From Working Silicon to a Production-Ready Device



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A semiconductor device goes through many stages before it becomes a product that can be manufactured and shipped at scale. Designing a chip and proving that the circuit works is only the beginning. The device also needs to operate correctly across voltage, temperature, process variation and different usage conditions. It must survive packaging, meet its electrical specifications, achieve acceptable manufacturing yield, plus demonstrate the required level of reliability.

Test Category	Where it Fits?	Main Question it Answers	Why it Matters?
Characterisation Testing	Development and productization.	How does the device behave across different operating conditions?	Helps establish specifications and operating limits.
Wafer Testing	Before individual dies are packaged.	Which dies meet the required electrical and functional checks?	Identifies unsuitable dies before additional packaging cost is added.
Final Testing	After packaging.	Does the packaged device meet its production test limits?	Confirms that completed components meet defined manufacturing requirements.
Burn-In Screening	During production where required.	Do susceptible devices fail under defined electrical and thermal stress?	Helps identify devices that may be prone to certain early failures.
System-Level Testing	During productization or production.	Does the device work correctly under representative workloads?	Can expose complex problems that conventional production tests may not detect.
Reliability Qualification	Before product release and when relevant changes occur.	Can the device and package withstand specified stresses?	Provides evidence that the product is robust enough for its intended use.

Table 1: Details on the key aspects of each respective test category

This is where semiconductor testing becomes an important part of silicon productization. Productization turns a working semiconductor design into a stable and manufacturable product. During development, test data helps engineers understand how the device behaves and where its operating limits lie. As the device moves closer to production, testing also helps establish specifications, production limits, manufacturing screens, qualification requirements, etc.

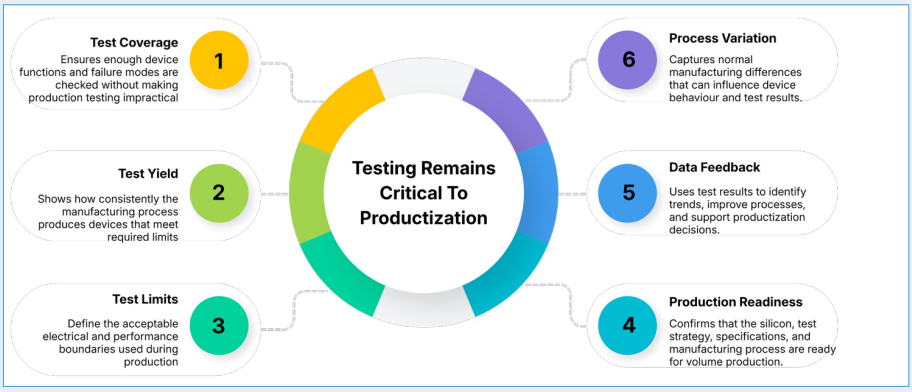


Figure 1: The testing activities that are central to productization

Testing continues after production begins. Wafer and final test data can help manufacturers monitor yield, identify process issues and track changes in electrical behaviour over time. Reliability testing adds another layer of confidence, by showing how the device and package respond to defined stresses. For product designers, this work is reflected in the specifications, operating limits and qualification information available when evaluating a component.

Each type of semiconductor test therefore answers a different question. Characterisation focuses on device behaviour, wafer and final testing support production decisions, reliability qualification evaluates robustness, while system-level testing can examine behaviour under more representative workloads. Together, these activities show how testing supports the path from 1st silicon to a production-ready device, with each stage contributing a different type of confidence.

Building confidence via semiconductor testing

Silicon testing begins well before high-volume manufacturing. During development, engineers use characterisation testing to understand how silicon behaves across temperature, supply voltage, frequency, electrical load and different operating modes. This helps define practical operating limits and supports the specifications that will eventually appear in product documentation. As the device moves closer to manufacturing, the purpose of testing expands. It must identify devices that do not meet production requirements while also providing information about yield, process stability and reliability. Different testing activities therefore contribute at different stages of silicon productization, with each one answering a specific question.

Wafer and final testing provide 2 important production checkpoints. Wafer testing identifies unsuitable dies before packaging and also generates useful information about manufacturing

yield. Final testing takes place after packaging and confirms that the completed device meets defined production limits. These limits must be carefully established because limits that are too wide may allow undesirable devices to pass, while overly narrow limits can reduce yield by rejecting otherwise usable parts.

Burn-in, system-level testing and reliability qualification add further layers of confidence. Burn-in can screen for certain early failures, while qualification evaluates how representative samples respond to defined stresses such as temperature, voltage, humidity, or temperature cycling. System-level testing looks at the device under more representative workloads and can expose problems caused by interactions between multiple functions. Together, these activities help turn working silicon into a product that can be manufactured consistently and released with clearly defined specifications.

