ZXCD1210
High performance analog input Class D modulator

Description

The ZXCD1210 provides complete control and modulation functions at the heart of high efficiency high performance Class D switching audio amplifier solutions. In combination with high performance output stages and open or closed loop architectures, the ZXCD1210 provides a high performance audio amplifier with all the inherent benefits of Class D.

The ZXCD1210 solution uses proprietary circuit design to realise the true benefits of Class D without the traditional drawback of poor distortion performance. The combination of reference circuit designs, magnetic component choice and layout are essential to realising these benefits.

The ZXCD1210 reference designs provide output powers up to 500W RMS with typical distortion and noise of less than 0.05% and a dynamic range of 98dB. The closed loop designs ensure a high damping factor and excellent supply rejection. The open loop designs provide high performance in the most economic implementation.

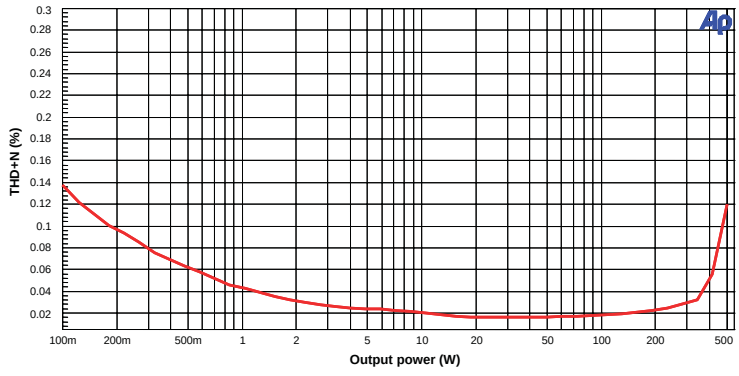
The closed loop reference designs include circuits specifically for subwoofer applications featuring a flat frequency response up to 250Hz. The open loop designs give the ZXCD1210 the ability to produce amplifiers with full a 20kHz bandwidth.

Features

- Output power 50W to 500W into 4Ω
- THD+N <0.05%
- Dynamic range 98dB
- Open loop and closed loop reference designs
- Frequency response
  Subwoofers: ±0.5dB from 10Hz to 250Hz
  Full band: ±0.5dB from 20Hz to 20kHz
- 200kHz PWM frequency
- Output drive free of crossover artifacts
- QFN16 4x4 package

Applications

- Subwoofers
- Home theatre systems
- Multimedia
- Wireless speakers
- Portable audio



This plot shows the THD+N versus power plot for a 500W closed loop subwoofer reference design. THD+N is 0.02% between 10W and 200W which is outstanding performance.

Absolute maximum ratings - Terminal voltage with respect to GND

V_{CC}	20V
Power dissipation	1W
Package thermal resistance (Θja)	55°C/W
Operating temperature range	-40°C to 70°C
Maximum junction temperature	125°C
Storage temperature range	-50°C to 85°C

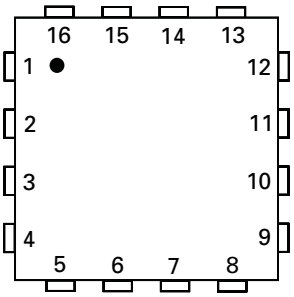
Stresses beyond those listed under 'Absolute maximum ratings' may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum conditions for extended periods may affect device reliability.

Electrical characteristics - Test conditions (unless otherwise stated) V_{CC} = 16V, T_A = 25°C

Symbol	Parameter	Conditions	Limits			Units
			Min.	Typ.	Max.	
V_{CC}	Operating voltage range	(*)	12	16	18	V
I_{SS}	Quiescent current	V_{CC} =12V			45	mA
		V_{CC} = 18V, 16V			50	mA
F_{CK}	Clock frequency	Clock capacitor =330pF	150	200	250	kHz
T_{CK}	Clock frequency tolerance	Clock capacitor = 330pF			±25	%
V_{OLPWM}	Low level PWM output voltage	No load			100	mV
V_{OHPWM}	High level PWM output voltage	No load	7.5			V
T_{DR}	PWM output rise and fall time	Load capacitance = 2200pF		50		ns
T_{REG5V5}	REG5V5 tolerance	1uF decoupling	5.23	5.5	5.77	V
T_{REG9V}	REF9V tolerance	1uF decoupling	8.32	8.75	9.18	V
R_{AIN}	Audio input impedance		1.35	1.8	2.3	kΩ
R_{SLI}	Modulation input impedance		1.35	1.8	2.3	kΩ
B_{AIN}	Audio input bias level		2.95	3.1	3.25	V
B_{SLI}	Modulation input bias level		2.95	3.1	3.25	V
V_{CK}	Clock amplitude		0.89	1.05	1.2	V

NOTES:
(*) For optimum thermal performance it is recommended that the ZXCD1210 is operated with a V_{CC} of 12V.

