SIEMENS

November 8, 2021

The Honorable Matthew S. Borman
Deputy Assistant Secretary for Export Administration
Bureau of Industry and Security
U.S. Department of Commerce
1401 Constitution Avenue NW
Washington, DC 20230

RE: Siemens Comments Responding to Bureau of Industry and Security Request for Public Comments on Risks in the Semiconductor Supply Chain

Dear Mr. Borman,

As both a user of semiconductors and supplier of technology to produce semiconductors, Siemens USA is grateful for the Department of Commerce's efforts to strengthen semiconductor supply chains and the opportunity to share our views. Our company is a global innovator focusing on digitalization, electrification and automation for the process and discrete manufacturing industries, and is a leader in intelligent infrastructure, distributed energy systems, and semiconductor design software. The United States is Siemens largest market where for more than 160 years, the company has developed technologies that support multiple American industries including manufacturing, electronics, energy, healthcare, and infrastructure.

Siemens supports Department efforts to partner with private sector innovators to grow and sustain a diverse semiconductor supply chain by increasing domestic state-of-the-art (SOTA) manufacturing and packaging capacity. The success of this effort will hinge on close, trusted collaboration between manufacturers, technology providers like Siemens and leaders in government.

Today, Siemens is the only company in the world that supplies products in each category of the semiconductor lifecycle, from new product ideation through all aspects of design and manufacturing operations management. Given our unique perspective as a supplier and enabler across the lifecycle, our comments come from our position as a supplier of technologies that can be leveraged to build more transparency, competitiveness and resiliency into this vital supply chain. Our experience indicates the right mix of technologies can bring more transparency and cost effectiveness to the supply chain in the short term and ultimately support more domestic manufacturing capacity over the long term.

About Siemens USA

Siemens Corporation, a U.S. subsidiary of Siemens AG, is a global technology powerhouse that has stood for engineering excellence, innovation, quality, reliability and internationality for more than 170 years. Active around the world, the company focuses on intelligent infrastructure for buildings and distributed energy systems and on automation and digitalization in the process and manufacturing industries. Siemens brings together the digital and physical worlds to benefit customers and society. Through Mobility, a leading supplier of intelligent mobility solutions for rail and road transport, Siemens is helping to shape the world market for passenger and freight

services. Via its majority stake in the publicly listed company Siemens Healthineers, Siemens is also a world-leading supplier of medical technology and digital health services. In addition, Siemens holds a minority stake in Siemens Energy, a global leader in the transmission and generation of electrical power that has been listed on the stock exchange since September 28, 2020. In fiscal 2020, Siemens Group USA generated revenue of $17 billion and employs approximately 40,000 people serving customers in all 50 states and Puerto Rico.

Siemens USA Semiconductor Technologies Bring Resiliency and Transparency to the Industry

Siemens is a trusted partner in the electronics and semiconductor design and manufacturing industry. Our focus is on supporting the industry today and innovating for tomorrow. Siemens Digital Industries is an innovation and technology leader in industrial automation and digitalization. In close cooperation with our partners and customers, we are the driving force for the digital transformation in design and manufacturing, including a special focus on semiconductors. For example, our Xcelerator portfolio enables SOTA design and ignites digital transformation, empowering companies of all sizes to embrace complexity and enhance productivity to gain a competitive advantage. To help customers harness complexity in today's environment, Siemens offers a comprehensive and integrated portfolio of software solutions for the electronics and semiconductor industries including Electronic Design Automation (EDA), Product Lifecycle Management (PLM), Application Lifecycle Management (ALM), Manufacturing Operations Management (MOM), Embedded Software and the Internet of Things (IoT) solutions that drive digital transformation for businesses of all sizes.

To be successful in today's marketplace, semiconductor companies must move faster than ever, constantly work to lower the cost of development and production, respond to changing customer demands, create new business models and out-innovate the competition. In this challenging business environment, managing complexity and rapid time to market are the key challenges.

Siemens provides business solutions for the semiconductor industry built within a complete End-to-End solution portfolio. Our vision is to be the leading provider of best-in-class digital solutions in strategic industries that seamlessly integrate with Product Lifecycle Management, Design Automation and manufacturing technologies to digitally transform our customers global operations. Our drive is to help manufacturers design and make the highest quality products faster than their competitors by providing industry-rich scalable, accessible, and flexible solutions that enable the Customer Driven Digital Enterprise.

