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New universal multi-beam Kelvin contactor concept for turret applications

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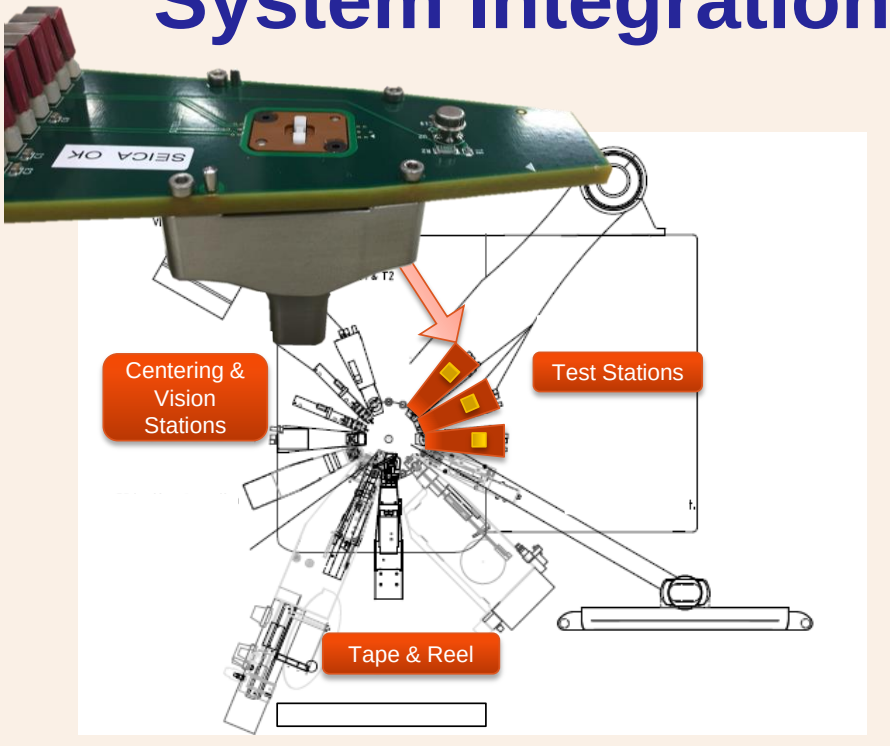
Agenda

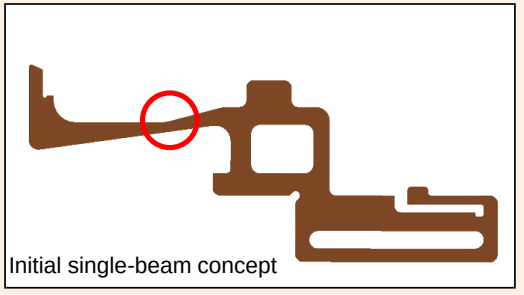
- System Integration Overview
- Why multi-beam Kelvin Contactor?
- Validation
- Why side-by-side Kelvin?
- Upside-down load board configuration
- Conclusion

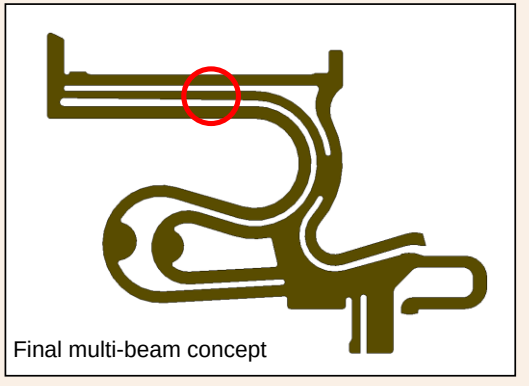
System Integration Overview



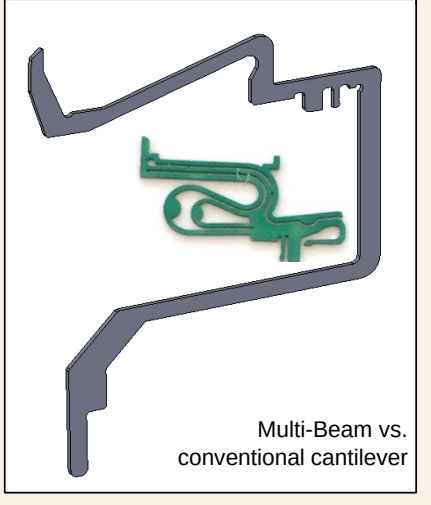
- To integrate test stations into a Turret Handler space is very limited
  Only compact cantilever Test Sockets can be integrated
- Turret Handler are typically running at high speed

