# Purpose

This document provides guidance to the engineer with regards to derating analysis of electrical and electronic designs. Derating helps the engineer identify any potential weaknesses which may lead to an unreliable or marginal design which is prone to failure.

The act of derating is redefining allowable operating specifications below the manufacturer recommendation to extend lifetime by ensuring devices are not designed to be stressed to their maximum potential.

# Scope

The most difficult part of derating is figuring out which parameters are required for each component, what are the correct derating values to use for each component, and the calculations to determine if the derated use case is ok.

This difficulty and ambiguity have been removed with the definition of component derating values and calculations found in EE-TL-001 Derating Worksheet.

The next most difficult part is derating every component in the design. This is a tedious process which can take weeks to grind out manually.

A good portion of the tediousness and calculation grinding has been removed with the use of E-CAD tools such as Altium and the derating parameter decoding table listed below. The engineer will add 16 standardized parameters to each component in the schematics. After each parameter has been filled out, the Altium BOM output generation is used to create an excel document with all of these parameters. The line items within the BOM setup in Altium will be organized alphabetically by the ‘Type’ parameter. This will ensure the raw derating output will be in the correct order to line up with the EE-TL-001 Derating Worksheet. The output of this derating ‘BOM’ can be copied and pasted into the EE-TL-001 Derating Worksheet for immediate results.

This semi-automated process removes derating guesswork, significantly reduces time spent on derating activities, and provides a more generic standardization of derating with respect to parameters, values, output format, etc.

# Standardized Derating Strategy

The EE-TL-001 Derating Worksheet expects the line items to be grouped by type and have a specific order of columns defining the derating parameters.

The derating parameter decoding tables define each standardized parameter by component type.

## User Inputs & E-CAD Parameters

These are defined as ‘inputs’ in the EE-TL-001 Derating Worksheet. All expected inputs must also correspond to the component parameter within the E-CAD tool.

### **General Component Information**

Each component in the design shall include the parameters listed below; they shall be consistently named. These parameters correlate to columns A-D in the EE-TL-001 Worksheet.

* **Designator** – This is the reference designator. Altium automatically adds this to each component.
* **Type** – Defined by components in EE-TL-001 Derating Worksheet
* **Sub Type** – This parameter shall be added, but is optional to fill out
* **Val** – This parameter shall be added. This parameter shall display the component values for passives such as resistors, capacitors, and inductors. This parameter shall hold the part number for other component types such as IC’s, transistors, motors, etc.

### **Vendor Specifications - Max Values – From Datasheets or Similar**

Each component in the design shall include the parameters listed below. Check derating parameter decoding table for definitions of these parameters by component type.

The ‘vs’ prefix standards for ‘vendor specifications’. These parameters correlate to columns E-H in the EE-TL-001 Worksheet.

* **vs\_1**
* **vs\_2**
* **vs\_3**
* **vs\_4**

### **Derating Specifications – Engineer Defined**

Each component in the design shall include the parameters listed below. Check derating parameter decoding table for definitions of these parameters by component type.

The ‘ds’ prefix standards for ‘derating specifications’. These parameters correlate to columns I-L in the EE-TL-001 Worksheet.

* **ds\_1**
* **ds\_2**
* **ds\_3**
* **ds\_4**

### **Design Inputs – Worst Case**

Each component in the design shall include the parameters listed below. Check derating parameter decoding table for definitions of these parameters by component type.

The ‘di’ prefix standards for ‘design inputs’. These parameters correlate to columns M-P in the EE-TL-001 Worksheet.

* **di\_1**
* **di\_2**
* **di\_3**
* **di\_4**

## Outputs/Calculations

The outputs/calculations from the EE-TL-001 Derating Worksheet should not be changed. They are meant to auto-calculate the appropriate values based in the inputs.

The output/calculations correlate to columns Q-X in the EE-TL-001 Worksheet.

### **Redefined (Derated) Component Specifications**

The Redefined Derated Component Spec’s section of the worksheet takes the ‘vendor specification’ inputs and applies the ‘derate specs’ input to define new values the component must adhere to.

### **Pass/Fail**

The Pass/Fail calculations compare the ‘design inputs’ and the ‘redefined derated component specs’ to determine if the operating conditions of the component meet the newly defined specifications.

