Silicon Microphone

BM51DBB(0131)

Bestow Mascot

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1. Description

1.1 General Description

The BM51DBB is a miniature, high- performance, low power, bottom port silicon digital microphone with a single bit PDM output. Using BM' high performance Silicon MEMS technology, the BM51DBB consists of an acoustic sensor, a low noise input buffer, and a high performance sigma-delta modulator. These devices are suitable for portable electronic devices where excellent wideband audio performance and RF immunity are required.

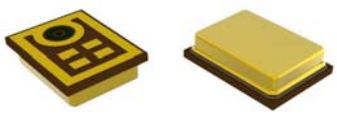
1.2 Features

- Low Noise
- High Drive Capability
- Low Current
- Flat Frequency Response
- RF Shielded
- Supports Dual Multiplexed Channels
- Standard SMD Reflow
- Omni directional

1.3 Applications

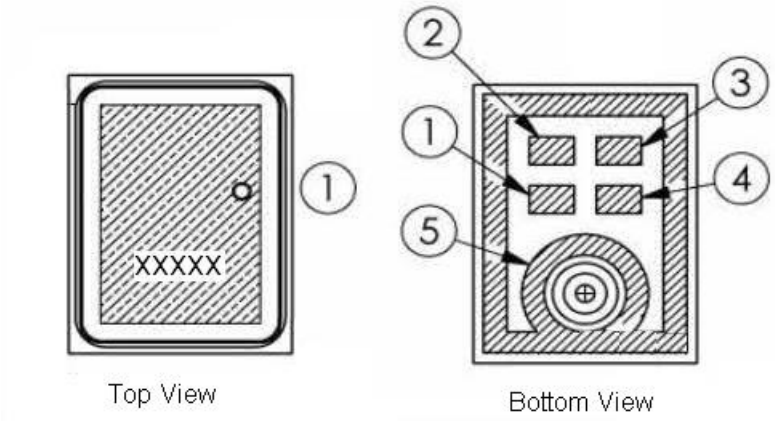
- Mobile terminals
- Laptop and notebook computers
- Portable media players
- VoIP
- Speech recognition
- A/V eLearning devices
- Gaming and virtual reality input devices
- Digital still and video cameras
- Antitheft systems

1.4 Package



Top View Bottom View

2. Pin Descriptions



Pin #	Pin Name	Type	Description
1	V_{DD}	Power	Power Supply
2	DATA	Digital O	PDM Output
3	CLOCK	Digital I	Clock Input
4	L/R	Non-Digital Input	Lo/Hi (L/R) Select This pin is internally pulled low.
5	GND	Power	Ground

3. Characteristics

3.1 Absolute Maximum Ratings

Parameter	Absolute Maximum Rating	Units
V_{DD}, DATA to GND	-0.3, +5.0	V
CLOCK to GND	-0.3, +5.0	V
L/R to GND	-0.3, +5.0	V
Input Current	±5	mA
Storage Temperature Range	-40 to +100	°C
Operation Temperature Range	-40 to +100	°C

Notes: Stresses exceeding these "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only. Functional operation at these or any other conditions beyond those indicated under "Acoustic & Electrical Specifications" is not implied. Exposure beyond those indicated under "Acoustic & Electrical Specifications" for extended periods may affect device reliability.

3.2 Acoustic & Electrical Specifications

Parameter	Symbol	Condition	Limits			Unit
			Min.	Nom.	Max.	
Supply Voltage	V_{DD}	-	1.5	1.8	3.6	V
Current Consumption[1]						
Working mode	-	1MHz<F_{CLK} <3.25MHz	-	520	-	μA
Standby mode[2]	-	F_{CLK}<300Hz or CLK is off	-	<5	-	μA
Sensitivity[3]	S	V_{DD}=1.8V, F_{CLK}=2.4MHz (0dBFS[4]=1V/Pa@1kHz)	-29	-26	-23	dB
S/N Ratio	S/N	A-Weighted	-	67	-	dB
Power Supply Reject Ratio	-	Measured within full audio bandwidth. Measured with 217Hz, 100mV_{pp} square wave and 100mV_{pp} noise	-	-80	-	dB
Total Harmonic Distortion	THD	100dB SPL	-	1		%
	AOP	120dB SPL	-	10		
Clock frequency range[5]	-	-	1	2.4	3.25	MHz
Short circuit current		Grounded data pin			1.3	mA
Load capacitance		-			100	pF
Directivity	-	-	Omni-directional			
Output Signal	-	-	1-Bit PDM			

Parameter	Symbol	Condition	Limits			Unit
			Min.	Nom.	Max.	
Fall-asleep time[6]	-	Power on, F_{CLK} <300Hz	-	5	-	ms
Wake-up time[7]	-	Power on, F_{CLK} >1MHz	-	40	-	ms
Power-up time[8]	-	-	-	40	-	ms
Mode[9]	Working mode					
	Standby mode					
	Power off mode					

Note1: The current consumption depends on the applied clock frequency and the load on the DATA output.

