DMEA
SBIR 15.2 PROPOSAL SUBMISSION INSTRUCTIONS

INTRODUCTION

The Defense Microelectronics Activity (DMEA) SBIR/STTR Program is implemented, administrated, and managed by the DMEA Program Control Division. If you have any questions regarding the administration of the DMEA SBIR/STTR Program, please contact the DMEA SBIR/STTR Program Manager (PM), Mr. Gene Graham, gene.graham@dmea.osd.mil.

For general inquiries or problems with electronic submission, contact the DoD SBIR Help Desk at 1-800-348-0787 between 9:00 am to 6:00 pm ET. For questions about the topic during the pre-solicitation period (24 April 2015 through 25 May 2015), contact the Topic Authors listed under each topic on the SBIR/STTR website at https://sbir.defensebusiness.org/ prior to the solicitation. Information regarding the DMEA mission and programs can be found at http://www.dmea.osd.mil.

PHASE I GUIDELINES

DMEA intends for Phase I to be only an examination of the merit of the concept or technology that still involves technical risk, with a cost not exceeding $150,000.

A list of the topics currently eligible for proposal submission is included in this section followed by full topic descriptions. These are the only topics for which proposals will be accepted at this time. The topics are directly linked to DMEA's core research and development requirements.

Please assure that your e-mail address listed in your proposal is current and accurate. DMEA cannot be responsible for notification to companies that change their mailing address, e-mail address, or company official after proposal submission.

PHASE I PROPOSAL SUBMISSION

Read the DoD front section of this solicitation for detailed instructions on proposal format and program requirements. When you prepare your proposal submission, keep in mind that Phase I should address the feasibility of a solution to the topic. Only UNCLASSIFIED proposals will be entertained.

The technical period of performance for the Phase I should be no more than six (6) months. DMEA will evaluate and select Phase I proposals using the evaluation criteria contained in Section 6.0 of the DoD Solicitation 15.2 preface. Due to limited funding, DMEA reserves the right to limit awards under any topic and only proposals considered to be of superior quality will be funded.

DMEA accepts Phase I proposals not exceeding $150,000. DMEA will conduct a price analysis to determine whether cost proposals, including quantities and prices, are fair and reasonable. Contractors should expect that cost proposals will be negotiated. Cost proposals that exceed $150,000 will not be considered for award.

If you plan to employ NON-U.S. citizens in the performance of a DMEA SBIR contract, please identify these individuals in your proposal as specified in Section 5.4.c(8) of the program solicitation.

It is mandatory that the ENTIRE Technical Volume, DoD Proposal Cover Sheet, Cost Volume and the Company Commercialization Report are submitted electronically through the DoD SBIR website at https://sbir.defensebusiness.org/. The DoD proposal submission site will lead you through the process for submitting your technical proposal and all of the sections electronically. Each of these documents is submitted separately through the website. If you have any questions or problems with the electronic proposal submission contact the DoD SBIR Help Desk at 1-800-348-0787.

Your proposal submission must be submitted via the submission site on or before the 6:00 a.m. ET deadline on 24 June 2015.

Proposal submissions that are not complete or that are received after the closing date and time will not be considered for award.

PHASE II GUIDELINES

Phase II is the prototype/demonstration of the technology that was found feasible in Phase I. DMEA encourages, but does not require, partnership and outside investment as part of discussions with DMEA sponsors for potential Phase II efforts.

Phase II proposals may be submitted for an amount not to exceed $1,000,000.

PHASE II PROPOSAL SUBMISSION

The Reauthorization of the SBIR/STTR Program has resulted in significant changes to the Phase II proposal submission process. On December 31, 2011, the President of the United States signed into law the National Defense Authorization Act for Fiscal Year 2012 (Defense Reauthorization Act), Public Law 112–81. Section 5001, Division E, of the Defense Reauthorization Act contains the SBIR/STTR Reauthorization Act of 2011 (SBIR/STTR Reauthorization Act), which extends both the SBIR and STTR Programs through September 30, 2017.