# Derating Specifications by Device

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| --- | --- | --- | --- | --- | --- | --- |
| **COMPONENT DERATING LUT** | | | | | | |
|  | | | | | | |
| **Capacitors** | | | | | | |
| **Device Type** | **Sub Type** | **Temp Below  Max Limit (°C)** | **Max Voltage Stress (%)** | **Max Ripple Stress (%)** | **Delta T (°C)** | **Comments** |
| Capacitor | Aluminum Electrolytic | 10 °C | 90% | 75% | 50 °C |  |
| Ceramic | 10 °C | 80% | 75% | 50 °C |  |
| Film | 10 °C | 60% | 75% | 50 °C |  |
| Mica and PTFE | 10 °C | 80% | 75% | 50 °C |  |
| Polymer | 10 °C | 80% | 75% | 50 °C |  |
| Tantalum | 10 °C | 80% | 75% | 50 °C |  |
| Variable, Trimmer | 10 °C | 80% | 75% | 50 °C |  |
| **Connectors** | | | | | | |
| **Device Type** | **Sub Type** | **Temp Below  Max Limit (°C)** | **Max Voltage Stress (%)** | **Max Current Stress (%)** | **Max Power Stress (%)** | **Comments** |
| Connector | General | 50 °C | 75% | 80% | 80% |  |
| RF | 30 °C | 90% | 80% | 80% |  |
| DC | 20 °C | 80% | 80% | 80% |  |
| **Crystals, Oscillators, Resonators** | | | | | | |
| **Device Type** | **Sub Type** | **Temp Below  Max Limit (°C)** | **Max Current Stress (%)** | **Max Power Stress (%)** | **-** | **Comments** |
| Crystal | General | 25 °C | 50% | 25% | - |  |
| **Displays** | | | | | | |
| **Device Type** | **Sub Type** | **Temp Below  Max Limit (°C)** | **Max Current Stress (%)** | **-** | **-** | **Comments** |
| Display | HMI, LED, LCD, OLED | 25 °C | 75% | - | - |  |
| **Diodes** | | | | | | |
| **Device Type** | **Sub Type** | **Max Tj Stress (%)** | **Max Reverse Voltage Stress (%)** | **Max Forward  Current Stress (%)** | **Max Power Stress (%)** | **Comments** |
| Diode | PIN | 75% | 70% | 75% | 75% |  |
| Rectifier | 75% | 100% | 50% | 50% |  |
| Schottky | 75% | 70% | 75% | 75% |  |
| TVS | 75% | 70% | 50% | 50% |  |
| General |  |  |  |  |  |
| Zener | 75% | 100% | 50% | 50% |  |
| **Fans & Motors** | | | | | | |
| **Device Type** | **Sub Type** | **Temp Below  Max Limit (°C)** | **Max Voltage Stress (%)** | **Max Current Stress (%)** | **Bearing Load (%)** | **Comments** |
| Fan/Motor | General | 25 °C | 95% | 90% | 75% |  |
| **Filters** | | | | | | |
| **Device Type** | **Sub Type** | **Temp Below  Max Limit (°C)** | **Max Voltage Stress (%)** | **Max Current Stress (%)** | **-** | **Comments** |
| Filter | EMI Filter | 35 °C | 50% | 50% | - |  |
|  | General Purpose | 35 °C | 50% | 50% | - |  |
| **Fuses** | | | | | | |
| **Device Type** |  | **Temp Below  Max Limit (°C)** | **Max Current Stress (%)** | **Max Voltage Stress (%)** | **-** | **Comments** |
| Fuse | AC, DC | 25 °C | 80% | 100% | - | 80% current derate per NEC Table 240.6(A) |
| **Hybrid ICs** | | | | | | |
| **Device Type** | **Sub Type** | **Temp Below  Max Limit (°C)** | **Max Voltage Stress (%)** | **Max Power Stress (%)** | **Delta T (°C)** | **Comments** |
| Hybrid | General | 25 °C | 75% | 75% | 40 °C |  |
| **Integrated Circuits, Analog** | | | | | | |
| **Device Type** | **Sub Type** | **Max Tj Stress (%)** | **Max Voltage Stress (%)** | **Max Power Stress (%)** | **-** | **Comments** |
| IC Analog | Operational Amplifiers | 75% | 95% | 80% | - |  |
| Comparators | 75% | 95% | 80% | - |  |
| Sense Amps | 75% | 95% | 80% | - |  |
| Current Amps | 75% | 95% | 80% | - |  |
| Voltage Regulators | 75% | 95% | 80% | - |  |
| Analog switches | 75% | 95% | 80% | - |  |
| General Purpose | 75% | 95% | 75% | - |  |
| **Integrated Circuits, Digital** | | | | | | |
| **Device Type** | **Sub Type** | **Max Tj Stress (%)** | **Max Voltage Stress (%)** | **Max Power Stress (%)** | **-** | **Comments** |
| IC Digital | General Purpose | 75% | 95% | 75% | - |  |
| Microprocessor | 75% | 95% | 75% | - |  |
| Memory | 75% | 95% | 75% | - |  |
| **Magnetics (Inductors, Coils, Chokes, Xfmrs)** | | | | | | |
| **Device Type** | **Sub Type** | **Temp Below  Max Limit (°C)** | **Temperature Rise (%)** | **Max Voltage Stress (%)** | **Max Current Stress (%)** | **Comments** |
| Magnetics | Inductor | 30 °C | 70% | 90% | 100% |  |
| Transformer | 30 °C | 70% | 90% | 100% |  |
| Coil | 30 °C | 70% | 90% | 100% |  |
| Choke | 30 °C | 70% | 90% | 100% |  |
| **MEMS** | | | | | | |
| **Device Type** | **Sub Type** | **Max RH Stress (%)** | **-** | **-** | **-** | **Comments** |
| MEMS | General | 40% | - | - | - |  |
| **Opto-Electronics (LD, LED, PD, Opto-Coupler)** | | | | | | |
| **Device Type** | **Sub Type** | **Max Tj Stress (%)** | **Max Vr Stress (%)** | **Max IF Stress (%)** | **Max Power Stress (%)** | **Comments** |
| Opto-Electronics | Laser Diode | 75% | - | - | 50% |  |
| Light Emitting Diode | 75% | 70% | 75% | 50% |  |
| Photo Diode | 75% | 70% | 75% | 50% |  |
| Opto-Coupler/Photo Transistor | 75% | 70% | 75% | 50% |  |
| Fiber-optic Cables | 75% | - | - |  | Minimum bend radius shall not be exceeded |
| **PCB(A)s** | | | | | | |
| **Device Type** | **Sub Type** | **Temp Below  Max Limit (°C)** | **-** | **-** | **-** | **Comments** |
| PCB Substrate | General | 40 °C | - | - | - |  |
| **Power Supplies and Converter Modules** | | | | | | |
| **Device Type** | **Sub Type** | **Max Current Stress (%)** | **Max Power Stress (%)** | **Max Tj Stress (%)** | **Max Voltage Stress (%)** | **Comments** |
| Power Supply | General | 95% | 95% | 90% | 100% |  |
| **Resistors** | | | | | | |
| **Device Type** | **Sub Type** | **Temp Below  Max Limit (°C)** | **Max Voltage Stress (%)** | **Max Power Stress (%)** | **Delta T (°C)** | **Comments** |
| Resistor | Carbon Composition | 30 °C | 80% | 50% | 70 °C |  |
| Metal (Film, Foil, Oxide) | 50 °C | 80% | 50% | 70 °C |  |
| RF | 50 °C | 80% | 75% | 70 °C |  |
| Wire-wound | 80 °C | 80% | 50% | 70 °C |  |
| Thick Film/Thin Film | 30 °C | 80% | 50% | 70 °C |  |
| Ceramic | 80 °C | 80% | 50% | 70 °C |  |
| **Switchable Contacts (Switches, Relays, & Contactors)** | | | | | | |
| **Device Type** | **Sub Type** | **Max Current Stress (%)  [Res/Cap Loads]** | **Max Current Stress (%)  [Ind. Loads]** | **Temp Below  Max Limit (°C)** | **Max Voltage Stress (%)** | **Comments** |
| Switchable Contact | Switches | 70% | 50% | 25 °C | 80% |  |
| Relays | 70% | 50% | 25 °C | 80% | Current load rating from MIL-HDBK-454B, Guideline 57 |
| Contactors | 70% | 50% | 25 °C | 80% |  |
| **Thermistors** | | | | | | |
| **Device Type** | **Sub Type** | **Temp Below  Max Limit (°C)** | **Max Voltage Stress (%)** | **Max Power Stress (%)** | **Delta T (°C)** | **Comments** |
| Thermistor | NTC, PTC | 30 °C | 80% | 50% | 70 °C |  |
| **Transistors** | | | | | | |
| **Device** | **Sub Type** | **Max Tj Stress  (%)** | **Max Power Stress (%)** | **Max Ic or Id Stress (%)** | **Max Vgs/Vbe Stress (%)** | **Comments** |
| Transistor | BJT | 35°C | 75% | 75% | 75% |  |
| FET | 35°C | 75% | 75% | 75% |  |
| Other | 35°C | 75% | 75% | 75% |  |

