

ECN for USB Power Delivery Specification Revision 3.2

Version 1.1, 2024-10

Title: Remove vEPRmax

Brief description of the functional changes:

Remove vEPRMax and simply reference “regional safety specifications”.
Leave vSPRMax as many designs and silicon already limited to this due to outside specification reuse. Also, vSPRMax covers some known issues.

Benefits as a result of the changes:

Presence of vSPRmax and vEPRmax have now caused an impact on outside specifications. Effectively for many devices, the “should” is now a “shall.” The coming update to IEC safety specifications will cause a huge cost increase to EPR capable sinks to support 55V, even if just something like a 22V sink. By removing vEPRMax, the Draft IEC 63315 safety spec requires only 1.3x the sink EPR max contract safety tolerance.

Also, changed requirement for Sink to prevent cycling on fault from “Shall” to “Should”. This is not possible in many cases such as bus powered devices or dead-battery conditions.

An assessment of the impact to the existing revision and systems that currently conform to the USB specification:

No impact

An analysis of the hardware implications:

Relax requirement and reduce cost of EPR sinks. Nothing forced to change.

An analysis of the software implications:

No implications

An analysis of the compliance testing implications:

No compliance test changes other than we should ensure that EPR checks are robust in general since a completed compliance report for USB PD is required for IEC certification and proper EPR behavior is what is considered functionally safe.

Update of vSprMax & vEprMax from USB-PD

Scott Jackson - Apple Inc.
April 29, 2025

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Reliability voltages should be updated in USB PD

Other specifications refer to USB PD and use recommended optional numbers as requirements



USB's charter is **not**
reliability or safety



Recommended numbers
were only for guidance and
are **not requirements**



EPR values create high cost
adder and not necessary for
safety



USB intent to **point to**
outside Safety specs but
are circular as those specs
point back to USB

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USB-PD Spec Parameters

7.2.9.2 Input Over Voltage Protection

Sinks **shall** implement input Over-Voltage Protection (OVP) to prevent damage from input voltage that exceeds the voltage handling capability of the *Sink*. The definition of voltage handling capability is left to the discretion of the *Sink* implementation. The over voltage response of *Sinks* **shall not** interfere with normal PD operation and **shall** account for *vSrcNew*, *vSrcValid* or *vPpsNew*, *vPpsValid* as determined by the *Negotiated VBUS* value. *SPR Sinks* **should** tolerate input voltages as high as *vSprMax* and **shall** meet applicable safety requirements if *vSprMax* is exceeded. Likewise, *EPR Sinks* **should** tolerate input voltages as high as *vEprMax* and **shall** meet applicable safety requirements if *vEprMax* is exceeded.

Table 7.24 Sink Electrical Parameters

Parameter	Description	MIN	TYP	MAX	UNITS	Reference
<i>vEprMax</i>	Highest voltage an <i>EPR Sink</i> is expected to tolerate			55	V	Section 7.2.9.2
<i>vSprMax</i>	Highest voltage an <i>SPR Sink</i> is expected to tolerate			24	V	Section 7.2.9.2

Source: Universal Serial Bus Power Delivery Specification Revision 3.2 version 1.1 October, 2024

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CTIO CRD for battery systems copied number from USB PD

Created additional requirements to test at over-voltage without inducing damage
"Should" in USB PD became a "Shall" in CTIO CRD

6.3 Overvoltage

Reference: IEEE 1725, Section 7.2.3

Purpose: Ensure host device is designed to indefinitely withstand the maximum voltage from the adapter, under a single fault condition, to prevent a cascading failure through the system to the battery pack and/or cell.

Procedure: Initiate a charging condition via a way that allows host to charge. Once charging is verified introduce the worst-case faulted overvoltage condition identified in the charging system analysis described in the design analysis tools identified in IEEE 1725 section paragraph 4.1. One sample is required for this test.

Compliance: For systems with recognized adapters, no cascading failure through the system to the battery pack and/or cell after 24 hours. At a minimum a complete charge cycle shall be performed under normal operating conditions to validate performance system specification after application of overvoltage.

For systems without adapters, no cascading failure through the system to the battery pack and/or cell after charging at 9 V (USB Micro-B) or 24 V (USB C) for 24 hours. At a minimum a complete charge cycle shall be performed under normal operating conditions to validate performance system specification after application of overvoltage.

