MAINTENANCE MANUAL
851-870 MHz, 100 WATT POWER AMPLIFIER
19D901841G2

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DESCRIPTION

The 800 MHz power amplifier assembly used in station applications uses five RF power transistors to provide a maximum of 100 watts output power. R11 on the Power Control Board (19D901803G3) provides adjustment of the output power over a 10 dB range (10W to 100W).

The power amplifier assembly consists of an RF board with all the amplifier stages and an output detector, a power control board, and an isolator.

Supply voltage from the system board is connected to TB1 and decoupled by C6.

CIRCUIT ANALYSIS

POWER AMPLIFIER

The exciter output (65-130 mW) is coupled to the amplifier input connector J1 by a 50 ohm coaxial cable. L1, C1, C2, and the base microstrip form the input matching circuit for Q1. Control voltage is applied to Q1 through a collector feed network consisting of C3, C4, and L3.

Interstage matching between Q1 and Q2 is provided by L4, L5, C6, C8, C9, and C10. Control voltage is applied to Q2 through a collector feed network consisting of Z1, C11-C13, and L7. The output of Q2 is matched to the input of Q3 by L8, L9, C30, C15, and the base microstrip.

Supply voltage for Q3 is applied through collector feed network Z2, C16-C18, and L11. The output of Q3 is matched to 50 ohms by microstrip W2. This output is applied to a Wilkinson divider consisting of microstrips W4 and W5. R1 provides isolation between the signal paths.

Input matching for Q4 and Q5 is provided by microstrips W8 and W9. Supply voltage is applied to Q4 and Q5 by collector feed networks Z3, Z4, C20-C25, L12, and L13. Microstrips W12 and W13 provide output matching.

The outputs of Q4 and Q5 are summed by a Wilkinson combiner consisting of W16, W17, and R3. The output of the combiner is connected to pin 1 of circulator U1.

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LBI-38134

A directional coupler, W19, and detector CR1 provide a voltage, proportional to the power out, to the power control.

WARNING

The RF Power Transistors used in the transmitter contain Beryllium Oxide, a TOXIC substance. If the ceramic, or other encapsulation is opened, crushed, broken, or abraded, the dust may be hazardous if inhaled. Use care in replacing transistors of this type.

NOTE

This amplifier is not field repairable. Should service become necessary, the complete power amplifier assembly must be returned to the factory for servicing.

POWER CONTROL

On the Power Control Board, the voltage from the detector is compared to a stable DC reference voltage in a high gain comparator, U2A. The comparator drives a DC amplifier, Q4 and pass transistor Q6 that supplies control voltage to the RF board.

Thermistor RT1 is connected to the PA heatsink and, by controlling the operation of Q2 and Q3, provides a power cut-back for ambient temperatures that exceed 70 degrees centigrade. Conduction of Q3 gradually decreases the power set voltage applied to Q4. The DC reference voltage is provided by Q1, U3, R17-19, and C5.

In other special applications of this power control board, U2-B, CR1, and Q5 provide a low power alarm. U1 is used to select one of four individually adjustable power levels.

R1, R4, R7, and R10 are factory adjusted values.

851-870 MHZ 100 WATT POWER AMPLIFIER 19D901841G2

SYMBOL	PARTS NO.	DESCRIPTION
A1		**POWER AMPLIFIER BOARD 19D901807G3**
		— — — CAPACITORS — — —
C1	19A702232P12	Ceramic: 9.1 pF ±5%, 50 VDCW.
C2	19A705108P13	Mica Chip: 10 pF ±5%, 500 VDCW, temp coef 0 + 200 PPM/°C.
C3	19A702232P31	Ceramic: 56 pF ±5%, 50 VDCW.
C4	19A702250P113	Polyester: 0.1 µF ±10%, 50 VDCW.
C6	19A702232P3	Ceramic: 3.9 pF ±.25 pF, 50 VDCW.
C7	19A702232P31	Ceramic: 56 pF ±5%, 50 VDCW.
C8	19A705108P13	Mica Chip: 10 pF ±5%, 500 VDCW, temp coef 0 + 200 PPM/°C.
C9 and C10	19A705108P13	Mica Chip: 10 pF ±5%, 500 VDCW, temp coef 0 + 200 PPM/°C.
C11	19A702232P31	Ceramic: 56 pF ±5%, 50 VDCW.
C12	19A702250P113	Polyester: 0.1 µF ±10%, 50 VDCW.
C13	19A701534P6	Tantalum: 4.7 µF ±20%, 35 VDCW.
C14	19A702232P31	Ceramic: 56 pF ±5%, 50 VDCW.
C15	19A705108P9	Mica: 6.8 pF ±.25 pF, 500 VDCW.
C16	19A705108P25	Mica Chip: 33 pF ±5%, 500 VDCW, temp coef 0 + 50 PPM/°C.
C17	19A702250P113	Polyester: 0.1 µF ±10%, 50 VDCW.
C18	19A701534P6	Tantalum: 4.7 µF ±20%, 35 VDCW.
C19	19A702232P31	Ceramic: 56 pF ±5%, 50 VDCW.
C20 and C21	19A705108P25	Mica Chip: 33 pF ±5%, 500 VDCW, temp coef 0 + 50 PPM/C.
C22	19A701534P6	Tantalum: 4.7 µF ±20%, 35 VDCW.
C23 and C24	19A702250P113	Polyester: 0.1 µF ±10%, 50 VDCW.
C25	19A701534P6	Tantalum: 4.7 µF ±20%, 35 VDCW.
C26 and C27	19A702232P31	Ceramic: 56 pF ±5%, 50 VDCW.
C28	19A702232P21	Ceramic: 22 pF ±5%, 50 VDCW.
C29	19A702232P1	Ceramic: 3.3 pF ±.25 pF, 50 VDCW.
C30	19A705108P8	Mica: 6.2 pF ±.25 pF, 500 VDCW.
C31 thru C35	19A705108P25	Mica Chip: 33 pF ±5%, 500 VDCW, temp coef 0 + 50 PPM/°C.
		— — — — DIODES — — — —
CR1 and CR2	19A700047P3	Silicon: 100 mW; sim to 1N6263.
		— — — — JACKS — — — — —
J1	19A700049P2	Connector, receptacle; 500 VDCW maximum; sim to NTTF-1058.
J2		Part of Circulator U1.
J3	19A704852P32	Printed wire, two part: 6 contacts, sim to Molex 22-29-2061.
J4 and J5	19A134263P1	Contact, electrical: sim to Selectro 229-1082-00-0-590.

* COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

SYMBOL	PARTS NO.	DESCRIPTION
		— — — INDUCTORS — — — —
L1		Part of printed wire board.
L2	19A701091G1	Coil.
L3	19A701091G1	Coil.
L4	19A701006P7	Strap.
L5		Part of printed wire board.
L6	19A701091G1	Coil.
L7	19A136533P2	Coil.
L8 and L9		Part of printed wire board.
L10	19A701091G1	Coil.
L11 thru L13	19A136533P2	Coil.
		— — — TRANSISTORS — — — —
Q1	19A703479P1	N Channel, field effect. sim to RF 2060.
Q2	19A703480P4	Silicon, NPN: Sim to MRF-891.
Q3	19A705125P1	Silicon, NPN: Sim to MRF-895.
Q4 and Q5	19A705125P2	Silicon, NPN: Sim to MRF-898.
		— — — RESISTORS — — — —
R1	19A700111P39	Composition: 100 ohms ± 5%, 2 w.
R2	19A700106P32	Composition: 51 ohms ± 5%, 1/4 w.
R3	19A143832P1	Power: 100 ohms ±5%, 75 w.
R4	19A700113P55	Composition: 470 ohms ± 5%, 1/2 w.
R5	H212CRP247C	Deposited carbon: 4.7K ohms ±5%, 1/4 w.
R6	H212CRP310C	Deposited carbon: 10K ohms ±5%, 1/4 w.
R7	19A700106P55	Composition: 470 ohms ± 5%, 1/4 w.
R8	19B800607P101	Metal film: 100 ohms ±5%, 1/8 w.
		— INTEGRATED CIRCUITS — —
U1	19B802097P2	Circulator: 120 watts.
		— — — — CABLES — — — — —
W1 thru W20		Part of printed wire board.
		— — — — FILTER — — — — —
Z1 thru Z4	19A701092G1	Filter.
	19B801426P2	Support plate.
	19B801426P1	Support plate.
A2		**POWER CONTROL BOARD 19D901803G3**
		— — — CAPACITORS — — — —
C1	19A700233P9	Ceramic: 2200 pF ±20%, 50 VDCW.
C2*	T644ACP322K	Polyester: 0.022 µF, ±10%, 50 VDCW.

SYMBOL	PARTS NO.	DESCRIPTION
C3 and C4	19A700233P9	Ceramic: 2200 pF ±20%, 50 VDCW.
C5	T644ACP310K	Polyester: .010 µF ±10%, 50 VDCW.
C6	19A701534P6	Tantalum: 4.7 µF ±20%, 35 VDCW.
C7	19A701624P12	Ceramic, disc: 15 pF ±5%, 500 VDCW, temp coef 0 PPM ±30.
C8	19A702250P113	Polyester: 0.1 µF ±10%, 50 VDCW.
C9 thru C12	19A701624P12	Ceramic, disc: 15 pF ±5%, 500 VDCW, temp coef 0 PPM ±30.
C13	19A700233P6	Ceramic: 680 pF ±20%, 50 VDCW.
		— — — — DIODES — — — — —
CR1	19A700028P1	Silicon: 75 mA, 75 PIV; sim to 1N4148.
		— — — — — JACKS — — — — —
J1	19A704852P31	Connector: 5 contacts; sim to Molex 22-29-2051.
J2	19A704852P32	Printed wire, two part: 6 contacts, sim to Molex 22-29-2061.
J3	19A700072P1	Printed wire: 2 contacts rated @ 2.5 amps; sim to Molex 22-03-2021.
		— — — TRANSISTORS — — —
Q1	19A700023P2	Silicon, NPN: sim to 2N3904.
Q2 and Q3	19A700022P2	Silicon, PNP: sim to 2N3906.
Q4 and Q5	19A700023P2	Silicon, NPN: sim to 2N3904.
Q6	19A700055P1	Silicon, PNP. (Included with Heat Sink Assembly 19B801427G4).
Q7 and Q8	19A700023P2	Silicon, NPN: sim to 2N3904.
		— — — — RESISTORS — — — —
R1	19A134248P4	Variable, cermet, 4 turns: 25K ohms ±10%, 1/2 w; sim to Bourns 3339P-1-253.
R2	19B800779P10	Variable: 10K ohms ±25%, 100 VDCW, .3 watt.
R3	H212CRP210C	Deposited carbon: 1K ohms ±5%, 1/4 w.
R4	19A134248P4	Variable, cermet, 4 turns: 25K ohms ±10%,1/2 w; sim to Bourns 3339P-1-253.
R5	19B800779P10	Variable: 10K ohms ±25%, 100 VDCW, .3 watt.
R6	H212CRP210C	Deposited carbon: 1K ohms ±5%, 1/4 w.
R7	19A134248P4	Variable, cermet, 4 turns: 25K ohms ±10%, 1/2 w; sim to Bourns 3339P-1-253.
R8	19B800779P10	Variable: 10K ohms ±25%, 100 VDCW, .3 watt.
R9	H212CRP210C	Deposited carbon: 1K ohms ±5%, 1/4 w.
R10	19A134248P4	Variable, cermet, 4 turns: 25K ohms ±10%, 1/2 w; sim to Bourns 3339P-1-253.
R11	19B800779P10	Variable: 10K ohms ±25%, 100 VDCW, .3 watt.
R12	H212CRP210C	Deposited carbon: 1K ohms ±5%, 1/4 w.
R13 and R14	H212CRP310C	Deposited carbon: 10K ohms ±5%, 1/4 w.
R15	H212CRP415C	Deposited carbon: 0.15M ohms ±5%, 1/4 w.

