Exhibit R-2, RDT&E Budget Item Justification: PB 2015 Army											Date: March 2014	
Appropriation/Budget Activity 2040: *Research, Development, Test & Evaluation, Army* / BA 2: *Applied Research*					R-1 Program Element (Number/Name) PE 0602705A / *ELECTRONICS AND ELECTRONIC DEVICES*							
COST ($ in Millions)	**Prior Years**	**FY 2013**	**FY 2014**	**FY 2015 Base**	**FY 2015 OCO #**	**FY 2015 Total**	**FY 2016**	**FY 2017**	**FY 2018**	**FY 2019**	**Cost To Complete**	**Total Cost**
Total Program Element	-	85.099	58.990	56.435	-	56.435	55.672	57.292	55.553	56.231	-	-
EM4: *Electric Component Technologies (CA)*	-	27.573	-	-	-	-	-	-	-	-	-	-
EM8: *High Power And Energy Component Technology*	-	14.438	14.920	13.182	-	13.182	12.232	12.761	12.968	13.020	-	-
H11: *Tactical And Component Power Technology*	-	9.851	11.685	11.769	-	11.769	11.895	11.980	9.686	9.656	-	-
H17: *Flexible Display Center*	-	5.915	2.702	0.571	-	0.571	1.145	1.017	1.031	1.082	-	-
H94: *Elec & Electronic Dev*	-	27.322	29.683	30.913	-	30.913	30.400	31.534	31.868	32.473	-	-

The FY 2015 OCO Request will be submitted at a later date.

Note

FY 13 adjustments attributed to Congressional Adds (33.0 million); Congressional General Reductions (-172 thousand); SBIR/STTR transfers (-864 thousand); and Sequestration Reductions (7.165 million)

A. Mission Description and Budget Item Justification

This program element (PE) designs and evaluates, power components, frequency control and timing devices, high power microwave devices, display technologies; and electronic components. The applied research on these technologies enable the ability to perform precision deep fires against critical mobile and fixed targets; investigate all-weather, day or night, theater air defense against advanced enemy missiles and aircraft; as well as investigate enhanced communications and target acquisition through support of capabilities such as autonomous missile systems, advanced land combat vehicles, smart anti-tank munitions, electric weapons, secure jam-resistant communications, automatic target recognition, foliage-penetrating radar, and combat identification. Project EM8 designs and evaluates high-power, microwave, electronic components and technologies. Project H11 designs, fabricates and evaluates advanced portable power technologies (batteries, fuel cells, hybrids, engines, chargers, and power management). Project H17 designs and evaluates flexible displays in conjunction with the Flexible Display Center. Project H94 researches and evaluates electronic component technologies such as photonics, micro electromechanical systems, imaging laser radar, magnetic materials, ferroelectrics, microwave and millimeter-wave components, and electromechanical systems.

Work in this PE complements and is fully coordinated with efforts in PE 0602120A (Sensors and Electronic Survivability), PE 0602709A (Night Vision Technology), PE 0602782A (Command, Control, Communications Technology), PE 0602783A (Computer and Software Technology), PE 0603001A (Warfighter Advanced Technology), and PE 0603772A (Advanced Tactical Computer Science and Sensor Technology).

Exhibit R-2, RDT&E Budget Item Justification: PB 2015 Army	Date: March 2014
Appropriation/Budget Activity 2040: *Research, Development, Test & Evaluation, Army I* BA 2: *Applied Research*	**R-1 Program Element (Number/Name)** PE 0602705A *I ELECTRONICS AND ELECTRONIC DEVICES*

The cited work is consistent with the Assistant Secretary of Defense for Research and Engineering Science and Technology priority focus areas and the Army Modernization Strategy.

Work is performed by the Army Research Laboratory, Adelphi, MD, and the Army Communications-Electronics Research, Development, and Engineering Center, Aberdeen Proving Ground, MD.

B. Program Change Summary ($ in Millions)	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO	FY 2015 Total
Previous President's Budget	60.300	59.021	56.711	-	56.711
Current President's Budget	85.099	58.990	56.435	-	56.435
Total Adjustments	24.799	-0.031	-0.276	-	-0.276
• Congressional General Reductions	-0.172	-0.031			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	33.000	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-0.864	-			
• Adjustments to Budget Years	-	-	-0.276	-	-0.276
• Sequestration	-7.165	-	-	-	-

Exhibit R-2A, RDT&E Project Justification: PB 2015 Army												Date: March 2014
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602705A / *ELECTRONICS AND ELECTRONIC DEVICES*				Project (Number/Name) EM4 / *Electric Component Technologies (CA)*			
COST ($ in Millions)	**Prior Years**	**FY 2013**	**FY 2014**	**FY 2015 Base**	**FY 2015 OCO #**	**FY 2015 Total**	**FY 2016**	**FY 2017**	**FY 2018**	**FY 2019**	**Cost To Complete**	**Total Cost**
EM4: *Electric Component Technologies (CA)*	-	27.573	-	-	-	-	-	-	-	-	-	-

The FY 2015 OCO Request will be submitted at a later date.

Note

Not applicable for this item.

A. Mission Description and Budget Item Justification

Congressional Interest Item funding for Electronic Component applied research.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Title: Silicon Carbide Research ***Description:*** This is a Congressional Interest Item. ***FY 2013 Accomplishments:*** Silicon Carbide Research	10.863	-	-
Title: Energy Efficiency ***Description:*** This is a Congressional Interest Item ***FY 2013 Accomplishments:*** Researched 3-D Printing Technology of Thermoelectric Materials for Multi-Function Applications; Environmental Control Unit Thermal Improvement Program; Flexible Electronics Research; Thermophotovoltaic Power Sources; High energy efficient electro-active materials for higher rate higher energy density energy storage; Lightweight, conformal Soldier-worn power sources	16.710	-	-
Accomplishments/Planned Programs Subtotals	27.573	-	-

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2015 Army		Date: March 2014
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602705A / *ELECTRONICS AND ELECTRONIC DEVICES*	**Project (Number/Name)** EM4 / *Electric Component Technologies (CA)*

E. Performance Metrics

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2015 Army			Date: March 2014
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602705A / *ELECTRONICS AND ELECTRONIC DEVICES*	Project (Number/Name) EM8 / *High Power And Energy Component Technology*	

COST ($ in Millions)	Prior Years	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO #	FY 2015 Total	FY 2016	FY 2017	FY 2018	FY 2019	Cost To Complete	Total Cost
EM8: *High Power And Energy Component Technology*	-	14.438	14.920	13.182	-	13.182	12.232	12.761	12.968	13.020	-	-

The FY 2015 OCO Request will be submitted at a later date.

