

# 3D-Design in Cadence Allegro / OrCAD

Holger Schröter  
FED Regionalgruppe Stuttgart  
12.04.2017

# Overview

- Flex
  - Cross Section
  - Layer Definition
  - Zones
  - Bend Area
  - Interlayer Checks
  - Contour Routing
  - Visualization
  - Cross Hatch Shapes
  - Outlook
- Embedded Components
  - Advantages
  - Cross Section
  - Attachment Method
  - Rules Setup
  - Analysis Modes
  - Additional Layers
  - Part Properties
  - Placement
  - Dual Sided Components
  - Manufacturing
  - Documentation
  - 3D Visualization
- Combination Flex and Embedded Components

# Personal Introduction

- Holger Schröter
- Studies: Communications Engineering at TU Braunschweig
- Distance control radar at TU Braunschweig
- Development and project management for VCO and frequency synthesizer at Tyco Electronics
- Development of memory modules at Qimonda (Infineon)
- PCB Design Flow und Methodology at Intel
- Application Engineer at FlowCAD

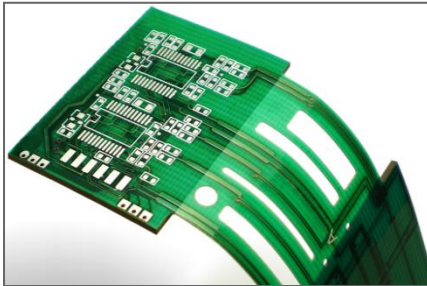


# Flexible PCB – Design

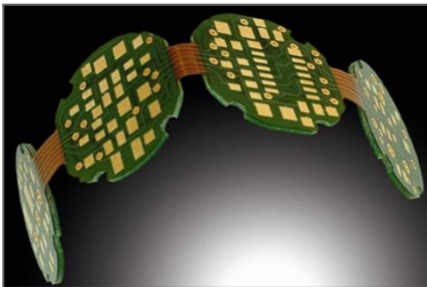
# Flexible PCB – Overview



- Flex
  - Permanent flexible
  - Based on polyimide
  - In most cases a PCB is build in a package twisted or folded
  - Can be used for static as well as dynamic applications



- Semi-flex
  - Limited number of bending cycles, bending radius
  - Based on FR4
  - Cost efficient „Flex to Install“ solution



- Rigid-flex
  - PCBs with flexible and rigid areas
  - Combination of polyimide and FR4
  - Connection of rigid PCB without cable and connectors
  - Advantages in costs and signal integrity

# Cross Section I

- Multi Stackups mode to be enabled under “View”

Cross Section Editor (Multi Stackups mode)

Export Import Edit View Filters

All stackups Primary Flex Main Flex Stiffened +

#	Name	Types	Thickness	Material	Primary	Flex Main	Flex Stiffened	Add Stackup
		Layer	mm					
		Surface			<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
	COVER_TOP	Mask	0.1	Polyimide	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
	ADHESIVE_TOP	Mask	0.025	Adhesive Epoxy	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
	SOLDERMASK_TOP	Mask	0.02	Soldermask	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
1	TOP	Conductor	0.03	Copper	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
		Dielectric	0.2	Polyimide	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
2	LAYER_1	Conductor	0.02	Copper	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
		Dielectric	0.2	Fr-4	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
3	LAYER_2	Conductor	0.02	Copper	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
		Dielectric	0.5	Fr-4	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
4	LAYER_3	Conductor	0.02	Copper	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
		Dielectric	0.2	Fr-4	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
5	LAYER_4	Conductor	0.02	Copper	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
		Dielectric	0.2	Polyimide	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
6	BOTTOM	Conductor	0.02	Copper	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
	SOLDERMASK_BOTTOM	Mask	0.02	Soldermask	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
	ADHESIVE_BOTTOM	Mask	0.025	Adhesive Epoxy	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
	COVER_BOTTOM	Mask	0.1	Polyimide	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
	STIFENER	Mask	5	Aluminum	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
		Surface			<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	

Add Layers...

Add Layer Pair Above

Add Layer Pair Below

---

Add Layer Above

Add Layer Below

6.72 mm

1.43 mm

---

Rename...

Remove Layer

Edit mask layer order...

Setup Unused pads suppression Refresh materials

PRIMARY FLEX\_MAIN FLEX\_STIFFENED

Surface  
COVER\_TOP Mask  
ADHESIVE\_TOP Mask  
SOLDERMASK\_TOP Mask  
1 TOP Conductor  
Dielectric  
2 LAYER\_1 Conductor  
Dielectric  
3 LAYER\_2 Conductor  
Dielectric  
4 LAYER\_3 Conductor  
Dielectric  
5 LAYER\_4 Conductor  
Dielectric  
6 BOTTOM Conductor  
SOLDERMASK\_BOTTOM Mask  
ADHESIVE\_BOTTOM Mask  
COVER\_BOTTOM Mask  
STIFENER Mask  
Surface

# Cross Section II

- Primary Stackup

Cross Section Editor (Multi Stackups mode)

Export Import Edit View Filters

All stackups Primary Flex Main Flex Stiffened +

Objects		Types >>		Thickness >>	Physical >>	
#	Name	Layer	Layer Function	Value mm	Layer ID	Material
*	*	Surface		*	*	*
	SOLDERMASK_TOP	Mask	Solder Mask	0.02		Soldermask
1	TOP	Conductor	Conductor	0.03	1	Copper
		Dielectric	Dielectric	0.2		Polyimide
2	LAYER_1	Conductor	Conductor	0.02	2	Copper
		Dielectric	Dielectric	0.2		Fr-4
3	LAYER_2	Conductor	Conductor	0.02	3	Copper
		Dielectric	Dielectric	0.5		Fr-4
4	LAYER_3	Conductor	Conductor	0.02	4	Copper
		Dielectric	Dielectric	0.2		Fr-4
5	LAYER_4	Conductor	Conductor	0.02	5	Copper
		Dielectric	Dielectric	0.2		Polyimide
6	BOTTOM	Conductor	Conductor	0.02	6	Copper
	SOLDERMASK_BOTTOM	Mask	Solder Mask	0.02		Soldermask
		Surface				

PRIMARY

Surface  
SOLDERMASK\_TOP Mask  
1 TOP Conductor  
Dielectric  
2 LAYER\_1 Conductor  
Dielectric  
3 LAYER\_2 Conductor  
Dielectric  
4 LAYER\_3 Conductor  
Dielectric  
5 LAYER\_4 Conductor  
Dielectric  
6 BOTTOM Conductor  
SOLDERMASK\_BOTTOM Mask  
Surface

# Cross Section III

- Flex Main

Cross Section Editor (Multi Stackups mode)

Export Import Edit View Filters

All stackups Primary Flex Main Flex Stiffened +

Objects		Types >>		Thickness >>	Physical >>	
#	Name	Layer	Layer Function	Value mm	Layer ID	Material
*	*	Surface		*	*	*
	COVER_TOP	Mask	Dielectric Coverlay	0.1		Polyimide
	ADHESIVE_TOP	Mask	Dielectric Adhesive	0.025		Adhesive Epoxy
5	LAYER_4	Conductor	Conductor	0.02	5	Copper
		Dielectric	Dielectric	0.2		Polyimide
	ADHESIVE_BOTTOM	Mask	Dielectric Coverlay	0.025		Adhesive Epoxy
	COVER_BOTTOM	Mask	Dielectric Coverlay	0.1		Polyimide
		Surface				

Surface  
COVER\_TOP Mask  
ADHESIVE\_TOP Mask  
5 LAYER\_4 Conductor  
Dielectric  
ADHESIVE\_BOTTOM Mask  
COVER\_BOTTOM Mask  
Surface

FLEX\_MAIN

- Flex Stiffened

Cross Section Editor (Multi Stackups mode)

Export Import Edit View Filters

All stackups Primary Flex Main Flex Stiffened +

Objects		Types >>		Thickness >>	Physical >>	
#	Name	Layer	Layer Function	Value mm	Layer ID	Material
*	*	Surface		*	*	*
	COVER_TOP	Mask	Dielectric Coverlay	0.1		Polyimide
	ADHESIVE_TOP	Mask	Dielectric Adhesive	0.025		Adhesive Epoxy
5	LAYER_4	Conductor	Conductor	0.02	5	Copper
		Dielectric	Dielectric	0.2		Polyimide
	ADHESIVE_BOTTOM	Mask	Dielectric Coverlay	0.025		Adhesive Epoxy
	COVER_BOTTOM	Mask	Dielectric Coverlay	0.1		Polyimide
	STIFENER	Mask	Dielectric Coverlay	5		Aluminum
		Surface				

Surface  
COVER\_TOP Mask  
ADHESIVE\_TOP Mask  
5 LAYER\_4 Conductor  
Dielectric  
ADHESIVE\_BOTTOM Mask  
COVER\_BOTTOM Mask  
STIFENER Mask  
Surface

FLEX\_STIFFENED



# Cross Section IV

- Layer details can be edited in different stackups
  - Physical details
  - Embedding
  - Signal Integrity

Cross Section Editor (Multi Stackups mode)

