ECSS-Q-ST-30-11C Rev.2 DIR1
19 May 2020

Space product assurance

Derating - EEE components

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Start of Public Review: 20 May 2020
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Noordwijk, The Netherlands

Foreword

This Standard is one of the series of ECSS Standards intended to be applied together for the management, engineering, product assurance and sustainability in space projects and applications. ECSS is a cooperative effort of the European Space Agency, national space agencies and European industry associations for the purpose of developing and maintaining common standards. Requirements in this Standard are defined in terms of what shall be accomplished, rather than in terms of how to organize and perform the necessary work. This allows existing organizational structures and methods to be applied where they are effective, and for the structures and methods to evolve as necessary without rewriting the standards.

This Standard has been prepared and maintained under the authority of the Space Components Steering Board (SCSB) in partnership with the European Space Agency (ESA), national space agencies (NSAs) and the European space industry, reviewed by the ECSS Product Assurance Panel and approved by the ECSS Steering Board.

The end-of-life parameter drifts are not covered by this Standard.

Disclaimer

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Introduction

This Standard specifies derating requirements applicable to electronic, electrical and electromechanical components.

Derating is a long standing practice applied to components used on spacecrafts. Benefits of this practice are now proven, but for competitiveness reasons, it becomes necessary to find an optimized reliability. Too high a derating can lead to over-design, over-cost and over-sizing of components, the direct consequence being excess volume and weight. The aim is to obtain reliable and high performance equipment without over-sizing of the components. For this reason and if possible, this Standard provides derating requirements depending on mission duration and mean temperature, taking into account demonstrated limits of component capabilities.

1
Scope

This Standard applies to all parties involved at all levels in the realization of space segment hardware and its interfaces.

The objective of this Standard is to provide customers with a guaranteed performance and reliability up to the equipment end-of-life. To this end, the following are specified:

- Load ratios or limits to reduce stress applied to components;
- Application rules and recommendations.

This standard may be tailored for the specific characteristics and constraints of a space project, in accordance with ECSS-S-ST-00.

2
Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this ECSS Standard. For dated references, subsequent amendments to, or revisions of any of these publications do not apply. However, parties to agreements based on this ECSS Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references the latest edition of the publication referred to applies.

ECSS-S-ST-00-01	ECSS system - Glossary of terms
ECSS-Q-ST-60	Space product assurance - Electrical, electronic and electromechanical (EEE) components
ESCC 2269010	Evaluation test programme for monolithic microwave integrated circuits (MMICS)
ESCC 2265010	Evaluation Test Programme for Discrete Microwave Semiconductors

3
Terms, definitions and abbreviated terms

3.1 Terms from other standards

a. For the purpose of this Standard, the terms and definitions from ECSS-ST-00-01 apply.

1. component
2. derating
3. performance

3.2 Terms specific to the present standard

3.2.1 ambient temperature

temperature surrounding a component

3.2.2 bundle

set of two or more wires arranged in parallel ,tied or laced together.

3.2.3 case temperature

temperature on the component package surface

3.2.4 hot spot temperature

highest measured or predicted temperature within any component

3.2.5 junction temperature

highest measured or predicted temperature at the junction within a semiconductor or micro-electronic device

NOTE Predicted temperature can be taken as T_{case} + thermal resistance between junction and case times actual power (Watt) of the device.

3.2.6 load ratio

permissible operating level after derating has been applied; given as a percentage of a parameter rating

3.2.7 operating conditions

parameter stress and environment (temperature, vibration, shock and radiation) in which components are expected to operate

3.2.8 RadPack

package designed to provide some form of radiation protection

3.2.9 rating

maximum parameter value specified and guaranteed by the component manufacturer and component procurement specification

NOTE Rating is considered as a limit not to be exceeded during operation and constitutes in most cases the reference for derating.

3.2.10 surge

strong rush or sweep

[Collins dictionary and thesaurus]

3.2.11 transient

brief change in the state of a system

[Collins dictionary and thesaurus]

3.3 Abbreviated terms

For the purpose of this Standard, the abbreviated terms from ECSS-S-ST-00-01 and the following apply:

Abbreviation	Meaning
A/D	analog to digital
ASIC	application specific integrated circuit
C	capacitance
DRAM	dynamic random access memory
EEPROM	electrical erasable programmable read only memory
EPROM	erasable programmable read only memory
ESCC	European Space Component Coordination

Abbreviation	Meaning
ESR	equivalent series resistance
f	frequency
FET	field effect transistor
GaAs	gallium arsenide
ISO	International Organization for Standardization
InP	indium posphide
LED	light emitting diode
MOS	metal on silicon
MIL (spec)	specification of the US Department of Defense
MMIC	monolithic microwave integrated circuit
NASA	National Aeronautics and Space Administration
P	power
PROM	programmable read only memory
RadHard	radiation hardened
Ri	insulation resistance
RF	radio-frequency
SEBO	single event burn-out
SEGR	single event gate rupture
Si, SiGe	silicon, silicon germanium
SOA	safe operating area
SRAM	static random access memory
$\mathbf{T_j}$	junction temperature
$\mathbf{T_{jmax}}$	absolute maximum rated junction temperature
$\mathbf{T_{op}}$	operating temperature
$\mathbf{V_{CE}}$	collector-emitter voltage

4
User responsibility

ECSS-Q-ST-30-11_0140001

a. The user of this Standard shall verify that the ordered assurance level of procured components is compatible with the intended application.

5
Derating

5.1 Overview

The term derating refers to the intentional reduction of electrical, thermal and mechanical stresses on components to levels below their specified rating. Derating is a means of extending component life, increasing reliability and enhancing the end-of-life performance of equipment.

Derating participates in the protection of components from unexpected application anomalies and board design variations.

The load ratios or limits given in clause 6 were derived from information available at the time of writing this Standard and do not preclude further derating for specific applications.

This Standard also defines how to handle transients.

5.2 Principles of derating

The component parameter strength defines the limits and the performance component technology in the particular application and varies from manufacturer to manufacturer, from type to type, and from lot to lot and can be represented by a statistical distribution. Likewise, component stress can be represented by a statistical distribution. Figure 5-1 illustrates the strength of a component and the stress applied at a given time, where each characteristic is represented by a probability density function.

A component operates in a reliable way if its parameter strength exceeds the parameter stress. The designer should ensure that the stress applied does not exceed the component parameter strength. This is represented by the intersection (shaded area) in Figure 5-1. The larger the shaded area, the higher the possibility of failure becomes.

There are two ways, which may be used simultaneously, in which the shaded area can be decreased:

- Decrease the stress applied (which moves the stress distribution to the left).

- Increase the component parameter strength (by selecting over-sized components) thereby moving the strength distribution to the right.

The goal is to minimize the stress-to-strength ratio of the component. Derating moves the parameter stress distribution to the left while the selection processes applied to the components for space applications contribute to moving the parameter strength distribution to the right. The selection processes also reduce the uncertainty associated with the component parameter strength.

Derating reduces the probability of failure, improves the end-of-life performance of components and provides additional design margins.

Another effect of derating is to provide a safety margin for design. It allows integrating parameter distribution from one component to another, and from one procurement to another.

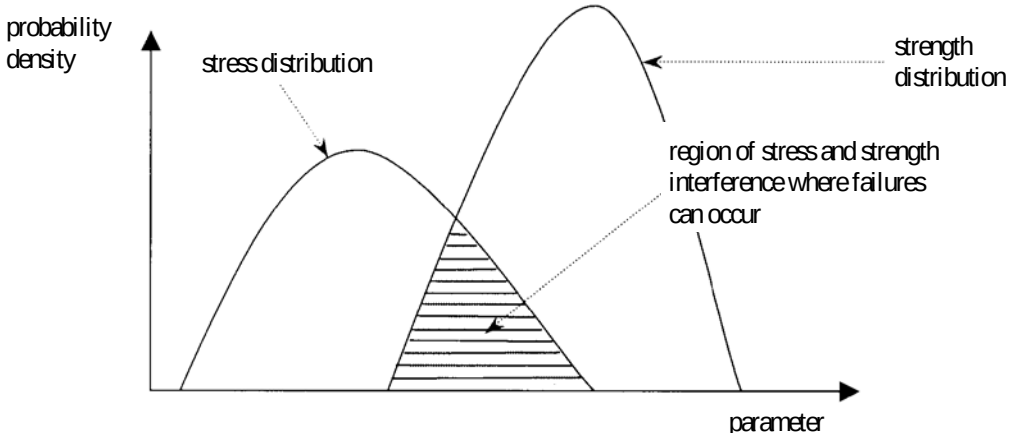


Figure 5-1: Parameter stress versus strength relationship

5.3 Applicability and component selection

5.3.1 Overview

This Standard applies to all components, selected for space applications, that are used for a significant duration. The meaning of "significant duration" is a period that contributes to the component life, for instance, one month is considered to be a significant duration. These requirements apply to screened components procured in accordance with approved space specifications.

This Standard only applies to approved components for which quality was proven after rigorous testing in accordance with ECSS-Q-ST-60.

Derating applies on normal operational conditions, where "normal" is opposed to "fault" and "Operational" indicates all functional modes of the unit.

Derating analysis is performed at the equipment maximum hot acceptance temperature, unless otherwise specified.

5.3.2 Requirements

ECSS-Q-ST-30-11_0140002

a. Derating shall be applied in consideration of temperature limits recommended by the manufacturer.

ECSS-Q-ST-30-11_0140003

b. The derating requirements of this Standard shall not be used as a justification to upgrade the quality level of components.

ECSS-Q-ST-30-11_0140004

c. The derating requirements shall be taken into account at the beginning of the design cycle of an equipment for any consequential design trade-off to be made..

NOTE It is important to pay specific attention to breadboards and engineering models where parameter derating was not considered.

ECSS-Q-ST-30-11_0140005

d. For families and groups of components excluded from this Standard due to the lack of experimental data and failure history, the user shall consult a component design and reliability specialist to apply the requirements of this Standard.

ECSS-Q-ST-30-11_0140006

e. Components may be excluded from this Standard if they are used for short durations of less than one month provided the device ratings are not exceeded, and it is ensured that the applied stress level does not exceed the component maximum rating.

NOTE For example, components used in solar generator deployment systems, redundancy commutation and launchers (except in some specific cases, noted family by family).

ECSS-Q-ST-30-11_0140007

f. The derating requirements are not applicable to test conditions for which the maximum ratings shall not be exceeded.

NOTE For example, circuit or equipment level qualification and EMC.

ECSS-Q-ST-30-11_0140008

g. Derating requirements are not applicable to fault conditions, for which the maximum rating shall not be exceeded, with the exception defined in 5.3.2h.

ECSS-Q-ST-30-11_0140009

h. Where components are required to operate in protection mode or in fail-safe mode in order to prevent failure propagation, the components concerned shall meet the derating requirements and application rules when performing the protection or fail-safe function under the worst failure case.

NOTE 1 Short circuit is an example of failure propagation.

NOTE 2 Example of protection or fail-safe function under the worst failure case: highest stress applied to the components that can last throughout the mission.

5.3.3 Requirements ESCC exceptions

ECSS-Q-ST-30-11_0140010

a. For a particular type or manufacturer, when a specific derating rule is defined in the appendix of the approved ESCC detail specification issued by the ESCC Executive, it shall take precedence over the generic requirement of this standard.

ECSS-Q-ST-30-11_0140011

b. Users shall check for application the actual status of the ESCC Derating exceptions on the following ESCC web site page: ESCC Derating deviations.

