

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

February 2000

BUDGET ACTIVITY

03 - Advanced Technology Development

PE NUMBER AND TITLE

0603203F Advanced Aerospace Sensors

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
Total Program Element (PE) Cost	26,260	37,948	28,311	29,714	26,107	25,269	27,389	Continuing	TBD
63665A Advanced Aerospace Sensors Technology	12,681	12,615	14,601	16,013	11,765	10,572	12,384	Continuing	TBD
6369CK Advanced Electronics	1,461	811	0	0	0	0	0	Continuing	TBD
6369DF Target Attack and Recognition Technology	12,118	24,522	13,710	13,701	14,342	14,697	15,005	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0

Note: In FY 2001, work performed under Project 6369CK and in PE 0603726F, Project 632863 moves to Project 63665A.

(U) A. Mission Description

This program develops technology to enable continued sensors superiority from space and aerial platforms. It develops and demonstrates the means to find, fix, target, track, and engage air and ground targets anytime, anywhere, and in any weather. Specifically, this program develops aerospace radio frequency (i.e., radar) and electro-optical sensors for detecting, locating, and targeting airborne, fixed, and time-critical mobile ground targets (whether those targets are obscured by natural or man-made means) while providing the capability to adapt to changes in target signatures and background environments. It also develops technology to enable combat aircraft to defeat increasingly sophisticated active and passive countermeasures, destroy a wide variety of targets with precision under a myriad of environmental conditions, and reliably perform complex missions with less logistics support in a world of proliferating threats. These advanced sensor capabilities will provide for flexible, multi-function/multi-mission combat aircraft that can: safely penetrate threat areas; destroy multiple ground targets per pass; accurately detect and identify targets beyond-visual-range within a complex mix of look-alike friendly, neutral, and enemy aircraft; win aerial engagements; and return to fight again. Note: In FY 2000, Congress added \$2.3 million for Airborne Ground Radar Imaging and \$9.0 million for the Integrated Demonstrations and Applications Laboratory.

(U) B. Budget Activity Justification

This program is in Budget Activity 3, Advanced Technology Development, since it develops and demonstrates technologies for existing system upgrades and/or new sensor and electronic combat system developments that have military utility and address warfighter needs.

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(U) C. Program Change Summary (\$ in Thousands)

	<u>FY 1999</u>	<u>FY 2000</u>	<u>FY 2001</u>	<u>Total Cost</u>
(U) Previous President's Budget (FY 2000 PBR)	28,534	29,405	32,330	
(U) Appropriated Value	28,642	38,405		
(U) Adjustments to Appropriated Value				
a. Congressional/General Reductions	-108	-2		
b. Small Business Innovative Research	-780			
c. Omnibus or Other Above Threshold Reprogram		-208		
d. Below Threshold Reprogram	-1,347			
e. Rescissions	-147	-247		
f. Other				
(U) Adjustments to Budget Years Since FY 2000 PBR			-4,019	
(U) Current Budget Submit/FY 2001 PBR	26,260	37,948	28,311	TBD

(U) Significant Program Changes:

Changes to this program since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) program.

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BUDGET ACTIVITY 03 - Advanced Technology Development				PE NUMBER AND TITLE 0603203F Advanced Aerospace Sensors				PROJECT 63665A		
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
63665A	Advanced Aerospace Sensors Technology	12,681	12,615	14,601	16,013	11,765	10,572	12,384	Continuing	TBD
<p>(U) <u>A. Mission Description</u> Develops and demonstrates aerospace sensor technologies for manned and unmanned platforms, including electro-optical (EO) sensors, radar sensors, components and algorithms, and electronic counter-countermeasures (ECCM) for radars. This project will provide aerospace platforms with the capability to precisely detect and target both airborne (conventional and low radar cross section) and ground-based, high-value, time-critical targets. Work includes developing both complete sensor capabilities as well as advanced component technologies. Desired warfighting capabilities include the ability to detect and target in difficult background conditions, especially the ability to counter improvements in camouflage, concealment, and deception techniques.</p> <p>(U) <u>FY 1999 (\$ in Thousands)</u></p> <p>(U) \$4,321 Developed integrated EO sensor technologies to detect, locate, and identify targets at ranges longer than currently achievable, whether the targets are camouflaged, low-observable, or employing other means of deception. Fabricated an EO sensor that operates in day or night across multiple bands.</p> <p>(U) \$1,482 Developed and demonstrated radar electronic counter-countermeasure techniques to negate air intercept and synthetic aperture radar electronic countermeasures. Assessed use of neural nets to identify and remove jamming waveforms.</p> <p>(U) \$2,743 Developed processing techniques to negate clutter and electromagnetic interference for uninterrupted sensor performance and increased detection and targeting performance against sophisticated and low radar cross section targets. Conducted laboratory and rooftop demonstrations of advanced mitigation techniques for severe interference and jamming environments.</p> <p>(U) \$3,253 Developed the radio frequency (RF) sensor and algorithm technology required to detect, identify, and target high-value, time-critical targets obscured by foliage or concealed through deception, including ground testing real-time image formation/interference mitigation for foliage penetrating synthetic aperture radars.</p> <p>(U) \$882 Developed critical components required to lower life cycle cost of current and future radar systems. Flight tested an affordable antenna suitable for unmanned vehicles.</p> <p>(U) \$12,681 Total</p>										
Project 63665A		Page 3 of 11 Pages				Exhibit R-2A (PE 0603203F)				

