

## Product Specification

### ML-2664-4030-DB1H2

### Bottom-port digital silicon microphone



#### ● Description

ML-2664-4030-DB1H2 is high-performance bottom-port digital silicon microphone that receives the sound signal from the hole on Bottom PCB. By using our own innovative and unique MEMS silicon microphone chip design, MicroLinkSenstech provides a series of packaged MEMS silicon microphones with compact size to achieve high performance such as high SNR, high sensitivity, excellent reliability and broad frequency response. This series of MEMS microphones find wide applications in smart speakers, cell phones, tablets, wearable devices and other portable electronic devices.

#### ● Features

- Tiny size of 4.0×3.0×1.0 mm
- Sensitivity of -26dBFS ( $\pm 1$ dBFS)
- High signal-to-noise ratio of 64 dB
- Extreme low THD of 0.5% at 94 dB SPL
- PDM Output
- High immune to RF/EM interference
- High mechanical strength
- High temperature resistance
- Excellent reliability.



## ● Absolute maximum ratings

| Parameter                  | Absolute Maximum Rating     | Units |
|----------------------------|-----------------------------|-------|
| Vdd, DATA to Ground        | -0.3, +5.0                  | V     |
| CLOCK to Ground            | -0.3, +5.0                  | V     |
| SELECT to Ground           | -0.3, +5.0                  | V     |
| Input Current              | ±5                          | mA    |
| Short Circuit to/from DATA | Indefinite to Ground or Vdd | sec   |
| Temperature                | -40 to +100                 | °C    |

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 and electrical specifications” is not implied. Exposure beyond those indicated under “Acoustic and electrical specifications” for extended periods may affect device reliability.

## ● Acoustic and electrical specifications

TEST CONDITIONS: 23 ±2° C, 55±20% R.H., VDD=1.8 V, F<sub>CLOCK</sub>=2.4 MHz, SELECT pin grounded, no load, unless otherwise indicated

General Microphone Specifications

| Parameter             | Symbol             | Condition                  | Min.                | Typ. | Max   | Unit            |
|-----------------------|--------------------|----------------------------|---------------------|------|-------|-----------------|
| Supply voltage        | Vdd                |                            | 1.6                 |      | 3.6   | V               |
| Sleep current         | I <sub>SLEEP</sub> | f <sub>CLOCK</sub> ≤ 1 kHz |                     | 32   | 42    | μA              |
| Clock frequency range | Sleep mode         | f <sub>CLOCK</sub>         | 0                   |      | 250   | KHz             |
|                       | Low-power mode     | f <sub>CLOCK</sub>         | 350                 | 768  | 800   | KHz             |
|                       | Normal mode        | f <sub>CLOCK</sub>         | 1.024               | 2.4  | 3.072 | MHz             |
| Clock Duty Cycle      |                    |                            | 40                  | 50   | 60    | %               |
| Directivity           |                    |                            | Omnidirectional     |      |       |                 |
| Data format           |                    |                            | 1/2 Cycle 1-bit PDM |      |       |                 |
| Output load           | C <sub>LOAD</sub>  |                            |                     |      | 140   | pF              |
| Dimension             |                    |                            | 4.0×3.0×1.0         |      |       | mm <sup>3</sup> |
| Directivity           |                    |                            | Omnidirectional     |      |       |                 |
| Frequency response    | F                  |                            | 100~10k             |      |       | Hz              |

### Normal mode

TEST CONDITIONS: VDD=1.8 V, F<sub>CLOCK</sub>=2.4MHz, unless otherwise indicated

| Parameter                 | Symbol          | Condition                                   | Min. | Typ. | Max | Unit     |
|---------------------------|-----------------|---|------|------|-----|----------|
| Sensitivity               | Sens            | 94dB SPL @1kHz                              | -27  | -26  | -25 | dBFS     |
| Signal to noise ratio     | SNR             | 94dB SPL @1kHz                              |      | 64   |     | dB (A)   |
| Current consumption       | I <sub>DD</sub> | Vdd=1.8V,<br>f <sub>CLOCK</sub> =2.4MHz     |      | 850  |     | μA       |
| Total harmonic distortion | THD             | 94 dB SPL @ 1kHz                            |      | 0.2  |     | %        |
| Acoustic Overload Point   | AOP             | 10% THD @ 1 kHz                             |      | 120  |     | dB SPL   |
| Power supply rejection    | PSR             | 100mVpp square wave<br>@ 217 Hz, A-weighted |      | -80  |     | dBFS (A) |

