Considerations on CO_2 Cooling of S-ALTRO16 on the next modules

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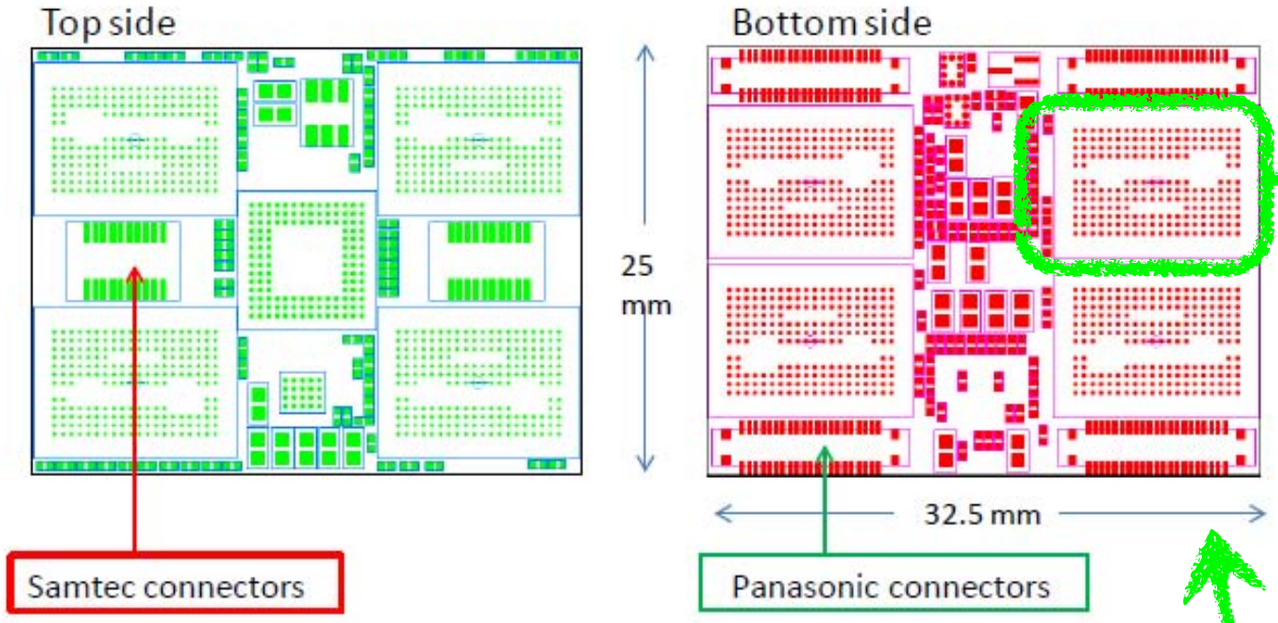
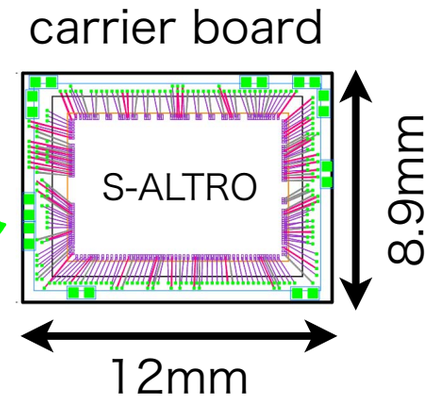
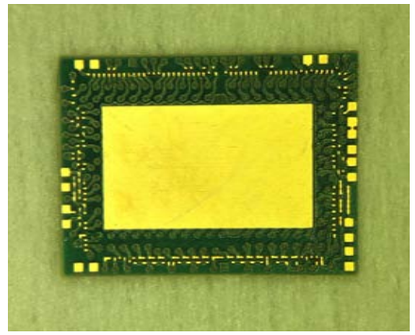
LCTPC Collaboration MTG

Readout electronics based on S-ALTRO16 chips

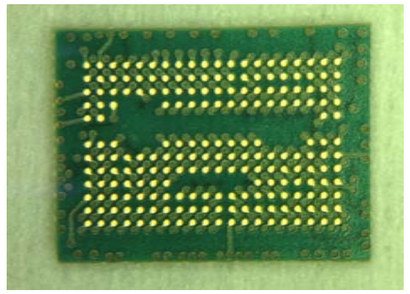
Final MCM Bd design by Lund Univ.







