The home of the turntable

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DENON

Hi Fi Component／Record Player

SERVICE MANUAL

SERVO-CONTROLLED DIRECT DRIVE RECORD PLAYER

MODEL DP-31F/32F SERIES

Model DP-31F／32F

NIPPON COLUMBIA CO., LTD.

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TABLE OF CONTENTS

FEATURES 1
SPECIFICATIONS 2
BLOCK DIAGRAM 3
PART NAMES AND FUNCTION 4
EXPLANATION OF THE MICROPROCESSOR (Motor Control IC) ..... 5~6
EXPLANATION OF THE MICROPROCESSOR (Arm Control IC) ..... 7~8
ADJUSTMENT PROCEDURES 9
EXPLODED VIEW OF TONEARM 10
PARTS LIST OF EXPLODED VIEW 11
EXPLODED VIEW OF MAIN PARTS 12
CIRCUIT DIAGRAM 13
PRINTED CIRCUIT BOARD 14
PARTS LIST (P.C. BOARD AND ACCESSORIES) 15

WARNING:

Parts marked with ⚠ are of importance in respect to the safety use the specified type without tail.

FEATURES

1. The use of a low mass straight arm

This arm is capable of maximizing the performance of high compliance cartridges with superb tracing ability. Even with the newest high-grade records, its tracing ability is outstanding.

2. Newly developed "Tonearm Float" mechanism

This mechanism "floats" the tonearm from the cabinet to protect it from vibrations, which makes it possible to reduce unwanted noises caused by howling.

3. Electronically controlled contact-less servo tonearm

With the use of a micro processor to control the electronically controlled contact-less servo tonearm, safe and easy automatic operation is possible, with little loss of sound quality.

4. Newly developed linear drive MF motor

The "Magne-Float" mechanism uses the attraction of the magnets and the stater yoke to reduce the load of the turntable and the rotor on the pivot. This reduces pivot wear, allowing the turntable to operate smoothly for a long period of time.

5. Bi-directional servo with DENON quartz

Speed accuracy is unequaled with a bi-directional servo and a combination of a magnetic pulse detector and a quartz lock.

6. Electronic damping method (Q-damping)

Low frequency resonance, caused by cartridge compliance and the tonearm mass is electronically damped, while effectively checking the effects of crosstalk and the increase of irregular distortion. (DP-32F)

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SPECIFICATIONS

• Phono motor section

Drive system	Servo controlled direct drive
Speeds	33-1/3 and 45 rpm
Wow flutter	0.012% WRMS or below (servo system) 0.02% WRMS or below (JIS)
S/N ratio	More than 78dB (DIN-B)
Rise time	Within 2 seconds (at 33-1/3 rpm)
Platter	Aluminum die-cast, 300mm diameter
Motor	MF (Magne-Float) Motor
Speed control method	Phase and speed servo with frequency detection
Load characteristics	0% (at outmost groove, 80g stylus force)
Brake	Electronic brake
Revolution speed deviation	Less than 0.002%

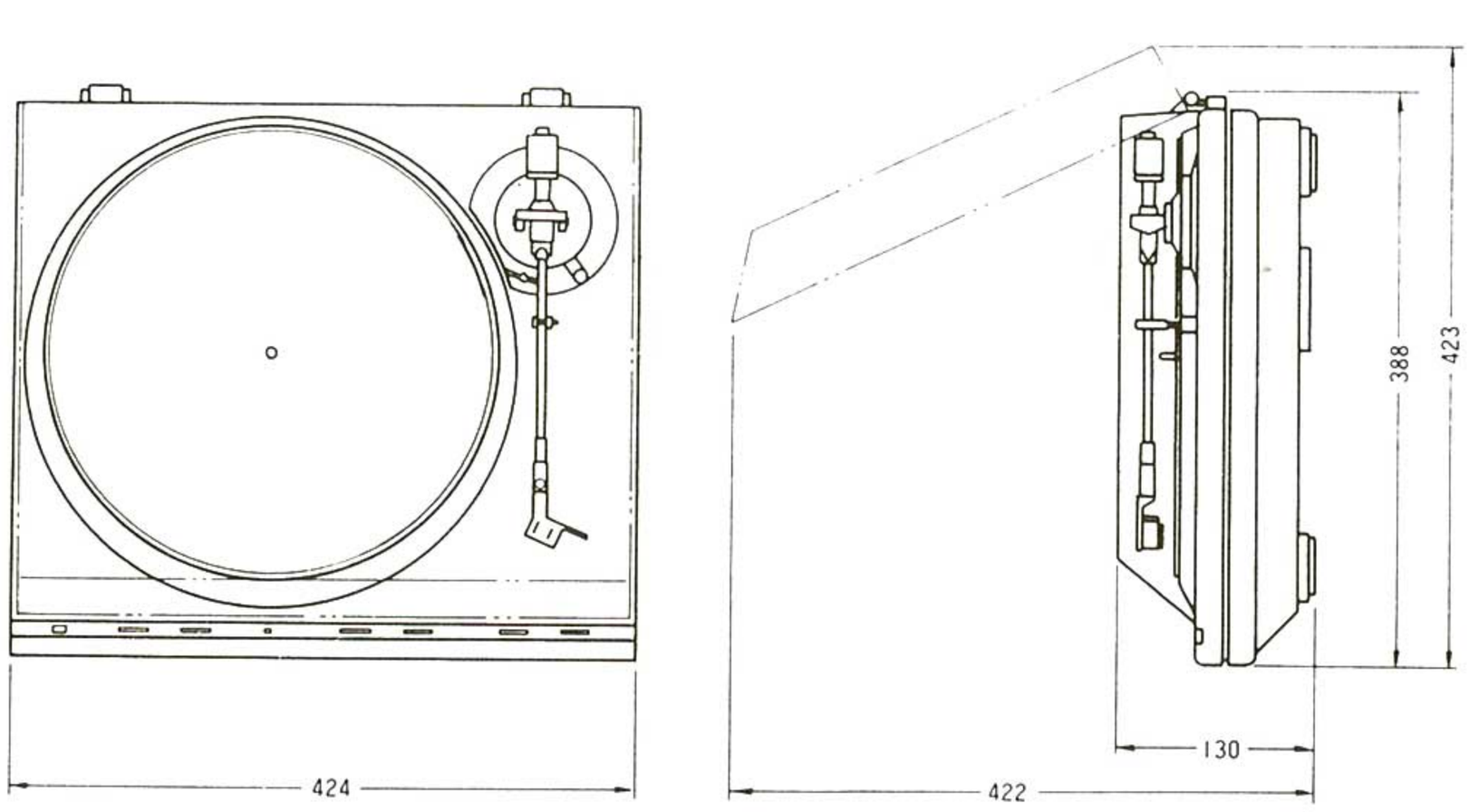
• Tonearm section

Arm type	Straight pipe, static balanced
Effective length	220mm
Overhang	16mm
Tracking error	Within 3°
Automatic mechanism	Fully automatic, electronically controlled
Adjustable stylus force range	0-2.5g per revolution (1 scale = 0.1g)
Suitable cartridge weight	Approx. 4-9g. (including screws, nuts)
Headshell	Specially hardened resin exclusive headshell
Anti-skating	Electronic
Q-damping	Electronic (DP-32F)

• General

Power supply	50Hz/60Hz, Voltage is shown on rating label at the back of cabinet.
Power consumption	6W
Dimensions	130 x 424 x 388mm (H x W x D)

*The specifications and design are subject to change due to product improvement.



Outer dimensions (mm)

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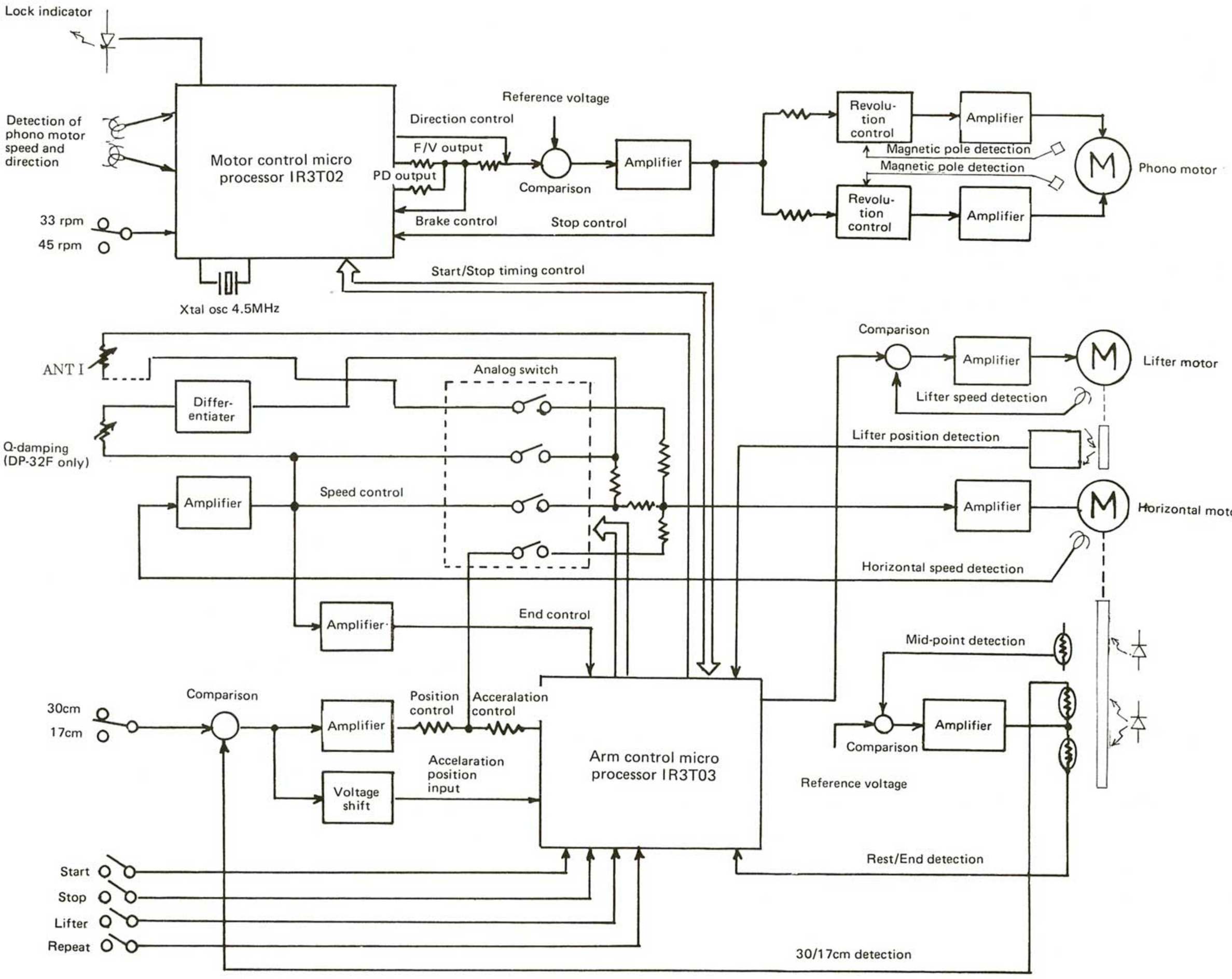
BLOCK DIAGRAM