Note2: The microphone enters standby mode when the F_{CLK} falls below 300Hz. The current consumption in standby mode is less than 5uA. And there is no data output in standby mode. This value is tested on L/R connected to GND.

Note3: Relative to the rms level of a sine wave with positive amplitude equal to 100% 1s density and negative amplitude equal to 0% 1s density.

Note4: dBFS=20*logA/B,where A is the level of signal, and B is the level that corresponds to full-scale level.

Note5: The microphone can work properly at CLK frequencies from 1MHz to 3.25MHz. Some specifications may not be guaranteed other than 2.4MHz.

Note6: Time from the F_{CLK} falls below 300Hz to the current consumption in standby mode is met when transitioning from working mode to standby mode.

Note7: Time from the F_{CLK} rises above 1MHz to the sensitivity settled within ±3dB of the final value when transitonsioning from standby mode to active mode.

Note8: Time from V_{DD} rises to 1.8V and F_{CLK} rises above 1MHz to the sensitivity settled within ±3dB of the final value. It is the same as wake-up time.

Note9: The three valid modes: power off mode (V_{DD}=0, CLK=0); standby mode (V_{DD}=ON, F_{CLK} <300Hz or CLK=0); working mode (V_{DD}=ON, 1MHz< F_{CLK} <3.25MHz). CLK must be connected to ground in power off mode.

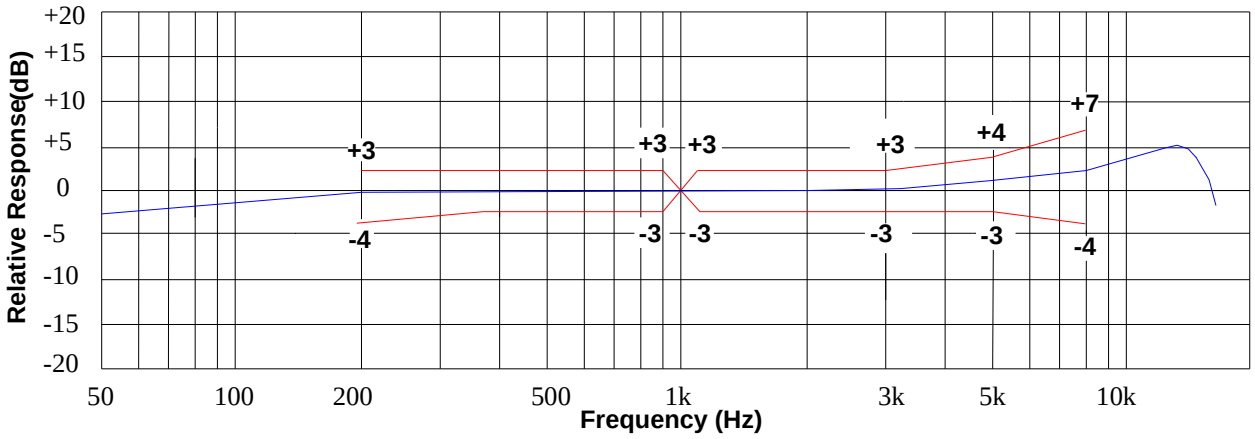
Note10: Test conditions: 20℃, 65±2% R.H., 96±10Kpa, Vdd=1.8V, F_{CLK}=2.4MHz, unless otherwise noted. If conditions are changed, some specifications are not guaranteed.

