

DIGITAL WE DAYS

2023



REDCUBE HIGH POWER TERMINALS

WÜRTH ELEKTRONIK MORE THAN YOU EXPECT

TODAY'S SPEAKERS



PRESENTATION

Stephan Bächle
Field Application Engineer



MODERATION

Markus Eberle
Marketing Department

INFORMATION ABOUT THE WEBINAR

You are muted during the webinar.

However, you can ask us questions using the chat function.

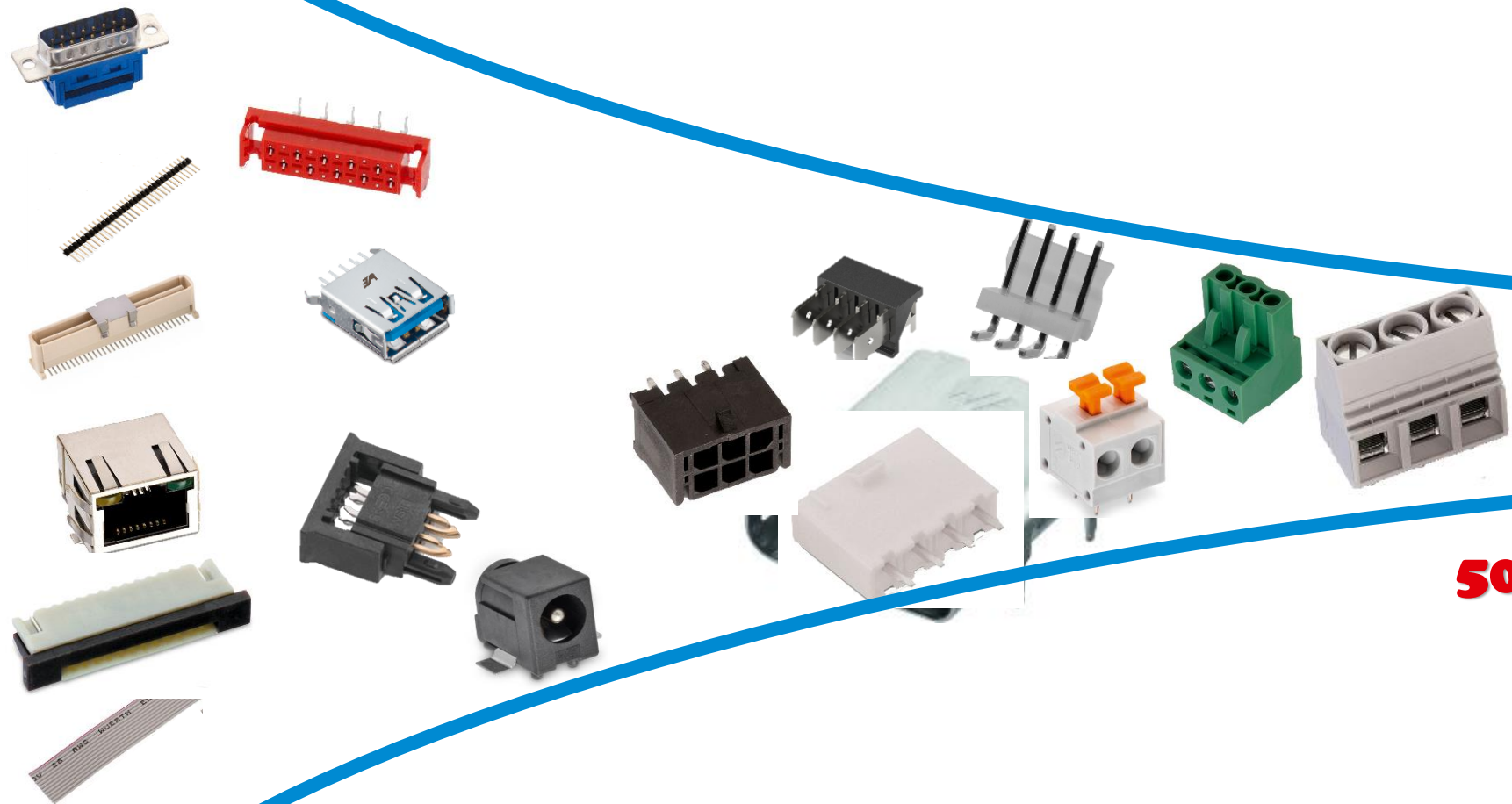
Duration of the presentation 30 Min
Q&A: 10 – 15 Min

Any questions?
No problem! Email us digital-we-days@we-online.com

Please help us to optimize our webinars!
We are looking forward to your feedback.

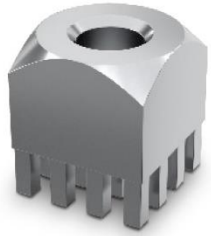
On our channel Würth Elektronik Group
And on [Digital WE Days 2023 YouTube Playlist](#)





50/100A

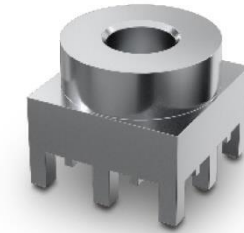
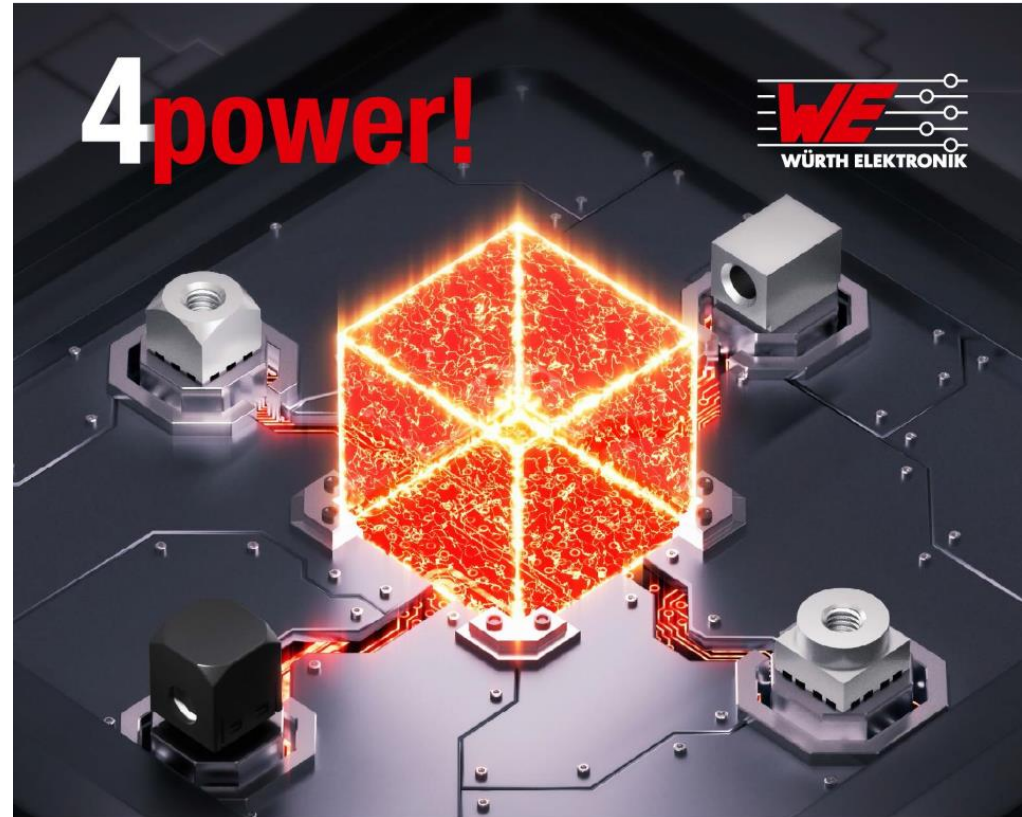
RED CUBE GLOBAL RANGE



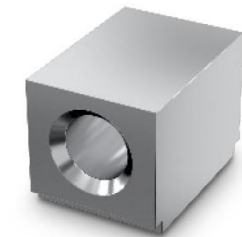
REDCUBE PRESS-FIT



REDCUBE PLUG

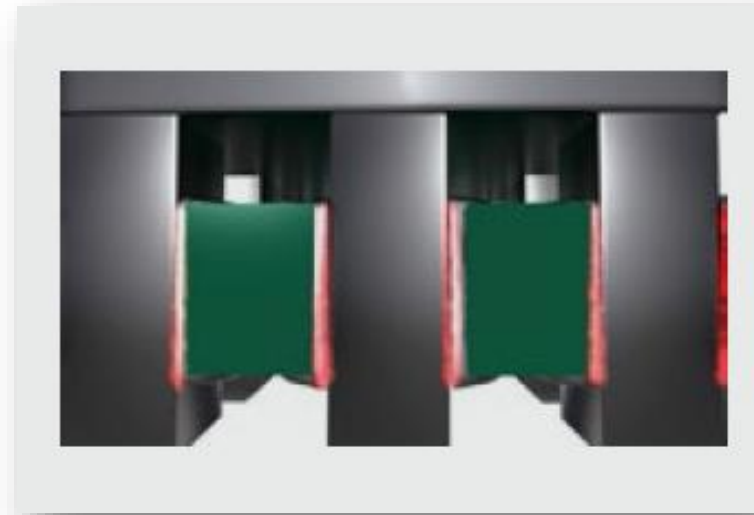
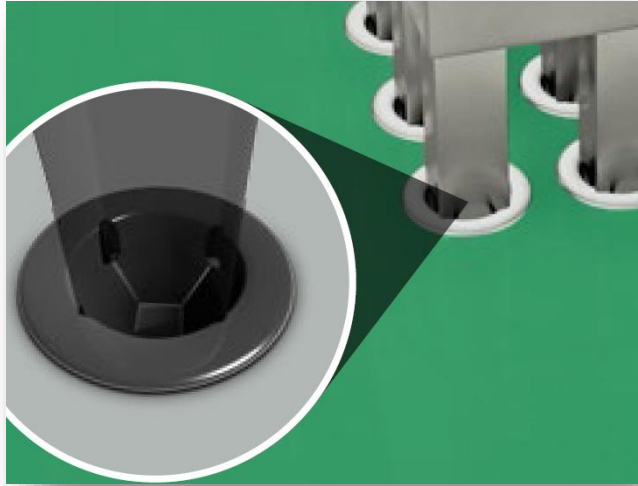


REDCUBE THR

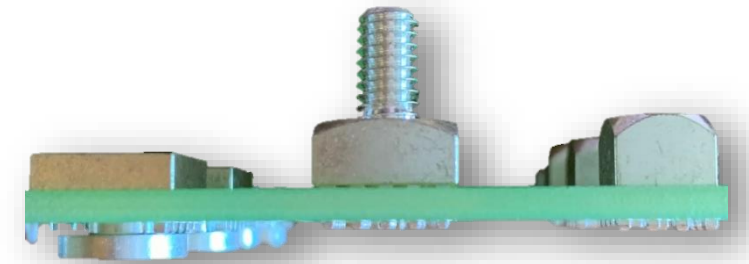
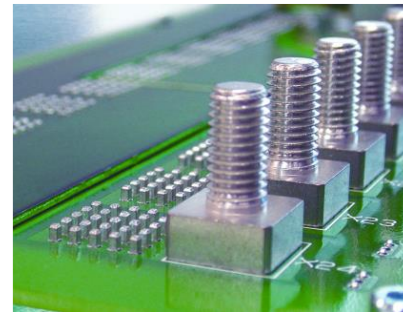


REDCUBE SMD

PRESS FIT: HOW DOES IT WORK ?



- solder free
- gastight
- Powerful electrical connection



HOW THIS IS CERTIFIED: ELECTRICAL

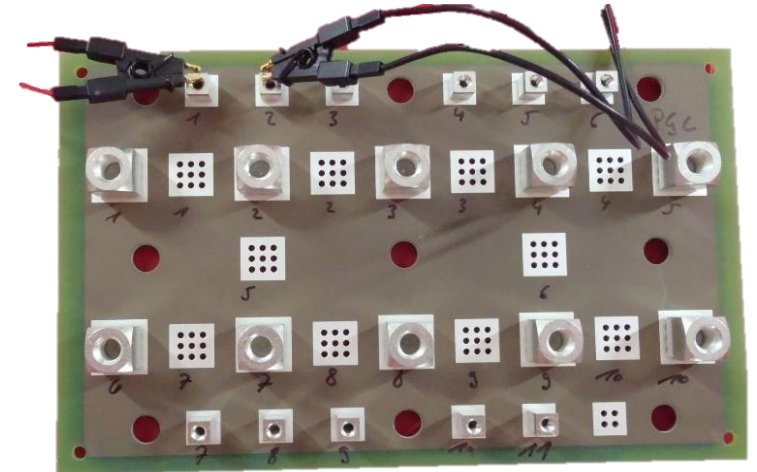
Contact resistance measurement IEC60512-2-1

Usual soldering power
connector

Red cube

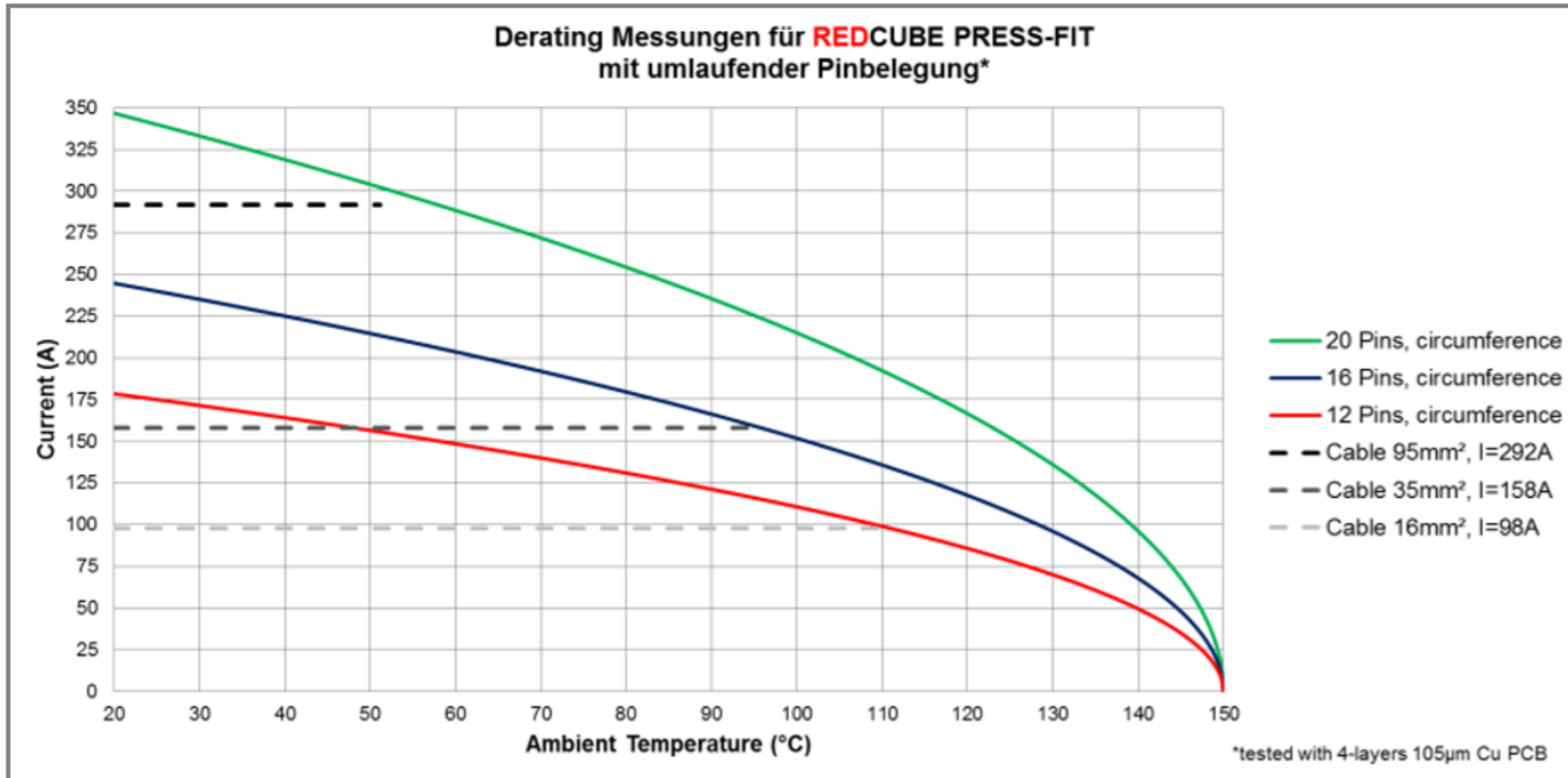
$<20\text{m}\Omega$

$<200\mu\Omega$



➤ Less contact resistance leads to less temperature rise

DERATING CURVES



2 rows



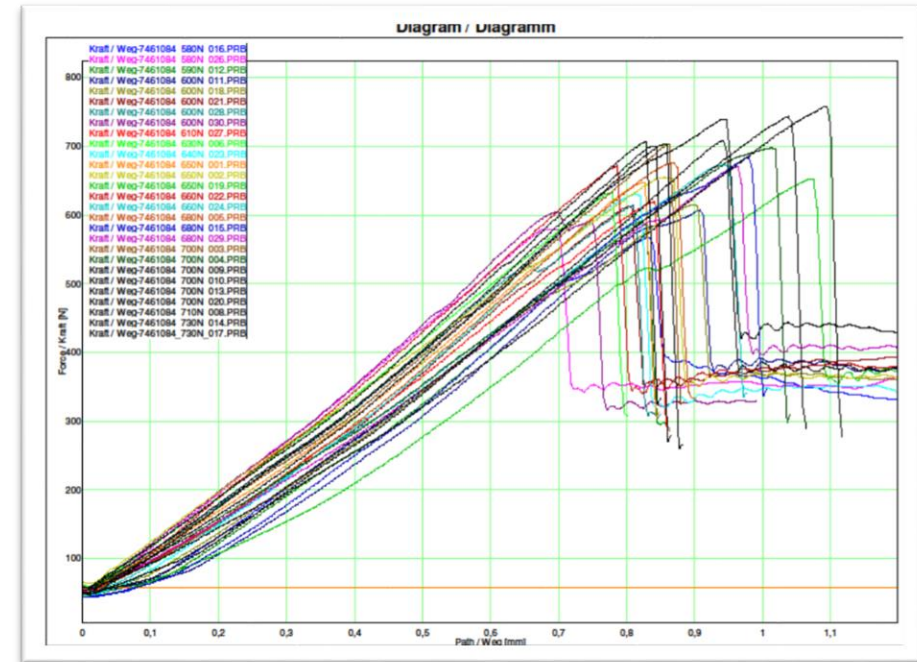
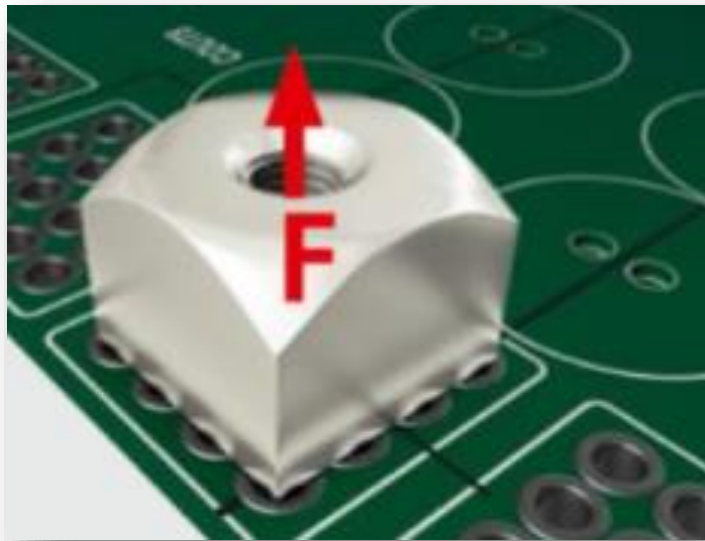
Circumference



