Signal Interface

1.1.1	USB2.0 Interface ESD Protection Solution (1)
1.1.2	USB2.0 Interface ESD Protection Solution (2)
1.2	Dual USB2.0 Interface ESD Protection Solution
1.3	USB3.0/TYPE-C Interface Single- Component ESD Protection Solution
1.4	USB3.0 / TYPE-C Interface Electrostatic Filtering Protection Multi-Component Solution
1.5	Electrostatic Surge Protection Solution for USB Port of Mobile Phone
1.6	USB Fast Charging ESD Protection (Voltage 5V, 12V, 36V)
1.7	USB 3.0 / Type-C Interface ESD Protection Solution
1.8	USB 3.1 Gen 2 Port ESD Protection Solution
1.9	USB 2.0-USB 3.1 Port ESD Protection Solution
1.10	USB-PD Fast Charging Power ESD Protection Solution
1.11	USB4 High-Speed Interface ESD Protection Solution
2.1	10G Ethernet Interface ESD Protection Solution
2.2	10G Ethernet Lightning Protection Solution
2.3	Gigabit Ethernet Discrete Lightning Protection Scheme
2.4	Gigabit Ethernet Integrated Lightning Protection Scheme
2.5.1	Gigabit Ethernet Small Size ESD Protection Scheme
2.5.2	Gigabit Ethernet 3.3V Low Residual Voltage High Current Integrated Protection Scheme
2.6	100M Network Split Type Lightning Protection Solution
2.7	100M Network Integrated Lightning Protection Solution

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2.8	100M Network Split Type ESD Protection Solution
2.9	100M Network Integrated ESD Protection Solution
2.10.1	POE Outdoor Lightning Protection 6KV Solution
2.10.2	POE Outdoor 4KV Lightning Protection Scheme
2.11	POE Power Supply Surge Protection Scheme
2.12	In-vehicle Ethernet Protection Scheme
3.1	Analog Video Interface ESD Protection Solution
3.2	S-VIDEO Interface Electrostatic Surge Protection Solution
3.3	YPbPr/YCbCr Interface Electrostatic Surge Protection Solution
3.4	Analog Audio Interface Electrostatic Protection Solution
4.1	Low-Speed MIPI Screen ESD Protection Solution
4.2	Mid-Speed MIPI Interface ESD Protection Solution
4.3	High-Speed MIPI Interface ESD Protection Solution
5.1	LVDS Interface ESD Protection Solution
6.1	HDMI 2.0 Interface Electrostatic Protection Solution
6.2	HDMI2.0 Interface Electrostatic Filtering Protection Solution
6.3	HDMI1.3 1.4 Electrostatic Filtering Protection Scheme
6.4	HDMI 1.4 Interface Electrostatic Protection Solution
7.1	DVI Video Interface Electrostatic Protection Solution
8.1	VGA Video Interface Electrostatic Protection Solution

9.1.1	SIM Card Electrostatic Protection Solution 1
9.1.2	SIM Card Electrostatic Protection Solution 2
9.2	SD Card SPI Mode Electrostatic Protection Scheme
9.2.1	SD Card Electrostatic Protection Scheme (Low Capacitance)
9.2.2	SD/TF Card SD Mode Electrostatic Protection Scheme
10.1	MMC Card Electrostatic Protection Solution
11.1	PROFIBUS Card Electrostatic Protection Solution
12.1	eSATA Interface Electrostatic Protection Solution
12.2	eSATA Interface Electrostatic Protection Solution 2
13.1	T1 E1 Interface Electrostatic Surge Protection Solution
14.1	IO Interface Electrostatic Protection Solution
14.2	MCU Serial Port UART Discrete Electrostatic Protection Solution
14.3	MCU Serial Port UART Integrated Electrostatic Protection Solution
15.1	Keyboard Key/Power Key/Volume Key Discrete Component Electrostatic Protection Solution
15.2	Keyboard Key Integrated Component ESD Protection Solution
16.1	CAN Interface Electrostatic Protection Solution
16.2	CAN Interface Isolation and Electrostatic Protection Solution
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17.1	Microphone Electrostatic Protection Solution

18.1	RS485 Interface ESD Protection Scheme
18.2	RS485 Surge Protection Scheme
18.3	RS485 Interface Isolation and ESD Protection Solution
18.4	RS485 Interface Surge Filter Protection Solution
18.5	RS422 RS485 Interface ESD Surge Protection Solution
19.1	RS422 Interface Electrostatic Protection Solution
19.2	RS422 Data Line with Power Supply Electrostatic Surge Protection Solution
20.1	RS232 Interface Integrated Electrostatic Protection Solution
20.2	RS232 Interface Integrated Surge and ESD Protection Solution
20.3	RS232 Interface Isolation and Electrostatic Protection Solution
20.4	Electrostatic Surge Protection Solution of RS232 Data Line with Power Supply
20.5	RS232 Interface Discrete ESD Protection Solution
20.6	RS232 Interface Split Surge and ESD Protection Solution
21.1	RF Antenna Electrostatic Surge Protection Solution
22.1	WIFI Antenna ESD and Surge Protection Solution
22.2	NB-IoT Antenna Electrostatic Surge Protection Solution
23.1	Mobile VBAT Electrostatic Discharge (ESD) and Surge Protection Solution
24.1	I2C Interface Isolation and Electrostatic Discharge (ESD) Protection Solution
25.1	SPI Interface Isolation and Electrostatic Discharge (ESD) Protection Solution
26.1	JTAG Interface ESD Protection Scheme (5V)

26.2	JTAG Interface ESD Protection Solution 3.3V
27.1	FlexRay Automotive Network ESD Protection Solution
28.1	Fingerprint Recognition Electrostatic Protection Solution
29.1	Coaxial Surge Protection Solution
30.1	GPS Surge Protection Solution
31.1	CVBS Interface Protection Solution
32.1	LIN Bus Interface ESD Protection Solution
33.1	NFC Interface Electrostatic Protection Solution
34.1	VIDEO Interface ESD Surge Protection Solution
35.1	RJ11 Surge Protection Solution
36.1	TTL Electrostatic Protection Solution
37.1	HD-SDI Interface Protection Solution

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Power Protection	
1.0	1.8V VCC Power Supply ESD Protection Solution
1.1	2.5V Vbus Power Supply ESD Protection Solution
2.1	3.3V Vbus Power Supply ESD Protection Solution
3.1	3.7V Lithium Battery Electrostatic Surge Protection Solution
4.1	5V DC Power Supply Surge Protection Solution
5.1	9V DC Power Supply Surge Protection Solution
6.1	12V DC Power Supply Surge Protection Solution
6.2	12V Automotive Power Surge Protection Solution
7.1	15V DC Power Supply Surge Protection Solution
8.1	18V DC power supply surge protection solution
9.1	24V DC Power Supply Surge Protection Solution
9.2	24V Automotive Power Surge Protection Solution
9.3	24V DC Surge Protection 2KV, Compact and Low Residual Voltage Solution
9.4	28V DC Power Supply Surge Protection Solution
10.1	36V DC Power Supply Surge Protection Solution
11.1	48V DC Power Supply Surge Protection Solution
11.2	11.2 DC 48V/60V Power Supply Lightning Protection Solution for Outdoor Equipment
11.3	64V DC Power Supply 6KV Surge Protection Solution
11.4	-48V Non-Freewheeling Power Supply Protection Method

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11.5	48V Automotive Power Surge Protection Solution
12.1	Surge Protection Solution for AC 110V Power Supply
12.2	Surge Protection Solution for AC 220V Power Supply
13.1	Surge Protection Solution of AC 380V Power Supply
14.1	Rectification Solution for LED Power Supply
15.1	Mobile Phone Fast Charging PD/TYPE-C Interface Protection
15.2	USB-PD Fast Charging Power Interface Electrostatic Surge Protection Solution
16.1	Apple Charging Cable Circuit Protection
17.1	Anti-reverse Protection Solution for Low VF Schottky Power Supply
17.2	Anti-reverse Protection Solution of Low IR Schottky Power Supply
18.1	Surge Protection Solution for DC-DC Conversion Power Supply
19.1	Silicon Carbide SIC New Energy Vehicle Charging Pile Solution
20.1	Vehicle Ignition System Lighting, Anti-static, Anti-reverse Protection Solution

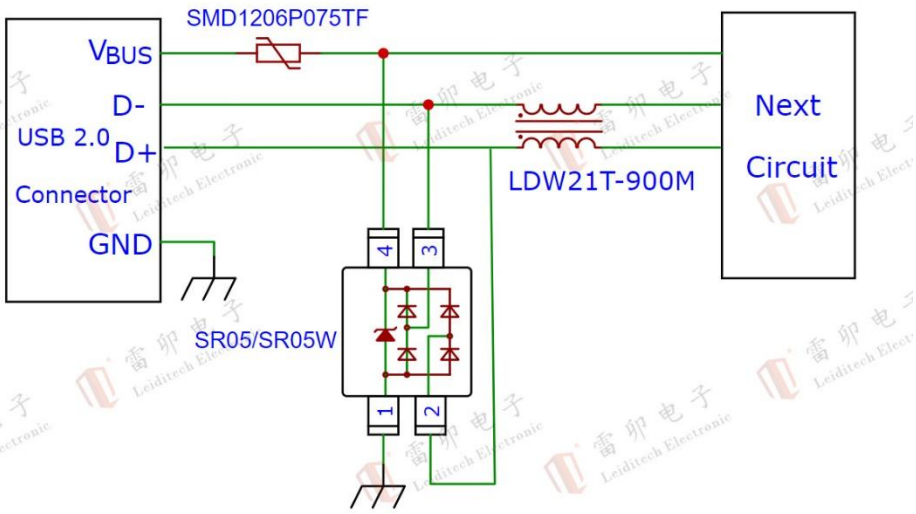
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Industrial Applications	
1.1	Application Solution of Power PLC Module
1.2	Carrier Signal Surge Protection Solution
2.1	Electrostatic Protection Solution for 4-20mA Sensors
3.1	Bluetooth Speaker Control Board Electrostatic Surge Protection Solution
3.2	TWS Wireless Bluetooth Earphone Electrostatic Surge Protection Solution
4.1	Circuit Solution for Radar Module LMXBR202010
5.1	LC03-6 Application Solution for T1, T3/E3, 10M/100M, High-Speed Drive Circuits, and ISDN-S/U Interface Circuits
6.1	Power Module and Open-circuit Protection Solution for Smart LED Lighting
7.1	Electrostatic Protection Solution for Screen Flickering and Malfunctioning
8.1	GaN Electrostatic Surge Protection Solution
9.1	Smart Watch Activity Tracker Solution
10.1	Earphone Interface Electrostatic Protection Solution
10.2	Electrostatic Protection Solution of TWS Wireless Bluetooth Headset

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1.1.1 USB2.0 Interface ESD Protection Solution (1)

Advantages of the Solution: The USB2.0 interface offers a data transmission speed of 500Mbps. This solution uses single-component for protection, saving space and ensuring signal integrity. The SR05 meets IEC61000-4-2 standards, with level 4 contact discharge of 20kV and air discharge of 20kV. The SR05W meets IEC61000-4-2 standards, with level 4 contact discharge of 30kV and air discharge of 30kV, providing a 7x performance improvement. It ensures that various industrial customers are protected from all kinds of electrical interference. If there are over current requirements for Vbus, PTC protection is needed.



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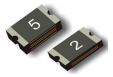
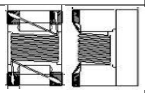
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1.1.1 USB2.0 Interface ESD Protection Solution (1)

Part Number	Description	IPP	CH.	Shape	Packaging
SR05	5V,单向，0.45PF ±20kV(air), ±20kV(contact)	5A	3		SOT-143
SR05W	5V,单向，3PF ±30kV(air), ±30kV(contact)	20A	3		
SMD1206P075TF	0.75A 0.07Ω 6V	0.75A	1		SMD1206
LDW21T-900M	2.05*1.25*1.2mm 90Ω	330mA	-		SMD

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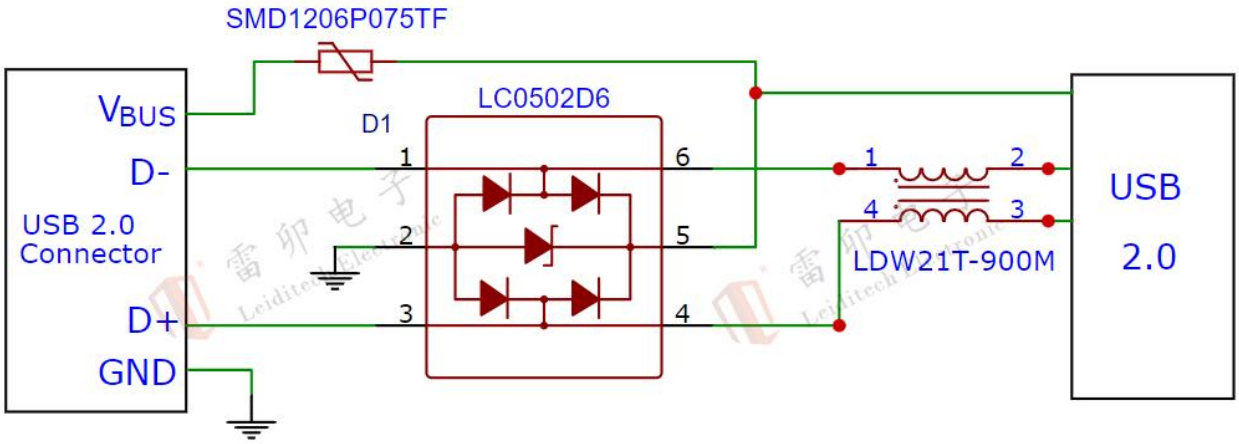
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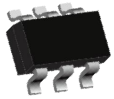
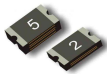
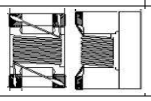
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1.1.2 USB2.0 Interface ESD Protection Solution (2)

Advantages：USB2.0 provides transmission speed of 500 Mbps，Leiditech adopts single-component protection, saving space while ensuring signal integrity. The LC0502D6’ s pins 1 and 6 are connected, meeting the IEC61000-4-2, Level 4 standards, with a contact discharge of 25kV and an air discharge of 30kV. It guarantees protection against various types of electrical interference from industrial customers. If there is an overcurrent requirement for Vbus, PTC protection is needed.



Part Number	Description	IPP	CH.	Shape	Packaging
LC0502D6	5V,单向，0.3PF ±30kV(air), ±25kV(contact)	10A	3		SOT-26
SMD1206P075TF	0.75A 0.07Ω 6V	0.75A	1		SMD1206
LDW21T-900M	2.05*1.25*1.2mm 90Ω	330mA	-		SMD

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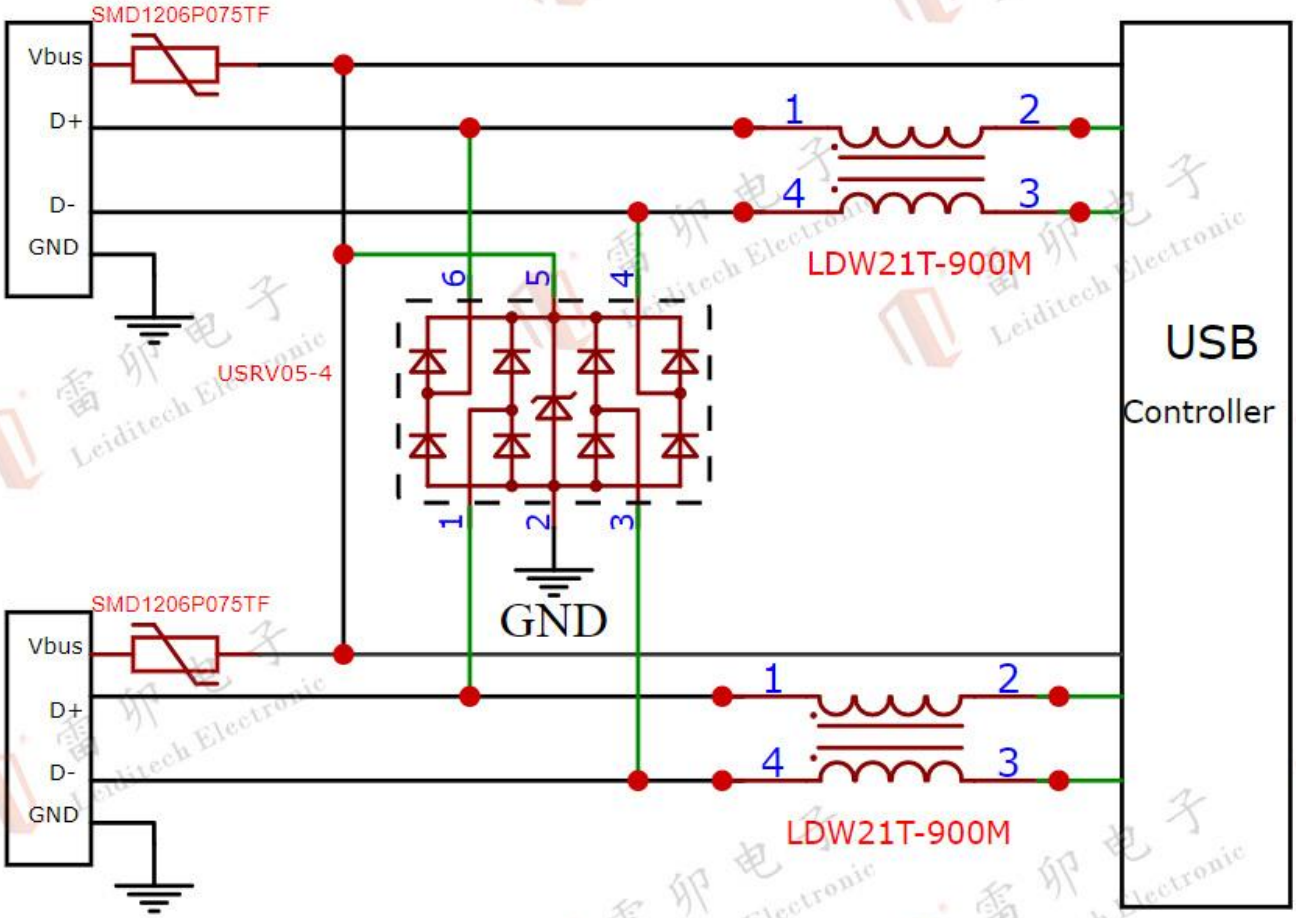
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1.2 Dual USB2.0 Interface ESD Protection Solution

Advantages: USB2.0 provides a transmission speed of 500 Mbps， Leiditech adopts a single component to protect two USB ports, saving space while ensuring signal integrity, meeting IEC61000-4-2 Level 4 standards, with contact discharge at 8kV and air discharge at 15kV.
If overcurrent protection is required for Vbus, PTC protection should be included.

Solution one



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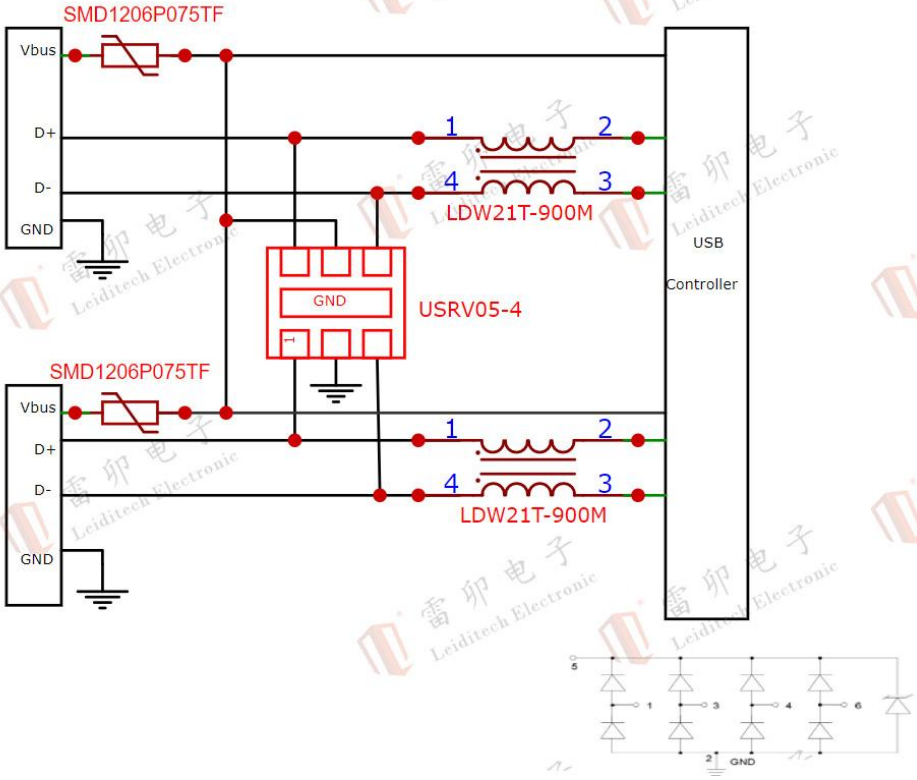
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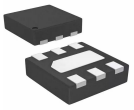
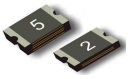
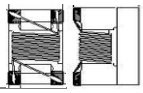
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1.2 Dual USB2.0 Interface ESD Protection Solution

Solution two



Part Number	Description	IPP	CH.	Shape	Packaging
ULC0504P	5V,Uni，0.4PF ±18kV(air), ±15kV(contact)	5A	5		DFN1616-6
USRV05-4	5V, Uni，0.5PF ±20kV(air), ±20kV(contact)	5A	5		SOT-26
SMD1206P075TF	0.75A 0.07Ω 6V	0.75A	1		SMD1206
LDW21T-900M	2.05*1.25*1.2mm 90Ω	330mA	-		SMD

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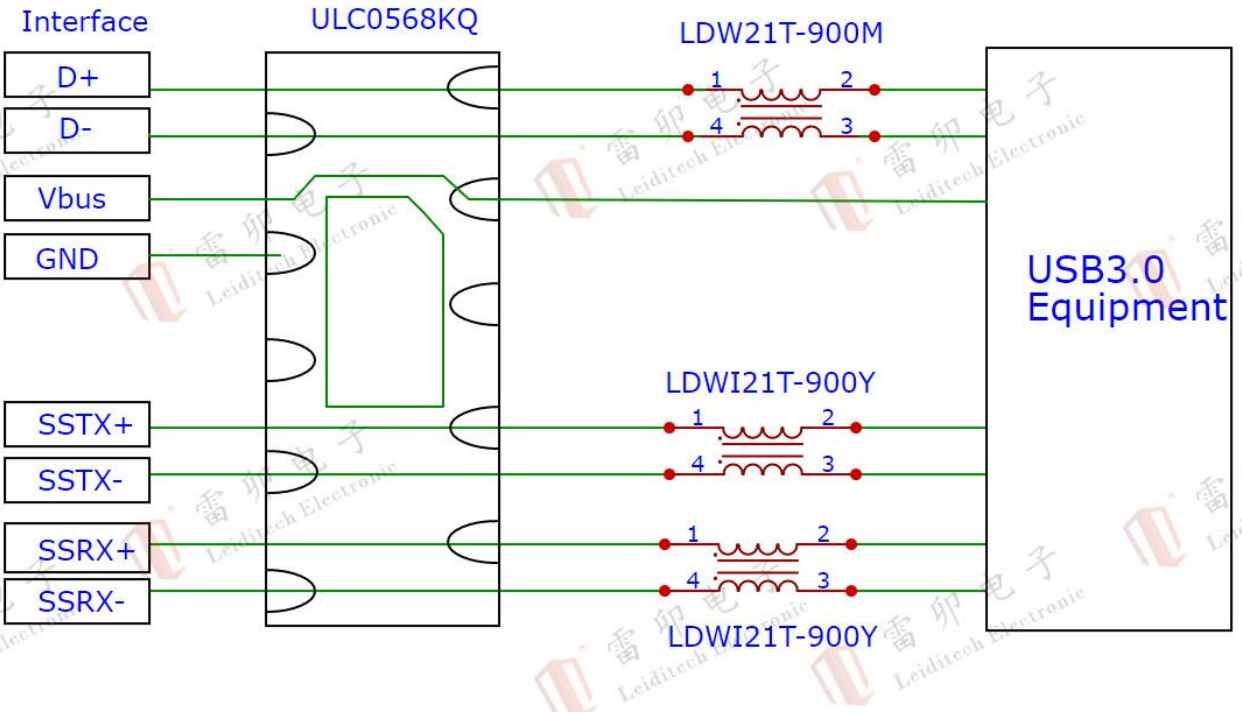
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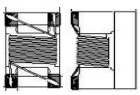
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1.3 USB3.0/TYPE-C Interface Single-Component ESD Protection Solution

Advantages: USB3.0 provides a transmission speed of 5.0 Gbps, Leiditech adopts single-component protection, which saves space and ensures signal integrity, meeting IEC61000-4-2 Level 4 standards, with contact discharge up to 20 kV and air discharge up to 25 kV.



Part Number	Description	IPP	CH.	Shape	Packaging
ULC0568KQ	5V,Uni，0.3PF ±25kV(air), ±20kV(contact)	4A	7		DFN4120
LDW21T-900M	2.05*1.25*1.2mm 90Ω	330mA	-		SMD
LDWI21T-900Y	2.05*1.25*1.2mm 90Ω	500mA	-		

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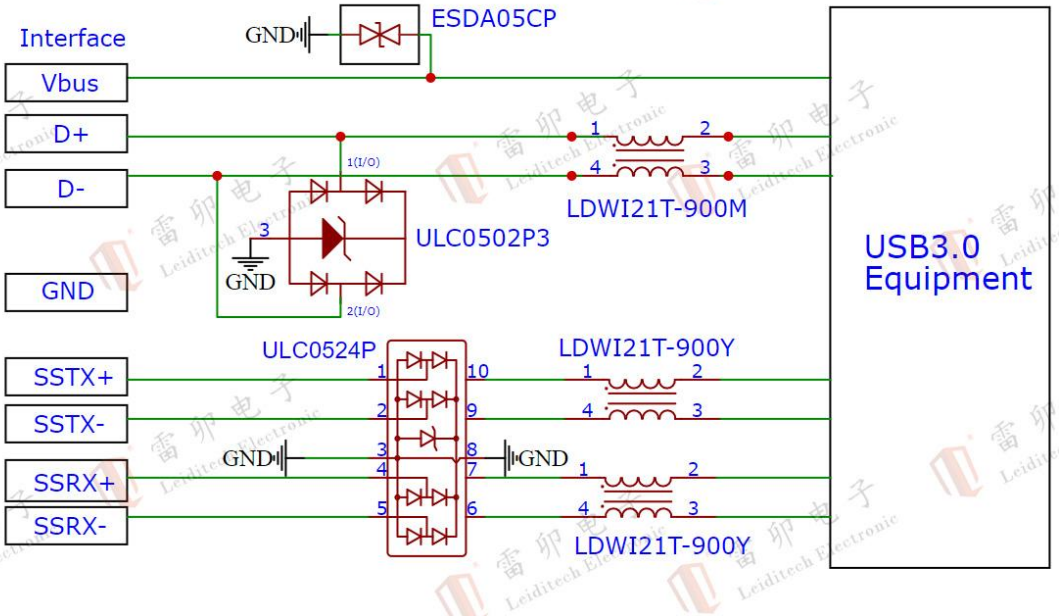
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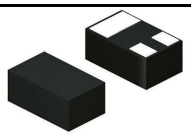
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1.4 USB3.0 / TYPE-C Interface Electrostatic Filtering Protection Multi-Component Solution

Advantages: USB3.0 provides a transmission speed of 5.0 Gbps, Leiditech adopts discrete component protection, which ensures signal integrity and meeting IEC61000-4-2 Level 4， with contact discharge at 8kV and air discharge at 15kV.



Part Number	Description	IPP	Channels	Shape	Packaging
ULC0524P	5V,Uni，0.3PF ±30kV(air), ±25kV(contact)	5A	4		DFN2510P10
ULC0502P3	5V Uni0.6PF ±30kV(air), ±25kV(contact)	5A	2		DFN1006-3
ESDA05CP	5V Bi 15PF ±25kV(air), ±25kV(contact)	8A	1		DFN1006-2

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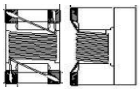
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1.4 USB3.0 / TYPE-C Interface Electrostatic Filtering Protection Multi-Component Solution

Part Number	Description	IPP	CH.	Shape	Packaging
LDW21T-900M	2.05*1.25*1.2mm 90Ω	330mA	-		SMD
LDWI21T-900Y	2.05*1.25*1.2mm 90Ω	500mA	-		

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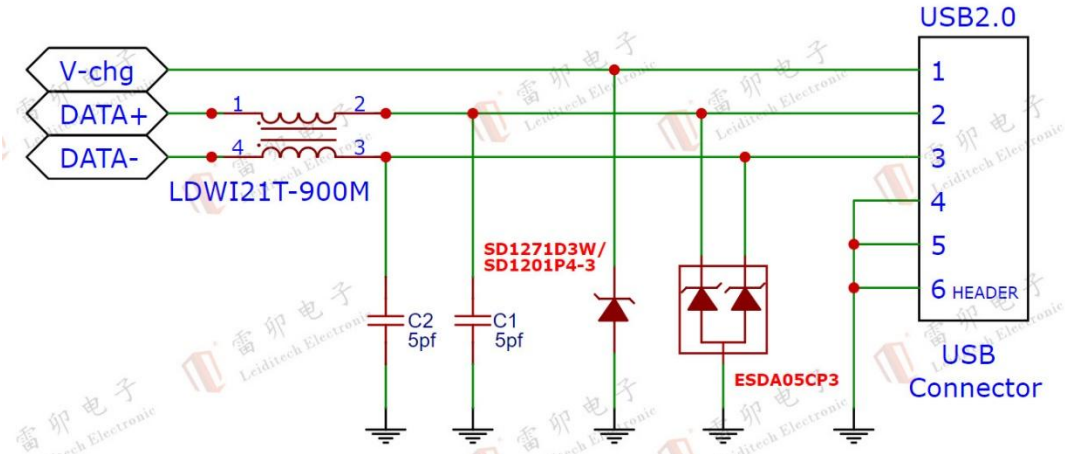
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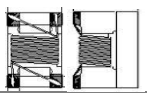
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1.5 Electrostatic Surge Protection Solution for USB Port of Mobile Phone

Advantages: This solution adopts a level-2 protection design, and saving space. It provides primary stage protection for large surge components, and it is suitable for international markets. The secondary stage uses DFN1006-3 dual-channel components for ESD protection, meeting the IEC61000-4-2 standard with contact discharge at 30kV and air discharge at 30kV.



Part Number	Description	IPP	CH.	Shape	Packaging
SD1271D3W	12V,Uni，550PF ±30kV（air） ±25kV(contact)	64A	1		SOD-323
SD1201P4-3	12V,Uni，450pf ±30kV（air） ±30kV(contact)	130A	1		DFN2020-3
ESDA05CP3	5V,Bi，2pf ±30kV（air） ±24kV(contact)	5A	2		DFN1006-3
LDW21T-900M	2.05*1.25*1.2mm，90Ω	330mA	-		SMD

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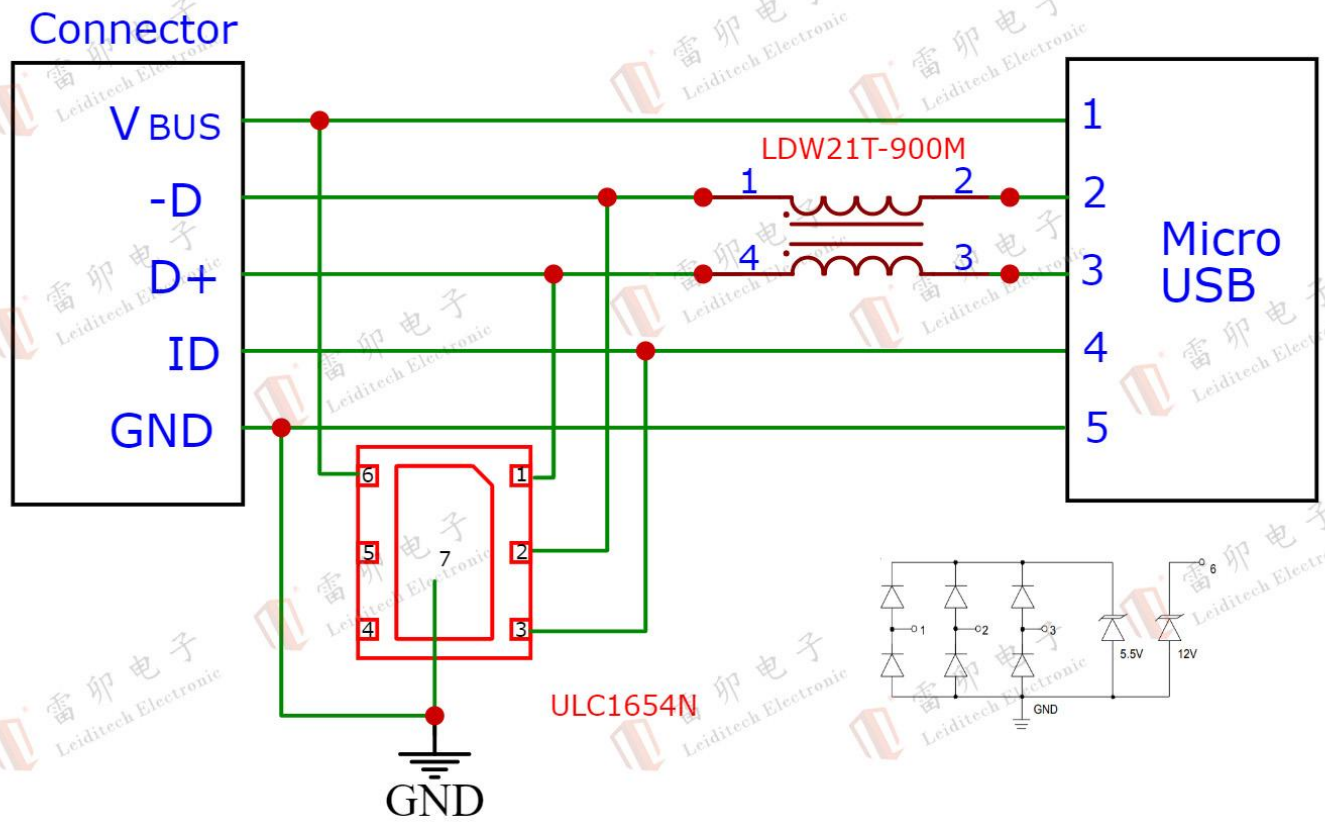
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1.6 USB Fast Charging ESD Protection (Voltage 5V, 12V, 36V)

Advantages of the solution: USB 2.0 provides a transmission speed of 500 Mbps. This solution uses a single-component ESD protector to save space, ensures signal integrity, and meets IEC61000-4-2, level 4 standards. It protects against contact discharges of 20 kV, air discharges of 25 kV, and has corresponding components for fast charging voltages of 5V, 12V, and 36V.



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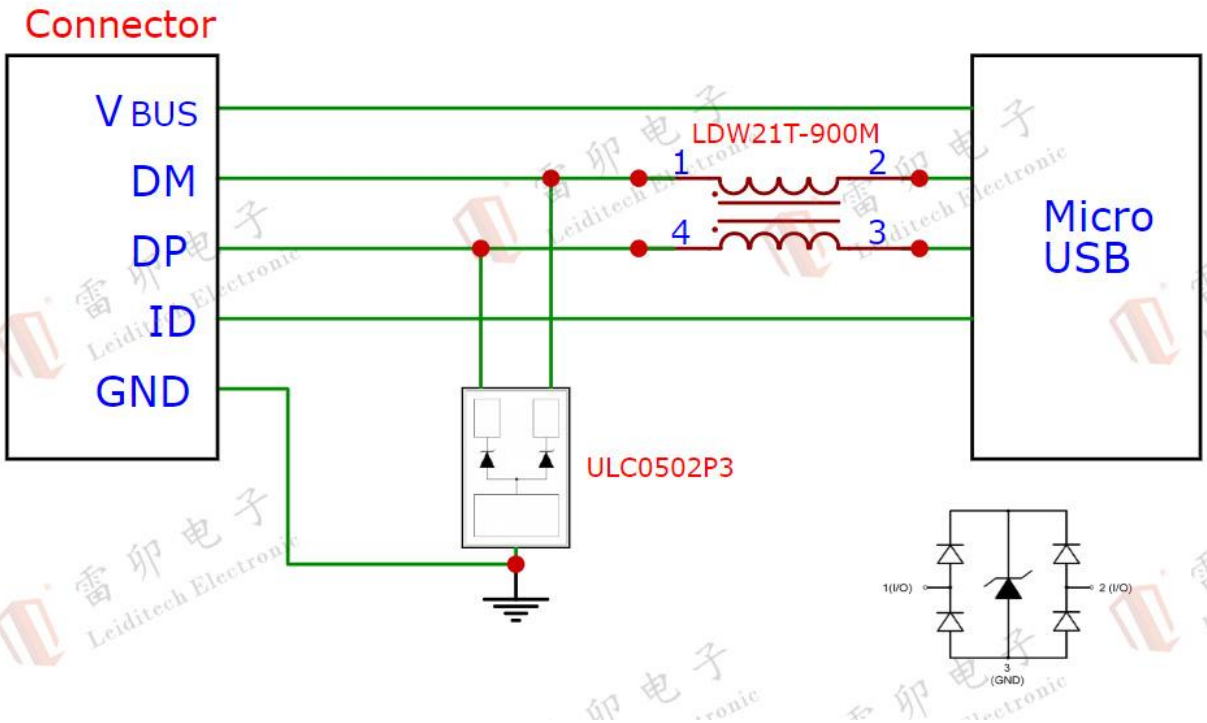
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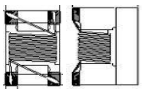
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1.6 USB Fast Charging ESD Protection (Voltage 5V, 12V, 36V)



Part Number	Description	IPP	CH.	Shape	Packaging
ULC1654N	VCC12V,Uni，I/O 0.8PF ±25kV（air） ±20kV(contact)	5A 12A(Vcc)	4		DFN1616
ULC3654N	VCC 36V,Uni，I/O 0.8PF ±25kV（air） ±20kV(contact)	130A	1		DFN1616
ULC0502P3	5V,Uni，0.6pf ±30kV（air） ±25kV(contact)	5A	2		DFN1006-3
LDW21T-900M	2.05*1.25*1.2mm 90Ω	330mA	-		SMD

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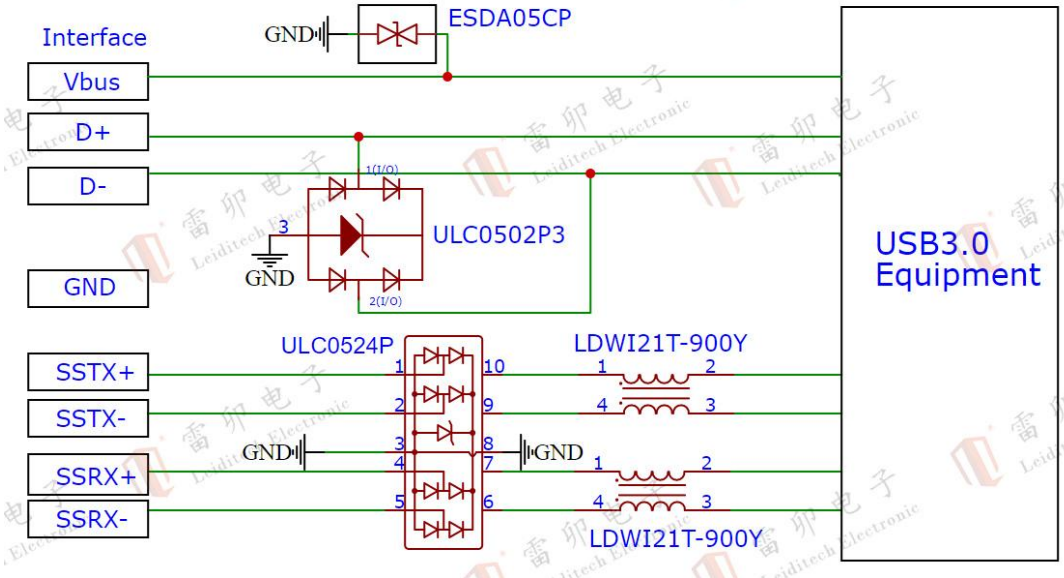
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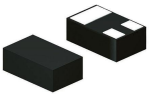
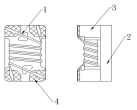
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1.7 USB 3.0 / Type-C Interface ESD Protection Solution

Advantages of the solution: USB 3.0 provides a transmission speed of 5.0 Gbps. This solution uses multiple integrated components for ESD protection, saving space, ensuring signal integrity, filtering noise, and meeting IEC61000-4-2 (level 4) standards. It protects against contact discharges of 25 kV and air discharges of 25 kV.



Part Number	Description	IPP	Channels	Shape	Packaging
ULC0524P	5V,Uni， 0.3PF ±30kV(air), ±25kV(contact)	5A	4		DFN2510P10
ULC0502P3	5V Uni0.6PF ±15kV(air), ±8kV(contact)	5A	2		DFN1006-3
ESDA05CP	5V Bi 5PF ±15kV(air), ±8kV(contact)	5A	1		DFN1006-2
LDWI21 T- 900Y	dimensions： 2.05*1.25*1.2mm R：90Ω	-	-		0805

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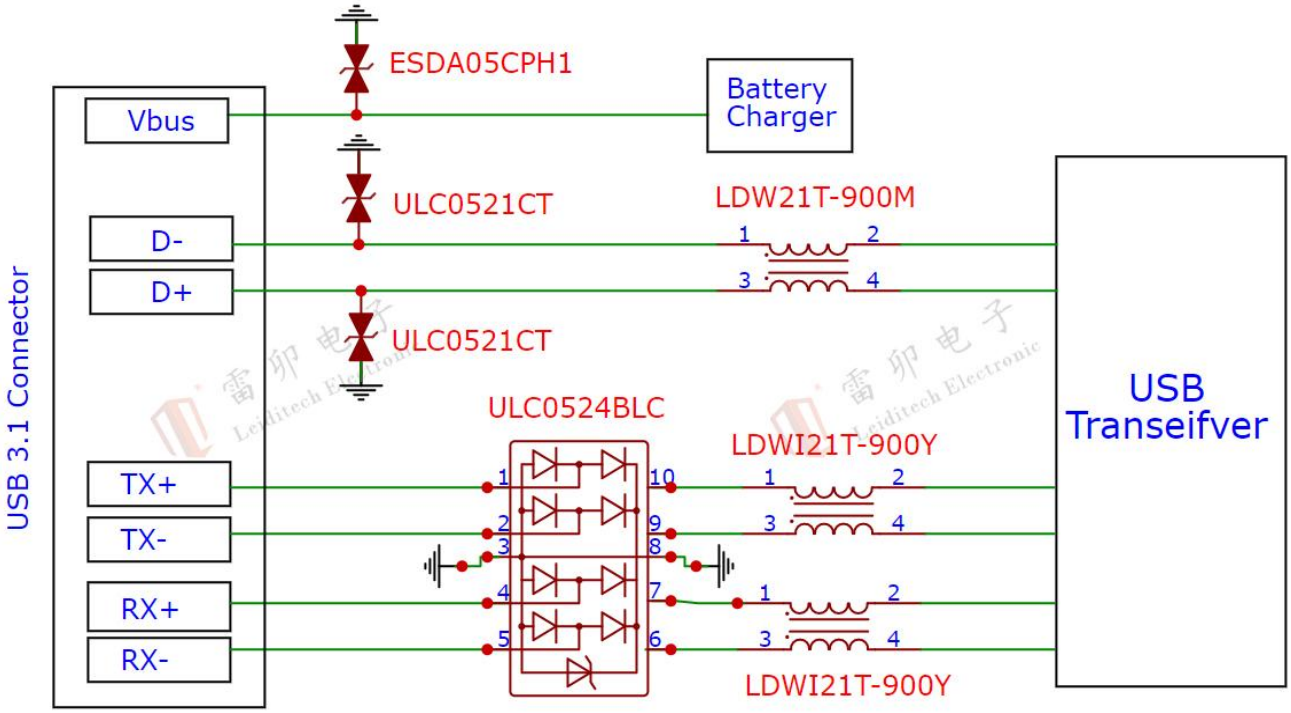
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1.8 USB 3.1 Gen 2 Port ESD Protection Solution



USB 3.1 Gen 2 supports a Tx/Rx differential pair with speeds up to 10 Gbps. At these speeds, the capacitance of ESD protection must be minimized to maintain signal integrity. The ESD protection for USB 3.1 Gen 2 should have a capacitance of 0.5 pF or lower and an operating voltage greater than 3.6V. The solution includes ultra-low capacitance data lines (Tx, Rx) and low capacitance ESD devices for D+/D- and VBUS lines.

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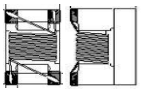
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1.8 USB 3.1 Gen 2 Port ESD Protection Solution

Part Number	Description	IPP	CH.	Shape	Packaging
ULC0524BLC	5V,Uni，0.3PF ±15kV（air） ±8kV(contact)	4A	4		DFN2510P10
ESDA05CPH1	5V,Bi，12PF ±30kV（air） ±30kV(contact)	10A	1		DFN1006
ULC0521CT	5V,Bi，0.18pf ±25kV（air） ±17kV(contact)	4A	1		DFN1006
LDW21T-900M	2.05*1.25*1.2mm 90Ω	330mA	-		SMD
LDWI21T-900Y	2.05*1.25*1.2mm 90Ω	500mA	-		SMD

leiditech Electronics offers various interface protection solutions, with its own EMC laboratory forcustomer testing.

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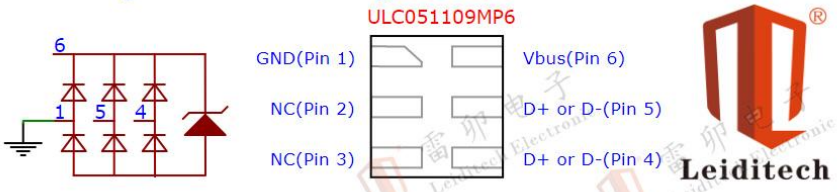
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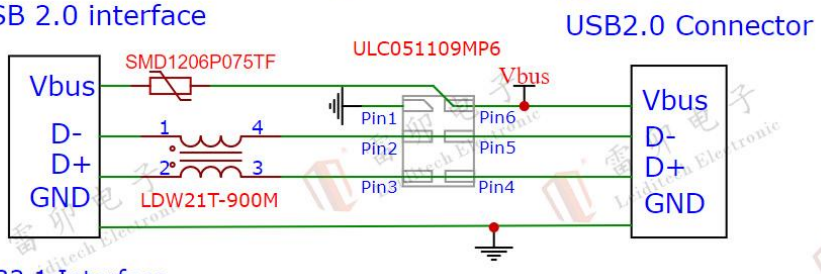
1.9 USB 2.0-USB 3.1 Port ESD Protection Solution

Background: USB ports have evolved from USB 2.0 to USB 3.1 Gen 2, with data speeds increasing from 480 Mbps to 10 Gbps. Higher data speeds require lower capacitance in ESD protection components to maintain signal integrity. The solution involves using ESD protection with low capacitance for the Tx/Rx lines, with operating voltages above 3.6V. The ESD protection is provided by three channels with ultra-low capacitance (0.25 pF) to protect the VCC, D+, D-, and GND lines, ensuring complete protection of both power and data lines.

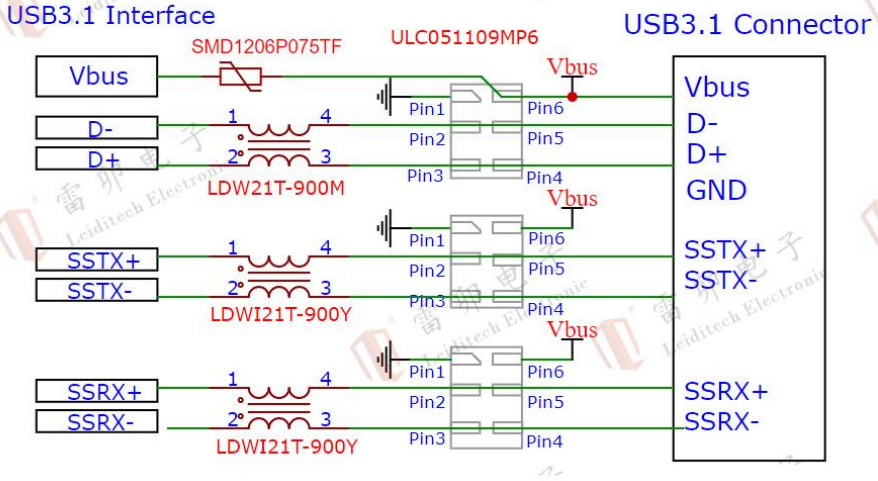
Pin Configuration& Circuit Diagram



USB 2.0 interface



USB3.1 Interface



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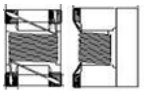
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1.9 USB 2.0-USB 3.1 Port ESD Protection Solution

Part Number	Description	IPP	CH.	Shape	Packaging
ULC051109MP6	5V,Uni，0.25PF ±17kV（air） ±15kV(contact)	3A	3		DFN1109 MP6
SMD1206P075TF	0.75A 0.07Ω 6V	0.75A	1		SMD1206
LDW21T-900M	2.05*1.25*1.2mm 90Ω	330mA	-		SMD
LDWI21T-900Y	2.05*1.25*1.2mm 90Ω	500mA	-		SMD

Leiditech Electronics provides a variety of interface protection solutions, with its own EMC lab to provide testing for customers.