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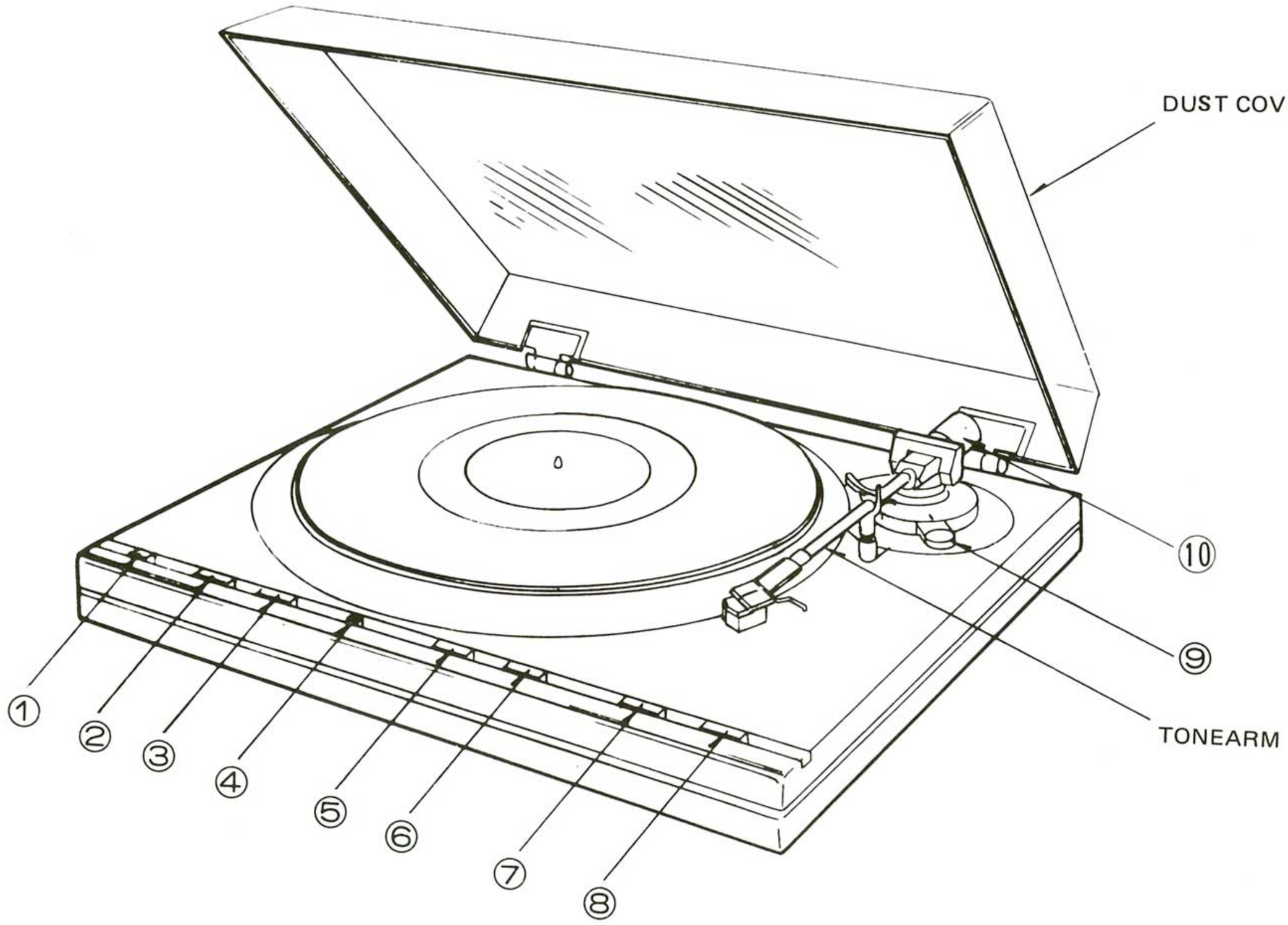
PART NAMES AND FUNCTION



(1) Power switch "POWER"
The power will be turned ON (▬) or OFF (■).

(2) Record size selector "SIZE"
Set, according to the size of record to be played.
30cm records . . . . . [30] (▬)
17cm records . . . . . [17] (■)

(3) Speed selector "SPEED"
Set, according to the desired record speed.
33-1/3 record speed . . . . . [33] (▬)
45 record speed . . . . . [45] (■)

(4) Lock indicator "LOCK"
When the power source is on, the lamp will light up. During play, the light will flash until the turntable reaches normal speed. When the normal speed is obtained, the lamp will again light up continuously.

(5) Repeat switch "REPEAT"
When repeated playing is desired, switch to the "ON" position. (■)

(6) Arm lifter switch "ARM LIFTER"
This is used when manually lowering and lifting the tonearm from the record.

(7) Start switch "START"
When playing records automatically, press this switch to start.

(8) Stop switch "STOP"
When stopping the record, press this switch.

(9) Anti-skating knob
Use this knob to adjust the anti-skating. With the DP-32F, Q damping will be adjusted automatically.

(10) Counter weight
Used to adjust the stylus force.

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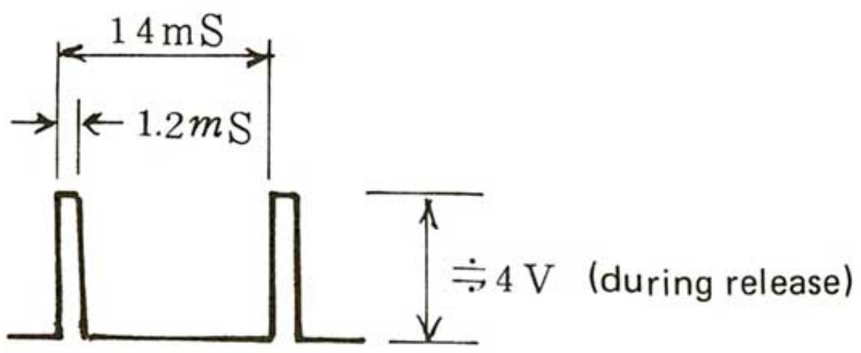
EXPLANATION OF THE MICROPROCESSOR

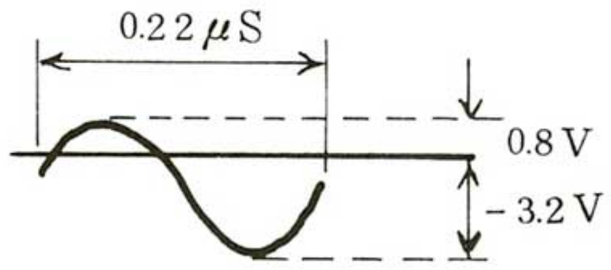
- **Motor Control IC . . . IR3T02 (at standard revolution of 33 rpm)**

The numbers on the left hand side indicates the terminal number.

