Technical Note

Land Pad Design for NOR Flash Memories

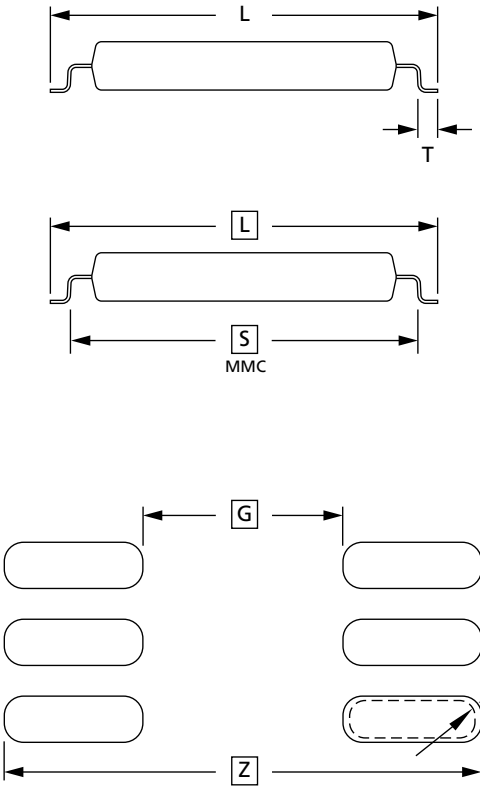
Introduction

This document provides high-level information on Micron's NOR Flash memory packages and their suggested PCB land patterns. For additional information and assistance for any manufacturability issues, contact your Micron representative or log on to www.micron.com.

Package Outlines and Suggested Land Pattern Designs

The following sections contain detailed mechanical descriptions of Micron's NOR Flash packages and the related suggested PCB land pattern designs. The suggested land pattern (mm) designs were developed using Mentor's *PCB Matrix Calculator software*, which is based on the IPC-7351B standard. For additional information refer to the NOR Flash section of Micron's website.

Figure 1: Key Land Pattern Sizes Definitions (from IPC-7351B)



There are many options available to determine the tolerances for each component. The IPC-7351B formulas for calculating the Z_{MAX} distance are shown below (based on the RMS method).

$$Z_{MAX} = L_{MIN} + 2J_T + \sqrt{C_L^2 + F^2 + P^2}$$

$$G_{MIN} = S_{MAX} - 2J_H - \sqrt{C_S^2 + F^2 + P^2}$$

$$X_{MAX} = W_{MIN} + 2J_S + \sqrt{C_W^2 + F^2 + P^2}$$

Where:

Z_{MAX} = overall length of land pattern
G_{MIN} = minimum distance between land of the pattern
X_{MAX} = maximum width of the pattern
S_{MAX} = maximum distance among component termination
W_{MIN} = minimum width of the lead
L_{MIN} = minimum distance of the component length
J_T = toe joint dimension
C_L = tolerance for component length
F = fabrication tolerance
P = positioning tolerance
J_H = solder fillet or land protrusion at heel
C_S = tolerance on distance between component terminations
C_W = tolerance on the lead width

Table 1: Tolerance Definitions (from IPC-7351b)

Tolerance Element	Description
Compound tolerance	The difference of maximum material condition (MMC) and least material condition (LMC) of each component dimension length, width, and distance between terminations or leads. This number is the "C" tolerance in the equations.
Printed board tolerance	The difference of MMC and LMC of each land pattern dimension length. This number is the "F" tolerance in the equations.
Positional accuracy	The diameter of true position (DTP). This is the variation of the part centroid related to the land pattern theoretical center (includes feature location tolerance from Table 2: Applied Tolerances on page 2.

All tolerances for lands are intended to provide a projected land pattern with individual lands at maximum size, while unilateral tolerance will result in a smaller area for solder joint formation. Land patterns are within these outer and inner extremities.

The LPW tool uses the distance between pin centers ("C" as shown in the land pattern figures) instead of the distance between the pin ends (Z). This is the way most of tools used in the industry manage that dimension.

Some rounding off of values occurs, which is controlled by the calculator settings tab. These settings should be reviewed and set to meet the user's fabrication and assembly best practices for their industry and their fabrication/assembly technology. The tolerances shown below have been used in all of the land pattern calculations that follow in this document.

Table 2: Applied Tolerances

Tolerance Element	Tolerance (mm)
Land-to-land MIN	0.20
Silkscreen to Land MIN	0.25
Solder mask web MIN	0.075
Fabrication	0.05
Placement	0.05
Land place round-off (C)	0.10
Land size round-off	0.05

Definitions of the areas and dimensions provided in this document:

- **Land pattern:** The combinations of lands used for the mounting of a particular component.
- **Courtyard:** The smallest rectangular area that provides a minimum electrical and mechanical clearance around the combined component body and land pattern boundaries.

- **Silkscreen:** The printed area of the position where the component body will be placed, in relation to the orientation indicator.
- **Assembly area:** Maximum area allowed for component body mounting on the PCB.

