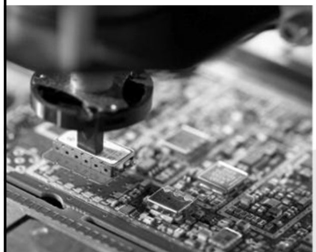

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YOUR PERFORMANCE

BB Electronics
How DfM, Virtual Prototype –
General approach.

Claus E. Nielsen – PE/DL

BB ELECTRONICS
EMS – from idea to solution





# How DfM?


## Abstract:

Due to the immense variety of possible analyses and reporting it is important to standardize the DfM approach.

How does BB Electronics manage the challenge and what tools, standards and reports are used to finalize our DfM reports.

Benefits of a supplemental BOM analysis, emphasizing the importance of compatibility of the critical process parameters of the various components in the BOM.


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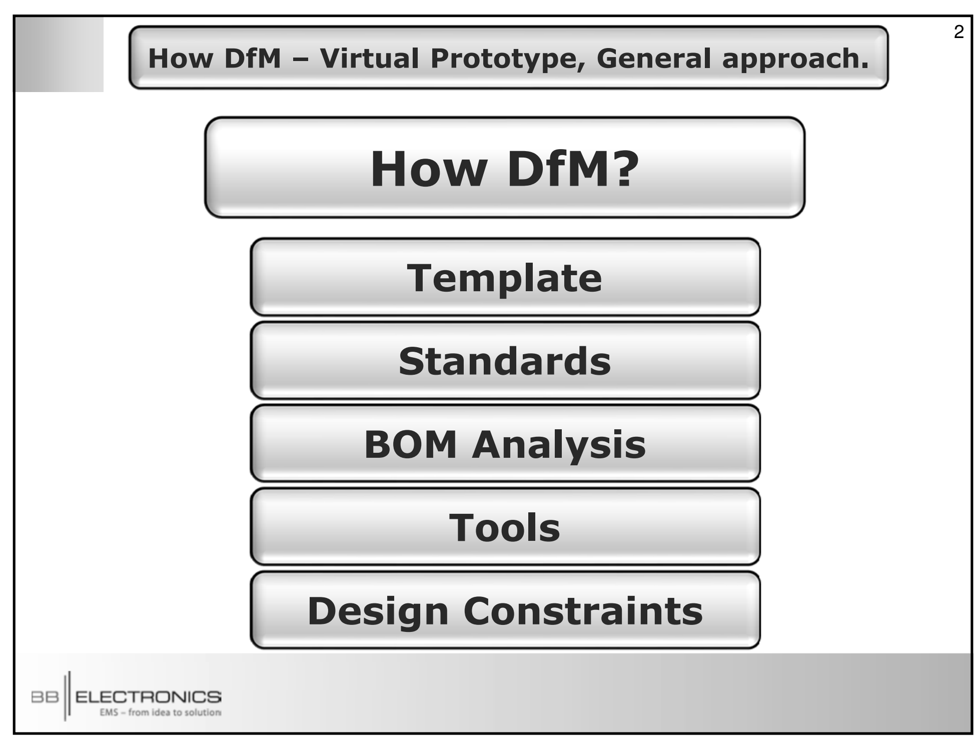
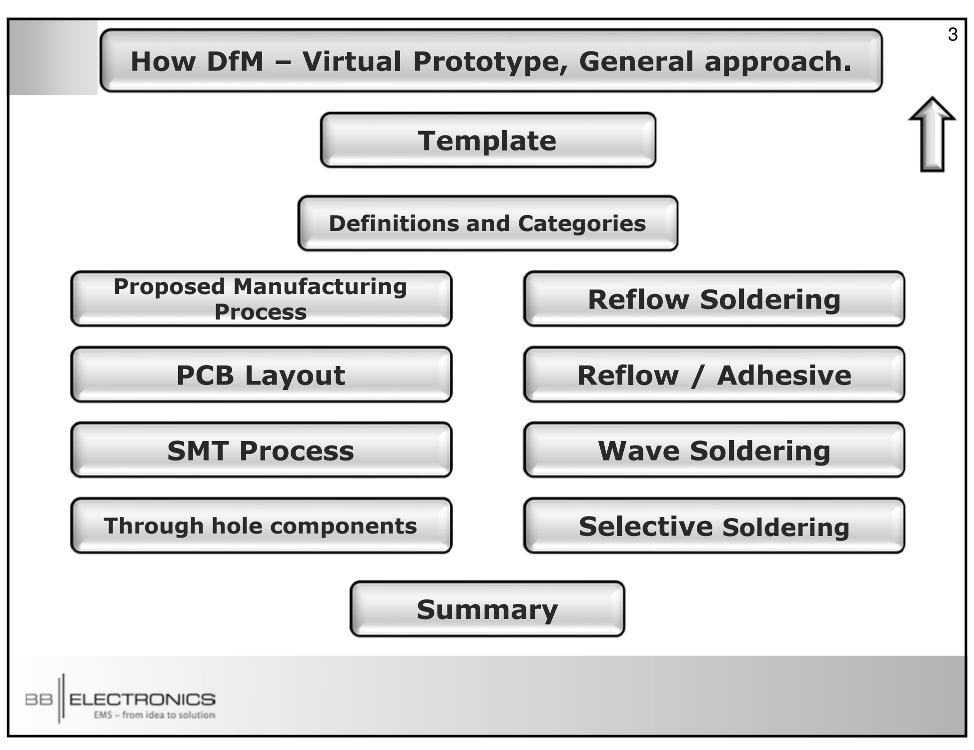
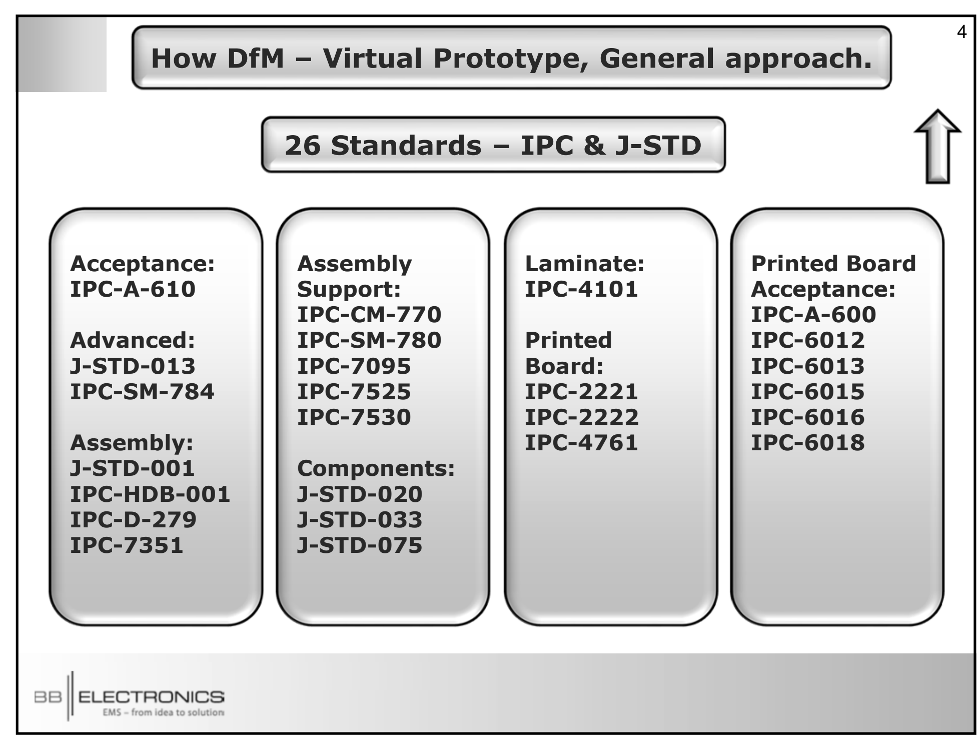
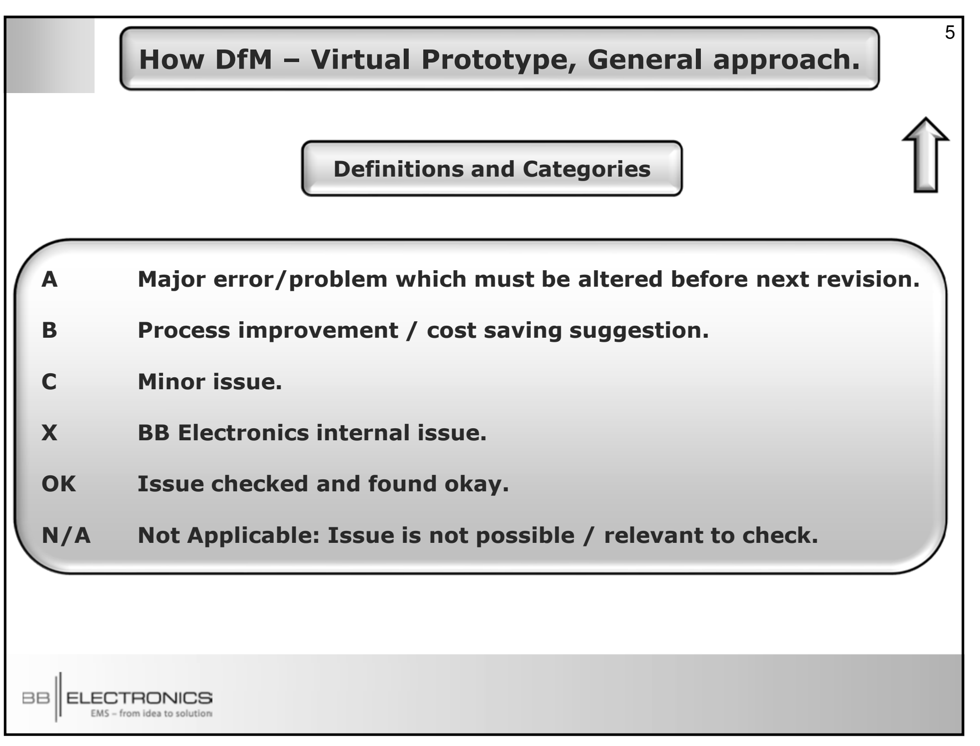
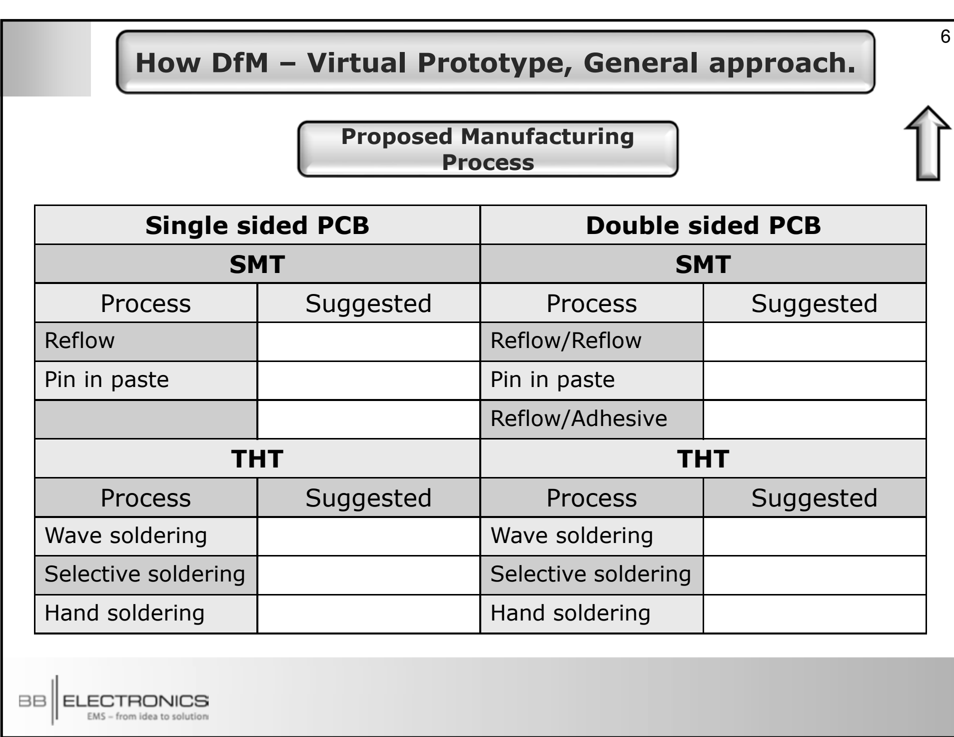

