PRINCIPLES
of
LANDPATTERN DESIGN

Land Pattern Development

Mathematical Model

Dimensioning Concepts

- *Concepts used for this analysis consider the assembly and /attachment requirements as their major goal*
- *Data sheets for components or dimensions for land patterns on boards may use other dimensioning concepts, however, the goal is to combine all concepts into a single system*
- *The system allows for tailoring of these concepts for robust process performance*

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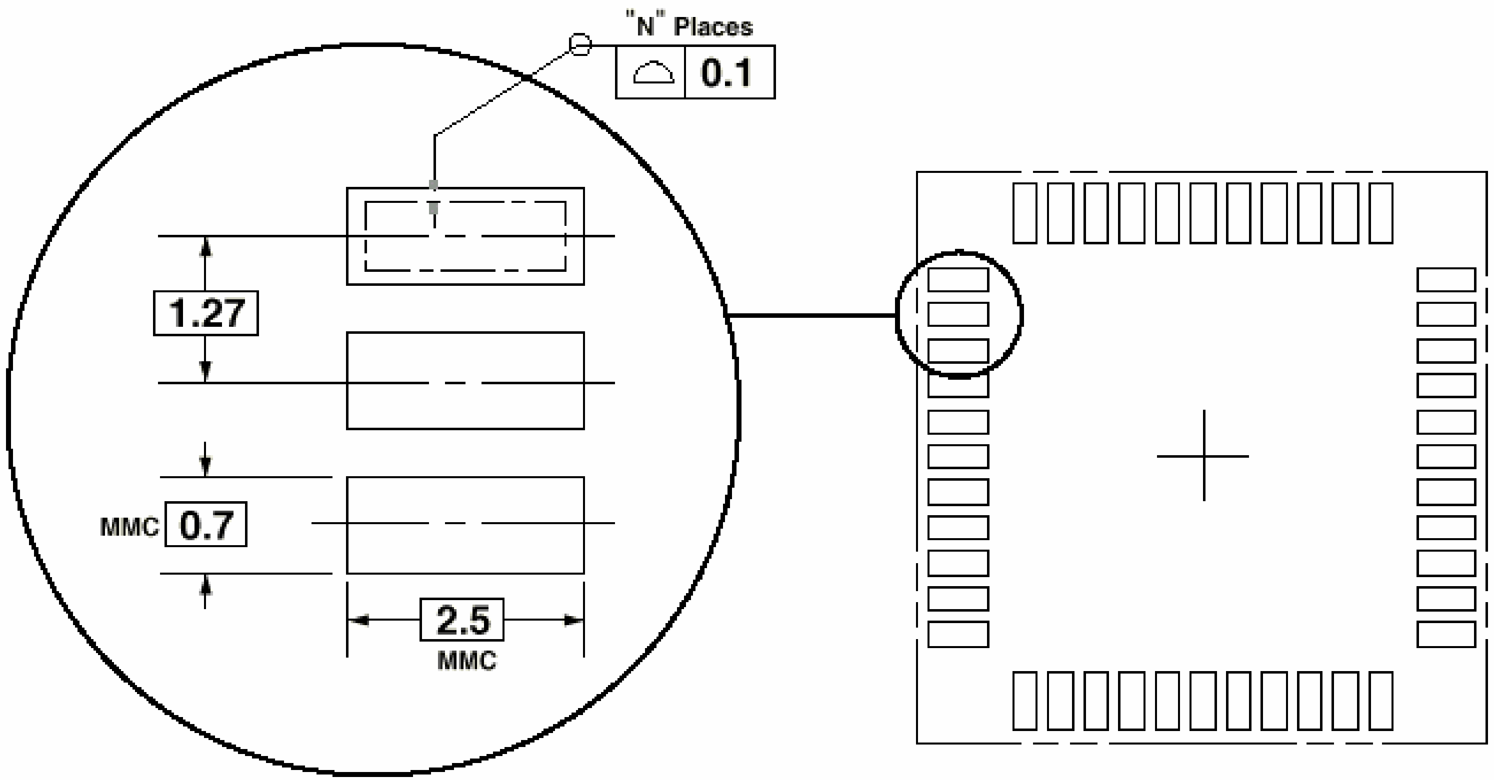
Dimensioning Requirements

- *All dimensions are basic (nominal)*
- *Limits of size control form as well as size*
- *Perfect form is required at maximum dimensions*
- *Datum reference and position tolerances apply at maximum dimensions and are dependent on feature size*

Dimensioning Requirements

- *Position dimensions originate from maximum dimensions*
- *Tolerances and their datum references other than size and position apply regardless of feature size (rfs)*
- *Interpretations are per ASME Y14.5 (IPC-2615)*

Profile Tolerancing Example



Component Tolerancing

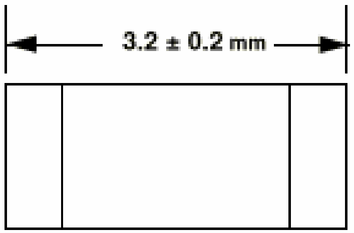
- Component manufacturers are responsible for the dimensioning and tolerancing of electronic components
- Their concepts have been converted to a functional equivalent using the profile tolerancing method
- All components are shown with their basic dimensions as limit dimensions (maximum or minimum size)

Component Tolerancing

- *Profile tolerances are unilateral, and are described to reflect the best condition for solder joint formation*
- *Component dimensions are evaluated using the surfaces of the termination or component lead involved in the formation of an acceptable solder joint*
- *Component manufactures provide nominal dimensions which are converted to maximum and minimum requirements*

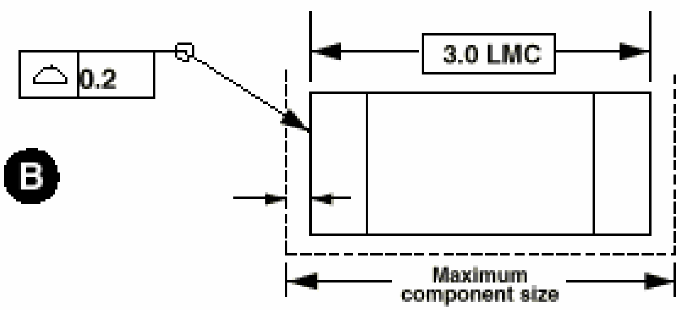
C1206 Capacitor example

A



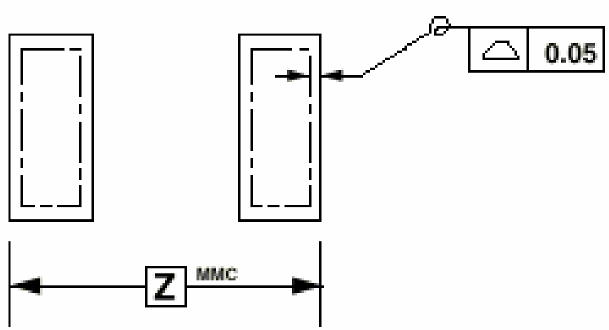
Manufacturers dimensions and tolerances (maximum length of part is 3.4 mm).

B



Part shown with length at "least material condition", and profile tolerance to indicate maximum range of component length at 3.4 mm.

C



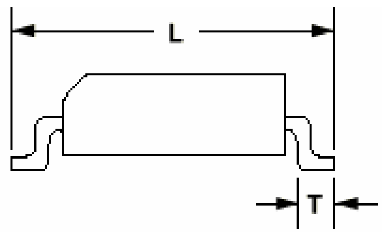
Land pattern with dimension $\boxed{Z}$ at "maximum material condition". Profile tolerance of part (0.2 X 2), plus profile tolerance of land pattern (0.05 X 2) plus placement accuracy (0.1 diameter of true position) are considered in determining the proper dimension for $\boxed{Z}$, plus the desired toe fillet.

Heel to Heel Dimensions

- *The outer dimensions of leaded or even leadless components are usually easy to determine, these are readily available from the component manufacturer*
- *The inner (heel-to-heel) dimensions are not provided and are more difficult to determine*
- *Inner dimensions must be derived by subtracting the sum of the dimensions of the leads (with their inherent tolerances) from the overall dimensions of the part.*

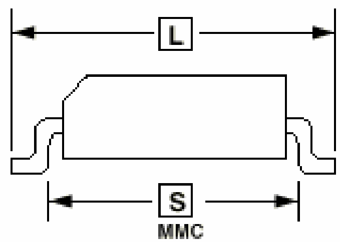
Gull Wing Leaded SOIC

A



Manufacturing dimensions of SOIC's

B

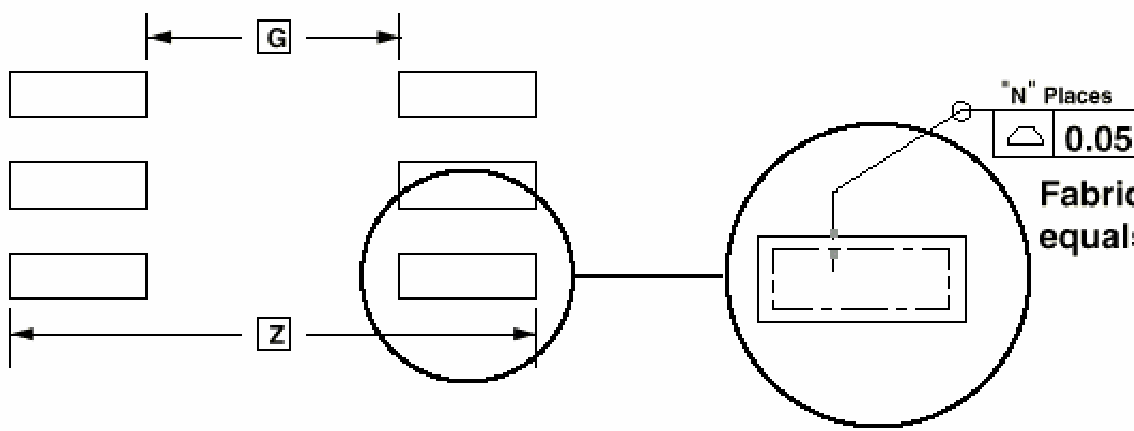


Manufacturers dimensions and tolerances converted to profile dimensions, with $\boxed{S}$ at "maximum material condition".

Note: if $\boxed{S}$ is not provided by the component manufacturer it may be determined by subtracting $\boxed{T}$ terminal dimensions from the length.

$$\underset{MMC}{\boxed{S}} = \underset{MMC}{\boxed{L}} - 2\underset{LMC}{\boxed{T}}$$

C



Fabrication tolerance equals 0.1 mm

Dimension "S" Determination

- *The inner dimensions between heel fillets on opposing sides are the most important*
- *Inner dimensions are derived by:*
  - ☞ *establishing the maximum width of the component as measured from lead termination to lead termination. (This dimension is shown as "L," and is provided by the manufacturer).*

Dimension “S” Determination

- establish the minimum amount of the lead length as measured across the component"footprint”, from heel to toe for gull-wing leads. (This is "T," and is provided by the manufacturer)
- subtract twice the minimum lead length of (T) from the maximum overall component length of (L) to arrive at the maximum length inside the leads across the length of the component (dimension between opposing heels)

Dimension "S" Determination

- *Including the tolerances on dimensions (L) and (T) will yield the minimum dimension between opposing heels. This signifies worst-case tolerance analysis.*
- *Three sets of tolerances are involved in the analysis described. These include tolerances on the overall component, plus the tolerances for the lead on each end*

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Root Mean Square (RMS)

- Recommended method to determine the statistical impact is to summarise the squares of the tolerances and take the square-root of their sum (RMS)
- RMS tolerance accumulation =

$$\sqrt{\left(L_{tol}\right)^2 + 2\left(T_{tol}\right)^2}$$

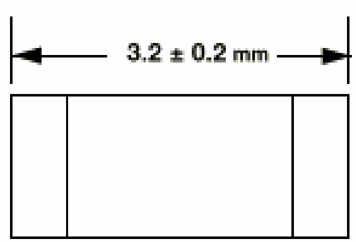
where

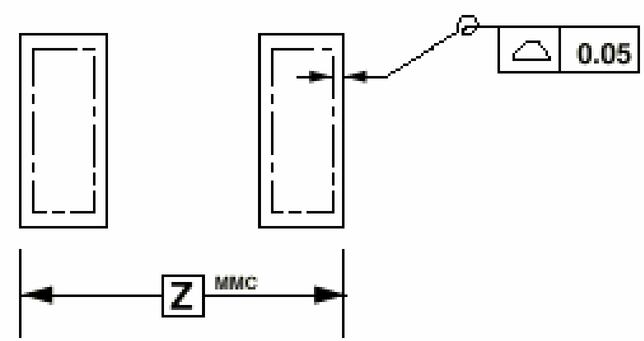
$$L_{tol} = L_{max} - L_{min}$$

$$T_{tol} = T_{max} - T_{min}$$

System Equations for Z

- *System concepts assume target values of parts and land patterns are maximised for solder joint formation*
  - ☞ *minimum outer dimensions of components*
  - ☞ *outer dimensions of land patterns at maximum size*





Total Tolerances

- C is the the unilateral profile tolerance(s) for the component
- F is the the unilateral profile tolerance(s) for the board land pattern
- P is the the diameter of true position placement accuracy to the centre of the land pattern

Land Pattern Equations

- $Z_{max} = L_{min} + 2J_T + \sqrt{C_L^{\,2} + F^2 + P^2}$
- $G_{min} = S_{max} - 2J_H - \sqrt{C_L^{\,2} + F^2 + P^2}$
- $X_{max} = W_{min} + 2J_S + \sqrt{C_L^{\,2} + F^2 + P^2}$

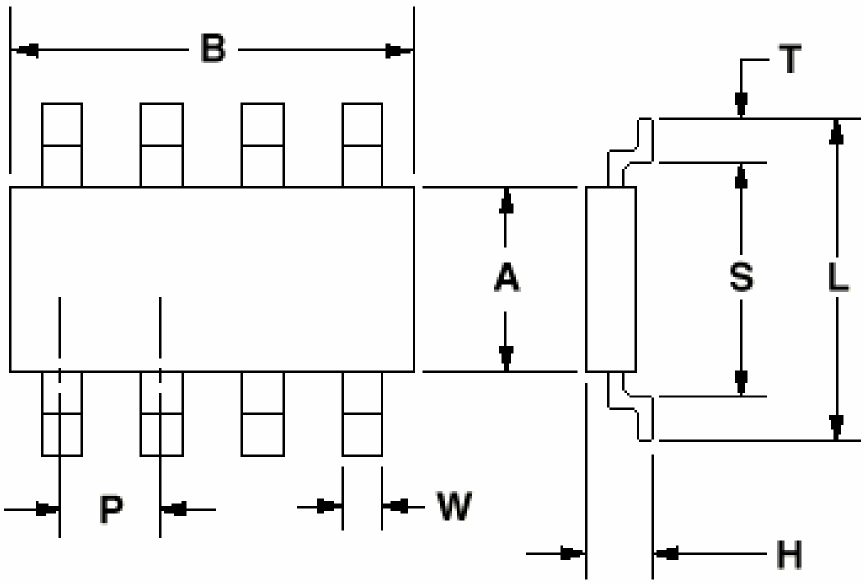
- ***where***
  - ***Z is the overall length of land pattern;***
  - ***G is the distance between lands of the pattern;***
  - ***X is the width of land pattern;***

Table 3–4 Tolerance Analysis Elements for Chip Devices

Tolerance Element	Detailed Description
Component Tolerance	The difference between the MMC and the LMC of each component dimension, length, width and distance between electrodes or leads. This number is the "C" tolerance in the equations.
Board Tolerance	The difference between the MMC and the LMC of each land pattern dimension. This number is "F" tolerance in the equations.
Positional Accuracy	0.1 – 0.2 mm DTP
Toe Fillet	0.4 – 0.6 mm
Heel Fillet	0.0 – 0.2 mm
Side Fillet Width	–0.02 – 0.02 mm

Component Characteristics

- L is the overall length of component;
- S is the distance between component terminations;
- W is the width of the lead or termination;



FOR OPTIMUM (BEST) FILLET

- *WORSE CASE ANALYSIS CONSIDERS COMPONENT BASIC DIMENSIONS AT MAXIMUM AND THE LAND AT ITS MINIMUM*

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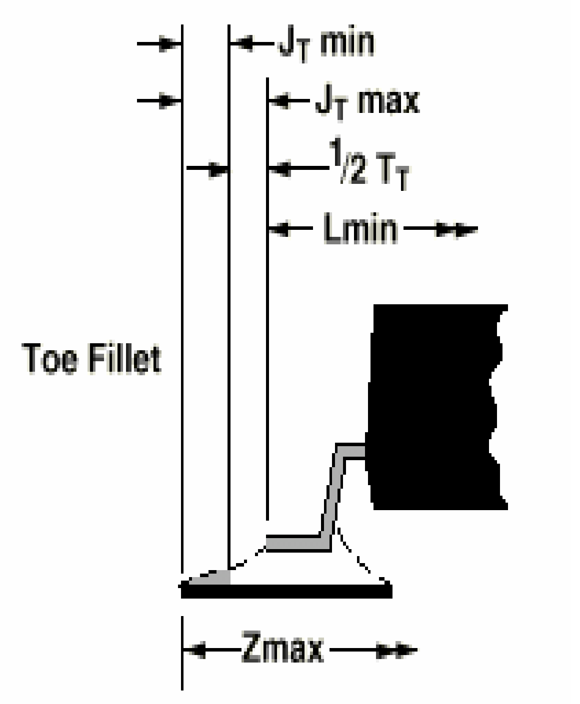
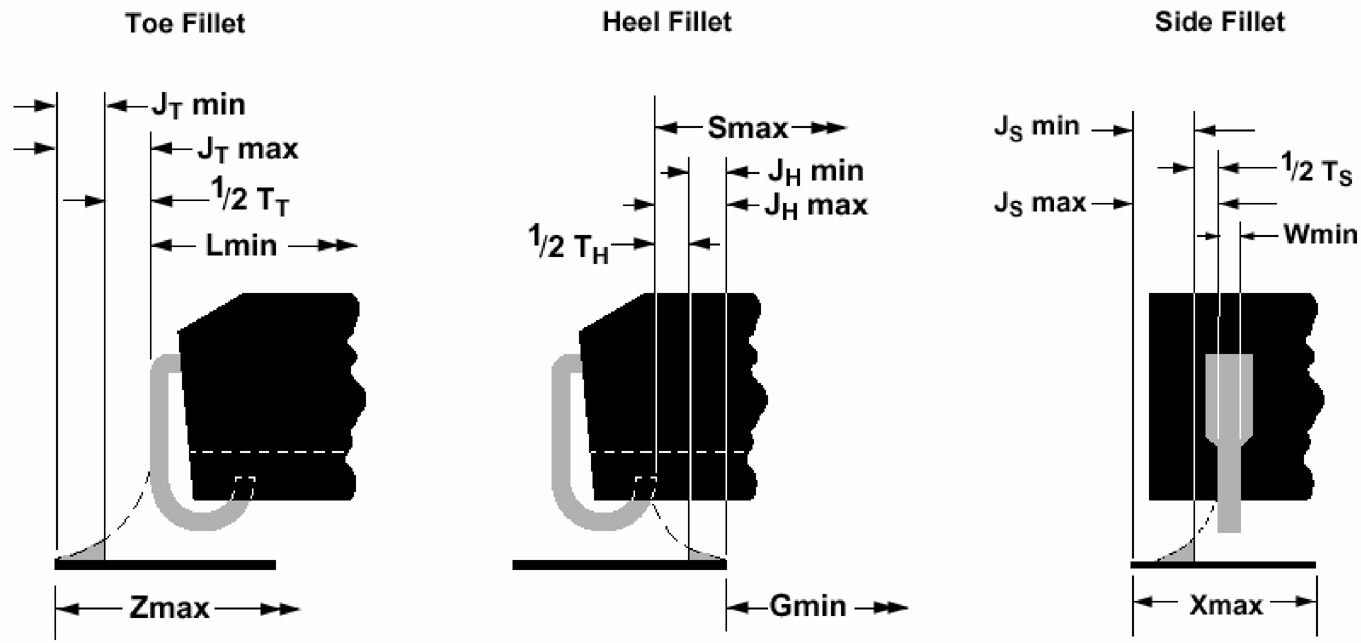
Solder Joint/Land Protrusion

