LIGHTHOUSE ELECTRIC

Analog & Digital ELECTRONICS **60-100W PA KIT ASSEMBLY MANUAL**

PO Box 44
Oracle, AZ 85623

Web site: www.lh-electric.net
Email: lh-electric@gmx.net

CIRCUIT DESCRIPTION
This amplifier circuit is a stable, proven design, implementing a quasi-complementary output stage topology. This version features short-circuit protection and a Baxandall diode (D7) for improved linearity. The input of the amplifier consists of a differential voltage amplifier (Q1, Q2) with a constant current source (Q3). The BIAS transistor (Q5) is mounted on a common heat sink with the output transistors for effective temperature tracking. Short circuit and overload protection is implemented by limiting the driver and output transistors current.

Specifications:

Frequency Response: 5Hz - 60kHz (-3dB)
Low Distortion THD 0.1% (1kHz at 60 Watt)
Signal to Noise Ratio S/N 90dB (shorted input)
Input Sensitivity: 775mV
Input Impedance: 20 kOhm
Output Impedance: 4-15 Ohms

Construction

Warning: Supplied solder contains lead, which is poisonous! Do not eat while assembly. Wash hands immediately after soldering is finished.
Start PCB assembly with low profile parts like jumper wires, resistors and diodes. Three small jumpers have to be installed on the PCB. Do not install more than 4-6 resistors at a time, for easier soldering. Cut off the ends and install the next batch. Since the PCB was manufactured, the specifications for Q4 and Q5 have changed. Use the Fig.4 “TRANSISTOR TYPES AND INSTALLATION GUIDE” below as placement guide. To install Q4, bent the center lead (collector) forward. Do not overheat diodes or other solid state components while soldering. Next install the plastic-film capacitors, then the electrolytic capacitors. Make sure the polarity of the electrolytic capacitors is correct. Install TR1 trim-pot as shown on the PCB, set-screw towards PCB center. Finally install the rest of the components. Q5 transistor will be mounted later on a common heat-sink with the output transistors. However, do not install it on the heat-sink yet. Use the supplied three lead flat cable to make the connection between the PCB and Q5 as shown in Fig.3 Observe correct transistor connections. Insulate the joints with silicone sealant. Solder in temporary a jumper into the input terminals. Carefully inspect the assembled PCB for any errors. Supplied solder contains organic flux, which can be cleaned off with water. To give a nice shiny look brush the solder side under hot water stream. Finally rinse off both PCB sides under hot water. Shake off excess water and set aside to dry. To speed-up drying time, use a hair dryer.

Set-Up and Initial Testing Procedure:
After the board is completely dry, make a visual inspection. Look for missed solder joints, possible solder shorts, wrong polarity of diodes, electrolytic capacitors etc. Let Q5 rest on the side of the PCB, not touching anything.
The output transistors Q10, Q11 must not be connected to the PCB yet.
Next, a power supply, with minimum +/- 15 Volts and 1 Amp current will be needed. If it is not available, then the designated amplifier PSU must be build first (Fig.1). Connect the plus and minus supply leads, in series with a 1 Amp AGC (quick blow) fuse, to 'B+' and 'B-' on the PCB respectively. Connect the zero (GND) lead to 'GND' on the PCB.

NOTE: Q8 and Q9 heat-sinks and mounting screws are not isolated and carry full B+ and B- rail voltages.
Make sure these screws are not making contact with ground or any bus voltage.

The trim-pot 'TR1' must be set fully clockwise (CW), requires several turns to do it. Measure resistance between R14 and R16, closest to TR1. Measured TR1 resistance if set fully CW should read about 1000 Ohms (1k).
NOTE: TR1 trim pot does not have end positions in order to avoid damage.
Make sure the board is somewhat secured, so it won't move when tested. Switch your multi-meter to 50 or 100 VDC. Connect the COM lead to 'GND'. Now turn the power on and measure B+ and B- rail voltages, directly on the board. If one or both voltages are missing, turn off power immediately. There is a wiring error present and one or both fuses are blown. Otherwise measure the output voltage at the 'OUT' point (where R24 and R25 join). There will be some voltage between + 5V and -5V present. Now turn the trim pot slowly counter-clockwise. After a few turns, the voltage at 'OUT' should change towards zero. As soon as zero volts is reached, stop turning. The board is now pre-set. At this point, the final assembly can be made. Turn off power and let the PSU capacitors discharge. Install the power-transistors on a heat sink, large enough to dissipate the rated output power. Make sure the pad and screw insulators are installed. Measure resistance between transistor (metal body) and heat-sink (GND). Meter should read very high resistance (open). Make the PCB connections with 18GA or larger wire. To prevent any feedback or oscillations, do not make the wires longer than necessary.

