                       | Not Used !      |                  |              | CN103                      | Wafer, 8P                        |                  | 4428525580 1  |
| C123/C124                       | Mylar           | 0.047 uF 100 V J | 3679473120 2 | CN104                      | Wafer, 4P                        |                  | 4428525540 1  |
| C125                            | Electrolytic SG | 2200 uF 25 V M   | 3409322249 1 | CN105                      | Wafer, 3P                        |                  | 4428513430 1  |
| C126                            | Electrolytic SG | 1000 uF 25 V M   | 3409310249 1 | CN106                      | Wafer, 4P                        |                  | 4428513440 1  |
| C128                            | Electrolytic SG | 100 uF 10 V M    | 3479310121 1 | CN107                      | Wafer, 10P                       |                  | 4428525600 1  |
| C129                            | Electrolytic SG | 1000 uF 25 V M   | 3409310249 1 | CN108                      | Wafer, 9P                        |                  | 4428525590 1  |
| C131                            | Ceramic Tubular | 0.01 uF 50 V J   | 3519103935 1 | CN109                      | Wafer, 16P, FPC, Angle           |                  | 4426001116 1  |
| C132                            | Ceramic Tubular | 0.022 uF 50 V J  | 3519223935 1 | CN110                      | Wafer, 9P                        |                  | 4428513490 1  |
| C133/C134                       | Electrolytic SG | 100 uF 16 V M    | 3479310131 2 | CN111                      | Wafer, 5P                        |                  | 4428525550 1  |
| C136                            | Ceramic Tubular | 220 pF 50 V J    | 3519221935 1 | <b>DIODES</b>              |                                  |                  |               |
| C137                            | Ceramic Tubular | 47 pF 50 V J     | 3519470935 1 | D101/D102                  | 1N4148, Switching                |                  | 2058322101 2  |
| C138                            | Electrolytic SG | 4.7 uF 50 V M    | 3479347971 1 | D103                       | Zener, UZ 2.7BSC                 |                  | 2258599115 1  |
| C140                            | Ceramic Tubular | 1000 pF 50 V J   | 3519102935 1 | D104                       | Zener, UZ 9.1BSC                 |                  | 2258599128 1  |
| C141                            | Ceramic Tubular | 220 pF 50 V J    | 3519221935 1 | D105                       | 1N4002, Rectifier                |                  | 2258100135 1  |
| C142                            | Ceramic Tubular | 0.01 uF 50 V J   | 3519103935 1 | D106/D107                  | Zener, UZ 4.3BSB                 |                  | 2258599102 2  |
| C143/C144                       | Ceramic Tubular | 10 pF 50 V J     | 3519100935 2 | D108                       | Zener, UZ 5.1BSB                 |                  | 2258599103 1  |
| C145                            | Ceramic Tubular | 120 pF 50 V J    | 3519121935 1 | D109/D110                  | 1N4002, Rectifier                |                  | 2258100135 2  |
| C146                            | Mylar           | 0.047 uF 100 V J | 3679473120 1 | D111-D114                  | 1N4148, Switching                |                  | 2058322101 4  |
| C147                            | Ceramic Tubular | 0.022 uF 50 V J  | 3519223935 1 | D115                       | 1N4002, Rectifier                |                  | 2258100135 1  |
| C148/C149                       | Ceramic Tubular | 100 pF 50 V J    | 3519101935 2 | D116/D117                  | 1N4148, Switching                |                  | 2058322101 2  |
| C150                            | Electrolytic SG | 100 uF 10 V M    | 3479310121 1 | D118/D119                  | 1N4002, Rectifier                |                  | 2258100135 2  |
| C151                            | Electrolytic SG | 10 uF 50 V M     | 3479310071 1 | D120                       | Zener, UZ 5.1BSB                 |                  | 2258599103 1  |
| C152                            | Mylar           | 0.002 uF 100 V J | 3679152120 1 | D121                       | 1N4002, Rectifier                |                  | 2258100135 1  |
| C153/C154                       | Ceramic Tubular | 10 pF 50 V J     | 3519100935 2 | D122                       | 1N4148, Switching                |                  | 2058322101 1  |
| C156                            | Ceramic Tubular | 2200 uF 16 V J   | 3519222915 1 | D123-D138                  | 1N4148, Switching                |                  | 2058322101 16 |
| C157                            | Electrolytic SG | 100 uF 16 V M    | 3479310131 1 | <b>INTEGRATED CIRCUITS</b> |                                  |                  |               |
| C158                            | Ceramic Tubular | 220 pF 50 V J    | 3519221935 1 | IC101-IC103                | TA7293S, Motor Control           |                  | 2168007204 3  |
| C159                            | Ceramic Tubular | 47 pF 50 V J     | 3519470935 1 | IC104                      | SM5871AP                         |                  | 2138099120 1  |
| C160                            | Ceramic Tubular | 0.01 uF 50 V J   | 3519103935 1 | IC105                      | KIA4559S/KIA75559S, Op Amp       |                  | 2168206103 1  |
| C161                            | Electrolytic SG | 100 uF 16 V M    | 3479310131 1 | IC106                      | KA9258D                          |                  | 2168202120 1  |
| C162                            | Electrolytic SG | 22 uF 50 V M     | 3479322071 1 | IC107                      | CXD2507Q                         |                  | 2138022120 1  |
| C163                            | Electrolytic SG | 100 uF 10 V M    | 3479310121 1 | IC108                      | KA7805, Regulator                |                  | 2168602105 1  |
| C164                            | Ceramic Tubular | 0.022 uF 50 V J  | 3519223935 1 | IC109                      | KA7812, Regulator                |                  | 2168602108 1  |
| C165                            | Electrolytic SG | 100 uF 16 V M    | 3479310131 1 | IC110                      | KA7812, Regulator                |                  | 2168602113 1  |
| C166                            | Electrolytic SG | 47 uF 16 V M     | 3479347031 1 | IC111                      | KA7808, Regulator                |                  | 2168602101 1  |
| C167                            | Electrolytic SG | 100 uF 16 V M    | 3479310131 1 | IC112                      | CXP82320-322, DWP325             |                  | 2138322197 1  |
| C168                            | Ceramic Tubular | 0.022 uF 50 V J  | 3519223935 1 | IC113                      | CXA1782BQ                        |                  | 2138022117 1  |
| C169                            | Ceramic Tubular | 220 pF 50 V J    | 3519221935 1 | <b>TRANSISTORS</b>         |                                  |                  |               |
| C170                            | Ceramic Tubular | 47 pF 50 V J     | 3519470935 1 | Q101                       | MPSA56Y, PNP, Silicon            |                  | 2208206113 1  |
| C171                            | Electrolytic SG | 0.47 uF 50 V M   | 3479347871 1 | Q102                       | DTC114YS                         |                  | 2208622106 1  |
| C172                            | Mylar           | 0.01 uF 100 V J  | 3679103120 1 | Q103/Q104                  | KTD1302B, NPN, Silicon           |                  | 2208606112 2  |
| C173                            | Ceramic Tubular | 0.022 uF 50 V J  | 3519223935 1 | Q105                       | KTA1023/BKTA965, PNP, Silicon    |                  | 2228106107 1  |
| C174                            | Mylar           | 0.033 uF 100 V J | 3679333120 1 | Q106                       | DTC114YS                         |                  | 2208622106 1  |
| C175/C176                       | Ceramic Tubular | 10 pF 50 V J     | 3519100935 2 | Q107                       | BKTA1266Y/KTA1015Y, PNP, Silicon |                  | 2208206105 1  |
| C177                            | Ceramic Tubular | 0.01 uF 50 V J   | 3519103935 1 | Q111                       | BKTC2235/KTC1027, NPN, Silicon   |                  | 2228406120 1  |
| C178                            | Electrolytic SG | 10 uF 50 V M     | 3479310071 1 | Q112                       | DTC114YS                         |                  | 2208622106 1  |
| C179                            | Electrolytic SG | 0.47 uF 50 V M   | 3479347871 1 | Q113-Q116                  | BKTC2240BL/BKTC3200, NPN, PNP    |                  | 2208606108 4  |
| C180                            | Ceramic Tubular | 120 pF 50 V J    | 3519121935 1 | Q117/Q118                  | KTA1023/BKTA965, PNP, Silicon    |                  | 2228106107 2  |
| C181                            | Ceramic Tubular | 0.022 uF 50 V J  | 3519223935 1 | Q119/Q120                  | MPSA06Y, NPN, Silicon            |                  | 2208206113 2  |
| C182                            | Not Used !      |                  |              | Q121/Q122                  | MPSA56Y, PNP, Silicon            |                  | 2208206104 2  |
| C183                            | Electrolytic SG | 3.3 uF 50 V M    | 3479333971 1 | Q123/Q124                  | KTA970/KTA1268, PNP, Silicon     |                  | 2228406120 2  |
| C184                            | Electrolytic SG | 22 uF 25 V M     | 3479322041 1 | Q125/Q126                  | BKTC2235/KTC1027, NPN, Silicon   |                  | 2208206104 2  |
| C185                            | Ceramic Tubular | 0.022 uF 50 V J  | 3519223935 1 | Q127/Q128                  | KTA970/KTA1268, PNP, Silicon     |                  | 2208206104 2  |
| C186/C187                       | Ceramic Tubular | 100 pF 50 V J    | 3519101935 2 | Q129                       | BKTA1266Y/KTA1015Y, PNP, Silicon |                  | 2208206105 1  |
| C188                            | Electrolytic SG | 33 uF 16 V M     | 3479333031 1 | Q130/Q131                  | KTC2240BL/BKTC3200, NPN, PNP     |                  | 2208606108 2  |
| C189                            | Electrolytic SG | 0.47 uF 50 V M   | 3479347871 1 | Q132/Q133                  | KTA1023/BKTA965, PNP, Silicon    |                  | 2228106107 2  |
| C190                            | Mylar           | 0.002 uF 100 V J | 3679152120 1 | Q134/Q135                  | KTC2240BL/BKTC3200, NPN, PNP     |                  | 2208606108 2  |
| C191/C192                       | Ceramic Tubular | 10 pF 50 V J     | 3519100935 2 | Q136/Q137                  | MPSA06Y, NPN, Silicon            |                  | 2208606114 2  |
| C193                            | Ceramic Tubular | 220 pF 50 V J    | 3519221935 1 | Q138                       | MPSA56Y, PNP, Silicon            |                  | 2208206113 1  |
| C194                            | Ceramic Tubular | 47 pF 50 V J     | 3519470935 1 | Q140                       | DTC114YS                         |                  | 2208622106 1  |
| C196                            | Ceramic Tubular | 0.022 uF 50 V J  | 3519223935 1 | Q141/Q142                  | BKTC2235/KTC1027, NPN, Silicon   |                  | 2228406120 4  |
| C197                            | Ceramic Disc CH | 33 pF 50 V J     | 3528330210 1 | Q143-Q146                  | KTA970/KTA1268, PNP, Silicon     |                  | 2208206104 2  |
| C198                            | Ceramic Tubular | 0.022 uF 50 V J  | 3519223935 1 | Q147/Q148                  | KTD1302B, NPN, Silicon           |                  | 2208606112 2  |
| C199                            | Ceramic Disc CH | 33 pF 50 V J     | 3528330210 1 | Q149/Q150                  | DTA114YS, PNP, Silicon           |                  | 2208222105 2  |
| C200                            | Electrolytic SG | 100 uF 16 V M    | 3479310131 1 | <b>RESISTORS</b>           |                                  |                  |               |
| C201/C202                       | Electrolytic SG | 0.47 uF 50 V M   | 3479347871 2 | R101/R102                  | Metal Film                       | 1 kohm 1/5 W J   | 3029102970 2  |
| C205                            | Mylar           | 0.033 uF 100 V J | 3679333120 1 | R103                       | Carbon Film                      | 47 kohm 1/5 W J  | 3069473970 1  |
| C206                            | Mylar           | 0.047 uF 100 V J | 3679473120 1 | R104                       | Metal Film                       | 4.4 kohm 1/5 W J | 3029472970 1  |
| C207                            | Mylar           | 0.01 uF 100 V J  | 3679223120 1 | R105-R109                  | Carbon Film                      | 47 kohm 1/5 W J  | 3069473970 5  |
| C208                            | Mylar           | 0.022 uF 100 V J | 3679104120 1 | R110                       | Metal Film                       | 2.7 kohm 1/5 W J | 3029272970 1  |
| C209                            | Mylar           | 0.1 uF 100 V J   | 3679104120 1 | R111                       | Metal Film                       | 2.2 ohm 1/5 W J  | 3029229970 1  |
| C210                            | Electrolytic SG | 4.7 uF 50 V M    | 3479347971 1 | R112                       | Carbon Film                      | 47 kohm 1/5 W J  | 3069473970 1  |
| C211                            | Mylar           | 0.1 uF 100 V J   | 3679104120 1 | R113                       | Carbon Film                      | 7.5 kohm 1/5 W J | 3069123970 1  |
| C212                            | Mylar           | 0.01 uF 100 V J  | 3679103120 1 | R116                       | Carbon Film                      | 12 kohm 1/5 W J  | 3069123970 1  |
| C219                            | Mylar           | 0.1 uF 100 V J   | 3679104120 1 | R117                       | Carbon Film                      | 3 kohm 1/5 W J   | 3069302970 1  |
| C220                            | Ceramic Tubular | 0.022 uF 50 V K  | 3519223520 1 | R118                       | Metal Film                       | 2.2 ohm 1/5 W J  | 3029229970 1  |
| C221                            | Ceramic Tubular | 0.002 uF 50 V K  | 3519222915 1 | R120                       | Metal Film                       | 2.2 kohm 1/5 W J | 3029222970 1  |
| C222                            | Electrolytic SG | 100 uF 10 V M    | 3479310121 1 | R121/R122                  | Metal Film                       | 1 kohm 1/5 W J   | 3029102970 2  |
| C223                            | Mylar           | 0.1 uF 100 V J   | 3679104120 1 | R123                       | Carbon Film                      | 47 kohm 1/5 W J  | 3069473970 1  |
| C224                            | Electrolytic SG | 1 uF 50 V M      | 3479310871 1 | R124                       | Metal Film                       | 1 kohm 1/5 W J   | 3029102970 1  |
| C225                            | Ceramic Tubular | 0.022 uF 50 V K  | 3519223520 1 |                            |                                  |                  |               |
| C226                            | Electrolytic SG | 47 uF 25 V M     | 3479347041 1 |                            |                                  |                  |               |
| C227/C228                       | Ceramic Tubular | 220 pF 50 V K    | 3519221935 2 |                            |                                  |                  |               |



