

# TN0018 Technical note

## Linear accelerometers in LGA package surface mounting guidelines

#### Introduction

This document is a general guidelines about soldering accelerometer products packaged in LGA surface mount.

Note:

Data provided in this document are to be intended as reference for PCB design and soldering process. For device specification refer to corresponding datasheet.

Contents TN0018

### **Contents**

| 1        | Gene            | ral guidelines about soldering surface mount accelerometer | . 3 |
|----------|-----------------|--|-----|
| 2        | <b>PCB</b> (2.1 | design guidelines  PCB design rules                        |     |
| 3        | Stenc           | il design and solder paste application                     | . 5 |
| 4        | Proce           | ess consideration  | . 6 |
| 5        | Solde           | er heat resistance and environmental specification         | . 7 |
| Appendix | A LO            | GA packages outlines                                       | . 8 |
|          | A.1             | LGA 5x5x1.6 mm, 8 lead                                     | . 8 |
|          | A.2             | LGA 5x5x1.6 mm, 16 lead                                    | . 9 |
|          | A.3             | LGA 4.4x7.5x1 mm, 16 lead                                  | 10  |
|          | A.4             | LGA 3x5x0.9 mm, 14 lead                                    | 11  |
|          | A.5             | LGA 4x4x1.5 mm, 16 lead                                    | 12  |
|          | A.6             | LGA 3x3x1.0mm, 16 lead                                     | 13  |
| 6        | Revis           | ion history  | 1/1 |

## 1 General guidelines about soldering surface mount accelerometer

As common PCB design and industrial practice when considering accelerometer soldering there are always 3 elements to take into consideration:

- 1. PCB with its own conductive layers (i.e. copper) and other organic materials used for board protection and dielectric isolation.
- Accelerometer to be mounted on the board. Accelerometer senses acceleration, but it senses also the mechanical stress coming from the board. This stress is minimized with simple PCB design rules.
- 3. Soldering paste like Sn/Ag/Cu. This soldering paste can be dispensed on the board with a screen printing method through a stencil. The pattern of the soldering paste on the PCB is given by the stencil mask itself.

5/

#### 2 PCB design guidelines

PCB land and solder masking general recommendations are shown in *Figure 1*. Refer to device datasheet or *Appendix A: LGA packages outlines* for pad count, size and pitch.

- It is recommended to open solder mask external to PCB land;
- The area below the sensor (on the same side of the board) must be defined as keepout area. It is strongly recommended to not place any structure in top metal layer underneath the sensor;
- 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 a better control of solder paste reduction after reflow;
- For better performances over temperature it is strongly recommended not to place large insertion components like buttons or shielding boxes at distance less than 2 mm from the sensor;
- Pin #1 indicator must be left unconnected to ensure proper device functionality.

#### 2.1 PCB design rules

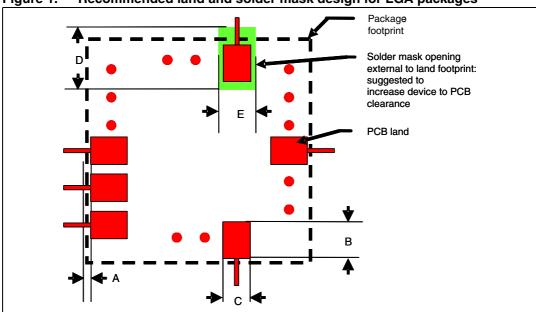


Figure 1. Recommended land and solder mask design for LGA packages

- ${\bf A}={\bf Clearance}$  from PCB land edge to solder mask opening  $\geq 0.25$  mm to ensure that solder mask is opened externally to device area
- $\mathbf{B} = \text{PCB}$  land length = LGA solder pad length + 0.1 mm
- C = PCB land width = LGA solder pad width + 0.1 mm
- **D** = Solder mask opening length = PCB land length + 0.3 mm: design 0.05mm inside and 0.25 mm outside
- **E** = 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 accelerometer 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 final thickness of soldering paste should allow proper cleaning of flux residuals and clearance between sensor package and PCB;
- Stencil aperture should have rectangular shape with dimension up to 25 μm (1 mil) smaller than PCB land;
- 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.

