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850 SERVICE MANUAL

850 SHORTS LOCATOR SERVICE MANUAL

WARRANTY

For a period of one year from its date of purchase new and undamaged from Polar Instruments Ltd, POLAR INSTRUMENTS LTD or its authorised distributors will, without charge, repair or replace at its option, this product if found to be defective in materials or workmanship, and if returned to POLAR INSTRUMENTS LTD or its authorised distributors transport prepaid. This warranty is expressly conditioned upon the product having been used only in normal usage and service in accordance with instructions of POLAR INSTRUMENTS LTD and not having been altered in any way or subject to misuse, negligence or damage, and not having been repaired or attempted to be repaired by any other than POLAR INSTRUMENTS LTD or its authorised distributors. EXCEPT FOR THE FOREGOING EXPRESS WARRANTY OF REPAIR OR REPLACEMENT POLAR INSTRUMENTS LTD MAKES NO WARRANTY OF ANY KIND, INCLUDING BUT NOT LIMITED TO, ANY EXPRESS OR IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE, AND POLAR INSTRUMENTS LTD SHALL NOT BE LIABLE FOR ANY DAMAGES, WHETHER DIRECT OR NOT OR OTHERWISE, BEYOND REPAIR OR REPLACING THIS PRODUCT.

SERVICE SAFETY

WARNING

The service instructions contained in this manual are for use by qualified personnel only.

WARNING

Failure to comply with the following instructions could cause the instrument to become unsafe under certain conditions. Any interruption of the protective conductor inside or outside the apparatus or disconnection of the protective ground (earth) is likely to make the equipment dangerous.

CAUTION

This unit contains STATIC SENSITIVE COMPONENTS. Static discharge can damage any semiconductor in this unit. Observe appropriate precautions to avoid damage.

ENCLOSURE – DANGEROUS VOLTAGES

When the unit is connected to its supply, the opening of the enclosure will expose dangerous voltages. In addition, capacitors inside may still be charged even if the unit has been disconnected from its voltage supply.

Any adjustment, maintenance or repair of the opened unit shall be performed only by a qualified person who is aware of the hazard involved.

POWER SUPPLY

This unit is designed to operate from either 100–130 volts or 200–250 volts at 50 or 60 Hz ac power supply with safety ground. Before switching the unit on, check that it is set to the correct range for the local supply. Voltage range is printed on the rear panel. For details of changing the voltage setting, refer to LINE VOLTAGE SELECTION.

GROUNDING

This unit must be earthed (grounded). Power cable colour codes are as follows:

Europe

BROWN	LIVE
BLUE	NEUTRAL
GREEN/YELLOW	EARTH (GROUND)

United States

BLACK	LIVE
WHITE	NEUTRAL
GREEN	GROUND

To avoid fire hazard, use only fuses of the rating stated in this manual.

SAFETY

It is Polar Instrument's design policy to comply with the recommendations made in BS4743 (IEC 348).

CONTENTS

Page

SECTION 1

850 SPECIFICATIONS

RESISTANCE RANGES

Ω, 200mΩ, 2Ω, 200Ω, 20kΩ.

ACCURACY

200mΩ, 2Ω, 200Ω ± 4%
20kΩ ± 5%
[Ω] uncalibrated, high sensitivity.
Approximately 40mΩ full scale.

PROBE VOLTAGE

60mV maximum.

READOUT

Tone and meter in all ranges.

PROBE PROTECTION

Momentary contact up to 250V

VOLTAGE RANGES

2mV, 20mV, 2V, 20V.

ACCURACY

± 4%, ± 15 microvolts

INPUT RESISTANCE

2mV, 20mV 120Ω
2V, 20V 1MΩ

READOUT

Tone and meter in 2mV and 20mV.
Meter in 2V and 20V.

PROBE PROTECTION

20V, 2V Momentary contact up to 250V.
20mV, 2mV Momentary contact up to 30V.

TRACE

READOUT

Tone and uncalibrated meter proportional to detected magnetic field strength.

SENSITIVITY

Current flow detected with 200Ω across DRIVE SOURCE.

DRIVE SOURCE

OUTPUT VOLTAGE

0 to 550mV adjustable.
TRACE ac, all other ranges dc.

Protected to ± 30V.

CONNECTORS

PROBES

One for needle probes, one for Current Trace Probe.

DRIVE SOURCE

One for DRIVE SOURCE leads.

EARPIECE

3.5mm jack socket.

POWER INLET

IEC three pin connector.

SECTION 2

LINE VOLTAGE SELECTION

Configuring the 850 for the local supply requires internal link position changes. These links should only be changed by a qualified technician. To change the links, disconnect the supply cable and remove the top cover as follows:

Turn the unit over to remove the two front fixing screws.

Raise the lid of the unit to remove the two rear fixing screws.

Lift off the cover and stand it beside the base unit.

The links are located near the transformer at the rear of the PCB.

For 240 volt operation, remove the links in the positions marked '120V' and insert a link in the position marked '240V'.

For 120 volt operation, remove the link in the position marked '240V' and insert links in the positions marked '120V'.

Change the power fuse to the value stated in the SPECIFICATIONS.

Re-assemble the enclosure. Ensure that the data plate on the rear panel, next to the power inlet connector, is changed to show the altered voltage.

