

MEMS audio sensor omnidirectional digital microphone

Datasheet - production data



Features

- Single supply voltage
- Low power consumption
- 120 dB SPL acoustic overload point
- Omnidirectional sensitivity
- PDM single-bit output with option for stereo configuration
- HLGA package (SMD-compliant) plastic or metal
- ECOPACK®, RoHS, and “Green” compliant

Applications

- Mobile terminals
- Laptop and notebook computers
- Portable media players
- VoIP
- Speech recognition
- A/V eLearning devices
- Gaming and virtual reality input devices
- Digital still and video cameras
- Antitheft systems

Description

The MP45DT02 is a compact, low-power, top-port, omnidirectional, digital MEMS microphone. The MP45DT02 is built with a sensing element and an IC interface with stereo capability.

The sensing element, capable of detecting acoustic waves, is manufactured using a specialized silicon micromachining process to produce audio sensors.

The IC interface is manufactured using a CMOS process that allows designing a dedicated circuit able to provide a digital signal externally in PDM format.

The MP45DT02 has an acoustic overload point of 120 dB SPL with a best on the market 61 dB signal-to-noise ratio and -26 dB sensitivity.

The MP45DT02 is available in an SMD-compliant metal (M) or plastic package and is guaranteed to operate over an extended temperature range from -30 °C to +85 °C.

The MP45DT02's digital output and package size (1.25 mm thick) make this device the best solution for laptop and portable computing applications.

Table 1: Device summary

| Order code | Temp. range [°C] | Package | Packing |
|--------------|------------------|-----------------------|---------------|
| MP45DT02 | -30 to +85 | HLGA 4.72x3.76 6LD | Tray |
| MP45DT02TR | -30 to +85 | HLGA 4.72x3.76 6LD | Tape and reel |
| MP45DT02TR-M | -30 to +85 | HLGA 4.72x3.76 6LD | Tape and reel |

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1 Pin description

Figure 1: Pin connections

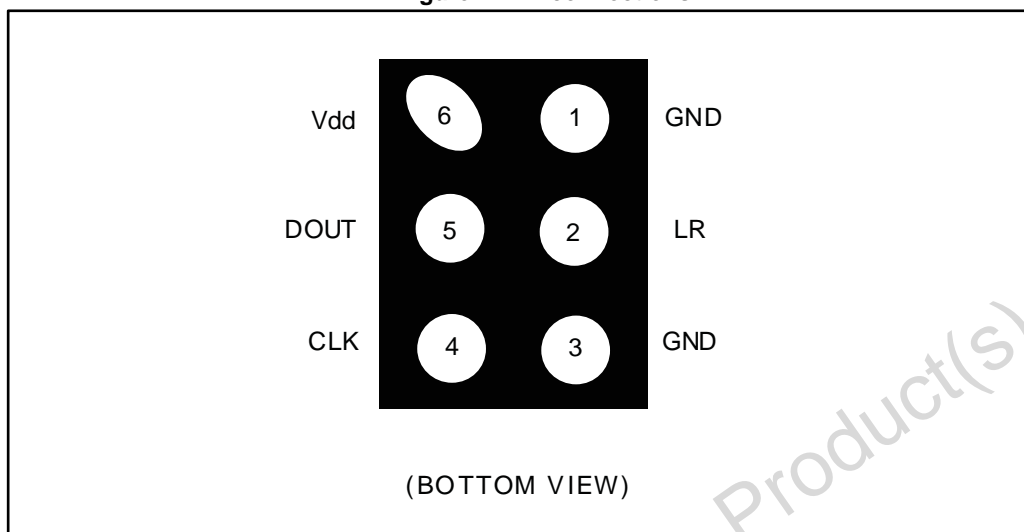


Table 2: Pin description

| Pin n° | Pin name | Function |
|--------|----------|---|
| 1 | GND | 0 V supply |
| 2 | LR | Left/right channel selection; MIC1 LR is connected to GND or Vdd and MIC2 LR is connected to Vdd or GND (see Figure 5: "MP45DT02 electrical connections for stereo configuration") |
| 3 | GND | 0 V supply |
| 4 | CLK | Synchronization input clock |
| 5 | DOUT | Left/right PDM data output |
| 6 | Vdd | Power supply |

2 Acoustic and electrical specifications

2.1 Acoustic and electrical characteristics

The values listed in the table below are specified for Vdd = 1.8 V, Clock = 2.4 MHz, T = 25 °C, unless otherwise noted.