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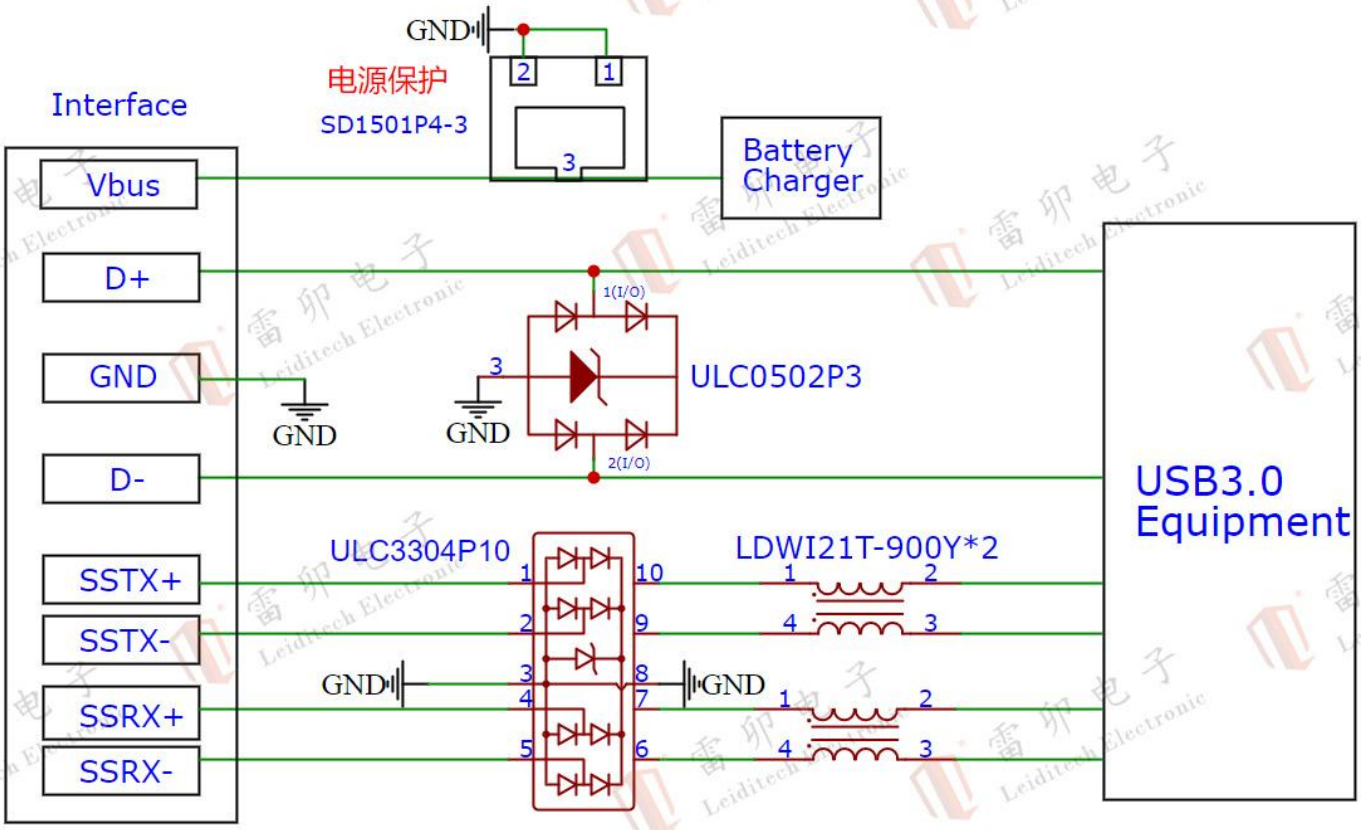
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1.10 USB-PD Fast Charging Power ESD Protection Solution

Advantages: The USB Power Delivery Specification, known as USB-PD, is a standard for fast charging via USB, supporting up to 240W power supply to systems. The VBUS pin commonly supports voltages of 12V, 15V, and 24V. This solution uses a small-sized (2mm x 2mm) DFN2020-3 series package from Leiditech, providing high-power ESD protection for fast charging applications.



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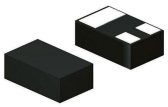
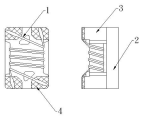
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1.10 USB-PD Fast Charging Power ESD Protection Solution

Part Number	Description	IPP	Channels	Shape	Packaging
ULC3304P10	3.3V,Uni， 0.4PF ±30kV(air), ±30kV(contact)	5A	4		DFN2510P10
ULC0502P3	5V Uni0.6PF ±15kV(air), ±8kV(contact)	5A	2		DFN1006-3
SD1201P4-3	12V Bi 1.2nF ±30kV(air), ±30kV(contact)	210A	1		DFN2020-3
SD1501P4-3	15V Bi 1.2nF ±30kV(air), ±30kV(contact)	180A	1		DFN2020-3
SD2401P4-3	24V Bi 1.2nF ±30kV(air), ±30kV(contact)	210A	1		DFN2020-3
LDWI21 T- 900Y	dimensions： 2.05*1.25*1.2mm R：90Ω	-	-		0805

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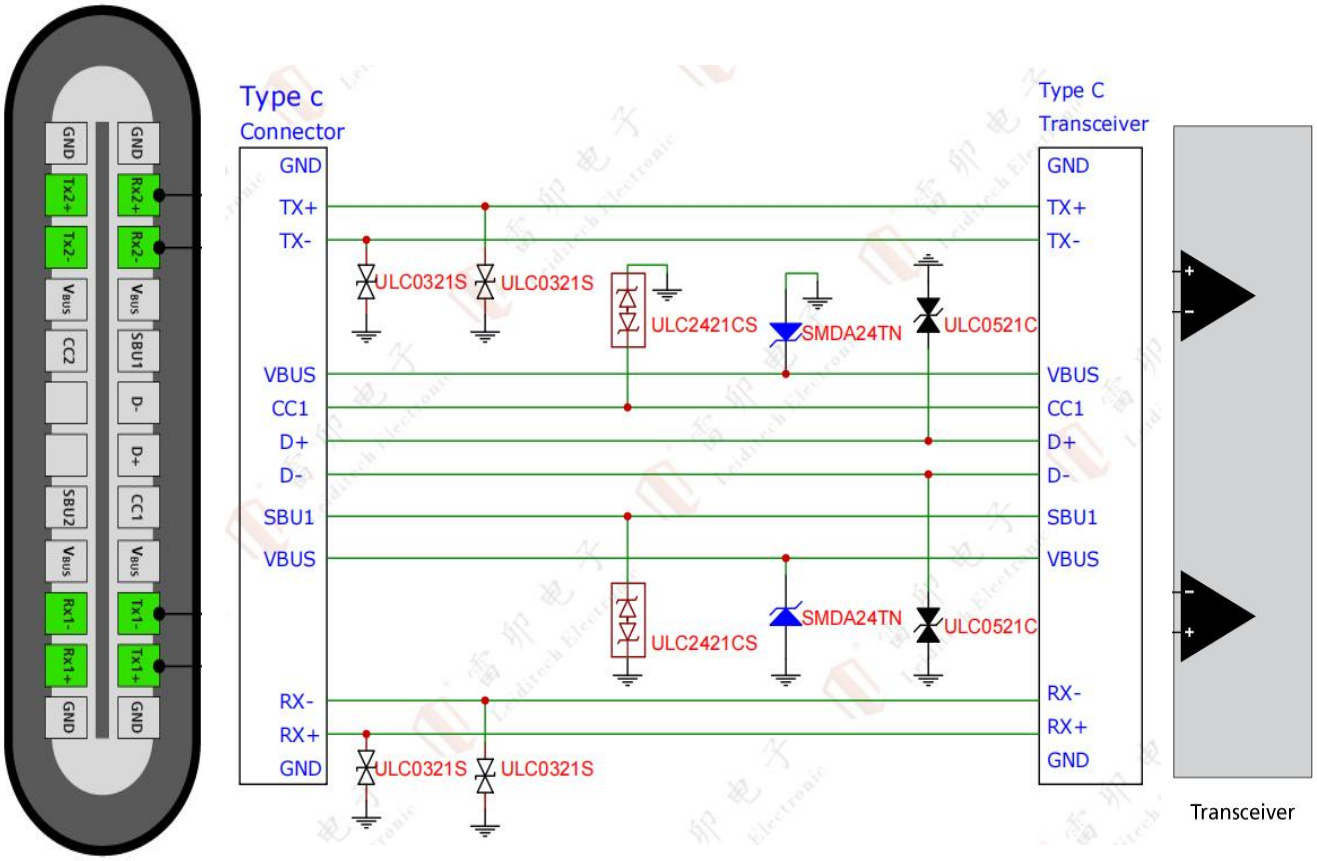
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1.11 USB4 High-Speed Interface ESD Protection Solution

Advantages: The USB4 interface supports data transmission speeds up to 40Gbps. This solution uses a low-capacitance (0.2pF), small-footprint DFN0603 package, incorporating a discrete component-based ESD protection scheme for easy routing. It ensures signal integrity, filters out noise, and meets IEC61000-4-2 (Level 4) standards.



USB Type-C Plug

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1.11 USB4 High-Speed Interface ESD Protection Solution

USB4 Signal Line	Part Number	Description	IPP	Channels	Shape	Packaging
RX+,RX- TX+,TX-	ULC0321S	3.3V,Bi0.2PF ±25kV(air), ±20kV(contact)	5A	1		DFN0603
D+,D-	ULC0521C	5V Bi0.3PF ±15kV(air), ±15kV(contact)	4A	1		DFN0603
VBUS	SMDA24TN	24V Uni 200PF ±30kV(air), ±30kV(contact)	30A	1		DFN1610-2
CC1, SBU1	ULC2421CS	24V Bi 8PF ±25kV(air), ±20kV(contact)	2A	1		DFN0603

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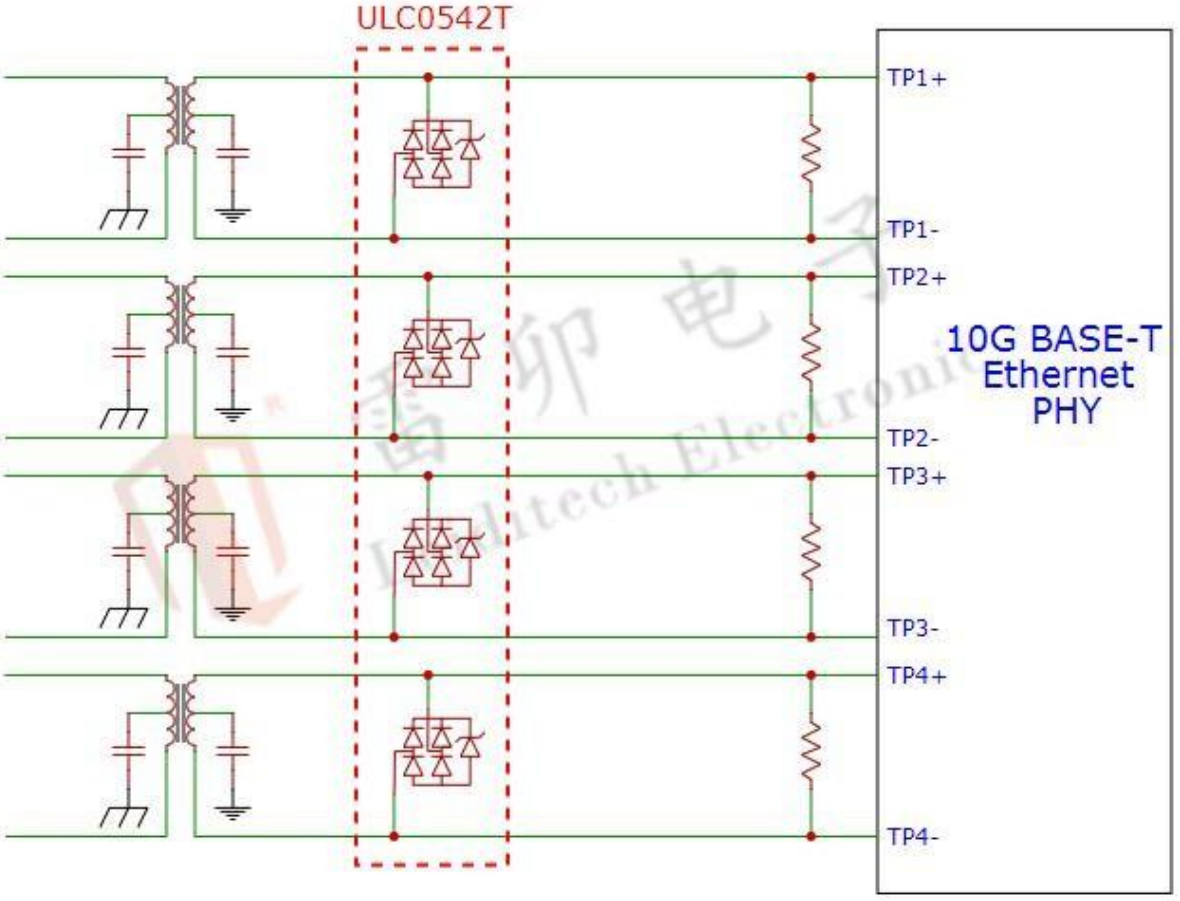
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2.1 10G Ethernet Interface ESD Protection Solution

Advantages: This solution is designed for indoor Ethernet interface ESD protection. It uses four ULC0542T chips to protect eight high-speed data lines. With an ultra-small DFN1610-6 package, a capacitance of 0.3pF, it meets IEC61000-4-2 (Level 4) standards, providing contact discharge protection up to 30kV and air discharge protection up to 30kV, and it can pass eye diagram tests.



Part Number	Description	IPP	Channels	Shape	Packaging
ULC0542T	5V,0.3PF ±30kV(air), ±30kV(contact)	5A	2		DFN1610-6

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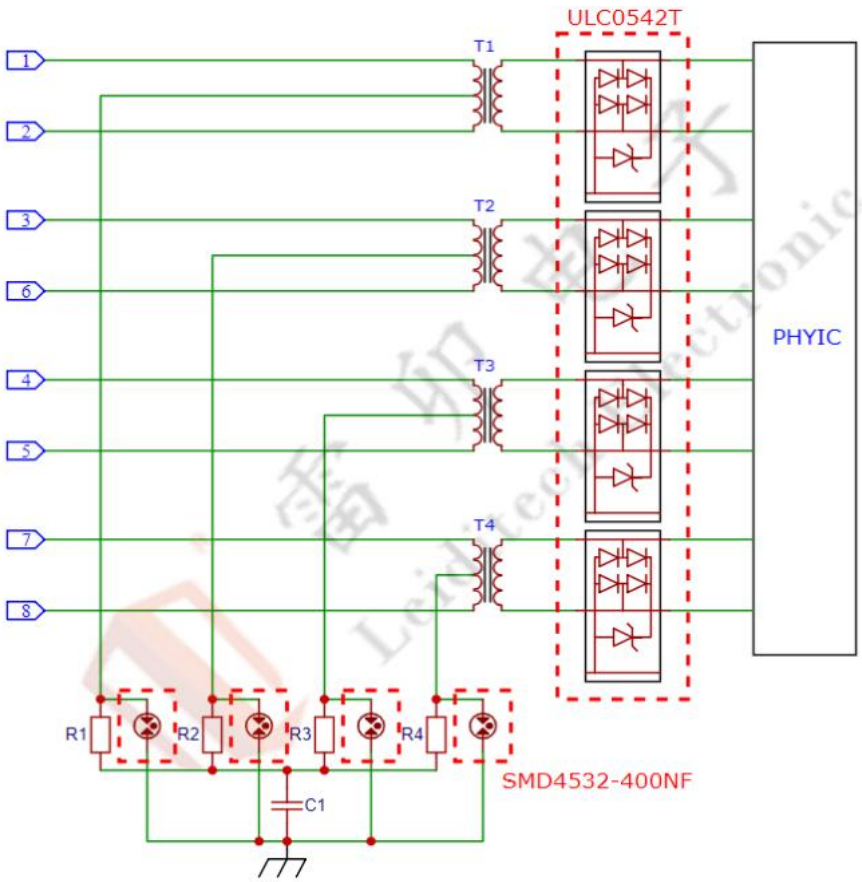
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2.2 10G Ethernet Lightning Protection Solution

Advantages: This solution is designed for outdoor 10G Ethernet port surge protection. It employs secondary protection, ensures reliable operation, and maintains signal integrity at high temperatures. It meets IEC61000-4-2 (Level 4) standards, with contact discharge protection up to 30kV and air discharge protection up to 30kV. It also complies with IEC61000-4-5, handling surges of 10/700μs, 40Ω, 6kV, ±5 cycles.

Solution One



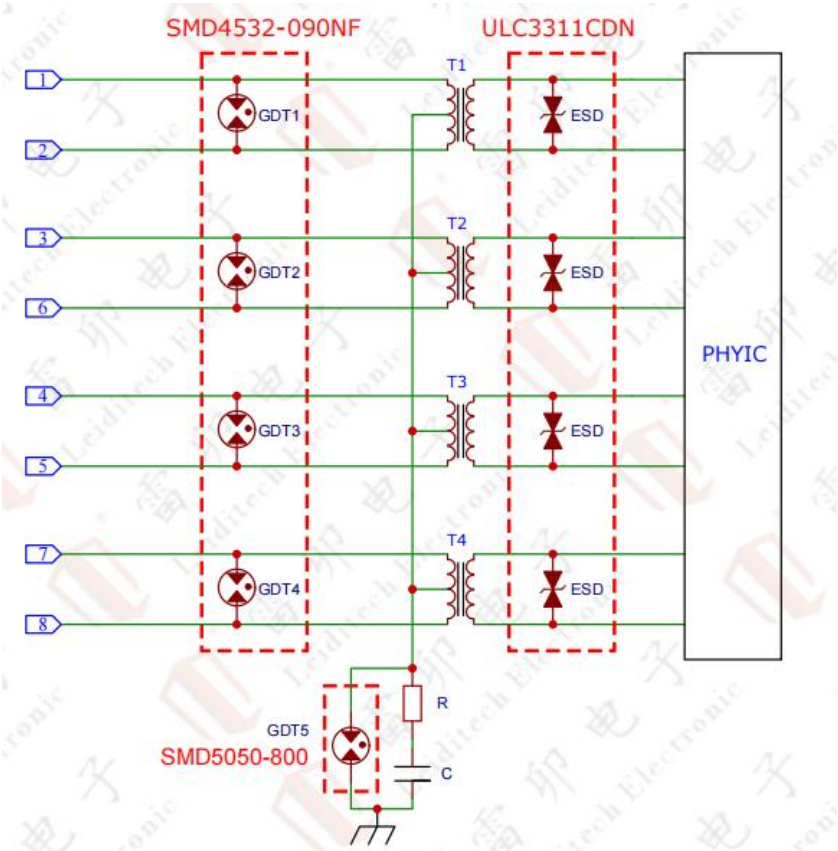
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Solution two



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2.2 10G Ethernet Lightning Protection Solution

Table of Materials for Solution One

Part Number	Description	IPP	Channels	Shape	Packaging
ULC0542T	5V, 0.3PF ±30kV(air), ±30kV(contact)	5A	2		DFN1610-6
SMD4532-400NF	400V Bi 0.5PF 4KV	2KA	1		SMD4532

Table of Materials for Solution two

Part Number	Description	IPP	Channels	Shape	Packaging
ULC3311CDN	3.3V, 0.3PF ±20kV(air), ±20kV(contact)	5A	1		DFN1006
SMD4532-090NF	90V Bi 0.5PF 4KV	2KA	1		SMD4532
SMD5050-800	800V Bi 1.0PF	5KA	1		SMD5050

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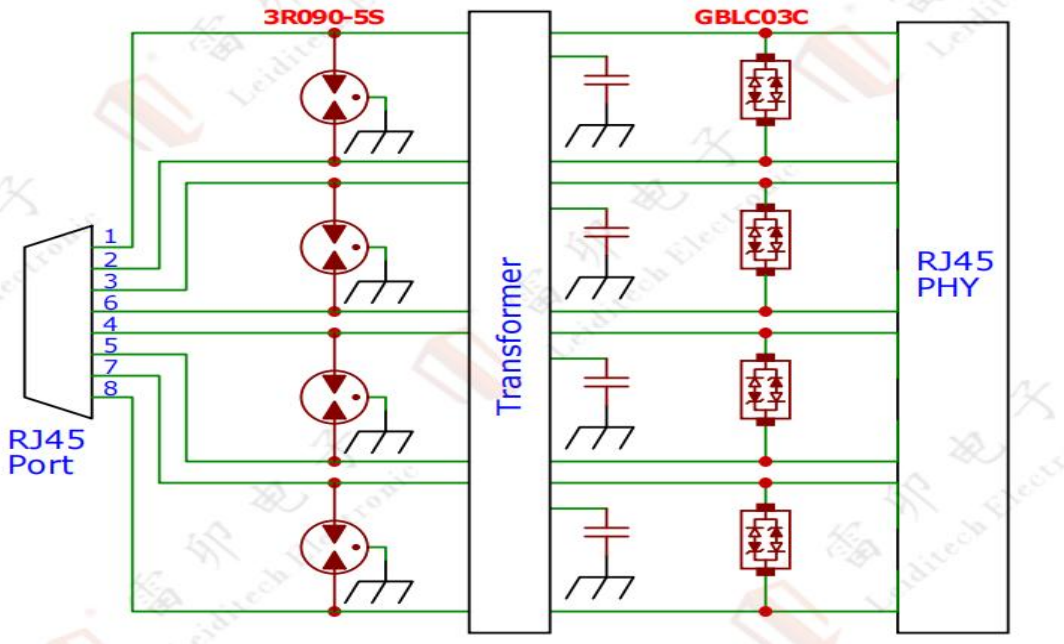
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2.3 Gigabit Ethernet Discrete Lightning Protection Scheme

Advantages of the Solution: For outdoor Gigabit Ethernet port (1000M) surge protection, this solution employs a two-stage protection system for reliable operation, ensuring signal integrity at high temperatures, and meeting IEC61000-4-2 Level 4 standards with contact discharge ratings of 30kV and air discharge ratings of 30kV. It also conforms to IEC61000-4-5 with a 10/700μs waveform, 40Ω impedance, 6kV voltage rating, and ±5 pulses. This solution ensures no packet loss during high-temperature transmission.



Part Number	Description	IPP	Channels	Shape	Packaging
GBLC03C	3.3V,Bi, 0.6 PF ±30kV(air), ±30kV(contact)	20A	1		SOD-323
GDT 3R090-5S	90V Bi 1.5PF	5KA	2		Three Poles D=5MM

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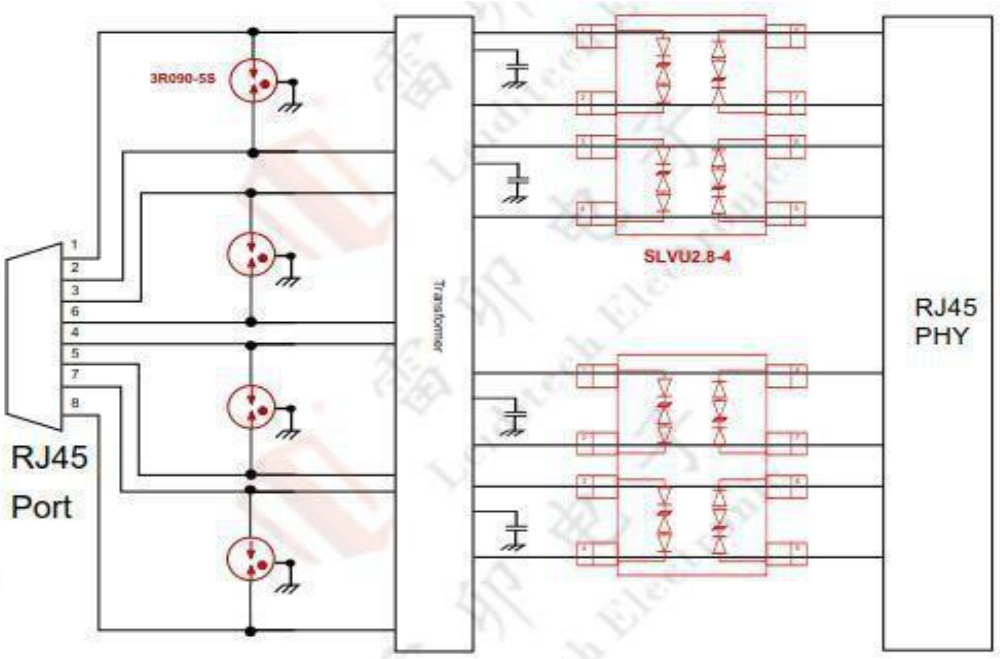
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2.4 Gigabit Ethernet Integrated Lightning Protection Scheme

Advantages of the Solution: For outdoor Gigabit Ethernet port (1000M) surge protection, this solution employs a two-stage protection system for reliable operation, ensuring signal integrity at high temperatures, and meeting IEC61000-4-2 Level 4 standards with contact discharge ratings of 30kV and air discharge ratings of 30kV. It also conforms to IEC61000-4-5 with a 10/700μs waveform, 40Ω impedance, 6kV voltage rating, and ±5 pulses.



Part Number	Description	IPP	Channels	Shape	Packaging
SLVU2.8-4	2.8V,Bi, 2 PF ±30kV(air), ±30kV(contact)	30A	4		SOP-08
GDT 3R090-5S	90V Bi 1.5PF	5KA	2		Three Poles D=5MM

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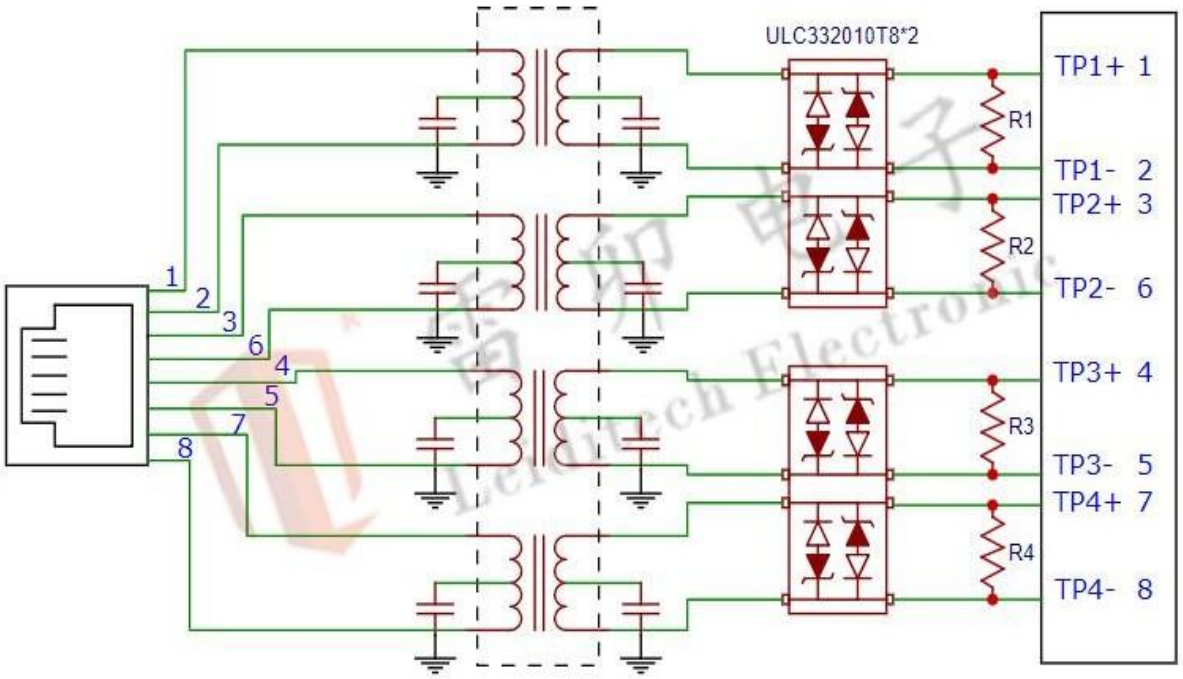
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2.5.1 Gigabit Ethernet Small Size ESD Protection Scheme

Advantages of the Solution: For Ethernet port ESD protection, this solution uses integrated multi-channel devices to ensure signal integrity, save space, and meet IEC61000-4-2 Level 4 standards with contact discharge ratings of 30kV and air discharge ratings of 30kV.



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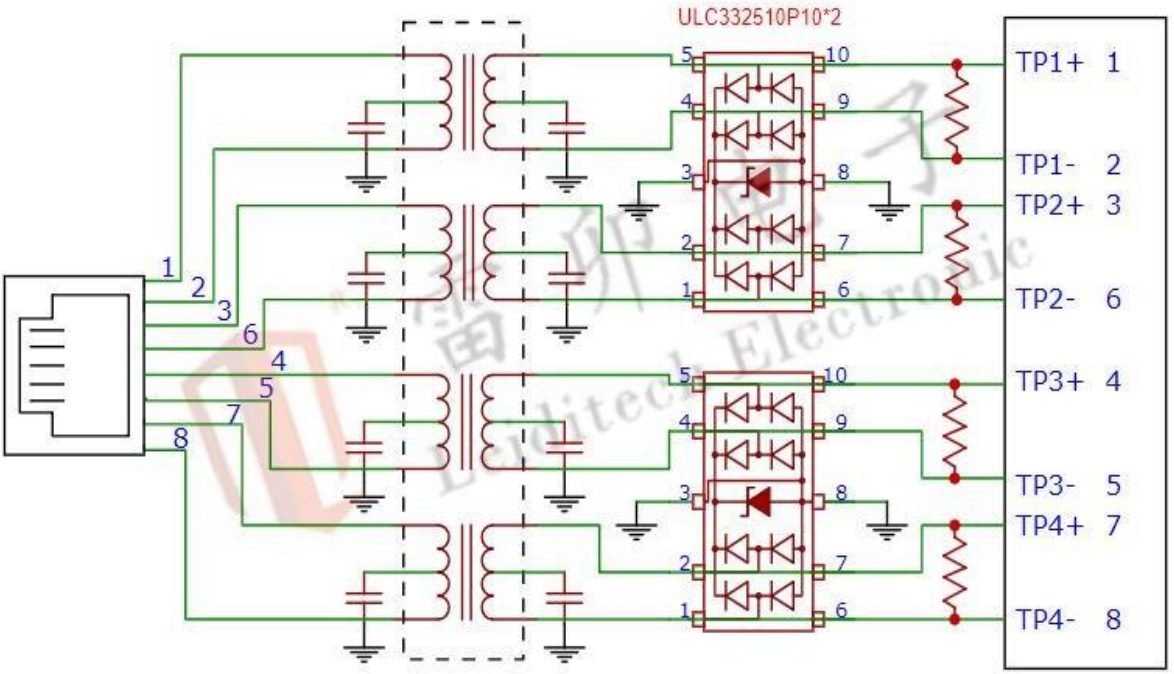
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2.5.1 Gigabit Ethernet Small Size ESD Protection Scheme



In the component ULC332510P10, pins 6, 7, 9, and 10 are left unconnected (no-load). There are direct connections between the following pin pairs: pins 5 and 10, pins 4 and 9, pins 2 and 7, and pins 1 and 6.

Part Number	Description	IPP	Channels	Shape	Packaging
ULC332010T8	3V, 0.6PF ±30 kV(air), ±30 kV(contact)	3A	4		DFN2010T8
ULC332510P10	3.3V, 0.6PF ±30 kV(air), ±25 kV(contact)	5A	4		DFN2510P10

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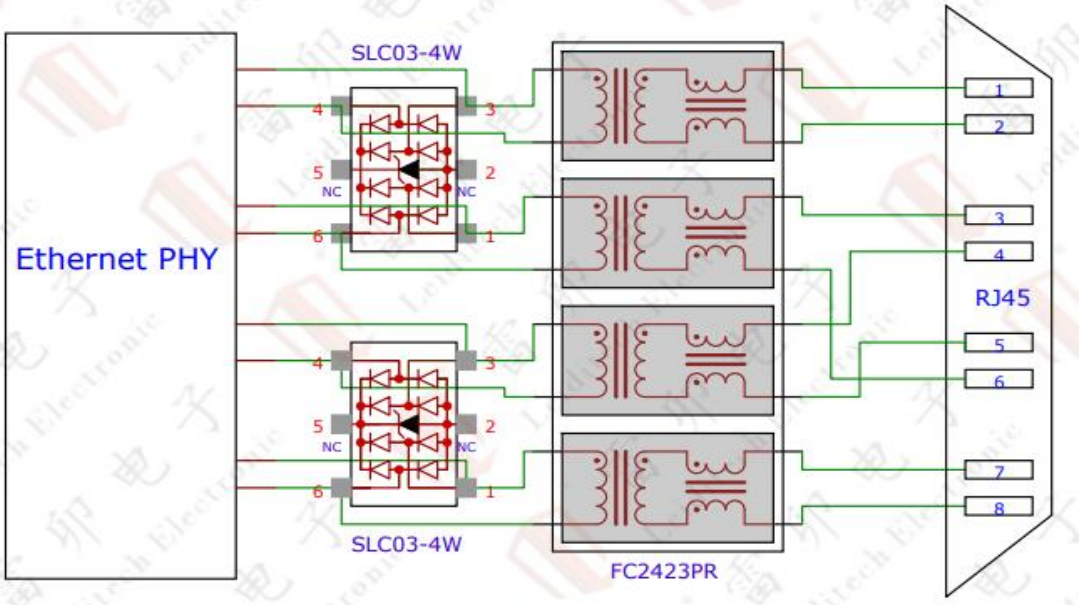
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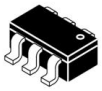
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2.5.2 Gigabit Ethernet 3.3V Low Residual Voltage High Current Integrated Protection Scheme

Advantages of the scheme: ESD protection features: Gigabit Ethernet port ESD protection using multiple integrated components with high ESD protection, small size, low capacitance. Ensures signal integrity, meeting the following standards:
IEC61000-4-2 (ESD) ±30kV (air), ±30kV (contact)
IEC61000-4-4 (EFT) 40A (5/50ns)
IEC61000-4-5 (Lightning) 32A (8/20μs)
Network transformer features: compact, low height, inductance factor 1:1, open inductance: 350uH; insertion loss: -1.1 dB Max, DC resistance 1.3Ω.



Part Number	Description	IPP	Channels	Shape	Packaging
SLC03-4W	3.3V,Uni，2PF ±30kV(air), ±30kV(contact)	32A	5		SOT-26

Part Number	Description	Rate	Voltage Rating	Shape	Packaging
FC2423PR	Single Gigabit PortPairing（±5%）: 1CT:1CT	1000Base-T	AC1500V		Ultra-thin SOP-24

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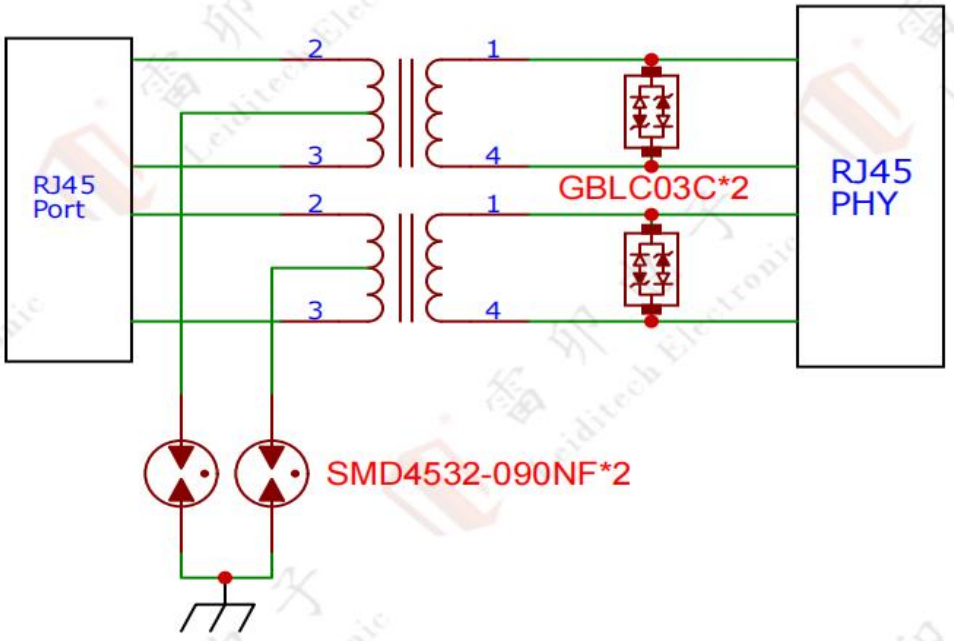
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2.6 100M Network Split Type Lightning Protection Solution

Advantages: Used for the 100M network port lightning protection outdoors. This solution adopts a two-stage protection with reliable operation, ensuring the integrity of signals under high temperatures, meeting IEC61000-4-2, Level 4, contact discharge 30kV, air discharge 30kV. IEC61000-4-5 10/700μs, 40Ω, 6kV, ±5 times, the 100M network port can be expanded to 4 ports.



Part Number	Description	IPP	Channels	Shape	Packaging
GBLC03C	3.3V,Bi，0.6PF ±30kV(air), ±30kV(contact)	20A	1		SOD-323
SMD4532-090NF	90V Bi 1PF	2KA	1		SMD1812

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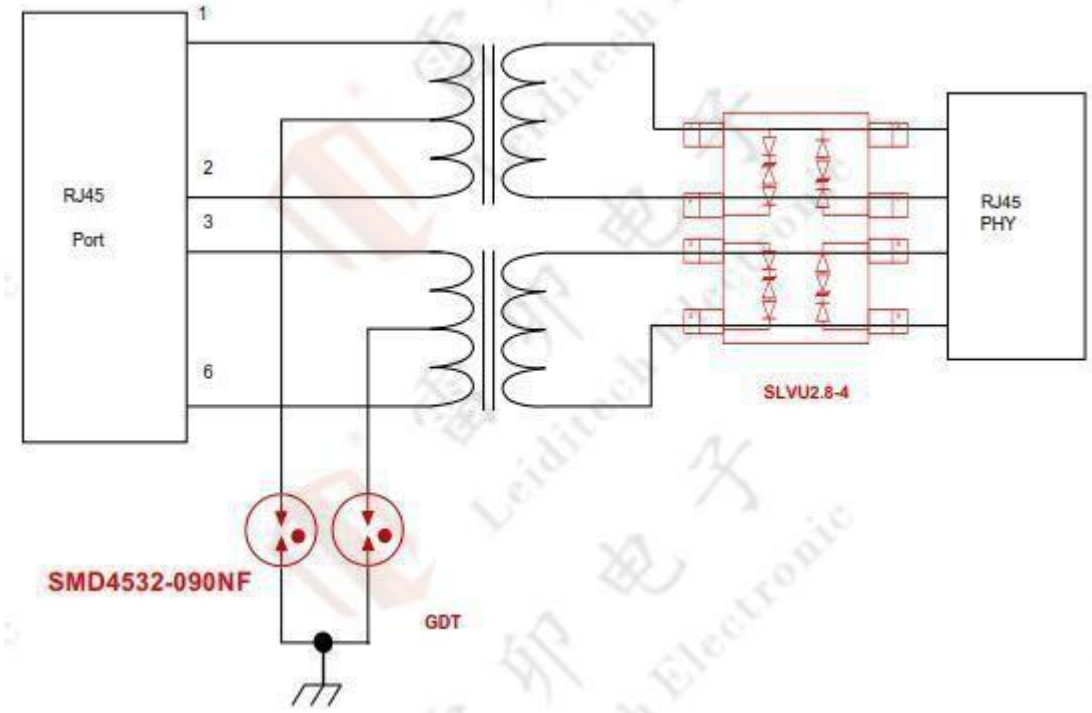
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2.7 100M Network Integrated Lightning Protection Solution

Advantages: Used for the 100M network port lightning protection outdoors. This solution adopts a two-stage protection with reliable operation, ensuring the integrity of signals under high temperatures, meeting IEC61000-4-2, Level 4, contact discharge 30kV, air discharge 30kV. IEC61000-4-5 10/700μs, 40Ω, 6kV, ±5 times.



Part Number	Description	IPP	Channels	Shape	Packaging
SLVU2.8-4	2.8V,Bi, 2 PF ±30kV(air), ±30kV(contact)	30A	4		SOP-08
SMD4532-090NF	90V Bi 1PF	2KA	1		SMD 1812

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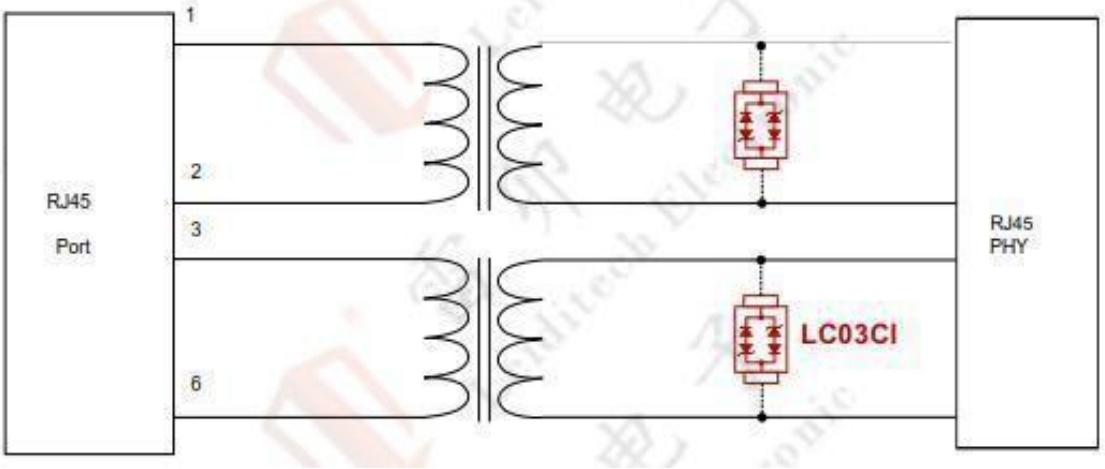
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2.8 100M Network Split Type ESD Protection Solution

Advantages: Used for the 100M network port ESD protection indoors. This solution adopts a two-device protection, saving space and ensuring the integrity of the signal, meeting IEC61000-4-2, Level 4, contact discharge 30kV, air discharge 30kV.



Part Number	Description	IPP	Channels	Shape	Packaging
LC03CI	3.3V,Bi, 1PF ±30kV(air), ±30kV(contact)	16A	1		SOD-323

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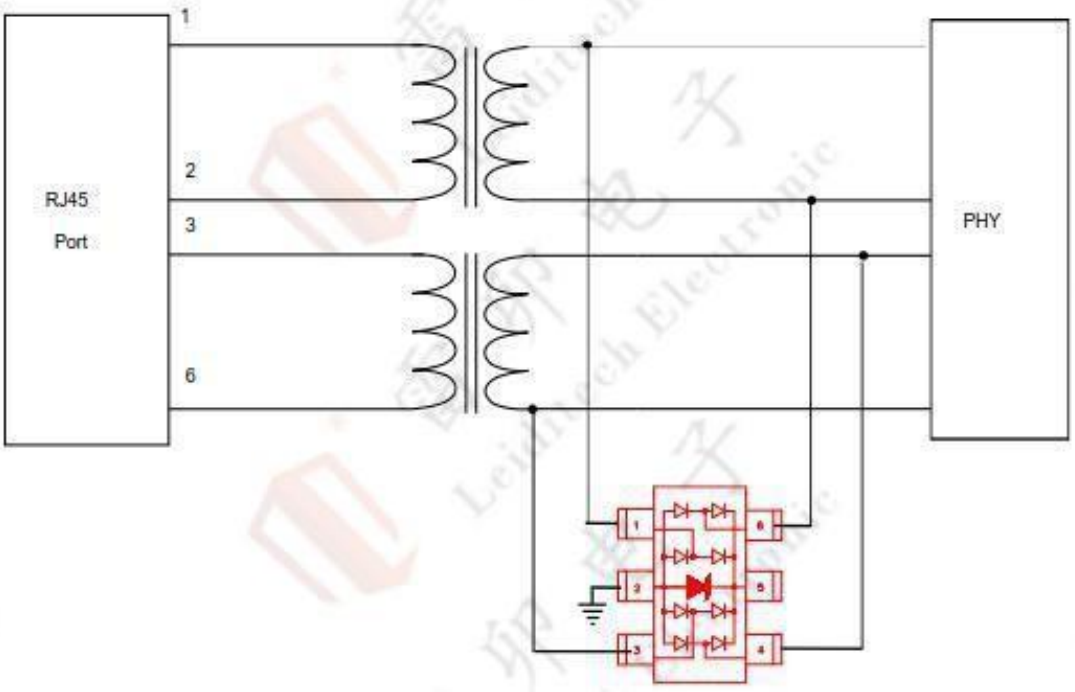
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2.9 100M Network Integrated ESD Protection Solution

Advantages: Used for the 100M network port ESD protection indoors. This solution adopts a single-device protection, saving space and ensuring the integrity of the signal, meeting IEC61000-4-2, Level 4, contact discharge 8kV, air discharge 15kV.



Part Number	Description	IPP	Channels	Shape	Packaging
USRV05-4	5V,Uni, 0.7PF ±15kV(air), ±8kV(contact)	5A	4		SOT-26

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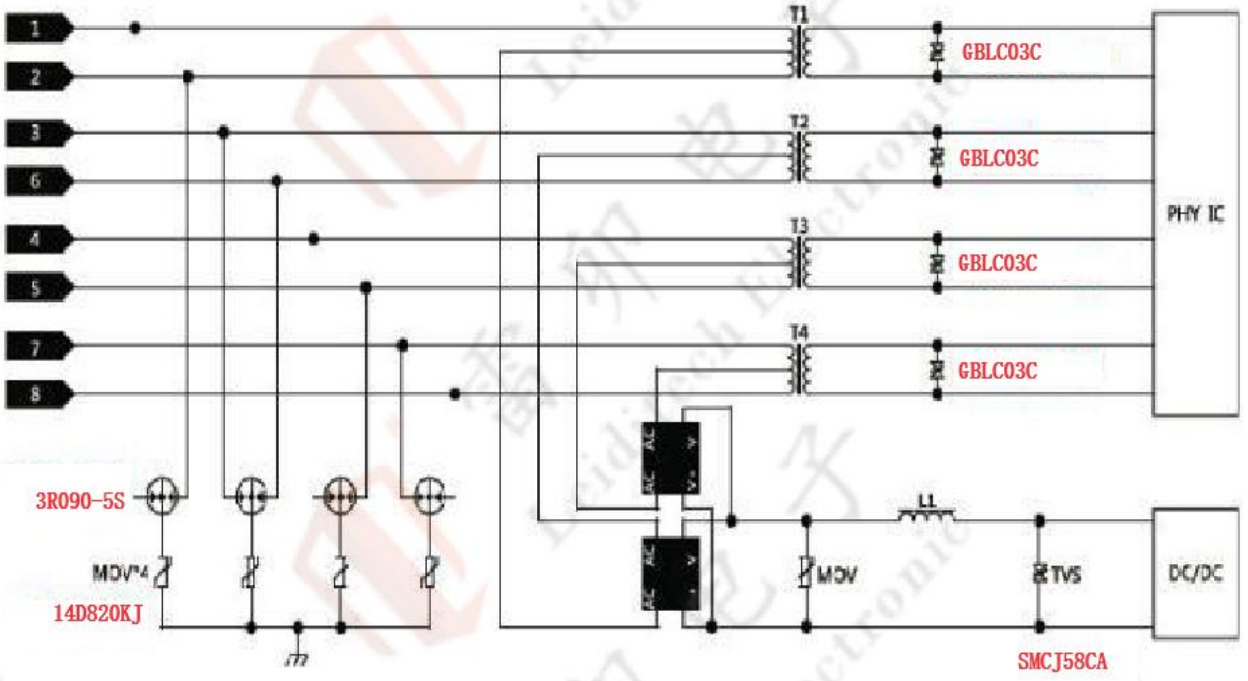
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2.10.1 POE Outdoor Lightning Protection 6KV Solution

Solution Advantages: Designed for outdoor POE network port surge protection, this solution adopts secondary protection, ensuring reliable operation. It guarantees the signal integrity at high temperatures, meets IEC61000-4-2, Level 4 standards, with a contact discharge of 30kV and air discharge of 30kV. IEC61000-4-5 standard testing: 10/700μs, 40Ω, 6kV, ±5 times. This solution ensures that the high-temperature transmission is lossless.

