ZinAmp

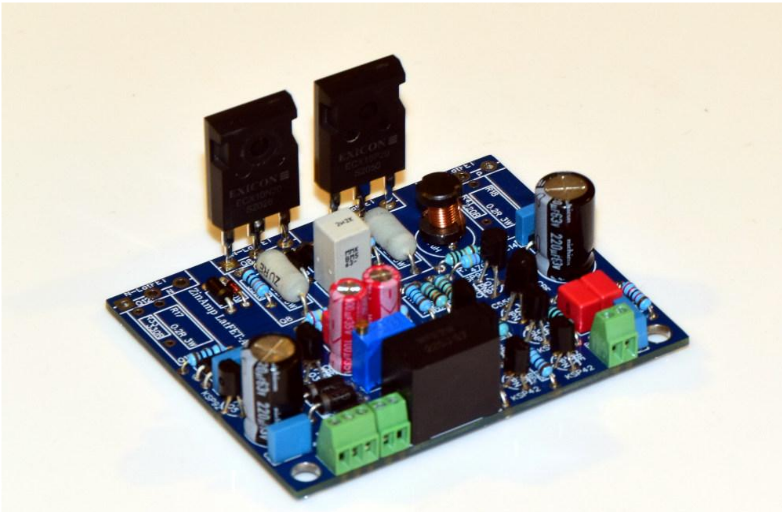
Beautiful sound, for people who love music

Datasheet

LatFET Class A/B Power Amplifier

Application & Purpose:
An exceptionally high-quality single-channel power-amp module, for driving passive speaker loads of between 4Ω and 10Ω. A LateralFET Class A/B stage can be configured to provide between 100 and 250 watts per channel. THD < 0.009% - mostly lower 2nd harmonic

WARNING: High DC voltage device. Care must be taken to avoid fatal electric shock.



Specification:

PCB Dimensions	77mm x 61mm x 1.6mm
Channels	One
Gain	27dB
Input Impedance	22kΩ
Frequency Response	15Hz-35kHz
Output Devices	Exicon Lateral MosFETS. 250W achievable using two pairs of double-die FETs. 100W achievable with 1 pair of single-die FETs
Output Impedance	< 0.15Ω
Damping Factor	≈100
Supply Voltage	-/+ 48v for 100W - 35-0-35v transformer - 160VA -/+ 56v for 150W - 40-0-40v transformer - 220VA -/+ 63v for 200W - 45-0-45v transformer - 300VA -/+ 70v for 250W - 50-0-50v transformer - 500VA **power figures are based on an 8ohm load.**
Idle Supply Current	100-400mA depending on configuration
Transformer	See above
Output Power	100W into 8ohms, 150W into 4ohms
Earth Nets	Power and Audio (separated by loop breaker)
THD	Typically 0.009% at 500Hz - mostly lower 2nd order

Details:

An exceptionally high-quality audio power-amplifier featuring a high-power class A/B Lateral MosFET output stage. Lateral MosFETs are highly regarded as audio devices and are specially designed for this purpose. This amplifier can be built in four power configurations from 100 to 250W per channel. Exicon Lateral MosFETs are available in single and double die types. Each power configuration requires the following FET types:

- 100W - 1 pair of single-die FETs on -/+48v DC rails
- 150W - 1 pair of double-die FETs on -/+56v DC rails
- 200W - 1 pair of double-die and 1 pair of single-die FETs on -/+63v DC rails
- 250W - 2 pair of double-die FETs on -/+70v DC rails

IMPORTANT: If you are using a power supply of more than -/+48v DC, you MUST make the following component swaps to avoid overbiasing and overheating:

-/+56v DC - R29: 3.3k; R30: 3.3k; R22: 150R

-/+63v DC - R29: 3.9k; R30: 3.9k; R22: 150R

-/+70v DC - R29: 3.9k; R30: 3.9k; R22: 120R

An intrinsically stable, low-distortion design, it features a differential input pair of BJT transistors with a linear current source, current-mirror and bootstrapped voltage amplification stage (VAS). THD and damping-factor benefit from global negative feedback and stability is bolstered by a frequency-dependent nested local feedback loop between the amplifier's output and the input to the VAS.

