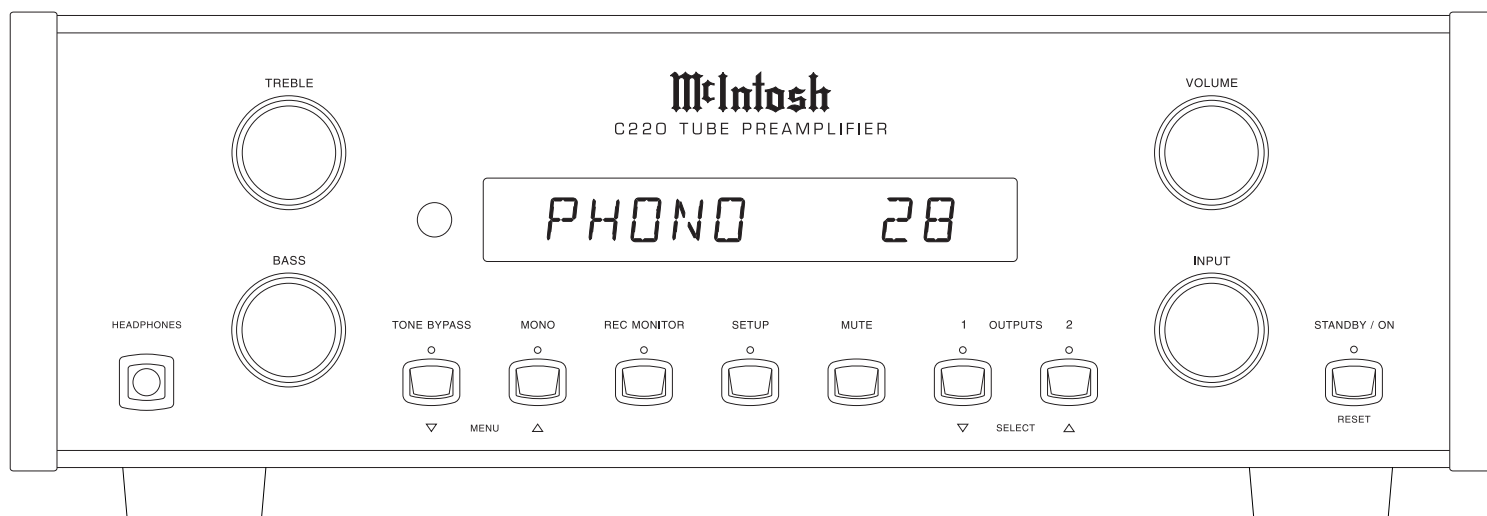




C220

TUBE PREAMPLIFIER

SERIAL NO. WS1001 And Above



CONTENTS

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SERVICE MANUAL

Serial Number WS1001 And Above

PERFORMANCE SPECIFICATIONS

Frequency Response

+0, -0.5dB from 20Hz to 20,000Hz

Total Harmonic Distortion

0.08% from 20Hz to 20,000Hz

Main Output

2.5V for rated input

Maximum Voltage Output

8V RMS Unbalanced, 16V RMS Balanced

Sensitivity (for rated output)

High Level, 450mV unbalanced, 900mV balanced
Phono, 4.5mV

Signal To Noise Ratio (A-Weighted)

High Level, 90dB below rated output
Phono, 80dB below 10mV input

Input Impedance

High Level, 22K ohms
Phono, 47K ohms; 65pF

Maximum Input Signal

High Level, 5V Unbalanced, 10V Balanced
Phono, 50mV (@ 1,000Hz)

Output Impedance

250 ohms

Voltage Gain

High Level to Tape Output: 0dB
High Level to Main Output: 15dB
Phono to Main Output: 55dB

Headphone Output Impedance

16 ohms to 250 ohms

Tube Compliment

Phono Circuitry: 2 - 12AX7A
High Level Circuitry: 2 - 12AX7A

Power Requirements

100 Volts, 50/60Hz at 75 watts
110 Volts, 50/60Hz at 75 watts
120 Volts, 50/60Hz at 75 watts
220 Volts, 50/60Hz at 75 watts
230 Volts, 50/60Hz at 75 watts
240 Volts, 50/60Hz at 75 watts

Note: Refer to the rear panel of the C220 for the correct voltage.

Overall Dimensions

Width is 17-1/2 inches (44.45cm)
Height is 6 inches (15.24cm) including feet
Depth is 18 inches (45.72cm) including the Front Panel, Knobs and Cables

Weight

21.1 pounds (9.59 kg) net, 37.5 pounds (17.05 kg) in shipping carton

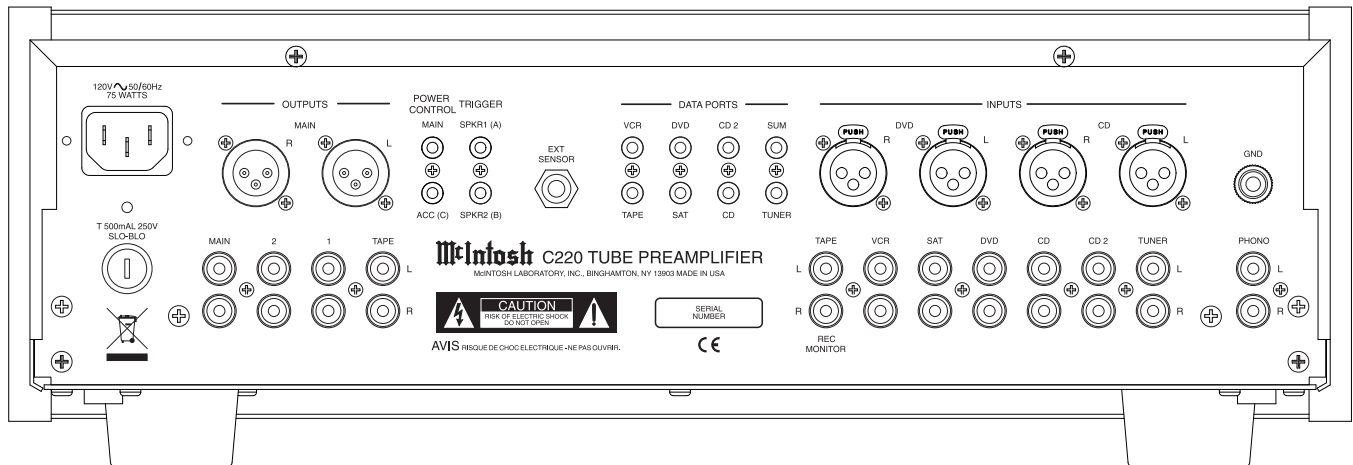
Shipping Carton Dimensions

Width is 26-1/2 inches (67.3cm)
Depth is 24-1/4 inches (62.2cm)
Height is 11-3/4 inches (29.9cm)

NOTES

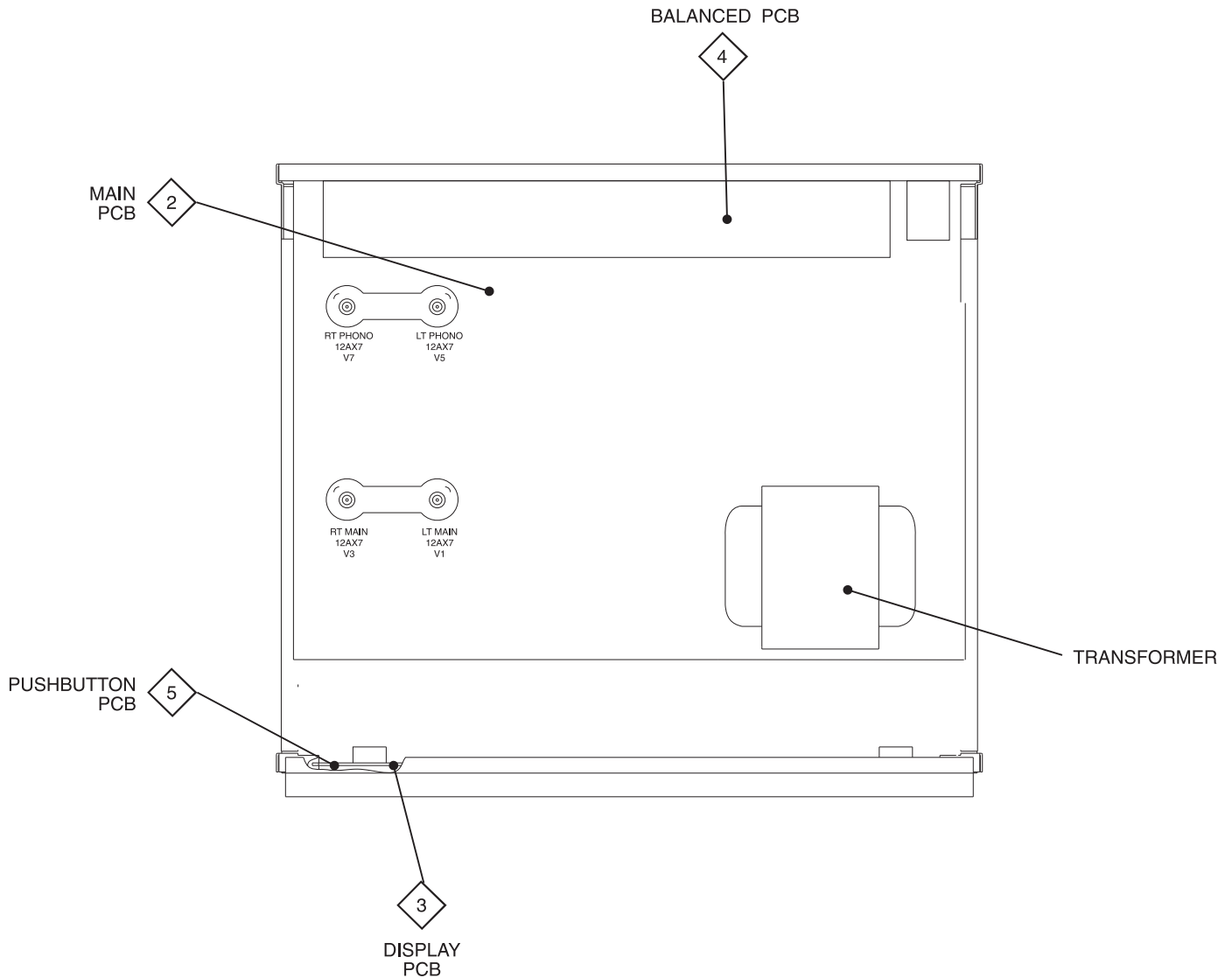
1. The heavy notes on the schematic denote the primary signal path.
2. Unless otherwise noted, all voltages indicated on the schematics are measured under the following conditions:
 - a. AC input at 120 volts, 50/60Hz.
 - b. All voltages are +/-10% with respect to ground. A high impedance (10 megaohm) voltmeter must be used.
3. Unless otherwise specified:
 - a. Resistor values are in ohms.
 - b. Capacitor values are microfarads (uF).
 - c. Inductor values are in microhenries (uH).
4. On PC board drawings, Square pad indicates:
 - a. Polarized Capacitors - Positive
 - b. Diodes - Cathode
 - c. Others - Pin 1
5. **WARNING**
Parts marked with the symbol  have critical characteristics. Use only replacement parts recommended by the manufacturer.

REAR PANEL



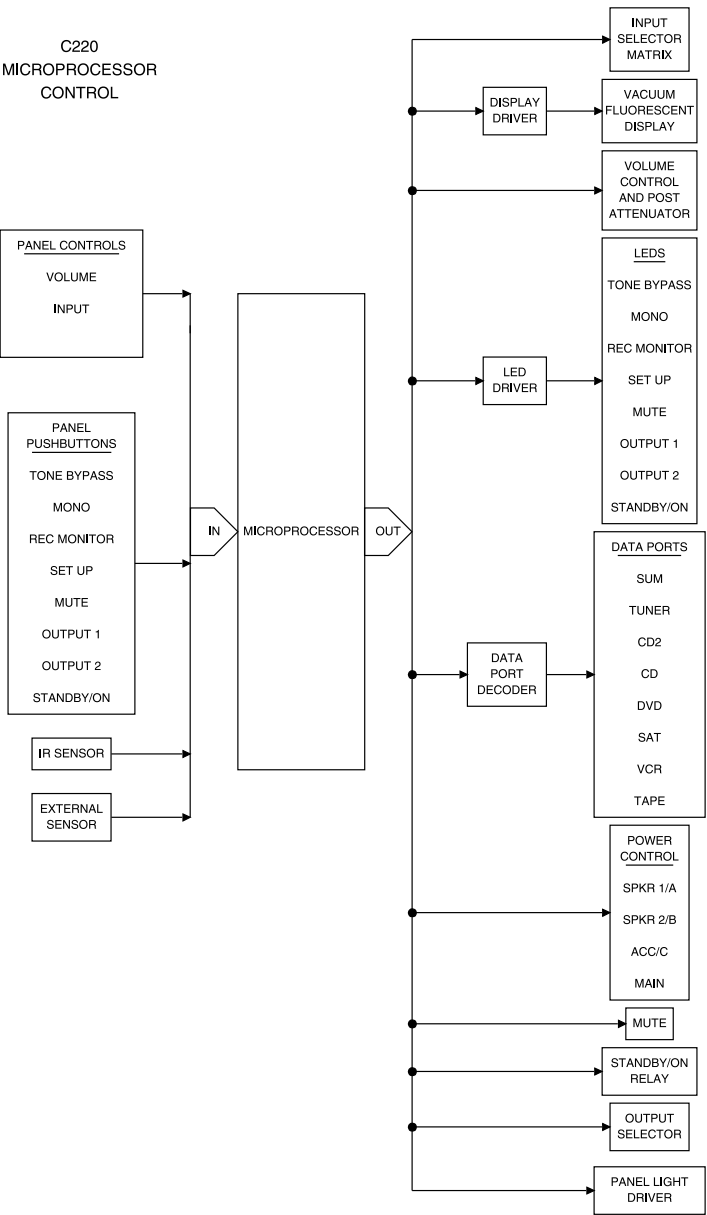
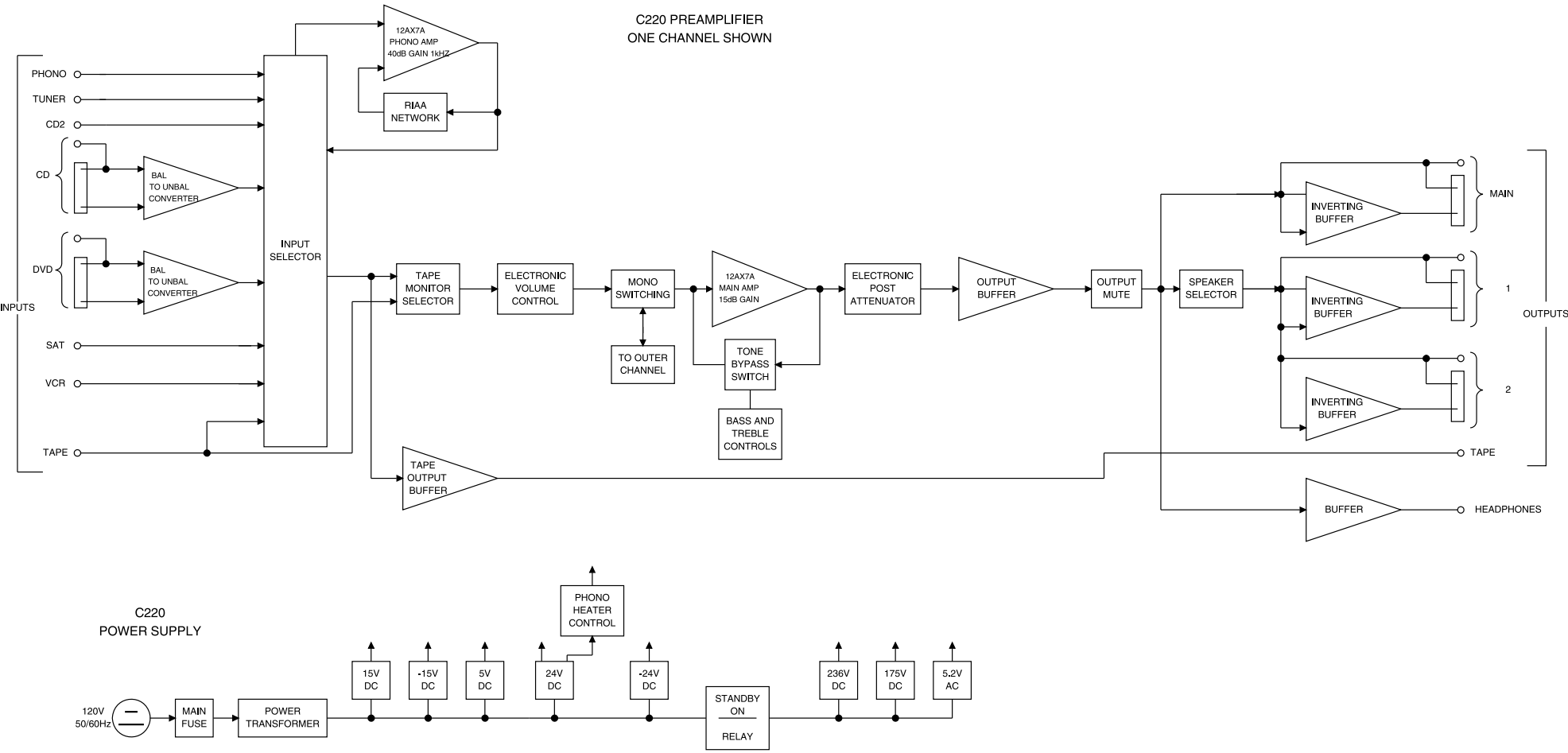
SECTION LOCATIONS

