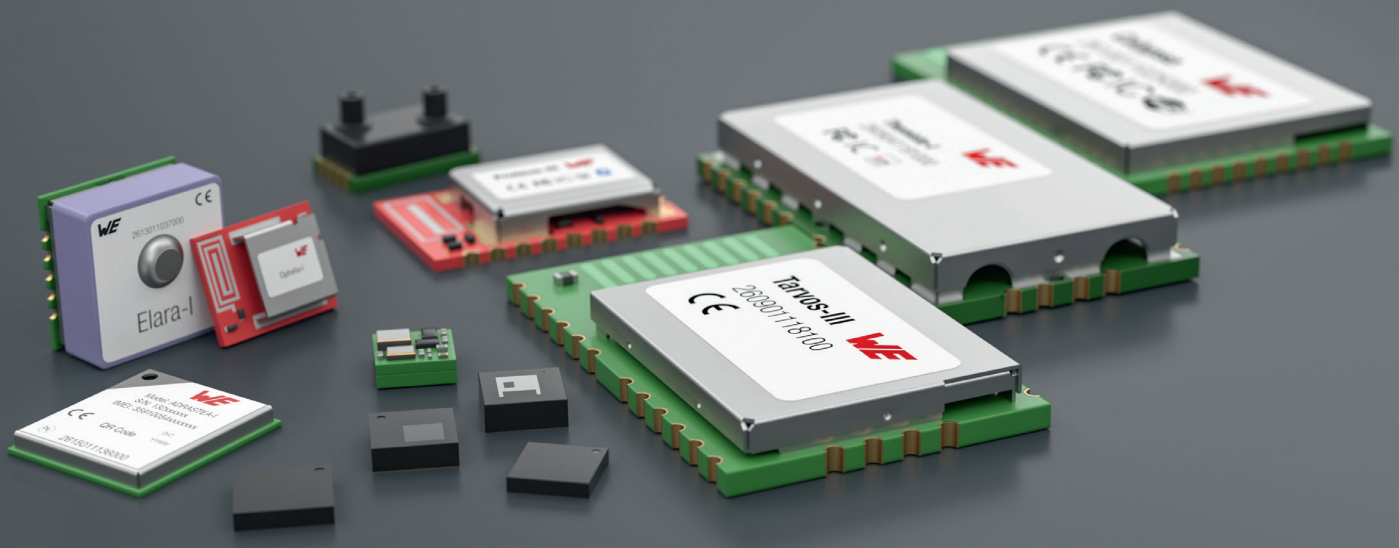

ANM001

MEMS Sensor PCB Design and Soldering Guidelines

Version 1.2

November 17, 2023

WÜRTH ELEKTRONIK MORE THAN YOU EXPECT

Sensors with LGA and DFN package

Sensor description	Order code
3-axis Acceleration Sensor	2533020201601
Absolute Pressure Sensor	2511020213301
Humidity Sensor	2525020210002
6-axis Inertial Measurement Unit	2536030320001

Revision history

App note version	Notes	Date
1.0	• Initial release of the app note	August 2019
1.1	• Sensor description in the first page updated • Chapter 2. PCB Design rules updated	January 2021
1.2	• Sensor description in the first page updated	November 2023

Abbreviations

Abbreviation	Description
GND	Negative supply voltage
I^2C	Inter integrated circuit
LGA	Land grid array
MEMS	Micro-electro-mechanical system
PCB	Printed circuit board
LSB	Least significant bit
VDD	Positive supply voltage

Contents

1 Introduction

This technical document provides necessary information and general guidelines for soldering and PCB design for the Würth Elektronik eiSos MEMS sensor products with an LGA surface-mount package.

