

Introduction

Philippe Pradoura



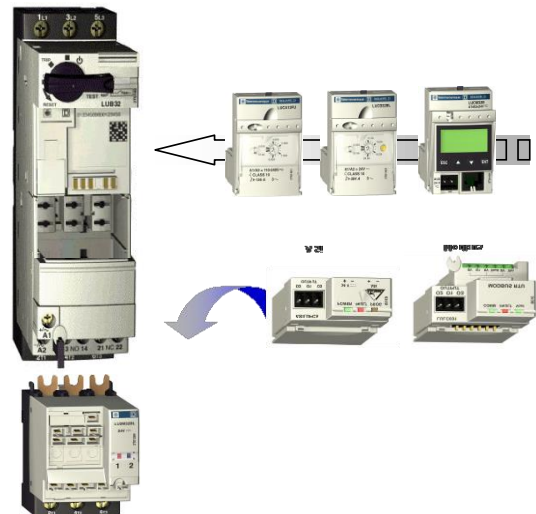
Motor Protection & Control



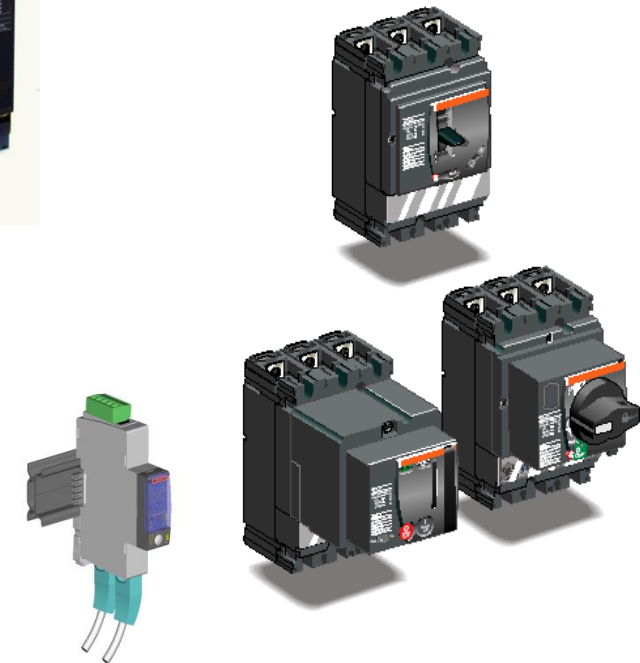
Medium Voltage relay



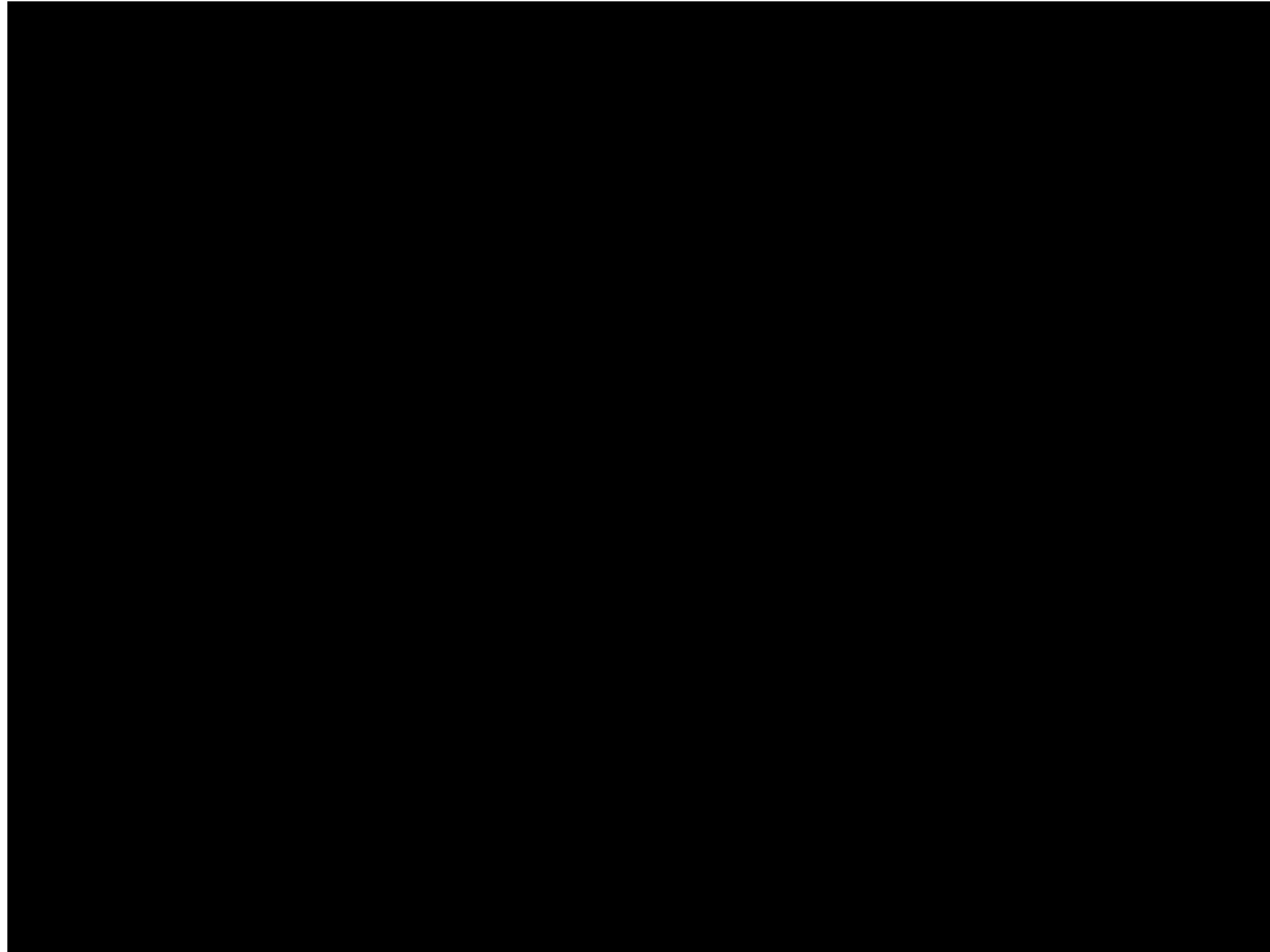
Insulation fault detection



Medium Voltage Protection



Low Voltage Power breakers



- Increase :
 - Density
 - Embedded functions
 - Performances
 - Reliability
 - Connectivity
 - Maintenance
- Reduction :
 - Volume
 - Weight
 - Power consumption
 - Cost
 - Number of parts



version
electromechanical (1980) Example



version
mechatronics (2000)

Innovation : 60 patents



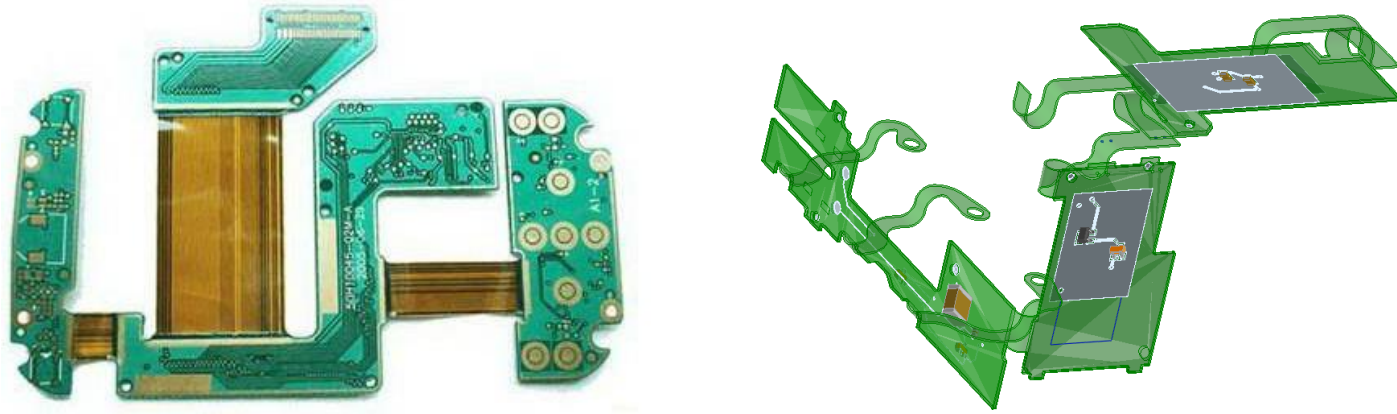
	Integral-32	Tesy-U	Reduction
Volume (cm ³)	1939	694	- 65% *
Weight (g)	2343	913	- 62% *
Amount of parts	485	187	- 61% *

