8000 SERIES TWO
LINEAR MOTOR ARM STEREO TURNTABLE

SERVICE MANUAL

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THIS MANUAL IS INTENDED FOR USE ONLY BY QUALIFIED TECHNICAL SERVICE PERSONNEL. HAZARDOUS VOLTAGES MAY BE ENCOUNTERED IN THE TEST AND SERVICING OF THE 8000II. USE EXTREME CAUTION; READ ALL INSTRUCTIONS.
1-0.- SPECIFICATIONS

MOTOR AND TURNTABLE:
Drive System: direct drive
Motor: Quartz PLL Hall motor
Turntable Platter: 310mm diam.
  aluminum alloy die-cast
Inertial Mass: 330kg-cm² (including platter mat mass)
Speeds: 33 1/3 and 45 RPM
Wow and Flutter:
  less than 0.013% (WRMS)
  0.025% (WRMS)
  0.035% (DIN)
(*) indicates wow and flutter for motor and does not include the cartridge or tone-arm load.
Signal-to-Noise Ratio:
  more than 78dB (DIN-B)

ROTATIONAL CHARACTERISTICS:
Build-up Time: within 90° rotation at 33 1/3 RPM
Speed Deviation:
  less than 0.002%
Speed vs. Load Characteristics:
  stable up to 220 grams
  drag load
Speed Drift: less than
  0.00008% per hour at
  33 1/3 RPM;
  less than
  0.00003% per degree of
  temperature change at 33 1/3

TONEARM:
Type: linear motor direct-drive; static-balance type; linear-tracking arm
Effective Arm Length: 190mm
Overhang: 0mm
Usable Cartridge Weight:
  4g (min.) to 24g (max.)
Arm Height Adjust Range: ±3mm
Headshell Weight: 10.5g

SEMICONDUCTORS:
IC's: 22
Transistors: 17
Diodes: 16
Hall Elements: 3
LED's: 14
Photo Transistors: 5
CdS: 1

MISCELLANEOUS:
Power Requirements:
  110-120vAC/50-60Hz only
Power Consumption: 35 watts
Weight: 26lb 8oz (12kg)
Dimensions:
  19 7/16(w) x 6 1/16(h) x
  17 15/16(d)in.
  494(w) x 154(h) x 456(d)mm

SUBFUNCTIONS:
Auto Lead-In
Auto-Return
Auto Cut
Quick Repeat
Quick Play
Quick Stop
Stylus Pressure Direct Readout
Counterweight
Arm Height Adjusting Device
Cueing Device
Free Stop Hinges

NOTE: Specifications and design subject to possible modification without notice, due to improvements.
1. POWER SWITCH
Used to switch on and off the power to the turntable. Power is supplied when the switch is depressed (ON). The SPEED switch indicator (33) comes on. The power is switched off when the POWER switch is released.

NOTES: * The platter does not rotate when the tonearm is positioned at the far right even if the switch is depressed and the power is supplied.

* With each push, this switch alternates between the ON and OFF positions.

* Keep the POWER switch at the OFF position when you are not using the turntable.

2. QUARTZ LOCK INDICATOR
This indicator illuminates when the platter is revolving at the
specified rate of 33 1/3 or 45 RPM.

NOTE: If the platter speed varies, such as when the speed switch is changed from one position to another or when you press momentarily on the platter, the indicator will go off. As the platter revolution returns to the specified speed, the indicator will illuminate again.

3. SPEED SWITCH
33......Set the switch to this position when playing a 33 1/3 RPM record such as an LP. When it is depressed, the 33 indicator lights up, and the platter rotates at a speed of 33 1/3 RPM.

45......Set the switch to this position when playing a 45 RPM record like an EP. When it is depressed, the 45 indicator lights up, and the platter rotates at a speed of 45 RPM.

4. DISC SIZE SWITCH
Selects the switch that corresponds to the size of the record you want to hear for auto play operation.
12"30......for 30cm records
10"25......for 25cm records
7"17......for 17cm records

* Used to select the record size when depressed. For instance, when the 30cm indicator lights up, depress the switch for the 25cm position, and depress it again for the 17cm position. Depressing the switch once more sets it to the 30cm position.

* When the power switch is turned ON, the turntable will always be set for records with a diameter of 30cm and the corresponding light will come on.

NOTE: This switch will not work if depressed when the tonearm is moving (auto lead-in, auto-return, auto cut).

5. REPEAT SWITCH
Press this switch for repeat play. When pressed the indicator will light up, and the record will be played again (refer to page 16 for further details on repeat play). Press this switch again to release it. The indicator will go off and the repeat play function will be released.

NOTE: This switch will not work if depressed when the tonearm is moving (auto-return, auto cut).

6. ARM ELEVATION SWITCH
Use this switch to interrupt play temporarily or to perform manual play.
When DOWN position is depressed the tonearm will descend and when the UP position is depressed the tonearm will rise. These two operations will be performed alternately every time the switch is pressed.

NOTES: * When the POWER switch is set to ON, the tonearm
- will start in the UP position.
* This switch will not work if depressed when the
tonearm is moving (auto lead-in, auto-return,
auto cut).
* When the switch is at UP, the auto-return cancel-
ing mechanism is actuated and so there will be
be no auto-return.

7. STOP/START SWITCH
Press this switch for auto play. The platter will start to
rotate, the tonearm will automatically move over to the edge
of the record and play will begin (auto lead-in).
If this switch is pressed during play, the tonearm will auto-
matically return to the arm clamp position, the platter will
stop rotating and play will be suspended (auto cut).

NOTE: This switch will not work if depressed when the tone-
arm is moving (auto lead-in).

8. REMOTE OPERATION KNOB
Used when moving the tonearm by remote control. Rotate coun-
terclockwise to move the tonearm to the left. Rotate clockwise to
move the tonearm to the right.

NOTE: When the arm elevation switch is at DOWN or auto lead-
in, auto cut, and auto-return, the tonearm does not move
even when the remote operation is released and the knob
rotated.

9. TONEARM
The tonearm function is to apply the correct tracking force to
the cartridge, maintain this value precisely, and allow the
stylus to trace the record grooves accurately.
The tonearm can be operated manually with your hand or remotely
with the remote operation knob. It is coupled to the motor
switch and when it moves across to the record the platter rotates
and it stops when the tonearm is returned to the arm clamp po-
sition.

NOTE: When the POWER switch is at OFF, the tonearm cannot be
moved by either manual or remote operation. If it is
forced at the OFF position, this may result in damage
so always remember to set the POWER switch to ON when
moving it.

10. ARM CLAMP
Used to secure the tonearm.
To secure the tonearm, move it to the right and then push down on
the clamp. When you do not intend to use the turntable, secure
the tonearm in this way. The tonearm is released when the clamp
is raised.

11. ARM REST
This secures the tonearm pipe. When playing a record, rotate the
arm rest counterclockwise and release the clamp. When not playing
a record, set the arm elevation switch to UP (▼) and then rotate
the arm rest clockwise and secure the pipe.
NOTE: When the arm elevation switch is at DOWN (▼), the tonearm pipe cannot be secured. Make sure this switch is set to the UP (▼) position.

12. PLATTER/RUBBER PLATTER MAT
When the tonearm is moved and power is supplied to the turntable, the platter will start rotating at the set rotation speed. The rubber platter mat stabilized the records and also absorbs external vibration.

13. DUST COVER
Keep this closed unless operating the controls or tonearm, or changing records. This serves to keep dust off of the records during play. When fully opened and pulled straight up, this dust cover can be removed from the cabinet.
3-6. DISSASSEMBLY

3.1 Panel

1. Remove the four turntable feet.
2. Remove the four insulating mounting screws (8mm deep socket).
3. Remove the top cover (five phillips screws).
4. Shift the tonearm across to the center (far left).
5. Lift the panel up and disconnect the three connectors from the PC board below.

