QUAD development

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Status

- Mechanical QUAD completed
  - Broken type F chips
  - Damaged grids (pickup tests)
  - Stump not positioned precisely
  - Not gastight
  - Chips not precisely positioned
  - Wire bonded

- Electrical QUAD completed
  - Class D chips
  - Poor grids (wrinkled)
    - One grid damaged
  - Stump better positioned (jig)
  - Chips not precisely positioned
    - Caused by pressing them into the attachment tape, improper dimensions wirebond board
  - Waiting for DAQ tests (Bas)
  - Gastight (not verified)
  - Some chips may operate in gas at proper grid voltage

Next electrical QUAD

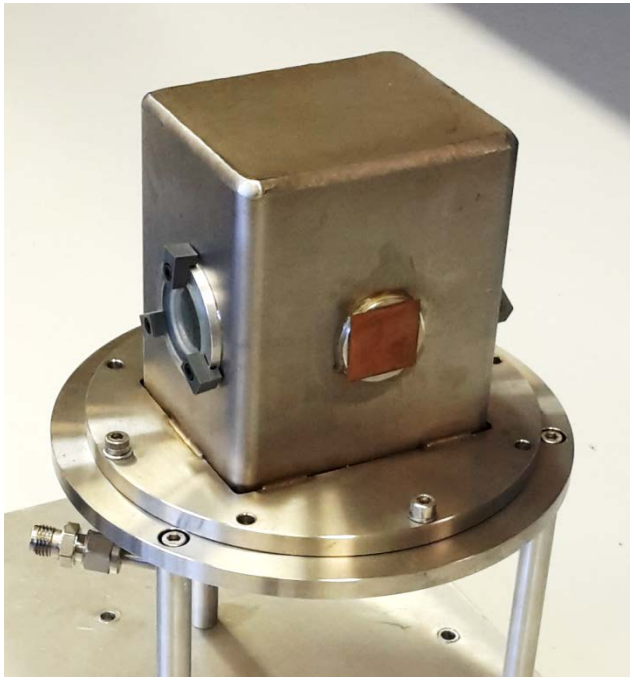
- We have still two proper PCBs / flexes (third one damaged during re-machining)
- Will have revised mechanics (coca, stump)
- And well machined wirebond board
- (hopefully) better aligned chips
- Suited for performance test in gas
- May be completed in mid September

- Which chips to be put on?
  - Existing class D chips with wrinkled grid (still 5 available)
  - Or better grids / class A/B chips

Planning near future

- New PCB /flex production
  - New production may take ~ 10 weeks
  - We need 2 holes for guard screws
  - We have to wait for the results of the DAQ tests by Bas

- Modified HV boards
  - Not critical
- Modified guard
  - Simplified, not critical
- Designing testbox for laser and testbeam
  - Simple one using existing housing
    - Performance tests
    - Primitive field shaping
    - Ready in September
  - Dedicated testbox using proper field shaping (Harry)

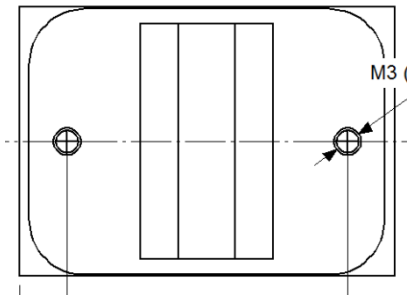


- Processing new TPX3 wafer
  - Modified dyke geometry

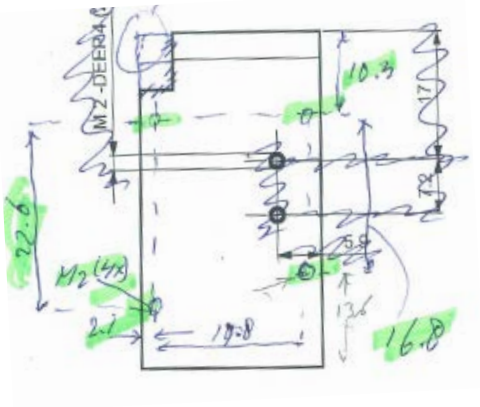
- Production of QUAD prototypes may proceed quite fast in future
  - 2 per week looks feasible