Why Multi-Beam Kelvin Contactor?

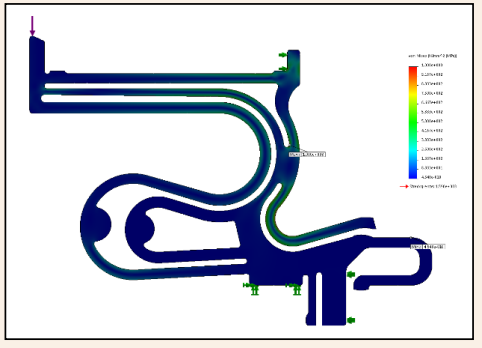

Initial single-beam concept


Final multi-beam concept

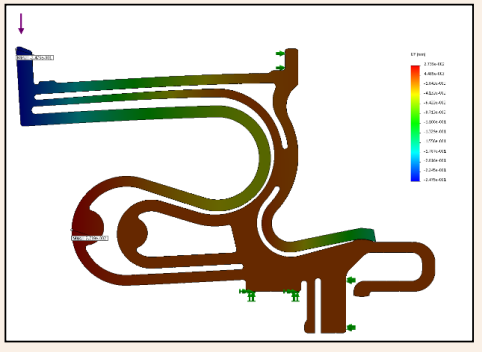
- Significant pin size reduction by maintaining high current carrying capability and good signal integrity
- The multi-beam concept allows to increase the current carrying capacity CCC from 2 A to 3 A
- The cross section was increased from 0.22 mm to 0.55 mm → x2.5!
- Low contact force of 0.20 N (0.20 mm deflection) by maintaining a big cross section


Multi-Beam vs.
conventional cantilever

Lifetime, Stress & Compression Simulation

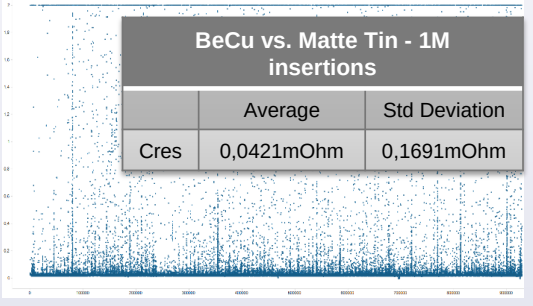


- Stress simulation
  - The multi-beam concept allows to distribute the stress over the three beams and assures a low mechanical stress in the pin structure
  - Mechanical validations did confirm no broken pins up to 10 million cycles

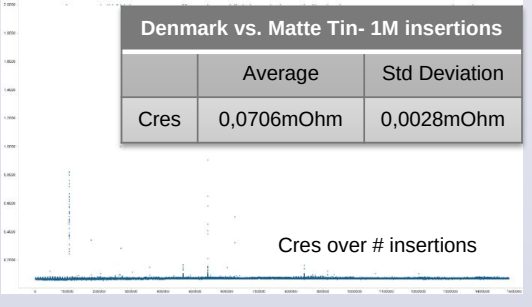


- Compression simulation
  - The multi-beam concept allows a high compression while maintain a low contact force (0.20mm – 0.2N)

CRES Validation



BeCu vs. Matte Tin - 1M insertions		
	Average	Std Deviation
Cres	0,0421mOhm	0,1691mOhm