NOTE A list of the ESCC detail specifications applicable at the time of publication and containing deviations to general derating requirements of this standard is available in informative Annex B.

ECSS-Q-ST-30-11_0140012

c. Users shall clearly identify in the Parts Stress Analysis document the list of the ESCC Derating exceptions taken into consideration in their analysis.

5.4 Derating parameters

5.4.1 Overview

Derating requirements are provided in clause 6 for each component family.

For each category, the parameters to be derated are identified. The main parameters to be derated are:

- junction or case temperature;
- power (rating, dissipation);
- voltage;
- current.

The parameters to be derated depend on component type.

A stress balancing concept offers flexibility between one stress versus another (voltage and temperature). In some cases, e.g. resistors, derating has a direct impact on component performance.

5.4.2 Requirements for transient and surge conditions

ECSS-Q-ST-30-11_0140013

a. For transient or surge conditions, if ratings are provided, the same derating figures as for steady-state equivalent parameters shall be used.

ECSS-Q-ST-30-11_0140014

b. For transient or surge conditions, if ratings are not provided, then it shall be assured that the transient or surge values are below the steady-state specified maximum ratings.

ECSS-Q-ST-30-11_0140015

c. For all periodic signals or transient conditions which are repeated or made incessant, the steady-state derating figures shall apply.

d. <<deleted>>

ECSS-Q-ST-30-11_0140016

e. As an exception in case clause 5.4.2c is not compatible for specific repeated and incessant transient use conditions, for the parts types and parameters listed, load ratio shall not exceed the steady state derated values +10 % or 80 % of the steady state rated values, which ever is lower:

1. Connectors: voltage, current
2. Ceramic Capacitors: voltage
3. Resistors: current
4. Diodes: current
5. Transistors_ bipolar , MOSFETs, power FETs: current.

5.5 Additional rules and recommendations

5.5.1 Overview

In addition to strict derating requirements, some application rules and recommendations are given in this Standard to achieve the suitable reliability. This additional application rules and recommendations are listed separately in the clauses titled "Additional requirements not related to derating". This disposition is valid until other adequate ECSS documents can host these additional clauses.

5.5.2 Additional requirements not related to derating

ECSS-Q-ST-30-11_0140017

a. Where radiation sensitive components are identified, the chosen component technologies and the mitigation factors, such as shielding, shall meet the customer's requirement.

6
Tables for load ratios or limits

6.1 Overview

This clause provides the load ratios or limits.

They are also available on the World Wide Web at the following address:

https://escies.org

Abbreviations used in the tables are explained in clause 3.

Annex A contains a complete listing of the family and group codes for parts that are referred to in this Standard.

Annex B contains ESCC exceptions at date of publication of this standard.

6.2 Capacitors: ceramic - family-group code: 01-01 and 01-02

6.2.1 General

ECSS-Q-ST-30-11_0140018

a. The capacitor stress sum value of steady-state voltage, AC voltage shall not exceed the load ratios specified hereunder. For transients refer to clause 5.4.

ECSS-Q-ST-30-11_0140163

b. <<deleted>>

ECSS-Q-ST-30-11_0140164

c. <<deleted>>

ECSS-Q-ST-30-11_0140165

d. Internal heating due to ESR can increase ageing and should be taken into account by applying a margin in temperature.

e. Where ESR is not known at the frequency of a ripple current, an extrapolation of the ESR value and resonance, from manufacturer's or test data, should be made where possible.

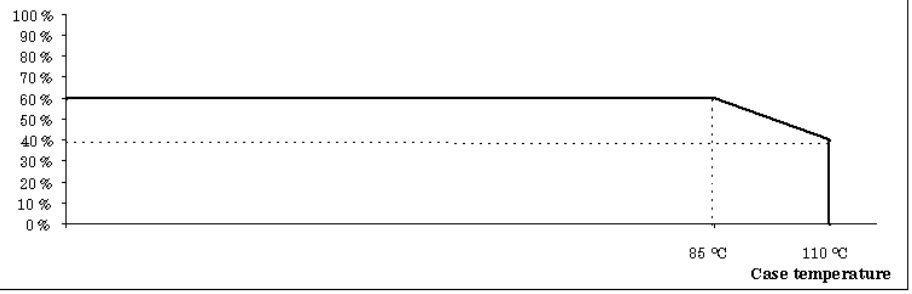
6.2.2 Derating

ECSS-Q-ST-30-11_0140020

a. Parameters of capacitors from family-group code 01-01 and 01-02 shall be derated as per Table 6-1.

ECSS-Q-ST-30-11_0140021

Table 6-1: Derating of parameters for capacitors family-group code 01-01 and 01-02

Parameters	Load ratio or limit
Voltage	

6.2.3 Additional requirements not related to derating

ECSS-Q-ST-30-11_0140022

a. The dV/dt rating capability of the capacitors shall be respected.

6.3 Capacitors: solid tantalum - family-group code: 01-03

6.3.1 General

ECSS-Q-ST-30-11_0140023

a. The capacitor stress sum value of steady-state voltage and AC voltage shall not exceed the load ratio specified hereunder, for transients refer to clause 5.4.

b. <<deleted - moved to 6.3.3a>>

ECSS-Q-ST-30-11_0140024

c. Surge current shall be derated to 75 % of the Isurge max. Isurge max is defined as Vrated/(ESR+Rs). Vrated is the maximum rated voltage, ESR is the maximum specified value and Rs is the value of series resistance specified in the circuit for surge current testing as defined in the applicable procurement specification.

ECSS-Q-ST-30-11_0140025

d. Reverse voltage shall not exceed 75 % of the manufacturer's specified maximum value for the reverse voltage.

ECSS-Q-ST-30-11_0140026

e. Ripple power shall never exceed 50 % of the manufacturer's specified maximum value.

ECSS-Q-ST-30-11_0140166

f. Internal heating due to ESR can increase ageing and should be taken into account by applying a margin in temperature.

g. Where ESR is not known at the frequency of a ripple current, an extrapolation of the ESR value and resonance, from manufacturer's or test data, should be made where possible.

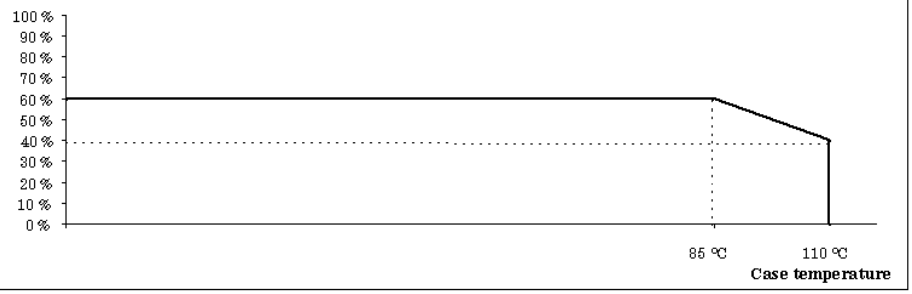
6.3.2 Derating

ECSS-Q-ST-30-11_0140027

a. Parameters of capacitors from family-group code 01-03 shall be derated as per Table 6-2.

ECSS-Q-ST-30-11_0140028

Table 6-2: Derating of parameters for capacitors family-group code 01-03

Parameters	Load ratio or limit
Voltage	

6.3.3 Additional requirements not related to derating

ECSS-Q-ST-30-11_0140029

a. 100 % surge current screening shall be applied for all surface mounted capacitors types.

ECSS-Q-ST-30-11_0140030

b. The dV/dt rating capability of the capacitors shall be respected.

6.4 Capacitors: non-solid tantalum - family-group code: 01-04

6.4.1 General

ECSS-Q-ST-30-11_0140031

a. Reverse voltage shall not exceed 75 % of the manufacturer's specified maximum value for the reverse voltage.

ECSS-Q-ST-30-11_0140032

b. Manufacturer's ratings for ripple power or current shall never be exceeded.

ECSS-Q-ST-30-11_0140167

c. Internal heating due to ESR can increase ageing and should be taken into account by applying a margin in temperature.

d. Where ESR is not known at the frequency of a ripple current, an extrapolation of the ESR value and resonance, from manufacturer's or test data, should be made where possible.

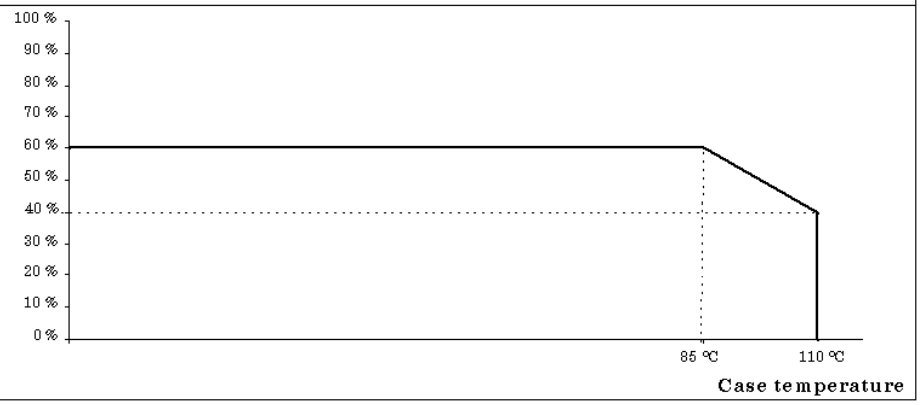
6.4.2 Derating

ECSS-Q-ST-30-11_0140033

a. Parameters of capacitors from family-group code 01-04 shall be derated as per Table 6-3.

ECSS-Q-ST-30-11_0140034

Table 6-3: Derating of parameters for capacitors family-group code

Parameters	Load ratio or limit
Voltage: voltage includes DC voltage and super-imposed AC voltage or surge voltage.	

6.4.3 Additional requirements not related to derating

ECSS-Q-ST-30-11_0140035

a. <<deleted>>

6.5 Capacitors: Plastic metallized - family-group code: 01-05

6.5.1 General

a. <<deleted - modified and moved to clause 6.5.3>>

b. <<deleted>>

ECSS-Q-ST-30-11_0140168

c. Internal heating due to ESR can increase ageing and should be taken into account by applying a margin in temperature.

d. Where ESR is not known at the frequency of a ripple current, an extrapolation of the ESR value and resonance, from manufacturer's or test data, should be made where possible.

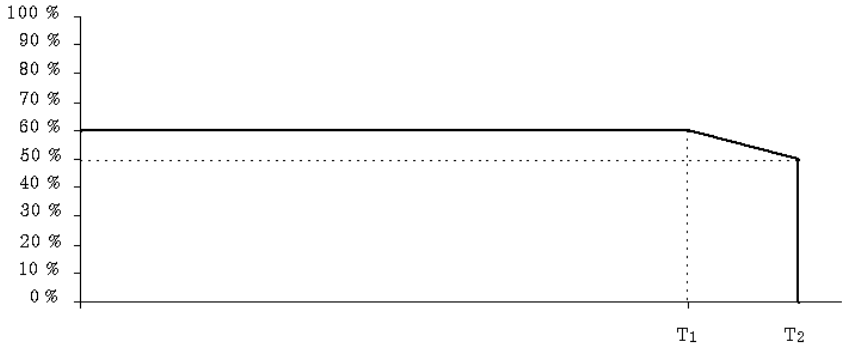
6.5.2 Derating

ECSS-Q-ST-30-11_0140036

a. Parameters of capacitors from family-group code 01-05 shall be derated as per Table 6-4.