SECTION 3

CHECKING THE 850

NOTE

The method described here allows for the input resistance of 120Ω across the probes in the 2mV and 20mV ranges. If any other method is used, the voltage source must have an output resistance below 1Ω.

With no probes connected or an incorrect range selected, spurious sounds may be generated by the 850.

EQUIPMENT REQUIRED

A dc voltage source, variable from 1V to 10V and accurate to 0.1%

High tolerance resistors (0.1%) of the following values:

10kΩ, 1kΩ, 200Ω, 100Ω, 1Ω, and 0.1Ω.

METHOD

Switch on and allow the 850 to warm up for 20 minutes.

1. Plug in the red and black needle probes and press **20V**.

2. Apply 10V dc to the probes and check that the reading is 10V ± 4%.

3. Press **2V**, apply 1V dc to the probes and check that the reading is 1V ± 4%.

4. Apply 10V to a 1kΩ 0.5% and a 1Ω 0.5% resistor in series. This produces 10mV across the 1Ω resistor.

5. Press **20mV** and check that the reading across the 1Ω resistor is 10mV ± 4%.

6. Adjust the voltage source from 0 to 20V and check that the tone varies in pitch. A steady warble should be generated with a negative voltage.

7. Apply 1V to the two resistors and press **2mV.**

8. Check that the reading across the 1Ω resistor is 1mV ± 4%.

9. Check that varying voltage generates varying tones. No tone should be produced below about 20μV.

10. Press **20kΩ** and measure a 10kΩ 0.1% resistor. The reading should be within 4%. A warble may be generated in this range.

11. Press **200Ω** and measure a 100Ω 0.1% resistor. The reading should be within 4%.

12. Press **2Ω** and measure a 1Ω 0.1% resistor. The reading should be within 4%.

13. Apply solder to the wire ends of a 100mΩ 0.1% resistor.

14. Press **200mΩ** and measure the resistor by pressing the probe tips into the solder. The reading should be within 4%. Readings vary with the pressure applied to the probes.

15. Press **TRACE** and connect the drive source leads across a 200Ω resistor. Turn the DRIVE SOURCE knob fully clockwise.

16. Hold the Current Trace probe tip near to one of the drive source leads and align it for maximum response.

17. Check that the display shows 20 or more.

SECTION 4

CALIBRATION PROCEDURE

CAUTION – Dangerous voltages are exposed with the instrument cover removed. This procedure should only be performed by qualified personnel.

Equipment required:

A high tolerance (0.1%) voltage source of 10V.
A high tolerance (0.1%) 100 ohm resistor.

1. Remove the 4 screws that retain the top moulding to the lower chassis. Do not disconnect the cable assemblies from the main pcb to the Display pcb and loudspeaker.

2. Apply power to the instrument and allow it to warm up for 20 minutes.

3. Select 20V range, plug in the needle probes and connect them to 10V.

4. Adjust R301 on the back of the display pcb for a reading of 10.00.

5. Select 200 ohm range and connect the needle probes across a 100 ohm resistor.

6. Adjust R64 for a reading of 100.0.

7. Select TRACE, plug in the Current Trace probe and plug in the Drive Source leads. Connect the Drive Source leads across a 100 ohm resistor. Turn the DRIVE SOURCE knob fully clockwise.

8. Place the Current Trace probe tip against one of the Drive Source leads and turn the probe for maximum reading on the display.

9. Adjust R78 for maximum display reading with the probe tip kept in this position.

10. Remove power and reassemble the instrument.

SECTION 5

CIRCUIT DESCRIPTIONS

The instrument consists of 6 sections as follows:

1. Main dc amplifier (Schematic 1)
2. Tone generation (Schematic 2)
3. Drive source and Current Trace Detector (Schematic 3)
4. DVM display (Schematic 4)
5. Resistance measurement drive (Schematic 5)
6. Power supply (Schematic 5).

5.1 Main DC Amplifier (Schematic 1)

U6 is a chopper stabilised operational amplifier whose overall gain to the DVM display is determined by R52, R47 and R40.

R40 is switched in parallel with R52 to reduce the gain in 20mV, 2V and 20V.

R38, R39 and R41 form a potential divider on U6 input in 20mV, 2V and 20V.

R56, R53 and the associated parallel diodes form a non linear shaping network for the output of U6 to drive the Tone Generator.

5.2 Tone Generator (Schematic 2)

U3D and Q1 form a voltage controlled oscillator whose output frequency is determined by the collector current of Q1.

U4B divides the output of U3D by 2 to provide a symmetrical squarewave which is amplified by U5 to drive the loudspeaker.

The voltages applied to the VCO are controlled by U2, U9B, U3A, U3B, U3C and the output voltage of U6 as follows:
a) 2V and 20V ranges
U4B pin 8 is held at +5V by S3 and S4. This sets U4B output blocking the squareware feed to U5. (Note that this feature is not present in early models)
b) 2mV and 20mV
+5V on U2 pin 6 switches U2D transmission gate on and U2B off. U6 output is inverted by U9B and connected to R117 thus driving the VCO.

If the probes are measuring a negative voltage greater than 20 microvolts (approximately) then U3B output is high turning gate U2A on. The dc levels prevent U9B from driving R117 and in this way the VCO does not run and no sound is produced.