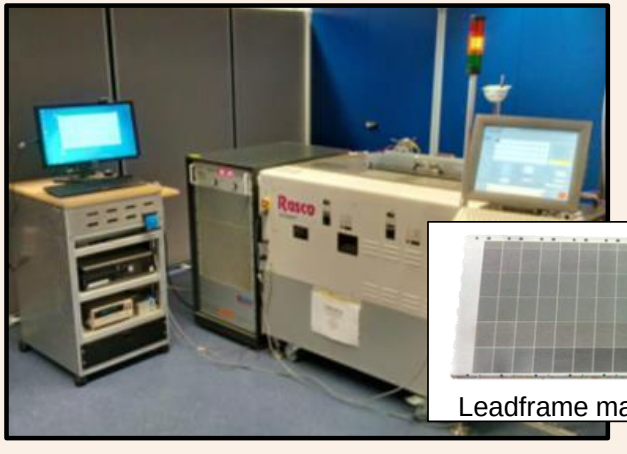


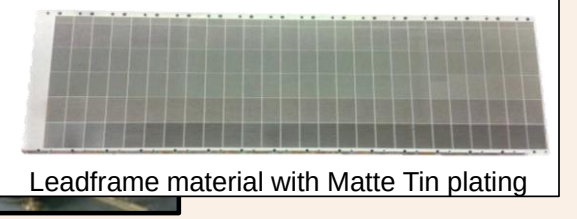
Denmark vs. Matte Tin- 1M insertions		
	Average	Std Deviation
Cres	0,0706mOhm	0,0028mOhm

Cres over # insertions

	BeCu	Denmark
Hardness	420 HV	535 HV
Cleaning frequency (typ)	50-100k insertions	250 – 500k
Lifespan (typ)	0,5M to 1M	1M – 2M

- Actual lead frame material was used to simulate “Test Floor environment”
- Denmark has significant higher hardness HV vs CuBe and shows a very tight CRES standard deviation
- Pin material prevents solder transfer and migration which results in longer cleaning intervals and improved pin lifetime

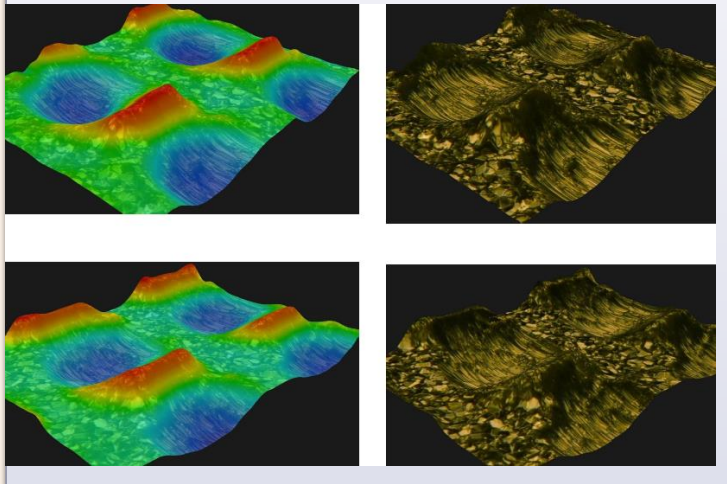




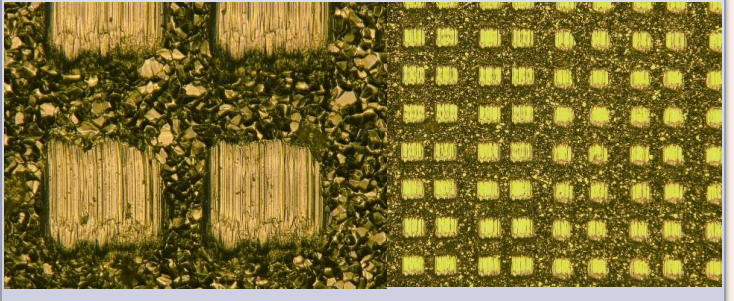
Leadframe material with Matte Tin plating

