EDM
Electronics Design & Manufacturing

BARCO
Visibly yours

# EDM Event

04 October 2013

# Who are we?

# Barco company structure

Four core divisions, five wholly-owned ventures

Entertainment

Healthcare

Control rooms & Simulation

Defense & Aerospace

dzine a Barco company — Digital signage

HIGH END SYSTEMS a Barco company — Lighting

LiveDots — LED

ORTHOGON — ATM software

SILEX — Design services



BARCO Visibly yours

# Barco Presence

## AMERICAS

### NORTH AMERICA

**United States**

- **California**
- **Georgia**
- **Ohio**
- **Oregon**
- **Texas**

Canada

### SOUTH AMERICA

Argentina
Brazil
Colombia
Mexico

## EMEA

**Belgium**
Denmark
**France**
**Germany**
Israel
**Italy**
Poland
Russia
Spain
Sweden
Switzerland
Turkey
UAE
**United Kingdom**

## APAC

### ASIA

**China**
**India**
Japan
Malaysia
Singapore
South-Korea
Taiwan

### PACIFIC

Australia

**Blue = R&D and/or Manufacturing**
**Red = Sales office**

# Barco Flagship Products

500,000+

Medical displays in the field

25,000+

Digital projectors in movie theaters

500,000+

LED pixels for U2's 360° tour

40,000+

Display cubes in control rooms

10,000+

Displays in air traffic control



BARCO
Visibly yours

# Barco Technologies

43,000

Lumens for world's brightest cinema projector

10 million

Pixels of grayscale perfection

unlimited

Number of sources with Barco's networked control rooms concept

10 million:1

Contrast ratio in Barco's simulation projectors

71°C

Our rugged displays can withstand temperatures this high

10x

More silent than competition in its class

# Agenda

- Introduction
- Benefit of a good NPI Follow up
- Design for Manufacturability, Reliability & Design Requirements
- Passport
- PBA Process Description & Embedded in NPI Process
- Status Implementation

EDM
Electronics Design & Manufacturing

# Agenda

- Introduction
- Benefit of a good NPI Follow up
- Design for Manufacturability, Reliability & Design Requirements
- Passport
- PBA Process Description & Embedded in NPI Process
- Status Implementation

BARCO
Visibly yours

# Introduction

**Complex PBA with complex requirements**

- *How to deal with environmental conditions*
  - Impact robustness and extreme exhausting of the PBA
- *How to deal with lifetime requirement of products*
  - Impact on materials, components & chosen processes
- *How to deal with reliability of the PBA*
  - Impact on the Solder joint fatigue, Via cracking, Corrosion, SIR ….
- *How to deal with critical performance requirements of these PBA's*
  - Very high speed signals, material choice
  - EMC restrictions
  - SI / PI restrictions
  - …

# Introduction

**Due to…**

- Reliability issues of PBA's in the past
- Lack of knowledge of PBA and PCB technologies
- Too many iterations in PCB design phase
- Too many revisions of the PBA before final production

**… we need a proactive approach**

- Design for manufacturability
- Identify the applicable manufacturing process requirements
- Select an appropriate manufacturer based on their capabilities
- Focus on early detection of failures/issues

# Introduction

## Therefore

- **A NPI PBA PCB workgroup was established**
  - Engineering
  - Purchase
  - SQA / QA
  - And EDM Electronics Design & Manufacturing
- **Defining the PBA design process in line with NPI**
  - PBA design procedure
  - PBA phase gate checklist
  - Work In Progress checklist
  - Tools to help Engineering: ***Passport Tool***



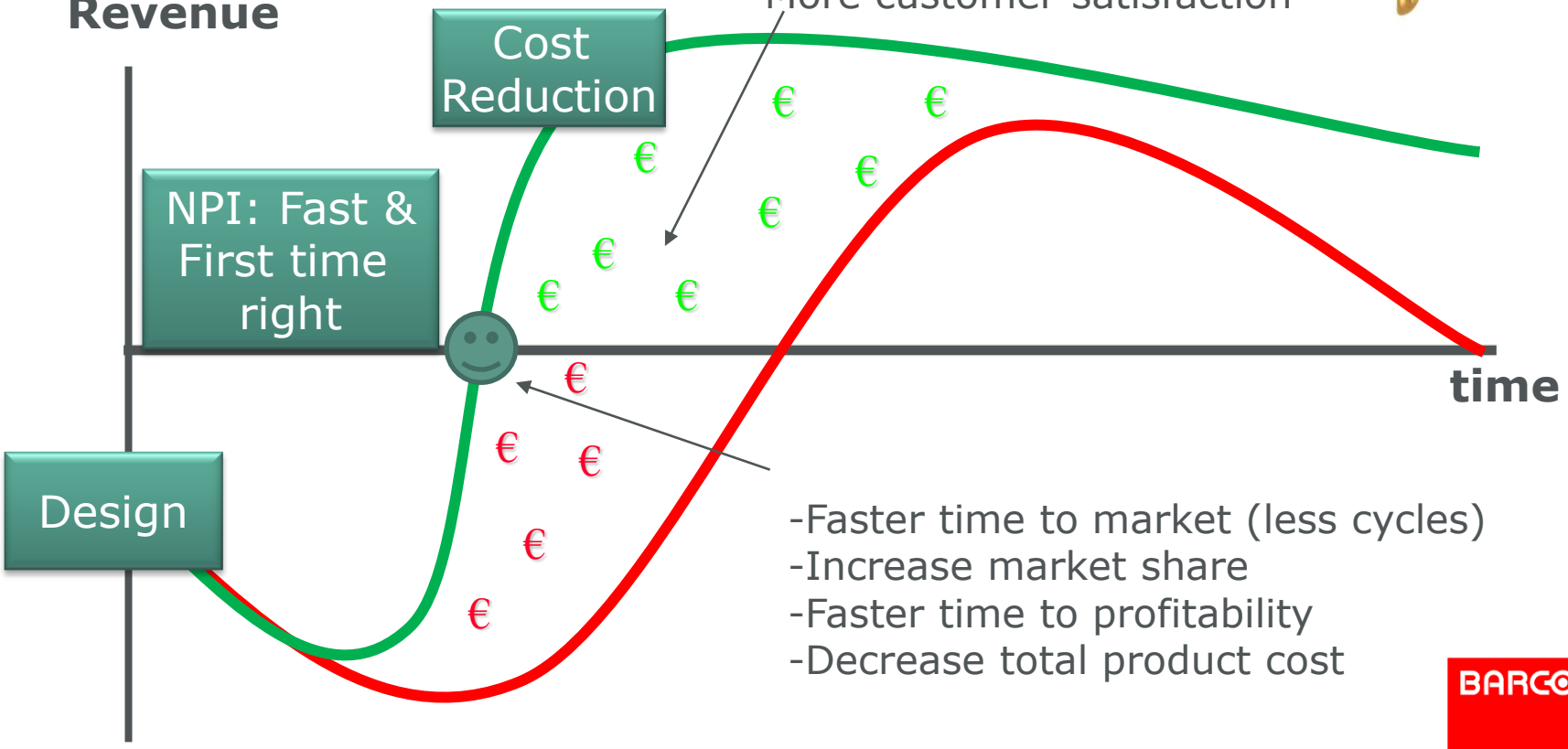
BARCO Visibly yours

# Agenda

- Introduction
- Benefit of a good NPI Follow up
- Design for Manufacturability, Reliability & Design Requirements
- Passport
- PBA Process Description & Embedded in NPI Process
- Status Implementation