**Low-power mode**

TEST CONDITIONS: VDD=1.8 V, F<sub>CLOCK</sub>=768KHz, unless otherwise indicated

| Parameter                 | Symbol          | Condition   | Min. | Typ. | Max | Unit     |
|---------------------------|-----------------|---|------|------|-----|----------|
| Sensitivity               | Sens            | 94dB SPL @1kHz  | -27  | -26  | -25 | dBFS     |
| Signal to noise ratio     | SNR             | 94dB SPL @1kHz  |      | 64   |     | dB (A)   |
| Current consumption       | I <sub>dd</sub> | V <sub>dd</sub> =1.8V,<br>f <sub>CLOCK</sub> =768KHz    |      | 380  |     | μA       |
| Total harmonic distortion | THD             | 94 dB SPL @ 1kHz  |      | 0.2  |     | %        |
| Acoustic Overload Point   | AOP             | 10% THD @ 1 kHz   |      | 120  |     | dB SPL   |
| Power supply rejection    | PSR             | 100mV <sub>pp</sub> square wave<br>@ 217 Hz, A-weighted |      | -80  |     | dBFS (A) |

● **Microphone interface specifications**

| Parameter        | Symbol           | Value                |      |                      | Unit |
|------------------|------------------|----------------------|------|----------------------|------|
|                  |                  | Min                  | Type | Max                  |      |
| Logic DATA high  | V <sub>IOH</sub> | 0.65×V <sub>dd</sub> |      | V <sub>dd</sub> +0.3 | V    |
| Logic DATA low   | V <sub>IOL</sub> | -0.3                 |      | 0.35×V <sub>dd</sub> | V    |
| Clock duty cycle | f <sub>%</sub>   | 40                   |      | 60                   | %    |

● **Frequency response**

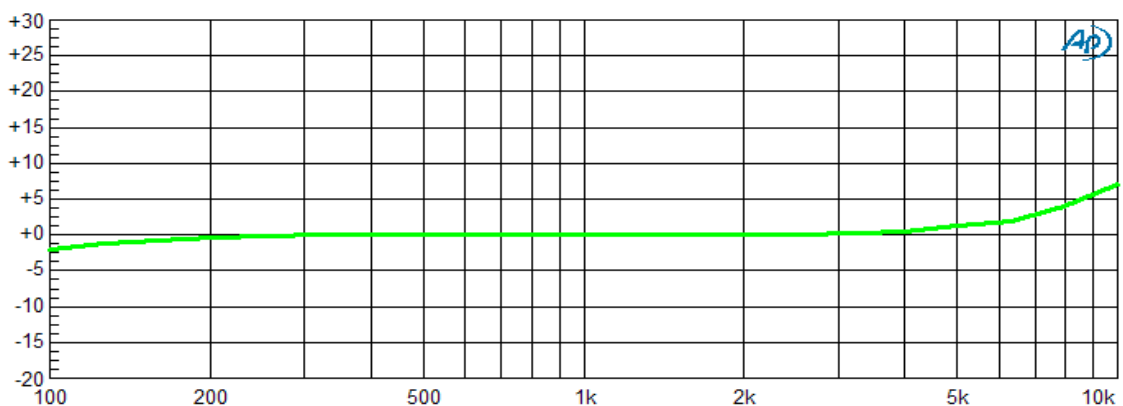
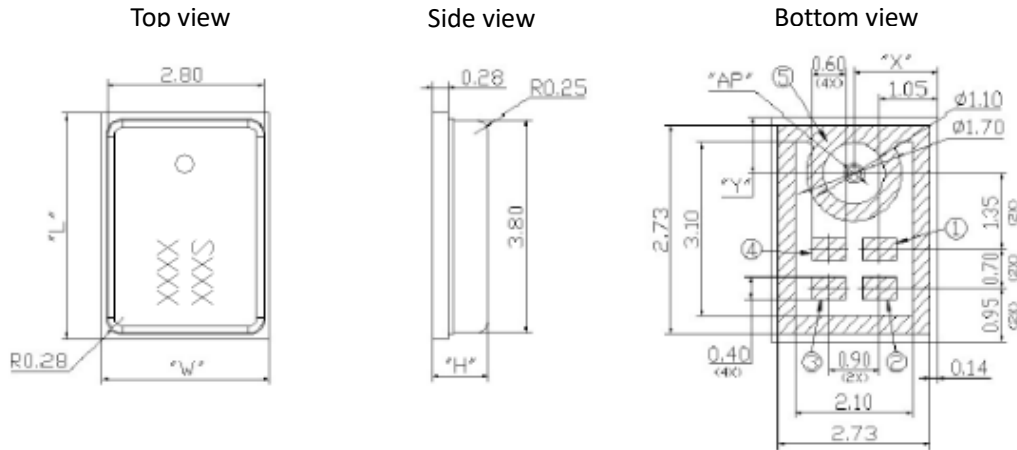