Fig. 3-1
3.2 Direct Drive Motor
1. Remove the three D.D. motor securing screws.
2. Disconnect the D.D. motor PC board connector.

3.3 Tonearm
1. Remove the plate pressing against the tonearm output cable.
2. Remove the coil and rail assembly.
3. Disconnect the ground lead connected to the front rail from PCB.
4. Remove the E-type washers and screw holding the gear and rail of the elevation mechanism. The front rail may then be removed by pulling out towards the right.
5. The other rail may also be removed by pulling out to the right after loosening the securing screw.
6. The tonearm may be removed once both rails have been pulled across to the right by at least 6 inches (15cm).
3.4 CdS Detector and Lamp

1. After removing the tonearm, remove the CdS detector and lamp in the way indicated in Fig. 3-5.

2. Remove the shutter before removing the spacer securing the CdS detector.
Hinge Plate L
942-8066

Tonearm Assembly
930-8023

Top Panel
942-8087

Cueing Knob
942-8055

Pushbutton Unit A
(POWER)
942-8075

Pushbutton Unit E
(SPEED)
942-8076

Pushbutton Unit C
(SIZE)
942-8077

Pushbutton Unit B
(START/STOP)
942-8078

Pushbutton Unit F
(ARM ELEVATION)
942-8080

Pushbutton Unit D
(REPEAT)
942-8079

The △ mark found on some component parts indicates the importance of the safety factor of the part. Therefore, when replacing, be sure to use parts of identical designation.
1. D.D. motor control
2. Tonearm control
3. Arm drive control
4. Full auto logic
5. Arm elevation control
6. EV, REPEAT, SIZE selector input

Photo 5-1
BLOCK DIAGRAM OPERATIONS

5.1 Tonearm Control Stage

a. Lead-in FF and Return FF(FlipFlop)
   1. Lead-in FF....This FF is set by pressing the STOP/START
      switch when the tonearm is on the arm rest, and
      is reset by a descend signal, or when the power
      switch is turned on.
      Return FF....This FF is set by pressing the STOP/START
      switch when the tonearm is not on the arm rest,
      and also by the end detector. It is reset when
      the power is turned on, or by the descend sig-
      nal, or when the tonearm returns to the arm rest.

b. When either of the above two FF's has been set, an "AUTO on"
   signal is generated resulting in the arm elevator being set
   up to the UP position, and inhibition of manual drive.

5.2 End Detector Stage

The end sensor input signal is rectified and then applied to the
detector stage consisting of a differential circuit, integration
channel, and a monostable multivibrator.

When the detector stage detects the arrival of two consecutive
input signals within the fixed time constant period, an output
signal is generated. This output, however, is inhibited by the
EV UP signal when the arm elevator is in the UP position.

5.3 Arm Elevation Control Stage

This stage consists of a J-K-

![Fig. 5-1]

The arm elevator is raised
(UP position) as a result of
the initial resetting, or by
the AUTO operation signal
from the tonearm control
stage. The elevator descends
again (DOWN position) when
the FF is reset by the descend
signal. Furthermore, whenever
the EV switch is pressed, Q and
Q are generated alternately, resulting in the arm elevator being
raised and lowered correspondingly.

The FF output is applied to a logical "and" circuit with the
outputs from the elevator UP and DOWN switches, the resultant
output being applied to the EV motor drive stage.

5.4 Size Selector Stage

This stage consists of a J-K FF 2-stage ring counter and the
Q1/Q2 logical "and"gate. As a result of the initial resetting,
Q1=Q2=L for automatic switching of the size selector to the 30cm
position. Every time the size selector switch is pressed after
that, the selector is switched from the 30 to 25 and 17 positions
in turn, and then back to 30 again. Note, however, that switching is inhibited when AUTO operation signals are received from the tonearm control stage (i.e. during lead-in, return, and repeat operations).

5.5 Repeat Control Stage

Consisting of a T-type FF, \( Q \) and \( \bar{Q} \) are inverted by REPEAT switch operation. Note that the FF is also turned off by the initial reset, and that there is no inversion while the tonearm control stage return FF remains set (i.e. during return and repeat operations). Furthermore, the FF is also turned off as a result of auto-cut operation during repeat mode.

5.6 Lowering Position Detector, Plunger Control Stage, and Descend Signal Generator

When the tonearm shutter passes between the sensors corresponding to the designated record size (sensors being mounted in positions corresponding to each record size), a lowering position detector output signal is generated. This signal is then applied to the plunger control stage (a monostable multivibrator), resulting in a fixed time constant pulse signal being generated to activate the plunger (during lead-in and repeat modes). The down stroke of the pulse signal is differentiated and a descend position signal is generated. Each of the tonearm control stage FF's is also cleared.

5.7 Display Stage and Plunger Driver

This stage is responsible for the LED display of elevator position, repeat mode, and selected record size, in addition to plunger drive.

5.8 Manual Drive Stage

By amplifying the input to the power generator motor mounted in the locate stage, the tracking sensor stage balance is upset, permitting the tonearm to be moved back and forth. Such operation is inhibited, however, when the elevator is DOWN during auto operation modes (lead-in, return, and repeat).

5.9 Tracking Sensor Stage and Tonearm Driver Stage

The tracking sensor stage (consisting of lamp, CdS element, and shutter) generates + and - voltage differences in response to tonearm movement. These output signals are then applied to the driver stage where they are amplified, and to pass a current through the drive coil to drive the tonearm in such a way as to eliminate tracking error (i.e. to avoid generation of tracking sensor outputs).

5.10 Direct Drive Motor Control Stage and Direct Drive Motor Stop Control

The phono motor stop control stage stops the motor when the rest sensor detects the presence of the tonearm back on the arm

16
rest. As long as the tonearm remains off the arm rest, the motor will continue to rotate. The phono motor control stage employs three specially designed IC's: PA2005, PA2004, and PD1003. These control stages also include the speed selector, speed indicator, and quartz lock indicator circuits.
CIRCUIT DESCRIPTIONS

6.1.1 Tonearm Control Stage

1. When the power switch is turned on, the lead-in FF and return FF are reset by the initial reset signal (passed from C29/R55 to IC16, to IC17, to IC19 and IC10). the phono motor will remain stationary if the tonearm is on the arm rest, but commence to rotate if it has already been moved away.

2. When the STOP/START switch is then pressed with the tonearm on the arm rest,
   * pin 8 of IC8 is switched to L level.
   * Pin 10 of IC8 is switched to H level, and this appears at pin 3 of IC10, resulting in the lead-in FF being set (and pin 10 of IC10 also being switched to H level).
   * Once pin 10 of IC10 is switched to H level, pin 3 of IC8 is switched to L level, resulting in pin 8 of IC11 being likewise switched to L level thereby inhibiting manual drive (locate operation).
     Pin 13 of IC14 is also switched to L level, resulting in pin 12 of IC12 being switched to H level, and the elevator being consequently raised to the UP position.
   * Pin 4 of IC11 is switched to H level, resulting in the inhibition of any further START/STOP switch inputs after a delay of about 1mS (in order to prevent the return FF from being set when the tonearm leaves the arm rest). At the same time, pin 12 of IC18 is switched to H level to inhibit switching of the size selector.
     Hence, the relevant FF's are set, the arm elevator raised, and record size selector switching inhibited.
   * Pin 11 of IC10 is switched to L, and this is transferred to pin 6 of IC8. Once the elevator is properly in the UP position, the UP detector switch is switched to the ON position, resulting in pin 5 of IC8 being switched to L level, and pin 4 of IC8 switched to H level.
   * This IC8 pin 4 H level signal then turns Q7 on, resulting in a current being passed from VR8 to VR5 and R99 via R93. If the potential at TP8 drops below the potential at TP10, the difference is amplified and a current passed through the coil to subsequently drive the carrier.
     The carrier is thus shifted across towards the record (assume size selector set to 30cm).
   * When the carrier reaches a position about 20mm in front of the 30cm position, the carrier shutter will block the light of the 30cm sensor.
   * Pin 13 of IC9 is thereby switched to L level, and pin 10 of IC9 switched to H level. This serves as a trigger for the monostable multivibrator incorporated in IC13, resulting in the generation of an H level signal of t=2.2 seconds. This is applied to TP3 and pin 9 of IC12, presetting the EV FF for lowering of the tonearm.
   * The TP3 H level signal is used to drive IC7, and in turn attracts the plunger and raise the index plate.
     The carrier continues to move further, coming to a stop when
6. CIRCUIT DESCRIPTIONS

6.1 FULL AUTO LOGIC
NOTES:
* L denotes L level.
* H denotes H level.
* EV denotes arm elevator, UP denotes that arm elevator is in UP position, while DN denotes that elevator is in the DOWN position.

