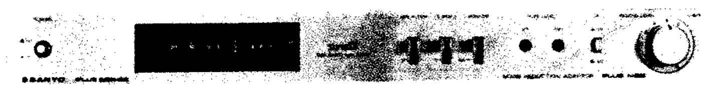
SERVICE MANUAL

NOISE REDUCTION SYSTEM

SANYO

PLUS N55

(EUROPE)



SILVER

BLACK

SPECIFICATIONS

Systems	Level companion & complementary band division
Companion rates	Compression rate: 1/2 Expansion rate: 2/1
SN ratio improvement	35 ~ 40dB (concerning tape decks with SN ration of 50dB or more)
Distortion rate	0.08% (reference input level: 1kHz)
No. of channels	4 (2 recording and 2 playback channels)
Input impedance/sensitivity	LINE IN: 50KΩ/100mV PB (playback) OUT: 50KΩ/85mV
Output impedance/level	LINE OUT: 7KΩ or lower/0.53V (at 50KΩ load) REC OUT: 7KΩ or lower/80mV (at 50KΩ load)
Frequency response	10Hz ~ 30kHz (during encoding & decoding processes)
Power supply	AC 115/220V, 50Hz
Power consumption	12W
Outside dimensions	17 3/8"(W) x 10 11/16"(D) x 1 3/4"(H) (440 x 270 x 44 mm)
Weight	9.5 lbs (4.3 kg)

* The specifications and design change without notice.

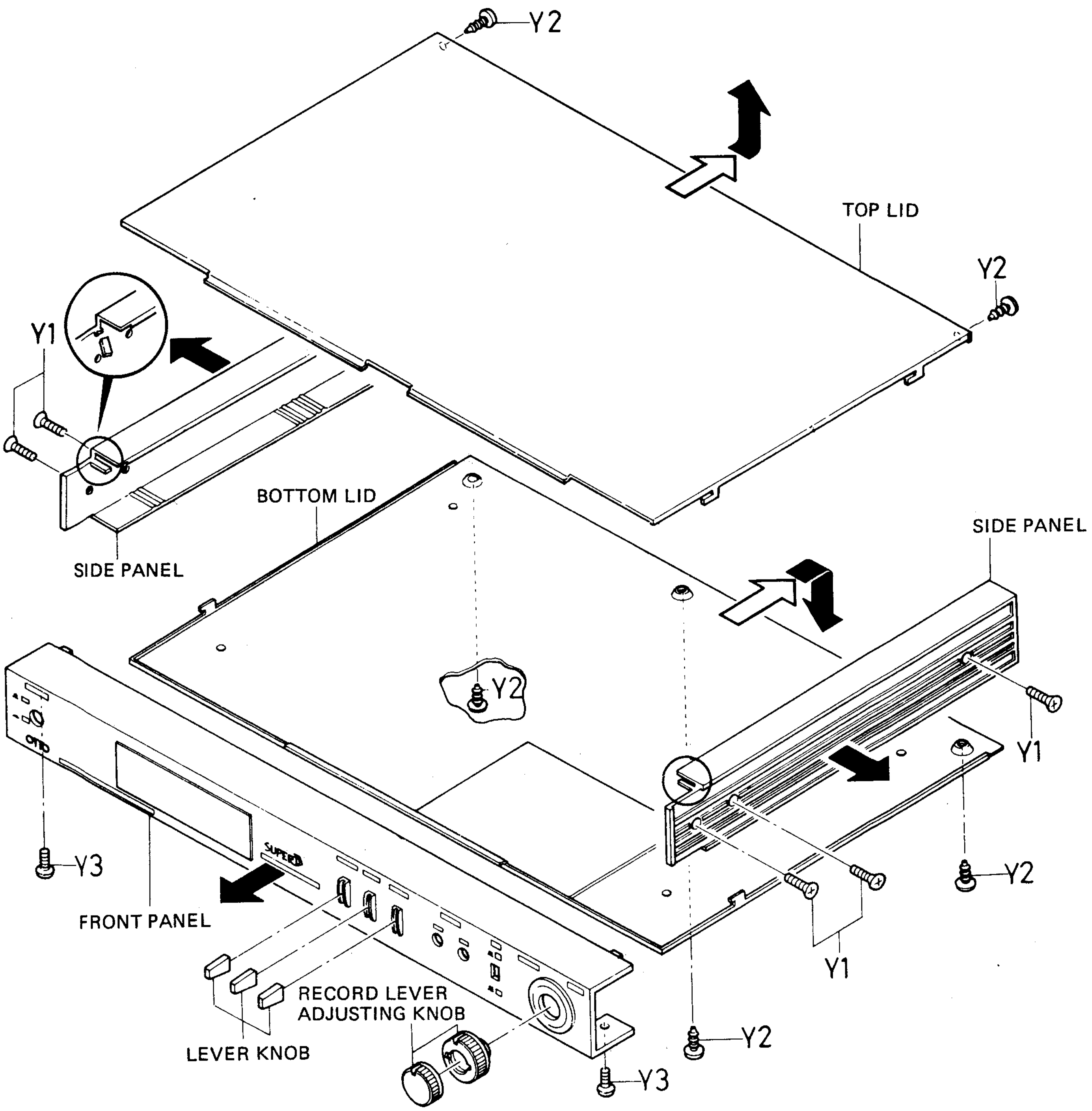
REMOVAL OF CABINET AND CHASSIS

1. **Removing the top lid**
   Take out 2 screws Y2 (binding head tapping, 3 x 6mm) from the top lid, slide the lid rearward about 1cm, and pull it off upwards.

2. **Removing the side panels**
   Take out 6 screws Y1 (flat head, 4 x 10mm) from right and left side panels, and dismount the panels gradually, using care not to break the pawl part (encircled part).

3. **Removing the front panel**
   Take out 3 lever knobs, 2 RECORD LEVEL adjusting knobs, and 2 screws Y3 (pan head, 3 x 6mm) from the front side of the head, then the panel can be dismounted forward.

4. **Removing the bottom lid**
   Take out 3 screws Y2 (binding head tapping, 3 x 6mm) from the bottom lid, and remove the bottom lid downward while sliding it about 5mm rearward.



NOISE REDUCTION ADAPTER

Outline

When recording input signals having a wide dynamic range into a cassette tape recorder, the upper limit of dynamic range of tape recorder is limited by the tape saturation level and the lower limit by the tape hiss noise level, as shown in Fig. 1, and the recording is disturbed by distortion when the signal is large or by noise when the signal is small.

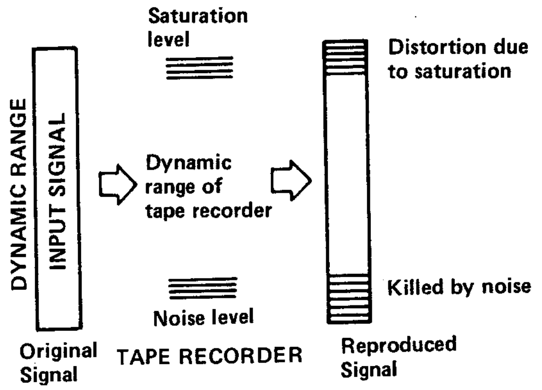


Fig. 1- Normal record and playback.

In order to solve this problem, various noise reduction methods have been developed conventionally, and saturation distortion has been improved owing to the dynamic range expanded by the reduction of hiss noise.
Among the methods to perform complementary signal compression and expansion in record and playback for noise reduction purpose, there is a method to use an encoder (a compressor) to compress signals to high level when recording and a decoder (an expander) to expand signals when playing back to return to the original level so as to reduce the noise existing between them. This is generally called a "compander." (See Fig. 2.)

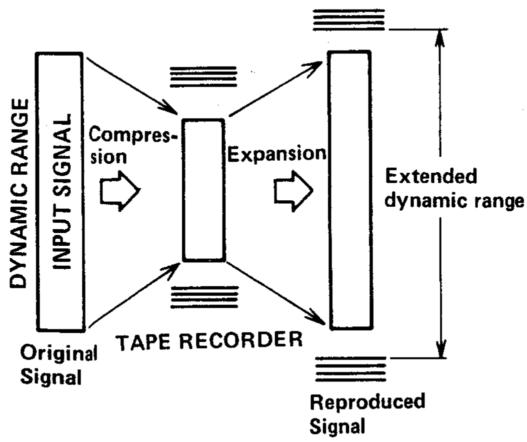


Fig. 2- Record and playback by compression and expansion.

However, the conventional companders have not been satisfactory with respect to the fidelity. Recently, thanks to the progress of semiconductor technology including ICs, the fidelity has been greatly improved.
The "Super D" method is a new circuit method intended to compress and expand in two divisions: medium-low band, and medium-high band.

Compander

The basic constitution of the compander is shown in Fig. 3. Both the compressor and the expander are composed of variable gain amplifier and signal level detector (or level sensor).

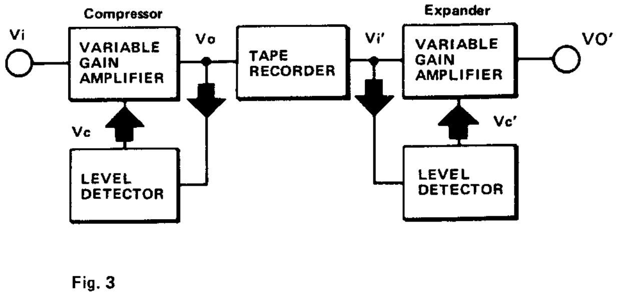


Fig. 3- Basic constitution of compander.

The level sensor detects the level of signal and applies control signal according to the detected level to the variable gain amplifier.
The variable gain amplifier, responding to the control signal sent from the level sensor, changes the gain, and controls the amplitude of the signal.
Working in this principle, the compander is capable of improving the S/N ratio (expanding the dynamic range). That is, when the original signal at S dB level is fed to the compressor, the signal passes through the variable gain amplifier, and its output is supplied into the level sensor. Suppose the compression/expansion ratio of the compander is 2 : 1, the original signal level S dB appears to be raised to S/2 dB because the variable gain amplifier increases the gain by S/2 dB, and, as a result, the level is compressed. The signal of S/2 dB level is recorded into tape recorder and played back. At this time, the S/N ratio becomes N dB – S/2 dB.
This playback signal is fed into the variable gain amplifier of the expander and is simultaneously supplied into the level sensor.
Since the variable gain amplifier reduces the S/2 dB gain in response to the control signal from the level sensor, the playback signal level is expanded to S dB to be delivered. At this time, the level of hiss noise changes from N dB to N dB + S/2 dB, so that S/N ratio improvement of S/2 dB is realized.
Or, when the signal level is higher than the reference level, the variable gain amplifier of the compressor reduces the gain while the variable gain amplifier of the expander increases the gain, thus performing compression and expansion. Therefore, the dynamic range above the reference level can be extended.
However, even if the dynamic range above the reference level appears to be extended, saturation distortion may be caused when the tape recording level is high. Hence, it is an effective way of using the noise reduction system to record at a slightly lower level than usual, by making use of the dynamic range improved by the noise reduction effect.

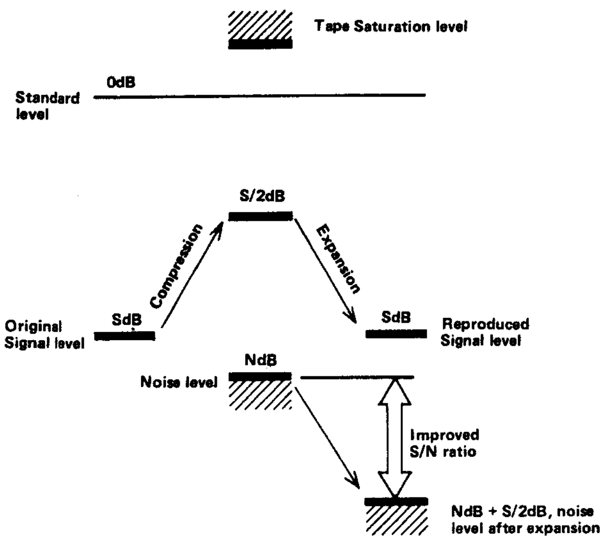


Fig. 4- Improvement of S/N ratio.

