



Naval Surface Warfare Center

*Miniature Cryogenic Shutter Assembly
Patent # 6,995,391*

Mini Market Study

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Prepared for:

NSWC-Crane Division

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Technology Synopsis

Miniature Cryogenic Shutter Assembly

- Used as a mechanism to calibrate small to medium sized infrared cameras using an “absolute measurement” of heat emitted by an object in very cold environments.
- Shutter provides a common zero reference base (zero radiance) that is needed to do true super-framing.
- Shutter allows you to do real-time super-framing, which previously could not be done.
- Super-framing is particularly useful for infrared camera systems that are used to image scenes with enormous differences in temperature.
- Shutter is sized to fit into existing camera dimensions.



Key Competition and Competitive Advantage



Company`

Product



Mini Cryogenic Shutter Assembly

Goddard Space Flight Center



Low Power Cryogenic Shutter Mechanism

Inventor: Richard D. Barney

Cryogenic Shutter

Goddard Space Flight Center



Two-dimensional MEMS microshutter arrays (MSA)

No other shutters are able to:

- Provide zero radiance referencing.
- Create super-framed images.
- Be used in small or medium format cryogenically cooled infrared cameras.



Potential Applications

Industry Segments

Market Size

Application Segments

Military	\$3.3 Billion	<ol style="list-style-type: none">1. Missile defense and protection2. Surveillance: Subjects of surveillance are obscured by ground fires or other thermal camouflage.
Space	<p>-\$5.6 billion on commercial satellite building</p> <p>-\$8.9 billion spent on missile defense agency</p>	<ol style="list-style-type: none">1. Satellites/Telescopes: Infrared images and spectroscopic observations of stellar phenomena2. To study the Earth's weather during both the day and night3. Missile defense
Commercial	\$1.5 Billion	<ol style="list-style-type: none">1. Thermography: Diagnostics of engines including internal combustion, jet engines, gas turbine, Medical Imaging, Scientific Imaging



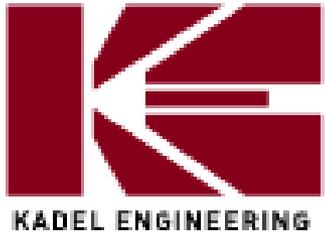
Reachable Market



- Kadel has close to 100% market share of the global Dewar market, and we view the technology as a component in dewars.
- Kadel manufactures about 4,000 dewars per year.
- The shutter is a component in some dewars (not all are for small to medium sized cameras). The actual market demand may be a few units per year considering that those who need this shutter require real-time super-framing as well as a high temperature dynamic range for research, space, or military applications.



Potential Targets for Licensing





Industry Insights



- **Tim Weiss, Senior Applications Engineer**
 - *"We have little to no marketing or sales. In order to make this work, it would require some marketing."*
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- **Christopher J. Bencal, Business Development Lead (Integrated Defense Systems)**
 - *"Sounds like an interesting technology"*
-



- **Dave Billister, President**
 - *"Sounds like an interesting product. I will get back to you once our engineers have looked at the technology."*
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Recommendation and Next Steps

- **View the assembly as an individual component that can be incorporated into small and medium format cryogenically cooled infrared cameras.**
- **Contact :**
 - **Tim Weiss at Kadel Engineering (317-745-2798)** to find out if they would be interested in adding the shutter to their Dewar as an option with a marketing and sales plan already in place.
 - **Co-Inventor, Roy Loma (Roy Loma Engineering)** to find out what it would take to produce a commercial shutter and if he would be interested in manufacturing them.
 - **Follow up with Raytheon (Christopher J. Bencal, 978-858-5715) and Infrared Laboratories (Dave Billister, 520-622-7657)** for space applications (satellites/telescopes, missile defense).
 - **FLIR Systems** to see if they would be interested manufacturing or being a licensee of this technology.
 - **Attend the SPIE Defense, Security, and Sensing Conference.**
 - The industry's leading exhibition with 500 top defense, security, and sensing contractors, suppliers, and integrators.
 - April 23-27, 2012 at the Baltimore Convention Center in Baltimore, Maryland, USA



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**For further discussions, contact: John Dement (john.dement@navy.mil)
NSWC-Crane Division**

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Inventor: Eric Hillenbrand**



Market Study Goals

- Conduct an abbreviated market study assessment to:
- a) Define the technology in common language as priority commercial and military application.
 - b) Create collateral material for industry outreach.
 - c) Validate collateral material communication through primary and secondary research.



Status to Date

Status	Required Tasks
Complete	Draft interview agenda/questions. Obtain mentor approval prior to interviews.
Complete	Perform in person interview with inventor(s) and/or subject matter experts (SME) in accordance with a provided checklist
Complete	Develop a short succinct (1-2 paragraphs) common language description
Complete	Perform a web search for similar / competing products.
Complete	Identify potential markets for the technology including an abbreviated horizontal and vertical analysis and potential company lists.
In Progress	For the top 2-3 markets, contact potential companies to determine interest, issues, etc.



Situational Summary



- Inventor Eric Hillenbrand of the NAVSEA Crane Lab invented a miniature cryogenic shutter assembly to calibrate zero radiance so that super-framing would be possible on small and medium-sized cameras in very cold environments.
- The technology is used in the military.
- Applications for the device are in the space, commercial and military field.
- Both primary and secondary research indicate market potential.



Market Opportunity

- Cooled camera market is very small.
- The value of the world image sensors market is expected to rise to \$11.7 billion by 2012, according to Global Industry Analysts Inc. of San Jose, Calif. ¹
- In 2009, FLIR's revenue was \$1.15 billion most of which came from thermal imaging systems.²

1. <http://www.photonics.com/Article.aspx?AID=36454>
2. [http://www.wikininvest.com/stock/FLIR_Systems_\(FLIR\)](http://www.wikininvest.com/stock/FLIR_Systems_(FLIR))