PCB Land Design and Surface Mount for DFN3x2 and DFN3x3 Punched Packages

Introduction

DFN package is a plastic encapsulated package with a copper lead frame substrate. It offers near chip scale footprint, thin profile, low weight and good thermal and electrical performance. Electrical contact to the PCB is made by soldering perimeter leads to PCB. There is no die attach pad exposed on the bottom surface of the package, which provides more flexible PCB level circuitry routing and in some cases, more thermal resistance for the heat conduction from PCB to component.

PCB Land Design

The PCB lands should be a little bit larger than the package's perimeter leads. Inward corners may be rounded to match leads shape. Dimension guidelines are shown in Appendices for various DFN packages.

For I/O lead solder land design, we suggest to use a Non Solder Mask Defined (NSMD) approach, remain a small amount of solder mask between the I/O leads to avoid solder bridging. The outward extension can be increased beyond 0.15 mm as this could potentially improve this external solder joint. The minimum inward extension is 0.05mm. The PCB land width should be 0.05 mm wider than lead width.

Solder Mask Design

For surface mount package, two types of stencil designs are used
1, Solder Mask Defined (SMD): solder mask openings smaller than metal pads.
2, Non-Solder Mask Defined (NSMD): solder mask openings lager than metal pads

For the perimeter I/O lands, NSMD is recommended; it improves the reliability of solder joints as this allows the solder to wrap around the sides of the metal pads.

0.125-0.150 mm thick stainless steel stencil is recommended for solder past application. The aperture walls should be trapezoidal and the corners are rounded for better paste release.

For the perimeter I/O lands, the stencil opening should be 0.05mm lager than the PCB land (0.025mm in each direction)

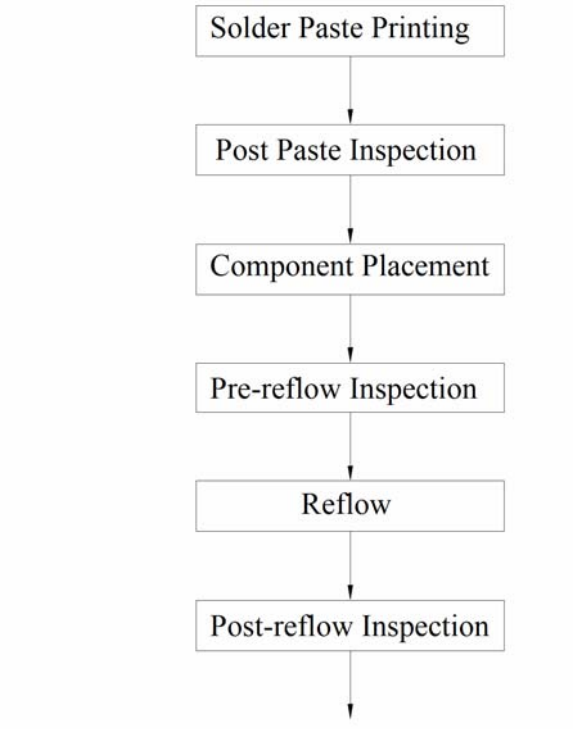
The recommended solder mask design is shown in Appendices for various DFN packages.

Solder Paste and Reflow Profile

Because DFN packages have a low profile and small terminal pitch, a No Clean, Type 3 solder paste and convection/IR reflow is recommended.

Refer to industrial standard lead free reflow profile, which can be used as starting point, the actual profile used will depend on the entire populated board and the solder used.

Surface Mount Assembly Flow



Rework Guidelines

After PCB assembly, the package should be inspected in transmission x-ray for the presence of voids, solder balling, or other defects underneath the package. Cross sectioning may also be required to determine the fillet shape and size, and the joint standoff height. Since solder joints are not fully exposed, any retouch is limited to the side fillet. For defects underneath the package, the whole package has to be removed. Rework of packages can be a challenge due to their small size, and in most applications, it will be mounted on smaller, thinner, and denser PCBs that introduce further challenges due to handling and heating issues. The following process provides a guideline and a starting point for the development of a successful rework process for this package.

Bake

Prior to any rework, it is strongly recommended that the PCB assembly be baked for at least 4 hours at 125C to remove any residual moisture from the assembly.