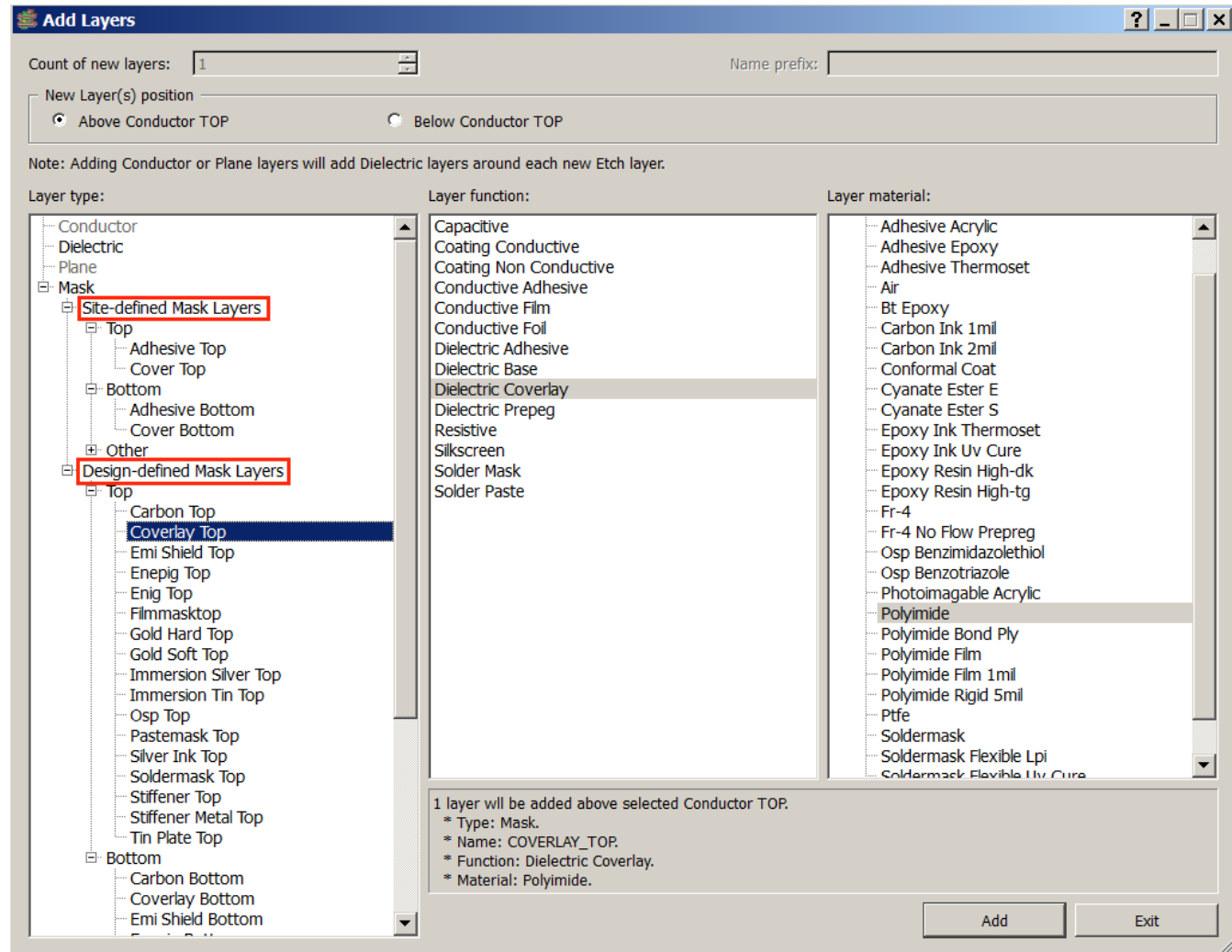
Export Import Edit View Filters

All stackups Primary Flex Main Flex Stiffened +

Objects		Types >>		Thickness >>	Physical <<					Embedded >>	Signal Integrity >>			
#	Name	Layer	Layer Function	Value mm	Layer ID	Material	Negative Artwork	No Fillet	Unused Pin Suppression	Unused Via Suppression	Embedded Status	Conductivity mho/cm	Dielectric Constant	SI Ignore
		Surface											1	
	SOLDERMASK_TOP	Mask	Solder Mask	0.02		Soldermask						0	3.7	<input type="checkbox"/>
1	TOP	Conductor	Conductor	0.03	1	Copper	<input type="checkbox"/>				Not embedded	595900	4.5	<input type="checkbox"/>
		Dielectric	Dielectric	0.2		Polyimide						0	4.3	<input type="checkbox"/>
2	LAYER_1	Conductor	Conductor	0.02	2	Copper	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	Not embedded	595900	4.5	<input type="checkbox"/>
		Dielectric	Dielectric	0.2		Fr-4						0	4.5	<input type="checkbox"/>
3	LAYER_2	Conductor	Conductor	0.02	3	Copper	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	Not embedded	595900	4.5	<input type="checkbox"/>
		Dielectric	Dielectric	0.5		Fr-4						0	4.5	<input type="checkbox"/>
4	LAYER_3	Conductor	Conductor	0.02	4	Copper	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	Not embedded	595900	4.5	<input type="checkbox"/>
		Dielectric	Dielectric	0.2		Fr-4						0	4.5	<input type="checkbox"/>
5	LAYER_4	Conductor	Conductor	0.02	5	Copper	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	Not embedded	595900	4.5	<input type="checkbox"/>
		Dielectric	Dielectric	0.2		Polyimide						0	4.3	<input type="checkbox"/>
6	BOTTOM	Conductor	Conductor	0.02	6	Copper	<input type="checkbox"/>				Not embedded	595900	4.5	<input type="checkbox"/>
	SOLDERMASK_BOTTOM	Mask	Solder Mask	0.02		Soldermask						0	3.7	<input type="checkbox"/>
		Surface											1	

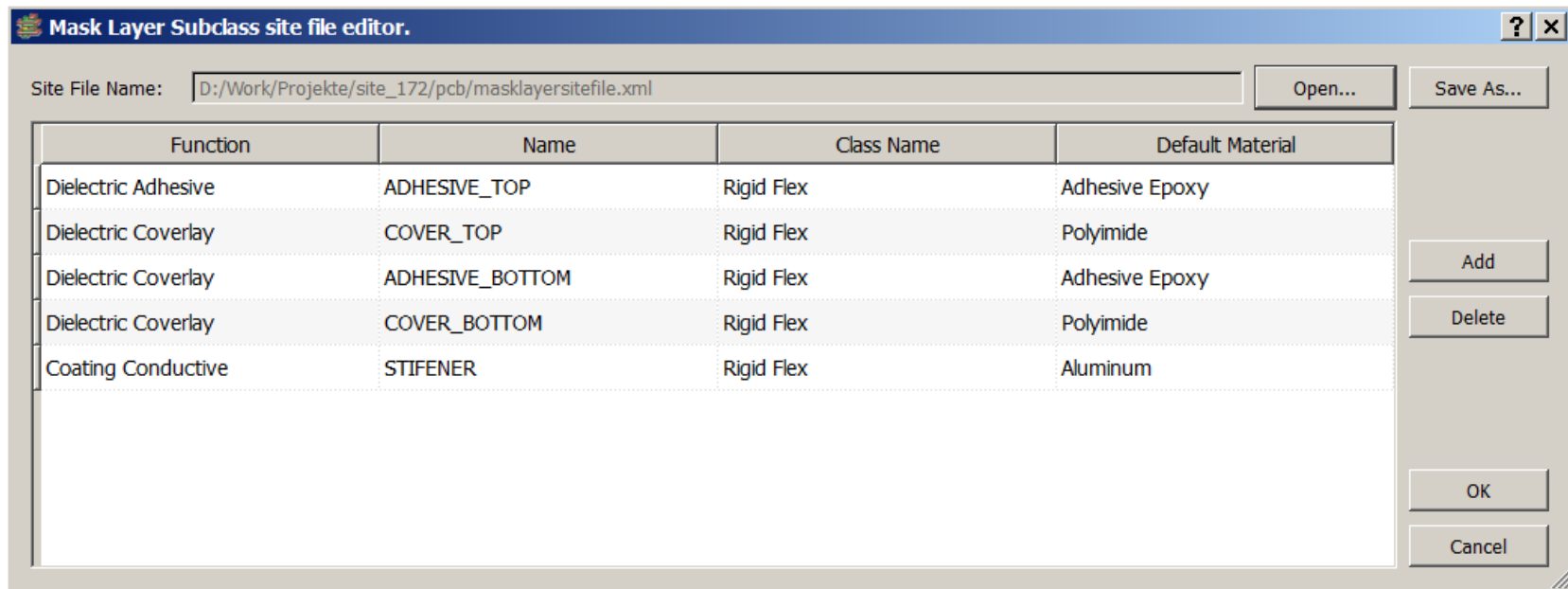
# Layer Definition

- Add Layers dialog to define Stackup in “All Stackups View”



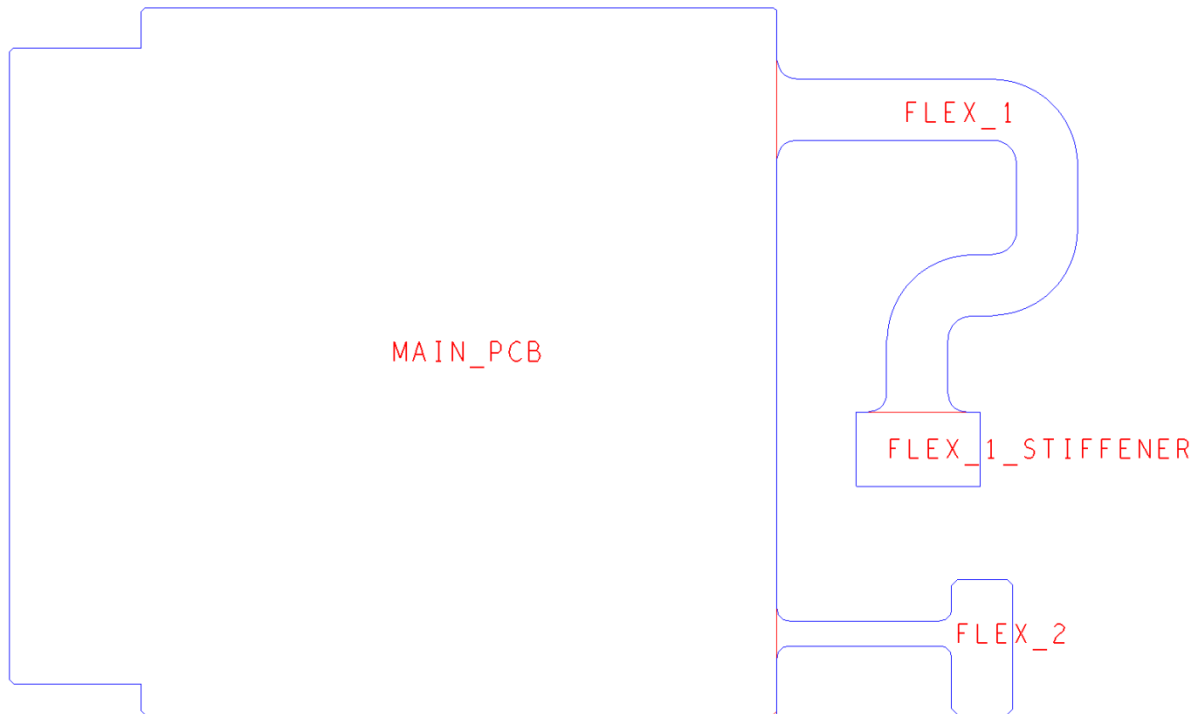
# Site Setup

- Mask Layer Site File (“Edit / Site File”)
- Useful due to limitless combinations of materials



- Default location: MATERIALPATH

# Zones



- Defined as shapes in layout
  - “Setup / Zones”

- Constraint regions and rooms can be defined in Zone Manager

Select	Name	Stackup	Start Layer	Stop Layer	Constraint Reg	Room
<input type="checkbox"/>	MAIN_PCB	PRIMARY	TOP	BOTTOM		
<input type="checkbox"/>	FLEX_1	FLEX_1	INNER1	INNER2	FLEX	
<input type="checkbox"/>	FLEX_1_STIFFENER	FLEX1_STIFFENED	INNER1	INNER2	FLEX	RF-AMP
<input type="checkbox"/>	FLEX_2	FLEX_2	INNER1	INNER2	FLEX	

# Bend Area

**Edit Bend Area**

Bend name: **BEND\_3**

Bend line start  
X: **22.350** Y: **52.672**

Bend line end  
X: **35.900** Y: **66.000**

Bending Parameters

Inner side: **Top**

Inner radius: **6.000**

Angle: **75.000**

Order: **3**

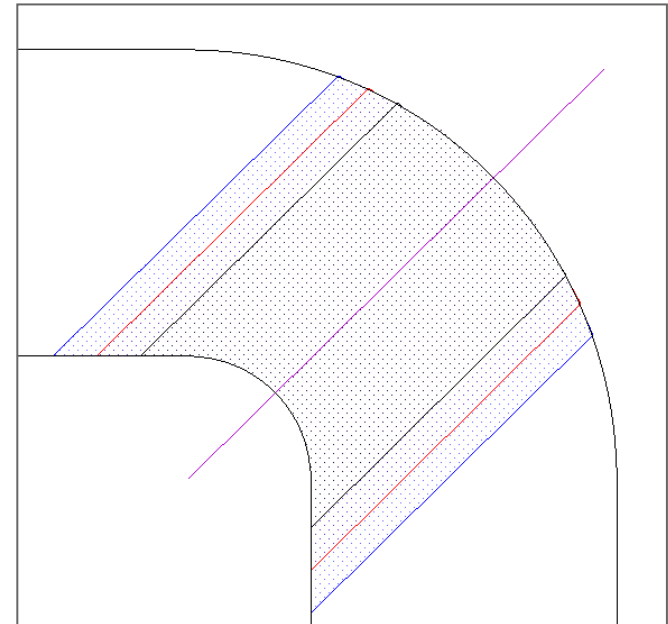
Bend Area Options

Via keepout  
Oversize: **1.000**

Package keepout  
Oversize: **2.000**

Apply Close Delete bend Help

- Bends are defined by following parameters:
  - Position
  - Direction
  - Radius
  - Angle
  - Additional keepouts



# Interlayer Checks – Constraint Manager

Allegro Constraint Manager (connected to Allegro PCB Designer 17.2) [2\_Flex] - [Spacing / Inter Layer / Spacing]

File Edit Objects Column View Analyze Audit Tools Window Help

Worksheet Selector: Electrical, Physical, **Spacing**

Spacing Constraint Set: All Layers, Net, Net Class-Class, Region, Inter Layer, Spacing

Layer 1: Geometries, Layer 2: Geometries

Layer 1 filter: Layer 2 filter:

	Zone_Outline	Transition_Zone	Tin_Plate_Top	Tin_Plate_Bottom	Time_Stamp	Stiffener_Inner2	Stiffener_Top	Stiffener_Metal_Top	Stiffener_Metal_Bottom	Stiffener_Bottom	Soldermask_Top	Soldermask_Inner2	Soldermask_Inner1	Soldermask_Bottom	Silver_Ink_Top	Silver_Ink_Bottom	Silkscreen_Top	Silkscreen_Bottom	Polarity_Top	Place_Bound_Top	Place_Bound_Bottom	Pastemask_Top	Pastemask_Inner2	Pastemask_Inner1	Pastemask_Bottom
Adhesive_Bottom	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Adhesive_Inner1	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Adhesive_Inner2	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Adhesive_Top	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Assembly_Inner1	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Assembly_Inner2	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Bend_Area	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Bend_Line	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Carbon_Bottom	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Carbon_Top	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Contact_Area	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Coverlay_Bottom	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Coverlay_Inner1	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Layer 1	Layer 2	Type	Value	Enabled	DRC label	DRC subclass	Description	Delete
Bend_Area	Stiffener_Top	Undefined	1.500	<input type="checkbox"/>	a	INTER_LAYER		<input checked="" type="checkbox"/>

