

Considerations on CO₂ Cooling for SALTR016 electronics

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LCTPC WP#198

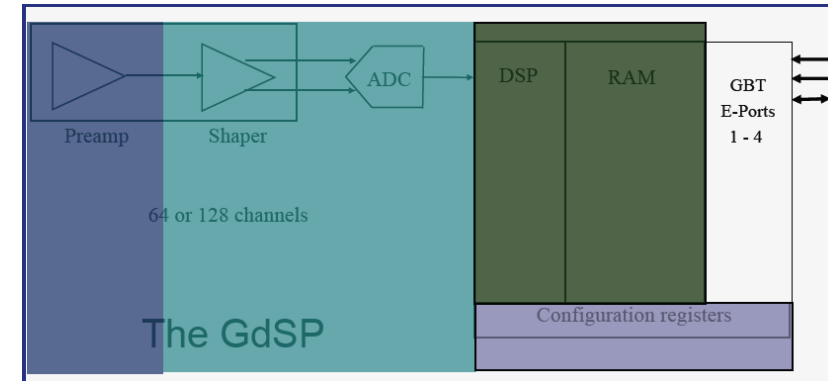
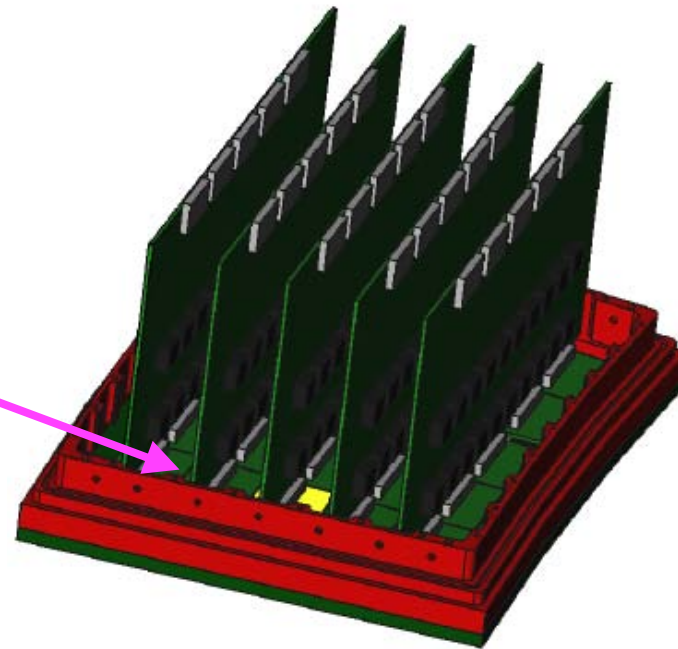
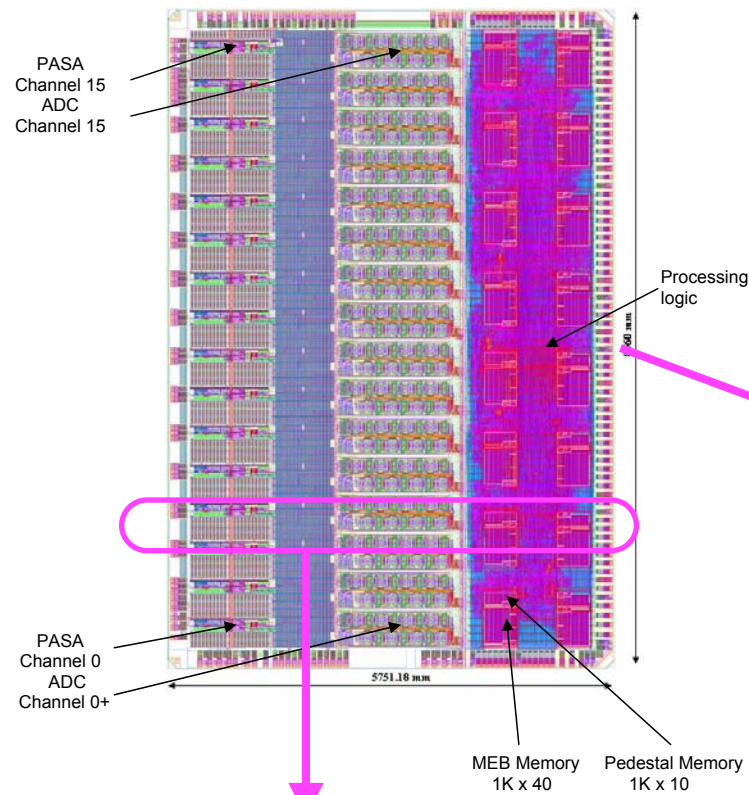
Introduction:

LCTPC Electronics Development for Pad Readout

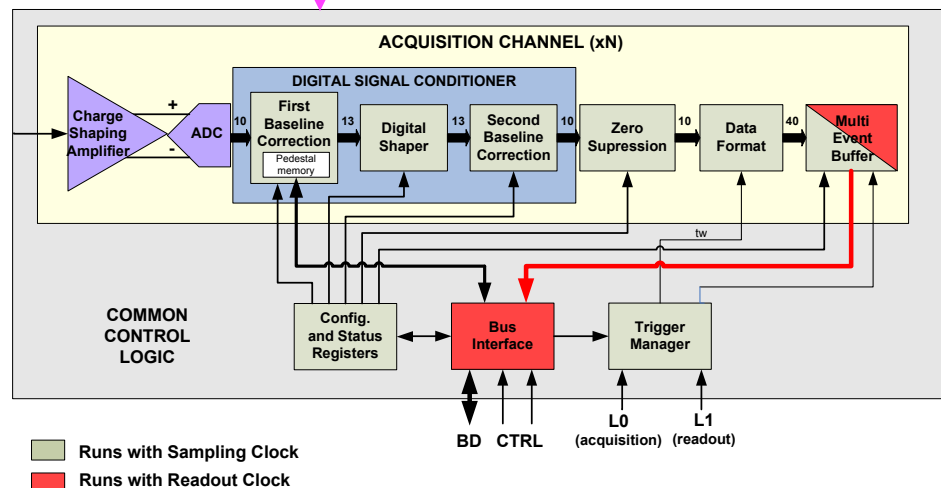
Next step
S-ALTRO16 (fabricated)

Electronics being prepared
by Lund group.