Install Q5 transistor on the same heat sink, possibly between the two power transistors. Use the supplied small clamp, and silicon paste to make a good heat transfer. Alternatively a MJ182 transistor (TO-126) may be supplied as Q5. Mount it using the supplied mica insulator.

Final Calibration:
This final calibration is to be made after all amplifier components are installed in a cabinet and the project is nearly finished. Again, make a visual inspection. Make sure all power supply connections are correct, the fuse is still 1A AGC. Check the power-transistor connections. Short the input terminals. Connect your multimeter to the B+ fuse-holder terminals, positive (red) probe on the power-supply side. Switch the meter to 10 Amps DC. Turn on the power. Now, remove the fuse from the fuse holder. The multimeter should indicate less than 1A (if any) current flow, otherwise turn off power immediately. Look for wiring errors. If the test was successful, switch you meter to 0.5 or 1 Amp DC. Adjust BIAS current with the TR1 trim-pot to 0.1A (100mA). Turn CCW to increase, CW to decrease. After 5 minutes re-adjust. Let it warm-up for 30 minutes and re-adjust again.
This finalizes the calibration procedure. Turn off the power and replace the fuses with correct values. Remove the shorting jumper from the input. Speakers are connected between amplifier “OUT” and power supply GND (0V). Do not connect to PCB ground. The amp is ready for operation.

PSU (not supplied):

Power supply is strait forward, as seen here. The output power depends on the rail DC supply voltages.
+/- 27 Volts will deliver 60 Watts RMS and +/- 34 Volts 100 Watts. C1, C2, C4 and C5 are the filter capacitors and C3 and C6 are noise by-pass capacitors. R1 and R2 are bleeding resistors.