Mechanical modifications

- Coca
  - Attach chips by double sticky thermal tape 3M 8940
    - Enabling chip replacement
    - Thickness 0.127 mm specified, 0.2 mm? reality
  - Coca thickness 5.0 => 4.8 mm
  - Proper fitting of stump into Coca
  - M3 holes for mounting



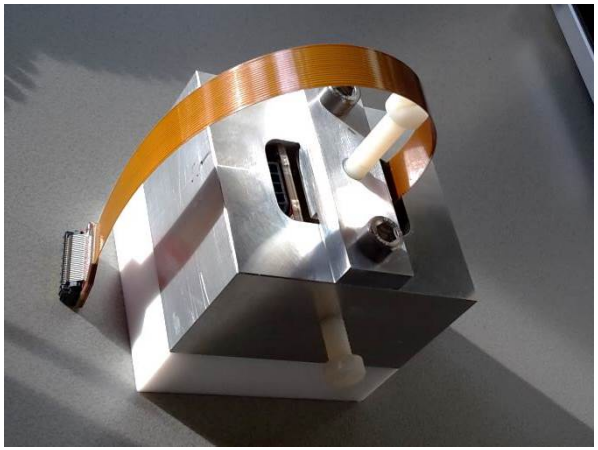
- Stump
  - Length reduced by 4 mm
  - Move/modify many holes
  - Omit clearance for HV flex
  - Add trenches for HV wires

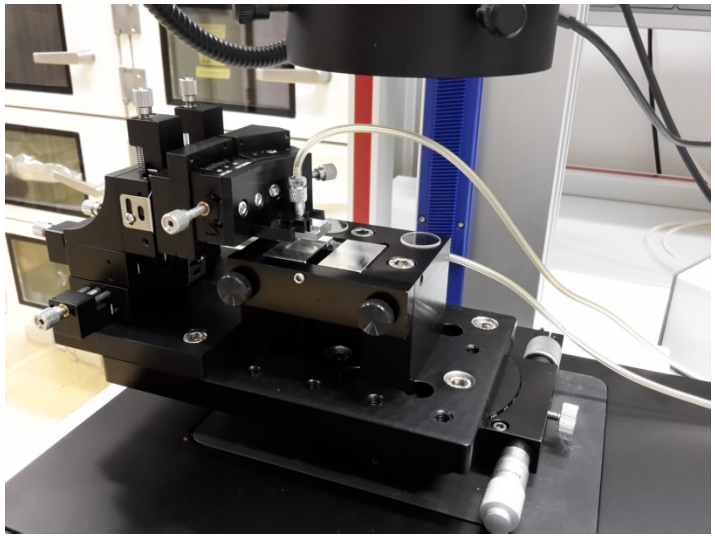


- Guard and grid connections
  - HV flex to guard and grids omitted
    - Replaced by 80 µm insulated copper wires
  - Guard screwed instead of glued
    - M1.2 Peek screws on wirebond PCB