Phase I awardees may submit a Phase II proposal without invitation not later than sixty (60) calendar days following the end of the Phase I contract. The Phase II proposal submission instructions are identified in the Phase I contract, Part I – The Schedule, Section H, Special contract requirements, "H-959 SBIR Phase II Proposal Submission Instructions."

All Phase II proposals must have a complete electronic submission. Complete electronic submission includes the submission of Cover Sheet, Cost Volume, Company Commercialization Report, the entire Technical Volume, and any appendices via the DoD submission site (https://sbir.defensebusiness.org/). The DoD proposal submission site will lead you through the process for submitting your technical volume and all of the sections electronically. Each of these documents is submitted separately through the website. Your proposal must be submitted via the submission site on or before the DMEA-specified deadline or it will not be considered for award.

DMEA will evaluate Phase II proposals based on the Phase II evaluation criteria listed in Section 8.0 of DoD Solicitation 15.2 Preface. DMEA does not have an established page limit for Phase II submissions. Please reference the DoD SBIR Submission site FAQs for more information on generating Phase II proposals. Due to limited funding, DMEA's ability to award any Phase II, regardless of proposal quality or merit, is subject to availability of funds. Please ensure that your proposal is valid for 120 days after submission, and any extension to that time period will be requested by the contracting officer.

COST VOLUME GUIDELINES

The on-line cost volume for Phase I and Phase II proposal submissions must be at a level of detail that would enable DMEA personnel to determine the purpose, necessity, and reasonability of each cost element. Provide sufficient information (a through i below) on how funds will be used if the contract is awarded. Include the itemized cost volume information (a through i below) as an appendix in your technical proposal. The itemized cost volume information (a through i below) will not count against the 20-page limit.

a. Special Tooling and Test Equipment and Material: The inclusion of equipment and materials will be carefully reviewed relative to need and appropriateness of the work proposed. The purchase of special tooling and test equipment must, in the opinion of the Contracting Officer, be advantageous to the government and relate directly to the specific effort. They may include such items as innovative instrumentation and/or automatic test equipment. Title to property furnished by the Government or acquired with Government funds will be vested with the DoD Component; unless it is determined that transfer of the title to the contractor would be more cost effective than recovery of the equipment by the DoD Component.
b. Direct Cost Materials: Justify costs for materials, parts, and supplies with an itemized list containing types, quantities, price, and where appropriate, purposes.
c. Other Direct Costs: This category of costs includes specialized services such as machining or milling, special testing or analysis, costs incurred in obtaining temporary use of specialized equipment. Proposals, which include teased hardware, must provide an adequate lease *versus* purchase justification or rationale.
d. Direct Labor: Identify key personnel by name if possible or by labor category if specific names are not available. The number of hours, labor overhead and/or fringe benefits and actual hourly rates for each individual are also necessary.
e. Travel: Travel costs must relate to the needs of the project. Break out travel cost by trip, with the number of travelers, airfare, and per diem. Indicate the destination, duration, and purpose of each trip.
f. Cost Sharing: Cost sharing is permitted. However, cost sharing is not required, nor will it be an evaluation factor in the consideration of a proposal.
g. Subcontracts: Involvement of university or other consultants in the planning and /or research stages of the project may be appropriate. If the offeror intends such involvement, describe the involvement in detail and include information in the cost proposal. The proposed total of all consultant fees, facility leases, or usage fees and other subcontract or purchase agreements may not exceed one-third of the total contract price or cost, unless otherwise approved in writing by the Contracting Officer. Support subcontract costs with copies of the subcontract agreements. The supporting agreement documents must adequately describe the work to be performed (i.e., Cost Volume). At the very least, a statement of work with a corresponding detailed cost volume for each planned subcontract must be provided.
h. Consultants: Provide a separate agreement letter for each consultant. The letter should briefly state what service or assistance will be provided, the number of hours required, and the hourly rate.