Pin connection diagrams



QFN16 4x4 package

Pin no.	Pin name	Pin description
1	PWML	PWM drive
2	REG5V5	Internal supply rail
3	AINL	Audio input
4	MODIL	Modulation control
5	MODOL	Modulation control
6	N/C	No connection
7	CK	External capacitor to set PWM frequency
8	MODOR	Modulation control
9	MODIR	Modulation control
10	AINR	Audio input
11	Sgnd	Signal ground
12	PWMR	PWM drive
13	Pgnd	Power ground
14	REG9VR	Internal supply rail
15	VCC	Internal supply pin
16	REG9VL	Internal supply rail

Functional description

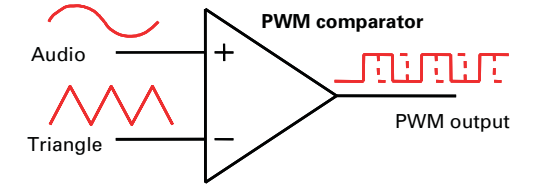
On chip series regulators drop the external V_{CC} supply (12V recommended) to the 9V and 5.5V supplies required by the internal circuitry of the device.

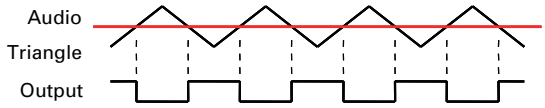
The on chip oscillator produces a clock which is set to approximately 200kHz by an external capacitor and an on chip resistor. The clock is set at least an order higher in frequency than the audio input. This clock is a triangle waveform which is used to modulate the incident analogue signal in order to produce the required PWM output.

With no audio input signal applied, the PWM duty cycle is nominally 50%. As the audio input signal ascends towards the peak level, the crossing points with the (higher frequency) triangle wave also ascend. The PWM output exhibits a corresponding increase in output duty cycle. Similarly, as the audio input signal descends, the duty cycle is correspondingly reduced. Thus the triangle modulates the audio input generating a pulse width modulated (PWM) output. This principle is illustrated below.

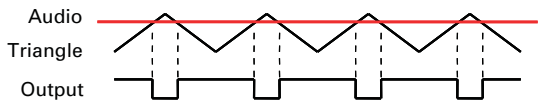
The PWM outputs drive the speaker load with the audio information contained in the PWM signal, via the off chip gate drivers, H bridge and single stage LC filter network.

The triangle amplitude is approximately 1V. The audio inputs are internally biased to a DC voltage of approximately $V_{CC}/5$. The mid point DC level of the modulation control is around 2V. The triangular wave at the CK pin traverses between about 2.7V and 3.8V.

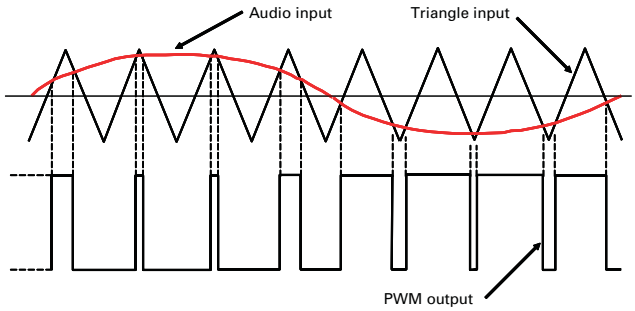




Comparator O/P (duty cycle = 50%)



Comparator O/P (duty cycle = 75%)

