

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)
- ECOPACK[®], RoHS, and “Green” compliant

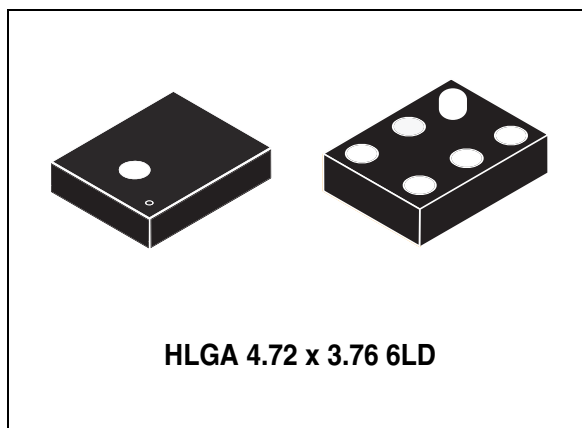
Applications

- 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 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	Temperature range [°C]	Package	Packing
MP45DT02	-30 to +85	HLGA 4.72 x 3.76 6LD	Tray
MP45DT02TR	-30 to +85	HLGA 4.72 x 3.76 6LD	Tape and reel

Contents

1	Pin description	5
2	Acoustic and electrical specifications	6
	2.1 Acoustic and electrical characteristics	6
	2.2 Timing characteristics	7
	2.3 Frequency response	8
3	Sensing element	9
4	Absolute maximum ratings	10
5	Functionality	11
	5.1 L/R channel selection	11
6	Application recommendations	12
7	Package mechanical data	13
8	Revision history	15

List of tables

Table 1.	Device summary	1
Table 2.	Pin description	5
Table 3.	Acoustic and electrical characteristics	6
Table 4.	Distortion specifications	6
Table 5.	Timing characteristics	7
Table 6.	Frequency response mask for digital microphones	8
Table 7.	Absolute maximum ratings	10
Table 8.	L/R channel selection	11
Table 9.	Recommended soldering profile limits	13
Table 10.	HLGA 4.72 mm x 3.76 mm 6-lead package dimensions.	14
Table 11.	Document revision history	15

List of figures

Figure 1.	Pin connections	5
Figure 2.	Timing waveforms	7
Figure 3.	Typical frequency response normalized at 1 kHz	8
Figure 4.	MP45DT02 electrical connections	12
Figure 5.	MP45DT02 electrical connections for stereo configuration	12
Figure 6.	Recommended soldering profile limits	13
Figure 7.	HLGA 4.72 mm x 3.76 mm 6-lead package outline	14