A. Mission Description and Budget Item Justification

This project provides for the research, development, and evaluation of high-power electronic components, materials, and related technologies. These technologies have application in compact and efficient power conversion, conditioning, and management sub-systems; energy storage and conversion devices; radio frequency (RF)/ microwave and solid-state laser directed energy weapons (DEW); and traditional and non-traditional RF and laser electronic attack. All project elements are coordinated with and, as appropriate, leveraged by DEW and power/energy programs in the Air Force, Navy, High Energy Laser Joint Technology Office, Defense Threat Reduction Agency, national labs, university consortia, and relevant industry and foreign partners. The products of this research are required by developers of Army (DoD) systems to evolve traditional (mechanical-based) sub-systems such as geared transmissions, plate armor, and kinetic projectiles to electrically-based ones. These products will provide the Soldier enhanced survivability and lethality through increased power management and energy savings as well as new fighting capabilities offered only by electrical power.

This project sustains Army science and technology efforts supporting the Ground and Soldier portfolio.

The work in this project is coordinated with the U.S. Army Tank and Automotive Research, Development, and Engineering Center (TARDEC); Armaments Research, Development, and Engineering Center (ARDEC); the U.S. Army Aviation and Missile Research, Development, and Engineering Center (AMRDEC); and the U.S. Army Communications-Electronics Research, Development, and Engineering Center (CERDEC). These efforts were previously funded in PE 0602120A (Sensors and Electronic Survivability).

The cited work is consistent with the Assistant Secretary of Defense for Research and Engineering science and technology priority focus areas and the Army Modernization Strategy.

Work on this project is performed by the U.S. Army Research Laboratory (ARL), Adelphi, MD.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Title: High Power and Energy Technologies	1.120	1.128	1.187
Description: Research and evaluate electronic materials, structures, and components that will enable the realization of higher energy density and efficiency required by future Army systems such as electromagnetic armor, directed energy weapons, power grid protection, and other pulsed-power systems. Special emphasis is on components operating at high voltages - greater than (>) 10 kilovolts (kV).			

Exhibit R-2A, RDT&E Project Justification: PB 2015 Army		Date: March 2014
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602705A / *ELECTRONICS AND ELECTRONIC DEVICES*	**Project (Number/Name)** EM8 / *High Power And Energy Component Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
FY 2013 Accomplishments: Investigated and conducted experiments with FY12 advanced wide band gap materials, such as silicon carbide (SiC), operation at e20kV with emphasis on high voltage packaging based on the results of FY12's >10 kV SiC component research; and identified and assessed wide band-gap semiconductors (such as aluminum nitride) that allow higher voltage (>25kV) operation for expanded power control in survivability and lethality applications. ***FY 2014 Plans:*** Investigate and develop advanced wide band gap materials and devices, for operation at and above 20kV to support survivability, lethality systems, and high voltage micro-grid application requirements; evaluate high voltage packaging needs and identify packaging research; and initiate research into wide band-gap semiconductors identified in FY13. ***FY 2015 Plans:*** Will investigate and develop advanced wide band gap materials and devices, for operation at and above 20kV to support survivability, lethality systems, and high voltage microgrid application requirements; research and evaluate high voltage packaging needs; and continue research into wide band-gap semiconductors identified initiated in FY14.			
Title: High Energy Laser Technology ***Description:*** Research novel solid-state laser concepts, architectures, and components with the goal of providing technology to Army directed energy weapon developers. Exploit breakthroughs in laser technology, material development and photonics basic research to meet the stringent weight/volume requirements for platforms. Applied research will be conducted in close collaboration with domestic and foreign material vendors, university researchers, as well as major laser diode manufacturers. ***FY 2013 Accomplishments:*** Investigated solid-state laser thermal management based on composite design of the gain elements (materials that are stimulated to produce laser light) with optically transparent heat sinking material in order to further increase beam power while preserving high beam quality. ***FY 2014 Plans:*** Experimentally validate feasibility of a fiber laser which could provide significantly improved thermal management in order to achieve advanced power scalability (>10X) with good beam quality; and scale chirped diode laser seed technique to obtain multi kW power output from a 1060 nm fiber amplifier. ***FY 2015 Plans:*** Will investigate techniques for power scaling continuous wave (CW) and pulsed mid-wave infrared (IR) sources for IR countermeasure (IRCM) applications; and explore laser materials with enhanced thermal conductivity that will provide superior	2.213	2.544	2.000