5/

Process consideration TN0018

#### 4 Process consideration

 In case of use of no self-cleaning solder paste it is mandatory proper washing of the board after soldering to eliminate any possible source of leakage between adjacent pads due to flux residues;

- The PCB soldering profile depends on the number, size and placement of components in the application board. It is not functional to define a specific soldering profile for the accelerometer only. Customer should use a time and temperature reflow profile that is derived from the PCB design and manufacturing experience.
- No solder material reflow on the side of the package is allowed since LGA packages show metal trace out of package side.

## 5 Solder heat resistance and environmental specification

In order to meet environmental requirements, ST offers these devices in ECOPACK<sup>®</sup> 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.

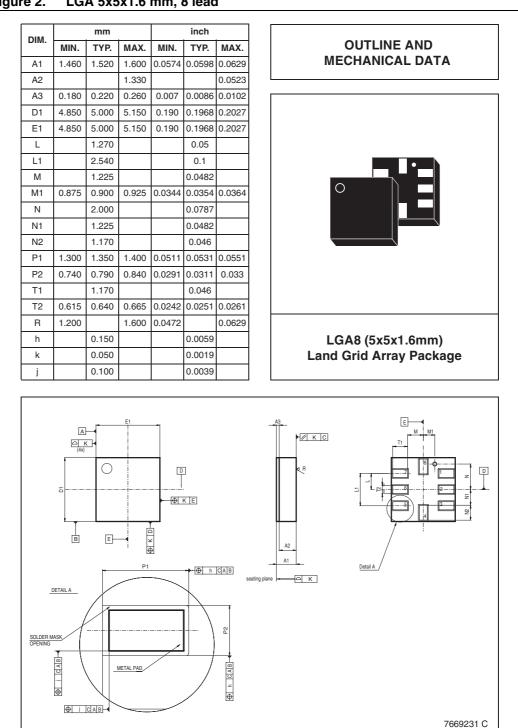
LGA packages for accelerometer are qualified for soldering heat resistance according to JEDEC J-STD-020C, in MSL3 condition.

5/

### Appendix A LGA packages outlines

#### A.1 LGA 5x5x1.6 mm, 8 lead

Figure 2. LGA 5x5x1.6 mm, 8 lead

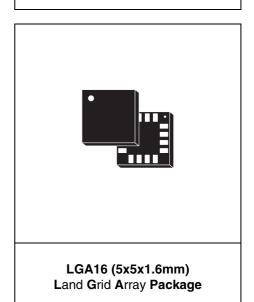


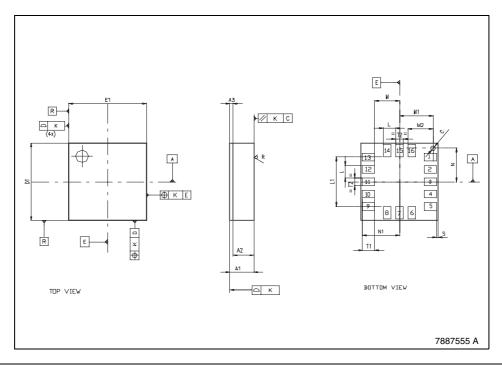
### A.2 LGA 5x5x1.6 mm, 16 lead

Figure 3. LGA 5x5x1.6 mm, 16 lead

| DIM. |       | mm    |       | inch   |        |        |
|------|-------|-------|-------|--------|--------|--------|
| DIM. | MIN.  | TYP.  | MAX.  | MIN.   | TYP.   | MAX.   |
| A1   | 1.460 | 1.500 | 1.600 | 0.575  | 0.0591 | 0.0630 |
| A2   | 1.    |       | 330   |        |        | 0.0524 |
| А3   | 0.160 | 0.200 | 0.240 | 0.0063 | 0.0079 | 0.0094 |
| С    | 0     | .300  |       |        | 0.0118 |        |
| D1   | 4.850 | 5.000 | 5.150 | 0.1909 | 0.1969 | 0.2028 |
| E1   | 4.850 | 5.000 | 5.150 | 0.1909 | 0.1969 | 0.2028 |
| L    | 0     | .800  |       |        | 0.0315 |        |
| L1   | 3     | .200  |       |        | 0.1260 |        |
| М    | 1     | .600  |       |        | 0.0630 |        |
| M1   | 2.150 | 2.180 | 2.200 | 0.0846 | 0.0858 | 0.0866 |
| M2   | 1     | .630  |       |        | 0.0642 |        |
| N    | 2     | .180  |       |        | 0.0858 |        |
| N1   | 2     | .400  |       |        | 0.0945 |        |
| T1   | 0     | .800  |       |        | 0.0315 |        |
| T2   | 0.480 | 0.500 | 0.530 | 0.0189 | 0.0197 | 0.0209 |
| R    | 1.200 |       | 1.600 | 0.0472 |        | 0.0630 |
| S    | 0     | .100  |       |        | 0.0039 |        |
| h    | 0     | .150  |       |        | 0.0059 |        |
| k    | 0     | .050  |       |        | 0.0020 |        |
| j    | 0     | .100  |       |        | 0.0039 |        |