Table 3: Acoustic and electrical characteristics

| Symbol | Parameter | Test condition | Min. | Typ. ⁽¹⁾ | Max. | Unit |
|------------------|---|-------------------------------------|----------|---------------------|----------|--------|
| Vdd | Supply voltage | | 1.64 | 1.8 | 3.6 | V |
| Idd | Current consumption in normal mode | No load on data line | | 0.65 | | mA |
| IddPdn | Current consumption in power-down mode ⁽²⁾ | | | 20 | | μA |
| Sc | Short-circuit current | | 1 | | 10 | mA |
| AOP | Acoustic overload point | | | 120 | | dB SPL |
| So | Sensitivity | | -29 | -26 | -23 | dB FS |
| SNR | Signal-to-noise ratio | A-weighted @ 1 kHz, 1 Pa | | 61 | | dB |
| PSR | Power supply rejection | Guaranteed by design ⁽³⁾ | | -70 | | dB FS |
| Clock | Input clock frequency ⁽⁴⁾ | | 1 | 2.4 | 3.25 | MHz |
| TWK | Wake-up time ⁽⁵⁾ | Guaranteed by design | | | 10 | ms |
| Top | Operating temperature range | | -30 | | +85 | °C |
| V _{IOL} | Low level logic input/output voltage | I _{out} = 1 mA | -0.3 | | 0.35xVdd | V |
| V _{IOH} | High level logic input/output voltage | I _{out} = 1 mA | 0.65xVdd | | Vdd+0.3 | V |

Notes:

⁽¹⁾Typical specifications are not guaranteed.

⁽²⁾Input clock in static mode.

⁽³⁾Test signal: 217 Hz square wave, 100 mVpp on Vdd pin.

⁽⁴⁾Duty cycle: min = 40% max = 60%.

⁽⁵⁾Time from the first clock edge to valid output data.

Table 4: Distortion specifications

| Parameter | Test condition | Value |
|------------|----------------------------|--------------|
| Distortion | 100 dB SPL (50 Hz - 4 kHz) | < 1% THD + N |
| Distortion | 115 dB SPL (1 kHz) | < 5% THD + N |

2.2 Timing characteristics

Table 5: Timing characteristics

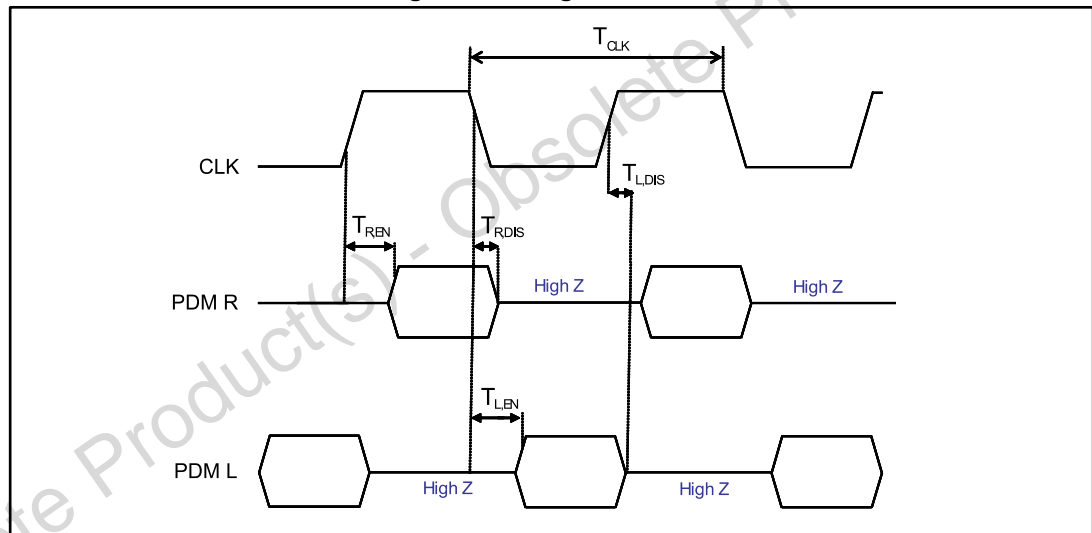
| Parameter | Description | Min | Max | Unit |
|-------------|---|-------------------|----------------------|------|
| f_{CLK} | Clock frequency for normal mode | 1 | 3.25 | MHz |
| f_{PD} | Clock frequency for power-down mode | | 0.23 | MHz |
| T_{CLK} | Clock period for normal mode | 308 | 1000 | ns |
| $T_{R,EN}$ | Data enabled on DATA line, L/R pin = 1 | 30 ⁽¹⁾ | | ns |
| $T_{R,DIS}$ | Data disabled on DATA line, L/R pin = 1 | | 16 ⁽¹⁾⁽²⁾ | ns |
| $T_{L,EN}$ | Data enabled on DATA line, L/R pin = 0 | 30 ⁽¹⁾ | | ns |
| $T_{L,DIS}$ | Data disabled on DATA line, L/R pin = 0 | | 16 ⁽¹⁾⁽²⁾ | ns |