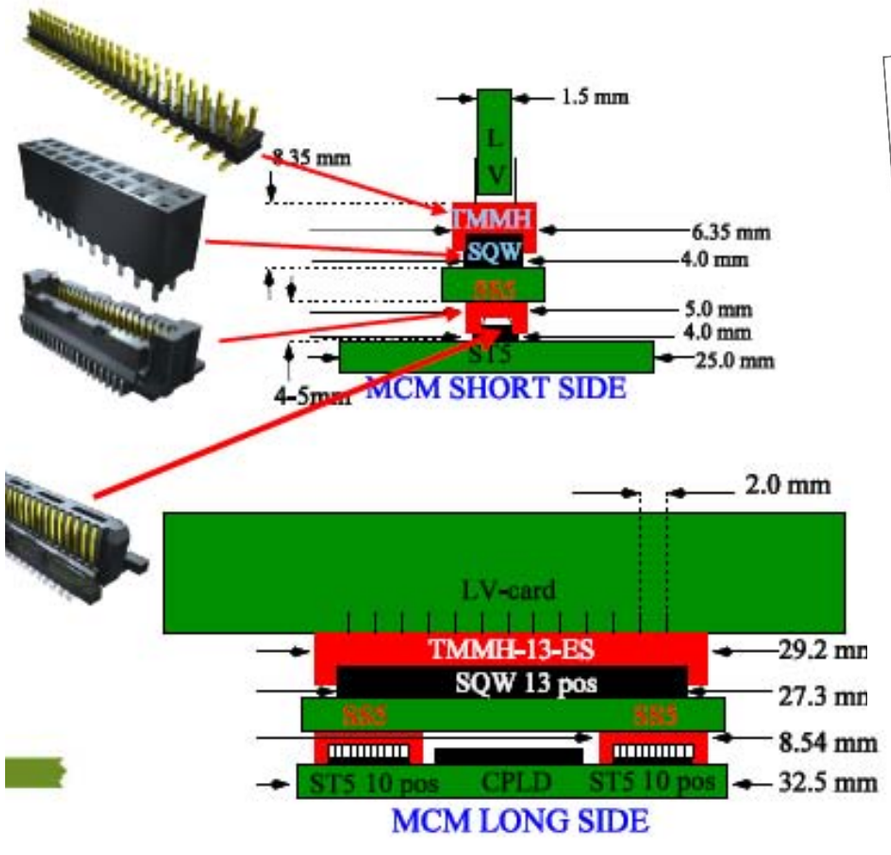
chip side

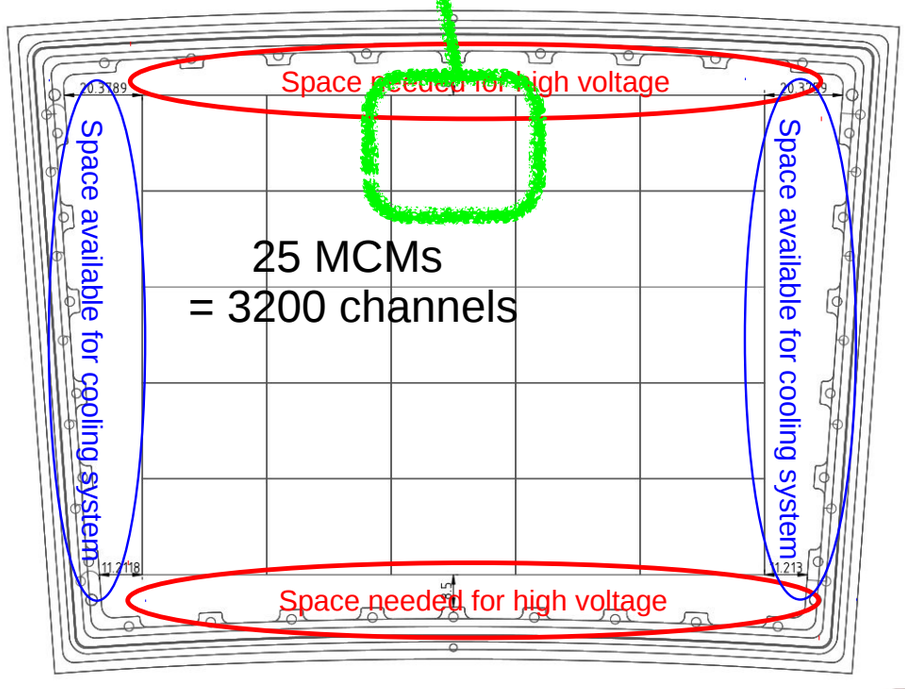


BGA side

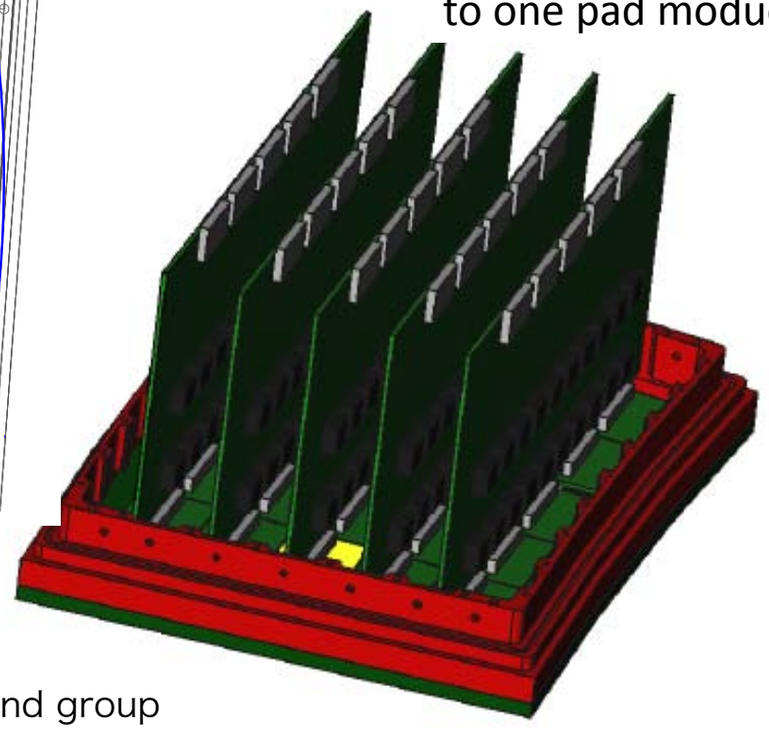
3 CBs were fabricated and ready for test