The Full Auto Logic section is made up of the following five main stages:
1. Tonearm control stage
2. End detector stage
3. Elevation control stage
4. Record size selector stage
5. Repeat control stage
the swing pin strikes the index plate.
* TP3 is switched back to L level 2.2 seconds later, the signal being differentiated by C34 and R44 to provide the tonearm descend signal which is passed via IC17, IC9, and IC10 to clear the FF's and stop the carrier drive current. The elevator UP, locate inhibition, and size selector switching inhibition are also cancelled at the same time.
* As a further result of TP3 being switched to L level, the charge held by C35 is discharged via R43 and the IC7 base resistance. During this discharge period (0.3 to 0.5 sec.) the plunger is maintained in the attracted position, but is forced back (by a spring) once the discharge has been completed. The elevator is thereby returned to DOWN position for start of play.

3. START/STOP switch pressed when tonearm is not on the arm rest.
* Pin 8 of IC8 is switched to L level.
* The IC8 pin 10 change to H level results in pin 4 of IC10 being changed to L level for the return FF to be set.
* This then results in the elevator being raised, and inhibition of size selector switching, S/S switch input after a delay of 1mS, and locate.
* The L level signal on pin 9 of IC9 is transferred to pins 5 and 6 of IC12, thereby inhibiting inversion of the repeat FF. Furthermore, the IC10 pin 4 L level change is transferred to pin 4 of IC12 via pin 8 of IC14 to clear the repeat FF. The purpose of the 1mS delay circuit referred to above is to permit sufficient time for the generation of the time pulse employed in clearing this FF.
* In a similar fashion to the lead-in operation, the L level signal appearing at pin 9 of IC9 once the elevator has been completely raised, is converted into an H signal at pin 11 of IC8, resulting in Q8 being turned on. In this case, however, the TP10 potential drops below the TP8 potential, resulting in the carrier being returned towards the arm rest.
* When the shutter cuts across the sensor light beam during the return motion, pin 10 of IC9 is switched to H level, but since the repeat mode has been switched off, pin 1 of IC13 will be at H level, thereby preventing operation of the monostable multivibrator.
* Once the carrier reaches the arm rest position, the rest sensor transfers an L level signal to pin 3 of IC16, resulting in pin 11 of IC11 being switched to L level to stop the phono motor.
* When pin 11 of IC11 is switched to L level, the charge stored on C43 is discharged via R71, the return FF being cleared after the potential on pin 1 of IC9 is reduced to \( \frac{1}{4} V_{cc} \) (delay circuit). During this period, the carrier remains pressed against the arm rest.

4. End Detector Operation
* When the repeat mode is off, pin 3 of IC9 is switched to L level by the end detector, and the return FF is consequently set. Subsequent steps are the same as during normal return mode.
* When the repeat mode is on, the return FF is again set in the same way for normal return operation. However, when the shutter cuts across the size sensor, the plunger is activated (TP3 switched to H level), followed by the generation of the descend signal in the same way as during lead-in. The elevator is thus lowered for recommencement of play.

6.1.2 End Detector Stage

1. Detector Principle

* Shutter structure:

The detector circuit (outlined in the block diagram) has been designed to detect the presence of two rising edges of the Schmitt circuit output within 1.06, ±0.1 seconds.

2. Circuit Description

The end sensor is mounted at a position R49mm from the spindle. When the left edge of the shutter slits reaches that position, the stylus tip will be at the R62.5mm position. That is, there is 20mm between the 62.5mm position and the point of entry into the detection range. Once the detection range is entered, the sensor commences to generate output signals with a waveform like that shown in Fig.6-1-2 above. This output is applied to the Schmitt trigger circuit composed of two inverters in ICl6 where it is rectified into the square wave as shown in Fig.6-1-3. This output is then differentiated by C39/R61 and applied to pin 5 of ICl4, while another portion of the same output is integrated by R62/C40 and applied to the monostable multivibrator composed of two NOR gates in ICl8, resulting in the generation of a 1.06, ±1 second H level signal (TP5). Although this signal is applied to pin 6 of ICl4, there is no detection by pin 5 because of the delay by the integration circuit. If, however, the next differential pulse is applied to pin 5 of ICl4 while the H signal is being generated at TP5, that pulse will be detected. Apart from this case, there is no detection because the differential pulse involves a slight delay before switching TP5 to H level.

Furthermore, when the elevator FF $\bar{Q}$ is connected to pin 6 of ICl8 to make $\bar{Q} = H$ (i.e. UP position), the monostable multivibrator is inhibited, thereby inhibiting the detector circuit. $\bar{Q} = H$ also when the power switch is turned on, again inhibiting the multivibrator.

6.1.3 Elevation Control Stage

* When the power switch is turned on, an initial reset signal is passed to pin 12 of ICl4 from R55/C29, resulting in pin 11 of ICl4 and pin 14 of ICl2 being switched to H level ($\bar{Q} = H$). This corresponds to the elevator being in the UP position, or in other words, UP priority is given when the power if first turned on.
* Since $\bar{Q} = H$, one of the IC7 transistors will be turned on to light up the UP indicator LED.
* Until the elevator reaches the UP position the UP detector switch remains in the normally closed (NC) position, resulting in pins 13 and 12 of IC17 being both switched to L level, and Q13 and Q16 of the elevator drive stage being both turned on to start up the motor.
* Once the elevator is properly in the UP position, the UP detector switch is switched to the normally open (NO) position resulting in pin 13 of IC17 being switched to H level, and pin 11 of IC17 being switched to L level. Q13 and Q16 are both turned off and the motor stopped.
* If the elevator switch is then pressed, a falling edge of differential pulse is generated on pins 1 and 2 of IC14, and a rising edge clock pulse on pin 13 of IC12. This results in $Q = H$ and $\bar{Q} = L$ for lowering of the elevator (DN).
* And since $Q = H$, the DN indicator LED will be lit up, and the UP indicator turned off.
* The DN detector switch remains in the NC position until the elevator is right down. During this period, pins 9 and 8 of IC17 will be both at L level, while pin 10 of IC17 will be at H level. The elevator drive stage Q14 and Q15 will thus be on and the motor rotating.
* If the elevator switch is pressed during this condition, $Q$ will switch to L and $Q$ to H (UP) to reverse the motor.

The above description relates to the operation of the elevator circuit itself. In addition,
* automatic mode UP (as described under the tonearm control stage), and
* DN at the lowering position, may be controlled via the elevator FF preset and clear terminals.