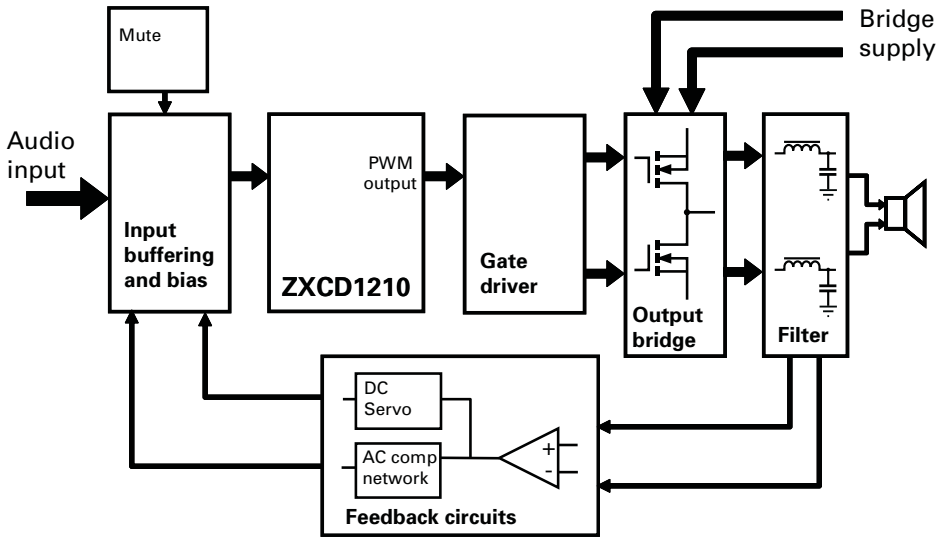


Applications information

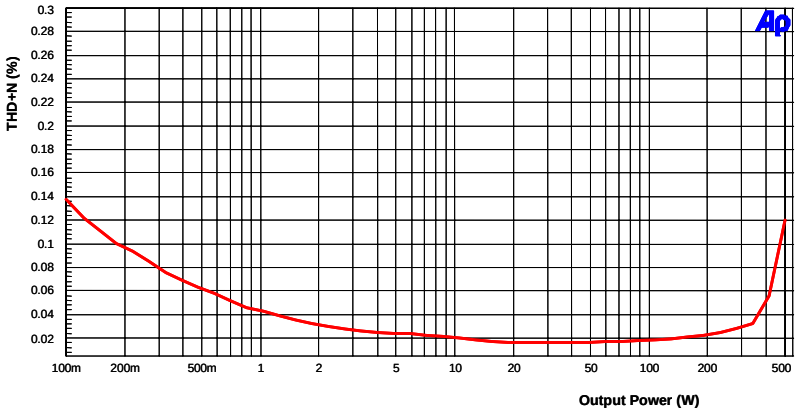
The high performance ZXCD1210 modulator IC forms the heart of the Zetex series of analog input Class D amplifier reference designs. The modulator device provides complete control of the modulation function.

Details of these reference designs are contained in individual data sheets: ZXCDSUBEV series, ZXCD50STEVAL and ZXCD100MOEVAL as well as the ZXCD series design guide.

The ZXCDSUBEV series of reference circuits are specifically designed for subwoofer applications. These switching amplifiers owe much of their outstanding audio performance to a unique feedback architecture designed to reduce distortion. By taking its feedback signal from the filtered amplifier output, the high gain circuit design compensates for bridge mismatches and filter non-linearities, to achieve a reduction in THD+N across the entire power band.



ZXCDSUBEV series architecture



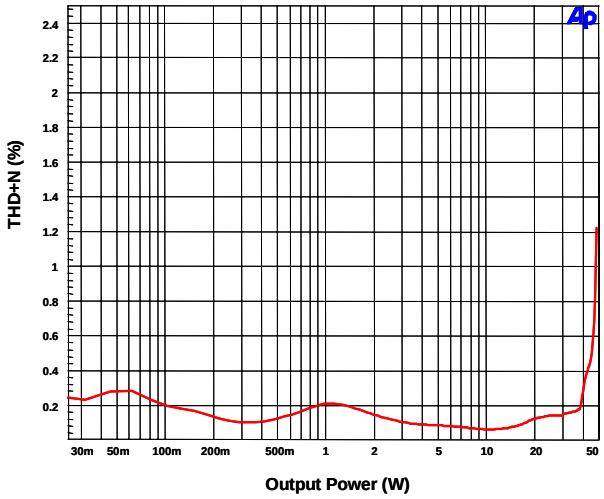
ZXCDSUBEV series THD+N versus power

The closed loop Class D architecture maintains high efficiency ensuring cool running in the smallest footprint whilst achieving much reduced output impedance for tight bass control. Additionally the feedback architecture compensates for supply dips and the bridge design accommodates high off load voltages. This means that use of a basic SMPS or an unregulated supply is achievable without compromising performance.