Power Supply: We sell an unregulated supply for this amplifier that is based on a conventional rectifier and filter capacitor design. You may choose to build your own. Our power supply PCB allows up to 4 x 6800uF capacitors to be soldered in, depending on power requirements. A single power supply can power two amplifier modules (L & R) with capacitors installed as follows:

100W - 2 x 4700uF Capacitors
150W - 2 x 6800uF Capacitors
200W - 4 x 4700uF Capacitors
250W - 4 x 6800uF Capacitors

Setup and Usage:

The output devices generate some latent heat and require a reasonable heatsink with a thermal resistance of around 0.45K/W. The heatsinks supplied with your ZinAmp amplifier are sufficient for this. Running this module with no heatsink will result in device failure within a few minutes. Secure to the heatsink and isolate the backs of the output devices from the metal-wall of the chassis with silicon or mica isolation pads. Isolation pads are critical - do not expose the metal backs of the output devices to the metal chassis as a short circuit will result.

Bias is fixed at just over 1v. This achieves a bias current of 100mA per pair of single-die FETs. Two pairs of double-die FETs will be biased at 400mA. This will dissipate a lot of heat - comparable with that of a class A amplifier. Do bear this in mind when planning a high power configuration - you will need a LARGE heatsink.

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Grounding and Hum:

This PCB has two separate ground nets; Power Ground and Audio Ground. Power Ground is marked as HUB on the POWER terminal. Audio Ground is marked as GND on the IN terminal. The term HUB refers to the star-earth of your amplifier. ZinAmp makes an Earth Hub PCB for this purpose.

Power Ground is connected to the star-earth / hub in your installation, not to your power supply otherwise unnecessary noise and distortion may be introduced.

For IN, use two-core screened instrument cable. Connect one core to the IN pin on the PCB which is the audio signal. Connect the other to the GND pin on the PCB which is the Audio Ground of the RCA input or your pre-amp/volume-pot. The cable-screen must make its own separate connection to the star-earth point or earth-hub in your installation. We don't recommend using the screen as the Audio Ground as this can pollute the audio ground with stray transformer EMI and introduce hum.

Don't connect power and audio earth terminals/nets together with a single piece of wire or hum will be audible. Grounding an amplifier without introducing hum is a delicate art! These ground nets must only meet / terminate at the star-earth or earth-hub.

Bridge Mode:

This module can be run in bridge mode, effectively doubling the output power. A terminal marked 'Bdg' is provided that connects to the feedback point of the amplifier. This can be connected to the output of another identical amplifier module via a 22k resistor. Running amplifiers in bridge mode is not officially supported and the constructor is fully responsible for any damage to their amplifier or loudspeakers, but as we don't want to ruin anyone's fun, here is a link to an article explaining how to do this:
https://sound-au.com/project20.htm

Safety Note:

This module runs with DC voltages that are close to 100v DC between negative to positive rails. This is enough to give you a very unpleasant and potentially fatal shock. Unlike AC current, DC is more dangerous when touched as you will tend to stick to it rather than be repelled from it, as with AC. Before handling this module, switch off, disconnect the AC power lead and discharge the power amp power supply in your amplifier by placing a screwdriver across it's discharge terminals for 10 seconds. Check the voltage with a meter - if less than 2v, this module is safe to handle.

Instability and Oscillation:

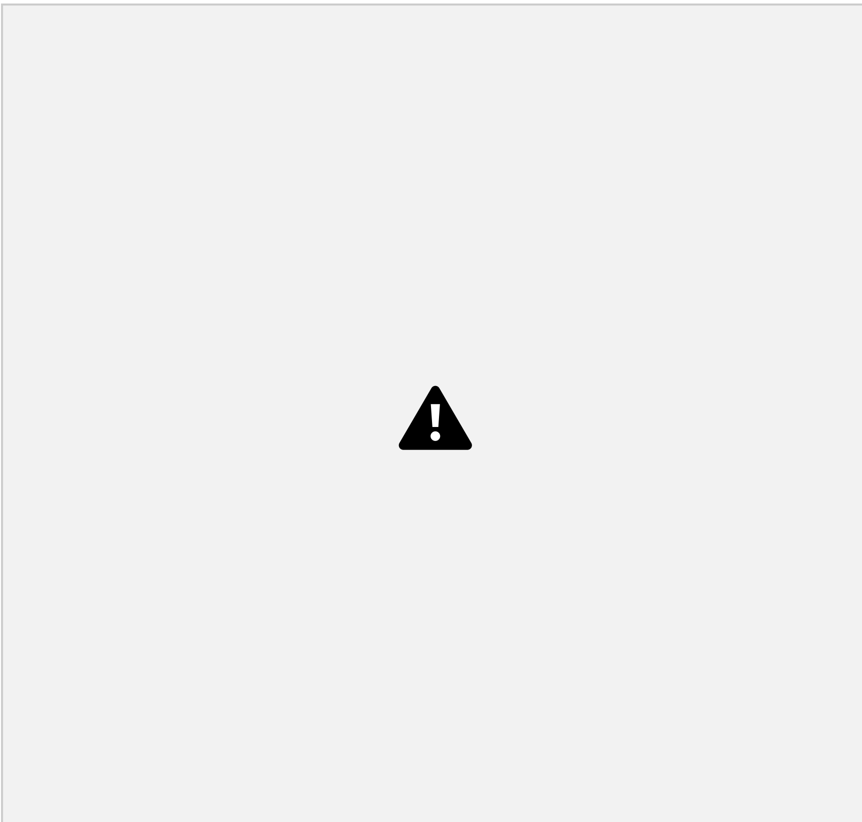
This amplifier is designed to be intrinsically stable and we do not envisage it breaking into oscillation. In the unlikely event of this happening, a resistor marked R26 on the PCB layout below may show evidence of smoke or blackening. This is a tell-tale sign that oscillation has occurred. If you assembled the amplifier yourself and this happens, switch off, remove the power cord, discharge the power supply and remove the amplifier module to inspect it. You will need to remove and replace R26 before proceeding to retest.

Heat Sink:

Do not attempt to run this amplifier without firmly attaching it to the heatsink - it will overheat and fail within 30 seconds. Transistors Q14 and Q8 are the thermal regulation devices. These must be aligned and in contact with Q9 and Q11 respectively and firmly screwed to the heatsink. Your amplifier will overheat and fail if you do not do this.

The amplifier is attached to the heatsink using 4 x M3 threaded machine-screws. You can make your own mounting plate or they can be purchased from ZinAmp here:
http://www.zinamp.co.uk/modules/wiring.html#PowerAmpMountingPlate

Connections:



Connections:

Connector	**Terminal**	**Destination**	**Notes**
DC (43-48v)	-	-ve terminal of power supply	Typically -42 to -48v
	HUB	Star-ground point on Chassis	Hub means Star-ground point
	+	+ve terminal of power supply	Typically +42 to +48v
IN	GND	Star-ground point on Chassis	Do not connect this directly to the HUB pin or hum will result!
OUT	Bdg	Do not connect	Only used for bridge mode!!
	Spk	+ve Speaker terminal	-ve speaker terminal connects to Star-ground

Star-ground: A star ground is a single point on the earthed metal chassis where ground connections are terminated. Making ground connections at different points on the chassis will result in hum. Directly connecting these ground points together will also result in hum; they must only meet at the star-ground point. For safety, **the metal chassis must be connected to earth** on your three-pin electrical plug.

Assembly - steps

Self assemblers, please follow these steps to avoid costly and hazardous mistakes. Please avoid the temptation to solder-in all components, then switch-on; this is likely to result in failure.

You need to assemble and test the board in stages:

1. Solder in all components, except for the main output devices Q12, Q9, Q9 and Q11.
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2. Attach the - GND + terminals to the power supply, ensuring the ground terminal is properly grounded to the star-earth/hub

3. Connect the pre-amp output to the input terminals of the power amp. If you are not using a pre-amp, ensure the IN-GND pin is connected to the star-earth/hub

4. Apply the power

5. Check for any obvious signs of smoke or heat. There should be none

6. Check the voltage between the speaker output terminal and ground. It should be between -150mV and +150mV. If it is much more than that, you have assembled the PBC incorrectly. Switch off, disconnect the power and investigate!

7. Check the voltages across R22. This should be approximately 1v. If this voltage is much lower or higher than 1v there is an assembly problem. Switch off, disconnect the power and investigate!

