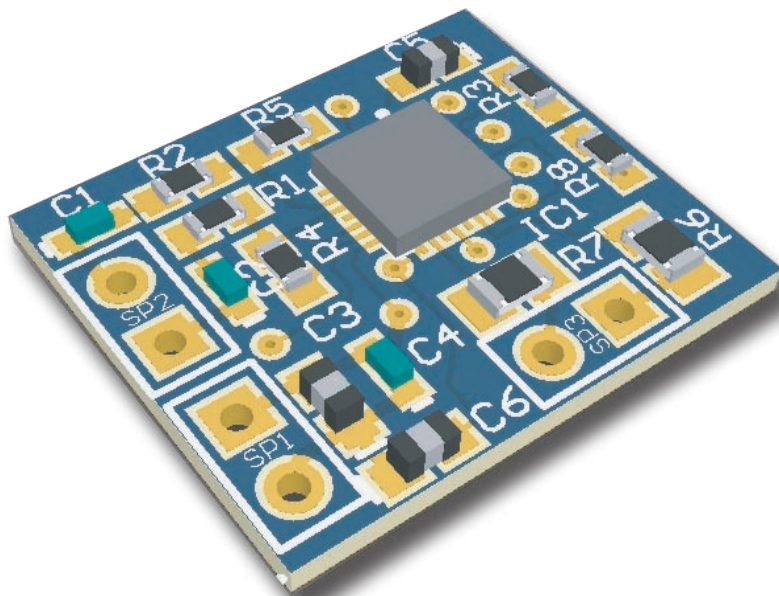


*Piezo-Ceramic Audio Amplifiers*  
**sonitron**® PAA-MAX9788-01

*Appnote PAA-MAX9788-01 Amplifier*



March 2010

Sonitron n.v.  
R&D department

## Appnote PAA-MAX9788-01 Amplifier

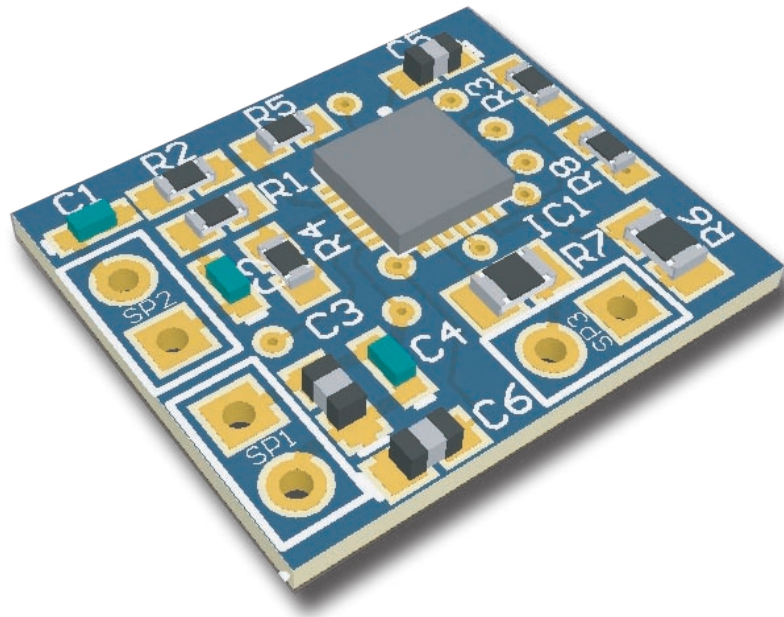
Designed on a printed circuits board of only 2,31 cm<sup>2</sup>, the "Max9788" piezo audio amplifier of Maxim fulfils the needs of very small designs in portable applications. A maximum output of 20Vpp and very low power consumption makes it even more attractive.

### Specifications:

- Integrated charge pump power supply
- Class G Amplifier
- Fully differential inputs and outputs
- Capacitive load up to 1 $\mu$ F
- 15 components

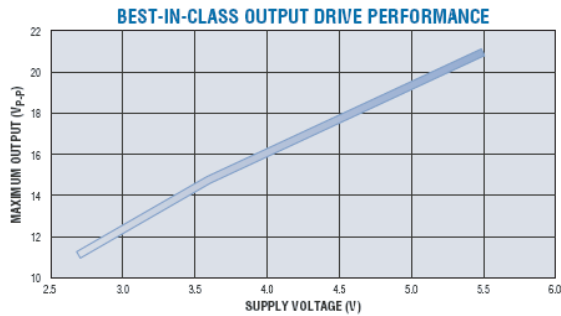
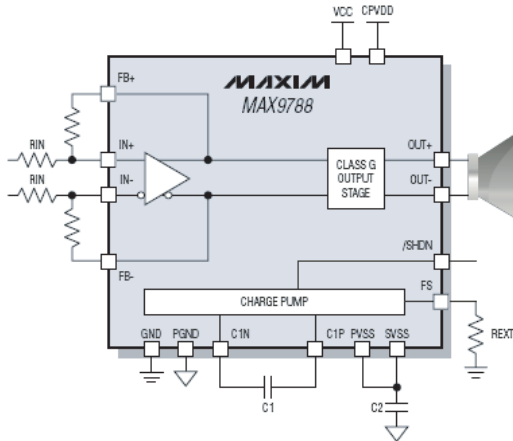
Fixed amplification ratio: +/- 80