3.3 Digital input-output specifications

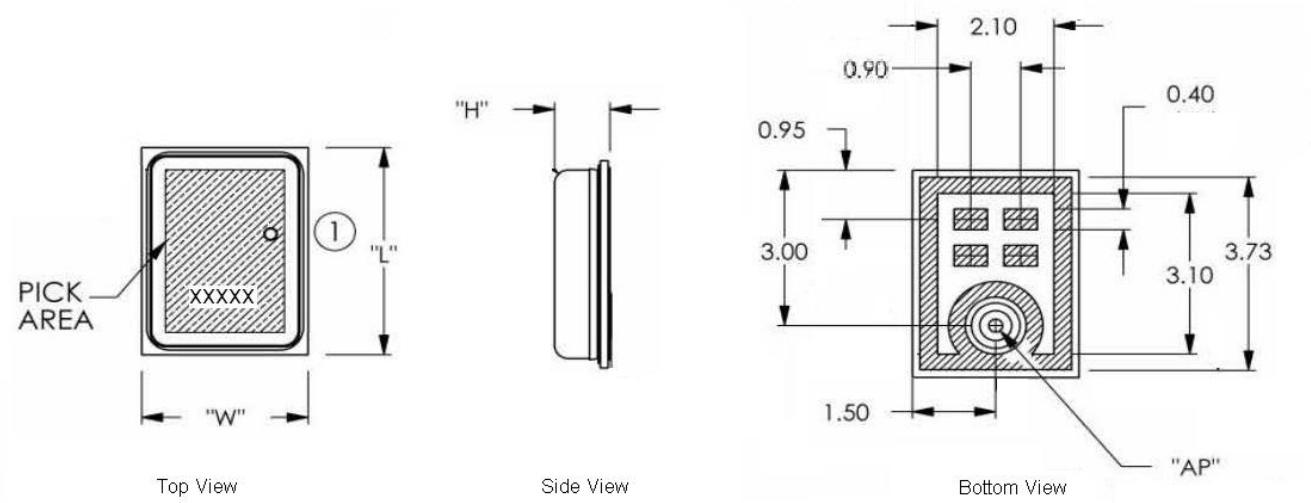
Parameter	Symbol	Limits			Unit
		Min.	Nom.	Max.	
Clock Freq.(Sample rate)	F_{CLK}	1	2.4	3.25	MHz
Clock duty cycle	F_{DC}	40	50	60	%
Operation Voltage	V_{DD}	1.5	1.8	3.6	V
Input/output voltage low	V_{IOL}	-0.3	-	$0.35\times V_{DD}$	V
Output voltage high	V_{OH}	$0.65\times V_{DD}$	-	V_{DD} +0.3	V
Input voltage high	V_{IH}	$0.65\times V_{DD}$	-	V_{DD} +0.3	V
Clock rise time	t_{CR}	-	-	10	ns
Clock fall time	t_{CF}	-	-	10	ns
Delay time for data valid[1]	t_{DV}	-	95	-	ns
Delay time for data high Z	t_{DH}	-	5	-	ns

Note 1: tested with 100pF load capacitance

3.4 Frequency Response Curve



4. Package Outline Information



Item	Dimension	Tolerance
Length (L)	4.00	±0.10
Width (W)	3.00	±0.10
Height (H)	1.00	±0.10
Acoustic Port (AP)	Ø0.25	±0.05

Notes: Pick Area only extends to 0.25 mm of any edge or hole unless otherwise specified

Dimensions are in millimeters unless otherwise specified. Tolerance is ±0.15mm unless otherwise specified.