Component Removal

The first step in removal of component is the reflow of solder joints. The reflow profile for part removal should be same as the one used for component attachment. However, the time above liquidus can be reduced as long as the reflow is complete.

In the removal process, it is recommended that the board should be heated from the bottom side using convective heaters and hot gas or air should be used on the top side of the component. Special nozzles should be used to direct the heating in the component area and heating of adjacent components should be minimized. Excessive airflow should be avoided; air velocity of 15-20 liters per minutes is a good starting point. The PCB and components being removed should reach at least $55\pm5C^0$ before applying the hot gas. The hot gas temperature can be approximately $425C^0$. The hot gas can be applied with nozzle tip approximately 15-25 mm away from the component in a circular motion to bring the component and underlying solder to reflow temperature. As reflow temperature is approached it is sometimes useful to apply the heat edge on to the component in order to try and get the heat to go under the package to reflow the large thermal land. It is also helpful to wedge a tweezer tip under a corner of the component and supply a slight upward force so when the thermal land begins to reflow the component will lift up

Once the joints have reflowed, remove the component with a vacuum lift-off or tweezer. Because of their small size the vacuum pressure should be kept below 15 inch of Hg. This will avoid the land liftoff if all joints have not been reflowed and component is not lifted out.

Site Redress

After the component has been removed, the site needs to be cleaned properly. It is best to use a combination of a blade-style conductive tool and desoldering braid. The width of the blade should be matched to the maximum width of the footprint and the blade temperature should be low enough not to cause any damage to the circuit board. Once the residual solder has been removed, the lands should be cleaned with a solvent. The solvent is usually specific to the type of paste used in the original assembly and paste manufacturer’s recommendation should be followed.

Solder Paste Printing

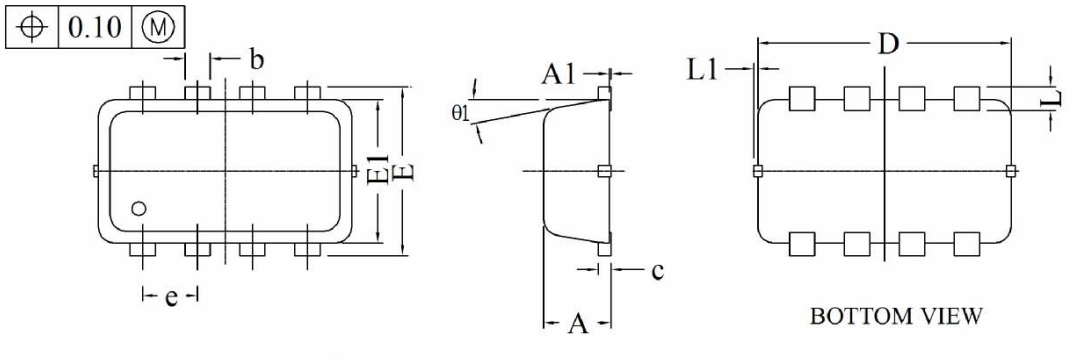
Because of their small size and finer pitches, solder paste deposition requires extra care. However, a uniform and precise deposition can be achieved if miniature stencil to the component is used. The stencil aperture should be aligned with the pads under 50 to 100X magnification. The stencil should then be lowed onto the PCB and the paste should be deposited with a small metal squeegee blade. Alternative, the mini stencil can be used to print paste on the package side. No-clean flux should be used, as small standoff of package does not leave much room for cleaning.

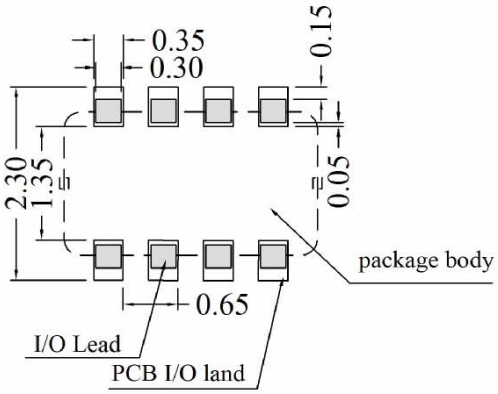
Component Placement and Attachment

This package is expected to have a superior self-centering ability due to their small mass. As the leads are on the underneath of the package, split-beam optical system should be used to align the component on the board. This will form an image of leads overlaid on the mating footprint and aid in proper alignment. Again, the alignment should be done at 50 to 100X magnification. This placement machine should have the capability of allowing fine adjustments in X, Y and rotational axes. The reflow profile developed during original attachment or removal should be used to attach the new component.

