T4086

Analog MEMS Microphone

GENERAL DESCRIPTION

The T4086 is an analog MEMS microphone with high SNR in small package size. The T4086 includes a MEMS microphone element, an impedance converter, and an output amplifier.

Other high-performance specifications include 127 dB SPL acoustic overload point, tight ±1 dB sensitivity tolerance and enhanced immunity to both radiated and conducted RF interference.

The T4086 is available in a small 2.75 mm × 1.85 mm × 0.9 mm bottom port surface-mount package.

APPLICATIONS

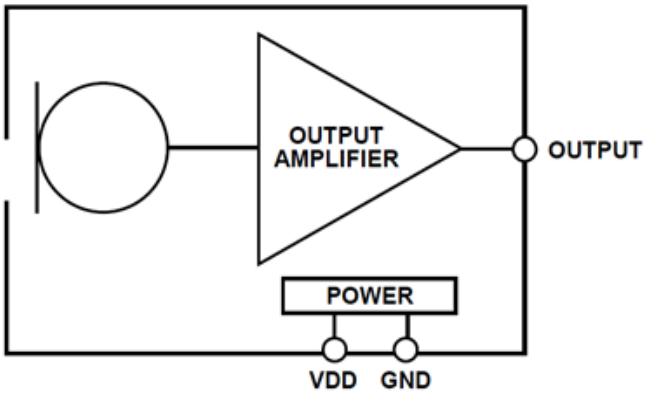
- Mobile phones
- Headsets
- Still and video cameras
- IoT devices

FEATURES

SPEC	PERFORMANCE
SNR	62 dBA
Current	140 µA
AOP	127 SPL

- Single ended, non-inverting analog output
- −38 dBV sensitivity
- ±1 dB sensitivity tolerance
- Frequency response from 95 Hz to 20 kHz
- Enhanced RF immunity
- −98 dBV(A) PSRR
- 2.75 × 1.85 × 0.9 mm surface-mount package
- Compatible with Pb-free solder processes
- RoHS compliant

FUNCTIONAL BLOCK DIAGRAM



ORDERING INFORMATION

PART	TEMP RANGE	PACKAGING
MMICT4086-00-908	-40°C to +85°C	330mm Tape and Reel
EV_T4086-FX	—	

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TABLE OF CONTENTS

Document Number: DS-000365
Revision: 1.1

SPECIFICATIONS

TABLE 1. ELECTRICAL CHARACTERISTICS

T_A = 25°C, V_{DD} = 1.8 V, unless otherwise noted. Typical specifications are not guaranteed.

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS	NOTES
PERFORMANCE						
Directionality			Omni			
Output Polarity			Non-Inverted			
Sensitivity	1 kHz, 94 dB SPL	−39	−38	−37	dBV	
Signal-to-Noise Ratio (SNR)	20 kHz bandwidth, A-weighted	60	62		dBA	
Equivalent Input Noise (EIN)	20 kHz bandwidth, A-weighted		32		dBA SPL	
Dynamic Range	Derived from EIN and acoustic overload point		95		dB	
Total Harmonic Distortion (THD)	115 dB SPL, 1kHz		1	2	%	
Power Supply Rejection Ratio (PSRR)	1 kHz, 200 mV p-p sine wave superimposed on V_{DD} = 1.8 V	65	75		dB	
Power Supply Rejection (PSR)	217 Hz, 200 mV p-p square wave superimposed on V_{DD} = 1.8 V		−98		dBV(A)	
Acoustic Overload Point	10% THD		127		dB SPL	
POWER SUPPLY						
Supply Voltage (V_{DD})	Standard mode	1.6		3.6	V	
Supply Current (I_S)	V_{DD} = 1.8 V		140	160	µA	
OUTPUT CHARACTERISTICS						
Output Impedance			250		Ω	
Output DC voltage			740		mV	
Startup Time	Output to within ±0.5 dB of stable sensitivity			30	ms	

ABSOLUTE MAXIMUM RATINGS

Stress above those listed as Absolute Maximum Ratings may cause permanent damage to the device. These are stress ratings only and functional operation of the device at these conditions is not implied. Exposure to the absolute maximum ratings conditions for extended periods may affect device reliability.