Voltage input: 5 V



## Specifications:

The MAX9788's Class G technology can deliver up to 20Vpp, ideal for driving ultra-thin piezoelectric and ceramic speakers, for portable applications such as cell phones, smartphones, and portable media players.



**MAX9788**  
14Vp-p, Class G Ceramic Speaker Driver

**General Description**  
The MAX9788 features a mono Class G power amplifier with an integrated inverting charge-pump power supply specifically designed to drive the high impedance of a ceramic loudspeaker. The charge pump can supply greater than 700mA of peak output current at 50kHz, guaranteeing an output of 14Vp-p.

**Features**  

- Integrated Charge-Pump Power Supply—No Inductor Required
- 14Vp-p Voltage Swing Into Piezoelectric Speaker
- 2.7V to 5.5V Single-Supply Operation
- Clickless/Popless Operation
- Small Thermally Efficient Packages: 4mm x 4mm 28-Pin TQFN, 2mm x 2.5mm 28-Pin WLP

**Ordering Information**

PART	PKG/PACKAGE	TEMP RANGE
MAX9788EUT08	28 TQFN	-40°C to +85°C
MAX9788EET	28 TQFN	-40°C to +85°C

**Applications**  
 Cell Phones, Smartphones, MP3 Players, Personal Media Players, Handheld Gaming Console, Notebook Computers

**Simplified Block Diagram**

**MAXIM** Maxim Integrated Products  
 For pricing, delivery, and ordering information, please contact Maxim Direct at 1-888-629-4642, or visit Maxim's website at www.maxim-ic.com.

More information regarding the IC MAX9788 can you find on the website <http://www.maxim-ic.com> and in the datasheet:

<http://datasheets.maxim-ic.com/en/ds/MAX9788.pdf>

Amplification settings are done by the resistors  $R_{IN}$  and  $R_F$

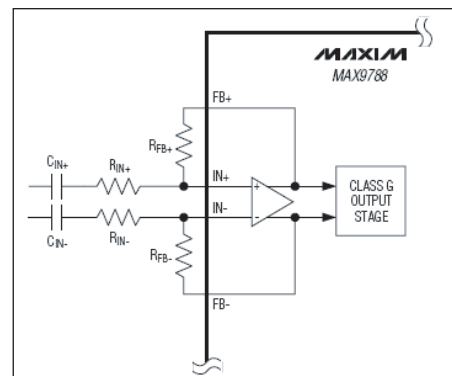
$$A_v = 20 \log \left[ 4 \times \left( \frac{R_{FB-}}{R_{IN-}} \right) \right] \text{ (dB)}$$

$$\frac{R_{FB+}}{R_{IN+}} = \frac{R_{FB-}}{R_{IN-}} \quad \text{and} \quad C_{IN+} = C_{IN-}$$

