ESCCON 2013 MS Kennedy Corp

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Activities related to Standardization of MIL-PRF-38534 Rad-Hard Hybrid/MCM and MIL-PRF-38535 Microcircuits

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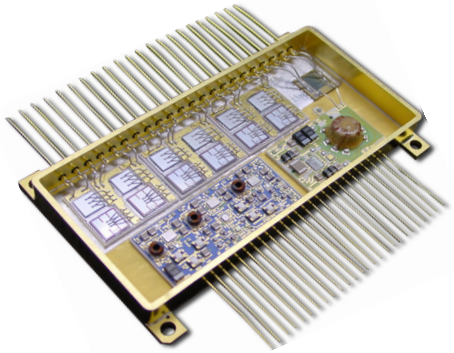
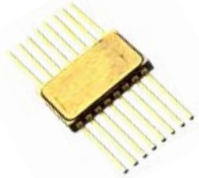
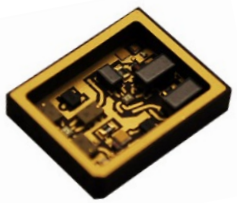
Products: Analog and RAD MCM/Hybrids and Microcircuits

- MIL-PRF-38534 Class G, H, K for RAD Voltage Regulators, Switching Regulators, Motor Controllers and Amplifier MCM/Hybrids
- MIL-PRF-38535 Class Q and V for RAD single chip and Analog Microcircuits
- MIL-PRF-38534 Class K for single chip quasi hybrid/MCM (Microcircuit on an insulating substrate mounted into a hermetic package)
- For US Market MSK also manufacturers a wide variety of custom Microcircuits/MCM/hybrids for unique program requirements







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MSK Involvement in MIL-PRF-38534 & -38535 Standards

- **MIL-PRF-38534**
- **MIL-PRF-38535**
- **AS9100**
- **JEDEC involvement of MSK -**
  MSK quality manager has been an active member for 25 years and is JC13.5 Chair for Hybrid/MCM technology.
- **Class K – Space level hybrid microcircuit, highest level of reliability for Hybrids/MCM devices**
- **Devices available in Defense Logistics Agency Standard Microcircuit Drawing (SMD), Customer controlled Source Controlled Drawings (SCD) or Manufacturer catalog data sheets**

Elements Used in MIL-PRF-38534 Hybrid/MCM Device

Ideal Class K hybrids use:

- MIL-PRF-38535 for compliant microcircuits (QML),
  MIL-PRF-19500 for compliant semiconductors (JANKC)
- MIL-PRF-55681 for compliant ceramic (CDR) capacitors
  MIL-PRF-55365 for compliant tantalum (CWR) capacitors
  MIL-PRF-55342 for compliant thickfilm (Class T) resistors
- Other MIL-PRF compliant passives (inductors, crystals, transformers).

When Compliant Elements are not available:

- MIL-PRF-38534 contains element evaluation tables
- Tables currently lack the proper element evaluations for Class K devices
- JEDEC has an active task group to improve EE tables for elements NOT manufactured to a MIL-PRF specification.

Elements Used in MIL-PRF-38534 MCM, continued

Key changes by JEDEC to MIL-PRF-38534 for element evaluation include:

- Microcircuit quantity increased from 10 to 22
- Semiconductors tested to MIL-PRF-19500 JANKC flow
- Ceramic capacitor up-screen flow generated
- Capacitor parallel plate flow generated
- Capacitor MOS flow generated
- Tantalum capacitors up-screen flow generated
- Thin film wirebondable resistors tested to a sample flow similar to MIL-PRF-55342
- Magnetics (closed and open construction) tested to a flow similar to MIL-STD-981
- Crystal flow generated
- Device finish verification added to applicable flows to prevent use of pure tin finishes

MIL-PRF-38534 Class K process monitoring

Includes wirebond and hermetic seal process controls

- Both are adequate although companies add value to both for improved process control

Wirebond controls

- Requirement: In-line group B -destruct wire testing on each machine every 13 weeks
- MSK performs this weekly to validate the machines and operators
- MSK Performs 300C bake with destruct bond pull and ball shear
- MSK performs destruct bond pull testing and ball shear testing prior to wirebonding of flight devices using simulated devices
- No current JEDEC plans to change wirebond process controls

