IPC Policy Recommendations

to the

Department Of Defense
Printed Circuit Board
Executive Agent

North American Electronic Interconnect Industry Support
to the Department Of Defense
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Electronic Interconnect Industry Policy Recommendations to the Printed Circuit Board Executive Agent

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About IPC
IPC is a global trade association dedicated to furthering the competitive excellence and financial success of its members, who are participants in the electronics industry. IPC represents all facets of the industry, including design, printed circuit board manufacturing and electronics assembly.

As a member-driven organization and leading source for industry standards, training, market research and public policy advocacy, IPC supports programs to meet the needs of an estimated $1.5 trillion global electronics industry. IPC maintains offices in Bannockburn, Ill.; Taos, N.M.; Arlington, Va.; Garden Grove, Calif.; Stockholm, Sweden; and Shanghai, China.

IPC devotes resources to management improvement and technology enhancement programs, the creation of relevant standards, protection of the environment, and pertinent government relations. IPC encourages the active participation of all its members in these activities and commits to full cooperation with all related organizations.

About the Department of Defense Executive Agent
Recognizing a threat to national security, Congress enacted legislation, contained in the FY 2009 National Defense Authorization Act, that directs the Department of Defense (DoD) to create a position of a Printed Circuit Board (PCB) Executive Agent. The law requires the appointment of the Executive Agent by January 2009.

Congress directed the Executive Agent to oversee the development and implementation of a PCB and interconnect technology roadmap for DoD. The Executive Agent is required to create a policy to assure that DoD has access to the PCB manufacturing capabilities and the technical expertise necessary to meet future military requirements. The law also requires the Executive Agent to assess and develop a plan to address the PCB supply chain to meet DoD and trus tworthiness requirements for PCB use in defense systems.

About the IPC Task Force
IPC, the electronic interconnect industry’s largest and most authoritative representative group, has formed a task force to assist and counsel the Executive Agent. IPC has extremely deep data points on the industry, first-hand comprehension of business matters and regulation, the foremost expertise on all electronic interconnect matters, and all major PCB and Electronic Manufacturing Services (EMS) participants among its membership.

IPC formed a panel of experts from among its membership for the purpose of advocating the positions and policy directions to the PCB Executive Agent. The goal of this task force is to advise the Executive Agent of the actions necessary to the creation and sustenance of a PCB industry capable of supporting DoD and prime original equipment manufacturers (OEM) needs.
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Preamble

IPC members manufacture circuit boards and electronics assemblies, the foundation of all of America’s consumer and industrial electronics, specifically critical electronic products for defense, transportation and telecommunications equipment. Over the past 20 years, the domestic circuit board industry has decreased from producing 42 percent of the global printed circuit board revenue to less than 10 percent, resulting in the loss of printed circuit board manufacturers and the disappearance of high-quality U.S. manufacturing jobs.

North America still has a competent, competitive and organized supply base to support current and future DoD requirements for PCB technology. However, IPC is gravely concerned with the loss of PCB manufacturing capabilities and the PCB supply chain that, if not immediately addressed and reversed, will result in a North American PCB industry unable to support DoD requirements.
The National Research Council’s (NRC) Committee on Manufacturing Trends in Printed Circuit Board Technology report, Linkages: Manufacturing Trends in Printed Circuit Technology,1 makes significant findings on the importance of domestic PCB manufacturing to support DoD requirements. IPC members were key contributors to this report and supplied the following description.

“There is a lack of clear understanding of the importance of high-quality, trustworthy PCBs for properly functioning weapons and other defense systems and components. PCBs connect, in increasingly sophisticated ways, a variety of active components (such as microchips and transistors) and passive components (such as capacitors and fuses) into electronic assemblies that control systems.

“Given DoD’s increasing interest in and reliance on networked operations, these applications will expand for the foreseeable future, and the use of and requirements for PCBs will continue to grow. Significant defense needs will be met only by the production of specialized, defense-specific PCBs that are unavailable from commercial manufacturers.

“Current trends have resulted in a reduction in defense-specific manufacturing and a parallel increase in support for commercial-military integration by industry.

“DoD relies on procurement of defense system components on the commercial sector wherever possible. For legacy systems already in the DoD inventory, DoD relies on a combination of private-sector businesses and DoD-owned capability to sustain performance through maintenance, repair and necessary upgrades.