- J is the desired dimension of solder fillet or land protrusion;
  - J_t is the solder fillet or protrusion at toe;
  - J_h is the solder fillet or protrusion at heel;
  - J_s is the solder fillet or protrusion at side;





$Zmax = Lmin + 2J_Tmin + T_T$

Where:

$J_T$min = Minimum toe fillet

T_T = Combined tolerances at toe fillet

$Gmin = Smax - 2J_Hmin - T_H$

Where:

$J_H$min = Minimum heel fillet

T_H = Combined tolerances at heel fillet

$Xmax = Wmin + 2J_Smin + T_S$

Where:

$J_S$min = Minimum side fillet

T_S = Combined tolerances at side fillet

IPC-782-12-2-4

RLP No.	Tolerance Assumptions (mm)		Solder Joint												
			Heel 1 and 2 (mm)					Toe 1 and 2 (mm)					Side 1 and 2 (mm)		
	F	P	C_L	J_{H1}min	J_{H1}max	J_{H2}min	J_{H2}max	C_S	J_{T1}min	J_{T1}max	J_{T2}min	J_{T2}max	C_W	$J_S$min	$J_S$max
810A	0.10	0.10	0.25	0.53	0.67	0.45	0.60	0.75	–0.48	–0.10	–0.40	–0.02	0.20	0.01	0.14

RMS Constituents

- ***C is the component tolerance***
  - ☞ *C_L is the tolerance on component length;*
  - ☞ *C_S is the tolerance on distance between component terminations;*
  - ☞ *C_W is the tolerance on component width;*
- ***F is the printed board fabrication (land pattern geometric) tolerances***
- ***P is the part placement tolerance (placement equipment accuracy)***

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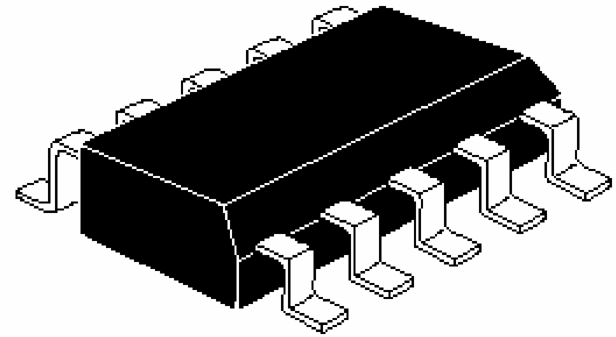
Components

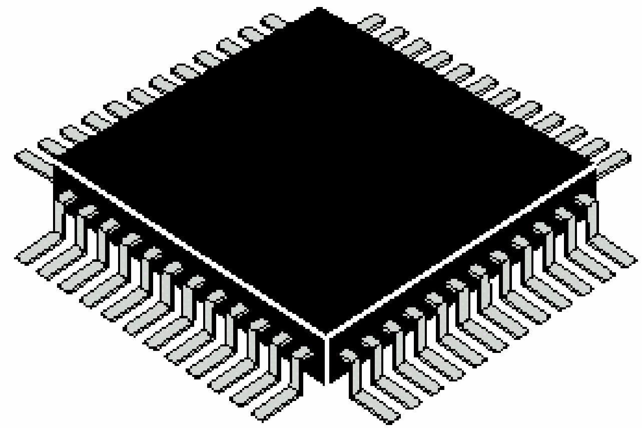
Ribbon Leads greater than 0.625



Flat ribbon L and gull-wing leads (greater than 0,625 mm pitch) (unit: mm)

Land pattern characteristics	Maximum Level 1	Median Level 2	Minimum Level 3
Toe-land protrusion	0,8	0,5	0,2
Heel-land protrusion	0,5	0,35	0,2
Side-land protrusion	0,05	0,05	0,03
Courtyard excess	0,5	0,25	0,05
Round-up factor	Nearest 0,5	Nearest 0,5	Nearest 0,05

Ribbon Leads less than 0.625



Flat ribbon L and gullwing leads
(less than or equal to 0,625 mm pitch) (unit: mm)

Land pattern characteristics	**Maximum Level 1**	**Median Level 2**	**Minimum Level 3**
Toe-land protrusion	0,8	0,5	0,2
Heel-land protrusion	0,2	0,2	0,2
Side-land protrusion	0,0	0,0	0,0
Courtyard excess	0,5	0,25	0,05
Round-up factor	Nearest 0,5	Nearest 0,05	Nearest 0,05

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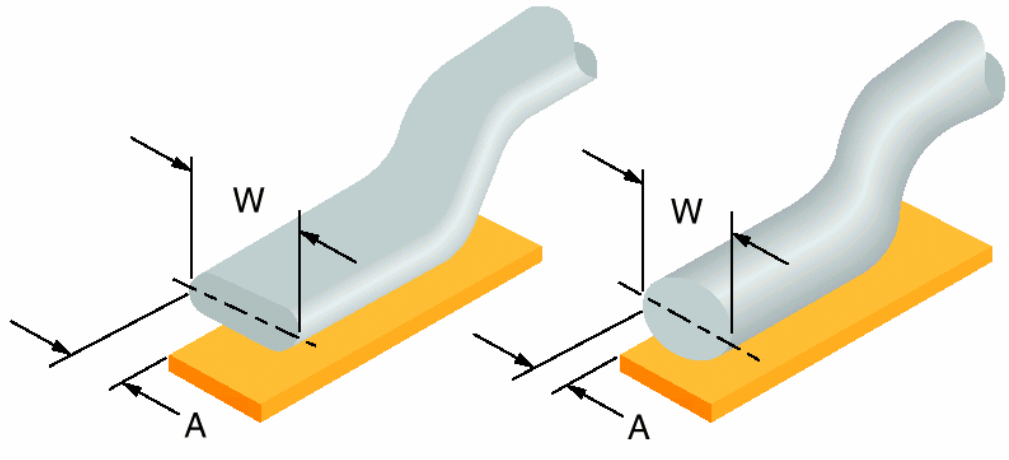
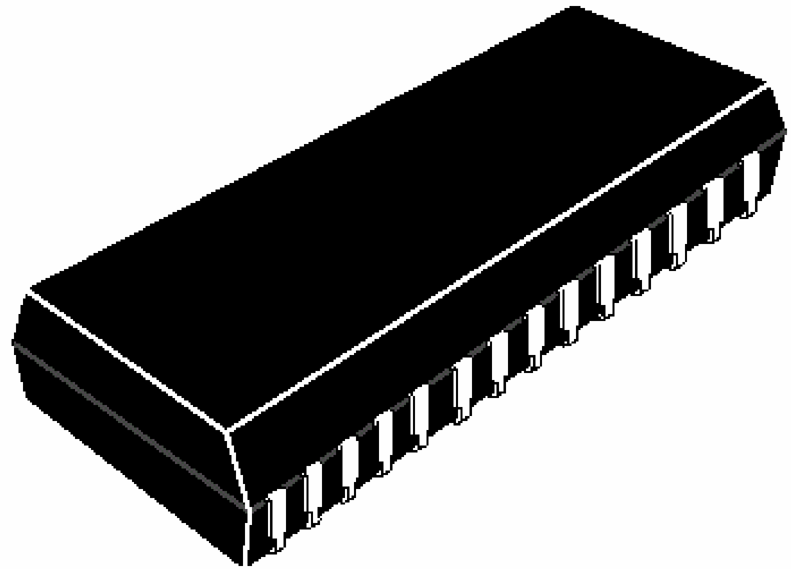
Round or Flattened Leads



Round or flattened (coined) leads (unit: mm)

Land pattern characteristics	**Maximum Level 1**	**Median Level 2**	**Minimum Level 3**
Toe-land protrusion	1,0	0,65	0,2
Heel-land protrusion	0,5	0,35	0,2
Side-land protrusion	0,1	0,1	0,1
Courtyard excess	0,5	0,25	0,05
Round-up factor	Nearest 0.5	Nearest 0.5	nearest 0.05

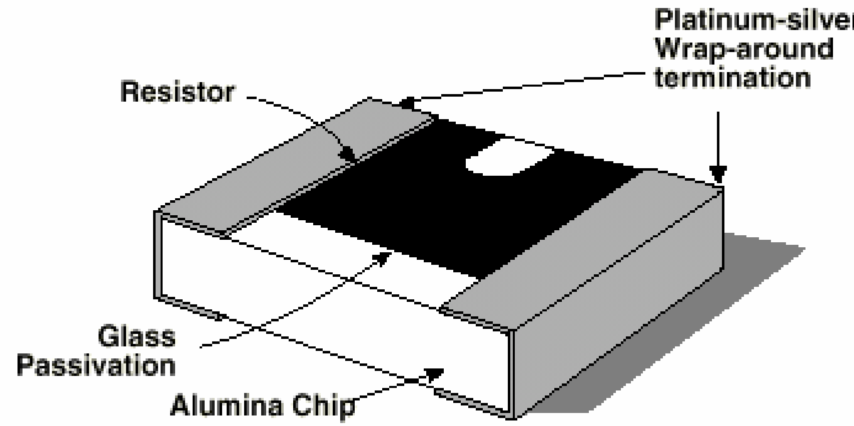
J Leaded Parts



J leads (unit: mm)

Land pattern characteristics	**Maximum Level 1**	**Median Level 2**	**Minimum Level 3**
Toe-land protrusion	0,2	0,2	0,2
Heel-land protrusion	0,8	0,6	0,4
Side-land protrusion	0,1	0,05	0,0
Courtyard excess	1,5	0,8	0,2
Round-up factor	Nearest 0,5	Nearest 0,5	Nearest 0,05

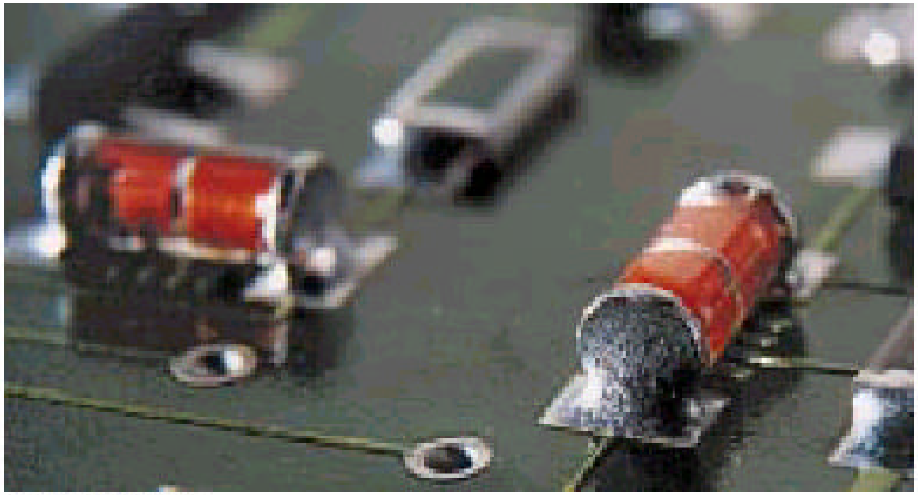
Rectangular Square end Terminations



Rectangular or square-end components (ceramic capacitors and resistors) (unit: mm)

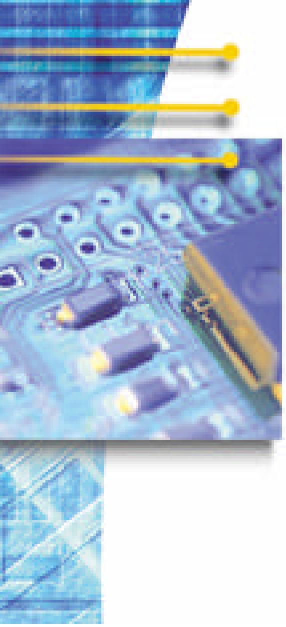
Land pattern characteristics	**Maximum Level 1**	**Median Level 2**	**Minimum Level 3**
Toe-land protrusion	0,6	0,4	0,2
Heel-land protrusion	0,0	0,0	0,0
Side-land protrusion	0,0	0,0	0,0
Courtyard excess	0,5	0,25	0,05
Round-up factor	Nearest 0,5	Nearest 0,05	Nearest 0,05

Metal Electrical Face

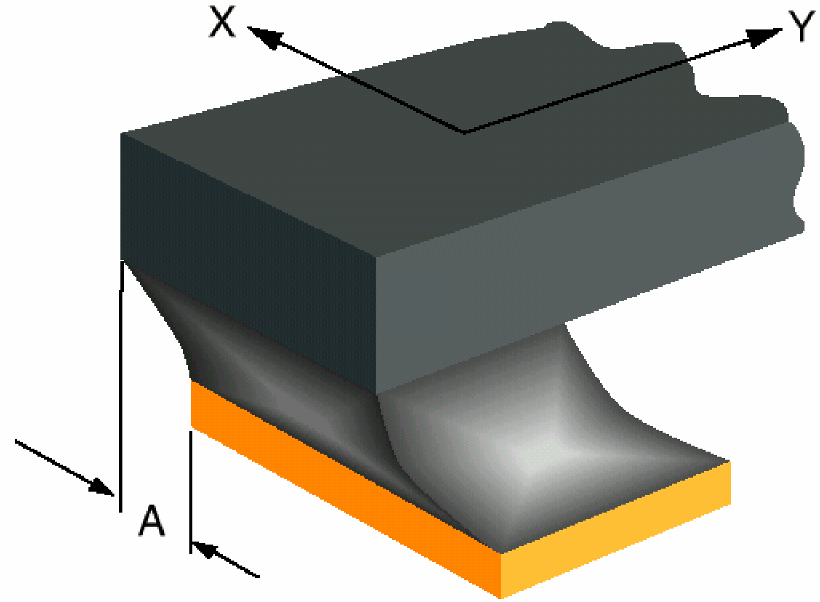


Cylindrical end cap terminations (MELF) (unit: mm)

Land pattern characteristics	**Maximum Level 1**	**Median Level 2**	**Minimum Level 3**
Toe-land protrusion	1,0	0,4	0,2
Heel-land protrusion	0,2	0,1	0,0
Side-land protrusion	0,2	0,1	0,0
Courtyard excess	0,5	0,25	0,05
Round-up factor	Nearest 0,5	Nearest 0,5	Nearest 0,05

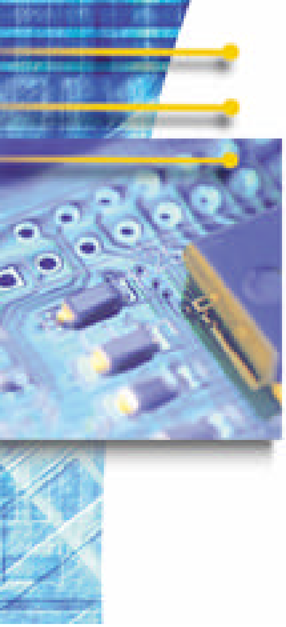


Bottom Only Terminations

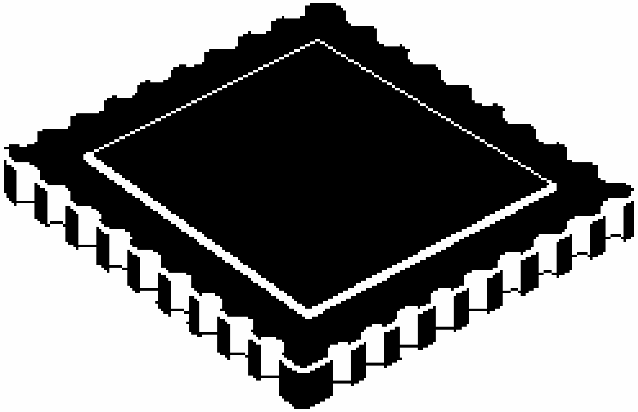


Bottom only terminations (unit: mm)

Land pattern characteristics	**Maximum Level 1**	**Median Level 2**	**Minimum Level 3**
Toe-land protrusion	0,2	0,1	0
Heel-land protrusion	0,2	0,1	0
Side-land protrusion	0,2	0,1	0
Courtyard excess	0,25	0,1	0,05
Round-up factor	Nearest 0,5	Nearest 0,05	Nearest 0,05



Leadless Chip Carriers



Leadless chip carrier with castellated terminations (unit: mm)

Land pattern characteristics	**Maximum Level 1**	**Median Level 2**	**Minimum Level 3**
Toe-land protrusion	1,5	1,25	1,0
Heel-land protrusion	0,4	0,2	0,1
Side-land protrusion	0,0	0,0	0,0
Courtyard excess	1,5	0,8	0,2
Round-up factor	Nearest 0,5	Nearest 0,5	Nearest 0,05

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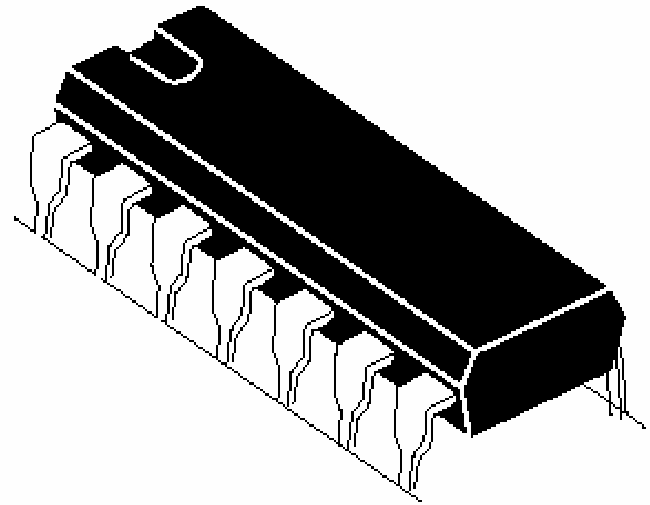
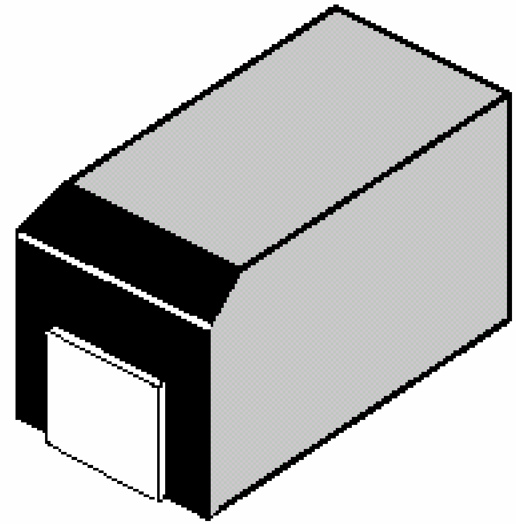
Butt Joints