(38mW/ch @ 20MS/s , 16chs/chip)





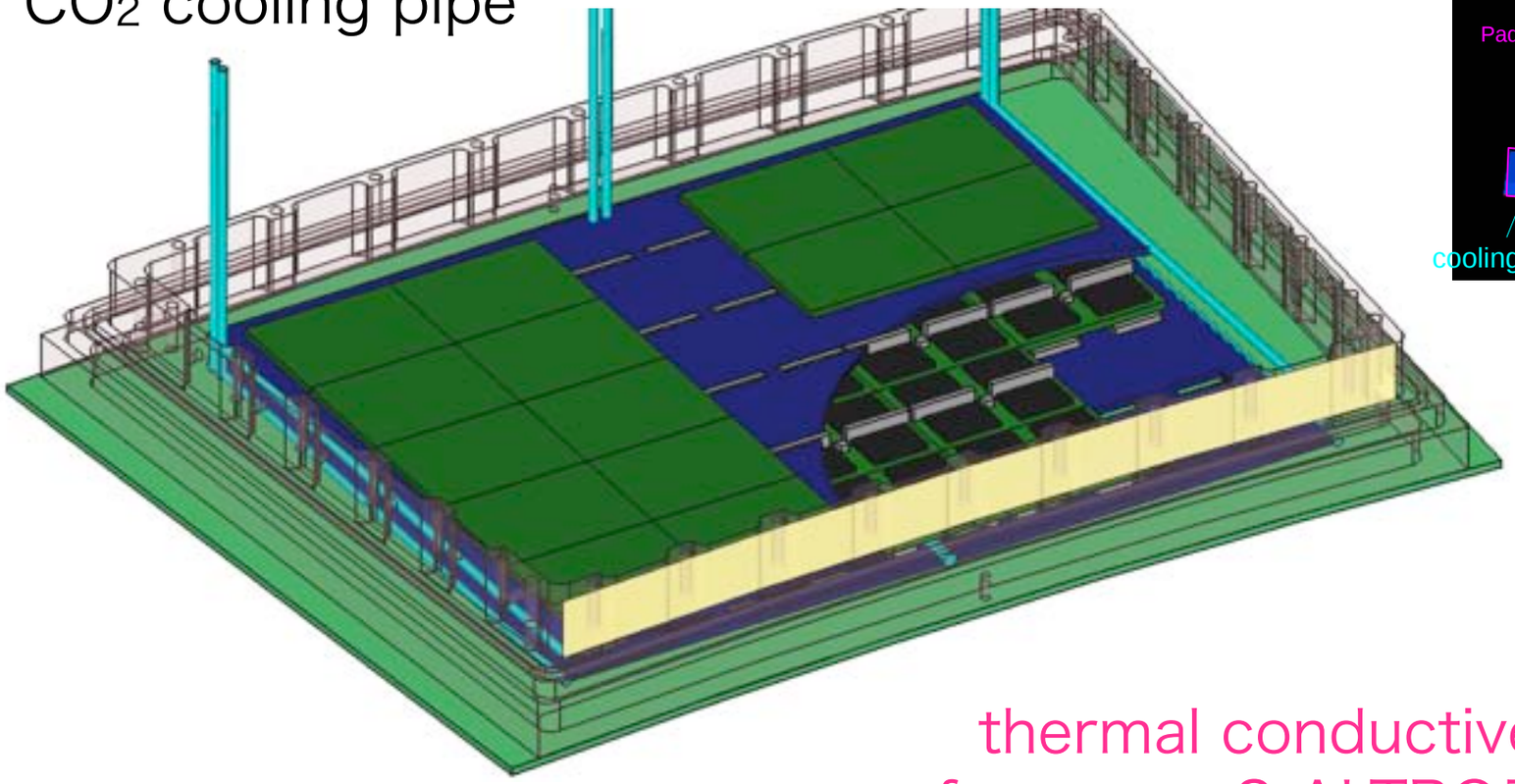
LV-boards attached to one pad modue

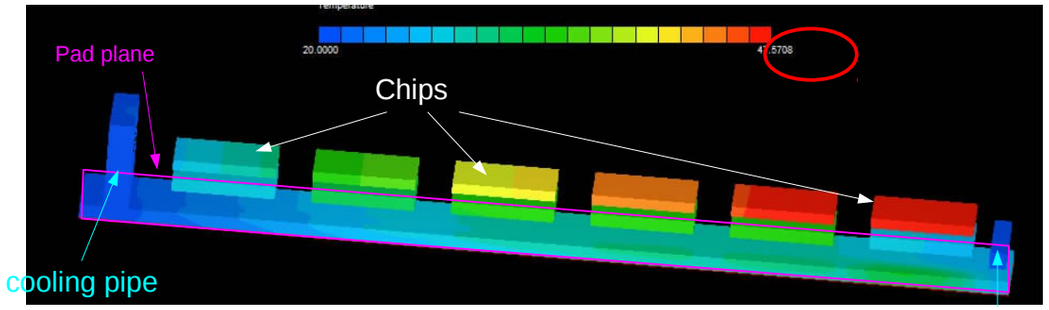


Figures from “Front-end electronics for the TPC in ILD; a status report April 2014,” etc. by the Lund group

