The Eyes of Threat Warning Sensors

Presented to

15th NDIA Night Operations Symposium

11 October 2000

by

Kirby Taylor
DRS Infrared Technologies
Dallas, Texas

jktaylor@drs-irtech.com
972-560-5932

DRS INFRARED TECHNOLOGIES, LP

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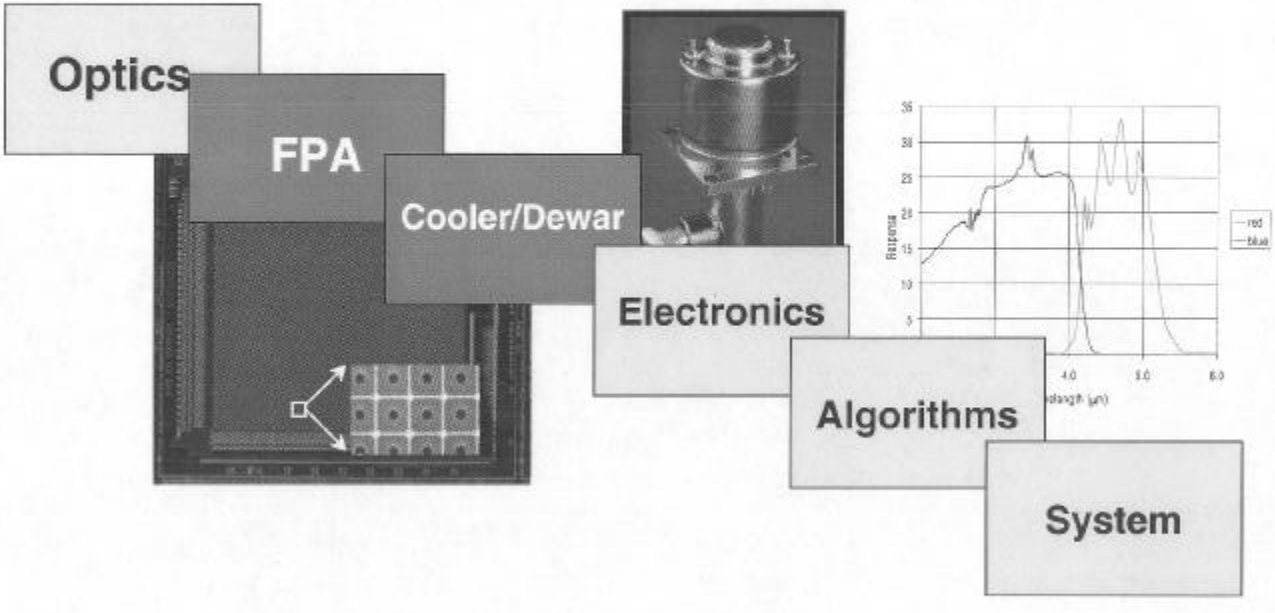
IR FPAs Are Enabling System Elements



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Missile Threat Warning

- Due to the relatively cheap and readily available E-O MANPAD weapons, the DoD has developed a countermeasure approach to this threat with a full active/passive system concept.

- Field tests show the viability of a laser-based active countermeasure, however there has been a shortcoming in the passive threat-warning sensor technology that, in turn, has led to excessive false alarms.

- Field measurements and data analyses show that a two-color MW/MW infrared sensor will provide adequate warning and directional information to the threat while maintaining the required low false alarm rate.

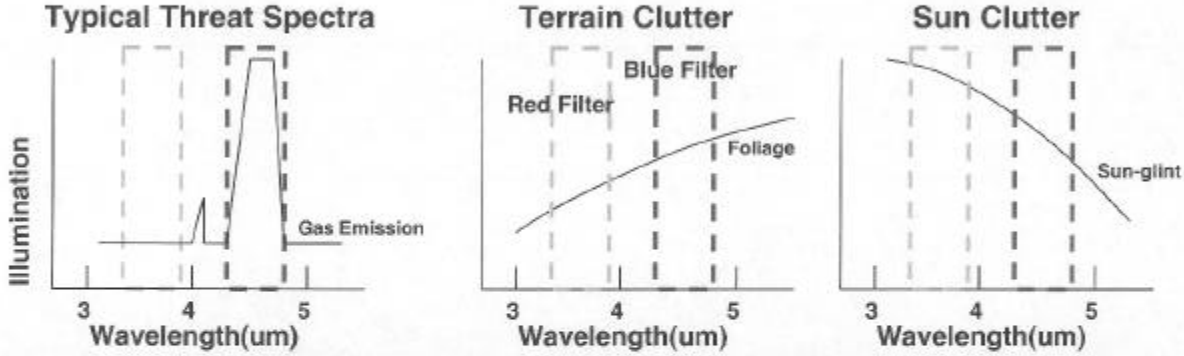
- The specified sensor heads are only a little more complex than a typical two-color FPA IDCA of today:

-Cooler	-Lens instead of window
-Dewar	-Sideboard electronics
-FPA	-Digital output

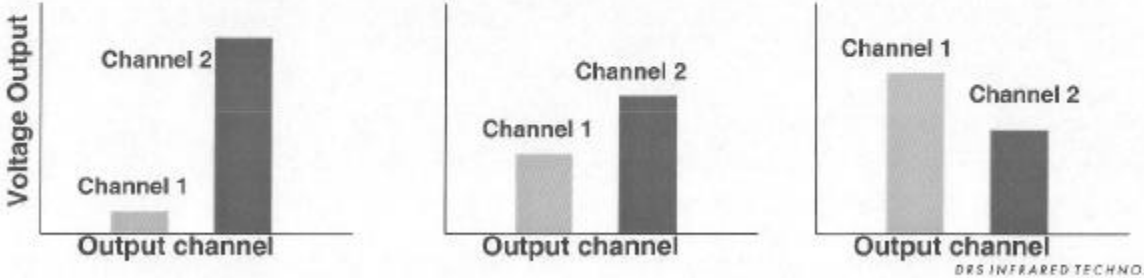
- The DRS IRT technology for two-color FPAs and for "chilled" operation is an important building block for modern threat warning systems.

Target Recognition and Discrimination

-Two-Color Concept-



Signatures of threat, terrain, and sun are different



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Issues in TW FPA Design

Size	Fit existing installations
Ambient temperature	100°C or above
Very WFOV	> 90 degrees
Integration time	< 3 milliseconds
2-color cell design	Simultaneous integration with coincident pixels
Outage clusters	None desired
Overall operability	> .99
PRICE - PRICE - PRICE	COST - COST - COST

DRS is Pursuing the Evolving "Next Generation" FPA

DRS Today:

Staring

Large
Staring

256^2, 40 micron pitch, MW, LW
480X640, 50 micron pitch, MW, LW

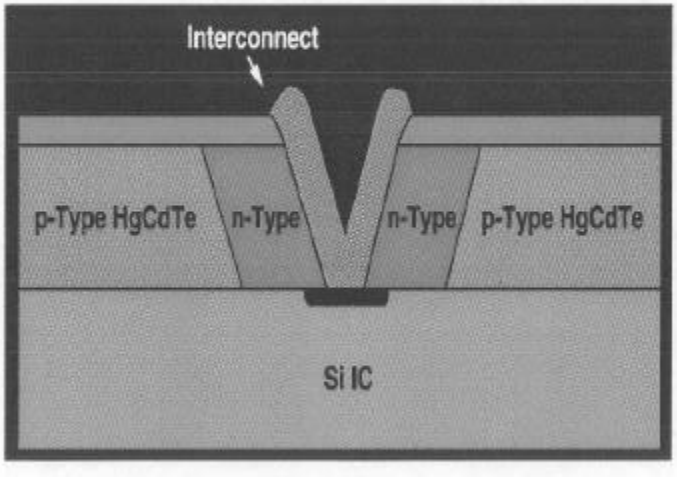
- Large
- Multi-color
- Staring

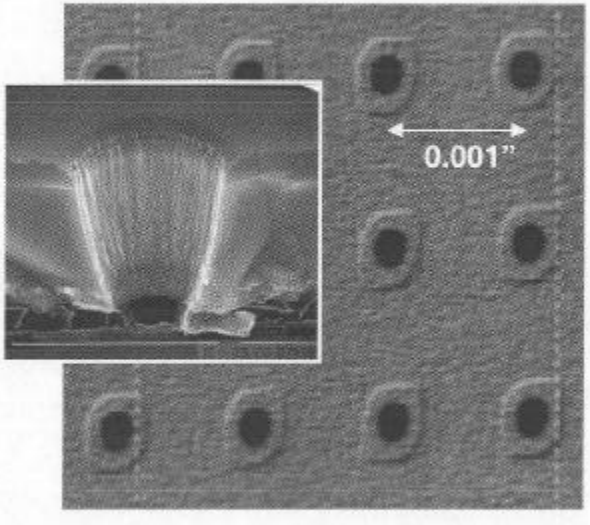
256^2, 30 micron pitch, MW/MW
240X320, 50 micron pitch, MW/MW, MW/LW

- Large
- Multi-color
- "Smart"
- Staring

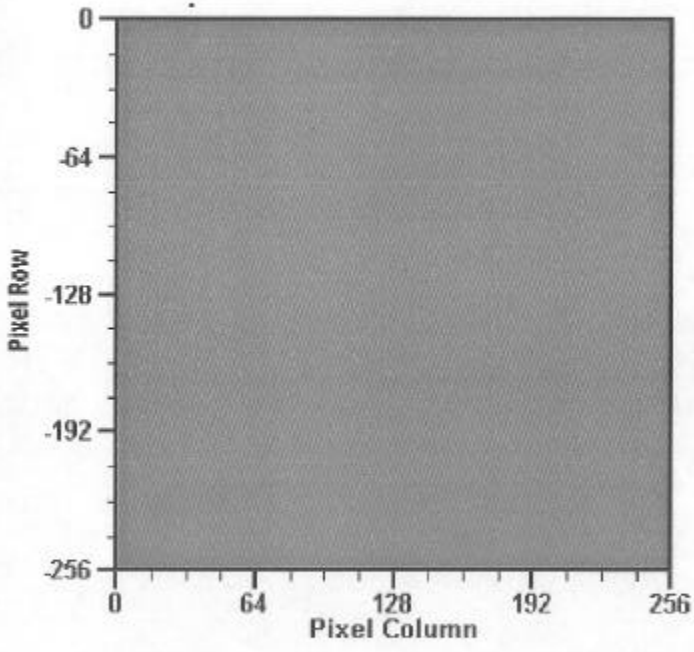
- Large
- Multi-color
- "Smart"
- Staring
- Digital output

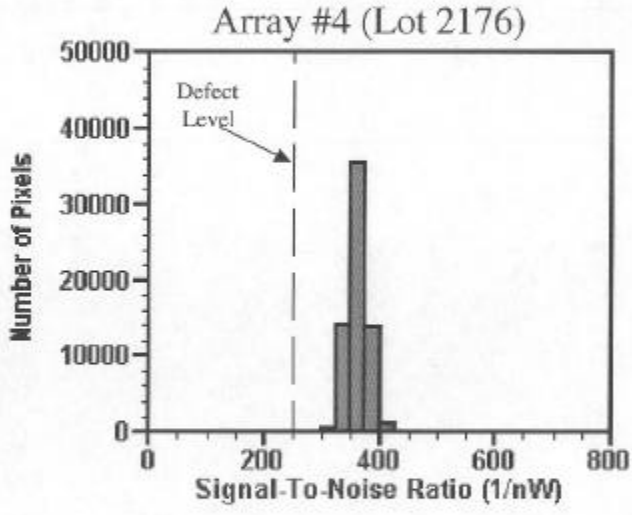
Common Technology Across Many Applications Reduces Cost





256^2 MWIR, 40 micron pitch





ARRAY OPERABILITY = 99.965 (25 TOTAL DEFECTS)