SYMBOL	PARTS NO.	DESCRIPTION
R16	H212CRP368C	Deposited carbon: 68K ohms ±5%, 1/4 w.
R17	19A701250P239	Metal film: 2490 ohms ±1%, 250 VDCW, 1/4 watt.
R18	19A701250P295	Metal film: 9.53K ohms ±1%, 1/4 w.
R19	H212CRP168C	Deposited carbon: 680 ohms ±5%, 1/4 w.
R20 and R21	H212CRP310C	Deposited carbon: 10K ohms ±5%, 1/4 w.
R22	H212CRP247C	Deposited carbon: 4.7K ohms ±5%, 1/4 w.
R23	H212CRP222C	Deposited carbon: 2.2K ohms ±5%, 1/4 w.
R24	H212CRP310C	Deposited carbon: 10K ohms ±5%, 1/4 w.
R25	H212CRP233C	Deposited carbon: 3.3K ohms ±5%, 1/4 w.
R26	H212CRP239C	Deposited carbon: 3.9K ohms ±5%, 1/4 w.
R27	H212CRP218C	Deposited carbon: 1.8K ohms ±5%, 1/4 w.
R28	H212CRP256C	Deposited carbon: 5.6K ohms ±5%, 1/4 w.
R29	H212CRP227C	Deposited carbon: 2.7K ohms ±5%, 1/4 w.
R30	H212CRP268C	Deposited carbon: 6.8K ohms ±5%, 1/4 w.
R31	H212CRP210C	Deposited carbon: 1K ohms ±5%, 1/4 w.
R32	H212CRP147C	Deposited carbon: 470 ohms ±5%, 1/4 w.
R33	19A143832P	Power: 50 ohms ±5%, 150 watts. (Used with A3).
R34	H212CRP439C	Deposited carbon: 0.39M ±5%, 1/4 w.
R35	H212CRP347C	Deposited carbon: 47K ohms ±5%, 1/4 w.
		— — — THERMISTOR — — — —
RT1	19A702176G2	Thermistor: 40K ohms ±20%.
		— INTEGRATED CIRCUITS — —
U1	19A700029P36	Digital: Single 8-Channel Multiplexer; sim to 4051B.
U2	19A701789P2	Linear: Dual Op Amp; sim to LM358.
U3	19A702939P2	Linear: Adjustable Shunt Regulator; sim to TL431CLP.
		— — MISCELLANEOUS — — —
	19A702364P305	Machine screw: TORX DRIVE, M3-.5 x 5.
	19B801427G4	Heat Sink Assembly. Includes Q6 and:
	19A700115P3	Insulator, plate.
	19A700068P1	Insularor, bushing.
	19B801428G3	Heat Sink.
	N404P11B6	Lockwasher; internal: No. 4.
	N402P5B6	Washer: narrow, steel.
	N80P9005B6	Machine screw: pan head, steel.
A3		**PRINTED WIRE BOARD**
		— — — — CABLES — — — — —
W1	19A705075P1	Cable.
W2	19B801431P3	Cable.
W3	19C851528G1	Cable. (Includes Feed-thru Plate, connector P1 and associated hardware).

