

AMENDMENT OF SOLICITATION/MODIFICATION OF CONTRACT

1. Contract ID Code
Cost Plus Fixed Fee

Page 1 Of 8

2. Amendment/Modification No. P00006	3. Effective Date 2013AUG30	4. Requisition/Purchase Req No. SEE SCHEDULE	5. Project No. (If applicable)
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6. Issued By U.S. ARMY CONTRACTING COMMAND STEPHANIE DICKINSON WARREN, MICHIGAN 48397-5000 HTTP://CONTRACTING.TACOM.ARMY.MIL EMAIL: STEPHANIE.DICKINSON1@US.ARMY.MIL	Code W56HZV	7. Administered By (If other than Item 6) DCMA LOS ANGELES 16111 PLUMMER STREET BUILDING: 10; FLOOR: 2 SEPULVEDA CA 91343	Code S0512A
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8. Name And Address Of Contractor (No., Street, City, County, State and Zip Code) TELEDYNE SCIENTIFIC & IMAGING, LLC 1049 CAMINO DOS RIOS THOUSAND OAKS, CA 91360-2362	<input type="checkbox"/>	9A. Amendment Of Solicitation No.
	<input type="checkbox"/>	9B. Dated (See Item 11)
	<input checked="" type="checkbox"/>	10A. Modification Of Contract/Order No. W56HZV-10-C-0114
	<input type="checkbox"/>	10B. Dated (See Item 13) 2010FEB25
Code 2D609	Facility Code	

11. THIS ITEM ONLY APPLIES TO AMENDMENTS OF SOLICITATIONS

The above numbered solicitation is amended as set forth in item 14. The hour and date specified for receipt of Offers

is extended, is not extended.

Offers must acknowledge receipt of this amendment prior to the hour and date specified in the solicitation or as amended by one of the following methods: (a) By completing items 8 and 15, and returning _____ copies of the amendments; (b) By acknowledging receipt of this amendment on each copy of the offer submitted; or (c) By separate letter or telegram which includes a reference to the solicitation and amendment numbers. **FAILURE OF YOUR ACKNOWLEDGMENT TO BE RECEIVED AT THE PLACE DESIGNATED FOR THE RECEIPT OF OFFERS PRIOR TO THE HOUR AND DATE SPECIFIED MAY RESULT IN REJECTION OF YOUR OFFER.** If by virtue of this amendment you desire to change an offer already submitted, such change may be made by telegram or letter, provided each telegram or letter makes reference to the solicitation and this amendment, and is received prior to the opening hour and date specified.

12. Accounting And Appropriation Data (If required)

ACRN: AA NET DECREASE: -\$500.00

**13. THIS ITEM ONLY APPLIES TO MODIFICATIONS OF CONTRACTS/ORDERS
It Modifies The Contract/Order No. As Described In Item 14.**

<input type="checkbox"/>	A. This Change Order is Issued Pursuant To: The Contract/Order No. In Item 10A.	The Changes Set Forth In Item 14 Are Made In
<input type="checkbox"/>	B. The Above Numbered Contract/Order Is Modified To Reflect The Administrative Changes (such as changes in paying office, appropriation data, etc.) Set Forth In Item 14, Pursuant To The Authority of FAR 43.103(b).	
<input checked="" type="checkbox"/>	C. This Supplemental Agreement Is Entered Into Pursuant To Authority Of:	Mutual agreement of both parties
<input type="checkbox"/>	D. Other (Specify type of modification and authority)	

E. IMPORTANT: Contractor is not, is required to sign this document and return _____ copies to the Issuing Office.

14. Description Of Amendment/Modification (Organized by UCF section headings, including solicitation/contract subject matter where feasible.)

SEE SECOND PAGE FOR DESCRIPTION

Except as provided herein, all terms and conditions of the document referenced in item 9A or 10A, as heretofore changed, remains unchanged and in full force and effect.