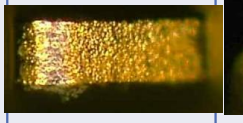
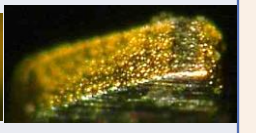
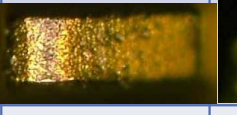
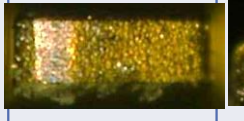
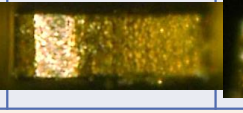
Validation

Scrub mark depth 7µm after 10 insertions

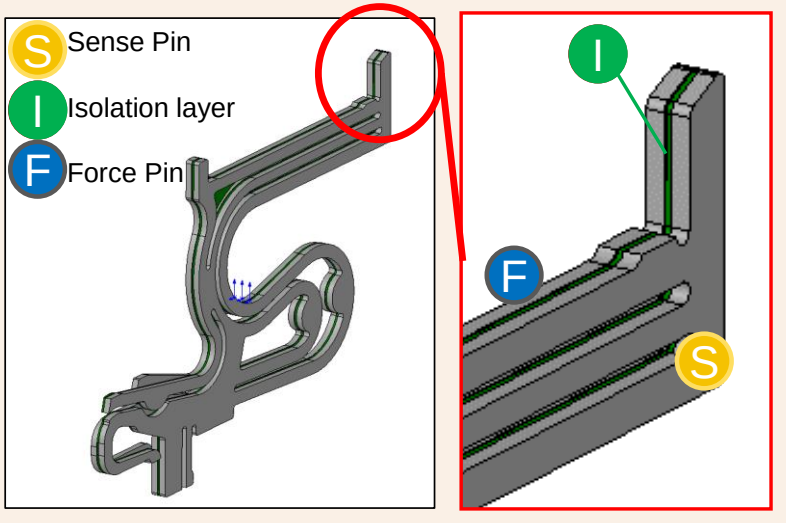


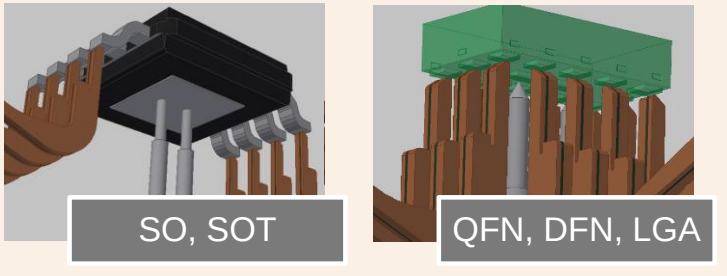
Scrub mark length validation 60µm



wear & tear rate validation			
insertions	wear rate (NIAuPD)	Top view	Oblique view
100k	3µm		
500k	6µm		
1M	10µm		
2M	12µm		
3M	14µm		

