Escola Tècnica Superior d'Enginyeries
Industrial i Aeronàutica de Terrassa
UNIVERSITAT POLITÈCNICA DE CATALUNYA

Proyecto de diseño de unos auriculares de cancelación activa de ruido

Trabajo Final de Grado

Tomo II: ANNEXOS

Curso 2014/2015 Q2

Grado en Ingeniería en Tecnologías Industriales *(GRETI)*

Autor: **Xavier Batista Lladó**
Director del TFG: **Jordi Romeu Garbi**

ÍNDICE

KOBITONE™ AUDIO COMPANY

Dynamic Speaker

Date: 03/22/12

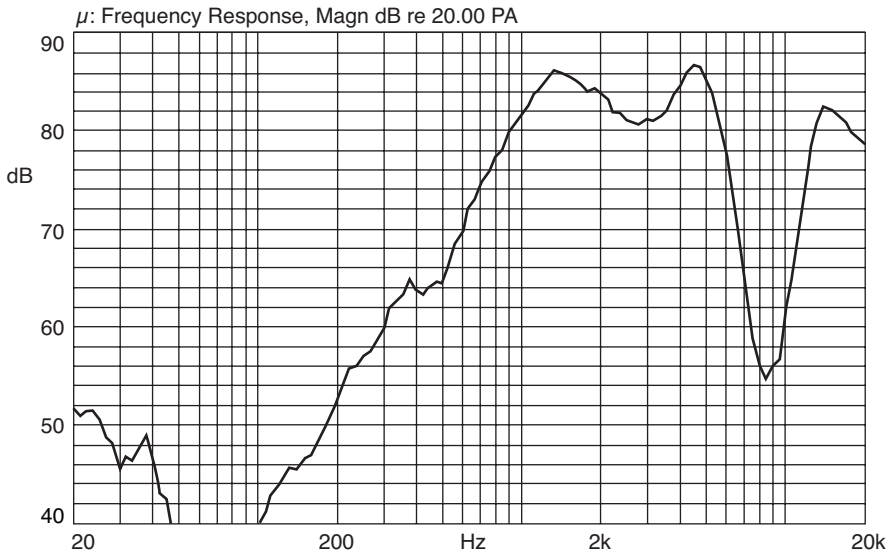
DIMENSIONS: mm (in.)

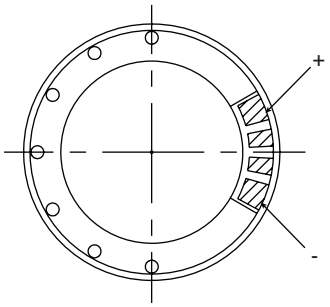
Part Number:

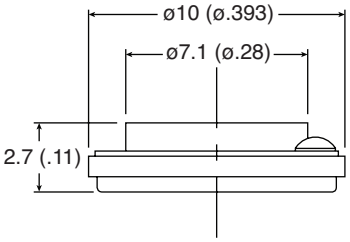
254-DS108-RO

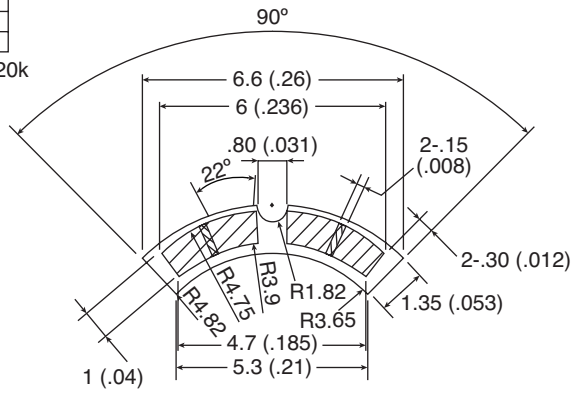
Dynamic Speaker

Frequency Response Curve









PCB Layout

KT-400533

Electrical Specifications:

- Rated Input Power: 0.15W
- Max. Input Power: Must be normal at 0.3W White Noise for 1 minute
- Impedance: 8Ω ± 15% at 3KHz, 1V
- Resonant Frequency (Fo): 1200Hz ± 20% at FO, 1V
- Frequency Range: Fo - 6KHz
- Sensitivity (S.P.L.): 72dB (W/m) ± 3dB
  83dB (0.15W/0.1m) ± 3dB

Mechanical Specifications:

- Operating Temperature: -20°C to + 60°C
- Storage Temperature: -30°C to +70°C

Materials:

- Magnet: Nd-Fe-B

Note:

- RoHS Compliant

Soldering Specifications:

- Recommend using constant branding iron in 30W
- Temperature Range: 360±5°C for 2 seconds

Mouser Electronics

Authorized Distributor

Click to View Pricing, Inventory, Delivery & Lifecycle Information:

Kobitone:
254-DS108-RO

KOBITONE™ AUDIO COMPANY

Speaker

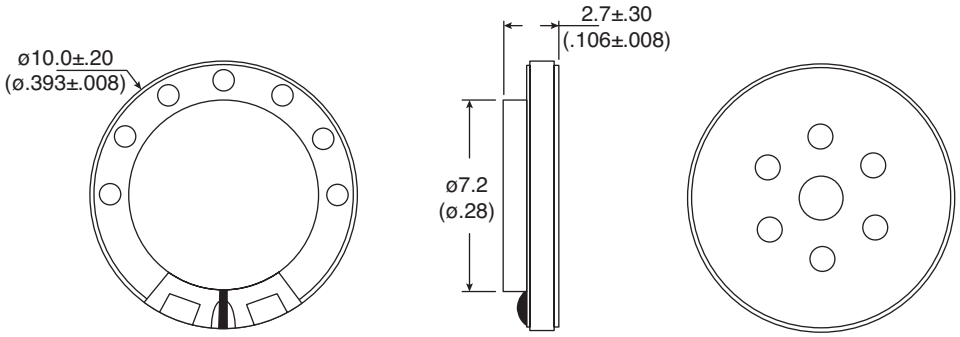
Date: 7/10/13

Dimensions: mm (in.)

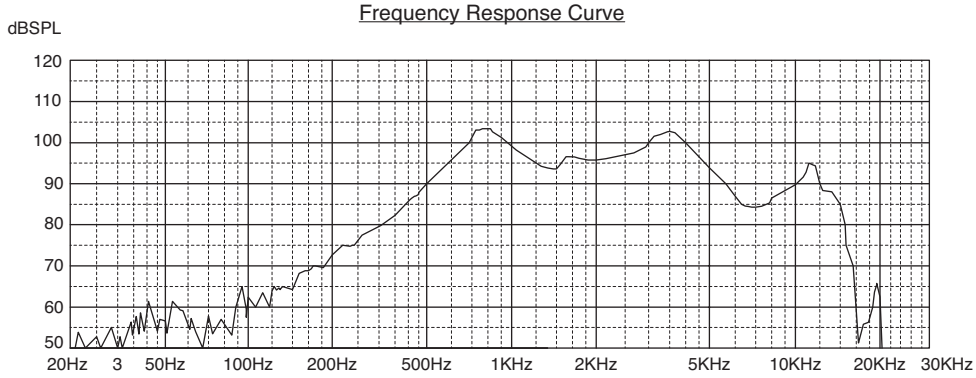
Part Number:

254-PS1032-RO

Speaker



Frequency Response Curve



KT-400557

Electrical Specifications:

- Nominal Impedance: 32Ω ± 15% at 1200Hz
- Power Rating: Normal 0.01W, Maximum 0.02W
- Lowest Resonant Frequency: 700±150Hz
- Output Sound Pressure Level: 97±3dB/0.01W/0.01 Meter Average at 1000~2000Hz
- Frequency Range: 400~6000Hz, Average SPL -20dB
- Distortion: 5% Maximum at 1000Hz/0.01W

Mechanical Specifications:

- Operating Temperature: -25°C to +50°C
- Storage Temperature: -25°C to +55°C

Materials:

- Magnet: Rare Earth
- Diaphragm: Mylar

Notes:

- RoHS Compliant

Mouser Electronics

Authorized Distributor

Click to View Pricing, Inventory, Delivery & Lifecycle Information:

Kobitone:
254-PS1032-RO

CUI INC®

MODEL: CDM-10008 | **DESCRIPTION:** SPEAKER

FEATURES
- metal frame
- mylar cone

RoHS

SPECIFICATIONS

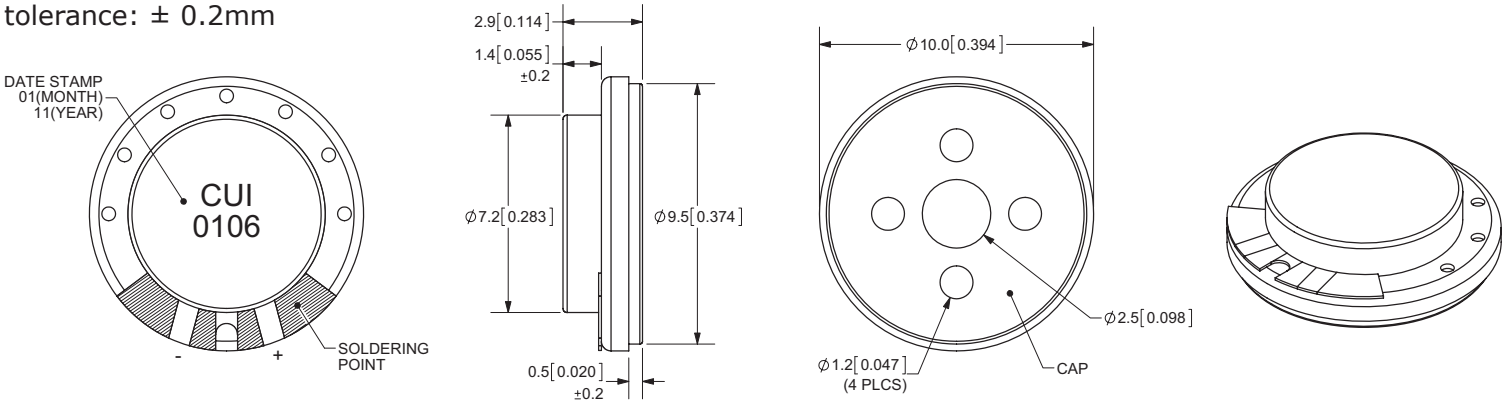
parameter	conditions/description	min	typ	max	units
diameter			10		mm
depth			2.9		mm
input power	max. power: IEC-60268-5, filter 60 s on / 120 s off, 10 cycles at room temp		0.3	0.5	W
impedance	at 1.5 kHz, 1 V	6.8	8	9.2	Ω
resonant frequency	at 1 V	960	1200	1,440	Hz
sound pressure level	0.3 W, 10 cm ave. at 1, 1.2, 1.5, 2 kHz 1 W, 1 m ave. at 1, 1.2, 1.5, 2 kHz	83 69	86 72	89 75	dB dB
response				20,000	Hz
distortion	at 1.5 kHz, 0.3 W			10	%
buzz, rattle, etc.	must be normal at sine wave 1.55 V				
magnet size	size: 5.3 x 1.0 mm				
operating temperature		-20		55	°C
weight			0.6		g
material	metal				
RoHS	yes				

SOLDERABILITY

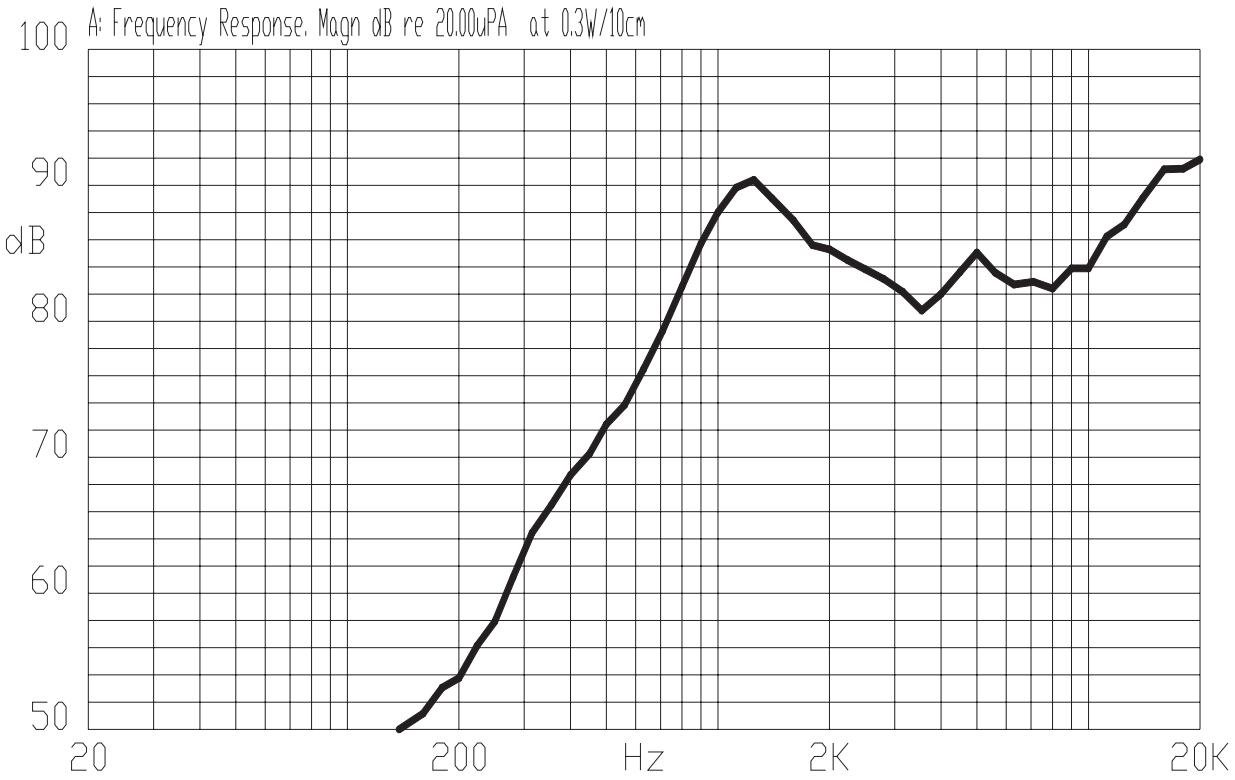
parameter	conditions/description
hand soldering	370 ±10°C for 3 ±1 seconds

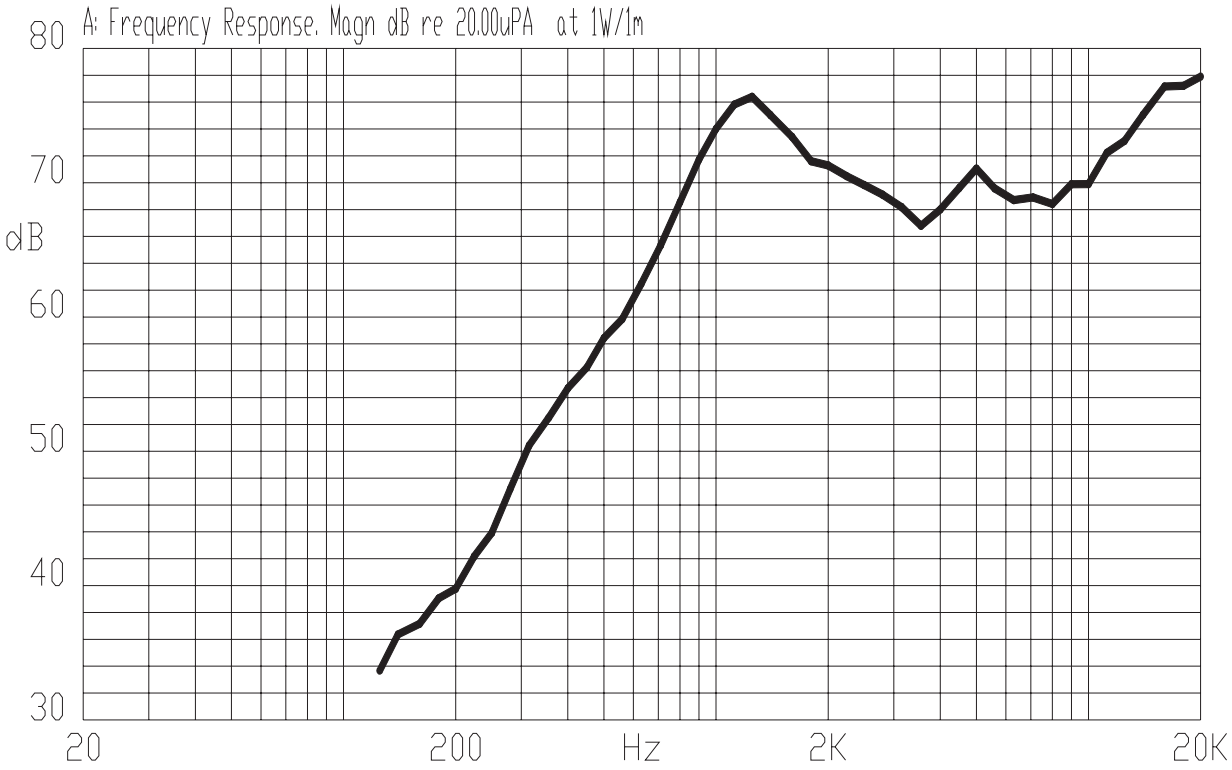
MECHANICAL DRAWING

units: mm
tolerance: ± 0.2mm

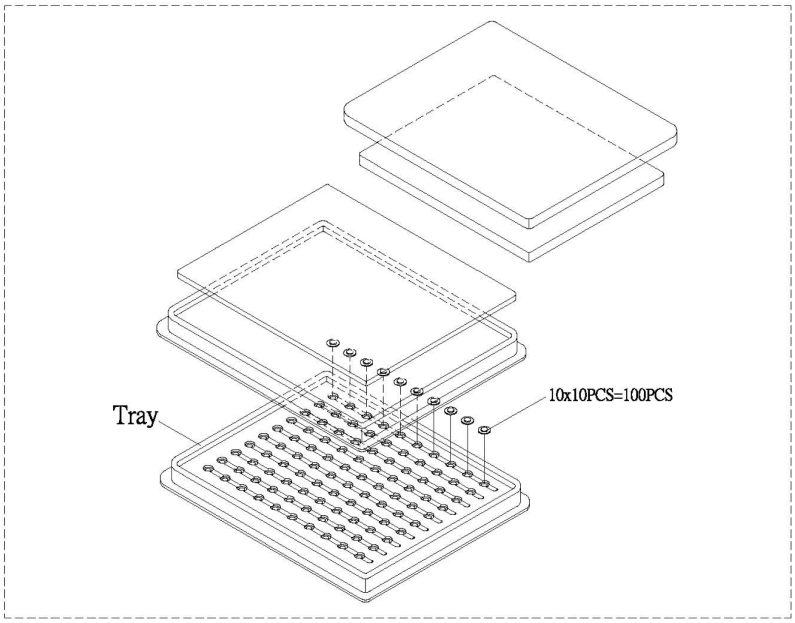


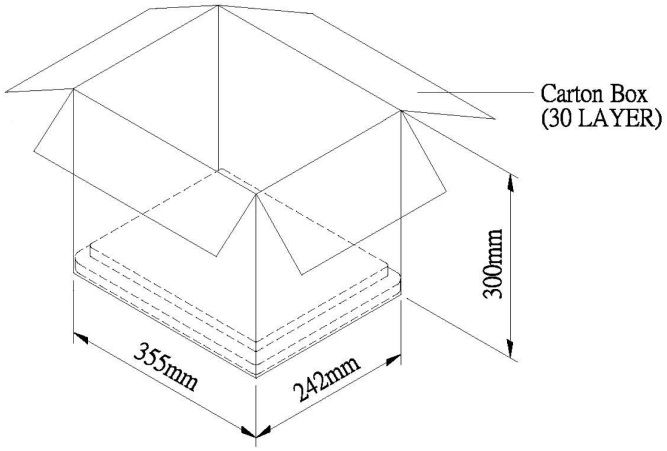
FREQUENCY RESPONSE CURVE





PACKAGING





Tray	340mmx230mmx20mm	1x100PCS=100PCS
Carton Box	355mmx242mmx300mm	100PCSx30=3,000PCS

REVISION HISTORY

rev.	description	date
1.0	initial release	11/08/2011

The revision history provided is for informational purposes only and is believed to be accurate.

Headquarters
20050 SW 112th Ave.
Tualatin, OR 97062
800.275.4899

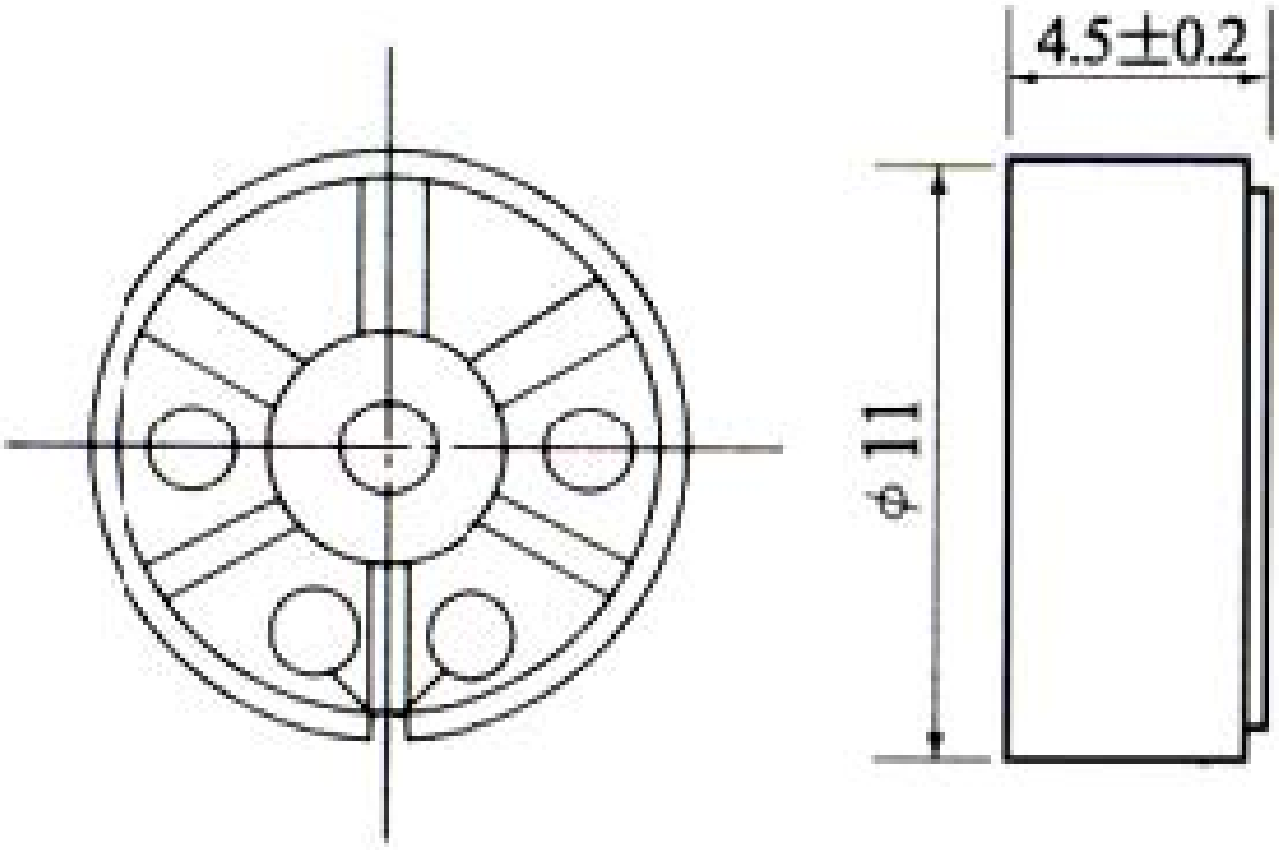
Fax 503.612.2383
cui.com
techsupport@cui.com

Mallory Sonalert Products Inc	Part # PSR-11N08S-JQ
Sales Outline Drawing	Revision **B**

Specifications:

Voice Coil Impedance (Ω)	8 ± 15% at 800 Hz / 1.0 V
Rated Input (W)	0.25
Max. Input (W)	0.30
Lowest Resonance Freq Fo (Hz)	1600 ± 20%
Frequency Range (Hz)	Fo ~ 9000
Output S.P.L. (dB)	75 ± 3 at 1W 1M .8k, 1k, 1.2k, 1.5kHZ
Magnet Size (mm)	∅ 10.5 * 1.0
Magnet	Ferrite
Core Material Mylar	Transparent Radial
Frame Material	Plastic
Operating / Storage Temp	-25 to 50°C
Options	For other options contact factory

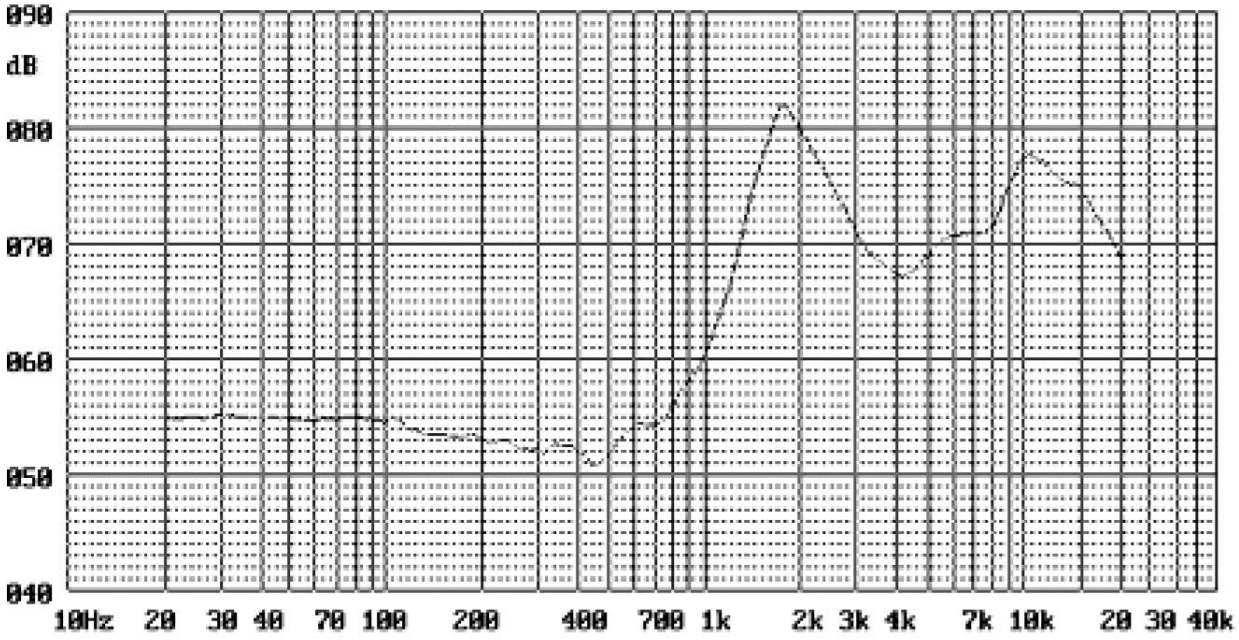
Dimensions: (units: mm) **ROHS Compliant**



MALLORY SONALERT PRODUCTS, INC.

PSR-11N08S-JQ

Frequency Response:

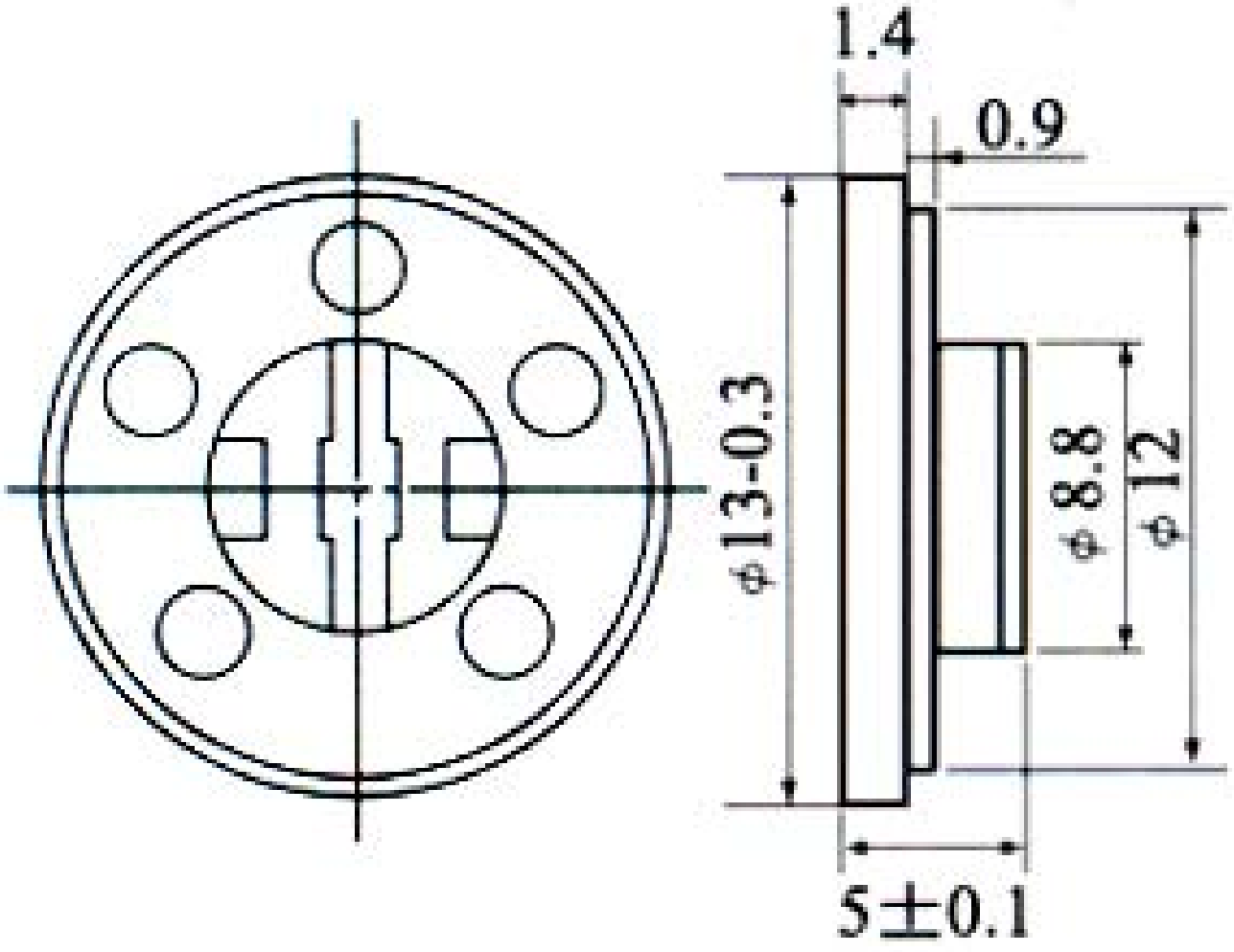


Mallory Sonalert Products Inc	Part # PSR-13N08A-JQ
Sales Outline Drawing	Revision B

Specifications:

Voice Coil Impedance (Ω)	8 ± 15% at 800 Hz / 1.0 V
Rated Input (W)	0.25
Max. Input (W)	0.30
Lowest Resonance Freq Fo (Hz)	1800 ± 20%
Frequency Range (Hz)	Fo ~ 7000
Output S.P.L. (dB)	75 ± 3 at 1W 1M .8k, 1k, 1.2k, 1.5kHZ
Magnet Size (mm)	∅ 6.5 * 1.5
Magnet	Ferrite
Core Material Mylar	Transparent
Frame Material	Metal
Operating / Storage Temp	-25 to 50°C
Options	For other options contact factory

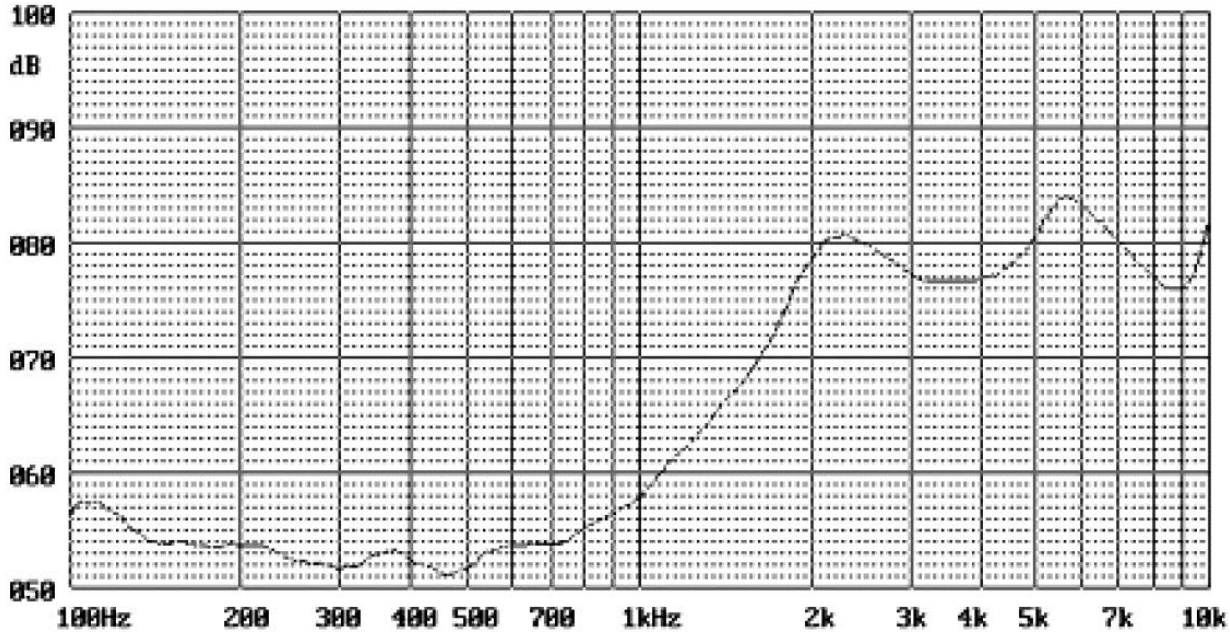
Dimensions: (units: mm) **ROHS Compliant**



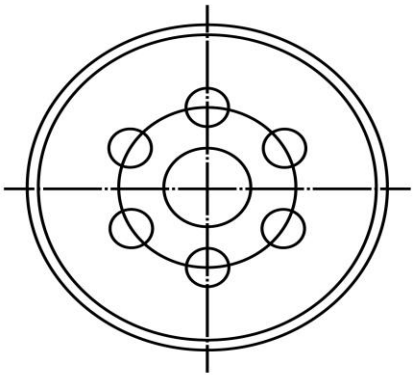
MALLORY SONALERT PRODUCTS, INC.

PSR-13N08A-JQ

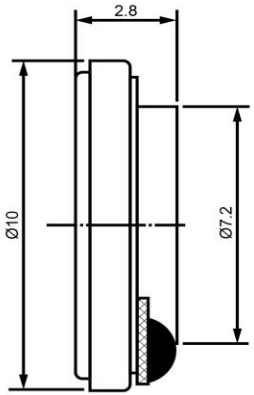
Frequency Response:



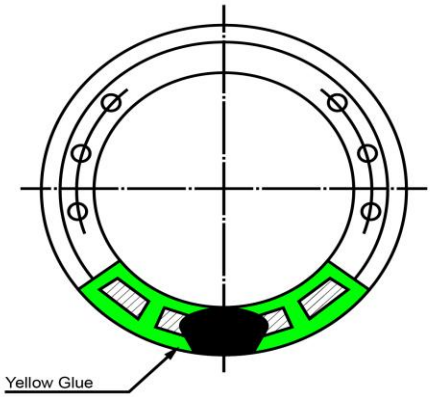
TOP VIEW



SIDE VIEW



BOTTOM VIEW



Specifications		
Description	**Value**	**Unit**
Shape	Round	
Resonant Frequency	1,200	(Hz)
Frequency Range	1,200 ~ 6,000	(Hz)
SPL @ 10cm	82	(dBA)
Impedance	8	(Ohm)
Cone Material	Mylar	
Nominal Power	0.15	(W)
Max Power	0.3	(W)
Mount Type	Flush Mount	
Operating Temperature	-20 ~ +60	°C
Storage Temperature	-20 ~ +60	°C
Weight	0.8	(g)

Notes

1) All dimensions are in mm unless otherwise noted
2) All parts meet RoHS

DB UNLIMITED

Dynamic Speaker

Revision History

Version	Description	Date	Approved
1	Released from Engineering	2/5/2014	J.S.