Notes:

⁽¹⁾From design simulations

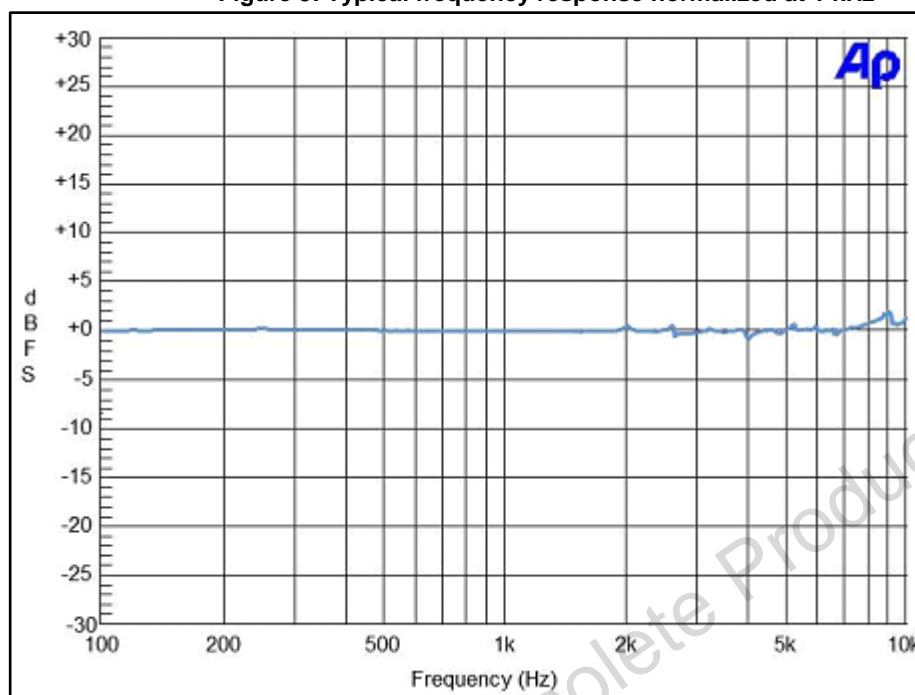
⁽²⁾In order to measure the disable time, a 1 k Ω pull-down resistor must be added to the DOUT pin.

Figure 2: Timing waveforms



2.3 Frequency response

Figure 3: Typical frequency response normalized at 1 kHz



3 Sensing element

The sensing element shall mean the acoustic sensor consisting of a conductive movable plate and a fixed plate placed in a tiny silicon chip. This sensor transduces the sound pressure into the changes of coupled capacity between those two plates.

Omron Corporation supplies this element for STMicroelectronics.

Obsolete Product(s) - Obsolete Product(s)

4 Absolute maximum ratings

Stresses above those listed as “absolute maximum ratings” may cause permanent damage to the device. This is a stress rating only and functional operation of the device under these conditions is not implied. Exposure to maximum rating conditions for extended periods may affect device reliability.

Table 6: Absolute maximum ratings

| Symbol | Ratings | Maximum value | Unit |
|------------------|------------------------------------|------------------------------|------|
| V _{dd} | Supply voltage | -0.3 to 6 | V |
| V _{in} | Input voltage on any control pin | -0.3 to V _{dd} +0.3 | V |
| T _{STG} | Storage temperature range | -40 to +125 | °C |
| ESD | Electrostatic discharge protection | 2 (HBM) | kV |



This device is sensitive to mechanical shock, improper handling can cause permanent damage to the part.