2 PCB Design rules

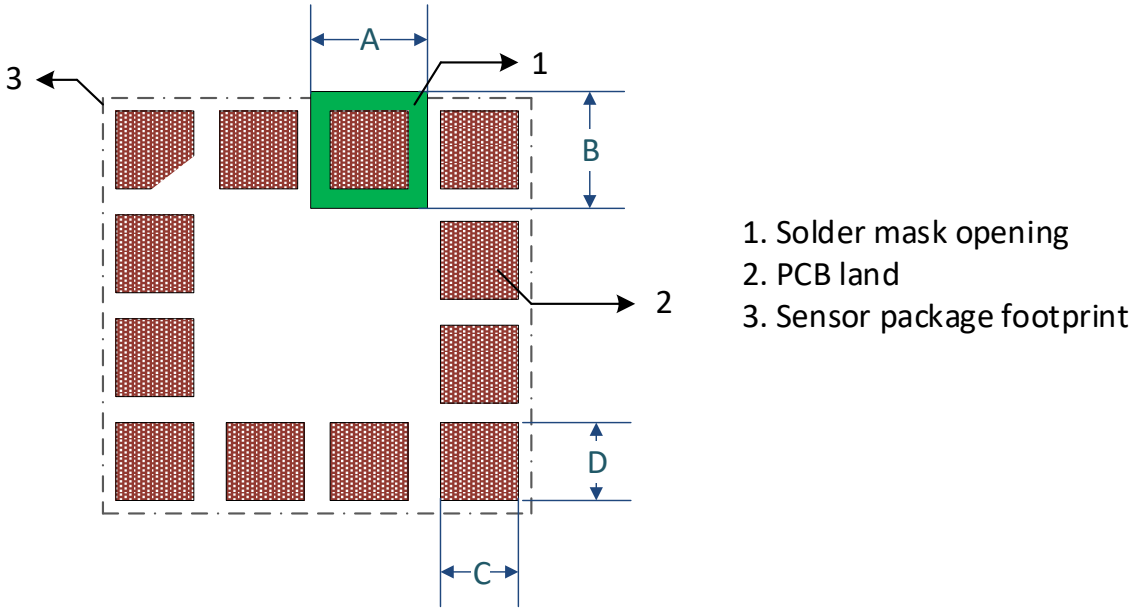

Figure 1: PCB land and solder mask recommendations for sensors with LGA package

Dimension	LGA pad spacing > 200 μm	LGA pad spacing $\leq$ 200 μm
PCB land width: C	LGA solder pad width + 0.1 mm	LGA solder pad width
PCB land length: D	LGA solder pad length + 0.1 mm	LGA solder pad length

Table 1: PCB land design dimensions

Dimension	Description
Solder mask opening width: A	PCB land length + 0.1 mm
Solder mask opening length: B (when applicable)	PCB land length + 0.1 mm

