ZXCD100MOEVAL

ACOUSTAR™
100W CLASS D AUDIO AMPLIFIER EVALUATION BOARD

DESCRIPTION

The ZXCD100MOEVAL evaluation board is based on the ZXCD1000 Class D audio amplifier solution from Zetex. This board allows the user to evaluate the high fidelity audio performance offered by the Zetex solution, with an output power upto 100W into 4Ω.

INTRODUCTION

The ZXCD100MOEVAL is a 100W RMS (4Ω Load) high performance class D amplifier. The circuitry contains MOSFET devices and should therefore be handled appropriately.

The board requires a single rail power supply of 13 volts minimum and 35 volts maximum. Voltages in excess of 35 volts may cause permanent damage to the board.

The heart of the solution is the ZXCD1000 class D controller IC and the user should refer to the ZXCD1000 data sheet for further technical information.

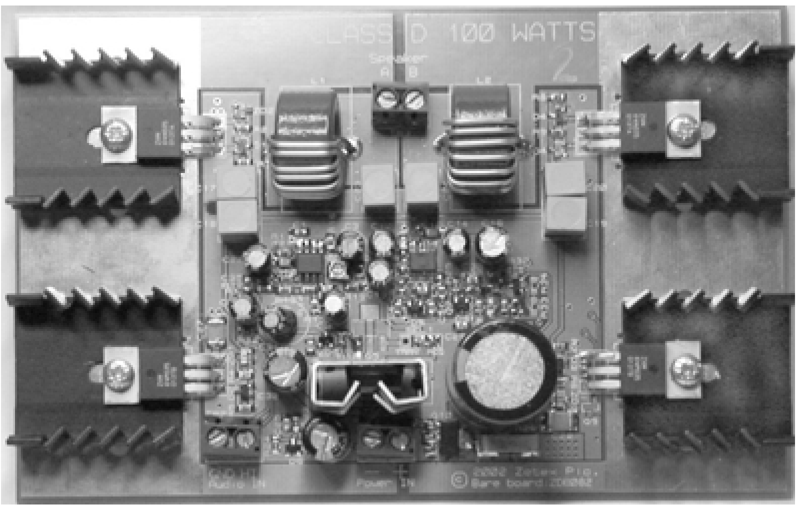
The circuit features pop suppression and over current protection.

FEATURES

- Class D architecture
- Single power supply
- Output power (Vsupply = 35V)

  100 W into 4Ω
- THD + N <0.8% @ 90% power
- >90% efficiency
- Flat frequency response 20Hz – 20 kHz
- Turn on / turn off pop suppression
- Over current protection
- Noise floor –115dB

Note: The ZXCD100MOEVAL is intended as an evaluation platform for Zetex Class D solutions. Zetex accepts no liability for external equipment connected to the ZXCD100MOEVAL or any other form of consequential damage or loss.



ZXCD100MOEVAL

CONNECTION AND OPERATION

The following PCB image shows the connections required for correct operation of the ZXCD100MOEVAL board. Simple connector blocks are provided to enable easy connection of the supply voltage, audio input and speaker output.

Power connection

The ZXCD100MOEVAL requires a single positive supply voltage:

35V @ approximately 3.3A for 100W in 4Ω

The supply should not exceed 35V and must not be less than 13V to ensure correct operation of the amplifier, Ensure the correct polarity of the supply is applied.

Audio input

The ZXCD100MOEVAL requires a single ended audio input as follows:

The input impedance is 18kΩ

Input signal amplitude required for full output power is approximately 2.5V peak to peak.

Speaker connection

A 4Ω speaker may be connected to the board as shown. If this board is being used as part of a multi-channel solution the ensure the correct polarity connection of the speaker to avoid phasing errors.