Proposed Cooling for S-ALTRO16-based electronics

CO_2 cooling pipe

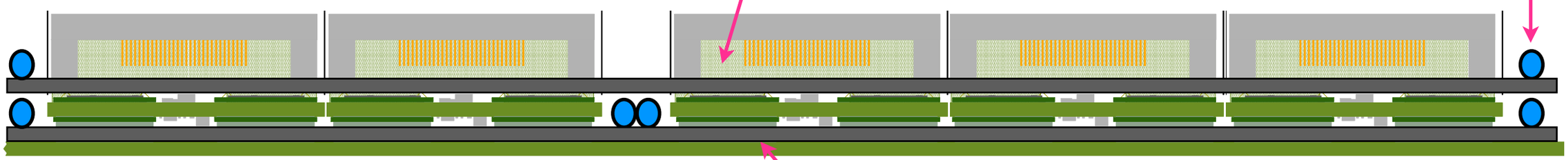




Simulation showed that
Middle pipe is necessary

thermal conductive plate
for upper S-ALTRO16 chips

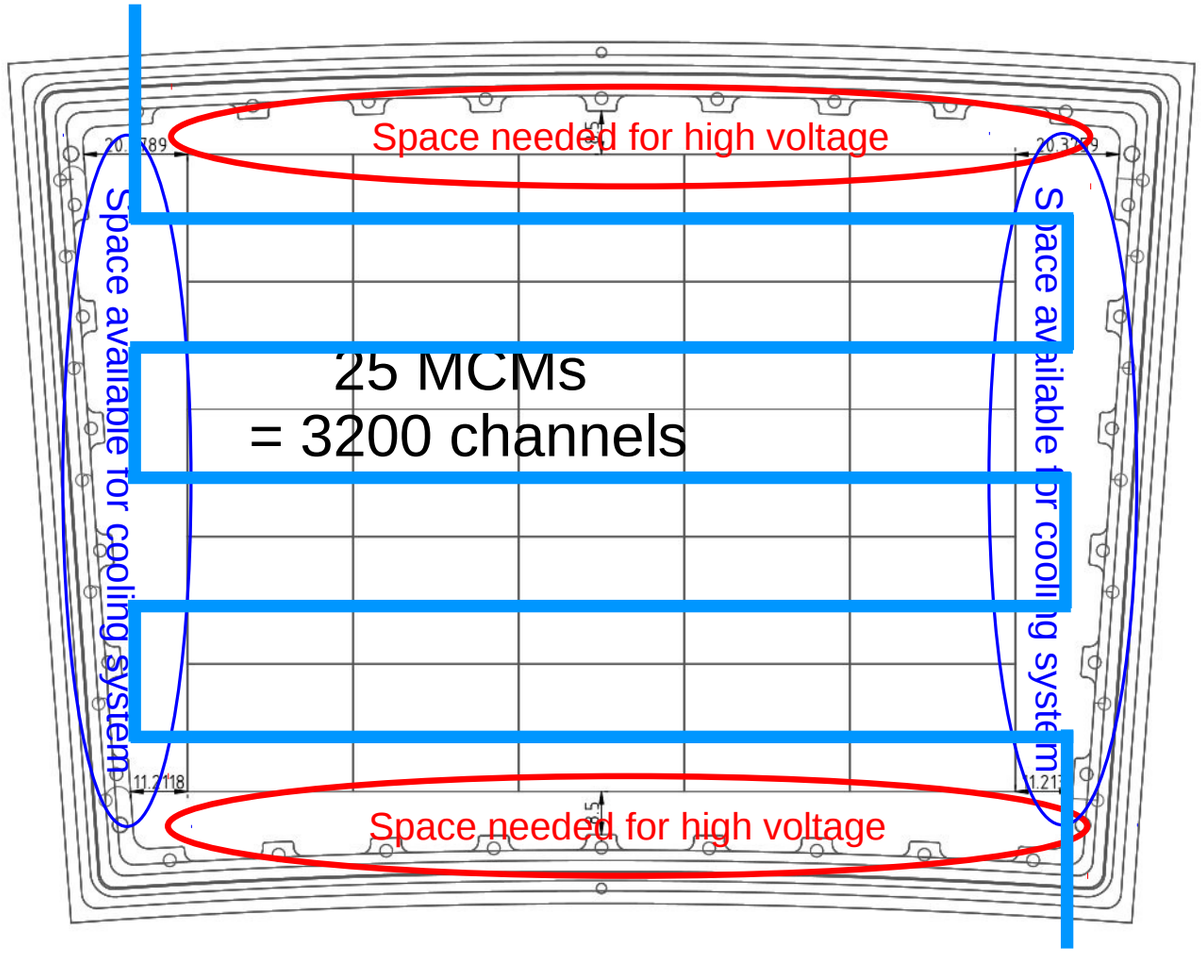