Full

HOW THIS IS CERTIFIED: MECHANICAL

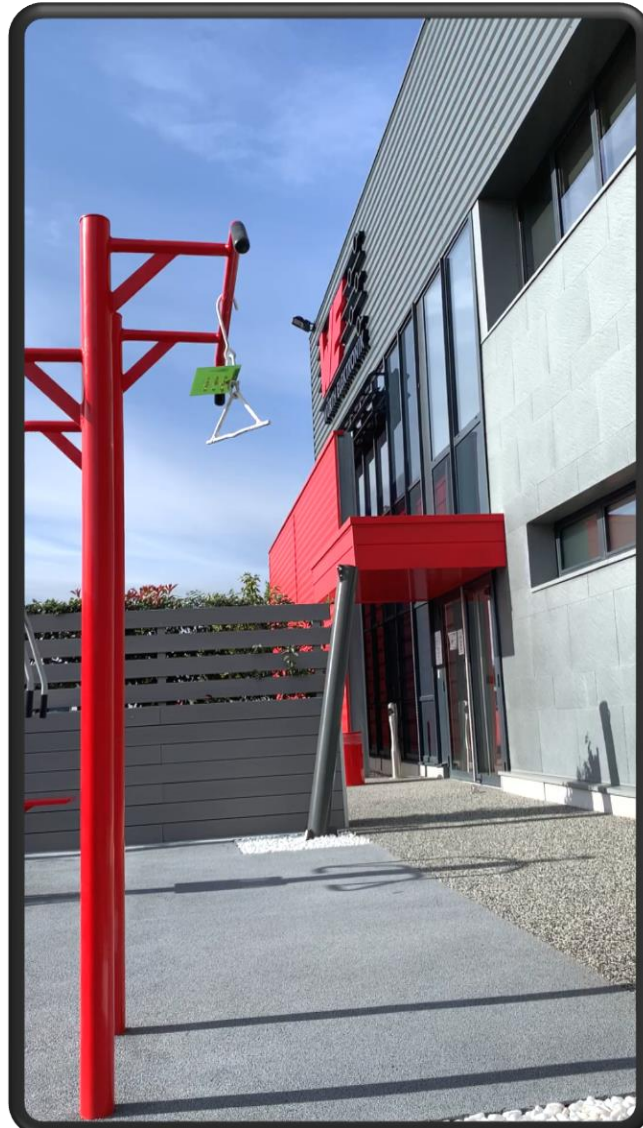
Pull-out test



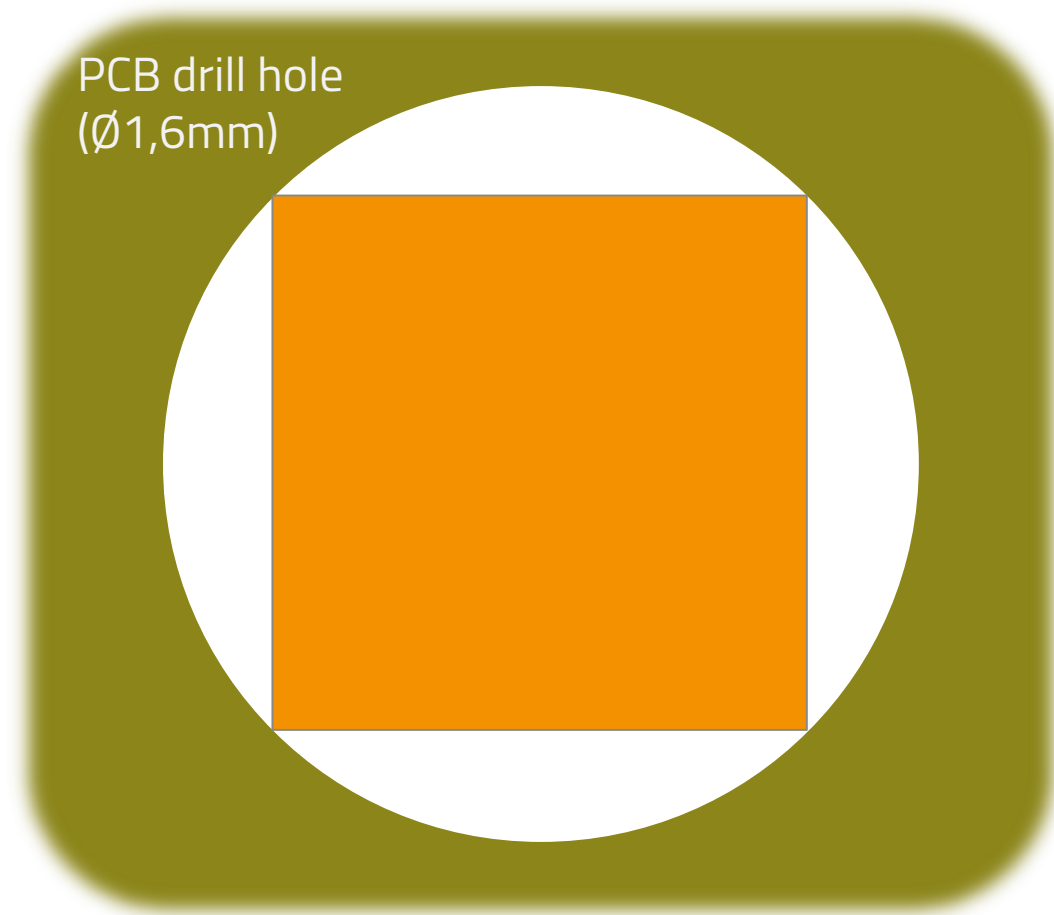
Extraction effort **10kg / pin**
with PCB 1,6mm

HOW THIS IS CERTIFIED: MECHANICAL

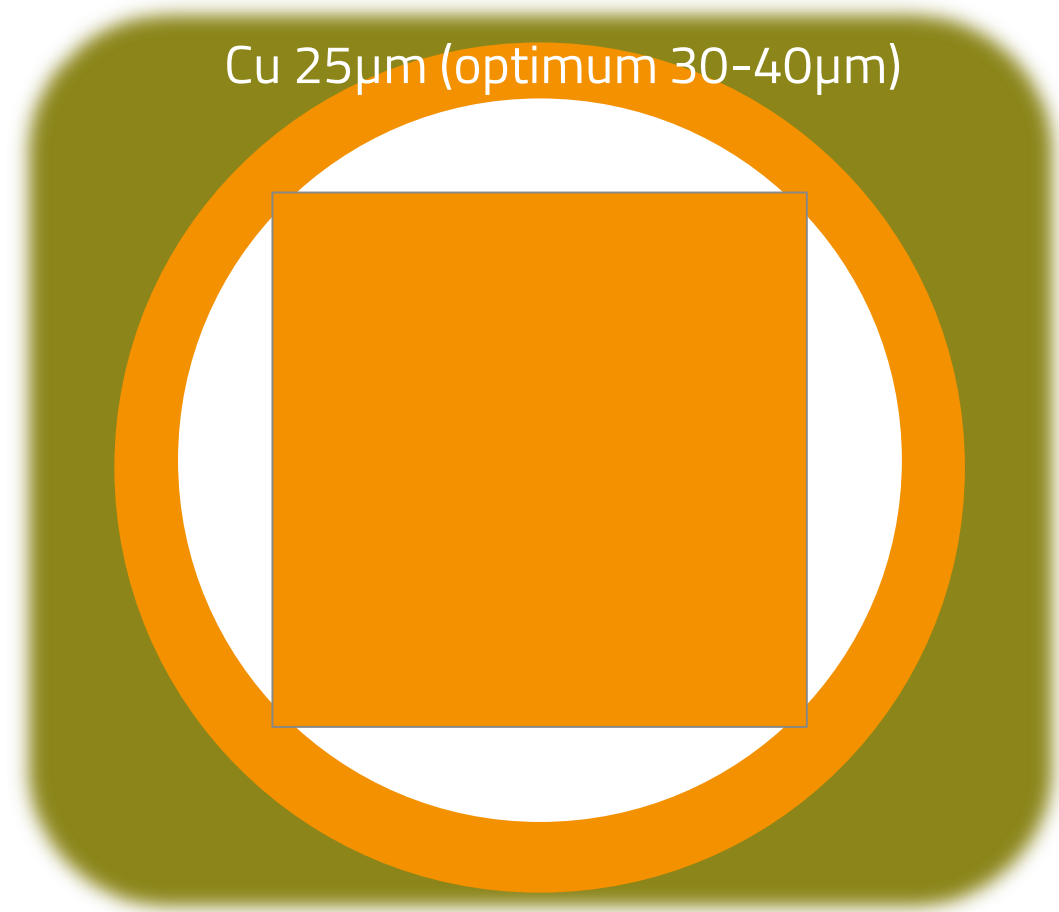
Pull-out test



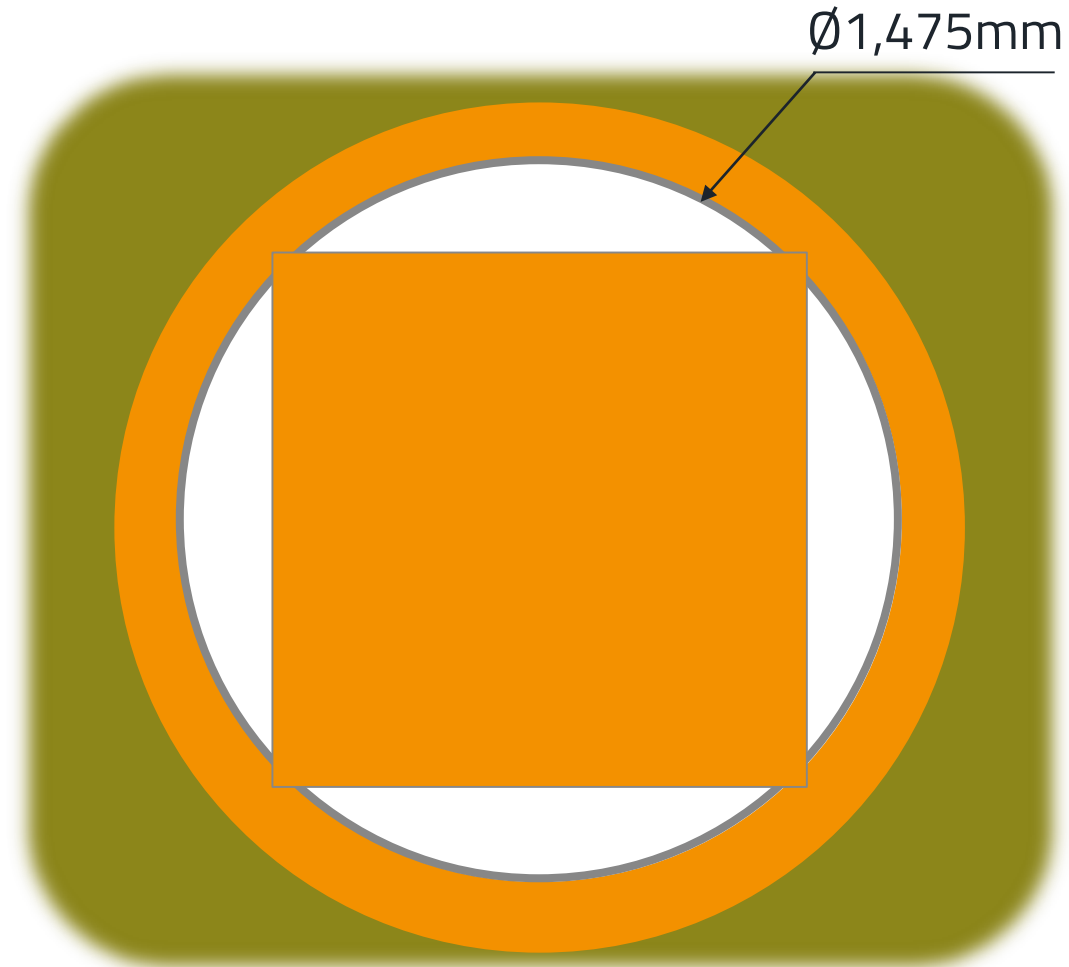
PRESS FIT: HOW DOES IT WORK ?



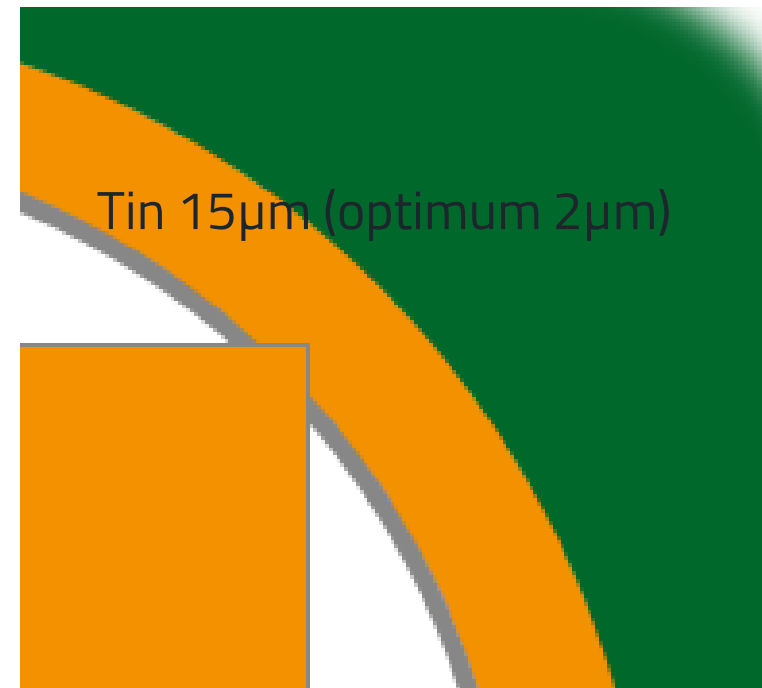
PRESS FIT: HOW DOES IT WORK ?



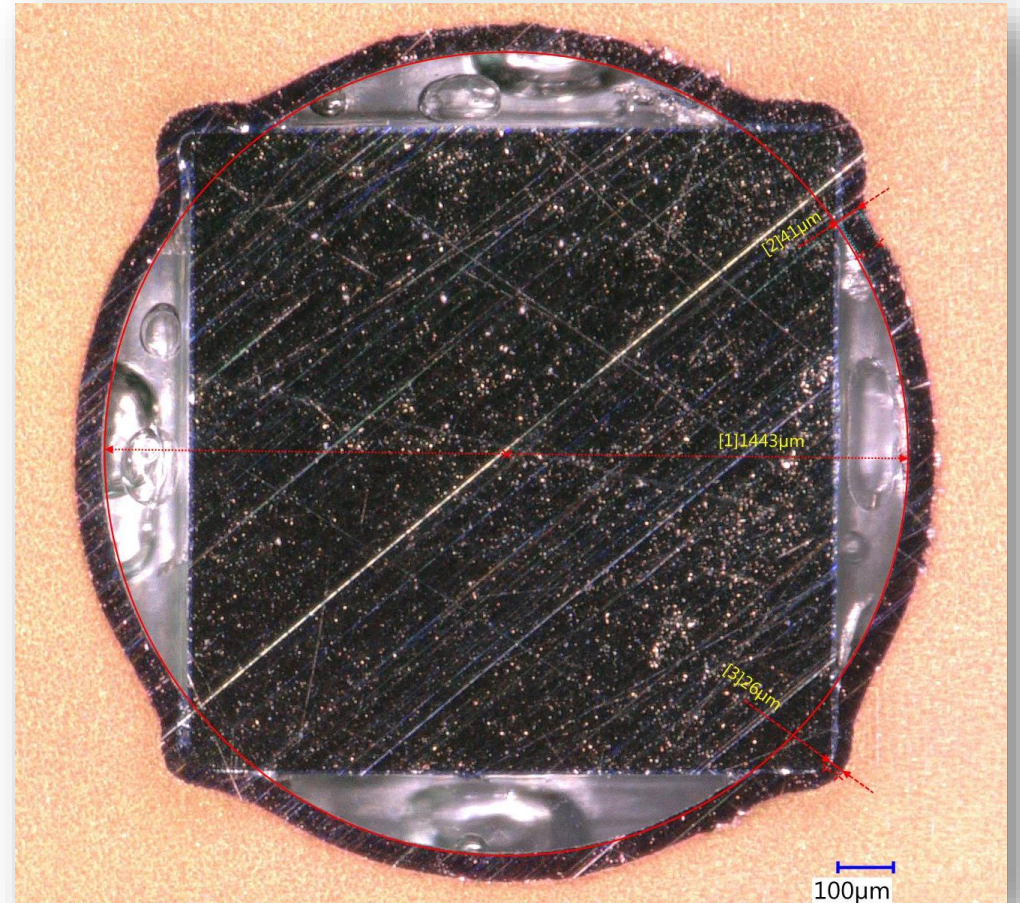
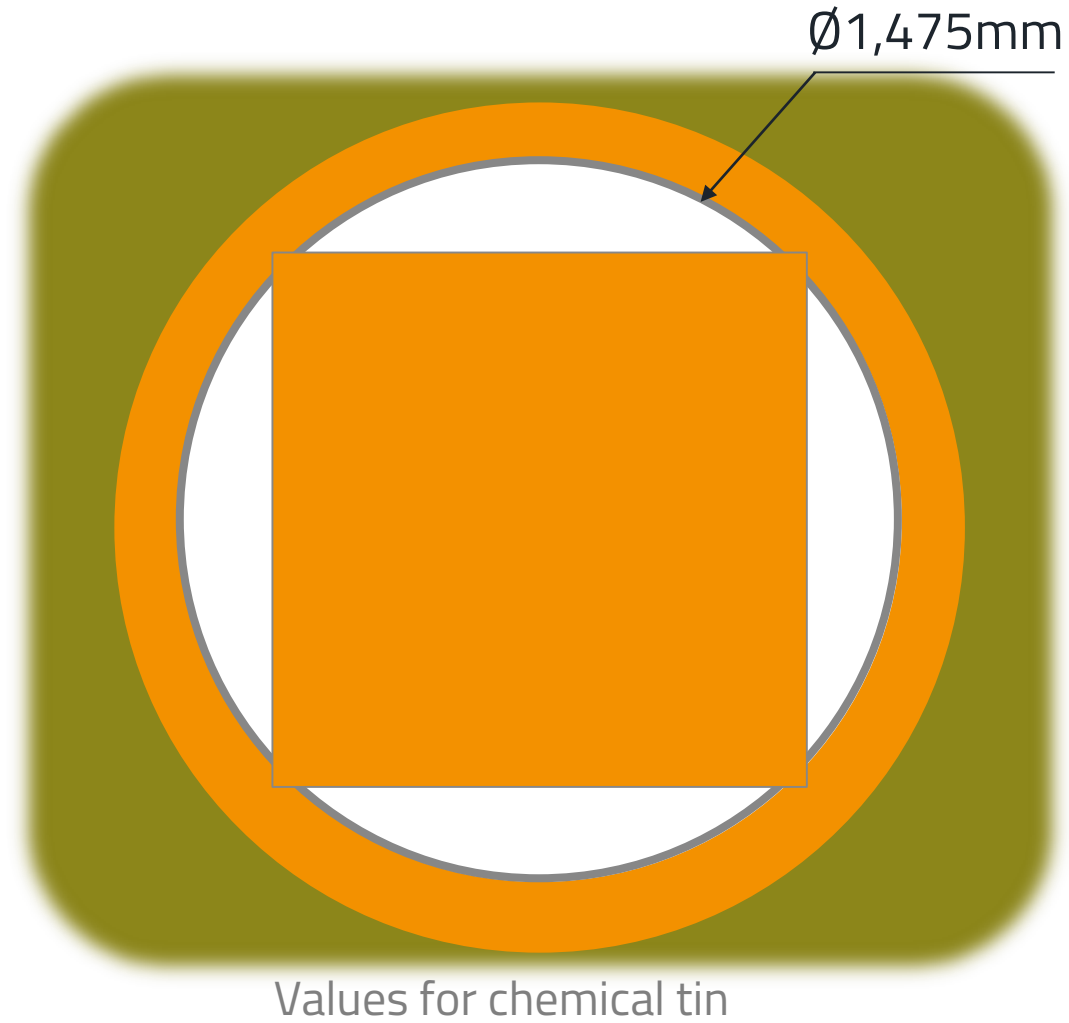
PRESS FIT: HOW DOES IT WORK ?