SO Packages

Figure 2: Calculated SO Parameters

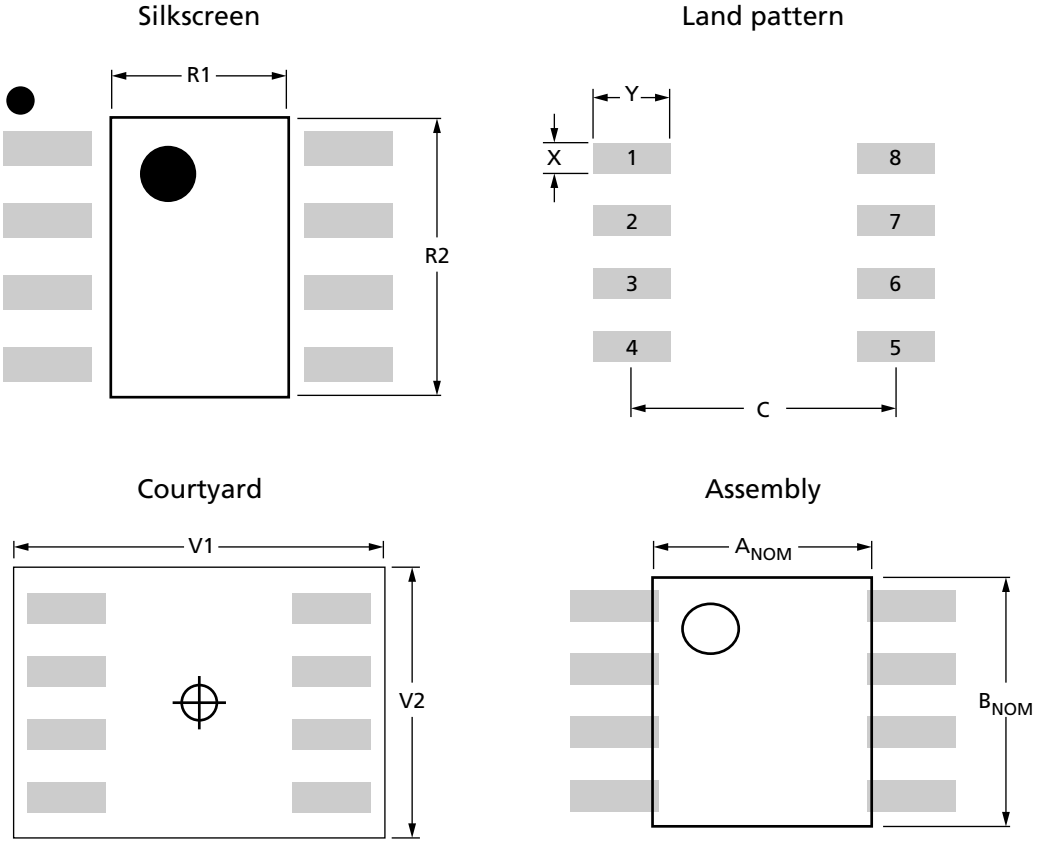
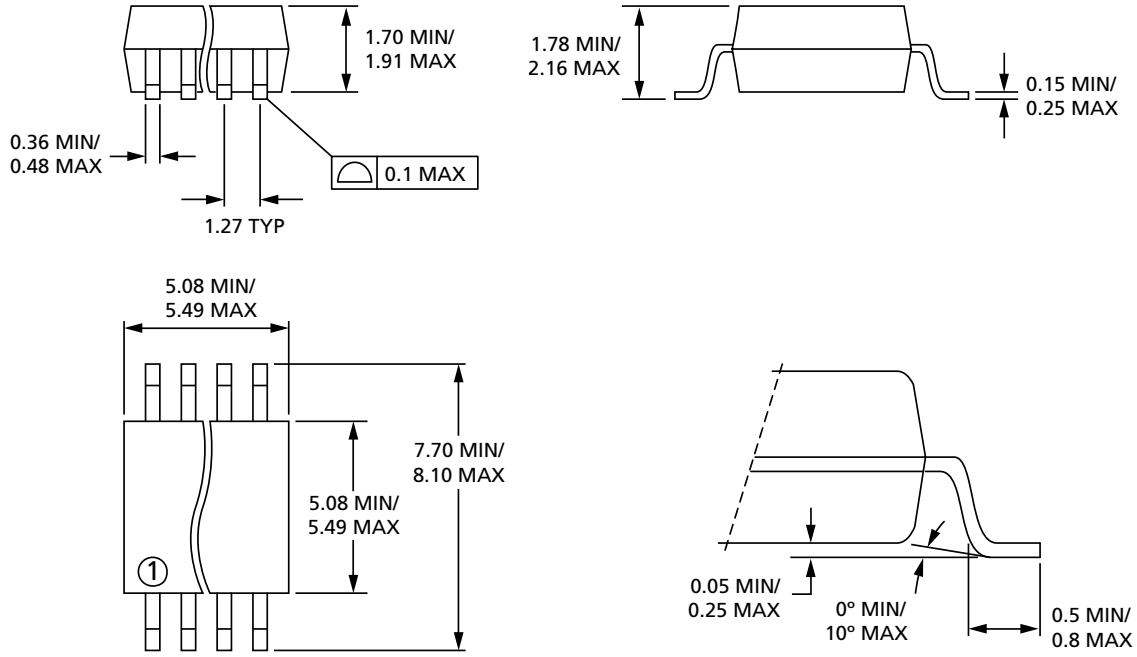


Table 3: SO Packages and Parameter Values

Package Type	Pins	Width (mm)	Length (mm)	Max Thickness (mm)	Pitch (mm)
SOP2-8 208 mils body width (SO8W)	8	5.28	7.9	2.16	1.27
SOP2-16 300 mils body width (SO16W)	16	10.3	10.3	2.65	1.27

SO8W

Figure 3: SOP2-8 208 Mils Body Width (SO8W) – Package Code: SE



Note: 1. All dimensions are in millimeters.

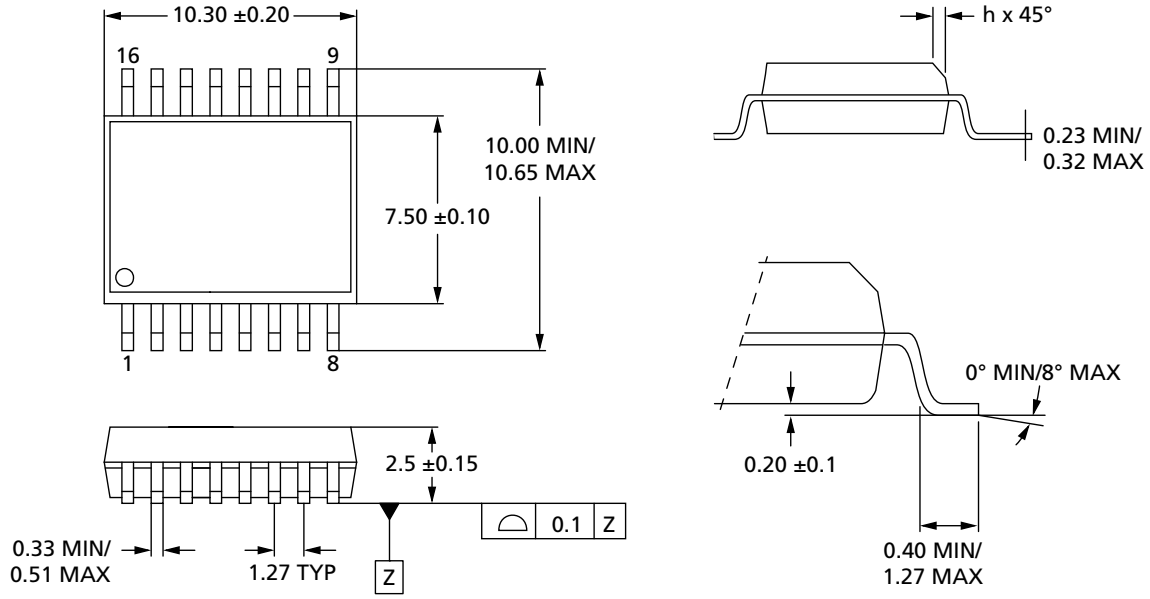
Table 4: SO8W Suggested Land Pattern Dimensions