EVALUATION BOARD DESCRIPTION AND OPERATION

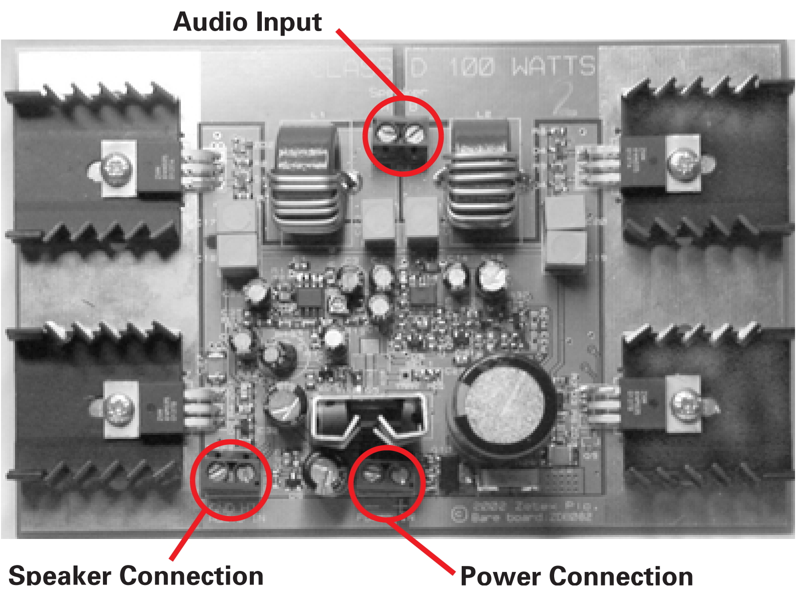
The top copper, bottom copper and silk screen ID overlay are shown in figures 1,2 and 3.

The ZXCD1000 is available in a 16-pin exposed pad QSOP package. The exposed pad on the underside of the package is soldered down to an area of copper on the PCB, to function as a heat sink. To further assist heat dissipation, the PCB has plated through vias connecting to an area of copper on the underside of the board.

The MOSFETs required on the board are Zetex ZXM64 series HDMOS parts. These TO220 parts are required to handle the power dissipation in the amplifier with a 100W load. The output bridge is approximately 90% efficient, leaving in the region of 2.5W per MOSFET at full power. Heat sinks are provided on the board to enable this dissipation with a minimised temperature rise.

The regulator transistor on the board is a TIP120, TO220 device. This device is required to supply the 12V rail to the board with its input voltage being the 35V bridge supply. A heat sink is attached to the transistor to enable good dissipation of the heat generated in this device.

The inductors in place on the board have been selected for their excellent linearity and low losses. These components ensure minimal distortion is introduced in the recovered audio signal across the full power band.



The speaker is connected as a Bridge Tied Load (BTL). This means that both sides of the speaker are driven from the Output Bridge and therefore neither side of the speaker connects to ground. This allows maximum power to be delivered to the load, from a given supply voltage.

If it is wished to view or measure the signal across the load, a floating monitor must be used - for example a differential probe. Alternatively this may be achieved with a two channel oscilloscope monitoring the speaker A and speaker B outputs, and using the invert and add functions. For diagnostic purposes, the speaker outputs can be monitored single-ended with respect to ground with an oscilloscope (or other instrument) if desired. However any results obtained in this manner, are not valid for assessing performance. The true performance depends upon some differential cancellation across the speaker load.

The board requires an input signal of 2.5V peak to peak nominal to yield the full output power. The input impedance of the board is nominally 18kΩ. This may attenuate the source voltage and may need to be allowed for, depending on the output impedance of the source.

The maximum supply voltage to the ZXCD100MOEVAL evaluation board is 35V nominal. A supply voltage of 35V will achieve 100W into a 4Ω load. With the suggested heat sinking in place this board can easily operate with a full 100W output for extended periods.

The full power output voltage across the (bridge tied) load will be approximately 60V peak to peak with a supply voltage of 35V. Viewing outputs single-ended will yield half these voltages. Smaller input voltages will yield smaller output voltages.

