

Service Manual

Direct drive automatic Turntable System

SL-1650 (M)



Specifications

Specifications are subject to change without notice for further improvement.

Turntable section

Type: Direct Drive Automatic Turntable System, Automatic start, Automatic return, Automatic shut-off, Multiple play with convenient "memo-gram" Knob, Repeat play and Manual play

Drive method: Direct Drive

Motor: Back Electromotive Force Frequency Generator servo DC motor employing one chip IC

Turntable platter: Aluminum die-cast, 33 cm (13")

Turntable speeds: 33-1/3 and 45 r.p.m.

Pitch controls: Individual adjustment controls, 10% adjustment range

Wow and flutter: 0.03% W.R.M.S. (JIS C5521) $\pm 0.042\%$ Weighted zero to peak (DIN 45507)

Rumble: -50 dB (DIN 45539A)
-70 dB (DIN 45539B)

Tonearm section

Type: Universal tubular arm, staticbalanced type

Effective length: 230 mm (9-1/16")

Overhang: 15 mm (19/32")

Friction: 7 mg (horizontally and vertically)
Effective mass: 22 g (6.0 g cartridge weight 1.75 g stylus pressure)

Tracking error angle: Within $+3^\circ$ [at the point of 145 mm (5-45/64") from the center]
within $+1^\circ$ [at the point of 55 mm (2-3/16") from the center]

Offset angle: 21.5°

Adjustable stylus pressure range: 0 to 3 g (stylus pressure direct reading type)

Cartridge weight range: 5 to 11 g

Head shell weight: 9.5 g

General

Power supply: AC 120 V, 50 or 60 Hz

Power consumption: 9 W

Dimensions: 17.5 x 45.3 x 36.5 cm
(6-7/8 x 17-12/16 x 14-3/8 inches)

Weight: 9.0 kg (19.8 lbs.)

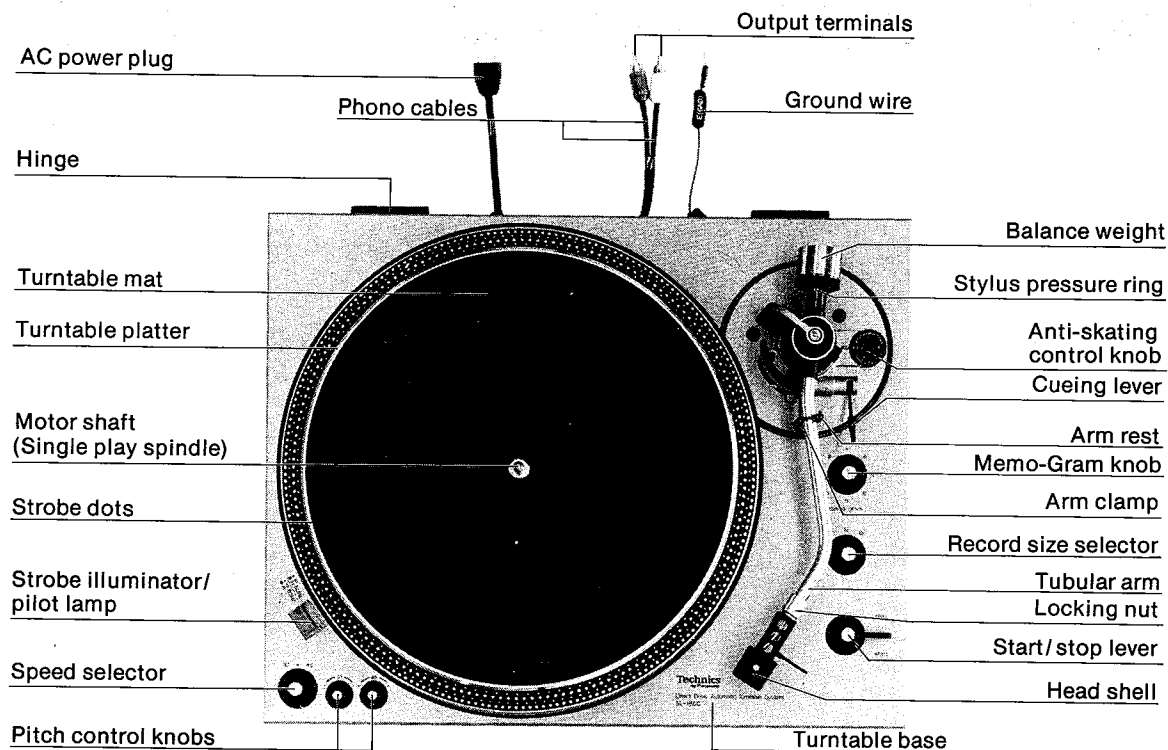
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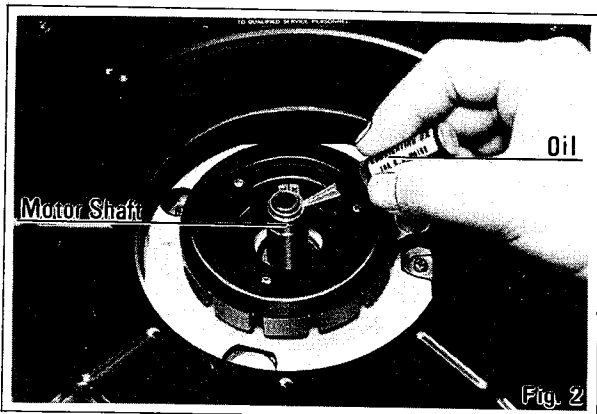
■ Parts identification



■ Assembly and set-up

Apply two or three drops of oil to the motor shaft using the furnished oil container. (See Fig. 2)

Although the unit has been lubricated before shipping from the factory, apply a few drops of oil to the motor shaft for assurance. After that, application of two or three drops of oil once every 2000 hours' operation or so is sufficient. The time interval is much longer than that of the former type motors (200 - 500 hours), so do not apply too much oil, nor more frequently than necessary. Never use any other type of oil.