Source: CTIA Certification Requirements for Battery System Compliance to IEEE 1725 Version 3.0 December 2022

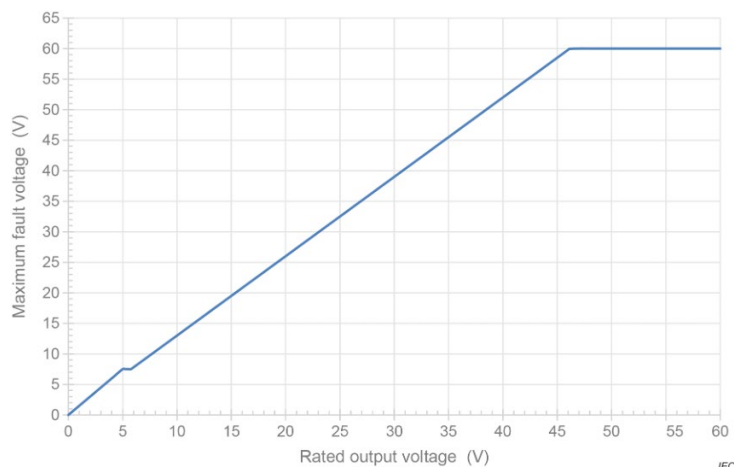
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Draft IEC 63315 ED1

When not called out by a base spec, 150% maximum negotiated voltage $\leq 5V$
and 130% maximum negotiated voltage $> 5V$ functional safety requirement



Source: Universal Serial Bus Power Delivery Specification Revision 3.2 version 1.1 October, 2024

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Draft IEC 63315 ED1 references numbers from USB PD

Any values called out in a base spec override requirement in safety spec
Created requirements beyond standard 150% and 130% over-voltage

Table C.2 – Examples of different USB PD power modes and how limits are derived

USB Mode	Typical Operational Range			Fault Current	Fault Voltage
	USB PDP (W)	Voltage	Current		
USB default ¹	Up to 15 W	Up to 5 VDC	Up to 5 A	Apply method in 5.3.3	9 V ²
USB PD SPR	Up to 100 W	Up to 20 VDC	Up to 5 A	Apply method in 5.3.3	24 V ³
USB PD EPR	Up to 240 W	Up to 48 VDC	Up to 5 A	Apply method in 5.3.3	55 V ⁴

Normal operating conditions and abnormal operating conditions are specified in 5.1, 5.3.3, and 5.5.1

Single fault conditions are specified in 5.1, 5.3.3, 5.4.1, 5.4.2

Protocol (3.10) safeguards are specified in 5.1 and 5.5

NOTE 1 Unless otherwise specified, the limits for single fault conditions should be used for abnormal operating conditions.

1) USB default includes legacy USB modes as well as Type-C USB current (non-USB PD modes). Typical initialization voltage and current is 5 V DC, 1.5 A, but refer to relevant specs.

2) USB default single fault voltage derived from 4.1.5 and Table 5-1 of IEC 62680-1-1:2015, USB BC Spec, charging interface failure voltage (VOHG_FAIL).

3) USB Power Delivery SPR single fault voltage derived from vSprMax in 7.2.9.2, and Table 7-25 of IEC 62680-1-2:2022 (USB IF USB Power Delivery Spec Revision 3.2, Version 1.0, Table 7.26).

4) USB Power Delivery EPR single fault voltage derived from vEprMax in 7.2.9.2, and Table 7-25 of IEC 62680-1-2:2022 (USB IF USB Power Delivery Spec Revision 3.2, Version 1.0, Table 7.26).

NOTE 2 For USB functional design considerations, refer to IEC 62680-1-2:2022 and IEC 62680-1-3:2022.