ECSS-Q-ST-30-11_0140037

Table 6-4: Derating of parameters for capacitors family-group code 01-05

Parameters	Load ratio or limit
Voltage: voltage includes DC voltage and superimposed AC peak voltage.	 T_1 = 85 °C or T_{max}* T_2 = 100 °C or T_{max}* whichever is lower * For capacitors rated 100 °C, the general rule is superseded by the application of a voltage derating of 60 % up to a temperature of 85 °C

6.5.3 Additional requirements not related to derating

ECSS-Q-ST-30-11_0140038

a. Self healing requirements (if applicable): clearing recommendations from manufacturers shall be followed.

ECSS-Q-ST-30-11_0140039

b. The dV/dt rating capability of the capacitors shall be respected.

6.6 Capacitors: glass and porcelain - family-group code: 01-06

6.6.1 General

ECSS-Q-ST-30-11_0140169

a. Internal heating due to ESR can increase ageing and should be taken into account by applying a margin in temperature.

b. Where ESR is not known at the frequency of a ripple current, an extrapolation of the ESR value and resonance, from manufacturer's or test data, should be made where possible.

6.6.2 Derating

ECSS-Q-ST-30-11_0140040

a. Parameters of capacitors from family-group code 01-06 shall be derated as per Table 6-5.

ECSS-Q-ST-30-11_0140041

Table 6-5: Derating of parameters for capacitors family-group code 01-06

Parameters	Load ratio or limit
Voltage: voltage includes DC voltage and super-imposed AC peak voltage.	

6.6.3 Additional requirements not related to derating

No additional requirement.

6.7 Capacitors: mica and reconstituted mica - family-group code: 01-07

6.7.1 General

ECSS-Q-ST-30-11_0140170

a. Internal heating due to ESR can increase ageing and should be taken into account by applying a margin in temperature.

b. Where ESR is not known at the frequency of a ripple current, an extrapolation of the ESR value and resonance, from manufacturer's or test data, should be made where possible.

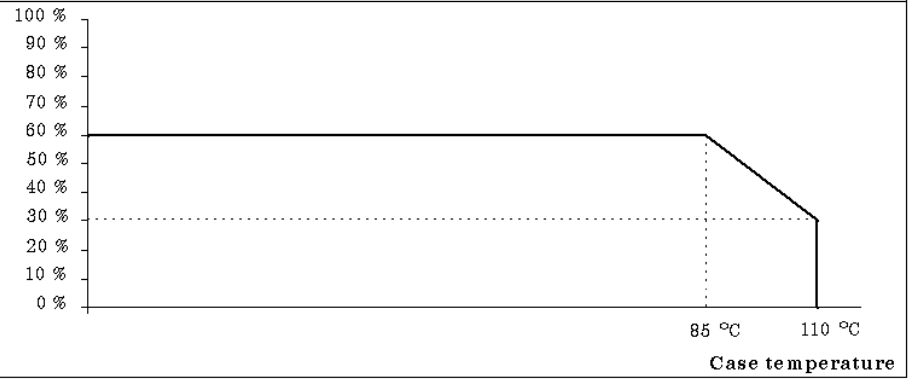
6.7.2 Derating

ECSS-Q-ST-30-11_0140042

a. Parameters of capacitors from family-group code 01-07 shall be derated as per Table 6-6.

ECSS-Q-ST-30-11_0140043

Table 6-6: Derating of parameters for capacitors family-group code 01-07

Parameters	Load ratio or limit
Voltage: voltage includes DC voltage and super-imposed AC peak voltage.	

6.7.3 Additional requirements not related to derating

No additional requirement.

6.8 Capacitors: feedthrough - family-group code: 01-10

6.8.1 General

ECSS-Q-ST-30-11_0140171

a. Internal heating due to ESR can increase ageing and should be taken into account by applying a margin in temperature.

b. Where ESR is not known at the frequency of a ripple current, an extrapolation of the ESR value and resonance, from manufacturer's or test data, should be made where possible.

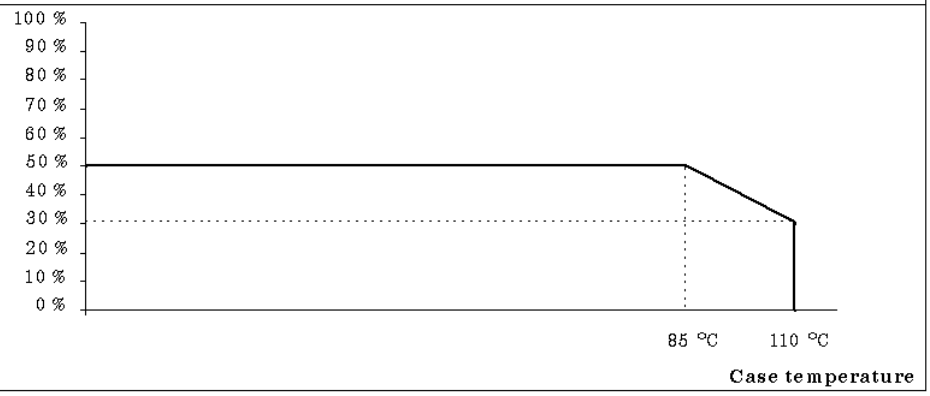
6.8.2 Derating

ECSS-Q-ST-30-11_0140044

a. Parameters of capacitors from family-group code 01-10 shall be derated as per Table 6-7.

ECSS-Q-ST-30-11_0140045

Table 6-7: Derating of parameters for capacitors family-group code 01-10

Parameters	Load ratio or limit
Voltage	

6.8.3 Additional requirements not related to derating

No additional requirement.

6.9 Capacitors: semiconductor technology (MOS type) - family-group code: 01-11

6.9.1 General

ECSS-Q-ST-30-11_0140172

a. Internal heating due to ESR can increase ageing and should be taken into account by applying a margin in temperature.

b. Where ESR is not known at the frequency of a ripple current, an extrapolation of the ESR value and resonance, from manufacturer's or test data, should be made where possible.

6.9.2 Derating

ECSS-Q-ST-30-11_0140046

a. Parameters of capacitors from family-group code 01-11 shall be derated as per Table 6-8.

ECSS-Q-ST-30-11_0140047

Table 6-8: Derating of parameters for capacitors family-group code 01-11

Parameters	Load ratio or limit
Voltage	

6.9.3 Additional requirements not related to derating

No additional requirement.

6.10 Capacitors: miscellaneous (variable capacitors) - family-group code: 01-99

6.10.1 General

ECSS-Q-ST-30-11_0140173

a. Internal heating due to ESR can increase ageing and should be taken into account by applying a margin in temperature.

b. Where ESR is not known at the frequency of a ripple current, an extrapolation of the ESR value and resonance, from manufacturer's or test data, should be made where possible.

6.10.2 Derating

ECSS-Q-ST-30-11_0140048

a. Parameters of capacitors from family-group code 01-99 shall be derated as per Table 6-9.

ECSS-Q-ST-30-11_0140049

Table 6-9: Derating of parameters for capacitors family-group code 01-99

Parameters	Load ratio or limit
Voltage	

6.10.3 Additional requirements not related to derating

No additional requirement.

6.11 Connectors - family-group code: 02-01, 02-02, 02-03, 02-07 and 02-09

6.11.1 General

a. <<deleted - moved to 6.11.3a>>

b. <<deleted - moved to 6.11.3b>>

c. <<deleted - moved to 6.11.3c>>

d. <<deleted - moved to 6.11.3d>>

6.11.2 Derating

ECSS-Q-ST-30-11_0140050

a. Parameters of connectors from family-group code 02-01, 02-02, 02-03, 02-07 and 02-09 shall be derated as per Table 6-10.

ECSS-Q-ST-30-11_0140051

Table 6-10: Derating of parameters for connectors family-group code 02-01, 02-02, 02-03, 02-07 and 02-09

Parameters	Load ratio or limit
Working voltage	25% of the connector Dielectric Withstanding test Voltage (at sea level, unconditioned) - or – 75% of the connector rated operating (working) voltage (at sea level), whichever is lower.
Current	50 %
Maximum operating temperature	30 °C below maximum rated temperature.
<<deleted>>	<<deleted - moved to 6.11.3e>>

6.11.3 Additional requirements not related to derating

ECSS-Q-ST-30-11_0140052

a. For power connectors, power and return lines shall be separated by at least one unassigned contact to reduce the short-circuit risk.

ECSS-Q-ST-30-11_0140053

b. Connector savers shall be used during testing of equipment to minimize number of mating and de-mating cycles.

ECSS-Q-ST-30-11_0140054

c. When multi-pin connectors are close to one another, they shall be configured such that mating with a wrong connector is not possible or the contact assignments are chosen such that mating with a wrong connector does not cause damage to the unit itself nor to any other element of the system.

ECSS-Q-ST-30-11_0140055

d. The connector and its constituent parts shall be from the same manufacturer.

ECSS-Q-ST-30-11_0140056

e. Maximum mating and de-mating cycles shall be limited to 50 cycles.

6.12 Connectors RF - family-group code: 02-05

6.12.1 General

a. <<deleted - moved to 6.12.3a>>

6.12.2 Derating

ECSS-Q-ST-30-11_0140057

a. Parameters of connectors RF from family-group code 02-05 shall be derated as per Table 6-11.

ECSS-Q-ST-30-11_0140058

Table 6-11: Derating of parameters for connectors RF family-group code 02-05

Parameters	Load ratio or limit
RF power	25% of the connector Dielectric Withstanding test Voltage (at sea level, unconditioned) - or – 75% of the connector rated operating (working) voltage (at sea level), whichever is lower.
Working voltage	50 % of specified voltage at any altitude (pin-to-pin and pin-to-shell).
Maximum operating temperature	30 °C below maximum rated temperature.
<<deleted>>	<<deleted - moved to 6.12.3c>>

6.12.3 Additional requirements not related to derating

ECSS-Q-ST-30-11_0140059

a. Connector savers shall be used during testing of equipment to minimize number of mating and demating cycles.

ECSS-Q-ST-30-11_0140060

b. RF power shall be limited such that a 6 dB margin exists before the onset of multipactor.

ECSS-Q-ST-30-11_0140061

c. Maximum mating and de-mating cycles shall be limited to 50 cycles.

6.13 Piezo-electric devices: crystal resonator - family-group code: 03-01

6.13.1 General

No general clause.

6.13.2 Derating

ECSS-Q-ST-30-11_0140062

a. Parameters of piezo-electric devices from family-group 03-01 shall be derated as per Table 6-12.

ECSS-Q-ST-30-11_0140063

Table 6-12: Derating of parameters for piezo-electric devices family-group code 03-01

Parameters	Load ratio or limit
Drive level	25 % power rated drive level (superseded by manufacturer required minimum drive level if not compatible).

6.13.3 Additional requirements not related to derating

No additional requirement.

6.14 Diodes - family-group code: 04-01, 04-02, 04-03, 04-04, 04-06, 04-08, 04-10 and 04-14

6.14.1 General

a. <<deleted - moved to 6.14.3a and 6.14.3b>>

6.14.2 Derating

6.14.2.1 Diode (signal/switching, rectifier, including Schottky, pin derating table

ECSS-Q-ST-30-11_0140064

a. Parameters of Diode (signal/switching, rectifier including Schottky, pin) shall be derated as per Table 6-13.

