

PRODUCT SELECTION & SERVICES GUIDE

Space Applications

Core Technologies, Upscreening & Customization



Industry-Leading Selection & Design Capability

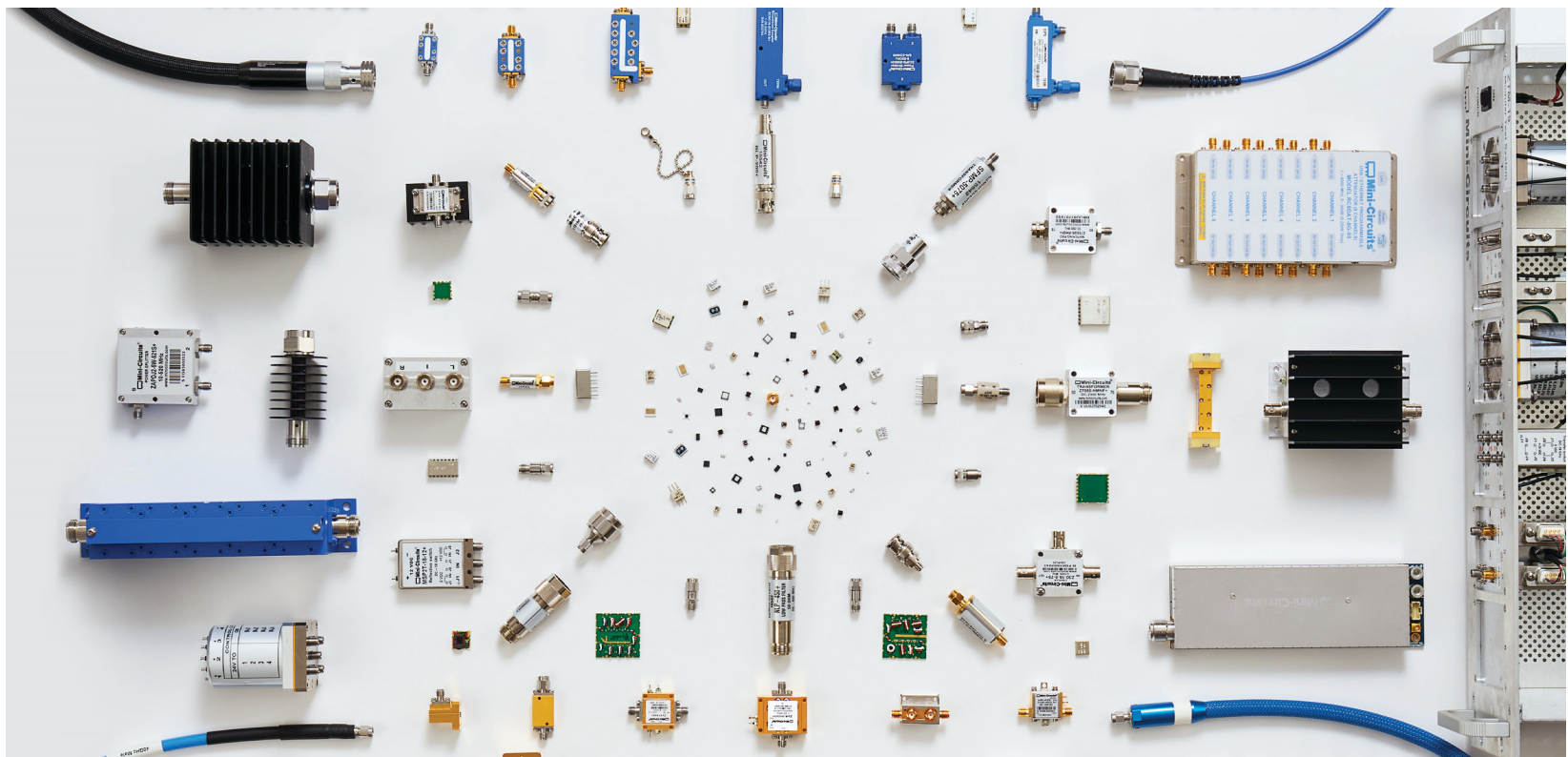
Portfolio Overview

Industry's widest RF Product Selection

- 27+ Product Lines
- 7,500+ Stocked Catalog Components
- 32,000+ Total Active Models
 - 14000+ SMT & 9500+ Connectorized models
 - 14000+ Custom Products
 - 6500+ Non-Catalog Items
 - 4400+ Test Boards
 - 3000+ Cable Assemblies

Core Technologies

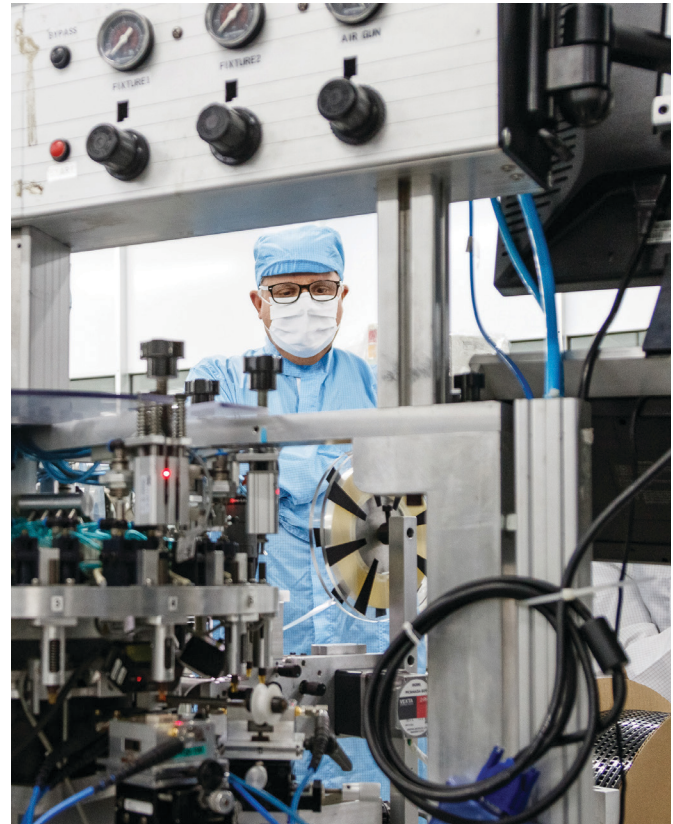
- MMIC
- LTCC
- Core & Wire
- High-Frequency Amplifiers & Modules
- High-Power Amplifiers
- Solid-State RF & Microwave Energy Solutions
- Connectorized Test Accessories & Interconnect Products
- Portable Test Instruments & Custom Test Solutions