# Benefit of a good NPI Follow up

- More profit
- Higher product reliability
- More customer satisfaction




-Faster time to market (less cycles)
-Increase market share
-Faster time to profitability
-Decrease total product cost

# Agenda

- Introduction
- Benefit of a good NPI Follow up
- Design for Manufacturability, Reliability & Design Requirements
- Passport
- PBA Process Description & Embedded in NPI Process
- Status Implementation

# Design for Manufacturability

## PCB

- **Impedance: layer stack up**
  - ✓ Available thicknesses of laminates
  - ✓ Preliminary calculation of the impendence: no exotic clearances / thicknesses
  - ✓ Definition of plane / signal layers : cu balancing

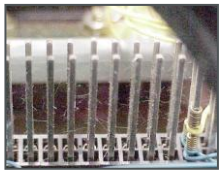
- **Complexity of the board determines PCB class**
  - ➢ Reference **EDM-D-005**

| Track Class | T300 | T250 | T200 | T150 | T125 | T125+ | T100 | T100+ | T80 |
|---|---|---|---|---|---|---|---|---|---|
| Min track width | 300 | 250 | 200 | 150 | 125 | 125 | 100 | 100 | 80 |
| Min track width in (BGA) footprint fanout area | 300 | 250 | 200 | 150 | 125 | 100 | 100 | 80 | 80 |
| Min copper spacing | 300 | 250 | 200 | 150 | 125 | 125 | 100 | 100 | 80 |
| Min. pad-to-pad & pad-to-via land (except BGA footprint=min. copper spacing) | 300 | 250 | 200 | 200 | 200 | 200 | 150 | 150 | 125 |
| Min. routing distance to cu outer layers min | 350 | 350 | 350 | 350 | 300 | 300 | 250 | 250 | 200 |
| Min. routing distance to cu inner layers min | 300 | 300 | 300 | 300 | 250 | 250 | 200 | 200 | 200 |
| Maximum Cu thickness (to be etched) | **105** | **70** | **70** | **35** | **18** | **18** | **18** | **18** | **12** |

# Design for Manufacturability

## BOM & Testing

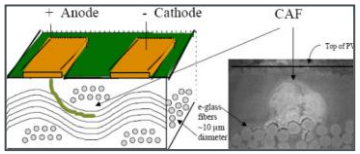
- **Bill of material complexity**
  - ✓ Component choice and impact in the design + obsolescence
  - ✓ What are the possible soldering methods for these components: reflow, wave, selective soldering …



- **Testing**
  - ✓ In Circuit Testing: design rules to be met!
  - ✓ Boundary Scan: component selection!

# Design for Reliability

- **Material selection**
  - ✓ CAF resistant requirement
  - ✓ FR4 material: thermal load on the board due to stuffing and during operation
  - ✓ Dimension of the boards: mouse bites position, mechanical restrictions




- **Component consideration**
  - ✓ Mechanical stress: location of critical components -> stycast, underfill?
  - ✓ Component on the board: placement in critical areas, such as height restrictions, vibration issues?

# Design for Reliability

- **Contamination level impact on**
  - Conformal coating
    - ✓ other design rules: cleaning, no entrapment of contamination?
    - ✓ areas, what kind of coating is best for my application?
  - Low standoff components lead to impossible flux outgassing

- **Environmental application**
  - Thermal cycles: on / off during application
  - Environmental application: humidity, salty environment, …

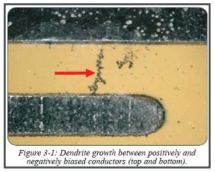
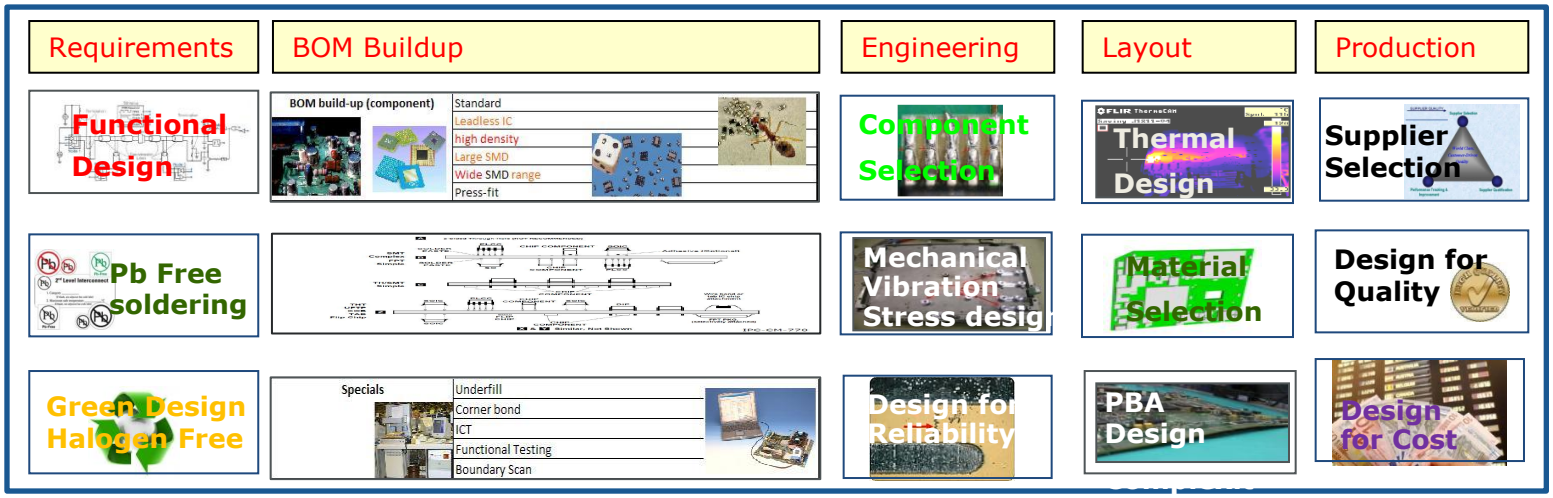


Figure 3-1: Dendrite growth between positively and negatively biased conductors (top and bottom).

# Design Requirements

- What type of components are used
- What kind of stuffing is required
- What IPC class is requested
- How is the PCB being build up?
- What are the needed standards to refer to?
- ….