ECSS-Q-ST-30-11_0140065

Table 6-13: Derating of parameters for Diode (signal/switching, rectifier including Schottky, pin)

Parameters	Load ratio or limit
Forward current (I_F):	75%
Reverse voltage (V_R)	75 %
Dissipated power (P_D)	50 % (only if dissipated power is defined by the manufacturer)
Junction temperature (T_j)	110 °C or $T_{j\,max}$ - 40 °C (whichever is lower) for Si devices. Exception : 125 °C or Tj max - 25 °C (whichever is lower) for Si, providing: 1. that the specified maximum rating Tjmax ≥ 150 °C, and 2. when life tests are performed at Tj_{max}

6.14.2.2 Diode (Zener, reference, transient suppression) derating table

ECSS-Q-ST-30-11_0140066

a. Parameters of Diode (Zener, reference, transient suppression) shall be derated as per Table 6-14.

ECSS-Q-ST-30-11_0140067

Table 6-14: Derating of parameters for Diode (Zener, reference, transient suppression)

Parameters	Load ratio or limit
<<deleted>>	<<deleted>>
Dissipated power (P_D) or Current (I_{ZM})	65 %
Junction temperature (T_j)	110 °C or Tj max - 40 °C (whichever is lower) for Si devices. Exception : 125 °C or Tj max - 25 °C (whichever is lower) for Si, providing: 1. that the specified maximum rating Tjmax ≥ 150 °C, and 2. when life tests are performed at T_{jmax}

6.14.3 Additional requirements not related to derating

ECSS-Q-ST-30-11_0140068

a. Diodes that can be radiation sensitive shall be:

1. recorded in the design file, and
2. the component selection be reviewed and approved as specified in ECSS-Q-ST-60.

ECSS-Q-ST-30-11_0140174

b. Where power cycling is critical this should be considered.

ECSS-Q-ST-30-11_0140069

c. The dV/dt rating capability of the diodes shall be respected.

6.15 Diodes: RF/microwave - family-group code: 04-05, 04-11 to 04-13, 04-15, 04-16 and 04-17

6.15.1 General

a. <<deleted - moved to 6.15.3a.>>

6.15.2 Derating

ECSS-Q-ST-30-11_0140070

a. Parameters of Diodes from family-group code 04-05, 04-11 to 04-13, 04-15, 04-16 and 04-17 shall be derated as per Table 6-15.

ECSS-Q-ST-30-11_0140071

Table 6-15: Derating of parameters for Diodes family-group code 04-05, 04-11 to 04-13, 04-15, 04-16 and 04-17

Parameters	Load ratio or limit
Forward current	50 %
Reverse voltage (V_R)	75 %
Dissipated power (P_D)	65 %
Junction temperature (T_j)	110 °C or $T_{j\,max}$ - 40 °C (whichever is lower) for Si devices. Exception : 125 °C or Tj max - 25 °C (whichever is lower) for Si, providing: 1. that the specified maximum rating Tjmax ≥ 150 °C, and 2. when life tests are performed at T_{jmax}
NOTE 1: Forward current is not applicable to varactors. NOTE 2: Reverse voltage is not applicable to Gunn diodes.	

6.15.3 Additional requirements not related to derating

ECSS-Q-ST-30-11_0140072

a. Diodes that can be radiation sensitive shall be:

1. recorded in the design file, and

2. the component selection be reviewed and approved as specified in ECSS-Q-ST-60.

6.16 Feedthrough filters - family-group code: 05-01

6.16.1 General

No general clause.

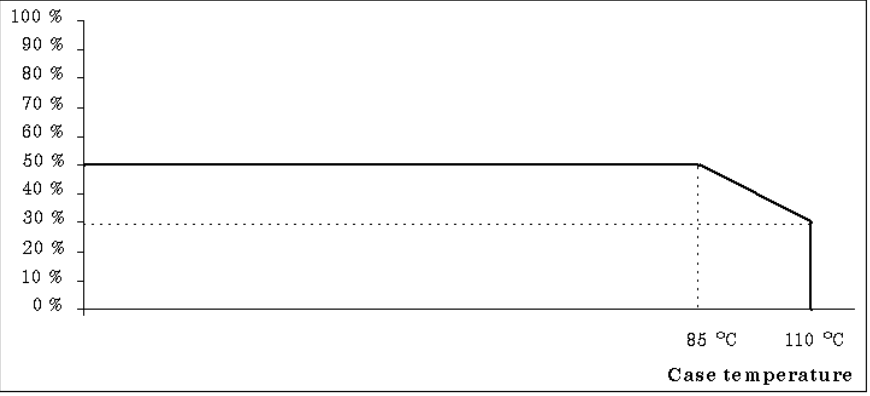
6.16.2 Derating

ECSS-Q-ST-30-11_0140073

a. Parameters of Feedthrough filters from family-group code 05-01 shall be derated as per Table 6-16.

ECSS-Q-ST-30-11_0140074

Table 6-16: Derating of parameters for Feedthrough filters family-group code 05-01

Parameters	Load ratio or limit
Current (continuous and surge)	70 %
Voltage	

6.16.3 Additional requirements not related to derating

No additional requirement.

6.17 Fuses: Cermet (metal film on ceramic) - family-group code: 06-01

6.17.1 General

ECSS-Q-ST-30-11_0140075

a. <<first sentence of requirement deleted - moved to 6.17.3a>>The derating requirements in 6.17.2 (below) are only applicable to Cermet types. The application and the deratings of other fuse technologies shall be justified.

b. <<deleted - moved to 6.17.3b>>

c. <<deleted - moved to 6.17.3c>>

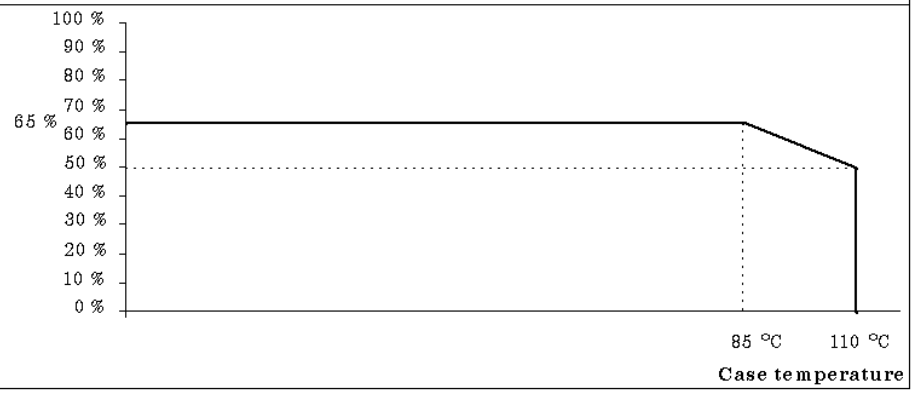
6.17.2 Derating

ECSS-Q-ST-30-11_0140076

a. Parameters of Fuses from family-group code 06-01 shall be derated as per Table 6-17.

ECSS-Q-ST-30-11_0140077

Table 6-17: Derating of parameters for Fuses family-group code 06-01

Parameters	Load ratio or limit
Current	

6.17.3 Additional requirements not related to derating

ECSS-Q-ST-30-11_0140078

a. Fuses shall be avoided whenever possible.

ECSS-Q-ST-30-11_0140079

b. The largest fuse rating compatible with the source capability shall be used.

ECSS-Q-ST-30-11_0140080

c. The power supply shall be capable of delivering three times the specified fuse rated current in order to obtain short fusing times.

6.18 Inductors and transformers - family-group code: 07-01 to 07-03 and 14-01

6.18.1 General

a. <<deleted - moved to 6.18.3a.>>

6.18.2 Derating

ECSS-Q-ST-30-11_0140081

a. Parameters of Inductors and transformers from family-group code: 07-01 to 07-03 and 14-01 shall be derated as per Table 6-18.

ECSS-Q-ST-30-11_0140082

Table 6-18: Derating of parameters for Inductors and transformers family-group code 07-01 to 07-03 and 14-01

Parameters	Load ratio or limit	Special conditions
Maximum operating voltage (1)	50 % of the applied insulation test voltage (2)	(1) Between winding-winding and between windings-case. The maximum operating voltage shall include DC, AC peak or combined. (2) <<deleted - moved to 6.18.3b>>
Hot spot temperature	20 °C below maximum rated temperature of any material used.	

6.18.3 Additional requirements not related to derating

ECSS-Q-ST-30-11_0140083

a. For custom-made inductors and transformers, the maximum rated temperature shall be evaluated taking into consideration the temperature characteristics of the materials used.

ECSS-Q-ST-30-11_0140084

b. Unless specified in the procurement specification, the minimum insulation test voltage applied shall be 500 V.

c. For operating voltages greater than 200 V the insulation test voltage shall be equal to the partial discharge voltage (V_{PD}), defined as the component qualification test level, where the partial discharge activity is detected, and with a test equipment sensitivity of no less than 1 pC.

6.19 Integrated circuits: logic - family-group code: 08-10, 08-20, 08-21, 08-29 to 08-42, and 08-80

6.19.1 General

a. <<deleted - moved to 6.19.3a>>

6.19.2 Derating

ECSS-Q-ST-30-11_0140085

a. Parameters of Integrated circuits from family-group code: 08-10, 08-20, 08-21, 08-29 to 08-42, and 08-80 shall be derated as per Table 6-19.

ECSS-Q-ST-30-11_0140086

Table 6-19: Derating of parameters for Integrated circuits family-group code: 08-10, 08-20, 08-21, 08-29 to 08-42, and 08-80

Parameters	Load ratio or limit	Special conditions
Supply voltage (V_{CC})	Maximum manufacturer recommended value	**Supply voltage** - Turn on transient peaks or other peaks shall not exceed the maximum rating. - The input voltage shall not exceed the supply voltage (unless otherwise stated in the device specification).
Output current (I_{out})	80 %	
Junction temperature (T_j)	110 °C or $T_{j\ max}$ - 40 °C (whichever is lower) for Si devices. Exception : 125 °C or Tj max - 25 °C (whichever is lower) for Si, providing: 1. that the specified maximum rating Tjmax ≥ 150 °C, and 2. when life tests are performed at T_{jmax}	<<deleted>>

6.19.3 Additional requirements not related to derating

ECSS-Q-ST-30-11_0140087

a. Devices that can be radiation sensitive shall be recorded and approved in accordance with ECSS-Q-ST-60.

6.20 Integrated circuits: non-volatile memories - family-group code: 08-22, 08-23 and 08-24

6.20.1 General

a. <<deleted - moved to 6.20.3a>>

6.20.2 Derating

ECSS-Q-ST-30-11_0140088

a. Parameters of Integrated circuits from family-group code: 08-22, 08-23 and 08-24 shall be derated as per Table 6-20.

ECSS-Q-ST-30-11_0140089

Table 6-20: Derating of parameters for Integrated circuits family-group code: 08-22, 08-23 and 08-24

Parameters	Load ratio or limit	Special conditions
Supply voltage (V_{CC})	Maximum manufacturer recommended value	**Supply voltage** - Turn on transient peaks or other peaks shall not exceed the maximum rating. - The input voltage shall not exceed the supply voltage (except adapted component design).
Output current (I_{out})	80 %	
Maximum junction temperature ($T_{j\,max}$)	110 °C or $T_{j\,max}$ - 40 °C (whichever is lower) for Si devices. Exception : 125 °C or Tj max - 25 °C (whichever is lower) for Si, providing: 1. that the specified maximum rating Tjmax ≥ 150 °C, and 2. when life tests are performed at T_{jmax}	<<deleted>>
Endurance and data retention		**Endurance** The endurance (number of write and erase cycles) and the retention time-to-failure of EPROM, EEPROM and Flash devices can be derated from the manufacturer specification case by case. An acceleration model, such as Arrhenius's law with an activation energy of 0,6 eV, or lower, shall be used to determine the equivalent time for space flight.