# Parameter Decoding Tables

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| --- | --- | --- | --- |
| **Parameter Decoding Table: Capacitor** | | | |
| Parameter Definition | Altium Param. Name | Units | Example Value |
| **General Component Information** | | | |
| Reference Designator | Designator | - | C1 |
| Type | Type | - | Capacitor |
| Sub Type | Sub Type | - | Ceramic |
| Value | Value | - | 10uF |
| **Vendor Specifications [Max Values]** | | | |
| Temperature | vs\_1 | °C | 125 |
| Voltage | vs\_2 | V | 50 |
| Power | vs\_3 | W | 0.075 |
| ESR | vs\_4 | Ω | 0.0035 |
| **Derating Specifications [Excelitas Defined]** | | | |
| Voltage Stress | ds\_1 | % | 80 |
| Temp Below Max | ds\_2 | °C | 10 |
| Ripple Stress | ds\_3 | % | 70 |
| Delta Temperature | ds\_4 | °C | 50 |
| **Design Inputs [Specific to Component Operation]** | | | |
| DC/RMS Voltage | di\_1 | V | 26.4 |
| Ripple Current | di\_2 | A | 0.01 |
| Ambient Temp | di\_3 | °C | 22 |
| Component Temp | di\_4 | °C | 28 |

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| --- | --- | --- | --- |
| **Parameter Decoding Table: Connectors** | | | |
| Parameter Definition | Altium Param. Name | Units | Example Value |
| **General Component Information** | | | |
| Reference Designator | Designator | - | J1 |
| Type | Type | - | Connector |
| Sub Type | Sub Type | - | AC/DC |
| Value | Value | - | Part Number |
| **Vendor Specifications [Max Values]** | | | |
| Temperature | vs\_1 | °C | 250 |
| Voltage | vs\_2 | V | 1350 |
| Current | vs\_3 | A | 4.5 |
| Power | vs\_4 | W | 35 |
| **Derating Specifications [Excelitas Defined]** | | | |
| Temp Below Max | ds\_1 | °C | 20 |
| Voltage Stress | ds\_2 | % | 80 |
| Current Stress | ds\_3 | % | 80 |
| Power Stress | ds\_4 | % | 80 |
| **Design Inputs [Specific to Component Operation]** | | | |
| Temperature | di\_1 | V | 30 |
| Voltage | di\_2 | A | 26.4 |
| Current | di\_3 | °C | 0.35 |
| Power | di\_4 | °C | 9.25 |