2
How DfM – Virtual Prototype, General approach.
How DfM?
Template
Standards
BOM Analysis
Tools
Design Constraints
BB ELECTRONICS
EMS – from idea to solution


3
How DfM – Virtual Prototype, General approach.
Template
Definitions and Categories
Proposed Manufacturing Process
Reflow Soldering
PCB Layout
Reflow / Adhesive
SMT Process
Wave Soldering
Through hole components
Selective Soldering
Summary
BB ELECTRONICS
EMS – from idea to solution


4
How DfM – Virtual Prototype, General approach.
26 Standards – IPC & J-STD
Acceptance:
IPC-A-610
Advanced:
J-STD-013
IPC-SM-784
Assembly:
J-STD-001
IPC-HDB-001
IPC-D-279
IPC-7351
Assembly Support:
IPC-CM-770
IPC-SM-780
IPC-7095
IPC-7525
IPC-7530
Components:
J-STD-020
J-STD-033
J-STD-075
Laminate:
IPC-4101
Printed Board:
IPC-2221
IPC-2222
IPC-4761
Printed Board Acceptance:
IPC-A-600
IPC-6012
IPC-6013
IPC-6015
IPC-6016
IPC-6018
BB ELECTRONICS
EMS – from idea to solution


5
How DfM – Virtual Prototype, General approach.
Definitions and Categories
A Major error/problem which must be altered before next revision.
B Process improvement / cost saving suggestion.
C Minor issue.
X BB Electronics internal issue.
OK Issue checked and found okay.
N/A Not Applicable: Issue is not possible / relevant to check.
BB ELECTRONICS
EMS – from idea to solution



6

## How DfM – Virtual Prototype, General approach.

**Proposed Manufacturing Process**

| Single sided PCB | | Double sided PCB | |
|---|---|---|---|
| **SMT** | | **SMT** | |
| Process | Suggested | Process | Suggested |
| Reflow | | Reflow/Reflow | |
| Pin in paste | | Pin in paste | |
| | | Reflow/Adhesive | |
| **THT** | | **THT** | |
| Process | Suggested | Process | Suggested |
| Wave soldering | | Wave soldering | |
| Selective soldering | | Selective soldering | |
| Hand soldering | | Hand soldering | |



7

## How DfM – Virtual Prototype, General approach.

**PCB Layout**

| No. | Issue | Result | [Position:] Comments |
|---|---|---|---|
| 5.09 | Via hole: 0.25mm min diameter. Min location from pads 0.254mm incl. trace. Min edge-to-edge 0.381mm if not masked. No underneath part (wave or adhesive). No mask if used for test. Tented/Capped when wave-soldered. | A | Numerous occasions, where vias are placed in pad. See comments below. |

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EMS – from idea to solution

## How DfM – Virtual Prototype, General approach.

### PCB Layout

| No. | Issue | Result | [Position:] Comments |
|---|---|---|---|
| 5.13 | No solder mask between 0402 or 0201 solder pads. | A | Numerous occasions of solder mask present between pads for 0402 components. See comment below. |

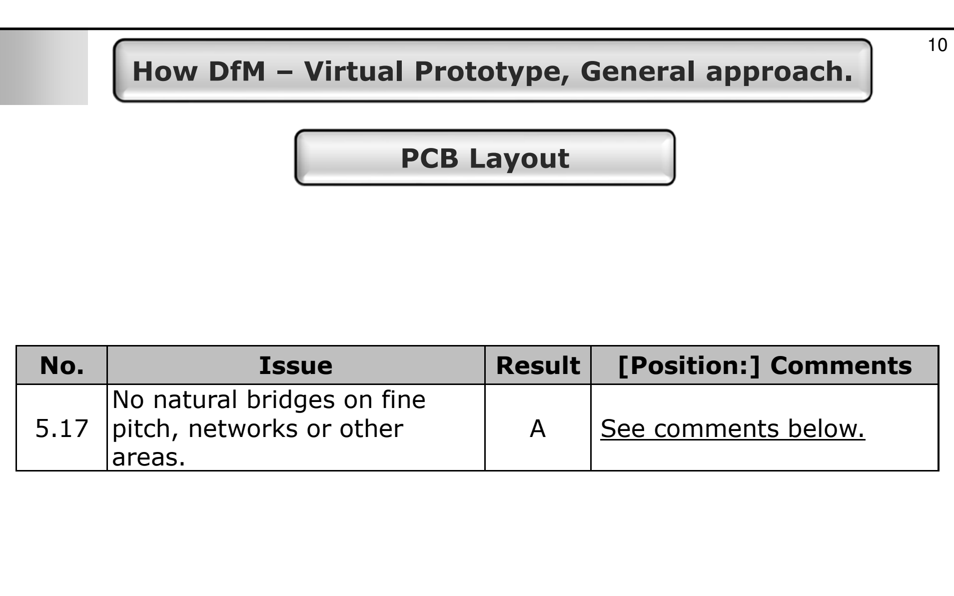




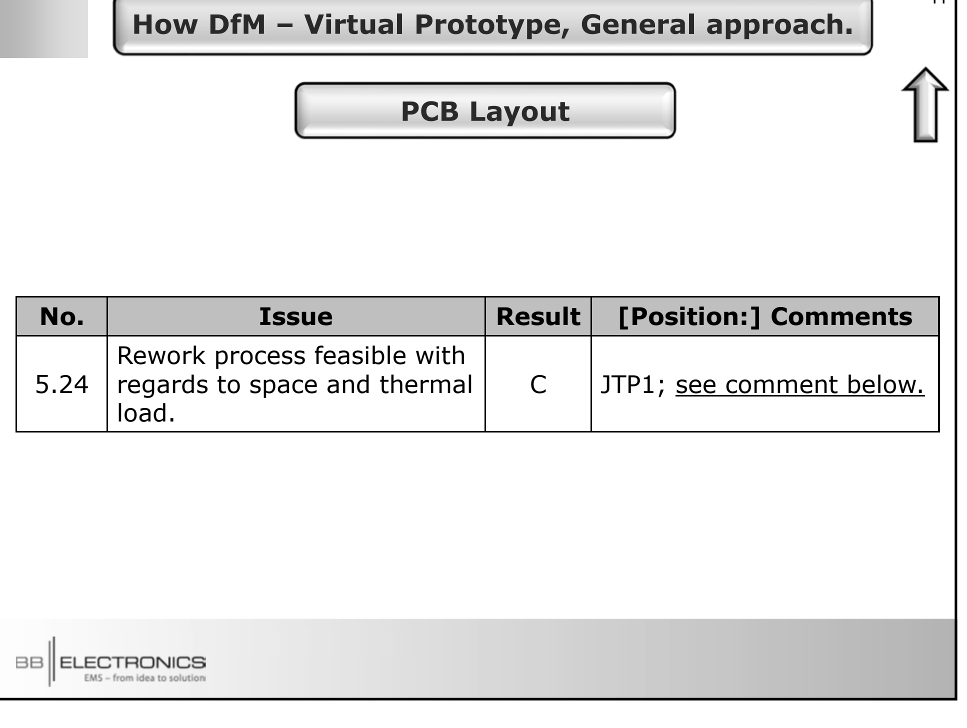
## How DfM – Virtual Prototype, General approach.

### PCB Layout

| No. | Issue | Result | [Position:] Comments |
|---|---|---|---|
| 5.15 | IPC-7351 land patterns used for general SMT design. | A | Numerous occasions where the recommendations listed in IPC-7351 has not been adhered to. See comments below. |




| No. | Issue | Result | [Position:] Comments |
|---|---|---|---|
| 5.17 | No natural bridges on fine pitch, networks or other areas. | A | See comments below. |




| No. | Issue | Result | [Position:] Comments |
|---|---|---|---|
| 5.24 | Rework process feasible with regards to space and thermal load. | C | JTP1; see comment below. |

## How DfM – Virtual Prototype, General approach.

### SMT Process

| No. | Issue | Result | [Position:] Comments |
|---|---|---|---|
| 6.02 | Min of 3-5mm free space around BGA type to allow for microscope inspection, rework possibility and mechanical fixtures for heatsinks. | A | IC202, see comment below. |
| 6.03 | Component to component body spacing. Min 0.3mm | A | C680, C684, C686, C689, C732 & IC219. See comment below. |

