EUROPEAN COOPERATION

**E**CSS

FOR SPACE STANDARDIZATION

# Space product assurance

## Derating - EEE components

**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.

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# Change log

| ECSS-Q-60-11A<br>7 September 2004 | First issue |
|---|---|
| ECSS-Q-30-11A<br>24 April 2006 | Second issue |
| ECSS-Q-30-11B | Never issued |
| ECSS-Q-ST-30-11C<br>31 July 2008 | Third issue<br><br>Minor editorial changes:<br>• Document converted to new ECSS template,<br>• Bibliography updated (reference to ECSS-S-ST-00 was added and reference to ECSS-E-10-12 and ECSS-Q-30 were deleted because not called from the text) |
| ECSS-Q-ST-30-11C Rev 1<br>4 October 2011 | Third issue Revision 1 |
| ECSS-Q-ST-30-11C Rev.2<br>23 June 2021 | Third issue Revision 2<br><br>The major changes between ECSS-Q-ST-30-11C Rev.1 (4 October 2011) and this version are:<br>• Implementation of Change Requests<br>• Addition of clause 6.26.2.9 "Thick Film Power"<br>• Informative Annex B "ESCC Exceptions" deleted<br>• Informative Annex C "Example of single wires rating currents calculation for the wires most commonly used for space applications" added<br><br>Detailed Change Record:<br>Deleted requirements:<br>6.2.1b; 6.4.3a; 6.13.3; 6.15.3a; 6.19.3a; 6.20.3a; 6.21.3a and b; 6.23.2b; 6.23.3a; 6.25.1a (modified and moved); 6.25.3a to c; 6.28.3a; 6.30.3a; 6.31.3a (replaced by informative statement); 6.32.2a to c; Table 6-39 and Table 6-40 |

(formerly Table 6-37 and Table 6-38); 6.33.3a to c.

Added requirements:

5.3.2i; 6.2.1e; 6.3.1g; 6.3.3c; 6.4.1d; 6.5.1d; 6.6.1b; 6.7.1b; 6.8.1b; 6.9.1b; 6.10.1b; 6.18.3c; 6.23.2c to e; Table 6-23; 6.24.3a; 6.25.1h to i (former req 6.25.1a, modified); 6.25.3e to h; 6.26.2.8c; 6.26.2.9a; Table 6-33; 6.30.2b to d; 6.31.2b to g; 6.32.4a to d; 6.32.5.1a; Table 6-41; 6.32.5.2a; Table 6-42, 6.32.6a to c.

Modified requirements:

5.3.2c to f and h; 5.3.3a Note added; 5.3.3b Note deleted; 5.5.2a; 6.2.1d; 6.3.1a and f; 6.4.1c; 6.5.1c; 6.6.1a; 6.7.1a; 6.8.1a; 6.9.1a; 6.10.1a; Table 6-10; Table 6-11; Table 6-13; Table 6-14; Table 6-15; 6.18.3b; Table 6-19; Table 6-20; 6.21.1a and b (correction of cross-reference); Table 6-21; 6.23.2a; 6.24.2a; 6.25.1d; 6.26.2.8a; Table 6-23; Table 6-32; Table 6-35; 6.28.3b and c; Table 6-36; 6.29.3b; Table 6-37.

Editorial changes:

- Update of Normative References in Clause 2
- Update of Definitions in Clause 3
- Several cross-references to Tables in text of requirements updated due addition of new Table 6-23 (starting with req. 6.25.2a)

# Table of contents

# Introduction

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

Derating is a long standing practice applied to components used on spacecraft. 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 |
| ECSS-Q-ST-60-13 | Commercial electrical, electronic and electromechanical (EEE) components |
| ECSS-Q-ST-60-15 | Radiation hardness assurance - EEE components |
| ESCC 2269010 | Evaluation test programme for monolithic microwave integrated circuits (MMICS) |
| ESCC 2265010 | Evaluation Test Programme for Discrete Microwave Semiconductors |
| ESCC Derating deviations | Component Derating - Deviations to ECSS-Q-ST-30-11: https://escies.org/webdocument/showArticle?id=825&groupid=6 |

# 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    **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.

### 3.2.9    **surge**

strong rush or sweep

### 3.2.10    **transient**

brief change in the state of a system

## 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 |
| ESR | equivalent series resistance |
| f | frequency |
| FET | field effect transistor |
| GaAs | gallium arsenide |
| ISO | International Organization for Standardization |

| Abbreviation | Meaning |
|---|---|
| InP | indium phosphide |
| 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 |
| $T_j$ | junction temperature |
| $T_{jmax}$ | absolute maximum rated junction temperature |
| $T_{op}$ | operating temperature |
| $V_{CE}$ | collector-emitter voltage |

## 3.4   Nomenclature

The following nomenclature applies throughout this document:

a.   The word "shall" is used in this Standard to express requirements. All the requirements are expressed with the word "shall".

b.   The word "should" is used in this Standard to express recommendations. All the recommendations are expressed with the word "should".

> NOTE   It is expected that, during tailoring, recommendations in this document are either converted into requirements or tailored out.

c.   The words "may" and "need not" are used in this Standard to express positive and negative permissions, respectively. All the positive

permissions are expressed with the word "may". All the negative permissions are expressed with the words "need not".

d.    The word "can" is used in this Standard to express capabilities or possibilities, and therefore, if not accompanied by one of the previous words, it implies descriptive text.

NOTE    In ECSS "may" and "can" have completely different meanings: "may" is normative (permission), and "can" is descriptive.

e.    The present and past tenses are used in this Standard to express statements of fact, and therefore they imply descriptive text.