Assembly experience

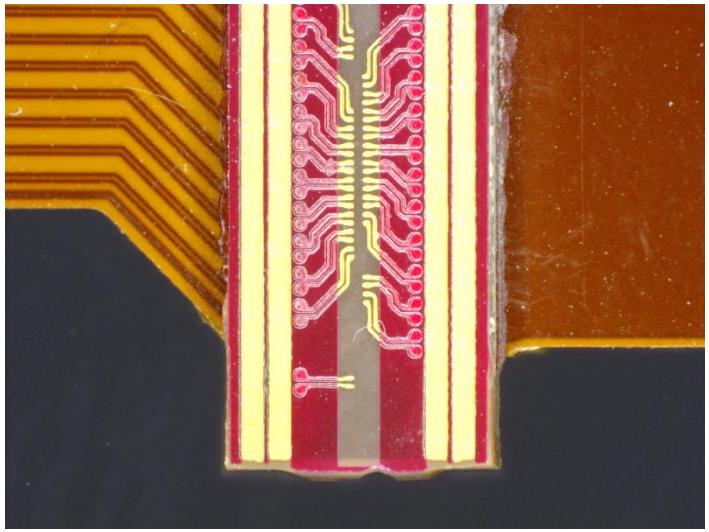
- Integrating coca, flex and stump
  - Using glue jig to define proper alignment
- Alignment chips onto Coca
  - Using microscope with accurate XY stage and dedicated tooling
  - Handling and alignment proceeds smoothly now
    - No pickup damage
  - Goes wrong when pressing the chips better onto double sticky tape
    - Errors ~ 30 µm in X, Y and φ
  - Errors in Z by glue residues in coca/ wirebond PCB joint
- Solution to XY and Z errors:
  1. Do not touch chips after alignment
     - May adhere better in time
  2. Take utmost care in cleaning and re-machining the coca / PCB corner after gluing/ making gastight



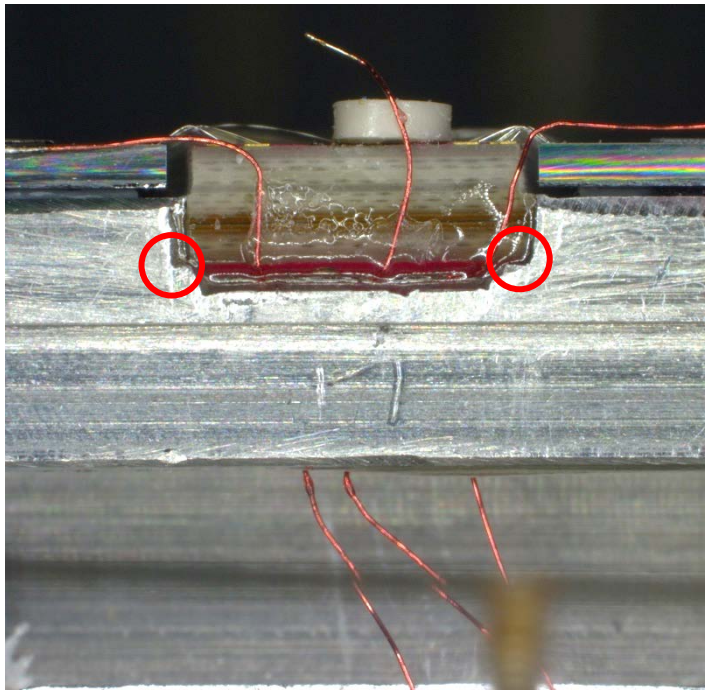


Assembly experience (cntd)

- Many problems with the rough edges of the wirebond PCB
  - Board is up to 1 mm too long and up to 0.4 mm too wide
  - Remains of epoxy
  - Probably the manufacturer is not able to do this much better

