

LDM-171
DISTORTION METER
SERVICE MANUAL

NOTE

These servicing instructions are for use by qualified personnel only. To avoid electrical shock, do not perform any servicing other than that contained in the service manual unless you are qualified to do so.



CONTENTS

	Page
1. SPECIFICATIONS	3
2. TEST EQUIPMENT REQUIRED	4
3. CALIBRATION PROCEDURE	5
3.1 General	5
3.2 Adjustment of Meter Mechanical Zero	5
3.3 Initial Control Settings	5
3.4 Power Supply	6
3.5 VOLTMETER	6
(1) Sensitivity Adjustment-1(mV RANGE)	6
(2) Frequency Response Adjustment-1(mV RANGE)	6
(3) Sensitivity Adjustment-2(V RANGE)	6
(4) Frequency Response Adjustment-2(V RANGE)	7
(5) Output Voltage Adjustment	7
3.6 S/N	7
(1) Attenuator High Frequency Compensation	7
(2) HPF	8
3.7 DISTORTION	8
(1) Gain Adjustment	8
(2) Dial and COARSE BALANCE Control Adjustment-1	9
(3) COARSE BALANCE Control Adjustment	9
(4) FINE BALANCE Control Adjustment	9
(5) FREQ FINE control Adjustment	10
(6) AUTO MODE Adjustment	10
4. TROUBLESHOOTING PROCEDURE	11
4.1 Troubleshooting Aid-1	11
4.2 Troubleshooting Aid-2	11
(1) Overall operation	11
(2) VOLTMETER function	11
(3) DISTORTION function	12
(4) S/N function	14
5. ADJUSTMENT LOCATIONS	15
6. PRINTED CIRCUIT BOARD(Component side view)	16
T-3683 FUNCTION board	16
T-3684 Filter board	16
T-3685 Main board	17

	Page
7. BLOCK DIAGRAM/SCHEMATIC DIAGRAM	18
(1/7) Block diagram	18
(2/7) FUNCTION switch	19
(3/7) Input circuit, Attenuator, HPF	20
(4/7) Meter circuit, Power supply	21
(5/7) AUTO MODE circuit	22
(6/7) Filter	23
(7/7) Pc board interconnections	24
8. PARTS LIST	25
9. CABINET REMOVAL	29

1. SPECIFICATIONS

2.1 Distortion Measurement

Frequency ranges	Three ranges: 20Hz to 20kHz
Measurement ranges	Seven ranges: 0.1%, 0.3%, 1%, 3%, 10%, 30% and 100%
Input voltage ranges	Four ranges: 0.35V to 1V, 1V to 3V, 3V to 10V, 10V to 30V
Minimum measurable input voltage	350mV
Maximum measurable input voltage	30V
Measurement accuracy	±5% of fullscale (except in 100% range)
Residual distortion	0.01% max.
Input impedance	Approx. 100k Ω , shunt capacitance 50pF max.
Filter characteristics	
Fundamental suppression	80dB min.
Harmonic attenuation	0.6dB max. (2nd and 3rd harmonics)
Auto-tuning	
Capture ranges	1%, 0.3%, 0.1%

2.2 Level Measurement

Frequency range	20Hz to 200kHz
Measurement ranges	Twelve ranges (0.3, 1, 3, 10, 30 and 100) in both mV and V
Measurement accuracy	±5% of fullscale
Input impedance	1M Ω , shunt capacitance 50pF max.

2.3 S/N Measurement

Measurement range	0dB to 80dB
Input voltage range	Same as for distortion measurement
Input impedance	Approx. 100k Ω , shunt capacitance 50pF max.

2.4 Common Specifications

High-pass filter	
Cutoff frequency	400Hz
Rolloff	12dB/oct
Monitor terminal	
Output voltage	1Vrms at fullscale reading
Output impedance	Approx. 1k Ω
Power requirements	100V ±10%, 50/60Hz. Alterable to 120V, 200V or 240V by rewiring transformer taps.
External dimensions	300(W) x 150(H) x 250(D)mm
Ambient temperature	0°C to 40°C
Accessories	1 banana tip/alligator clip lead Instruction manual

2. TEST EQUIPMENT REQUIRED

The following test equipment is required for calibration and servicing of the Model LDM-171. The suggested specifications are the minimum necessary for proper calibration of this instrument.

<u>Test Equipment</u>	<u>Minimum Spec</u>
- Multimeter	0 - 20V Accuracy < 1%
- Oscilloscope	Dual trace 10mV sensitivity 10MHz bandwidth Low capacitance probe
- AC Voltmeter Calibrator	1mV - 100V 1kHz
- Audio Generator	20Hz - 20kHz Flatness < 0.2dB Distortion < 0.005% 30Vrms output voltage if available
- AC Millivoltmeter	1mV full scale 100kHz band width

3. CALIBRATION PROCEDURE

3.1 General

Calibration should be performed after a 30 minute warm-up period. It should also be confirmed that the unit is connected to the rated power line voltage.

All adjustments should be completed in the given order, because some adjustments interact with others.

During the adjustment procedure, remove the case only when necessary and replace immediately after making an adjustment. This will maintain all circuits at constant operating temperature.

3.2 Adjustment of Meter Mechanical Zero.

Turn the instrument off and allow 30 second for all capacitors discharge.

Rotate zero adjustment screw clockwise or counterclockwise so that the pointer indicates exactly zero.

After pointer is exactly at zero, rotate the screw slightly opposite direction to release tension of meter suspension.

3.3 Initial Control Settings

The initial control settings to be used for each check and adjustment are listed below. Any variations from these settings are stated in the applicable procedure.

FUNCTION	VOLTMETER/V
HPF	OUT
FREQ RANGE	x100
Hz dial	10
BALANCE	
FINE	Center
COARSE	Center
FREQ FINE	Center
MODE	MAN
SET LEVEL	1V
VERNIER	Fully counterclockwise
RANGE	100V

3.4 Power Supply

- Connect the DC voltmeter between test point on the pc board(T-3685) and chassis.
- Check that the DC voltage is within tolerance according to Table 3-1.

<u>Voltage</u>	<u>Tolerance</u>
+15V	+14.4V to +15.6V
+9V	+8.6V to +9.4V
-15V	-14.4V to -15.6V
-9V	-8.6V to -9.4V

Table 3-1

3.5 VOLTMETER

(1) Sensitivity Adjustment-1(mV RANGE)

- Set: FUNCTION RANGE VOLTmeter/mV 100mV
- Connect the voltmeter calibrator to INPUT terminal and set the frequency to 1kHz, output voltage to 100mVrms.
- Adjust VR1(T-3685) for a meter reading of 100mVrms.