6.1.4 Record Size Selector Stage
* When the power is turned on, the initial reset signal from R55/C29 is passed to IC16 to switch pin 11 to H level, resulting in IC15 being cleared.
* Pin 1 (Q1) and pin 15 (Q2) of IC15 are both switched to L level, this then being transferred to pins 8 and 9 of IC18. Pin 10 of IC18 is thus switched to H level and the 30cm indicator LED is lit up.
* If the size selector is then pressed, the falling edge differential pulse applied to pin 13 of IC18 when pin 12 of this IC was at L level (i.e. when none of the lead-in, return, or repeat modes were operative), is instead applied to pin 11 of IC18 as a rising edge clock pulse, thereby activating the ring counter in IC15. As a result, Q1 = H and Q2 = L. The 30cm indicator LED is turned off, and the 25cm indicator LED turned on.
* If the size selector is pressed again, the 17dm indicator LED is turned on. Every time the selector is pressed, the size is switched in a cyclic order 30 to 25 to 17 to 30...

6.1.5 Repeat Control Stage
* When the power is turned on, the initial reset signal from R55/C29 is applied to pin 8 of IC14, resulting in pin 10 of this IC being switched to H level, and pin 1 (Q) of IC12
being switched to L level.
* The repeat indicator LED will thus be turned off (since Q=L).
* If the repeat switch is then pressed, a falling edge differential pulse will be applied to pins 5 and 6 of IC17, and a rising edge clock pulse generated at pin 4. As long as the repeat or return modes are not operative at this time, pin 5 (K) and 6 (J) of IC12 will both be at H level, resulting in Q = H, and \( \overline{Q} = L \) for the repeat indicator LED to be turned on. At the same time, pin 13 of IC13 is switched to L level, thereby enabling the monostable multivibrator consisting of two gate circuits in IC13 to operate during repeat.
* If the repeat switch is then pressed again, the \( J = K = H \) status will be inverted.

In addition to the above repeat control stage,
* The START/STOP switch may be pressed to activate return mode. In this case, a falling edge pulse is generated on pin 8 of IC14. Pin 10 of IC14 is thus switched to H level, and the IC12 FF cleared (repeat off), resulting in \( Q = L \) and \( \overline{Q} = H \).
* When the return FF is set (during return or repeat mode), pin 9 of IC9 is switched to L level, this being transferred to the J and K terminals of the repeat FF, thereby inhibiting any inversion.
6.2 TONEARM DRIVE

The tonearm drive stage contains the following three major component circuits:

1. Tracking sensor circuit
2. Tonearm drive circuit
3. Manual operation circuit (locate operation circuit)

6.2.1 Tracking Sensor Circuit

An outline of the tracking sensor circuit is shown on page 27. When the stylus is positioned exactly at right angles to the carrier, the lamp beam is directed practically equally onto both CdS elements, which means that the resistance in both elements will also be more or less equal. These two elements form part of a Wheatstone bridge with R93, R94, and VR8, this latter variable control being adjusted so that no potential difference is generated across TP8 and TP10 when the stylus is located at right angles to the carrier. If the stylus should happen to move to either left or right, the amount of light striking the CdS elements will change, resulting in the resistance of one element being increased, and the resistance in the other element being decreased. A potential difference will thus be generated across TP8 and TP10. The relation between stylus movement and the potential difference generated is shown in Fig. 6-4. VR7 is used for adjustment purposes.

* When the stylus is positioned at right angles to the carrier, the bridge is balanced, and the carrier remains stationary.
* If the stylus should tend towards the left of the carrier, a (+) potential will be generated across TP8 and TP10. This signal is amplified in the tonearm drive circuit (see section 6.2.2), resulting in a coil current to move the carrier to the left (during record trace, or when moved to the left by hand).
* If the stylus should happen to tend towards the right, a (-) potential will be generated across TP8 and TP10. After amplification in the tonearm drive circuit, the resultant coil current serves to move the carrier to the right (during record trace, or when moved to the right by hand).
* During lead-in Q7 is turned on, and a current is passed from R93 to R99 via VR5. A (+) potential difference is generated between TP8 and TP10 by the voltage drop across R93, resulting in the carrier being moved to the left. Speed is controlled by adjusting the current passing through VR5.
* During return and repeat modes, Q8 is turned on, resulting in a current being passed from R94 to R98 via VR6. Consequently, a (-) potential difference is generated between TP8 and TP10 by the voltage drop across R94, thereby moving the carrier to the right. In this case, speed is controlled by adjusting the current passing through VR6.

6.2.2 Tonearm Drive Circuit

The tonearm drive circuit consists of a current booster formed by a differential amplifier and Q's 9 through 12. The DC voltage created by the CdS element when the stylus tends toward the left or right is amplified by differential op amp IC21 and current boosters Q9, Q10, Q11, and Q12. This voltage is then passed on
to the linear motor drive coil. The drive voltage is temperature compensated by thermistors TH1 and TH2.

6.2.3 Manual Operation Circuit (locate Operation Circuit)
* When elevator is not completely in the UP position (UP detector switch in the NC position),
* During automatic modes (lead-in, return, repeat).

Under the above conditions, pin 10 of IC11 in the full auto logic stage is switched to H level, thereby turning Q4 and Q5 on. The collector voltage of these two transistors will thus be almost zero. Current will also flow through the D10 - R82 - Q4 and D9 - R81 - Q5 routes, resulting in the base of Q6 being biased in the reverse direction due to the voltage drop of $V_f$ of D9 and D10 in respect to the emitter. Q6 is thus turned off to inhibit locate operation.
* When locate dial is rotated,
* When the motor generates power,
* When the motor RPM is low (slow rotation of the dial), the amplifier gain is determined by $\frac{R76 + R77}{R78} + 1$.

but once the motor RPM is increased by a certain rate, the gain will be clamped by the voltage determined by D7 and D8, or D5 and D6.
* When the differential amplifier is activated, one side of Q6 is turned on according to the rotational direction of the dial, resulting in a voltage drop across R93 or R94, and the generation of a potential difference between TP8 and TP10. This is subsequently amplified, and results in a current being passed through the coil to move the carrier.
7. ADJUSTMENTS

Adjustment position
Fig. 6-5
7-0. ADJUSTMENTS
Preparation:
1. Disconnect the panel according to the disassembly method outlined in section 3-0.
2. Use extension leads to connect the panel to the printed circuit board located in the base section.
3. Remount the turntable platter (but without tightening the securing screws).

7.1 Direct Drive Motor Operating Point Adjustment
1. Connect the TP1 and TP2 terminals to the CH1 and CH2 inputs of a dual-trace oscilloscope.
2. Start the turntable platter turning by shifting the tonearm over towards the center of the record from the arm rest position.
3. Observe the waveforms in the oscilloscope, and adjust the corresponding controls so that the rising edge of the TP2 output waveform lies within the TP1 output waveform.
4. VR1 is the control to adjust for 45 RPM speed, while VR2 is the control for 33 1/3 RPM adjustment.

![Fig. 7-2](image)

7.2 Auto Lead-In Timing Adjustment
1. Set the record size selector to the 30cm position.
2. Press the START/STOP key to start the tonearm lead-in movement.
3. When the tonearm is about 20mm away from the outer edge of the record, an output pulse signal will appear at TP3 (see fig. 7-3). Adjust VR3 to obtain a time constant of 2.2 - 2.5 seconds for this pulse signal.

![Fig. 7-3](image)

7.3 End Sensor Sensitivity Adjustment
1. Connect the oscilloscope to the TP4 terminal.
2. Set the arm elevator to the UP position, and shift the tonearm across to near the lead-out groove.
3. Hold the tonearm carrier by hand, and move the tonearm back and forth at a rate of 5 to 10 cm/second.
4. During this operation, adjust VR9 so that the TP4 output saturates at H and L levels at about 50% duty.