Hermetic Seal controls

- MSK's hermetic seal process is in accordance with MIL-PRF-38534
- Some companies perform Internal Vapor Analysis process monitoring

MIL-PRF-38534 Class K Screening

Class K screening has not changed in many years although JEDEC is discussing tighter leak test limits

- MSK believes the science behind the air exchange of a hermetic device could allow oxygen or other gases inside a device and could potentially cause a device failure.
- A potential but unlikely failure is present in all manufacturing processes and materials and it is up to Industry to reduce risk in high reliability electronics.
- MSK supports tightening of the fine leak limits.
- MSK is reviewing different leak test methods available and will be making a capital investment within the next 3 months. The new test method include:
  - Kr85 leak testing
  - Optical leak testing
  - CHLD leak testing
- MSK records helium fine leak data for each device

MIL-PRF-38534 Class K Screening

Typical Screening Options flowed down:

- Some customers require special testing of devices at pre-cap inspection to validate the device prior to continuing the processing.
  - These include SEM, destruct bond pull, die shear, etc.
  - MSK does not believe these tests are needed based on SEM at element evaluation, wirebond set up data is in compliance and processes are QML qualified
- Pre-cap photographs
- Full temperature testing with recorded data prior to burn-in.
- Burn in test conditions being discussed in JEDEC
- Delta testing
- X-Ray in additional axis (X and Y modes)

Qualification testing to MIL-PRF-38534

A device must be qualified (QML compliant) once in the devices life unless a major change has been made

- The initial compliant testing include:
  - Class K screening 100%
  - Final electrical/"Group A" electrical testing
  - In-line or End of line "Group B" testing
  - QML or "Group C" testing (if processes and materials are QML compliant, then Periodic Inspection testing should be performed)
  - Life test of the design at "Group C2"
  - "Group D" testing (normally package EE data is used for "Gp D")
- For each Class K production build, as a minimum, the devices are
  - Class K screened
  - Final electrical/Group A tested
  - In-line or End of line Group B tested
- The QML and life test data performed initially does not have to be performed on future production builds

Does MIL-PRF-38534 lack reliability testing for each build?

Customer Qualification Requirements

A majority of space programs have specific requirements above the MIL-PRF-38534 Class K baseline

- A SCD depicting unique qualification requirements (vib, shock, vacuum)
- A SCD calling out a SMD with unique requirements
- A SCD with QML testing and life test every date code or inspection lot
- A SCD with End-of- line “Group B” that may state no ball lifts
- A SCD with Periodic Inspection testing every date code or inspection lot.
- A SCD with QML and DPA testing.
- DPA quantity of 1, 3, 5 or a percentage of the date code or inspection lot
- What are your special requirements?

For these reasons and lack of consistency in the space industry, JEDEC can not address the concerns of qualification testing and will keep MIL-PRF-38534 as is with no recommended changes

Can a 5962X SMD part number be purchased and meet the requirements?

MIL-PRF-38534 Radiation

MIL-PRF-38534 Appendix G for Radiation

- JEDEC and DLA working on revising Appendix G to include:
  - Specify what the RAD element/device is tested to
  - Minimum testing includes TID and ELDRS characterization
  - Specify test plan requirements (RAD levels, RAD testing, test limits, bias conditions, burn-in time,
  - Specify if ELDRS testing was performed
  - Specify the Design Analysis performed (EOL, Hydrogen, temperature, over test, 99/90, etc)
  - Element technology for radiation effects
  - Determine Hydrogen effects and IVA test RAD build as required
  - Element and Hybrid/MCM verification requirements
  - Other radiation testing to be flowed down based on program

Questions Regarding Space Level Devices

- MIL-PRF-38534 Class K compliant hybrids sometimes do not meet US program requirements (i.e. GPSIII)
- Are MIL-PRF-38534 Class K SMD products acceptable as is? MSK believes YES, based on non military space programs
- Is extra testing of a SMD device required? MSK believes NO, since the device is QML compliant and qualified.
- MIL-PRF-38534 and QML are all about reliability and reducing risk, although each of us may have a unique view on the subject!!!!
- Is MIL-PRF-38534 and QML an acceptable baseline for ESA? MSK believes YES, based on the activities in place.
- What MIL-PRF-38534 baseline additions are necessary to cover industry needs and be cost effective?
- Beyond TID and LDR radiation testing……each program is unique.

Thank you!

Dan Miller
MS Kennedy

Questions?