APPLICATION NOTE

# Application Note 105

## Recommended Land Patterns for QFN Devices

## Introduction

Application Note 102 applies to all packaged SMT devices that Custom MMIC deliver. This Application Note documents the recommended PCB Land Pattern, Solder Mask, and Solder Stencil designs for the QFN SMT devices.

The information provided in this application note is for reference only. Users are advised to optimize their own PCB level design in order to obtain proper solder reflow and device attach.

Custom MMIC recommends using a NSMD (Non Solder Mask Defined) land pattern due to tighter tolerance on copper etching than SMD land pattern. NSMD also provides a larger copper pad area and allows the solder to adhere to the edges of the pad providing improved solder joint attachment and reliability.

It should be emphasized that these guidelines are general in nature and should be considered a starting point only. The end user must apply their experience and development efforts to optimize their design and manufacturing processes to meet their specific application.

## General PCB Land Pattern Guidelines

The exposed PCB metal I/O pads should be designed to be 0.2mm to 0.5mm longer than the device I/O pads. Inward corners may be rounded to match the device I/O pad. The I/O land width should match the device I/O pad width, 1:1 ratio.

The PCB thermal land pad should be designed with multiple vias so that that when the thermal pad is properly soldered, it will connect the exposed pad of the device to a metal plane in order to improve the thermal dissipation of the device during operation. The thermal land pattern should match a 1:1 ratio with the exposed thermal pad of the device.

Please review the drawings on the following pages for recommended PCB land pattern designs.

## General Solder Mask Design Guidelines

Two types of solder mask land patterns are used for SMT devices; Solder Mask Defined (SMD), where the solder mask openings are smaller than the metal pads, and Non-Solder Mask Defined (NSMD), where the openings are larger than the metal pads. Better control of the copper etching process as compared to the solder masking process makes NSMD the preferable design. The SMD pad definition can also introduce stress concentrations near the solder mask overlap region that can result in solder joints cracking under extreme fatigue conditions. NSMD design improves the reliability of solder joints as solder is allowed to “wrap around” the sides of the metal pads on the board.

Custom MMIC recommends a non-solder mask defined design where the solder mask openings are slightly larger than the land pattern metal pads. The solder mask opening should be about 120um to 150um larger than the metal pad, providing a 60um to 75um clearance between the pad and solder mask. Rounded pads should have matching rounded solder mask openings.

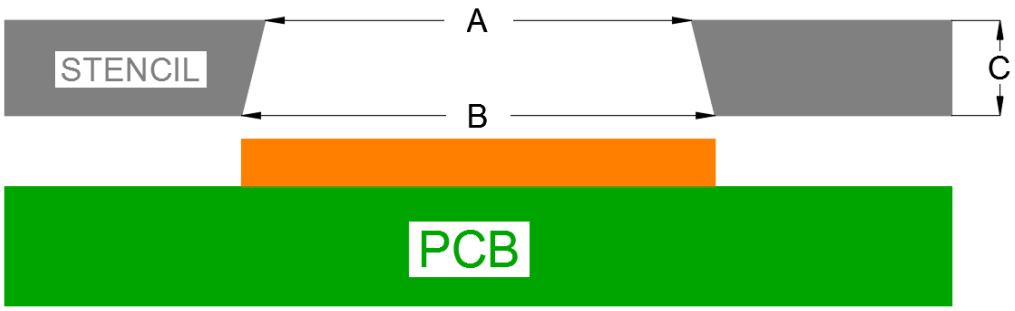
For package sizes with the thermal pad size near the maximum size for the package, the gap between the thermal pad and the exposed I/O pads may not be wide enough to minimize solder bridging concerns. In this case, we recommend a SMD design for the thermal pad solder mask. The solder mask should be 100um smaller than the thermal pad on both sides, which increases the solder mask web between the thermal pad and the exposed I/O pads.