Side-by-side Architecture

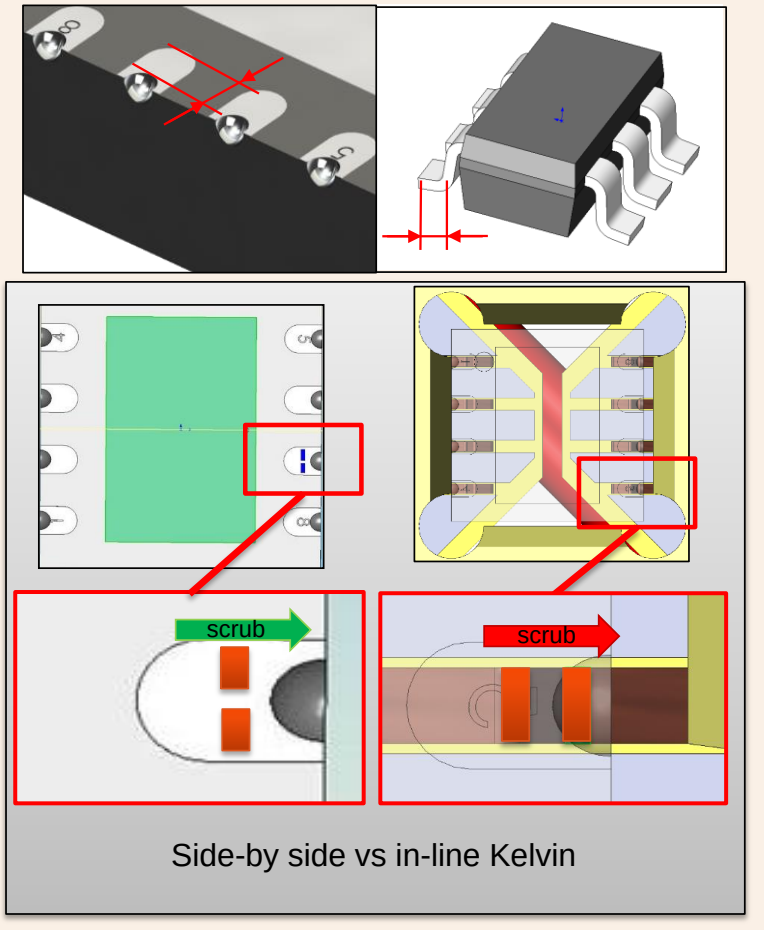




- Force & Sense pin are able to move independently
- High performance insulation layer extremely durable and flexible
- Isolation layer is attached to the force pin
- Total pin thickness ~0.25 mm
- Pin compression creates a 60 µm scrub on the device pad / lead
- Multi-beam structure allows passive cooling for power applications

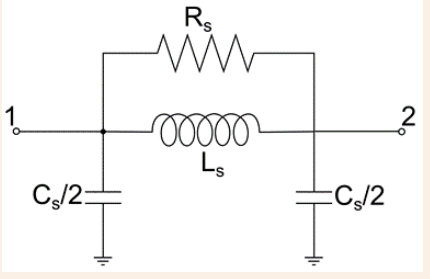
Why Side-by-side Kelvin Contactor?

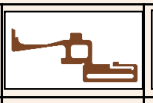
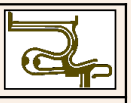
- QFN Devices show a trend towards shorter pad lenghts
- Solderbility Inspection features reducing the available contact area further
- The lead length of small SOT Devices provide insufficient contact area
- Typical contact surface areas are < 0.25mm x 0.2mm
- Low CRES requirements demand a homogenous pin with a defined scrub of 60µm