Fig. 7-4

7.4 End Timer Adjustment
1. Connect the oscilloscope to the TP5 terminal.
2. Secure the tonearm to the arm rest, and remove the turntable platter.
3. Insert a piece of paper (or any other light shield) into the and sensor stage.
4. As soon as the piece of paper (or light shield) is removed, an output signal appears at TP5. Adjust the time constant of this output to 1.06 ±0.1 second by means of VR4.

Fig. 7-5

7.5 Tracking Sensor Zero Point Adjustment
1. Set the arm elevator to the UP position, and adjust VR8 to obtain a voltage of less than ±0.1 volt between TP9 (-) and TP12 (+).
2. Set the arm elevator to the UP and DOWN positions repeatedly, and also perform each of the automatic mode operations. Finally set the arm elevator back to the UP position, and check that the voltage across the TP9 and TP12 terminals remains below ±0.35 V.
7.6 Tracking Sensor Gain Adjustment

1. Disconnect the drive coil connector, and insert a piece of paper (or any other light shield) into the rest sensor stage and stop the direct drive motor rotation.

2. Shift the tonearm across to any desired position above the turntable platter, and then fix the rail and roller to secure the carrier.

3. With the arm elevator in the DOWN position, shift the tonearm across to a position 4mm to the left of the tonearm center position.

4. Then adjust VR7 so as to obtain a voltage of 1.2 to 1.25V across the TP8 and TP10 terminals.

5. Next shift the tonearm to a position 4mm to the right of the tonearm center, and check that the voltage across TP8 and TP10 varies by no more than ±0.15V from the value measured in step 4 above.

NOTES: * Because of the "ghost" tendency caused by light from the tracking sensor lamp (as shown in fig. 7-8), this adjustment must be performed with care.

* Perform the above tracking sensor adjustment procedures (7.5 and 7.6) at least twice.

7.7 Lead-In and Return Speed Adjustment

1. Set the record size selector to the 17cm position.

2. Press the START/STOP key to commence the tonearm lead-in operation.

3. Adjust VR5 so that the time required to reach the 17cm position is 5.5 to 6.5 seconds.

4. Then adjust VR6 so that the time required for the tonearm to return to rest from the 17cm position is also 5.5 to 6.5 seconds.
8. TIMING CHART

(1) LEAD IN PLAY

(A) Rest signal

(B) 30 Size ind.

(C) S/S SW

(D) Lead in F.F.O (IC10-10)

(E) EV SW1 (up detector)

(F) EV SW2 (DN detector)

(G) 30mm sensor (IC9-12)

(H) Solenoid timing signal (IC13-3)

(I) Lead in signal (IC8-4)

(J) Arm operation

(2) REJECT

(A) Rest signal

(B) 30 size ind.

(C) S/S SW

(D) Return F.F.O (IC9-6)

(E) EV SW1 (up detector)

(F) EV SW2 (DN detector)

(G) Return signal (IC8-11)

(H) Arm operation

(3) REPEAT

(A) Rest signal

(B) 30 size ind.

(C) 30mm sensor (IC9-12)

(D) End sensor

(E) End detector signal (IC14-4)

(F) Return F.F.O (IC9-6)

(G) EV SW1 (up detector)

(H) EV SW2 (DN detector)

(I) Repeat ind.

(J) Solenoid timing signal (IC13-3)

(K) Arm operation

UP  Play
DN  Arm down

Arm up  Reject
NOTES:

- UP — Arm elevation UP
- DN — Arm elevation DOWN
- S/S — START-STOP Switch
- F.F. — Flip Flop
- EV — Elevation (Tonearm)
9. TROUBLE SHOOTING

9.1 CIRCUIT BLOCK

9.1.1

No elevator operation

Auto mode in operation? YES

NO

Is pin (15) of IC12 inverted every time the elevator switch is pressed? NO

YES

Is there a voltage applied across the elevation motor terminals? NO

YES

Is there any fault in the elevator mechanism? (Dislodged belt, or poor gear inter-meshing)? NO

YES

Defective elevator motor drive stage

Defective elevator mechanism

Defective elevator motor

9.1.2

No repeat switch on/off switching

Return or repeat mode in operation? YES

NO

Recheck after completion of present operation.

Defective repeat FF (IC12)

Defective LED

Defective IC7
9.1.3

No record size selector switching

Auto mode in operation?

NO

Is pin (10) of IC18 and pins (1) and (15) of IC15 switched to H level every 3rd time that the record size selector switch is pressed?

NO

Defective size selector FF stage (IC15).

YES

Do the corresponding LED lamps light up when pins (11), (12) and (13) of IC7 are connected (separately)?

NO

Defective LED

YES

Defective IC7

9.1.4

No 33/45 switching

Is pin (13) of IC5 inverted every time the 33/45 switch is pressed?

NO

Defective IC5

YES

Does IC6 function correctly as an inverter?

NO

Defective IC6

YES

Defective LED / Defective PA2004 / Defective PD1003
Lead-in failure

START/STOP switch pressed immediately after completion of return operation?

- NO
  - Has the UP detector switch (elevator mechanism) been properly depressed?
    - NO
      - Defective elevator mechanism or defective elevator control stage
    - YES
      - Does the voltage drop across TP9 and TP12 read a little above 10V?
        - NO
          - Defective drive coil, defective drive transistor, or incorrect magnetic polarity.
        - YES
          - Is there a voltage difference of about 0.7 to 1.4V between TP8 and TP10?
            - NO
              - Defective IC21
            - YES
              - Does a voltage difference exist between TP8 and TP10 when the tonearm is moved by hand?
                - NO
                  - Defective tracking sensor stage
                - YES
                  - Has pin (10) of IC10 been switched to H level?
                    - NO
                      - Defective IC8, Q7
                    - YES
                      - Has pin (6) of IC9 been switched to H level?
                        - NO
                          - Defective rest sensor
                        - YES
                          - Defective lead-in FF stage (IC10), defective START/STOP switch.
9.1.6

Return failure

Has the elevator mechanism UP detector switch been properly depressed?

NO

Defective elevator mechanism Defective elevator control stage

YES

Does the voltage difference between TP9 and TP12 register a little above 10V?

YES

Defective drive coil / Defective drive transistor / Incorrect magnet polarity

NO

Is the voltage difference between TP8 and TP12 about 0.7 to 1.4?

YES

Defective IC21

NO

Is there a voltage difference between TP8 and TP10 when the tonearm is moved by hand?

YES

Defective tracking sensor stage?

NO

Has pin (6) of IC9 been switched to H level?

YES

Defective IC8, Q8

NO

Has pin (10) of IC10 been switched to H level?

YES

Defective rest sensor

NO

Defective return FF stage (IC9) or START/STOP switch

9.1.7

End detector failure

Does the end sensor operate normally (is there sufficient output width when passing the slit section)?

NO

Out of adjustment, or defective sensor

YES

Does the unstable multivibrator operate normally (including the time constant)?

NO

Defective IC18 or surrounding components

YES

Defective IC14
9.1.8

Repeat failure

Is the repeat FF (IC12) inverted every time the repeat switch is pressed?

YES

Are pins (11), (12) and (13) of IC9 switched from H to L level (separately) when the tonearm passes the corresponding record size position when the repeat switch is on?

Designated size
30cm → pin (12)
25cm → pin (13)
17cm → pin (11)

NO Defective sensor circuit board

NO Defective IC12

YES Defective sensor circuit board

NO Defective IC13

YES Defective IC7 or defective plunger

9.1.9

Tonearm fails to stop at designated lowering position

Are pins (11), (12) and (13) of IC9 switched from H to L level when the tonearm passes the designated lowering positions?

YES

Is TP3 switched to H level during the above H to L level switching?