**And, yes … Designed according to the functional requirements from customer**

EDM
Electronics Design & Manufacturing

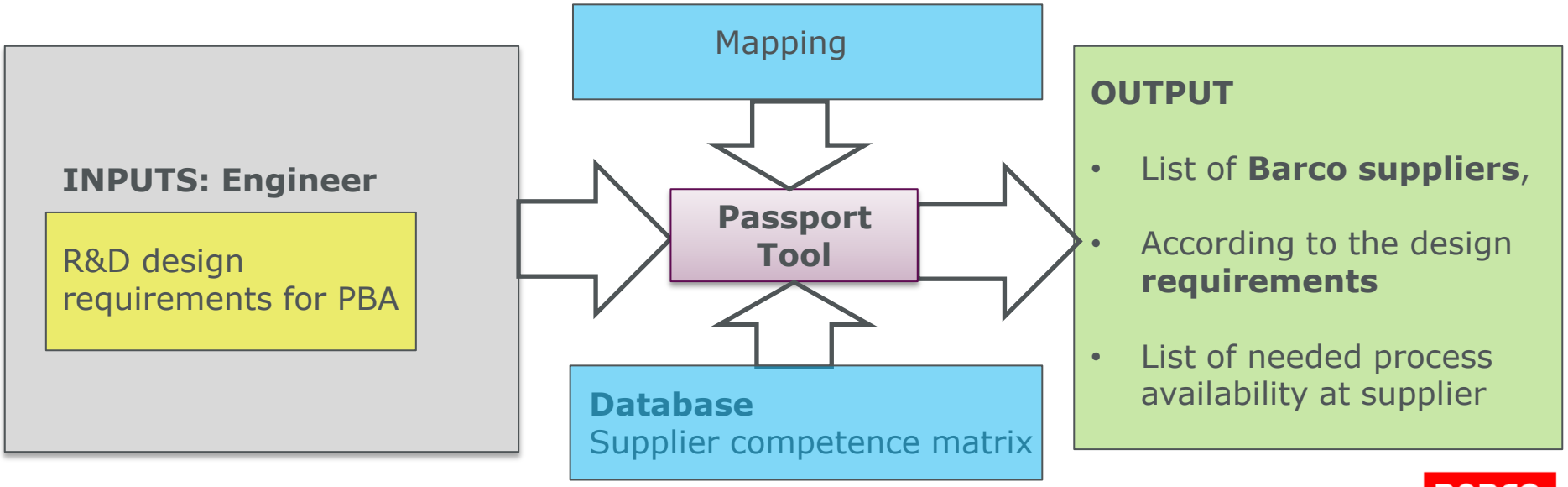
# Agenda

- Introduction
- Benefit of a good NPI Follow up
- Design for Manufacturability, Reliability & Design Requirements
- Passport
- PBA Process Description & Embedded in NPI Process
- Status Implementation

BARCO
Visibly yours

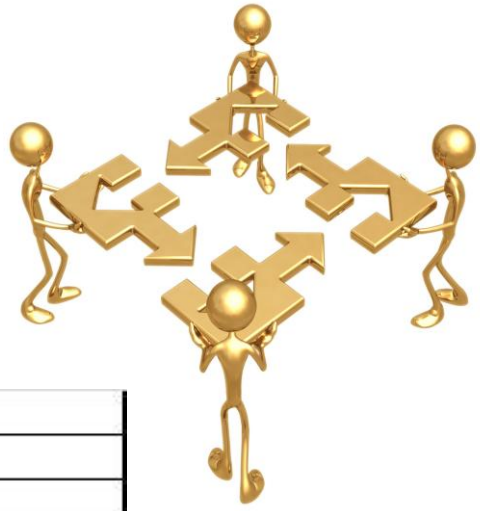
# Passport

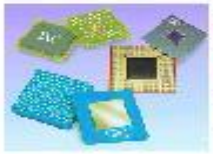
- **Design definitions: Design requirements**
  - *How is the PBA and PCB being buildup & designed ?*
- **Process requirements towards EMS and PCB manufacturer**
  - *What is needed as process requirement and capability to manufacture and stuff the board?*



# Passport

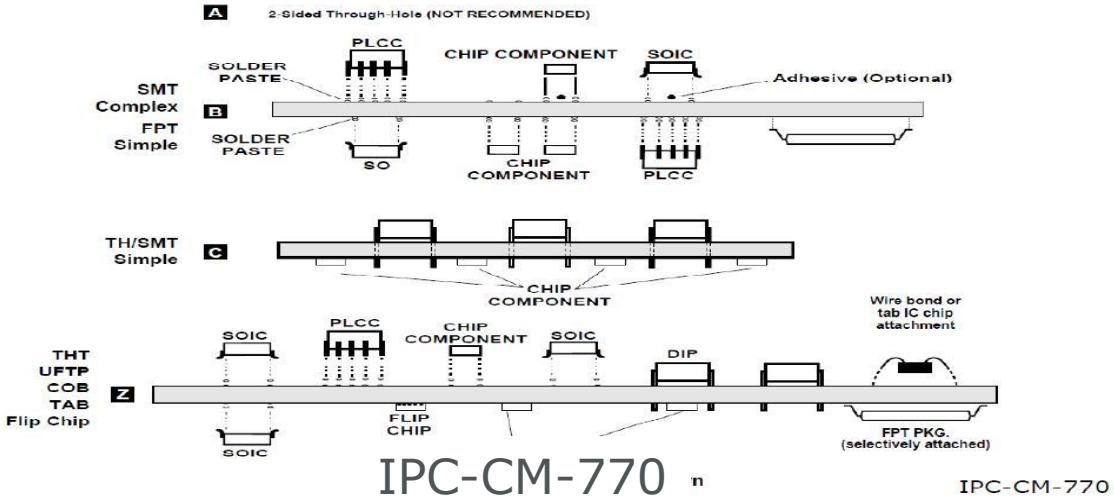
## PBA Requirements



| | |
|---|---|
| **PBA Design Options & Attributes** | PBA Height |
| | PBA Width |
| | RoHS compliant |
| | REACH Declaration |
| | SnPb soldered or Lead-free soldered |
| | No-clean |
| | IPC Class ? |
| | Green requirement |
| | High reliability (No clean req.) |
| | Conformal coated needed |
| **BOM build-up (component)**  | Standard |
| | Leadless IC |
| | high density |
| | Large SMD |
| | Wide SMD range |
| | Press-fit |
| **Specials** | Underfill |
| | Corner bond |
| | ICT |
| | Functional Testing |
| | Boundary Scan |

# Passport

## PBA Requirements




IPC-CM-770

| |
|---|
| 1A SS TH wave solder |
| 1B SS SMD Reflow |
| 1C/X/Y/Z SS SMD+TH Reflow-wave |
| 2B DS SMD Reflow-Reflow |
| 2C Top TH/Bot SMD wave solder |
| 2C/X/Y/Z DS SMD-TH Reflow-Wave |
| 2C/X/Y/Z DS SMD-TH Reflow-Reflow-Sel. |
| 2C/X/Y/Z DS SMD-TH Reflow-Reflow-Sel. (including wire soldering) |

# Passport

## PCB Requirements

- PCB Design Options & Attributes
  - ✓ IPC Class
  - ✓ RoHS
  - ✓ UL
  - ✓ Finish
  - ✓ Contact finishes
  - ✓ High Reliability requirement
  - ✓ Dimensions
  - ✓ Stackup: Cu foils
  - ✓ Definition of the laminates: classification
- Specials
  - ✓ Metal cores
  - ✓ Flex – Flex-Rigid
  - ✓ V-cuts, Mouse bites

**FR4 Laminate Overview**

(copper clad and prepreg materials)

Version: 1.6
29-Mar-2011

***EDM-D-001***

Disclaimer

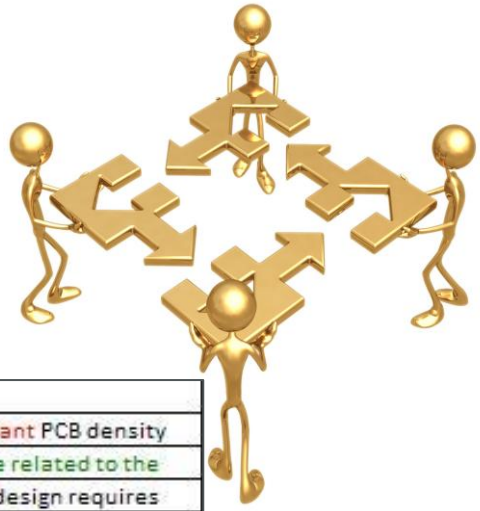
| Material Identification | | | | Criteria | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Lead-free Solderability | | | | | Soldering Cycles to via failure | Soldering Cycles to delamination | Glass Transition | Moisture | Chemistry | | |
| Manufacturer Name | Manufacturer Designator | IPC-4101C Class | Cat. | $T_d$ (5%) (TGA) | $T_{260}$ (TMA) | $T_{288}$ (TMA) | $T_{300}$ (TMA) | $CTE_z$ | | | $T_g$ (DSC) | Moisture Absorption | CAF Resistant | Non-dicy / Phenolic | 'Halogen-free' |
| | | | | °C | min | min | min | % | | | °C | % | - | - | - |
| Soldering Performance Category | | | | Minimum Values | | | | | | | | | | | |
| Basic | | | | ≥ 310 °C | ≥ 30 min | ≥ 5 min | - | ≤ 4% | | | ≥ 110 °C | - | - | - | - |
| Mid | | | | ≥ 325 °C | ≥ 50 min | ≥ 10 min | - | ≤ 3.5% | | | ≥ 150 °C | ≤ 0.18% | - | - | - |
| High | | | | ≥ 340 °C | ≥ 80 min | ≥ 15 min | 2 | ≤ 3% | | | ≥ 170 °C | ≤ 0.15% | - | - | - |