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| --- | --- | --- | --- |
| **Parameter Decoding Table: Crystal/Osc/Resonator** | | | |
| Parameter Definition | Altium Param. Name | Units | Example Value |
| **General Component Information** | | | |
| Reference Designator | Designator | - | Y1 |
| Type | Type | - | Crystal |
| Sub Type | Sub Type | - | Quartz |
| Value | Value | - | Part Number |
| **Vendor Specifications [Max Values]** | | | |
| Temperature | vs\_1 | °C | 85 |
| Current | vs\_2 | V | 0.008 |
| Power | vs\_3 | A | 0.005 |
|  | vs\_4 | - |  |
| **Derating Specifications [Excelitas Defined]** | | | |
| Temp Below Max | ds\_1 | °C | 25 |
| Current Stress | ds\_2 | % | 80 |
| Power Stress | ds\_3 | % | 50 |
|  | ds\_4 | - |  |
| **Design Inputs [Specific to Component Operation]** | | | |
| Temperature | di\_1 | °C | 30 |
| Current | di\_2 | A | 0.002 |
| Power | di\_3 | W | 0.0007 |
|  | di\_4 | - |  |

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| --- | --- | --- | --- |
| **Parameter Decoding Table: Display** | | | |
| Parameter Definition | Altium Param. Name | Units | Example Value |
| **General Component Information** | | | |
| Reference Designator | Designator | - | DS1 |
| Type | Type | - | Display |
| Sub Type | Sub Type | - | LCD |
| Value | Value | - | Part Number |
| **Vendor Specifications [Max Values]** | | | |
| Temperature | vs\_1 | °C | 70 |
| Current | vs\_2 | A | 0.036 |
|  | vs\_3 | - |  |
|  | vs\_4 | - |  |
| **Derating Specifications [Excelitas Defined]** | | | |
| Temp Below Max | ds\_1 | °C | 25 |
| Current Stress | ds\_2 | % | 75 |
|  | ds\_3 | - |  |
|  | ds\_4 | - |  |
| **Design Inputs [Specific to Component Operation]** | | | |
| Junction Temperature | di\_1 | V | 28 |
| Forward Current | di\_2 | A | 0.005 |
|  | di\_3 | - |  |
|  | di\_4 | - |  |

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| --- | --- | --- | --- |
| **Parameter Decoding Table: Diodes** | | | |
| Parameter Definition | Altium Param. Name | Units | Example Value |
| **General Component Information** | | | |
| Reference Designator | Designator | - | D1 |
| Type | Type | - | Diode |
| Sub Type | Sub Type | - | Schottky |
| Value | Value | - | Part Number |
| **Vendor Specifications [Max Values]** | | | |
| Junction Temperature | vs\_1 | °C | 85 |
| Forward Current | vs\_2 | A | 0.5 |
| Peak Power | vs\_3 | W | 0.3 |
| Reverse Voltage | vs\_4 | V | 60 |
| **Derating Specifications [Excelitas Defined]** | | | |
| Tj Stress | ds\_1 | % | 75 |
| Current Stress | ds\_2 | % | 75 |
| Power Stress | ds\_3 | % | 75 |
| Vr Stress | ds\_4 | % | 70 |
| **Design Inputs [Specific to Component Operation]** | | | |
| Junction Temperature | di\_1 | °C | 32 |
| Forward Current | di\_2 | A | 0.02 |
| Peak Power | di\_3 | W | 0.085 |
| Reverse Voltage | di\_4 | V | 28 |

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| --- | --- | --- | --- |
| **Parameter Decoding Table: Fans/Motors** | | | |
| Parameter Definition | Altium Param. Name | Units | Example Value |
| **General Component Information** | | | |
| Reference Designator | Designator | - | M1 |
| Type | Type | - | Fan/Motor |
| Sub Type | Sub Type | - | Brushed DC |
| Value | Value | - | Part Number |
| **Vendor Specifications [Max Values]** | | | |
| Max Temperature | vs\_1 | °C | 90 |
| Max Voltage | vs\_2 | V | 3.6 |
| Max Current | vs\_3 | A | 0.07 |
| Max Bearing Load | vs\_4 | Nm | 0.6 |
| **Derating Specifications [Excelitas Defined]** | | | |
| Temp Below Max | ds\_1 | °C | 25 |
| Voltage Stress | ds\_2 | % | 95 |
| Current Stress | ds\_3 | % | 90 |
| Bearing Load Stress | ds\_4 | % | 75 |
| **Design Inputs [Specific to Component Operation]** | | | |
| Max Temperature | di\_1 | °C | 25 |
| Max Voltage | di\_2 | V | 3.3 |
| Max Current | di\_3 | A | 0.056 |
| Max Bearing Load | di\_4 | Nm | 0.2 |