“Many DoD requirements have become more sophisticated. Applications generally require long life spans, performance on demand under extreme conditions and very high reliability.

“These requirements cannot be met by high-volume, short-lived consumer products. In fact, few if any defense-specific components with such characteristics can even be provided by manufacturers of PCBs used in commercial durable goods such as automobiles, appliances and heavy equipment, because of the high cost of interrupting high-efficiency production to manufacture a handful of defense-unique PCBs.

“When procuring defense systems, DoD focuses on the best price for purchase of the total system, not the reliability and trustworthiness of individual components such as PCBs. There is currently little incentive for, or ability to justify, spending more to ensure that individual defense system components like PCBs will perform reliably and be protected from tampering during their manufacture, assembly and distribution.

“Commercial-military integration relies on the commercial market to meet defense needs. However, commercial manufacturers’ capacity for and spending on research and development (R&D) has declined, and the remaining limited technology innovation is targeted at high-volume consumer goods.

North American PCB Supply Chain

Many trends have resulted in a dwindling North American PCB supply base. Left unchecked, these trends will result in an ever shrinking North American supplier base unable to serve the capacity or technology requirements of DoD. Clearly visible trends are:

• Consolidation of the North American manufacturer base has resulted in PCB failures and a dramatically reduced capacity

• North American PCB manufacturing net profit margins have dwindled to single digits among those able to show a profit at all

• Remaining North American manufacturers compete for a shrinking market highlighted by niche categories:
  - MIL-SPEC certified product (MIL-PRF-31032, MIL-P-50884 and J-STD-001)
  - High technology products (HDI, RF and ATE)
  - Quick turn and prototyping
  - Flex circuits and rigid-flex boards

Printed Circuit Board Technology

The NRC report Linkages, goes on to state “The function of a PCB is to connect a variety of active components (such as microchips and transistors) and passive components (such as capacitors and fuses) into an electronic assembly that controls a system.

“A typical printed circuit board consists of conductive ‘printed wires’ attached to a rigid, insulating sheet of glass-fiber-reinforced polymer, or ‘board.’ The insulating board is often called the substrate. When the substrate is an un-reinforced film, the circuit board is called a ‘flex circuit.’

“An important characteristic of PCBs is that they are usually product-unique. The form factor, i.e., the size, configuration or physical arrangement, of a PCB can range from a system literally painted on to another component, to a structural element that supports the entire system.

“Interconnecting electronics in increasingly complex systems leads to complex designs, components and systems. The advent of integrated electronics, such as a system-on-a-chip and multichip modules, has increased speed and reduced latency in electronics. The interconnections for these components have become equally diverse.

“Contributors to the final PCB product include designers, board manufacturers, assembly companies, suppliers and original equipment manufacturers (OEMs).”

“Markets for interconnection technology range across the whole of the global economy. Sectors include government, military and aerospace uses; medical devices; automotive electronics; computers and business electronics; consumer electronics; industrial electronics and instrumentation; and communication.

“Today, more than half of the PCBs produced worldwide are for high-volume, low-cost, short-lived products such as cellular telephones, small appliances and toys. Increasing consumer use has led to a shift of the assortment of products fabricated by PCB manufacturers.

“The increasing globalization of the electronics industry has driven the capability to manufacture interconnection technology overseas. The intense competition in the face of this increasing globalization currently challenges manufacturers and leaves many firms unable to raise prices to keep pace with rising production costs. Without a technology innovation base, they are also unable to increase their productivity.”
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To address the fundamental concerns of a viable North American printed circuit board industry, IPC formed a task force composed of the top North American manufacturers. The task force includes either the presidents or senior executives of Colonial Circuits, DDi Corp., Endicott Interconnect Technologies, Hunter Technology, IMI Inc., Merix Corp., Sanmina-SCI, TTM Technologies, Vulcan Flex Circuits Corporation.

The following are recommendations to the PCB Executive Agent.

1. DoD should source non-critical technology domestically in order to support a robust and technically advanced domestic supply base.

Exclusive North American Market. The electronic interconnect industry requires a vibrant and self-sustaining marketplace. Participants can compete with one another while delivering products encompassing all levels of technology to DoD in a timely fashion. Various types of technology development forums, independent research and development (IR&D), consortiums, partnerships, grants and funded R&D are needed. These forums will only be effective if the marketplace allows a sufficient number of suppliers to operate profitably.