TOP VIEW WITH COVER REMOVED

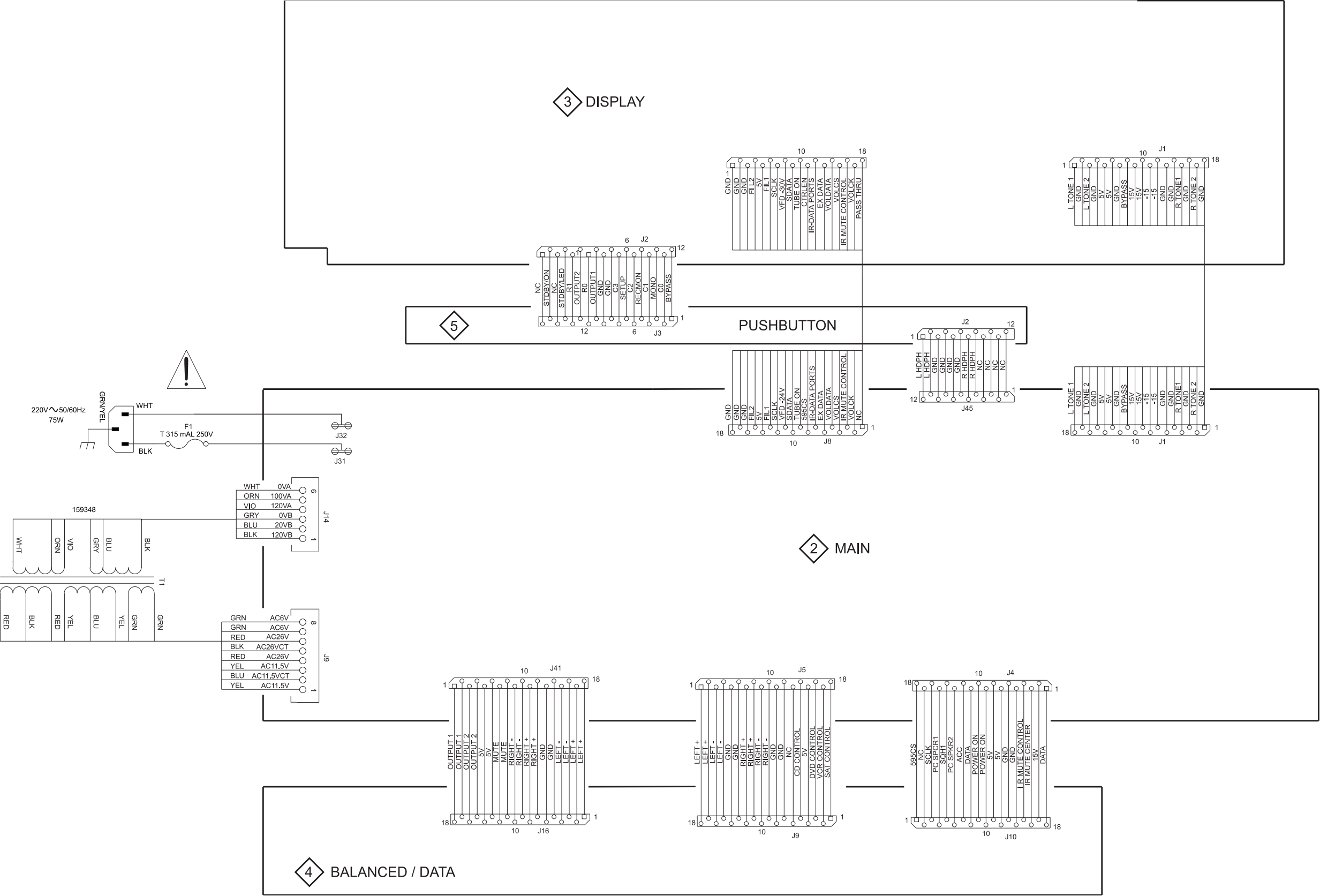


NOTES

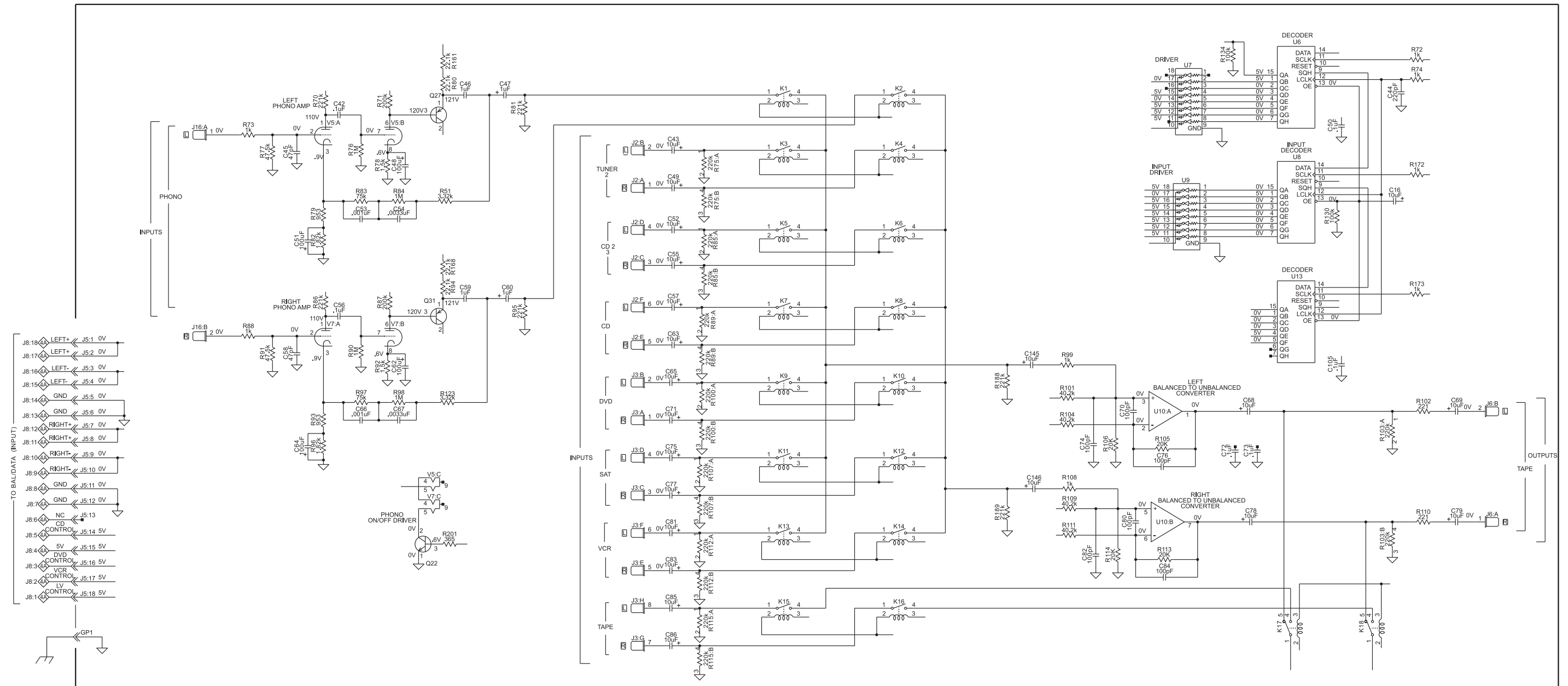
BLOCK DIAGRAM

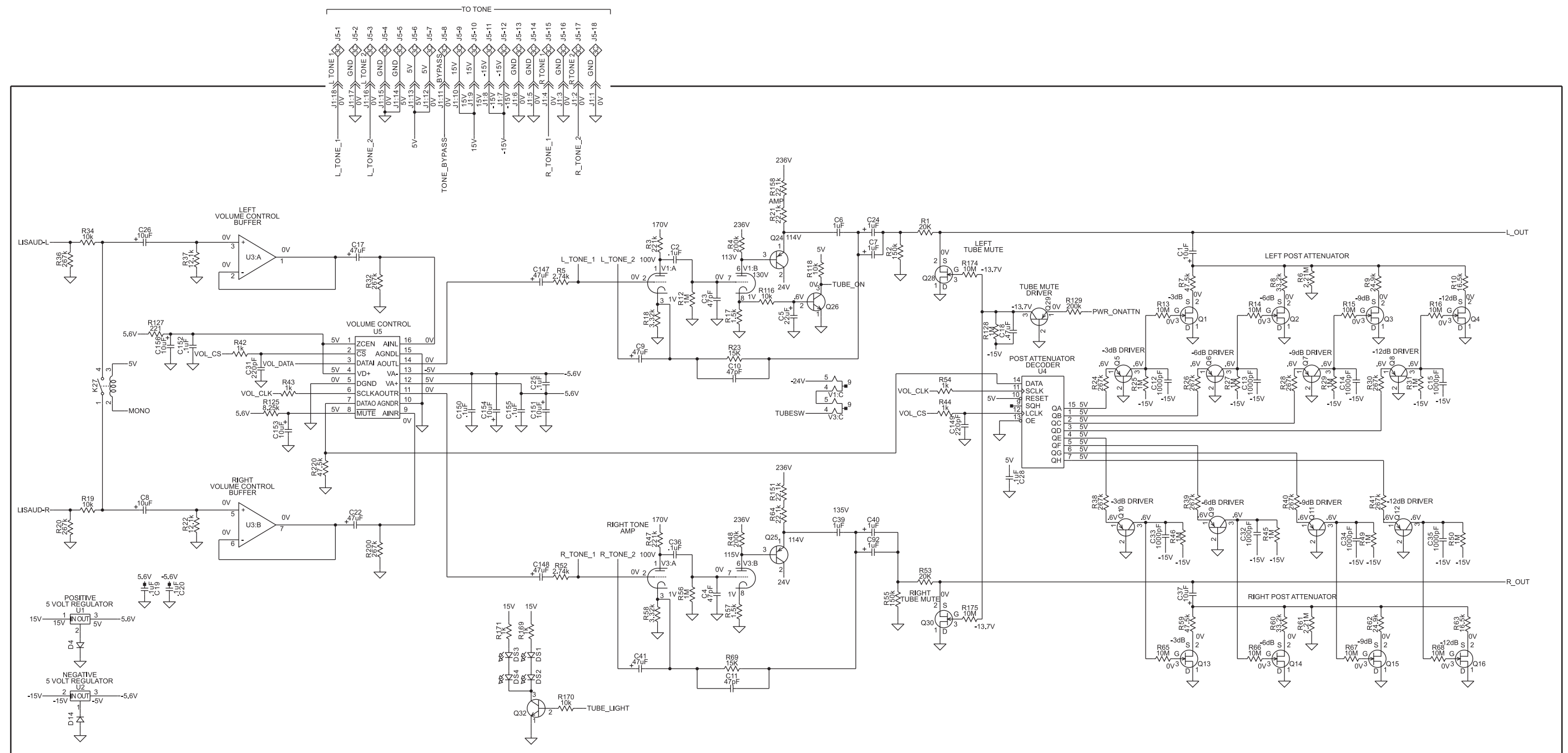


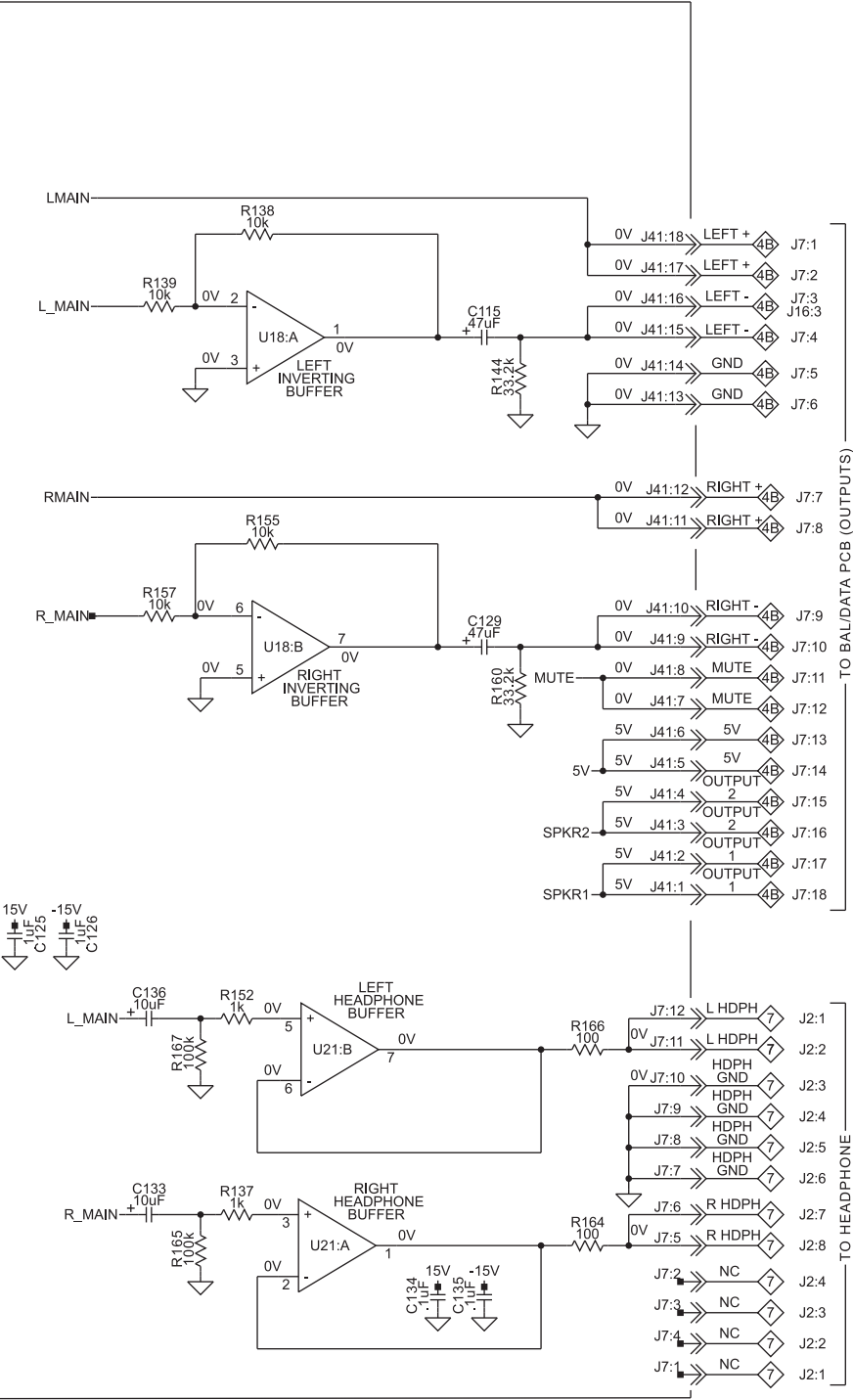
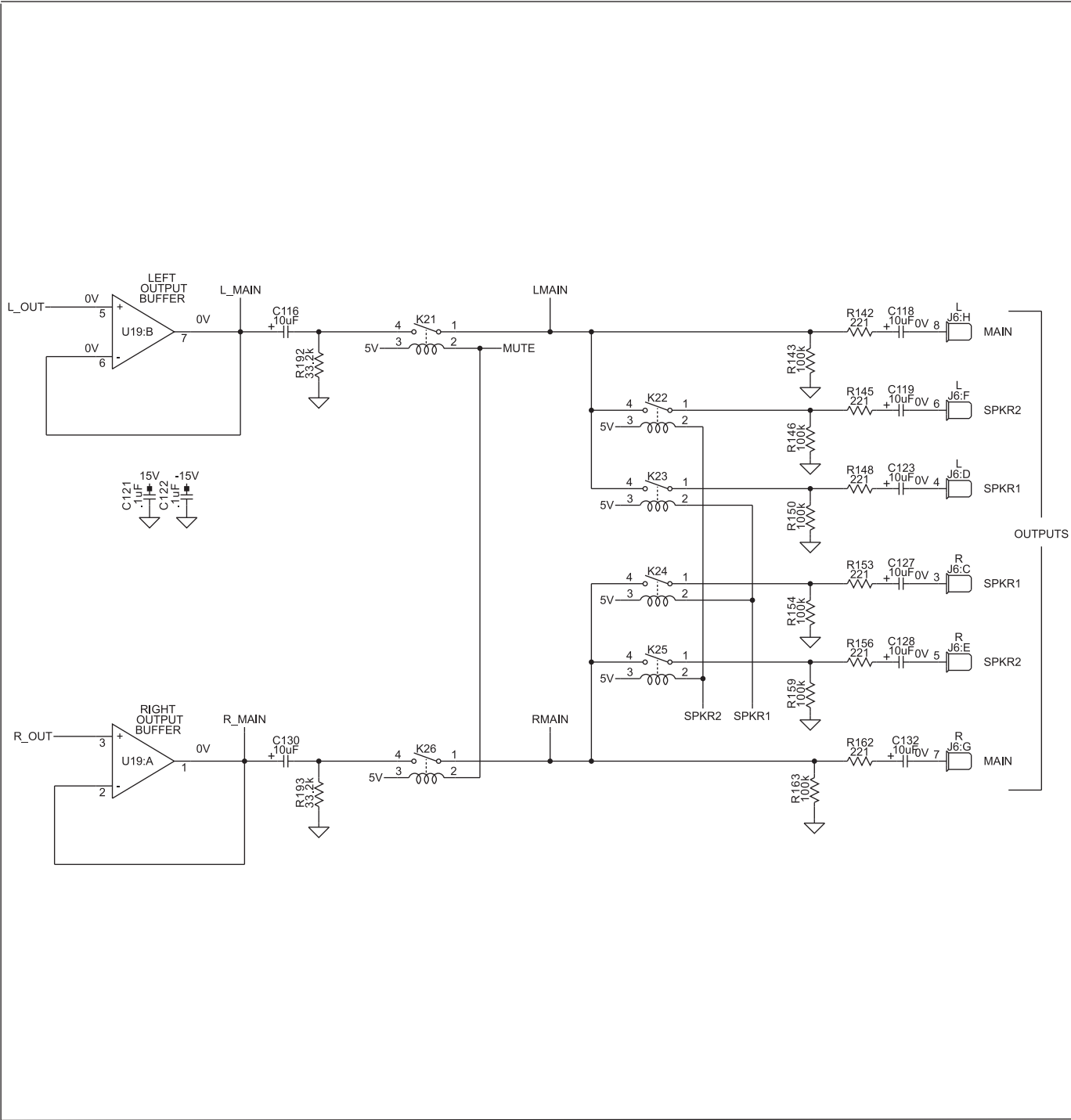