Drawn by	Date	Checked by	Date	Approved by	Date
G.W.	1/27/2014	C.E.	2/4/2014	J.S.	2/5/2014

SM101208-1

sales@dbunlimitedco.com | www.dbunlimitedco.com

Mouser Electronics

Authorized Distributor

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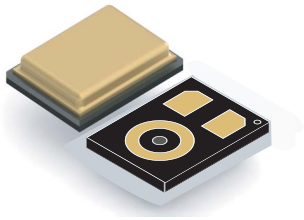
DB Unlimited:

SM101208-1

MP23AB02B

MEMS audio sensor
high-performance analog bottom-port microphone

Datasheet - production data



RHLGA metal cap 3-lead

3.35 x 2.5 x 0.98 mm

Features

- Single supply voltage operation
- Low power consumption
- Omnidirectional sensitivity
- High signal-to-noise ratio
- High bandwidth
- Package compliant with reflow soldering

Description

The MP23AB02B is a compact, low-power microphone built with a low-profile sensing element.

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

The MP23AB02B has an acoustic overload point of 125 dBSPL with a 64 dB signal-to-noise ratio.

The MP23AB02B is available in a package compliant with reflow soldering and is guaranteed to operate over an extended temperature range from -40 °C to +85 °C.

Table 1. Device summary

Order code	Temperature range (°C)	Package	Packing
MP23AB02B	-40 to +85	(3.35 x 2.5 x 0.98) mm	Tray
MP23AB02BTR	-40 to +85	(3.35 x 2.5 x 0.98) mm	Tape and reel

1 Pin description

Figure 1. Pin connections

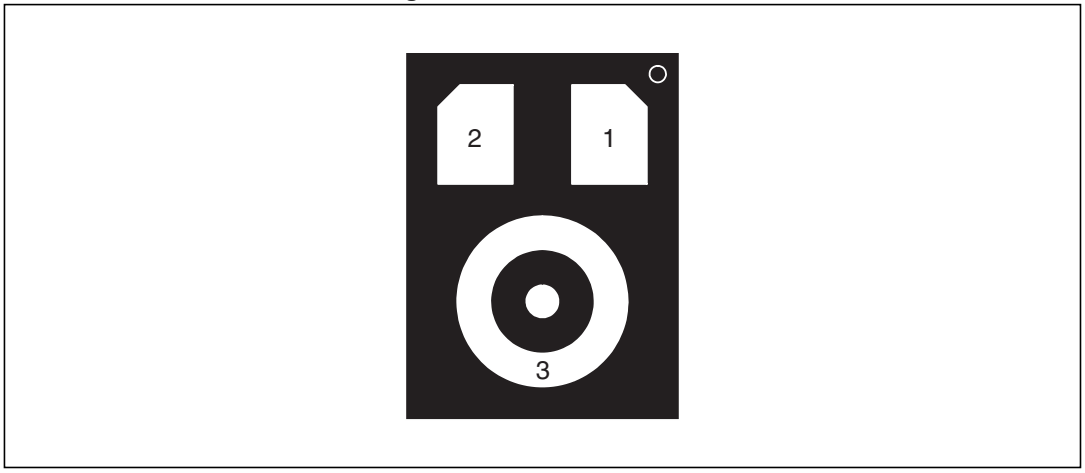


Table 2. Pin description

Pin n°	Pin name	Function
1	Out	Analog output
2	Vdd	Power supply
3	GND	Ground

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, T_{amb} = 25 °C unless otherwise specified.

Table 3. Acoustic and electrical characteristics

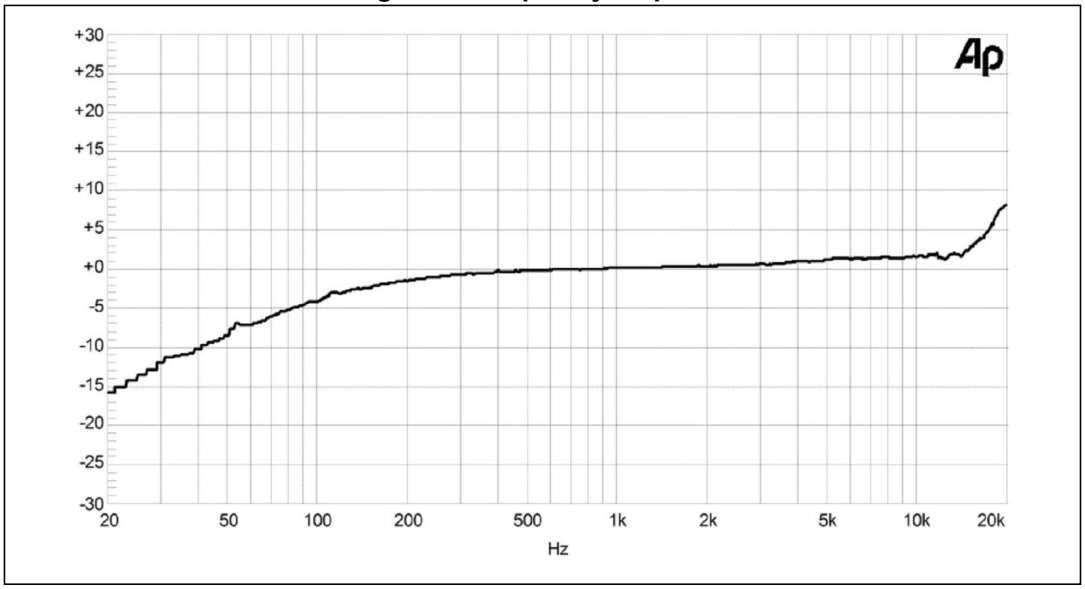
Symbol	Parameter	Test condition	Min.	Typ.(1)	Max.	Unit
Vdd	Supply voltage		1.6	1.8	3.6	V
Idd	Current consumption	mean value = 2 V		150	220	µA
So	Sensitivity	1 kHz (0 dB = 1 V/Pa)	-41	-38	-35	dBV/PA
SNR	Signal-to-noise ratio	A-weighted, 1 kHz (0 dB = 1 V/Pa)		64		dBA
Top	Operating temperature range		-40		+85	°C

1. Typical specifications are not guaranteed

Table 4. Distortion specifications at 1 kHz

Parameter	Test condition	Value
Distortion	94	< 0.5%
Distortion	120	< 2%
Distortion	124	= 10%

Figure 2. Frequency response



3 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 5. Absolute maximum ratings

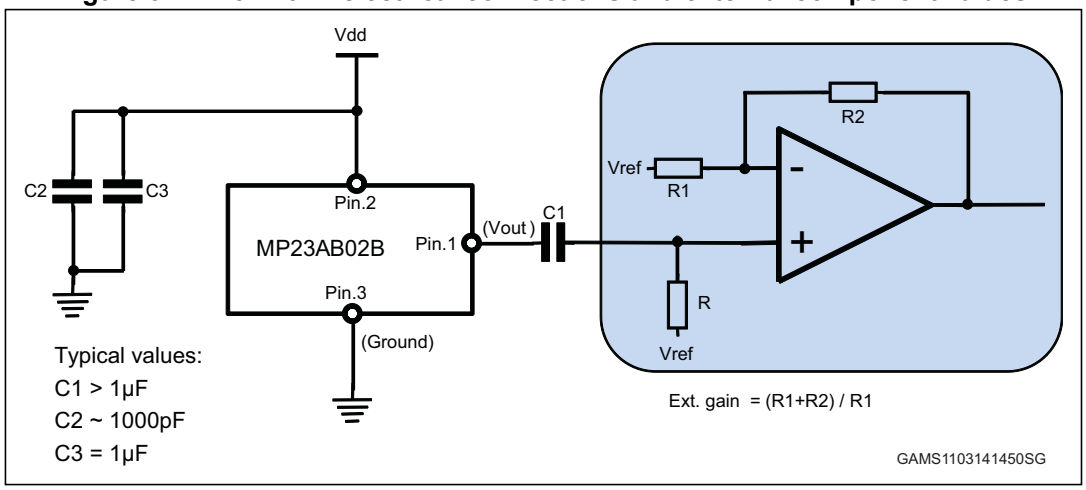
Symbol	Ratings	Maximum value	Unit
Vdd	Supply voltage	-0.5 to 4	V
T_{STG}	Storage temperature range	-40 to +125	°C

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.

4 Application recommendations

Figure 3. MP23AB02B electrical connections and external component values



5 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.

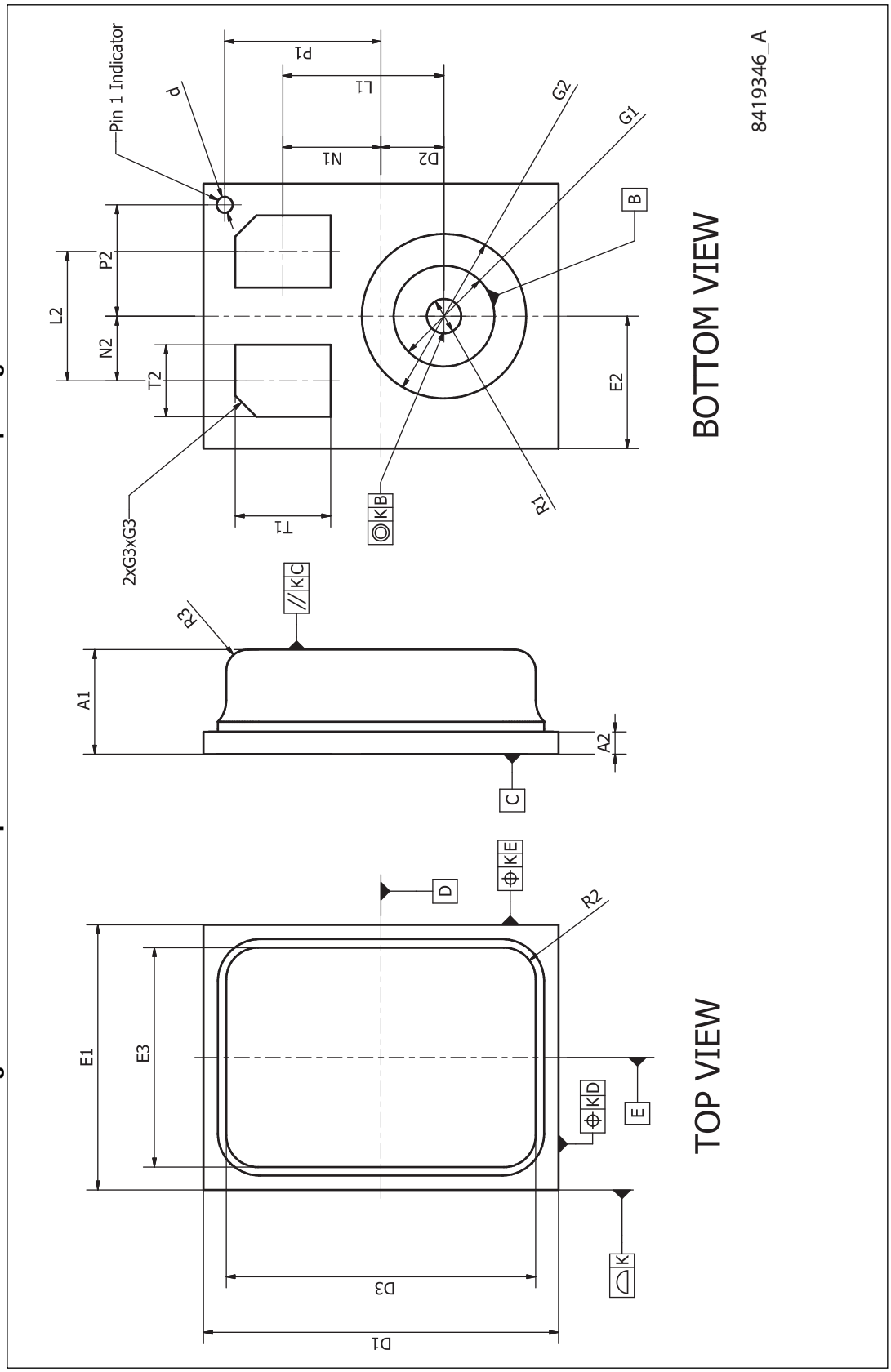
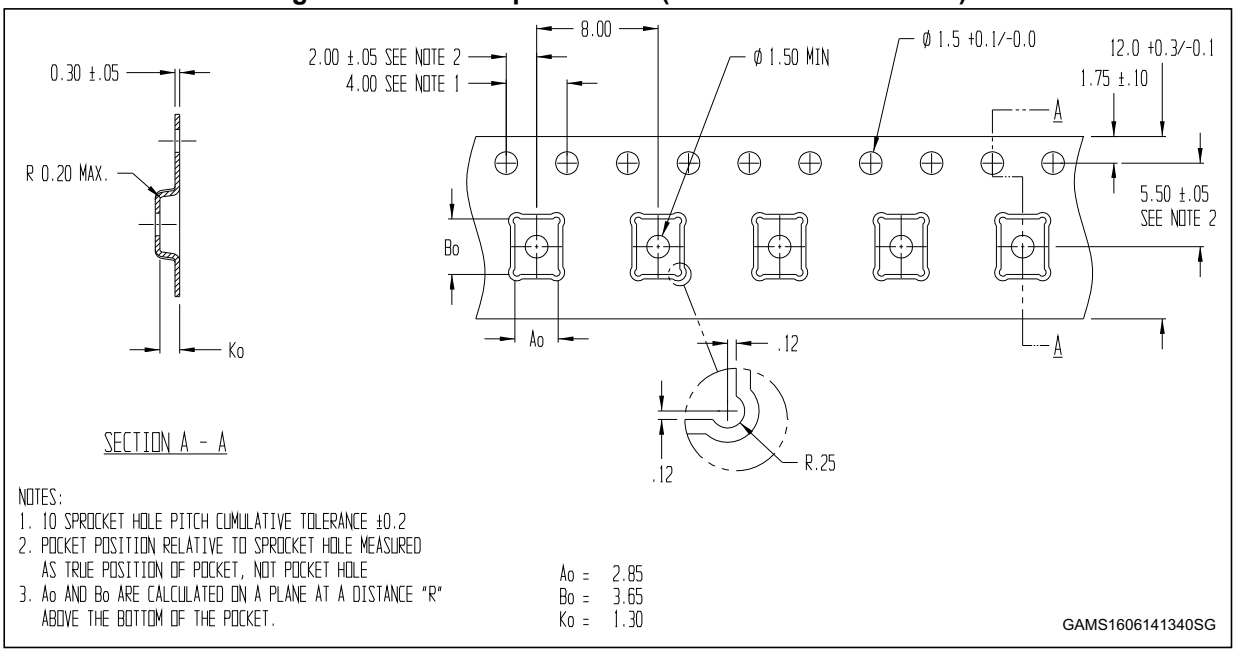


Figure 4. RHLGA metal cap 3-lead 3.35 mm x 2.5 mm x 0.98 mm package outline

Table 6. RHLGA metal cap 3-lead (3.35 x 2.5 x 0.98 mm9 package dimensions

Reference	Dimensions (mm)		
	Min.	Typ.	Max.
A1	0.880	0.980	1.080
A2	0.200	0.250	0.300
D1	3.250	3.350	3.450
D2	0.495	0.595	0.695
D3	2.770	2.920	3.070
R1	0.275	0.325	0.375
R2		0.28	
R3		0.25	
E1	2.400	2.500	2.600
E2	1.150	1.250	1.350
E3	1.920	2.070	2.220
L1	1.480	1.520	1.560
L2	1.180	1.220	1.260
N1	0.885	0.925	0.965
N2	0.570	0.610	0.650
T1	0.860	0.900	0.940
T2	0.640	0.680	0.720
G1	0.900	0.950	1.000
G2	1.400	1.550	1.600
G3	0.100	0.150	0.200
P1	1.425	1.475	1.525
P2	1.000	1.050	1.100
d		0.150	
K		0.050	

Figure 5. RHLGA tape and reel (dimensions are in mm.)



6 Soldering information

Figure 6. Recommended soldering profile limits

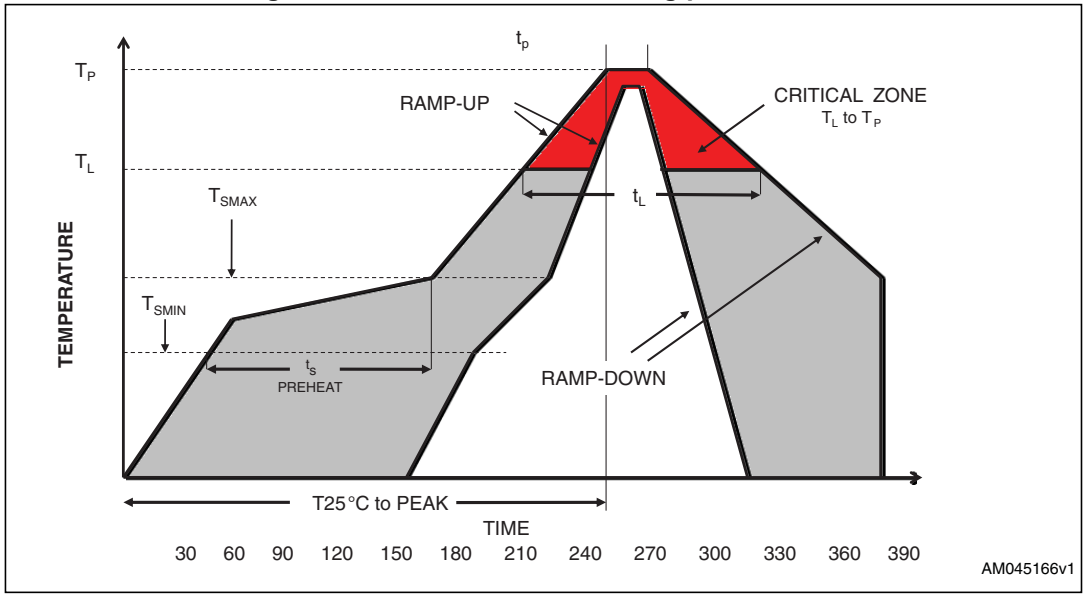


Table 7. Recommended soldering profile limits

Description	Parameter	Pb free
Average ramp rate	T_L to T_P	3 °C/sec max
Preheat Minimum temperature Maximum temperature Time (T_{SMIN} to T_{SMAX})	 T_{SMIN} T_{SMAX} t_S	 150 °C 200 °C 60 sec to 120 sec
Ramp-up rate	T_{SMAX} to T_L	
Time maintained above liquidus temperature Liquidus temperature	t_L T_L	60 sec to 150 sec 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 °C) to peak temperature		8 minutes max

7 Revision history

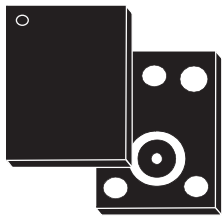
Table 8. Document revision history

Date	Revision	Changes
21-Mar-2014	1	Initial release.
16-Jun-2014	2	Updated *Figure 5 on page 9*.
22-Sep-2014	3	Updated acoustic overload point in *Description*.

MP33AB01

MEMS audio surface-mount bottom-port silicon microphone with analog output

Datasheet - production data



RHLGA 3.76 x 2.95 x 1.0 mm

Features

- Single supply voltage
- Low power consumption
- Omnidirectional sensitivity
- High signal-to-noise ratio
- High bandwidth
- Package compliant with reflow soldering

Description

The MP33AB01 is a compact, low-power microphone built with a low-profile sensing element.

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

The MP33AB01 has an acoustic overload point of 125 dBSPL with a 63 dB signal-to-noise ratio.

The MP33AB01 is available in a package compliant with reflow soldering and is guaranteed to operate over an extended temperature range from -30 °C to +100 °C.

Table 1. Device summary

Order code	Temperature range [°C]	Package	Packing
MP33AB01	-30 to +100	RHLGA (3.76 x 2.95 x 1.0) mm	Tray
MP33AB01TR	-30 to +100	RHLGA (3.76 x 2.95 x 1.0) mm	Tape and reel

Contents

1 Pin description

Figure 1. Pin connections

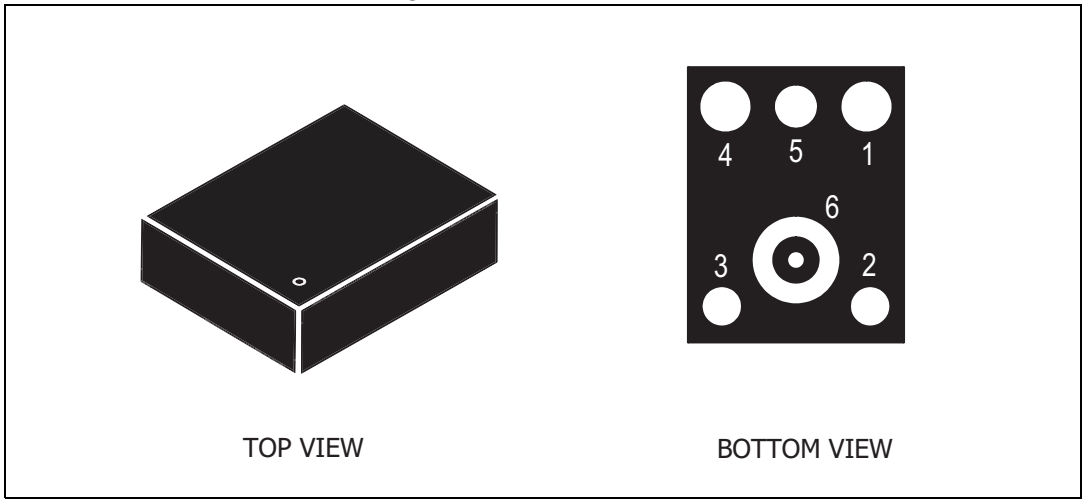


Table 2. Pin description

Pin #	Pin name	Function
1	Output	Analog output
2	GND	0 V supply
3	GND	0 V supply
4	Vdd	Power supply
5	GND	0 V supply
6	GND	0 V supply

2 Acoustic and electrical specifications

2.1 Acoustic and electrical characteristics

The values listed in the table below are specified for Vdd = 2.2 V unless otherwise noted.

Table 3. Acoustic and electrical characteristics

Symbol	Parameter	Test condition	Min.	Typ.(1)	Max.	Unit
Vdd	Supply voltage		1.5	2.2	3.6	V
Idd	Current consumption	mean value = 2 V			0.25	mA
FR	Frequency range		100		10000	Hz
So	Sensitivity	at 1 kHz (0 dB = 1 V/Pa)	-41	-38	-35	dBV
SNR	Signal-to-noise ratio	at 1 kHz (0 dB = 1 V/Pa)		63		dB
Top	Operating temperature range		-30		+100	°C

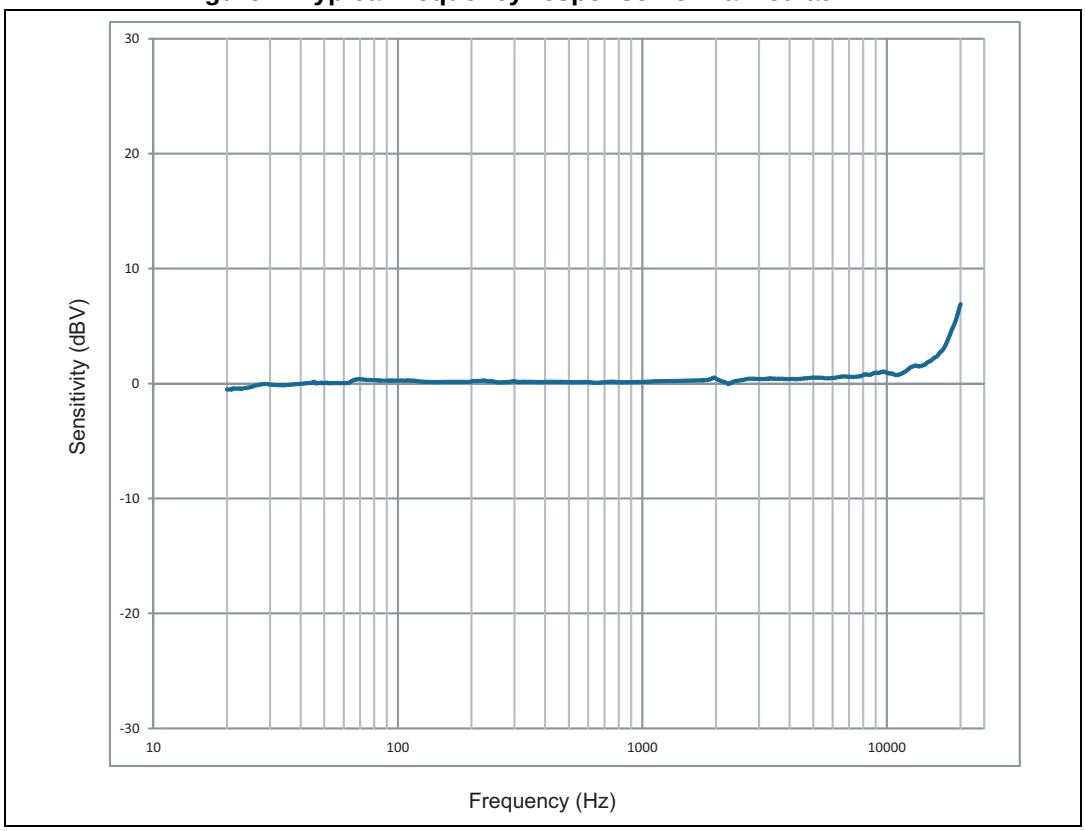
1. Typical specifications are not guaranteed.

Table 4. Distortion specifications at 1 kHz

Parameter	Test condition	Value
Distortion	94 dBSPL	< 1% THD
Distortion	125 dBSPL	10% THD (typ.)

2.2 Frequency response

Figure 2. Typical frequency response normalized at 1 kHz



3 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 5. Absolute maximum ratings

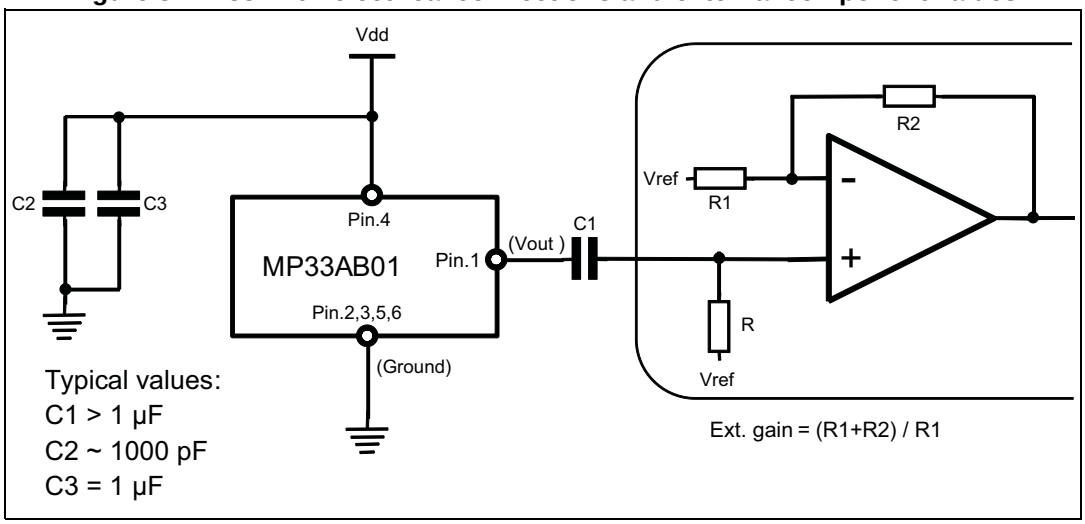
Symbol	Ratings	Maximum value	Unit
Vdd	Supply voltage	-0.5 to 4	V
T_{STG}	Storage temperature range	-40 to +100	°C

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.

4 Application recommendations

Figure 3. MP33AB01 electrical connections and external component values



The DC-blocking capacitor C1 is required on the Vout pin as shown in *Figure 3*. The C1 value and the input resistance of the interface circuit (R) affect the cut-off frequency of the Audio signal path as:

$$3\ dB\ cut\text{-}off\ freq = 1 / 2\pi RC1$$

It's advisable to have a cut-off frequency well below 20 HZ, so for a typical input resistance of about 20 kΩ it is recommended to use a C1 > 1 µF.

5 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 RHLGA (3.76 x 2.95) mm package is also compliant with the RoHS and “Green” standards and is qualified for soldering heat resistance according to JEDEC J-STD-020.

Land pattern and soldering recommendations are available at *www.st.com*.

Figure 4. Recommended soldering profile limits

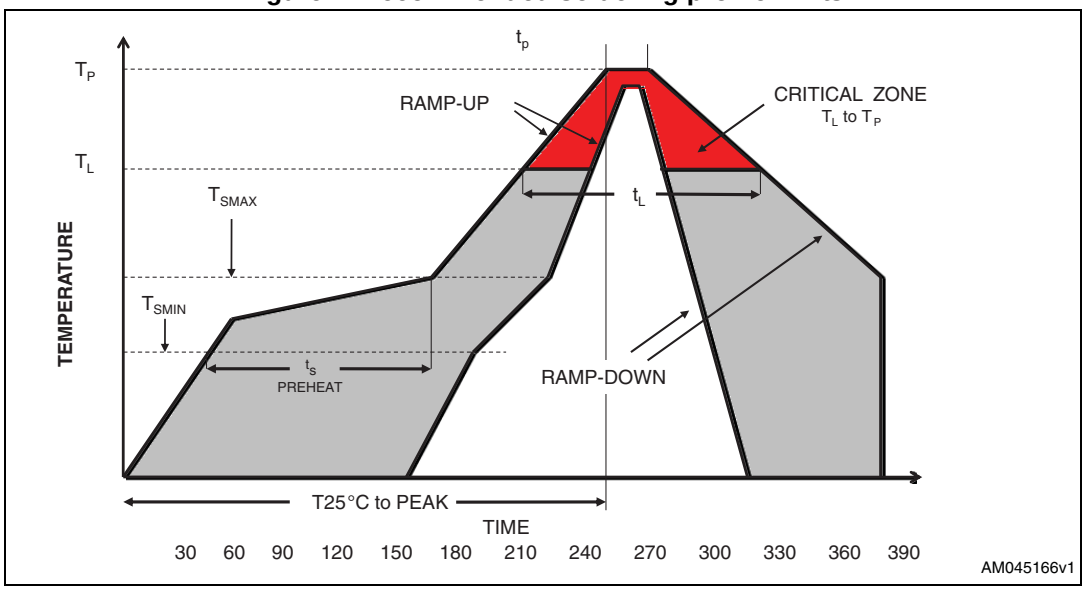


Table 6. Recommended soldering profile limits

Description	Parameter	Pb free
Average ramp rate	T_L to T_P	3 °C/sec max
Preheat Minimum temperature Maximum temperature Time (T_{SMIN} to T_{SMAX})	 T_{SMIN} T_{SMAX} t_S	 150 °C 200 °C 60 sec to 120 sec
Ramp-up rate	T_{SMAX} to T_L	
Time maintained above liquidous temperature Liquidous temperature	t_L T_L	60 sec to 150 sec 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 (t25 °C) to peak temperature		8 minutes max

Figure 5. RHLGA 3.76 mm x 2.95 mm x 1.0 mm package outline

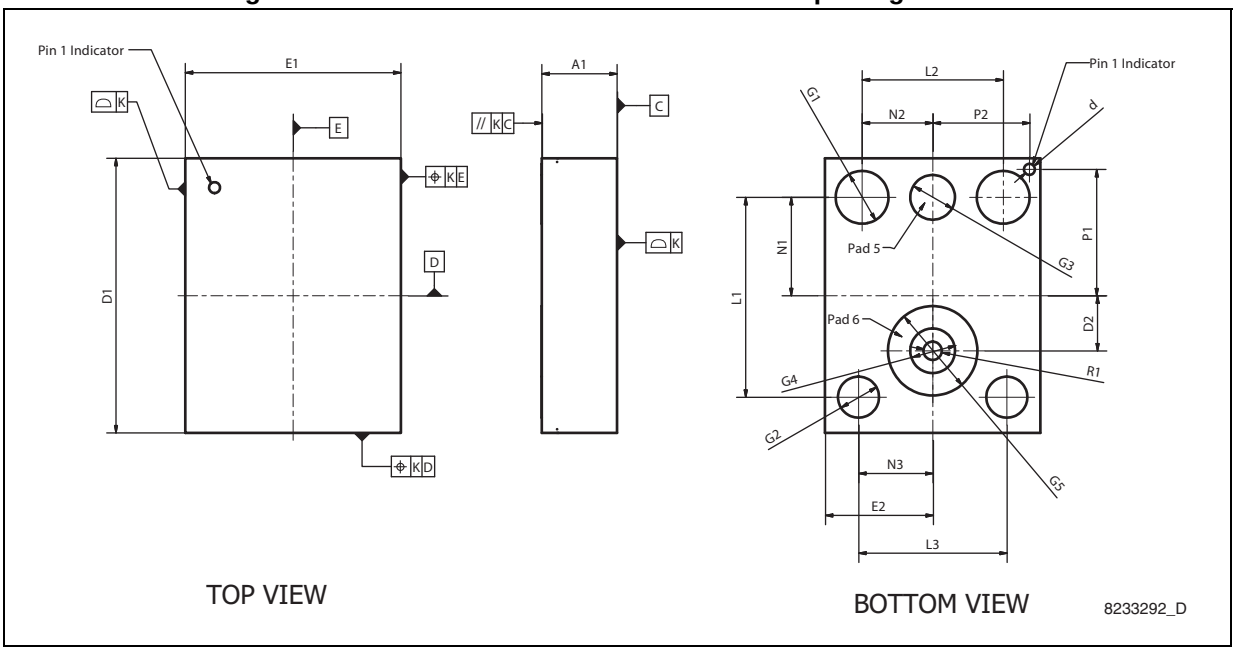


Table 7. RHLGA 3.76 mm x 2.95 mm x 1.0 mm package dimensions

Symbol	mm			inch.		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A1	0.900	1.000	1.100	0.0354	0.0394	0.0433
D1	3.660	3.760	3.860	0.1441	0.1480	0.1520
D2	0.600	0.750	0.900	0.0236	0.0295	0.0354
R1	0.200	0.250	0.300	0.0079	0.0098	0.0118
E1	2.850	2.950	3.050	0.1122	0.1161	0.1201
E2	1.325	1.475	1.625	0.0522	0.0581	0.0640
L1	2.690	2.740	2.790	0.1059	0.1079	0.1098
L2	1.882	1.932	1.982	0.0741	0.0761	0.0780
L3	1.981	2.031	2.181	0.0780	0.0800	0.0859
N1	1.300	1.350	1.400	0.0512	0.0531	0.0551
N2	0.916	0.966	1.116	0.0361	0.0380	0.0440
N3	0.965	1.015	1.065	0.0380	0.0400	0.0419
G1	0.673	0.723	0.763	0.0265	0.0285	0.0300
G2	0.512	0.562	0.612	0.0202	0.0221	0.0241
G3	0.562	0.612	0.662	0.0221	0.0241	0.0261
G4	0.562	0.612	0.662	0.0221	0.0241	0.0261
G5	1.174	1.224	1.274	0.0462	0.0482	0.0502
P1	1.680	1.730	1.780	0.0661	0.0681	0.0701
P2	1.275	1.325	1.375	0.0502	0.0522	0.0541