The greatest current deterrent to a viable marketplace for PCB defense contractors is the trend by tier 1 and 2 defense contractors to source DoD-destined products outside North America. This is most common among lower-technology, higher production-volume products. Sourcing lower-technology, higher production-volume products to North American suppliers will steady the revenue base to support research and development efforts.

Currently, the North American PCB manufacturing base competes for very complex, high technology DoD products that are characterized by very high material content, very long build cycles and very low yields. Failure to include the North American PCB industry in fabricating products for the low-technology market has a negative financial impact on North American PCB manufacturers.

To ensure that the North American electronic interconnect industry is able to sustain its current economic viability, the industry must have access to the less complex PCB market of DoD products. Businesses diversify their projects to ensure that volatile market fluctuations do not result in devastating financial losses or closure of the facility. Access to less complex PCBs for DoD use will provide manufacturers with sustained, predictable funding. In turn, this will stabilize PCB manufacturers resulting in a dependable and consistent supply base.

IPC recommends that the Executive Agent pursue regulations requiring defense contractors to formally explain overseas sourcing of PCB products (e.g., technology not available in North America). We do not suggest completely prohibiting overseas sourcing of PCB products, only a justification of the action.

Pricing should not be a valid reason for overseas sourcing. Items manufactured in countries without similar regulations and without the United States’ security at interest will naturally cost less. North American-made PCB products will always work best in North American-made defense systems. In most cases, the PCB items were bid to DoD with North American supplier pricing and awarded by DoD on this basis. Preserving a North American marketplace assures DoD continued access to a competent, competitive and organized PCB industry. Sourcing domestically will result in a vibrant North American PCB market to support current and future DoD requirements for PCB technology.
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2. Creation of a DoD-funded PCB consortium to conduct research and development to ensure that PCB manufacturers are able to supply DoD/OEMs and support future DoD/OEM product needs.

This consortium should have direct access to dedicated R&D funding and work to develop advanced technologies as identified by OEM/DoD on technology roadmaps issued by recognized organizations such as IPC and iNEMI. The consortium would share any newly discovered technologies resulting from R&D with the industry.

The consortium will facilitate the creation of an infrastructure promoting the development of nationally valuable technologies that will be the world’s best-in-class. Concurrently, the consortium will determine the best course of action of logistics concerns between competing PCB fabricators.

The need for a PCB consortium is predicated on the fact greater demand for higher reliability, performance, and functionality places pressure to increase density of electronic interconnect products. Furthermore, the trend toward miniaturization in the electronics industry demands significant capital investment for new tools, equipment and systems.

Three key factors requiring a consortium supported by DoD to drive the development of new technologies and reward companies that are innovative are:

- Increasingly complex electronic components requiring higher lead counts or input/output (I/O) on the same size (or smaller footprint) package
- Switching speeds continue to increase, which relates to signal integrity
- Portability in wireless communication devices and instrumentation requires increased complexity in electronic functions to be contained in a small area.

Examples are aviation and aerospace equipment, armored and unarmored vehicles, naval communication equipment, special operations equipment, naval warfare, etc.

3. DoD shall mandate that prime contractors include a circuit board technology GAP analysis in their formal bids to DoD with the purpose of ascertaining what is feasible, and accordingly dedicate R&D funding for technologically limited areas.

Narrative of the R&D Flowchart:
The overall business process would initially begin with a product design from the prime OEM. The OEM would be required to conduct a GAP analysis to ascertain the technical feasibility of creating PCBs to fulfill requirements. For those PCBs identified where current technology cannot be used to manufacture the product, a new roadmap would be created to detail the process, time required and other factors necessary to create the final product. A result would be R&D funding dedicated to a PCB manufacturer for the newly identified technologically limited areas in order to create the final end-product required by the OEM.
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4. Transparent information on DoD funding, as well as creation of tax incentives, rebates or credits for PCB manufacturers that supply DoD, will significantly renew interest and investment by U.S.-based companies.

Current Independent Research and Development (IR&D)/Bid and Proposal (B&P) Law. Section 802 of the National Defense Authorization Act for Fiscal Years 1992 and 1993 (Public Law 102-190, December 5, 1991) provides for payment of independent research, development, bid and proposal costs under defense contracts. It requires the Secretary of Defense to prescribe regulations governing the payment of contractor IR&D and B&P costs by DoD and states that these regulations shall encourage contractors to engage in R&D activities of potential interest to DoD, shall not infringe on the independence of contractors to choose which technologies to pursue in their IR&D activities, and shall provide that IR&D and B&P costs are allowable as indirect expenses on covered contracts to the extent that those costs are allocable, reasonable and not otherwise unallowable by law or under the Federal Acquisition Regulation (FAR).