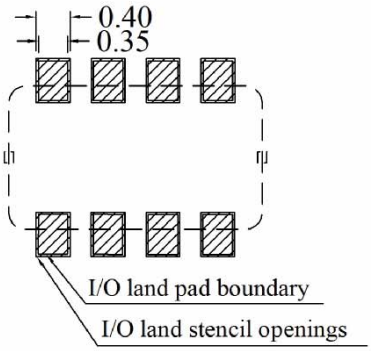
This guideline is general and only for customer reference. The customer must apply their experiences to optimize the PCB and solder mask design, and perform assembly process according to actual components, board and materials used.

Appendix A: DFN3x2-A (AON4404, AON4409, AON4604, AON4605, AON4703)





Recommended Land Pattern
Unit: mm

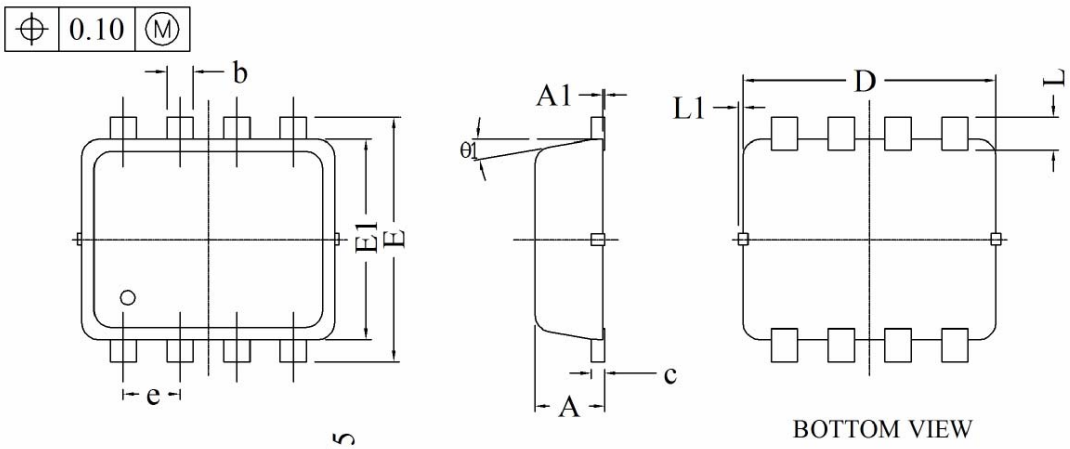


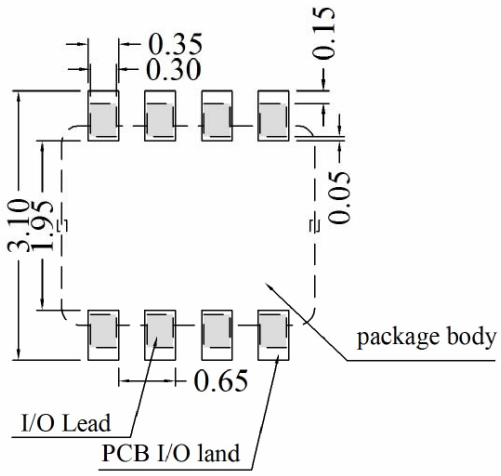
Suggested Stencil Design

NOTE
1. PAKCAGE BODY SIZES EXCLUDE MOLD FLASH AND GATE BURRS.
MOLD FLASH AT THE NON-LEAD SIDES SHOULD BE LESS THAN 6 MILS.
2. CONTROLLING DIMENSION IS MILLIMETER.
CONVERTED INCH DIMENSIONS ARE NOT NECESSARILY EXACT.