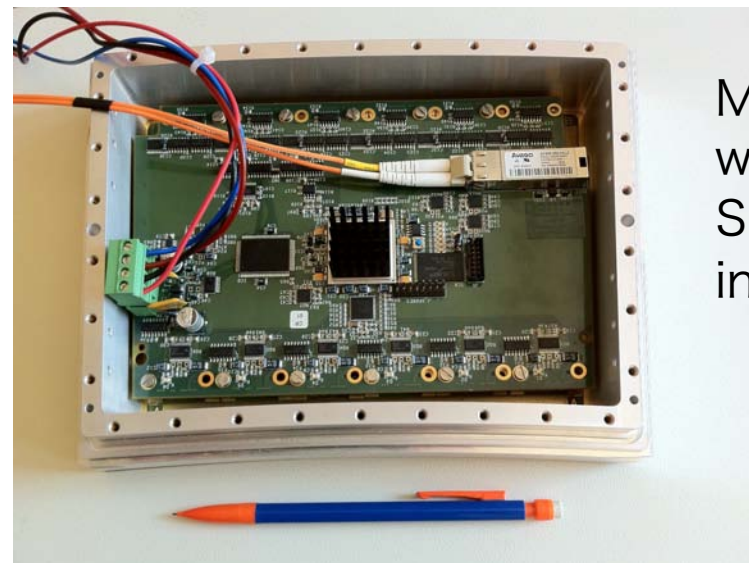
GdSP concept in the future?



- 64 or 128 channels in a chip.
- Low power consumption (7-8mW/ch).
- 65nm process or less?
not ready to start now?



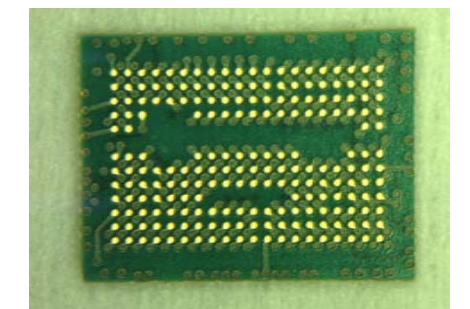
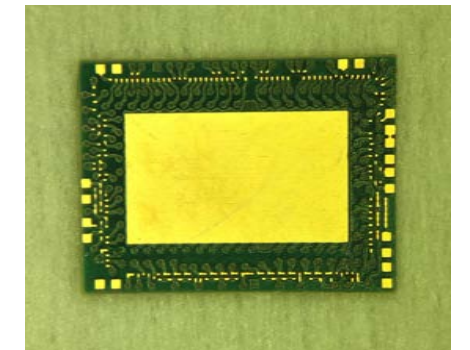
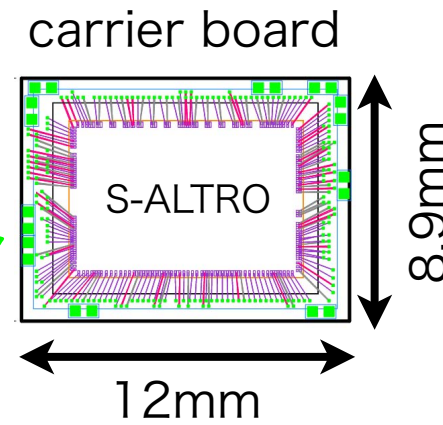
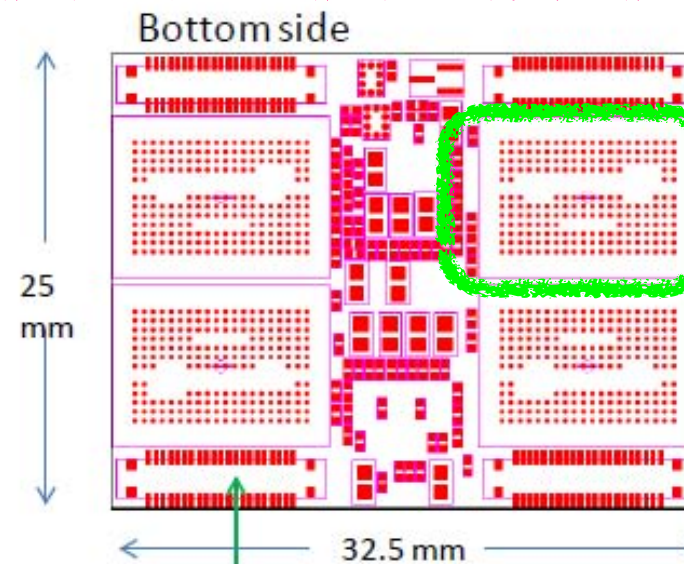
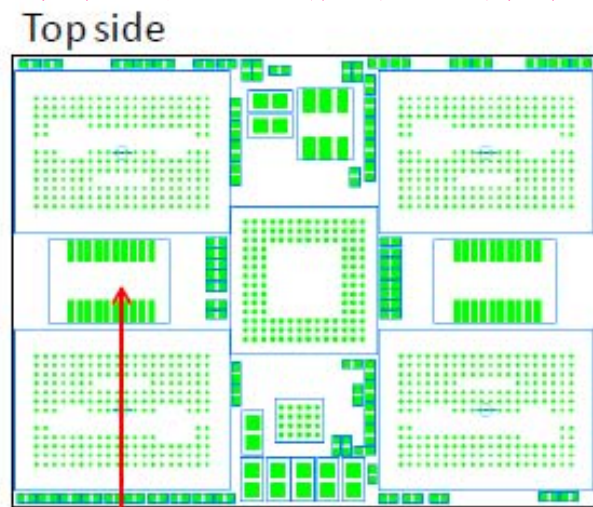
- 16 channels in a chip.
- 38 (56) mW per channel @ 20MS/s without (with) links and regulators.



MicroMegas module
with AFTER-based electronics.
Success with CO₂ cooling
in beamtests Feb/2014.