IR&D/B&P Regulations.
The following regulations govern the treatment of IR&D and B&P costs under defense contracts:

- **Federal Acquisition Regulation (FAR) 31.205-18.** This regulation provides the contract cost principles and procedures for IR&D and B&P costs under government contracts, including: definitions of IR&D and B&P costs, cost allowability, deferred IR&D costs and cooperative arrangements. The regulation states, in part, that IR&D and B&P costs are allowable as indirect expenses on contracts to the extent that those costs are allocable and reasonable, with certain exceptions.

- **Defense Federal Acquisition Regulation Supplement (DFARS) 231.205-18.** This regulation provides the contract cost principles and procedures for IR&D and B&P costs under defense contracts, including: definitions of covered contract, covered segment and major contractor; cost allowability; and a list of activities that are of potential interest to DoD. For major defense contractors, allowable IR&D/B&P costs are limited to those for projects that are of potential interest to DoD. The cognizant administrative contracting officer (ACO) or corporate ACO determines whether the IR&D/B&P projects are of potential interest to DoD.

- **Defense Federal Acquisition Regulation Supplement (DFARS) 242.771.** This regulation provides the contract administration functions relating to IR&D and B&P costs incurred by major defense contractors, including the responsibilities of: the cognizant ACO or corporate ACO, the Defense Contract Management Agency or the Military Department responsible for performing contract administration functions and the Director for Defense Research and Engineering.

- **Cost Accounting Standard (CAS) 420.** This regulation provides criteria for the accumulation and allocation of IR&D and B&P costs to cost objectives based on the beneficial or causal relationship between such costs and cost objectives. (A cost objective is a pool, center or area established for the accumulation of cost(s), such as organizational units, functions, objects or items of expense, as well as ultimate cost objectives including specific titles, cost categories, grants/awards, program activities, projects, contracts and/or other activities.) The regulation provides definitions, fundamental requirement, techniques for application and illustrations.

- **DoD IR&D Program Directive.** Department of Defense Directive 3204.1, May 10, 1999, establishes policy and assigns responsibilities for both the technical and business aspects of IR&D and B&P activities. The Directive establishes the Technical Coordination Group (TCG) to provide both oversight of the IR&D Program and effective communications between industry and DoD.

- **Navy Instruction.** Navy IR&D Program activities are governed by SECNAVINST 3900.40C, Policy and Assignment of Responsibilities for the Independent Research and Development (IR&D) Program, 23 February 2000.
5. DoD should enforce compliance with current standards, such as military (MIL-SPEC), International Traffic in Arms Regulations (ITAR), and DoD-adopted IPC standards, in order to ensure trust for PCBs intended for DoD.

Industry-accepted standards, imposed by the customer and adhered to by the manufacturer, create a superior and quality product. Manufacturers that fully comply with industry-accepted standards ensure reliability, conformance to requirements, technological objectivity and lowest total cost-in-use.

Manufacturers rely extensively on standards during all phases of fabrication, such as design, testing, compatibility, functionality and ultimately production. The process of adhering to the specifications forces the manufacturer to establish and maintain systems to ensure high product reliability. Examples are thorough testing and complete material traceability. Suppliers who do not adhere to the specifications will not be burdened with associated costs, but also will not be disciplined by their requirements. Only strict enforcement of standards compliance will eliminate potential counterfeit, poor quality and unreliable products.

6. Prime contractors working on DoD programs must be involved in and actively participate in the development and ongoing maintenance of PCB technology roadmaps.
Conclusion

The Executive Agent is vital in guaranteeing that the industry is able to meet DoD PCB requirements, ensure our national security, help sustain state-of-art technology within the North American PCB industry, and promote a North American PCB industry capable of supporting DoD and prime original equipment manufacturers’ (OEM) needs.

Special Thanks

IPC is very grateful to all of the organizations and individuals that provided support and guidance to make the policy recommendations possible. The following companies are to be applauded for their contributions to the development of the policy recommendations as well as their commitment to ensure the success of the electronic interconnect industry.

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