When the probes are measuring a voltage lower than −20 microvolts then U3A takes R11B low and U3B via D80 allows oscillator U3C to run. This pulses U4B causing a unique pulsing tone for negative voltages.
c) All resistance ranges.
U2D is held off and U2B is on coupling U6 output to R117. For very low readings U3B output goes high allowing U3C oscillator to run. This pulses U4B to cause a pulsing tone for low resistance readings.
d) Trace
The conditions are as for 2mV and 20mV.

5.3 Drive Source and Current Trace Detector (Schematic 3)

U1C and U1D form an amplifier for the signal detected by the current trace probe.
U1A is a precision rectifier producing a DC output across C3 proportional to the detected signal. This is buffered by U1B and divided by R14 and R15.
This output is then applied to U6 which drives the display and tone generator.

U7,U8,Q5 and Q6 form the Drive Source circuit. When TRACE is selected U7A oscillator is allowed to free run at a frequency of 80kHz (approximately) adjusted by R78.U8 and Q6 provide a low impedance output to drive the Circuit Under Test.

U7C monitors the voltage across R90 caused by Drive Source current. When this exceeds 5mA (approximately) then U7C output goes low causing the Drive Source LED to come on.

U7D and Q5 are a protection circuit that turns off the supply of current to Q6 if the Drive Source leads are connnected to a negative voltage.

5.4 DVM Display (Schematic 4)

U300 performs the analogue to digital conversion and drive waveforms for the liquid crystal display (LCD)

U301 is used to convert the DC decimal point levels from the range switch into squarewaves necessary for the LCD.

5.5 Resistance Measurement Drive (Schematic 5)

U9A, Q2 and Q3 form a low output resistance source used to drive current through the Resistance Under Measurement. The DC voltage appearing at D27 cathode is 56mV (approximately) set by R64.
This voltage is applied via the range switches to R57, R58, R59, R60, R61 or R62 which then drive the required current through the Resistance Under Test. (Shown on Schematic 1)

5.5 Power Supply (Schematic 5)

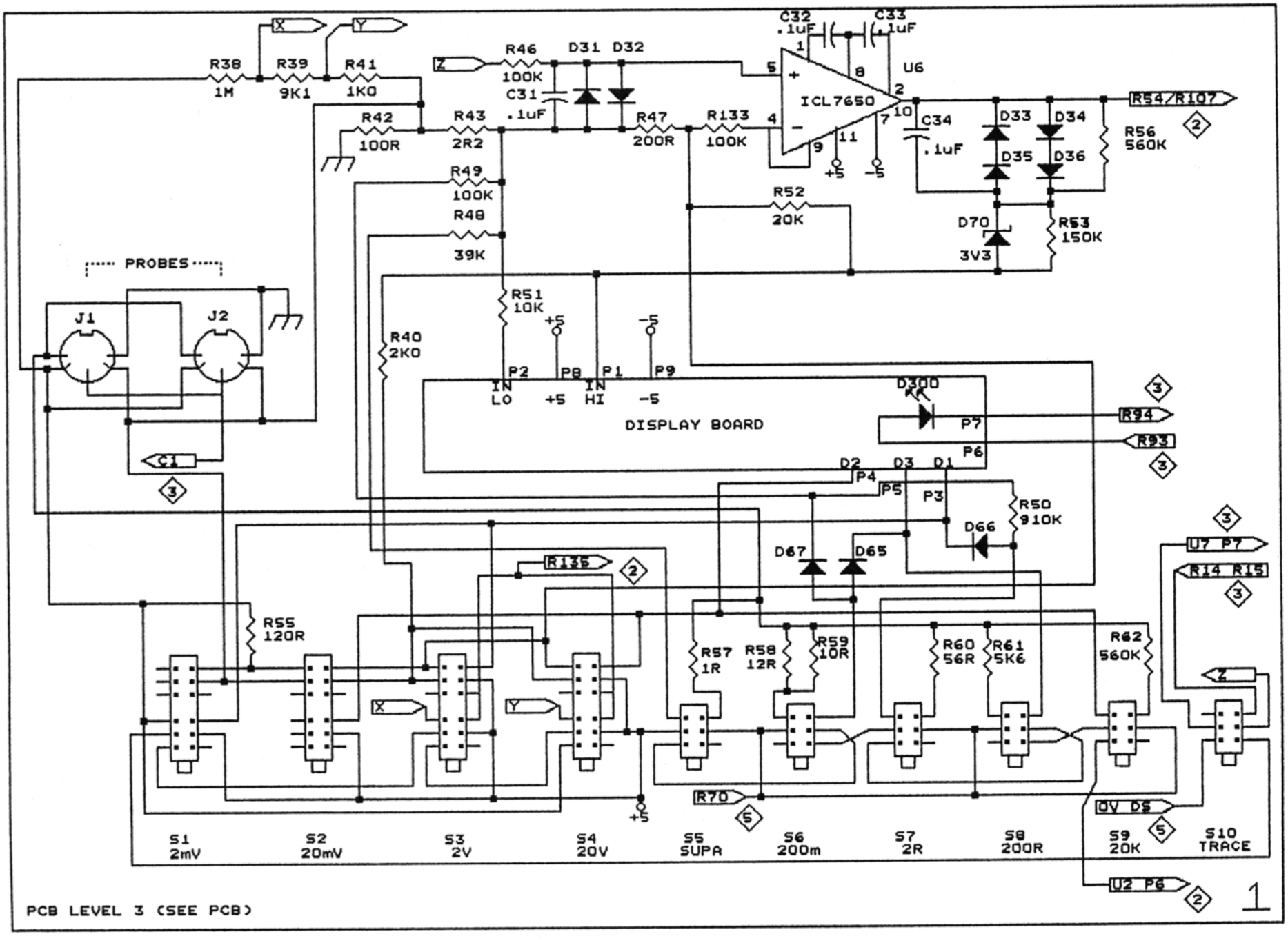
U11 and U12 are 3 terminal regulators that provide the +5V and −5V supplies for the main instrument. U13 provides an isolated +5V used by the Drive Source.

