

The background of the slide features a complex, stylized circuit board pattern in shades of gray and white, with various traces, pads, and vias. A solid red rectangular block is positioned on the right side of the slide, containing the main title and date.

# DFM Aware CAD Libraries

- Designing for Manufacturability Upfront

Aug 8<sup>th</sup>, 2024

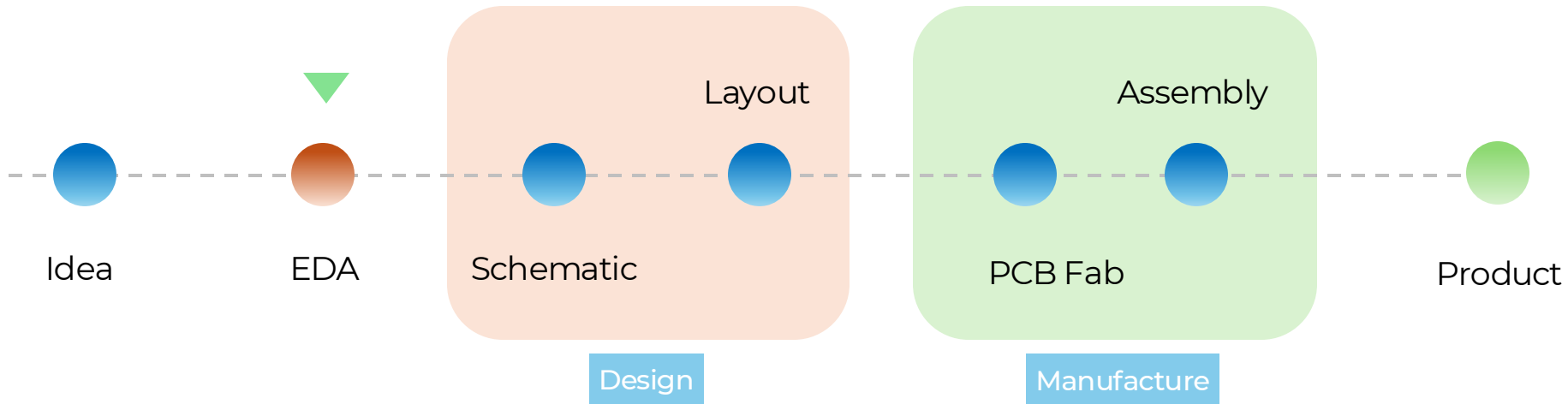
footprintku AI

 Ultra  
Librarian

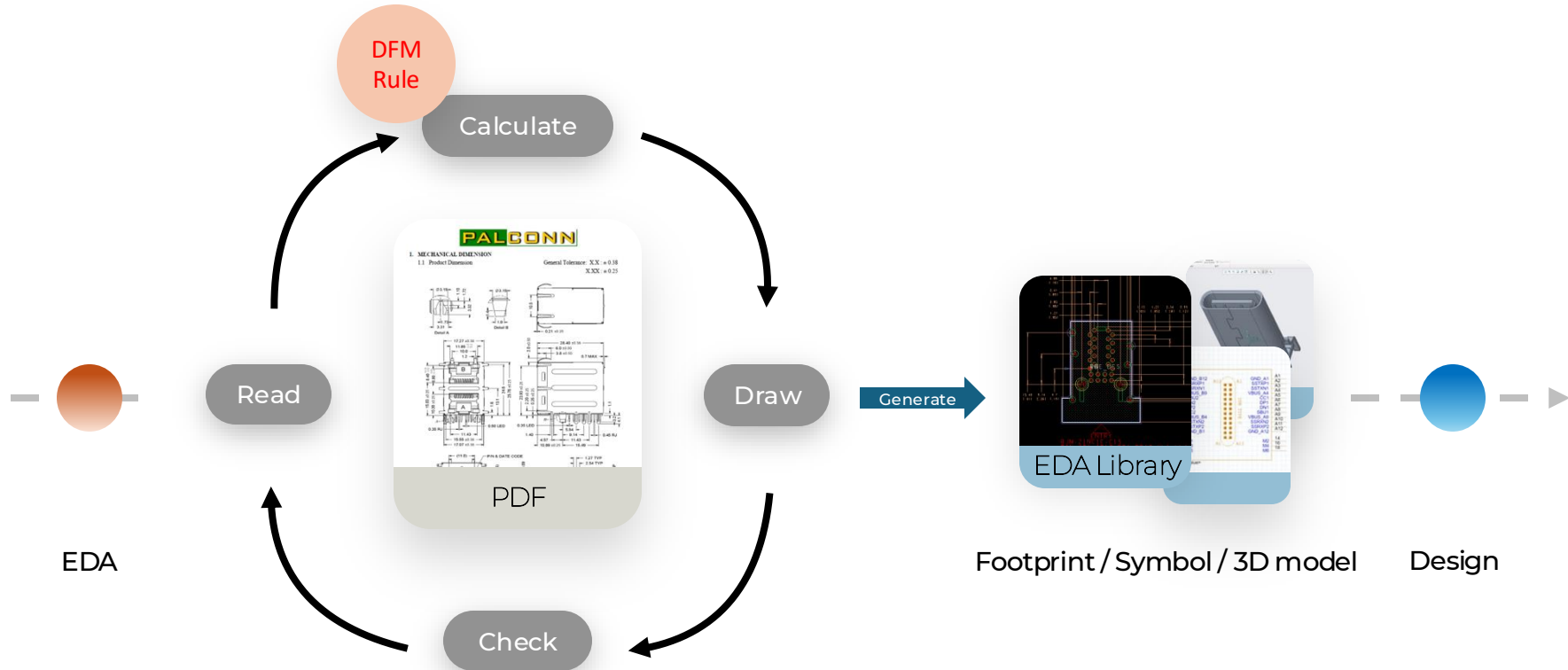
## Agenda

- Importance of DFM-aware Library
- Case Studies: Impact of DFM Rules on Manufacturability
- Developing a DFM-aware Library
- Integrating to Virtual Librarian Service
- Q&A