EDM
Electronics Design & Manufacturing

# Passport

## PCB Requirements

- PCB Complexity: Barco Classes
  - ✓ Track class
  - ✓ Via Class



## *EDM-D-005*

| TRACK CLASS | Specifies routing capability in the X-Y planes of the PCB | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Design: | Essential to PCB component and interconnection density. Most important PCB density | | | | | | | | |
| PCB: | Essential to PCB routing density on Cu-planes. Manufacturing limits are related to the | | | | | | | | |
| Assembly: | Indicative for lead pitch of components: low, standard or high density design requires | | | | | | | | |
| Class identification: | T[track width][+: local 20% track width reduction allowed in fanout area] | | | | | | | | |
| **Track Class** | T300 | T250 | T200 | T150 | T125 | T125+ | T100 | T100+ | T80 |
| Min track width | 300 | 250 | 200 | 150 | 125 | 125 | 100 | 100 | 80 |
| Min track width in (BGA) footprint fanout area | 300 | 250 | 200 | 150 | 125 | *100* | 100 | *80* | 80 |
| Min copper spacing | 300 | 250 | 200 | 150 | 125 | 125 | 100 | 100 | 80 |
| Min. pad-to-pad & pad-to-via land (except BGA footprint=min. copper spacing) | 300 | 250 | 200 | 200 | 200 | 200 | 150 | 150 | 125 |
| Min. routing distance to cu outer layers min | 350 | 350 | 350 | 350 | 300 | 300 | 250 | 250 | 200 |
| Min. routing distance to cu inner layers min | 300 | 300 | 300 | 300 | 250 | 250 | 200 | 200 | 200 |
| Maximum Cu thickness (to be etched) | 105 | 70 | 70 | 35 | 18 | 18 | 18 | 18 | 12 |

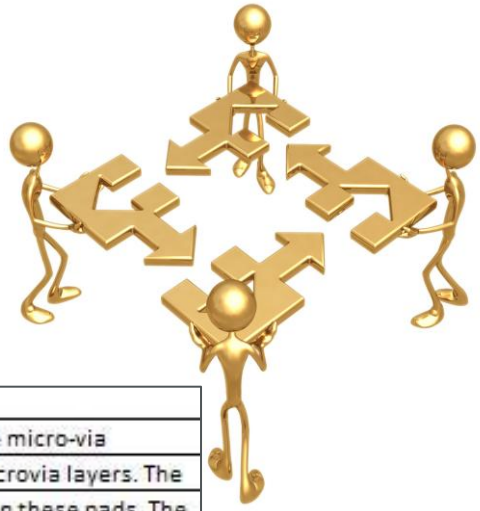
| VIA CLASS | Specifies routing capability in the Z-direction of the PCB | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Design: | The via land size is directly related to PCB component and interconnection density and, | | | | | | | | |
| PCB: | Critical subclass for manufacturability of the PCB. Manufacturing limits are related to | | | | | | | | |
| Assembly: | Impact on assembly is limited to the via land class dependent risk of via failure and heat | | | | | | | | |
| Class identification: | V[annular ring inner layer in microns] [+: plating process aspect ratio bonus] | | | | | | | | |
| **Via class** | V250 | V225 | V200 | V175 | V150 | V150+ | V125 | V125+ | V100 |
| Minimum outer via land size | 950 | 850 | 800 | 700 | 600 | 550 | 500 | 450 | 400 |
| Minimum inner via land size | 1000 | 900 | 850 | 750 | 650 | 600 | 550 | 500 | 450 |
| Annular ring IPC6012 Class 2: Outer | 200 | 200 | 175 | 150 | 125 | 125 | 100 | 100 | 75 |
| Annular ring IPC6012 Class 2: Inner | *250* | *225* | *200* | *175* | *150* | *150* | *125* | *125* | *100* |
| Annular ring IPC6012 Class 3: Outer | 250 | 250 | 225 | 200 | 175 | 175 | 150 | 150 | 125 |
| Annular ring IPC6012 Class 3: Inner | 250 | 250 | 225 | 200 | 175 | 175 | 150 | 150 | 125 |
| Min. distance PTH to Cu on inner layers | 550 | 475 | 400 | 325 | 275 | 275 | 225 | 225 | 180 |
| Min. distance PTH to PTH | 700 | 650 | 550 | 450 | 375 | 375 | 300 | 300 | 230 |
| Min. distance NPTH drill to cu on outer layers | 350 | 350 | 300 | 250 | 200 | 200 | 200 | 200 | 200 |
| Min. distance NPTH drill to cu on inner layers | 275 | 250 | 225 | 200 | 175 | 175 | 150 | 150 | 125 |

BARCO
Visibly yours

# Passport

## PCB Requirements

- PCB Complexity: Barco Classes
  - ✓ Micro Via class
  - ✓ Solder mask class



***EDM-D-005***

| MICROVIA CLASS | High density routing capability in the Z-direction of the PCB | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Design: | High density routing capability is extended with the use of one or more micro-via | | | | | | | | |
| PCB: | PCB manufacturing yield wil reduce superlinear with the number of microvia layers. The | | | | | | | | |
| Assembly: | Unfilled microvia in pad will lead to excessive voiding in solder joints on these pads. The | | | | | | | | |
| Class identification: | MV[# via levels -0.5x(# via levels-# lamination steps)] | | | | | | | | |
| **Microvia class** | **MV.5** | **MV1** | **MV1.5** | **MV2** | **MV2.5** | **MV3** | **MV3.5** | **MV4** | |
| Number via levels | 1 | 1 | 2 | 2 | 3 | 3 | 4 | 4 | |
| Number of additional microvia lamination | 0 | 1 | 1 | 2 | 2 | 3 | 3 | 4 | Manuf. limit: min. thickness landing Cu |
| Min. microvia land size | 350 | 350 | 300 | 300 | 300 | 300 | 275 | 275 | |
| Min. microvia landing pad size | 350 | 350 | 300 | 300 | 300 | 300 | 275 | 275 | |
| µvia diameter 75um build-up layer | 125 | 125 | 125 | 125 | 125 | 125 | 125 | 125 | TBD |
| µvia diameter 100um build-up layer | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | TBD |
| µvia diameter 150um build-up layer | 175 | 175 | 175 | 175 | 175 | 175 | 175 | 175 | TBD |

| SOLDER MASK CLASS | Solder mask definition | | | | | |
|---|---|---|---|---|---|---|
| Design: | Solder mask is not directly related to | | | | | |
| PCB: | Manufacturing limits to solder mask | | | | | |
| Assembly: | Solder mask quality is essential to | | | | | |
| Class identification: | SM[min overlap/clearance] | | | | | |
| **Solder mask class** | **SM150** | **SM100** | **SM75** | **SM60** | **SM50** | **SM40** |
| Min. overlap/clearance | 150 | 100 | 75 | 60 | 50 | 40 |
| Min Mask Barrier Width (Mask Segment) | 200 | 150 | 125 | 100 | 100 | 80 |
| Manuf. limit: Max finished Cu thickness | 210 | 210 | 105 | 105 | 70 | 35 |