* High quality level preserved

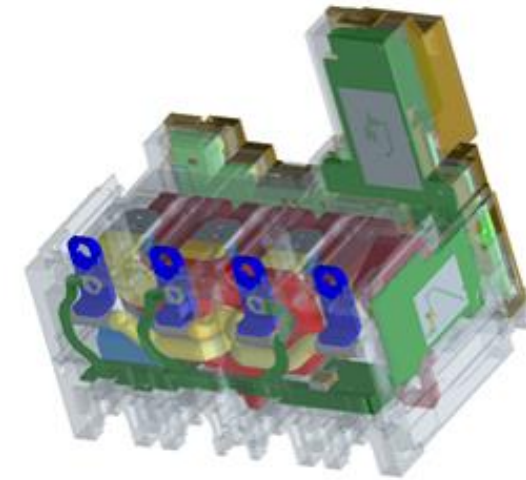
Electronic integration brings many challenges

All those products must be compliant with electrical distance regulations (IEC / UL)

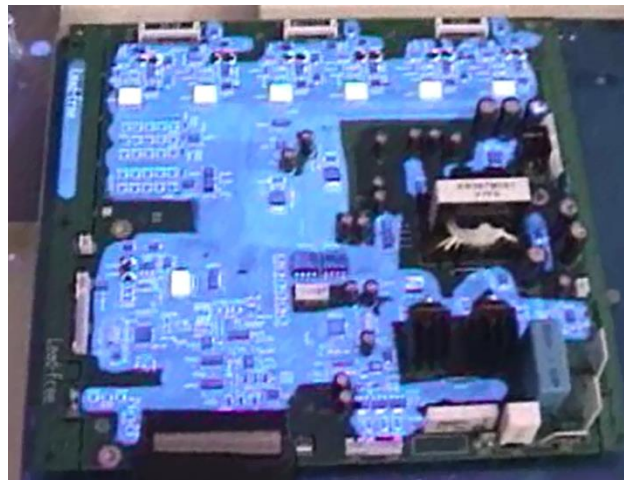
- Flex boards



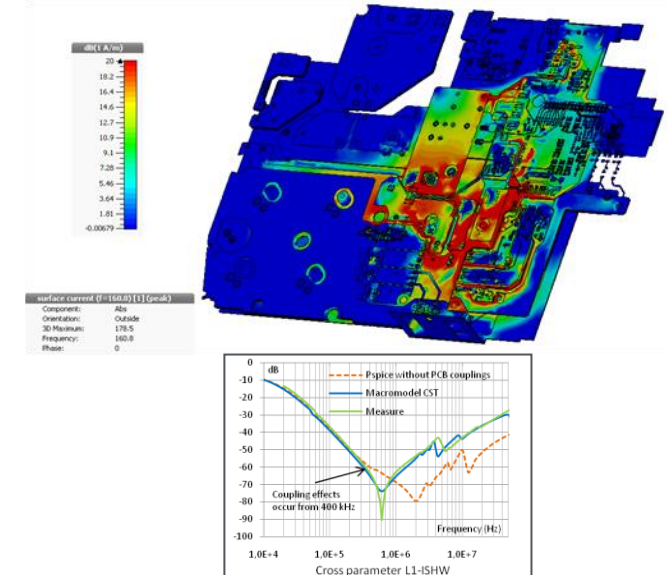
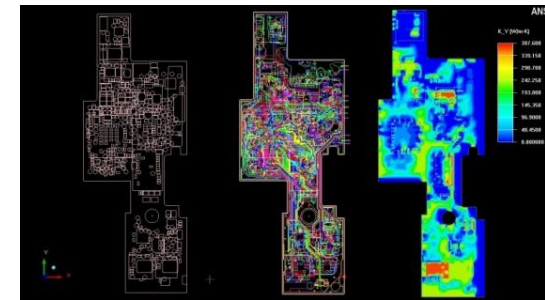
- Tight electrical integration of electrical parts 50kA at 480 V and electronic boards



- ProFormal coating



- Thermal and EMC simulation



Electrical standards are defining distances depending on voltage

Several Groups identified: L1, L1-1, N

Table 1 – Rated impulse voltage for equipment energized directly from the low-voltage mains

Nominal voltage of the supply system ¹⁾ based on IEC 60038 ³⁾		Voltage line to neutral derived from nominal voltages a.c. or d.c. up to and including	Rated impulse voltage ²⁾			
Three phase V	Single phase V		Overtoltage category ⁴⁾			
		V	I V	II V	III V	IV V
		50	330	500	800	1 500
		100	500	800	1 500	2 500
	120-240	150 ⁵⁾	800	1 500	2 500	4 000
230/400 277/480		300	1 500	2 500	4 000	6 000
400/690		600	2 500	4 000	6 000	8 000
1 000		1 000	4 000	6 000	8 000	12 000

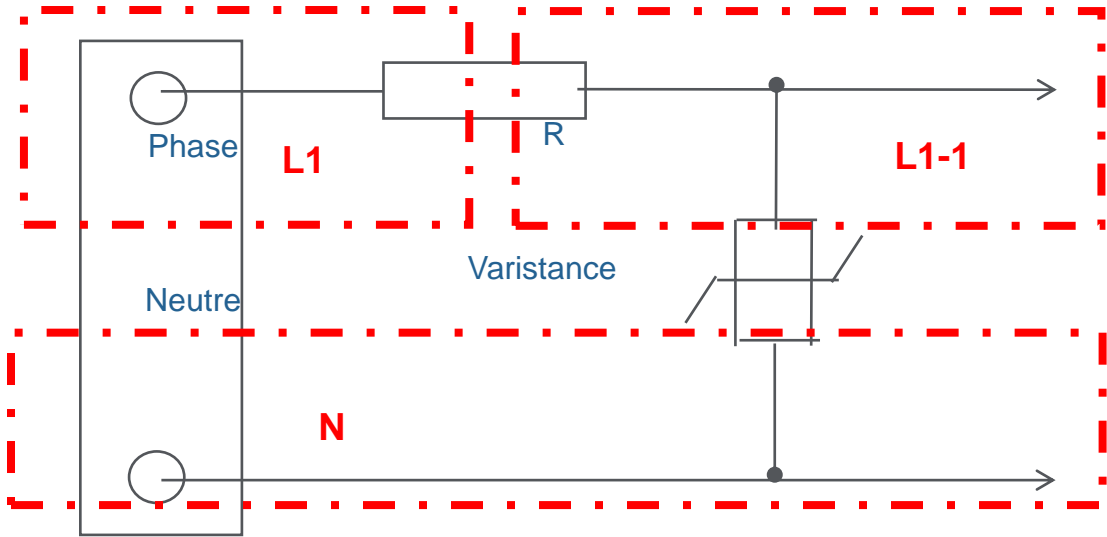


Table 2 – Clearances to withstand transient overvoltages

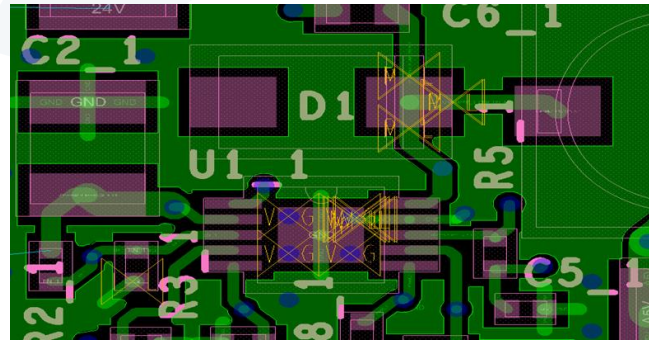
Required impulse withstand voltage ^{1) 5)}	Minimum clearances in air up to 2 000 m above sea level					
	Case A Inhomogeneous field (see 1.3.15)			Case B Homogeneous field (see 1.3.14)		
	Pollution degree ⁶⁾			Pollution degree ⁶⁾		
kV	1 mm	2 mm	3 mm	1 mm	2 mm	3 mm
0,33 ²⁾	0,01	0,2 ^{3) 4)}	0,8 ⁴⁾	0,01	0,2 ^{3) 4)}	0,8 ⁴⁾
0,40	0,02			0,02		
0,50 ²⁾	0,04			0,04		
0,60	0,06			0,06		
0,80 ²⁾	0,10			0,10		
1,0	0,15			0,15		
1,2	0,25	0,25	0,2	0,2		
1,5 ²⁾	0,5	0,5	0,3	0,3		
2,0	1,0	1,0	0,45	0,45		
2,5 ²⁾	1,5	1,5	0,60	0,60		
3,0	2,0	2,0	0,80	0,80		
4,0 ²⁾	3,0	3,0	1,2	1,2	1,2	