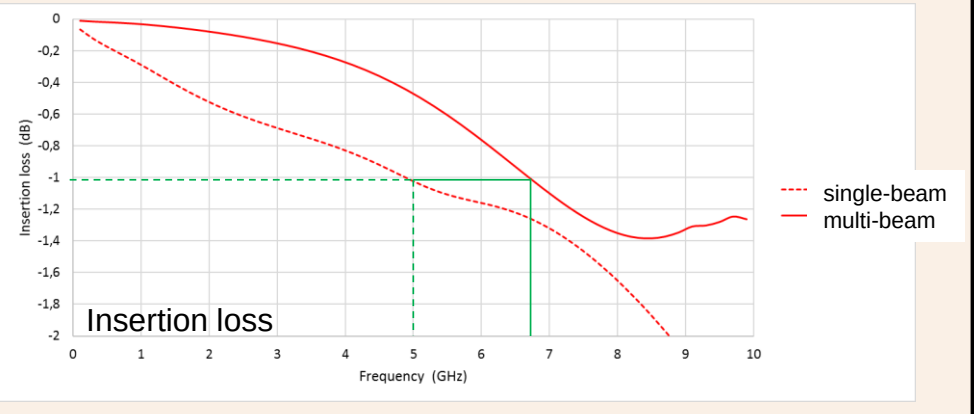


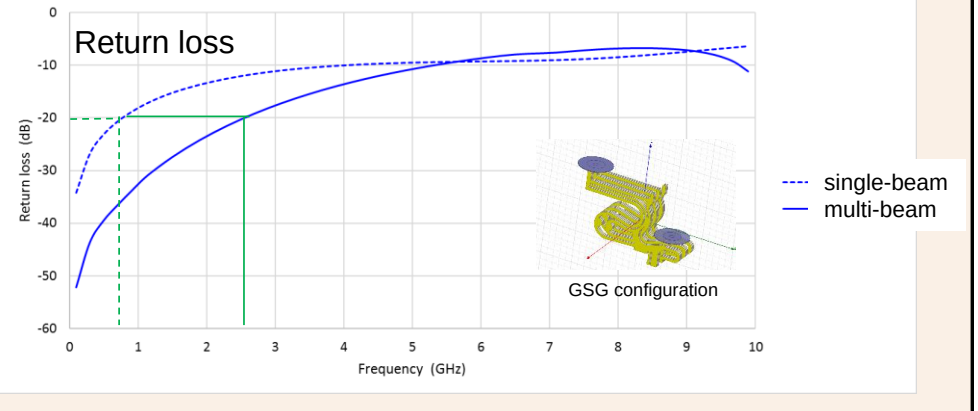
Side-by side vs in-line Kelvin

Comparison: Single- vs Multi-beam

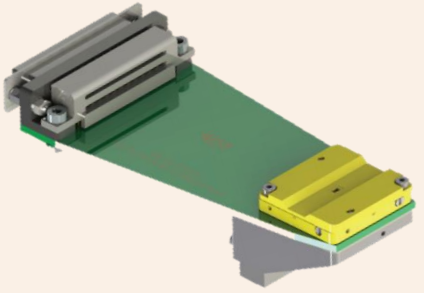


		
Insertion loss @ -1 dB	4.88	6.70
Return loss @ -20 dB	0.78	2.54
Self inductance (nH)	4.21	2.70
Ground capacitance (pF)	0.78	0.92

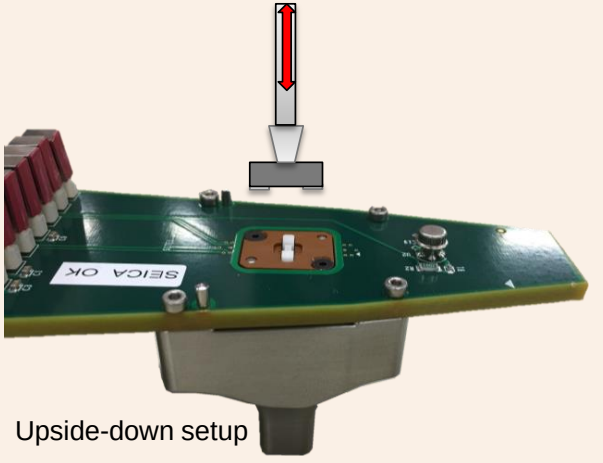




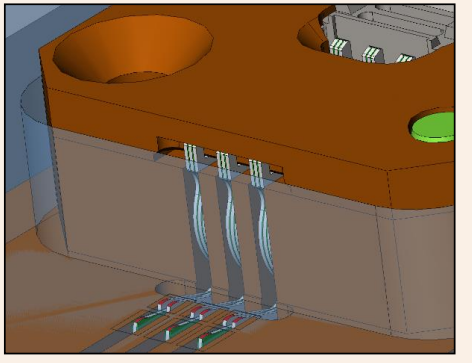
Upside-down Load Board Configuration



Conventional setup



Upside-down setup



- Turret Handlers are optimized to run at very high UPH
  - mounting the PCB on top of the socket creates a z-plunge reduction which assures a short index time < 50ms
- Upside-down load board configuration helps to exchange the PCB within minutes and eliminates time consuming contactor fine tuning

Conclusion

- New multi-beam released to the marked and confirmed favorable performance multiple customers
- Outstanding lifetime and ease of use have significantly reduced cost of test and increased the efficiency of the test cell
- Multi-beam concept does have the potential to be applied for RF and Power final test and wafer level applications