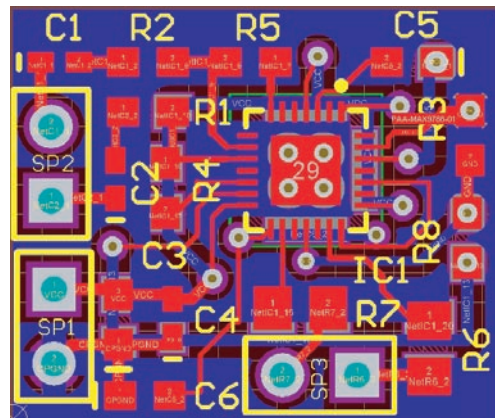
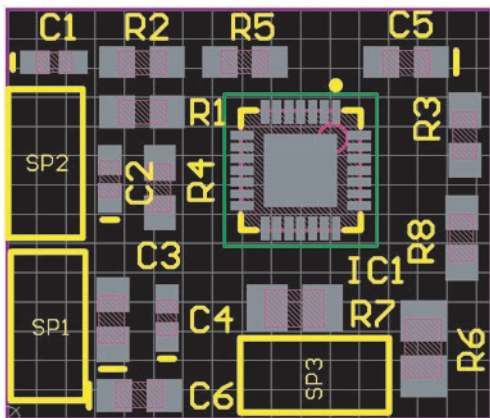
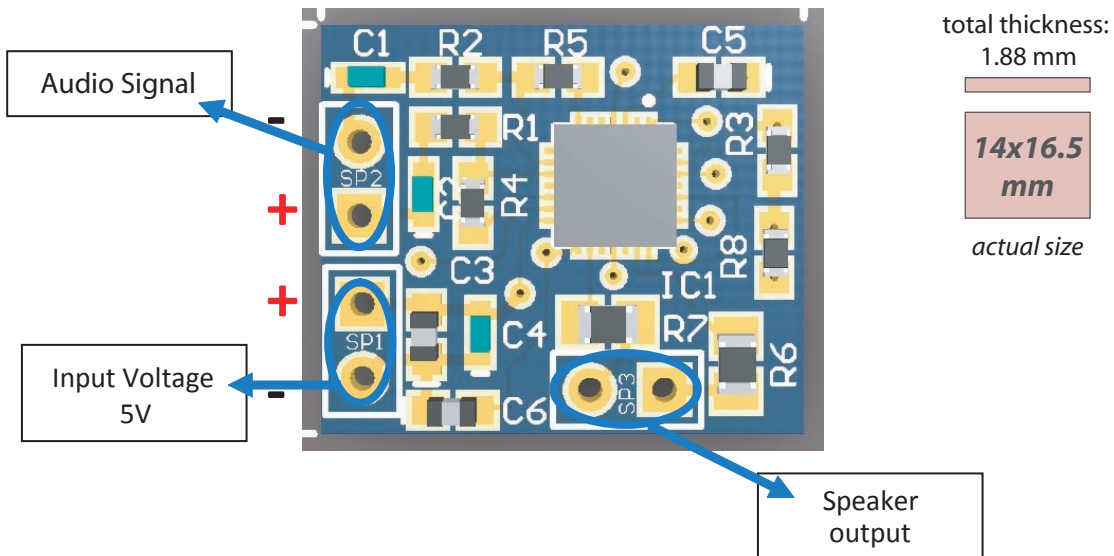
values:  $C = 68 \text{ nF}$ ,  $R_{FB} = 200\text{K}$ ,  $R_{IN} = 10\text{K}$   
 $A_v = 20 \log (80) = +38 \text{ dB}$

## Overview Specifications:

- Class G amplifier to drive a bridge -tied-load (BTL)
- Input Voltage : 5V (stable)
- Input Audio Signal: 0V To 1Vpp
- Output Audio Signal: Max 20Vpp
- Capacitive load up to 1μF

