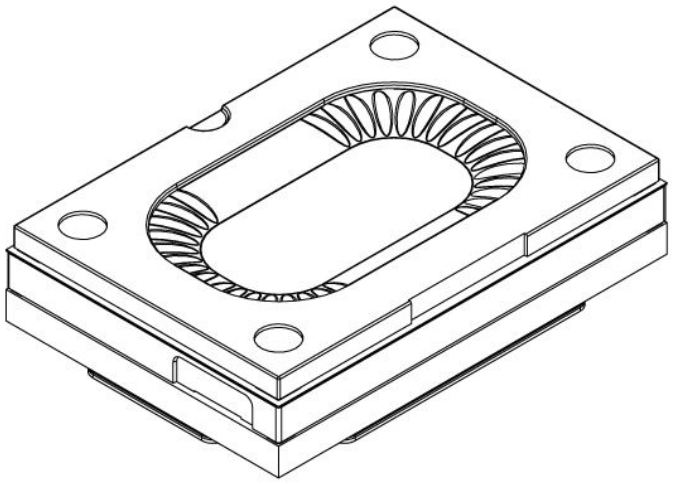
ADAP

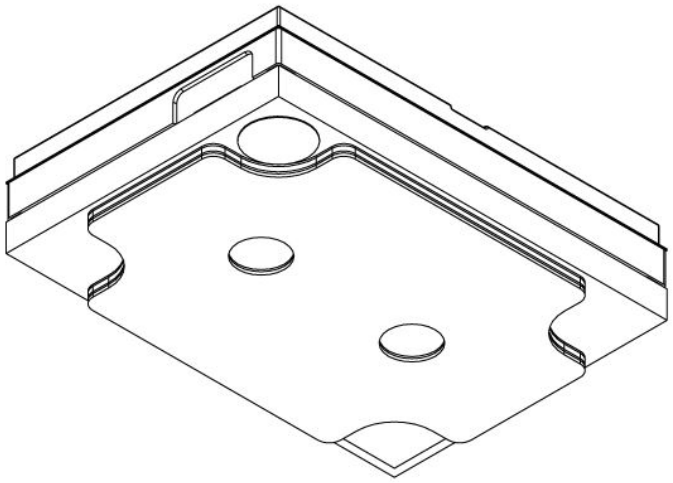
Ganymede Family

UT-P 2013 | DATASHEET

With their compact size, **Ganymede** speakers (Achelous and Adap) are ideal for in-ear headphone designs, wearables such as true-wireless headsets. As the perfect addition to traditional speakers, they can be easily retrofitted into standard enclosures to improve treble or implement 3D-audio systems.

Adap speakers are optimised as tweeters with a flat frequency response radiating into free-field. They are also suited for in-ear applications where less damping is needed from the driver.





FEATURES

- Small form factor
  6.7 x 4.7 x 1.62 mm
- High flexibility for acoustic system integration
- Low heat generation
- No magnetic field
- High input impedance suitable for thin wires or PCB traces

SPECIFICATIONS

Mechanics

Total speaker weight	[mg]	46
Total speaker volume	[mm³]	51

Acoustics

In IEC 60318-4 coupler		
SPL@250 Hz / 15 V_P	[dB]	111
SPL@1k Hz / 15 V_P	[dB]	113
THD@250 Hz / 15 V_P	[%]	6.2
f_{res}	[kHz]	4.0
Lower bandwidth (-3 dB)	[Hz]	<20 Hz

In IEC 60268-5 baffle		
SPL@1 kHz / 15 V_P	[dB]	51
SPL@4 kHz / 15 V_P	[dB]	72
THD@4 kHz / 15 V_P	[%]	20
f_{res}	[kHz]	3.3
Q at f_{res}	[-]	0.8
Lower bandwidth (-10 dB)	[kHz]	1.9

Effective membrane surface - S_D	[mm²]	12
Equivalent volume – V_{AS}	[mm³]	30
Front volume inside speaker	[mm³]	5.6
Back volume inside speaker	[mm³]	16.2

