Introduction

This technical note provides general guidelines for soldering MEMS sensor products housed in an LGA surface-mount package.

Note: Information provided in this document is to be intended for use as reference material concerning PCB design and soldering processes. For device specifications, refer to the corresponding datasheet.
Contents

1 General guidelines for soldering surface-mount MEMS sensors .......... 3

2 PCB design guidelines ................................................. 4
   2.1 PCB design rules ............................................... 5

3 Stencil design and solder paste application ............................... 6

4 Process considerations .................................................. 6

5 Solder heat resistance and environmental specifications ............... 7

6 Revision history .......................................................... 8
1 General guidelines for soldering surface-mount MEMS sensors

The following three elements must be considered in order to adhere to common PCB design and good industrial practices when soldering MEMS sensors:

- PCB design should be as symmetrical as possible
  - large traces on Vdd / Gnd lines are not required (very low power consumption)
  - no vias or traces below the sensor footprint
- Solder paste must be as thick as possible (after soldering) in order to:
  - reduce the decoupling stress from the PCB to the sensor
  - avoid that the PCB solder mask touches the device package
- Solder paste thickness must be as uniform as possible (after soldering) to avoid uneven stress:
  - Final volume of soldering paste within 20% among lands is possible using the SPI (Solder Paste Inspection) control technique
2 PCB design guidelines

PCB land and solder mask general recommendations are shown in Figure 1. Refer to the device datasheet for pad count, size and pitch.

- It is recommended to open the solder mask external to the PCB land;
- It is strongly recommended not to place any structure on the top metal layer underneath the sensor (on the same side of the board). This must be defined as a keepout area.
- Traces connected to pads should be as much symmetric as possible. Symmetry and balance for pad connection will help component self-alignment and will lead to better control of solder paste reduction after reflow;
- For optimal performance of the device, it is strongly recommended to place screw mounting holes at a distance greater than 2 mm from the sensor.
- If present, the pin #1 indicator must be left unconnected to ensure proper device functionality.
- In order to prevent noise coupling and thermo-mechanical stress, following standard industry design practices for component placement is advised.
2.1 PCB design rules

Figure 1. Recommended land and solder mask design for LGA packages

PCB land design and connecting traces should be designed symmetrically.

For LGA pin spacing greater than 200 μm:

A = PCB land length = LGA solder pin length + 0.1 mm
B = PCB land width = LGA solder pin width + 0.1 mm

For LGA pin spacing equal to or less than 200 μm:

A = PCB land length = LGA solder pin length
B = PCB land width = LGA solder pin width

C = Solder mask opening length (when applicable) = PCB land length + 0.1 mm
D = Solder mask opening width = PCB land width + 0.1 mm
3 Stencil design and solder paste application

The thickness and the pattern of the soldering paste are important for the proper MEMS sensor mounting process.

- Stainless steel stencils are recommended for solder paste application;
- A stencil thickness of 90 - 150 μm (3.5 - 6 mils) is recommended for screen printing;
- The openings of the stencil for the signal pads should be between 70% and 90% of the PCB pad area;
- Optionally, for better solder paste release, the aperture walls should be trapezoidal and the corners rounded;
- The fine pitch of the IC leads requires accurate alignment of the stencil to the printed circuit board. The stencil and printed circuit assembly should be aligned to within 25 μm (1 mil) prior to application of the solder paste.

4 Process considerations

- The soldering profile depends on the number, size and placement of components in the application board. For this reason it is not possible to define a unique soldering profile for the sensor only. The customer should use a time and temperature reflow profile based on PCB design and manufacturing expertise.
- In order to reduce residual stress on the components, the recommended ramp-down temperature slope should not exceed -3 °C/s.
- No solder material reflow on the side of the package is allowed since LGA packages show metal traces on the side of the package.
- If “self-cleaning” solder paste is not used, the board must be properly cleaned after soldering to eliminate any possible source of leakage between adjacent pads due to flux residues.
- The final volume of soldering paste applied to each PCB land is recommended to be within 20% among (all) the PCB land pads.
- Based on the Jedec 9702 standard, a component shows negligible output variation up to stress intensity of 500 me (microstrain).
5 Solder heat resistance and environmental specifications

In order to meet environmental requirements, ST offers these devices in ECOPACK® packages. These packages have a lead-free second level interconnect. The category of second level interconnect is marked on the inner box label, in compliance with JEDEC Standard JESD97. The maximum ratings related to soldering conditions are also marked on the inner box label.