TABLE 2. ABSOLUTE MAXIMUM RATINGS

PARAMETER	RATING
Supply Voltage (V_{DD})	0 V to 5 V
Temperature Range	
Operating	−40°C to +85°C
Storage	−40°C to +125°C
Mechanical shock	10,000 g
ESD capability MM	200 V any pin according to JESD22-A115A.
ESD capability HBM	2,000 V any pin according to JESD22-A114E.

ESD CAUTION

ESD (electrostatic discharge) sensitive device. Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore proper ESD precautions should be taken to avoid performance degradation or loss of functionality.

Document Number: DS-000365
Revision: 1.1

SOLDERING PROFILE

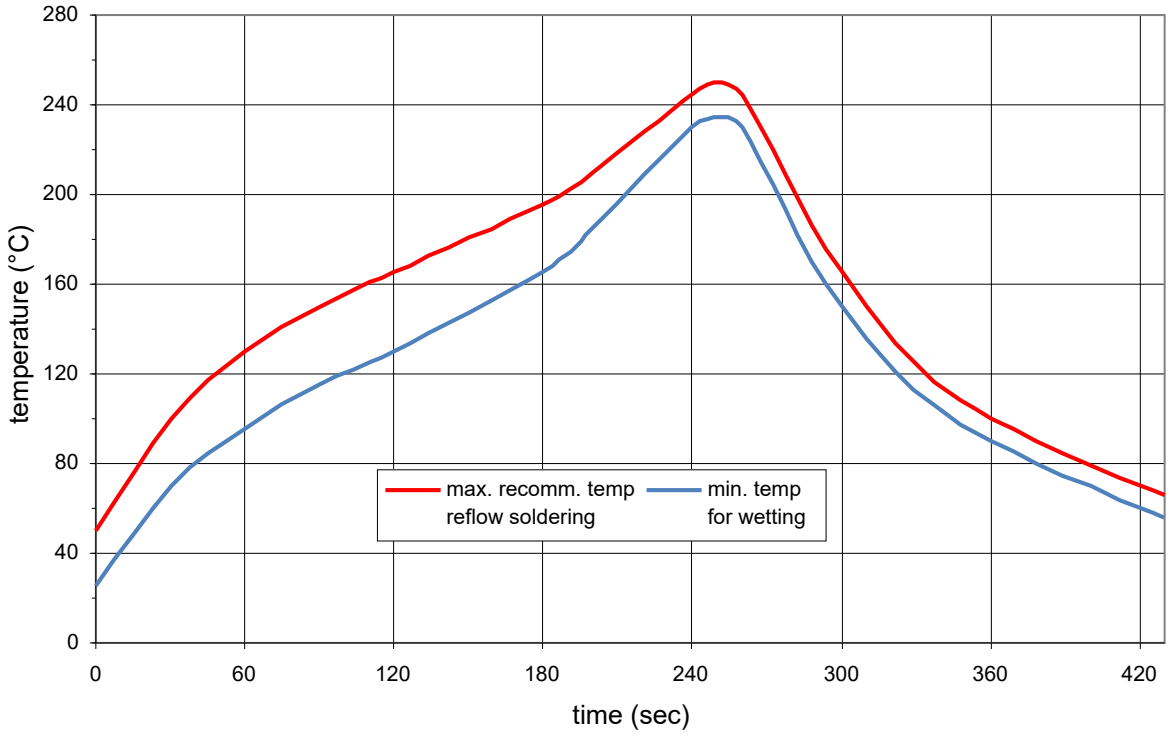

Figure 1. Recommended Soldering Profile Limits

TABLE 3. RECOMMENDED SOLDERING PROFILE

PROFILE FEATURE	Pb-Free
Ramp rate	≤ 3 K/s
Preheat	125°C to 220°C, 150 s to 210 s, 0.4 K/s to 1.0 K/s
T > 220°C	30 s to 70 s
T > 230°C	Min. 10 s
T > 245°C	Max. 20 s
T ≥ 255°C	–
Peak temperature T_{peak}	250°C +0/-5°C
Wetting temperature T_{min}	230°C +5/-0°C for 10 s ± 1 s
Cooling rate	≤ 3 K/s
Soldering temperature T	Measured at solder pads