Butt joints (unit: mm)

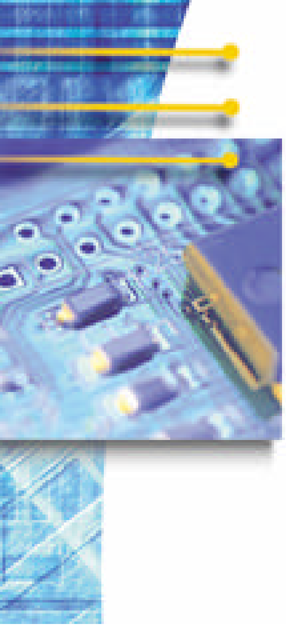
Land pattern characteristics	**Maximum Level 1**	**Median Level 2**	**Minimum Level 3**
Toe-land protrusion	1,0	0,8	0,6
Heel-land protrusion	1,0	0,8	0,6
Side-land protrusion	0,3	0,2	0,1
Courtyard excess	1,5	0,8	0,2
Round-up factor	Nearest 0,5	Nearest 0,5	Nearest 0,05

Inward L shaped Leads

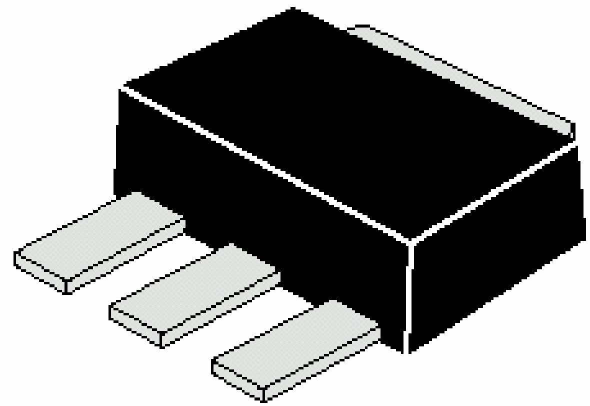


Inward L shaped ribbon leads (unit: mm)

Land pattern characteristics	**Maximum Level 1**	**Median Level 2**	**Minimum Level 3**
Toe-land protrusion	0,1	0,1	0,0
Heel-land protrusion	1,0	0,5	0,2
Side-land protrusion	0,1	0,1	0,1
Courtyard excess	0,5	0,25	0,05
Round-up factor	Nearest 0,5	Nearest 0,5	nearest 0,05



Flat Lug Leads



Flat lug leads

Land pattern characteristics	**Maximum Level 1**	**Median Level 2**	**Minimum Level 3**
Toe-land protrusion	1,0	0,8	0,5
Heel-land protrusion	0	0	0
Side-land protrusion	1,0	0,5	0,3
Courtyard excess*	2,0	1,5	1,0
Round-up factor	Nearest 0,5	Nearest 0,5	Nearest 0,05
* Depends on thermal requirements			

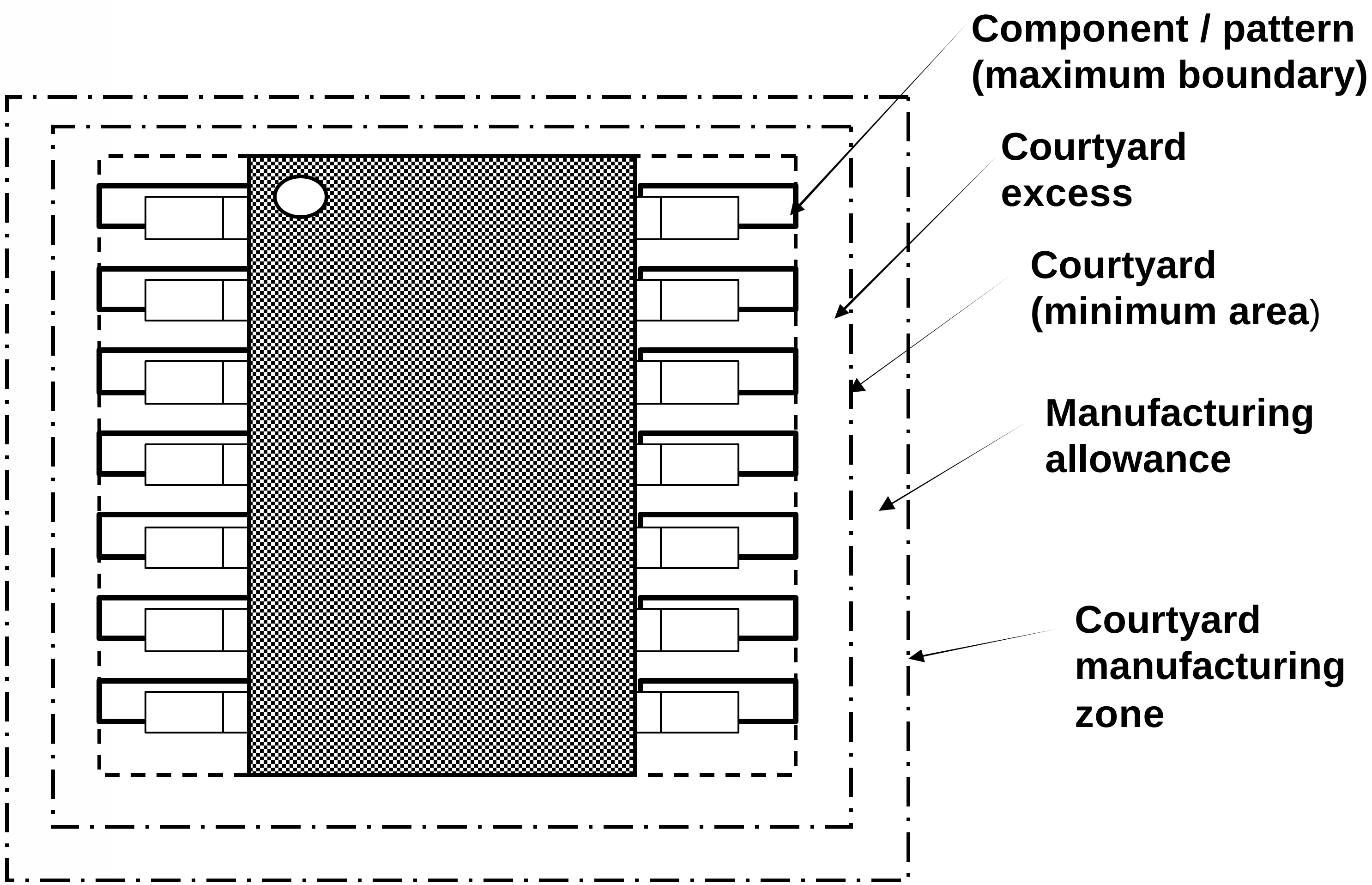
Design Considerations

- *Land pattern concepts*
- *Component selection*
- *Mounting substrate design*
- *Assembly methods*
- *Method of test*
- *Phototool generation*
- *Meeting solder joint requirements*
- *Stencil fixture requirements*
- *Providing access for inspection*
- *Access for rework and repair*

Manufacturing Allowance

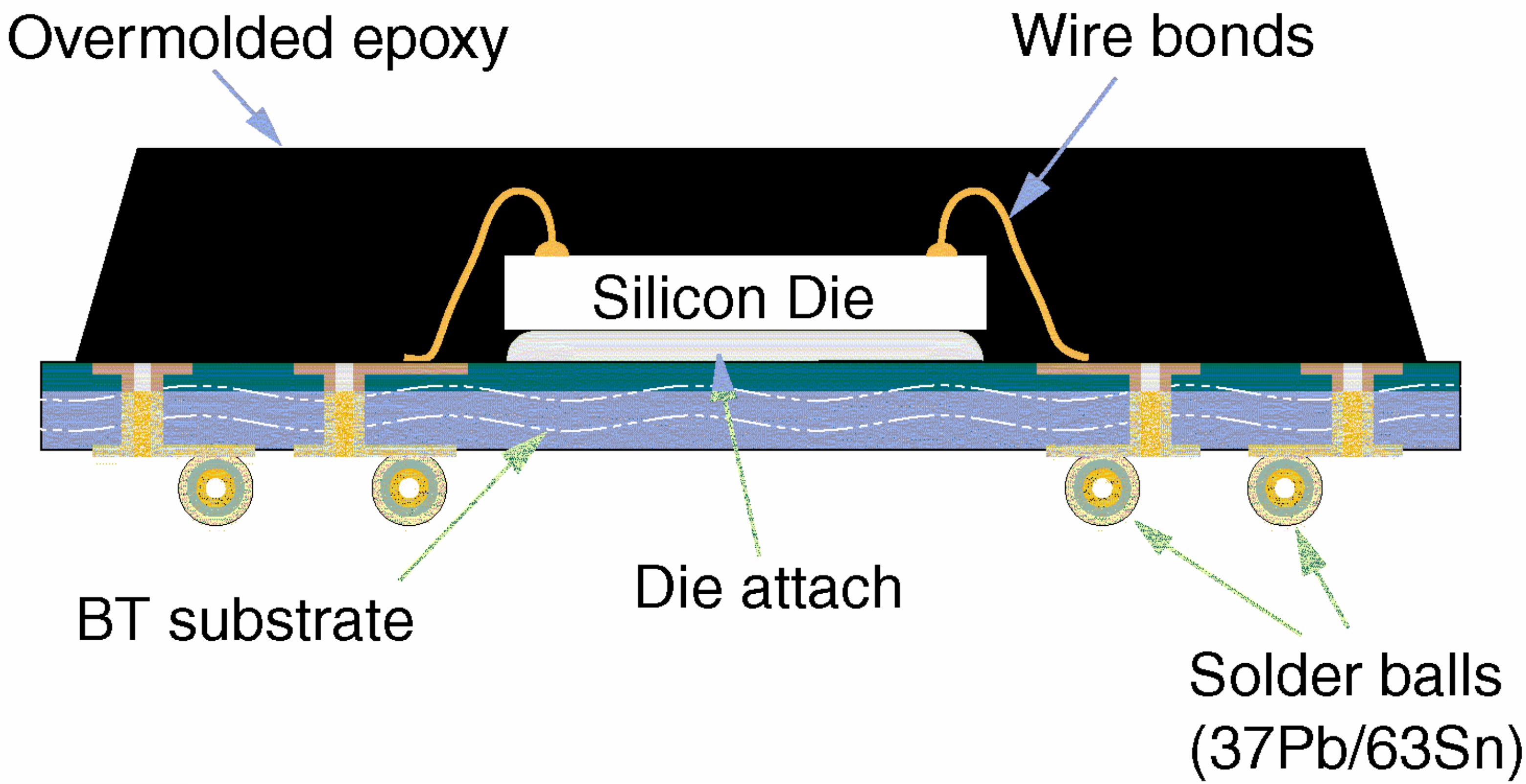
- *Manufacturing allowance must be considered in the design process*
- *The courtyard represents the starting point of the minimum area needed for the component and the land pattern*
- *Manufacturing, assembly and testing representatives should assist in determining the additional room needed to accommodate placement, testing, modification and repair*

Land Pattern Courtyard Determination

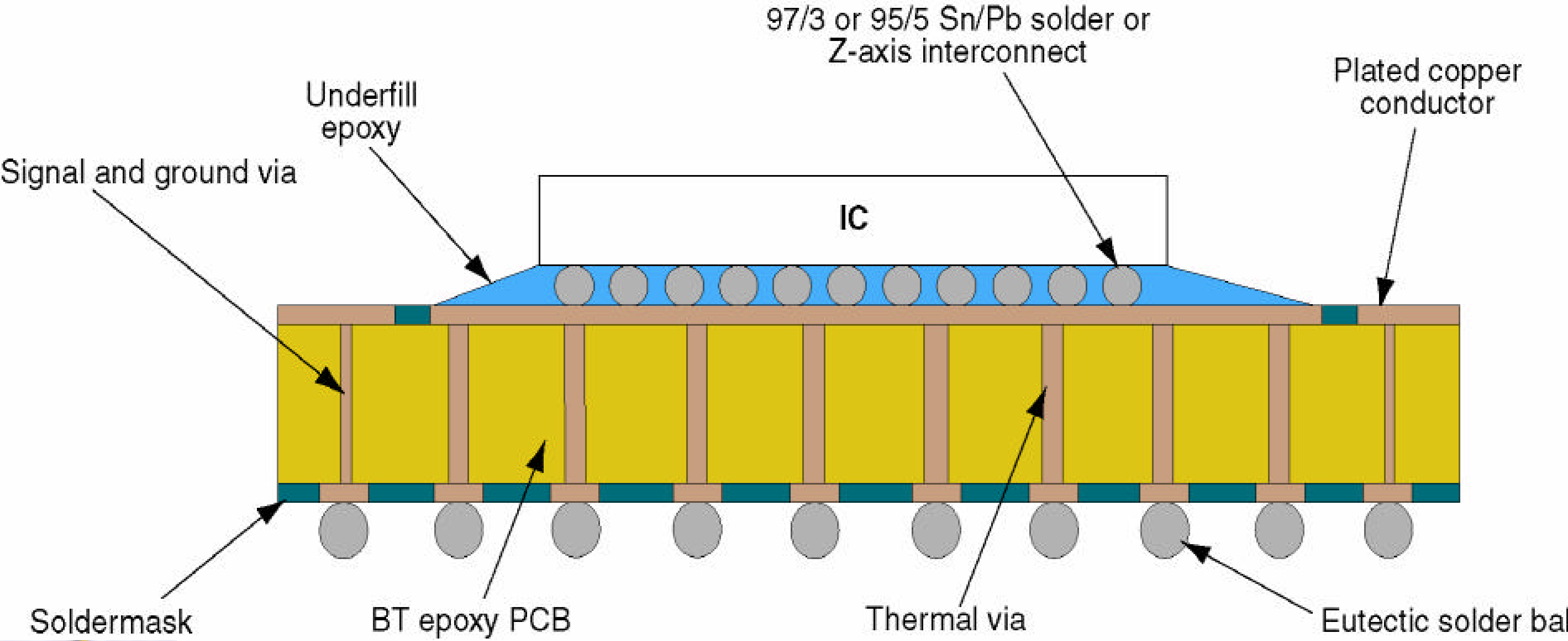


BGA Layout Considerations

Plastic Ball Grid Array, Chip Wire Bonded



Ball Grid Array, Flip Chip Bonded



The BGA Substrate

- *Surface redistribution layers require very aggressive layout rules*
- *Opposing sets of lands must be connected by the package substrate*
- *One or more interconnecting lines between two adjacent bonding lands*
- *Must access multiple rows of the interior I/O lands for connection to the vias or PTHs for eventual connection to the solder balls on the bottom side*

Micro Processor Requirements

- *40 - 60% of their I/O dedicated to power and ground*
- *Signal I/O escape wiring, and their interconnection to other high I/O packages, requires HDI Boards*
- *I/O on a chip increases the body size of the single chip package*
- *multichip module packaging solution considered as an alternative.*

Land Patterns and Circuit Board Considerations

- Components are soldered to the board on the surface mount lands
- Lands are areas of copper about the shape and size of the lead
- Land pattern design is critical-affects:
  - solder defect rate
  - cleanability and testability
  - repair/rework
  - solder joint's reliability.

Ball Pitch

- *Two groups of BGAs pitches*
  - ☞ *regular - 1.50, 1.27, and 1.00 mm*
  - ☞ *fine pitch - 0.80, 0.75, 0.65, 0.50, 0.40, 0.30 and 0.25 mm*
- *Most popular pitch is 1.27 - followed by 1.00, 0.80, 0.75, and 0.50 mm*
- *At the moment, very few component manufacturers are providing parts with 1.5 mm pitch, pressure is on form factor*
- *Pitch plays a large role.*

Ball Diameter Sizes for PBGAs

Nominal Ball Diameter (mm)	Tolerance Variation (mm)	Pitch (mm)
0.75	0.90 - 0.65	1.5, 1.27
0.60	0.70 - 0.50	1.0
0.50	0.55 - 0.45	1.0, 0.8
0.45	0.50 - 0.40	1.0, 0.8, 0.75
0.40	0.45 - 0.35	0.80, 0.75, 0.65
0.30	0.35 - 0.25	0.8, 0.75, 0.65, 0.50
0.25	0.28 - 0.22	0.40
0.20	0.22 - 0.18	0.30
0.15	0.17 - 0.13	0.25

Land Approximation

- *Component manufacturers and board designers are encouraged to reduce the land size by some percentage of the nominal ball diameter*
- *Reduction is based on the original ball size*
- *Used to determine the average land*
- *Manufacturing allowance for land size has been determined to be 0.1 mm between MMC and LMC*

Big Vs. Small Land and Impact on Routing

- *Diameter of the solder land can affect reliability of solder joints and also the routing of conductors*
- *Land diameter is usually smaller than the ball diameter of the BGA*
- *Land size reduction of 20 to 25% provides reliable attachment criteria*
- *Larger the lands, the less room for routing between lands.*

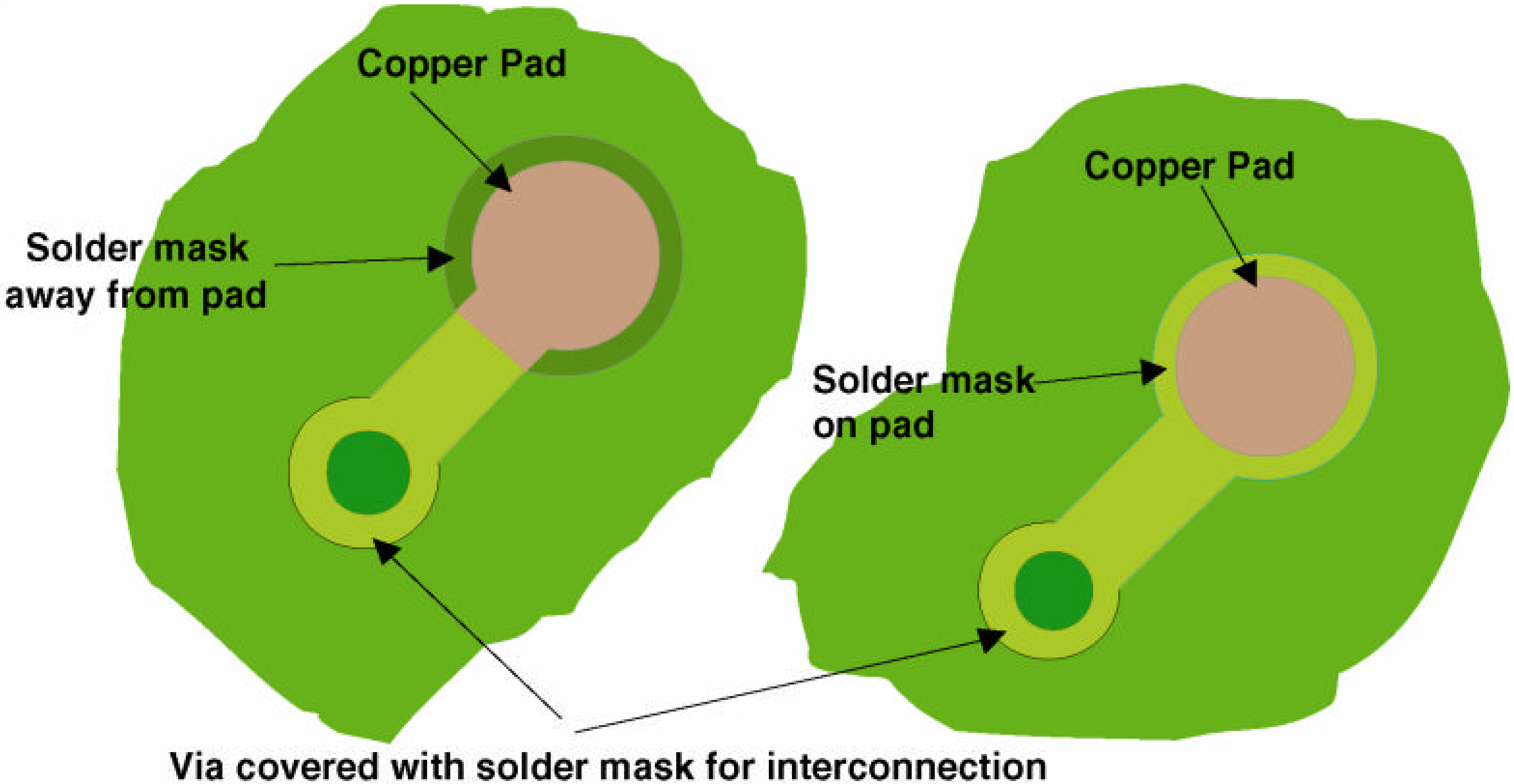
Land Pattern Approximation

Nominal Ball Diameter (mm)	Reduction	Nominal Land Diameter (mm)	Land Variation (mm)
0.75	25%	0.55	0.60 - 0.50
0.60	25%	0.45	0.50 - 0.40
0.50	20%	0.40	0.45 - 0.35
0.45	20%	0.35	0.40 - 0.30
0.40	20%	0.30	0.35 - 0.25
0.30	20%	0.25	0.25 - 0.20