NO Defective IC13

YES Defective IC7 or defective plunger
9.1.10

**Tonearm fails to move**

- **Does a voltage difference (of at least 1V) appear between TP8 and TP10 when the tonearm is moved back and forth?**
  - **NO**
    - Defective tracking sensor stage (defective lamp or CdS element, or disconnected lead wire).
  - **YES**
    - Is there a voltage difference between TP9 and TP12 (around 10 to 15V)?
      - **NO**
        - Defective IC21
      - **YES**
        - Defective drive coil / Defective drive transistor / Incorrect magnetic polarity

9.1.11

**Abnormal tonearm movement**

- **Has the zero adjustment been properly performed?**
  - **NO**
  - Defective CdS element, disconnected lead wire, dislodged tracking sensor.
  - **YES**
    - **Can proper zero adjustment be obtained?**
      - **NO**
        - Defective CdS element, disconnected lead wire, dislodged tracking sensor.
      - **YES**
        - Proceed with zero adjustment

**Correct carrier inclination to horizontal position**
9.1.12

Phono motor fails to rotate

Is the rest sensor working?  NO → Defective rest sensor

YES

Do pins (1) and (16) of IC6 respond correctly to the rest sensor output? NO → Defective IC6 / Defective IC16 or IC17

YES

Is there a 10V output on pin (15) of PA2005? NO → Defective PA2005, or defective component connected to pin (15).

YES

Is there a voltage difference of 0.5 to 1V between pins (16) and (18) of PA2005? NO → Defective PA2004

YES

Is there a voltage of about 1.5V on pin (19) of PA2005? NO → Defective PA2005

YES

Are each of the Hall element output terminal voltages about 4V? NO → Defective Hall element, defective Hall element resistors R101 ~ R103, or defective PA2005

YES

Turn the power off, and check the resistance across pins (1) and (2), (1) and (3), and (2) and (3) of PA2005. Do they read about 45? NO → Defective armature core unit

YES → Defective PA2005
9.1.13

Quartz lock failure

Is there a 10V output at pin (15) of PA2005?

NO → Defective PA2005, or defective surrounding component

YES →

Is there a 27.78Hz signal (at 33rpm) of 10V amplitude and 0.66ms pulse width at pin (15) of PD1003?

NO → Defective crystal oscillator (PD1003)

YES → Operating point out of adjustment

9.1.14

Defective “quick stop” operation

Is there a 10V output on pin (15) of PA2005?

NO → Defective PA2005, or defective surrounding component

YES →

Does the stipulated voltage register on pin (10) of PA2004?

NO → Defective PA2004

YES →

Is there a differential pulse on pin (13) of PA2005?

NO → Defective C33 component

YES →

Does a delta wave signal appear at pin (14) of PA2005 when the turntable is rotated by hand?

NO → Defective PA2005, R12, or C17

YES → Defective PA2005
Motor runaway

Is there a 10V output on pin (15) of PA2005?  

NO  Defective PA2005 or surrounding component

YES

Is there a 55.5Hz square wave signal on pin (5) of PA2004 when the motor speed is held to 33-1/3rpm by hand?  

NO  Is there an input from the FG circuit board?  

NO  Defective wiring, or defective speed detector circuit board

YES  Defective PA2004

Is there a 55.5Hz square wave signal on pin (10) of PA2004 when the motor is held to the same speed (33-1/3rpm) in the same way again?  

NO  Defective PA2004

YES

While measuring the voltage between pins (12) (−) and (14) (+) of PA2004 with the motor stopped by hand, let the motor speed (rpm) increase gradually. Does the voltage vary gradually from −0.5 to +2V?  

NO  Is there a 27.78Hz signal (at 33-1/3rpm) on pin (15) of PD1003?  

NO  Defective PD1003

YES  Defective PA2004 or related component

NO  Defective Hall element or Hall element resistance

YES  Defective PA2005

Hall element output waveforms

A. Normal waveform  
300mVp-p (max.)  
Approx. DC 4V

B. Low output waveform (AC output)  
Below 300mVp-p

C. Examples of distorted waveform (but normal output level)

Ex. 1  
Ex. 2
9.2 MECHANISM BLOCK

9.2.1

Significant difference in left and right direction speeds when operating the locate dial

\[ \text{Is the platter perfectly horizontal?} \]

- **NO** Readjust the platter mounting

- **YES** Is there any "play" in the tonearm ass'y or elevator shaft?

  - **YES** Defective tonearm ass'y, elevator shaft or bearing
  
  - **NO** Is the tonearm movement too "free"?

    - **YES** Circuit adjustment error

    - **NO** Does the speed remain constant during lead-in and return?

      - **YES** Defective damper bearing

      - **NO** Do the lead wires below the carrier base (A) ass'y scrape against the guide bar?

        - **YES** Rearrange wires to prevent any interference

        - **NO** Does the carrier float?

          - **YES** Proceed to section 9.2.2.

          - **NO** Circuit not properly adjusted

9.2.2

Does the carrier float?

- **YES** Defective damper bearing

- **NO** The damper bearing has big play in it (backward and forward).

  - **YES** Defective damper bearing

  - **NO** Defective magnet mounting
9.2.3

Irregular movement in carrier base

- Is the platter perfectly horizontal? NO → Readjust the platter mounting
  YES → Is the guide bar clean? NO → Wipe clean
  YES → Does the carrier move too quickly? YES → Damper bearing silicon has been forgotten
  NO → Is there a gap between the elevator shaft unit and elevator bar when the elevator is lowered? NO → Elevator mechanism not properly adjusted
  YES → Do the lead wires below the carrier base (A) ass'y scrape against the guide bar? YES → Rearrange the wires to prevent any interference
  NO → Does the carrier float? YES → Proceed to section 9.2.2.
  NO → Defective damper bearing or roller

9.2.4

Carrier base fails to move

- Do the damper bearing and roller move smoothly? NO → Defective damper bearing or roller
  YES → Does the tracking shutter operate OK? NO → Defective CdS element or lamp, or disconnected lead wire, or loose soldering
  YES → Has the carrier clamper or tonearm clamper been removed? NO → Remove the clamper
  YES → Do the relevant parts move smoothly when moved by hand? NO → Foreign matter in the carrier base, or jammed lead wire
  YES → Loose magnet mounting YES → Defective magnet mounting
  NO → Defective circuit
9.2.5

Carrier base moves too freely

- Is the platter perfectly horizontal?
  - NO → Readjust the platter mounting
  - YES →
    - Is there any "play" in the tonearm ass'y or elevator shaft?
      - YES → Defective tonearm ass'y, elevator shaft or bearing
      - NO →
        - Is there a gap between the elevator sheet and tonearm rubber tip?
          - YES → Circuit not properly adjusted
          - NO → Readjust the height of the elevator sheet
  - NO →
    - Circuit not properly adjusted

9.2.6

When tonearm shifts across and traces record groove

- Does the tonearm shift when the elevator is raised?
  - YES → Defective tonearm
  - NO → Does gouging occur in the damper bearing and roller?
    - YES → Defective damper bearing and roller
    - NO →
      - Tonearm fails to move normally
        - YES → Tracking shutter not properly adjusted
        - NO →
          - Is the platter perfectly horizontal?
            - YES →
              - Is the guide bar clean?
                - YES →
                  - Carrier base (B) shifts but fails to trace
                    - YES → Defective carrier base (B)
                    - NO → Circuit not properly adjusted.
                - NO → Wipe clean
            - NO → Readjust the platter mounting
9.2.7

Howling noise

Has the AC cord been stretched tight?
  YES → Let the cord lie loose
  NO

  NO → Remove the screws

  YES

  Defective float adjustment

9.2.8

Turntable inclined

Defective float adjustment

9.2.9

Locate dial does feel right

Problem with the actual locate base?
  YES → Defective locate base
  NO

Check sections 9.2.1 & 9.2.3.

