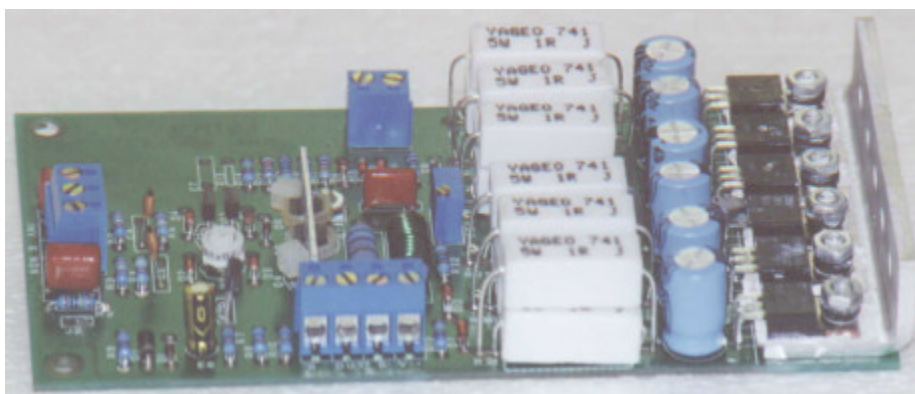


Marchand Electronics Inc.

PO Box 473, Webster, NY 14580
Tel:(716) 872-0980 Fax:(716) 872-1960
info@marchandelec.com http://www.marchandelec.com
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PM124 Installation Instructions



General

The PM124 is a power amplifier module capable of driving an 8 Ohm or 4 Ohm load. It has a differential input, but can also be used with a single ended input. The amplifier needs an external dual voltage DC power supply and must be bolted onto a heatsink.

Input

The input is differential. There is a 3-position terminal block on the circuit board, labeled INV-GND-NON. These are the inverting input, the ground terminal and the Non Inverting inputs. These should be hooked to the signal source. For single ended input, choose GND and either INV or NON INV. The unused terminal MUST be grounded to the GND terminal.

The inputs are AC or DC coupled. For DC coupling, install two shorting blocks on the 4-pin header near the input. For AC coupling remove the shorting blocks.

Output

Connect the load to the two terminals labeled OUT-GND on the 4-position terminal block. The PM124 is designed for loads of 4 Ohm or 8 Ohm. Maximum output power depends on the value of the load and the power supply voltage. With a 8 Ohm load and a power supply voltage

of +/- 65 Volt, an output power of 200W RMS can be achieved. In a 4 Ohm load the max power will be 200 Watt using a 45 Volt power supply.

Power Supply

A regulated or unregulated dual power supply of nominally +/- 50 Volt should be connected to the terminals V-- GND of the 4-position terminal block and terminals V++ GND of the 3-position terminal block. Use stranded insulated hookup wire of 22 gauge or thicker. The minimum supply voltage is +/- 25V, and the maximum value is +/- 75 V. A higher value than 75V may damage the amplifier. The current capability of the power supply depends on the load and the voltage. For a 40 volt supply and an 8Ohm load, a rating of 2.5 Amp on each side is recommended.

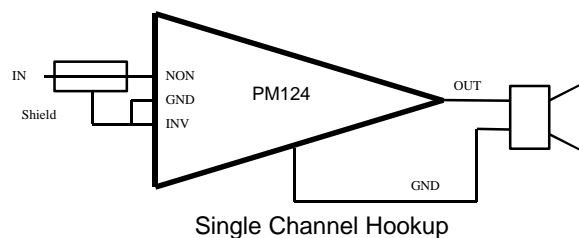


Figure 1

See important note about revisions of this board on the last page.