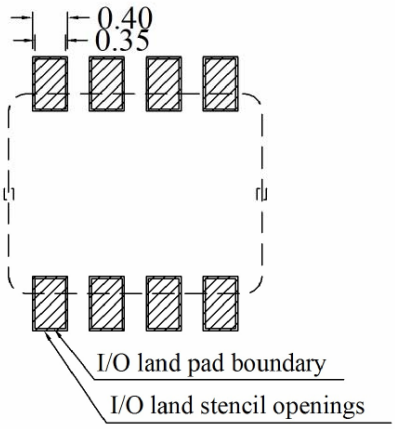
SYMBOLS	DIMENSIONS IN MILLIMETERS			DIMENSIONS IN INCHES		
	MIN	NOM	MAX	MIN	NOM	MAX
A	0.70	0.80	0.90	0.028	0.031	0.035
A1	0.00	——	0.05	0.000	——	0.002
b	0.24	0.30	0.35	0.009	0.012	0.014
c	0.08	0.15	0.25	0.003	0.006	0.010
D	3.00 BSC			0.118 BSC		
E	2.00 BSC			0.079 BSC		
E1	1.70 BSC			0.067 BSC		
e	0.65 BSC			0.026 BSC		
L	0.20	0.28	0.40	0.008	0.011	0.016
L1	0	——	0.10	0	——	0.004
θ1	0°	10°	12°	0°	10°	12°

Appendix B: DFN3x3-A (AON3603, AON3404)





Recommended Land Pattern
Unit: mm

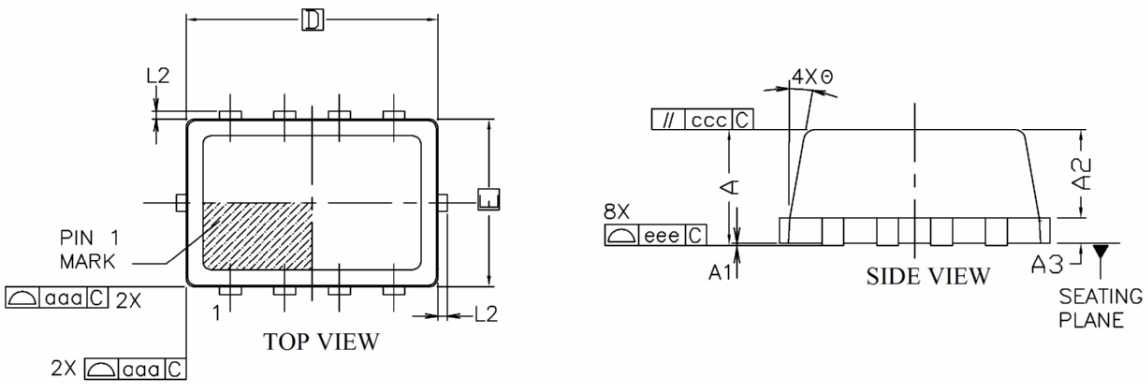


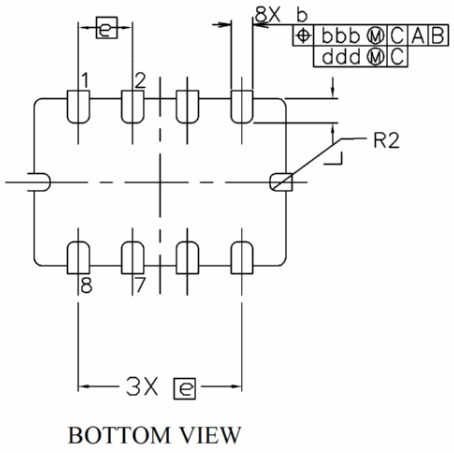
Suggested Stencil Design

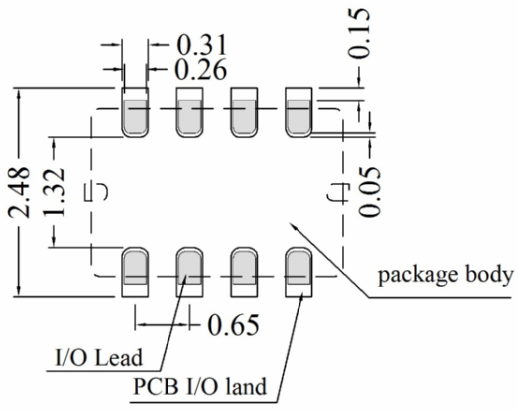
NOTE
1. PAKCAGE BODY SIZES EXCLUDE MOLD FLASH AND GATE BURRS.
MOLD FLASH AT THE NON-LEAD SIDES SHOULD BE LESS THAN 6 MILS.
2. CONTROLLING DIMENSION IS MILLIMETER.
CONVERTED INCH DIMENSIONS ARE NOT NECESSARILY EXACT.