This device is sensitive to electrostatic discharge (ESD), improper handling can cause permanent damage to the part.

5 Functionality

5.1 L/R channel selection

The L/R digital pad lets the user select the DOUT signal pattern as explained in [Table 7: "L/R channel selection"](#). The L/R pin must be connected to Vdd or GND.

Table 7: L/R channel selection

| L/R | CLK low | CLK high |
|-----|----------------|----------------|
| GND | Data valid | High impedance |
| Vdd | High impedance | Data valid |

6 Application recommendations

Figure 4: MP45DT02 electrical connections

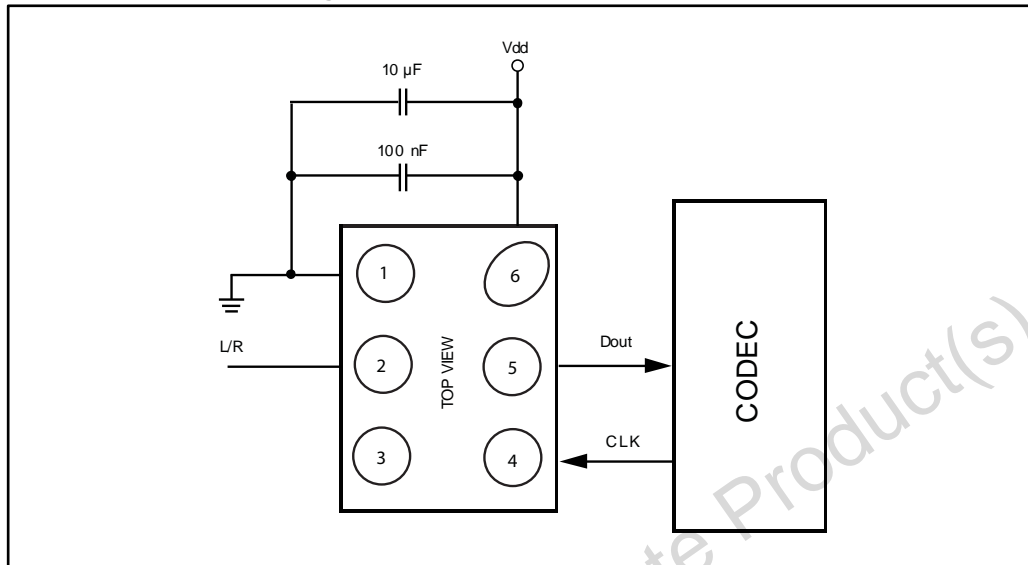
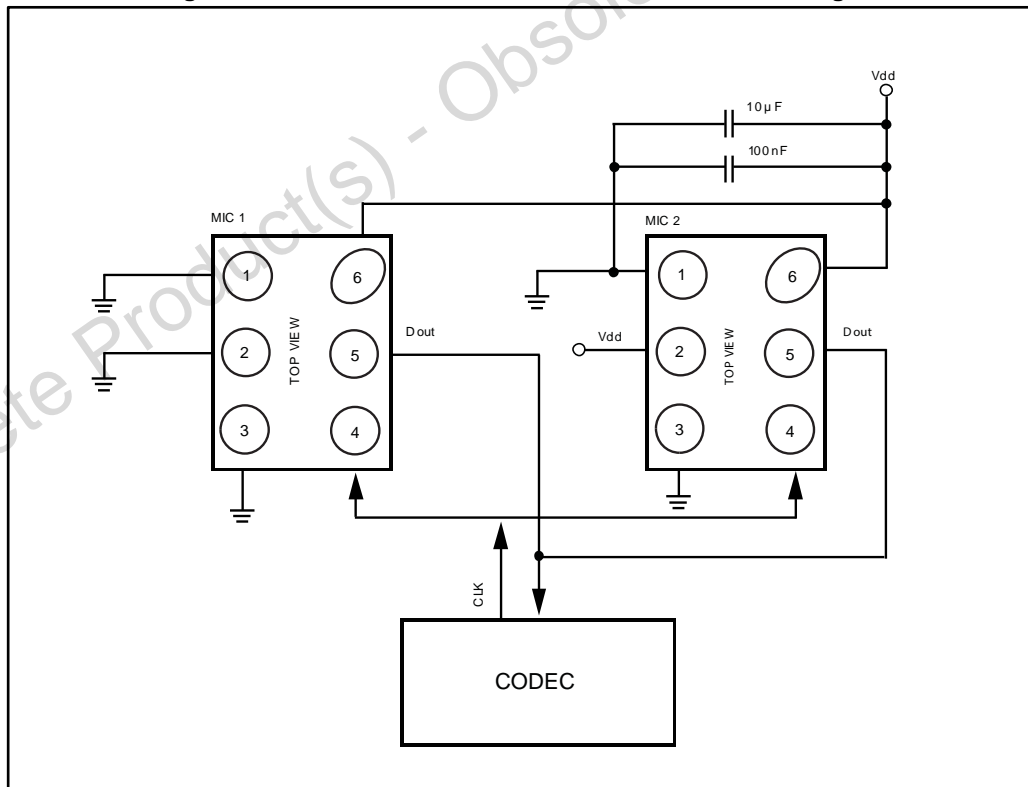