Breathing

Generally, the larger the compression/expansion ratio of the compander, the greater becomes the improvement of S/N ratio. However, as shown in Fig. 5, when the signal level changes, the gain of the variable gain amplifier varies accordingly. Besides, as shown in Fig. 4, the noise level also changes, and the noise changes as in Fig. 5

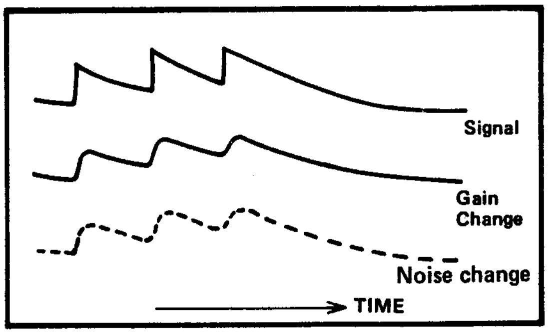


Fig. 5- Breathing.

On the other hand, the human ear is sensitive to "noisiness" at higher frequency, and the noise in the vicinity of high signal level tends not to be felt by masking effect. Therefore, in signals of large amplitude having relatively rapid attenuation of reverberation and harmonics, and which are remote from the frequency range of tape hiss noise, the change of noise becomes obvious as the gain of variable gain amplifier changes, and a "breathing" sound is heard. (This phenomenon, called "breathings", is inevitable for the compander, but is improved to practical level by some means or other.

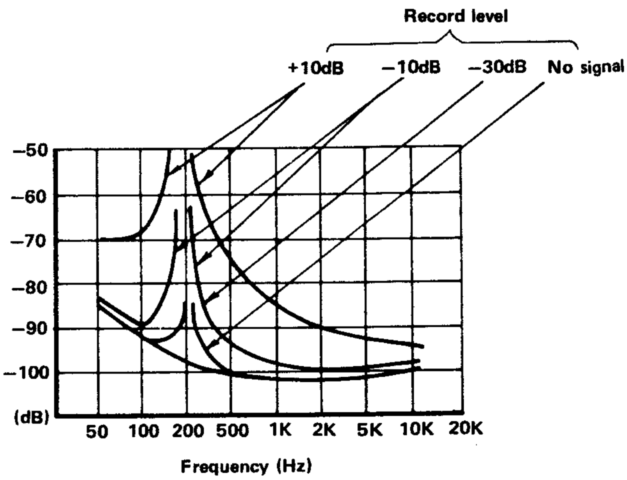


Fig. 6- Change of hiss noise.

In addition, as an intrinsic phenomenon of a tape recorder, the higher the recording level, the higher becomes the hiss noise. This tends to be obvious when the S/N ratio is improved by the compander.

In order to improve this and also to reduce high frequency noise, the pre-emphasis and de-emphasis method is appended to the method of compression and expansion, and the rate of S/N ratio improvement is usually increased by this procedure.

Circuit description of Super D

Figure 7 is the block diagram of this unit. The playback input terminal is connected to the playback output terminal of the deck, the record output terminal to the record input terminal of the deck, the input terminal to the record output terminal of the preamplifier, and the output terminal to the tape playback terminal of the preamplifier.

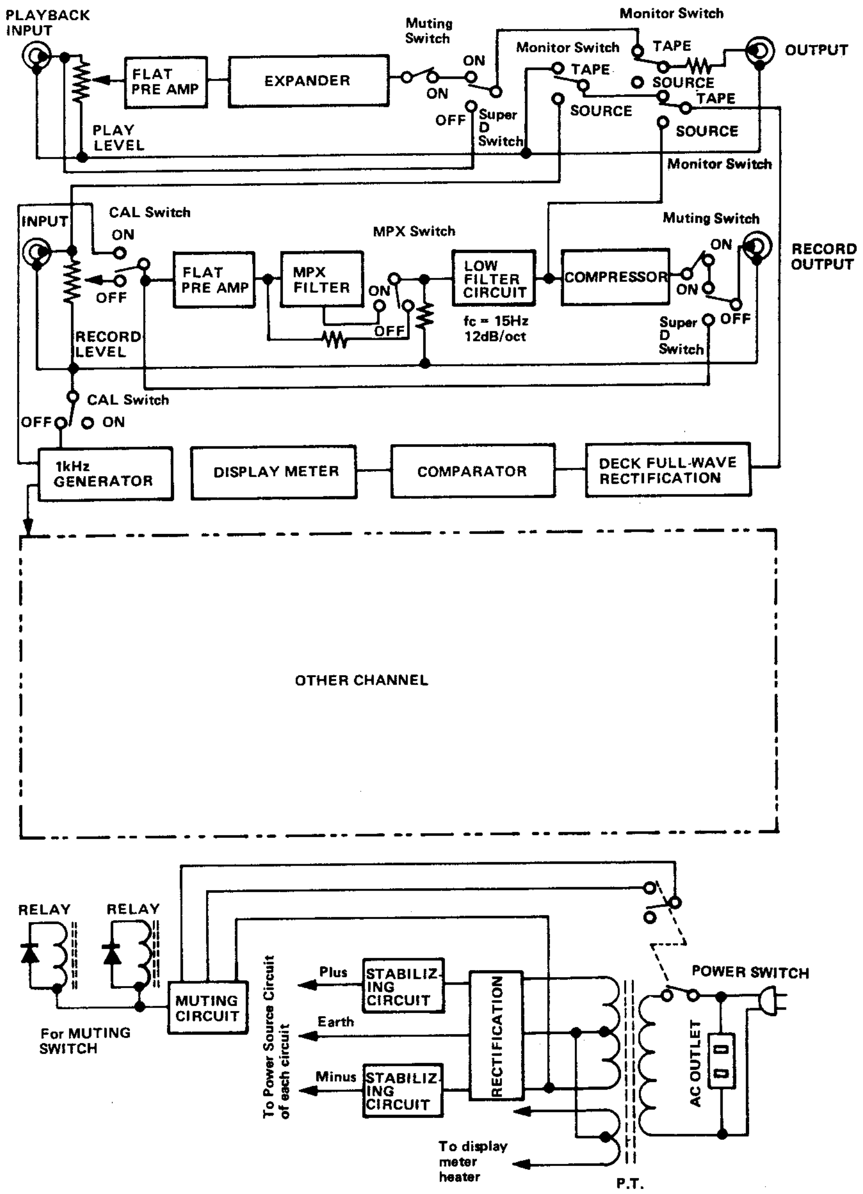


Fig. 7- Block diagram of PLUS N55.

When the tape monitor switch of the preamplifier is set to the tape side, the source signal can be directly monitored through speaker by turning on the SUPER D switch and setting the monitor switch to SOURCE side. The meter indicates the input level of the compressor, and its input level can be adjusted by RECORD LEVEL knob. The meter is a peak meter of 10 msec. attach time and 1.5 sec recovery time.

When the monitor switch is set to TAPE side, the output of the deck can be monitored. At this time, the meter shows the output signal of the expander circuit. When the SUPER D switch is turned off, the record signal passes only through the RECORD LEVEL and the playback signal is directly delivered, so that the recording level of the deck can be set by the RECORD LEVEL knob. Besides, since this circuit does not include amplifier, it can be used similarly whether the power switch is turned on or off.

The flat preamplifier is designed to amplify the input signal to the level to permit the expander circuit and compressor circuit to function at the optimum S/N ratio point.

The MPX filter in the encoder circuit is designed to remove pilot signal in order to prevent malfunction of the compressor circuit due to pilot signal when recording FM broadcast. The low filter circuit prevents malfunction of compressor circuit due to ultralow sound caused by "warp" of disc when recording from disc record.

The 1 kHz generator is intended to facilitate input and output level setting of Super D and the deck. Once set, it is not necessary to set again if tapes are changed.

Compressor circuit (encoder)

The input signal of the compressor circuit passes through the pre-emphasis circuit of high range elevation, and is led to operational amplifier, of which output, partly, is divided by high pass filter and low pass filter to be fed into the VCAs. And, the other output passes through the weighting line which emphasises the high frequency range, and is divided by the high pass filter and low pass filter to be fed into the level sensors in each band. The level sensors operate according to the time constant in each band to actuate the VCAs. As a result, the feedback amount of the operational amplifier is determined, and the output is changed by the amount corresponding to 1/2 of the input changing amount. (See Fig. 8.)
(VCA: voltage control amplifier)

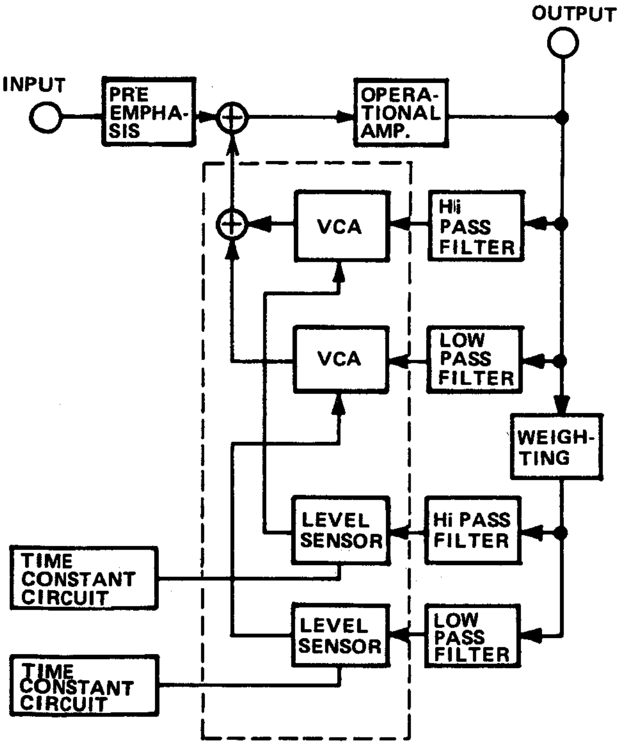


Fig. 8- Compressor circuit (encoder).

Expander circuit (decoder).

The input signal of the expander circuit, partly, is divided by high pass filter and low pass filter, and is fed into VCAs, while the rest passes through the weighting line which emphasizes the high frequency range, and is divided by high pass filter and low pass filter, then led into the level sensors. According to the time constant in each band, the level sensors are operated, and the gain of VCA is determined.
The output of VCA is fed into the operational amplifier having the de-emphasis of high range lowering, and is then delivered. (See Fig. 9.)

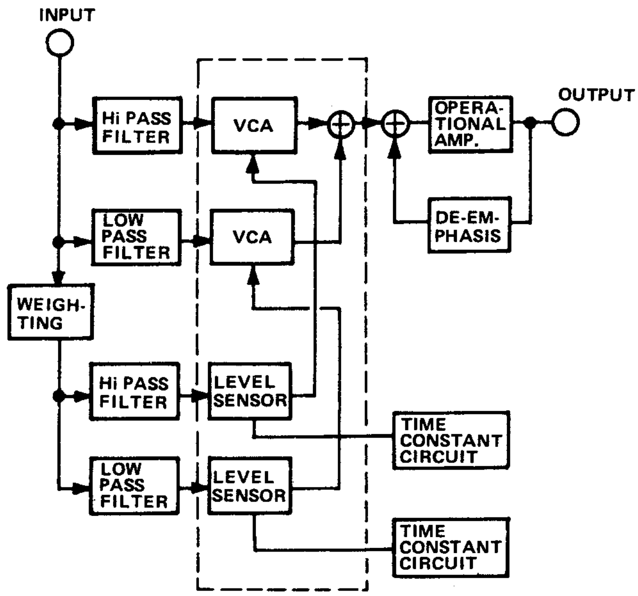
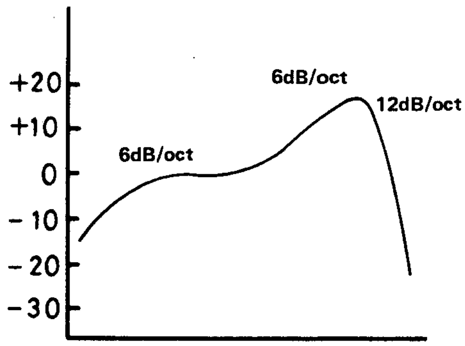


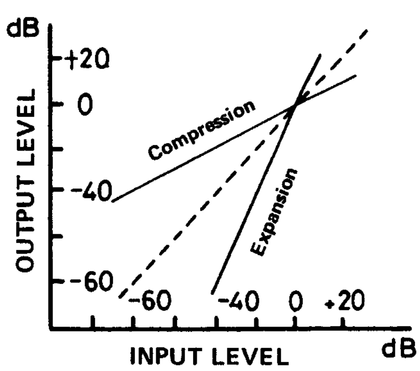
Fig. 9- Expander circuit (decoder).