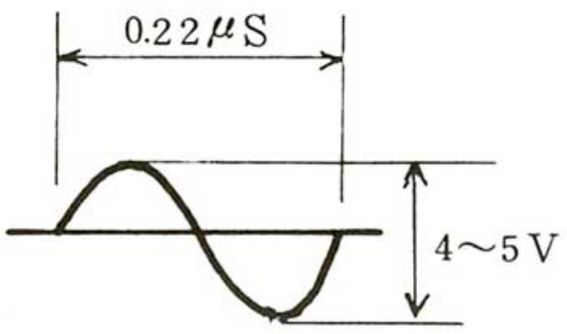
1. strobe drive



2. 4.5MHz OSC



3. 4.5MHz OSC



4. rpm selector

H: 45 rpm
L: 33 rpm

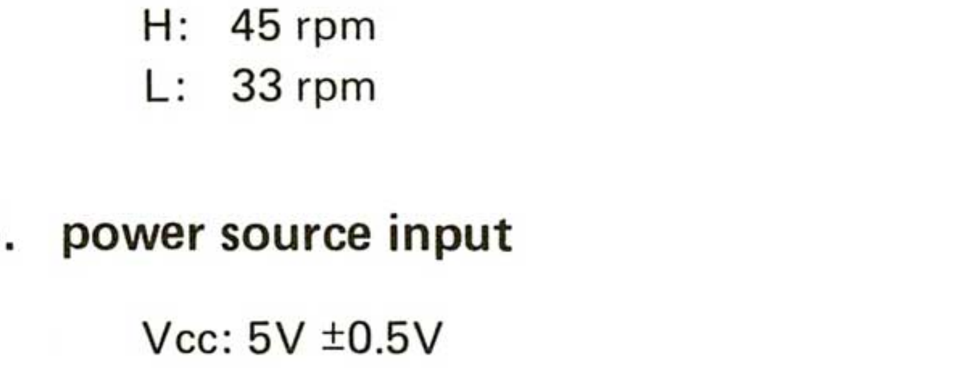
5. power source input

Vcc: 5V ±0.5V

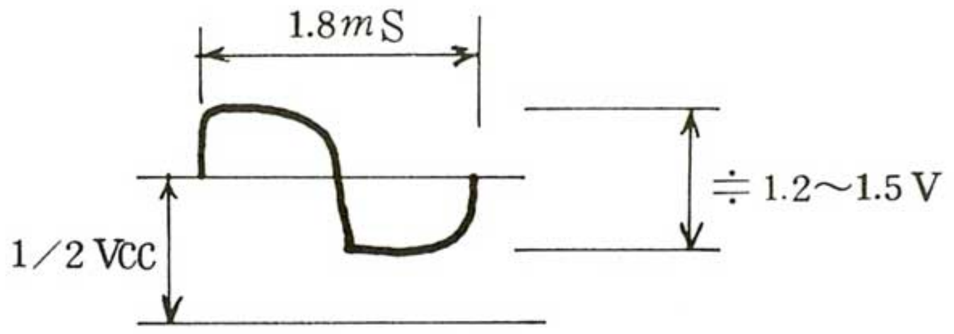
6. FG I bypass terminal

E6 ≒ ½Vcc

7. FG I lowpass terminal



8. FG I output



9. FG I inverse input

The gain set element is connected.
E9 ≒ ½Vcc

10. FG I non-inverse input

10mVpp ～ 100mVpp
E10 ≒ ½Vcc

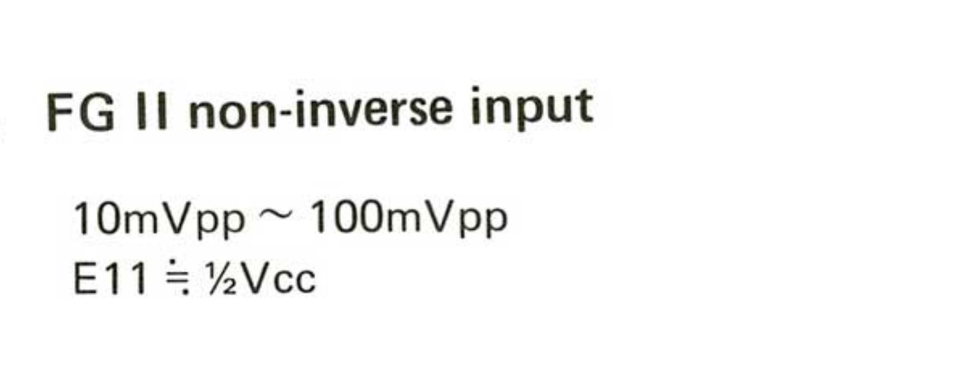
11. FG II non-inverse input

10mVpp ～ 100mVpp
E11 ≒ ½Vcc

12. FG II inverse input

The gain set element is connected.
E12 ≒ ½Vcc

13. FG II output



14. ground terminal

15. F/V output

slower than normal revolution: 2 ～ 4.5V
normal revolution: ≒ 2V
faster than normal revolution: 0 ～ 2V

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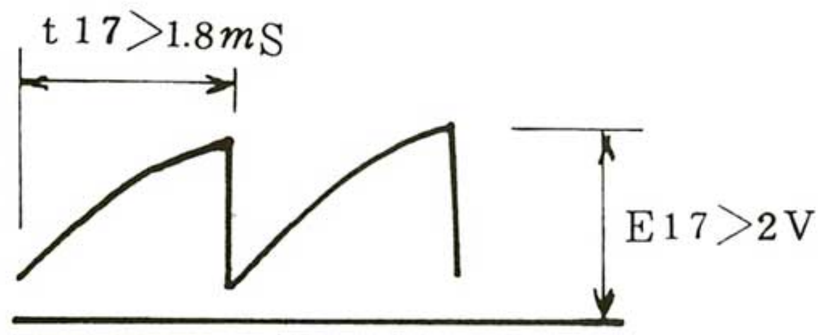
16. F/V hold terminal

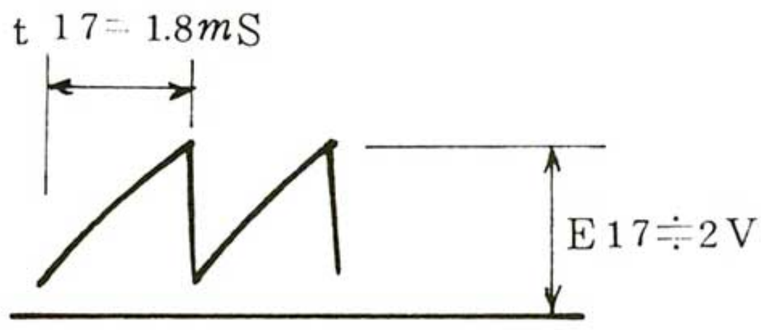
same as terminal 15

17. F/V triangular wave

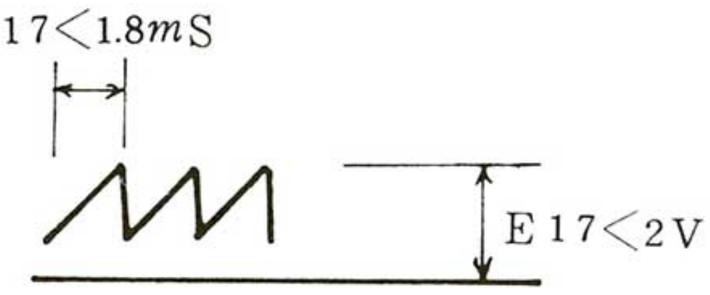
slower than normal revolution



normal revolution



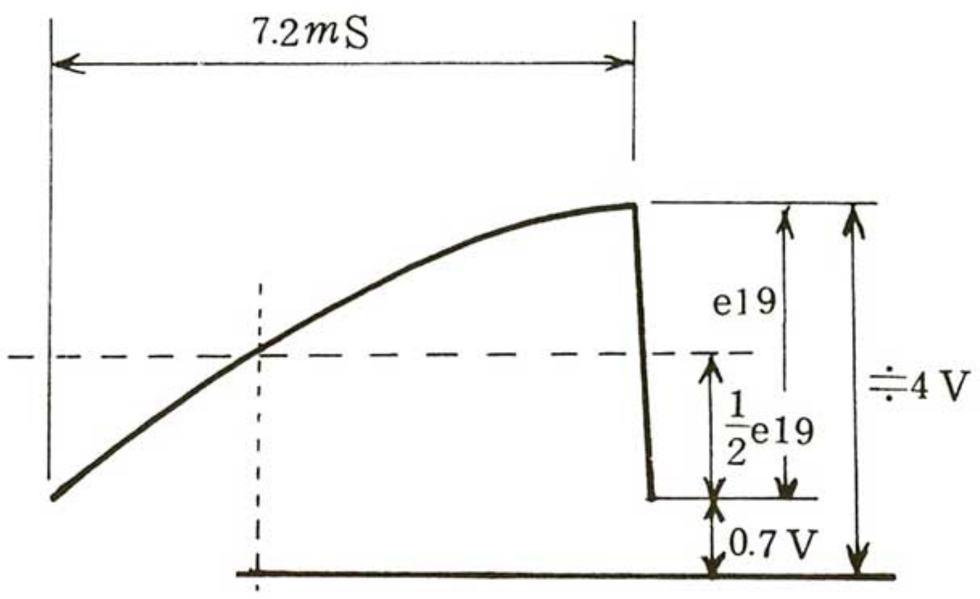
faster than normal revolution



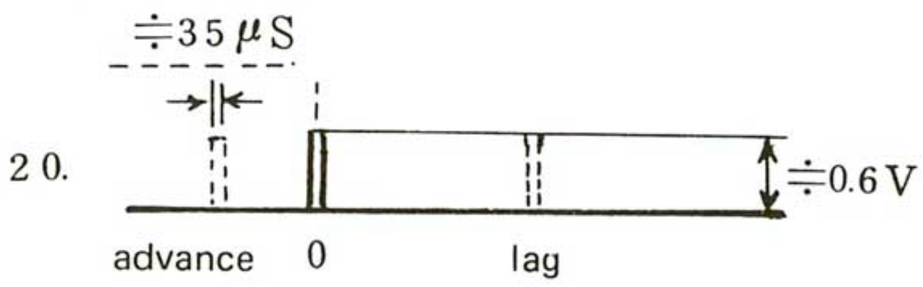
18. timing pulse width-set terminal

E18 ≒ 0.6V

19. PD triangular wave



20. sample pulse monitor terminal



21. PD hold terminal

slow phase: 2 ~ 4V
normal phase: ≒ 2V
advanced phase: 1 ~ 3V

22. PD output

same as terminal 21

23. Lock detector time set terminal

during lock: 0.6V
lock disengaged: 0V

24. Direction detector output

normal revolution: 0V
reverse revolution: ≒ 4V

25. Revolution detector

during revolution: ≒ 4V

stop: 0V

26. START/STOP terminal

H → START
L → STOP

27. Stop output

during stop control: 0V
during start: open

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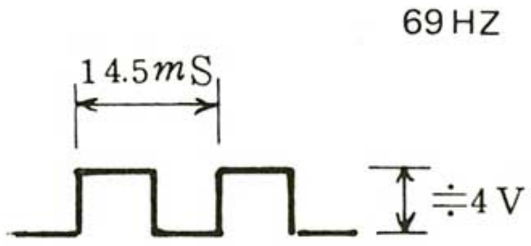
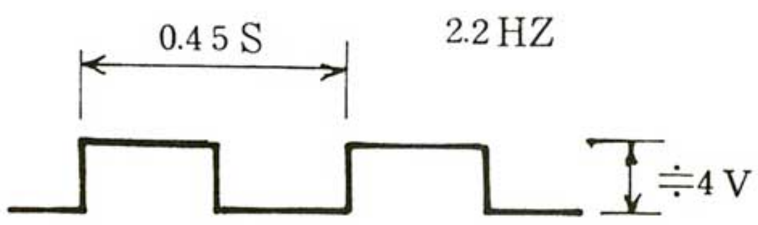
28. Lock indicator

during lock . . . . . (LED lit dimly)



stop . . . . . (LED lit)

during transition . . (LED flashes)



• Arm Control IC IR3T03

The numbers on the left side indicates the terminal number of the IR3T03.

