



# EIA Standard Board Layout Drawing for BGA, CCGA, CSP, and QFN

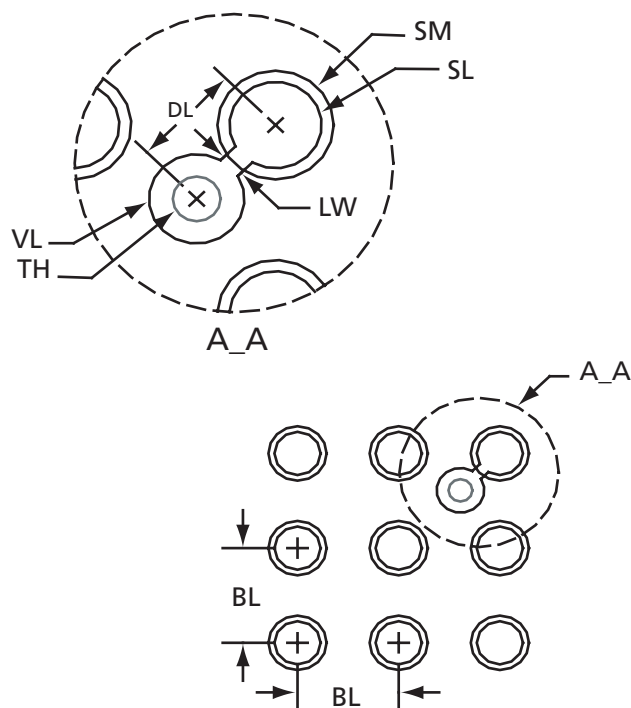


Figure 1: Suggested Board Layout of Soldered Pads for BGA Packages

#### Notes:

1. Table 2a through Table 6 on page 11 contain the recommended guidelines for board layout soldered pad dimensions for the following Actel packages (including pad dimension for prototyping socket accordingly): **CS** (Chip Scale BGA, 0.8 mm pitch), **FG** (Fine Pitch BGA, 1.00 mm pitch), **BG** (Plastic Ball Grid Array, 1.27 mm pitch), **CG** (Ceramic Column Grid Array, 1.27 mm pitch), CG adapter socket, **QN** (Quad Fine Pitch No-Lead QFN, 0.5 mm pitch).
2. For E-tec prototyping socket soldering, Actel recommends using non-silver type solder paste with 6 mils thickness.

**Table 1a: Recommended PCB design guidelines for Actel CS (0.5 mm pitch BGA) package**

| Dim.                                           | uCS36             | uCS81             | CS81           | CS121          | CS196          | CS201          | CS281          |
|------------------------------------------------|-------------------|-------------------|----------------|----------------|----------------|----------------|----------------|
| Component Land Pad Diameter (SMD)              | 0.33              | 0.33              | 0.35           | 0.35           | 0.35           | 0.35           | 0.35           |
| Solder Land Diameter (SL)                      | 0.23              | 0.23              | 0.25           | 0.25           | 0.25           | 0.25           | 0.25           |
| Solder Mask Opening Diameter (SM)              | 0.33              | 0.33              | 0.35           | 0.35           | 0.35           | 0.35           | 0.35           |
| Solder Ball Land Pitch (BL)                    | 0.4               | 0.4               | 0.50           | 0.50           | 0.50           | 0.50           | 0.50           |
| Line Width Between Via and Solder Land (LW)    | Via In Pad        | Via In Pad        | 0.15 to 0.20   | 0.15 to 0.20   | 0.15 to 0.20   | 0.15 to 0.20   | 0.15 to 0.20   |
| Distance Between Via and Solder Land (DL)      | Via In Pad        | Via In Pad        | 0.353          | 0.353          | 0.353          | 0.353          | 0.353          |
| Via Land Diameter (VL)                         | See Land Diameter | See Land Diameter | 0.200 to 0.250 | 0.200 to 0.250 | 0.200 to 0.250 | 0.200 to 0.250 | 0.200 to 0.250 |
| Through Hole Diameter (TH)                     | 0.100 to 0.125    | 0.100 to 0.125    | 0.100 to 0.125 | 0.100 to 0.125 | 0.100 to 0.125 | 0.100 to 0.125 | 0.100 to 0.125 |
| Line Width (L)                                 | 0.075             | 0.075             | 0.075          | 0.075          | 0.075          | 0.075          | 0.075          |
| Line Width (L) If Inner Outer Via's Staggered. | NA                | NA                | NA             | NA             | NA             | NA             | 0.10           |
| Line Space (S)                                 | 0.085             | 0.085             | 0.085          | 0.085          | 0.085          | 0.085          | 0.085          |
| Pad Array                                      | Full              | Full              | Full           | Full           | Full           | Perimeter      | Perimeter      |
| Pad Matrix                                     | 6 x 6             | 9 x 9             | 9x9            | 11x11          | 14x14          | 15x15          | 19x19          |
| Periphery Rows                                 | –                 | –                 | –              | –              | –              | 4, 1, 5        | 2, 2, 7        |