Undefined  
Gap  
Overlap  
1 inside 2  
2 inside 1

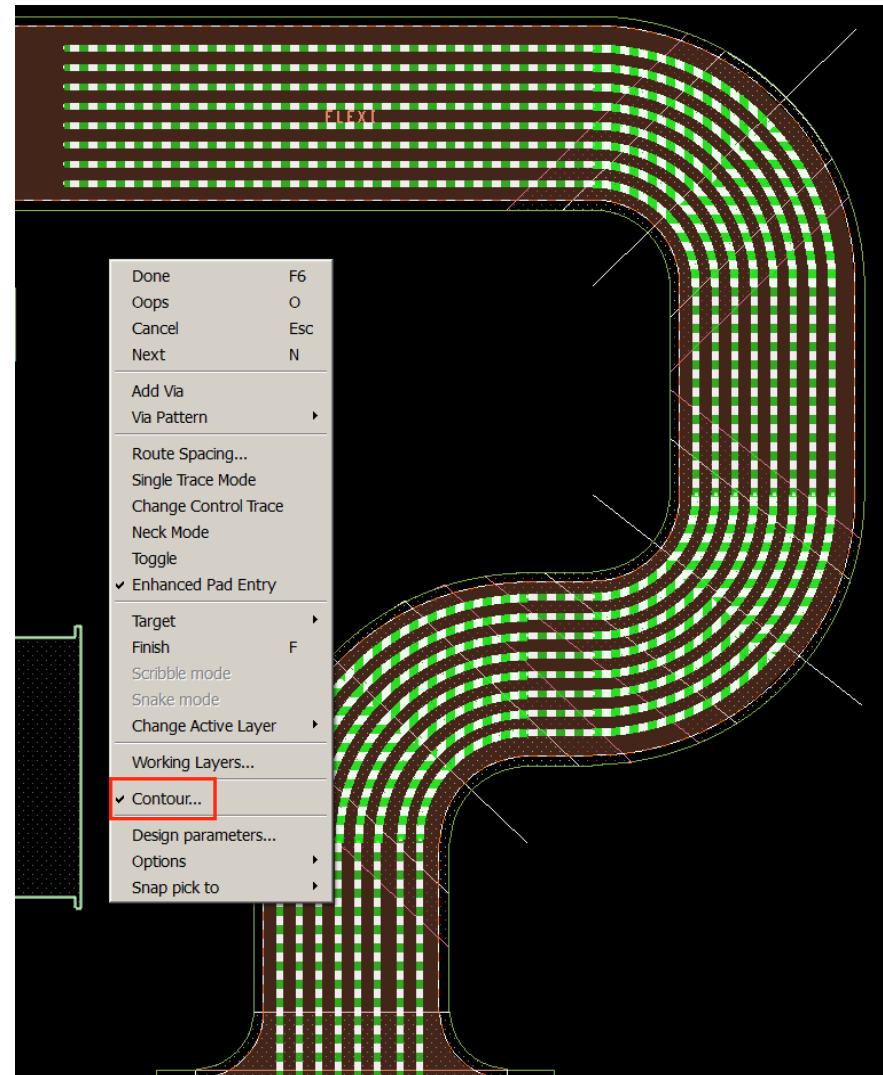
Idle DRC Sync on.

# Interlayer Checks – Rule Examples

- DRC engine designed to check
  - Mask layer to mask layer geometry
  - Mask layer to surface metal
- Layer selection GUI
  - Matrix of applicable subclasses
  - Filtering capabilities
  - Comment field
- Gaps:
  - Coverlay to pad
  - Mask to pad
  - Precious metal to coverlay
  - Bend area/line to stiffener, component, pin, and via
- Minimum overlap, e.g.:
  - Transition zone must overlap bend area by 15 mils
- Inside Rule:
  - (Layer 1) inside (layer 2)
  - Geometry on one subclass must be contained within the geometry of another subclass geometry

# Contour Routing

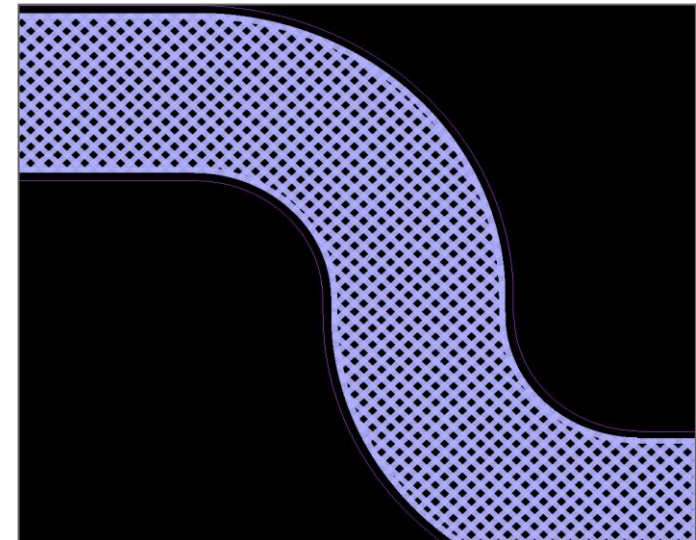
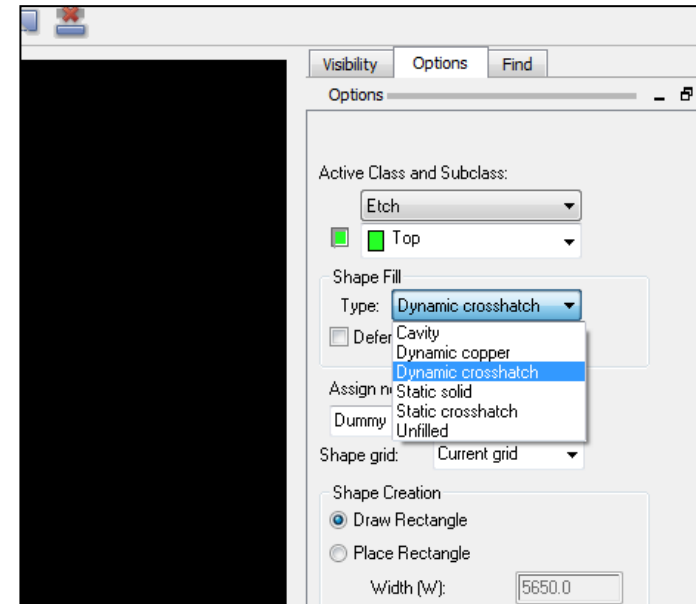
- Simplified routing of traces along rounded contour of flex boards





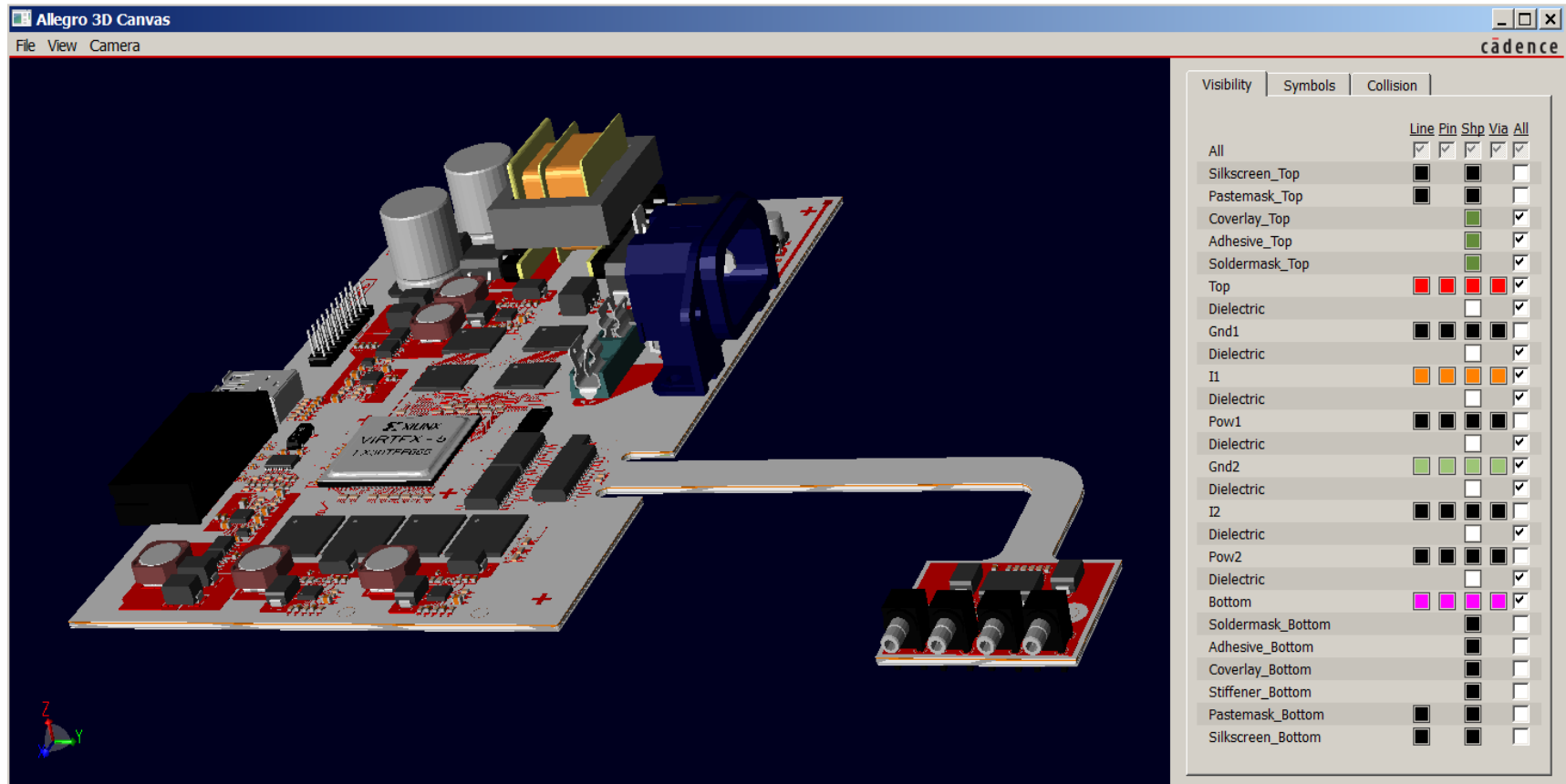
# Cross Hatch Shapes

- Cross Hatch (Xhatch) shapes are common with Flex PCBs
  - Lighter in weight
  - Adheres better, less prone to cracking at bend areas
- Dynamic cross hatch is supported by shape-add feature



# Visualization / Interfaces

- Interactive 3D Canvas



- Step export of complete design

# Outlook

- Visualization of different stackups in Interactive 3D Canvas
  - Currently only the primary stackup is displayed
  
- Bending in Interactive 3D Canvas
  - In preparation, planned for this year

# Embedded Components

# Advantages

- Miniaturization
  - Significant reduction of form factor
- Electrical performance
  - E.g. passives closer to active components
- Protection of components
- Less bending stress
- EMI protection
- IP-protection
  - Internal die has no marking
- Compatible to traditional SMT processes

# Cross Section

- Not embedded: Default, no embedded placement on this layer
- Body up: Components can be placed on this layer with body up
- Body down: Components can be placed on this layer with body down
- Protruding allowed: Components can break through this etch layer