Document Number: DS-000365
Revision: 1.1

PIN CONFIGURATIONS AND FUNCTION DESCRIPTIONS

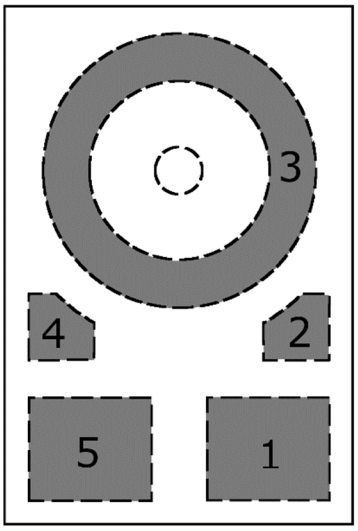

Figure 2. Pin Configuration (Top View, Terminal Side Down)

TABLE 4. PIN FUNCTION DESCRIPTIONS

PIN	NAME	FUNCTION
1	OUT	Output
2	KOA	keep out area, no structure on PCB recommended
3	GND	Ground
4	KOA	keep out area, no structure on PCB recommended
5	VDD	Supply Voltage

TYPICAL PERFORMANCE CHARACTERISTICS

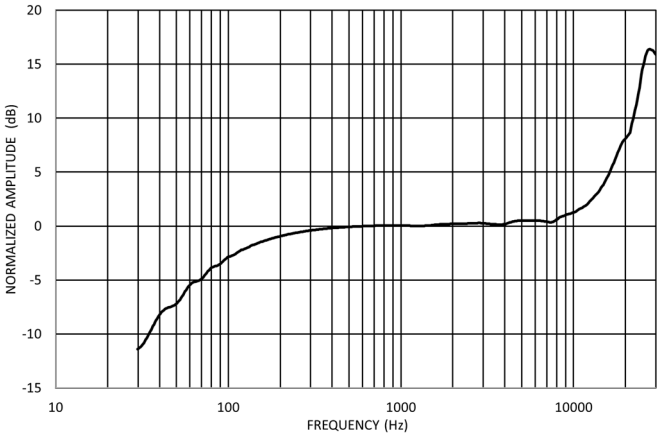

Figure 3. Typical Frequency Response (Measured)