## EDA Library in Product Design

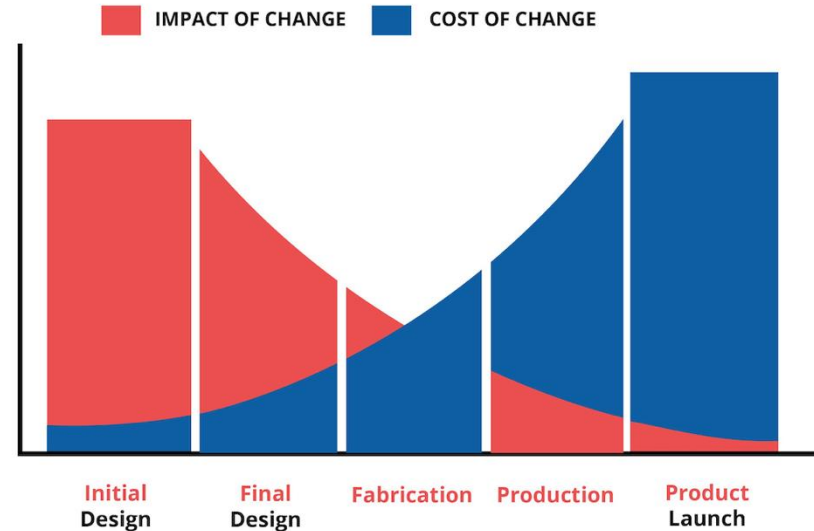


# Process of Creating an EDA Library



## What Happens When DFM Rules are Overlooked in Early Design Cycles?

“The cost of having to re-work design at a post-design check or even after discovering initial product build is faulty, is much higher than making changes in the initial design to ensure it can be manufactured right-first-time.”



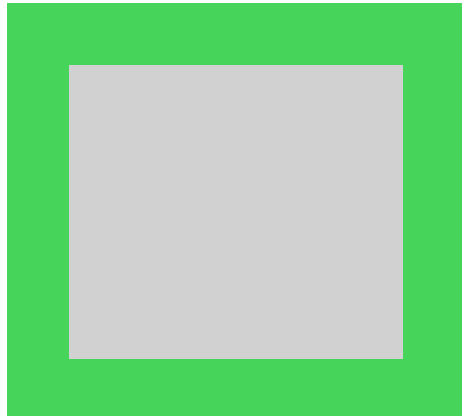


## Impact of DFM Rules on Manufacturability

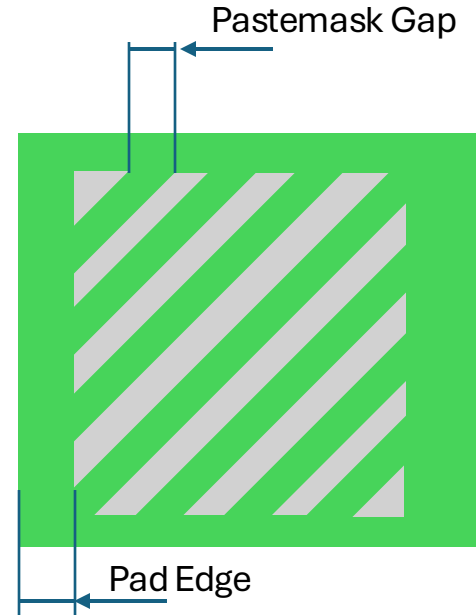
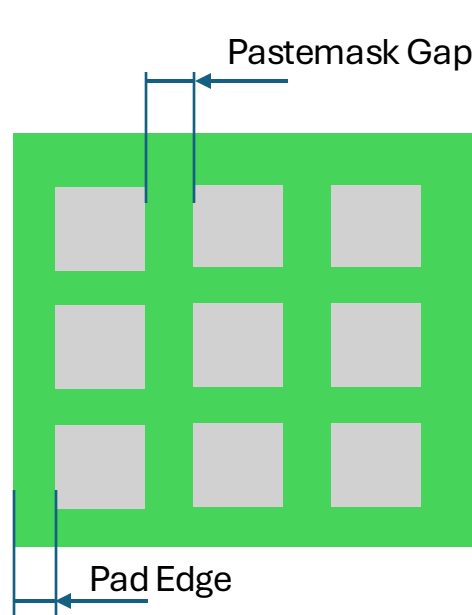
- Manufacturing condition and capabilities
- Increasing yield and minimize errors
- Engineer's experience