DMEA SBIR PHASE II ENHANCEMENT PROGRAM

To encourage transition of SBIR into DoD systems, DMEA has a Phase II Enhancement policy. DMEA's Phase II Enhancement program requirements include: up to one year extension of existing Phase II, and up to $500,000 matching SBIR funds. Applications are subject to review of the statement of work, the transition plan, and the availability of funding. DMEA will generally provide the additional Phase II Enhancement funds by modifying the Phase II contract.

PHASE I PROPOSAL SUBMISSION CHECKLIST:

All of the following criteria <u>must be met</u> or your proposal will be REJECTED.

_____1. Your Technical Volume, the DoD Cover Sheet, the DoD Company Commercialization Report (required even if your firm has no prior SBIRs), and the Cost Volume have been submitted electronically through the DoD submission site by 6:00 a.m. ET on 24 June 2015.

_____2. The Phase I proposal does not exceed $150,000.

DMEA SBIR 15.2 Topic Index

DMEA SBIR 15.2 Topic Descriptions

DMEA152-001 TITLE: Rapid Non-destructive Detection of Advanced Counterfeit Electronic Materiel

TECHNOLOGY AREAS: Sensors, Electronics

OBJECTIVE: Develop a tool which illuminates an electronic component with free field electromagnetic (EM) energy in the RF and microwave bands to non-destructively scan the part in both powered-on and powered-off conditions to determine authenticity. The tool should be capable of detecting multiple categories of counterfeit electronics, including aged, cloned, and subversively modified devices. It should also be capable of handling a wide range of electrical devices, from small Surface-Mount Technology (SMT) to modern System-On-a-Chip (SOC) architectures. The developed innovation should be able to assess the authenticity and proper functionality of electronic devices in real time with a high probability of counterfeit detection (Pd > 95%) and low False Alarm Rate (FAR < 5%).

DESCRIPTION: Counterfeit and subversively modified electronic components represent a substantial threat to Department of Defense (DoD) systems. Testimony to the Senate Armed Services Committee (SASC) concluded that "the scope and impact of counterfeits is not known … counterfeit electronic parts can compromise performance and reliability, risk national security, and endanger the safety of military personnel … [and] weaknesses in the testing for electronic parts create vulnerabilities that are exploited by counterfeiters" [1]. The need for advanced tools with widespread applicability towards electronics employed by the DoD is evident. The latest, most sophisticated forms of counterfeiting includes cloned integrated circuits (ICs), overproduced ICs, and tampered ICs created by state-sponsored counterfeiters, with the goal of embedding a back door and/or the capability to remotely disrupt/disable/destroy the system the IC is installed in. Cloned ICs are created when a component is reverse engineered, then produced without the permission of the Original Component Manufacturer (OCM). Currently, extensive electrical testing is required to detect advanced counterfeit components such as cloned ICs. Such testing requires expensive equipment, is time consuming, requires extensive data and cooperation from the OCM, and results vary wildly, depending on interpretation by subject matter experts (SMEs) [2]. Although automated inspection equipment may help identify tampered or cloned components, extensive work has been done to camouflage IC layouts and standard cell functionality, which is capable of defeating automated inspection [3]. A tool is required which can rapidly detect and compare the characteristic EM emissions and reflections of a device, in real time. Such a tool would be able to detect cloned and tampered ICs unless they were made with the exact same material, via the same processes, by the same production equipment. By capturing and comparing the unique signature or "fingerprint" of each component, the most sophisticated counterfeit components would be detected before installation. Electronic components exhibit characteristic electromagnetic responses when powered. These responses are currently being used for quality control, electronic health monitoring, and counterfeit detection. DMEA is seeking a novel tool which electromagnetically scans an electronic device without need for a test fixture and when the device is in both a powered-on and powered-off state. The tool should be able to simultaneously illuminate the device via EM radiation and collect its characteristic responses to illumination to non-destructively determine part authenticity and identify any subversive modifications made to the part. This re-radiation of the incident EM energy is analogous to X-ray fluorescence, in that the resulting radiation is unique to the inspected component. Only devices made of the exact same material, via the same processes, will exhibit identical signatures. Assessment of electronic components must be made in real-time (no post-processing required) and able to be performed by an operator with minimal training. The tool needs to be applicable to a wide range of device types and sizes and be able to detect multiple types of typical and sophisticated counterfeit modalities. The developed tool must be capable of achieving a Pd of >95% with a FAR of <5% to avoid adverse effects on trusted materiel in the DoD supply chain.