Readout electronics based on S-ALTRO16 chips

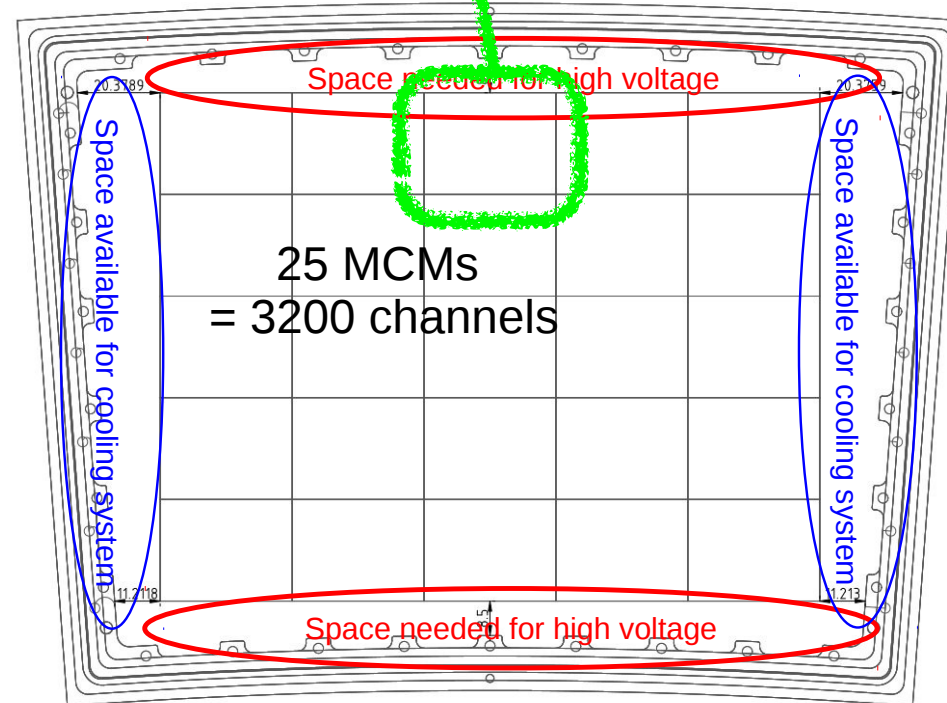
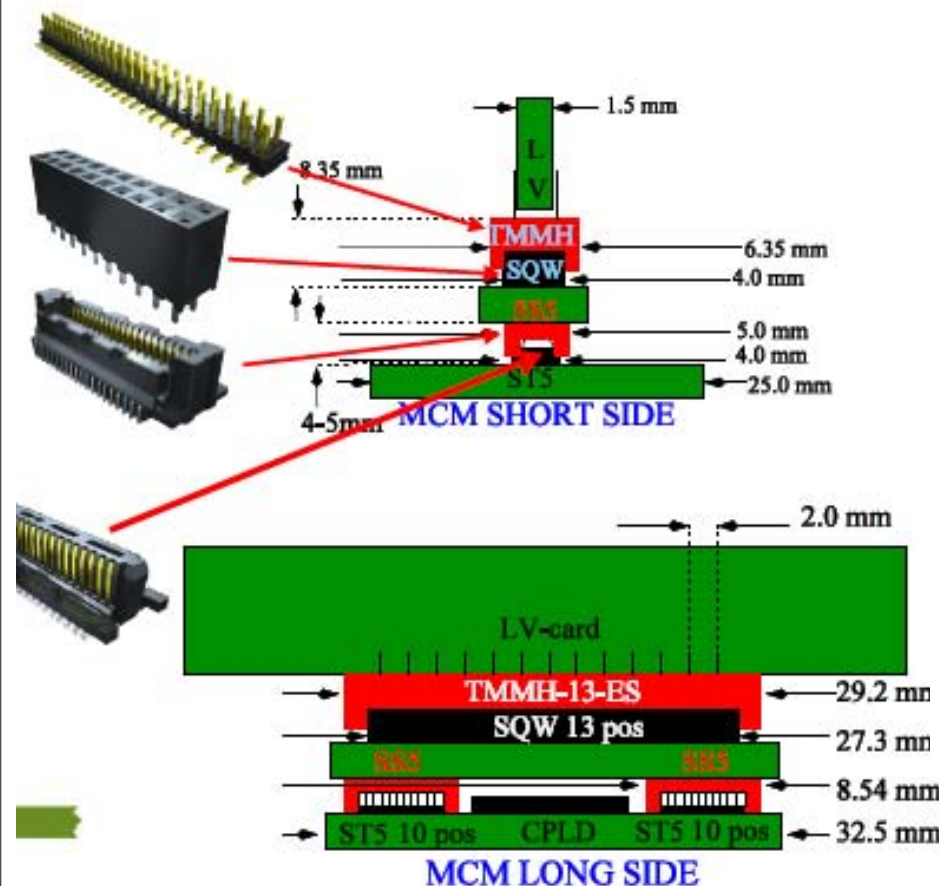
Final MCM Bd design by Lund Univ.



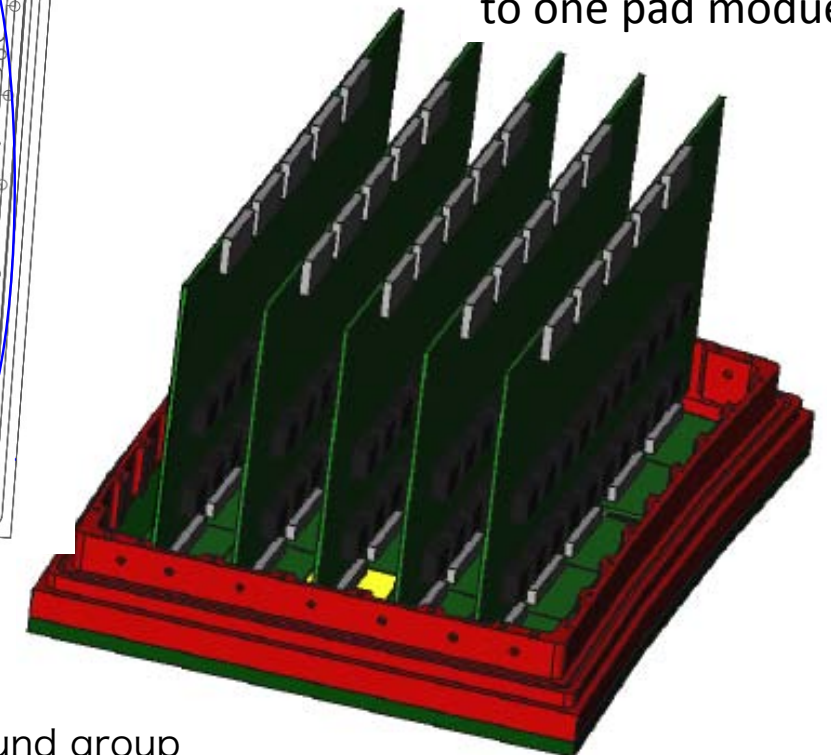
3 CBs were fabricated and ready for test