Cross Section Editor

Export Import Edit View Filters

Primary

Objects		Types >>		Thickness >>	Physical >>		Embedded >>
#	Name	Layer	Layer Function	Value mm	Layer ID	Material	Embedded Status
*	*	Surface			*	*	*
1	TOP	Conductor	Conductor	0.03	1	Copper	Not embedded
		Dielectric	Dielectric	0.2		Fr-4	
2	LAYER_1	Conductor	Conductor	0.03	2	Copper	Body down
		Dielectric	Dielectric	0.4		Fr-4	
3	LAYER_2	Conductor	Conductor	0.03	3	Copper	Not embedded
		Dielectric	Dielectric	0.5		Fr-4	
4	LAYER_3	Conductor	Conductor	0.03	4	Copper	Protruding allowed
		Dielectric	Dielectric	0.4		Fr-4	
5	LAYER_4	Conductor	Conductor	0.03	5	Copper	Body up
		Dielectric	Dielectric	0.2		Fr-4	Not embedded
6	BOTTOM	Conductor	Conductor	0.03	6	Copper	Body up
		Dielectric	Dielectric				Body down
		Dielectric	Dielectric				Protruding allowed
		Surface					

cadence

PRIMARY

Surface

1 TOP Conductor

Dielectric

2 LAYER\_1 Conductor

Dielectric

3 LAYER\_2 Conductor

Dielectric

4 LAYER\_3 Conductor

Dielectric

5 LAYER\_4 Conductor

Dielectric

6 BOTTOM Conductor

Surface

# Attachment Method

- Direct attach:
  - Standard process
  - Component is directly soldered to inner layer
- Indirect attach
  - Components are mounted in substrate
  - Contacted by single layer  $\mu$ Vias

Cross Section Editor

Export Import Edit View Filters

Primary

Objects		Thickness >>	Physical >>		Embedded <<	
#	Name	Value mm	Layer ID	Material	Embedded Status	Attach Method
*	*	*	*	*	*	*
1	TOP	0.03	1	Copper	Not embedded	
		0.3		Fr-4		
2	LAYER_1	0.03	2	Copper	Body down	Direct attach
		0.5		Fr-4		
3	LAYER_2	0.03	3	Copper	Not embedded	
		0.6		Fr-4		
4	LAYER_3	0.03	4	Copper	Protruding allowed	
		0.5		Fr-4		
5	LAYER_4	0.03	5	Copper	Body up	Indirect attach
		0.3		Fr-4		
6	BOTTOM	0.03	6	Copper	Not embedded	

Surface

1 TOP Conductor  
Dielectric

2 LAYER\_1 Conductor  
Dielectric

3 LAYER\_2 Conductor  
Dielectric

4 LAYER\_3 Conductor  
Dielectric

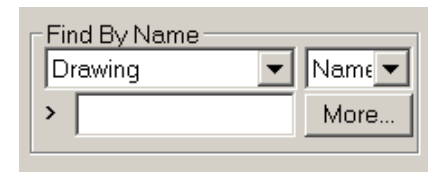
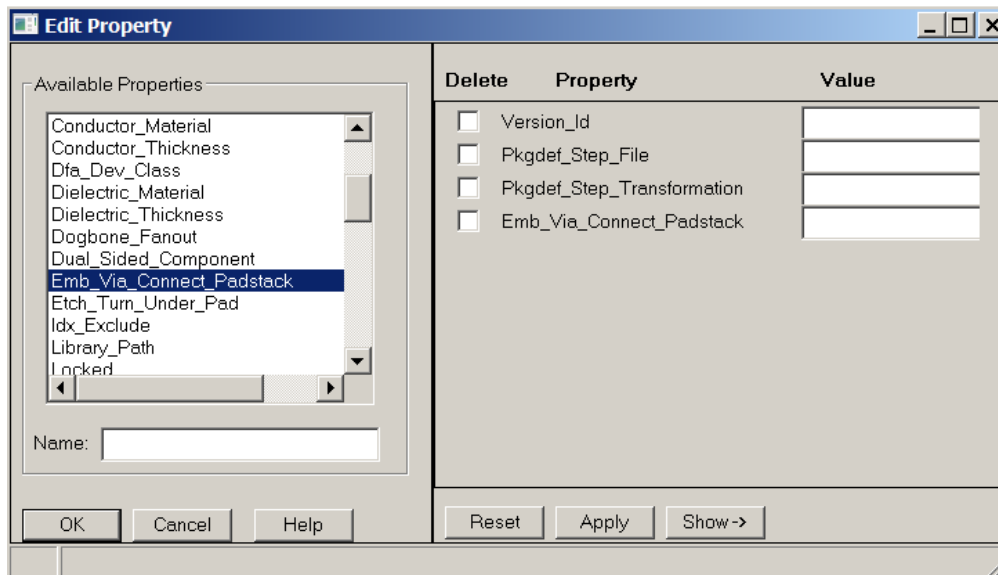
5 LAYER\_4 Conductor  
Dielectric

6 BOTTOM Conductor  
Surface

PRIMARY

# Indirect Attach Vias

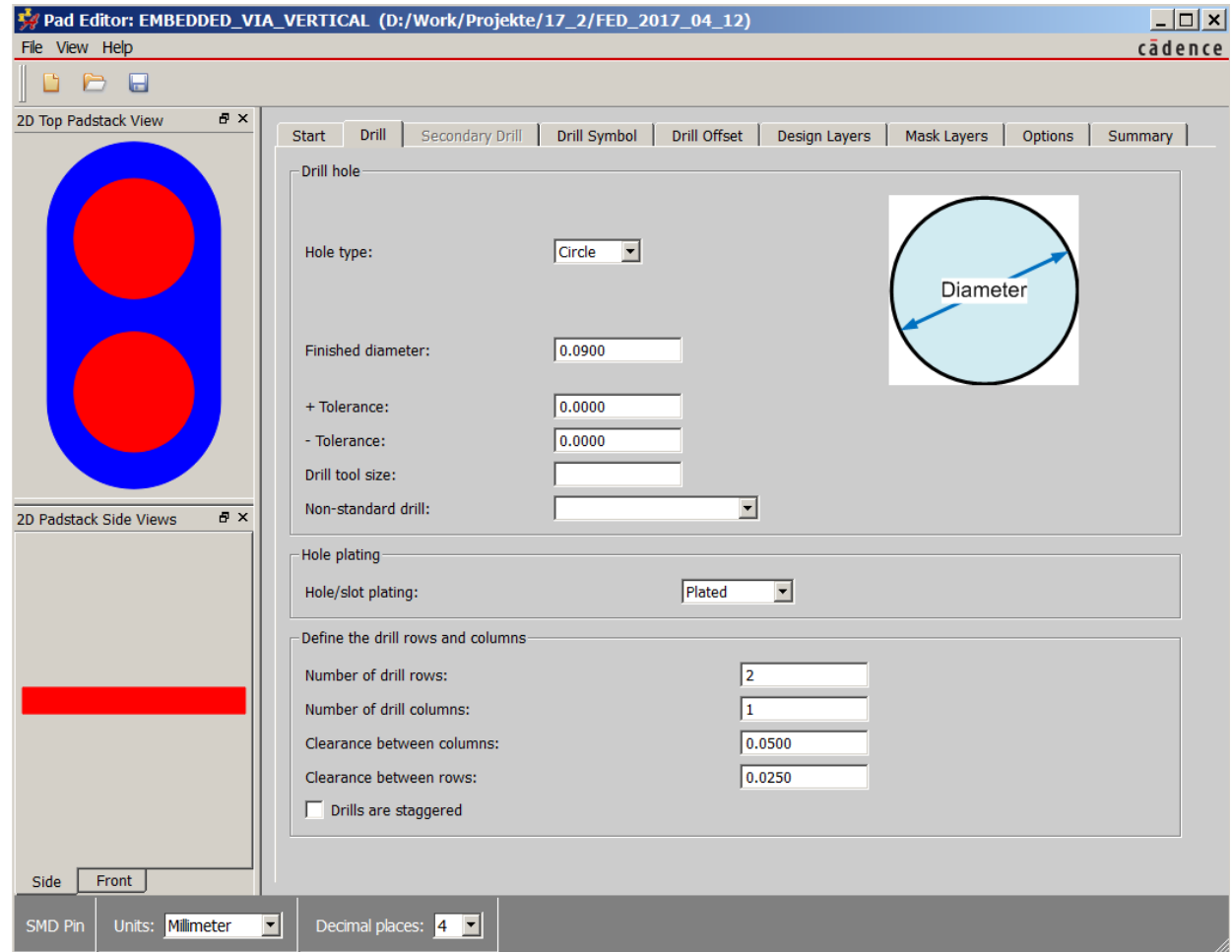
- Property EMB\_VIA\_CONNECT\_PADSTACK
  - Specifies the name of the via padstack to be used for connecting the embedded component to the etch layer (indirect attach)
  - Has to be specified at drawing level of a symbol





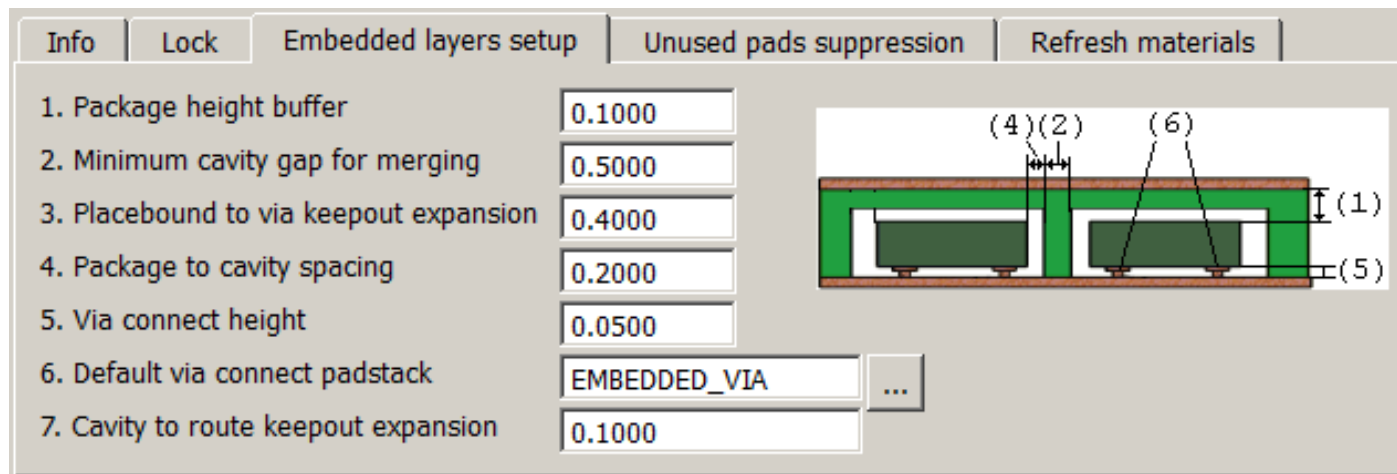
# Redundant Vias

- Possibility to define in Padstack Editor



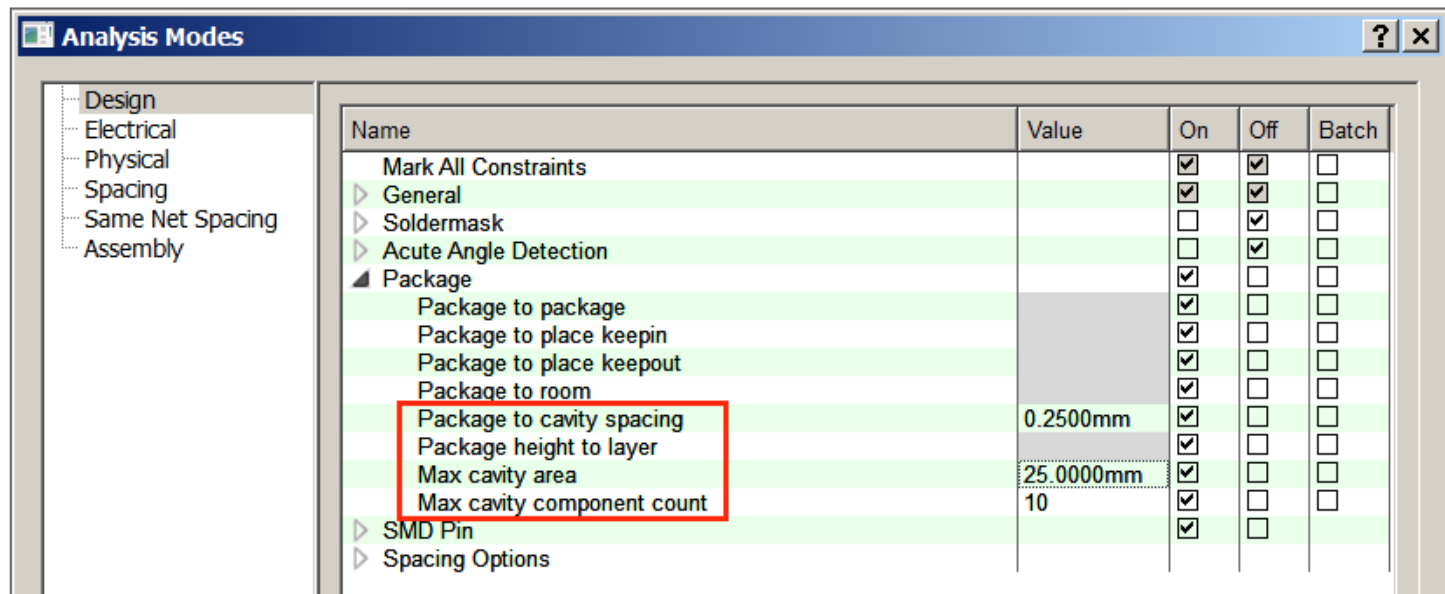
# Rules Setup

1. Height buffer to next etch layer
2. Minimal gap to next cavity before merging
3. Creates a via keepout based on placebound
4. Package to cavity spacing, same as under Constraints / Modes / Design Options
5. Gap between etch layer and component pad
6. If padstack for embedding is not defined within component, this padstack will be used
7. Route keepout around cavity, when components protrudes