Source: Universal Serial Bus Power Delivery Specification Revision 3.2 version 1.1 October, 2024

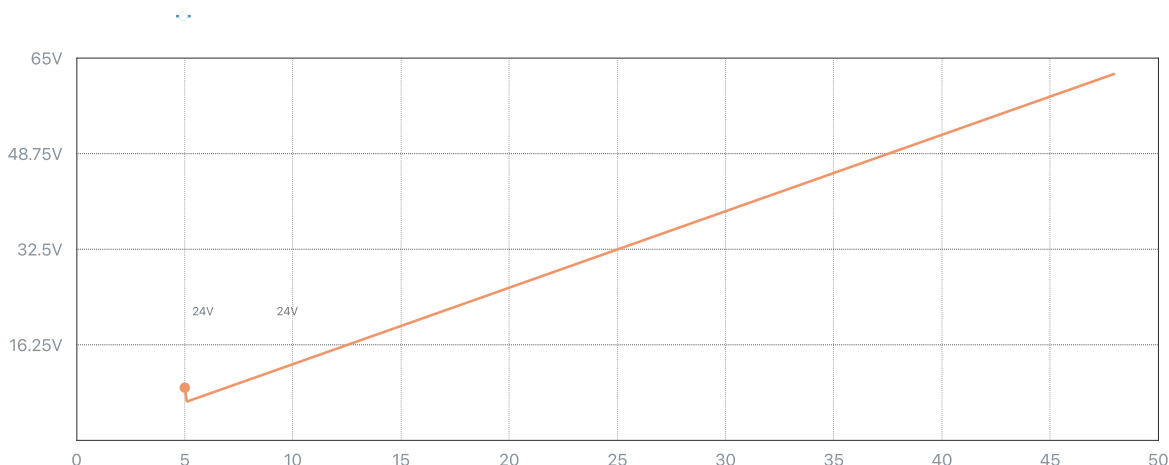
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USB PD affects Safety rules for Sinks

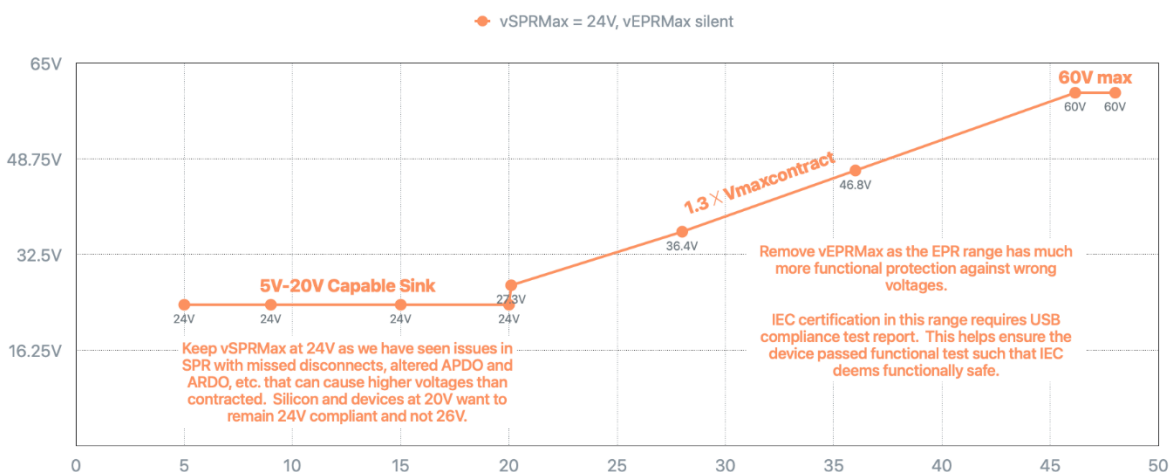
Current voltage requirements in USB spec based on maximum contract voltage



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USB Spec Defined Sink Reliability

Proposal to keep vSPRMax = 24V and remove vEPRMax and let it default to IEC +30%



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Actual Change

(a). Section 7.2.9.2, Page 337,

From Text:

7.2.9.2 Input Over Voltage Protection

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*Sinks **Should** attempt to send **Hard Reset** Signaling when OVP engages followed by an **Alert** Message indicating an OVP event once an *Explicit Contract* has been established. The OVP response **May** engage at either the *Port* or system level. Systems or ports that have engaged OVP **Shall** resume *USB Default Operation* when the *Source* has re-established **vSafe5V** on *VBUS*.*

*The Sink **Shall** be able to Re-negotiate with the Source after resuming *USB Default Operation*. The decision of how to respond to Re-negotiation after an OVP event is left to the discretion of the Sink implementation.*

*The Sink **Shall** prevent continual system or Port cycling if OVP continues to engage after initially resuming either *USB Default Operation* or *Re-negotiation*. Latching off the Port or system is an acceptable response to recurring over voltage.*

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(b). Table 7.24, Page 414,

From Text:

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