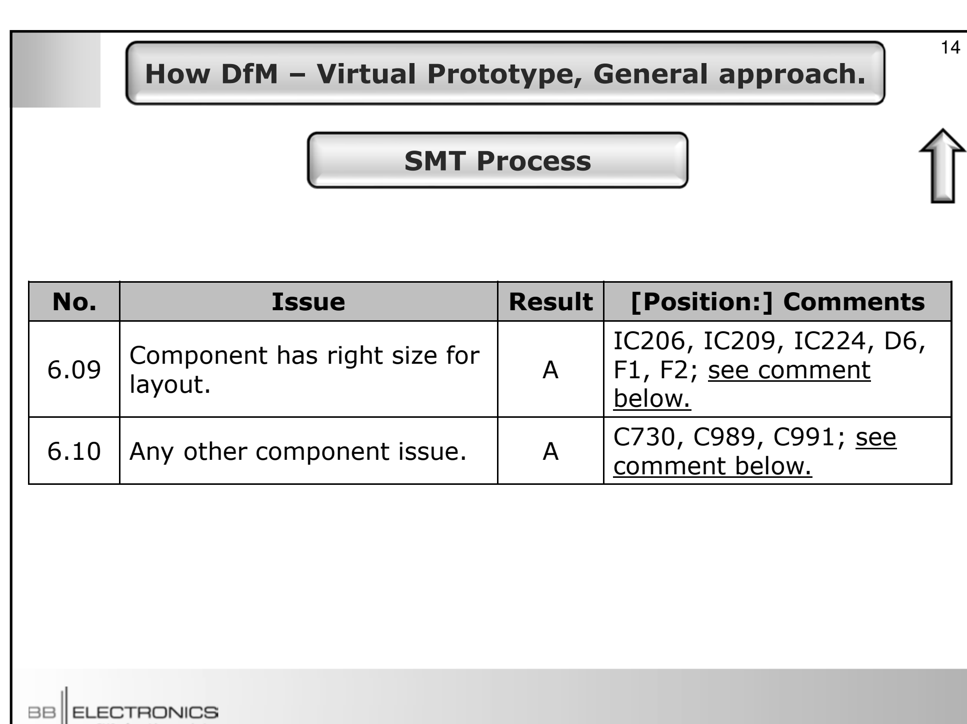




## How DfM – Virtual Prototype, General approach.

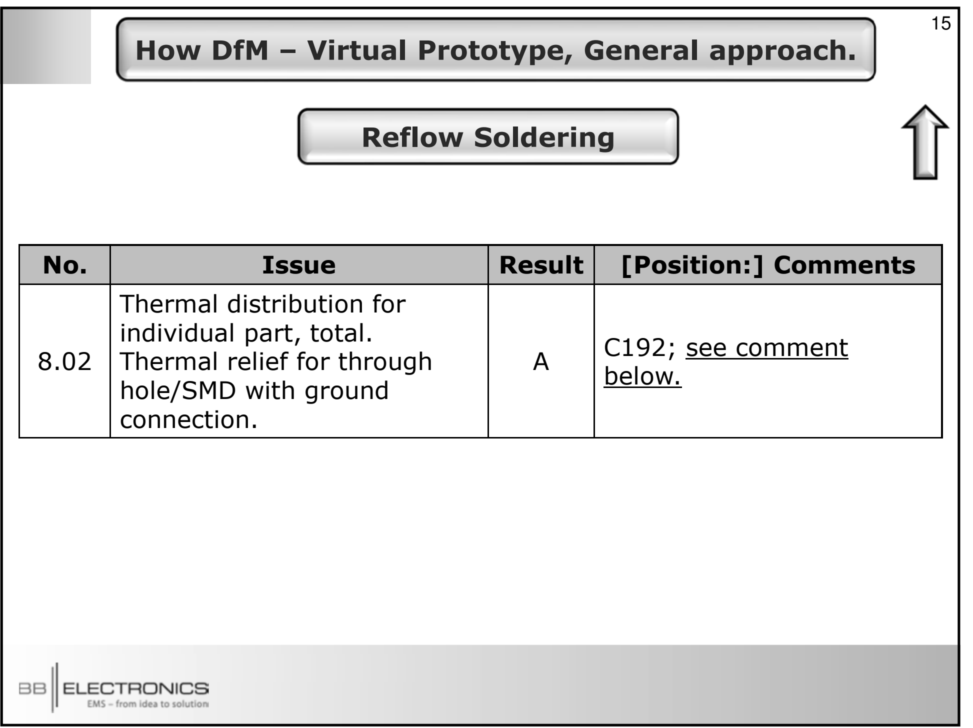
### SMT Process

| No. | Issue | Result | [Position:] Comments |
|---|---|---|---|
| 6.04 | Component board edge clearance. Top side min 3mm, Bottom side min 5mm. If panelized >= 0.5mm from edge. Special considerations for ceramics. | A | R301; see comment below. |

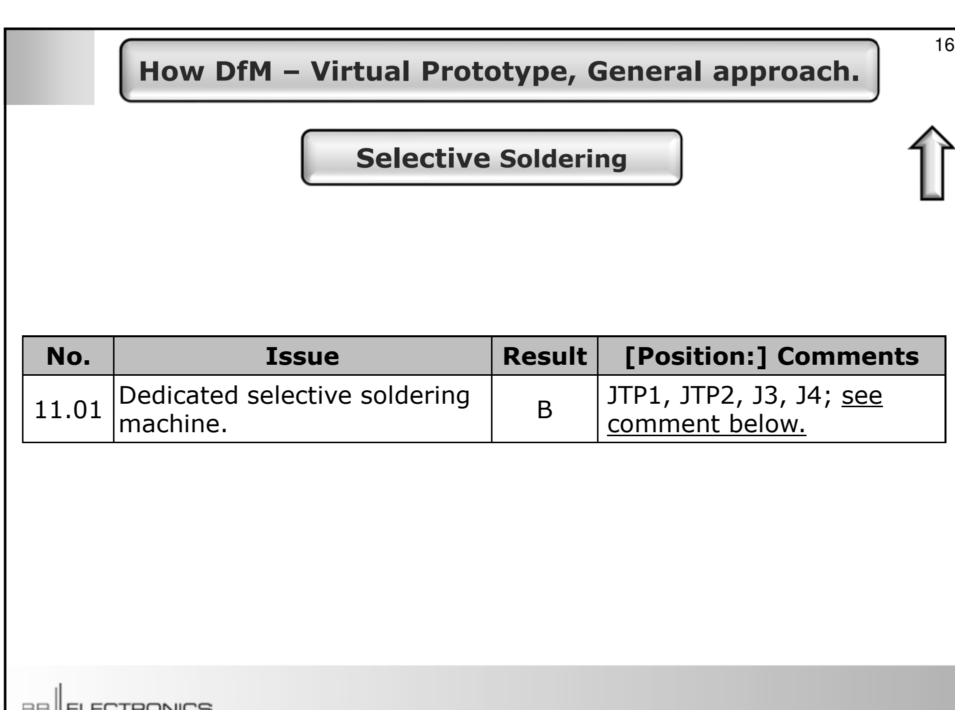



| No. | Issue | Result | [Position:] Comments |
| --- | --- | --- | --- |
| 6.09 | Component has right size for layout. | A | IC206, IC209, IC224, D6, F1, F2; see comment below. |
| 6.10 | Any other component issue. | A | C730, C989, C991; see comment below. |

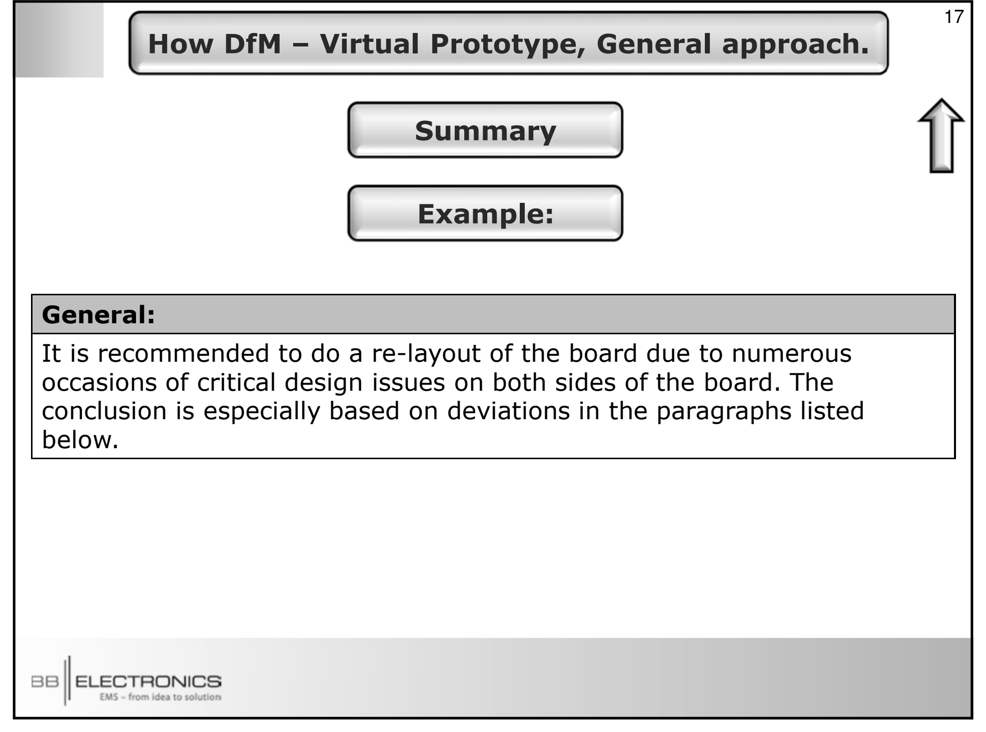




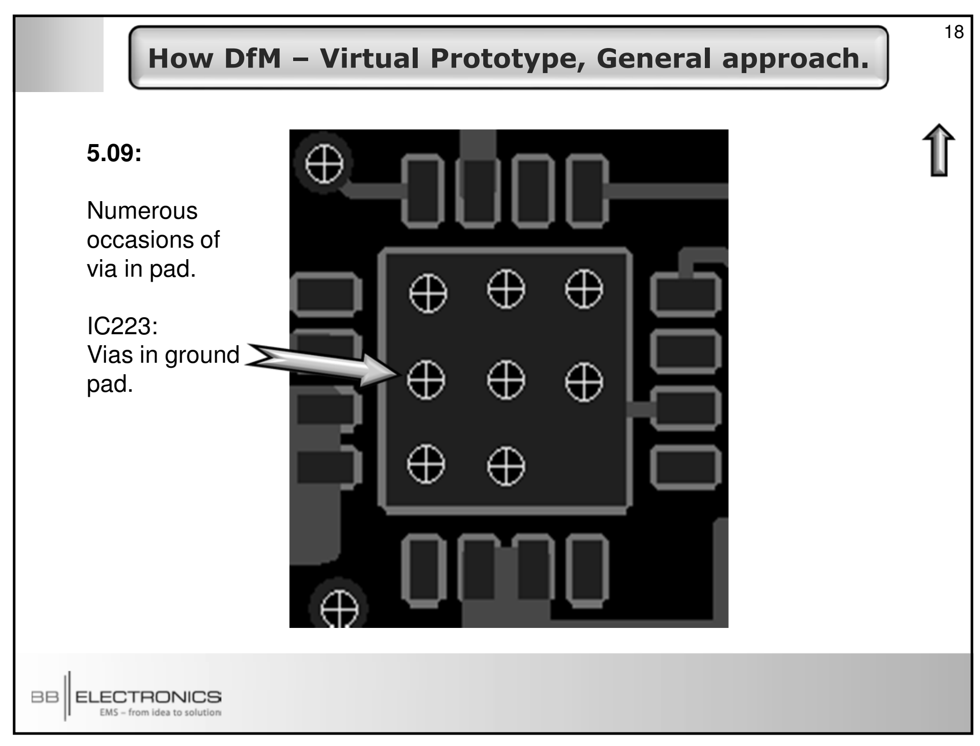

| No. | Issue | Result | [Position:] Comments |
| --- | --- | --- | --- |
| 8.02 | Thermal distribution for individual part, total. Thermal relief for through hole/SMD with ground connection. | A | C192; see comment below. |