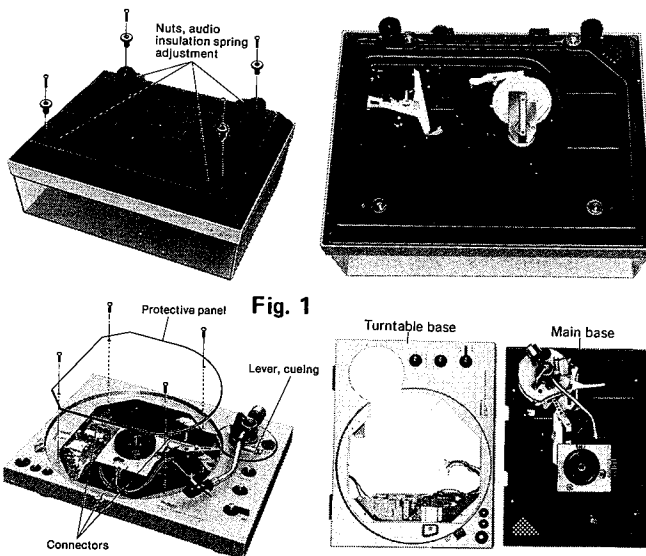


7. Holding the player firmly with both hands, to prevent separation of upper section (turntable base) from lower section (main base), turn it carefully upwards.
8. Remove the 4 screws from the protective top panel (Fig. 2).
9. Unplug the 3 plug-in connectors (main base).
10. To remove the turntable base from the main base bottom section, turn cueing lever upward (cueing position) and move tone arm towards center of spindle. Top section can be lifted up easily. (Fig. 3).

Note:

The turntable horizontally to the panel face is already adjusted before shipment.

If deviated, correct it by means of the adjust screws using a 5mm box spanner.



1. Remove headshell and balance weight.
2. Clamp tone arm to the arm rest.
3. Remove turntable platter.
4. Close dust cover.
5. Turn unit upside down taking special care not to damage or scratch the dust cover.
6. Remove the 4 legs and the 6 screws from bottom cabinet (main base) (Fig. 1).

■ Adjustments

Adjustment of the arm lift height (See Figs. 4 and 5)

The arm lift height (distance between the stylus tip and record surface when cueing lever is raised) has been adjusted at the factory before shipping to approximately 15 to 18mm.

If the clearance becomes too narrow or too wide because of the physical size of the different cartridges on the market turn the adjustment screw clockwise or counterclockwise, at the same time pushing the arm lift down.

Clockwise rotation

—distance between the record and stylus tip is reduced.

Counterclockwise rotation

—distance between the record and stylus tip increases.

Note:

As the adjusting screw has a hexagon head, be sure to make the adjustment while depressing the arm lift.

Adjustments for automatic start and automatic return positions (See Fig. 6)

Should the tonearm not function correctly, make adjustments according to the following procedures.

Adjustment for automatic start position

(Remove the rubber cap.)

In cases where the stylus tip descends outside of the record.

— Move clockwise.

In cases where the stylus tip descends onto halfway of a recorded piece.

— Move counterclockwise

Adjustment for automatic return position

(Remove turntable sheet.)

In cases where the tonearm tends to return before the playing has finished.

— Move clockwise.

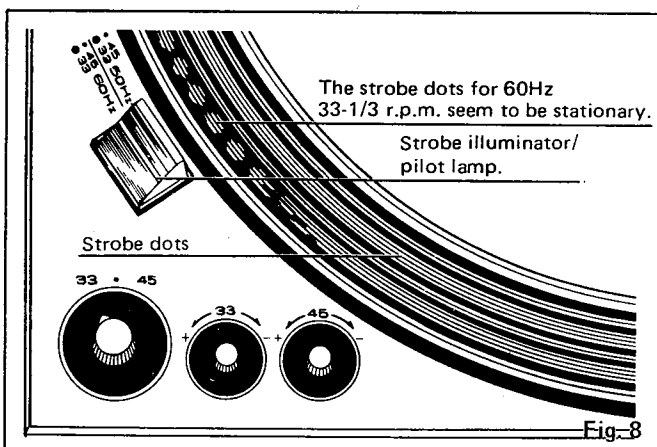
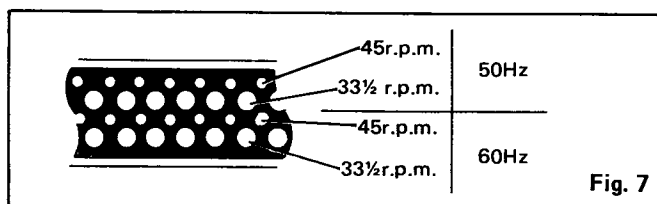
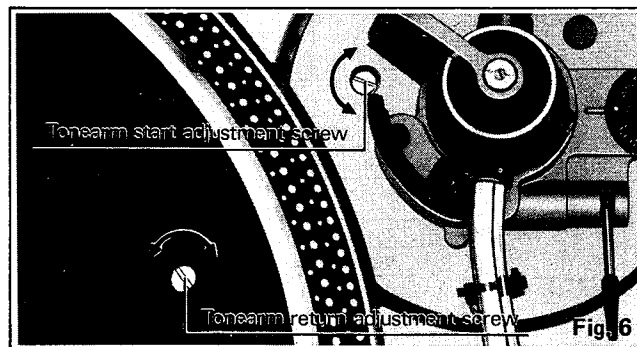
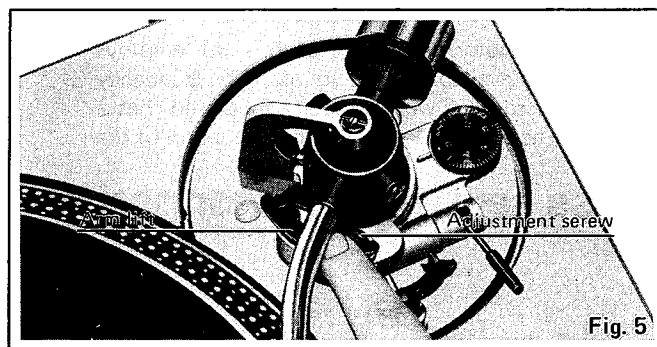
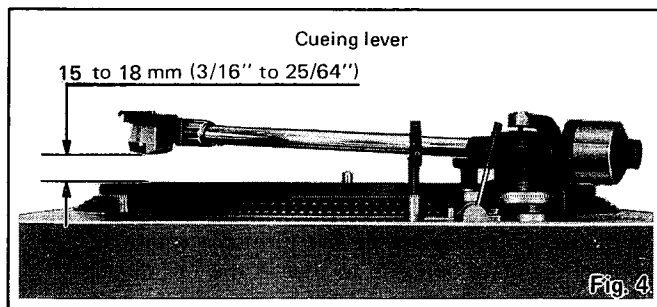
In cases where the tonearm fails to return after the last groove of the record.

— Move counterclockwise.

Speed adjustment (with pitch control knobs) (See Figs. 7, 8 and 9)

Strobe dots are set on the tapered rim of the turntable platter according to the power frequency and the number of revolutions of the records. Make adjustment, referring to strobe dot indication. (See Fig. 7)

1. Set the speed selector to the number of revolutions to be adjusted. (See Fig. 8)
2. Release the arm clamp and raise the cueing lever.
3. Move the tonearm to a slight extent towards the turntable platter.
The strobe illuminator/pilot lamp will be lit for illuminating the strobe dots.
4. While turning the pitch control knobs either to "+" side or "-" side, adjust to such an extent that the strobe dots of the turntable look as if they were stationary.