Table 7. RHLGA 3.76 mm x 2.95 mm x 1.0 mm package dimensions (continued)

Symbol	mm			inch.		
	Min.	Typ.	Max.	Min.	Typ.	Max.
d		0.150			0.0059	
K		0.050			0.0020	

Figure 6. Device footprint and PCB land pattern

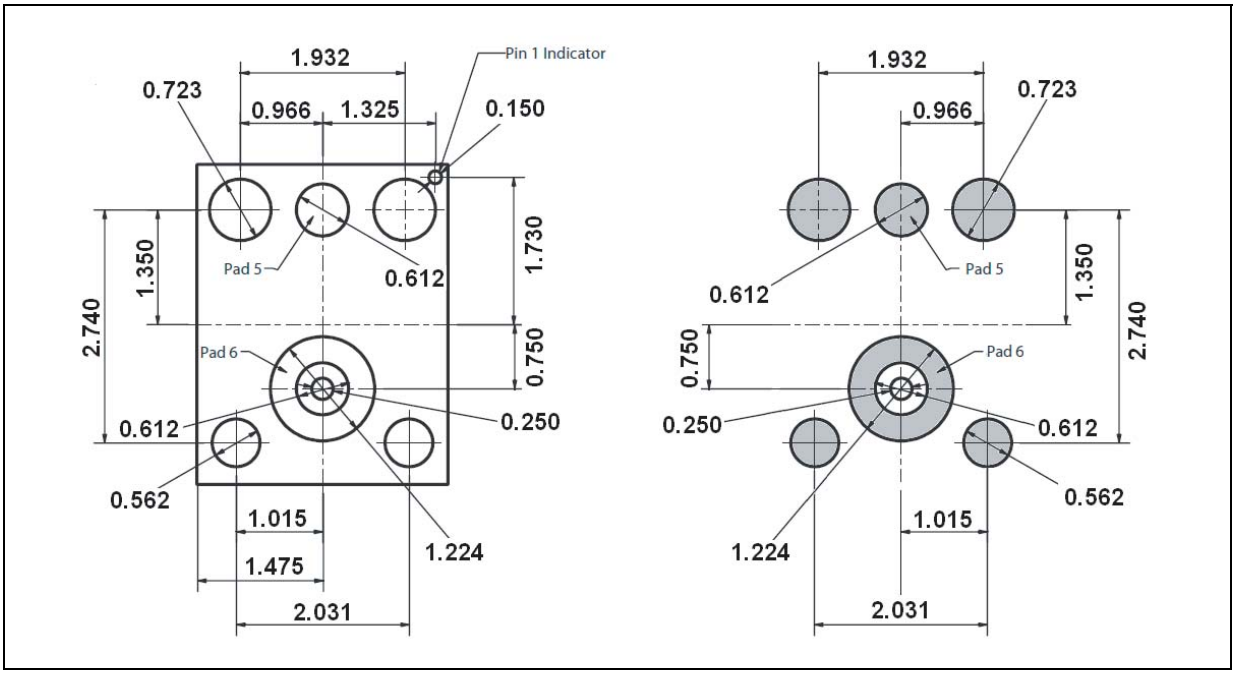
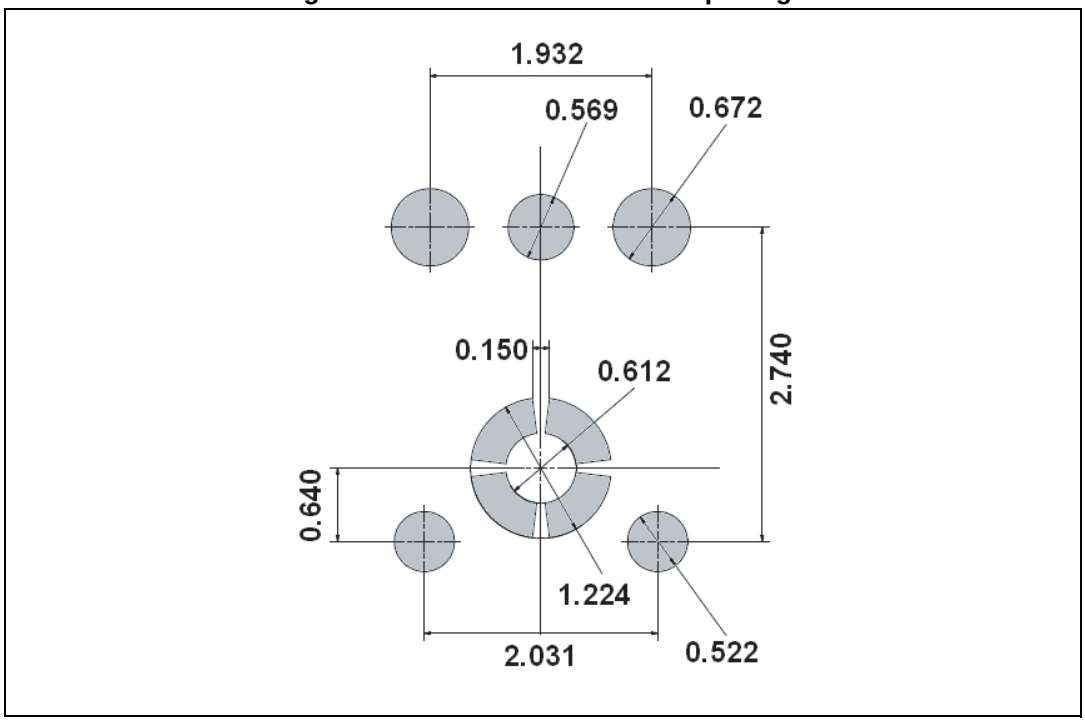


Figure 7. Recommended stencil openings



6 Revision history

Table 8. Document revision history

Date	Revision	Changes
17-Jan-2013	1	Initial release
13-Sep-2013	2	Modified *Figure 3 on page 7*

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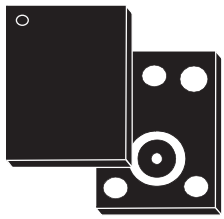
www.st.com

MP33AB01H

MEMS audio surface-mount bottom-port silicon microphone with analog output

Datasheet - production data



RHLGA 3.76 x 2.95 x 1.0 mm

Features

- Single supply voltage
- Low power consumption
- Omnidirectional sensitivity
- High signal-to-noise ratio
- High bandwidth
- Package compliant with reflow soldering

Description

The MP33AB01H is a compact, low-power microphone built with a low-profile sensing element.

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

The MP33AB01H has an acoustic overload point of 125 dBSPL with a 66 dB signal-to-noise ratio.

The MP33AB01H is available in a package compliant with reflow soldering and is guaranteed to operate over an extended temperature range from -30 °C to +100 °C.

Table 1. Device summary

Order code	Temperature range [°C]	Package	Packing
MP33AB01H	-30 to +100	RHLGA (3.76 x 2.95 x 1.0) mm	Tray
MP33AB01HTR	-30 to +100	RHLGA (3.76 x 2.95 x 1.0) mm	Tape and reel

Contents

1 Pin description

Figure 1. Pin connections

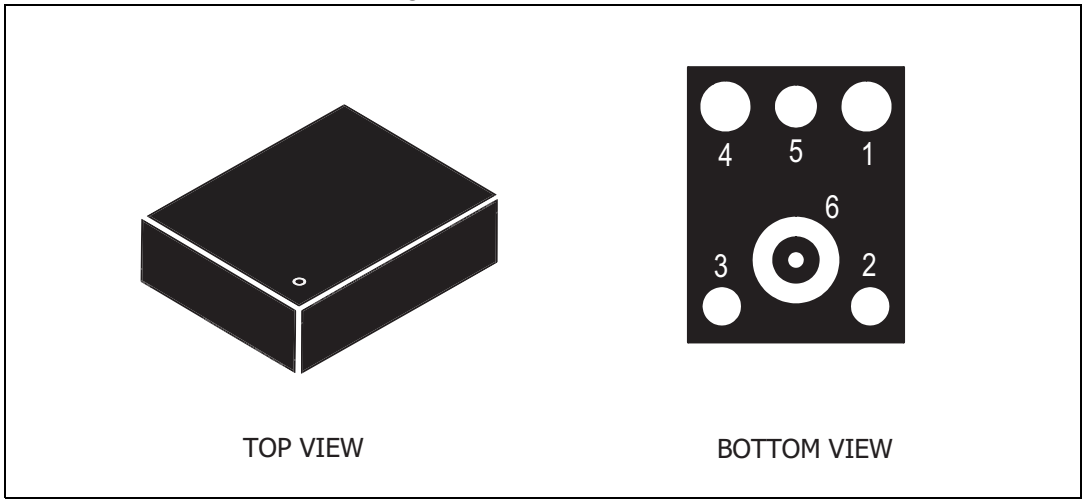


Table 2. Pin description

Pin #	Pin name	Function
1	Output	Analog output
2	GND	0 V supply
3	GND	0 V supply
4	Vdd	Power supply
5	GND	0 V supply
6	GND	0 V supply

2 Acoustic and electrical specifications

2.1 Acoustic and electrical characteristics

The values listed in the table below are specified for Vdd = 2.2 V unless otherwise noted.

Table 3. Acoustic and electrical characteristics

Symbol	Parameter	Test condition	Min.	Typ.(1)	Max.	Unit
Vdd	Supply voltage		1.5	2.2	3.6	V
Idd	Current consumption	mean value = 2 V			0.25	mA
FR	Frequency range		100		10000	Hz
So	Sensitivity	at 1 kHz (0 dB = 1 V/Pa)	-41	-38	-35	dBV
SNR	Signal-to-noise ratio	at 1 kHz (0 dB = 1 V/Pa)	64	66		dB
Top	Operating temperature range		-30		+100	°C

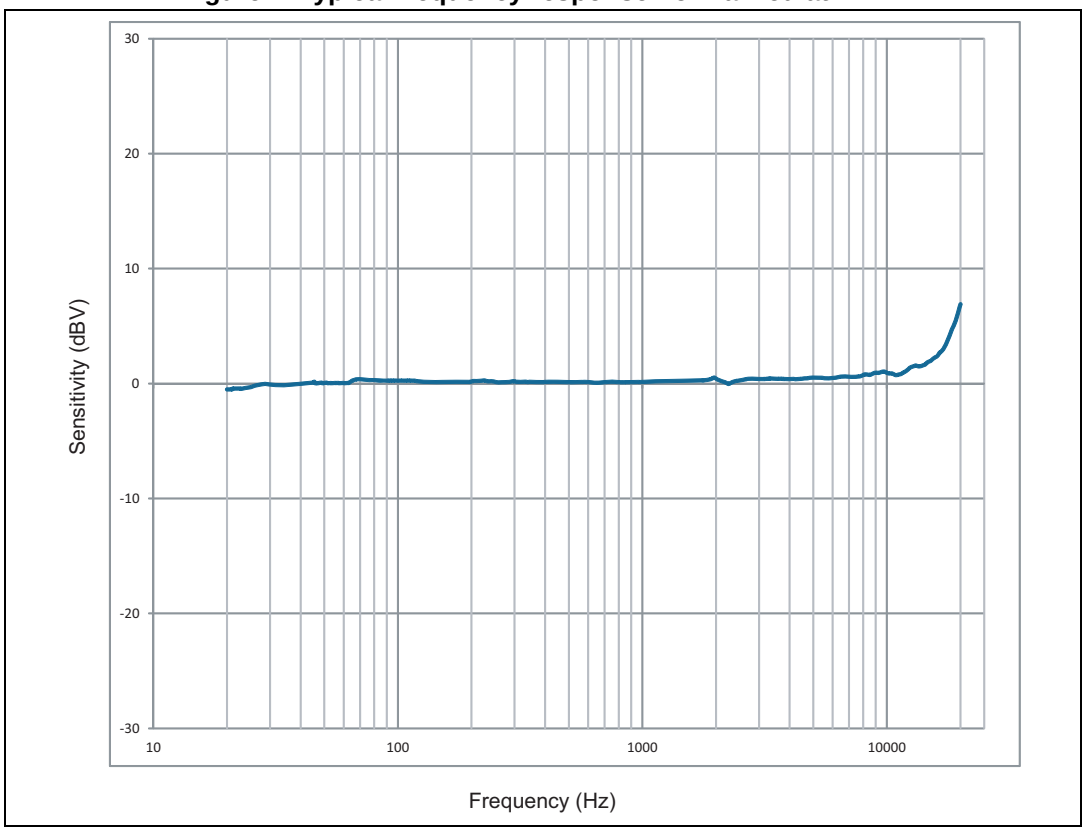
1. Typical specifications are not guaranteed.

Table 4. Distortion specifications at 1 kHz

Parameter	Test condition	Value
Distortion	94 dBSPL	< 1% THD
Distortion	125 dBSPL	10% THD (typ.)

2.2 Frequency response

Figure 2. Typical frequency response normalized at 1 kHz



3 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 5. Absolute maximum ratings

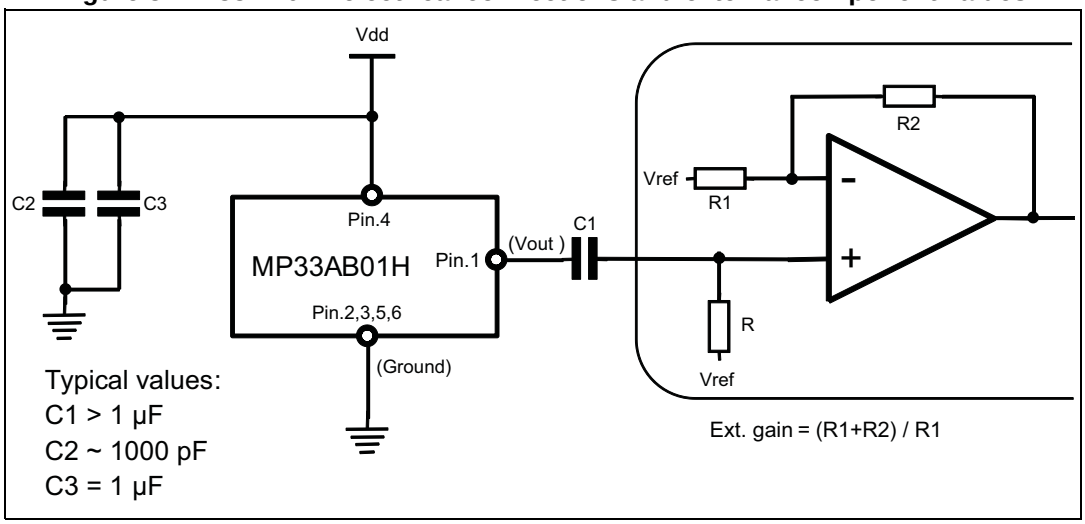
Symbol	Ratings	Maximum value	Unit
Vdd	Supply voltage	-0.5 to 4	V
T_{STG}	Storage temperature range	-40 to +100	°C

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.

4 Application recommendations

Figure 3. MP33AB01H electrical connections and external component values



The DC-blocking capacitor C1 is required on the Vout pin as shown in *Figure 3*. The C1 value and the input resistance of the interface circuit (R) affect the cut-off frequency of the Audio signal path as:

$$3\ dB\ cut\text{-}off\ freq = 1 / 2\pi RC1$$

It's advisable to have a cut-off frequency well below 20 HZ, so for a typical input resistance of about 20 kΩ it is recommended to use a C1 > 1 µF.

5 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 RHLGA (3.76 x 2.95) mm package is also compliant with the RoHS and “Green” standards and is qualified for soldering heat resistance according to JEDEC J-STD-020.

Land pattern and soldering recommendations are available at *www.st.com*.

Figure 4. Recommended soldering profile limits

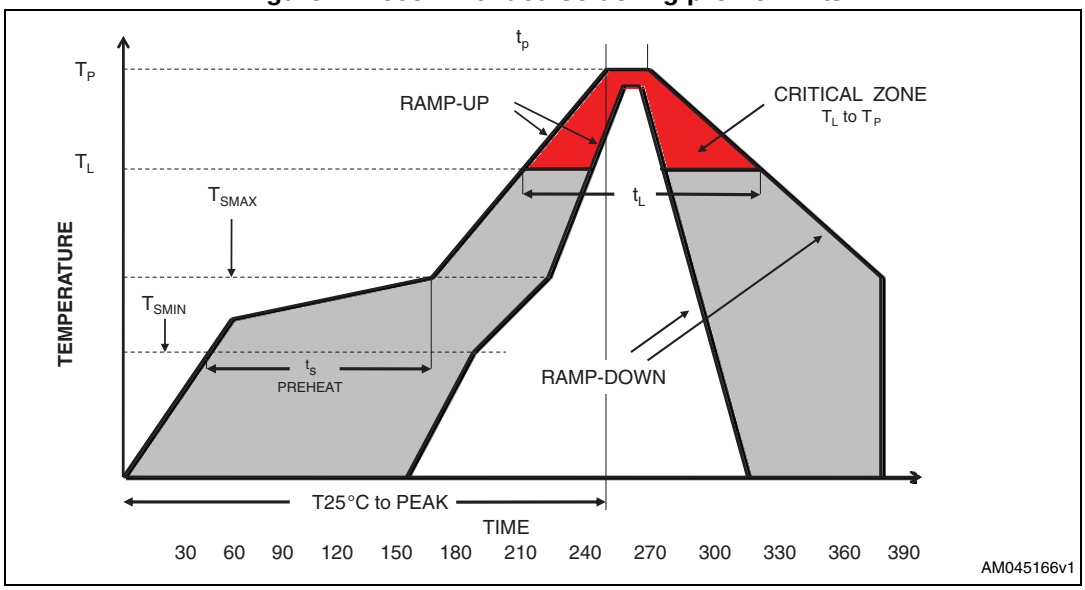


Table 6. Recommended soldering profile limits

Description	Parameter	Pb free
Average ramp rate	T_L to T_P	3 °C/sec max
Preheat Minimum temperature Maximum temperature Time (T_{SMIN} to T_{SMAX})	 T_{SMIN} T_{SMAX} t_S	 150 °C 200 °C 60 sec to 120 sec
Ramp-up rate	T_{SMAX} to T_L	
Time maintained above liquidous temperature Liquidous temperature	t_L T_L	60 sec to 150 sec 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 (t25 °C) to peak temperature		8 minutes max

Figure 5. RHLGA 3.76 mm x 2.95 mm x 1.0 mm package outline

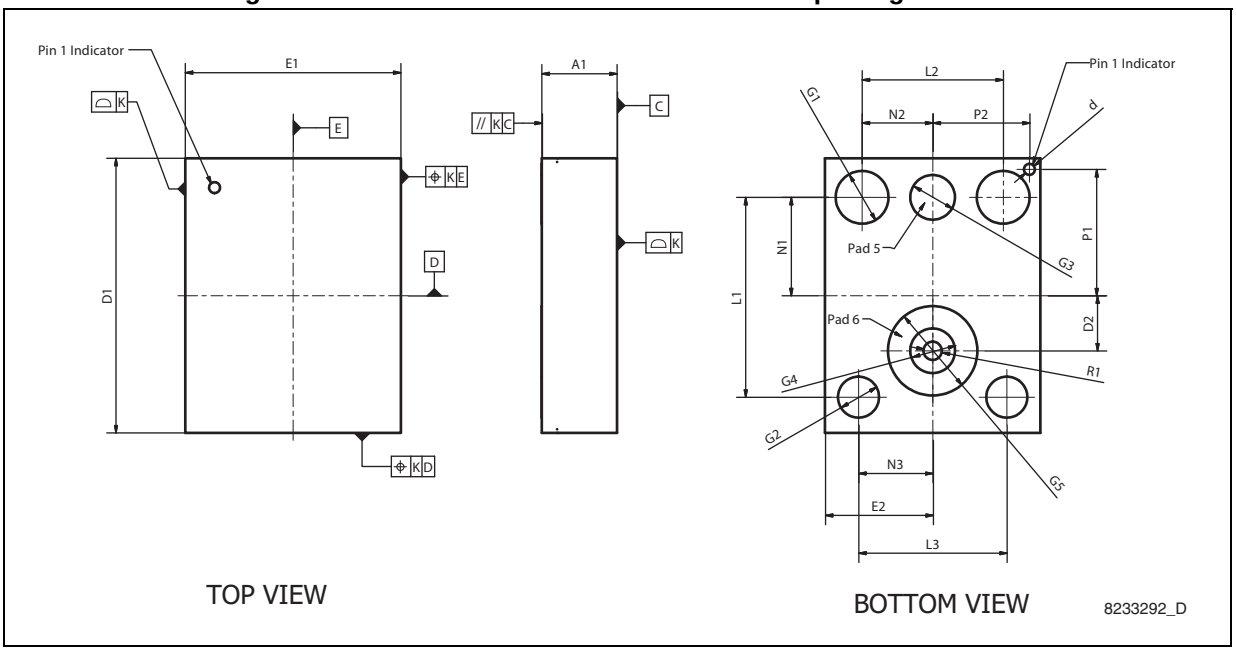


Table 7. RHLGA 3.76 mm x 2.95 mm x 1.0 mm package dimensions

Symbol	mm.			inch.		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A1	0.900	1.000	1.100	0.0354	0.0394	0.0433
D1	3.660	3.760	3.860	0.1441	0.1480	0.1520
D2	0.600	0.750	0.900	0.0236	0.0295	0.0354
R1	0.200	0.250	0.300	0.0079	0.0098	0.0118
E1	2.850	2.950	3.050	0.1122	0.1161	0.1201
E2	1.325	1.475	1.625	0.0522	0.0581	0.0640
L1	2.690	2.740	2.790	0.1059	0.1079	0.1098
L2	1.882	1.932	1.982	0.0741	0.0761	0.0780
L3	1.981	2.031	2.181	0.0780	0.0800	0.0859
N1	1.300	1.350	1.400	0.0512	0.0531	0.0551
N2	0.916	0.966	1.116	0.0361	0.0380	0.0440
N3	0.965	1.015	1.065	0.0380	0.0400	0.0419
G1	0.673	0.723	0.763	0.0265	0.0285	0.0300
G2	0.512	0.562	0.612	0.0202	0.0221	0.0241
G3	0.562	0.612	0.662	0.0221	0.0241	0.0261
G4	0.562	0.612	0.662	0.0221	0.0241	0.0261
G5	1.174	1.224	1.274	0.0462	0.0482	0.0502
P1	1.680	1.730	1.780	0.0661	0.0681	0.0701
P2	1.275	1.325	1.375	0.0502	0.0522	0.0541

Table 7. RHLGA 3.76 mm x 2.95 mm x 1.0 mm package dimensions (continued)

Symbol	mm.			inch.		
	Min.	Typ.	Max.	Min.	Typ.	Max.
d		0.150			0.0059	
K		0.050			0.0020	

Figure 6. Device footprint and PCB land pattern

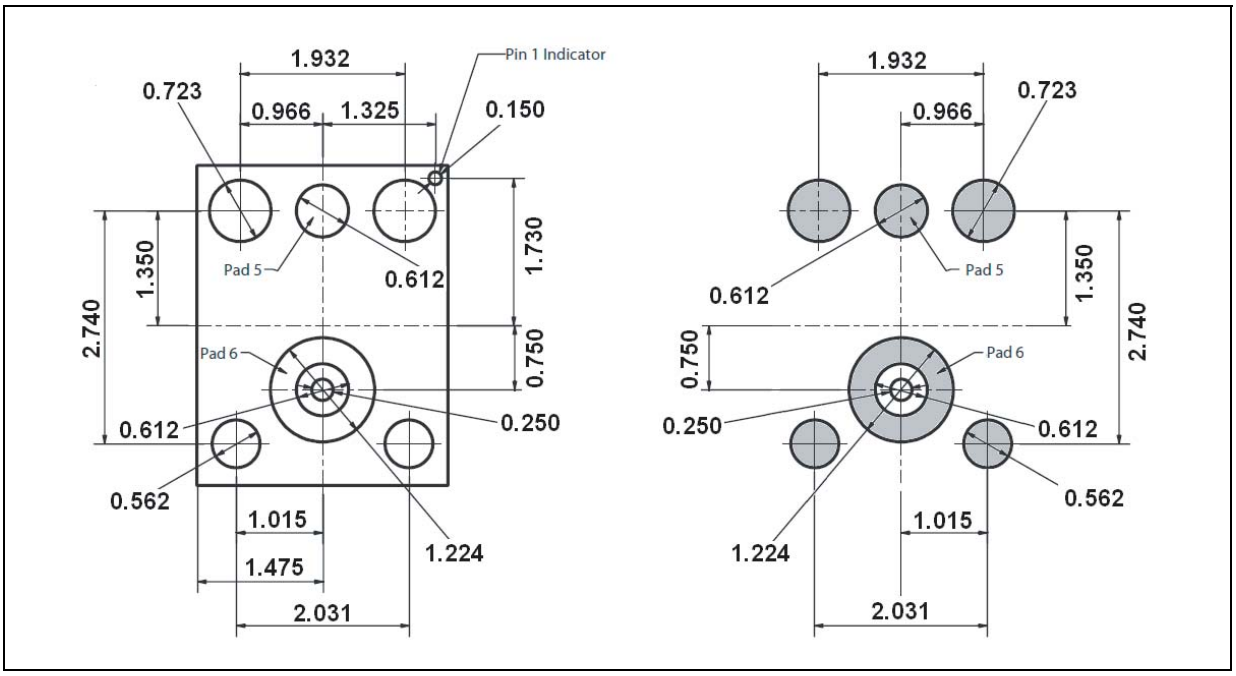
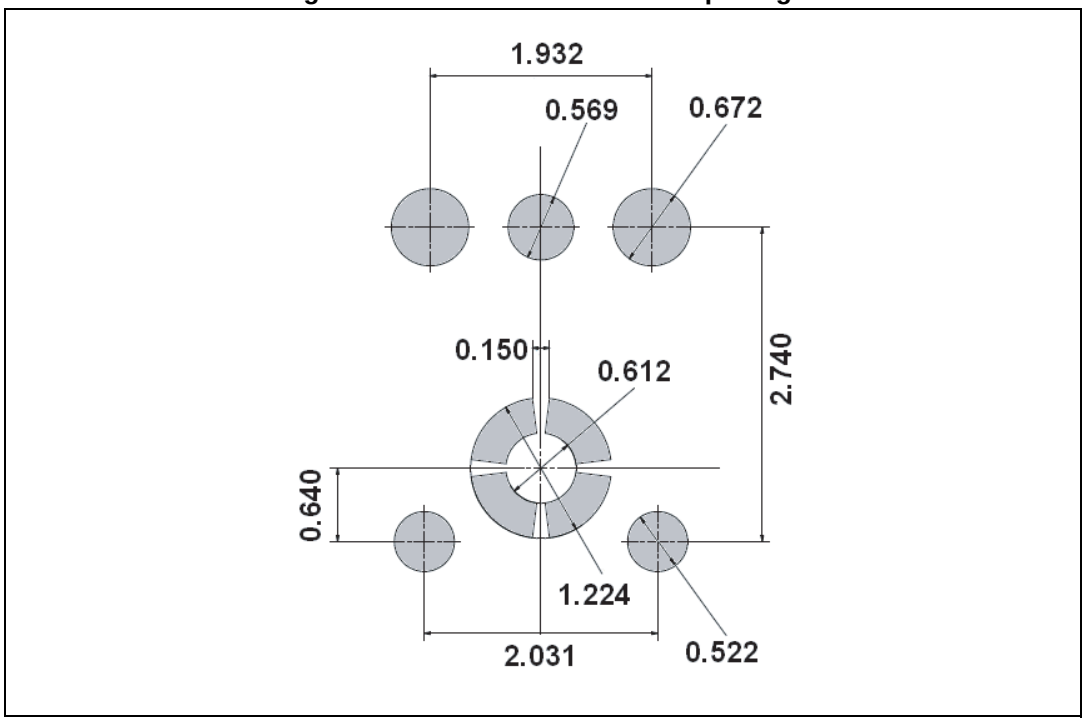


Figure 7. Recommended stencil openings



6 Revision history

Table 8. Document revision history

Date	Revision	Changes
17-Jan-2013	1	Initial release
13-Sep-2013	2	Modified *Figure 3 on page 7*
10-Oct-2013	3	Modified description value in cover page from 63 dB to 66 dB

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www.st.com

MP34DB01

MEMS audio sensor omnidirectional digital microphone

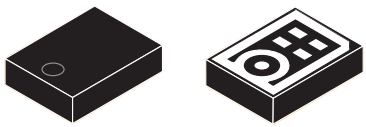
Datasheet – production data

Features

- Single supply voltage
- Low power consumption
- 120 dBSPL acoustic overload point
- 62.6 dB signal-to-noise ratio
- Omnidirectional sensitivity
- –26 dBFS sensitivity
- PDM single-bit output with option for stereo configuration
- RHLGA package
  - Bottom-port design
  - SMD-compliant
  - EMI-shielded
  - 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



RHLGA 3x4x1 4LD

Description

The MP34DB01 is an ultra-compact, low-power, omnidirectional, digital MEMS microphone built with a capacitive sensing element and an IC interface with stereo operation capability.

The sensing element, capable of detecting acoustic waves, is manufactured using a specialized silicon micromachining process dedicated 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 MP34DB01 has an acoustic overload point of 120 dBSPL with a best on the market 62.6 dB signal-to-noise ratio and -26 dBFS sensitivity.

The MP34DB01 is available in a bottom-port, SMD-compliant, EMI-shielded package and is guaranteed to operate over an extended temperature range from -40 °C to +85 °C.

Table 1. Device summary

Part number	Temperature range [°C]	Package	Packing
MP34DB01	-40 to +85	RHLGA (3x4x1) mm 4LD	Tray
MP34DB01TR	-40 to +85	RHLGA (3x4x1) mm 4LD	Tape and reel

Contents

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1 Pin description

Figure 1. Pin connections

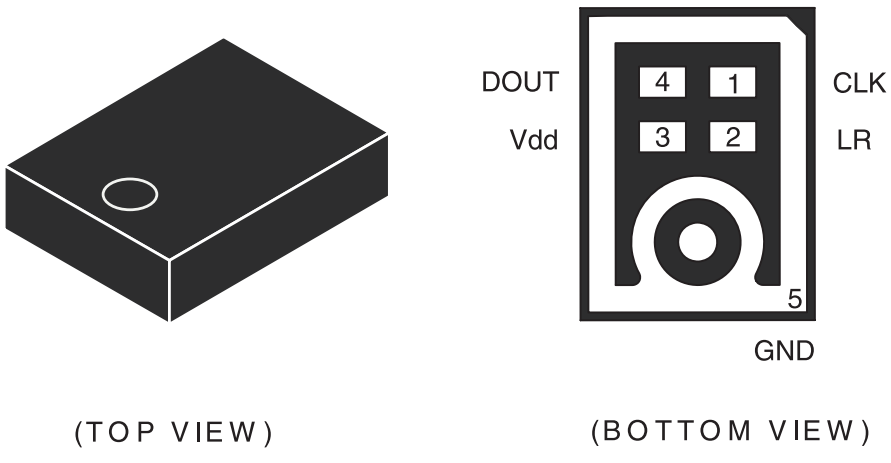


Table 2. Pin description

Pin #	Pin name	Function
1	CLK	Synchronization input clock
2	LR	Left/right channel selection
3	Vdd	Power supply
4	DOUT	Left/right PDM data output
5 (ground ring)	GND	0 V 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	Mean value(2)		0.65		mA
IddPdn	Current consumption in power-down mode(3)			20		µA
Scc	Short-circuit current		1		10	mA
AOP	Acoustic overload point			120		dBSPL
So	Sensitivity	at 1 kHz, 1 Pa	-29	-26	-23	dBFS
SNR	Signal-to-noise ratio	A-weighted at 1 kHz, 1 Pa		62.6		dB
PSR	Power supply rejection	Guaranteed by design		-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		-40		+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. No load on DOUT line.
3. Input clock in static mode.
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 dBSPL (50 Hz - 4 kHz)	< 1% THD + N
Distortion	115 dBSPL (1 kHz)	< 5% THD + N

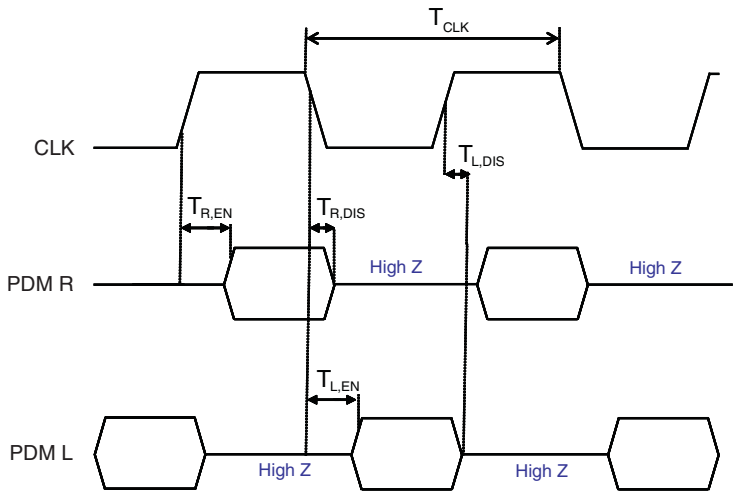
2.2 Timing characteristics

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



2.3 Frequency response

Figure 3. Typical frequency response normalized at 1 kHz

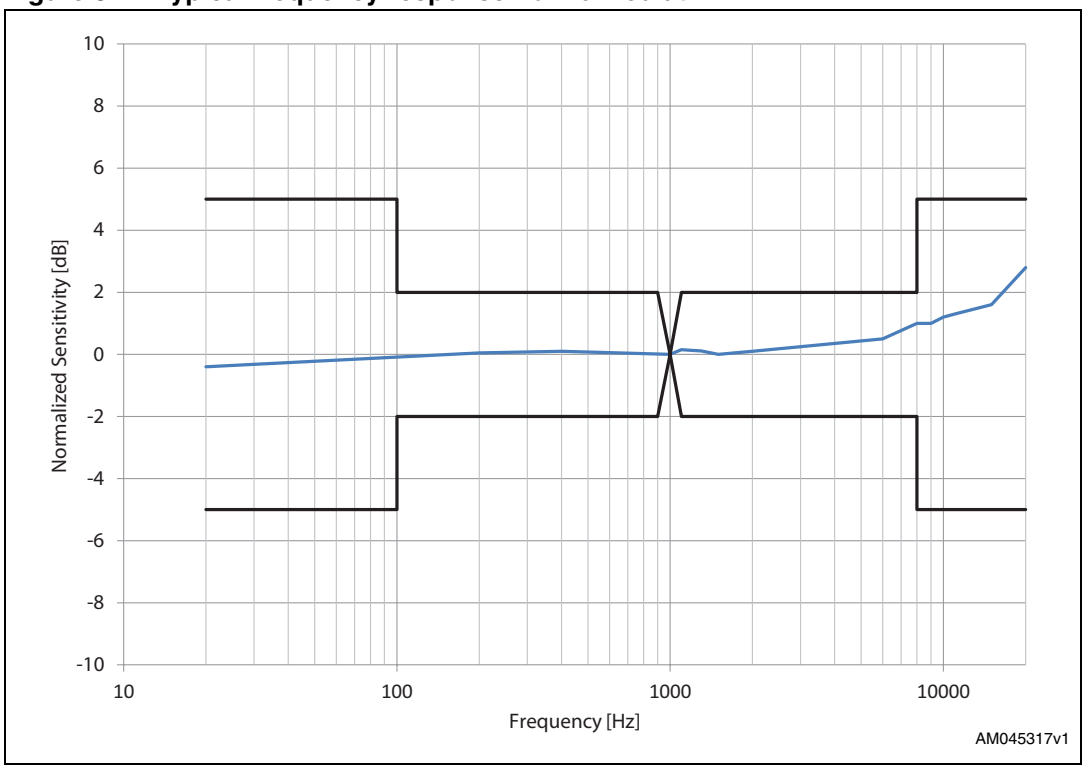


Table 6. Frequency response mask for digital microphones

Frequency / Hz (1)	Lower limit	Upper limit	Unit
20...100	-5	+5	dBr 1kHz
100...8000	-2	+2	dBr 1kHz
8000...20000	-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. MP34DB01 electrical connections