1. Accelaration input

Except for the matching range of the lead-in detector (E7 ≦ | ±0.6V |), it will recognize the situation and control the accelaration during automatic tonearm operation.

2. Accelaration output

E1 ≦ | ±2.37V ±0.1V | . . . . open (will not control the accelaration within the matching range)

E1 ≧ | ±2.3V ±0.1V | . . . . E2 ≒ ±3.95V

−3.95V: will accelarate toward the inside from rest.

+3.95V: will accelarate toward rest from the inside.

3. UP/DOWN selection of the arm lifter

When E9 is H, the control output for lifting the arm will be made at E3 ≒ −Vcc.

When E9 is L, the control output for lowering the arm will be made at E3 ≒ +Vcc.

4. Detection of the rest position

E4 ≦ −2.64V will be recognized as the arm being at rest.

5. Detection of the END position

When E5 ≧ 2.64V, it will be recognized to be within the END detection range.

6. End control

Whithin the END detection range of 5 (above), (E5 ≧ 2.64V), the arm will be returned by the END control when E6 ≧ 0.23V.

7. Matching input

E7 ≦ | ±0.6V | will be recognized as the match range for lead-in.

8. Drive output

When the T/T drive level is at or near (E8 ≧ | ±2.87V |) full torque in either normal or reverse (brake direction) directions, the current fed into the lifter motor will be limited to increase the stability of the power supply.

9. UP control output

When the lifter is in the UP position during automatic arm operations or when the UP signal is sent by pressing the arm lifter button, pin 9 will be at H level.

E9H ≒ 4V

E9L ≒ 0V

10. DOWN time constant

To ensure that the arm is lowered completely before proceeding to the next movement, a resistor between pins 9 and 10 and a capacitor on pin 10 has a preset discharge time constant which is somewhat longer than the time required for the arm to be lowered. Thus, when pin 9 becomes L (E9L ≒ 0V), and the fixed amount of time elapses, the arm will be recognized to be DOWN as soon as E10 < 2V.

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11. ANT (Anti-skating) control

When E10 $<$ 2V, then E11 $\fallingdotseq$ −4V will be the control output needed for the anti-skating to be engaged.
When E10 $\geqq$ 2V, then E11 $\fallingdotseq$ +4V will be the control output needed for the anti-skating to be disengaged.

12. Negative power source

Supplies −5V.

13. Lifter control

Besides limiting the drive current to the lift motor to an input of E8 $\geqq$ | ±2.87V | at pin 8, it is also the lifter motor drive control terminal to stop the lifter movement when it is in the H level and UP position at pin 27.

14. SUB (substratum)

To prevent any interference from the inner elements of the LSI, the substratum terminal is connected to the unregulated side of the negative power source, since it has the lowest electric potential.

15. GND

Standard zero electric potential is the GND.

16. UP SW movement time constant

The UP SW detects the lifter in the UP position. To fill the gap between the completely lifted arm and the UP position as detected by the UP SW, a charge time constant is set by the resistor in the LSI and the capacitor on the outside to stabilize the circuitry. When the lifter is UP: E16 $\fallingdotseq$ 1.2V, other than up: E16 $\fallingdotseq$ 0V.

17. Return control

When the stop command is given, or when the repeat is disengaged and the END is detected (E6 $\geqq$ 0.23V), a control signal output (E17H $>$ 4V) is made to return the arm to rest.
E17H $>$ 4V
E17L: release

18. Horizontal drive control

When the arm is in resting position, or when the arm reaches the lead-in position during automatic play, and comes into the matching range (E7 $\leqq$ | ±0.6V |), a control signal output (E18H $\fallingdotseq$ 4V) is made to stop the horizontal motion of the arm.

19. Initial set

This is the preparation time setting terminal when the power source is turned on. The resistor in the LSI and the outer capacitor will set the charge time constant and carry out the initial set.

20. LCTD (Located) time constant

The LSI and its outer circuits will set the LCTD time constant to improve the detection accuracy of the lead-in position and the arm rest position.

E20H $\fallingdotseq$ 1.2V . . . . A few moments after the arm reaches the range of detection, in other words, after the set LCTD time constant elapses, it will become H level, where it is memorized immediately and then reset to the L level.
E20L $\fallingdotseq$ 0V . . . . . Before and after detection, it will become L level.

21. T/T (Turntable) drive control

When the arm reaches the matching range (E7 $\leqq$ | ±0.6V |) of the lead-in position, or when the arm has returned to the rest position, the horizontal drive of the arm is disengaged, after the set time of pin 20 has elapsed. During this time, the turntable will rotate when the arm is not on the arm rest, or it will otherwise stop. Consult the movement explanation for pin 22.
E21L $\fallingdotseq$ 0V . . . . . This will stop the turntable
E21H release . . . . This will rotate the turntable

22. T/T (Turntable) starting position

This terminal sets the starting position of the turntable
Connecting pin 22 to GND . . . During automatic play, the turntable will start when the arm reaches the lead-in position, and is in the matching range (E7 $\leqq$ | ±0.6V |). During manual play, the turntable will start when the arm is lifted from the arm rest (E4 $>$ −2.64V). This model is operated with this pin 22 at GND.
Opening pin 22 . . Regardless of automatic or manual play, the turntable will start when the arm is lifted from the arm rest.

23. Start

Will start automatically at the GND level.

24. Auto stop

Will stop automatically at the GND level.

25. Lifter

Will raise the lifter automatically at the GND level.

26. Repeat

Will engage the repeat automatically at the GND level.

27. UP SW

When the arm lifter is raised, this terminal will be opened and made H level, otherwise, the UP detector will control it to make it GND level.
With this model, photo reflectors to detect the presence of reflected light from a light emitting diode and a sensor is placed opposite to the reflector cam. When the lifter is in the UP position, the reflector cam blocks the ray of light, and the raised lifter position is detected, as there is no reflection.

28. Positive power supply

Supplies +5V.

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ADJUSTMENT PROCEDURES

Measure, using a two-channel oscilloscope using test point (TP) 51 as the ground standard point.

• Adjusting the arm control section

1. Adjusting the horizontal offset

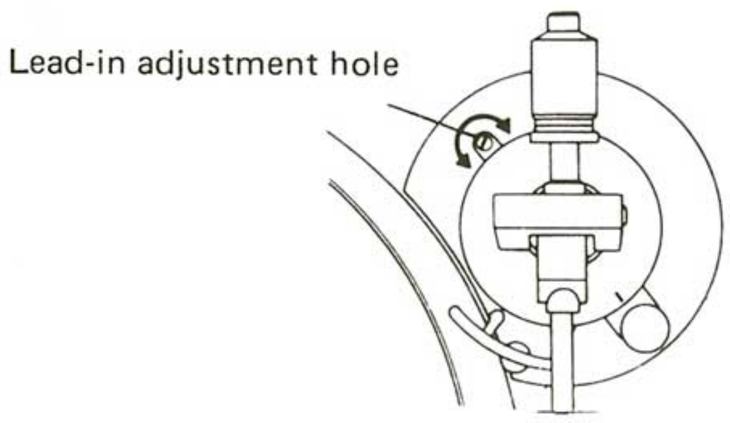
1) Fix the tonearm to its rest and connect the oscilloscope to TP 52 .
2) Turn VR 9 and adjust to 0 ±0.01V.

2. Adjusting the lifter offset

1) With the tonearm on its rest, release the clamp and connect the oscilloscope to TP 54 .
2) Turn VR 10 and adjust to 0 ±0.1V.

3. Adjusting the lead-in position for 30cm records

1) Set the record size selector to 30cm.
2) By continuously pressing start switch S4, the arm will begin to move. Using a small flat head (—) screwdriver, turn and adjust the lead-in adjustment cam on the arm base so that the stylus tip stops at the lead-in position for 30cm records.



- When the stylus is lowered toward the inside, turn the screw counter clockwise (↺)
- When the stylus is lowered toward the outside, turn the screw clockwise (↻)

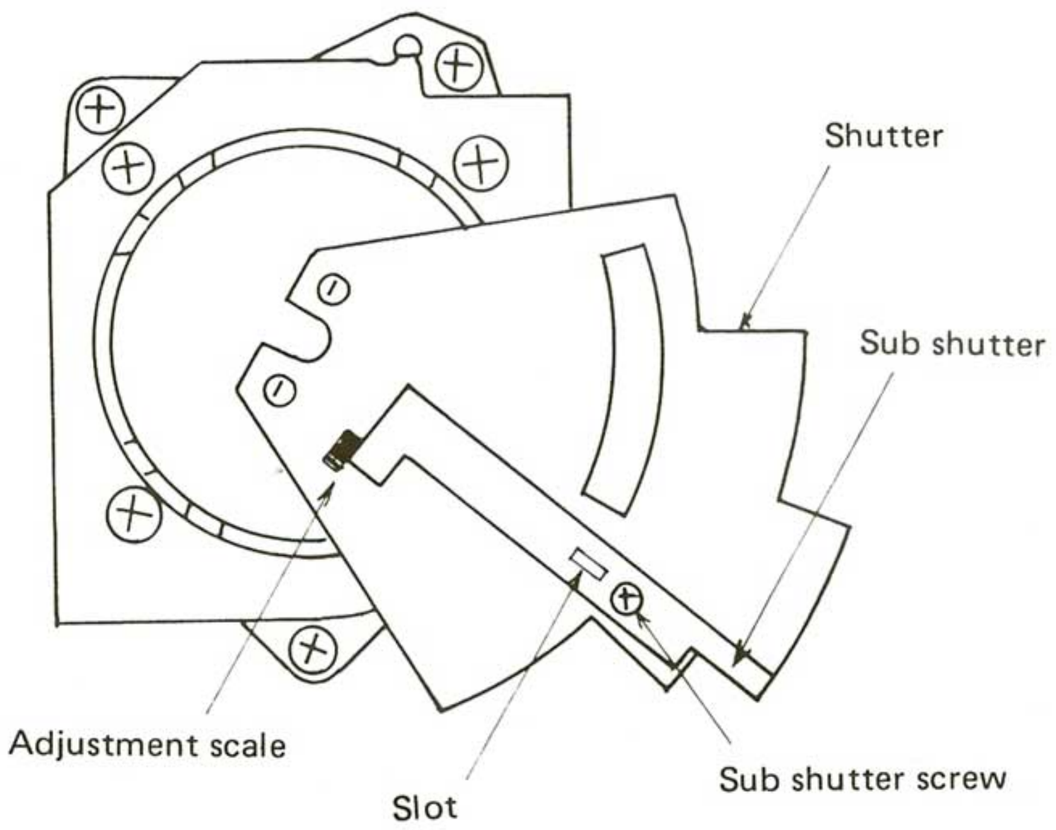
NOTE

The screwdriver used for this adjustment should have a 4-5mm width tip with a large grip. The shaft diameter should be less than ϕ5; when turning the cam, make sure the tip is placed securely in the slot.