Figure 5: MP45DT02 electrical connections for stereo configuration



Power supply decoupling capacitors (100 nF ceramic, 10 µF ceramic) should be placed as near as possible to pin 6 of the device (common design practice).

The L/R pin must be connected to Vdd or GND (refer to [Table 7: "L/R channel selection"](#)).

7 Package information

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK® packages, depending on their level of environmental compliance. ECOPACK® specifications, grade definitions and product status are available at: www.st.com. ECOPACK® is an ST trademark.

7.1 Soldering information

The HLGA (4.72 x 3.76 x 1.25) mm package is also compliant with the RoHS and “Green” standards and is qualified for soldering heat resistance according to JEDEC J-STD-020.

Landing pattern and soldering recommendations are available at www.st.com.

Figure 6: Recommended soldering profile limits

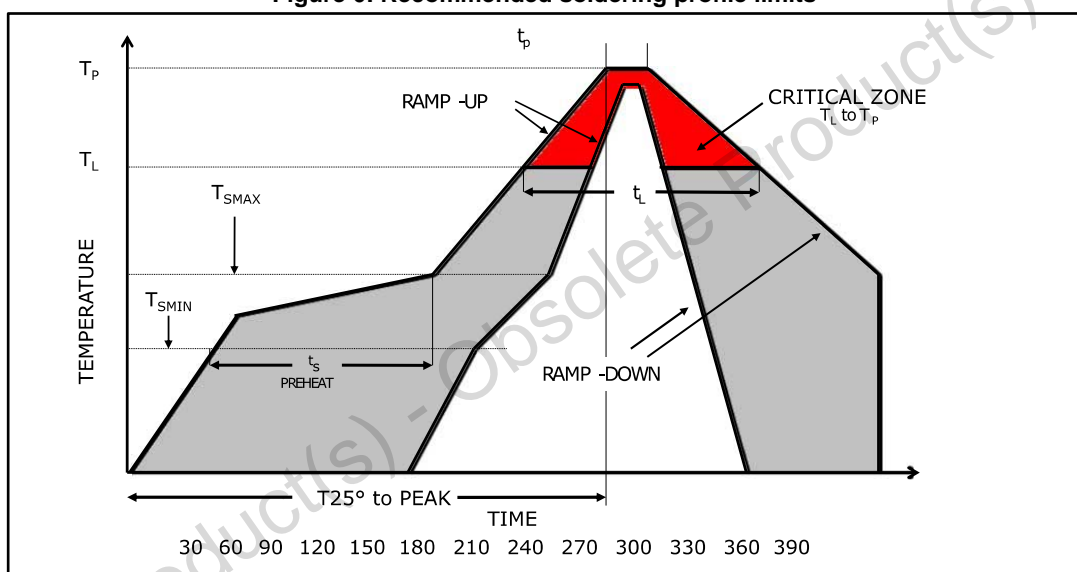


Table 8: Recommended soldering profile limits

| Description | Parameter | Pb free |
|---|---------------------|-------------------|
| Average ramp rate | T_L to T_P | 3 °C/sec max |
| Preheat | | |
| Minimum temperature | T_{SMIN} | 150 °C |
| Maximum temperature | T_{SMAX} | 200 °C |
| Time (T_{SMIN} to T_{SMAX}) | t_s | 60 sec to 120 sec |
| Ramp-up rate | T_{SMAX} to T_L | |
| Time maintained above liquidus temperature | t_L | 60 sec to 150 sec |
| Liquidus temperature | T_L | 217 °C |
| Peak temperature | T_P | 260 °C max |
| Time within 5 °C of actual peak temperature | | 20 sec to 40 sec |
| Ramp-down rate | | 6 °C/sec max |
| Time 25 °C (t_{25}) to peak temperature | | 8 minutes max |

7.2 HLGA (4.72 x 3.76 mm) 6L (plastic) package information

Figure 7: HLGA (4.72 x 3.76 mm) 6-lead package outline

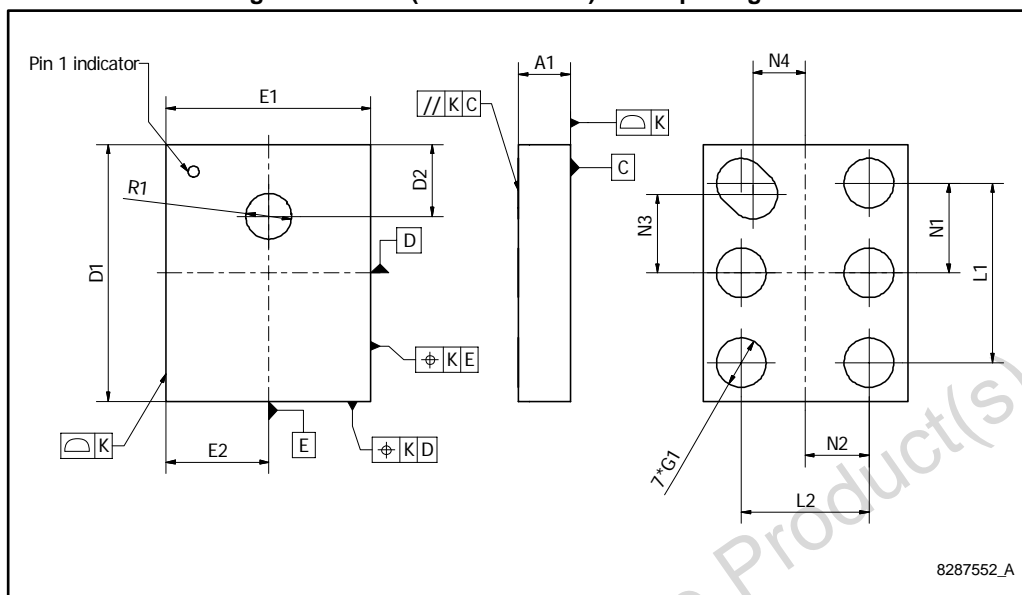
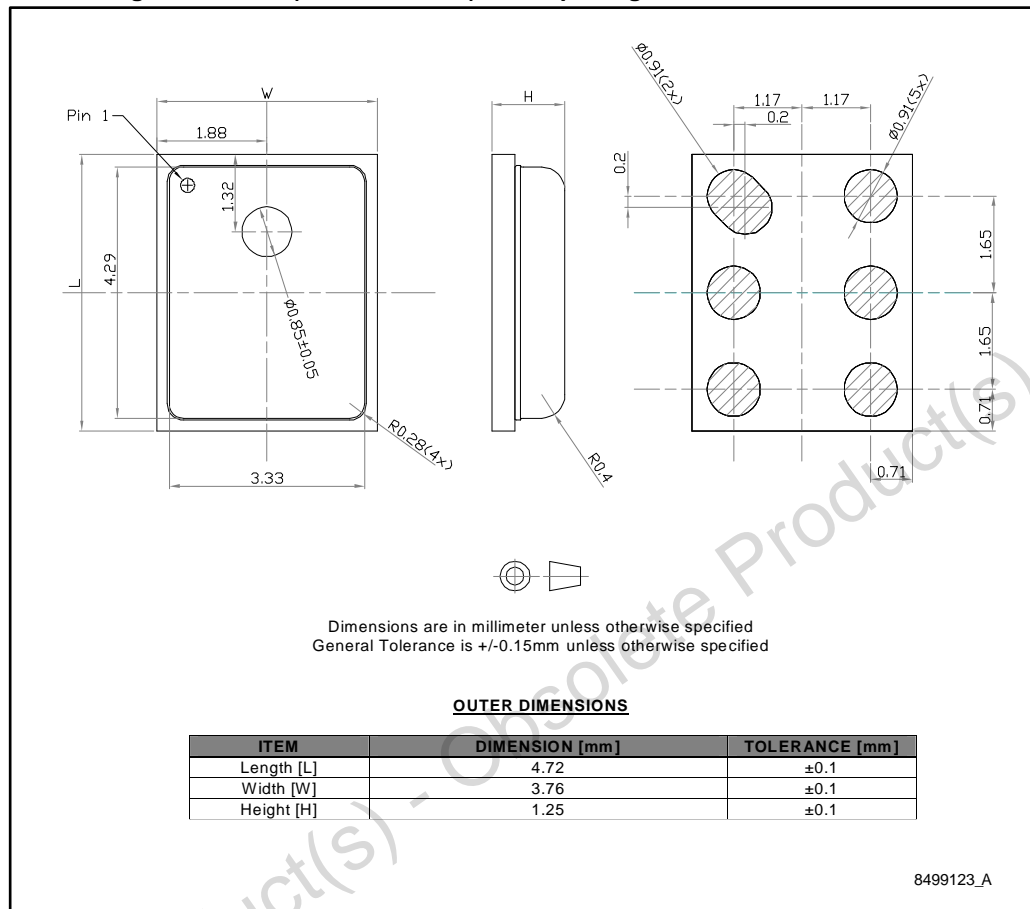