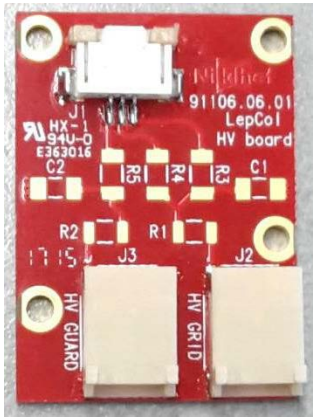


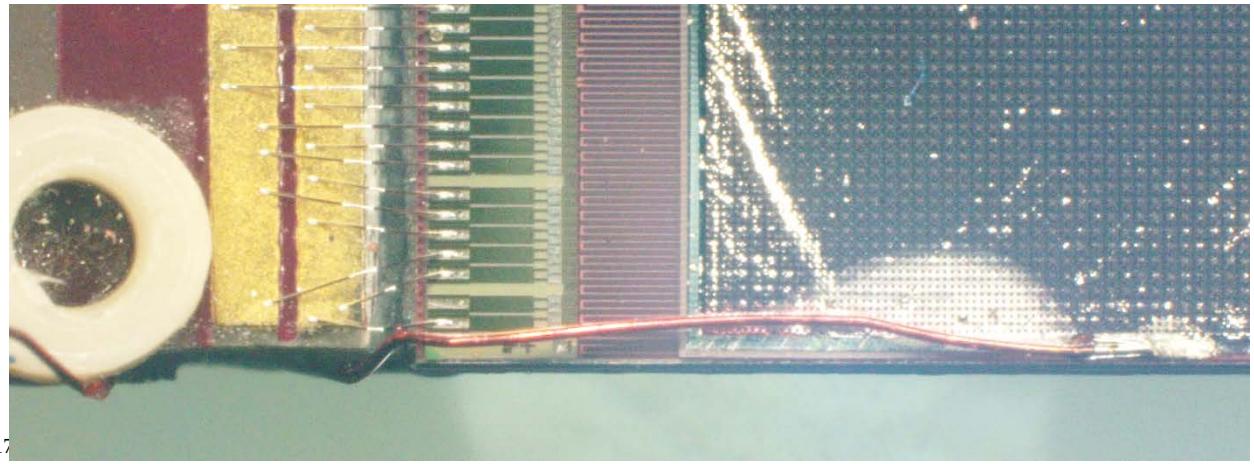
- => also in future we have to re-machine the PCB ourselves
  - Hard to clamp => we need to make dedicated support
  - Machining very close (10 µm) to the flex
  - => we will need a table top grinding machine and a 3D microscope on a swivelling arm
- Position of wirebond board critical
  - The position of a properly re-machine board is mainly determined by its support on the coca



Grid connections

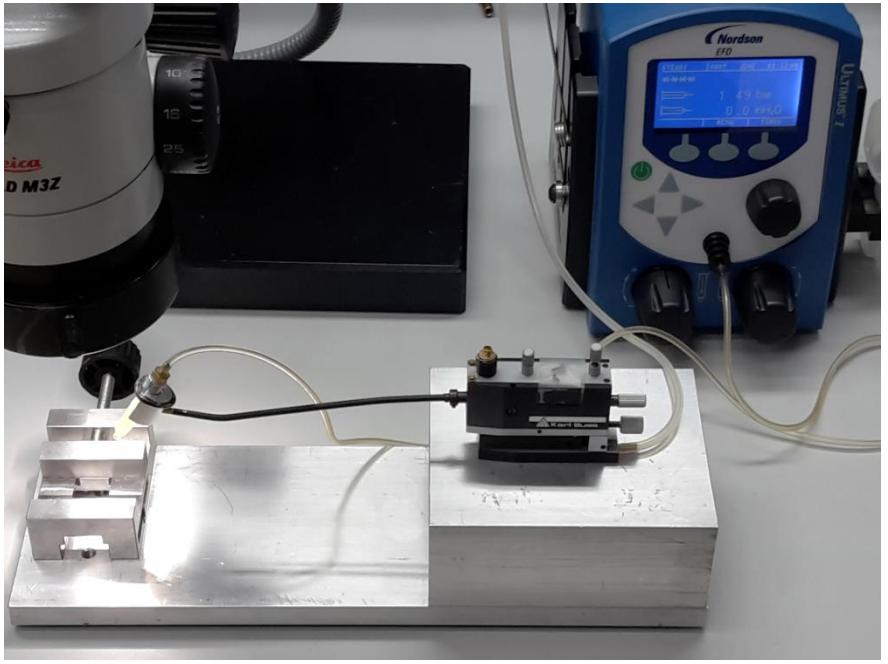
- Using Temco magnet wire
  - 40 AWG insulated copper wire (80 µm)
  - Insulated by polyurethane + polyamide cladding
  - Insulation specified at 1220 V
    - Breakdown at 3780 V
- HV PCB to be modified
  - HV wires directly soldered onto the board
  - Each wire has its own 100 MΩ resistor now
    - Reducing the grid capacity to minimum
  - Capacitors for reading grid signal (auto triggering)
- Wires to be bend and directed to the narrow side dyke of the grid
  - **Hard job of bending the springy wire in the right shape**
  - Not to be done for more than a few QUAD prototypes
  - Next wafer InGrids will have very broad dyke at the wirebond side