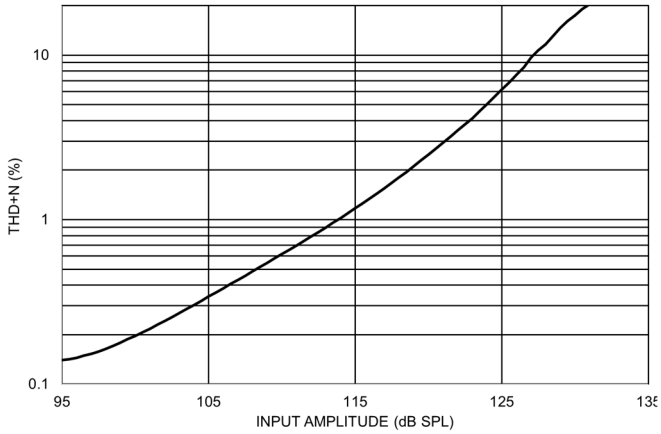

Figure 4. THD + N vs. Input Amplitude, 1kHz

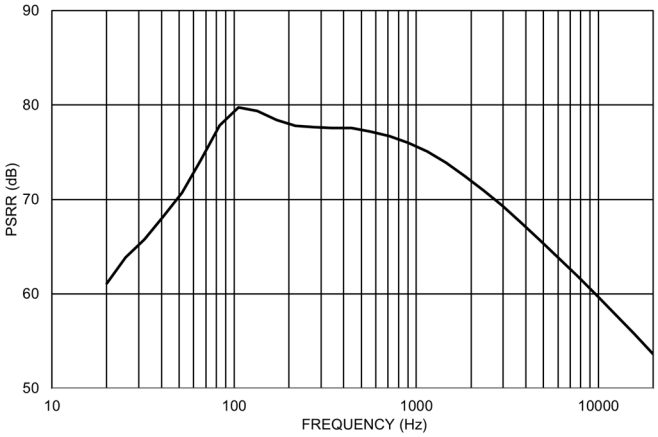

Figure 5. Power-Supply Rejection Ratio (PSRR) vs. Frequency

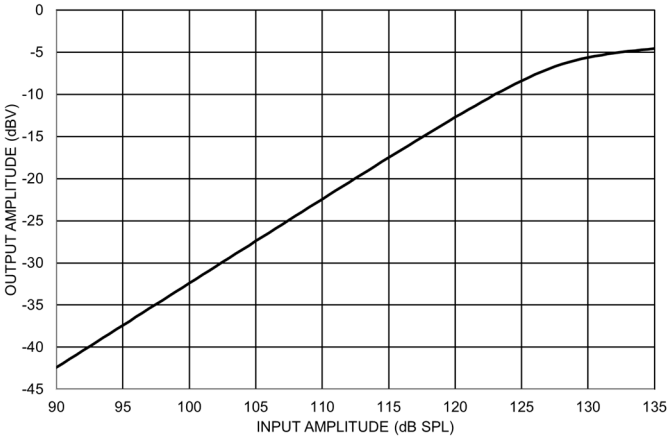

Figure 6. Linearity

Document Number: DS-000365
Revision: 1.1

APPLICATIONS INFORMATION

CODEC CONNECTION

The T4086 output can be connected to a dedicated codec microphone input (see Figure 7) or to a high input impedance gain stage. A 0.1 µF ceramic capacitor placed close to the T4086 supply pin is used for testing and is recommended to adequately decouple the microphone from noise on the power supply. A dc blocking capacitor is required at the output of the microphone. This capacitor creates a high-pass filter with a corner frequency at

$$f_C = 1/(2\pi \times C \times R)$$

where *R* is the input impedance of the codec.

A minimum value of 2.2 µF is recommended in Figure 7 for codecs, which may have a very low input impedance at some PGA gain settings.

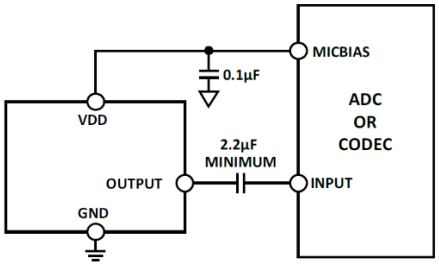

Figure 7. T4086 Connected to a Single-Ended-Input Codec

Document Number: DS-000365
Revision: 1.1

SUPPORTING DOCUMENTS

For additional information, see the following documents.

EVALUATION BOARD USER GUIDE

AN-000013, *Analog Output MEMS Microphone Flex Evaluation Board User Guide*

APPLICATION NOTES

AN-100, *MEMS Microphone Handling and Assembly Guide*
AN-1003, *Recommendations for Mounting and Connecting the InvenSense Bottom-Ported MEMS Microphones*
AN-1112, *Microphone Specifications Explained*
AN-1124, *Recommendations for Sealing InvenSense Bottom-Port MEMS Microphones from Dust and Liquid Ingress*
AN-1140, *Microphone Array Beamforming*
AN-1165, *Op Amps for Microphone Preamp Circuits*
AN-000161, *ESD Design and Test Guidelines for MEMS Microphones*

PCB DESIGN AND LAND PATTERN LAYOUT

Lay out the PCB land pattern for the T4086 at a 1:1 ratio to the solder pads on the microphone package (see Figure 8.) Take care to avoid applying solder paste to the sound hole in the PCB. Figure 9 shows a suggested solder paste stencil pattern layout.
The response of the T4086 is not affected by the PCB hole size, as long as the hole is not smaller than the sound port of the microphone (0.25 mm in diameter). A 0.5 mm to 1 mm diameter for the hole is recommended.

Align the hole in the microphone package with the hole in the PCB. The exact degree of the alignment does not affect the performance of the microphone as long as the holes are not partially or completely blocked.

Note: All dimensions in mm unless otherwise stated.