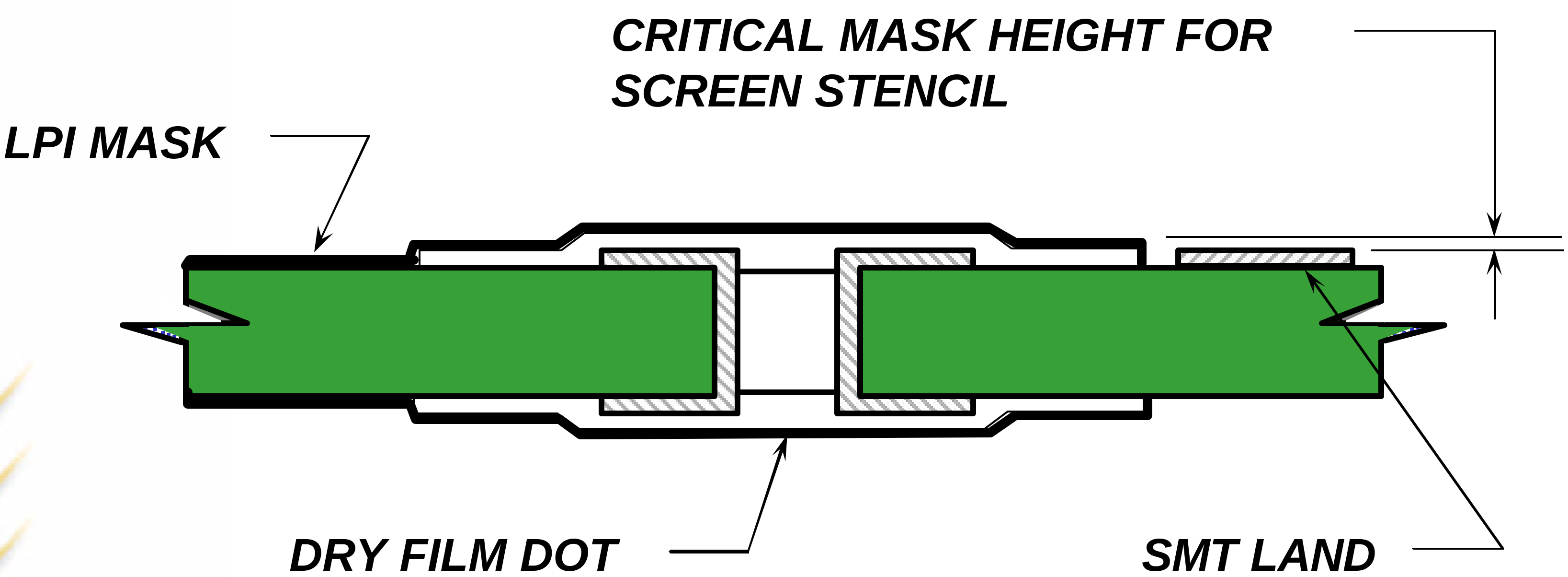
Solder Mask Vs. Metal Defined Land Design

- Two basic types of solder lands used for BGA packages
  - ☞ Nonsolder mask defined (NSMD)
  - ☞ Solder mask defined (SMD)
- NSMD lands are copper defined - solder mask clearance around land
- SMD lands have solder mask overlapping the copper land

Solder Lands for BGA Components



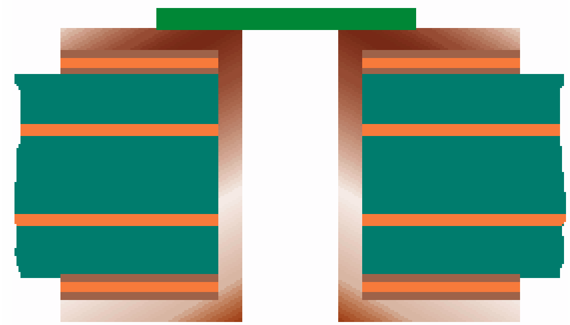
Soldermask Tenting



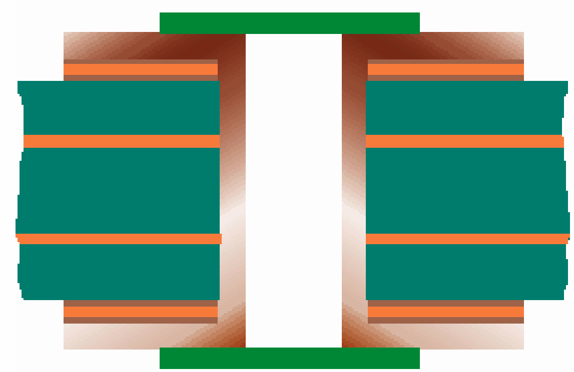
TYPE I - Tented

- Tented Via (Type 1 Via) - A via with a mask material (typically dry film) applied bridging over the via wherein no additional materials are in the hole. It may be applied to one side or both

A via covered with dry film soldermask; the via is not filled. When tenting from both sides there may be issues with trapped air that expands during mass soldering.



Type 1 Single-Sided



Type 1 Double-Sided

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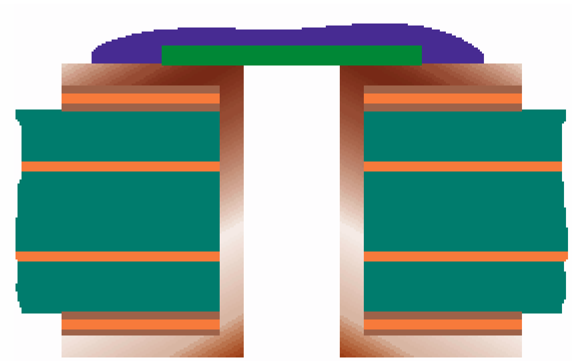
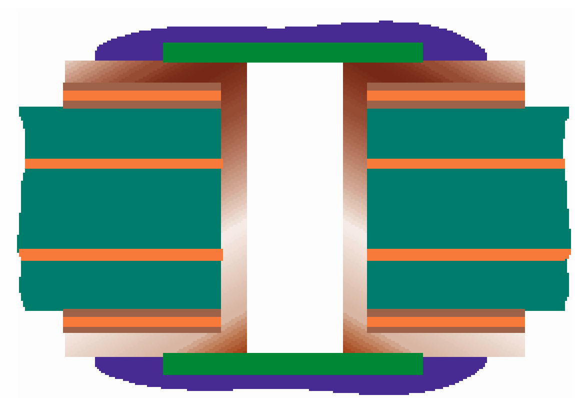
TYPE II - Tented and Covered

- Tented and Covered Via (Type II Via) - A Type I via with a secondary covering of mask material applied over the tented via.

A via covered with dry film and the LPI soldermask; the via is not filled. Just like Type 1 when tenting from both sides there may be issues with trapped air that expands during mass soldering.



Type II Single-Sided

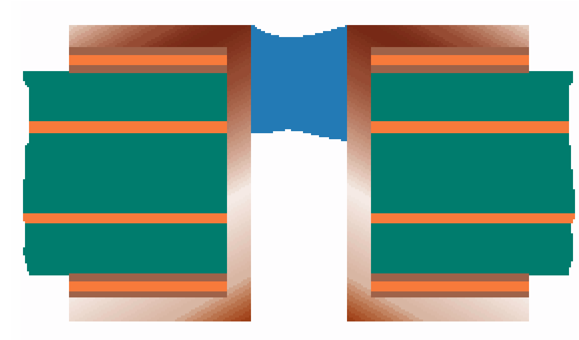


Type II Double-Sided

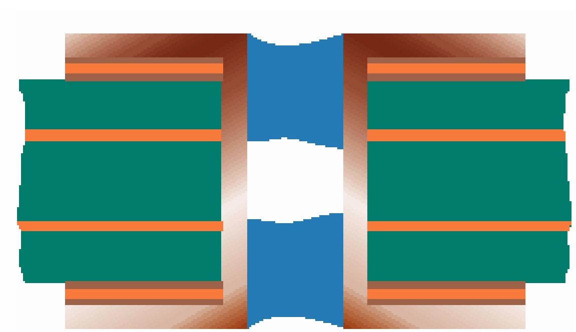
TYPE III - Plugged

- Plugged Via (Type III Via) - A via with material applied allowing partial penetration into the via. It may be applied from either one side or both sides

During soldermask application the via is flooded with soldermask. The via is partially filled. Chemical entrapment is a major concern.



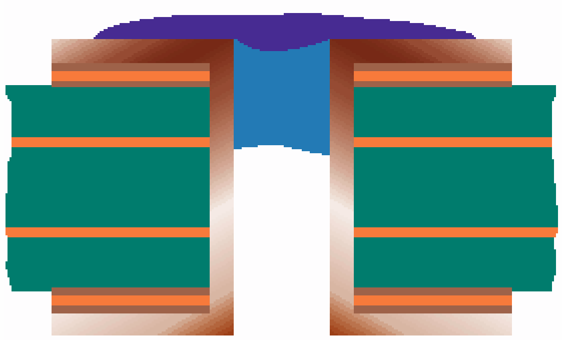
Type III Single-Sided



Type III Double-Sided

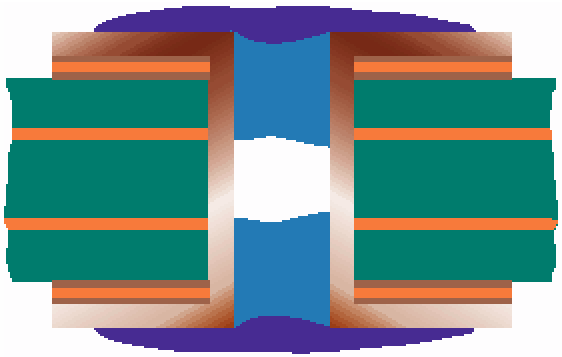
TYPE IV - Plugged and Covered

- Plugged and Covered Via (Type IV Via) - A Type III via with a secondary covering of material applied over the via.



Type IV Single-Sided

An additional operation which is done independent of soldermask application on one or both sides of the via. The via is partially filled. When capping from both sides there may be issues with trapped air that expands during mass soldering.



Type IV Double-Sided

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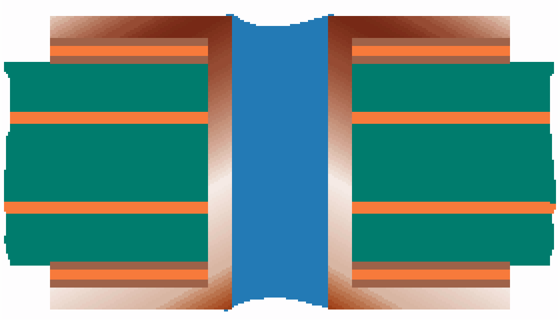
TYPE V - Filled

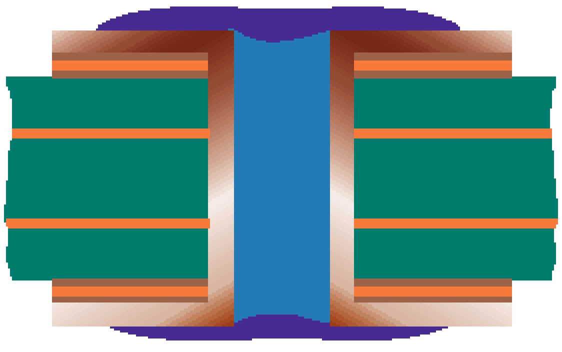
- Filled Via (Type V Via) - A via with material applied into the via targeting a full penetration and encapsulation of the hole

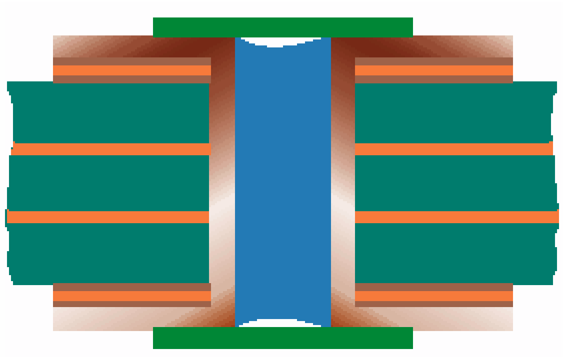


An additional operation which is done independent of soldermask application. The via is filled with a non-conductive material.

Type VI - Filled and Covered

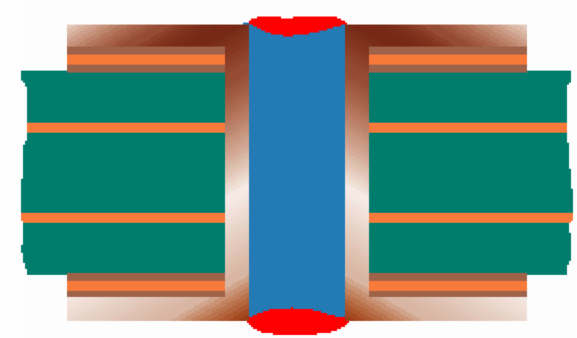
- Filled and Covered Via (Type VI Via) - A Type V via with a secondary covering of material (liquid or dry film soldermask) applied over the via. It may be applied from either one side or both sides.



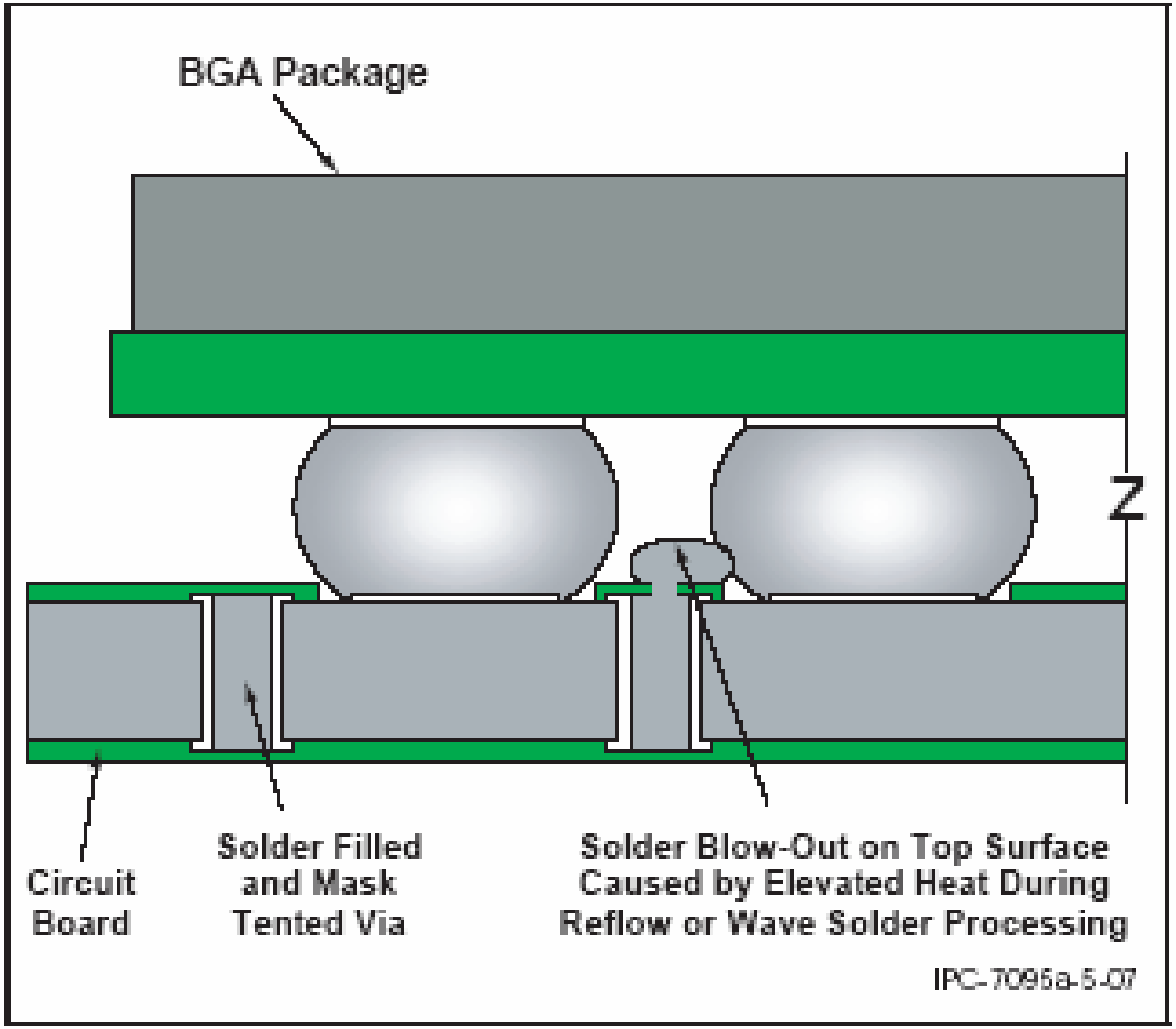


Type VII - Filled and Capped

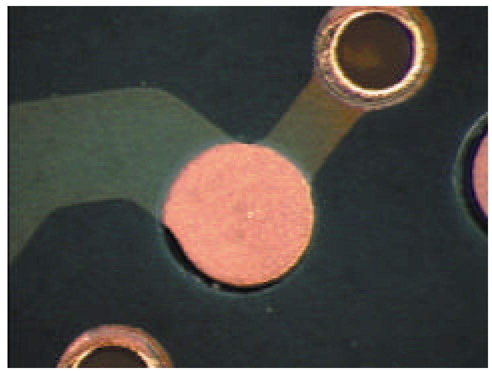
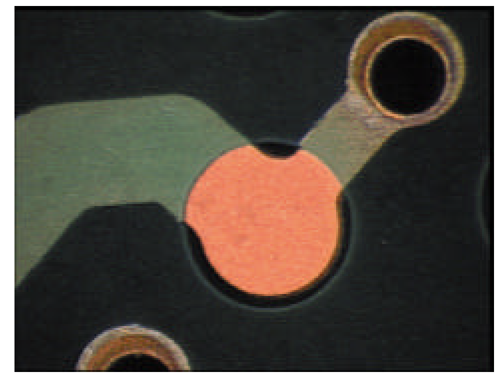
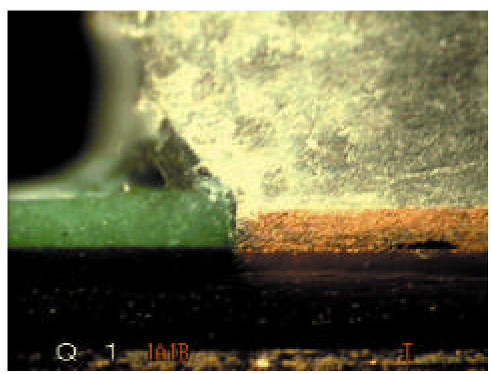
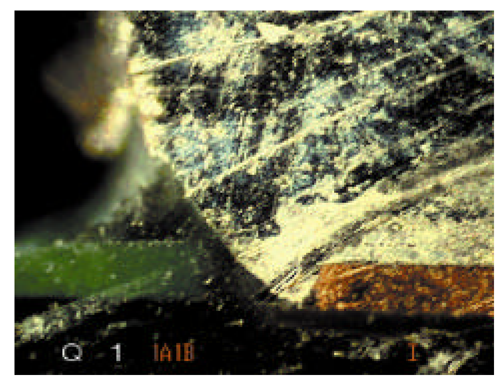
- Filled and Capped Via (Type VII Via) - A Type V via with a secondary metallized coating covering the via. The metallization is on both sides