(2) Frequency Response Adjustment-1(mV RANGE)

- Set: Same as (1).
- Connect the audio generator to INPUT connector and set the frequency to 1kHz, output level for 100mV indication.
- Change the frequency to 200kHz.
- Adjust TC4(T-3685) for a meter reading of 100mVrms.
- Change the frequency to 100kHz.
- The meter reading should be 100mVrms within +, -2%.

(3) Sensitivity Adjustment-2(V RANGE)

- Set: FUNCTION RANGE VOLTmeter/mV 1V ✓
- Connect the voltmeter calibrator to INPUT terminal and set the frequency to 1kHz, output voltage to 1Vrms.
- Adjust VR1(T-3683) for a meter reading of 1Vrms.

(4) Frequency Response Adjustment-2(V RANGE)

- Set: Same as (3).
- Connect the audio generator to INPUT connector and set the frequency to 1kHz, output level for 1V indication.
- Change the frequency to 200kHz.
- Adjust VC1(T-3683) for a meter reading of 1Vrms.
- Repeat (3) and (4) if necessary.

(5) Output Voltage Adjustment

- Set: Same as (1).
- Connect the audio generator to INPUT terminal and set the frequency to 1kHz, output level for full scale indication.
- Connect the AC millivoltmeter to OUTPUT terminal.
- Adjust VR2(T-3685) for the AC millivoltmeter reading of 1Vrms.

3.6 S/N

(1) Attenuator High Frequency Compensation

- | | |
|-----------------|-----------------|
| - Set: FUNCTION | S/N |
| SET LEVEL | 1V |
| VERNIER | Fully clockwise |
| RANGE | 0dB |
- Connect the audio generator to INPUT connector and set the frequency to 1kHz, output level for 0dBm indication.
 - Change the frequency to 200kHz.
 - The meter reading should be 0dBm within +, - 0.2dB.
Note the meter reading.

- Set: SET LEVEL	3V
RANGE	-10dB

 - Set the generator frequency to 1kHz, output for "0dBm" indication.
 - Change the generator frequency to 200kHz.

- Adjust TC1(T-3685) for the same meter reading as above noted.
- Apply the same procedure for 10V and 30V position according to Table 3-2.

SET LEVEL	RANGE	Adjustment
1V	0dB	-
3V	-10dB	TC1
10V	-20dB	TC2
30V	-30dB	TC3

Table 3-2

(2) HPF

- Set: HPF RANGE IN 1V
- Connect the audio generator to INPUT terminal and set the frequency to 5kHz, output level for full scale indication.
- Change the frequency to 50Hz.
- The meter reading should be -34dB(0.02Vrms) or low.

3.7 DISTORTION

- Set: FUNCTION DISTORTION
- HPF OUT
- FREQ RANGE x100
- Hz Dial 10
- BALANCE
- FINE Center
- COARSE Center
- FREQ FINE Center
- MODE MAN
- SET LEVEL 1V
- VERNIER Fully clockwise
- RANGE 100%

- Connect the audio generator to INPUT terminal and set the frequency to 1kHz, output level for full scale indication.

(1) Gain Adjustment

- Set: FREQ RANGE x10
- RANGE SET

4. TROUBLESHOOTING PROCEDURE

4.1 Troubleshooting Aid-1

Confirm that the any equipment used with the LDM-171 is operating correctly.

Check all control settings, because an incorrect setting can make a good unit appear defective. If there is any question about the function, refer to the INSTRUCTION MANUAL for a correct operation.

Check all circuit for visual defects such as broken component, loose connection of a connector, open wire, poor soldering etc.

Some troubles can be solved with proper adjustment.

Check the voltage and waveform as shown in the Schematic Diagram to locate the defective circuit. Start with the power supply.

Typical voltage and waveform are obtained under the same conditions as "3.3 Initial Control Settings"

The distortion meter consists of a voltmeter and a fundamental rejection filter. Therefore, troubleshoot the VOLTMETER function first to confirm that it works properly, then proceed to troubleshooting of the DISTORTION function.

4.2 Troubleshooting Aid-2

(1) Overall operation is not satisfactory, or unit is dead.

a. Check that the power supply voltage is within tolerance according to Table 3-1.

Yes: Proceed to step (2).

No: Check and troubleshoot on following points.

Line fuse.

Secondary voltage of the power transformer.

+15V: IC18 and associated circuit.

+9V: +15V line, IC17 and associated circuit.

-15V: IC20 and associated circuit.

-9V: -15V line, IC9 and associated circuit.

(2) VOLTMETER function

a. Set the controls for VOLTMETER operation and select the RANGE switch to 1V.

Connect the AC voltmeter calibrator to INPUT terminal and set the frequency to 1kHz, output voltage to 1Vrms.

If the sensitivity is too low or no meter deflection, trace the signal from the input stage to meter circuit by using the AC millivoltmeter, monitored by oscilloscope at the output connector, to locate the defective circuit.

- b. Check the sine wave at TP3(T-3685) for approximately 25mVrms.
 - Yes: Proceed to step "c".
 - No: Check the sine wave at TP1(T-3685) for approximately 1mVrms.
 - Yes- Troubleshoot Amplifier(IC1), 2nd attenuator(R27-37, 39 IC3, 4), Buffer (IC5a), FUNCTION switch on the pc board(T-3685) and associated circuit.
 - No- Troubleshoot FUNCTION switch, Input attenuator(T-3683), Impedance converter(Q1-4, T-3685).
- c. Check the sine wave at TP6(T-3685) for approximately 50mVrms.
 - Yes: Troubleshoot Amplifier(Q6, 7, 16, IC9), Detector(D8, 9) on the pc board T-3685 and associated circuit.
 - No: Check sine wave at TP5(T-3685) for approximately 25mVrms.
 - Yes- Troubleshoot Amplifier(IC7 T-3685) and associated circuit.
 - No- Troubleshoot Buffer(IC5b T-3685) FUNCTION switch and associated circuit.

(3) DISTORTION function

Confirm that the VOLTMETER function works properly before proceed to troubleshooting of the DISTORTION function.

Set the controls for DISTORTION meter operation with MANUAL MODE and set the SET LEVEL controls to 3V/fully clockwise, RANGE switch to SET.

Apply the 1kHz, 1Vrms sine wave from the audio generator to the INPUT terminal.