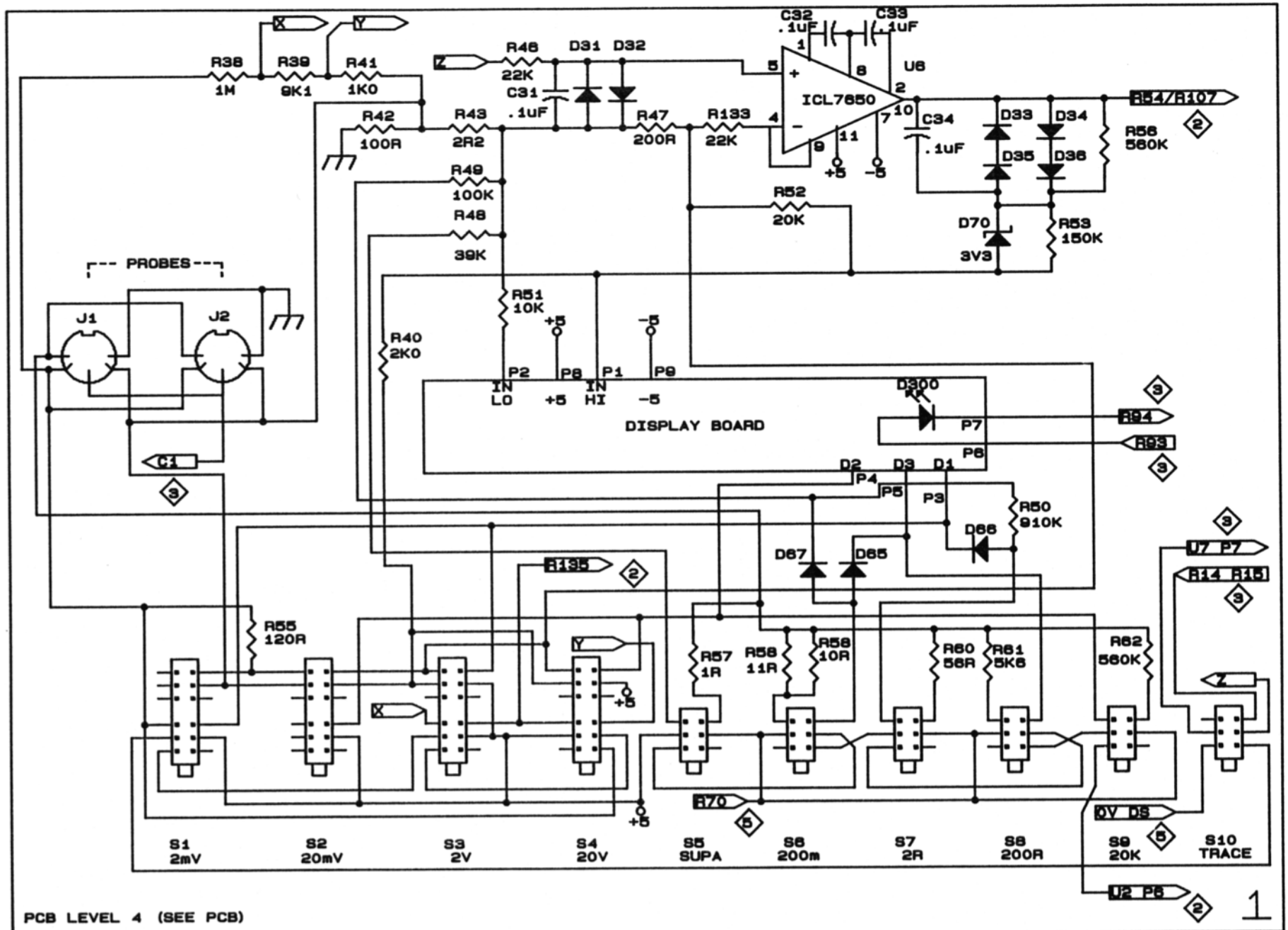
SECTION 6

REPLACEMENT PARTS

To ensure correct parts are supplied, orders for replacements should include the following details:

Instrument type
Instrument Serial Number
Circuit reference (if applicable, otherwise by descripion).


