

LDM-171  
DISTORTION METER  
SERVICE MANUAL

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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.

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# 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 $\Omega$ , 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 $\Omega$ , 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 $\Omega$ , 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 $\Omega$
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

- Set the generator frequency to 1kHz, output level for full scale indication.
  - Depress 100% button of the RANGE switch.
  - Adjust VR2(T-3684) for a meter reading of full scale.
- (2) Dial and COARSE BALANCE Control Adjustment-1
- Set the generator frequency to 700Hz, output level for -10 dBV(0.316Vrms).
  - Adjust Dial and COARSE BALANCE control alternately to obtain a minimum meter indication. It should be about 1% or less of the full scale indication.
  - If the dial indication is excessively off from the letter "7", correct the dial position by using set screws on the Dial knob.
  - Set the COARSE BALANCE control to the center.
  - Adjust VR3(T-3684) for minimum meter indication.
- (3) COARSE BALANCE Adjustment-2
- Set: RANGE    x1k
  - Set the generator frequency to 20kHz.
  - Adjust Dial and COARSE BALANCE adjustment for minimum meter indication. It should be about 1% or less.
  - Set the COARSE BALANCE control to the center.
  - Adjust VR4(T-3684) for minimum meter indication.
  - Check that the COARSE BALANCE control is positioned between about 10 and 2 o'clock position when nulling at 2kHz, 7kHz and 20kHz.  
If not, adjust VR3 and 4(T-3684) slightly to compromise the nulling point.
- (4) FINE BALANCE Control Adjustment
- Set the generator frequency to 1kHz, output level for full scale indication.

- Adjust Dial and COARSE BALANCE control (do not touch the FINE BALANCE control) alternately to obtain a minimum meter indication. It should be about 0.1% or less at the 3% RANGE.
- Adjust VR1(T-3684) for meter indication should be about 0.6% when the FINE BALANCE control is positioned at the both extremes.

(5) FREQ FINE Control Adjustment

- Set: FREQ FINE Center
- Set the generator frequency to 1kHz, output level for full scale indication.
- Adjust Dial and BALANCE controls (do not touch the FREQ FINE control) alternately to obtain a minimum meter indication. It should be about 0.1% or less at the 3% RANGE.
- Adjust VR5(T-3685) for meter indication should be about 0.5% when the FREQ FINE control is positioned at the both extremes.

(6) AUTO MODE Adjustment

- Set: FREQ RANGE x1k
- Dial 20
- RANGE 100%
- MODE AUTO
- Set the generator frequency to 20kHz.
- Adjust Dial, FREQ FINE and BALANCE controls alternately to obtain a minimum meter indication.
- Set the RANGE switch to 3%.
- Adjust FINE controls for minimum meter indication.
- Set the RANGE switch to 0.1%.
- Adjust VR3 and VR4(T-3685) alternately for minimum meter indication.

NOTE: Recommend to observe the INPUT and OUTPUT waveforms by using the dual trace oscilloscope for easy nulling.

## 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

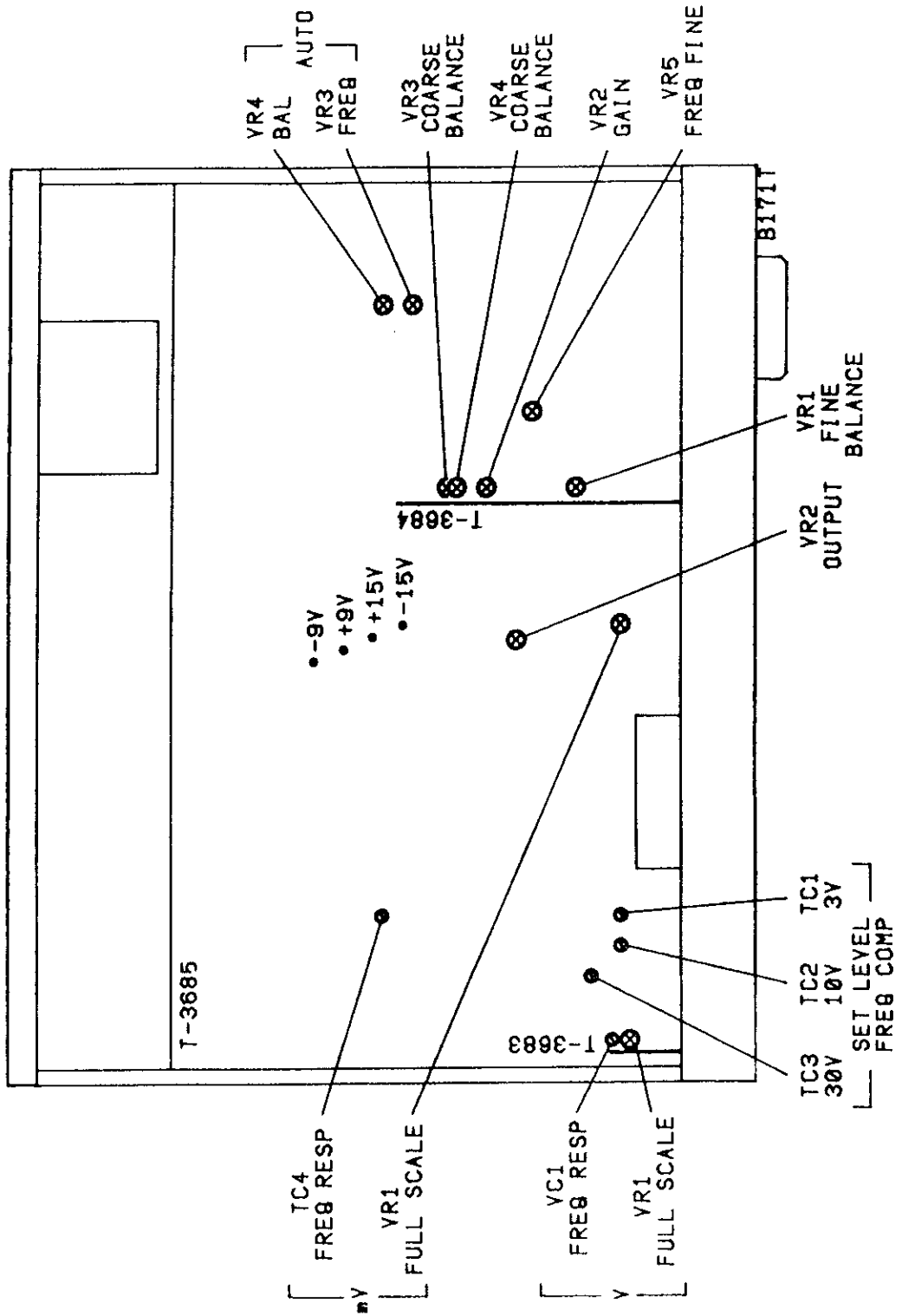
Confirm that the VOLTMETER and DISTORTION function work properly before proceed to troubleshooting of the S/N function.