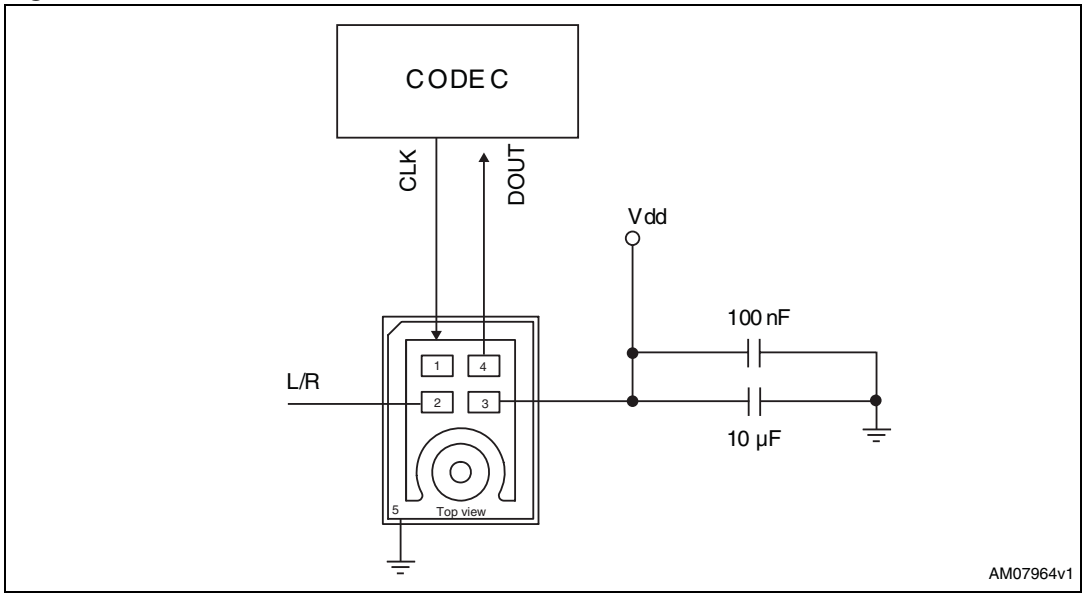
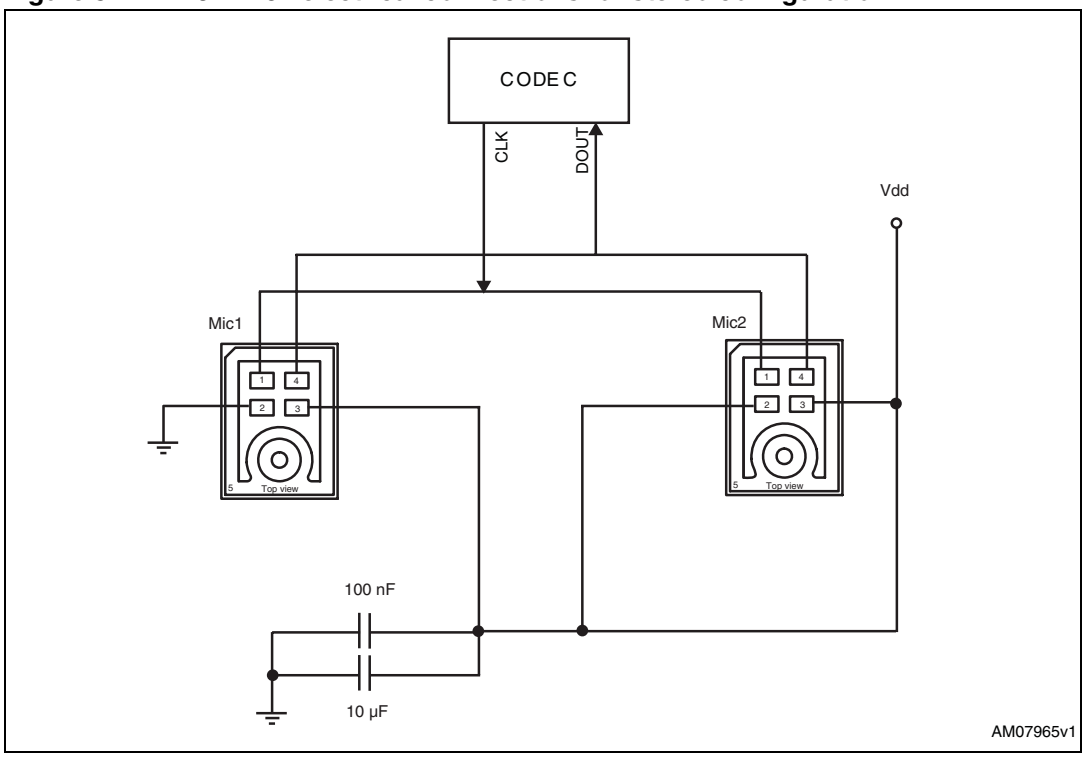


Figure 5. MP34DB01 electrical connections for stereo configuration



Power supply decoupling capacitors (100 nF ceramic, 10 µF ceramic) should be placed as near as possible to pin 3 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 RHLGA (3 x 4 x 1) 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

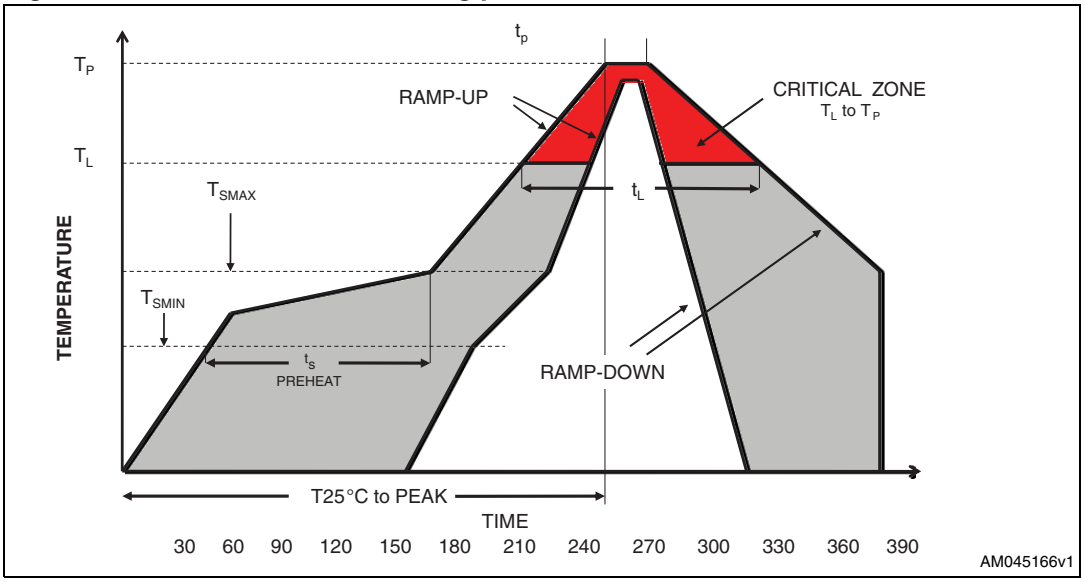


Table 9. Recommended soldering profile limits

Description	Parameter	Pb free
Average ramp rate	T_L to T_P	3 °C/sec max
Preheat Minimum temperature Maximum temperature Time (T_{SMIN} to T_{SMAX})	 T_{SMIN} T_{SMAX} t_S	 150 °C 200 °C 60 sec to 120 sec
Ramp-up rate	T_{SMAX} to T_L	
Time maintained above liquidous temperature Liquidous temperature	t_L T_L	60 sec to 150 sec 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 (t25 °C) to peak temperature		8 minutes max

Figure 7. RHLGA 3 mm x 4 mm x 1 mm 4-lead package outline

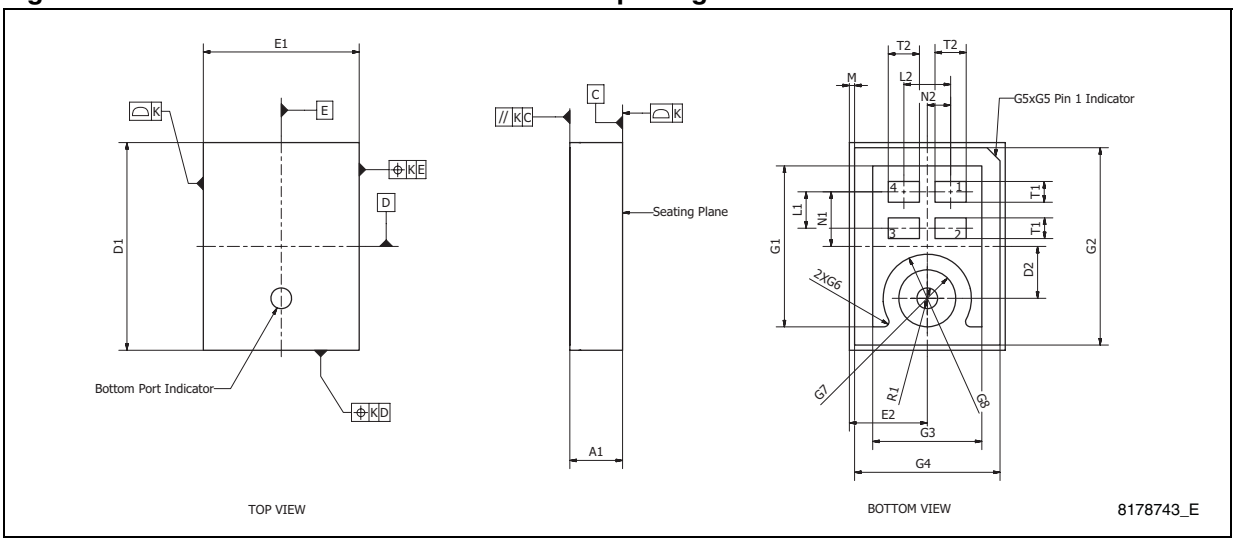


Table 10. RHLGA 3 mm x 4 mm x 1 mm 4-lead package dimensions

Symbol	mm		
	Min	Typ	Max
A1	0.900	1.000	1.100
D1	3.900	4.000	4.100
D2	0.950	1.000	1.050
R1	0.350	0.400	0.450
E1	2.900	3.000	3.100
E2	1.450	1.500	1.550
L1	0.650	0.700	0.750
L2	0.850	0.900	0.950
N1	1.000	1.050	1.100
N2	0.400	0.450	0.500
T1	0.350	0.400	0.450
T2	0.550	0.600	0.650
G1	3.050	3.100	3.150
G2	3.750	3.800	3.850
G3	2.050	2.100	2.150
G4	2.750	2.800	2.850
G5	0.250	0.300	0.350
G6	0.050	0.100	0.150
G7	0.500	0.550	0.600
G8	0.800	0.850	0.900
M		0.100	
K		0.050	

8 Revision history

Table 11. Document revision history

Date	Revision	Changes
28-Mar-2011	1	Initial release
05-Apr-2011	2	Updated *Table 3* and *Table 5*
21-Oct-2011	3	Added max. peak temperature T_P to *Table 9*
18-Nov-2011	4	Updated SNR typical value in *Table 3*; document promoted from preliminary to full datasheet
04-Jan-2012	5	Updated *Features* and *Description* Updated *Figure 3: Typical frequency response normalized at 1 kHz*
20-Mar-2012	6	Added test condition criterion to PSR in *Table 3: Acoustic and electrical characteristics*
07-May-2012	7	Added V_{IOL}, V_{IOH} to *Table 3: Acoustic and electrical characteristics*
05-Jul-2012	8	Added *Section 3: Sensing element* Updated operating temperature range throughout datasheet

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www.st.com

MP34DB02

MEMS audio sensor omnidirectional digital microphone

Datasheet - production data

RHLGA (3 x 4 x 1 mm) 4LD

Features

- Single supply voltage
- Low power consumption
- 120 dBSPL acoustic overload point
- 62.6 dB signal-to-noise ratio
- Omnidirectional sensitivity
- –26 dBFS sensitivity
- PDM single-bit output with option for stereo configuration
- RHLGA package
  - Bottom-port design
  - SMD-compliant
  - EMI-shielded
  - 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 MP34DB02 is an ultra-compact, low-power, omnidirectional, digital MEMS microphone built with a capacitive sensing element and an IC interface with stereo operation capability.

The sensing element, capable of detecting acoustic waves, is manufactured using a specialized silicon micromachining process dedicated 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 MP34DB02 has an acoustic overload point of 120 dBSPL with a best on the market 62.6 dB signal-to-noise ratio and -26 dBFS sensitivity.

The MP34DB02 is available in a bottom-port, SMD-compliant, EMI-shielded package and is guaranteed to operate over an extended temperature range from -40 °C to +85 °C.

Table 1. Device summary

Part number	Temperature range [°C]	Package	Packing
MP34DB02	-40 to +85	RHLGA (3x4x1) mm 4LD	Tray
MP34DB02TR	-40 to +85	RHLGA (3x4x1) mm 4LD	Tape and reel

Contents

1 Pin description

Figure 1. Pin connections

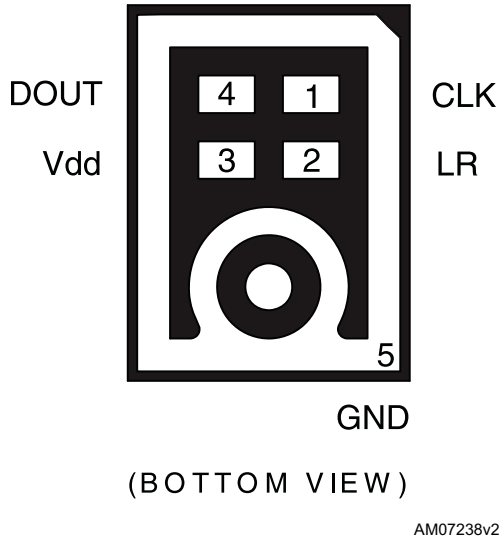


Table 2. Pin description

Pin n°	Pin name	Function
1	CLK	Synchronization input clock
2	LR	Left/right channel selection
3	Vdd	Power supply
4	DOUT	Left/right PDM data output
5 (ground ring)	GND	0 V 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	Mean value(2)		0.65		mA
IddPdn	Current consumption in power-down mode(3)			20		µA
Scc	Short-circuit current		1		10	mA
AOP	Acoustic overload point			120		dBSPL
So	Sensitivity	at 1 kHz, 1 Pa	-29	-26	-23	dBFS
SNR	Signal-to-noise ratio	A-weighted at 1 kHz, 1 Pa		62.6		dB
PSR	Power supply rejection			-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		-40		+85	°C

1. Typical specifications are not guaranteed.
2. No load on DOUT line.
3. Input clock in static mode.
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 dBSPL (50 Hz - 4 kHz)	< 1 % THD + N
Distortion	115 dBSPL (1 kHz)	< 5 % THD + N

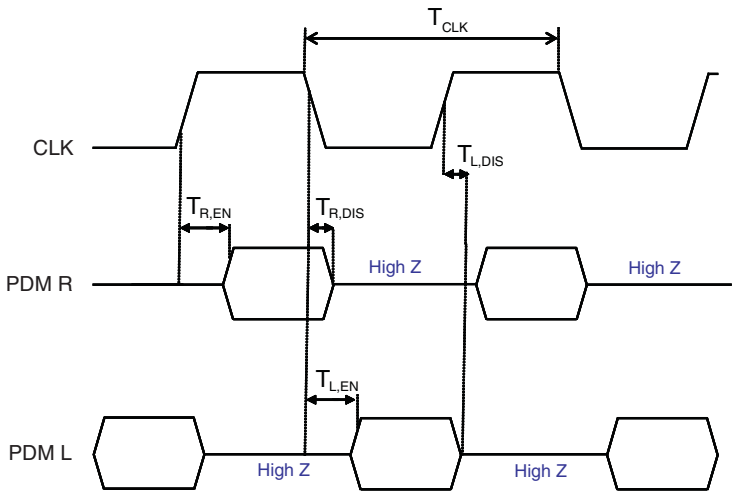
2.2 Timing characteristics

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	18(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	18(1)	30(1)	ns
$T_{L,DIS}$	Data disabled on DATA line, L/R pin = 0		16(1)	ns

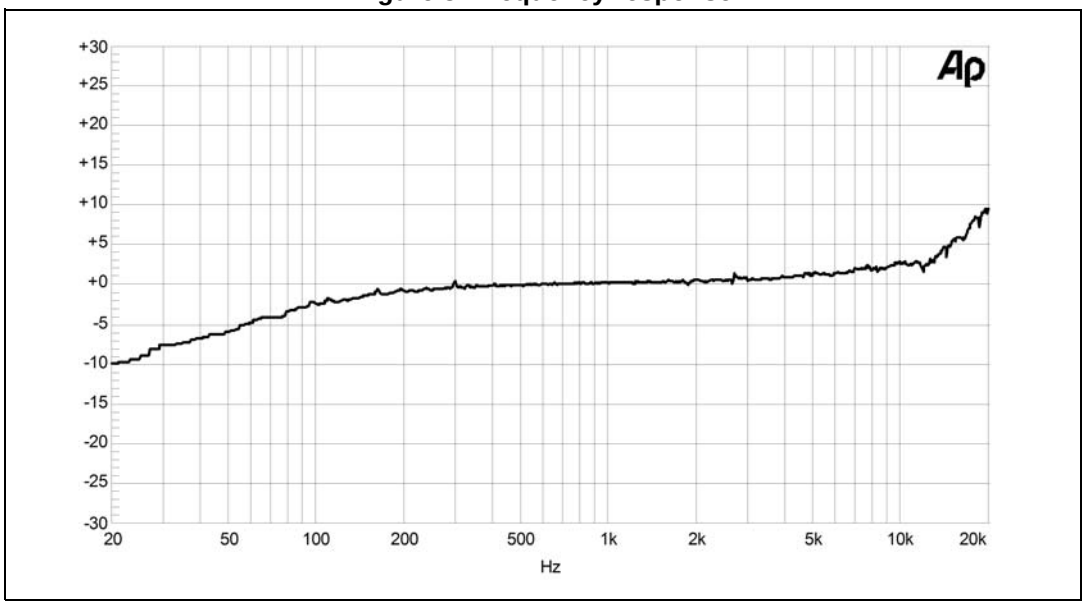
1. From design simulations

Figure 2. Timing waveforms



2.3 Frequency response

Figure 3. Frequency response



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 6. 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 7*. 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. MP34DB02 electrical connections

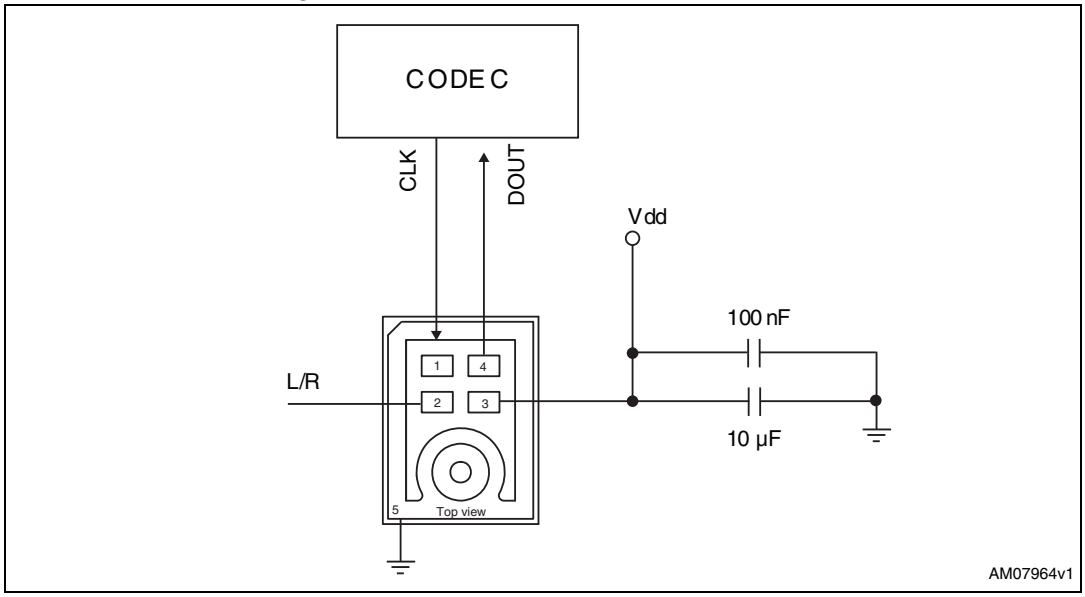
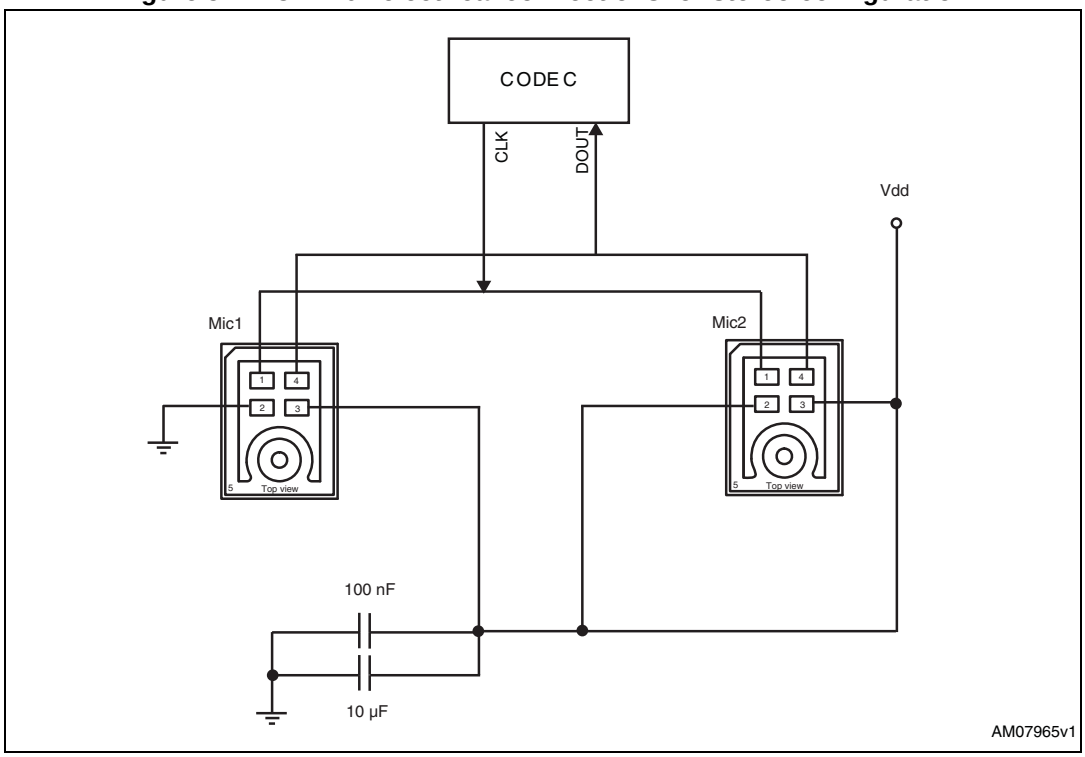


Figure 5. MP34DB02 electrical connections for stereo configuration



Power supply decoupling capacitors (100 nF ceramic, 10 µF ceramic) should be placed as near as possible to pin 3 of the device (common design practice).

The L/R pin must be connected to Vdd or GND (refer to *Table 7*).

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 RHLGA (3 x 4 x 1) 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

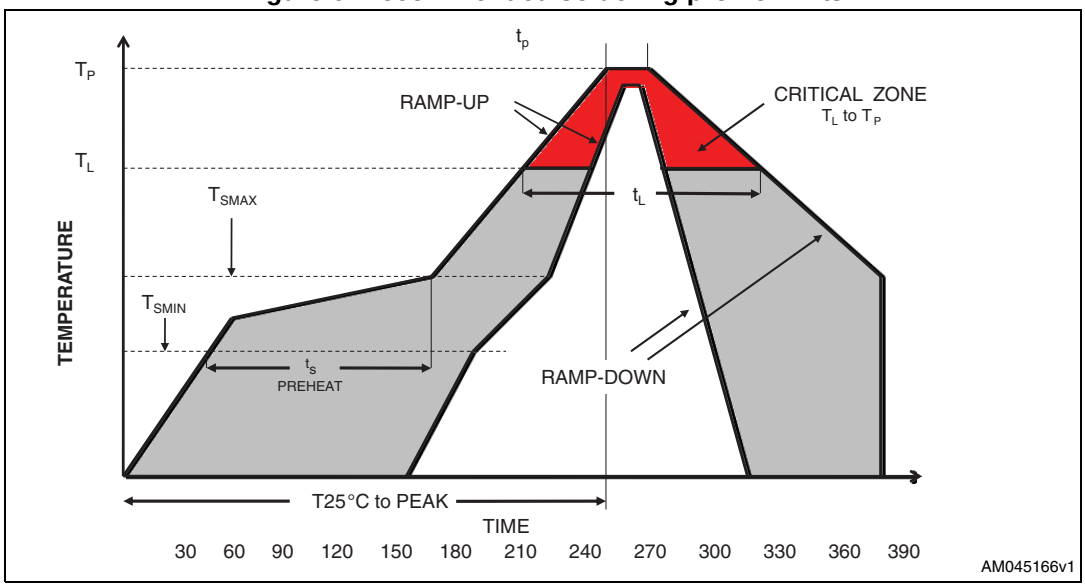


Table 8. Recommended soldering profile limits

Description	Parameter	Pb free
Average ramp rate	T_L to T_P	3 °C/sec max
Preheat Minimum temperature Maximum temperature Time (T_{SMIN} to T_{SMAX})	 T_{SMIN} T_{SMAX} t_S	 150 °C 200 °C 60 sec to 120 sec
Ramp-up rate	T_{SMAX} to T_L	
Time maintained above liquidus temperature Liquidus temperature	t_L T_L	60 sec to 150 sec 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 (t25 °C) to peak temperature		8 minutes max

Figure 7. RHLGA 3x4 (Metal Cap) 0.25mm Port Hole 4LD package outline

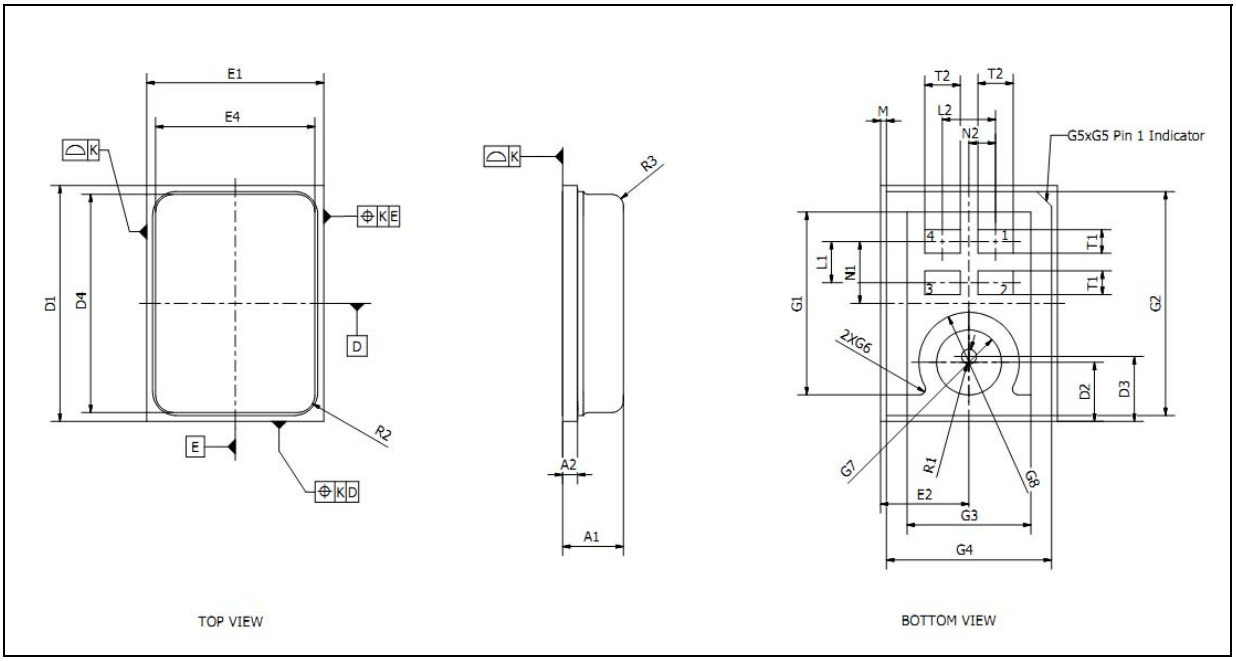


Table 9. RHLGA 3 x 4 (Metal Cap) 0.25 mm Port Hole 4LD package dimensions

Symbol	mm.		
	Min.	Typ.	Max.
A1	0.900	1.000	1.100
A2	0.200	0.250	0.300
D1	3.900	4.000	4.100
D2	0.900	1.000	1.100
D3	1.000	1.100	1.200
D4	3.610	3.700	3.790
R1	0.200	0.250	0.300
R2		0.280	
R3		0.250	
E1	2.900	3.000	3.100
E2	1.300	1.500	1.700
E4	2.610	2.700	2.790
L1	0.650	0.700	0.750
L2	0.850	0.900	0.950
N1	1.000	1.050	1.100
N2	0.400	0.450	0.500
T1	0.350	0.400	0.450
T2	0.550	0.600	0.650

Table 9. RHLGA 3 x 4 (Metal Cap) 0.25 mm Port Hole 4LD package dimensions (continued)

Symbol	mm.		
	Min.	Typ.	Max.
G1	3.050	3.100	3.150
G2	3.750	3.800	3.850
G3	2.050	2.100	2.150
G4	2.750	2.800	2.850
G5	0.250	0.300	0.350
G6	0.050	0.100	0.150
G7	0.500	0.550	0.600
G8	0.800	0.850	0.900
M		0.100	
K		0.050	

8 Revision history

Table 10. Document revision history

Date	Revision	Changes
21-Mar-2014	1	Initial release.

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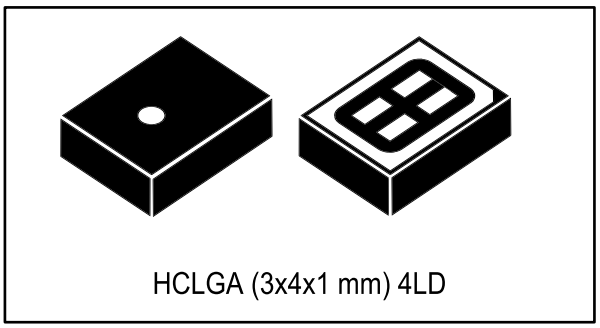
MP34DT01

MEMS audio sensor omnidirectional digital microphone

Datasheet - production data



HCLGA (3x4x1 mm) 4LD

Features

- Single supply voltage
- Low power consumption
- 120 dBSPL acoustic overload point
- 63 dB signal-to-noise ratio
- Omnidirectional sensitivity
- –26 dBFS sensitivity
- PDM output
- HCLGA package
  - Top-port design
  - SMD-compliant
  - EMI-shielded
  - 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 MP34DT01 is an ultra-compact, low-power, omnidirectional, digital MEMS microphone built with a capacitive sensing element and an IC interface.

The sensing element, capable of detecting acoustic waves, is manufactured using a specialized silicon micromachining process dedicated 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 MP34DT01 has an acoustic overload point of 120 dBSPL with a 63 dB signal-to-noise ratio and –26 dBFS sensitivity.

The MP34DT01 is available in a top-port, SMD-compliant, EMI-shielded package and is guaranteed to operate over an extended temperature range from -40 °C to +85 °C.

Table 1: Device summary

Order codes	Temp. range [°C]	Package	Packing
MP34DT01	-40 to +85	HCLGA (3x4 x1 mm) 4LD	Tray
MP34DT01TR	-40 to +85	HCLGA (3x4x1 mm) 4LD	Tape and reel

Contents

List of tables

List of figures

1 Pin description

Figure 1: Pin connections

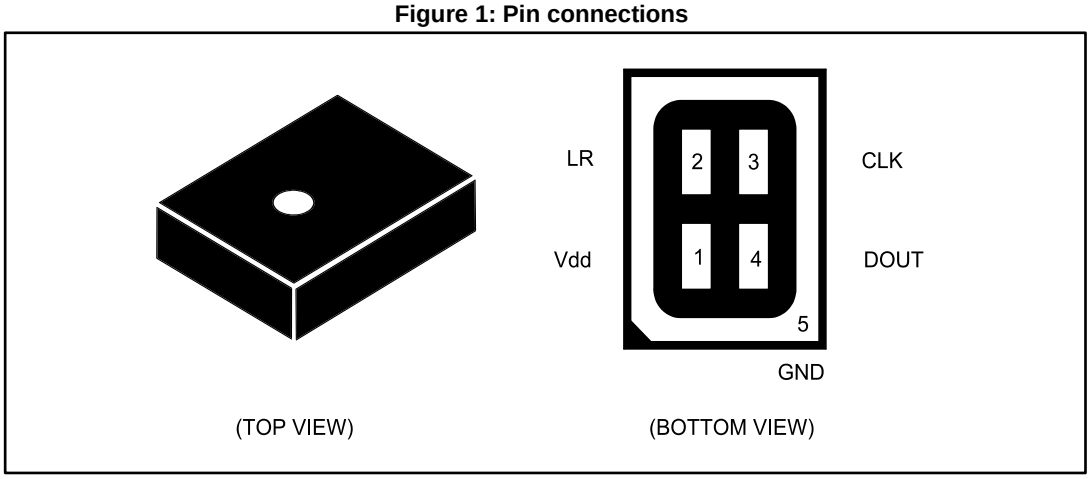


Table 2: Pin description

Pin #	Pin name	Function
1	Vdd	Power supply
2	LR	Left/Right channel selection
3	CLK	Synchronization input clock
4	DOUT	Left/Right PDM data output
5 (ground ring)	GND	0 V 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	Mean value		0.6		mA
IddPdn	Current consumption in power-down mode (2)			20		µA
Scc	Short-circuit current		1		10	mA
AOP	Acoustic overload point			120		dBSPL
So	Sensitivity		-29	-26	-23	dBFS
SNR	Signal-to-noise ratio	A-weighted at 1 kHz, 1 Pa		63		dB
PSR	Power supply rejection	Guaranteed by design		-70		dBFS
Clock	Input clock frequency (3)		1	2.4	3.25	MHz
Ton	Turn-on time (4)	Guaranteed by design			10	ms
Top	Operating temperature range		-40		+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)Duty cycle: min = 40% max = 60%.