Quality Excellence

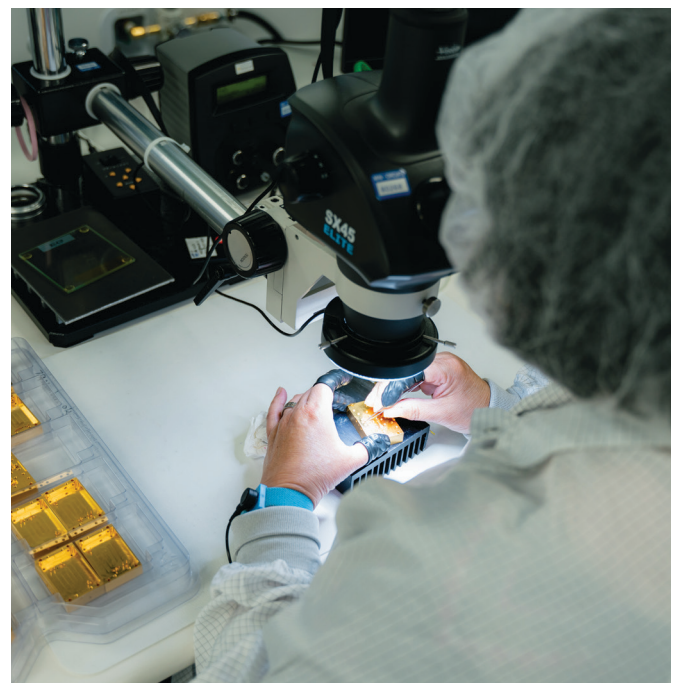
Facts

- **Quality Manual Structure** based on AS9100 Rev D
- **Document Structure** based on ISO 9001 & AS9100 Rev D and controlled via ECN process
- **All departments, functions, and ISO/AS elements are audited extensively:**
 - More than 150 audits per year
 - Department audit frequency adjusted based on previous audit results and QA recommendation
 - "On the Spot" audits conducted to maintain continuous improvement
- **Management Reviews** conducted more than 10 times per year
- Additional reviews to address specific issues or customer needs
- Engineers regularly trained in quality concepts (FMEA, SPC, etc.)



End-to-End Process Control

- **Quality begins in design** for product concepts in the design review stage
- **In-process inspection & electrical testing** performed in-house for Mini-Circuits designs and all sourced components
- **Automatic notification** of lot consistency / model yield variation at every production stage



Space Heritage

30+ Years of In-House Launch Prep

Mini-Circuits has a long history of space-level screening and testing servicing some of the earliest government space missions all the way through to the modern independent enterprises. Most of our catalog and custom components can be upscreened in-house for Mil Standard or equivalent in as little as 90 days. Our in-house screening reduces costs and accelerates your project timeline.

Space Shuttle Discovery Launched Sep 1988 Power Splitter provided by Mini-Circuits

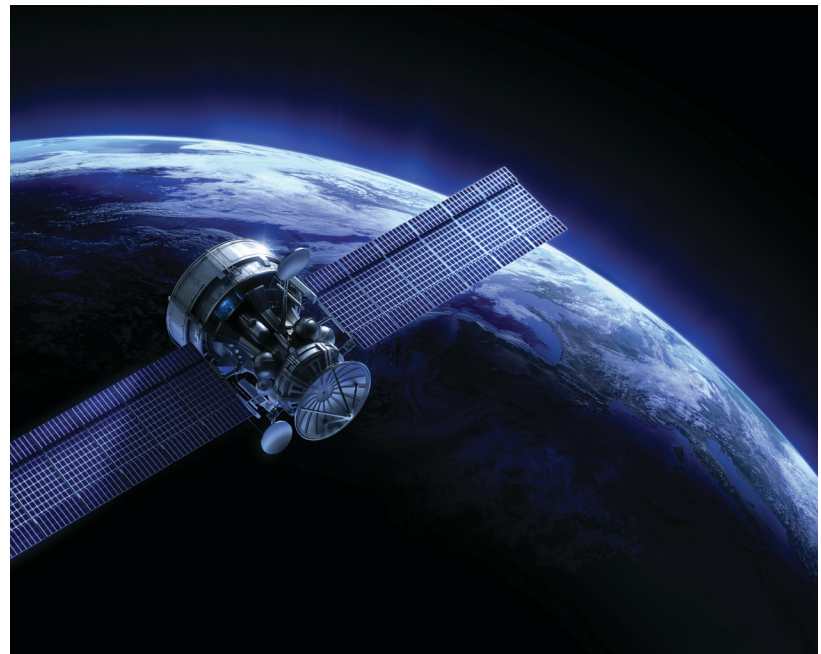
Mission: STS-26R,
Crew Members: 5
Duration: 4d 1h
Landing Site: Edwards