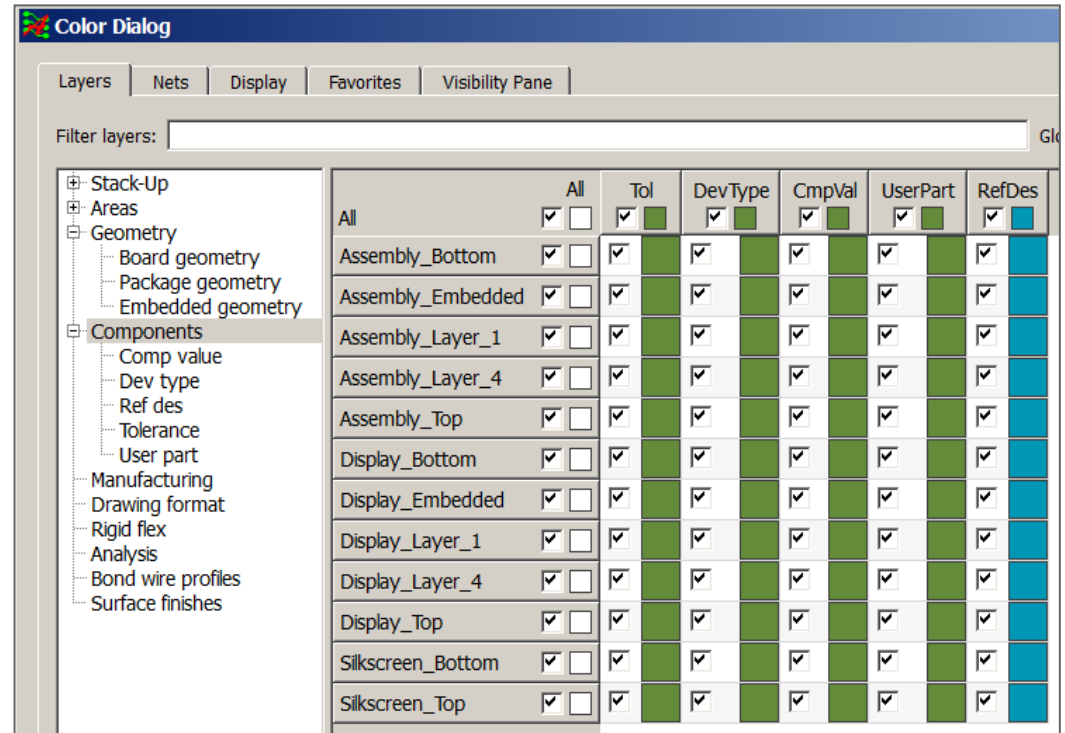
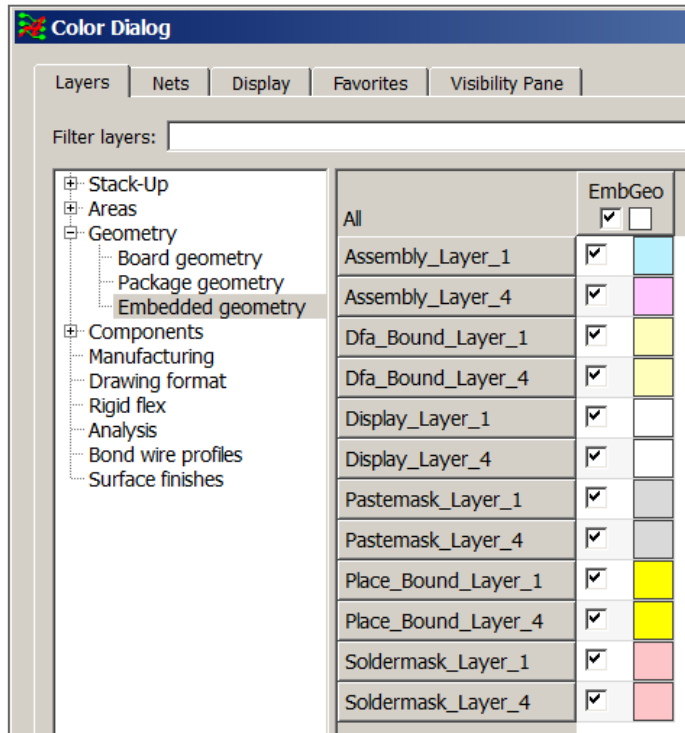
# Analysis Modes

- Package to cavity spacing, same as in Cross Section Editor
- Check package height + buffer to next etch layer
- Maximal area of a cavity
- Maximal number of components in one cavity



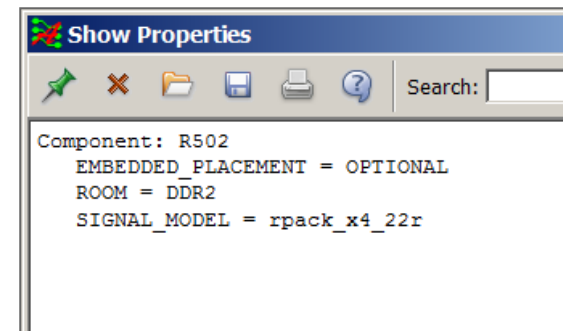
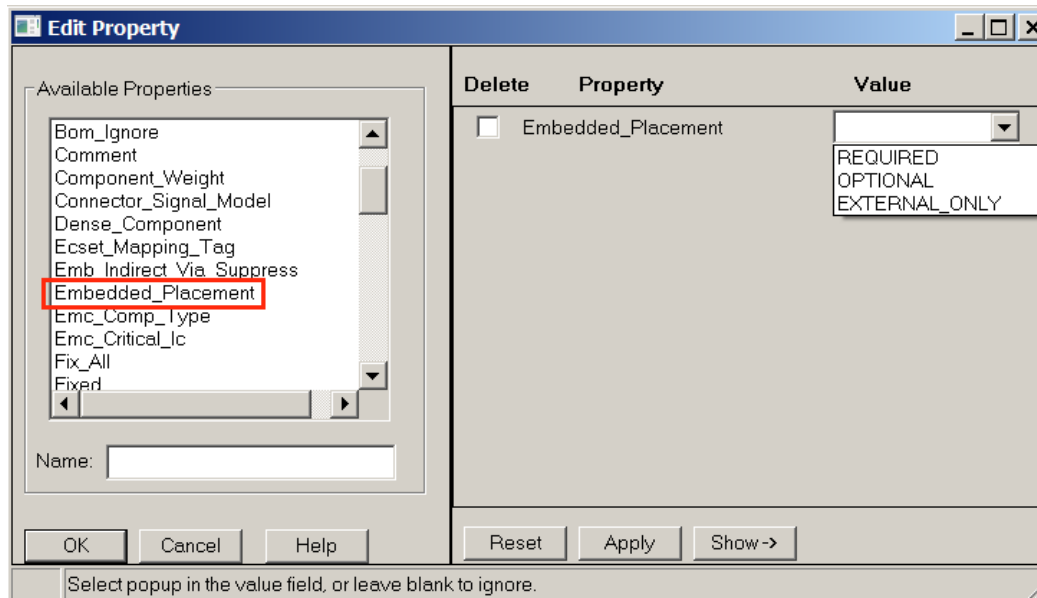
# Additional Layers

- Required additional layers are auto generated:



# Part Properties I

- Embedded Placement is triggered by Property „Embedded\_Placement“:
  - Required: Component has to be embedded, no placement on outer layer allowed
  - Optional: Component can be embedded
  - External Only: Placement on outer layer only
- Can already be done at schematic level



# Part Properties II

- Handling in Constraint Manager
- Important for Dual Sided Components
  - Embedded Placement Property required to place

Allegro Constraint Manager (connected to Allegro PCB Designer 17.2) [embedded\_1] - [Properties / Component / Component Properties]

File Edit Objects Column View Analyze Audit Tools Window Help

Worksheet Selector **embedded\_1**

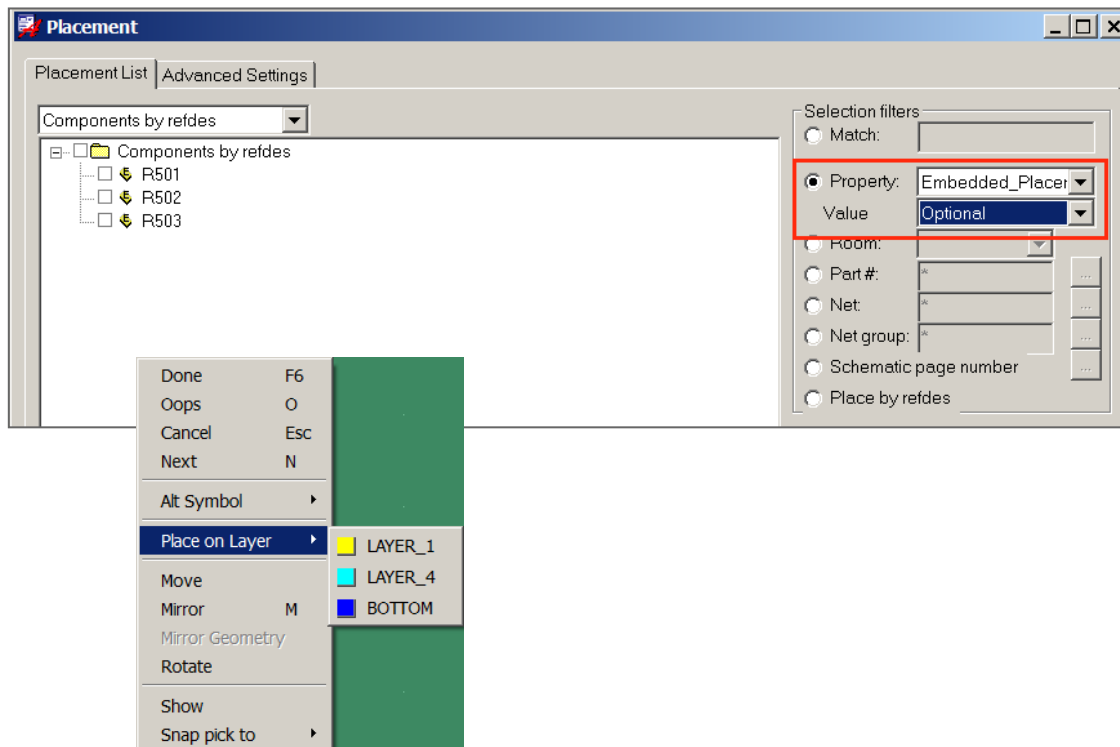
Electrical  
Physical  
Spacing  
Same Net Spacing  
Assembly  
Properties