9.2.10

Difference in stylus tip height when in rest position and when on the record exceeds 4mm

Defective elevator bar
9.2.11

Abnormal noise from speakers

Are the lead wires arranged correctly?
  NO
  YES

Foreign matter on guide bar?
  NO
  YES

Noise like tumbling roller?
  NO
  YES

Do the PU leads and/or shield tubing strike against the guide bar under carrier (A)?
  NO
  YES

PU cable ground floating noise

9.2.12

Abnormal noise direct from turntable platter

Are there any magnetic materials below the platter or in the linear arm portion?
  YES
  NO

Is the noise generated when tonearm is moving to the lowering position?
  NO
  YES

Noise generated when elevator moved up and down?
  NO
  YES

Defective roller, damper bearing

Set the lead wires in correct arrangement

Clean the guide bar

Defective roller damper bearing or guide bar

Reset lead wires and tubing in correct position

Remove such materials

Stopper unit dislodged from stopper rubber or plunger rubber

Defective driver (E) ass’y
9.2.13

Elevator does not move

Does guide bar A rotate?
  YES
  NO

Does the driver (E) ass'y motor rotate?
  YES
  NO

Does the elevator start to move when the large pulley is rotated?
  YES
  NO

Does the elevator bar strike against the stater base?
  YES
  NO

Defective circuit or disconnected wiring

Flash or foreign matter in the carrier base (A) ass'y elevator bearing. Clean out and/or remove flashes from the bearing.

Clean off any oil on the rubber belt

Reglue forward guide bar bearing

Gear (F) and worm stuck together, or defective driver (E) ass'y

Readjust the elevator bar position

9.2.14

Lowering position not attained

Is the platter perfectly horizontal?
  YES
  NO

Does the guide bar need cleaning?
  YES
  NO

Do the roller and damper bearing operate without gouging?
  YES
  NO

Are the lead wires in the correct position?
  YES
  NO

Does the swing plate move without gouging?
  YES
  NO

Does the arm move too freely?
  YES
  NO

Lowering position not properly adjusted

Readjust the platter mounting

Clean the guide bar

Defective roller, damper bearing

Return the lead wires to the correct position

Defective swing plate

Return to section 1.d.
9.2.15

Tonearm fails to lower on to record after stopping at lowering position, or if it does lower onto the record it continues to trace the same one groove

Is the platter perfectly horizontal?

YES

Does the lowering position sensor function properly?

NO

Defective sensor

YES

Is there an unusual metallic sound?

NO

Stopper unit position needs readjustment

YES

Does stopper unit rub against the plunger spring?

NO

Stopper unit position needs readjustment

YES

Does the plunger tend to gouge?

NO

Defective plunger

YES

Defective index bar or adjustment bearing

NO

Does the index plate move normally when plunger is turned on and off?

YES

Defective index adjustment

NO

Defective circuit

9.2.16

Return failure

Does the elevator operate normally?

NO

Defective driver (E) ass’y

YES

Is there gouging in the damper bearing?

YES

Defective damper bearing

NO

Defective circuit or lead wires
10. EXPLODED VIEWS

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10.3 Tonearm Assembly . . 59
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Parts List of Exterior

NOTES: * The △ mark found on some component parts indicates the importance of the safety factor of the part. Therefore, when replacing, be sure to use parts of identical designation.

* Parts without part numbers CANNOT be supplied.

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<th>Part No.</th>
<th>Description</th>
<th>Key No.</th>
<th>Part No.</th>
<th>Description</th>
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# Parts List of Bottom Plate

**NOTE:** *Parts without part numbers CANNOT be supplied.*

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### Parts List of Tonearm

**NOTE:** *Parts without part number CANNOT be supplied.*

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</tr>
</tbody>
</table>
10.4 EV MECHANISM

NOTE: *Parts without parts numbers CANNOT be supplied.

---

**Parts List**

<table>
<thead>
<tr>
<th>Key No.</th>
<th>Part No.</th>
<th>Description</th>
<th>Key No.</th>
<th>Part No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>922-8048</td>
<td>Circlip:EW3</td>
<td>11.</td>
<td>942-8044</td>
<td>Pulley</td>
</tr>
<tr>
<td>2.</td>
<td>922-8029</td>
<td>Washer</td>
<td>12.</td>
<td>942-8045</td>
<td>Collar</td>
</tr>
<tr>
<td>3.</td>
<td>922-8024</td>
<td>Washer</td>
<td>13.</td>
<td>930-8018</td>
<td>Worm gear</td>
</tr>
<tr>
<td>4.</td>
<td>942-8049</td>
<td>Gear F.</td>
<td>14.</td>
<td>942-8045</td>
<td>Collar</td>
</tr>
<tr>
<td>5.</td>
<td></td>
<td>Plate</td>
<td>15.</td>
<td></td>
<td>Chassis</td>
</tr>
<tr>
<td>6.</td>
<td>942-8043</td>
<td>Cam</td>
<td>16.</td>
<td>922-8017</td>
<td>Screw:PSA2.6 x 5</td>
</tr>
<tr>
<td>7.</td>
<td>922-9068</td>
<td>Screw:PT2 x 10</td>
<td>17.</td>
<td></td>
<td>Frame</td>
</tr>
<tr>
<td>8.</td>
<td>929-8022</td>
<td>Microswitch</td>
<td>18.</td>
<td>942-8071</td>
<td>Motor pulley</td>
</tr>
<tr>
<td>9.</td>
<td>924-8021</td>
<td>Connector harness</td>
<td>19.</td>
<td>942-8038</td>
<td>Tube</td>
</tr>
<tr>
<td>10.</td>
<td>942-8067</td>
<td>Belt</td>
<td>20.</td>
<td>929-8050</td>
<td>Motor</td>
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11. PACKING

![Diagram of packing materials]

**Parts List:**

<table>
<thead>
<tr>
<th>Key No.</th>
<th>Part No.</th>
<th>Description</th>
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<tbody>
<tr>
<td>1</td>
<td>942-8073</td>
<td>Rubber mat assy.</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>Owner's manual</td>
</tr>
<tr>
<td>3</td>
<td>952-8004</td>
<td>Protector:L</td>
</tr>
<tr>
<td>4</td>
<td>952-8005</td>
<td>Protector:R</td>
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<tr>
<td>5</td>
<td>922-8032</td>
<td>Screw</td>
</tr>
<tr>
<td>6</td>
<td>952-8007</td>
<td>Fiber washer</td>
</tr>
<tr>
<td>7</td>
<td>942-8057</td>
<td>Shipping box</td>
</tr>
<tr>
<td>8</td>
<td>942-8056</td>
<td>Arm holder</td>
</tr>
<tr>
<td>9</td>
<td>922-8081</td>
<td>Screw:PSB4 x 12</td>
</tr>
<tr>
<td>10</td>
<td>922-8082</td>
<td>Screw:PSB3 x 15</td>
</tr>
<tr>
<td>11</td>
<td>952-8006</td>
<td>Plastic cover</td>
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</table>

**Accessories:**

<table>
<thead>
<tr>
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<th>Part No.</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>943-8009</td>
<td>Counterweight</td>
<td></td>
</tr>
<tr>
<td>930-8035</td>
<td>Screwdriver</td>
<td></td>
</tr>
<tr>
<td>942-8070</td>
<td>EP(45RPM) adaptor</td>
<td></td>
</tr>
<tr>
<td>922-8036</td>
<td>Cartridge mount kit</td>
<td></td>
</tr>
<tr>
<td>942-8036</td>
<td>Overhang gauge</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cleaning cloth</td>
<td></td>
</tr>
<tr>
<td>930-8022</td>
<td>Bubble level</td>
<td></td>
</tr>
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</table>

**NOTE:** *With the exception of the owner's manual, parts without part number CANNOT be supplied.*
12. PARTS LISTS OF PC BOARD ASSEMBLIES

NOTE: *The △ mark found on some component parts indicates the importance of the safety factor of the part. Therefore, when replacing, be sure to use parts of identical description.