Space-Level Upscreening

Mil Spec or Equivalent Qualification with EEE-INST-002 Compliant Workflows

- Screening and qualification work can be carried out to meet provided SCDs
- Parts can be subjected to various Environmental and Mechanical processes including vibration, thermal cycling, solvent resistance, high power life testing
- Capability for Mechanical, Electrical, Visual, and Radiographic inspection
- Screening and Qualification reports available for traceability and compliance



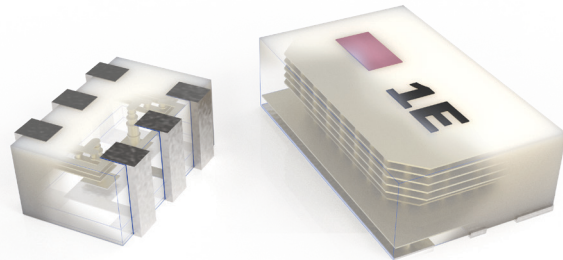
LTCC (Low Temperature Co-Fired Ceramic)

Multi-layered ceramic and ferrite construction with embedded capacitors, inductors and distributed structures

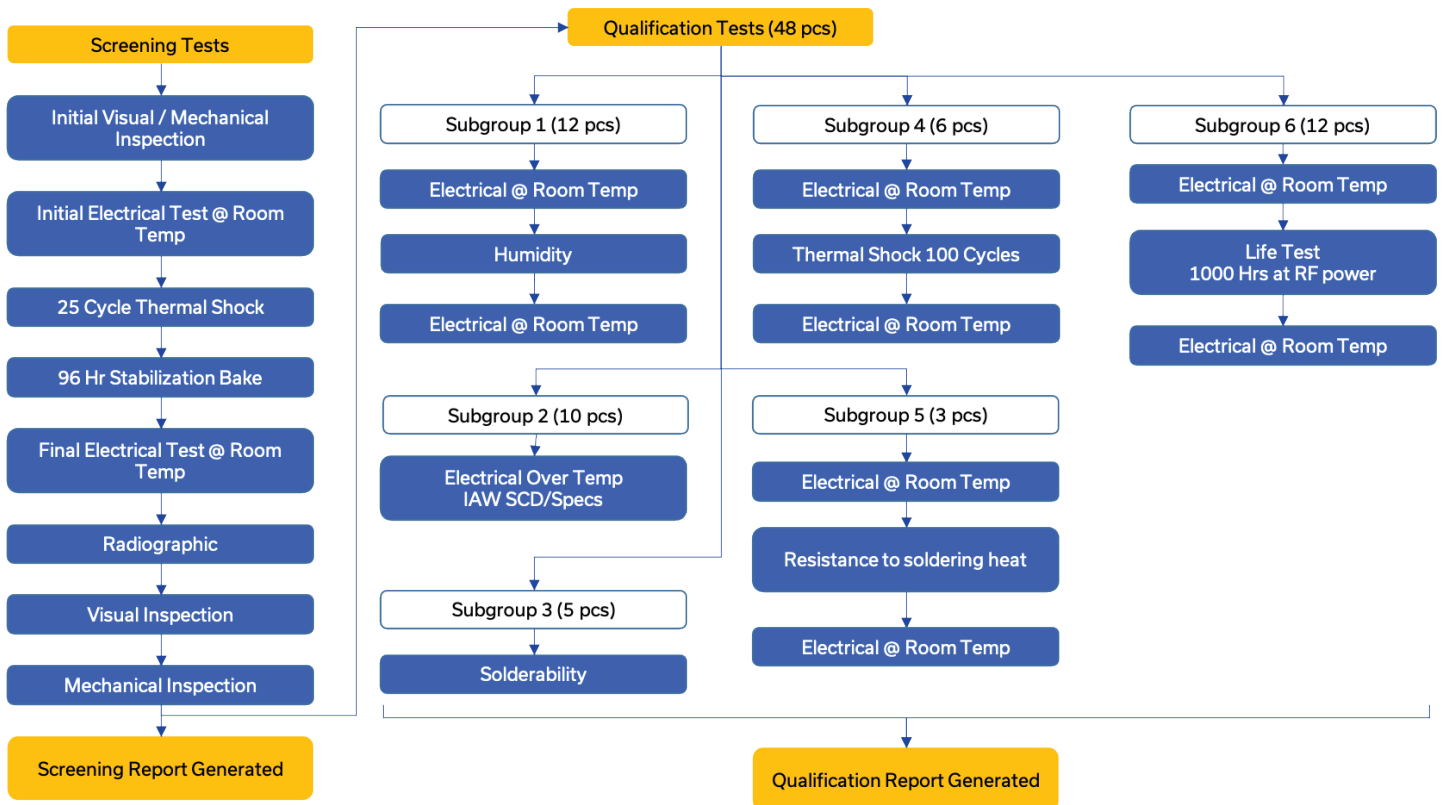
Screening and qualifications are performed IAW Mil-STD-202, as applicable

Examples of Space-Qualified Components:

- Filters - LFCN-320, LFCG-1700
- Baluns & Transformers - NCS2-33
- Power Splitters - SCN-2-27, QCS-592
- Directional Couplers - BDCN-14-22



