



USB Power Delivery

Advanced protection solutions



Fundamentals

Is this presentation suited for you?

Where do you stand with USB Power Delivery?

Beginner?

I am not familiar with this subject. I am in the discovery phase and would like an overview and a basic understanding of the technology.

[Click here to continue to next slide](#)

[Overview](#)

Intermediate?

I have a basic understanding of this subject. I would like to go deeper in details and tackle more aspects of this subject.

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[Fundamentals](#)

Advanced?

I am very familiar with this subject. I would like to deepen my knowledge and become an expert.

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[In depth](#)

- The success of the USB Battery Charging standard for mobile devices demonstrated the **need for a standardized connector** to power small devices.
- To power up bigger devices like SSD/HDD, laptops or even screens, it is necessary to reach **power up to 100 W**.

A new specification

- The **USB Power Delivery specification V1.1** was released on May 7, 2015 to address these needs.
- This specification is an **extension** to the existing **USB 2.0, USB 3.1, USB Type-C and Battery Charging specifications** covering only the elements required to implement USB Power Delivery.

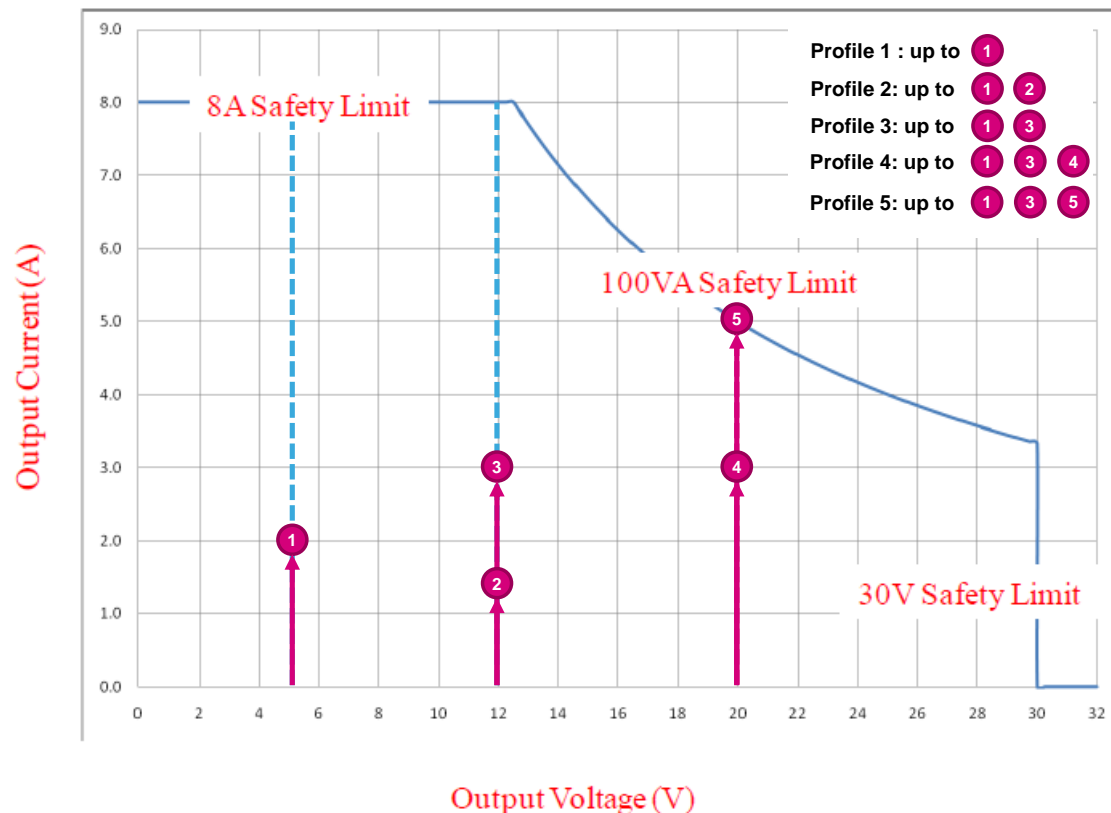
- **6 power profiles** are defined extending the supply voltages (*profile 0 is reserved*)
- This requires **new cables** withstanding voltages higher than 5 V and currents higher than 1.5 A.
- Profile 4 is the limit for the micro-B/AB connector.