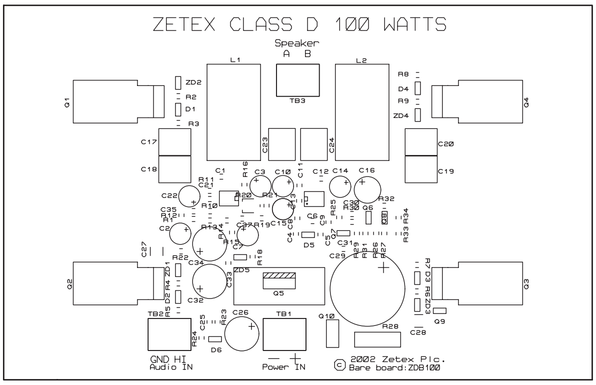


Fig.1. Component Overlay

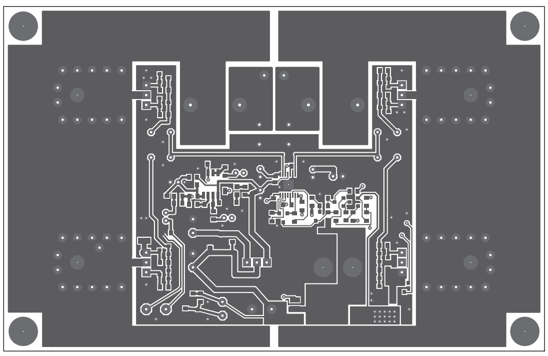


Fig.2. Top Copper

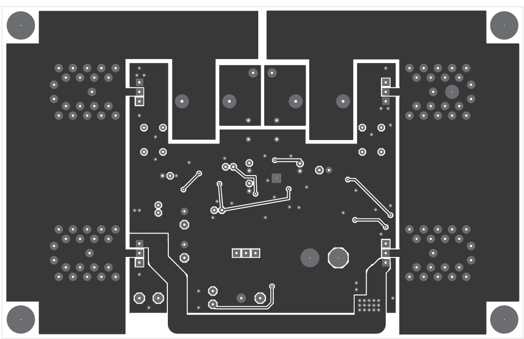


Fig.3. Bottom Copper

ZXCD100MOEVAL CIRCUIT DESCRIPTION.

Propriety circuit design and high quality magnetics are necessary to yield the excellent THD performance of the solution. At the heart of the circuit is the Zetex ZXCD1000 class D audio IC.

The ZXCD100MOEVAL circuit diagram is shown in figure 4. The circuit consists of a voltage regulator, an input phase splitter, the ZXCD1000, an output bridge to drive the load - via L-C filters, an anti-pop slow start circuit and an over-current protection circuit. (Note components are shown also for an over-temperature circuit however this circuit is application dependant and is not used on the demonstration board)

The voltage regulator (Q5, ZD5 etc.) is necessary to drop higher supply voltages (35V on the bridge for 100W) to a level suitable for the ZXCD1000 and input phase splitter (12V on the board). The input phase splitter, built around the NE5532 dual op amp, is necessary to drive the Audio A and Audio B channels on the ZXCD1000.

The Output Bridge is built around the Zetex ZXM64P035L3 and ZXM64N035L3 PMOS and NMOS TO220 transistors.

Q10 and its associated compnents facilitate a slow start for the bridge supply voltage This circuit performs anti-pop for the solution.

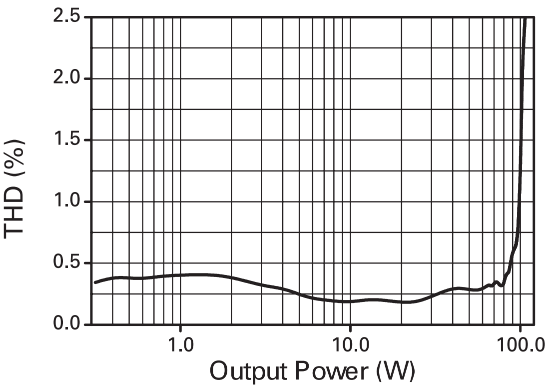
R28 is an over current sense resistor. The circuit shown (Q6, Q8 etc) enables an over-current protection for the solution. In fault conditions the circuit disables the triangle modulation waveform and thus disables the output bridge. Protection is given for speaker shorts and speaker to ground shorts.