6.20.3 Additional requirements not related to derating

ECSS-Q-ST-30-11_0140090

a. Devices that can be radiation sensitive shall be recorded and approved in accordance with ECSS-Q-ST-60.

6.21 Integrated circuits: linear - family-group code: 08-50 to 08-60 and 08-69

6.21.1 General

a. <<deleted - moved to 6.21.1a.>>

b. <<deleted - moved to 6.21.1b.>>

6.21.2 Derating

ECSS-Q-ST-30-11_0140091

a. Parameters of Integrated circuits from family-group code 08-50 to 08-60 and 08-69 shall be derated as per Table 6-21.

ECSS-Q-ST-30-11_0140092

Table 6-21: Derating of parameters for Integrated circuits family-group code 08-50 to 08-60 and 08-69

Parameters	Load ratio or limit	Special conditions
Supply voltage (V_{CC})	90 % of the maximum rated value	Supply voltage shall include DC + AC ripple.
Input voltage (V_{IN}) or Input current (I_{IN})	For operational amplifiers: Max rated of V_{IN} (or 50 % on the input current) For comparators: 100 % or derated circuit supply voltage, whichever is lower, For rail to tail amplifiers: 100 % or derated circuit supply voltage, whichever is lower . For regulators: 90 %	
Output current (I_{out})	80 %	
Transients	Shall not exceed the specified maximum ratings.	
Maximum junction temperature ($T_{j\,max}$)	110 °C or $T_{j\,max}$ - 40 °C, whichever is lower for Si devices. Exception : 125 °C or Tj max - 25 °C (whichever is lower) for Si, providing: 1. that the specified maximum rating Tjmax ≥ 150 °C, and 2. when life tests are performed at T_{jmax}.	

6.21.3 Additional requirements not related to derating

ECSS-Q-ST-30-11_0140093

a. Linear circuits that can be radiation sensitive shall be:

1. recorded in the design file, and

2. the component selection be reviewed and approved as specified in ECSS-Q-ST-60.

ECSS-Q-ST-30-11_0140175

b. Additional margins can be applied for radiation effects.

6.22 Integrated circuits: linear converters - family-group code: 08-61 and 08-62

6.22.1 General

a. <<deleted - moved to6.22.3a.>>

6.22.2 Derating

ECSS-Q-ST-30-11_0140095

a. Parameters of Integrated circuits from family-group code 08-61 and 08-62shall be derated as per Table 6-22.

ECSS-Q-ST-30-11_0140096

Table 6-22: Derating of parameters for Integrated circuits family-group code 08-61 and 08-62

Parameters	Load ratio or limit	Special conditions
Junction temperature (T_j)	110 °C or $T_{j\,max}$ - 40 °C, whichever is lower, for Si devices. Exception : 125 °C or Tj max - 25 °C (whichever is lower) for Si, providing: 1. that the specified maximum rating Tjmax ≥ 150 °C, and 2. when life tests are performed at T_{jmax}.	
Supply voltage (V_{CC})	90 %	Supply voltage shall include DC + AC ripple.
Input voltage (V_{IN})	100 % or derated circuit supply voltage, whichever is less.	
Output current (I_{out})	80 % (D/A converters only)	

6.22.3 Additional requirements not related to derating

ECSS-Q-ST-30-11_0140097

a. Linear circuits that can be radiation sensitive shall be:

1. recorded in the design file, and
2. the component selection be reviewed and approved as specified in ECSS-Q-ST-60.

6.23 Integrated circuits: MMICs - family-group code: 08-95

6.23.1 General

a. <<deleted - moved to 6.23.3a.>>

6.23.2 Derating

ECSS-Q-ST-30-11_0140098

a. Each discrete cell constituting analogue custom MMICs shall be derated in accordance with this document's requirements for the applicable family.

NOTE Discrete cells are for example: capacitors, resistors, diodes and transistors.

ECSS-Q-ST-30-11_0140099

b. When operational reliability data is available, the compression level shall be derated to 2 dB under the highest compression level showing no drift.

c. MMICs having no compression data shall not be submitted to more than 1 dB of compression.

d. For digital cells, the derating rules applicable to integrated circuits shall be applied.

e. Parameters of custom designed MMICs shall be derated as per Table 6-38.

f. Parameters of non-custom MMICs shall be derated as per Table 6-23

Table 6-23:Derating of parameters for non-custom MMICs

Parameter	Load Ratio or Limit
Ipositive_supply_current	75%
Inegative _supply_current	75%
Vpositive_supply	80% for analog; max recommended value for digital
Vnegative supply	80% for analog; min recommended value for digital
Vin_dig_max (max input digital command)	Less than or equal to Vpos (applied Vpositive_supply)
Vin_dig_min (min input digital command)	100%
Power dissipation	80%
Tj_max	Same rules as defined for transistors depending on the relevant technology

6.23.3 Additional requirements not related to derating

ECSS-Q-ST-30-11_0140100

a. MMICs that can be radiation sensitive shall be chosen based on suitability and application.

b. Selection and use of MMICs specified in 6.23.3a shall be in accordance with ECSS-Q-ST-60 and this Standard.

6.24 Integrated circuits: miscellaneous - family-group code: 08-99

6.24.1 General

a. <<deleted - modified and moved to 6.24.2a>>

b. << deleted - moved to 6.24.3a>>

6.24.2 Derating

ECSS-Q-ST-30-11_0140101

a. For all ICs not considered in the previous subgroups, the following derating rules shall be followed:

1. Manufacturer's derating values.
2. Junction temperature: 110 °C or $T_{j\ max}$ - 40 °C, whichever is lower.
3. For the part of the IC similar to logic ICs, apply the derating rules for logic subgroups, for the part similar to linear ICs, apply the derating rules for linear subgroups and so forth.

6.24.3 Additional requirements not related to derating

ECSS-Q-ST-30-11_0140102

a. Integrated circuits that can be radiation sensitive shall be

1. recorded in a design file, and
2. the component selection be reviewed and approved as specified in ECSS-Q-ST-60.

6.25 Relays and switches - family-group code: 09-01, 09-02 and 16-01

6.25.1 General

ECSS-Q-ST-30-11_0140103

a. <<deleted, modified and moved to 6.25.1h and 6.25.1i>>

ECSS-Q-ST-30-11_0140104

b. The minimum coil pulse duration for latching relays shall be 3 times the latch time (t_L) or 40 ms, whichever is greater.

c. <<deleted - moved to 6.25.3a>>

ECSS-Q-ST-30-11_0140105

d. Rated contact load voltage shall not be exceeded..

NOTE Voltage application has a strong impact on the contact current.

e. <<deleted - moved to 6.25.3b>>

f. <<deleted - moved to 6.25.3c.>>

g. <<deleted - moved to 6.25.3d.>>

h. The coil supply voltage shall be within the specified voltage range or between the specified rated and the maximum coil voltage.

i. When no minimum coil voltage is provided, the coil voltage shall be between 110 % of the maximum latch or reset or pick-up voltage over the full temperature range and the maximum coil voltage.

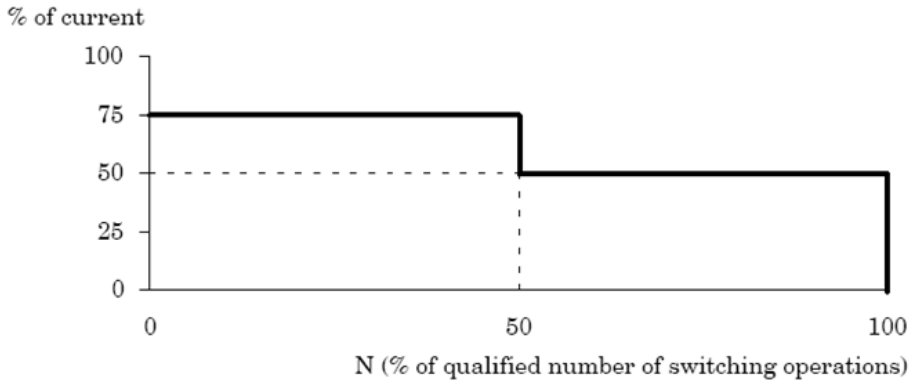
NOTE Latch or reset voltage are specified for latching device, pick-up voltage is specified for non-latching devices.

6.25.2 Derating

ECSS-Q-ST-30-11_0140106

a. Parameters of Relays and switches from family-group code 09-01, 09-02 and 16-01 shall be derated as per Table 6-24.

Table 6-24: Derating of parameters for Relays and switches family-group code 09-01, 09-02 and 16-01

Parameters	Load ratio or limit
Contact current • Resistive load	 Number of operations less than 100 (including integrating and testing) • When the specified overload current is rated at twice the rated contact current, the rated contact current may be used. • When the specified overload current is rated at 4 times the rated contact current, twice the rated contact current may be used.
• Inductive load	50 % of inductive load if specified, or 40 % of resistive load otherwise. If an arc suppressor or snubber system is used, the load factor for resistive load may be applied.
• Motor load	50 % of motor load if specified, or 20 % of resistive load otherwise
• Filament load	10 % of resistive load.
Minimum contact current	• For rated contract current (I_{CR}) ≤ 1 A, no limit needs to be considered. • For 1 A < I_{CR} ≤ 5 A, the current shall be greater than 10 mA. • For I_{CR} > 5 A, the current shall be greater than 10 % of the rated current.
Surge contact current (I_{SCR})	When the surge duration ≤ 10 µs, the surge contact current shall not exceed 4 times the rated contact current. For surge duration > 10µs : $I^2tp < 16\,Ir^2 * 10^{-5}(A^2.s)$ where: I = Surge current Ir = Rated current tp = Surge duration
NOTE Current derating does not apply to contacts that only carry current and do not switch it or to contacts that switch at zero current. In the latter case, the number of operations is limited to the qualified number of operations.	

6.25.3 Additional requirements not related to derating

a. <<deleted and moved as NOTE to Table 6-24>>

ECSS-Q-ST-30-11_0140109

b. <<deleted, modified and moved to 6.25.3e and 6.25.3f>>

ECSS-Q-ST-30-11_0140110

c. <<deleted, modified and moved to 6.25.3g and 6.25.3h>>

ECSS-Q-ST-30-11_0140111

d. Suppression diodes shall not be used inside relays.

e. A double throw contact shall not be used to switch a load, movable contact, between a power supply and ground, stationary contacts.

f. A double throw contact may be accepted under the following conditions:

1. when switching off the power supply the other stationary contact is not connected to ground, or
2. the potential difference between stationary contacts is less than 10 V and the switched current less than 0,1 A.

g. Paralleled relays shall not be used to increase current switching capabilities of contacts.

h. When relays are paralleled for redundancy, in order to increase the system's reliability, the sum of the paralleled currents shall not exceed the contact current rating.

6.26 Resistors - family-group code: 10-01 to 10-11

6.26.1 General

No general clause.

6.26.1.1 <<deleted>>

a. <<deleted - moved as Note to derating tables Table 6-25 to Table 6-31>>

<<6.26.1.2 to 6.26.1.7 deleted - modified and moved to 6.26.2.1 to 6.26.2.7>>

<<6.26.1.8 to 6.26.1.10 deleted>>

6.26.2 Derating

a. <<deleted - moved to 6.26.2.8a including the derating table>>

6.26.2.1 Metal film precision resistor (type RNC, except RNC 90) derating table

ECSS-Q-ST-30-11_0140112

a. Parameters of Metal film precision resistor (type RNC, except RNC 90) shall be derated as per Table 6-25.