| Ref. No. | Description | Part No. | Q'ty |
|----------|-------------|----------|------|
|----------|-------------|----------|------|

|             |                                          |              |   |
|-------------|------------------------------------------|--------------|---|
| <b>PCB7</b> | <b>ASSEMBLY PCB POWER SWITCH</b>         |              |   |
| CN701       | Plug, 3P, Angle                          | 4428851103   | 1 |
| CP111       | Lead Ass'y, 5P, 350mm, to Main B'D CN111 | 436205353332 | 1 |
| R701        | Metal Film 1 ohm 1/5 W J                 | 3029109970   | 1 |
| SW701       | Switch, Push, Power                      | 4628058310   | 1 |

|             |                              |            |   |
|-------------|------------------------------|------------|---|
| <b>PCB8</b> | <b>ASSEMBLY PCB LED</b>      |            |   |
| CP701       | Plug, BOT. 3P                | 4428861003 | 1 |
| DB01        | LED, SPR-54MDW3, Green/Amber | 2308222205 | 1 |

|             |                                |            |   |
|-------------|--------------------------------|------------|---|
| <b>PCB9</b> | <b>ASSEMBLY PCB CONNECTION</b> |            |   |
| CN601       | Connector, Wafer, 5P           | 4428516140 | 1 |
| CN602       | Connector, Wafer, 5P           | 4428516140 | 1 |
| CN603       | Connector, Wafer, 6P, FPC      | 4428606965 | 1 |
| CN103       | Connector, Wafer, 16P, FPC     | 4428616965 | 1 |

|              |                                     |            |   |
|--------------|-------------------------------------|------------|---|
| <b>PCB10</b> | <b>ASSEMBLY PCB ROULETTE SENSOR</b> |            |   |
| R601         | RES, Carbon Film 150 ohm 1/5 W J    | 3069151970 | 1 |
| R602         | RES, Carbon Film 10 kohm 1/5 W J    | 3069103970 | 1 |
| R603         | RES, Carbon Film 100 ohm 1/5 W J    | 3069101970 | 1 |
| CN603        | Connector, Wafer, 6P, FPC           | 4428606965 | 1 |
| CN604        | Connector, Wafer, 2P                | 4428525520 | 1 |
| R.SENSOR     | Sensor, Photo, SG-23F1              | 2408001111 | 1 |
| DISC SENSOR  | Sensor, Photo, ON2173-R,S           | 2408210001 | 1 |

1. This parts list based on American version is for European version.

2. Each Initial in the Remark is denoted as follows.

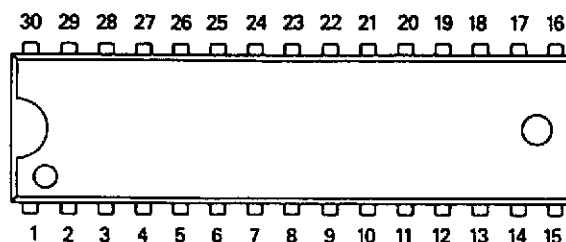
C: Changed, D: Deleted, A: Added

| Ref. No.    | Description               | Mfr. Part No. | Q't | Remark |
|-------------|---------------------------|---------------|-----|--------|
| <b>PCB7</b> | <b>ASSEMBLY PCB POWER</b> | 044002008258  |     |        |
| F301        | Fuse, T 250 V, 160 m      | 5508301035    | 1   | C      |
| CN302       | Wafer, AC, 2P             | 4428100291    | 1   | C      |

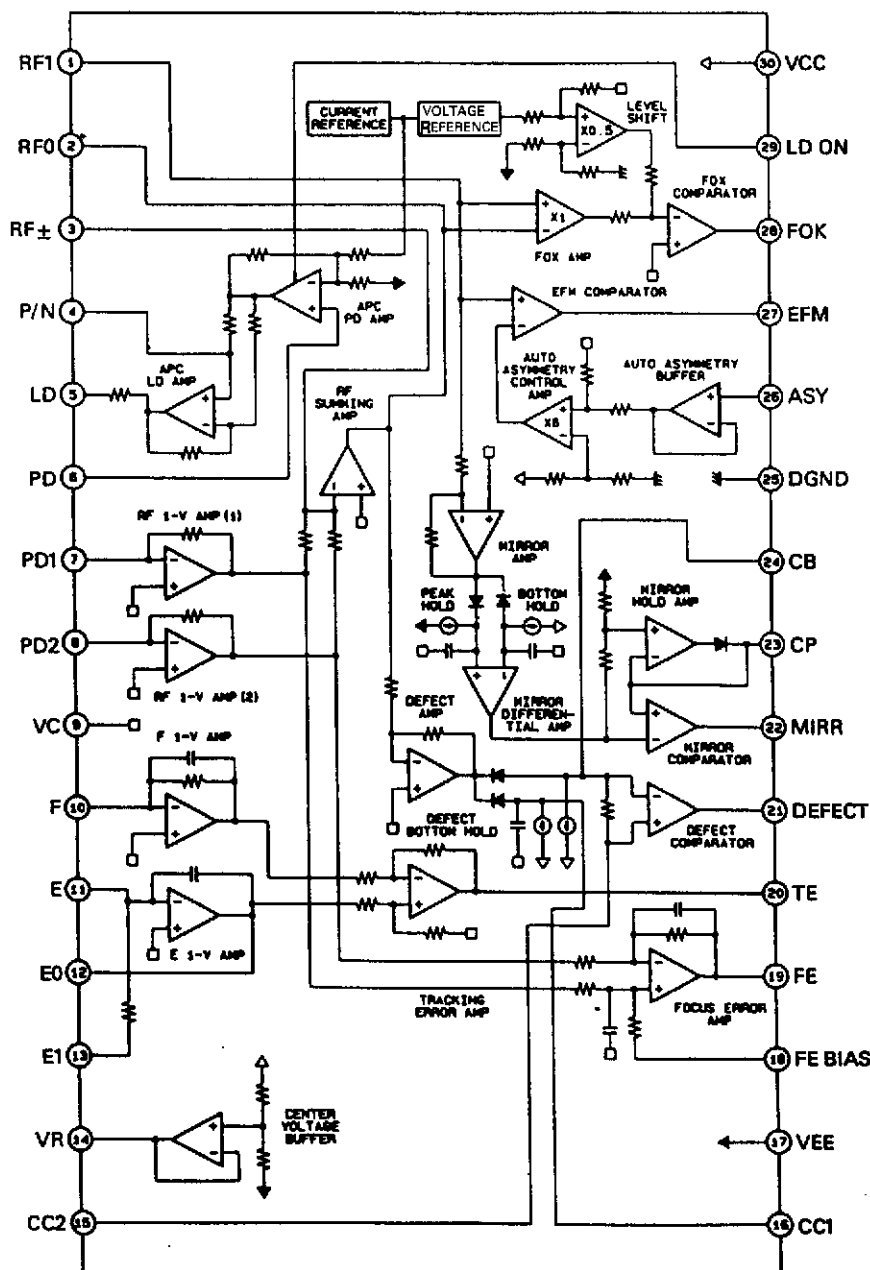
# IC'S LEAD IDENTIFICATION & INTERNAL DIAGRAMS

CXA1081S : IC108 (RF AMP)