The ZXCD1000 outputs drive Output Bridge MOSFET's, with the PWM signal, which subsequently drives the load via L-C filters. The purpose of this network is to low pass filter the high frequency switching PWM signal from the bridge. Thus the lower frequency audio signal is recovered and is available at the speaker outputs.

ZXCD100MOEVAL CIRCUIT PERFORMANCE

The graph shown in fig 5 indicates the THD performance of the 100W solution. THD is shown from zero up to full power.

Distortion is sub 1% all the way up to full power, typically at 1W 1kHz, distortion is 0.4%.



Output Power v THD

WARNING - Appropriate safety precautions should be taken by a competent person if the ZXCD100MOEVAL is to be connected to any potentially hazardous equipment.

ZETEX CLASS D 100W MONO BOARD BOM

(Manufactures names and series numbers are given for component specification guidance only)

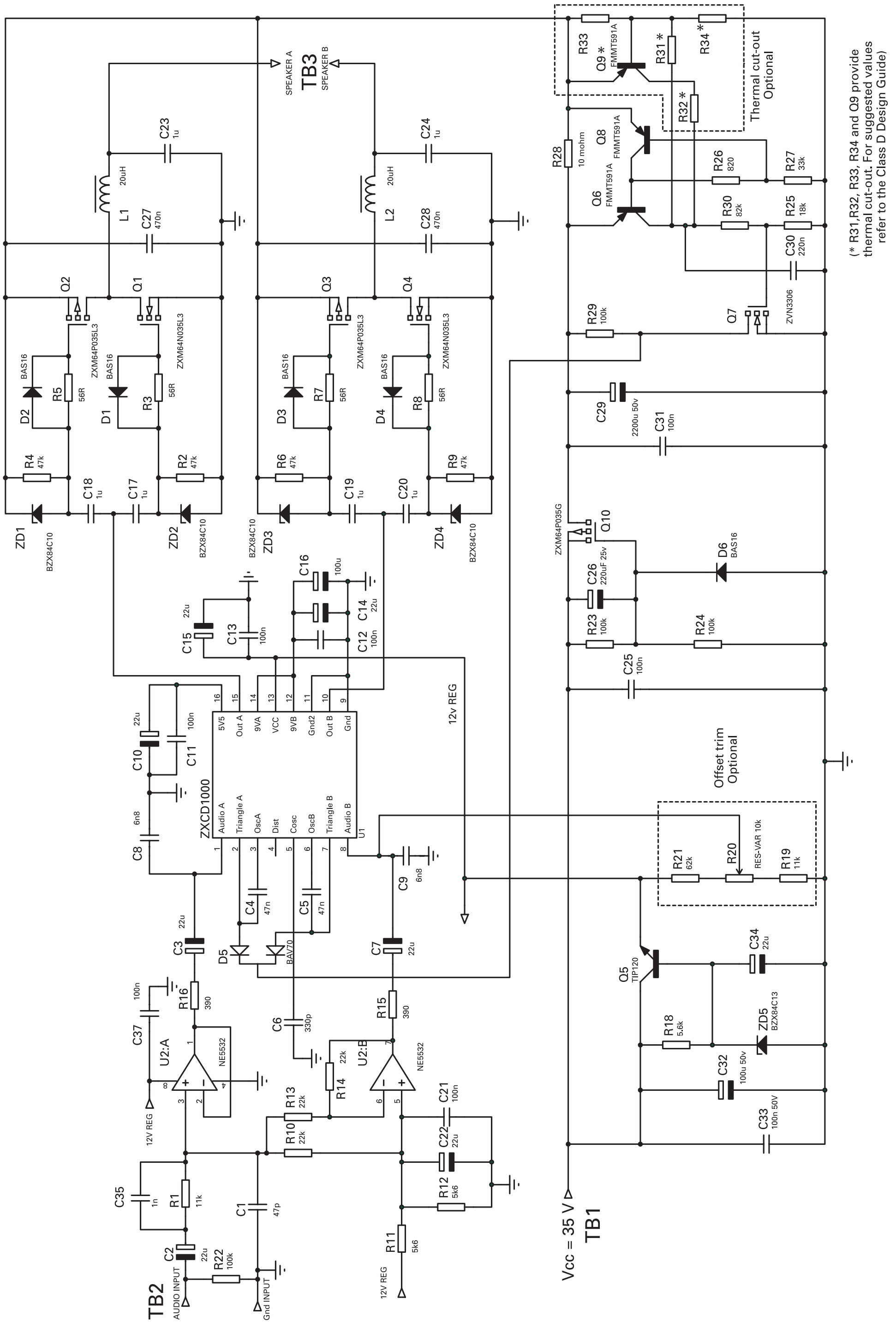
PCB ID	Value	Case	Notes
Resistors :-			
R1	11k	SMD 0805 5% 0.1w	
R2	47k	SMD 0805 5% 0.1w	
R3	56R	SMD 0805 5% 0.1w	
R4	47k	SMD 0805 5% 0.1w	
R5	56R	SMD 0805 5% 0.1w	
R6	47k	SMD 0805 5% 0.1w	