Solution



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2.10.1 POE Outdoor Lightning Protection 6KV Solution

Part Number	Description	IPP	Channels	Shape	Packaging
GBLC03C	3.3V,Bi, 0.6 PF ±30kV(air), ±30kV(contact)	20A	1		SOD-323
GDT 3R090-5S	90V Bi 1.5PF	5KA	2		Three Poles D=5MM
14D820KJ	Varistor Voltage82V	6KA	1		14D
SMCJ58CA	58V Bi,1.5KW	16.1A	1		DO-214AB SMC

Part Number	Description	IPP	Channels	Shape	Packaging
SLVU2.8-4	2.8V,Bi, 12PF ±30kV(air), ±30kV(contact)	30A	4		SOP-8
GDT 3R090-5S	90V Bi 1.5PF	5KA	2		Three Poles D=5MM

6KV solution 2

Solution Advantages: After rectifying the 48V voltage, this solution uses only one high-power TVS (Transient Voltage Suppressor) LM1K58CC to protect the DC to DC converter at the output, eliminating the need for the MOV (Metal Oxide Varistor) and inductor L1 from Solution 1, saving space and cost.

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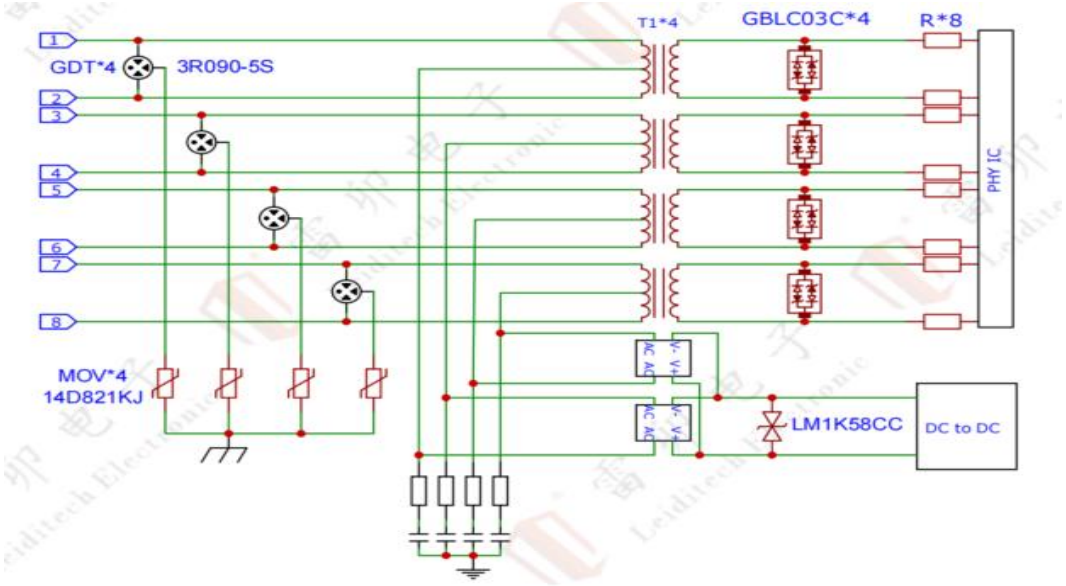
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2.10.1 POE Outdoor Lightning Protection 6KV Solution



Part Number	Description	IPP	Channels	Shape	Packaging
GBLC03C	3.3V,Bi, 0.6 PF ±30kV(air), ±30kV(contact)	20A	1		SOD-323
GDT 3R090-5S	90V Bi 1.5PF	5KA	2		Three Poles D=5MM
14D820KJ	Varistor Voltage82V	6KA	1		14D
LM1K58CC	58V Bi 2KV(8/20us)	-	1		DO-214AB SMC

Part Number	Description	IPP	Channels	Shape	Packaging
SLVU2.8-4	2.8V,Bi, 2PF ±30kV(air), ±30kV(contact)	30A	4		SOP-8
GDT 3R090-5S	90V Bi 1.5PF	5KA	2		Three Poles D=5MM

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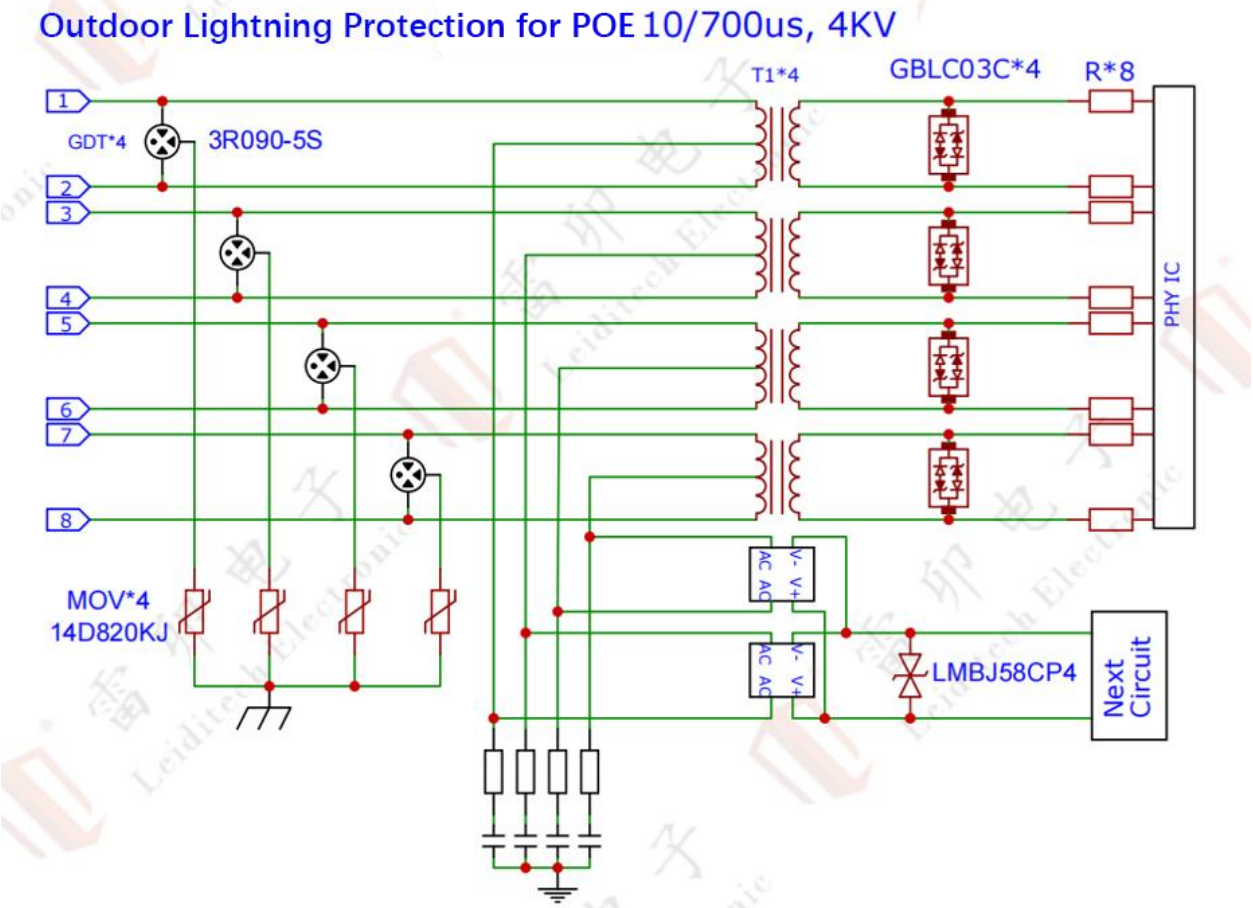
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2.10.2 POE Outdoor 4KV Lightning Protection Scheme

Advantage: This plan is designed for surge protection of POE network ports used outdoors. It adopts a secondary protection approach that ensures reliable operation, maintains signal integrity at high temperatures, and meets the IEC61000-4-2 standard, level 4, with a contact discharge rating of 30kV and air discharge rating of 30kV. The plan also complies with the IEC61000-4-5 standard (10/700μs, 40Ω, 4kV, ±5 times), using LMBJ58CP4 specifically designed for POE 48V power supply, ensuring high-temperature transmission without packet loss.



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2.10.2 POE Outdoor 4KV Lightning Protection Scheme

Part Number	Description	IPP	Channels	Shape	Packaging
GBLC03C	3.3V,Bi, 0.6 PF ±30kV(air), ±30kV(contact)	20A	1		SOD-323
GDT 3R090-5S	90V Bi 1.5PF	5KA	2		Three Poles D=5MM
14D820KJ	Varistor Voltage82V	6KA	1		14D
LMBJ58CP4	58V Bi,3KW	50A	1		DO-214AA SMB

Part Number	Description	IPP	Channels	Shape	Packaging
SLVU2.8-4	2.8V,Bi, 2PF ±30kV(air), ±30kV(contact	30A	4		SOP-8
GDT 3R090-5S	90V Bi 1.5PF	5KA	2		Three Poles D=5MM

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2.11 POE Power Supply Surge Protection Scheme

Plan Application Background: As POE applications become more widespread, long cables may bring induced surge risks, necessitating that designed products comply with the IEC 61000-4-5 standard.

Plan Advantage: The scheme uses SM15T68CA, which can withstand a clamping voltage of 68V, ensuring stable 48V power supply and appropriate filtering. It guarantees instantaneous voltage control on PCB boards, passing the IEC61000-4-5 surge standard's level 4 test, 8/20μs, 42Ω, 4kV, ±10 times.

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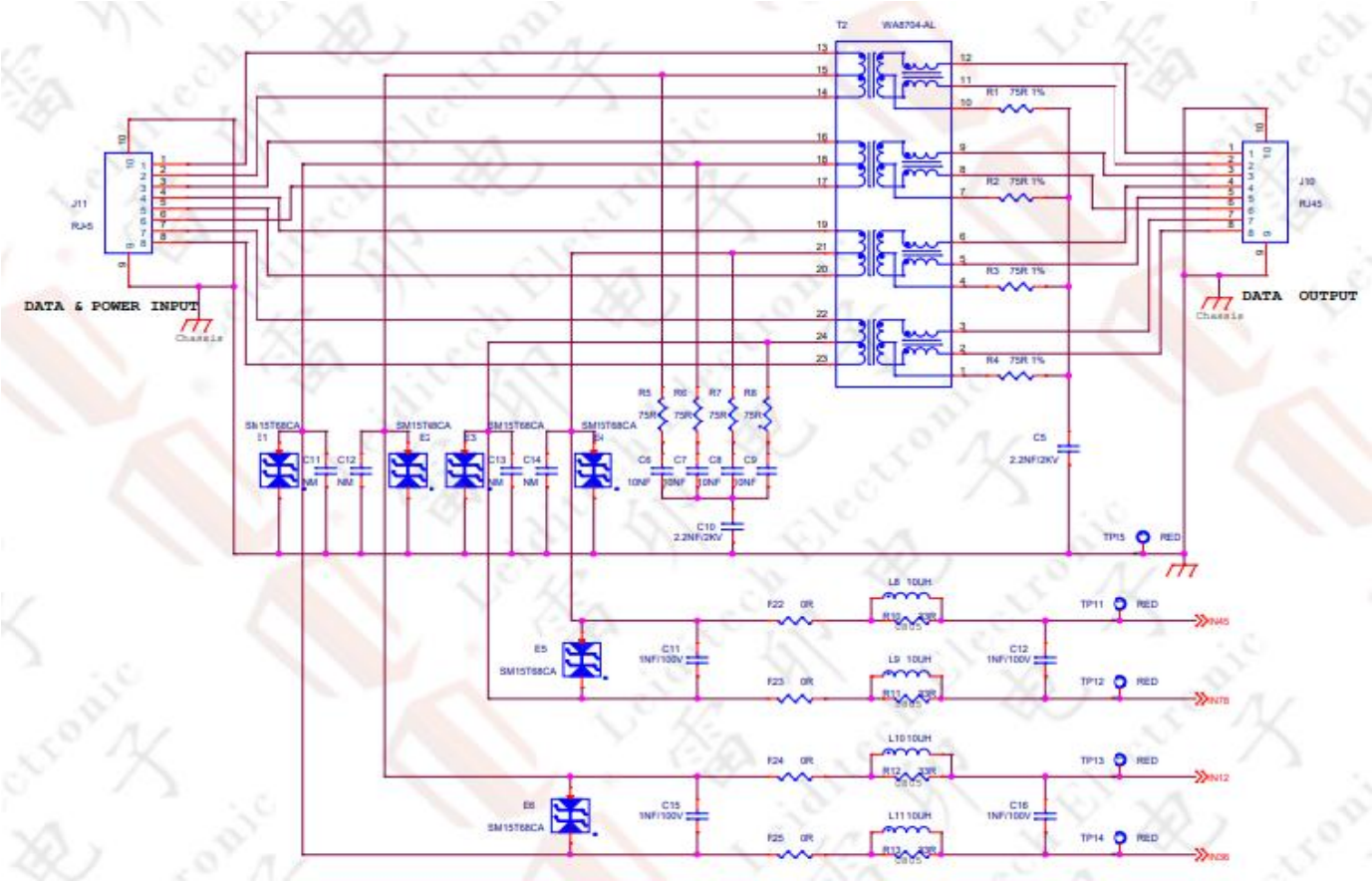
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2.11 POE Power Supply Surge Protection Scheme



Part Number	Description	IPP	Channels	Shape	Packaging
SM15T68CA	V_{RWM}，58V V_C, 103V $V_{BR\ MAX}$,74.1V	14.6A	1		SMC

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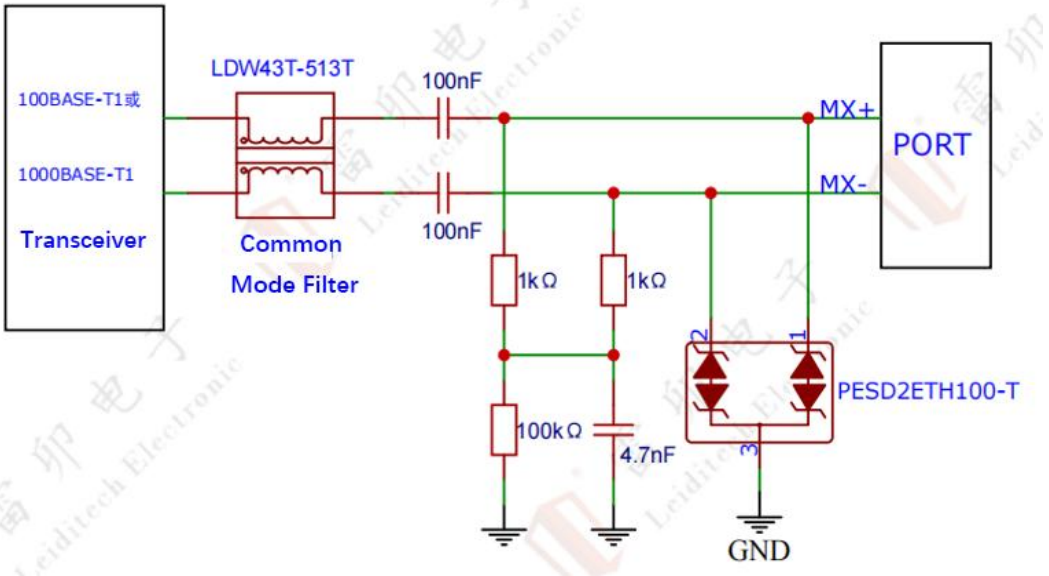
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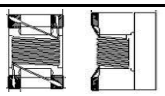
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2.12 In-vehicle Ethernet Protection Scheme

Advantage: LeiDitech provides a protection scheme based on 100BASE-T1 and 1000BASE-T1 development alliance standards, designed to protect against ESD and other transients without compromising the in-vehicle Ethernet system. The ESD device used in this scheme adopts silicon technology, offering higher reliability with a dual-diode capacitance value of 3pF, ensuring signal integrity.



The left-side transceiver contains the PHY along with some basic filtering components and on-chip ESD. CMC is used to reduce common mode. The ESD device PESD2ETH100-T is located near the RJ45 connector, where high ESD currents will be directed to GND, protecting the backend PCB, PHY, and other components.

Part Number	Description	IPP	Channels	Shape	Packaging
PESD2ETH100-T	24V,Bi 3PF 30KV	3A	2		SOT-23
LDW43T-513T	dimensions4.5* 3.2*2.6 2800Ω 51UH	-	-		SMD

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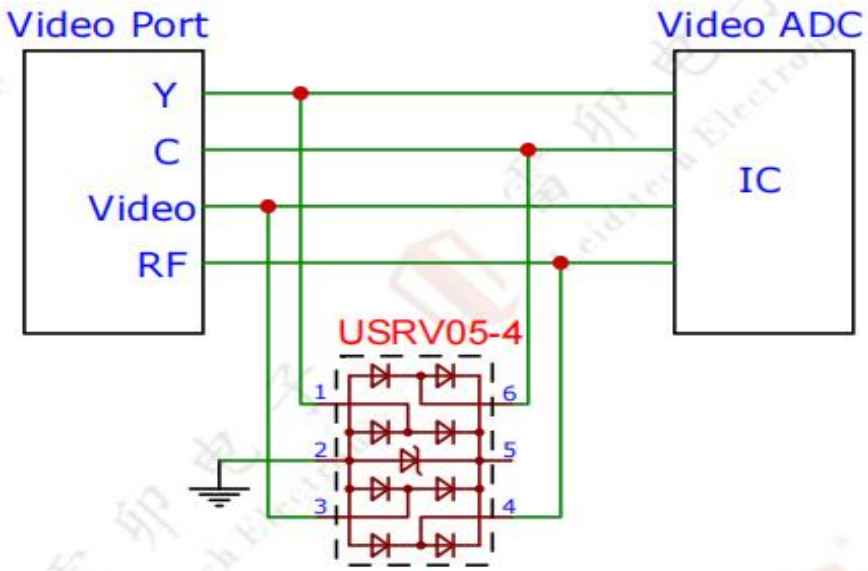
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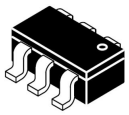
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3.1 Analog Video Interface ESD Protection Solution

Advantages of the solution: For analog video with a maximum transmission speed of <5Mbit/s, ordinary low-capacitance devices can be used for ESD protection. It meets the IEC61000-4-2, Level 4 standard, with contact discharge of 20kV and air discharge of 20kV. A single-channel 0402 packaged device can be selected.



Part Number	Description	IPP	Channels	Shape	Packaging
USRV05-4	5V,Uni, 0.5PF ±20kV(air), ±20kV(contact)	5A	4		SOT-23-6
ULC0542C	5V Bi 0.3PF ±25kV(air), ±22kV(contact)	4A	1		DFN1006-2

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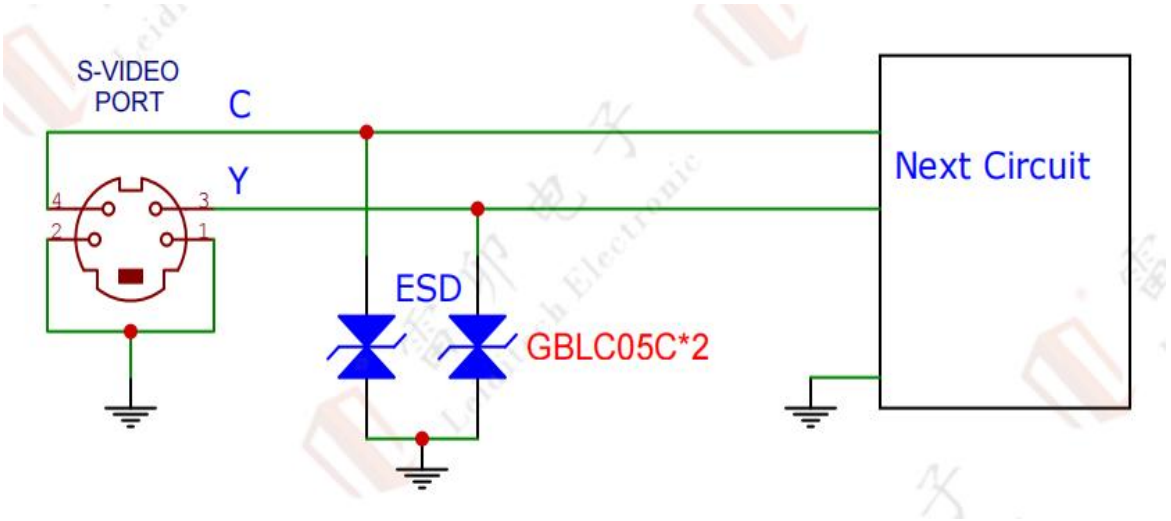
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3.2 S-VIDEO Interface Electrostatic Surge Protection Solution

Solution 1: Discrete Component GBLC05C Solution .

Advantages of the solution: This solution uses ESD diodes GBLC05C for surge protection of the S-VIDEO interface. The discrete components are SOD-323 packaged, facilitating wiring. It has low capacitance, high IPP current of 18A, ensuring complete signal integrity while providing certain surge protection. It complies with the IEC61000-4-2 (ESD) ±30kV (air) and ±30kV (contact) standards, offering strong ESD protection.



Part Number	Description	IPP	Channels	Shape	Packaging
GBLC05C	5V,Bi 0.6PF ±30kV(air), ±30kV(contact)	18A	1		SOD-323

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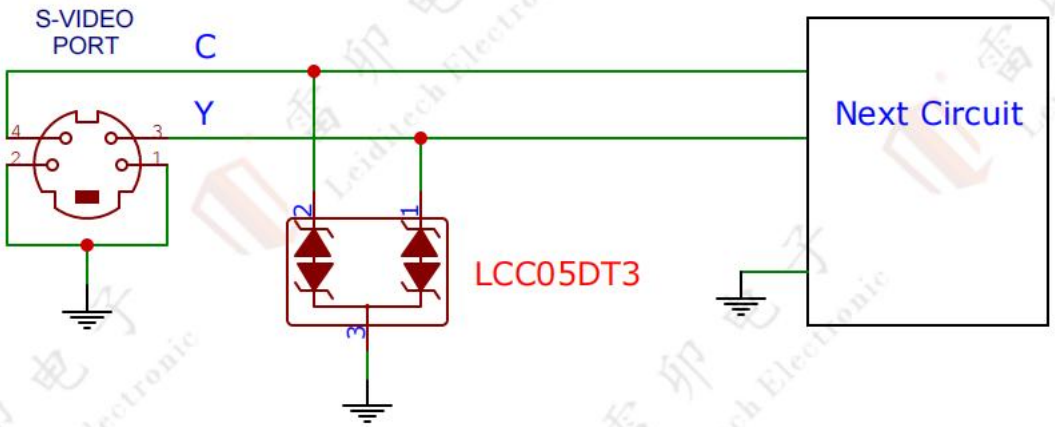
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3.2 S-VIDEO Interface Electrostatic Surge Protection Solution

Solution 2: Integrated Component LCC05DT3 Solution.
Advantages of the solution: This solution uses ESD diodes LCC05DT3 for surge protection of the interface. The integrated component is SOT-23 packaged, saving space, with low capacitance and high IPP current of 12A. It ensures complete signal integrity while providing certain surge protection. It meets the IEC61000-4-2 (ESD) ±30kV (air) and ±30kV (contact) standards, offering strong ESD protection capability.



Part Number	Description	IPP	Channels	Shape	Packaging
LCC05DT3	5V,Bi 1.2PF ±30kV(air), ±30kV(contact)	12A	2		SOT-23

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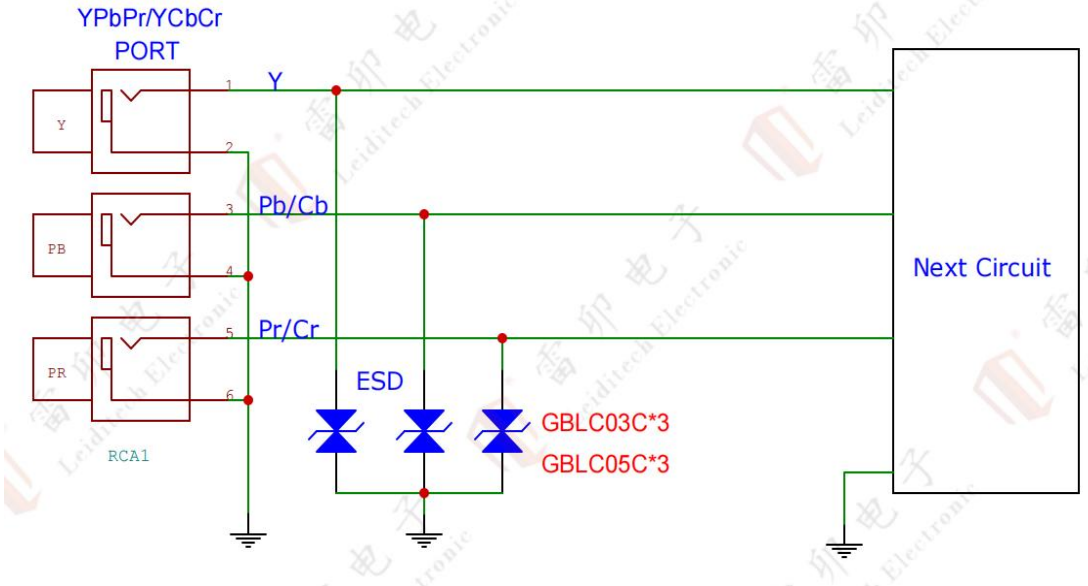
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3.3 YPbPr/YCbCr Interface Electrostatic Surge Protection Solution

Solution 1: Discrete Component Solution GBLC03C/GBLC05C

Advantages of the Solution: This solution uses three discrete ESD diodes to complete the electrostatic surge protection of the interface, facilitating wiring, with low junction capacitance and a large IPP of 20A/18A. It ensures the integrity of the signal transmission while providing a certain degree of surge protection. The ESD resistance complies with IEC 61000-4-2 (Electrostatic Discharge) ±30kV (air) and ±30kV (contact) standards.



Part Number	Description	IPP	Channels	Shape	Packaging
GBLC03C	3.3V,Bi 0.6PF ±30kV(air), ±30kV(contact)	20A	1		SOD-323
GBLC05C	5V,Bi 0.6PF ±30kV(air), ±30kV(contact)	18A	1		SOD-323

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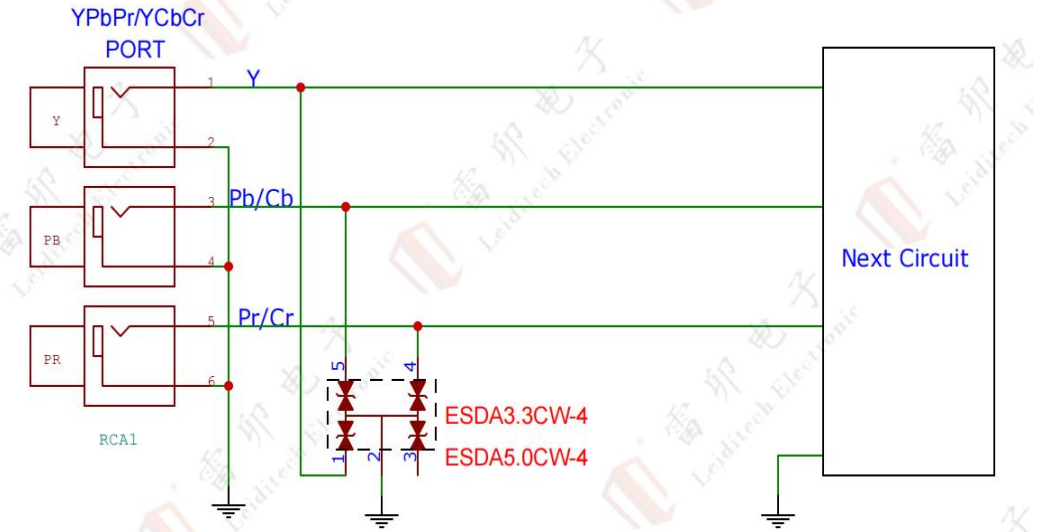
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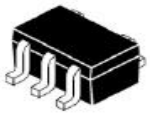
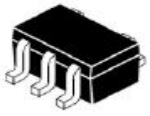
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3.3 YPbPr/YCbCr Interface Electrostatic Surge Protection Solution

Solution 2: Integrated Component Solution ESDA3.3CW-4/ESDA5.0CW-4. Advantages of the Solution: The solution employs a single integrated ESD (Electrostatic Discharge) diode to complete the electrostatic surge protection of the interface, saving space, with low junction capacitance, and a large IPP (Peak Pulse Current) of 10A/7A. It ensures the integrity of the signal transmission while providing a certain degree of surge protection. The ESD resistance complies with IEC 61000-4-2 (Electrostatic Discharge) ±30kV (air) and ±30kV (contact) standards.



Part Number	Description	IPP	Channels	Shape	Packaging
ESDA3.3CW-4	3.3V,Bi 15PF ±30kV(air), ±30kV(contact)	10A	4		SOT-353
ESDA5.0CW-4	5V,Bi 12PF ±30kV(air), ±30kV(contact)	7A	4		SOT-353

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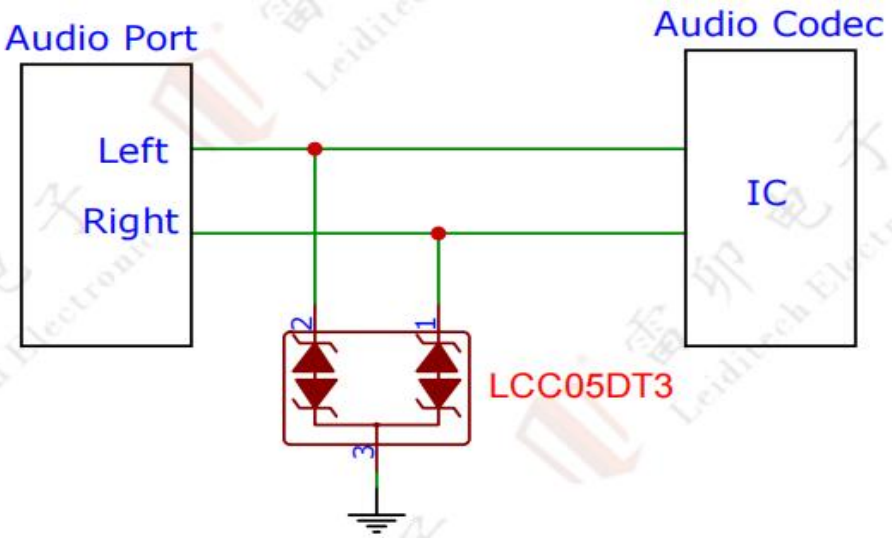
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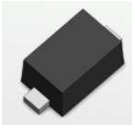
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3.4 Analog Audio Interface Electrostatic Protection Solution

Advantages of the Solution: This solution uses the LCC05DT3, a low junction capacitance two-channel integrated ESD protection device, which saves space, or employs single-channel ULC0542C, ESDA05CTL, ESD5Z5CL, and other packaged protection devices to provide protection, meeting IEC61000-4-2, Level 4 standards.



Part Number	Description	IPP	Channels	Shape	Packaging
LCC05DT3	5V,Bi, 1.2PF ±30kV(air), ±30kV(contact)	12A	2		SOT-23
ULC0542C	5V Bi 0.3PF ±25kV(air), ±22kV(contact)	4A	1		DFN1006-2
ESDA05CTL	5V Bi 5PF ±15kV(air), ±8kV(contact)	5A	1		SOD-523
ESD5Z5CL	5V Bi 0.35PF ±20kV(air), ±15kV(contact)	4A	1		

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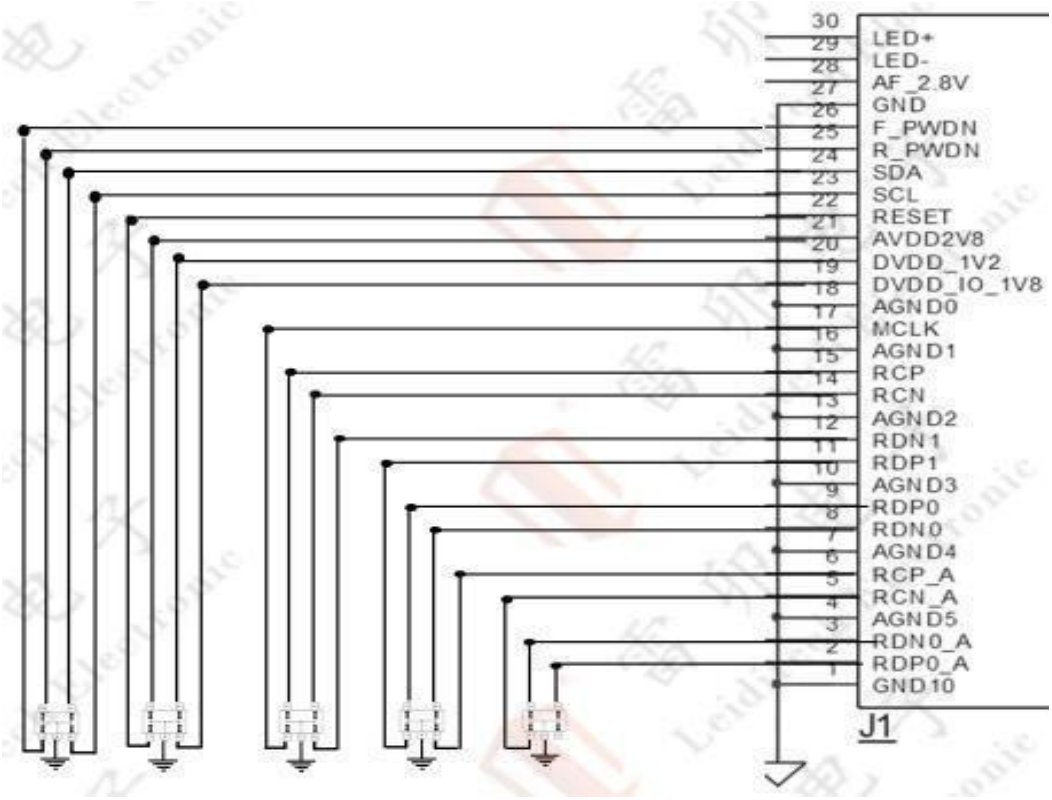
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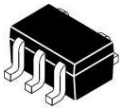
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4.1 Low-Speed MIPI Screen ESD Protection Solution

Advantages: The MIPI screen has a large number of interfaces, with voltages as low as 3.3V. This solution requires ordinary low-capacitance integrated components for ESD protection. It meets the requirements of IEC61000-4-2, Level 4, with contact discharge of 8kV and air discharge of 15kV. Single-channel 0402 packaged components can be used for flexible PCB design.



Part Number	Description	IPP	Channels	Shape	Packaging
ESDA3.3CW- 4	3.3V,Bi, 13PF ±15kV(air), ±8kV(contact)	2.5A	4		SOT-353
ESDA33CP	3.3V Bi 8PF ±15kV(air), ±8kV(contact)	4.5A	1		DFN1006-2

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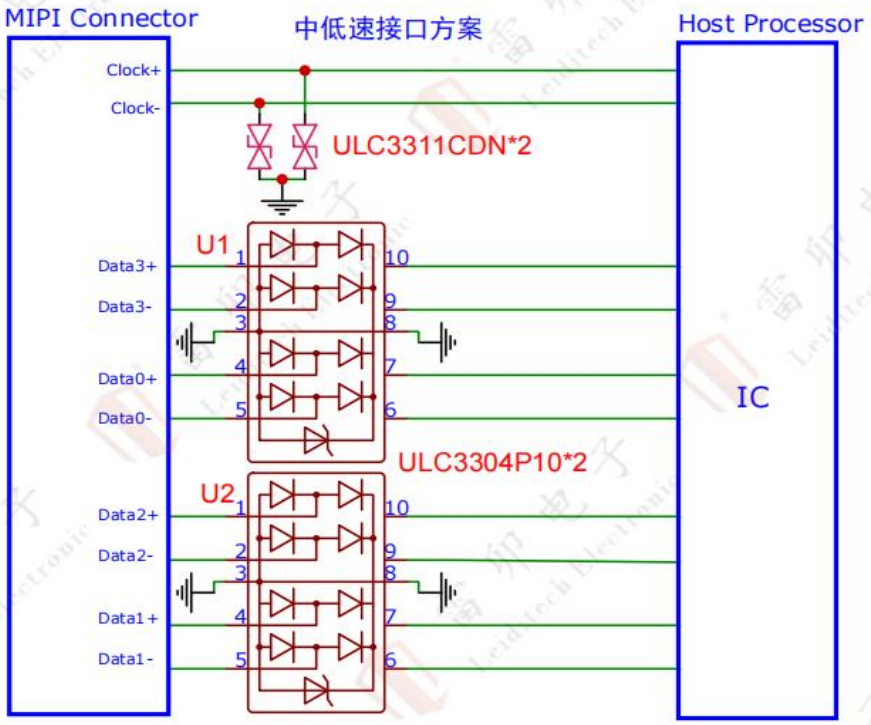
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4.2 Mid-Speed MIPI Interface ESD Protection Solution

Advantages: The MIPI interface offers mid-speed protection solutions (10M-1Gbps). This solution uses integrated components for ESD protection with a parasitic capacitance of less than 1pF, ensuring signal integrity. It meets the requirements of IEC61000-4-2, Level 4, with contact discharge of 8kV and air discharge of 15kV.



* U1,U2 PIN 1-10,2-9,4-7,5-6 芯片内部没有连接，需要外部布线连接

Part Number	Description	IPP	Channels	Shape	Packaging
ULC3304P10	3.3V,Uni，0.6PF ±20kV(air) ,±25kV(contact)	4.5A	4		DFN2510P10
ULC3311CDN	3.3,Bi，0.45PF ±25kV(air), ±20kV(contact)	4A	1		DFN1006

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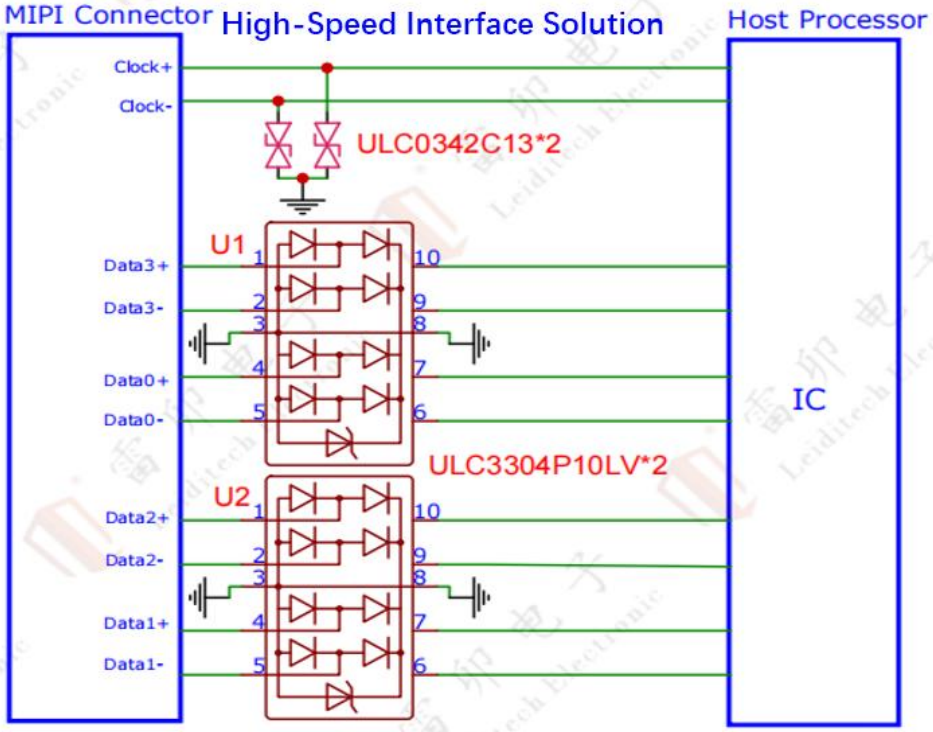
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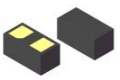
4.3 High-Speed MIPI Interface ESD Protection Solution

Advantages: The MIPI interface offers a transmission speed of 2.5Gbit/s. This solution uses integrated components for ESD protection with parasitic capacitance of less than 0.5pF, ensuring signal integrity. It meets the requirements of IEC61000-4-2, Level 4, with contact discharge of 8kV and air discharge of 15kV.

1.High-speed Interface Protection solution (Above 1Gbps up to 2.5Gbps)



For U1 and U2, pins 1 to 10, 2 to 9, 4 to 7, and 5 to 6 are not internally connected within the chip and require external wiring for connection.

Part Number	Description	IPP	Channels	Shape	Packaging
ULC3304P10LV	3.3V, Uni, 0.28PF ±25kV(air), ±20kV(contact)	3A	4		DFN2510P10
ULC0342C13	3.3, Bi, 0.13PF ±20kV(air), ±20kV(contact)	3A	1		DFN1006

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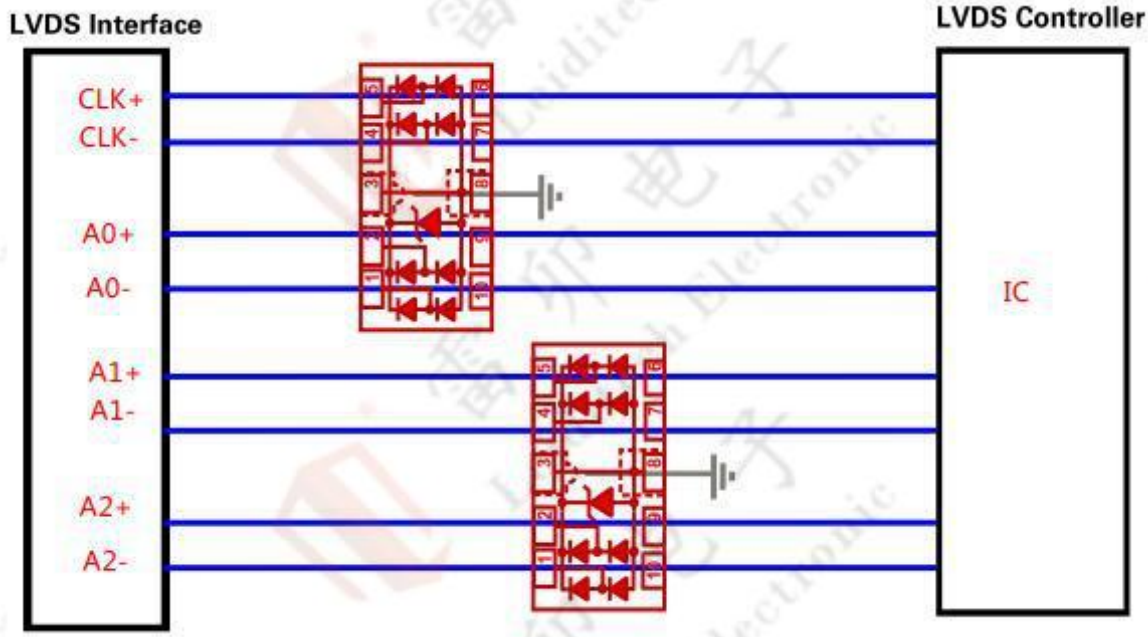
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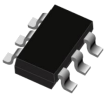
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5.1 LVDS Interface ESD Protection Solution

Advantages: The LVDS interface offers a transmission speed of 655Mbit/s. This solution uses integrated components for ESD protection with a parasitic capacitance of less than 1pF, ensuring signal integrity. It meets the requirements of IEC61000-4-2, Level 4, with contact discharge of 8kV and air discharge of 15kV.



Part Number	Description	IPP	Channels	Shape	Packaging
PUSB3FR4	3.3V,Uni 0.7PF ±15kV(air), ±15kV(contact)	7A	4		DFN2510P10
ULC0524P	5V,Uni，0.8PF ±15kV(air), ±8kV(contact)	5A	4		DFN2510P10
USRV05-4	5,Uni，0.5PF ±15kV(air), ±8kV(contact)	5A	5		SOT-26

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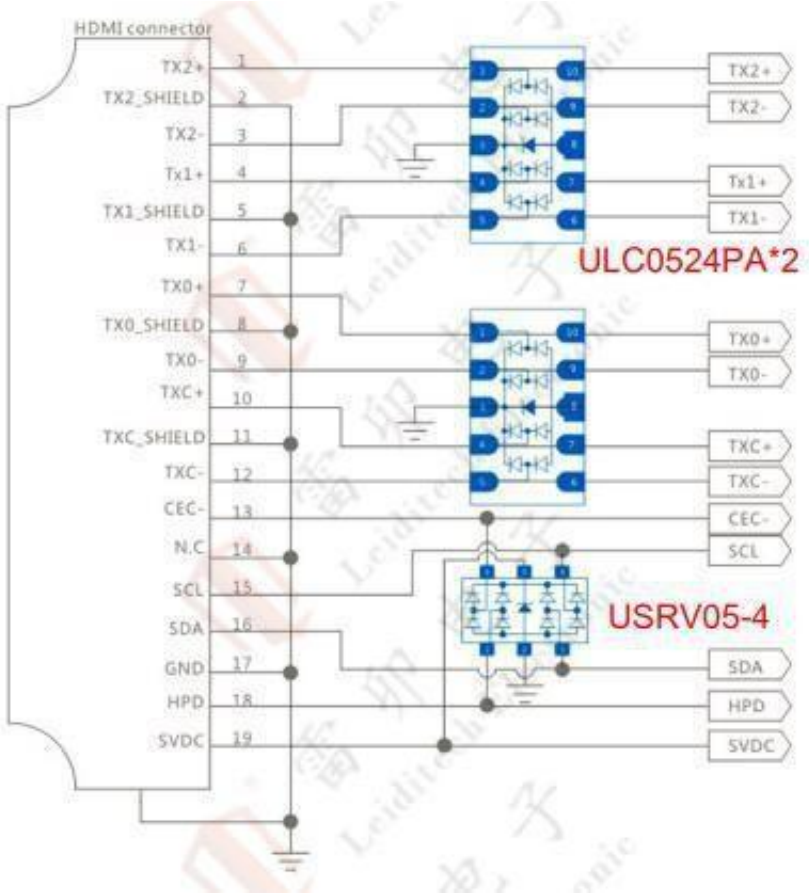
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6.1 HDMI2.0 Interface Electrostatic Protection Solution



Part Number	Description	IPP	Channels	Shape	Packaging
ULC0524PA	5V,Uni, 0.3PF ±15kV(air), ±8kV(contact)	4A	4		DFN2510P10
USRV05-4	5V,Uni, 0.5PF ±15kV(air), ±8kV(contact)	5A	5		SOT-26

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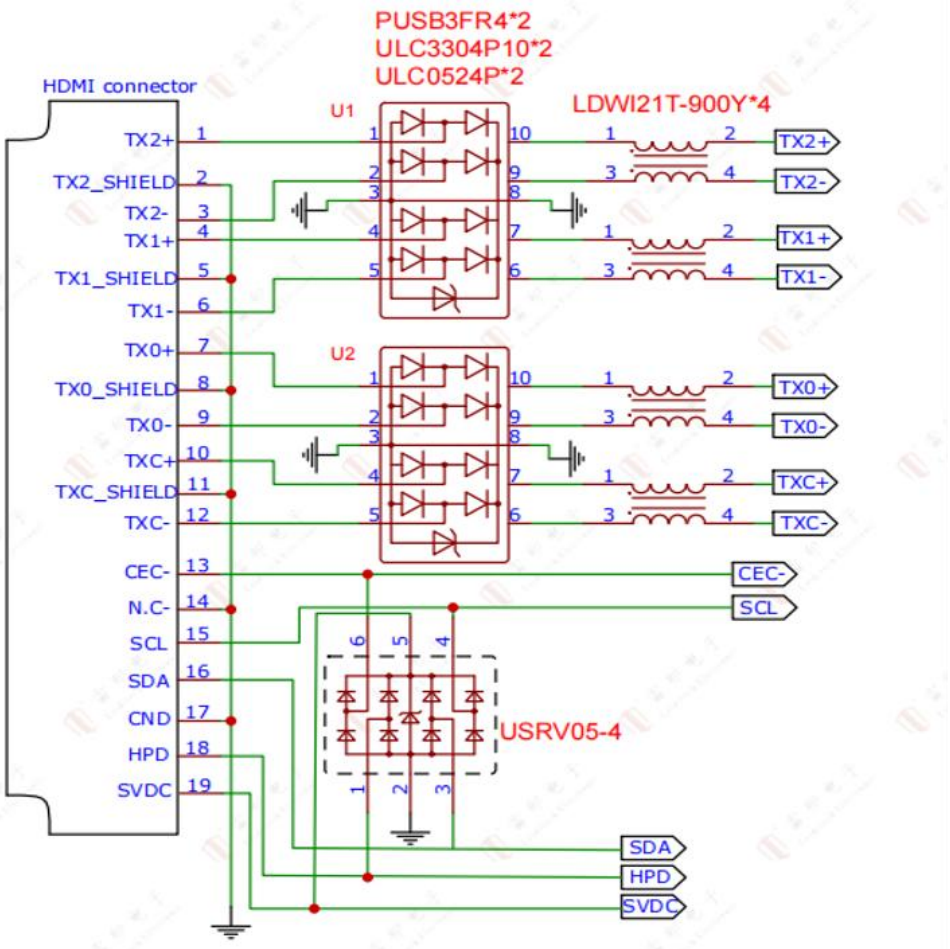
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6.2 HDMI2.0 Interface Electrostatic Filtering Protection Solution

Advantages: For HDMI2.0, this solution uses multi-channel integrated device protection, saving space, ensuring signal integrity, filtering out noise, meeting IEC61000-4-2 (Class 4), with contact discharge at 25kV and air discharge at 30kV.