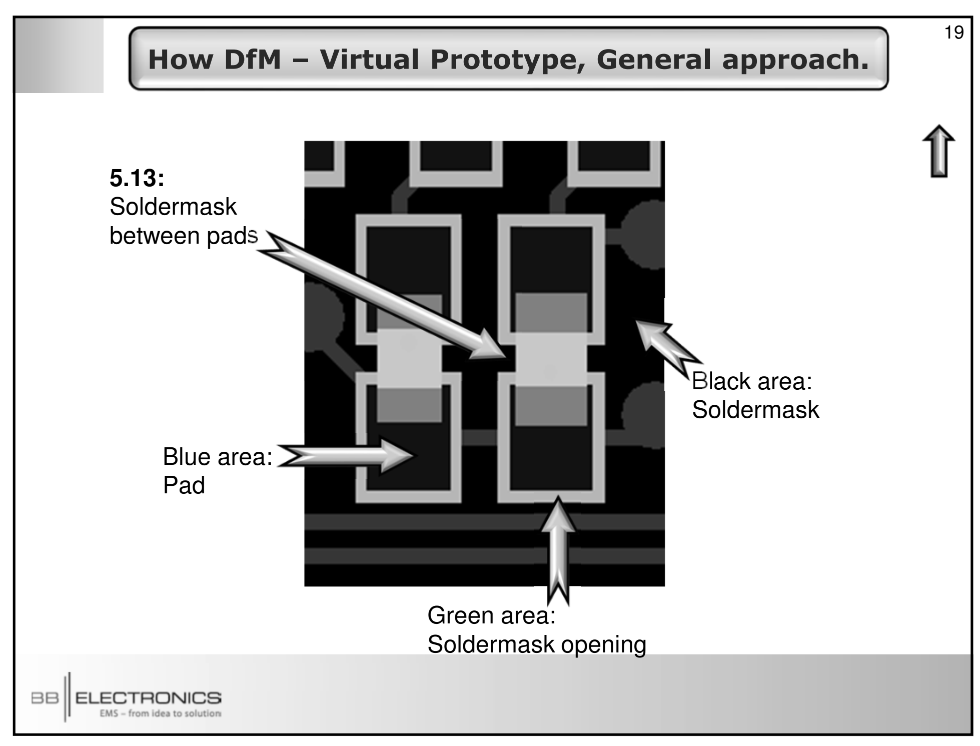


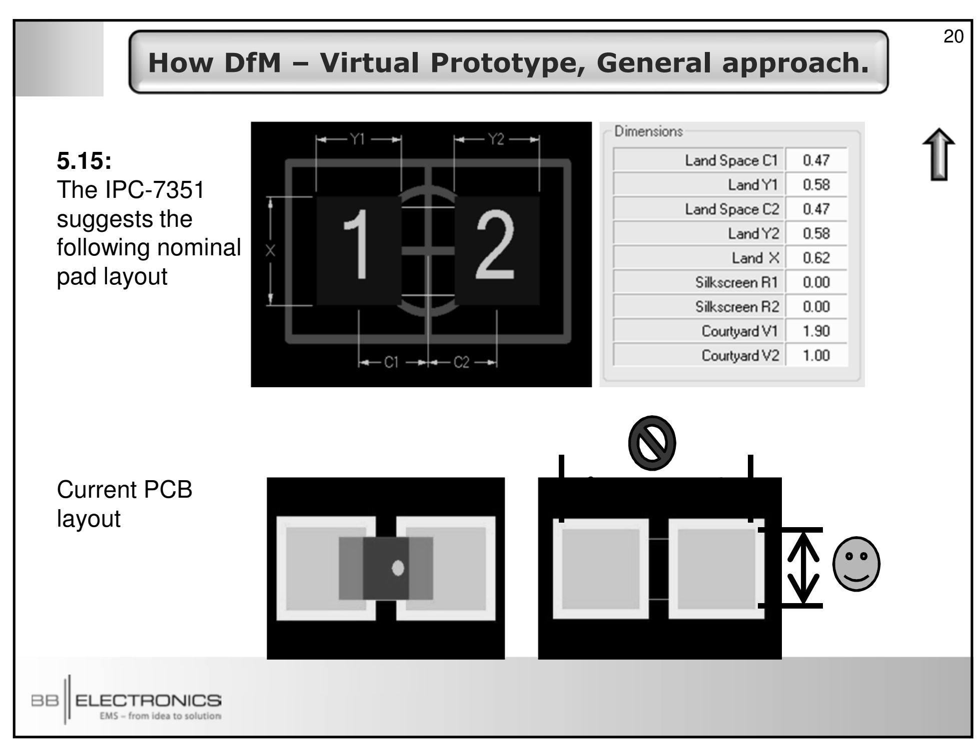

| No. | Issue | Result | [Position:] Comments |
|---|---|---|---|
| 11.01 | Dedicated selective soldering machine. | B | JTP1, JTP2, J3, J4; see comment below. |

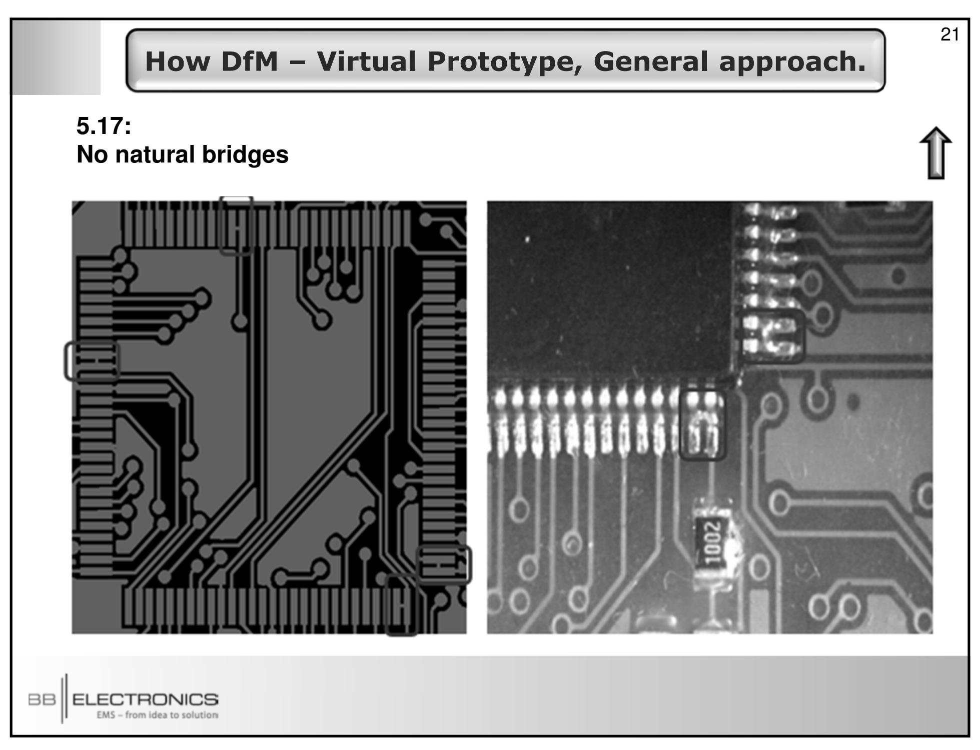


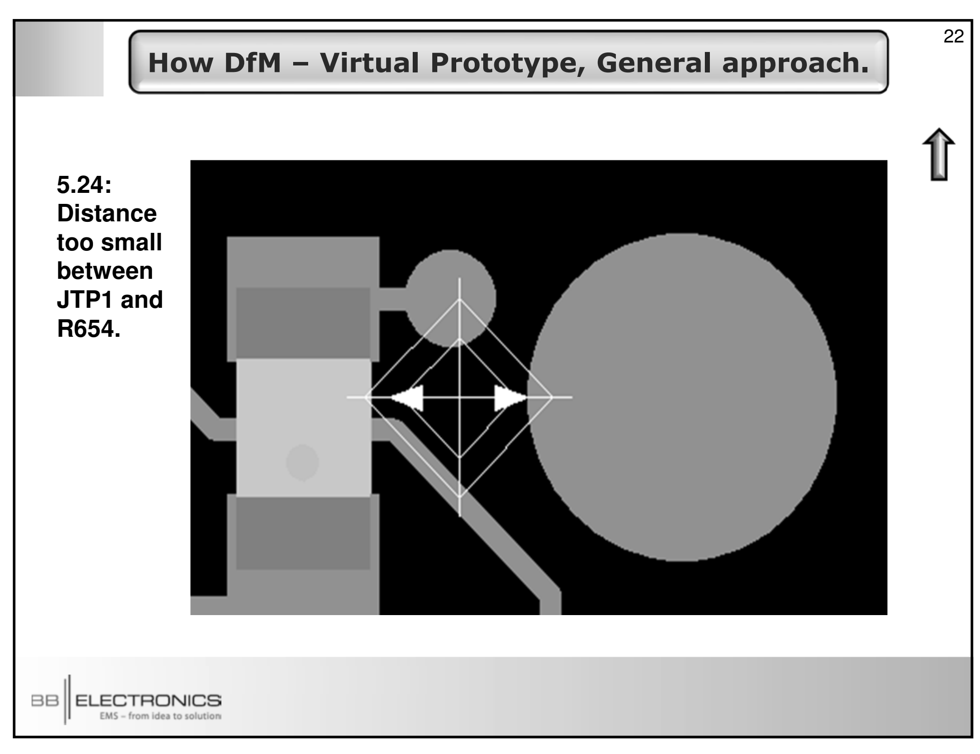

| General: |
|---|
| It is recommended to do a re-layout of the board due to numerous occasions of critical design issues on both sides of the board. The conclusion is especially based on deviations in the paragraphs listed below. |

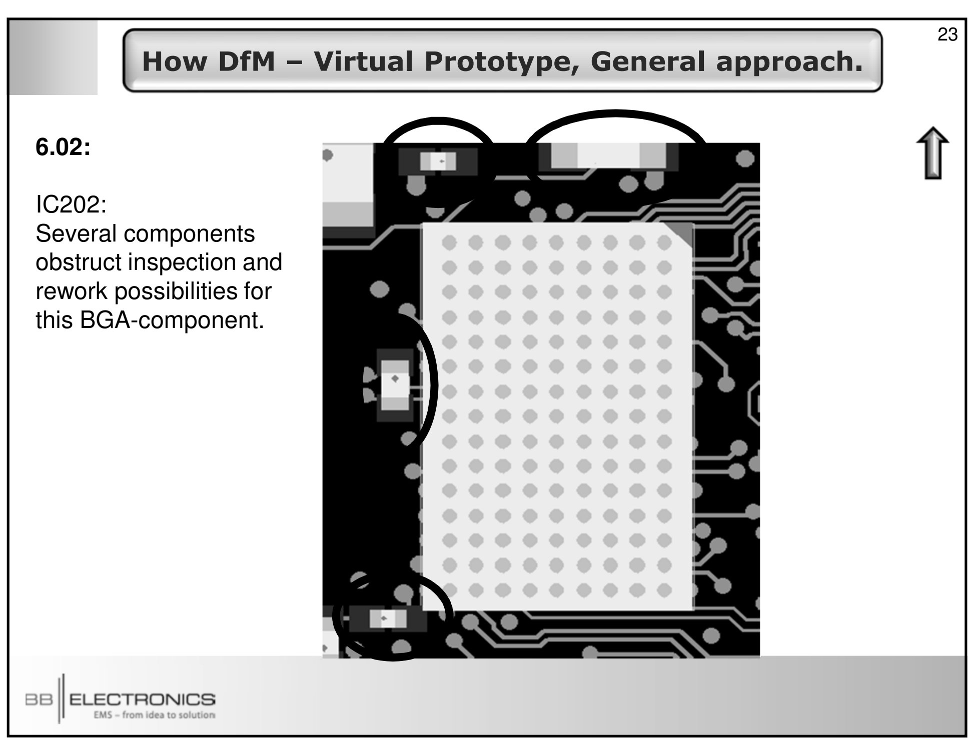

18
How DfM – Virtual Prototype, General approach.
5.09:
Numerous occasions of via in pad.
IC223:
Vias in ground pad.
BB ELECTRONICS
EMS – from idea to solution

