

Uprating

Requirement

The system/equipment that contains *uprated* parts must meet all safety, mission, and performance requirements. The system/equipment manufacturer, not the government or the part manufacturer, is responsible for meeting these requirements.

- a. *Uprating* is a process to assess the capability of a device to meet the performance requirements of the application in which the device is used outside the manufacturer-specified temperature range (term specified by the Avionics Working Group). For standardization purposes, this term/definition will be used. Other terms/definitions from the Avionics Working Group are not yet acceptable for inclusion in this document/database.
- b. *Derate* – To reduce the voltage, current, or power rating of a part to improve its reliability or to permit operation at high ambient temperatures.
- c. *Derating* – The reduction in rating of a part especially the maximum power-dissipation rating at higher temperatures.
- d. *Derating factor* – The factor by which the ratings of parts are reduced to provide additional safety margins in critical applications or when the parts are subjected to extreme environmental conditions for which their normal ratings do not apply.

Discussion

A part's operating temperature (T_A) range is the concern when *uprating*.

Part characteristics. Part manufacturers characterize for operation over a temperature range (e.g., 0°C to 70°C). Power, voltage and current maximum ratings are established from this operating temperature. A part that has a 0°C to 70°C operating temperature (T_A) range may have a -65°C to +150°C (T_{OP}) storage temperature range. In addition, the part's junction temperature (T_J) will be some other temperature. Both the operating and storage temperature ranges, on a data sheet, are established standards and used to warranty the functionality and reliability of the product. The junction temperature (T_J), which is usually not listed on a data sheet, is the most critical temperature.

The 0°C to 70°C operating temperature range predates microcircuits. Microcircuits were invented in the early 1960's. The 0°C to 70°C operating temperature range was used, as a standard, as early as the 1950's and was probably established to control the failure rates of transistor leakage currents.

Part manufacturers consider the operating temperature range (0°C to 70°C) as part of their warranty. If a system/equipment manufacturer uses a part in a higher temperature than the part manufacturer range the system/equipment takes on the risk and responsibility for safety, mission, and performance requirements.

System/equipment needs. System/equipment manufacturers, at times, need to select a part that's operating temperature range is 0°C to 70°C and their application operating temperature is greater than 70°C. This is a potential *uprating* situation. The concern is will the part function reliable in the application at the higher temperature and still meet safety, mission, and performance requirements.

To *uprate*, a part the system/equipment manufacturer must know the application operating temperature, functionality and reliability requirements.

Comparing Uprating to Derating. Technically *uprating* and *derating* are similar. Below shows comparison and requirements for part usage.

1. All parts must meet safety, mission, and performance requirements including functionality and reliability.
2. No part can exceed its maximum rated power conditions. That being voltage, current, thermal resistance and junction temperature.
3. Temperature related parameters could be adjusted down or controlled to meet performance temperature requirements. Examples being slowing the device speed down, heat-sinking the device, and air or liquid cooling.
4. The part could be temperature-sensitivity characterized. This is done to parts that the warranted operating temperature (T_A) range of the part (e.g., 0°C to 70°C) is below the application temperature (e.g., 80°C). The operating temperature range, of a part, is not a maximum rated condition. It could be exceeded following a characterization assessment. Even if the T_A is exceeded the part, in the application, must meet the performance requirements including functionality and reliability. To meet the application performance requirements including functionality and reliability the part most likely would have to be *derated*. *Derating* is adjusting down a parameter for the part to meet the application performance requirements. A part that is *derated* and one that straight out meet performance requirements, following a characterization assessment, is *uprating*.