Electronics

Capacity (measured at 1 kHz)	[nF]	40

TEST CONDITIONS

Measured with IEC 60318-4 coupler	
Coupler type	IEC 60318-4 (711)
Coupler volume	1.26 cm³
Connection tube length	1.6 mm
Connection tube diameter	3.7 mm

Microphone	GRAS 43AC
Microphone amplifier	B&K Nexus
Loudspeaker amplifier	G.R.A.S. 12AU
Measurement system	APx 526

Measurement signal	Exp. sweep
Voltage levels – audio $V_{DC} + V_{AC}$	15 V + 15 V_P
Voltage levels – ultrasound $V_{DC} + V_{AC}$	15 V + 5 V_P

Applied back volume	Open (infinite)

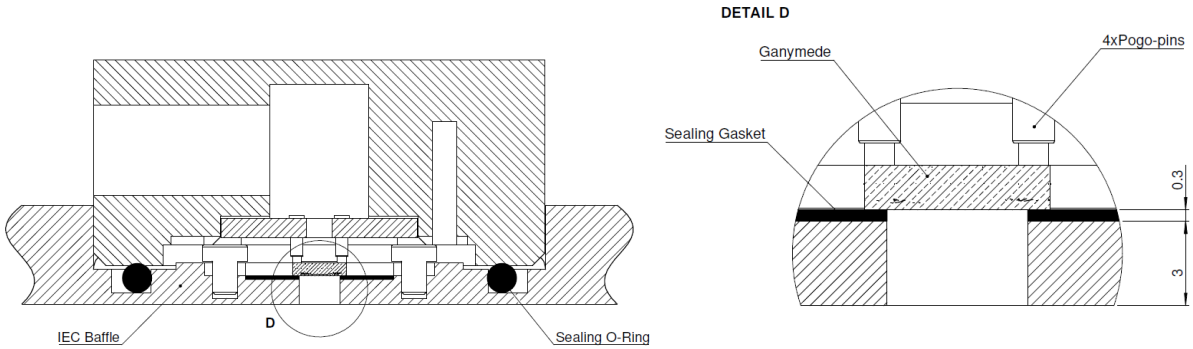
Measured with IEC 60268-5 baffle	
Baffle type	IEC 60268-5
Mic distance	3 cm
Reference distance	10 cm

Microphone	GRAS 46AC
Microphone diameter	1/2"
Microphone amplifier	B&K Nexus
Loudspeaker amplifier	G.R.A.S. 12AU
Measurement system	APx 526

Measurement signal	Exp. sweep
Voltage levels – audio $V_{DC} + V_{AC}$	15 V + 15 V_P
Voltage levels – audio $V_{DC} + V_{AC}$	15 V + 5 V_P

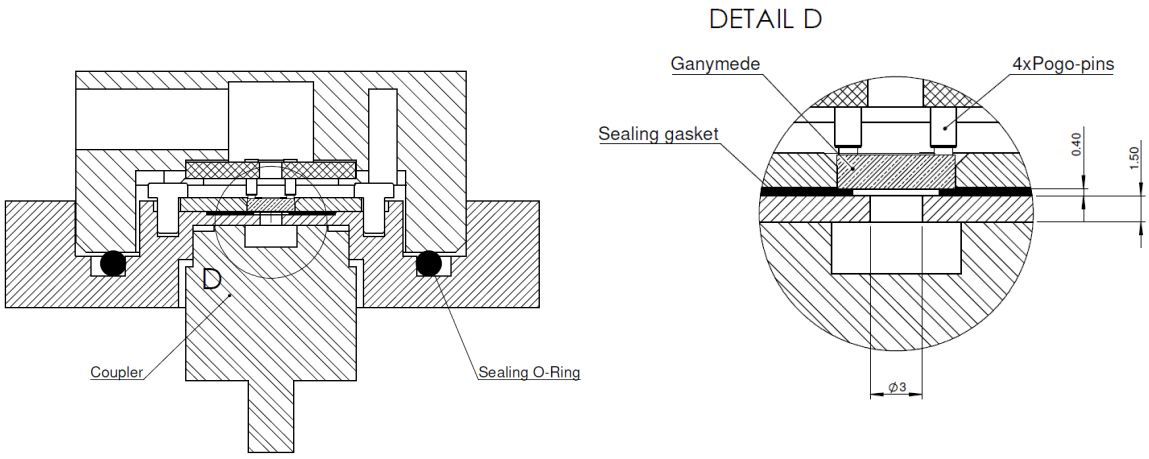
Applied back volume	Open (infinite)