Check FUNCTION switch and associated circuit.

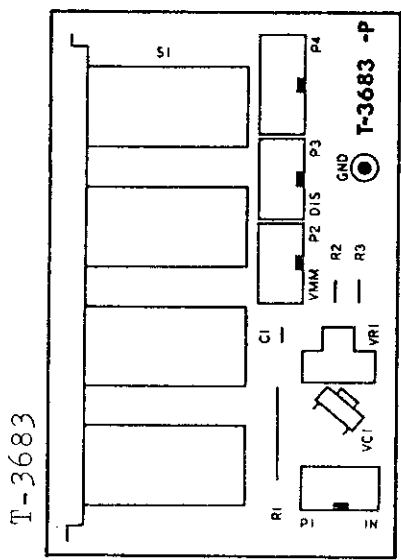
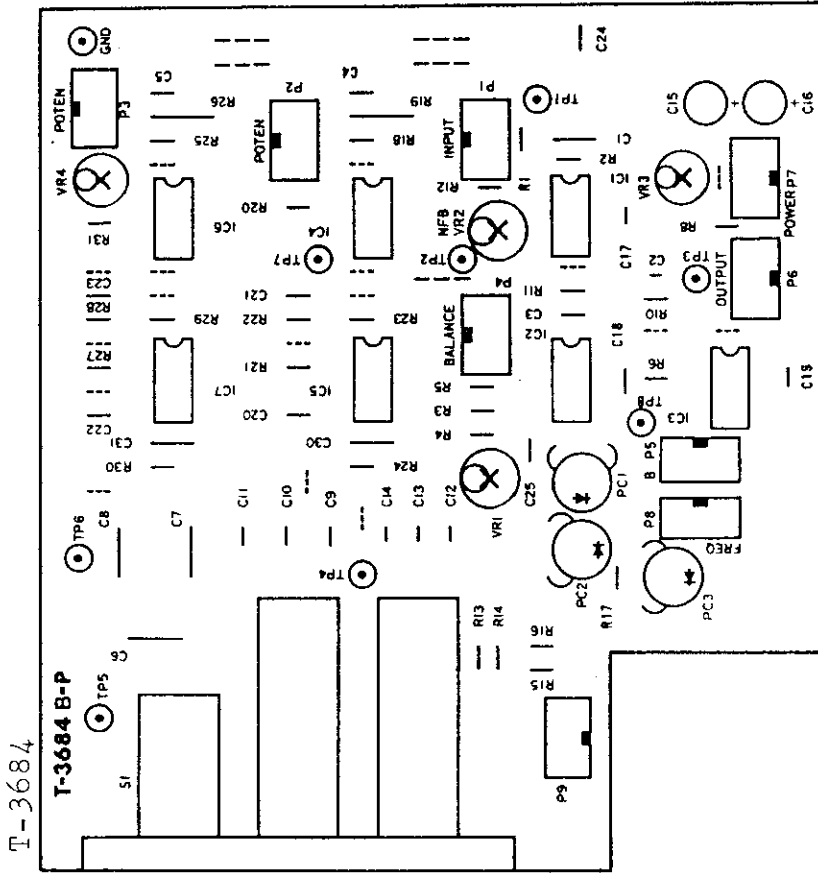


