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ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)	DATE February 2000
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BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602120A Sensors and Electronic Survivability
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COST (In Thousands)	FY1999 Actual	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	16334	24850	20722	21994	23040	23432	24495	Continuing	Continuing
AH15 Ground Combat Identification Technology	3378	3330	3474	3555	3645	3883	4069	Continuing	Continuing
AH16 S3I Technology	10197	16553	14536	15155	16016	16038	16740	Continuing	Continuing
A140 High Power Microwave (HPM) Technology	2759	3005	2712	3284	3379	3511	3686	Continuing	Continuing
A142 Passive Millimeter Wave (MMW) Camera	0	1962	0	0	0	0	0	0	2000

A. Mission Description and Justification: The objectives of this program are: (1) to provide sensor, signal and information processing technology for advanced reconnaissance, surveillance, and target acquisition (RSTA), ground to ground and air to ground combat identification (ID), and fire control systems as well as the fuzing and guidance integrated fuzing functions in future munitions; and (2) to significantly improve the survivability, lethality and mobility/range of Future Combat Systems (FCS) through the development of high-power electronic components and technologies for compact, light-weight power and energy storage, conversion and conditioning, and RF/microwave directed energy (RF-DE) weapons. Three critical technologies are addressed to increase the combat effectiveness of tactical Army forces: (1) high power, solid-state/vacuum power/RF technology; (2) combat identification technology; (3) sensors, signatures, signal and information processing (S3I) technology. Work in this program element is consistent with the Army Science and Technology Master Plan (ASTMP) and the Army Force Modernization Plan.

B. Program Change Summary	<u>FY 1999</u>	<u>FY 2000</u>	<u>FY 2001</u>
Previous President's Budget (FY 2000/2001 PB)	16614	22978	23723
Appropriated Value	16895	24978	
Adjustments to Appropriated Value			
a. Congressional General Reductions	-281		
b. SBIR / STTR	-125		
c. Omnibus or Other Above Threshold Reductions		-57	
d. Below Threshold Reprogramming	-89		
e. Rescissions	-66	-71	
Adjustments to Budget Years Since (FY 2000/2001 PB)			-2001
New Army Vision/Transformation Adjustment		TBD	-1000
Current Budget Submit (FY 2001 PB)	16334	24850	20722

Change Summary Explanation: Funding – FY 01: Decrease due to reprogramming to higher priority activities and to reflect new Army Vision/Transformation.