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)		DATE
BUDGET ACTIVITY		PROJECT
03 - Advanced Technology Development	0603203F Advanced Aerospace Sensors	February 2000 63665A
(U)	<u>A. Mission Description Continued</u>	
(U)	<u>FY 2000 (\$ in Thousands)</u>	
(U)	\$1,679	Develop integrated electro-optical (EO) sensor technologies to search, detect, locate, and identify targets at ranges longer than currently achievable, whether the targets are camouflaged, low-observable, or employing other means of deception. Complete fabrication and initiate flight test of an EO sensor that operates in day or night across multiple bands.
(U)	\$2,236	Develop EO sensor technologies to detect and locate deep hide targets from high altitudes. Collect infrared sensor model validation data. Create hyperspectral imaging/fusion algorithms.
(U)	\$2,183	Develop radar signal processing techniques to mitigate clutter and interference and improve detection and tracking of difficult targets. Develop adaptive processing for fighter detection of low-observable targets, demonstrating improved radar performance via enhanced antenna implementation. Develop integrated processing methods for improved ground target detection and tracking.
(U)	\$3,398	Develop radio frequency (RF) sensor and algorithm technology required to detect, identify, and target high-value, time-critical targets obscured by foliage or obscured by deceptive techniques. Flight test image formation processing and automatic target detection.
(U)	\$1,555	Develop technology to lower life cycle costs of radar systems. Laboratory test low-cost digital receivers and sensor components. Evaluate space-based apertures using micro-electro-mechanical phase shifters. Demonstrate a millimeter wave array for high-altitude unmanned aerial vehicles
(U)	\$1,564	Develop technology for non-cooperative target identification. Build high resolution algorithms. Validate models. Flight test sensor hardware. Evaluate laser vibration as a solution to target identification.
(U)	\$12,615	Total
(U)	<u>FY 2001 (\$ in Thousands)</u>	
(U)	\$1,915	Develop integrated EO sensor technology to search, detect, locate and identify air and ground targets at ranges longer than currently achievable, whether the targets are camouflaged, low-observable, or employing other means of deception. Optimize sensor design and perform utility assessments for affordable integrated targeting capability.
(U)	\$3,320	Develop EO sensor technologies to detect and locate camouflaged and concealed targets for aerospace intelligence, surveillance, and reconnaissance applications. Complete critical signature data collection experiments to determine performance parameters for day/night hyperspectral sensors. Fabricate a hyperspectral imaging sensor for high altitude reconnaissance aircraft.
(U)	\$1,908	Develop advanced radar signal processing techniques to mitigate clutter and jamming interference and improve detection and tracking of difficult targets. Demonstrate ability to detect slow moving airborne and ground targets from an airborne platform.
(U)	\$2,470	Develop and demonstrate the radio frequency sensor and algorithm technology required to detect, identify, and target high-value, time-critical targets obscured by foliage or concealed through deceptive techniques. Perform flight test demonstration of foliage penetration radio frequency (RF) sensor and real-time image formation algorithms.
Project 63665A		Exhibit R-2A (PE 0603203F)

