**Defining SOCAMM Torque Value for Optimal Assembly and Customer Applications**

Tejas Shetty, *Engineer, Pkg DDQA,* Krishan Arpidani, *Package Reliability Engineer,*

Harith Hamdani, *Reliability Test Process Engineer,* Abdul Rasheed, *Sr Package Reliability Process Engineer*,

Gangeshsoorya, *Sr Package Reliability Technician*, See Meng Lim, *Principal DFM Engineer*

***Abstract:* Micron Technology Inc. introduces the Small Outline Compression Attached Memory Module (SOCAMM), integrating LPDDR5X memory with CAMM technology. SOCAMM offers superior bandwidth and power efficiency in a compact form factor, surpassing traditional DDR5 RDIMM modules. Establishing torque specifications is crucial for ensuring manufacturing quality, reliability, and seamless integration. This paper presents a characterization study defining torque standards for both manufacturing and customer applications. The defined torque specifications enhance product reliability, streamline manufacturing processes, reduce costs, enable new product development, and ensure consistent performance. These advancements position Micron at the forefront of innovation, providing a competitive edge and contributing to business growth. Future work includes ongoing testing, integration with emerging technologies, market expansion, continuous improvement, and adaptation based on customer feedback to further refine torque standards and optimize SOCAMM performance.**

***Index Terms:* *SOCAMM, LPDDR5X memory, Torque specifications, CAMM Technology***

# Introduction

Micron Technology Inc. has introduced the Small Outline Compression Attached Memory Module (SOCAMM), a compact and efficient memory solution that combines LPDDR5X with CAMM technology. SOCAMM delivers higher bandwidth and power efficiency compared to traditional DDR5 RDIMM modules, making it ideal for next-generation computing. However, due to its novelty, there are no established torque specifications for its assembly, which are crucial for ensuring mechanical integrity and consistent performance. This paper addresses that gap by presenting a detailed study to determine optimal torque values, aiming to improve reliability, streamline manufacturing, reduce costs, and support new product development—ultimately reinforcing Micron’s leadership in memory innovation

# Methodology

To characterize the screw torque strain behavior of SOCAMM modules, a structured experimental approach was conducted using two SOCAMM units—one with underfill and one without—to assess the impact of underfill on mechanical strain. Each unit was mounted onto a HAST (Highly Accelerated Stress Test) board to simulate realistic assembly conditions.

A group of small electronic components

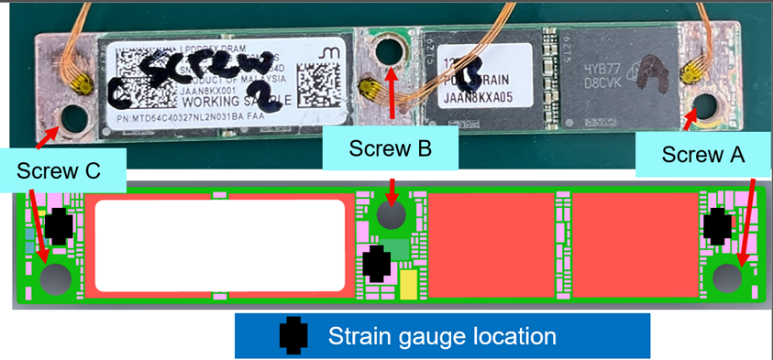
AI-generated content may be incorrect.Fig. 1. SOCAMM HAST board

Torque was applied using a CEDAR DID-4 digital torque driver, which ensured precise and repeatable torque application at each specified value. Two torque application sequences were tested: Screw C > Screw B > Screw A and

Screw B > Screw C > Screw A, representing different screw tightening orders. For each configuration, two trials were performed, resulting in a total of four trials.

A close-up of a device

AI-generated content may be incorrect.Fig. 2. CEDAR DID-4 Torque Driver

Fig. 3. Strain location and sequence of the torque

During each trial, torque was applied at four discrete levels: 0.15 Nm, 0.25 Nm, 0.35 Nm, and 0.49 Nm. Strain data were collected at each torque level using appropriate strain measurement instrumentation to capture the mechanical response of the module under varying conditions.

In parallel, electrical testing was performed using 4 different SOCAMM units to assess the functional impact of torque variation. A baseline electrical test was first conducted on four SOCAMM units (two with underfill, two without). Following this, 15 torque applications were performed at each screw location using M2 x 10 mm screws, across the same four torque levels (0.15 Nm, 0.25 Nm, 0.35 Nm, and 0.49 Nm), resulting in a total of 720 torque applications across all units. After completing torque applications at 0.49 Nm, a post-electrical test was conducted to evaluate any changes in electrical performance.