LTCC Testing Workflow



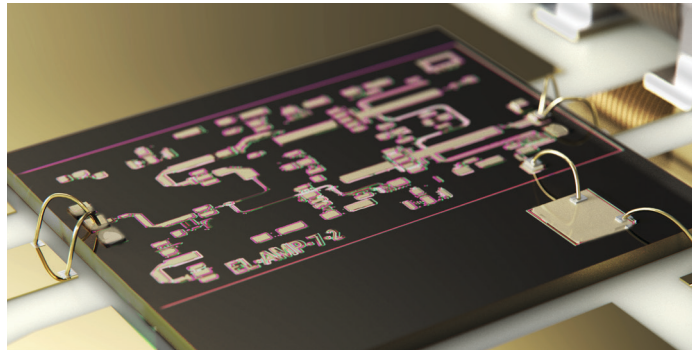
MMIC Active Die

GaAs PHEMT, GaAs HBT and InGaP HBT
 0.5 to 0.15um PHEMT, Power HBT

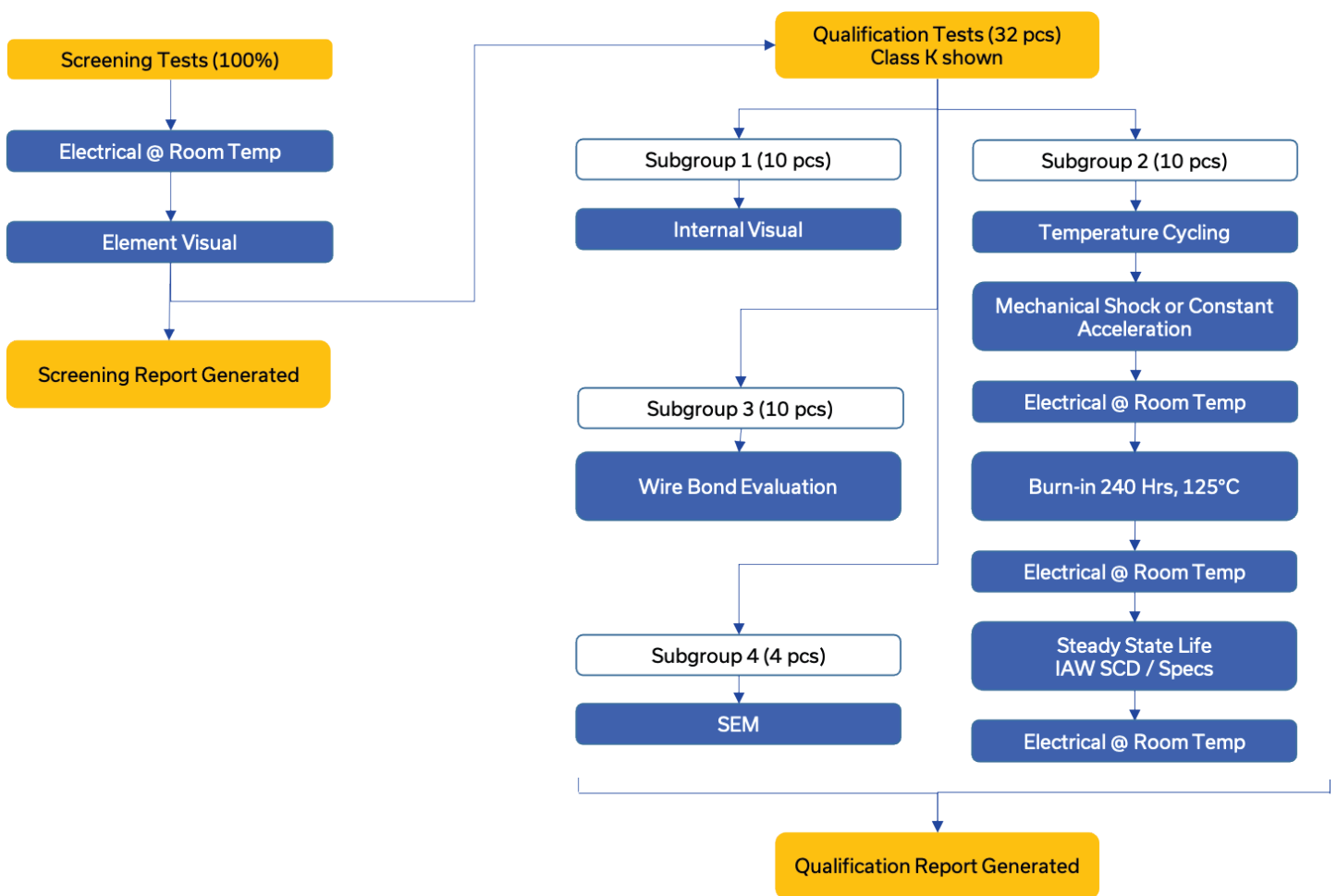
Screening IAW MIL-PRF-38534 class H or K
 Examples of Space-Qualified Components:

Amplifiers

- GVA-123-DG (GaAs HBT)
- MNA-4A-DG (GaAs PHEMT)
- PGA-103-DG (GaAs PHEMT)
- MAR-8A-DG (InGaP HBT)



MMIC Active Die Testing Workflow



MMIC Passive Die

InGaP HBT, GaAs HBT & GaAs IPD

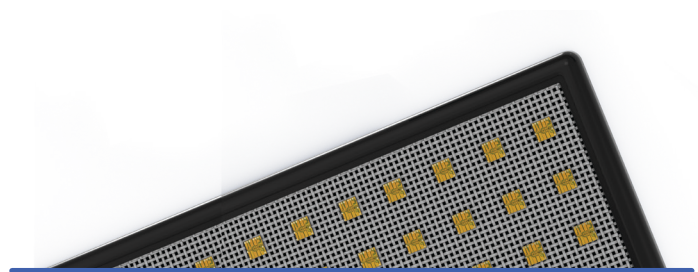
Evaluation Screening IAW MIL-PRF-38534 class H or K

Examples of Space-Qualified Components:

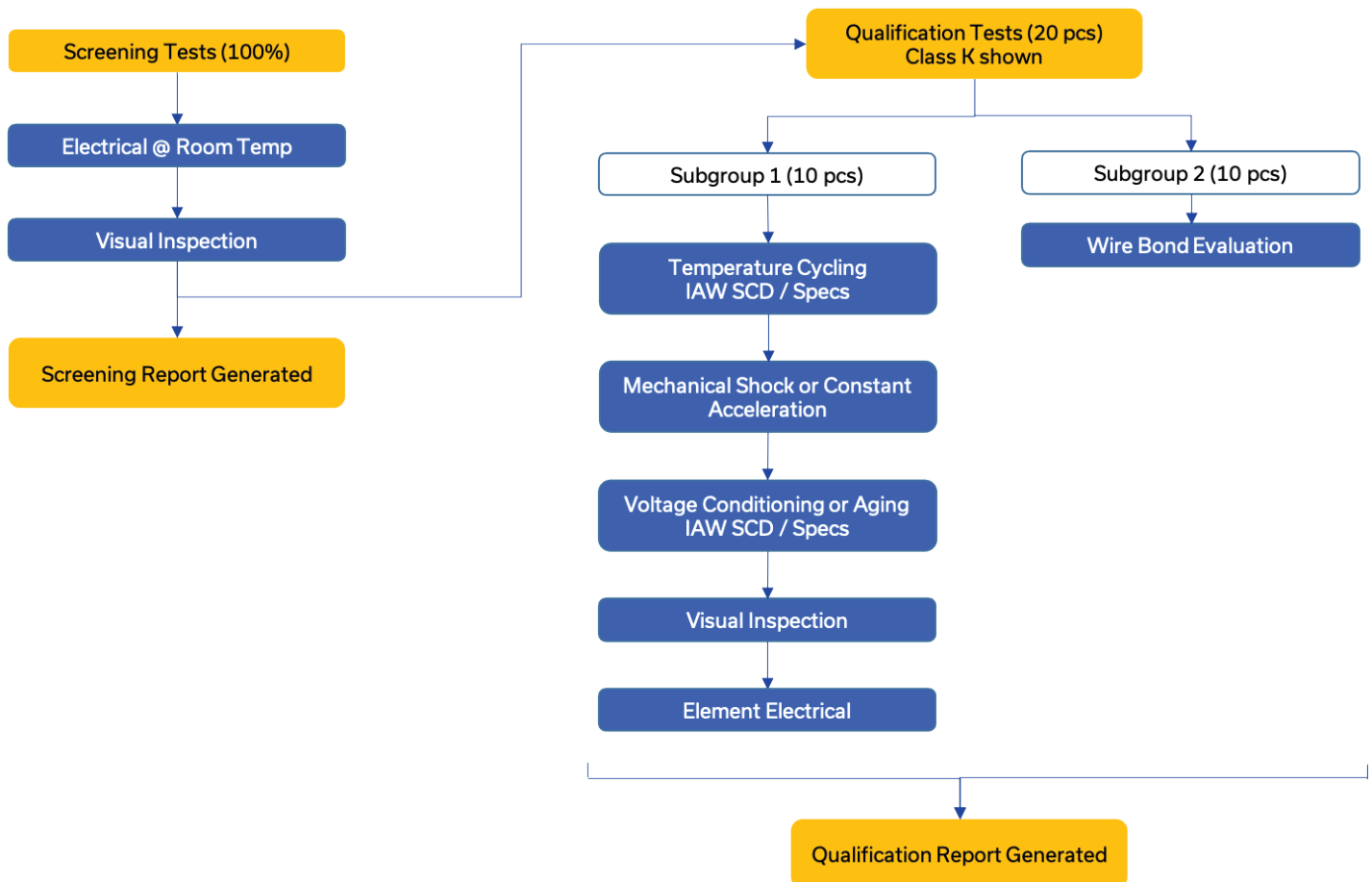
- Power Splitters & Hybrids - EP2K-D
- Reflection-less filters - XBF-163-D, XLF-123-D

Also Available

- Mixers, Multipliers & I-Q / Image Reject Mixers
- Couplers, Transformers & Bias Tees
- Attenuators
- Equalizers



MMIC Passive Die Testing Workflow



Plastic Encapsulated Microcircuits (PEMS)

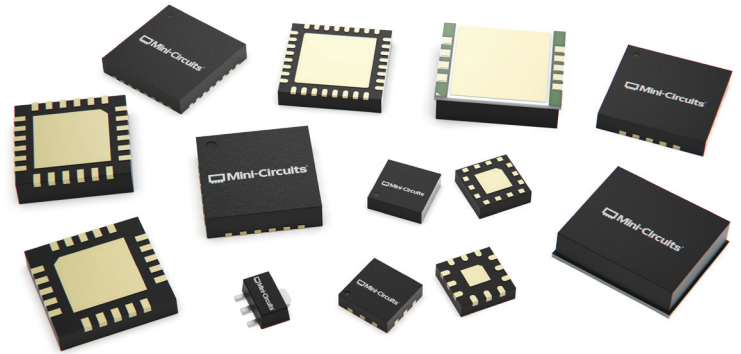
Plastic Encapsulated Single Chip MMICs and IPDs