The state under which the strobe dots seem to be stationary represents the correct speed. (See Fig. 8)

"+" direction

This increases the speed of the turntable rotation, and the strobe dot pattern seems to flow in the same direction as the rotational direction of the turntable platter.

"-" direction

This decreases the speed of the turntable rotation, resulting in a state opposite to that in the "+" direction.

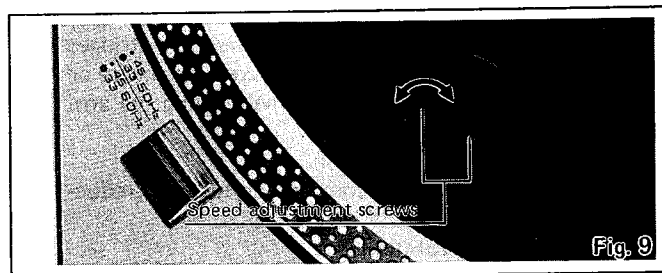
Note:

Strobe dot pattern.

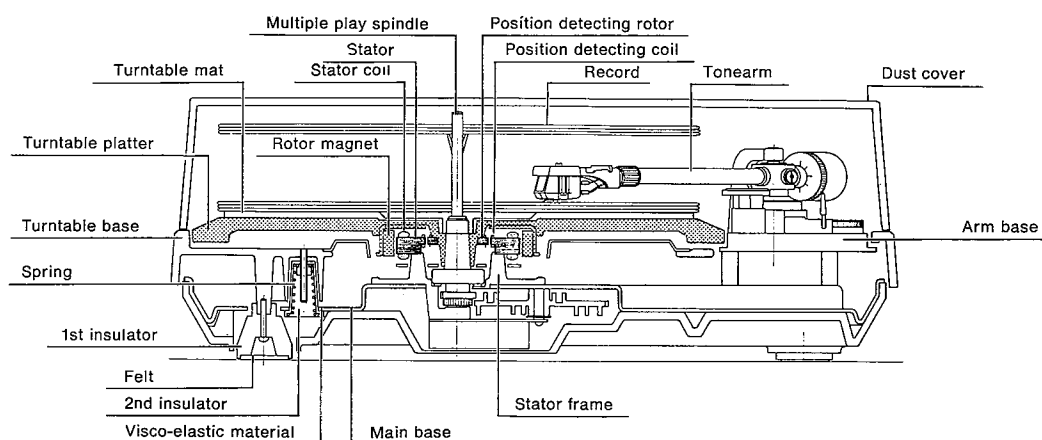
The strobe illuminator/pilot lamp of this unit employs the commercially available power source. The frequency of such power source, when actually measured, has a fluctuation of about 0.2%. As such a fluctuation of the

power source affects the strobe illuminator, the strobe dot pattern also seems to fluctuate to a certain extent. But the unit is not affected by the fluctuations of the power source, since a D.C. motor is employed.

5. If the desired speed can not be obtained by the variable pitch controls, turn the speed adjusting screws with a screw driver for further adjustments. (See Fig. 9)



■ Cross section of motor portion and double insulator



■ Operation principles of the SL-1650

This unit, like the SL 1300 has a rational motor structure, and its drive control circuit is the B.F.G. type (Back TECHNICAL EXPLANATION electromotive force frequency generator) which is constructed on a single integrated circuit (IC) chip (AN630). The following is a block diagram of the IC (AN630) for which the operating principle will be briefly explained.

■ Operating principle

The back electromotive force, which is generated by the drive coil winding according to the rotation of the motor, is detected and converted to a frequency signal that is proportional to the number of revolutions. Conversion is performed by a wave-shaping circuit and a logic circuit (This is referred to as the B.F.G. method). This frequency signal is compared with a standard signal by means of a frequency-voltage conversion circuit which converts it to a voltage signal in order maintain a constant number of revolutions. After removing unnecessary

frequency components, with the operational-amplifier active filter, from this voltage signal, it controls the current flow in three differential switching circuits. As a result, the flow of current in the drive coil winding is always constant maintaining the correct rotational speed. Control of the rotational speed can be performed by means of adjusting the standard signal generator circuit according to the rotational speed adjustment circuit.

■ Explanation of each part

1. B.F.G. METHOD (BACK ELECTROMOTIVE FORCE FREQUENCY GENERATOR)

Making use of the back electromotive force that is generated in the drive coil winding of the motor as a frequency generator, the frequency of the frequency generator is converted to the number of revolutions for the turntable.

After shaping the wave form of this back electromotive force, it is composed logically, and a frequency is generated that is proportional to the number of revolutions. This is the use of the B.F.G. Making use of the drive coil winding, frequency generator coil windings and magnets are not necessary, yielding a motor structure that is very compact.

2. FREQUENCY-VOLTAGE CONVERSION CIRCUIT

Being composed of a trapezoidal wave generating circuit, a pulse generating circuit and a sampling integration circuit, the B.F.G. output frequency is converted to a voltage, and control output voltage is generated in order to maintain the rotational speed of the turntable at a constant level.

3. OPERATION CONTROL CIRCUIT

The operation control circuit functions as a control output voltage control keeping the rotational speed of the turntable constant with regard to the start of turntable operation and the operation of the mechanism. With this circuit, transient response characteristics and starting characteristics are very good.

4. OPERATIONAL AMPLIFIER (OP AMP) ACTIVE FILTER

Because of using an operational amplifier in the active filter, an ideal filter operation is possible.

As a result, such high performance as a signal-to-noise (SN) ratio of 60 dB (IEC-B) and a wow-and-flutter level of 0.03% (WRMS) have been achieved.