This combined mechanical and electrical methodology provides a comprehensive understanding of how torque affects both the structural integrity and functional reliability of SOCAMM modules, supporting the development of robust torque specifications and providing critical insights for defining optimal torque parameters to ensure SOCAMM reliability and performance.

# Data findings

A screenshot of a computer

AI-generated content may be incorrect.Fig. 4. Relationship between strain value at different torque value

The box plot analysis reveals a clear relationship between torque value and strain in SOCAMM modules. As torque increases from 0.15 Nm to 0.49 Nm, the highest strain values also increase, indicating a direct correlation between applied torque and mechanical stress. Differences between the two tightening sequences (BCA and CBA) suggest that the order of screw application influences strain distribution. Additionally, strain varies by SG location (A, B, and C), with some positions consistently experiencing higher strain, highlighting location-specific sensitivity. At the highest torque level (0.49 Nm), strain variability also increases, suggesting greater mechanical sensitivity and potential risk of over-tightening.

A screenshot of a computer

AI-generated content may be incorrect.Fig. 5. Relationship between strain value and strain gauge location

The box plot analysis of strain versus SG location reveals that Location A consistently experiences the highest strain values, with a broader distribution and higher mean compared to the other locations. This suggests that Location A is the most sensitive to torque application and may be a critical point for mechanical stress in the SOCAMM assembly. Location B shows moderate strain levels with a narrower spread, indicating more stable behavior under torque. Location C exhibits the lowest strain values, suggesting it is the least affected by torque. Additionally, the tightening sequence (BCA vs. CBA) influences strain distribution, particularly at Location A, where the difference between sequences is most pronounced.

A black background with blue letters

AI-generated content may be incorrect.Table 1. Relationship between strain value at different torque range and torque sequence

Based on Table 1, the strain values vary with both torque level and torque sequence. At lower torque levels (0.15Nm), the B > C > A sequence generally results in lower strain values compared to C > B > A, apart from 0.25 Nm where B > C > A shows a noticeably higher strain. As torque increases to 0.35 Nm and 0.49 Nm, the strain values for both sequences rise, with B > C > A consistently showing slightly higher strain than C > B > A. This suggests that both the magnitude of torque and the order of screw tightening influence the mechanical strain experienced by the SOCAMM module, with the B > C > A sequence potentially inducing more strain at higher torque levels.

A screenshot of a computer screen

AI-generated content may be incorrect.Table. 2. Electrical test results at different torque value

Based on the table, electrical testing across different torque levels for SOCAMM units—both with and without underfill—shows consistent and successful results. A baseline test (T0) for all units recorded that all units are passing. The following torque applications are at 0.15 Nm, 0.25 Nm, and 0.35 Nm. After the final torque application at 0.49 Nm, the post-electrical test also indicates a pass. These results demonstrate that the SOCAMM units maintained electrical integrity throughout the torque range tested, suggesting that torque levels up to 0.49 Nm do not negatively impact electrical performance. This supports the robustness of the design and validates the torque range as safe for assembly and operation.

# Conclusions

This study established optimal torque specifications for Micron’s SOCAMM modules through detailed mechanical strain analysis and electrical performance validation. By testing various torque levels (0.15 Nm to 0.49 Nm), tightening sequences, and module configurations (with and without underfill), we identified how torque magnitude and screw order influence mechanical stress and strain distribution. Electrical testing confirmed that SOCAMM modules maintained functional integrity across all torque levels, with no failures observed even at the highest torque of 0.49 Nm.

Based on the combined mechanical and electrical data, 0.25 Nm was selected as the recommended torque value. This level provides a balanced outcome, minimizing mechanical strain while ensuring consistent and reliable electrical performance. It also offers a safe margin below the upper limit (0.49 Nm), reducing the risk of overtightening and long-term mechanical fatigue.

Adopting 0.25 Nm as the standard torque ensures robust assembly quality, supports manufacturing consistency, and enhances product reliability in customer applications. The outcomes not only close a critical knowledge gap for SOCAMM integration but also reinforce Micron’s position at the forefront of memory technology innovation.

Acknowledgment

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References

1. **Papers:** J. K. Author (initials first), “Paper title,” *Journal Title*, vol. number, issue no., inclusive page numbers (pp.), month (three-letter abbrev.), year. [Note: “et al.” is acceptable if three or more authors.] May be (forthcoming).
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