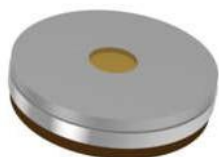
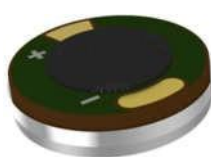


## General Description

Ø 6.0 x 1.49 mm MEMS Speaker



Top View



Bottom View



## ELECTRICAL SPECIFICATIONS

| Parameters                          | Value     | Unit            |
|-------------------------------------|-----------|-----------------|
| Resonance Frequency                 | 2300 ±10% | Hz              |
| Q-Factor                            | 1.5       | -               |
| Effective membrane surface – $S_D$  | 13.6      | mm <sup>2</sup> |
| Equivalent volume – $V_{AS}$        | 60        | mm <sup>3</sup> |
| Internal back volume of the speaker | 9.4       | mm <sup>3</sup> |

Note: Nominal driving conditions, if not otherwise noted: 1.5 V<sub>RMS</sub> (2.1V<sub>P</sub>) + 10 V<sub>DC</sub> required.

## Electronics

| Parameters                              | Value  | Unit |
|---|--------|------|
| Capacitance (with LCR-Meter at 1V/1kHz) | 11±2.1 | nF   |
| SPL @ 1 kHz / 1mW                       | 105±3  | dB   |

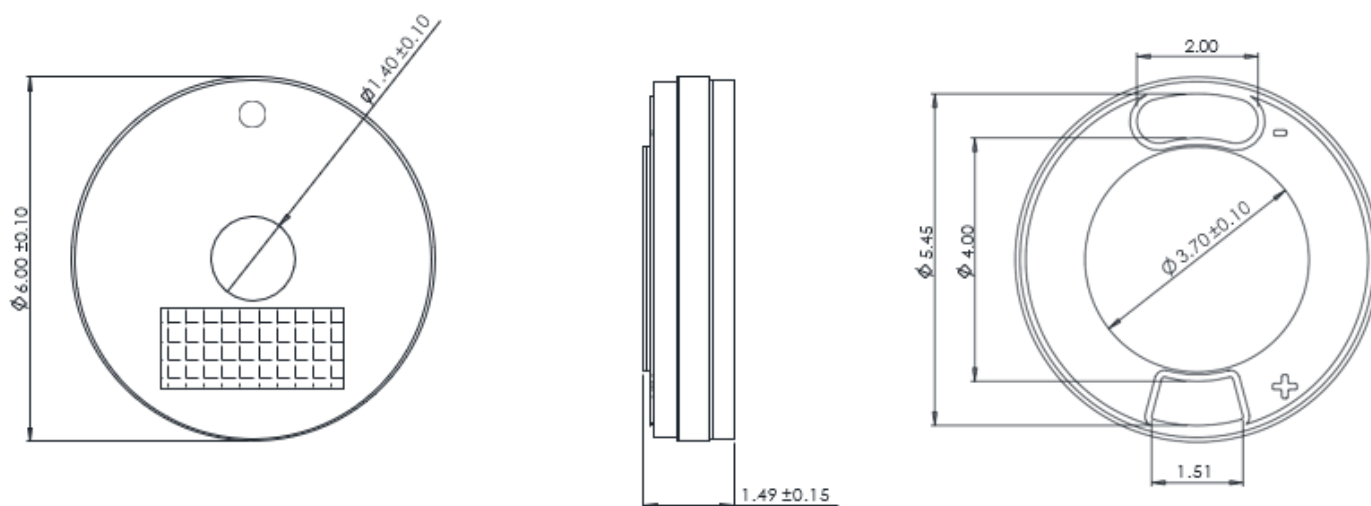
## Maximum Operating Conditions

| Parameters                      | Value | Unit |
|---------------------------------|-------|------|
| Voltage Range(AC+DC)            | 13.5  | V    |
| Upper Operating Frequency Limit | 80    | kHz  |