Measurement Adapter - Baffle



The outlet through the baffle for the speaker has the same shape as the inside of the speaker cover (4.99 x 3.01 mm with radius 1.2 mm).

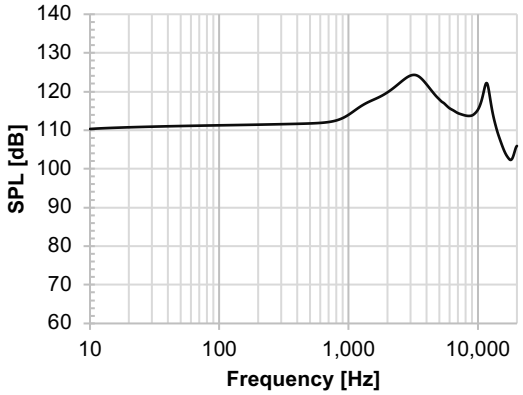
Measurement Adapter – Coupler



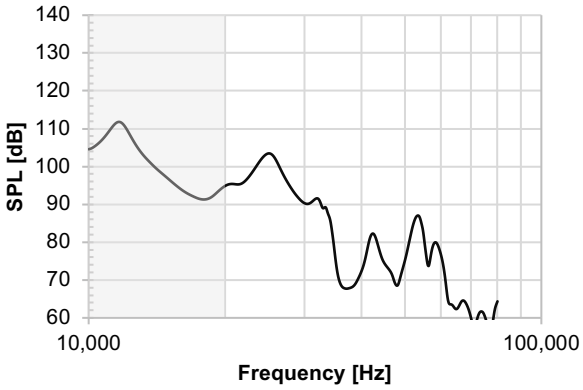
The outlet from the speaker to the coupler is round with a diameter of 3 mm.

