

## Top Port Analogue Silicon Microphone

### DESCRIPTION

The WM7121P is a low-profile silicon analogue microphone. It offers high Signal to Noise Ratio (SNR) and low power consumption and is suited to a wide variety of consumer applications.

The WM7121P incorporates Wolfson's proprietary CMOS/MEMS membrane technology, offering high reliability and high performance in a miniature, low-profile package. The WM7121P 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 WM7121P Top Port microphone offers matched performance to the WM7132P Bottom Port microphone. The matched characteristics enable highly accurate sound pick-up in opposite directions, suitable for noise cancellation and other DSP algorithms.

The WM7121PE variant offers a tighter tolerance on the microphone sensitivity, giving reduced variation between parts. This removes the need for in-line production calibration of part-to-part microphone variations.

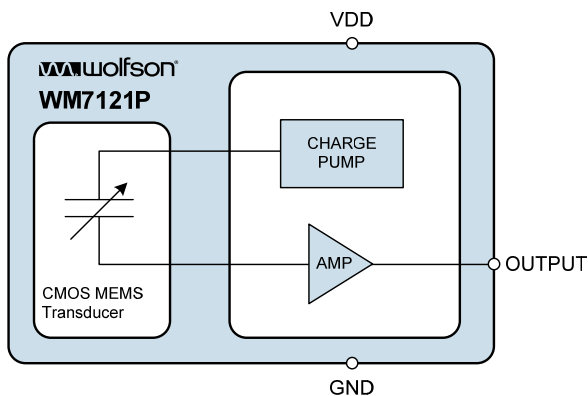
### FEATURES

- High SNR (65dB)
- Low variation in sensitivity
  - $\pm 3\text{dB}$  tolerance (WM7121P)
  - $\pm 1\text{dB}$  tolerance (WM7121PE)
- Matched pair with Bottom Port microphone WM7132P
  - Matched sensitivity, roll-off, and phase response
- Low current consumption (190 $\mu\text{A}$ )
- Analogue output
- Top Port LGA Package
- 1.5V to 3.7V supply

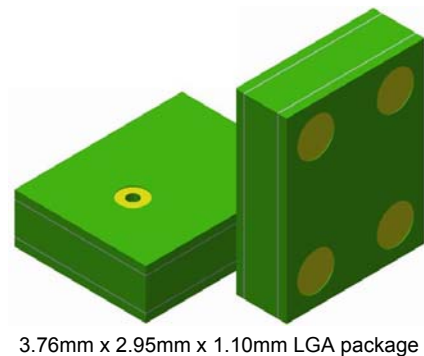
### APPLICATIONS

- Mobile phone handsets
- Portable media players
- Digital still cameras
- Digital video cameras
- Bluetooth headsets
- Portable navigation devices
- Portable games consoles

### BLOCK DIAGRAM

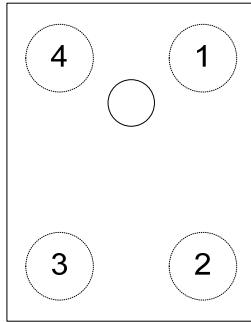


### 3D VIEW



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**PIN CONFIGURATION**

Top View

**PIN DESCRIPTION**

PIN	NAME	TYPE	DESCRIPTION
1	VDD	Supply	Analogue Supply
2	GND	Supply	Analogue ground
3	GND	Supply	Analogue ground
4	OUTPUT	Analogue Output	Microphone analogue output signal

**ORDERING INFORMATION**

DEVICE	DESCRIPTION	TEMPERATURE RANGE	MOISTURE SENSITIVITY LEVEL	PEAK SOLDERING TEMPERATURE
WM7121PIMS/RV	Standard (tape and reel)	-40 to +100°C	MSL2A	+260°C
WM7121PIMSE/RV	Enhanced (tape and reel)	-40 to +100°C	MSL2A	+260°C

**Note:**

Reel quantity = 5000

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 <math>30^{\circ}\text{C}</math> / 85% Relative Humidity. Not normally stored in moisture barrier bag.

