
LOAD MAP OF SUMITOMO 415DP CRYOCOOLER IN THE TEMPERATURE RANGE OF 40-400K

Fraunhofer Institute for High Frequency Physics (FHR)
Fraunhoferstr. 20, 53343 Wachtberg, Germany

T. Wirths, S. Putselyk, N. Ben Bekhti, A. Fröhlich, O. Grenz, F. König, L. Naumann, F. Rahlf, M. Tiesing

AGENDA

- Introduction
- Cryocooler model
- Test procedure
- Results
- Discussion

INTRODUCTION

- The demand for a high temperature load map
 - It is necessary to know the cool down / warm up time of applications with high thermal mass and / or assembly of different materials and interconnections
 - From a lumped element model it is possible to estimate number of cold heads which are needed

CRYOCOOLER MODEL

- Sumitomo cryocooler RDK-415DP
- Cooling capacity @ 50Hz
 - 1.Stage 50K @ 35W
 - 2.Stage 4,2K @ 1,4W
- Cooling capacity loss through orientation – max. 15%
- Cooling capacity loss through degradation within 10 000Hrs – less than 10%
- Cooling capacity loss through high ambient Temperature – max 5%

Guaranteed point 4.2 K @ 1. stage and 50 K @ 2. stage

RDK-415D Typical Load Map (50Hz)