ECSS-Q-ST-30-11_0140113

Table 6-25: Derating of parameters for Metal film precision resistor (type RNC, except RNC 90)

Parameters	Load ratio or limit
Voltage	80 %
rms Power	50 % up to 125 °C and further decreasing to 0 % at 150 °C
NOTE: The mentioned temperatures cited refer to case temperatures.	

6.26.2.2 Metal film semi-precision resistor (type RLR) derating table

ECSS-Q-ST-30-11_0140114

a. Parameters of Metal film semi-precision resistor (type RLR) shall be derated as per Table 6-26.

ECSS-Q-ST-30-11_0140115

Table 6-26: Derating of parameters for Metal film semi-precision resistor (type RLR)

Parameters	Load ratio or limit
Voltage	80 %
rms Power	50 % up to 70 °C and further decreasing to 0 % at 125 °C
NOTE: The mentioned temperatures cited refer to case temperatures.	

6.26.2.3 Foil resistor (type RNC 90) derating table

ECSS-Q-ST-30-11_0140116

a. Parameters of Foil resistor (type RNC 90) shall be derated as per Table 6-27.

ECSS-Q-ST-30-11_0140117

Table 6-27: Derating of parameters for Foil resistor (type RNC 90)

Parameters	Load ratio or limit
Voltage	80 %
rms Power	50 % up to 70 °C and further decreasing to 0 % at 125 °C
NOTE: The mentioned temperatures cited refer to case temperatures.	

6.26.2.4 Wire-wound high precision resistor (type RBR 56) derating table

ECSS-Q-ST-30-11_0140118

a. Parameters of Wire-wound high precision resistor (type RBR 56) shall be derated as per Table 6-28.

ECSS-Q-ST-30-11_0140119

Table 6-28: Derating of parameters Wire-wound high precision resistor (type RBR 56)

Parameters	Load ratio or limit
Voltage	80 %
rms Power (type RBR 56)	Wire-wound for all tolerances: 50 % up to 115 °C, decreasing to 0 % at 130 °C
NOTE: The mentioned temperatures cited refer to case temperatures.	

6.26.2.5 Wire-wound power resistor (type RWR, RER) derating table

ECSS-Q-ST-30-11_0140120

a. Parameters of Wire-wound power resistor (type RWR, RER) shall be derated as per Table 6-29.

ECSS-Q-ST-30-11_0140121

Table 6-29: Derating of parameters for Wire-wound power resistor (type RWR, RER)

Parameters	Load ratio or limit
Voltage	80 %
rms Power	60 % up to 25 °C, decreasing to 0 % at 175 °C
NOTE: The mentioned temperatures cited refer to case temperatures.	

6.26.2.6 Chip resistor (RM), network resistor derating table

ECSS-Q-ST-30-11_0140122

a. Parameters of Chip resistor (RM), network resistor shall be derated as per Table 6-30.

ECSS-Q-ST-30-11_0140123

Table 6-30: Derating of parameters for Chip resistor (RM), network resistor

Parameters	Load ratio or limit
Voltage	80 %
rms Power	50 % up to 85 °C, decreasing to 0 % at 125 °C
NOTE: The mentioned temperatures cited refer to case temperatures.	

6.26.2.7 Carbon composition resistor table

ECSS-Q-ST-30-11_0140124

a. Parameters of Carbon composition resistor shall be derated as per Table 6-31.

ECSS-Q-ST-30-11_0140125

Table 6-31: Derating of parameters for Carbon composition resistor

Parameters	Load ratio or limit
Voltage	80 %
rms Power	50 % up to 70 °C, decreasing to 0 % at 100°C
NOTE: The mentioned temperatures cited refer to case temperatures.	

6.26.2.8 Heaters

ECSS-Q-ST-30-11_0140126

a. Actual rated power shall be specified in the applicable heater design drawing and be determined from the specified heating area (s) in cm^2 taking into account the thermal properties of the mounted heater in the application.

ECSS-Q-ST-30-11_0140127

b. Parameters of heaters shall be derated as per Table 6-32.

Table 6-32: Derating of parameters for Heaters

Parameters	Load ratio or limit
Temperature(°C)	Foil heaters: 50 °C below the heater max rated temperature, or 30 °C below the adhesive max rated temperature for heater delivered with adhesive, whichever is lower.
Power density	Glued heaters: Rated Power Density with heater suspended in still air defined in the specification

6.26.2.9 Thick Film Power

a. Parameter of Thick Film Power from family group code 10-06 shall be derated as per Table 6-33

Table 6-33: Derating of parameters for Thick Film Power

Parameters	Load ratio or limit
Voltage	80%
Rated power (W)	Power : 60% up to 25°C. Decreasing to 0% at Tmax

6.26.3 Additional requirements not related to derating

No additional requirement.

6.27 Thermistors - family-group code: 11-01 to 11-03

6.27.1 General

No general clause.

6.27.2 Derating

ECSS-Q-ST-30-11_0140129

a. Parameters of Thermistors from family-group code 11-01 to 11-03 shall be derated as per Table 6-34.

ECSS-Q-ST-30-11_0140130

Table 6-34: Derating of parameters for Thermistors family-group code 11-01 to 11-03

Parameters	Load ratio or limit
Power	50 % of the maximum power

6.27.3 Additional requirements not related to derating

No additional requirement.

6.28 Transistors: bipolar - family-group code: 12-01 to 12-04 and 12-09

6.28.1 General

a. <<deleted - moved to 6.28.3a>>

6.28.2 Derating

ECSS-Q-ST-30-11_0140131

a. Parameters of Transistors from family-group code 12-01 to 12-04 and 12-09 shall be derated as per Table 6-35.

ECSS-Q-ST-30-11_0140132

Table 6-35: Derating of parameters for Transistors family-group code 12-01 to 12-04 and 12-09

Parameters	Load ratio or limit
Collector-emitter voltage (V_{CE0})	75 %
Collector-base voltage (V_{CB0})	75 %
Emitter-base voltage (V_{EB0})	75 %
Collector current (I_C max)	75 %
Base current (I_B max), if specified	75 %
Power (P_D)	65 % of maximum power
Junction temperature (T_j)	110 °C or $T_{j\,max}$ - 40 °C (whichever is lower) for Si devices. Exception : 125 °C or Tj max - 25 °C (whichever is lower) for Si, providing: 1. that the specified maximum rating Tjmax ≥ 150 °C, and 2. when life tests are performed at Tj_{max}.
<<Notes deleted and moved to 6.28.3b and 6.28.3c>>	

6.28.3 Additional requirements not related to derating

ECSS-Q-ST-30-11_0140133

a. Transistors that can be radiation sensitiveshall be:

1. recorded in the design file, and
2. the component selection be reviewed and approved as specified in ECSS-Q-ST-60.

ECSS-Q-ST-30-11_0140176

b. The safe-operating area when specified shall be respected.

ECSS-Q-ST-30-11_0140177

c. In applications where power cycling is critical, the effects of power cycling shall be verified by analysis or test.

6.29 Transistors: FET - family-group code: 12-05 and 12-06

6.29.1 General

a. <<deleted - moved to 6.29.3a>>

b. <<deleted - moved to 6.29.3b>>

6.29.2 Derating

ECSS-Q-ST-30-11_0140134

a. Parameters of Transistors from family-group code 12-05 and 12-06 shall be derated as per Table 6-36.

ECSS-Q-ST-30-11_0140135

Table 6-36: Derating of parameters for Transistors family-group code 12-05 and 12-06

Parameters	Load ratio or limit
Drain to source voltage (V_{DS})	Drain to source voltage (V_{DS}) 80 % of rated, or 80% of the SEE safe operating area (V_{DS} versus V_{GS}), whichever is lower. If SEE Safe Operating Area was determined in accordance with ESCC 25100 then further derating of the SEE determined V_{DS} is not required.
Gate to source voltage (V_{GS})	75% of rated, or the SEE safe operating area (V_{DS} versus V_{GS}), whichever is lower If SEE Safe Operating Area was determined in accordance with ESCC 25100 then further derating of the SEE determined V_{GS} is not required.
Drain current (I_{DS})	75 %
Power dissipation (P_D) max	65 % max
Junction temperature (T_j)	110 °C or $T_{j\,max}$ - 40 °C (whichever is lower) for

	Si devices. Exception : 125 °C or Tj max - 25 °C (whichever is lower) for Si, providing: 1. that the specified maximum rating Tjmax ≥ 150 °C, and 2. when life tests are performed at Tj_{max}

6.29.3 Additional requirements not related to derating

ECSS-Q-ST-30-11_0140136

a. Only SEE radiation characterized MOSFETs shall be used in space applications.

ECSS-Q-ST-30-11_0140178

b. In applications where power cycling is critical, the effects of power cycling shall be verified by analysis or test.

6.30 Transistors: RF: bipolar - family-group code: 12-10 and 12-13

6.30.1 General

a. <<deleted - moved to 6.30.3a.>>

6.30.2 Derating

ECSS-Q-ST-30-11_0140137

a. Parameters of Transistors from family-group code 12-10 and 12-13 shall be derated as per Table 6-37.

Table 6-37: Derating of parameters for Transistors family-group code 12-10 and 12-13

Parameters	Load ratio or limit
Collector-emitter voltage (V_{CE})	75 %
Collector-base voltage (V_{CB})	75 %
Emitter-base voltage (V_{EB})	75 %
Collector current (I_C)	75 %
Base current (I_B), if specified	75 %
Power dissipation (P_D)	65 % or limited by the derating on operating temperature.
Junction temperature (T_j)	110 °C or $T_{j\,max}$ - 40 °C (whichever is lower) for Si and SiGe bipolar transistors. Exception : 125 °C or Tj max - 25 °C (whichever is lower) for Si, providing: 1. that the specified maximum rating Tjmax ≥ 150 °C, and 2. when life tests are performed at T_{jmax}. 115 °C or $T_{j\,max}$ - 25°C (whichever is lower) for GaAs and InP bipolar transistors. ESCC Exception: 125 °C for GaAs or InP, providing 1. # that the specified maximum rating Tmax ≥ 150 °C , 2. # that Devices or Processes are supported by ESCC 2269010 and 2265010 evaluation program or equivalent 3. # that the related evaluation reports are available
NOTE	

b. When not supported by reliability data, compression levels shall not exceed 1 dB.

c. When supported by reliability data, the RF input power shall be derated by 2 dB back off from the highest level showing no drift.

d. In the case when the transistor is specified through a maximum RF input power, the RF input power shall be derated by 3 dB back off from the specified RF input power.

6.30.3 Additional requirements not related to derating

ECSS-Q-ST-30-11_0140139

a. Transistors that can be radiation sensitiveshall be :

1. recorded in the design file, and
2. the component selection be reviewed and approved a specified in ECSS-Q-ST-60.

6.31 Transistors: RF: FET - family-group code: 12-12, 12-14, 12-15(FET) and 12-16(FET)

6.31.1 General

a. <<deleted - moved to 6.31.3a.>>

6.31.2 Derating

ECSS-Q-ST-30-11_0140140

a. Parameters of Transistors from family-group code 12-12, 12-14, 12-15(FET) and 12-16(FET) shall be derated as per Table 6-38.

b. Parameters of custom designed MMICs shall be derated as per Table 6-38.

c. When not supported by reliability data, compression levels shall not exceed 1 dB.

d. When supported by reliability data, the RF input power shall be derated by 2 dB back off from the highest level showing no drift.

e. In the case when the transistor is specified through a maximum RF input power, the RF input power shall be derated by 3dB back off from the specified RF input power.