Profile	5 V	12 V	20 V
1	2.0 A, 10 W		
2		1.5 A, 18 W	
3		3.0 A, 36 W	
4			3.0 A, 60 W
5		5.0 A, 60 W	5.0 A, 100 W

V_{BUS} voltage and current

- Sources with 100 W operation capability must meet various worldwide **safety standards**. As such, the continuous output power cannot exceed **100 W** and the continuous output current cannot exceed **5 A**.

Interpretation of the safety requirements imposed by IEC/UL 60950



More power means more protection

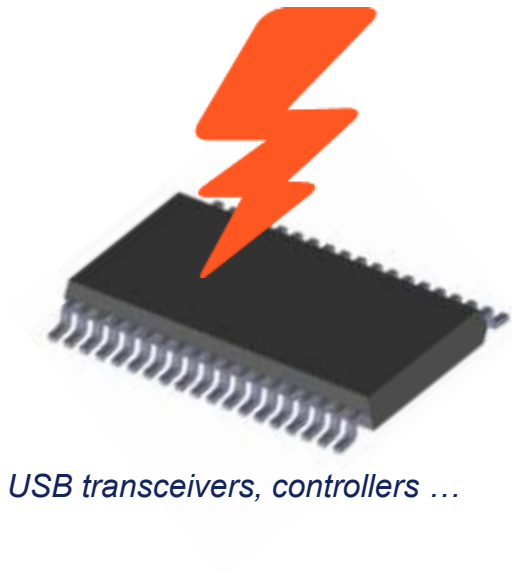
- With USB power capability increasing, the risks of **surges and transients** must be properly **mitigated**.
- Portable devices often implement miniature ICs using the **thinnest - and more vulnerable - technologies**.
- The **power sources are not controlled** by the portable device manufacturers, so the need to **protect power ports** is obvious.



Two types of hazards:

- ESD hazards
- Lightning and industrial surges

ESD protection needed ...



USB transceivers, controllers ...

Advanced technology with very **thin lithography** and gate oxide highly vulnerable to ESD

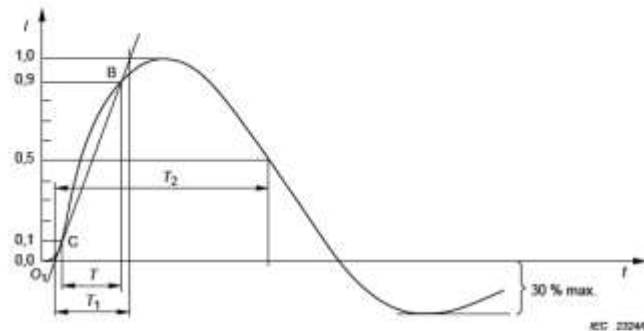
Integrated electronics systems with **high component-density PCBs** facilitating ESD coupling and propagation

IC manufacturers reluctant to use robust embedded ESD protection diodes that would require a **significant active area of their advanced and expensive technology.**

And surge protection too

Experiments and measurements have demonstrated that the **current waveform** of a lightning strike or switching noise has a rise time close of **8 μ s** to reach the peak.

==> The IEC/UL 61000-4-5 has provided a **standardized current waveform** called **8/20 μ s** waveform modeling lightning stresses or switching noise.