 **WARNING** Parts located in the shaded area have critical characteristics. Use only replacement parts recommended by the manufacturer.

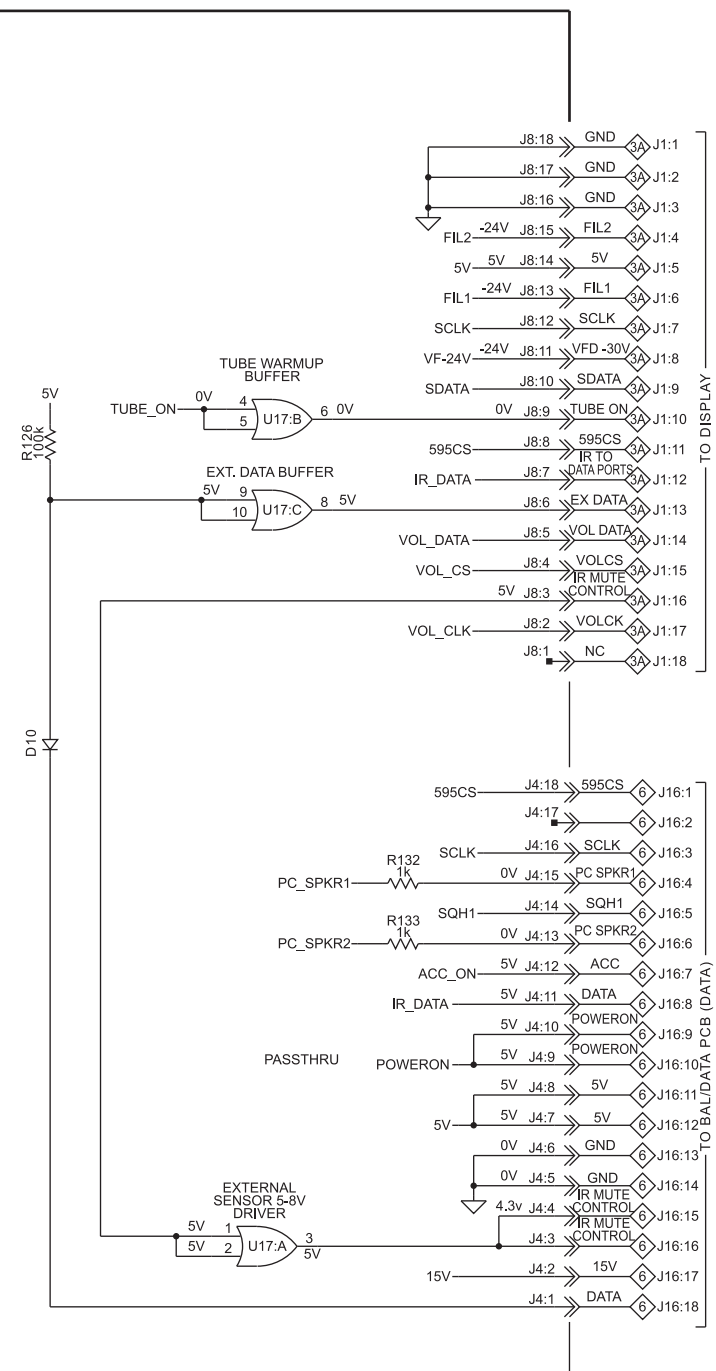
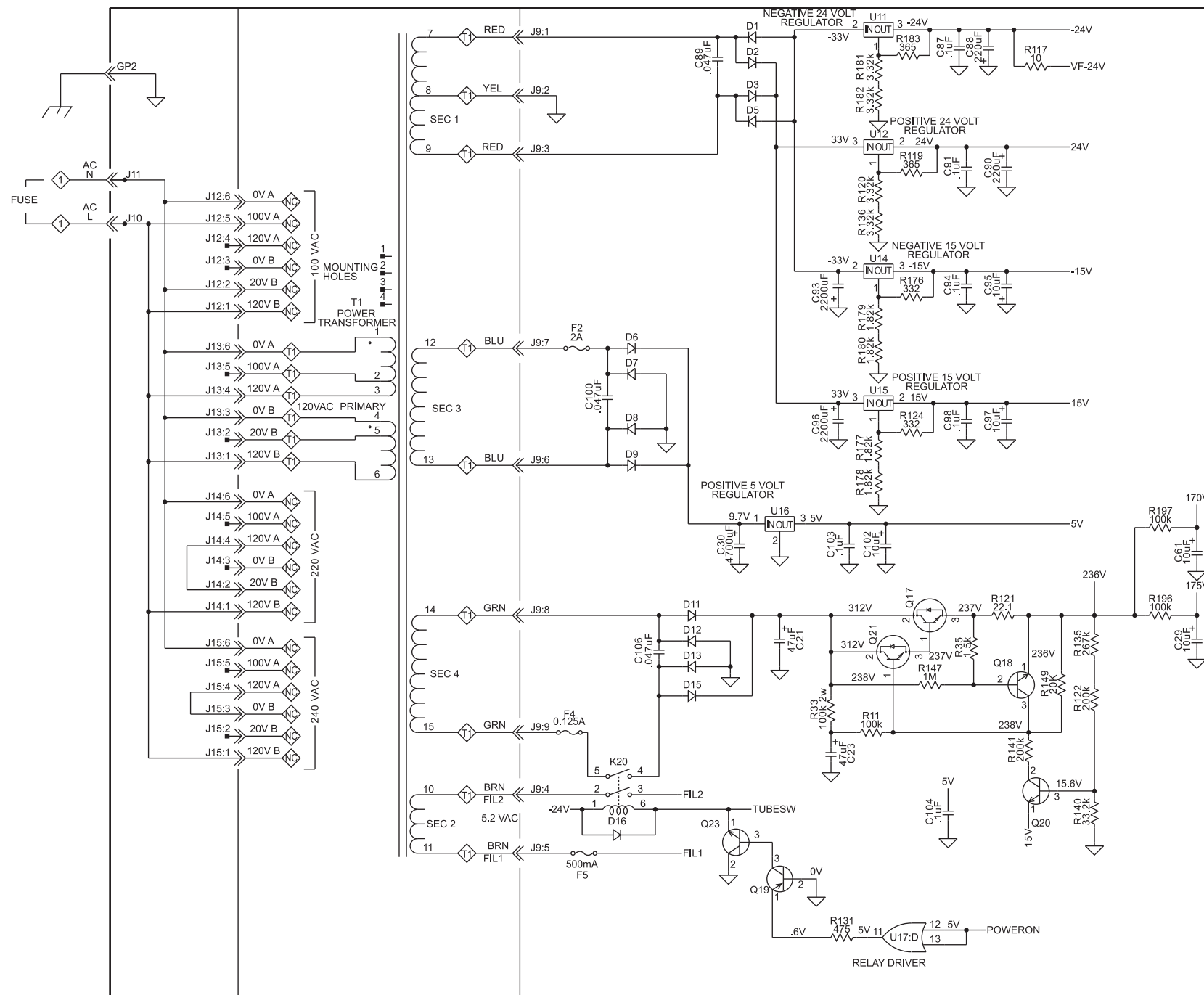