	Clearances			Creepage		
	L1	L1-1	N	L1	L1-1	N
L1						
L1-1	●					
N	●	●				

1,5 mm

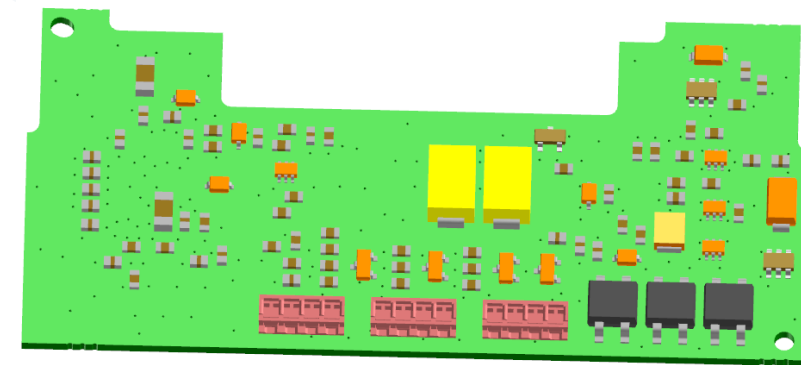
- **Cadence**

- ECAD-MCAD IDX collaboration
- 2D simulation only
- Layer to layer simulation



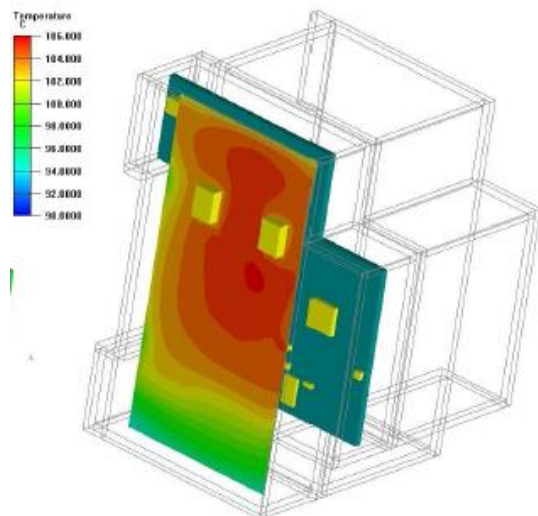
- **Creo Parametric ECAD-MCAD**

- ECAD-MCAD IDX collaboration
- 3D detailed library of electronic components



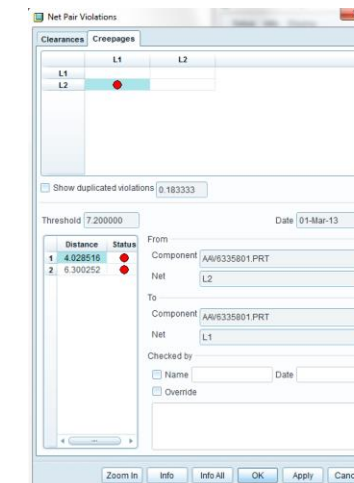
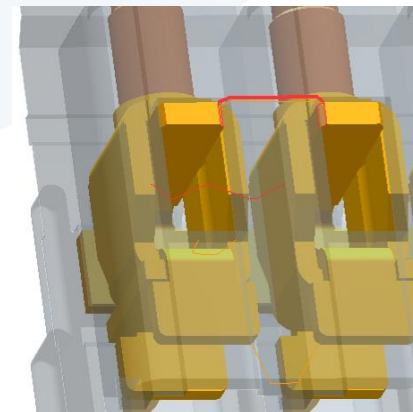
- **Thermal & EMC simulation**

- Based upon Cadence-Creo models



- **Creo Parametric SPARK analysis**

- 3D electrical compliance checks toward IEC std



Schneider Electric improved its air gap checks thanks to PTC Creo Parametric Spark Analysis Extension (SAX)

Productivity compared on recent projects compared to previous projects on equivalent check tasks

- **productivity** **x 2**
- **detection rate** **70% ↗ 100%**
- **Revision / Protos** **30% ↘**

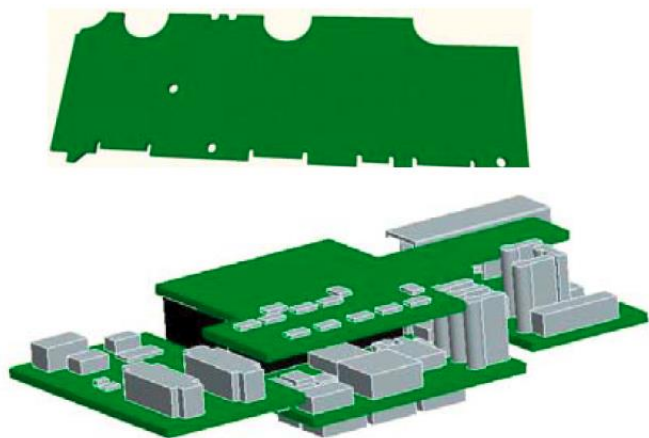
Related to the risk of bad insulation

What were the main steps and difficulties

Gregory Xuereb

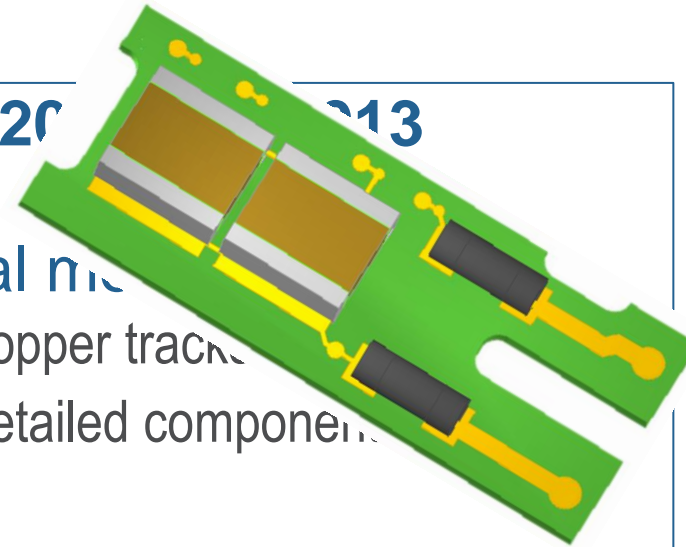
< 2011

- IDF 3.0 ECAD-MCAD exchanges
- No Copper track
- Component enveloppes
- Manual checks



2011 < 2013

- Manual checks
 - Copper tracks
 - Detailed components
- Advanced tests of SPARK
 - WF5 early testing
 - Creepage IEC pollution issue detected
 - SPARK results sharing difficulties
 - Voltage / Distance settings
 - No SPARK training available
- **Decision to move forward and implement SPARK in projects in spite of issues detected**