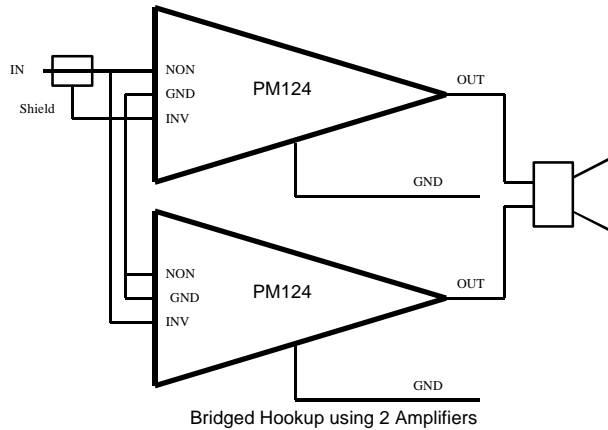


Figure 2

Heat sink

The PM124 should be bolted onto a heat sink of sufficient size to keep the amplifier cool. (see Figure 6) Use of a thermal cutout mounted on the heatsink is recommended. Use a Normally Closed thermal switch of 5A and 70°C rating. Install this switch in the AC line going to the power transformer.

Bias current

The PM124 operates in class AB. The bias current can be set with potentiometer R34. A bias current of ~ 100 mA, when cold, is normal. The bias current can be observed with an Amp-Meter in the power supply, or by measuring the voltage across R31. See the section "Bias Current Adjustment". The voltage between the two testpoints will be 16 mV for a bias current of 100 mA. The bias current will increase or decrease slightly when the amplifier is warm. This is normal

PM124 Parts List

ID	Value	Description
Resistors		
R1	1.00M	1% ,1/4W, Metal Film
R2	1.00M	1%, 1/4W, Metal Film
R3	24.9K	1%, 1/4W, Metal Film
R4	499K	1%, 1/4W, Metal Film
R5	24.9K	1%, 1/4W, Metal Film
R6	499K	1%, 1/4W, Metal Film
R7	1.50K	1%, 1/4W, Metal Film
R8	154Ohm	1%, 1/4W, Metal Film
R9	100K	1%, 1/4W, Metal Film

R10	154Ohm	1%, 1/4W, Metal Film
R11	1.00M	1%, 1/4W, Metal Film
R12	1.00M	1%, 1/4W, Metal Film
R13	-----	not used
R14	1.00M	1%, 1/4W, Metal Film
R15	4.22K	1%, 1/4W, Metal Film
R16	154Ohm	1%, 1/4W, Metal Film
R17	4.22K	1%, 1/4W, Metal Film
R24	5.6 Ohm	2W
R25	5.6 Ohm	2W
R18	49.9 Ohm	1%, 1/4W, Metal Film
R19	49.9 Ohm	1%, 1/4W, Metal Film
R20	49.9 Ohm	1%, 1/4W, Metal Film
R21	49.9 Ohm	1%, 1/4W, Metal Film
R22	49.9 Ohm	1%, 1/4W, Metal Film
R23	49.9 Ohm	1%, 1/4W, Metal Film
R26a	1.0 Ohm	5W Wirewound
R26b	1.0 Ohm	5W Wirewound
R27a	1.0 Ohm	5W Wirewound
R27b	1.0 Ohm	5W Wirewound
R28a	1.0 Ohm	5W Wirewound
R28b	1.0 Ohm	5W Wirewound
R29a	1.0 Ohm	5W Wirewound
R29b	1.0 Ohm	5W Wirewound
R30a	1.0 Ohm	5W Wirewound
R30b	1.0 Ohm	5W Wirewound
R31a	1.0 Ohm	5W Wirewound
R31b	1.0 Ohm	5W Wirewound
R32	1.50K	1% ,1/4W, Metal Film
R33	100 Ohm	Trimmer Potentiometer
R34	10 KOhm	Trimmer Potentiometer
R35	154Ohm	1% ,1/4W, Metal Film

Capacitors

C1	1uF	Stacked Film
C2	1uF	Stacked Film
C3	1pF	Ceramic NPO
C4	1pF	Ceramic NPO
C5	-----	not used
C6	10uf, 50v	Aluminum Electrolytic
C7	-----	not used
C8	.22uF, 100V	Stacked Film
C9	47uF, 100V	Aluminum Electrolytic
C10	47uF, 100V	Aluminum Electrolytic
C11	47uF, 100V	Aluminum Electrolytic
C12	47uF, 100V	Aluminum Electrolytic
C13	47uF, 100V	Aluminum Electrolytic
C14	47uF, 100V	Aluminum Electrolytic
C15	.22uF, 100V	Stacked Film

