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C3Or4C-01: Characterization of SWaP COTS rotary coolers for space application

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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 to choose the 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 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 i.e. of compactness, efficiency and cost make them as attractive contenders especially when volume is reduced. Furthermore there are new space applications where the lifetime of rotary cryocoolers is adequate for the mission and the SWAP advantage rotary coolers offers is an adbvantage.
These aspects can be advantages for applications where space claim, consumption, thermal management, shorter mission lifetimes, and costs are critical. This is the case for CubeSat.
Thales current portfolio initially address tactical market. Nevertheless, it can address a large range of space applications from the smallest at intermediate temperatures, which is addressed by the RMs1 (1W@150K, 20℃), to more stringent applications requiring larger power requirements, that are efficiently fulfilled by the RM3 or RM4 (resp 550mW and 730mW@77K, 20℃). Some tests have been realized in collaboration with the CNES (French Space Agency) in order to characterize Thales COTS rotary coolers behavior in space conditions. First of all, cryogenics performances were characterized in vacuum and temperature. In a second time, launch mechanical stress were applied with success on the coolers. Finally, we subjected coolers to radiation stress.
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 describe trends and constraints for space application and their impacts on cryogenics, then the current Thales portfolio will be described. Finally we will describe the coolers characterization performed in collaboration with CNES.

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