# AIM Cryocooler developments for HOT detectors

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## ABSTRACT

Significantly increased FPA temperatures for both Mid Wave and Long Wave IR detectors, i.e. HOT detectors, which have been developed in recent years are now leaving the development phase and are entering real application. HOT detectors allowing to push size weight and power (SWaP) of Integrated Detectors Cooler Assemblies (IDCA's) to a new level. Key component mainly driving achievable weight, volume and power consumption is the cryocooler.

AIM cryocooler developments are focused to compact, lightweight linear cryocoolers driven by compact and high efficient digital cooler drive electronics (DCE) to also achieve highest MTTF targets. This technology is using moving magnet driving mechanisms and dual or single piston compressors. Whereas SX030 which was presented at SPIE in 2012 consuming less 3 $W_{DC}$ to operate a typical IDCA at 140K, next smaller cooler SX020 is designed to provide sufficient cooling power at detector temperature above 160K. The cooler weight of less than 200g, a total compressor length of 60mm makes it an ideal solution for all applications with limited weight and power budget, like in handheld applications. For operating a typical 640x512, 15µm MW IR detector the power consumption will be less than $1.5W_{DC}$.

MTTF for the cooler will be in excess of 30,000h and thus achieving low maintenance cost also in 24/7 applications. The SX020 compressor is based on a single piston design with integrated passive balancer in a new design achieves very low exported vibration in the order of 100mN in the compressor axis.

AIM is using a modular approach, allowing the use of 5 different compressor types with the same type of Stirling expander. The 6mm expander with a total length of 74mm is now available in a new design that fits into standard dewar bores originally designed for rotary coolers. Also available is a 9mm coldfinger in both versions. In development is an ultra-short expander with around 35mm total length to achieve highest compactness.

Technical solutions and key performance data for AIM's HOT cryocoolers will be presented.

SHORT

SX030 cooler which was presented at SPIE in 2012 consuming less 3 $W_{DC}$ to operate a typical IDCA at 140K, next smaller cooler SX020 is designed to provide cooling power at detector temperature above 160K. The cooler weight < 200g, a compressor length < 60mm makes it an ideal solution for applications with limited weight and power budget. For a typical 640x512, 15µm MW IR detector the power consumption will be < $1.5W_{DC}$.

MTTF for the cooler will be in excess of 30,000h. The SX020 compressor has a single piston design with integrated passive balancer. Exported vibrations are around 100mN.

## KEYWORD LIST

Cryocooler, Moving Magnet, IDCA, single piston, long life