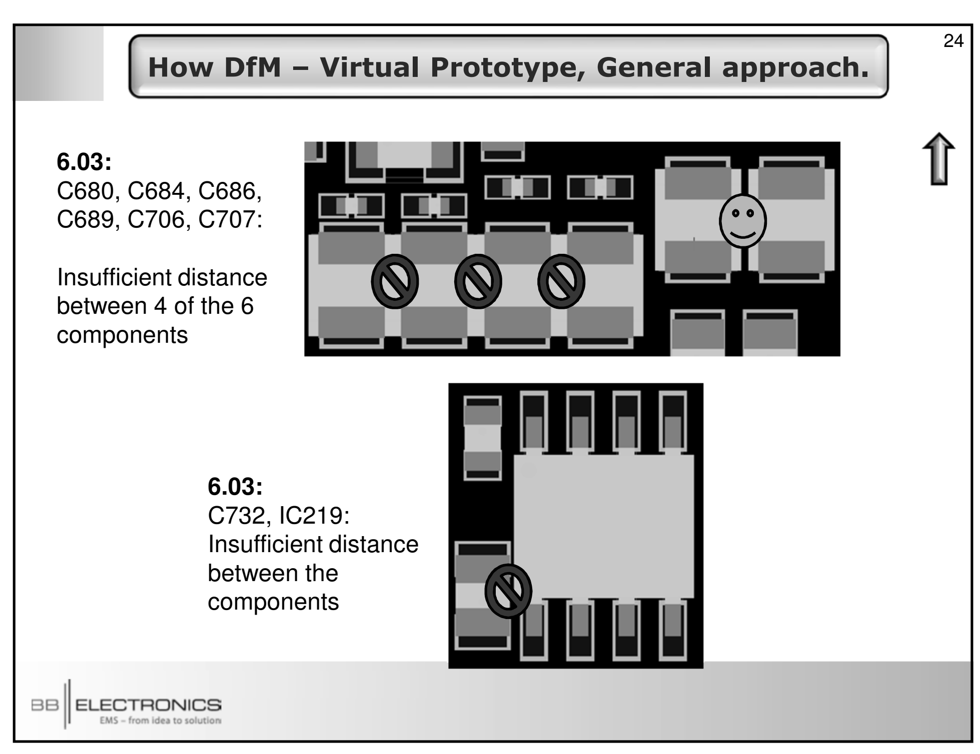

19
How DfM – Virtual Prototype, General approach.
5.13:
Soldermask between pads
Black area:
Soldermask
Blue area:
Pad
Green area:
Soldermask opening
BB ELECTRONICS
EMS – from idea to solution

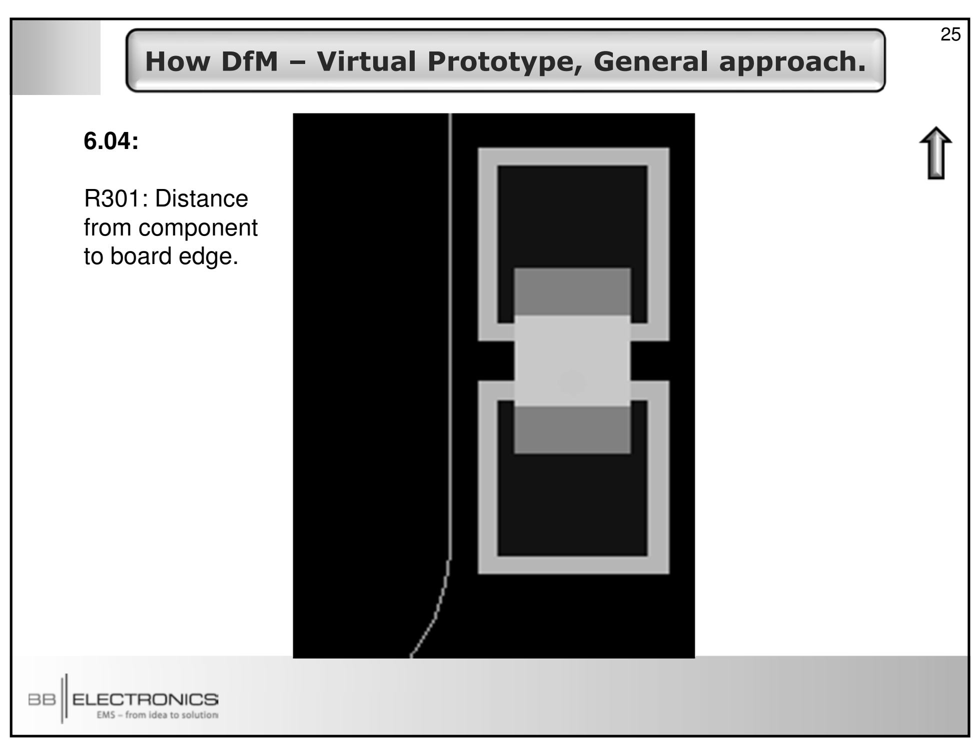

20
How DfM – Virtual Prototype, General approach.
5.15:
The IPC-7351 suggests the following nominal pad layout
Y1
Y2
X
1
2
C1
C2
Dimensions
Land Space C1 0.47
Land Y1 0.58
Land Space C2 0.47
Land Y2 0.58
Land X 0.62
Silkscreen R1 0.00
Silkscreen R2 0.00
Courtyard V1 1.90
Courtyard V2 1.00
Current PCB layout
BB ELECTRONICS
EMS – from idea to solution

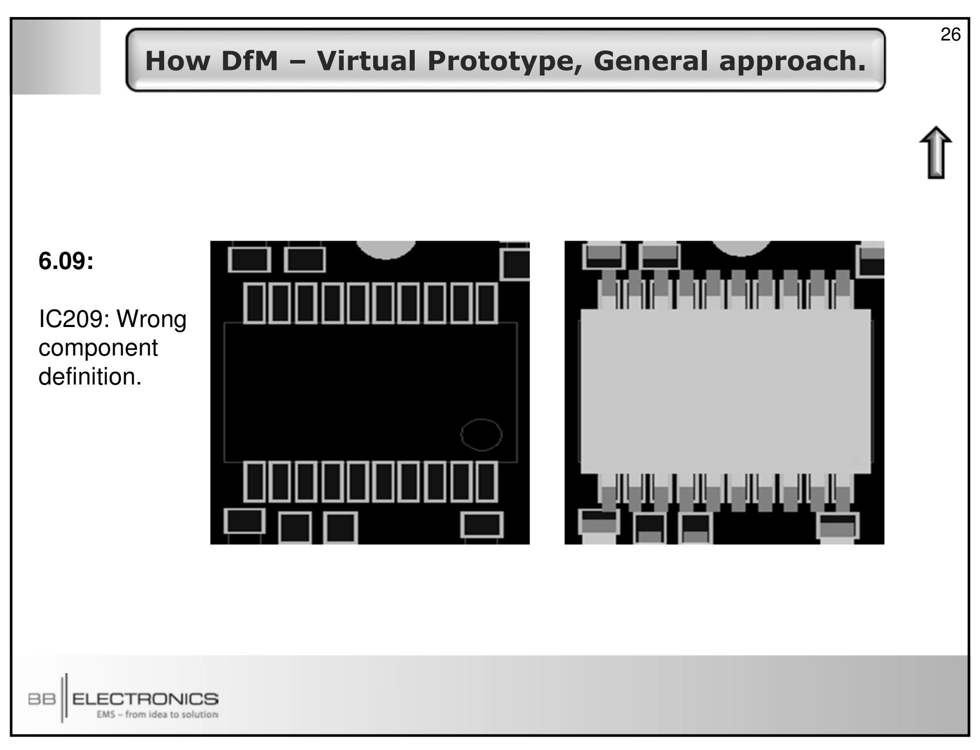

21
How DfM – Virtual Prototype, General approach.
5.17:
No natural bridges
1002
BB ELECTRONICS
EMS – from idea to solution

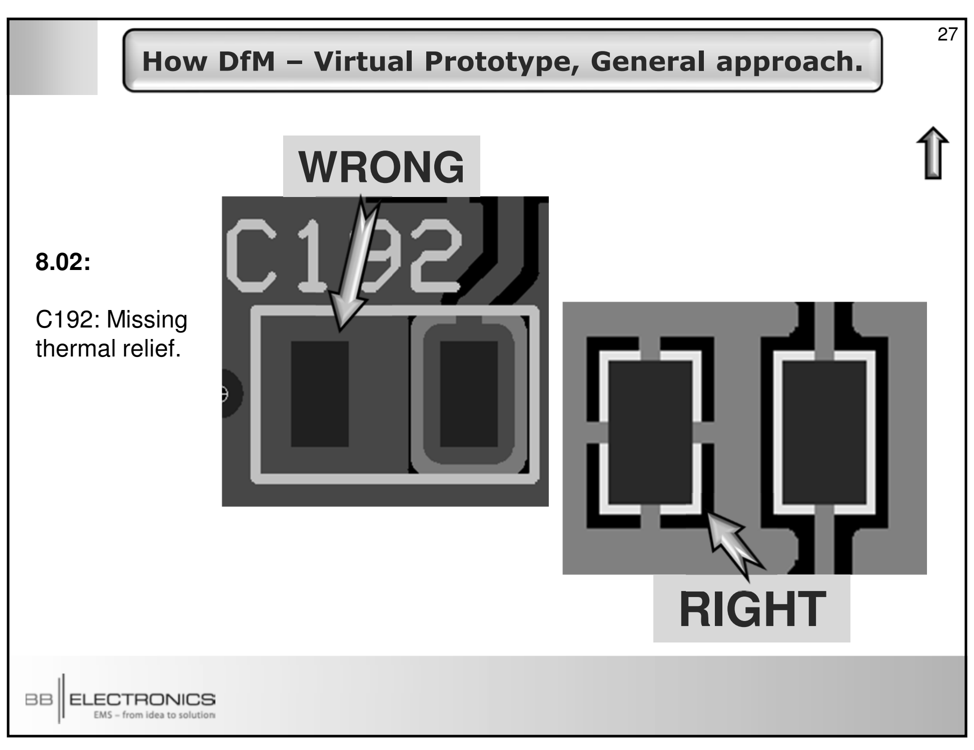

22
How DfM – Virtual Prototype, General approach.
5.24:
Distance
too small
between
JTP1 and
R654.
BB ELECTRONICS
EMS – from idea to solution

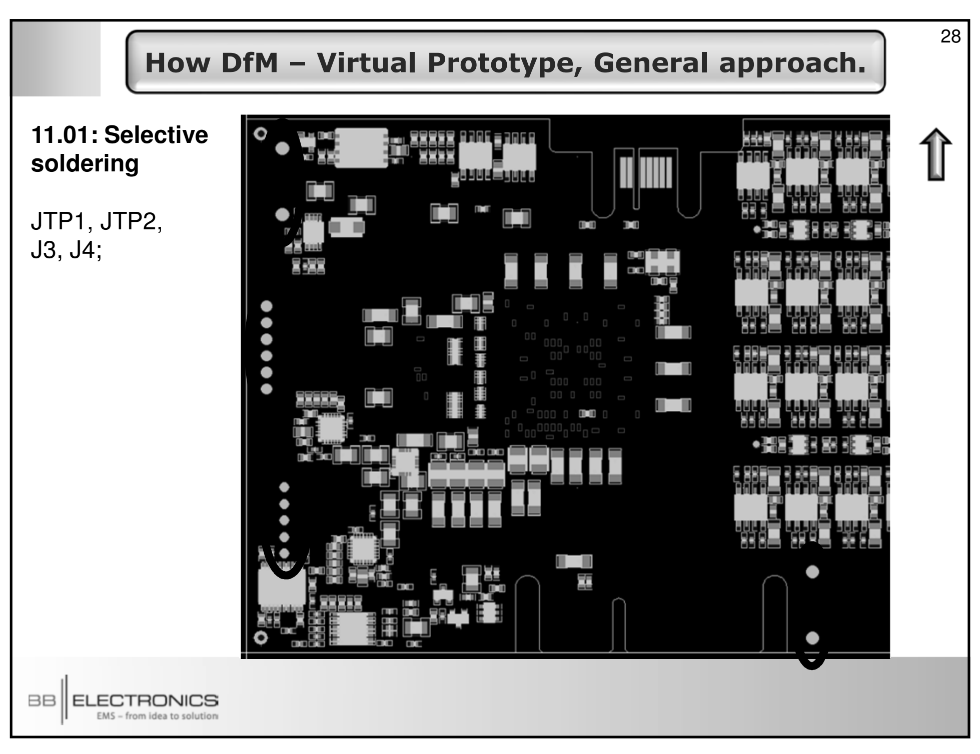

23
How DfM – Virtual Prototype, General approach.
6.02:
IC202:
Several components
obstruct inspection and
rework possibilities for
this BGA-component.
BB ELECTRONICS
EMS – from idea to solution