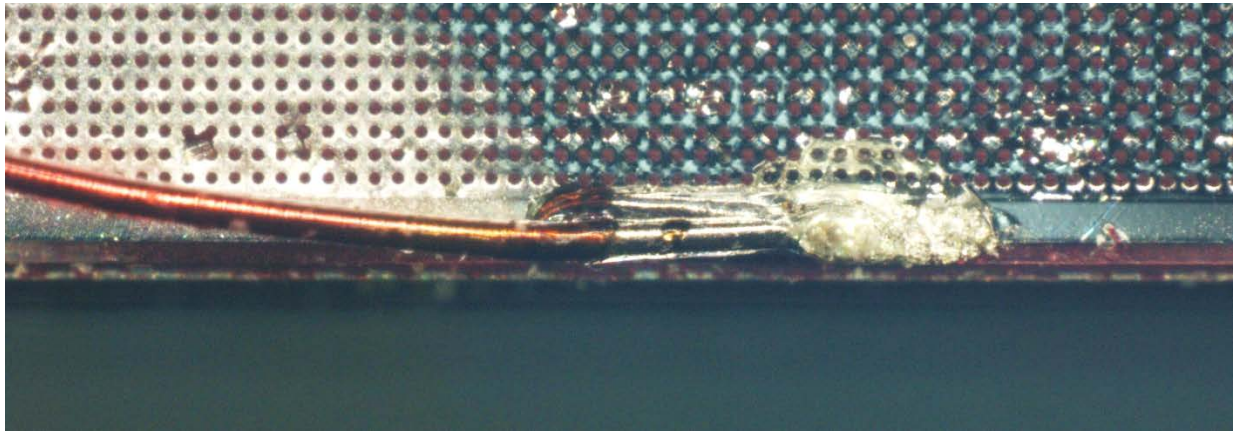




Grid connections (cntd)

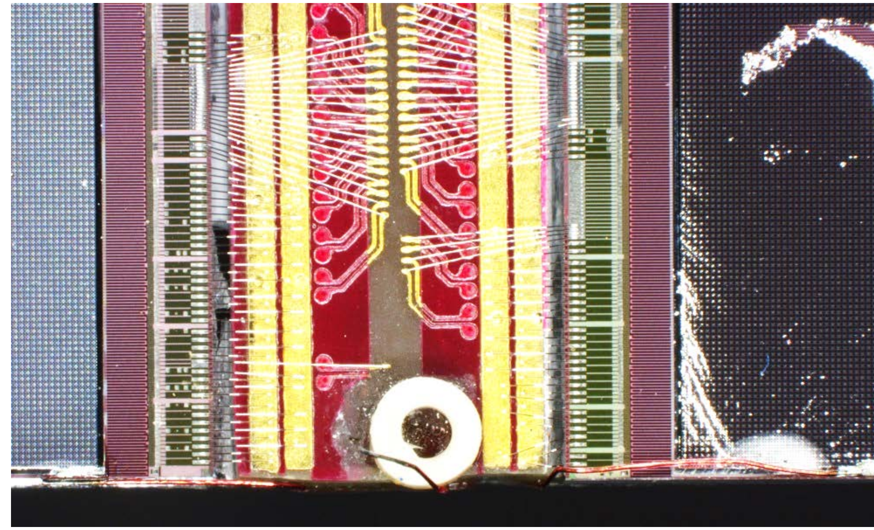
- Gluing still critical (conductive glue almost shorting a grid) but doable using the dedicated tools
  - Conductive glue (Traduct)
  - Araldite (securing)
  - Much better for next TPX3 wafer
- Glue joint reliable (once it is properly done)