- a. Check that the meter indicates 90% of the full scale or more. Check waveform at TP1(T-3685) for approximately 1V.
 - Yes: Troubleshoot SET LEVEL pot, FUNCTION switch and associated circuit.
 - No: FUNCTION switch, SET LEVEL switch and associated circuit.

- b. No nulling works
Connect TP2 and TP8(T-3684) to chassis respectively, with short clip leads.

Connect the AC millivoltmeter, monitored by the oscilloscope, to TP1(T-3684).

Set the SET LEVEL controls for 100mVrms at the TP1.

Check the at TP3 for approximately 120mVrms.

Yes: Proceed to step "c".

No: Check the at TP7 for approximately 100mVrms.

Yes- IC2, 3(T-3684) and associated circuit.

No- IC1(T-3684) and associated circuit.

- c. Remove the clip lead between TP8 and chassis. (TP2 is still connected to chassis)

The sine wave amplitude at TP4(T-3684) is changed by rotating the Dial.

Yes: Proceed to step "d".

No: Check C multiplier(IC4, 5 T-3684) and associated circuit.

- d The sine wave amplitude at TP5(T-3684) is changed by rotating the Dial.

Yes: FREQ RANGE switch and associated circuit.

No: Check C multiplier(IC6, 7 T-3684) and associated circuit.

- e. No FINE BALANCE works

Troubleshoot IC8b, IC16b, LED(PC) DRIVER(IC13a, 15a, Q14), on the pc board T-3685.

- f. No FREQ FINE works

Troubleshoot IC8b, IC16b, LED(PC) DRIVER(IC13b, 15b, Q15), on the pc board T-3685.

- g. No AUTO MODE works

Connect the dual trace oscilloscope to INPUT and OUTPUT terminal respectively to observe the amplitude and relative phase of the waveforms.

Set the MODE switch to MAN.

Adjust FREQUENCY and BALANCE controls for 1% or lower meter indication, then set the MODE switch to AUTO position.

If the amplitude is decrease and no relative phase is changed, check Phase detector(IC12a, 14, Q8-10 T-3685) and associated circuit.

If the no amplitude is decrease and relative phase is changed, check Phase shifter(IC10, 11), Phase detector IC12b, 14, 16a, Q8-10) on the pc board T-3685 and associated circuit.

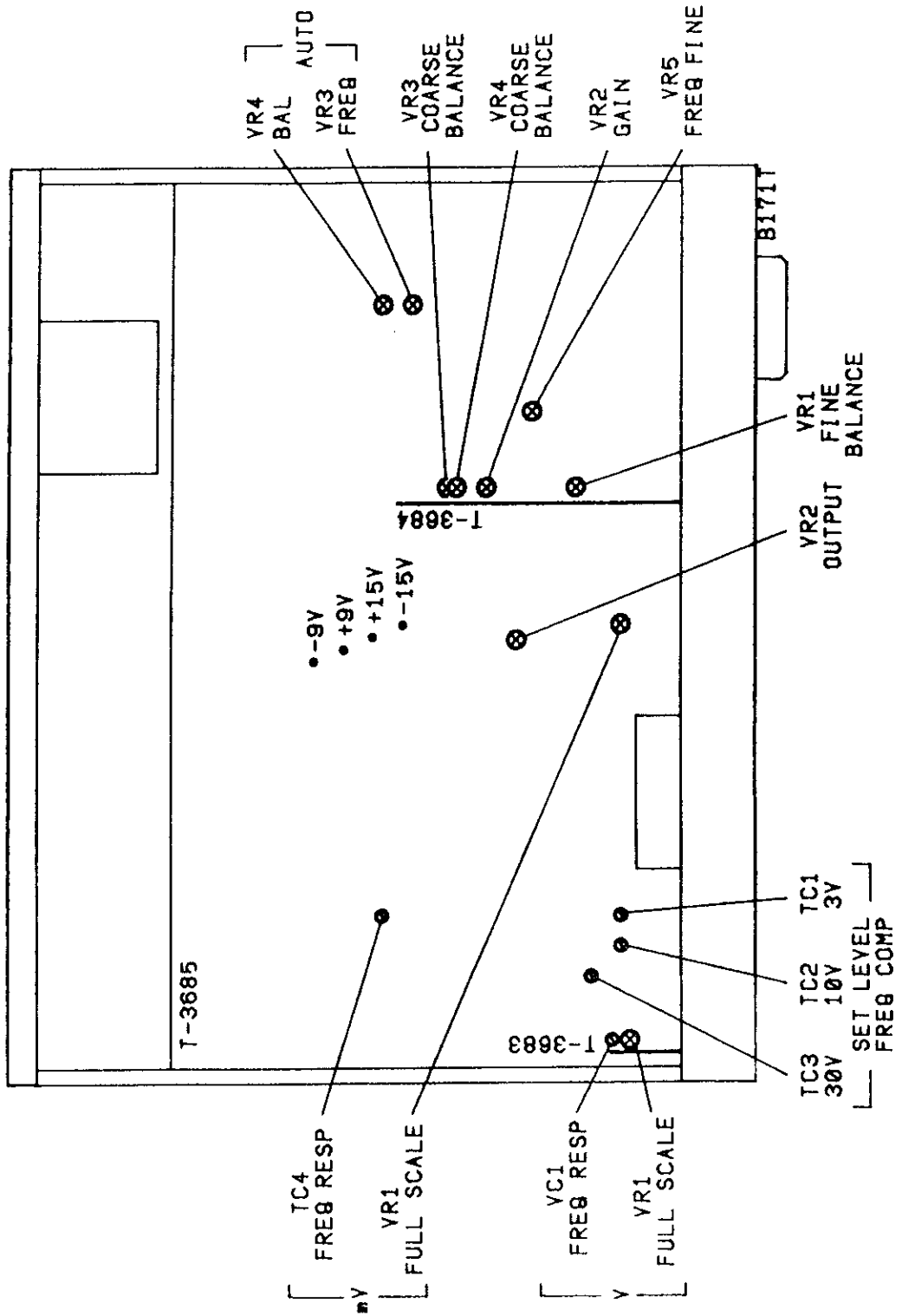
(4) No S/N function works

Confirm that the VOLTMETER and DISTORTION function work properly before proceed to troubleshooting of the S/N function.