Diodes

D1	1N5232	5.6 Volt Zener Diode
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D2	1N4148	Signal Diode			
D3	1N4148	Signal Diode	2	1uF	Stacked Film
D4	1N4148	Signal Diode	2	1pF	NPO Ceramic
D5	1N4148	Signal Diode	2	.22uF, 100V	Stacked Film
D6	1N5232B	5.6 Volt Zener Diode	1	10uf, 50v	Aluminum Electrolytic
D7	1N5232B	5.6 Volt Zener Diode	6	47uF, 100V	Aluminum Electrolytic
D8	1N5232B	5.6 Volt Zener Diode			
D9	1N4148	Signal Diode			
D10	1N4148	Signal Diode			
D11	HER102	High Efficiency Diode			
D12	1N4148	Signal Diode	8	1N4148	Signal Diode
D13	1N4148	Signal Diode	4	1N5232B	5.6 Volt Zener Diode
			1	HER102	High Efficiency Diode

* UFR102 may be substituted for HER102

Diodes

Transistors

Transistors

Q1*	ZVNL120A	N-Channel SS MOSFET
Q2*	ZVNL120A	N-Channel SS MOSFET
Q3	ZVNL120A	N-Channel SS MOSFET
Q4	ZVNL120A	N-Channel SS MOSFET
Q5	ZVNL120A	N-Channel SS MOSFET
Q6	ZVP2120A	P-Channel SS MOSFET
Q7	ZVP2120A	P-Channel SS MOSFET
Q8	ZVNL120A	N-Channel SS MOSFET
Q9	IRF640	N-Channel Power MOSFET
Q10	IRF640	N-Channel Power MOSFET
Q11	IRF640	N-Channel Power MOSFET
Q12	IRF9640	P-Channel Power MOSFET
Q13	IRF9640	P-Channel Power MOSFET
Q14	IRF9640	P-Channel Power MOSFET

*NOTE Q1,Q2 come as a matched pair

The PM124 kits contains the following parts:

Qu.	Value	Description
Resistors		
6	49.9 Ohm	1%, 1/4W, Metal Film
4	154 Ohm	1%, 1/4W, Metal Film
2	1.50K	1%, 1/4W, Metal Film
2	4.22K	1%, 1/4W, Metal Film
2	24.9K	1%, 1/4W, Metal Film
1	100K	1%, 1/4W, Metal Film
2	499K	1%, 1/4W, Metal Film
5	1.00M	1%, 1/4W, Metal Film
1	100 Ohm	Trimmer Potentiometer
1	10 KOhm	Multiturn Trimmer Potentiometer
12	1.0 Ohm	5W Wirewound
2	5.6 Ohm	2W Power Resistor

Capacitors

1pair	ZVNL120A	N-Channel SS MOSFET
4	ZVNL120A	N-Channel SS MOSFET
2	ZVP2120A	P-Channel SS MOSFET
3	IRF640	N-Channel Power MOSFET
3	IRF9640	P-Channel Power MOSFET

Mechanical

Quantity	Description
1'	20 gauge magnet wire
1	2 Pos. Terminal block
1	3 Pos. Terminal block
1	4 Pos. Terminal block
6	TO220 Insulator
6	TO220 plastic washer
6	#4 fiber washer
8	4/40x1/2" Machine Screw
8	4/40 Nut
6	#4 split lockwasher
1	Heat Sink Bracket
1	TO92 heatsink
2	3" cable tie
1	Bag Heat Sink Compound
1	Tube Silicone Glue
1	PM124 circuit board
2	2 pin header
2	shorting block

Assembly Instructions

Most parts are installed in the usual way. Insert the part at the location on the circuit board as indicated by the silk screen identification and solder on the solder side of the board. Start with installing smaller parts and install large parts last. This makes installation easiest. The circuit board has plated through holes, so parts need only be soldered on the solder side of the

board. **NOTE:** do **NOT** install transistor Q8 till last and follow the special installation instructions below. Do **NOT** install R25 before reading the section on inductor below.