Table 2: Solder mask opening dimensions

Any structure underneath the sensor should be avoided

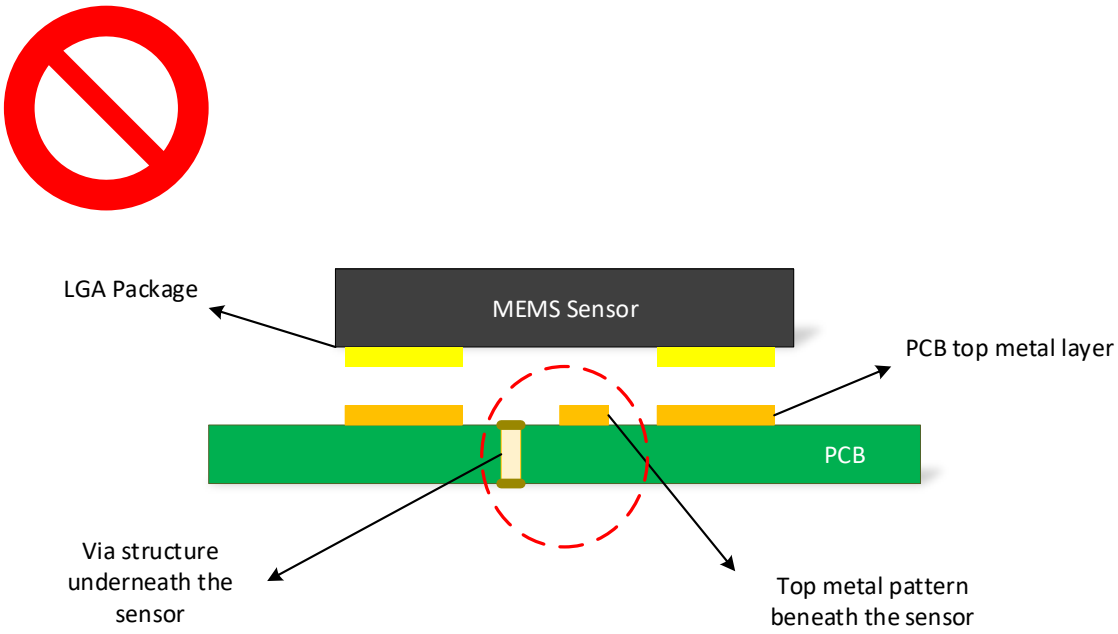

Figure 2: Incorrect PCB design

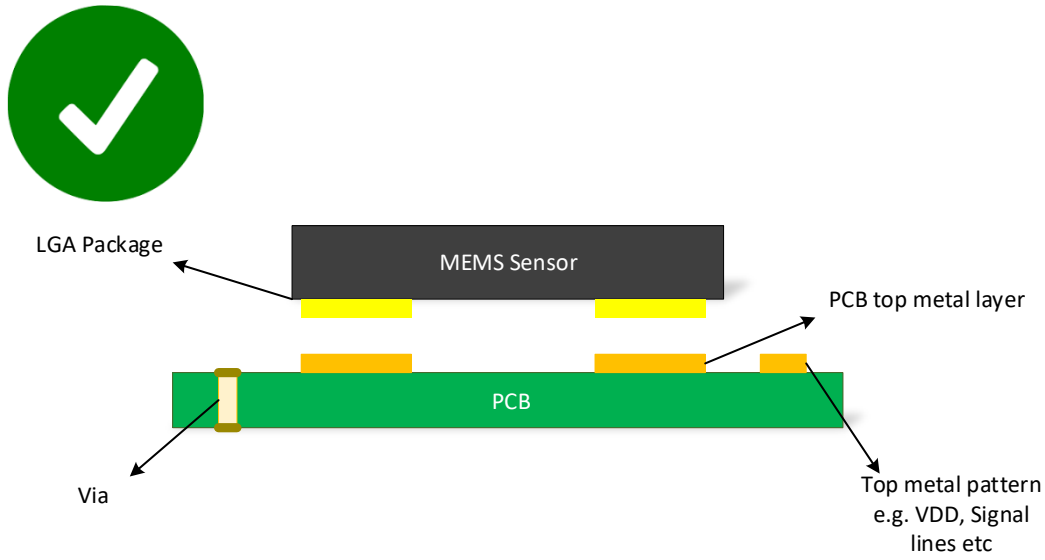

Figure 3: Correct PCB design

Screw mounting holes, vias and components at a distance greater than 2mm from the sensor is highly recommended to get optimal performance of the sensor

