

## Digital Silicon Microphone

### DESCRIPTION

The WM7210 is a low-profile silicon digital microphone. It offers high Signal to Noise Ratio (SNR) and low power consumption and is suited to a wide variety of consumer applications.

The WM7210 incorporates Wolfson's proprietary CMOS/MEMS membrane technology, offering high reliability and high performance in a miniature, low-profile package. The WM7210 is designed to withstand the high temperatures associated with automated flow solder assembly processes. (Note that conventional microphones can be damaged by this process.)

The WM7210 incorporates a high performance ADC, which outputs a single-bit Pulse Density Modulated (PDM) audio data stream. The WM7210 supports selectable left/right channel assignment for a two-channel digital microphone interface, enabling efficient connection of multiple microphones in stereo/array configurations.

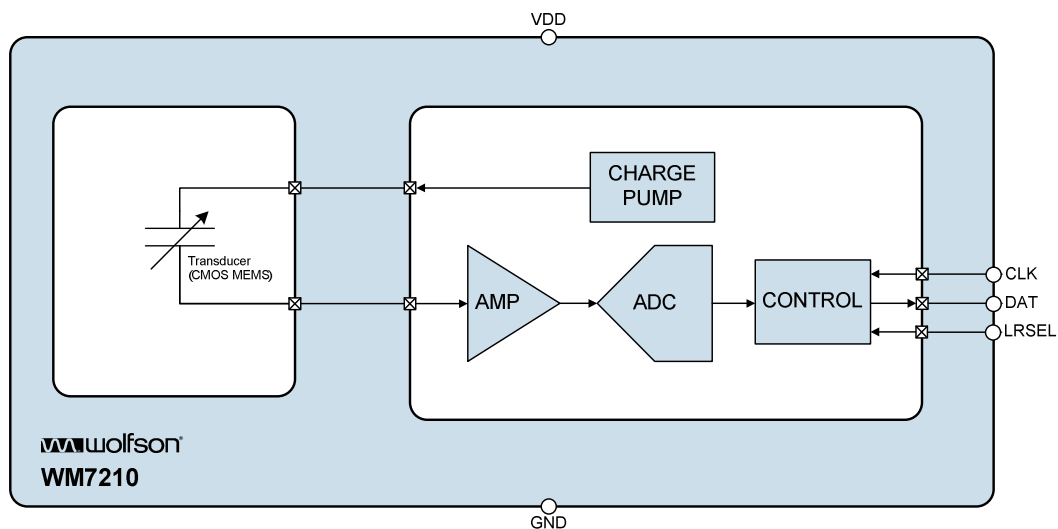
### FEATURES

- High SNR (58dB)
- Low power
  - Sleep mode - 10 $\mu$ A
  - Normal operation - 650 $\mu$ A
- Low profile packaging
- Support for automated flow solder assembly
- PDM digital audio output
- Stereo/array operation
- Proprietary ADC technology
  - Reduced clock jitter sensitivity
  - Low noise floor modulation
  - Stable in overload condition
- Top port package
- 1.64V to 3.7V supply
- 4 x 3 x 1mm thin package design

### APPLICATIONS

- Mobile telephone handsets
- Portable computers
- Portable media players
- Digital still cameras
- Digital video cameras
- Bluetooth headsets
- Portable navigation devices

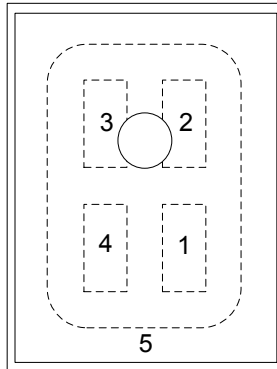
### BLOCK DIAGRAM



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## PIN CONFIGURATION



Top View

## PIN DESCRIPTION

| PIN | NAME  | TYPE           | DESCRIPTION   |
|-----|-------|----------------|---|
| 1   | VDD   | Supply         | Supply  |
| 2   | LRSEL | Digital Input  | Channel Select<br>0 = Data output following rising CLK edge<br>1 = Data output following falling CLK edge |
| 3   | CLK   | Digital Input  | Clock input   |
| 4   | DAT   | Digital Output | PDM Data Output   |
| 5   | GND   | Supply         | Ground  |