ECSS-Q-ST-30-11_0140141

Table 6-38: Derating of parameters for Transistors family-group code 12-12, 12-14, 12-15(FET) and 12-16(FET)

Parameters	Load ratio or limit
Drain to source voltage (V_{DS})	75 %
Gate to source voltage (V_{GS})	75 %
Gate to drain voltage (V_{GD})	75 %
Drain current (I_{DS})	75 %
Power dissipation (P_D)	80 % or limited by the derating on operating temperature.
Junction temperature (T_j)	110 °C or $T_{j\,max}$ - 40 °C (whichever is lower) for Si FET and SiGe bipolar transistors. Exception : 125 °C or Tj max - 25 °C (whichever is lower) for Si, providing: 1. that the specified maximum rating Tjmax ≥ 150 °C, and 2. when life tests are performed at T_{jmax}. 115 °C or $T_{j\,max}$ - 25 °C (whichever is lower) for GaAs and InP bipolar transistors. 145 °C or $T_{j\,max}$ - 25 °C (whichever is lower) for GaN transistors ESCC Exceptions : (a) 125 °C for GaAs or InP, providing that: 1. the specified maximum rating $T_{max} \geq 150$ °C , 2. Devices or Processes are supported by ESCC 2269010 and 2265010 evaluation program or equivalent, and 3. the related evaluation reports are available. (b) 160 °C for GaN, providing that: 1. the specified maximum rating $T_{jmax} \geq 200$ °C , 2. the temperature junction definition is consistent with the one used for reliability demonstration, and 3. Devices or Processes are supported by ESCC 2269010 and 2265010 evaluation program or equivalent and that the related evaluation reports are available. It is important that test results include the

	evidence of an equivalent operation life time ≥ 20 years. (c) 125 °C or Tj max - 25 °C (whichever is lower) for Si, providing that: 1. the specified maximum rating Tj max ≥ 150 °C , 2. when life tests are performed at Tj max, and 3. Devices or Processes are supported by ESCC 2269010 and 2265010 evaluation program or equivalent and that the related evaluation reports are available. It is important that test results include the evidence of an equivalent operation life time ≥ 20 years.

NOTE 1: For SI, GaAs and INP devices, when supported by reliability data, the compression level is derated to 2dB under the highest compression level showing no drift. No compression levels exceeding 1dB are applied to FETs without compression data.

NOTE 2: For GaN devices, when supported by step stress reliability data, the maximum allowed operating output power level is Pout(PAE_{max}). The available stress test data for varying input power levels demonstrates the achievement of at least Pout(PAE_{max}) +2dB without observation of any drift. Pout(PAE_{max}) - 3dB is the maximum allowed operating power when compression step stress data is not available.

NOTE 3: It is expected that the manufacturer datasheets use guidelines specified in IEC60134 (“Absolute maximum and design ratings of tube and semiconductor devices”) for definition of AMR and ROR ratings.

6.31.3 Additional requirements not related to derating

ECSS-Q-ST-30-11_0140142

a. Transistors that can be radiation sensitivshall be:

1. recorded in the design file, and
2. the components selection be reviewed and approved as specified in ECSS-Q-ST-60.

6.32 Wires and cables - family-group code: 13-01 to 13-03

6.32.1 <<deleted>>

.

6.32.2 <<deleted>>Derating

ECSS-Q-ST-30-11_0140143

a. <<deleted>>

ECSS-Q-ST-30-11_0140144

b. <<deleted>>

ECSS-Q-ST-30-11_0140145

c. <<deleted>>

ECSS-Q-ST-30-11_0140146

Table 6-39: <<deleted>>

ECSS-Q-ST-30-11_0140147

Table 6-40: <<deleted>>

6.32.3 <<deleted>>

6.32.4 Single wire sizing

a. Parameters of Wires and cables from family-group code 13-01 to 13-03 shall be rated as follows:

   1. Voltage: 50 %
   2. The surface temperature of the wire remains 50 °C lower than the manufacturer's maximum rating.

b. The following formula may be used to rate the maximum current in a single wire (ISW), specified in requirement 6.32.4a in vacuum, for an environment temperature of T_{env} environment, to reach a wire surface temperature of $T_{wire,}$ providing the following conditions are met:

1. the radial thermal gradient between wire outer surface and the inner conductor core is insignificant under nominal currents and can therefore be neglected:

   $T_{wire} \approx T_{cond} \approx T_{diel}$

   where

   T_{wire} = Effective wire temperature [K]

   T_{cond} = Conductor temperature [K]

   T_{diel} = External temperature of the wire's dielectric [K]

2. the heat transfer along the axis of the conductor can be neglected (i.e. there is no significant temperature gradient along the wire)

3. the dielectric is fully opaque e.g. the absorptivity equals 1

4. no external radiative source are present (e.g.: no solar flux), the absorptivity of the environment considered as a black body is supposed to be equal to 1

5. no overshields or braids are applied.

$$I_{SW} = \sqrt{\frac{\varepsilon . D . \pi}{R_{Tref}}} \times \sqrt{\frac{\sigma(T_{wire}{}^4 - T_{env}{}^4)}{1 + C_t(T_{wire} - T_{ref})}}$$

where:

I_{SW} = Single wire current for the considered wire gauge [A]

α = Stephan-Boltzman constant = 5,67 E10-8 [W /(m² K⁴)]

T_{wire} = Effective wire temperature [K]

T_{ref} = Reference temperature for the resistance (for example 293,15 K or 20 °C [K]

T_{env} = Temperatures of the environment considered as a black body [K]

R_{Tref} = Ohmic resistance (ohm/m) at T_{ref} (for example at 20 °C as previously considered) [Ω/m]

C_t = Coefficient of temperature for the wire resistance [K^{-1}]

ε = Thermal Emissivity of the wire's surface [-]

D = Wire's external diameter [m]

c. In case conditions specified in the requirement 6.32.4b are not fulfilled, a specific thermal analysis shall be conducted in accordance with requirements from clause 6.32.6.

NOTE An example of calculation with conservative values for commonly used wires is given in Annex C.

d. The harness designer shall make sure that the temperature of each component connected to the wire is compatible with the selected wire temperature T_{wire}.

NOTE Examples of components connected to the wire are contacts, connectors, etc.

6.32.5 Sizing of wires and cables in bundles

6.32.5.1 Fully loaded bundles

a. The derating on current for bundles with N wires IBW, shall be calculated as IBW = ISW × K, with ISW being the rated current for single wire and K as specified in Table 6-41.

NOTE A graphically representation of Table 6-41 is given in Figure C-1 of Annex C.

Table 6-41: Derating factor for bundles (fully loaded)

Count of wires		1	2	3	4	5	6	7	8	9	10	15	25	50	100	200	300
Bundle derating factor		1	0,9	0,81	0,76	0,71	0,66	0,62	0,6	0,59	0,57	0,49	0,4	0,29	0,21	0,15	0,12

6.32.5.2 Partially loaded bundles

a. In case of wires in cold redundancy or wires not used in the same bundle, some with current, others without current, the derating current for bundle, IBW, shall be calculated as IBW = ISW × K x L, with ISW being the rated current for single wire, K as specified in Table 6-41, and L as specified in Table 6-42.

Table 6-42: Additional factor for partially loaded bundles

Percentage of used wires	Less than 25%	Above 25% and less than 50%	More than 50%
L	1,2	1,1	1

6.32.6 Sizing of wires and cables in bundles for specific cables or environment conditions

a. If the conditions specified in clause 6.32.4 are not met, or for specific cables or load conditions, a thermal simulation to validate that the surface temperature of the wire remains 50 °C lower than the manufacturer's maximum rating shall be proposed.

b. The simulation specified in the requirement 6.32.6a shall include:

   1. the radiative and conductive thermal exchanges within the bundle,

   2. the radiative exchanges between the bundle and the environment, including possible solar fluxes,

   3. the worst case physical parameters of the wires: minimum diameter, surface emissivity, maximum resistance at the worst case operating temperature,

   4. application of overshields or braids if applicable.

c. The simulation tool and its parameters shall be validated experimentally on bundles during thermal vacuum tests.

6.33 Opto-electronics - family-group code: 18-01 to 18-05

6.33.1 General

a. <<deleted - moved to 6.33.3a>>

b. <<deleted - moved to 6.33.3b>>

c. <<deleted - moved to 6.33.3c>>

6.33.2 Derating

ECSS-Q-ST-30-11_0140148

a. Parameters of Opto-electronics from family-group code 18-01 to 18-05 shall be derated as per Table 6-43.

ECSS-Q-ST-30-11_0140149

Table 6-43: Derating of parameters for Opto-electronics family-group code 18-01 to 18-05

Parameters	Load ratio or limit
Light emitting diode:	
Forward current	Manufacturer recommended value, or derate to 50 % if not available
Reverse voltage	Derate to 75 %
Photo transistor:	
Maximum collector current	Derate to 80 %
Maximum collector-emitter voltage	Derate to 75 %
Light emitting diode and photo transistor:	
Junction temperature (T_j)	110 °C or $T_{j\,max}$ -40 °C (whichever is lower)

6.33.3 Additional requirements not related to derating

ECSS-Q-ST-30-11_0140150

a. Light emitting diodes that can be radiation sensitive shall be:

1. recorded in the design file, and
2. the component selection be reviewed and approved as specified in ECSS-Q-ST-60.

NOTE Light emitting diodes have high sensitivity to proton displacement damage.

ECSS-Q-ST-30-11_0140151

b. Opto-couplers that can be radiation sensitive shall be:

1. recorded in the design file, and
2. the component selection be reviewed and approved as specified in ECSS-Q-ST-60.

NOTE Operation of opto-couples at low diode currents increase radiation senstitivity.

ECSS-Q-ST-30-11_0140152

c. Photo-transistors that can be radiation sensitiveshall be:

1. recorded in the design file, and
2. the component selection be reviewed and approved as specified in ECSS-Q-ST-60.

6.34 RF passive components: family-group code: 30-01, 30-07, 30-09, 30-10 and 30-99

6.34.1 General

a. <<deleted - moved to 6.34.3a.>>

6.34.2 Derating

<<Table deleted - Requirement for RF power moved to 6.34.3b>>

6.34.2.1 Low power < 5 W

ECSS-Q-ST-30-11_0140153

a. Parameters of RF passive components from family-group code 30-01, 30-07, 30-09, 30-10 and 30-99 shall be derated for Low power < 5 W as per Table 6-44 and for High power ≥ 5 W as per Table 6-45.

ECSS-Q-ST-30-11_0140154

Table 6-44: Derating of parameters for RF passive components from family-group code 30-01, 30-07, 30-09, 30-10 and 30-99 - Low power < 5 W

Parameters	Load ratio or limit
RF power	75 %
Hot spot temperature	30 °C below maximum rated temperature.

6.34.2.2 High power ≥ 5 W

ECSS-Q-ST-30-11_0140155

a. Parameters of RF passive components from family-group code 30-01, 30-07, 30-09, 30-10 and 30-99 shall be derated for High power ≥ 5 W as per Table 6-45.

ECSS-Q-ST-30-11_0140156

Table 6-45: Derating of parameters for RF passive components from family-group code 30-01, 30-07, 30-09, 30-10 and 30-99 - Low power ≥ 5 W

Parameters	Load ratio or limit
RF power	75 %
Hot spot temperature	5 °C below qualification temperature

6.34.3 Additional requirements not related to derating

ECSS-Q-ST-30-11_0140157

a. For connectorized components, connector savers shall be used during testing of equipment to minimize number of mating and demating cycles.