Samtec connectors

Panasonic connectors



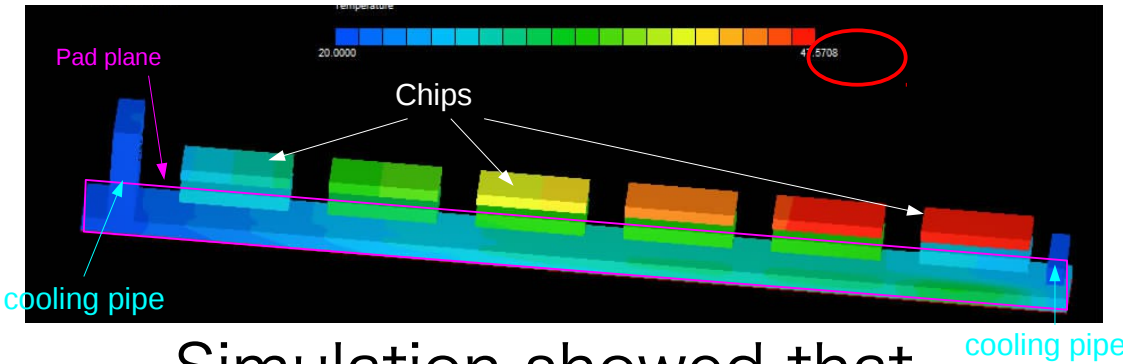
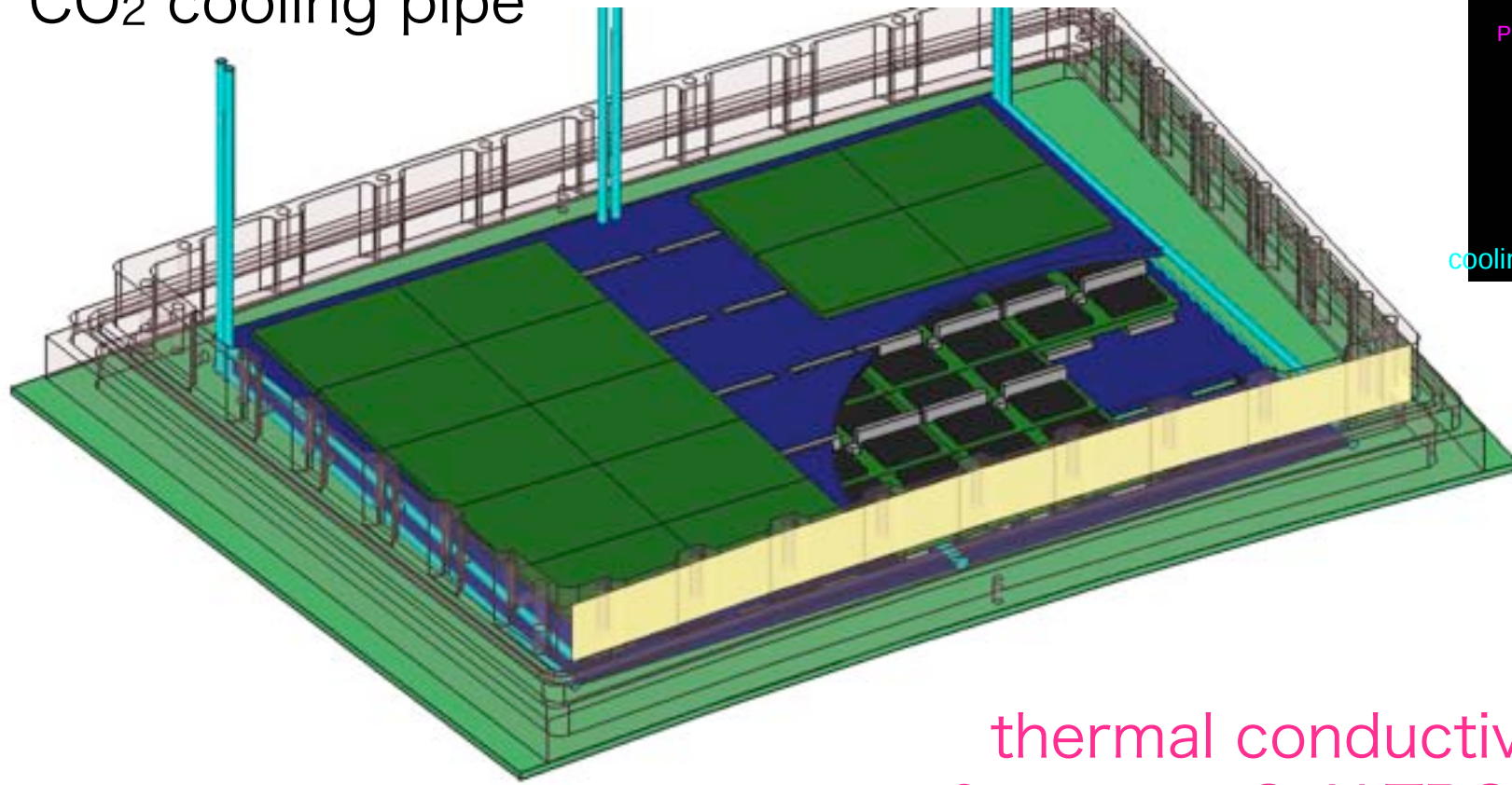
LV-boards attached to one pad module



Figures from "Front-end electronics for the TPC in ILD; a status report April 2014," etc. by the Lund group

Proposed Cooling for S-ALTR016-based electronics

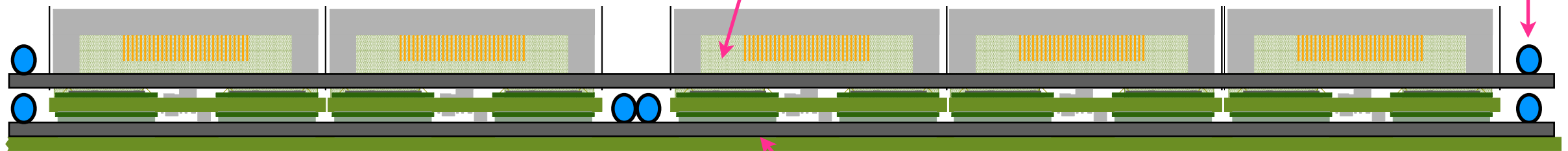
CO₂ cooling pipe



Simulation showed that Middle pipe is necessary

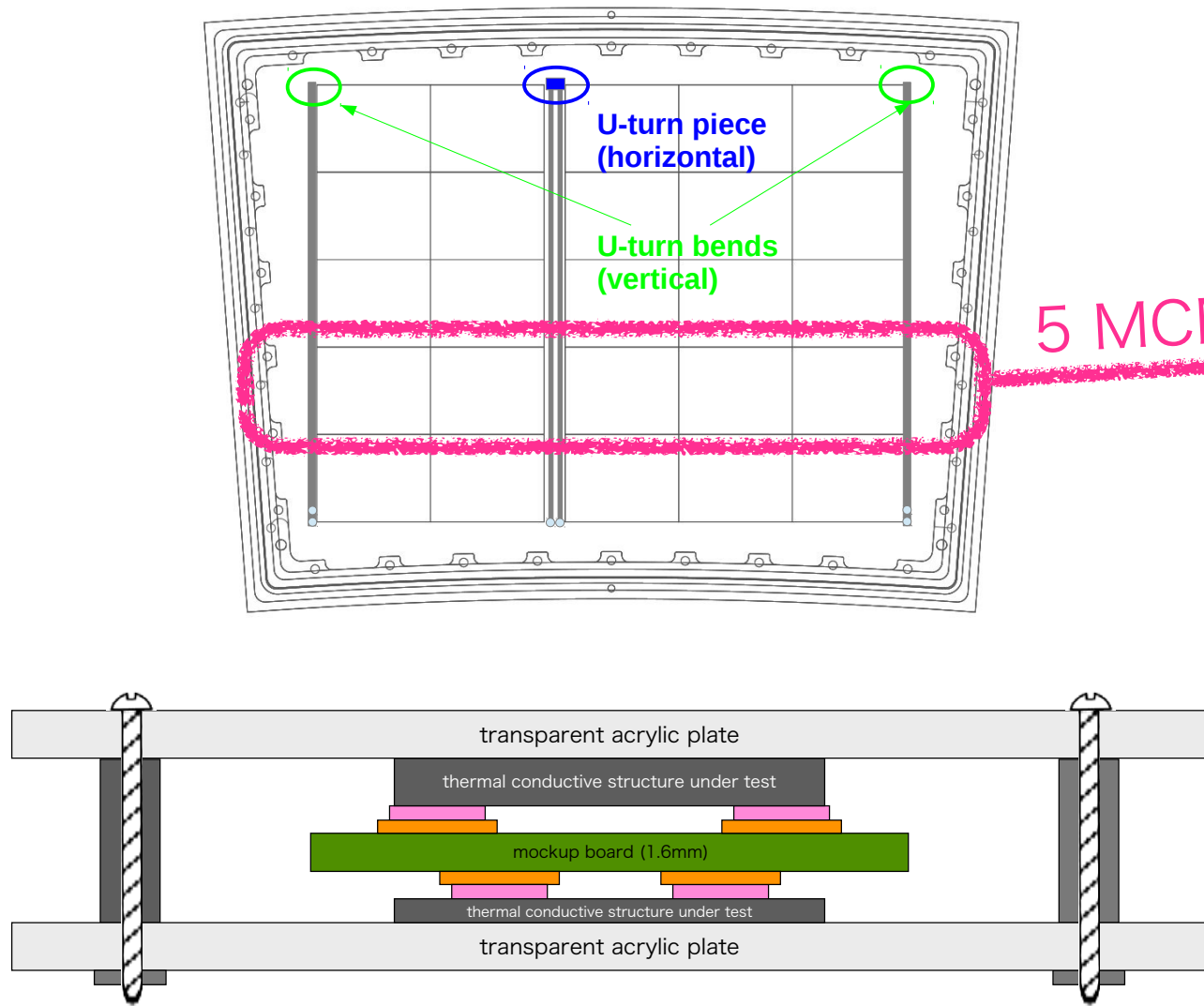
thermal conductive plate for upper S-ALTR016 chips