15A. Name And Title Of Signer (Type or print)	16A. Name And Title Of Contracting Officer (Type or print) PAMELA L. GROZDON PAMELA.L.GROZDON@US.ARMY.MIL (586)282-9700		
15B. Contractor/Offeror (Signature of person authorized to sign)	15C. Date Signed	16B. United States Of America By _____ /SIGNED/ (Signature of Contracting Officer)	16C. Date Signed 2013AUG30

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	PIIN/SIIN W56HZV-10-C-0114 MOD/AMD P00006	
Name of Offeror or Contractor: TELEDYNE SCIENTIFIC & IMAGING, LLC		

SECTION A - SUPPLEMENTAL INFORMATION

Buyer Name: STEPHANIE DICKINSON
 Buyer Office Symbol/Telephone Number: CCTA-AHL-B/(586)282-8116
 Type of Contract: Cost Plus Fixed Fee
 Kind of Contract: Research and Development Contracts
 Type of Business: Large Business Performing in U.S.
 Surveillance Criticality Designator: C
 Weapon System: No Identified Army Weapons Systems
 Contract Expiration Date: 2013DEC16

*** End of Narrative A0000 ***

Contract: W56HZV-10-C-0114
 Modification: P00006
 Previous Amount: \$2,272,394.00
 Amount of this Action: \$ (500.00)
 Revised Amount: \$2,271,894.00

1. The purpose of this bilateral modification, P00006, is to extend the period of performance completion date and in return the contractor shall provide (\$500.00) in consideration to the Government.
2. The period of performance completion date is hereby extended from 31 August 2013 to 16 December 2013. The following sections have been updated to reflect the new period of performance

C.4.2

FROM: The contractor shall initiate, plan, coordinate and conduct twelve (12) quarterly program In Progress Reviews (IPR) of the contract effort. IPR # 12 on or around Jun 30, 2013. The contractor shall provide briefing materials two (2) business days prior to the IPR IAW CDRL Item A006. The final Program Review shall be conducted at TARDEC, on or before 08/15/2013; TO: The contractor shall initiate, plan, coordinate and conduct thirteen (13) quarterly program In Progress Reviews (IPR) of the contract effort. IPR # 13 on or around Oct 30, 2013. The contractor shall provide briefing materials two (2) business days prior to the IPR IAW CDRL Item A006. The final Program Review shall be conducted at TARDEC, on or before 12/15/2013.

C.5.4

FROM: The contractor shall submit draft engineering manuals 41 months after contract award, no later than 07/31/2013; TO: The contractor shall submit draft engineering manuals 45 months after contract award, no later than 11/31/2013.

C.6:

FROM: The contractor shall deliver one (1) power converter that meets the requirements listed in section C.3 to TARDEC no later than 07/31/2013; TO: The contractor shall deliver one (1) power converter that meets the requirements listed in section C.3 to TARDEC no later than 11/31/2013

F.2.1

FROM - The period of performance shall be forty two (42) months from the date of award, including submission of final technical report.
 TO - The period of performance shall be forty six (46) months from the date of award, including submission of final technical report

3. CLIN 0001 and Subclin 000101 are hereby decreased in the amount of (\$500.00) from \$2,272,394.00 to \$2,271,894.00, to fund the Contractor's consideration to the Government.
4. As a result of this modification, the total obligated amount of this contract is decreased by (\$500.00) from \$2,272,394.00 to \$2,271,894.00.
5. Except as provided herein, all other terms and conditions of Contract W56HZV-10-C-0114 as previously modified remain unchanged, in full force and effect.