**Table 2a: Recommended PCB Design Guidelines for Actel CS (0.8 mm Pitch BGA) Package**

| Dimension                                   | CS49 | CS128     | CS180     |
|---------------------------------------------|------|-----------|-----------|
| Component Land Pad Diameter (SMD)           | 0.35 | 0.35      | 0.35      |
| Solder Land Diameter (SL)                   | 0.30 | 0.30      | 0.30      |
| Solder Mask Opening Diameter (SM)           | 0.45 | 0.45      | 0.45      |
| Solder Ball Land Pitch (BL)                 | 0.80 | 0.80      | 0.80      |
| Line Width Between Via and Solder Land (LW) | 0.15 | 0.15      | 0.15      |
| Distance Between Via and Solder Land (DL)   | 0.56 | 0.56      | 0.56      |
| Via Land Diameter (VL)                      | 0.50 | 0.50      | 0.50      |
| Through Hole Diameter (TH)                  | 0.25 | 0.25      | 0.25      |
| Pad Array                                   | Full | Perimeter | Perimeter |
| Pad Matrix                                  | 7x7  | 12x12     | 14x14     |
| Periphery Rows                              | –    | 4         | 5         |

**Table 2b: Recommended PCB Design Guidelines for Prototyping Socket of CS Package**

| <b>Dimension</b>                            | <b>CS49<br/>Prototyping Socket.<br/>Actel P/N:<br/>SE-CS49-H</b> | <b>CS128<br/>Prototyping Socket.<br/>Actel P/N:<br/>SE-CS128-H</b> | <b>CS180<br/>Prototyping Socket.<br/>Actel P/N:<br/>SE-CS180-H</b> |
|---------------------------------------------|------------------------------------------------------------------|--------------------------------------------------------------------|--------------------------------------------------------------------|
| Socket Pin Diameter                         | 0.45                                                             | 0.45                                                               | 0.45                                                               |
| Solder Land Diameter (SL)                   | 0.50                                                             | 0.50                                                               | 0.50                                                               |
| Solder Mask Opening Diameter (SM)           | 0.60                                                             | 0.60                                                               | 0.60                                                               |
| Solder Ball Land Pitch (BL)                 | 0.80                                                             | 0.80                                                               | 0.80                                                               |
| Line Width Between Via and Solder Land (LW) | 0.15                                                             | 0.15                                                               | 0.15                                                               |
| Distance Between Via and Solder Land (DL)   | 0.56                                                             | 0.56                                                               | 0.56                                                               |
| Via Land Diameter (VL)                      | 0.50                                                             | 0.50                                                               | 0.50                                                               |
| Through Hole Diameter (TH)                  | 0.25                                                             | 0.25                                                               | 0.25                                                               |
| Pad Array                                   | Full                                                             | Perimeter                                                          | Perimeter                                                          |
| Pad Matrix                                  | 7×7                                                              | 12×12                                                              | 14×14                                                              |
| Periphery Rows                              | –                                                                | 4                                                                  | 5                                                                  |

