Defense Threat Reduction Agency US Army RDECOM
Flexible X-ray Development effort Information brief

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Flexible X-ray Detector Past Development

2010
Integrate Gen 1 flexible X-ray Detector with a glass Visual display.

2011
Develop Gen II flexible X-ray Detector (5.2”x5.7”) – Hard chassis. Develop a 6” Mixed Oxide TFT prototype wafer w GE. 3.6”x3.6 flex detectors images integrated into prototype cases.

2012
aSi 5.2x5.7” Flex PEN TFT detector w hard electronic board.

2013
Develop drive interface using commercial ruggedized phones, computers or existing vendor hardware and software.
Flexible X-ray Detector Past Development

2014

8” Diagonal (10.25”x6.75”)
10.3” diagonal (10”x 10.5”)
on polyimide. Demonstrated large scale manufacturing is feasible.

2015

10.3” diagonal polyimide with Android Galaxy 5 & 6 Phone and NEXUS 9& 10 Tablets. Final Packaging.
Flexible X-ray Detector – Current Development under T&E.

2016  2017

Specifications: 2015 X-ray Detectors (Version 4)

- Configuration: Plastic a-Si X-ray detector configured as USB peripheral
- Overall Size: 273mm x 187mm x 14mm
- Active X-ray Imaging Area: 212mm x 140mm, region etched on chassis
- Minimum Edges: Two edges ≤ 5mm from edge of chassis to active
- Weight: 1.0 kg detector with batteries, no tablet
- Pixel Pitch: 0.210mm
- Resolution: 720x1024
- Display: via Android app on phone or tablet
- Dynamic Range: 16 bit design, SNR 12-14 bit
- X-Ray Energy Response: 60-400kVp
- Power: Internal, secondary cells; recharge with 12-36V DC or 120-240 AC
- Active Operating Time: >2 hours active
- Image Storage and Transfer: Internal fixed flash, ~25,000 images
- Image Files: Lossless compressed images ISO/IEC 15948:2004
- Controls: Android app integrated with XTK (Sandia)
- Image Manipulation: As provided by XTK: brightness, contrast, magnification, and panning
- Software: Auto-loading, free (GPL2, etc), open-source software.
- Storage / Operating Range: ~30 to +80°C / -20 to 70°C
- Case: Unibody aluminum. Shock and moisture resistant.
- Generator Synchronization: Golden Engineering XR-150, XR53, and XR54

For more information, please contact:
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Leveraging a Partnership for Future Development of Fully Formable Detector

NextFlex Industry and Academic Partnership Flexible Hybrid Electronics Packaging

Flexible DOD DR Partners

- Army G3/5/7 ACEs Endorsement
- PEO Ammo C-IED C-WMD Endorsement in process
- SOCOM DTRA EOD Endorsement
- PEO Soldier (PM SWAR) Nett Warrior Integration

Corporate

Tier 1
- Boeing

Tier 2
- Eastman

Tier 3
- Acellent
- Jabil
- Raytheon
- ON Semiconductor
- Uniqarta

Observer
- American Semiconductor

Academic/Non-Profit

Tier 1
- Auburn University
- Binghamton University

Tier 2
- Georgia Tech
- UMass
- Texas

Tier 3
- University of Arizona
- School of Engineering
- University of Washington
- Western Michigan University
- University of San Diego

Federal Government

Tier 1
- Army
- AF
- Navy
- DTRA
- DoD Lab

Tier 2
- State/Local Government
- Dept of Energy
- Dept of the Navy
- Dept of the Army
- Dept of the Air Force

Tier 3
- Corporate Academic/Non-Profit
- Federal Government

Observer
- FlexTech
- SEMI
- IPC
- Team NEO
Manufacturing Path Forward

- Options for Collaborative Relationships
  - Shared resources/shared risks/optimize use of assets/increase potential for development of manufacturing.
  - Develop demand for a common product
    - Incentive for vendor to produce
    - Reduced cost
- Develop Transition Plan for FY18 and beyond
  - Mitigate engineering requirements and conflicts
  - Coordinated effort to address challenges
Back up
Discussion

• Roadmap to Manufacturing Development
  • ManTech SME & Support
    • Business Model Development
    • Contract Agreements
    • Other
OSD FlexTech Alliance

NextFlex | America’s Flexible Hybrid Electronics Manufacturing Institute
Lead: FlexTech Alliance, Headquartered San Jose, CA

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(NextFlex Director for Commercialization)
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NextFlex Manufacturing Base

Established: 28 August 2015
Lead: FlexTech Alliance
Hub location and fab: San Jose, California
Proposed Members: 145+ in 27 states
Federal Funding: $75M
Gov’t agency engaged: 17 DOD and OGAs

Focus: Combining the entrepreneurial & innovative culture of Silicon Valley with a national network of regional & technology nodes to commercialize FHE technology through manufacturing advancements in integrated printing & packaging, system design tools, materials scale-up, thinned device processing, and reliability testing & modeling.
Flexible Hybrid Electronics For DoD With Parallel Commercial Applications

**IMPACT**

- Novel Form Factors
- Light-weight, rugged
- Low-cost approaches through new manufacturing
- Enabling novel-sensing capabilities

**Warfighters**

**DOD EXAMPLES**

- Flexible ubiquitous Sensors
- Wearable Soldier Sensing, Performance and Training
- Conformable, compact, lightweight, flexible, low-power electronics and sensors
- Distributed media
Leverage Industry to Develop
Leveraging Display Infrastructure

- TFT arrays for sensing array platforms
- X-Ray, Neutron, Gamma, Biomedical, chemical explosive detectors
**X-ray TFT**

**X-ray Source**

Digital Radiography Panel  
Passive pixel  
PiN photodiodes  
207 \( \mu \)m x 207\( \mu \)m pixels
M.ARL.2014.01 Flexible Electronics for Large Area Sensors

**Purpose:**
- Develop US manufacturing base for large area flexible electronic sensor technology fabricated on plastic substrates. Demonstrate capability through integration of lightweight, rugged sensors into digital radiography (DR) panels for Soldier portable Explosive Ordnance Disposal (EOD) inspection and forensics applications.

**Products:**
- 1000 line (8” & 10” diag) flexible digital radiography panel with > 20 line defects.
- Manufacturing processes to reduce the Si CMOS packaging for Army Force Protection

**Payoff:**
- Meet x-ray inspection Tech-gaps, EOD JUONs
- US Manufacturing base for flexible electronics
- G3/5/7; PEO Ammo; TRADOC ST Investment (#1 CWMD, Tactical Intell); Connect to PEO Soldier Nett Warrior architecture
- Cost Benefit of $21.2M with ROI of 3.1:1

Funding: Army Mantech, DTRA, JIEDDO, G38
Coordination:
- NextFlex (flex electronics packaging)
- SOCOM, PEO Ammo/PM CCS, ARDEC
- NAVOEDECHDIV

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