X
Y
Z
R38
1M
R39
9K1
R41
1K0
R42
100R
R43
2R2
R46
100K
C31
.1uF
D31
D32
R47
200R
R133
100K
C32
.1uF
C33
.1uF
U6
ICL7650
C34
.1uF
+5
-5
D33
D34
D35
D36
R56
560K
R54/R107
R52
20K
D70
3V3
R53
150K
R49
100K
R48
39K
PROBES
J1
J2
C1
R51
10K
R40
2K0
P2
P8
P1
P9
IN
LO
IN
HI
DISPLAY BOARD
D300
P7
P6
R94
R93
D2
D3
D1
P4
P5
P3
R50
910K
D66
D67
D65
R135
R55
120R
R57
1R
R58
12R
R59
10R
R60
56R
R61
5K6
R62
560K
U7 P7
R14 R15
Z
R70
0V DS
U2 P6
S1
2mV
S2
20mV
S3
2V
S4
20V
S5
SUPA
S6
200m
S7
2R
S8
200R
S9
20K
S10
TRACE
PCB LEVEL 3 (SEE PCB)
1


PROBES
J1
J2
C1
R38 1M
R39 9K1
R41 1K0
R42 100R
R43 2R2
R46 22K
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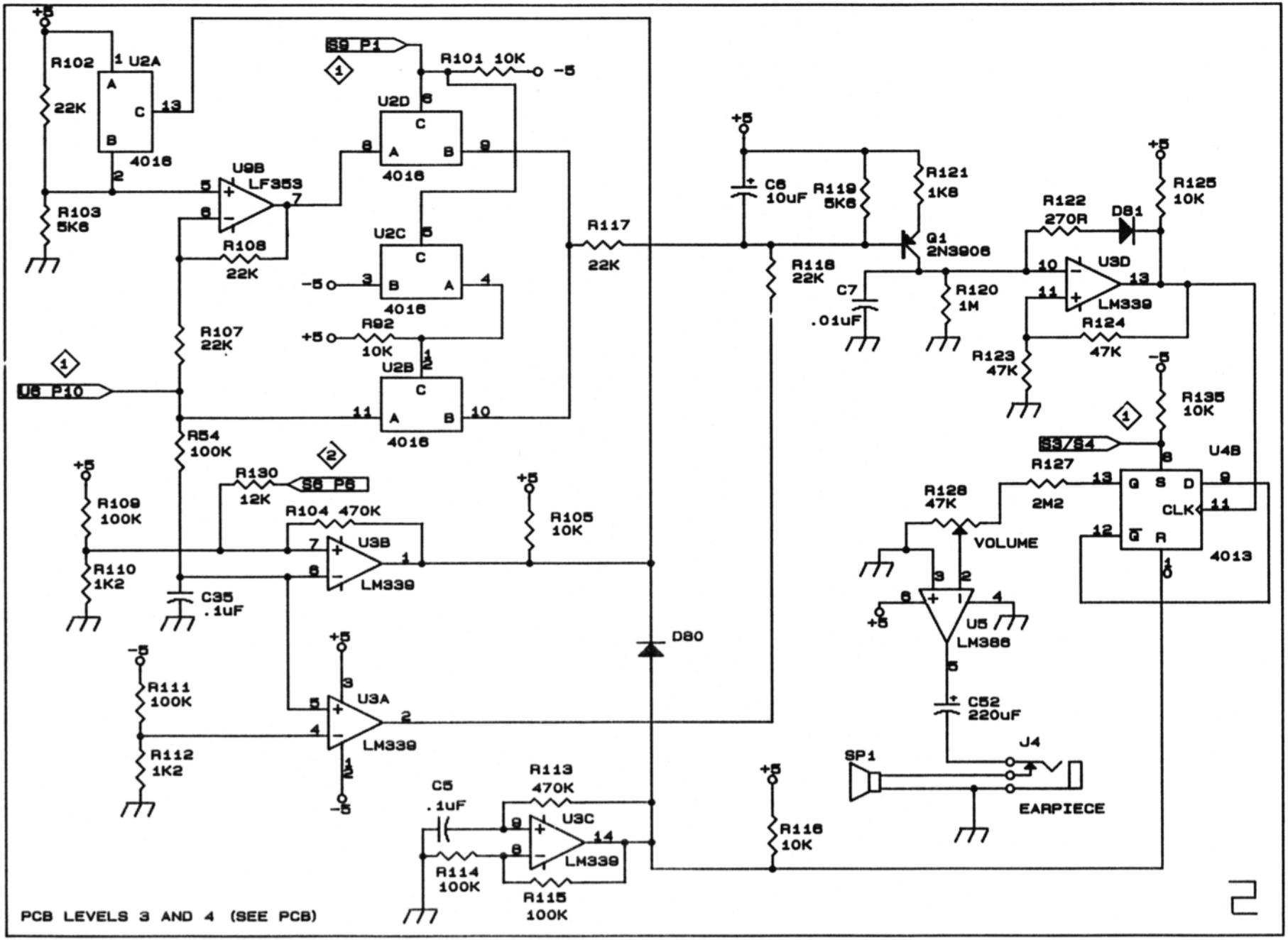
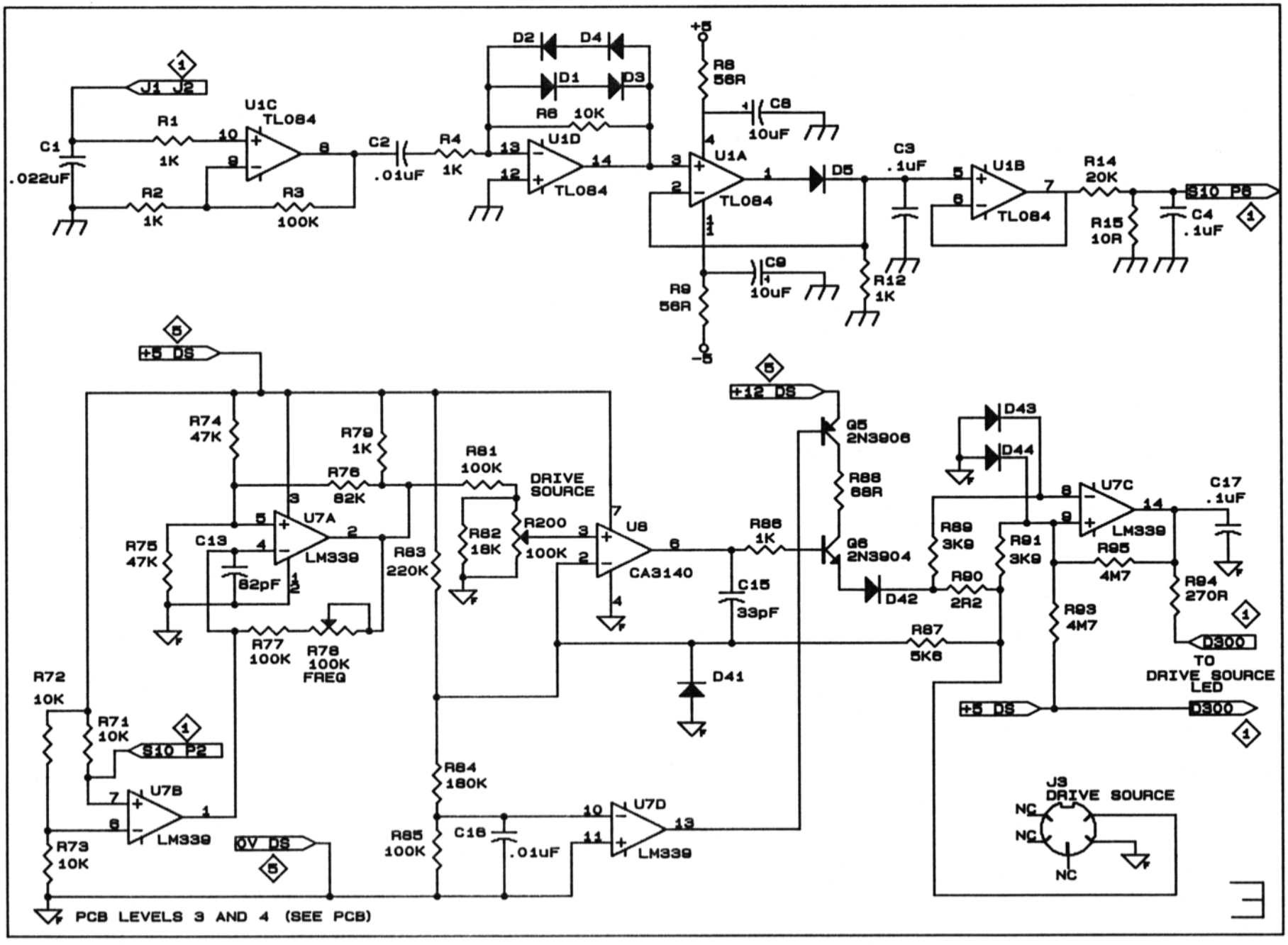
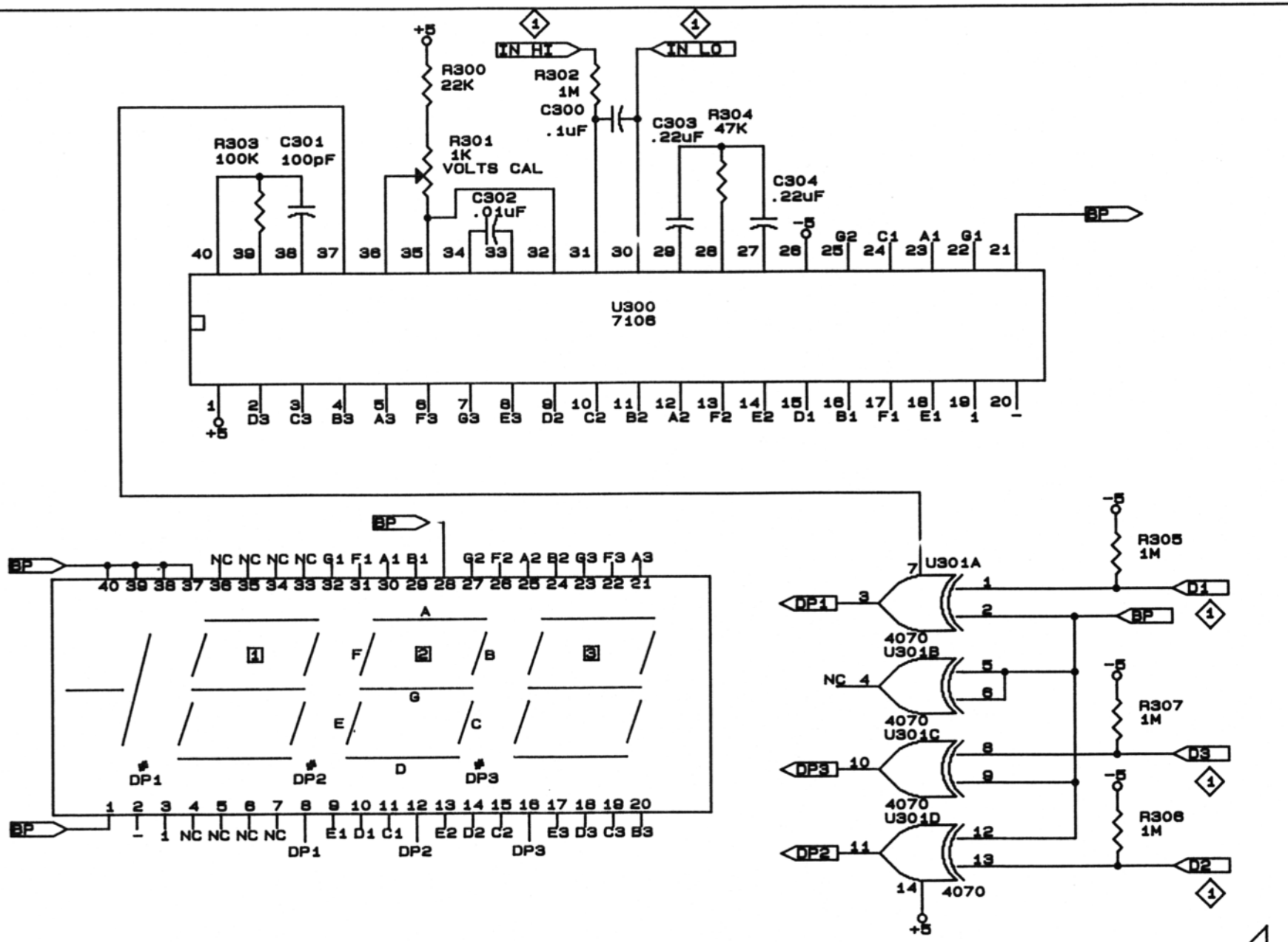
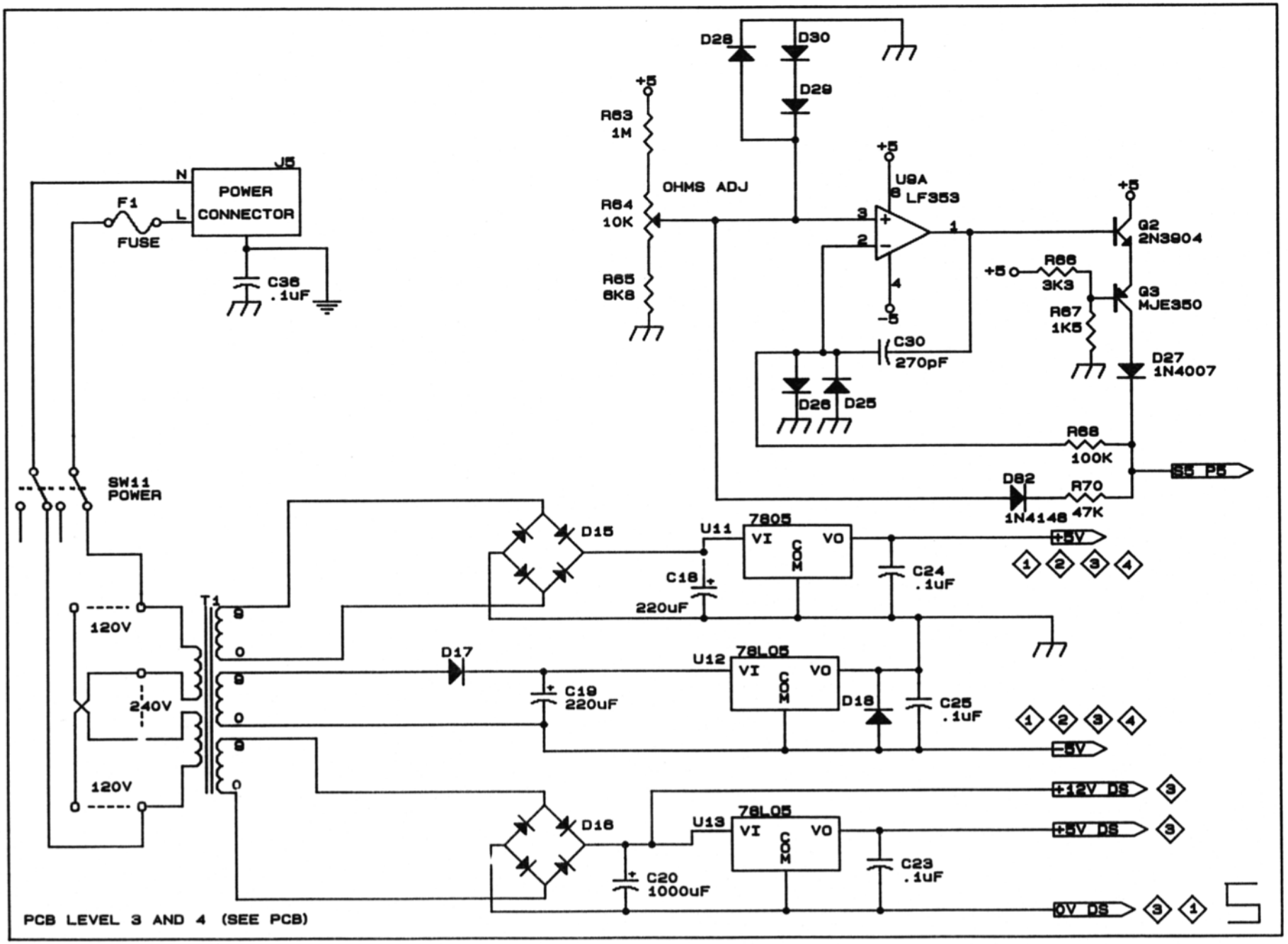
D31 D32
R47 200R
R133 22K
C32 .1uF
C33 .1uF
U6
ICL7650
C34 .1uF
D33 D34 D35 D36
R54/R107
R56 560K
R52 20K
D70 3V3
R53 150K
R49 100K
R48 39K
R51 10K
R40 2K0
+5
-5
P2 IN LO
P8 +5
P1 IN HI
P9 -5
DISPLAY BOARD
D300
P7
P6
R94
R93
D2 D3 D1
P4 P5 P3
R50 910K
D66
D67 D65
R135
R55 120R
R57 1R
R58 11R
R59 10R
R60 56R
R61 5K6
R62 560K
U7 P7
R14 R15
Z
R70
0V DS
U2 P6
S1 2mV
S2 20mV
S3 2V
S4 20V
S5 SUPA
S6 200m
S7 2R
S8 200R
S9 20K
S10 TRACE
PCB LEVEL 4 (SEE PCB)
1