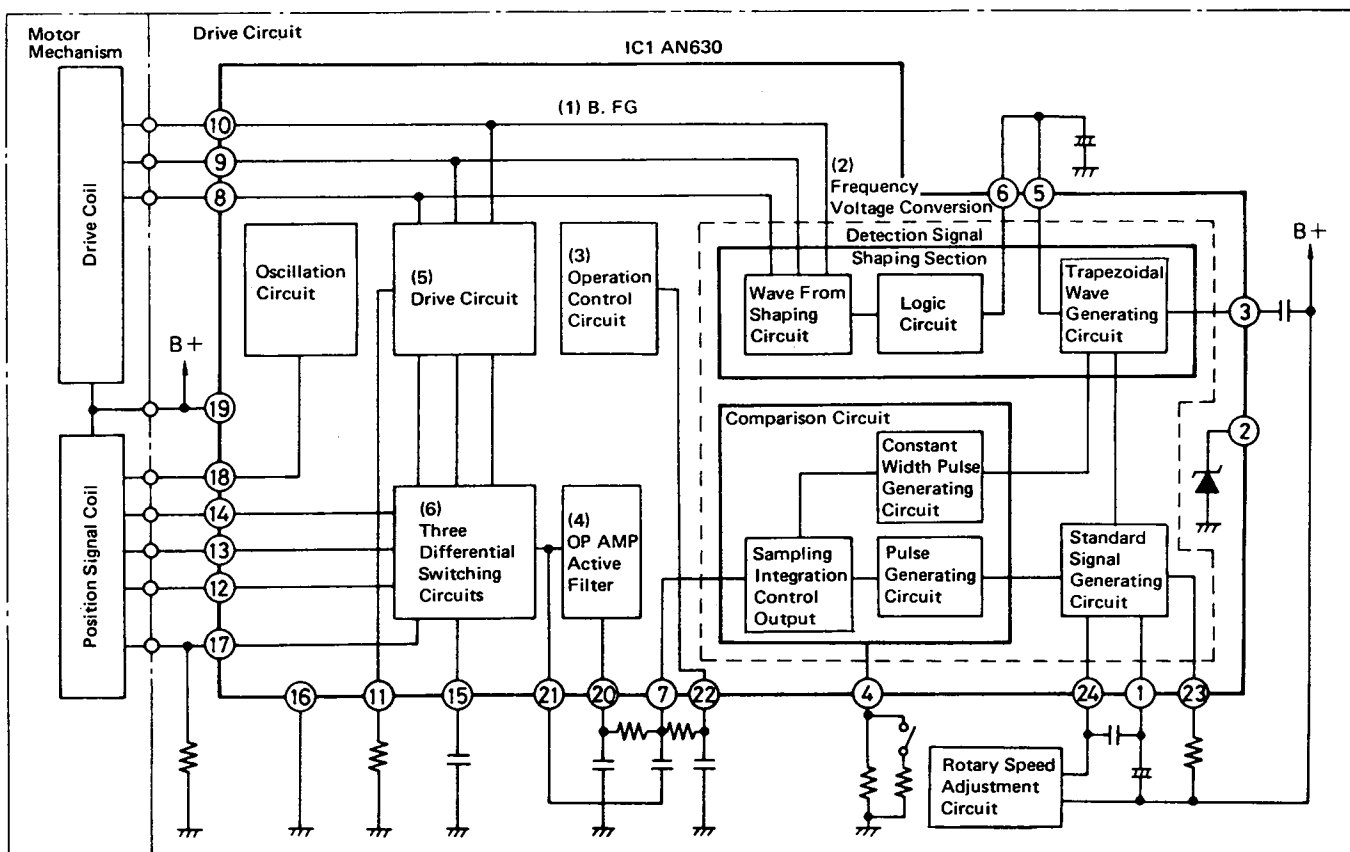
5. DRIVE CIRCUIT

By incorporating a large capacity power transistor in the integrated circuit, a starting torque of 1 kg-cm can be obtained. By means of this large starting torque, prompt starts have been realized.

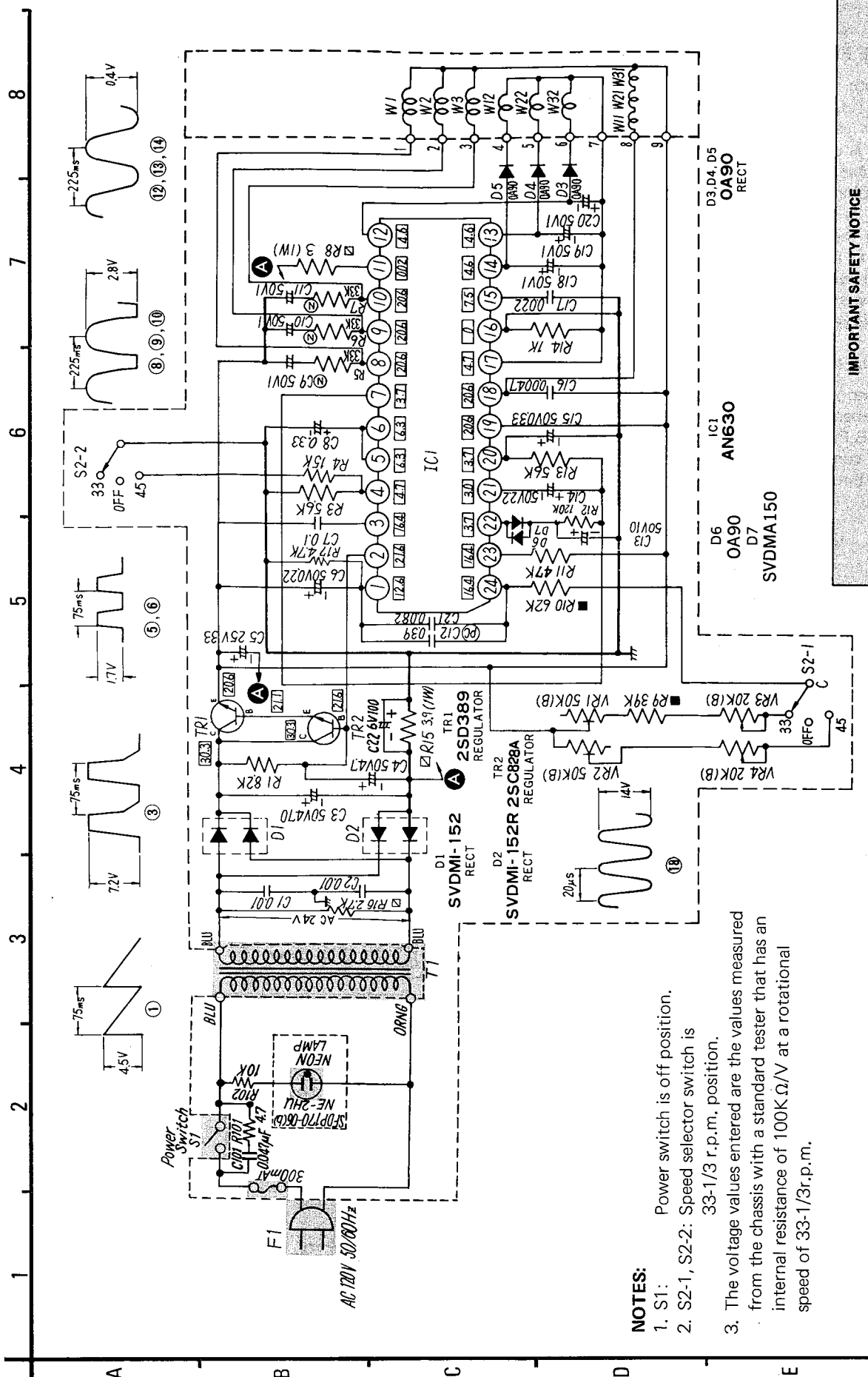
6. THREE DIFFERENTIAL SWITCHING CIRCUITS

By means of the signal from the position signal coil, the starting circuit power transistor selector operates, obtaining smooth rotation.