Acoustic parameters IEC 60318-4 coupler

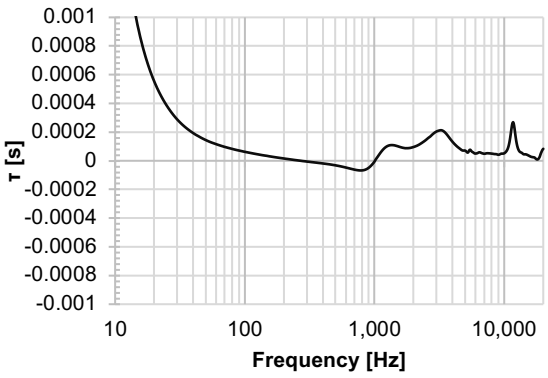
SPL (@15 V_P drive) - Audio



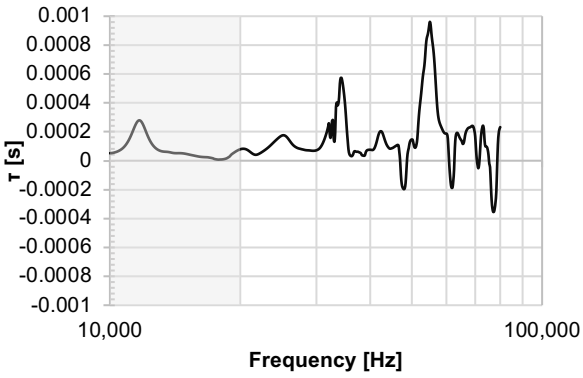
SPL (@5 V_P drive) - Ultrasound



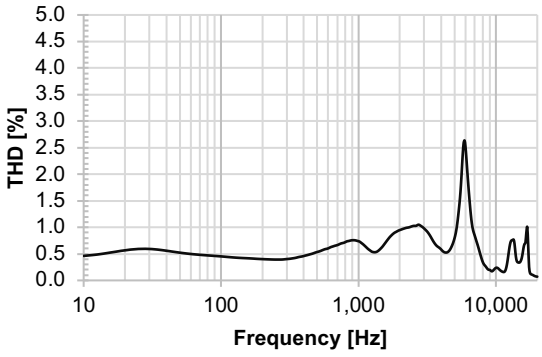
Group Delay - Audio



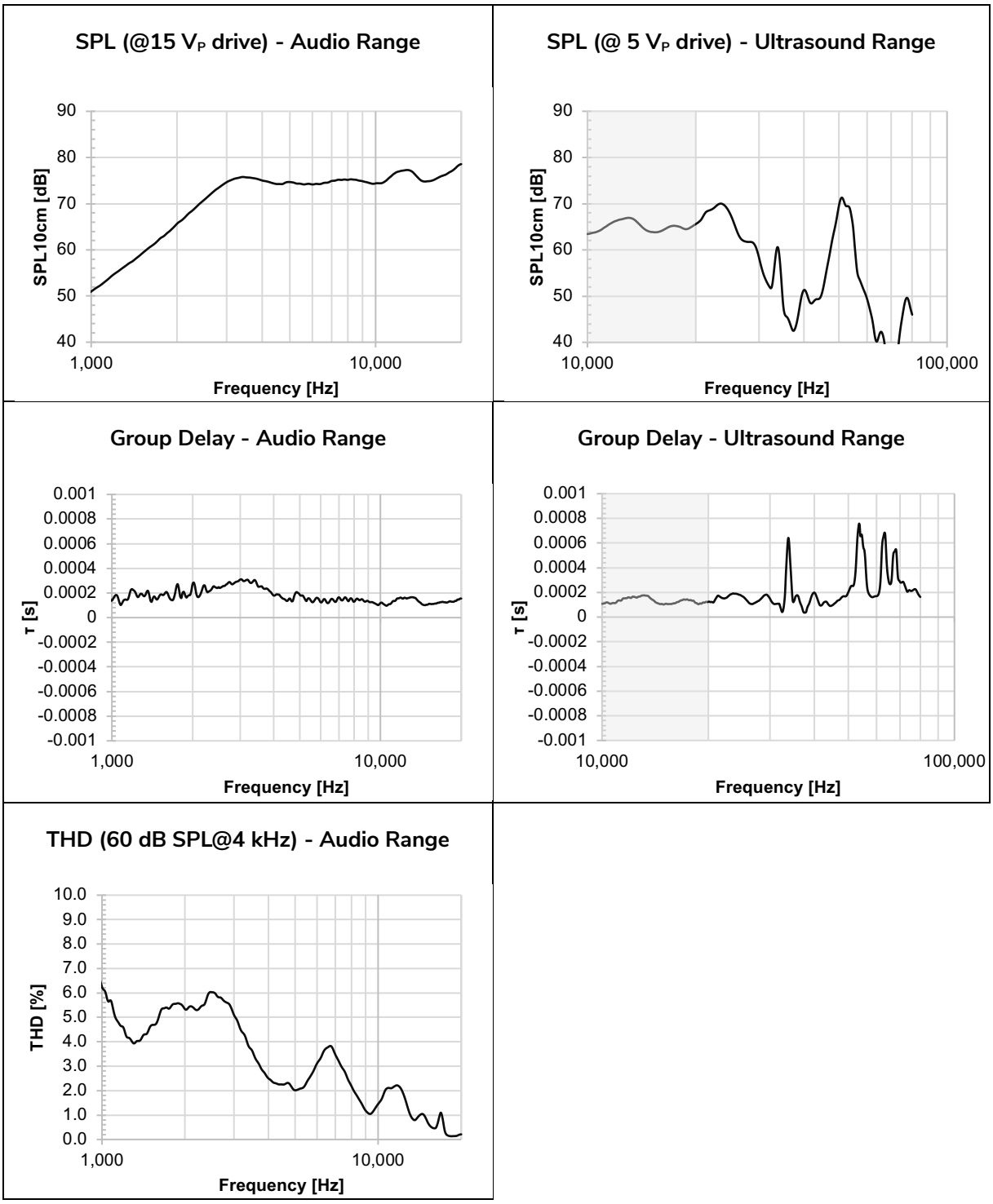
Group Delay - Ultrasound



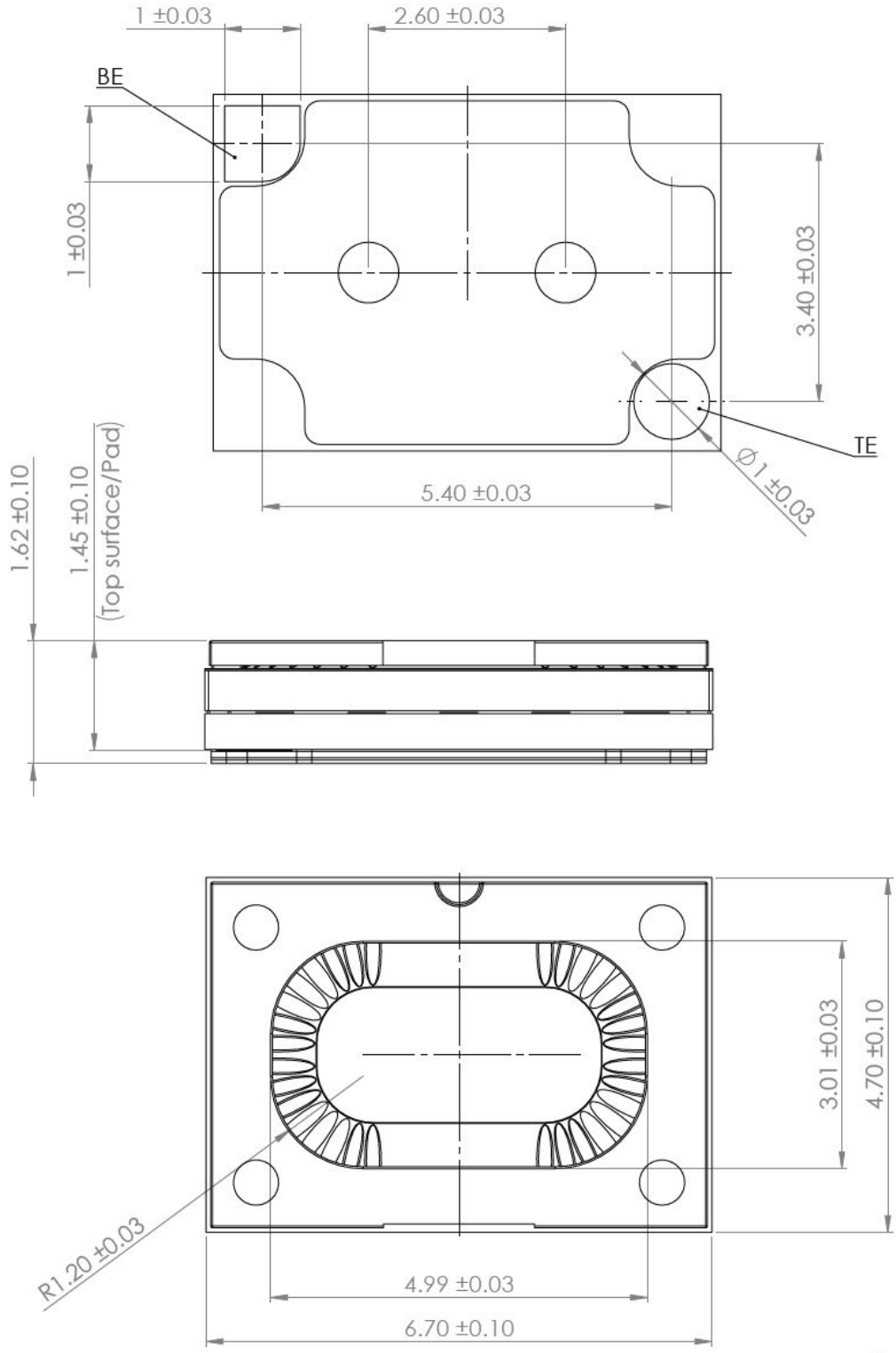
THD (94 dB SPL@1 kHz) - Audio



Acoustic parameters IEC 60268-5 baffle

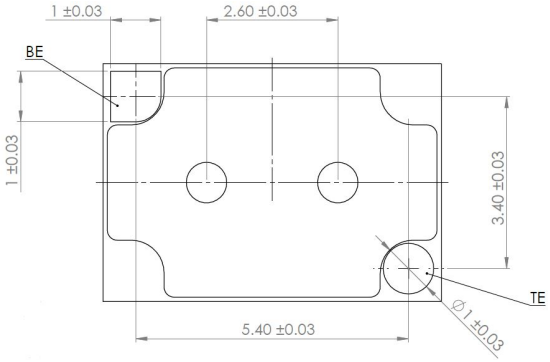


MECHANICAL DIMENSIONS



CONNECTIVITY

The speaker is driven by applying voltage between the connections for the top electrode (TE) and the bottom electrode (BE). The potential of BE has to be always equal or higher than the TE. To ensure that, a DC voltage together with the AC signal have to be applied on BE.