Reference	Land Pattern (mm)			Silkscreen (mm)		Assembly (mm)		Courtyard (mm)	
	C	Y	X	R1	R2	ANOM	BNOM	V1	V2
Typical dimension	7.2	1.6	0.6	5.15	6	5.62	5.95	9.4	6.3

Note: 1. See Figure 2: Calculated SO Parameters on page 4 for suggested land pattern.

SO16W

Figure 4: SOP2-16 300 Mils Body Width (SO16W) – Package Code: SF



Note: 1. All dimensions are in millimeters.

Table 5: SO16W Suggested Land Pattern Dimensions

Reference	Land Pattern (mm)			Silkscreen (mm)		Assembly (mm)		Courtyard (mm)
	C	Y	X	R1	R2	ANOM	BNOM	V1
Typical dimension	9.2	1.75	0.6	6.8	10.3	7.5	10.3	10.7

Note: 1. See Figure 2: Calculated SO Parameters on page 4 for suggested land pattern.

DFN Packages

Figure 5: Calculated DFN Parameters

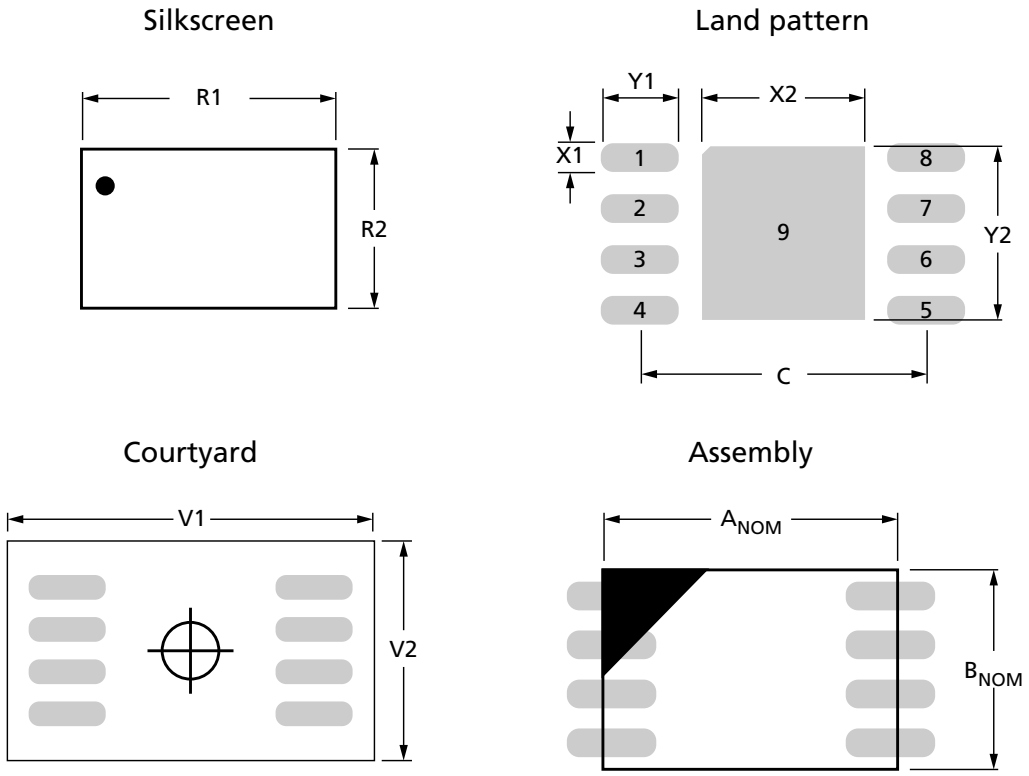
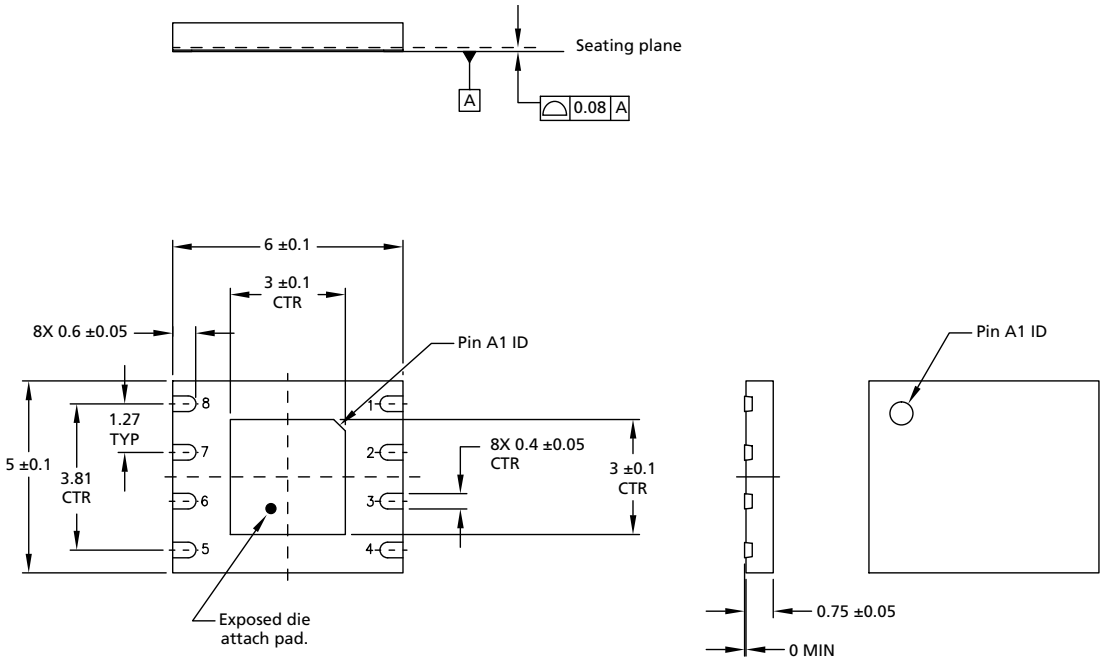


