

## Building notes on Power Amp based on M2 Output Stage + Opamp

XEN Audio

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### 1) Input Options

The PCB is designed for differential or single-ended input.

When using differential input, the source (preamp) should be capable of driving 1k load with low distortion. Leave Rg (0805 Jumper) open (a MUST). Source connections are +IN, -IN and GND.

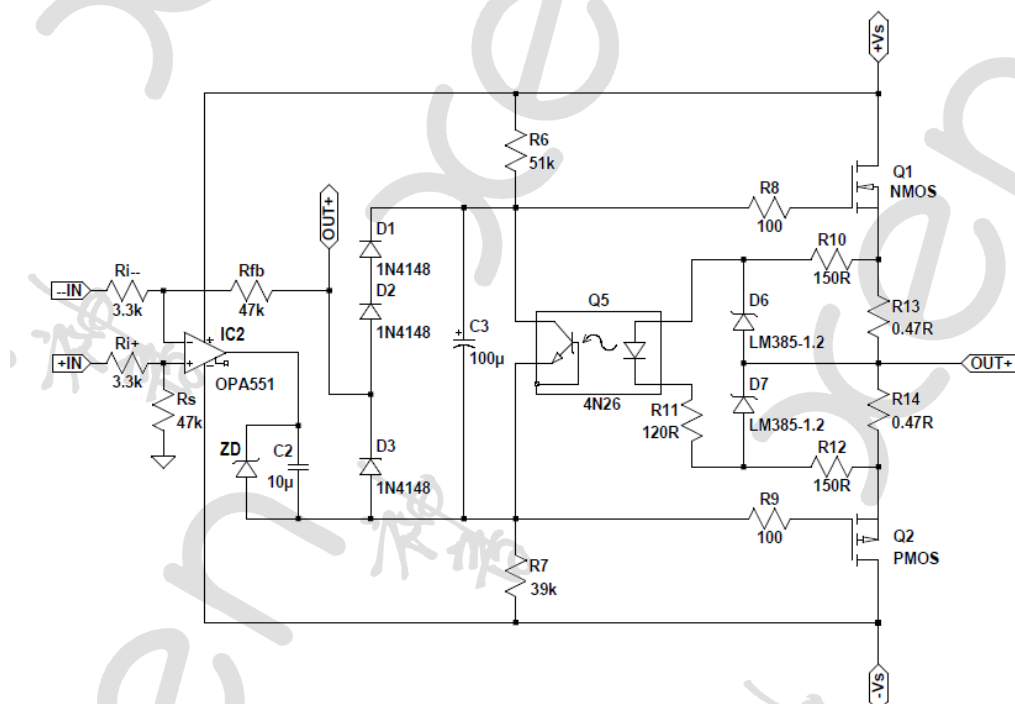
When using single ended input, populate Rg. Source connections are +IN and GND. -IN is shorted to Gnd by Rg.

### 2) Global Negative Feedback

The PCB is designed for two different feedback options, namely opamp local feedback, and global feedback including the M2 Output Stage (M2OPS).

When using global feedback (as in WHAMMY), populate Rfb with a Dale RN60 resistor. Rfb2 (SMD 0805) should be left unpopulated. One can in principle replace C2 in the original M2 schematics with a jumper. However, the opamp output now sits at Vg of the PMOS, which is ~ -5V when using IRFP9240. This in turn will lead to asymmetrical clipping on the negative cycle at a much lower voltage. To overcome this, one needs to level shift the opamp output, e.g. with a 5.1V Zener in parallel with C2. However, the 5.1V Zener needs to be conducting at all times. This can be done reducing R7 to 39k. R6 can now be 51k, and trimmer Rv1 replaced by a jumper on the PCB.

This also applies when using Toshiba 2SK3497/2SJ618. But because of their different Vgs at bias, a 2.7V Zener should be used instead. You can solder this Zener under C2.