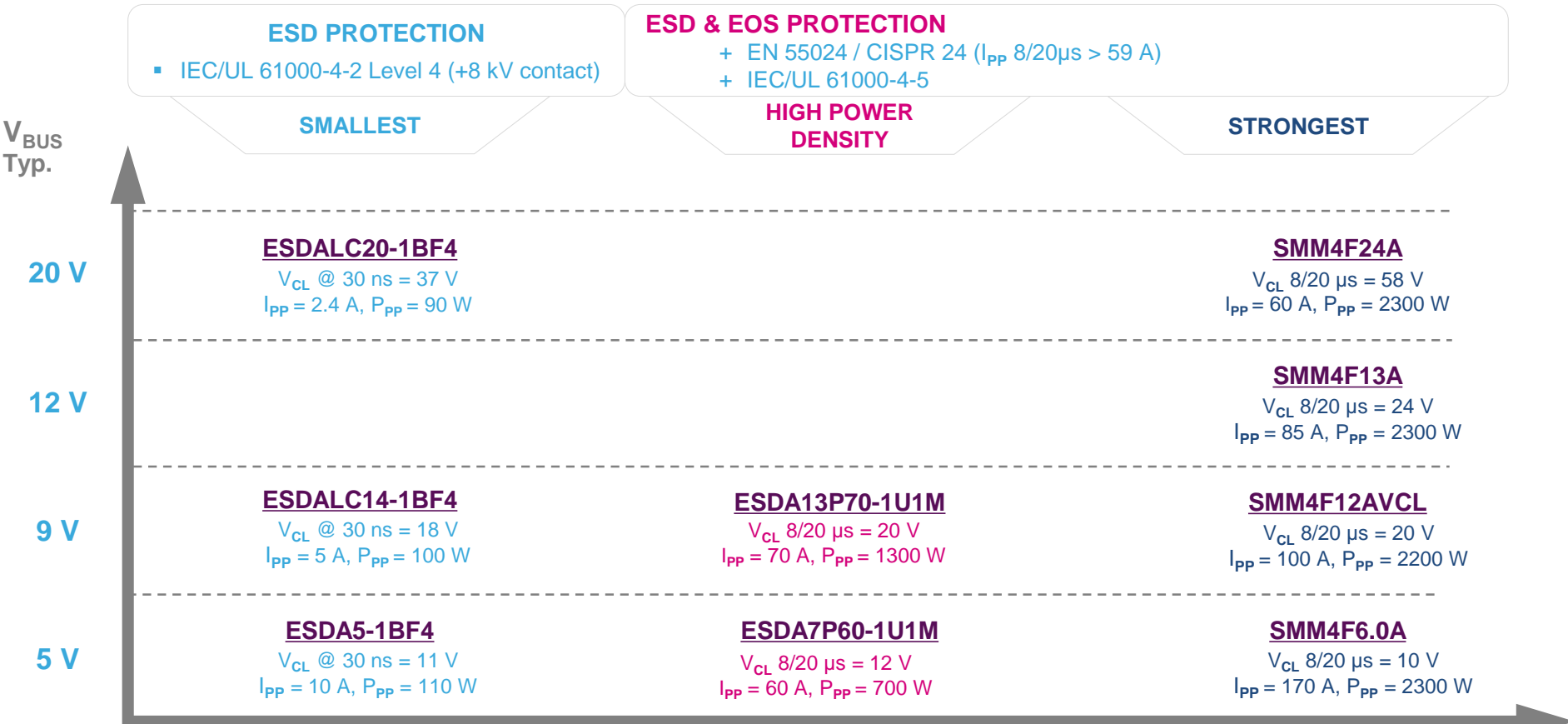
Front time: $T_1 = 1,25 \times T = 8 \mu\text{s} \pm 20\%$
Time to half-value: $T_2 = 20 \mu\text{s} \pm 20\%$

NOTE: The 30% undershoot specification applies only at the generator output. At the output of the coupling/decoupling network there is no limitation on undershoot or overshoot.