Figure 1. Typical free field frequency response (Normalized to 1 KHz)



● Mechanical specifications



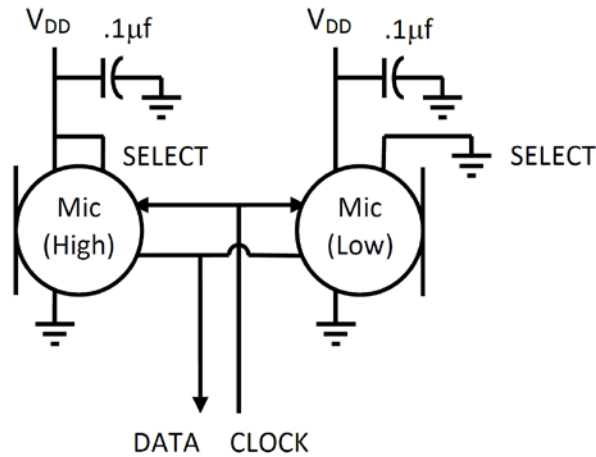
| ITEM              | DIMENSION | TOLERANCE | UNITS |
|-------------------|-----------|-----------|-------|
| LENGTH(L)         | 4.00      | ±0.10     | mm    |
| WIDTH(W)          | 3.00      | ±0.10     | mm    |
| HEIGHT(H)         | 1.00      | ±0.10     | mm    |
| ACOUSTIC PORT(AP) | φ0.25     | ±0.10     | mm    |
| AP-X              | 1.50      | ±0.20     | mm    |
| AP-Y              | 1.00      | ±0.20     | mm    |

| PIN OUTPUT |          |
|------------|----------|
| PIN#       | FUNCTION |
| 1          | VDD      |
| 2          | DATA     |
| 3          | CLOCK    |
| 4          | SELECT   |
| 5          | GROUND   |