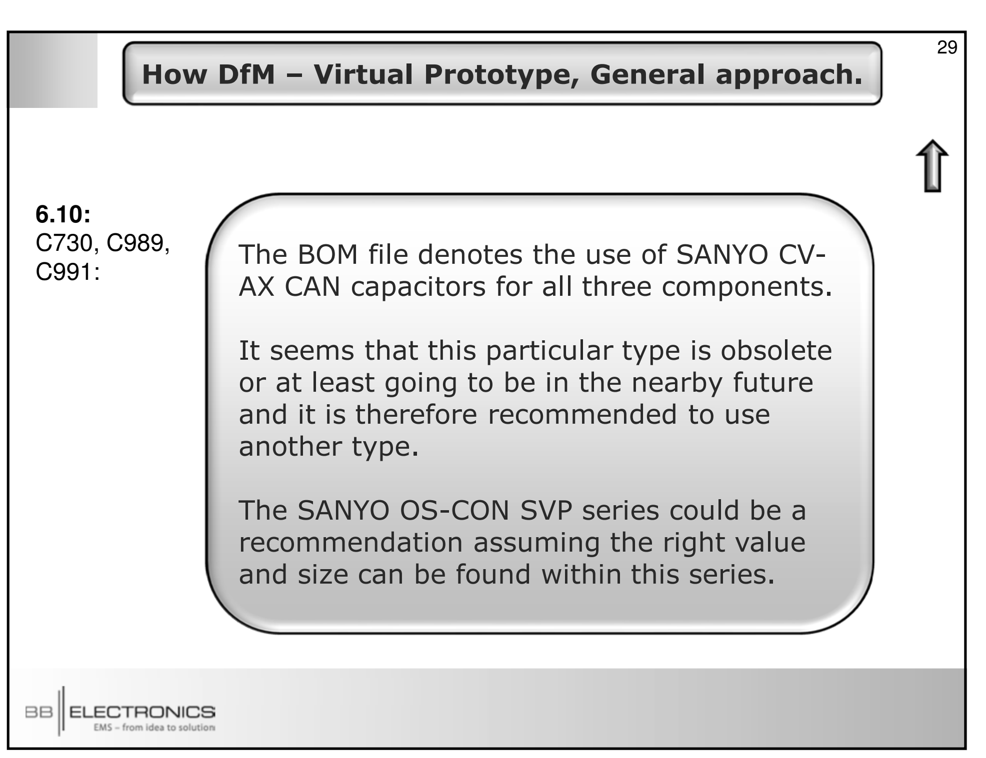

24
How DfM – Virtual Prototype, General approach.
6.03:
C680, C684, C686,
C689, C706, C707:
Insufficient distance
between 4 of the 6
components
6.03:
C732, IC219:
Insufficient distance
between the
components
BB ELECTRONICS
EMS – from idea to solution

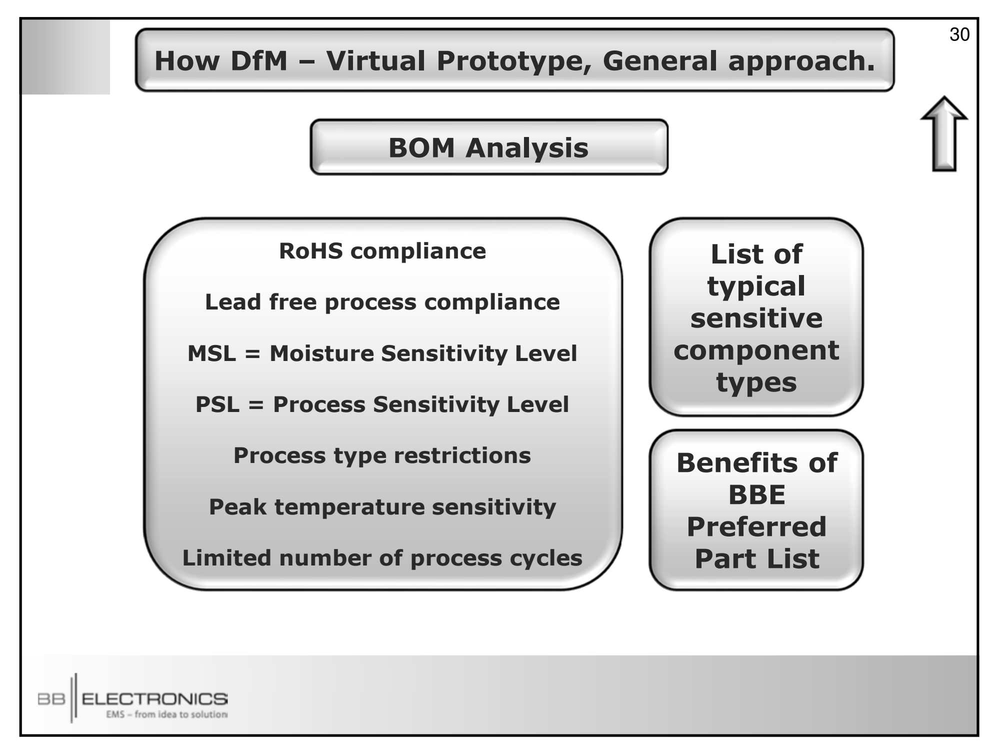

25
How DfM – Virtual Prototype, General approach.
6.04:
R301: Distance
from component
to board edge.
BB ELECTRONICS
EMS – from idea to solution

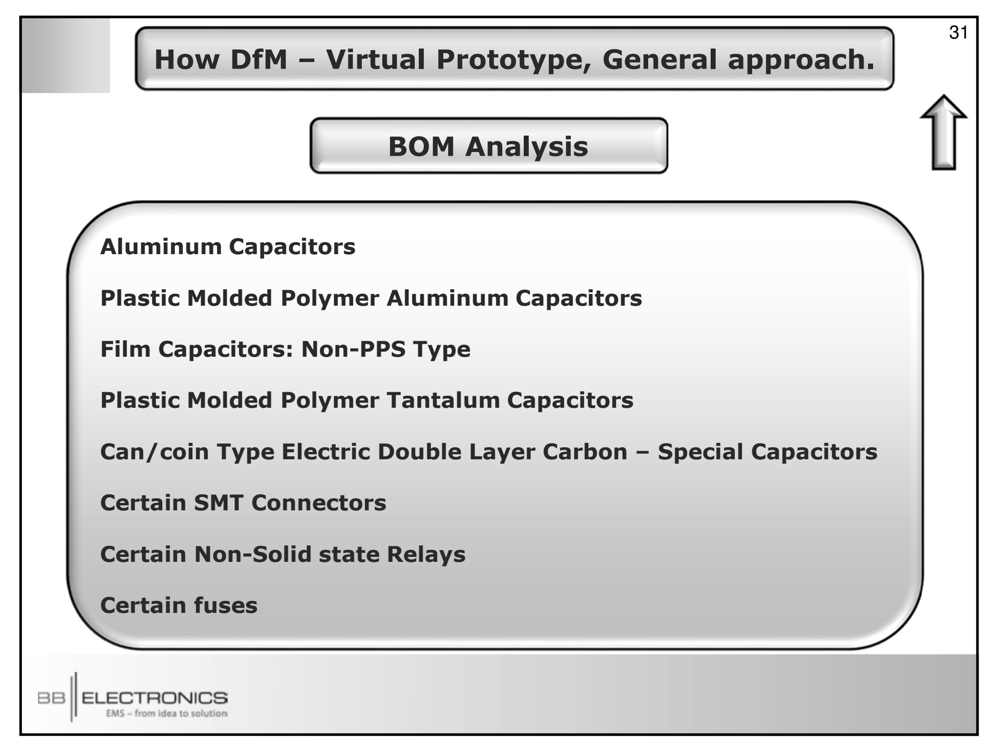

26
How DfM – Virtual Prototype, General approach.
6.09:
IC209: Wrong component definition.
BB ELECTRONICS
EMS – from idea to solution

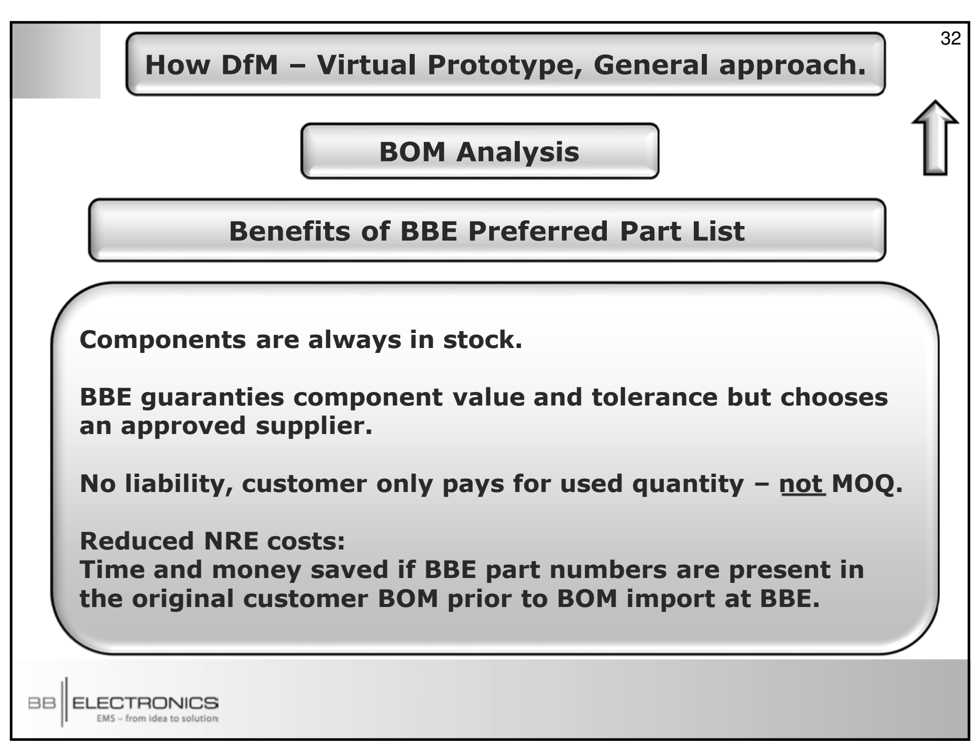

27
How DfM – Virtual Prototype, General approach.
WRONG
8.02:
C192: Missing thermal relief.
RIGHT
BB ELECTRONICS
EMS – from idea to solution


28
How DfM – Virtual Prototype, General approach.
11.01: Selective soldering
JTP1, JTP2, J3, J4;
BB ELECTRONICS
EMS – from idea to solution