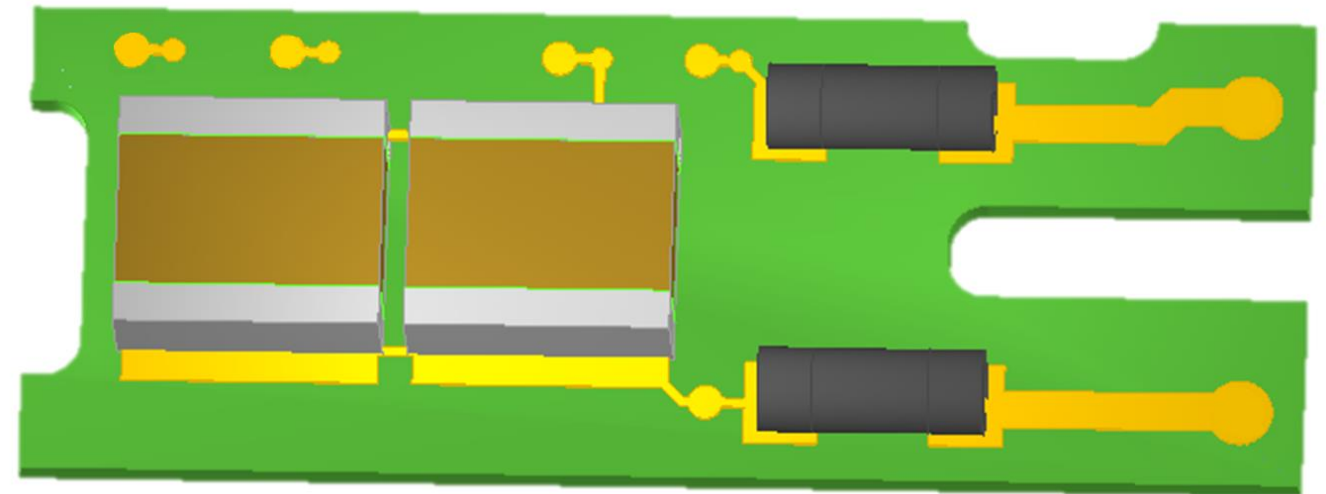
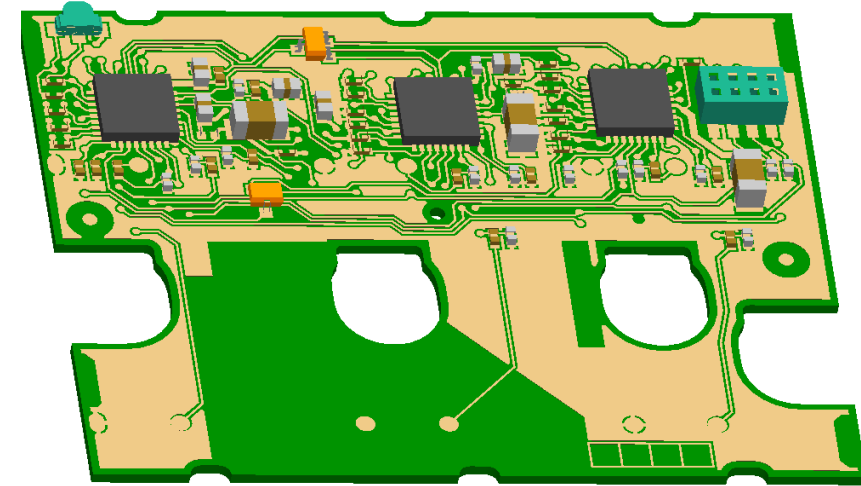
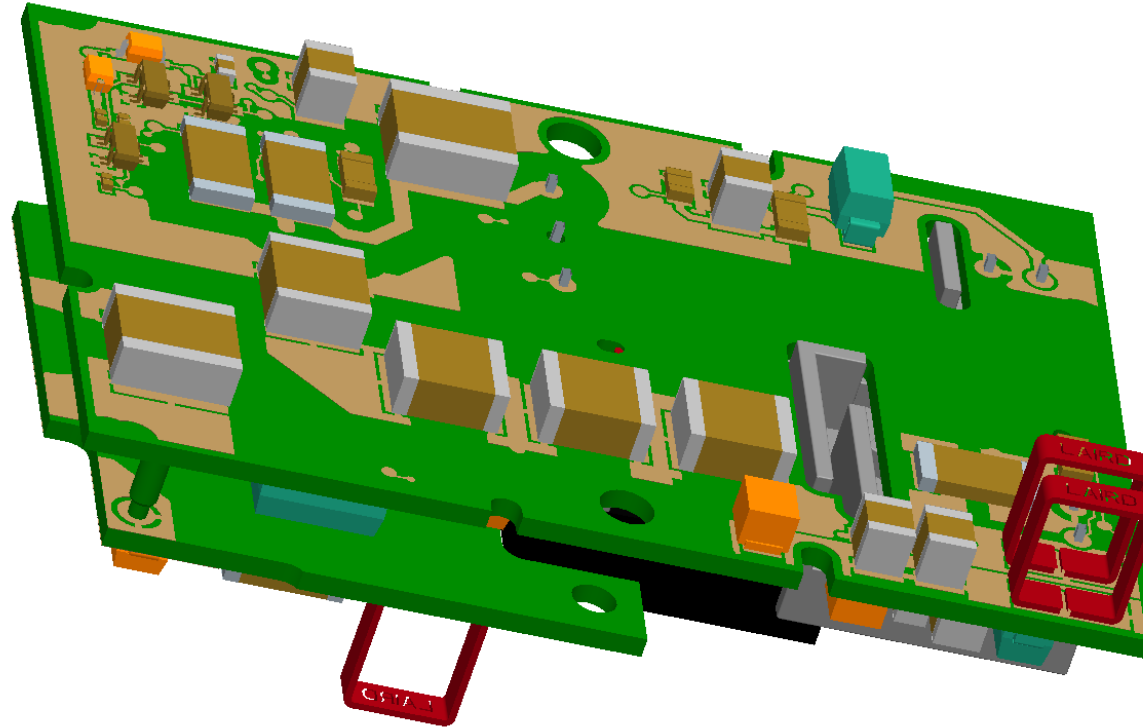


2013 < 2015

- Implementation in 2 projects
 - X2 productivity on clearance
 - 70% ↗ 100% detection rate
- Detailed models in Windchill Library
- Methods and deployment plan
 - Manual copper track import
 - Proper use of SPARK for Voltage / Distance settings
- More issues detected lately

Copper tracks imported by twisting Cadence / ProENGINEER WF5 export / import capabilities

- Complex to setup
- Creates too many prt objects
 - Too difficult to manage in Windchill
- Non desired interferences with components
- Many issues and calls to PTC Support

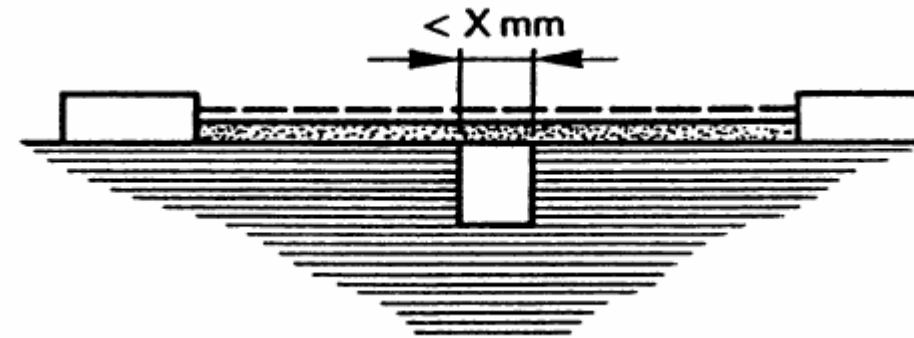


PTC Creo Parametric SAX difficulty #1 detected with non compliance to IEC standard for pollution