PHASE I: The goal of Phase I is to establish a design for a proof-of-concept tool capable of remotely scanning an electronic component with free field EM energy to assess its authenticity and proper functionality. Proof-of-concept should be established through laboratory experimentation on representative material. The technique must be environmentally safe and not exceed MIL-STD-461 emissions requirements. Utilization of actual counterfeit, defective, and/or subversively modified components in establishing feasibility is desirable. The hardware and software architecture needed for an integrated tool will be designed. At the conclusion of this phase a feasibility study report will be produced.

PHASE II: Phase II will build and test a prototype version of the assessment tool whose architecture was designed under Phase I. Prototype demonstration will include tests performed on relevant electronic devices to determine performance statistics (Pd, FAR). In conjunction with the demonstration, a detailed plan for achieving Manufacturing Readiness Level >6 and for transitioning the tool for insertion within the DoD supply chain will be prepared.

PHASE III: Phase III will transition the developed tool for active use by the DoD, academic and private sectors. Commercialization of the concept will occur as SMEs from each sector have identified a critical need for such capabilities. Integration and testing will be coordinated with a DoD organization that handles electronic parts within the supply chain. Additional government and commercial insertion points for the screening tool will be identified.

REFERENCES:
1. "Report of the Inquiry into Counterfeit Electronic Parts in the Department of Defense Supply Chain," Senate Armed Services Committee, May 21, 2012 (112th Congress, 2nd Session, Senate Report 112–167).

2. U. Gruin, M. Tehranipoor, D. DiMase, and M. Megrdician, "Counterfeit IC detection and Challenges Ahead," ACM SIGDA, March 2013.

3. J. Rajendran, M. Sam, O. Sinanoglu, and R. Karri, "Security Analysis of Integrated Circuit Camouflaging," ACM Conference on Computer & Communications Security, pp. 709-720, 2013.

KEYWORDS: Anti-counterfeit, Counterfeit, Advanced counterfeit screening, Detection of cloned integrated circuits, IC reverse engineering

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DMEA152-002 TITLE: Analysis of Integrated Circuits Using Limited X-rays

TECHNOLOGY AREAS: Sensors, Electronics

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), which controls the export and import of defense-related material and services. Offerors must disclose any proposed use of foreign nationals, their country of origin, and what tasks each would accomplish in the statement of work in accordance with section 5.4.c.(8) of the solicitation.

OBJECTIVE: Design and implement algorithms in software to accurately analyze data from an X-ray microscope in order to identify and map the conductors in integrated circuits (ICs). This system should minimize the time required to image a multilayer laminar IC.