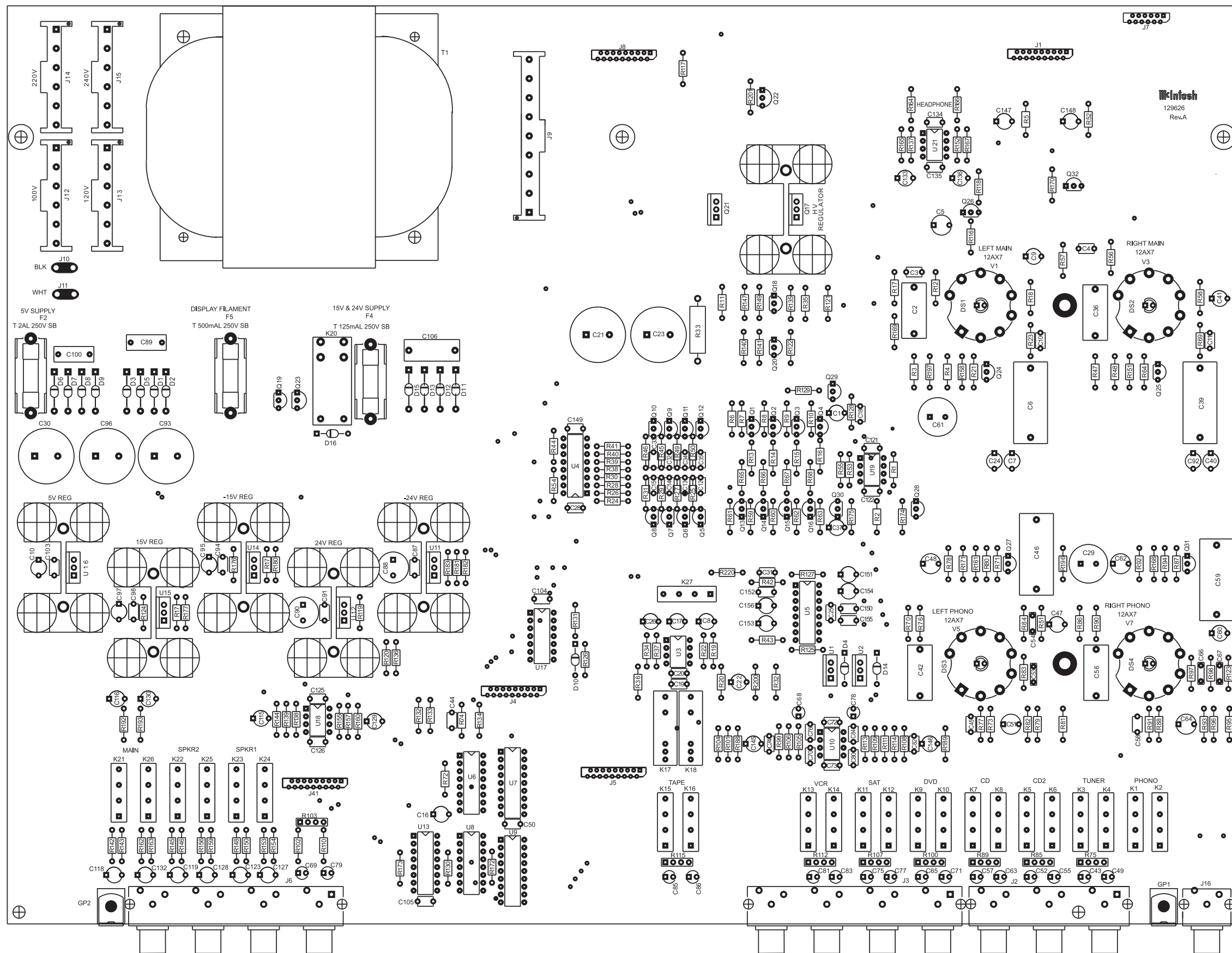
! WARNING Parts located in the shaded area have critical characteristics. Use only replacement parts recommended by the manufacturer.



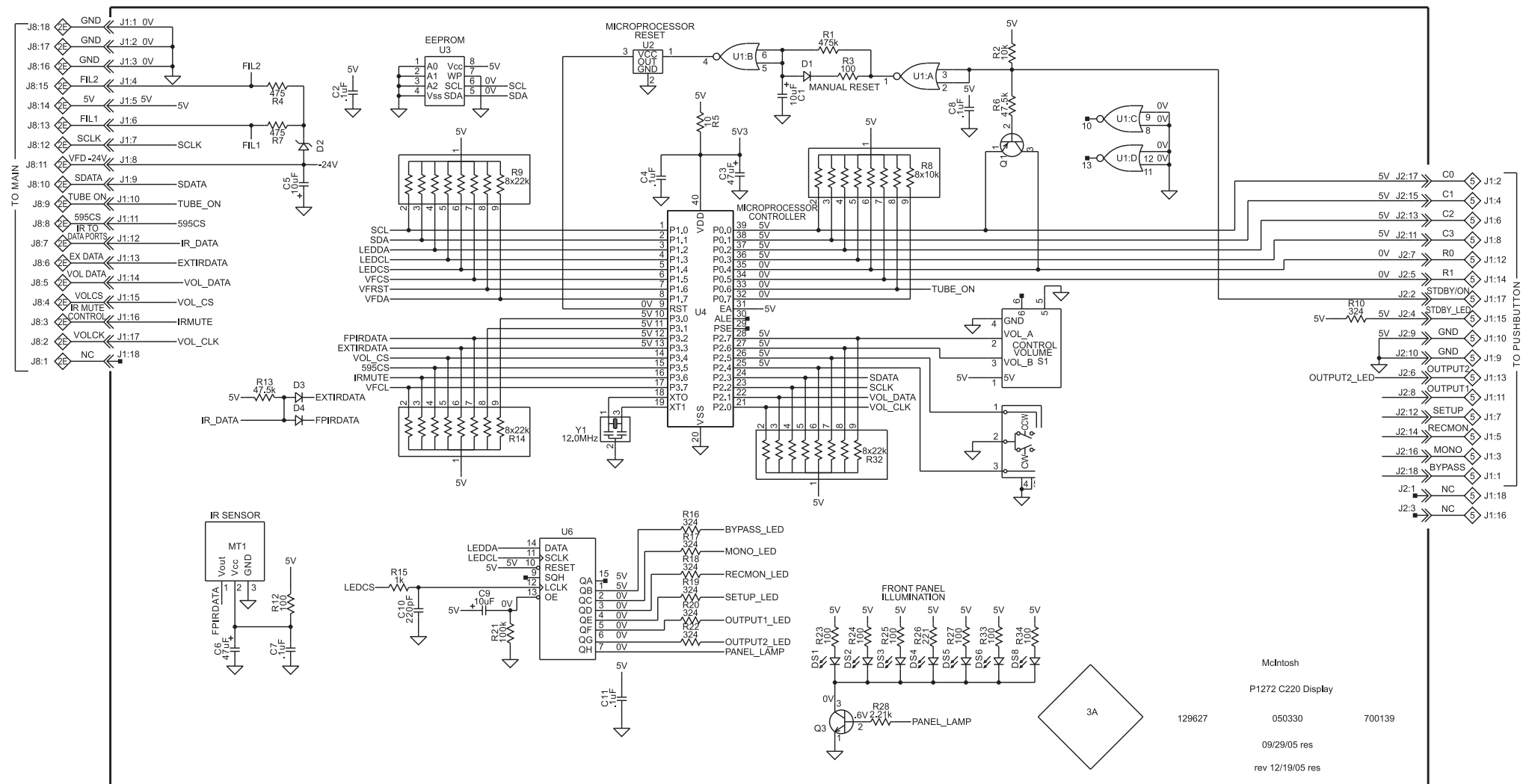




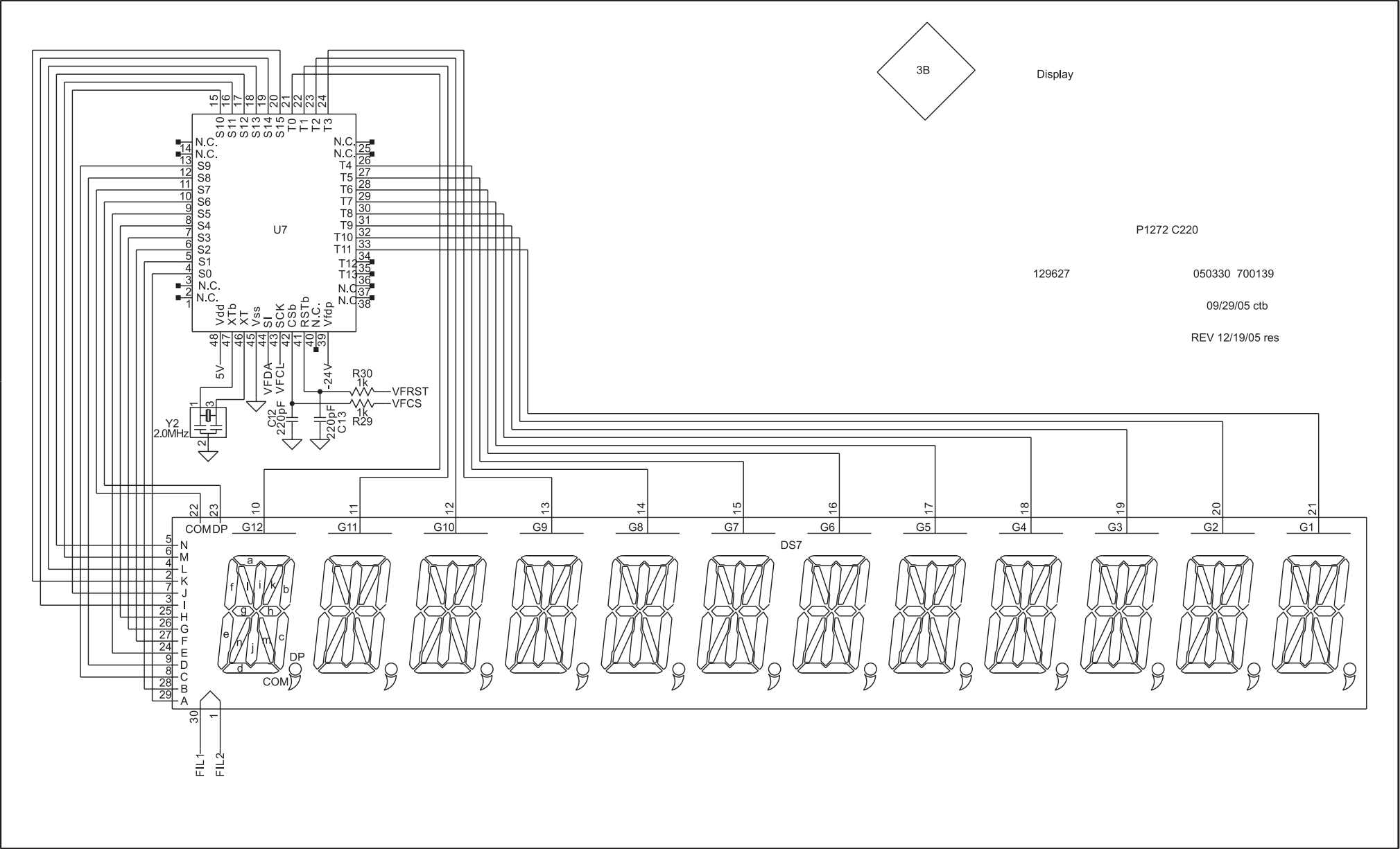


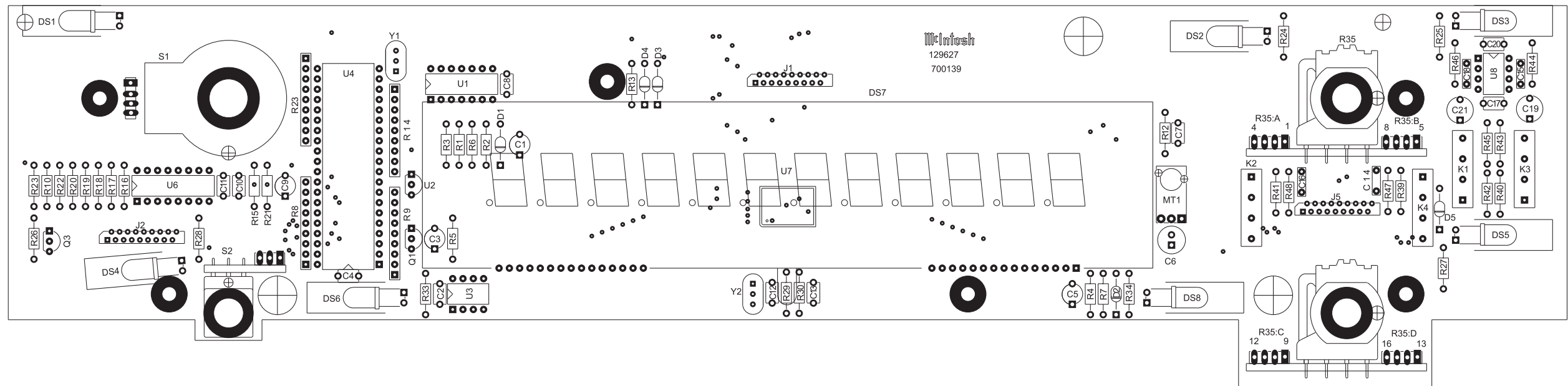
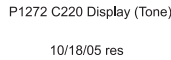