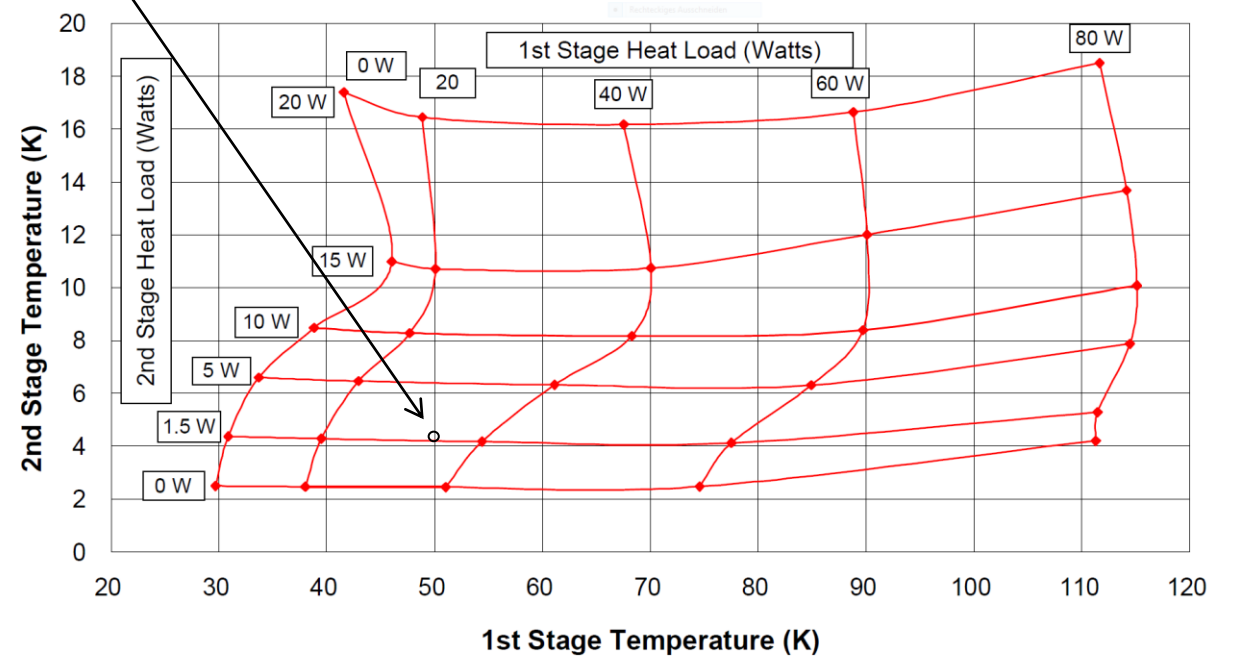


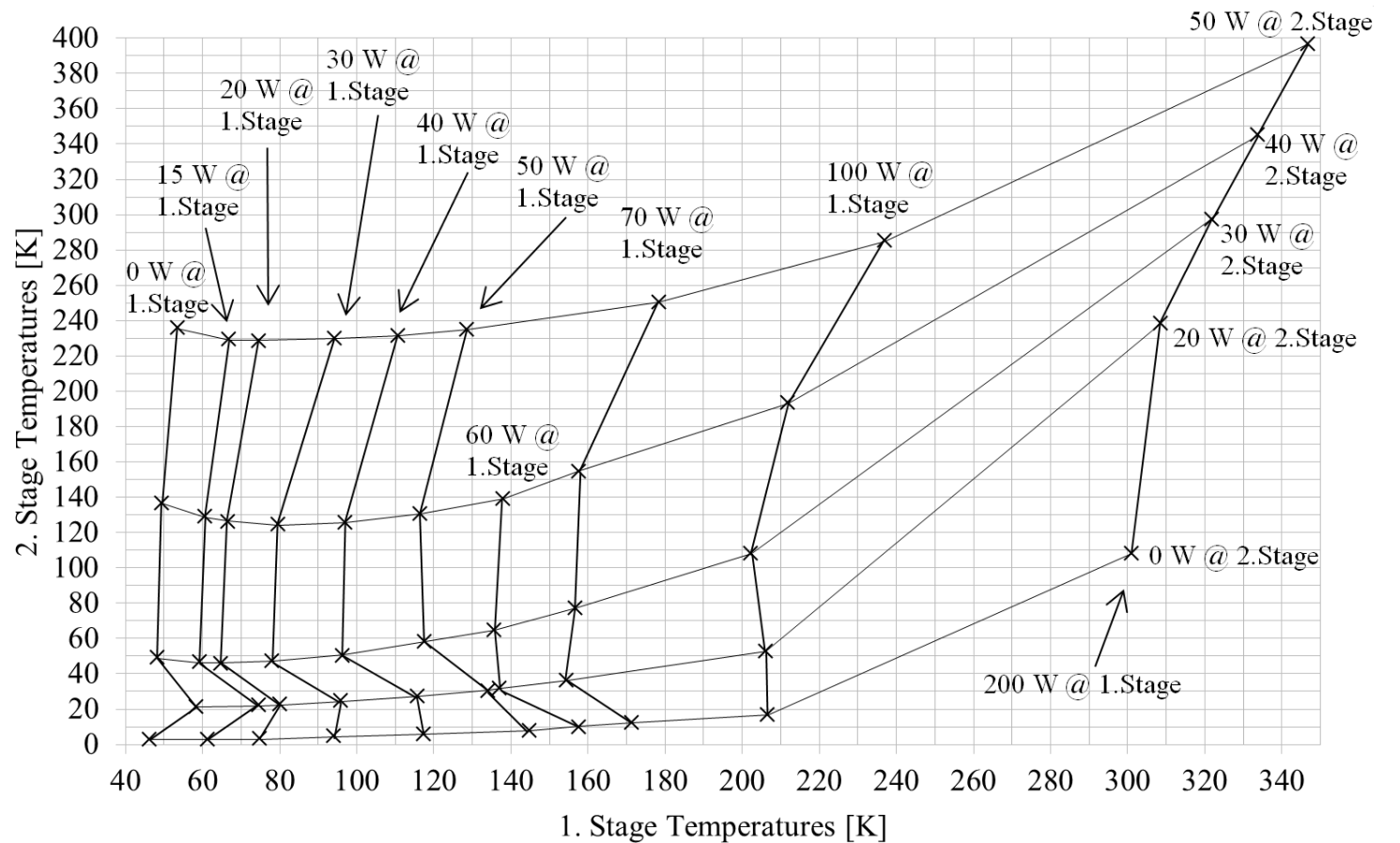
Figure from: Sumitomo Heavy Industries Ltd. Cryogenics Division

TEST PROCEDURE

- The experimental cryostat has been prepared by removing unnecessary cold mass
- Thermal equilibrium has reached if temperature deviation was lower than $\pm 0.5\text{K}$ for the last 3 hours
- 1. First measurement point was 0 W @ 1. stage and 0 W @ 2. stage
 - This value has been used for cross-check of the measurement set-up
 - This measurement point has been repeated after the heating power on the 2. stage has been increased
- 2. Increased heating power of 1. Stage while the heating power on the 2. Stage was held constant
- 3. Change of heating power of 2. Stage while the heating power on the 1. Stage was held constant and continue with point 1
- Some measurement points has been approached by changing direction (cooling down / warming up) to detect temperature differences

RESULTS

- The measurement points resulted in following load map
- 1. Stage power:
 - 0W; 15W; 20W; 30W; 40W; 50W; 60W; 70W; 100W; 200W
- 2. Stage power:
 - 0W; 20W; 30W; 40W; 50W
- Sensors and standard deviation
 - 1. stage 3x Pt100 with ± 3 K (2σ)
 - 2. stage 2x Si-diodes with ± 0.3 K (2σ)



DISCUSSION

- High parasitic heat load of 40 ± 5 W has been detected on 1. stage
 - For cross-checking a smaller radiation shield with reflective aluminum has been build
 - The parasitic heat load has been reduced to 13 W

CONCLUSION

- The load map of the Sumitomo SRDK-415DP-A61D cryocooler is presented in the range of 40-350 K for the 1. stage and 3-400 K for the 2. stage
- A parasitic heat load of around 40 W due to the radiation shield could be detected
- A hysteresis effect of the measured points by cooling down or warming up could not be observed

Thank you for your attention!
Questions?