## ORDERING INFORMATION

| DEVICE       | DESCRIPTION                 | TEMPERATURE RANGE | MOISTURE SENSITIVITY LEVEL | PEAK SOLDERING TEMPERATURE |
|--------------|-----------------------------|-------------------|----------------------------|----------------------------|
| WM7210IMS/V  | Standard                    | -40 to +100°C     | MSL2A                      | +260°C                     |
| WM7210IMS/RV | Standard<br>(tape and reel) | -40 to +100°C     | MSL2A                      | +260°C                     |

**Note:**

Reel Quantity = 5700

All devices are Pb-free and Halogen free.

## ABSOLUTE MAXIMUM RATINGS

Absolute Maximum Ratings are stress ratings only. Permanent damage to the device may be caused by continuously operating at or beyond these limits. Device functional operating limits and guaranteed performance specifications are given under Electrical Characteristics at the test conditions specified.



ESD Sensitive Device. This device is manufactured on a CMOS process. It is therefore generically susceptible to damage from excessive static voltages. Proper ESD precautions must be taken during handling and storage of this device.

Wolfson tests its package types according to IPC/JEDEC J-STD-020 for Moisture Sensitivity to determine acceptable storage conditions prior to surface mount assembly. These levels are:

MSL1 = unlimited floor life at <30°C / 85% Relative Humidity. Not normally stored in moisture barrier bag.

MSL2 = out of bag storage for 1 year at <30°C / 60% Relative Humidity. Supplied in moisture barrier bag.

MSL2A = out of bag storage for 4 weeks at <30°C / 60% Relative Humidity. Supplied in moisture barrier bag.

MSL3 = out of bag storage for 168 hours at <30°C / 60% Relative Humidity. Supplied in moisture barrier bag.

The Moisture Sensitivity Level for each package type is specified in Ordering Information.

| CONDITION                                   | MIN                   | MAX    |
|---|-----------------------|--------|
| Supply Voltage                              | -0.3V                 | +4.2V  |
| Operating temperature range, T <sub>A</sub> | -40°C                 | +100°C |
| Storage temperature prior to soldering      | 30°C max / 60% RH max |        |
| Storage temperature after soldering         | -40°C                 | +100°C |

## IMPORTANT ASSEMBLY GUIDELINES

Do not put a vacuum over the port hole of the microphone. Placing a vacuum over the port hole can damage the device.

For information on recommended pick and place vacuum point, refer to the package dimension drawing.

Do not board wash the microphone after a re-flow process. Board washing and the associated cleaning agents can damage the device. Do not expose to ultrasonic cleaning methods.

Do not use vapour phase re-flow process. The vapour can damage the device.

## RECOMMENDED OPERATING CONDITIONS

| PARAMETER             | SYMBOL           | MIN  | TYP | MAX  | UNIT |
|-----------------------|------------------|------|-----|------|------|
| Analogue Supply Range | VDD              | 1.64 |     | 3.7  | V    |
| Ground                | GND              |      | 0   |      | V    |
| Clock Frequency       | F <sub>CLK</sub> | 1    |     | 3.25 | MHz  |

