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**Exhibit R-2, RDT&E Budget Item Justification:** PB 2021 Air Force **Date:** February 2020

<b>Appropriation/Budget Activity</b>					<b>R-1 Program Element (Number/Name)</b>							
3600: <i>Research, Development, Test &amp; Evaluation, Air Force I BA 4: Advanced Component Development &amp; Prototypes (ACD&amp;P)</i>					PE 0604201F / PNT Resiliency, Mods, and Improvements							
<b>COST (\$ in Millions)</b>	<b>Prior Years</b>	<b>FY 2019</b>	<b>FY 2020</b>	<b>FY 2021 Base</b>	<b>FY 2021 OCO</b>	<b>FY 2021 Total</b>	<b>FY 2022</b>	<b>FY 2023</b>	<b>FY 2024</b>	<b>FY 2025</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
Total Program Element	-	86.445	124.600	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	211.045
641030: <i>GPS Receiver Development</i>	-	86.445	124.600	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	211.045

**A. Mission Description and Budget Item Justification**

PE 0604201F, Project 641030 covers the research, development, qualification, and testing of Enhanced Anti-Jam (EAJ) Military Code (M-Code) Global Positioning System (GPS) receivers for Air Force and joint weapon systems. This includes updates to weapon mission planning software to support new M-Code and EAJ receiver development. These acquisitions will enable the Air Force to increase its operational Position, Navigation, and Timing (PNT) resiliency while satisfying the DoD and civil mandates. Fielding of EAJ M-Code weapons requires the research, development, qualification and testing of M-Code receivers across the Air Force Program Executive Officer (AFPEO) Weapons Portfolio. Funds may be used to address emerging and short notice Diminishing Manufacturing Sources and Material Shortages (DMSMS) issues.

This program element may include necessary civilian pay expenses required to manage, execute, and deliver M-Code GPS receiver capabilities. The use of such program funds would be in addition to the civilian pay expenses budgeted in program element 0605831F.

This requirement supports performance of a full financial audit as required by title 10 U.S.C. Chapter 9A, Sec 240-D.

This effort is in Budget Activity 4, Advanced Component Development and Prototypes (ACD&P), because efforts are necessary to evaluate integrated technologies, representative modes or prototype systems in a high fidelity and realistic operating environment.

<b>B. Program Change Summary (\$ in Millions)</b>	<b>FY 2019</b>	<b>FY 2020</b>	<b>FY 2021 Base</b>	<b>FY 2021 OCO</b>	<b>FY 2021 Total</b>
Previous President's Budget	81.271	92.600	0.000	0.000	0.000
Current President's Budget	86.445	124.600	0.000	0.000	0.000
Total Adjustments	5.174	32.000	0.000	0.000	0.000
• Congressional General Reductions	0.000	0.000			
• Congressional Directed Reductions	0.000	0.000			
• Congressional Rescissions	0.000	0.000			
• Congressional Adds	0.000	32.000			
• Congressional Directed Transfers	0.000	0.000			
• Reprogrammings	8.000	0.000			
• SBIR/STTR Transfer	-2.826	0.000			
• Other Adjustments	0.000	0.000	0.000	0.000	0.000

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**Congressional Add Details (\$ in Millions, and Includes General Reductions)**

**Project:** 641030: *GPS Receiver Development*

Congressional Add: *Program Increase - M-Code EAJ*

Congressional Add Subtotals for Project: 641030

Congressional Add Totals for all Projects

	FY 2019	FY 2020
	-	32.000
	-	32.000
	-	32.000

**Change Summary Explanation**

FY 2019 increase of \$8.0M due to a below threshold reprogramming for M-Code weapons receiver development and a decrease of -\$2.156M for Small Business Innovative Research (SBIR).

FY 2020 Congressional Add of \$32M for M Code EAJ

**UNCLASSIFIED**

<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2021 Air Force										<b>Date:</b> February 2020		
<b>Appropriation/Budget Activity</b> 3600 / 4					<b>R-1 Program Element (Number/Name)</b> PE 0604201F / PNT Resiliency, Mods, and Improvements				<b>Project (Number/Name)</b> 641030 / GPS Receiver Development			
<b>COST (\$ in Millions)</b>	<b>Prior Years</b>	<b>FY 2019</b>	<b>FY 2020</b>	<b>FY 2021 Base</b>	<b>FY 2021 OCO</b>	<b>FY 2021 Total</b>	<b>FY 2022</b>	<b>FY 2023</b>	<b>FY 2024</b>	<b>FY 2025</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
641030: GPS Receiver Development	-	86.445	124.600	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	211.045
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

**A. Mission Description and Budget Item Justification**

This munitions receiver development project includes development of a GPS M-code receiver with EAJ and analysis efforts. M-code receivers with EAJ provide advanced positioning, navigation, and timing (PNT) capabilities required for weapons to operate in adversarial anti-access/area denial (A2/AD) environments. M-Code receivers with EAJ also provide increased accuracy, better signal acquisition, and advanced security.