MSL2 = out of bag storage for 1 year at <math>30^{\circ}\text{C}</math> / 60% Relative Humidity. Supplied in moisture barrier bag.

MSL2A = out of bag storage for 4 weeks at <math>30^{\circ}\text{C}</math> / 60% Relative Humidity. Supplied in moisture barrier bag.

MSL3 = out of bag storage for 168 hours at <math>30^{\circ}\text{C}</math> / 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 (VDD)	-0.3V	+4.2V
Operating temperature range, $T_A$	-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.

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 a vapour phase re-flow process. The vapour can damage the device.

Please refer to application note WAN0273 (MEMS MIC Assembly and Handling Guidelines) for further assembly and handling guidelines.

## RECOMMENDED OPERATING CONDITIONS

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT
Analogue Supply Range	VDD	1.5		3.7	V
Ground	GND		0		V

## ACOUSTIC AND ELECTRICAL CHARACTERISTICS

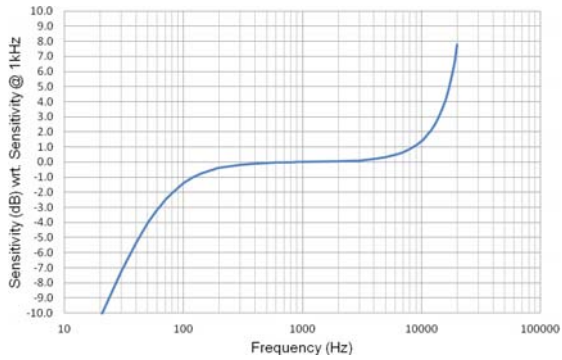
**Test Conditions:** VDD=2.1V, 1kHz test signal, T<sub>A</sub> = 25°C, unless otherwise stated.

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Directivity			Omni-directional			
Polarity		Positive sound pressure	Positive output voltage			
Sensitivity (WM7121P)	S	94dB SPL	-41	-38	-35	dBV
Sensitivity (WM7121PE)	S	94dB SPL	-39	-38	-37	dBV
Acoustic Overload		No Load, THD < 10%		126		dB SPL
Total Harmonic Distortion	THD	100dB SPL		0.1	1	%
		114dB SPL		0.2		
		122dB SPL		1		
Signal to Noise Ratio	SNR	A-weighted		65		dB
Dynamic Range	DR	A-weighted		93		dB
Frequency Response		-3dB low frequency		62		Hz
		+3dB high frequency		15000		
Frequency Response Flatness		200Hz to 6kHz	-1		+1	dB
Acoustic Noise Floor		A-weighted		29		dB SPL
Electrical Noise Floor		A-weighted		-103		dBV
Power Supply Rejection Ratio	PSRR	217Hz sine wave, 100mV (peak-peak)		46		dB
Power Supply Rejection	PSR	217Hz square wave, 100mV (peak-peak)		-72		dBV
Current Consumption	I <sub>VDD</sub>			190	240	μA
Output DC Impedance	Z <sub>OUT</sub>			55	150	Ω