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BUDGET ACTIVITY 2 - Applied Research				PE NUMBER AND TITLE 0602120A Sensors and Electronic Survivability				PROJECT AH15				
COST (In Thousands)				FY1999 Actual	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
AH15 Ground Combat Identification Technology				3378	3330	3474	3555	3645	3883	4069	Continuing	Continuing
<p>Mission Description and Justification: This program provides the enabling technology necessary for advanced Combat Identification (CI) concepts and systems for mission areas not considered to date. The hardware and software improvements and modeling and simulation advances provided by this project are essential to expand and build upon the midterm CI architecture. The operational impacts to be realized are reduced fratricide and a significant increase in combat effectiveness. CI is also strongly related to the Army's larger objective of Battlefield Digitization and synergistically supplements that effort by addressing the fusion of situational awareness (SA) and point-of-engagement target identification (TI).</p> <p>FY 1999 Accomplishments:</p> <ul style="list-style-type: none"> • 3378 - Successfully demonstrated technical and operational feasibility of Combat ID for Dismounted Soldier (CIDDS) with the Force XXI Land Warrior ensemble. <ul style="list-style-type: none"> - Assessed the technical risks for a ground vehicle-to-dismounted soldier ID system based on CIDDS. - Completed Phase 1 algorithm design and development phase of the Ground Integrated Target ID System (GITIS) Objective Ground to Ground target ID system. Performed operational analysis of concept with emphasis on Man-Machine Interface (MMI) concepts. - Developed Phase II high-fidelity ground simulator of GITIS (sensor fusion SA + TI). - Developed an ID concept based on SINCGARS SIP+ that allows the Fire Support Team (FIST) to ID vehicles before calling for indirect fire. - Completed Phase I Simulation Study of Combat Identification for Helicopters. <p>Total 3378</p> <p>FY 2000 Planned Program:</p> <ul style="list-style-type: none"> • 3245 - Conduct high-fidelity technical and operational evaluations of GITIS algorithms and simulators. <ul style="list-style-type: none"> - Perform technical field trials and operational trials of the SINCGARS SIP+ FIST with user participation. - Select CI solution for Helicopters and design hardware. - Develop Architecture Study to investigate emerging technologies. - Prepare SINCGARS SIP+ study to migrate to Advanced System Improvement Program (ASIP) radio. • 85 Small Business Innovative Research/Small Business Technology Transfer Programs (SBIR/STTR) <p>Total 3330</p>												
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<p>FY 2001 Planned Program:</p> <ul style="list-style-type: none"> • 3474 - Characterize GITIS technical and operational performance. - Characterize SINCGARS SIP + FIST technical and operational performance - Characterize technical performance of CI for Apache-Longbow. - Complete Architecture Study to determine and define emerging technologies. - Analyze results of SINCGARS SIP + /ASIP study. <p>Total 3474</p>		
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BUDGET ACTIVITY 2 - Applied Research				PE NUMBER AND TITLE 0602120A Sensors and Electronic Survivability				PROJECT AH16				
COST (In Thousands)				FY1999 Actual	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
AH16 S3I Technology				10197	16553	14536	15155	16016	16038	16740	Continuing	Continuing
<p>Mission Description and Justification: This project provides for the synergistic applied research for sensors; signal processors; sensor and information processing; and automatic target recognition (ATR) technology for reconnaissance, intelligence, surveillance, and target acquisition (RISTA), fire control, smart munitions and fuzing systems. In the RISTA and fire control area, the project will investigate: (1) advanced ultra wide band (UWB) radar technology for adverse weather, wide-area detection, location and recognition of tactical ground targets concealed in foliage, and buried mines; (2) innovative algorithms for the detection, discrimination, and classification of stationary targets from a low flying helicopter; (3) ATR algorithms that synergistically use outputs of forward looking infrared (FLIR), millimeter wave (MMW) radar and laser radar (LADAR) sensors to identify combat vehicles and perform signature predictions in many bands (infrared, visible, MMW, and LADAR) from targets and backgrounds at specified times, weather conditions and locations; (4) affordable, lightweight target acquisition radar technology for man-portable and battlefield platform applications; (5) advanced optical processing techniques to automatically process, at the sensor, the received signals into target information of sufficiently narrow bandwidth to be compatible with Army communications systems; (6) advanced battlefield sensor and information processing to conduct a dynamic and real time situation assessment to present a common picture of the battlespace to commanders; and (7) advanced information processing methods to provide automatic information technologies to enable commanders to utilize widely dispersed sensor and legacy information sources. Project goals in the smart munitions