## Case 1 : Thermal Pad Pastemask Patterns



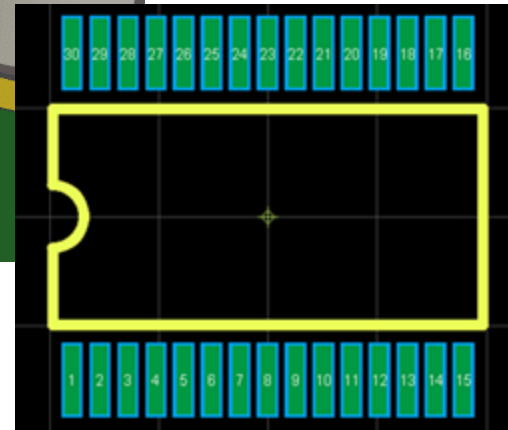
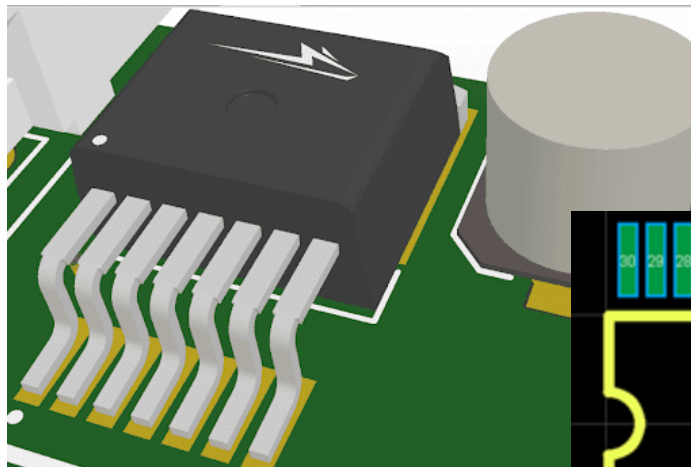
60 - 70 % covering rate