Table 6: DFN Packages and Parameter Values

Package Type	Pins	Width (mm)	Length (mm)	Max Thickness (mm)	Pitch (mm)
W-PDFN-8 (MPL8) – 6 x 5mm	8	5	6	0.8	1.27
W-PDFN-8 (MLP8) – 8 x 6mm	8	6	8	0.8	1.27

DFN-8 6mm x 5mm

Figure 6: W-PDFN-8 (MLP8) 6mm x 5mm – Package Code: W7



Note: 1. All dimensions are in millimeters.

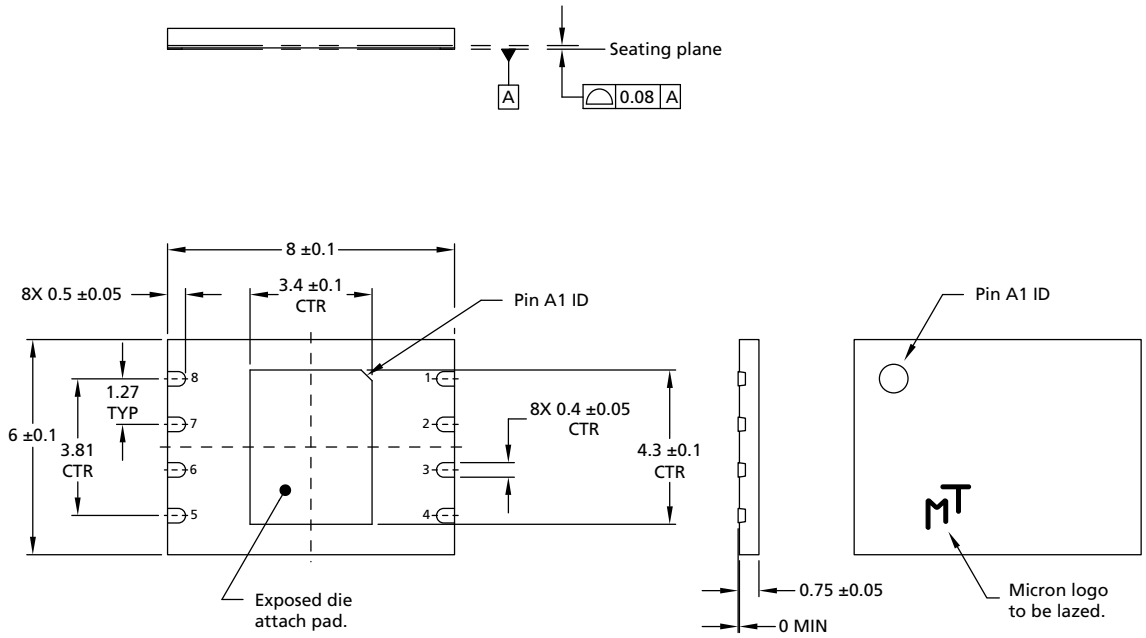
Table 7: DFN-8 6mm x 5mm Suggested Land Pattern Dimensions

Reference	Land Pattern (mm)					Silkscreen (mm)		Assembly (mm)		Courtyard (mm)	
	C	X1	Y1	X2	Y2	R1	R2	ANOM	BNOM	V1	V2
Typical dimension	5.7	0.45	1.05	3.0	3.0	3.7	5	6	5	6.8	5.4

Note: 1. See Figure 5: Calculated DFN Parameters for suggested land pattern.

DFN-8 8mm x 6mm

Figure 7: W-PDFN-8 (MLP8) 8mm x 6mm – Package Code: W9



Note: 1. All dimensions are in millimeters.

Table 8: DFN-8 8mm x 6mm Suggested Land Pattern Dimensions

Reference	Land Pattern (mm)					Silkscreen (mm)		Assembly (mm)		Courtyard (mm)	
	C	X1	Y1	X2	Y2	R1	R2	ANOM	BNOM	V1	V2
Typical dimension	7.8	0.45	0.95	3.40	4.30	8	6	8	6	8.8	6.4

Note: 1. See Figure 5: Calculated DFN Parameters for suggested land pattern.