For U1 and U2, pins 1 to 10, 2 to 9, 4 to 7, and 5 to 6 are not internally connected within the chip and require external wiring for connection.

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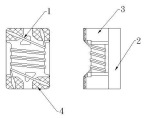
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6.2 HDMI2.0 Interface Electrostatic Filtering Protection Solution

Part Number	Description	IPP	Channels	Shape	Packaging
ULC3304P10	3.3V,Uni, 0.4PF ±30kV(air), ±30kV(contact)	5A	4		DFN2510P10
PUSB3FR4	3.3V,Uni, 0.35PF ±15kV(air),Snap back ±15kV(contact)	7A	4		DFN2510P10
ULC0524P	5V,Uni, 0.8PF ±30kV(air), ±25kV(contact)	5A	4		DFN2510P10
USRV05-4	5V,Uni, 0.5PF ±20kV(air), ±20kV(contact)	5A	5		SOT-26
LDWI21T-900Y	dimensions : 2.05*1.25*1.2mm R: 90Ω	-	-		0805

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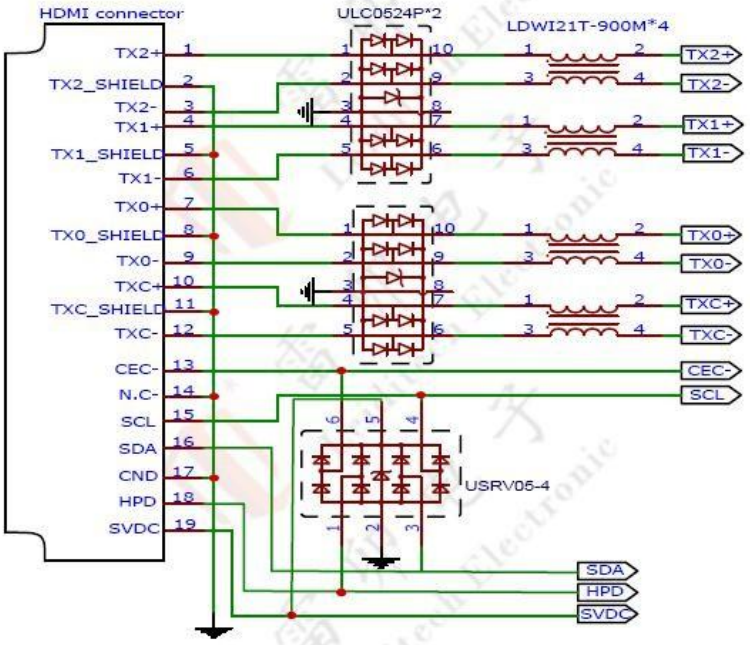
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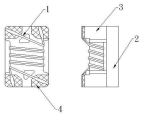
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6.3 HDMI1.3 1.4 Electrostatic Filtering Protection Scheme

Advantages: For HDMI1.3 1.4, this solution uses multi-channel integrated device protection, saving space, ensuring signal integrity, filtering out noise, meeting IEC61000-4-2 (Class 4), with contact discharge at 25kV and air discharge at 30kV.



Part Number	Description	IPP	Channels	Shape	Packaging
ULC0524P	5V,Uni, 0.8PF ±15kV(air), ±8kV(contact)	4A	4		DFN2510P10
USRV05-4	5V,Uni, 0.5PF ±15kV(air), ±8kV(contact)	5A	5		SOT-26
LDWI21T-900Y	dimensions : 2.05*1.25*1.2mm R: 90Ω frequency: 100MHZ	-	-		0805

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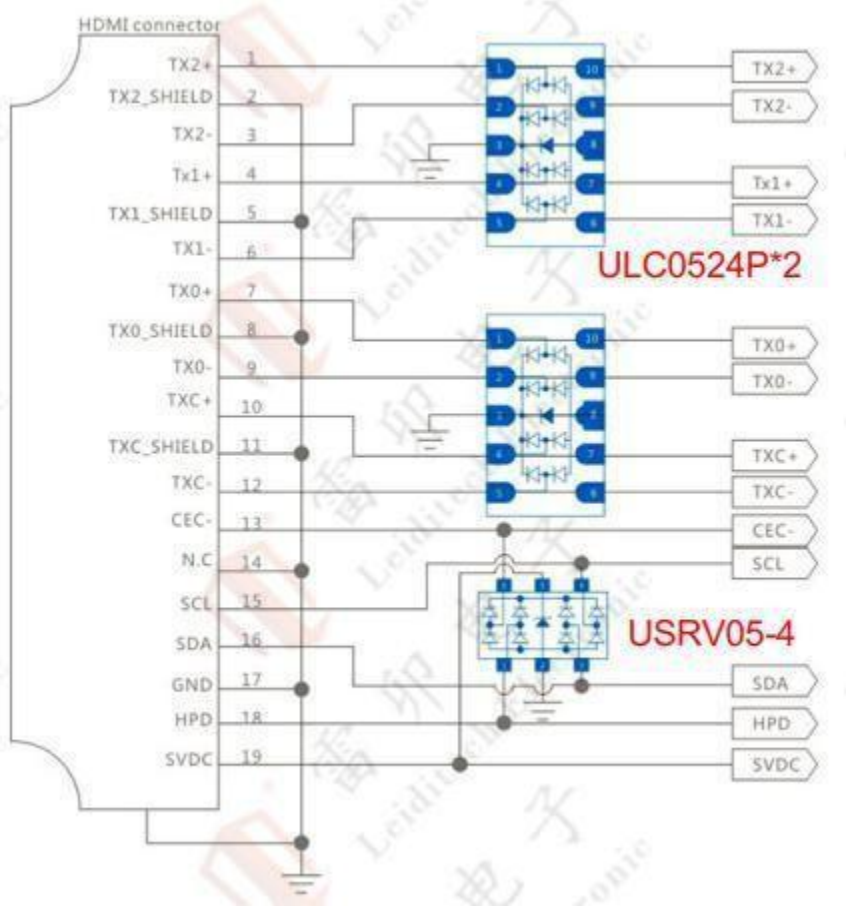
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6.4 HDMI 1.4 Interface Electrostatic Protection Solution



Part Number	Description	IPP	Channels	Shape	Packaging
ULC0524P	5V,Uni, 0.8PF ±15kV(air), ±8kV(contact)	4A	4		DFN2510P10
USRV05-4	5V,Uni, 0.5PF ±15kV(air), ±8kV(contact)	5A	5		SOT-26

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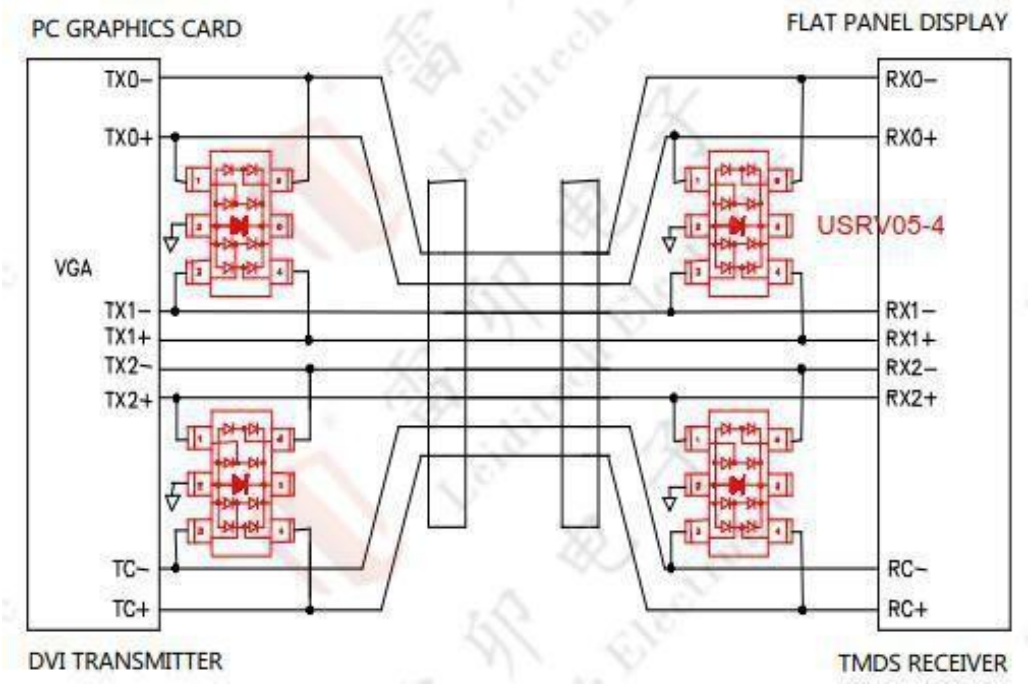
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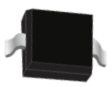
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7.1 DVI Video Interface Electrostatic Protection Solution

Advantages of the solution: This solution uses integrated circuits for protection with a capacitance of less than 2pF, ensuring signal integrity while passing the electrostatic test. It complies with the IEC61000-4-2, level 4 standard, with contact discharge protection of 8kV and air discharge protection of 15kV. The discrete LC05CI component also meets these requirements.



Part Number	Description	IPP	Channels	Shape	Packaging
USRV05-4	5,Uni, 0.5PF ±15kV(air), ±8kV(contact)	5A	5		SOT-26
LC05CI	±5V Bi 1PF ±15kV(air), ±8kV(contact)	20A	1		SOD-323

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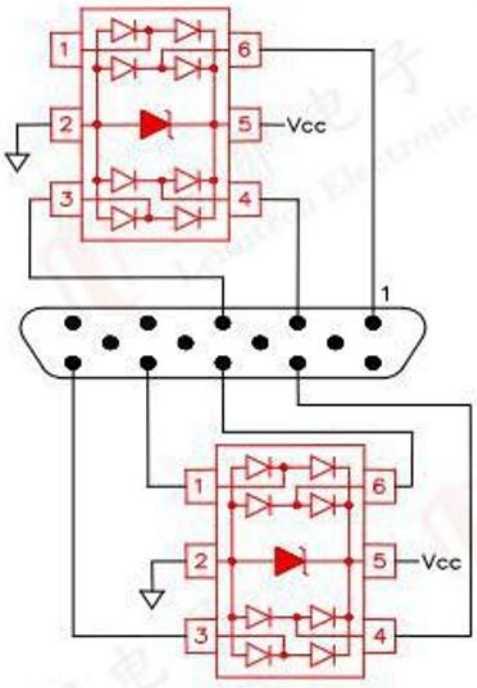
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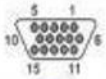
8.1 VGA Video Interface Electrostatic Protection Solution

Solution Advantage: Adopts integrated device protection with capacitance less than 1pf, which can ensure signal integrity while passing the ESD test. It complies with IEC61000-4-2 Level 4 standards, with a contact discharge of 8kV and air discharge of 15kV. The smaller LC0504F package meets the same requirements.

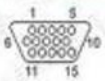




The interface on the graphics card is a 15-pin female connector.



The interface at the display connection end is a 15-pin male connector.



针脚定义:

1	Video-Red
2	Video-Green
3	Video-Blue
4	GND
5	CPU sense
6	GND-R
7	GND-G
8	GND-B
9	No pin present
10	GND-sync/self-raster
11	GND
12	DDC data
13	H-sync
14	V-sync
15	DDC clock

Part Number	Description	IPP	Channels	Shape	Packaging
USRV05-4	5,Uni, 0.5PF ±15kV(air), ±8kV(contact)	5A	5		SOT-26
LC0504F	5V Uni 0.8PF ±15kV(air), ±8kV(contact)	5A	5		SOT-363

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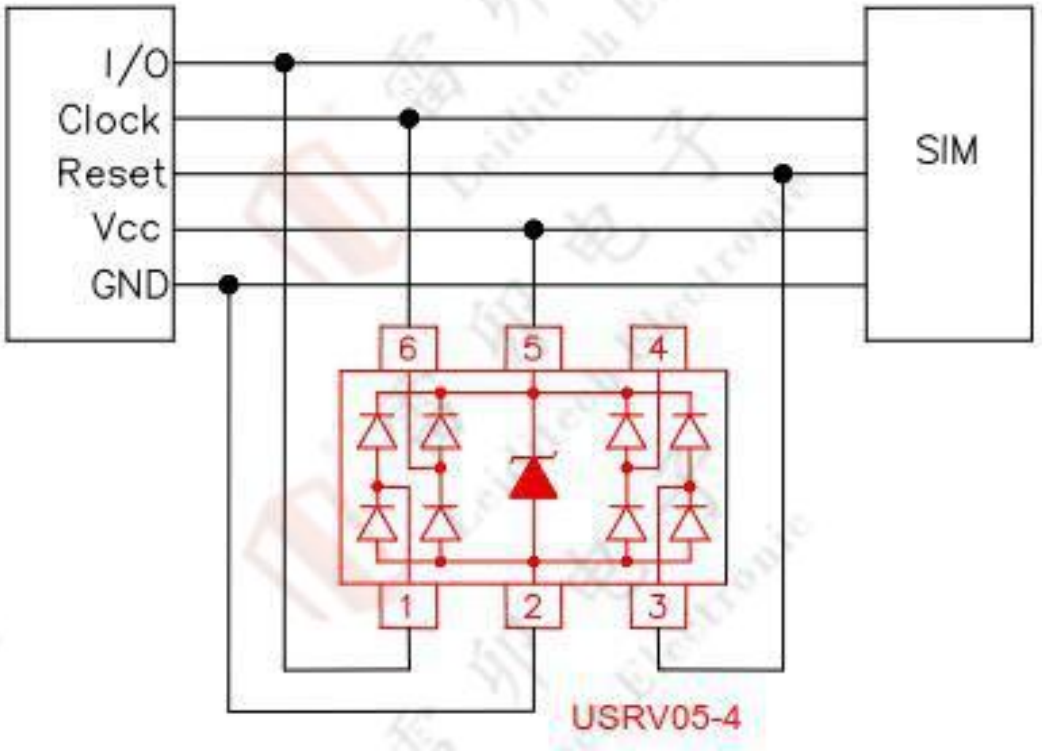
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9.1.1 SIM Card Electrostatic Protection Solution 1

Solution Advantage: The SIM card provides a transmission speed of 7.2Mbps. This solution adopts integrated device protection, saving space, ensuring signal integrity, and complying with IEC61000-4-2 Level 4 standards, with a contact discharge of 8kV and air discharge of 15kV.



Part Number	Description	IPP	Channels	Shape	Packaging
USRV05-4	5,Uni，0.5PF ±15kV(air), ±8kV(contact)	5A	5		SOT-26

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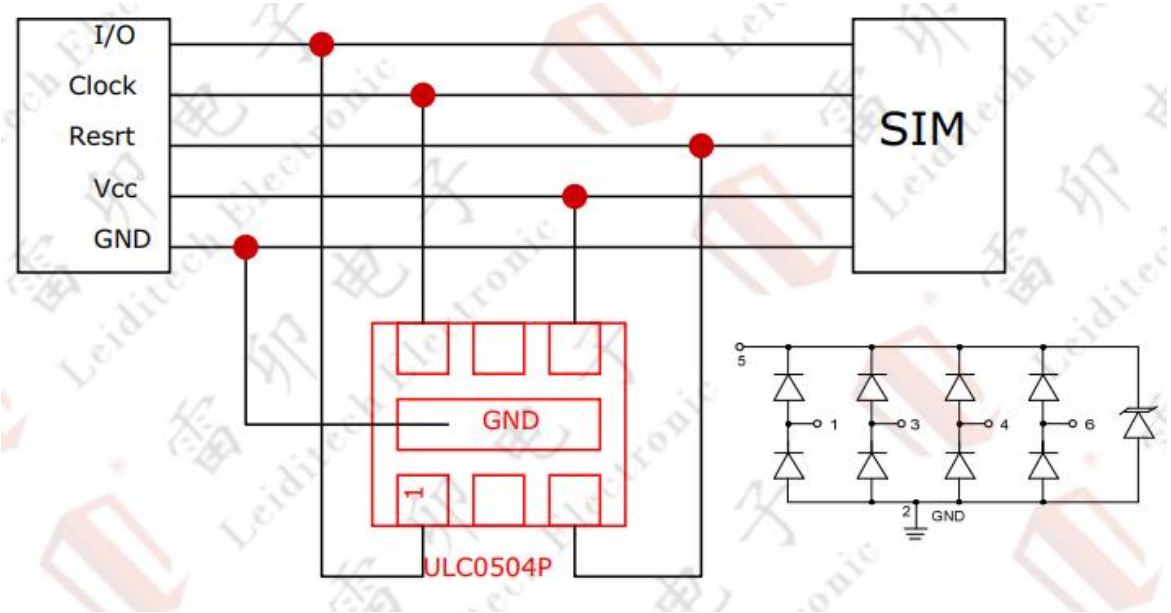
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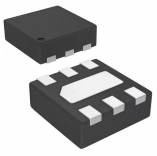
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9.1.2 SIM Card Electrostatic Protection Solution 2

Solution Advantage: The SIM card provides a transmission speed of 7.2Mbps. This solution adopts integrated device protection, saving space, ensuring signal integrity, and complying with IEC61000-4-2 Level 4 standards, with a contact discharge of 8kV and air discharge of 15kV.



Part Number	Description	IPP	Channels	Shape	Packaging
ULC0504P	5,Uni，0.4PF ±18kV(air), ±15kV(contact)	5A	5		DFN1616-6

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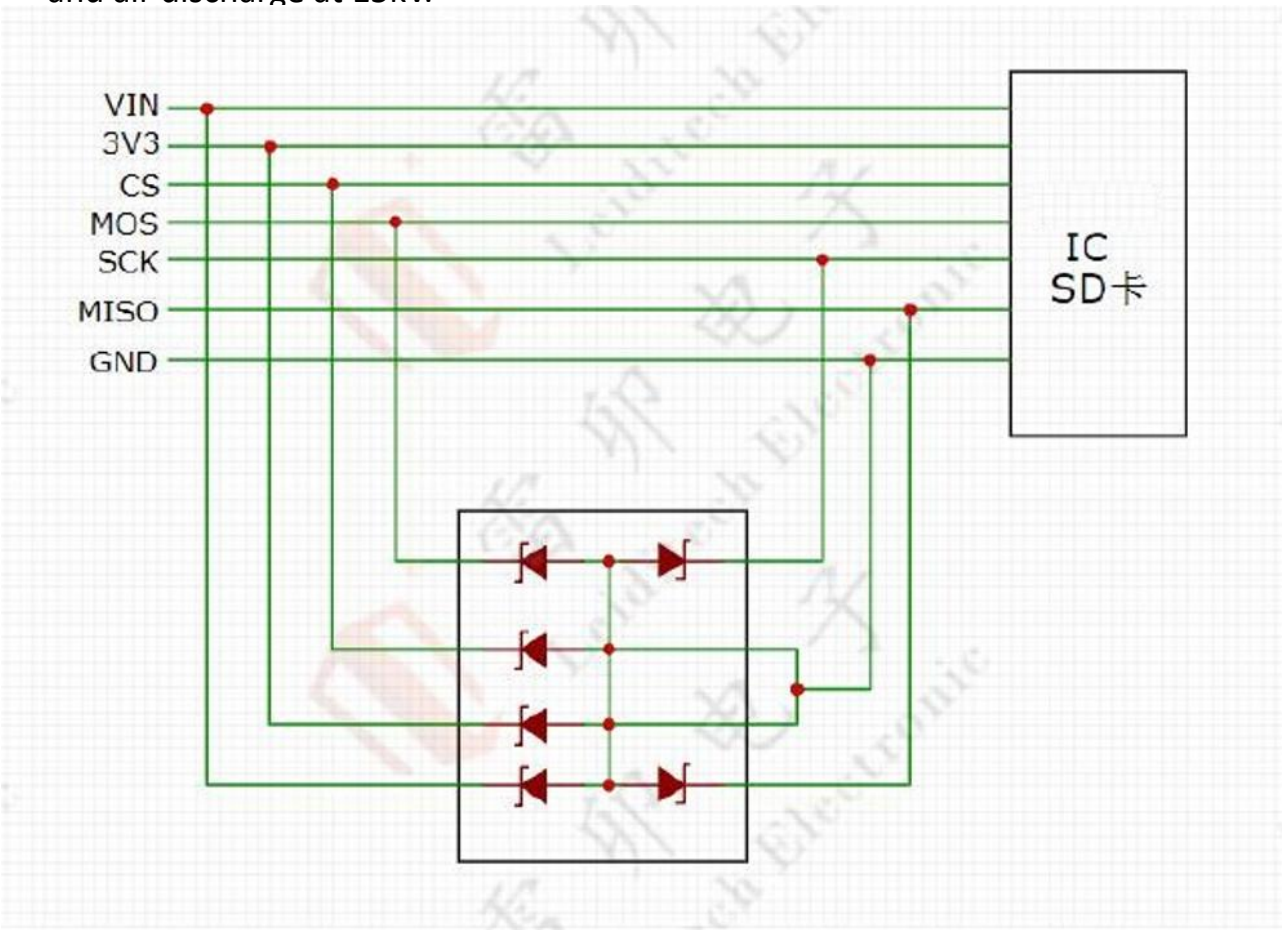
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9.2 SD Card SPI Mode Electrostatic Protection Scheme

Advantages: This solution uses integrated devices for protection, with a capacitance of 8pF, ensuring signal integrity while passing ESD testing. It meets the IEC61000-4-2, ISO10605-2, Level 4 standards with contact discharge at 8kV and air discharge at 15kV.



Part Number	Description	IPP	Channels	Shape	Packaging
ESD0506M8	8,Uni, 8PF ±15kV(air), ±8kV(contact)	2A	8		TSSOP-8

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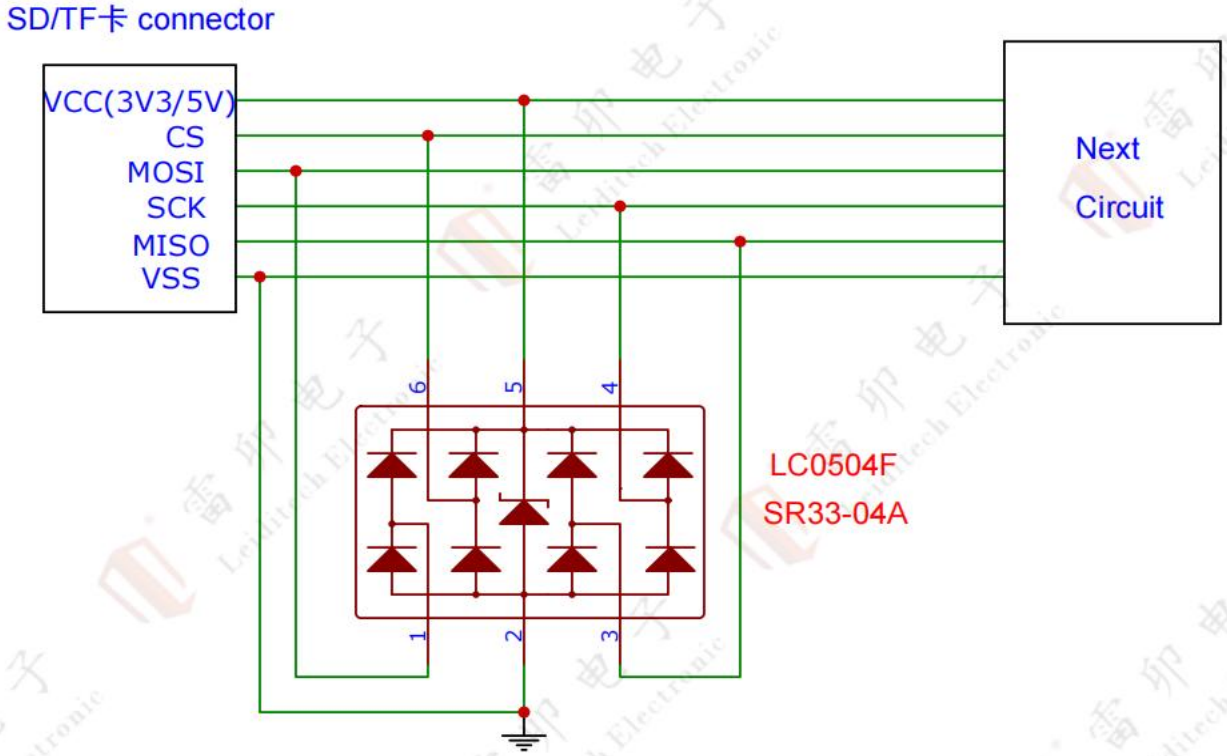
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9.2.1 SD Card Electrostatic Protection Scheme (Low Capacitance)

Advantages: This solution uses integrated devices for protection, with a capacitance of less than 1pF, ensuring signal integrity while passing ESD testing. It meets the IEC61000-4-2, ISO10605-2, Level 4 standards with contact discharge at 8kV and air discharge at 15kV.



Part Number	Description	IPP	Channels	Shape	Packaging
LC0504F	5V,Uni, 0.8PF ±15kV(air), ±8kV(contact)	5A	5		SOT-363
SR33-04A	3.3V,Uni,0.6PF ±20kV(air), ±20kV(contact)	11A	5		SOT-23-6

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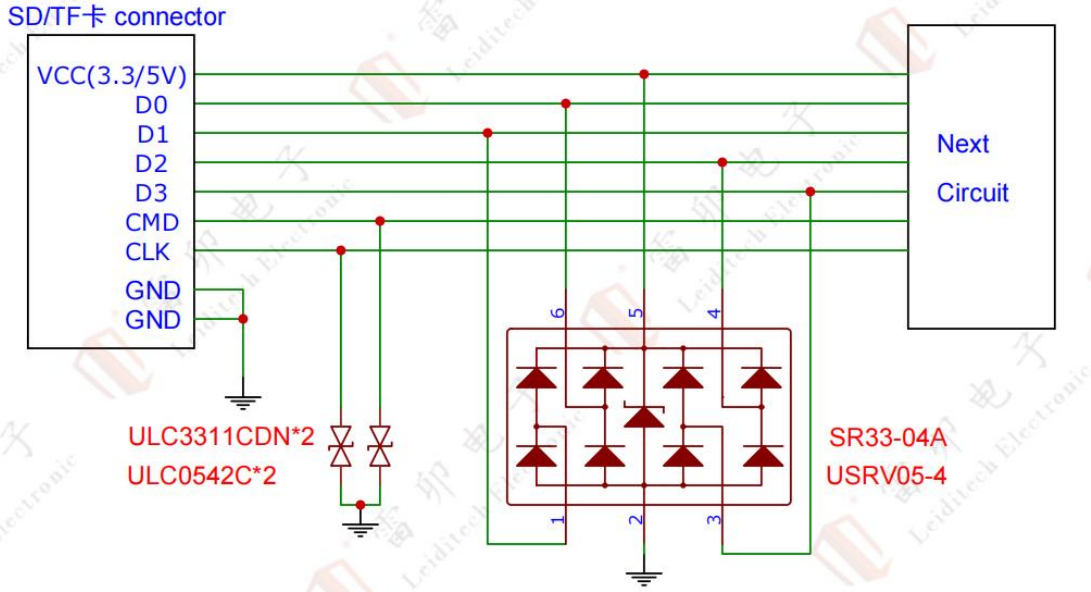
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9.2.2 SD/TF Card SD Mode Electrostatic Protection Scheme

Advantages: This solution uses integrated devices for protection, with a capacitance of less than 1pF, ensuring signal integrity while passing ESD testing. It meets the IEC61000-4-2, ISO10605-2, Level 4 standards with contact discharge at 8kV and air discharge at 15kV.



Part Number	Description	IPP	Channels	Shape	Packaging
USRV05-4	5V,Uni，0.6PF ±20kV(air), ±15kV(contact)	4.5A	5		SOT-23-6
SR33-04A	3.3V,Uni,0.6PF ±20kV(air), ±20kV(contact)	11A	5		SOT-23-6
ULC0542C	5V,Uni，0.3PF ±25kV(air), ±22kV(contact)	4A	1		DFN1006
ULC3311CDN	3.3V,Bi，0.45PF ±25kV(air), ±20kV(contact)	4A	1		DFN1006

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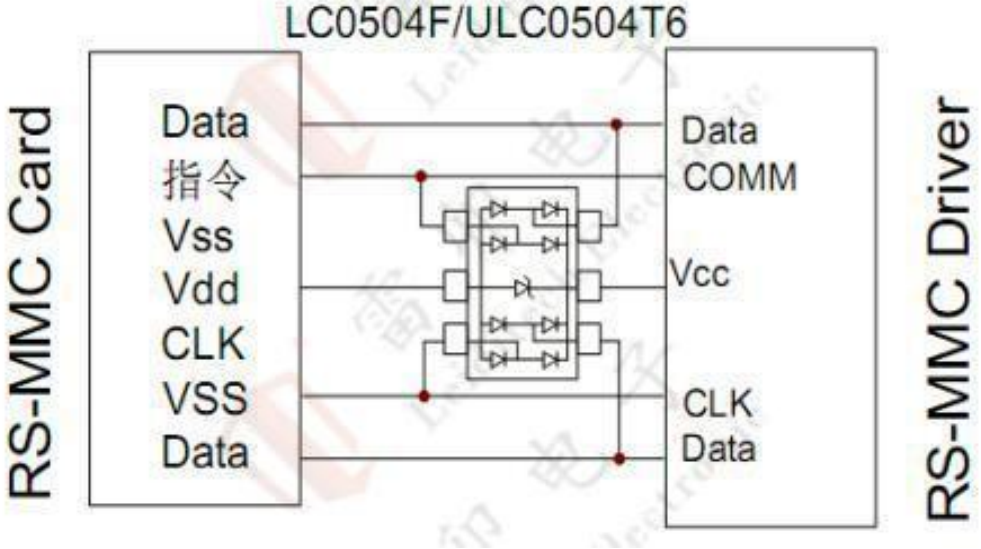
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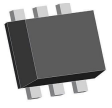
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10.1 MMC Card Electrostatic Protection Solution

Solution Advantages: The MMC card supports a maximum transmission speed of 10 Mbits/s. This solution uses an ultra-compact integrated protection device with a capacitance of less than 2pF, which can ensure signal integrity while passing the electrostatic discharge (ESD) test. It complies with IEC61000-4-2, level 4, withstanding contact discharge of 8kV and air discharge of 15kV.



Part Number	Description	IPP	Channels	Shape	Packaging
USRV05-4	5V,Uni，0.5PF ±15kV(air), ±8kV(contact)	5A	5		SOT-26
LC0504F	5V,Uni，0.8PF ±15kV(air), ±8kV(contact)	5A	5		SOT-363
ULC0504T6	5V,Uni，0.8PF ±15kV(air), ±8kV(contact)	2A	5		SOT-563

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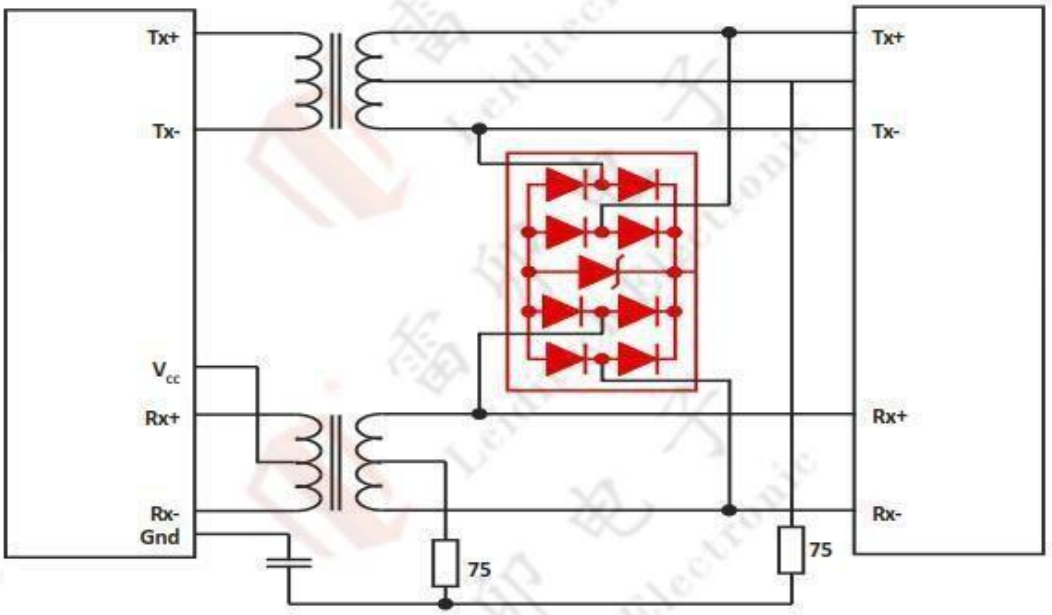
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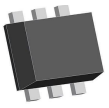
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11.1 PROFIBUS Card Electrostatic Protection Solution

Solution Advantages: The Profibus solution uses an ultra-compact integrated protection device with a capacitance of less than 2pF, ensuring signal integrity while passing the ESD test. It complies with IEC61000-4-2, level 4, withstanding contact discharge of 8kV and air discharge of 15kV.



Part Number	Description	IPP	Channels	Shape	Packaging
USRV05-4	5V,Uni，0.5PF ±15kV(air), ±8kV(contact)	5A	5		SOT-26
LC0504F	5V,Uni，0.8PF ±15kV(air), ±8kV(contact)	5A	5		SOT-363
ULC0504T6	5V,Uni，0.8PF ±15kV(air), ±8kV(contact)	2A	5		SOT-563

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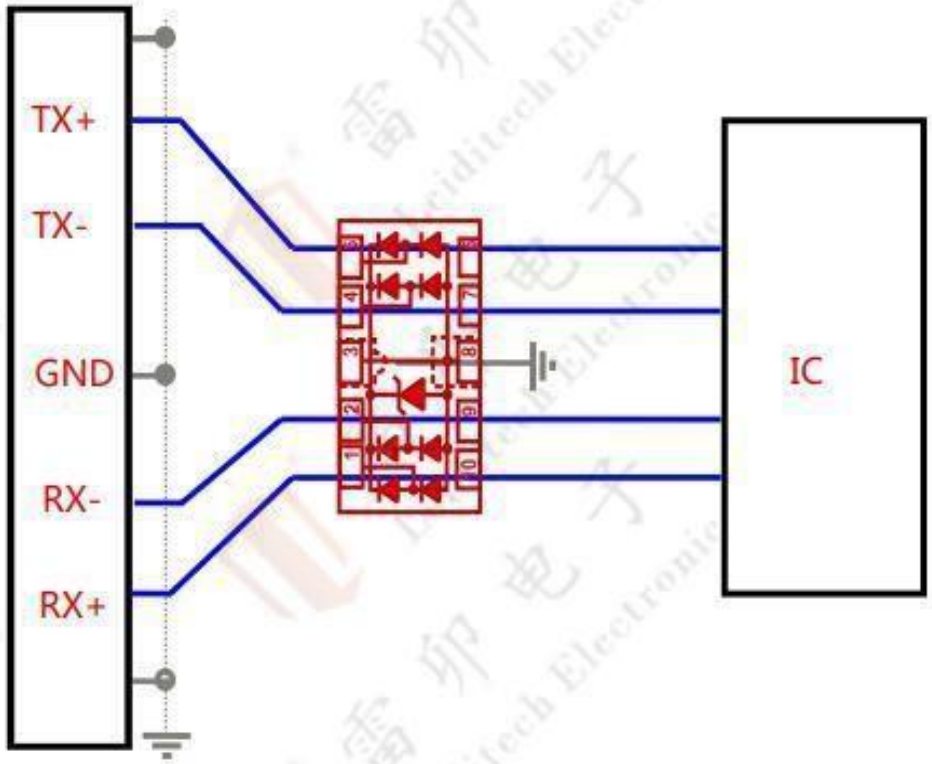
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12.1 eSATA Interface Electrostatic Protection Solution

Advantages: eSATA provides 6000Mbit/s transmission speed, this solution uses integrated device protection with parasitic capacitance <1pF, ensuring signal integrity, meeting IEC61000-4-2, Class 4, with contact discharge at 8kV and air discharge at 15kV.



Part Number	Description	IPP	Channels	Shape	Packaging
ULC0524P	5V, Uni, 0.8PF ±15kV(air), ±8kV(contact)	5A	4		DFN2510P10

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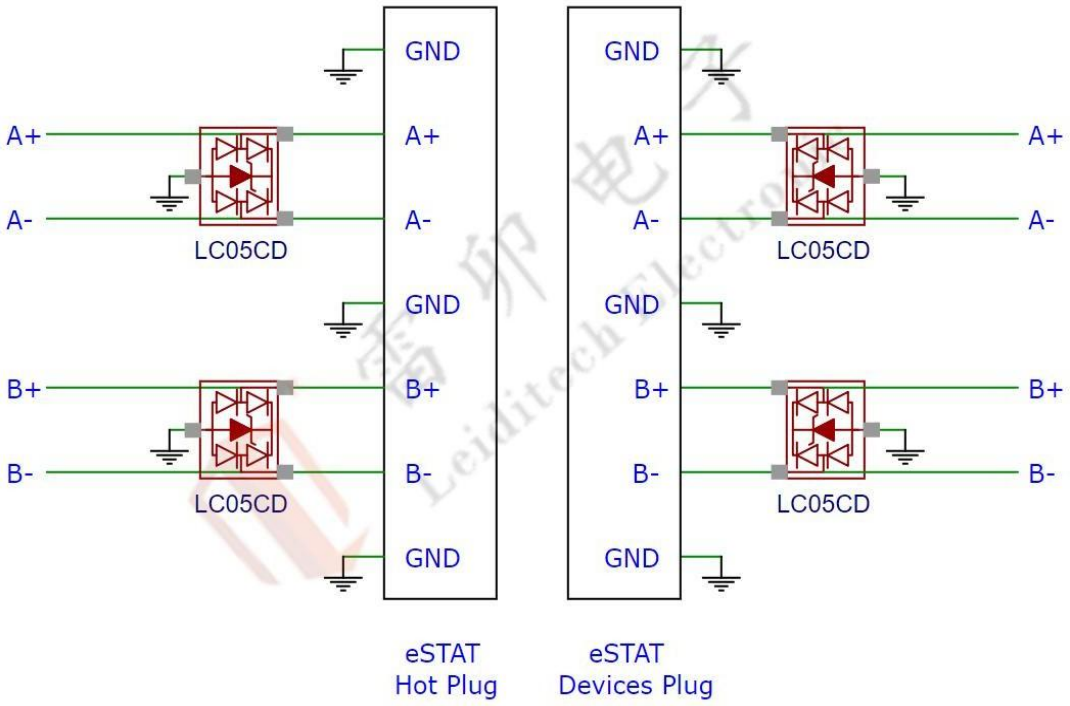
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12.2 eSATA Interface Electrostatic Protection Solution 2

Advantages: The eSATA interface can use LC05CD or ULC0502M3Q. This solution employs ultra-low capacitance integrated device protection, with parasitic capacitance <1pF, ensuring signal integrity while passing the electrostatic test. It meets IEC61000-4-2, level 4, contact discharge 30kV, air discharge 30kV.



Part Number	Description	IPP	Channel	Shape	Packaging
LC05CD	5V, 0.5PF ±30kV(air), ±30kV(contact)	5A	2		SOT-23
ULC0502M3Q	5V, 0.3PF ±30kV(air), ±30kV(contact)	4A	2		SOT-723

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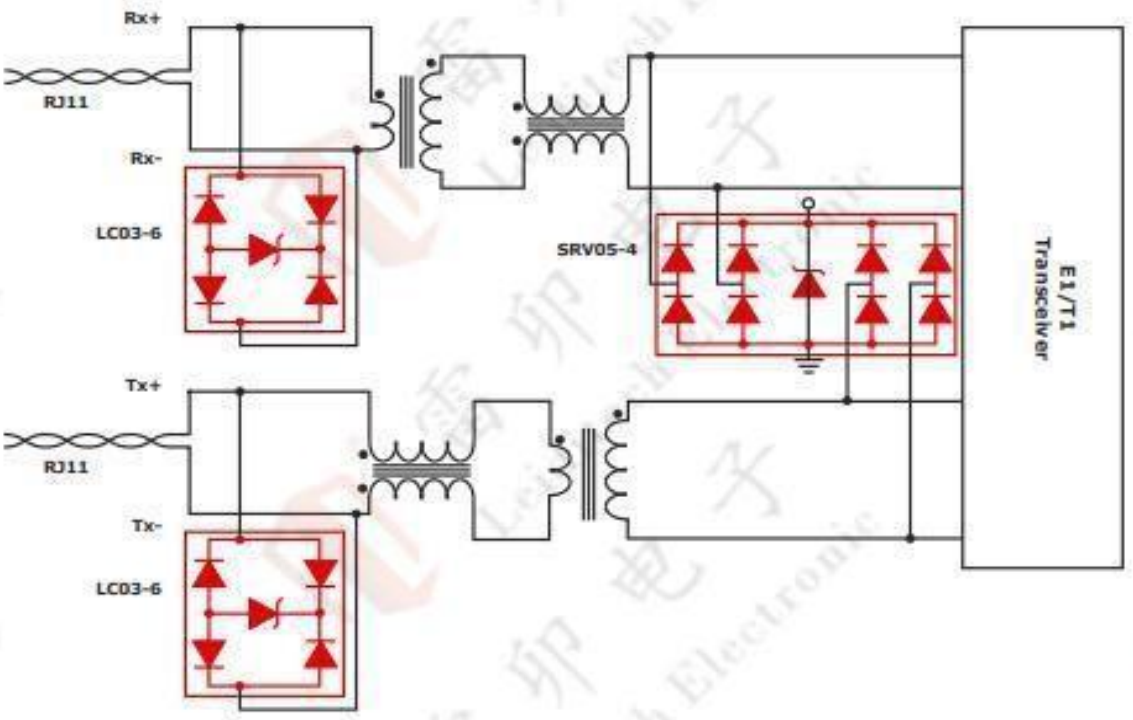
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13.1 T1 E1 Interface Electrostatic Surge Protection Solution

Advantages: This solution uses integrated device protection, saving space, providing surge devices for front-end protection. Ensuring signal integrity, meeting IEC61000-4-2, Class 4, with contact discharge at 8kV and air discharge at 15kV.



Part Number	Description	IPP	Channels	Shape	Packaging
USRV05-4	5V,Uni, 0.5PF ±15kV(air), ±8kV(contact)	5A	5		SOT-26
LC03-6	6V,Bi, 8pf ±15kV(air), ±8kV(contact)	100A	2		SOP-08

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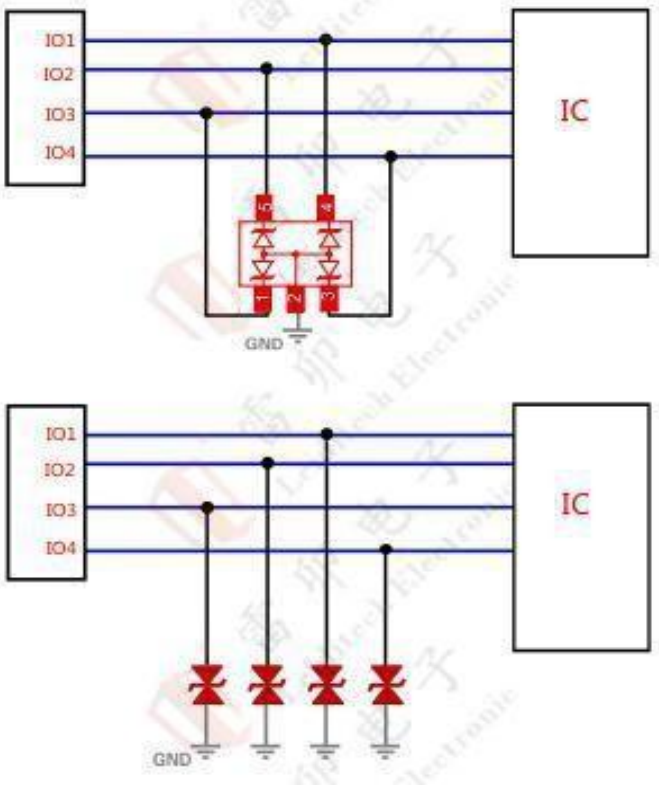
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14.1 IO Interface Electrostatic Protection Solution

Solution Advantages: Ordinary low-capacitance integrated components can be used for electrostatic protection, meeting IEC61000-4-2, Level 4, contact discharge 8kV, air discharge 15kV. 0402 packaged components for single circuits are optional.



Part Number	Description	IPP	Channels	Shape	Packaging
SDA05W5	5V,Uni, 30PF ±15kV(air), ±8kV(contact)	3A	4		SOT-353
ESDA05CP	5V Bi 10PF ±15kV(air), ±8kV(contact)	5A	1		DFN1006-2

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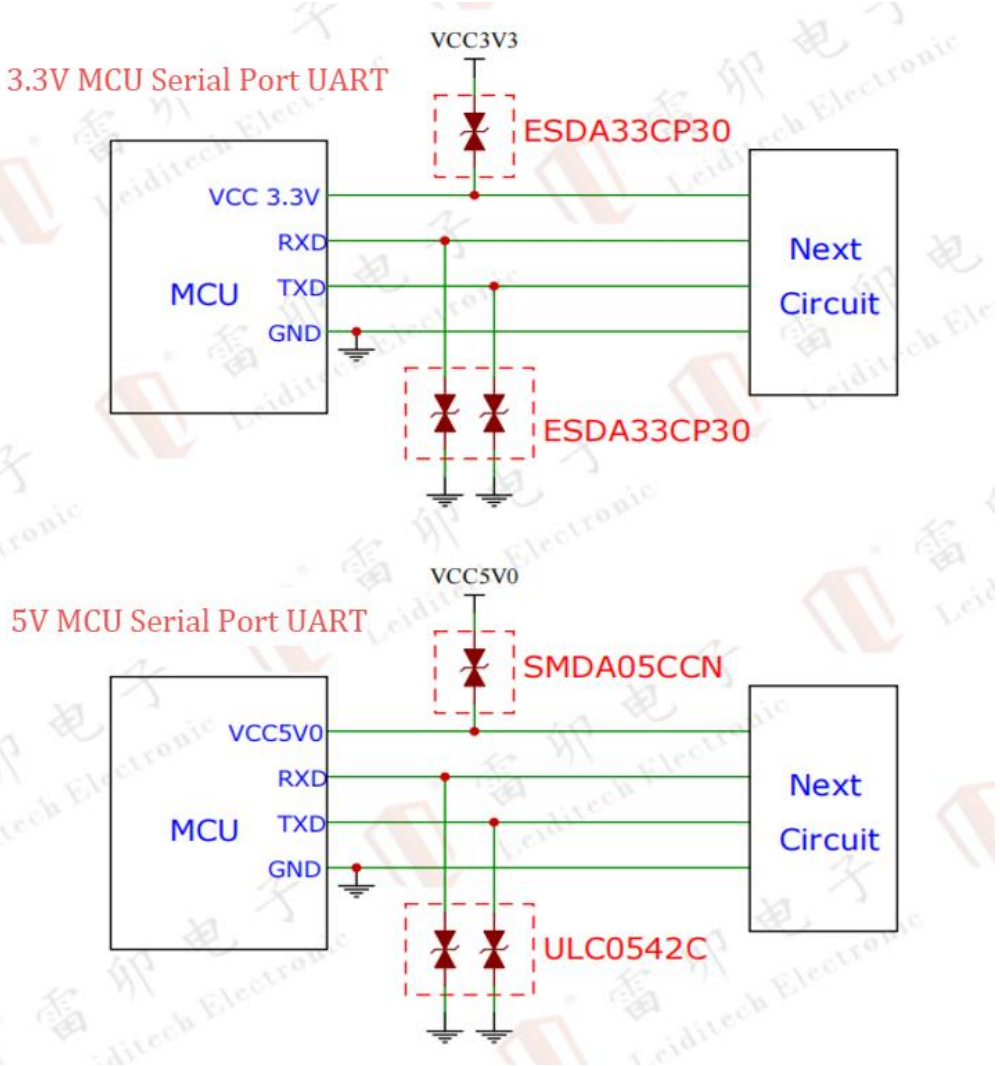
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14.2 MCU Serial Port UART Discrete Electrostatic Protection Solution

Solution Advantages: Common UART provides a transmission speed of 115200Mbps. This solution uses discrete components for protection, facilitating design placement and ensuring signal integrity. ESDA33CP30, SMDA05CCN, and ULC0542C meet IEC61000-4-2, Level 4.



