PREFERRED
RELIABILITY
PRACTICES

EEE PARTS DERATING

Practice:

Derate applied stress levels for electrical, electronic, and electromechanical (EEE) part characteristics and parameters with respect to the maximum stress level ratings of the part. The allowed stress levels are established as the maximum levels in circuit applications.

Benefits:

Derating lowers the probability of failures occurring during assembly, test, and flight. Decreasing mechanical, thermal, and electrical stresses lowers the possibility of degradation or catastrophic failure.

Program That Certified Usage:

All Goddard Space Flight Center (GSFC) flight programs

Center to Contact for More Information:

GSFC

Implementation:

EEE parts derating can be established as either design policies or from reliability requirements. In general, NASA has taken the approach of establishing derating policies that cover all applications of the various part types in space flight equipment. These policies are available in MIL-STD-975, "NASA Standard Parts List." Table 1 provides typical derating factors from that document. If derating is to be determined from a reliability requirement, the reference document is MIL-HDBK-217, "Reliability Prediction of Electronic Equipment." MIL-HDBK-217 contains the information necessary to quantitatively estimate the effects of stress levels on reliability.

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TABLE 1. TYPICAL PART DERATING GUIDELINES

PART TYPE	RECOMMENDED DERATING LEVEL
Capacitors	Max. of 60% of rated voltage
Resistors	Max. of 60% of rated power
Semiconductor Devices	Max. of 50% of rated power
	Max. of 75% of rated voltage
	Max. junction temperature of 110°C
Microcircuits	Max. supply voltage of 80% of rated voltage
	Max. of 75% of rated power
	Max. junction temperature of 100°C
Inductive Devices	Max. of 50% of rated voltage
	Max. of 60% of rated temperature
Relays and Connectors	Max. of 50% of rated current

NOTE: Maximum junction temperature levels should not be exceeded at any time or during any ground, test, or flight exposure. Thermal design characteristics should preclude exceeding the stated temperature levels.

Technical Rationale:

The reliability of a EEE part is directly related to the stresses caused by the application, including both the environment and the circuit operation. MIL-HDBK-217 contains specific part failure rate models for a wide variety of part types. The models include factors for calculating the effects of various stresses on the failure rate and thus on part reliability. The types of factors include (for example): environment, quality levels, voltage, frequency, and temperature. Given the extensive tables of factors in MIL-HDBK-217, one can formulate reliability predictions for piece parts.

As shown in Figure 1, the plot of piece part failures versus an application stress level such as temperature, voltage, or current indicates decreasing failure rates for lower levels of stress. Therefore, a part's reliability in an application can be increased by decreasing the maximum

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allowed stress levels from the absolute maximum for which a part is rated.

Derating policy documents such as those prepared by NASA and DoD, and generally required in their contracts, allow the designer to avoid lengthy and involved calculations by mandating the derating of specific characteristics and parameters.

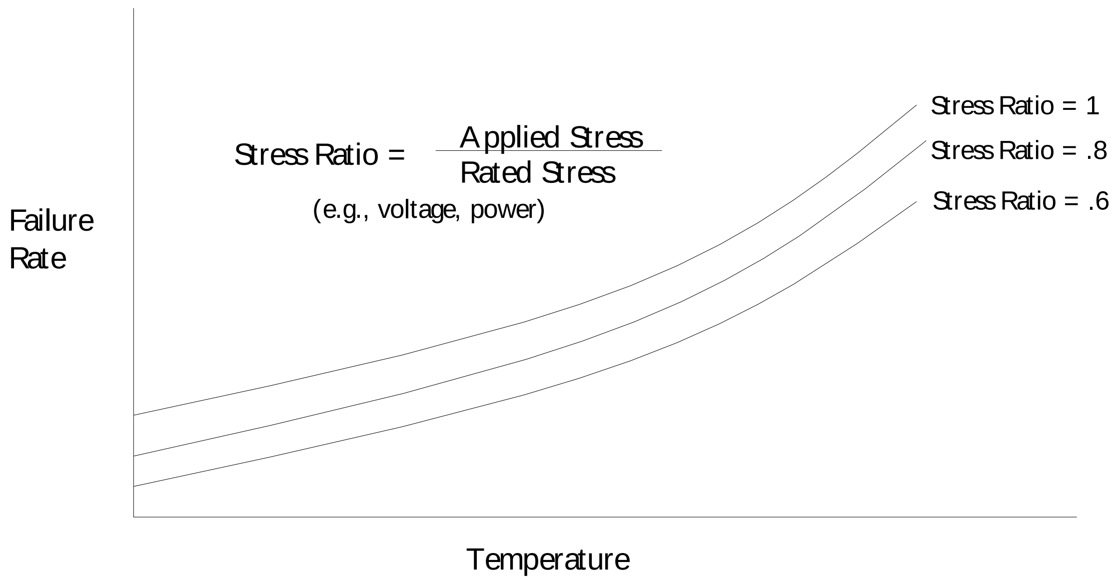

Figure 1. Piece-part Failure Rate vs. Temperature