## 1. Package Outline

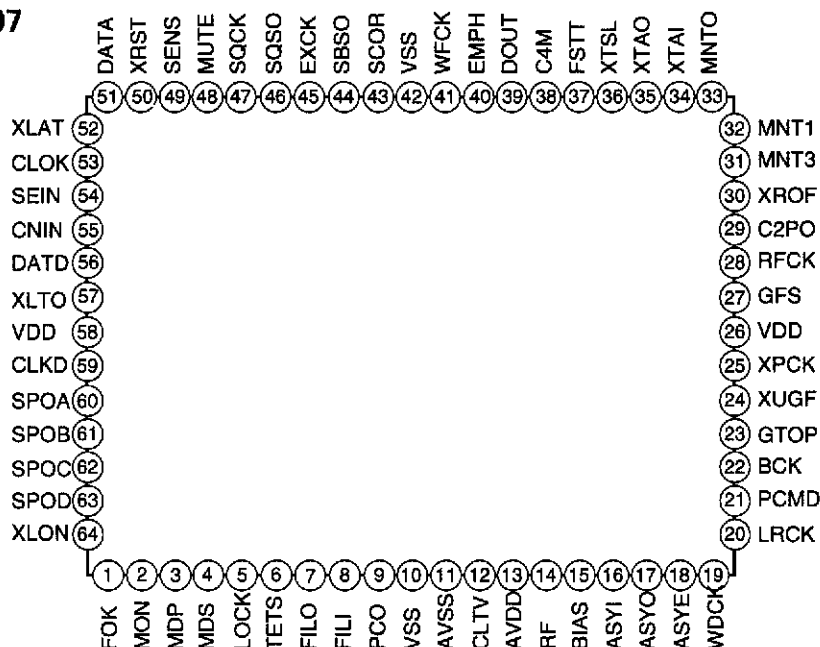


## 2. Block Diagram

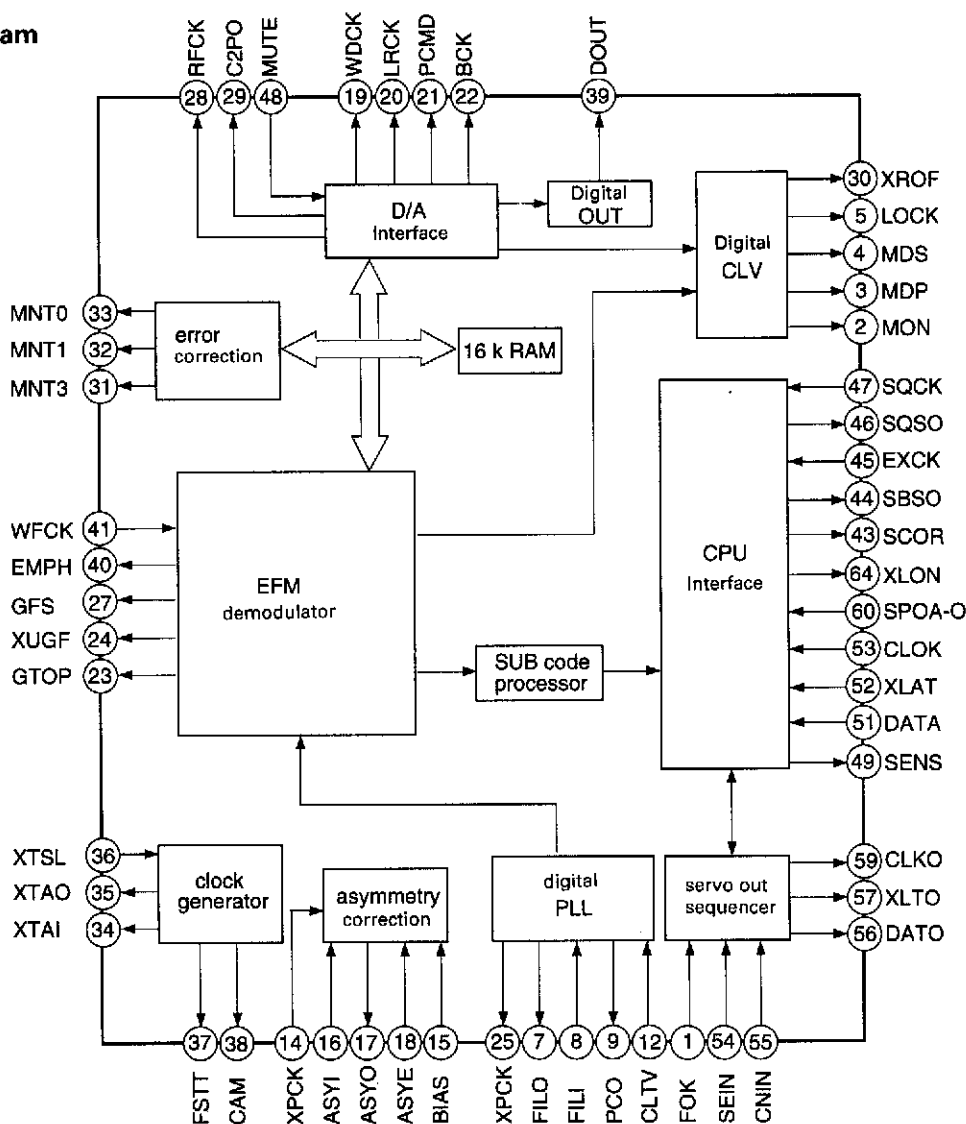


## CXD 2607Q : IC107

## 1. Pin Diagram



## 2. Block Diagram



## 3. Pin Description

| Pin No. | Symbol           | I/O |         | Description                                                                                                                                |
|---------|------------------|-----|---------|--------------------------------------------------------------------------------------------------------------------------------------------|
| 1       | FOK              | I   |         | Focus OK input. Used for SENS output and the servo auto sequencer.                                                                         |
| 2       | MON              | O   | 1, 0    | Spindle motor on/off control output.                                                                                                       |
| 3       | MDP              | O   | 1, Z, 0 | Spindle motor servo control.                                                                                                               |
| 4       | MDS              | O   | 1, Z, 0 | Spindle motor servo control.                                                                                                               |
| 5       | LOCK             | O   | 1, 0    | GFS is sampled at 460 Hz; when GFS is high, this pin outputs a high signal. If GFS is low eight consecutive samples, this pin outputs low. |
| 6       | TEST             | I   |         | TEST pin. Normally GND.                                                                                                                    |
| 7       | FILO             | O   | Analog  | Master PLL (slave=digital PLL) filter output.                                                                                              |
| 8       | FILI             | I   |         | Master PLL filter input.                                                                                                                   |
| 9       | PCO              | O   | 1, Z, 0 | Master PLL charge pump output.                                                                                                             |
| 10      | V <sub>SS</sub>  | —   | —       | GND.                                                                                                                                       |
| 11      | AV <sub>SS</sub> | —   | —       | Analog GND.                                                                                                                                |
| 12      | CLTV             | I   |         | Master VCO control voltage input.                                                                                                          |
| 13      | AV <sub>DD</sub> | —   | —       | Analog power supply (+5 V)                                                                                                                 |
| 14      | RF               | I   |         | EFM signal input.                                                                                                                          |
| 15      | BIAS             | I   |         | Constant current input of asymmetry circuit.                                                                                               |
| 16      | ASYI             | I   |         | Asymmetry comparator voltage input.                                                                                                        |
| 17      | ASYO             | O   | 1, 0    | EFM full-swing output (low=V <sub>SS</sub> , high=V <sub>DD</sub> ).                                                                       |
| 18      | ASYE             | I   |         | Low: asymmetry circuit off; high: asymmetry circuit on.                                                                                    |
| 19      | WDCK             | O   | 1, 0    | D/A interface. Word clock $f=2F_s$ .                                                                                                       |
| 20      | LRCK             | O   | 1, 0    | D/A interface. LR clock $f=F_s$ .                                                                                                          |
| 21      | PCMD             | O   | 1, 0    | D/A interface. Serial data (two's complement, MSB first).                                                                                  |
| 22      | BCK              | O   | 1, 0    | D/A interface. Bit clock.                                                                                                                  |
| 23      | GTOP             | O   | 1, 0    | GTOP output.                                                                                                                               |
| 24      | XUGF             | O   | 1, 0    | XUGF output.                                                                                                                               |
| 25      | XPCK             | O   | 1, 0    | XPLCK output.                                                                                                                              |
| 26      | V <sub>DD</sub>  | —   | —       | Power supply (+5 V).                                                                                                                       |
| 27      | GFS              | O   | 1, 0    | GFS output.                                                                                                                                |
| 28      | RFCK             | O   | 1, 0    | RFCK output.                                                                                                                               |
| 29      | C2PO             | O   | 1, 0    | C2PO output.                                                                                                                               |
| 30      | XROF             | O   | 1, 0    | XRAOF output.                                                                                                                              |
| 31      | MNT3             | O   | 1, 0    | MNT 3 output.                                                                                                                              |
| 32      | MNT1             | O   | 1, 0    | MNT 1 output.                                                                                                                              |
| 33      | MNT0             | O   | 1, 0    | MNT 0 output.                                                                                                                              |
| 34      | XTAI             | I   |         | 16.9344 MHz crystal oscillation circuit input, or 33.8688 MHz input.                                                                       |
| 35      | XTAO             | O   | 1, 0    | 16.9344 MHz crystal oscillation circuit output.                                                                                            |
| 36      | XTSL             | I   |         | Crystal selection input. Set low when the crystal is 16.9344 MHz, high when 33.8688 MHz.                                                   |
| 37      | FSTT             | O   | 1, 0    | 2/3 frequency divider output for Pins 34 and 35.                                                                                           |
| 38      | C4M              | O   | 1, 0    | 4.2336 MHz output.                                                                                                                         |

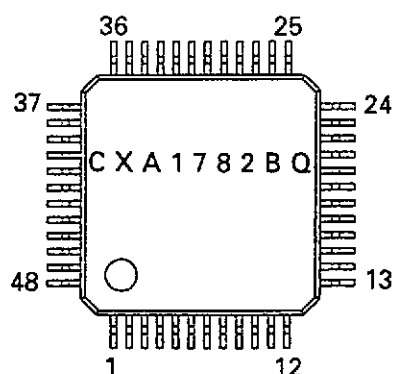
| Pin No. | Symbol          | I/O |      | Description                                                                           |
|---------|-----------------|-----|------|---------------------------------------------------------------------------------------|
| 39      | DOUT            | O   | 1, 0 | Digital_Out output.                                                                   |
| 40      | EMPH            | O   | 1, 0 | Outputs high signal when the playback disc has emphasis, low signal when no emphasis. |
| 41      | WFCK            | O   | 1, 0 | WFCK output.                                                                          |
| 42      | V <sub>SS</sub> | —   | —    | GND.                                                                                  |
| 43      | SCOR            | O   | 1, 0 | Outputs high signal when either subcode sync S0 or S1 is detected.                    |
| 44      | SBSO            | O   | 1, 0 | Sub P to W serial output.                                                             |
| 45      | EXCK            | I   |      | SBSO readout clock input.                                                             |
| 46      | SQSO            | O   | 1, 0 | SubQ 80-bit serial output.                                                            |
| 47      | SQCK            | I   |      | SQSO readout clock input.                                                             |
| 48      | MUTE            | I   |      | High: mute; low: release                                                              |
| 49      | SENS            | O   | 1, 0 | SENS output to CPU.                                                                   |
| 50      | XRST            | I   |      | System reset. Reset when low.                                                         |
| 51      | DATA            | I   |      | Serial data input from CPU.                                                           |
| 52      | XLAT            | I   |      | Latch input from CPU. Serial data is latched at the falling edge.                     |
| 53      | CLOK            | I   |      | Serial data transfer clock input from CPU.                                            |
| 54      | SEIN            | I   |      | Sense input from SSP.                                                                 |
| 55      | CNIN            | I   |      | Track jump count signal input.                                                        |
| 56      | DATO            | O   | 1, 0 | Serial data output to SSP.                                                            |
| 57      | XLTO            | O   | 1, 0 | Serial data latch output to SSP. Latched at the falling edge.                         |
| 58      | V <sub>DD</sub> | —   | —    | Power supply (+5 V).                                                                  |
| 59      | CLKO            | O   | 1, 0 | Serial data transfer clock output to SSP.                                             |
| 60      | SPOA            | I   |      | Microcomputer extended interface (input A).                                           |
| 61      | SPOB            | I   |      | Microcomputer extended interface (input B).                                           |
| 62      | SPOC            | I   |      | Microcomputer extended interface (input C).                                           |
| 63      | SPOD            | I   |      | Microcomputer extended interface (input D).                                           |
| 64      | XLON            | O   | 1, 0 | Microcomputer extended interface (output).                                            |

Notes: • PCMD is two's complement output of MSB first.