### ACOUSTICS IN COUPLER (IEC 60318-4)

| Parameters                         | Value   | Unit |
|------------------------------------|---------|------|
| SPL @ 250 Hz / 1.4VRMS (2 Vp)      | 97±3    | dB   |
| SPL @ 1 kHz / 1.4VRMS (2 Vp)       | 100±3   | dB   |
| SPL @ 2.5 kHz / 1.4VRMS (2 Vp)     | 108±3   | dB   |
| SPL @ 5 kHz / 1.4VRMS (2 Vp)       | 97±3    | dB   |
| SPL @ 250 Hz / 1.4VRMS (2 Vp)      | 114±3   | dB   |
| SPL @ 1 kHz / 9.5 VRMS (13.5 Vp)   | 117±3   | dB   |
| SPL @ 2.5 kHz / 9.5 VRMS (13.5 Vp) | 124±3   | dB   |
| SPL @ 5 kHz / 9.5 VRMS (13.5 Vp)   | 114±3   | dB   |
| THD @ 250 Hz / 1.4VRMS (2Vp)       | 0.8+0.5 | %    |
| THD @ 1 kHz / 1.4VRMS (2Vp)        | 2+1.2   | %    |
| THD @ 2.5 kHz / 1.4VRMS (2Vp)      | 0.1+0.1 | %    |
| THD @ 5 kHz / 1.4VRMS (2Vp)        | 0.6+0.3 | %    |

### DIMENSIONS

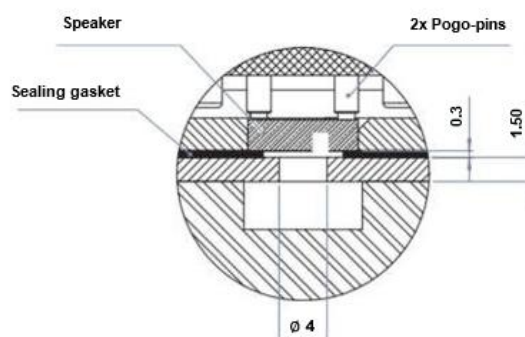
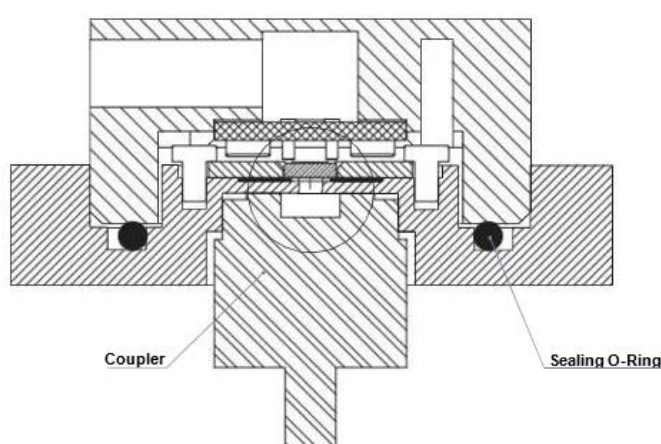


Unit : mm    Unmarked Tolerance:  $\pm 0.1$  (mm)

## MEASUREMENT SYSTEM SETUP

| General                |                                     |
|------------------------|-------------------------------------|
| Measurement system     | Audio Precision APx                 |
| Measurement signal     | Exp. Sweep                          |
| Voltage level $V_{AC}$ | 1.4 VRMS (2Vp // 9.5 Vrms (13.5 Vp) |
| Applied back volume    | Open (infinite)                     |