M-code receivers with EAJ capability assures continued weapon system precision and lethality.

Fielding EAJ M-Code weapons requires the research, development, qualification, testing, and mission planning of M-Code receivers across the Weapons Portfolio. This will include all systems, subsystems, software, fuzing, and support activities associated with the development and implementation of M-Code receivers.

This program element may include necessary civilian pay expenses required to manage, execute, and deliver M-Code GPS receiver capabilities. The use of such program funds would be in addition to the civilian pay expenses budgeted in program elements 0605831F.

**B. Accomplishments/Planned Programs (\$ in Millions)**

	<b>FY 2019</b>	<b>FY 2020</b>	<b>FY 2021</b>
<b>Title:</b> M-Code EAJ	86.445	92.600	0.000
<b>Description:</b> M-Code/EAJ receivers provide an enhanced anti-jam capability. M-Code/EAJ receivers provide the capability to operate in increasing adversarial A2/AD jamming environment. M-Code/EAJ receivers also provide increased accuracy, better signal acquisition, and advanced security.			
<b>FY 2020 Plans:</b> Conduct research, development, qualification, and testing of M-Code/EAJ receivers across the AFPEO Weapons portfolio.			
<b>FY 2021 Plans:</b> N/A			
<b>FY 2020 to FY 2021 Increase/Decrease Statement:</b> Funding decreased in accordance with planned development activities.			
<b>Accomplishments/Planned Programs Subtotals</b>	86.445	92.600	0.000

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**Exhibit R-2A, RDT&E Project Justification:** PB 2021 Air Force **Date:** February 2020

<b>Appropriation/Budget Activity</b> 3600 / 4	<b>R-1 Program Element (Number/Name)</b> PE 0604201F / PNT Resiliency, Mods, and Improvements	<b>Project (Number/Name)</b> 641030 / GPS Receiver Development
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	FY 2019	FY 2020
<b>Congressional Add:</b> Program Increase - M-Code EAJ	-	32.000
<b>FY 2020 Plans:</b> Funds M-Code GPS receiver development for five munitions manufactured by three different contractors. Develop and test Strategic Anti-Jam Beamforming Receiver-Modernized (SABR-M) receiver prototype, continue design and development of High Anti-Jam Miniature M-Code Enhanced Receiver (HAMMER), and support design of JASSM Anti-Jam GPS Receiver (JAGR) M-Code capability.		
<b>Congressional Adds Subtotals</b>	-	32.000

**C. Other Program Funding Summary (\$ in Millions)**

Line Item	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
• RDTE 07 0207325F: <i>Joint Air-to-Surface Standoff Missile (JASSM)</i>	4.073	0.000	0.000	-	0.000	0.000	-	-	-	0.000	4.073
• RDTE 05 PE 0604329F, BPAC 655191: <i>SDB Increment II</i>	25.911	11.439	11.340	-	11.340	0.000	-	-	-	0.000	48.690
• RDTE 05 0604602F: <i>Armament/Ordnance Development</i>	4.469	-	-	-	-	-	-	-	-	0.000	4.469
• RDTE 04 PE 0604327F, BPAC 645341: <i>Direct Strike Penetrators</i>	4.500	0.000	2.150	-	2.150	-	-	-	-	0.000	6.650
• RDTE 05 0604618F: <i>Joint Direct Attack Munition</i>	-	-	7.926	-	7.926	-	-	-	-	0.000	7.926

**Remarks**

**D. Acquisition Strategy**

M-Code/EAJ effort uses a family of systems approach where the three prime weapons contractors develop receivers capable of operating in any of their Air Force weapons. The receivers are based on a common, internally-developed interface requirements specification (IRS), technology requirement document (TRD), and threat scenarios. This approach uses a combination of contract types based on acquisition phase (Technology Maturation & Risk Reduction (TMRR), Development, Production) and risk. The weapons system program offices share a common development program element (PE) to allow flexibility in funding and planning, switching to individual PEs for receiver integration, operational testing, and production. The M-Code/EAJ Weapons Receiver Development effort leverages technology currently under development by the Military GPS User Equipment (MGUE) program and will provide the warfighter with unmatched capability to operate in future A2/AD environments.