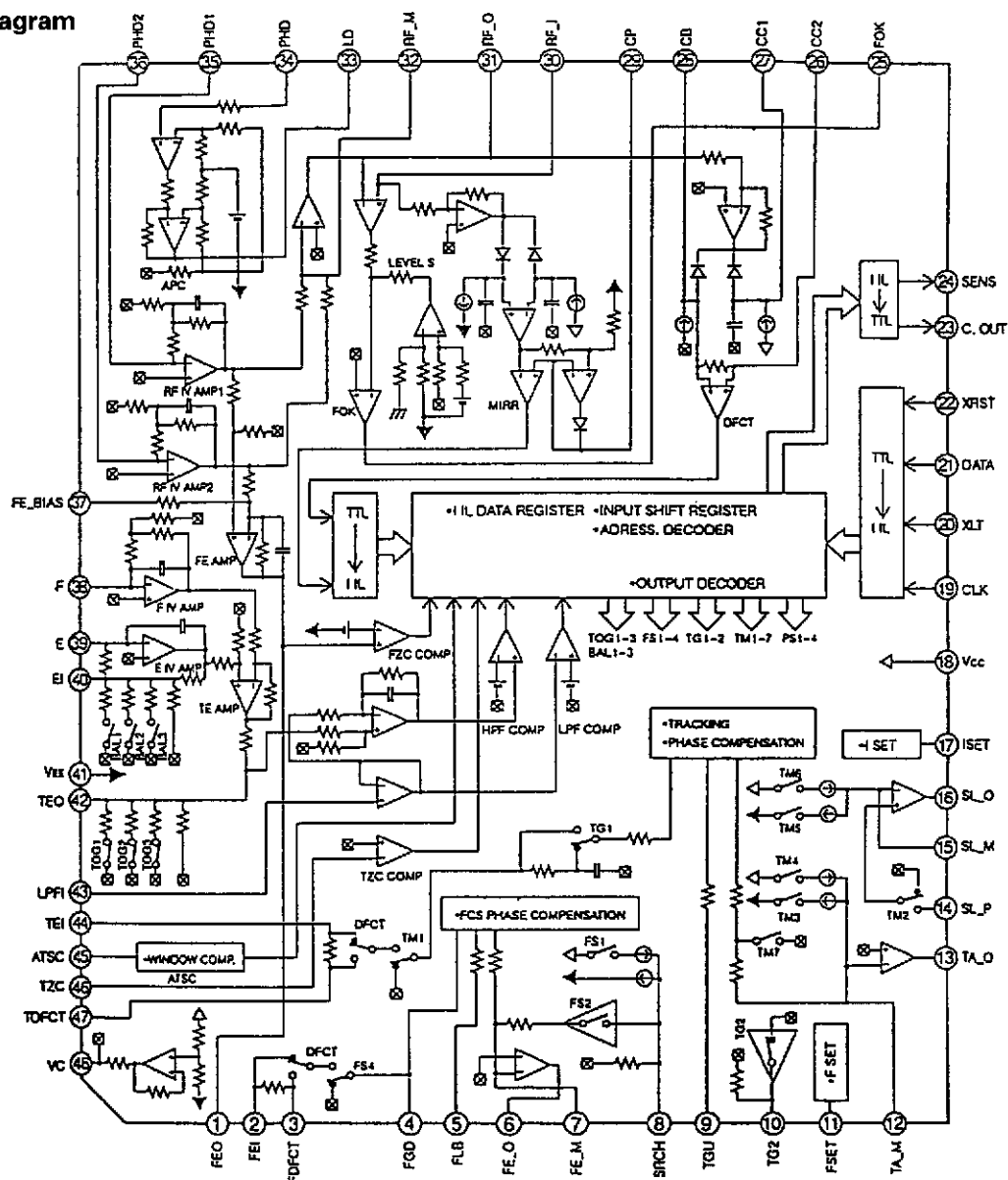
- GTOP is used to monitor the frame sync protection status.
- XUGF is the negative pulse for the frame sync derived from the EFM signal. It is the signal before sync protection.
- XPLCK is the inverse of the EFM PLL clock. The PLL is designed so that the falling edge and the EFM signal transition point coincide.
- GFS goes high when the frame sync and the insertion protection timing match.
- RFCK is derived from the crystal accuracy. This signal has a cycle of 136 $\mu$ .
- C2PO represents the data error status.
- XRAOF is generated when the 16K RAM exceeds the  $\pm 4F$  jitter margin.

# CXA 1782BQ : IC113

## 1. Package Outline



## 2. Block Diagram

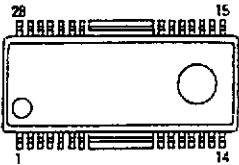


- \* The switch state in Block Diagram is for initial resetting.
- \* Switch turns to ○ side for 1 and to ● side for 0 in Serial Data Truth Table on pages 30 and 31.
- \* DFCT switch turns to ○ side when defect signal generates for DEFECT=E in Serial Data Truth Table.
- \* TG1 switch turns to ○ side and TG2 switch is left open when TG1 and TG2 (address 1 : D3) is 1.

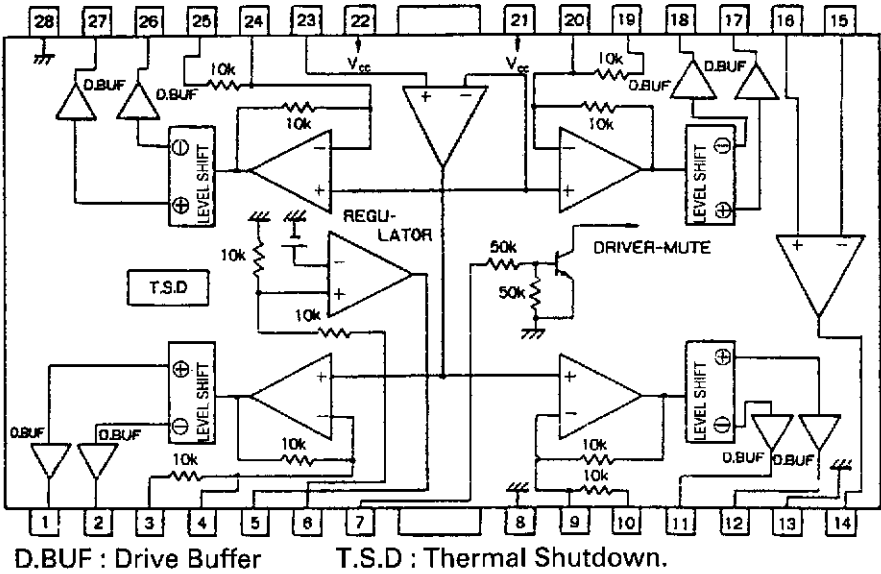
KA 9258D : IC106

KIA4559S/

1. Package Outline



2. Block Diagram



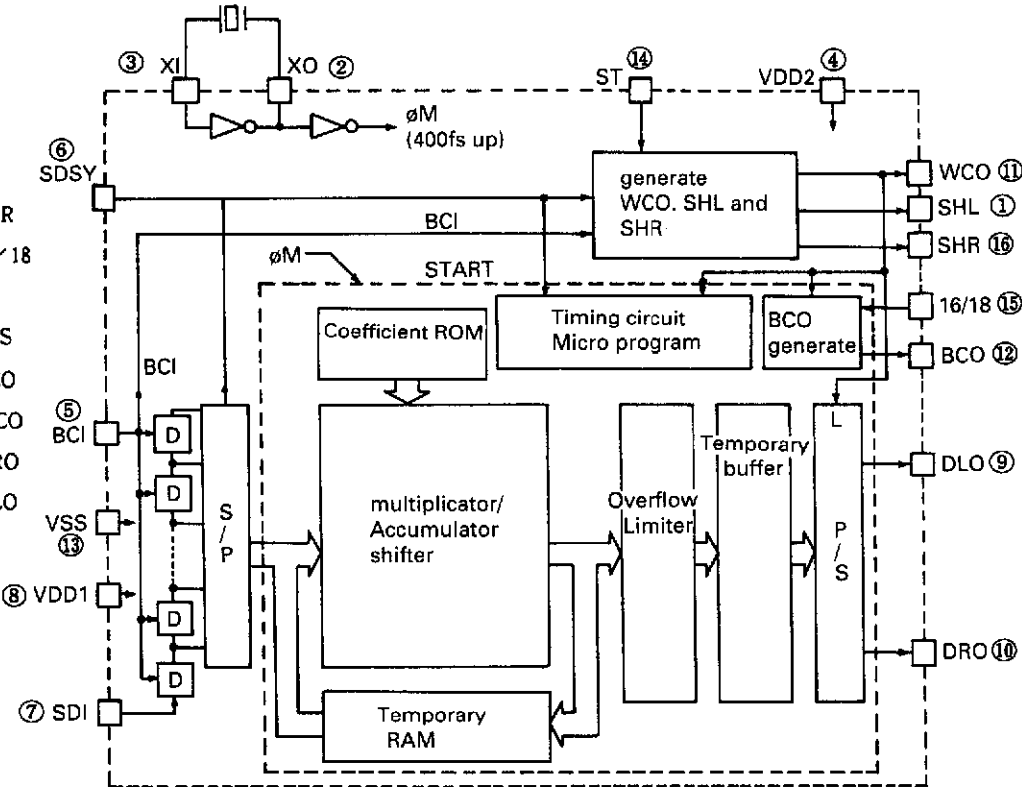
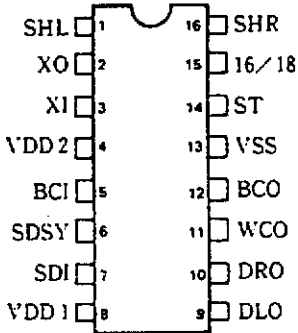
KA78XX :