**Table 3a: Recommended PCB Design Guidelines for Actel FG (1.00 mm Pitch BGA) Package**

| Dimension                                   | FG144 | FG256 | FG324 | FG484 23×23 | FG484     | FG676 | FG896 | FG1152 |
|---------------------------------------------|-------|-------|-------|-------------|-----------|-------|-------|--------|
| Component Land Pad Diameter (SMD)           | 0.40  | 0.45  | 0.45  | 0.45        | 0.45      | 0.45  | 0.45  | 0.45   |
| Solder Land Diameter (SL)                   | 0.35  | 0.40  | 0.40  | 0.40        | 0.40      | 0.40  | 0.40  | 0.40   |
| Solder Mask Opening Diameter (SM)           | 0.50  | 0.55  | 0.55  | 0.55        | 0.55      | 0.55  | 0.55  | 0.55   |
| Solder Ball Land Pitch (BL)                 | 1.00  | 1.00  | 1.00  | 1.00        | 1.00      | 1.00  | 1.00  | 1.00   |
| Line Width Between Via and Solder Land (LW) | 0.15  | 0.15  | 0.15  | 0.15        | 0.15      | 0.15  | 0.15  | 0.15   |
| Distance Between Via and Solder Land (DL)   | 0.70  | 0.70  | 0.70  | 0.70        | 0.70      | 0.70  | 0.70  | 0.70   |
| Via Land Diameter (VL)                      | 0.60  | 0.60  | 0.60  | 0.60        | 0.60      | 0.60  | 0.60  | 0.60   |
| Through Hole Diameter (TH)                  | 0.30  | 0.30  | 0.30  | 0.30        | 0.30      | 0.30  | 0.30  | 0.30   |
| Pad Array                                   | Full  | Full  | Full  | Full        | Perimeter | Full  | Full  | Full   |
| Pad Matrix                                  | 12×12 | 16×16 | 18×18 | 22×22       | 26×26     | 26×26 | 30×30 | 34×34  |
| Periphery Rows                              | –     | –     | –     | –           | 5 + 8×8   | –     | –     | –      |

**Table 3b: Recommended PCB Design Guidelines for Prototyping Socket of FG Package**

| Dimension                                   | FG144 Prototyping Socket.<br>Actel P/N: SE-FG144-H | FG256 Prototyping Socket.<br>Actel P/N: SE-FG256-HU | FG324 Prototyping Socket.<br>Actel P/N: SE-FG324-H | FG484 23×23 Prototyping Socket.<br>Actel P/N: SE-FG484-S-H | FG484 Prototyping Socket.<br>Actel P/N: SE-FG484-H | FG676 Prototyping Socket.<br>Actel P/N: SE-FG676-H | FG896 Prototyping Socket.<br>Actel P/N: SE-FG896 | FG1152 Prototyping Socket.<br>Actel P/N: SE-FG1152 |
|---------------------------------------------|----------------------------------------------------|-----------------------------------------------------|----------------------------------------------------|------------------------------------------------------------|----------------------------------------------------|----------------------------------------------------|--------------------------------------------------|----------------------------------------------------|
| Socket Pin Diameter                         | 0.45                                               | 0.45                                                | 0.45                                               | 0.45                                                       | 0.45                                               | 0.45                                               | 0.45                                             | 0.45                                               |
| Solder Land Diameter (SL)                   | 0.58                                               | 0.58                                                | 0.58                                               | 0.58                                                       | 0.58                                               | 0.58                                               | 0.58                                             | 0.58                                               |
| Solder Mask Opening Diameter (SM)           | 0.73                                               | 0.73                                                | 0.73                                               | 0.73                                                       | 0.73                                               | 0.73                                               | 0.73                                             | 0.73                                               |
| Solder Ball Land Pitch (BL)                 | 1.00                                               | 1.00                                                | 1.00                                               | 1.00                                                       | 1.00                                               | 1.00                                               | 1.00                                             | 1.00                                               |
| Line Width Between Via and Solder Land (LW) | 0.15                                               | 0.15                                                | 0.15                                               | 0.15                                                       | 0.15                                               | 0.15                                               | 0.15                                             | 0.15                                               |
| Distance Between Via and Solder Land (DL)   | 0.70                                               | 0.70                                                | 0.70                                               | 0.70                                                       | 0.70                                               | 0.70                                               | 0.70                                             | 0.70                                               |
| Via Land Diameter (VL)                      | 0.60                                               | 0.60                                                | 0.60                                               | 0.60                                                       | 0.60                                               | 0.60                                               | 0.60                                             | 0.60                                               |
| Through Hole Diameter (TH)                  | 0.30                                               | 0.30                                                | 0.30                                               | 0.30                                                       | 0.30                                               | 0.30                                               | 0.30                                             | 0.30                                               |
| Pad Array                                   | Full                                               | Full                                                | Full                                               | Full                                                       | Perimeter                                          | Full                                               | Full                                             | Full                                               |
| Pad Matrix                                  | 12×12                                              | 16×16                                               | 18×18                                              | 22×22                                                      | 26×26                                              | 26×26                                              | 30×30                                            | 34×34                                              |
| Periphery Rows                              | –                                                  | –                                                   | –                                                  | –                                                          | 5 + 8×8                                            | –                                                  | –                                                | –                                                  |