TSOP Package

Figure 8: Calculated TSOP Parameters

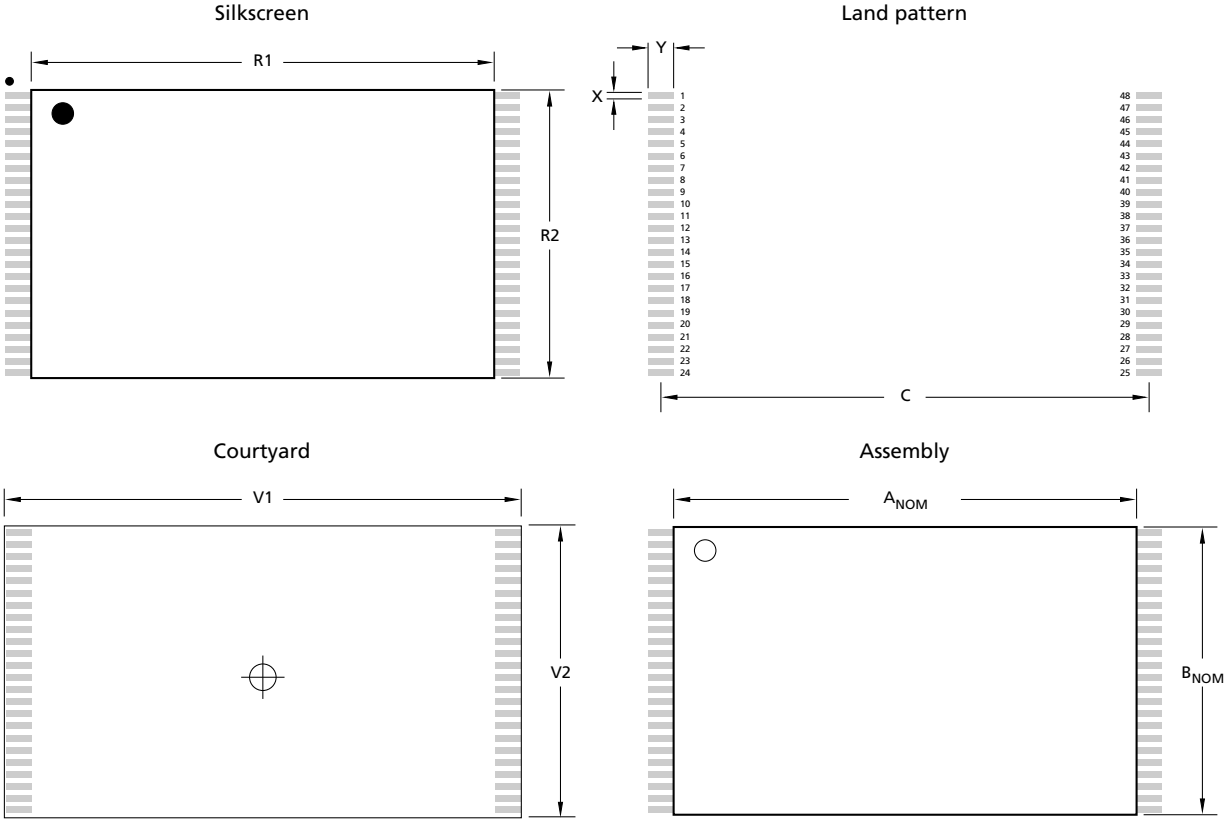
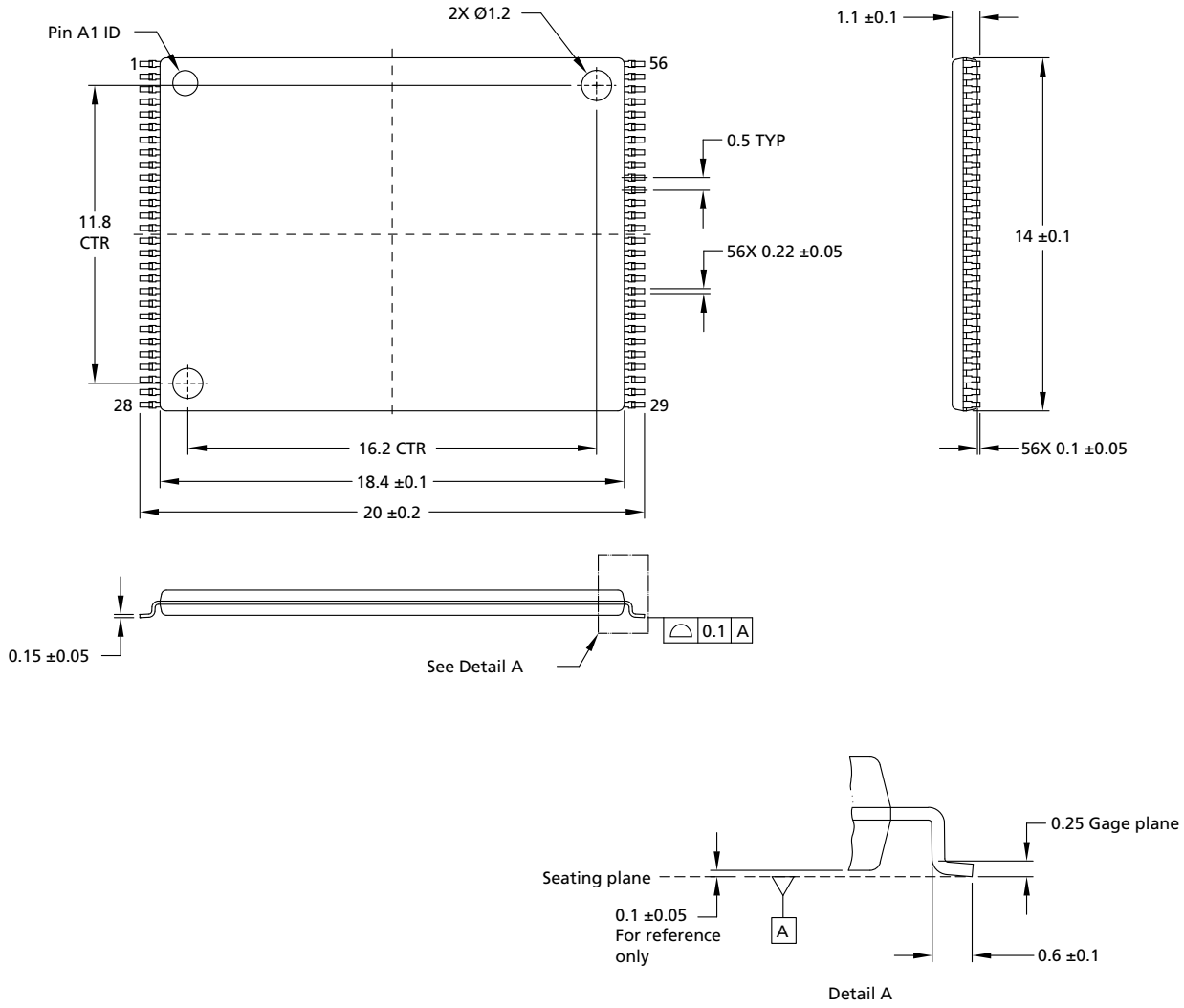


Table 9: TSOP Packages and Parameter Values

Package Type	Pins	Width (mm)	Length (mm)	Max Thickness (mm)	Pitch (mm)
TSOP56: 14mm x 20mm	56	14	20	1.2	0.5

TSOP-I 56 14mm x 20mm

Figure 9: 56-Pin TSOP – 14mm x 20mm – Package Code: JS



Note: 1. All dimensions are in millimeters.