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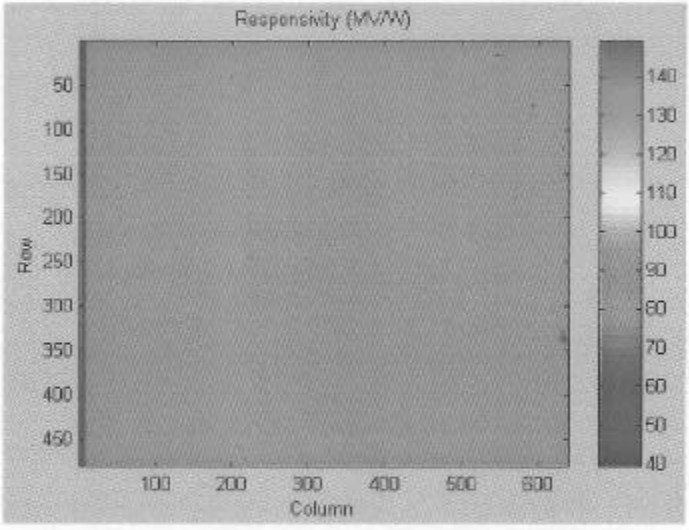
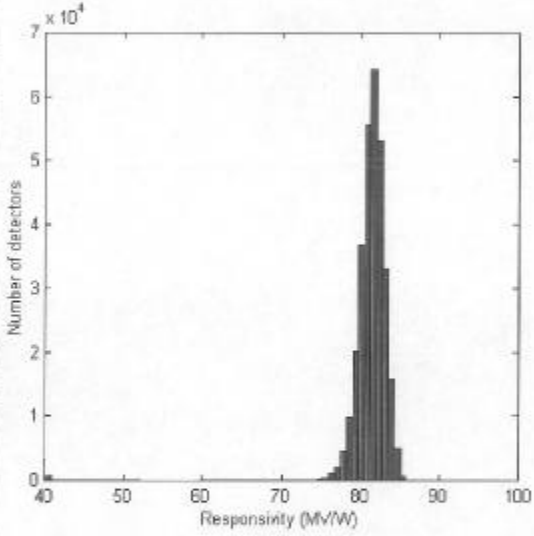
640x480 MWIR, 25 micron pitch





101 < half mean Resp* Defects

99.97% operability

s/mean = 1.90%

Collection Efficiency = 66%

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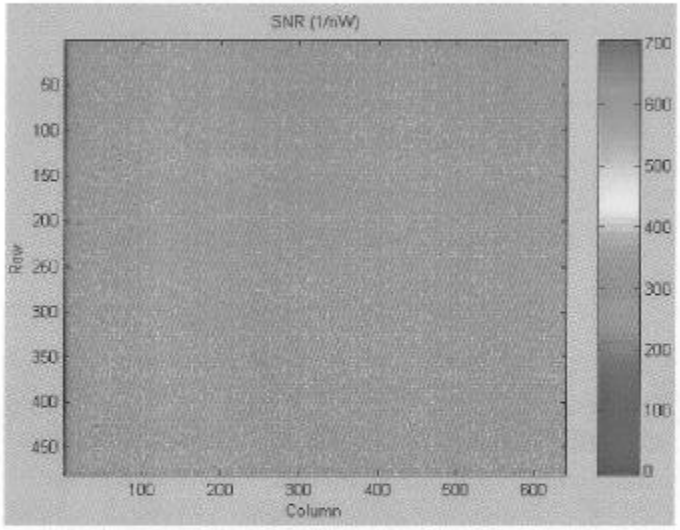
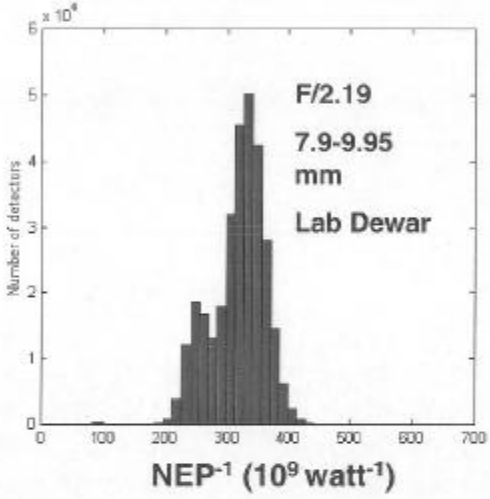
640x480 LWIR, 25 micron pitch