YM3433B-D : IC103

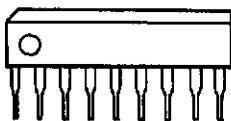
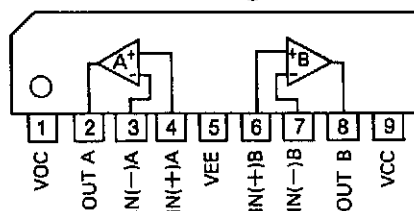
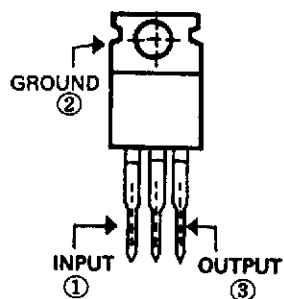
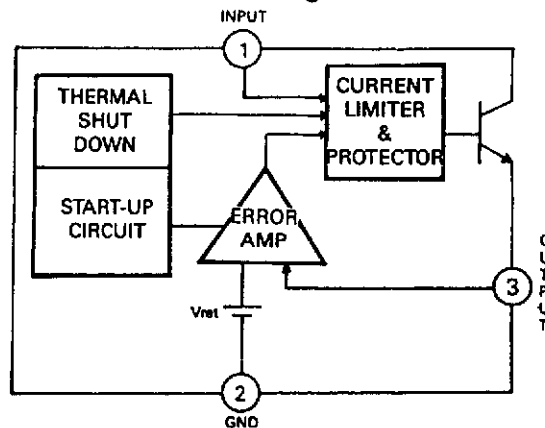
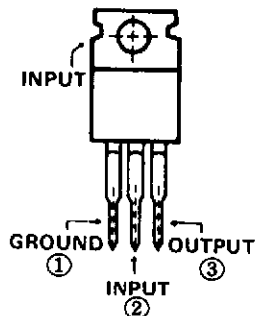
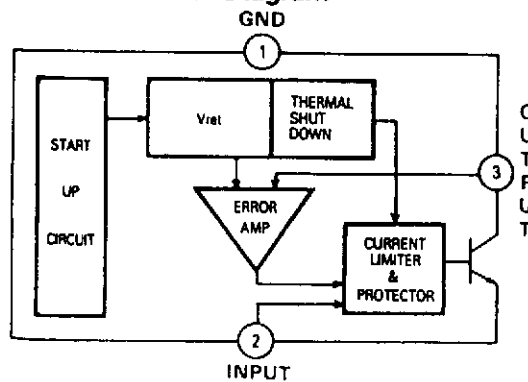
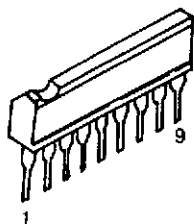
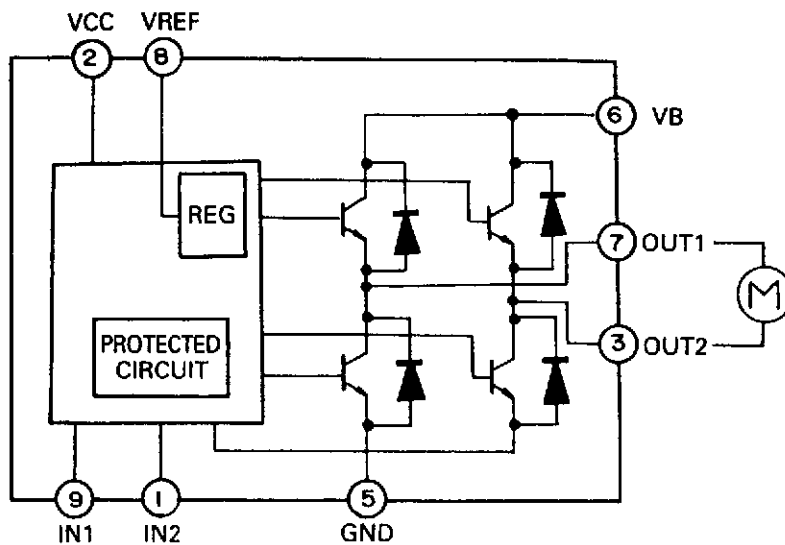
KA79XX :

2. Block Diagram

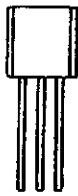
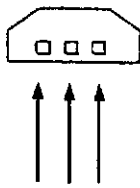
1. Package Outline

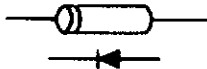
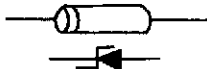


TA7291S ;

**KIA4559S/KIA75559S : IC105****1. Package Outline****2. Block Diagram****KA78XX : IC111, IC108, IC109****1. Package Outline****2. Block Diagram****KA79XX : ICT110****1. Package Outline****2. Block Diagram****TA7291S ; IC101, IC102, IC103****1. Package Outline****2. Block Diagram**

TRANSISTOR AND DIODE LEAD IDENTIFICATION

| TRANSISTOR                                                                                                                                         | FRONT VIEW                                                                                | BOTTOM VIEW                                                                                 |
|----------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|
| KTA 1268BL<br>KTC 2240B/KTC3200BL<br>KTC 1815Y/KTC 3198Y<br>KTA 1015Y/KTA 1266Y<br>2SD 1302S<br>KTC 2235Y/KTC1027<br>KTC 2236AY<br>KTA965Y/KTA1023 | <br>ECB  | <br>ECB  |
| MPSA 06<br>MPSA56                                                                                                                                  | <br>EBC  | <br>EBC  |
| DTA 114YS/KRA107M<br>DTC 114YS                                                                                                                     | <br>ECB | <br>ECB |

| DIODE                                    | PACKAGE VIEW                                                                         |
|------------------------------------------|--------------------------------------------------------------------------------------|
| 1N 4148<br>1N 4002<br>1N 4003            |  |
| UN XX. XBSX                              |  |
| TERMINAL NAME                            |                                                                                      |
| B : BASE<br>C : COLLECTOR<br>E : EMITTER |                                                                                      |