3 **DISPLAY 050330 SCH 1 of 3**

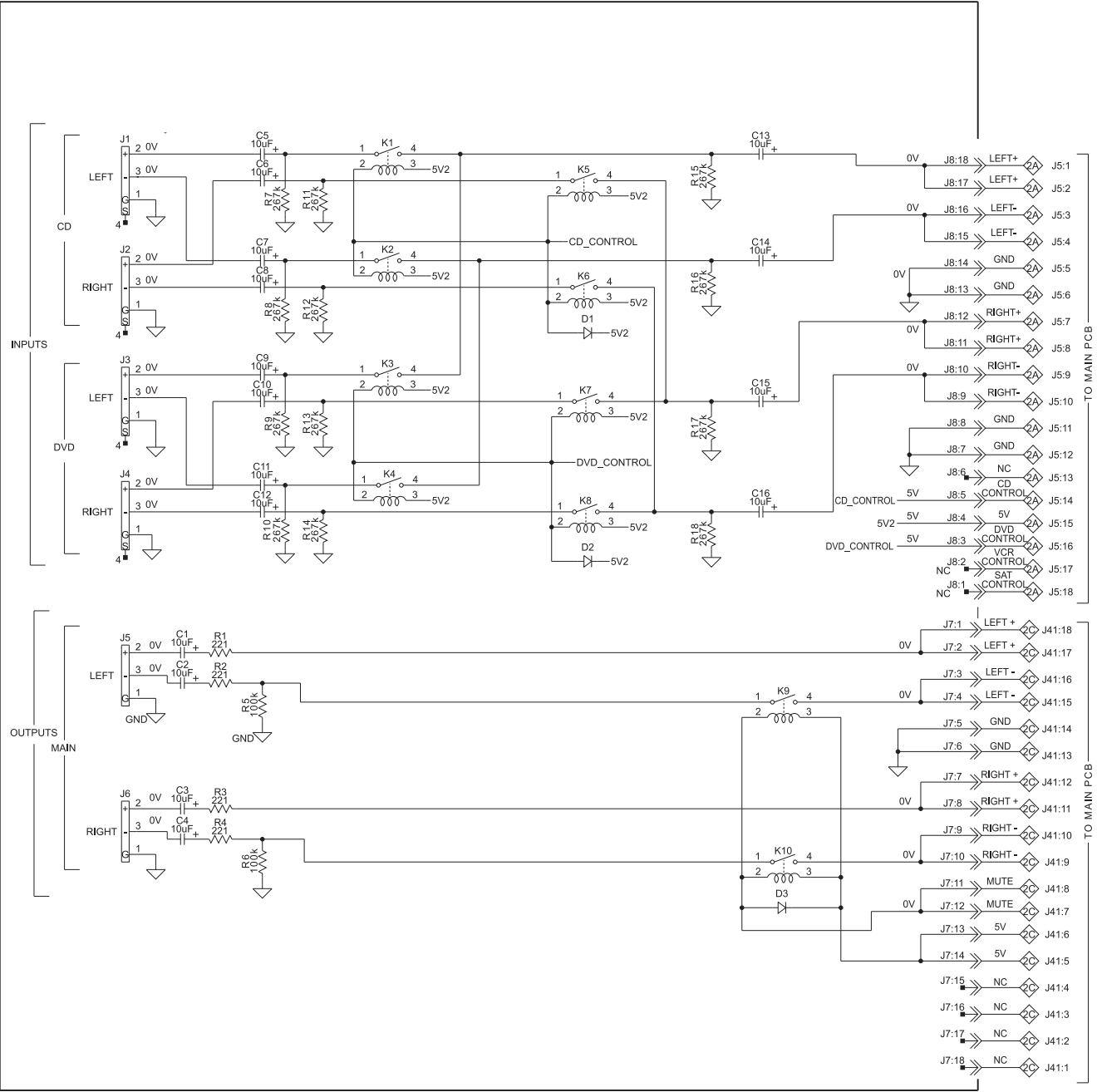


3 **DISPLAY** 050330 SCH 2 of 3

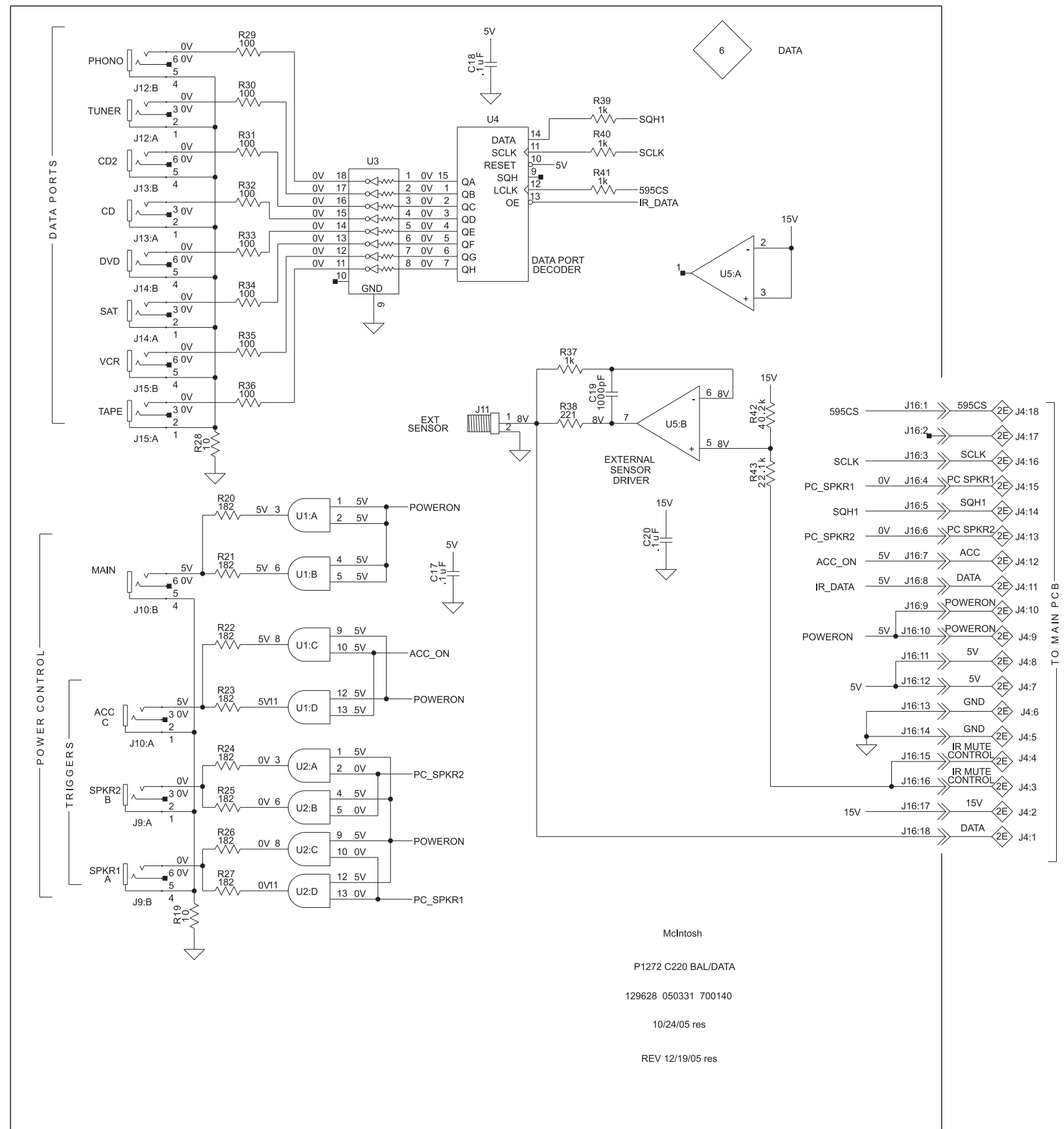




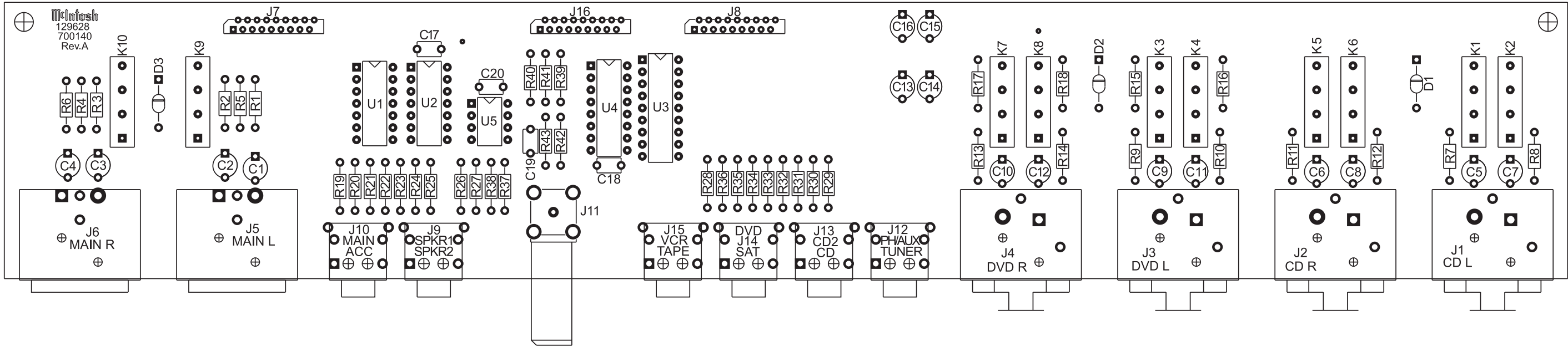
4 *BALANCED / DATA* 051331 SCH 1 of 2



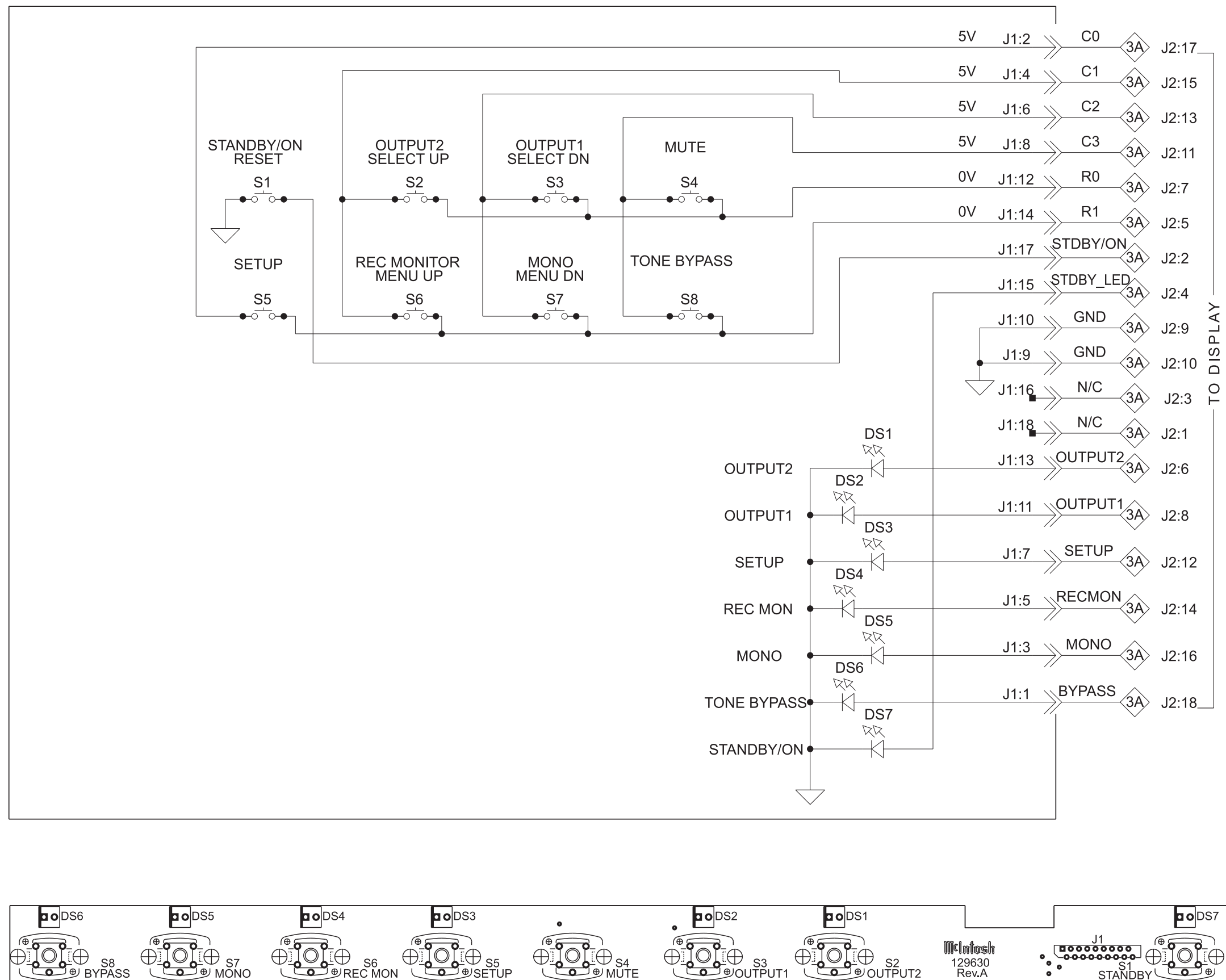
4 BALANCED / DATA 050331 SCH 2 of 2



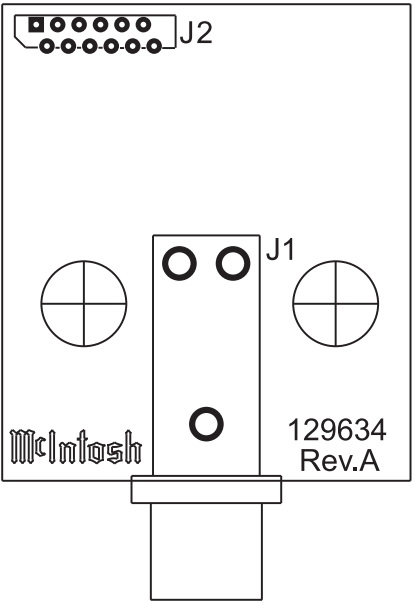
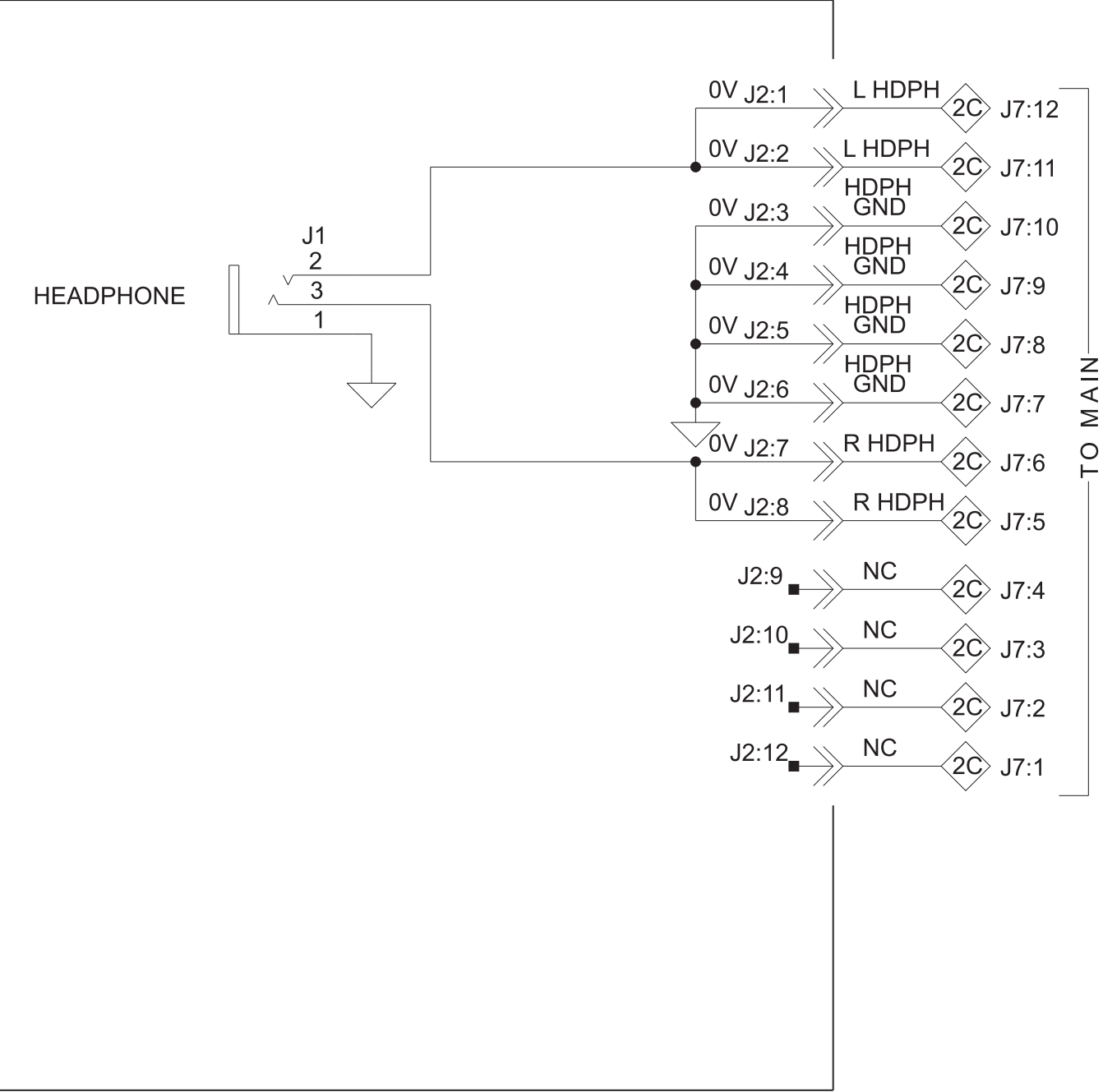
4 *BALANCED / DATA* 050331 PCB