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

Table 4: Distortion specifications

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

2.2 Timing characteristics

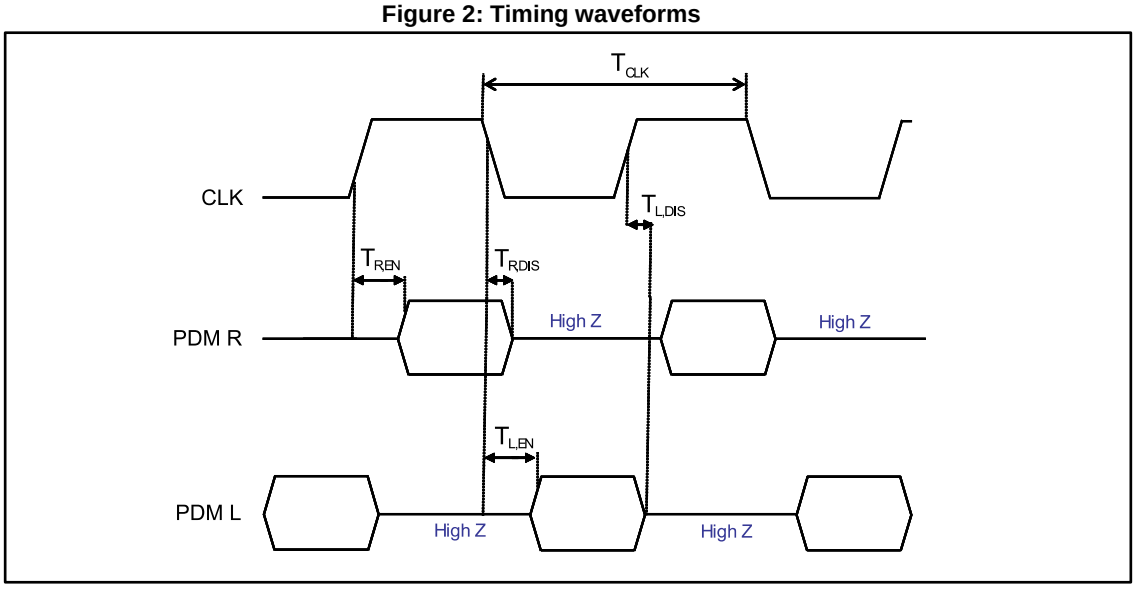
Table 5: Timing characteristics

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	18 (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	18(1)		ns
$T_{L,DIS}$	Data disabled on DATA line, L/R pin = 0		16(1)	ns

Notes:

(1)From design simulations

Figure 2: Timing waveforms



2.3 Frequency response

Figure 3: Frequency response and mask

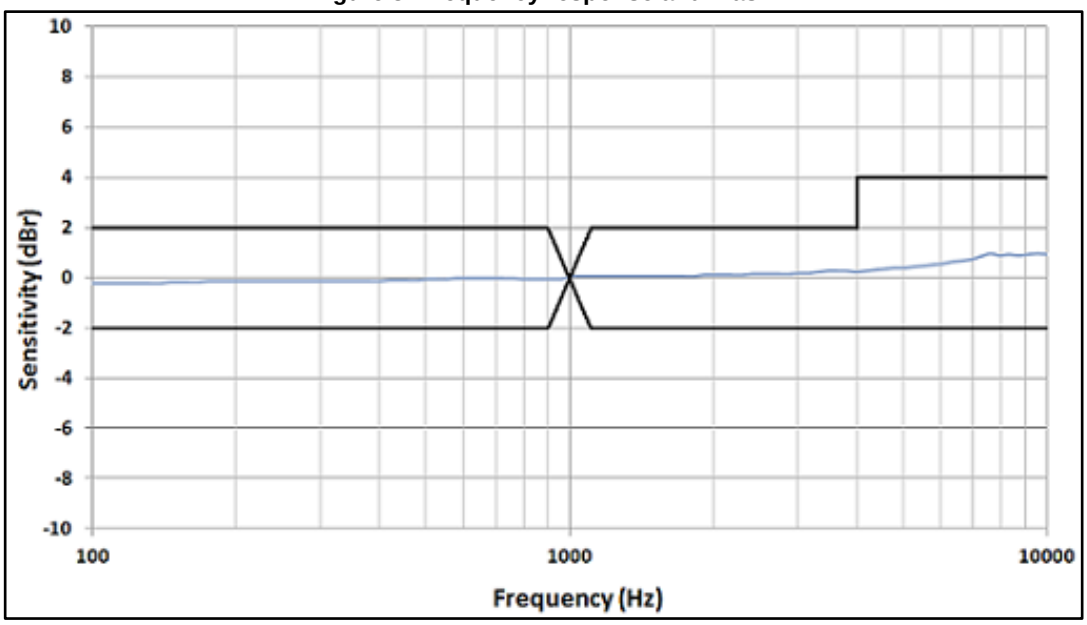


Table 6: Frequency response mask for digital microphones

Frequency / Hz (1)	Lower limit	Upper limit	Unit
100...4000	-2	+2	dBr 1 kHz
4000...10000	-2	+4	dBr 1 kHz

Notes:

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

3 Carrier tape mechanical specifications

Figure 4: Carrier tape without microphone (top view)

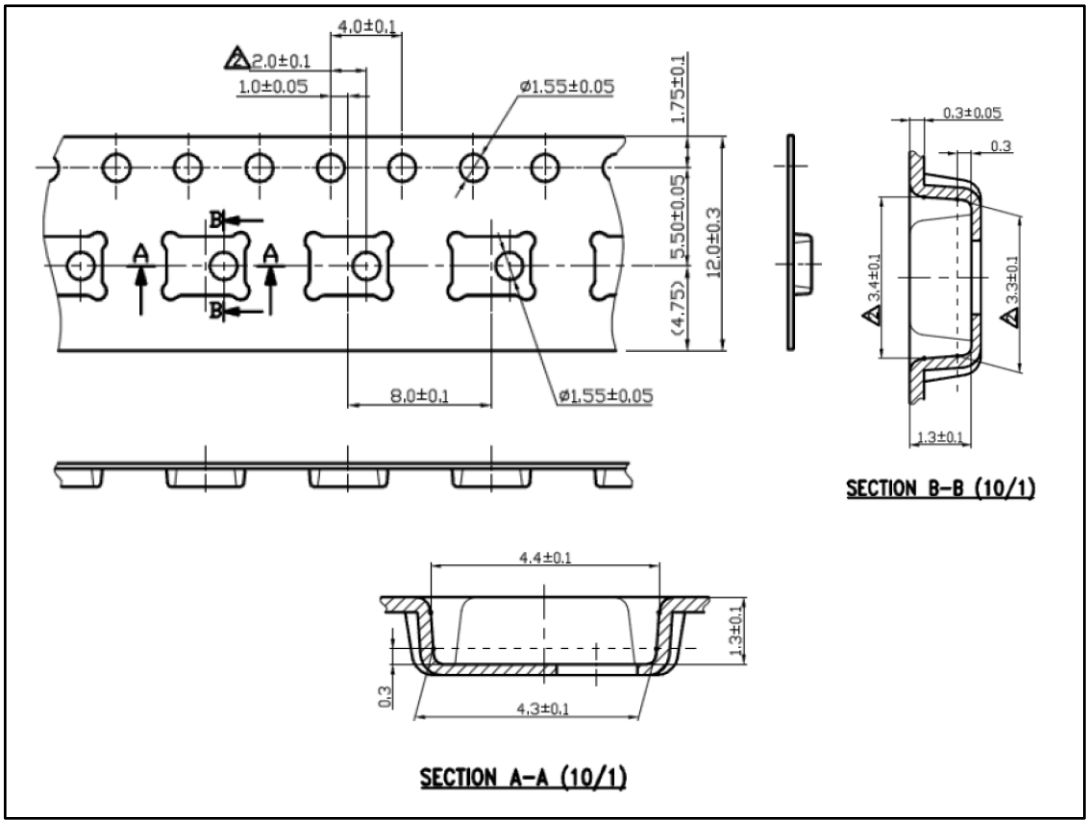
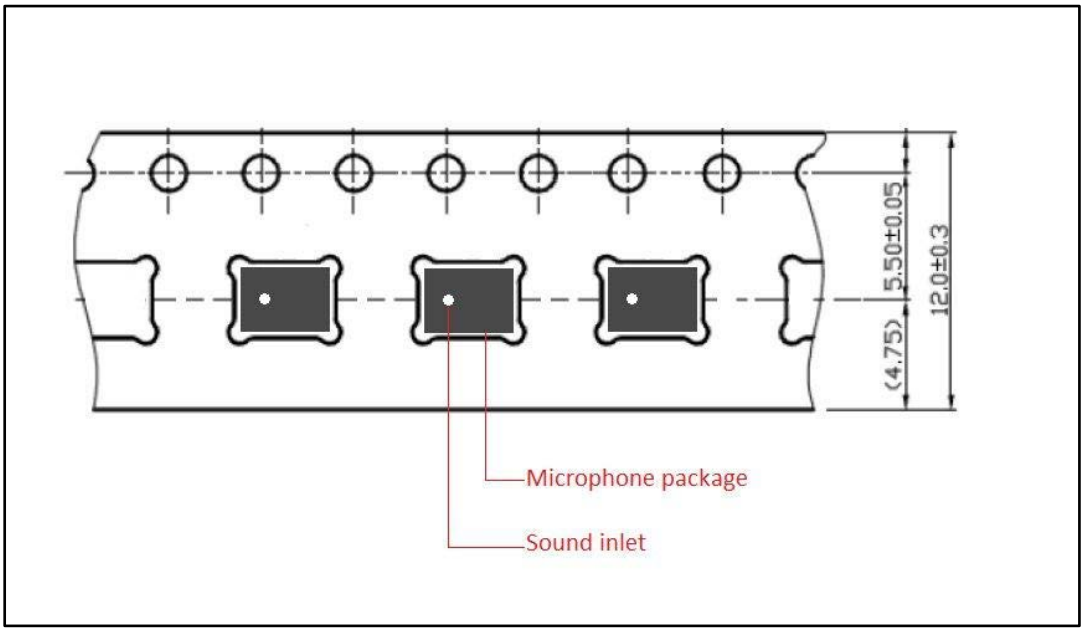


Figure 5: Carrier tape with microphone (top view)

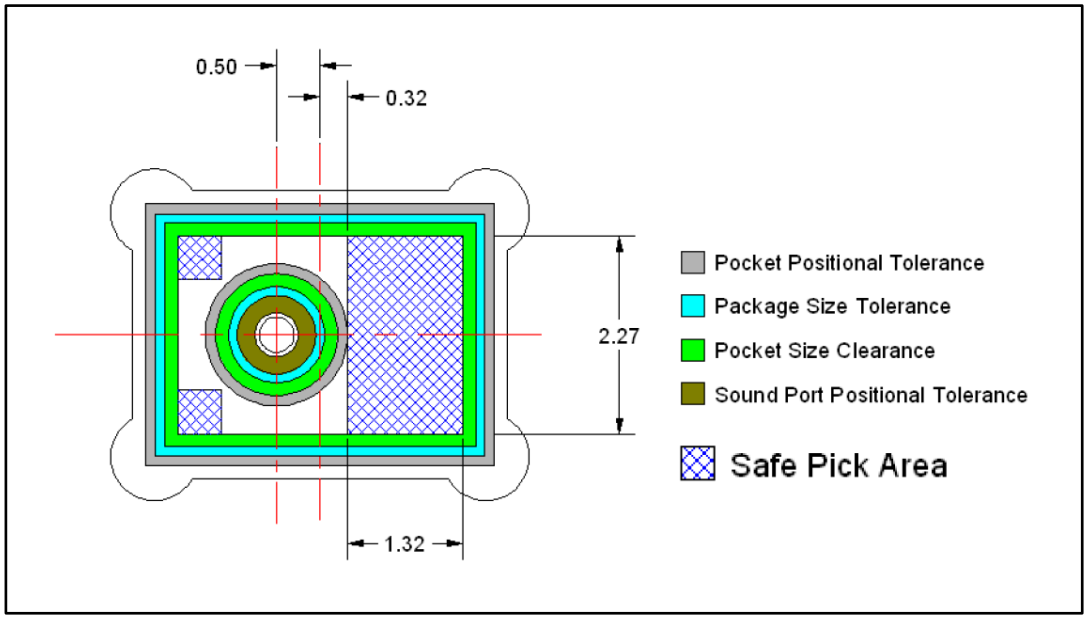


4 Process recommendations

To ensure a consistent manufacturing process it is strongly advised to comply with the following recommendations:

- The recommended pick-up area for the MP34DT01 package must be defined using the worst case (ie. no device alignment during the picking process). This area has been defined considering all the tolerances of the components involved (reel, package, sound inlet). The picker tolerance shall be considered as well.
- To prevent damage to the MEMS membrane or incorrect pick-up and placement, do not pick up the component on the inlet area
- For the package outline please refer to *Figure 5: "Carrier tape with microphone (top view)"*. Nozzle shape, size, and placement accuracy are the other key factors to consider when deciding on the coordinates for picking.
- Device alignment before picking is highly recommended.
- A vacuum force greater than 7 psi must be avoided
- 1 kPa = 0.145 psi (lb/in2) = 0.0102 kgf/cm² = 0.0098 atm
- All recommended dimensions (device safe-picking area) do not include the pick-and-place equipment tolerances

Figure 6: Recommended picking area

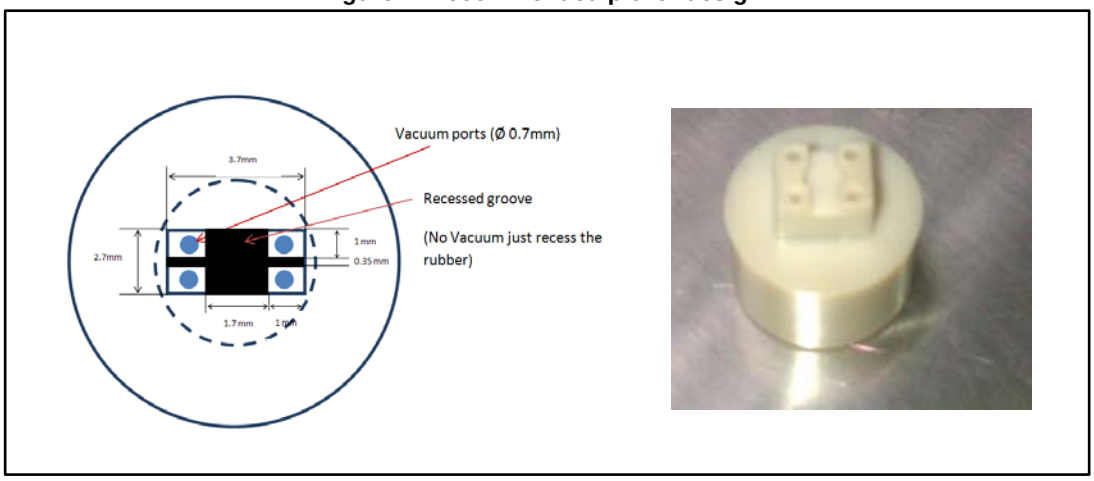


To have a safe pick-up "by design", ST strongly advises an ad hoc nozzle.

The following picker ensures that the holes for the vacuum and the air stream are ALWAYS away from the porthole of the device (4 vacuum ports located at each corner of the device).

The recommended nozzle also has a recess, in the form of a cross, which guarantees that the porthole is always left at atmospheric pressure. By using the recommended nozzle, the membrane will not suffer any sudden air disturbances during the picking or placing of the devices in the tape and reel.

Figure 7: Recommended picker design



5 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.

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

7 Functionality

7.1 L/R channel selection

The L/R digital pad lets the user select the DOUT signal pattern as shown in *Table 8: "L/R channel selection"*. 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

8 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.

8.1 Soldering information

The HCLGA (3 x 4) 4LD package is also compliant with the RoHS and “Green” standards and is qualified for soldering heat resistance according to JEDEC J-STD-020.

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

Figure 8: Recommended soldering profile limits

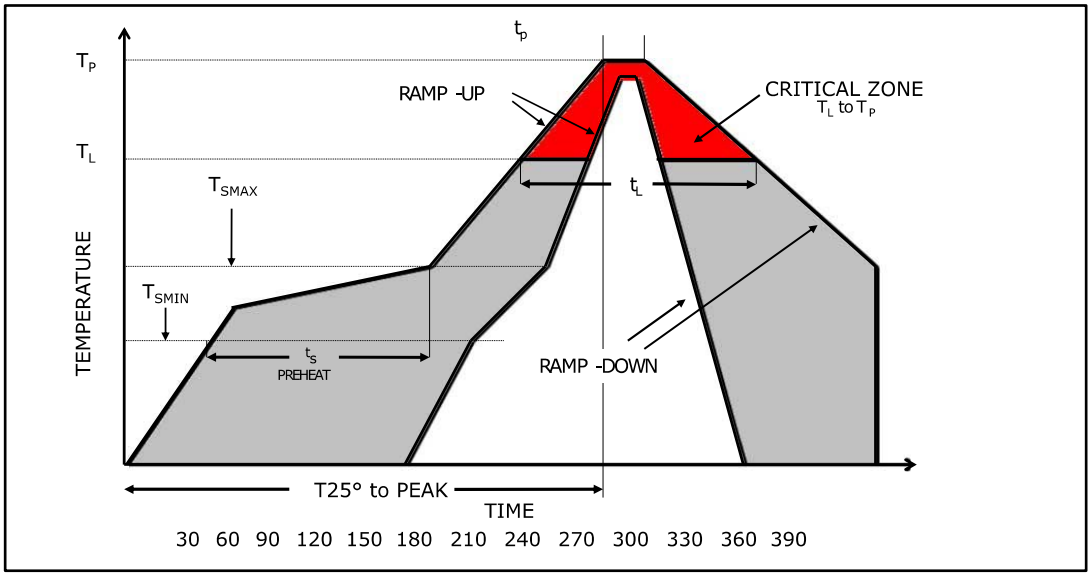
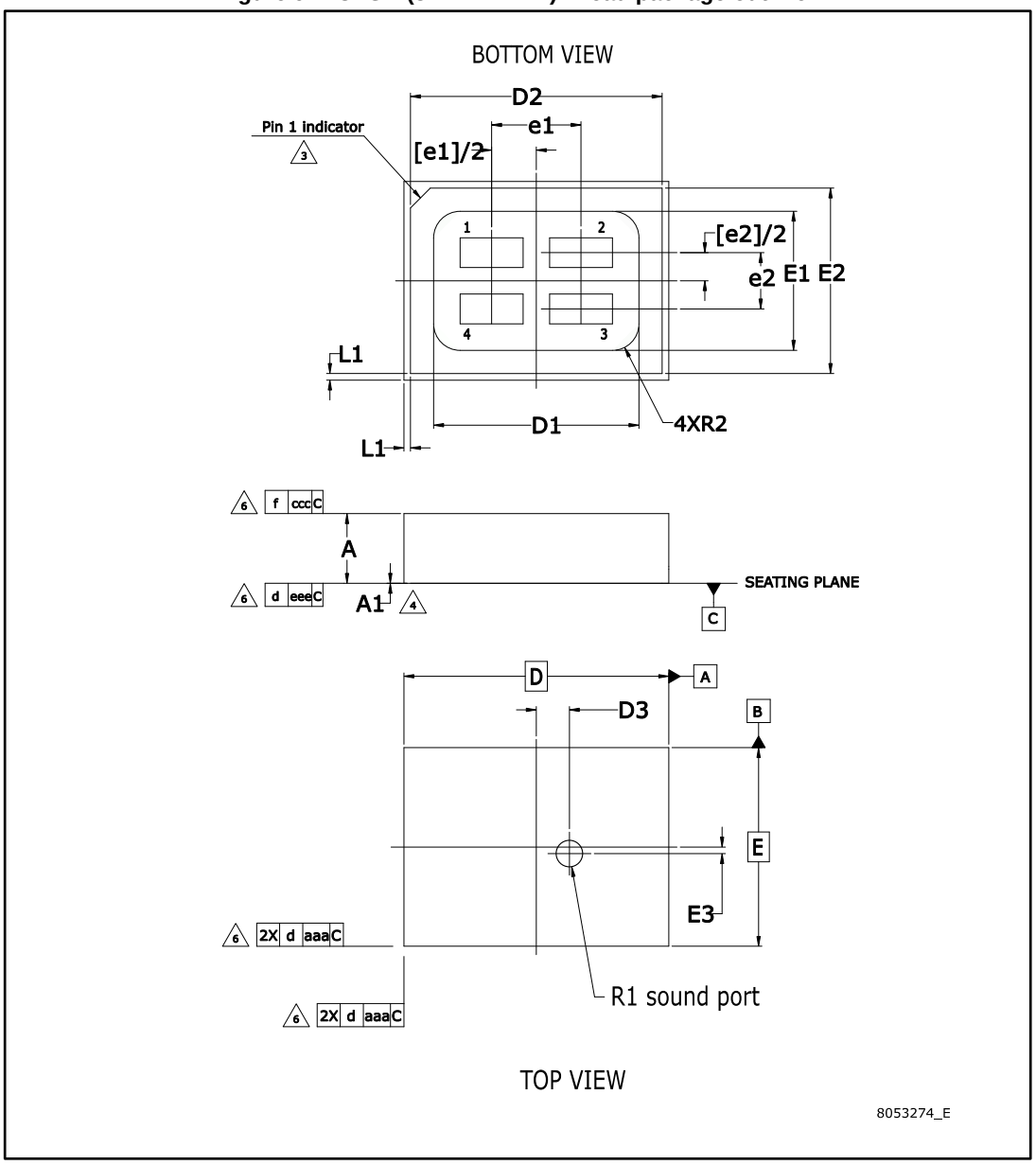


Table 9: Recommended soldering profile limits

Description	Parameter	Pb free
Average ramp rate	T_L to T_P	3 °C/sec max
Preheat Minimum temperature Maximum temperature Time (T_{SMIN} to T_{SMAX})	 T_{SMIN} T_{SMAX} t_S	 150 °C 200 °C 60 sec to 120 sec
Ramp-up rate	T_{SMAX} to T_L	
Time maintained above liquids temperature Liquids temperature	t_L T_L	60 sec to 150 sec 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 (t25 °C) to peak temperature		8 minutes max

8.2 HCLGA package information

Figure 9: HCLGA (3 x 4 x 1 mm) 4-lead package outline

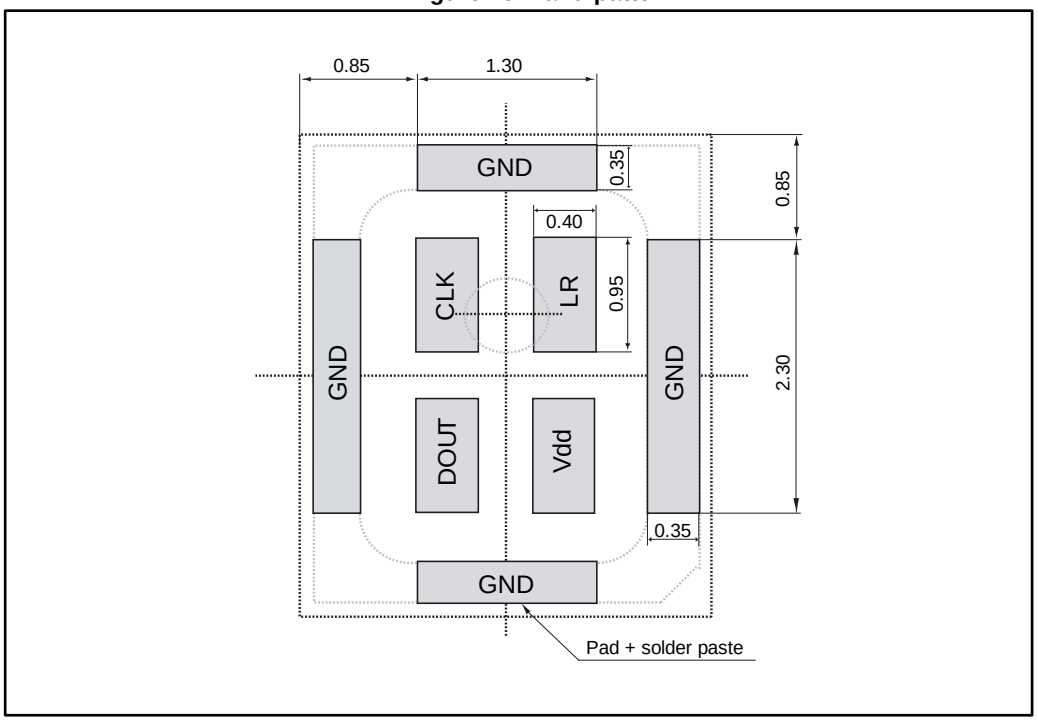


Note: The MEMS microphone plastic cap can exhibit some level of variation in color when the device is subjected to thermal processes.

Table 10: HCLGA (3 x 4 x 1 mm) 4-lead package dimensions

Symbol	mm		
	Min.	Typ.	Max.
A	0.90	1.00	1.10
A1	0.00	-	0.05
b	0.35	0.45	0.50
D	3.90	4.00	4.10
D1	3.05	3.10	3.15
D2	3.75	3.80	3.85
D3	0.30	0.50	0.70
E	2.90	3.00	3.10
E1	2.05	2.10	2.15
E2	2.75	2.80	2.85
E3	-0.20	0.00	0.20
e1	1.30	1.35	1.40
e2	0.80	0.85	0.90
h	0.25	0.30	0.35
L	0.90	0.95	1.00
L1	-	0.10	-
N	4		
R1	0.30	0.40	0.50
R2	-	0.40	-
aaa	0.15		
ccc	0.10		
eee	0.08		

Figure 10: Land pattern



9 Revision history

Table 11: Document revision history

Date	Revision	Changes
06-Oct-2011	1	Initial release
18-Nov-2011	2	Removed “stereo” from title, *Section "Features"*, and *Section "Description"*
29-Nov-2011	3	Updated *Section "Features"* and *Section "Description"*
04-Jan-2012	4	Updated Added So limits to *Table 3: "Acoustic and electrical characteristics"* Minor textual updates
23-Mar-2012	5	Updated *Figure 9: "HCLGA (3 x 4 x 1 mm) 4-lead package outline"* Pin 1 indicator removed from top view of package on page 1 and *Figure 1: "Pin connections"* Updated *Table 10: "HCLGA (3 x 4 x 1 mm) 4-lead package dimensions"*
06-Apr-2012	6	Updated maximum supply voltage in *Table 3: "Acoustic and electrical characteristics"*
07-May-2012	7	Added V_{IOL}, V_{IOH} to *Table 3: "Acoustic and electrical characteristics"*
18-May-2012	8	Updated *Table 5: "Timing characteristics"*
05-Jul-2012	9	Added *Section 5: "Sensing element"* Added *Figure 10: "Land pattern"* Updated temperature range to -40 to +85 °C throughout datasheet
21-Feb-2013	10	Updated dimension T2 in *Table 10: "HCLGA (3 x 4 x 1 mm) 4-lead package dimensions"*
07-Jun-2013	11	Updated - *Figure 3: "Frequency response and mask"* - *Table 6: "Frequency response mask for digital microphones"* - HCLGA mechanical data *Figure 9: "HCLGA (3 x 4 x 1 mm) 4-lead package outline"* and *Table 10: "HCLGA (3 x 4 x 1 mm) 4-lead package dimensions"* Added - *Section 3: "Carrier tape mechanical specifications"* - *Section 4: "Process recommendations"*
27-Feb-2015	12	Minor textual updates Added note below *Figure 9: "HCLGA (3 x 4 x 1 mm) 4-lead package outline"*

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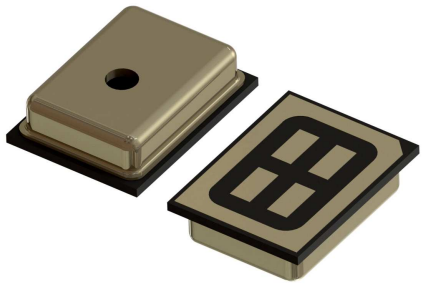
MP34DT01-M

MEMS audio sensor omnidirectional digital microphone

Datasheet - production data



HCLGA (3 x 4 x 1.06 4LD)

Features

- Single supply voltage
- Low power consumption
- 120 dBSPL acoustic overload point
- 61 dB signal-to-noise ratio
- Omnidirectional sensitivity
- – 26 dBFS sensitivity
- PDM output
- HCLGA package
  - Top-port design
  - SMD-compliant
  - EMI-shielded
  - 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 MP34DT01-M is an ultra-compact, low-power, omnidirectional, digital MEMS microphone built with a capacitive sensing element and an IC interface.

The sensing element, capable of detecting acoustic waves, is manufactured using a specialized silicon micromachining process dedicated 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 MP34DT01-M has an acoustic overload point of 120 dBSPL with a 61 dB signal-to-noise ratio and –26 dBFS sensitivity.

The MP34DT01-M is available in a top-port, SMD-compliant, EMI-shielded package and is guaranteed to operate over an extended temperature range from -40 °C to +85 °C.

Table 1. Device summary

Order codes	Temperature range [°C]	Package	Packing
MP34DT01-M	-40 to +85	HCLGA (3 x 4 x 1.06) mm 4LD	Tray
MP34DT01TR-M			Tape and reel

Contents

1 Pin description

Figure 1. Pin connections

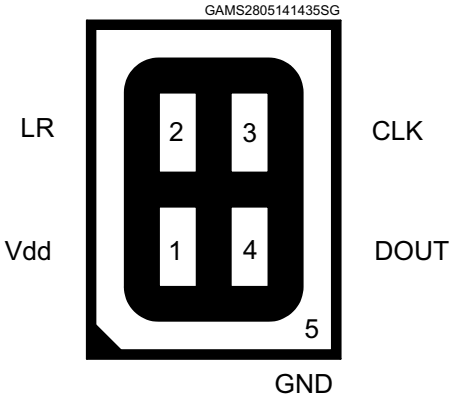


Table 2. Pin description

Pin #	Pin name	Function
1	Vdd	Power supply
2	LR	Left/Right channel selection
3	CLK	Synchronization input clock
4	DOUT	Left/Right PDM data output
5 (ground ring)	GND	0 V 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	Mean value		0.6		mA
IddPdn	Current consumption in power-down mode (2)			20		µA
Scc	Short-circuit current		1		10	mA
AOP	Acoustic overload point			120		dBSPL
So	Sensitivity		-29	-26	-23	dBFS
SNR	Signal-to-noise ratio	A-weighted at 1 kHz, 1 Pa		61		dB
PSR	Power supply rejection	Guaranteed by design		-70		dBFS
Clock	Input clock frequency (3)		1	2.4	3.25	MHz
Ton	Turn-on time (4)	Guaranteed by design			10	ms
Top	Operating temperature range		-40		+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

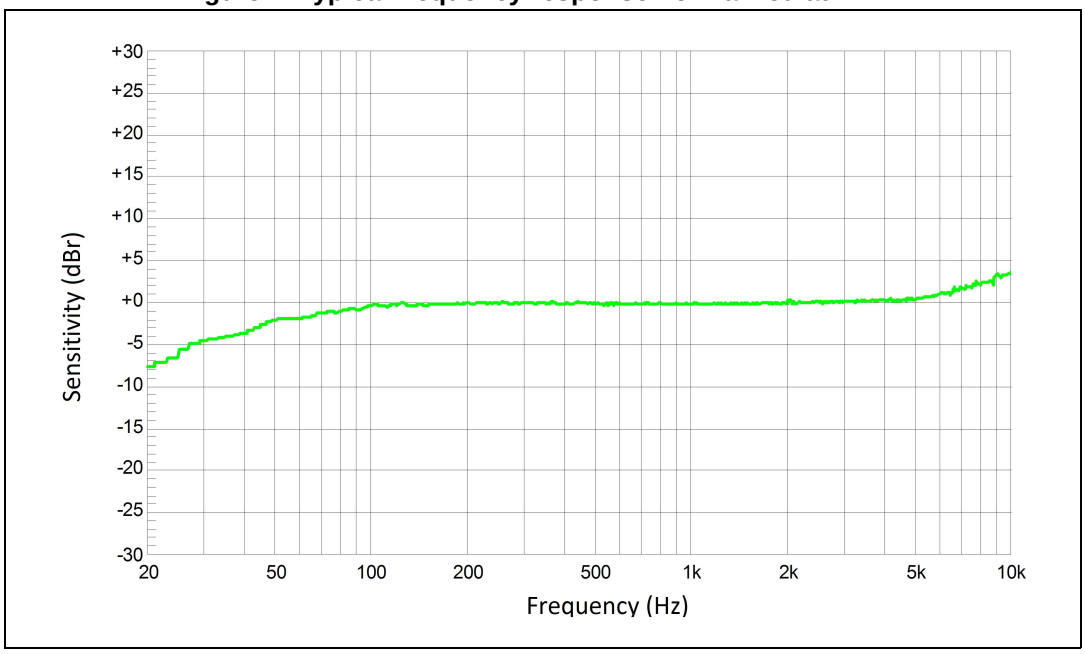
1. Typical specifications are not guaranteed.
2. Input clock in static mode.
3. Duty cycle: min = 40% max = 60%.
4. Time from the first clock edge to valid output data.