*** END OF NARRATIVE A0007 ***

CONTINUATION SHEET

Reference No. of Document Being Continued
 PIIN/SIIN W56HZV-10-C-0114 MOD/AMD P00006

Name of Offeror or Contractor: TELEDYNE SCIENTIFIC & IMAGING, LLC

ITEM NO	SUPPLIES/SERVICES	QUANTITY	UNIT	UNIT PRICE	AMOUNT										
0001	<p>SECTION B - SUPPLIES OR SERVICES AND PRICES/COSTS</p> <p><u>SIC RESEARCH -ARRA FUNDED</u></p> <p>GENERIC NAME DESCRIPTION: SIC RESEARCH - ARRA FUNDED CLIN CONTRACT TYPE: Cost Plus Fixed Fee</p> <p>RECOVERY ACT</p> <p><u>Consideration is given to the Government in the amount of (\$500) for processing modification P00006.</u></p> <p>(End of narrative B002)</p> <p><u>Inspection and Acceptance</u> INSPECTION: Destination ACCEPTANCE: Destination</p> <p><u>Deliveries or Performance</u></p> <table border="0"> <tr> <td>DLVR SCH</td> <td>PERF COMPL</td> </tr> <tr> <td><u>REL CD</u></td> <td><u>QUANTITY</u></td> </tr> <tr> <td>001</td> <td>1</td> </tr> <tr> <td></td> <td><u>DATE</u></td> </tr> <tr> <td></td> <td>30-AUG-2013</td> </tr> </table> <p>\$ 2,271,894.00</p>	DLVR SCH	PERF COMPL	<u>REL CD</u>	<u>QUANTITY</u>	001	1		<u>DATE</u>		30-AUG-2013	1	LO		\$ 2,271,894.00
DLVR SCH	PERF COMPL														
<u>REL CD</u>	<u>QUANTITY</u>														
001	1														
	<u>DATE</u>														
	30-AUG-2013														
000101	<p><u>SIC RESEARCH -ARRA FUNDED</u></p> <p>PRON: R392C384R3 PRON AMD: 03 ACRN: AA AMS CD: 633903ER200 RECOVERY ACT</p> <p><u>Consideration is given to the Government in the amount of (\$500) for processing modification P00006.</u></p> <p>(End of narrative B001)</p> <p>(AMOUNT: \$ 2,271,894.00)</p>														

Name of Offeror or Contractor: TELEDYNE SCIENTIFIC & IMAGING, LLC

SECTION C - DESCRIPTION/SPECIFICATIONS/WORK STATEMENT

C. Statement of Work for Silicon Carbide Semiconductor

C.1 Introduction

The contractor shall develop and demonstrate a power converter using silicon carbide (SiC) power semiconductor devices. The contractor shall seek to maximize efficiency, power density, and specific power while maintaining reliability. The contractor shall design and demonstrate one (1) type of power converter using only SiC semiconductor switching devices in the power stages of the converter. This converter must operate at power specifications and power levels that are suitable for future use in Army applications such as hybrid electric propulsion and on-board and export electrical power systems. The converter must be able to operate reliably and efficiently and meet all performance specifications at a coolant inlet temperature of greater than or equal to 100 degrees Celsius. The contractor shall develop the deliverables shown below to a TRL 5 by the end of the contract.

C.1.1 The Contractor, as an independent contractor and not as an agent of the Government, shall provide all necessary personnel, facilities, materials and services to complete the efforts described in this Scope of Work.

C.2 Silicon Carbide Power Modules

C.2.1 Silicon Carbide Power Modules Development

The contractor shall develop all the device and module specifications necessary to meet the overall converter performance requirements as described in section C.3. The contractor shall present and provide the device and module specifications at the start of work meeting. Upon Government approval of the device and module specifications in accordance with (IAW) Contract Data Requirement List (CDRL) Item A001, the contractor shall design, develop, and build the power modules that meet the specifications derived from the converter requirements.

C.2.2 Silicon Carbide Power Module Testing

The contractor shall conduct verification testing to validate the performance and reliability of the power modules in accordance with the specifications established in C.3.1 before integrating them into the converter. The contractor shall perform limited life testing of module samples at rated converter power and greater than or equal to 100 degrees Celsius inlet coolant temperature for a period of 100 hrs to assess reliability of the modules. Upon successful completion of 100 hrs testing, the contractor shall acquire and conduct performance testing on a new batch of modules to ensure the modules meet the established specifications before they are incorporated into the converter. These tests should include but are not limited to measurement of blocking voltage, forward voltage drop and module current. The forward voltage drop shall be performed at rated current and inlet coolant temperature greater than or equal to 100 degrees Celsius. The contractor shall submit all power module test results within the quarterly reports IAW CDRL Item A002.