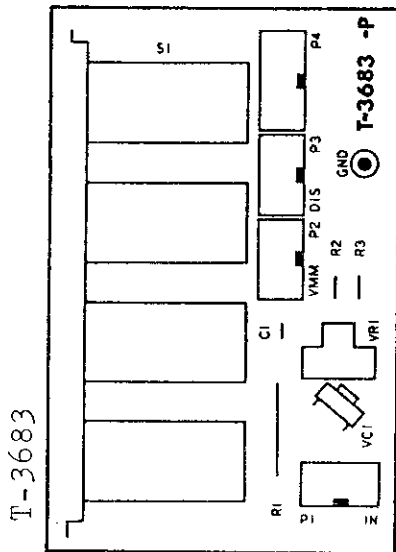
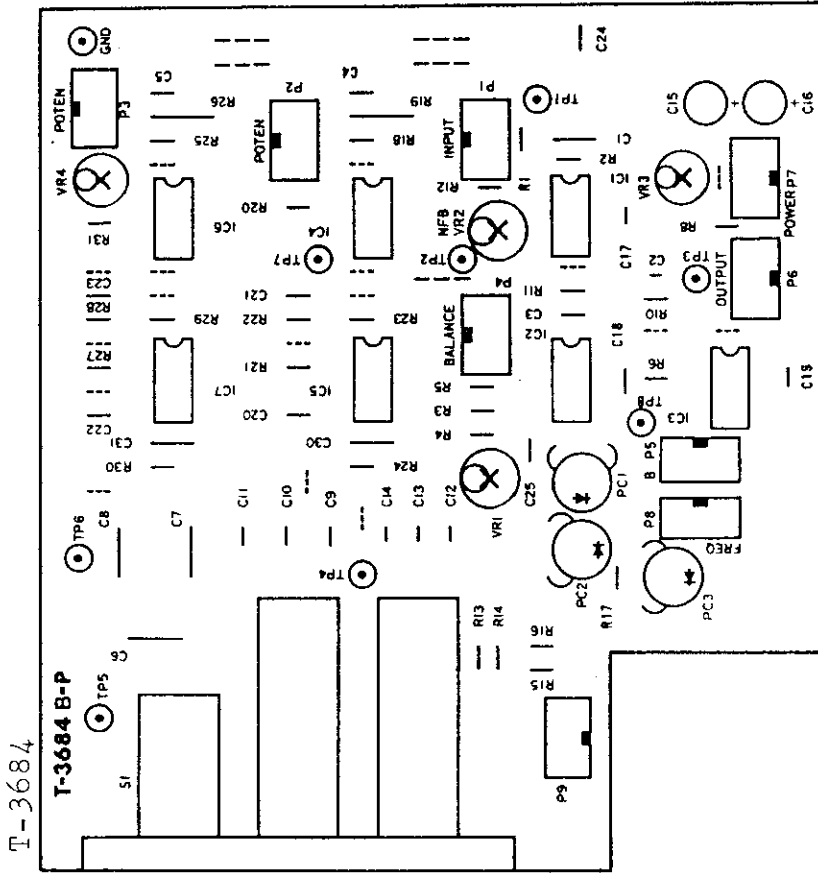
Check FUNCTION switch and associated circuit.