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BUDGET ACTIVITY 03 - Advanced Technology Development		PE NUMBER AND TITLE 0603203F Advanced Aerospace Sensors
		PROJECT 63665A
(U)	<u>A. Mission Description Continued</u>	
(U)	<u>FY 2001 (\$ in Thousands) Continued</u>	
(U)	\$874	Develop technology to lower life cycle costs of radar systems. Develop low-cost, lightweight antennas using micro-electro-mechanical phase shifters for aerospace surveillance and strike radar applications.
(U)	\$2,180	Develop advanced electro-optical sensor technology for non-cooperative target identification. Flight test eye-safe sensor. Perform necessary modifications prior to sensor transition.
(U)	\$825	Develop advanced multi-function sensor component technologies for radar, electronic warfare, navigation, and communications applications. Demonstrate and evaluate affordable, high performance RF circuits and packaging technologies for use in phased array transmit/receive modules on manned and unmanned platforms. (In FY 2000, this work was performed in Project 6369CK)
(U)	\$1,109	Develop advanced RF photonic signal control and distribution technologies for phased array apertures. Demonstrate and evaluate photonic beamforming. Design and fabricate true-time-delay photonic technology for phased array antennas used in intelligence, surveillance, and reconnaissance applications. (In FY 2000, this effort was conducted under PE 0603726F, Project 632863.)
(U)	\$14,601	Total
(U)	<u>B. Project Change Summary</u> Not Applicable.	
(U)	<u>C. Other Program Funding Summary (\$ in Thousands)</u>	
(U)	Related Activities: PE 0602204F, Aerospace Sensors. PE 0603205F, Flight Vehicle Technology. PE 0603707F, Weather Systems Advanced Development. PE 0602111N, Weapons Technology. PE 0602232N, Space and Electronic Warfare (SEW) Technology. PE 0604249F, LANTIRN Night Precision Attack. PE 0603270F, Electronic Combat Technology. A memorandum of agreement has been established between the Air Force Research Laboratory and the Defense Advanced Research Projects Agency (DARPA) to jointly develop the technology required to detect high-value, time-critical targets in a variety of environments including deception, camouflage, concealment, and deep hide. This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.	
Project 63665A		Exhibit R-2A (PE 0603203F)

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BUDGET ACTIVITY 03 - Advanced Technology Development	PE NUMBER AND TITLE 0603203F Advanced Aerospace Sensors	PROJECT 63665A
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- (U) **D. Acquisition Strategy**
Not Applicable.
- (U) **E. Schedule Profile**
- (U) Not Applicable.

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BUDGET ACTIVITY 03 - Advanced Technology Development				PE NUMBER AND TITLE 0603203F Advanced Aerospace Sensors				PROJECT 6369CK		
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
6369CK	Advanced Electronics	1,461	811	0	0	0	0	0	Continuing	TBD
<p>(U) <u>A. Mission Description</u> Develops and demonstrates military specific microwave, microelectronic, and photonic devices, tools, and components to improve performance, reliability, and affordability of aerospace radar, communications, and electronic counter-countermeasure systems for both retrofit and new system applications. Results provide the warfighter with improved sensor capabilities in terms of increased situational awareness, higher accuracy detection and tracking of targets and threats at longer ranges, and more precise weapon employment. This project develops electronics technologies unavailable from commercial sources and includes development of: aerospace radar monolithic solid state transmit/receive modules; high-speed analog-to-digital converters; photonic processing techniques; high reliability electronics power distribution; microwave and microelectronics packaging and interconnect techniques; and radio frequency (RF) photonic distribution subsystems.</p> <p>(U) <u>FY 1999 (\$ in Thousands)</u> (U) \$1,461 Developed advanced multi-function sensor electronics, including integrated analog/digital applications, to increase reliability, improve performance and jam resistance, and decrease cost, weight, and volume in aerospace sensors. Developed very high-speed digital assemblies. Fabricated and tested high performance RF/digital multichip assemblies. Completed preliminary designs for miniature, all-digital microwave receiver components. (U) \$1,461 Total</p> <p>(U) <u>FY 2000 (\$ in Thousands)</u> (U) \$456 Develop advanced multi-function sensor electronics. Develop affordable, high performance radio frequency circuits and packaging technologies for use in phased array transmit/receive modules on manned and unmanned platforms. (U) \$355 Perform application trade studies for space-based photonics RF signal distribution, including photonic beamforming for Global Positioning System (GPS) applications. (U) \$811 Total</p> <p>(U) <u>FY 2001 (\$ in Thousands)</u> (U) \$0 Effort transferred to Project 63665A. (U) \$0 Total</p> <p>(U) <u>B. Project Change Summary</u> Not Applicable.</p>										
Project 6369CK			Page 7 of 11 Pages				Exhibit R-2A (PE 0603203F)			