■ Block diagram



This schematic diagram may be modified at any time with the development of new technology)



IMPORTANT SAFETY NOTICE

THE SHADED AREA ON THIS SCHEMATIC DIAGRAM INCORPORATES SPECIAL FEATURES IMPORTANT FOR SAFETY.

WHEN SERVICING IT IS ESSENTIAL THAT ONLY MANUFACTURER'S SPECIFIED PARTS BE USED FOR THE CRITICAL COMPONENTS IN THE SHADED AREAS OF THE SCHEMATIC.

■ Circuit Board Wiring View

IC1 AN630

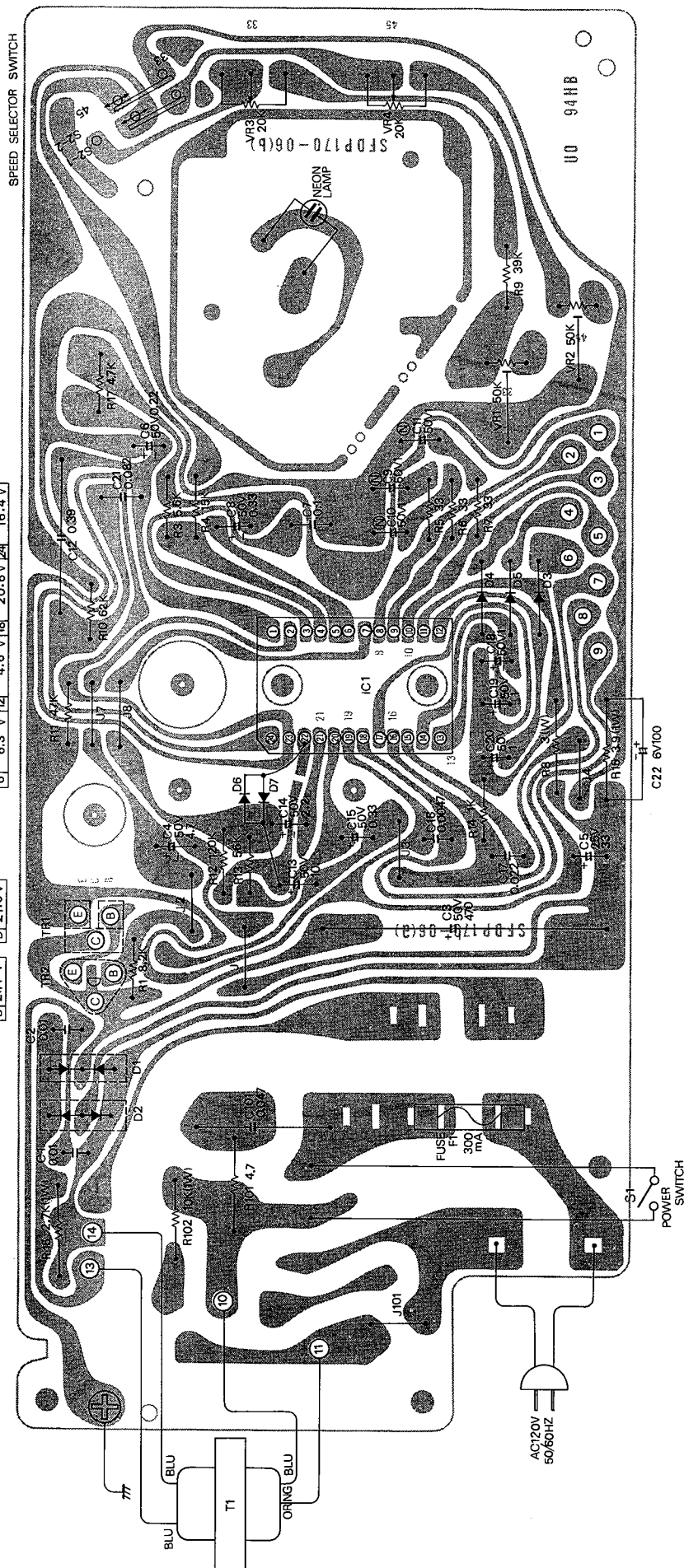
1	12.6 V	7	3.7 V	13	4.6 V	19	20.6 V
2	21.6 V	8	20.6 V	14	4.6 V	20	3.7 V
3	16.4 V	9	20.6 V	15	7.5 V	21	3 V
4	4.7 V	10	20.6 V	16	0 V	22	3.7 V
5	6.3 V	11	0.06 V	17	4.7 V	23	16.4 V
6	6.3 V	12	4.6 V	18	20.6 V	24	16.4 V