5. Reliability Specifications

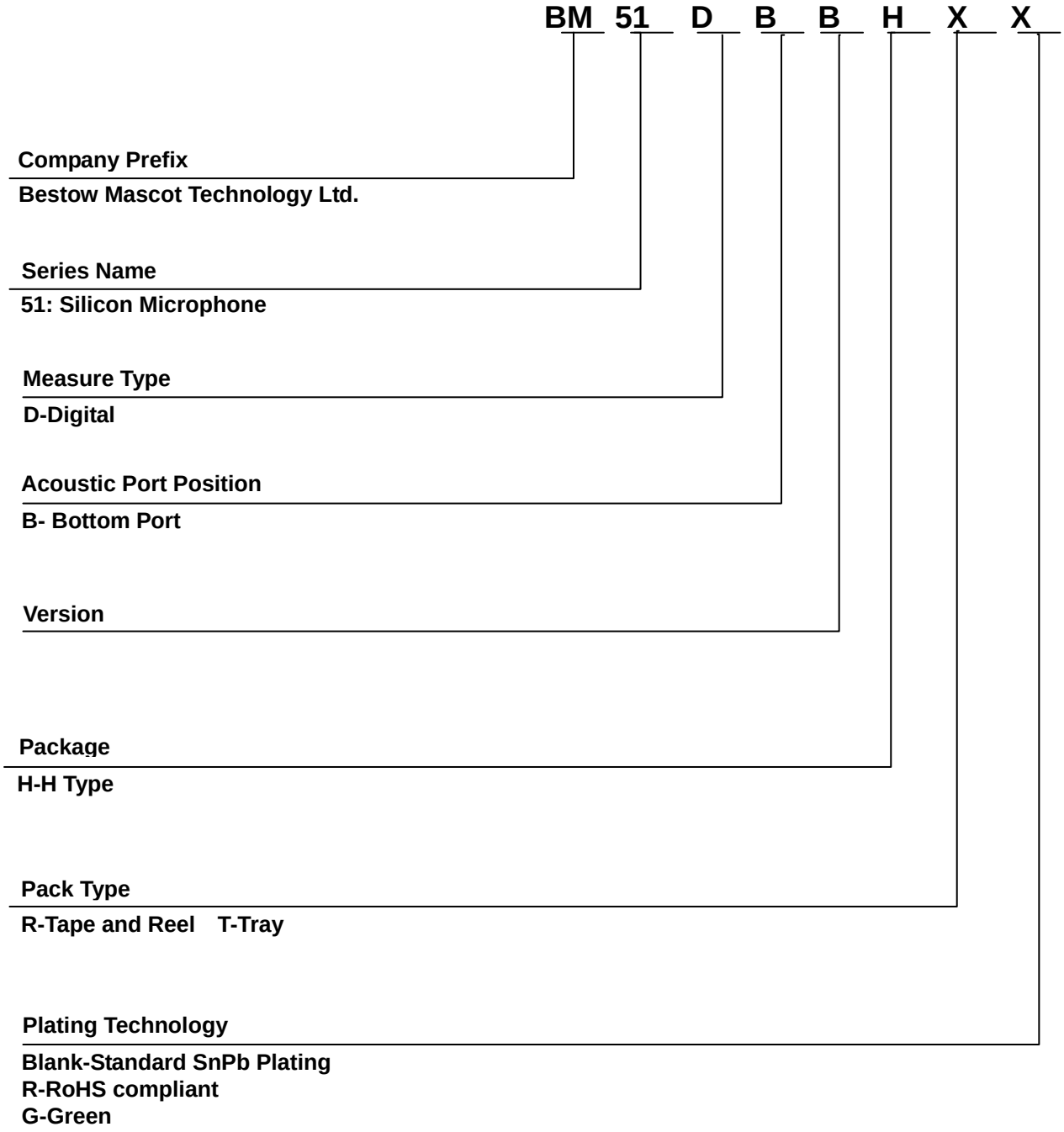
Test	Description
Thermal Shock	32 cycles air-to-air thermal shock from -40℃ to +85℃ with 30 minute soaks.
High Temperature Test	240 hours at +85℃
Low Temperature Test	240 hours at -40℃
Temperature / Humidity Test	240 hours at +70℃/93% R.H. under bias.
Vibration	Frequency: 10-55Hz Amplitude: 1.52mm Direction: 2 directions Duration: 2 hours
Drop Test	Drop the microphones to the floor without package. Height: 1.5m Reference Surface: slippery marble floor Duration: 5 times
Electrostatic Discharge	The tests are performed acc. to IEC61000-4-2 level 3: a. Contact Discharge Discharge Position: Output of Microphone Charge Voltage:±6000VDC Discharge Network: 150pF& 330Ω b. Air Discharge Discharge Position: Sound Hole Charge Voltage: ±8000VDC Discharge Network: 150pF & 330Ω

Note:

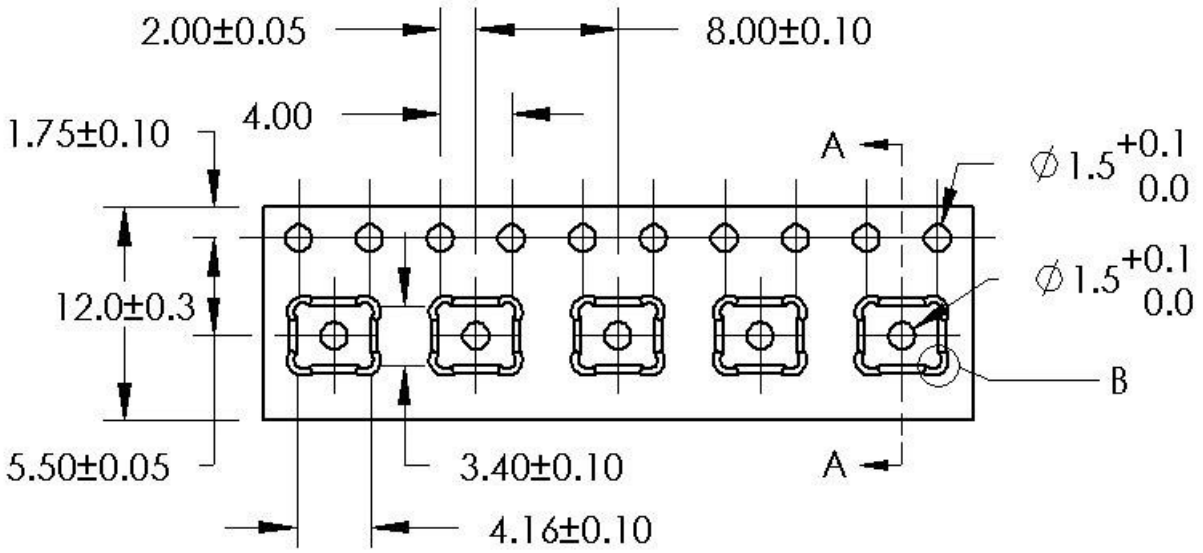
After reliability tests are performed, the sensitivity of the microphones shall not deviate more than ±3 dB from its initial value and shall keep its initial operation and appearance.

