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Module cooling unit

The module cooling unit is a device for cooling ITk pixel modules during production and testing for the purposes of:

- Temperature cycling
- Long-term burn-in tests
- Evaluation and tuning at operational temperatures

The module cooling unit is provided as design files with an assembly manual.

DOWNLOAD LINKS

The current version of the Quad cooling unit is **V0.3** : [Download link](#)

The current version of the Quad vacuum chuck is **V1.5** : [Download link](#)

The current version of the Triplet cooling unit is **doesn't exist**

The current version of the Linear Triplet vacuum chuck is **V1.0** : [Download link](#)

The current version of the Ring Triplet vacuum chuck is **V1.0** : [Download link](#)

FAQ

What other equipment is needed to use the cooling unit?

You will require a way of controlling the Peltier and a circulating chiller. A source of dry air is also required to prevent condensation on the module and vacuum chuck. To reach -55 degrees on the module, a circulating chiller with 110W of cooling capacity at -10C is required.

Where can we get the 3mm OD tubing required to connect the vacuum and dry air?

3mm OD flexible tubing is available from several sources.

- [RS Online](#)
- [Amazon](#)
- [Newegg](#)

What kind of XPS foam is needed?

The foam must have a compression strength of roughly 300 kPa and a heat conductivity less than 0.035 W/mK.

Where can we purchase the XPS foam?

Solid XPS foam is a common construction material and can be purchased at most hardware and building shops. It is pink or blue in color and usually comes in large plates. Each manufacturer uses their own names, common ones include Styrofoam and Foamular.

Can XPS foam be machined in a CNC?

Yes, XPS is machinable, but it produces a lot of plastic dust.

Why must the clamping screws be made from RENY? Can we use nylon screws?

The clamping screws must be made from RENY or a similarly hard material with low thermal conductivity, e.g. PEEK. Nylon screws cannot be used because it is too soft to withstand the clamping forces, and because it has a large thermal expansion coefficient, which would cause the clamping force to vary by temperature.

Where can we purchase the RENY screws?

The RENY screws can be purchased from Polymerscrews.com and Misumi.

Can the vacuum chuck and its cutout in the foam be a different shape than hexagonal?

Yes, the vacuum chuck can be any shape as long as the placement of the screws holes and the thickness of the vacuum chuck is not changed. This is in order to ensure even distribution of pressure on Peltier device.

Can we use other types of Peltier devices?

Yes, you are free to choose other peltier devices. But the performance of the cooling unit is strongly depending on the performance of the peltier. The peltier you choose must have a max DT > 82C and Qmax > 50W.

Can we use other types of thermal interface material (TIM) sheets?

Yes, but performance will likely be negatively affected.

Are the M2x35 screws required?

No, these screws are only for the fringe case where you want to cool the module through the module carrier bottom cover without vacuum enabled to the chuck.

Can this cooling unit be used in a cleanroom?

No, not as it is. If you want to use it in a cleanroom it must be sanded down to get a smooth surface and then painted with a thin layer of watered-out acrylic paint.

Why is there a temperature sensor on the coldplate?

A Peltier PID loop requires both a hot-side and cold-side temperature measurement to function. In the case of the cooling unit the coldplate is the hot side, and it therefore requires a temperature sensor. A naïve solution would be to assume that the coldplate temperature is constant and skip the temperature sensor, but this is not the case. The coldplate temperature varies by as much as 8 degrees depending on the peltier power output and therefore a temperature sensor is needed.

Why is there a temperature sensor on the vacuum chuck instead of on the Peltier itself?

The cold-side temperature measurement for the Peltier PID loop comes from the vacuum chuck. A Peltier PID loop technically only requires a temperature measurement of the hot side and a temperature measurement of whatever it is attempting to cool down (the vacuum chuck in our case), not the surface of the Peltier itself.

Will there be condensation on the outside of the carrier since dry air is only flushed into the module carrier?

From experience I can say that the module carrier does experience condensation on its exterior when cooled down in the cooling unit. The dry air is flushed into the interior of the module carrier, exits through the holes in the lid, and fills the interior of the cooling unit. So the interior of the cooling unit is also dry, but less so than the interior of the module carrier. It can be improved by increasing the flow rate of dry air and tightening gaps and holes in the cooling unit with tape.

Major updates:

-- MagneEikLauritzen1 - 2020-01-29

Responsible: MagneEikLauritzen1

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