Characterization of SWaP Rotary Coolers

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High resolution space IR detection requires the use of cooled detectors. The broadness of the landscape of cooling systems that are available nowadays allows one to choose the best suited cryocooler for each of the applications.

Yesterday, rotary Stirling coolers were usually not the preferred choice in space application context because of their lower level of reliability and availability compared to other cooling solutions such as pulse tube coolers for instance. Nevertheless, recent improvements on rotary coolers offer now extended lifetime for these products and their natural advantages in field ie. of compactness, efficiency and cost make them as attractive contenders especially when volume is reduced.

These aspects can be advantages for applications where space claim, consumption, thermal management and costs are critical. This is the case for CubeSat.

Thales current portfolio can address a large range of space applications from the smallest at intermediate temperatures, which is addressed by the RMs1 (1W at 150K, 20°C), to more stringent applications requiring larger power requirements, that are efficiently fulfilled by the RM3 or RM4 (resp 550mW and 730mW at 77K, 20°C). Some tests have been realized in collaboration with the CNES (French Space Agency) in order to characterize Thales rotary coolers behavior in space conditions.

This presentation proposes to discuss advantages and drawbacks of Stirling rotary coolers to be used in space applications. This discussion will be based on tests and characterization performed in space environments. After an introduction, the paper will firstly describes trends and constraints for space application and their impacts on cryogenics. In a second time, current Thales portfolio will be described. A third part will describe coolers characterization performed in collaboration with CNES.