## ACOUSTIC AND ELECTRICAL CHARACTERISTICS

**Test Conditions:** VDD=1.8V, 1kHz test signal, CLK=2.4MHz, T<sub>A</sub> = 25°C

| PARAMETER                      | SYMBOL            | TEST CONDITIONS                  | MIN              | TYP  | MAX           | UNIT   |
|--------------------------------|-------------------|----------------------------------|------------------|------|---------------|--------|
| Directivity                    |                   |                                  | Omni-directional |      |               |        |
| Sensitivity                    | S                 | 94dB SPL input                   | -29              | -26  | -23           | dBFS   |
| Acoustic Overload              |                   | THD < 10%                        |                  | 120  |               | dB SPL |
| Signal to Noise Ratio          | SNR               | A-Weighted                       |                  | 58   |               | dB     |
| Total Harmonic Distortion      | THD               | 100dB SPL input                  |                  | 0.1  | 1             | %      |
| Frequency response             |                   | -3dB Low frequency               |                  | 35   |               | Hz     |
|                                |                   | +3dB High frequency              |                  | 8600 |               | Hz     |
| Acoustic Noise Floor           | ENL               | A-weighted                       |                  | 36   |               | dB SPL |
| Electrical Noise Floor         |                   | A-weighted                       |                  | -86  |               | dBFS   |
| Power Supply Rejection         | PSR               | 217Hz Square Wave<br>100mV pk-pk |                  | 70   |               | dBFS   |
| <b>Digital Input / Output</b>  |                   |                                  |                  |      |               |        |
| CLK Input HIGH Level           | V <sub>IH</sub>   |                                  | 0.65 x<br>VDD    |      |               | V      |
| CLK Input LOW Level            | V <sub>IL</sub>   |                                  |                  |      | 0.35 x<br>VDD | V      |
| DAT Output HIGH Level          | V <sub>OH</sub>   | I <sub>OH</sub> = +1mA           | 0.9 x<br>VDD     |      |               | V      |
| DAT Output LOW Level           | V <sub>OL</sub>   | I <sub>OL</sub> = -1mA           |                  |      | 0.1 x<br>VDD  | V      |
| Input capacitance (CLK)        | C <sub>IN</sub>   |                                  |                  | 5    |               | pF     |
| Maximum load capacitance (DAT) | C <sub>LOAD</sub> |                                  |                  |      | 100           | pF     |
| Input Leakage                  |                   |                                  |                  |      | 1             | µA     |
| Short Circuit Output Current   | I <sub>SC</sub>   | DAT connected to GND             |                  |      | 10            | mA     |
| <b>Miscellaneous</b>           |                   |                                  |                  |      |               |        |
| Current Consumption            | I <sub>VDD</sub>  | Active Mode                      |                  | 650  |               | µA     |
|                                |                   | SLEEP Mode                       |                  |      | 10            |        |
| Start-up Time                  |                   | From OFF                         |                  | 50   |               | ms     |
|                                |                   | From SLEEP                       |                  | 10   |               |        |
| CLK Sleep Frequency            |                   |                                  |                  |      | 1.0           | kHz    |

## TERMINOLOGY

- Sensitivity (dBFS) – Sensitivity is a measure of the microphone output in response to the acoustic pressure of a 1kHz 94dB SPL (1Pa) sine wave. This is referenced to the Full Scale Range (FSR) of the microphone.
- Signal-to-Noise Ratio (dB) – SNR is a measure of the difference in level between the output resulting from a 1kHz 94dB SPL sine wave and the idle noise output.
- Total Harmonic Distortion (dB) – THD is the level of the rms value of the sum of harmonic distortion products in the specified bandwidth (see note below) relative to the amplitude of the fundamental (ie. Test frequency) output.
- All performance measurements carried out with 20kHz brick wall filter and, where noted, an A-weighted filter. Failure to use such a filter will result in higher THD and lower SNR readings than are found in the Acoustic and Electrical Characteristics. The brick wall filter removes out of band noise; although it is not audible, it affects dynamic specification values.
- Sensitivity and Electrical Noise Floor are measured in dBFS, relative to Full Scale Range (FSR). Full scale range is the digital maximum full scale range reached when the part is excited by a 1kHz input test signal of 116dB SPL as the test signal reaches full-scale amplitude. In general this is the large possible undistorted signal that will fit in the numerical range. Because the definition of full scale range is based on a sine wave, it will be possible with square-wave test signals to achieve +3,01dBFS.
- SLEEP Mode is enabled when the CLK input is below the CLK Sleep Frequency noted above. This is a power-saving mode. Normal operation resumes automatically when the CLK input is above the CLK Sleep Frequency. Note that the VDD supply is still required in SLEEP mode.