CO₂ cooling pipe



thermal conductive plate for lower S-ALTR016 chips and to keep pad-plane temperature

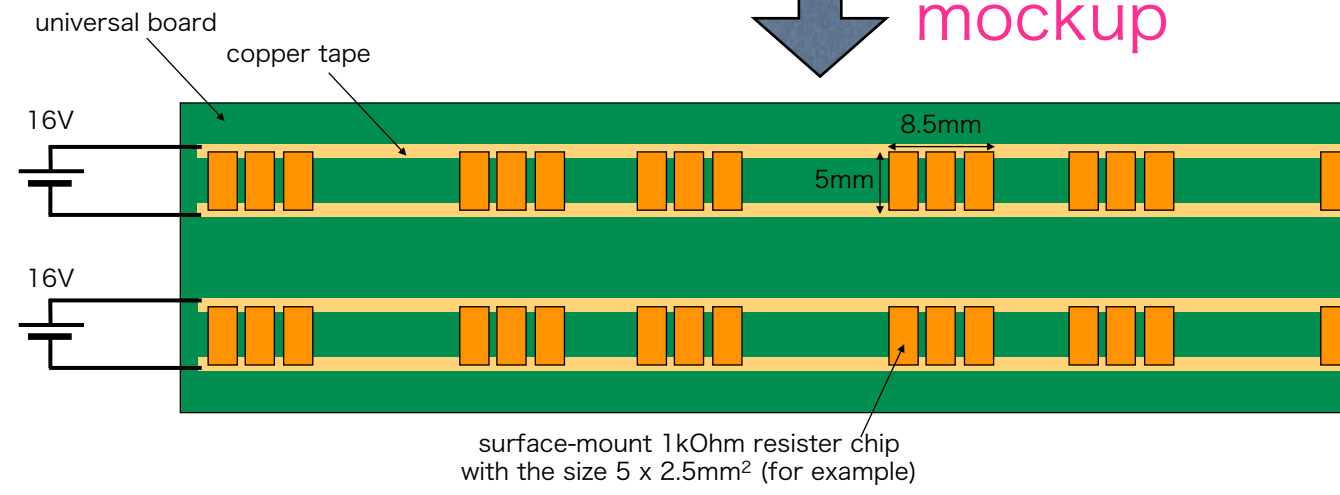
Mockup Test Plan



5 MCMs



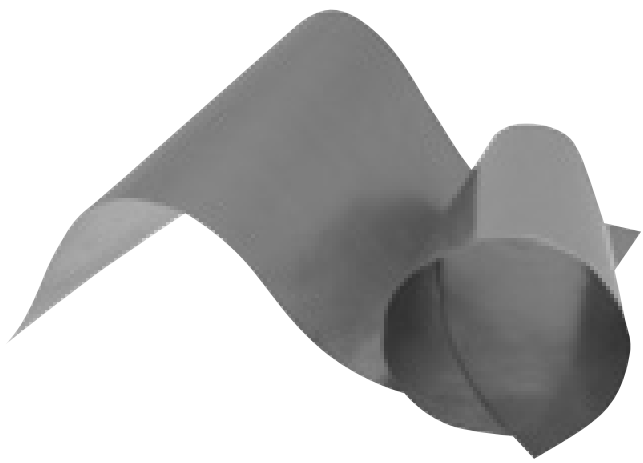
mockup



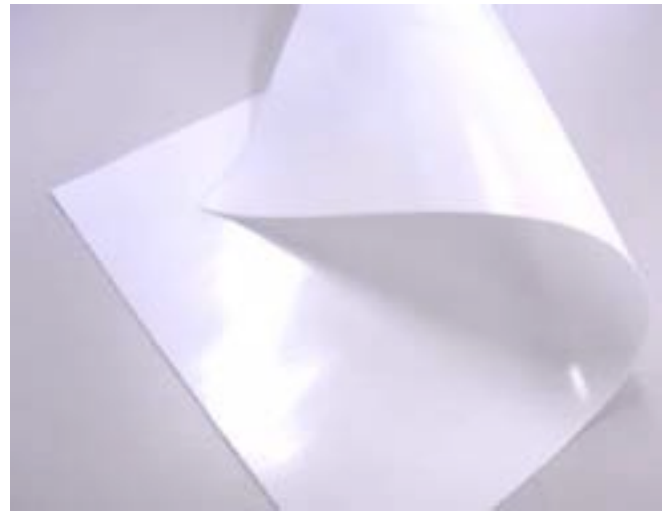
Combination of various thermal conductor/insulator will be tried