CO_2 cooling pipe



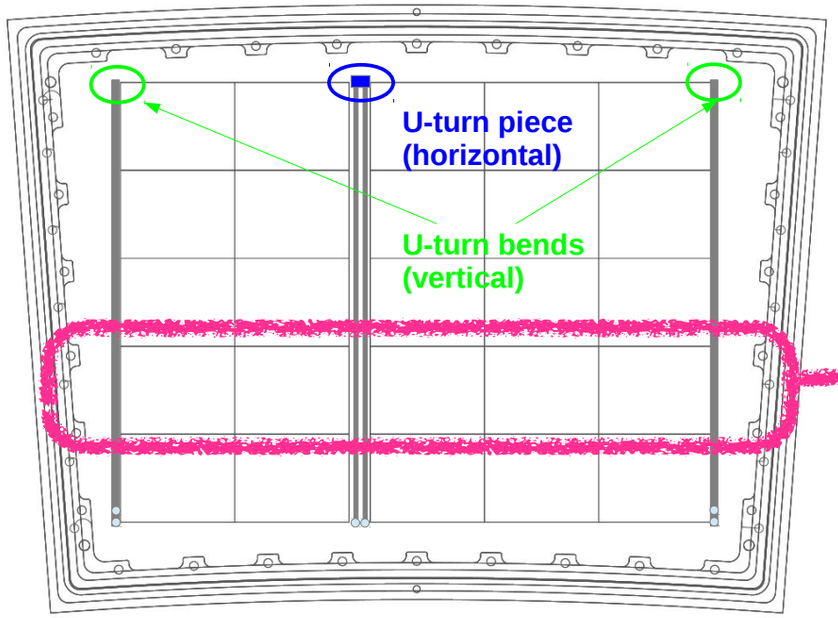
thermal conductive plate
for lower S-ALTRO16 chips
and to keep pad-plane temperature

Another possible option

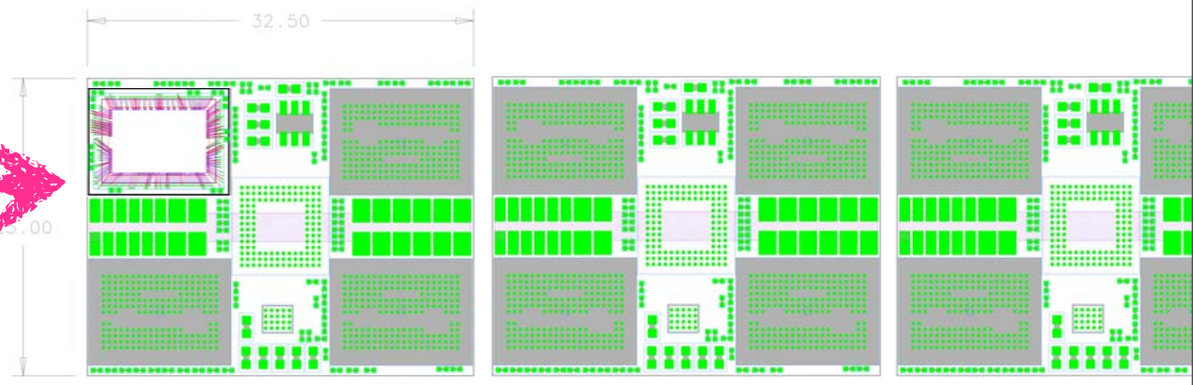
pipe on every MCM (or every chip)