C.3 Silicon Carbide Power Converter Development

C.3.1. Power Converter Types

The contractor shall design, build, and test one (1) power converter type. The contractor shall design the converter to be functional in ambient temperatures ranging from -50 degrees Celsius to 55 degrees Celsius. The contractor shall design the all-SiC power converter with soft start capability to maximize efficiency, power density (kW/liter) and specific power (kW/kg), while maintaining or improving power converter reliability. The contractor shall develop the converter to a TRL 5 by the end of the contract and must clearly demonstrate improvements compared with the silicon based state-of-the art through testing power density, specific power, and efficiency as shown in Section C.3.1.1.

The one (1) power converter type and its operating specifications are as follows:

C.3.1.1 Low Voltage Bidirectional Battery to Bus DC-DC Converter

The contractor shall design, develop, and build a DC-DC converter capable of operating in both buck and boost modes at 30 kW continuous output and greater than or equal to 100 degrees Celsius inlet coolant temperature at 300 Vdc bus and 28 Vdc battery. The converter must be able to operate at a battery voltage down to 20 Vdc at reduced power.

When supplying power to the bus, the converter must be capable of regulating the bus voltage or regulating the output current to a programmed value. When supplying power to the battery, the converter must be capable of regulating battery voltage or current to a programmed value. The converter, in buck mode, must be capable of regulating the bus voltage. When regulating bus voltage under steady state conditions, the voltage must be held within +/- 5% of the nominal 300Vdc bus voltage. When used to regulate the bus voltage, the converter shall have the capability of switching between buck and boost modes automatically to maintain the programmed value. The control system of the converter shall be designed to handle upper and lower voltage and current limit settings which can be configured to ensure system and battery safety. The converter shall operate at a threshold efficiency of 89%, and an objective of 93%, when measured at full rated power. The converter shall be designed to minimize EMI to ensure EMC in accordance with MIL-STD-461F.

The converter shall be capable of meeting the following:

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- 1) Power: 30kW continuous bidirectional,
- 2) Power density (power/volume): threshold 1.3kW/liter, objective 2kW/liter,
- 3) Specific power (power/weight): threshold 1kW/kg, objective 1.5kW/kg.

The power used to compute the power density and specific power shall be the continuous electrical power of the converter. Continuous operation is defined as operation for 60 minutes at constant output power and stabilized conditions with coolant inlet temperatures of greater than or equal to 100 degrees Celsius inlet while operating from 300V dc bus and 28 Vdc battery.

The volume and weight used for the power density and specific power calculation includes the total converter enclosure and all components that are mechanically and permanently attached, including but not limited to all converter hardware such as the power stage, gate drive/power supply, inductors, sensors, filters, and interfaces.

C.3.2. Power Converter Inlet Coolant Temperature

The converter must be liquid cooled and have the capability of operating at full rated continuous power with coolant inlet temperatures greater than or equal to 100 degrees Celsius. The flow rate shall not exceed 6 gal/min.

C.3.3 Power Converter Testing

The contractor shall test all power converter circuits to ensure the converter meets the requirements, as well as determine efficiency and power output, under the conditions specified in sections C.3.1, C.3.1.1, and C.3.2. All test results with recorded data shall be delivered as part of the technical progress report IAW CDRL Item A002.

C.3.3.1 Transient Test

The contractor shall determine maximum transient output current and power for two (2) time durations, 1 second (corresponding to stall condition) and 10 seconds, from stabilized conditions with the converter operating at greater than or equal to 100 degrees Celsius inlet coolant temperature. Prior to testing, the converter must be operating at full rated continuous power. The test shall be conducted at the maximum achievable transient current and power before reaching the allowable safety limits beyond which there may be degradation or damage to the converter as determined by the contractor.