Table 10: TSOP-I 56 14mm x 20mm Suggested Land Pattern Dimensions

Reference	Land Pattern (mm)			Silkscreen (mm)		Assembly (mm)		Courtyard (mm)	
	C	X	Y	R1	R2	ANOM	BNOM	V1	V2
Typical dimension	19.4	0.25	1.1	17.65	14	18.4	14	20.7	14.3

Note: 1. See Figure 8: Calculated TSOP Parameters for suggested land pattern.

BGA Packages

BGA land pattern calculations are mainly based on ball size, but other features are also considered. Variations that affect BGA land patterns include pitch, ball diameter, the positional accuracy of the balls vs. the true position of the component on the PCB, and the manufacturing allowance that can be held for the land on the substrate that mounts the ball.

We recommend referring to CSN-33: Micron BGA Manufacturer's User Guide, specifically to the Printed Circuit Board Design Guidelines, for more information. Also refer to IPC publication 7351B, Generic Requirements for Surface Mount Design and Land Pattern Standard, for additional details regarding metal land pad dimensions and other PCB design considerations.

BGA Calculated Land Pattern Parameters

Figure 10: BGA Calculated Land Pattern Parameters

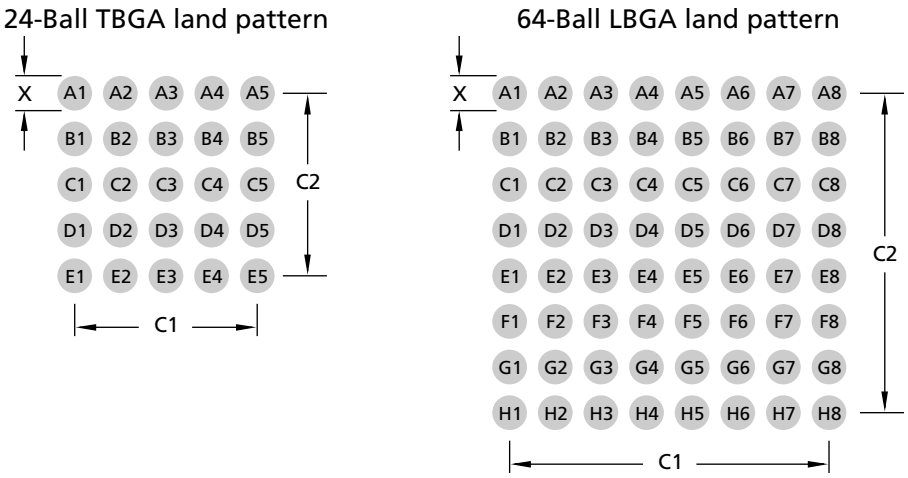
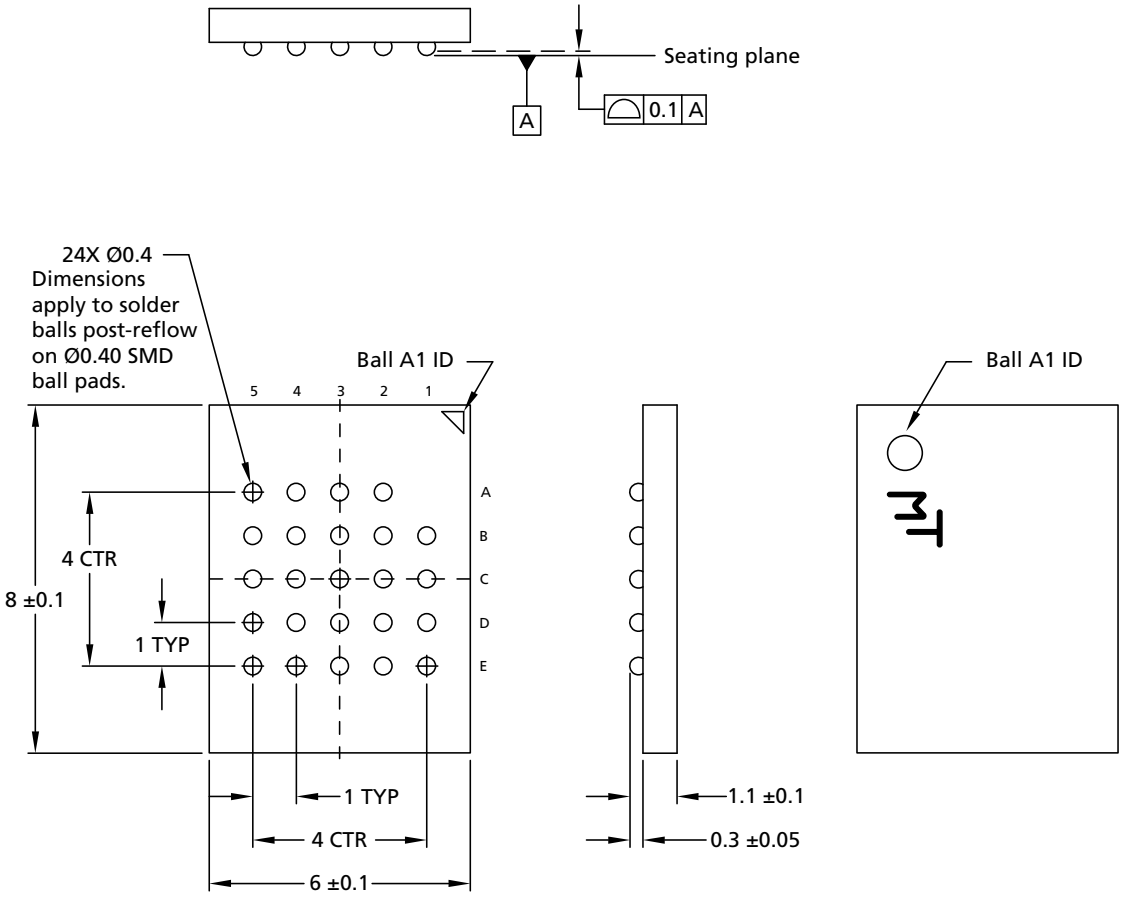


Table 11: BGA Packages and Parameter Values

Package Type	Balls	Width (mm)	Length (mm)	Max Thickness (mm)	Pitch (mm)
64-Ball LBGA – 11mm x 13mm	64	10	13	1.4	1
24-Ball T-PBGA (5 x 5 ball grid array) 6mm x 8mm	24	6	8	1.2	1

24-Ball TBGA

Figure 11: 24-Ball T-PBGA (5 x 5 Ball Grid Array) 6mm x 8mm – Package Code: 12



Note: 1. All dimensions are in millimeters.