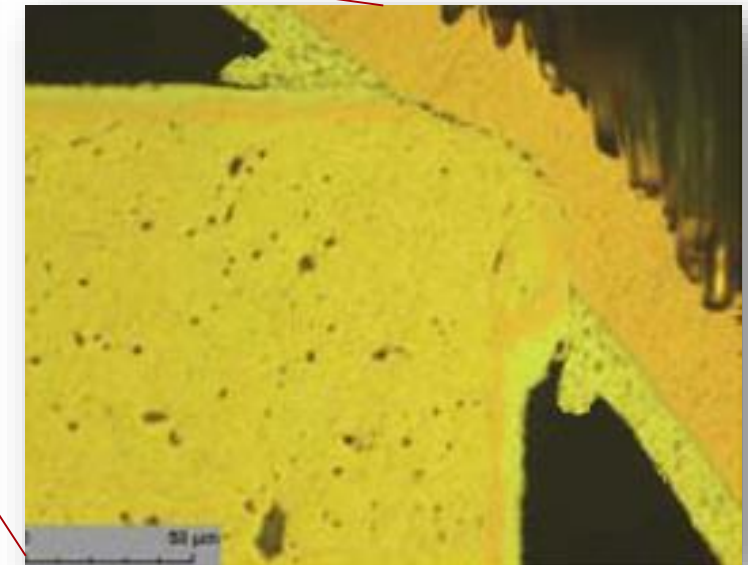
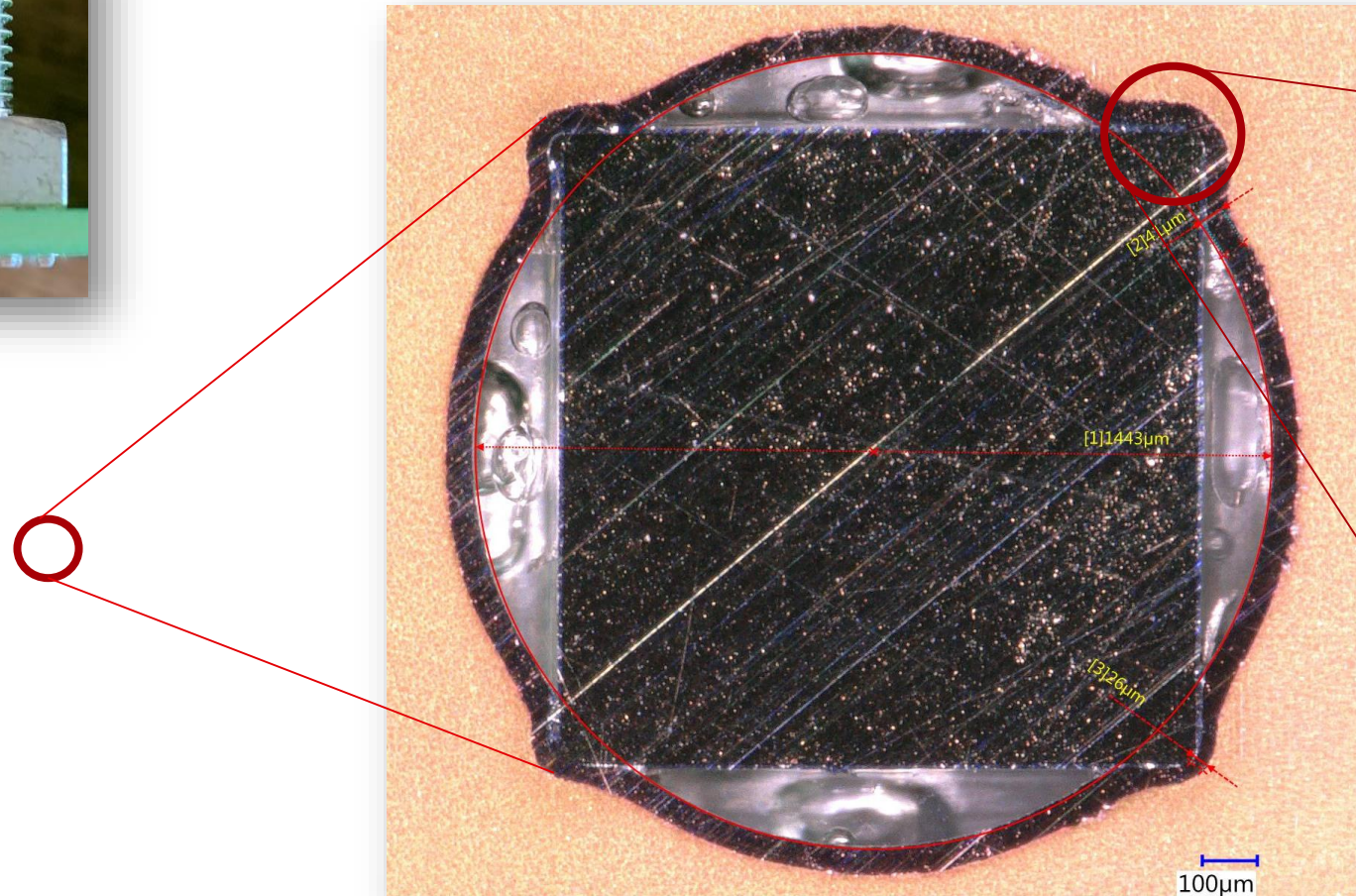
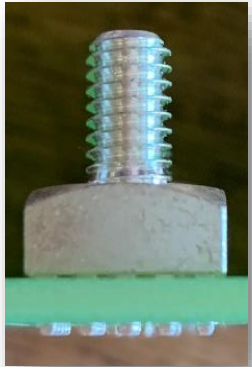
Values for chemical tin



PRESS FIT: HOW DOES IT WORK ?



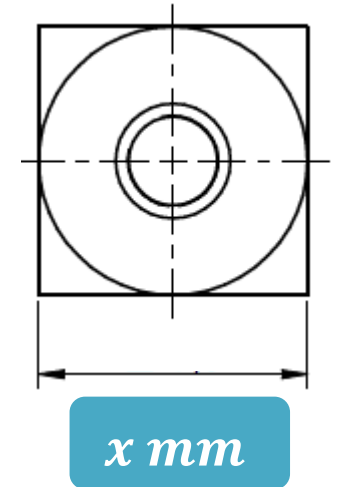
PRESS FIT: HOW DOES IT WORK ?



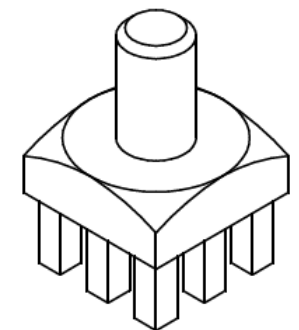
DESIGN A POWER PCB WITH RED CUBE: RULE OF THUMB



$$\text{width} \approx x \cdot 3 \text{ mm}$$



$$\text{thickness} \approx \frac{I}{0,3} \mu\text{m}$$



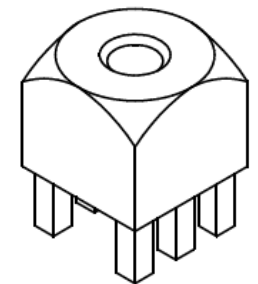
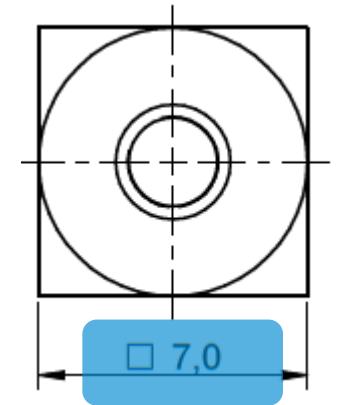
Properties	Test conditions		Value	Unit	Tol.
Rated Current	@ 20 °C	I_R	I	A	max.

DESIGN A POWER PCB WITH RED CUBE: SOME TIPS



width \approx 21 mm

*thickness \approx 330 μ m
4 or 5 layers of 70 μ m
or
3 layers of 105 μ m*

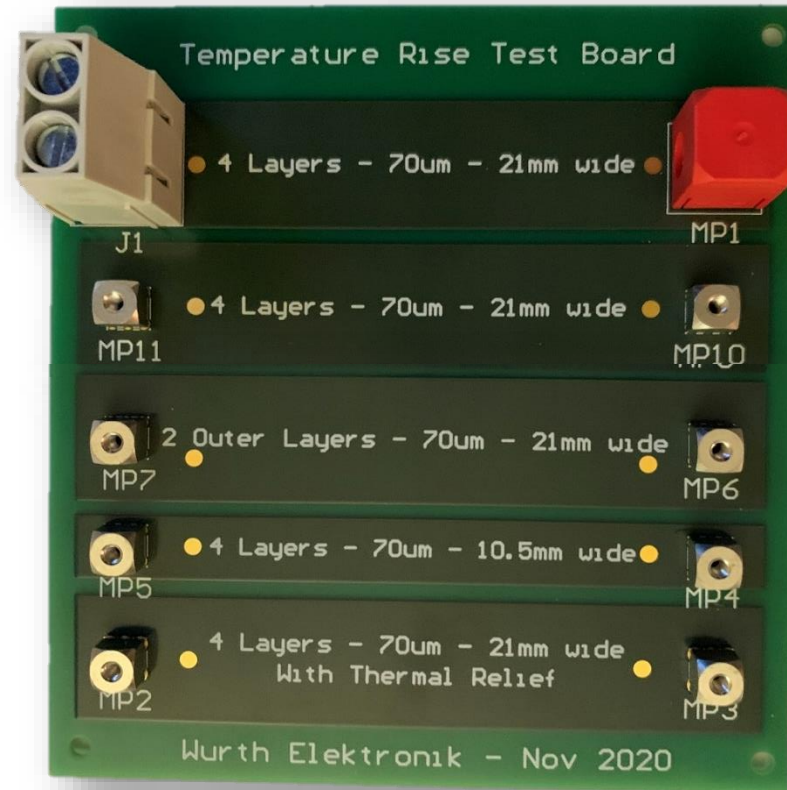


Properties	Test conditions		Value	Unit	Tol.
Rated Current	@ 20 °C	I_R	100	A	max.

TEMPERATURE RISE TESTS

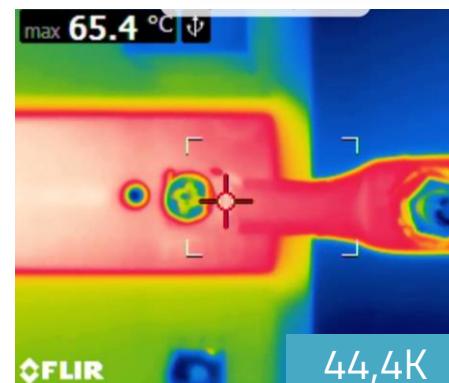
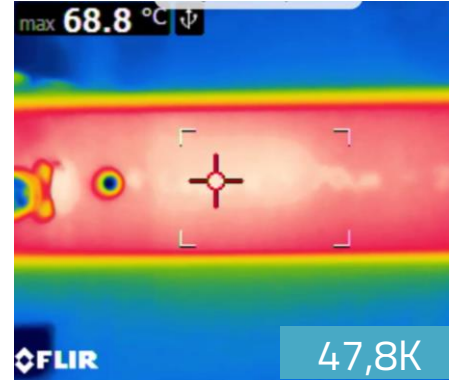
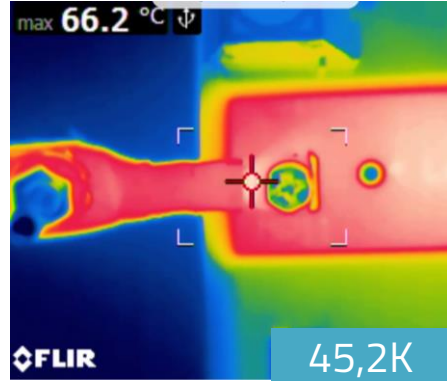
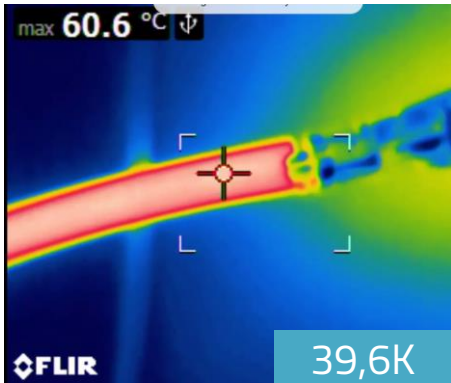
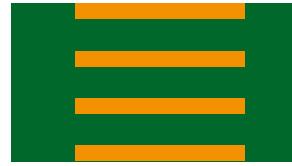
Test goal:

- Heat repartition
- Verify trace design
- Nb of layers influence

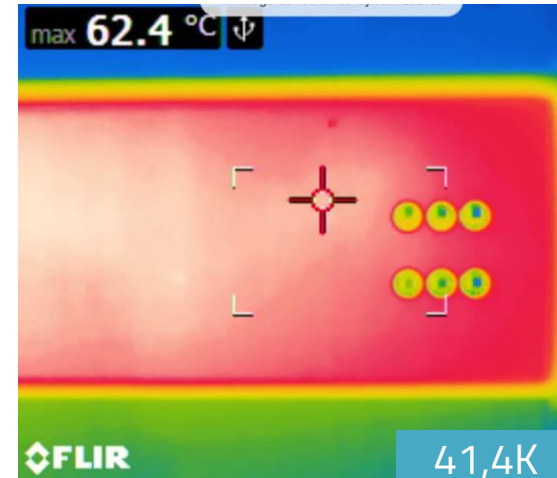
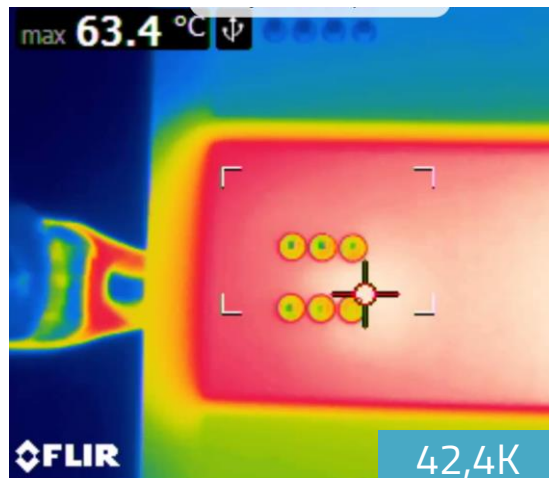


TEMPERATURE RISE TESTS

Working current 100A
4 layers 70µm 21mm wide
Ambient Temp = 21°C



Bottom view

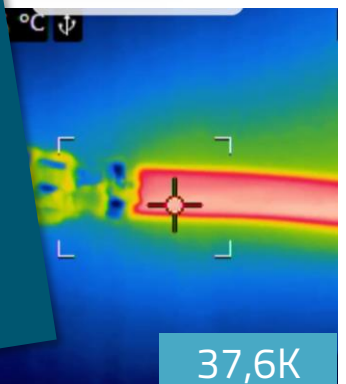
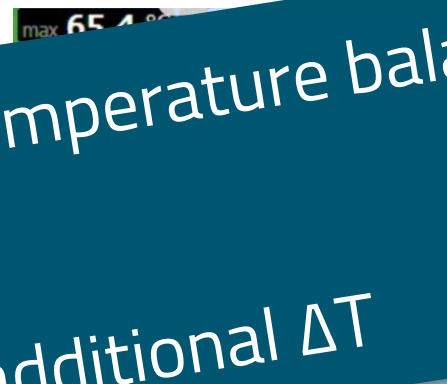
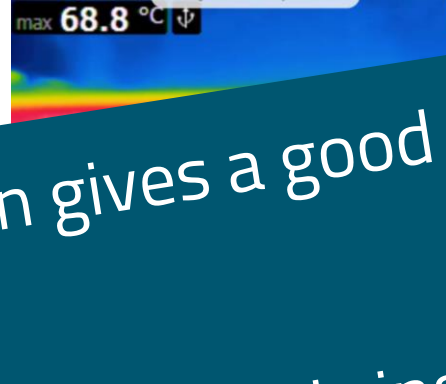
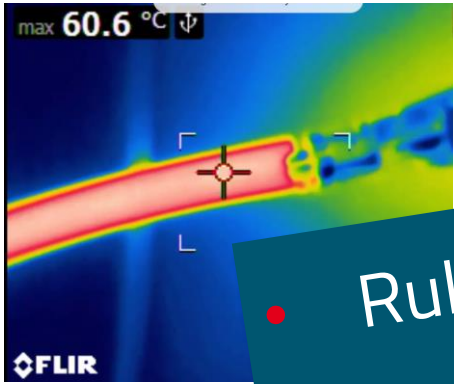