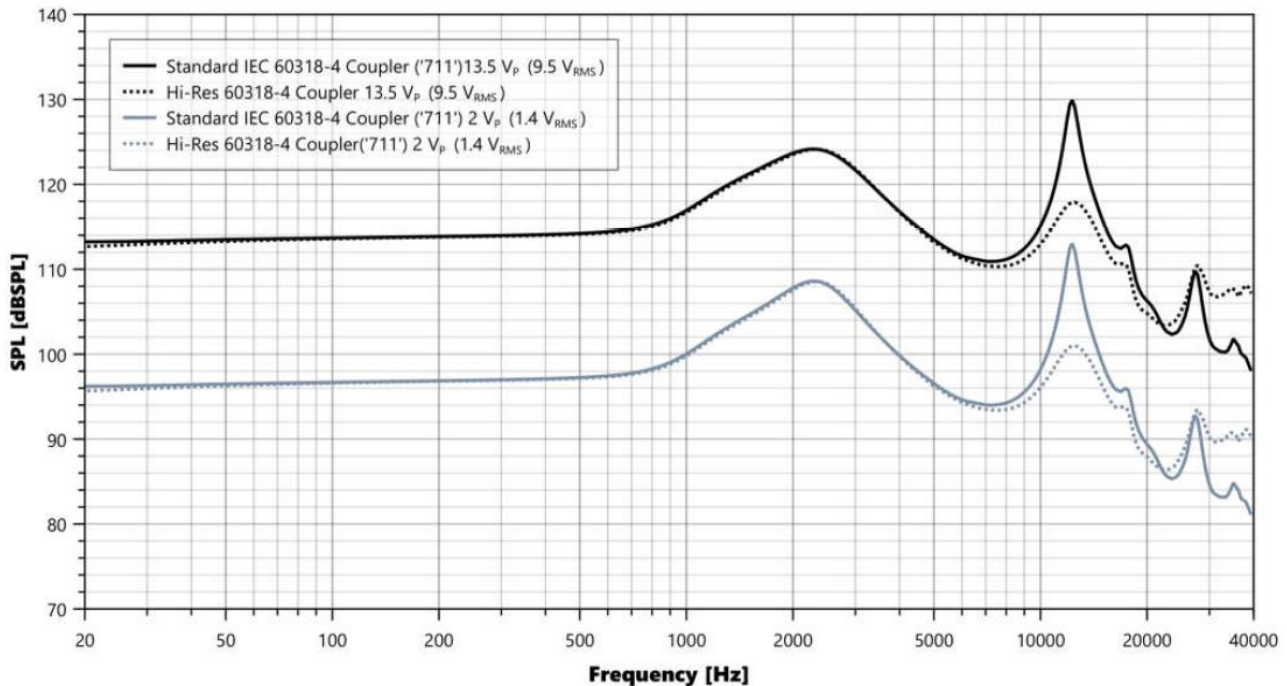
| Coupler (IEC 60318-4)    |                      |
|--------------------------|----------------------|
| Coupler type             | IEC 60318-4 ('711')  |
| Coupler volume           | 1.26 cm <sup>3</sup> |
| Connection tube length   | 1.5 mm               |
| Connection tube diameter | 4.0 mm               |
| Microphone               | GRAS 43AC            |