Time constant in each band (msec)

	Attack time	Recovery time
Compression (high/low)	2/15	50/50
Expansion (high/low)	5/50	100/70



WEIGHTING CHARACTERISTICS



INPUT & OUTPUT CHARACTERISTICS

FL display level meter

The output from the TAPE or SOURCE side of the monitor switch of the Super D is full-wave rectified and amplified by IC3 and IC4, and, after offset voltage is applied, is rectified by D5 and D11 to be applied to terminal (1) of IC1 and IC2.

As shown in Fig. 11, IC1 and IC2 consist of voltage comparator circuit and switching circuit. Based on the constant voltage power source (Vcc) supplied into terminal (9), the voltage fed from terminal (1) is compared. According to the result of voltage comparison, the switching circuit is operated to set the plate output voltage to 15V or 0V, thereby controlling the plate voltage of FL meter. SVR3, SVR4 are the variable resistors for setting the reference comparative voltage at the time of specified record level input (0 dB adjustment).

Figure 12 shows input voltages (V_{IN}) of IC1, IC2 necessary for illuminating the indicators of FL meter.

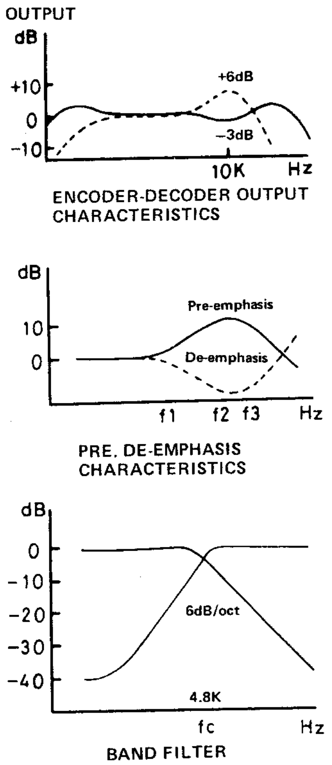
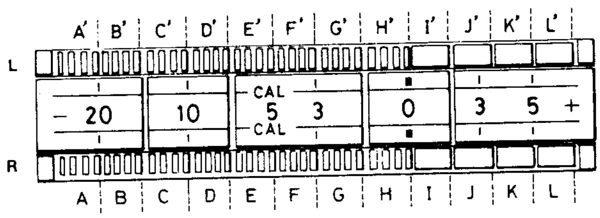


Fig. 10



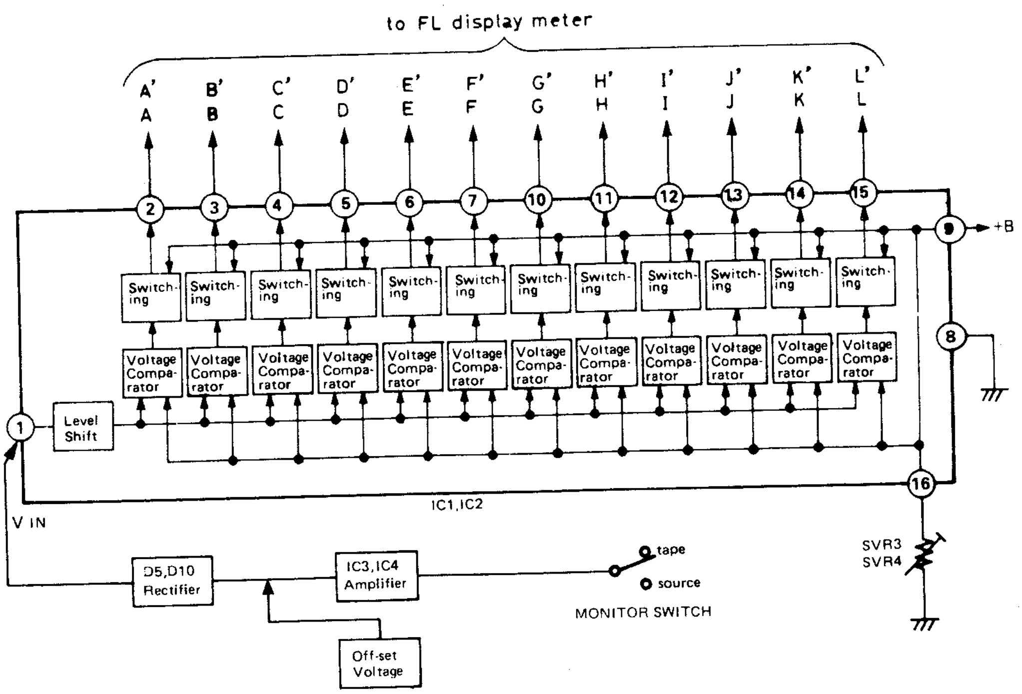
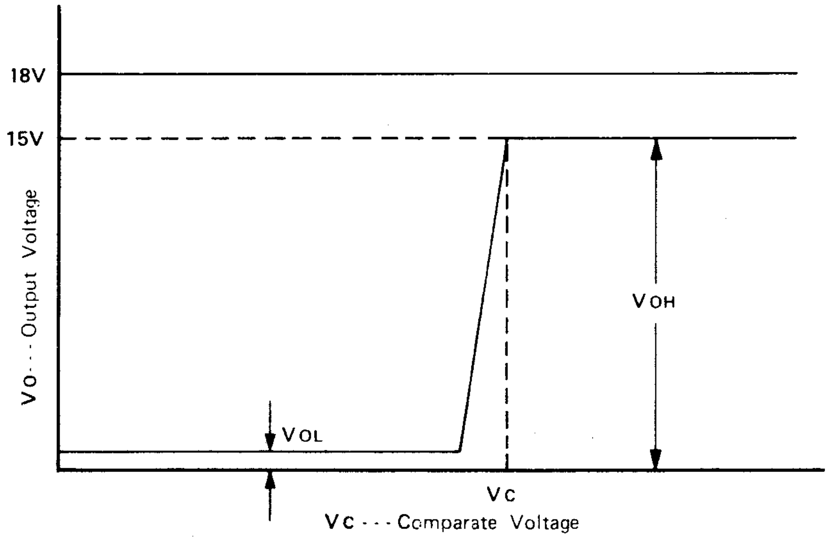


Fig. 11

	Input voltage (V_{IN})			Remarks
	Min.	St'd	Max.	
Output voltage, low V_{OL}	–	0 V	0.5 V	
Output voltage, high V_{OH}	14.0 V	15.0 V	–	
Offset voltage V_{OS}	1.1 V	1.35 V	1.6 V	
Comparate voltage V_C −20 dB	–	0.30 V	–	Voltage at 15.0 V, output of pin 2
Comparate voltage V_C −15 dB	0.40 V	0.46 V	0.52 V	Voltage at 15.0 V, output of pin 3
Comparate voltage V_C −10 dB	0.65 V	0.73 V	0.83 V	Voltage at 15.0 V, output of pin 4
Comparate voltage V_C −7 dB	0.92 V	0.99 V	1.07 V	Voltage at 15.0 V, output of pin 5
Comparate voltage V_C −5 dB	1.15 V	1.23 V	1.30 V	Voltage at 15.0 V, output of pin 6
Comparate voltage V_C −3 dB	1.43 V	1.52 V	1.61 V	Voltage at 15.0 V, output of pin 7
Comparate voltage V_C −1 dB	1.77 V	1.88 V	2.00 V	Voltage at 15.0 V, output of pin 10
Comparate voltage V_C 0 dB	–	2.10 V	–	Voltage at 15.0 V, output of pin 11
Comparate voltage V_C +1 dB	2.21 V	2.34 V	2.49 V	Voltage at 15.0 V, output of pin 12
Comparate voltage V_C +3 dB	2.76 V	2.93 V	3.10 V	Voltage at 15.0 V, output of pin 13
Comparate voltage V_C +5 dB	3.37 V	3.66 V	3.97 V	Voltage at 15.0 V, output of pin 14
Comparate voltage V_C +8 dB	4.72 V	5.12 V	5.76 V	Voltage at 15.0 V, output of pin 15

$*V_{IN} = V_C + V_{OS}$

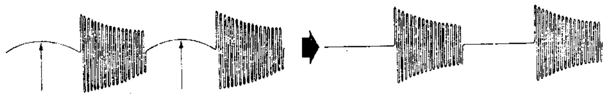


ADJUSTMENT OF SUPER D SECTION

Adjustment of compressor circuit (encoder)

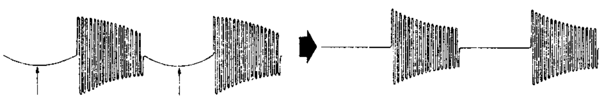
Turn on SUPER D switch, set monitor switch to SOURCE side, turn off MPF filter switch and CAL switch, and feed input signal of –6 dB (1 kHz) into IN (input) terminal. Connect VTVM and oscilloscope to TP-3 and the earth. Turn RECORD LEVEL adjusting knobs until the output becomes 350 mV ± 0.2 dB. Then, connect VTVM and oscilloscope to TP-4 and the earth. In the following explanation, the SVR refers to the left channel, and that of the right channel is included in parentheses.

1. **Tracking adjustment (1 kHz)**
   Set input signal to –46 dB (1 kHz). Turning SVR506 (SVR706), find the level transformation part, and set SVR just before this point.
2. **Tracking adjustment (10 kHz)**
   Set input signal to –46 dB (10 kHz). Adjust SVR503 (SVR703) in the same manner as in item 1.
   *In both items 1 and 2, set input signal to –66 dB, and make sure the output drops by 10 dB.
3. **Output adjustment (1 kHz)**
   Set input signal to –6 dB (1 kHz). Turn SVR501 (SVR701) until the output becomes 350 mV ± 0.2 dB.
4. **Output adjustment (10 kHz)**
   Set input signal to –46 dB (10 kHz). Turn SVR502 (SVR702) until the output lowers 3 dB from that in item 3.
5. **DC shift adjustment (1 kHz)**
   Using tone burst generator (e.q. TRIO Model 5201), set input signal to –46 dB (1 kHz), and adjust SVR504 (SVR704) to obtain the output waveform as shown below.



Set these segments as straight as possible, and make the waveform symmetrical vertically.

6. **DC shift adjustment (10 kHz)**
   In the same manner as in item 5, set input signal to –46 dB (10 kHz), and adjust SVR505 (SVR705) to obtain the output waveform as shown below.



Set these segments as straight as possible, and make the waveform symmetrical vertically.

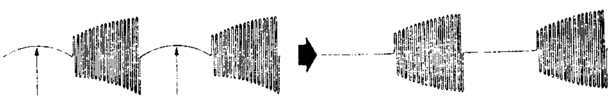
*Since the adjustments in items 5 and 6 influence each other, repeat the adjustments to check the result.

7. **Output adjustment**
   Connect VTVM to REC (record output) terminal. Set input signal to –6 dB (1 kHz). Turn SVR101 (SVR201) until the REC terminal output becomes 58 mV.
8. **CAL OSC adjustment**
   Connect VTVM to D401. Turn off SUPER D switch, turn on CAL switch. Adjust SVR401 so that the output of D401 becomes 6V.
9. **CAL level adjustment**
   Connect VTVM to REC (record output) terminal. Turn off SUPER D switch, turn on CAL switch. Adjust SVR402 so that the REC terminal output becomes 58 mV.

Adjustment of expander circuit (decoder)

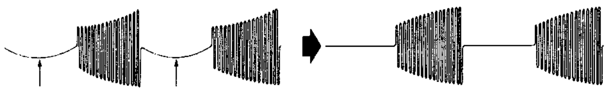
Turn on SUPER D switch, set monitor switch to TAPE, turn off MPX filter switch and CAL switch, and feed input signal of –6 dB (1 kHz) into PB (playback input) terminal. Connect VTVM and oscilloscope to TP-2 and the earth. Set PLAY LEVEL knob so that the output becomes 350 mV ± 0.2 dB. Then, connect VTVM and oscilloscope to TP-1 and the earth. The SVR in the following explanation refers to the left channel, and that of the right channel is given in parentheses.