Continued

SYMBOL	PARTS NO.	DESCRIPTION
	19B226212G5	Heat Sink. (Mounts on Plate, Qty of 1).
	NP280071	Nameplate. (CAUTION).
	19B209103P410	Tap screw, hex head: No. 8-32 x 5/8. (Secures Heat Sink to plate).
	19B201074P308	Tap screw, Phillips POZIDRIV: No. 6-32 x 1/2. (Used with A1, Q4, Q5 and ground strap).
	19B209103P306	Tap screw, hex head: No. 6-32 x 3/8. (Secures frame to plate).
	N403P13B6	Lockwasher: No. 6. (Used with ground strap).
	N81P9012	Machine screw, recessed pan: No. 4-40 x 3/4.
	N414P11	Lockwasher, internal tooth: No. 4. (Used with Circulator).
	N44P9006B6	Machine screw, fillister head. (Secures Q2-Q5).
	N405P5B6	Lockwasher. (Used with Q2-Q5, R3 and R33).
	5492178P2	Washer, spring tension: sim to Wallace Barnes 375-20. (Used with Q1).
	19A148323P1	Heat Sink. (Used with Q1).
	N210P15B6	Nut, hex: No. 8-32. (Used with Q1).
	N402P8B6	Flatwasher, steel: No. 8. (Used with Q1).
	19C851552P1	Guide. (Used around potentiometers on A2).
	19B201074P320	Tap screw, Phillips POZIDRIV: No. 6-32 x 1-1/4. (Secures A2 Q6 Heat Sink).
	19A705329P1	Temperature indicator: sim to Tempil Division of Big Three Industries Cat. No. BU-175/79. (Attached to A1 Q4).
	19A116552P3	Cable clip: sim to Richco KKC-4. (Supports W3).
	19A705097G1	Support. (Used with input connector J1).
	N80P13004B6	Screw, machine: Pan head; No. 6-32 x 1/4". (Secures support).
	19D438235G7	Fan Assembly, 24 Vdc.
	19A701863P13	Cable clip. (Secures fan assembly wiring).
	7141225P2	Nut, Hex: 4-40. (Secures cable clip).
	N80P13006B6	Machine screw: Pan head, Phillips; No. 8-32 x 3/8"
	N404P13B6	Lockwasher, internal tooth: No. 6.
	N402P7B6	Flatwasher, narrow: No. 6.
	7141225P3	Hex Nut: No. 6-32.
	N80P9005B6	Machine screw, pan head, steel, No. 4-40UNC x 5/16".
	N402P5B6	Washer: narrow, steel.
	N404P11B6	Lockwasher, internal tooth, No. 4.

PRODUCTION CHANGES

Changes in the equipment to improve performance or to simplify circuits are identified by a "Revision Letter" which is stamped after the model number of the unit. The revision stamped on the unit includes all previous revisions. Refer to the Parts List for the descriptions of parts affected by these revisions.

REV. A - POWER AMPLIFIER 19D901807G3

To allow maximum power transfer from the exciter, changed C2 and L4, deleted R6 and added R7.

C2 was 19A705108P15 Mica: 12pF ±5%, 500 VDCW.
L4 was 19A701006P6 Strap.
R6 was H212CRP310C Deposited carbon: 10K ±5%, 1/4 w.

REV. B - POWER AMPLIFIER 19D901807G3

To improve power cutoff when no RF is present at the input. Changed R5 and added R6.

R5 was H212CRP318C Deposited carbon: 18K ±5%, 1/4 w.

REV. C - POWER AMPLIFIER 19D901807G3

To improve stability, added R8.

REV. A - POWER CONTROL BOARD 19D901803G3

To allow alarming of a low or missing drive level to the Power Amplifier, changed R15, R16, R35 and Q8. Changed R34 and relocated as shown below. Also changed R1, R4, R7 and R10 from a 1 turn potentiometer to a 4 turn potentiometer.

R1 is 19A134248P4 - Variable, cermet, 4 turns: 25K ohms ±10%, 1/2 w; sim to Bourns 3339P-1-253.

R4 is 19A134248P4 - Variable, cermet, 4 turns: 25K ohms ±10%, 1/2 w; sim to Bourns 3339-1-253.