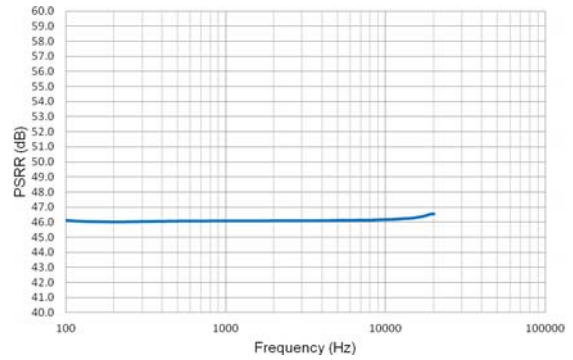
## TERMINOLOGY

- Sensitivity (dBV) – Sensitivity is a measure of the microphone output response to the acoustic pressure of a 1kHz 94dB SPL (1Pa RMS) sine wave.
- Total Harmonic Distortion (%) – THD is the ratio of the RMS sum of the harmonic distortion products in the specified bandwidth (see note below) relative to the amplitude of the fundamental (ie. test frequency) output.
- Signal-to-Noise Ratio (dB) – SNR is a measure of the difference in level between the output response of a 1kHz 94dB SPL sine wave and the idle noise output.
- Dynamic Range (dB) – DR is the ratio of the 1% THD microphone output level (in response to a sine wave input) and the idle noise output level.
- All performance measurements are carried out within a 20Hz to 20kHz bandwidth and, where noted, an A-weighted filter. Failure to use these filters will result in higher THD and lower SNR values than are found in the Acoustic and Electrical Characteristics. The low pass filter removes out of band noise.

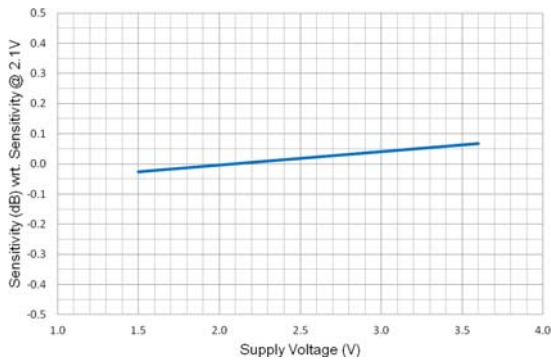
**TYPICAL PERFORMANCE**



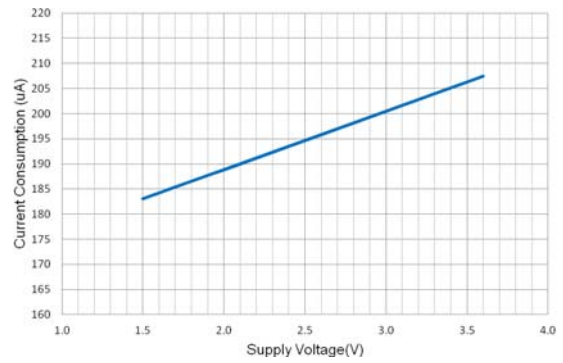
**Sensitivity vs. Frequency**



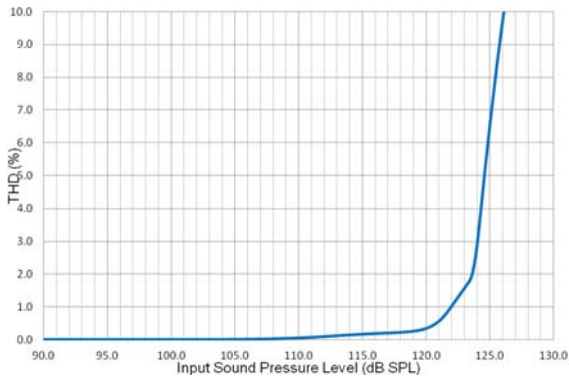
**PSRR vs. Frequency**



**Sensitivity vs. Supply Voltage**



**Current Consumption vs. Supply Voltage**



**THD vs. Sound Pressure Level**

## APPLICATIONS INFORMATION

### RECOMMENDED EXTERNAL COMPONENTS

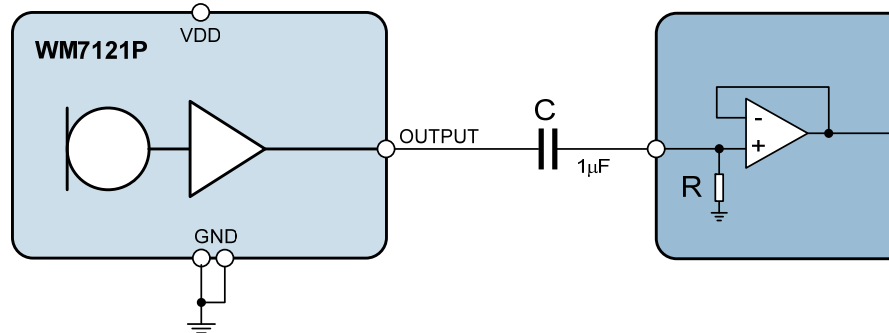


Figure 1 WM7121P Recommended External Components

A DC-blocking output capacitor is required on the OUTPUT pin, as illustrated in Figure 1. A single capacitor is required for a single-ended connection. The capacitor must be correctly selected as it affects the cut-off frequency of the output path. A low cut-off frequency is desirable as it means there is no significant filtering of the audio bandwidth.