DESCRIPTION: The DARPA TRUST program established the potential usefulness of using an X-Ray microscope to analyze ICs at a synchrotron. We would like to further that development using a lab based X-Ray source. When utilizing a lab X-ray source, acquisition times for X-ray images increase significantly compared to using a synchrotron X-ray source. This is due to the decreased number of X-ray photons (i.e., X-ray flux) produced by a lab source. This reduced X-ray flux combined with a relatively large imaging area makes image acquisition prohibitively slow at the resolution required for the analysis of modern ICs. It therefore becomes necessary to develop an approach to X-ray imaging that can minimize the imaging time, while still being able to reconstruct the internals of a multilayer laminar IC. This problem is very similar to the one faced in medical imaging to reduce the total radiation dosage to a patient. However, unlike in medical imaging, the internal structure of ICs is very regular and defined by design rules. These design rules limit the geometries and materials used in an IC. This a priori information can be combined with recent advances in low dose X-ray imaging to create software with innovative algorithms optimized for IC inspection. The X-ray microscope, for which the imaging approach will be applicable, will conform to the following: 1) Sample will be mounted on a stage with at least four degrees of freedom (i.e., x, y, z, and rotation around an axis). 2) Stage positional uncertainty (i.e., error in reported position) will be smaller than the minimum feature size. 3) A scintillator and camera will be used to acquire an X-ray image of a specific region of the sample at a time. This region will be much smaller than the area of interest; therefore, many images will need to be taken and stitched together to image the entire area of interest. 4) Image data can be sent to a computer for real-time analysis and there will be an interface for a computer to control the stage and image acquisition equipment. This communication can be used to dynamically optimize the scanning and reconstruction algorithms. The software is required to do the following: 1) Direct the X-ray microscope to acquire X-ray images. a. Interface to microscope will allow the following to be controlled: i. x, y, and z position. ii. Angle iii. X-ray exposure time b. Software will need to decide the best way to position the sample and at which angles to acquire images to minimize the total time it takes to image the IC. 2) Analyze the resulting X-ray images in such a way that the conductors in the entire IC are modeled a. A 3D model is anticipated as the output format. b. The data must be segmented based on X-ray absorption contrast.

PHASE I: Develop a prototype of the Phase I concept and demonstrate its operation. Validate the performance using an X-ray microscope over multiple dissimilar, modern ICs (e.g., FPGA or microprocessor of 90nm technology node or better) and develop a test plan to fully characterize the prototype. The software being developed must have a royalty-free license for the Government, including its support service contractors, to use, modify, reproduce, release, perform, display, or disclose technical data or computer software generated for any United States government purpose. The software under development will operate on an X-ray microscope specified and made available by DMEA.

PHASE II: Develop a prototype of the Phase I concept and demonstrate its operation. Validate the performance using an X-ray microscope over multiple dissimilar, modern ICs (e.g., FPGA or microprocessor of 90nm technology node or better) and develop a test plan to fully characterize the prototype. The software being developed must have a royalty-free license for the Government, including its support service contractors, to use, modify, reproduce, release, perform, display, or disclose technical data or computer software generated for any United States government purpose. The software under development will operate on an X-ray microscope specified and made available by DMEA.

PHASE III: There may be opportunities for further development of this software for use in a specific military or commercial application. During a Phase III program, the contractor may refine the performance of the design and produce pre-production quantities for evaluation by the Government.

REFERENCES:

1. Michael Bajura, Greg Boverman, John Tan, Gene Wagenbreth, Craig Milo Rogers, Michael Feser, Juana Rudati, Andrei Tkachuk, Stephen Aylward, Patrick Reynolds. “Imaging Integrated Circuits with X-ray Microscopy” (2011) GOMACTech 36.

2. Il Yong Chun, Ben Adcock, Thomas M. Talavage. “Non-convex compressed sensing CT reconstruction based on tensor discrete Fourier slice theorem.” (2014) Engineering in Medicine and Biology Society (EMBC), 2014 36th Annual International Conference of the IEEE.

3. Emil Y. Sidky, Rick Chartrand, John M. Boone, Xiaochuan Pan “Constrained Minimization for Enhanced Exploitation of Gradient Sparsity: Application to CT Image Reconstruction.” (2014) Translational Engineering in Health and Medicine, IEEE Journal of, Volume 2.

4. Rick Chartrand, Emil Y. Sidky, Xiaochuan Pan “Nonconvex compressive sensing for X-ray CT: an algorithm comparison.” (2013) Signals, Systems and Computers, 2013 Asilomar Conference on.

5. Zunying Li, Yizhong Song. “Improving Algebraic Reconstruction Techniques with Nonlinear Iterating Algorithms.” (2009) Fifth International Conference on Natural Computation.

KEYWORDS: X-Ray Microscopy, Integrated Circuits, Reverse Engineering, 3D Reconstruction, Tomography, Software, Algorithms

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