Attention: The AC peak voltage must be always smaller or equal the DC voltage.

Connections from Amplifier	Connections on the speaker
Positive voltage	BE (bottom electrode)
Negative voltage	TE (top electrode)

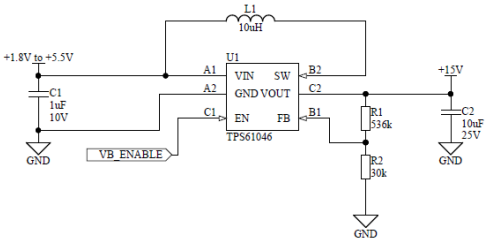
OPERATING CONDITIONS

Maximum AC voltage (peak) – up to 20 kHz	[V_P]	15
Maximum AC voltage (peak) – up to 40 kHz	[V_P]	5
Maximum DC voltage	[V]	15
Maximum AC current (peak)	[mA_P]	200

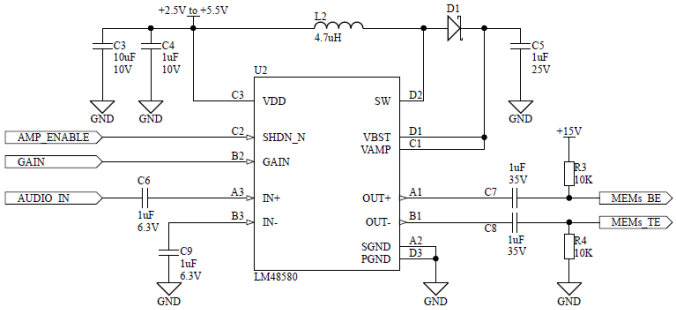
REFERENCE AMPLIFIER SCHEMATIC

The figure below shows the typical driving circuit with the TI LM48580 amplifier. The circuit consists of two main blocks:

- LM48580 amplifier including needed passive components
- TPS61046 boost converter including needed passive components



The boost converter is configured to provide a constant 15 V_{DC} offset for the amplifier. The amplifier circuit itself is based on the typical application diagram from the LM48580 datasheet. It is based on a single ended input signal but can be also modified according to the datasheet to a differential input.



The circuit has three pins for configuration. These can be switched via a microcontroller, logic or simply hard wired.

Enabling the boost converter: The boost converter can be enabled/disabled using the VB_ENABLE signal. If no microcontroller or logic is available, the pin can be pulled high so that the boost converter is always enabled as soon as the supply voltage is present.