5 **PUSHBUTTON** 051332 SCH and PCB



6 *HEADPHONE 051333 SCH and PCB*



NOTES

PARTS LIST

MAIN PCB 050329

Ref No.	Description	Part No.	Ref No.	Description	Part No.
C1	CAPELECT 10UF 50V	066445	C57	CAPELECT 10UF 16V	066580
C2	CAPMPF 0.1UF 630VDC	064431	C58	CAP MONO 47PF 200V 10% NPO	061340
C3	CAP MONO 47PF 200V 10% NPO	061340	C59	CAPPOLYPROP 1UF 20% 250VDC	064433
C4	CAP MONO 47PF 200V 10% NPO	061340	C60	CAPELECT 1UF 50V	066510
C5	CAPELECT 22UF 100V	066574	C61	CAPELECT 10UF 250V	066493
C6	CAPPOLYPROP 1UF 20% 250VDC	064433	C62	CAPELECT 100UF 25V	066573
C8	CAPELECT 10UF 50V	066445	C63	CAPELECT 10UF 16V	066580
C7	CAPELECT 1UF 50V	066510	C64	CAPELECT 100UF 25V	066573
C9	CAPELECT 47UF 35V	066446	C65	CAPELECT 10UF 16V	066580
C10	CAP MONO 47PF 200V 10% NPO	061340	C66	CAP PF 0.001UF 5% 63VDC	064453
C11	CAP MONO 47PF 200V 10% NPO	061340	C67	CAPMPF 0.0033UF 5% 63VDC	064306
C12	CAP MONO 1000PF 50V 10% NPO	061344	C68	CAPELECT 10UF 16V	066580
C13	CAP MONO 1000PF 50V 10% NPO	061344	C69	CAPELECT 10UF 16V	066580
C14	CAP MONO 1000PF 50V 10% NPO	061344	C70	CAP MONO 100PF 100V 10% NPO	061341
C15	CAP MONO 1000PF 50V 10% NPO	061344	C71	CAPELECT 10UF 16V	066580
C16	CAPELECT 10UF 50V	066445	C72	CAP MONO .1UF 50V 20% Z5U	061346
C17	CAPELECT 47UF 35V	066446	C73	CAP MONO .1UF 50V 20% Z5U	061346
C18	CAP DISC MONO .47UF 50V	061320	C74	CAP MONO 100PF 100V 10% NPO	061341
C19	CAP MONO .1UF 50V 20% Z5U	061346	C75	CAPELECT 10UF 16V	066580
C20	CAP MONO .1UF 50V 20% Z5U	061346	C76	CAP MONO 100PF 100V 10% NPO	061341
C21	CAPELECT 47UF 450V	066497	C77	CAPELECT 10UF 16V	066580
C22	CAPELECT 47UF 35V	066446	C78	CAPELECT 10UF 16V	066580
C23	CAPELECT 47UF 450V	066497	C79	CAPELECT 10UF 16V	066580
C24	CAPELECT 1UF 50V	066510	C80	CAP MONO 100PF 100V 10% NPO	061341
C25	CAP MONO .1UF 50V 20% Z5U	061346	C81	CAPELECT 10UF 16V	066580
C26	CAPELECT 10UF 50V	066445	C82	CAP MONO 100PF 100V 10% NPO	061341
C28	CAP MONO .1UF 50V 20% Z5U	061346	C83	CAPELECT 10UF 16V	066580
C29	CAPELECT 10UF 250V	066493	C84	CAP MONO 100PF 100V 10% NPO	061341
C30	CAPELECT 4700UF	066443	C85	CAPELECT 10UF 16V	066580
C31	CAP MONO 220PF 200V 10% NPO	061342	C86	CAPELECT 10UF 16V	066580
C32	CAP MONO 1000PF 50V 10% NPO	061344	C87	CAP MONO .1UF 50V 20% Z5U	061346
C33	CAP MONO 1000PF 50V 10% NPO	061344	C88	CAPELECT 220UF 50V 20%	066254
C34	CAP MONO 1000PF 50V 10% NPO	061344	C89	CAPPOLYPROP .047UF 10% 250VDC	064364
C35	CAP MONO 1000PF 50V 10% NPO	061344	C90	CAPELECT 220UF 50V 20%	066254
C36	CAPMPF 0.1UF 630VDC	064431	C91	CAP MONO .1UF 50V 20% Z5U	061346
C37	CAPELECT 10UF 50V	066445	C92	CAPELECT 1UF 50V	066510
C39	CAPPOLYPROP 1UF 20% 250VDC	064433	C93	CAPELECT 2200UF 50V 20%	066440
C40	CAPELECT 1UF 50V	066510	C94	CAP MONO .1UF 50V 20% Z5U	061346
C41	CAPELECT 47UF 35V	066446	C95	CAPELECT 10UF 50V	066445
C42	CAPMPF 0.1UF 630VDC	064431	C96	CAPELECT 2200UF 50V 20%	066440
C43	CAPELECT 10UF 16V	066580	C97	CAPELECT 10UF 50V	066445
C44	CAP MONO 220PF 200V 10% NPO	061342	C98	CAP MONO .1UF 50V 20% Z5U	061346
C45	CAP MONO 47PF 200V 10% NPO	061340	C100	CAPPOLYPROP .047UF 10% 250VDC	064364
C46	CAPPOLYPROP 1UF 20% 250VDC	064433	C102	CAPELECT 10UF 50V	066445
C47	CAPELECT 1UF 50V	066510	C103	CAP MONO .1UF 50V 20% Z5U	061346
C48	CAPELECT 100UF 25V	066573	C104	CAP MONO .1UF 50V 20% Z5U	061346
C49	CAPELECT 10UF 16V	066580	C105	CAP MONO .1UF 50V 20% Z5U	061346
C50	CAP MONO .1UF 50V 20% Z5U	061346	C106	CAPPOLY .047UF 10% 1000VDC	064434
C51	CAPELECT 100UF 25V	066573	C115	CAPELECT 47UF 35V	066446
C52	CAPELECT 10UF 16V	066580	C116	CAPELECT 10UF 50V	066445
C53	CAP PF 0.001UF 5% 63VDC	064453	C118	CAPELECT 10UF 50V	066445
C54	CAPMPF 0.0033UF 5% 63VDC	064306	C119	CAPELECT 10UF 50V	066445
C55	CAPELECT 10UF 16V	066580	C121	CAP MONO .1UF 50V 20% Z5U	061346
C56	CAPMPF 0.1UF 630VDC	064431	C122	CAP MONO .1UF 50V 20% Z5U	061346

PARTS LIST *con't*

MAIN PCB 050329 (cont'd)

Ref No.	Description	Part No.
	CAP MONO .1UF 50V	066445
C125	CAP MONO .1UF 50V 20% Z5U	061346
C126	CAP MONO .1UF 50V 20% Z5U	061346
C127	CAPELECT 10UF 50V	066445
C128	CAPELECT 10UF 50V	066445
C129	CAPELECT 47UF 35V	066446
C130	CAPELECT 10UF 50V	066445
C132	CAPELECT 10UF 50V	066445
C133	CAPELECT 10UF 50V	066445
C134	CAP MONO .1UF 50V 20% Z5U	061346
C135	CAP MONO .1UF 50V 20% Z5U	061346
C136	CAPELECT 10UF 50V	066445
C145	CAPELECT 10UF 50V	066445
C146	CAPELECT 10UF 50V	066445
C147	CAPELECT 47UF 35V	066446
C148	CAPELECT 47UF 35V	066446
C149	CAP MONO 220PF 200V 10% NPO	061342
C150	CAP MONO .1UF 50V 20% Z5U	061346
C152	CAP MONO .1UF 50V 20% Z5U	061346
C155	CAP MONO .1UF 50V 20% Z5U	061346
C151	CAPELECT 10UF 50V	066445
C153	CAPELECT 10UF 50V	066445
C154	CAPELECT 10UF 50V	066445
C156	CAPELECT 10UF 50V	066445
D1	DIODE SIL 400 PIV @ 1.5A	070031
D2	DIODE SIL 400 PIV @ 1.5A	070031
D3	DIODE SIL 400 PIV @ 1.5A	070031
D4	DIODE SILICON	070174
D5	DIODE SIL 400 PIV @ 1.5A	070031
D6	DIODE SIL 400 PIV @ 1.5A	070031
D7	DIODE SIL 400 PIV @ 1.5A	070031
D8	DIODE SIL 400 PIV @ 1.5A	070031
D9	DIODE SIL 400 PIV @ 1.5A	070031
D10	DIODE SILICON	070174
D11	DIODE SIL 400 PIV @ 1.5A	070031
D12	DIODE SIL 400 PIV @ 1.5A	070031
D13	DIODE SIL 400 PIV @ 1.5A	070031
D15	DIODE SIL 400 PIV @ 1.5A	070031
D14	DIODE SILICON	070174
D16	DIODE SILICON	070174
DS1	LED GREEN 3MM HI INTENSITY	058172
DS2	LED GREEN 3MM HI INTENSITY	058172
DS3	LED GREEN 3MM HI INTENSITY	058172
DS4	LED GREEN 3MM HI INTENSITY	058172
F2	FUSE 2A 250V SLO-BLO 5X20 IEC	089088
(F2)	HOLDER FUSE 5X20MM PCB MOUNT	178159
F4	FUSE 1/8A SLO-BLO 5X20 IEC	089094
(F4)	HOLDER FUSE 5X20MM PCB MOUNT	178159
F5	FUSE 0.5A SLO-BLO 5X20 IEC	089092
(F5)	HOLDER FUSE 5X20MM PCB MOUNT	178159
GP1	BRACKET PCB CARD MOUNTING	003611
GP2	BRACKET PCB CARD MOUNTING	003611
J1	CONN FFC 18PIN	117765
J2	JACK PHONO 6P GOLD PLATED	117449

Ref No.	Description	Part No.
J3	JACK PHONO 8P GOLD PLATED	117455
J4	CONN FFC 18PIN	117765
J5	CONN FFC 18PIN	117765
J6	JACK PHONO 8P GOLD PLATED	117455
J7	CONN 12 PIN FFC	117720
J8	CONN FFC 18PIN	117765
J9	HEADER 9 CIRCUIT POST NATURAL	117724
J10	BLADE FASTON W/FEET	117708
J11	BLADE FASTON W/FEET	117708
J12	CONN PCB MOUNT POWER RED	117719
J13	CONN PCB MOUNT POWER RED	117719
J14	CONN PCB MOUNT POWER RED	117719
J15	CONN PCB MOUNT POWER RED	117719
J16	JACK PHONO GOLD PJ261G	117436
J41	CONN FFC 18PIN	117765
K1	RELAY REED SPST-NO 5V 1.2A	087078
K2	RELAY REED SPST-NO 5V 1.2A	087078
K3	RELAY REED SPST-NO 5V 1.2A	087078
K4	RELAY REED SPST-NO 5V 1.2A	087078
K5	RELAY REED SPST-NO 5V 1.2A	087078
K6	RELAY REED SPST-NO 5V 1.2A	087078
K7	RELAY REED SPST-NO 5V 1.2A	087078
K8	RELAY REED SPST-NO 5V 1.2A	087078
K9	RELAY REED SPST-NO 5V 1.2A	087078
K10	RELAY REED SPST-NO 5V 1.2A	087078
K11	RELAY REED SPST-NO 5V 1.2A	087078
K12	RELAY REED SPST-NO 5V 1.2A	087078
K13	RELAY REED SPST-NO 5V 1.2A	087078
K14	RELAY REED SPST-NO 5V 1.2A	087078
K15	RELAY REED SPST-NO 5V 1.2A	087078
K16	RELAY REED SPST-NO 5V 1.2A	087078
K17	RELAY REED FORM 1C 5V 125 OHM	087056
K18	RELAY REED FORM 1C 5V 125 OHM	087056
K20	RELAY 24VDC 5A 277VAC	087057
K21	RELAY REED SPST-NO 5V 1.2A	087078
K22	RELAY REED SPST-NO 5V 1.2A	087078
K23	RELAY REED SPST-NO 5V 1.2A	087078
K24	RELAY REED SPST-NO 5V 1.2A	087078
K25	RELAY REED SPST-NO 5V 1.2A	087078
K26	RELAY REED SPST-NO 5V 1.2A	087078
K27	RELAY REED SPST-NO 5V 1.2A	087078
Q1	TRANSISTOR N JFET	132318
Q2	TRANSISTOR N JFET	132318
Q3	TRANSISTOR N JFET	132318
Q4	TRANSISTOR N JFET	132318
Q5	TRANSISTOR PNP SILICON	132304
Q6	TRANSISTOR PNP SILICON	132304
Q7	TRANSISTOR PNP SILICON	132304
Q8	TRANSISTOR PNP SILICON	132304
Q9	TRANSISTOR PNP SILICON	132304
Q10	TRANSISTOR PNP SILICON	132304
Q11	TRANSISTOR PNP SILICON	132304
Q12	TRANSISTOR PNP SILICON	132304
Q13	TRANSISTOR N JFET	132318

PARTS LIST *con't*

MAIN PCB 050329 (cont'd)