Resistors: The 1% metal film resistors are identified with colored bands in the usual way. The 1% Metal film resistors have the following markings:

49.9 Ohm	Yellow-White-White-Gold--Brown
150 Ohm	Brown- Green -Black-Black--Brown
1.50 K	Brown-Green-Black-Brown--Brown
4.22 K	Yellow-Red-Red-Brown--Brown
24.9 K	Red-Yellow-White-Red--Brown
100 K	Brown-Black-Black-Orange--Brown
499 K	Yellow-White-White -Orange-Brown
1.00 M	Brown-Black-Black-Yellow--Brown

When placing resistors it is recommended to check each value with a DMM. The six power resistors R26 .. R31 are installed in pairs. Each location holds two resistors, mounted one on top of the other. When installing the power resistors leave a gap of about 0.1" between the body of the resistor and the circuit board and between the two resistors of each pair. This will improve the cooling of the resistors. The small resistors can be installed flush with the circuit board.

The multiturn trimmer resistor R34 should be installed as shown in Figure 3.

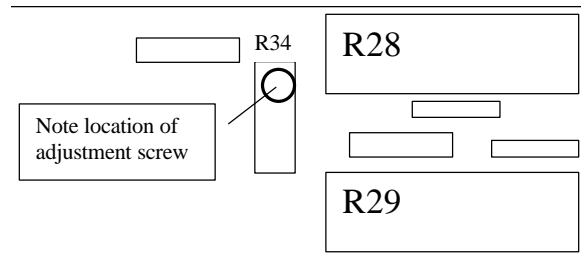


Figure 3 Orientation of R34. This is important.

Capacitors: The Electrolytic capacitors are all radial type. Be **sure** to observe polarity markings when installing. The stacked film capacitors are brown and have marking 224 for .22 uF and 105 for the 1 uF part.

Inductor: The inductor L1 is made up with 10 turns of 20 gauge magnet wire on resistor R25. Install as usual. Carefully wind the wire tightly around the 2W power resistors. Strip the ends of the magnet wire and solder to the resistor leads.

Diodes: Diodes D1 ... D13 are installed in the usual way. Make sure to observe polarity: the

band indicated on the circuit board must coincide with the band on the device.

Transistors: Transistors Q1,2,3,4,6,7 and are the small black parts with the three leads. Note that the black part has a big flat side and a round side. Note that Q1 and Q2 come as a matched pair in a separate bag. Make sure to use these in the locations Q1 and Q2. Install the transistors according to the marking on the circuit board. Make **sure** there is no mistake here.

Transistors Q4,5,6,7 are mounted on a small heatsink. Install the heatsink onto the circuit board using a 4/40 screw and nut as shown in Figure 4. Mount the transistors so that the body of the each is between two of the three holes in the heatsink. After soldering the transistors attach them to the heatsink with some silicone glue and a cable tie. The cable tie goes through the holes on each side and around both transistors, securing them firmly to the heatsink.

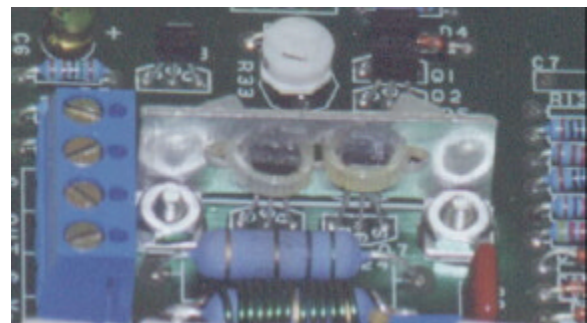


Figure 4

Power transistors Q9 through Q14 are installed onto the heat-sink bracket. Use the insulating wafers between the transistors and the heat-sink bracket.

Apply a thin uniform layer of the white silicone compound on both sides of the insulating wafers before installing. Install the transistors with the 4/40 screws, plastic washer, fiber washer, split lockwasher and nut. See Figure 5. Orient the screws so that the head of the screw is on the solder side and the nut is on the component side. The black plastic shoulder washer fits between the transistor tab and the nut. It serves to isolate the transistor from the mounting screw. Solder the three transistor pins only after all the mounting screws have been tightened.

Header: Install the two 2-pin next to R1 and R2. The two jumper blocks are installed onto the

header. Remove these for AC coupling. Leave for DC coupling.

Terminal Blocks: Install the 2-pin 3-pin and 4-pin terminal blocks at the edge of the circuit board. The 4-pin terminal block is made by joining two 2-pin terminal blocks together.