1 Pin description

Figure 1. Pin connections

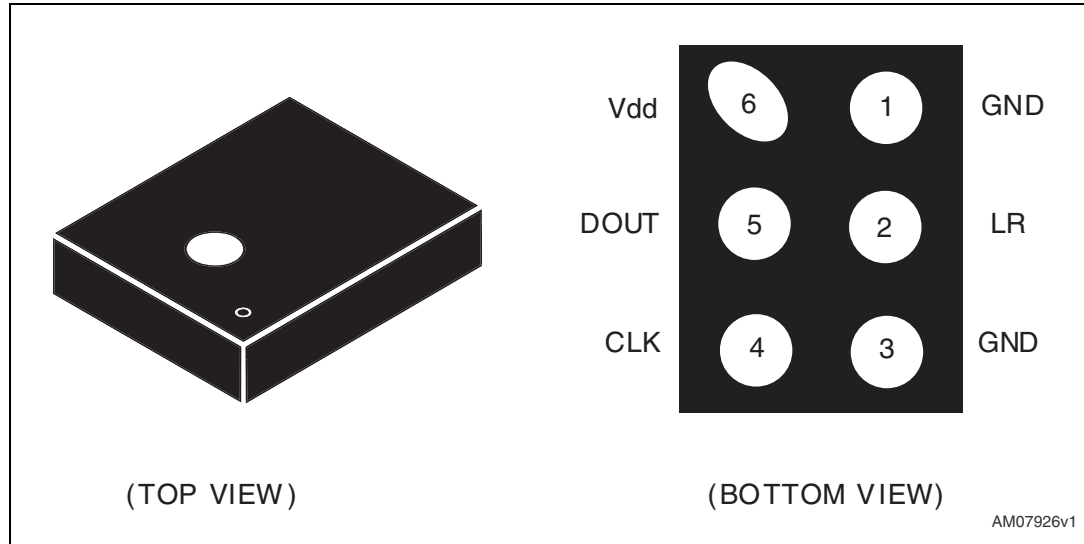


Table 2. Pin description

Pin #	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)
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	dBFS
SNR	Signal-to-noise ratio	A-weighted @ 1 kHz, 1 Pa		61		dB
PSR	Power supply rejection	Guaranteed by design ⁽³⁾		-70		dBFS
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

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

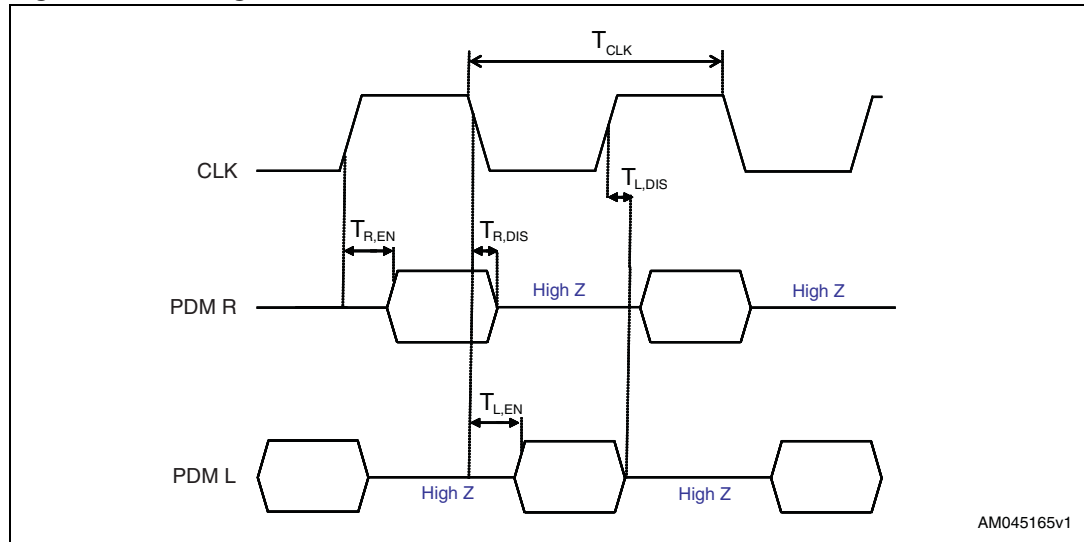
2.2 Timing characteristics

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⁾	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⁾	ns