Exhibit R-2A, RDT&E Project Justification: PB 2015 Army		Date: March 2014
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602705A / *ELECTRONICS AND ELECTRONIC DEVICES*	**Project (Number/Name)** EM8 / *High Power And Energy Component Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
ability to meet stringent Army size, weight, and power (SWAP) requirements for counter radar-absorbing material (RAM) applications.			
Title: Directed Energy/Electromagnetic Environments (EME) Technologies ***Description:*** Investigate and evaluate emerging technologies related to DE technology, electronic warfare (EW) survivability/ lethality, operations in the EME, and supporting high power components with the goal of enhancing the survivability/lethality of Army platforms. ***FY 2013 Accomplishments:*** Investigated the susceptibility of a variety of Improvised Explosive Device (IED) targets in order to determine the vulnerability of these threats as well as design neutralization strategies; designed and developed an initial neutralization sub-component that is a part of a integrated radio frequency based detection, location and IED neutralization technology for future counter IED devices; and investigated the effect of Digital Radio Frequency Memory (DRFM) technology (one of the top concerns in EW across the DoD) on U.S. sensors and receivers and transitioned data to ARDEC, CERDEC, U.S. Army Test and Evaluation Command (ATEC), and program managers as appropriate. ***FY 2014 Plans:*** Characterize the susceptibility of emerging IED threats to identify their unique susceptibilities/vulnerabilities. Design neutralization waveforms and techniques based on their vulnerabilities; and develop and evaluate smart RF waveforms to create countermeasures to affect electronic devices. ***FY 2015 Plans:*** Will determine the susceptibility of emerging threat electronics (to include those related to IEDs) to electronic attack; characterize parameters for use in the development of neutralization waveforms and techniques; investigate DRFM technology and its effects on jamming/counter-jamming applications; and develop cognitive RF architecture and baseline hardware and algorithms for sensing and exploiting electromagnetic environment.	2.277	2.386	2.396
Title: Electronic Components and Materials Research ***Description:*** Investigate, and evaluate compact, high-efficiency, high-temperature, high-power component technologies (such as semiconductor, magnetic, and dielectric devices) for hybrid-electric propulsion, electric power generation and conversion, and smart/micro-grid power distribution. Research addresses current and future Army-unique performance and operational requirements. ***FY 2013 Accomplishments:***	4.334	4.335	3.000

Exhibit R-2A, RDT&E Project Justification: PB 2015 Army		Date: March 2014
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602705A / *ELECTRONICS AND ELECTRONIC DEVICES*	**Project (Number/Name)** EM8 / *High Power And Energy Component Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Investigated advanced wide band gap modules developed in FY12 for use in vehicle and micro-grid applications that potentially provided improved fault tolerant operation and efficiency; and conducted applied research on next-generation wide band-gap materials and devices to provide high temperature, voltage, and current conversion for micro-grid applications. ***FY 2014 Plans:*** Investigate advanced control and diagnostic methods intended for power switches to improve fault tolerance and efficiency; conduct applied research on next-generation materials and fabrication methods for passives and wide band-gap materials and devices and develop switching components to provide power conversion components for micro-grid applications. ***FY 2015 Plans:*** Will investigate both gallium nitride (GaN) and silicon carbide (SiC) based electronic components for device reliability and characterize these materials; investigate advanced control and diagnostic methods for power switches to improve fault tolerance and efficiency; conduct applied research on next-generation materials and fabrication methods for compact power switching components that provide high voltage, high current, and/or high frequency operation; and investigate and develop advanced power semiconductor devices and modules, for operation at above 20kV and at high currents.			
Title: Power System Components Integration and Control Research ***Description:*** Research and evaluate the configuration of electronic components and control strategies required to achieve high-power density and high efficiency power utilization in current and future platform sub-systems, vehicle, and micro-grid (installation) applications to include the operation of military-specific power distribution topologies at the system and circuit levels. ***FY 2013 Accomplishments:*** Conducted applied research in designing advanced control techniques, such as smart switches, to provide more efficient, robust, and reliable power delivery for vehicle power applications; and conducted investigations at the system and circuit levels to evaluate micro-grid topology effectiveness. ***FY 2014 Plans:*** Conduct applied research in intelligent controls and diagnostics for power conversion modules and circuits to provide more efficient, robust, and reliable power delivery and conversion for vehicle and micro-grid power applications; research intelligent control methodologies for micro-grids and other power distribution systems; and investigate bidirectional power conversion circuits for platform and micro-grids. ***FY 2015 Plans:*** Will conduct applied research in power management, intelligent controls, and diagnostics for power conversion modules and circuits to provide more efficient, robust, and reliable power delivery and conversion for vehicle and micro-grid power applications; investigate advanced behavior based Tactical Energy Network control and prediction techniques; and research distributed control	3.550	3.787	4.599

Exhibit R-2A, RDT&E Project Justification: PB 2015 Army		Date: March 2014
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602705A / *ELECTRONICS AND ELECTRONIC DEVICES*	**Project (Number/Name)** EM8 / *High Power And Energy Component Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
strategies to enable more robust and failure resistant grids (e.g. utilize swarm (hive or colony) control, where each member of the swarm represents a specific piece of equipment).			
Title: Pulsed-Power Components and Systems Research ***Description:*** Investigate, and evaluate emerging technologies such as energy storage capacitors, high voltage converters, and high rate-of-current-rise semiconductor switches, explosive based pulse generators, that improve the reliability and efficiency of pulsed-power components for applications such as electromagnetic armor, electronic fuze initiators, and electronic protection systems. ***FY 2013 Accomplishments:*** Experimentally characterized and validated the FY12 silicon carbide (SiC) switch and other components in an electromagnetic armor demonstration system in support of efforts in PE 062618/project H80 and with TARDEC in PE 063005/project 441; and designed novel compact high power devices, modules, converters and passive components utilizing emerging wideband gap materials that provide enhanced power density for survivability systems with reduced space and weight. ***FY 2014 Plans:*** Analyze semiconductor switch and component operation under extreme currents and voltages; experimentally characterize and validate improved FY13 SiC switches and other components for electromagnetic armor systems; and develop enhanced power dense power conversion hardware to reduce size and weight for platform survivability efforts through the implementation of novel materials, circuits and module designs.	0.944	0.740	-
Accomplishments/Planned Programs Subtotals	14.438	14.920	13.182

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2015 Army			Date: March 2014
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602705A / *ELECTRONICS AND ELECTRONIC DEVICES*	Project (Number/Name) H11 / *Tactical And Component Power Technology*	

COST ($ in Millions)	Prior Years	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO #	FY 2015 Total	FY 2016	FY 2017	FY 2018	FY 2019	Cost To Complete	Total Cost
H11: *Tactical And Component Power Technology*	-	9.851	11.685	11.769	-	11.769	11.895	11.980	9.686	9.656	-	-

The FY 2015 OCO Request will be submitted at a later date.