TPG plate (by Momentive)
~1500W/m · K
sandwiched by Al plate

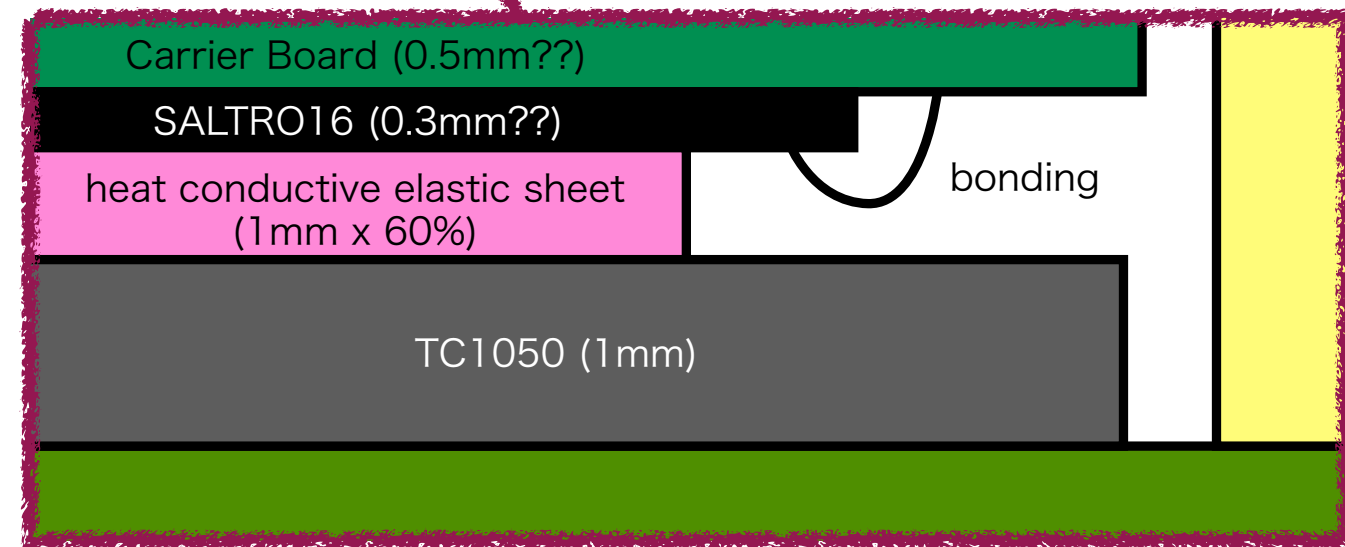
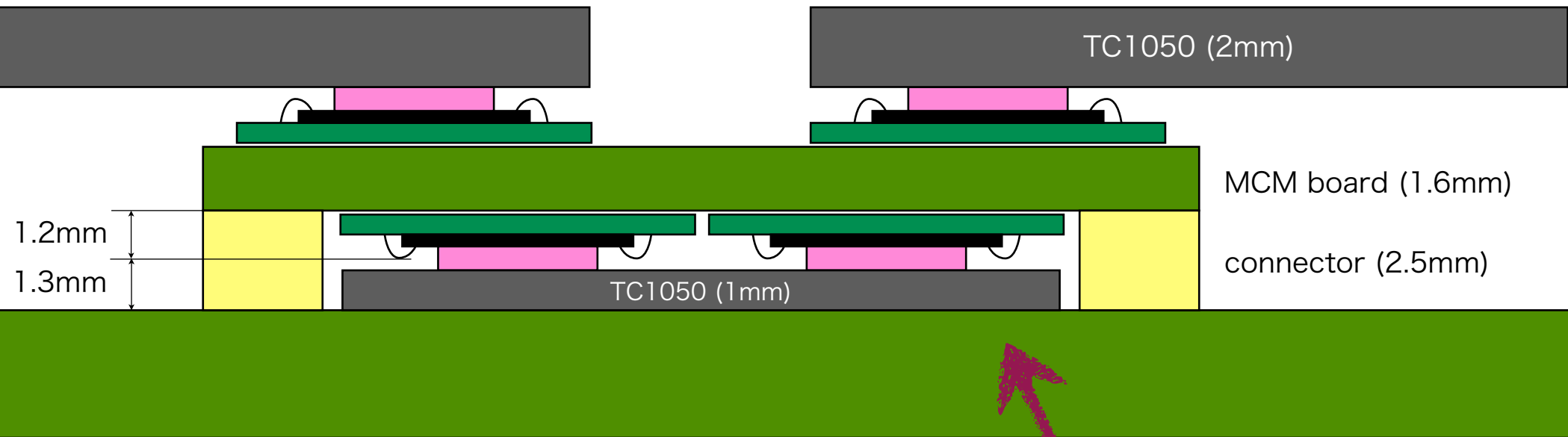


PGS graphite sheet (by Panasonic)
~1500W/m · K



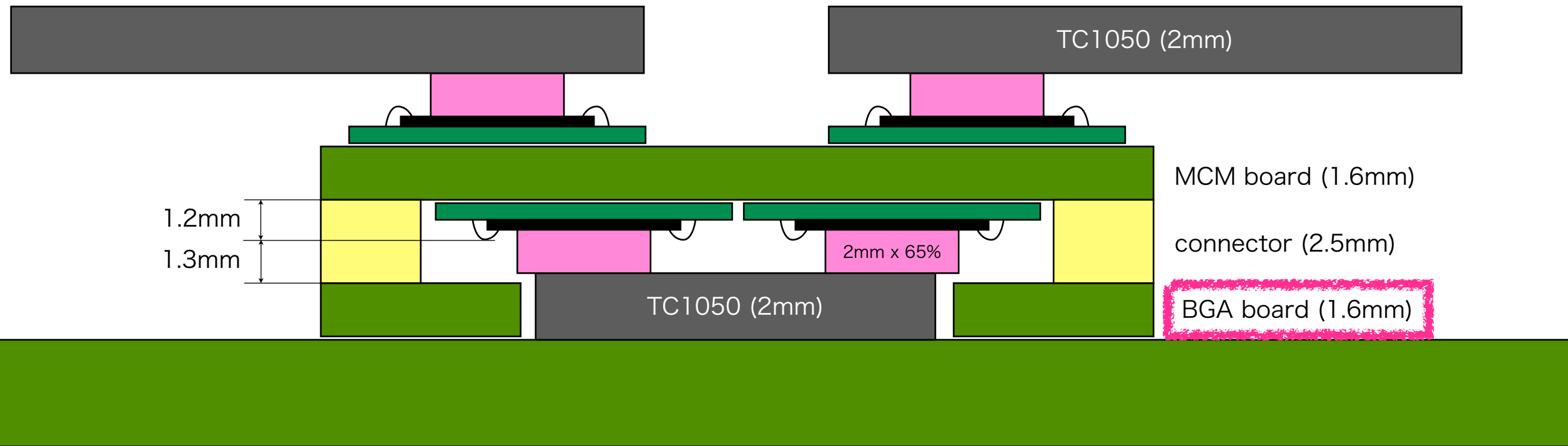
heat insulating sheet (by Polymatech)
~0.02W/m · K