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| --- | --- | --- | --- |
| **Parameter Decoding Table: Filters** | | | |
| Parameter Definition | Altium Param. Name | Units | Example Value |
| **General Component Information** | | | |
| Reference Designator | Designator | - | FL1 |
| Type | Type | - | Filter |
| Sub Type | Sub Type | - | EMI |
| Value | Value | - | Part Number |
| **Vendor Specifications [Max Values]** | | | |
| Operating Temp | vs\_1 | °C | 85 |
| Max Voltage | vs\_2 | V | 250 |
| Max Current | vs\_3 | A | 6 |
| - | vs\_4 | - | - |
| **Derating Specifications [Excelitas Defined]** | | | |
| Temp Below Max | ds\_1 | °C | 25 |
| Voltage Stress | ds\_2 | % | 80 |
| Current Stress | ds\_3 | % | 50 |
| - | ds\_4 | - | - |
| **Design Inputs [Specific to Component Operation]** | | | |
| Max Temperature | di\_1 | °C | 45 |
| Max Voltage | di\_2 | V | 125 |
| Max Current | di\_3 | A | 2.8 |
| - | di\_4 | - | - |

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| **Parameter Decoding Table: Fuses** | | | |
| Parameter Definition | Altium Param. Name | Units | Example Value |
| **General Component Information** | | | |
| Reference Designator | Designator | - | F1 |
| Type | Type | - | Fuse |
| Sub Type | Sub Type | - | General |
| Value | Value | - | V & I Rating |
| **Vendor Specifications [Max Values]** | | | |
| Operating Temp | vs\_1 | °C | 85 |
| Max Current | vs\_2 | A | 3 |
| Max Voltage | vs\_3 | V | 250 |
| - | vs\_4 | - | - |
| **Derating Specifications [Excelitas Defined]** | | | |
| Temp Below Max | ds\_1 | °C | 25 |
| Current Stress | ds\_2 | % | 80 |
| Voltage Stress | ds\_3 | % | 100 |
| - | ds\_4 | - | - |
| **Design Inputs [Specific to Component Operation]** | | | |
| Max Temp | di\_1 | °C | 45 |
| Max Current | di\_2 | A | 1.75 |
| Max Voltage | di\_3 | V | 125 |
| - | di\_4 | - | - |

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| --- | --- | --- | --- |
| **Parameter Decoding Table: Hybrids** | | | |
| Parameter Definition | Altium Param. Name | Units | Example Value |
| **General Component Information** | | | |
| Reference Designator | Designator | - | A1 |
| Type | Type | - | Hybrid |
| Sub Type | Sub Type | - | WiFi Module |
| Value | Value | - | Part Number |
| **Vendor Specifications [Max Values]** | | | |
| Operating Temp | vs\_1 | °C | 125 |
| Max Voltage | vs\_2 | V | 5 |
| Max Power | vs\_3 | W | 0.25 |
| - | vs\_4 | - | - |
| **Derating Specifications [Excelitas Defined]** | | | |
| Temp Below Max | ds\_1 | °C | 25 |
| Voltage Stress | ds\_2 | % | 75 |
| Current Stress | ds\_3 | % | 75 |
| Delta T | ds\_4 | °C | 50 |
| **Design Inputs [Specific to Component Operation]** | | | |
| Max Voltage | di\_1 | V | 3.3 |
| Max Power | di\_2 | W | 0.15 |
| Ambient Temp | di\_3 | °C | 28 |
| Device Temp | di\_4 | °C | 40 |

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| **Parameter Decoding Table: IC Analog** | | | |
| Parameter Definition | Altium Param. Name | Units | Example Value |
| **General Component Information** | | | |
| Reference Designator | Designator | - | U1 |
| Type | Type | - | IC Analog |
| Sub Type | Sub Type | - | Op-Amp |
| Value | Value | - | Part Number |
| **Vendor Specifications [Max Values]** | | | |
| Operating Temp | vs\_1 | °C | 85 |
| Max Voltage | vs\_2 | V | 36 |
| Max Power | vs\_3 | W | 1.2 |
| - | vs\_4 | - | - |
| **Derating Specifications [Excelitas Defined]** | | | |
| Tj Stress | ds\_1 | % | 75 |
| Voltage Stress | ds\_2 | % | 95 |
| Power Stress | ds\_3 | % | 75 |
| - | ds\_4 | - | - |
| **Design Inputs [Specific to Component Operation]** | | | |
| Junction Temp | di\_1 | °C | 55 |
| Max Voltage | di\_2 | V | 12 |
| Max Power | di\_3 | W | 0.075 |
| - | di\_4 | - | - |

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| --- | --- | --- | --- |
| **Parameter Decoding Table: IC Digital** | | | |
| Parameter Definition | Altium Param. Name | Units | Example Value |
| **General Component Information** | | | |
| Reference Designator | Designator | - | U1 |
| Type | Type | - | IC Digital |
| Sub Type | Sub Type | - | MCU |
| Value | Value | - | Part Number |
| **Vendor Specifications [Max Values]** | | | |
| Operating Temp | vs\_1 | °C | 125 |
| Max Voltage | vs\_2 | V | 3.63 |
| Max Power | vs\_3 | W | 0.25 |
| - | vs\_4 | - | - |
| **Derating Specifications [Excelitas Defined]** | | | |
| Tj Stress | ds\_1 | % | 75 |
| Voltage Stress | ds\_2 | % | 95 |
| Power Stress | ds\_3 | % | 75 |
| - | ds\_4 | - | - |
| **Design Inputs [Specific to Component Operation]** | | | |
| Junction Temp | di\_1 | °C | 55 |
| Max Voltage | di\_2 | V | 3.3 |
| Max Power | di\_3 | W | 0.075 |
| - | di\_4 | - | - |