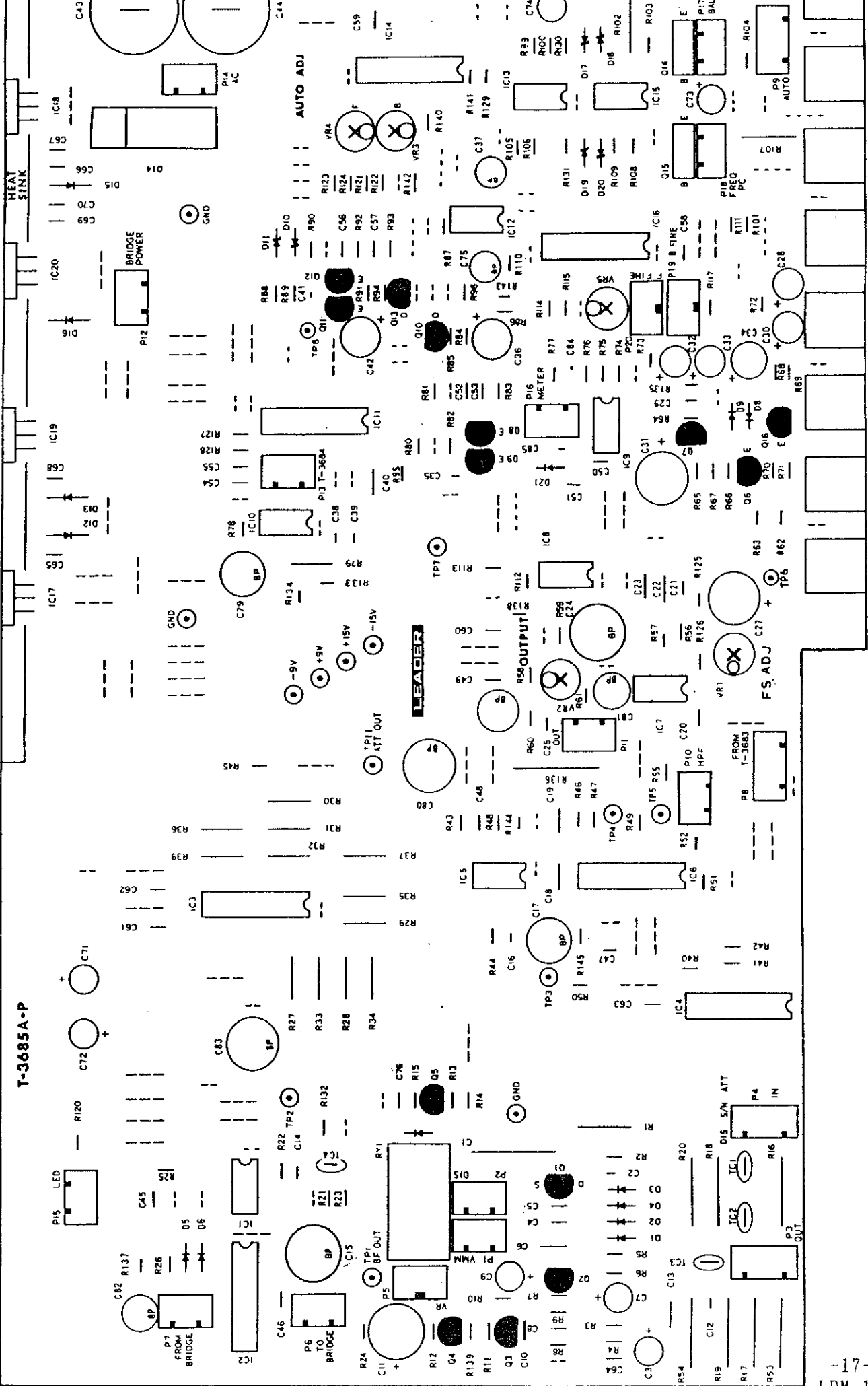
5. ADJUSTMENT LOCATIONS

<TOP VIEW>



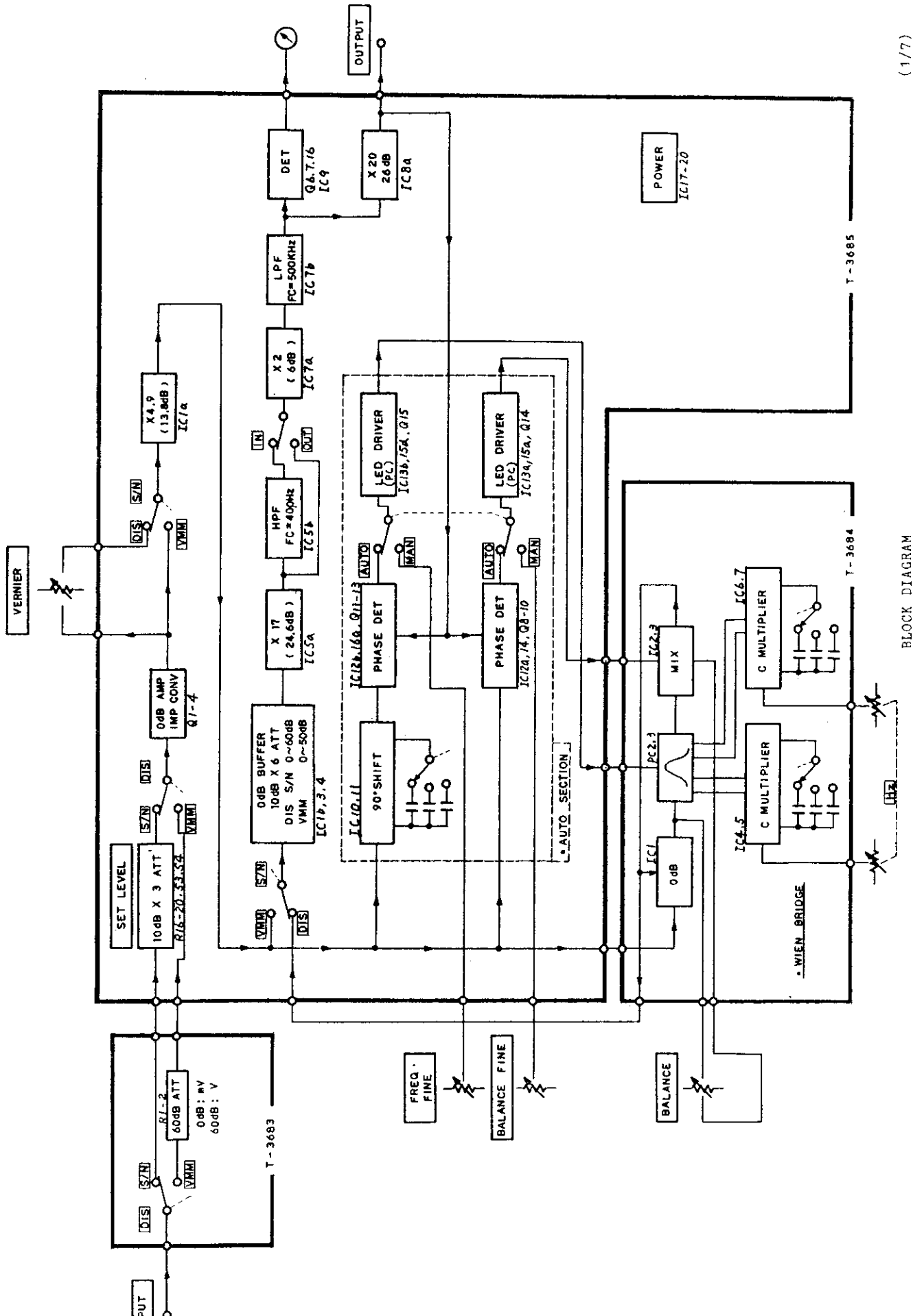
6. PRINTED CIRCUIT BOARD

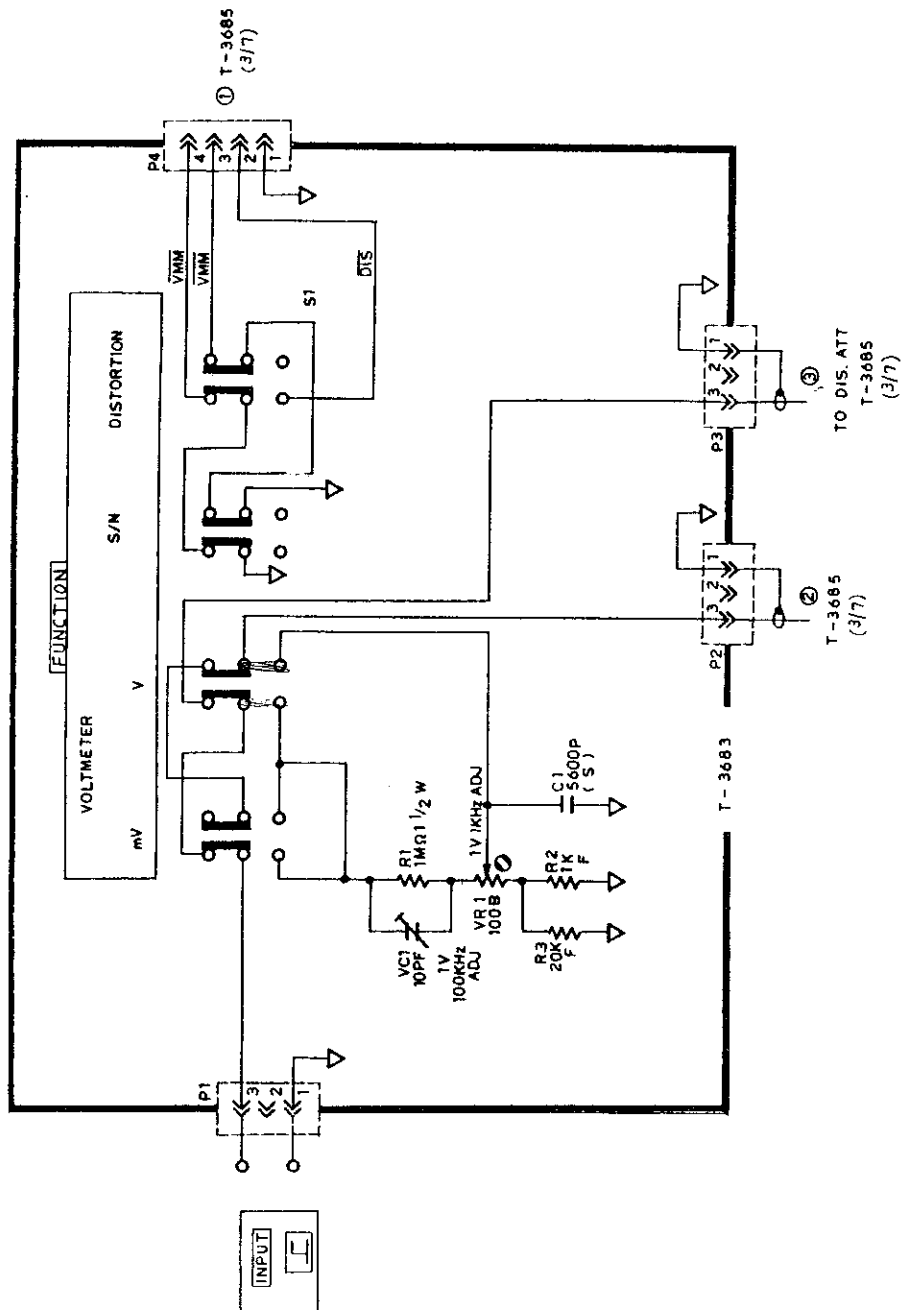