Figure 2. Detailed mechanical drawings

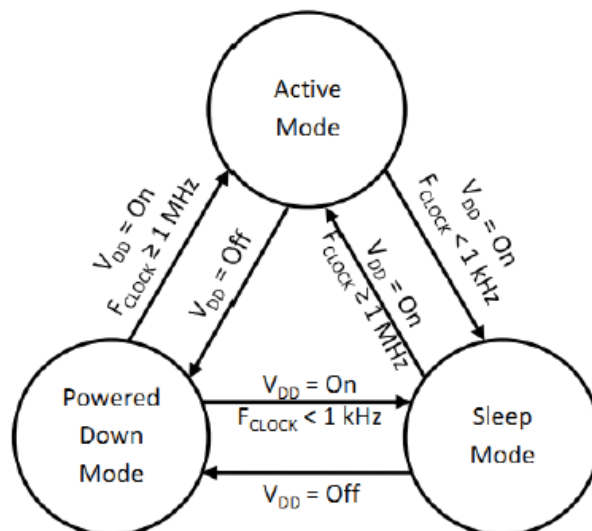


● Interface circuit



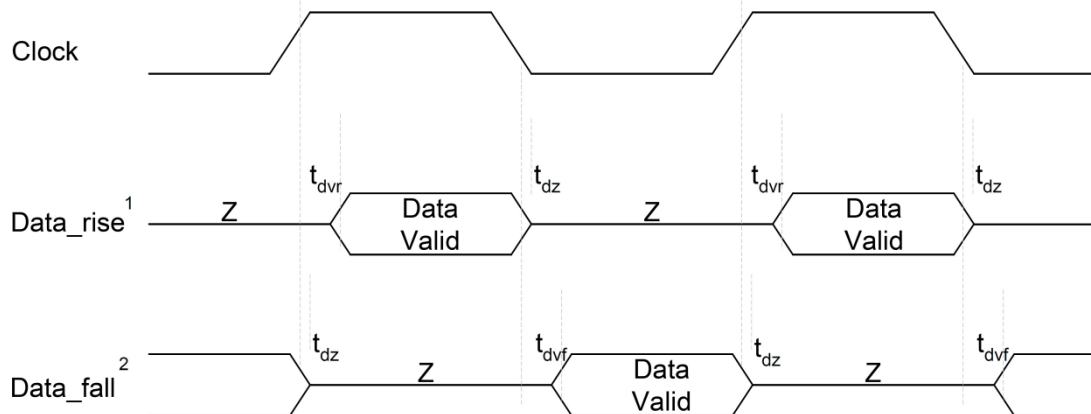
| Microphone | SELECT          | Asserts DATA On    | Latch DATA On      |
|------------|-----------------|--------------------|--------------------|
| Mic (High) | V <sub>DD</sub> | Rising Clock Edge  | Falling Clock Edge |
| Mic (Low)  | GND             | Falling Clock Edge | Rising Clock Edge  |

● Device state diagram



● Time diagram

| Parameter  | Symbol    | Min   | Typ | Max   | Conditions                                   |
|--|-----------|-------|-----|-------|--|
| Time required for data valid on the rising edge clock  | $t_{dvr}$ | 18 ns |     | 40 ns | $R_L = 1\text{ M}\Omega, C_L = 12\text{ pF}$ |
| Time required for data valid on the falling edge clock | $t_{dvf}$ | 18 ns |     | 40 ns | $R_L = 1\text{ M}\Omega, C_L = 12\text{ pF}$ |
| Time required for data to be Z                         | $t_{dz}$  | 0 ns  |     | 15 ns | $R_L = 1\text{ M}\Omega, C_L = 12\text{ pF}$ |



Note:

1. Data\_rise : Data configured to be valid on the rising edge of the clock
2. Data\_fall : Data configured to be valid on the falling edge of the clock