Table 9: HLGA (4.72 x 3.76 mm) 6-lead package mechanical data

| Symbol | mm. | | |
|--------|-------|-------|-------|
| | Min. | Typ. | Max. |
| A1 | 1.125 | 1.250 | 1.375 |
| D1 | 4.670 | 4.720 | 4.770 |
| D2 | | 1.320 | |
| R1 | 0.750 | 0.840 | 0.930 |
| E1 | 3.710 | 3.760 | 3.810 |
| E2 | | 1.880 | |
| L1 | 3.200 | 3.300 | 3.400 |
| L2 | 2.250 | 2.350 | 2.450 |
| N1 | 1.550 | 1.650 | 1.750 |
| N2 | 1.075 | 1.175 | 1.275 |
| N3 | 1.350 | 1.450 | 1.550 |
| N4 | 0.865 | 0.965 | 1.065 |
| G1 | 0.810 | 0.910 | 1.010 |
| K | | 0.050 | |

7.3 HLGA (4.72 x 3.76 mm) 6L (metal) package information

Figure 8: HLGA (4.72 x 3.76 mm) 6-lead package outline and mechanical data



Note: The MEMS microphone metal cap can exhibit some level of variation in color when the device is subjected to a thermal process.

8 Revision history

Table 10: Document revision history

| Date | Revision | Changes |
|-------------|----------|---|
| 28-Mar-2011 | 1 | Initial release |
| 21-Oct-2011 | 2 | Added max. peak temperature T_P to Added min. and max. sensitivity S_o to <i>Table 3: "Acoustic and electrical characteristics"</i> |
| 01-Mar-2012 | 3 | Document status promoted from preliminary to production data Updated SNR to 61 dB (<i>"Description"</i> and <i>Table 3: "Acoustic and electrical characteristics"</i>) |
| 07-May-2012 | 4 | Added V_{IOL} , V_{IOH} to <i>Table 3: "Acoustic and electrical characteristics"</i> |
| 05-Jul-2012 | 5 | Added <i>Section 4: "Sensing element"</i> |
| 21-Mar-2014 | 6 | Added new package <i>"Figure 8: "HLGA (4.72 x 3.76 mm) 6-lead package outline and mechanical data"</i> |
| 17-Jun-2014 | 7 | Updated <i>"Figure 3: Typical frequency response normalized at 1 kHz"</i> |
| 26-Jan-2016 | 8 | Added footnote concerning disable time to <i>Table 5: "Timing characteristics"</i> |

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