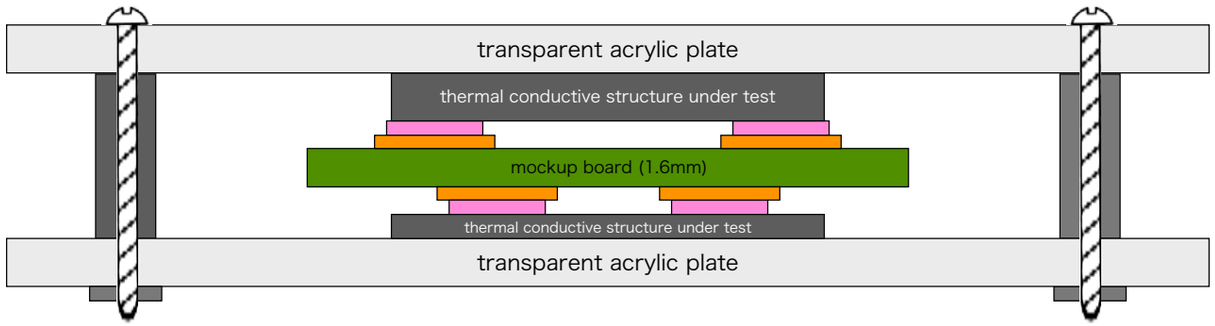
Mockup Test Plan

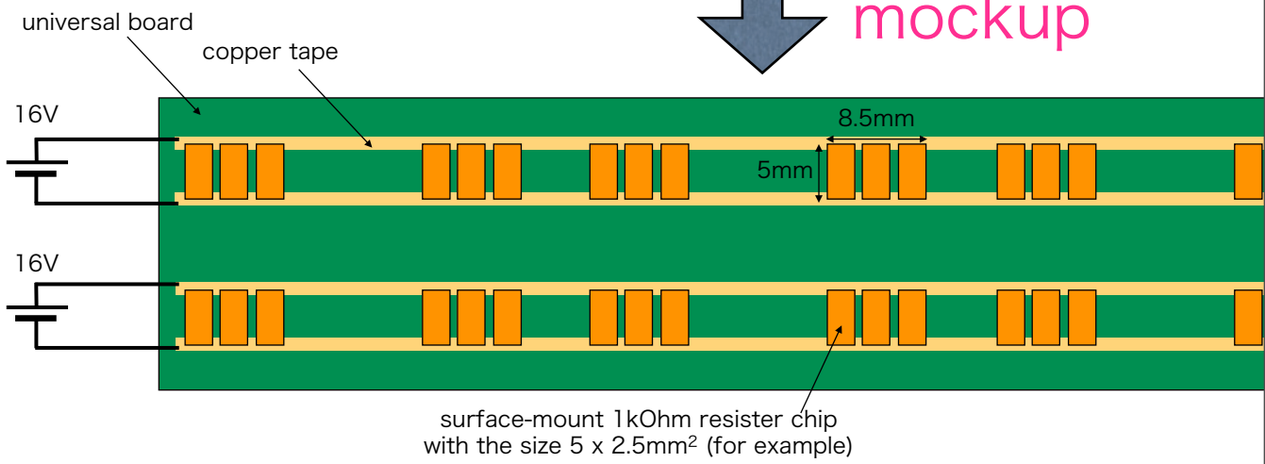


5 MCMs



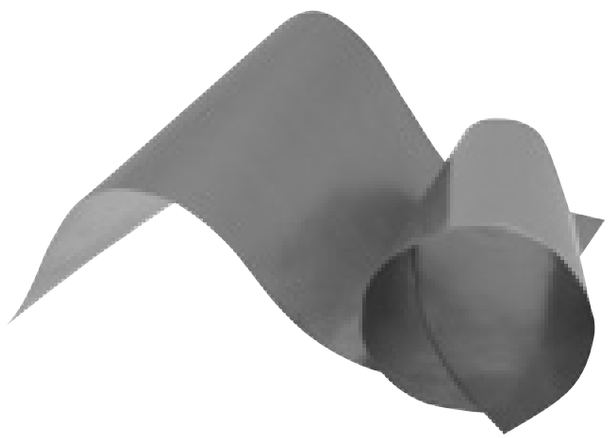
mockup





Combination of various thermal conductor/insulator will be tried

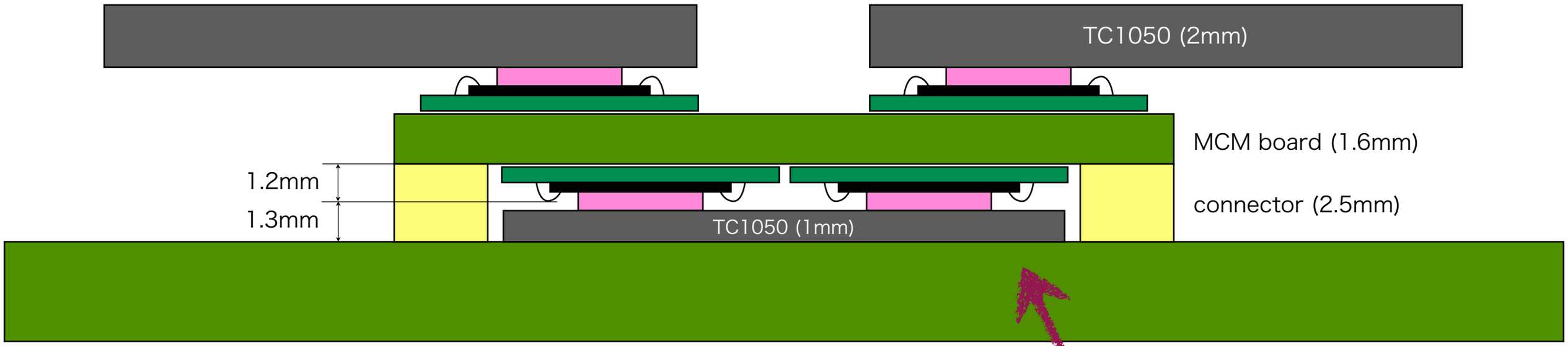
TPG plate (by Momentive)
~1500W/m・K
sandwiched by Al plate