1. **Tracking adjustment (1 kHz)**
   Set input signal to –16 dB (1 kHz). Turning SVR603 (SVR803), find the level transformation point, and set it to the position just before this point.
2. **Tracking adjustment (10 kHz)**
   Set input signal to –16 dB (10 kHz). Adjust SVR606 (SVR806) in the same manner as in item 1.
   *Both in items 1 and 2, set input signal to –36 dB, and make sure the output lowers by 40 dB.
3. **Output adjustment (1 kHz)**
   Set input signal to –6 dB (1 kHz). Turn SVR601 (SVR801) until the output becomes 300 mV ± 0.2 dB.
4. **Output adjustment (10 kHz)**
   Set input signal to –16 dB (10 kHz). Turn SVR602 (SVR802) until the output rises 6 dB from that in item 3.
5. **DC shift adjustment (1 kHz)**
   Using tone burst generator (e.q. TRIO Model 5201), set input signal to –16 dB (1 kHz), and adjust SVR605 (SVR805) so as to obtain the output waveform as shown below.



Set these segments as straight as possible, and make the waveform symmetrical vertically.

6. DC shift adjustment (10 kHz)
In the same manner as in item 5, set input signal to −16 dB (10 kHz), and adjust SVR604 (SVR804) so as to obtain the output waveform as shown below.

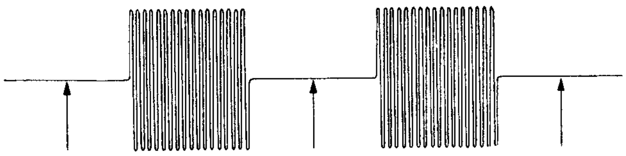


Set these segments as straight as possible, and make the waveform symmetrical vertically.

*Since the adjustments in items 5 and 6 influence each other, repeat the adjustments to check the result.

Checking of comprehensive characteristics
Set RECORD LEVEL and PLAY LEVEL adjusting knobs to maximum position, turn on SUPER D switch, place monitor switch in TAPE position, turn off MPX filter switch and CAL switch, feed input signal into IN (input) terminal, and connect VTVM and oscilloscope to OUT (output) terminals.

1. **Frequency response**
   Feed input signals 0 dB (20 Hz, 1 kHz, 10 kHz, 20 kHz), and make sure the output is, when the output at 1 kHz is taken as 0 dB, ± 1.5 dB at 20 Hz, ± 1 dB at 10 kHz, and ± 1.5 dB at 20 kHz.
   *When failing to satisfy the values above, check items 3 and 4 of the adjustment of compressor circuit and expander circuit.
2. **Tracking**
   Change input signals 0 dB (100 Hz, 1 kHz, 10 kHz) to −60 dB, and make sure the outputs are also lowered by 60 dB.
3. **Tone burst characteristics**
   Feed input signals −20 dB (1 kHz, 10 kHz), and make sure the output waveform becomes as follows.



These segments should be straight. The waveform should be symmetrical vertically.

ADJUSTMENT OF 0 dB AND −20 dB

Bring SUPER D switch to "off", MPX FILTER switch to "off", MONITOR switch to "tape", and CAL switch to "off", impress 1 kHz input signal on DECODE IN (LINE OUT) terminal, and connect VTVM to DECODE OUT (TAPE PLAY) terminal.

a. Adjust input with the aid of low-frequency signal generator so that VTVM reads 530 mV, and take the resulting input as 0 dB.
b. Put out level meter's 0 dB segment (the segment of Hand H' part in Fig. 12) once by rotating SVR3 and SVR4, and thereafter, adjust them to a point where the above-mentioned segment begins to light up.
c. With an input obtained in step a above reduced down to −18 dB − which is equal to VTVM reading of 67 mV, put out level meter's −20 dB segment (the segment of A and A' part in Fig. 12) once by rotating SVR1 and SVR2, and thereafter, adjust them to a point where the −20 dB segment begins to light up. Besides, make sure that the above segment is sure to go out with the input down to −19 dB (60 mV in VTVM reading) and that the segment comes on again when the input reaches within −18 ± 0.5 dB (67 ± 3 mV in VTVM reading).
d. Make certain that the said 0 dB segment lights up when the input recovers the level in step a. At the same time make certain that the 0 dB segment is sure to go out with the input down to −1 dB (477 mV in VTVM reading) and that the 0 dB segment comes on again when the input stays within 0 ± 0.5 dB (530 ± 25 mV in VTVM reading). In case satisfactory results cannot be achieved, repeat steps b thru d.

ADJUSTMENT OF −5 dB CALIBRATION

Bring SUPER D switch to "off", MPX FILTER switch to "off", MONITOR switch to "source", and CAL switch to "on", and connect VTVM to ENCODE OUT (LINE IN) terminal.

a. Rotate SVR402, and fix it when the reading of VTVM goes 3 to 4 mV higher than the value VTVM registers when −5 dB segments of both channels begin to light up. The reading of VTVM reaches then about 55 to 58 mV. For location of SVR402, consult page 10.

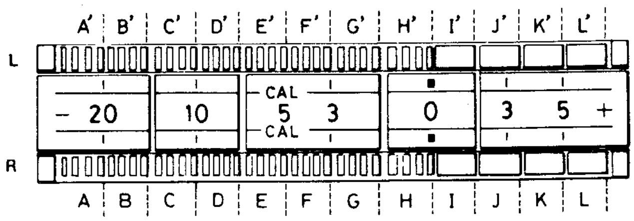
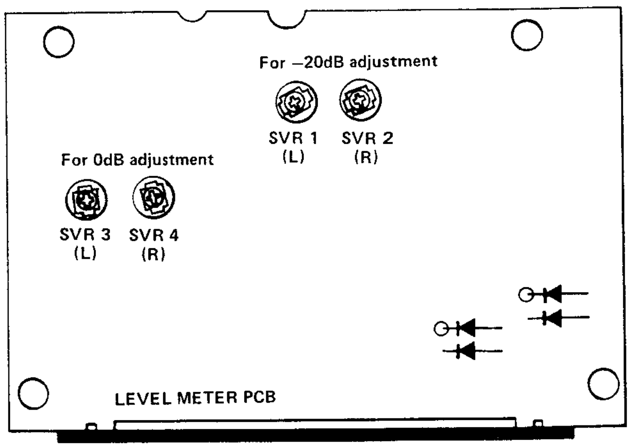
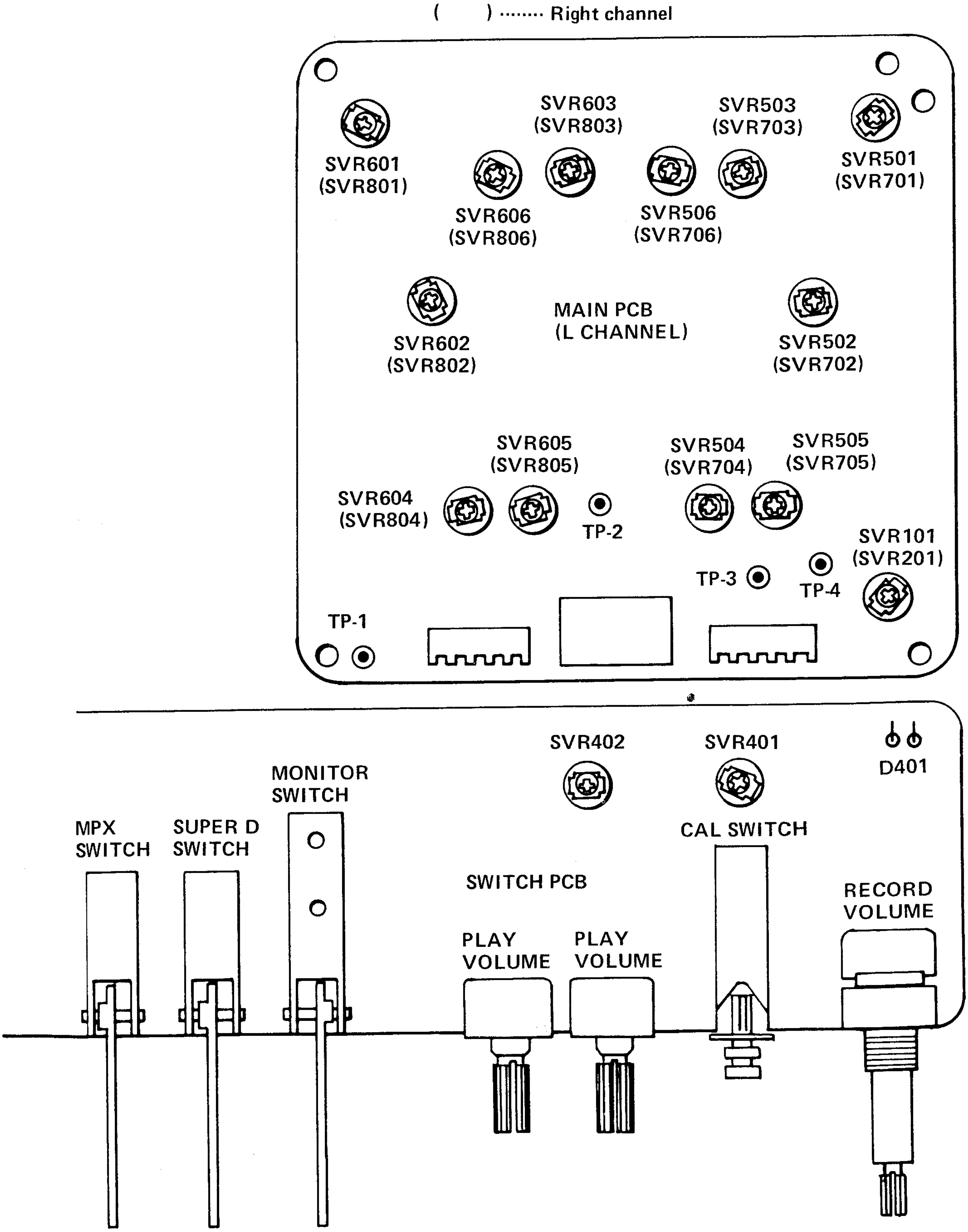