TR1 2SD389

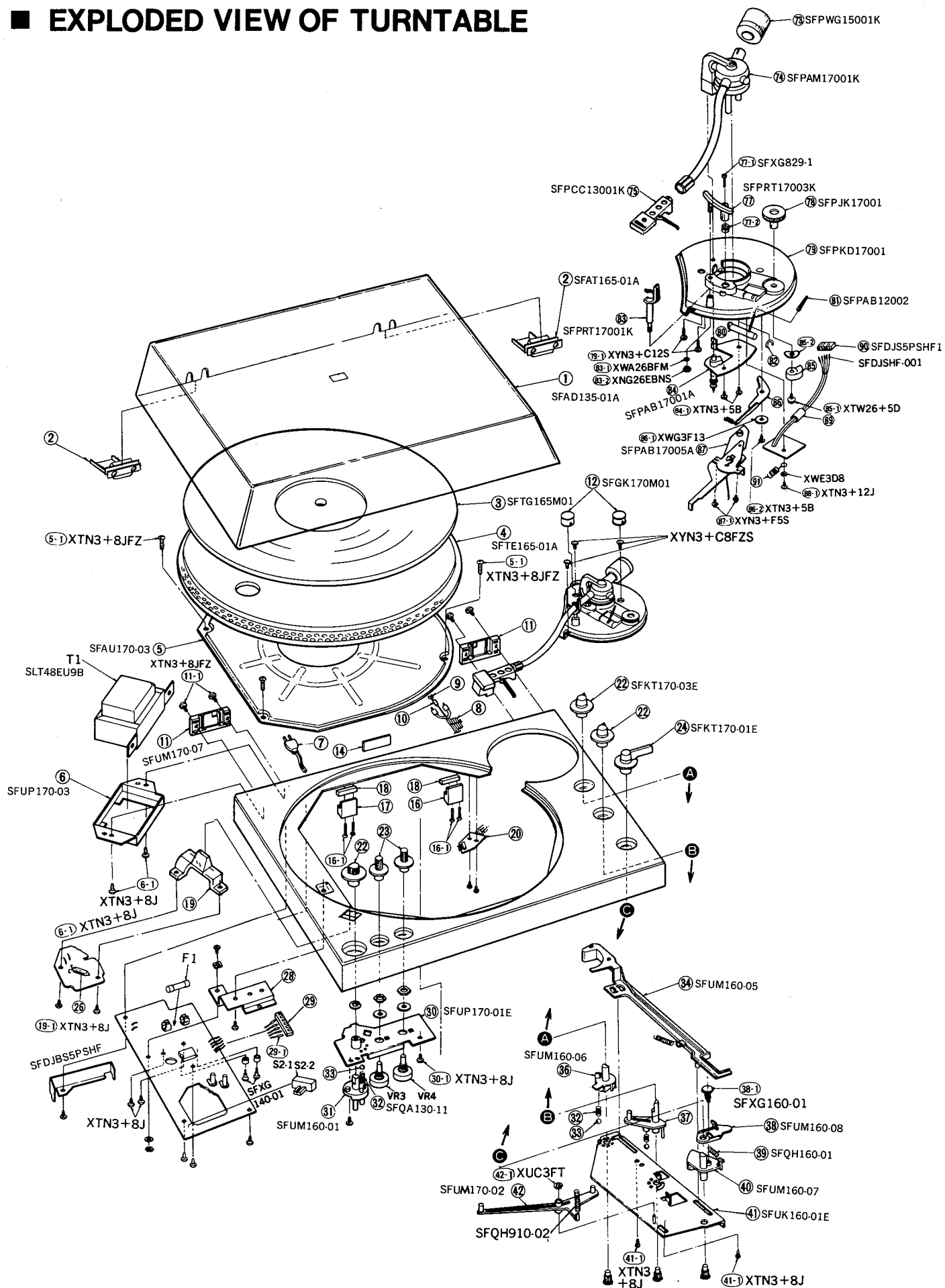
E	20.6 V
C	30.3 V
B	21.1 V

TR2 2SC828

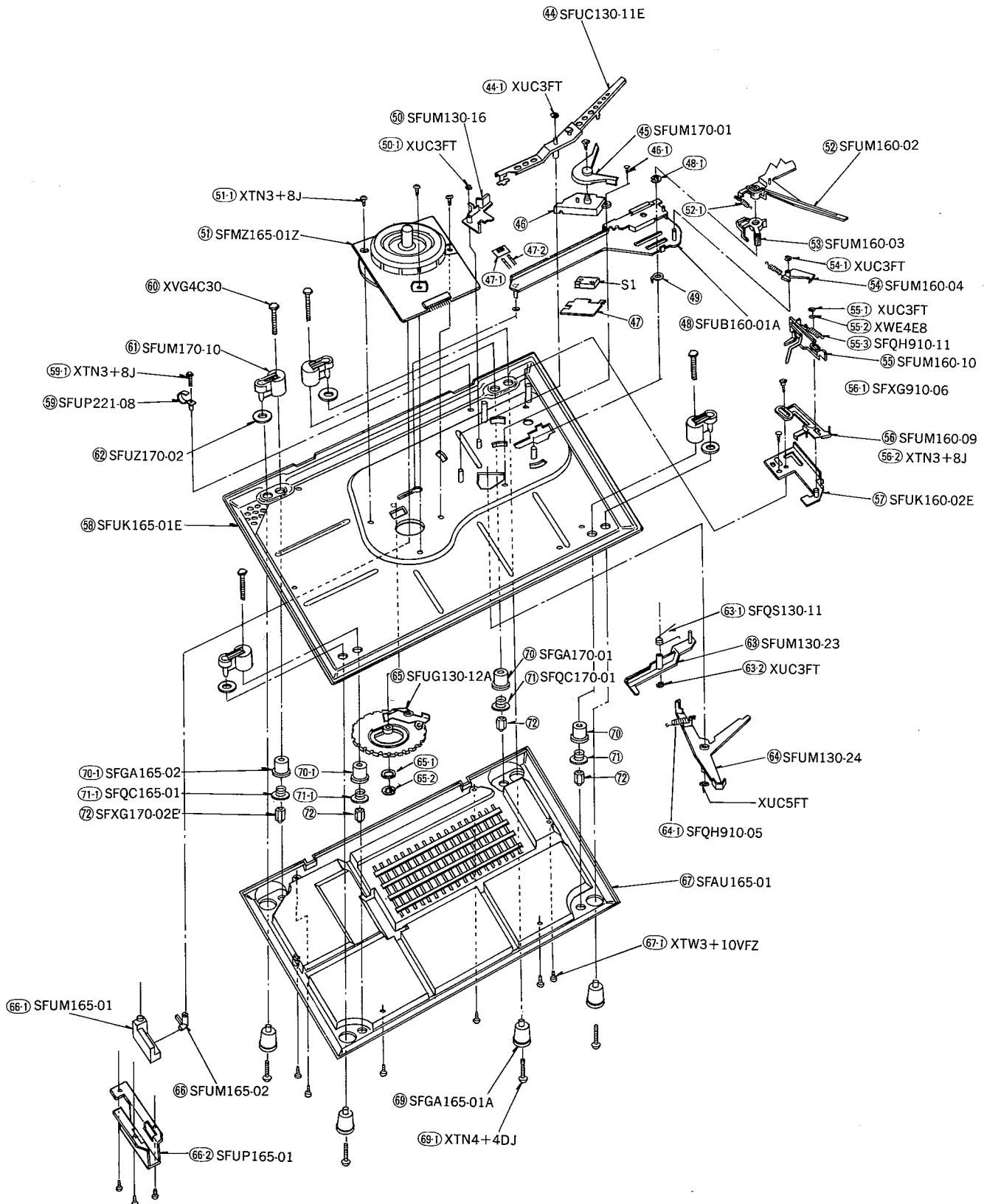
E	21.1 V
C	30.3 V
B	21.6 V



■ EXPLODED VIEW OF TURNTABLE



■ EXPLODED VIEW OF TURNTABLE



REPLACEMENT PARTS LIST

Important Safety Notice
Components identified by shaded area have special characteristics important for safety. When replacing any of these components use only manufacturer's specified parts.

NOTE: 1. Part numbers are indicated on most mechanical parts.
Please use this part number for parts orders.