380 D* Defects

Operability = 99.88%

$\overline{D^*}_I$ = 132% of Spec

= 3.2x10^{10} Jones

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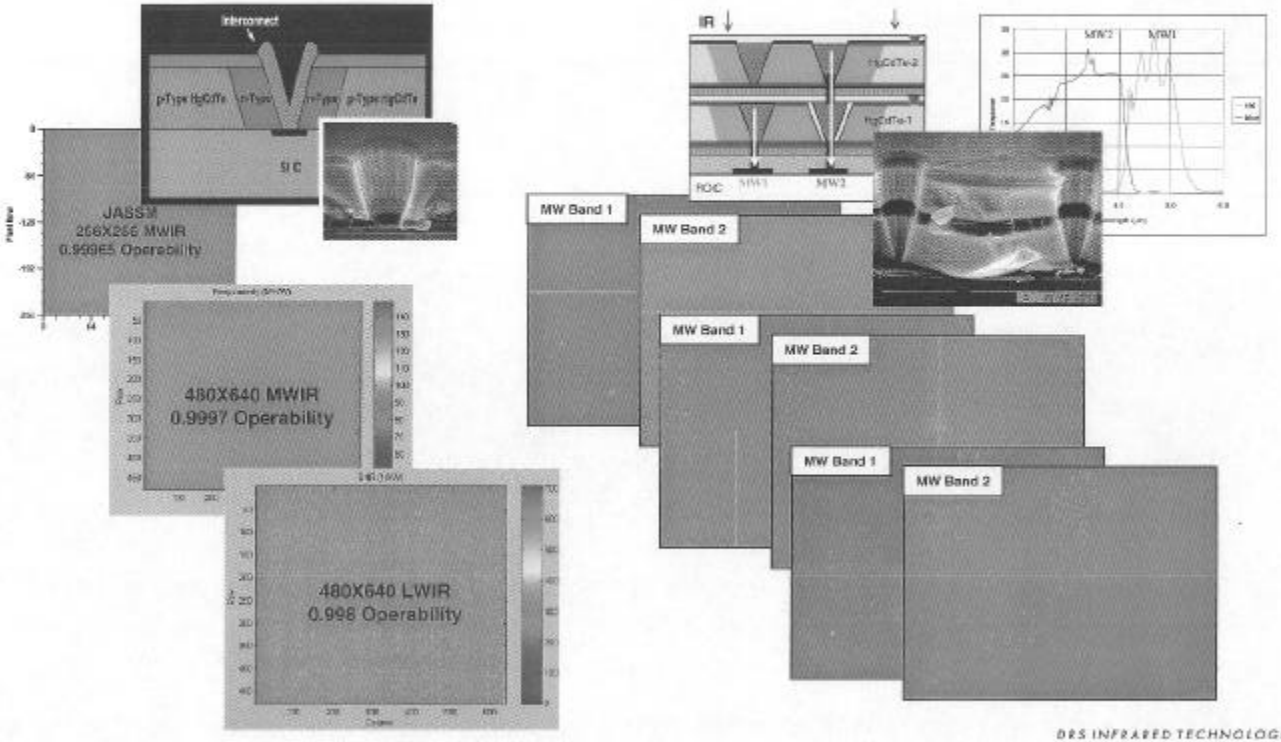
HDVIP™ 2-Color Architecture Follows the Trend of Monocolor Technology



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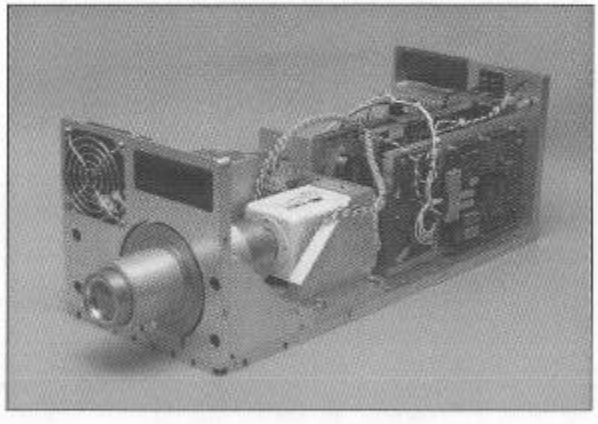
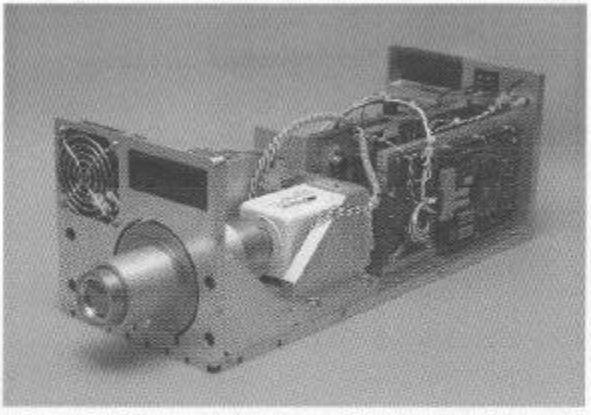
Two-Color Sensors