Table 4. Distortion specifications

Parameter	Test condition	Value
Distortion	100 dBSPL (1 kHz)	< 1% THD+N
Distortion	115 dBSPL (1 kHz)	< 2% THD+N
Distortion	120 dBSPL (1 kHz)	< 10% THD+N

2.2 Frequency response

Figure 2. Typical frequency response normalized at 1 kHz



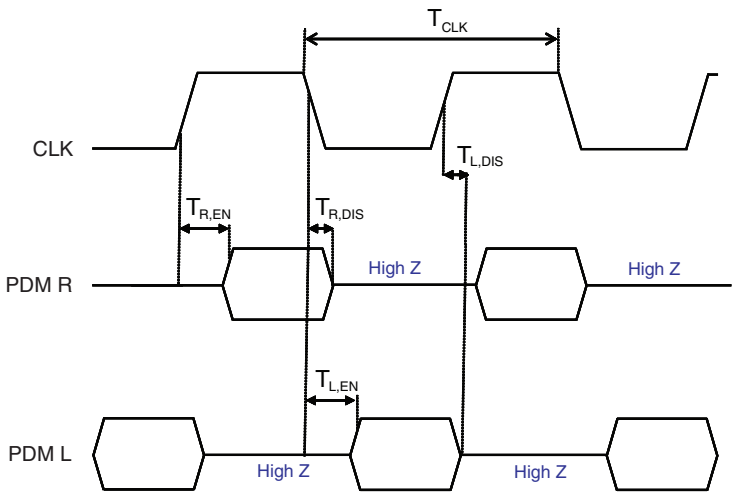
2.3 Timing characteristics

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	18(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	18(1)		ns
$T_{L,DIS}$	Data disabled on DATA line, L/R pin = 0		16(1)	ns

1. From design simulations

Figure 3. Timing waveforms



3 Application recommendations

Figure 4. MP34DT01-M electrical connections (Top view)

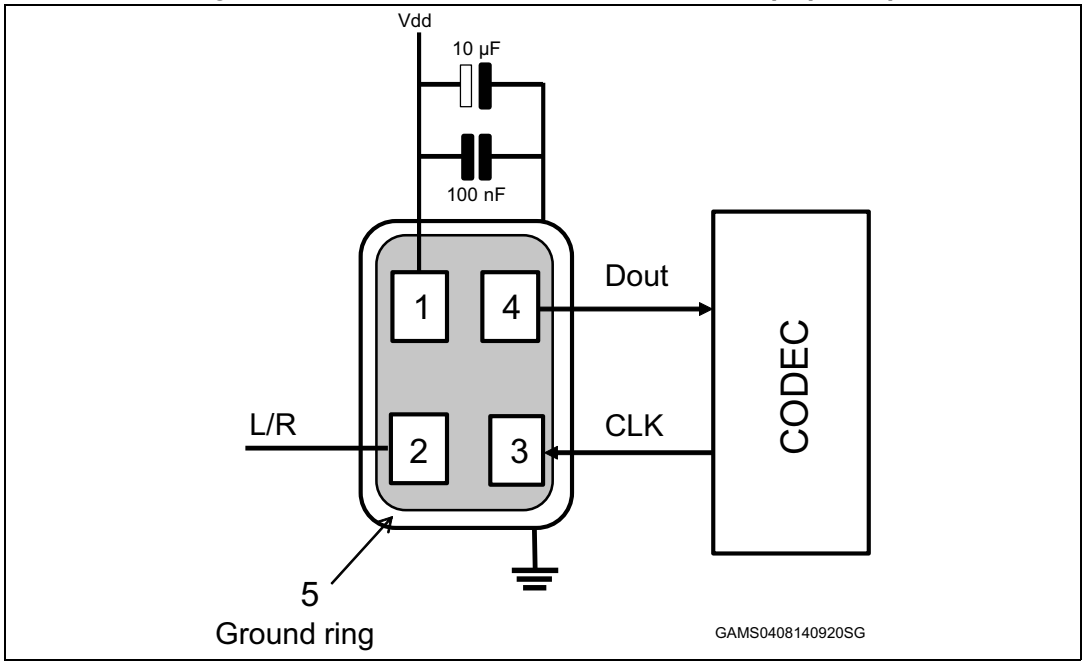
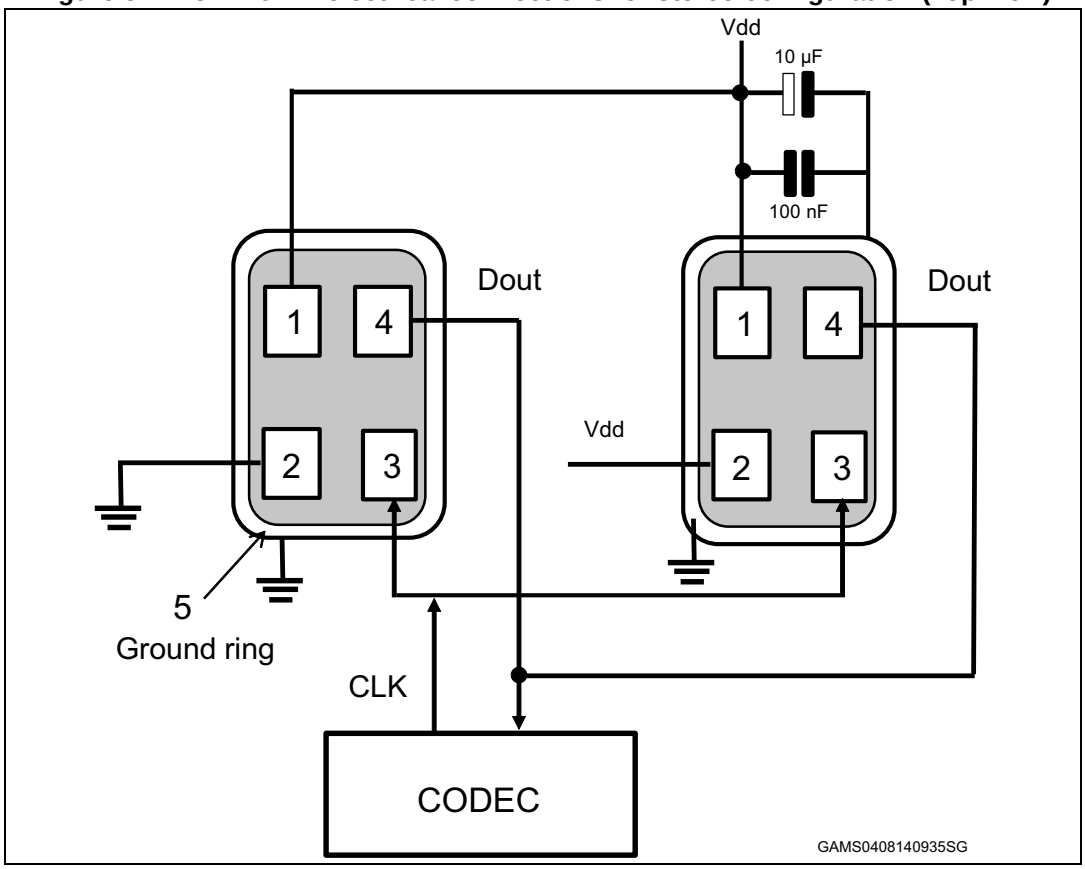


Figure 5. MP34DT01-M electrical connections for stereo configuration (Top view)



Power supply decoupling capacitors (100 nF ceramic, 10 µF ceramic) should be placed as near as possible to pin 1 of the device (common design practice).

The L/R pin must be connected to Vdd or GND (refer to *Table 5*).

4 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 transducers the sound pressure into the changes of coupled capacity between those two plates.

Omron Corporation supplies this element for STMicroelectronics.

5 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
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
	3 discharges at ± 8 kV direct contact to lid when unit is grounded (IEC 61000-4-2) and 3 discharges at ± 2 kV direct contact to I/O pins. (MIL 883E, Method 3015.7)	± 8	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.

6 Functionality

6.1 L/R channel selection

The L/R digital pad lets the user select the DOUT signal pattern as shown in *Table 7*. 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

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 HCLGA 3x4 4LD 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

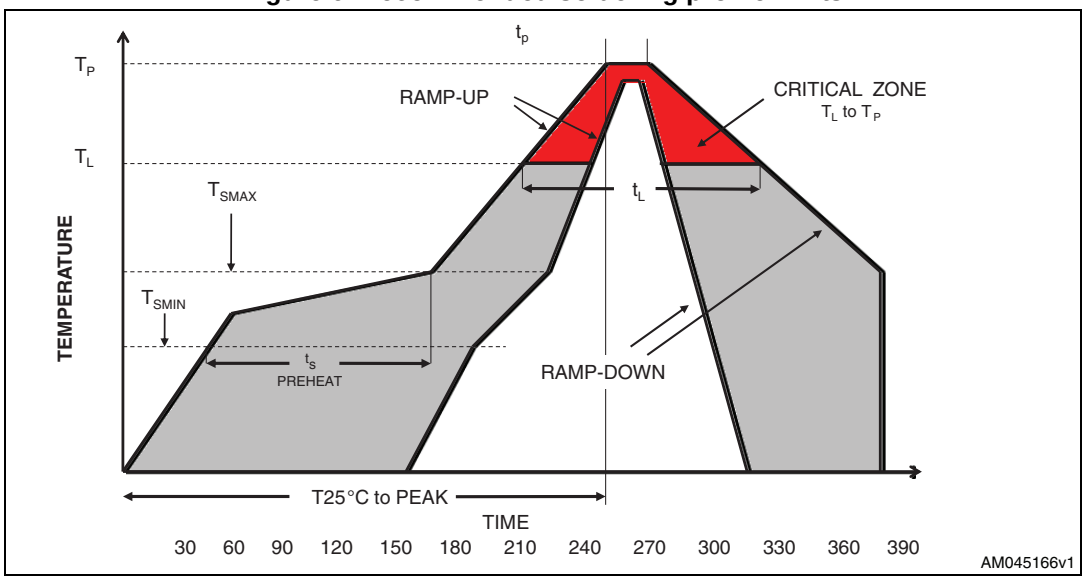
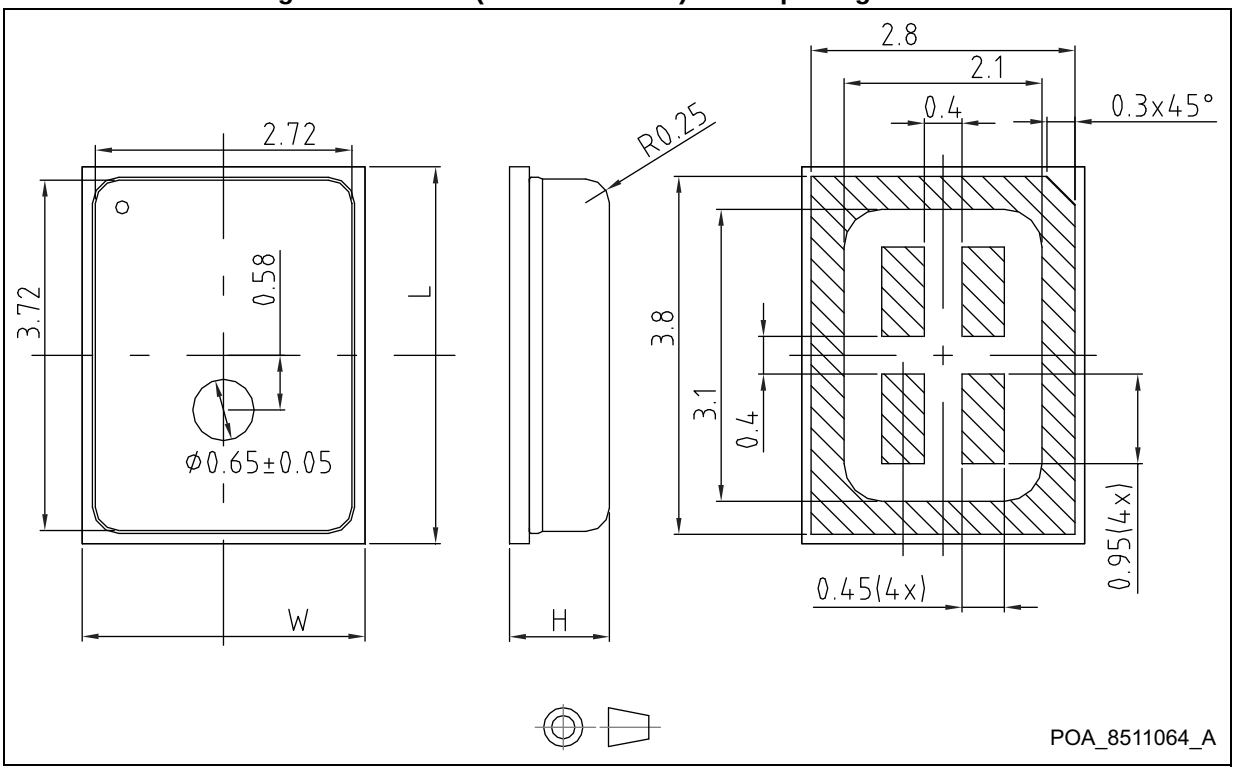


Table 8. Recommended soldering profile limits

Description	Parameter	Pb free
Average ramp rate	T_L to T_P	3 °C/sec max
Preheat Minimum temperature Maximum temperature Time (T_{SMIN} to T_{SMAX})	 T_{SMIN} T_{SMAX} t_S	 150 °C 200 °C 60 sec to 120 sec
Ramp-up rate	T_{SMAX} to T_L	
Time maintained above liquidus temperature Liquidus temperature	t_L T_L	60 sec to 150 sec 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 (t25 °C) to peak temperature		8 minutes max

Figure 7. HCLGA (3 x 4 x 1.06 mm) 4-lead package outline



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

Dimensions are in millimeter unless otherwise specified. General tolerance is ± 0.15 mm unless otherwise specified.

Table 9. HCLGA (3 x 4 x 1.06 mm) mechanical data

Item	Dimension (mm)	Tolerance (mm)
Length [L]	4	± 0.1
Width [W]	3	± 0.1
Height [H]	1.06	± 0.1

8 Carrier tape mechanical specifications

Figure 8. Carrier tape without microphone-top view

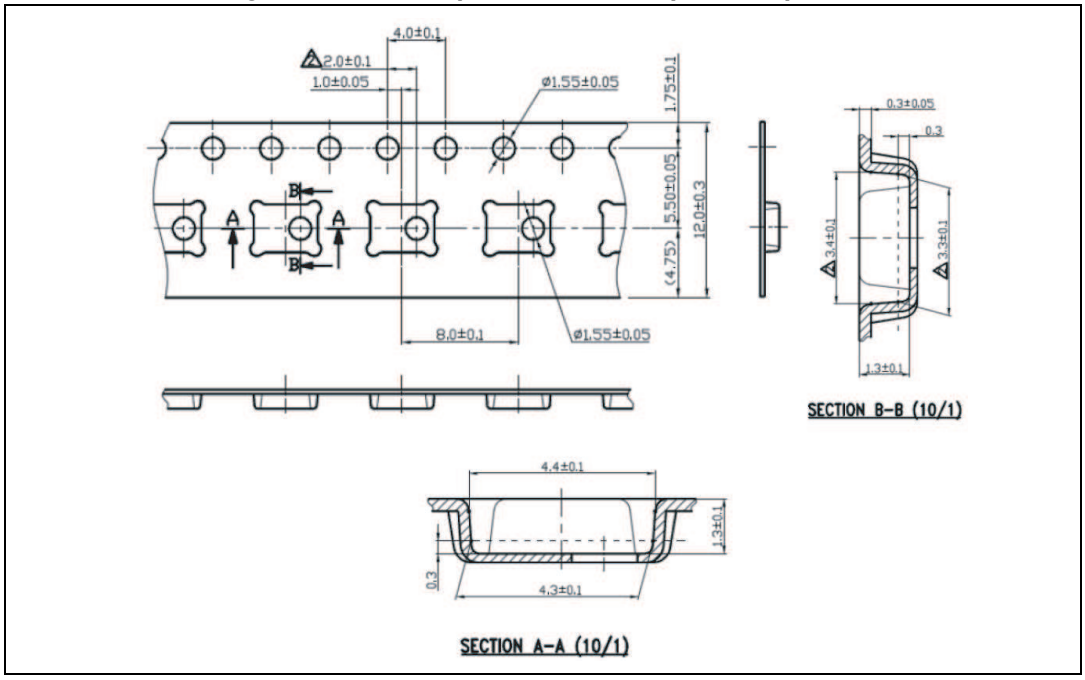
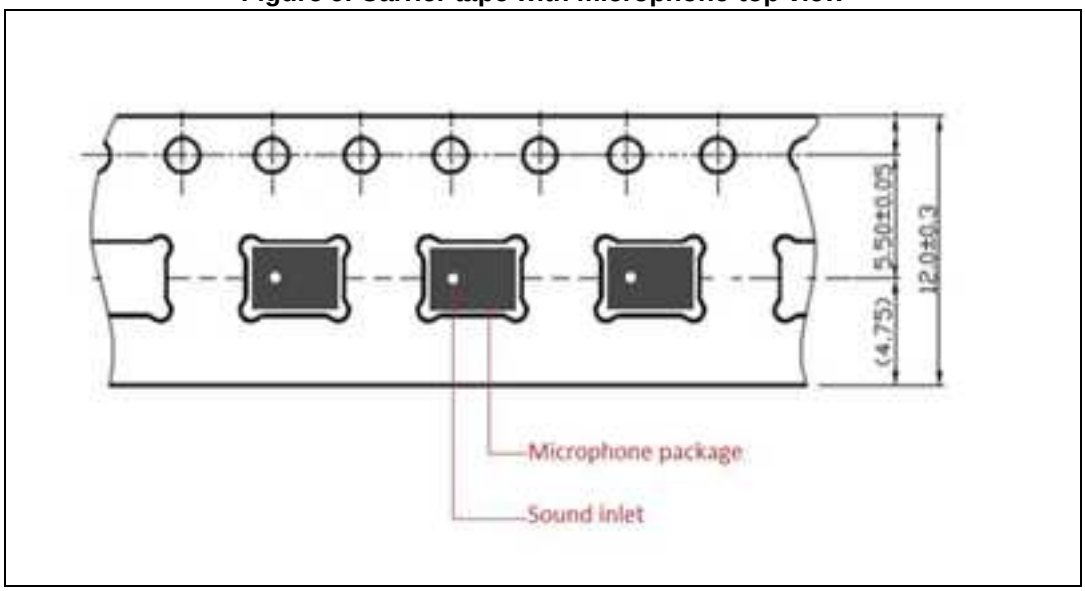


Figure 9. Carrier tape with microphone-top view

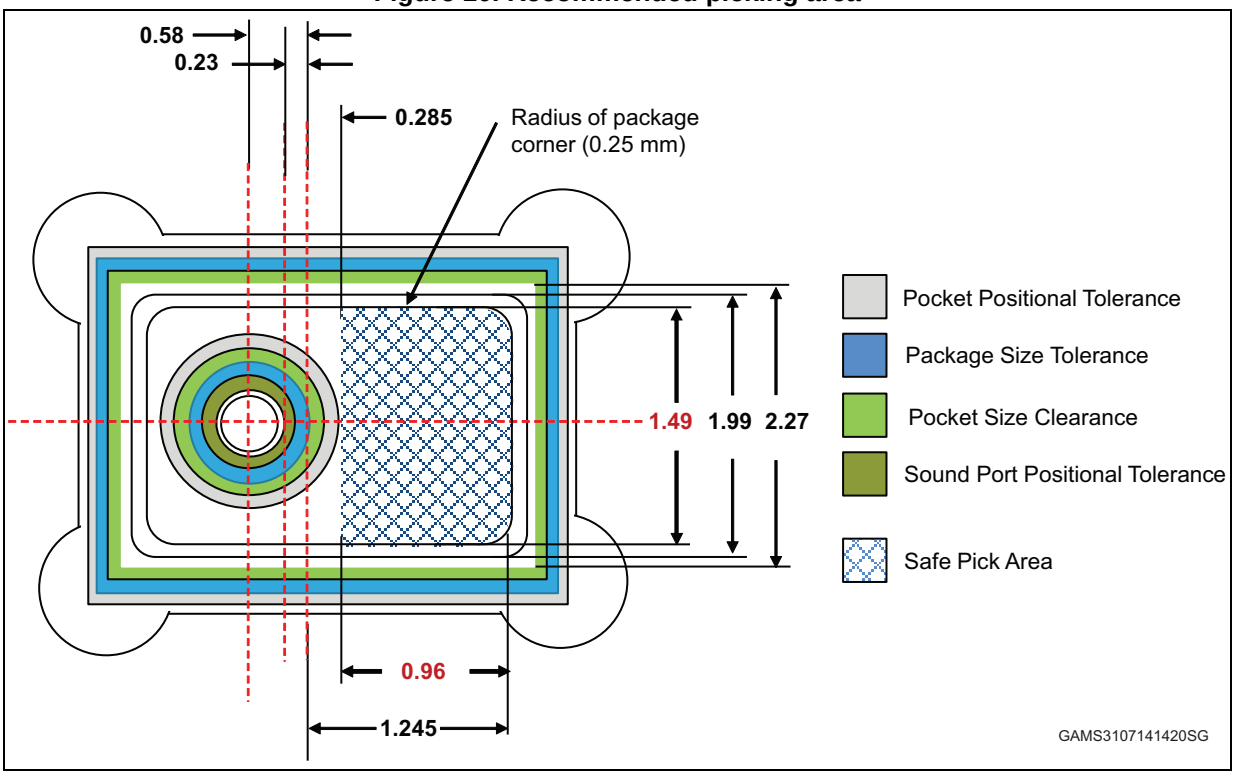


9 Process recommendations

To ensure a consistent manufacturing process it is strongly advised to comply with following recommendations:

- The recommended pick-up area for the MP34DT01-M package must be defined using the worst case (ie. no device alignment during picking process). This area has been defined considering all the tolerances of the components involved (reel, package, sound inlet). Picker tolerance shall be considered as well.
- To prevent damage to the MEMS membrane or incorrect pick-up and placement, do not pick up the component on the inlet area
- For the package outline please refer to *Figure 10*. Nozzle shape, size, and placement accuracy are the other key factors to consider when deciding on the coordinates for the picking.
- Device alignment before picking is highly recommended.
- A vacuum force greater than 7 psi must be avoided
- 1 kPa = 0.145 psi (lb/in2) = 0.0102 kgf/cm² = 0.0098 atm
- All the recommended dimensions (device safe pick area) do not include the pick and place equipment tolerances
- According to *Figure 10*, standard picker tool can be used to handle this device

Figure 10. Recommended picking area



10 Revision history

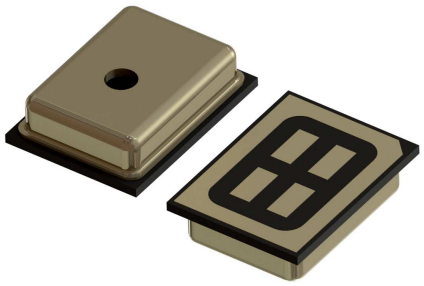
Table 10. Document revision history

Date	Revision	Changes
19-Jun-2014	1	Initial release
09-Jul-2014	2	Modified Min. and Max. values So parameter *Table 3 on page 4*
03-Sep-2014	3	Added: – *Table 4: Distortion specifications on page 4* – *Section 3: Application recommendations on page 7* – *Section 9: Process recommendations on page 15*

MP34DT02

MEMS audio sensor omnidirectional digital microphone

Datasheet - production data



HCLGA (3 x 4 x 1.06) mm 4LD

Features

- Single supply voltage
- Low power consumption
- 120 dBSPL acoustic overload point
- 60 dB signal-to-noise ratio
- Omnidirectional sensitivity
- –26 dBFS sensitivity
- PDM output
- HCLGA package
  - Top-port design
  - SMD-compliant
  - EMI-shielded
  - 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 MP34DT02 is an ultra-compact, low-power, omnidirectional, digital MEMS microphone built with a capacitive sensing element and an IC interface.

The sensing element, capable of detecting acoustic waves, is manufactured using a specialized silicon micromachining process dedicated 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 MP34DT02 has an acoustic overload point of 120 dBSPL with a 60 dB signal-to-noise ratio and –26 dBFS sensitivity.

The MP34DT02 is available in a top-port, SMD-compliant, EMI-shielded package and is guaranteed to operate over an extended temperature range from -40 °C to +85 °C.

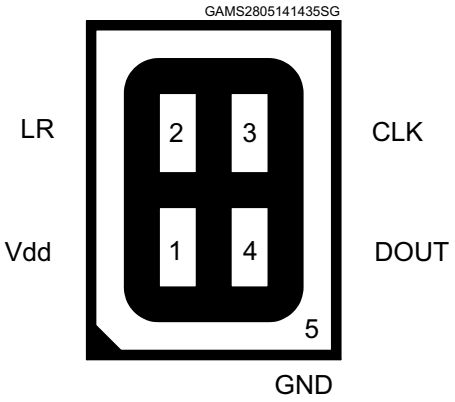
Table 1. Device summary

Order codes	Temperature range [°C]	Package	Packing
MP34DT02	-40 to +85	HCLGA (3 x 4 x 1.06) mm 4LD	Tray
MP34DT02TR	-40 to +85	HCLGA (3 x 4 x 1.06) mm 4LD	Tape and reel

Contents

1 Pin description

Figure 1. Pin connections



(BOTTOM VIEW)

Table 2. Pin description

Pin n°	Pin name	Function
1	Vdd	Power supply
2	LR	Left/Right channel selection
3	CLK	Synchronization input clock
4	DOUT	Left/Right PDM data output
5 (ground ring)	GND	0 V 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	Mean value		0.6		mA
IddPdn	Current consumption in power-down mode(2)			20		µA
Scc	Short-circuit current		1		10	mA
AOP	Acoustic overload point			120		dBSPL
So	Sensitivity		-29	-26	-23	dBFS
SNR	Signal-to-noise ratio	A-weighted at 1 kHz, 1 Pa		60		dB
PSR	Power supply rejection	Guaranteed by design		-70		dBFS
Clock	Input clock frequency(3)		1	2.4	3.25	MHz
Ton	Turn-on time (4)	Guaranteed by design			10	ms
Top	Operating temperature range		-40		+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

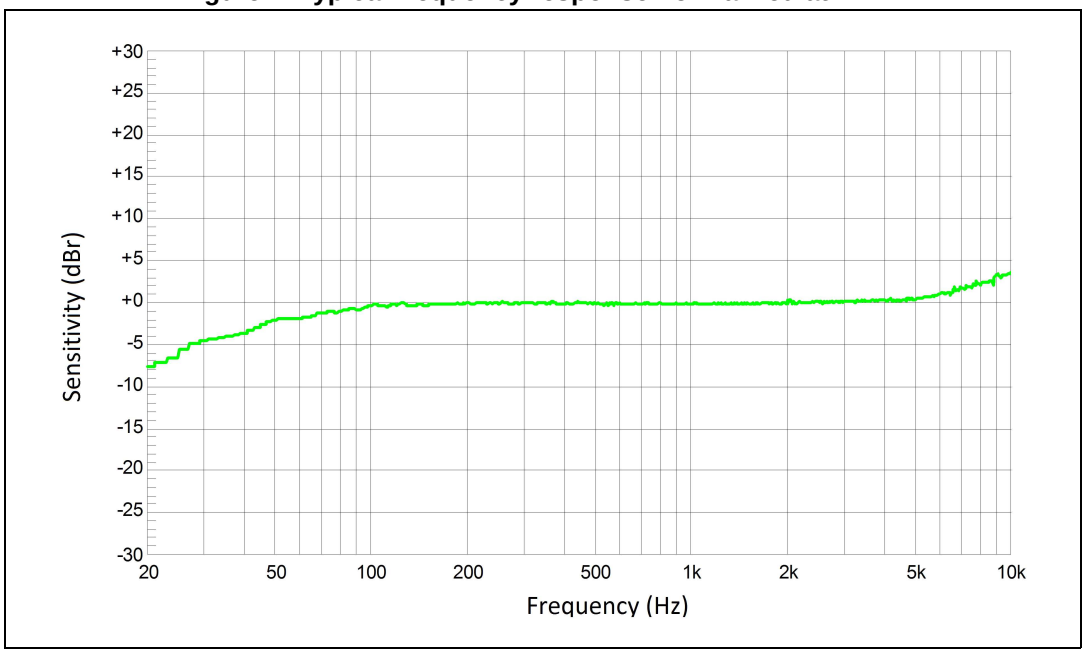
1. Typical specifications are not guaranteed.
2. Input clock in static mode.
3. Duty cycle: min = 40% max = 60%.
4. Time from the first clock edge to valid output data.

Table 4. Distortion specifications

Parameter	Test condition	Value
Distortion	100 dBSPL (1 kHz)	< 1% THD+N
Distortion	115 dBSPL (1 kHz)	< 2% THD+N
Distortion	120 dBSPL (1 kHz)	< 10% THD+N

2.2 Frequency response

Figure 2. Typical frequency response normalized at 1 kHz



3 Application recommendations

Figure 3. MP34DT02 electrical connections (Top view)

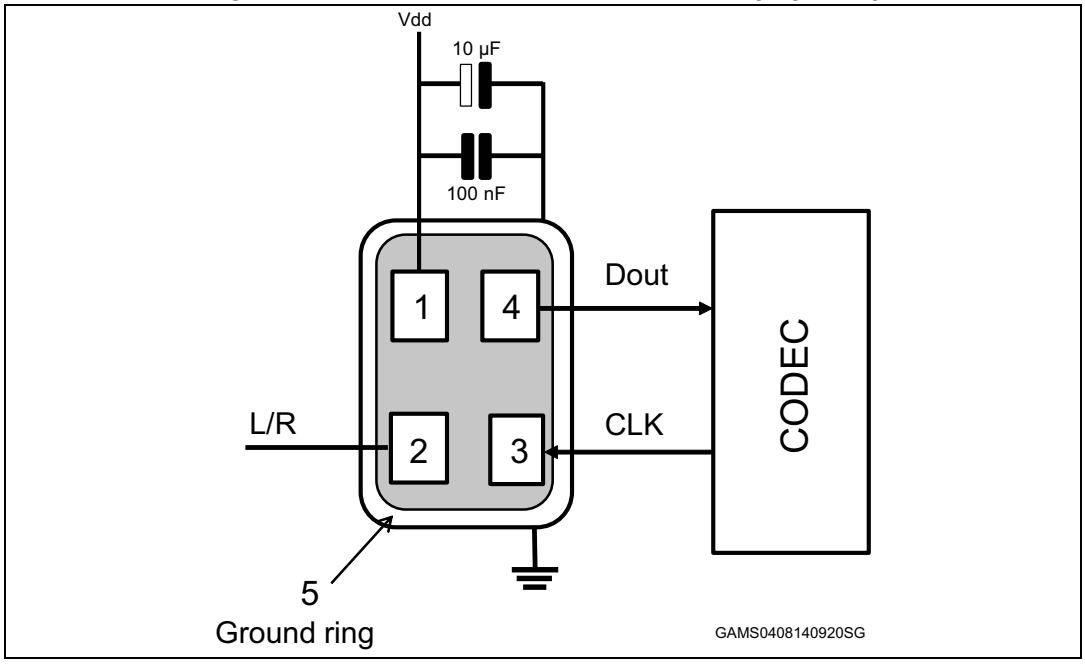
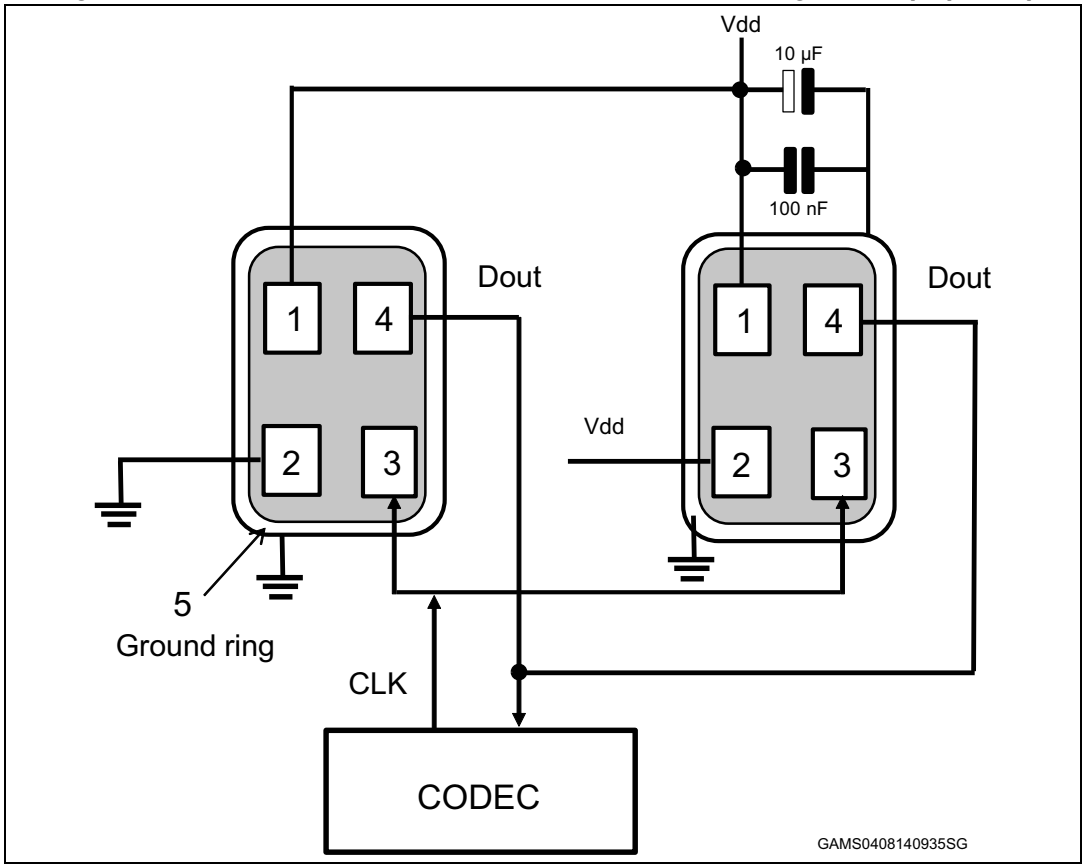


Figure 4. MP34DT02 electrical connections for stereo configuration (Top view)



Power supply decoupling capacitors (100 nF ceramic, 10 µF ceramic) should be placed as near as possible to pin 1 of the device (common design practice).

The L/R pin must be connected to Vdd or GND (refer to *Table 5*).

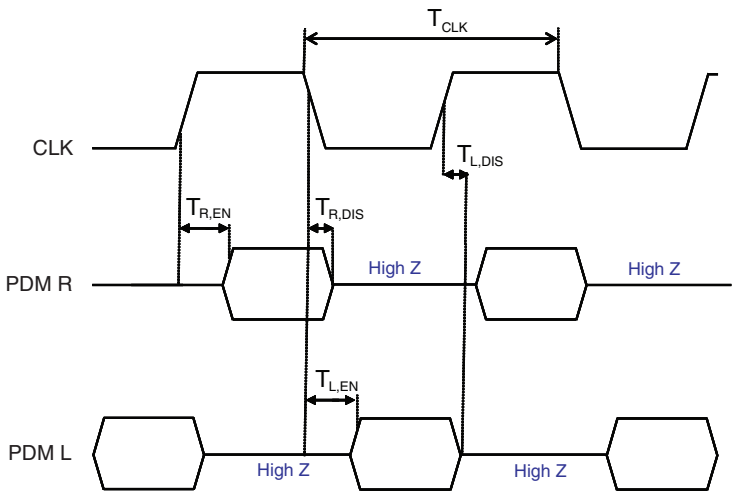
3.1 Timing characteristics

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	18(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	18(1)		ns
$T_{L,DIS}$	Data disabled on DATA line, L/R pin = 0		16(1)	ns

1. From design simulations

Figure 5. Timing waveforms



4 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 transducers the sound pressure into the changes of coupled capacity between those two plates.

Omron Corporation supplies this element for STMicroelectronics.

5 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
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
	3 discharges at ± 8 kV direct contact to lid when unit is grounded (IEC 61000-4-2) and 3 discharges at ± 2 kV direct contact to I/O pins. (MIL 883E, Method 3015.7)	± 8	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.