Siemens also has unique expertise in bringing transparency to supply chains. Our portfolio includes Supplyframe, a leading marketplace for the global electronics value chain. Supplyframe is a Design-to-Source Intelligence (DSI) ecosystem with over 10 million engineering and supply chain professionals worldwide, transforming how businesses design, source, market and sell products in the global electronics value chain. Within the DSI Network, users access comprehensive, continuously updated information spanning a universe of over 1 billion in-market part attributes, including real-time availability and lead-time data, along with 700,000 downloadable 2D/3D models. Most importantly, user engagement within the DSI Network fuels billions of continuous signals related to global electronics part supply, demand, risk factors, and commercial intent. This rapidly expanding data asset is the foundation for transformational intelligence that informs our comments to the Department.

Smart, digitalized solutions are necessary for electronics and semiconductor companies of all sizes and market types (e.g., computing, communication, consumer, automotive, aerospace & defense, and industrial) to achieve rapid time to market delivering customer specified design and manufacturing infrastructure with today's complex products and systems. The most innovative and leading companies in the semiconductor industry, new or old, large or small, rely on Siemens software and other technology to support their digital transformation journeys.

A secure supply of chips is both an economic and national security imperative. At Siemens Government Technologies, we have seen firsthand the powerful benefits blockchain-like technologies can enable for the Department of Defense and other government agencies to advance visibility, improve supply chain assurance, protect critical data, enhance security and improve traceability. Given their prevalence and indispensability to the defense industrial base, microelectronics are a major concern in the defense sector as a potential pathway for adversaries to infiltrate business supply chains. We have worked with our partners to develop solutions to these challenges by bridging the gap between the physical and digital worlds of supply chain stakeholders and developing hierarchical assurance and logistics systems that enable supply chain collaboration and trust.

For example, blockchain or similar technology can help secure the DoD's microelectronics supply chain by providing measurably secure asset visibility and mitigating risk of counterfeit or fraudulent components. Excitement around the technology is building as federal agencies begin piloting and testing blockchain applications for supply chain and procurement operations, record management, manufacturing, and cybersecurity. These solutions also hold promise for the commercial sector and should be considered as the Bureau of Industry and Security looks for innovative ways to increase transparency and resiliency in the semiconductor supply chain.

Siemens Works Across All Semiconductor Technology Nodes, Material Types and Device Types

All semiconductor company types (designers, IP suppliers, fabs, fabless, IDMs, foundries, OSATs, packaging, assembly, test) can use SOTA software solutions for the semiconductor industry from Siemens to drive innovation and increase productivity. These solutions would benefit the supply chains of all microelectronics technologies including SOTA and legacy logic, processors, memory, analog, RF, mixed-signal, photonics and MEMS technologies. We help companies digitally transform their operations with edge-to-edge solutions covering all aspects of the semiconductor device (IC, Chip) lifecycle, from concept to design, through production to operations and optimized service lifecycle management.

Siemens provides business solutions for the semiconductor design and manufacturing industry and can deliver scalable, adaptable, and flexible solutions in support of high yield, first-time-right advanced manufacturing of these complex technologies for current and future technology nodes. The technology node (i.e., process node, process technology or simply node) refers to a specific semiconductor manufacturing process technology and its design rules. Different nodes often imply different circuit generations and architectures (e.g., 14nm ➔10nm ➔ 5nm). Generally, the smaller the technology node means the smaller the transistor feature size, enabling smaller transistors which are both faster and more power efficient.

Leading-edge chips are manufactured in state-of-the-art 300mm fabs using various advanced processes ranging from 16nm/14nm to 5nm. In addition, 300mm fabs also manufacture devices at mature nodes ranging from 65nm to 20nm. Chips also are manufactured in older 200mm fabs using processes ranging from 350nm to 90nm. Semiconductor companies leverage industry 4.0

best practices to manufacture better quality products at more competitive prices by working with Siemens. Taken together, our business offers the world's most comprehensive portfolio of IC design, verification, and manufacturing tools for the semiconductor industry. Siemens innovative software solutions make it possible for all semiconductor companies to create products with fewer design re-spins and a higher degree of design success.