5. ADJUSTMENT LOCATIONS

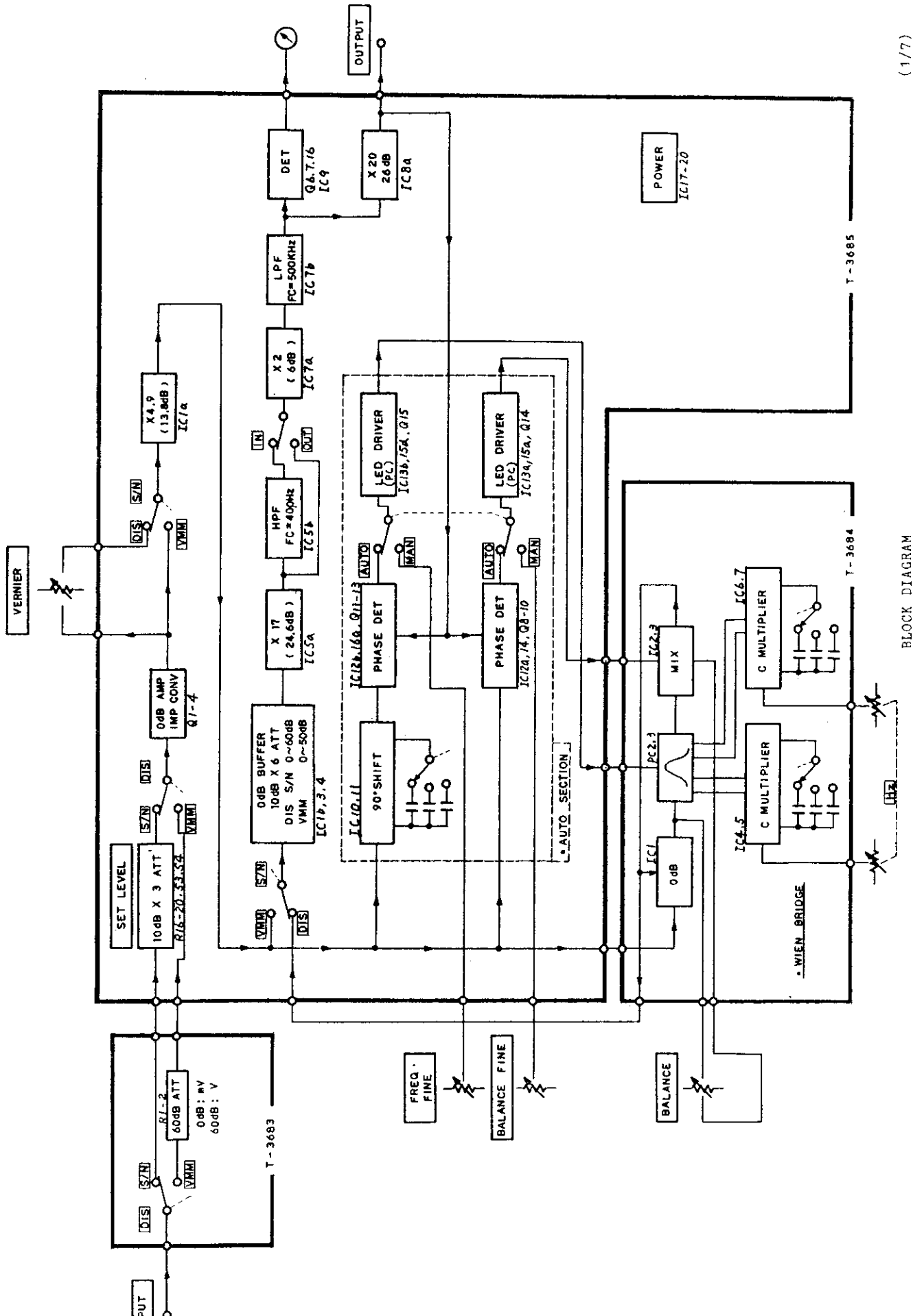
<TOP VIEW>

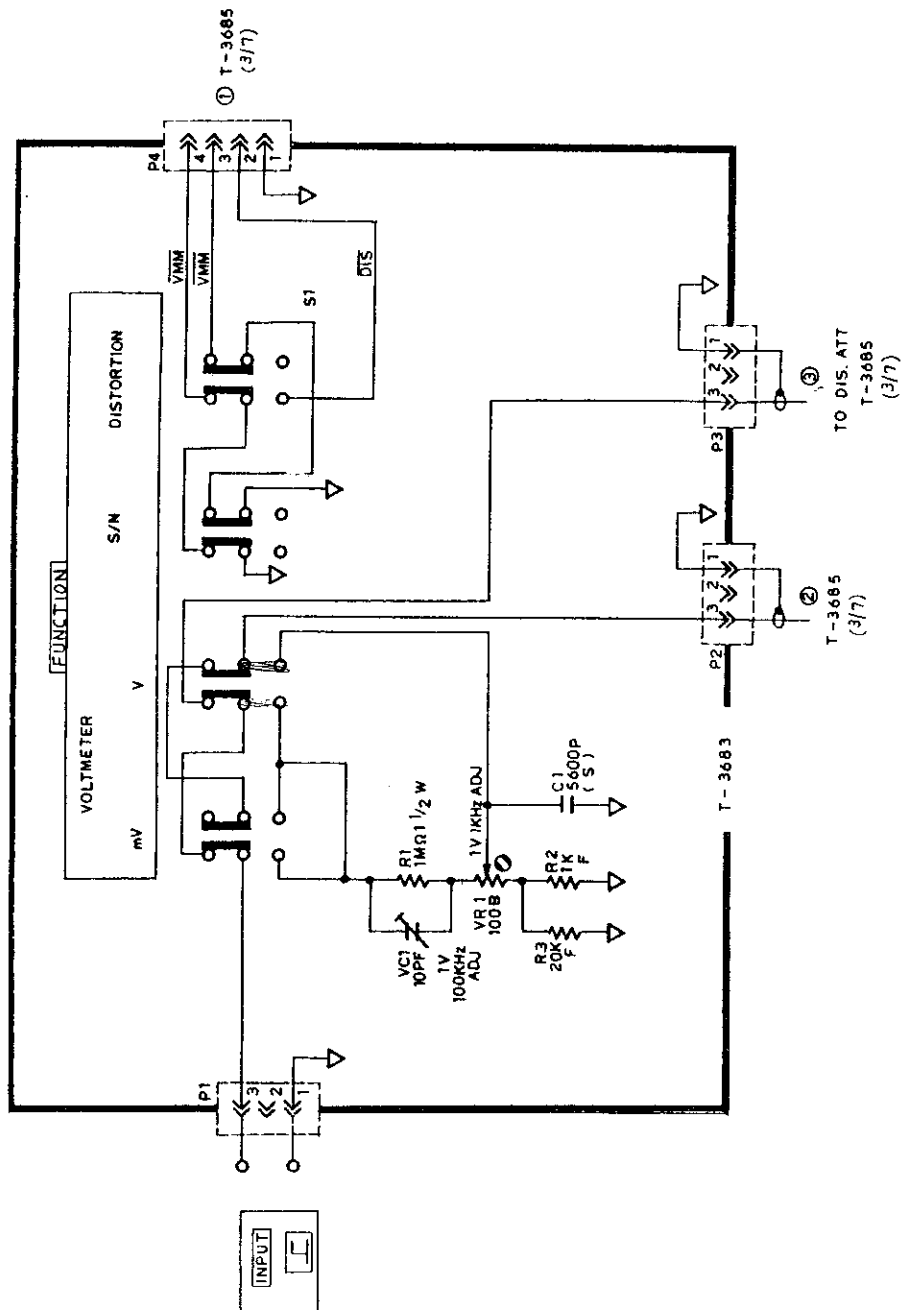


6. PRINTED CIRCUIT BOARD



