M.S. KENNEDY CORPORATION
4707 DEY ROAD LIVERPOOL, NY 13088
PHONE: (315) 701-6751 | FAX: (315) 701-6752
MSK Web Site: http://www.mskennedy.com/

WCSA – Worst Case Stress Analysis

The worst case stress analysis verifies that all individual components are operated within their specified maximum ratings and/or de-rated ratings. It is important to consider that in many instances maximum ratings are specified singularly. For example a voltage regulator rated for 40V input to output, 3A output current may be rated for a maximum power dissipation of 15W. At full load current of 3A the 15W power rating will be exceeded if the input to output voltage is greater than 5V. Conversely, if the input to output voltage is 40V the 15W power rating will be exceeded if the output current is greater than 0.375A. Some specifications only provide a maximum junction temperature and a thermal resistance rather than a power rating. It is also important to consider that not all specified maximum ratings are singular. In some cases multiple stresses may be able to be applied simultaneously but may be limited by another condition such as temperature. In all cases, "Exceeding the absolute maximum ratings or prolonged exposure to the absolute maximum ratings may cause permanent damage to the device." Every hybrid MS Kennedy produces receives a WCSA during the design phase verifying that as a minimum, the absolute maximum ratings of the complete hybrid do not stress any components inside the hybrid beyond its specific absolute maximum ratings. If the application conditions are different than the generic conditions, the program may require an application specific WCSA. In order to complete an application specific WCSA the full range of operating conditions must be known. This list will include but is not limited to; input voltage range including transients, output voltage, load current range including transients, signal pin input voltage range, case temperature range, etc... Transient information should include magnitude and duration. In addition to the operating conditions program specific requirements must be known.

WCCA – Worst Case Circuit Analysis (& End of Life Analysis)

The worst case circuit analysis verifies the device will perform as required under all expected operating conditions. An extensive WCCA includes the end of life analysis; EOLA need not be specified separately. Device performance and change in performance over time typically varies with the specific application variables and stresses; voltage, current, power, temperature, radiation etc… Parameters like closed loop stability may be highly dependent on external components such as input and output capacitors, filters and loading. A generic WCCA can predict the device performance and EOL performance for the conditions given in the WCCA only. If the application conditions are different than the generic conditions, the program may require an application specific WCCA. In order to complete an application specific WCCA the full range of operating conditions must be known. This list will include but is not limited to; input voltage range including transients, output voltage, load current range including transients, signal pin input voltage range, etc... External component manufacturer and part number may be required for stability analysis. Generic part numbers may not be suitable because the specific characteristics of one manufactures part may be significantly different than another's but they may both be well within the generic data sheet specifications. In some cases sample components will have to be characterized. Transient information should include magnitude and duration. In addition to the operating conditions program specific requirements must be known.

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Mechanical Analysis

The mechanical analysis verifies that the device can withstand all mechanical stresses that are expected over the entire mission life. These stresses can include; vibration, constant acceleration, shock, thermal expansion, etc… These stresses may be the result of a launch event, impact events, vibration from engines and/or rotors, etc… In order to perform a mechanical analysis the program specific requirements must be known. In lieu of program specific requirements, MIL-PRF-38534 is used as a guideline.

Thermal Analysis

Thermal analysis is often performed in conjunction with the WCSA. Each component is analyzed to verify that it does not exceed the maximum junction temperature under the worst case operating conditions. In most hybrids the majority of the heat is removed through the base plate or bottom of the device into a heat sink or PC board. Component junction temperatures are calculated as a temperature rise from the case temperature. The worst case condition for one component may not be the worst case condition for another so all ranges of operating conditions must be considered during the analysis. Every hybrid MS Kennedy produces receives a thermal analysis as part of the WCSA during the design phase verifying that as a minimum, the maximum junction temperatures for each component are not exceeded when the device is operated under the specific conditions used for the analysis. Thermal resistances of power components are typically published for many devices giving the designer the ability to verify their specific conditions. If the application conditions are different than the generic conditions, the program may require an application specific thermal analysis. In order to complete an application specific thermal analysis the full range of operating conditions must be known. This list will include but is not limited to; operating case temperature, input voltage range, output voltage, load current range, signal pin input voltage range, etc... Transient information may be required if the transient is large enough to effect the component temperatures and should include magnitude and duration. . In addition to the operating conditions program specific requirements must be known.

SOW – Statement of Work

MS Kennedy recommends using a SOW to define analysis requirements. MS Kennedy has developed a generic SOW with AEI Corporation. For a copy of this document, please contact the factory.