The 3dB cut-off frequency of the output path is given by the equation below, where C is the output capacitance and R is the input resistance of the other circuit.

$$3\text{dB filter roll-off frequency} = \frac{1}{2\pi RC}$$

A typical recommended configuration, with 1µF DC-blocking capacitor and 20kΩ minimum input circuit impedance, gives a 3dB cut-off frequency of 10Hz or less. Tantalum electrolytic capacitors are particularly suitable for the DC-blocking components as they offer high stability in a small package size.

### OPTIMISED SYSTEM RF DESIGN

For optimised RF design please refer to document WAN0278 (Recommended PCB Layout for Microphone RF Immunity in Mobile Cell Phone Applications) for further information.

## CONNECTION TO A WOLFSON CODEC

Wolfson provides a range of audio CODECs incorporating an analogue microphone input interface; these support connection to silicon microphones such as the WM7121P.

The recommended connection of a WM7121P silicon microphone is illustrated in Figure 2 (for single-ended mode) and Figure 3 (for pseudo-differential mode).

A DC blocking capacitor is required, as described in the previous section. A 2.2 $\mu$ F decoupling capacitor is also recommended; this should be positioned close to the VDD pin of the WM7121P.

Further information on Wolfson audio CODECs is provided in the respective product datasheet, which is available from the Wolfson website.

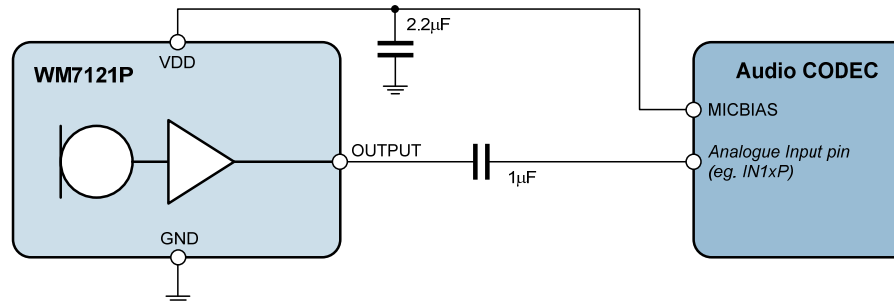


Figure 2 WM7121P Silicon Microphone Single-ended Connection

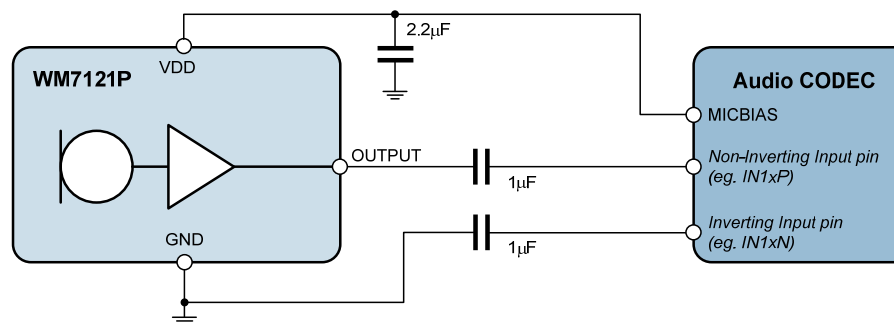


Figure 3 WM7121P Silicon Microphone Pseudo-differential Connection

## MATCHED MICROPHONE PAIRS

The WM7121P Top Port microphone offers matched performance to the WM7132P Bottom Port microphone. The 'enhanced' variants, WM7121PE and WM7132PE, offer an even greater level ( $\pm 1$ dB) of sensitivity performance matching.