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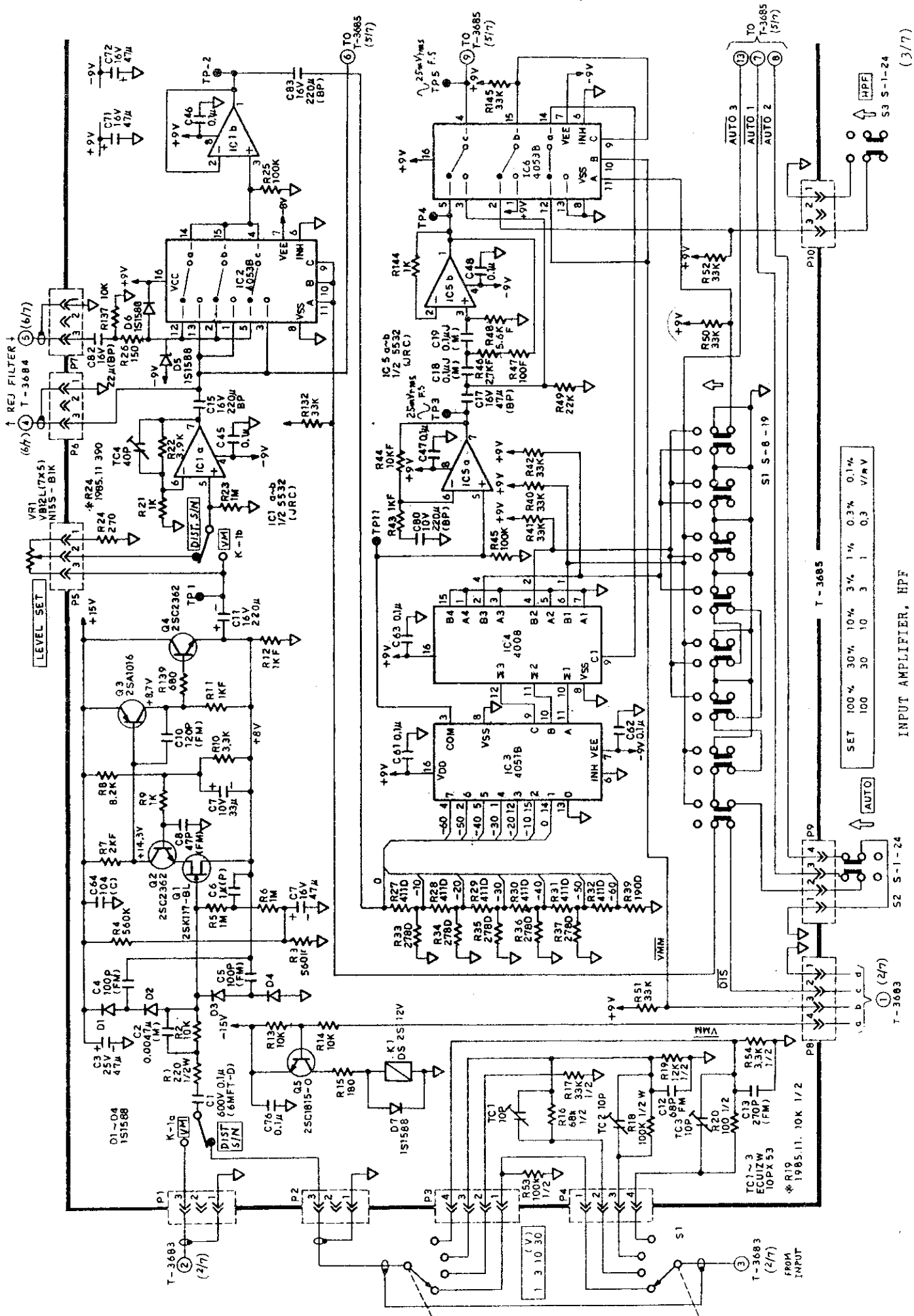
7. BLOCK DIAGRAM/SCHEMATIC DIAGRAM





FUNCTION

(2/7)