# 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.
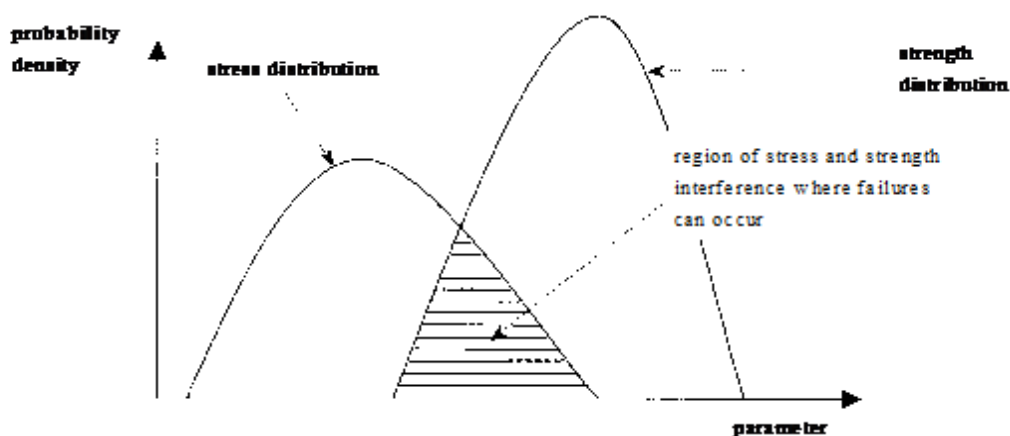


**Figure 5-1: Parameter stress versus strength relationship**

## 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.

## 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.

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.

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 mode that can potentially propagate .

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

i.   Derating analysis shall be performed at the equipment maximum hot acceptance temperature, unless otherwise specified.

## 5.3.3   Requirements ESCC exceptions

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.

NOTE      There are many misunderstandings about ratings vs derating. Specifications normally only contain ratings. The exceptions are listed in 5.3.3b.

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

**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 specific requirements within ECSS-Q-ST-60-15 shall be applied.

# 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.

**ECSS-Q-ST-30-11_0140180**

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.

**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.

**ECSS-Q-ST-30-11_0140181**

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.

**ECSS-Q-ST-30-11_0140182**

c.    For control of ESR drift especially in the case of polymer tantalum capacitors, a higher derating may be applied than specified.

> NOTE    For example 50 % to 85 °C maximum and no use at higher temperature than 85 °C.

## 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.

**ECSS-Q-ST-30-11_0140183**

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.

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

| Parameters | Load ratio or limit |
|---|---|
| Voltage:<br>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.

**ECSS-Q-ST-30-11_0140184**
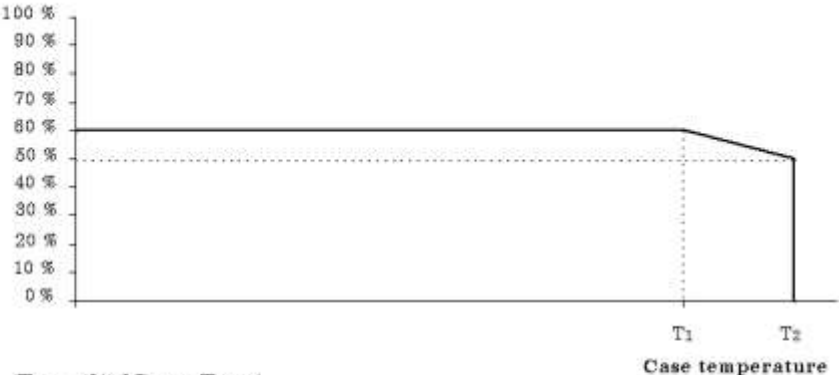
d.    Where ESR is not known at the frequency of a ripple current, an extrapolation of the ESR value and resonance, from manufacturer's or test data, should be made where possible.

### 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.

**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. | <br><br>T₁ = 85 °C or Tmax*<br>T₂ = 100 °C or Tmax*<br>whichever is lower<br><br>* 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

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

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.
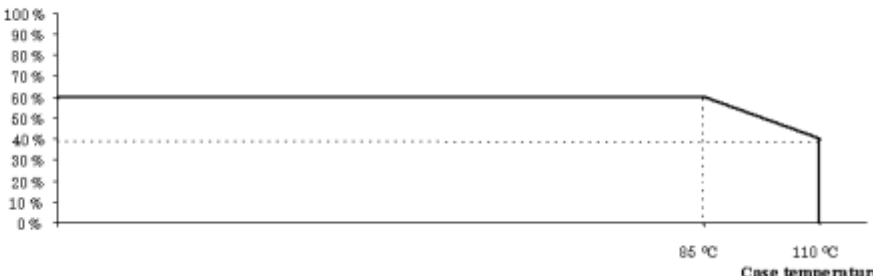
**ECSS-Q-ST-30-11_0140185**

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.