and fuzing area include advanced microwave, MMW, acoustic, electrostatic, and LADAR technologies to reliably sense low cross section targets in high countermeasures and clutter environments. These technologies support the FCS; Army Vision; and Advanced Technology Demonstrations/ Advanced Concept Technology Demonstrations (ATD/ACTD), DoD initiatives, and systems such as: Target Acquisition; Multi Function Staring Sensor Suite (MFS³); Warrior Extended Battlespace sensors (WEBS); Smart Sensor Webs; Raptor; Anti-personnel Landmine Alternative (APLA); Battlespace Command and Control; Joint Combat Identification; Rapid Battlefield Visualization; Longbow; advanced submunitions; standoff fuzing for anti-armor munitions; proximity fuzing; range finding for bursting munitions; smart mines; multi-option fuze for artillery; guided and unguided tank, mortar and artillery ammunition; and anti-aircraft applications including projectile and missile fuzing.</p> <p>FY 1999 Accomplishments:</p> <ul style="list-style-type: none"> • 1157 -Collected X-band radar signatures of kinetic energy (KE) rounds during live-fire tests for full spectrum active protection system (APS). -Completed fully polarimetric monopulse Ka-band instrumentation radar for high resolution inverse synthetic aperture radar (ISAR) measurements to support smart munitions sensor development. • 2129 -Integrated second-generation algorithms into ultra-wideband radar to detect land mines. -Established improved stationary target classification for real-beam radars. • 2811 -Designed optoelectronic processor interconnect circuit involving advanced CMOS drive circuits capable of some processing functions and VCSEL array interconnects. -Designed and fabricated infrared (IR) imaging acousto-optic tunable filter (AOTF) in support of hyperspectral imaging STO. -Characterized optical limiters for TARDEC applications. 												
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BUDGET ACTIVITY 2 - Applied Research		February 2000
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<p>FY 1999 Accomplishments: (continued)</p> <ul style="list-style-type: none"> <ul style="list-style-type: none"> -Improved ability to fabricate miniature lenses using subwavelength diffractive optical elements for high speed image processors. -Explored optimum conditions for invariant focusing via optical processing for Future Combat System (FCS) optical systems. <ul style="list-style-type: none"> 4100 -Determined an acoustic detection algorithm for multiple target identification. Developed body-worn sensor for soldier performance monitoring; developed capability for medic to interrogate soldiers remotely; evaluated mortar munition test firings to demonstrate capability to glide extended ranges in excess of 12km with a 120mm mortar munition; evaluated potential impact of magnetic sensors for unattended ground sensors. -Investigated concepts and tools for sensor fusion on unattended ground sensors. -Trained an ATR algorithm originally developed using 8-12 micron thermal emission phenomenology with 3-5 micron data and assessed performance. <p>Total 10197</p> <p>FY 2000 Planned Program:</p> <ul style="list-style-type: none"> <ul style="list-style-type: none"> 4056 -Evaluate field techniques for calibration of coherent fully polarimetric active and passive MMW target acquisition systems to provide increased situation awareness for the future network centric forces. -Evaluate performance of second-generation mine detection algorithms and performance of forward-looking vehicle mounted sensors for increased mobility and survivability of FCS. -Investigate impact of near and far field signatures on MMW target acquisition emulations and algorithm development for increased lethality of FCS. <ul style="list-style-type: none"> 2100 - Investigate visible imaging microsensor and IR imaging microsensor designs for WEBS. -Evaluate magnetic sensor capabilities for unattended ground sensors. <ul style="list-style-type: none"> 4281 - Investigate advanced acoustic target identification algorithms. - Investigate multi-target acoustic tracking for WEBS and MFS³. - Investigate a fused 3-5 micron and 8-12 micron ATR algorithm exploiting unique characteristics of each and assess performance. <ul style="list-style-type: none"> 3137 - Design high data rate, highly parallel opto-electronic interconnects. - Evaluate extended depth-of-field optical systems. - Investigate algorithm and processing architecture for hyperspectral imaging. - Investigate breadboard optical limiters for TARDEC applications. <ul style="list-style-type: none"> 2085 - Investigate techniques for the auto-rectification of submeter resolution sensor data for viewing in an integrated 2D / 3D environment. - Integrate (from AH48) intelligent system technology that compares, in the background, sensor information against user specified priority information requests and focuses user attention to the sensed information. - Integrate robust speech, natural language, and untethered gesture recognition research into multimodal computer interface modules. 		
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BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602120A Sensors and Electronic Survivability PROJECT AH16	