6 Functionality

6.1 L/R channel selection

The L/R digital pad lets the user select the DOUT signal pattern as shown in *Table 7*. 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

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 HCLGA 3x4 4LD 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

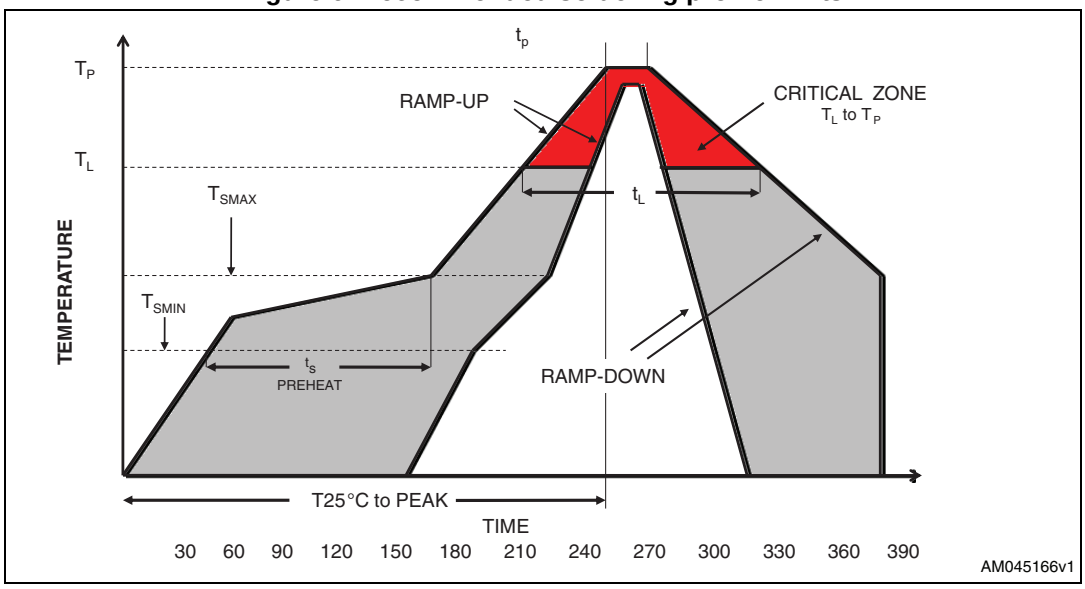
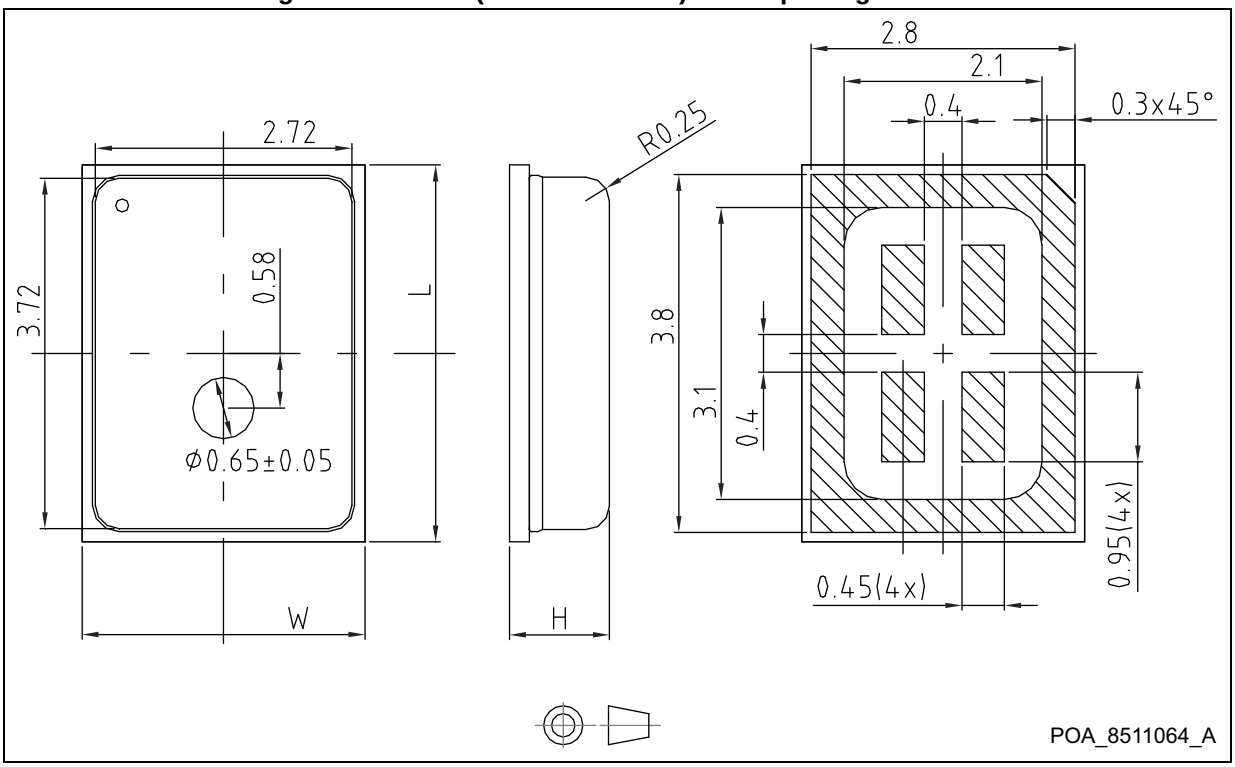


Table 8. Recommended soldering profile limits

Description	Parameter	Pb free
Average ramp rate	T_L to T_P	3 °C/sec max
Preheat Minimum temperature Maximum temperature Time (T_{SMIN} to T_{SMAX})	 T_{SMIN} T_{SMAX} t_S	 150 °C 200 °C 60 sec to 120 sec
Ramp-up rate	T_{SMAX} to T_L	
Time maintained above liquidus temperature Liquidus temperature	t_L T_L	60 sec to 150 sec 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 (t25 °C) to peak temperature		8 minutes max

Figure 7. HCLGA (3 x 4 x 1.06 mm) 4-lead package outline



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

Dimensions are in millimeter unless otherwise specified. General tolerance is ± 0.15 mm unless otherwise specified.

Table 9. HCLGA (3 x 4 x 1.06 mm) mechanical data

Item	Dimension (mm)	Tolerance (mm)
Length [L]	4	± 0.1
Width [W]	3	± 0.1
Height [H]	1.06	± 0.1

8 Carrier tape mechanical specifications

Figure 8. Carrier tape without microphone-top view

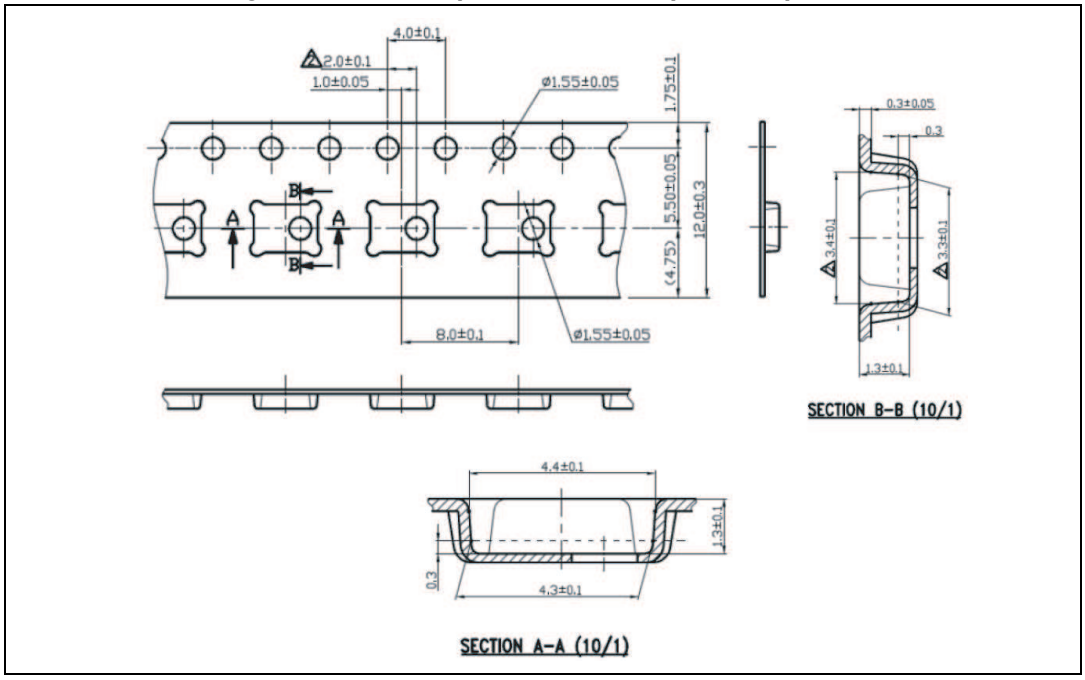
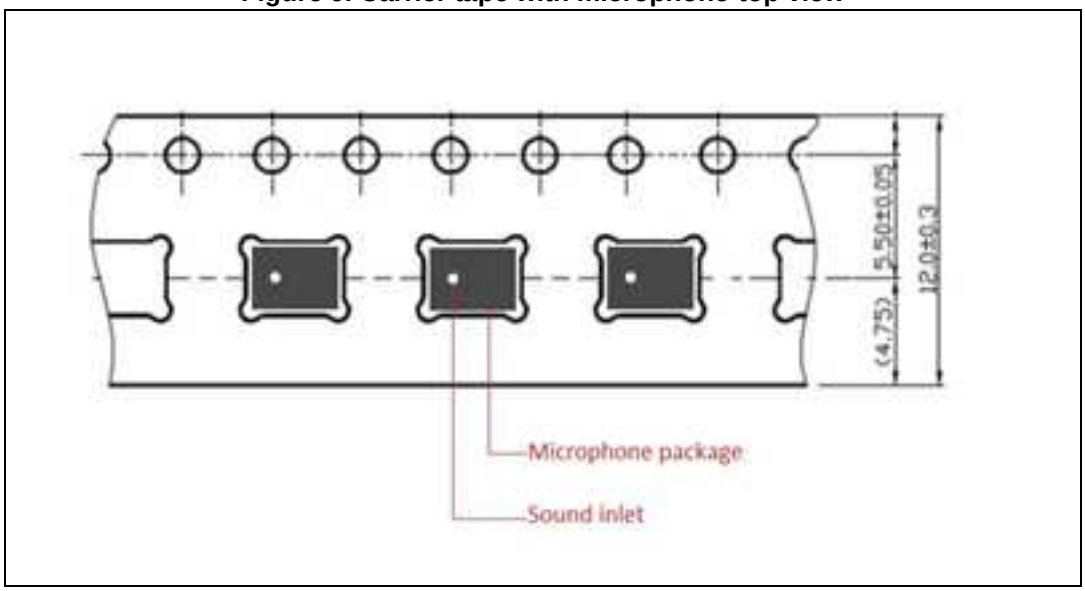


Figure 9. Carrier tape with microphone-top view

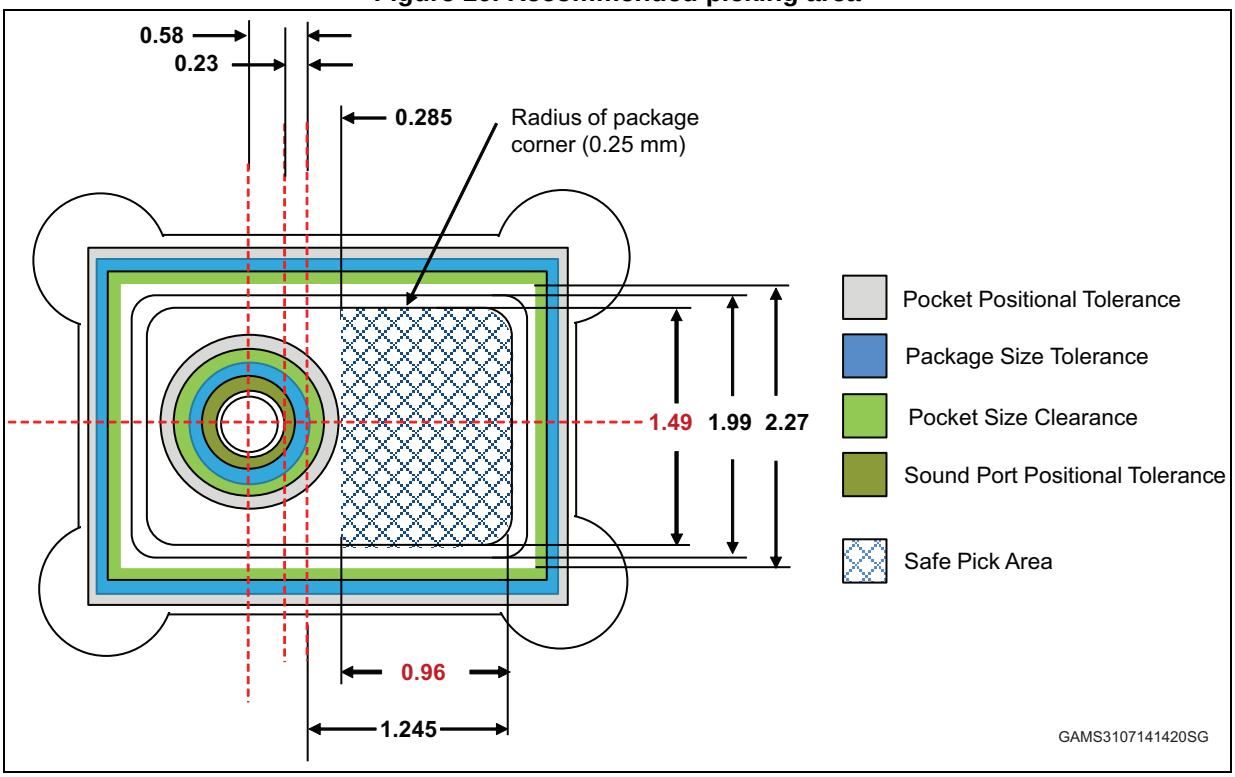


9 Process recommendations

To ensure a consistent manufacturing process it is strongly advised to comply with following recommendations:

- The recommended pick-up area for the MP34DT02 package must be defined using the worst case (ie. no device alignment during picking process). This area has been defined considering all the tolerances of the components involved (reel, package, sound inlet). Picker tolerance shall be considered as well.
- To prevent damage to the MEMS membrane or incorrect pick-up and placement, do not pick up the component on the inlet area
- For the package outline please refer to *Figure 10*. Nozzle shape, size, and placement accuracy are the other key factors to consider when deciding on the coordinates for the picking.
- Device alignment before picking is highly recommended.
- A vacuum force greater than 7 psi must be avoided
- 1 kPa = 0.145 psi (lb/in2) = 0.0102 kgf/cm² = 0.0098 atm
- All the recommended dimensions (device safe pick area) do not include the pick and place equipment tolerances
- According to *Figure 10*, standard picker tool can be used to handle this device

Figure 10. Recommended picking area



10 Revision history

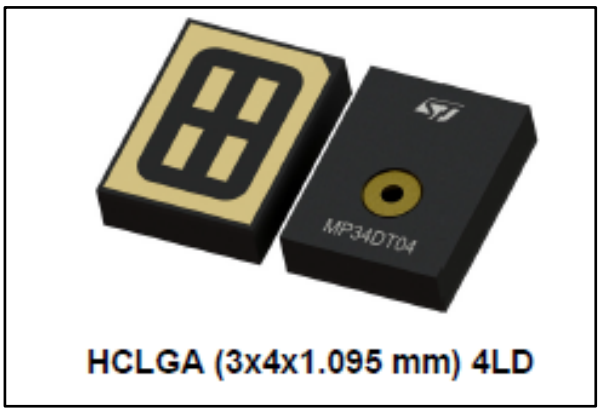
Table 10. Document revision history

Date	Revision	Changes
19-Jun-2014	1	Initial release
03-Sep-2014	2	Updated sensitivity values parameter *Table 3 on page 4* Added: – *Table 4: Distortion specifications on page 4* and *Figure 2: Typical frequency response normalized at 1 kHz on page 5* – *Section 3: Application recommendations on page 6* – *Section 9: Process recommendations on page 14*

MP34DT04

MEMS audio sensor omnidirectional digital microphone

Datasheet - production data



HCLGA (3x4x1.095 mm) 4LD

Features

- Single supply voltage
- Low power consumption
- 120 dBSPL acoustic overload point
- 64 dB signal-to-noise ratio
- Omnidirectional sensitivity
- –26 dBFS sensitivity
- PDM output
- HCLGA package
  - Top-port design
  - SMD-compliant
  - EMI-shielded
  - 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 MP34DT04 is an ultra-compact, low-power, omnidirectional, digital MEMS microphone built with a capacitive sensing element and an IC interface.

The sensing element, capable of detecting acoustic waves, is manufactured using a specialized silicon micromachining process dedicated 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 MP34DT04 has an acoustic overload point of 120 dBSPL with a 64 dB signal-to-noise ratio and –26 dBFS sensitivity.

The MP34DT04 is available in a top-port, SMD-compliant, EMI-shielded package and is guaranteed to operate over an extended temperature range from -40 °C to +85 °C.

Table 1: Device summary

Order codes	Temp. range [°C]	Package	Packing
MP34DT04	-40 to +85	HCLGA (3x4 x1.095 mm) 4LD	Tray
MP34DT04TR	-40 to +85	HCLGA (3x4x1.095 mm) 4LD	Tape and reel

Contents

List of tables

List of figures

1 Pin description

Figure 1: Pin connections

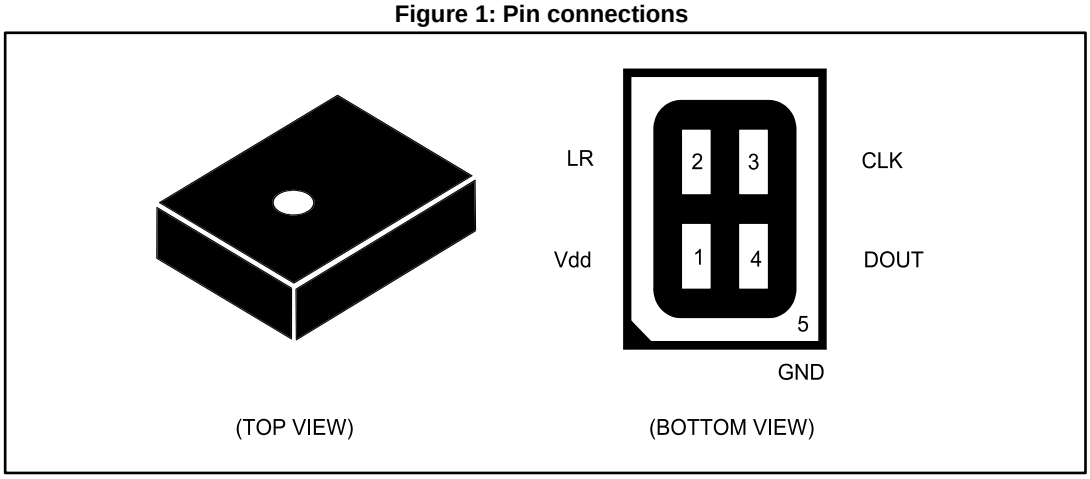


Table 2: Pin description

Pin #	Pin name	Function
1	Vdd	Power supply
2	LR	Left/Right channel selection
3	CLK	Synchronization input clock
4	DOUT	Left/Right PDM data output
5 (ground ring)	GND	0 V 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		1.6	1.8	3.6	V
Idd	Current consumption in normal mode	Mean value		600	700	µA
IddPdn	Current consumption in power-down mode (2)				10	µA
Scc	Short-circuit current		1		10	mA
AOP	Acoustic overload point			120		dBSPL
So	Sensitivity		-29	-26	-23	dBFS
SNR	Signal-to-noise ratio	A-weighted at 1 kHz, 94 dB SPL		64		dB (A)
PSR	Power supply rejection	100 mVpp sine 1 kHz		-70		dBFS
Clock	Input clock frequency (3)		1	2.4	3.25	MHz
Ton	Turn-on time (4)	Guaranteed by design			10	ms
Top	Operating temperature range		-40		+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)Duty cycle: min = 40% max = 60%.

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

Table 4: Distortion specifications

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

2.2 Timing characteristics

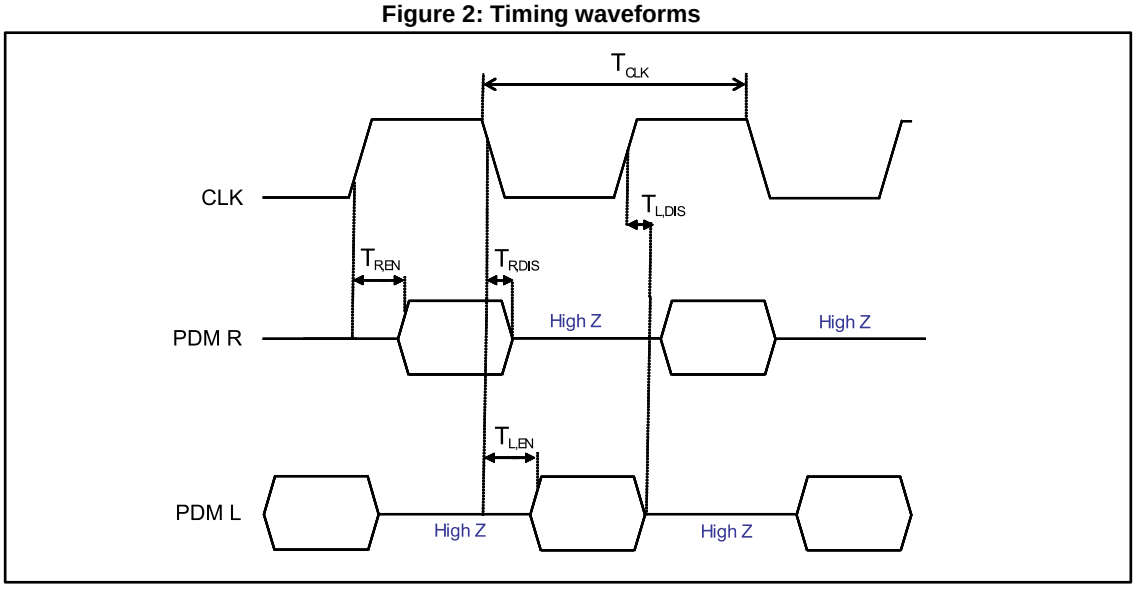
Table 5: Timing characteristics

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	18 (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	18(1)		ns
$T_{L,DIS}$	Data disabled on DATA line, L/R pin = 0		16(1)	ns

Notes:

(1)From design simulations

Figure 2: Timing waveforms



2.3 Frequency response

Figure 3: Frequency response and mask

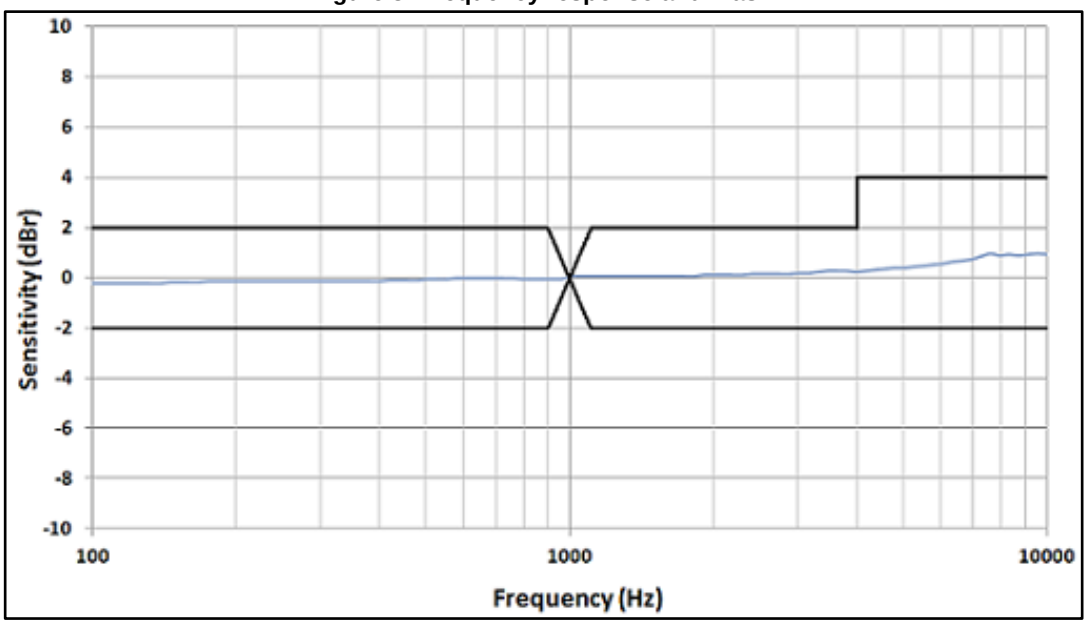


Table 6: Frequency response mask for digital microphones

Frequency / Hz (1)	Lower limit	Upper limit	Unit
100...4000	-2	+2	dBr 1 kHz
4000...10000	-2	+4	dBr 1 kHz

Notes:

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

3 Application recommendations

Figure 4: MP34DT04 electrical connections (top view)

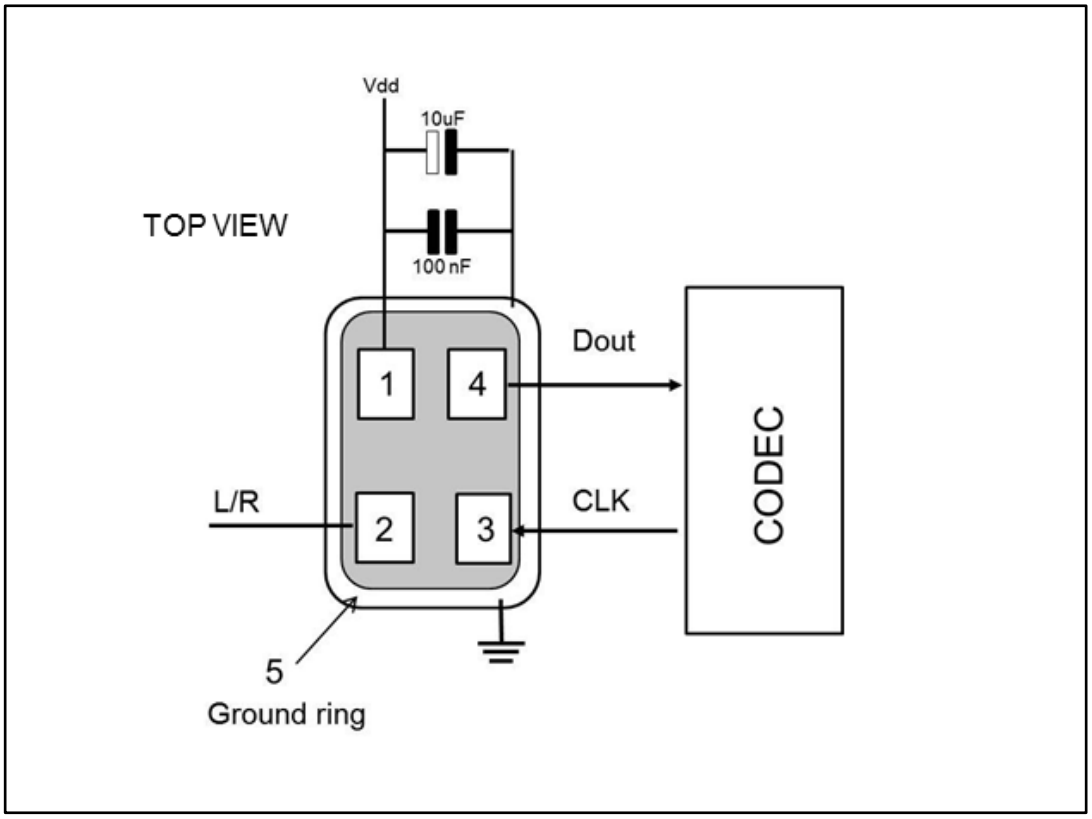
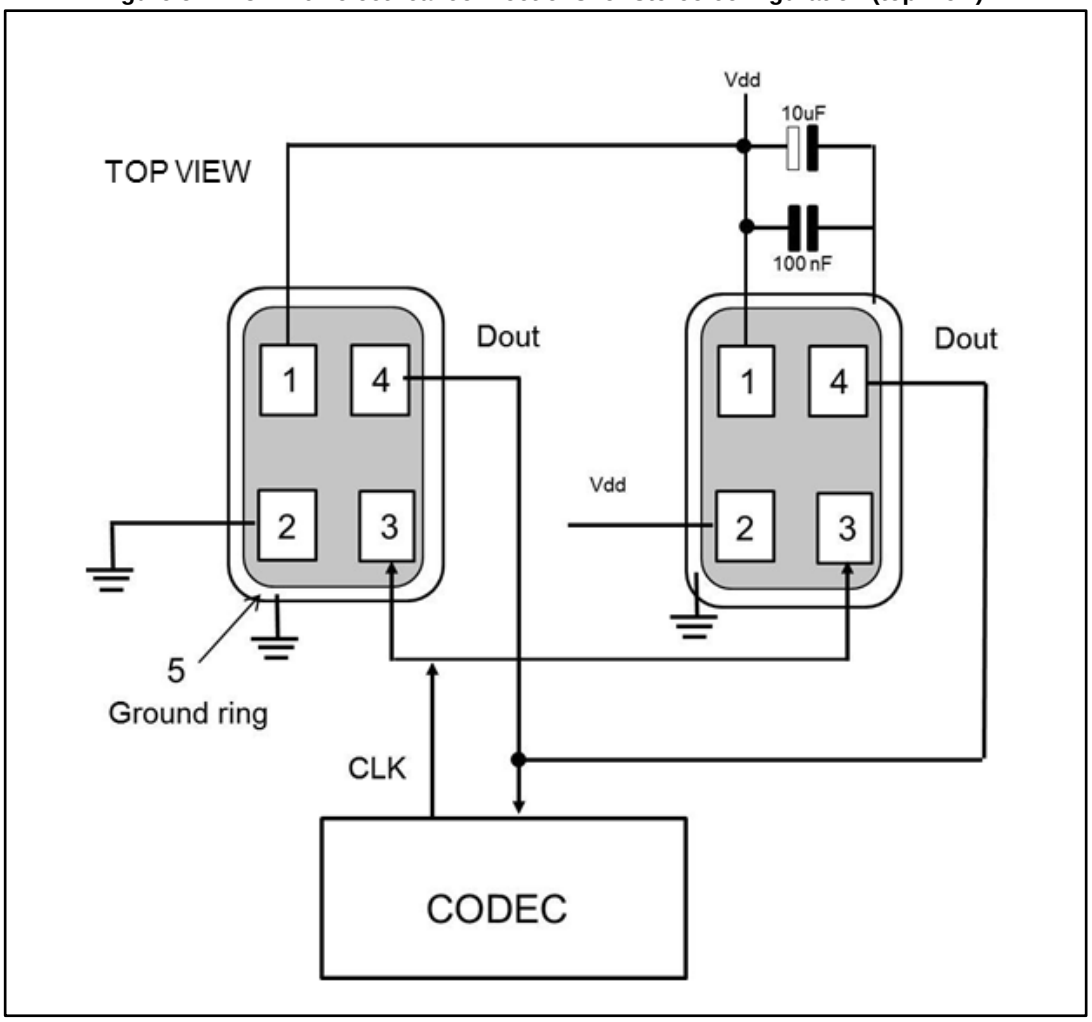


Figure 5: MP34DT04 electrical connections for stereo configuration (top view)



Power supply decoupling capacitors (100 nF ceramic, 10 µF ceramic) should be placed as near as possible to pin 1 of the device (common design practice).

The L/R pin must be connected to Vdd or GND (refer to *Table 8: "L/R channel selection"*).

4 Carrier tape mechanical specifications

Figure 6: Carrier tape without microphone (top view)

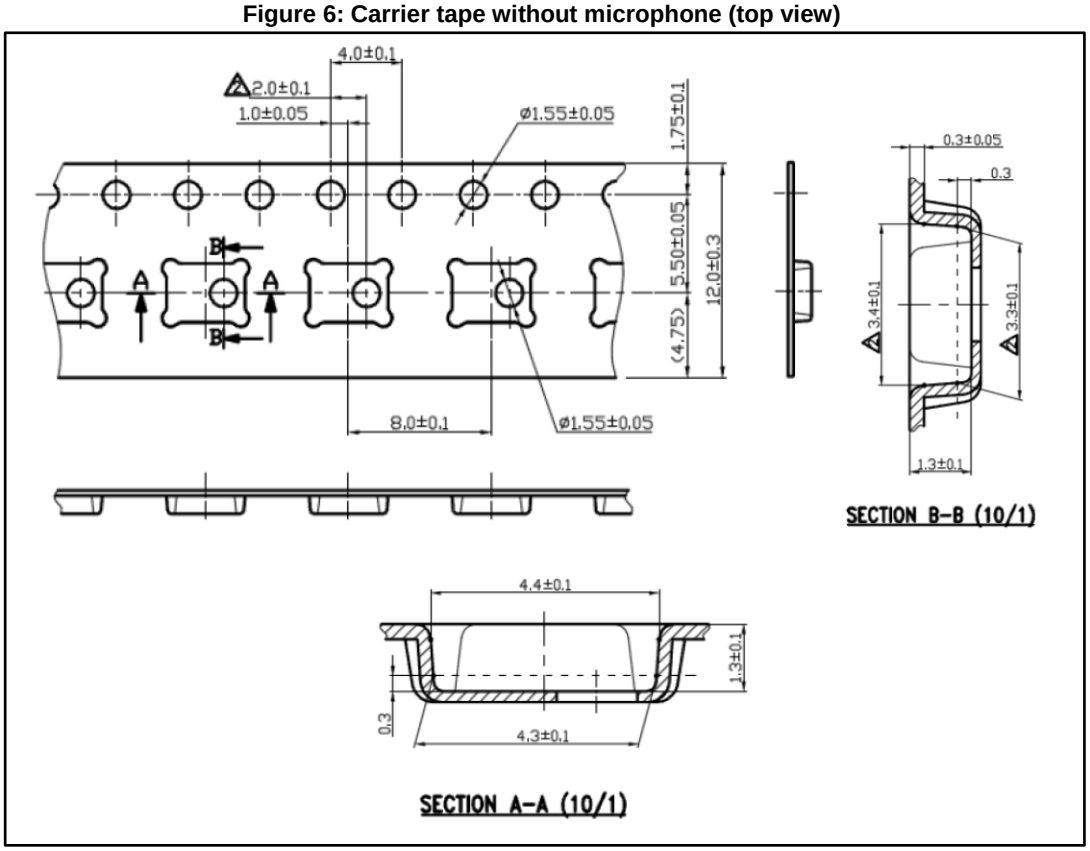
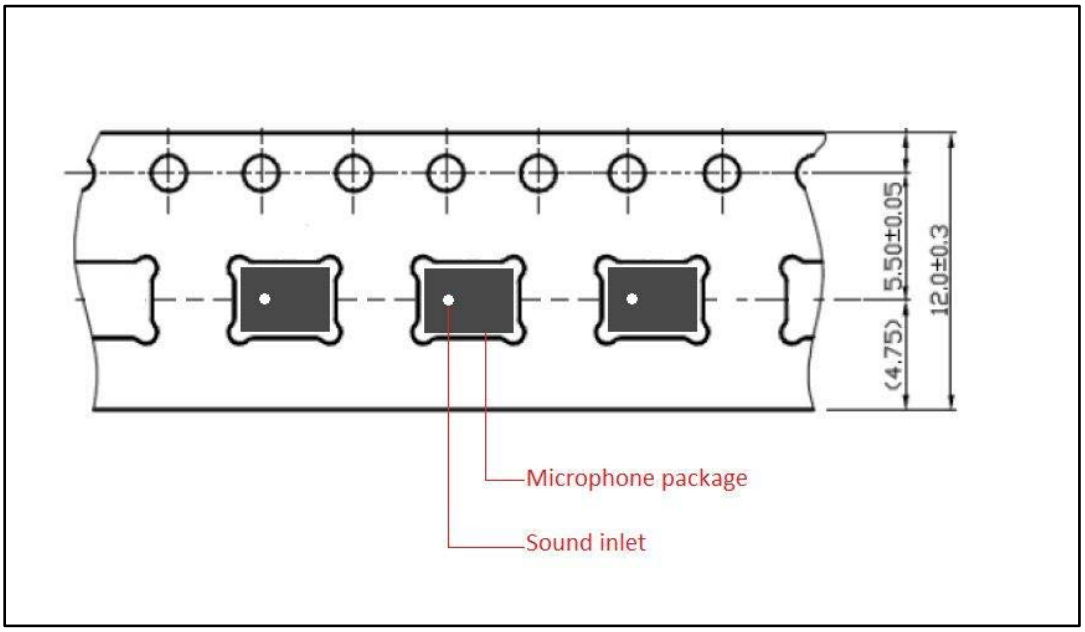


Figure 7: Carrier tape with microphone (top view)

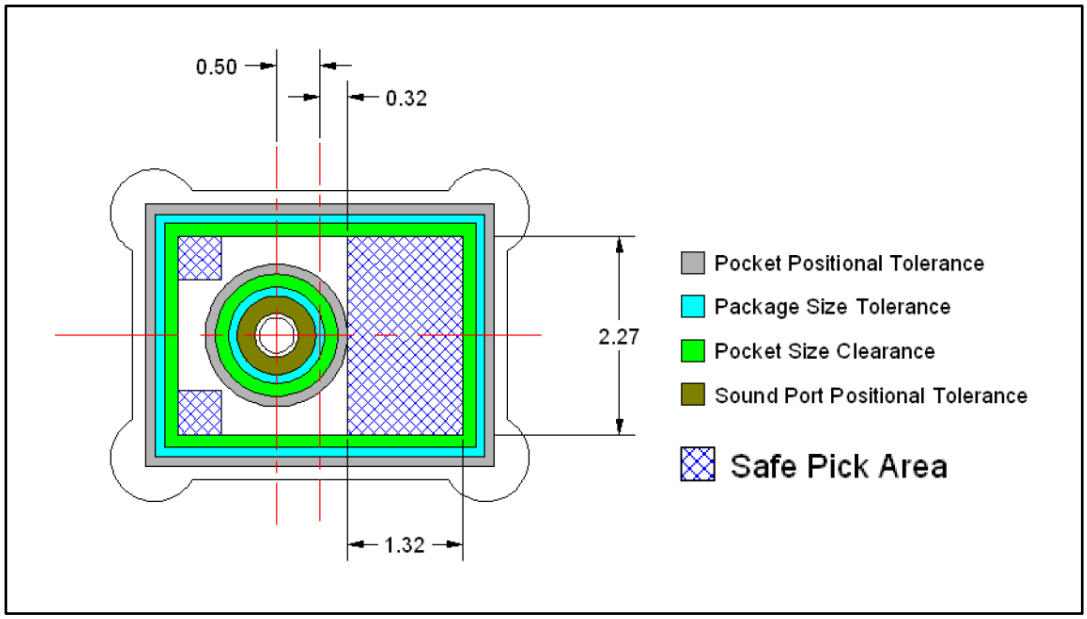


5 Process recommendations

To ensure a consistent manufacturing process it is strongly advised to comply with the following recommendations:

- The recommended pick-up area for the MP34DT04 package must be defined using the worst case (ie. no device alignment during the picking process). This area has been defined considering all the tolerances of the components involved (reel, package, sound inlet). The picker tolerance shall be considered as well.
- To prevent damage to the MEMS membrane or incorrect pick-up and placement, do not pick up the component on the inlet area
- For the package outline please refer to . Nozzle shape, size, and placement accuracy are the other key factors to consider when deciding on the coordinates for picking.
- Device alignment before picking is highly recommended.
- A vacuum force greater than 7 psi must be avoided
- 1 kPa = 0.145 psi (lb/in2) = 0.0102 kgf/cm² = 0.0098 atm
- All recommended dimensions (device safe-picking area) do not include the pick-and-place equipment tolerances

Figure 8: Recommended picking area

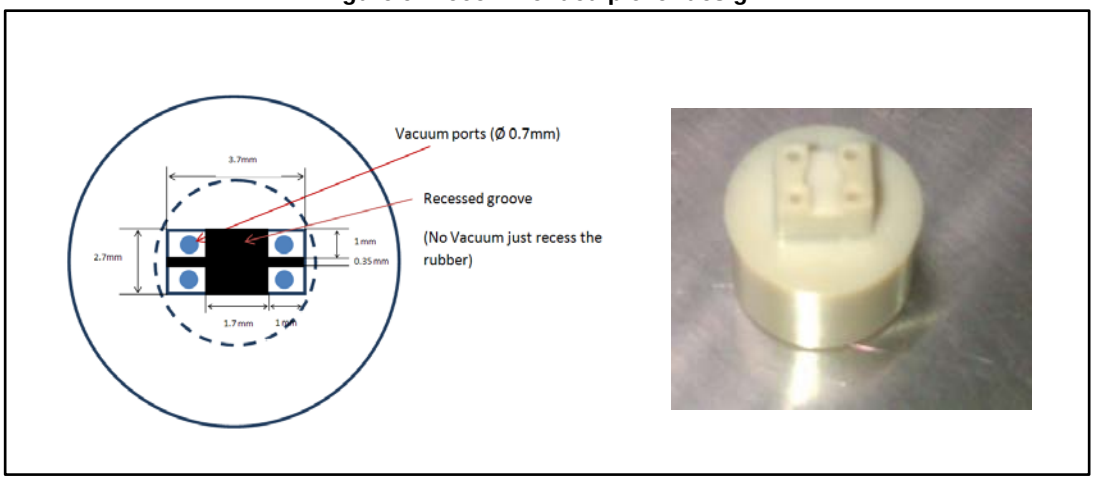


To have a safe pick-up "by design", ST strongly advises an ad hoc nozzle.