**Table 4a: Recommended PCB Design Guidelines for Actel BG (1.27 mm Pitch BGA) Package**

| Dimension                                   | BG272     | BG313     | BG329     | BG456     | BG729 |
|---------------------------------------------|-----------|-----------|-----------|-----------|-------|
| Component Land Pad Diameter (SMD)           | 0.63      | 0.63      | 0.63      | 0.63      | 0.63  |
| Solder Land Diameter (SL)                   | 0.58      | 0.58      | 0.58      | 0.58      | .058  |
| Solder Mask Opening Diameter (SM)           | 0.73      | 0.73      | 0.73      | 0.73      | 0.73  |
| Solder Ball Land Pitch (BL)                 | 1.27      | 1.27      | 1.27      | 1.27      | 1.27  |
| Line Width Between Via and Solder Land (LW) | 0.15      | 0.15      | 0.15      | 0.15      | 0.15  |
| Distance Between Via and Solder Land (DL)   | 0.80      | 0.80      | 0.80      | 0.80      | 0.80  |
| Via Land Diameter (VL)                      | 0.60      | 0.60      | 0.60      | 0.60      | 0.60  |
| Through Hole Diameter (TH)                  | 0.30      | 0.30      | 0.30      | 0.30      | 0.30  |
| Pad Array                                   | Perimeter | Staggered | Perimeter | Perimeter | Full  |
| Pad Matrix                                  | 20×20     | 25×25     | 23×23     | 26×26     | 27×27 |
| Periphery Rows                              | 4 + 4×4   | —         | 4 + 5×5   | 5 + 6×6   | —     |

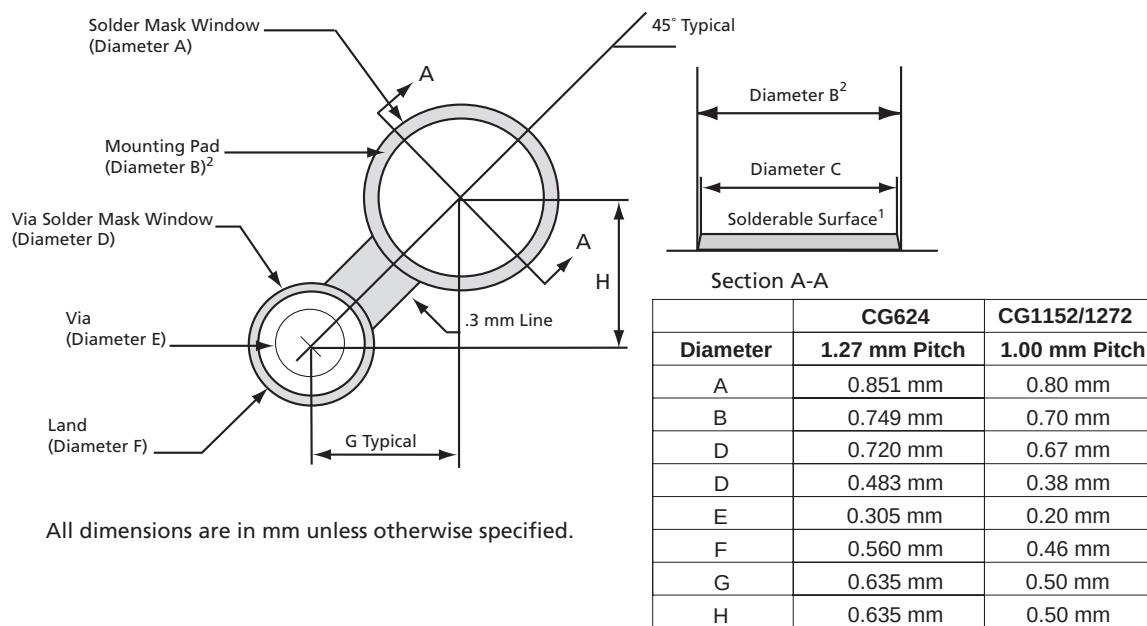
**Table 4b: Recommended PCB Design Guidelines for Prototyping Socket of BG Package**