2.5mm space limited by the connector height



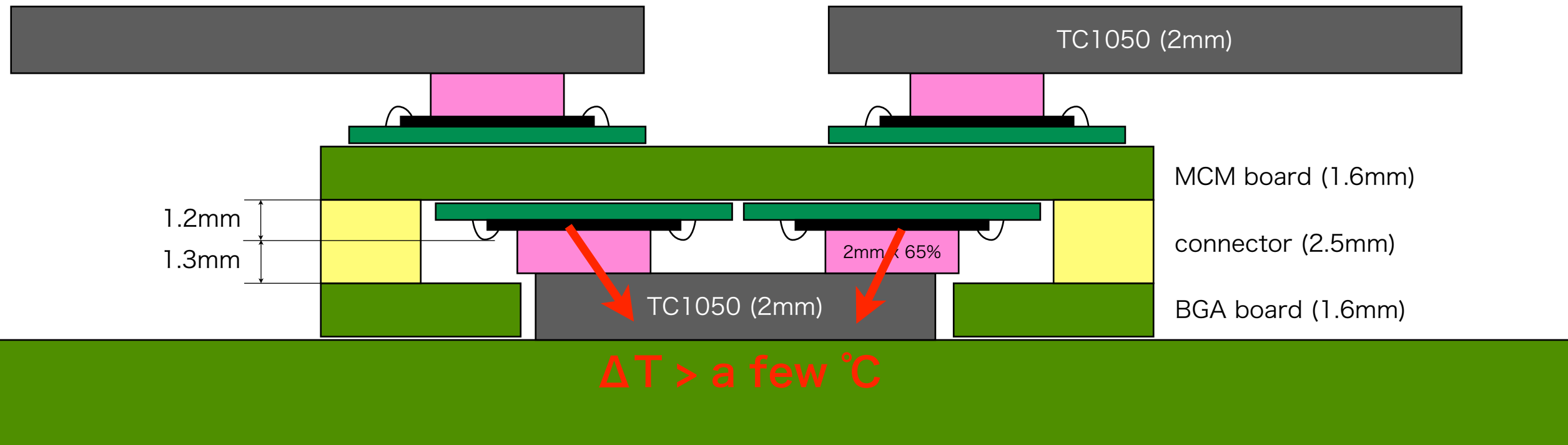
Taking into account the epoxy layer (0.8mm) for bonding protection, insertion of 1mm-thick TC1050 will be difficult. → This structure will not go well.

Idea: BGA board can increase the height



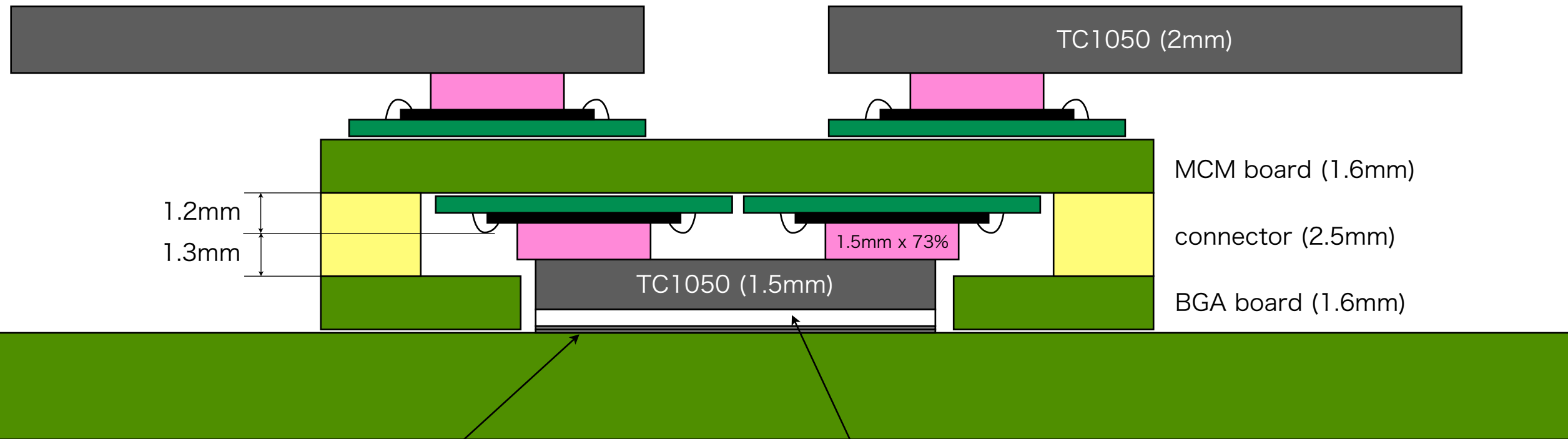
Make it higher so that 2mm-thick TC1050 can be inserted.

Idea: BGA board can increase the height

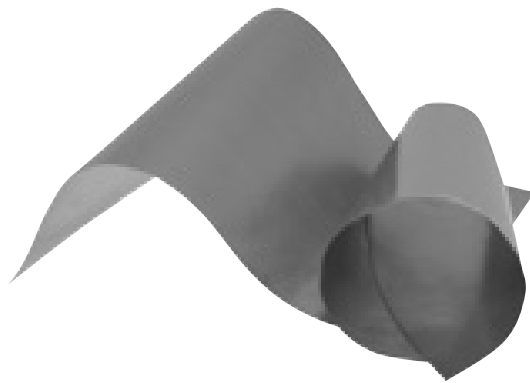


Even with this setup, temperature gradient will be a few $^\circ\text{C}$.

Idea: combination of conductor and insulator



"PGS® graphite sheet



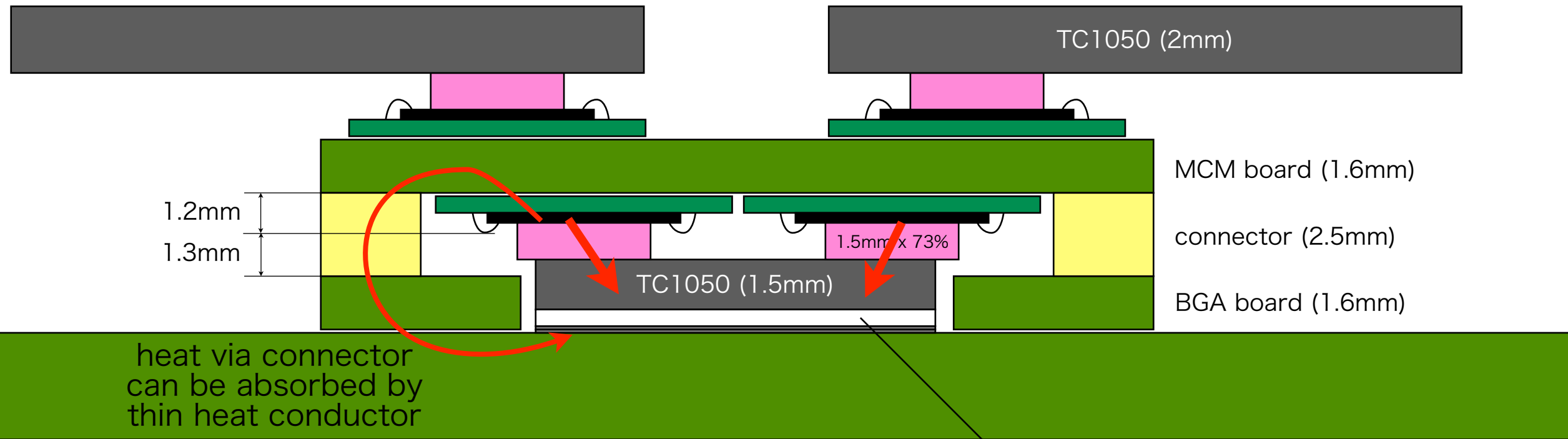
http://industrial.panasonic.com/www-ctlg/ctlgj/qAYA0000_JP.html