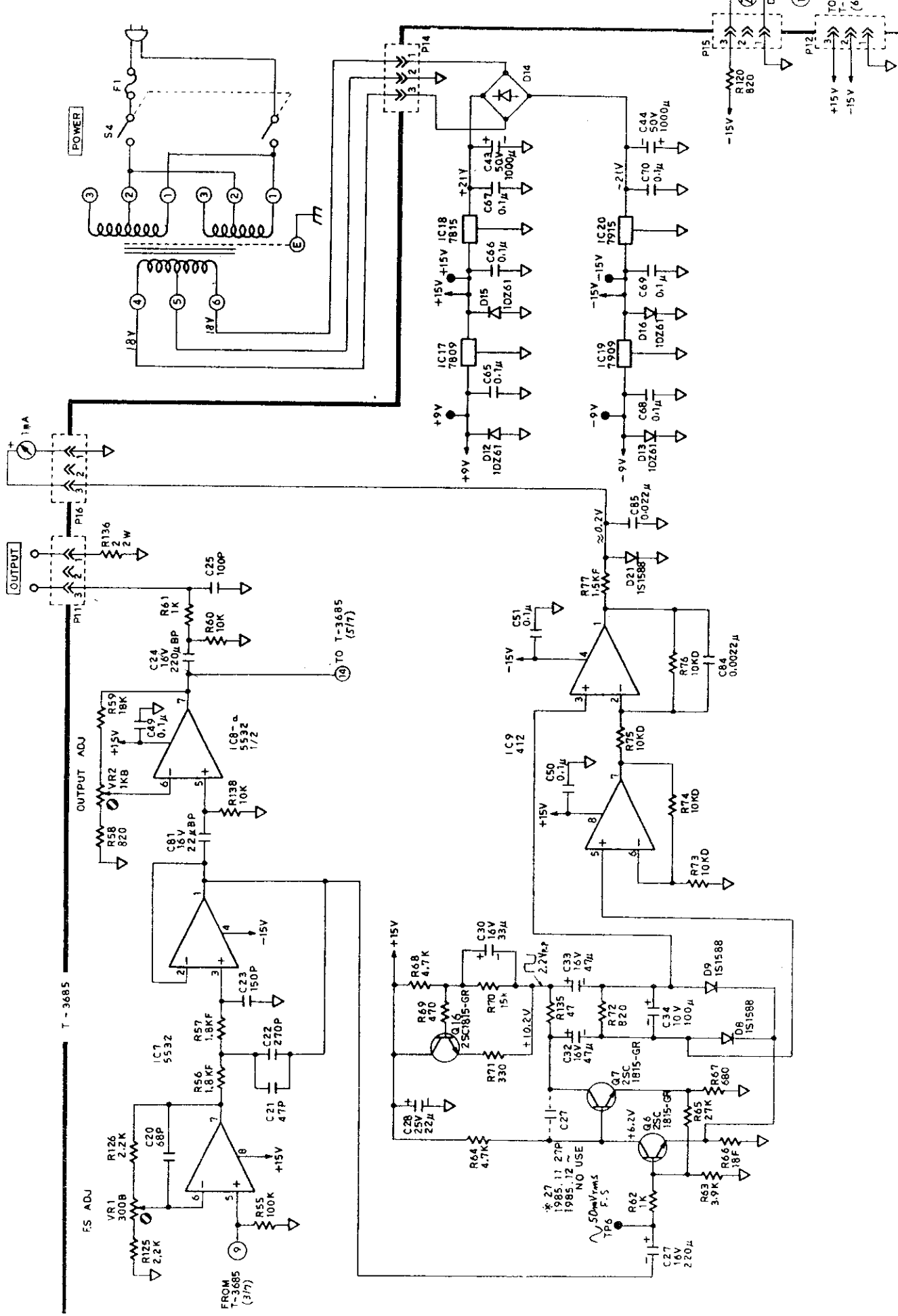
7. BLOCK DIAGRAM/SCHEMATIC DIAGRAM

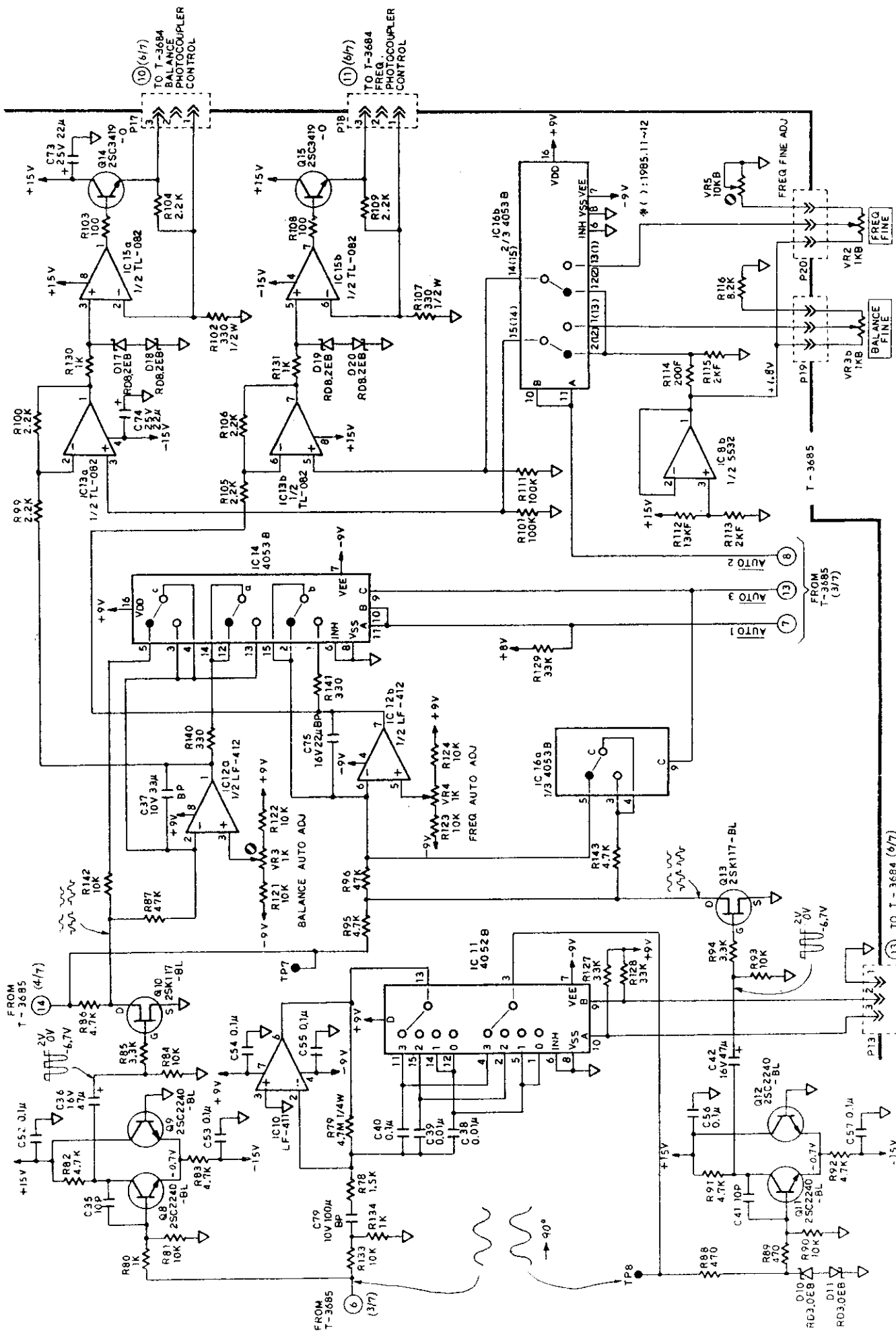