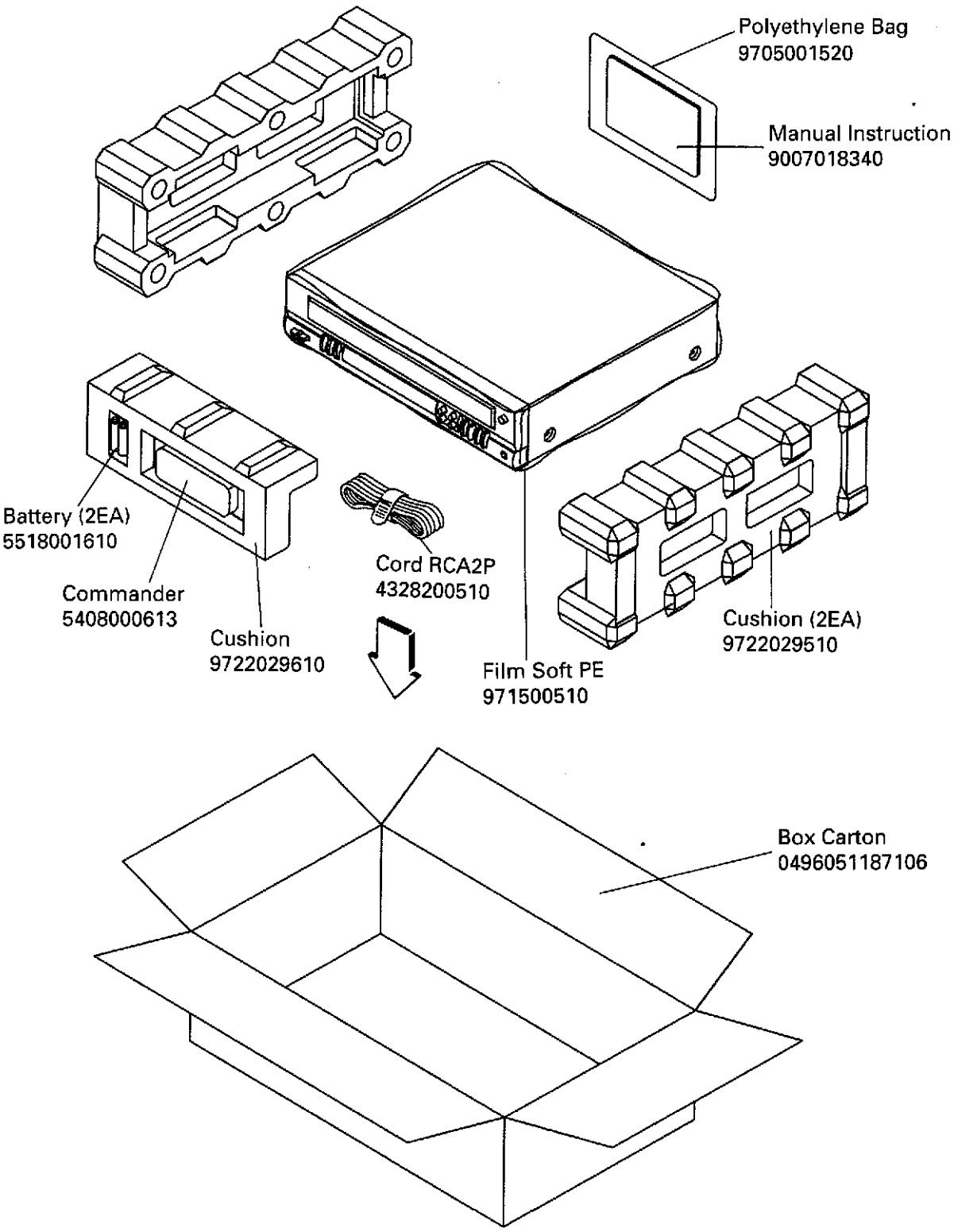
PACKAG

Battery (2  
55180016

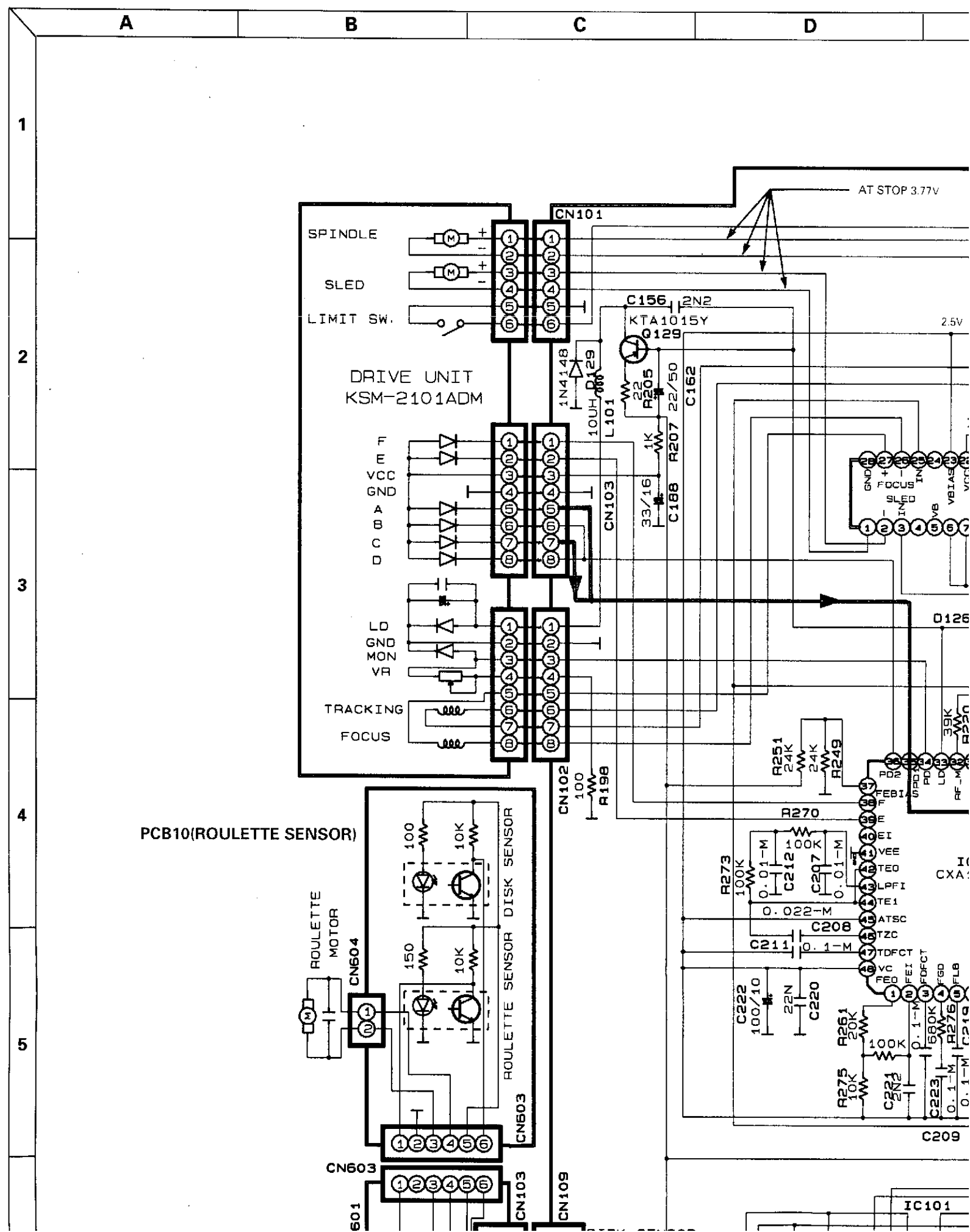
Cor  
540

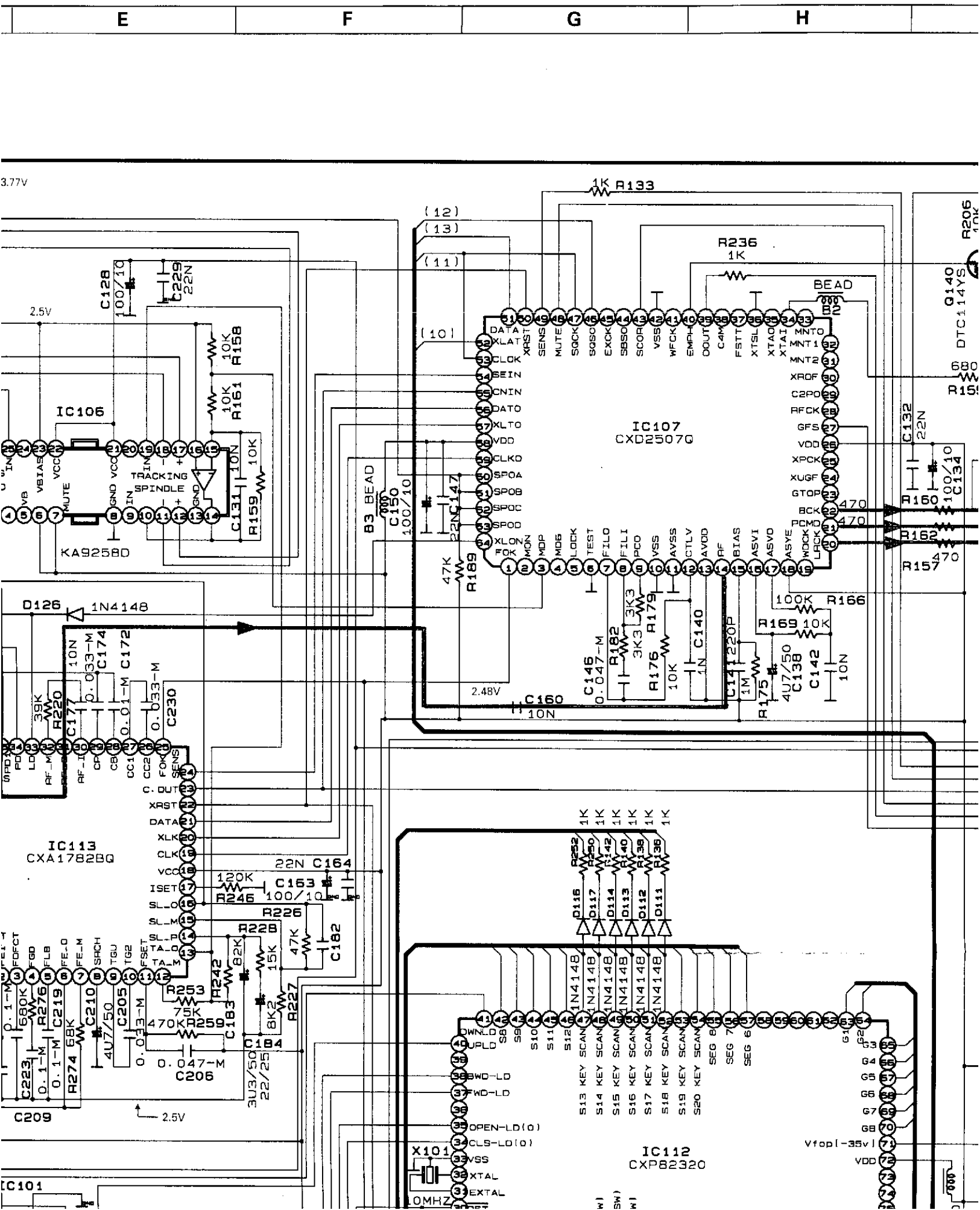
EW

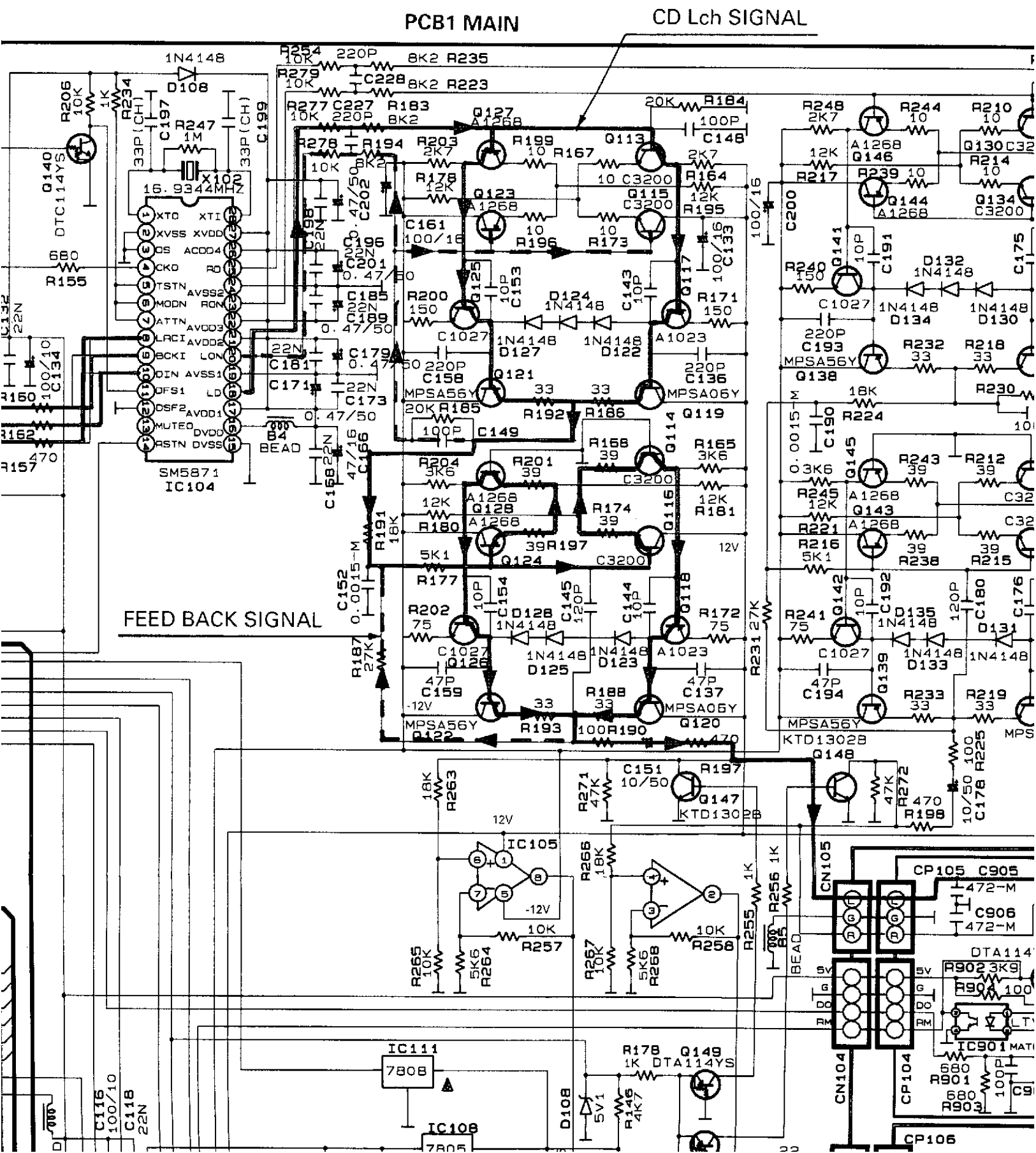
PACKAGE



### SCHEMATIC DIAGRAM



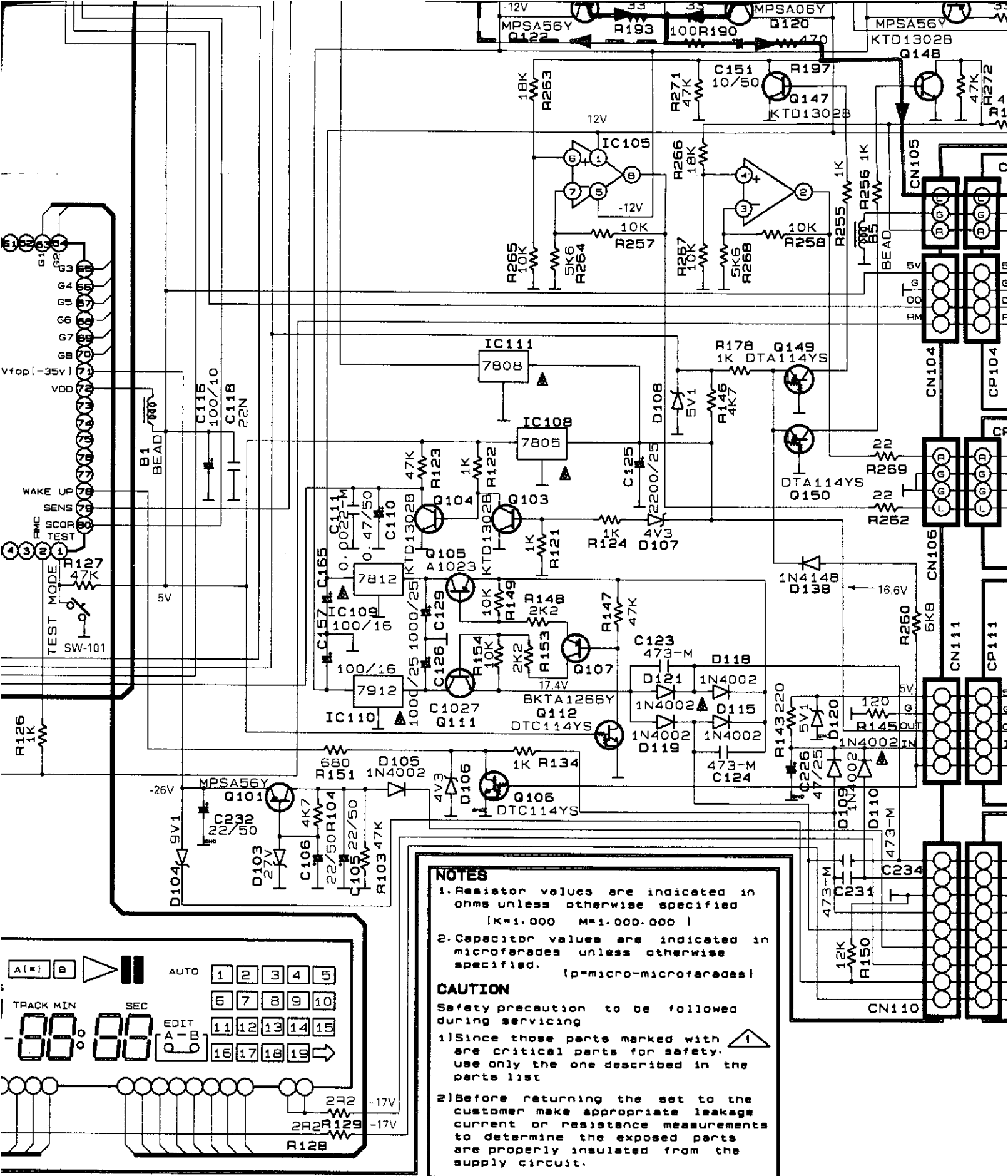