The following picker ensures that the holes for the vacuum and the air stream are ALWAYS away from the porthole of the device (4 vacuum ports located at each corner of the device).

The recommended nozzle also has a recess, in the form of a cross, which guarantees that the porthole is always left at atmospheric pressure. By using the recommended nozzle, the membrane will not suffer any sudden air disturbances during the picking or placing of the devices in the tape and reel.

Figure 9: Recommended picker design



6 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.

7 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 5	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	±2000 (HBM)	V
		±200 (MM)	
		±750 (CBM)	
ESD	Product standard EN 55024:2010 - 3 air discharge	±15000	V

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.

8 Functionality

8.1 L/R channel selection

The L/R digital pad lets the user select the DOUT signal pattern as shown in *Table 8: "L/R channel selection"*. 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

9 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.

9.1 Soldering information

The HCLGA (3 x 4) 4LD package is also compliant with the RoHS and “Green” standards and is qualified for soldering heat resistance according to JEDEC J-STD-020.

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

Figure 10: Recommended soldering profile limits

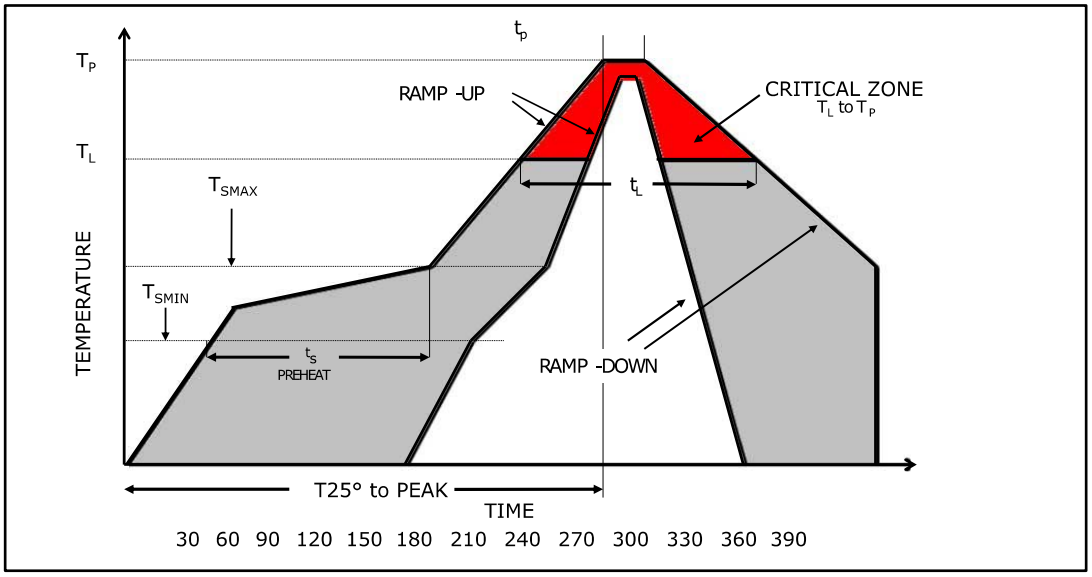
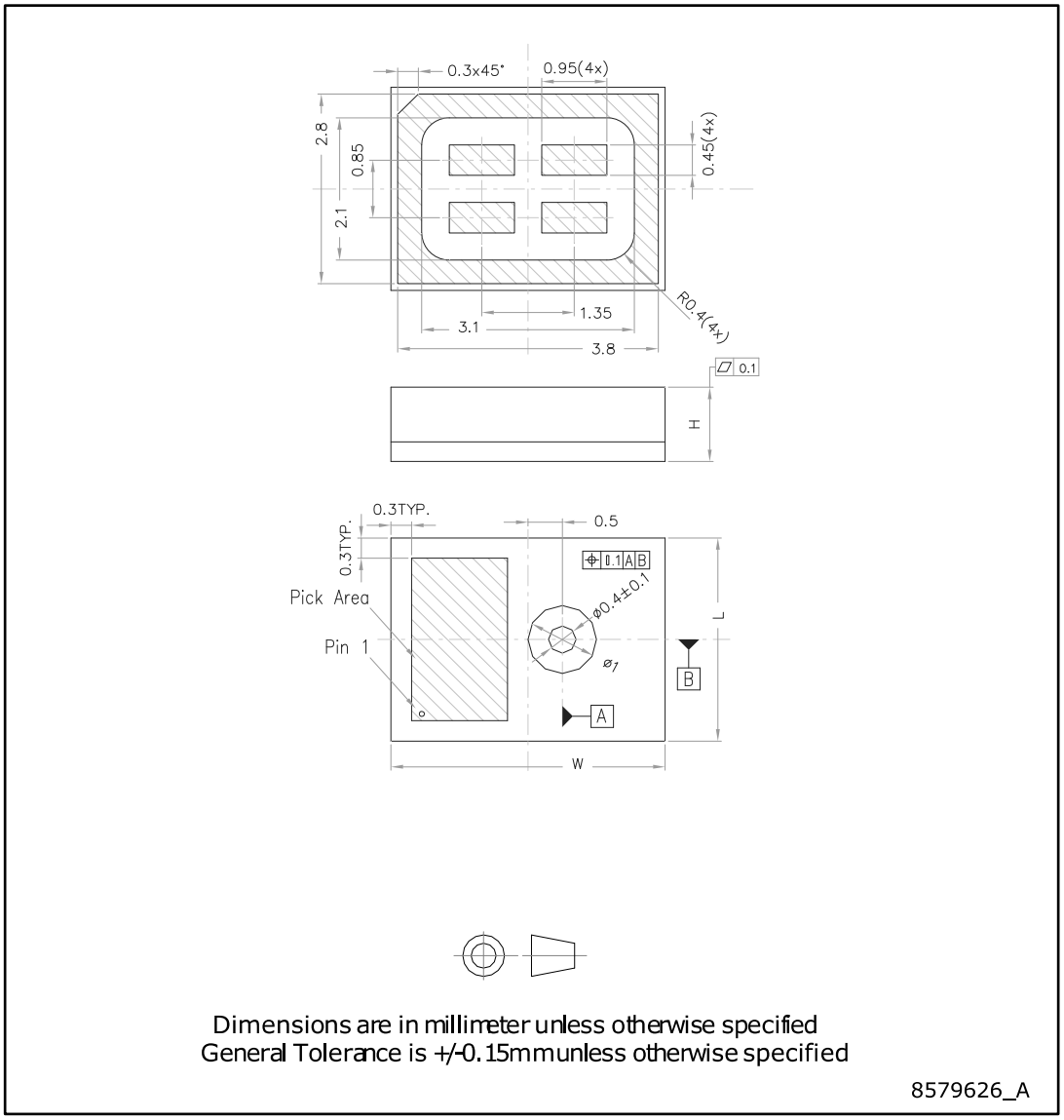


Table 9: Recommended soldering profile limits

Description	Parameter	Pb free
Average ramp rate	T_L to T_P	3 °C/sec max
Preheat Minimum temperature Maximum temperature Time (T_{SMIN} to T_{SMAX})	 T_{SMIN} T_{SMAX} t_S	 150 °C 200 °C 60 sec to 120 sec
Ramp-up rate	T_{SMAX} to T_L	
Time maintained above liquids temperature Liquids temperature	t_L T_L	60 sec to 150 sec 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 (t25 °C) to peak temperature		8 minutes max

9.2 HCLGA package (3x4x1.095mm)

Figure 11: HCLGA (3x4x1.095) 4-lead package outline

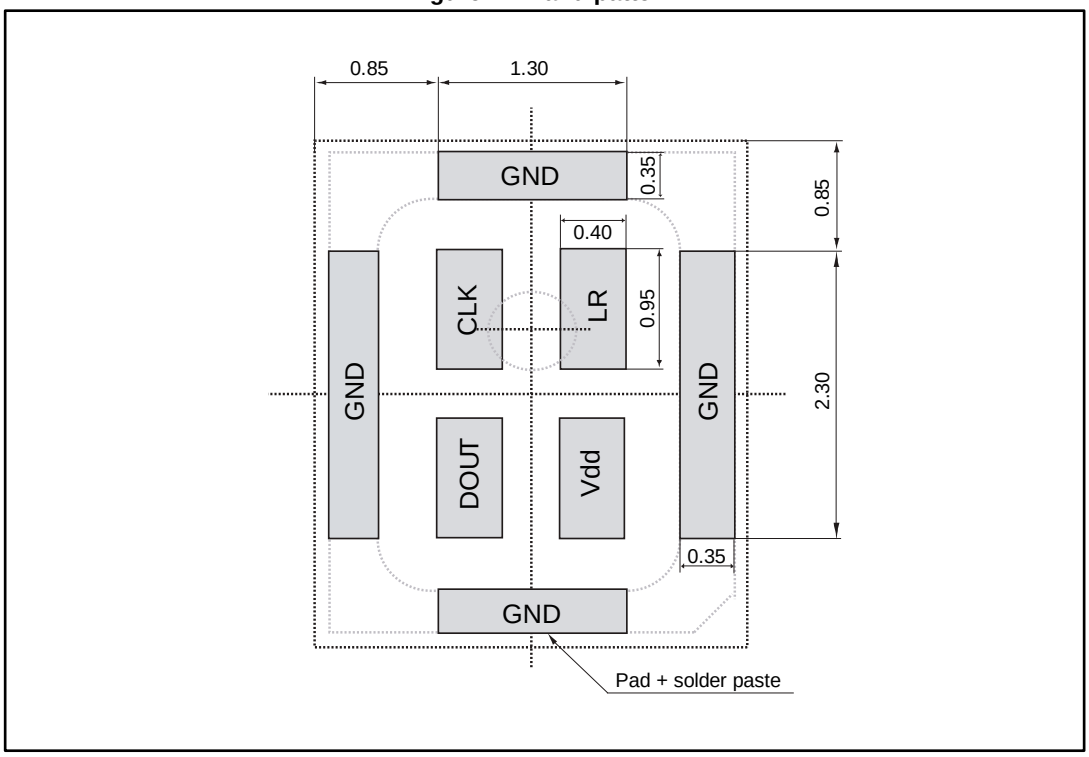


1. The MEMS microphone plastic cap can exhibit some level of variation in color when the device is subjected to thermal processes.
2. Ring plating can be subject to change not affecting acoustic and electrical performance.

Table 10: Outer dimensions

Symbol	Dimension (mm)	Tolerance (mm)
Length	3	±0.1
Width	4	±0.1
Height	1.095	±0.1
AP	Φ0.4	±0.1

Figure 12: Land pattern



10 Revision history

Table 11: Document revision history

Date	Revision	Changes
10-Mar-2015	1	Initial release

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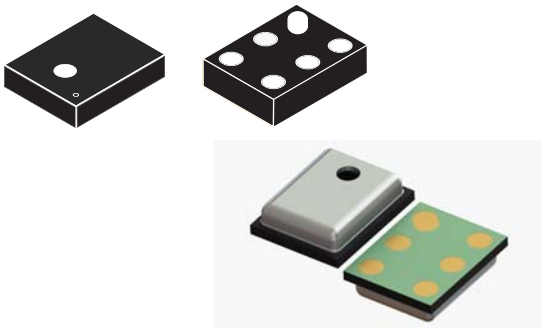
MP45DT02

MEMS audio sensor omnidirectional digital microphone

Datasheet - production data



HLGA (4.72 x 3.76 mm) 6LD

Features

- Single supply voltage
- Low power consumption
- 120 dBSPL 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 dBSPL 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 metal (M) or plastic 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
MP45DT02TR-M	-30 to +85	HLGA 4.72 x 3.76 6LD	Tape and reel

Contents

1 Pin description

Figure 1. Pin connections

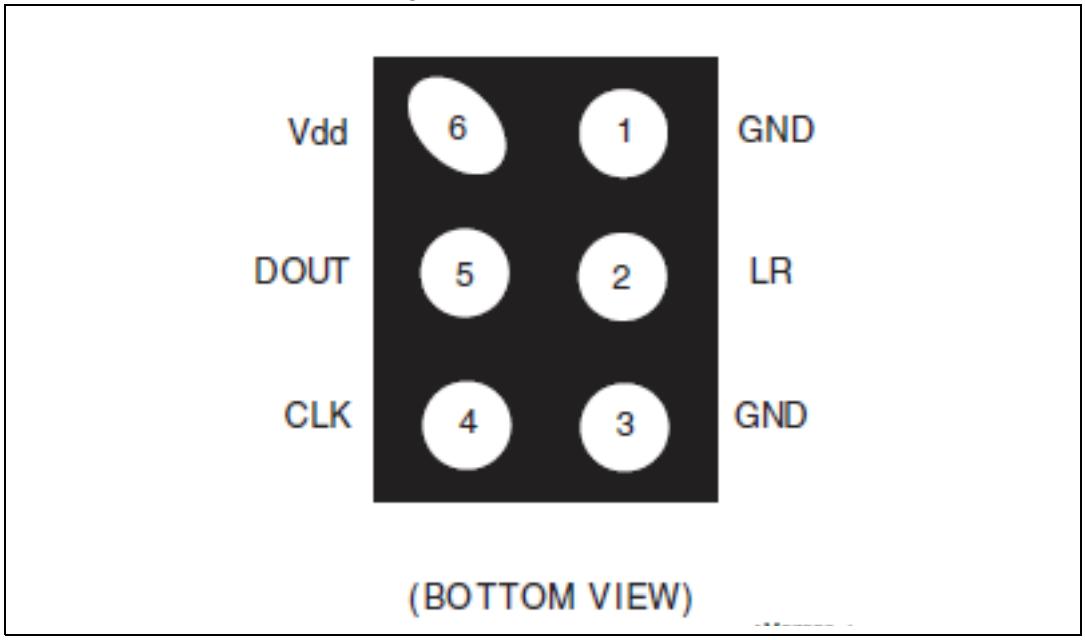


Table 2. Pin description

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*)
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
Scc	Short-circuit current		1		10	mA
AOP	Acoustic overload point			120		dBSPL
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 dBSPL (50 Hz - 4 kHz)	< 1% THD + N
Distortion	115 dBSPL (1 kHz)	< 5% THD + N

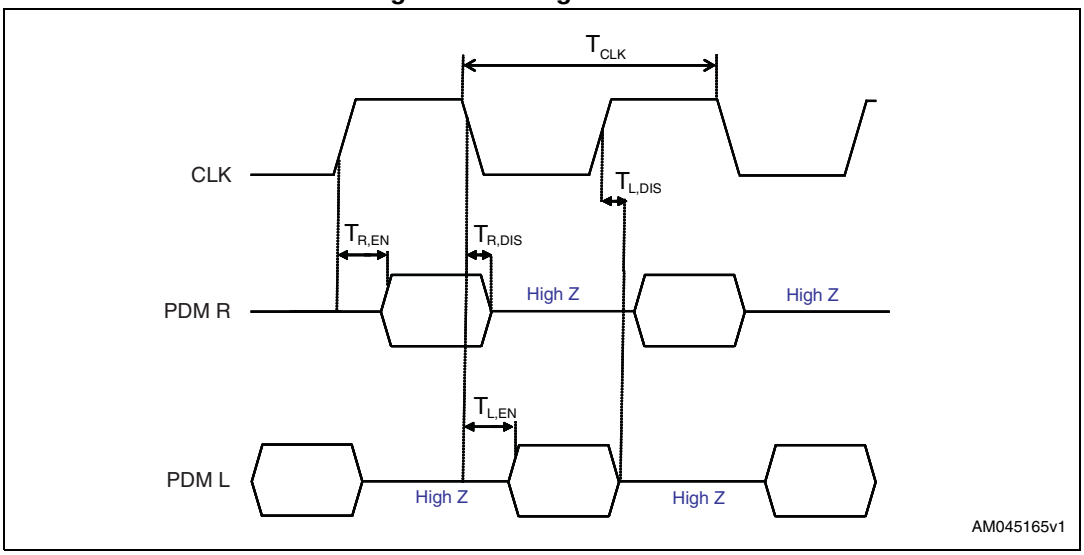
2.2 Timing characteristics

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

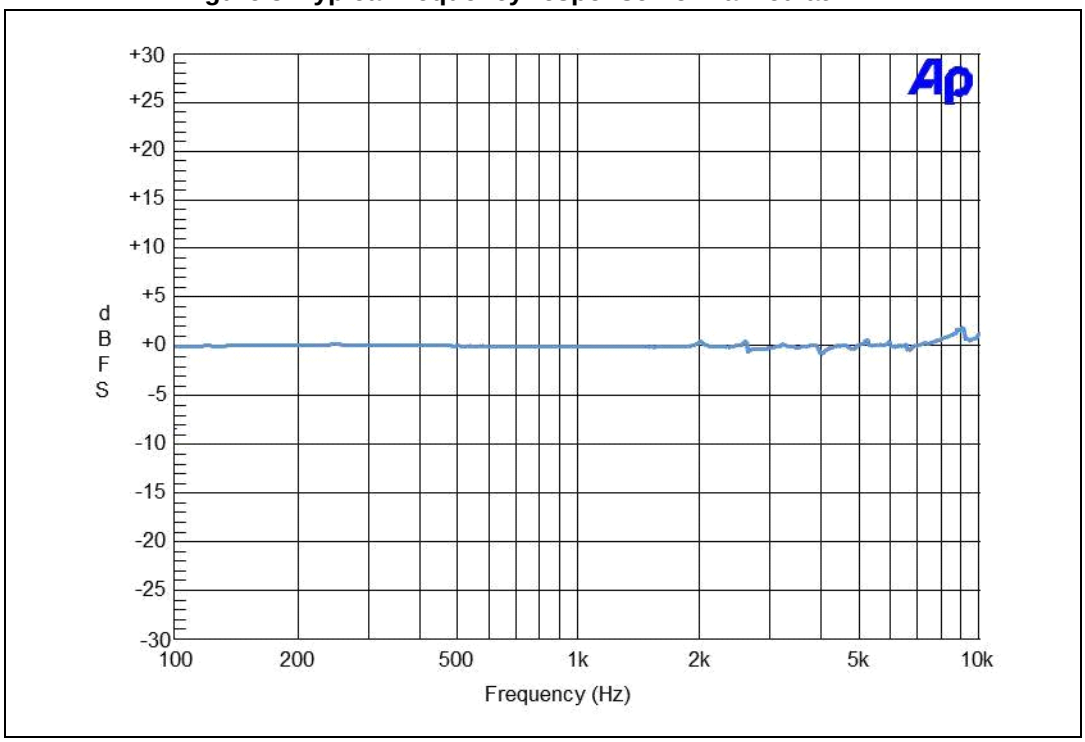
1. From design simulations

Figure 2. Timing waveforms



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.

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
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 7*. 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 impedence
Vdd	High impedence	Data valid

6 Application recommendations

Figure 4. MP45DT02 electrical connections

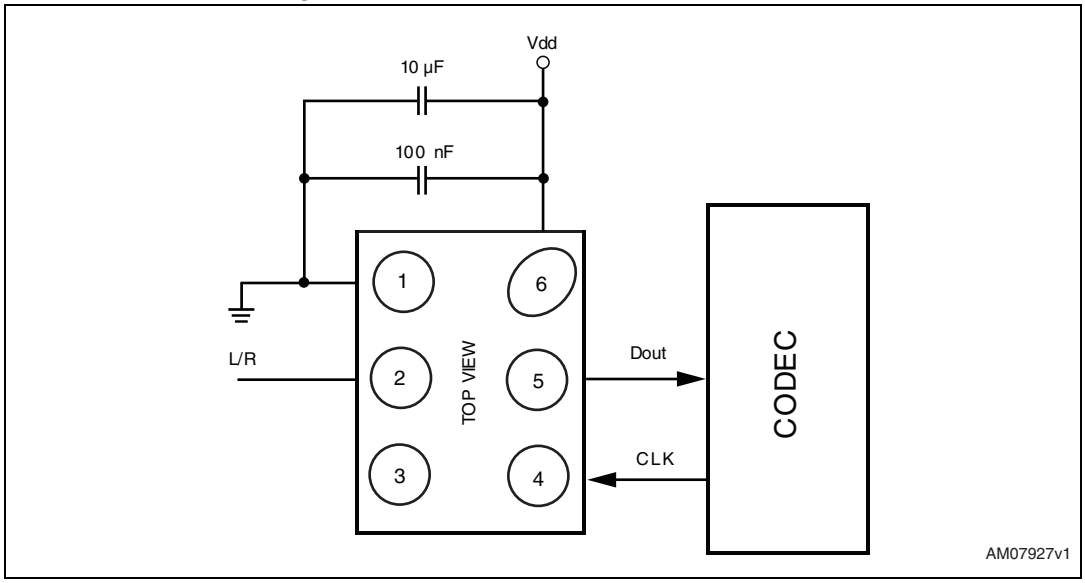
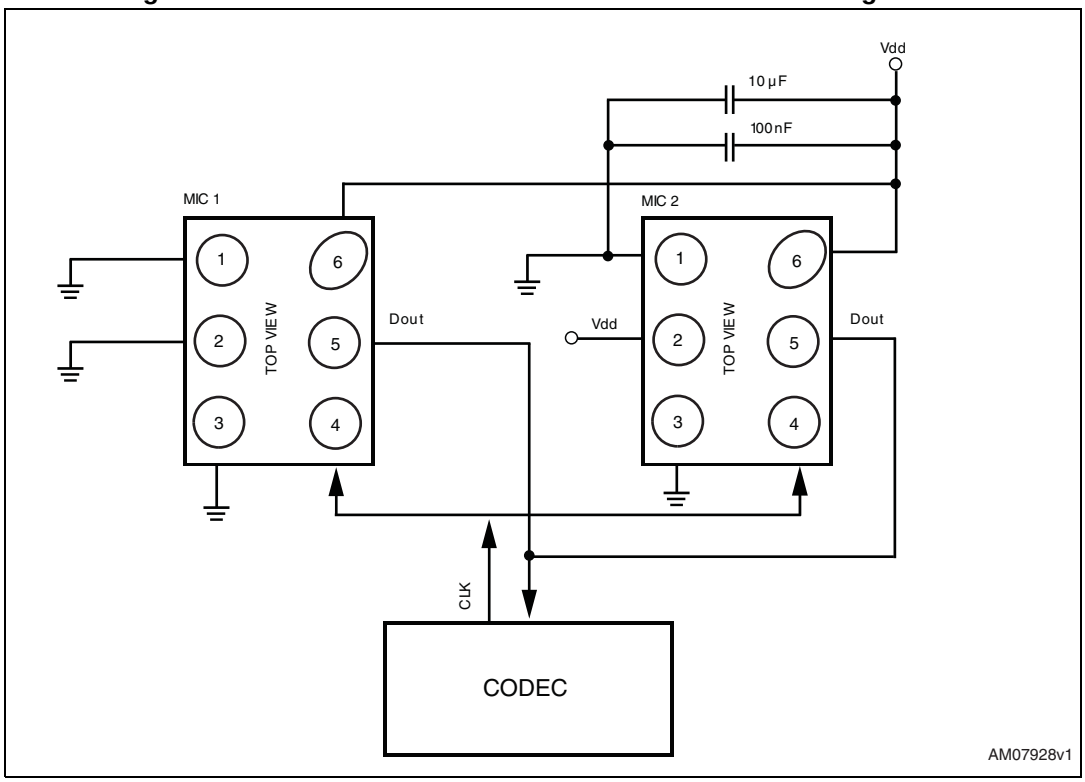


Figure 5. MP45DT02 electrical connections for stereo configuration



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*).

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

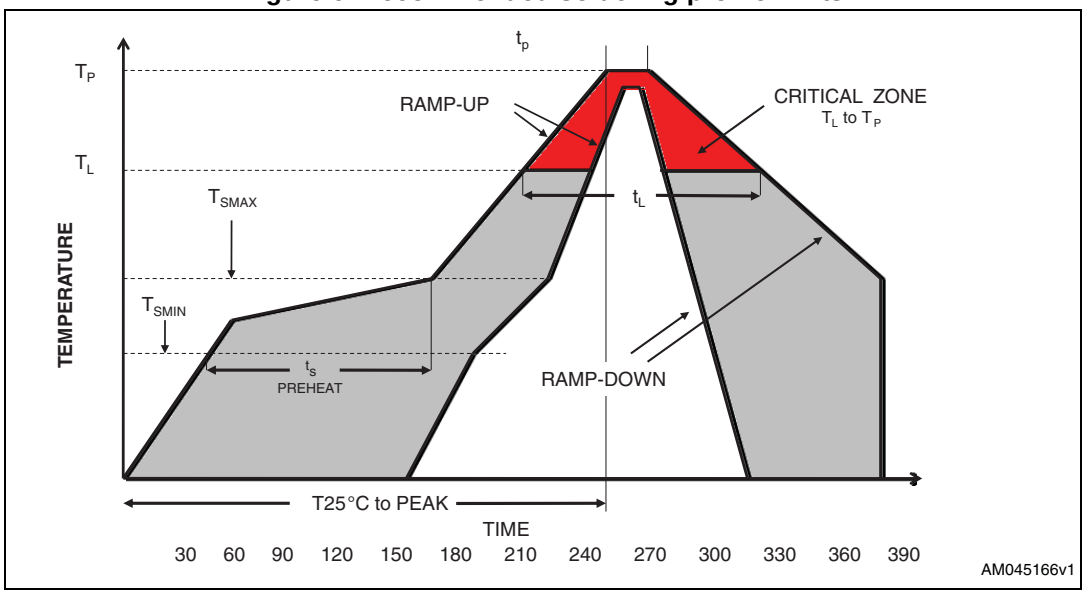
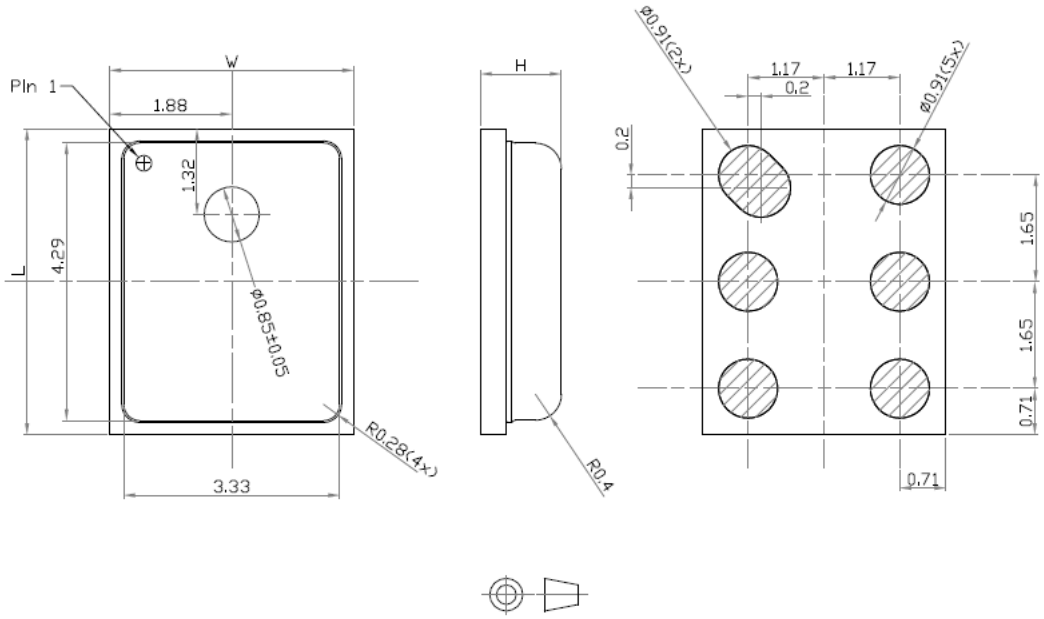


Table 8. Recommended soldering profile limits

Description	Parameter	Pb free
Average ramp rate	T_L to T_P	3 °C/sec max
Preheat Minimum temperature Maximum temperature Time (T_{SMIN} to T_{SMAX})	 T_{SMIN} T_{SMAX} t_S	 150 °C 200 °C 60 sec to 120 sec
Ramp-up rate	T_{SMAX} to T_L	
Time maintained above liquidus temperature Liquidus temperature	t_L T_L	60 sec to 150 sec 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 (t25 °C) to peak temperature		8 minutes max

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



OUTER DIMENSIONS

ITEM	DIMENSION [mm]	TOLERANCE [mm]
Length [L]	4.72	±0.1
Width [W]	3.76	±0.1
Height [H]	1.25	±0.1

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

Figure 8. HLGA (4.72 x 3.76 mm9 6-lead package outline

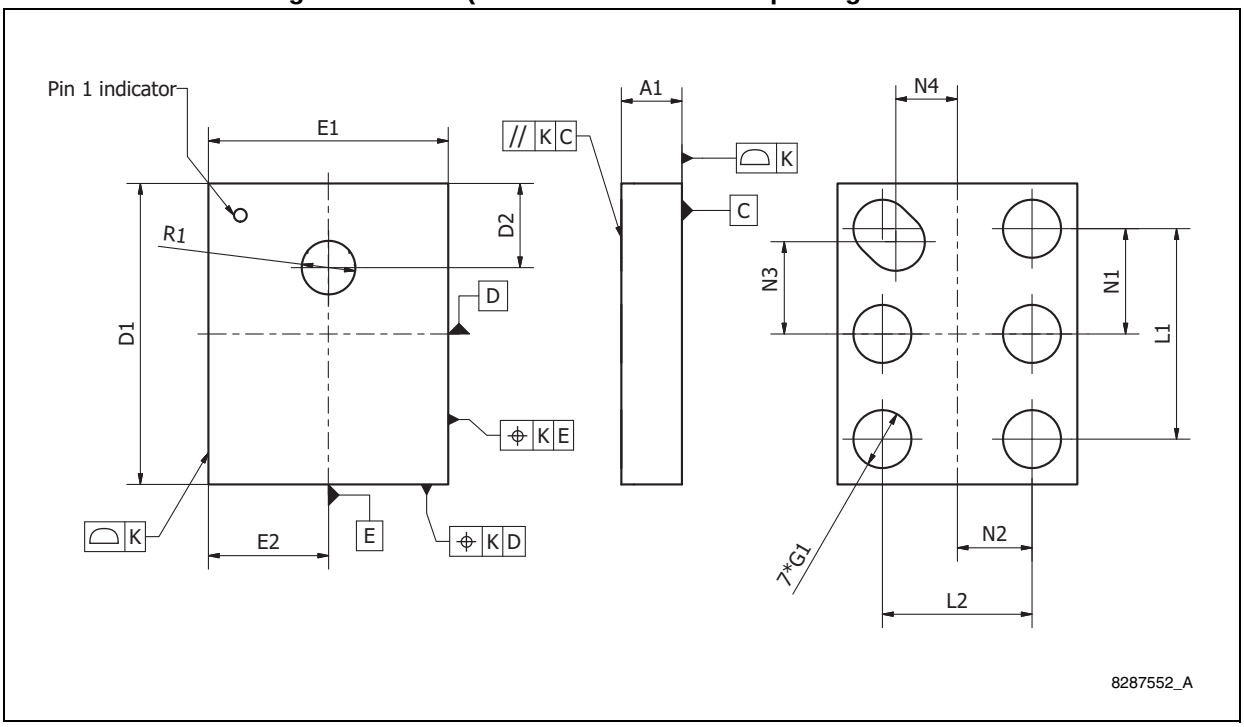


Table 9. HLGA (4.72 x 3.76 mm) 6-lead package dimensions

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 10. Document revision history

Date	Revision	Changes
28-Mar-2011	1	Initial release
21-Oct-2011	2	Added max. peak temperature T_P to *Table 8* Added min. and max. sensitivity So 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*
21-Mar-2014	6	Added new package *Figure 7: HLGA (4.72 x 3.76 mm) 6-lead package outline*
17-Jun-2014	7	Updated *Figure 3 on page 6*

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