FUNCTION

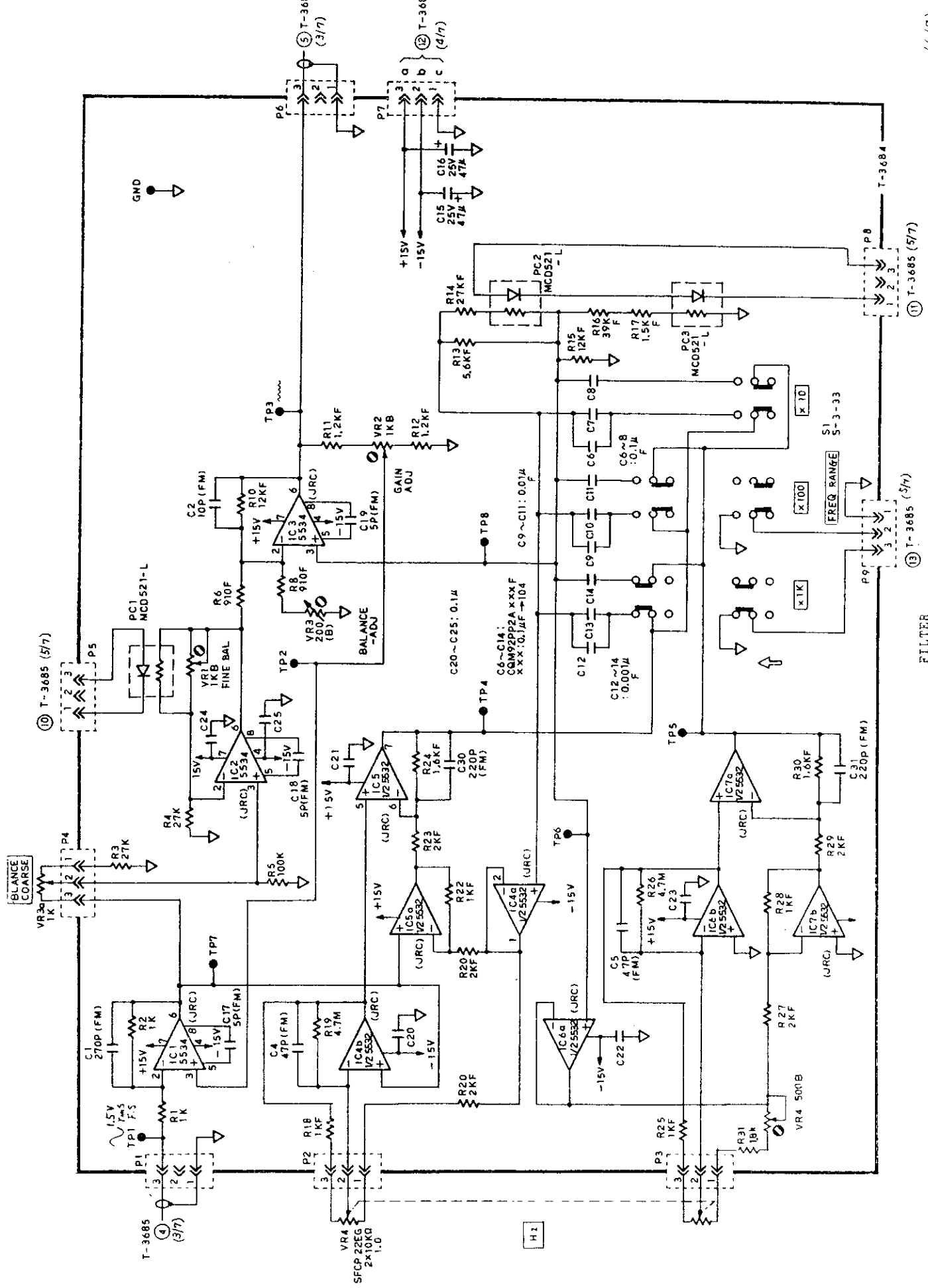
(2/7)

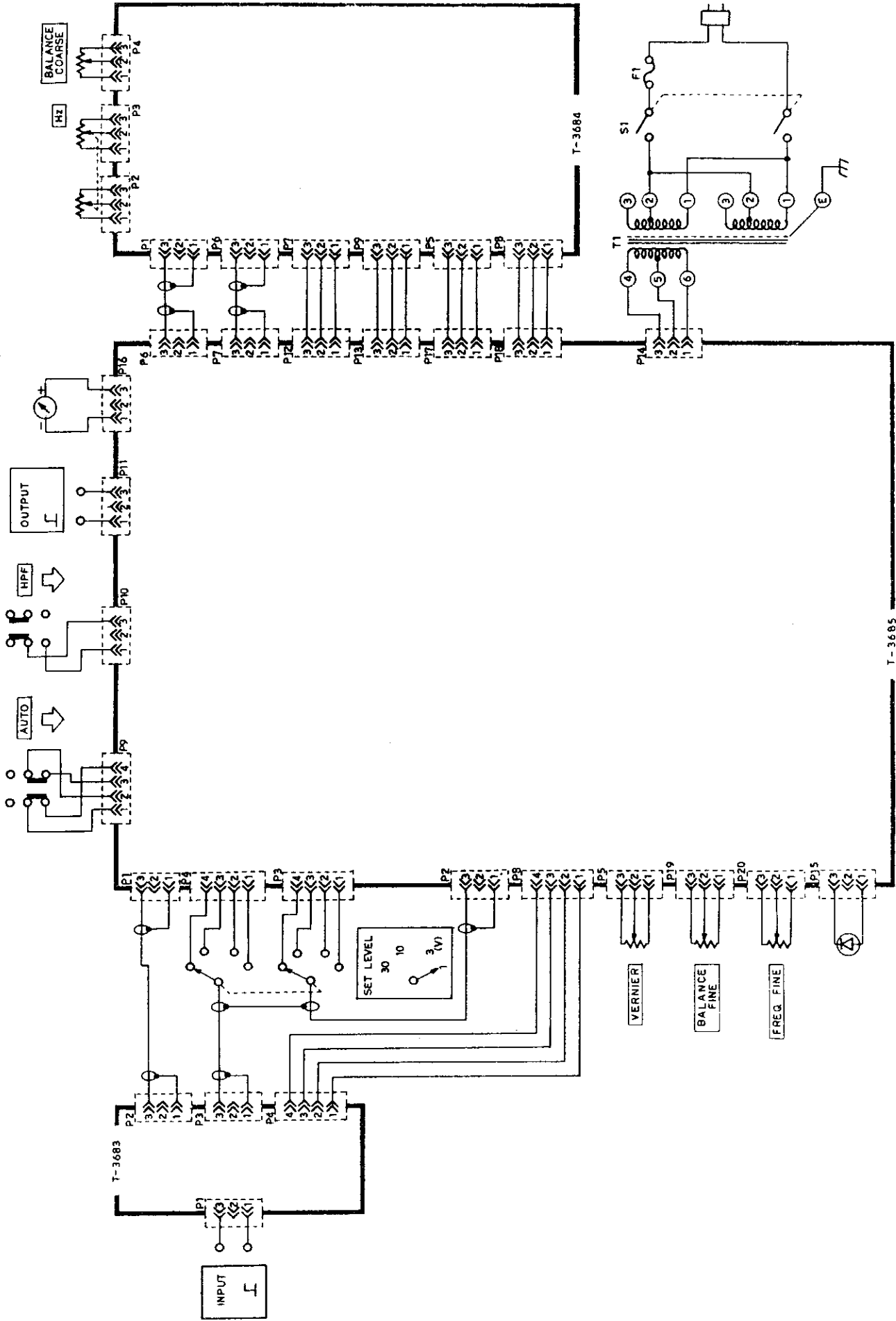




AUTO MODE CIRCUIT

TO T-3684 (6/7)