4. Adjusting the lead-in position for 17cm records

Adjust as necessary, such as when parts of the sensor section have been replaced.
However, the following procedures should only be used when a discrepancy is found for the 17cm lead-in position, after the 30cm lead-in position has been adjusted.

1) Set the record size selector S2 to 17cm.
2) By continuously pressing the start switch S4, the arm will move over and stop. At this time, check how many millimeters, toward the inside or outside, the stylus tip deviates from the required 17cm lead-in position.
3) Take off the bottom cover of the cabinet and check the adjustment scale position of the shutter. (One adjustment scale corresponds to a stylus tip movement of 5mm.)
4) Untighten the screw holding the sub shutter and place a small screwdriver into the slot of the shutter. When the stylus position is toward the inside, compared to the required position, move the sub shutter toward the right of the scale; when the stylus position is toward the outside, move the sub shutter toward the left. When completed, tentatively tighten the screw holding the sub shutter.
5) After the adjustments are made, press the start switch S4, and check whether or not the stylus stops at the 17cm lead-in position.
6) If the stylus stops at the required position, then tighten the sub shutter screw.



NOTE

If the player is started when the phono motor section has not been adjusted, or when the turntable is not placed in position, the arm will be lead-in and the lifter will be lowerd; the phono motor will start to rotate. Sometimes, when the start or stop switch is pressed again, the arm may not move accordingly. This is because when the phono motor current is at its maximum, the lifter does not raise, since the current flow to the lift motor is restricted and the arm does not go into horizontal motion. Thus, it is not due to any mechanical trouble.

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• Adjustment of the phono motor section

1. Adjusting the motor amp. offset voltage

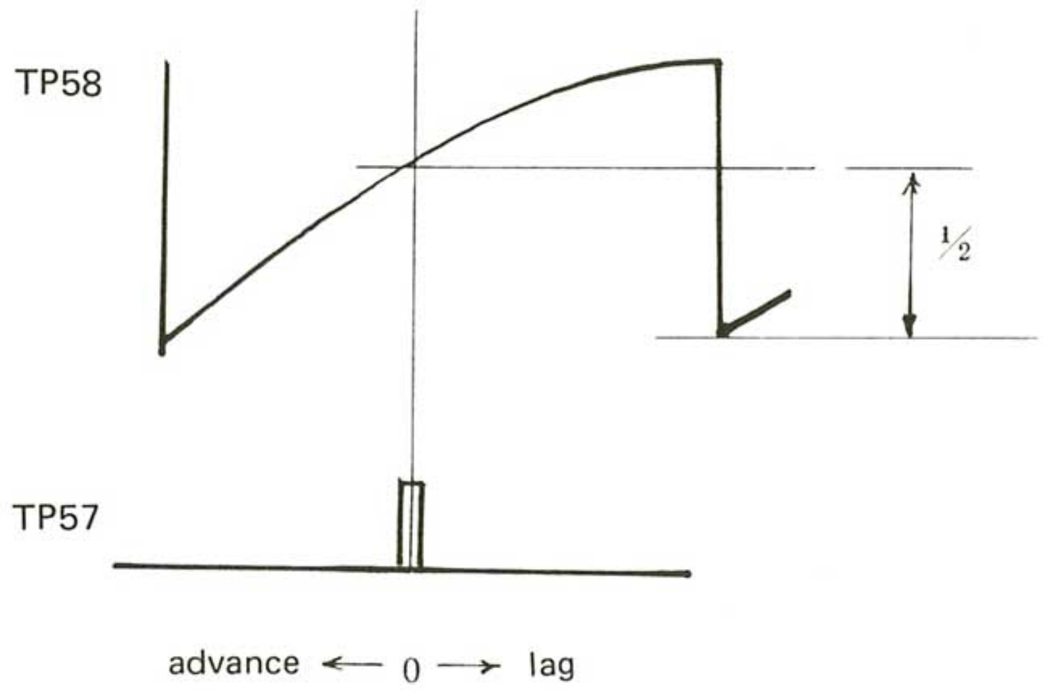
1) Fix the tonearm to the arm rest and connect the oscilloscope to TP 59 and 60 .
2) Rotating the turntable by hand, adjust the center of amplitude at TP 59 to 0 ±0.1V by turning VR 4.
3) Following the preceding directions adjust to 0 ±0.1V by turning VR 3 for TP 60 .

2. Adjusting the motor torque

1) Ground TP 56 .
2) Connect TP 59 and 60 to the oscilloscope.
3) Raise the tonearm from the arm rest and rotate the turntable at a fast rate.
4) When at TP 59 , turn VR 6 and adjust ro 15Vp-p ±0.5V.
5) When at TP 60 , turn VR 5 and adjust to 15Vp-p ±0.5V.

3. Adjusting the 45 rpm

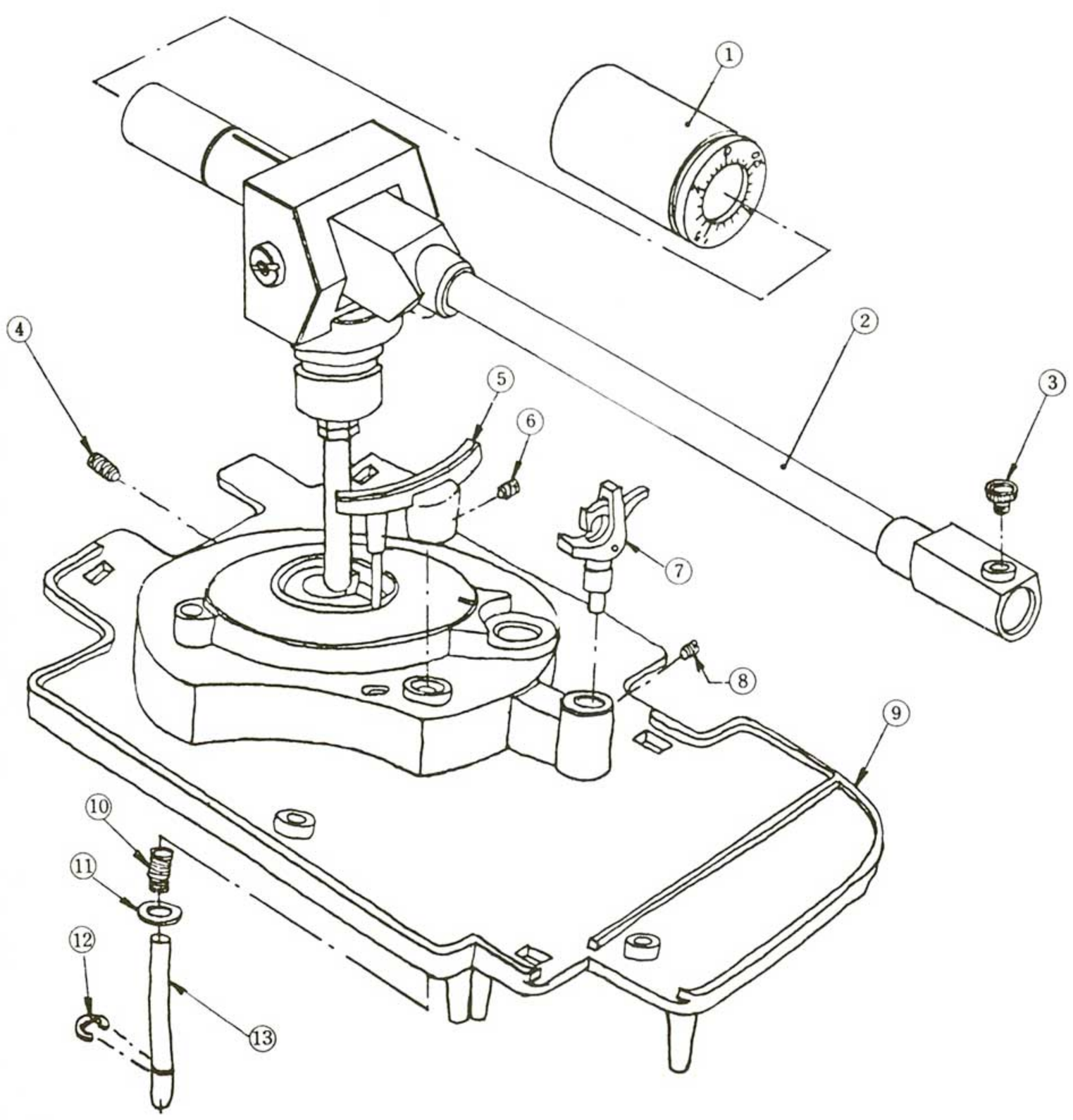
1) Connect TP 57 and 58 to the two-channel oscilloscope.
2) Set the speed selector S1 to 45 rpm.
3) Take the arm off the armrest and start the phono motor.
4) Adjust VR 2 so that the pulse from TP 57 is positioned at half the amplitude of the triangular wave from TP 58 .



