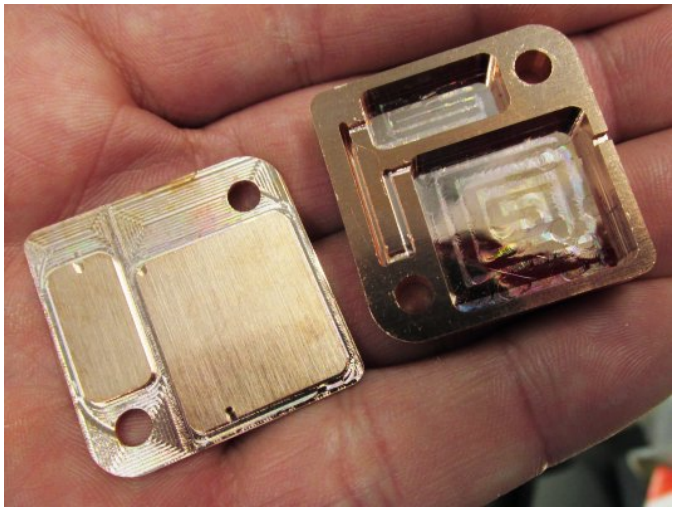
Thermometers for dilution fridges (V.Zavjalov, 11.2018)

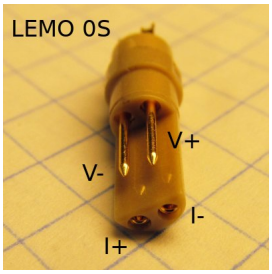
The goal is to make standard thermometers for use in dilution fridges. I use carbon OHMITE resistors (OD/OF series) [1], which are claimed to be good thermometers at millikelvin temperatures [2]. The series OD and OF have different sizes (diameter 2.5 mm and 3.8 mm and length 7 mm and 10 mm respectively). I grind resistors down to approximately 0.7 mm thickness and glue it in a slit in a copper box using Stycast 2850. This provides a good thermal contact with the box, mechanical stability, and protection against moisture.

Copper boxes are ordered in Schaeffer-AG company [3]. The box has $30 \times 30 \times 5$ mm size. It contains a $20 \times 18 \times 3$ mm compartment for RC lowpass filters, a $1 \times 16 \times 4$ mm slit for the resistor and a $16 \times 7 \times 3$ mm additional compartment which can be used for sample chips. Holes are compatable with standard 20×20 M4 hole grid on BlueFors refrigerator plates. Drawings in FPD format are available [4], price was 315€ for 10 boxes and 10 lids.



PCBs for filters are ordered in Multi-CB company [5]. Price is 75€ for 10 boards with two different filters and two small sample plates each. Gerber files are available [6].

To connect thermometers to BlueFors 4-pin sockets we use inserts of LEMO `FFA.0S.304.CLAC44` connectors (Farnell number: 2442870).



List of devices:

N	Resistor	R_0	R_1	R_2
2018-11-02 N1	OD270JE	27	56	56.0
2018-11-02 N2	OD270JE	27	59	64.4
2018-11-02 N3	OF121JE	120	231	277

Here R_0, R_1, and R_2 are nominal resistance, resistance after grinding, and resistance after soldering and glueing (change during glueing probably means that contacts with carbon are not stable after grinding).

References

[1] `https://www.ohmite.com/assets/docs/res_od_of_oa.pdf`

[2] N. Samkharadze, A. Kumar, G. A. Csáthy, A New Type of Carbon Resistance Thermometer with.Excellent Thermal Contact at Millikelvin Temperatures, *JLTP*, **160**, 246–253 (2010), `https://doi.org/10.1007/s10909-010-0192-5`

[3] `https://www.schaeffer-ag.de/en/`

[4] `box.zip`

[5] `https://portal.multi-circuit-boards.eu`

[6] `filter_pcb.zip`