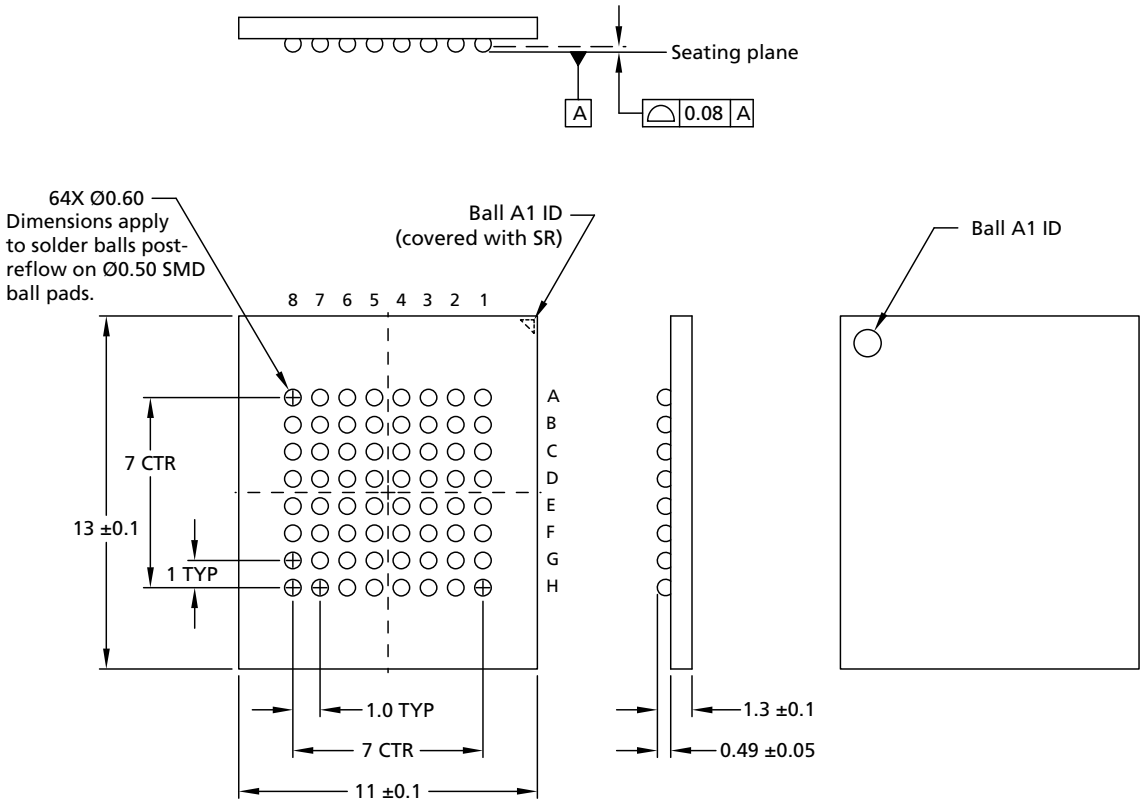
Table 12: 24-Ball T-PBGA (5 x 5 Ball Grid Array) 6mm x 8mm – Package Code: 12

Reference	Land Pattern (mm)		
	C1	C2	X
Typical dimension	4	4	See Note 2

Notes: 1. See Figure 10: BGA Calculated Land Pattern Parameters on page 13 for suggested land pattern.
2. Refer to CSN-33: Micron BGA Manufacturer's User Guide.

Easy BGA64

Figure 12: 64-Ball LBGA 11mm x 13mm - Package Code: PC



Note: 1. All dimensions are in millimeters.

Table 13: 64-Ball LBGA Suggested Land Pattern Dimensions

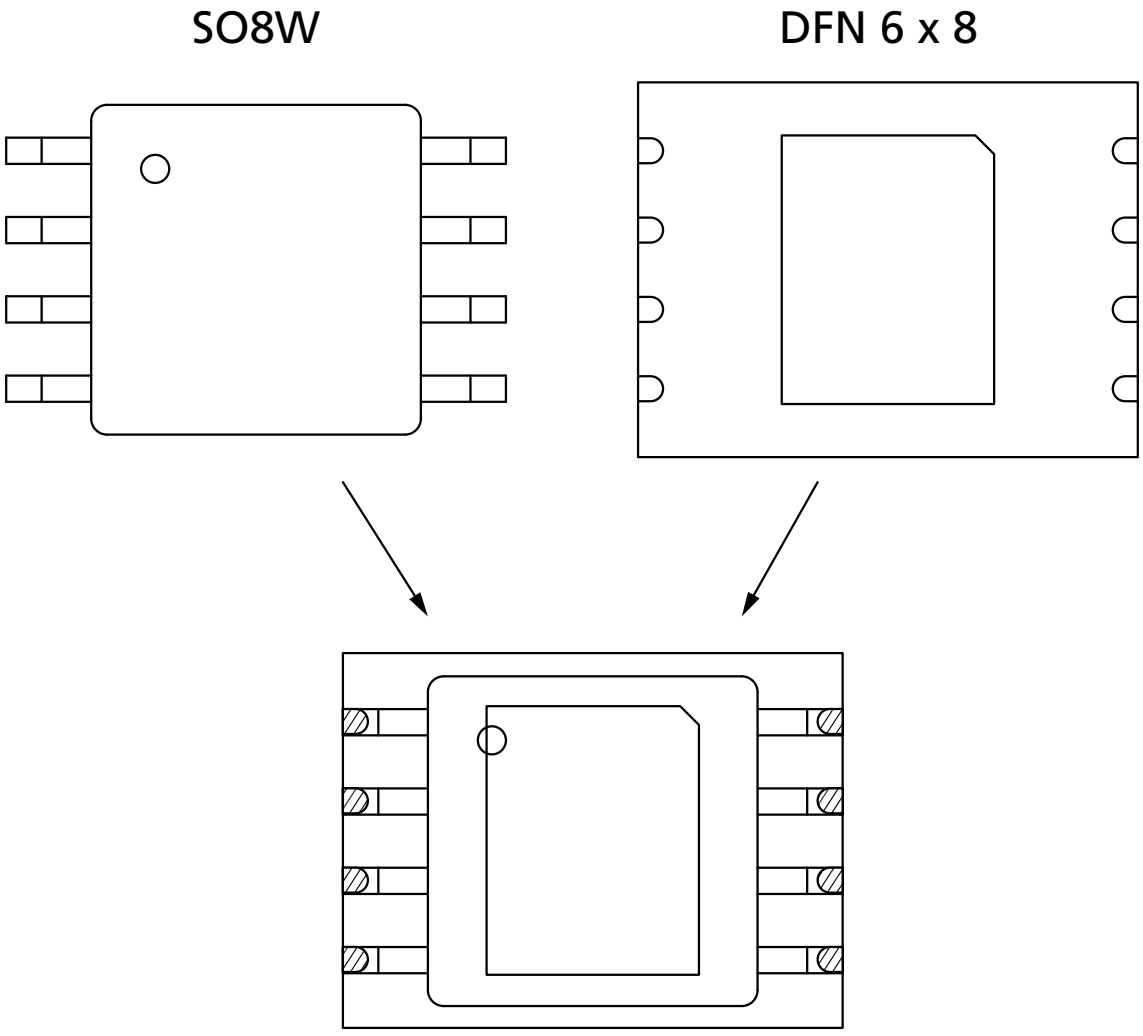
Reference	Land Pattern (mm)		
	C1	C2	X
Typical dimension	7	7	See Note 2