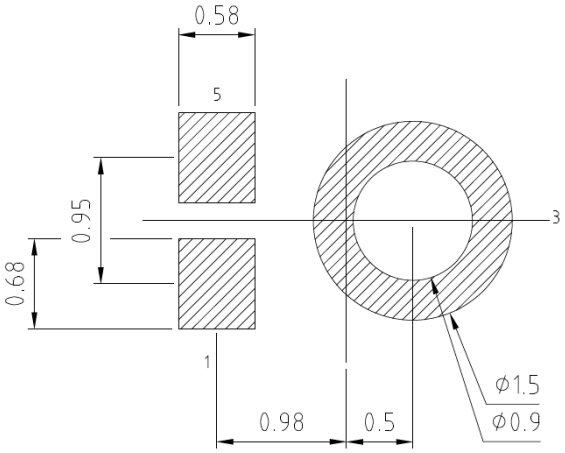

Figure 8. Recommended PCB Land Pattern Layout

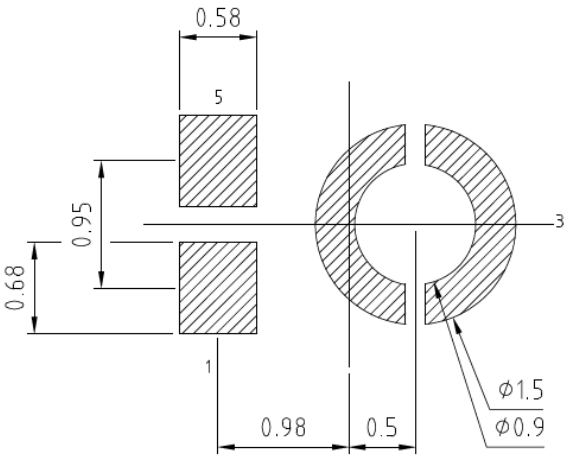

Figure 9. Recommended Solder Paste Stencil Pattern Layout

PCB MATERIAL AND THICKNESS

The performance of the T4086 is not affected by PCB thickness. The T4086 can be mounted on either a rigid or flexible PCB. A flexible PCB with the microphone can be attached directly to the device housing with an adhesive layer. This mounting method offers a reliable seal around the sound port while providing the shortest acoustic path for good sound quality.

HANDLING INSTRUCTIONS

PICK AND PLACE EQUIPMENT

The MEMS microphone can be handled using standard pick-and-place and chip shooting equipment. Take care to avoid damage to the MEMS microphone structure as follows:

- Use a standard pickup tool to handle the microphone. Because the microphone hole is on the bottom of the package, the pickup tool can make contact with any part of the lid surface.
- Do not pick up the microphone with a vacuum tool that makes contact with the bottom side of the microphone. Do not pull air out of or blow air into the microphone port.
- Do not use excessive force to place the microphone on the PCB.

REFLOW SOLDER

For best results, the soldering profile must be in accordance with the recommendations of the manufacturer of the solder paste used to attach the MEMS microphone to the PCB. It is recommended that the solder reflow profile not exceed the limit conditions specified in Figure 1 and Table 3.

BOARD WASH

When washing the PCB, ensure that water does not make contact with the microphone port. Do not use blow-off procedures or ultrasonic cleaning.