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

| Parameters | Load ratio or limit |
|---|---|
| Voltage:<br>voltage includes DC voltage and super-imposed AC peak voltage. |  |
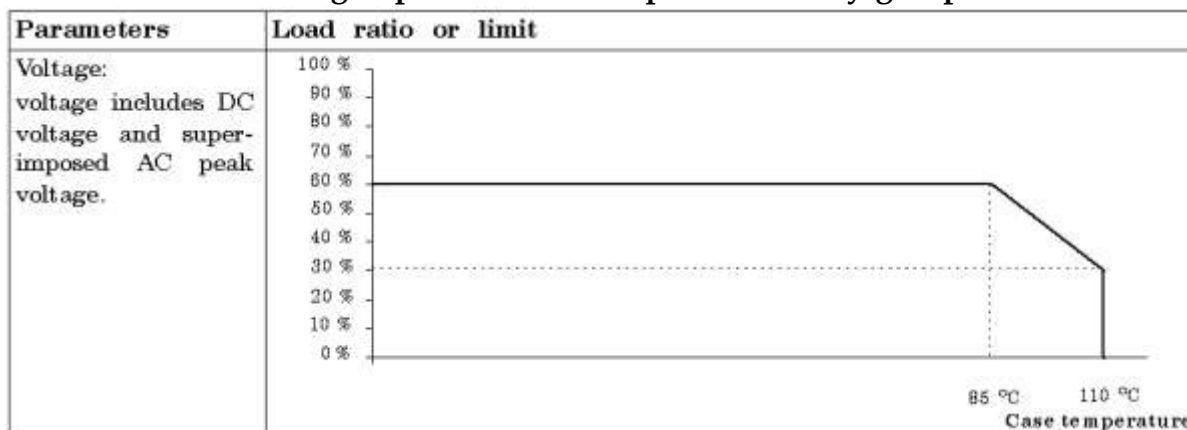
### 6.6.3 Additional requirements not related to derating

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.

**ECSS-Q-ST-30-11_0140186**

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. |  |
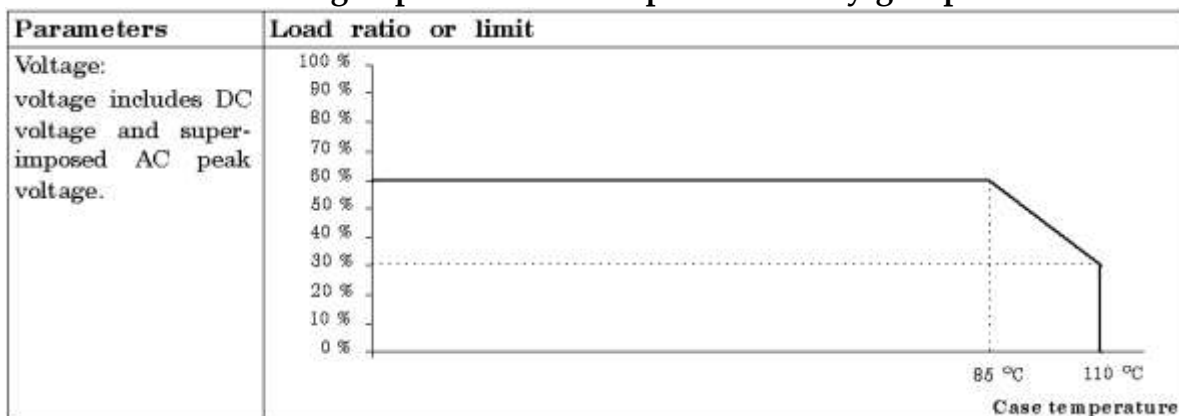
### 6.7.3 Additional requirements not related to derating

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.

**ECSS-Q-ST-30-11_0140187**

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 |  |
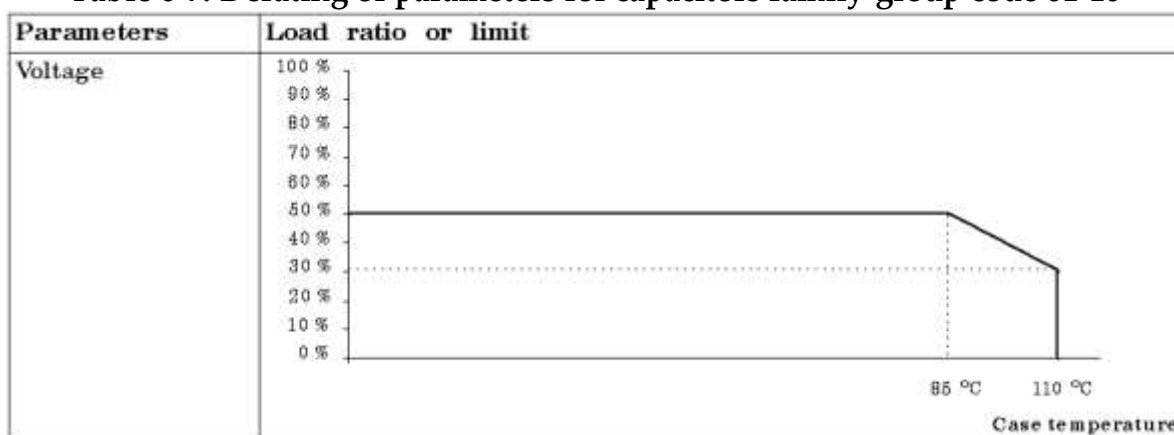
## 6.8.3 Additional requirements not related to derating

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.