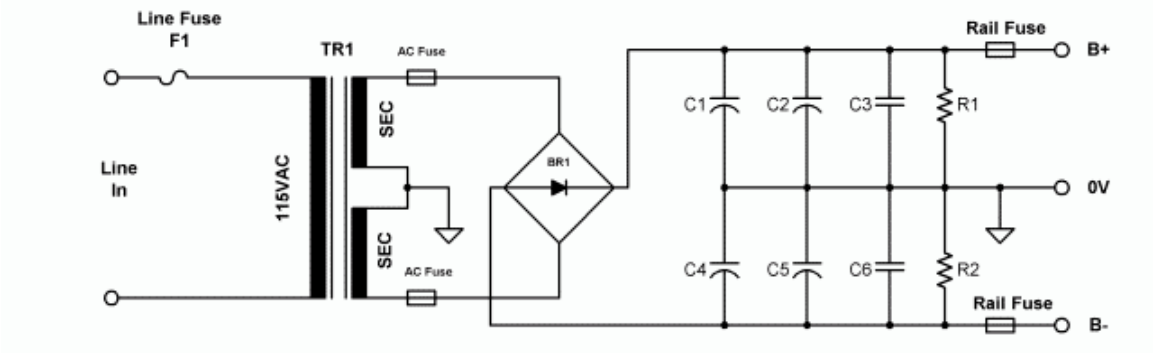


Fig.1 Power Supply Schematic

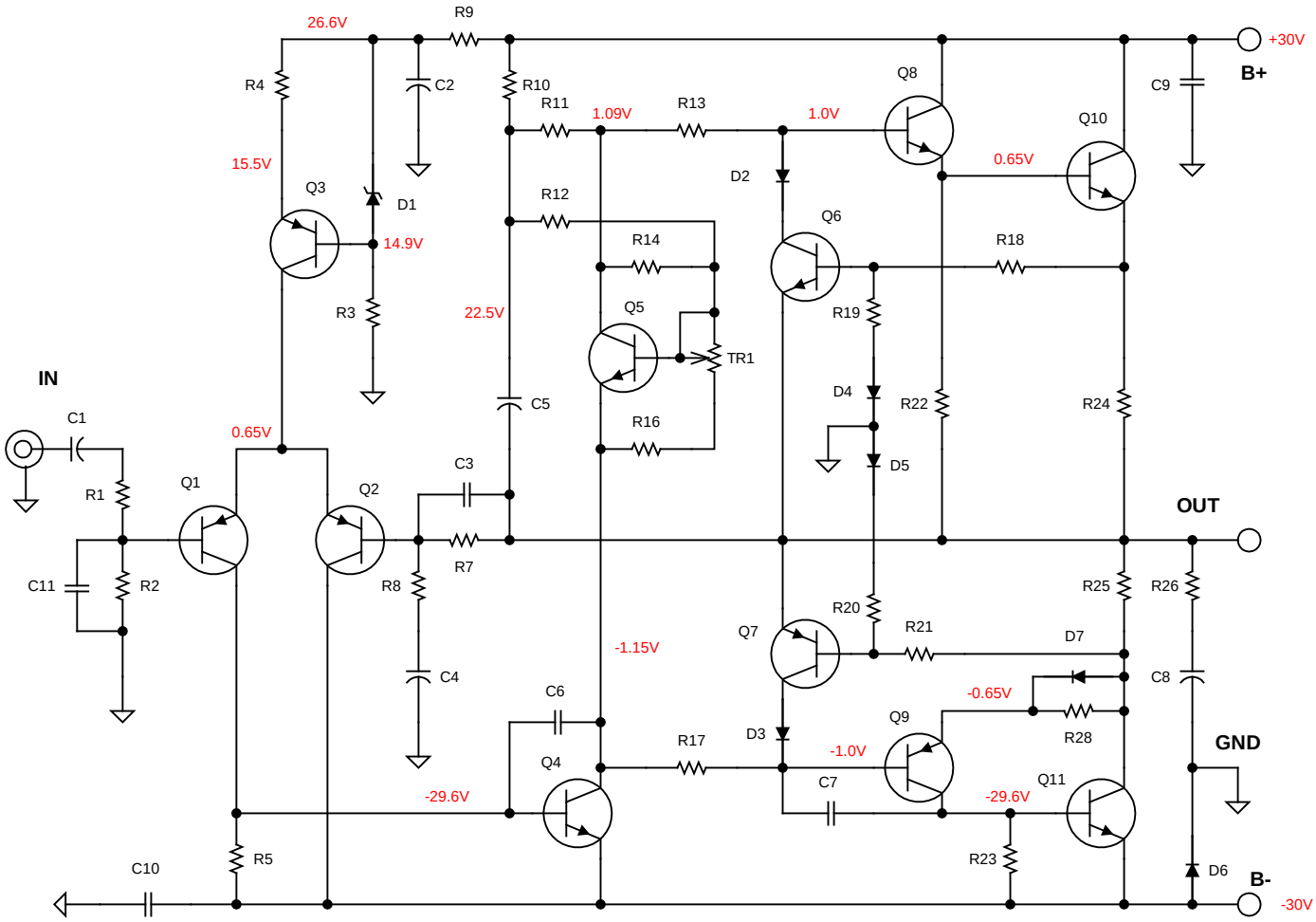
Power Supply Parts List:

Up to 60 Watts:
Transformer AC Secondary Voltage 44VAC CT (2 x 22VAC) 1.7A
Rectifier Bridge BR1 100V 4A
C1, C2, C4, C5 = 3300uF/35V, alternatively C1, C4 (omit C2, C5) = 6800uF/35V
R1, R2 = 3.3k/0.5W
C3, C6 = 0.1uF/100V
Line Fuse =1A MDL Rail Fuses =2 A MDL

Up to 100 Watts:
Transformer AC Secondary Voltage 56VAC CT (2 x 28VAC) 2.2A
Rectifier Bridge BR1 200V 5A
C1, C2, C4, C5 =4700uF/50V, alternatively C1, C4 (omit C2, C5) =8200uF/50V
R1, R2 = 4.7k/0.5W
C3, C6 = 0.1uF/100V
Line Fuse = 1A MDL Rail Fuses = 2.5 A MDL