A. Mission Description and Budget Item Justification

This project identifies, advances, and enhances emerging power generation, energy storage, and power management components and software. This project researches advancements in enabling small unit & Soldier power management, decision making, and distribution. This project also researches power sources that are smaller and more fuel-efficient, advanced cooling systems that enable tactical sustainability and survivability.

This project supports Army science and technology efforts in the Command, Control, Communications and Intelligence, Soldier/Squad and Innovative Enablers portfolios. Work in this Project complements and is fully coordinated with efforts in PE 0603001A (Warfighter Advanced Technology).

The cited work is consistent with the Assistant Secretary of Defense for Research and Engineering Science and Technology priority focus areas and the Army Modernization Strategy.

Work in this project is performed by the Army Research, Development and Engineering Command (RDECOM), Communications-Electronics Research, Development, and Engineering Center (CERDEC), Aberdeen Proving Ground, MD.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Title: Soldier Power Technologies (formerly Soldier Hybrid Power and Smart Chargers)	6.197	7.721	7.529
Description: This effort designs, fabricates and validates Soldier-borne hybrid power sources, batteries, rapid battery chargers, and power management software, devices and techniques in order to decrease Soldier load and power burden, increase power capabilities such as extending battery run-time, and decrease battery sizes and costs.			
FY 2013 Accomplishments: Fabricated higher rate lithium (Li) ion conducting membranes and air electrode catalysts for advanced Li/Air disposable battery; validated bio-inspired cathode coatings for rechargeable lithium ion cells to improve and exhibit battery safety characteristics and cell performance in a representative environment; further enhanced rechargeable Li/Air battery to achieve and exhibit greater cell energy density in laboratory environment; validated a rechargeable Soldier hybrid power source (external combustion or fuel cell) with greater energy density and extended run time in a laboratory environment; optimized electro-catalyst and alkaline membrane electrolyte performance with different fuels; improved sulfur tolerant catalysts to promote longer system life.			
FY 2014 Plans:			

Exhibit R-2A, RDT&E Project Justification: PB 2015 Army		Date: March 2014
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602705A / *ELECTRONICS AND ELECTRONIC DEVICES*	**Project (Number/Name)** H11 / *Tactical And Component Power Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Investigate very high energy density lighter weight Soldier hybrid power sources including wearable conformal Li/Air disposable batteries; increase power density of Li/Air by designing, fabricating and assessing carbon nano-based air electrodes; investigate highly conducting, robust, lower cost lithium ion conducting membranes to further reduce weight and cost of Soldier batteries; investigate renewable multi-fueled Soldier portable power sources and aluminum hydride (high energy density) based fuel cells with extended run time, higher energy density and higher fuel to energy conversion efficiency; assess Soldier wireless power and energy harvesting concepts to reduce electrical wiring and connectors, achieve greater power transmission efficiencies and reduce energy logistics for extended missions; investigate processes, techniques and hardware for safe wireless power distribution for Soldier borne equipment and wireless charging of Soldier borne batteries. ***FY 2015 Plans:*** Will mature very high energy density hybrid power sources as a wearable conformal power source; design a smart Soldier power grid capable of integrating energy storage and power generation devices with smart power management and distribution with little to no user interaction; mature internal components to facilitate a renewable multi-fueled Soldier portable power source; investigate a system to integrate wireless power and energy harvesting technologies into the smart Soldier power grid to reduce cabling and connectors; continue to investigate techniques to increase wireless power transfer efficiency and distance; conduct experiments on novel energy harvesting components to increase efficiency and reduce weight of carried power sources.			
Title: Energy Informed Operations (formerly Silent Mobile Power) ***Description:*** This effort investigates power generation materials, components and systems to increase energy output, reduced weight and noise, while increasing fuel and cost efficiency in mobile power generation sources. Products are silent mobile power components and materials, waste-heat recovery components and systems, transitional power sources in the 500 watts (W) to 2 kilowatts (kW) range, towable generator sets up to 100 kW and renewable energy components and power management systems up to 5 kW. ***FY 2013 Accomplishments:*** Fabricated and validated advanced logistic fueled 250 to 1000 W mobile power generators with advanced sensors, power electronics/controls and advanced materials to achieve greater fuel-to-electric efficiency and increase component survivability through real time response to rapid changes in load, environment, and usage; designed and fabricated 3 to 5 kilowatt-hour military standard hybrid energy storage components to maximize fuel economy, extend mission times, reduce recharging and disposal burden of batteries, and support patrol base and command post applications; designed and fabricated integrated components and code software for power management of a smart power grid scalable from Brigade to installation power levels; fabricated and conducted experiments with smaller, lighter hybrid renewable (battery/engine/wind/solar) energy and co-generation equipment with improved fuel-to-electric efficiencies that provide environmental control (i.e., air conditioning) for Brigade tactical operations. ***FY 2014 Plans:***	3.654	3.964	4.240

Exhibit R-2A, RDT&E Project Justification: PB 2015 Army		Date: March 2014
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602705A / *ELECTRONICS AND ELECTRONIC DEVICES*	**Project (Number/Name)** H11 / *Tactical And Component Power Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Investigate monitoring tools for Squad, Platoon and Brigade command post renewable energy power grids (300 W to 10 kW) to provide grid status to the commander; code intelligent power management protocols to increase reliability and efficiency of renewable energy integrated with fossil fuel generators; design and assess high energy density, efficient energy storage modules; investigate advanced harvesting of carbon dioxide (CO2) from exhaust to provide for autonomous power generation (fuel cells and external/internal combustion) and reduced fuel logistics; design alternative CO2 based co-generation capabilities for greater cooling capacity and reduced weight/size of environmental control units. ***FY 2015 Plans:*** Will develop intelligent power management architecture for mobile power generation grids to enable energy informed operations for integrated command, control, communications, computers, intelligence, surveillance and reconnaissance platforms; design a system of interconnected power grids of various voltages with multiple controllers using a master/slave control scheme capable of supporting ad-hoc connections and configuration; establish standards for renewable power generation and energy storage and incorporate into demonstration grid; establish power management protocols and policies for interfacing with mission systems; develop power planning tools and applications for monitoring and controlling grid status; develop advanced 2kW fuel efficient silent power generation systems with greater than 30% fuel to electric efficiencies.			
Accomplishments/Planned Programs Subtotals	9.851	11.685	11.769

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2015 Army			Date: March 2014
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602705A / *ELECTRONICS AND ELECTRONIC DEVICES*	Project (Number/Name) H17 / *Flexible Display Center*	

COST ($ in Millions)	Prior Years	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO #	FY 2015 Total	FY 2016	FY 2017	FY 2018	FY 2019	Cost To Complete	Total Cost
H17: *Flexible Display Center*	-	5.915	2.702	0.571	-	0.571	1.145	1.017	1.031	1.082	-	-

The FY 2015 OCO Request will be submitted at a later date.