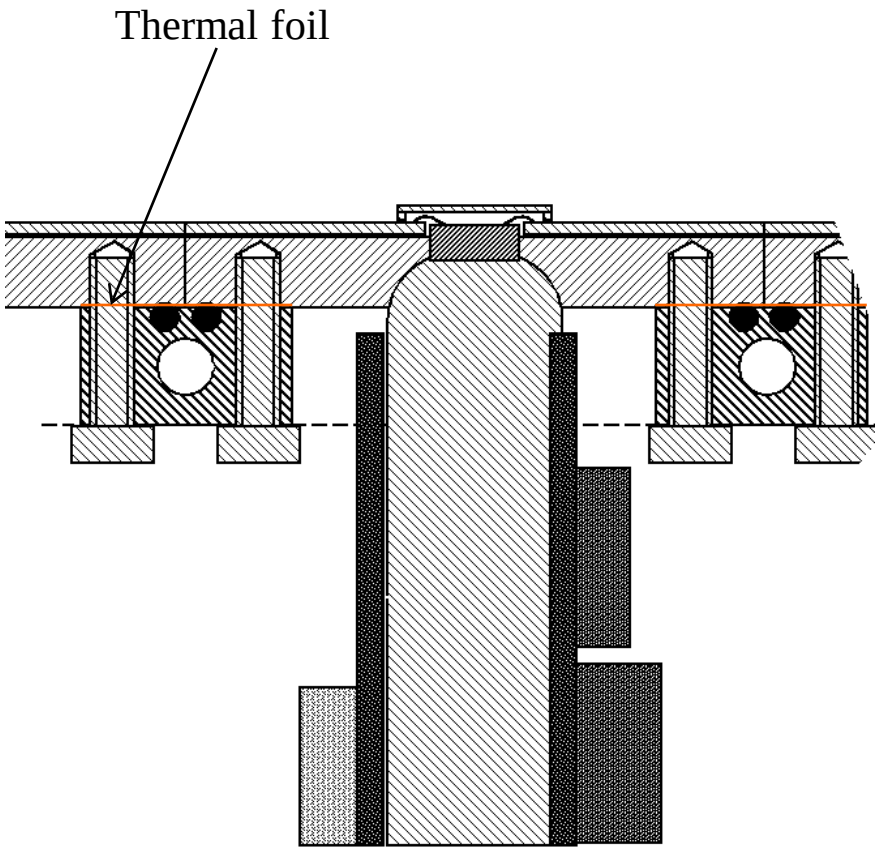
Guard modifications

- Re-machining also required to get the proper dimensions
  - Need a jig for this
- Flex omitted
  - HV wire soldered
- Not glued but screwed (peek M1.2 bolts)
- Clearance at the ends of all ribs for grid HV wires