• 700	- Next- Generation Autonomous Vehicle Navigation Control System (AUTOVAV) (Partner: Germany): Continue design of an advanced autonomous vehicle navigation control system. Complete sub-system tests of obstacle detection, classification, and avoidance technologies.	
• 194	Small Business Innovative Research/Small Business Technology Transfer Programs (SBIR/STTR)	
Total	16553	
FY 2001 Planned Program:		
• 3546	-Validate second generation mine detection algorithms with plastic mines in new environments for increased mobility of FCS. -Extend functionality of MMW radar emulation to smart weapons like MMW Longbow Hellfire and Tank Extended Range Munitions (TERM) for increased lethality of FCS. -Apply calibration and image formation techniques to field tests to support Ka-Band vehicle mounted multifunction radio frequency sensor for increased survivability and lethality of FCS.	
• 2308	- Model and optimize hybrid diffractive optical elements (DOEs) on vertical cavity surface emitting lasers (VCSELs) and detectors for OE processing architectures. - Determine limitations of image formation and performance of various optical designs and processors.	
• 1300	-Design integrated acoustic/seismic/imaging microsensor network for WEBS. - Investigate sensor fusion concepts for acoustic/seismic/magnetic sensor. - Evaluate magnetic sensor capabilities in WEBS testbed.	
• 4856	- Determine advanced acoustic target identification algorithms with real targets. -Design first iteration of a multi-band spectral imager-based ATR algorithm compatible with land warfare scenarios.	
• 1996	- Validate performance of algorithms that will focus a commander's attention to critical sensor inputs and assist in synchronizing operations. - Validate performance of an integrated multimodal computer interface on-the-move control of ground station and Tactical Operations Center (TOC) displays. - Investigate if the use of submeter terrain will significantly enhance the operational utility of analytical tools that have been developed to assist a commander.	
• 530	- Next- Generation Autonomous Vehicle Navigation Control System (AUTOVAV) (Partner: Germany): Continue design of an advanced autonomous vehicle navigation control system. Complete sub-system tests of obstacle detection, classification, and avoidance technologies.	
Total	14536	
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ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)								DATE February 2000				
BUDGET ACTIVITY 2 - Applied Research				PE NUMBER AND TITLE 0602120A Sensors and Electronic Survivability				PROJECT A140				
COST (In Thousands)				FY1999 Actual	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
A140 High Power Microwave (HPM) Technology				2759	3005	2712	3284	3379	3511	3686	Continuing	Continuing
<p>Mission Description and Justification: The objective of this project is to significantly improve the survivability, lethality and mobility/range of Future Combat Systems (FCS) through the development of high-power electronic components and technologies for compact, light-weight power and energy storage, conversion and conditioning, and RF/microwave directed energy (RF-DE) weapons. This program is coordinated and, when appropriate, leveraged with RF-DE and power programs in the Air Force, Navy, Defense Special Weapons Agency, National Labs, University Consortia and relevant industry and foreign partners.</p> <p>FY 1999 Accomplishments:</p> <ul style="list-style-type: none"> • 2759 -Determined system design requirements for enhanced counter-air capability (ECAC) and conducted an electromagnetic compatibility (EMC) analysis of a counter-air weapon system in support of US Army Air Defense Artillery School (USADASC). <ul style="list-style-type: none"> -Conducted RF effects investigations & experiments on a fuze, forward looking infrared (FLIR) and a Global Positioning System (GPS) for TRADOC, CECOM RDEC, and Joint Live Fire Test & Evaluation (JLFT&E) office. -Completed the design of electromagnetic (EM) shielding components for the High Mobility Multipurpose Wheeled Vehicle (HMMWV) shelter for NRDEC. -Conducted research into new weapon systems with tunable capabilities for lethal, non-lethal, anti-personnel, and anti-materiel applications in support of ARDEC for the Army After 2010 and beyond. - Provided expertise to Army RDECs, PMs, DoD IG, TRADOC, and intelligence community regarding directed energy (DE) threat environments, effects, and hardening technology insertion. -Completed design of beam stick and output cavities for high average power broadband klystron amplifier and report on possibilities for size and weight reduction. -Conducted theoretical study of electron beam dynamics in linear beam tubes such as Reltron and klystron. -Completed full complement of linear beam design and simulation codes for high power vacuum electronics. -Designed a slotted waveguide array for use on Army platforms and field tests. -Conducted theoretical study of broadband klystron amplifiers for Army applications. -Validated benign and threat effects on Abrams and Longbow Apache information flow models, and transferred to CECOM's suite of System Performance Models. -Determined new test and simulation methods to study the effects and mitigation of RF-directed energy weapons (DEW) on military and commercial systems. 												
Total				2759								