1. From design simulations

Figure 2. Timing waveforms



AM045165v1

2.3 Frequency response

Figure 3. Typical frequency response normalized at 1 kHz

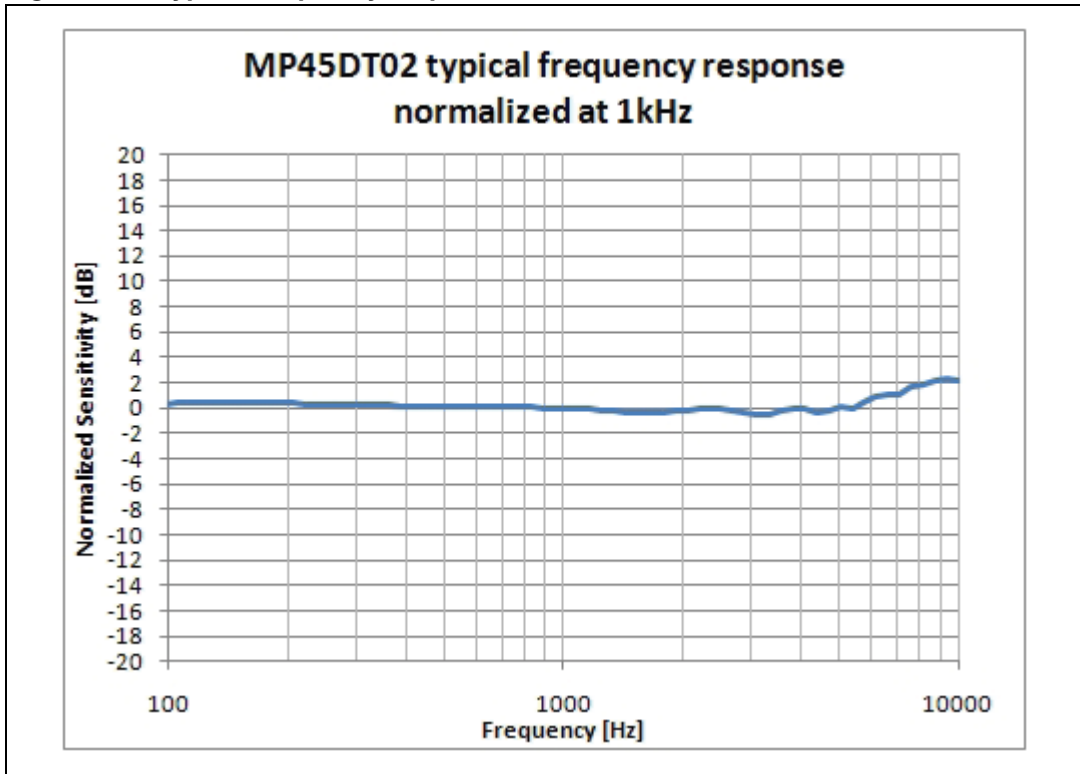


Table 6. Frequency response mask for digital microphones

Frequency / Hz ⁽¹⁾	Lower limit	Upper limit	Unit
20...100	-5	+5	dBr 1kHz
100...8000	-2	+2	dBr 1kHz
8000...10000	-5	+5	dBr 1kHz

1. At T = 20 °C and acoustic stimulus = 1 Pa (94 dB SPL)

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.


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 7. Absolute maximum ratings

Symbol	Ratings	Maximum value	Unit
Vdd	Supply voltage	-0.3 to 6	V
Vin	Input voltage on any control pin	-0.3 to Vdd +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 ESD-sensitive, improper handling can cause permanent damage to the part.

5 Functionality

5.1 L/R channel selection

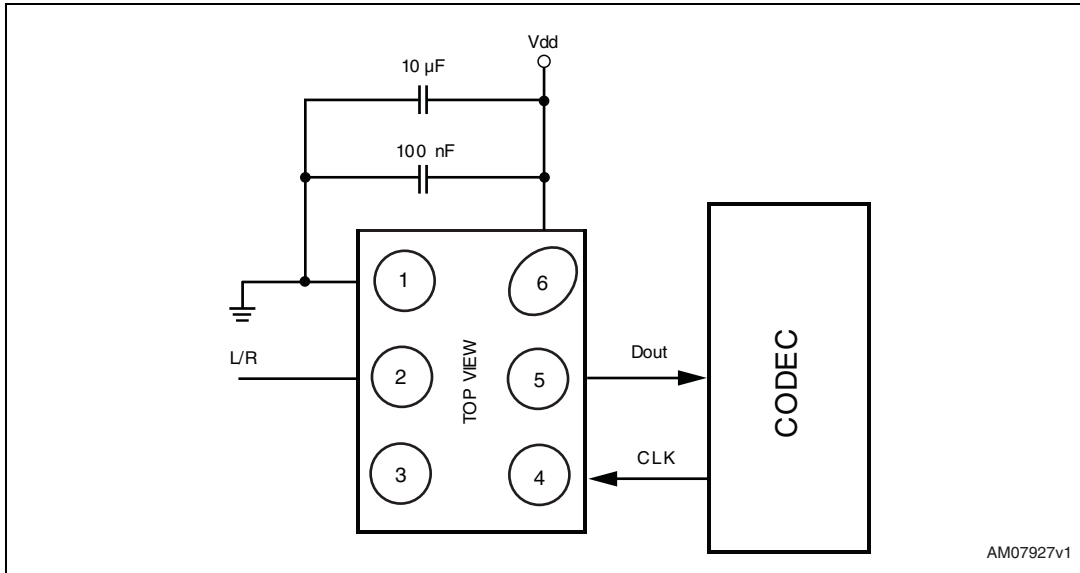
The L/R digital pad lets the user select the DOUT signal pattern as explained in [Table 8](#). The L/R pin must be connected to Vdd or GND.