MCL preferred SMT packaging option

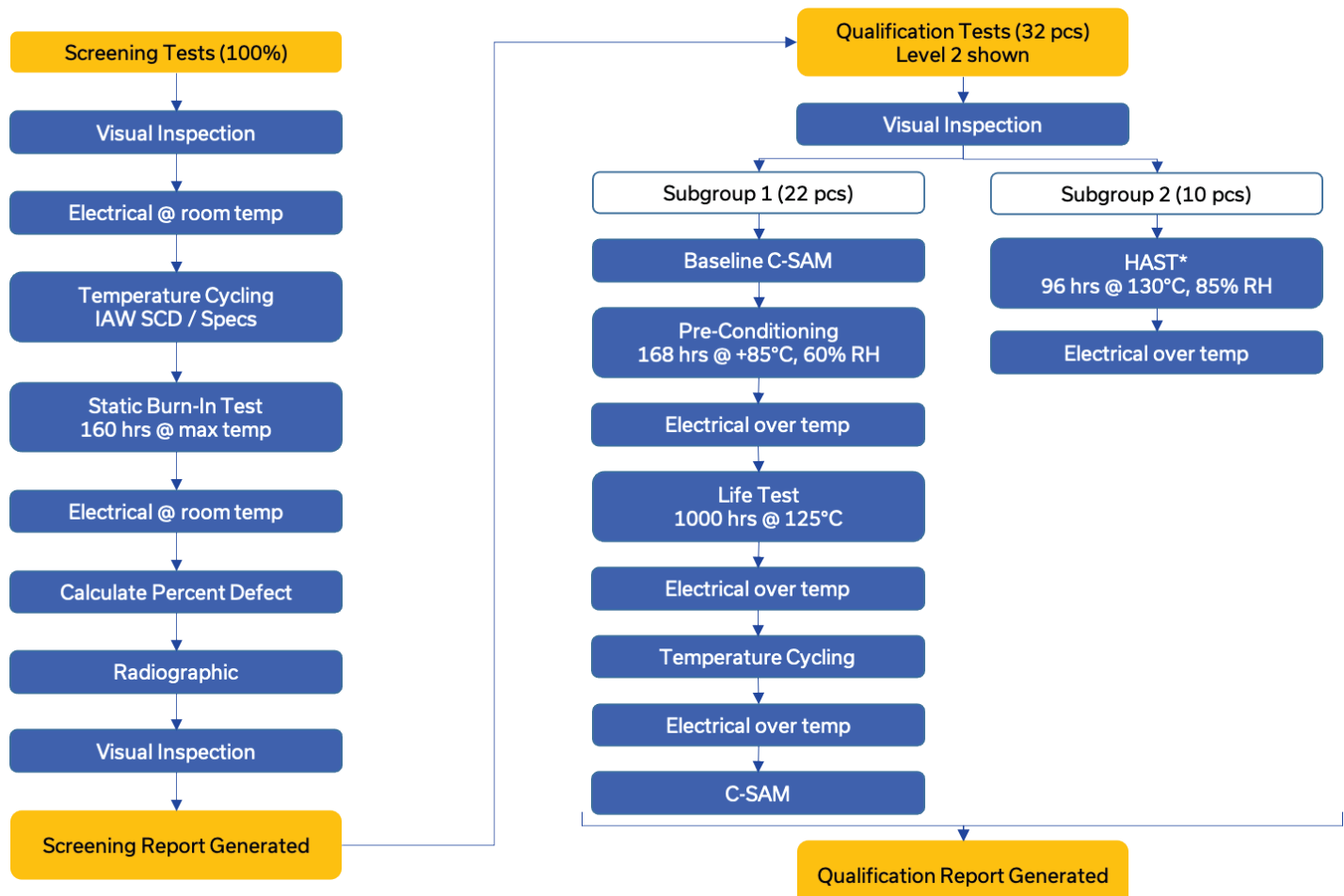
Applicable to all technologies and product types available as bare die + more

Examples of Space-Qualified Components:

- Amplifiers – PMA series (GaAs PHEMT)
- Transistors – SAV-541 (GaAs PHEMT)
- Attenuators – YAT-xA Series (GaAs IPD)



PEMS Testing Workflow



* HAST test will be Biased for active PEMS and Unbiased for passive PEMS

Open Carrier Core & Wire

Twisted wire-coupled structure around ferrite cores

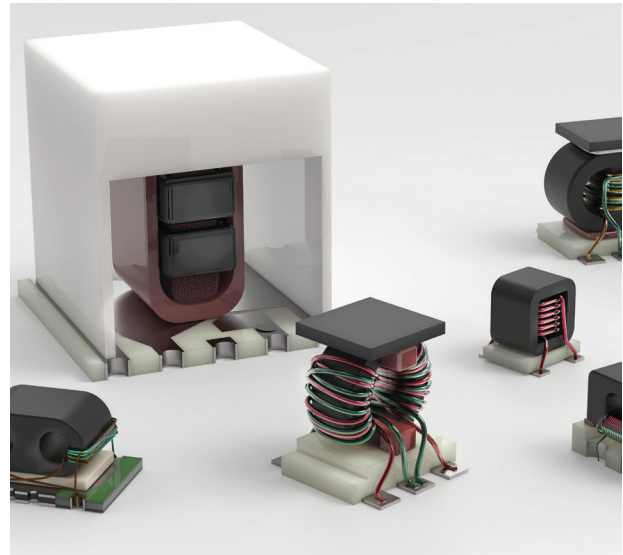
Screening and qualifications are performed IAW MIL-STD-981 for Family 11, as applicable

Examples of Space-Qualified Components:

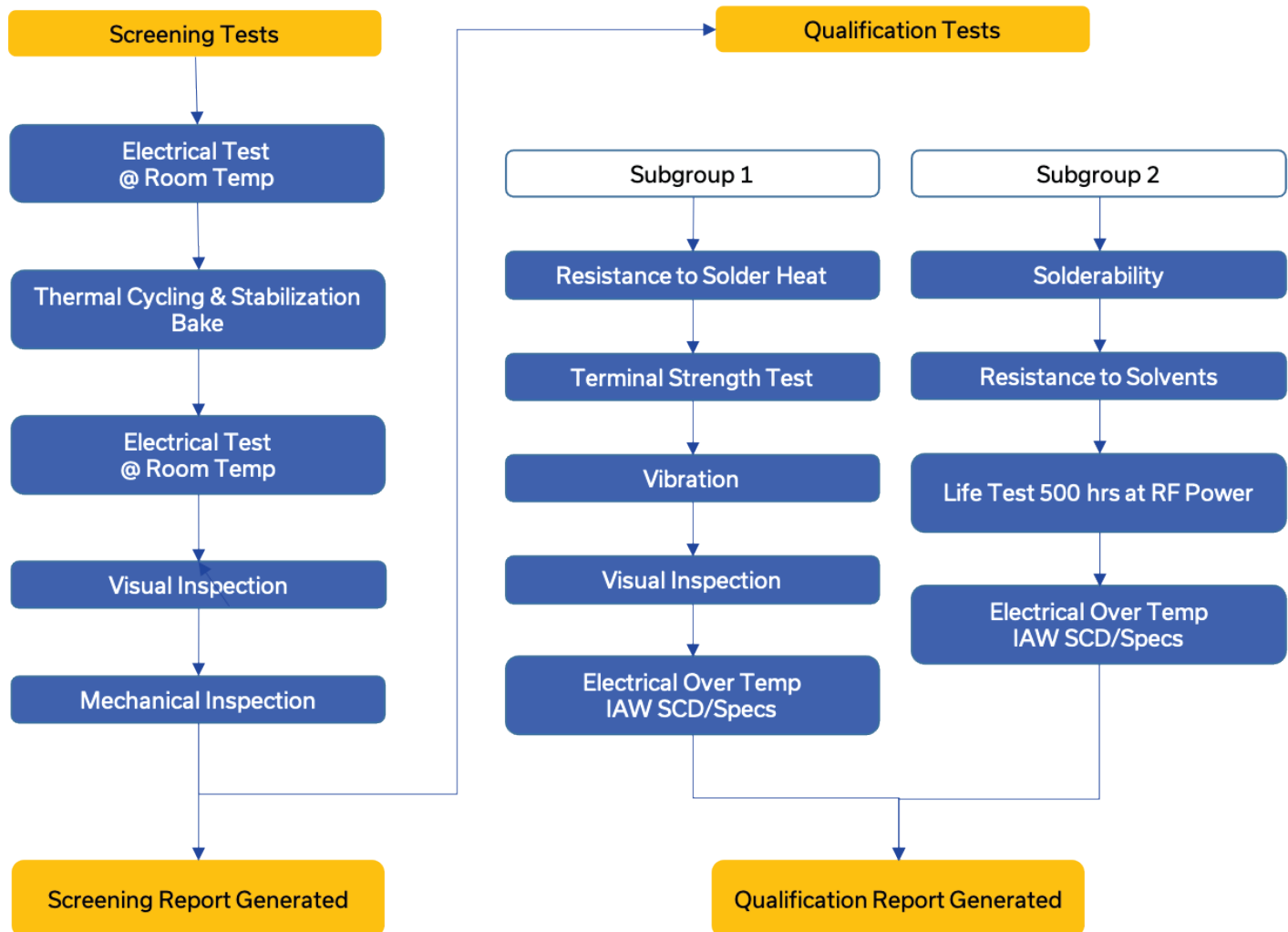
- Baluns & Transformers - TCM4-452X+, TC1-1-13M
- Power Splitters - TCP-2-272