| Dimension                                   | BG272<br>Prototyping<br>Socket.<br>Actel P/N:<br>SM-BG272-B | BG313<br>Prototyping<br>Socket.<br>Actel P/N:<br>SM-BG313-B | BG329<br>Prototyping<br>Socket.<br>Actel P/N:<br>SM-BG329-B | BG456<br>Prototyping<br>Socket.<br>Actel P/N:<br>SM-BG456-B | BG729<br>Prototyping<br>Socket.<br>Actel P/N:<br>SE-BG729 |
|---------------------------------------------|-------------------------------------------------------------|-------------------------------------------------------------|-------------------------------------------------------------|-------------------------------------------------------------|-----------------------------------------------------------|
| Socket Pin Diameter                         | 0.55                                                        | 0.55                                                        | 0.55                                                        | 0.55                                                        | 0.55                                                      |
| Solder Land Diameter (SL)                   | 0.58                                                        | 0.58                                                        | 0.58                                                        | 0.58                                                        | .058                                                      |
| Solder Mask Opening Diameter (SM)           | 0.73                                                        | 0.73                                                        | 0.73                                                        | 0.73                                                        | 0.73                                                      |
| Solder Ball Land Pitch (BL)                 | 1.27                                                        | 1.27                                                        | 1.27                                                        | 1.27                                                        | 1.27                                                      |
| Line Width Between Via and Solder Land (LW) | 0.15                                                        | 0.15                                                        | 0.15                                                        | 0.15                                                        | 0.15                                                      |
| Distance Between Via and Solder Land (DL)   | 0.80                                                        | 0.80                                                        | 0.80                                                        | 0.80                                                        | 0.80                                                      |
| Via Land Diameter (VL)                      | 0.60                                                        | 0.60                                                        | 0.60                                                        | 0.60                                                        | 0.60                                                      |
| Through Hole Diameter (TH)                  | 0.30                                                        | 0.30                                                        | 0.30                                                        | 0.30                                                        | 0.30                                                      |
| Pad Array                                   | Perimeter                                                   | Staggered                                                   | Perimeter                                                   | Perimeter                                                   | Full                                                      |
| Pad Matrix                                  | 20×20                                                       | 25×25                                                       | 23×23                                                       | 26×26                                                       | 27×27                                                     |
| Periphery Rows                              | 4 + 4×4                                                     | —                                                           | 4 + 5×5                                                     | 5 + 6×6                                                     | —                                                         |

**Figure 2: Recommended PCB Design Guidelines for Actel CCGA (Ceramic Column Grid Array, or CG) Package**

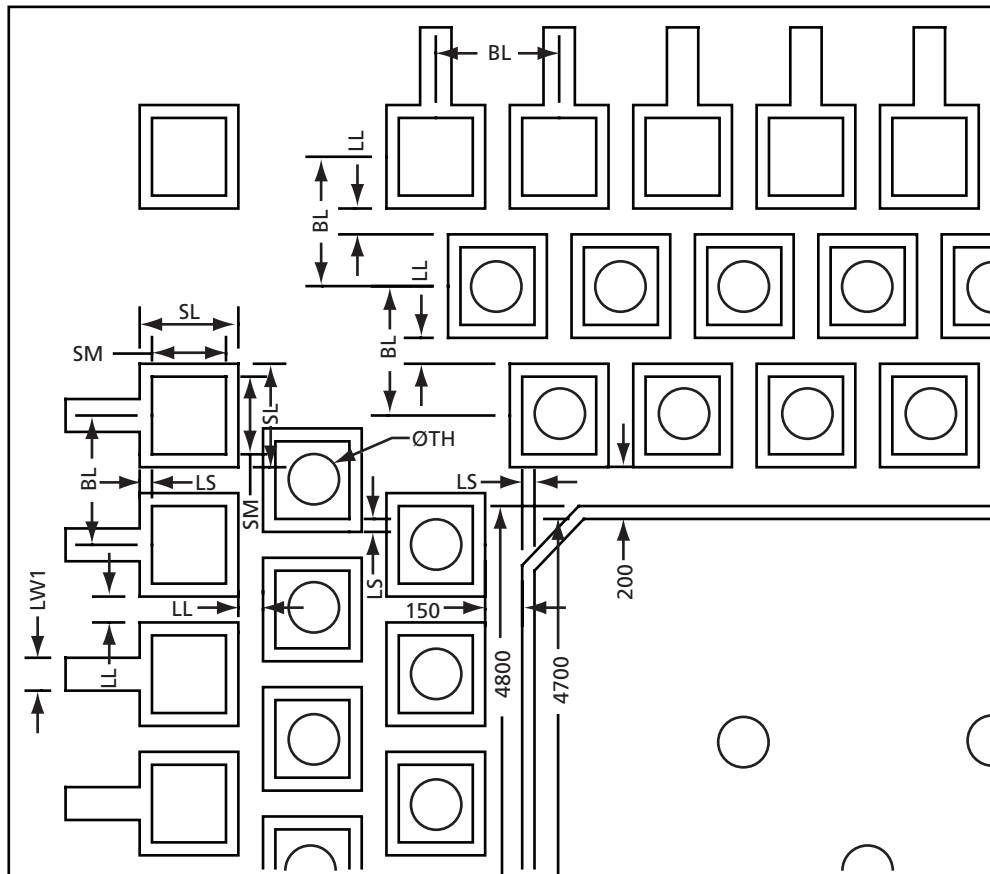
**Table 5: Recommended PCB Design Guidelines for Actel CCGA (Ceramic Column Grid Array, or CG) Package**