## Case2 : Land Pattern Design

- IPC 7351
- Vendor Land Pattern
- Lead types and extensions
- Package types



## Case2 : Land Pattern Design

### IPC 7351

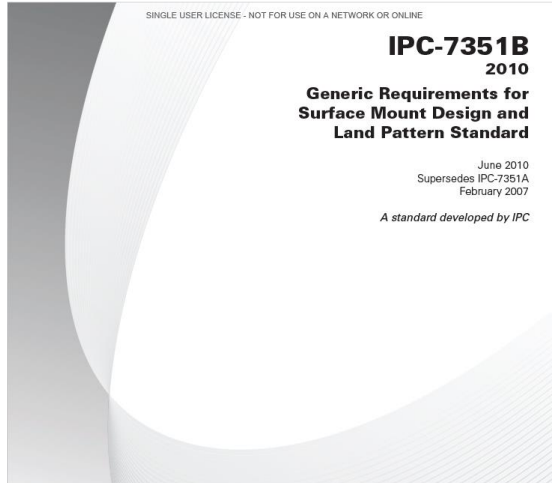


Table 3-23 IPC-7351 Land Pattern Naming Convention

Component, Category	Land Pattern Name
Ball Grid Array's	BGA + Pin Qty + C or N + Pitch P + Ball Columns X Ball Rows - Body Length X Body Width X Height
BGA w/Dual Pitch	BGA + Pin Qty + C or N + Col Pitch X Row Pitch P + Ball Columns X Ball Rows - Body Length X Body Width X Height
BGA w/Staggered Pins	BGAS + Pin Qty + C or N + Pitch P + Ball Columns X Ball Rows - Body Length X Body Width X Height
BGA Note: The C or N = Collapsing or Non-collapsing Balls	
Capacitors, Chap, Array, Concave	CAPCAV + Pitch P + Body Length X Body Width X Height - Pin Qty
Capacitors, Chap, Array, Flat	CAPCAF + Pitch P + Body Length X Body Width X Height - Pin Qty
Capacitors, Chap, Non-polarized	CAPC + Body Length + Body Width X Height
Capacitors, Chap, Polarized	CAPCP + Body Length + Body Width X Height
Capacitors, Chap, Wire Rectangle	CAPCWR + Body Length + Body Width X Height
Capacitors, Molded, Non-polarized	CAPM + Body Length + Body Width X Height
Capacitors, Molded, Polarized	CAPMP + Body Length + Body Width X Height
Capacitors, Aluminum Electrolytic	CAPAE + Base Body Size X Height
Ceramic Flat Packages	CFP127P + Lead Span Nominal X Height - Pin Qty
Column Grid Array, Circular Lead	CGA + Pin Qty + C + Pitch P + Pin Columns X Pin Rows - Body Length X Body Width X Height
Column Grid Array, Square Lead	CGA + Pin Qty + S + Pitch P + Pin Columns X Pin Rows - Body Length X Body Width X Height
Crystals (2 leads)	XTAL + Body Length X Body Width X Height
Dual Flat No-lead	DFN + Body Length X Body Width X Height - Pin Qty
Diodes, Chap	DIOC + Body Length + Body Width X Height
Diodes, Molded	DIOM + Body Length + Body Width X Height
Diodes, MELF	DIOMELF + Body Length + Body Diameter
Diodes, Side Concave, 2 Pin	DIOSC + Body Length X Body Width X Height - Pin Qty
Diodes, Side Concave, 4 Pin	DIOSC + Pitch P + Body Length X Body Width X Height - Pin Qty
Dual-Inline Package (Butt Mounted)	DIP + Pitch P + Lead Span Nominal X Height - Pin Qty
Fuses, Molded	FUSM + Body Length + Body Width X Height

**3.1.5.6 Padstack Naming Convention** The padstack consists of combinations of letters and numbers that represent the shape, or dimensions, of lands on different layers of printed boards or documentation. The name of the padstack needs to represent all the various combinations. These are used in combination with the land pattern conventions defined herein according to the rules established in the IPC-2220 design series.

The first part of the padstack convention consists of a land shape. There are six basic land shape identifiers. See Figure 3-6 for an example of modifications to the land shape.

**Note:** All alphabetical characters are "lower case". This helps discriminate numeric values.

#### 3.1.5.6.1 Basic Land Shape Letters

c = Circular

s = Square

r = Rectangle

b = Oblong

u = Contour (Irregular Shape)

d = D Shape (Square on one end and Circular on the other end)

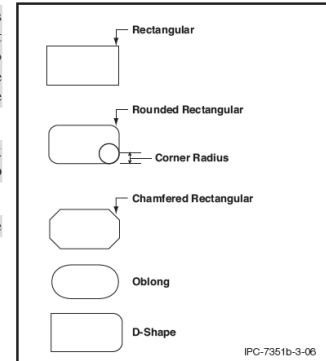
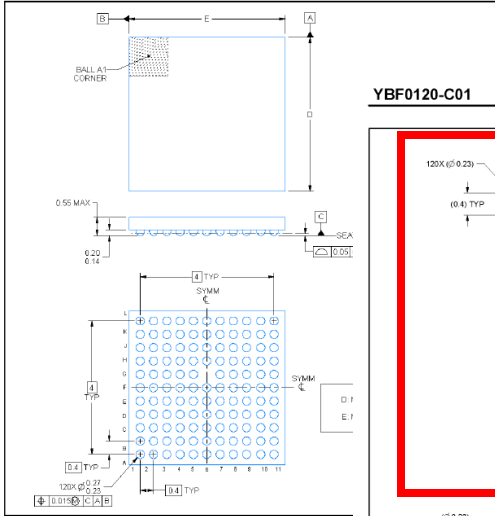


Figure 3-6 Examples of Land Shape Modifiers

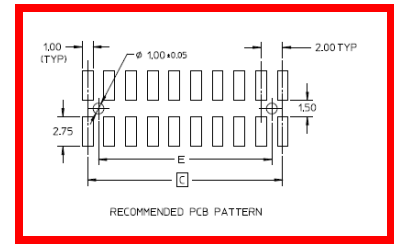
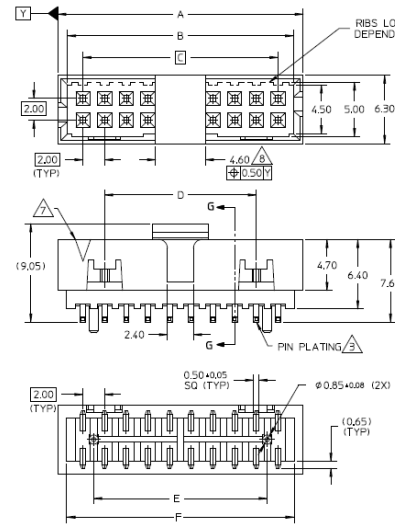
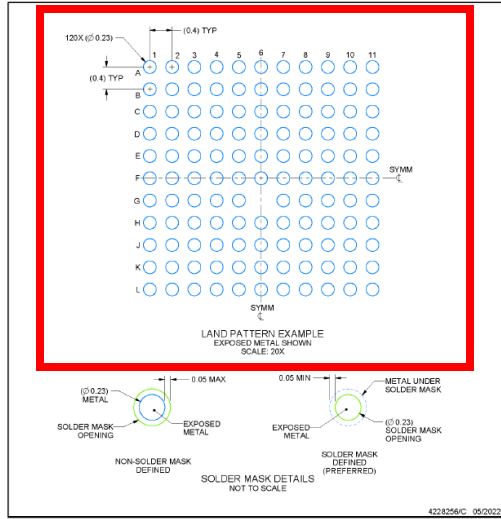
## Case2 : Land Pattern Design