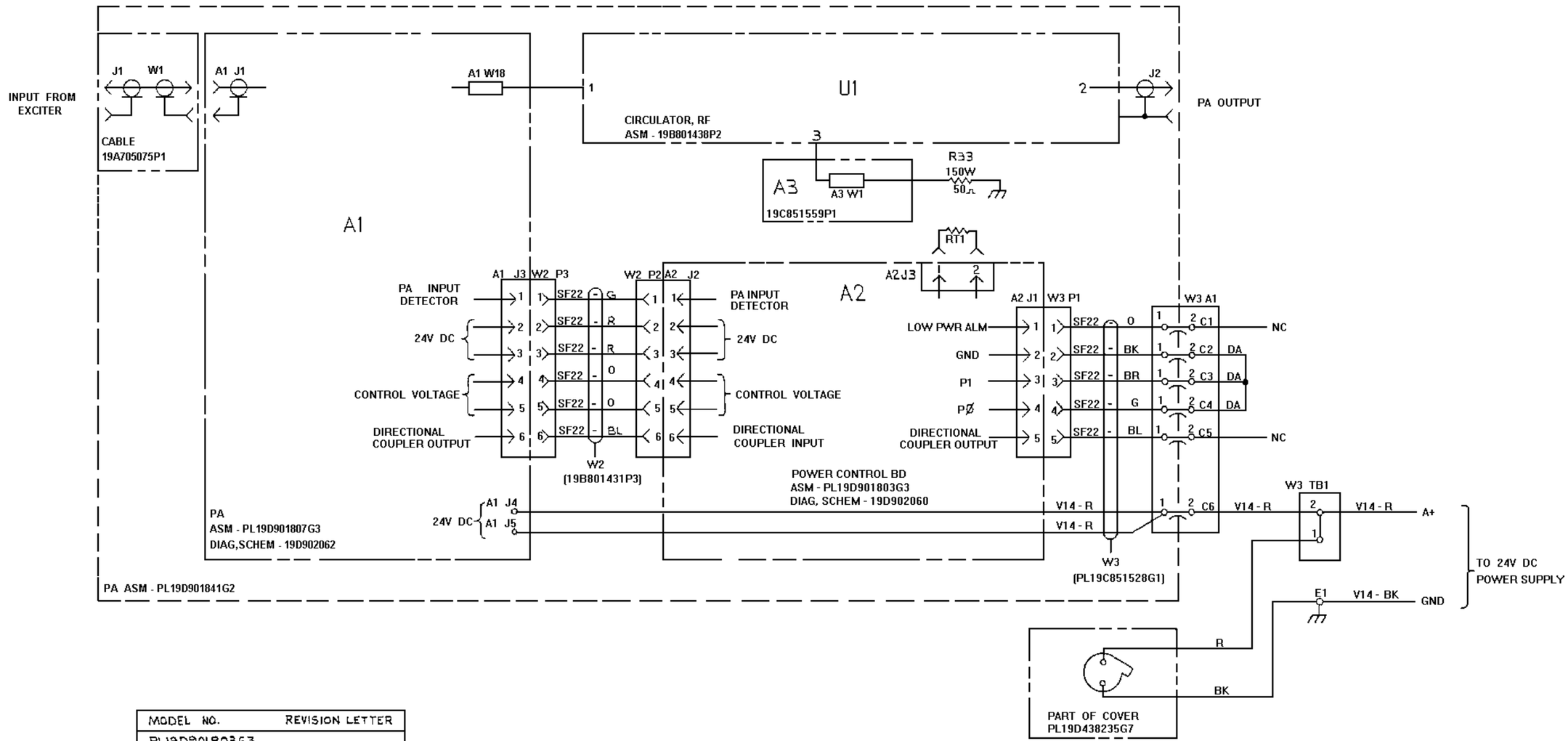
R7 is 19A134248P4 - Variable, cermet, 4 turns: 25K ohms ±10%, 1/2 w; sim to Bourns 3339P-253.

R10 is 19A134248P4 - Variable, cermet, 4 turns: 25K ohms ±10%, 1/2 w; sim to Bourns 3339P-1-253.

R15 is H212CRP415C - Deposited carbon: .15M ohms ±5%, 1/4 w.
R16 is H212CRP368C - Deposited carbon: 68K ohms ±5%, 1/4 w.
R34 is H212CRP439C - Deposited carbon: .39M ohms ±5%, 1/4 w.
R35 is H212CRP347C - Deposited carbon: 47K ohms ±5%, 1/4 w.
Q8 is 19A700023P2 - Silicon, NPN: sim to 2N3904.

REV. B - POWER CONTROL BOARD 19D901803G3

To reduce transmit rise time of power amplifier to prevent overshoot.
C2 was (19A700233P9.) Ceramic 2200 pF.