The recommended guidelines for the 1.27 mm pitch package pertain to the Actel CG624 package, the CG624 to FG484 Adapter Socket, and the CG624 to FG896 Adapter Socket. The 1.00 mm pitch recommendations relate to the Actel CG1152 and CG1272 packages.



**Notes:**

1. Functional surface
2. Normal diameter at Copper/Polyimide interface with typical edge angle



**Note:** This suggested board layout is for SMD. To use NSMD, swap SL and SM dimensions.

Figure 3: **Suggested Board Layout of Soldered Pads for QFN (Top) Packages**



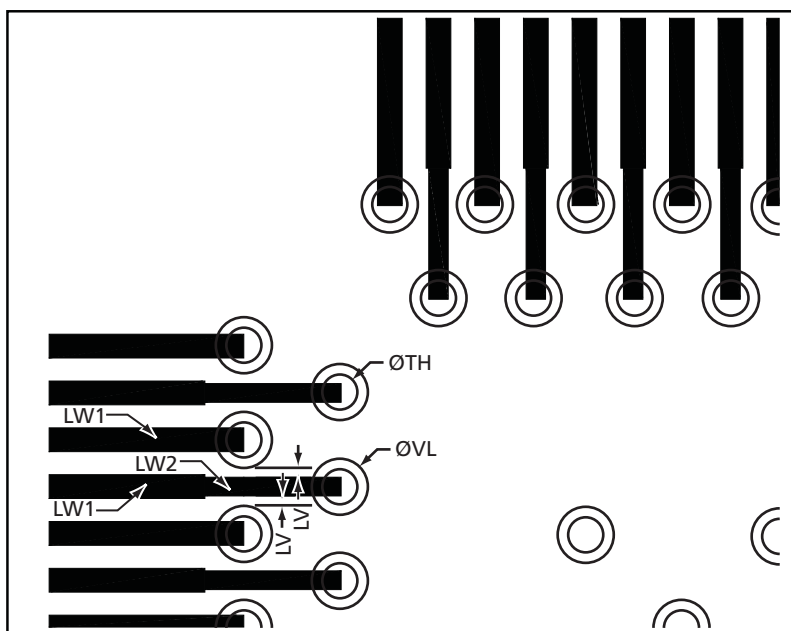
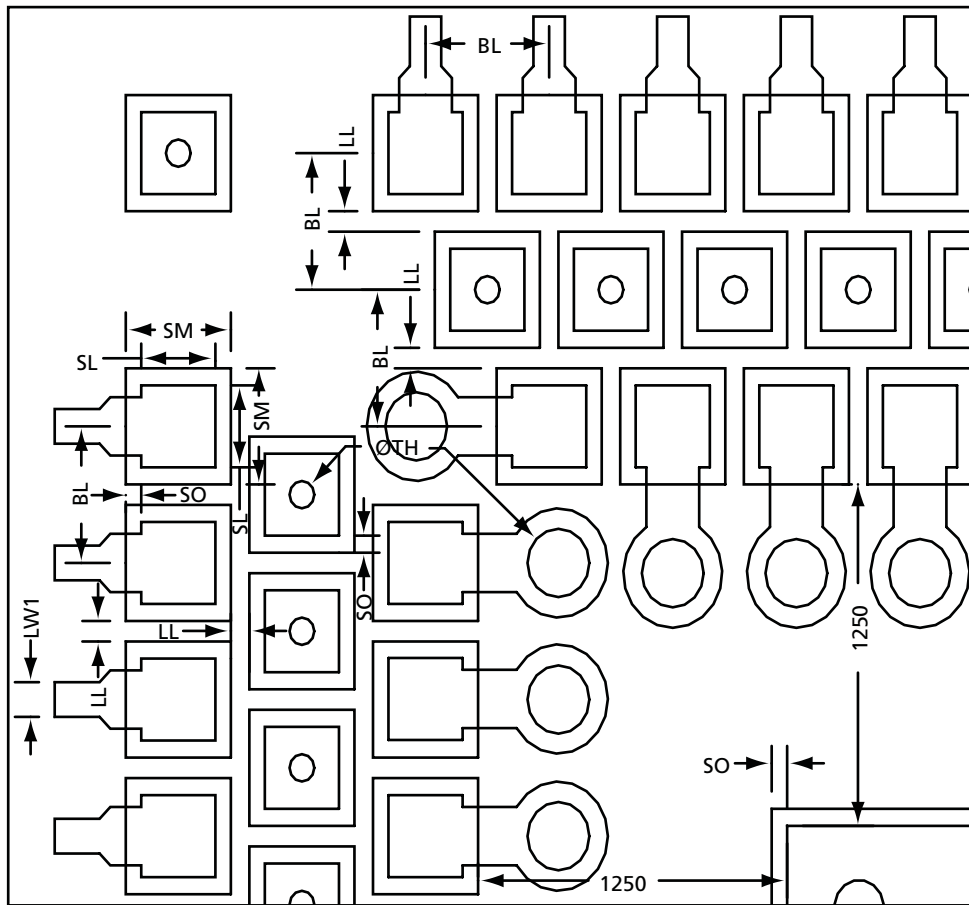