Recommendations for Growing the U.S. Semiconductor Industry

Siemens has been supporting the Administration's efforts on infrastructure modernization. We are very pleased to see a vision that goes well beyond roads and bridges and tunnels to include boosting domestic manufacturing of critical supplies like semiconductors. When the national spotlight shines on America's aged infrastructure, we don't typically see U.S. manufacturing. Yet recent challenges to rapidly produce and distribute vital supplies for the COVID-19 pandemic response and beyond have shown us that modernizing our industrial base is of national importance. Prioritizing the digital transformation of America's factories will raise the competitiveness of U.S. manufacturing and prepare us for the next crisis.

We agree that securing our supply chain and boosting U.S. manufacturing aren't just industry issues – these are of national importance. The disruptions caused by the pandemic have laid bare the importance of being "glocal"; that is, having a secure, reliable supply of semiconductors is critical to our economic competitiveness, to our national preparedness, and to making our infrastructure more connected and ultimately intelligent. With this in mind, we respectfully offer the following recommendations for how government and industry can jointly support the growth of a resilient, secure, and advanced domestic semiconductor industry.

1. **Fund the CHIPS Act and pass the FABS Act to grow U.S. semiconductor manufacturing capacity with digitalization.**
   Our nation must build smart, digitalized operations to increase connectivity, flexibility, control and security of the chip design and manufacturing environments. Urgent investment is needed due to the two to four years it takes to bring new fabrication facilities online. The pandemic teaches us that traditional "just in time" approach to chips fails when dealing with unforeseen circumstances like a public health crisis or resource shortage.

   There is a clear role for public/private collaboration here, which is why Siemens encourages swift action by the U.S. Congress and Biden Administration to provide maximum funding for the Creating Helpful Incentives for the Production of Semiconductors (CHIPS) Act, to include dedicated funding for the existing domestic fabrication base. Likewise, we recommend the U.S. Congress approve the Facilitating American Built Semiconductors (FABS) Act, with an investment tax credit for both design and manufacturing. Action on both initiatives will help the United States regain a leadership position in the semiconductor industry, by supporting research, design and manufacturing.

   The best way to lower cost parameters for domestic manufacturing is to leverage digitalization. Funding the CHIPS Act and approving the FABS Act will help Siemens and other technology providers deliver transformational technologies to the industry. It will also help make our supply chains more resilient over the long-term, as we can mitigate a significant portion of supply chain risk if electronic products (or systems) are designed for resiliency across the supply chain from the start. This requires a digital transformation of the enterprise.

Component selection in the initial product development process is a root cause of downstream continuity of supply, resiliency, cost, and risk. In fact, up to 70% of the lifetime risk and cost is locked in at the product design phase. Getting intelligent insights into risk, cost, lead time, and building diverse sources of supply at the point of design greatly reduces the downstream risks across the product lifecycle. The same IoT devices that are bringing tremendous variation to the industry, adding to the supply crunch, are also capable of optimizing our manufacturing outputs. The value of smart manufacturing is its ability to bring new insights, opportunities, and automation earlier into the chip/system/product design realms that can lead to significant production cost savings while improving product reliability. This gives domestic semiconductor companies a competitive advantage.

Supporting the digital transformation of existing/legacy chip fabrication site infrastructure to make them smart factories will allow them to quickly expand domestic manufacturing capacity of commodity-level chips. Currently, there is national attention on the availability of chips for the U.S. auto industry and consumer products. While we encourage research and investments in the next generation of chips, it is important to keep in mind that the chips that are used in consumer electronics and automobiles are not necessarily the most state-of-the-art technology. There are several dozen U.S. fab sites that are ripe for upgrades to their IoT infrastructure and manufacturing processes that will allow them to boost output, lower costs and be globally competitive. This presents an opportunity for the "legacy" chips industry to adopt smart manufacturing and learn from adjacent industries, such as the auto industry's use of digital twins, virtual commissioning, simulation, and IIoT connectivity from the shop floor to the c-suite. They would benefit from having clear signals from government and industry before they embark on capital improvements. The investments laid out in the U.S. Innovation and Competitiveness Act to dedicate $2B for legacy fabs will help here.

Additionally, we recommend the Administration dedicate effort to stabilizing and sustaining the U.S. memory chip industry. Existing domestic memory companies face global competition and must be included in domestic semiconductor investment strategies to help them maintain and grow their global positions. All electronic systems are dependent on a robust memory chip supply chain.