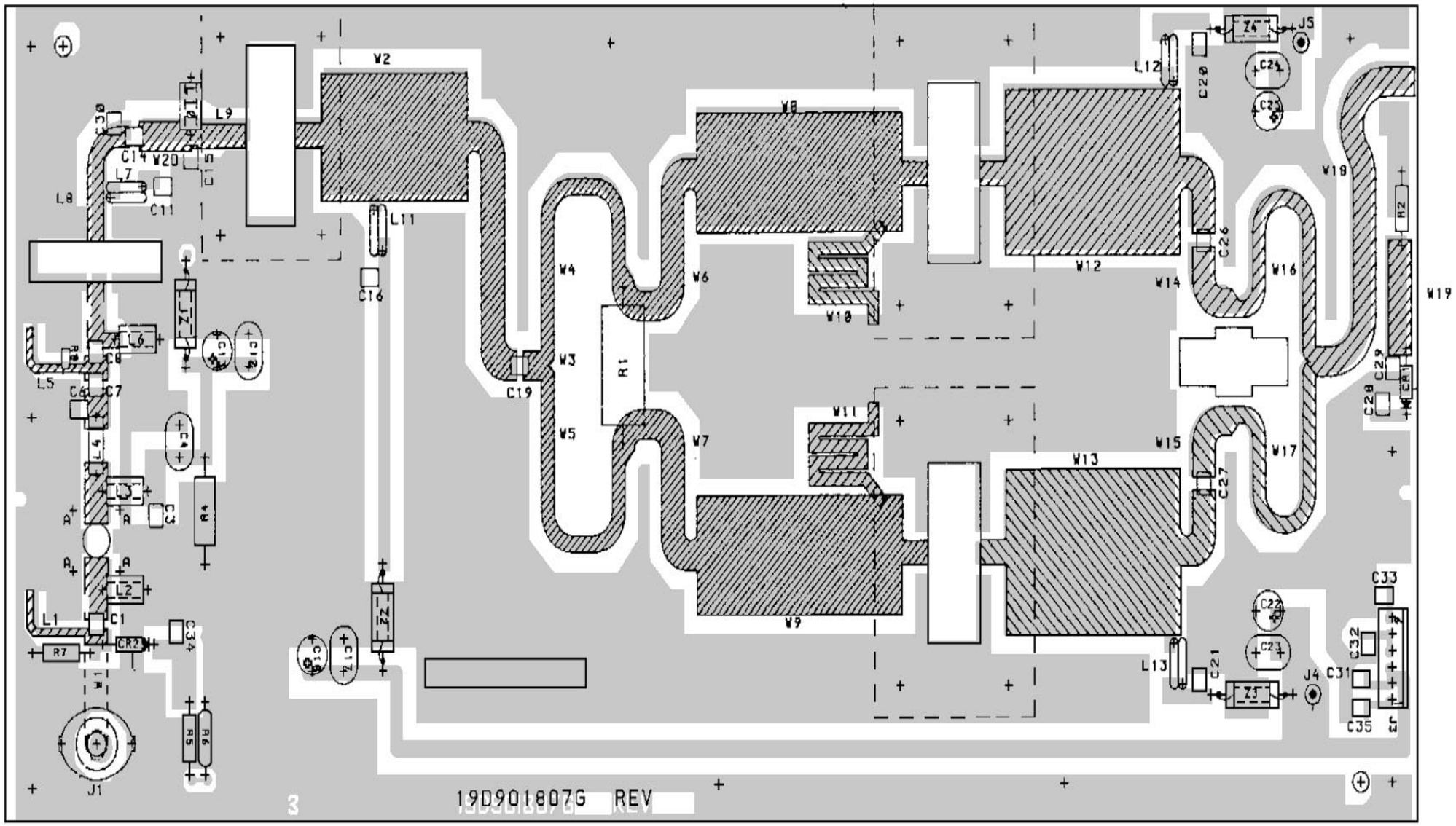


MODEL NO.	REVISION LETTER
PL19D901803G3	
PL19D901807G3	A
PL19D901841G2	

POWER AMPLIFIER
19D901841G2

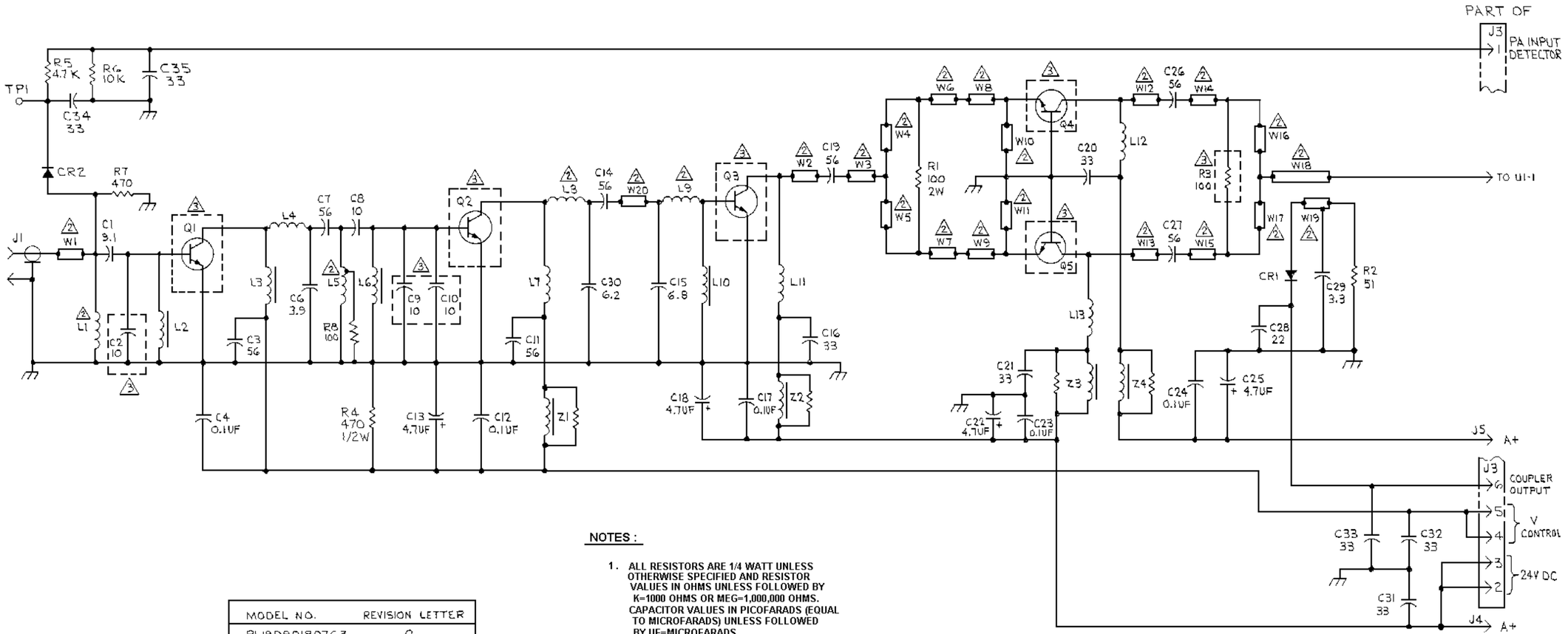
(19D902064, Sh. 1, Rev. 1)

COMPONENT SIDE



POWER AMPLIFIER
19D901807G3

(19D901807, Sh. 2, Rev. 6)
(19D705468, Sh. 1, Rev. 3)
(19A705468, Sh. 2, Rev. 1)



MODEL NO.	REVISION LETTER
PL19D901807G3	C

NOTES :