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

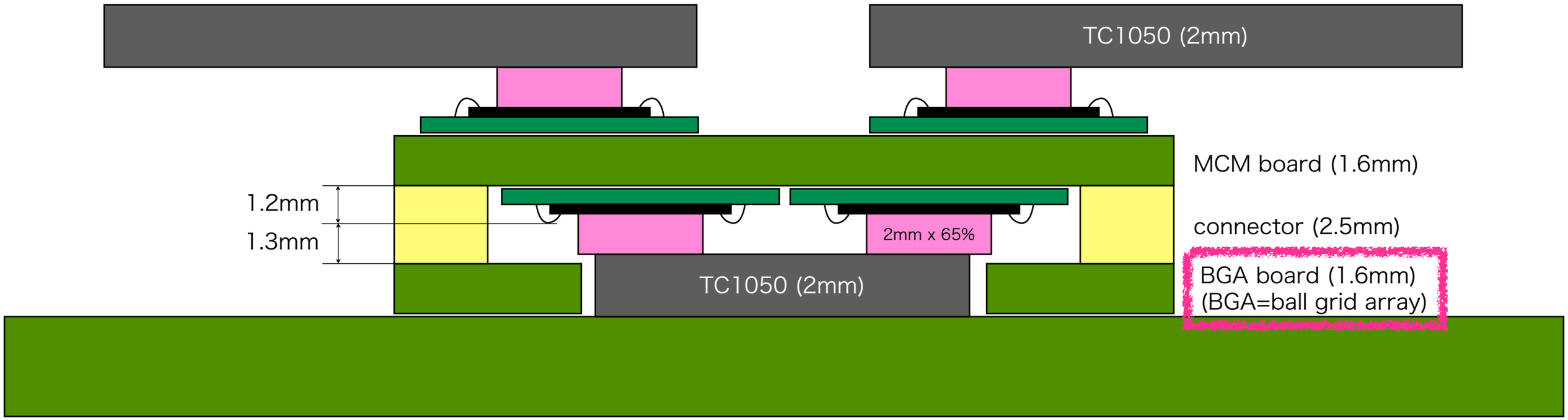
heat insulating sheet
(by Polymatech)
~0.02W/m・K

2.5mm space limited by the connector height



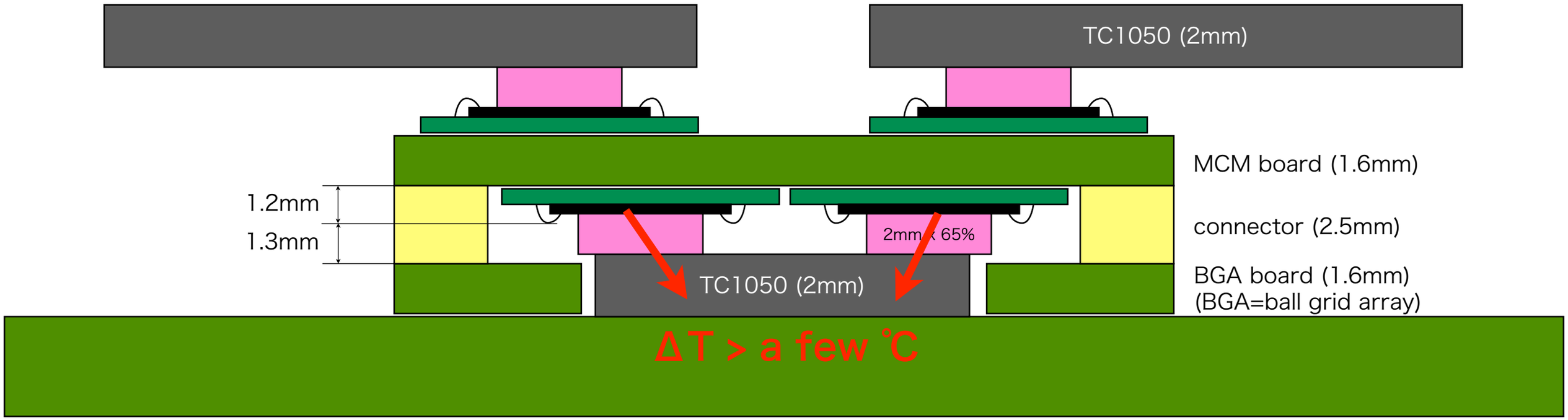
Taking into account the epoxy layer (0.8mm) for bonding protection, insertion of 1mm-thick TC1050 will be difficult. → This structure will not go well.

Idea: BGA board can increase the height



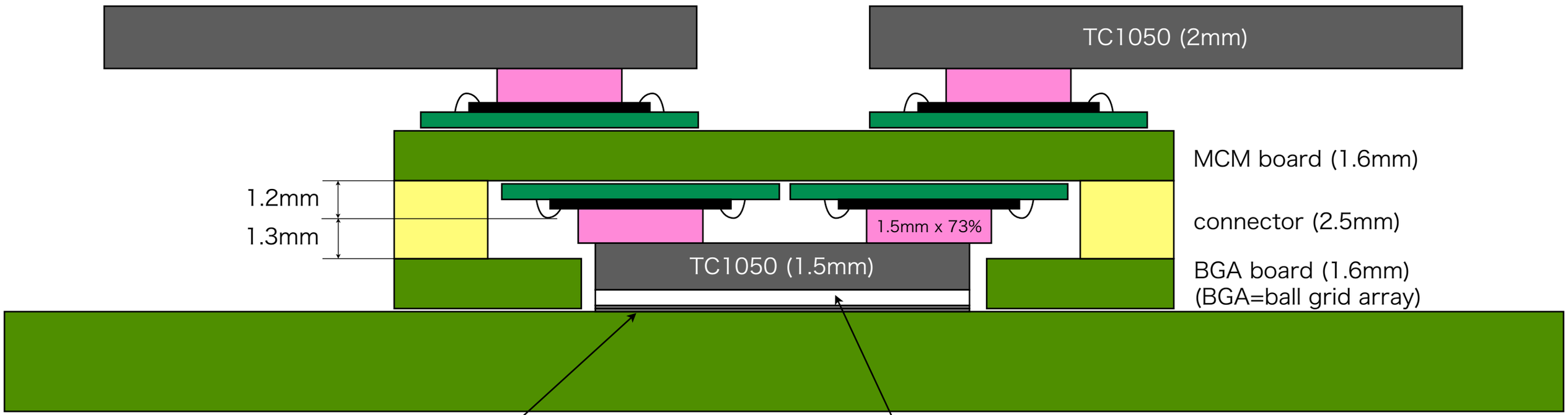
Make it higher so that 2mm-thick TC1050 can be inserted.