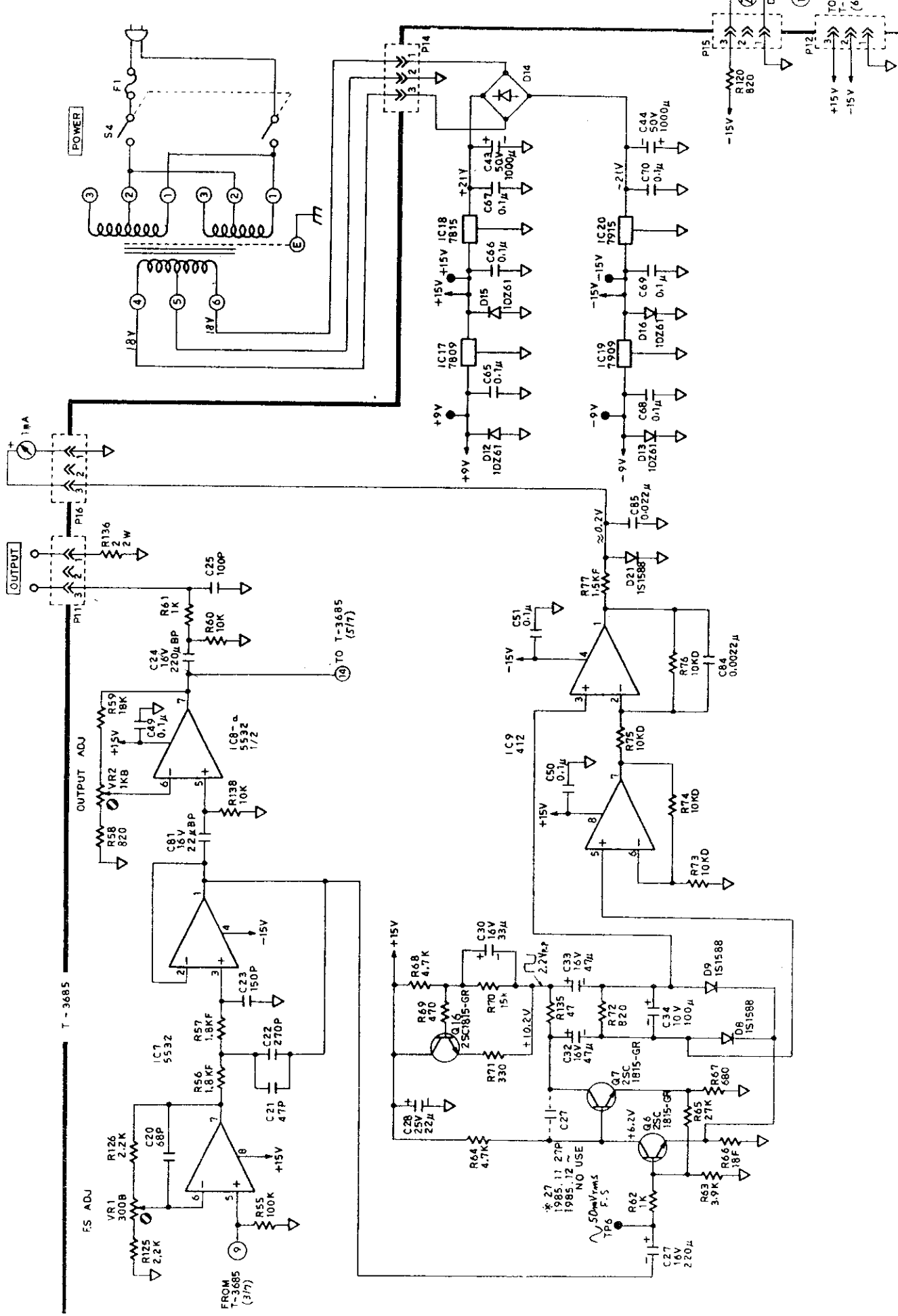


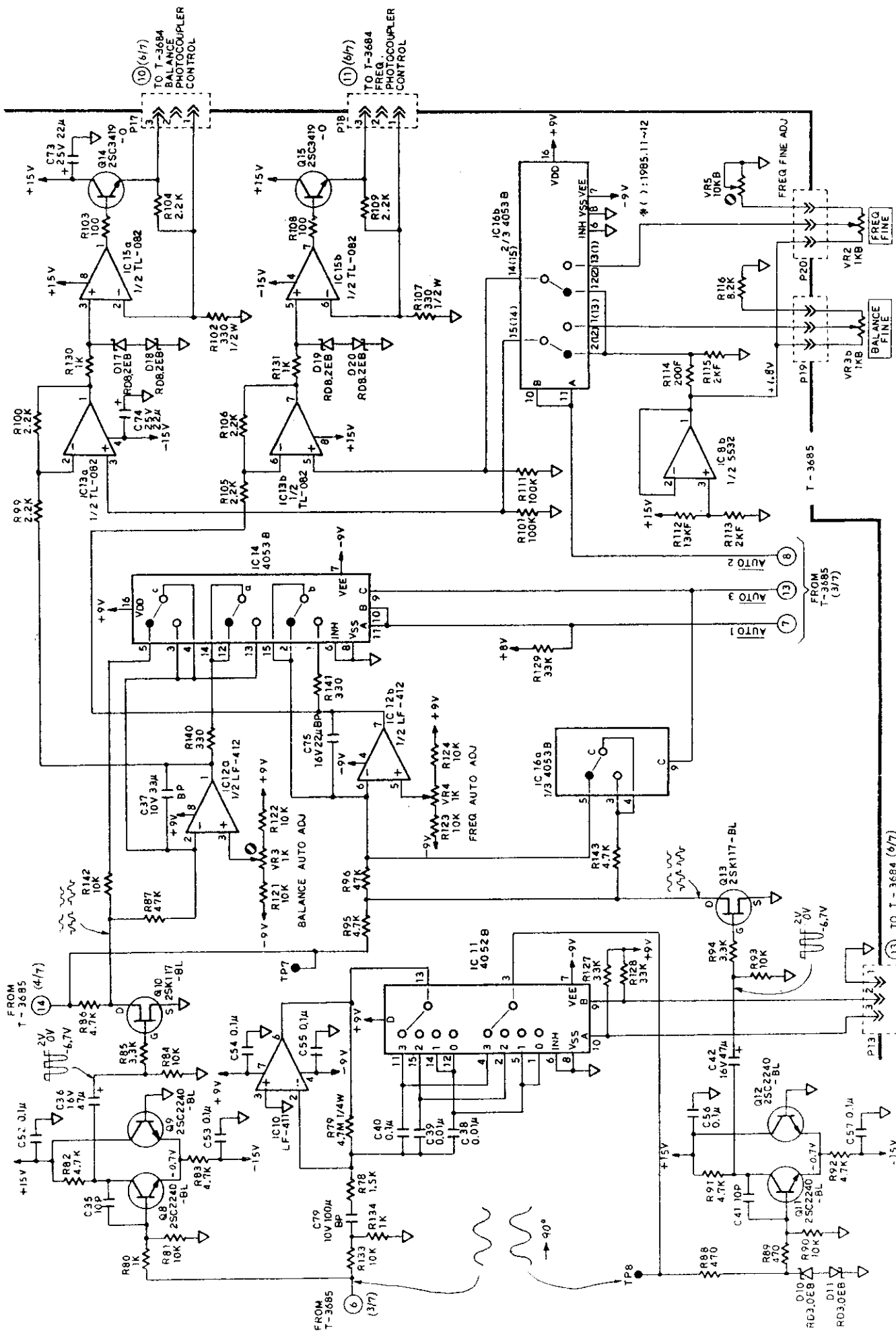
SET

100%	30%	10%	3%	1%	0.3%	0.1%
100	30	10	3	1	0.3	0.1
						V/MV

AUTO

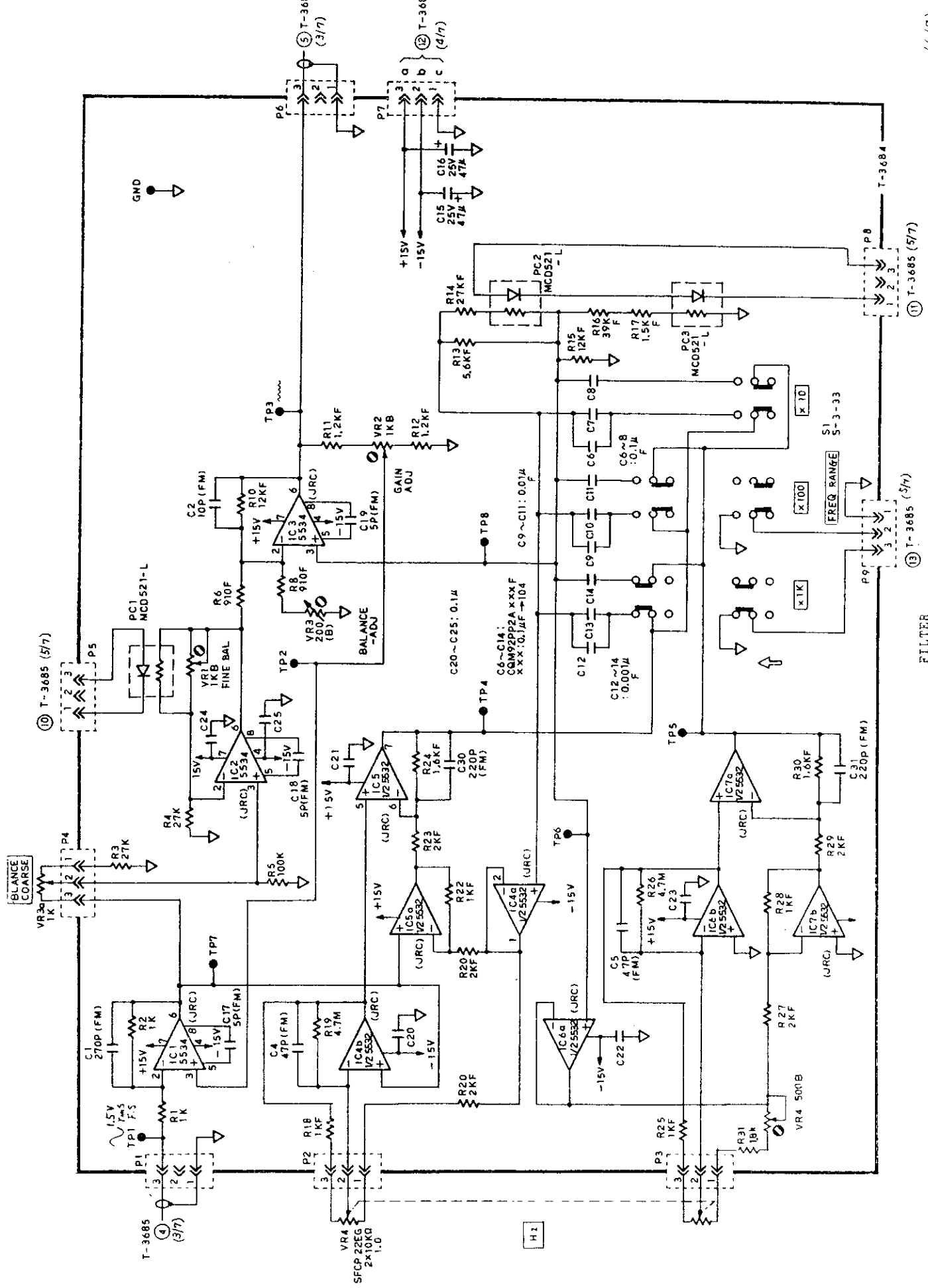
INPUT AMPLIFIER, HPF

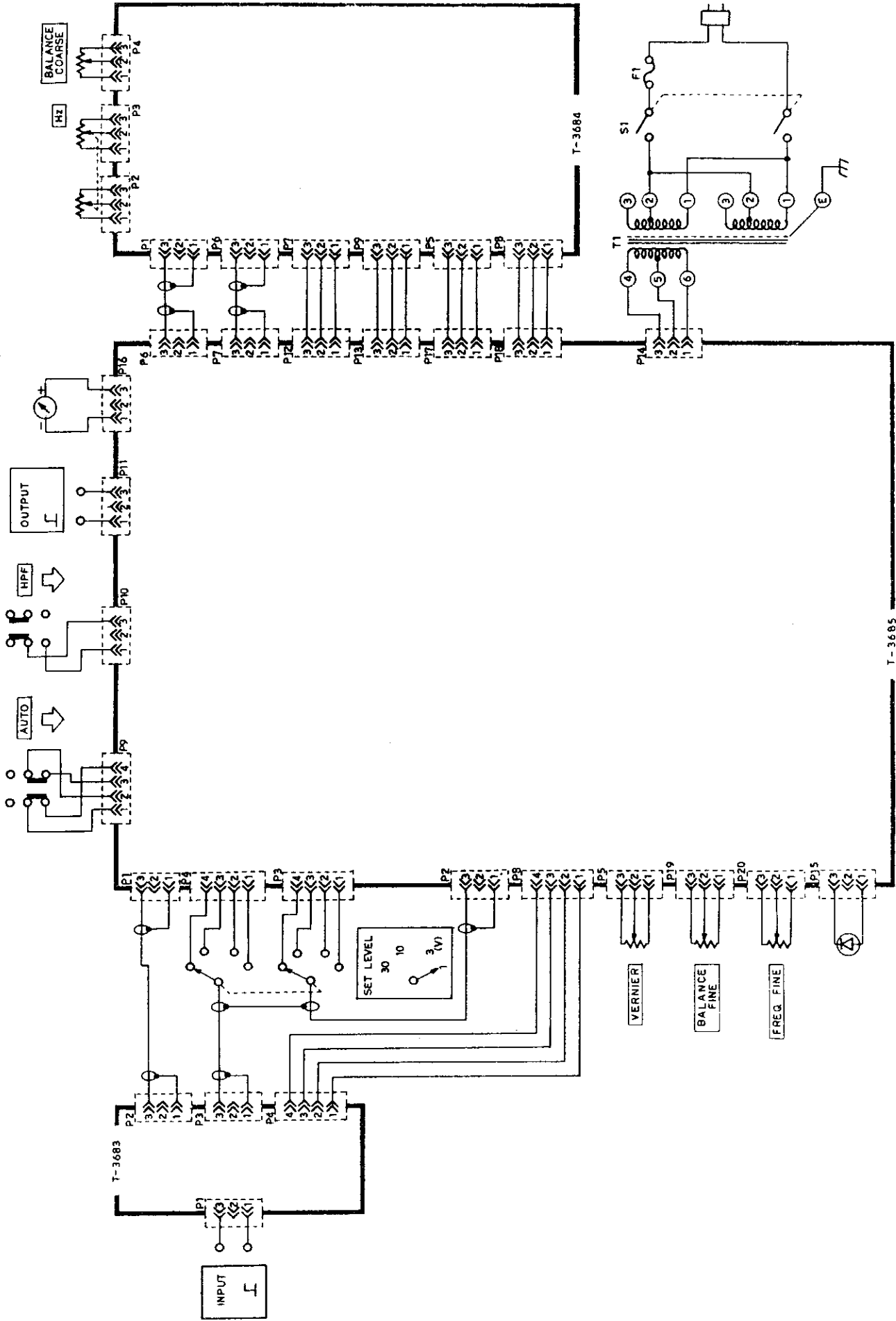




AUTO MODE CIRCUIT







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	1815024004	CARBON FILM	1K OHM 20% 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	12K 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	20% 25V
C16	2240470009	ELECTROLYTIC	47uF	20% 25V
C19	2120050005	MICA	5pF	500V
C20	2090016006	CERAMIC	0.1uF	50V
C21	2090016006	CERAMIC	0.1uF	50V