ECSS-Q-ST-30-11_0140158

b. RF power shall be limited such that a 6 dB margin exists before the onset of multipactor.

ECSS-Q-ST-30-11_0140159

c. Maximum mating and de-mating cycles shall be limited to 50 cycles.

6.35 Fibre optic components: fibre and cable: family-group-code: 27-01

6.35.1 General

<<deleted - Table moved to Table 6-46>>

6.35.2 Derating

No derating clause.

6.35.3 Additional requirements not related to derating

ECSS-Q-ST-30-11_0140160

a. Parameters of Fibre optic components shall be derated as per Table 6-46.

ECSS-Q-ST-30-11_0140161

Table 6-46: Derating of parameters for Fibre optic components

Parameters	Load ratio or limit
Bend radius	200 % of the minimum value
Cable tension	50 % of the rated tensile strength
Fibre tension	20 % of the proof test

6.36 Hybrids

a. <<Requirement 6.36a. from previous issue moved to 6.36.2a>>

6.36.1 General

<<No general clause>>

6.36.2 Derating

ECSS-Q-ST-30-11_0140162

a. For hybrids, individual components shall be in conformance with their respective derating rules.

6.36.3 Additional requirements not related to derating

No additional requirement.

Annex A (informative) Family and group codes

This annex contains an extract from the European preferred parts list (EPPL) and it lists all the parts referred to in this Standard providing their family and group codes.

Family code	Group code	Family	Group
01	01	Capacitors	Ceramic
01	02	Capacitors	Ceramic Chip
01	03	Capacitors	Tantalum solid
01	04	Capacitors	Tantalum non-solid
01	05	Capacitors	Plastic metallized
01	06	Capacitors	Glass
01	07	Capacitors	Mica and reconstituted mica
01	10	Capacitors	Feedthrough
01	11	Capacitors	Semiconductor
01	99	Capacitors	Miscellaneous
02	01	Connectors	Circular
02	02	Connectors	Rectangular
02	03	Connectors	Printed circuit board
02	07	Connectors	Microminiature
02	09	Connectors	Rack and panel
03	01	Piezo-electric devices	Crystal resonator
04	01	Diodes	Switching

Family code	Group code	Family	Group
04	02	Diodes	Rectifier
04	03	Diodes	Voltage regulator
04	04	Diodes	Voltage reference/zener
04	05	Diodes	RF/microwave Schottky - Si
04	06	Diodes	Pin
04	08	Diodes	Transient suppression
04	10	Diodes	High voltage rectifier
04	11	Diodes	Microwave varactor - GaAs
04	12	Diodes	Step recovery
04	13	Diodes	Microwave varactor - Si
04	14	Diodes	Current regulator
04	15	Diodes	Microwave Schottky - GaAs
04	16	Diodes	RF/microwave - PIN
04	17	Diodes	Microwave Gunn - GaAs
05	01	Filters	Feedthrough
06	01	Fuses	All
07	01	Inductors	RF coil
07	02	Inductors	Cores
07	03	Inductors	Chip
08	10	Microcircuits	Microprocessors/microcontrollers/ peripherals
08	20	Microcircuits	Memory SRAM
08	21	Microcircuits	Memory DRAM
08	22	Microcircuits	Memory PROM
08	23	Microcircuits	Memory EPROM
08	24	Microcircuits	Memory EEPROM
08	29	Microcircuits	Memory others
08	30	Microcircuits	Programmable logic
08	40	Microcircuits	ASIC technologies digital
08	41	Microcircuits	ASIC technologies linear

Family code	Group code	Family	Group
08	42	Microcircuits	ASIC technologies mixed analogue/digital
08	50	Microcircuits	Linear operational amplifier
08	51	Microcircuits	Linear sample and hold amplifier
08	52	Microcircuits	Linear voltage regulator
08	53	Microcircuits	Linear voltage comparator
08	54	Microcircuits	Linear switching regulator
08	55	Microcircuits	Linear line driver
08	56	Microcircuits	Linear line receiver
08	57	Microcircuits	Linear timer
08	58	Microcircuits	Linear multiplier
08	59	Microcircuits	Linear switches
08	60	Microcircuits	Linear multiplexer/demultiplexer
08	61	Microcircuits	Linear analog to digital converter
08	62	Microcircuits	Linear digital to analogue converter
08	69	Microcircuits	Linear other functions
08	80	Microcircuits	Logic families
08	95	Microcircuits	MMIC
08	99	Microcircuits	Miscellaneous
09	01	Relays	Non-latching
09	02	Relays	Latching
10	01	Resistors	Metal oxide
10	02	Resistors	Wire-wound precision - including surface mount
10	03	Resistors	Wire-wound chassis mounted
10	04	Resistors	Variable trimmers
10	05	Resistors	Composition
10	07	Resistors	Shunt
10	08	Resistors	Metal film
10	09	Resistors	Chip - all
10	10	Resistors	Network - all
10	11	Resistors	Heaters, flexible

Family code	Group code	Family	Group
11	01	Thermistors	Temperature compensating
11	02	Thermistors	Temperature measuring
11	03	Thermistors	Temperature sensor
12	01	Transistors	Low power, NPN - < 2 W
12	02	Transistors	Low power, PNP - < 2 W
12	03	Transistors	High power, NPN - > 2 W
12	04	Transistors	High power, PNP - > 2 W
12	05	Transistors	FET N channel
12	06	Transistors	FET P channel
12	09	Transistors	Switching
12	10	Transistors	RF/microwave NPN low power/low noise
12	12	Transistors	RF/microwave FET N-channel/P-channel
12	13	Transistors	RF/microwave bipolar power
12	14	Transistors	RF/microwave FET power - Si
12	15	Transistors	Microwave power - GaAs
12	16	Transistors	Microwave low noise - GaAs
13	01	Wires and cables	Low frequency
13	02	Wires and cables	Coaxial
13	03	Wires and cables	Fibre optic
14	01	Transformers	Power
16	01	Switches	Standard DC/AC power toggle

Family code	Group code	Family	Group
18	01	Opto-electronics	Opto-coupler
18	02	Opto-electronics	LED
18	03	Opto-electronics	Phototransistor
18	04	Opto-electronics	Photo diode/sensor
18	05	Opto-electronics	Laser diode
27	01	Fibreoptic components	Fibre/cable
30	01	RF passive devices	Coaxial couplers
30	07	RF passive devices	Isolator/circulator
30	09	RF passive devices	Coaxial power dividers
30	10	RF passive devices	Coaxial attenuators/loads
30	99	RF passive devices	Miscellaneous

Annex B (informative)
ESCC Exceptions

This annex contains the list of the ESCC detail specifications applicable at the time of publication and containing deviations to general derating requirements of this standard.

There are presently no ESCC Detail Specifications recording derating deviations to ECSS-Q-ST-30-11.

Annex C (informative) Example of single wires rating currents calculation for the wires most commonly used for space applications

C.1 Introduction

All of the values given in this Annex are for information: it's the designer's responsibility to assess the values of the parameters for the type of wires and cables that have been selected.

C.2 Typical conservative parameters

- Emissivity of the wire surface: E = 0,75.
- Coefficient of temperature for the wire resistance:

  Ct = 0,00396 K-1 for copper

  Ct = 0,004 K-1 for aluminum wires.

  The above values are given for: Tref = 293,15 K.

As an example, the tables here after give a set of physical parameter values for each gauge of wire which are conservative for most of the cables covered by the ESCC 3901/xxx. The minimum value of the diameter is considered because it represents the worst case as it minimizes the radiative surface of the wire, and therefore its cooling capability.

Table C-1: Parameters for Copper and Copper Alloy wires

Wire Size (AWG)	28	26	24	22	20	18	16	14	12	10	8	4	0
Resistance at 20°C (mOhm/m)	242	148	105	50,9	32,2	20,6	14,3	10,1	6,03	3,9	2,38	0,91	0,38
Min diameter (mm)	0,6	0,7	0,8	1	1,2	1,45	1,77	2,07	2,68	(*)	(*)	(*)	(*)
(*) Gauges not available in ESCC3901													

Table C-2: Parameters for Aluminum wires

Wire Size (AWG)	22	20	18	16	14	12	10	8
Resistance at 20°C (mOhm/m)	92	52	33	23	17	10,3	6,4	3,6
Min diameter (mm)	0,88	1,13	1,38	1,73	2,1	2,7	3,45	4,85

C.3 Example of current rating values for single wires

The values in Table C-3, Table C-4 were calculated using the above formula and list of parameters, for an environment temperature of 70 °C.

Copper wires:

Maximum wire temperature: 150°C

Table C-3: Single wire rated current for a copper conductor for the parameter values of Table C-1

Wire Size (AWG)	28	26	24	22	20	18	16	14	12
Rated current (A) ISW	1,9	2,7	3,4	5,6	7,7	10,6	14	18,1	26,7

Aluminum wires:

Maximum wire temperature: 100 °C

Table C-4: Single wire rated current for an aluminum conductor for parameter values of Table C-2

Wire Size (AWG)	22	20	18	16	14	12	10	8
Rated current (A) ISW	2,3	3,4	4,8	6,4	8,3	12,1	17,3	27,4

C.4 Chart of Derating Factor K for Fully Loaded Bundles

Figure C-1 is a graphical representation of the table provided in Table 6-41.

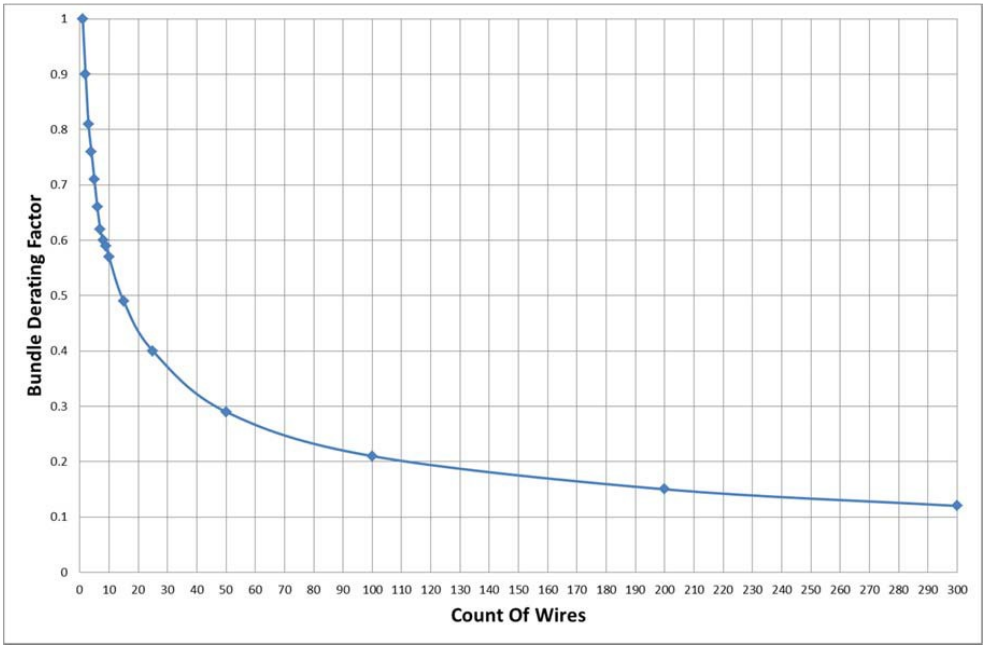


Figure C-1: Derating factor for fully loaded bundle

Bibliography

ECSS-S-ST-00 ECSS system - Description and implementation and general requirements