### OUTLINE AND MECHANICAL DATA





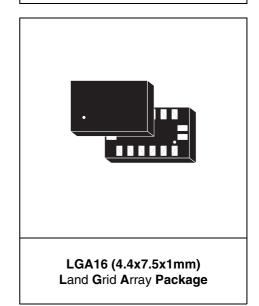
577

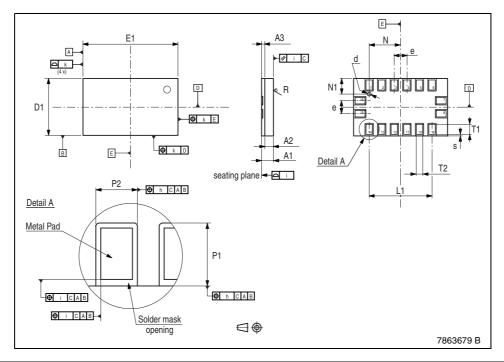
### A.3 LGA 4.4x7.5x1 mm, 16 lead

Figure 4. LGA 4.4x7.5x1 mm, 16 lead

| DIM. | mm    |       |       | inch   |        |        |
|------|-------|-------|-------|--------|--------|--------|
|      | MIN.  | TYP.  | MAX.  | MIN.   | TYP.   | MAX.   |
| A1   |       | 0.92  | 1     |        |        | 0.0394 |
| A2   |       |       | 0.7   |        |        | 0.0276 |
| А3   | 0.180 | 0.220 | 0.260 | 0.0071 | 0.0087 | 0.0102 |
| D1   | 4.250 | 4.400 | 4.550 | 0.1673 | 0.1732 | 0.1791 |
| E1   | 7.350 | 7.500 | 7.650 | 0.2894 | 0.2953 | 0.3012 |
| е    |       | 1.0   |       |        | 0.0394 |        |
| d    |       | 0.3   |       |        | 0.0118 |        |
| L1   |       | 5.000 |       |        | 0.1969 |        |
| N    |       | 2.5   |       |        | 0.0984 |        |
| N1   |       | 1.2   |       |        | 0.0472 |        |
| P1   | 0.965 | 0.975 | 0.985 | 0.0380 | 0.0384 | 0.0388 |
| P2   | 0.64  | 0.65  | 0.66  | 0.0252 | 0.0256 | 0.0260 |
| T1   | 0.75  | 0.8   | 0.85  | 0.0295 | 0.0315 | 0.0335 |
| T2   | 0.45  | 0.5   | 0.55  | 0.0177 | 0.0197 | 0.0217 |
| R    | 1.200 |       | 1.600 | 0.0472 |        | 0.0630 |
| h    |       | 0.150 |       |        | 0.0059 |        |
| k    |       | 0.050 |       |        | 0.0020 |        |
| i    |       | 0.100 |       |        | 0.0039 |        |
| s    |       | 0.100 |       |        | 0.0039 |        |