TEMPERATURE RISE TESTS

Working current 100A

4 layers 70µm 21mm wide

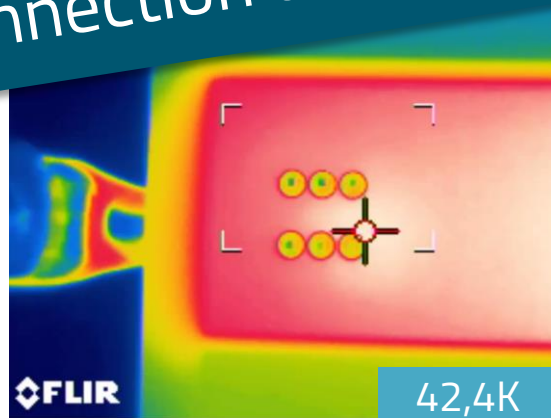
Ambient Temp = 21°C



• Rule of thumb design gives a good temperature balance in the full system

• Pressfit connection does not bring additional ΔT

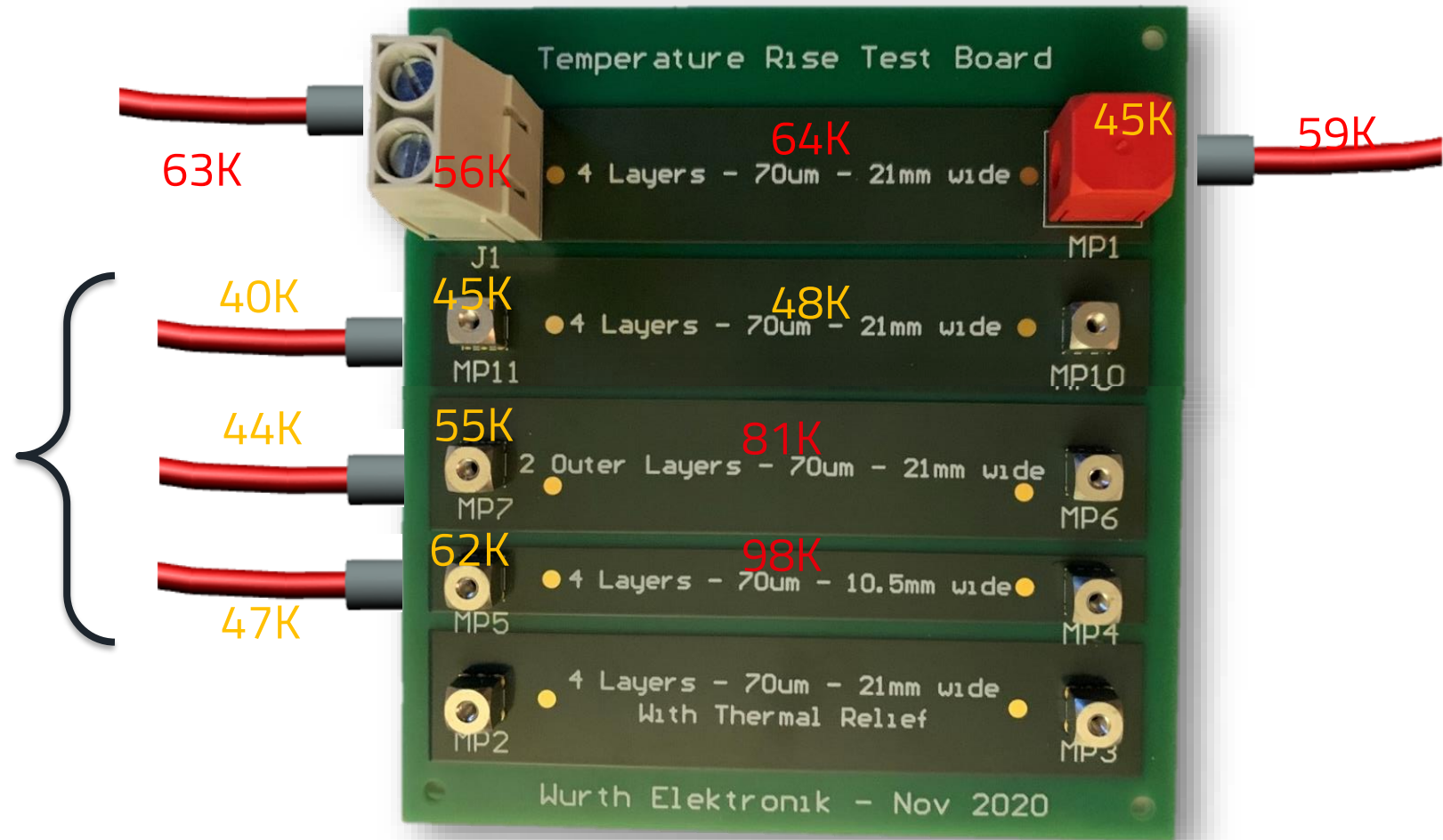
Bottom view



TEMPERATURE RISE TESTS

Working current 100A
10mm²

Working current 100A
16mm²

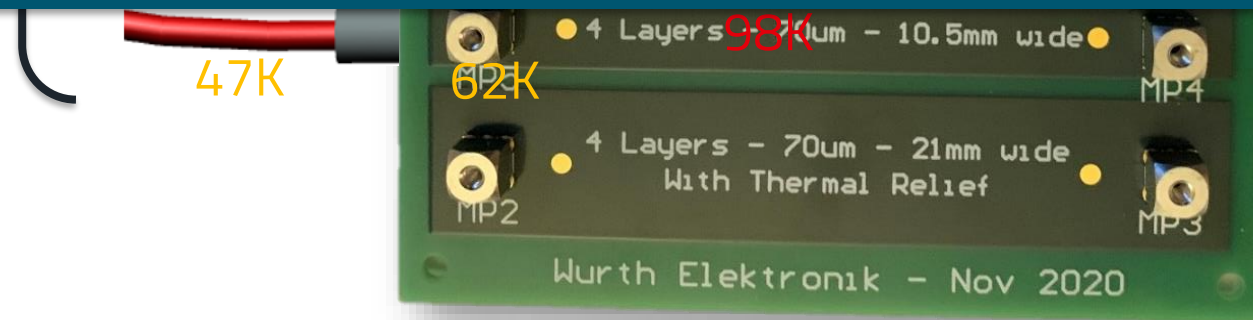


TEMPERATURE RISE TESTS

Work

- Redcube is
 - small
 - high current
 - cooling down PCBs
- Rule of thumb high current design is a good approach
- Always check temperature with prototype test

Worki

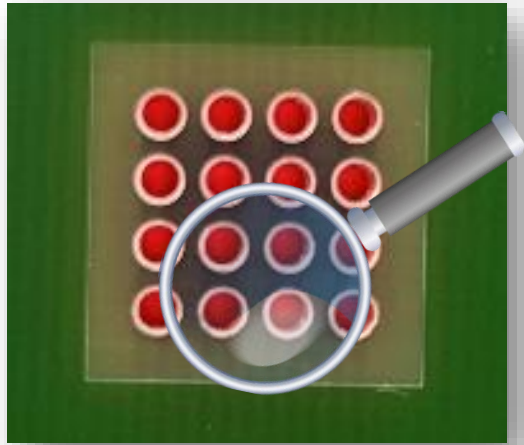


PRESS-FIT PROCESS

- Materiel needed:
 - PCB
 - Support
 - Base
 - Stamp
 - Press

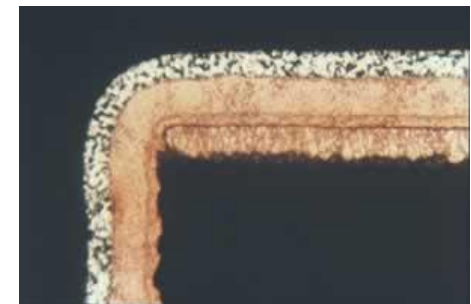
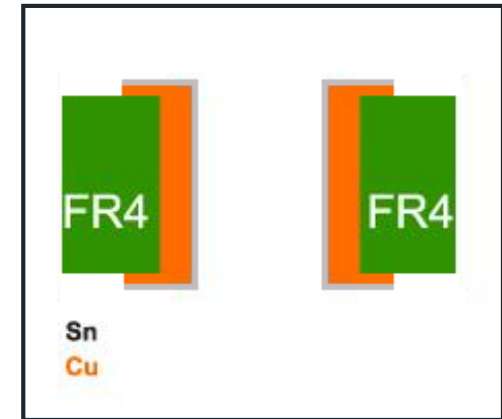
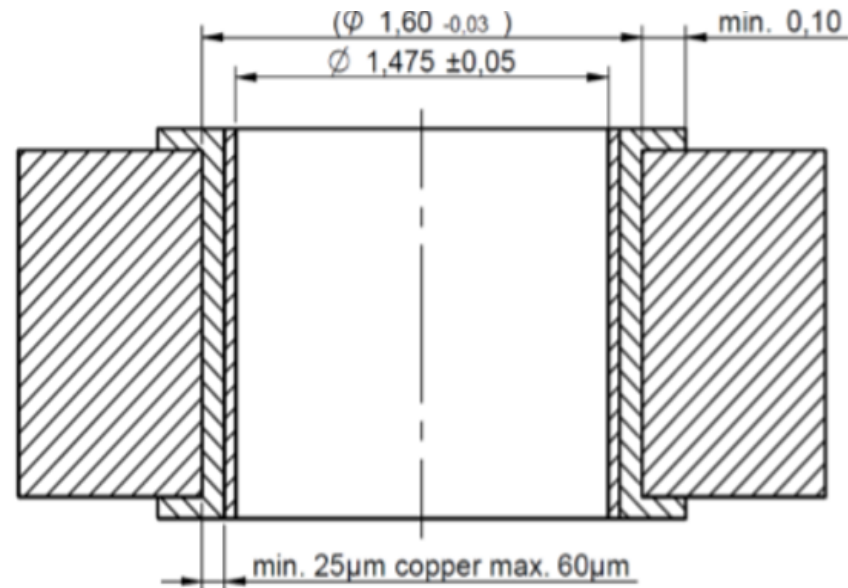


PRESS-FIT PROCESS - PCB



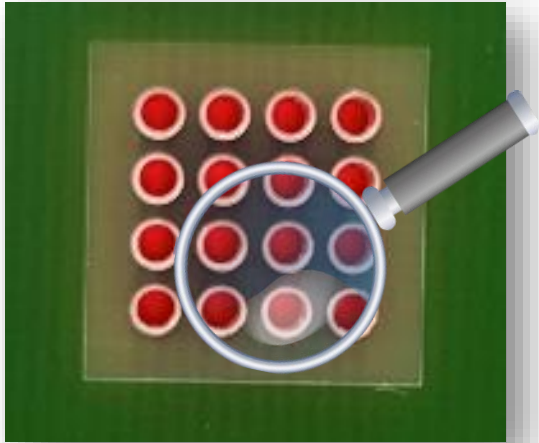
Chemical tin

ENIG (NiAu)

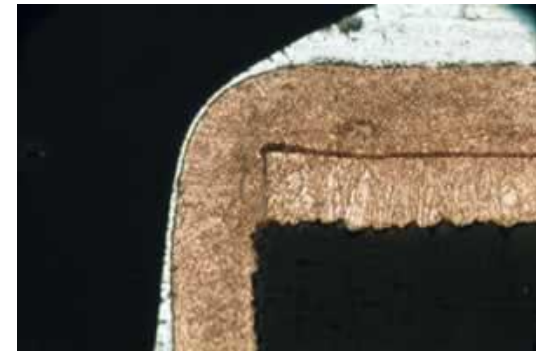
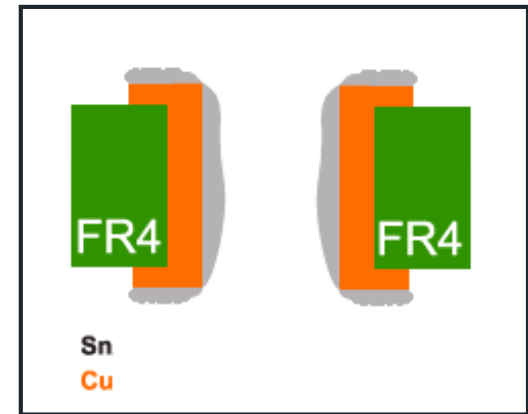
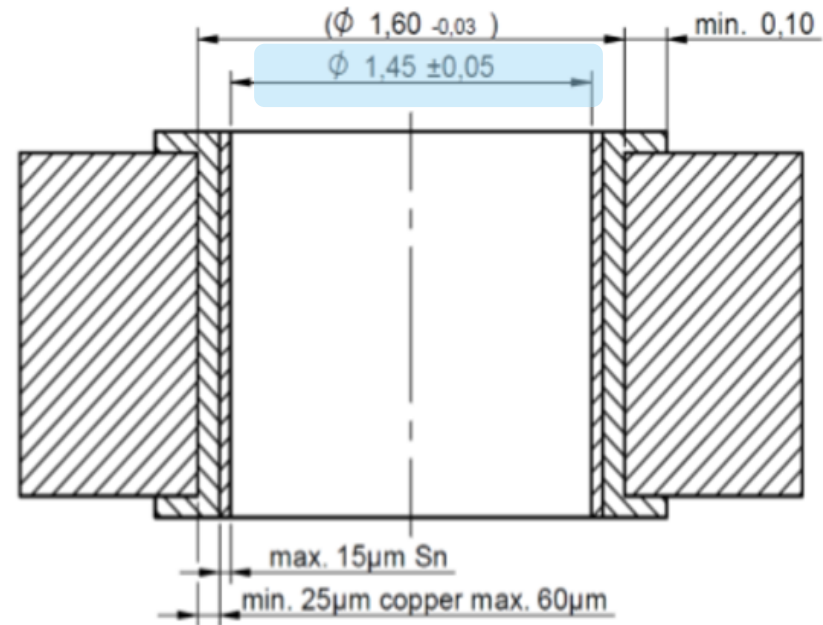


- *25 - 60μm Copper - optimum 30-40μm*
- *max. 15μm Tin - optimum 2μm*

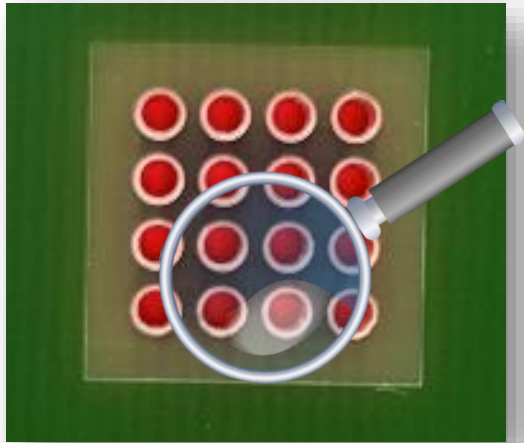
PRESS-FIT PROCESS - PCB



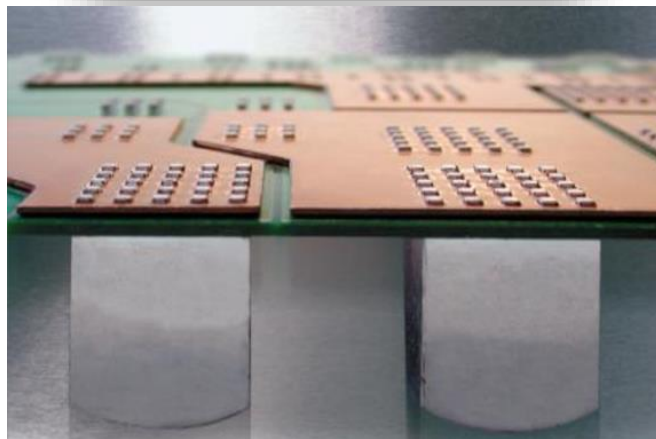
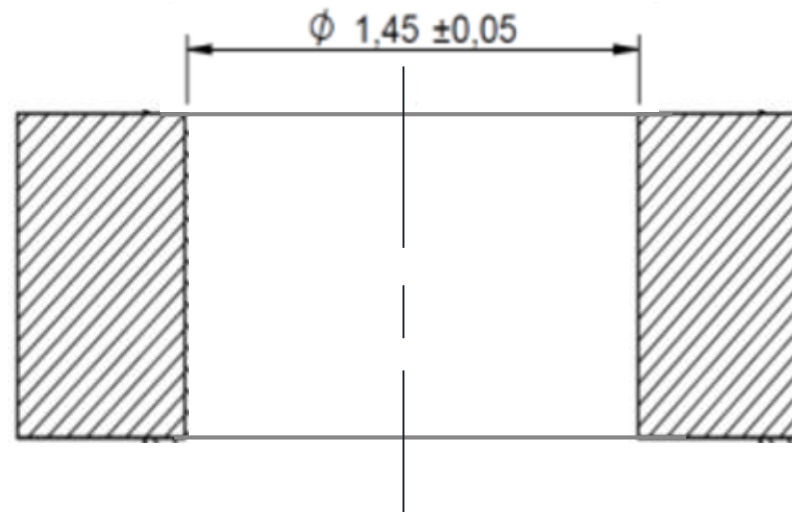
HAL – Hot Air Levelling



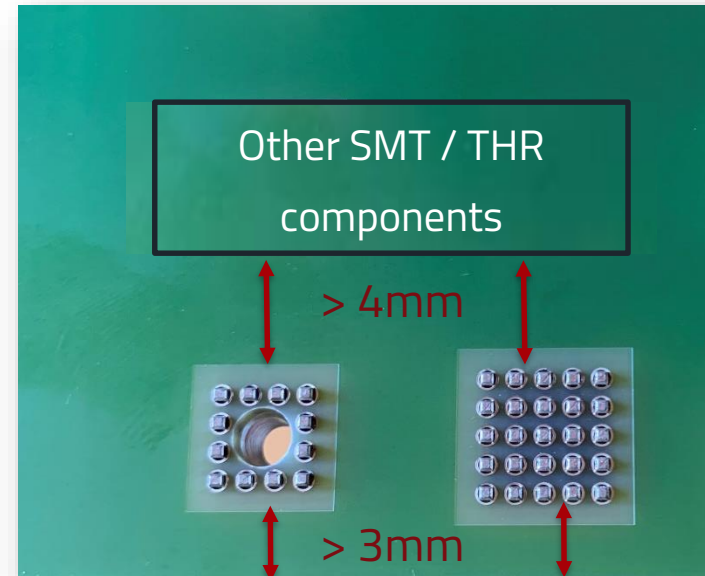
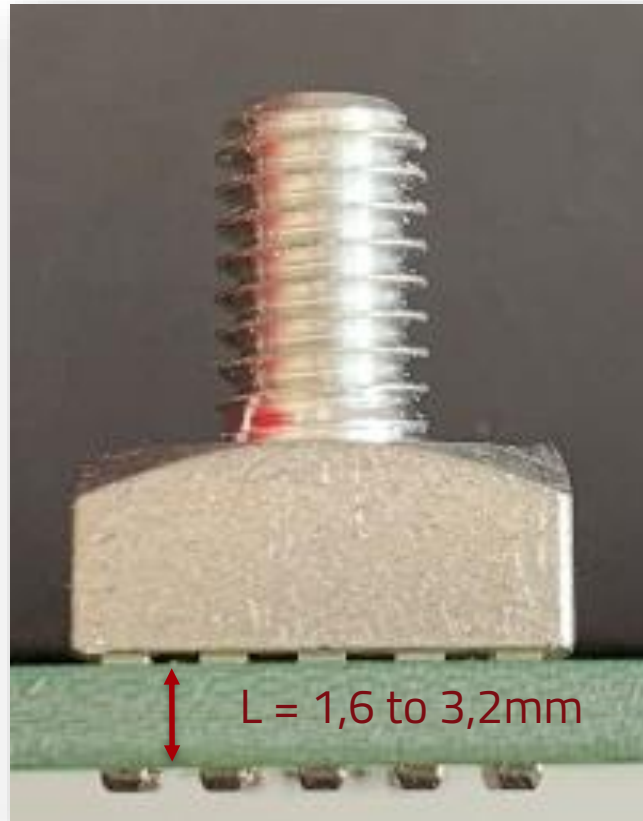
PRESS-FIT PROCESS - PCB



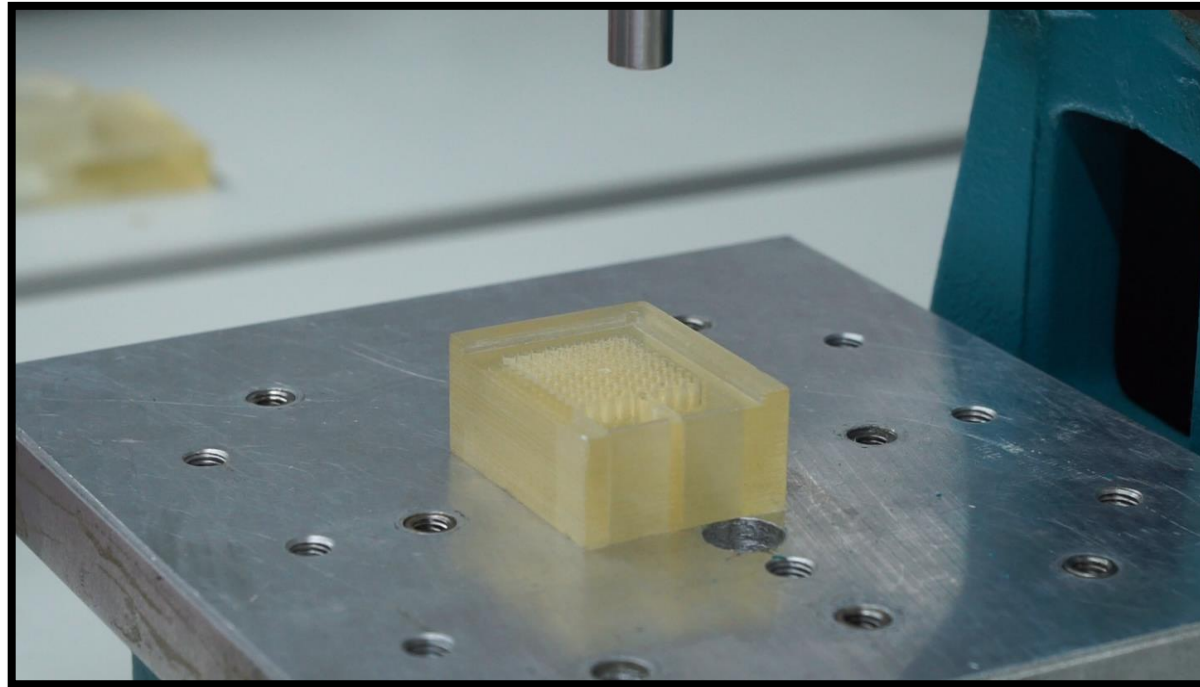
Pure copper bar (Drill hole
 $1,45 \pm 0,05$)