No.	LDR PT No.	DESCRIPTION	LDR PT No.	DESCRIPTION
(T-3695 CONT'D)				
-VARIABLE RESISTORS-				
VR1	1711004024	CERMET	300 OHM	20% 1/3W
VR2	1711004042	CERMET	1K OHM	20% 1/3W
VR3	1711004042	CERMET	1K OHM	20% 1/3W
VR4	1711004042	CERMET	1K OHM	20% 1/3W
VR5	1711004079	CERMET	10K OHM	20% 1/3W
-CAPACITORS-				
C1	2180104004	PLASTIC FILM	0.1uF	10%
C2	2140472014	PLASTIC FILM	4700pF	10%
C3	2240470009	ELECTROLYTIC	470pF	20%
C4	2120101006	MICA	100pF	10%
C5	2120101006	MICA	100pF	10%
C6	2610105007	PLASTIC FILM	1uF	10%
C7	2230470002	ELECTROLYTIC	47uF	20%
C8	2120470016	MICA	47pF	10%
C9	2230330006	ELECTROLYTIC	33uF	20%
C10	2120121002	MICA	120pF	10%
C11	2230221001	ELECTROLYTIC	220pF	20%
C12	2120680008	MICA	68pF	10%
C13	2120271001	MICA	270pF	10%
C15	2320039012	ELECTROLYTIC BP	220uF	20%
C17	2320004004	ELECTROLYTIC BP	47uF	20%
C19	2140104006	PLASTIC FILM	0.1uF	5%
C20	2120680008	MICA	68pF	10%
C21	2120470016	MICA	47pF	10%
C22	2120271001	MICA	270pF	10%
C23	2120151001	MICA	150pF	10%
C24	2320039012	ELECTROLYTIC BP	220uF	20%
C25	2120101006	MICA	100pF	10%
C26	2320038001	ELECTROLYTIC BP	100uF	20%
C27	2230221001	ELECTROLYTIC	220uF	20%
C28	2240220006	ELECTROLYTIC	22uF	10%
C29	2120220004	MICA	22pF	10%
C30	2230330006	ELECTROLYTIC	33uF	20%
C31	2230221001	ELECTROLYTIC	220uF	20%
C32	2230470002	ELECTROLYTIC	47uF	20%
C33	2230470002	ELECTROLYTIC	47uF	20%
C34	2220101004	ELECTROLYTIC	100pF	20%
C35	2120100004	MICA	10pF	10%
C36	2230470002	ELECTROLYTIC	47uF	20%
C37	2320055001	ELECTROLYTIC BP	33uF	20%
C38	2140102011	PLASTIC FILM	1000pF	10%
C39	2140103013	PLASTIC FILM	0.01uF	10%
C40	2140104015	PLASTIC FILM	0.1uF	10%
C41	2120100004	MICA	10pF	10%
C42	2230470002	ELECTROLYTIC	47uF	20%
C43	2250102007	ELECTROLYTIC	1000uF	20%
C44	2250102007	ELECTROLYTIC	1000uF	20%
C45	2090016006	CERAMIC	0.1uF	20%
C46	2090016006	CERAMIC	0.1uF	20%
C47	2090016006	CERAMIC	0.1uF	20%
C48	2090016006	CERAMIC	0.1uF	20%
C49	2090016006	CERAMIC	0.1uF	20%
C50	2090016006	CERAMIC	0.1uF	20%

No.	LDR PT No.	DESCRIPTION	LDR PT No.	DESCRIPTION
(T-3695 CONT'D)				
R87	1000473002	CARBON FILM	47K OHM	5% 1/6W
R88	1000471008	CARBON FILM	470 OHM	5% 1/6W
R89	1000471008	CARBON FILM	470 OHM	5% 1/6W
R90	1000103009	CARBON FILM	10K OHM	5% 1/6W
R91	1000472000	CARBON FILM	4.7K OHM	5% 1/6W
R92	1000472000	CARBON FILM	4.7K OHM	5% 1/6W
R93	1000103009	CARBON FILM	10K OHM	5% 1/6W
R94	1000322004	CARBON FILM	3.3K OHM	5% 1/6W
R95	1000472000	CARBON FILM	4.7K OHM	5% 1/6W
R96	1000473002	CARBON FILM	47K OHM	5% 1/6W
R99	1000222007	CARBON FILM	2.2K OHM	5% 1/6W
R100	1000222007	CARBON FILM	2.2K OHM	5% 1/6W
R101	1000104001	CARBON FILM	100K OHM	5% 1/6W
R102	1020331006	CARBON FILM	330 OHM	5% 1/2W
R103	1000101005	CARBON FILM	100 OHM	5% 1/6W
R104	1000222007	CARBON FILM	2.2K OHM	5% 1/6W
R105	1000222007	CARBON FILM	2.2K OHM	5% 1/6W
R106	1000222007	CARBON FILM	2.2K OHM	5% 1/6W
R107	1020331006	CARBON FILM	330 OHM	5% 1/2W
R108	1000101005	CARBON FILM	100 OHM	5% 1/6W
R109	1000222007	CARBON FILM	2.2K OHM	5% 1/6W
R110	1000333006	CARBON FILM	33K OHM	5% 1/6W
R111	1000104001	CARBON FILM	100K OHM	5% 1/6W
R112	1461302005	METAL FILM	13K OHM	1% 1/6W
R113	1461801003	METAL FILM	1.8K OHM	1% 1/6W
R114	1462000005	METAL FILM	200 OHM	1% 1/6W
R115	1462001007	METAL FILM	2K OHM	1% 1/6W
R117	1000822001	CARBON FILM	8.2K OHM	5% 1/6W
R120	1000821009	CARBON FILM	820 OHM	5% 1/6W
R121	1000103009	CARBON FILM	10K OHM	5% 1/6W
R122	1000103009	CARBON FILM	10K OHM	5% 1/6W
R123	1000103009	CARBON FILM	10K OHM	5% 1/6W
R124	1000103009	CARBON FILM	10K OHM	5% 1/6W
R125	1000222007	CARBON FILM	2.2K OHM	5% 1/6W
R126	1000222007	CARBON FILM	2.2K OHM	5% 1/6W
R127	1000333006	CARBON FILM	33K OHM	5% 1/6W
R128	1000333006	CARBON FILM	33K OHM	5% 1/6W
R129	1000333006	CARBON FILM	33K OHM	5% 1/6W
R130	1000102007	CARBON FILM	1K OHM	5% 1/6W
R131	1000102007	CARBON FILM	1K OHM	5% 1/6W
R132	1000333006	CARBON FILM	33K OHM	5% 1/6W
R133	1000103009	CARBON FILM	10K OHM	5% 1/6W
R134	1000102007	CARBON FILM	1K OHM	5% 1/6W
R135	1000470006	CARBON FILM	47 OHM	5% 1/6W
R136	1220209005	METAL OXIDE	2 OHM	2W
R137	1000103009	CARBON FILM	10K OHM	5% 1/6W
R138	1000103009	CARBON FILM	10K OHM	5% 1/6W
R139	1000681009	CARBON FILM	680 OHM	5% 1/6W
R140	1000331002	CARBON FILM	330 OHM	5% 1/6W
R141	1000331002	CARBON FILM	330 OHM	5% 1/6W
R142	1000103009	CARBON FILM	10K OHM	5% 1/6W
R143	1000472000	CARBON FILM	4.7K OHM	5% 1/6W
R144	1000102007	CARBON FILM	1K OHM	5% 1/6W
R145	1000333006	CARBON FILM	33K OHM	5% 1/6W