SYMBOLS	DIMENSIONS IN MILLIMETERS			DIMENSIONS IN INCHES		
	MIN	NOM	MAX	MIN	NOM	MAX
A	0.70	0.80	0.90	0.028	0.031	0.035
A1	0.00	---	0.05	0.000	---	0.002
b	0.24	0.30	0.35	0.009	0.012	0.014
c	0.08	0.15	0.25	0.003	0.006	0.010
D	2.90 BSC			0.114 BSC		
E	2.80 BSC			0.110 BSC		
E1	2.30 BSC			0.091 BSC		
e	0.65 BSC			0.026 BSC		
L	0.20	0.38	0.45	0.008	0.015	0.018
L1	0	---	0.10	0	---	0.004
θ1	0°	10°	12°	0°	10°	12°

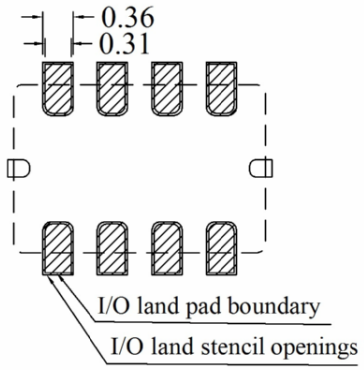
Appendix C: DFN3x2 (AON4402, AON4405, AON4602, AON4603, AON4701)