2. **Develop and sustain a comprehensive, long-term U.S. microelectronics strategy with a focus on manufacturing, and research and development of capability and security.** Currently, the U.S. government's investment approach to semiconductors lacks an over-arching strategy across all electronics-oriented departments (e.g. the Departments of Defense, Commerce and Energy) that moves the nation towards being a robust and world-leading supplier of SOTA semiconductors. As the Department of Commerce continues to investigate this challenge, we recommend an inter-agency approach towards the development and sustainment of a national strategy that maximizes the impact of applied research and development programs, with the goal of setting a strategy that prioritizes measurable security, assurance, and/or quantitative assurance for microelectronic and electronic systems. Additionally, the national strategy should define a plan for SOTA and legacy semiconductor manufacturing and packaging.

3. **Collaborate with U.S. and allied nation industry to leverage forecasting technologies that build resiliency and ensure a diverse ecosystem of vendors is available to support semiconductor manufacturing.**
The disruption and risk in the season of COVID-19 have unleashed a dramatic impact on supply chains, bringing new uncertainty to an already complex electronics landscape. The

global spotlight on these challenges provides opportunities for increased collaboration among allied nations.

The immense complexity of today's hardware products and designs is compounded by increasing competitive pressures, supply market volatility, delayed lead times, cost, and capacity constraints. Addressing these unknown forces requires new forms of global intelligence, delivered with immediacy at the point of need. The "next normal" requires that the design, sourcing, and manufacturing ecosystem be increasingly focused on how to make better decisions, with better intelligence.

Siemens has been able to significantly mitigate our own supply chain disruptions through a combination of market intelligence tools, proactive supply chain risk management practices, working with a strong and diverse supplier network, and we are increasingly adopting new tools to increase our capabilities such as predictive analytics to reduce our risk. In the early stages of design and innovation, the technical decisions made by engineers and supply chain professionals are typically only as good as the quality of data driving those decisions; and yet, these data points exist, but are generally hard to interpret. Digital engagement during new design cycles and related sourcing events is essential to influence and convert new opportunities. We have found that Design-to-Source Intelligence (DSI) is a powerful new paradigm for driving greater resiliency and agility in the electronics value chain that can be used as a powerful source of insight to create awareness, influence decisions, and deliver a new form of customer experience.

Logistical and communications failures are some of the root causes for the shortages. The ultimate solution to this is further utilization of digital tools that improve processes and communications across companies. Industry and government can partner to improve supply market intelligence, visibility to source of supply, identified risk drivers (financial, lead time, weather, geopolitical, etc.) for critical sectors of the US manufacturing base. We encourage the Bureau of Industry and Security and others within the U.S. government to consider leveraging DSI as it works on this challenge.

Additionally, we recommend the U.S. government work with partners and through multilateral forums to ensure a diverse ecosystem of vendors to support semiconductor manufacturing, including software, and to collaborate on export control policy. The Administration should take a measured, cautious approach to fully assess foreign availability before considering new export restrictions on electronic design automation (EDA) and industrial software as directed by the Export Control Reform Act of 2018. Given the strong foreign investment, availability and capability in non-U.S. EDA tools, EDA should not be listed in future Foundational Technologies rulemaking. Applying export restrictions to items meetings these characteristics may not achieve the Administration's foreign policy goals. Proper considerations about export controls will ensure United States firms along the semiconductor supply chain are able to maintain their market presence, revenue streams and ultimately their research & development in new tools to invest in U.S. semiconductor industry development. Finally, to remain competitive with the growing non-U.S. EDA market, the U.S. should dedicate funding to advancing EDA technology, such as through research and development, public-private partnerships, and manufacturing institutes.

4. **Support the establishment of one or more domestic chip assembly and test houses**. A significant risk for the U.S. semiconductor supply chain is that there are no accessible Outsourced Semiconductor Assembly and Test (OSAT) facilities in the US or EU that are currently capable of packaging, assembling and testing semiconductors with advanced

state-of-the-art (SOTA) capabilities (or densities). This makes the US reliant on distant OSAT supply chains and is a potential area for US-EU cooperation on a shared challenge. We recommend leveraging existing local and federal investments (e.g., Skywater/BRIDG in Florida) that are already aimed at growing SOTA packaging capabilities in the U.S. The current crisis demonstrates that adopting smart manufacturing in the semiconductor industry has never been more important. It helps address the daunting combination of complexity, safety, and optimization. It enables the exploration and evaluation of possible solutions for design, fab or packaging companies.