### OUTLINE AND MECHANICAL DATA



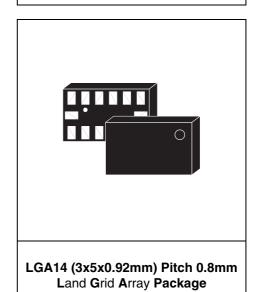


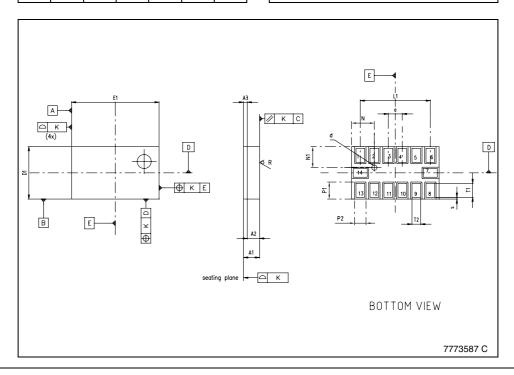
### A.4 LGA 3x5x0.9 mm, 14 lead

Figure 5. LGA 3x5x0.9 mm, 14 lead

| DIM. | mm    |       |       | inch   |        |        |
|------|-------|-------|-------|--------|--------|--------|
|      | MIN.  | TYP.  | MAX.  | MIN.   | TYP.   | MAX.   |
| A1   |       | 0.920 | 1.000 |        | 0.0362 | 0.0394 |
| A2   |       |       | 0.700 |        |        | 0.0275 |
| А3   | 0.180 | 0.220 | 0.260 | 0.0071 | 0.0087 | 0.0102 |
| D1   | 2.850 | 3.000 | 3.150 | 0.1122 | 0.1181 | 0.1240 |
| E1   | 4.850 | 5.000 | 5.150 | 0.1909 | 0.1968 | 0.2027 |
| е    |       | 0.800 |       |        | 0.0315 |        |
| d    |       | 0.300 |       |        | 0.0118 |        |
| L1   |       | 4.000 |       |        | 0.1575 |        |
| N    |       | 1.360 |       |        | 0.0535 |        |
| N1   |       | 1.200 |       |        | 0.0472 |        |
| P1   | 0.965 | 0.975 | 0.985 | 0.0380 | 0.0384 | 0.0386 |
| P2   | 0.640 | 0.650 | 0.660 | 0.0252 | 0.0256 | 0.0260 |
| T1   | 0.750 | 0.800 | 0.850 | 0.0295 | 0.0315 | 0.0335 |
| T2   | 0.450 | 0.500 | 0.550 | 0.0177 | 0.0197 | 0.0217 |
| R    | 1.200 |       | 1.600 | 0.0472 |        | 0.0630 |
| h    |       | 0.150 |       |        | 0.0059 |        |
| k    |       | 0.050 |       |        | 0.0020 |        |
| i    |       | 0.100 |       |        | 0.0039 |        |
| s    |       | 0.100 |       |        | 0.0039 |        |

### OUTLINE AND MECHANICAL DATA





**577** 

### A.5 LGA 4x4x1.5 mm, 16 lead

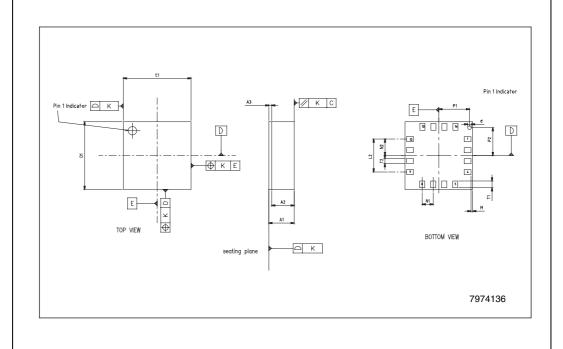
Figure 6. LGA 4x4x1.5mm, 16 lead

|      | Dimensions |       |       |        |        |        |  |  |
|------|------------|-------|-------|--------|--------|--------|--|--|
| Ref. |            | mm    |       | inch   |        |        |  |  |
| Kei. | Min.       | Тур.  | Max.  | Min.   | Тур.   | Max.   |  |  |
| A1   |            | 1.500 | 1.600 |        | 0.0591 | 0.0630 |  |  |
| A2   |            |       | 1.330 |        |        | 0.0524 |  |  |
| А3   | 0.160      | 0.200 | 0.240 | 0.0063 | 0.0079 | 0.0094 |  |  |
| d    |            | 0.300 |       |        | 0.0118 |        |  |  |
| D1   | 3.850      | 4.000 | 4.150 | 0.1516 | 0.1575 | 0.1634 |  |  |
| E1   | 3.850      | 4.000 | 4.150 | 0.1516 | 0.1575 | 0.1634 |  |  |
| L2   |            | 1.950 |       |        | 0.0768 |        |  |  |
| М    |            | 0.100 |       |        | 0.0039 |        |  |  |
| N1   |            | 0.650 |       |        | 0.0256 |        |  |  |
| N2   |            | 0.975 |       |        | 0.0384 |        |  |  |
| P1   |            | 1.750 |       |        | 0.0689 |        |  |  |
| P2   |            | 1.525 |       |        | 0.0600 |        |  |  |
| T1   |            | 0.400 |       |        | 0.0157 |        |  |  |
| T2   |            | 0.300 |       |        | 0.0118 |        |  |  |
| k    |            | 0.050 |       |        | 0.0020 |        |  |  |

