Reliability testing of NEM switches

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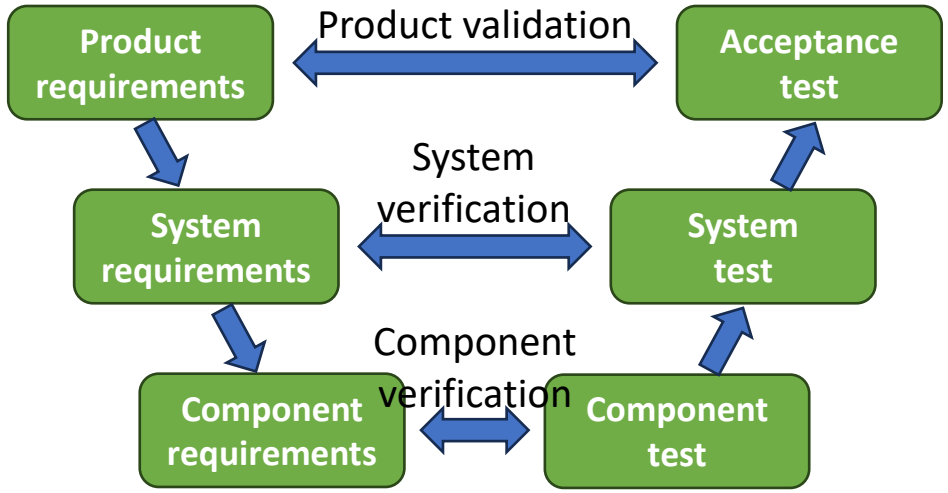
i-EDGE
EDGE COMPUTING FOR EXTREME ENVIRONMENTS

CSEM introduction

- CSEM is a not-for-profit ***Research and Technology Organization (RTO)*** *supported by the Swiss government*
- **CSEM's mission** is to develop and transfer world-class (micro) technologies to the industrial sector
- **A public-private partnership:**
  - 31 % public
  - 69 % private
- **Key figures:**
  - Revenues ~ CHF 82 mio
  - Employees ~ 500
- In the i-Edge project: sector **Additive Manufacturing and Component Reliability**

Why reliability is important

- **Product Performance:** Reliability ensures that electronic devices perform consistently and as expected over their intended lifespan
- **Safety:** A malfunction due to an unreliable component can result in severe consequences, including injury or loss of life
- **Cost:** Failures caused by unreliable components can incur significant costs, including those associated with warranty replacements, repairs, and potential lawsuits
- **Downtime:** Unreliable components can lead to system downtime, causing disruptions in operations, loss of productivity, and missed opportunities
- **Customer Satisfaction, Regulatory Compliance, Long-Term Viability**, etc…



Test program

Aims of the reliability test program:

- Performance assessment under stress
- Identification of weaknesses and failure modes
- Improvement of design and manufacturing processes
- Reliability quantification (e.g. operational limits, failure rates, probability of failures, etc…)
- Lifespan prediction
- Meeting regulatory requirements

Customer inputs:

- Application requirements
- Reliability targets
- Regulatory compliance
- Life cycle considerations
- Cost constraints
- Criticality of operation
- End-user feedback

i-Edge reliability test program

- The following reliability specifications are targeted at the level of individual NEM switches and systems thereof:

Stress factor	Target specification
Maximum operation temperature	+325°C
Minimum operation temperature	-271°C (2K)
Temperature cycling	1500 cycles @ -65°C / +175°C
Mechanical shock	1000g @ 1ms half-sine pulse
Mechanical vibrations	50g sine sweeps and random
Total ionizing dose (gamma radiation)	1 & 10 Mrad(Si) @ 25°C, Vcc_{max}
Single event Latchup (heavy ion source)	Up to a LET of 78 MeV.cm^2/mg 10^7 ions/cm^2 @ 125°C, Vcc_{max}
Single event Upset (heavy ion source)	Up to a LET of 78 MeV.cm^2/mg 10^7 ions/cm^2 @ 25°C, Vcc_{min}
* Hermeticity and humidity resistance tests for the packaging solutions	Package-type specific (plastic and hermetic options)

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