Fig. 12

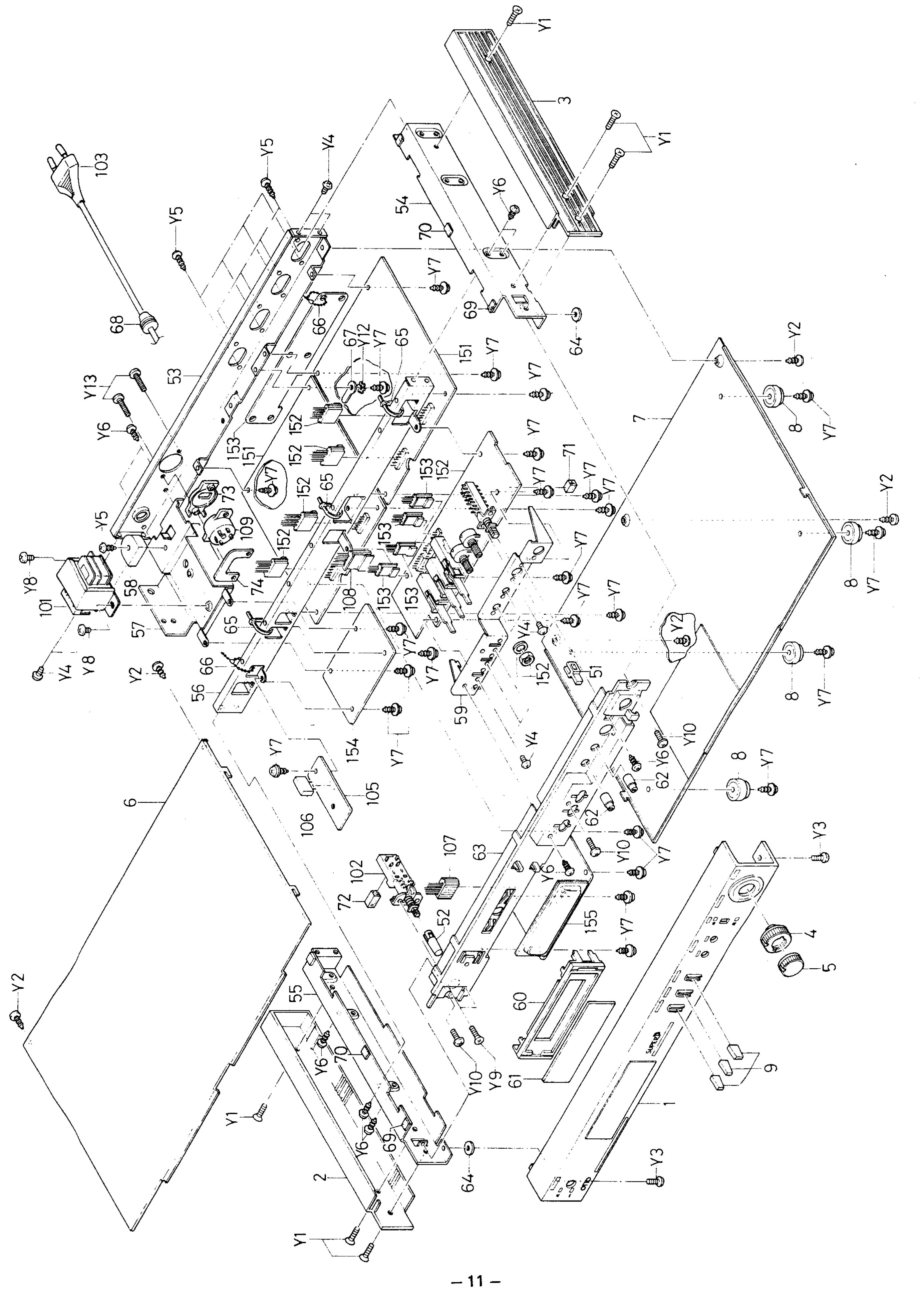


DISPLAY LEVEL METER

Fig. 13


( ) .... Right channel
SVR603
(SVR803)
SVR503
(SVR703)
SVR601
(SVR801)
SVR501
(SVR701)
SVR606
(SVR806)
SVR506
(SVR706)
MAIN PCB
(L CHANNEL)
SVR602
(SVR802)
SVR502
(SVR702)
SVR605
(SVR805)
SVR504
(SVR704)
SVR505
(SVR705)
SVR604
(SVR804)
TP-2
SVR101
(SVR201)
TP-3
TP-4
TP-1
SVR402
SVR401
D401
MONITOR
SWITCH
MPX
SWITCH
SUPER D
SWITCH
CAL SWITCH
SWITCH PCB
RECORD
VOLUME
PLAY
VOLUME
PLAY
VOLUME

EXPLODED VIEW (CABINET)



PARTS LIST

Key No.	Part No.	Description	Q'ty
PACKING			
	141-6-133T-08800	Individual Carton (Silver)	1
	141-6-133T-08801	Individual Carton (Black)	1
	141-6-144T-58100	Foam Plastic Case	2
	141-6-317T-15200	Pad	1
	141-6-231T-40550	Inner Polye Cover, Set	1
	141-6-231T-10300	Inner Polye Cover, AC cord	1
	141-6-231T-10150	Inner Polye Cover, Bracket Handle	2
	141-6-231T-25350	Inner Polye Cover, Printed Matter	1
	123-6-453R-00100	Inspection Sheet	2
	141-2-246T-67400	Sheet 460 x 260	1
	141-6-410T-38200	Instruction Manual	1
ACCESSARY			
	141-2-862T-00500	Driver, Tuning	1
	4-243T-13302	Lead Cord Ass'y	1
CABINET			
1	141-0-122T-29031	Front Panel Ass'y (Silver)	1
	141-0-122T-29001	Front Panel Ass'y (Black)	1
2	141-0-123T-03800	Side Panel Ass'y, Right (Silver)	1
	141-0-123T-03830	Side Panel Ass'y, Right (Black)	1
3	141-0-123T-03900	Side Panel Ass'y, Left (Silver)	1
	141-0-123T-03930	Side Panel Ass'y, Left (Black)	1
4	141-0-163T-59800	Rotary Knob Ass'y (Silver)	1
	141-0-163T-59830	Rotary Knob Ass'y (Black)	1
5	141-0-163T-59900	Rotary Knob Ass'y (Silver)	1
	141-0-163T-59930	Rotary Knob Ass'y (Black)	1
6	141-2-124T-24500	Top Lid (Silver)	1
	141-2-124T-24530	Too Lid (Black)	1
7	141-2-125T-17000	Bottom Lid (Silver)	1
	141-2-125T-17030	Bottom Lid (Black)	1
8	141-0-174T-05101	Stand Ass'y	4
9	141-2-162T-16001	Lever Knob (Silver)	3
	141-2-162T-16030	Lever Knob (Black)	3
10	141-2-174T-08502	Stand	4
CHASSIS			
51	141-0-156T-23700	Knob Ass'y, CAL (Silver)	1
	141-0-156T-23730	Knob Ass'y, CAL (Black)	1
52	141-0-156T-21701	Knob Ass'y, Power Switch (Silver)	1
	141-0-156T-21731	Knob Ass'y, Power Switch (Black)	1
53	141-2-126T-29202	Back Lid (Silver)	1
	141-2-126T-29232	Back Lid (Black)	1
54	141-2-315T-17900	Reinforcement, Right	1
55	141-2-315T-18000	Reinforcement, Left	1
56	141-2-315T-17500	Reinforcement, Center	1
57	141-2-310T-21300	Bracket, Trans	1
58	141-2-464T-33400	Fixer, AC Cord	1
59	141-2-365T-42700	Bracket, Switch	1
60	141-2-210T-11500	Bracket, Degital	1
61	141-2-132T-14300	Sign Window (Silver)	1
	141-2-132T-14330	Sign Window (Black)	1
62	141-2-163T-61100	Rotary Knob, VR	2
63	141-2-210T-13800	Bracket, Front Chassis	1
64	141-2-453T-02101	Washer 3 x 10 x 0.3	2
65	141-2-464T-20671	Fixer	4
66	141-2-464T-08700	Fixer	1
67	123-2-472R-00401	Lug	1
68	141-2-445T-16200	Rubber Cushion	1
69	141-2-447T-33300	Sheet 4 x 8 x 1mm	2
70	141-2-447T-33400	Sheet 10 x 7 x 0.5mm	2
71	141-2-447T-34200	Cushion 6 x 10 x 6mm	1
72	141-2-447T-39102	Cushion 8 x 8 x 15mm	1
73	141-2-135T-66900	Cover, Voltage Select Switch	1
74	141-2-411T-08100	Plate Nut	1
SCREW MOUNTING			
Y1		Flat Head Screw 4 x 10mm	6
Y2		Binding Head Tapping Screw 3 x 6mm	5
Y3		Pan Head Screw 3 x 6mm	2
Y4		Pan Head Screw 3 x 4mm	4
Y5		Tapping Screw 3 x 10mm	9
Y6		Tapping Screw 3 x 6mm	9
Y7		Washer Head Tapping Screw 3 x 6mm	18
Y8		Binding Head Screw 3 x 4mm	2
Y9		Flat Head Screw 3 x 10mm	2
Y10		Binding Head Screw 3 x 6mm	2
Y11		Pan Head Screw 3 x 4mm	3

Key No.	Part No.	Description	Q'ty
SCREW MOUNTING			
Y12		External Toothlock Washer 3 x 6.5 x 0.45mm	1
Y13		Binding Head Screw 3 x 14mm	2
ELECTRICAL PARTS			
101	4-300T-04600	Power Trans	1
102	4-231T-76472	Power Switch	1
103	4-243T-77172	Power Supply Cord	1
104	141-2-382T-07300	Terminal	3
105	4-233T-20700	P.C. Board, Connecting	1
106	4-223T-04700	Capacitor	1
107	4-235T-71600	Socket	1
108	4-235T-71700	Socket	1
109	4-231T-53677	Switch, Voltage Select	1
MAIN PCB ASS'Y			
151	141-4-230T-95400	P.C. Board Ass'y, Main	1
SVR101, 502, 602, 503, 603, 504, 604, 505, 605, 506, 606	4-222T-62083	Semifixed Variable Resistor 10KΩ	11
SVR501, 601	4-222T-62089	Semifixed Variable Resistor 100KΩ	2
	4-236T-10273	Plug	2
	4-232T-04500	Relay	1
IC102, 152,		IC LM2902N	2
IC103, 153		IC LM324N	2
IC104, 154		IC μA747C	2
IC151		IC NJM4558	1
IC106		IC LM301A	1
IC105, 155		IC NE570N	2
Q101,151, 102,152		Transistor 2SC536	4
D504,604		Diode RD5.6E B3	2
D508,509		Diode 02BZ4.7	2
D501,601, 505,605, 506,606, 507,607, 502,602, 503,603, 610		Diode DS442X	13
	RESISTORS		
R507,607		Metal or Carbon 82K ohm ±2% 1/4W	2
R506,606		Metal or Carbon 8.2K ohm ±2% 1/4W	2
R539,639		Metal or Carbon 10K ohm ±2% 1/4W	2
R541,641		Metal or Carbon 68K ohm ±2% 1/4W	2
R540,640		Metal or Carbon 12K ohm ±5% 1/4W	2
R647,648		Carbon 33K ohm ±5% 1/4W	2
R551,555, 651,655		Carbon 330 ohm ±5% 1/4W	4
R512,612		Carbon 330 ohm ±5% 1/4W	2
R549,649		Carbon 3.3M ohm ±5% 1/4W	2
R550,650		Carbon 100 ohm ±5% 1/4W	2
R556,656		Carbon 6.8K ohm ±5% 1/4W	2
R547,548		Carbon 33K ohm ±5% 1/4W	2
R542,642		Carbon 1K ohm ±5% 1/4W	2
R502,503, 602,603		Carbon 33K ohm ±5% 1/4W	4
R605,505 611,511		Carbon 10K ohm ±5% 1/4W	4
R153		Carbon 56K ohm ±5% 1/4W	1
R154		Carbon 15K ohm ±5% 1/4W	1
R152		Carbon 330 ohm ±5% 1/4W	1
R537,637		Carbon 4.7K ohm ±5% 1/4W	2

PARTS LIST

Ref. No.	Part No.	Description	Q'ty
MAIN PCB ASS'Y			
R538,638		Carbon 3.3K ohm ±5% 1/4W	2
R535,536, 635,636		Carbon 1K ohm ±5% 1/4W	4
R518,519, 618,619		Carbon 1K ohm ±5% 1/4W	4
R522,523, 622,623		Carbon 2.2K ohm ±5% 1/4W	4
R532,534, 632,634		Carbon 2.2K ohm ±5% 1/4W	4
R521,621, 533,633		Carbon 220 ohm ±5% 1/4W	4
R524,624, 531,631		Carbon 56 ohm ±5% 1/4W	4
R515,615, 517,617		Carbon 10K ohm ±5% 1/4W	4
R553,653, 644		Carbon 10K ohm ±5% 1/4W	3
R508,608		Carbon 39K ohm ±5% 1/4W	2
R509,609		Carbon 47K ohm ±5% 1/4W	2
R530,630, 554,654		Carbon 33K ohm ±5% 1/4W	4
R520,620		Carbon 33K ohm ±5% 1/4W	2
R513,613, 501,601		Carbon 33K ohm ±5% 1/4W	4
R504,604, 616		Carbon 100K ohm ±5% 1/4W	3
R514,614, 516		Carbon 100K ohm ±5% 1/4W	3
R646		Carbon 330 ohm ±5% 1/4W	1
R529,629, 528,628		Carbon 15K ohm ±5% 1/4W	4
R552,553, 653,652		Carbon 6.8K ohm ±5% 1/4W	4
R525,625		Carbon 3.9K ohm ±5% 1/4W	2
R527,627, 526,626		Carbon 68K ohm ±5% 1/4W	4
R151		Carbon 100K ohm ±5% 1/4W	1
R543,643		Carbon 10K ohm ±5% 1/4W	2
R155		Carbon 10K ohm ±5% 1/4W	1
	CAPACITORS		
C501,601, 526,626		Mylar 0.1μF 50V ±5%	4
C502,602, 534,634		Mylar 0.001μF 50V ±5%	4
C522,622, 533,633		Mylar 0.001μF 50V ±5%	4
C606,506, 611,511		Mylar 0.001μF 50V ±5%	4
C505,605, 519,619		Mylar 0.0022μF 50V ±5%	4
C550		Mylar 0.001μF 50V ±5%	1
C503,603		Ceramic 270pF 50V ±5%	2
C535		Ceramic 150pF 50V ±5%	1
C525,625		Ceramic 100pF 50V ±5%	2
C153,618		Ceramic 10pF 50V ±5%	2
C518		Ceramic 5pF 50V ±0.5pF	1
C536		Ceramic 47pF 50V ±5%	1
C504,604		Electrolytic 100μF 25V	2
C527,627		Electrolytic 100μF 16V	2
C523,623		Electrolytic 22μF 25V	2
C155,154, 555,655		Electrolytic 10μF 25V	4
C551,552, 553,554		Electrolytic 10μF 25V	4
C651,652, 653,654		Electrolytic 10μF 25V	4
C508,608, 528		Electrolytic 1μF 50V	3
C529,531, 629,631		Electrolytic 1μF 50V	4
C516,616, 524,624		Electrolytic 1μF 50V	4
C617,621		Electrolytic 4.7μF 25V	2
C517,521		Electrolytic 4.7μF 25V	2
C514,515		Electrolytic 3.3μF 25V	2
C513,613		Al Electrolytic 0.1μF 16V +40–20%	2
C614,615		Electrolytic 3.3μF 25V	2