Notes: 1. See Figure 10: BGA Calculated Land Pattern Parameters on page 13 for suggested land pattern.
2. Refer to CSN-33: Micron BGA Manufacturer's User Guide.

Land Pattern Compatibility

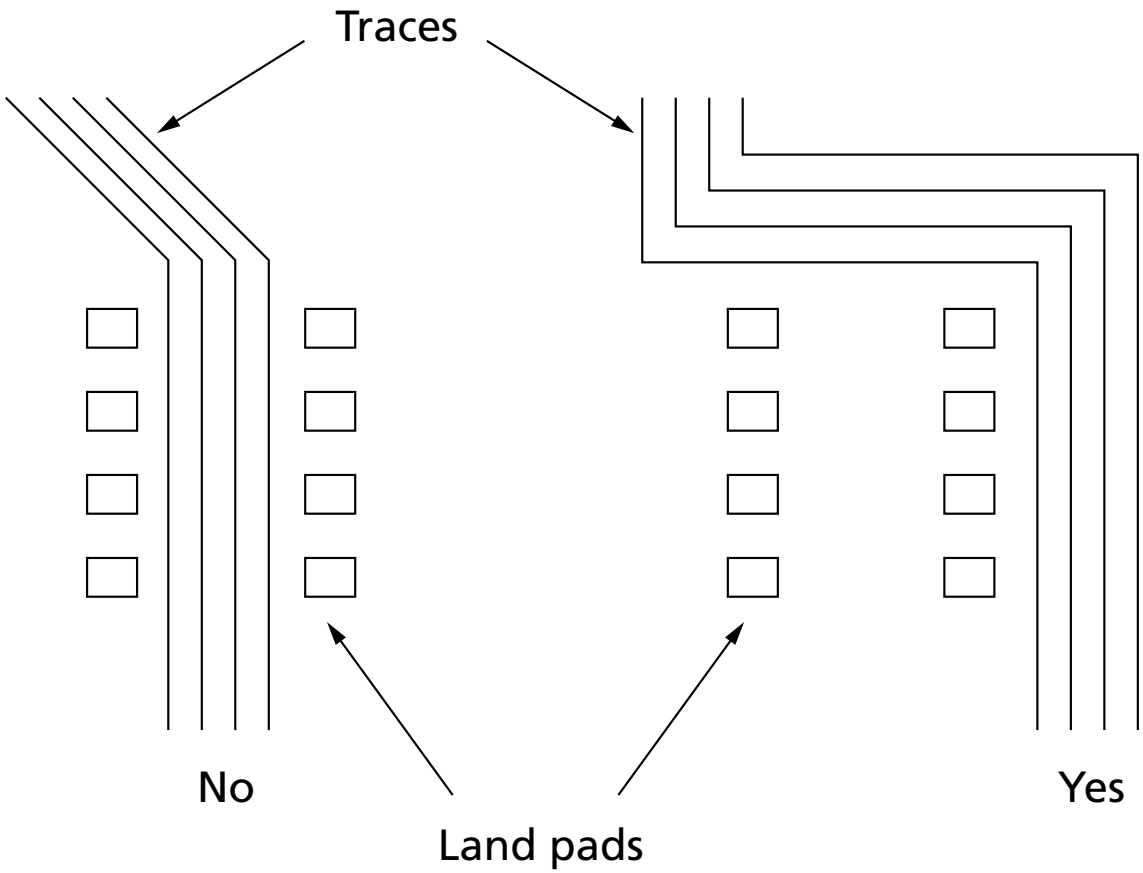
Some small outline (SO) and dual flat no-lead (DFn) packages can use the same land pattern on a PCB. SO8W and DFN8L 6 x 8mm packages have a very similar overall footprint; both packages fit the same area on the PCB. The shaded areas in the picture below indicate the areas that match between the DFN8L 6 x 8mm and the SO8W packages. All of the dimensions for the DFN 6 x 8mm, particularly pads, are smaller than the corresponding maximum dimensions for the SO8W packages.

Figure 13: SO8W and DFN 6 x 8mm Land Pattern Compatibility



Another difference between the packages is the DFN's central conductive pad, which does not require a solder connection. Micron recommends that no PCB traces run below the DFN package, because they could short-circuit to the central pad. A recommended trace routing in the PCB specifically for DFN packages is shown in the figure below.

Figure 14: Recommended Trace Routing for DFN and SO Packages



A complete analysis and verification of the design and requirements regarding the variations between the packages should be made before attempting to match the PCB land pad.

Revision History

Rev. B – 10/22

- Removed references to the package options not in running production
- Updated Package Outline drawings and Suggested Land Pattern Dimensions tables for the package options in running production

Rev. A – 10/13

- Initial release