Why testing remains critical to productization

One of the biggest challenges in semiconductor testing is balancing test coverage, test time, manufacturing cost and yield. Modern devices can contain billions of transistors and many interacting functions, making it impractical to test every possible operating condition during production. Test limits must also account for normal process variation and measurement uncertainty. Limits that are too loose can allow undesirable devices to pass, while limits that are too tight can unnecessarily reduce yield. As devices and packages become more complex, developing an efficient and effective test strategy becomes an important part of silicon productization.

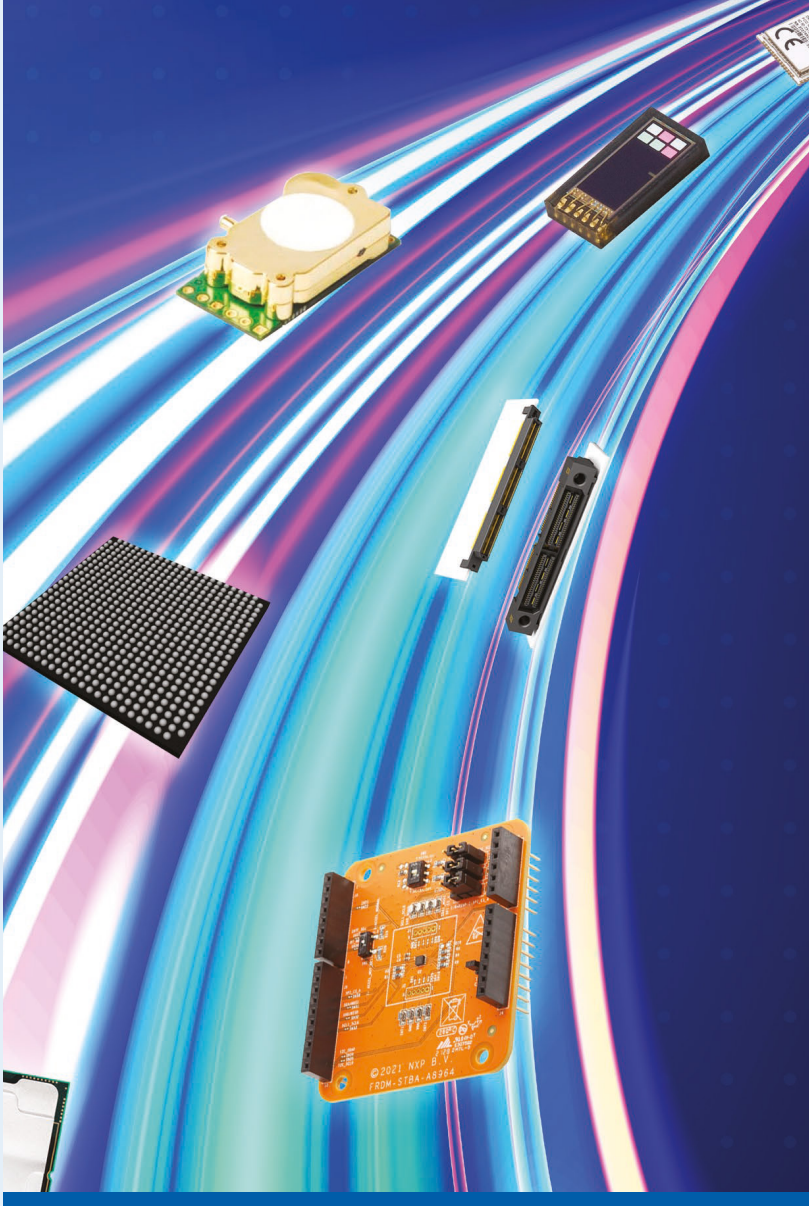
Thus, testing is also becoming more important as semiconductor products combine more processing, memory, analogue functions, interfaces and advanced packaging technologies. Some problems may only appear under particular workloads, environmental conditions, or interactions between different parts of the device. This is why manufacturers often rely on a combination of characterisation, production testing, system-level testing and reliability qualification - rather than expecting one test to provide complete confidence.

Ultimately, semiconductor testing connects working silicon with a production-ready product. It helps establish specifications, control manufacturing quality, improve yield, identify potential weaknesses and provide evidence of reliability. For product designers, understanding what has been tested at component level and what those results actually represent makes it easier to evaluate components and plan system-level validation. A reliable electronic product therefore depends not only on a well-designed semiconductor, but also on a test strategy that supports the device from development through productization and into volume manufacturing.

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