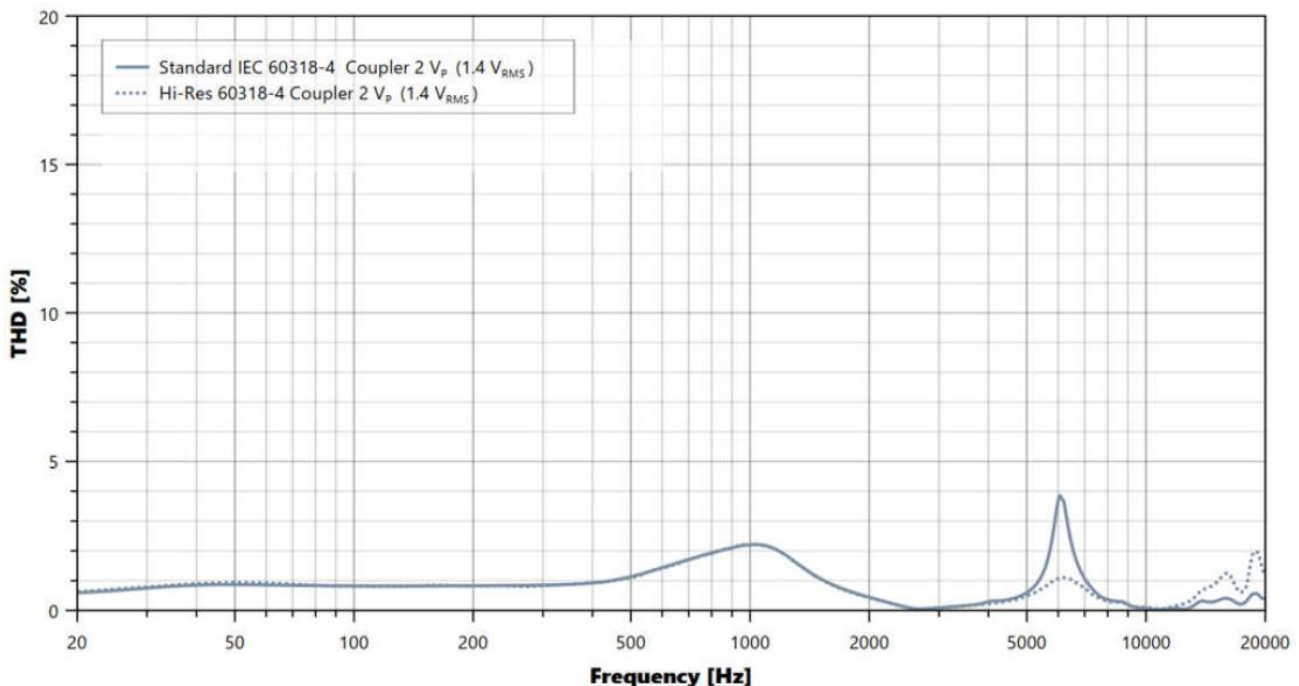
Coupler adapter cross-section. The speaker adapter is directly screwed onto the coupler; the ear mold adapter is not used.

The outlet for the speaker is round with a diameter of  
4 mm and length of 1.5 mm.

### FREQUENCY CHARACTERISTICS



SPL at 1.4 V<sub>RMS</sub> (2 V<sub>P</sub>) drive and at 9.5 V<sub>RMS</sub> (13.5 V<sub>P</sub>) drive, measured with the standard 711-Coupler (IEC 60318-4) and with the Hi-Res Coupler from GRAS, the latter replicates the frequency response above 10 kHz more accurately.



## CONNECTIVITY

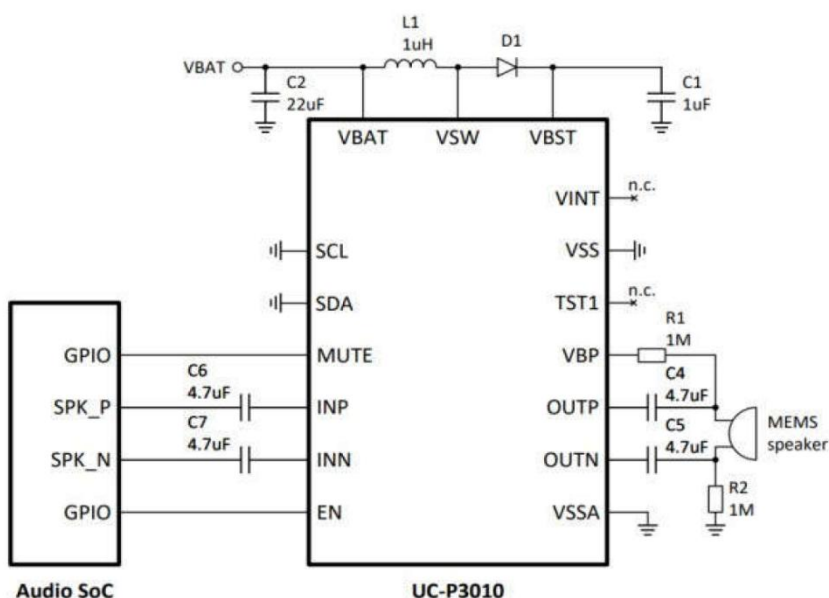
The speaker is driven by applying a voltage between the (+) and the (-) contacts. The bigger pad corresponds to the negative input, the smaller pad to the positive (Figure ).