OUTLINE DIMENSIONS

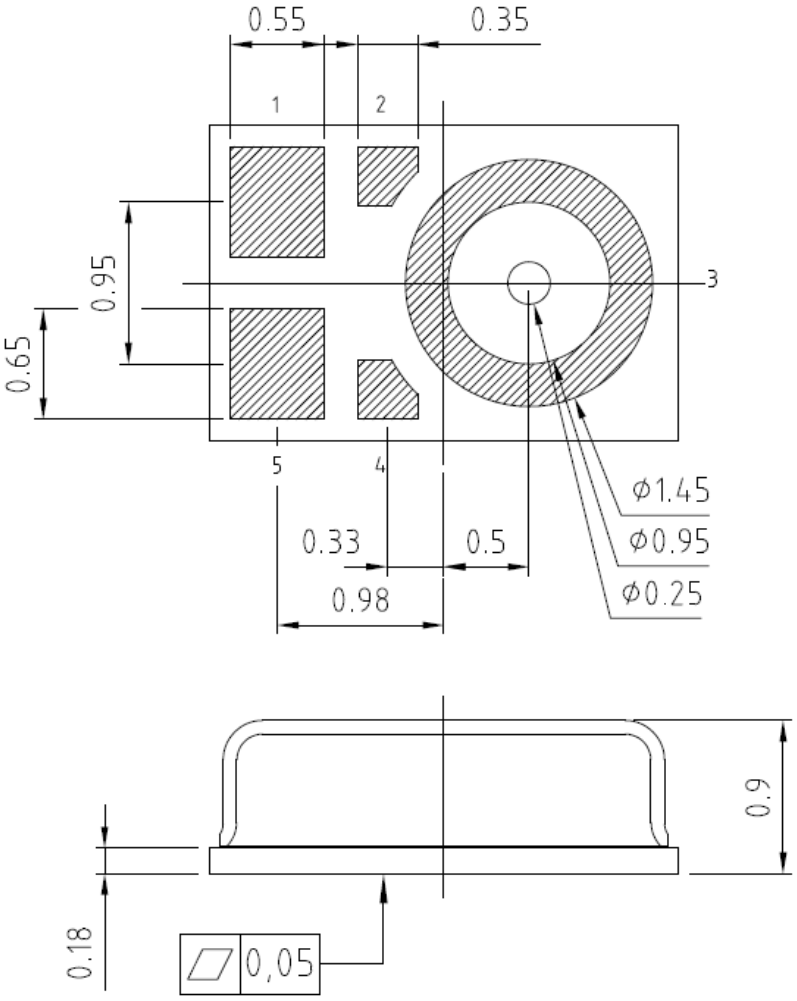

Figure 10. 2.75 mm × 1.85 mm × 0.9 mm body (Bottom and side view)

Item	Nominal	Tolerance
Length	2.75	±0.1
Width	1.85	±0.1
Height	0.9	±0.1

Note: All dimensions in mm unless otherwise stated.

Document Number: DS-000365
Revision: 1.1

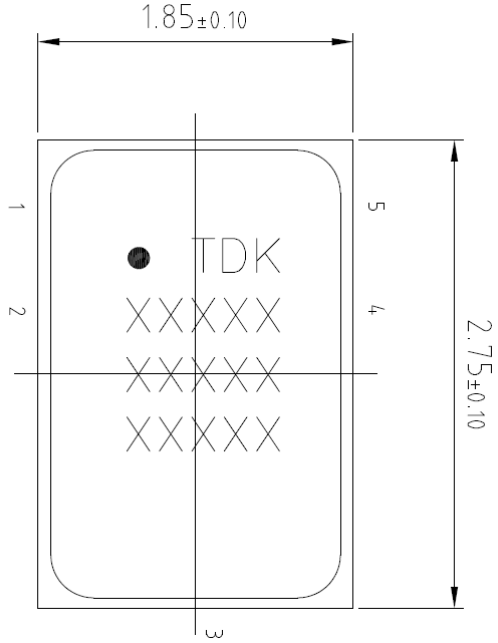

Figure 11. Package Marking Specification (Top View, not to scale)

Character Area:

1st row:	Pin 1 mark	Blank	T	D	K
2nd row:	Type and Revision (see below table)				
Example:	E	4	0	8	6
3rd row:	Blank	Production ID (4 digit)			
Example:		4	2	2	6
4th row:	Production ID (5 digit)				
Example:	A	0	G	5	9

Type and revision scheme:

Production status	Product marking	Example
Engineering Sample	"E" + Type	E4086
MP release	Type	4086
Product change (PCN)	Type + PCN revision	40861

ORDERING GUIDE

PART	TEMP RANGE	PACKAGE	QUANTITY	PACKAGING
MMICT4086-00-908	-40°C to +85°C	5-Terminal LGA_CAV	9,000	330mm Tape and Reel
EV_T4086-FX	—	Flexible Evaluation Board	—	

REVISION HISTORY

REVISION DATE	REVISION	DESCRIPTION
Feb 12, 2020	0.1	Initial issue
Oct 12, 2020	1.0	Production release
Nov 19, 2020	1.1	Corrected EIN and Dynamic Range specification typos in Table 1

COMPLIANCE DECLARATION DISCLAIMER

TDK believes the environmental and other compliance information given in this document to be correct but cannot guarantee accuracy or completeness. Conformity documents substantiating the specifications and component characteristics are on file. TDK subcontracts manufacturing, and the information contained herein is based on data received from vendors and suppliers, which has not been validated by TDK.