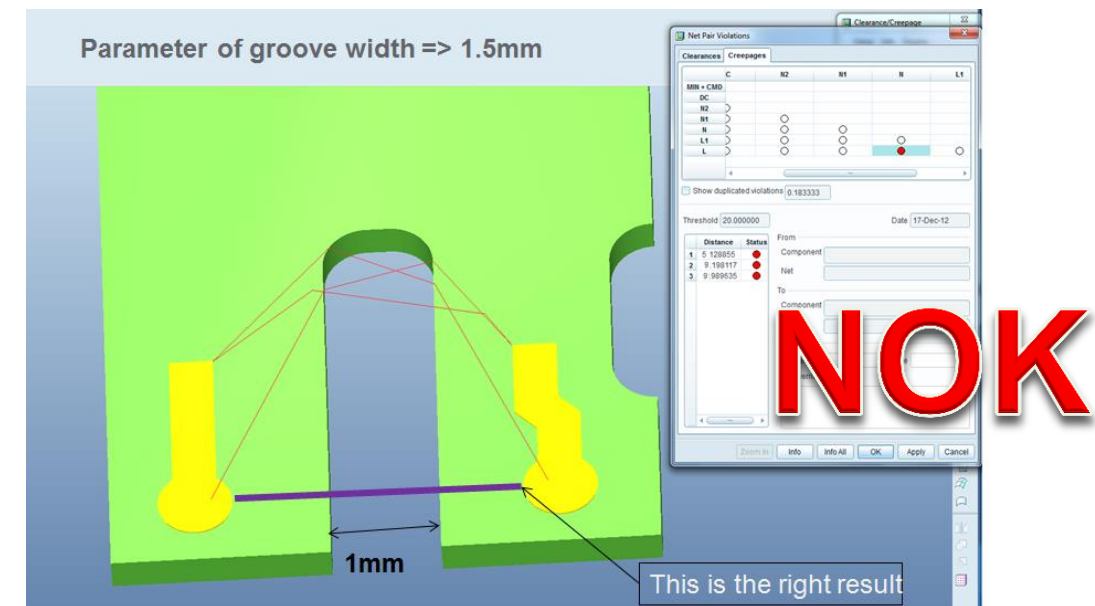
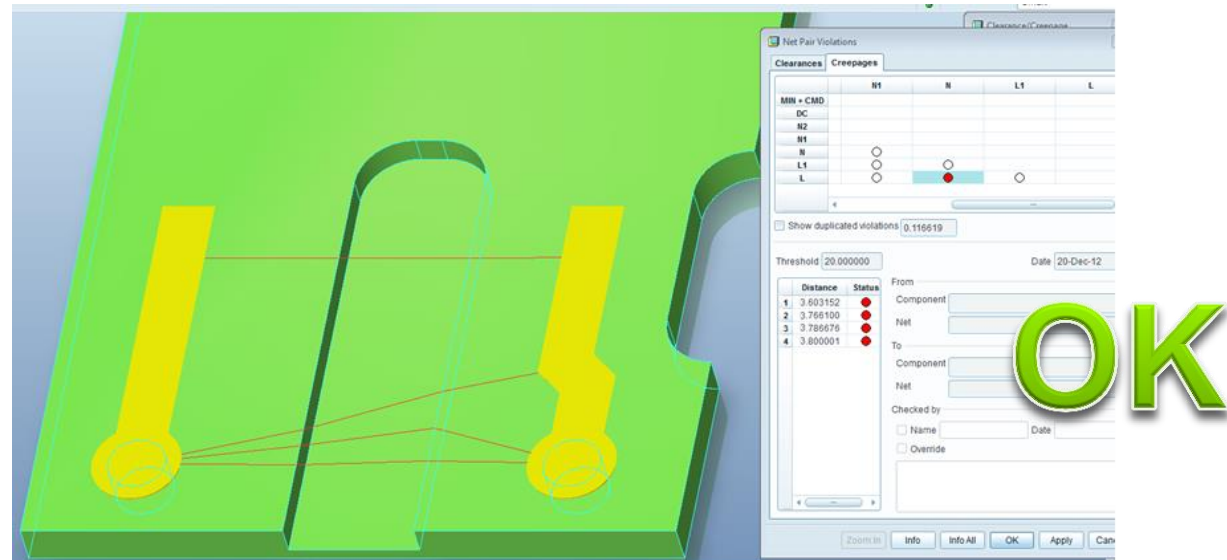
Creepage does not account floating parts, open grooves for which pollution passes through air

- All creepage issues detected are OK
- No creepage issues is not reliable : additional manual checks are necessary

- Picture of issue and IEC std

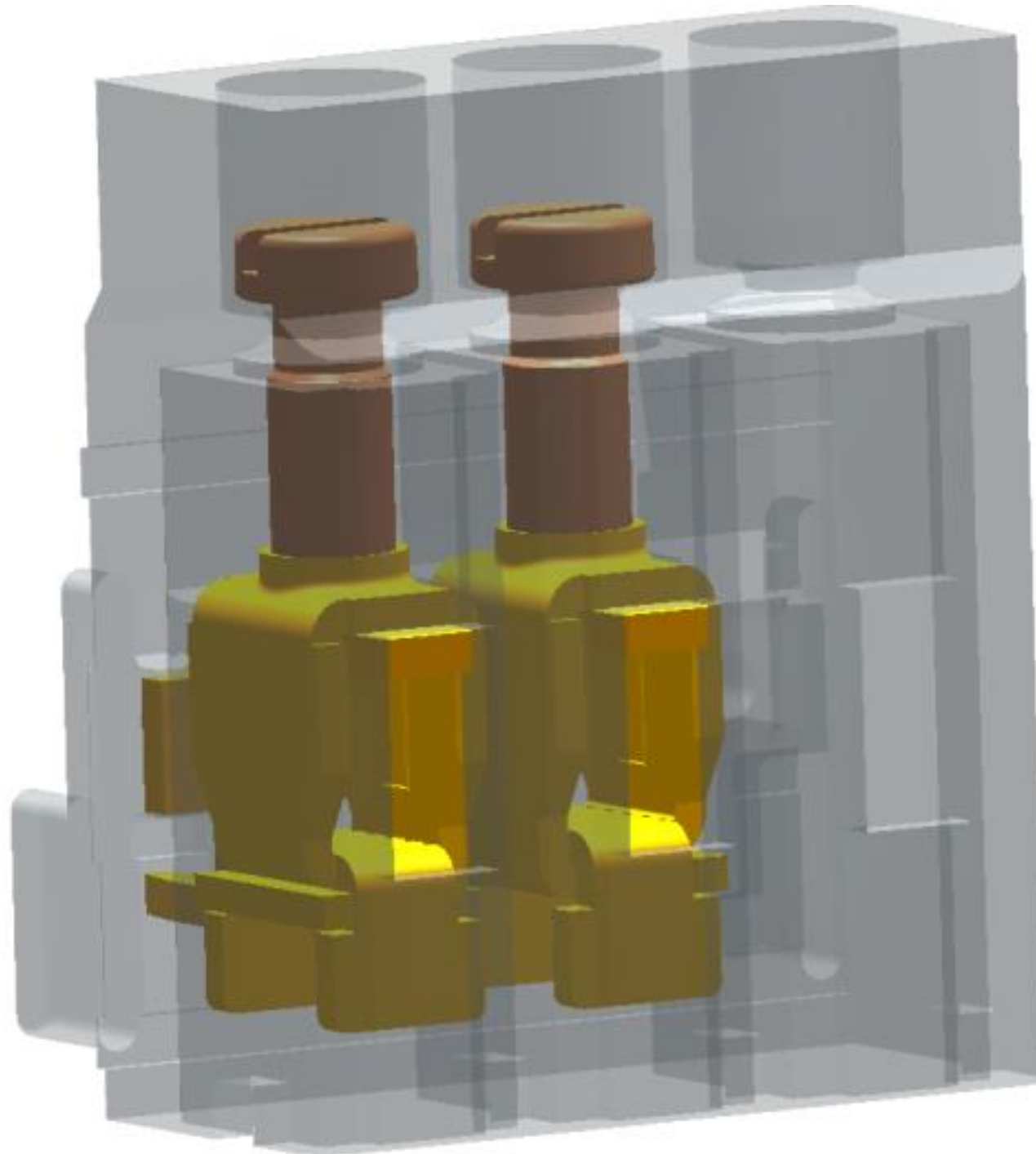


- Condition: Path under consideration includes a parallel- or converging-sided groove of any depth with a width less than X mm.
- Rule: Creepage distance and clearance are measured directly across the groove as shown.