A. Mission Description and Budget Item Justification

This project fabricates and evaluates flexible display and electronic components emerging from the Army's Flexible Display Center (FDC) at the Arizona State University and materials and devices for flexible electronics developed at the Army Research Laboratory. This applied research on flexible display and electronic technologies makes them inherently rugged (no glass), light weight, conformal, potentially low cost, and low power. The resultant technology would enable enhanced and new capabilities across a broad spectrum of Army applications (such as hands-free/wrist mounted situational awareness devices, flexible X-Ray devices, large areas sensor, tagging, tracking, and soldier monitoring.)

This project supports Army science and technology efforts in the Command, Control, Communications and Intelligence and Soldier portfolios.

The cited work is consistent with the Assistant Secretary of Defense for Research and Engineering science and technology priority focus areas and the Army Modernization Strategy.

Work in this project is executed by the U.S. Army Research Laboratory (ARL), Adelphi, MD.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Title: Flexible Display Center (FDC) and Flexible Electronics Development	5.915	2.702	0.571
Description: The Flexible Display Center is developing high resolution flexible reflective (electrophoretic) and emissive (organic light emitting diodes) displays and sensing arrays. The U.S. Army Research Laboratory is developing materials and devices and processes for flexible electronics for Army applications.			
FY 2013 Accomplishments: Continued to design full color light emitting displays and the related flexible electronics for soldier applications.			
FY 2014 Plans: Develop flexible electronic sensor devices for Army applications to include radiation sensors (visible to x-ray) and particle detection.			
FY 2015 Plans:			

Exhibit R-2A, RDT&E Project Justification: PB 2015 Army		Date: March 2014
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602705A / *ELECTRONICS AND ELECTRONIC DEVICES*	**Project (Number/Name)** H17 / *Flexible Display Center*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Will develop printable sensor materials and devices that will enable new and enhanced capabilities in a areas such as flexible electronic large areas sensors, tagging, tracking, and soldier monitoring.			
Accomplishments/Planned Programs Subtotals	5.915	2.702	0.571

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2015 Army			Date: March 2014
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602705A / *ELECTRONICS AND ELECTRONIC DEVICES*	Project (Number/Name) H94 / *Elec & Electronic Dev*	

COST ($ in Millions)	Prior Years	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO #	FY 2015 Total	FY 2016	FY 2017	FY 2018	FY 2019	Cost To Complete	Total Cost
H94: *Elec & Electronic Dev*	-	27.322	29.683	30.913	-	30.913	30.400	31.534	31.868	32.473	-	-

The FY 2015 OCO Request will be submitted at a later date.

Note

Not applicable for this item.

A. Mission Description and Budget Item Justification

This project designs and evaluates electronics and electronic components and devices for Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance (C4ISR) applications and battlefield power and energy applications. Significant areas of component research relevant to C4ISR include: antennas, millimeter wave components and imaging, micro- and nanotechnology, eye-safe laser radar (LADAR), vision and sensor protection, infrared imaging (IR), photonics, and prognostics and diagnostics. Areas of research relevant to power and energy include power and thermal management, micro-power generators and advanced batteries, fuel reformers, fuel cells for hybrid power sources, and photosynthetic routes to fuel and electricity.

This project supports Army science and technology efforts in the Command Control and Communications, Soldier, Ground and Air portfolios. Work in this project is fully coordinated with PE 0602709A (Night Vision Technology), PE 0603001A (Warfighter Advanced Technology), PE 0603004A (Weapons and Munitions Advanced Technology), PE 0603005A (Combat Vehicle and Automotive Advanced Technology), PE 0603008A (Command, Control, Communications Advanced Technology), PE 0603313A (Missile and Rocket Advanced Technology) and PE 0603772A (Advanced Tactical Computer Science and Sensor Technology).

The cited work is consistent with the Assistant Secretary of Defense, Research and Engineering Science and Technology priority focus areas and the Army Modernization Strategy.

Work in this project is performed by the U.S. Army Research Laboratory (ARL), Adelphi, MD.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Title: Antennas and Millimeter Wave Imaging	3.400	4.574	3.439
Description: This effort designs evaluates and validates high performance antenna components and software for multifunction radar and communication systems. Research areas include scanning techniques, broadbanding, beamforming, polarization, platform integration, and affordability.			
FY 2013 Accomplishments:			