**Net**  
**Component**  
Component Properties  
General  
Thermal  
Swapping  
Reuse  
Pin Properties

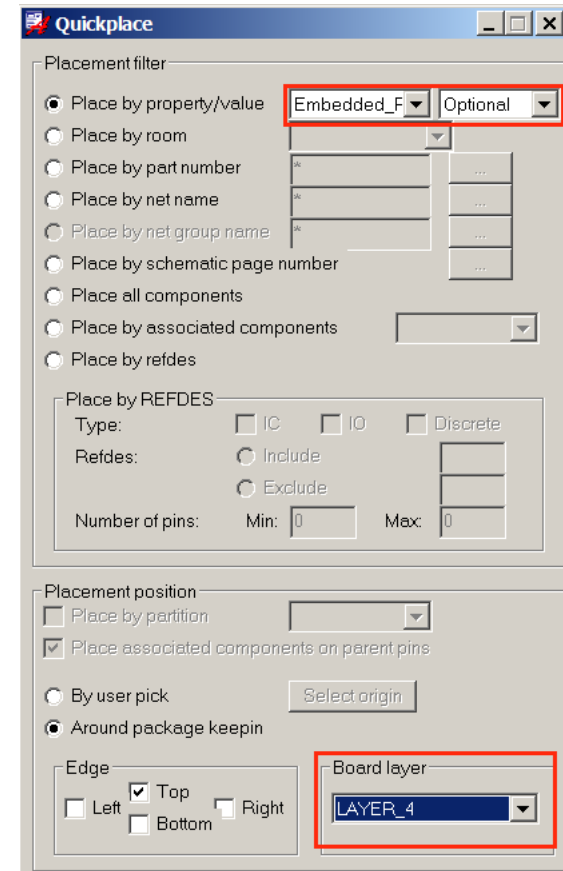
Objects		Embedded				Plac	
Type	S	Name	Layer	Status	Attach	Placement	Tag
*	*	*					*
Prtl		R620					
PrtD		RES_H_4X_RES_RS4N_DISCRETE_22_F					
Prtl		R500					
Prtl		R501				OPTIONAL	
Prtl		R502	LAYER_1	BODY_DOWN	DIRECT_ATTACH	OPTIONAL	
Prtl		R503	LAYER_4	BODY_UP	INDIRECT_ATTACH	OPTIONAL	
Prtl		R512					
Prtl		R513					
Prtl		R514					
Prtl		R515					
Prtl		R516					
Prtl		R517					

# Placement

Manual:

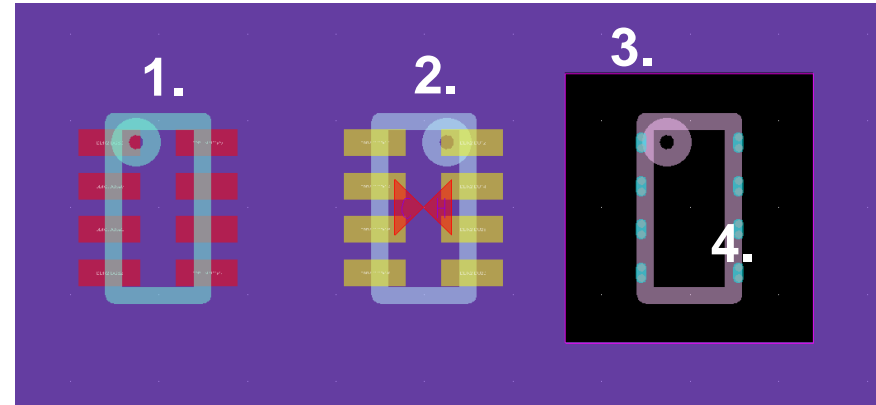


Quickplace:



# Cases

1. Top
2. Layer\_1, Direct attach
  - DRC: Package Height to Layer Spacing
3. Layer\_3, Protruding allowed
4. Layer\_4, Indirect attach



Cross Section Editor

Export Import Edit View Filters

Primary

#	Objects	Thickness >>	Physical >>		Embedded <<	
		Value mm	Layer ID	Material	Embedded Status	Attach Method
*	*	*	*	*	*	*
1	TOP	0.03	1	Copper	Not embedded	
		0.3		Fr-4		
2	LAYER_1	0.03	2	Copper	Body down	Direct attach
		0.5		Fr-4		
3	LAYER_2	0.03	3	Copper	Not embedded	
		0.6		Fr-4		
4	LAYER_3	0.03	4	Copper	Protruding allowed	
		0.5		Fr-4		
5	LAYER_4	0.03	5	Copper	Body up	Indirect attach
		0.3		Fr-4		
6	BOTTOM	0.03	6	Copper	Not embedded	

Surface

1 TOP Conductor

Dielectric

2 LAYER\_1 Conductor

Dielectric

3 LAYER\_2 Conductor

Dielectric

4 LAYER\_3 Conductor

Dielectric

5 LAYER\_4 Conductor

Dielectric

6 BOTTOM Conductor

Surface

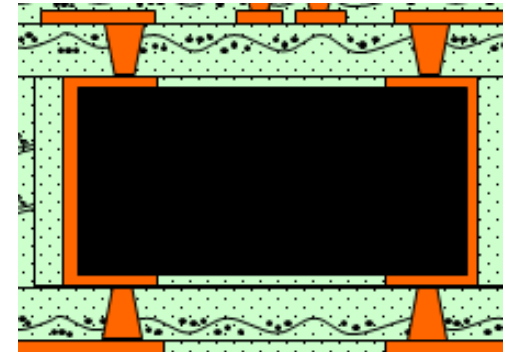
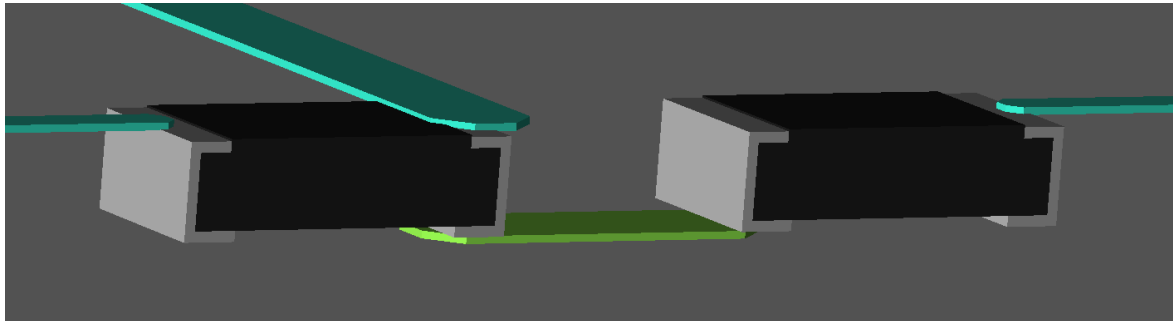
PRIMARY

The diagram shows a cross-section of a PCB with six layers. The layers are labeled 1 through 6, corresponding to the table. Layer 1 is the top conductor, followed by a dielectric layer, then Layer 2 conductor, dielectric, Layer 3 conductor, dielectric, Layer 4 conductor, dielectric, and finally the bottom conductor (Layer 6). A primary surface is shown on the right side of the diagram.



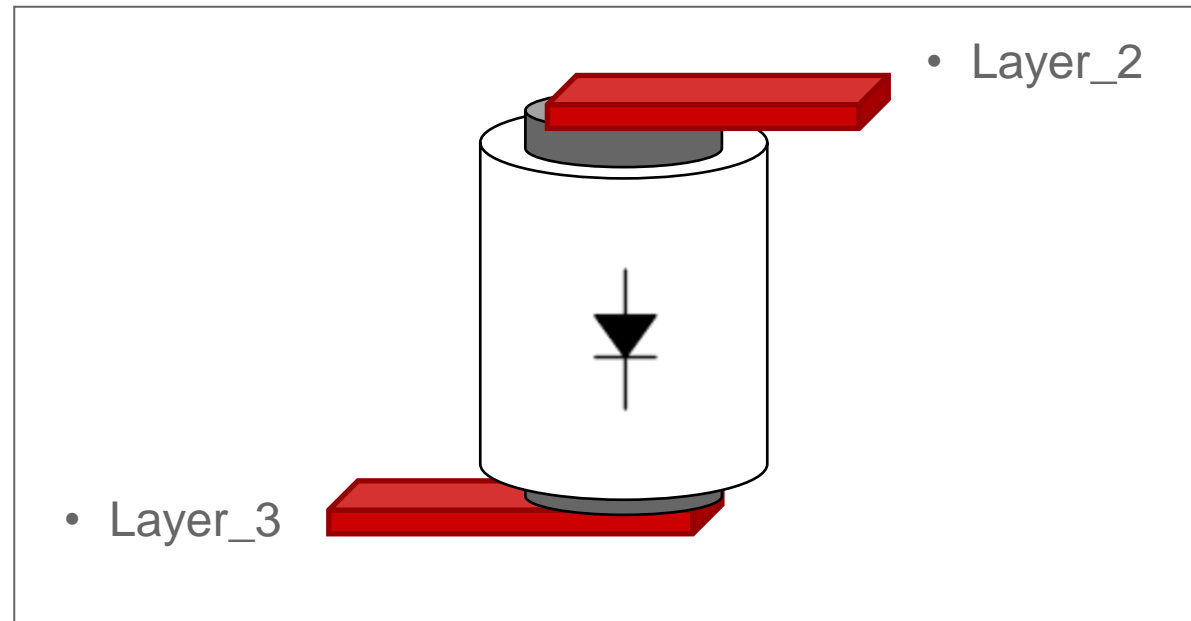
# Dual Sided Components

- Allegro PCB Editor supports use of dual-sided contact components
- Benefits: Reduction of vias
- Requirement:
  - “DUAL\_SIDED\_COMPONENT” Property on Symbols (.dra) defined on drawing level
  - Padstacks must have begin and end layer pad
  - “EMBEDDED\_PLACEMENT = OPTIONAL or REQUIRED” on Component
    - No placement of dual sided components allowed on outer layers
- All PCB Editor embedded setup methodologies are fully supported:
  - Direct / indirect attach
    - Typically indirect attach is used
  - Body up / body down

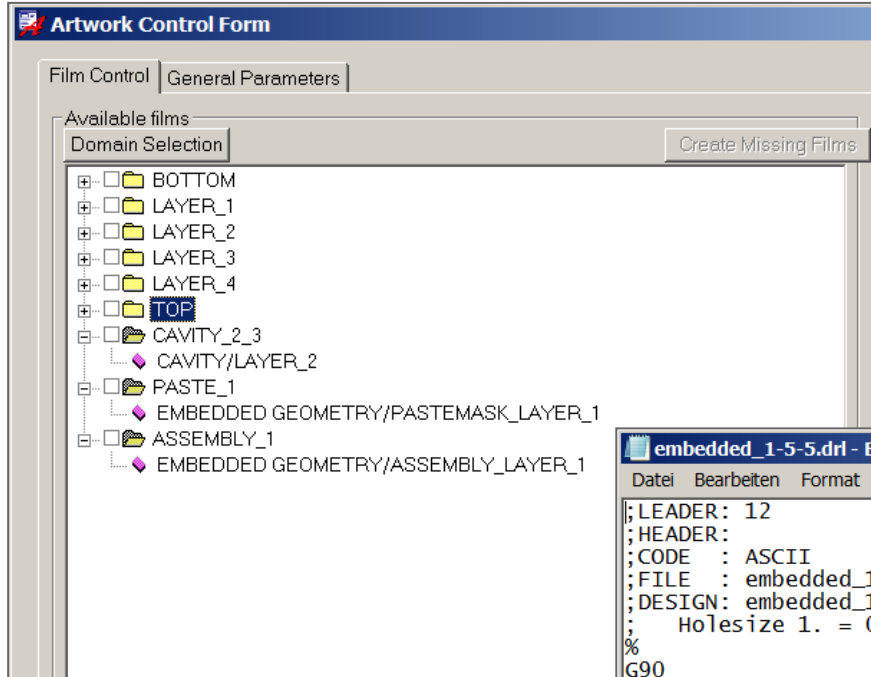


# Vertical Components

- “Special case” of Dual Sided Components
- Mapped to different padstacks with Begin or End Layer pad



# PCB Manufacturing



- Embedded layers can be use for Film generation

- NC Drill supports single layer vias for indirect attach

```

;LEADER: 12
;HEADER:
;CODE : ASCII
;FILE : embedded_1-5-5.drl for ... layers LAYER_4 and LAYER_4
;DESIGN: embedded_1.brd
; Holesize 1. = 0.100000 Tolerance = +0.000000/-0.000000 PLATED MM Quantity = 16
%
G90
X4338750Y0975000
X4351250Y0975000
X4338750Y0925000
X4351250Y0925000
X4338750Y0875000
X4351250Y0875000
X4338750Y0825000
X4351250Y0825000
X4448750Y0825000
X4461250Y0825000
X4448750Y0875000
X4461250Y0875000
X4448750Y0925000
X4461250Y0925000
X4448750Y0975000
X4461250Y0975000
M30
  