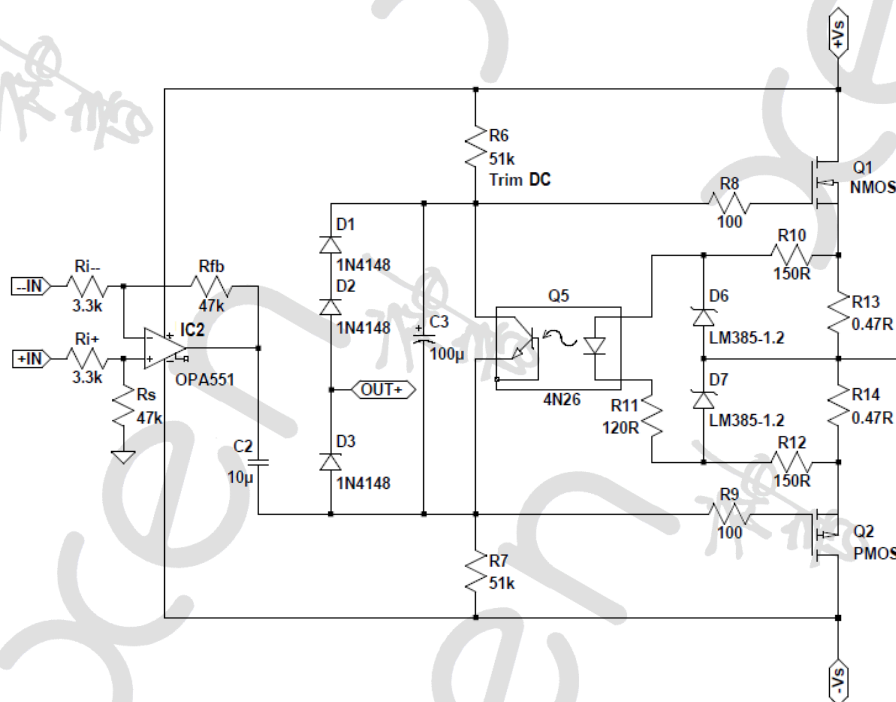


### 3) Opamp Local Feedback

Some might prefer to use the M2OPS in open loop, as in the original M2. In that case the Opamp merely acts as a voltage gain stage. This can be done by leaving out Rfb and populating Rfb2 instead. The opamp will ensure that the input to C2 sits at Gnd with grounded inputs. But the M2OPS needs to be trim for DC offset on its own.

This is done by :

- removing the Zener mentioned above, leaving C2 on its own
- Using 47k for R6, 51k for R7, and reinstalling Rv1
- With grounded inputs to the opamp, adjust Rv1 until output of M2OPS is at 0V.  
(Note that this offset adjustment is sensitive to rail voltages)



### 4) Additional Safety

The opto-biasing circuit of the M2OPS normally keep the voltage across C3 in check. This is roughly equal to sum of MOSFET Vgs + 1.3V; in case of IRFP ~ 10V. In the unlikely event of opto-coupler malfunction, one can protect C3 by placing another Zener in parallel. This also serves to protect the MOSFETs. For IRFP, use a 13V 0.5W Zener; for Toshiba, use 9V1, to be soldered directly under C3.

## Bill of Material (Global Feedback)

### Opamp

Qty	Designation	Description	Remark
1	IC2	OPA551 DIP8	OPA604 for rails < 24V
2	Cs	WIMA MKS2 3.3μ	
2	Rs	RN55 22R 1%	
2	Ri+, Ri-	Beyschlag MELF 0204 3.3k	
1	Rs	Beyschlag MELF 0204 47k	
1	Rfb	Dale RN60 47k 1%	
1	Rfb2	unpopulated	
1	Rg	1206 0R jumper	for single ended input, -IN to Gnd

### M2 OPS

1	Q1	IRFP240	Vgs match at 1.3A
1	Q2	IRFP9240 Harris	Vgs match at 1.3A
1	Q5	4N26 DIP6	
3	D1,2,3	1N4148W	
2	D6,7	LM385-1.2 SOT23-3	
1	ZD	5.1V 0.5W Zener	2.7V for 2SK3497/2SJ618
1	C2	WIMA MKS2 10μ	
1	C3	Nichicon UKA 100μ 16V	
1	C3B	WIMA MKS02 1μ	optional, Panasonic ECPU 1μ 16V
2	Cs1,2	Nichicon UKT 10000μ 25V	or 6800μ 35V for rails > 24V
1	R6	RN55 51k 1%	
1	R7	RN55 39k 1%	
1	Rv1	Bypass with jumper	
2	R8,9	RN55 100R 1%	
2	R10,12	Beyschlag MELF 0204 150R	
1	R11	Beyschlag MELF 0204 120R	
2	R13,14	KOA BPR58 0.68R	or Caddock MP915

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2	Ri+, Ri-	Beyschlag MELF 0204 3.3k	
1	Rs	Beyschlag MELF 0204 47k	
1	Rfb	Unpopulated	
1	Rfb2	Beyschlag MELF 0204 47k	
1	Rg	1206 0R jumper	for single ended input, -IN to Gnd

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1	Q2	IRFP9240 Harris	Vgs match at 1.3A
1	Q5	4N26 DIP6	
3	D1,2,3	1N4148W	
2	D6,7	LM385-1.2 SOT23-3	
1	ZD	Unpopulated	
1	C2	WIMA MKS2 10μ	
1	C3	Nichicon UKA 100μ 16V	
1	C3B	WIMA MKS02 1μ	optional, Panasonic ECPU 1μ 16V
2	Cs1,2	Nichicon UKT 10000μ 25V	or 6800μ 35V for rails > 24V
1	R6	RN55 47k 1%	
1	R7	RN55 51k 1%	
1	Rv1	Bourns 3296W 10k	
2	R8,9	RN55 100R 1%	
2	R10,12	Beyschlag MELF 0204 150R	
1	R11	Beyschlag MELF 0204 120R	
2	R13,14	KOA BPR58 0.68R	or Caddock MP915