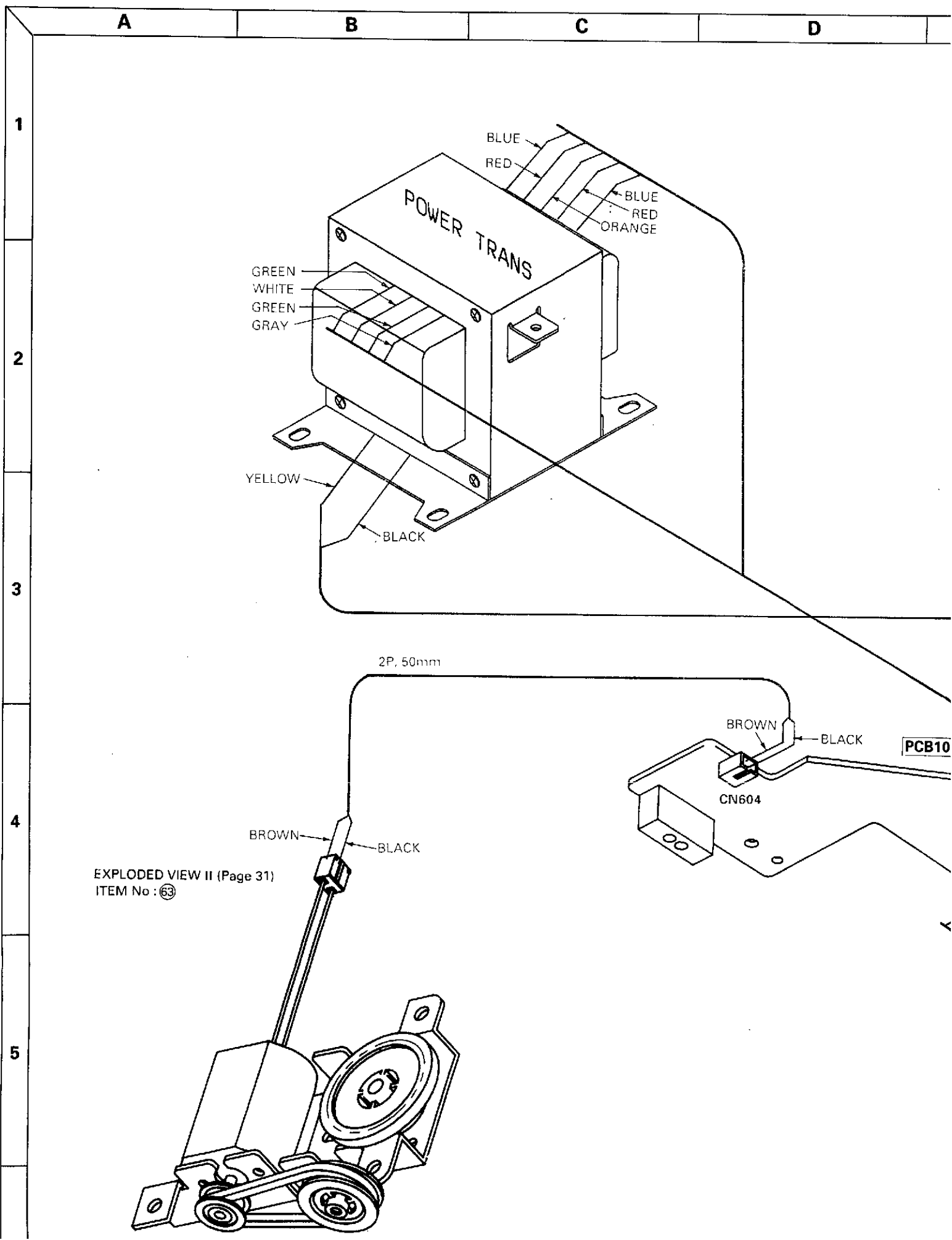




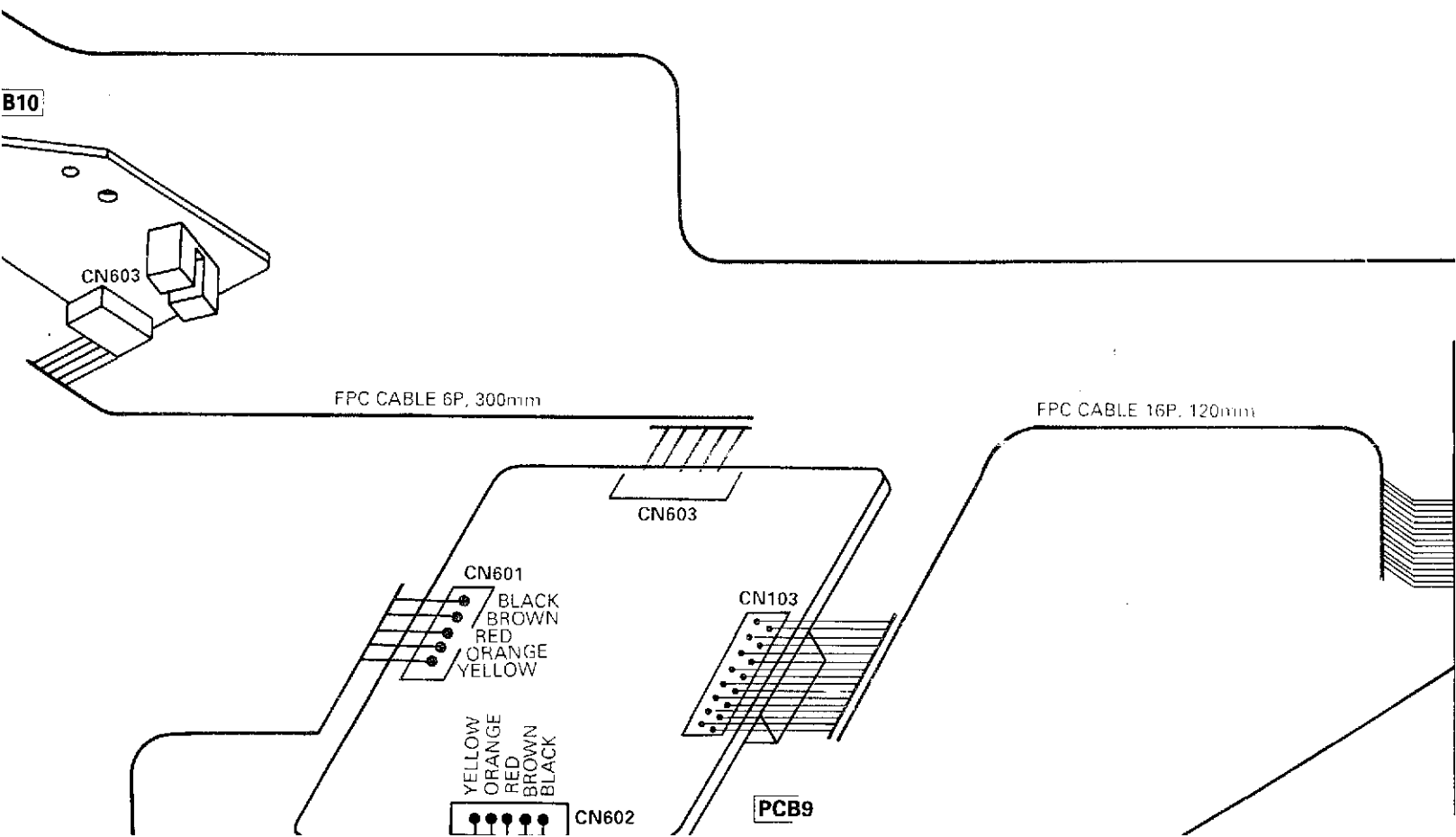
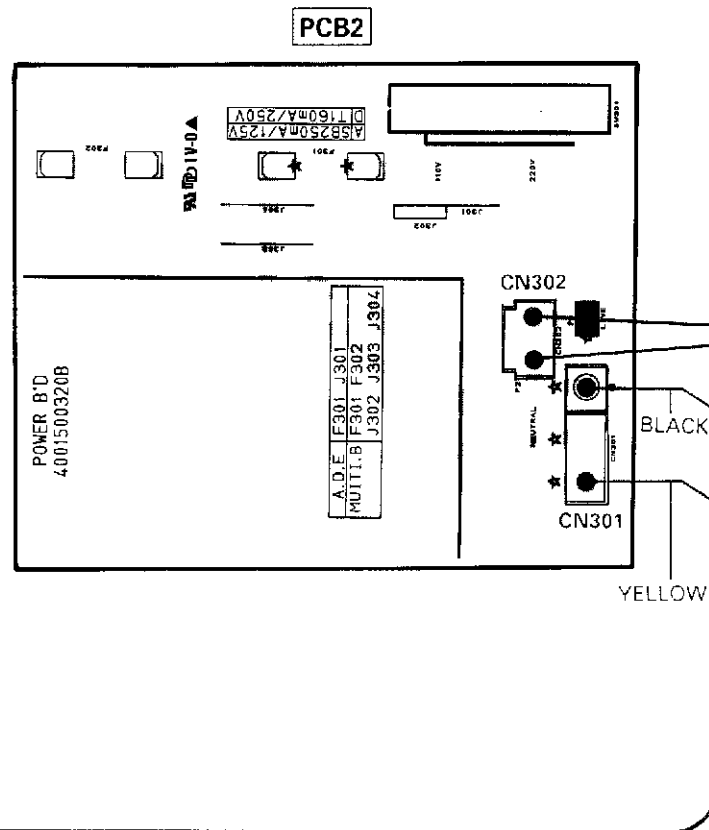




# WIRING DIAGRAM



H



I

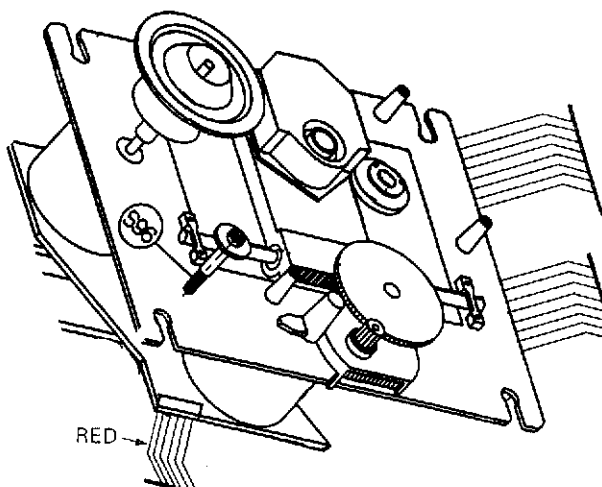
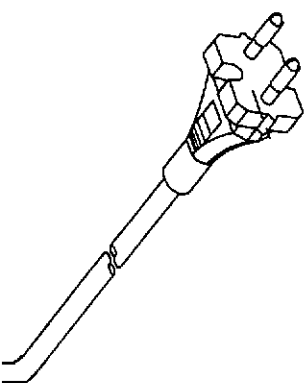
J