MW/LW Camera



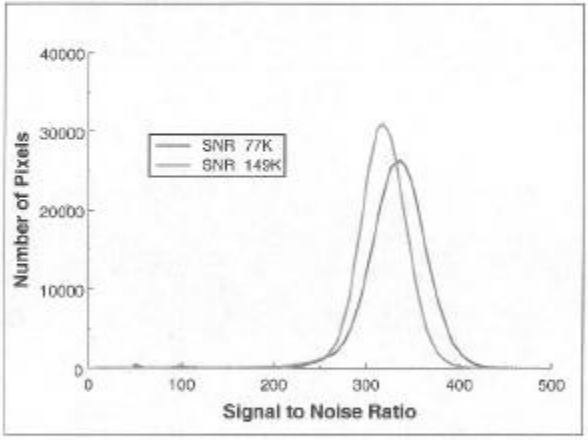
- Completed by NVESD/DRS team 6/99
- 320x240 MW/LW array in SADA II Dewar
- Two color WFOV optics, f/3
- cut-off 10.2 mm LWIR
  5.2 mm MWIR
- Temp = 77K
- Sequential operation due to limitations of monocolor 640x480 ROIC
- 60 Hz Frame Rate (30 Hz for both MW and LW)

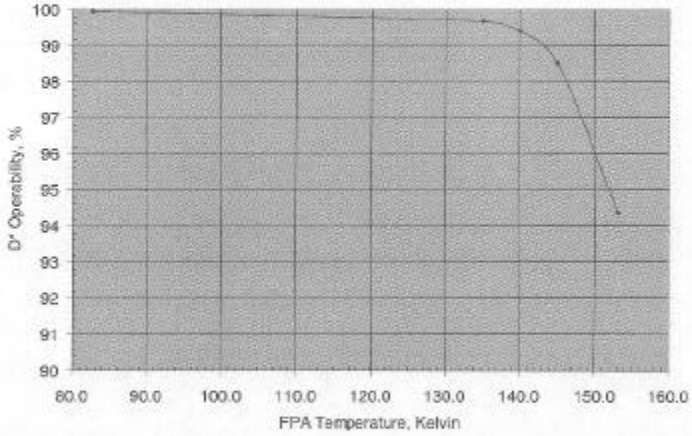
Exploit "Chilled" Detector Technology

- Midwave HgCdTe arrays operate well at high temperatures
  - good performance at 120K
  - acceptable performance at 150K
- Can "chilled" detectors enable low cost?
  - simplified dewars
  - high heatload tolerance
    - low cost insulation
  - higher temperature refrigerants have more cooling capacity
  - tolerate more mass
    - commercial package
  - simplify cryostat
    - fixed orifice operation

480x640 MWIR HgCdTe "Chilled" Operation
.....performance to 149 K

S/N at 77K and 149K





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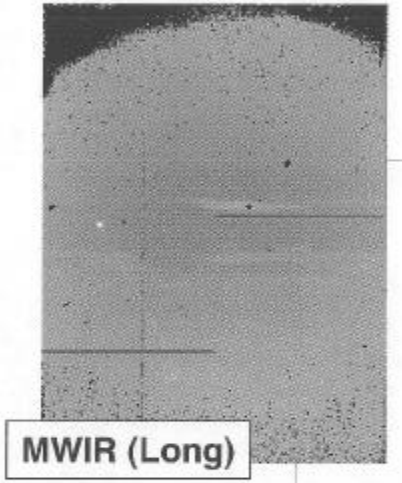
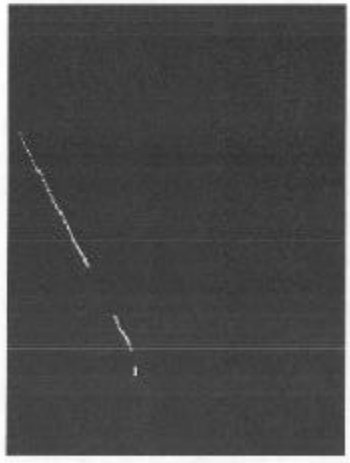
New Data