No.	LDR PT No.	DESCRIPTION	No.	LDR PT No.	DESCRIPTION
(T-3685 CONT'D)					
C51	2090016006	CERAMIC	50V		
C52	2090016006	CERAMIC	50V		
C53	2090016006	CERAMIC	50V		
C54	2090016006	CERAMIC	50V		
C55	2090016006	CERAMIC	50V		
C56	2090016006	CERAMIC	50V		
C57	2090016006	CERAMIC	50V		
C58	2090016006	CERAMIC	50V		
C59	2090016006	CERAMIC	50V		
C60	2090016006	CERAMIC	50V		
C61	2090016006	CERAMIC	50V		
C62	2090016006	CERAMIC	50V		
C63	2090016006	CERAMIC	50V		
C64	2090016006	CERAMIC	50V		
C65	2090016006	CERAMIC	50V		
C66	2090016006	CERAMIC	50V		
C67	2090016006	CERAMIC	50V		
C68	2090016006	CERAMIC	50V		
C69	2090016006	CERAMIC	50V		
C70	2230470002	ELECTROLYTIC	20%		
C71	2230470002	ELECTROLYTIC	20%		
C72	2230470002	ELECTROLYTIC	20%		
C73	2240220006	ELECTROLYTIC	20%		
C74	2240220006	ELECTROLYTIC	20%		
C75	2320047002	ELECTROLYTIC BP	20%		
C76	2090016006	CERAMIC	50V		
C77	2320033001	ELECTROLYTIC BP	20%		
C78	2320043004	ELECTROLYTIC BP	20%		
C79	2320047002	ELECTROLYTIC BP	20%		
C80	2320047002	ELECTROLYTIC BP	20%		
C81	2320047002	ELECTROLYTIC BP	20%		
C82	2320039012	ELECTROLYTIC BP	20%		
C83	2140220002	PLASTIC FILM	10%		
C84	2140220002	PLASTIC FILM	5%		
C85	2140223004	PLASTIC FILM	5%		
-VARIABLE CAPACITORS-					
VC1	2910018006	CERAMIC	2.8-10pF	250V	
VC2	2910018006	CERAMIC	2.8-10pF	250V	
VC3	2910018006	CERAMIC	2.8-10pF	250V	
VC4	2910022007	CERAMIC	4-40pF	250V	
-TRANSISTORS-					
Q1	3050117003	FET	2SK117-BL		
Q2	3032362004	NPN	2SC2362-G		
Q3	3011015005	PNP	2SA1016-G		
Q4	3032362004	NPN	2SC2362-G		
Q5	3031815009	NPN	2SC1815-0 or Y		
Q6	3031815027	NPN	2SC1815-GR		
Q7	3031815027	NPN	2SC1815-GR		
Q8	3032240000	NPN	2SC2240-BL		
Q9	3032240000	NPN	2SC2240-BL		
Q10	3050117003	FET	2SK117-BL		
Q11	3032240000	NPN	2SC2240-BL		
Q12	3032240000	NPN	2SC2240-BL		
Q13	3050117003	FET	2SK117-BL		
Q14	3033419003	NPN	2SC3419-0		
Q15	3033419003	NPN	2SC3419-0		
Q16	3031815027	NPN	2SC1815-GR		

No.	LDR PT No.	DESCRIPTION	No.	LDR PT No.	DESCRIPTION
(T-3685 CONT'D)					
-DIPDES-					
D1	3110006004	DETECTOR			IS1588
D2	3110006004	DETECTOR			IS1588
D3	3110006004	DETECTOR			IS1588
D4	3110006004	DETECTOR			IS1588
D5	3110006004	DETECTOR			IS1588
D6	3110006004	DETECTOR			IS1588
D7	3110006004	DETECTOR			IS1588
D8	3110006004	DETECTOR			IS1588
D9	3110006004	DETECTOR			IS1588
D10	3120067001	ZENER			RD3.0EB
D11	3120067001	ZENER			RD3.0EB
D12	3110019003	RECTIFIER			1D261
D13	3110019003	RECTIFIER			1D261
D14	3110062004	BRIDGE RECTIFIER			KBU4D
D15	3110019003	RECTIFIER			1D261
D16	3110019003	RECTIFIER			1D261
D17	3120028001	ZENER			RD8.2EB
D18	3120028001	ZENER			RD8.2EB
D19	3120028001	ZENER			RD8.2EB
D20	3120028001	ZENER			RD8.2EB
D21	3110006004	DETECTOR			IS1588
-INTEGRATED CIRCUITS-					
IC1	3220086012	LINEAR			NJM 5532DD
IC2	3310053999	CMOS			4053B
IC3	3310051995	CMOS			4051B
IC4	3310008994	CMOS			4008B
IC5	3230086012	LINEAR			NJM 5532DD
IC6	3310053999	CMOS			4053B
IC7	3220086012	LINEAR			NJM 5532DD
IC8	3220086012	LINEAR			NJM 5532DD
IC9	3220076000	OP AMP			LF412
IC10	3220075008	OP AMP			LF411
IC11	3310052997	CMOS			4052B
IC12	3220076000	OP AMP			LF412
IC13	3220038002	OP AMP			TL082
IC14	3310053999	CMOS			4053B
IC15	3220038002	OP AMP			TL082
IC16	3310053999	CMOS			4053B
IC17	3217809992	REGULATOR			7809
IC18	3217815997	REGULATOR			7815P
IC19	3217909996	REGULATOR			7909P
IC20	3217915991	REGULATOR			7915P
-SWITCH-					
S1	4020191003	PUSH			S-8-19 "RANGE"
-PC BOARD-					
	5903685012				T-3685A
-MISCELLANEOUS-					
K1	4080048000	RELAY			DS2-S-DC12V

## 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.