## AUDIO INTERFACE TIMING

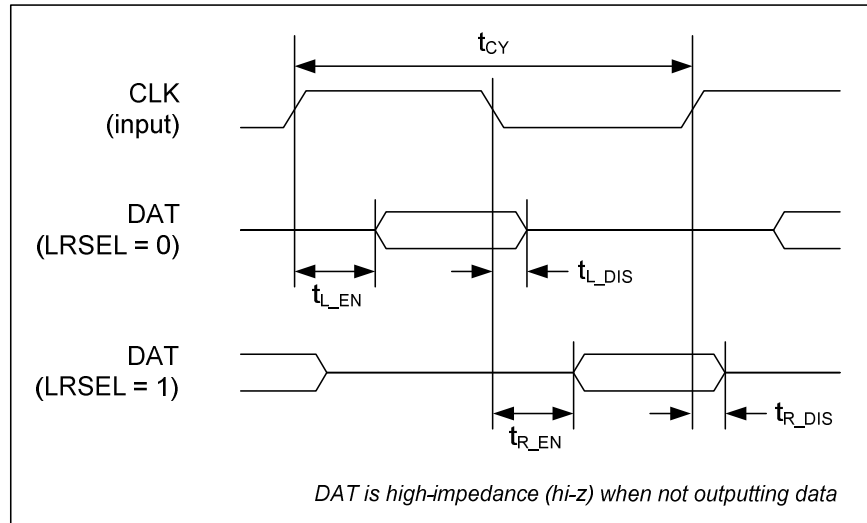


Figure 1 Digital Microphone Interface Timing

## Test Conditions

The following timing information is valid across the full range of recommended operating conditions.

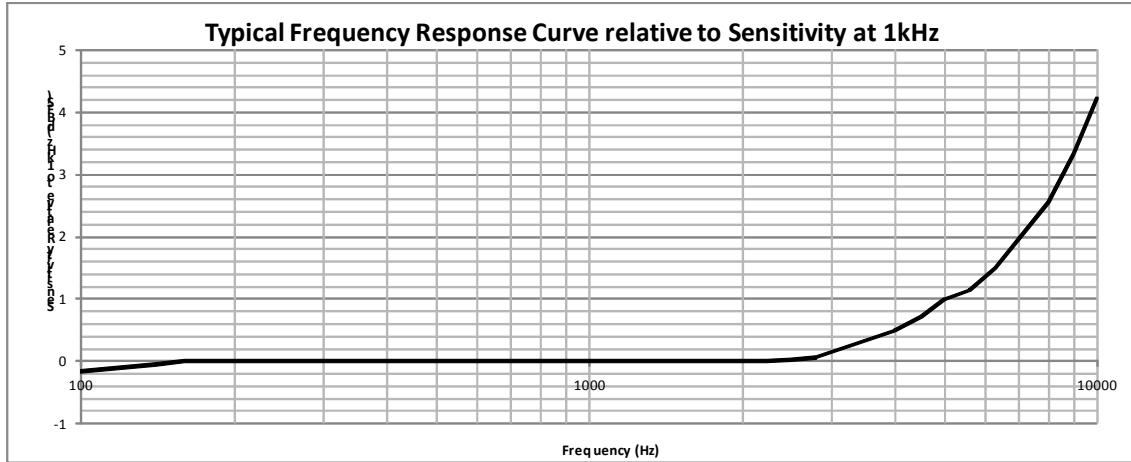
| PARAMETER                                     | SYMBOL       | MIN   | TYP | MAX   | UNIT |
|---|--------------|-------|-----|-------|------|
| <b>Digital Microphone Interface Timing</b>    |              |       |     |       |      |
| CLK cycle time                                | $t_{CY}$     | 325   |     | 976   | ns   |
| CLK duty cycle                                |              | 60:40 |     | 40:60 |      |
| DAT enable from rising CLK edge (LRSEL = 0)   | $t_{L\_EN}$  |       | 18  |       | ns   |
| DAT disable from falling CLK edge (LRSEL = 0) | $t_{L\_DIS}$ |       |     | 16    | ns   |
| DAT enable from falling CLK edge (LRSEL = 1)  | $t_{R\_EN}$  |       | 18  |       | ns   |
| DAT disable from rising CLK edge (LRSEL = 1)  | $t_{R\_DIS}$ |       |     | 16    | ns   |

The DAT output is high-impedance when not outputting data; this enables the outputs of two microphones to be connected together with the data from one microphone interleaved with the data from the other. (The microphones must be configured to transmit on opposite channels in this case.)