**ECSS-Q-ST-30-11_0140188**

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.
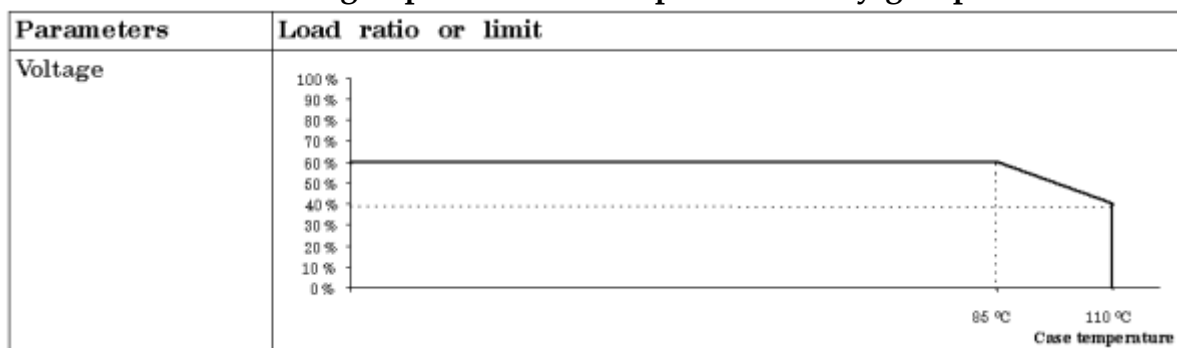
### 6.9.2 Derating

**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**
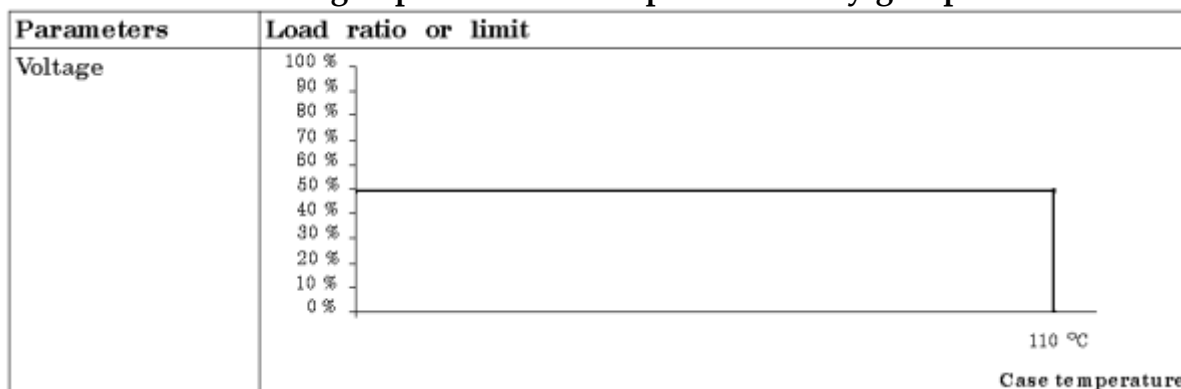


### 6.9.3 Additional requirements not related to derating

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.
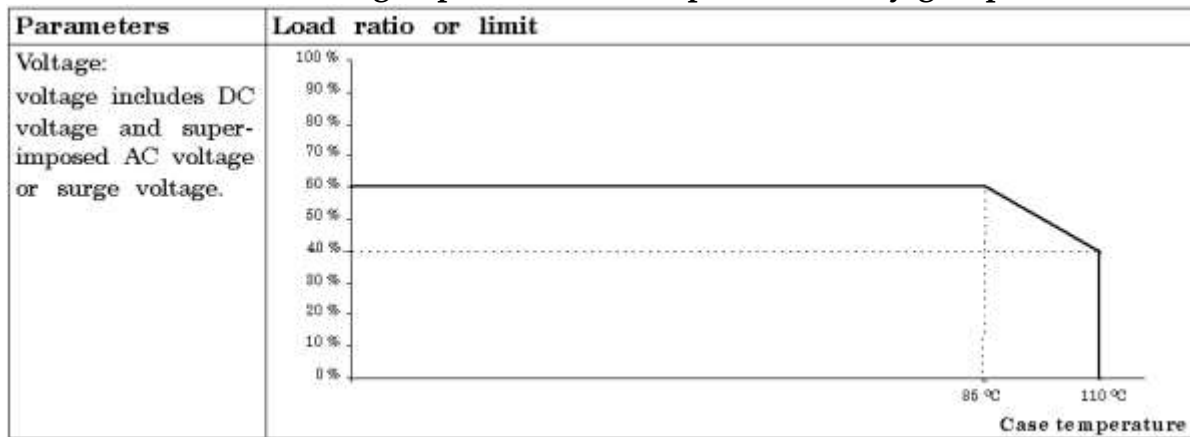
**ECSS-Q-ST-30-11_0140189**

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 |  |
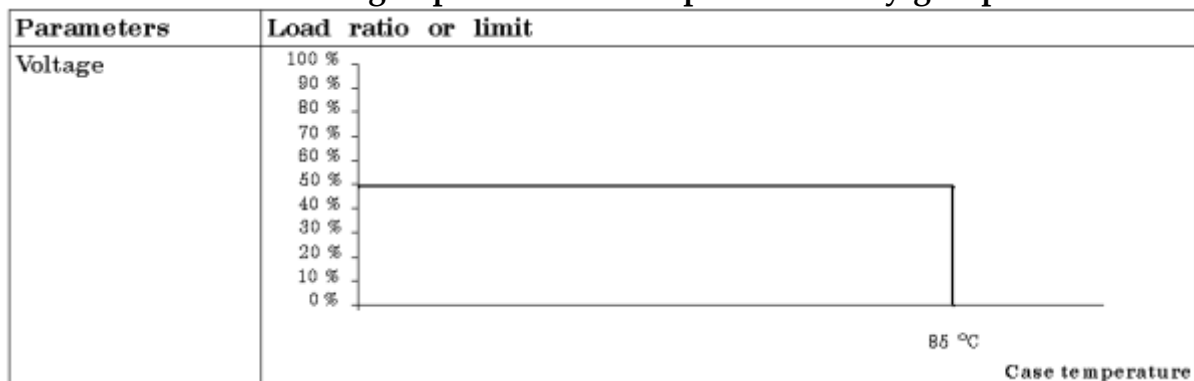
### 6.10.3 Additional requirements not related to derating