Via's and BGAs



Effect of Having Solder Mask Relief Around the BGA Lands of the Board

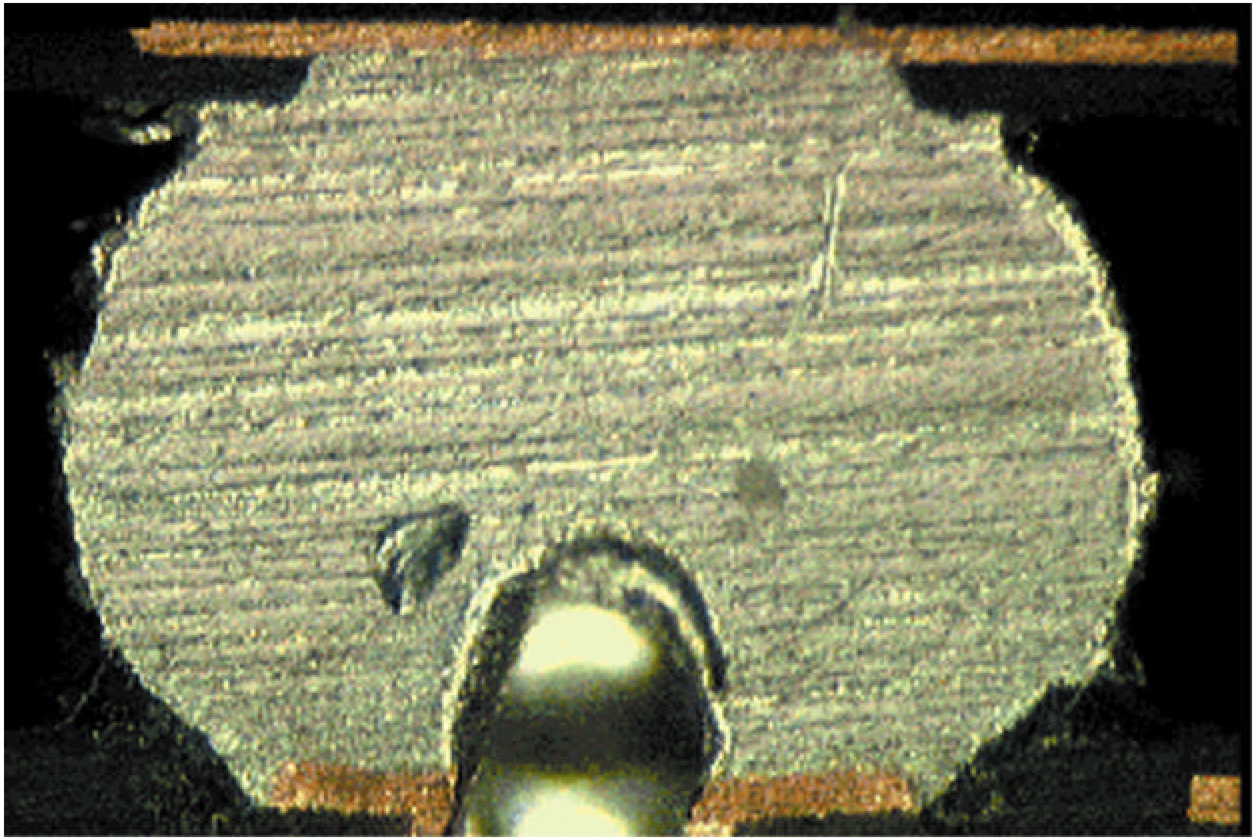
Soldermask Relief Around Land	**~0 mm**	**0.75 mm**
Top view of land illustrating increase of effective land diameter due to trace connections		
Cross-sectional view of land with solder ball joint illustrating the solder wetting down the edge of the land when there is solder mask relief away from the land edge		

Via-in-Pad and Impact on Reliability

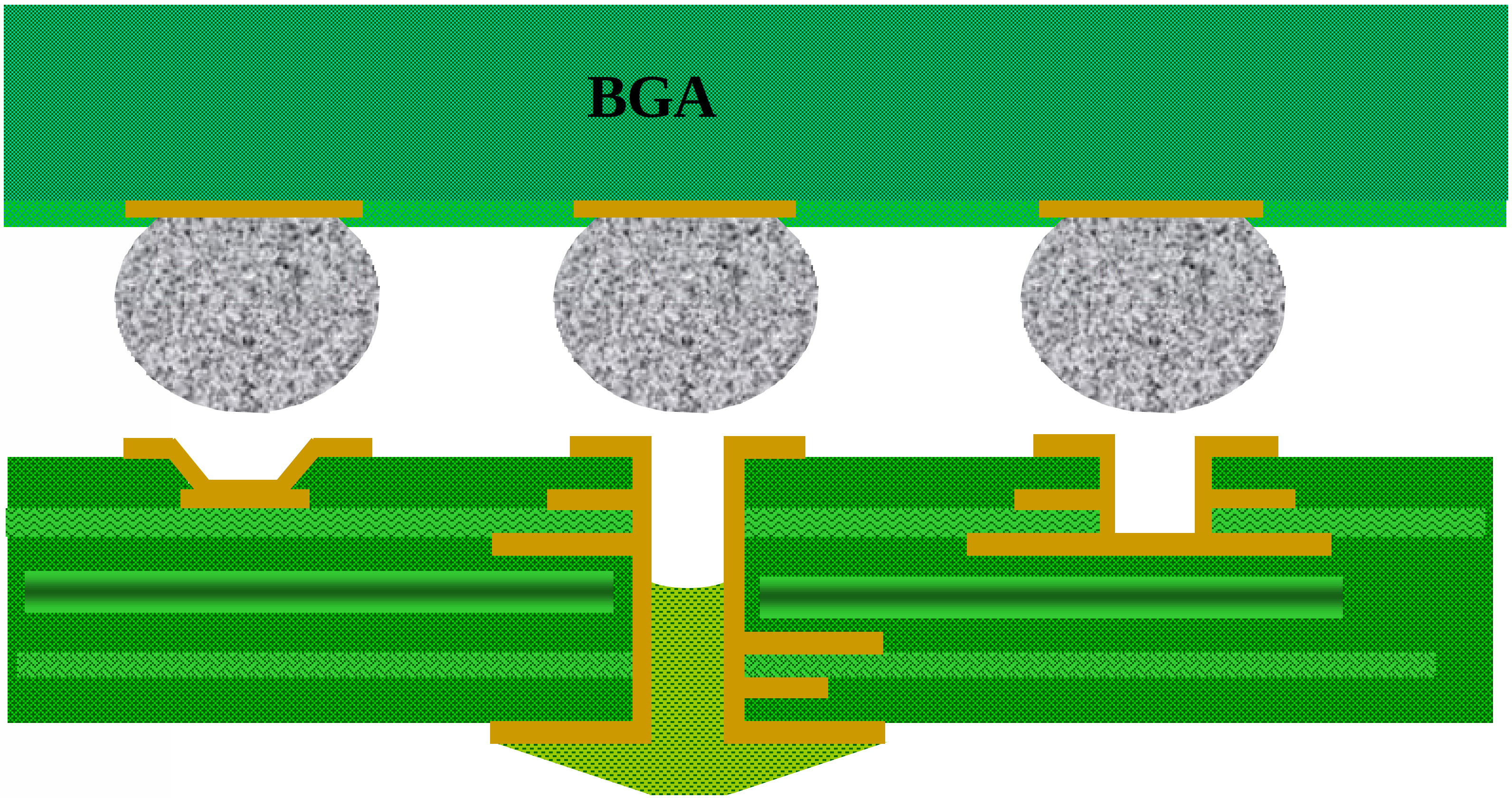
Via-in-Pad (through-hole via, capped on bottom of the board) for BGA Lands cause voids in the BGA solder joints, which may impact reliability.

Current data indicate that, for the standard 25 - 35 mm package with 0.75 mm balls, there is no reliability risk from voids. Accelerated aging tests have been performed and the failure rate was statistically equivalent to standard dog bone designs. It appears that void consistency is

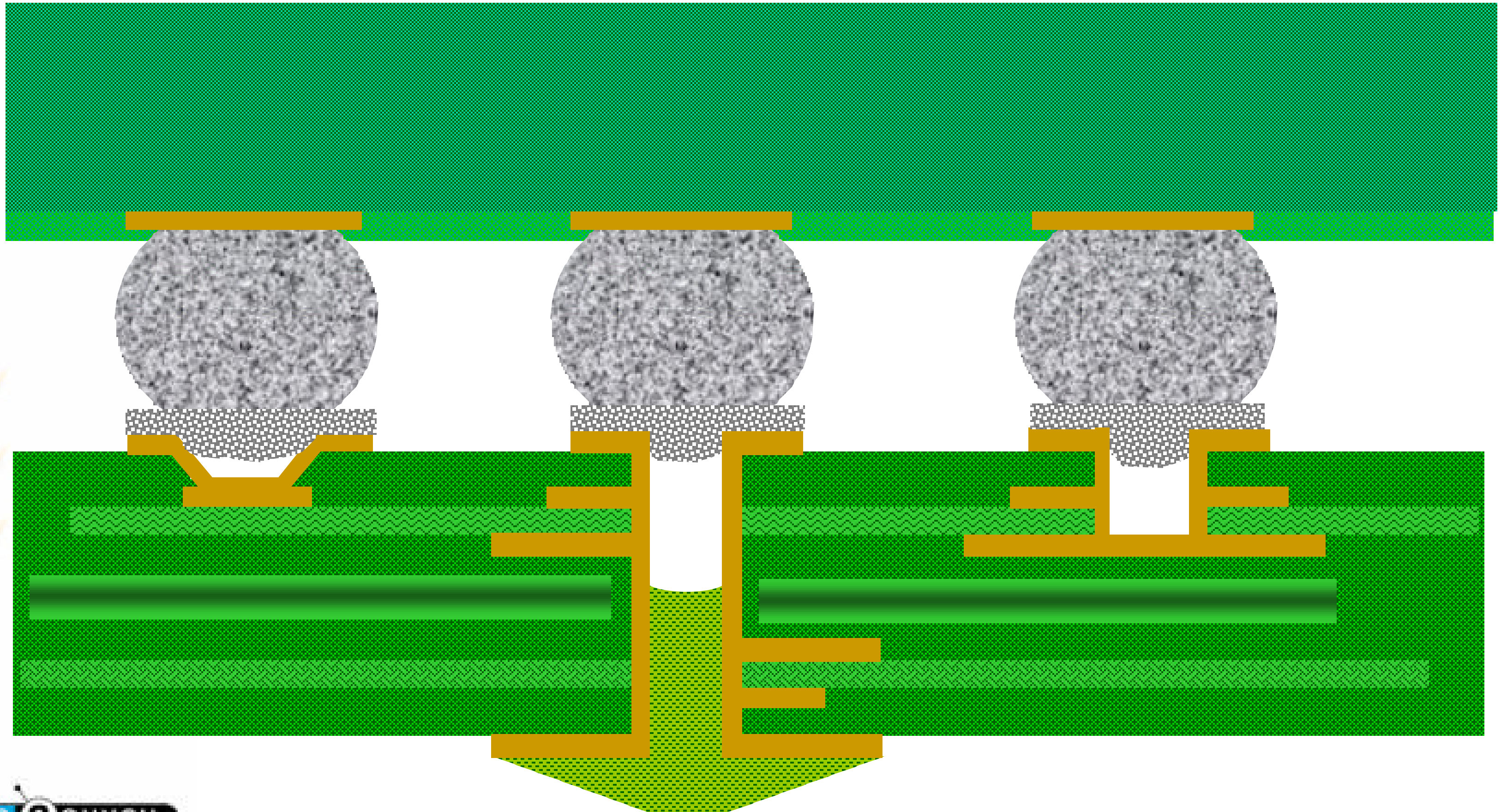
Cross Section of 0.75mm Ball with Via-in-Pad Structure



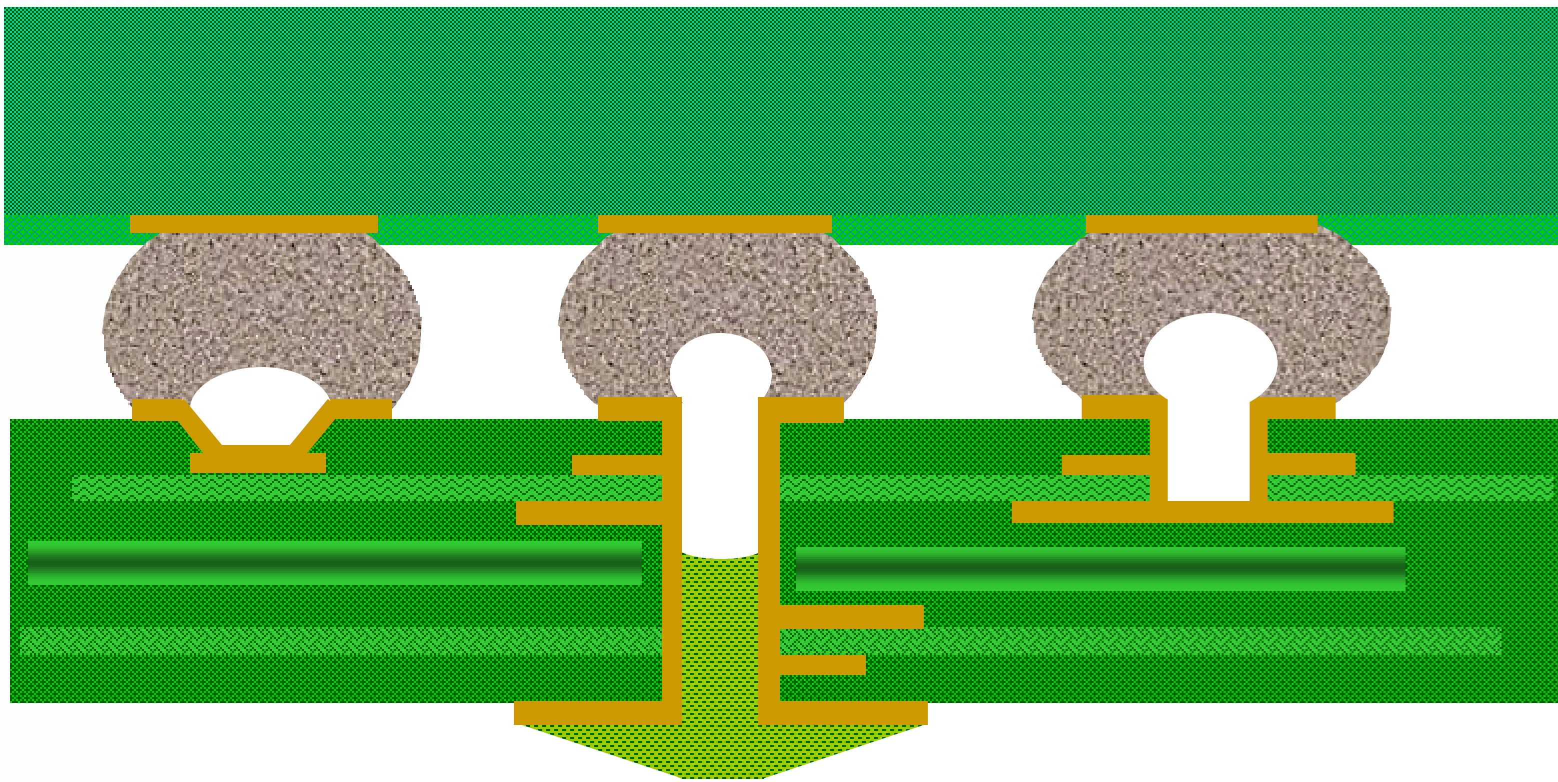
Before Assembly Process



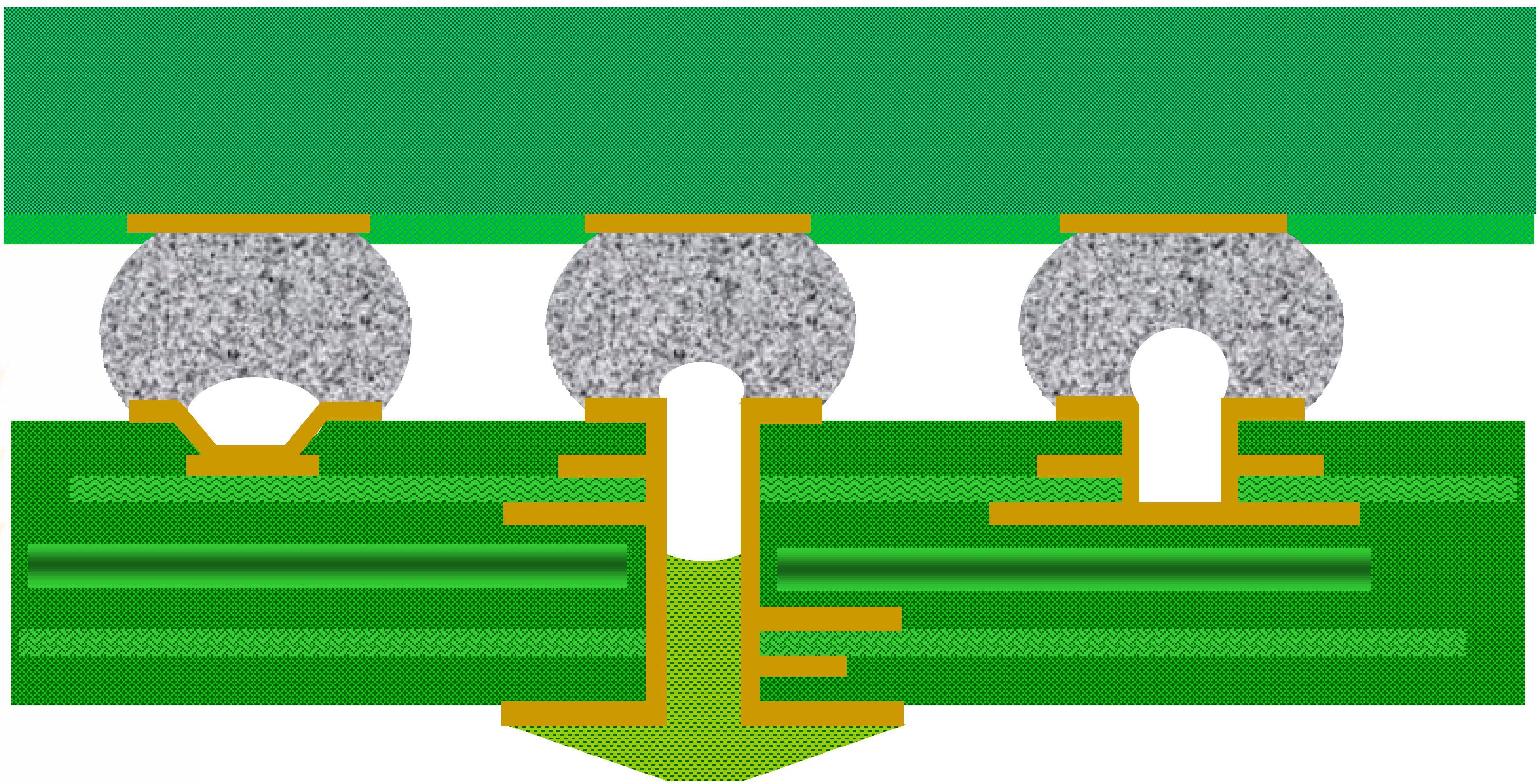
After Printing Paste, and BGA Placement



During Reflow Soldering



Post Reflow Soldering



Data Analysis for IPC-SM-782 Land Patterns - Microsoft Internet Explorer

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Please select a component family: CFP

Enter

INTRODUCTION

Because of the movement to international and global standardization, the values used in the calculator reflect the international grid system detailed in IPC-1902/IEC 60097.