### Vendor Land Pattern

**YBF0120-C01**  
**DSBGA - 0.55 mm max height**  
DIE SIZE BALL GRID ARRAY



**YBF0120-C01**  
**DSBGA - 0.55 mm max height**  
DIE SIZE BALL GRID ARRAY

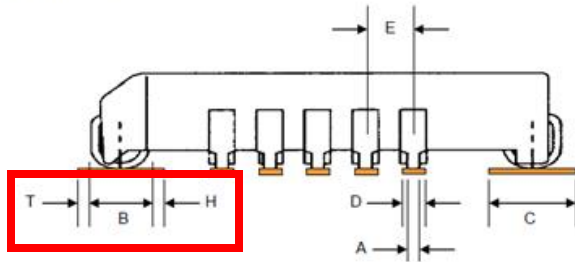


- NOTES:**
- FOR ILLUSTRATION
  - MATERIAL : HOUSING & CAP : FIN : 150MM SQ PLATING : SEE SH PRODUCT SPECIFIC COPLANARITY IS 1 ON & GAUGE SUR NO SIDE LOCKING CKT 4 & 6 HAS N POSITION OF CAP REGARDLESS OF 9. TOP SURFACE OF BY VACUUM SUCT THIS HEADER MAT AT FORM DRIFT.

# Case2 : Land Pattern Design

## ● Toe / Heel Calculation

### J-LEAD TERMINATION



#### Copper Pad

Toe Extension (T) X.XX

Heel Extension (H) X.XX

Copper Pad Length (C) = Component Lead Length (B) + Toe Extension (T) + Heel Extension (H)

Copper Pad Width (D) = MAXIMUM Component Lead Width (A) + X.XX

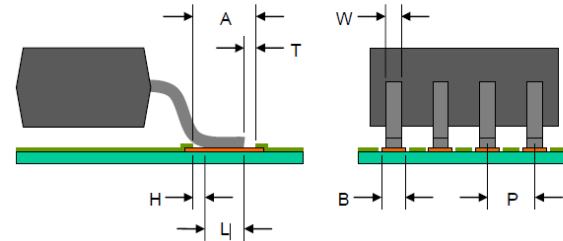
#### Soldermask Pad

The padstack shall be copper defined.

#### Pastemask Pad

The pastemask pad shall be 1:1 with copper pad.

### GULL WING TERMINATION



#### Metal (Copper) Pad

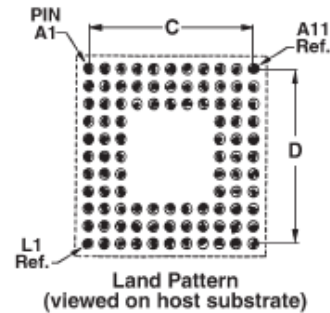
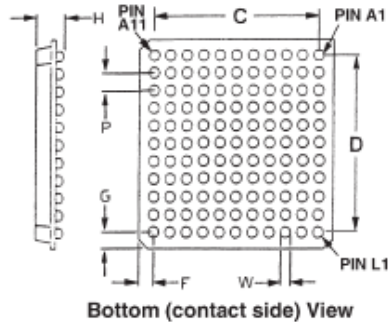
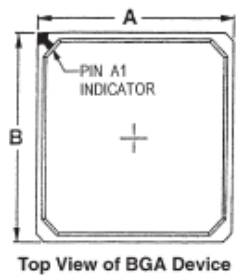
The metal pad width (B) shall be defined per the following table:

Pin Pitch (P)	Toe Extension (T)	Heel Extension (H)	Metal Pad Width (B)
P = 0.50			
0.50 < P <= 0.65			Nominal Lead Width (W) +
0.65 < P <= 0.80			Nominal Lead Width (W) +
0.80 < P <= 1.27			Nominal Lead Width (W) +
1.27 < P <= 1.71			Max. Lead Width (W) +
1.71 < P <= 2.54			Max. Lead Width (W) +
P > 2.54			Max. Lead Width (W) +