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| **Parameter Decoding Table: Magnetics** | | | |
| Parameter Definition | Altium Param. Name | Units | Example Value |
| **General Component Information** | | | |
| Reference Designator | Designator | - | L1 |
| Type | Type | - | Magnetic |
| Type | Type | - | Inductor |
| Value | Value | - | 22uH |
| **Vendor Specifications [Max Values]** | | | |
| Operating Temp | vs\_1 | °C | 125 |
| Temp Rise | vs\_2 | °C | 50 |
| Working Voltage | vs\_3 | V | 200 |
| Saturation Current | vs\_4 | A | 3.8 |
| **Derating Specifications [Excelitas Defined]** | | | |
| Voltage Stress | ds\_1 | % | 90 |
| Temp Below Max | ds\_2 | °C | 30 |
| Temp Rise Derate | ds\_3 | % | 70 |
| Sat. Current Derate | ds\_4 | % | 100 |
| **Design Inputs [Specific to Component Operation]** | | | |
| Voltage | di\_1 | V | 32 |
| Current | di\_2 | A | 0.02 |
| Ambient Temp | di\_3 | °C | 0.085 |
| Temp Rise | di\_4 | °C | 28 |

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| **Parameter Decoding Table: MEMS** | | | |
| Parameter Definition | Altium Param. Name | Units | Example Value |
| **General Component Information** | | | |
| Reference Designator | Designator | - | U1 |
| Type | Type | - | MEMS |
| Sub Type | Sub Type | - | Accelerometer |
| Value | Value | - | Part Number |
| **Vendor Specifications [Max Values]** | | | |
| Operating Temp | vs\_1 | °C | 85 |
| Max Voltage | vs\_2 | V | 36 |
| Max Power | vs\_3 | W | 1.2 |
| - | vs\_4 | - | - |
| **Derating Specifications [Excelitas Defined]** | | | |
| Tj Stress | ds\_1 | % | 75 |
| Voltage Stress | ds\_2 | % | 95 |
| Power Stress | ds\_3 | % | 75 |
| - | ds\_4 | - | - |
| **Design Inputs [Specific to Component Operation]** | | | |
| Junction Temp | di\_1 | °C | 55 |
| Max Voltage | di\_2 | V | 12 |
| Max Power | di\_3 | W | 0.075 |
| - | di\_4 | - | - |

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| **Parameter Decoding Table: Opto-Electronics** | | | |
| Parameter Definition | Altium Param. Name | Units | Example Value |
| **General Component Information** | | | |
| Reference Designator | Designator | - | U1 |
| Type | Type | - | Opto-Electronics |
| Sub Type | Sub Type | - | Opto Coupler |
| Value | Value | - | Part Number |
| **Vendor Specifications [Max Values]** | | | |
| Junction Temp | vs\_1 | °C | 135 |
| Max Reverse Voltage | vs\_2 | V | 5 |
| Max Forward Current | vs\_3 | A | 0.05 |
| Max Power | vs\_4 | W | 0.15 |
| **Derating Specifications [Excelitas Defined]** | | | |
| Tj Stress | ds\_1 | % | 75 |
| Reverse Voltage Stress | ds\_2 | % | 70 |
| Forward Current Stress | ds\_3 | % | 75 |
| Power Stress | ds\_4 | % | 50 |
| **Design Inputs [Specific to Component Operation]** | | | |
| Junction Temp | di\_1 | °C | 55 |
| Max Reverse Voltage | di\_2 | V | 0 |
| Max Forward Current | di\_3 | A | 0.02 |
| Max Power Dissipation | di\_4 | W | 0.01 |

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| **Parameter Decoding Table: PCB Substrate** | | | |
| Parameter Definition | Altium Param. Name | Units | Example Value |
| **General Component Information** | | | |
| Reference Designator | Designator | - | PCB |
| Type | Type | - | PCB Substrate |
| Sub Type | Sub Type | - | General |
| Value | Value | - | Part Number |
| **Vendor Specifications [Max Values]** | | | |
| Tg Temp | vs\_1 | °C | 175 |
| - | vs\_2 | - | - |
| - | vs\_3 | - | - |
| - | vs\_4 | - | - |
| **Derating Specifications [Excelitas Defined]** | | | |
| Temp Below Max | ds\_1 | °C | 40 |
| - | ds\_2 | - | - |
| - | ds\_3 | - | - |
| - | ds\_4 | - | - |
| **Design Inputs [Specific to Component Operation]** | | | |
| Max Temp | di\_1 | °C | 60 |
| - | di\_2 | - | - |
| - | di\_3 | - | - |
| - | di\_4 | - | - |

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| **Parameter Decoding Table: Power Supplies** | | | |
| Parameter Definition | Altium Param. Name | Units | Example Value |
| **General Component Information** | | | |
| Reference Designator | Designator | - | U1 |
| Type | Type | - | Power Supply |
| Sub Type | Sub Type | - | LDO |
| Value | Value | - | LT3081 |
| **Vendor Specifications [Max Values]** | | | |
| Junction Temperature | vs\_1 | °C | 125 |
| Output Current | vs\_2 | A | 1.5 |
| Input Voltage | vs\_3 | V | 40 |
| Output Power | vs\_4 | W | 15 |
| **Derating Specifications [Excelitas Defined]** | | | |
| Voltage Stress | ds\_1 | % | 100 |
| Temp Below Max | ds\_2 | °C | 80 |
| Current Stress | ds\_3 | % | 95 |
| Power Stress | ds\_4 | % | 95 |
| **Design Inputs [Specific to Component Operation]** | | | |
| Input Voltage | di\_1 | V | 26.4 |
| Output Current | di\_2 | W | 0.4 |
| Power | di\_3 | °C | 2 |
| Device Temp | di\_4 | °C | 53 |