Ref. No.	Part No.	Part Name & Description	Per Set	Remarks
INTEGRATED CIRCUIT				
IC1	AN630U	Integrated Circuit	1	O
TRANSISTORS				
TR1	2SD389A-Q	Transistor	1	
TR2	2SC132B-T	Transistor	1	
DIODES				
D1	RVD10DC2	Diode	1	
D2	RVD10DC2R	Diode	1	
D3, 4, 5, 6	OA90	Diodes	4	
D7	SVDMA150	Diode	1	
TRANSFORMER				
T1	SLT48E-09B	Power Transformer	1	
FUSE				
F1	XBA2F03NU160	0.3A (Fuses)	1	
VARIABLE RESISTORS				
VR1, 2	EVLV3AS15B54	50K Ω , Pitch controls	2	
VR3, 4	EVHGMAF15B24	20K Ω , Speed adjustment	2	
SWITCHES				
S1	SFDSA176503	Micro Switch, Power	1	
S2-1, S2-2	SFDS160-02	Speed selector Switch	1	
RESISTORS				
R1	ERD25TJ622	8.2K Ω , 1/4W, $\pm$ 5%, Carbon	1	
R3	ERD25TJ562	5.6K Ω , 1/4W, $\pm$ 5%, Carbon	1	
R4	ERD25TJ153	15K Ω , 1/4W, $\pm$ 5%, Carbon	1	
R5, 6, 7	ERD25TJ330	33 Ω , 1/4W, $\pm$ 5%, Carbon	3	
R8	ERX1ANJ3R3	3.3 Ω , 1W, $\pm$ 5%, Metallic	1	
R9	ERD25CKF3902	39K Ω , 1/4W, $\pm$ 1%, Metallic	1	
R10	ERD25CKF6202	62K Ω , 1/4W, $\pm$ 1%, Metallic	1	
R11	ERD25TJ473	47K Ω , 1/4W, $\pm$ 5%, Carbon	1	
R12	ERD25TJ124	120K Ω , 1/4W, $\pm$ 5%, Carbon	1	
R13	ERD25TJ563	56K Ω , 1/4W, $\pm$ 5%, Carbon	1	
R14	ERD25TJ102	1K Ω , 1/4W, $\pm$ 5%, Carbon	1	
R15	ERX1ANJ3R9	3.9 Ω , 1W, $\pm$ 5%, Metallic	1	
R16	ERG1ANJ272	2.7K Ω , 1W, $\pm$ 5%, Metallic	1	
R17	ERD25TJ472	4.7K Ω , 1/4W, $\pm$ 5%, Carbon	1	
R101	ERD50TJ4R7	4.7 Ω , 1/2W, $\pm$ 5%, Carbon	1	
R102	ERG1ANJ103	10K Ω , 1W, $\pm$ 5%, Metallic	1	

Ref. No.	Part No.	Part Name & Description	Per Set	Remarks
CAPACITORS				
C1, 2	ECOM1H103KZ	0.01 μ F, 50WV, $\pm$ 10%, Polyester	2	
C3	ECB63V470	470 μ F, 50WV, -10 - +50%, Electrolytic	1	
C4	ECEA50M4R7R	4.7 μ F, 50WV, $\pm$ 20%, Electrolytic	1	
C5	ECEA25V33	33 μ F, 25WV, -10% - +50%, Electrolytic	1	
C6	ECEA50Z2R22	0.22 μ F, 50WV, $\pm$ 20%, Polyester	1	
C7	ECQM1H104KZ	0.1 μ F, 50WV, $\pm$ 10%, Electrolytic	1	
C8	ECEA50Z2R33	0.33 μ F, 50WV, $\pm$ 10%, Electrolytic	3	
C9, 10, 11	ECEA50V1	1 μ F, 200V, $\pm$ 10%, Polyester	1	
C12	ECQC2394KN	0.39 μ F, 50WV, $\pm$ 20%, Electrolytic	1	
C13	ECEA50M10R	2.2 μ F, 50WV, $\pm$ 20%, Electrolytic	1	
C14	ECEA50M2R2R	0.33 μ F, 50WV, $\pm$ 20%, Electrolytic	1	
C15	ECEA50MR33R	0.47 μ F, 50WV, $\pm$ 10%, Polyester	1	
C16	ECQM1H472KZ	0.022 μ F, 50WV, $\pm$ 10%, Electrolytic	3	
C17	ECOM1H223KZ	1 μ F, 50WV, $\pm$ 10%, Polyester	1	
C18, 19, 20	ECEA50V1	0.082 μ F, 50WV, $\pm$ 10%, Polyester	1	
C21	ECOM1H823KZ	0.047 μ F, 125V, $\pm$ 20%, Polyester	1	
C101	ECQF1A473MD	100 μ F, 10V, $\pm$ 20%, Electrolytic	1	
C22	ECEA10V100			
CABINET and CHASSIS PARTS				
1	SFAD135-01A	Dust Cover	1	
2	SFAT165-01A	Hinge Ass'y	2	
3	SFTG165M01	Turntable Mat	1	
4	SFTE165-01A	Turntable	1	
5	SFAU170-03	Panel Cover	1	
5-1	XTN3+8JFZ	Screw	4	
6	SFUP170-03	Bracket, Transformer	1	
6-1	XTN3+8J	Screw	2	
7	RJA10A	AC Power Cord	1	
8	SFDH360M01	Phono Cord	1	
9	SFEL028-01E	Ground Wire Ass'y	1	
11	SFUM170-07	Case, Hinge	2	
11-1	XTN3+8JFZ	Screw	4	
12	SFGK170M01	Rubber Cap	2	
13	SFAC165M01	Player Case	1	
14	SFNN165M01	Name Plate	1	
16	SFUM170-11	Clamper, Phono Cord	1	
16-1	XTN3+14TFZ	Screw	4	
17	SFUM170-05	Clamper, AC Power Cord	1	
18	SFUM170-06	Spacer, AC Power Cord	1	
19	SFUM130-01	Base, Neon Lamp	1	
19-1	XTN3+8J	Screw	2	
20	SFDP170-03	P.C.B. Phono Cord	1	
20-1	XTN3+8J	Screw	2	
22	SFKT170-03E	Knob, Selector	3	
23	SFKT170-04E	Knob, Speed Adjustment	2	
24	SFKT170-01E	Knob, Start	1	
25	SJT345	Holder, Fuse	2	
26	SFONJ2HJ	Neon Lamp	1	
29	SFDJ5047-09	Connector	1	
29-1	SFDJ2759	Terminal	1	
30	SFUP170-01E	Bracket, Variable Resistor	1	
30-1	XTN3+8J	Screw	2	
31	SFUM160-01	Cam, Selector	1	
32	SFOA130-11	Spring, Cam	1	
33	SFYB5-32	Steel Ball	1	
34	SFUM160-05	Starting Plate	1	
35	SFOH910-11	Spring, Starting Plate	1	