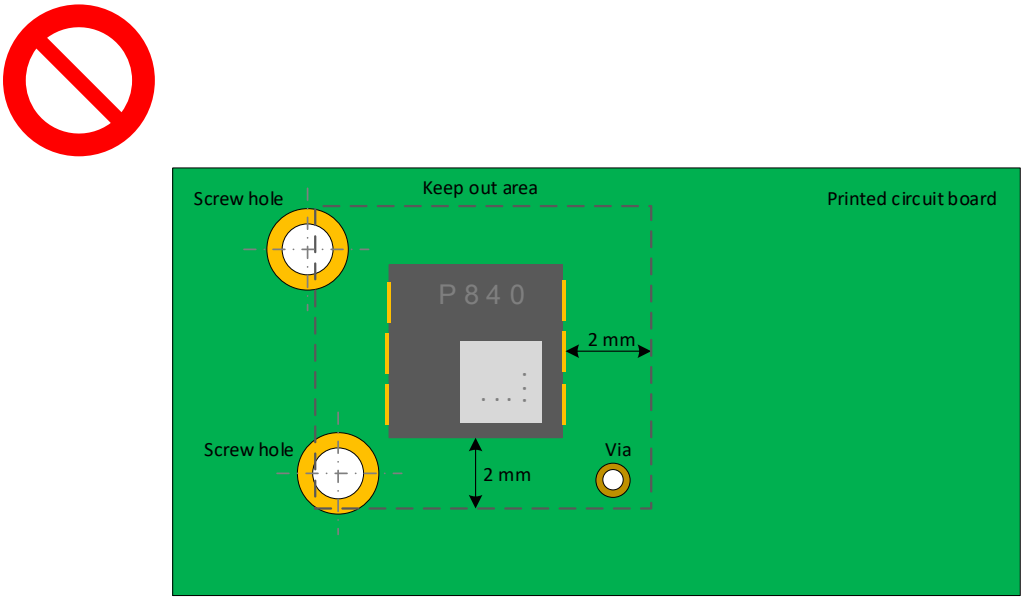

Figure 4: Components inside sensor keep out area

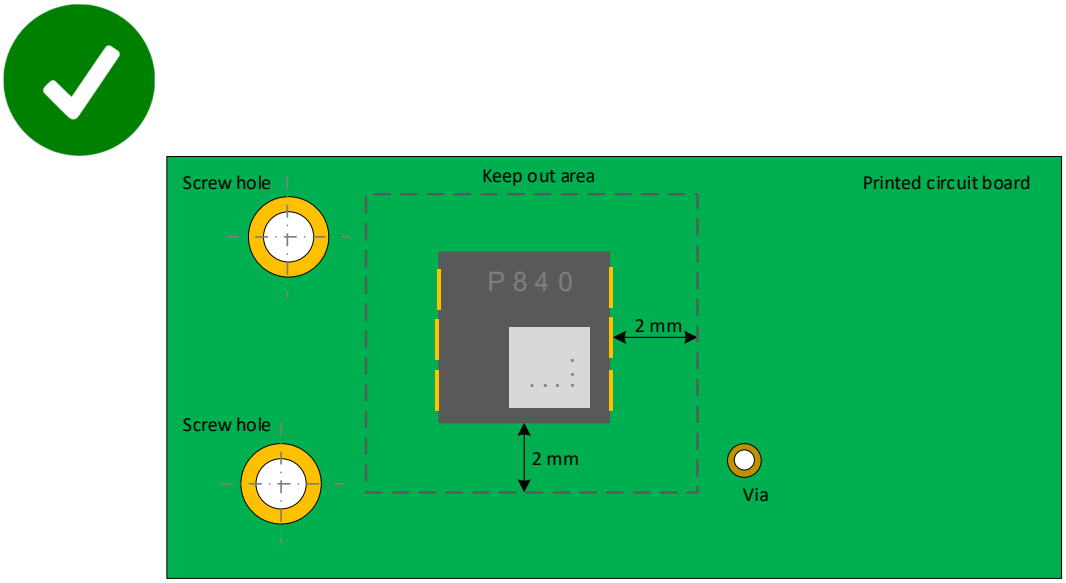

Figure 5: Components outside sensor keep out area

3 Guidelines for PCB Design

- The solder mask opening external to the PCB land is highly recommended. Please refer to figure 1.
- It is recommended to define a keep-out area for the sensor. Any structure underneath the sensor should be avoided.
- The traces connected to the pads should be as symmetrical as possible. Symmetry and balance to the pad connections will help the sensor self-align which leads to better control of solder paste reduction after reflow.
- Screw mounting holes at a distance greater than 2mm from the sensor is highly recommended to get optimal performance of the sensor.
- We recommend to separate digital ground from analog ground in the PCB, if enough space or layer is available. The relatively large, sharp pulses of digital current transitions might affect the precise analog signals if the two signals are not separated.

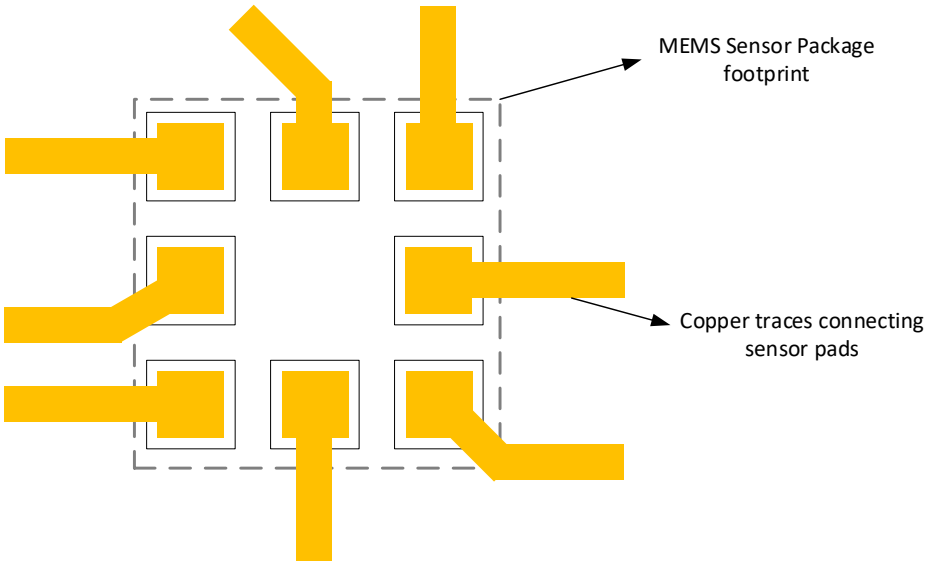

Figure 6: Asymmetrical trace and sensor pad connections

Information of the PCB design and soldering processes provided in this document is considered for use as a reference.