4. Adjusting the 33 rpm

1) Set the speed selector S1 to 33 rpm.
2) As in the adjustments for 45 rpm, adjust VR 1.

EXPLODED VIEW OF TONEARM



Ref. No.	Part No.	Part Name
1	3158561002	MAIN WEIGHT ASS'Y
2	3158555103	MAIN BODY ASS'Y
3	3158557004	FINGER SCREW
4	4744203017	3 x 10 BSS
5	3158563001	ARM LIFTER ASS'Y
6	4744003013	3 x 3 SS
7	3158564000	ARM REST ASS'Y
8	4744003013	3 x 3 SS
9	3158562109	ARM BASE ASS'Y
10	4638065109	LIFTER SPRING
11	4751005004	4W
12	4761003009	3E RING
13	3158541104	LIFTER SHAFT

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PARTS LIST OF EXPLODED VIEW

Ref. No.	Part No.	Part Name	Remarks
1	4731803006	3x12 CPTS (=)	
2	4751005004	4W	
3	1048066005	INSULATOR ASS'Y	
4	1058057305	BOTTOM COVER	
5	4218217209	RECORDED TURNTABLE	
6	4218220005	RUBBER SHEET	
7	4628023009	BUSHING	
8	1468115206	DUST COVER ASS'Y	
9	4018041002	HINGE	
10	FPU-950	CARTRIDGE UNIT	DP-31F only
11	3158564000	ARM REST ASS'Y	
12	3158554201	TONE ARM ASS'Y	
13	3158563108	ARM LIFTER ASS'Y	
14	4638065109	LIFTER SPRING	
15	4751005004	4W	
16	4761003009	3E RING	
17	4730306012	3x12 CBRTS (1)	
18	4761001001	2E RING	
19	4761003009	3E RING	
20	4770090058	WASHER	
21	4418220203	CONNECTION PLATE	
22	4248009005	CAM	
23	4218121104	MOTOR ARM	
24	4770032003	3x6 SS	
25	4418799006	SHIELD PLATE	
26	2178038313	MOTOR (C) ASS'Y	
27	2118068000	V16V20KB204	DP-31F
	2118064004	V1620V20KB20A	DP-32F
28	4730305013	3x10 CBRTS	
29	4418707001	PLATE	
30	1128069207	KNOB	
31	2228456007	SERVO CONTROL PCB	29G~29K
32	4418606102	SPRING PLATE	
33	3158542608	ARM BASE	
34	4730406035	4x12 CBRTS (1)	
35	4638099007	SHUTTER SPRING	
36	4770182005	WASHER	
37	4418743201	SENSOR HOLDER	
38	4438158054	COLLAR	
39	WA-0107-4	WASHER	
40	4418274107	MAGNET HOLDER	
41	4730308010	3x14 CBRTS (1)	
42	2398007506	COIL ASS'Y	
43	3418017200	MAGNET ASS'Y	
44	4338168209	SHUTTER	
45	4712304045	3x8 CFS	
46	4338172004	SUB SHUTTER	
47	4171810019	2x3 CPS	
48	4338165406	YOKE (A) ASS'Y	
49	4770032003	3x6 SS	
50	4711312012	3x30 CPS	
51	2228456007	SERVO CONTROL PCB	29B
52	4418648306	CDS HOLDER	
53	4438470208	LED HOLDER	
54	2228456007	SERVO CONTROL PCB	29C
55	4148147009	SHEET	
56	2228456007	SERVO CONTROL PCB	29A
57	FTS-0616-4	WASHER	
58	4751006003	5W	
59	3158451003	FRICTION WASHER	
60	4248015400	ADJUST CAM	
61	4418704101	SHIELD COVER	
62	2228339205	OUTPUT PCB	
63	2098019014	EARTH LEAR	
64	4713303016	3x6 CBS	
65	4418708000	SHIELD PLATE	
66	4698008009	INSULATER MAT	
67	2033642103	OUTPUT CORD ASS'Y	
68	4731803019	3x16 CPTS (=)	
69	4618031001	PAD	
	4618042003	PAD	EU only
70	FG-280	MOTOR UNIT	
71	4418773006	ANGLE (B)	
72	4418772007	ANGLE (A)	
73	4418710001	PLATE	
74	4618101009	RUBBER	
⚠ 75	2339045006	POWER TRNAS	E2, EA, EF, EK
	2339046005	POWER TRANS	E1
	2334072003	POWER TRANS	EU
	2339049002	POWER TRANS	EC
⚠ 76	2062002031	AC CORD	E2, EF
	2062019008	AC CORD	EU, EC (DP-32F)
	2006031026	AC CORD WITH PLUG	E1
	2006019307	AS 3P AC CORD	EA
	2062024006	AC CORD WITH LABEL	EK
77	4418321005	BUSH PLATE	E2, EA, EF, EK
	4418314009	BUSH PLATE	E1, EU
⚠ 78	4450020005	BUSHING	E2, EF, EK
	MD-3802	BUSHING	E1, EU
	MD-2982H	BUSHING	EA
⚠ 79	PS-160	POWER SOURCE UNIT	E2, EA, EF, EK
	PS-161	POWER SOURCE UNIT	E1
	PS-159	POWER SOURCE UNIT	EU
	PS-163	POWER SOURCE UNIT	EC
80	4038001006	CAP	
81	2129067003	PUSH SWITCH	
82	2129087007	MINI PUSH SWITCH	
83	3939153009	LED (PR-5524S-1)	DP-32F only
84	3939041001	LED (LN81RCP HL)	
86	3939053028	CDS (10-15KΩ)	
87	3939053002	CDS	
88	2228456007	SERVO CONTROL PCB	29F
89	2618006009	SPARK KILLER	EU, EC
90	1038145402	CABINET ASS'Y	E2, EA, EF, EK
	1038145415	CABINE TASS'Y	E1
	1038168104	CABINET ASS'Y	EU
	1038168117	CABINET ASS'Y	EC
91	5298006002	45 ADAPTOR	
92	EP-4772	CORD HOLDER	
93	4418703102	SHIELD PLATE	
94	4730303015	3x6 CBRTS (1)	
95	4753201000	3TWB	
96		3x15 CBS	BSBW, MBNI.II
97	3918425004	MAGNETIC HEAD ASS'Y	
98	4700009019	3x6 CPS W	
99	4730205016	2.6x10 CPTS (1)	
⚠ 100	2129136015	POWER SWITCH	
101	1138110104	SW. KNOB	
102	2228456007	SERVO CONTROL PCB	29D
103	2228456007	SERVO CONTROL PCB	29E
104	KU-428	SERVO CONTROL UNIT	DP-31F
	KU-401	SERVO CONTROL UNIT	DP-32F
105	1138112102	MINI SW, KNOB	
106	1138111103	PUSH SW, KNOB	
107	3939042000	GL-9PR2 (LED)	
	3939043009	GL-9NG2 (LED)	
⚠ 108	2123315023	VOLTAGE SELECTOR	E1 only
109	4730204017	2.6x8 CBRTS (1)	E1 only

Note:
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E2: European conrinent
EF: France
EA: Australia
EK: U.K.

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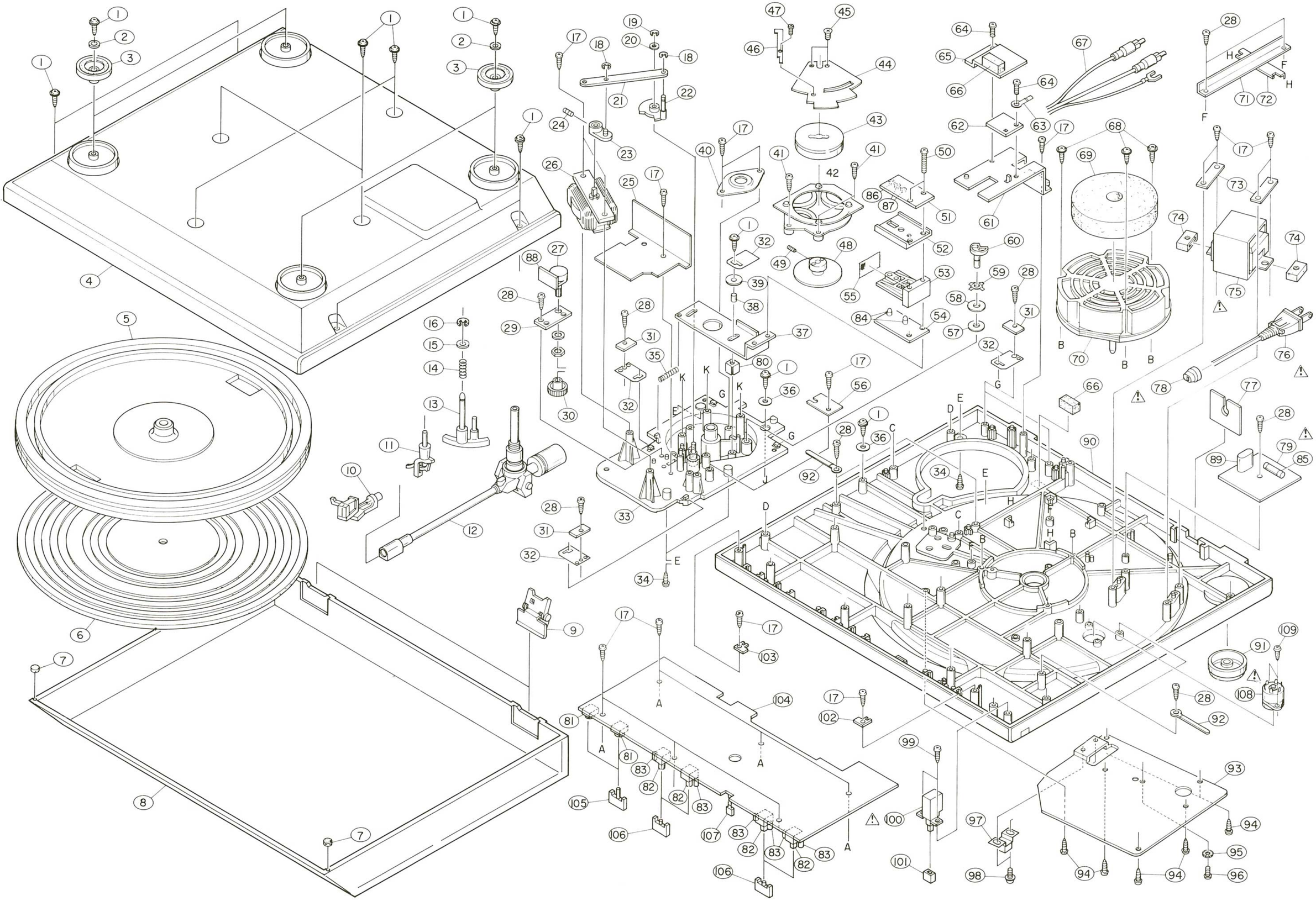
EXPLODED VIEW OF MAIN PARTS