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, see Note)<br><br>- or –<br><br>75% of the connector rated operating (working) voltage (at sea level),<br><br>whichever is lower. |
| Current | 50 % |
| Maximum operating temperature | 30 °C below maximum rated temperature. |
| <<deleted>> | <<deleted - moved to 6.11.3e>> |
| NOTE   It is good practice to consider Voltage Max rating at any altitude as the load limit when the connecter is used during launch. | |

## 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 | 75 % |
| Working voltage | 25% of the connector Dielectric Withstanding test Voltage (at sea level, unconditioned, see Note) <br> - or – <br> 75% of the connector rated operating (working) voltage (at sea level), <br><br> whichever is lower. |
| Maximum operating temperature | 30 °C below maximum rated temperature. |
| <<deleted>> | <<deleted - moved to 6.12.3c>> |
| NOTE   It is good practice to consider Voltage Max rating at any altitude as the load limit when the connecter is used during launch. | |

### 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.

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

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 % <br> or <br> SEE Safe Operating Area, whichever is lower if applicable |
| 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). <br> Exception: <br> 125 °C, providing: <br> 1. that the specified maximum rating Tjmax ≥ 150 °C, and <br> 2. that Devices or Processes are supported by ESCC 226500 and 226900 evaluation program or equivalent and that the related evaluation reports are available (see NOTE). |
| NOTE: It is important that test results include the evidence of an equivalent operation life time covering the mission application. | |

### 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) <br> Exception: <br> 125 °C, providing: <br> 1. that the specified maximum rating Tjmax ≥ 150 °C, and <br> 2. that Devices or Processes are supported by ESCC 226500 and 226900 evaluation program or equivalent and that the related evaluation reports are available (see NOTE). |
| NOTE:  It is important that test results include the evidence of an equivalent operation life time covering the mission application. | |

## 6.14.3 Additional requirements not related to derating

**ECSS-Q-ST-30-11_0140068**

a.    <<deleted>>

**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) |
| | Exception: |
| | 125 °C, providing: |
| | 1. that the specified maximum rating Tjmax ≥ 150 °C, and |
| | 2. that Devices or Processes are supported by ESCC 2265010 and 2269010 evaluation program or equivalent and that the related evaluation reports are available (see NOTE 3). |
| NOTE 1: Forward current is not applicable to varactors. | |
| NOTE 2: Reverse voltage is not applicable to Gunn diodes. | |
| NOTE 3: It is important that test results include the evidence of an equivalent operation life time covering the mission application. | |

### 6.15.3 Additional requirements not related to derating

**ECSS-Q-ST-30-11_0140072**

a.      <<deleted>>

## 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 |  | | |
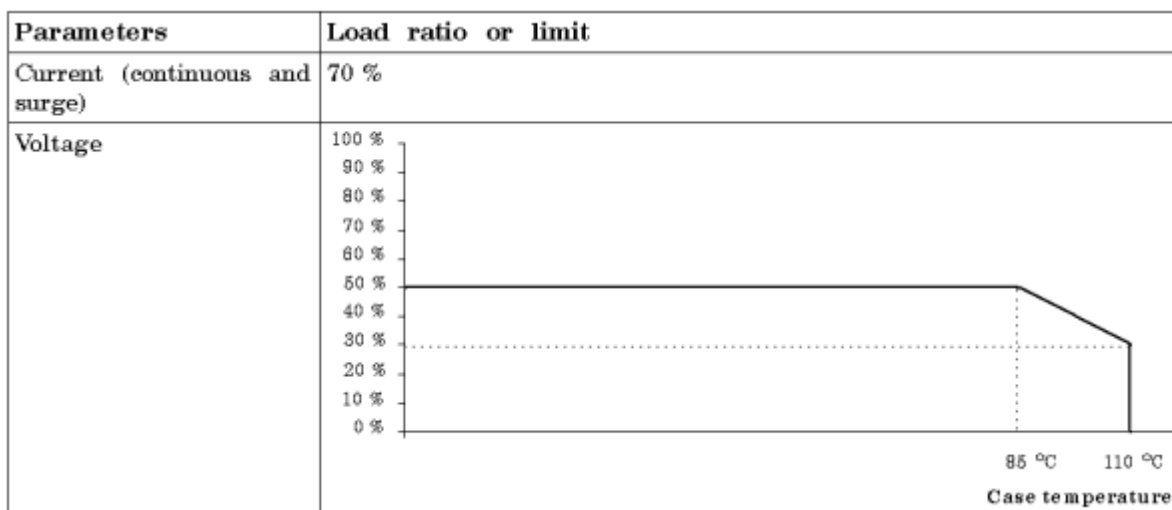
### 6.16.3   Additional requirements not related to derating

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.