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BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602120A Sensors and Electronic Survivability	PROJECT A140
FY 2000 Planned Program:		
<ul style="list-style-type: none"> • 2965 • 40 Total 3005 	<ul style="list-style-type: none"> - Conduct RF effects investigation and experiments of selected target(s) of interest to TRADOC, CECOM RDEC, and JLFT&E. - Conduct research into new RF-DEW components and systems with tunable capabilities for lethal, non-lethal, anti-personnel, and anti-materiel applications in support of ARDEC for the FCS. - Provide expertise to Army RDECs, PMs and TRADOC regarding DE threat environments, effects, and hardening technology insertion. - Investigate designs for size/weight reduction of high power linear beam tubes (e.g. Reltrons) for FCS platforms. - Complete designs for series of experimental Reltron linear beam tubes for improved lethality against electronic targets. - Investigate advanced designs for principal broadband amplifier components including diode, cavities, and beam stick. - Investigate advanced antennas and techniques for more compact, light-weight FCS applications. - Support RDEC demos and application studies. - Design and test high power solid-state power conversion/conditioning devices/technologies for hybrid/all electric drives and RF-DE, laser and EM/ETC gun loads for FCS. Small Business Innovative Research/Small Business Technology Transfer Programs (SBIR/STTR) 	
FY 2001 Planned Program:		
<ul style="list-style-type: none"> • 2712 Total 2712 	<ul style="list-style-type: none"> - Conduct research into new DEW components and systems with tunable capabilities for lethal, non-lethal, anti-personnel, and anti-materiel applications in support of ARDEC for the FCS. - Provide expertise to Army RDECs, PMs and TRADOC regarding DE threat environments, effects, and hardening technology insertion. - Complete first stage designs for size/weight reduction of linear high power beam tubes. - Construct experimental designs for series of broadband klystron amplifier experiments. - Design a high gain, broadband antenna or antenna system for high power FCS applications. - Support RDEC demos and application studies. - Design and test high power solid-state power conversion/conditioning devices/technologies for hybrid/all electric drives and RF-DE, laser and electric gun loads for FCS. 	
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BUDGET ACTIVITY 2 - Applied Research	PE NUMBER AND TITLE 0602120A Sensors and Electronic Survivability	PROJECT A142
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COST (In Thousands)	FY 1999 Actual	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
A142 Passive Millimeter Wave (MMW) Camera	0	1962	0	0	0	0	0	0	2000

Mission Description and Justification: This is a Congressionally funded program; not part of the Army's core mission. This is a development technology program for a passive/active MMW imaging system to demonstrate its performance capabilities as a covert all-weather surveillance and target acquisition system. Funding is provided to perform research on enabling MMW technologies in support of passive/active MMW imaging. These funds have been provided to the Army Research Lab as a result of Congressional interest for the development of a Passive MMW Camera (PMC).

FY 1999 Accomplishments: Project not funded in FY 1999.

FY 2000 Planned Program:

- 1909 - Establish a better thermal resolution and wider field of view version of the PMC that will be lightweight, low-cost and flightworthy for performing radio-silent navigation and landing, reconnaissance, and search and rescue under conditions of clouds and fog.
- 53 Small Business Innovative Research/Small Business Technology Transfer Programs (SBIR/STTR)

Total 1962

FY 2001 Planned Program: Project not funded in FY 2001.