```

# Assembly

- Reports feature in Allegro PCB Editor support Embedding

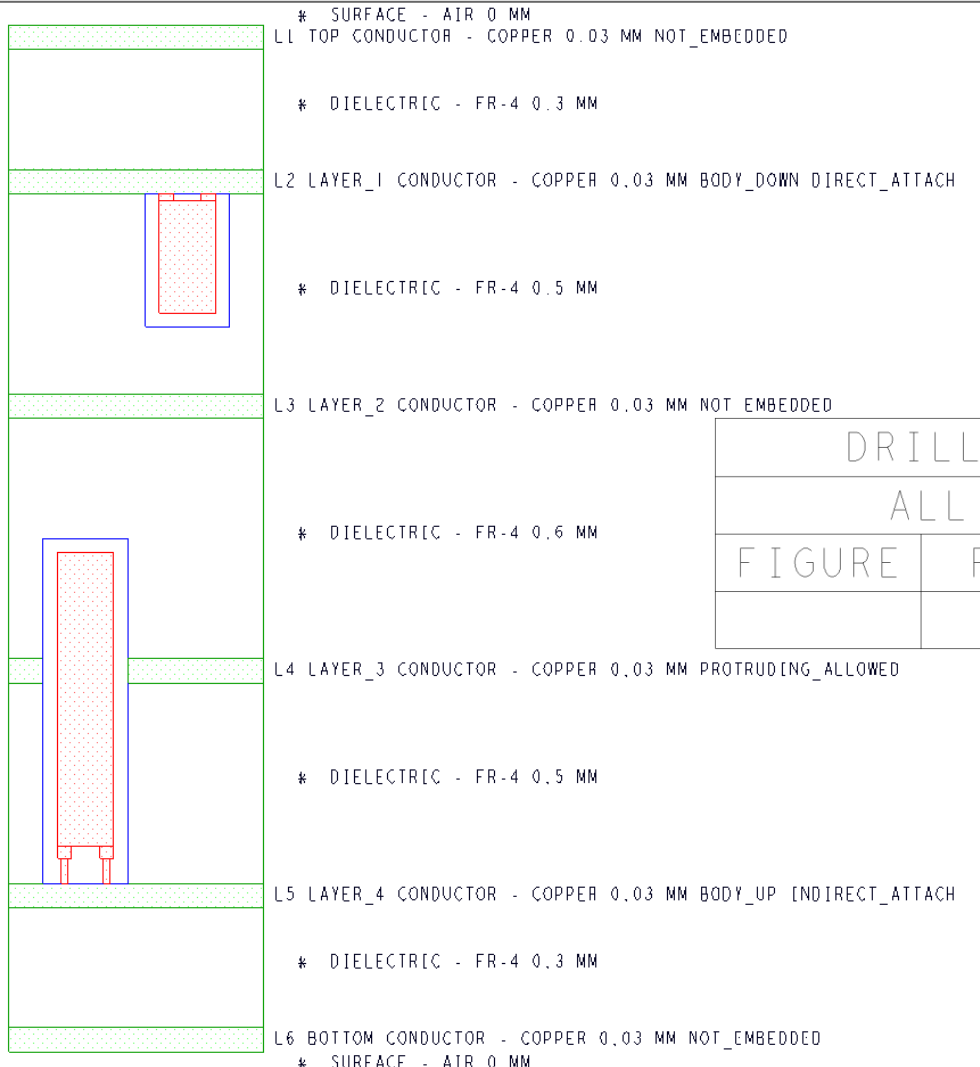
	A	B	C	D	E	F	G	H
1	Allegro Report							
2	D:/Work/Projekte/17_2/FED_2017_04_12/embedded_1.brd							
3	Fri Mar 24 12:55:29 2017							
4								
5	REFDES	PART_NAME	EMBEDDED_LAYER	EMBEDDED_STATUS	EMBEDDED_ATTACH	SYM_CENTER_X	SYM_CENTER_Y	SYM_ROTATE
260	R506	RES_V				21.000	10.000	0.000
384	R502	RES_H_4x	LAYER_1	BODY_DOWN	DIRECT_ATTACH	39.000	9.000	0.000
385	R503	RES_H_4x	LAYER_4	BODY_UP	INDIRECT_ATTACH	44.000	9.000	0.000
386								

- IPC2581
- ODB++ Version 9.1

# Documentation

- Cross Section Chart contains embedding information

Drill Chart supports single layer vias for indirect attach



```

* SURFACE - AIR 0 MM
L1 TOP CONDUCTOR - COPPER 0.03 MM NOT_EMBEDDED

* DIELECTRIC - FR-4 0.3 MM

L2 LAYER_1 CONDUCTOR - COPPER 0.03 MM BODY_DOWN DIRECT_ATTACH

* DIELECTRIC - FR-4 0.5 MM

L3 LAYER_2 CONDUCTOR - COPPER 0.03 MM NOT_EMBEDDED

* DIELECTRIC - FR-4 0.6 MM

L4 LAYER_3 CONDUCTOR - COPPER 0.03 MM PROTRUDING_ALLOWED

* DIELECTRIC - FR-4 0.5 MM

L5 LAYER_4 CONDUCTOR - COPPER 0.03 MM BODY_UP INDIRECT_ATTACH

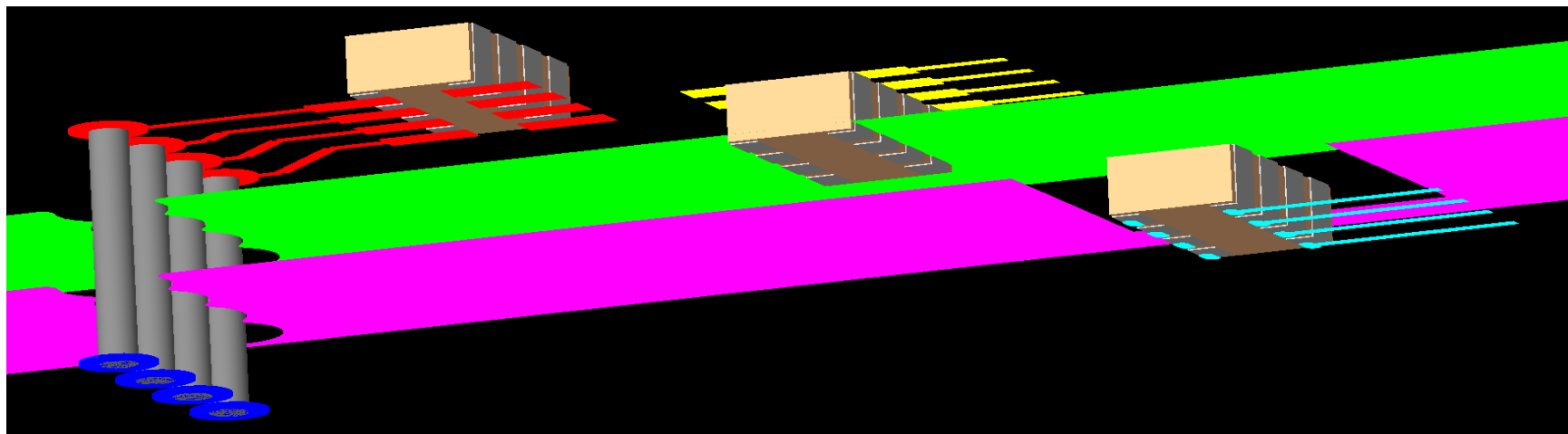
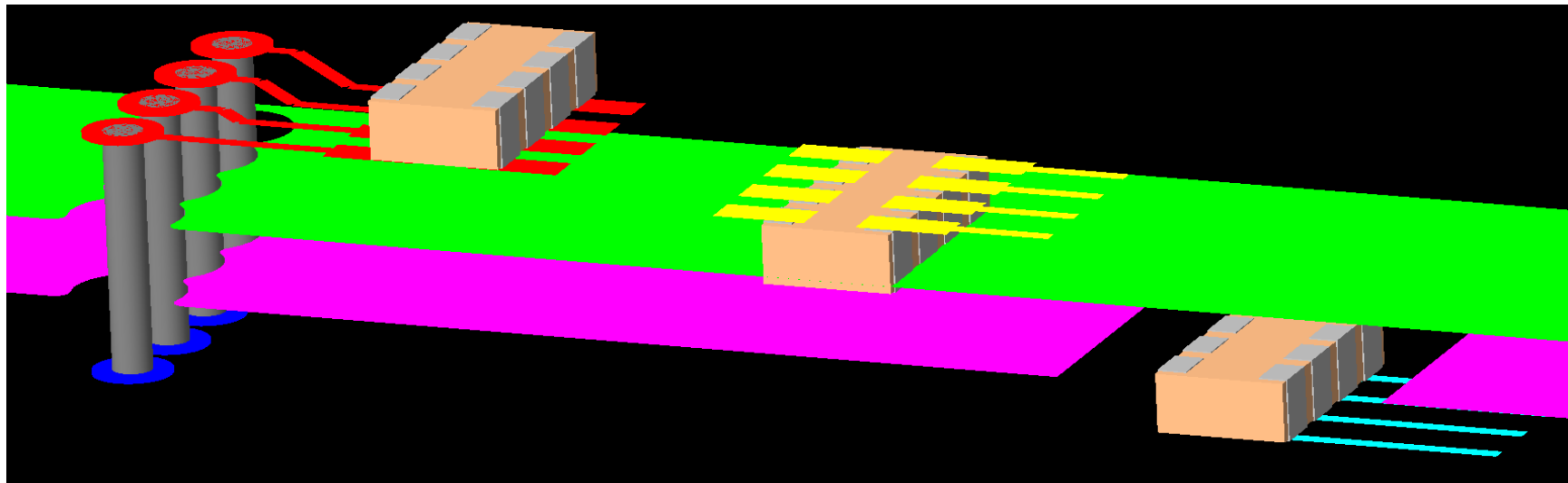
* DIELECTRIC - FR-4 0.3 MM

L6 BOTTOM CONDUCTOR - COPPER 0.03 MM NOT_EMBEDDED
* SURFACE - AIR 0 MM
    
```

DRILL CHART: LAYER_4 to LAYER_4			
ALL UNITS ARE IN MILLIMETERS			
FIGURE	FINISHED_SIZE	PLATED	QTY
	0.1	PLATED	16

DESIGN CROSS SECTION CHART  
TOTAL THICKNESS 2.38 MM

# 3D Visualization



# Combination Flexible PCB and Embedded Components

# Combination Flex / Embedded Components

Cross Section Editor (Multi Stackups mode)

Export Import Edit View Filters

All stackups Primary Flex Main Flex Stiffener +

Objects		Types	Thickness	Material	Primary	Flex Main	Flex Stiffener	Add Stackup
#	Name	Layer	mm					
*	*	Surface			<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
	COVERLAY_TOP	Mask	0.2032	Polyimide	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
	ADHESIVE_TOP	Mask	0.025	Adhesive Epoxy	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
	SOLDERMASK_TOP	Mask	0.015	Soldermask ...	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
1	TOP	Conductor	0.055	Copper	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
		Dielectric	0.15	Fr-4	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
2	GND1	Plane	0.03	Copper	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
		Dielectric	0.25	Fr-4	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
3	I1	Conductor	0.033	Copper	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
		Dielectric	0.2032	Polyimide	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
4	POW1	Conductor	0.033	Copper	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
		Dielectric	0.2032	Fr-4	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
5	GND2	Conductor	0.033	Copper	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
		Dielectric	0.2032	Polyimide	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
6	I2	Conductor	0.033	Copper	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
		Dielectric	0.25	Fr-4	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
7	POW2	Plane	0.03	Copper	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
		Dielectric	0.15	Fr-4	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
8	BOTTOM	Conductor	0.055	Copper	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
	SOLDERMASK_BOTTOM	Mask	0.015	Soldermask ...	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
	ADHESIVE_BOTTOM	Mask	0.025	Adhesive Epoxy	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
	COVERLAY_BOTTOM	Mask	0.2032	Polyimide	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
	STIFFENER_BOTTOM	Mask	5	Ptfe	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
		Surface			<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	