Therefore the values in the tables :

- Are represented in millimeters
- Reflect the international grid of 0.5mm
- Are represented as two-place decimals for finished dimensions.

Dimensions shown in the calculator follow the principles of Y14.5M and IPC-2615. The equations in the calculator use profile dimensioning factors to derive the appropriate land patterns. All dimensions shown are basic, with limits of size controlling form as well as size. Perfect form is required at the maximum dimensions, which is the intent of the land pattern, described in the calculator.

CALCULATION STEPS

1. Select the component family you wish to either search for or modify an existing land pattern. If modifying an existing land pattern, the numbers will transfer to a modification screen, enabling you to modify the numbers.

2. If you are creating a new land pattern, you will be asked to input your component data, as well as the fabrication and assembly tolerances. Component dimensions for existing JEDEC (Joint Electronic Device Engineering Council) package types can be accessed on-line via JEDEC Publication 95 "Registered and Standard Outlines for Solid State and Related Products" at www.jedec.org.

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Data Analysis for IPC-SM-782 Land Patterns - Microsoft Internet Explorer

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Please select a component family: CFP

SOP
SOT 143
SOT 223
SOT 23
SOT 89
SQFP/QFP (Rectangular)
SQFP/QFP (Square)
SSOIC
Tantalum Capacitors
TO 252/TO 268
TSOP

INTRODUCTION

Because of the movement to international and global standardization, the val t the international grid system detailed in IPC-1902/IEC 60097.

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IPC

SQFP/QFP (Square)	
Registered Land Pattern (RLP)	◉ 630A
Component ID	○ QFP 32X32-184
Manufacturer, Part Number	○ SELECT
Other	○

View or Design

INSTRUCTIONS

1. Use the radio buttons to choose a search criteria. If you know the part has been approved by the IPC, select either the part's RLP or Component ID. If the part has not been approved, but you know the manufacturer, select the Manufacturer, Part Number option. If you would like to design your own part from scratch in this family, choose Other.
2. If you did not select Other, choose the desired part from the drop down box next to the selected radio button. If you selected Other, continue to Step 3.
3. Press the View or Design button. Please note: if you selected Manufacturer, Part Number and left the default choice (SELECT), you will be returned to the family selection page.

Done | Internet

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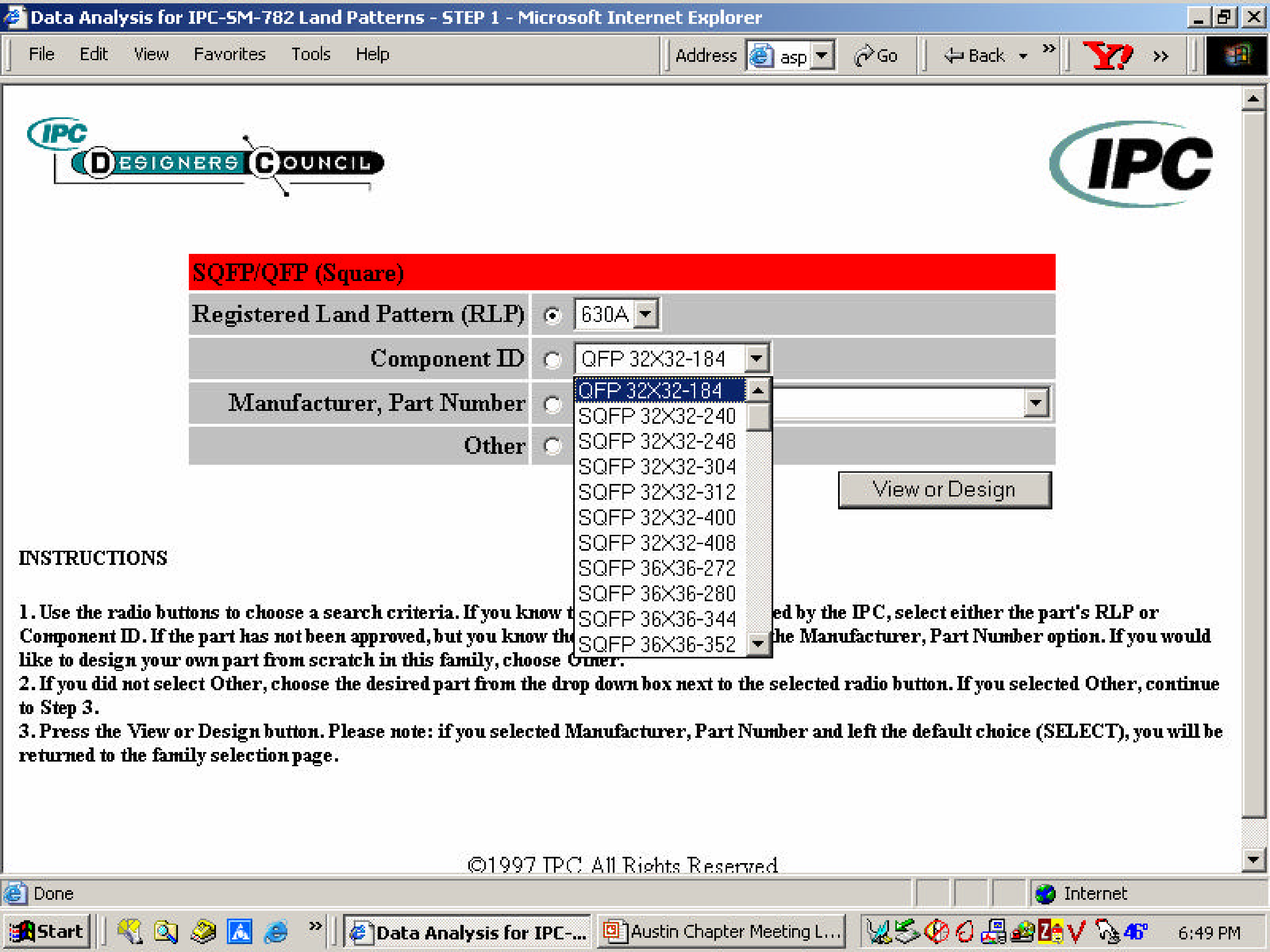

Data Analysis for IPC-SM-782 Land Patterns - STEP 1 - Microsoft Internet Explorer
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IPC DESIGNERS COUNCIL
IPC
SQFP/QFP (Square)
Registered Land Pattern (RLP) 630A
Component ID QFP 32X32-184
Manufacturer, Part Number
Other
QFP 32X32-184
SQFP 32X32-240
SQFP 32X32-248
SQFP 32X32-304
SQFP 32X32-312
SQFP 32X32-400
SQFP 32X32-408
SQFP 36X36-272
SQFP 36X36-280
SQFP 36X36-344
SQFP 36X36-352
View or Design
INSTRUCTIONS
1. Use the radio buttons to choose a search criteria. If you know t ed by the IPC, select either the part's RLP or Component ID. If the part has not been approved, but you know th he Manufacturer, Part Number option. If you would like to design your own part from scratch in this family, choose Other.
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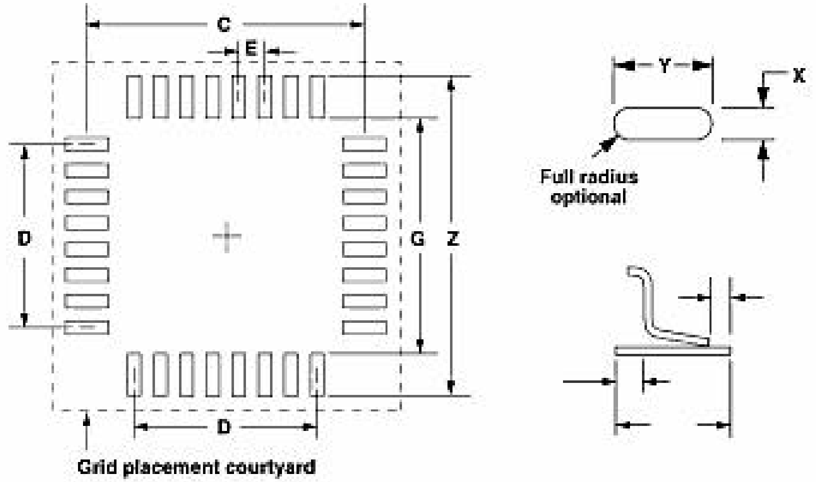
Please note: For best printing results, set your printer to Landscape

FAMILY: SQFP/QFP (Square)

RLP: 630A

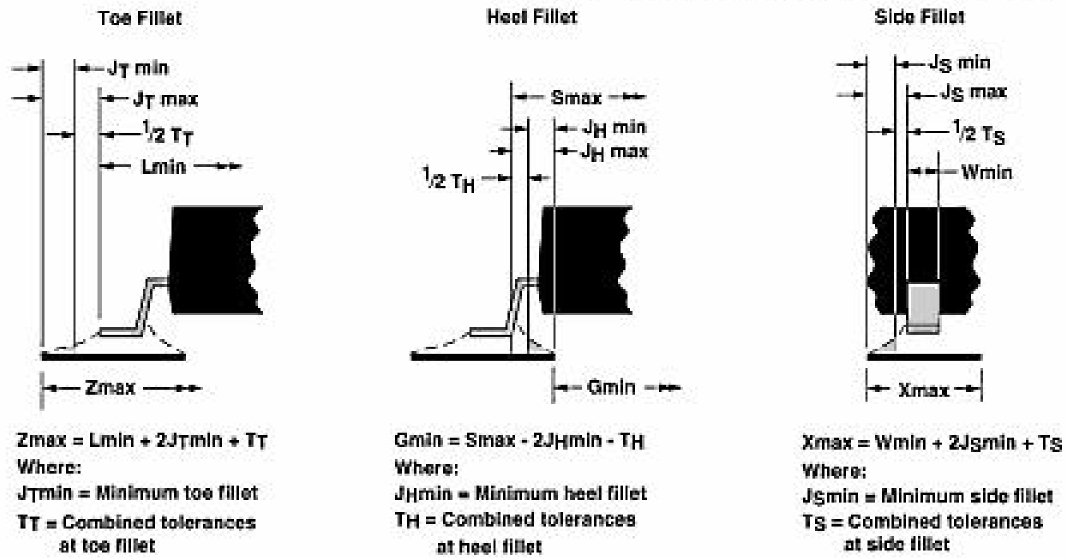
CID: QFP 32X32-184

LAND PATTERN DIMENSIONS



(Max) Z	(Min) G	(Max) X	(Ref) Y	(Ref) C/C	D	E	PIN	(Ref) PLMT GRID
35.8	32.2	0.4	1.8	34	29.25	0.65	184	74X74

TOLERANCE AND SOLDER JOINT ANALYSIS



Tol. Assumptions		Toe			Heel			Side		
F	P	Cl	Jt min	Jt max	Cs	Jh min	Jh max	Cw	Js min	Js max
0.1	0.1	0.5	0.17	0.43	0.66	0.42	0.75	0.16	-0.02	0.09

Return to the front page | Modify this part

STEP1 - Microsoft Internet Explorer

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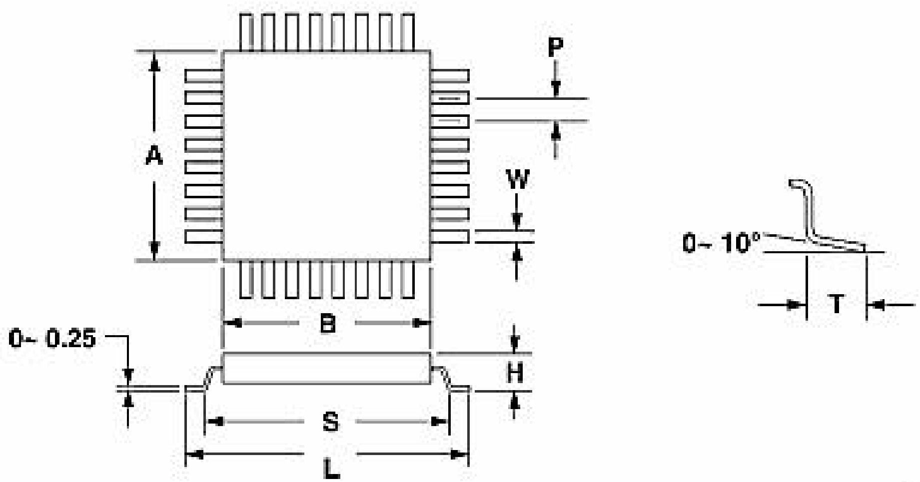
Please enter information in *all* of the open fields. When you are done, press CALCULATE. If numeric information has been filled in all of the fields, press the NEXT button. NOTE: Depending on the size of your screen and your screen settings, you may have to scroll to the right to see all of the data fields.

Component Dimensions														M Allo
L Min Lgth	L Max Lgth	S Min Space	S Max Space	W Min Width	W Max Width	T Min Term	T Max Term	A Ref Dim	B Ref Dim	H Min Height	H Max Height	P Nom Dim	Pin Count	F Fab Tol.
34.95	35.45			0.22	0.38	0.65	0.95	32	32	3.8	4.2	0.65	184	0.1

CALCULATE



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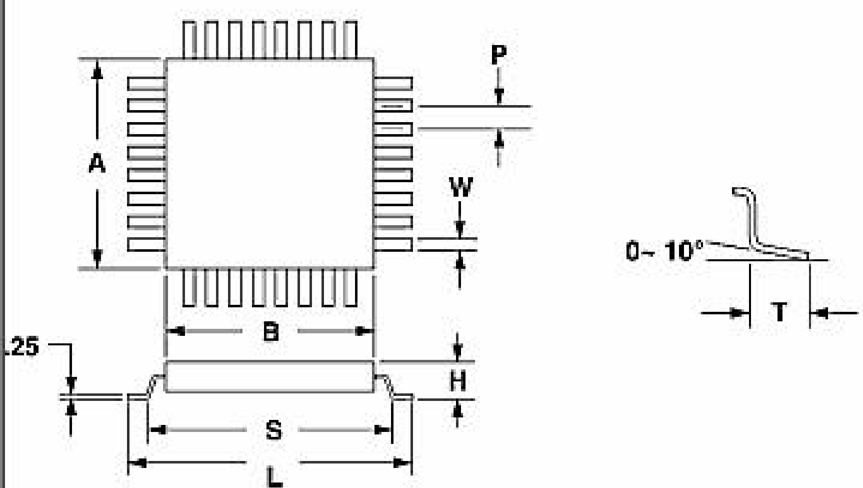
n fields. When you are done, press CALCULATE. If numeric information has been filled in all of the
pending on the size of your screen and your screen settings, you may have to scroll to the right to

Component Dimensions										Man. Allowance		Solder Joint Design Goal		
Min dth	W Max Width	T Min Term	T Max Term	A Ref Dim	B Ref Dim	H Min Height	H Max Height	P Nom Dim	Pin Count	F Fab. Tol.	P Place Acrcy	J/T Toe Min	J/H Heel Min	J/S Side Min
2	0.38	0.65	0.95	32	32	3.8	4.2	0.65	184	0.1	0.1	0.4	0.5	0



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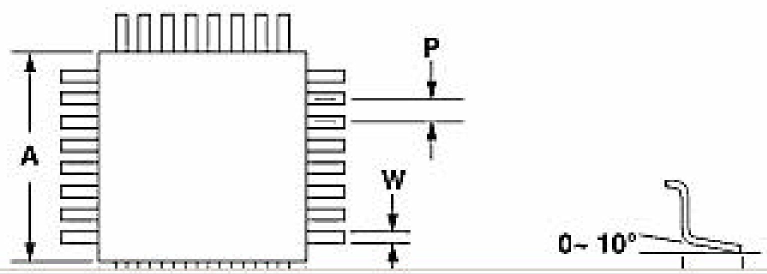
Component Dimensions														M Allo
L Min Lgth	L Max Lgth	S Min Space	S Max Space	W Min Width	W Max Width	T Min Term	T Max Term	A Ref Dim	B Ref Dim	H Min Height	H Max Height	P Nom Dim	Pin Count	F Fab Tol
34.95	35.45	33.05	33.71	0.22	0.38	0.65	0.95	32	32	3.8	4.2	0.65	184	0.1

CALCULATE NEXT



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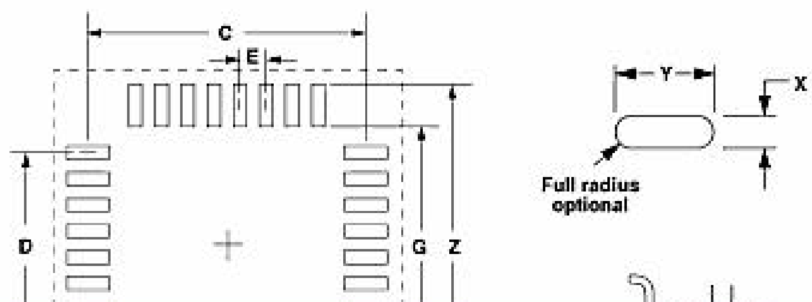
Please enter information in *all* of the open fields. When you are done, press CALCULATE. If numeric information has been filled in all of the fields, press the NEXT button. NOTE: Depending on the size of your screen and your screen settings, you may have to scroll to the right to see all of the data fields.