The designs feature soft start controls and under voltage lockout controls to maintain anti-pop behavior. Design options include short circuit, thermal and DC offset protection circuits. Volume and phase controls and high/low pass filters are simply added to the input circuitry.

The scalable architecture of the ZXCDSUBEV series utilises all N-channel output stage with either bridge tied load (BTL) or single ended (SE) configurations, together with power supply options to generate 150W, 300W or 500W RMS into 4Ω designs from a single platform. Many more power options readily produced.

The ZXCD50STEVAL stereo and ZXCD100MOEVAL mono reference designs have an open loop architecture and feature output stages constructed using Zetex MOSFETs directly driven from the ZXCD modulator device.



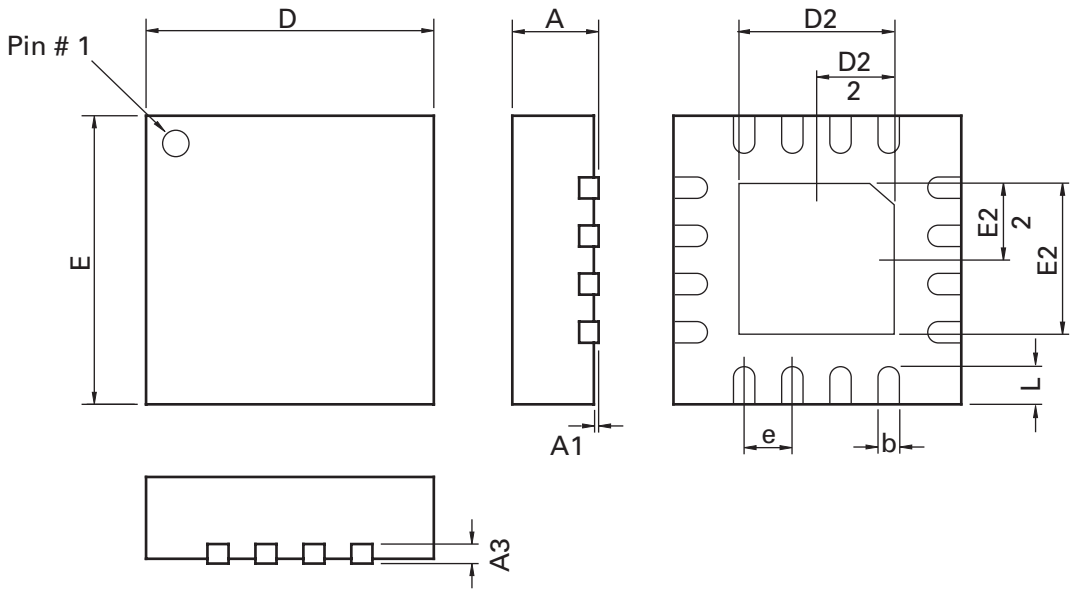
ZXCD50STEVAL THD+N versus output power

They offer 50W and 100W into 4Ω respectively with typical THD+N of 0.5% and 0.9% up to 90% full power. Careful design has eliminated any potential crossover distortion artifacts. Frequency response is flat to 20kHz in these designs, typical noise floor is -110dB. These designs feature anti-pop and over current protection and operate simply from a single supply rail.

Alternative configurations of these designs are possible with multi-channel applications simply created with a master slave arrangement. Single ended operation is possible with the associated performance compromises.

For further information on the ZXCD series reference designs, contact your local Zetex supplier with details of your production project requirements.

Package outline



Dim.	Millimeters		Inches	
	Min.	Max.	Min.	Max.
A	0.70	0.80	0.028	0.032
A1	0.00	0.05	0.00	0.002
A3	0.178	0.228	0.007	0.009
b	0.25	0.35	0.010	0.014
D	3.95	4.05	0.156	0.159
D2	2.05	2.15	0.081	0.085
E	3.95	4.05	0.156	0.159
E2	2.05	2.15	0.081	0.085
e	0.65 BSC		0.026 BSC	
L	0.35	0.45	0.014	0.018

Note: Controlling dimensions are in millimeters. Approximate dimensions are provided in inches

Ordering information

Device	Description	Package	Tape and reel suffix
ZXCD1210JB16	Class D modulator	QFN16 4x4	TA (1,000 per reel) TC (3,000 per reel)

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"Last time buy (LTB)"	Device will be discontinued and last time buy period and delivery is in effect
"Not recommended for new designs"	Device is still in production to support existing designs and production
"Obsolete"	Production has been discontinued

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