Recommended Land Pattern
Unit: mm



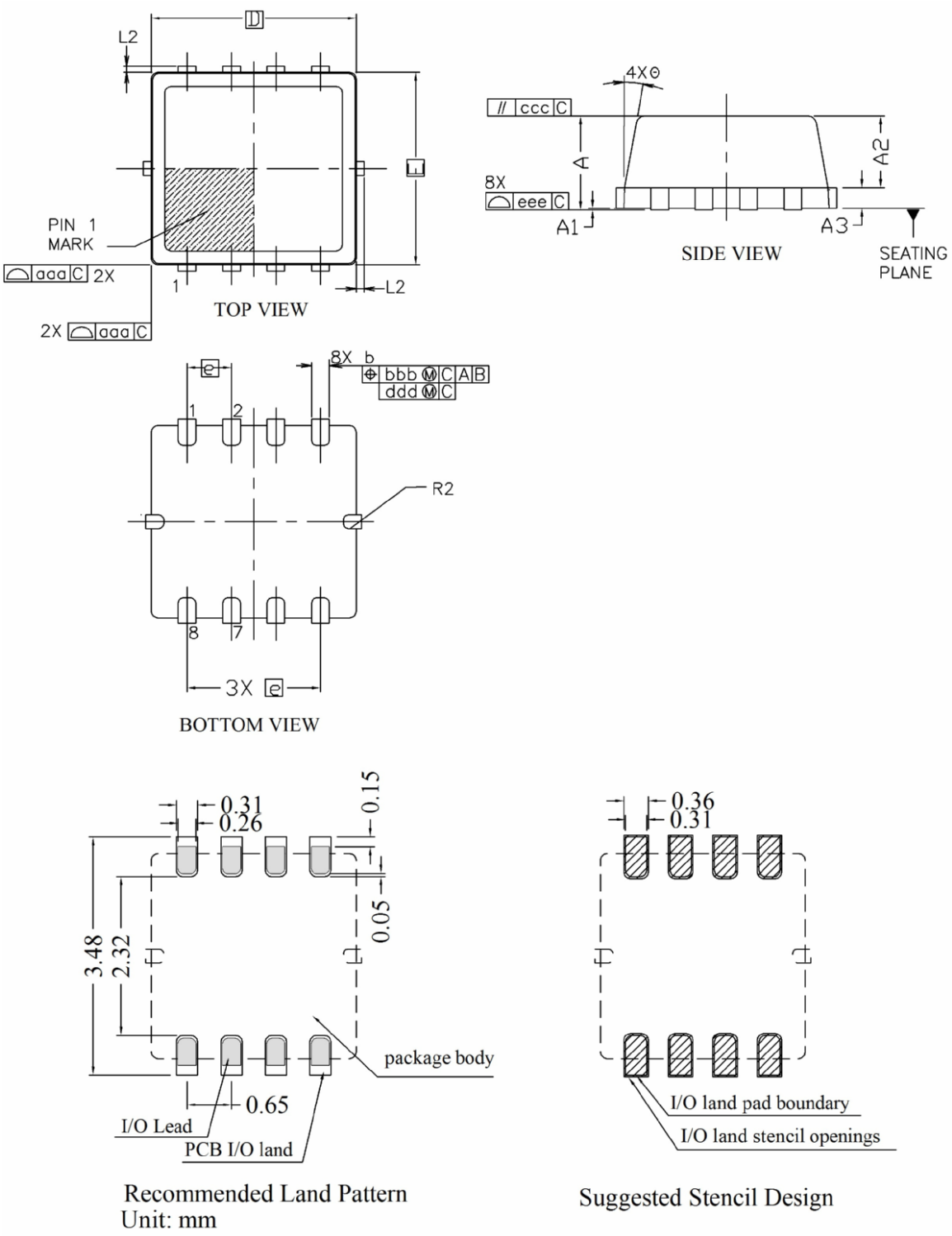
Suggested Stencil Design

SYMBOL	DIMENSIONS IN MILLIMETERS			DIMENSIONS IN INCHES		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A	0.80	0.90	1.00	0.031	0.035	0.039
A1	0.00	0.025	0.05	0.000	0.001	0.002
A2	0.65	0.70	0.75	0.026	0.028	0.030
A3	0.15	0.20	0.25	0.006	0.008	0.010
b	0.24	0.26	0.34	0.009	0.010	0.013
D	3.0 BSC			0.118 BSC		
E	2.0 BSC			0.079 BSC		
e	0.65 BSC			0.026 BSC		
K	0.20	---	---	0.008	---	---
L	0.20	0.29	0.45	0.008	0.011	0.018
L1	0.20	0.29	0.45	0.008	0.011	0.018
L2	---	---	0.125	---	---	0.005
R1	0.075 REF			0.003 REF		
R2	0.075 REF			0.003 REF		
aaa	0.10			0.004		
bbb	0.10			0.004		
ccc	0.10			0.004		
ddd	0.05			0.002		
eee	0.08			0.003		
θ	0°	10°	12°	0°	10°	12°

Note:

1. Dimensioning and tolerancing conform to ASME Y14.5M–1994.
2. All dimensions are in millimeters. All angles are in degrees.
3. Dimensions b apply to metallized terminal and is measured between 0.15 and 0.20mm from terminal tip.
4. Coplanarity applies to the terminal.
5. Profile tolerance (aaa) will be applicable only to the plastic body, and not to the metallized features (such as the terminal tips and tie bars.) Metallized features may protrude a maximum of L2 from the plastic body profile.
6. Corner will be sharp unless otherwise specified with radius dimensions.

Appendix D: DFN3x3 (AON3402, AON3601, AON3806)



SYMBOL	DIMENSIONS IN MILLIMETERS			DIMENSIONS IN INCHES		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A	0.80	0.90	1.00	0.031	0.035	0.039
A1	0.00	0.025	0.05	0.000	0.001	0.002
A2	0.65	0.70	0.75	0.026	0.028	0.030
A3	0.15	0.20	0.25	0.006	0.008	0.010
b	0.24	0.26	0.34	0.009	0.010	0.013
D	3.0 BSC			0.118 BSC		
E	3.0 BSC			0.118 BSC		
e	0.65 BSC			0.026 BSC		
K	0.20	---	---	0.008	---	---
L	0.38	0.42	0.45	0.015	0.017	0.018
L1	0.20	0.29	0.35	0.008	0.011	0.014
L2	---	---	0.125	---	---	0.005
R1	0.075 REF			0.003 REF		
R2	0.075 REF			0.003 REF		
aaa	0.10			0.004		
bbb	0.10			0.004		
ccc	0.10			0.004		
ddd	0.05			0.002		
eee	0.08			0.003		
θ	0°	10°	12°	0°	10°	12°

Note:

1. Dimensioning and tolerancing conform to ASME Y14.5M–1994.
2. All dimensions are in millimeters. All angles are in degrees.
3. Dimensions b apply to metallized terminal and is measured between 0.15 and 0.20mm from terminal tip.
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6. Corner will be sharp unless otherwise specified with radius dimensions.