BARCO
Visibly yours

# Passport

Output: example

## Approved manufacturers

- Subcontractor indication

| PBA/PCB | **PBA 1** | **PBA 2** | **PBA 3** | **PBA 4** |
|---|---|---|---|---|
| **PCB 10** | | X | | X |
| **PCB 11** | X | | | X |
| **PCB 12** | X | | | X |

Passport

Output: example

## PCB rejected

- Link to which processes
- Reason why rejected
- Link to Design requirement

| Plant | Requirement | Process | Value | Plant Process Level | Plant Process Value | Approved? | Reason |
|---|---|---|---|---|---|---|---|
| PCB 1 | Lead-free soldered | Logistics: PCB moisture control IPC-1601 | TRUE | | | Rejected | Not available. |
| PCB 2 | PCB Lenght (X in mm) | Min PCB Width (mm) | 160 | Available | 305 | Rejected | Value not in range. |
| PCB 2 | PCB Width (Y in mm) | Min PCB Height (mm) | 152 | Available | 305 | Rejected | Value not in range. |
| PCB 7 | Cu foil thickness on outer layers (µm) | Cu-thicknesses outer layers (foil) | 17 | Available | 35\|70\|105\|140 | Rejected | Value mismatch |
| PCB 7 | Lead-free soldered | Logistics: PCB moisture control IPC-1601 | TRUE | | | Rejected | Not available. |
| PCB 7 | Cu foil thickness on outer layers (µm) | Cu-thicknesses outer layers (foil) | 17 | Available | 35\|70\|105\|140 | Rejected | Value mismatch |
| PCB 8 | PCB Lenght (X in mm) | Min PCB Width (mm) | 160 | Available | 457 | Rejected | Value not in range. |
| PCB 8 | PCB Width (Y in mm) | Min PCB Height (mm) | 152 | Available | 355 | Rejected | Value not in range. |

EDM Electronics Design & Manufacturing

Passport

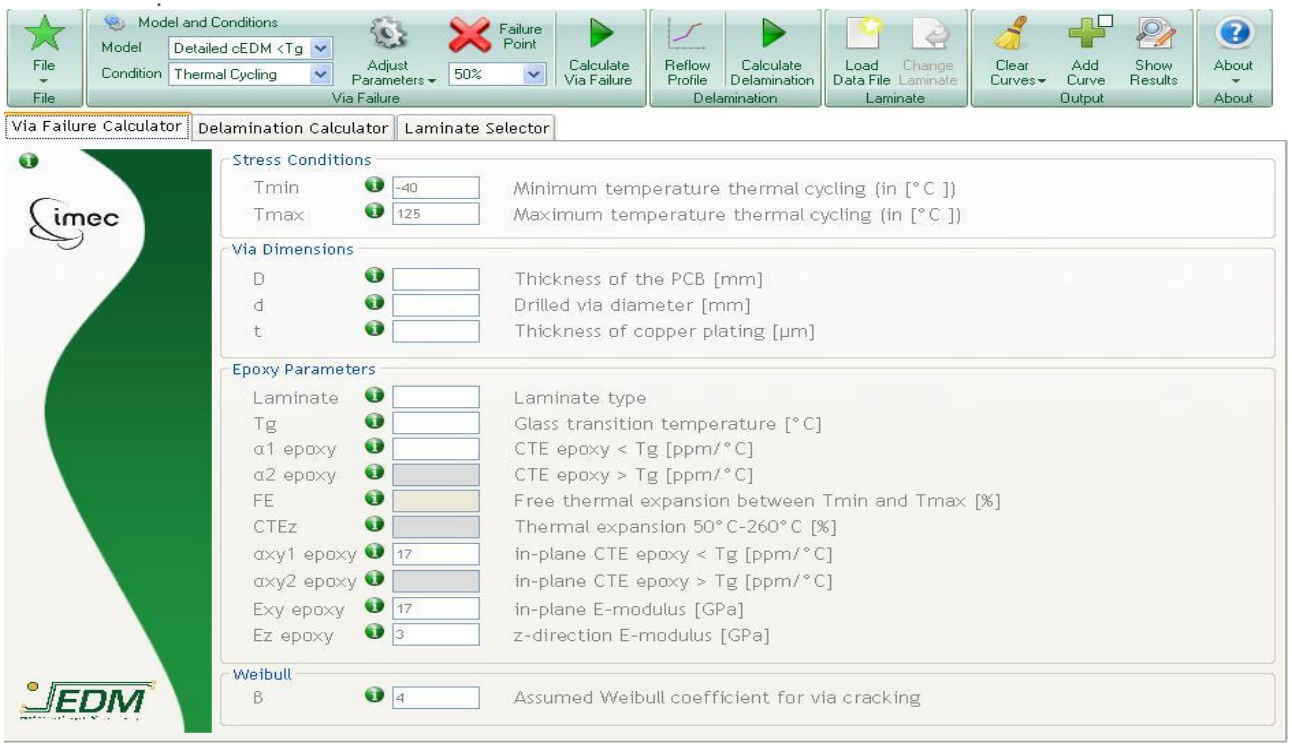
Output: example

## PBA Approved

- Link to which processes
- Reason why approved
- Link to Design requirement

| Plant | Requirement | Process | Value | Plant Process Level | Plant Process Value | Approved? | Reason |
|---|---|---|---|---|---|---|---|
| PBA A | Lead-free soldered | Logistics: Lead-free soldering | TRUE | Alternative | TRUE | Approved | Qualified |
| PBA A | Lead-free soldered | Testing: AOI | TRUE | Alternative | TRUE | Approved | Qualified |
| PBA A | IPC Class 2 PBA | Logistics: J-STD-001 Class 2 assembly | TRUE | Available | TRUE | Approved | Qualified |
| PBA A | Top SMD: Reflow | Processes: Convective reflow soldering | TRUE | Available | TRUE | Approved | Qualified |
| PBA A | Top SMD: Reflow | Repair: Passives, small active components,... | TRUE | Available | TRUE | Approved | Qualified |
| PBA A | Standard | Processes: Stencil thickness range 125/150 | TRUE | Available | TRUE | Approved | Qualified |
| PBA A | Standard | Processes: Local Paste Application | TRUE | Available | TRUE | Approved | Qualified |
| PBA A | Standard | Placement: Chip down to 0402 | TRUE | Available | TRUE | Approved | Qualified |
| PBA A | Standard | Placement: Peripheral leaded down to 0.5mm pitch | TRUE | Available | TRUE | Approved | Qualified |
| PBA A | Standard | Placement: BGA down to 0.8mm pitch | TRUE | Available | TRUE | Approved | Qualified |
| PBA A | Standard | Placement: QFN down to 0.5mm pitch - LGA down to 0.8mm | TRUE | Available | TRUE | Approved | Qualified |
| PBA A | Standard | Repair: Peripherally leaded components (QFP, SOIC,...) | TRUE | Available | TRUE | Approved | Qualified |
| PBA A | Standard | Repair: Area Array components (BGA) >= 0.8mm pitch | TRUE | Available | TRUE | Approved | Qualified |
| PBA A | PBA Length (X in mm) | Max PBA Width (mm) | 160 | Available | 457 | Approved | Qualified |
| PBA A | PBA Length (X in mm) | Min PBA Width (mm) | 160 | Available | 50 | Approved | Qualified |
| PBA A | PBA Width (Y in mm) | Max PBA Height (mm) | 152 | Available | 356 | Approved | Qualified |
| PBA A | PBA Width (Y in mm) | Min PBA Height (mm) | 152 | Available | 50 | Approved | Qualified |