700W/m · K



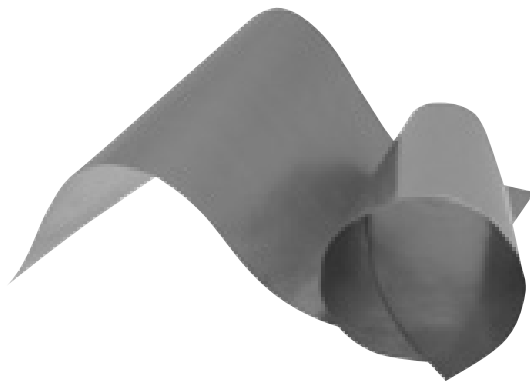
heat insulator with conductance 1/10 of kapton and less than air.
<http://www.polymatech.co.jp/c-6.html>

Idea: combination of conductor and insulator



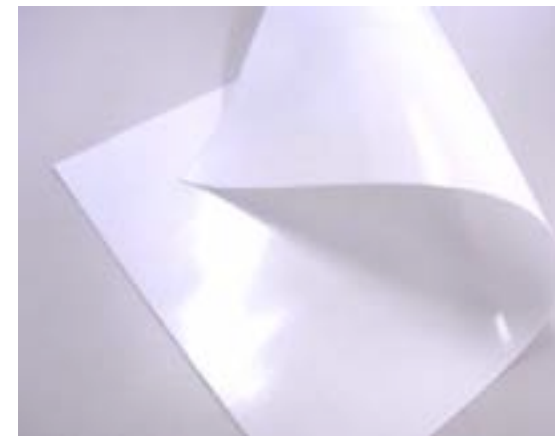
ΔT is blocked

“PGS[®] graphite sheet



http://industrial.panasonic.com/www-ctlg/ctlgj/qAYA0000_JP.html

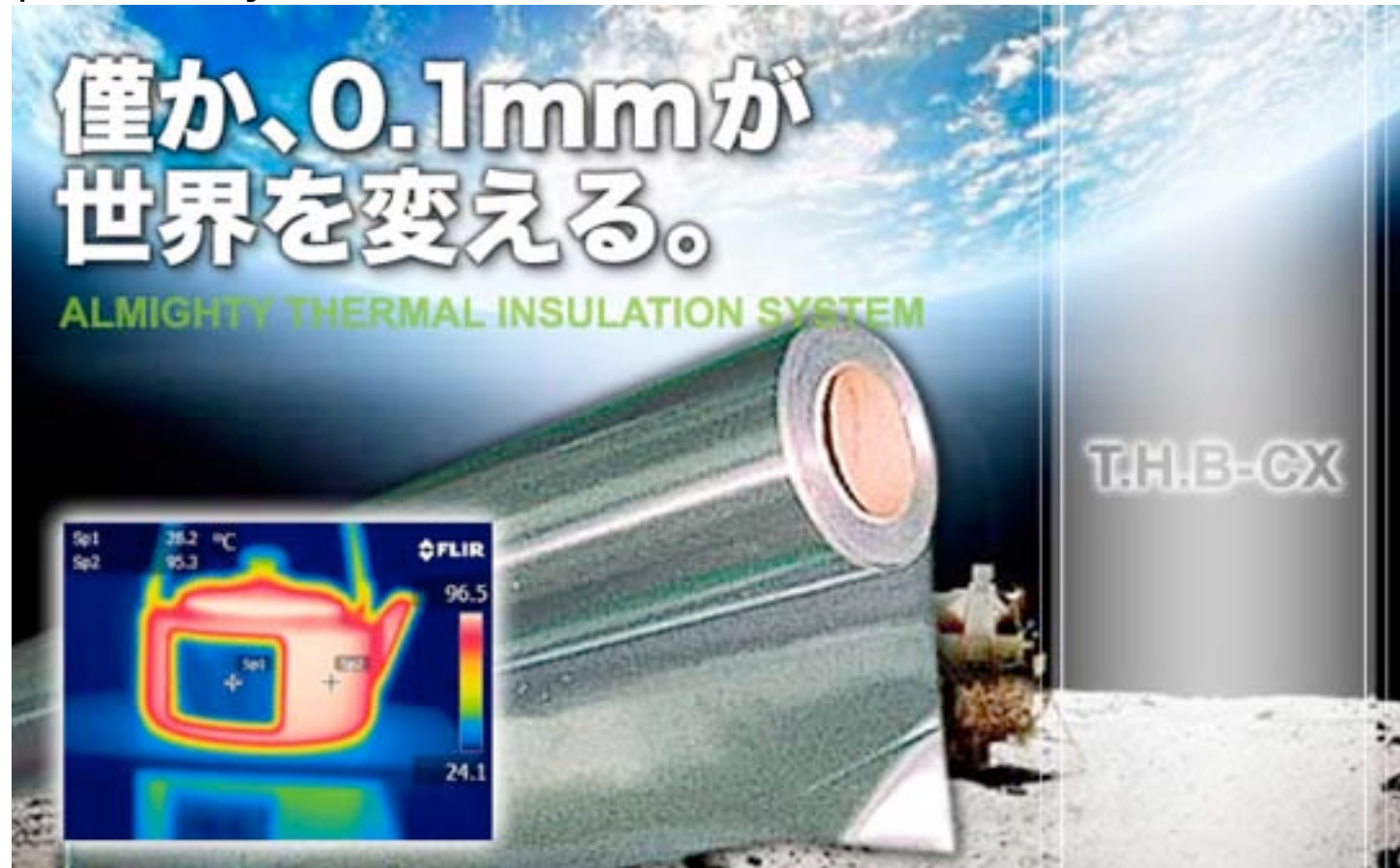
700W/m · K



heat insulator with conductance 1/10 of kapton and less than air.
<http://www.polymatech.co.jp/c-6.html>

Better heat insulator?

product by nihon-shanetsu.



<http://topheat.jp/product/index.html>

0.1mm-thick with 5 layer structure.

According to the website, pressure may increase the heat conductance, which is not good for us.

Instead, the material may be useful for blocking heat transfer btw. VTX and TPC, or btw. TPC and CAL.