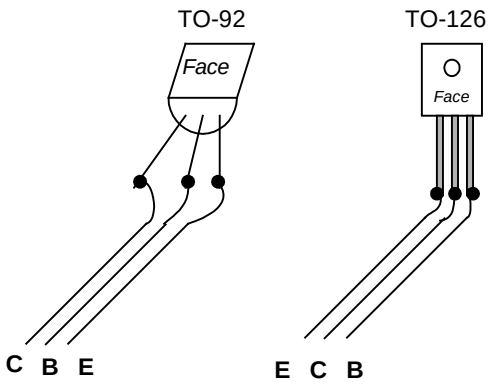
NOTE: For Stereo operation, double the transformer and fuse current ratings.
Bridge rectifier and capacitor specifications are minimum ratings. These components may be substituted with higher ratings.

Fig.2 Power Amplifier Schematic:

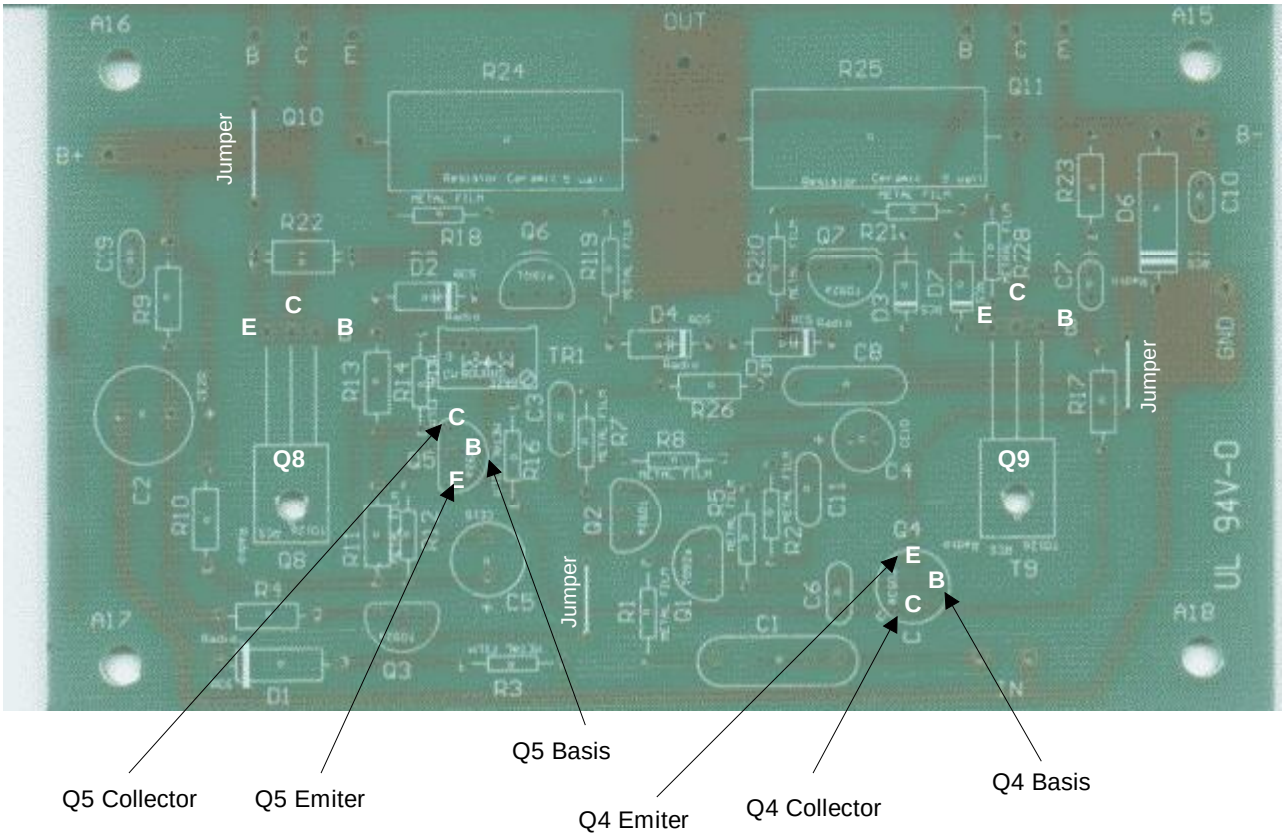


ALL VOLTAGES SHOWN ARE BASED ON +/- 30V RAIL VOLTAGE MEASURED TO GND

Fig.3
Q5 three wire connection for TO-92 or TO-126 transistor cases.