8. Double check that both Power GND and Audio GND are grounded, then check the voltage between the speaker output and ground. This should be within +/- 100mV. If it is greater than this, you may have an assembly problem. If audio ground is not grounded, the speaker terminal may be more than -/+ 200mV. Turn the trimmer (VR1) until the voltage at the speaker terminal is close to zero as you can get it. You may not be able to zero the speaker terminal while the output devices are not fitted, but within -/+50mV should be possible. Once you have done this, you can safely proceed to step 9.

9. Solder in the remaining components and attach the module firmly to the heatsink as described on the previous page. Ensure the N and P FETs are the right way around. Getting these the wrong way around will result in a large explosion! Do take care….

10. Reapply the power and recheck the voltage at the speaker output. If it has moved, turn the 'Offset' trimmer (VR1) until the voltage at the speaker terminal is close to zero (+/- 10mV).

Parts List:

CONNECTORS: Both blank and ready-built PCB requires connectors be purchased and soldered on by the constructor. This is to give the constructor a choice of how they wire their own particular installation. Terminal block connectors are indicated in the list below in blue and can be swapped for equivalent 2.54mm pitch connectors e.g. Molex KK254 headers, which are provided to the constructor in kits with ready-made wiring.

PLEASE NOTE THE QUANTITIES BELOW ARE FOR ONE **PAIR** OF POWER AMPS (L & R):

Email parts@zinamp.co.uk for help

Parts highlighted in yellow may differ from your PCB. Please use the part indicated below:

Designator	Value/Spec	Qty	Manuf	Manuf Part	RS Part
43-48V	-|HUB|+	1	RS-PRO	790-1092	790-1092
OUT, IN	Bdg|Spk,IN	2	RS-PRO	790-1098	790-1098
C2	100p	1	Wima	FKP2/100/100/7	484-1980
C13,C14,C12,C3	100n	4	Epcos	B32529C1104K000	896-1332
C10,C7	220p	2	Wima	FKP2/220/100/5	484-1984
C11	2.2u 40vAC	1	Kemet	MMK5225K63J06L4BULK	191-985
C1	2.2u	1	Kemet	MMK5225K63J06L4BULK	191-985
Q1,Q4,Q3,Q5,Q14	KSP92	5	OnSemi	KSP92TA	806-4627
R5,R10	22R	2	TE Connectivity	LR1F2R2	150-644
R8,R19,R21	1.8k	3	Vishay	MRS25000C1801FCT00	683-3231
R7,R2	100R	2	TE Connectivity	LR1F100R	125-1155
R9	22k	1	TE	LR1F22K	125-1167
R6,R11	68R	2	TE Connectivity	LR1F68R	148-219
R4,R41,R16	220R	3	Vishay	MRS25000C2200FCT00	683-3314
R1,R12,R27	1k	3	Vishay	MRS25000C1001FCT00	683-3165
R3	47k	1	TE Connectivity	LR1F47K	148-893
R13	22K	1	TE	LR1F22K	125-1167
R26,R20,R37	10R	3	Vishay	MBB02070C1009FCT00	477-7568
R33,R15	330R	2	Vishay	MRS25000C3300FCT00	683-3540
R29,R30	2.7k	2	TE Connectivity	LR1F2K7	125-1161
R14	470R	1	TE Connectivity	LR1F470R	125-1158
R34,R36,R17,R18	0.2R 3W	4	TE	ER74R22KT	151-518

R22	150R	1	Vishay	MRS25000C1500FCT00	683-3058
D5,D12	10V	2	Nexperia	BZX79-C10,113	544-4461
C5,C4	220u 63v	2	Nichicon	UVR1J221MPD1TD	862-3294
C6,C9	100u 35v	2	Vishay	MAL203850101E3	684-1973
VR1	100k	1	Bournes	PV36W104C01B00	769-2160
Q2,Q6	BC550/BC337	2	OnSemi	BC33725TA	671-1116
Q10,Q13,Q7	KSP42	3	OnSemi	KSP42BU	739-0372
Q12,Q8	N-LatFET	2	Exicon	ECX10N20	ECX10N20
Q11,Q9	P-LatFET	2	Exicon	ECX10P20	ECX10P20
D7,D8	50v 2A	2	Vishay	SBYV27-50-E3/54	629-6746
D10,D9,D1,D2,D3,D4,D6,D11	50v 1A	8	Vishay	1N4001-E3/54	628-8931
L1	3.9uH	1	Panasonic	ELC11D3R9F	675-5343

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