PRESS-FIT PROCESS - PCB

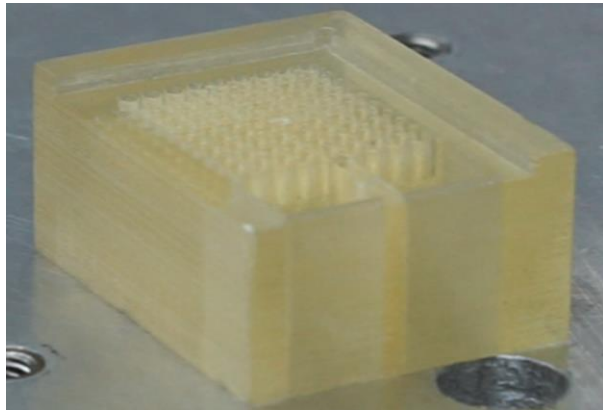


BASIC PROCESS FOR PRESS-FIT

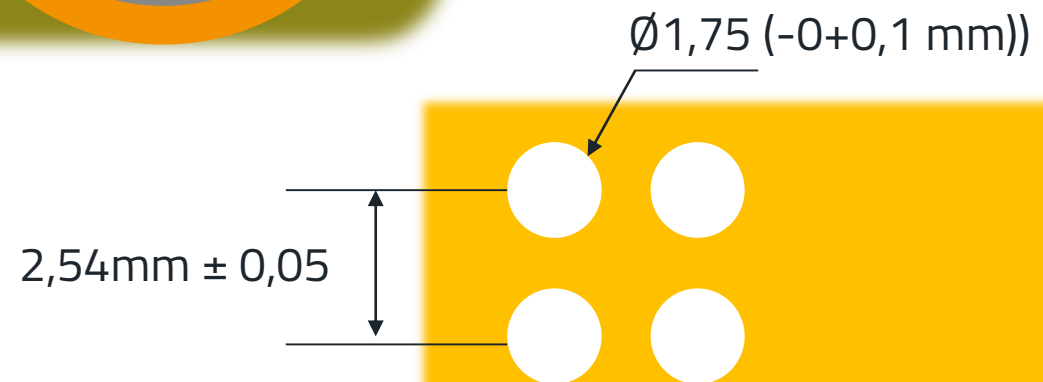
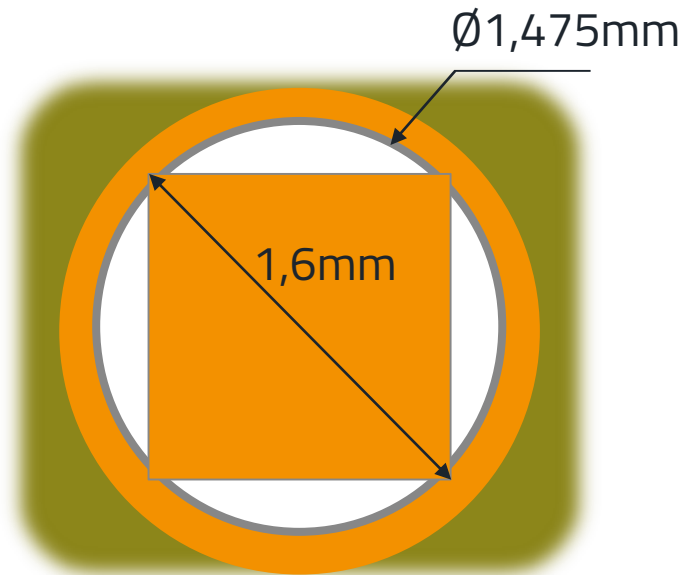


PRESS FIT PROCESS: SUPPORT

Support location

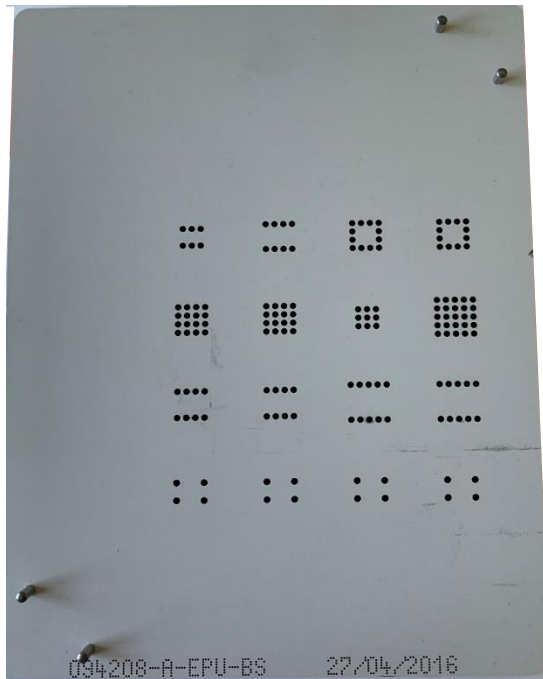


3D printing prototype

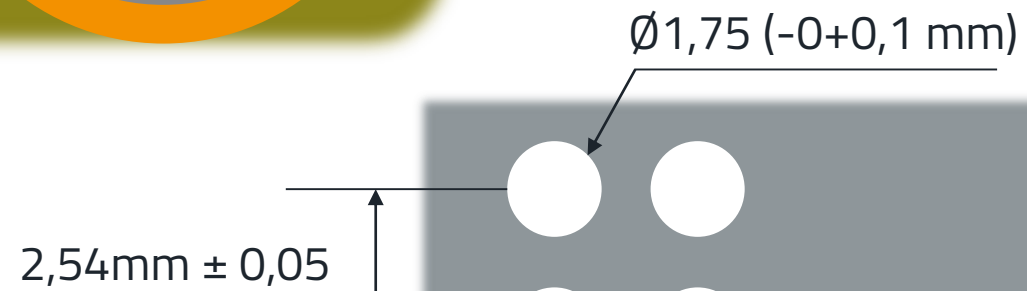
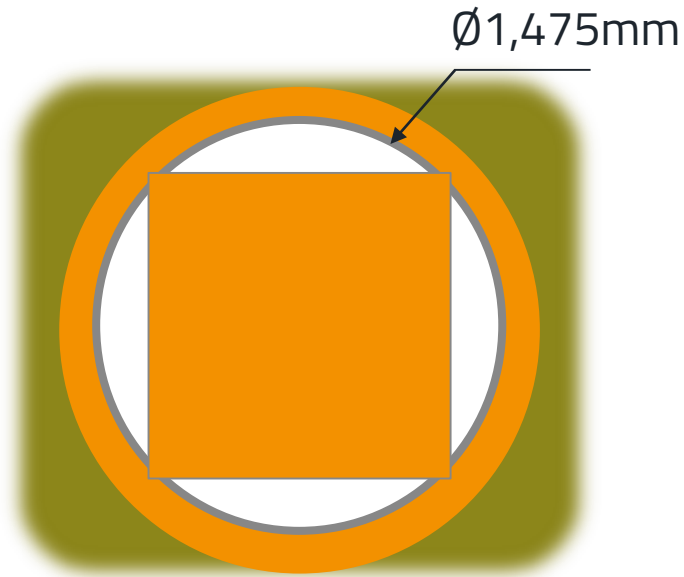


PRESS FIT PROCESS: SUPPORT

Support location

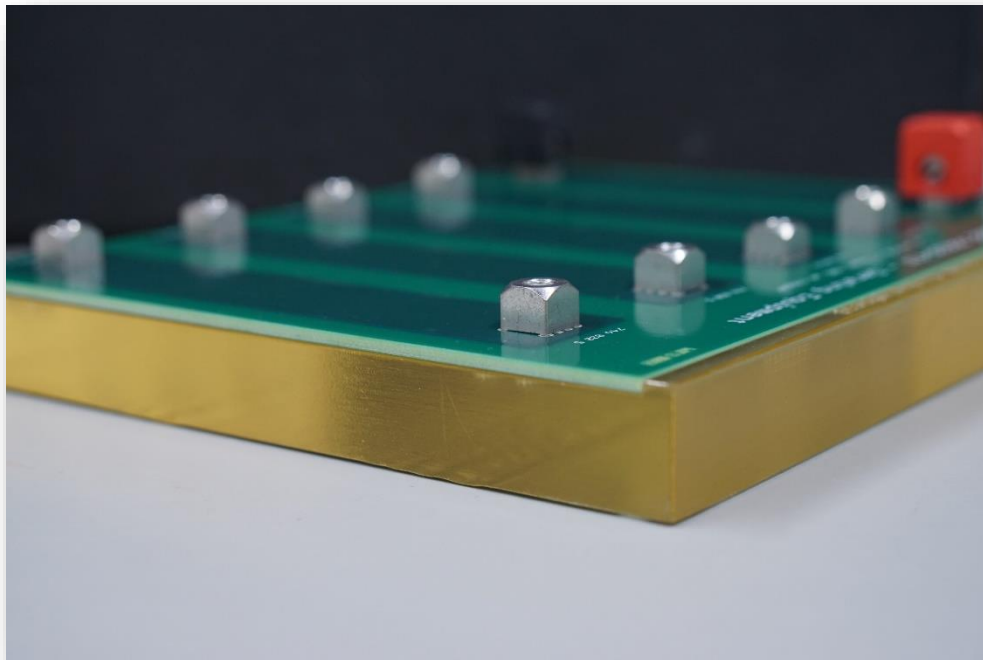


Metal final version

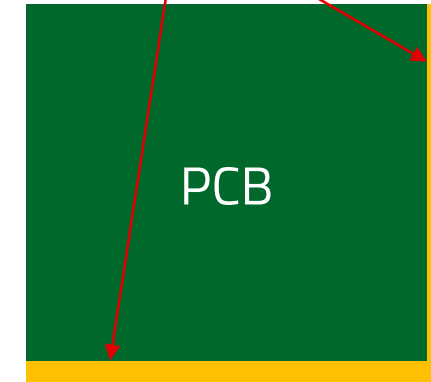


PRESS FIT PROCESS: SUPPORT

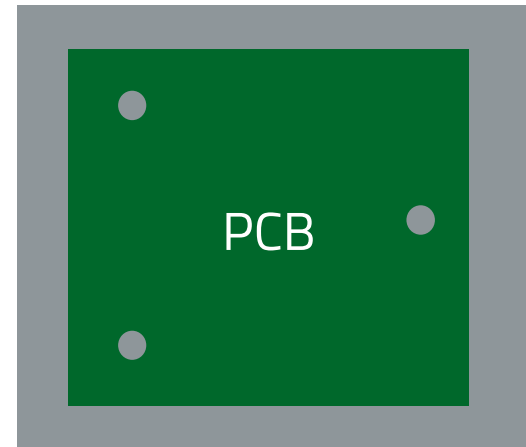
Support locating



locating

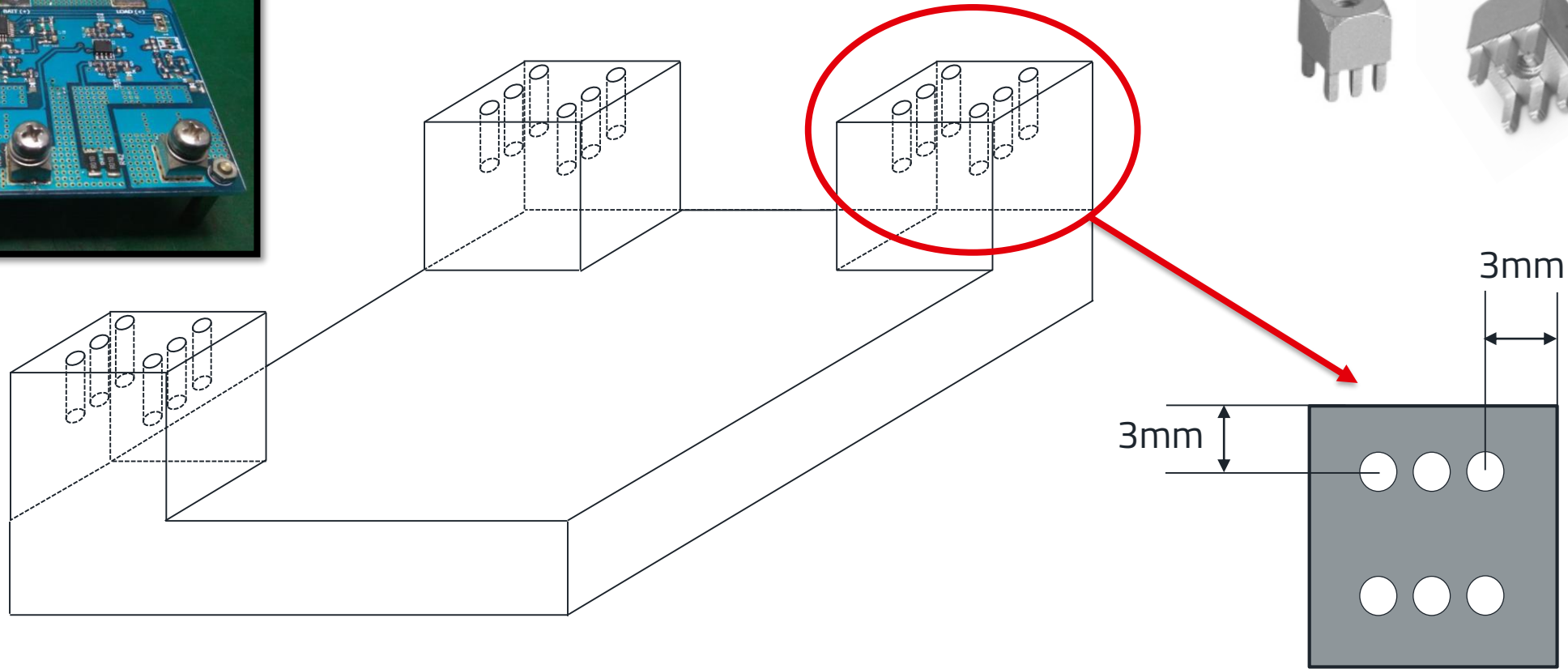


3D
printing
support



Metal
support

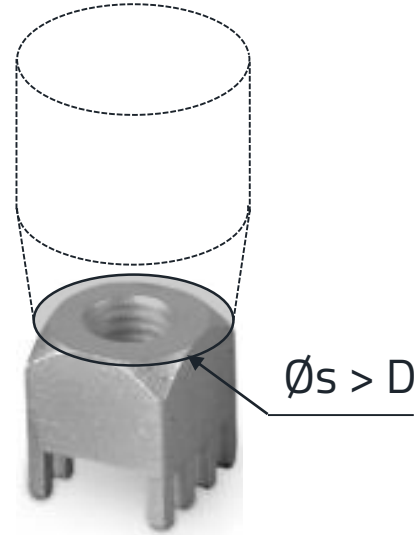
PRESS FIT PROCESS: SUPPORT REAL CASE



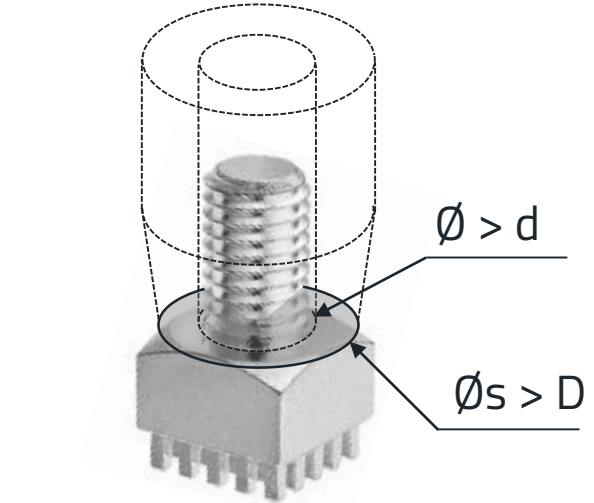
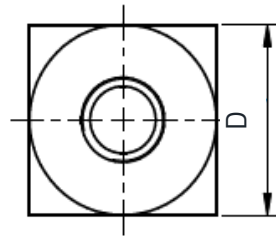
PRESS FIT PROCESS: STAMP



\varnothing_s

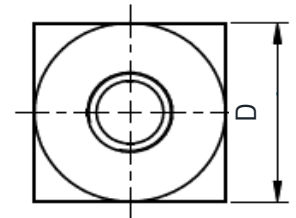
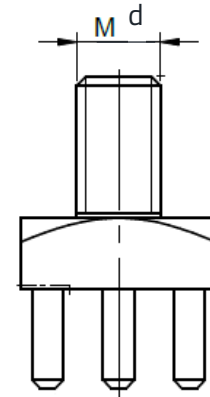


$\varnothing_s > D$

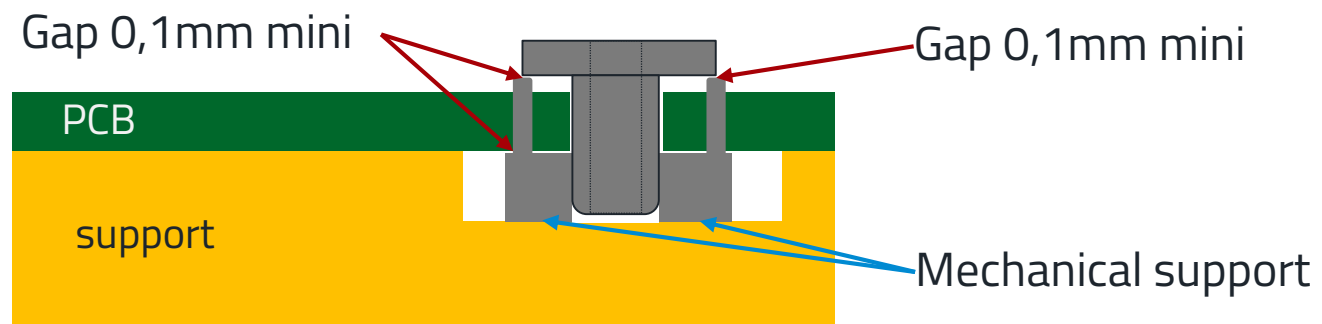
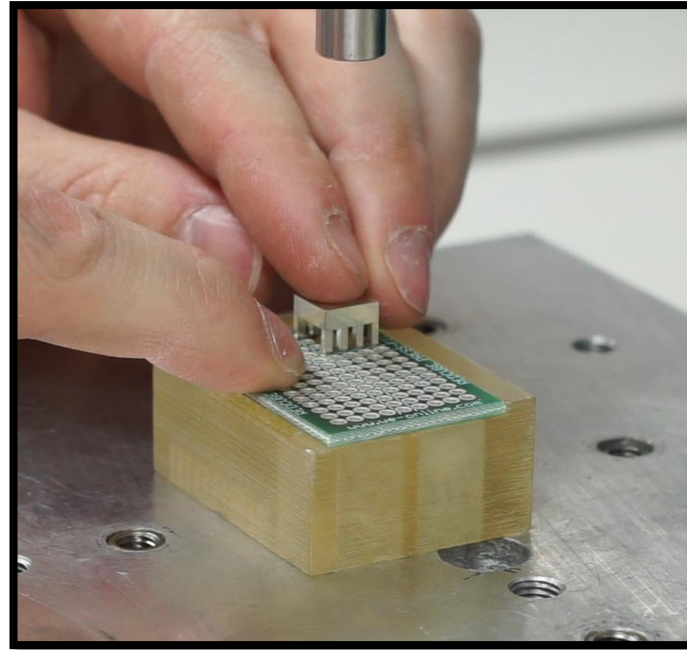


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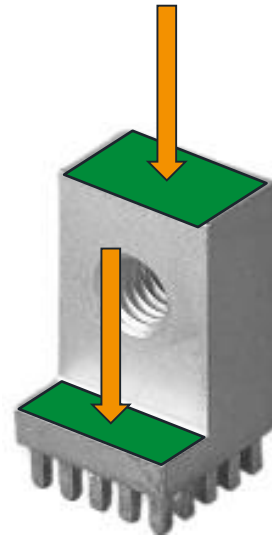
$\varnothing_s > D$



PRESS FIT PROCESS: STAMP



PRESS FIT PROCESS: STAMP



PRESS FIT PROCESS: PRESS

All type of press for REDCUBE

- [Press Schmidt](#)



- [Press Gechter](#)