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

| Parameters | Load ratio or limit |
|---|---|
| Current |  |
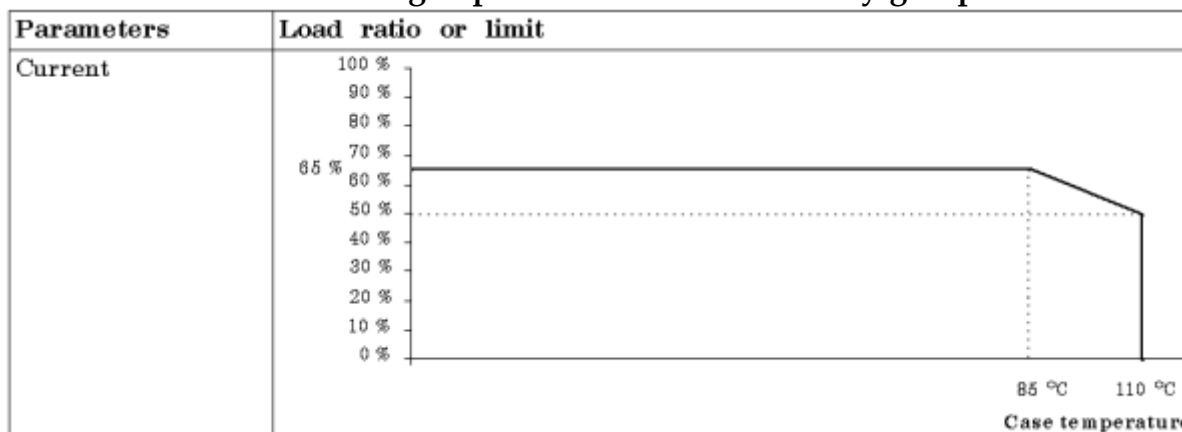
## 6.17.3 Additional requirements not related to derating

**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.<br>(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.

**ECSS-Q-ST-30-11_0140190**

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**<br>- Turn on transient peaks or other peaks shall not exceed the maximum rating.<br>- 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).<br>Exception :<br>125 °C or Tj max - 25 °C (whichever is lower), providing:<br>1. that the specified maximum rating Tjmax ≥ 150 °C, and<br>2. that Devices or Processes are supported by ESCC 226500 and 226900 evaluation program or equivalent and that the related evaluation reports are available (see NOTE). | <<deleted>> |
| NOTE: It is important that test results include the evidence of an equivalent operation life time covering the mission application. | | |

### 6.19.3 Additional requirements not related to derating

**ECSS-Q-ST-30-11_0140087**

a.    <<deleted>>

## 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**<br>- Turn on transient peaks or other peaks shall not exceed the maximum rating.<br>- 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)<br><br>Exception :<br><br>125 °C, providing:<br><br>1. that the specified maximum rating Tjmax ≥ 150 °C, and<br><br>2. that Devices or Processes are supported by ESCC 226500 and 226900 evaluation program or equivalent and that the related evaluation reports are available (see NOTE). | <<deleted>> |
| Endurance and data retention | | **Endurance**<br>The endurance (number of write and erase |

| Parameters | Load ratio or limit | Special conditions |
|---|---|---|
| | | 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. |
| NOTE: It is important that test results include the evidence of an equivalent operation life time covering the mission application. | | |

### 6.20.3 Additional requirements not related to derating

ECSS-Q-ST-30-11_0140090

a.      <<deleted>>

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

### 6.21.1 General

a.    <<deleted - moved to 6.21.3a>>

b.    <<deleted - moved to 6.21.3b>>

### 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.

**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 rail 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. Exception : 125 °C, providing: 1. that the specified maximum rating Tjmax ≥ 150 °C, and 2. that Devices or Processes are supported by ESCC 226500 and 226900 evaluation program or equivalent and that the related evaluation reports are available (see NOTE). | |
| NOTE: It is important that test results include the evidence of an equivalent operation life time covering the mission application. | | |

### 6.21.3 Additional requirements not related to derating

**ECSS-Q-ST-30-11_0140093**

a.   <<deleted>>

**ECSS-Q-ST-30-11_0140175**

b.   <<deleted>>

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

### 6.22.1 General

a.     <<deleted - moved to6.23.3a.>>

### 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.

**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.<br><br>Exception:<br><br>125 °C, providing:<br><br>1. that the specified maximum rating Tjmax ≥ 150 °C, and<br><br>2. that Devices or Processes are supported by ESCC 226500 and 226900 evaluation program or equivalent and that the related evaluation reports are available. | |
| 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) | |
| NOTE: It is important that test results include the evidence of an equivalent operation life time covering the mission application. | | |

## 6.22.3 Additional requirements not related to derating

a.      <<deleted>>

## 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.    <<deleted>>

**ECSS-Q-ST-30-11_0140191**

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

**ECSS-Q-ST-30-11_0140192**

d.    Transistors parameters of custom designed MMICs shall be derated as per Table 6-37 and Table 6-38, for RF bipolar and RF field effect transistors, respectively.

**ECSS-Q-ST-30-11_0140193**

e.    Parameters of non-custom MMICs shall be derated as per Table 6-23 including the following conditions for RF:

1.    when not supported by reliability data, compression levels do not exceed 1 dB;

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

3.    in the case when the non-custom MMIC is specified through a maximum RF input power, the RF input power be derated by 3 dB back off from the specified RF input power.

**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.      <<deleted>>

## 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, or

3.    Junction temperature exception: 125 °C, providing

     (a)    that the specified maximum rating Tjmax ≥ 150 °C, and

     (b)    that Devices or Processes are supported by ESCC 226500 and 226900 evaluation program or equivalent and that the related evaluation reports are available.