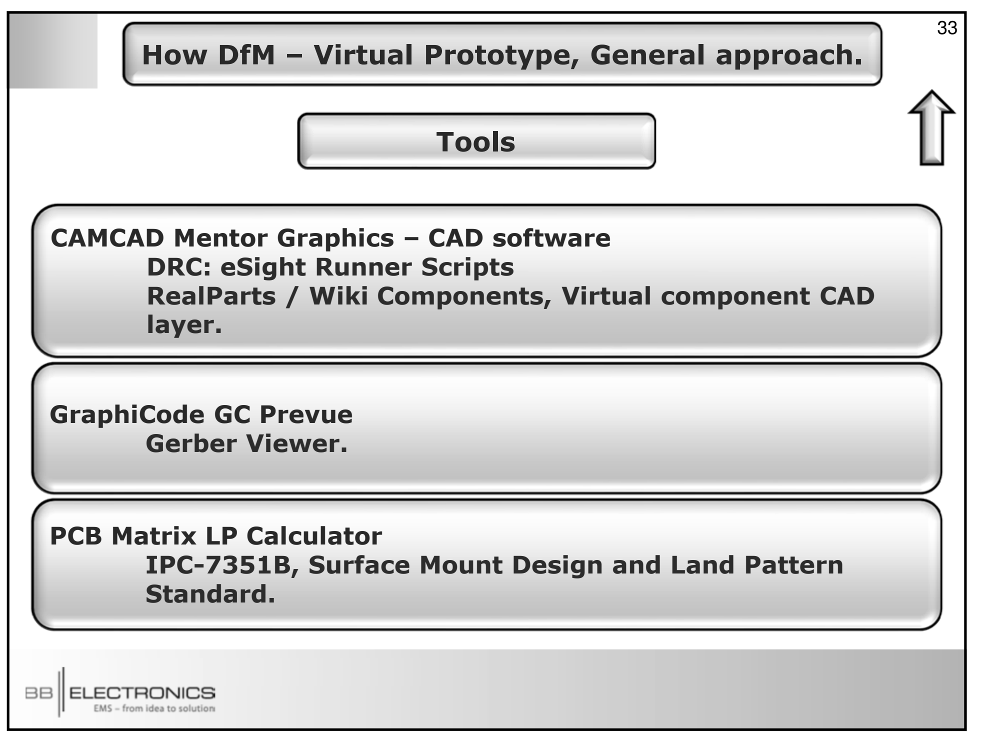

29
How DfM – Virtual Prototype, General approach.
6.10:
C730, C989, C991:
The BOM file denotes the use of SANYO CV-AX CAN capacitors for all three components.
It seems that this particular type is obsolete or at least going to be in the nearby future and it is therefore recommended to use another type.
The SANYO OS-CON SVP series could be a recommendation assuming the right value and size can be found within this series.
BB ELECTRONICS
EMS – from idea to solution


30
How DfM – Virtual Prototype, General approach.
BOM Analysis
RoHS compliance
Lead free process compliance
MSL = Moisture Sensitivity Level
PSL = Process Sensitivity Level
Process type restrictions
Peak temperature sensitivity
Limited number of process cycles
List of typical sensitive component types
Benefits of BBE Preferred Part List
BB ELECTRONICS
EMS – from idea to solution


31
How DfM – Virtual Prototype, General approach.
BOM Analysis
Aluminum Capacitors
Plastic Molded Polymer Aluminum Capacitors
Film Capacitors: Non-PPS Type
Plastic Molded Polymer Tantalum Capacitors
Can/coin Type Electric Double Layer Carbon – Special Capacitors
Certain SMT Connectors
Certain Non-Solid state Relays
Certain fuses
BB ELECTRONICS
EMS – from idea to solution



32
How DfM – Virtual Prototype, General approach.
BOM Analysis
Benefits of BBE Preferred Part List
Components are always in stock.
BBE guaranties component value and tolerance but chooses an approved supplier.
No liability, customer only pays for used quantity – not MOQ.
Reduced NRE costs:
Time and money saved if BBE part numbers are present in the original customer BOM prior to BOM import at BBE.
BB ELECTRONICS
EMS – from idea to solution

33
How DfM – Virtual Prototype, General approach.
Tools
CAMCAD Mentor Graphics – CAD software
DRC: eSight Runner Scripts
RealParts / Wiki Components, Virtual component CAD layer.
GraphiCode GC Prevue
Gerber Viewer.
PCB Matrix LP Calculator
IPC-7351B, Surface Mount Design and Land Pattern Standard.
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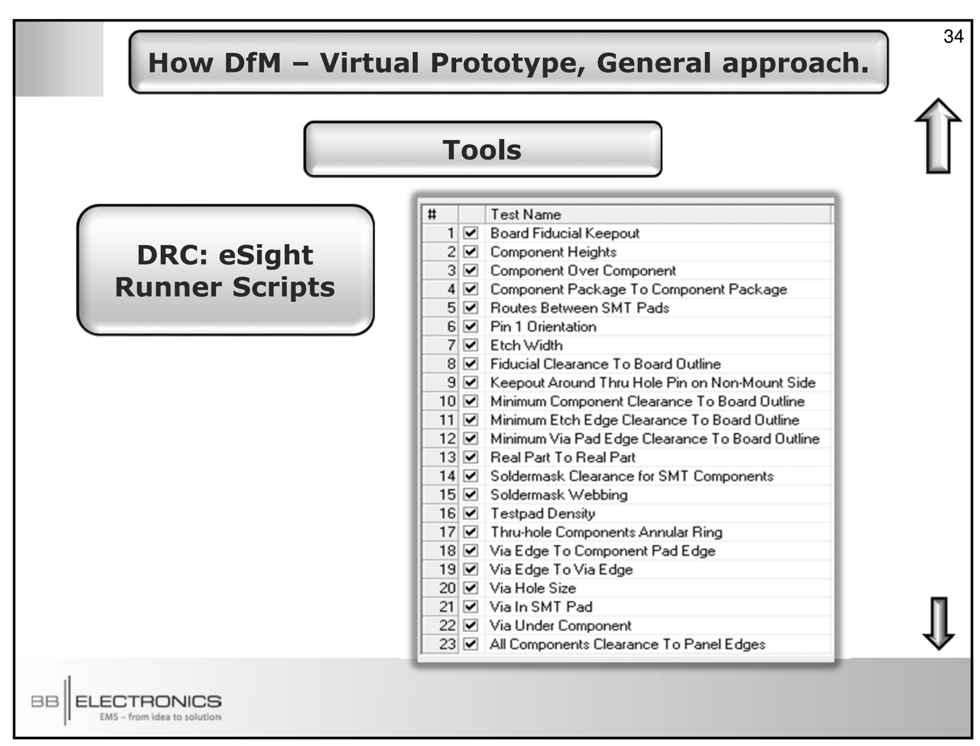
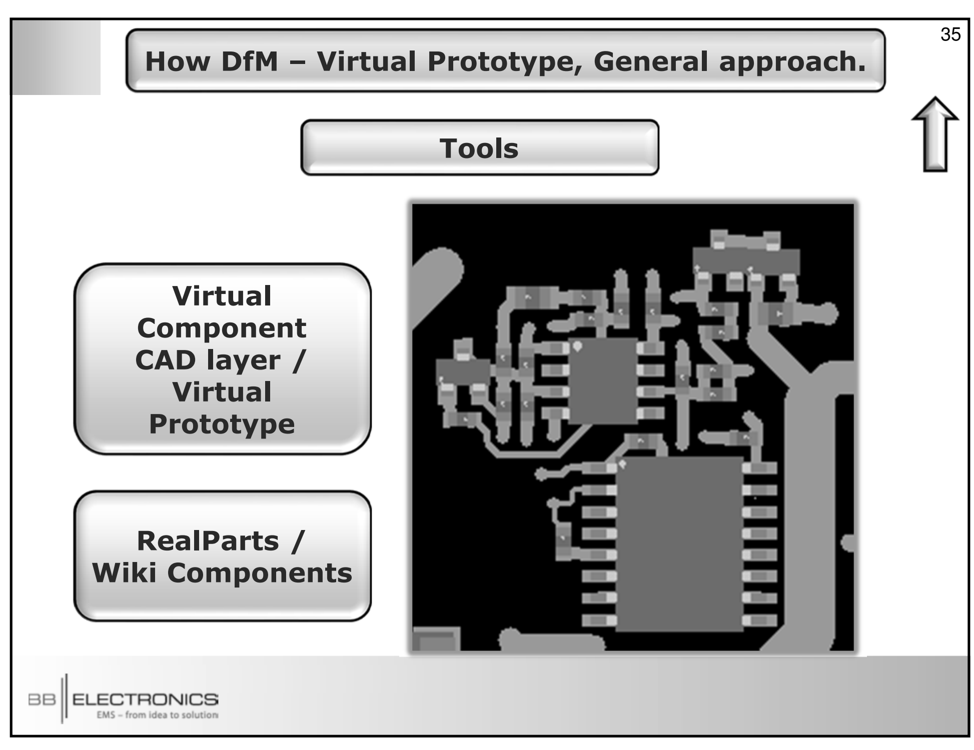
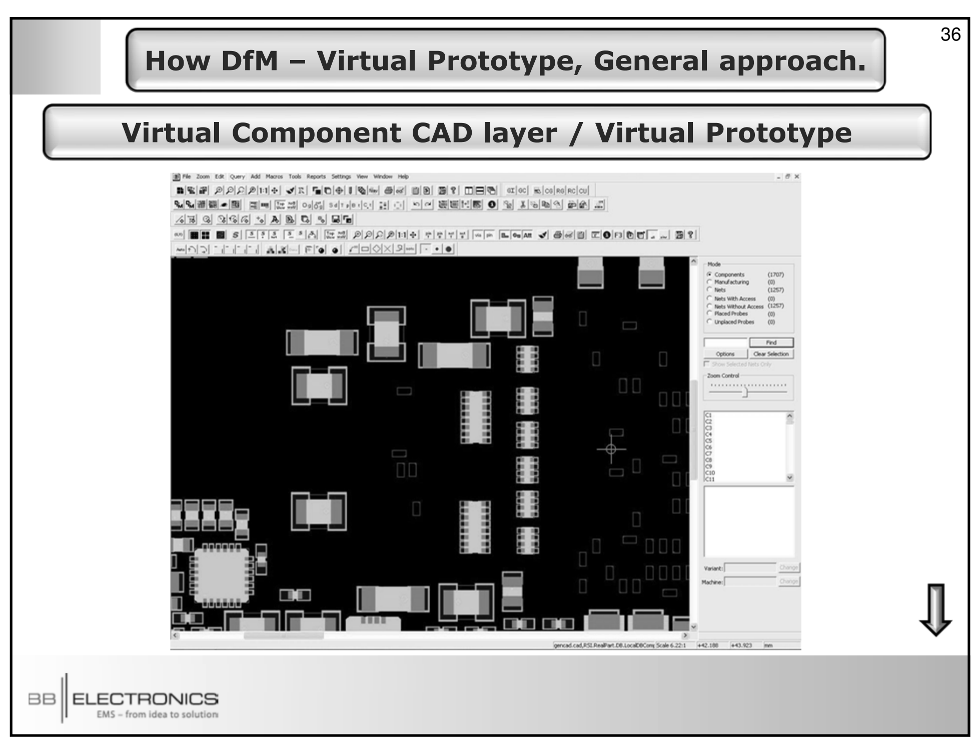
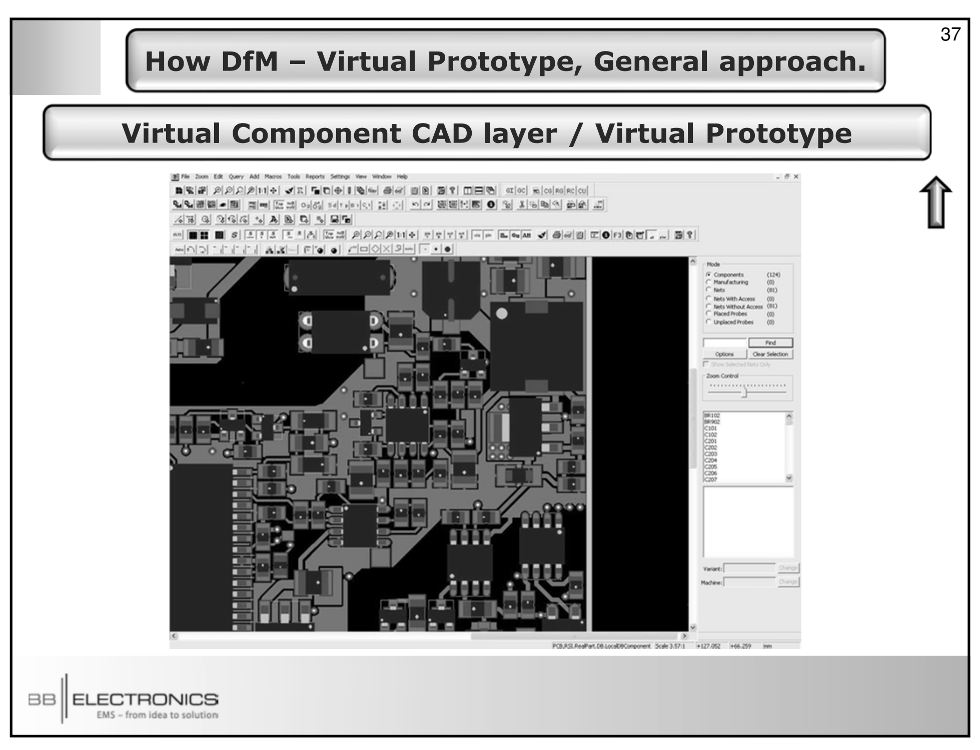
EMS – from idea to solution