● Example Land Pattern

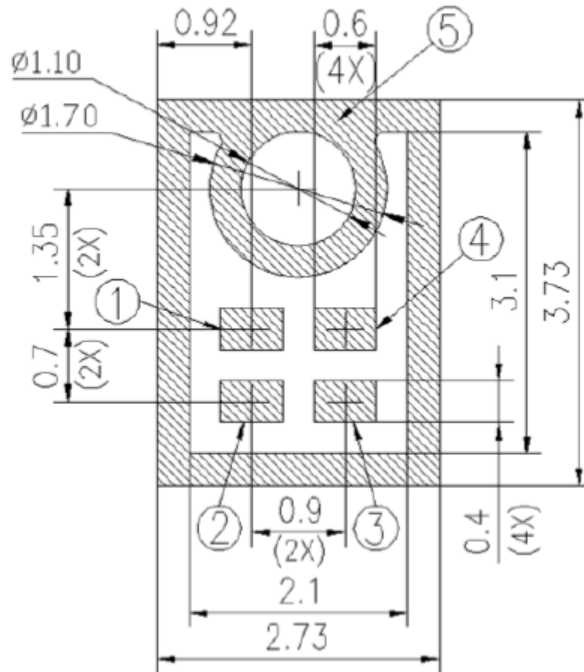
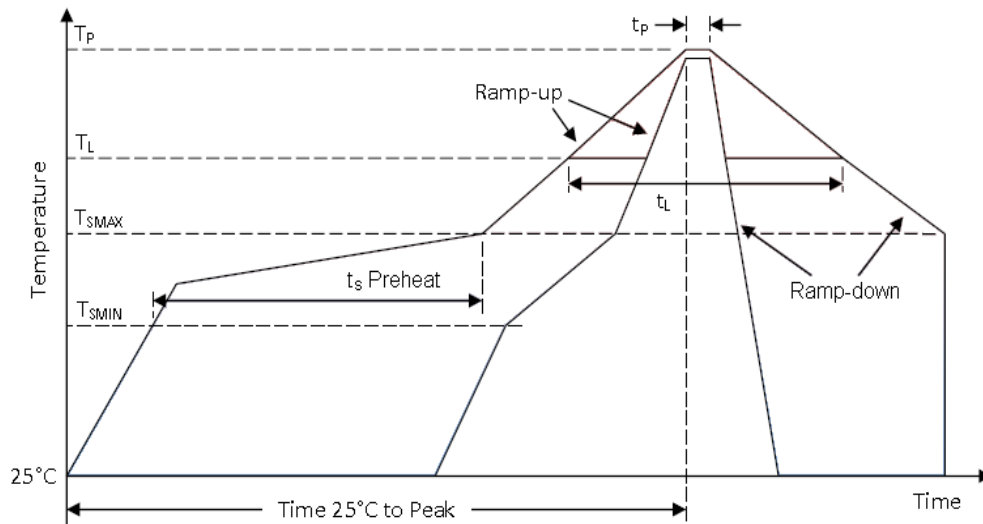


Figure 3. Recommended landing pattern on customers' PCB



## ● Reflow profile



### Recommended reflow profile limits

| Description   |   | Parameter (lead-free) |
|---|---|-----------------------|
| Average temperature change rate ( $T_{SMAX}$ to $T_P$ ) |   | 3°C/second max.       |
| Preheat   | Minimum temperature ( $T_{SMIN}$ )          | 150°C                 |
|   | Maximum temperature ( $T_{SMAX}$ )          | 200°C                 |
|   | Time ( $T_{SMIN}$ to $T_{SMAX}$ ) ( $t_s$ ) | 60-180 seconds        |
| Reflow  | Temperature ( $T_L$ )                       | 217°C                 |
|   | Time ( $t_L$ )                              | 60-150 seconds        |
| Peak temperature  | Temperature ( $T_P$ )                       | 260°C                 |
|   | Time ( $t_p$ )                              | 20-40 seconds         |
| Cooling rate ( $T_P$ to $T_{SMAX}$ )                    |   | 6°C/second max        |
| Time required from 25°C to peak temperature             |   | 8 minutes max         |

#### Notes:

- 1) The air speed during reflow process should be low to avoid impurity entering the acoustic hole during reflow process.
- 2) Do not wash or clean the product to avoid impurity entering the product.
- 3) Do not carry out the reflow process more than 5 times. If the melting point of solder is lower, the peak temperature should be accordingly reduced.