Table 8. L/R channel selection

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

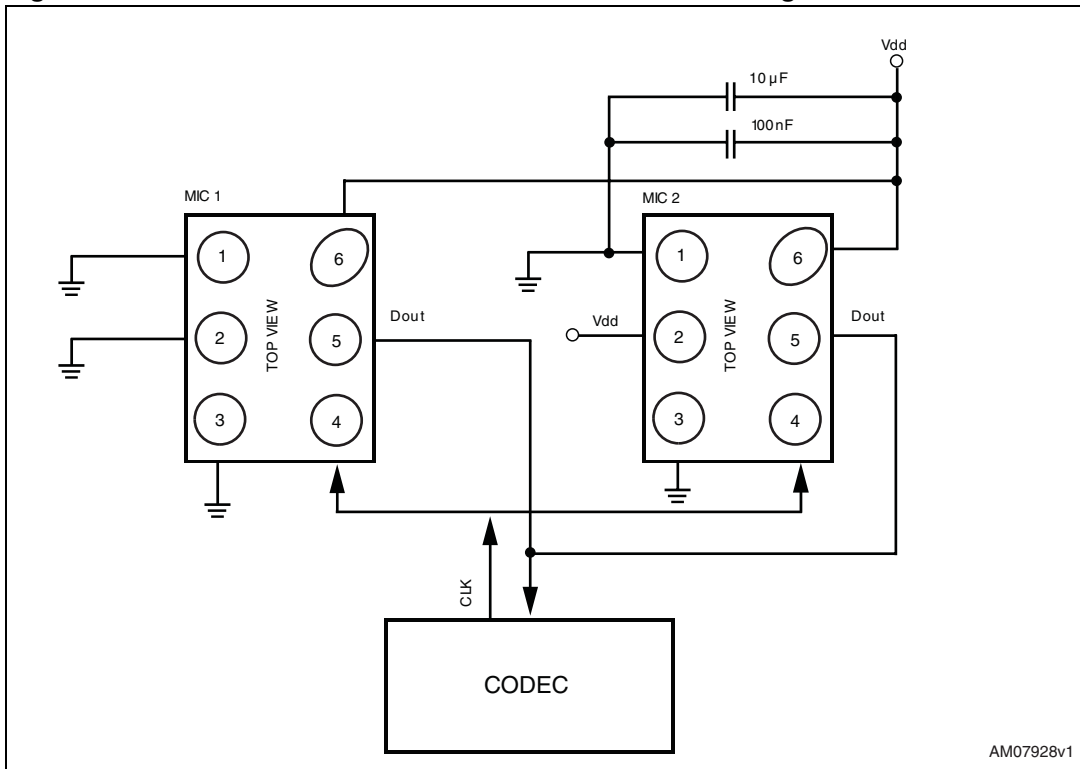
6 Application recommendations

Figure 4. MP45DT02 electrical connections



AM07927v1

Figure 5. MP45DT02 electrical connections for stereo configuration



AM07928v1

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 8](#)).

7 Package mechanical data

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.