CIRCUIT DIAGRAM

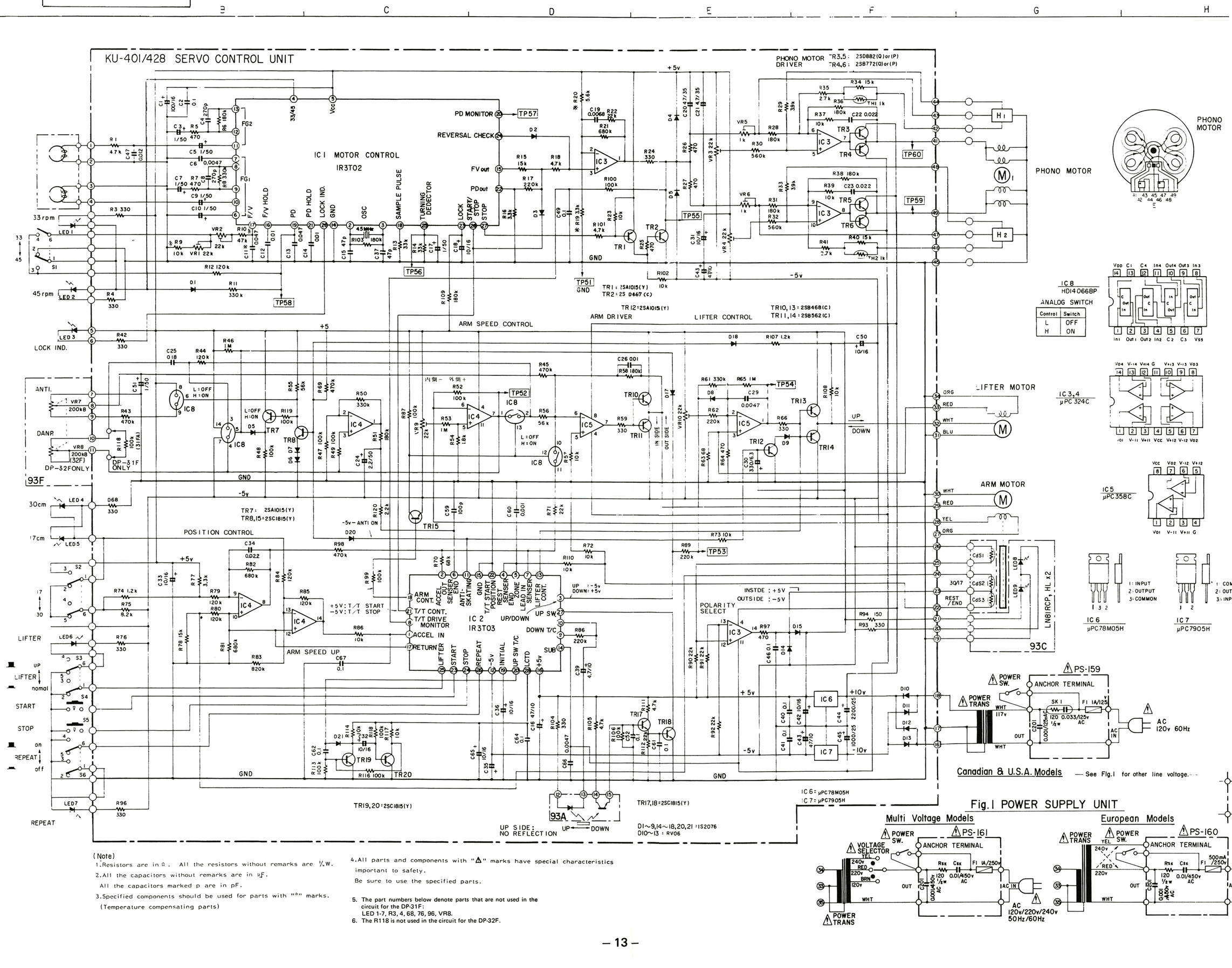
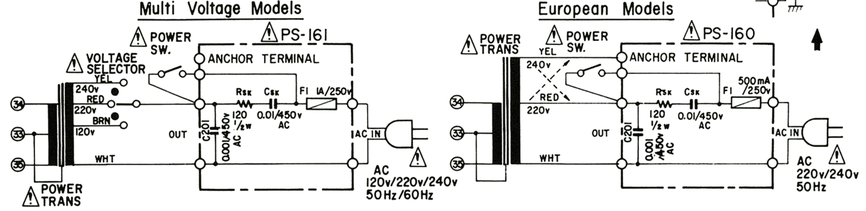


Fig.1 POWER SUPPLY UNIT

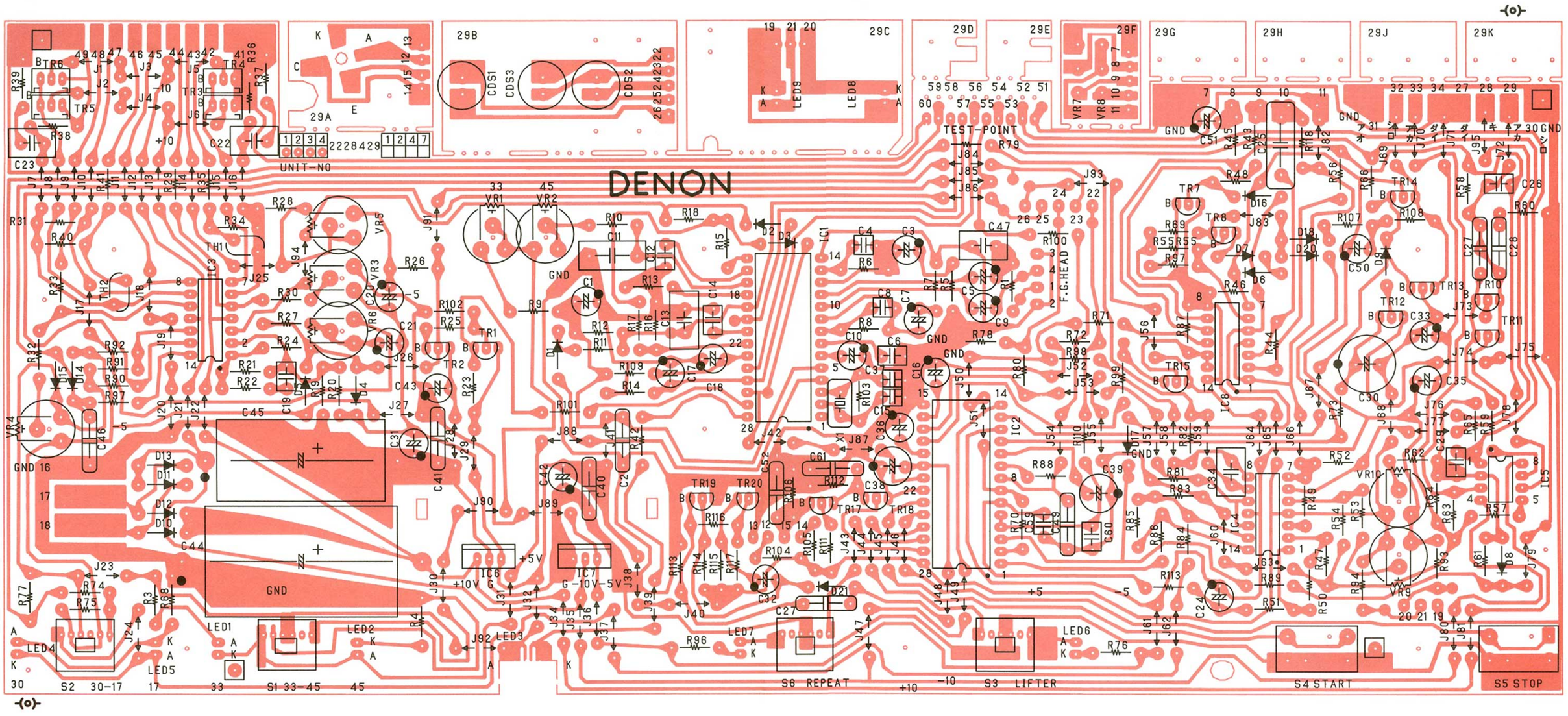


(Note)

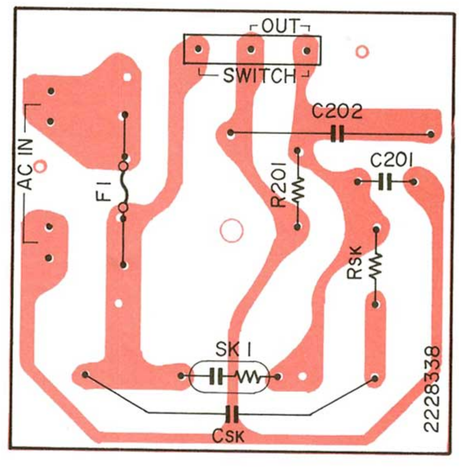
1. Resistors are in Ω. All the resistors without remarks are ¼W.
2. All the capacitors without remarks are in μF.
   All the capacitors marked p are in pF.
3. Specified components should be used for parts with "*" marks.
   (Temperature compensating parts)
4. All parts and components with "⚠" marks have special characteristics important to safety.
   Be sure to use the specified parts.
5. The part numbers below denote parts that are not used in the circuit for the DP-31F:
   LED 1-7, R3, 4, 68, 76, 96, VR8.
6. The R118 is not used in the circuit for the DP-32F.