There are several options available for the thermal vias in order to prevent solder from wicking away from the thermal pad into the vias and creating potential solder voids under the thermal land pad. The vias can be plugged or tented with solder mask either from the top or bottom surface. The vias can also be filled with a conductive or non-conductive material. To maximize thermal dissipation performance, we recommend using copper filled vias to improve heat dissipation from the device thermal pad to the ground plane.

Please review the drawings on the following pages for recommended solder mask opening designs. The end user must apply their experience and development efforts to optimize their solder mask design to meet their specific application.

## General Solder Stencil Design Guidelines

Custom MMIC recommends using a stainless steel stencil with electropolished trapezoidal walls to minimize surface friction in order for a clean paste release. Please see the Figure below;



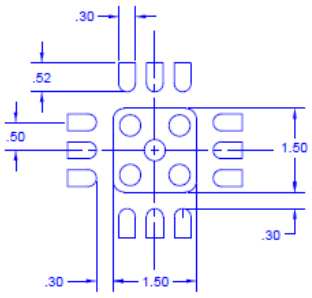

The stencil aperture opening should be a 1:1 ratio to the metal pad. In the illustration above, dimension “B” is equal to the metal pad width, dimension “A” is equal to 90% of dimension “B”, and dimension “C” is typically 100 um to 150 um. Actual thickness will depend on other components on the board.

If the thermal pad of the device is larger than 2 mm X 2 mm, the stencil aperture for the thermal pad area may need to be designed as an array of openings instead of one large opening. In this case, the total open area of the stencil should equal 50% to 60% of the total area of the exposed metal thermal pad of the device. This will allow proper solder flow with minimal voiding, and eliminate the potential for the device to “float” on excessive solder. Custom MMIC recommends a “window pane” design be utilized for any device with a device thermal pad larger than 2 mm X 2 mm.

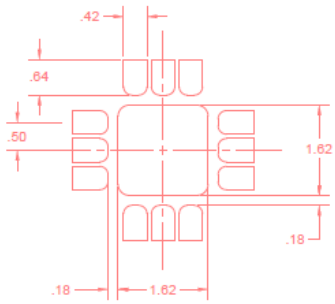
It should be emphasized that these guidelines are general in nature and should be considered a starting point only. The end user must apply their experience and development efforts to optimize their design and manufacturing processes to meet their specific application.

Please review the drawings on the following pages for recommended solder stencil pattern designs.

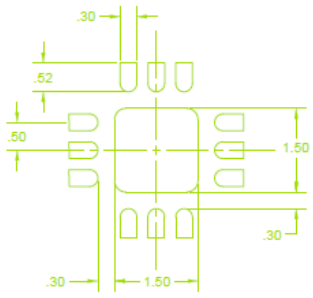
## Ceramic QFN 3x3 mm x 12 leads




METALIZATION

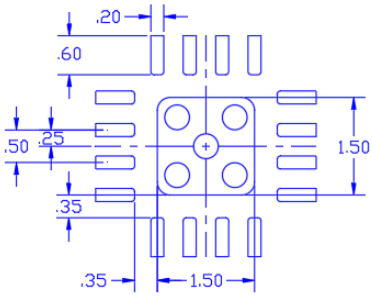



SOLDER MASK




SOLDER STENCIL

## Plastic QFN 3x3 mm x 16 leads

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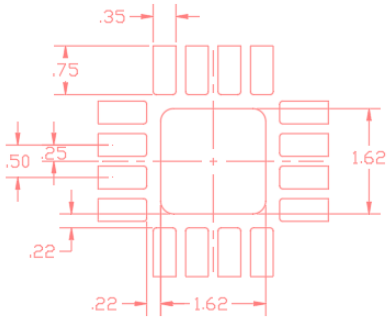
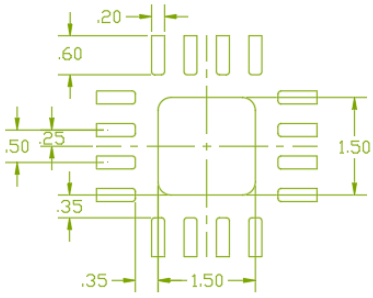
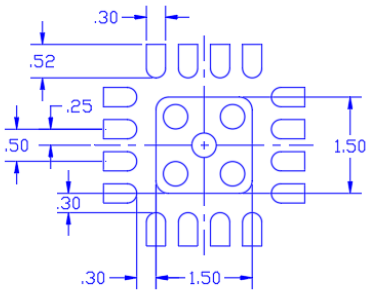