A positive voltage on the positive pad will result in the membrane moving up (away from the pads).

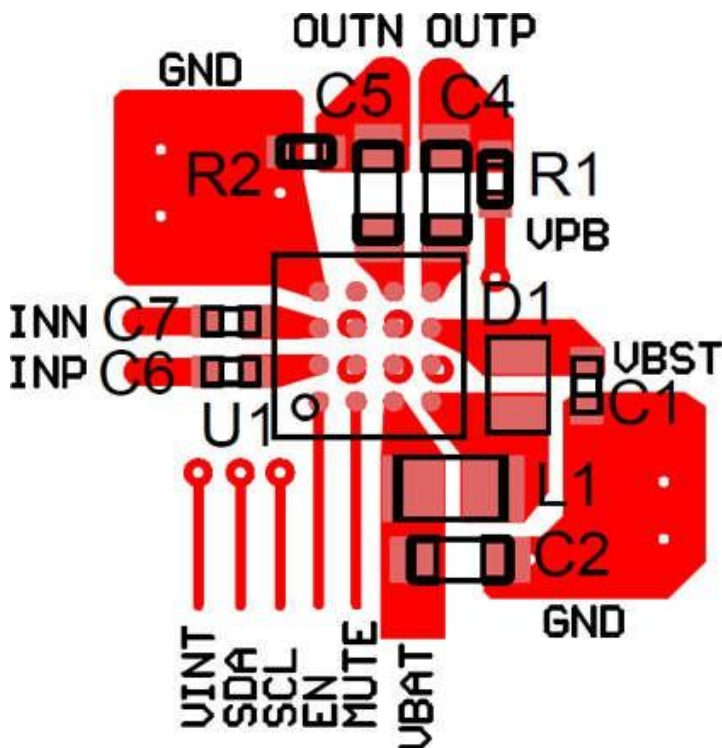


Electrical contacts of the MEMS speaker.

## TYPICAL APPLICATION CIRCUIT



## RECOMMENDED PCB LAYOUT



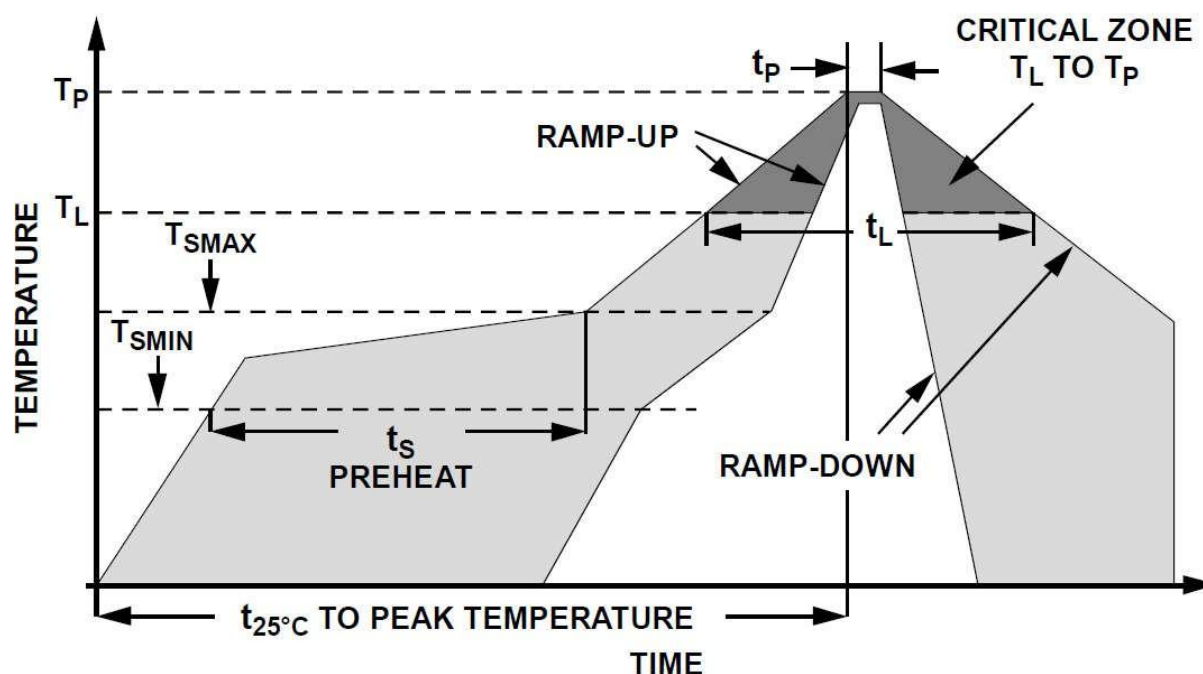
The input capacitors C6 and C7 as well as the output capacitors C4 and C5 linearity (minimal change of capacitance over voltage) is important for minimal contribution to the THD, typically achieved with higher voltage rating ceramic capacitors.