Surface  
COVERLAY\_TOP Mask  
ADHESIVE\_TOP Mask  
SOLDERMASK\_TOP Mask  
1 TOP Conductor  
Dielectric  
2 GND1 Plane  
Dielectric  
3 I1 Conductor  
Dielectric  
4 POW1 Conductor  
Dielectric  
5 GND2 Conductor  
Dielectric  
6 I2 Conductor  
Dielectric  
7 POW2 Plane  
Dielectric  
8 BOTTOM Conductor  
SOLDERMASK\_BOTTOM Mask  
ADHESIVE\_BOTTOM Mask  
COVERLAY\_BOTTOM Mask  
STIFFENER\_BOTTOM Mask  
Surface

PRIMARY  
FLEX\_MAIN  
FLEX\_STIFFENER

Info Lock Embedded layers setup Unused pads suppression Refresh materials

Total thickness: 7.198 mm  
Total thickness without masks: 1.7116 mm  
Layers: 15  
Conductor: 6  
Plane: 2  
Mask: 7

Ok Cancel Apply Help



# Kontakt zu FlowCAD

Für weitere Fragen und Informationen stehen wir gerne zur Verfügung

- Please don't hesitate to contact us

## FlowCAD (Deutschland)

Mozartstrasse 2  
85622 Feldkirchen bei München  
Tel: +49 (89) 4563-7770  
Fax: +49 (89) 4563-7790  
[info@FlowCAD.de](mailto:info@FlowCAD.de)



## FlowCAD (Schweiz)

Hintermättlistrasse 1  
5506 Mägenwil  
Tel: +41 (0) 56 485 91 91  
Fax: +41 (0) 56 485 91 95  
[info@FlowCAD.ch](mailto:info@FlowCAD.ch)



## FlowCAD (Polen)

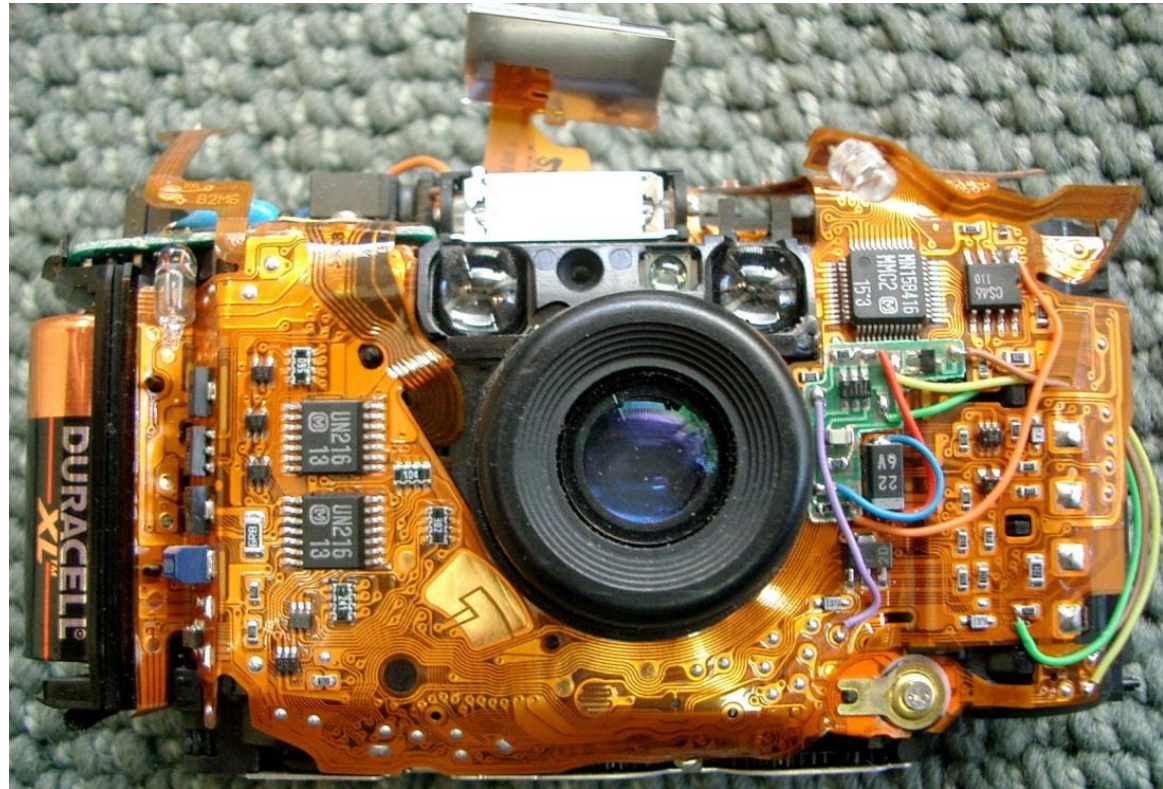
ulica Sasiedzka 2A  
80-298 Gdansk  
Tel: +48 58 342 75 94  
Fax: +48 58 342 70 60  
[info@FlowCAD.pl](mailto:info@FlowCAD.pl)



FlowCAD

# Backup

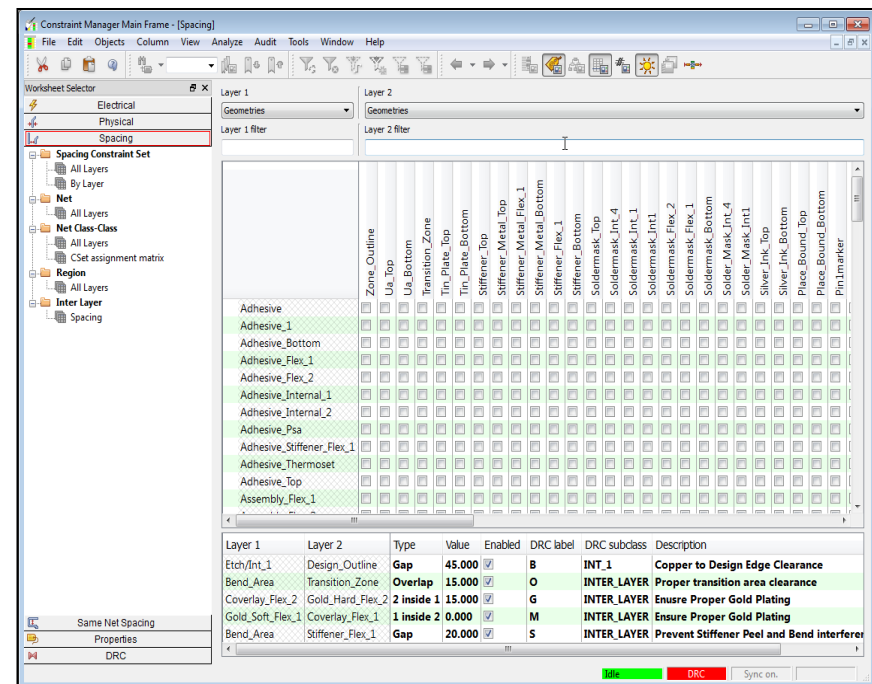
# Flex Example



# Inter-Layer Design Rule Checks Rigid-Flex

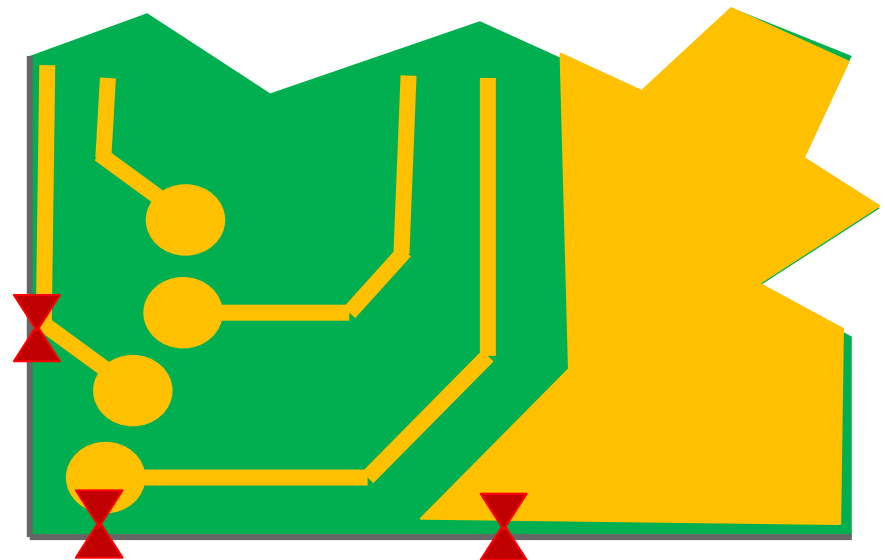
# Inter Layer Checks

- DRC engine designed to check
  - Mask layer to mask layer geometry
  - Mask layer to surface metal
- Allows checks for
  - Coverlay to pad checks
  - Mask to pad checks
  - Precious metal to coverlay
  - Bend area/line to stiffener, component, pin, and via
- Layer selection GUI
  - Matrix of applicable subclasses
  - Filtering capabilities
  - User defined DRC 2<sup>nd</sup> letter (“I” fix first character)
  - Comment field

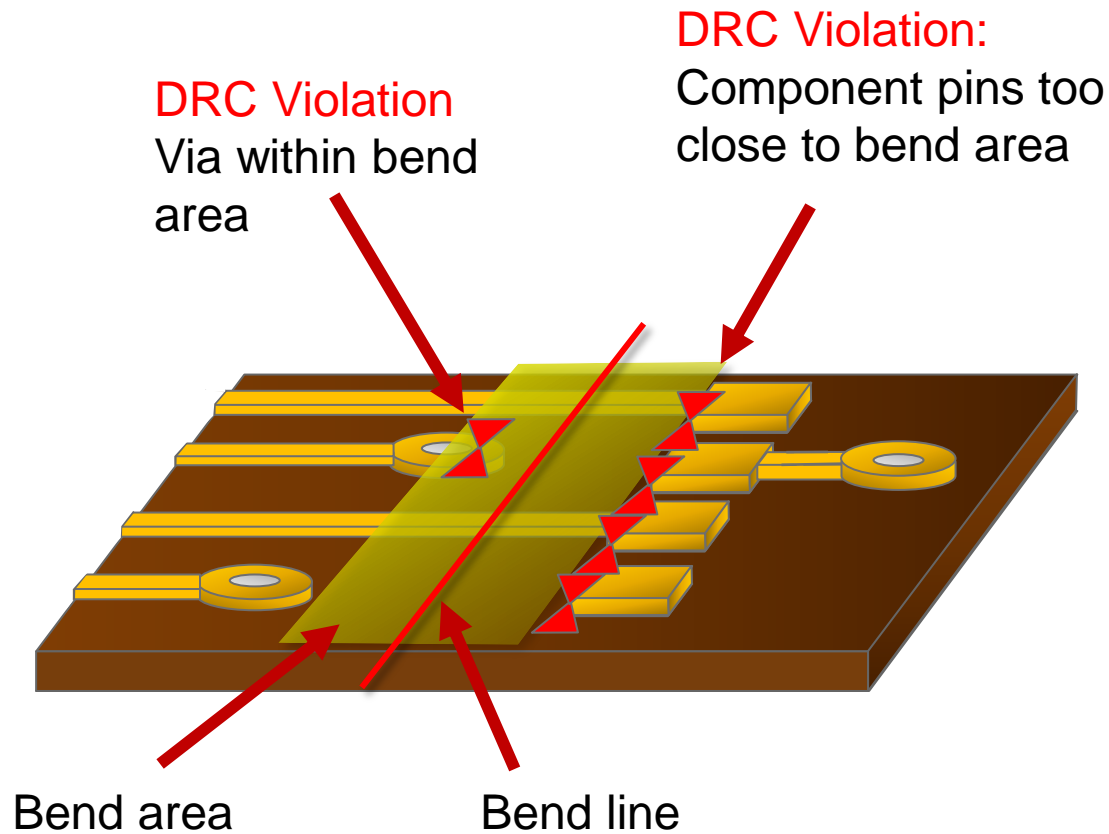


# Inter Layer Check Gap Rule

- DRC verifies geometry spacing between subclasses
- Example:
  - Vias, pins and conductors must have 30 mils spacing from Outline



# Inter Layer Check Gap Rule





# Inter Layer Check Overlap Rule

- Specifies a minimum overlap of two geometries on different subclasses
- Example:
  - Transition zone must overlap bend area by 15 mils
  - Special rules apply in transition zone



# Inter Layer Check Inside Rule

- (Layer 1) inside (layer 2)
- (Layer 2) inside (layer 1)
- Geometry on one subclass must be contained within the geometry of another subclass geometry