6. Ordering Information

6.1 Part Numbering



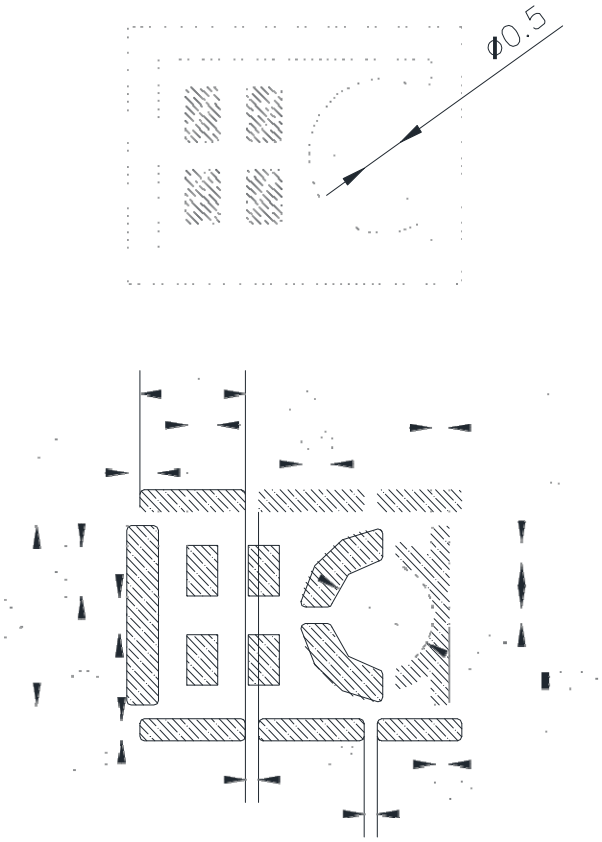
6.2 Tape and Reel Information



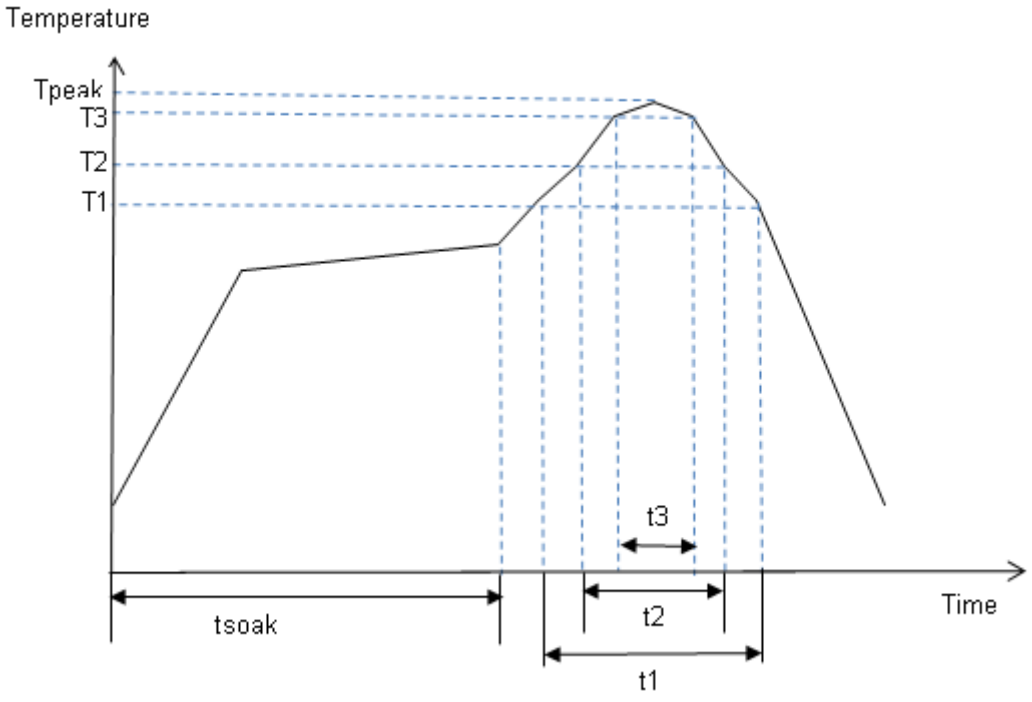
Container	Tape and reel
Reel Diameter	13''
Quantity Per Reel	5500 pcs

7. Application Design Suggestions

7.1 Recommended PCB Design



7.2 Recommended Reflow Profile



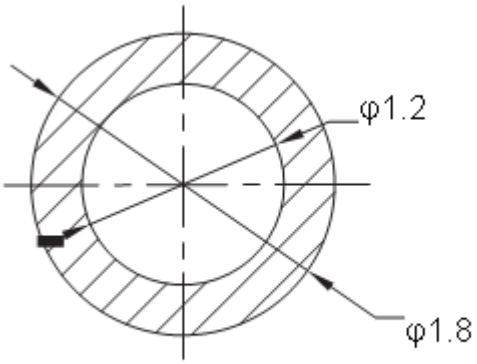
Profile Feature		Specification
Ramp up	Average ramp up rate to T_{peak}	2.5℃/Second Max.
Soak Time (tsoak)		120-150 Seconds
Time above 217℃(t1)		Max 60s
Time above 230℃(t1)		Max 50s
Time above 250℃(t1)		Max 10s
Peak temperature (Tpeak)		255℃(-0/+5℃)
Ramp down	Average ramp down rate	5℃ / Second Max.

Note:

After the initial reflow, the MIC shall be resumed to room temperature if more reflow is needed.

The test should be conducted after the MIC unit has been exposed to room temperature for 3 hours.