Figure 4: Suggested Board Layout of Soldered Pads for QFN (Bottom) Packages



**Figure 5: Suggested Board Layout of Soldered Pads for QFN Packages (PCB Bottom Layer)**

This Suggested board layout is for reduced thermal pad, NSMD, to use SMD swap SL and SM dimensions.

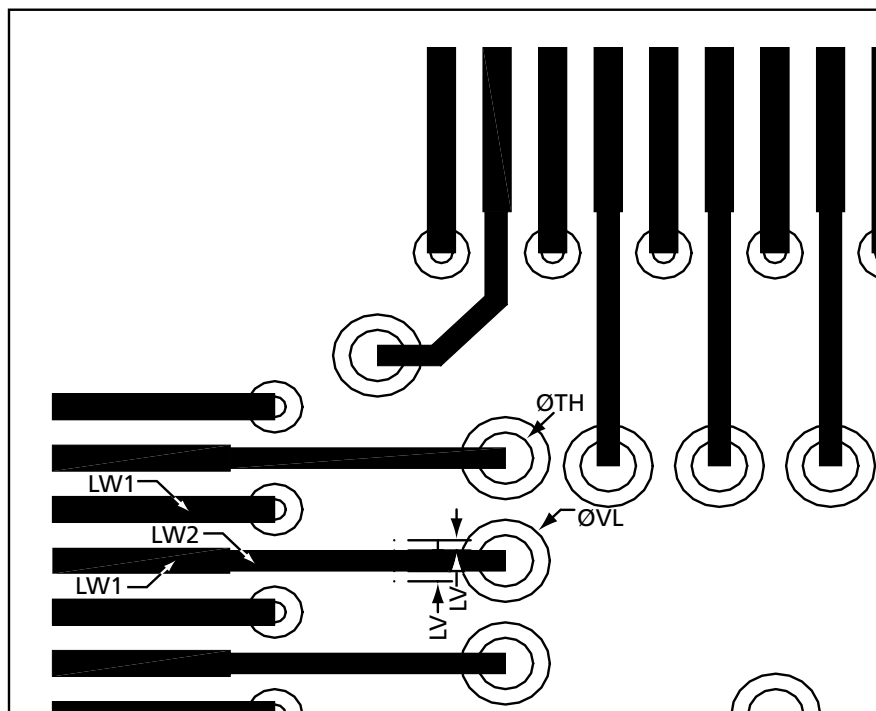


Figure 6: Suggested Board Layout of Soldered Pads for QFN Packages (PCB Bottom Layer), Reduced Thermal Pad

Table 6 contains the recommended Guidelines for board layout soldered pad dimension for Actel QN (0.5 mm pitch QFN) packages only.