Example of creepage issue #1 regarding IEC compliance for pollution

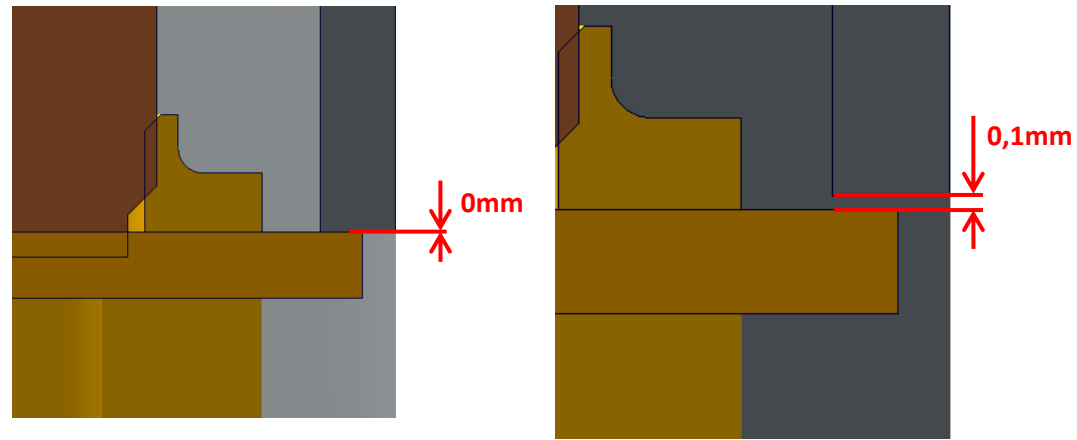
Simple Case => screw terminal block



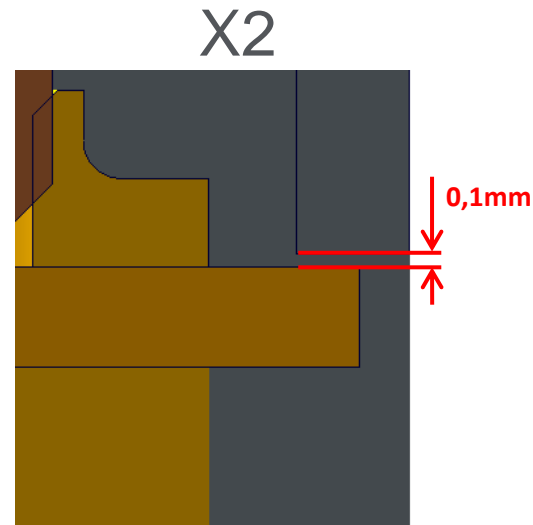
Example of creepage issue #1 regarding IEC compliance for pollution

Simple Case => screw terminal block

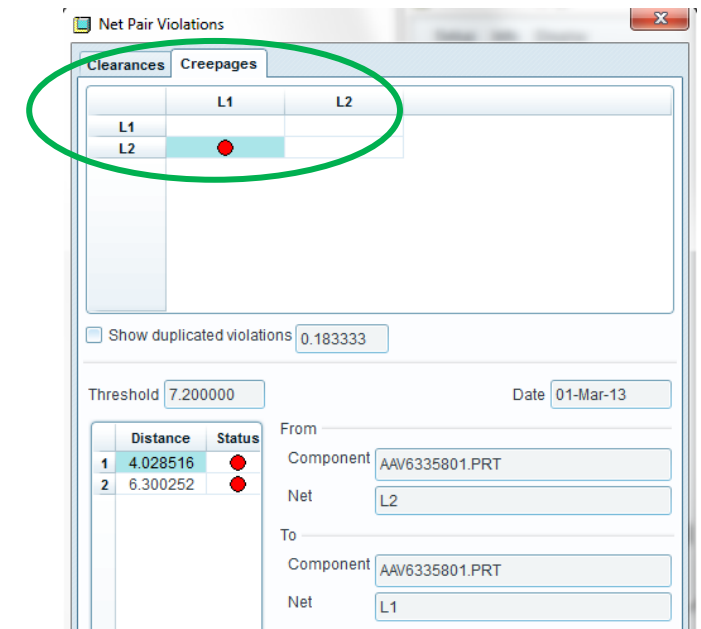
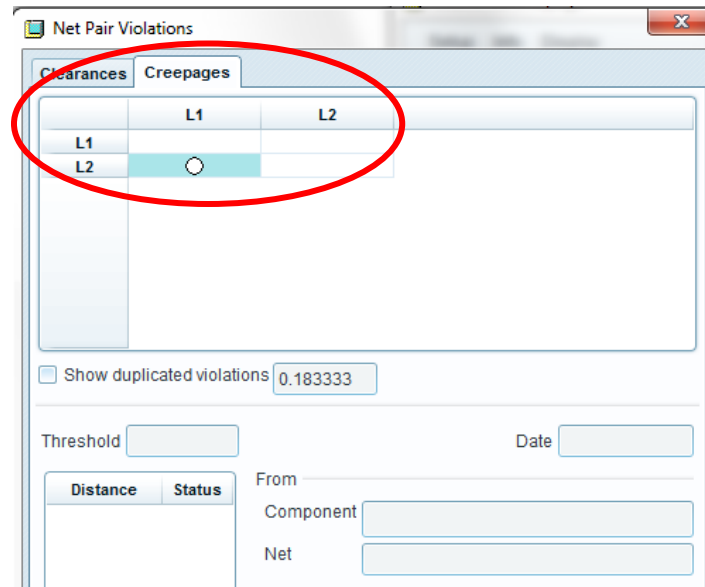
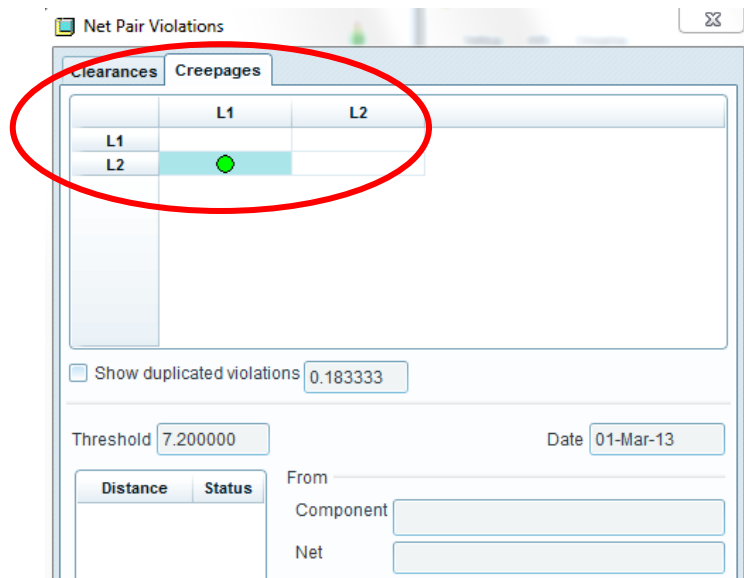
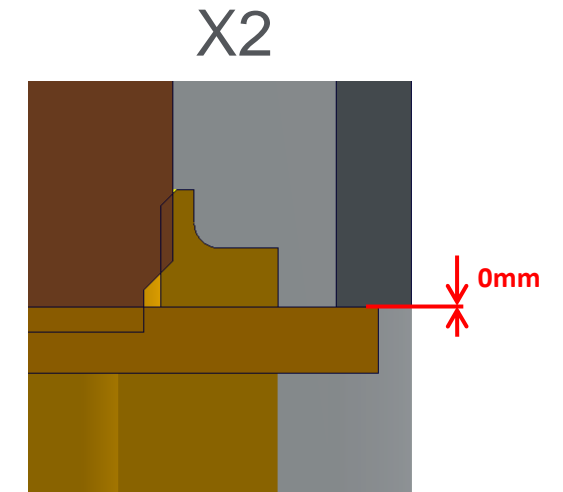
- One conductor part in contact with the housing:



- Conductor parts without contact with the housing:

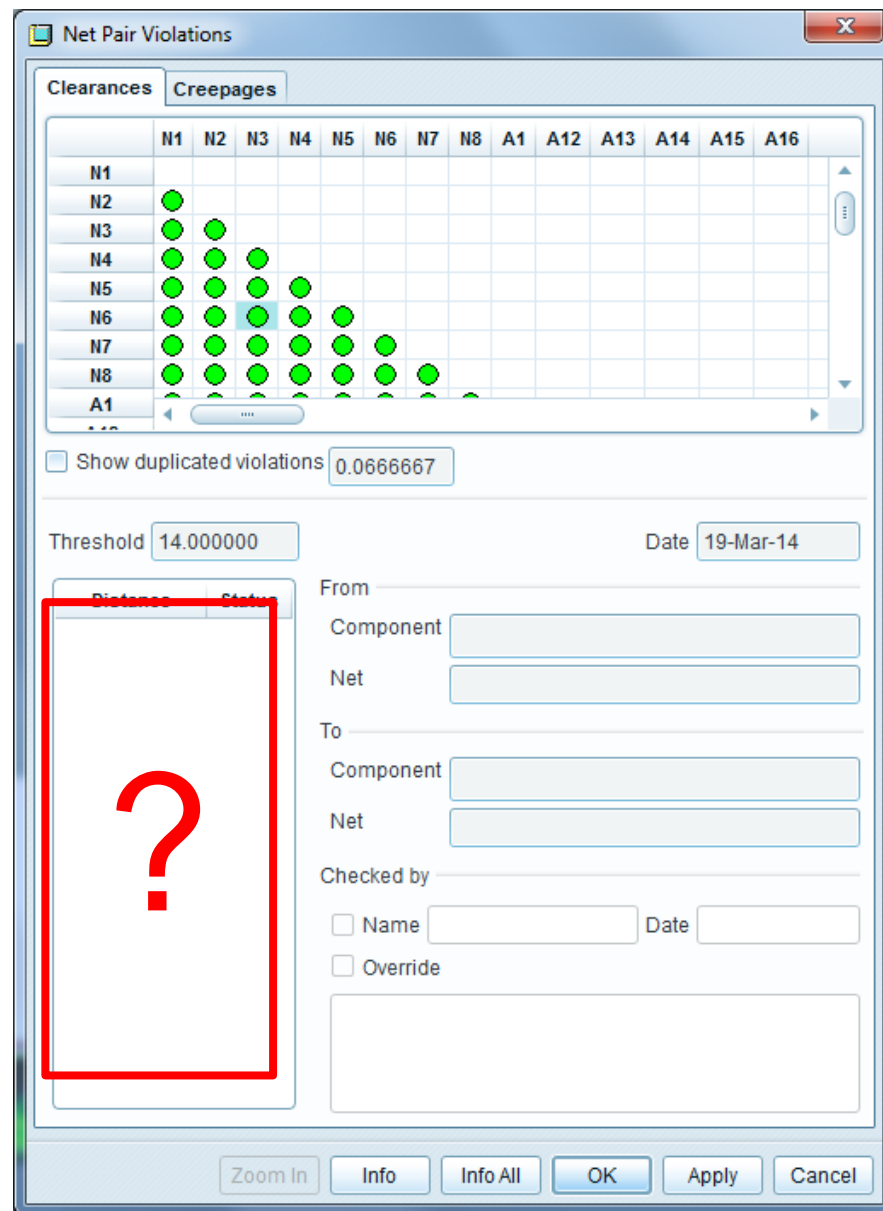


- Conductor parts in contact with the housing:

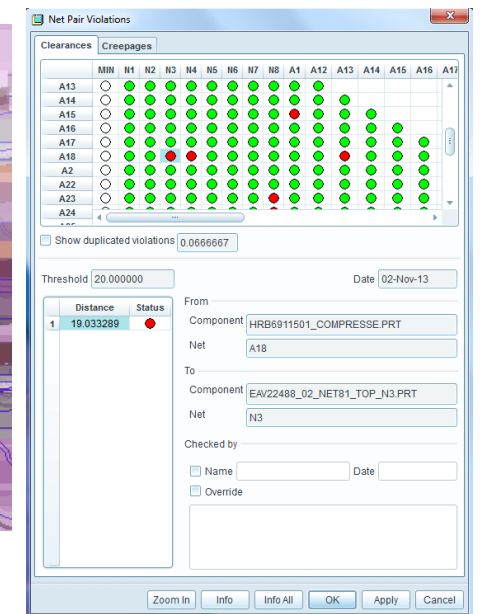
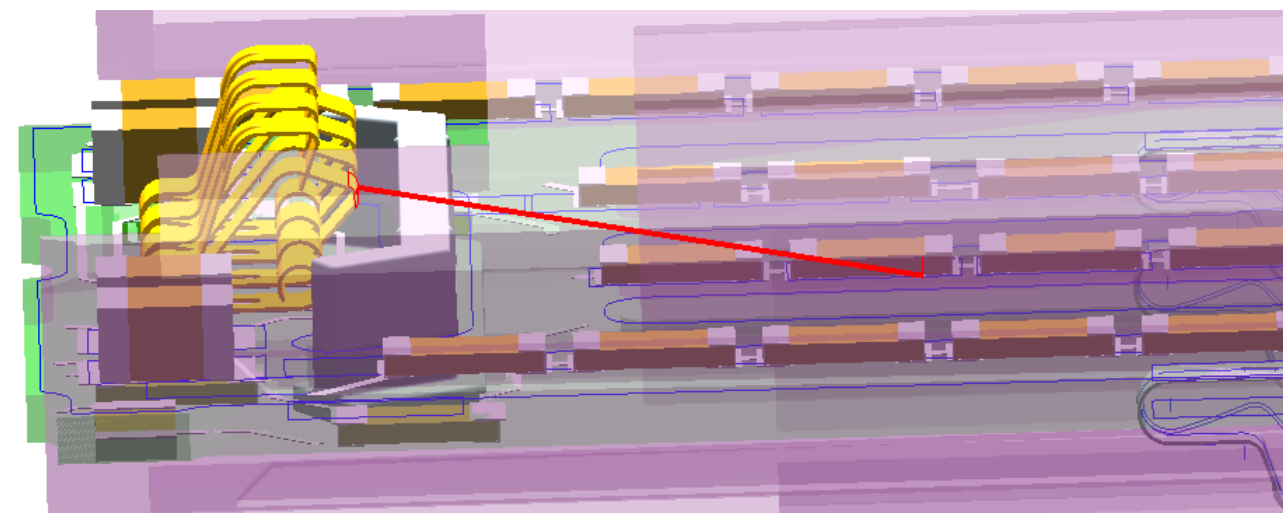
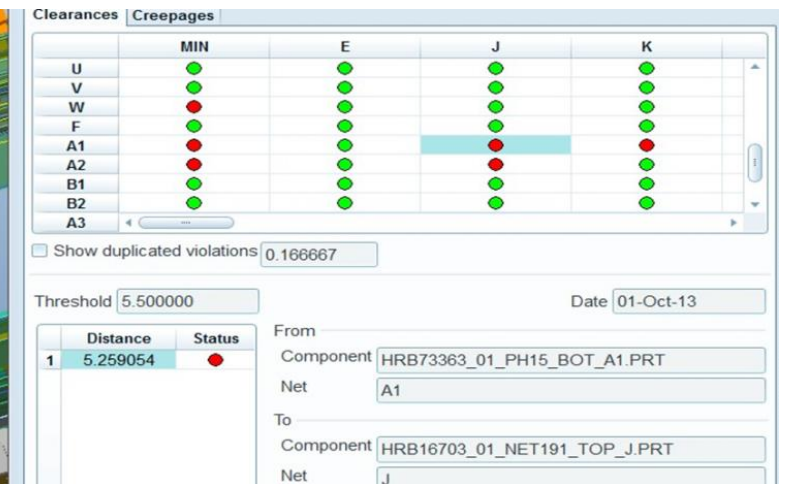
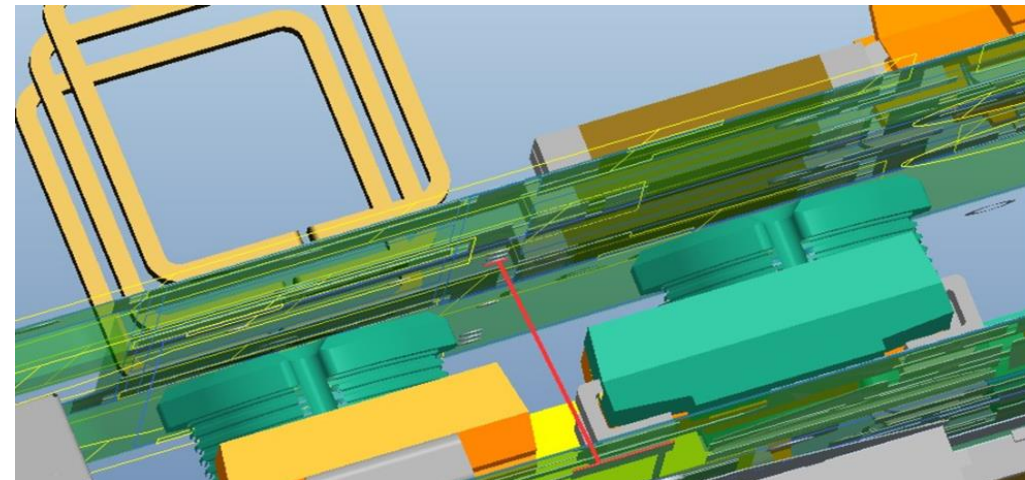


PTC Creo Parametric SAX difficulty #2 found in sharing SAX results with non Creo Parametric users to be difficult

- No display of all correct distances



- No way to export in Creo View in order to share in 3D : static snapshots sent to Electrical engineers



PTC Creo Parametric SAX difficulty #3 found with the conductive surfaces on a same part