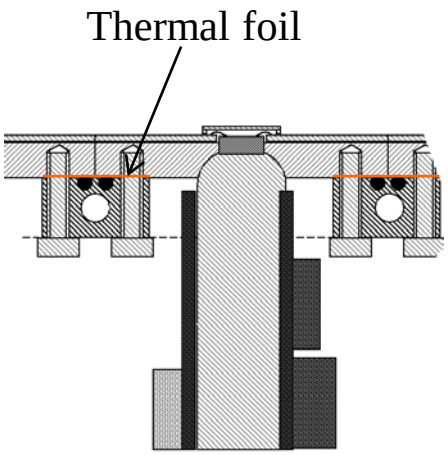
Assembling multiple QUADs

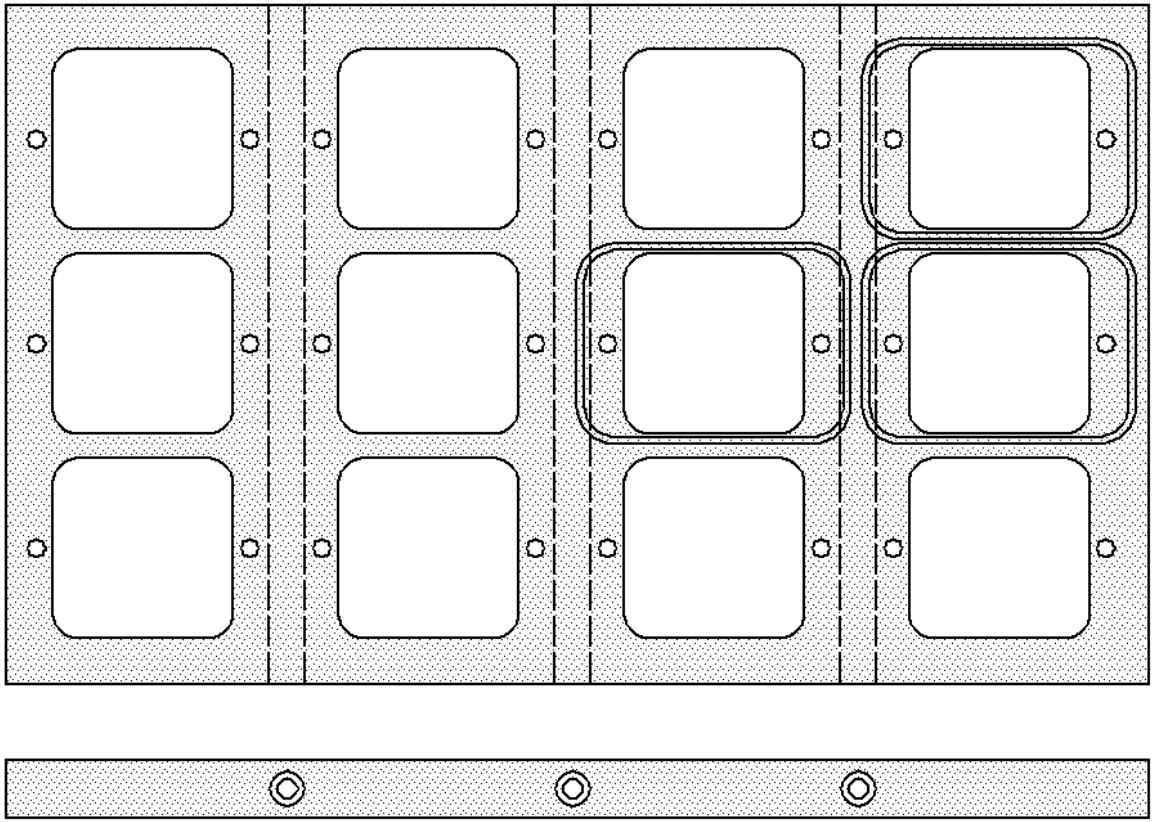
- Use frame with 25 x 25 mm holes
- Cover it with thermal foil
- Load QUADs from above
- Clamp them (M3 screws) from below
- Push them tight together from aside
- Make gas tight by 2 mm O-rings
  - Maybe thermal foil is sufficient for gas tightness



Assembly frame

- 25 x 25 mm holes
- Cooling by pipes in the frame
  - Excellent thermal contact between chips and cooling channels





Assembly sequence QUAD

1) Insert wirebond PCB in coca and glue stump to it using the jig
2) Add the thermal tape to the coca surfaces
3) Insert QUAD into alignment block and align two chips. Press the chips onto the tape
4) Rotate QUAD by 180° in alignment block and align the two other chips onto the tape
5) Add wirebonds to the chips
6) Test the electronics
7) Mount the HV PCB and insert the HV wires on both sides of the stump under the coca. Glue the wires in this place by Araldite
8) Make the HV wire connections to the 4 grids by conductive glue, followed by Araldite
9) Apply HV tests
10) Mount the guard and solder the HV wire to it.