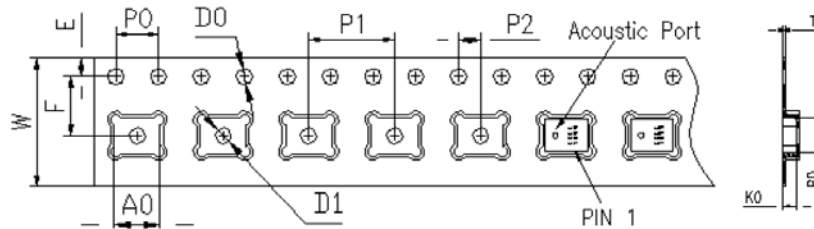


● Reliability index

| Test item                                    | Description  | Reference  |
|--|--|--|
| Test under constant temperature and humidity | 1,000 hours at +85°C/85% R.H. under bias   | JESD22-A101A-B   |
| Thermal shock                                | 100 cycles air-to-air thermal shock from -40°C to +125°C with 15minute soaks.  | IEC 68-2-4   |
| High temperature test                        | 1,000 hours at +105°C environment  | IEC 68-2-2   |
| Low temperature test                         | 1,000 hours at -40°C environment   | IEC 68-2-2   |
| Drop test                                    | Using 150g fixture, 3 drops along each of 6 axes from 1.5m height onto slippery marble floor   | IEC 68-2-27  |
| ESD  | 3 discharges of ±8 kV direct contact to lid while unit is grounded. 3 discharges of ±2 kV direct contact to I/O pins. 3 discharges of ±200 V direct contact to I/O pins. | MIL 883E, Method 3015.7<br>IEC 61000-4-2<br>ESD STM5.2 |
| Vibration test                               | 4 cycles of 20 to 2,000 Hz sinusoidal sweep with 20 G peak acceleration lasting 12 minutes in X, Y, and Z directions   | Mil-Std-883E, Method 2007.2 A                          |
| Reflow test                                  | 5 reflow cycles with peak temperature of +260°C  | -  |
| Mechanical Shock                             | 3 pulses of 10,000 G in the X, Y, and Z direction  | IEC 68-2-27, Test Ea                                   |

Notes: After reliability tests are performed, the sensitivity of the microphones shall not deviate more than 3 dB from its initial value. After 3 reflow cycles, the sensitivity of the microphone shall not deviate more than 3 dB from its initial value.

## ● Packaging and marking detail



|    |                   |    |                   |
|----|-------------------|----|-------------------|
| D0 | $1.5 \pm 0.1$ mm  | W  | $12.0 \pm 0.3$ mm |
| D1 | $1.5 \pm 0.1$ mm  | E  | $1.75 \pm 0.1$ mm |
| A0 | $4.2 \pm 0.1$ mm  | F  | $5.5 \pm 0.1$ mm  |
| B0 | $3.2 \pm 0.1$ mm  | P0 | $4.0 \pm 0.1$ mm  |
| K0 | $1.5 \pm 0.1$ mm  | P1 | $8.0 \pm 0.1$ mm  |
| T  | $0.3 \pm 0.05$ mm | P2 | $2.0 \pm 0.1$ mm  |

| Model Number       | Reel Diameter | Quantity Per Reel | Quantity Per Carton       |
|--------------------|---------------|-------------------|---------------------------|
| ML-2664-4030-DB1H2 | 13"           | 5,000             | $4,500 * 10 = 50,000$ Pcs |

Notes:

- 1) Dice are packaged in black carrier band which uses anti-electrostatic material.  
Each volume of packaged products is 5000 pcs.
- 2) The space between two dice is 8mm packaged in the carrier band with 12-mm width rolled in the reel of 13-inch diameter.
- 3) The first 50 pcs and the last 20 pcs are vacant.
- 4) The package requirements mentioned below is the company's standard delivery specifications. If you need special packages, please contact our sales staff.
- 5) All dimensions are in millimeters (mm) with tolerance of  $\pm 0.3$ mm.



## ● Materials Statement

- Meets the requirements of the European RoHS directive 2011/65/EC as amended.
- Meets the requirements of the industry standard IEC 61249-2-21:2003 for halogenated substances and SV SensTech Green Materials Standards Policy section on Halogen-Free.

## ● Remarks

- (A) MSL (moisture sensitivity level) Class 1.
- (B) Maximum of 3 reflow cycles is recommended.
- (C) In order to minimize device damage:
  - Do not board wash or clean after the reflow process.
  - Do not brush board with or without solvents after the reflow process.
  - Do not directly expose to ultrasonic processing, welding, or cleaning.
  - Do not insert any object in port hole of device at any time.
  - Do not apply over 30 psi of air pressure into the port hole.
  - Do not pull a vacuum over port hole of the microphone.
  - Do not apply a vacuum when repacking into sealed bags at a rate faster than 0.5 atm/sec.



## ● Version updates

| Version | Updated Content                        | Updated Date |
|---------|--|--------------|
| 1.0     | Initial release                        | 2019-12-09   |
| 1.1     | Update Current                         | 2020-7-10    |
| 1.2     | Update the packaging quantity per reel | 2021-4-22    |
|         |  |              |
|         |  |              |
|         |  |              |
|         |  |              |
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