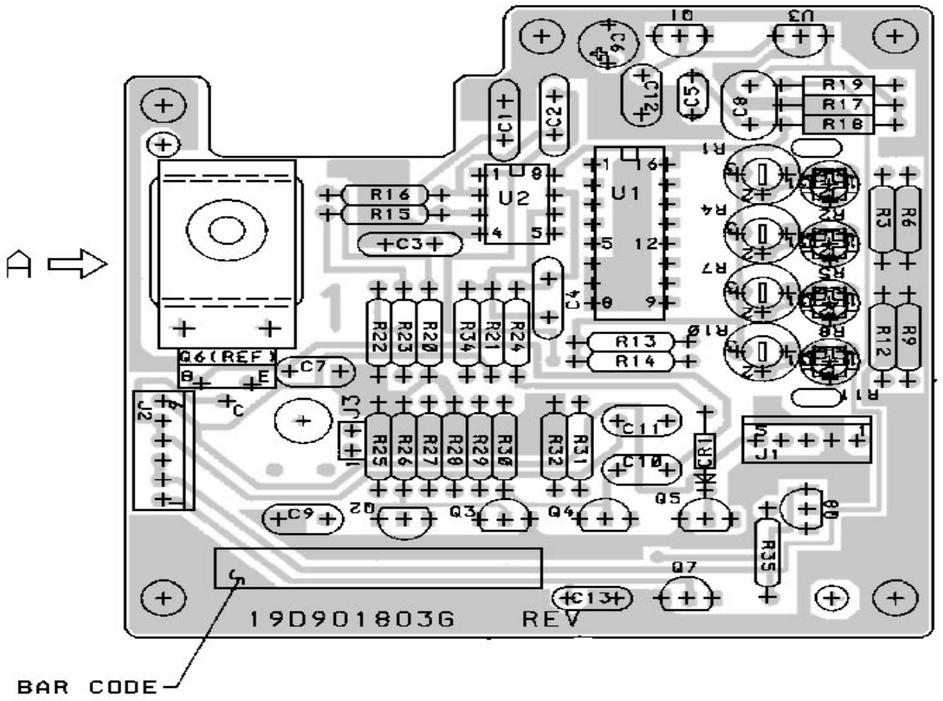
1. ALL RESISTORS ARE 1/4 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K=1000 OHMS OR MEG=1,000,000 OHMS. CAPACITOR VALUES IN PICOFARADS (EQUAL TO MICROFARADS) UNLESS FOLLOWED BY UF=MICROFARADS.

(2) PART OF PWB.
(3) PART OF NEXT HIGHER ASM.

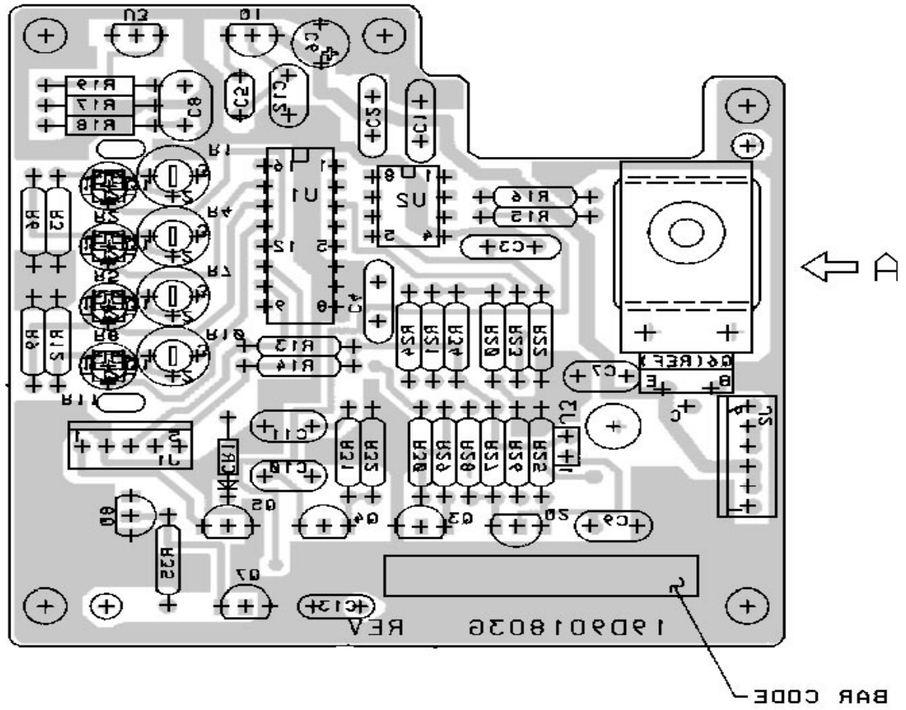
POWER AMPLIFIER
19D901807G3

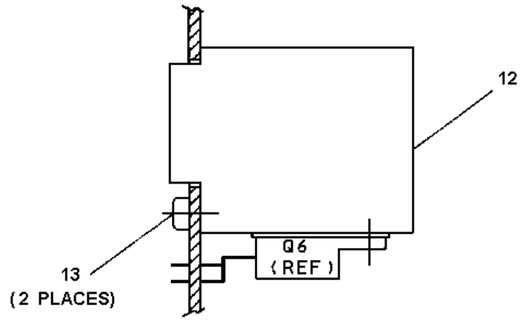
(19D902062, Rev. 4)

COMPONENT SIDE

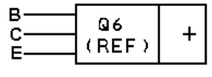


SOLDER SIDE

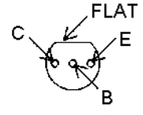




VIEW "A"



LEAD IDENTIFICATION
FOR Q1-Q5,Q7 AND Q8

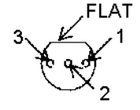


IN - LINE

TOP VIEW

NOTE: CASE SHAPE IS DETERMINING FACTOR FOR LEAD IDENTIFICATION.