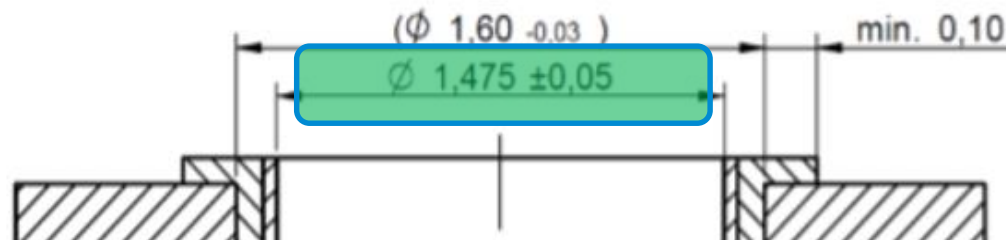
INSERTION FORCE – PRESS DIMENSIONING

PCB thickness (mm)

Empirical press-in PCB insertion force per (N/pin) min / max

(mm)	Chemical tin						ENIG						HAL					
	Ø1,425		Ø1,475		Ø1,525		Ø1,425		Ø1,475		Ø1,525		Ø1,40		Ø1,45		Ø1,50	
1,6	120	220	80	160	40	130	140	250	100	200	60	170	140	250	100	200	50	170
2,4	170	330	110	240	60	200	200	400	130	300	70	250	200	400	130	300	70	250
3,2	220	460	140	340	80	280	260	500	170	420	80	360	260	500	170	420	80	360

Specification for chemical surfaces



INSERTION FORCE – PRESS DIMENSIONING

PCB thickness (mm)	Empirical press-in PCB insertion force per (N/pin) min / max														
	Chemical tin						ENIG						HAL		
(mm)	Ø1,425	Ø1,475	Ø1,525	Ø1,425	Ø1,475	Ø1,525	Ø1,40	Ø1,45	Ø1,50	Ø1,425	Ø1,475	Ø1,525	Ø1,40	Ø1,45	Ø1,50
1,6	120 220	80 160	40 130	140 250	100 200	60 170	140 250	100 200	50 170	140 250	100 200	60 170	140 250	100 200	50 170
2,4	170 330	110 240	60 200	200 400	130 300	70 250	200 400	130 300	70 250	200 400	130 300	70 250	200 400	130 300	70 250
3,2	220 460	140 340	80 280	260 500	170 420	80 360	260 500	170 420	80 360	260 500	170 420	80 360	260 500	170 420	80 360



Example: redcube12 pins – PCB chemical tin thickness 3,2mm

→ 1,7 kN < press effort < 4 kN

INSERTION FORCE – PRESS DIMENSIONING



Example: redcube 12 pins – PCB chemical tin thickness 3,2mm

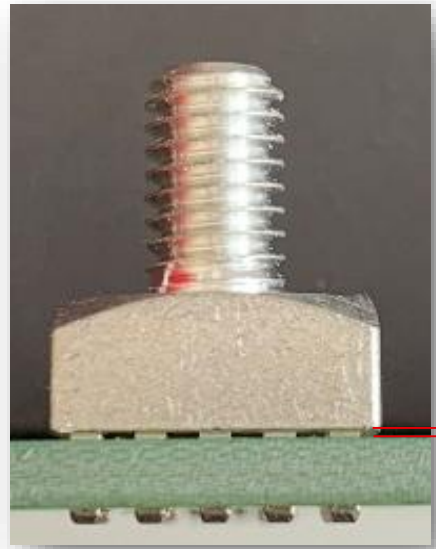
→ 1,7 kN < press effort < 4 kN

Press dimensioning > max effort +20% security

Example: press rack and pinion of 5kN.

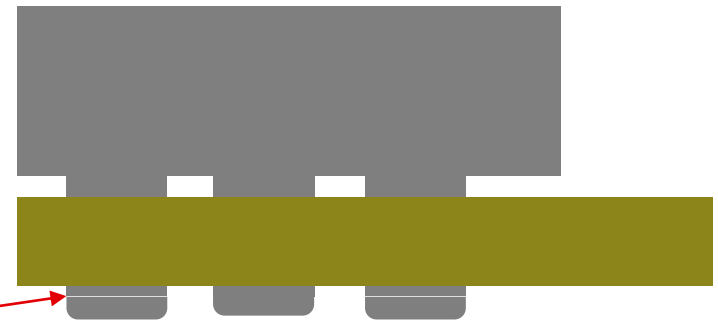


PRESS-FIT PROCESS



0,1mm

Flat zone
exceed PCB

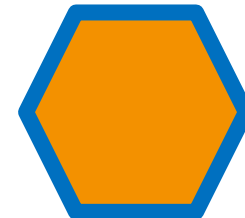
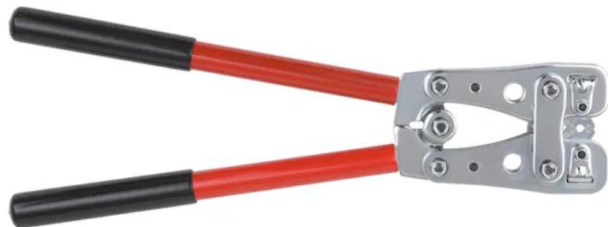


Press end stop

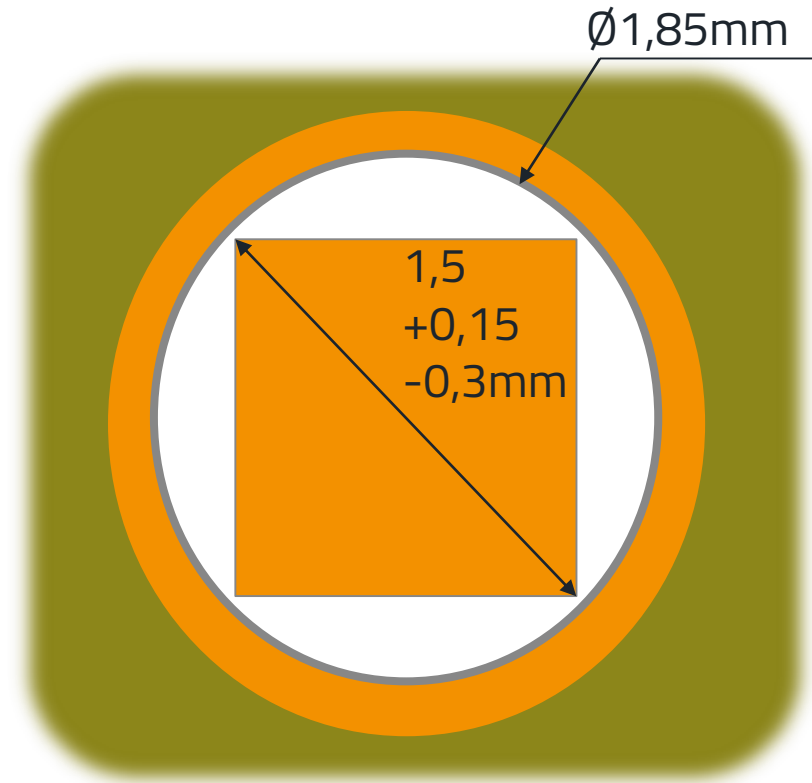
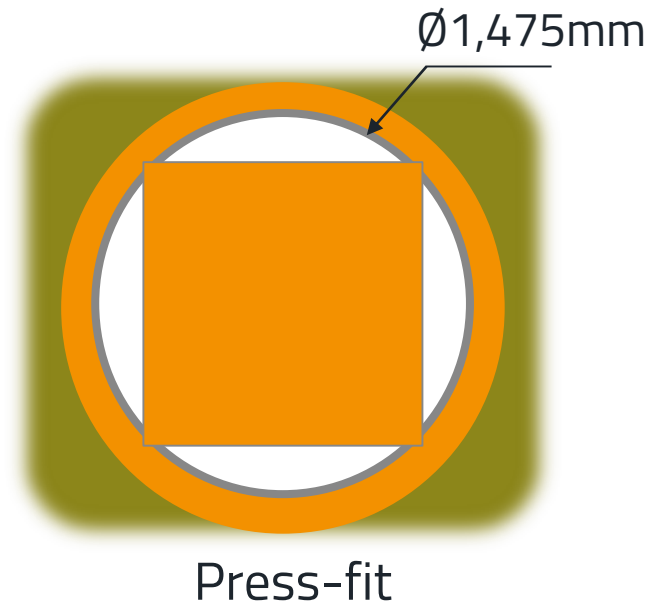
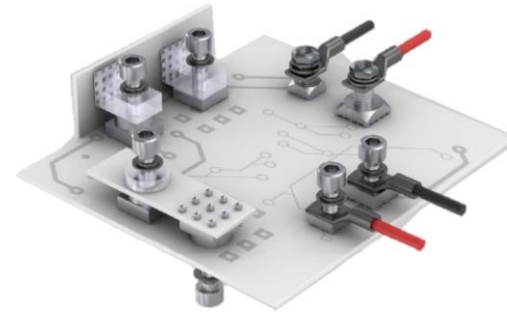
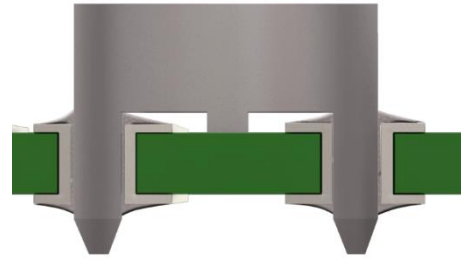
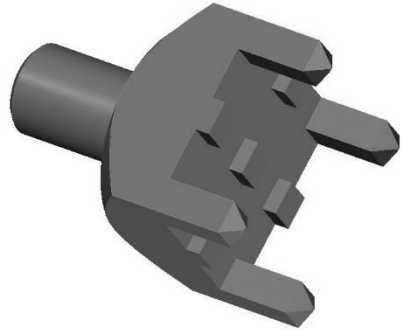


Insertion speed \approx 100-250mm/mn
Insertion done in 1 single time

CRIMPING TOOLS FOR TERMINALS

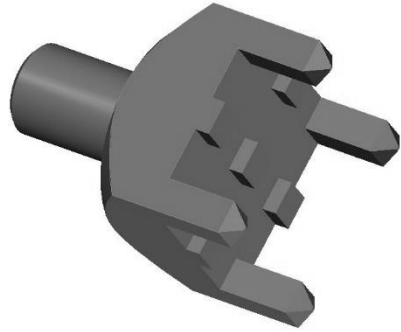


THR

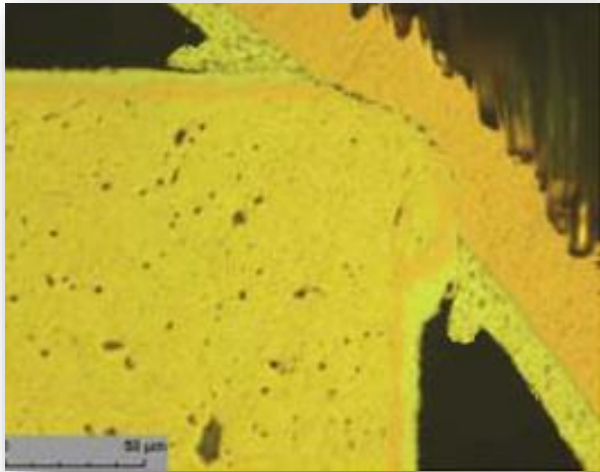
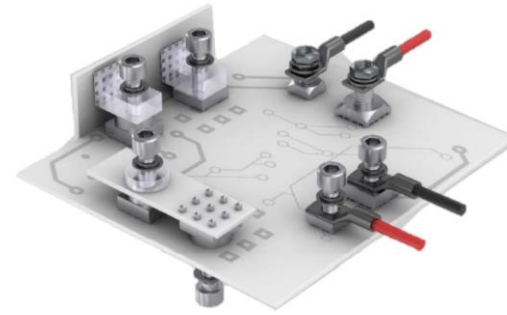
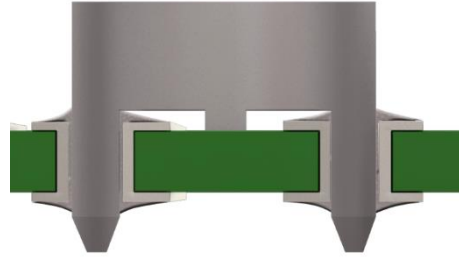


THR

THR



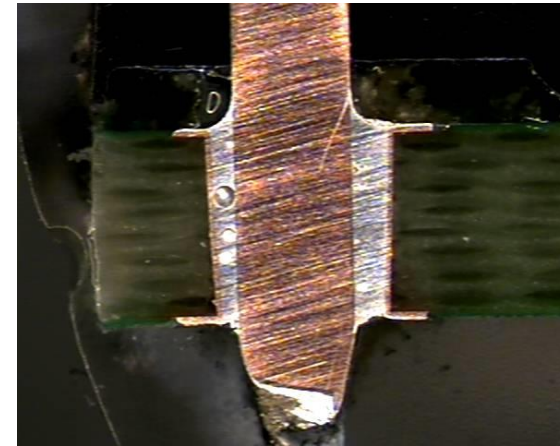
Press-fit



Up to 350A

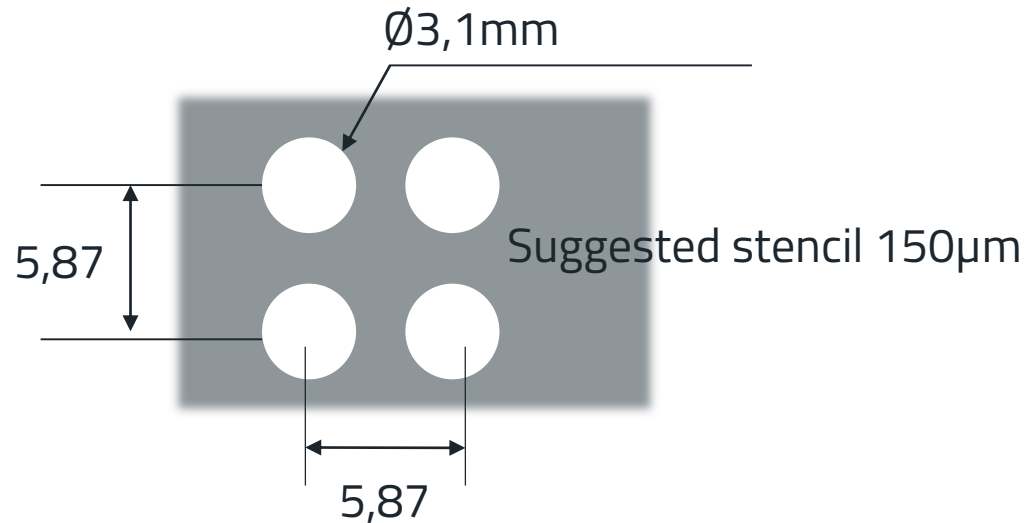
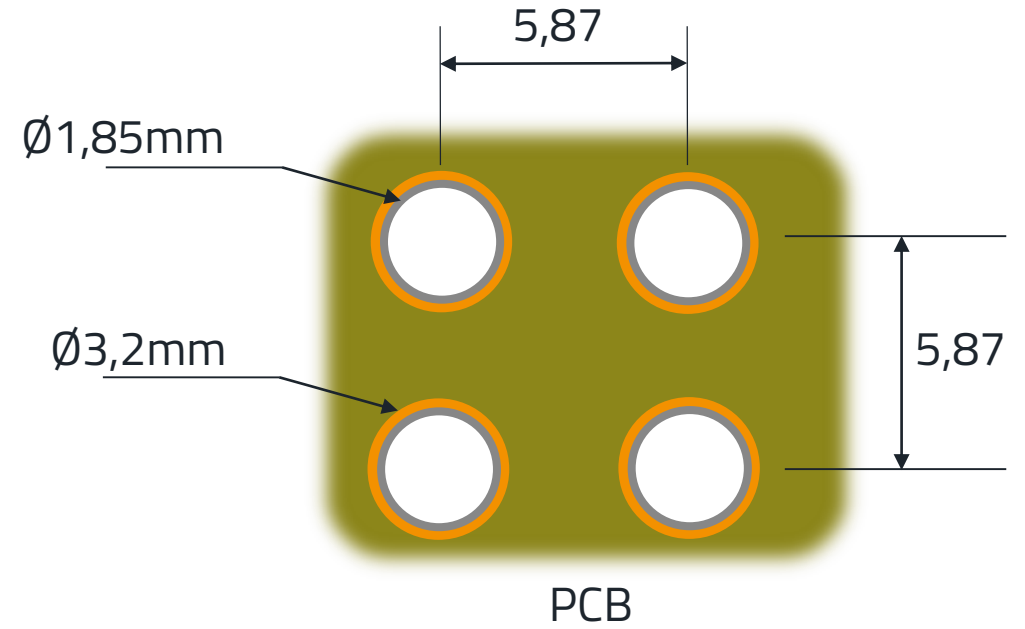
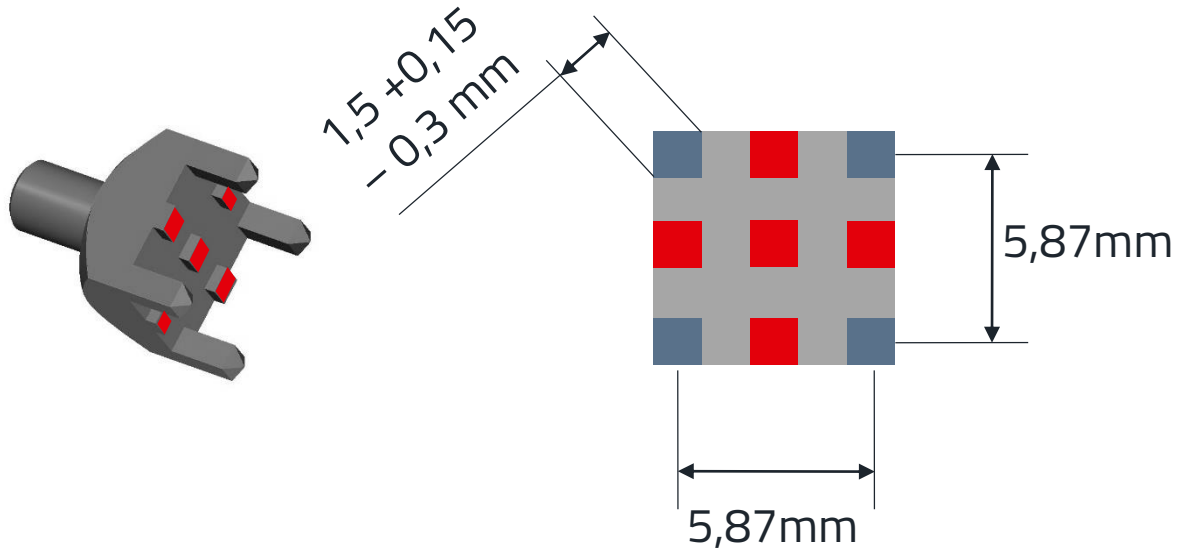


THR

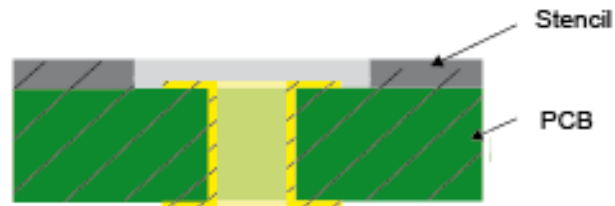


Up to 85A

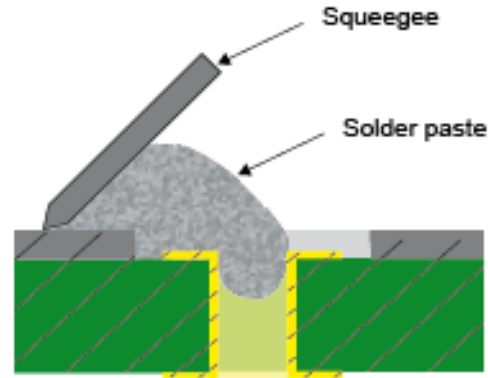
THR



THR



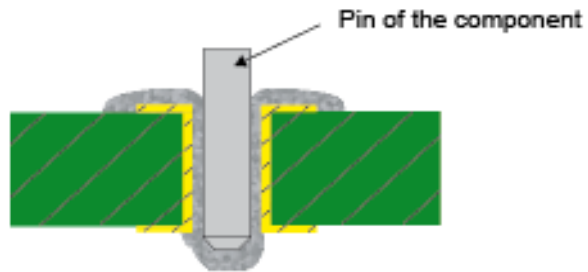
Positioning of the stencil



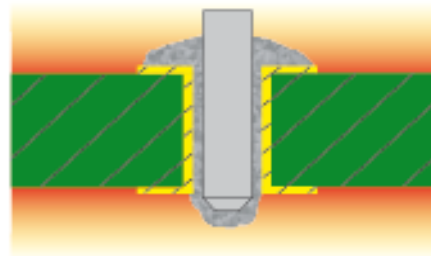
Applying of the solder paste



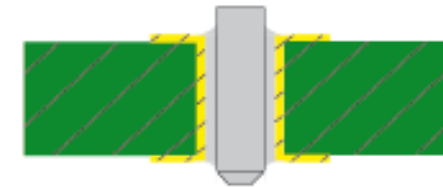
Solder paste fills the stencil's aperture