Effective Copper Length (A) = MAXIMUM Lead Length (L) + Toe extension (T) + Heel extension (H)

## Case2 : Land Pattern Design

### ● Standard Package



Land Approximation (mm) for Collapsible Solder Balls

Nominal Ball Diameter	Reduction	Nominal Land Diameter	Land Variation
0.75	25%	0.55	0.60 - 0.50
0.65	25%	0.50	0.55 - 0.45
0.60	25%	0.45	0.50 - 0.40
0.55	25%	0.40	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
0.35	20%	0.28	0.33 - 0.23
0.30	20%	0.25	0.25 - 0.20
0.25	20%	0.20	0.20 - 0.17
0.20	15%	0.17	0.20 - 0.14
0.17	15%	0.15	0.18 - 0.12
0.15	15%	0.13	0.15 - 0.10

# Developing a DFM-Aware Library

Step 1 > Step 2 > Step 3

Step 1 - Layer Properties

Please set layer properties

Object Type \* Line

Class \* PACKAGE GEOMETRY SILKSCREEN\_TOP

Line Width \* Fixed Value 0.127

Line Font \* Solid

Drawing Direction \* Counterclockwise Drawing Start Point \* Lower Left

Continued

Previous Next



## Digitalization

A digital DFM knowledge base linked to library creation process



## Customization

Allow users to customize their DFM standards.



## Transferability

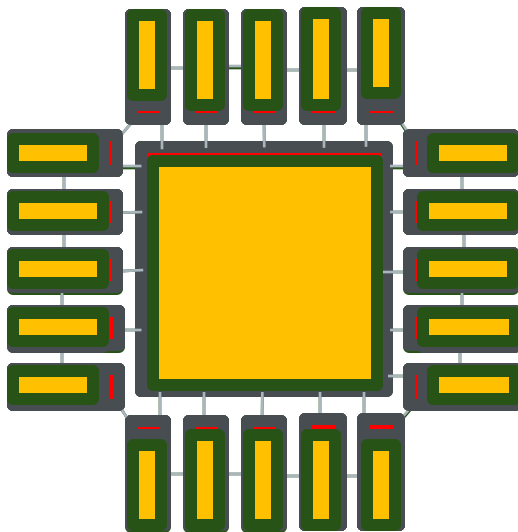
Easy to share and transfer the experience.



## Management

Trackable tolerance modifications to meet Design consistency.