5. **Build security into any new investments through Trusted Traceability**.
With new investment, we can leverage the power of the digital thread to track the detailed genealogy of an entire electronic product's supply chain down into the details of design, manufacturing and everything that follows. Doing this will provide measured assurance (measured security or quantitative assurance) that the chips in the final system are exactly what is expected—nothing more and nothing less. There are thousands of steps in the chip design, production and packaging processes. By verifying these steps through a digitalized, secure, distributed ledger system (e.g., block chain), we can know exactly what is going into a chip (e.g., design IP and materials), where it was made, who made it, when and that it was all done according to specific, provable design and manufacturing standards.

   This approach will allow us to build a secure, closed-loop, domestic ecosystem of electronic system production that starts at the beginning of the supply chain with semiconductor design and fabrication. It helps with both security and predictability of the supply chains, as well as measuring and monitoring foreign content. As our government helps global semiconductor companies to setup fabs in the US, we should encourage them to participate in genealogy-tracking solutions like Trusted Traceability.

   This approach is applicable to much more than semiconductors. Trusted Traceability can be applied to any sensitive vertical: pharmaceuticals, medical equipment, communications equipment, automotive, food/beverage, advanced batteries, aerospace and more. Siemens does this today with medical devices in partnership with the FDA: the agency is leveraging digital evidence to speed the approval of medical devices through virtual commissioning, rather than waiting for physical prototypes. Siemens has also been working with the largest leaders in the food and beverage industry over the last four years to develop and prototype these Trusted Traceability capabilities. Siemens proposes to migrate these same techniques into the semiconductor and other industries.

6. **Ensure semiconductor investments support infrastructure and sustainability goals.**
The public investments envisioned should include requirements for continuous monitoring of energy, water, and chemical usage to optimize outputs and build a more resilient industry. This will allow the US to "build back better" with a more connected, smart, environmentally sound infrastructure system for the future. We have a demonstration of this technology underway now at the Dubai Expo, where visitors can see how data can be monitored in real time to optimize output and minimize environmental impacts.

7. **Build the Technology Workforce of the Future.** Sustainment of the domestic semiconductor industry is predicated on having a strong, diverse technical workforce. The microelectronics ecosystem is unique in that it is made up of multiple research- and development-driven disciplines which interact throughout the supply chain, to include software design tools; high capital and R&D based advanced node IC manufacturing; IC packaging, and test and assembly. The industry is founded in broad, collaborative STEM-

based expertise; mechanical, electrical and chemical engineering, material scientists and physicists cooperating across many companies to produce leading edge microelectronics.

The U.S. has a persistent technical workforce skills gap, particularly with regard to advanced manufacturing and technology capabilities. Siemens has partnered with U.S. secondary schools, trade/technology schools and universities to provide access to our suite of digital design and manufacturing software and hardware automation tools. The software is frequently incorporated into student coursework and research related to design, engineering simulation, industrial design, digital manufacturing and manufacturing management.

When the COVID-19 pandemic hit the United States last year, Siemens responded to the U.S. government's call to make online learning resources more accessible for teachers, parents, and students, as more Americans are encouraged to stay home amid the COVID-19 outbreak. Siemens Digital Industries Software provided complimentary access to two sets of professional manufacturing software educational offerings.

Semiconductor manufacturing, design and engineering jobs worldwide are currently unfilled due to the growing skills gap. With these tools, students at all educational and experience levels can develop technical skills needed to prepare for Industry 4.0 through a comprehensive solution of tools, technical expertise, and strong industry collaboration. Our company is prepared to further partner with the Administration, industry and academia on building the technology workforce of the future.

Siemens is Committed to Supporting Department Efforts

Siemens has a deep understanding of the semiconductor industry and ways to mitigate supply chain risk by leveraging digitalization. We stand ready to assist the Department's ongoing efforts to bring more transparency to the supply chain and increase the capacity of domestic manufacturers to produce these critical supplies.

For more information, please contact Harrison Wadsworth, Head of Digital and Transportation Policy, at Siemens Corporation.

Respectfully submitted:

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