7.3 Recommended Nozzle for Reflow MIC

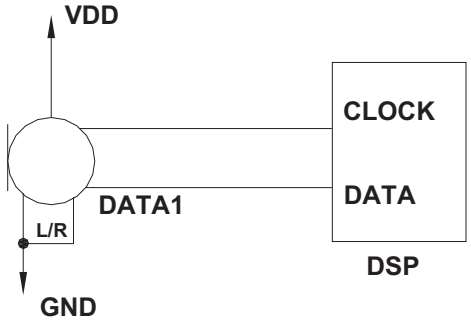


External diameter is φ1.8mm

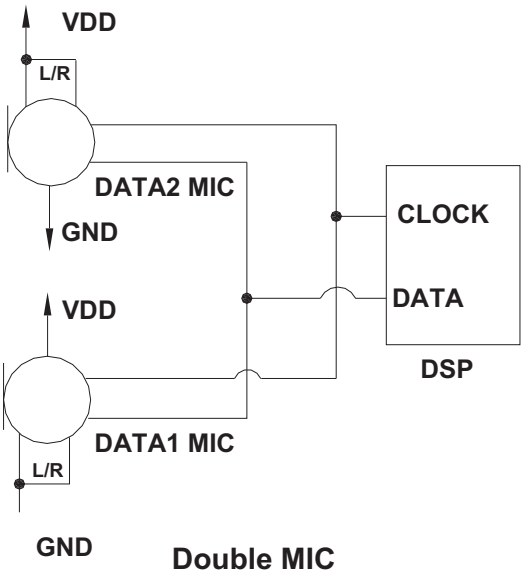
Inside diameter is φ1.2mm

7.4 Recommended interface circuit & timing diagram

7.4.1 Recommended interface circuit



Single MIC

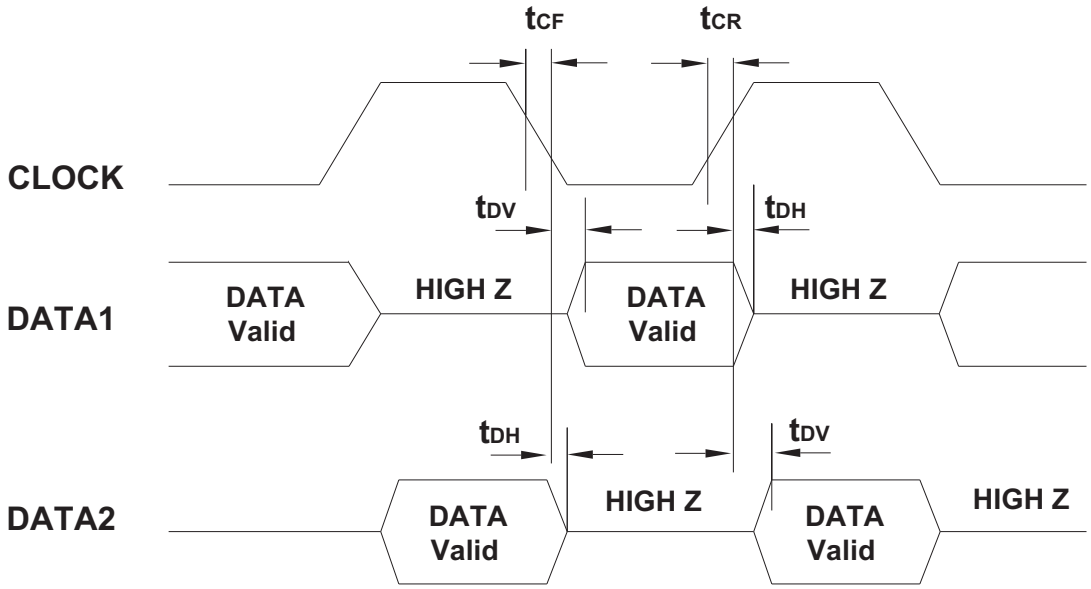


Double MIC

7.4.2 Channel selection

Channel	L/R pad connection
DATA1	GND
DATA2	VDD

7.4.3 Recommended timing diagram



8. Notice

●General Precaution

1) Before you use our Products, you are requested to carefully read this document and fully understand its contents. BM shall not be in any way responsible or liable for failure, malfunction or accident arising from the use of any BM's Products against warning, caution or note contained in this document.

2) All information contained in this document is current as of the issuing date and subject to change without any prior notice. Before purchasing or using BM's Products, please confirm the latest information with a BM sales representative.

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1) Our Products are designed and manufactured for application in ordinary electronic equipments (such as AV equipment, OA equipment, telecommunication equipment, home electronic appliances, amusement equipment, etc.). If you intend to use our Products in devices requiring extremely high reliability (such as medical equipment, transport equipment, traffic equipment, aircraft/spacecraft, nuclear power controllers, fuel controllers, car equipment including car accessories, safety devices, etc.) and whose malfunction or failure may cause loss of human life, bodily injury or serious damage to property ("Specific Applications"), please consult with the BM sales representative in advance. Unless otherwise agreed in writing by BM in advance, BM shall not be in any way responsible or liable for any damages, expenses or losses incurred by you or third parties arising from the use of any BM's Products for Specific Applications.

2) BM designs and manufactures its Products subject to strict quality control system. However, semiconductor products can fail or malfunction at a certain rate. Please be sure to implement, at your own responsibilities, adequate safety measures including but not limited to fail-safe design against the physical injury, damage to any property, which a failure or malfunction of our Products may cause. The following are examples of safety measures:

[a] Installation of protection circuits or other protective devices to improve system safety

[b] Installation of redundant circuits to reduce the impact of single or multiple circuit failure

3) Our Products are designed and manufactured for use under standard conditions and not under any special or extraordinary environments or conditions, as exemplified below. Accordingly, BM shall not be in any way responsible or liable for any damages, expenses or losses arising from the use of any BM's Products under any special or extraordinary environments or conditions. If you intend to use our Products under any special or extraordinary environments or conditions (as exemplified below), your independent verification and confirmation of product performance, reliability, etc, prior to use, must be necessary:

[a] Use of our Products in any types of liquid, including water, oils, chemicals, and organic solvents

[b] Use of our Products outdoors or in places where the Products are exposed to direct sunlight or dust

[c] Use of our Products in places where the Products are exposed to sea wind or corrosive gases, including Cl_2, H_2S, NH_3, SO_2, and NO_2

[d] Use of our Products in places where the Products are exposed to static electricity or electromagnetic waves

[e] Use of our Products in proximity to heat-producing components, plastic cords, or other flammable items

[f] Sealing or coating our Products with resin or other coating materials

[g] Use of our Products without cleaning residue of flux (even if you use no-clean type fluxes, cleaning residue of flux is recommended); or Washing our Products by using water or water-soluble cleaning agents for cleaning residue after soldering

[h] Use of the Products in places subject to dew condensation

4) The Products are not subject to radiation-proof design.

5) Please verify and confirm characteristics of the final or mounted products in using the Products.

6) In particular, if a transient load (a large amount of load applied in a short period of time, such as pulse) is applied, confirmation of performance characteristics after on-board mounting is strongly recommended. Avoid applying power exceeding normal rated power; exceeding the power rating under steady-state loading condition may negatively affect product performance and reliability.

7) De-rate Power Dissipation (Pd) depending on Ambient temperature (Ta). When used in sealed area, confirm the actual ambient temperature.

8) Confirm that operation temperature is within the specified range described in the product specification.

9) BM shall not be in any way responsible or liable for failure induced under deviant condition from what is defined in this document.

●Precaution for Mounting / Circuit board design

1) When a highly active halogen us (chlorine, bromine, etc.) flux is used, the residue of flux may negatively affect product performance and reliability.

2) In principle, the reflow soldering method must be used; if flow soldering method is preferred, please consult with the BM representative in advance. For details, please refer to BM Mounting specification

●Precautions Regarding Application Examples and External Circuits

1) If change is made to the constant of an external circuit, please allow a sufficient margin considering variations of the characteristics of the Products and external components,

including transient characteristics, as well as static characteristics.

2) You agree that application notes, reference designs, and associated data and information contained in this document are presented only as guidance for Products use. Therefore, in case you use such information, you are solely responsible for it and you must exercise your own independent verification and judgment in the use of such information contained in this document. BM shall not be in any way responsible or liable for any damages, expenses or losses incurred by you or third parties arising from the use of such information.

●Precaution for Electrostatic

This Product is electrostatic sensitive product, which may be damaged due to electrostatic discharge. Please take proper caution in your manufacturing process and storage so that voltage exceeding the Products maximum rating will not be applied to Products. Please take special care under dry condition (e.g. Grounding of human body / equipment / solder iron, isolation from charged objects, setting of Ionizer, friction prevention and temperature / humidity control).

●Precaution for Storage / Transportation

1) Product performance and soldered connections may deteriorate if the Products are stored in the places where:

[a] the Products are exposed to sea winds or corrosive gases, including Cl_2, H_2S, NH_3, SO_2, and NO_2

[b] the temperature or humidity exceeds those recommended by BM

[c] the Products are exposed to direct sunshine or condensation

[d] the Products are exposed to high Electrostatic

2) Even under BM recommended storage condition, solder ability of products out of recommended storage time period may be degraded. It is strongly recommended to confirm solder ability before using Products of which storage time is exceeding the recommended storage time period.

3) Store / transport cartons in the correct direction, which is indicated on a carton with a symbol. Otherwise bent leads may occur due to excessive stress applied when dropping of a carton.

4) Use Products within the specified time after opening a humidity barrier bag. Baking is required before using Products of which storage time is exceeding the recommended storage time period.

●Precaution for Product Label

QR code printed on BM Products label is for BM's internal use only.

●Precaution for Disposition

When disposing Products please dispose them properly using an authorized industry waste company.

●Precaution for Foreign Exchange and Foreign Trade act

Since our Products might fall under controlled goods prescribed by the applicable foreign exchange and foreign trade act, please consult with BM representative in case of export.

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9. Revision History

Version	Publication date	Pages	Revise Description
1.0	Mar.2016	16	Initial Document Release
1.1	Mar.2017	17	Update Parameters