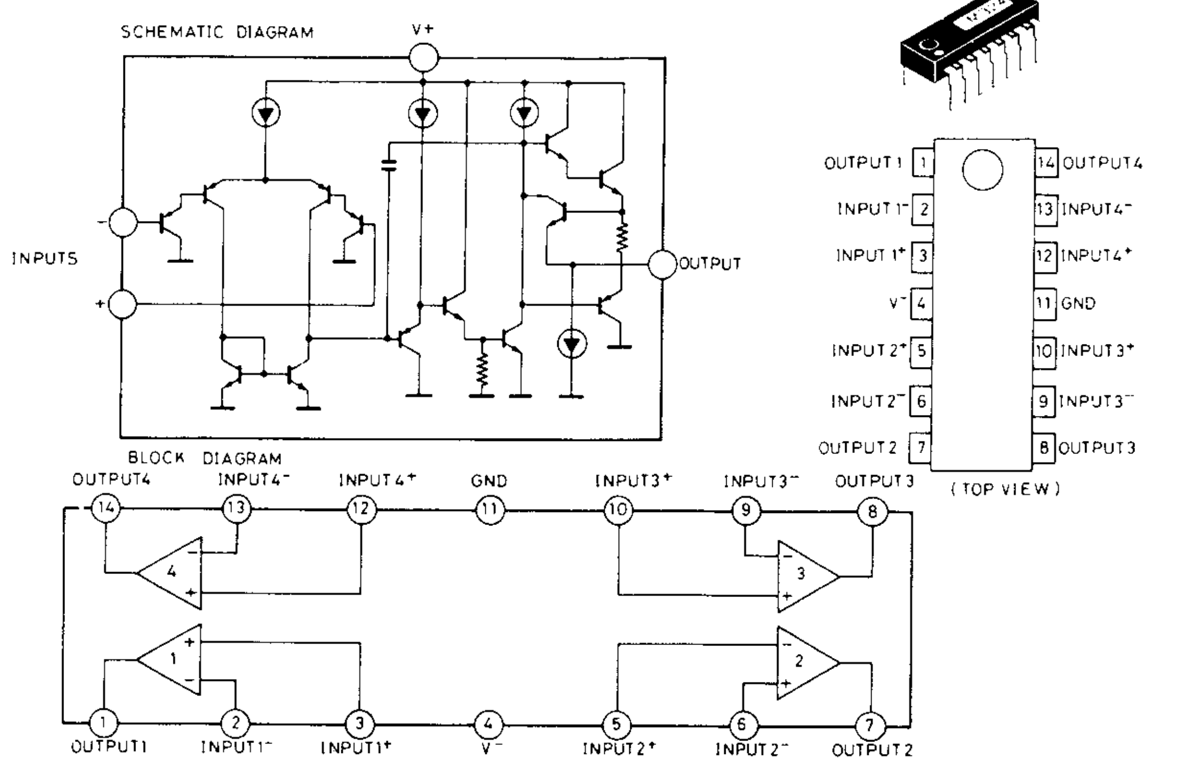
Ref. No.	Part No.	Description	Q'ty
MAIN PCB ASS'Y			
C628		Electrolytic 2.2μF 50V	1
C151		Electrolytic Nonpolar 1.0μF 50V	1
SWITCH PCB ASS'Y			
152	141-4-230T-95500	P.C. Board Ass'y, Switch	1
VR101, 201	4-222T-78000	Variable Resistor 50K, Rec	1
VR151, 251	4-222T-74290	Variable Resistor 50K, Play	2
S2,3	4-231T-82300	Switch, MPX Super D	2
S4	4-231T-87900	Switch, Monitor	1
S5	4-231T-80771	Switch, CAL	1
SVR402	4-222T-62089	Semifixed Variable Resistor 100KΩ	1
SVR401	4-222T-62083	Semifixed Variable Resistor 10KΩ	1
L101,201	4-255T-01600	MPX Coil	2
	4-236T-10273	Plug	1
	4-236T-10200	Plug	4
	4-235T-71400	Socket	1
	4-235T-71500	Socket	3
IC401		IC RC4558P	1
IC101, 201		IC NJM4558	2
D401,402		Diode DS442X	2
	RESISTORS		
R104,204		Carbon 5.6K ohm ±5% 1/4W	2
R105,205		Carbon 47K ohm ±5% 1/4W	2
R111,211		Carbon 100K ohm ±5% 1/4W	2
R103,203		Carbon 330 ohm ±5% 1/4W	2
R115,215		Carbon 10K ohm ±5% 1/4W	2
R117,217		Carbon 39K ohm ±5% 1/4W	2
R112,212		Carbon 100K ohm ±5% 1/4W	2
R113,213		Carbon 330 ohm ±5% 1/4W	2
R107,207		Carbon 2.7K ohm ±5% 1/4W	2
R109,209		Carbon 5.6K ohm ±5% 1/4W	2
R102,202		Carbon 150K ohm ±5% 1/4W	2
R610,810		Carbon 330 ohm ±5% 1/4W	2
R404,405		Carbon 10K ohm ±5% 1/4W	2
R401,402		Carbon 150K ohm ±5% 1/4W	2
R116,216		Carbon 150K ohm ±5% 1/4W	2
R114,214		Carbon 100K ohm ±5% 1/4W	2
R108,208		Carbon 2.7K ohm ±5% 1/4W	2
R403		Carbon 150K ohm ±5% 1/4W	1
R406		Carbon 150K ohm ±5% 1/4W	1
R28,29		Carbon 120K ohm ±5% 1/4W	2
	CAPACITORS		
C103,203		Ceramic 33pF 50V ±10%	2
C100,200		Ceramic 100pF 50V ±10%	2
C106,206, 107,207		Mylar 0.15μF 50V ±5%	4
C401,402		Mylar 0.001μF 50V ±5%	2
C404		Mylar 0.047μF 50V ±20%	1
C104,204, 110,210		Electrolytic 10μF 25V	4
C403		Electrolytic 1μF 50V	1
C101,201		Electrolytic Nonpolar 4.7μF 25V	2
C108,208		Electrolytic Nonpolar 2.2μF 50V	2
SOCKET PCB ASS'Y			
153	141-4-230T-95600	P.C. Board Ass'y, Socket	1
	4-235T-68571	Socket	4
	4-235T-71300	Socket	1
	4-235T-71371	Socket	1

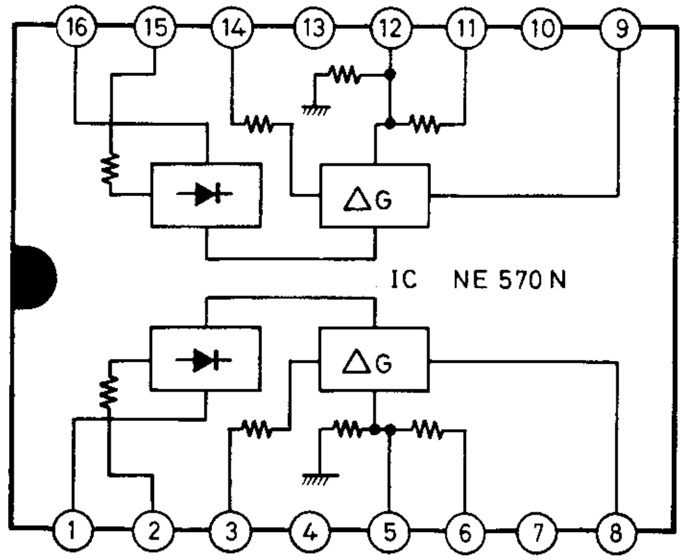
PARTS LIST

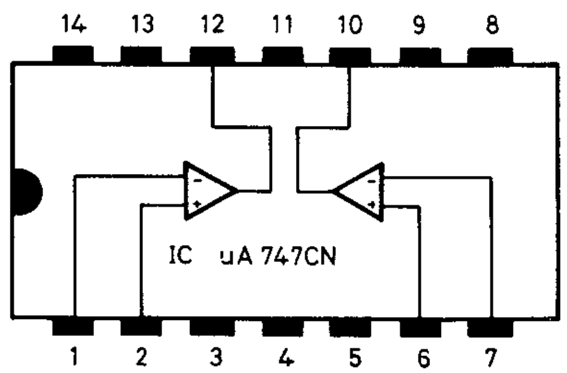
Ref. No.	Part No.	Description	Q'ty
SOCKET PCB ASS'Y			
	4-235T-71372	Socket	1
	4-235T-71373	Socket	1
C331,332, 333,334		Ceramic Cap. 0.01μF 50V +80−20%	4
R118,218		Carbon Res. 1K ohm ±5% 1/4W	2
DC POWER PCB ASS'Y			
154	141-4-230T-95701	P.C. Board Ass'y, DC Power	1
Q305,306 308,311		Transistor 2SC536	4
Q307		Transistor 2SB560	1
Q309		Transistor 2SD330	1
D304		Diode W02	1
D301		Diode DS442X or 1S2473	1
D303		Diode WZ157	1
D321		Diode RD5.6E B3	1
	CAPACITORS		
C312,313		Electrolytic 1000μF 35V	2
C322,323		Electrolytic 220μF 25V	2
C315,316		Electrolytic 470μF 25V	2
C311,314		Electrolytic 100μF 25V	2
C303		Electrolytic 1μF 50V	1
C304		Electrolytic 470μF 6.3V	1
C317		Ceramic 0.01μF 50V +80−20%	1
	RESISTORS		
R314		Metal 5.6 ohm ±5% 1W	1
R313		Metal 100 ohm ±5% 1W	1
R307		Carbon 100K ohm ±5% 1/4W	1
R304		Carbon 150K ohm ±5% 1/4W	1
R305		Carbon 33K ohm ±5% 1/4W	1
R302		Carbon 27K ohm ±5% 1/4W	1
R303		Carbon 22K ohm ±5% 1/4W	1
R308		Carbon 15K ohm ±5% 1/4W	1
R311,312		Carbon 820 ohm ±5% 1/4W	2
R324		Carbon 10K ohm ±5% 1/4W	1
R323		Carbon 5.6K ohm ±5% 1/4W	1
R322,325		Carbon 6.8K ohm ±5% 1/4W	2
R321		Solid 5.6 ohm ±10% 1/2W	1
LEVEL METER PCB ASS'Y			
155	141-4-230T-95800	P.C. Board Ass'y, Level Meter	1
SVR1,2	4-222T-62081	Semifixed Variable Resistor 4.7KΩ	2
SVR3,4	4-222T-62083	Semifixed Variable Resistor 10KΩ	2
	4-985T-01100	Fluorescent Display	1
	4-236T-10274	Plug 7 pin	1
IC1,2		IC BA658	2
IC3,4		IC RC4558P	2
D1 ∼ 12		Diode 1S2473	12
	RESISTORS		
R1,11		Carbon 20K ohm ±2% 1/4W	2
R2,12		Carbon 20K ohm ±2% 1/4W	2
R3,13		Carbon 20K ohm ±2% 1/4W	2
R4,14		Carbon 10K ohm ±2% 1/4W	2
R5,15		Carbon 10K ohm ±5% 1/4W	2
R6,16		Carbon 10K ohm ±5% 1/4W	2
R7,17		Carbon 1M ohm ±5% 1/4W	2
R8,18		Carbon 270 ohm ±5% 1/4W	2
R9,19		Carbon 680K ohm ±5% 1/4W	2