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

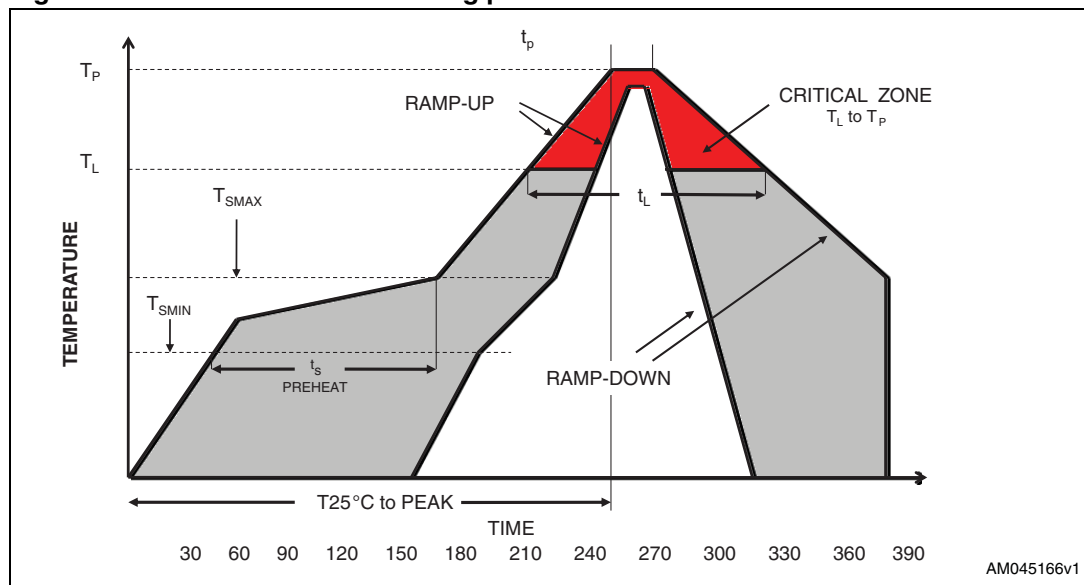
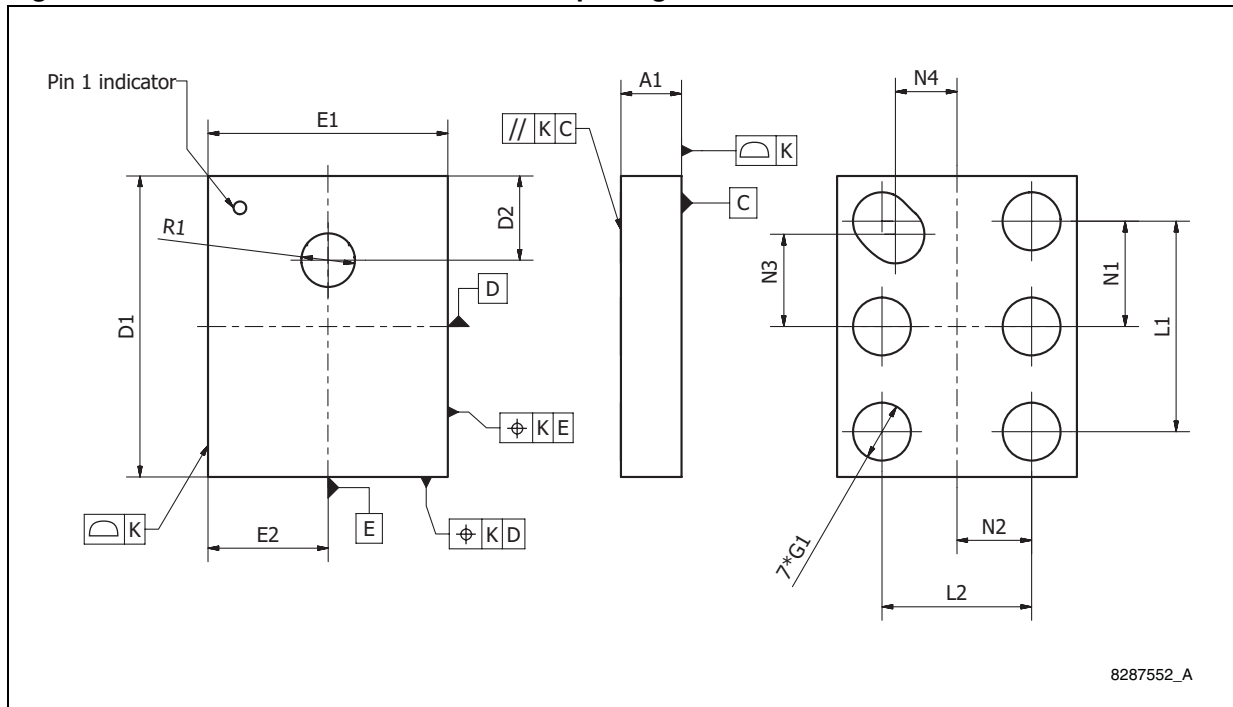