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Exhibit R-3, RDT&E Project Cost Analysis: PB 2021 Air Force												Date: February 2020			
Appropriation/Budget Activity				R-1 Program Element (Number/Name)				Project (Number/Name)							
3600 / 4				PE 0604201F / PNT Resiliency, Mods, and Improvements				641030 / GPS Receiver Development							
Product Development (\$ in Millions)				FY 2019		FY 2020		FY 2021 Base		FY 2021 OCO		FY 2021 Total	Cost To Complete	Total Cost	Target Value of Contract
Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	Cost	Award Date	Cost	Award Date	Cost	Award Date	Cost	Award Date	Cost			
Common Weapons M-Code Receiver Development (SDB II)	Various	Raytheon : Tucson, AZ	-	29.772	Jan 2019	43.600	Oct 2019	-		-		-	0.000	73.372	-
Common Weapons M-Code Receiver Development (CAAP ASIC)	MIPR	DMEA/Global Foundries : Hopewell Junction, NY	-	6.230	Feb 2019	9.700	May 2020	-		-		-	0.000	15.930	-
Common Weapons M-Code Receiver Development (JDAM/MOP/ SDB I Phase II)	Various	Boeing : St Louis, MO	-	12.518	Feb 2019	24.100	Oct 2019	-		-		-	0.000	36.618	-
Common Weapons M-Code Receiver Development (AJ ASIC)	Various	Collins Aerospace : Cedar Rapids, IA	-	6.511	Feb 2019	6.400	Feb 2020	-		-		-	0.000	12.911	-
Common Weapons M-Code Receiver Development (AJ ASIC/ MIPR)	Various	DMEA/Global Foundries : Hopewell Junction, NM	-	4.000	Feb 2019	6.000	Oct 2019	-		-		-	0.000	10.000	-
Common Weapons M-Code Receiver Development (Pre-EMD JASSM)	Various	Lockheed Martin : Orlando, FL	-	5.700	Nov 2018	7.100	Oct 2019	-		-		-	0.000	12.800	-
Common Weapons M-Code Receiver Development (JASSM C+ + Phase II)	Various	Lockheed Martin : Orlando, FL	-	5.300	Nov 2018	6.900	Oct 2019	-		-		-	0.000	12.200	-
Common Weapons M-Code Receiver Development (JASSM MCU)	Various	Lockheed Martin : Orlando, FL	-	13.879	Feb 2019	18.800	Oct 2019	-		-		-	0.000	32.679	-
<b>Subtotal</b>			-	83.910		122.600		-		-		-	0.000	206.510	N/A



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<b>Exhibit R-4, RDT&amp;E Schedule Profile: PB 2021 Air Force</b>		<b>Date:</b> February 2020
<b>Appropriation/Budget Activity</b> 3600 / 4	<b>R-1 Program Element (Number/Name)</b> PE 0604201F / <i>PNT Resiliency, Mods, and Improvements</i>	<b>Project (Number/Name)</b> 641030 / <i>GPS Receiver Development</i>

	FY 2019				FY 2020				FY 2021				FY 2022				FY 2023				FY 2024				FY 2025			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4

<b>M-Code/EAJ Receivers</b>	
M-Code/EAJ Research, Development & Qualification	[REDACTED]
M-Code/EAJ Test and Evaluation	[REDACTED]

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<b>Exhibit R-4A, RDT&amp;E Schedule Details:</b> PB 2021 Air Force		<b>Date:</b> February 2020
<b>Appropriation/Budget Activity</b> 3600 / 4	<b>R-1 Program Element (Number/Name)</b> PE 0604201F / <i>PNT Resiliency, Mods, and Improvements</i>	<b>Project (Number/Name)</b> 641030 / <i>GPS Receiver Development</i>

Schedule Details

Events by Sub Project	Start		End	
	Quarter	Year	Quarter	Year
<b><i>M-Code/EAJ Receivers</i></b>				
M-Code/EAJ Research, Development & Qualification	1	2019	2	2021
M-Code/EAJ Test and Evaluation	3	2020	2	2021