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| **Parameter Decoding Table: Resistors** | | | |
| Parameter Definition | Altium Param. Name | Units | Example Value |
| **General Component Information** | | | |
| Reference Designator | Designator | - | R1 |
| Type | Type | - | Resistor |
| Sub Type | Sub Type | - | Thick Film |
| Value | Value | - | 22k |
| **Vendor Specifications [Max Values]** | | | |
| Temperature | vs\_1 | °C | 155 |
| Working Voltage | vs\_2 | A | 75 |
| Overload Voltage | vs\_3 | V | 150 |
| Power | vs\_4 | W | 0.1 |
| **Derating Specifications [Excelitas Defined]** | | | |
| Voltage Stress | ds\_1 | % | 80 |
| Temp Below Max | ds\_2 | °C | 30 |
| Power Stress | ds\_3 | % | 50 |
| Delta T | ds\_4 | % | 70 |
| **Design Inputs [Specific to Component Operation]** | | | |
| Voltage | di\_1 | V | 26.4 |
| Power | di\_2 | W | 0.0024 |
| Ambient Temp | di\_3 | °C | 22 |
| Device Temp | di\_4 | °C | 28 |

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| **Parameter Decoding Table: Switchable Contacts** | | | |
| Parameter Definition | Altium Param. Name | Units | Example Value |
| **General Component Information** | | | |
| Reference Designator | Designator | - | K1 |
| Type | Type | - | Switchable Contact |
| Sub Type | Sub Type | - | Relay |
| Value | Value | - | Part Number |
| **Vendor Specifications [Max Values]** | | | |
| Max Temperature | vs\_1 | °C | 70 |
| Max Current | vs\_2 | A | 1 |
| Max Voltage | vs\_3 | V | 24 |
| - | vs\_4 | - | - |
| **Derating Specifications [Excelitas Defined]** | | | |
| Current Stress [res/cap load] | ds\_1 | % | 70 |
| Current Stress [ind load] | ds\_2 | % | 50 |
| Temp Below Max Limit | ds\_3 | °C | 25 |
| Voltage | ds\_4 | % | 80 |
| **Design Inputs [Specific to Component Operation]** | | | |
| Current [res/cap load] | di\_1 | A | 0.22 |
| Current [ind load] | di\_2 | A | 0 |
| Max Voltage | di\_3 | V | 12 |
| Max Temperature | di\_4 | °C | 28 |

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| **Parameter Decoding Table: Thermistors** | | | |
| Parameter Definition | Altium Param. Name | Units | Example Value |
| **General Component Information** | | | |
| Reference Designator | Designator | - | RT1 |
| Type | Type | - | Thermistor |
| Sub Type | Sub Type | - | NTC |
| Value | Value | - | 10k |
| **Vendor Specifications [Max Values]** | | | |
| Temperature | vs\_1 | °C | 155 |
| Working Voltage | vs\_2 | A | 75 |
| Overload Voltage | vs\_3 | V | 150 |
| Power | vs\_4 | W | 0.1 |
| **Derating Specifications [Excelitas Defined]** | | | |
| Voltage Stress | ds\_1 | % | 80 |
| Temp Below Max | ds\_2 | °C | 30 |
| Power Stress | ds\_3 | % | 50 |
| Delta T | ds\_4 | % | 70 |
| **Design Inputs [Specific to Component Operation]** | | | |
| Voltage | di\_1 | V | 26.4 |
| Power | di\_2 | W | 0.0024 |
| Ambient Temp | di\_3 | °C | 22 |
| Device Temp | di\_4 | °C | 28 |

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| **Parameter Decoding Table: Transistors** | | | |
| Parameter Definition | Altium Param. Name | Units | Example Value |
| **General Component Information** | | | |
| Reference Designator | Designator | - | Q1 |
| Type | Type | - | Switchable Contact |
| Sub Type | Sub Type | - | Relay |
| Value | Value | - | Part Number |
| **Vendor Specifications [Max Values]** | | | |
| Junction Temperature | vs\_1 | °C | 150 |
| Power Dissipation | vs\_2 | W | 0.5 |
| Ic or Id | vs\_3 | A | 1 |
| Vgs or Vbe | vs\_4 | V | 7 |
| **Derating Specifications [Excelitas Defined]** | | | |
| Tj Stress | ds\_1 | % | 75 |
| Power Stress | ds\_2 | % | 75 |
| Ic/Id Stress | ds\_3 | % | 75 |
| Vgs/Vbe Stress | ds\_4 | % | 75 |
| **Design Inputs [Specific to Component Operation]** | | | |
| Junction Temperature | di\_1 | °C | 28 |
| Max Power | di\_2 | W | 0.000018 |
| Ic or Id | di\_3 | A | 0.005 |
| Vgs or Vbe | di\_4 | V | 4.2 |