LEAD IDENTIFICATION
FOR U3



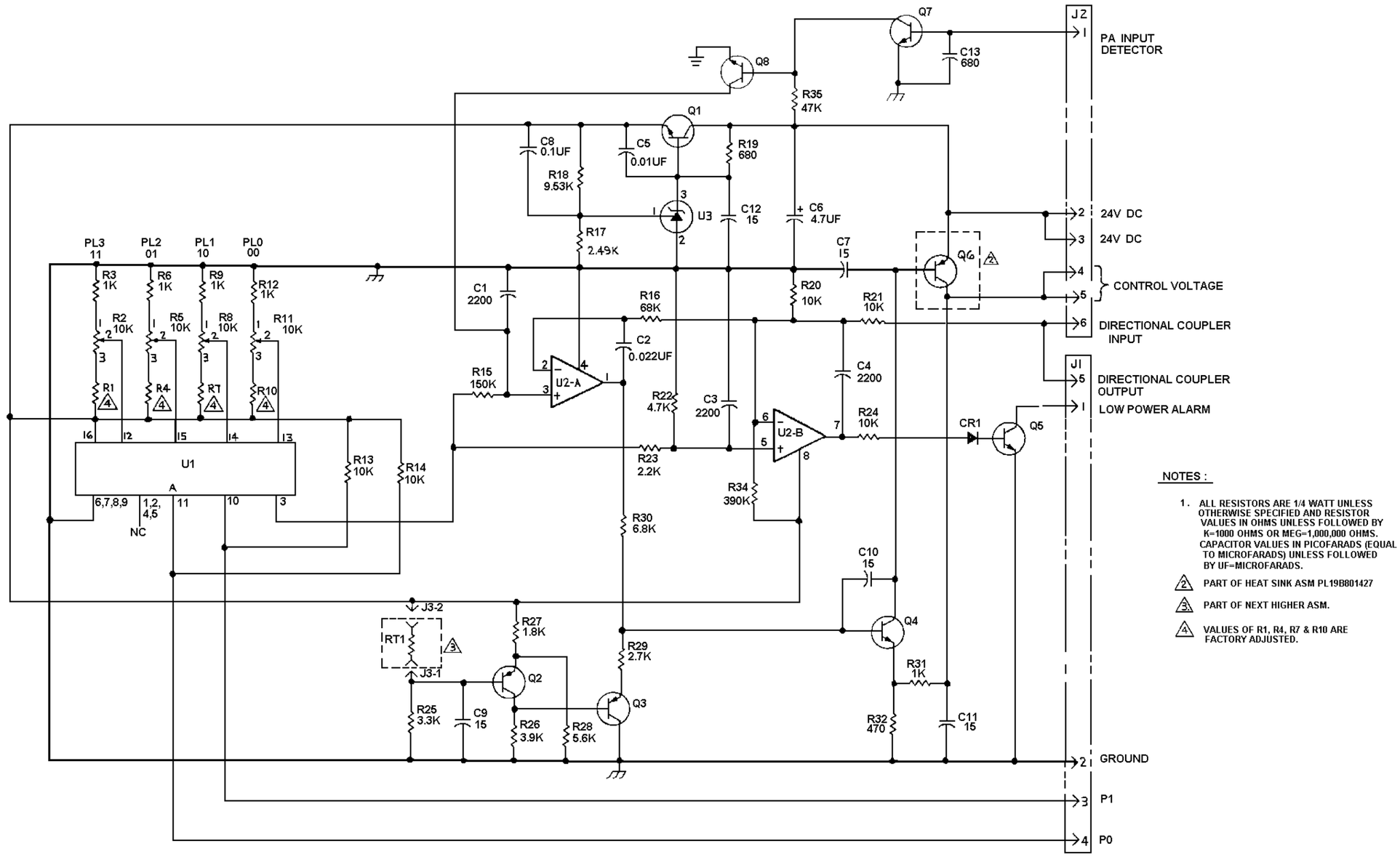
IN - LINE

TOP VIEW

NOTE: CASE SHAPE IS DETERMINING FACTOR FOR LEAD IDENTIFICATION.

POWER CONTROL BOARD
19D901803G3

(19D901803, Sh. 1, Rev. 1)
(19D902059, Component Side, Rev. 1)
(19D902059, Solder Side, Rev. 1)



NOTES :

1. ALL RESISTORS ARE 1/4 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K=1000 OHMS OR MEG=1,000,000 OHMS. CAPACITOR VALUES IN PICOFARADS (EQUAL TO MICROFARADS) UNLESS FOLLOWED BY UF=MICROFARADS.

2. PART OF HEAT SINK ASM PL19B801427

3. PART OF NEXT HIGHER ASM.

4. VALUES OF R1, R4, R7 & R10 ARE FACTORY ADJUSTED.

POWER CONTROL BOARD
19D901803G3

(19D902060, Sh. 1, Rev. 2)

MODEL NO.	REVISION LETTER
PL19D901803G3	B

LBI-38134

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