

Applications & Cases



CeraDiodes prevent static discharges

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Compact protection for USB

CeraDiode arrays can protect several USB ports simultaneously from static discharges. This significantly reduces the space requirement on the board as well as logistics costs. CeraDiodes are ceramic components developed to provide ESD protection for data, audio and video lines as well as for ICs and interfaces. They are not only a cost-effective alternative to the relevant ESD protection components based on semiconductors such as zener and TVS diodes, but also offer technical benefits. In many cases, a semiconductor diode can be replaced by a CeraDiode on a one-to-one

basis without making any changes to the landpad and thus the layout.

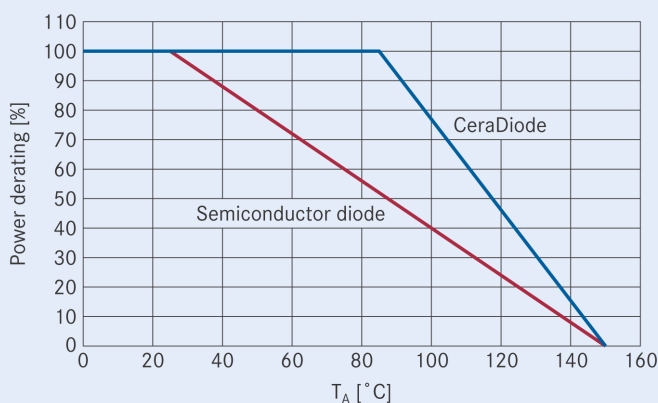
Because high data rates of up to 480 Mbit/s are transmitted via the universal serial-bus (USB) connection, the capacitance of the ESD protection element should be minimized in order to avoid transmission losses and signal distortions. The protection function can be realized both by single and array components, the latter being preferred for reasons of space and cost saving. The protection components must additionally satisfy the international ESD standard IEC 61000-4-2, level 4. EPCOS offers CeraDiodes as single and array components that meet these requirements precisely.

Properties and benefits of CeraDiodes

CeraDiodes are bidirectional components. As such, there is no danger of positioning them in the wrong direction. All CeraDiodes satisfy the requirements of the international ESD standard IEC 61000-4-2 levels 1 to 4, which involves testing the components within the human body model (330 Ω / 150 pF). The ESD protection properties of the CeraDiodes are constant up to an operating temperature of 85°C. This contrasts with semiconductor diodes, whose properties already begin to derate at 25 °C (Fig. 1).



FIGURE 1: COMPARISON OF A CERADIODE WITH A SEMICONDUCTOR DIODE



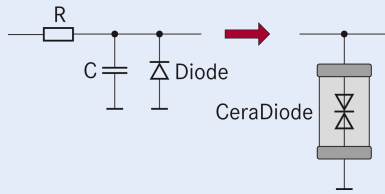
In semiconductor diodes, the ESD protective properties already begin to derate at 25 °C. In contrast, CeraDiodes can be operated up to 85 °C with their properties unimpaired.

Thanks to their internal electrode structure, CeraDiodes offer not only ESD protection but also have a defined capacitance, i.e. capacitor properties. This capacitance is type-dependent and can be used for filter functions. In this way a CeraDiode can replace not only a semiconductor diode, but also a capacitor (Fig. 2).

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FIGURE 2: SIMPLIFYING CIRCUITS WITH CERADIODES



With the aid of CeraDiodes, one component can replace three.

This translates into additional space and cost savings as well as lower logistics costs. In the normal operating case, CeraDiodes allow only an extremely low leakage current in the μA range and have a reaction time of <0.5 ns in the case of ESD. Even with these values, they are superior to semiconductor solutions. The CeraDiodes suitable for USB applications are listed in the following tables.

TABLE 1: SINGLE COMPONENTS

Size	EPCOS type code	Semi diode package	Lines to protect	V_{DC} [V]	$V_{BR, min}$ [V] @ 1 mA	$V_{clamp, max}$ [V] @ 1 A	C_{typ} [pF]
0402	CDS2C15 GTH	SOD-723	1	15	23	66	10
0402	CDS2C16 GTH	SOD-723	1	16	65	290	2
0402	CDS2C15 GTA ¹⁾	SOD-723	1	15	20	46	47
0603	CDS3C16 GTH	SOD-523	1	16	65	290	3
0603	CDS3C30 GTH	SOD-523	1	30	50	120	10
0603	CDS3C15 GTA ¹⁾	SOD-523	1	15	22	42	160
1003	CDS4C16 GTH	SOD-323	1	16	38	146	3
1003	CDS4C12 GTA ¹⁾	SOD-323	1	12	16	46	82

¹⁾ Protection of the power supply line

TABLE 2: ARRAY COMPONENTS

Size	EPCOS type code	Semi diode package	Lines to protect	V_{DC} [V]	$V_{BR, min}$ [V] @ 1 mA	$V_{clamp, max}$ [V] @ 1 A	C_{typ} [pF]
0508	CDA4C16 GTH	-	4	16	22	66	10
0612	CDA5C16 GTH	-	4	16	80	350	3
1012	CDA6C05 GTH	SOT-23 6L	4 data + 1 supply	5.6	52	195	5

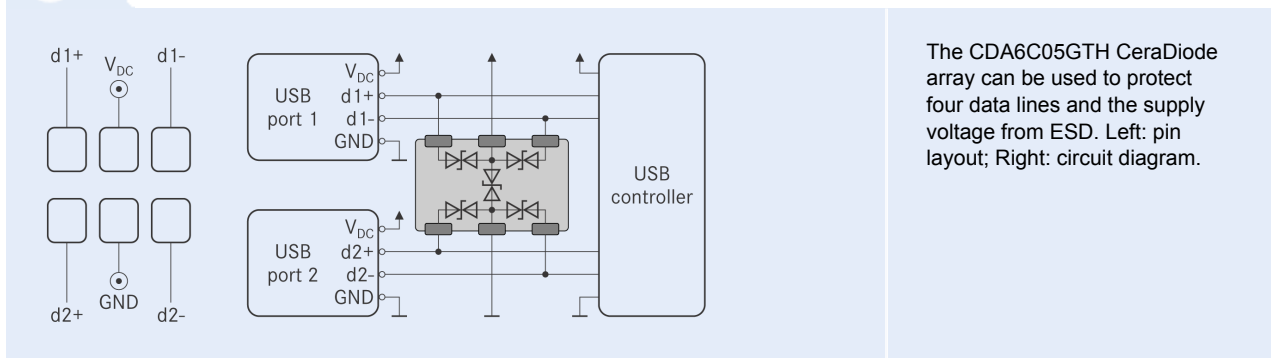
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CDA6C06GTH USB arrays

Within this product range, the CDA6C05GTH array developed specifically for the ESD protection of USB ports merits particular interest. This array (size 1012) can be used to protect two USB ports with a single component (Fig. 3). It protects four data lines and a power supply line. The single path that protects the power supply line has a surge-current resistance of up to 20 A peak current in the case of a 8/20 μ s pulse. The CDA6C05GTH array can naturally also be used to protect a single USB port.



FIGURE 3: COMPLETE PROTECTION OF TWO USB PORTS



The suitability of the CeraDiodes in single and array form was confirmed in a USB compliance test. The CeraDiodes listed in the tables are also ideal for the ESD protection of IEEE 1394 (Firewire), Ethernet and DVI interfaces.



FIGURE 4: ESD PROTECTION WITH DISCRETE CERADIODES