In a typical configuration, the Left channel is transmitted following the rising CLK edge (LRSEL = 0). In this case, the Left channel should be sampled by the receiving device on the falling CLK edge,

Similarly, the Right channel is typically transmitted following the falling CLK edge (LRSEL = 1). In this case, the Right channel should be sampled by the receiving device on the rising CLK edge.

### FREQUENCY RESPONSE CURVE



## APPLICATIONS INFORMATION

### RECOMMENDED EXTERNAL COMPONENTS

It is recommended to connect a 0.1 $\mu$ F decoupling capacitor between the VDD and GND pins of the WM7210. A ceramic 0.1 $\mu$ F capacitor with X7R dielectric or better is suitable. The capacitor should be placed as close to the WM7210 as possible.

### CONNECTION TO A WOLFSON AUDIO CODEC

Wolfson provides a range of audio CODECs incorporating a digital microphone input interface; these support direct connection to digital microphones such as the WM7210.

Stereo connection of two WM7210 digital microphones to the WM8903 CODEC is illustrated in Figure 2. Further information on the WM8903 is provided in the product datasheet, which is available from the Wolfson website. The equivalent connections can be made to other Wolfson devices supporting a digital microphone interface.

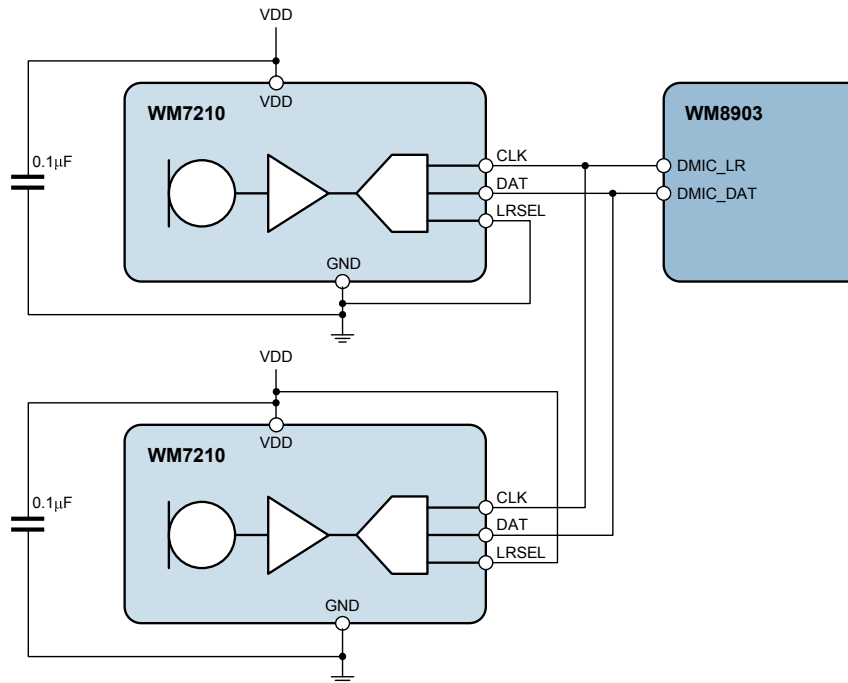
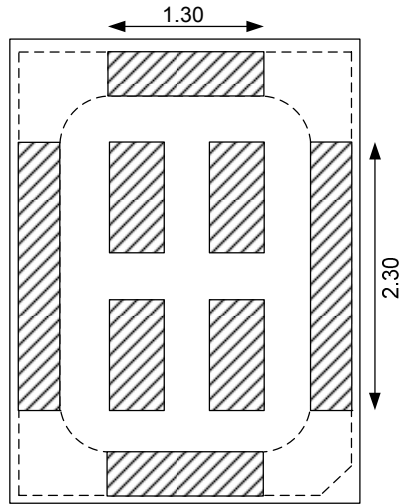