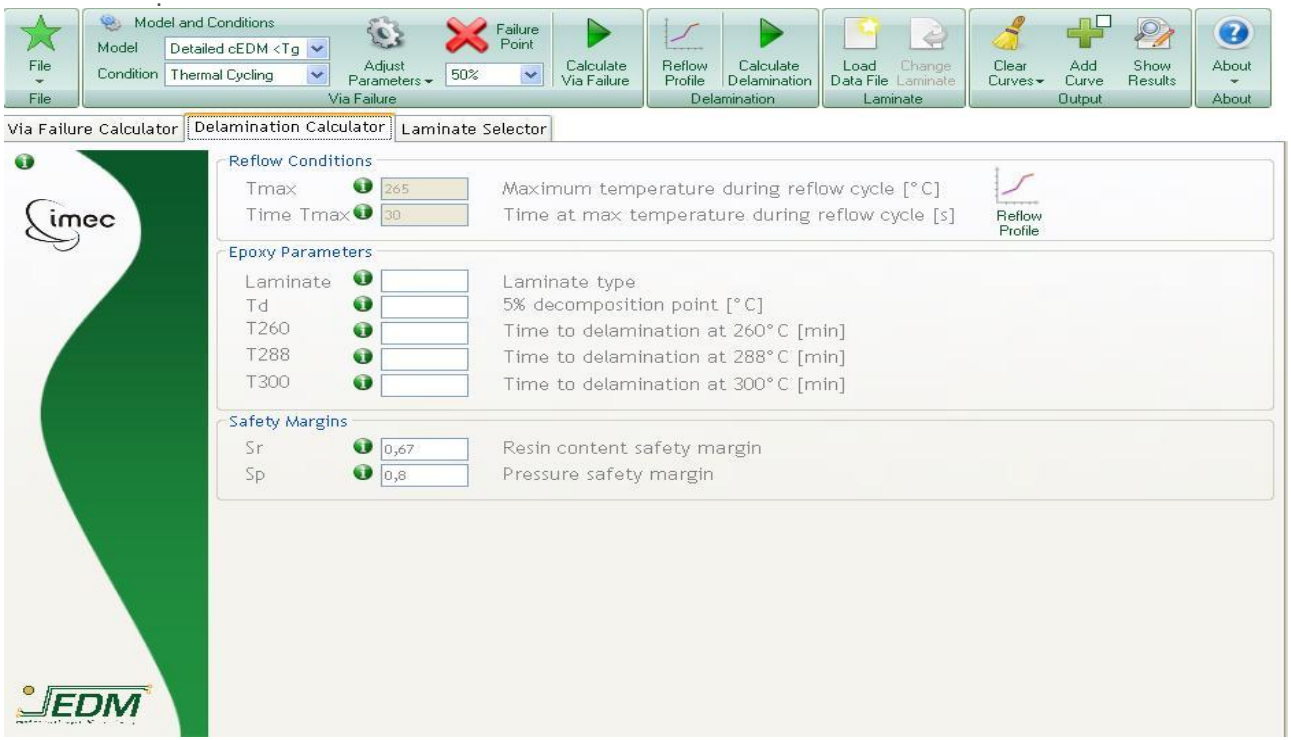
# Other tools



## Via Calculator

- The 'Via Failure Calculation Tool' calculates the lifetime - failure probability - of plated through hole via's under soldering and under accelerated thermal cycling conditions.
- Input parameters are: thermal properties of laminate and plated copper, via dimensions and thermal load conditions. Default material properties are provided for copper.

# Other tools



## Delamination Calculator

The 'Delamination Calculation Tool' calculates the number of lead-free solder cycles to cohesive delamination for a specific laminate. An J-STD-20 based reflow profile with a peak of 265°C is used as a reference profile. It uses a selection of the laminate thermal properties (Td, T260, T288, T300) for the delamination calculation and calculates missing thermal properties e.g. T300.

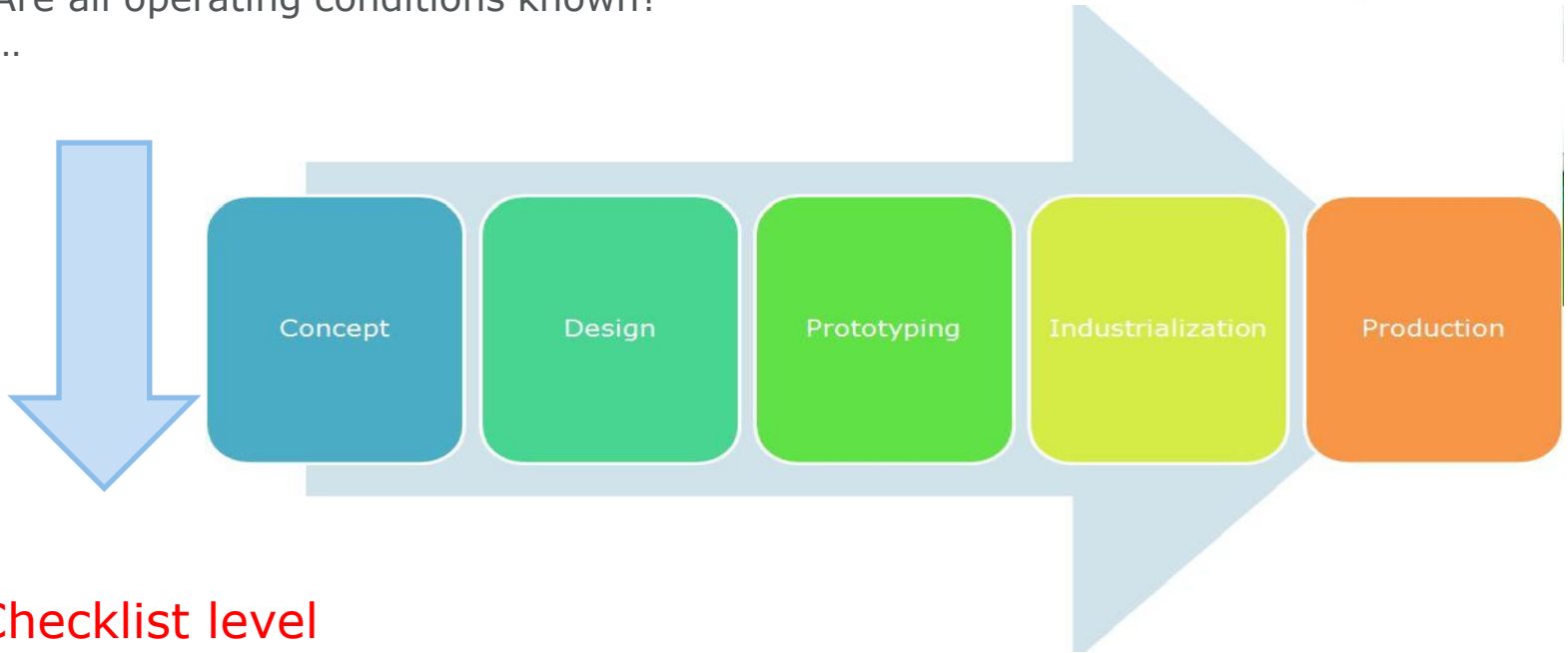
# Agenda

- Introduction
- Benefit of a good NPI Follow up
- Design for Manufacturability, Reliability & Design Requirements
- Passport
- PBA Process Description & Embedded in NPI Process
- Status Implementation