Land Pattern Calculations																
Z Min Fin	Z Max Fin	Z Max Cal	Z Adj Fact	G Max Fin	G Min Fin	G Min Cal	G Adj Fact	X Min Fin	X Max Fin	X Max Cal	X Adj Fact	Y Ref Cal	Clr Ref Cal	C/C Ref Cal	D1 Ref Cal	D2 Ref Cal
36.17	36.27	36.27		32.135	32.035	32.035		0.334	0.434	0.434		2.117	0.216	34.152	29.25	29.2

CALCULATE



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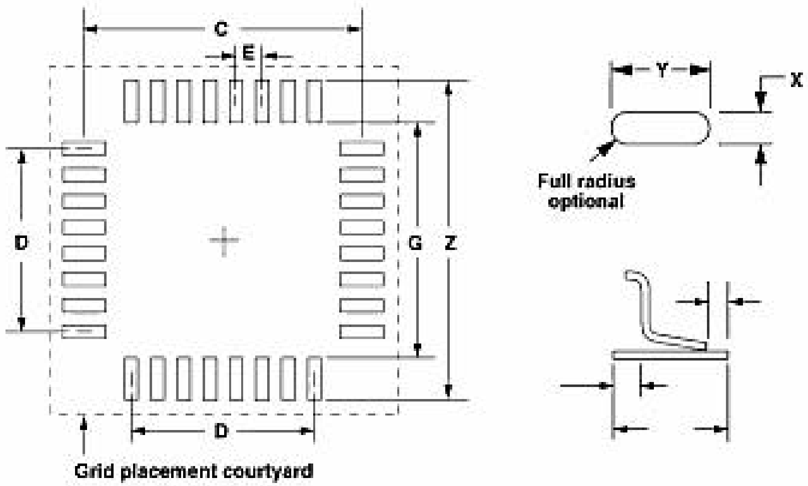
Please enter information in *all* of the open fields. When you are done, press CALCULATE. If numeric information has been filled in all of the fields, press the NEXT button. NOTE: Depending on the size of your screen and your screen settings, you may have to scroll to the right to see all of the data fields.

Land Pattern Calculations

Z Min Fin	Z Max Fin	Z Max Cal	Z Adj Fact	G Max Fin	G Min Fin	G Min Cal	G Adj Fact	X Min Fin	X Max Fin	X Max Cal	X Adj Fact	Y Ref Cal	Clr Ref Cal	C/C Ref Cal	D1 Ref Cal	D2 Ref Cal
35.97	36.07	36.27	-0.2	32.635	32.535	32.035	.5	0.034	0.134	0.434	-.3	1.767	0.516	34.302	29.25	29.2

CALCULATE NEXT



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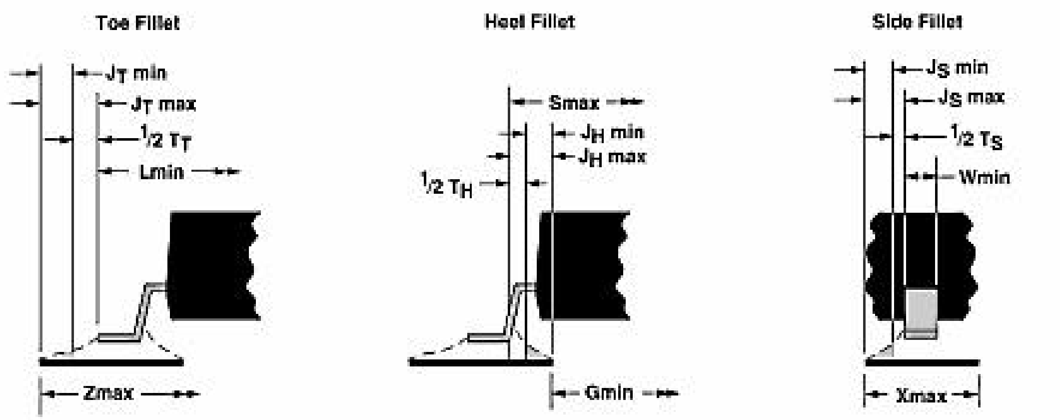
If you are satisfied with the measurements listed click FINISH, otherwise click PREVIOUS to go back a step and modify your Adjustment Factors.

Solder Joint Analysis								
Toe			Heel			Side		
Design Goal	Statis Min	Statis Max	Design Goal	Statis Min	Statis Max	Design Goal	Statis Min	Statis Max
0.4	0.3	0.56	0.5	0.25	0.585	0	-0.15	-0.043

PREVIOUS FINISH



$Zmax = Lmin + 2J_Tmin + T_T$
Where:
J_Tmin = Minimum toe fillet
T_T = Combined tolerances at toe fillet

$Gmin = Smax - 2J_Hmin - T_H$
Where:
J_Hmin = Minimum heel fillet
T_H = Combined tolerances at heel fillet

$Xmax = Wmin + 2J_Smin + T_S$
Where:
J_Smin = Minimum side fillet
T_S = Combined tolerances at side fillet

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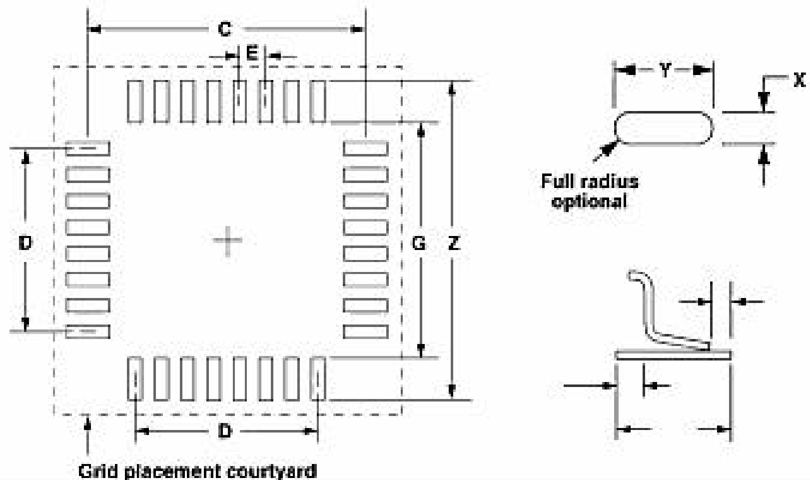

Component ID		Finished Land Pattern Dimensions								
RLP	Comp ID	(Max) Z	(Min) G	(Max) X	(Ref) Y	(Ref) C/C	(Ref) D	(Ref) E	(Ref) PIN COUNT	(Ref) PLMT GRID
User	Part	36.07	32.53	0.13	1.77	34.3	29.25	0.65	184	

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STEP 4 - Microsoft Internet Explorer

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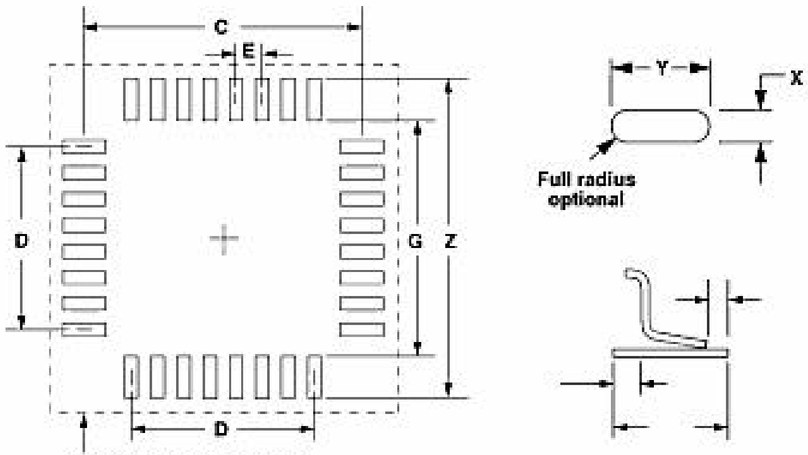

Component ID		Finished Land Pattern Dimensions								
RLP	Comp ID	(Max) Z	(Min) G	(Max) X	(Ref) Y	(Ref) C/C	(Ref) D	(Ref) E	(Ref) PIN COUNT	(Ref) PLMT GRID
User	Part	36.07	32.53	0.13	1.77	34.3	29.25	0.65	184	

Please fill in both the Manufacturer and the Man. Part Number fields.

First Name: | Last Name:

Email Address: garyf40@aol.com | Company:

Manufacturer's Part Number: | Manufacturer:

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Finished Land Pattern Dimensions

	IPC	Min.	Median	Max.
Z1 (Max)	12.80	12.60	13.20	13.50
Z2 (Max)	16.80	16.60	17.20	17.50
G1 (Min)	9.6	9.8	9.8	9.6
G2 (Min)	13.6	13.8	13.8	13.6
X (Max)	0.30	0.35	0.35	0.50
Y (Ref)	1.60	1.41	1.71	1.96
C/C1 (Ref)	11.20	11.19	11.49	11.54
C/C2 (Ref)	15.20	15.19	15.49	15.54
D1	8.50	8.50	8.50	8.50
D2	12.50	12.50	12.50	12.50
E	0.50	0.50	0.50	0.50
PIN1	18	18	18	18
PIN2	26	26	26	26
PLMT GRID (mm)	14.00 X 18.00	12.70 X 16.70	13.70 X 17.70	14.50 X 18.50
	Modify	Modify	Modify	Modify

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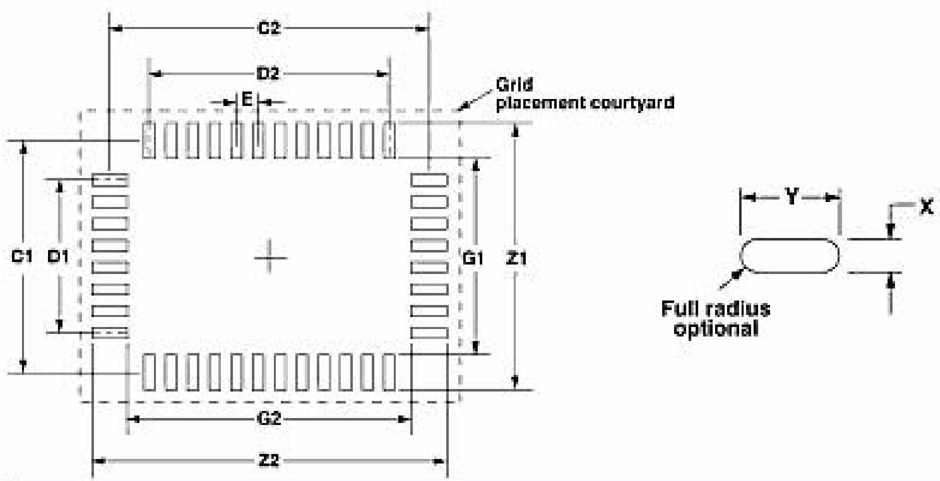
D2	12.50	12.50	12.50	12.50
E	0.50	0.50	0.50	0.50
PIN1	18	18	18	18
PIN2	26	26	26	26
PLMT GRID (mm)	14.00 X 18.00	12.70 X 16.70	13.70 X 17.70	14.50 X 18.50
	Modify	Modify	Modify	Modify



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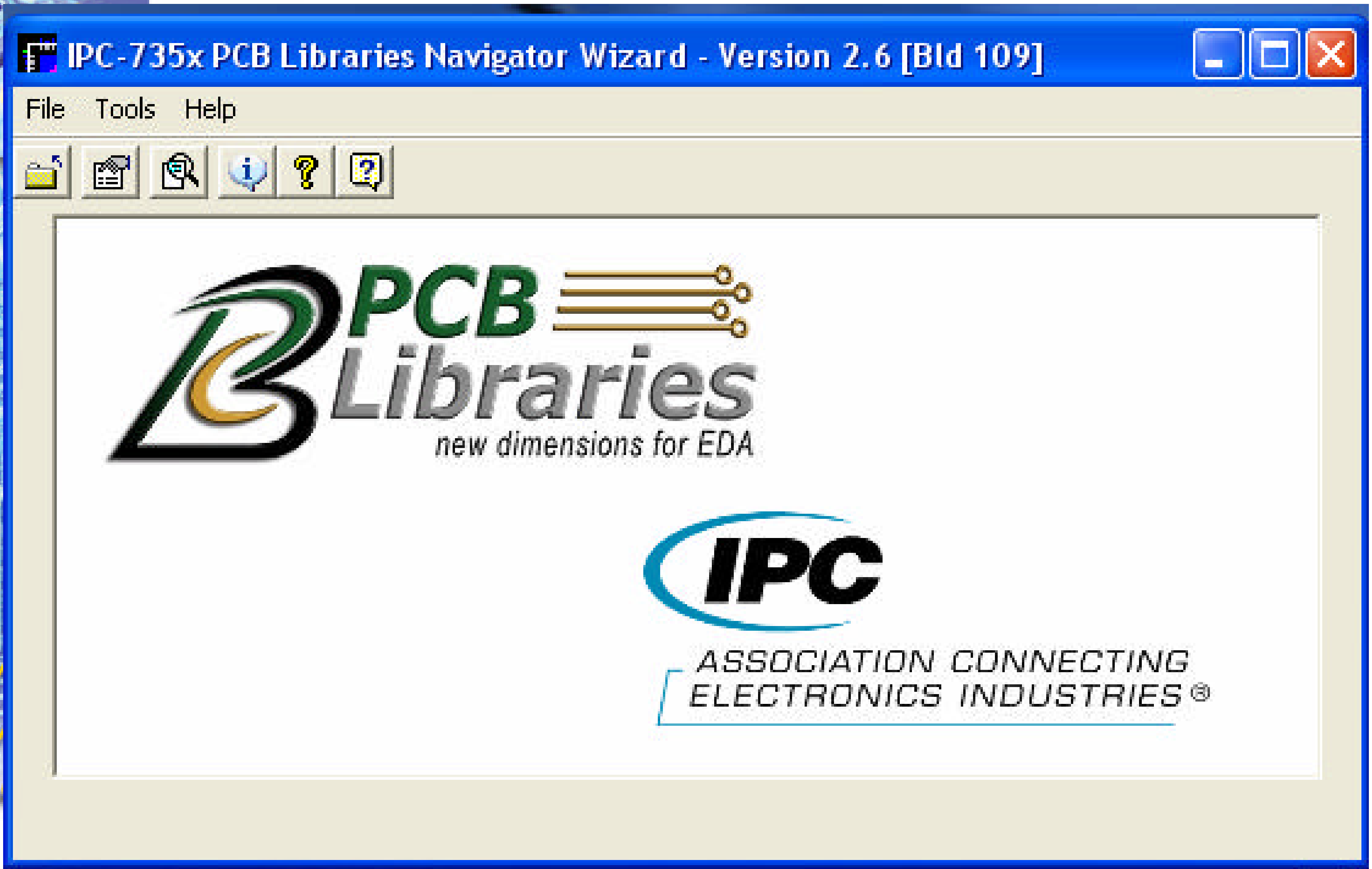
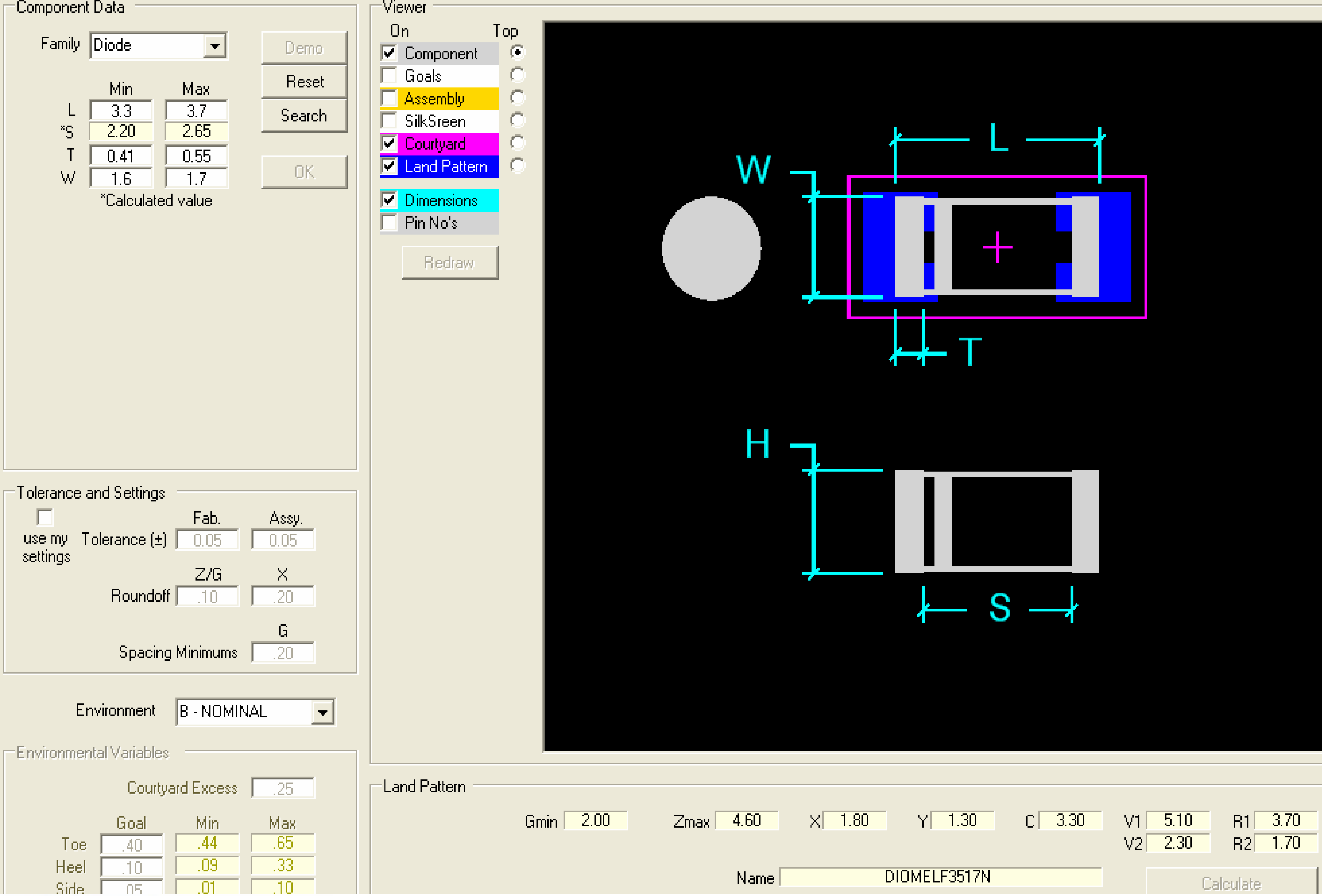
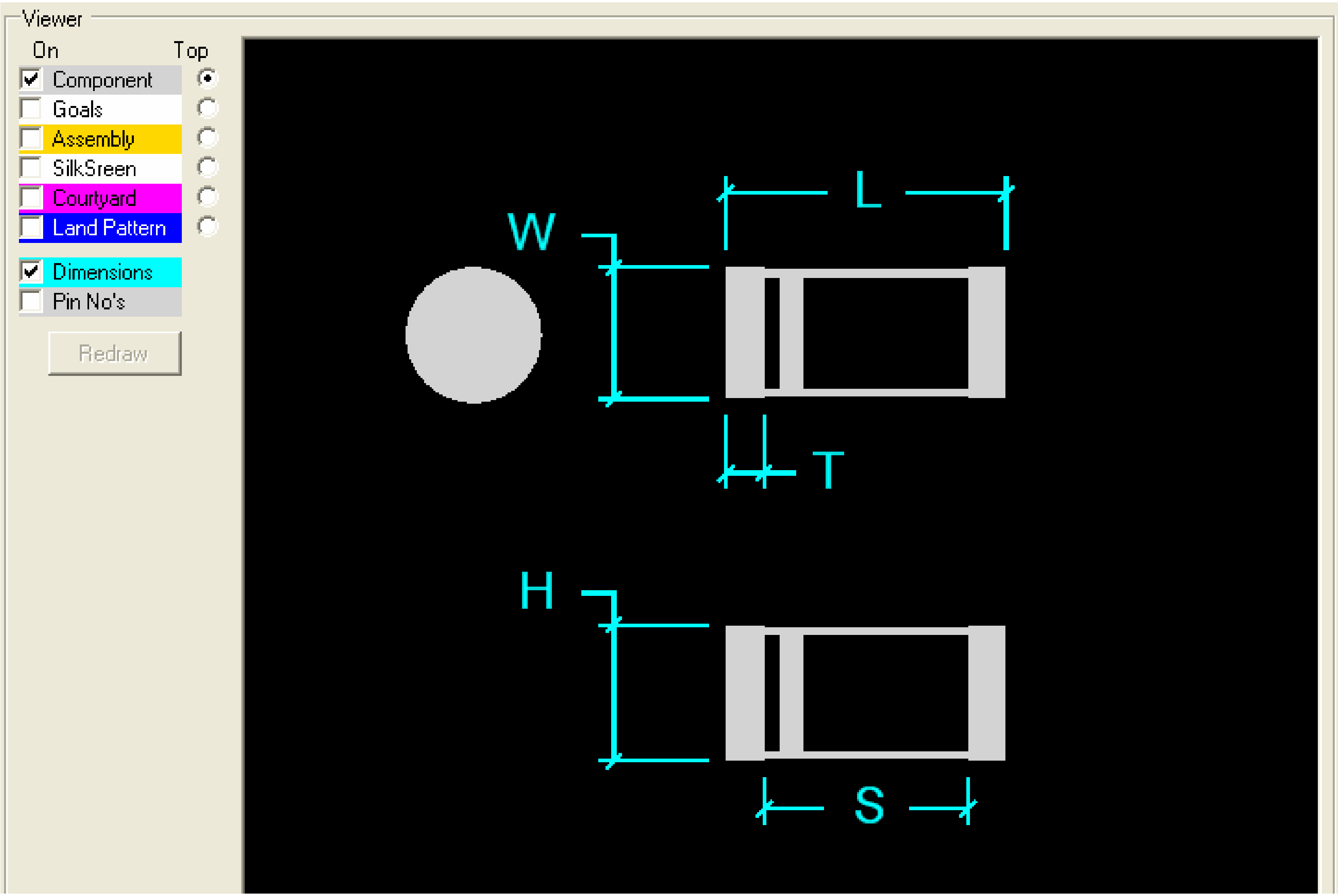
Future Libraries