Also Available

- TCD and DBTC series Directional Couplers



Open Carrier Core & Wire Testing Workflow



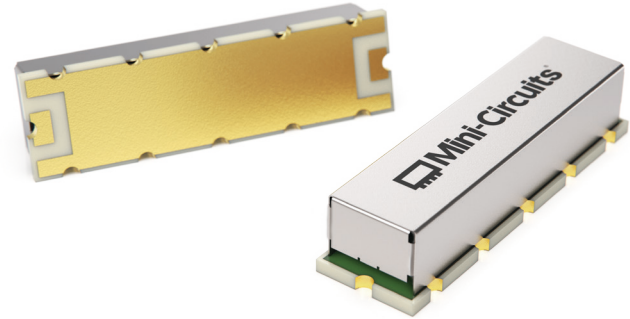
Non-Hermetic Surface Mount

Applies to multi-component assemblies

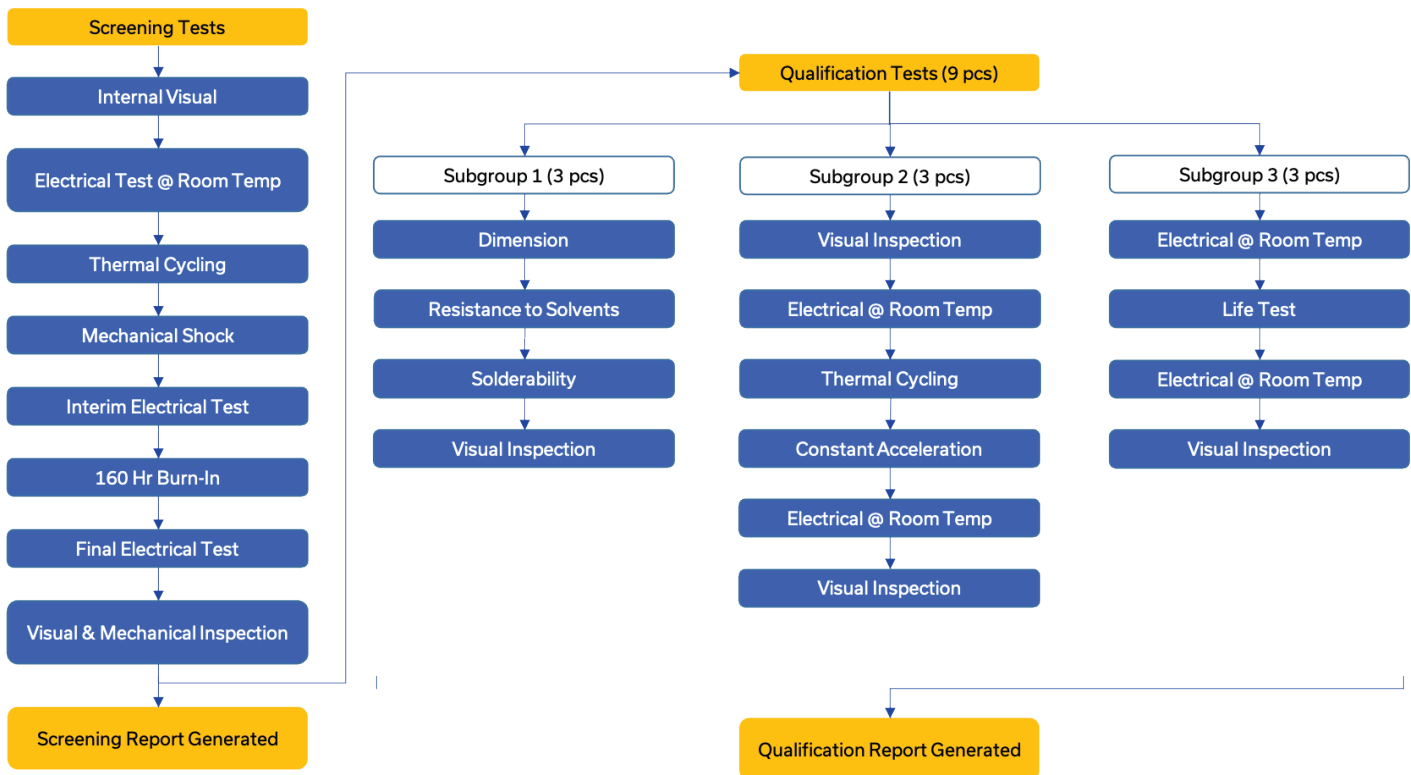
Screening and qualifications are performed IAW MIL-PRF-38534 class L of F, as applicable

Examples of Space-Qualified Components:

- Multipliers - SYK-2R
- Power Splitters - AD4PS-1
- Lumped Element Filters - SXBP-425
- Couplers - JDC-10-2
- Mixers - JMS-11X
- Bias Tees & Chokes - TCBT-14



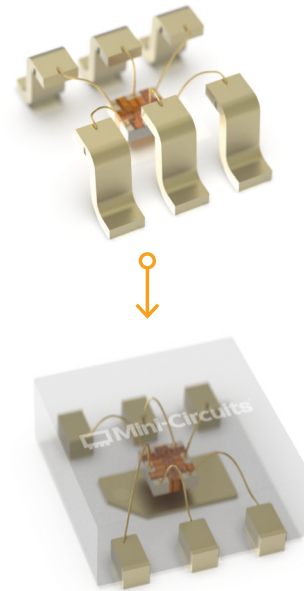
Non-Hermetic Surface Mount Testing Workflow



Model Customizations

Modifications commonly made to standard models to facilitate Space Qualification include:

- Changing plating (Sn to SnPb – “Spoiling”)
- Removing a “Top-Hat” from core-and-wire parts
- Changing transformer carriers
E.g. 5 lead to 6 lead for additional robustness
- Changing epoxies or marking inks to low outgassing
- Adding guaranteed electrical specs under specific conditions to create pass/fail limits for tests over temperature, thermal cycling, life test etc.

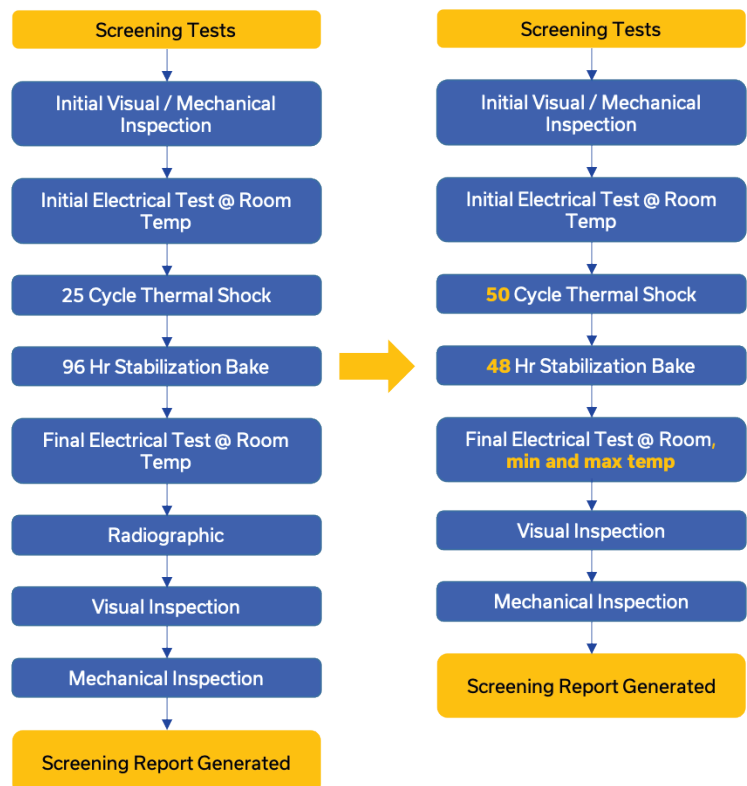


Customization of Screening Workflows

All of Mini-Circuits’ screening flow templates can be modified with tests added or removed to your project requirements.

For example:

- Adding tests from more stringent standards
E.g. level 1 tests from PEM INST 001 where level 2 is used
- Changing the number of units passing through group B qualification sub-groups
- Changing the conditions for qualification tests such as temperature, duration, humidity etc.



Contacts

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