# PBA Process Description

## Task level

Which are the ***DfX*** at each Stage gate ?
Guidelines & Technologies used?
Prototype & Volume Qty?
Are all operating conditions known?
…



## Checklist level

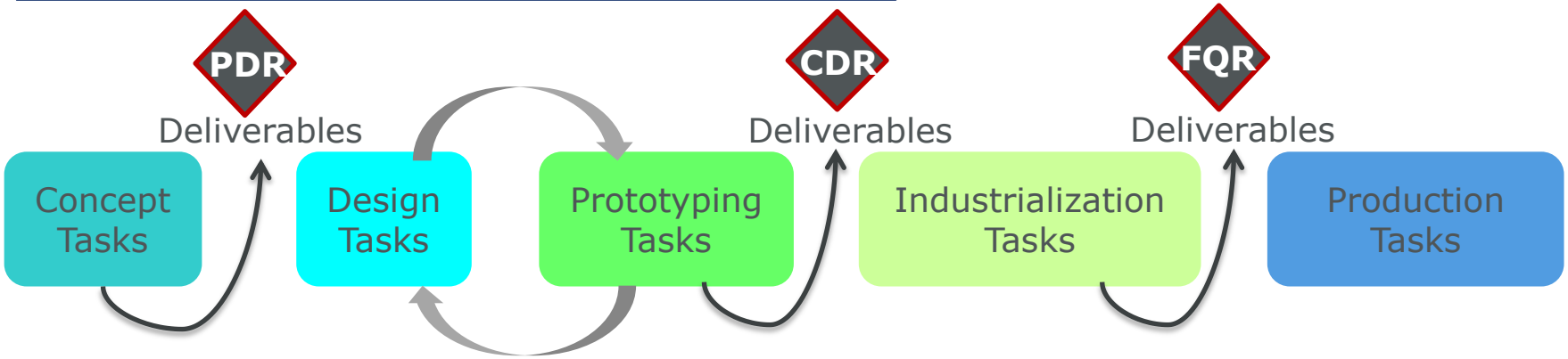
Are Tasks and ***DfX*** performed at each Stage gate, by who?
Documented Deviations and Checks for DfX performed?
…

# Embedded in NPI process

NPI Process

**NPI Checklist**

- Tasks
- Input:
  - Completion of PBA Checklist
  - Completion of Passport
- Responsibilities: R&D Project Leader




PBA Process

**PBA PCB Checklist**

- Tasks
- Responsibilities: PBA PCB Team
- Outcome: Status for NPI Milestones

**Passport Tool**

- During PCB design
- Responsible: HW Engineer & PCB engineer
- Outcome: Status for NPI Milestone

# Embedded in NPI process

## PBA PCB Team

| | PBA |
|---|---|
| PBA number | R761234 |
| Description | Controller |
| Responsible: | Jan HW |
| Date: | |

| | |
|---|---|
| NPI Manager | Jos NPI |
| R&D Project Leader | Piet Project Leader |
| Procurement Lead | Pol Procurement |
| SQA Responsible | Karel SQA |
| *Hardware Engineer* | Jan HW |
| *Mechanical Engineer* | Tom Mech |
| *Test Engineer* | Vik Test |
| *EMC Engineer* | Rony EMC |
| *SI/PI Engineer* | Lode SI/PI |
| *PCB Engineer* | Rudi PCB |
| *PCB2 Engineer* | Claude PCB |
| *ELS Responsible* | Els ELS |
| *Other Teammembers* | |
| *Other Teammembers* | |
| *Other Teammembers* | |
| | |

### General Overview

- Team
- Checklist PBA Status

| | | |
|---|---|---|
| *PBA PCB Stage gates* | *Status Concept* | 0% |
| *NPI Milestone* | ***Preliminary Design Review PDR*** | 0% |
| *PBA PCB Stage gates* | *Status Design* | 0% |
| *PBA PCB Stage gates* | *Status Prototype* | 0% |
| *NPI Milestone* | ***Critical Design Review CDR*** | 0% |
| *PBA PCB Stage gates* | *Status Industrialization* | 0% |
| *NPI Milestone* | ***Final Qualification Review FQR*** | 0% |
| *PBA PCB Stage gates* | *Status Production* | 0% |
| *NPI Milestone* | ***Phase out review POR*** | 0% |



BARCO
Visibly yours

# Embedded in NPI process

## Concept Phase

| | PBA |
|---|---|
| PBA number | R761234 |
| Description | Controller |
| Responsible: | Jan HW |
| Date: | |

**Checklist**

- Tasks
- Responsibilities

| PBA Phase: Concept | Task | Responsible | Value | Remarks |
|---|---|---|---|---|
| | | | | |
| **Line of Business** | Select from drop - down | Piet Project Leader | | |
| **Operating conditions** | | | | |
| | *Environmental: Ambient Temperature* | | | |
| | *Tmin: [°C]* | Piet Project Leader | | |
| | *Tmax: [°C]* | Piet Project Leader | | |
| | *Environmental: Ambient Humidity* | | | |
| | *Airconditioned: Select [Y/N]* | Piet Project Leader | | |
| | *Constant Ambient Temperature: [°C]* | Piet Project Leader | | |
| | *RH: [%]* | Piet Project Leader | | |
| | *Outdoor: [Y/N]* | Piet Project Leader | | |
| | *Environmental: Altitude* | | | |
| | *Height [m]:* | Piet Project Leader | | |
| | *Environmental: Vibration* | | | |
| | *Enter value [grms]* | Piet Project Leader | | |
| | *Enter value [grms]* | Piet Project Leader | | |
| | *Environmental: Shock* | | | |
| | | Piet Project Leader | | |
| | | Piet Project Leader | | |
| | *Environmental: Chemical* | | | |
| | *Select* | Piet Project Leader | | |
| | *Reliability:* | | | |
| | *Component Repair allowed: Select [Y/N]* | Piet Project Leader | | |
| | *Operational conditions:* | | | |
| | *On / Off cycles [#/Day]* | Piet Project Leader | | |
| | *Foreseen lifetime [Years]* | Piet Project Leader | | |
| | ***Calculated thermal cycli 0*** | | | |
| | | | ***Value*** | ***Remarks*** |
| | | | | |
| **Prototypes and Volumes** | Enter Prototype QTY | Pol Procurement | | |
| | Enter yearly Volume Qty | Pol Procurement | | |
| | | | ***Status*** | ***Remarks*** |
| | | | | |
| **ACL too early: determine components (temp range, no commercial, industrial?), concept strategy (SI, EMC...), contraints, rules, Class** | Enter Status | Jan HW | | |
| **Check test requirement** | Enter Status | Wik Test | | |
| **Thermal and mechanical constraints** | Enter Status | Jan HW | | |
| **Technology available used?** | Enter Status | Jan HW | | |

# Embedded in NPI process

## Design Phase

| | PBA |
|---|---|
| PBA number | R761234 |
| Description | Controller |
| Responsible: | Jan HW |
| Date: | |