Matched microphone pairs are ideal for accurate sound pick-up from opposite directions in slim, low-profile applications. For best acoustic matching, the Top Port and Bottom Port microphones should be positioned close together, on the same side of the PCB.

The WM7121P and WM7132P microphones offer matched sensitivity, low-frequency roll-off, and phase response characteristics, enabling simplified system design when using these complementary devices.



## PCB LAND PATTERN AND PASTE STENCIL

The recommended PCB Land Pattern and Paste Stencil Pattern for the WM7121P microphone are shown in Figure 4 and Figure 5.

See also Application Note WAN0284 (General Design Considerations for MEMS Microphones) for further details of PCB footprint design.

Full definition of the package dimensions is provided in the "Package Dimensions" section.

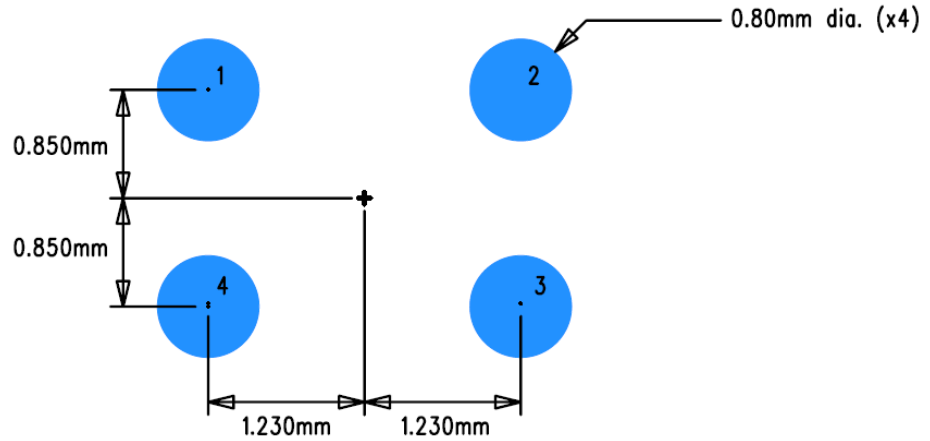


Figure 4 DM124 - PCB Land Pattern, Top View

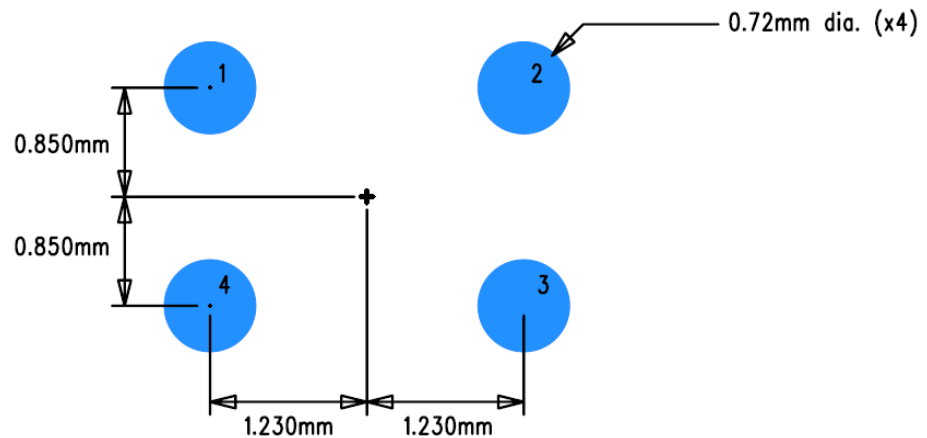
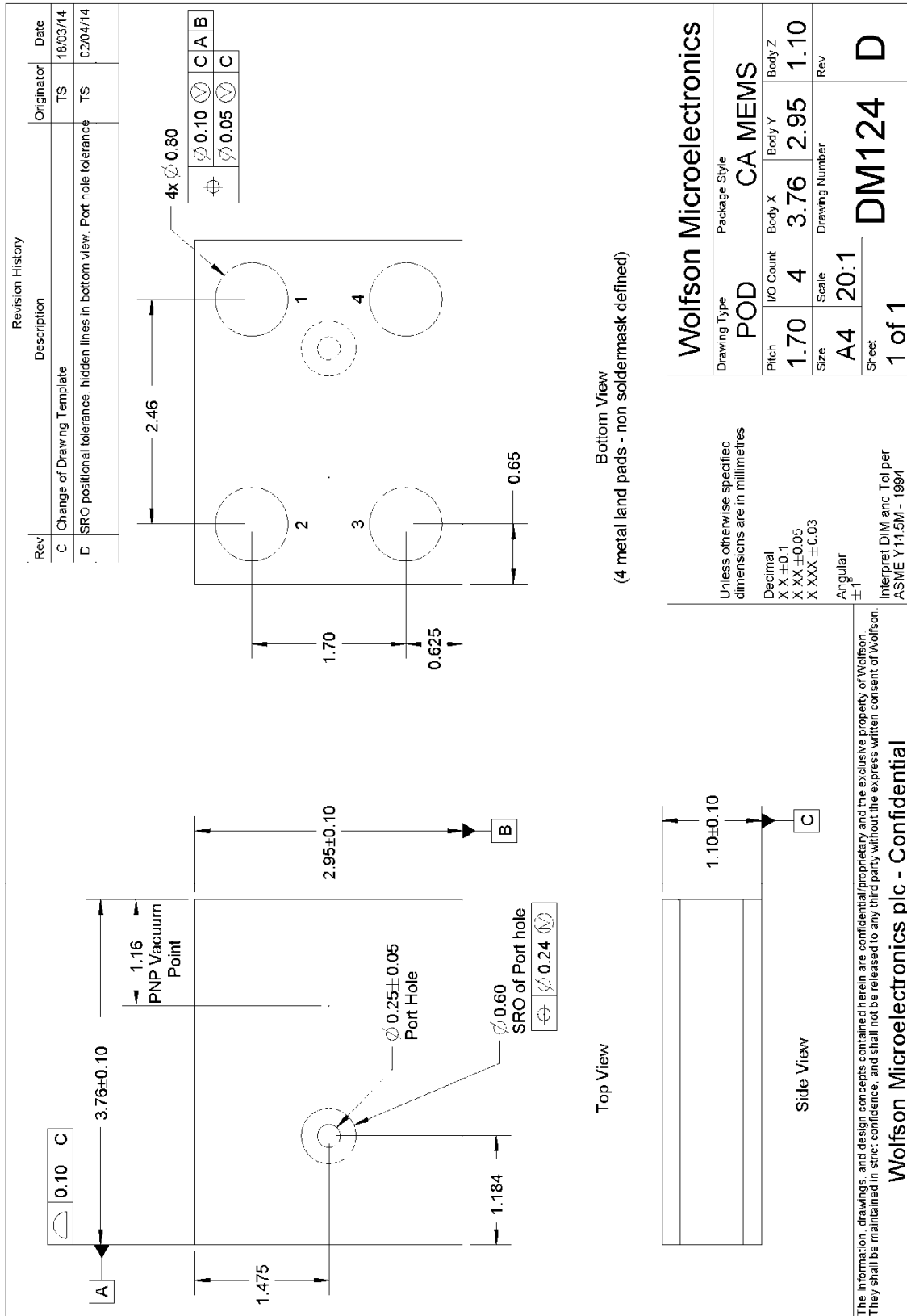


Figure 5 DM124 - Paste Stencil Pattern, Top View

PACKAGE DIMENSIONS



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**REVISION HISTORY**

<b>DATE</b>	<b>REV</b>	<b>DESCRIPTION OF CHANGES</b>	<b>PAGE</b>	<b>CHANGED BY</b>
26/02/14	1.0	First Release		IS
25/03/14	2.0	Formatting and miscellaneous updates throughout document	1-9	PH
		Electrical Characteristics updated	5	
		Package Outline Drawing updated	10	
13/06/14	3.0	Electrical Characteristics updated	5	PH
		Typical Performance graphs added	6	
		PCB Stencil drawings updated	9	
		Package Outline Drawing updated	10	

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