### Parts List of Control PCB Assembly (901-8012)

**SEMI+CONDUCTORS:**

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Description</th>
<th>Symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>926-8023</td>
<td>PD1003</td>
<td>IC1</td>
</tr>
<tr>
<td>926-8028</td>
<td>PA2004</td>
<td>IC2</td>
</tr>
<tr>
<td>926-8031</td>
<td>PA2005</td>
<td>IC3</td>
</tr>
<tr>
<td>926-8049</td>
<td>NJM2903D</td>
<td>IC4</td>
</tr>
<tr>
<td>926-8114</td>
<td>JC4013BP</td>
<td>IC5</td>
</tr>
<tr>
<td>926-8046</td>
<td>TD62504P</td>
<td>IC6</td>
</tr>
<tr>
<td>926-8052</td>
<td>M54517P</td>
<td>IC7</td>
</tr>
<tr>
<td>926-8056</td>
<td>TC4001BP</td>
<td>IC8, IC13, IC17, IC18</td>
</tr>
<tr>
<td>926-8050</td>
<td>TC4023BP</td>
<td>IC9</td>
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<tr>
<td>926-8118</td>
<td>TC4011BP</td>
<td>IC10, IC11, IC14</td>
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<tr>
<td>926-8044</td>
<td>TC4027BP</td>
<td>IC12, IC15</td>
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<td>926-8113</td>
<td>TC4069UPB</td>
<td>IC16</td>
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<tr>
<td>926-8115</td>
<td>uFC4558C</td>
<td>IC20, IC21</td>
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<td>926-8048</td>
<td>uFC78L08</td>
<td>IC22</td>
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<tr>
<td>926-8002</td>
<td>2SC945</td>
<td>Q1-Q5, Q7, Q8</td>
</tr>
<tr>
<td>926-8030</td>
<td>(2SC1815)</td>
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<tr>
<td>926-8003</td>
<td>2SC1583</td>
<td>Q6</td>
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<td>926-8005</td>
<td>2SC1626</td>
<td>Q9, Q11</td>
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<td>926-8020</td>
<td>2SA816</td>
<td>Q10, Q12</td>
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<td>926-8107</td>
<td>2SA562TM-Y</td>
<td>Q13, Q14</td>
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<td>926-8051</td>
<td>2SC1959-Y</td>
<td>Q15, Q16</td>
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<td>926-8041</td>
<td>WZ-085</td>
<td>D1</td>
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<td>926-8035</td>
<td>IS1885</td>
<td>D2</td>
</tr>
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<td>926-8037</td>
<td>IS2473</td>
<td>D3, D4, D6, D8-D10, D14, D15</td>
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<td>926-8116</td>
<td>VD1212</td>
<td>D5, D7</td>
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<td>926-8108</td>
<td>RD2.4EB</td>
<td>D12</td>
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<td>926-8089</td>
<td>WZ-150</td>
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**VARIABLE RESISTORS:**

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<thead>
<tr>
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<th>Description</th>
<th>Symbol</th>
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<tbody>
<tr>
<td>929-8025</td>
<td>6.8K-B</td>
<td>VR1</td>
</tr>
<tr>
<td>929-8017</td>
<td>10K-B</td>
<td>VR2</td>
</tr>
<tr>
<td>929-8056</td>
<td>680K-B</td>
<td>VR3</td>
</tr>
<tr>
<td>929-8053</td>
<td>680K-B</td>
<td>VR4</td>
</tr>
<tr>
<td>929-8055</td>
<td>33K-B</td>
<td>VR5, VR6</td>
</tr>
<tr>
<td>929-8054</td>
<td>220-B</td>
<td>VR7</td>
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<td>929-8057</td>
<td>330-B</td>
<td>VR8</td>
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<tr>
<td>929-8001</td>
<td>3.3K-B</td>
<td>VR9</td>
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**MISCELLANEOUS:**

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<th>Description</th>
<th>Symbol</th>
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<tbody>
<tr>
<td>926-8103</td>
<td>Crystal</td>
<td>X-tal</td>
</tr>
<tr>
<td>928-8006</td>
<td>Thermistor</td>
<td>TH1, TH2</td>
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### Parts List of Power Supply PCB Assembly (901-8002)

**SEMI+CONDUCTORS:**

<table>
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<th>Part No.</th>
<th>Description</th>
<th>Symbol</th>
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</thead>
<tbody>
<tr>
<td>926-8047</td>
<td>uFC78MD8H</td>
<td>IC101</td>
</tr>
<tr>
<td>926-8109</td>
<td>2SD686</td>
<td>Q101</td>
</tr>
<tr>
<td>926-8036</td>
<td>S1RBA10</td>
<td>D101</td>
</tr>
<tr>
<td>926-8053</td>
<td>S2VB10</td>
<td>D102</td>
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<tr>
<td>926-8097</td>
<td>BZ-250</td>
<td>D103</td>
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**CAPACITORS:**

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<th>Symbol</th>
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<tbody>
<tr>
<td>927-8008</td>
<td>.047/450:myl</td>
<td>C101</td>
</tr>
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**RESISTORS:**

<table>
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<th>Part No.</th>
<th>Description</th>
<th>Symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>928-8007</td>
<td>2W:1K</td>
<td>R101</td>
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**HARDWARE:**

<table>
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<th>Part No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>921-8057</td>
<td>Spacer</td>
</tr>
<tr>
<td>921-8058</td>
<td>Spacer</td>
</tr>
<tr>
<td>922-8031</td>
<td>Screw</td>
</tr>
</tbody>
</table>
Parts List of Lamp PCB Assembly (901-8004)

<table>
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<tr>
<th>Part No.</th>
<th>Description</th>
<th>Symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>921-8015</td>
<td>8V 70mA lamp</td>
<td>PLL</td>
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</table>

Parts List of LED Sensor PCB Assembly (901-8003)

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Description</th>
<th>Symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>926-8042</td>
<td>LED</td>
<td>D301-D305</td>
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</tbody>
</table>

Parts List of CdS PCB Assembly (901-8016)

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<tr>
<th>Part No.</th>
<th>Description</th>
<th>Symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>928-8005</td>
<td>CdS</td>
<td>CdS</td>
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</table>

Parts List of Phototransistor PCB Assembly (901-8017)

<table>
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<th>Part No.</th>
<th>Description</th>
<th>Symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>926-8043</td>
<td>TPS605-Y</td>
<td>Q301-Q305</td>
</tr>
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</table>

Parts List of Control A PCB Assembly (901-8018)

<table>
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<th>Part No.</th>
<th>Description</th>
<th>Symbol</th>
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</thead>
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<tr>
<td>926-8101</td>
<td>GL-2PR1</td>
<td>D201-D205</td>
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<tr>
<td>929-8015</td>
<td>Switch</td>
<td>S3, S4</td>
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Parts List of Control B PCB Assembly (901-8019)

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<tr>
<th>Part No.</th>
<th>Description</th>
<th>Symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>926-8101</td>
<td>GL-2PR1</td>
<td>D207-D209</td>
</tr>
<tr>
<td>929-8015</td>
<td>Switch</td>
<td>S5-S7</td>
</tr>
</tbody>
</table>
AC 110, 120V
50/60 Hz

See p.69 for assembly diagram
12.1 CONTROL PCB ASSEMBLY (901-8012)

NOTE: * See pp. 67 and 68 for interconnect diagrams.