Transistor Types and Installation Guide



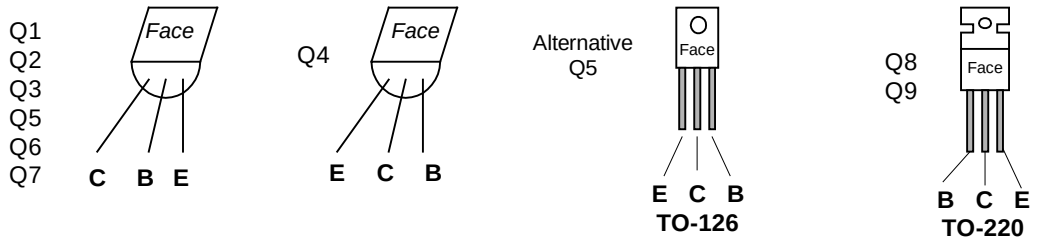


Fig.4

PA COMPONENTS			
SYMBOL	DESCRIPTION	COLORS	QUANTITY
R1, R10	1k Resistor 5% 0.25W	brn-blk-red-gold	2
R2	47k Resistor 5% 0.25W	yel-purp-org-gold	1
R3	4.7k Resistor 5% 0.25W	yel-purp-red-gold	1
R4	5.6k Resistor 5% 0.25W	grn-blue-red-gold	1
R5, R9	680R Resistor 5% 0.25W	blue-gry-brn-gold	2
R6, R27	not used		
R7	22k Resistor 5% 0.25W	red-red-org-gold	1
R8, R14	2.2k Resistor 5% 0.25W	red-red-red-gold	2
R11	2.7k Resistor 5% 0.25W	red-purp-red-gold	1
R12	150k Resistor 5% 0.25W	brn-grn-yel-gold	1
R13, R17	330R Resistor 5% 0.25W	org-org-brn-gold	2
R16	510R Resistor 5% 0.25W	grn-brn-brn-gold	1
R18, R21	180R Resistor 5% 0.25W	brn-gry-brn-gold	2
R19, R20	1.2k Resistor 5% 0.25W	brn-red-red-gold	2
R22, R23, R28	100R Resistor 5% 0.25W	brn-blk-brn-gold	3
R24, R25	0.33 Resistor 5% 5W	na	2
R26	15R Resistor 5% 0.25W	brn-grn-blk-gold	1
SYMBOL	DESCRIPTION	CODE	QUANTITY
C1	2.2uF/50V Non-polarized	na	1
C2	220uF/50V cap radial	na	1
C3, C11	22pF/50V cap ceramic	22	2
C4, C5	100uF/50V cap radial	na	2
C6	100pF/50 cap ceramic	101	1
C7	220pF/50V cap ceramic	221	1
C8	0.1uF/100V cap film	104	1
C9, C10	0.1uF/100V cap ceramic	104	2
Q1, Q2, Q3, Q7	BC 556 PNP transistor	na	4
Q4	BC639 or C2383 NPN	na	1
Q5	MJE182 or BC546 NPN	na	1
Q6	BC546 NPN transistor	na	1
Q8	TIP31C NPN transistor	na	1
Q9	TIP32C PNP transistor	na	1
Q10, Q11	2N3773 or TIP35 NPN	na	2
D1	1N5242B Zener 12V 0.5W	na	1
D2, D3, D4, D5	1N4148 Diode	na	4
D6	2A05 Diode 200V 3A	or equivalent	1
D7	FR152 or UF4002 Diode	or equivalent	1
TR1	1K trimpot	T93YA-1K	1
na	Heat Sink Thermalloy	577202B00	2