R7	56R	SMD 0805 5% 0.1w	
R8	56R	SMD 0805 5% 0.1w	
R9	47k	SMD 0805 5% 0.1w	
R10	22k	SMD 0805 5% 0.1w	
R11	5k6	SMD 0805 5% 0.1w	
R12	5k6	SMD 0805 5% 0.1w	
R13	22k	SMD 0805 5% 0.1w	
R14	22k	SMD 0805 5% 0.1w	
R15	390R	SMD 0805 5% 0.1w	
R16	390R	SMD 0805 5% 0.1w	
R17	-		Not Used
R18	5k6	SMD 0805 5% 0.1w	
R19	11k	SMD 0805 5% 0.1w	Optional trim component
R20	10K	SMD 3mm Pot	Optional trim component Meggitt 3203 series
R21	62k	SMD 0805 5% 0.1w	Optional trim component
R22	100k	SMD 0805 5% 0.1w	
R23	100k	SMD 0805 5% 0.1w	
R24	100k	SMD 0805 5% 0.1w	
R25	18k	SMD 0805 5% 0.1w	
R26	820R	SMD 0805 5% 0.1w	
R27	33k	SMD 0805 5% 0.1w	
R28	0.01Ω	Open Air	Welwyn OARS series
R29	100k	SMD 0805 5% 0.1w	
R30	82k	SMD 0805 5% 0.1w	
R31			Not Used
R32			Not Used
R33			Not Used
R34			Not Used

Capacitors :-

(The following Capacitor voltage ratings should be as specified or greater)
(Electrolytic, COG, X7R and polyester refer to the dielectric material)
(A more stable dielectric may be used as an alternative to that specified in all cases)
(TH 105C = Through - hole radial, max operating temp. 105 deg.C)