Exhibit R-2A, RDT&E Project Justification: PB 2015 Army		Date: March 2014
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602705A / *ELECTRONICS AND ELECTRONIC DEVICES*	**Project (Number/Name)** H94 / *Elec & Electronic Dev*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Developed low-profile antennas suitable for conformal and embedded platform applications; and developed and assessed millimeter wave and terahertz imaging devices and phenomenology for a wide range of applications such as low-visibility navigation and detection of concealed body-borne threats. ***FY 2014 Plans:*** Develop new terahertz detector for covert surveillance; continue millimeter wave antenna development; develop and evaluate carbon nanotube based antenna structures for potential integration into soldier uniforms; and design and develop antenna components to allow interoperability of and reduce interference between electronic warfare and communications functions on a single antenna system; and validate performance of antenna components in laboratory experiments. ***FY 2015 Plans:*** Will evaluate the performance of millimeter wave transceivers for covert communications and sensing; extend and modify microwave radar rain scattering models to frequencies above 200 GHz to support transmission of data through rain and dust; and develop and evaluate conformal antennas for non-standard vehicle, covert applications.			
Title: Advanced Micro and Nano Devices	3.353	2.637	2.525
Description: This effort designs and evaluates micro and nanotechnology components for multifunctional and integrated radio frequency (RF) applications, microrobotics, integrated energetics, control sensor interfaces and sensors for improved battlefield awareness. Work being accomplished under PE 0601102A /project H47 compliments this effort. ***FY 2013 Accomplishments:*** Validated mechanical microcontroller for integrated control of electronically-scanned antennas; developed methods to extend autonomous jumping microrobot to multiple jumps > 5cm for increased mobility; designed and evaluated Microelectromechanical Systems (MEMS) based, low power rotational acceleration switch arrays for detection of potential traumatic brain injury-causing events; evaluated carbon based devices and developed circuits for future amplifiers and frequency doublers; and grew, characterized and fabricated graphene materials and structures for future high performance and low power Army electronic applications. ***FY 2014 Plans:*** Develop, synthesize and evaluate conformal and transparent graphene based electronics, and super-capacitors for high energy and power density; develop MEMS ultra high frequency (UHF) switchable filter module with variable bandwidth, center frequency tuning, and insertion loss <3 dB; investigate integration of MEMS and nano-energetics to enable directionality for jumping microrobots; develop piezoMEMS actuators for tethered flight and millimeter scale robotics; develop a digital interface between			

Exhibit R-2A, RDT&E Project Justification: PB 2015 Army		Date: March 2014
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602705A / *ELECTRONICS AND ELECTRONIC DEVICES*	**Project (Number/Name)** H94 / *Elec & Electronic Dev*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
the MEMS acceleration switch arrays and the electronics to reduce power consumption; and investigate MEMS-based magnetic permeability sensing hardware for reading and writing non-erasable magnetic memory. ***FY 2015 Plans:*** Will develop and prototype MEMS technologies for enabling frequency agile RF systems, mm-scale robotic platforms, and novel MEMS and sensor fusion solutions for enabling position, navigation, and timing in global positioning system (GPS) denied environments; continue investigation of novel stacked two dimensional (2-D) electronic materials (e.g. graphene, moly-di-sulphide, boron nitride) for Army relevant high performance electronic devices such as flexible and transparent transistors, antennas, oscillators, and amplifiers; develop nanoscale energetic materials for micro-autonomous vehicle propulsion, technology protection, and fuze initiators; optimize magnetic tunnel junction interface with magnetic permeability bits to enhance memory density and read speed; develop MEMS acoustic vector intensity probes for target localization and wind mitigation; and develop intrusion detection algorithm to enhance communication link security.			
Title: Millimeter Wave Components and Architectures for Advanced Electronic Systems ***Description:*** This effort researches, designs and evaluates component materials, structures, devices, and the electromagnetic issues of millimeter wave (mmw) components and active devices. The goal is to develop components that can enable advanced systems that combine multiple RF functionalities. ***FY 2013 Accomplishments:*** Designed high density RF circuit with reduced size, weight and power (SWaP) for radar, communications, and electronic warfare applications; refined mmw power amplifier linearization design to optimize efficiency and output power for improved data throughput and reduced SWaP in satellite communications (SATCOM) applications; and designed, fabricated and experimentally validated radio receiver components that can sense, identify and exploit RF threat signatures for improved standoff threat signal identification. ***FY 2014 Plans:*** Investigate and evaluate RF component integration techniques; build and evaluate test antennas and amplifiers capable of receiving inherently weak wideband threat signatures; and design and fabricate a circuit that digitizes signals at mmw frequencies to enable architectures for SATCOM with smaller form factors. ***FY 2015 Plans:*** Will develop and test multi-function RF components capable of receiving weak signals and threat detection using a combination of advanced processing and hardware architectures; investigate novel thermal management techniques for heat removal in high power amplifiers; and develop and evaluate efficient, wideband, secured communications at mmw/terahertz frequencies.	3.641	4.207	5.357
Title: Imaging Laser Radar (LADAR) and Vision Protection	2.196	2.715	2.749

Exhibit R-2A, RDT&E Project Justification: PB 2015 Army		Date: March 2014
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602705A / *ELECTRONICS AND ELECTRONIC DEVICES*	**Project (Number/Name)** H94 / *Elec & Electronic Dev*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Description: This effort develops and assesses eye-safe three dimensional (3-D) laser radar (LADAR) components and phenomenology for long-range reconnaissance and short-range unmanned ground and air vehicle applications. The effort also develops and evaluates materials for passive protection of electro-optic (EO) vision systems from lasers. ***FY 2013 Accomplishments:*** Assessed skin-based, long-range biometric identification phenomenology for uncooperative subjects; and completed assessment of LADAR on small-robotic platforms to validate perception performance under realistic conditions. ***FY 2014 Plans:*** Integrate and evaluate enhanced switching technology with an inorganic crystal-based optical switch for improving laser protection electro-optic shutters; develop and evaluate skin-based spectroscopic and advanced holographic technologies for the identification and verification of uncooperative subjects; and design and develop miniaturized components for high resolution active imaging systems (LADAR and holographic) for higher range and angular resolution. ***FY 2015 Plans:*** Will advance the development of fast EO shutters using inorganic crystal-based materials in conjunction with device tiling with the goal of increasing aperture size for non-focal plane vision protection from lasers; research new LADAR concepts to reduce hardware cost/complexity and multi-spectral illumination to detect explosive constituents and targets; and conduct field experimentation on novel hostile fire sensing component technology.			
Title: Photonics and Opto-Electronic devices ***Description:*** This effort investigates and evaluates novel photonic components and architectures to enable detection of hazardous substances for enhanced Soldier situational awareness and survivability. In addition, this effort develops and assesses the hybridization of opto-electronic (OE) devices with electronics for optical fuze applications. ***FY 2013 Accomplishments:*** Investigated active optical fuses to advance target detection device performance; evaluated laser spectroscopic phenomenology to determine inherent specificity and sensitivity for detection of hazardous or suspicious materials at several ranges; and examined trace detection capability of infrared photoacoustic spectroscopy for detecting energetic materials as well as electromagnetic signatures to enhance detection of hostile threats. ***FY 2014 Plans:***	1.901	2.316	1.287