+5
R102
22K
1 U2A
A
B
C
13
4016
2
R103
5K6
U9B
LF353
5
6
7
R108
22K
S9 P1
1
R101 10K
-5
U2D
C
8
A
B
9
4016
U2C
5
C
-5
3
B
A
4
4016
+5
R92
10K
12
U2B
C
11
A
B
10
4016
R107
22K
1
U6 P10
R54
100K
2
R130
12K
S6 P6
+5
R109
100K
R104 470K
R105
10K
U3B
7
6
1
LM339
R110
1K2
C35
.1uF
-5
R111
100K
+5
3
U3A
5
4
2
LM339
R112
1K2
12
-5
C5
.1uF
R113
470K
U3C
9
8
14
LM339
R114
100K
R115
100K
D80
R117
22K
+5
C6
10uF
R119
5K6
R121
1K8
Q1
2N3906
R118
22K
C7
.01uF
R120
1M
R122
270R
D81
R125
10K
U3D
10
11
13
LM339
R124
47K
R123
47K
-5
R135
10K
1
S3/S4
U4B
8
R127
2M2
13
Q
S
D
9
CLK
11
12
Q
R
4013
R128
47K
VOLUME
3
2
6
1
4
+5
U5
LM386
5
C52
220uF
J4
SP1
EARPIECE
+5
R116
10K
PCB LEVELS 3 AND 4 (SEE PCB)
2