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14.2 MCU Serial Port UART Discrete Electrostatic Protection Solution

Part Number	Description	IPP	Channels	Shape	Packaging
ESDA33CP30	3.3V,向，Bi12PF ±30kV(air), ±30kV(contact)	8A	1		DFN1006
SMDA05CCN	5V,Bi，60PF ±30kV(air), ±30kV(contact)	30A	1		DFN1006
ULC0542C	5V,Bi，0.3PF ±25kV(air), ±22kV(contact)	4A	1		DFN1006

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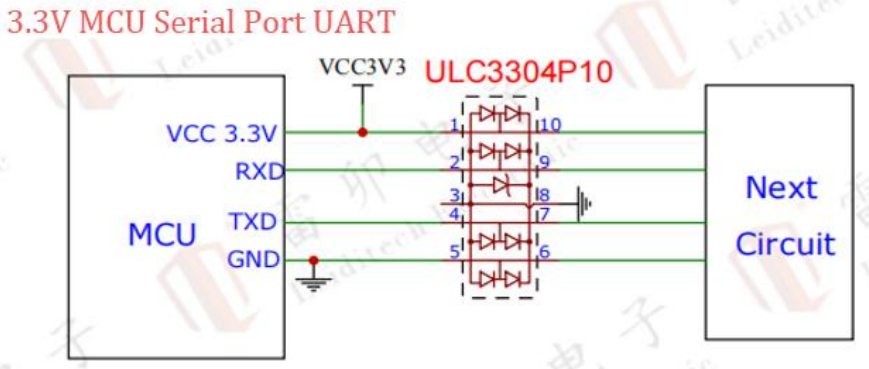
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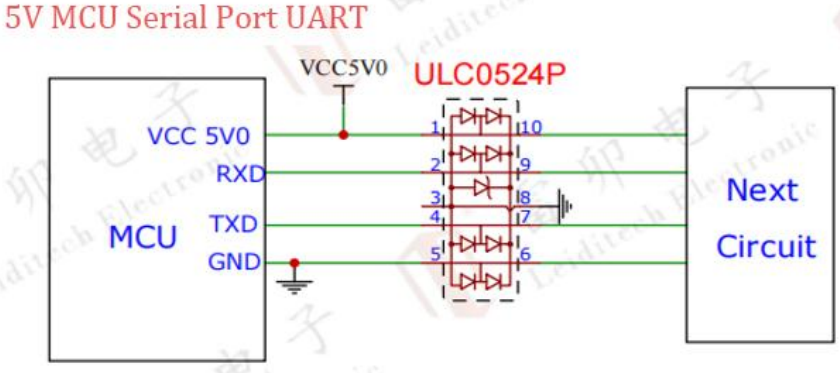
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14.3 MCU Serial Port UART Integrated Electrostatic Protection Solution

Solution Advantages: UART provides a transmission speed of 11520Mbps. This solution uses a single integrated component for protection, saving space and ensuring signal integrity. The connection between pins 1 and 6, pins 2 and 9, and pins 4 and 7 of ULC3304P10 and ULC0524P can be linked, facilitating PCB layout. It meets IEC61000-4-2, Level 4, contact discharge 30kV, air discharge 30kV, ensuring the protection of various industrial electrical devices from interference.





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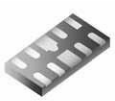
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14.3 MCU Serial Port UART Integrated Electrostatic Protection Solution

Part Number	Description	IPP	Channels	Shape	Packaging
ULC3304P10	3.3V,Uni, 0.4PF ±30kV(air), ±30kV(contact)	5A	4		DFN2510P10
ULC0524PA	5V,Uni, 0.3PF ±30kV(air), ±30kV(contact)	4A	4		DFN2510P10

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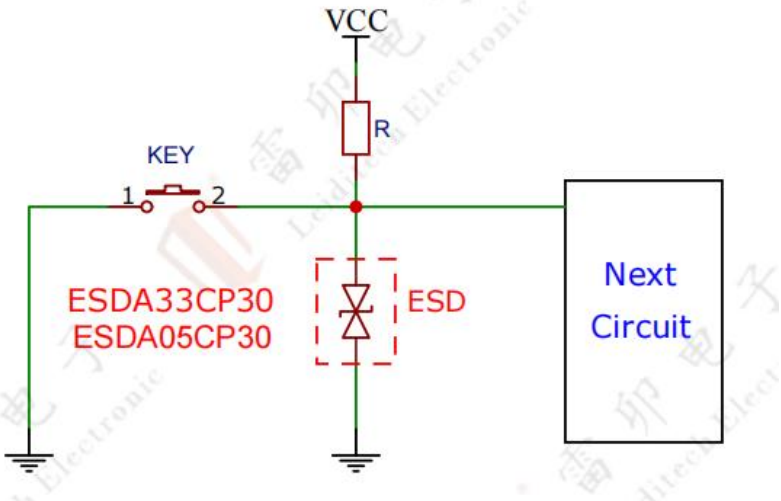
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15.1 Keyboard Key/Power Key/Volume Key Discrete Component Electrostatic Protection Solution

Solution Advantages: Common low-capacitance discrete components can be used for ESD protection, meeting the IEC61000-4-2 standard, Level 4, with contact discharge 8kV and air discharge 15kV.



Part Number	Description	IPP	Channels	Shape	Packaging
ESDA33CP30	3.3V,Bi, 15PF ±30kV(air) ±30kV(contact)	8A	1		DFN1006
ESDA05CP30	5V Bi, 12PF ±30kV(air), ±30kV(contact)	8A	1		
ESDA33CT30	3.3V,Bi, 10.3PF ±30kV(air) ±30kV(contact)	9A	1		SOD-523
ESDA05CT30	5V Bi, 15PF ±30kV(air), ±30kV(contact)	8A	1		

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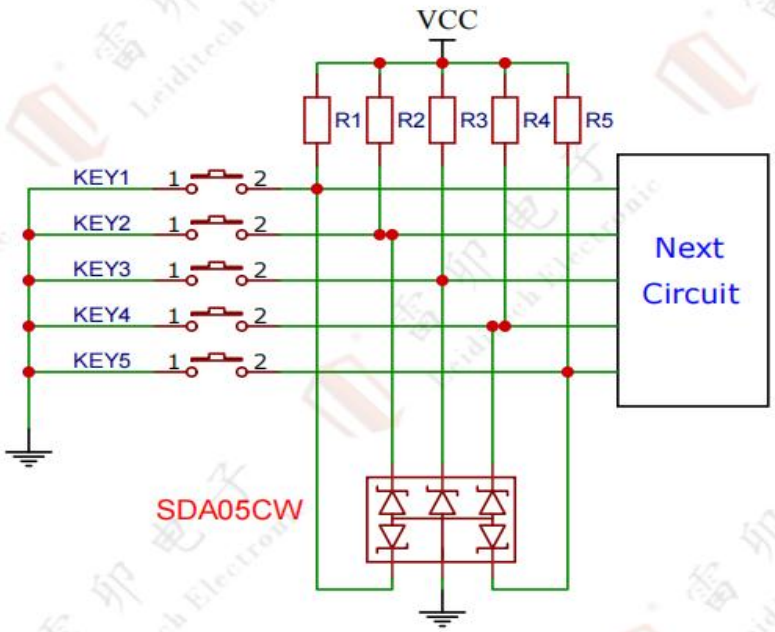
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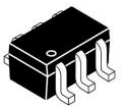
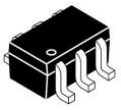
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15.2 Keyboard Key Integrated Component ESD Protection Solution

Solution Advantages: Common low-capacitance integrated components can be used for ESD protection, meeting the IEC61000-4-2 standard, Level 4, with contact discharge 8kV and air discharge 15kV.



Part Number	Description	IPP	Channels	Shape	Packaging
SDA05CW	5V,Uni, 50PF ±25kV(air) ±16kV(contact)	5A	5		SOT-363
ESDA5.0CW-4	5V,Bi, 12PF ±30kV(air) ±30kV(contact)	7A	4		SOD-353
ESDA3.3CW-4	3.3V Bi, 15PF ±30kV(air), ±30kV(contact)	10A	4		

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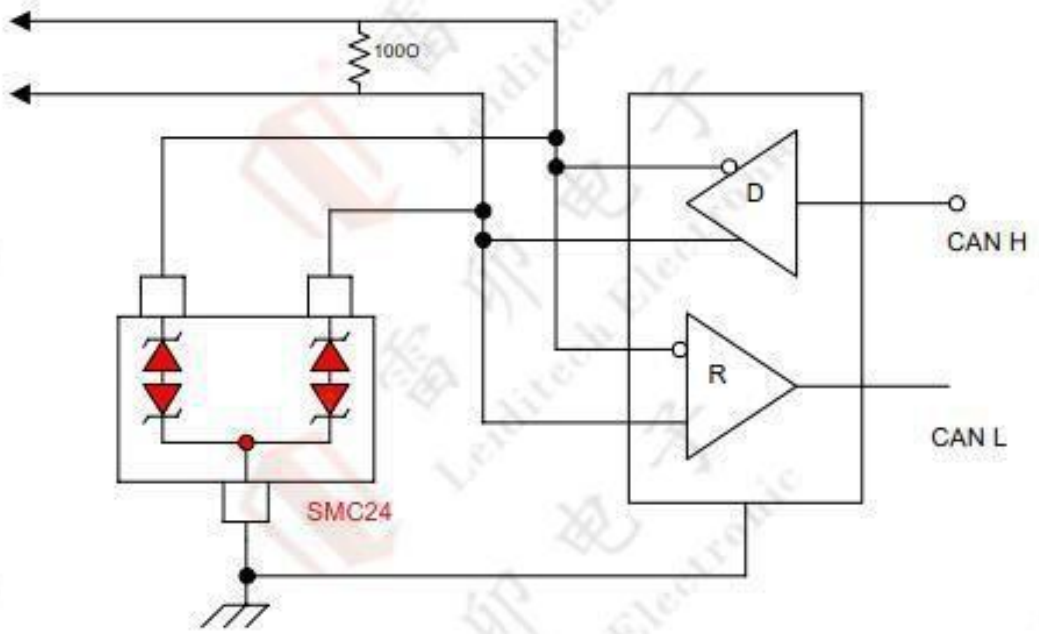
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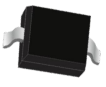
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16.1 CAN Interface Electrostatic Protection Solution

Solution Advantages: This solution uses integrated device protection. With a capacitance of <50pF, it ensures signal integrity while passing the ESD test. It meets the requirements of IEC61000-4-2, Level 4, withstanding a contact discharge of 30kV and an air discharge of 30kV. The SMC24 has passed automotive-grade AEC-Q101 certification.



Part Number	Description	IPP	Channels	Shape	Packaging
SMC24	24V,Bi, 25PF ±30kV(air), ±30kV(contact)	5A	2		SOT-23
SD24C	24V,Bi, 50PF ±30kV(air), ±30kV(contact)	12A	1		SOD-323

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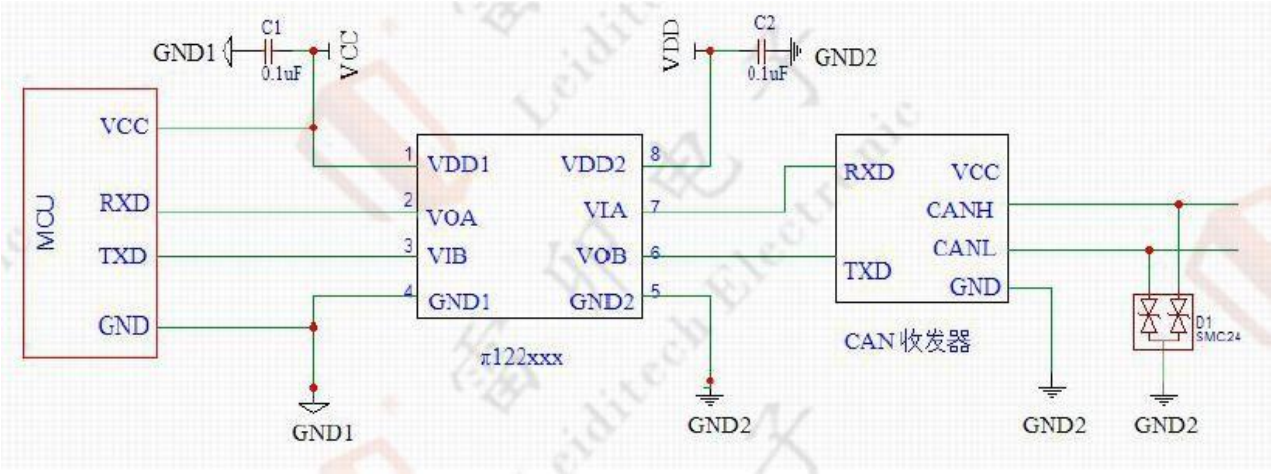
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16.2 CAN Interface Isolation and Electrostatic Protection Solution



Electrostatic Protection Recommended Components:

Part Number	Description	IPP	Channels	Shape	Packaging
SMC24	24V, Bi, 25PF ±30KV(AIR) ±30KV(CONTACT)	5A	2		SOT-23
SD24C	24V, Bi, 50PF ±30KV(AIR) ±30KV(CONTACT)	12A	1		SOD-323

Digital Isolation Recommended Components:

Part Number	Channels	Speed	Isolation Voltage	Temperature Performance	Packaging
π 122xxx	2	A series: 600Mbps E series: 200Mbps M series: 10Mbps U series: 150Kbps	Option: AC 6000Vrms AC 3000Vrms	-40℃-125℃	WSOP-16 SOP-8

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16.2 CAN Interface Isolation and Electrostatic Protection Solution

Part Number	Chip Name	Description	Communication Speed	Shape	Packaging
LM82C250	CAN Transceiver	5V Supply	1Mbps		SOP-8

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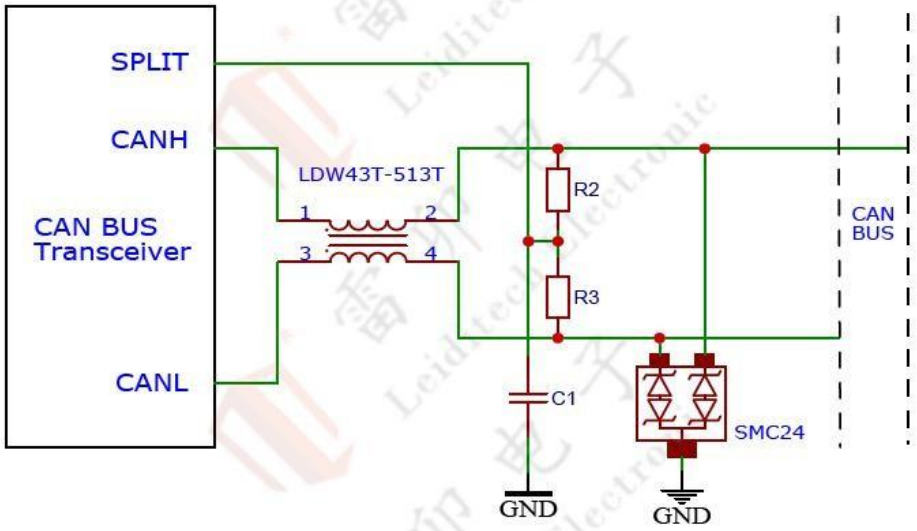
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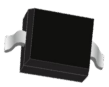
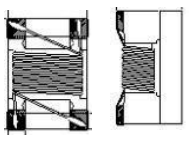
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16.3 CAN Interface Electrostatic Filter Protection Solution

Solution Advantages: This solution uses multi-path integrated circuit protection. With a capacitance of <50pF, it ensures signal integrity and removes noise while passing the ESD test. It meets the requirements of IEC61000-4-2, Level 4, withstanding a contact discharge of 30kV and an air discharge of 30kV. The SMC24 has passed automotive-grade AEC-Q101 certification.



Part Number	Description	IPP	Channels	Shape	Packaging
SMC24	24V, Bi, 25PF ±30kV(air), ±30kV(contact)	5A	2		SOT-23
SD24C	24V, Bi, 50PF ±30kV(air), ±30kV(contact)	12A	1		SOD-323
LDW43T-513T	dimensions: 4.5*3.2*2.6 2800Ω 51UH	-	-		SMD

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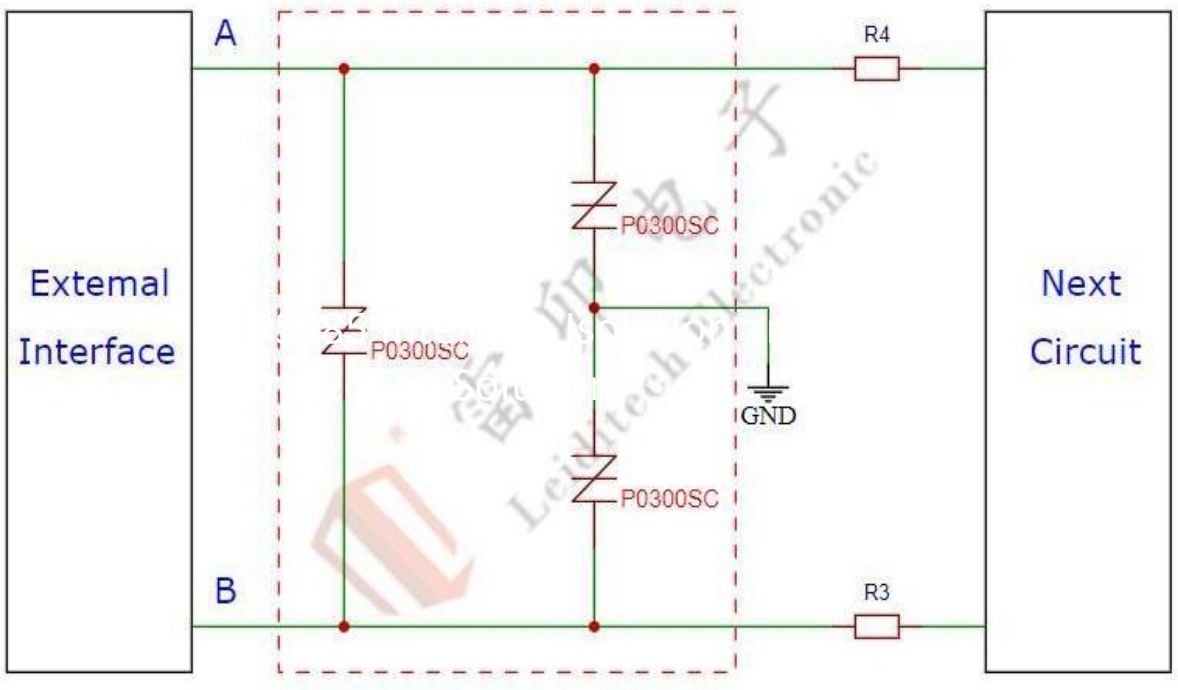
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16.4 CAN Interface Electrostatic Surge Protection Solution

Solution Advantages: This solution is used for surge and electrostatic protection of CAN interfaces. It uses low residual voltage TSS (Transient Suppression System), effectively protecting CAN interfaces with ns-level response time. It can prevent surges, electrostatic discharge, and ensures signal integrity. It meets IEC61000-4-2, Level 4, withstanding a contact discharge of 15kV, an air discharge of 8kV; IEC61000-4-5 surge test 10/700μs, 8kV.



Part Number	Description	10/700 μs surge	Channels	Shape	Packaging
P0300SC	25V, 80PF	6KV	1		SMB DO214-AA

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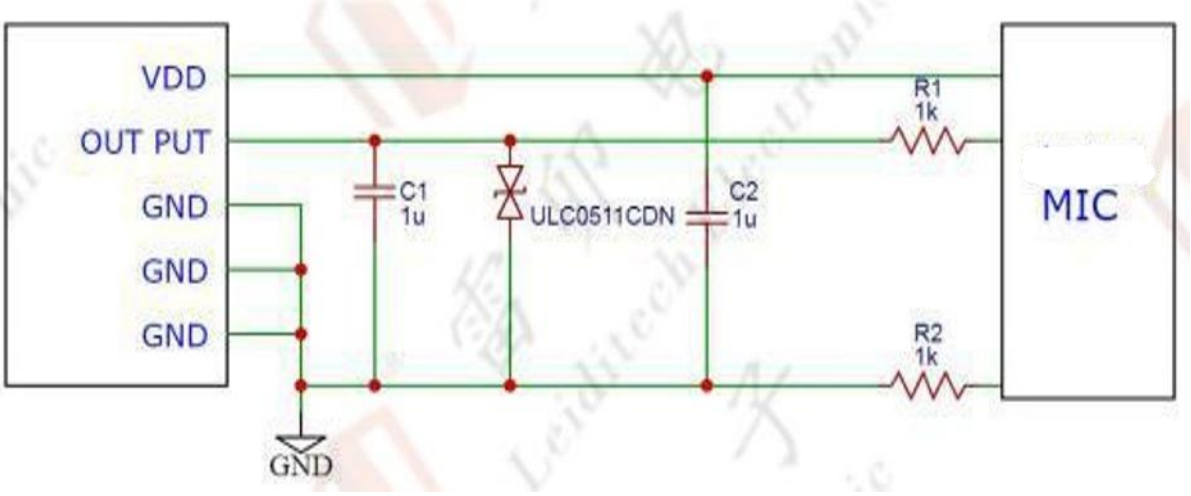
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17.1 Microphone Electrostatic Protection Solution

Solution Advantages: Integrated device protection with 0.22pF capacitance. It ensures signal integrity while passing the ESD test. Complies with: IEC61000-4-2, contact discharge 30kV, air discharge 30kV.



Part Number	Description	IPP	Channels	Shape	Packaging
ULC0511CDN30	5V,Bi, 0.22PF ±30kV(air), ±30kV(contact)	4.5A	1		DFN1006

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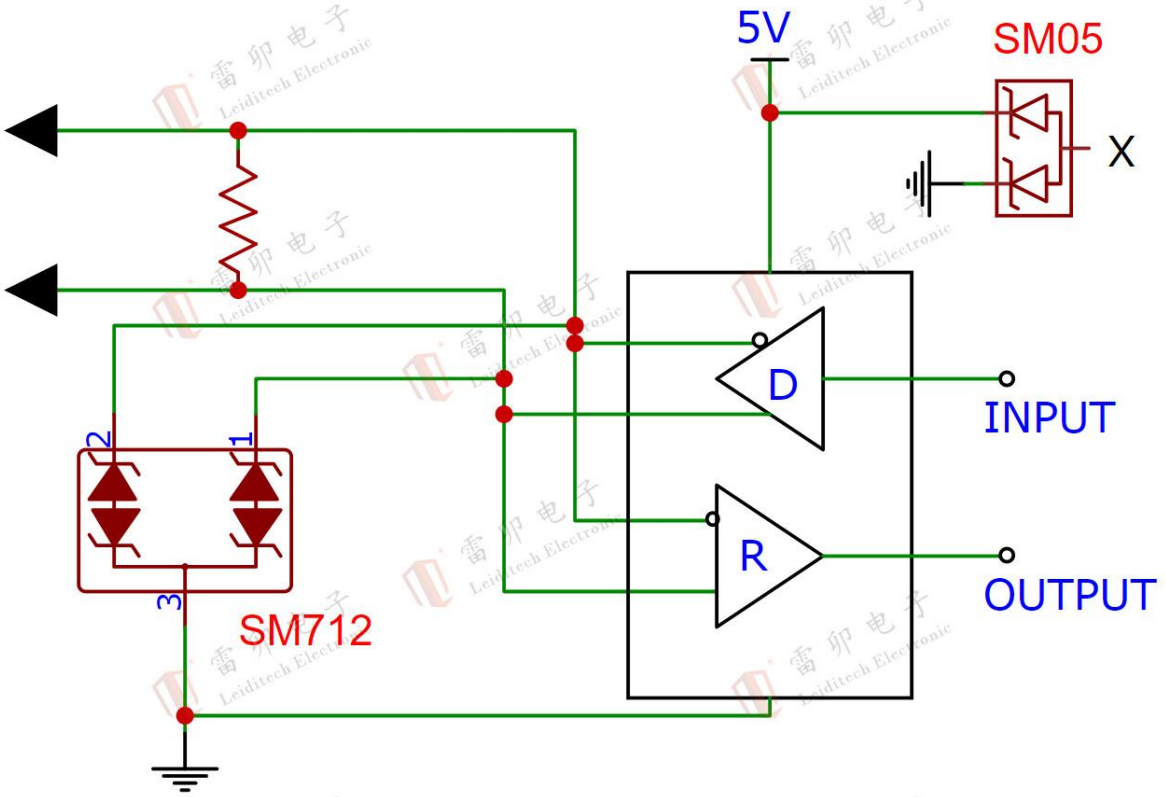
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18.1 RS485 Interface ESD Protection Solution



part number	description	IPP	Channel	shape	packaging
SM712	7V/12V,Bi, 45PF ±30kV(air), ±30kV(contact)	17A	2		SOT-23
SM05	5V,Uni, 300PF ±15kV(air), ±8kV(contact)	12A	2		SOT-23

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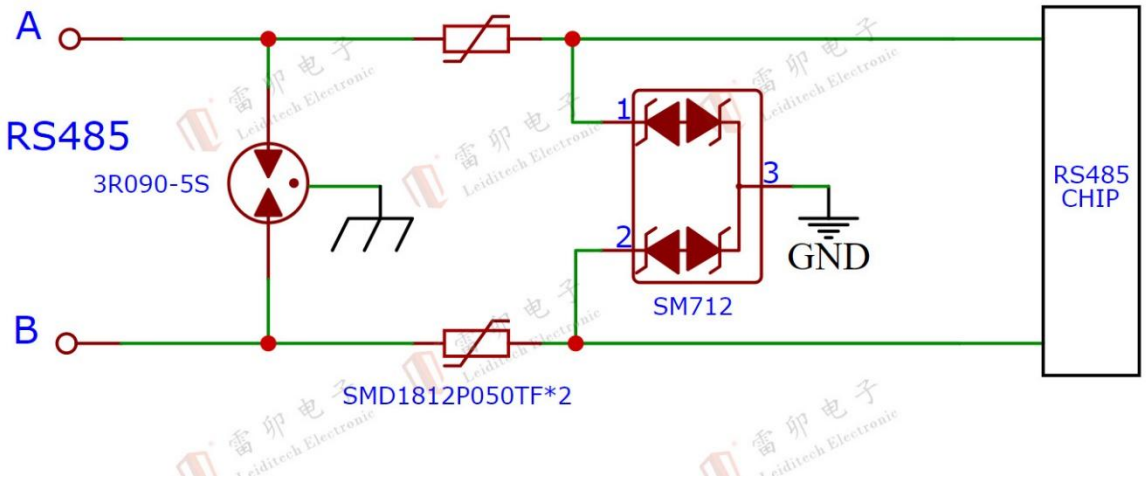
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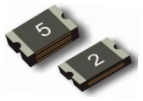
18.2 RS485 Surge Protection Solution

Solution Advantages: This solution uses two-level protection. The first level adopts GDT for surge protection, and the second level uses ESD diodes for electrostatic discharge protection. The ESD protection meets the IEC 61000-4-2 (ESD) standard of ±30kV (air) and ±30kV (contact). The surge protection level is 8/20μs, 5KA.



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18.2 RS485 Surge Protection Solution

Part Number	Description	IPP	CH.	Shape	Packaging
SM712	7V/12V,Bi，34PF ±30kV(air), ±30kV(contact)	22A	2		SOT-23
SM712H	7V/12V,Bi，75PF ±30kV(air), ±30kV(contact)	36A	2		SOT-23
SMD1812P050TF	0.5A,0.15Ω,15V	0.5A	1		SMD1812
3R090-5S	90V 1.5PF	5KA	2		贴片5*7.6(1头方1头圆)
3R090SB-8	90V 1.5PF	10KA	2		贴片(8*6)一圆一方
3R090SD-8	90V 1.5PF	20KA	2		贴片(8*6)一圆一方

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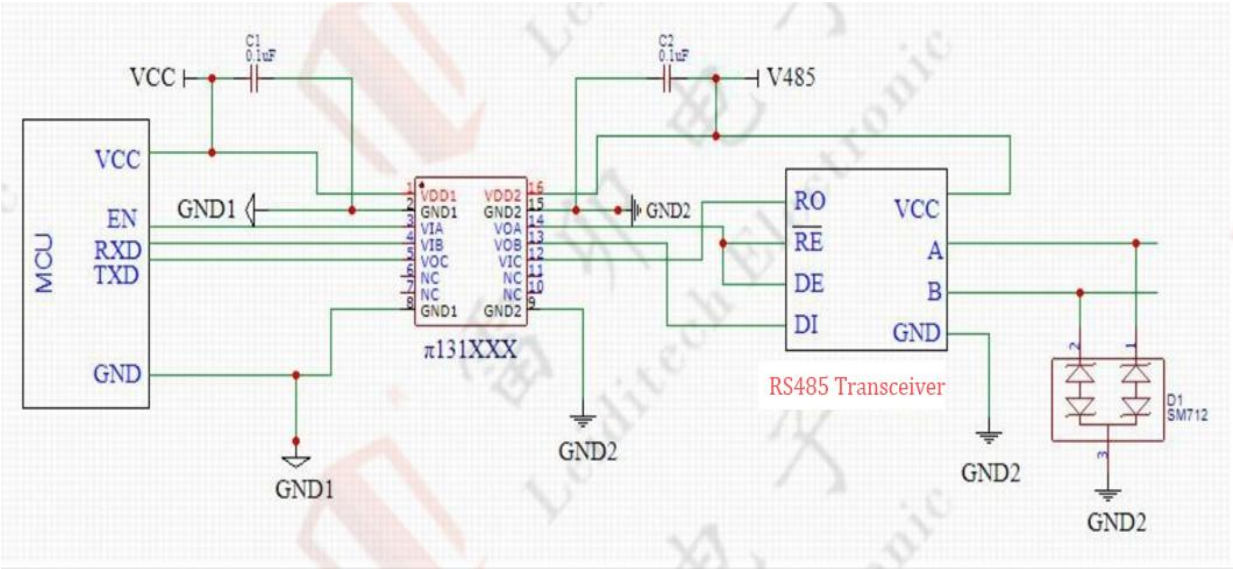
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18.3 RS485 Interface Isolation and ESD Protection Solution



Static discharge protection recommended components:					
Part Number	Description	IPP	Channels	Shape	Packaging
SM712	7V/12V,Bi, 45PF ±30KV(AIR) ±30KV (CONTACT)	5A	2		SOT-23

Digital isolation recommended components::					
Part Number	Channels	Speed	Isolation Voltage	Temperature Performance	Packaging
π131xxx	3	A series: 600Mbps E series: 200Mbps M series: 10Mbps U series: 150Kbps	Option: AC 6000Vrms AC 3000Vrms	-40℃-125℃	WSOP-16 SOP-16 SSOP-16

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18.3 RS485 Interface Isolation and ESD Protection Solution

Part Number	Chip Name	Description	Communication Speed	Shape	Packaging
LM3085ESA	RS-485 Communication Chip	5V, ±16kV(air), ±16kV(contact)	1Mbps		SOP-8

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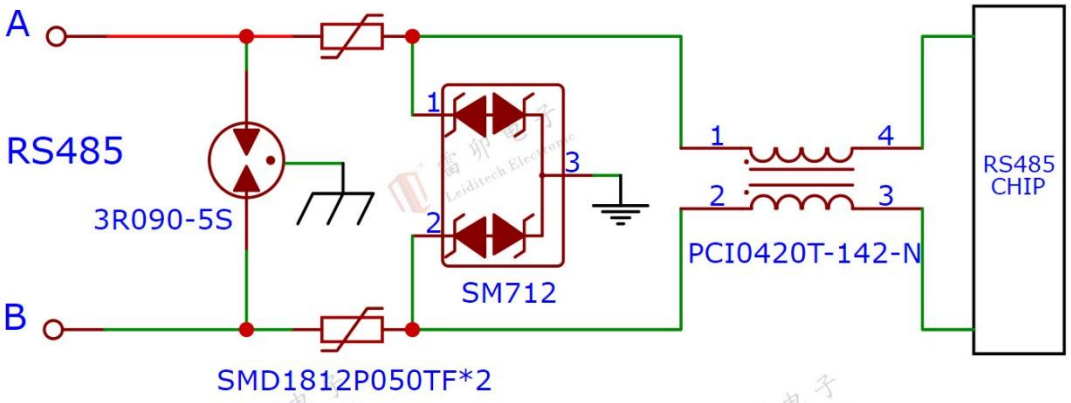
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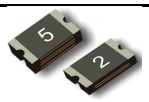
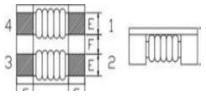
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18.4 RS485 Interface Surge Filter Protection Solution

Advantages: This solution adopts multi-channel integrated circuit protection, ensuring the integrity of the signal while filtering out noise. It passes static electricity tests and meets the IEC61000-4-2, ISO10605-2 standards, level 4, with contact discharge of 30kV and air discharge of 30kV.



Part Number	Description	IPP	Channels	Shape	Packaging
SM712	7V/12V,Bi,34PF ±30kV(air), ±30kV(contact)	22A	2		SOT-23
SM712H	7V/12V,Bi,75PF ±30kV(air), ±30kV(contact)	36A	2		SOT-23
SMD1812P050TF	0.5A 15V,0.15Ω	0.5A	1		SMD1812
3R090-5S	90V 1.5PF	10KA	2		Three Poles D=5MM
PCI0420T-142-N	dimensions: 4.7*4.5*2.0mm R: 1400Ω	-	-		0420

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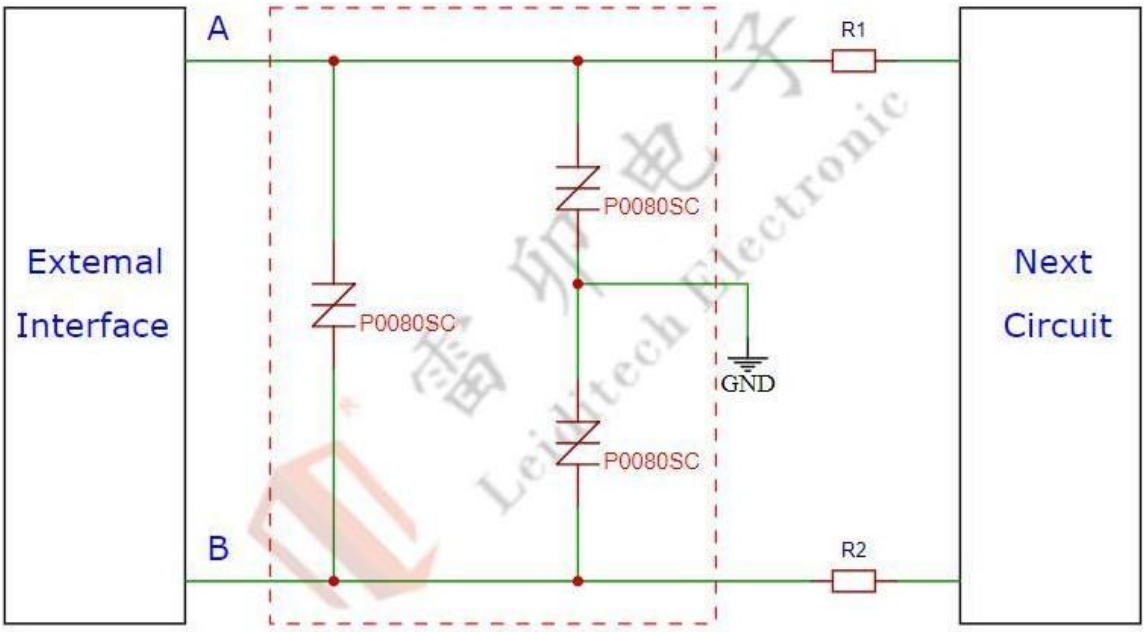
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18.5 RS422 RS485 Interface ESD Surge Protection Solution

Advantages: This solution provides surge protection for RS422 RS485 interfaces using low residual voltage TSS. The TSS effectively protects RS422 RS485 chips with a response time in the ns range. It offers both surge and static electricity protection, ensuring signal integrity. It meets the IEC61000-4-2, ESD level 4 standards, with contact discharge of 15kV and air discharge of 8kV; meets the IEC61000-4-5 surge 10/700μs, 6kV standard.



Part Number	Description	10/700 μs surge	Channels	Shape	Packaging
P0080SC	6V,100PF	6KV	1		SMB DO214-AA

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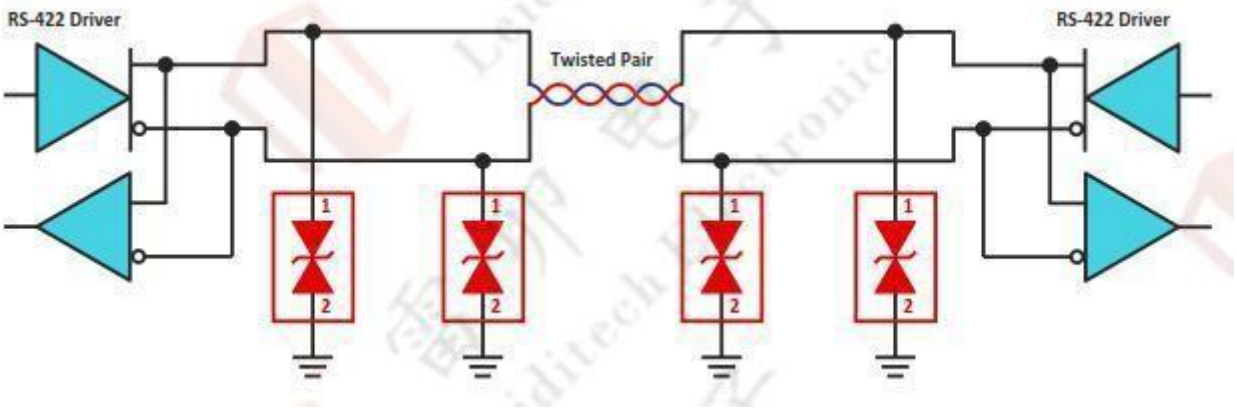
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19.1 RS422 Interface Electrostatic Protection Solution



Part Number	Description	IPP	Channels	Shape	Packaging
SD05C	5V,Bi20PF ±15kV(air), ±8kV(contact)	24A	1		SOD-323

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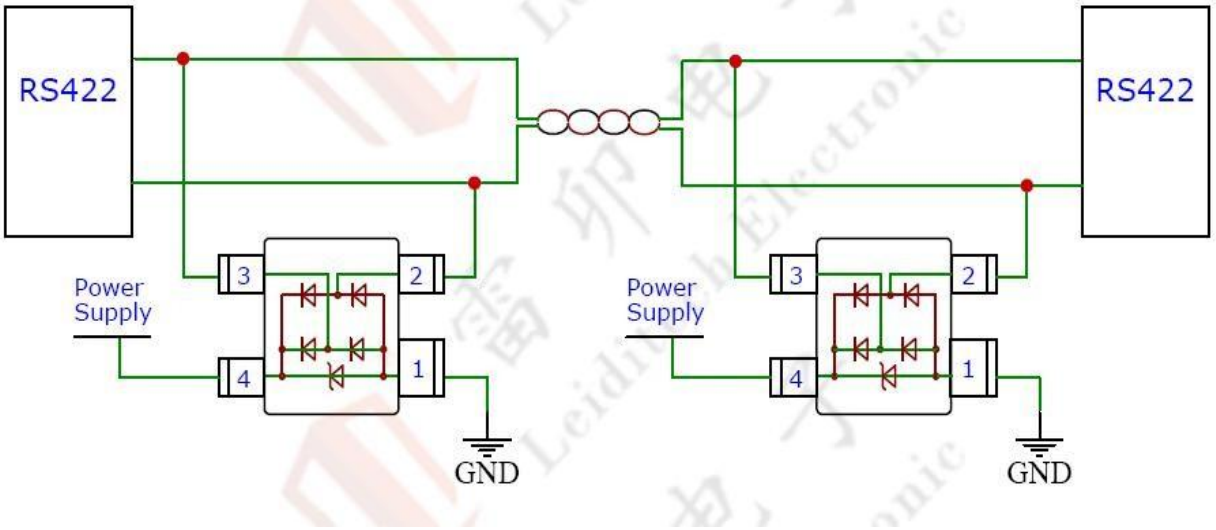
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19.2 RS422 Data Line with Power Supply Electrostatic Surge Protection Solution

Advantages of the Solution: This solution adopts integrated circuit protection, which can ensure signal integrity while passing the electrostatic test. It meets the standards of IEC61000-4-2, ISO10605-2 Level 4, with contact discharge of 30kV and air discharge of 30kV.



Part Number	Description	IPP	Channels	Shape	Packaging
SR12W	Uni，5PF ±30kV(air), ±30kV(contact)	16A	4		SOT-143

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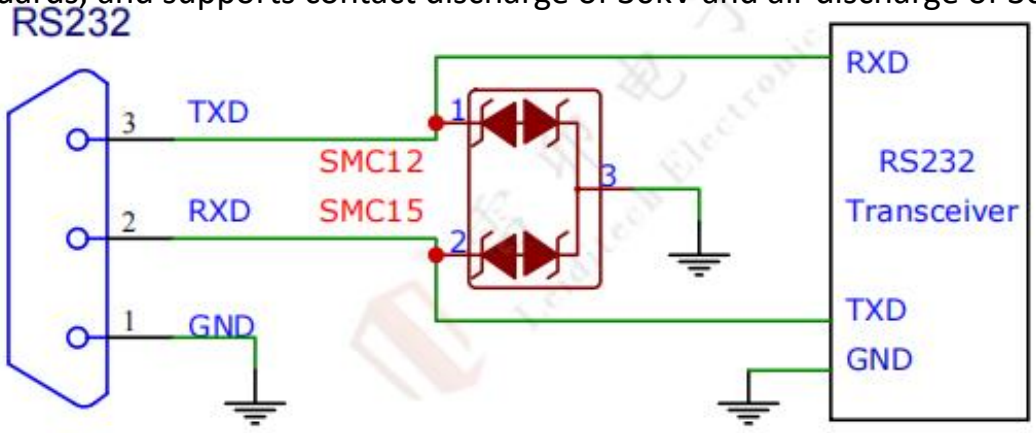
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20.1 RS232 Interface Integrated Electrostatic Protection Solution

The RS-232 standard interface, also known as EIA RS-232, is a commonly used serial communication interface standard, typically applied to point-to-point communication over shorter distances. This interface is often used as a test interface on communication devices, and as a communication interface between boards and monitoring signal interfaces, with a maximum baud rate of 115,200 bps. Solution Advantages: This solution employs integrated components for protection, ensuring signal integrity while passing electrostatic discharge (ESD) tests. It complies with IEC61000-4-2, ISO10605-2, Level 4 standards, and supports contact discharge of 30kV and air discharge of 30kV.



Part Number	Description	IPP	Channels	Shape	Packaging
SMC12	12V,Bi, 45PF ±30kV(air), ±30kV(contact)	15A	2		SOT-23
SMC15	15V,Bi, 40PF ±30kV(air), ±30kV(contact)	9A	2		SOT-23

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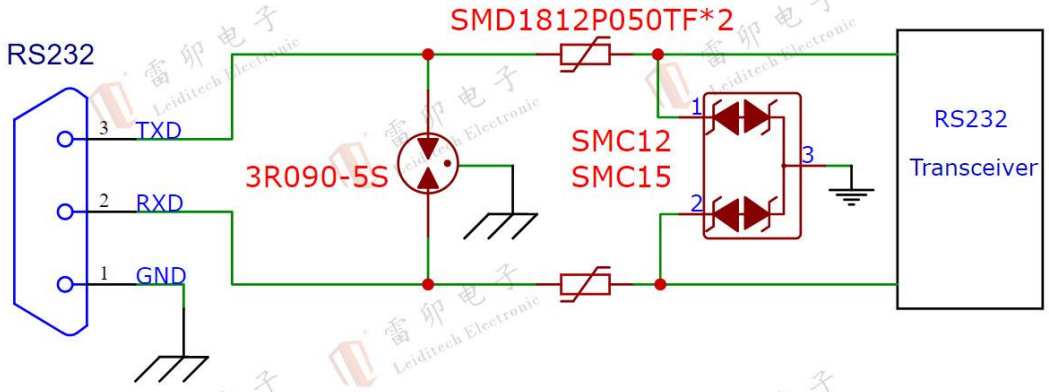
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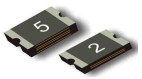
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20.2 RS232 Interface Integrated Surge and ESD Protection Solution

Solution Advantages: This solution employs a two-level protection system, with the first level using a GDT for surge protection and the second level using an ESD diode for electrostatic discharge protection. The ESD protection complies with the IEC 61000-4-2 (ESD) ±30kV (air) and ±30kV (contact) standards. The surge protection level is 8/20μs 5KA.



Part Number	Description	IPP	Channels	Shape	Packaging
SMC12	12V,Bi45PF ±30kV(air), ±30kV(contact)	10A	2		SOT-23
SMC15	15V,Bi, 40PF ±30kV(air), ±30kV(contact)	9A	2		SOT-23
SMD1812P050TF	0.5A,0.15Ω,15V	0.5	1		SMD1812
3R090-5S	90V 1.5PF	5KA	2		Three Poles D=5MM

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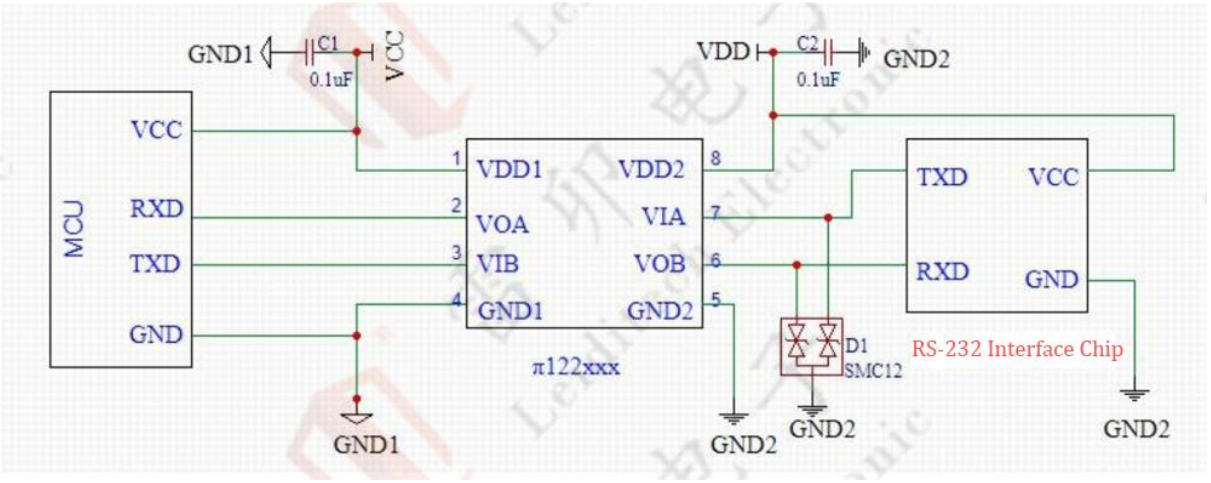
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20.3 RS232 Interface Isolation and Electrostatic Protection Solution



Static discharge protection recommended components:					
Part Number	Description	IPP	Channels	Shape	Packaging
SMC12	12V,Bi, 35PF ±30KV(AIR) ±30KV（CONTACT）	10A	2		SOT-23

Digital isolation recommended components::					
Part Number	Channel	Speed	Isolation Voltage	Temperature Performance	Packaging
π122xxx	2	A series: 600Mbps E series: 200Mbps M series: 10Mbps U series: 150Kbps	Option: AC 6000Vrms AC 3000Vrms	-40℃-125℃	WSOP-16 SOP-8

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20.3 RS232 Interface Isolation and Electrostatic Protection Solution

Part Number	Chip Name	Description	Communication Speed	Shape	Packaging
LM3232ESA	RS-232 Communication Chip	3.3V, dual ±16kV(air), ±16kV(contact)	120kbps		SOP-16

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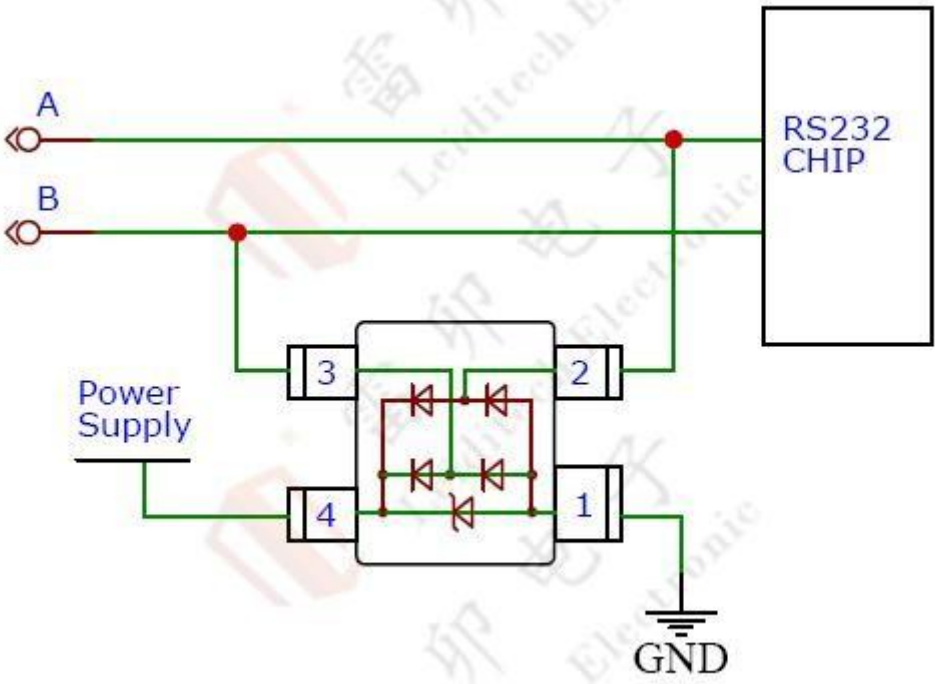
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20.4 Electrostatic Surge Protection Solution of RS232 Data Line with Power Supply

Solution Advantages: Integrated device protection ensures signal integrity while passing the ESD test. Complies with: IEC61000-4-2, ISO10605-2 Class 4, contact discharge 30kV, air discharge 30kV.