Exhibit R-2A, RDT&E Project Justification: PB 2015 Army		Date: March 2014
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602705A / *ELECTRONICS AND ELECTRONIC DEVICES*	**Project (Number/Name)** H94 / *Elec & Electronic Dev*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Measure the optical spectra of energetic and energetic related materials using ultra fast laser spectroscopy techniques and infrared photo-acoustic spectroscopy to identify explosive materials; and simulate, fabricate, and characterize advanced silicon photonic devices for improved sensing and processing. ***FY 2015 Plans:*** Will evaluate ultrafast laser spectroscopy techniques, especially multiplex Coherent Anti-Stokes Raman Scattering (CARS), to enable remote explosives detection; explore infrared photothermal technique used in conjunction with laser Doppler vibrometry for energetic-related material detection; and simulate and characterize advanced optical components in a threat detection device for active protection defeat of both kinetic energy and non-kinetic energy targets.			
Title: Power and Thermal Management for Small Systems ***Description:*** This effort investigates designs and fabricates MEMS based components to improve power generation and micro-cooling technology for both dismounted Soldier and future force applications. ***FY 2013 Accomplishments:*** Designed and evaluated compact thermal management components utilizing phase change materials to improve heat rejection capabilities, increase cooling capacity, and reduce volume; fabricated efficient high power density, multifunctional components and sub-systems for capturing, transforming, and delivering power to emerging microsystems; developed and experimentally validated combustion models for JP-8 and alternative fuels and integrate into the design of catalytic liquid fueled energy converters; and characterized catalysts for fuel conversion and fuel synthesis to identify mechanisms for efficient alternative fuels production. ***FY 2014 Plans:*** Establish models for package integrated thermal solutions to balance continuous and transient loads in electronic substrates; assess emerging thermoelectric materials and modules for power generation under the high temperature conditions required for efficient direct power generation or waste heat recovery; characterize catalysts for fuel conversion (JP-8 and alternative fuels) to build reaction models for efficient combustion design; investigate improved interconnects between solar cells with gallium nitride materials with advanced structures and interfacing to lower resistance and thereby improve efficiency of the modules; and investigate new 3D ultra-high density integration process that will enable disparate best-of-breed sensors and electronics to be integrated within a single package with minimal packaging overhead and interconnect losses. ***FY 2015 Plans:*** Will investigate heat management techniques for improving engine waste heat recovery; implement techniques for thermal interface measurements to evaluate heat transfer in novel materials; investigate thermoelectric, pyroelectric, and thermophotovoltaic power generation techniques and materials for applicability in direct power generation; will characterize advanced materials for improved fuel conversion efficiency and apply them toward developing improved reaction models;	3.717	3.972	3.390

Exhibit R-2A, RDT&E Project Justification: PB 2015 Army		Date: March 2014
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602705A / *ELECTRONICS AND ELECTRONIC DEVICES*	**Project (Number/Name)** H94 / *Elec & Electronic Dev*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
investigate improved techniques for wide bandgap material and device design for power supply and conversion systems; and develop improved models and measurement techniques for prediction of silicon carbide device performance and reliability for high power applications.			
Title: Emerging Electronic Devices and Circuits ***Description:*** This effort investigates and evaluates emerging electronics such as analog, mixed signal, and millimeter wave. Efforts entail design, fabrication, and evaluation of electronic devices and integrated circuits for use in extreme environments necessary for Army applications ***FY 2013 Accomplishments:*** Assessed and evaluated digital source collectors for use in the areas of structural health, usage monitoring, and integrated prognosis; applied prognostics and diagnostics methodologies for built-in self test of RF integrated circuits; evaluated algorithms to assess current health and predict the remaining useful life of wide bandgap (WBG) RF power devices and circuits; and explored diagnostic sensing with non-traditional semiconductors that are potentially extremely low cost, very robust, and conformable. ***FY 2014 Plans:*** Develop and design devices and integrated circuits based upon leading edge group IV and III-V semiconducting materials and nanoelectronic approaches; and develop specialized approaches to accommodate extreme environment operation (built-in self-test, ultra-high power/high thermal stress, etc.). ***FY 2015 Plans:*** Will mature the design of devices and integrated circuits including built-in self test of high speed integrated circuits based upon leading edge group IV and III-V semiconducting materials; and investigate emerging electronics and prognostics and diagnostics strategies for microgrid energy & power applications.	1.873	1.769	2.050
Title: Advanced Infrared Technology (previously titled Infrared (IR) Imaging) ***Description:*** This effort designs and evaluates materials, components and focal plane arrays (FPA) for the next generation of Army's night vision systems, missile seekers, and general surveillance devices. Technologies investigated include mercury cadmium telluride (HgCdTe) on Silicon (Si), strained layer superlattices (SLS) and corrugated quantum well infrared photodetector (C-QWIP) detector arrays for both the mid-wave infrared (MWIR) and long-wave infrared (LWIR) spectral regions with goals to increase the operating temperature and decrease the cost of focal plane arrays. Work accomplished under PE 0602709A/ project H95 and PE 0601120A/project 31B compliments this effort. ***FY 2013 Accomplishments:***	2.280	2.410	2.662