Positioning of the component

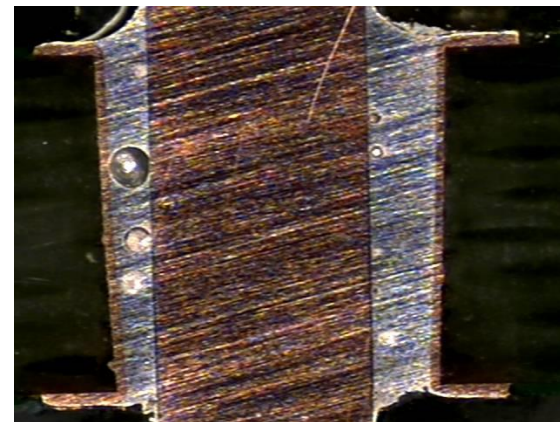
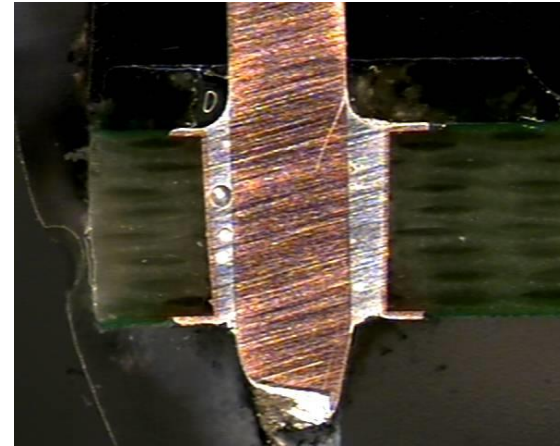
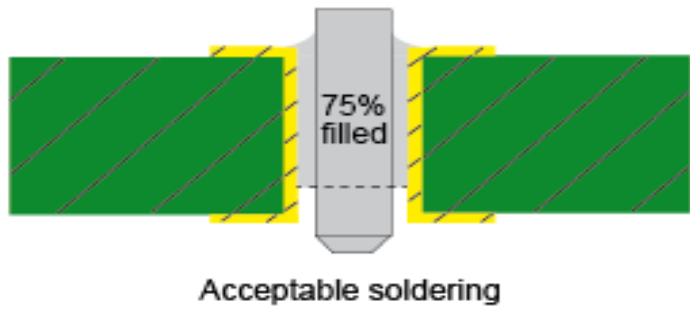
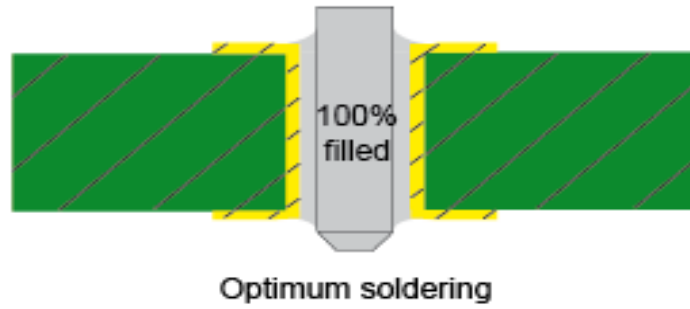


Reflow soldering

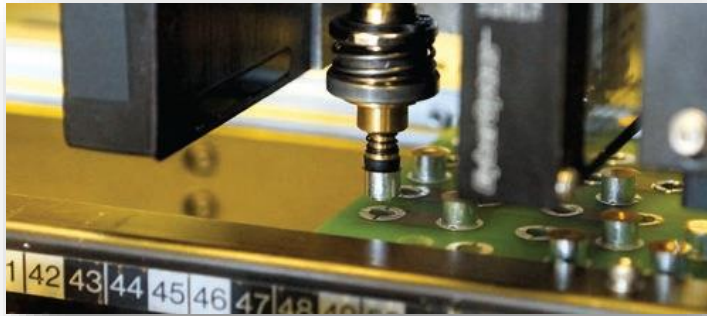


Component soldered

THR



SMT PRINCIPLE

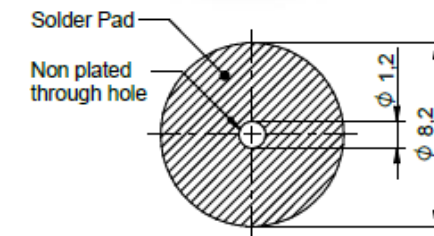
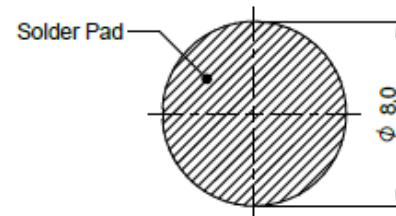
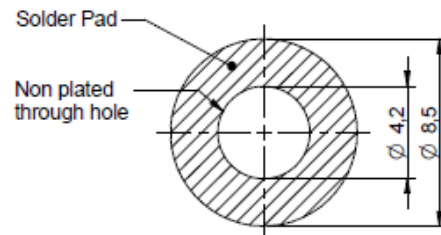


Open thread

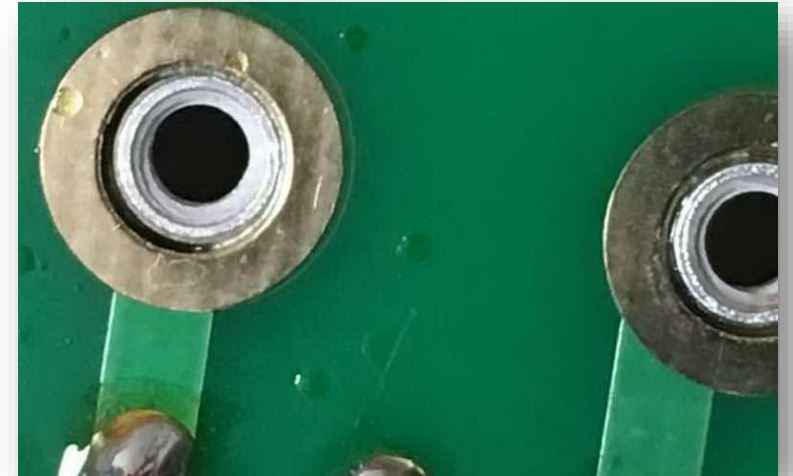
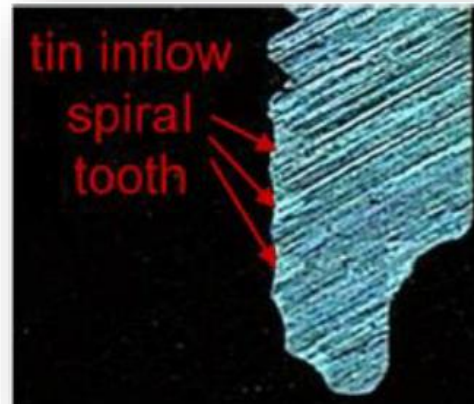
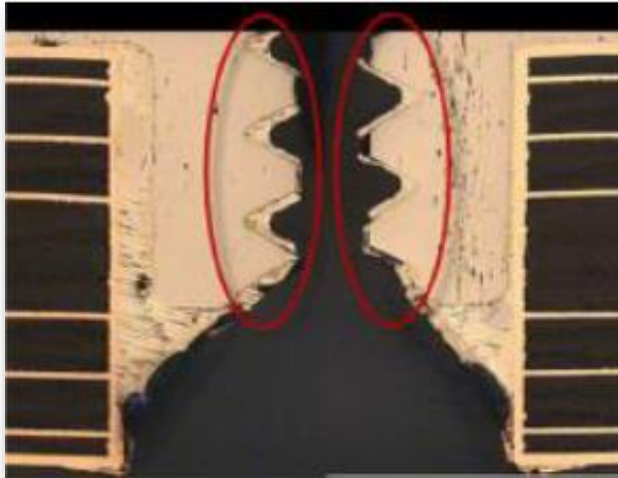
Increase torque

PCB centered

Up to 85A

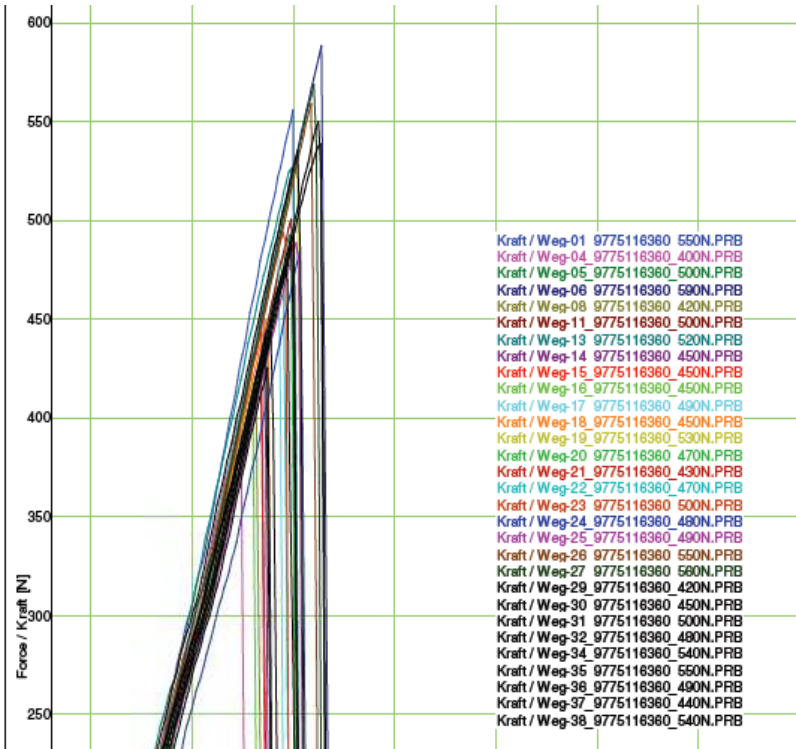


SMT: WHY NOT PLATED THROUGH HOLE



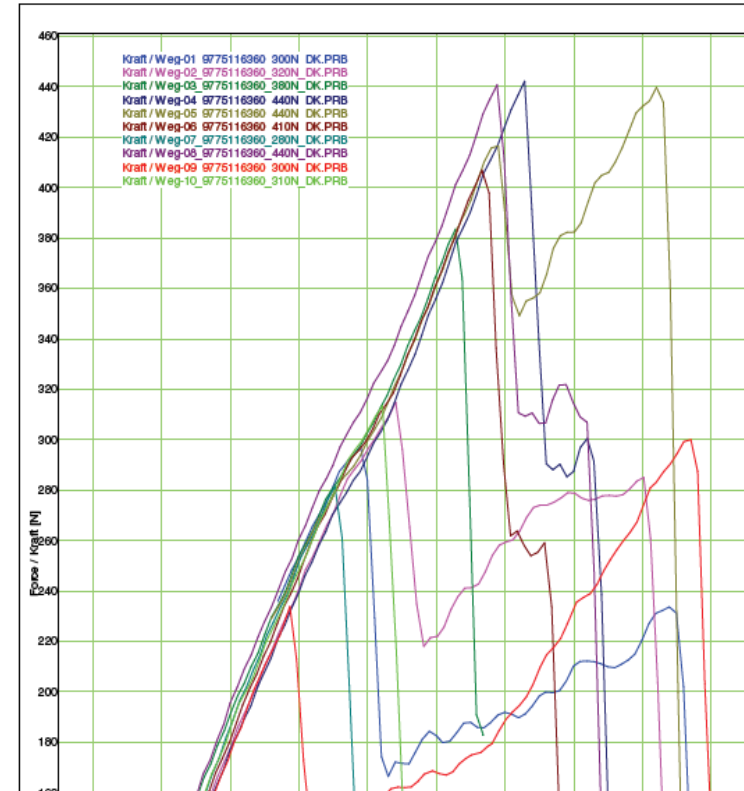
SMT: WHY NOT PLATED THROUGH HOLE

NON plated through hole
Shear force



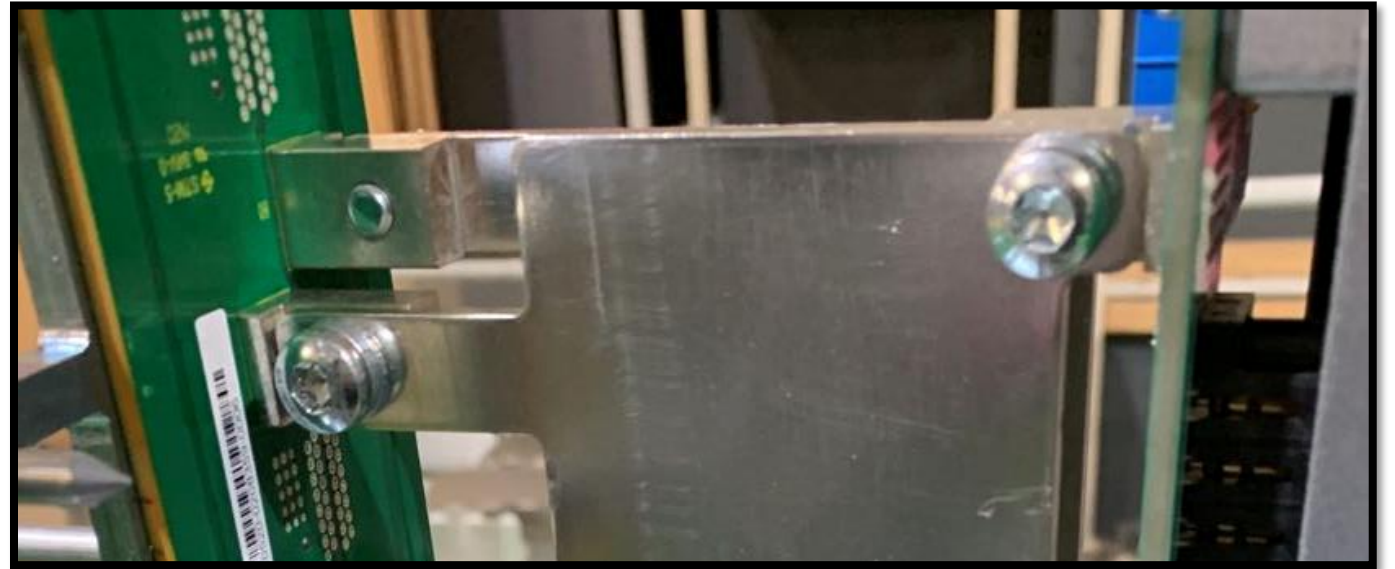
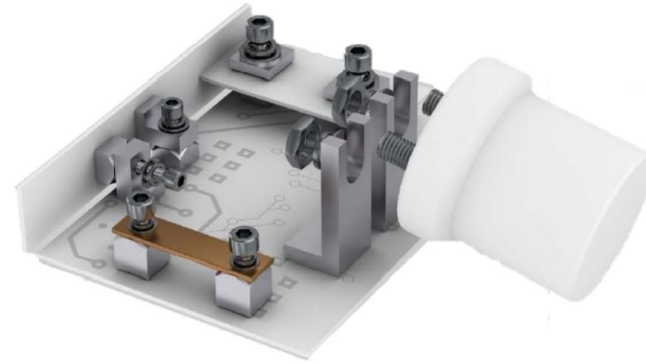
From 490 to 590 N

Plated through hole
Shear force

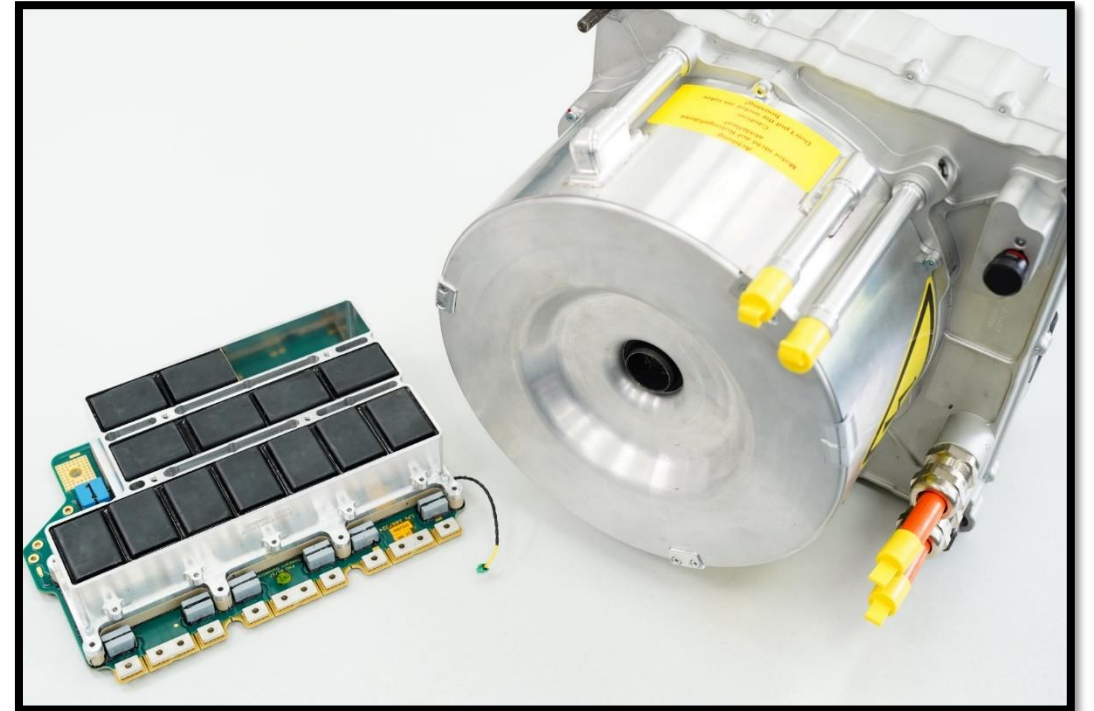
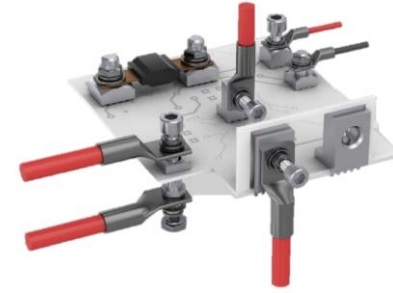
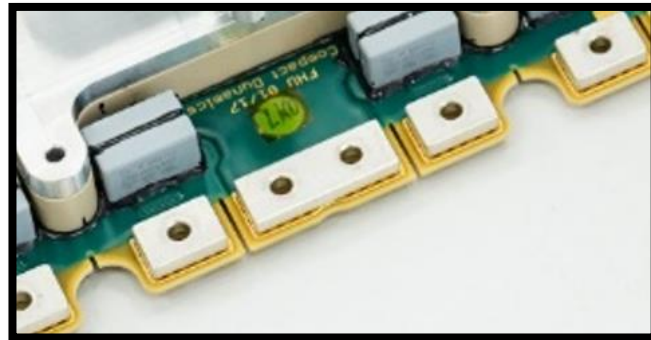
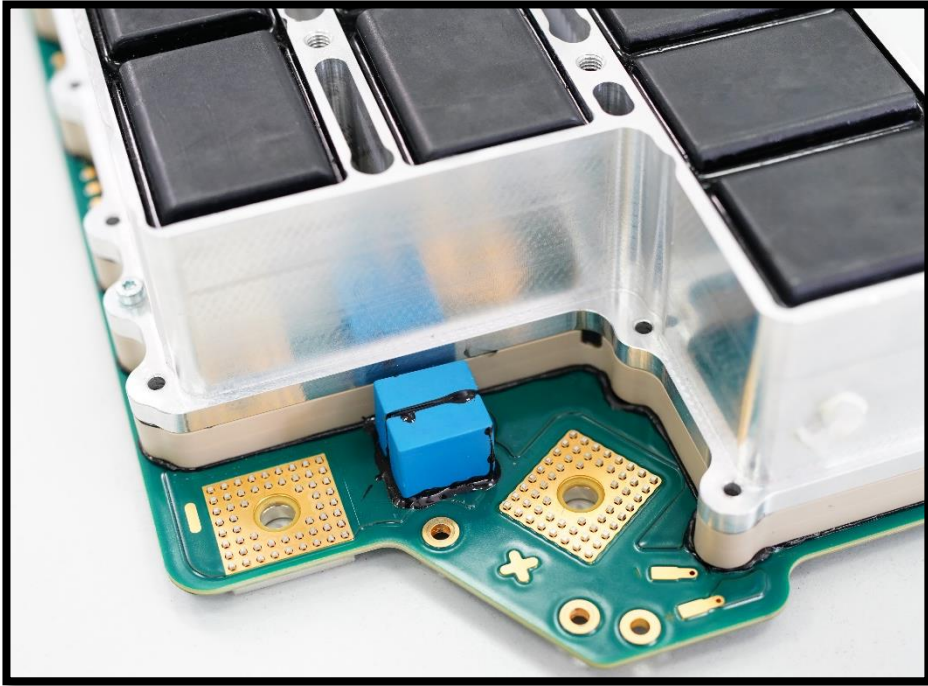


