

The Advantages of Semiconductor Chip Up-Screening – Part 1: Elevating Semiconductor Components

INTRODUCTION

The semiconductor industry has long been the foundation of technological innovation, driving progress in virtually every sector from consumer electronics to automotive to communications to military, aerospace, space, energy and beyond. Semiconductor chips, such as microprocessors and memory, are the invisible force that powers the devices and systems that impact many aspects of modern life. Since their inception, the industry has continued to push the boundaries of what is possible, developing more complex and miniaturized components to keep pace with the unstoppable pace of technological development.

While this rapid pace of innovation is essential for progress, it has also brought with it significant challenges, most notably the obsolescence of semiconductor components. As new generations of semiconductor technologies are developed, older components are phased out, posing a variety of challenges for industries that rely on the long-term operation and support of legacy systems.

THE GROWING PROBLEM OF OBSOLESCENCE

The advent of artificial intelligence (AI) will likely accelerate Moore's Law, delivering chips with increased transistor density that are vastly more powerful and efficient. This will also lead to an acceleration in the obsolescence of semiconductor chips. Gone are the days when a chip could remain relevant for new applications for several years. This rapid obsolescence poses major challenges for industries such as aerospace, defense, power generation, and industrial manufacturing, who rely on the availability of industrial and military grade, high reliability, components to sustain the legacy systems critical to their missions. This rapid obsolescence of semiconductor chips is a serious concern.

One of the most promising approaches to solving this problem is chip up-screening, a process in which commercially available components are tested to higher standards to ensure that they meet the stringent requirements of specific applications.

“Up-Screening Commercial-off-the-shelf (COTS) components for high reliability applications can eliminate the need for expensive and time-consuming redesigns or requalification of new or alternative parts”

- Dr. Nicholas Williams, SMT Corp. Labs Director

WHAT IS SEMICONDUCTOR CHIP UP-SCREENING?

Chip up-screening involves subjecting components to additional testing and qualification processes beyond the manufacturer's specifications. The goal is to ensure that these components operate reliably in environments that demand higher performance and/or higher reliability, such as extreme temperatures, faster speeds, radiation exposure, or extended operational lifespans.

The chip up-screening process shares similarities with the rigorous testing procedures, such as those defined for Class B/Q devices under MIL-STD-883, specifically the 5004 and 5005 methods. Here's how they connect:

1. **Environmental Stress Testing:** Just like in up-screening, Class B/Q devices go through tests that expose them to extreme temperatures, moisture, and physical stress. This is done to make sure they can handle tough environments.
2. **Burn-In Testing:** This process involves running the components at extreme temperatures for a long time to catch any early failures. This step is crucial for determining the reliability of the devices.
3. **Electrical Testing:** In both up-screening and the 5004/5005 methods, components are tested to make sure they meet all the necessary electrical standards, like voltage and timing. This step ensures the components will perform as expected.
4. **Screening for Defects:** Like up-screening, Class B/Q devices are inspected and tested for any physical defects, like cracks, leaks, or other issues, that could affect their performance. This can include visual checks and X-rays.

Using the 5004 and 5005 methods as a guide gives a good idea of what up-screening might involve. However, depending on the specific situation, some of these steps could be necessary, while others might not be practical.

WHAT ARE THE STRATEGIC ROLES AND BENEFITS OF CHIP UP-SCREENING?

Chip Up-Screening offers an alternative to sourcing obsolete industrial and military grade components by enabling the use of available commercial grade parts that are up-screened, thus avoiding the need for custom designs or costly redesigns. This process not only extends the operational lifespan of legacy systems by ensuring that obsolete components continue to perform reliably but also reduces the risk of failures in critical applications through rigorous testing. Additionally, up-screening enhances supply chain flexibility, allowing companies to adapt to component shortages or discontinuations while maintaining high standards of quality and performance.

CHALLENGES AND CONSIDERATIONS

While chip up-screening offers numerous benefits, it is not without its challenges. The process can be time-consuming and requires specialized equipment and expertise. Additionally, not all components are suitable for up-screening, and the availability of certain parts may still pose a challenge. Companies must carefully evaluate the cost-benefit ratio of up-screening versus other alternative strategies, such as independent distributors, parts "resurrection", or system redesign.



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WHAT TO LOOK FOR IN A CHIP UP-SCREENING PARTNER?

Choosing the right partner for chip up-screening is a strategic decision that can greatly improve your ability to manage semiconductor component obsolescence. When evaluating potential partners, it's essential to consider:

1. Does the partner understand high reliability requirements like military, aerospace, space, and high-temperature operations such as oil drilling, as these conditions are often extreme and unforgiving?
2. Are their testing processes aligned with industry accepted high reliability standards, such as MIL-STD-883 and MIL-STD-750? MIL-STD-883 includes a variety of tests designed to simulate the stresses that components might face in real-world conditions where any failure could lead to catastrophic consequences.
3. Can they ensure only genuine, high-quality components are sourced?
4. Do they understand what is needed in high-stakes environments, such as military operations, aerospace, or critical infrastructure where non-conforming or counterfeit components could lead to severe consequences compromising safety, mission success, and operational integrity?
5. Are their labs equipped to undertake the process involved covering rigorous testing and validation to ensure that components can withstand the unique stresses of their intended environment?
6. Can they deliver a comprehensive component testing service that ensures components perform reliably under the extreme conditions they will encounter? This service includes rigorous assessments for durability, heat resistance, and operational stability, verifying that each component meets the stringent demands of its intended environment to guarantee that your systems will operate flawlessly in even the most challenging conditions.

The above specialized knowledge and capabilities of an up-screen testing partner is essential for ensuring that systems in these critical applications remain functional, safe, and effective, even in the most challenging conditions.

SMT Corp has more than 15 years of experience in these fields, focusing on the highest standards of precision and reliability for demanding industrial and military customers. We have extensive experience in sourcing and/or testing semiconductor components to various standards including MIL-STD-750, MIL-STD-883 and customer specified requirements. SMT Corp also has an experienced, degreed engineering staff that will perform all test fixturing and software development in house. As your partner, SMT Corp can test quantities from "tens" to "tens of thousands" and guarantee that every tested component will perform reliably under the most demanding conditions and reduce the risk of failure.



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About SMT, Corp

SMT Corp is the industry leader for sourcing & authentication of DMSMS and hard-to-find electronics components, electrical testing services, and inventory management solutions. SMT Corp is a highly accredited and recognized expert with full on-site sourcing (AS6081), authentication (AS6171), and electrical testing to mitigate the risk of counterfeit, cloned, altered and substandard products from entering the critical infrastructure supply chain. <https://smtcorp.com/>

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