Table 9. Recommended soldering profile limits

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 liquidous temperature	t_L	60 sec to 150 sec
Liquidous 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 ($t_{25\text{ °C}}$) to peak temperature		8 minutes max

Figure 7. HLGA 4.72 mm x 3.76 mm 6-lead package outline



8287552_A

Table 10. HLGA 4.72 mm x 3.76 mm 6-lead package dimensions

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	

8 Revision history

Table 11. Document revision history

Date	Revision	Changes
28-Mar-2011	1	Initial release
21-Oct-2011	2	Added max. peak temperature T_P to Table 9 Added min. and max. sensitivity S_o to Table 3
01-Mar-2012	3	Document status promoted from preliminary to production data Updated SNR to 61 dB (Description and Table 3)
07-May-2012	4	Added V_{IOL} , V_{IOH} to Table 3: Acoustic and electrical characteristics
05-Jul-2012	5	Added Section 3: Sensing element

Please Read Carefully:

Information in this document is provided solely in connection with ST products. STMicroelectronics NV and its subsidiaries ("ST") reserve the right to make changes, corrections, modifications or improvements, to this document, and the products and services described herein at any time, without notice.

All ST products are sold pursuant to ST's terms and conditions of sale.

Purchasers are solely responsible for the choice, selection and use of the ST products and services described herein, and ST assumes no liability whatsoever relating to the choice, selection or use of the ST products and services described herein.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted under this document. If any part of this document refers to any third party products or services it shall not be deemed a license grant by ST for the use of such third party products or services, or any intellectual property contained therein or considered as a warranty covering the use in any manner whatsoever of such third party products or services or any intellectual property contained therein.

UNLESS OTHERWISE SET FORTH IN ST'S TERMS AND CONDITIONS OF SALE ST DISCLAIMS ANY EXPRESS OR IMPLIED WARRANTY WITH RESPECT TO THE USE AND/OR SALE OF ST PRODUCTS INCLUDING WITHOUT LIMITATION IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE (AND THEIR EQUIVALENTS UNDER THE LAWS OF ANY JURISDICTION), OR INFRINGEMENT OF ANY PATENT, COPYRIGHT OR OTHER INTELLECTUAL PROPERTY RIGHT.

UNLESS EXPRESSLY APPROVED IN WRITING BY TWO AUTHORIZED ST REPRESENTATIVES, ST PRODUCTS ARE NOT RECOMMENDED, AUTHORIZED OR WARRANTED FOR USE IN MILITARY, AIR CRAFT, SPACE, LIFE SAVING, OR LIFE SUSTAINING APPLICATIONS, NOR IN PRODUCTS OR SYSTEMS WHERE FAILURE OR MALFUNCTION MAY RESULT IN PERSONAL INJURY, DEATH, OR SEVERE PROPERTY OR ENVIRONMENTAL DAMAGE. ST PRODUCTS WHICH ARE NOT SPECIFIED AS "AUTOMOTIVE GRADE" MAY ONLY BE USED IN AUTOMOTIVE APPLICATIONS AT USER'S OWN RISK.

Resale of ST products with provisions different from the statements and/or technical features set forth in this document shall immediately void any warranty granted by ST for the ST product or service described herein and shall not create or extend in any manner whatsoever, any liability of ST.

ST and the ST logo are trademarks or registered trademarks of ST in various countries.

Information in this document supersedes and replaces all information previously supplied.

The ST logo is a registered trademark of STMicroelectronics. All other names are the property of their respective owners.

© 2012 STMicroelectronics - All rights reserved

STMicroelectronics group of companies

Australia - Belgium - Brazil - Canada - China - Czech Republic - Finland - France - Germany - Hong Kong - India - Israel - Italy - Japan - Malaysia - Malta - Morocco - Philippines - Singapore - Spain - Sweden - Switzerland - United Kingdom - United States of America

www.st.com