## Programmable DFM – Automatically Embedding DFM rules during Library Creation



### Rule Manager

#### Verify Condition +

Regular Pad Begin Layer ▼

>= ▼

8 mil

Regular Pad Soldermask Top ▼

>= ▼

4 mil

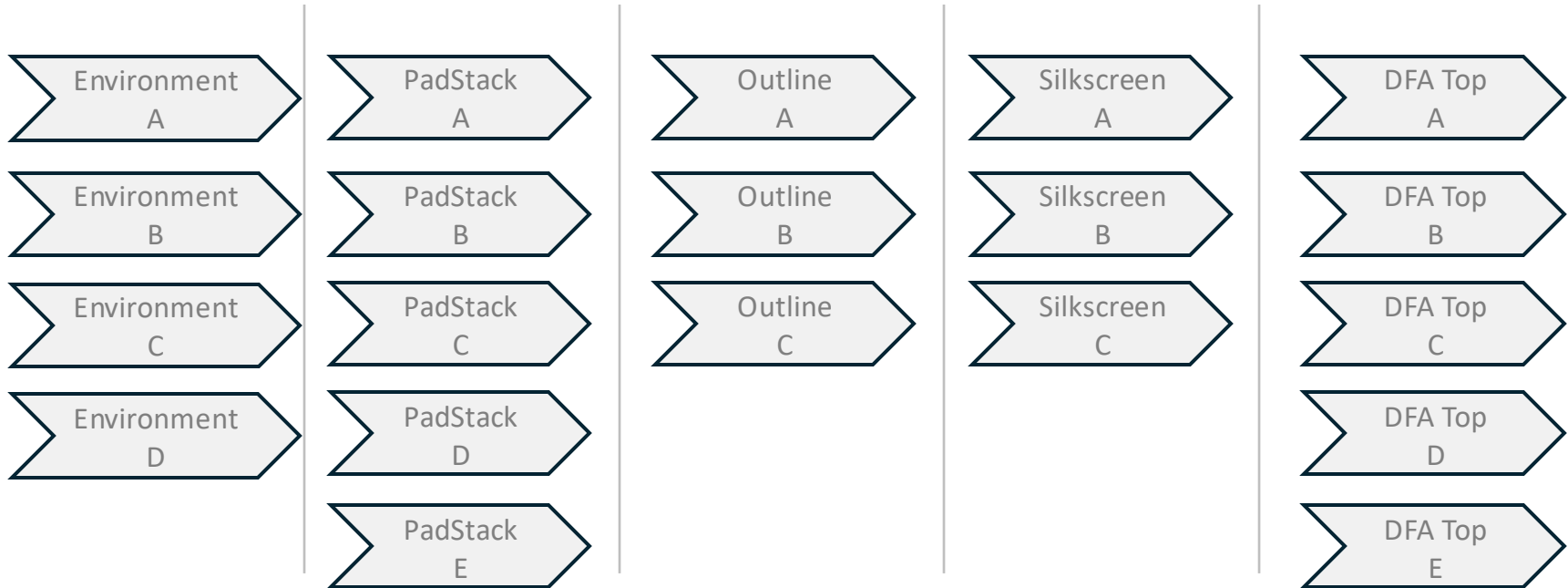
#### Pad minimum size

Lead Size (Avg.) ▼

#### Priority

- ↓ Adjusting Epad using Avg.
- ↓ Reducing Signal Pin Heel by 1 mil until it meets the requirements
- ↓ Reducing Signal pin Width by 1 mil until it meets the requirements
- ↓ Reducing corner Signal pin Heel by 1 mil until it meets the requirements

# Modularized DFM Knowledge







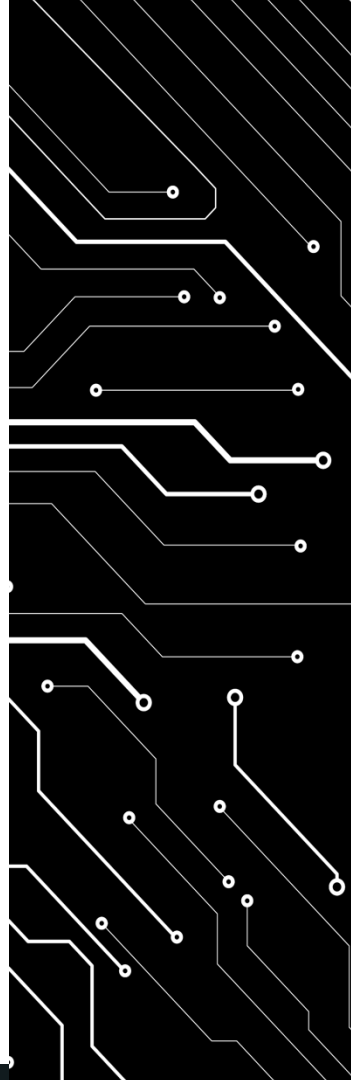
Rule Manager

Automated DFM Rules Management and Implementation Tool

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footprintku AI

# HOW DOES VLS WORK?



## CUSTOM DASHBOARD



VLS provides a unique, custom dashboard for designers. Each user has a unique login to access both a personal and company-wide parts library.

## REQUEST PARTS



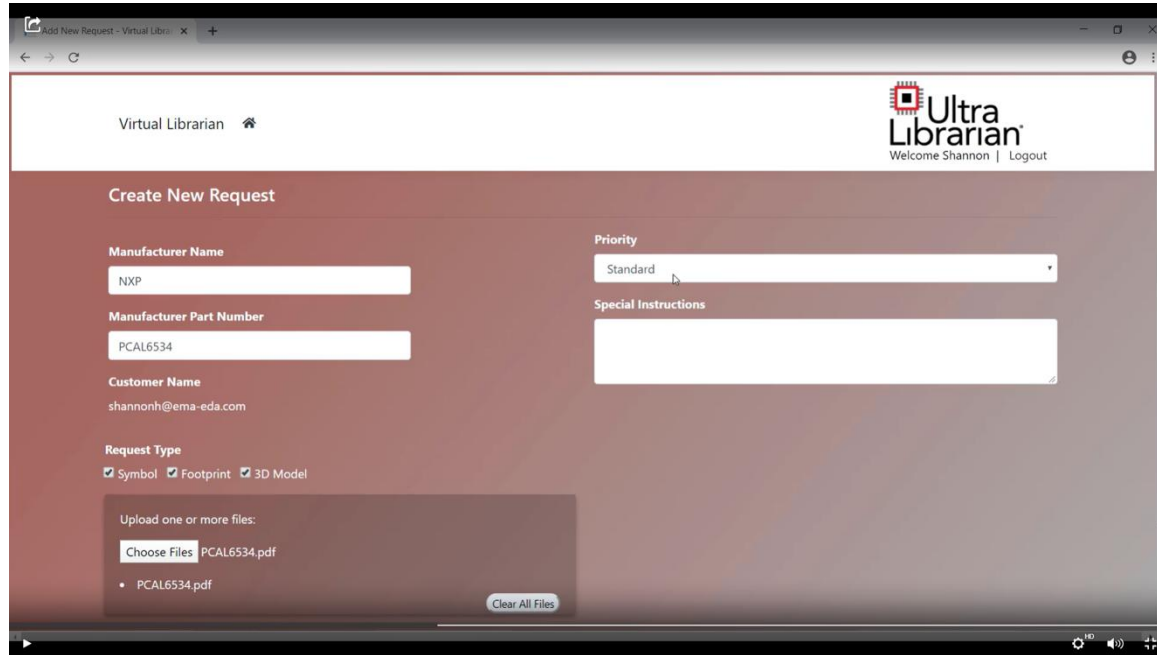
All requested parts are created to match your internal standards and requirements. Just provide the datasheets, drawings, or specs and any special requests for your part and we handle the rest.