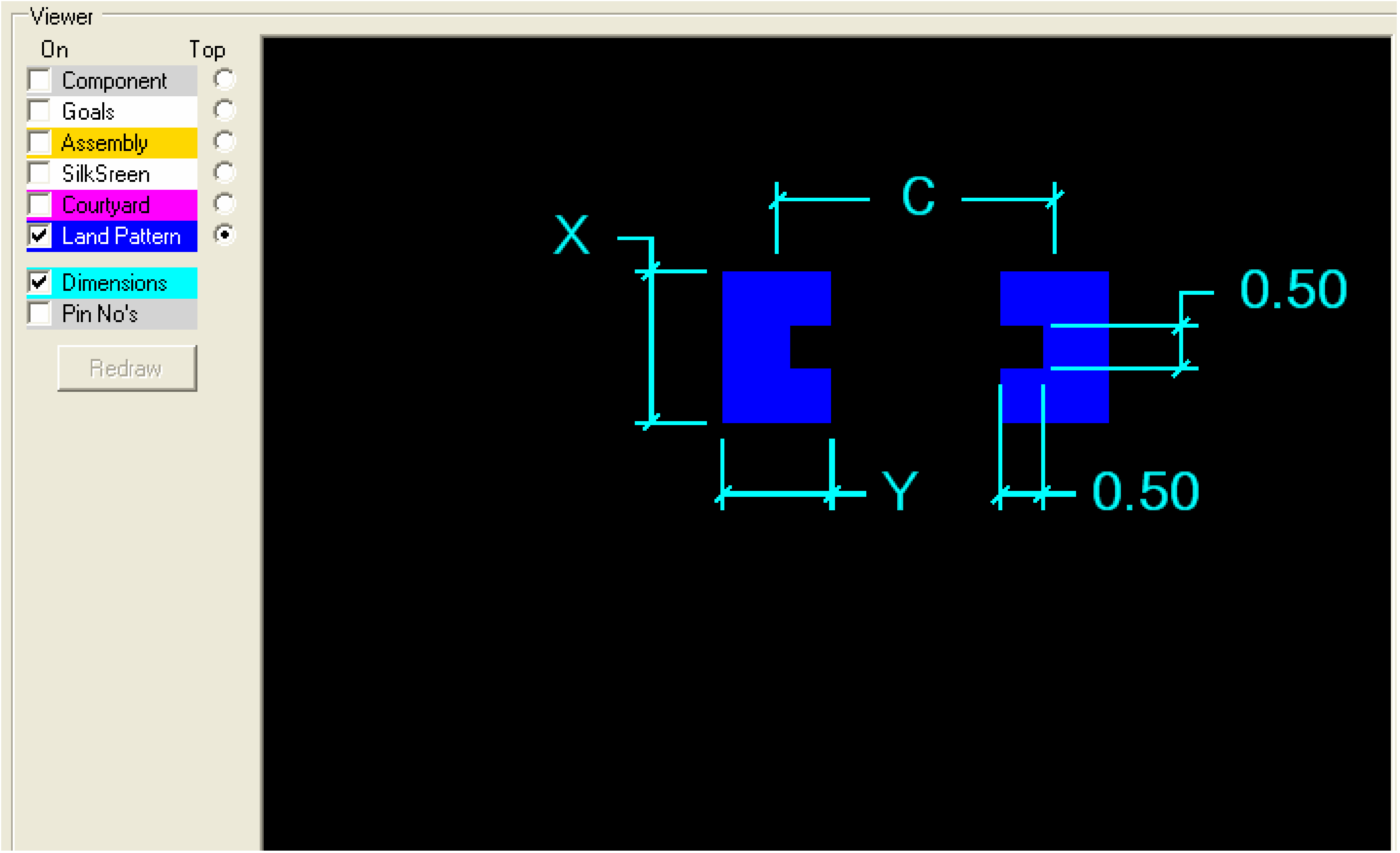


IPC DESIGNERS COUNCIL

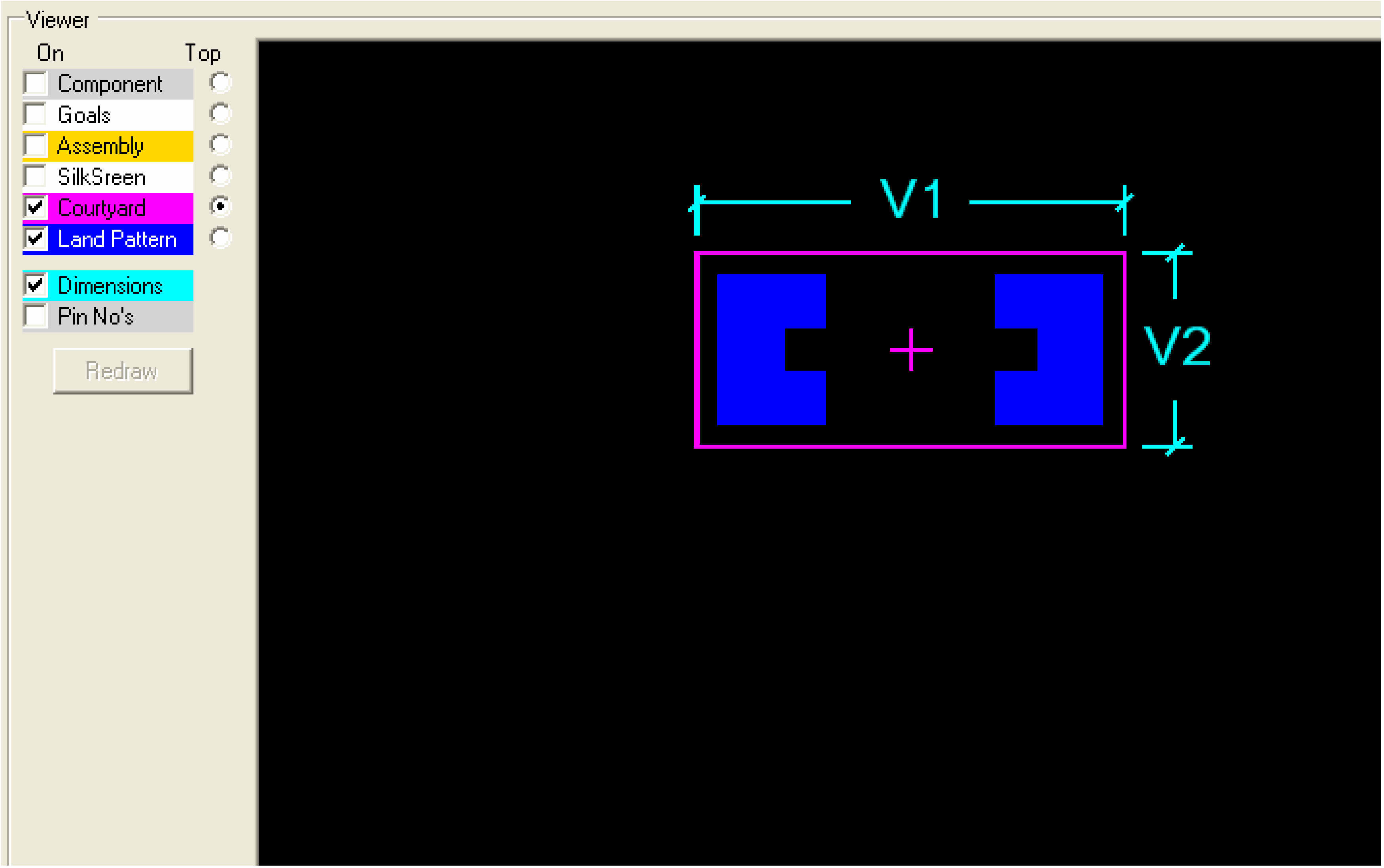
Component Descriptions

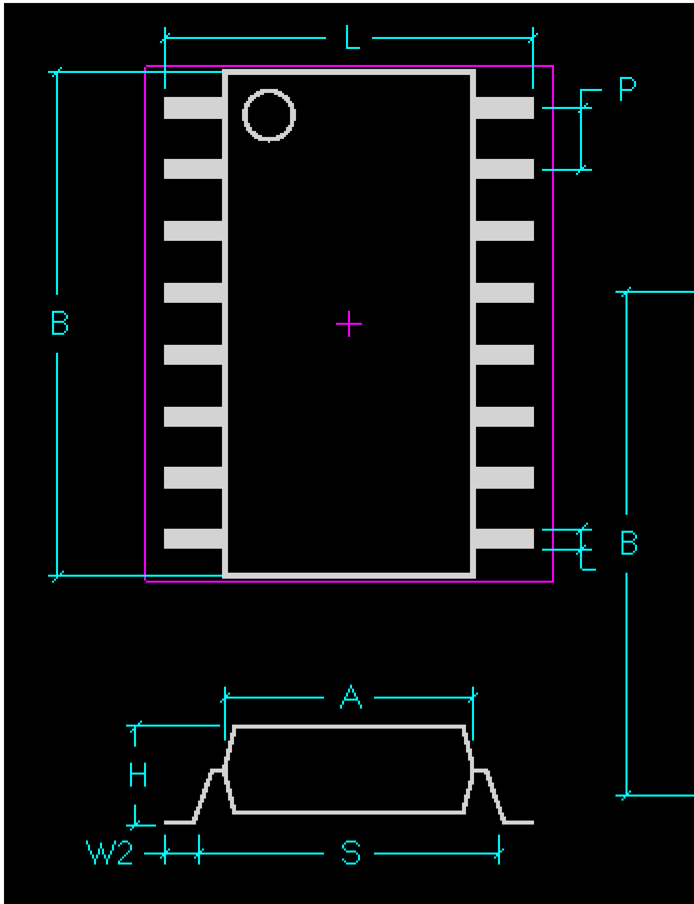


Land Patterns



Land Patterns and Courtyards





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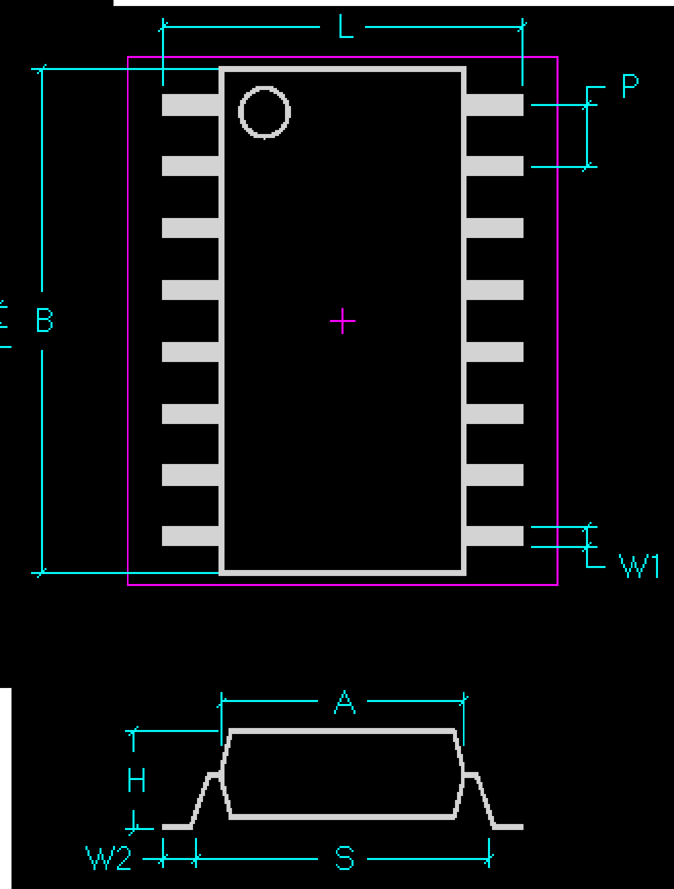

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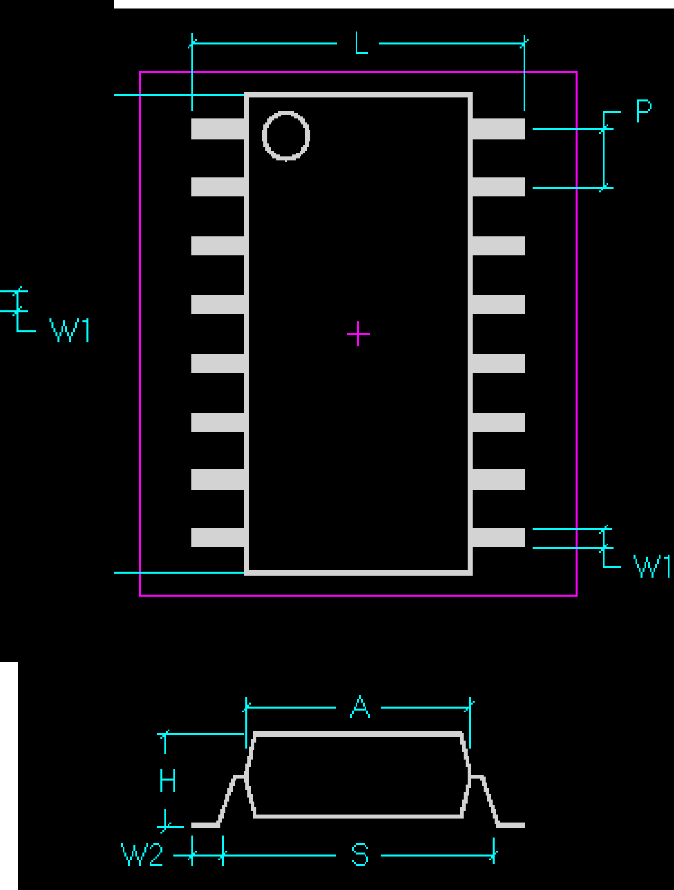
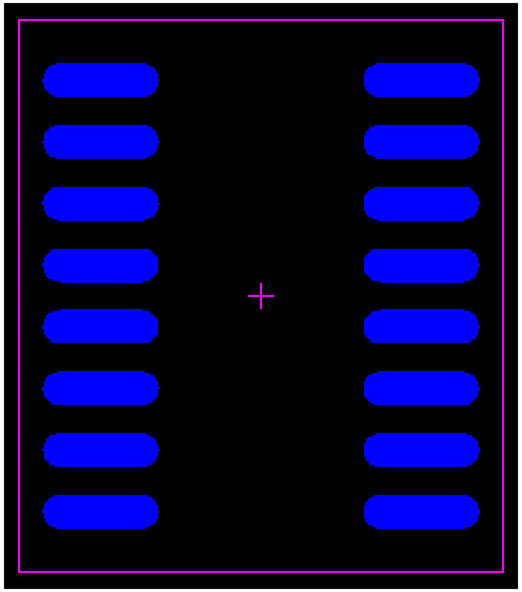


Land Patterns and Courtyards



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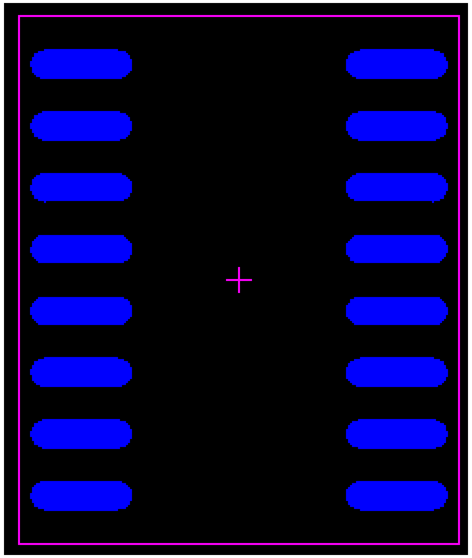

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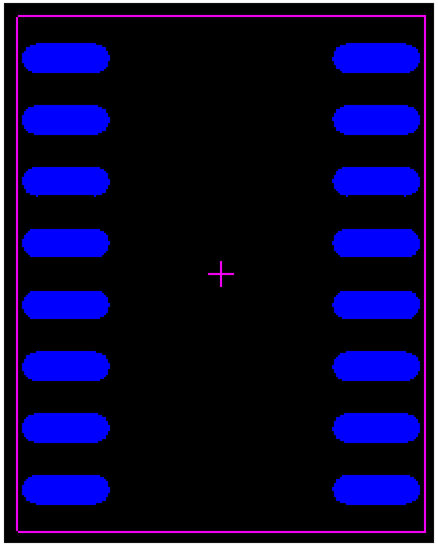

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Conclusions

- Mathematical models provide a method for process control
- Development of standards avoid duplication efforts
- New software code provides a neutral format for libraries
- Methodology is transportable for new or unique components
- Standard library concepts will enhance testing capabilities