PCB ID	Value	Case	Notes
C1	47pF COG 16V	SMD 0805	
C2	22μF 16V Elect. ±20%	TH 105C 7mmHx5mmDx2mmP	Multicomp MCMHR series
C3	22μF 16V Elect. ±20%	TH 105C 7mmHx5mmDx2mmP	Multicomp MCMHR series
C4	47n X7R 16V	SMD 0805	
C5	47n X7R 16V	SMD 0805	
C6	330pF COG / NPO 16V	SMD 0805	
C7	22μF 16V Elect. ±20%	TH 105C 7mmHx5mmDx2mmP	Multicomp MCMHR series
C8	6n8 X7R 16V	SMD 0805	
C9	6n8 X7R 16V	SMD 0805	
C10	22μF 16V Elect. ±20%	TH 105C 7mmHx5mmDx2mmP	Multicomp MCMHR series
C11	100n X7R 25V	SMD 0805	
C12	100n X7R 25V	SMD 0805	
C13	100n X7R 25V	SMD 0805	
C14	22μF 16V Elect. ±20%	TH 105C 7mmHx5mmDx2mmP	Multicomp MCMHR series
C15	22μF 16V Elect. ±20%	TH 105C 7mmHx5mmDx2mmP	Multicomp MCMHR series
C16	100μF 16V Elect ±20%	TH 105C 11mmHx6.3mmDx2.5mmP	Rubycon YXF series Low imp
C17	1μF 63V	5mm pitch	Polyester
C18	1μF 63V	5mm pitch	Polyester

PCB ID	Value	Case	Notes
Capacitors cont. :-			
C19	1µF 63V	5mm pitch	Polyester
C20	1µF 63V	5mm pitch	Polyester
C21	100nF X7R 25V	SMD 0805	
C22	22µF 16V Elect. ±20%	TH 105C 7mmHx5mmDx2mmP	Multicomp MCMHR series
C23	1µF 63V	5mm pitch	Polyester
C24	1µF 63V	5mm pitch	Polyester
C25	100n 50V X7R	SMD 0805	
C26	220µF 25V Elect ±20%	3.5mmP	
C27	470n 50V X7R	SMD 1812	
C28	470n 50V X7R	SMD 1812	
C29	2200µF 50V Elect. ±20%	TH 105C 35.5mmHx18mmDx7.5mmP	Panasonic FC series Low imp.
C30	220n 50V X7R	SMD 0805	
C31	100n 50V X7R	SMD 0805	
C32	100µF 50V Elect ±20%	TH 105C 11.5mmHx8mmDx3.5mmP	Rubycon ZL series Low imp.
C33	100n 50V X7R	SMD 0805	
C34	22µF 16V Elect. ±20%	3.5mmP	
C35	1nF 16V X7R	SMD 0805	
C36	-		Not Used
C37	100n 16V X7R	SMD 0805	
Integrated Circuits :-			
U1	ZXCD1000	QSOP16 (Exposed Pad)	
U2	NE5532	SMD SO8	
Transistors :-			
Q1	ZXM64N035L3	TO220	
Q2	ZXM64P035L3	TO220	
Q3	ZXM64P035L3	TO220	
Q4	ZXM64N035L3	TO220	
Q5	TIP120	TO220	
Q6	FMMT591A	SMD SOT23	
Q7	ZVN3306	SMD SOT23	
Q8	FMMT591A	SMD SOT23	
Q9	FMMT591A	SMD SOT23	
Q10	ZXM64P035G	TO220	
Diodes :-			
D1	BAS16	SMD SOT23	
D2	BAS16	SMD SOT23	
D3	BAS16	SMD SOT23	
D4	BAS16	SMD SOT23	
D5	BAV70	SMD SOT23	Double Diode
D6	BAS16	SMD SOT23	
ZD1	BZX84C10	SMD SOT23	10V Zener diode
ZD2	BZX84C10	SMD SOT23	10V Zener diode
ZD3	BZX84C10	SMD SOT23	10V Zener diode
ZD4	BZX84C10	SMD SOT23	10V Zener diode
ZD5	BZX84C13	SMD SOT23	13V Zener diode
Inductors :-			
L1	PG0058 (Pulse)	20µH	100W inductor
	555-8820-20(Cambion)	20µH	100W inductor
L2	PG0058 (Pulse)	20µH	100W inductor
	555-8820-20(Cambion)	20µH	100W inductor



Fg 4. 100W into 4Ω circuit diagram

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