Table 6: Recommended QFN Design Guidelines

| Dimension                                      | QN68*         | QN108         | QN132         | QN180         |
|------------------------------------------------|---------------|---------------|---------------|---------------|
| Component Land Pad Diameter (SMD)              | 0.200/0.400   | 0.3           | 0.3           | 0.3           |
| Solder Land Diameter (SL)                      | 0.200/0.400   | 0.3           | 0.3           | 0.3           |
| Solder Mask Opening Diameter (SM)              | 0.300/0.500   | 0.425         | 0.425         | 0.425         |
| Solder Land To Solder Land (LL)                | 0.075         | 0.075         | 0.075         | 0.075         |
| Solder Mask Overlap (SO)                       | 0.0625        | 0.0625        | 0.0625        | 0.0625        |
| Solder Land Pitch (BL)                         | 0.400         | 0.5           | 0.5           | 0.5           |
| Line Width Between Via and Via Land (LW2)      | N/A           | 0.1           | 0.1           | 0.1           |
| Line Width Between Via out side Via Land (LW1) | 0.127         | 0.127         | 0.127         | 0.127         |
| Line to Via Land (LV)                          | N/A           | 0.050 - 0.100 | 0.050 - 0.100 | 0.050 - 0.100 |
| Via Land Diameter (VL)                         | N/A           | 0.250 - 0.400 | 0.250 - 0.400 | 0.250 - 0.400 |
| Through Hole Diameter (TH)                     | N/A           | 0.100 - 0.250 | 0.100 - 0.250 | 0.100 - 0.250 |
| Die Attach Pad (DP)                            | 2.920 x 2.920 | 4.700 x 4.700 | 5.700 x 5.700 | 6.300 x 6.300 |
| Pad Array                                      | Perimeter     | Perimeter     | Perimeter     | Perimeter     |
| Body Size                                      | 8x8           | 8x8           | 8x8           | 10x10         |
| Periphery Rows                                 | 1             | 2             | 3             | 3             |

**Note:** \*Component Land Pad and Solder Lands are rectangular, longest dimension is perpendicular to package edge.

## PCB Land Pattern Design File

You can download the [QN132 PCB Land Patter design file](http://www.actel.com/documents/PCB_QN132_DF.zip) from Actel's website. This can be used to assist the layout of the board. Download the file from [http://www.actel.com/documents/PCB\\_QN132\\_DF.zip](http://www.actel.com/documents/PCB_QN132_DF.zip).

## List of Changes

The following table lists critical changes that were made in the current version of the document.

| Previous Version | Changes in Current Version                                                                                                                                                                       | Page    |
|------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|
| 55700007-6/7.08* | Table 1a: Recommended PCB design guidelines for Actel CS (0.5 mm pitch BGA) package was updated to include uC36 data.                                                                            | page 3  |
| 55700007-5/3.08* | Table 1a: Recommended PCB design guidelines for Actel CS (0.5 mm pitch BGA) package was updated to include uC81 data.                                                                            | page 3  |
|                  | Table 6: Recommended QFN Design Guidelines was updated to include QN68 data.                                                                                                                     | page 11 |
| 55700007-4/2.08* | Table 1a: Recommended PCB design guidelines for Actel CS (0.5 mm pitch BGA) package was updated to include CS201 and CS281.                                                                      | page 3  |
|                  | Figure 5:Suggested Board Layout of Soldered Pads for QFN Packages (PCB Bottom Layer) This Suggested board layout is for reduced thermal pad, NSMD, to use SMD swap SL and SM dimensions. is new. | page 10 |
|                  | Figure 6:Suggested Board Layout of Soldered Pads for QFN Packages (PCB Bottom Layer), Reduced Thermal Pad is new.                                                                                | page 11 |
|                  | Table 6: Recommended QFN Design Guidelines was updated.                                                                                                                                          | page 11 |

**Note:** \*The part number is located on the last page of the document.

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