Part Number	Description	IPP	Channels	Shape	Packaging
SR12W	Uni, 5PF ±30kV(air), ±30kV(contact)	16A	4		SOT-143

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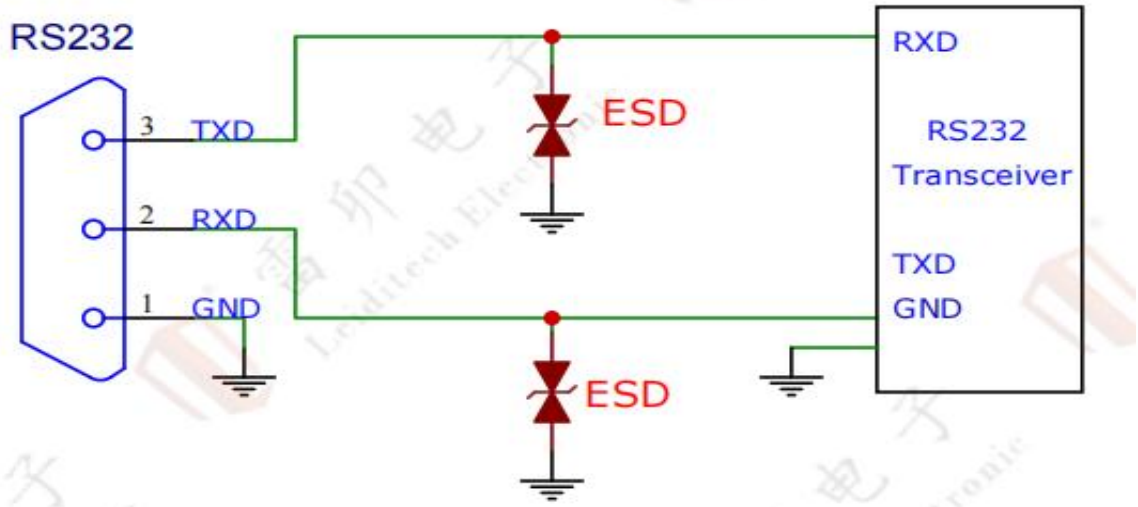
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20.5 RS232 Interface Discrete ESD Protection Solution

The RS-232 standard interface, also known as EIA RS-232, is a commonly used serial communication interface standard, typically applied in short-distance point-to-point communication. This interface is used on communication devices as a test interface, board-to-board communication interface, and monitoring signal interface, with a maximum baud rate of 115,200 bps. Solution Advantages: This solution adopts discrete devices for protection, ensuring signal integrity while passing ESD testing. Compliance: Meets IEC61000-4-2, ISO10605-2, Class 4, withstanding contact discharge of 30kV and air discharge of 30kV.



Part Number	Description	IPP	Channels	Shape	Packaging
SD12C	12V,Bi, 45PF ±30kV(air), ±30kV(contact)	15A	1		SOD-323
SD15C	15V,Bi, 45PF ±30kV(air), ±30kV(contact)	6A	1		SOD-323

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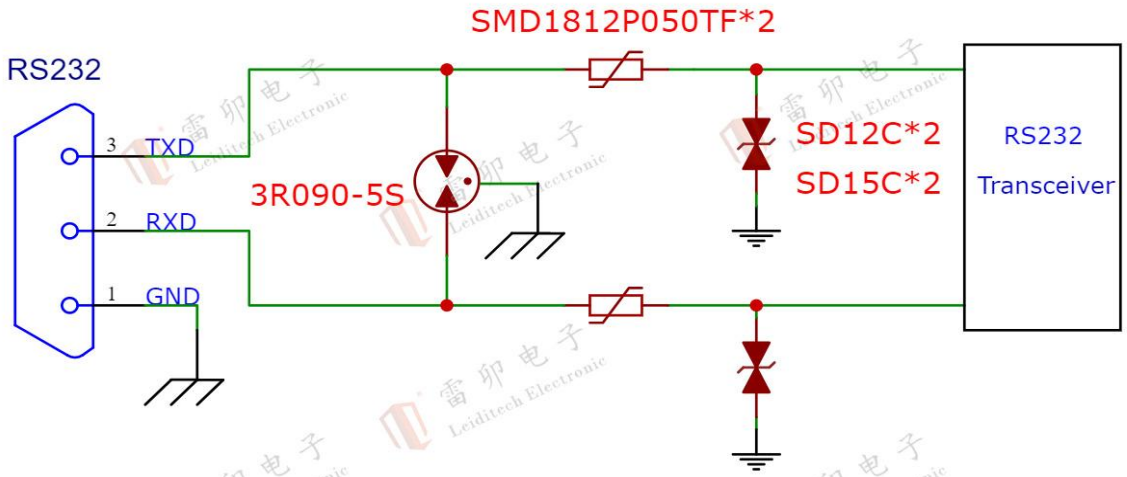
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20.6 RS232 Interface Split Surge and ESD Protection Solution

Advantages of the solution: This solution adopts two-level protection: the first level uses a Gas Discharge Tube (GDT) for surge protection, while the second level uses an ESD diode to protect against electrostatic discharge, utilizing discrete components. The ESD protection conforms to the IEC 61000-4-2 (ESD) standard with ±30kV (air) and ±30kV (contact). The surge protection level is 8/20μs, 5kA.



Part Number	Description	IPP	Channels	Shape	Packaging
SD12C	12V,Bi, 45PF ±30kV(air), ±30kV(contact)	15A	1		SOD-323
SD15C	15V,Bi, 45PF ±30kV(air), ±30kV(contact)	6A	1		SOD-323
SMD1812P050TF	0.5A,0.15Ω,15V	0.5	1		SMD1812
3R090-5S	90V 1.5PF	5KA	2		Three Poles D=5MM

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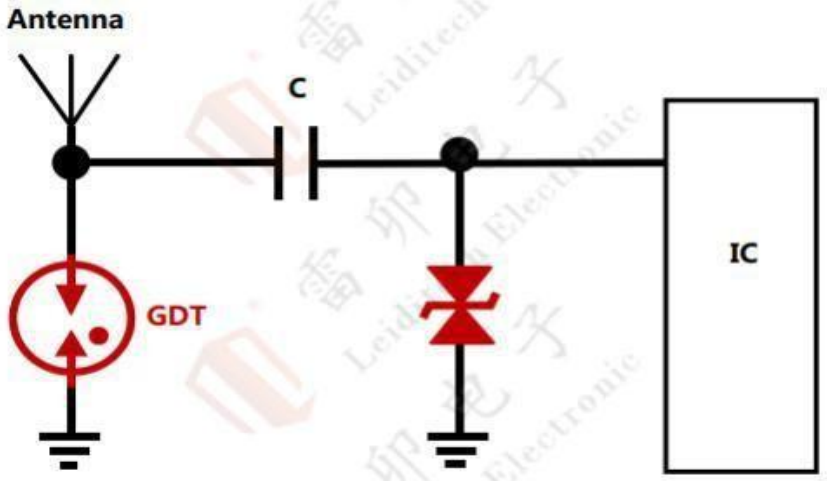
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21.1 RF Antenna Electrostatic Surge Protection Solution

Advantages of the Solution: Used to meet the electrostatic protection requirements of RF antenna interfaces, with ultra-low capacitance, ensuring signal transmission integrity. Contact discharge: 30kV； Air discharge: 30kV. If IEC61000-4-5 surge test requirements need to be met, GDT components should be installed at the front end.



Part Number	Description	IPP	Channels	Shape	Packaging
ULC0511CDN	5V,Bi 0.35PF 30KV	5A	1		DFN1006-2
LC05CI	5V,Bi 2PF 30KV	5A	1		SOD-323
SMD4532-090NF	90V,Bi 2KA	2000A	1		SMD4532
2R090SD-8	90V,Bi 20KA	20000A	1		SMD(8*6)

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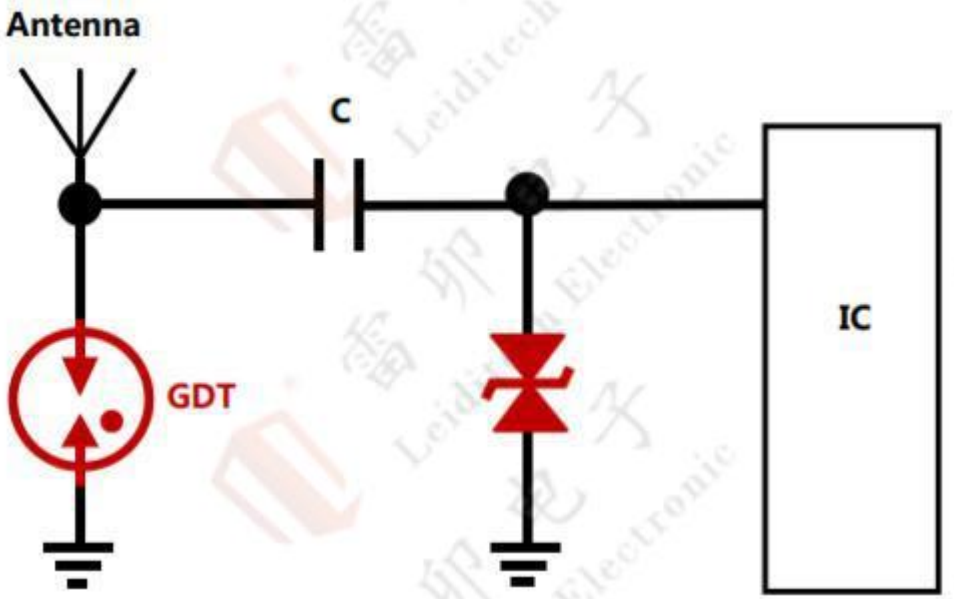
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22.1 WIFI Antenna ESD and Surge Protection Solution

Solution Advantages:This solution is designed to meet the electrostatic discharge (ESD) protection needs for WIFI antenna interfaces. It features ultra-low capacitance, ensuring signal transmission integrity. The protection includes contact discharge and air discharge capabilities, both rated at 30kV.If compliance with IEC61000-4-5 surge testing is required, GDT (Gas Discharge Tube) components should be installed at the front end of the circuit.



Part Number	Descriptions	IPP	Channels	Shape	Packaging
ULC0511CDN	5V,Bi 0.22PF 30KV	5A	1		DFN1006-2
ULC0542C-13	5V,Bi 0.13PF 2 0KV	3A	1		DFN1006-2
SMD4532-090NF	90V,Bi 2KA	2000A	1		SMD4532

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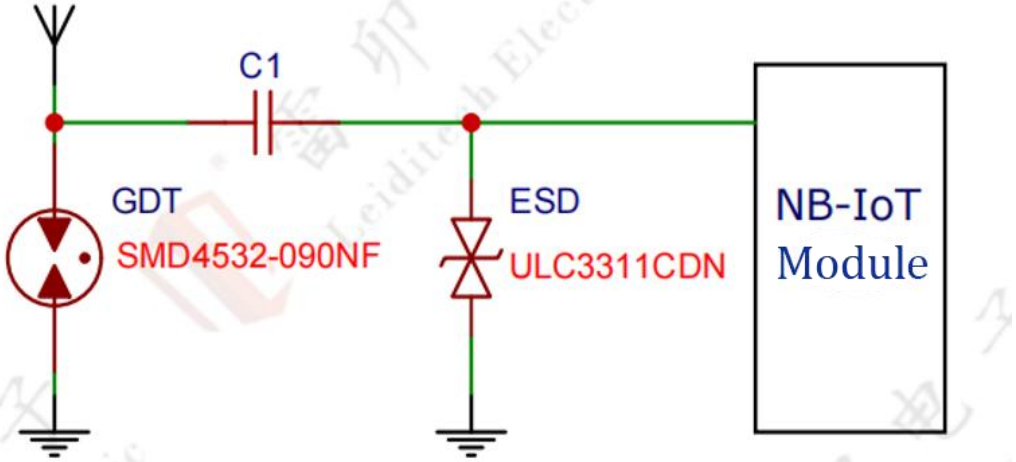
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22.2 NB-IoT Antenna Electrostatic Surge Protection Solution

Solution Advantages: Used for electrostatic surge protection of NB-IoT antenna interfaces with ultra-low capacitance to ensure signal integrity. According to the module voltage of NB-IoT, choose a 3.3V low capacitance diode ULC3311CDN or a 5V low capacitance ESD diode ULC0511CDN30, meeting IEC61000-4-2 (Level 4). If IEC61000-4-5 surge testing is required on the front-end, use GDT components such as SMD4532-090NF or 2R090-5S.



Part Number	Description	IPP	Channels	Shape	Packaging
ULC3311CDN	3.3VBi,0.45PF ±25kV(air), ±20kV(contact)	4A	1		DFN1006-2
ULC0511CDN30	5V Bi,0.22PF ±30kV(air), ±30kV(contact)	5A	1		DFN1006-2
SMD4532-090NF	90V,Bi 2KA	2A	1		SMD4532
2R090-5S	90V,Bi 5KA	5KA	1		SMD5.5X6

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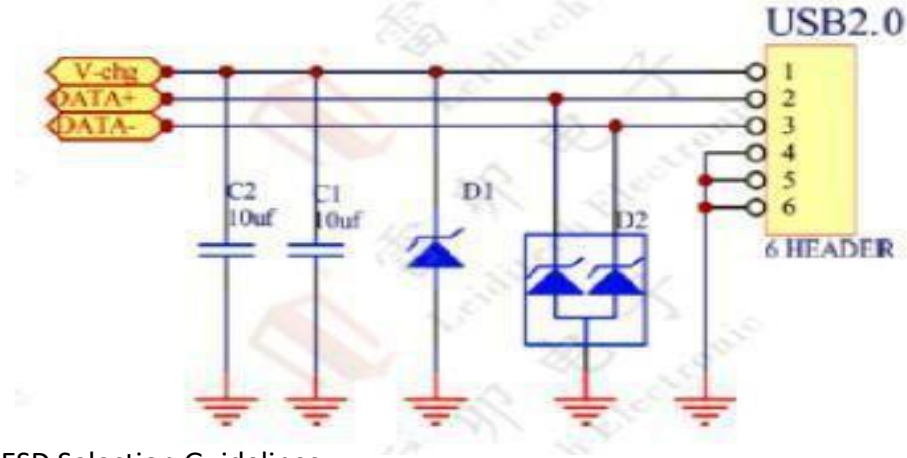
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23.1 Mobile VBAT Electrostatic Discharge (ESD) and Surge Protection Solution

Solution Advantages: This solution employs a two-level protection mechanism that saves space and provides advanced surge protection for front-end components, suitable for the Indian and Southeast Asian markets. The back-end employs DFN1006-3 dual-line ESD protection components, meeting IEC61000-4-2 standards, with contact discharge of 8kV and air discharge of 15kV.



Notes:ESD Selection Guidelines:

1. Choose the appropriate package.
2. Ensure the clamping voltage of the TVS is higher than the maximum operating voltage of the circuit.
3. Select the power that meets the test requirements.
4. Choose a smaller capacitance value.

Part Number	Description	IPP	Channels	Shape	Packaging
SD4571D3W	4.5V,Uni, 500PF ±30kV(air), ±30kV(contact)	130A	1		SOD-323
SD4501P4-3	4.5V,Uni, 650pf ±30kV(air), ±30kV(contact)	200A	1		DFN2020-3
ESDA05CP3	5V,Bi, 2pf, ±15kV(air), ±12kV(contact)	5A	2		DFN1006-3

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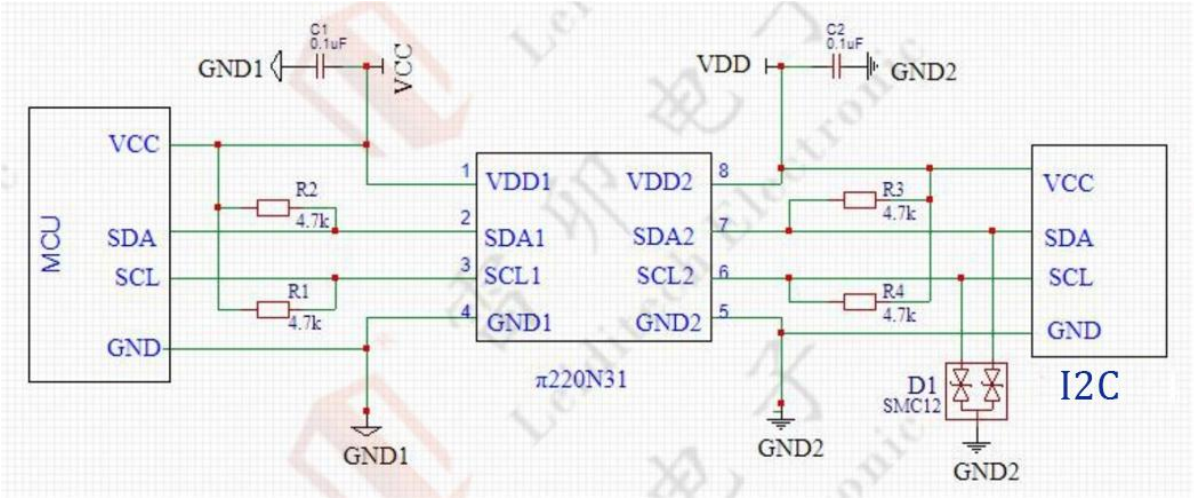
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24.1 I2C Interface Isolation and Electrostatic Discharge (ESD) Protection Solution



Static discharge protection recommended components:：

Part Number	Description	IPP	Channels	Shape	Packaging
SMC12	12V,Bi，35PF ±15kV(air), ±8kV(contact)	10A	2		SOT-23

Digital isolation recommended components:：

Part Number	Channels	Speed	Isolation Voltage	Temperature Performance	Packaging
π220N31	2	2Mhz	AC 3000Vrms Surge 10000V	-40℃-125℃	SOP-8

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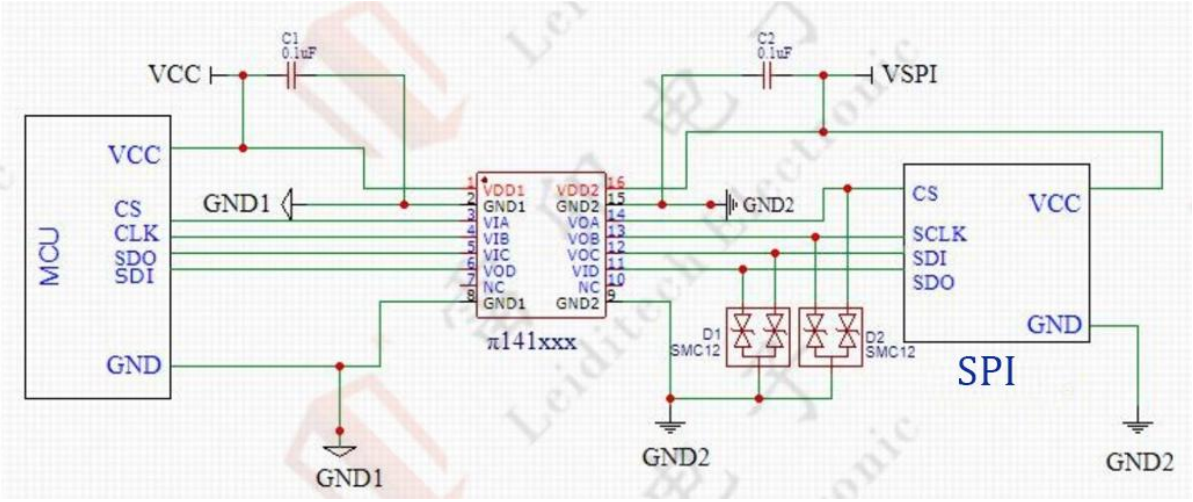
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25.1 SPI Interface Isolation and Electrostatic Discharge (ESD) Protection Solution



Static discharge protection recommended components:：

Part Number	Description	IPP	Channels	Shape	Packaging
SMC12	12V,Bi，35PF ±15kV(air), ±8kV(contact)	10A	2		SOT-23

Digital isolation recommended components:：

Part Number	Channels	Speed	Isolation Voltage	Temperature Performance	Packaging
π141xxx	4	A series：600Mbps E series：200Mbps M series：10Mbps U series：150Kbps	Option： AC 6000Vrms AC 3000Vrms	-40℃-125℃	WSOP-16 SOP-16 SSOP-16

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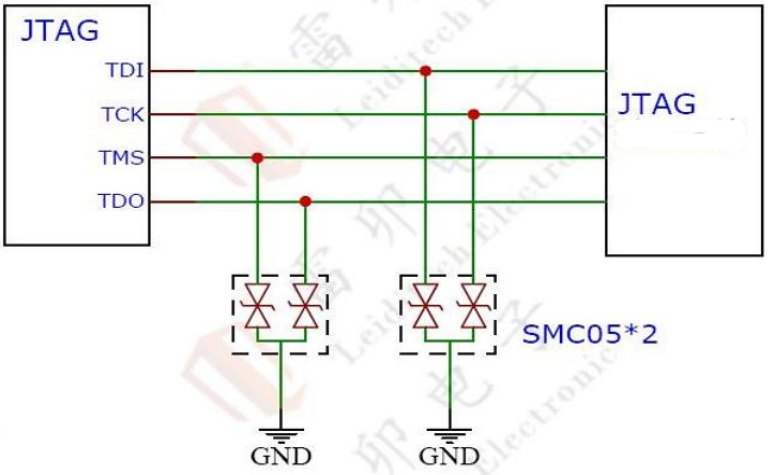
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26.1 JTAG Interface ESD Protection Scheme (5V)

Solution Advantages: The programming download interface commonly used by FPGA/ARM is the JTAG interface. The JTAG interface is frequently used as a type of programming interface, and it is also an interface that often involves electrical plugging and unplugging. This inevitably generates some static electricity or surge currents. Therefore, if some protective measures are not taken, it is very easy for the JTAG-related pins to be struck by ESD discharge, potentially damaging the internal core circuit of the CPU, resulting in permanent damage to the internal circuitry of the CPU. The solution uses integrated device protection, which can ensure signal integrity while passing the ESD test. It meets IEC61000-4-2, contact discharge 30kV, air discharge 30kV.



Part Number	Description	IPP	Channels	Shape	Packaging
SMC05	Bi, 80PF ±30kV(air), ±30kV(contact)	18A	2		SOT-23
ESDA05CP30	Bi, 15PF ±30kV(air), ±30kV(contact)	6	1		DFN1006

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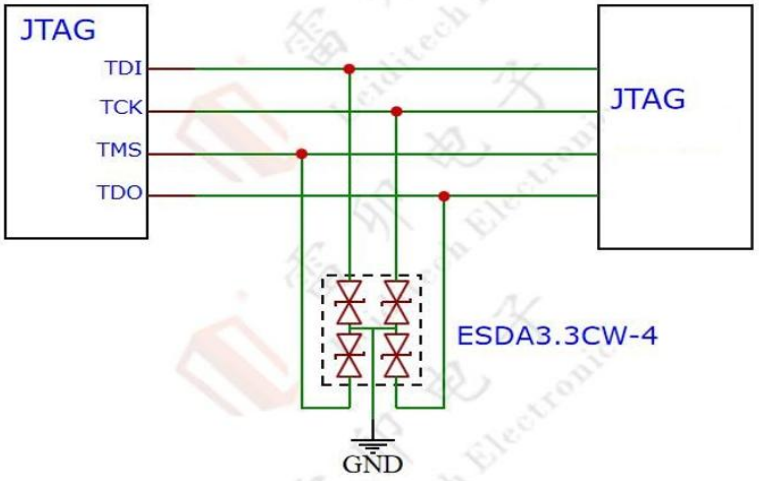
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26.2 JTAG Interface ESD Protection Solution 3.3V

Generally, the programming download interface used by general FPGA/ARM is JTAG interface. JTAG interface is a type of programming interface that is often used, and it is also a type of interface that often involves plug-in and plug-out operations. Such operations can inevitably generate some static electricity or surge currents. Therefore, if some protective measures are not taken, it is very easy for the JTAG-related pins to be damaged by ESD discharge, which can even damage the core circuit inside the CPU, causing permanent damage to the internal circuits. Solution Advantages: Using integrated device protection can ensure the integrity of the signal while passing the ESD test. Standard Compliance: Meets IEC61000-4-2, withstanding contact discharge of 30kV and air discharge of 30kV.



Part Number	Description	IPP	Channels	Shape	Packaging
ESDA3.3CW-4	Bi, 13PF ±30kV(air), ±30kV(contact)	2.5A	4		SOT-353
ESDA33CP30	Bi, 6PF ±30kV(air), ±30kV(contact)	7	1		DFN1006

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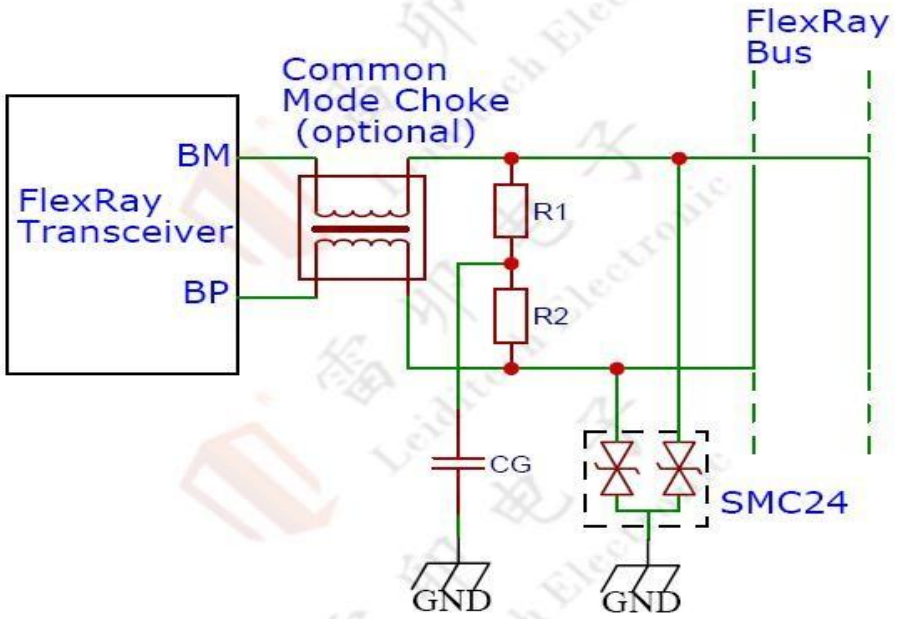
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27.1 FlexRay Automotive Network ESD Protection Solution

FlexRay automotive network standards have become the basis for similar products, representing the latest development following CAN and LIN. FlexRay offers faster data speeds, more flexible data communication, and comprehensive options and error handling. FlexRay can support various topologies, achieving 20 times the bandwidth of CAN networks (20Mbit/S).Solution Advantages: Leiditech provides multiple protection solutions to address potential ESD damage or other transient over-voltage issues, including low-energy 8/20μs surge currents.Compliance:The solution meets the IEC61000-4-5 standard for 8/20μs surge current.



Part Number	Description	IPP	Channels	Shape	Packaging
SMC24	24V Bi, 11PF ±25kV(air), ±20kV(contact)	3A	2		SOT-23

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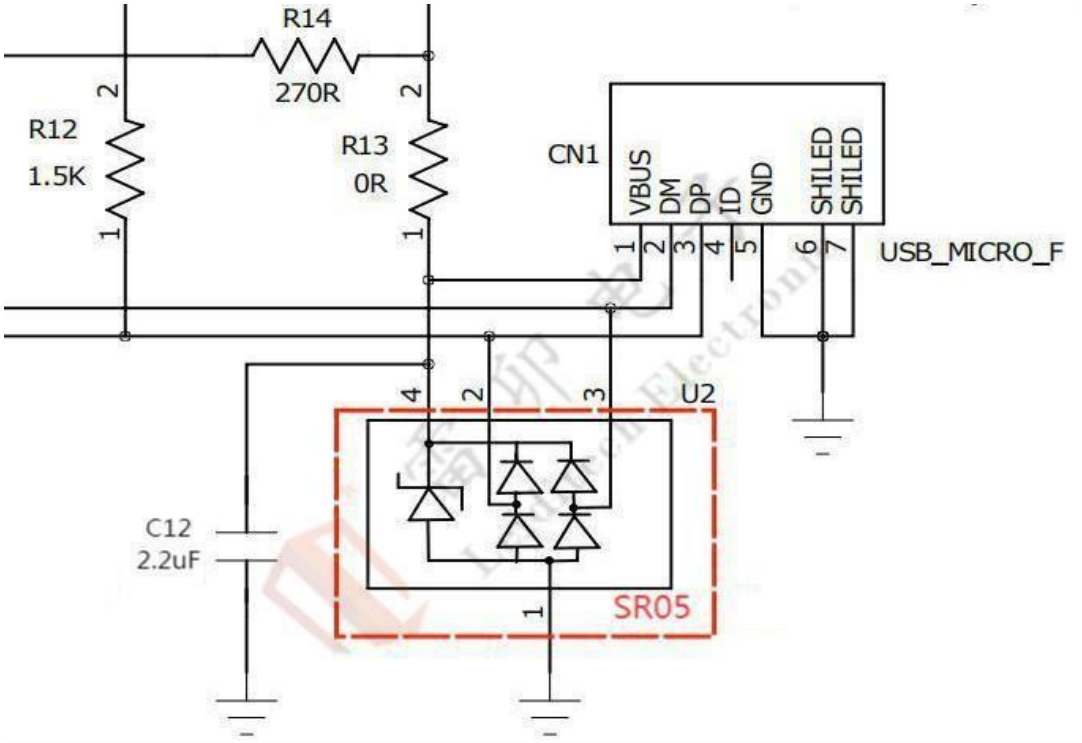
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28.1 Fingerprint Recognition Electrostatic Protection Solution

Solution Advantages:Humans are the largest carriers of static electricity, typically carrying tens of thousands of volts. During the dry autumn and winter seasons, static electricity is more likely to accumulate on the human body. Given that fingerprint recognition inevitably involves contact with humans, electrostatic protection becomes crucial. This solution uses single component protection, saving space, ensuring signal integrity, and meeting IEC61000-4-2 standards, Class 4, with contact discharge at 20kV and air discharge at 20kV.



Part Number	Description	IPP	Channels	Shape	Packaging
SR05	5V, Ultra-Low Capacitance 0.45PF ±20kV(air), ±20kV(contact)	3A	3		SOT-143

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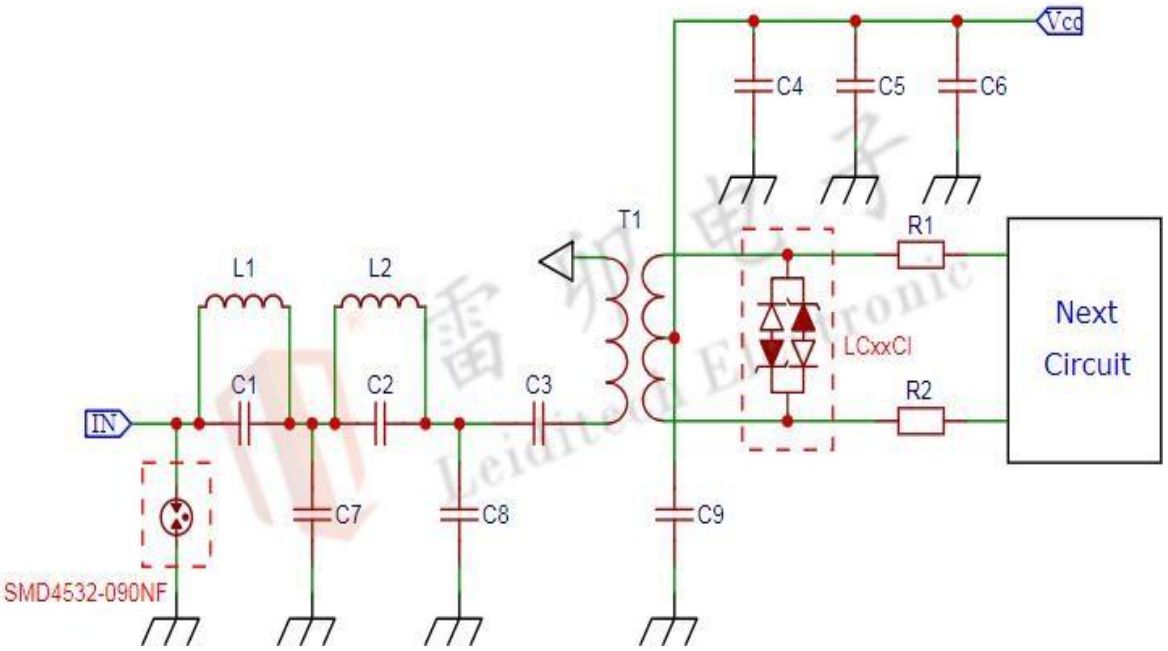
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29.1 Coaxial Surge Protection Solution

Solution Advantages: This solution is designed to protect the GPS interface, safeguarding both the power supply and the emitted signal from surges. The solution employs a two-stage protection mechanism, ensuring reliable operation and maintaining signal integrity at high temperatures. It complies with IEC61000-4-2, level 4 standards, with contact discharge protection up to 30kV and air discharge protection up to 30kV. Additionally, it meets the IEC61000-4-5 standard with an 8/20μs surge capability of 5kA.



Part Number	Description	IPP	Channels	Shape	Packaging
LC05CI	3.3~24V, 1PF ±30kV(air), ±30kV(contact)	18A	1		SOD-323
SMD4532-090NF	90V Bi 1PF	3KA	1		SMD4532

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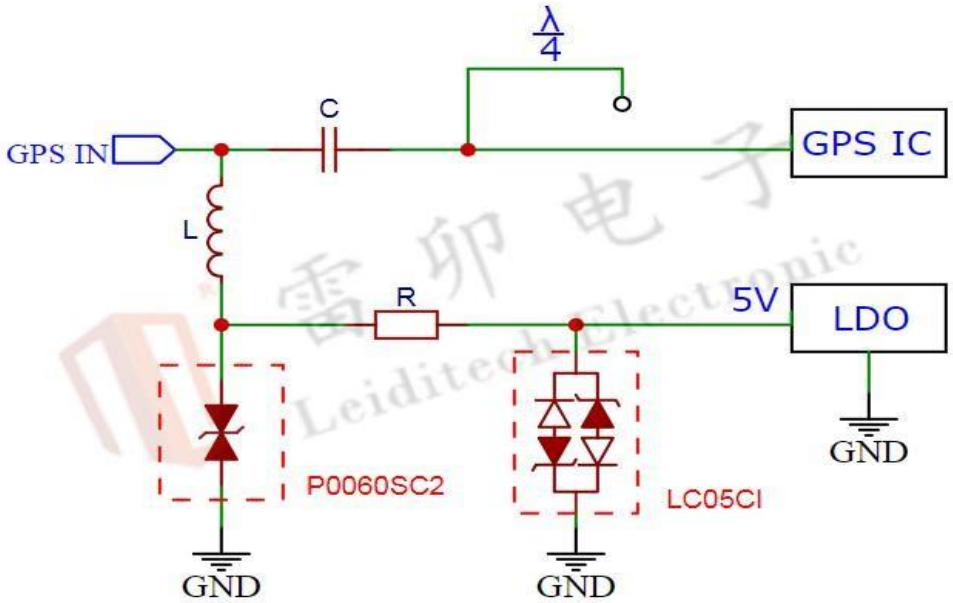
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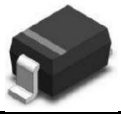
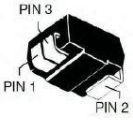
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30.1 GPS Surge Protection Solution

Solution Advantages:This solution is designed to protect the GPS interface, safeguarding both the power supply and the emitted signal from surges. The solution employs a two-stage protection mechanism, ensuring reliable operation and maintaining signal integrity at high temperatures. It complies with IEC61000-4-2, level 4 standards, with contact discharge protection up to 30kV and air discharge protection up to 30kV. Additionally, it meets the IEC61000-4-5 standard with an 8/20μs surge capability of 5kA.



Part Number	Description	IPP	Channels	Shape	Packaging
LC05CI	5V, 1PF ±30kV(air), ±30kV(contact	18A	1		SOD-323
P0060SC2	6V,80PF	0.4KA	2		SMB-3

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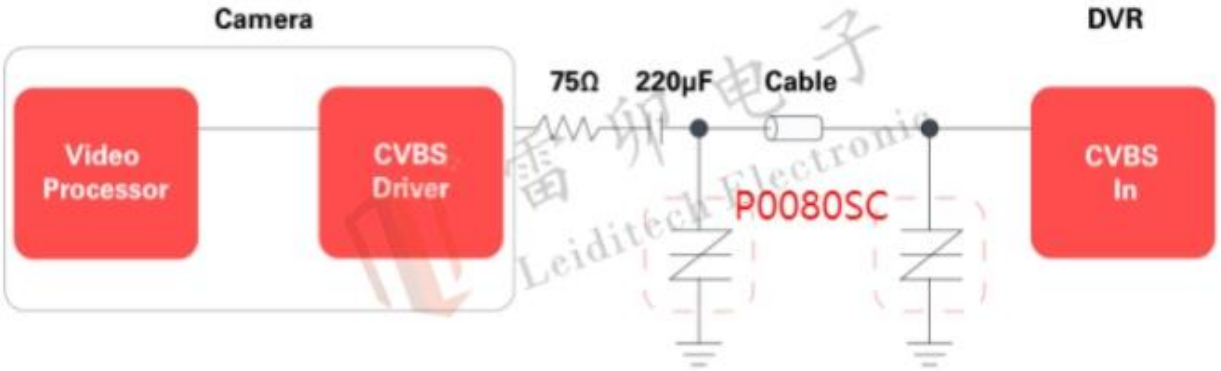
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31.1 CVBS Interface Protection Solution

Solution Highlights: This solution is designed for lightning and surge protection of CVBS interfaces, utilizing two-level protection to ensure reliable operation and maintain signal integrity at high temperatures. Meets IEC61000-4-5 standards; Complies with GB/T17626.5 requirements; Capable of handling 8/20μs 400A, 10/1000μs 100A surges.



Part Number	Description	IPP	Channels	Shape	Packaging
P0080SC	6V, 150PF	100A	1		SMB

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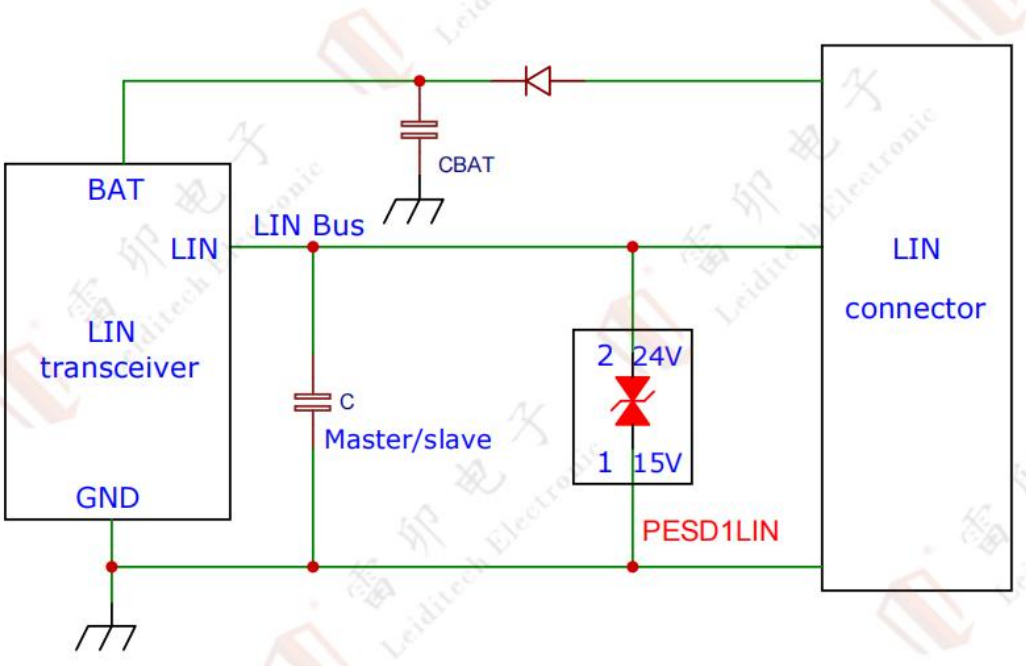
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32.1 LIN Bus Interface ESD Protection Solution

LIN (Local Interconnect Network) is a low-cost serial communication network used to implement distributed electronic system control in vehicles. It serves as a complement to controller area network (CAN) for vehicle multiplexing, suitable for applications where bandwidth, performance, or fault tolerance are not critical. LIN uses SCI (UART) data format, typically with a single master controller/multiple slaves mode.Solution Advantages:This solution uses integrated components for protection, with a capacitance of <20pF, ensuring signal integrity and passing ESD testing. It meets IEC61000-4-2, Class 4, with contact discharge at 30kV and air discharge at 25kV.



Part Number	Description	IPP	Channels	Shape	Packaging
PESD1LIN	24V, 15VBi, 15PF ±23kV(air), ±23kV(contact)	5A	1		SOD-323

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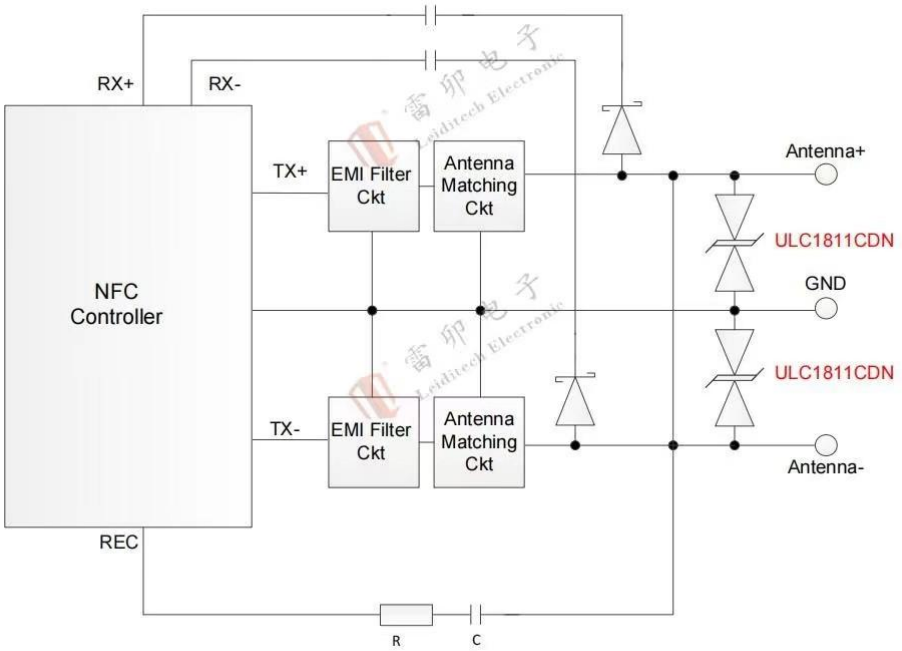
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33.1 NFC Interface Electrostatic Protection Solution

Leiditech's component ULC1811CDN meets the low-capacitance parameter requirements of 18V, and with a low clamping voltage (VC), it can reliably protect the NFC interface antenna for long-term reliability.



- NFC Protection Example

Leiditech

ULC1811CDN

Electrical Characteristics(TA=25°C unless otherwise specified)

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
Reverse Working Voltage	V_{RWM}				18	V
Breakdown Voltage	V_{BR}	I_T = 1mA	19.5			V
Reverse Leakage Current	I_R	V_{RWM} = 18V			0.2	μA
Clamping Voltage	V_C	I_{PP} = 2A (8 x 20 μs pulse)			40	V
Junction Capacitance	C_J	V_R = 0V, f = 1MHz		0.3		pF

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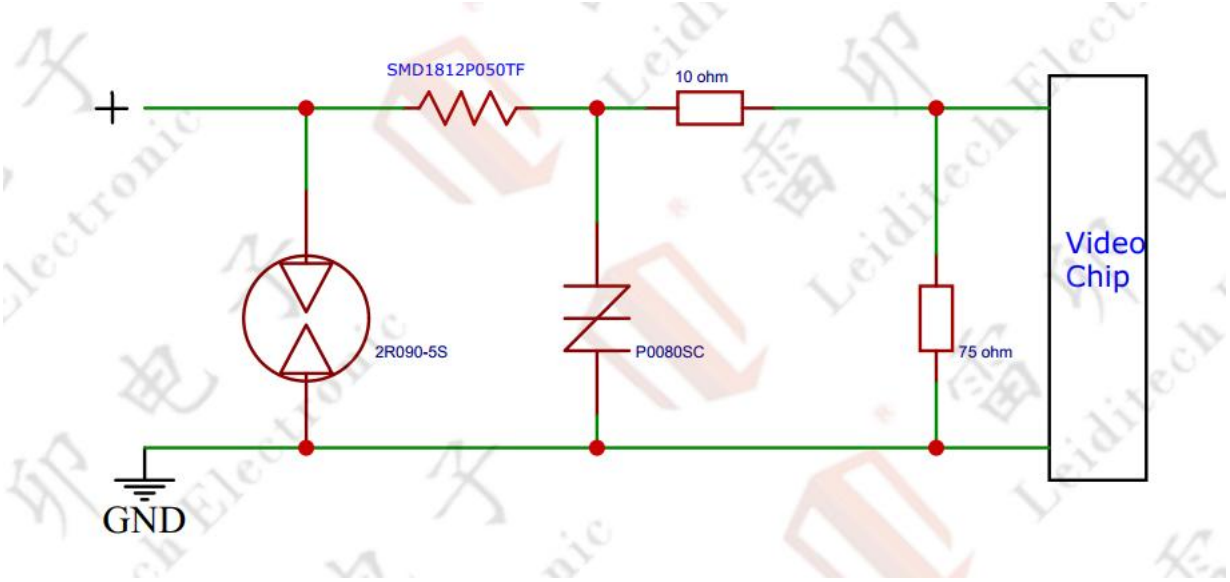
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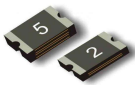
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34.1 VIDEO Interface ESD Surge Protection Solution

Solution Advantages: This solution employs a two-level protection, ensuring reliable operation and signal integrity with a transmission frequency of 10MHz.
Note: For currents > 1A, use an inductor for retreat; for currents < 1A, PPPTC is more effective.
Complies with: IEC61000-4-2, Class 4, contact discharge 8KV, air discharge 15KV; IEC61000-4-5 10/700μs 6KV



Part Number	Description	IPP	Channels	Shape	Packaging
2R090-5S	90V, Bi, 1PF	5KA	1		D=5.5MM
P0080SC	6V, Bi, 100PF	100A	1		SMB
SMD1812P050TF	0.5A, 0.15Ω, 15V	0.5	1		SMD1812

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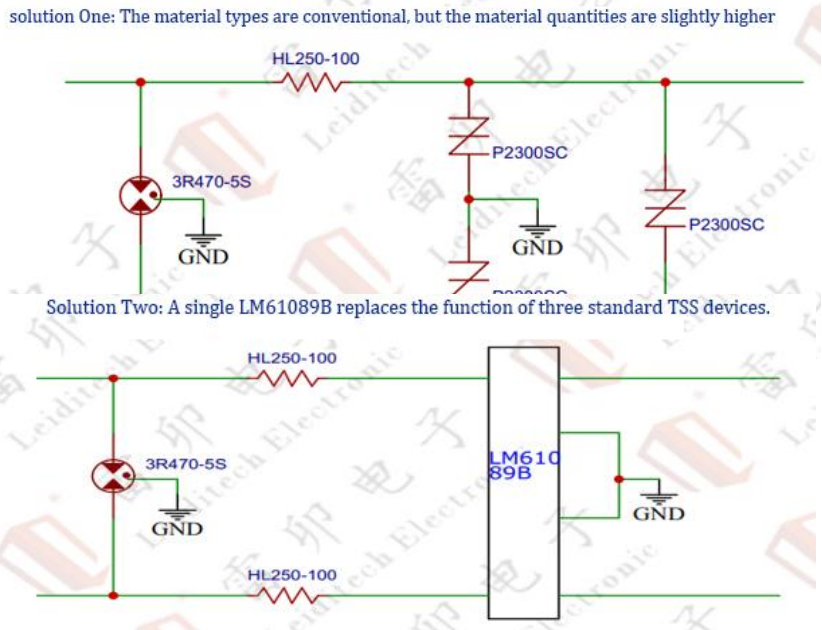
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35.1 RJ11 Surge Protection Solution

Solution Advantages:The solution uses two-level protection for reliable operation, ensuring signal integrity with a transmission frequency of 56KHz.Compliance: IEC61000-4-2, Class 4: Contact discharge 8KV, air discharge 15KV; IEC61000-4-5: 10/700μs 6KV.