LGA packages for MEMS sensors are qualified for soldering heat resistance according to JEDEC J-STD-020, in MSL3 condition.
### 6 Revision history

<table>
<thead>
<tr>
<th>Date</th>
<th>Revision</th>
<th>Changes</th>
</tr>
</thead>
<tbody>
<tr>
<td>12-Oct-2006</td>
<td>1</td>
<td>Initial release</td>
</tr>
<tr>
<td>30-Apr-2008</td>
<td>2</td>
<td>Added appendix with mechanical information</td>
</tr>
<tr>
<td>30-Jul-2013</td>
<td>3</td>
<td>Updated Section 2: PCB design guidelines</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Updated Section 4: Process considerations</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Removed Appendix A with LGA package drawings and dimensions</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Minor textual updates throughout technical note</td>
</tr>
<tr>
<td>31-Oct-2013</td>
<td>4</td>
<td>Textual update in Note on page 5</td>
</tr>
<tr>
<td>24-Mar-2014</td>
<td>5</td>
<td>Updated Section 2: PCB design guidelines; Section 3: Stencil design and solder paste application; and Section 4: Process considerations</td>
</tr>
</tbody>
</table>
Please Read Carefully:

Information in this document is provided solely in connection with ST products. STMicroelectronics NV and its subsidiaries (“ST”) reserve the right to make changes, corrections, modifications or improvements, to this document, and the products and services described herein at any time, without notice.

All ST products are sold pursuant to ST’s terms and conditions of sale. Purchasers are solely responsible for the choice, selection and use of the ST products and services described herein, and ST assumes no liability whatsoever relating to the choice, selection or use of the ST products and services described herein.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted under this document. If any part of this document refers to any third party products or services it shall not be deemed a license grant by ST for the use of such third party products or services, or any intellectual property contained therein or considered as a warranty covering the use in any manner whatsoever of such third party products or services or any intellectual property contained therein.

UNLESS OTHERWISE SET FORTH IN ST’S TERMS AND CONDITIONS OF SALE ST DISCLAIMS ANY EXPRESS OR IMPLIED WARRANTY WITH RESPECT TO THE USE AND/OR SALE OF ST PRODUCTS INCLUDING WITHOUT LIMITATION IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE (AND THEIR EQUIVALENTS UNDER THE LAWS OF ANY JURISDICTION), OR INFRINGEMENT OF ANY PATENT, COPYRIGHT OR OTHER INTELLECTUAL PROPERTY RIGHT.

ST PRODUCTS ARE NOT DESIGNED OR AUTHORIZED FOR USE IN: (A) SAFETY CRITICAL APPLICATIONS SUCH AS LIFE SUPPORTING, ACTIVE IMPLANTED DEVICES OR SYSTEMS WITH PRODUCT FUNCTIONAL SAFETY REQUIREMENTS; (B) AERONAUTIC APPLICATIONS; (C) AUTOMOTIVE APPLICATIONS OR ENViRONMENTS, AND/OR (D) AEROSPACE APPLICATIONS OR ENVIRONMENTS. WHERE ST PRODUCTS ARE NOT DESIGNED FOR SUCH USE, THE PURCHASER SHALL USE PRODUCTS AT PURCHASER’S SOLE RISK, EVEN IF ST HAS BEEN INFORMED IN WRITING OF SUCH USAGE, UNLESS A PRODUCT IS EXPRESSLY DESIGNATED BY ST AS BEING INTENDED FOR “AUTOMOTIVE, AUTOMOTIVE SAFETY OR MEDICAL” INDUSTRY DOMAINS ACCORDING TO ST PRODUCT DESIGN SPECIFICATIONS. PRODUCTS FORMALLY ESCC, QML OR JAN QUALIFIED ARE DEEMED SUITABLE FOR USE IN AEROSPACE BY THE CORRESPONDING GOVERNMENTAL AGENCY.

Resale of ST products with provisions different from the statements and/or technical features set forth in this document shall immediately void any warranty granted by ST for the ST product or service described herein and shall not create or extend in any manner whatsoever, any liability of ST.

ST and the ST logo are trademarks or registered trademarks of ST in various countries. Information in this document supersedes and replaces all information previously supplied. The ST logo is a registered trademark of STMicroelectronics. All other names are the property of their respective owners.

© 2014 STMicroelectronics - All rights reserved

STMicroelectronics group of companies
Australia - Belgium - Brazil - Canada - China - Czech Republic - Finland - France - Germany - Hong Kong - India - Israel - Italy - Japan - Malaysia - Malta - Morocco - Philippines - Singapore - Spain - Sweden - Switzerland - United Kingdom - United States of America

www.st.com