- Recent live missile firings
- New 30 micron pitch MW/MW FPA

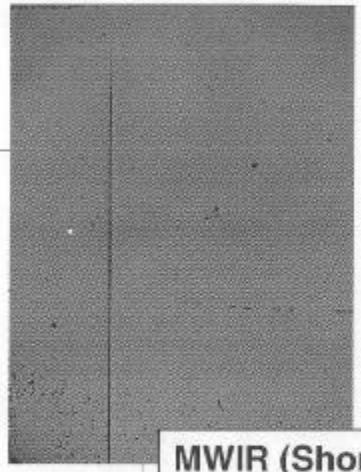
Live Missile Firing



MWIR (Long)



Processed and Integrated



MWIR (Short)

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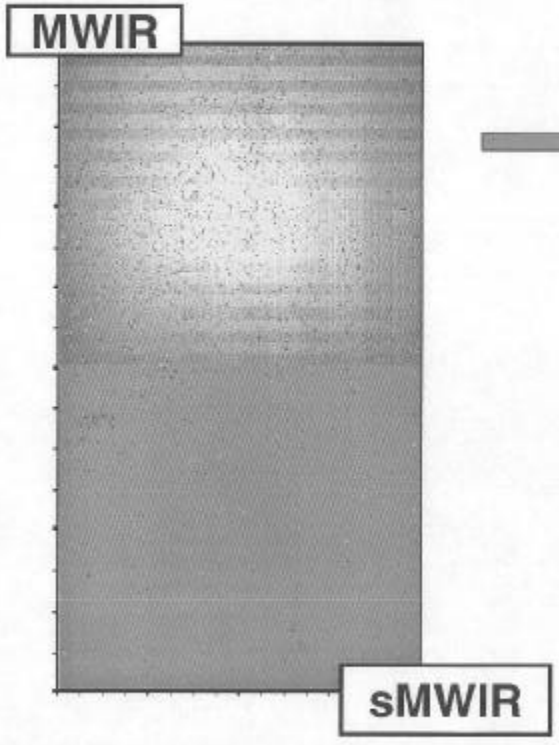
256^2 MW/MW, 30 micron pitch

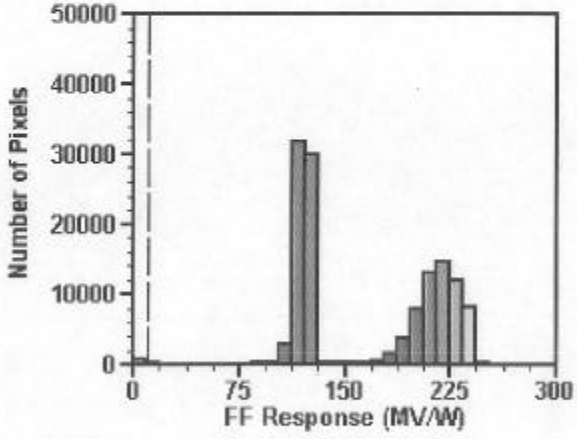


A2749.12

256x256, 30um pitch, 2-color HgCdTe

99+% Response Operability

Data recorded at 77°K operating temperature



This Is the Product of a Cooperative LMMFCS/DRS Program

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Summary

- The MANPAD threat is real.
- Field tests have validated a robust theoretical solution.
- Two-color IR FPAs are required to enable that solution.
- The first point-design for a threat warning FPA has been fabricated.
- Supporting components are being developed to provide cost-effective solutions for the total threat-warning sensor heads.

Thanks to all who have contributed to this work:

- DARPA
- AFRL
- NRL
- NVESD
- ARL
- Sanders
- Lockheed-Martin Orlando
- The DRS FPA Design, Fabrication and Field Test Team