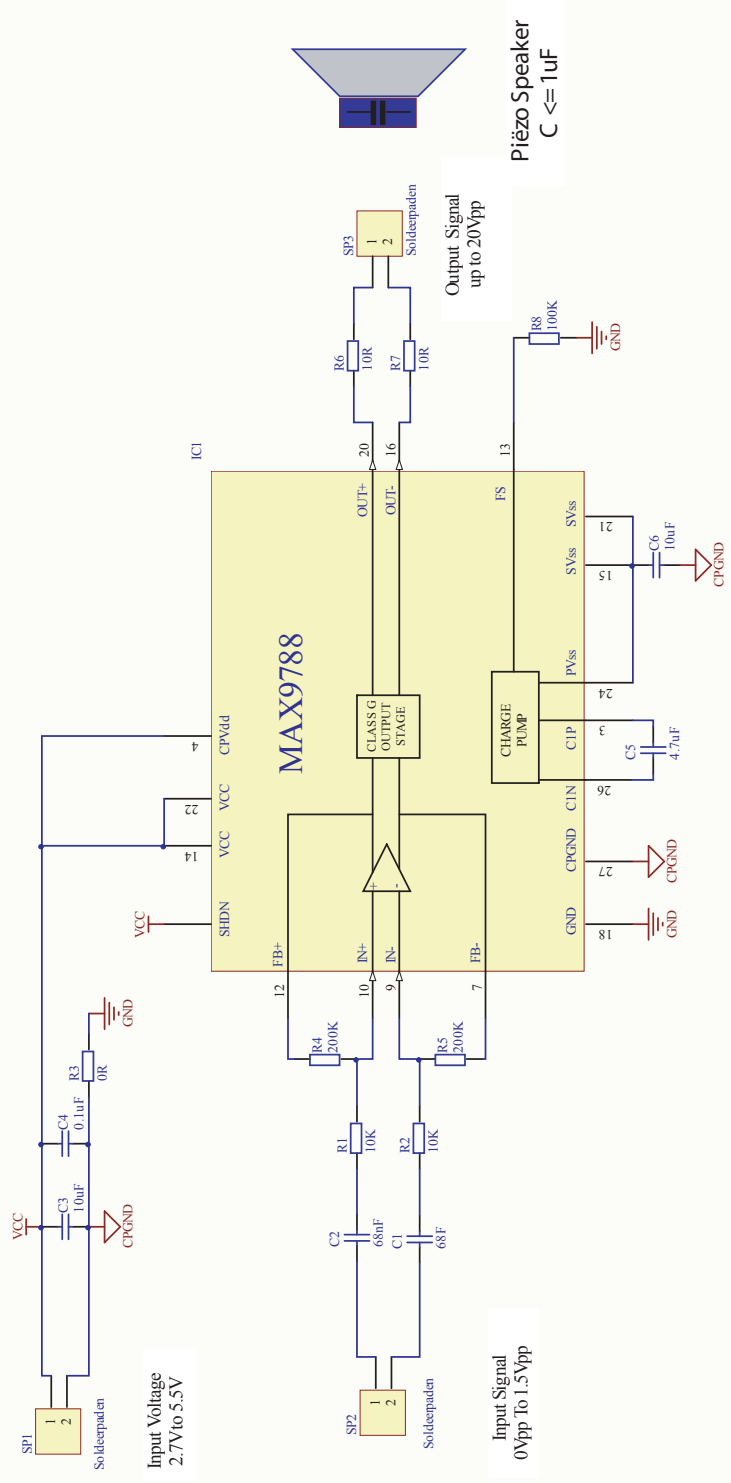


**Dimensions, components & control pins**



	Designator	Description	Package	Quantity
1	R1, R2	Chip Resistor 10k/1%	R0603	2
2	R3	Chip Resistor 0R/1 %	R0603	1
3	R4,R5	Chip Resistor 200k/1%	R0603	2
4	R6,R7	Chip Resistor 10R/1%	R0805	2
5	R8	Chip Resistor 100K/1 %	R0603	1
6	C1,C2	Ceramic Capacitor 68nF/16V/10%/X7R	C0402	2
7	C3,C6	Ceramic Capacitor 10uF/6,3V/20%/X5R	C0603	2
8	C4	Ceramic Capacitor 0,1uF/16V/10%/X5R	C0402	1
9	C5	Ceramic Capacitor 4,7uF/6,3V/10%/X5R	C0603	1
10	U1	MAX9788 Piezo Ceramic Speaker Amplifier	Thin QFN28	1

# Class G Piëzo Audio Amplifier



B-9100 Sint-Niklaas (Belgium)

Name:

Project:

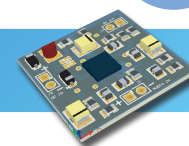
PAA-MAX9788-01

Piëzo Audio Amplifier

Designer :

Number: 1  
Sheet 1 of 1  
Revision  
Date 12/11/2008

## PIEZO AUDIO AMPLIFIERS



### INTRODUCTION

The **P**iezo **A**udio **A**mplifiers-series are a total solution to drive piezoceramic sound components. A range of different PCB sizes, amplifier topologies and maximum voltage peak to peak outputs, cover a wide solution to piezo audio amplification.

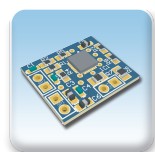
Piezo audio amplifiers are designed to handle capacitive loads and have the possibility to deliver large voltages peak to peak over the complete audio frequency range.

The heart of a piezo audio component is a ceramic piezo stone that interacts when it feels a certain voltage difference. An increase of a voltage peak to peak will have a larger piezo deformation and results in a larger sound output.

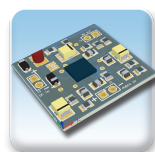
The PAA-series give a quality amplifier solution where a quality sound is needed.

### GENERAL OVERVIEW PAA SERIES

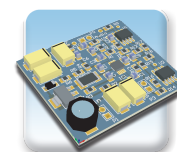
Model	PAA-MAX9788-01	PAA-LM4960-02	PAA-StepUpBTL-01
Measurements PCB(mm)	14x16.5mm	25x25mm	40x35mm
Voltage input (V)	5V	5V	5V-25V
MAX Capacitance Piezo Speaker	1µF	600nF	1µF
Max Voltage Output Vpp	20Vpp	24Vpp	60Vpp
Voltage Topology	Integrated step up converter	Integrated step up converter	Step up converter
Amplifier classification	Class G	Class AB	Class AB
Used amplifier configuration	Fully Differential	Bridge Tied Load	Bridge Tied Load
Average current consumption of speaker and amplifier (mA)	15mA	85mA	40mA-400mA (2 Watt)



**PAA-MAX9788-01**



**PAA-LM4960SQ-02**



**PAA-StepUpBTL-01**

**For more information see the Sonitron Catalogue 2010**  
 Piezo Audio Amplifiers Page 103 - 111 (or click the link below)

<http://cde.cerosmedia.com/piezo-buzzer-transducer-alarm-siren-speaker-amplif/1N4bbf4084e44f9012.cde/page/102>



Piezo Speakers & Piezo Audio Amplifiers