SOLDER MASK




SOLDER STENCIL

## Ceramic QFN 3x3 mm x 16 leads

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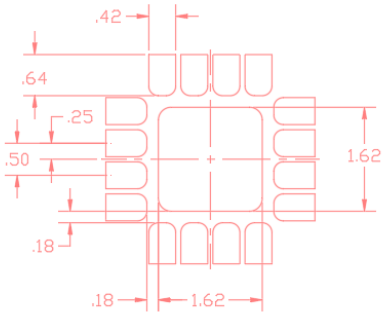


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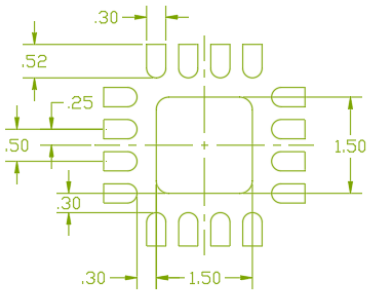
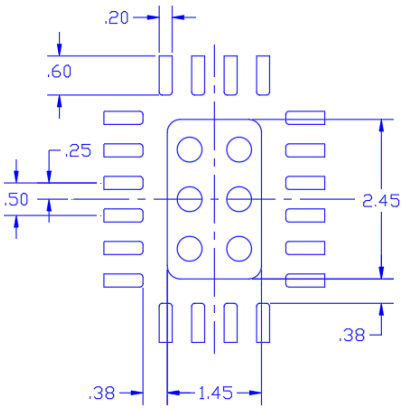



SOLDER STENCIL

## Plastic QFN 3x4 mm x 20 leads

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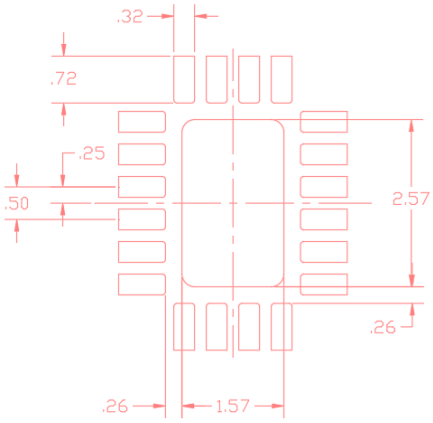


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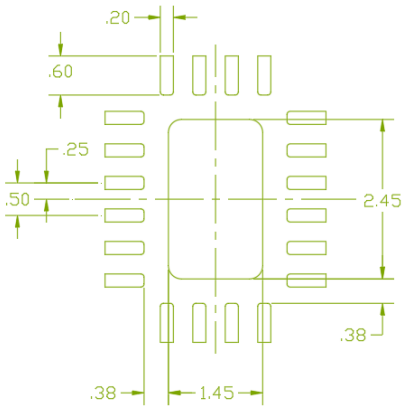
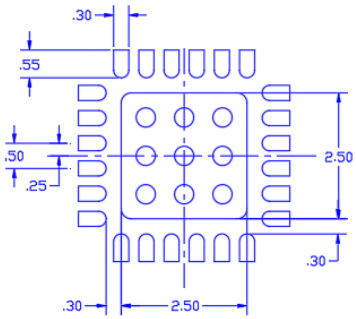



SOLDER STENCIL

## Ceramic QFN 4x4 mm x 24 leads

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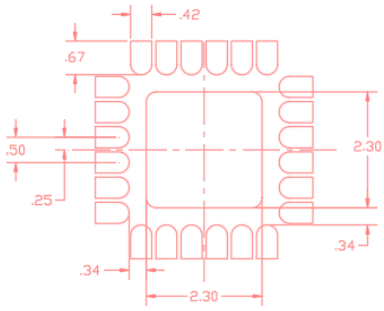