Exhibit R-2A, RDT&E Project Justification: PB 2015 Army		Date: March 2014
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602705A / *ELECTRONICS AND ELECTRONIC DEVICES*	**Project (Number/Name)** H94 / *Elec & Electronic Dev*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Experimentally validated optimized HgCdTe devices on alternate substrates to provide a more sensitive large format and higher resolution LWIR and MWIR C-QWIP FPA; and designed voltage tunable two color C-QWIP FPAs that results in increased resolution and higher operating temperatures for more efficient operation and robust target detection. ***FY 2014 Plans:*** Model and exploit electromagnetic resonant effects to design and fabricate high quantum efficiency (up to 70%), large format, long wavelength, quantum well infrared photo-detector focal plane arrays with resolution up to 4 megapixel or higher; develop high quality scalable substrates with Cadmium (Zinc, Selenium) Telluride buffer layers on Silicon; and develop Mercury Cadmium (Telluride, Selenide) based infrared sensing materials and devices; and use thermal cycle annealing to reduce dislocations propagating in the active region, which currently limits operability. ***FY 2015 Plans:*** Will develop high quality scalable substrates with Cadmium (Zinc, Selenium) Telluride buffer layers on Silicon and develop HgCdTe material in collaboration with industrial partners; further study thermal cycle annealing (TCA) of HgCdTe IR detecting material to advance the development of low cost, dual-color, high performance night vision detectors; and develop and test high quantum efficiency, high definition resonator quantum well IR photodetector QWIP (R-QWIP) detectors for longwave/midwave infrared (LWIR/MWIR) imaging.			
Title: Power and Energy ***Description:*** This effort designs and evaluates chemistries, materials and components for advanced batteries, fuel reformers, and fuel cells. Potential applications include hybrid power sources, smart munitions, hybrid electric vehicles, and Soldier power applications. Investigate applicability of photosynthesis to provide fuel and electricity for Soldier power applications. Investigate silicon carbide (SiC) power module components to enable compact high efficiency, high temperature, and high power density converters for motor drive and pulse power applications. ***FY 2013 Accomplishments:*** Designed and evaluated thin film battery devices for munitions; evaluated advanced alkaline membranes and catalysts with improved efficiency for alkaline fuel cells; evaluated catalyzed lithium (Li)-air battery reactions for faster charging and high current discharge; investigated and evaluated processes for synthetically generating energy through photosynthesis; evaluated device physics reliability issues (i.e. material defects, interface impedances) of wide bandgap devices; and investigated and characterized high frequency operation of wide bandgap devices and for new device material implementation in vehicle motor drives and pulse power applications. ***FY 2014 Plans:*** Evaluate thin film thermal batteries; experimentally validate computational models of hydroxyl-ion transport in alkaline membranes for alkaline fuel cells; evaluate lithium/sulfur battery chemistry for grid energy storage, investigate solid electrolyte interphase	4.961	5.083	3.954

Exhibit R-2A, RDT&E Project Justification: PB 2015 Army		Date: March 2014
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602705A / *ELECTRONICS AND ELECTRONIC DEVICES*	**Project (Number/Name)** H94 / *Elec & Electronic Dev*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
formation on Si anodes for Li ion batteries; demonstrate production of hydrogen gas using photosynthetic methods for alternative energy applications; continue to evaluate and characterize material defects and interface impedances using a diode structure to improve the reliability of electronic power devices; and investigate and characterize high frequency operation of silicon carbide devices for new device material implementation in vehicle motor drives and pulse power applications. ***FY 2015 Plans:*** Will transition thin film thermal batteries to U S. Army Armament Research, Development and Engineering Center (ARDEC) for augmented munitions power; determine transport properties of anion exchange polymers for alkaline fuel cells; investigate components for sodium (Na) ion batteries, optimize electrolyte composition for Si anodes for Li ion batteries, develop three dimensional (3-D) strategies for photosynthetic production of hydrogen (H2) for alternative energy applications; and experimentally validate models developed through the multiscale modeling effort for batteries and fuel cells; will investigate gallium nitride (GaN) material based devices in addition to SiC based Metal Oxide Semiconductor Field Effect Transistors (MOSFETs) for reliability and operability characterization.			
Title: Sensor Protection Technologies ***Description:*** This research will develop technologies to specifically address laser threats at different frequencies (IR, UV, etc.) and at a variety of pulse widths (pico-second, femto-second). This research will develop technologies to protect Army radars by agile spectrum exploitation, reconfigurable, high speed switching technology and by investigating novel RF power limiters and switching devices to protect RF front ends in contested environments as well as from self-interference challenges where multiple RF systems are operating in close proximity. ***FY 2015 Plans:*** Will investigate non-linear EO materials and devices for use in a broad range of sensors, UV, MWIR, and LWIR against very short pulse (down to femto-second) laser threats; investigate materials and novel devices to delay the onset of thermal destruction of optics and optical structures from high energy lasers; improve laser protection by exploring fast EO shutters, using inorganic crystal-based materials, in conjunction with device tiling with the goal of providing increased protection for large aperture sensors; and investigate novel electronic materials to support fast switching devices and power dissipation techniques to protect RF front ends.	-	-	2.000
Title: Energy Harvesting ***Description:*** This research develops technologies to substantially reduce the number of batteries required to operate electronics needed to accomplish dismounted Soldier/Squad mission objectives, significantly reducing Soldier-borne load and reducing logistics requirements. Research will explore technologies to harvest electrical power by converting and storing energy via engineered structures and electronic bandgaps, MEMS-based microscale power conversion and heterogenous 3D assembly of	-	-	1.500

Exhibit R-2A, RDT&E Project Justification: PB 2015 Army		Date: March 2014
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602705A / *ELECTRONICS AND ELECTRONIC DEVICES*	**Project (Number/Name)** H94 / *Elec & Electronic Dev*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
MEMS with other devices to enable efficient distributed power conversion. Research explores novel paths to local fuel and energy production, including artificial photosynthesis to extract hydrogen and electricity directly from water and sunlight. ***FY 2015 Plans:*** Will explore novel thermal photo-voltage devices to achieve high efficiency conversion considering available microcombustors and wavelength-optimized semiconductor devices; investigate plasmonic and meta-materials for enhanced surface catalysis experiments for enhanced energy harvesting from battlefield scavenged resources; explore options for reducing parasitic losses for military thermoelectrics; and examine pyroelectric materials and models to determine suitability for energy harvesting.			
Accomplishments/Planned Programs Subtotals	27.322	29.683	30.913

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

N/A