K

L

EXPLODED VIEW II (Page 31)

ITEM No : 61



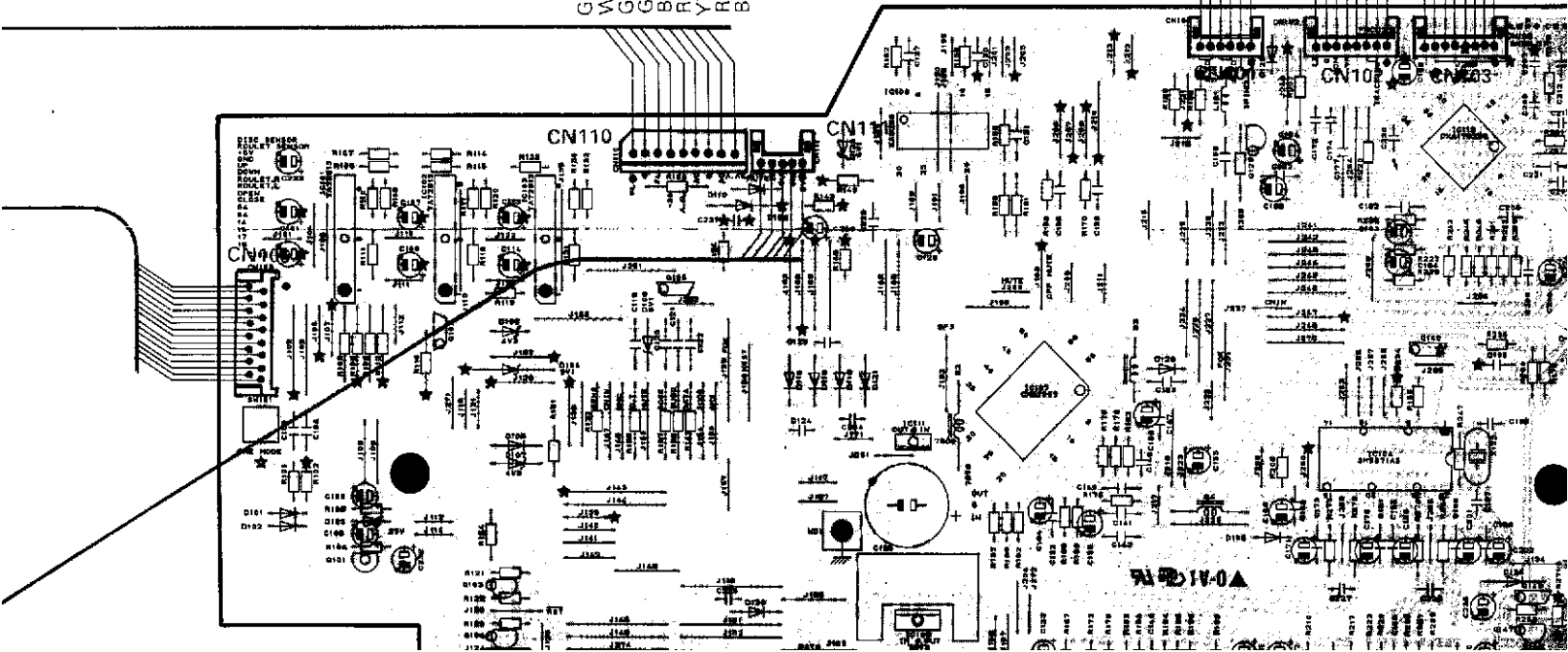
RED

6P

8P

GREEN  
WHITE  
GREEN  
GRAY  
BLUE  
RED  
YELLOW  
RED  
BLUE

PCB1



K

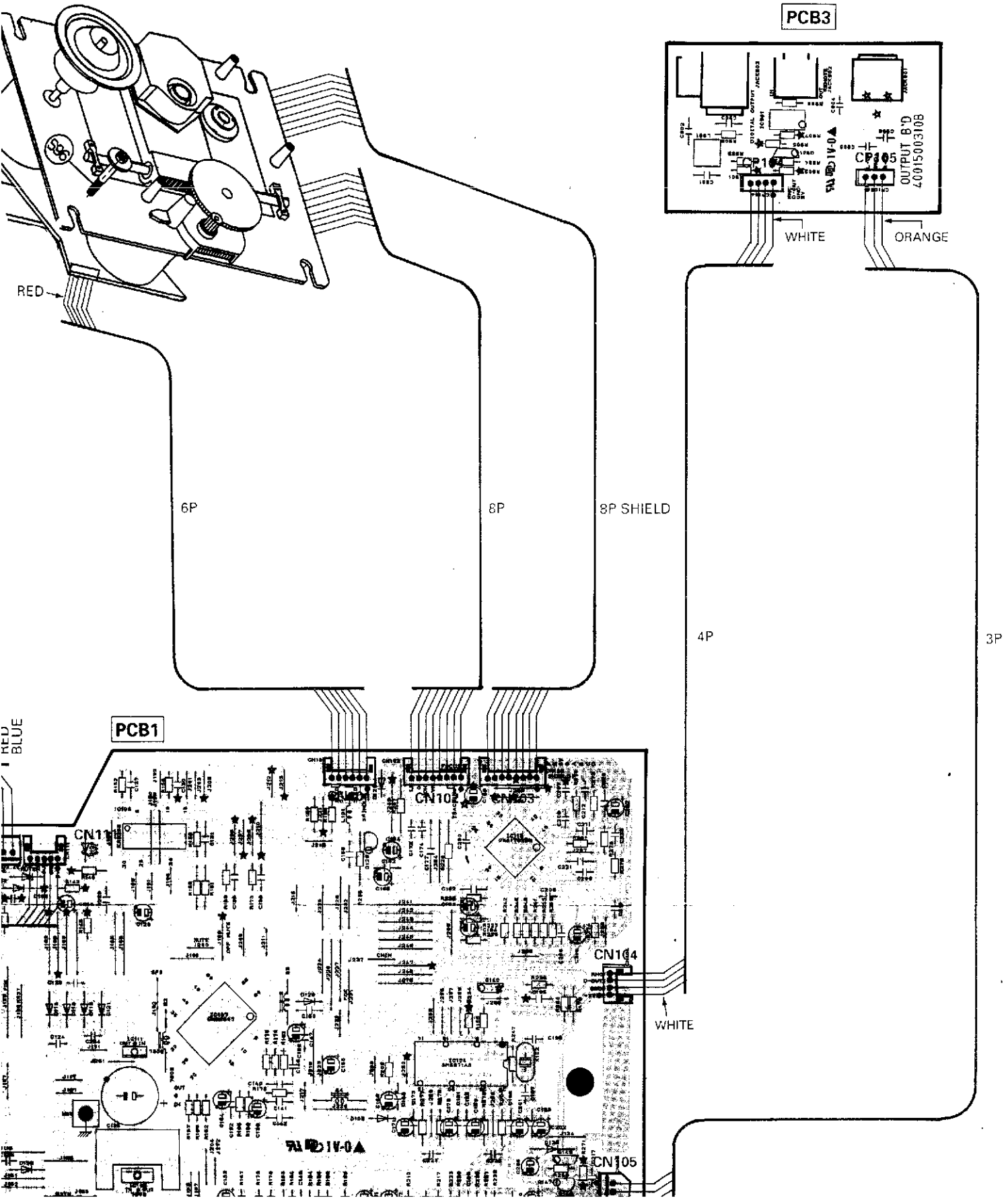
L

M

N

EXPLODED VIEW II (Page 31)

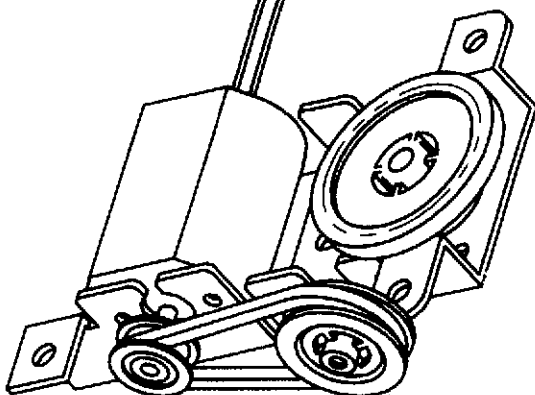
ITEM No: 61



4

EXPLODED VIEW II (Page 31)  
ITEM No : 63

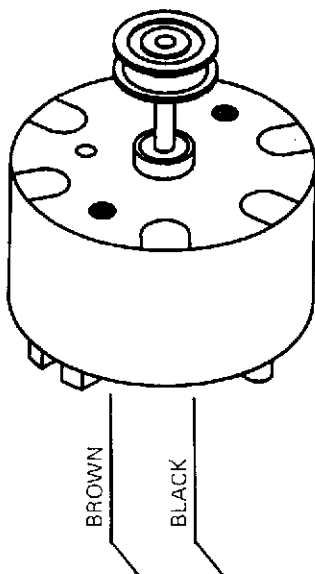
BROWN BLACK



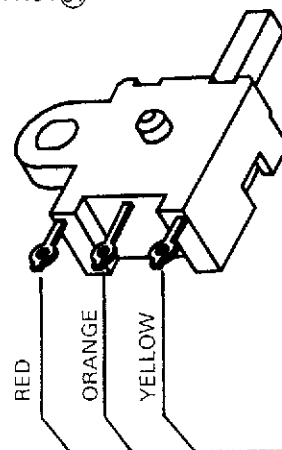
5

6

EXPLODED VIEW II (Page 31)  
ITEM No : 62

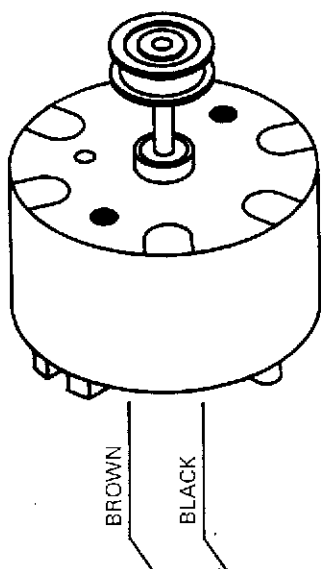


EXPLODED VIEW II (Page 31)  
ITEM No : 64

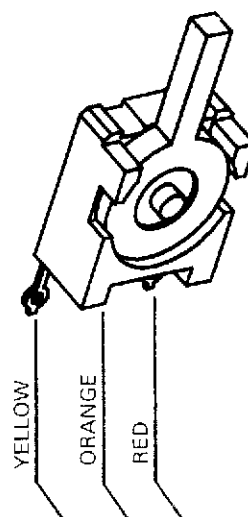


7

EXPLODED VIEW II (Page 31)  
ITEM No : 62



EXPLODED VIEW II (Page 31)  
ITEM No : 64



8

9

CN603

FPC CABLE 6P, 300mm

FPC CABLE 16P, 120mm

CN603

CN601

BLACK  
BROWN  
RED  
ORANGE  
YELLOW

CN103

YELLOW  
ORANGE  
RED  
BROWN  
BLACK

CN602

PCB9

PCB7

CP111

POWER SW B'D  
4005612530B

CN701

B'D TO B'D

PCB8

CP701

LED B'D  
4005512540B

1V-0A

DB01

PC

CP108

WHITE