C.3.3.2 Efficiency Map

The contractor shall measure efficiencies across the operating range of each converter and develop an efficiency map for the converter as follows:

1. DC-DC converter: Measure electrical efficiency at 10% increments of power flow (bidirectional) and 20% increments of battery voltage and verify using a thermal method of measuring efficiency at 25%, 50%, 75%, and 100% increments of power flow and battery voltage to corroborate the electrical measurement of efficiency

C.4. Meetings

C.4.1 Start of Work Meeting

The contractor shall conduct the Start of Work Meeting at TARDEC within 30 days of the award of the contract. The contractor shall coordinate with the Contracting Officer's Representative (COR) to schedule the specific date and time of the meeting. The contractor shall provide an update on the state of development of the selected SiC devices for this effort in addition to presenting their program execution plan and milestone schedule, reviewing objectives, and projected monthly expenditures. The contractor shall cover all proposed aspects of their planned work effort to include potential delays and risk mitigation plans should delays occur. In addition, at the Start of Work meeting, the methods for tracking contract progress shall be discussed and planned. The Contractor shall provide copies of all presentation materials to the COR two (2) business days prior to the meeting IAW CDRL Item A006. Following the Start of Work meeting the contractor shall record and provide meeting minutes IAW CDRL Item A001 to the COR within 10 working days after the meeting.

C.4.2 Program Reviews

The contractor shall initiate, plan, coordinate and conduct thirteen (13) quarterly program In Progress Reviews (IPR) of the contract effort. IPR # 13 on or around Oct 30, 2013. The contractor shall provide briefing materials two (2) business days prior to the IPR IAW CDRL Item A006. The final Program Review shall be conducted at TARDEC, on or before 12/15/2013. However, the other IPRs may be held by Video Conference, Teleconference, or on site at either the contractors location or Governments location by mutual agreement. The time and location of the IPRs shall be established at the Start of Work meeting by the COR and the contractor. The contractor shall record and provide meeting minutes IAW CDRL Item A001 to the COR within 10 working days after the meeting.

C.5 Deliverables

C.5.1 Meeting Minutes

The contractor shall record all working group minutes from the Start of Work Meeting, Program Reviews, all teleconferences and video conferences contributing to the achievement of objectives/milestones and submit to the U.S. Government IAW CDRL Item A001.

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Name of Offeror or Contractor: TELEDYNE SCIENTIFIC & IMAGING, LLC		

C.5.2 Progress Reports

C.5.2.1 Technical Progress Reports

The contractor shall submit technical progress reports at the end of every 90 days, beginning 90 days after contract award and no less than 5 business days in advance of the Program Reviews (see C.4.2). The report shall summarize progress made during the period as well as all experimental / detailed findings, gap analyses between deliverables, objectives, milestones, problems and mitigation strategies. For the technical progress report submission 12 months after contract award, the contractor shall provide a comprehensive, cumulative report summarizing progress and results. The technical progress reports shall be submitted to the U.S. Government IAW CDRL ITEM A002.

C.5.2.2 Financial Progress Reports

The contractor shall submit bi-monthly financial reports to the U.S. Government IAW CDRL Item A003, starting 60 days after contract award. These reports shall summarize funds spent and/or committed, percentage of work completed, and a statement as to whether the remaining funds are sufficient to complete the task.

C.5.3 Final Technical Report

The contractor shall prepare a Final Technical Report, including a written report and PowerPoint presentation, to document all the technical aspects and results of the contract effort to include the cited deliverables for each objective and task. The contractor shall present a draft of the Final Technical Report IAW CDRL Item A004 to the U.S. Government 30 calendar days prior to end of the contract period of performance for review and comment; draft report to be returned to the contractor with 15 business days after submission. After receiving comments from the U.S. Government, the contractor shall deliver the complete Final Technical Report within 10 business days to the U.S. Government IAW CDRL Item A004.