Q8 (do this last !!): This transistor senses the temperature of the output transistors. It is glued to transistor Q12. Insert transistor Q8 in the designated holes near transistor Q12. Leave the leads long, do **not** cut them at this point. Bend the leads of Q8 90 degrees so that the body of Q8 rests onto the leads of the power transistor Q12. Holding the transistor in place solder the leads of Q8. Now apply a generous amount of silicone glue between the two transistors.

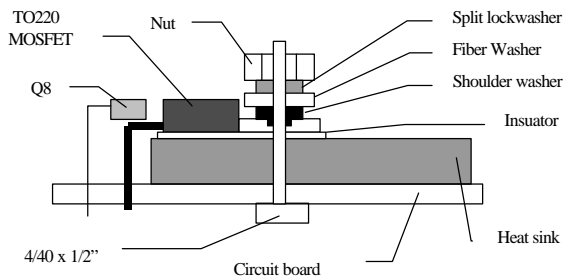


Figure 5 Mounting of power transistors.

Assembly is now complete. Take a few minutes to check all components and orientations. Also make sure there are no solder bridges.

Bias current adjustment (Class AB) .

The bias current of the amplifier must be adjusted by setting the potentiometer R34. First turn the potentiometer fully counterclockwise. This will set the bias current to zero. Hook the PM124 to a bipolar power supply. The supply voltage should be between +/- 30V and +/- 60 V. For doing this step it is best to use a 30V supply. This lower voltage will reduce chance of damage to the parts if there is an error in the installation of the parts. It is best to mount the PM124 onto a large heatsink during testing. Connect a DVM or suitable voltmeter between the leads of power resistor R31. If the DMM indicates a voltage of more than a few mV turn the power off **immediately** and check all parts placements. A very safe way to do this step is to use a variac to increase the power supply voltage slowly from zero to about 30V, while

observing the DMM. Now slowly adjust R34 clockwise until a reading of 15 mV is shown on the DMM. Precise adjustment is difficult. But a value between 10 mV and 20 mV is acceptable. Note that the unit will start heating up a little. The adjustment should be made when cold. When the amplifier is hot, the bias current will change a little. This is normal.

Bias current adjustment (Class A) .

For operation in class A the bias current should be set to a higher value. Proceed as outlined above for the class AB bias and confirm that the amplifier is working properly. After this adjust the bias current to the class A operating point according to Table 1.

Max. output power	4 Ohm Load		8 Ohm Load	
	Bias current	R37 reading	Bias current	R37 reading
25W	1.8A	300mV	1.2A	200mV
50W	2.4A	400mV	1.8A	300mV
100W	3.6A	600mV	2.5A	400mV

Table 1 Bias settings for class A

A large heatsink is required to keep the amplifier cool with these bias currents. The standard heatsink shown in Figure 6 is usually not sufficient. An alternative solution is to run in partial class A mode. Adjusting the operating levels to about half those shown in Table 1 will result in class A operation for low level signals, up to about ¼ of the power shown. At higher power levels the amp will then operate in class AB.

Offset adjustment.

The offset voltage of the amplifier must be adjusted by setting the potentiometer R33. With no signal applied to the inputs, adjust R33 for minimum DC voltage at the outputs. A residual output voltage of a few mV is normal.

The assembly and adjustment of PM124 is now complete.

Gain adjustment.

The gain of the amplifier can be changed by replacing the two resistors R3 and R5. These two resistors should be of equal value. It is best to use 1% 1/4W metal film resistors, but other

types, like 5% carbon, can also be used. The gain is given by $A=499/R3$, R3 in Kohm. See Table 1. Use nearest available values.