# Calculations for Reference

## Capacitor Ripple Current:

* Capacitors are derating has two paths: 1.) Voltage potential between leads & 2.) Power dissipation.
* Power dissipation corresponds to the current flowing through the capacitor or the ripple current.
* Calculate this for both the ripple current as seen in the design as well as the max ripple current as specified by the vendor.
* Power dissipated in a capacitor is *V2/ESR* or *I2\*ESR.*
* If the device temperature is > 40°C, derate the max power an additional 10%.
* The ripple current expected within the design can be found with the following:
* VWRK is the working voltage on the capacitor, so the AC component. If you have noise superimposed on a DC bias, the working voltage would be the Vpp of the AC coupled noise. On an AC signal, it is the RMS of the AC voltage.
* Z is the impedance, which has a real resistive part and a reactance.
* =

## Magnetics Temp Rise:

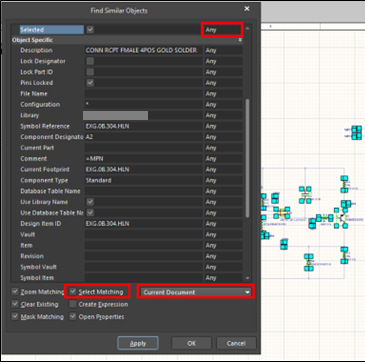
* This is the temperature difference between the hotspot and the rest of the device and ambient.

## Junction Temperature, General:



# Example: Import Derating Data

* Step 1 – Open Altium Designer and schematic design which you want to derate.
* Step 2 – Select any component. *Right Click 🡪 Find Similar Objects*
  + Ensure “*Select Matching*” Option is enabled
  + If there are more than 1 schematic sheet, select “*Project Documents*” from the drop down menu

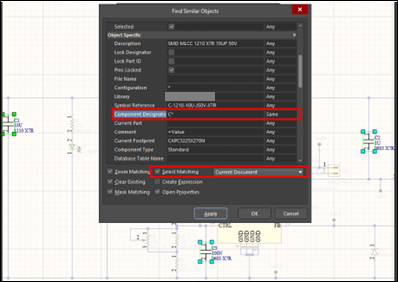


* Step 3 – Add the parameters to every selected component in one step

A screenshot of a computer

Description automatically generated

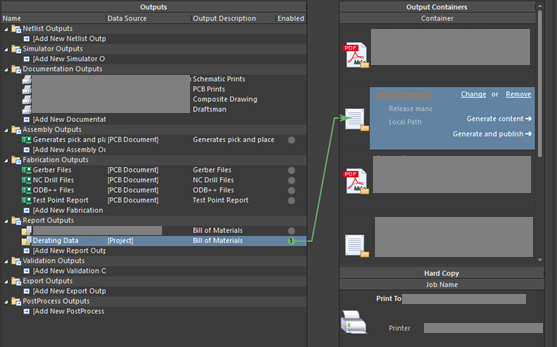
* Step 4 – Select like components and apply common vendor/derating/design inputs.



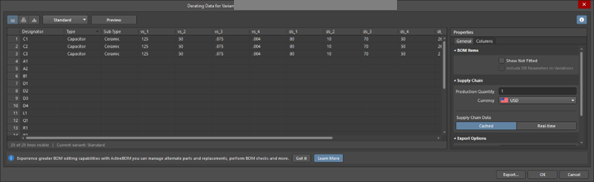
A screenshot of a computer

Description automatically generated

* Step 5 – Fill out all the component specific information with respect as to how the component is used in the design. This will be the most tedious part of the derating analysis.
* Step 6 – Open the output jobs and select to generate ‘Derating Data’ under the “Report Outputs” section.



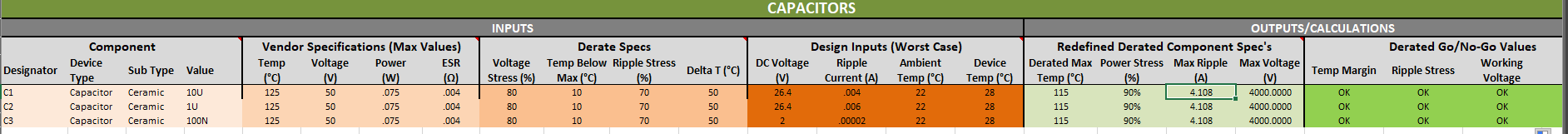
* Step 7 - Ensure ‘Derating Data’ is formatted correctly. The order of columns should be:
  + Designator, Type, Sub Type, val, vs\_1, vs\_2, vs\_3, vs\_4, ds\_1, ds\_2, ds\_3, ds\_4, di\_1, di \_2, di \_3, di \_4



* Step 8 – Generate the ‘Derating Data’ output. You should get a document formatted like the following:



* Step 9 – Open the EE-TL-001 Derating Worksheet. Add the appropriate number of rows under each component category.
* Step 10 – Copy the derating data generated from Altium relevant to the component. Right click paste values into the EE-TL-001.



1. **Example: Capacitor Derating Calculation**

A paper with text and diagrams

Description automatically generated

A white paper with writing on it

Description automatically generated

1. **REVISION HISTORY**

|  |  |  |  |
| --- | --- | --- | --- |
| **Revision** | **Description** | **Author** | **Date** |
| 01 | Initial Release | J. Petrilli | 09/22/2022 |
|  |  |  |  |