Ref. No.	Part No.	Part Name & Description	Per Set	Remarks
36	SFUM160-06	Cam, Repeat	1	
37	SFUM160-01	Cam, Selector	1	
38	SFUM160-08	Cam, Start B	1	
39	SFQH160-01	Spring	1	
40	SFUM160-07	Cam, Start A	1	
41	SFUK160-01E	Plate, Operation	1	
41-1	XTN3+8J	Screw	2	
42	SFUM170-02	Cutting Plate	1	
42-1	XUC3FT	Circlip	1	
43	SFQH001-02	Spring, Catting Plate	1	
44	SFUC130-11E	Actuating Plate Ass'y	1	
44-1	XUC3FT	Circlip	1	
45	SFUM170-01	Lever, Cut	1	
45-1	XTN3+8B	Screw	1	
46	SFUM170-08	Cover, Micro Switch	1	
46-1	XTN3+8J	Screw	1	
47	SFUP170-06	Base, Micro Switch	1	
47-1	SFDJ2139-03	Connector	1	
47-2	SFDJ2478	Terminal	2	
48	SFUB160-01A	Operating Plate Ass'y	1	
48-1	XUC5FT	Circlip	1	
49	SF-XW130-13	Washer	1	
50	SFUM130-16	Support, Switch	1	
50-1	XUC3FT	Circlip	1	
51	SFMZ165-01Z	D.D. Motor	3	
51-1	XTN3+8J	Screw	1	
52	SFUM160-02	Index Plate Ass'y	1	
52-1	SFQH160-02	Spring	1	
53	SFUM160-03	Support, Index Plate	1	
54	SFUM160-04	Lever, Repeat	1	
54-1	XUC3FT	Circlip	1	
55	SFUM160-10	Plate, Sensing	1	
55-1	XUC3FT	Circlip	1	
55-2	XWE4E8	Washer	1	
55-3	SFQH910-11	Spring	1	
56	SFUM160-09	Support, Start Plate	1	
56-1	SFXG910-06	Screw	1	
56-2	XTN3+8J	Screw	1	
57	SFUK160-02E	Plate, Auxiliary Plate	1	
58	SFUK165-01E	Plate, Main Base	1	
59	SFUP221-08	Clamper, Cord	1	
59-1	XTN3+8J	Screw	1	
60	XVG4C30	Hexagon Bolt	4	
61	SFUM170-10	Support, Insulation	4	
62	SFUZ170-02	Felt, Insulation	4	
63	SFUM130-23	Plate, Gear Setting	1	
63-1	SFOS130-11	Spring, Gear Setting	1	
63-2	XUC3FT	Circlip	1	
64	SFUM130-24	Lever, Switch	1	
64-1	SFQH910-05	Spring, Lever	1	
65	SFUG130-12A	Main Gear Ass'y	1	
65-1	SF-XW890B01	Washer	1	
65-2	XUC5FT	Circlip	1	
66	SFUM165-02	Plate, Spindle	1	
66-1	SFUM165-01	Cam, Spindle	1	
66-2	SFUP165-01	Holder, Spindle cam	1	
67	SFAU165-01	Bottom Cover	1	
67-1	XTW3+10VZF	Screw	6	
69	SFGA165-01A	Foot, Audio Insulation	4	
69-1	XTN4+4DJ	Screw	4	

Ref. No.	Part No.	Part Name & Description	Per Set	Remarks
70	SFGA170-01	Rubber, Insulation	2	
70-1	SFGA165-02	Rubber, Insulation	2	
71	SFQC170-01	Spring, Cushion	2	
71-1	SFQC165-01	Spring, Cushion	2	
72	SFXG170-02E	Nut	4	
73	SFPWG15001K	Balance Weight Ass'y	1	
74	SFPAM17001K	Tone Arm Ass'y	1	
75	SFPC13001K	Head Shell	1	
77	SFPRT17003K	Life Ass'y	1	
77-1	SFXG829-1	Screw, Tone Arm Rest Adjustment	1	
77-2	SFOA829-03	Spring, Lift	1	
78	SFPJK17001	Knob, Anti-Skate Force Control	1	
79	SFPKD17001	Arm Base	1	
79-1	SYNHC12S	Screw	2	
80	SFPJL00101K	Cueing Lever	1	
81	SFPAB12002	Knob, Lift	1	
82	SFPGM20001	Rubber, Cueing	1	
83	SFPRT17001K	Arm Rest	1	
83-1	XWA26BFM	Washer	1	
83-2	XNG26EBNS	Nut	1	
84	SFPAB17001A	Arm Lift Ass'y	1	
84-1	XTN3+5B	Screw	2	
85	SFPJK17002	Cam, Canceler A	1	
85-1	XTW26+5D	Screw	1	
85-2	SFEW13005	Washer	1	
86	SFSPH17001	Lever, Canceler	1	
86-1	XWG3F13	Washer	1	
86-2	XTN3+5B	Screw	1	
87	SFPAB17005A	Plate, Tone Arm	1	
87-1	XYN3+FS	Screw	2	
88-1	XTN3+12J	Screw	1	
89	SFGT829T02	Tube	1	
90	SFDJS5PSHF1	Connector, 5P	1	
91	SFPSP17003	Spring	1	

ACCESSORY PARTS

A1	SFNU165M01	Instruction Book	1	
A2	SFVA165M01Z	Spindle, EP	1	
A3	SFVS165-01A	Spindle	1	
A4	SFVS135-02	Spindle, Manual	1	
A5	SFW0010	Oil	1	
A6	SFWE154A1	45 rpm Adaptor	1	
A7	SFPEV7800	Screw, Cartridge	2	
A8	SFCZV8800	Screw, Cartridge	2	
A9	SFYF05A06	Polyethylene Bag	1	
A10	SFKO135M01E	Overhang Gauge	1	

PACKING MATERIALS

P1	SFHP165M01	Carton	1	
P2	SFHH165-01	Pad, Front	1	
P3	SFHH165-02	Pad, Rear	1	
P4	SFHD165-01	Pad, Top	1	
P5	SFHD165-02	Pad, Turntable	1	
P6	SFHS170-02	Spacer, Arm Base	1	
P6-1	SFHS165-01	Spacer, Panel	2	
P7	SFHY60A60	Polyethylene Bag	2	
P7-1	SFYF45A50	Polyethylene Bag	1	
P7-2	SFYF10A30	Polyethylene Bag	2	
P8	SFHH165-03	Part Box	1	
P8-1	SFHH165-04	Top Lid, Part Box	1	

■ PACKING PARTS