PRINTED CIRCUIT BOARD

SERVO CONTROL UNIT



POWER SOURCE UNIT



⚠ PS-159/PS-163 POWER SOURCE UNIT

Ref. No.	Part No.	Part Name	Remarks
	2228338219	P.C. BOARD	
C201	2538004000	CK45B2BAC102KW	0.001μF 125VAC
SK1	2618006009	SPARK KILLAR	
	EE-1656	BASE TERMINAL	
	2050087039	3P TERMINAL	
F1	2061024007	FUSE	1A/125V UL
	FEP1258H2	FUSE CAP	PS-163 only

⚠ PS-160 POWER SOURCE UNIT

Ref. No.	Part No.	Part Name	Remarks
	2228338206	P.C. BOARD	
CSK	2518001007	CP05C==AC103M	0.01μF 450VAC
C201	2518001049	CP05C==AC102M	0.001μF 450VAC
RSK	2410163001	RD14B2H121J	120Ω ½W
F1	2061015003	FUSE	500mA/250V
	FEP1287	FUSE HOLDER	
	EE-1656	BASE TERMINAL	
	2050087042	4P TERMINAL	

⚠ PS-161 POWER SOURCE UNIT

Ref. No.	Part No.	Part Name	Remarks
	2228338206	P.C. BOARD	
CSK	2518001007	CP05C==AC103M	0.01μF 450VAC
C201	2518001049	CP05C==AC102M	0.001μF 450VAC
	2410163001	RD14B2H121J	120Ω ½W
F1	EP-72663	FUSE	1A/250V UL
	EE-1656	BASE TERMINAL	
	2050087042	4P TERMINAL	

ACCESSORIES GROUP

Ref. No.	Part No.	Part Name	Remarks
	5298006002	45 ADAPTOR	
	5118186109	INSTURCTION MANUAL	E2, E1, EA EK
	5118189009	INSTRUCTION MANUAL	EF, EC
	5118188000	INSTRUCTION MANUAL	EU
	5138195060	RATING SHEET	E2
	5138195057	RATING SHEET	E1
	5138195073	RATING SHEET	EA, EK
	5138197013	RATING SHEET	EF
	5138195044	RATING SHEET	EU
	5138218015	RATING SHEET	EC
	5138199008	LABEL	
	5130140000	EARTH LABEL	EA
	5130210008	NOTICE SHEET	EA

CARTON CASE GROUP

Ref. No.	Part No.	Part Name	Remarks
	5018188139	CARTON CASE ASS'Y	
	5028039207	PACKING ASS'Y	
	5048007002	SHEET	
	5048007028	SHEET	
	5058092010	LAMINATE ENVELOPE	500x600x0.06
	5058014056	ENVELOPE	30x200x0.03
	5058023018	ENVELOPE	350x640x0.05
	5058006006	ENVELOPE	60x100x0.03

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EA: Australia
EK: U.K.

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PARTS LIST

KU-428/401 SERVO CONTROL UNIT

Ref. No.	Part No.	Part Name	Remarks
SEMICONDUCTOR GROUP			
IC1	2630173004	IR3T02	
IC2	2630174003	IR3T03	
IC3, 4	2630146002	μPC324C	
IC5	2630161003	μPC358C	
IC6	2630147001	μPC78M05H	
IC7	2630160004	μPC7905H	
IC8	2620276005	HD14066BP	
TR1, 7, 12	2710102005	2SA1015 (Y)	
TR11, 14	2720025004	2SB562 (C)	
TR4, 6	2720055029	2SB772 (Q/P)	
TR2, 8, 15 17~20	2730198002	2SC1815 (Y)	
TR10, 13	2740036002	2SD468 (C)	
TR3, 5	2740078031	2SD882 (Q/P)	
D1~9, 14~18 20, 21	2760049008	1S2076	
D10~13	2760237001	RV06	
TH1, 2	2760311008	THERMISTOR	1KΩ
LED8, 9	3939041001	LED	LN81RP(HL)
cds1, 3	3939053002	CDS	
cds2	3939053028	CDS	
	3939152000	PHOTO REF.	NJL5141E-B
RESISTOR GROUP			
			Carbon film
R63	2412064001	RD14B2E680J	68ΩJ ¼W
R94	2412072006	RD14B2E151J	150ΩJ ¼W
R3, 4, 24, 42 59, 66, 68, 76, 93, 96, 104	2412080001	RD14B2E331J	330ΩJ ¼W
R5, 7, 25~27 64, 97	2412084007	RD14B2E471J	470ΩJ ¼W
R74, 107	2412094000	RD14B2E122J	1.2KΩJ ¼W
R54	2412098006	RD14B2E182J	1.8KΩJ ¼W
R120	2412100004	RD14B2E222J	2.2KΩJ ¼W
R35, 41	2412102002	RD14B2E272J	2.7KΩJ ¼W
R16, 77	2412104000	RD14B2E332J	3.3KΩJ ¼W
R29, 33	2412106008	RD14B2E392J	3.9KΩJ ¼W
R1, 18, 101 105, 111	2412108006	RD14B2E472J	4.7KΩJ ¼W
R75	2412114003	RD14B2E822J	8.2KΩJ ¼W
R23, 37, 39 57, 72, 73 86, 102, 108 110, 114, 117	2412116001	RD14B2E103J	10KΩJ ¼W
R15, 34, 40, 78	2412120000	RD14B2E153J	15KΩJ ¼W
R22, 71, 90~92, 112	2412124006	RD14B2E223J	22KΩJ ¼W
R13, 14	2412128002	RD14B2E353J	33KΩJ ¼W
R55, 56	2412134009	RD14B2E563J	56KΩJ ¼W
R70	2412136007	RD14B2E683J	68KΩJ ¼W
R47~49, 52, 87, 99, 100 106, 113, 115, 116, 118, 119	2412140006	RD14B2E104J	100KΩJ ¼W
R12, 44, 58, 78, 80, 84, 85	2412142004	RD14B2E124J	120KΩJ ¼W
R6, 28, 31, 36, 38, 50, 51, 103, 109	2412146000	RD14B2E184J	180KΩJ ¼W
R17, 62, 88, 89	2412148008	RD14B2E224J	220KΩJ ¼W

Ref. No.	Part No.	Part Name	Remarks
R8, 11, 61	2412152007	RD14B2E334J	330KΩJ ¼W
R43, 45, 68, 69	2412156003	RD14B2E474J	470KΩJ ¼W
R30, 32	2412158001	RD14B2E564J	560KΩJ ¼W
R21, 80, 81	2412160002	RD14B2E684J	680KΩJ ¼W
R83	2412162000	RD14B2E824J	820KΩJ ¼W
R46, 53, 65	2412164008	RD14B2E105J	1MΩJ ¼W
			Metal film
R19	2452195008	RN14K2E332G	3.3KΩG ¼W
R20	2452201002	RN14K2E562G	5.6KΩG ¼W
R9	2452207006	RN14K2E103G	10KΩG ¼W
R10	2452108901	RN14K2E473G	47KΩG ¼W
			Variable resistor
VR5, 6	EP-5462H7	SOLID VOLUME	1KΩ
VR1~4, 9, 10	EP-5462H15	SOLID VOLUME	22KΩ
VR7	2118068000	V16V20KB204	200KΩ
CAPACITOR GROUP			
			Ceramic
C59	2531055069	CK45B1H101K	
C60	2531004007	CK45B1H102K	
C29	2531008003	CK45B1H472K	
C2, 40, 41, 46, 49, 52, 61, 62	2531027000	CK45F1H104Z	
C15, 37	2533619005	CC45SL1H470J	
C4, 8	2533637003	CC45SL1H271J	
			Electrolitic
C30	2544005006	CE04W0J331=	330μF 6.3V
C16, 39, 43	2544129005	CE04W1A470=	47μF 10V
C18, 31~33, 35, 36, 42, 50, 65	2544132005	CE04W1C100=	10μF 16V
C1	2544136001	CE04W1C101=	100μF 16V
C45	2542037005	CE02W1E102=	1000μF 25V
C44	2542038004	CE02W1E222=	2200μF 25V
C20, 21	2544140000	CE04W1V4R7=	4.7μF 35V
C3, 5, 7, 9, 10, 17, 51	2544146004	CE04W1H010=	1μF 50V
C24	2544147003	CE04W1H2R2	22μF 50V
			Film
C11	2554194017	CQ93P1H473J	0.047μF 50V
C6, 66	2551068007	CQ93M1H472K	0.0047μF 50V
C19	2551070008	CQ93M1H682K	0.0068μF 50V
C12, 14, 26	2551072006	CQ93M1H103K	0.01μF 50V
C47	2551073005	CQ93M1H123K	0.012μF 50V
C22, 23, 34	2551076002	CQ93M1H223K	0.022μF 50V
C13	2551122008	CQ93M1H473J	0.047μF 50V
C25	2551122079	CQ93M1H184J	0.18μF 50V
OTHER PARTS GROUP			
	2228429005	P.C. BOARD	KU-428
	2228456007	P.C. BOARD	KU-429
	4178028101	HEAT SINK	
	3998023002	CRYSTAL	4.5MHz
S4, 5	2129067003	PUSH SWITCH	
S1, 2, 3, 6	2129089007	MINI PUSH SW	
	2045391002	10P MINI CONNE SOCKET	

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