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BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
03 - Advanced Technology Development	0603203F Advanced Aerospace Sensors	6369CK
<p>(U) <u>C. Other Program Funding Summary (\$ in Thousands)</u></p> <p>(U) Related Activities:</p> <p>(U) PE 0602204F, Aerospace Sensors.</p> <p>(U) PE 0603270F, Electronic Combat Technology.</p> <p>(U) PE 0603739E, Electronic Manufacturing Technology.</p> <p>(U) PE 0603706E, Microwave/Millimeter Wave Integrated Circuits.</p> <p>(U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.</p> <p>(U) <u>D. Acquisition Strategy</u></p> <p>Not Applicable.</p> <p>(U) <u>E. Schedule Profile</u></p> <p>(U) Not Applicable.</p>		

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BUDGET ACTIVITY 03 - Advanced Technology Development				PE NUMBER AND TITLE 0603203F Advanced Aerospace Sensors				PROJECT 6369DF	
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
6369DF Target Attack and Recognition Technology	12,118	24,522	13,710	13,701	14,342	14,697	15,005	Continuing	TBD
<p>(U) <u>A. Mission Description</u> Develops and demonstrates advanced technologies for attack management, fire control, and target identification and recognition. This includes developing and demonstrating integrated and cooperative fire control techniques to provide for adverse-weather precision air strikes against multiple targets per pass and at maximum weapon launch ranges. Specific fire control technologies under development include attack management, sensor fusion, automated decision aids, advanced tracking for low radar cross section threats, and targeting using both on-board and off-board sensor information. This project also evaluates targeting techniques to support theater missile defense efforts in surveillance and attack. These fire control technologies will provide force multiplication and reduce warfighter exposure to hostile fire. This project also develops and demonstrates target identification and recognition technologies for positive, high confidence cueing, recognition, and identification of airborne and ground-based, high-value, time-critical targets at longer ranges than are currently possible. The goal is to apply these technologies to tactical air-to-air and air-to-surface weapon systems so they are able to operate in all weather conditions, during day or night, and in high-threat, multiple target environments. Model-based vision algorithms and target signature development techniques are the key to target identification and recognition. This project is maturing these technologies in partnership with the Defense Advanced Research Projects Agency and evaluating the techniques to support theater missile defense efforts in surveillance and attack. Fire control and recognition technologies developed and demonstrated in this project are high leverage efforts, providing for significant advancements in operational capabilities largely through software improvements readily transitionable to new and existing weapon systems.</p>									
<p>(U) <u>FY 1999 (\$ in Thousands)</u></p>									
(U) \$1,932	Developed and demonstrated advanced air-to-air detection, tracking, identification, and engagement technologies. Investigated advanced sensors suites. Analyzed ground test data for target identification through combined radar modes.								
(U) \$5,290	Developed advanced situation awareness technologies to increase air-to-ground engagement lethality and survivability. Demonstrated multisource fusion of electronic intelligence with synthetic aperture radar (SAR). Flight demonstrated real-time rerouting of a low-observable platform using real-time information-in-the-cockpit technology. Developed and flight tested fusion of forward looking infrared and SAR data on an interdiction fighter.								
(U) \$4,896	Develop and demonstrate innovative air-to-ground automatic target recognition (ATR) and identification technologies to increase the ability to detect, identify, and target hostile ground forces. Developed and integrated an ATR/fusion algorithm testbed. Downselected and integrated an optimal algorithm for the longer timelines of reconnaissance radars. Performed detailed analysis of air-to-ground ATR algorithms using enhanced radar with third-generation forward looking infrared and multispectral automatic target recognition (ATR). Demonstrated the identification of friendly and hostile ground forces.								
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BUDGET ACTIVITY		PROJECT
03 - Advanced Technology Development	0603203F Advanced Aerospace Sensors	February 2000 6369DF
(U) <u>A. Mission Description Continued</u>		
(U) <u>FY 1999 (\$ in Thousands) Continued</u>		
(U) \$12,118	Total	
(U) <u>FY 2000 (\$ in Thousands)</u>		