4.    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.    <<deleted>>

## 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.>>

**ECSS-Q-ST-30-11_0140195**

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

**ECSS-Q-ST-30-11_0140196**

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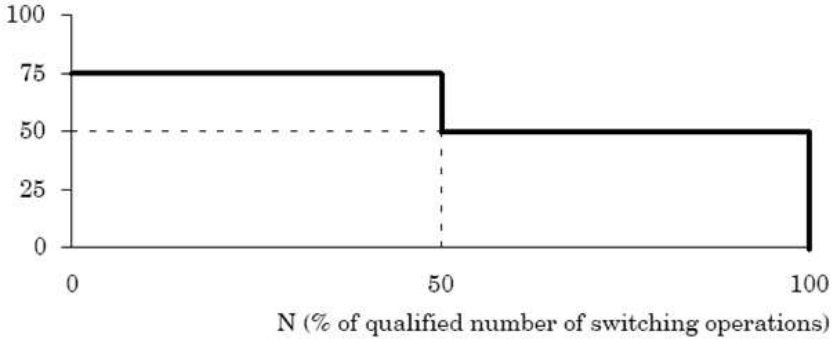
> NOTE    Latch or reset voltage are specified for latching device, pick-up voltage is specified for non-latching devices.

## 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<br><br>• Resistive load | <br><br>Number of operations less than 100 (including integrating and testing)<br><br>• When the specified overload current is rated at twice the rated contact current, the rated contact current may be used.<br><br>• 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.<br><br>• For 1 A < $I_{CR}$ ≤ 5 A, the current shall be greater than 10 mA.<br><br>• 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.<br><br>For surge duration > 10μs :<br><br>$$I^2 tp < 16\, Ir^2 * 10^{-5} (A^2.s)$$<br><br>where:<br><br>$I$ = Surge current<br><br>$Ir$ = Rated current<br><br>$tp$ = 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.

**ECSS-Q-ST-30-11_0140197**

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

**ECSS-Q-ST-30-11_0140198**

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.

**ECSS-Q-ST-30-11_0140199**

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

**ECSS-Q-ST-30-11_0140200**

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

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

#### 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

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

#### 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.

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

c.    In case heater, temperature is unknown the power density shall be below the Rated Power Density with heater suspended in still air defined in the specification.

**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. |

### 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). Exception: 125 °C, providing: 1. that the specified maximum rating Tjmax ≥ 150 °C, and 2. that Devices or Processes are supported by ESCC 226500 and 226900 evaluation program or equivalent and that the related evaluation reports are available (see NOTE). |
| <<Notes deleted and moved to 6.28.3b and 6.28.3c>> ||
| NOTE: It is important that test results include the evidence of an equivalent operation life time covering the mission application. ||

### 6.28.3 Additional requirements not related to derating

**ECSS-Q-ST-30-11_0140133**

a.    <<deleted>>

**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 ($V_{DS}$) | 80 % of rated, <br> or <br> the SEE safe operating area (VDS versus VGS), whichever is lower |
| Gate to source voltage ($V_{GS}$) | 75% of rated, <br> or <br> the SEE safe operating area ($V_{DS}$ versus $V_{GS}$), whichever is lower |
| 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) <br> Exception: <br> 125 °C, providing: <br> 1. that the specified maximum rating Tjmax ≥ 150 °C, and <br> 2. that Devices or Processes are supported by ESCC 226500 and 226900 evaluation program or equivalent and that the related evaluation reports are available (see NOTE). |
| NOTE:  It is important that test results include the evidence of an equivalent operation life time covering the mission application. | |

### 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.

**ECSS-Q-ST-30-11_0140204**

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

**ECSS-Q-ST-30-11_0140205**

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.

**ECSS-Q-ST-30-11_0140206**

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.

**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.<br><br>115 °C or $T_{j\,max}$ – 25 °C (whichever is lower) for GaAs and InP bipolar transistors.<br><br>Exceptions:<br>a) 125 °C for Si and SiGe bipolar transistors , providing:<br>1. that the specified maximum rating Tjmax ≥ 150 °C, and<br>2. that Devices or Processes are supported by ESCC 2265010 and 2269010 evaluation program or equivalent and that the related evaluation reports are available (see NOTE).<br><br>b) 125 °C  for GaAs or InP, providing that<br>   1.  the specified maximum rating Tmax ≥ 150 °C ,<br>   2.  Devices or Processes are supported by ESCC 2269010 and 2265010 evaluation program or equivalent and that the related evaluation reports are available (see NOTE)<br>   3.  <<deleted>> |
| NOTE | It is important that test results include the evidence of an equivalent operation life time covering the mission application. |

### 6.30.3 Additional requirements not related to derating

**ECSS-Q-ST-30-11_0140139**

a.    <<deleted>>

## 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.

**ECSS-Q-ST-30-11_0140207**

b.    Except for wide band gap semiconductor GaN, specified in requirements 6.31.2e and 6.31.2f, when not supported by reliability data, compression levels shall not exceed 1 dB.

**ECSS-Q-ST-30-11_0140208**

c.    Except for wide band gap semiconductor GaN, specified in requirements 6.31.2e and 6.31.2f, when supported by reliability data, the RF input power shall be derated by 2 dB back off from the highest level showing no drift.

**ECSS-Q-ST-30-11_0140209**

d.    Except for wide band gap semiconductor GaN, specified in requirements 6.31.2e and 6.31.2f, 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.

**ECSS-Q-ST-30-11_0140210**

e.    Due to the soft Pin-Pout compression characteristics of GaN technology, P1dB, P3dB compression definitions are not always representative, therefore the maximum allowed RF output power shall correspond to the maximum power added efficiency operating condition as defined 6.31.2f.