Note: For currents less than 1A, PPPTC provides better protection. For currents greater than 1A, use inductance for protection.



Part Number	Description	IPP	Channels	Shape	Packaging
3R470-5S	470V, Bi1PF	5KA	2		Three Poles D=5.0MM
P2300SC	190V, Bi, 120PF	100A	1		SMB
LM61089B	167V, 100PF	50A	4		SOP-8
HL250-100	0.1A, 20Ω, 250V	0.1A	1		PTH

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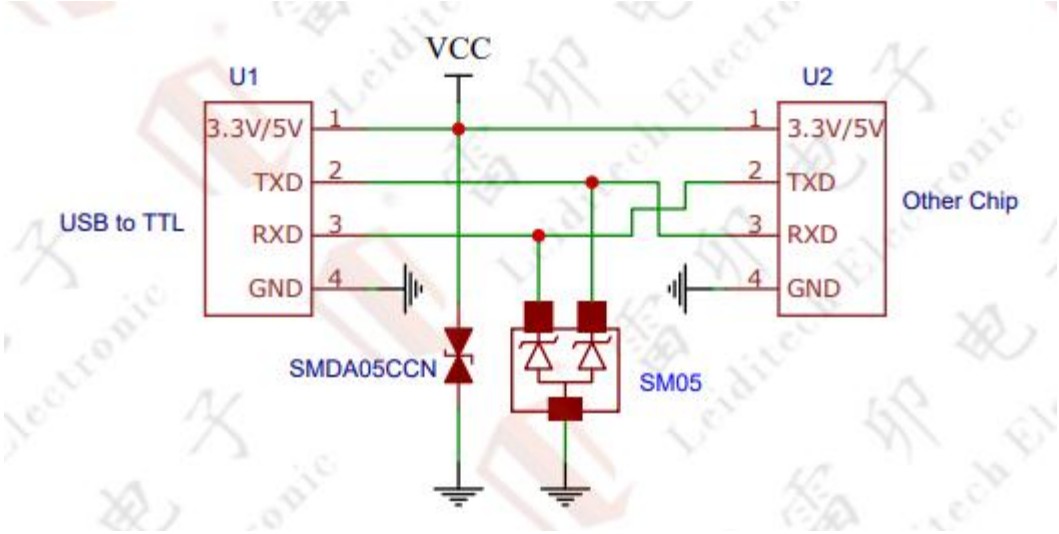
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36.1 TTL Electrostatic Protection Solution

Solution Advantages: This solution uses single components for protection. The small package size saves space and ensures signal integrity. It meets the IEC61000-4-2 standard, Class 4, with contact discharge of 30kV and air discharge of 30kV.



Part Number	Description	IPP	Channels	Shape	Packaging
SMDA05CCN	5V,Bi，60PF ±30kV(air), ±30kV(contact)	30A	1		DFN1006
SM05	5V,Uni，168PF ±30kV(air), ±30kV(contact)	30A	2		SOT-23

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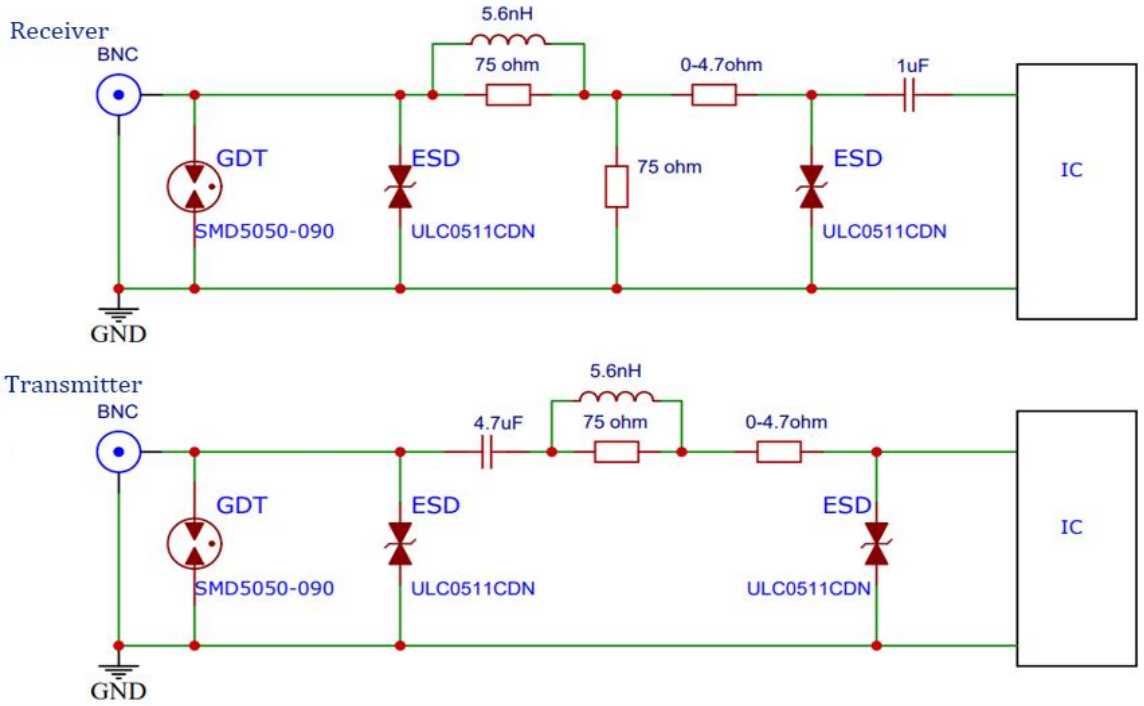
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37.1 HD-SDI Interface Protection Solution

Advantages of this solution: As a real-time high-definition technology, the application scope of HD-SDI is increasingly widespread, making the protection of its receiving and transmitting ends essential. Leiditech Electronics provides the following protection solution for this interface.
Features: Transmission frequency of 1.485G–2.97GHz. Compliant with IEC61000-4-5 standards (10/700US 6KV, 1.2/50US & 8/20US 6KV/3KA) and IEC61000-4-2 standards for contact discharge of 8KV and air discharge of



Part Number	Description	IPP	Channels	Shape	Packaging
ULC0511CDN	5V,Bi 0.35PF 30KV	5A	1		DFN1006-2
SMD5050-090NF	90V,Bi 5KA	5000A	1		SMD5050

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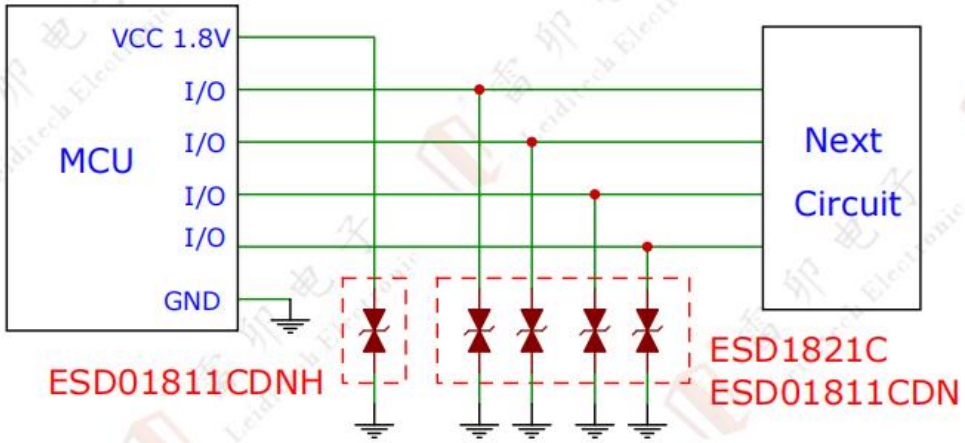
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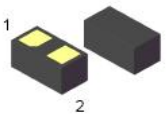
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1.0 1.8V VCC Power Supply ESD Protection Solution

Solution Advantages: Designed to meet the ESD surge protection requirements for IC VCC 1.8V power supply. Depending on the power supply environment, appropriate ESD devices are selected for ESD current protection; I/O interfaces select ESD01811CDN, ensuring signal integrity while passing ESD testing. Complies with IEC61000-4-2, Level 4, withstanding contact discharge of 30KV and air discharge of 30KV.



Part Number	Description	IPP	Channels	Shape	Packaging
ESD1821C	1.8V, 25PF ±30kV(air), ±30kV(contact)	18A	1		DFN0603
ESD01811CDN	1.8V, 30PF ±30kV(air), ±30kV(contact)	12A	1		DFN1006
ESD01811CDNH	1.8V, 80PF ±30kV(air), ±30kV(contact)	38A	1		DFN1006

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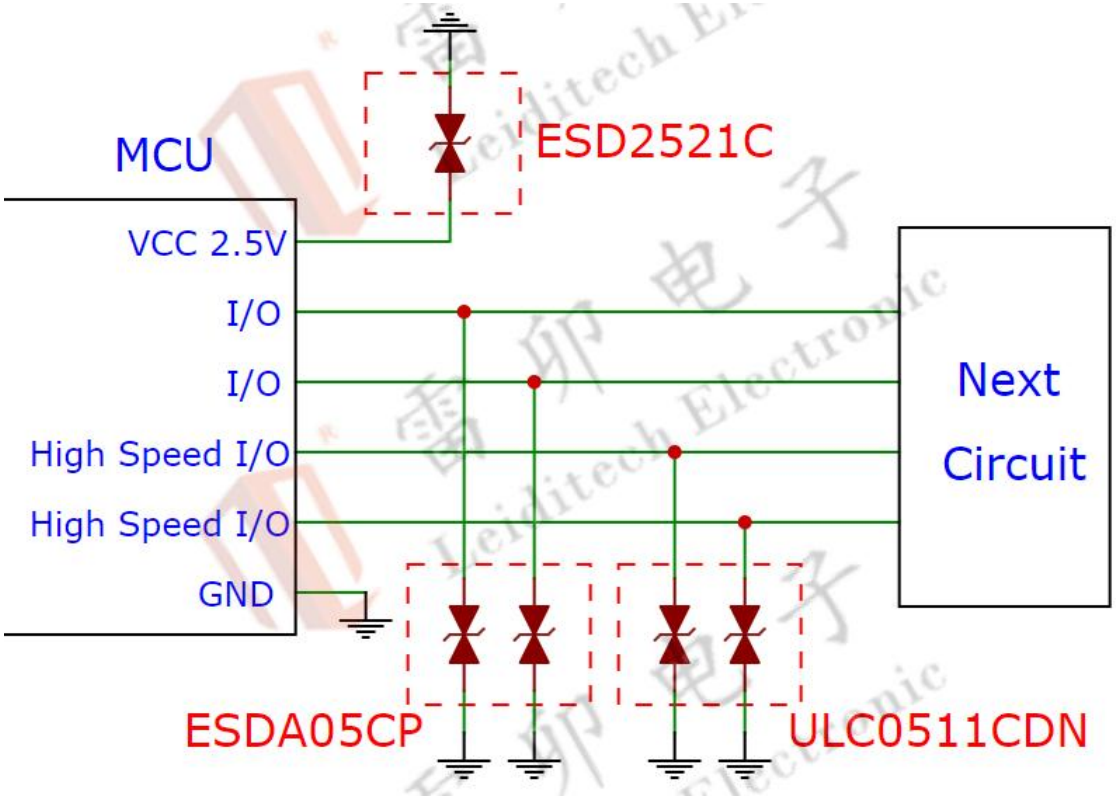
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1.1 2.5V Vbus Power Supply ESD Protection Solution

Solution Advantages: This solution is designed to meet the ESD surge protection requirements for IC VCC 2.5V. Based on the power supply environment, suitable ESD components are selected to protect the current. For high-speed transmission interfaces, the ultra-low capacitance ULC2511CDN is chosen to ensure signal integrity and pass ESD tests. It meets the IEC61000-4-2 standard, Class 4, withstanding 30KV contact discharge and 30KV air discharge.



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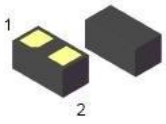
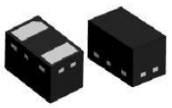
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1.1 2.5V Vbus Power Supply ESD Protection Solution

Part Number	Description	IPP	Channels	Shape	Packaging
ESD2521C	2.5V，23PF ±30kV(air), ±30kV(contact)	17A	1		DFN0603
ESD2511CDN	2.5V，58PF ±30kV(air), ±30kV(contact)	24A	1		DFN1006
SD2881D3W	2.8V，320PF ±30kV(air), ±30kV(contact)	150A	1		SOD-323
ULC0511CDN	3.3V，0.25PF ±30kV(air), ±30kV(contact)	3A	1		DFN1006

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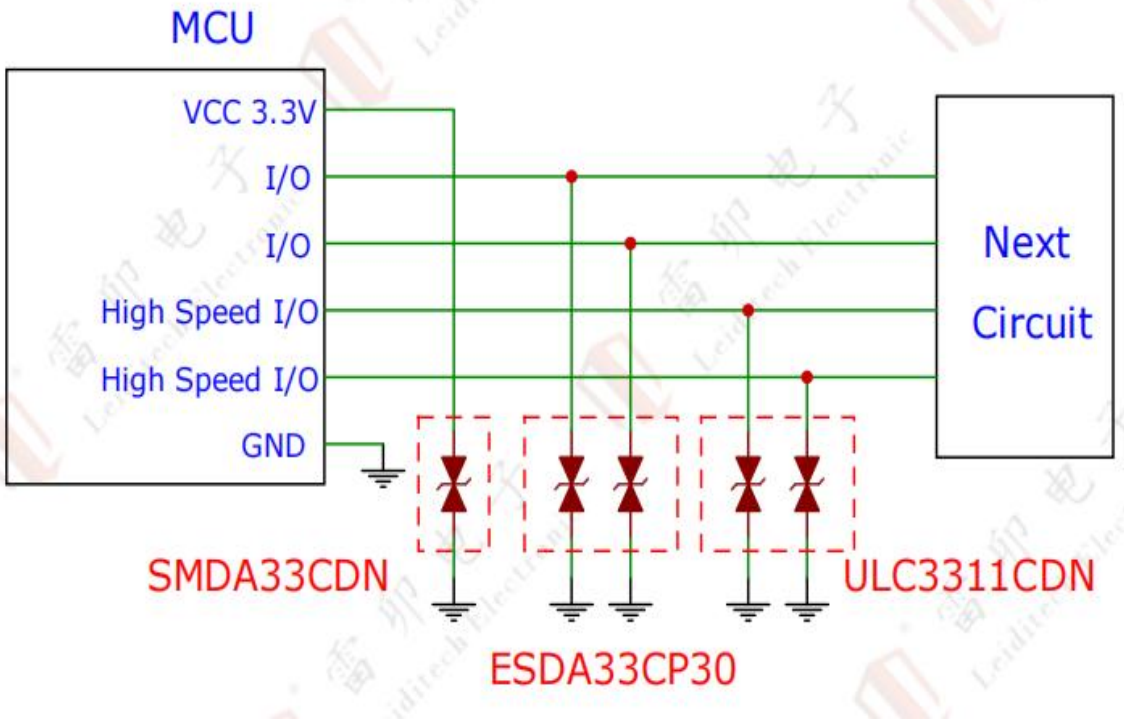
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2.1 3.3V Vbus Power Supply ESD Protection Solution

Solution Advantages: This solution is designed to meet the ESD surge protection requirements for IC VCC 3.3V. Based on the power supply environment, suitable ESD components are selected to protect the current. For high-speed transmission interfaces, the ultra-low capacitance ULC0511CDN is chosen to ensure signal integrity and pass ESD tests. It meets the IEC61000-4-2 standard, Class 4, withstanding 30KV contact discharge and 30KV air discharge.



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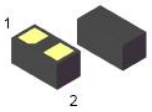
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2.1 3.3V Vbus Power Supply ESD Protection Solution

Part Number	Description	IPP	Channels	Shape	Packaging
ESD3321CH	3.3V, 15PF ±30kV(air), ±30kV(contact)	16A	1		DFN0603
ULC3311CDN	3.3V, 0.45PF ±30kV(air), ±30kV(contact)	4A	1		DFN1006
ESDA33CP30	3.3V, 8PF ±30kV(air), ±30kV(contact)	8A	1		DFN1006
SDA3311CDN	3.3V, 50PF ±30kV(air), ±30kV(contact)	35A	1		DFN1006
SD03CW	3.3V, 50PF ±30kV(air), ±30kV(contact)	38A	1		SOD-323

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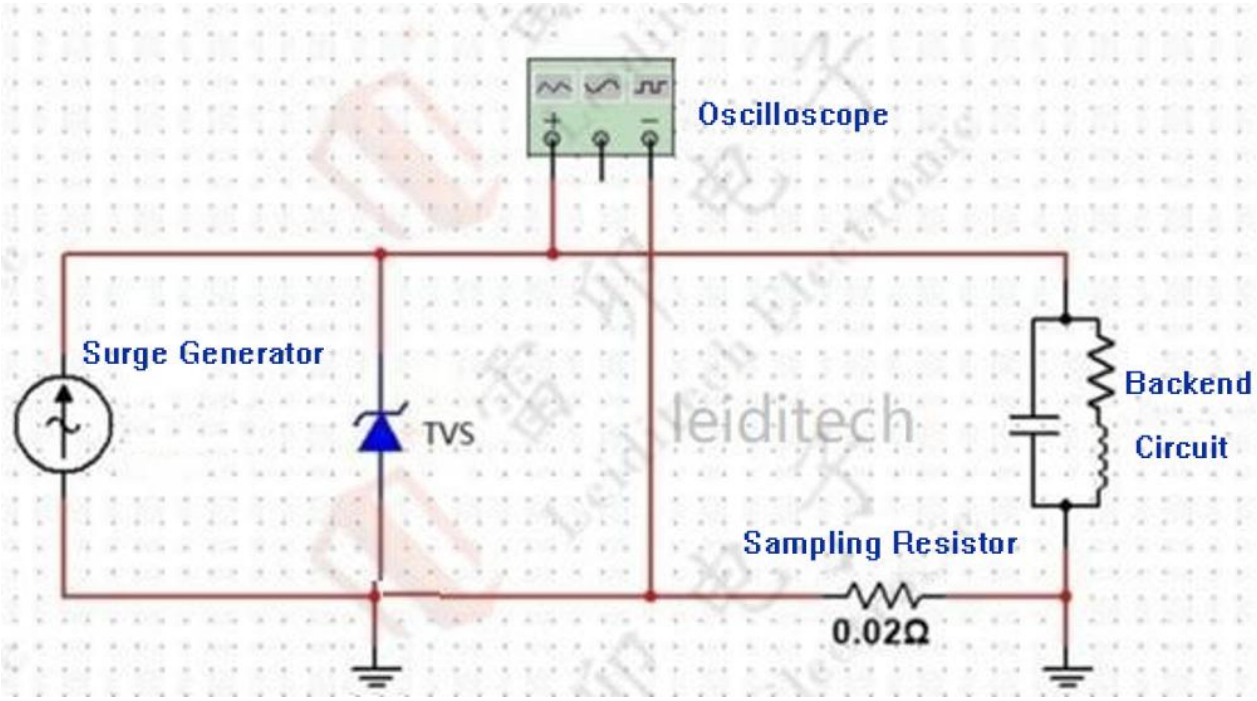
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3.1 3.7V Lithium Battery Electrostatic Surge Protection Solution

(Adding a sampling resistor after the TVS circuit aims to limit current flow, making it easier for the TVS to release surges, thus protecting the back-end circuit.)



When designing a PCB to suppress electrostatic discharge (ESD), electrical fast transients (EFT), and surge, follow these guidelines:

1. Place TVS diodes as close as possible to the input connector.
2. Minimize the length of the routing between TVS, ESD diodes, and protected lines.
3. Reduce the number of horizontal signal layers.
4. Avoid running unprotected traces parallel to protected ones.
5. Minimize conductive loop areas on the PCB, including power and ground traces.
6. Reduce the length of ground return paths.
7. Avoid sharing ground points with transient return paths.
8. Use ground planes when possible. For multilayer PCBs, use ground vias.

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3.1 3.7V Lithium Battery Electrostatic Surge Protection Solution

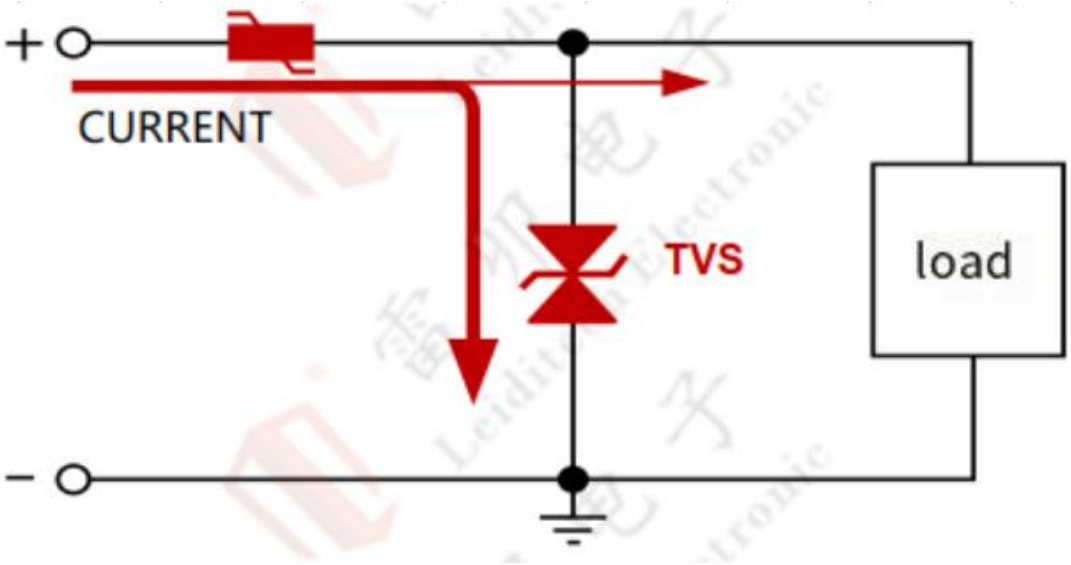
The typical voltage of a mobile phone battery is 4.2-4.5V. For precise protection, Leiditech recommends using a 4.5V TVS diode.

Part Number	Description	IPP	Channels	Shape	Packaging
ESD4521CM	4.5V, 150PF ±30kV(air), ±30kV(contact)	50A	1		DFN1006
SD4581P6W	4.5V, 280PF ±30kV(air), ±30kV(contact)	110A	1		DFN1610
SD4571D3W	4.5V, 500PF ±30kV(air), ±30kV(contact)	130A	1		SOD-323
SD4501P4-3	4.5V, 650PF ±30kV(air), ±30kV(contact)	200A	2		DFN2020-3
P4SMFJ6.0CA	6V,400W, Bi	38.83A	1		SOD-123FL
SMAJ6.0CA	6V,400W, Bi	38.8A	1		SMA
SMBJ6.0CA	6V,600W, Bi	58.3A	1		SMB
SMCJ6.0CA	6V,1500W, Bi	145.6A	1		SMC
SMDJ6.0CA	6V,3000W, Bi	291.3A	1		SMC

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4.1 5V DC Power Supply Surge Protection Solution

Solution Advantages: Used for surge protection at 5V DC power interfaces. Depending on the power source environment, choose suitable TVS components to protect the current, meeting IEC61000-4-2, Class 4, with contact discharge at 8KV and air discharge at 15KV. For higher-level surge tests complying with IEC61000-4-5, use high-power SMC components.



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4.1 5V DC Power Supply Surge Protection Solution

Part Number	Description	IPP	Channels	Shape	Packaging
PTVS0542H100	5V, 190PF ±30kV(air), ±30kV(contact)	105A	1		DFN1006
ESDA05CC	5V, 39PF ±30kV(air), ±30kV(contact)	20A	1		SOD-523
USSD0571P6W	5V, 350PF ±30kV(air), ±30kV(contact)	110A	1		DFN1610
SD05C	5V, 11PF ±30kV(air), ±30kV(contact)	5A	1		SOD-323
SD05CW	5V, 200PF ±30kV(air), ±30kV(contact)	40A	1		SOD-323
SD0581D3W	5V, 300PF ±30kV(air), ±30kV(contact)	95A	1		SOD-323

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4.1 5V DC Power Supply Surge Protection Solution

Part Number	Description	IPP	Channels	Shape	Packaging
MMF6.5CA	6.5V,200W, Bidirectional	17.9A	1		SOD-123FL
SMAJ6.5CA	6.5V,400W, Bidirectional	35.7A	1		SMA
SMBJ6.5CA	6.5V,600W, Bidirectional	53.6A	1		SMB
SMCJ6.5CA	6.5V,1500W, Bidirectional	134A	1		SMC
SMDJ6.5CA	6.5V,3000W, Bidirectional	267.9A	1		SMC

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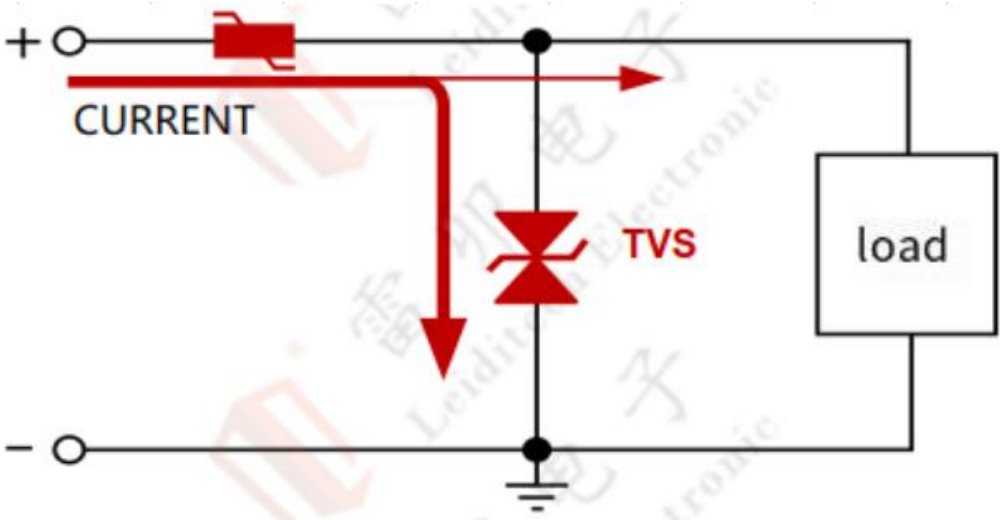
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5.1 9V DC Power Supply Surge Protection Solution

Solution Advantages: Used for surge protection at 9V DC power interfaces. Depending on the power source environment, choose suitable TVS components to protect the current, meeting IEC61000-4-2, Class 4, with contact discharge at 8KV and air discharge at 15KV. For higher-level surge tests complying with IEC61000-4-5, use high-power SMC components.



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5.1 9V DC Power Supply Surge Protection Solution

Part Number	Description	IPP	Channels	Shape	Packaging
SMF10CA	10V,200W, Bidirectional	11.8A	1		SOD-123FL
SMAJ10CA	10V,400W, Bidirectional	23.5A	1		SMA
SMBJ10CA	10V,600W, Bidirectional	35.3A	1		SMB
SMCJ10CA	10V,1500W, Bidirectional	88.2A	1		SMC
SMDJ10CA	10V,3000W, Bidirectional	176.5A	1		SMC

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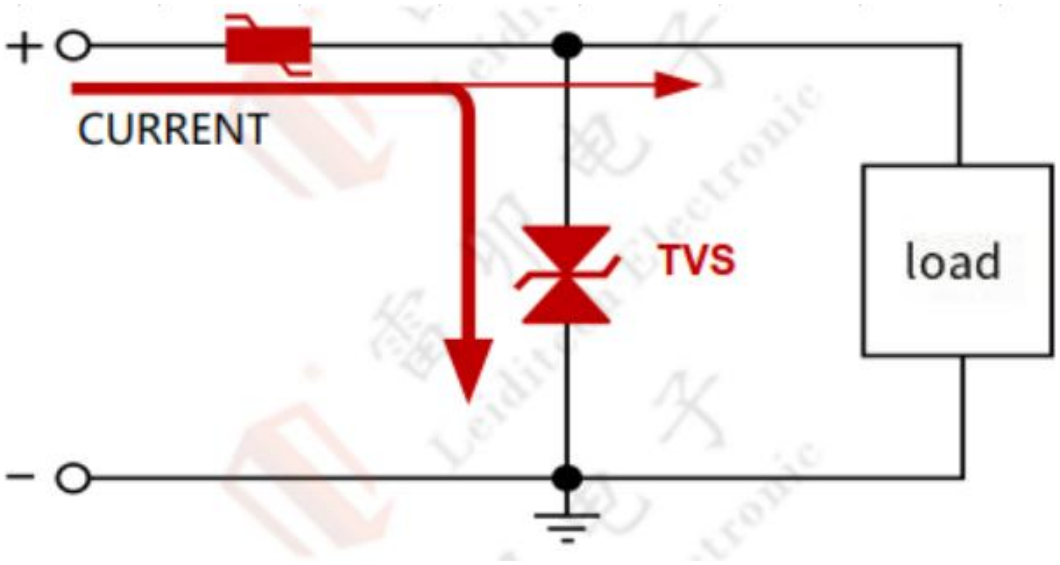
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6.1 12V DC Power Supply Surge Protection Solution

Solution Advantages: Used for surge protection at 12V DC power interfaces. Depending on the power source environment, choose suitable TVS components to protect the current, meeting IEC61000-4-2, Class 4, with contact discharge at 8KV and air discharge at 15KV. For higher-level surge tests complying with IEC61000-4-5, use high-power SMC components.



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6.1 12V DC Power Supply Surge Protection Solution

Part Number	Description	IPP	Channels	Shape	Packaging
SDA1211CDN	12V, 8PF ±30kV(air), ±30kV(contact)	8A	1		DFN1006
SD1271P6W	12V, 500PF ±30kV(air), ±30kV(contact)	64A	1		DFN1610
SD12C	12V, 56PF ±30kV(air), ±30kV(contact)	13A	1		SOD-323
SD12CW	12V, 100PF ±30kV(air), ±30kV(contact)	40A	1		SOD-323
SD1271D3W	12V, 500PF ±30kV(air), ±30kV(contact)	64A	1		SOD-323

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6.1 12V DC Power Supply Surge Protection Solution

Part Number	Description	IPP	Channels	Shape	Packaging
SMF15CA	15V,200W, Bi	8.2A	1		SOD-123FL
SMAJ15CA	15V,400W, Bi	16.4A	1		SMA
SMBJ15CA	15V,600W, Bi	24.6A	1		SMB
SMCJ15CA	15V,1500W, Bi	61.5A	1		SMC
SMDJ15CA	15V,3000W, Bi	123A	1		SMC

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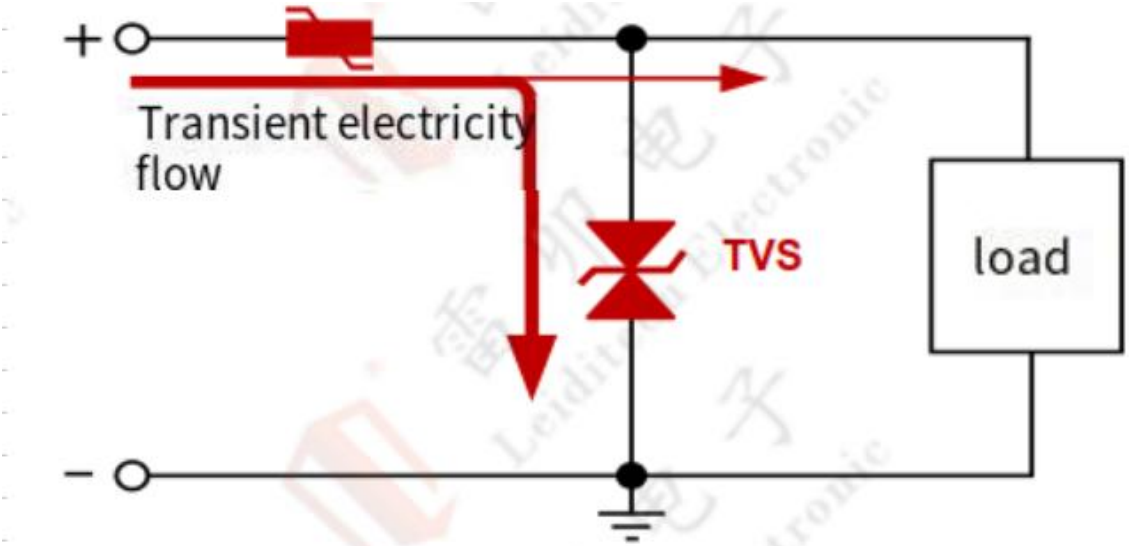
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6.2 12V Automotive Power Surge Protection Solution

Solution Advantages: This solution is designed to meet the pre-installed automotive ISO7637-2 5A5BA test standards and can use a standalone high-power TVS or a combination of PTC + TVS. It complies with ISO10605-2, Class 4, and can withstand contact discharge of 15KV and air discharge of 25KV.



Part Number	Description	Electric Current IPP	Channels	Exterior	Packaging
SM8S24A	24V, unidirectional, 87V, 0.5Ω test	170A	1		DO-218AB
5KP24CA	24V, bidirectional, 87V, 1Ω test	131A	1		R6
SMDJ24CA	24V, bidirectiona, 87V, 4Ω test	77A	1		DO-214AB SMC
SMCJ24CA	24V, bidirectional 5B test	38A	1		DO-214AB SMC
PTC HL30-300	30V, 3A, 0.025Ω	3A	1		ADT

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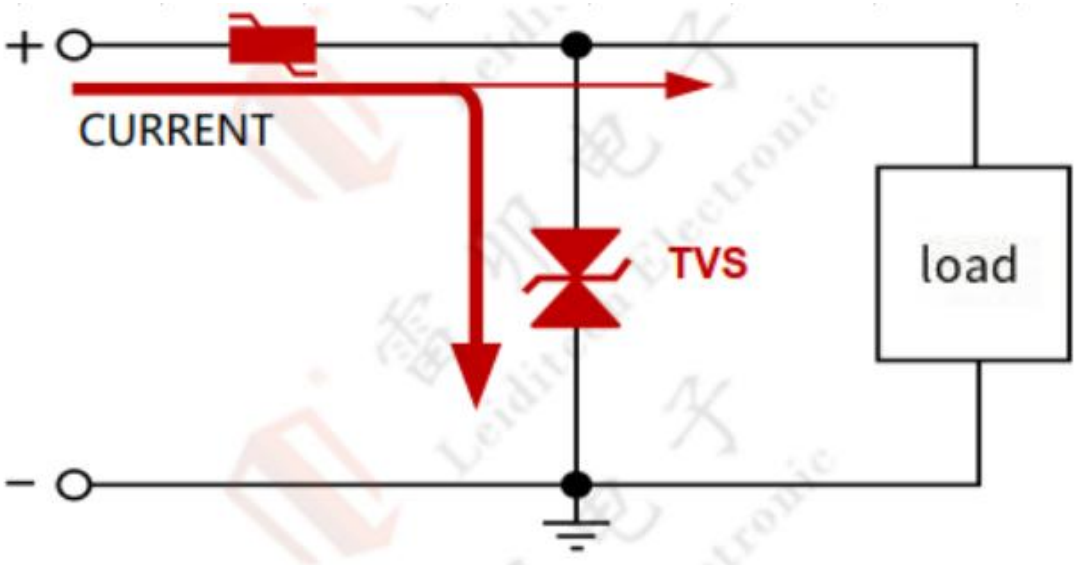
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7.1 15V DC Power Supply Surge Protection Solution

Solution Advantages: Used for surge protection at 15V DC power interfaces. Depending on the power source environment, choose suitable TVS components to protect the current, meeting IEC61000-4-2, Class 4, with contact discharge at 8KV and air discharge at 15KV. For higher-level surge tests complying with IEC61000-4-5, use high-power SMC components.



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7.1 15V DC Power Supply Surge Protection Solution

Part Number	Description	IPP	Channels	Shape	Packaging
SDA1511DN	15V, 50PF ±30kV(air), ±30kV(contact)	10A	1		DFN1006
SD1571P6W	15V, 450PF ±30kV(air), ±30kV(contact)	54A	1		DFN1610
SD15CW	15V, 80PF ±30kV(air), ±30kV(contact)	34A	1		SOD-323
SD1571D3W	15V, 450PF ±30kV(air), ±30kV(contact)	54A	1		SOD-323
MMF18CA	18V,200W, Bi	6.8A	1		SOD-123FL
SMAJ18CA	18V,400W, Bi	13.7A	1		SMA
SMBJ18CA	18V,600W, Bi	20.6A	1		SMB
SMCJ18CA	18V,1500W, Bi	51.4A	1		SMC
SMDJ18CA	18V,3000W, Bi	102.7A	1		SMC

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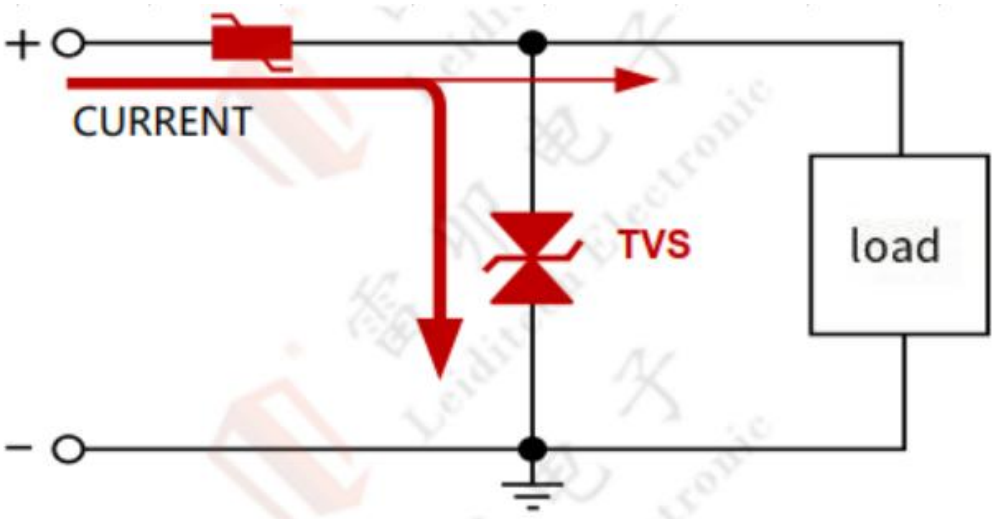
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8.1 18V DC Power Supply Surge Protection Solution

Solution Advantages: Used for surge protection at 18V DC power interfaces. Depending on the power source environment, choose suitable TVS components to protect the current, meeting IEC61000-4-2, Class 4, with contact discharge at 8KV and air discharge at 15KV. For higher-level surge tests complying with IEC61000-4-5, use high-power SMC components.



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8.1 18V DC power supply surge protection solution

Part Number	Description	IPP	Channels	Shape	Packaging
SD1871P6W	18V, 350PF ±30kV(air), ±30kV(contact)	46A	1		DFN1610
SD18CW	18V, 57PF ±30kV(air), ±30kV(contact)	15A	1		SOD-323
SD1871D3W	18V, 350PF ±30kV(air), ±30kV(contact)	46A	1		SOD-323
MMF22CA	22V, 200W, Bi	5.6A	1		SOD-123FL
SMAJ22CA	22V, 400W, Bi	11.3A	1		SMA
SMBJ22CA	22V, 600W, Bi	16.9A	1		SMB
SMDJ22CA	22V, 3000W, Bi	84.5A	1		SMC

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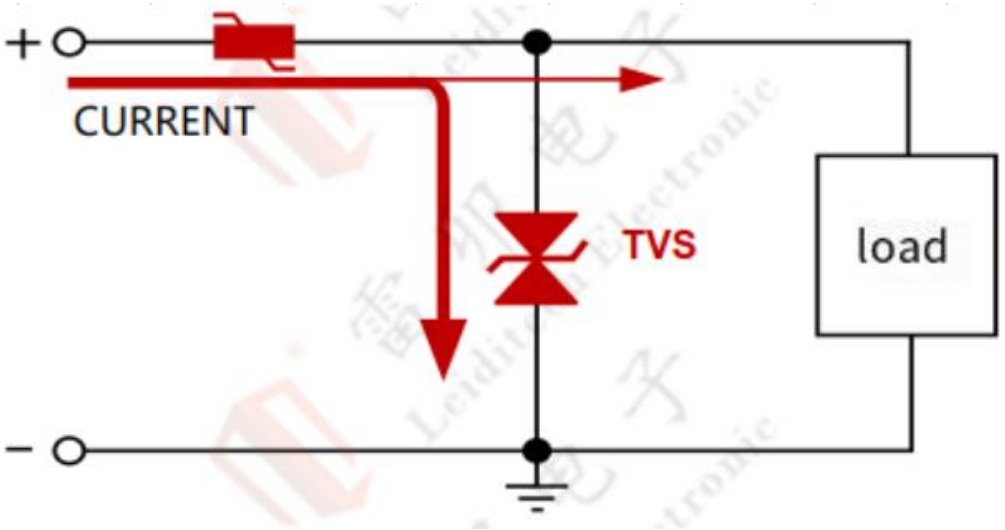
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9.1 24V DC Power Supply Surge Protection Solution

Solution Advantages: Used for surge protection at 24V DC power interfaces. Depending on the power source environment, choose suitable TVS components to protect the current, meeting IEC61000-4-2, Class 4, with contact discharge at 8KV and air discharge at 15KV. For higher-level surge tests complying with IEC61000-4-5, use high-power SMC components.



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9.1 24V DC Power Supply Surge Protection Solution

Part Number	Description	IPP	Channels	Shape	Packaging
SD24CW	24V, 50PF ±30kV(air), ±30kV(contact)	23A	1		SOD-323
SD2471D3W	24V, 200PF ±30kV(air), ±30kV(contact)	30A	1		SOD-323
MMF28CA	28V,200W, Bi	4.4A	1		SOD-123FL
SMAJ26CA	26V,400W, Bi	9.5A	1		SMA
SMBJ26CA	26V,600W, Bi	14.3A	1		SMB
LM1K24CA	24V,30KW, Bi	2KA	1		SMB
SMCJ26CA	26V,1.5KW, Bi	35.6A	1		SMC
SMDJ26CA	26V,3KW, Bi	71.3A	1		SMC

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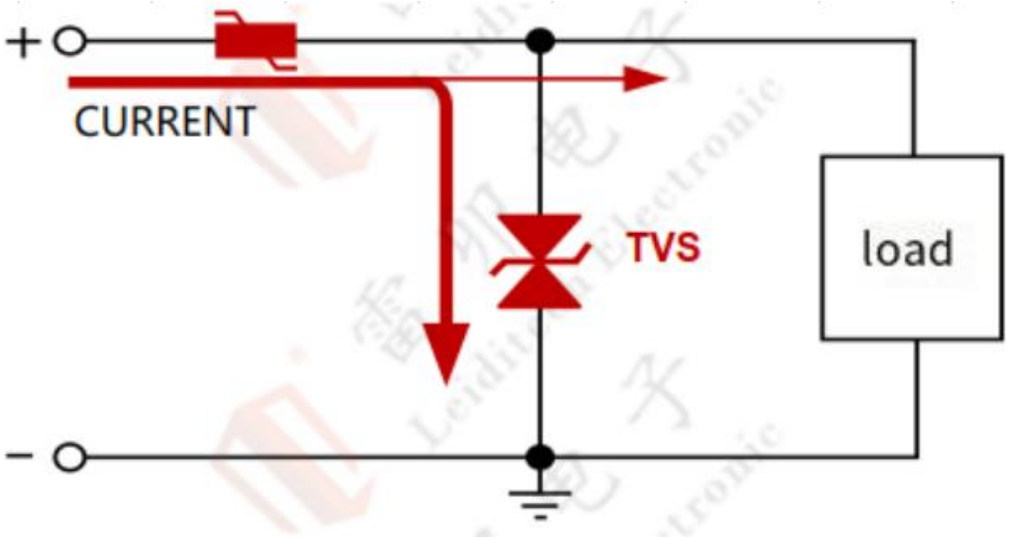
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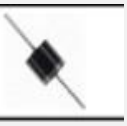
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9.2 24V Automotive Power Surge Protection Solution

Solution Advantages: This solution is designed to meet the pre-installed automotive ISO7637-2 5A5BA test standards and can use a standalone high-power TVS or a combination of PTC + TVS. It complies with ISO10605-2, Class 4, and can withstand contact discharge of 15KV and air discharge of 25KV.



Part Number	Description	IPP	Channels	Shape	Packaging
SM8S36A	36V,Uni 174V 2Ω Test	114A	1		DO-218AB
15KP363CA	36V,Bi. 174V 1Ω Test	252A	1		R6
P8S36CA	36V,Bi. 174V 2Ω Test	137A	1		
5.0SMDJ36CA	36V,Bi. 5BTest	86A	1		DO-214AB SMC
PTC HL60-300	60V 3A 0.025Ω	3A	1		PTH

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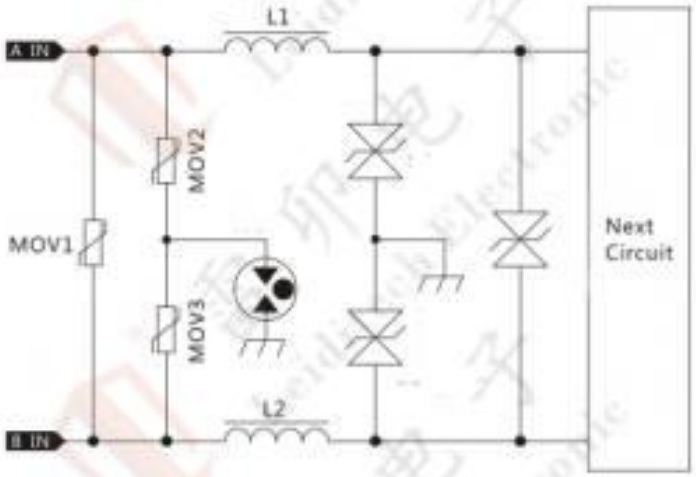
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9.3 24V DC Surge Protection 2KV, Compact and Low Residual Voltage Solution

Recently, many customers have reported that DC power supply products fail to protect against lightning strikes, leading to frequent malfunctions and significant losses. Traditionally, improving lightning protection reliability is seen as requiring significant investment. However, Leiditech Electronics has now introduced a new solution for protecting DC24V DC 2KV with a small form factor for testing. Here, we also compare this with traditional lightning protection solutions.

1. Traditional Solution DC Power Surge Protection



The traditional surge protection solution comprises GDT (3R090-5S) + MOV (10D470KJ) + Inductor + TVS (SMCJ24CA). This combination can protect against surges up to 4KV, with residual voltage levels tested at about 40V. The back-end LDO requires a significant margin of withstanding voltage.The necessity of many components is due to the layered approach in surge protection, where surges are decomposed layer by layer, ultimately reduced to TVS, ensuring IC protection. GDTs handle large surges but have a slow response and high residual voltage, necessitating MOVs and TVS for continued voltage reduction and rapid response. Inductors and PTCs are ideal for decoupling before the TVS, explaining the complexity of the circuit.