## TURN AROUND TIME



All parts are created within two business days, and an email will be sent to alert the requester when it's

# PARTS BUILT TO YOUR STANDARDS, ON YOUR TIMELINE



The screenshot shows a web browser window with the address bar displaying "Add New Request - Virtual Librarian". The page header includes "Virtual Librarian" on the left and the "Ultra Librarian" logo on the right, which also says "Welcome Shannon | Logout". The main content area is titled "Create New Request" and contains several input fields and a file upload section.

**Manufacturer Name**  
NXP

**Manufacturer Part Number**  
PCAL6534

**Customer Name**  
shannonh@ema-eda.com

**Priority**  
Standard

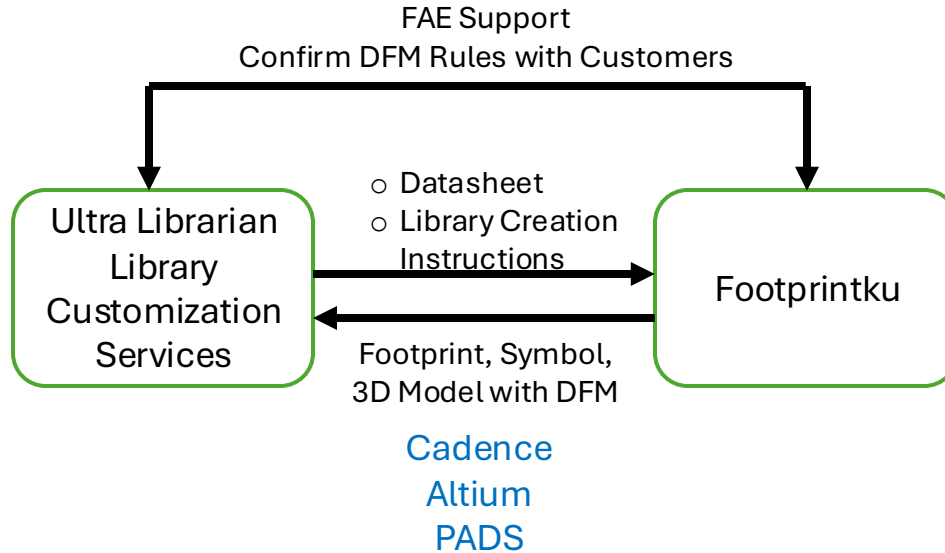
**Special Instructions**

**Request Type**  
 Symbol  Footprint  3D Model


Upload one or more files:  
Choose Files PCAL6534.pdf  
• PCAL6534.pdf  
Clear All Files




# INTERNAL WORKFLOW



# PARTS BUILT TO YOUR STANDARDS, ON YOUR TIMELINE











Virtual Librarian 

 Ultra Librarian  
Welcome Shannon | Logout

### Dashboard

Create New Request

Select Filter  RESET Last 4 Weeks

Request Id	Date Requested	Requestor	Manufacturer Name	Manufacturer Part Number	Priority	Date Completed	Complexity	Request Status	Assignee Name	
ZOSLFG	3/30/2020 9:33:06 AM	Henry, Shannon	NXP	PCAL6534	High Priority		Not Set	New		 
IH83WX	3/30/2020 9:24:56 AM	Customer, Erin	Texas Instruments	THS1206IDA	High Priority		Not Set	New	User, Erin	 
TGEWSA	3/30/2020 9:24:03 AM	Customer, Erin	ST Microelectronics	STM32F302K8U6	Standard		Not Set	New		 
OHZ9YJ	3/30/2020 9:23:14 AM	Customer, Erin	Molex	5054331271	Standard		Not Set	New		 
UO3BJN	3/30/2020 9:22:05 AM	Customer, Erin	Texas Instruments	LSF0102DCTR	Standard		Not Set	New		 



# Librarian Service Onboarding

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- Establish Symbol creation guidelines
- Agree on turn around time, Prioritization
- Setup part request and fulfillment process,
  - Virtual Librarian Service Portal (Recommended)
  - Email alias and file transfer area
- Monthly checkpoint
  - Dashboard review
  - Invoicing approval





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