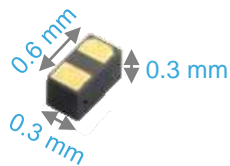
Figure 3 – Waveform of short-circuit current (8/20 μ s) at the output of the generator with no CDN connected (waveform definition according to IEC 60060-1)

The key performance factor for a V_{BUS} protection is the clamping voltage versus 8/20 μ s surges (IEC/UL 61000-4-5 standard)

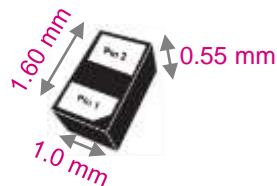
A wide portfolio



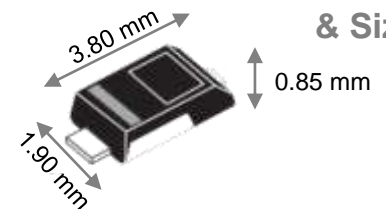
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STmiteFLAT



Package & Size

Small but robust

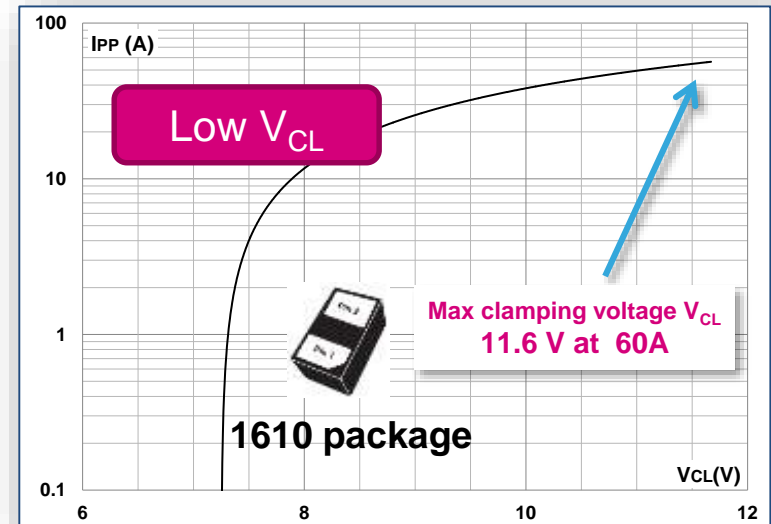
- Can withstand 30 kV contact discharge ESD strikes
- A high transient current (I_{PP} 60 A for 8/20 μ s) in a small 1.6 mm² package .

USB transceiver is safe!

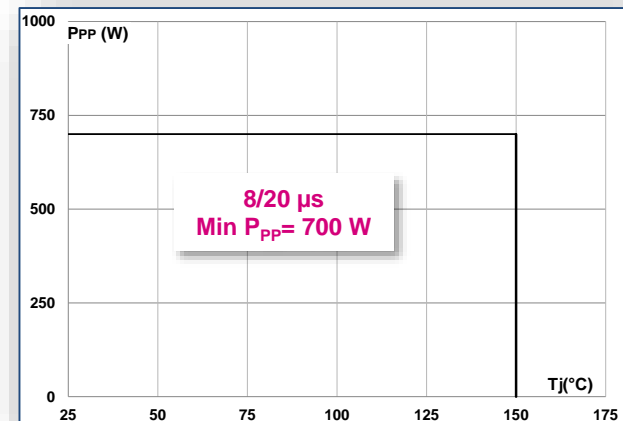
- This product is able to keep the overvoltage at 11.6 V while shunting 60 A to the GND.

Strong even at high temperature

- Peak pulse power guaranteed up to 150 °C.



Constant P_{PP} guaranteed over T°



Electrical parameters

Symbol	Test Condition	Min.	Typ.	Max.	Units
V_{BR}	$I_R = 1 \text{ mA}$	6.4	6.8	7.2	V
I_{RM}	$V_{RM} = 5 \text{ V}$			200	nA

Overview information

- [USB type-C™ advanced protection](#) quick start guide
- [USB2.0 protection and IPAD™ solutions](#) presentation

Fundamentals

- [USB type-C™ dataline advanced protection](#) presentation
- [IEC 61000-4-5 standard overview](#) *Application note #AN4275*

In-depth information

- [ESD - IEC 61000-4-2 standard testing](#) *Application note #AN3353*
- [TVS short pulse dynamic resistance measurement ...](#) *Application note #AN4022*

Selection & sampling

- [Protection devices & integrated EMI filtering](#) selection guide
- [USB port protection](#) web product selector
- [USB IPAD™ \(including ECMF™\)](#) web product selector



Thank you