(U) \$2,661	Develop advanced situation awareness technologies for rapid detection, location, and prosecution of time-critical targets. Demonstrate ground station fusion of synthetic aperture radar and signals intelligence. Develop on-board/off-board data and image fusion algorithms.	
(U) \$2,909	Develop and demonstrate real-time information-in-the-cockpit technologies. Flight demonstrate and simulate real-time route replanning and retargeting for stealth strike platforms. Develop real-time retargeting algorithms for special operation forces.	
(U) \$1,539	Develop and evaluate radar ATR algorithms for tracking moving ground targets. Evaluate radar algorithms for tracking moving ground target. Reduce transition risk by planning affordable upgrades to strike and reconnaissance platforms.	
(U) \$1,176	Develop target recognition concepts using hyperspectral imaging and other candidate sensor inputs to determine requirements for ATR and target/background phenomenology efforts. Build algorithms using hyperspectral imaging data.	
(U) \$2,966	Test and integrate Defense Advanced Research Projects Agency multi-sensor ATR fusion algorithms into the Air Force ATR evaluation test facility for application to Air Force intelligence, surveillance, and reconnaissance functions.	
(U) \$2,041	Develop advanced tactical targeting technology in conjunction with Defense Advanced Research Projects Agency for suppression of enemy air defenses. Conduct hardware-in-the-loop testing against threat radio frequency signals.	
(U) \$2,262	Develop air-to-ground radar imaging technology for all-weather detection and identification of ground targets.	
(U) \$8,968	Develop integrated demonstrations and applications laboratory testbed for maturing aerospace sensor technologies through hardware-in-the-loop simulation. Create the capability to generate high fidelity emissions that simulate real battlespace threat systems, allowing warfighters to affordably evaluate sensor technologies under realistic combat conditions.	
(U) \$24,522	Total	
(U) <u>FY 2001 (\$ in Thousands)</u>		
(U) \$2,113	Develop advanced situation awareness technologies for rapid detection, location, and prosecution of time-critical targets. Demonstrate algorithms for multisensor fusion of on- and off-board data and images.	
(U) \$2,857	Develop and demonstrate technologies for real-time information in- and out-of-the-cockpit for improved situational awareness. Complete route replanning simulations. Continue to develop real-time retargeting algorithms for special operation forces applications.	
(U) \$1,820	Develop and evaluate radar automatic target recognition (ATR) algorithms for tracking and identifying moving and stationary ground targets. Conduct risk reduction activities to improve affordability and smooth transition of technology via planned sensor upgrades to strike and reconnaissance platforms.	
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BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
03 - Advanced Technology Development	0603203F Advanced Aerospace Sensors	6369DF
<p>(U) <u>A. Mission Description Continued</u></p> <p>(U) <u>FY 2001 (\$ in Thousands) Continued</u></p> <p>(U) \$1,146 Develop target recognition concepts using hyperspectral imaging data and other candidate sensor inputs to determine requirements for ATR and target/background phenomenology efforts. Evaluate algorithms using hyperspectral imaging data.</p> <p>(U) \$2,600 Continue testing and integrating Defense Advanced Research Projects Agency (DARPA) multi-sensor automatic target recognition fusion algorithms into the Air Force ATR evaluation test facility for application to Air Force intelligence, surveillance, and reconnaissance missions.</p> <p>(U) \$3,174 Develop advanced tactical targeting technology in conjunction with DARPA for suppression of enemy air defenses. Optimize targeting algorithms and techniques. Modify brassboard units that triangulate threat emitter position and provide targeting for precision guided munitions.</p> <p>(U) \$13,710 Total</p> <p>(U) <u>B. Project Change Summary</u> Not Applicable.</p> <p>(U) <u>C. Other Program Funding Summary (\$ in Thousands)</u></p> <p>(U) Related Activities:</p> <p>(U) PE 0602204F, Aerospace Sensors.</p> <p>(U) PE 0603253F, Advanced Sensor Integration.</p> <p>(U) PE 0603762E, Sensor and Guidance Technology.</p> <p>(U) Theater Missile Defense System Program Office.</p> <p>(U) Low Altitude Night Targeting and Infrared Navigation (LANTIRN) System Program Office.</p> <p>(U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.</p> <p>(U) <u>D. Acquisition Strategy</u> Not Applicable.</p> <p>(U) <u>E. Schedule Profile</u></p> <p>(U) Not Applicable.</p>		
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