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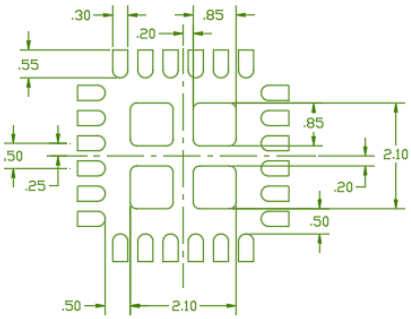
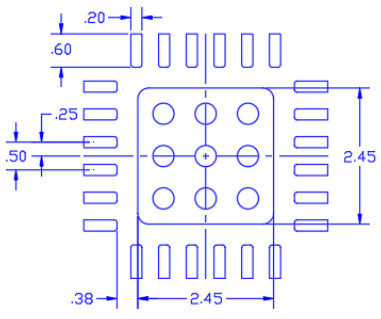



SOLDER STENCIL

## Plastic QFN 4x4 mm x 24 leads

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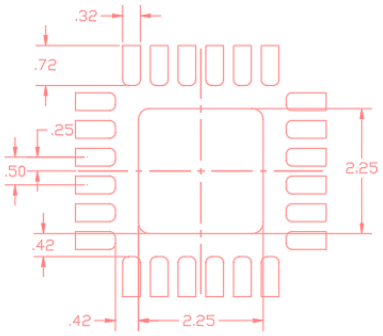


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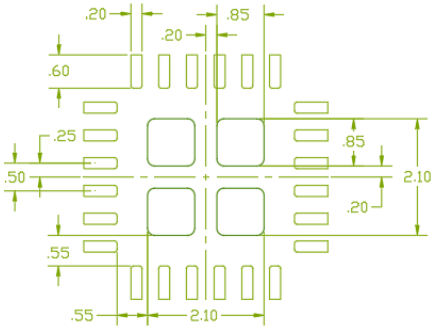


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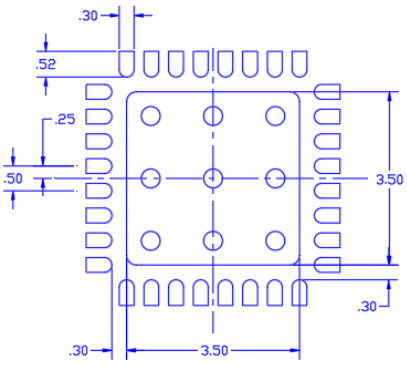
## Ceramic QFN 5x5 mm x 32 leads

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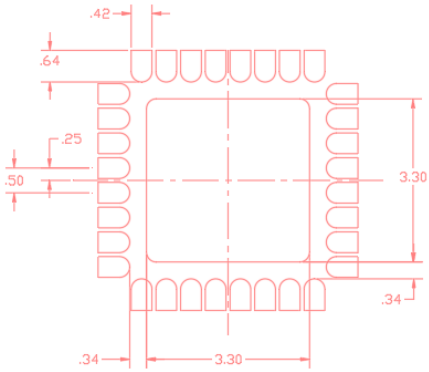


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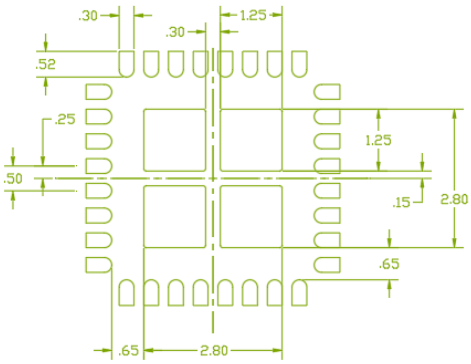


SOLDER STENCIL

## Additional Information

For information on ESD, Soldering Profiles, Packaging Standards, Handling and Assembly, please contact Qorvo for general guidelines.

## Contact Information

For the latest specifications, additional product information, worldwide sales and distribution locations:
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