

TrEOS ESD protection for USB Type-C®



Nexperia's TrEOS Protection offers the ideal combination of low capacitance, low clamping voltage and high ESD robustness for your design. Helping safeguard 20 Gbps data lines systems against ESD and surge events.

TrEOS Protection

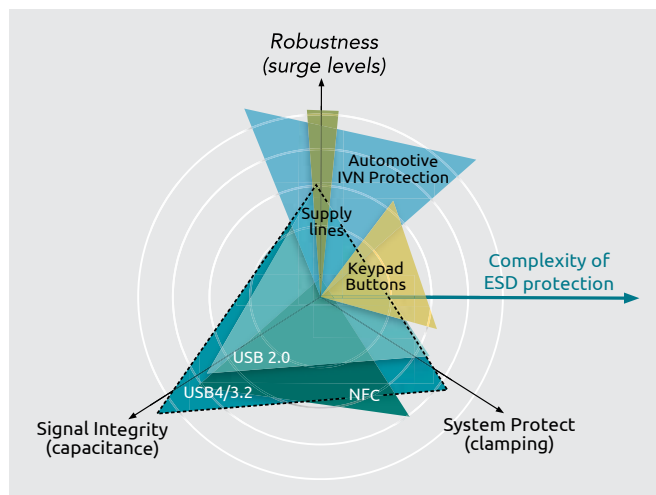
Optimizing the three pillars of ESD protection:

1. **Low capacitance** for highest signal integrity down to 0.1 pF
2. **Low clamping & trigger** for enhanced system protection down to $0.1 \Omega (R_{dyn})$
3. **High robustness** against ESD up to 30 kV & Surge up to 20 A at 8/20 μ s

Functions & Applications

- › USB Type-C (USB 2.0 / 3.2 / 4)
- › Thunderbolt (up 40 Gbps)
- › HDMI 2.1, FRL (up to 12 Gbps) and TMDS
- › SD-Card protection
- › All other sensitive I/Os

The ideal combination for every design



Key features

- › Available in specifications between 1.2 V and 9 V VRWM
- › Extremely fast switching time under 1 ns
- › Snap-back technology allows for lowest clamping voltage
- › Suitable for up to ~20Gbps per line pair
- › Reliable protection for sensitive transceiver SoCs
- › Ultra-low dynamic resistance/ capacitance combination
- › Exceeding IEC61000-4-2 level 4, offering IEC61000-4-5 grade robustness
- › Available in 3 very compact, low-inductance and extreme-robustness DSN packages)

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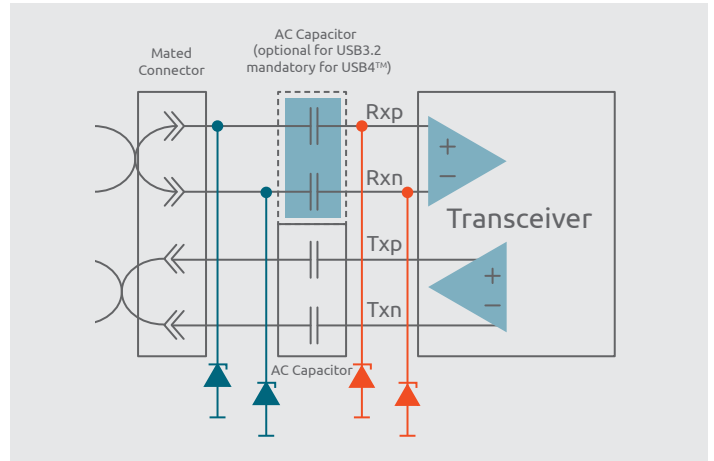
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Nexperia TrEOS portfolio for high-speed data-lines

Our TrEOS family is composed of two subsets of devices which can be employed together or separately:

- Extremely high surge robustness devices are designed to be placed between the connector and AC capacitor to protect the decoupling capacitor and transceiver against possible peak pulses (up to 20 A).
- Extremely low peak voltages devices are designed to be placed between the capacitor and the device, offering industry-leading low-trigger voltage to maximize system-level protection (V_{t1} as low as 3.5 V).

Combining a protection device from both subsets is suggested, to achieve ultimate ESD protection.



Portfolio selection

	Type	Direction	Protected lines	V_{RWM} (V)	Cline typ (pF)	ESD rating max (kV)	Surge robustness 8/20 μ s (A)	R_{dyn} (Ω)	Package
Extremely high surge ratings	PESD6V5C1USF	Unidirectional	1	6.5	0.45	20	9	0.1	DSN0603-2
	PESD2V8R1BSF	Bidirectional		2.8	0.1	10	4.5	0.45	
	PESD3V3Z1BSF			3.3	0.28	20	9.5	0.19	
	PESD4V0Z1BCSF			4	0.45	25	15	0.11	
	PESD4V0W1BCSF			4	0.55	30	20	0.1	
	PESD5V0C1BSF			5	0.2	20	9	0.23	
	PESD5V0H1BSF			5	0.15	15	7	0.25	
	PESD7V0C1BSF			7	0.2	20	9	0.23	
	PESD7V0H1BSF			7	0.15	15	7	0.25	
	PESD9V0C1BSF			9	0.2	18	8.5	0.2	
	PESD9V0W1BCSF			9	0.5	30	20	0.1	
	PESD5V0H1BSN			5	0.17	15	7	0.21	
	PUSB3BB2DF			2	4	0.26	20	8	0.25

	Type	Direction	Protected lines	V_{RWM} (V)	Cline typ (pF)	ESD rating max (kV)	Trigger voltage V_{t1} (V)	R_{dyn} (Ω)	Package
Extremely low peak voltages	PESD1V2Y1BSF	Bidirectional	1	1.2	0.26	15	3.5	0.26	DSN0603-2
	PESD2V0Y1BSF			2	0.69	20	4.3	0.2	
	PESD2V5Y1BSF			2.5	0.25	15	4.9	0.23	
	PESD3V3Y1BSF			3.3	0.24	15	7	0.25	
	PESD4V0Y1BSF			4	0.24	15	7	0.25	

Package details

TrEOS solutions are available in the high-compactness, low-inductance, extreme-robustness DSN- and DFN packages. These small-footprint packages allow to reduce clamping voltage by up to 50% compared to bond-wire alternatives.

SOD992B (DSN0402)	SOD962-2 (DSN0603-2)	SOT8013 (DFN0603-3)
		
0.4 x 0.2 x 0.2	0.6 x 0.3 x 0.3	0.6 x 0.3 x 0.3

TrEOS protection solutions also exist with common mode filtering and for multi-line needs. Browse our full portfolio: <https://www.nexperia.com/usb-type-c-protection>

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