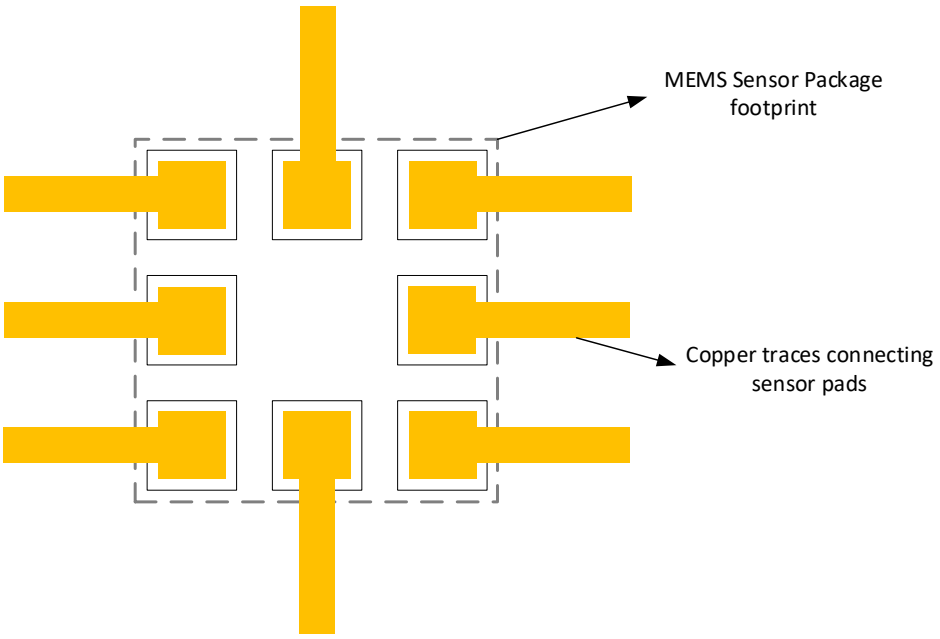

Figure 7: Symmetrical trace and sensor pad connections

PCB land design and connecting traces should be designed symmetrically

For sensor specific information please refer to corresponding data sheet of the product.

4 Guidelines for soldering

The following soldering guidelines should be taken into consideration for a common PCB design and industrial practices.

4.1 Before soldering

- Routing traces and vias below the sensor should be avoided. The active signals that are routed under may interfere with the MEMS sensor, which will affect the sensor performance.
- It is not necessary to have large traces on VDD/GND line, as the power consumption of the MEMS sensors are very low.
- For best performance of the sensor, design a ground plane under the sensor in order to reduce the PCB signal noise from the board.
- The placement of the MEMS sensor on the PCB should avoid locations in close proximity to heat sources e.g. microprocessors, batteries, graphic controllers etc.
- Push-buttons, screws and PCB anchor points can produce mechanical stress onto the PCB, hence the sensor placement close to these components should be avoided.
- PCB bending will induce mechanical stress to the sensor therewith influence the sensor performance.

4.2 After soldering

- In general, high-amplitude resonant vibrations of the PCB should be avoided. It could possibly damage the MEMS structure.
- The thickness of solder paster must be uniform to reduce the inconsistent stress on the sensor.
- Solder paste must be as thick as possible to reduce the decoupling stress and to avoid the PCB solder mask touching the device package.

5 Guidelines for stencil design and solder paste

For proper mounting process of the MEMS sensor, thickness and soldering paste pattern are very important.

- Stencil thickness of 90 - 150 μm (3.5 - 6 mils) is recommended for screen printing.
- Stainless steel stencils are recommended for solder paste application.
- The signal pad openings of the stencil should be between 70% and 90% of the PCB pad area.
- It is recommended that for better solder paste release, the aperture walls should be trapezoidal and the corners rounded.
- The stencil and printed circuit assembly should be aligned to within 25 μm (1 mil) before applying the solder paste.

6 Guidelines for process considerations

- To reduce the residual stress on the components, the recommended ramp-down temperature slope should not exceed -3 °C/s.
- LGA packages show metal traces on the side of the package, hence no solder material reflow on the side of the package is allowed.
- The final volume of the solder paste applied to a single PCB land should be less than 20% of the volume of the solder paste of all pads of one device.
- It is not possible to define a specific soldering profile only for the sensors. The soldering profile depends on the number, size and placement of the components in the application board.
- Customer should use a time and temperature reflow profile based on PCB design and manufacturing knowledge.
- No-clean solder paste is recommended for assembly of the MEMS sensor to prevent further cleaning steps.
- Sensor with opening surface on top should be handled carefully. Do not pick the component with vacuum tools which make direct contact with the opening of the sensor.

It is recommended to use a standard pick and place process and equipment. Do not use the hand soldering process.

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