**Checklist**

- Tasks
- Responsibilities

| PBA Phase: Design | Task | Responsible | Status | Remarks |
|---|---|---|---|---|
| | | | | |
| **DfM analysis** | | | | |
| Design verification | Check Design rules (EMC, SI/PI, DfM, env, derating, safety) | Jan HW | | |
| Design recommendation | Concept (crosscheck) / DfM report | Jan HW | | |
| Document design rules deviations | Document design rules deviations | Jan HW | | |
| **DfT analysis** | | | | |
| Testability verification | Review Schematics wrt testability: test directive | Vik Test | | |
| Testability recommendation | Concept (crosscheck) / DfT report | Vik Test | | |
| Test strategy prototype + volume | Test directive | Vik Test | | |
| **DfR analysis** | | | | |
| FMEA | FMEA | Jos NPI | | |
| Reliability recommendations | Concept (crosscheck) / DfR report | Jan HW | | |
| Document design rules deviations | Document design rules deviations | Jan HW | | |
| **Verify applied technologies** | | | | |
| Check used components (ACL, green) | Check used components (ACL, green) | Jan HW | | |
| Check lifetime / leadtime / single source components | Check lifetime / single source components | Jan HW | | |
| PBA Passport for Supllier selection | PBA Passport for Supllier selection | Jan HW | | |
| Check production quantities at Supplier | Check production quantities at Supplier | Pol Procurement | | |
| **Setup Prototyping: logistic Support** | **Setup Prototyping: logistic Support** | | | |
| Prototype supplier PBA + PCB: technology, capability, leadtime | Prototype supplier PBA + PCB: technology, capability, leadtime | Pol Procurement | | |
| Prototype Datacommunication & Specification setup: partlists, versions | Prototype Datacommunication & Specification setup: partlists, versions | Pol Procurement | | |
| | Setup prototyping testing according test directive | Pol Procurement | | |
| Prototypelogistical path setup: forecasting, batch sizes | Prototypelogistical path setup: forecasting, batch sizes | Pol Procurement | | |
| Prototype legal path setup: contracts, incoterms | Prototype legal path setup: contracts, incoterms | Pol Procurement | | |

# Embedded in NPI process

## Prototype Phase

| | PBA |
|---|---|
| PBA number | R761234 |
| Description | Controller |
| Responsible: | Jan HW |
| Date: | |

**Checklist**

- Tasks
- Responsibilities

| PBA Phase: Protophase | Task | Responsible | Status | Remarks |
|---|---|---|---|---|
| **DfM analysis** | | | | |
| Prototype DfM review | Check assembly errors during prototype evaluation: route cause & check prototype report from the EMS & PCB manufacturer | Jan HW | | |
| Check modification requests | Check requirement modifcations or functional spec changes by Product management | Jan HW | | |
| Design recommendation | Check outcome of DfM and modification request from design issues | Jan HW | | |
| Document design rules deviations | Analyse Design rules based upon previous actions and document | Jan HW | | |
| **DfT analysis** | | | | |
| Prototyping testability& coverage review | Verify testability and test coverage report | Vik Test | | |
| Test results evaluation | Check yield and remaining errors during board startup | Vik Test | | |
| Testability recommendation | Make recommendations to improve test directive, test coverage and testimplementation | Vik Test | | |
| Test strategy volume | Check test coverage and test time against estimated volumes and available test equipment | Vik Test | | |
| **DfR analysis** | | | | |
| Verification actual prototyping wrt reliability : Qualification tests | Check confidence test plan report | Jan HW | | |
| Reliability recommendations | Reliability recommendations from report & failures reported in i-track | Jan HW | | |
| Document design rules deviations | | | | |
| **Check technologies & processes** | | | | |
| Verify EMS process & equipment capability | | | | |
| Verify PCB process & equipment capability | | | | |
| PBA Passport for Supllier selection | PBA Passport for Supllier selection | Jan HW | | |
| **Setup Volume supply chain for** | | | | |
| Prototype supplier PBA + PCB: technology, capability, flexibility | Select final PBA manufacturer and PCB manufacturer | Pol Procurement | | |
| Volume Datacommunication & Specification setup: partlists, versions | Production Data preparation | Pol Procurement | | |
| Volum logistical path setup: forecasting, batch sizes | Quotation negoziation | Pol Procurement | | |
| Volume legal path setup: contracts, incoterms | Quotation negoziation | Pol Procurement | | |
| Volume ramp up plan | Quotation negoziation | Pol Procurement | | |
| **Check used components (ACL)** | Data package preparation | Jan HW | | |

# Embedded in NPI process
## Industrialization Phase

| | PBA |
|---|---|
| PBA number | R761234 |
| Description | Controller |
| Responsible: | Jan HW |
| Date: | |

**Checklist**

- Tasks
- Responsibilities

| PBA Phase:Industrialization | Task | Responsible | Status | Remarks |
|---|---|---|---|---|
| **Handle modification request - design rule / DfX safeguard** | | | | |
| handle modification request | handle ECP | Jan HW | | |
| handle design rules and deviation | check impact on qualification testing | Jan HW | | |
| **Check technology & processes** | | | | |
| Verify process capability | Check first pass yield at the EMS | Jan HW | | |
| | Check test results from PBA qualification | Jan HW | | |
| | | | | |
| Tooling ready for volume | Check production tooling | Jan HW | | |
| **Check logistic supply chain ready for volumes** | | | | |
| check EMS supplier ready for volume | check EMS supplier ready for volume | Pol Procurement | | |
| check PCB supplier ready for volume | check PCB supplier ready for volume | Pol Procurement | | |
| Check components suppliers ready for volume | Check components suppliers ready for volume | Pol Procurement | | |

# Embedded in NPI process
## Production Phase

| | PBA |
|---|---|
| PBA number | R761234 |
| Description | Controller |
| Responsible: | Jan HW |
| Date: | |

**Checklist**

- Tasks
- Responsibilities

| PBA Phase: Production | Task | Responsible | Status | Remarks |
|---|---|---|---|---|
| Handle modification requests | handle ECP | Els ELS | | |
| design rule / DfX safeguarding | check impact on product quality | Els ELS | | |
| Monitor volume production: quality and reliability data | Monitor volume production: quality and reliability data | Karel SQA | | |

# Agenda

- Introduction
- Benefit of a good NPI Follow up
- Design for Manufacturability, Reliability & Design Requirements
- Passport
- PBA Process Description & Embedded in NPI Process
- Status Implementation

# Status Implementation

- **Passport**
  - Current features
    - Report on rejected manufacturer due to
      - Missing capabilities
      - Missing processes
      - Impact on design requirement
    - Link towards PBA stage gates
      - Concept phase
      - Design phase

  - Additional features to be implemented (2014)
    - Database maintenance
    - Integration in PCB Layout job request
    - Documented guidelines / design rules to be used for PBA

# Status Implementation

- **NPI PBA PCB Process**
  - Current features
    - Checklists
    - Link towards PBA stage gates
      - Concept phase
      - Design phase
  - Additional features to be implemented: running
    - The documents import of automated DfX tools as prove to be able to perform risk assessments

# Status Implementation

- **WW rollout**
  - Training 4 hrs.
    - Passport tool: 2 hrs.
    - NPI Implementation: 2 hrs.
  - Sites
    - All European sites, India and China (April – June)
    - To be done: US sites (through WebEx, October)

# Questions?

# Thank you!

EDM
Electronics Design & Manufacturing

BARCO
Visibly yours

# EDM Event 04 October 2013

www.youtube.com/BarcoTV
www.twitter.com/Barco
www.facebook.com/Barco