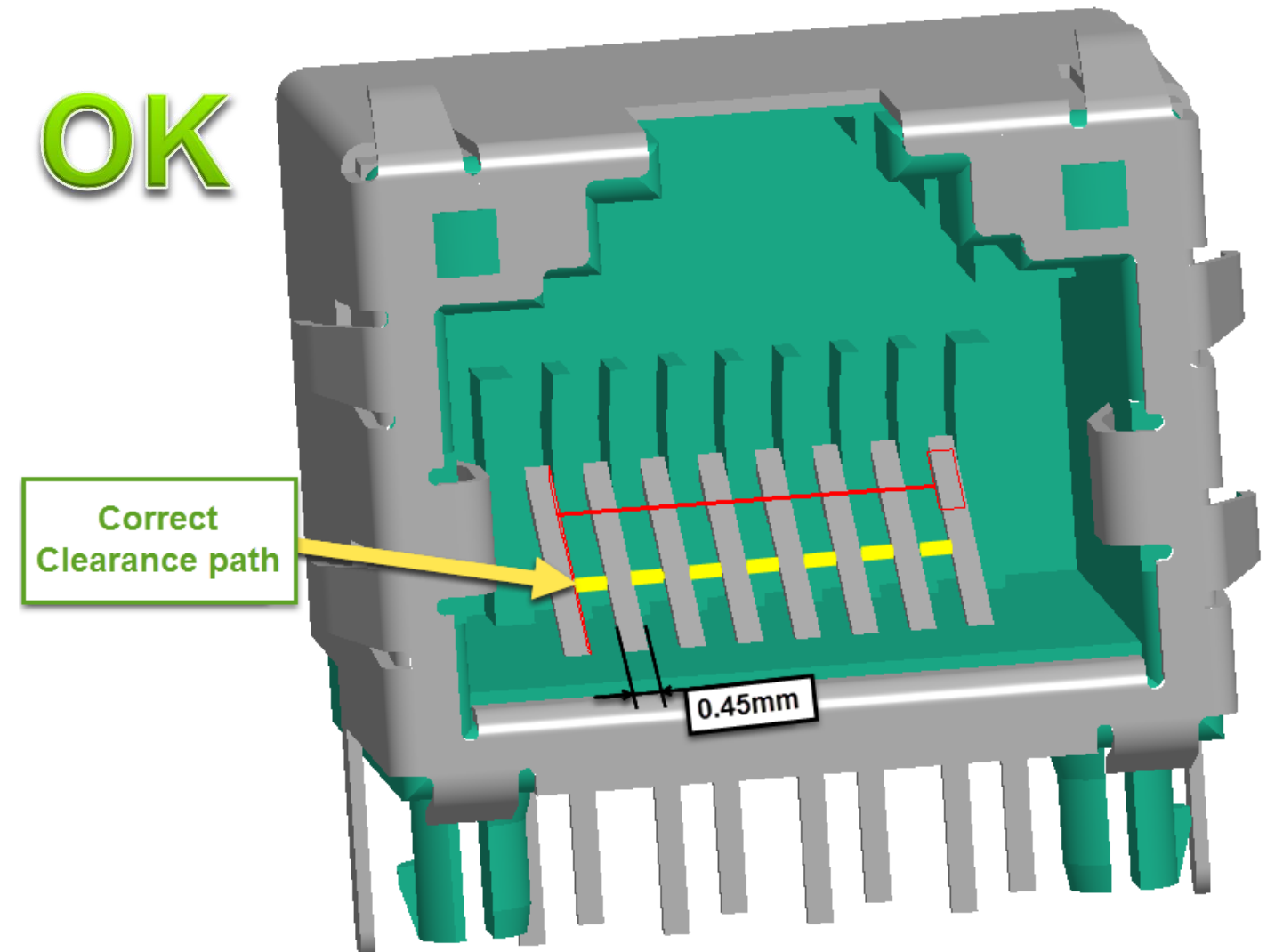
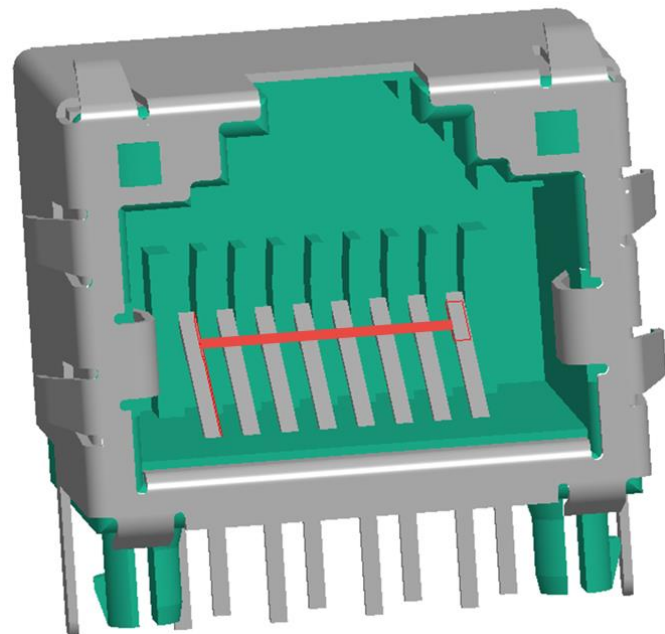
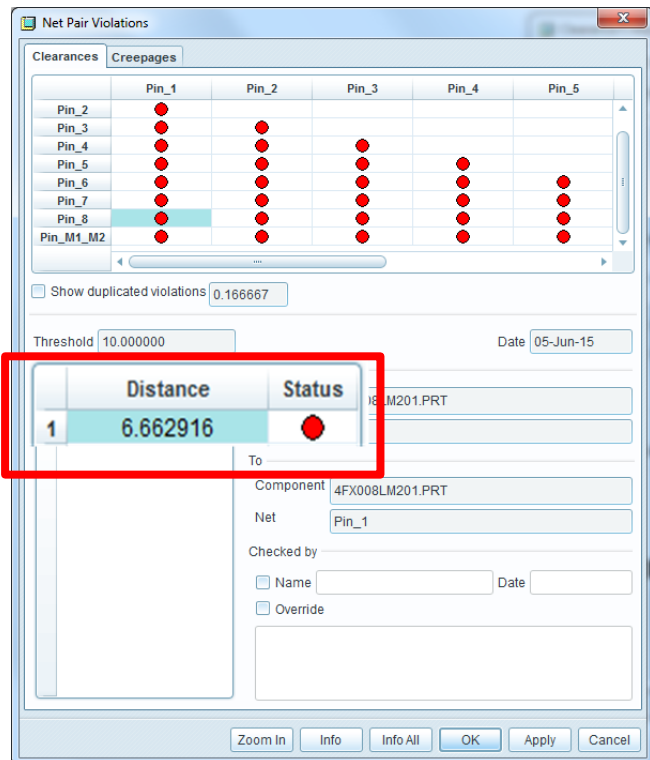
Surfaces issues with libraries components

- Clearance path by SAX
 - Sax ignore the conductives surfaces when are not included in the net pair analyzed
 - Path mesured = **6,662mm**

- Correct Clearance path
 - Correct path = $6,662 - (0,45 \times 6) = \mathbf{3,962mm}$

NOK

OK



Conclusion

Philippe Pradoura

Because PTC Creo Parametric **SPARK Analysis Extension** brings **significant improvements in electrical compliance checks** detection rate and productivity, in spite of **significant improvements** still pending in PTC Creo Parametric, PTC Creo Parametric SPARK is now a key simulation tool in mechatronics product design electrical compliancy.

PTC Creo Parametric modules and features are providing nice mechatronics capabilities

- SPARK Analysis
- ECAD-MCAD IDX collaboration
- 3D detailed library of electrical components

Mechatronics design implementation involves a deep change in company's organization

- Internal methods and skills to define
 - Electrical compliance methods
 - Voltage / Distance settings in SAX
 - Copper tracks

We are expecting further enhanced mechatronics capabilities from future releases of PTC Creo Parametric

- SAX Creepage compliancy with IEC pollution standard
- Copper track import from Cadence into Creo Parametric within IDX process
- Flex board with variable thickness
- SPARK training / eLearning capability

We are ready for further exchanges, feel free to contact us

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- Don't miss out on the chance to provide your feedback
- Gain a chance to win an instant prize!
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