Idea: BGA board can increase the height

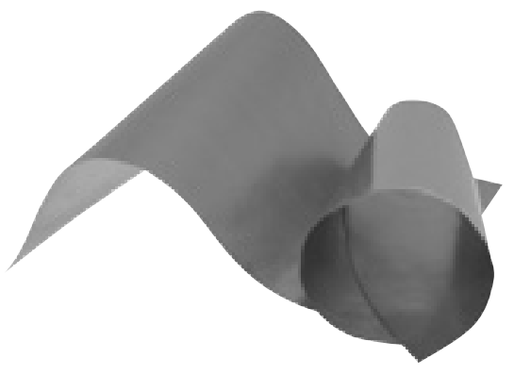


Even with this setup, temperature gradient will be a few ℃.

Idea: combination of conductor and insulator

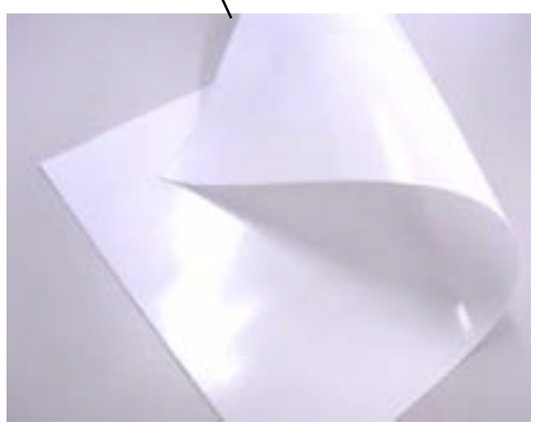


"PGS® graphite sheet



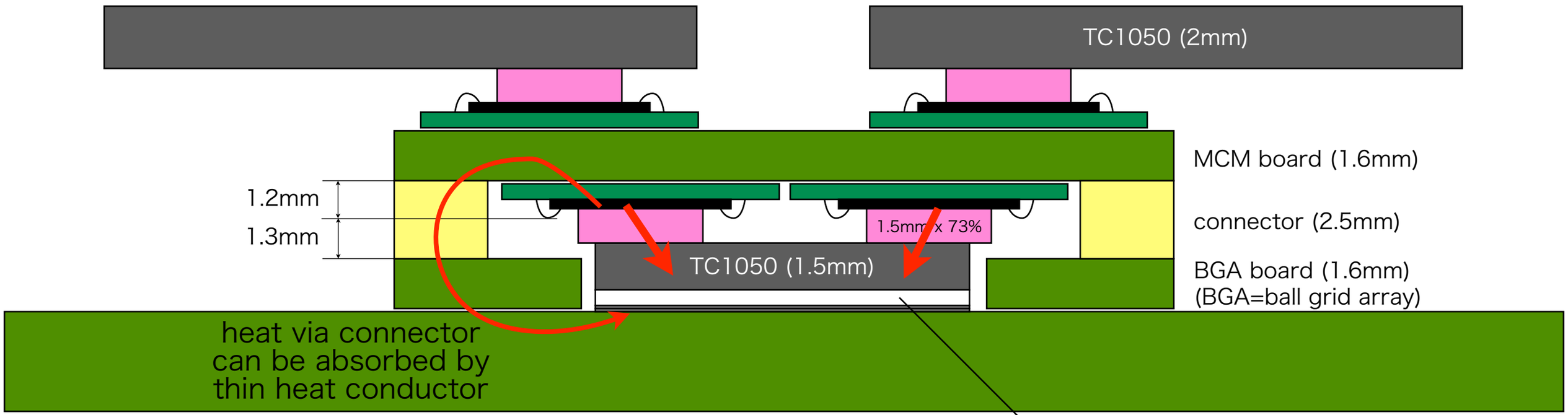
http://industrial.panasonic.com/www-ctlg/ctlgj/qAYA0000_JP.html

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



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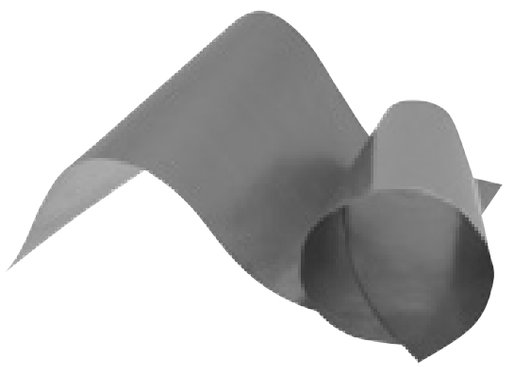

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700W/m・K

heat insulator with conductance 1/10 of kapton and less than air.
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Issues on the next module cooling

- How to route the cooling pipes. At the middle and edges of the module, or on every MCMs. (-> mockup heat test)
- Depending on the piping, there may be conflicts between LV electronics, HV connectors, and cooling pipes. So we need to design them as a whole system.
- Mechanical / Electronic stability of the complicated structure should be tested.