Ref No.	Description	Part No.	Ref No.	Description	Part No.
Q14	TRANSISTOR N JFET	132318	R35	RES MF 1.5K 1% 1/4W	144539
Q15	TRANSISTOR N JFET	132318	R36	RES MF 267K 1% 1/4W	144532
Q16	TRANSISTOR N JFET	132318	R37	RES MF 12.1K 1% 1/4W	144550
Q17	TRANSISTOR NPN POWER	132295	R38	RES MF 267K 1% 1/4W	144532
(Q17)	HEATSINK TO-220	080017	R39	RES MF 267K 1% 1/4W	144532
Q19	TRANSISTOR PNP SILICON	132304	R40	RES MF 267K 1% 1/4W	144532
Q29	TRANSISTOR PNP SILICON	132304	R41	RES MF 267K 1% 1/4W	144532
Q21	TRANSISTOR NPN POWER	132295	R42	RES MF 1K 1% 1/4W	144513
Q22	TRANSISTOR NPN 2A 50V	132302	R43	RES MF 1K 1% 1/4W	144513
Q23	TRANSISTOR NPN 2A 50V	132302	R44	RES MF 1K 1% 1/4W	144513
Q18	TRANSISTOR NPN SILICON	132317	R45	RES MF 1M 1% 1/4W	144577
Q24	TRANSISTOR PNP	132326	R46	RES MF 1M 1% 1/4W	144577
Q25	TRANSISTOR PNP	132326	R47	RES MF 221K 1% 1/4W	144629
Q26	TRANSISTOR NPN SILICON	132317	R48	RES MF 200K 1% 1/4W	144531
Q27	TRANSISTOR PNP	132326	R49	RES MF 1M 1% 1/4W	144577
Q28	TRANSISTOR N JFET	132318	R50	RES MF 1M 1% 1/4W	144577
Q30	TRANSISTOR N JFET	132318	R51	RES MF 3.32K 1% 1/4W	144518
Q31	TRANSISTOR PNP	132326	R52	RES MF 2.74K 1% 1/4W	144587
Q32	TRANSISTOR NPN SILICON	132317	R53	RES MF 20K 1% 1/4W	144524
Q20	TRANSISTOR NPN	132325	R54	RES MF 1K 1% 1/4W	144513
R1	RES MF 20K 1% 1/4W	144524	R55	RES MF 150K 1% 1/4W	144627
R2	RES MF 150K 1% 1/4W	144627	R56	RES MF 1M 1% 1/4W	144577
R3	RES MF 221K 1% 1/4W	144629	R57	RES MF 1.5K 1% 1/4W	144539
R4	RES MF 200K 1% 1/4W	144531	R58	RES MF 3.32K 1% 1/4W	144518
R5	RES MF 2.74K 1% 1/4W	144587	R59	RES MF 47.5K 1% 1/4W	144526
R6	RES MF 2.21M 1% 1/4W	144576	R60	RES MF 33.2K 1% 1/4W	144694
R7	RES MF 47.5K 1% 1/4W	144526	R61	RES MF 2.21M 1% 1/4W	144576
R8	RES MF 33.2K 1% 1/4W	144694	R62	RES MF 24.9K 1% 1/4W	144439
R9	RES MF 24.9K 1% 1/4W	144439	R63	RES 16.5K 1% 1/4W	144103
R10	RES 16.5K 1% 1/4W	144103	R64	RES MF 22.1K 1% 1/4W	144564
R11	RES MF 100K 1% 1/4W	144528	R65	RES MF 10M 1% 1/4W	144575
R12	RES MF 1M 1% 1/4W	144577	R66	RES MF 10M 1% 1/4W	144575
R13	RES MF 10M 1% 1/4W	144575	R67	RES MF 10M 1% 1/4W	144575
R14	RES MF 10M 1% 1/4W	144575	R68	RES MF 10M 1% 1/4W	144575
R15	RES MF 10M 1% 1/4W	144575	R69	RES MF 15K 1% 1/4W	144623
R16	RES MF 10M 1% 1/4W	144575	R70	RES MF 221K 1% 1/4W	144629
R17	RES MF 1.5K 1% 1/4W	144539	R71	RES MF 200K 1% 1/4W	144531
R18	RES MF 3.32K 1% 1/4W	144518	R72	RES MF 1K 1% 1/4W	144513
R19	RES MF 10K 1% 1/4W	144504	R73	RES MF 1K 1% 1/4W	144513
R20	RES MF 267K 1% 1/4W	144532	R74	RES MF 1K 1% 1/4W	144513
R21	RES MF 22.1K 1% 1/4W	144564	R75	RES NETWORK 2 X 220K ISO	144678
R22	RES MF 12.1K 1% 1/4W	144550	R76	RES MF 1M 1% 1/4W	144577
R23	RES MF 15K 1% 1/4W	144623	R77	RES MF 47.5K 1% 1/4W	144526
R24	RES MF 267K 1% 1/4W	144532	R78	RES MF 1.5K 1% 1/4W	144539
R25	RES MF 1M 1% 1/4W	144577	R79	RES MF 953 OHM 1% 1/4W	144473
R26	RES MF 267K 1% 1/4W	144532	R80	RES MF 22.1K 1% 1/4W	144564
R27	RES MF 1M 1% 1/4W	144577	R81	RES MF 221K 1% 1/4W	144629
R28	RES MF 267K 1% 1/4W	144532	R82	RES MF 1.82K 1% 1/4W	144582
R29	RES MF 1M 1% 1/4W	144577	R83	RES MF 75K 1% 1/4W	144156
R30	RES MF 267K 1% 1/4W	144532	R84	RES MF 1M 1% 1/4W	144577
R31	RES MF 1M 1% 1/4W	144577	R85	RES NETWORK 2 X 220K ISO	144678
R32	RES MF 267K 1% 1/4W	144532	R86	RES MF 221K 1% 1/4W	144629
R33	RES MO 100K 5% 2W	144698	R87	RES MF 200K 1% 1/4W	144531
R34	RES MF 10K 1% 1/4W	144504	R88	RES MF 1K 1% 1/4W	144513

PARTS LIST *con't*

MAIN PCB 050329 (cont'd)

Ref No.	Description	Part No.	Ref No.	Description	Part No.
R89	RES NETWORK 2 X 220K ISO	144678	R143	RES MF 100K 1% 1/4W	144528
R90	RES MF 1M 1% 1/4W	144577	R144	RES MF 33.2K 1% 1/4W	144694
R91	RES MF 47.5K 1% 1/4W	144526	R145	RES MF 221 OHM 1% 1/4W	144559
R92	RES MF 1.5K 1% 1/4W	144539	R146	RES MF 100K 1% 1/4W	144528
R93	RES MF 953 OHM 1% 1/4W	144473	R147	RES MF 1M 1% 1/4W	144577
R94	RES MF 22.1K 1% 1/4W	144564	R148	RES MF 221 OHM 1% 1/4W	144559
R95	RES MF 221K 1% 1/4W	144629	R149	RES MF 20K 1% 1/4W	144524
R96	RES MF 1.82K 1% 1/4W	144582	R150	RES MF 100K 1% 1/4W	144528
R97	RES MF 75K 1% 1/4W	144156	R151	RES MF 22.1K 1% 1/4W	144564
R98	RES MF 1M 1% 1/4W	144577	R152	RES MF 1K 1% 1/4W	144513
R99	RES MF 1K 1% 1/4W	144513	R153	RES MF 221 OHM 1% 1/4W	144559
R100	RES NETWORK 2 X 220K ISO	144678	R154	RES MF 100K 1% 1/4W	144528
R101	RES MF 40.2K 1% 1/4W	144525	R155	RES MF 10K 1% 1/4W	144504
R102	RES MF 221 OHM 1% 1/4W	144559	R156	RES MF 221 OHM 1% 1/4W	144559
R103	RES NETWORK 2 X 220K ISO	144678	R157	RES MF 10K 1% 1/4W	144504
R104	RES MF 40.2K 1% 1/4W	144525	R158	RES MF 22.1K 1% 1/4W	144564
R105	RES MF 20K 1% 1/4W	144524	R159	RES MF 100K 1% 1/4W	144528
R106	RES MF 20K 1% 1/4W	144524	R160	RES MF 33.2K 1% 1/4W	144694
R107	RES NETWORK 2 X 220K ISO	144678	R161	RES MF 22.1K 1% 1/4W	144564
R108	RES MF 1K 1% 1/4W	144513	R162	RES MF 221 OHM 1% 1/4W	144559
R109	RES MF 40.2K 1% 1/4W	144525	R163	RES MF 100K 1% 1/4W	144528
R110	RES MF 221 OHM 1% 1/4W	144559	R164	RES MF 100 OHM 1% 1/4W	144568
R111	RES MF 40.2K 1% 1/4W	144525	R165	RES MF 100K 1% 1/4W	144528
R112	RES NETWORK 2 X 220K ISO	144678	R166	RES MF 100 OHM 1% 1/4W	144568
R113	RES MF 20K 1% 1/4W	144524	R167	RES MF 100K 1% 1/4W	144528
R114	RES MF 20K 1% 1/4W	144524	R168	RES MF 22.1K 1% 1/4W	144564
R115	RES NETWORK 2 X 220K ISO	144678	R169	RES MF 1K 1% 1/4W	144513
R116	RES MF 10K 1% 1/4W	144504	R170	RES MF 10K 1% 1/4W	144504
R117	RES MF 10 OHM 1% 1/4W	144553	R171	RES MF 1K 1% 1/4W	144513
R118	RES MF 10K 1% 1/4W	144504	R172	RES MF 1K 1% 1/4W	144513
R119	RES MF 365 OHM 1% 1/4W	144505	R173	RES MF 1K 1% 1/4W	144513
R120	RES MF 3.32K 1% 1/4W	144518	R174	RES MF 10M 1% 1/4W	144575
R121	RES MF 22.1 OHM 1% 1/4W	144554	R175	RES MF 10M 1% 1/4W	144575
R122	RES MF 200K 1% 1/4W	144531	R176	RES MF 332 OHM 1% 1/4W	144646
R123	RES MF 3.32K 1% 1/4W	144518	R177	RES MF 1.82K 1% 1/4W	144582
R124	RES MF 332 OHM 1% 1/4W	144646	R178	RES MF 1.82K 1% 1/4W	144582
R125	RES MF 8.25K 1% 1/4W	144549	R179	RES MF 1.82K 1% 1/4W	144582
R126	RES MF 100K 1% 1/4W	144528	R180	RES MF 1.82K 1% 1/4W	144582
R127	RES MF 221 OHM 1% 1/4W	144559	R181	RES MF 3.32K 1% 1/4W	144518
R128	RES MF 1M 1% 1/4W	144577	R182	RES MF 3.32K 1% 1/4W	144518
R129	RES MF 200K 1% 1/4W	144531	R183	RES MF 365 OHM 1% 1/4W	144505
R130	RES MF 100K 1% 1/4W	144528	R188	RES MF 221K 1% 1/4W	144629
R131	RES MF 475 OHM 1% 1/4W	144509	R189	RES MF 221K 1% 1/4W	144629
R132	RES MF 1K 1% 1/4W	144513	R192	RES MF 33.2K 1% 1/4W	144694
R133	RES MF 1K 1% 1/4W	144513	R193	RES MF 33.2K 1% 1/4W	144694
R134	RES MF 100K 1% 1/4W	144528	R196	RES MF 100K 1% 1/4W	144528
R135	RES MF 267K 1% 1/4W	144532	R197	RES MF 100K 1% 1/4W	144528
R136	RES MF 3.32K 1% 1/4W	144518	R200	RES MF 267K 1% 1/4W	144532
R137	RES MF 1K 1% 1/4W	144513	R201	RES MF 365 OHM 1% 1/4W	144505
R138	RES MF 10K 1% 1/4W	144504	R220	RES MF 47.5K 1% 1/4W	144526
R139	RES MF 10K 1% 1/4W	144504	T1	TRANSFORMER R-CORE POWER	159348
R140	RES MF 33.2K 1% 1/4W	144694	U1	IC REGULATOR 5V	133250
R141	RES MF 200K 1% 1/4W	144531	U2	IC -5V REGULATOR	133253
R142	RES MF 221 OHM 1% 1/4W	144559	U3	IC DUAL OPERATIONAL AMPLIFIER	133260

***PARTS LIST** *con't**

MAIN PCB 050329 (cont'd)

Ref No.	Description	Part No.	Ref No.	Description	Part No.
U4	IC SHFT REG SER-PAR	133186	D5	DIODE SILICON	070174
U5	IC STEREO DGTL VOLUME CONTROL	133331	DS1	LED GRN 5MM HI-INTENSITY	058165
U6	IC SHFT REG SER-PAR	133186	(DS1)	SPACER LED	112108
U7	IC OCTAL DARLNGTON TRANS ARRAY	133258	DS2	LED GRN 5MM HI-INTENSITY	058165
U8	IC SHFT REG SER-PAR	133186	(DS2)	SPACER LED	112108
U9	IC OCTAL DARLNGTON TRANS ARRAY	133258	DS3	LED GRN 5MM HI-INTENSITY	058165
U10	IC DUAL OPERATIONAL AMPLIFIER	133260	(DS3)	SPACER LED	112108
U11	IC VOLTAGE REGLTR VARIABLE NEG	133334	DS4	LED GRN 5MM HI-INTENSITY	058165
(U11)	HEATSINK TO-220	080017	(DS4)	SPACER LED	112108
U12	IC VOLTAGE REGLTR VARIABLE POS	133333	DS5	LED GRN 5MM HI-INTENSITY	058165
(U12)	HEATSINK TO-220	080017	(DS5)	SPACER LED	112108
U13	IC SHFT REG SER-PAR	133186	DS6	LED GRN 5MM HI-INTENSITY	058165
U14	IC VOLTAGE REGLTR VARIABLE NEG	133334	(DS6)	SPACER LED	112108
(U14)	HEATSINK TO-220	080017	DS7	DISPLAY 12 CHARACTER	058150
U15	IC VOLTAGE REGLTR VARIABLE POS	133333	DS8	LED GRN 5MM HI-INTENSITY	058165
(U15)	HEATSINK TO-220	080017	(DS8)	SPACER LED	112108
U16	IC REGULATOR +5V	133108	J1	CONN FFC 18PIN	117765
(U16)	HEATSINK TO-220	080017	J2	CONN FFC 18PIN	117765
U17	IC 2 INPUT X 4	133167	J5	CONN FFC 18PIN	117765
U18	IC DUAL OPERATIONAL AMPLIFIER	133260	K1	RELAY REED SPST-NO 5V 1.2A	087078
U19	IC DUAL OPERATIONAL AMPLIFIER	133260	K2	RELAY REED SPST-NO 5V 1.2A	087078
U21	IC DUAL OPERATIONAL AMPLIFIER	133260	K3	RELAY REED SPST-NO 5V 1.2A	087078
V1	SOCKET 9 PIN TUBE CERAMIC	178170	K4	RELAY REED SPST-NO 5V 1.2A	087078
V3	SOCKET 9 PIN TUBE CERAMIC	178170	MTGPA1	DBL COATED MTG-TAPE 1/16 THK	094409
V5	SOCKET 9 PIN TUBE CERAMIC	178170	MTGPA2	DBL COATED MTG-TAPE 1/16 THK	094409
V7	SOCKET 9 PIN TUBE CERAMIC	178170	MTGPA3	DBL COATED MTG-TAPE 1/16 THK	094409
18574	ASSEMBLY INSERTION PCB MAIN	700138	MT1	SENSOR IR 38KHZ	121046
	ASSY INSERTION PCB MAIN	701138	Q1	TRANSISTOR PNP	132304
			Q3	TRANSISTOR NPN 2K/REEL	132317
			R1	RES MF 475K 1% 1/4W	144604
			R2	RES MF 10K 1% 1/4W	144504
			R3	RES MF 100 OHM 1% 1/4W	144568
			R4	RES MF 475 OHM 1% 1/4W	144509
			R5	RES MF 10 OHM 1% 1/4W	144553
			R6	RES MF 47.5K 1% 1/4W	144526
			R7	RES MF 475 OHM 1% 1/4W	144509
			R8	RES NET 10K X8 RES BUSSED	144253
			R9	RES NETWORK 9X-1-223	144238
			R10	RES MF 324 OHM 1% 1/4W	144597
			R12	RES MF 100 OHM 1% 1/4W	144568
			R13	RES MF 47.5K 1% 1/4W	144526
			R14	RES NETWORK 9X-1-223	144238
			R15	RES MF 1K 1% 1/4W	144513
			R16	RES MF 324 OHM 1% 1/4W	144597
			R17	RES MF 324 OHM 1% 1/4W	144597
			R18	RES MF 324 OHM 1% 1/4W	144597
			R19	RES MF 324 OHM 1% 1/4W	144597
			R20	RES MF 324 OHM 1% 1/4W	144597
			R22	RES MF 324 OHM 1% 1/4W	144597
			R21	RES MF 100K 1% 1/4W	144528
			R23	RES MF 100 OHM 1% 1/4W	144568
			R24	RES MF 100 OHM 1% 1/4W	144568
			R25	RES MF 100 OHM 1% 1/4W	144568
			R26	RES MF 221 OHM 1% 1/4W	144559
			R27	RES MF 100 OHM 1% 1/4W	144568