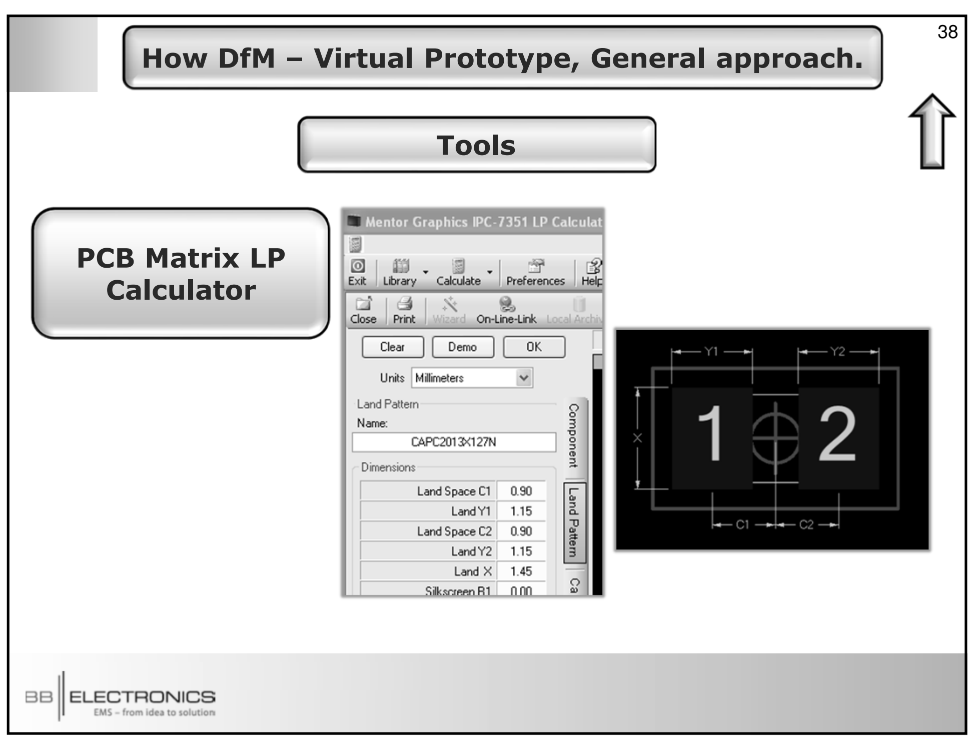


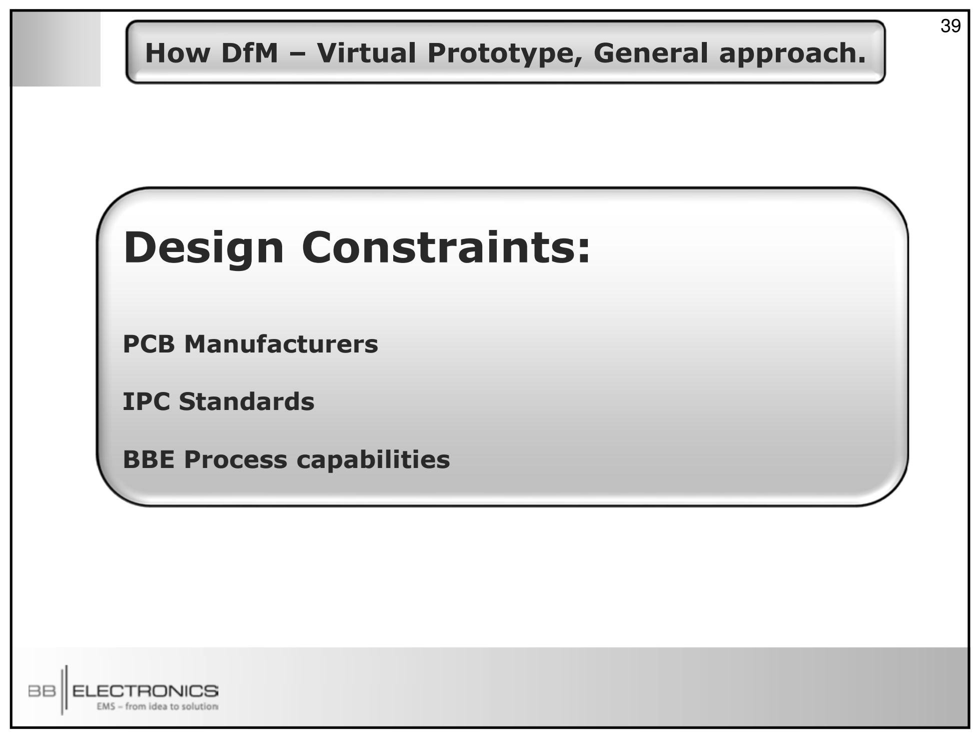

| # | | Test Name |
|---|---|---|
| 1 | ☑ | Board Fiducial Keepout |
| 2 | ☑ | Component Heights |
| 3 | ☑ | Component Over Component |
| 4 | ☑ | Component Package To Component Package |
| 5 | ☑ | Routes Between SMT Pads |
| 6 | ☑ | Pin 1 Orientation |
| 7 | ☑ | Etch Width |
| 8 | ☑ | Fiducial Clearance To Board Outline |
| 9 | ☑ | Keepout Around Thru Hole Pin on Non-Mount Side |
| 10 | ☑ | Minimum Component Clearance To Board Outline |
| 11 | ☑ | Minimum Etch Edge Clearance To Board Outline |
| 12 | ☑ | Minimum Via Pad Edge Clearance To Board Outline |
| 13 | ☑ | Real Part To Real Part |
| 14 | ☑ | Soldermask Clearance for SMT Components |
| 15 | ☑ | Soldermask Webbing |
| 16 | ☑ | Testpad Density |
| 17 | ☑ | Thru-hole Components Annular Ring |
| 18 | ☑ | Via Edge To Component Pad Edge |
| 19 | ☑ | Via Edge To Via Edge |
| 20 | ☑ | Via Hole Size |
| 21 | ☑ | Via In SMT Pad |
| 22 | ☑ | Via Under Component |
| 23 | ☑ | All Components Clearance To Panel Edges |

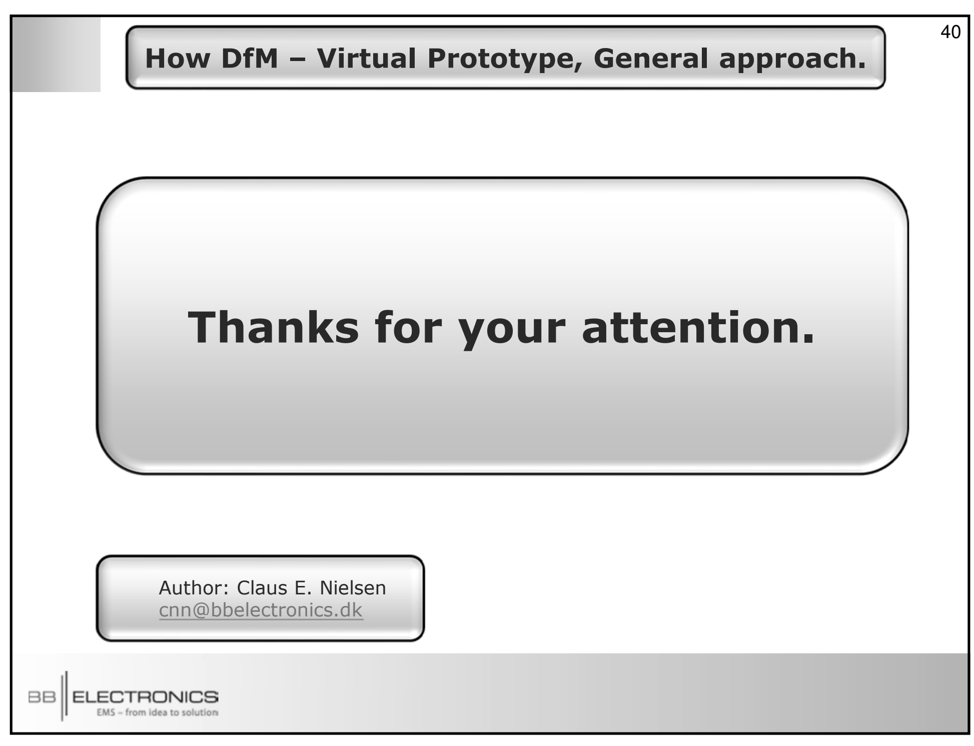



36
How DfM – Virtual Prototype, General approach.
Virtual Component CAD layer / Virtual Prototype
BB ELECTRONICS
EMS – from idea to solution


37
How DfM – Virtual Prototype, General approach.
Virtual Component CAD layer / Virtual Prototype
BB ELECTRONICS
EMS – from idea to solution


38
How DfM – Virtual Prototype, General approach.
Tools
PCB Matrix LP Calculator
Mentor Graphics IPC-7351 LP Calculat
Exit
Library
Calculate
Preferences
Close
Print
Wizard
On-Line-Link
Clear
Demo
OK
Units
Millimeters
Land Pattern
Name:
CAPC2013X127N
Dimensions
Land Space C1 0.90
Land Y1 1.15
Land Space C2 0.90
Land Y2 1.15
Land X 1.45
Component
Land Pattern
Y1
Y2
X
1
2
C1
C2
BB ELECTRONICS
EMS – from idea to solution


39
How DfM – Virtual Prototype, General approach.
Design Constraints:
PCB Manufacturers
IPC Standards
BBE Process capabilities
BB ELECTRONICS
EMS – from idea to solution


40
How DfM – Virtual Prototype, General approach.
Thanks for your attention.
Author: Claus E. Nielsen
cnn@bbelectronics.dk
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EMS – from idea to solution