From 280 to 440 N

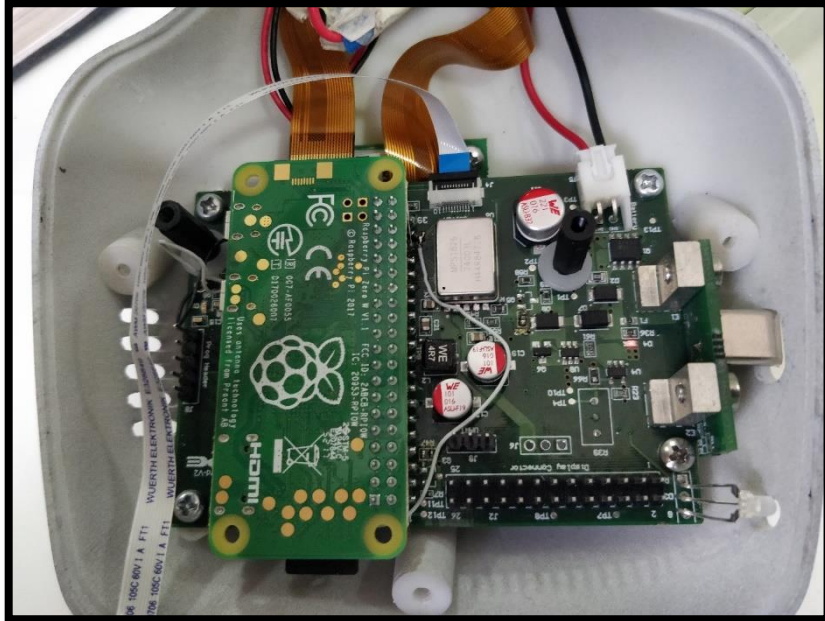
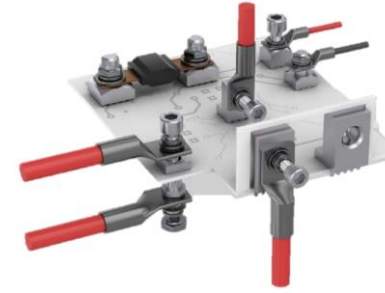
APPLICATIONS: COPPER BAR



APPLICATIONS: FORMULA-E

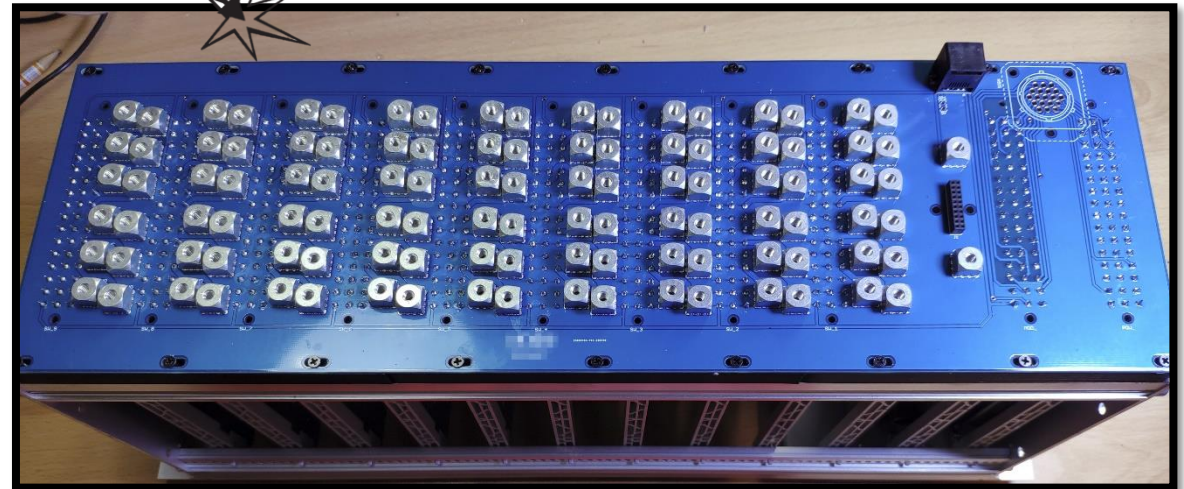


PRESS FIT



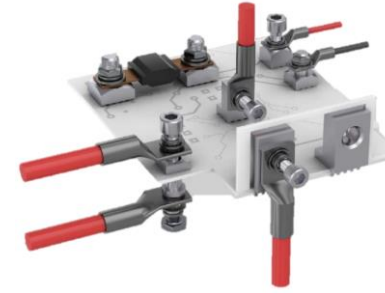
Perpendicular board to board

POLAR

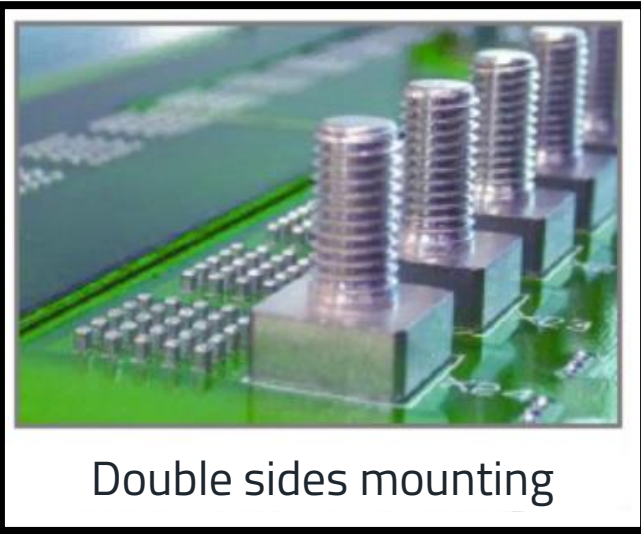


High power backplane

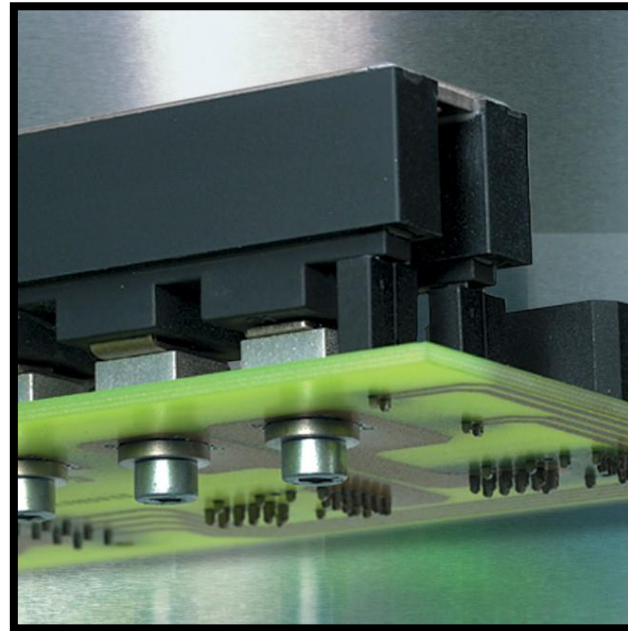
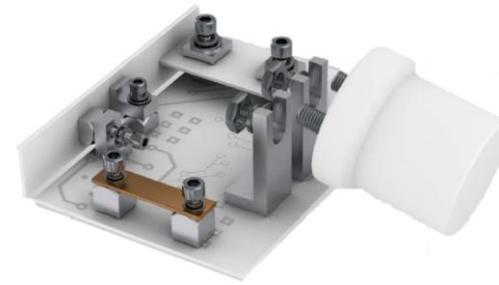
WATER TIGHTNESS POWER BATTERY



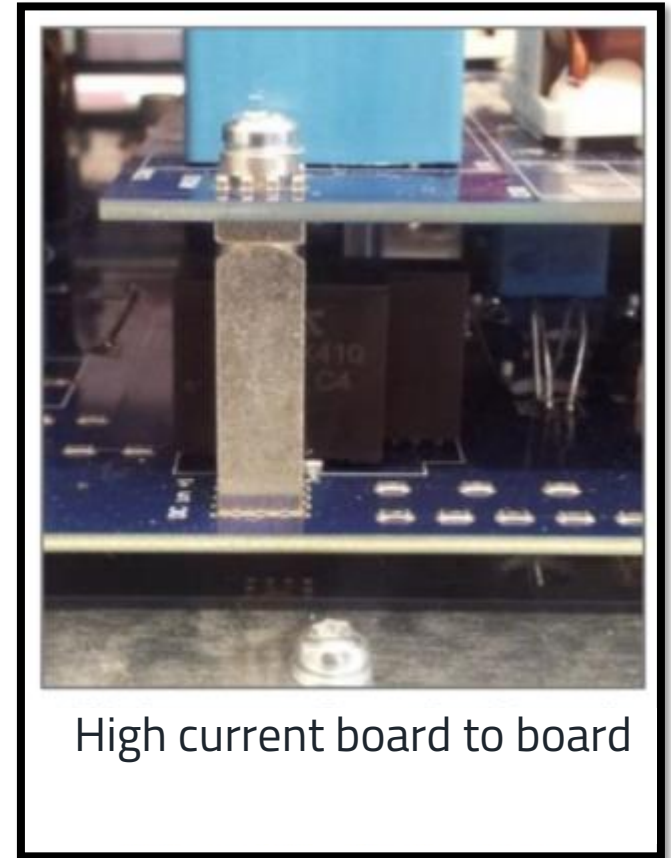
SPECIFIC APPLICATIONS



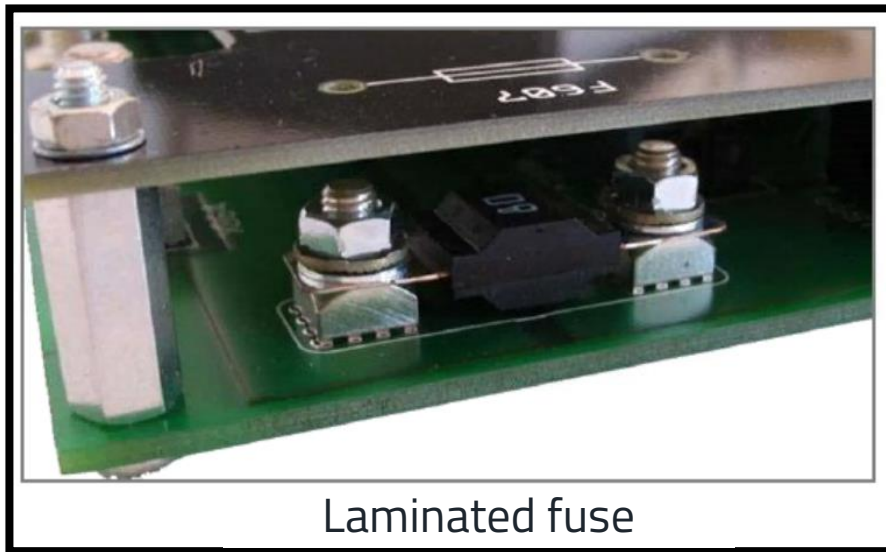
Double sides mounting



IGBT connection

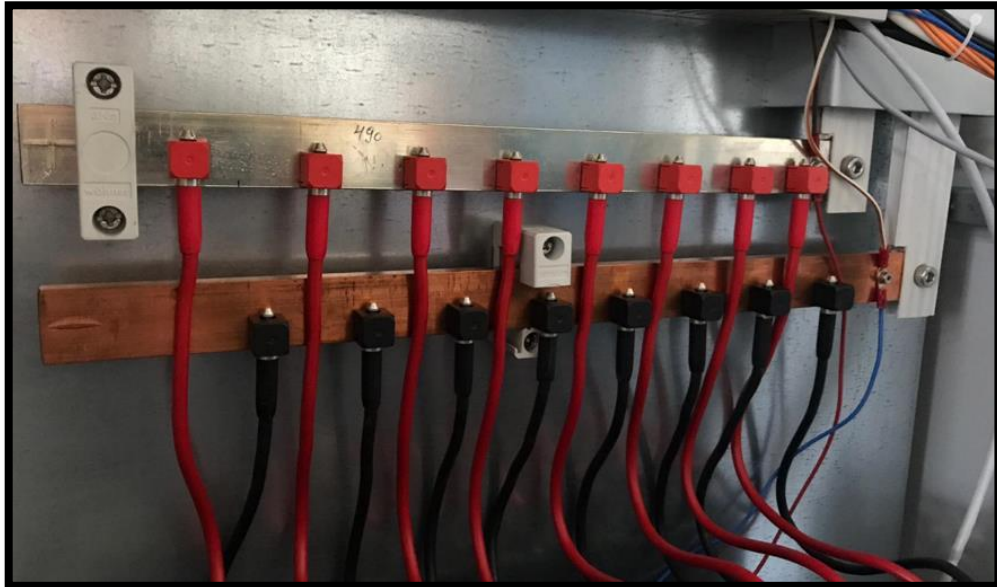
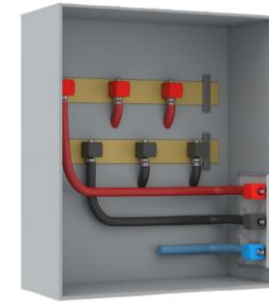


High current board to board

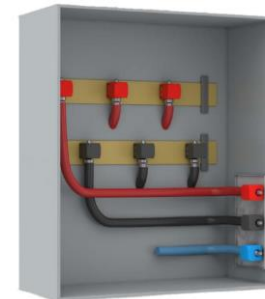
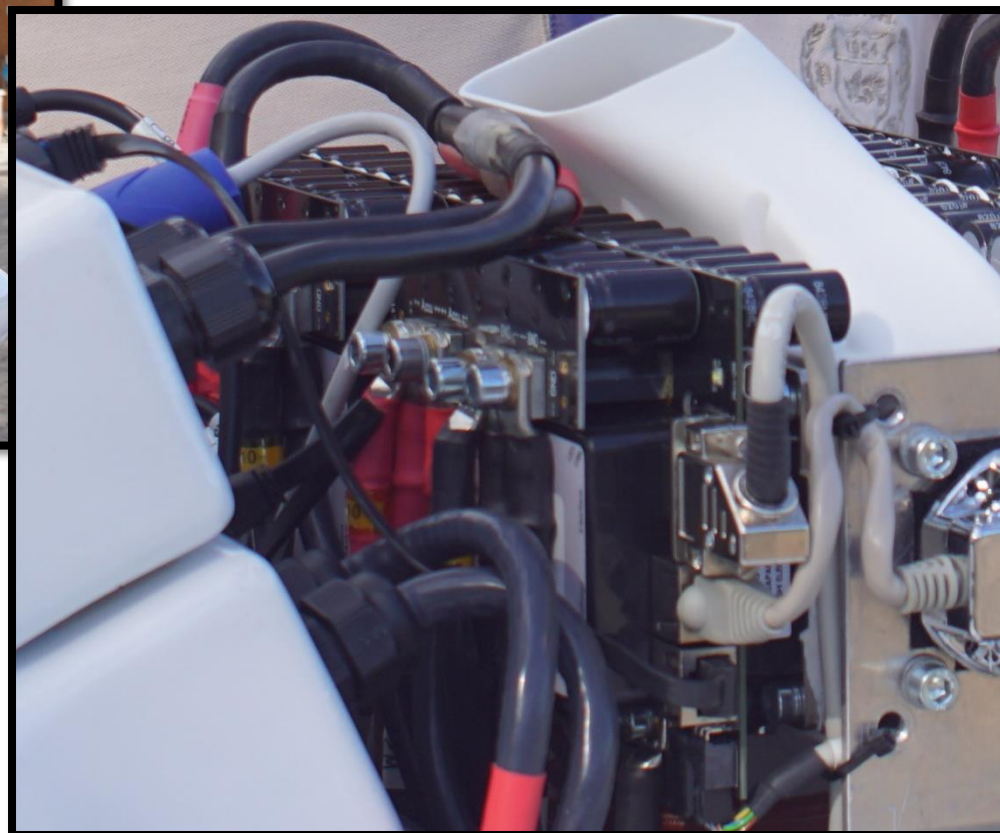
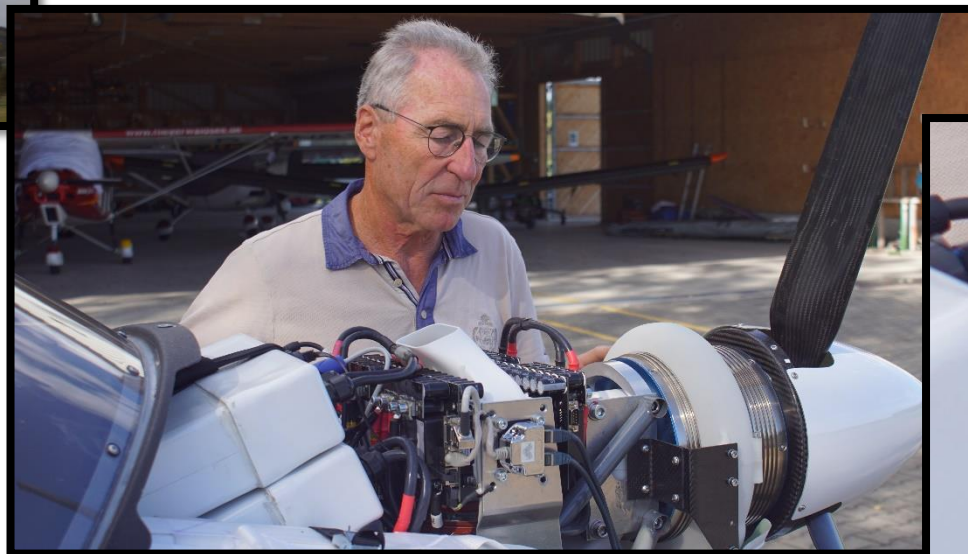


Laminated fuse

COPPER BAR DISTRIBUTION



REDCUBES IN THE AIR



Questions

& Answers



We are here for you now!
Ask us directly via our chat or via E-Mail.

digital-we-days@we-online.com
Stephan.Baechle@we-online.de