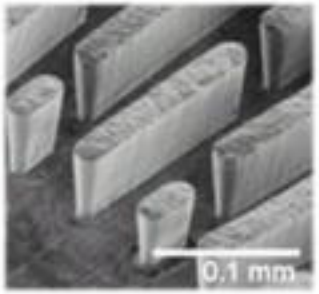
NASA
Glenn
Success
Stories

MEMS Stirling Device

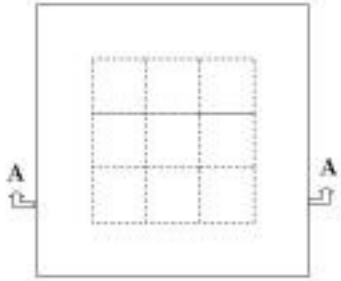
Polar Thermal Technologies, Inc., Chicago, Illinois, and John Hopkins Applied Physics Laboratory, Laurel, Maryland

TECHNOLOGY

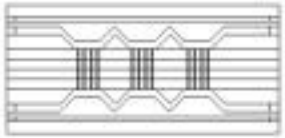
High efficiency cooling and precise temperature control on a millimeter scale footprint that provides an order-of-magnitude efficiency improvement over state-of-the-art thermoelectric (Peltier) coolers.



Metal microstructures (Polar Thermal Technologies, Inc.)



TOP VIEW: MEMS Stirling Cooler Unit



A-A: Crossection

COMMERCIAL APPLICATION

◆**Electronics:** microprocessors, optical and RF sources, and other high density components

◆**MEMS/Microsystems:** lab-on-a-chip, harsh environments, and heat generating devices

◆**Sensors:** infrared, temperature-dependent, precision, and high temperature instruments

◆**Biomedical:** bio-processing, drug discovery, in vivo electronics, and other temperature control applications

SOCIAL / ECONOMIC BENEFIT

◆Extended environmental temperature ranges

◆Ability to generate cooling temperatures well below the ambient temperature, allowing junction temperatures to be driven much lower

◆Precision spatial and temporal thermal control for temperature sensitive devices

◆Lower operating temperatures for increased reliability and performance

◆Enabling of micro-scale devices that require active cooling and/or temperature control

NASA APPLICATIONS

◆Supports future NASA missions by providing higher efficiency cooling and more precise temperature control

- **Space Science:** Advanced technologies in avionics, power sources, optics, bioassay, technology, and sample return
- **Earth Science:** New generation of small, highly capable active, passive, and in situ instruments
- **Aerospace Technology:** miniaturized sensors and actuators embedded throughout vehicles
- **Micro and Nano Satellites:** thermal management

NASA Contact: Matt Moran
Company Contact: Stephan Steiter (ssteiter@polar-group.com) (Polar) and Ann Darrin (JHUAPL)