C.5.4 Engineering Manual

The contractor shall supply two (2) hard copies and one (1) electronic copy of an engineering manual for the one (1) converter. The engineering manual shall include a description of all thermal, electrical, and user interfaces, sensors, operating procedures, safety limits, and all parameters required for operation and characterization of the converter. The contractor shall submit draft engineering manuals 45 months, after contract award, no later than 11/31/2013 ; draft reports to be returned to the contractor within 15 days after submission. After receiving comments from the U.S. Government, the contractor shall deliver the complete final engineering manuals (two (2) hard copies and one (1) electronic copy) within 15 days to the U.S. Government IAW CDRL Item A005.

C.5.5 Presentation Material

The contractor shall deliver Presentation Materials to the COR, IAW CDRL Item A006, two (2) business days prior to each meeting.

C.6. Hardware Deliverables

The contractor shall deliver one (1) power converter that meets the requirements listed in section C.3 to TARDEC no later than 11/31/2013. The contractor shall include all required electrical, plumbing, and mounting interface hardware required for converter operation.

*** END OF NARRATIVE C0001 ***

CONTINUATION SHEET**Reference No. of Document Being Continued****Page 7 of 8****PIIN/SIIN** W56HZV-10-C-0114**MOD/AMD** P00006**Name of Offeror or Contractor:** TELEDYNE SCIENTIFIC & IMAGING, LLC

SECTION F - DELIVERIES OR PERFORMANCE

F.1 Delivery

F.1.1 Delivery of Data set forth in the Contract shall be in accordance with the Contract Data Requirements List, DD Form 1423.

F.1.2 All items other than data (if any) called for in the Contract shall be delivered FOB Destination to:

ATTN: Mr. Kevin Boice, Mail Stop 121
U.S. Army Tank Automotive Research
Building 212, Floor 1, Room 1
6501 E. Eleven Mile Road
Warren, MI 48397-5000

F.2 Performance

F.2.1 The period of performance shall be forty six (46) months from the date of award, including submission of final technical report.

F.2.2 The contractor shall submit a Draft Final Scientific and Technical Report thirty (30) days before the end of the period of performance completion date. Reports shall be submitted for review and comment to the U.S. Government and be returned to the Contractor within fifteen (15) days. After receiving comments from the U.S. Government, the Contractor shall deliver the complete Final Technical Report within fifteen (15) days to the U.S. Government in accordance with Exhibit A CDRL Item A002. Acceptance of Final Technical Report will constitute completion.

*** END OF NARRATIVE F0001 ***

CONTINUATION SHEET

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Name of Offeror or Contractor: TELEDYNE SCIENTIFIC & IMAGING, LLC

SECTION G - CONTRACT ADMINISTRATION DATA

LINE	PRON/ AMS CD/ <u>ITEM</u>	OBLG <u>STAT</u>	JO NO/ <u>ACCT ASSIGN</u>	<u>ACRN</u>	<u>PRIOR AMOUNT</u>	<u>INCREASE/ DECREASE</u>	<u>CUMULATIVE AMOUNT</u>
000101	R392C384R3 633903ER200	2	92C384	AA \$	2,272,394.00 \$	-500.00 \$	2,271,894.00
					NET CHANGE \$	-500.00	

<u>ACRN</u>	<u>ACCOUNTING CLASSIFICATION</u>	<u>INCREASE/ DECREASE</u>
AA	21 92041000096N6N7EP633903255Y S20113 W56HZV	\$ -500.00
NET CHANGE \$		-500.00

	<u>PRIOR AMOUNT OF AWARD</u>	<u>INCREASE/DECREASE AMOUNT</u>	<u>CUMULATIVE OBLIG AMT</u>
NET CHANGE FOR AWARD:	\$ 2,272,394.00	\$ -500.00	\$ 2,271,894.00

LINE	<u>ACRN</u>	<u>EDI/SFIS ACCOUNTING CLASSIFICATION</u>
000101	AA	21 091020410000 S20113 96N6N7E633903ER200255Y 92C384S20113 W56HZV