R3 = R5	Gain	
10K	50	34 dB
15K	33	30 dB
25K	20	26 dB
50K	10	20 dB
100K	5	14 dB

Table 2 Gain vs. R3

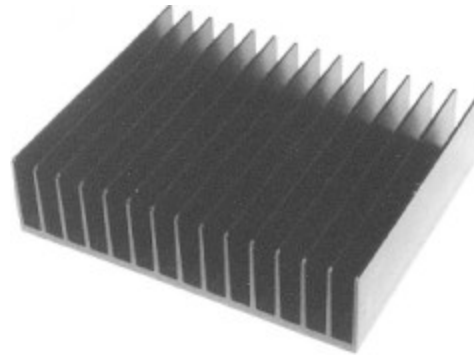
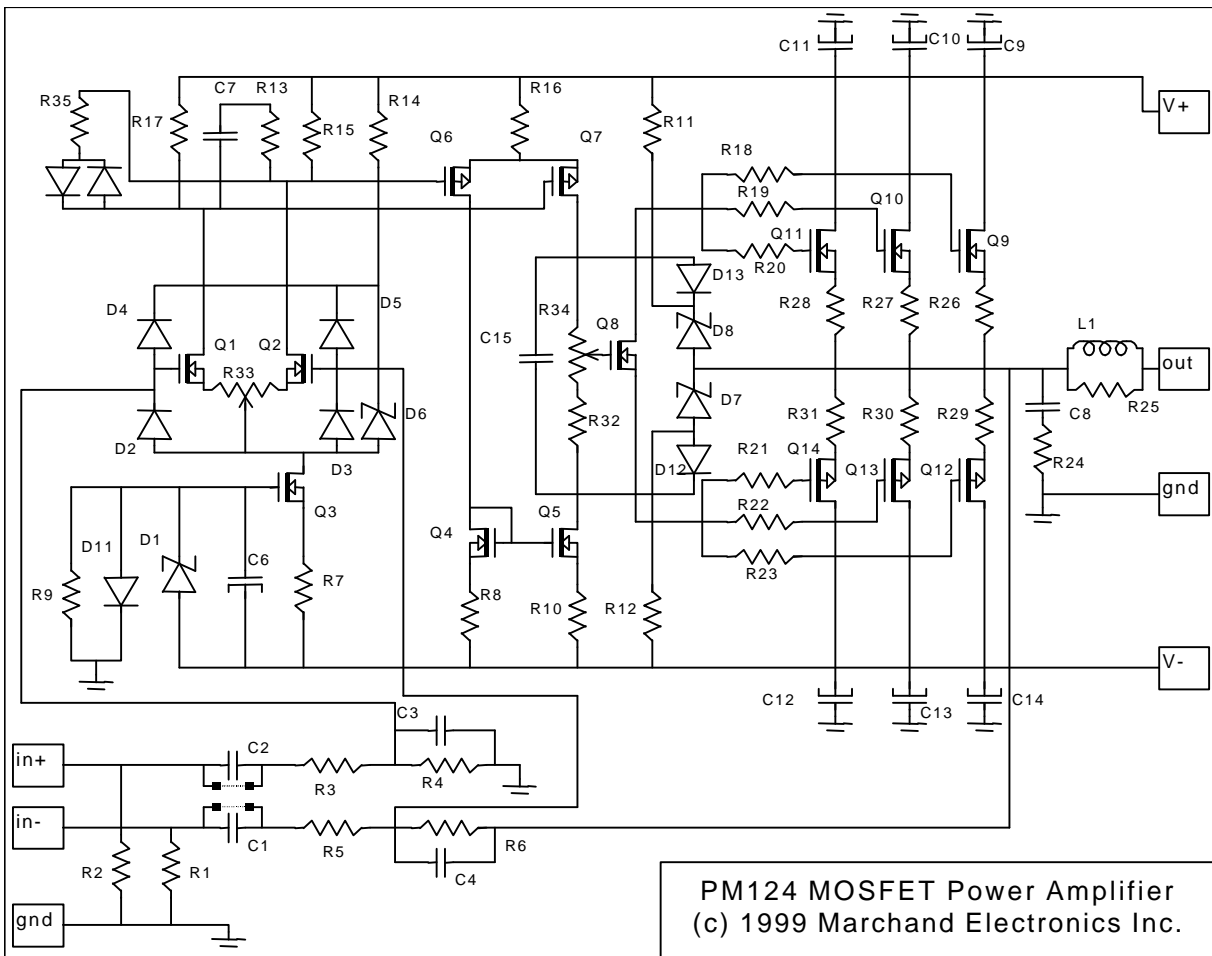


Figure 6 PM124HS. Typical heatsink for PM124. Dimensions are 5"x6.1"x1.6"; 0.8°C/W.



Important Note:

On circuit board PM124-REV1 Diodes D7, D12 and D13 are shown REVERSED.
 All other revisions (notably REV 1099 and later) are labeled correctly.