**ECSS-Q-ST-30-11_0140211**

f.    For GaN devices, when supported by step stress reliability data, shall:

1.    the operating input power level not be above Pin (PAEmax),

2.  the Stress test data be provided for varying input power levels to at least Pin(PAEmax) + 2dB without observation of any drift above agreed qualification limits.

    NOTE    Pin (PAEmax) being the value to achieve the output power Pout(PAEmax). i.e. the RF output power level corresponding to the maximum power added efficiency operating condition.

**ECSS-Q-ST-30-11_0140212**

g.  For GaN devices, when not supported by step stress reliability data, the input RF power level shall not be above Pin(PAEmax) -3dB.

**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 (NOTE 1) |
|---|---|
| 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 FET. 115 °C or $T_{j\,max}$ - 25 °C (whichever is lower) for GaAs and InP FET transistors. 145 °C or $T_{j\,max}$ - 25 °C (whichever is lower) for GaN FET ESCC Exceptions : (a) 125 °C for Si, providing that: 1. the specified maximum rating Tjmax ≥ 150 °C, and 2. Devices or Processes are supported by ESCC 2269010 and 2265010 evaluation program or equivalent, and that the related evaluation reports are available (see NOTE 2) b) 125 °C for GaAs or InP, providing that: 1. the specified maximum rating $T_{max}$ ≥ 150 °C , 2. Devices or Processes are supported by ESCC 2269010 and 2265010 evaluation program or equivalent, and that the related evaluation reports are available (see NOTE 2) (c) 160 °C for GaN, providing that: 1. the specified maximum rating Tjmax ≥ 200 °C, 2. Devices or Processes are supported by ESCC 2269010 and 2265010 evaluation program or equivalent and that the related evaluation reports are available (see NOTE 2). |
| NOTE 1: | Load ratio or limits are specified against Absolute Max Ratings (AMR). 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 Absolute Max Ratings (AMR) and Recommended Operating Rating (ROR). |
| NOTE 2: | It is important that test results include the evidence of an equivalent operation life time covering the mission application. |

### 6.31.3    Additional requirements not related to derating

It is good practice to consider the Recommended Operation Rating (ROR) only when it is not in contradiction with the derating load ratio or limit.

**ECSS-Q-ST-30-11_0140142**

a.      <<deleted>>

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

### 6.32.1 <<deleted>>

### 6.32.2 <<deleted>>

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

ECSS-Q-ST-30-11_0140213

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]

$\alpha$   =   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]

$\varepsilon$   =   Thermal Emissivity of the wire's surface [-]

$D$   =   Wire's external diameter [m]

**ECSS-Q-ST-30-11_0140215**

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.

**ECSS-Q-ST-30-11_0140216**

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

**ECSS-Q-ST-30-11_0140217**

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.

**ECSS-Q-ST-30-11_0140218**

**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

ECSS-Q-ST-30-11_0140219

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.

ECSS-Q-ST-30-11_0140220

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

ECSS-Q-ST-30-11_0140221

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.

ECSS-Q-ST-30-11_0140222

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.

ECSS-Q-ST-30-11_0140223

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.  <<deleted>>

**ECSS-Q-ST-30-11_0140151**

b.  <<deleted>>

**ECSS-Q-ST-30-11_0140152**

c.  <<deleted>>

## 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 6.36.3a>>

### 6.36.2    General

No general clause

### 6.36.3    Derating

**ECSS-Q-ST-30-11_0140162**

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

### 6.36.4    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)
## <<deleted>>


# Annex C

# 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**

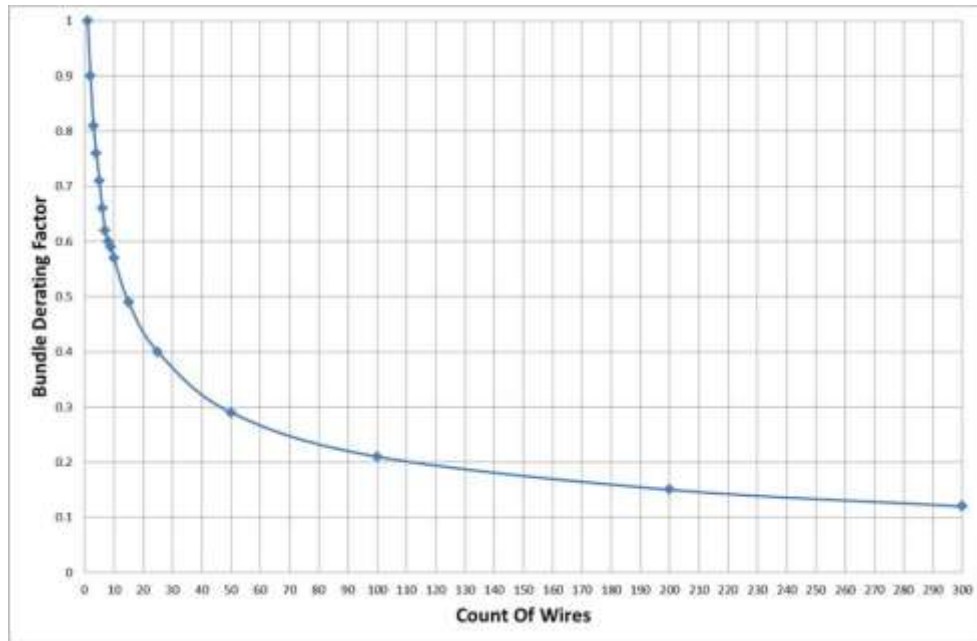# **Bibliography**

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