PC BOARD INTERCONNECTIONS

(7/7)

No.	LDR PT No.	DESCRIPTION	LDR PT No.	DESCRIPTION
*** MAIN FRAME ***				
-VARIABLE RESISTORS-				
VR1	1816007101	CARBON FILM	1K OHM 20% 1/20W	"SET LEVEL"
VR2	1815924004	CARBON FILM	1K OHM 30% 1/6W	"FREQ FINE"
VR3	1817003109	CARBON FILM	1K OHM 20% 1/20W	"BALANCE"
VR4	1940048007	PLASTIC	10K OHM 1.5% LIN. 1W	"HZ"
-DIODE-				
D1	3130063000	LED	TLG164	"POWER"
-TRANSFORMER-				
T1	3800543009	TRANSFORMER	J-543	
-SWITCHES-				
S1	4010006005	ROTARY	SRM1034220	"SET LEVEL"
S2	4020019001	PUSH	S-1-24 "MODE"	
S3	4020019001	PUSH	S-1-24 "HPF"	
S4	4020138009	PUSH	ESB-70702Y	"POWER"
-METER-				
M1	4210009025		1mA	(H-1031)
-FUSE-				
F1	4363730007	TIME LAG	ST4 200mA	"180V-364V"
F1	4363735007	TIME LAG	ST4 250mA	"90V-132V"
-MISCELLANEOUS-				
	4371009003	FUSE HOLDER	FH-032<6.35X31.8>	
*** FUNCTION BOARD				
-RESISTORS-				
R1	1331004008	METAL FILM	1.00M OHM	1% 1/2W
R2	1461001001	METAL FILM	1K OHM	1% 1/6W
R3	1462002009	METAL FILM	20K OHM	1% 1/6W
-VARIABLE RESISTOR-				
VR1	1711005071	CERMET	100 OHM 20%	1/3W
-CAPACITOR-				
C1	2130562009	PLASTIC FILM	5600pF	10% 50V
-VARIABLE CAPACITOR-				
VC1	2910048005	CERAMIC	2-12pF	250V
-SWITCH-				
S1	4020193007	PUSH	S-4-18	"FUNCTION"
-PC BOARD-				
	5903683009		T-3683	

No.	LDR PT No.	DESCRIPTION	LDR PT No.	DESCRIPTION
*** FILTER BOARD				
-RESISTORS-				
R1	1000102007	CARBON FILM	1K OHM	5% 1/6W
R2	1000102007	CARBON FILM	1K OHM	5% 1/6W
R3	1000273004	CARBON FILM	27K OHM	5% 1/6W
R4	1000273004	CARBON FILM	27K OHM	5% 1/6W
R5	1000104001	CARBON FILM	100K OHM	5% 1/6W
R6	1469100001	METAL FILM	910 OHM	1% 1/6W
R8	1469100001	METAL FILM	910 OHM	1% 1/6W
R10	1461202001	METAL FILM	12K OHM	1% 1/6W
R11	1461201009	METAL FILM	1.2K OHM	1% 1/6W
R12	1461201009	METAL FILM	1.2K OHM	1% 1/6W
R13	1465601009	METAL FILM	5.6K OHM	1% 1/6W
R14	1462702007	METAL FILM	27K OHM	1% 1/6W
R15	1461202001	METAL FILM	12K OHM	1% 1/6W
R16	1463902001	METAL FILM	39K OHM	1% 1/6W
R17	1461501001	METAL FILM	1.5K OHM	1% 1/6W
R18	1461001001	METAL FILM	1K OHM	1% 1/6W
R19	1010475003	CARBON FILM	4.7M OHM	5% 1/4W
R20	1462001007	METAL FILM	2K OHM	1% 1/6W
R21	1462001007	METAL FILM	2K OHM	1% 1/6W
R22	1461001001	METAL FILM	1K OHM	1% 1/6W
R23	1462001007	METAL FILM	2K OHM	1% 1/6W
R24	1461601005	METAL FILM	1.6K OHM	1% 1/6W
R25	1461001001	METAL FILM	1K OHM	1% 1/6W
R26	1010475003	CARBON FILM	4.7M OHM	5% 1/4W
R27	1462001007	METAL FILM	2K OHM	1% 1/6W
R28	1461001001	METAL FILM	1K OHM	1% 1/6W
R29	1462001007	METAL FILM	2K OHM	1% 1/6W
R30	1461601005	METAL FILM	1.6K OHM	1% 1/6W
R31	1461801003	METAL FILM	1.8K OHM	1% 1/6W
-VARIABLE RESISTORS-				
VR1	1711005026	CERMET	1K OHM 20%	1/3W
VR2	1711005026	CERMET	1K OHM 20%	1/3W
VR3	1711005127	CERMET	200 OHM 20%	1/3W
VR4	1711005017	CERMET	500 OHM 20%	1/3W
-CAPACITORS-				
C1	2120271001	MICA	270pF	10% 500V
C2	2120100004	MICA	10pF	10% 500V
C4	2120470016	MICA	47pF	10% 500V
C5	2120470016	MICA	47pF	10% 500V
C6	2192032004	PLASTIC FILM	0.1uF	1% 100V
C7	2192032004	PLASTIC FILM	0.1uF	1% 100V
C8	2192032004	PLASTIC FILM	0.1uF	1% 100V
C9	2192032003	PLASTIC FILM	0.01uF	1% 100V
C10	2192032003	PLASTIC FILM	0.01uF	1% 100V
C11	2192032003	PLASTIC FILM	0.01uF	1% 100V
C12	2192022001	PLASTIC FILM	1000pF	1% 100V
C13	2192022001	PLASTIC FILM	1000pF	1% 100V
C14	2192022001	PLASTIC FILM	1000pF	1% 100V
C15	2240470009	ELECTROLYTIC	47uF	25V 20%
C16	2240470009	ELECTROLYTIC	47uF	25V 20%
C19	2120050005	MICA	5pF	500V
C20	2090016006	CERAMIC	0.1uF	50V
C21	2090016006	CERAMIC	0.1uF	50V

9. CABINET REMOVAL

The Top and Bottom cover can be detached by removing the four cord wrappers and the two additional screws on the rear panel.