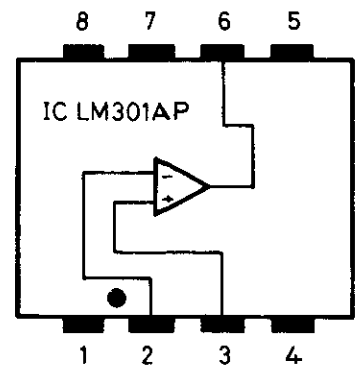
Ref. No.	Part No.	Description	Q'ty
LEVEL METER PCB ASS'Y			
R10,20		Carbon 1K ohm ±5% 1/4W	2
R21		Carbon 10K ohm ±5% 1/4W	1
R22		Carbon 820 ohm ±5% 1/4W	1
R24		Solid 82 ohm ±10% 1/2W	1
R25,26		Carbon 1M ohm ±5% 1/4W	2
R27		Carbon 10K ohm ±5% 1/4W	1
	CAPACITORS		
C2,5		Electrolytic 4.7μF 25V	2
C1,4		Electrolytic Nonpolar 1.0μF 50V	2
C7		Electrolytic 220μF 25V	1
C3,6		Tantal 2.2μF 16V ±20%	2

LM324 (OPERATIONAL AMPLIFIERS)

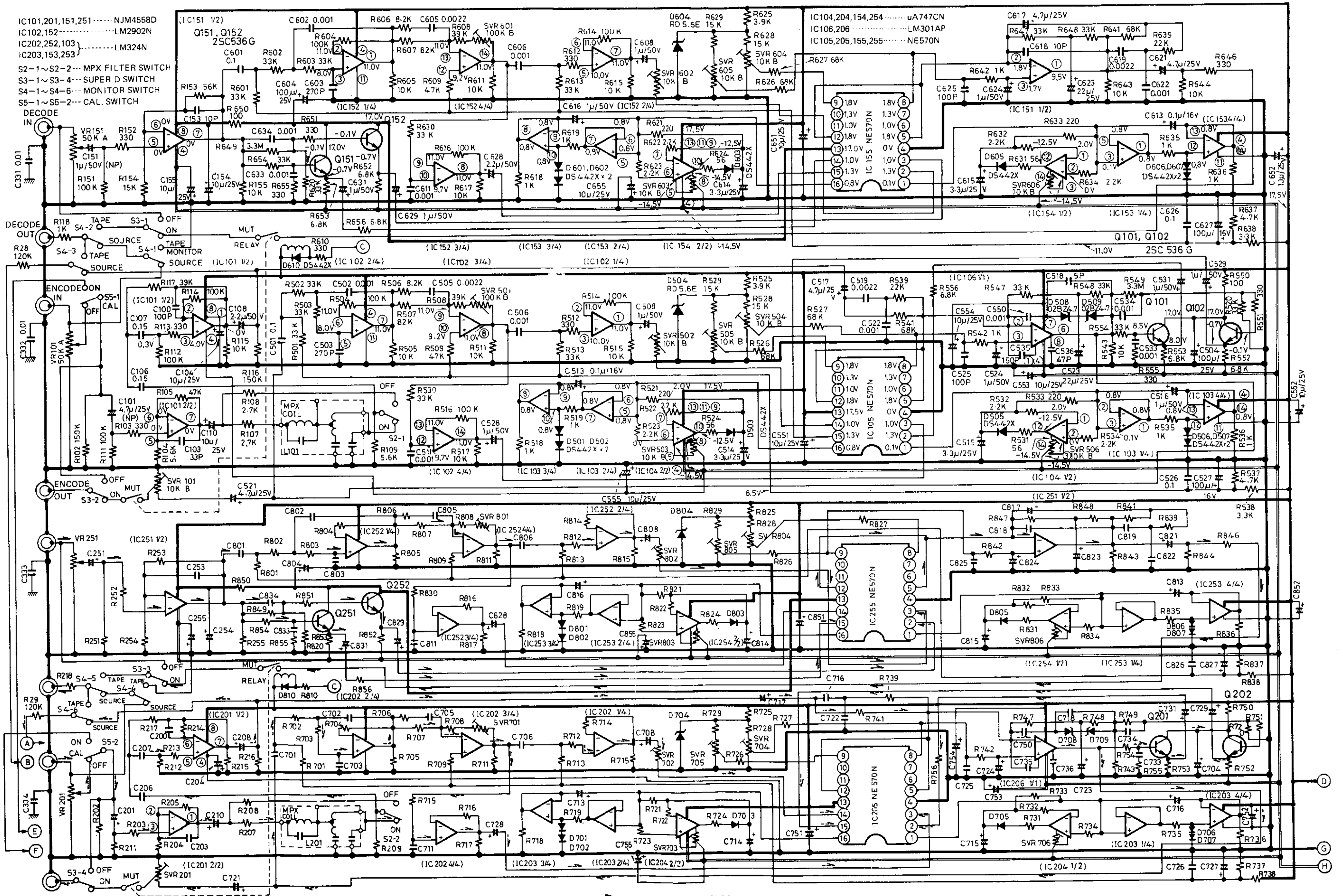








SCHEMATIC DIAGRAM



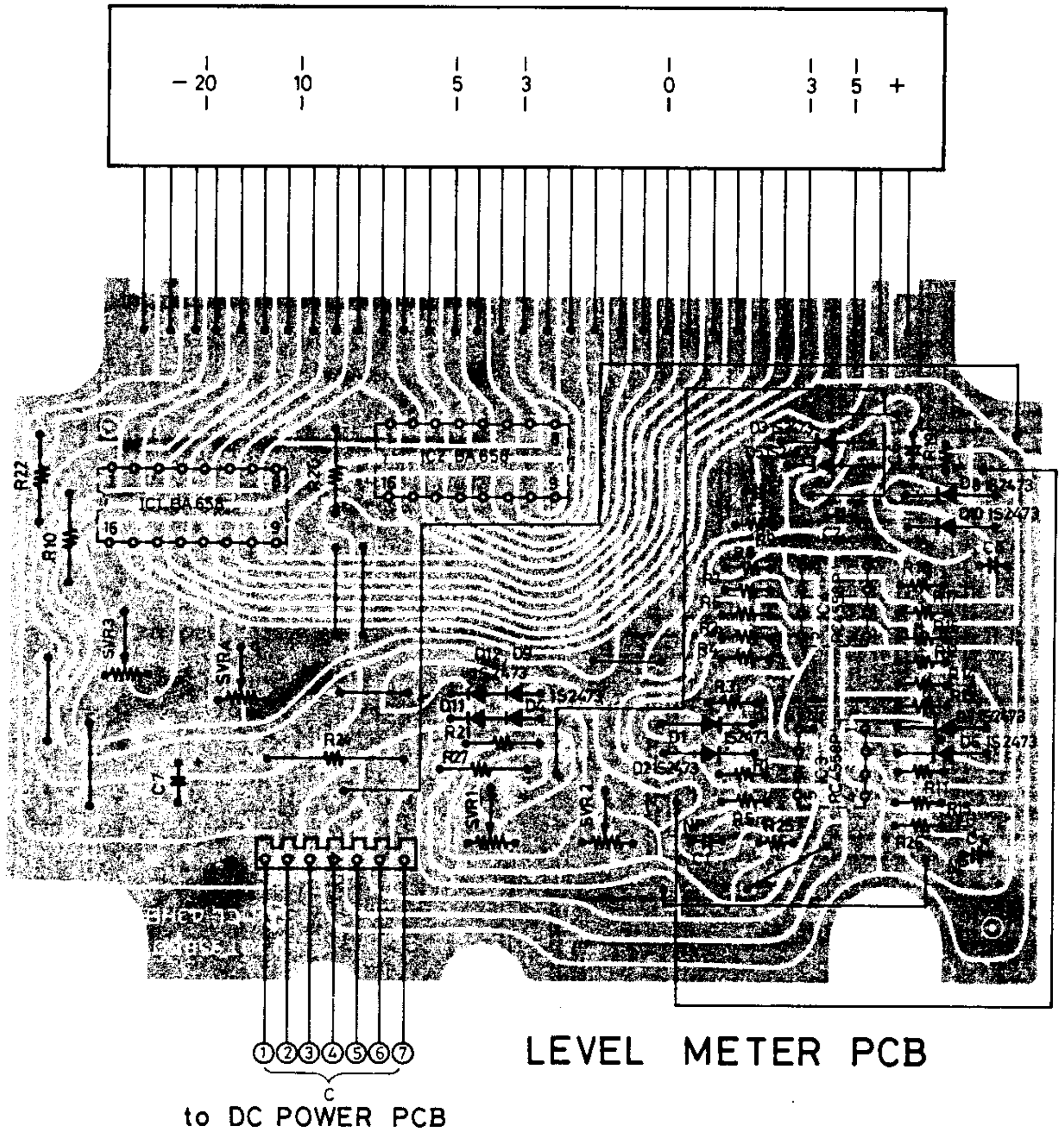
indicates signal flow of DECODER CIRCUIT.

indicates signal flow of ENCODER CIRCUIT.

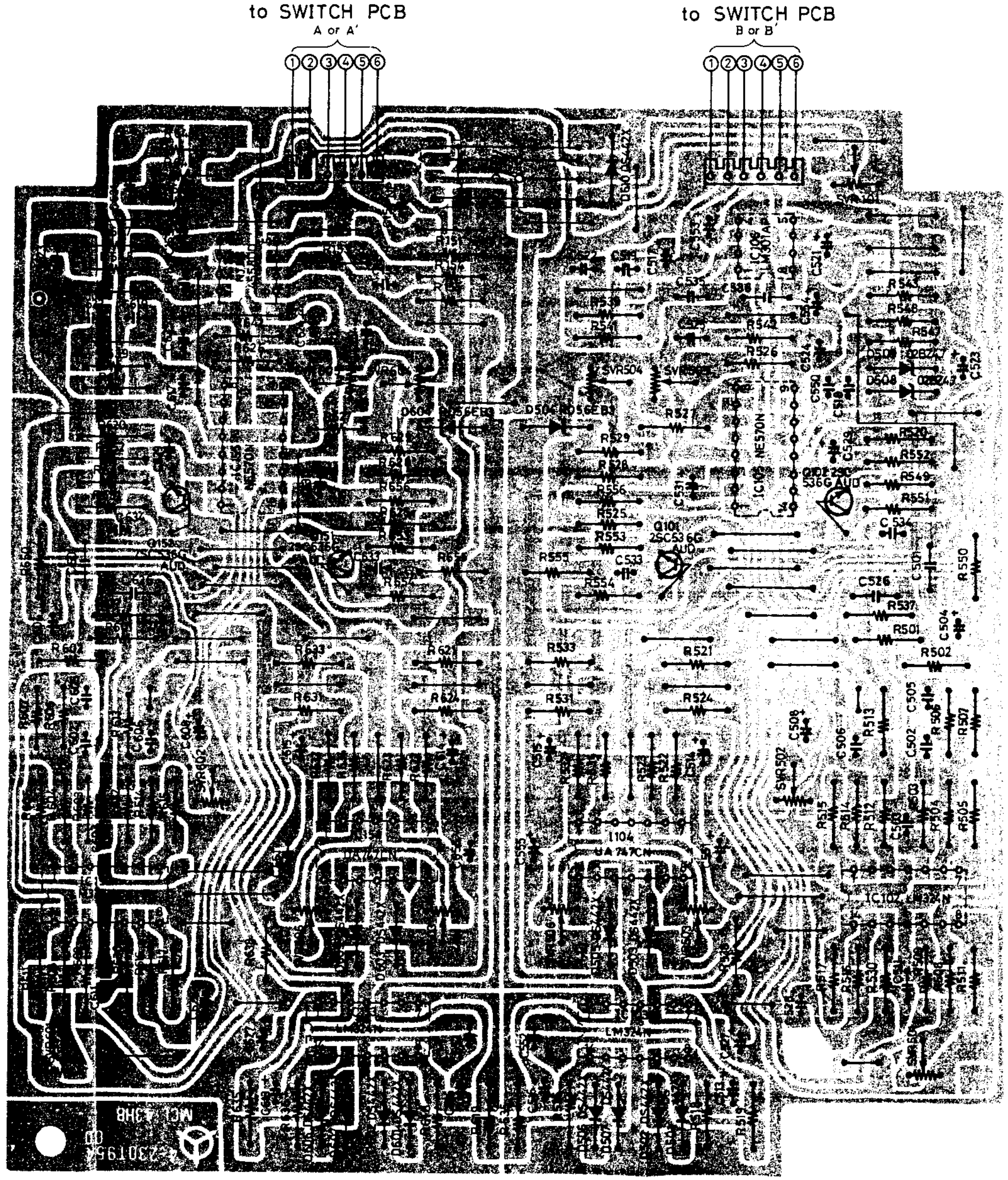
indicates positive line.

indicates negative line.

indicates ground.

