

RapidCycle 100 EC Heat Load Map

Applicable Products	RapidCycle™ 100 EC		
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Purpose

This document is intended to explain the heat load vs temperature capabilities of the RapidCycle™ 100 EC.

Background

The tradeoff between additional heat load and base temperature of a cryostat is based on the cooling capacity (also called cooling power) of the system. Cooling capacity dictates the amount of additional wiring (DC, RF, etc.) that can be brought into the cold space while maintaining the user's desired base temperature. The RapidCycle™ 100 EC utilizes a Gifford-McMahon cryocooler which allows the system to rapidly cool down to <4.2K in under one hour. This allows users to quickly test electrical components at cryogenic temperatures without waiting for a long cooldown to base temperature.

Applicable Theory

The RapidCycle™ 100 EC has base specifications of >300mW of cooling capacity at 4.2K. This allows for high density DC (up to 48) and RF (up to 12) lines to be installed in the system without sacrificing overall base temperature. The RapidCycle™ 100 EC system has two cooling stages, stage 1 and stage 2 (sample platform). Stage 1 is thermally lagged to the warmer radiation shield to handle the bulk of the applied heat load. This allows the sample platform to cool a smaller heat load, achieving a better overall base temperature. Figure 1 shows the effect that additional heat load on stage 1 and the sample platform has on each stage's respective temperature.

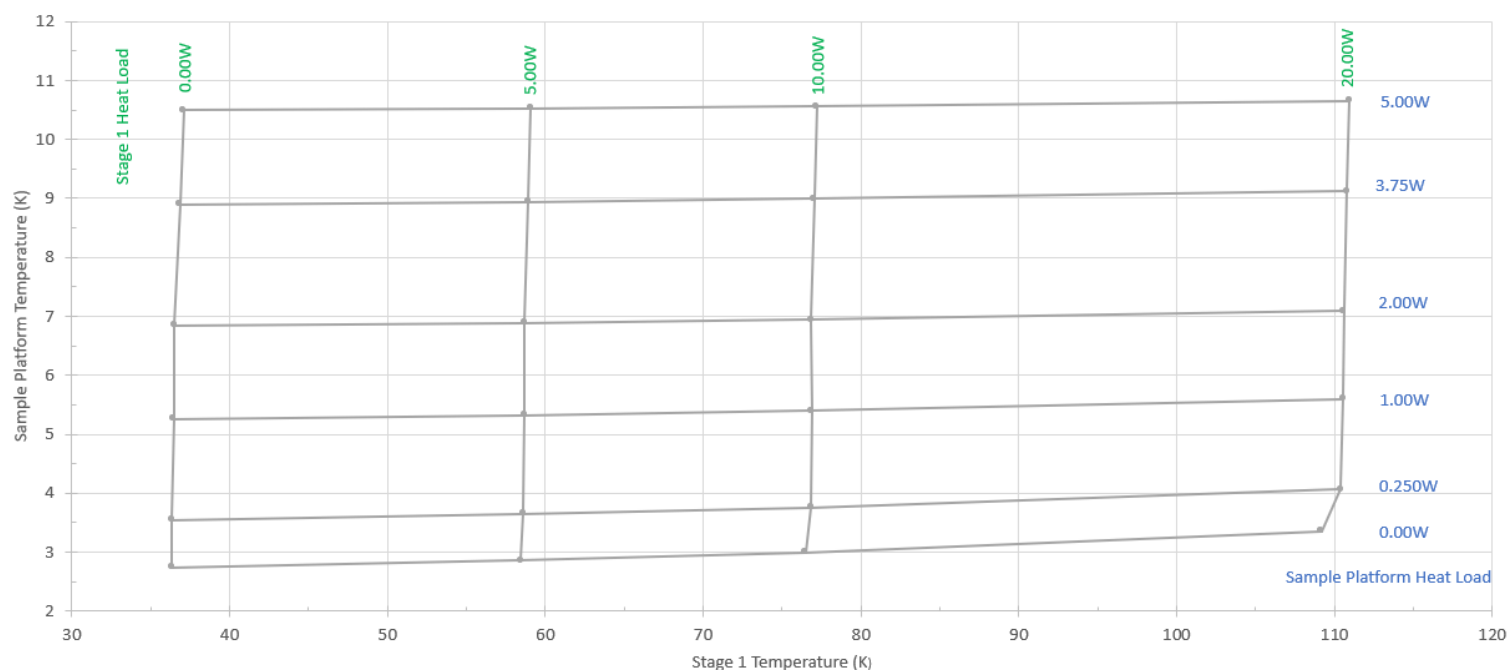


Figure 1: Heat Load vs Base Temperature on the RapidCycle™ 100 EC

The heat load map of the RapidCycle™ 100 EC shows how both stage 1 and the sample platform temperatures increase based on an applied heat load. Stage 1 (green on chart) can handle a higher overall heat load compared to the sample platform (blue on chart). In practice, additional heat load is lagged to stage 1 to limit its effect on the sample space. The sample platform at 5W still maintains a temperature of ~10 K, thanks to the higher cooling capacity of the RapidCycle™ 100 EC.

To read other points on the chart, find the heat load of interest for both stage 1 and the sample platform. For example, heat loads of 20 W for stage 1 and 5 W on the sample platform would be the top right data point in the chart, with temperatures of 110.97 K and 10.66 K for stage 1 and the sample platform respectively. Another example would be no heat load on stage 1 but 5 W on the sample platform. The corresponding data point is the top left point on the chart.

Summary

The RapidCycle™ 100 EC offers high cooling capacity and less than 1 hour cooldown and less than 1 hour warm-up without sacrificing base temperature. Using the heat load map seen in Figure 1, base temperature can be estimated for a given heat load on stage 1 and the sample platform. The ease of installing additional wiring in the system also allows users to easily connect or disconnect wiring for a given test. By disconnecting unused wiring, the heat load on the system can be lowered to improve performance. In practice, the combination of higher cooling power and fast cycle time allows for a high throughput of test components, increasing testing efficiency and limiting downtime. To learn more about the RapidCycle™ 100 EC, [contact](#) a Montana Instruments sales engineer.