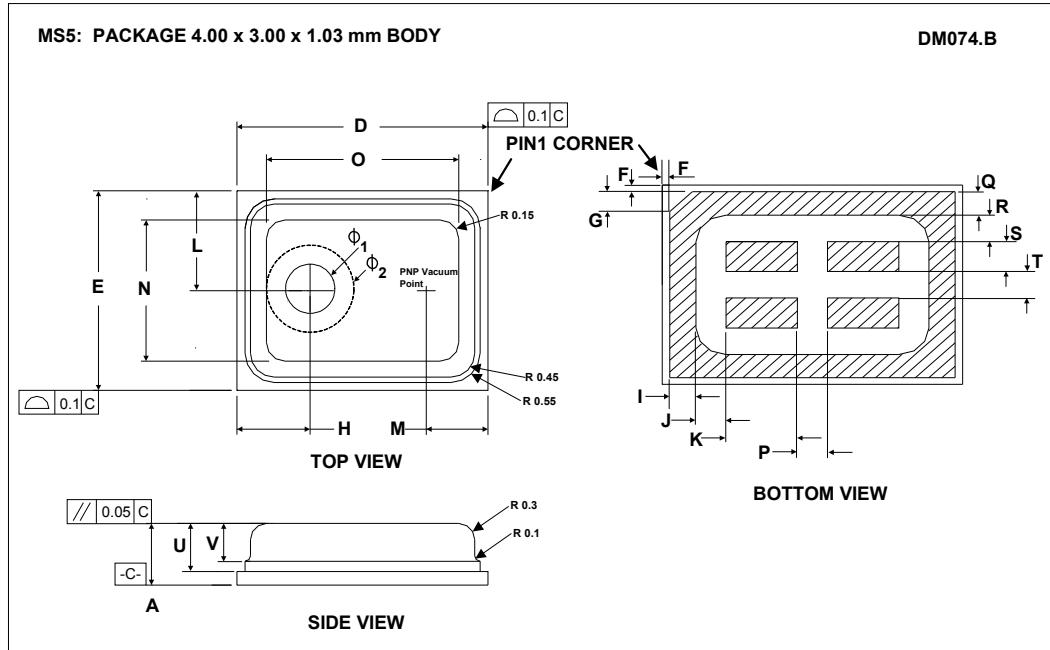
Figure 2 Stereo WM7210 Digital Microphone connection to WM8903



**RECOMMENDED PCB LAND PATTERNS****Figure 3 Recommended Customer PCB Land Pattern**

(Note that all other dimensions can be obtained from the package dimensions)

PACKAGE DIMENSIONS



| Symbols | Dimensions (mm) |      |      | NOTE |
|---------|-----------------|------|------|------|
|         | MIN             | NOM  | MAX  |      |
| A       | 0.96            | 1.03 | 1.10 |      |
| D       | 3.90            | 4.00 | 4.10 |      |
| E       | 2.90            | 3.00 | 3.10 |      |
| F       | 0.05            | 0.10 | 0.15 |      |
| G       | 0.25            | 0.30 | 0.35 |      |
| H       |                 | 1.50 |      |      |
| I       | 0.30            | 0.35 | 0.40 |      |
| J       | 0.35            | 0.40 | 0.45 |      |
| K       | 0.90            | 0.95 | 1.00 |      |
| L       |                 | 1.50 |      |      |
| M       |                 | 1.10 |      |      |
| N       |                 | 1.95 |      |      |
| O       |                 | 2.95 |      |      |
| P       | 0.35            | 0.40 | 0.45 |      |
| Q       | 0.30            | 0.35 | 0.35 |      |
| R       | 0.35            | 0.40 | 0.45 |      |
| S       | 0.40            | 0.45 | 0.50 |      |
| T       | 0.35            | 0.40 | 0.45 |      |
| U       | 0.76            | 0.79 | 0.82 |      |
| V       |                 | 0.64 |      |      |
| ø1      | 0.65            | 0.70 | 0.75 |      |
| ø2      |                 | 1.31 |      |      |

NOTES:  
 1. THE SEATING PLANE IS REPRESENTED BY PRIMARY DATUM -C-  
 2. THE DEVIATION FROM THE SEATING PLANE DUE TO WARPAGE OR TWIST IS SPECIFIED AS MAX 50µm (FLATNESS).  
 3. LID SHOULD BE PARALLEL TO THE SEATING PLANE ±50µm.

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