### Outline and mechanical data



LGA 16L (4x4x1.5mm) Land Grid Array Package

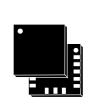


### A.6 LGA 3x3x1.0mm, 16 lead

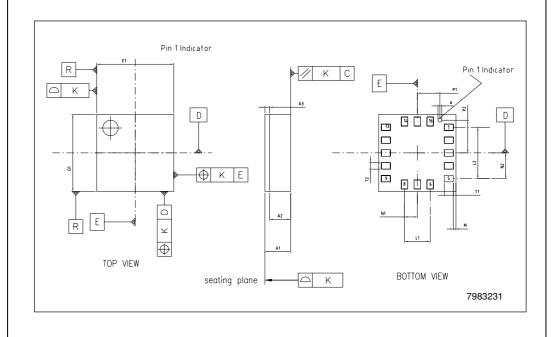
Figure 7. LGA 3x3x1.0mm, 16 lead

| Dimensions |       |       |       |        |        |        |  |
|------------|-------|-------|-------|--------|--------|--------|--|
| Dof        |       | mm    |       | inch   |        |        |  |
| Ref.       | Min.  | Тур.  | Max.  | Min.   | Тур.   | Max.   |  |
| A1         |       |       | 1.000 |        |        | 0.0394 |  |
| A2         |       | 0.785 |       |        | 0.0309 |        |  |
| А3         |       | 0.200 |       |        | 0.0079 |        |  |
| D1         | 2.850 | 3.000 | 3.150 | 0.1122 | 0.1181 | 0.1240 |  |
| E1         | 2.850 | 3.000 | 3.150 | 0.1122 | 0.1181 | 0.1240 |  |
| L1         |       | 1.000 | 1.060 |        | 0.0394 | 0.0417 |  |
| L2         |       | 2.000 | 2.060 |        | 0.0787 | 0.0811 |  |
| N1         |       | 0.500 |       |        | 0.0197 |        |  |
| N2         |       | 1.000 |       |        | 0.0394 |        |  |
| М          | 0.040 | 0.100 | 0.160 | 0.0016 | 0.0039 | 0.0063 |  |
| P1         |       | 0.875 |       |        | 0.0344 |        |  |
| P2         |       | 1.275 |       |        | 0.0502 |        |  |
| T1         | 0.290 | 0.350 | 0.410 | 0.0114 | 0.0138 | 0.0161 |  |
| T2         | 0.190 | 0.250 | 0.310 | 0.0075 | 0.0098 | 0.0122 |  |
| d          |       | 0.150 |       |        | 0.0059 |        |  |
| k          |       | 0.050 |       |        | 0.0020 |        |  |

### Outline and mechanical data



LGA16 (3x3x1.0mm) Land Grid Array Package



577

Revision history TN0018

### 6 Revision history

Table 1. Document revision history

| Date      | Revision | Changes  |
|-----------|----------|--|
| 12-Oct-06 | 1        | Initial release.   |
| 30-Apr-08 | 2        | Added appendix paragraphs A.5: LGA 4x4x1.5 mm, 16 lead and A.6: LGA 3x3x1.0mm, 16 lead |

#### 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.

UNLESS EXPRESSLY APPROVED IN WRITING BY AN AUTHORIZED ST REPRESENTATIVE, ST PRODUCTS ARE NOT RECOMMENDED, AUTHORIZED OR WARRANTED FOR USE IN MILITARY, AIR CRAFT, SPACE, LIFE SAVING, OR LIFE SUSTAINING APPLICATIONS, NOR IN PRODUCTS OR SYSTEMS WHERE FAILURE OR MALFUNCTION MAY RESULT IN PERSONAL INJURY, DEATH, OR SEVERE PROPERTY OR ENVIRONMENTAL DAMAGE. ST PRODUCTS WHICH ARE NOT SPECIFIED AS "AUTOMOTIVE GRADE" MAY ONLY BE USED IN AUTOMOTIVE APPLICATIONS AT USER'S OWN RISK.

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.

© 2008 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 - Singapore - Spain - Sweden - Switzerland - United Kingdom - United States of America

www.st.com