3 DISPLAY PCB 050330

C1	CAPELECT 10UF 50V	066445
C2	CAP MONO .1UF 50V 20% Z5U	061346
C3	CAPELECT 47UF 35V	066446
C4	CAP MONO .1UF 50V 20% Z5U	061346
C5	CAPELECT 10UF 50V	066445
C6	CAPELECT 47UF 16V	066380
C7	CAP MONO .1UF 50V 20% Z5U	061346
C8	CAP MONO .1UF 50V 20% Z5U	061346
C9	CAPELECT 10UF 50V	066445
C10	CAP MONO 220PF 200V 10% NPO	061342
C11	CAP MONO .1UF 50V 20% Z5U	061346
C12	CAP MONO 220PF 200V 10% NPO	061342
C13	CAP MONO 220PF 200V 10% NPO	061342
C14	CAP MPF 0.033UF 5% 63VDC	064318
C15	CAP MPF 0.033UF 5% 63VDC	064318
C16	CAP MPF 0.033UF 5% 63VDC	064318
C17	CAP MONO .1UF 50V 20% Z5U	061346
C18	CAP MPF 0.033UF 5% 63VDC	064318
C19	CAPELECT 22UF 100V	066574
C20	CAP MONO .1UF 50V 20% Z5U	061346
C21	CAPELECT 22UF 100V	066574
D1	DIODE SILICON	070174
D2	DIODE ZENER 6.2V 5% 500MW	070085
D3	DIODE SILICON	070174
D4	DIODE SILICON	070174

PARTS LIST *con't*

DISPLAY PCB 050330 (cont'd)

Ref No.	Description	Part No.	Ref No.	Description	Part No.
R28	RES MF 2.21K 1% 1/4W	144584	C13	CAP ELECT 10UF 50V	066445
R29	RES MF 1K 1% 1/4W	144513	C14	CAP ELECT 10UF 50V	066445
R30	RES MF 1K 1% 1/4W	144513	C15	CAP ELECT 10UF 50V	066445
R32	RES NETWORK 9X-1-223	144238	C16	CAP ELECT 10UF 50V	066445
R33	RES MF 100 OHM 1% 1/4W	144568	C17	CAP MONO .1UF 50V 20% Z5U	061346
R34	RES MF 100 OHM 1% 1/4W	144568	C18	CAP MONO .1UF 50V 20% Z5U	061346
R35	PC BD TONE	129629	C19	CAP MONO 1000PF 50V 10% NPO	061344
(R35)	POTEQUAL	134509	C20	CAP MONO .1UF 50V 20% Z5U	061346
(R35A)	CONN 4 PIN RIGHT ANGLE	117927	D1	DIODE SILICON	070174
(R35B)	CONN 4 PIN RIGHT ANGLE	117927	D2	DIODE SILICON	070174
(R35C)	CONN 4 PIN RIGHT ANGLE	117927	D3	DIODE SILICON	070174
(R35D)	CONN 4 PIN RIGHT ANGLE	117927	J1	CONN XLR FEM HORIZ PCB LATCH	117814
R39	RES MF 1M 1% 1/4W	144577	J2	CONN XLR FEM HORIZ PCB LATCH	117814
R43	RES MF 100K 1% 1/4W	144528	J3	CONN XLR FEM HORIZ PCB LATCH	117814
R44	RES MF 681 OHM 1% 1/4W	144567	J4	CONN XLR FEM HORIZ PCB LATCH	117814
R46	RES MF 681 OHM 1% 1/4W	144567	J5	RECEPTACLE XLR MALE	117686
R45	RES MF 100K 1% 1/4W	144528	J6	RECEPTACLE XLR MALE	117686
R47	RES MF 475 OHM 1% 1/4W	144509	J7	CONN FFC 18PIN	117765
R48	RES MF 475 OHM 1% 1/4W	144509	J8	CONN FFC 18PIN	117765
R40	RES MF 1M 1% 1/4W	144577	J9	JACK HEADPHONE DUAL BLACK 1/8	117825
R41	RES MF 1M 1% 1/4W	144577	J10	JACK HEADPHONE DUAL BLACK 1/8	117825
R42	RES MF 1M 1% 1/4W	144577	J11	CONN GOLD F RIGHT ANGLE	117661
S1	ENCODER OPTICAL ROTARY	146246	J12	JACK HEADPHONE DUAL BLACK 1/8	117825
S2	SWITCH ROT PULSE	146258	J13	JACK HEADPHONE DUAL BLACK 1/8	117825
S2	PC BD SWITCH	129294	J14	JACK HEADPHONE DUAL BLACK 1/8	117825
(S2)	CONN 3-PIN RIGHT ANGLE	117670	J15	JACK HEADPHONE DUAL BLACK 1/8	117825
U1	IC NOR 2 INPUT X 4	133176	J16	CONN FFC 18PIN	117765
U2	IC MICRO RESET POS	133241	K1	RELAY REED SPST-NO 5V 1.2A	087078
U3	IC CMOS EPROM	133249	K2	RELAY REED SPST-NO 5V 1.2A	087078
U4	IC PROGRAMMED V1.00 C220	133584	K3	RELAY REED SPST-NO 5V 1.2A	087078
U3	SOCKET IC 8-POS	178096	K4	RELAY REED SPST-NO 5V 1.2A	087078
U4	SOCKET IC 40-PIN	178133	K5	RELAY REED SPST-NO 5V 1.2A	087078
U6	IC SHFT REG SER-PAR	133186	K6	RELAY REED SPST-NO 5V 1.2A	087078
U8	IC DUAL OPERATIONAL AMPLIFIER	133260	K7	RELAY REED SPST-NO 5V 1.2A	087078
Y1	CERAMIC RESONATOR 12MHZ	180059	K8	RELAY REED SPST-NO 5V 1.2A	087078
Y2	RES MF 8.25K 1% 1/4W	144549	K9	RELAY REED SPST-NO 5V 1.2A	087078
Y2	RESONATOR CERAMIC 2.00MHZ	180064	K10	RELAY REED SPST-NO 5V 1.2A	087078
	ASSEMBLY INSERTION PCB DISPLAY	700139	PCB1	PC BD BAL/DATA	129628
	ASSY INSERTION PCB DISPLAY	701139	R1	RES MF 221 OHM 1% 1/4W	144559
	ASSY DISPLAY PCB SM PART	750360	R2	RES MF 221 OHM 1% 1/4W	144559
			R3	RES MF 221 OHM 1% 1/4W	144559
			R4	RES MF 221 OHM 1% 1/4W	144559
			R5	RES MF 100K 1% 1/4W	144528
			R6	RES MF 100K 1% 1/4W	144528
			R7	RES MF 267K 1% 1/4W	144532
			R8	RES MF 267K 1% 1/4W	144532
			R9	RES MF 267K 1% 1/4W	144532
			R10	RES MF 267K 1% 1/4W	144532
			R11	RES MF 267K 1% 1/4W	144532
			R12	RES MF 267K 1% 1/4W	144532
			R13	RES MF 267K 1% 1/4W	144532
			R14	RES MF 267K 1% 1/4W	144532
			R15	RES MF 267K 1% 1/4W	144532
			R16	RES MF 267K 1% 1/4W	144532
			R17	RES MF 267K 1% 1/4W	144532

4 BALANCED/DATA PCB 050331

C1	CAPELECT 10UF 50V	066445
C2	CAPELECT 10UF 50V	066445
C3	CAPELECT 10UF 50V	066445
C4	CAPELECT 10UF 50V	066445
C5	CAPELECT 10UF 50V	066445
C6	CAPELECT 10UF 50V	066445
C7	CAPELECT 10UF 50V	066445
C8	CAPELECT 10UF 50V	066445
C9	CAPELECT 10UF 50V	066445
C10	CAPELECT 10UF 50V	066445
C11	CAPELECT 10UF 50V	066445
C12	CAPELECT 10UF 50V	066445

***PARTS LIST** con't*

BALANCED/DATA PCB 050331 (cont'd)

Ref No.	Description
R18	RES MF 267K 1% 1/4W
R19	RES MF 10 OHM 1% 1/4W
R20	RES MF 182 OHM 1% 1/4W
R21	RES MF 182 OHM 1% 1/4W
R22	RES MF 182 OHM 1% 1/4W
R23	RES MF 182 OHM 1% 1/4W
R24	RES MF 182 OHM 1% 1/4W
R25	RES MF 182 OHM 1% 1/4W
R26	RES MF 182 OHM 1% 1/4W
R27	RES MF 182 OHM 1% 1/4W
R28	RES MF 10 OHM 1% 1/4W
R29	RES MF 100 OHM 1% 1/4W
R30	RES MF 100 OHM 1% 1/4W
R31	RES MF 100 OHM 1% 1/4W
R32	RES MF 100 OHM 1% 1/4W
R33	RES MF 100 OHM 1% 1/4W
R34	RES MF 100 OHM 1% 1/4W
R35	RES MF 100 OHM 1% 1/4W
R36	RES MF 100 OHM 1% 1/4W
R37	RES MF 1K 1% 1/4W
R38	RES MF 221 OHM 1% 1/4W
R39	RES MF 1K 1% 1/4W
R40	RES MF 1K 1% 1/4W
R41	RES MF 1K 1% 1/4W
R42	RES MF 40.2K 1% 1/4W
R43	RES MF 22.1K 1% 1/4W
U1	IC AND 2 INPUT X 4
U2	IC AND 2 INPUT X 4
U3	IC 8 LN DRIVER ARRAY
U4	IC SHFT REG SER-PAR
U5	IC OPERATIONAL AMPLIFIER
18574	ASSY INSERTION PCB BAL/DATA

	5	TONE PCB 129629 ?????	
Part No.	Ref No.	Description	Part No.
144532	1	PCB Part Number	129629
144553	2	LOGO	
144579	J1	CONN 4-PIN RIGHT ANGLE	117927
144579	J2	CONN 4-PIN RIGHT ANGLE	117927
144579	R1	Potentiometer	134457
144579			
144579	7	PUSHBUTTON PCB 050333	
144579	1	Pushbutton PCB	129630
144579	2	LOGO	
144579	DS1	LED SQUARE RED	58109
144553	DS2	LED SQUARE RED	58109
144568	DS3	LED SQUARE RED	58109
144568	DS4	LED SQUARE RED	58109
144568	DS5	LED SQUARE RED	58109
144568	DS6	LED SQUARE RED	58109
144568	DS7	LED SQUARE RED	58109
144568	J1	CONN FFC 18PIN	117765
144568	S1	SWITCH PB TACT	150058
144568	S2	SWITCH PB TACT	150058
144513	S3	SWITCH PB TACT	150058
144559	S4	SWITCH PB TACT	150058
144513	S5	SWITCH PB TACT	150058
144513	S6	SWITCH PB TACT	150058
144513	S7	SWITCH PB TACT	150058
144525	S8	SWITCH PB TACT	150058
144564			
133175			
133175	?	HEADPHONE PCB 050332	
133180	1	PCB Part Number	129634
133186	2	LOGO	
133189	J1	HEADPHONE JACK	117881
701140	J2	CONN 12 PIN FFC	117720

NOTES

REPACKING INSTRUCTIONS

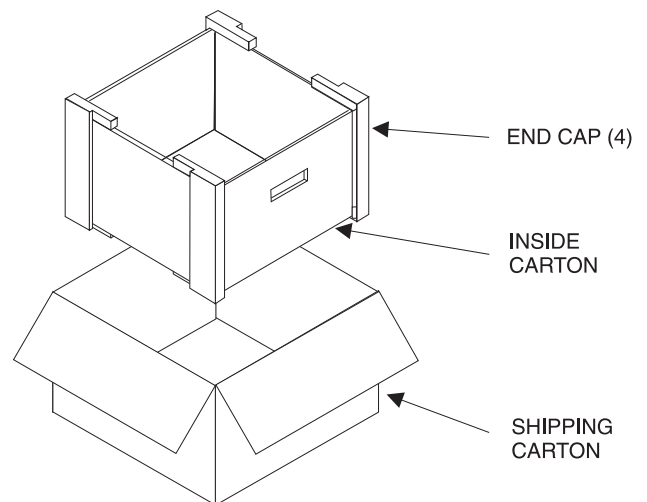
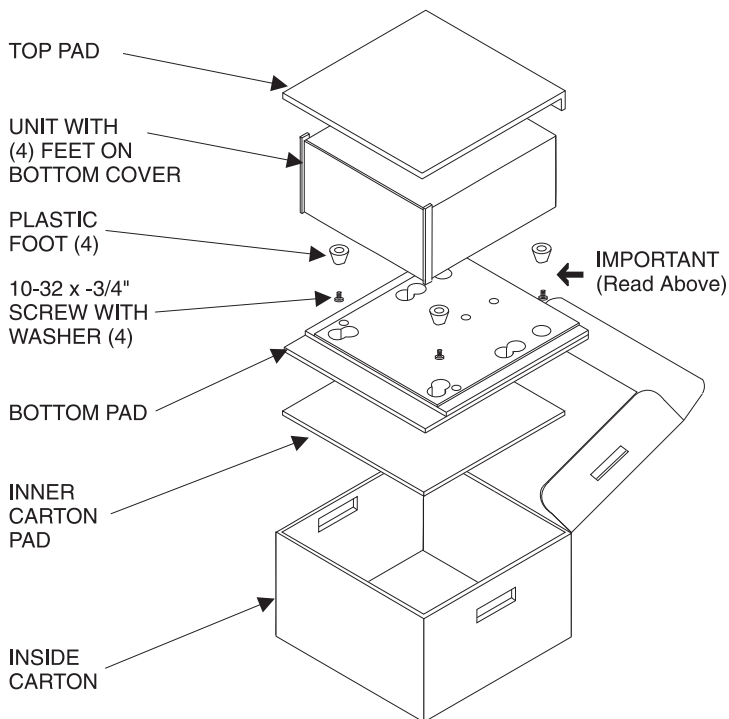
In the event it is necessary to repack the unit for shipment, the unit must be packed exactly as shown below.

IMPORTANT - The four plastic feet must be attached to the bottom of the unit so they will locate in the four holes of the bottom pad. Failure to do this will result in shipping damage.

If a shipping carton or any of the interior parts is needed, please call or write the Customer Service Department of McIntosh Laboratory. Order parts from the accompanying list by part number.

Use the original shipping carton and interior parts only if they are in good serviceable condition.

Qty.	Part No.	Description
1	033838	Shipping carton only
4	033837	Foam end cap
1	033836	Inside carton only
1	033725	Top pad
1	034301	Bottom pad
1	034037	Inner carton pad
4	017937	Plastic foot
4	100159	#10-32 x 3/4" Machine screw
4	104083	#10 x 7/16" Flat washer



C220

TUBE PREAMPLIFIER

SERIAL NO. WS1001 And Above



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