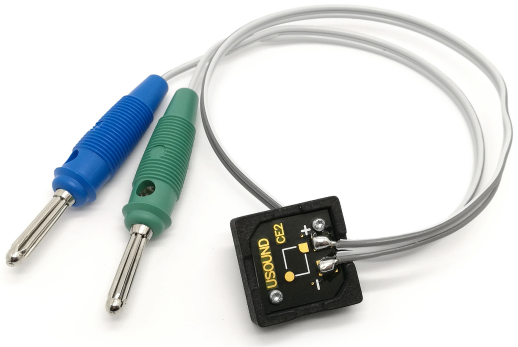
Enabling the amplifier: The amplifier can be enabled/disabled using the AMP_ENABLE signal. If no microcontroller or logic is available, the pin can be pulled high so that the boost converter is always enabled as soon as the supply voltage is present.

Amplifier gain: The LM48580 has three different gain settings which can be configured using the GAIN signal. The gain pin can be either ground, floating or VDD depending on the needed gain.

Gain Pin Voltage	Resulting Gain Setting
GND	24 dB
Float	18 dB
V_{DD}	30 dB

CARME TEST BOX

To analyse the performance of the MEMS speaker Adap, the test box Carme is available. With a back volume of 100 mm³, Carme provides the necessary sealing to avoid an acoustic short circuit and a convenient way to connect Adap to the USound's linear amplifier, Amalthea.

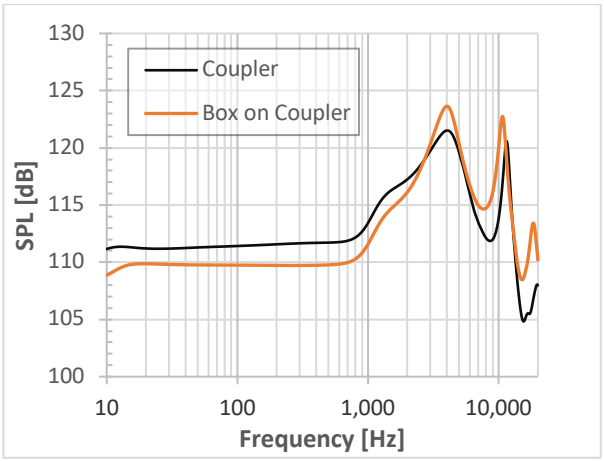


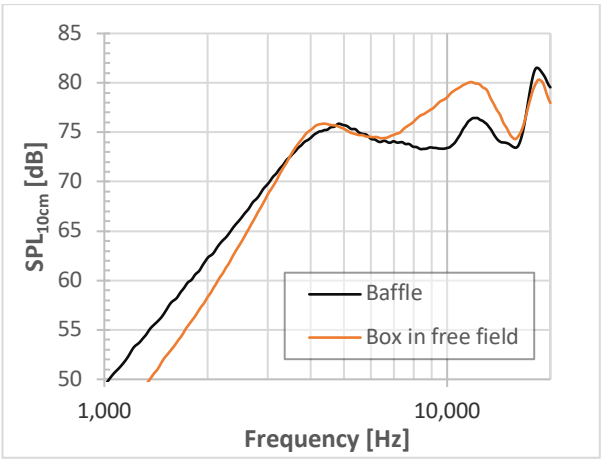
In order to set up Carme, unscrew and separate the PCB from the shell. Remove the housing gasket and place the Adap MEMS speaker with the contact side up. Place the PCB matching the orientation marks to the speaker. Tighten the screw for proper sealing.

Positive input (BE)	Blue
Negative input (TE)	Green

The colour coding matches the outputs of Amalthea.

Using the Carme speaker box, Adap can be measured in free field as well as on the coupler. In the latter case, a gasket needs to be placed between the coupler base part and the speaker box to ensure proper sealing of the front volume. As a reference, the SPL result of both applications (in free field and on the coupler) in comparison to the standard USound measurement setup (denoted as coupler and baffle in the graphs) is shown below.





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WWW.USOUND.COM | CUSTOMER-SERVICE@USOUND.COM