### LAYOUT GUIDELINE:

A low-impedance compact PCB layout design is required in the DC-DC part. This includes the pins VSW, VSS, VBST, the inductor L1 and the Schottky diode D1. Design a short and wide connection for VSW (L1-D1) and VBAT, especially in the connectivity of the boost diode (D1), boost Inductor (L1), boost capacitor (C1) and VBAT bypass capacitor (C2).

Components C3 and R3 require a very short and wide connection as well to function appropriately. The unused pins B2 and B3 should be grounded. The unused pins C3 and B4 should be floating.

### RECOMMENDED PCB LAYOUT



| Parameter   |                               | Reference           | Specification |
|---|-------------------------------|---------------------|---------------|
| Average Ramp Rate   |                               | $T_L$ to $T_P$      | 3°C/sec max   |
| Preheat   | Minimum Temperature           | $T_{SMIN}$          | 110°C         |
|   | Maximum Temperature           | $T_{SMAX}$          | 145°C         |
|   | Time $T_{SMIN}$ to $T_{SMAX}$ | $t_s$               | 60 sec        |
| Ramp-Up Rate  |                               | $T_{SMAX}$ to $T_L$ | 3°C/sec       |
| Liquidous Temperature                                       |                               | $T_L$               | 157°C         |
| Peak Temperature  |                               | $T_P$               | 200°C         |
| Ramp-Down Rate  |                               | $T_P$ to $T_{SMAX}$ | 6°C/sec max   |
| Time +25°C ( $t_{25^{\circ}\text{C}}$ ) to Peak Temperature |                               |                     | 240 sec       |



## SPECIAL CAUTIONS

### GENERAL

It needs to be considered that MEMS devices consist of silicon structures, and therefore, they should be handled with care. Any bending of the MEMS speakers must be avoided while handling during the assembly process, otherwise the speaker can be damaged.

### HANDLING

Careful handling of these speakers is recommended to avoid damage. Use tweezers or a similar tool, applying light contact to the speaker's side wall.

### HAND SOLDERING

Improper soldering of MEMS speakers at high temperatures can potentially damage the component. Apply soldering iron only on the electrical pads on the bottom side of the speaker during the soldering process. It is recommended to follow the standard IPC J-STD-001 "Requirements for Soldered Electrical and Electronic Assemblies." For inspection, it is suggested to follow IPC-A-610G.

| Type                        | Recommended Parameters | Comments   |
|-----------------------------|------------------------|------------|
| Soldering Temperature 340°C | 340°C                  | -          |
| Soldering Time              | 1-2 s                  | Maximum 5s |

## APPROVAL

|             |   |
|-------------|---|
| DRAWN BY    | AR, June 12, 2025   |
| APPROVED BY | CP, June 12, 2025   |
| REVISION    | A, Initial Release  |
|             | B, AR, July 04, 2025<br>Updated the current revision levels |



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