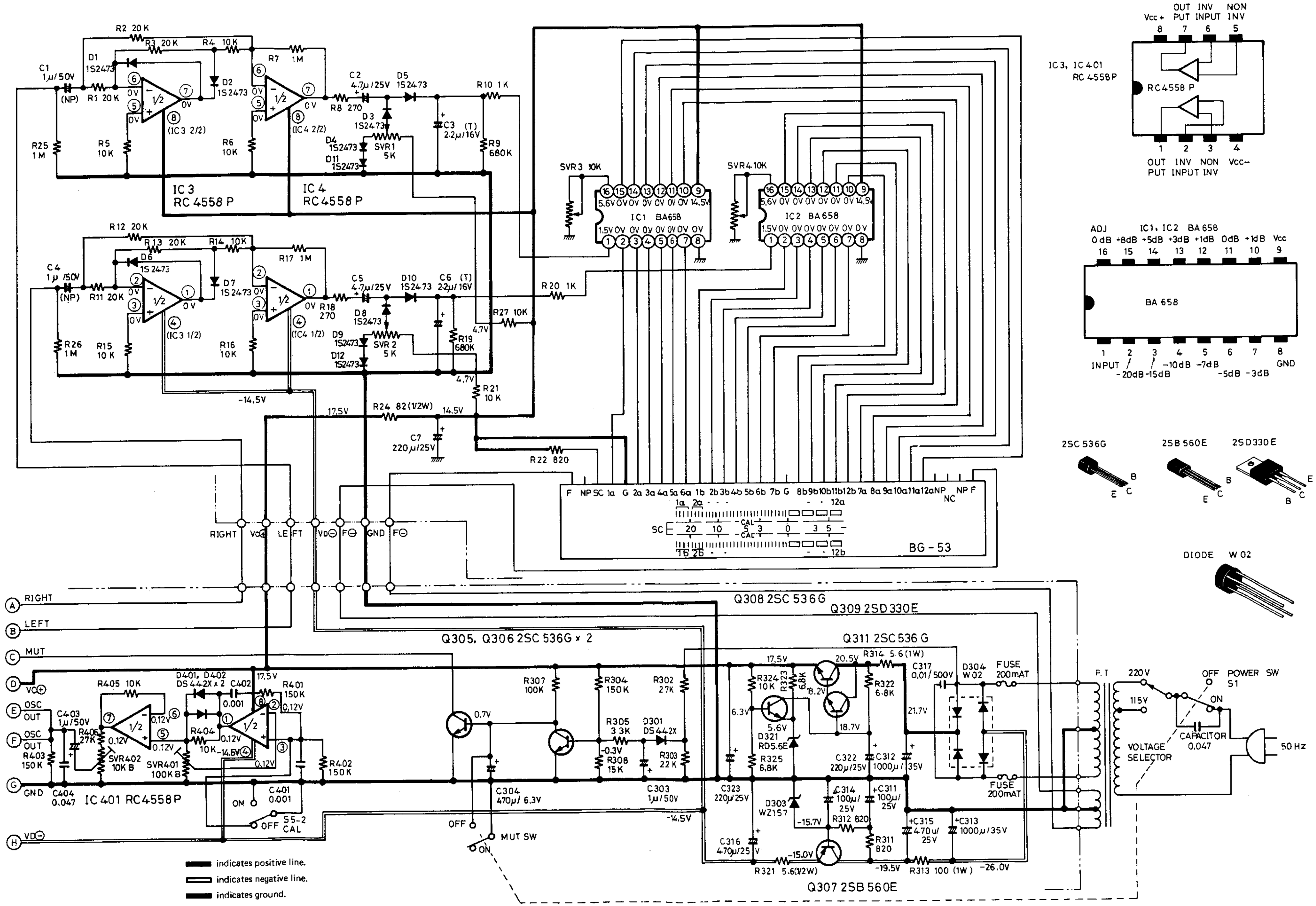


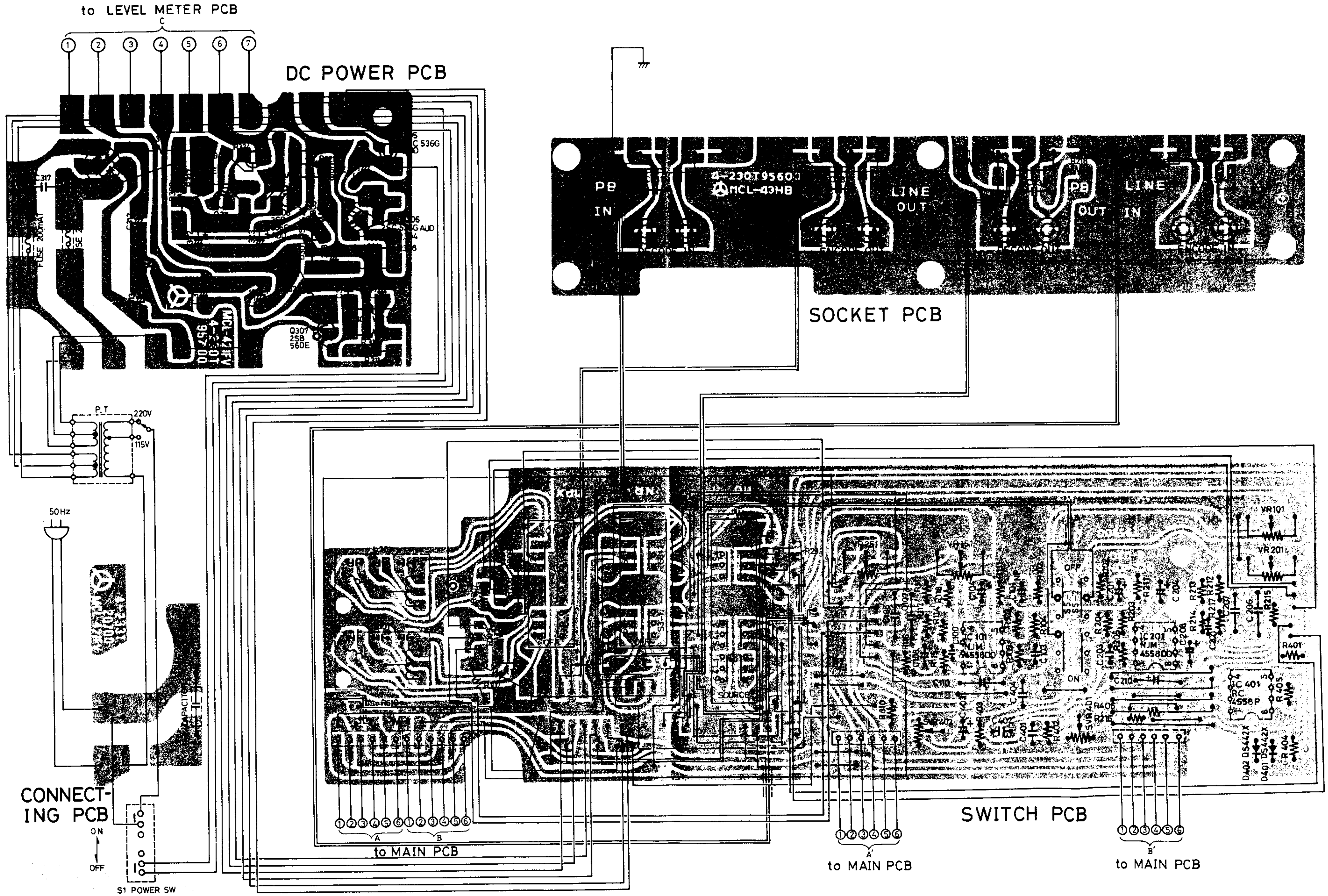
LEVEL METER PCB



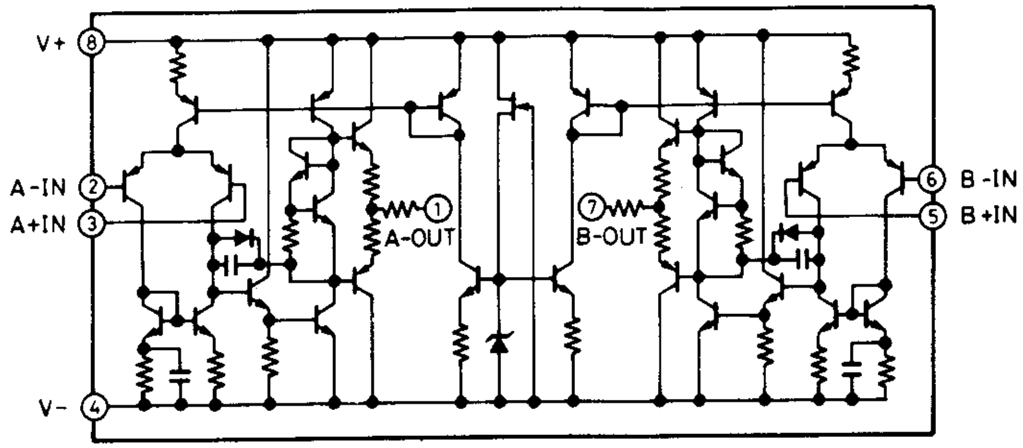
MAIN PCB

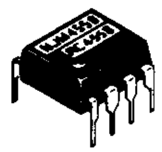
SCHEMATIC DIAGRAM

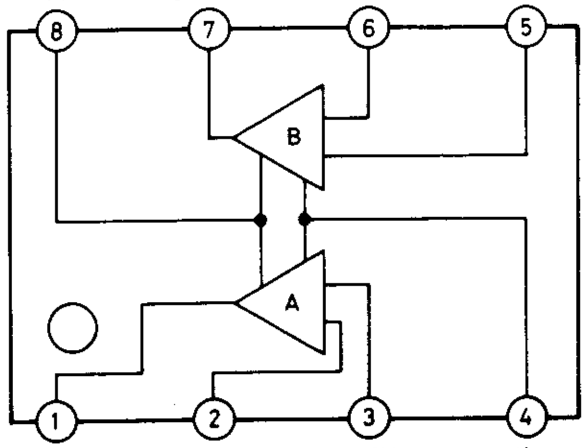


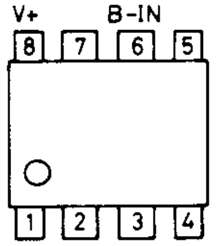

to LEVEL METER PCB
C
DC POWER PCB
SOCKET PCB
PB IN
LINE OUT
PB OUT
LINE IN
4-230T9560
MCL-43HB
P.T
220V
115V
50Hz
CONNECTING PCB
ON
OFF
S1 POWER SW
SWITCH PCB
Q307 2SB 560E
VR101
VR201
R401
IC 401 RC 4558P
IC 201 NJM 4558DD
to MAIN PCB
A
B
A'
B'
to MAIN PCB
to MAIN PCB

NJM4558
(DUAL HIGH-PERFORMANCE OPERATIONAL AMPLIFIERS)









(TOP VIEW)

SANYO ELECTRIC TRADING CO., LTD.
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Osaka-fu, 570 Japan

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