J1 J2
U1C TL084
R1 1K
R2 1K
R3 100K
C1 .022uF
C2 .01uF
R4 1K
D2 D4 D1 D3
R6 10K
U1D TL084
+5
R8 56R
C8 10uF
U1A TL084
D5
C3 .1uF
U1B TL084
R14 20K
R15 10R
C4 .1uF
S10 P5
R9 56R
C9 10uF
R12 1K
-5
+5 DS
R74 47K
R79 1K
R81 100K
R76 82K
DRIVE SOURCE
U7A LM339
R75 47K
C13 82pF
R82 18K
R200 100K
U8 CA3140
R83 220K
R77 100K
R78 100K FREQ
C15 33pF
+12 DS
Q5 2N3906
R88 68R
Q6 2N3904
D42
R86 1K
D43
D44
U7C LM339
C17 .1uF
R89 3K9
R91 3K9
R90 2R2
R95 4M7
R94 270R
R93 4M7
R87 5K6
D300
TO DRIVE SOURCE LED
D41
R72 10K
R71 10K
S10 P2
U7B LM339
R73 10K
0V DS
R84 180K
R85 100K
C16 .01uF
U7D LM339
J3 DRIVE SOURCE
NC
NC
NC
PCB LEVELS 3 AND 4 (SEE PCB)



PCB LEVEL 1 (SEE PCB)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+5
R63
1M
OHMS ADJ
R64
10K
R65
6K8
U9A
LF353
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R66
3K3
Q3
MJE350
R67
1K5
D27
1N4007
C30
270pF
D26
D25
R68
100K
S5 P5
D82
1N4148
R70
47K
J5
POWER
CONNECTOR
N
L
F1
FUSE
C38
.1uF
SW11
POWER
120V
240V
120V
T1
D15
U11
7805
VI
VO
COM
C18
220uF
C24
.1uF
+5V
D17
U12
78L05
C19
220uF
D18
C25
.1uF
-5V
D16
U13
78L05
C20
1000uF
C23
.1uF
+12V DS
+5V DS
0V DS
PCB LEVEL 3 AND 4 (SEE PCB)
5