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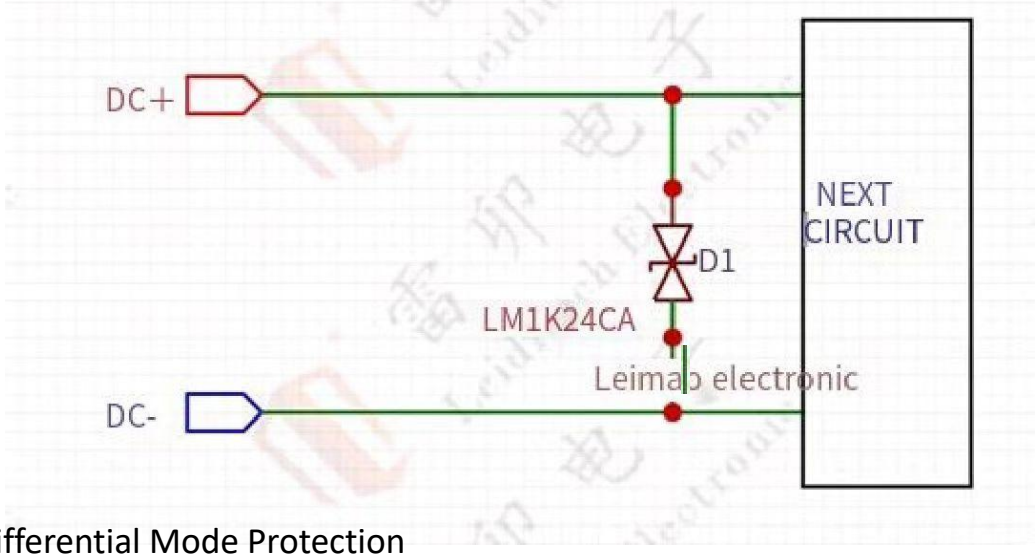
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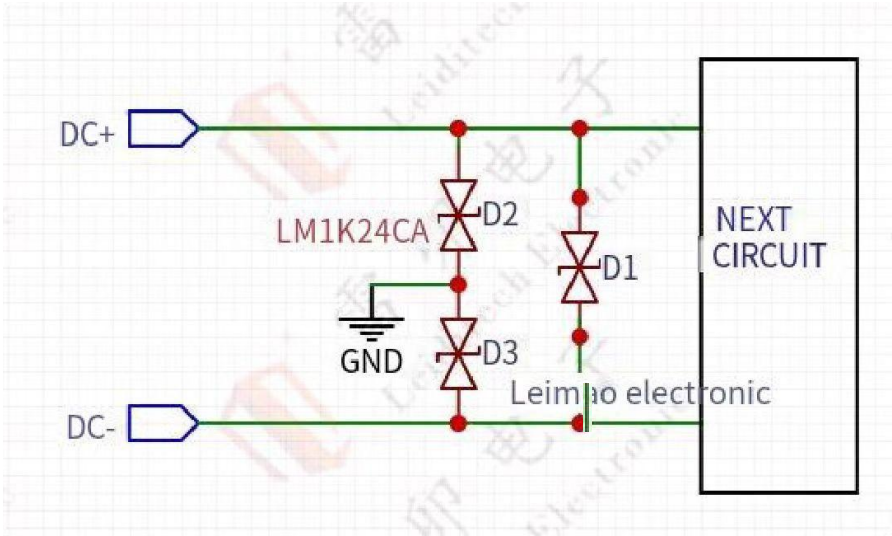
9.3 24V DC Surge Protection 2KV, Compact and Low Residual Voltage Solution

Leiditech's optimized new solution: Single-component DC power supply surge protection 2KV

If the customer's requirements are not as high and only 2KV surge protection is needed, how do we design it? As shown in the diagram below:



Differential Mode Protection



Common Mode Protection

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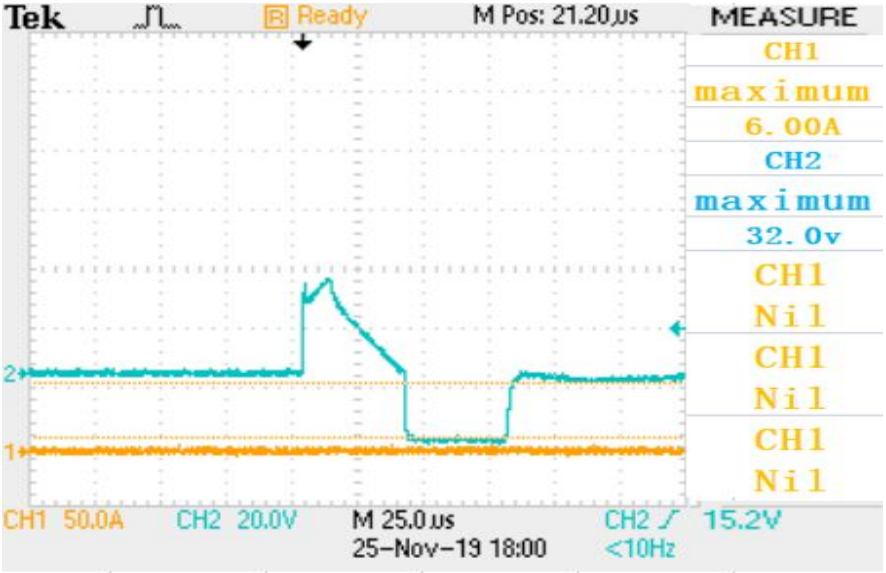
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9.3 24V DC Surge Protection 2KV, Compact and Low Residual Voltage Solution



Screenshot of the oscilloscope voltage for a 2KV surge test, typical maximum 32V.

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LM1K24CA

ELECTRICAL CHARACTERISTICS(T_A=25℃)

Part Number	V_R	I_R@V_R	V_{BR}@I_T		I_T	V_C@V_{PP}①	V_{PP}①
Bi-Polar	V	μA	min(V)	max(V)	mA	max(V)	V
LM1K24CA	24	1	25	29.5	1	35	1600

① Surge waveform: 1.2/50μs &8/20μs

V_R: Stand-off voltage -- Maximum voltage that can be applied

V_{BR}: Breakdown voltage

V_C: Clamping voltage -- Peak voltage measured across the suppressor at a specified V_{PP}

I_R: Reverse leakage current

LM1K24CA Features:

1. Package small SMB
2. 2. Low residual voltage, VC=35V, can reduce the withstand voltage cost of LDO or DC-DC
3. 3. Single can protect the level up to 2KV.

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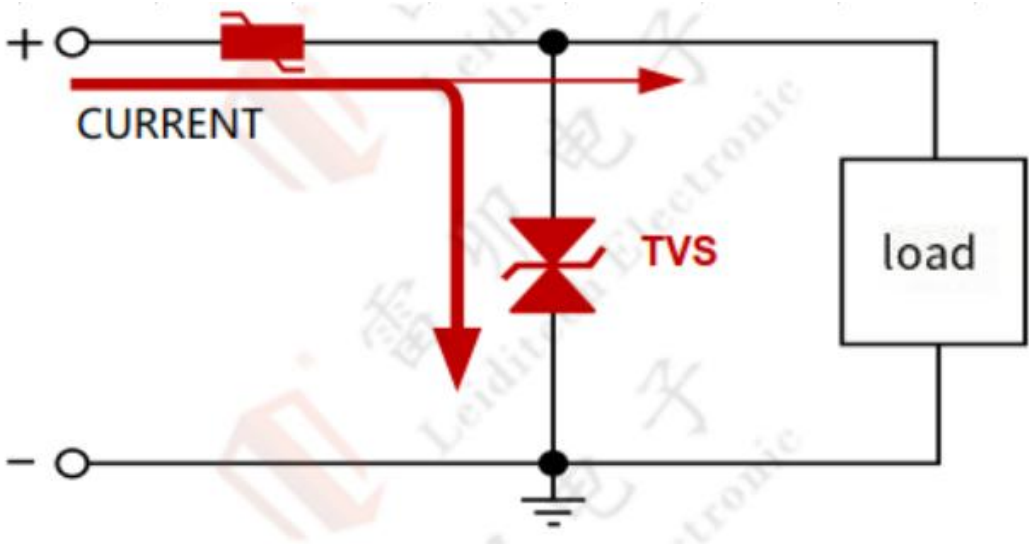
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9.4 28V DC Power Supply Surge Protection Solution



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9.4 28V DC Power Supply Surge Protection Solution

Part Number	Description	IPP	Channels	Shapes	Packaging
SMAJ30CA	30V, 400W, Bi.	8.3A	1		SMA
SMAJ33CA	33V, 400W, Bi.	7.5A	1		
SMBJ30CA	30V, 600W, Bi.	12.4A	1		SMB
SMBJ33CA	33V, 600W, Bi.	11.3A	1		
SMCJ30CA	30V, 1.5KW, Bi.	31.0A	1		SMC
SMCJ33CA	33V, 1.5KW, Bi.	28.2A	1		
SMDJ30CA	30V, 3KW, Bi.	62.0A	1		
SMDJ33CA	33V, 3KW, Bi.	56.3A	1		
5.0SMDJ30CA	30V, 5KW, Bi.	105.4A	1		
5.0SMDJ33CA	33V, 5KW, Bi.	95.7A	1		

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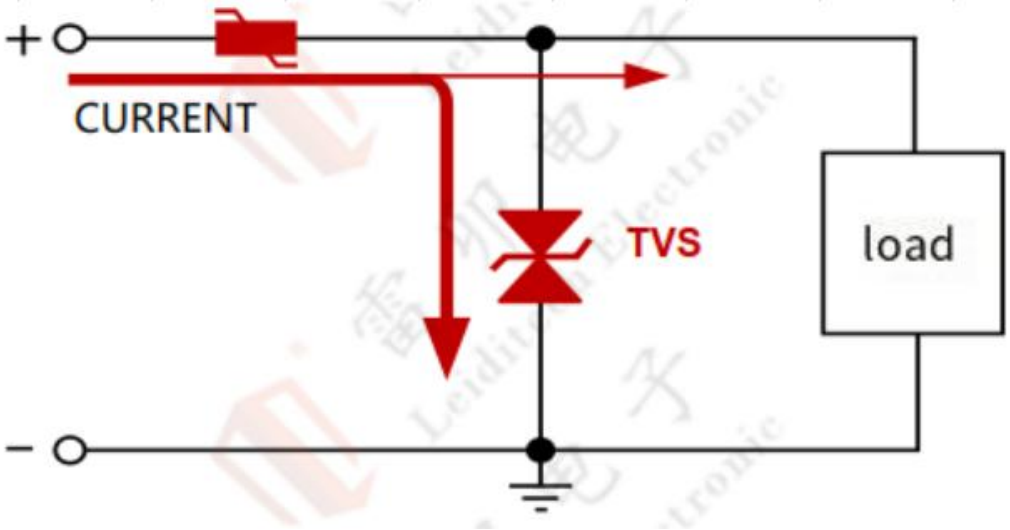
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10.1 36V DC Power Supply Surge Protection Solution

Solution Advantages: This solution is designed to address the surge protection requirements for a 36V DC power interface. Depending on the environmental conditions of the power supply, appropriately rated ESD (Electrostatic Discharge) / TVS (Transient Voltage Suppression) devices are selected to ensure compliance with IEC61000-4-2, level 4 standards, which entail withstanding contact discharge of 8kV and air discharge of 15kV. In order to meet the higher-level surge testing stipulated by IEC61000-4-5, high-power SMC devices must be employed.



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10.1 36V DC Power Supply Surge Protection Solution

Part Number	Description	IPP	Channels	Shapes	Packaging
SD3671P6W	36V, 150PF ±30kV(air), ±30kV(contact)	20A	1		DFN1610
SD3671D3W	36V, 150PF ±30kV(air), ±30kV(contact)	20A	1		SOD-323
P4SMFJ40CA	40V,400W, Bi	6.2A	1		SOD-123FL
SMAJ40CA	40V,400W, Bi	6.2A	1		SMA
SMBJ40CA	40V,600W, Bi	9.3A	1		SMB
SMCJ40CA	40V,1500W, Bi	23.3A	1		SMC
SMDJ40CA	40V,3000W, Bi	46.5A	1		SMC

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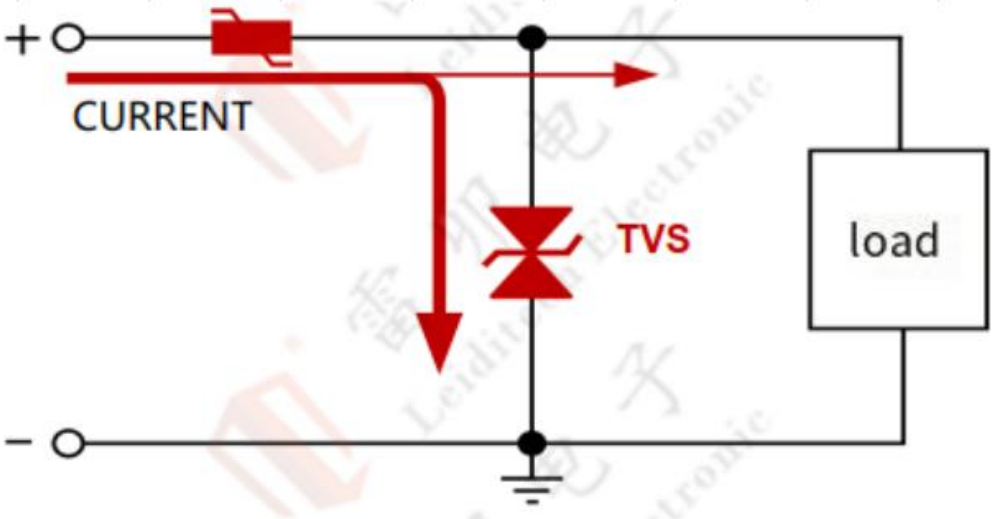
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11.1 48V DC Power Supply Surge Protection Solution

Solution Advantages: Designed to provide surge protection for 48V DC power interfaces. According to the power supply's operational environment, select the appropriate protection current of the TVS device. Complies with IEC61000-4-2, Class 4, contact discharge 8KV, air discharge 15KV. For higher-grade IEC61000-4-5 surge testing, high-power SMC components are required.



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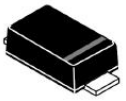
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11.1 48V DC Power Supply Surge Protection Solution

Part Number	Description	IPP	Channels	Shape	Packaging
SD48C	48V, Bi 11PF ±30kV(air), ±25kV(contact)	3A	1		SOD-323
MMF58CA	58V,200W,Bi.	2.1A	1		SOD-123FL
SMAJ58CA	58V,400W,Bi.	4.3A	1		SMA
SMBJ54CA	54V,600W,Bi.	6.9A	1		SMB
SMCJ58CA	58V,1500W,Bi.	16.1A	1		SMC
SMDJ58CA	58V,3000W,Bi.	32.1A	1		SMC
LM1K58CC	58V,Bi. , 2KV Protection	1KA	1		SMC

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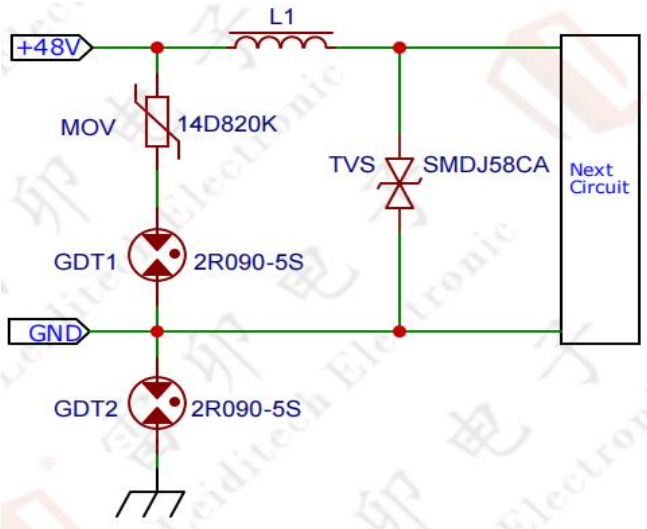
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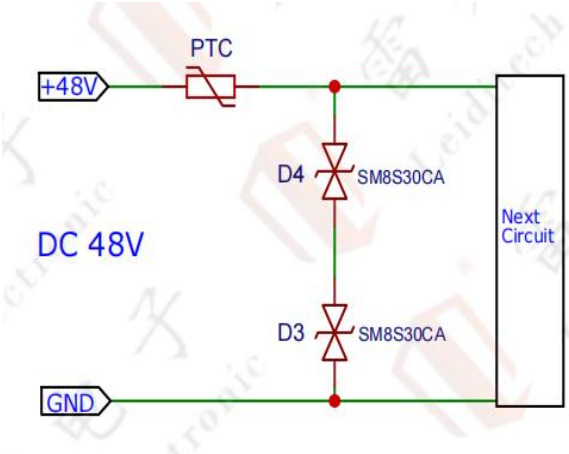
11.2 DC 48V/60V Power Supply Lightning Protection Solution for Outdoor Equipment

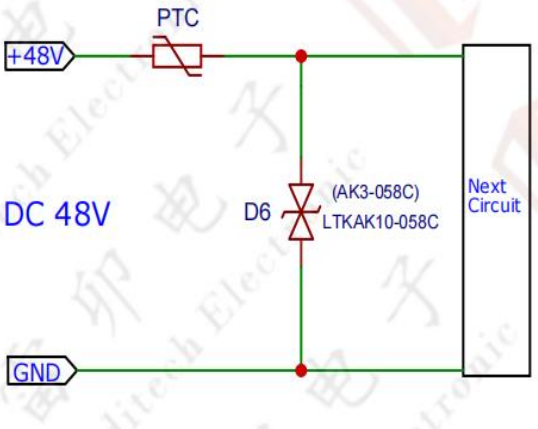
Solution Advantages: For surge protection of 48V DC power interfaces for outdoor equipment, two schemes can be considered. Select the appropriate TVS component based on the operational environment of the equipment power supply, complying with IEC61000-4-2, Class 4, contact discharge 8KV, air discharge 15KV. If higher-grade IEC61000-4-5 surge testing is required, select high-power components.

1. Traditional Solution



2. Simplified Solution





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11.2 DC 48V/60V Power Supply Lightning Protection Solution for Outdoor Equipment

3. Material list for traditional Solution

Part Number	Description	IPP	Channels	Shape	Packaging
14D820K	Varistor Voltage 82V,Bi.	4.5KA	1		14D
14D820KJ	High Energy Varistor Voltage 82V,Bi.	6KA	1		14D
2R090-5S	90V,1.5PF,Bi.	5KA	1		2R-5
SMCJ58CA	58V,1500W,Bi.	16.1A	1		SMC
SMDJ58CA	58V,3000W,Bi.	32.1A	1		SMC
LM1K58CC	58V,Bi.,2KV Protection	1KA	1		SMC

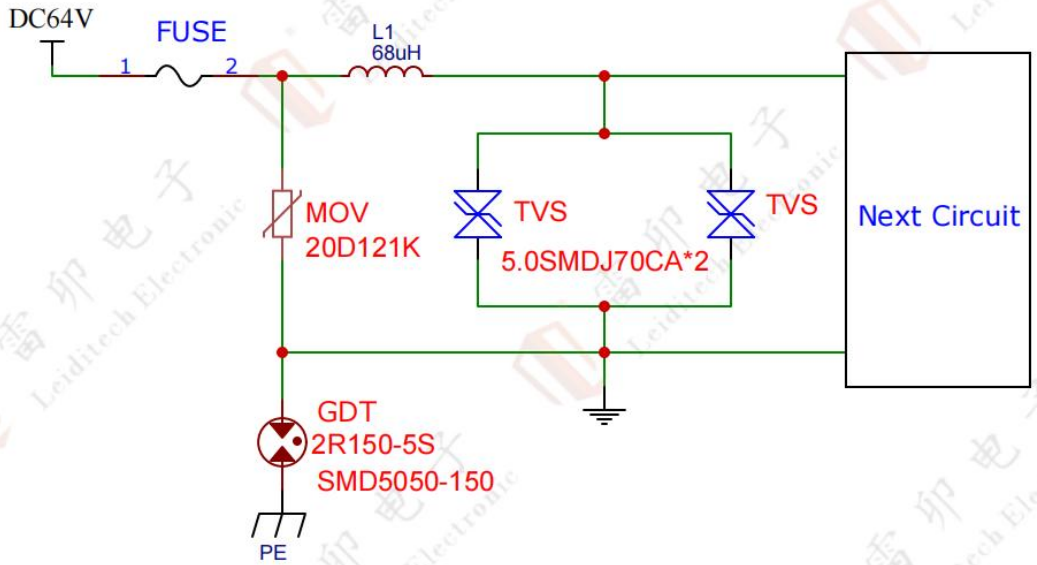
4. Material list for simplified Solution

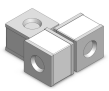
Part Number	Description	IPP	Channels	Shape	Packaging
LM1K58CC	58V, Bi. 2KVProtection	1KA	1		SMC
SM8S30CA	30V,6600W Bi.,4KVProtection	136A	1		DO-218AB
SM8S36CA	36V,6600W Bi.,4KVProtection	114A	1		DO-218AB
AK3-058C	58V,Bi.	3KA	1		AK
LTKAK10-058C	58V,Bi.	10KA	1		SMTO-218

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11.3 64V DC Power Supply 6KV Surge Protection Solution

DC64V surge protection adopts two-level protection: the first level uses a varistor for high current absorption, and the second level uses a TVS for precise clamping. An inductor is used in between for decoupling. It complies with IEC61000-4-2, Class 4, contact discharge 8KV, air discharge 15KV, and meets 8/20μs combined wave differential and common mode 6KV tests.



Part Number	Description	IPP	Channels	Shape	Packaging
20D121K	Varistor Voltage 120V, Bidirectional	6.5KA	1		20D
SMD5050-150	150V, 1.0PF, Bidirectional	5KA	1		5X5X4.2
2R150-5S	150V, 1.5PF, Bidirectional	5KA	1		5.5X5.5X6
5.0SMDJ70CA	70V, 5000W, Bidirectional	45.1A	1		SMC

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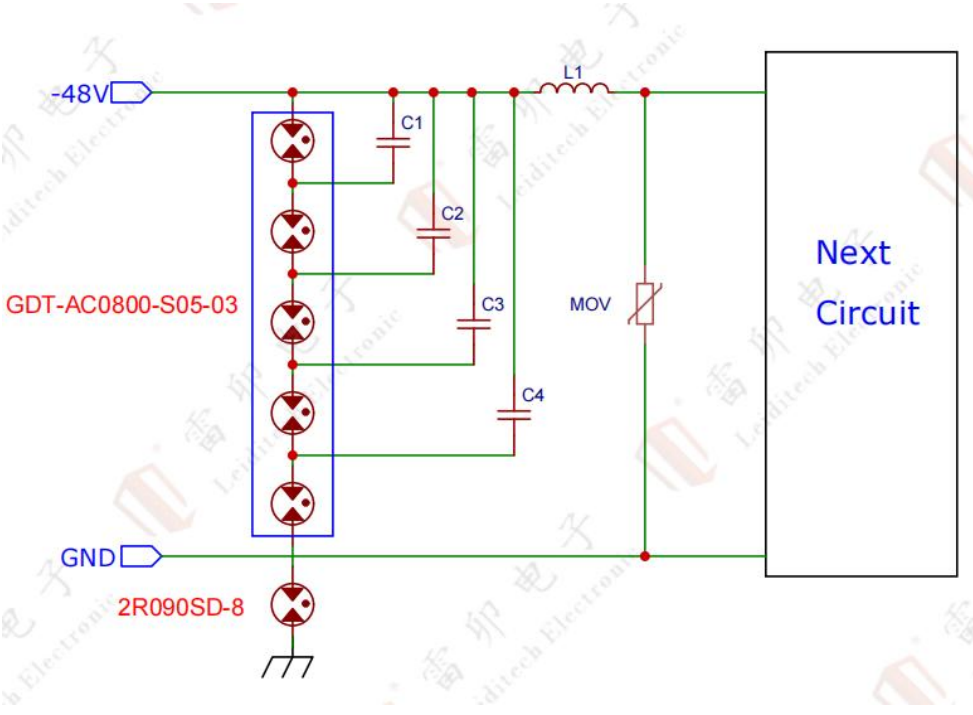
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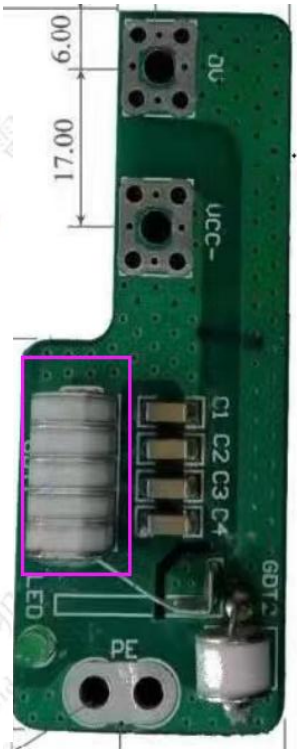
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11.4 -48V Non-Freewheeling Power Supply Protection Method

Solution Advantages: Designed to provide surge protection for -48V DC power interfaces with a protection rating of 8/20μs CM/DM:20KA.





Part Number	Description	IPP	Channels	Shape	Packaging
GDT-AC0800-S05-03	600-1000V@100V/S 2300V@1KV/μS Bi.	20KA	1		8.4×9×16
2R090SD-8	90V, 1.5PF, Bi.	20KA	1		2R-8(8.3x8.3x6)

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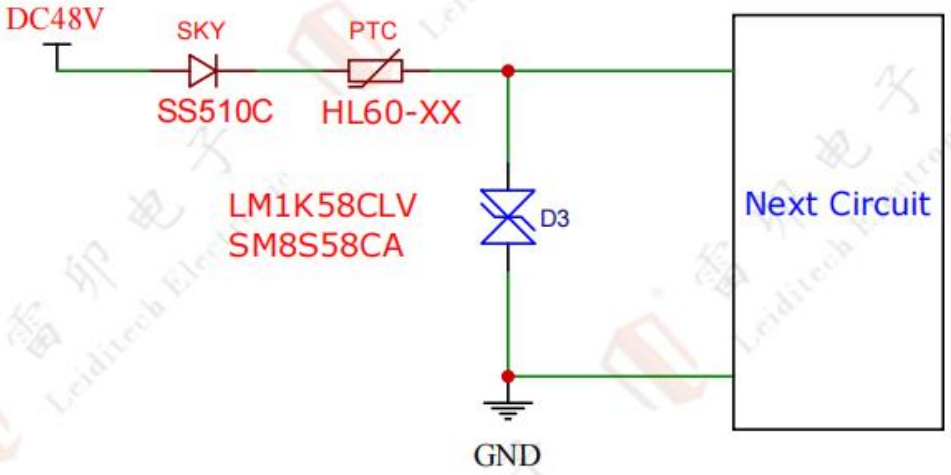
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11.5 48V Automotive Power Surge Protection Solution

The advantages of the solution: The SM8S58CA is used to meet the ISO7637-2 5A/5B test requirements, while the LM1K58CLV can pass the IEC61000-4-5 and GB/T17626.5 8/20μs 2kV standards. This solution offers low cost and a simple circuit design, and it satisfies the ISO61000-4-2 (Level 4) requirements for contact discharge up to 30kV and air discharge up to 30kV



Type	Part Number	Description	IPP	CH.	Shape	Packaging
TVS	SM8S58CA	58V,Bi, 174V 3Ω Test	70A	1		DO-218AB
	LM1K58CLV	58V,Bi, Vpp 2KV	-	1		SMC
SKY	SS310C	100V	3A	1		
	SS510C	100V	5A	1		
PTC	HL60-375	60V	3.75A	1		DIP
	HL60-500	60V	5A	1		

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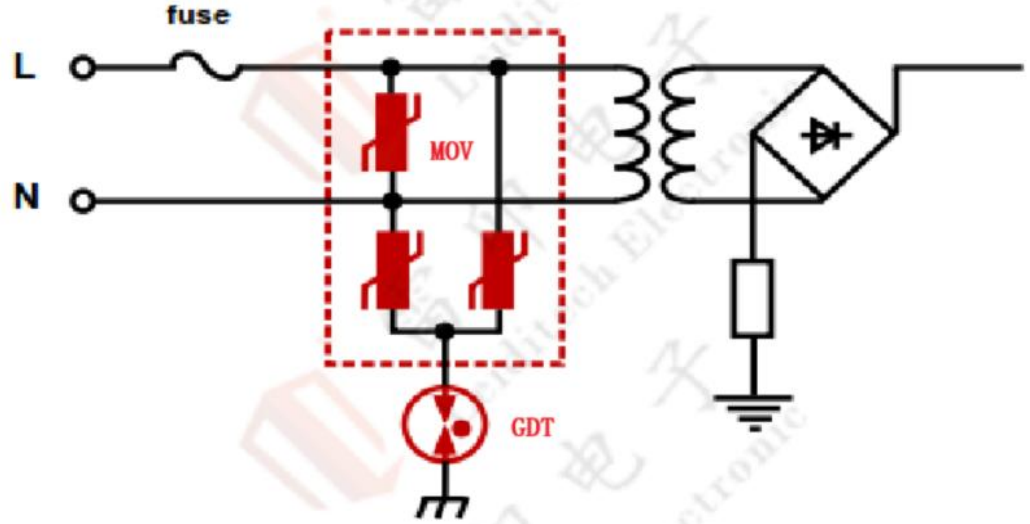
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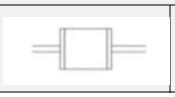
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12.1 Surge Protection Solution for AC 110V Power Supply

Solution Advantages: Designed to provide surge protection of 110V AC power interfaces. This solution selects different levels of protection components according to the environment of the power supply, complying with IEC61000-4-5 4KV~8KV different levels of testing.



Part Number	Description	IPP	Channels	Shape	Packaging
MOV 10D271K	Varistor Voltage270V，Bidirectional	2500A	1		10D
MOV 14D271K	Varistor Voltage270V，Bidirectional	4500A	1		14D
MOV 20D271K	Varistor Voltage270V，Bidirectional	6500A	1		20D
In regions with unstable voltages in the West, MOV should choose 14D271K series product.					
GDT 2R300TB-5	300V，Bi.，8/20 Surge 5KA	5KA	1		Diameter 6*5.5MM

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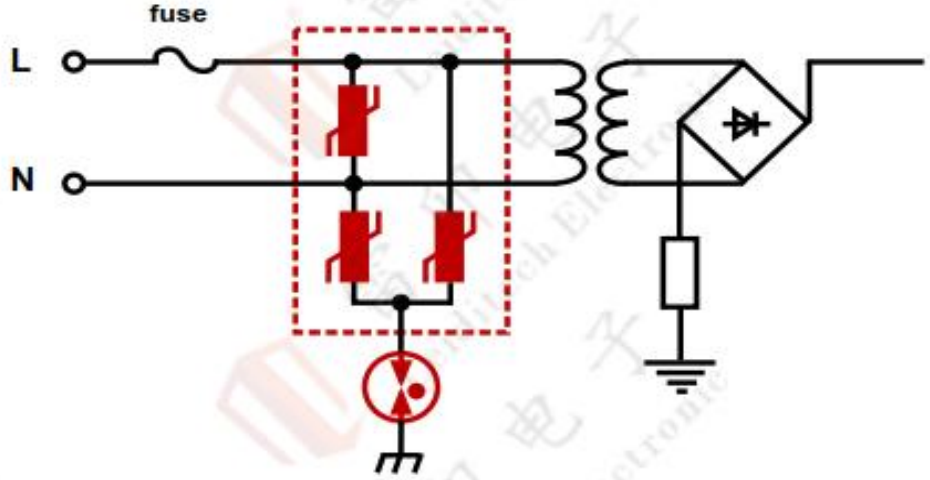
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12.2 Surge Protection Solution for AC 220V Power Supply

Advantages of the solution: Designed to provide surge protection for 220V AC power interfaces, this solution selects different levels of protection devices according to the environment where the power supply is located and meets the IEC61000-4-5 4KV~8KV test at different levels.



Model	Description	Electric Current IPP	Channels	Exterior	Packaging
MOV 14D471K	Pressure sensitive voltage470V ,bidirectional	4500A	1		14D
MOV 20D471K	Pressure sensitive voltage470V ,bidirectional	6500A	1		20D
MOV 25D471K	Pressure sensitive voltage470V ,bidirectiona	15000A	1		25D
In the area with unstable voltage in the west,MOV should choose 14D561K series products.					
GDT 2R600-8L	600V,bidirectional 8/20 surge 10KA	10KA	1		diameter 8MM
If there is a need for insulation withstand voltage test,GDT should be more than 2500V.					

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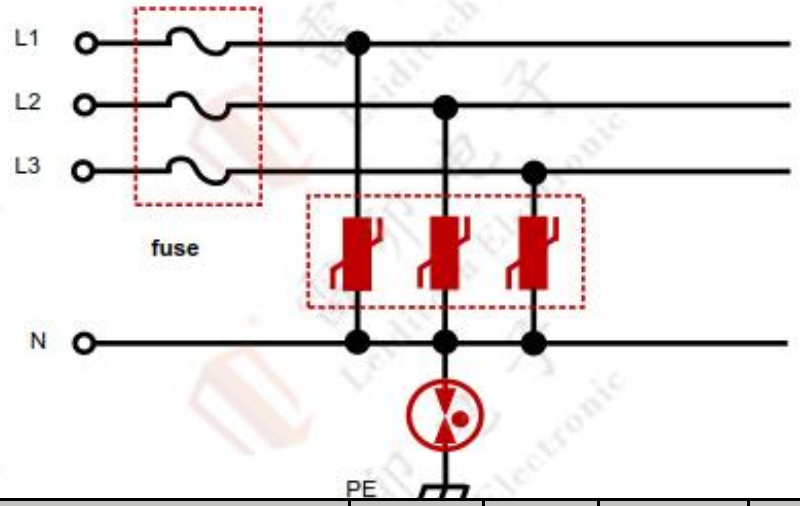
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13.1 Surge Protection Solution of AC 380V Power Supply

Solution advantages: Designed to provide surge protection for 380V AC power interfaces. Different levels of protection devices can be selected according to the environment in which the power supply is located, meeting the IEC61000-4-5 standards for testing at levels ranging from 4KV to 8KV.



Model	Description	Electric Current IPP	Channels	Exterior	Packaging
MOV 14D471K	Pressure sensitive voltage470V ,bidirectional	4500A	1		14D
MOV 20D471K	Pressure sensitive voltage470V ,bidirectional	6500A	1		20D
MOV 25D471K	Pressure sensitive voltage470V ,bidirectiona	15000A	1		25D
In the area with unstable voltage in the west,MOV should choose 14D561K series products.					
GDT 2R600-8L	600V,bidirectional 8/20 surge 10KA	10KA	1		diameter 8MM
If there is a need for insulation withstand voltage test,GDT should be more than 2500V.					

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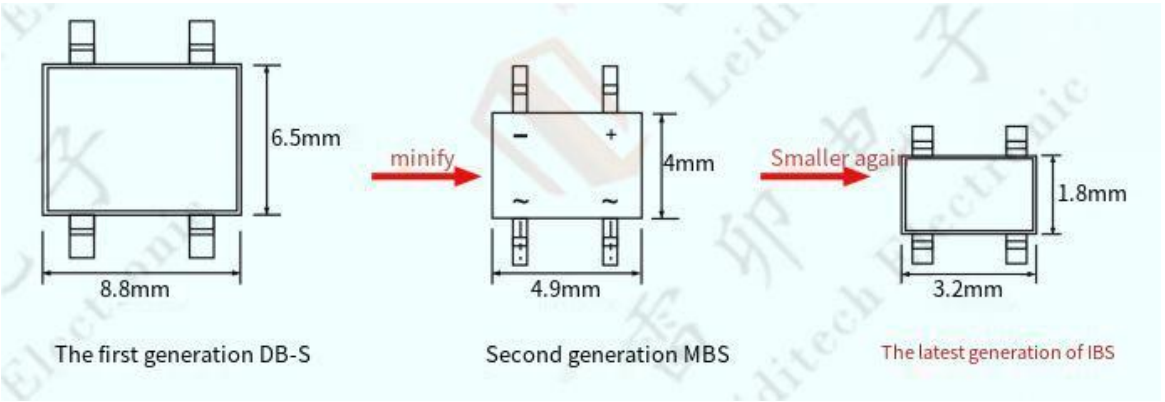
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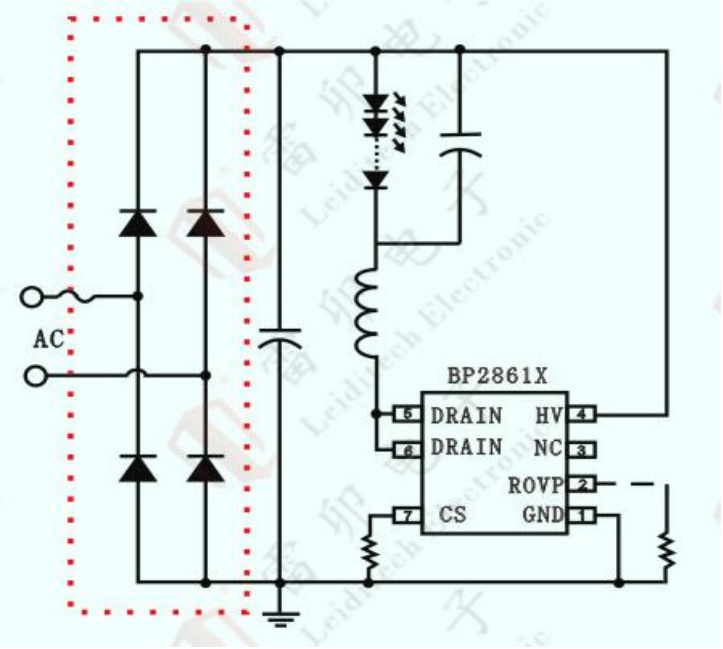
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14.1 Rectification Solution for LED Power Supply

The IBS package rectifier bridge is the industry's smallest SMD rectifier bridge. The IB-S series is professionally used in the field of LED lighting.



The rectifier bridge is composed of four diodes, which play a rectifying role in the circuit. It can not only convert AC to DC but also ensure polarity-free DC output. It can be applied to switching power supplies, lamp beads, etc., in LED intelligent lighting.



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14.1 Rectification Solution for LED Power Supply

Different packages, different currents,
the highest VRRM products that can be passed are shown as follows:

Part No.	VRRM	IF(AV) (A)	IFSM (A)	VF (V)	IR (T = 25)	Package	Dimensions (mm)
IB0310S (min current)	1000	0.3	16	0.92@IF=300mA	5μA	IBS	3.2x1.8x1.4
IB0510S	1000	0.5	20	0.95@IF=500mA	5μA	IBS	3.2x1.8x1.4
VMB0510S	1000	0.5	20	0.95@IF=500mA	5μA	IBS	3.2x1.8x1.4
VMB10S	1000	0.8	30	1@IF=800mA	5μA	IBS	3.2x1.8x1.4
UMB10F	1000	0.8	20	0.96@IF=400mA	5μA	UMBF/SOF2-4	4.05x3.9x1.3
MB110F	1000	1	35	1.1@IF=1A	5μA	MBF	4.6x5.6x1.2
MB10F	1000	0.8	30	1.05@IF=500mA	10μA	MBF	4.95x3.6x1.6
MB10F-S	1000	0.8	30	1@IF=500mA	5μA	MBF-S	4.95x4.1x1.6
MB110F-S	1000	1	35	1.1@IF=400mA	5μA	MBF-S	4.95x4.1x1.6
MB10S	1000	0.8	35	1@IF=400mA	5μA	MBS	4.95x4.1x2.7
MB310S	100	3	80	0.85@IF=3A	0.05mA	MBS	4.95x4.1x2.7
MB110S	1000	1	35	1.1@IF=1A	5μA	MBS	4.9x4x2.7
MBSK210S	100	2	50	0.85@IF=1A	0.5mA	MBS	4.9x4x2.7
ABS10	1000	0.5	20	1@IF=500mA	5μA	ABS	5.1x4.5x1.5
ABS110	1000	1	35	1@IF=1A	5μA	ABS	5.1x4.5x1.5
ABS210	1000	2	60	1.1@IF=2A	5μA	ABS	5.1x4.5x1.5
LB10S	1000	0.8	30	1@IF=500mA	5μA	ABS	5.1x4.6x1.5
DF157S	1000	1.5	50	1.1@IF=1.5A	10μA	DF-S	8.32x6.35x2.35
DB107	1000	1	30	1.1@IF=1A	10μA	DB	8.3x6.5x2.5
DB207	1000	2	50	1.1@IF=2A	10μA	DB	8.3x6.5x2.5
DB157S	1000	1.5	50	1.1@IF=1.5A	10μA	DBS	8.51x6.5x3.3
DB107S	1000	1	30	1.1@IF=1A	10μA	DB-S	8.8x6.5x2.7
DB207S	1000	2	50	1.1@IF=2A	5μA	DB-S	8.8x6.5x2.7

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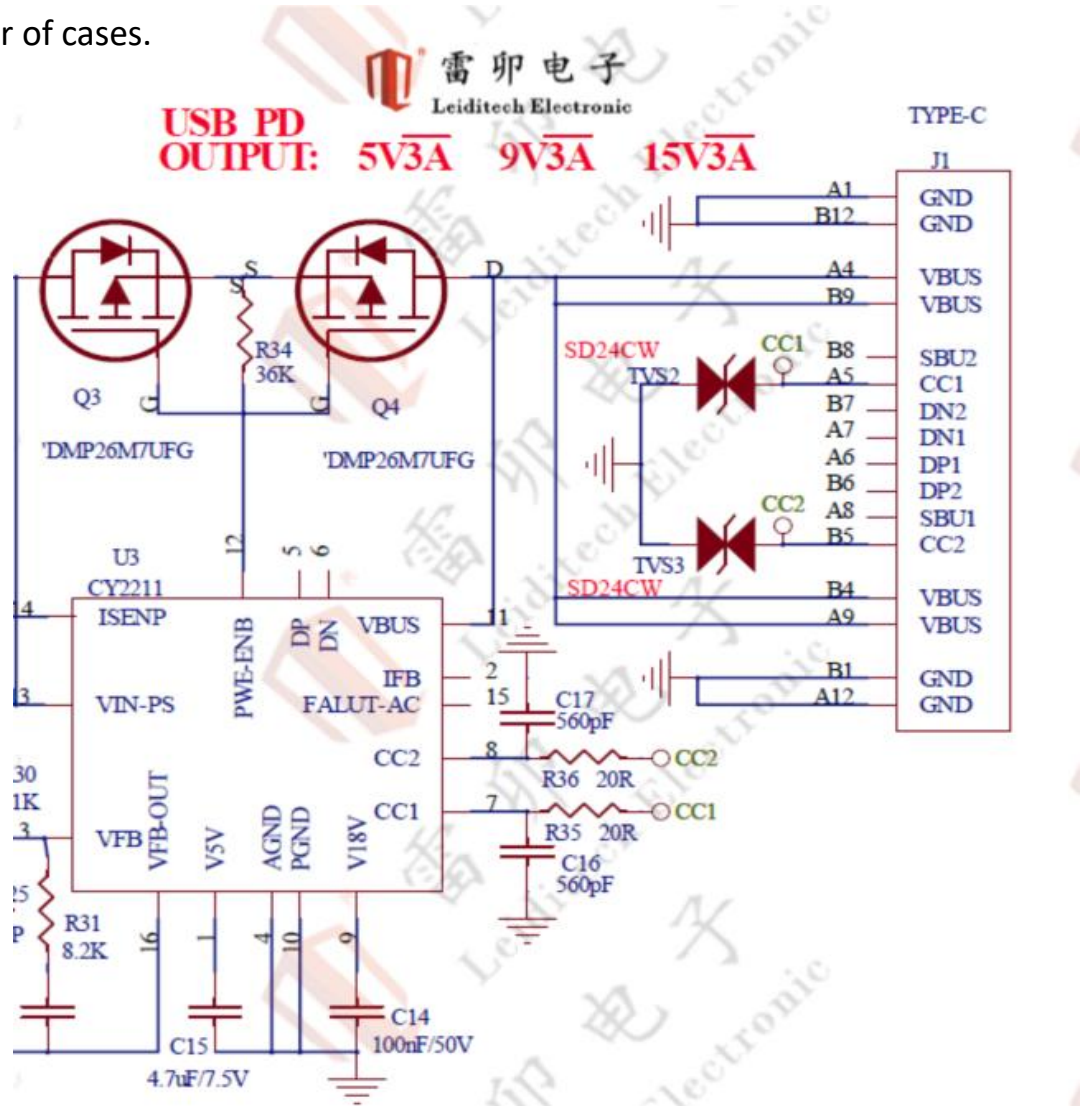
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15.1 Mobile Phone Fast Charging PD/TYPE-C Interface Protection

The full name of PD is called USB Power Delivery Specification, which is a fast charging standard introduced by the USB standardization organization. This solution adopts Leiditech SD24CW (package SOD-323 24V) to effectively protect plugging static electricity and surges, and has been maturely applied in a large number of cases.



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15.1 Mobile Phone Fast Charging PD/TYPE-C Interface Protection

(USB PD fast charge 15W 27W 45W)

1. VBUS charges and supplies power for mobile phones.

2.CC1/CC2 is the Configuration Channel.

Main functions of CC1/CC2 pins:

A. detect the connection of data lines, distinguish the front and back insertion of data lines, and distinguish the master and slave devices.

B. Configure VBUS (there are two modes: USB TYPE_C and USB Power Delivery)

C. when configuring other modes, such as audio accessories

The TX1/RX1 TX2/RX2 D+D- pins will be used in some schemes.

TX1/RX1 TX2/RX2 are USB3.1 data transmission, and only one of them is used by Type-c mobile phones at present.

D+D- is a USB2.0 data transmission signal

See the following table for more high current electrostatic surge protection and small package ESD:

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15.1 Mobile Phone Fast Charging PD/TYPE-C Interface Protection

VRWM	Part Number	Description	IPP	Channels	Shape	Packaging
4.5V	SD4581P6W	4.5V，280PF ±30kV(air), ±30kV(contact)	110A	1		DFN1610
5V	SD0581P6W	5V，300PF ±30kV(air), ±30kV(contact)	95A	1		DFN1610
	USSD0571P6W	5V，350PF ±30kV(air), ±30kV(contact)	110A	1		DFN1610
7V	SD0771P6W	7V，550PF ±30kV(air), ±30kV(contact)	75A	1		DFN1610
12V	SD1271P6W	12V，500PF ±30kV(air), ±30kV(contact)	64A	1		DFN1610
15V	SD1571P6W	15V，450PF ±30kV(air), ±30kV(contact)	54A	1		DFN1610
18V	SD1871P6W	18V，350PF ±30kV(air), ±30kV(contact)	46A	1		DFN1610
24V	SD2471P6W	24V，200PF ±30kV(air), ±30kV(contact)	30A	1		DFN1610
36V	SD3671P6W	36V，150PF ±30kV(air), ±30kV(contact)	20A	1		DFN1610

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15.1 Mobile Phone Fast Charging PD/TYPE-C Interface Protection

VRWM (V)	Part Number	Description	IPP	Channel	Shape	Packaging
4.5V	SD4581D3W	4.5V，300PF ±30kV(air), ±30kV(contact)	100 A	1		SOD-323
5V	SD0581D3W	5V，300PF ±30kV(air), ±30kV(contact)	95A	1		SOD-323
7V	SD0771D3W	7V，550PF ±30kV(air), ±30kV(contact)	75A	1		SOD-323
8V	SD08CW	8V，120PF ±30kV(air), ±30kV(contact)	32A	1		SOD-323
12V	SD1271D3W	12V，550PF ±30kV(air), ±30kV(contact)	64A	1		SOD-323
15V	SD1571D3W	15V，450PF ±30kV(air), ±30kV(contact)	54A	1		SOD-323
18V	SD1871D3W	18V，350PF ±30kV(air), ±30kV(contact)	46A	1		SOD-323
20V	SD20W	20V，127PF ±30kV(air), ±30kV(contact)	14.5 A	1		SOD-323
24V	SD2471D3W	24V，200PF ±30kV(air), ±30kV(contact)	30A	1		SOD-323

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15.1 Mobile Phone Fast Charging PD/TYPE-C Interface Protection

VRWM	Part Number	Description	IPP	Channels	Shape	Packaging
30V	SD30CW	30V，42PF ±30kV(air), ±30kV(contact)	9.3A	1		SOD-323
33V	SD33CW	33V，38PF ±30kV(air), ±30kV(contact)	8.5A	1		SOD-323
36V	SD3671D3W	36V，150PF ±30kV(air), ±30kV(contact)	20A	1		SOD-323

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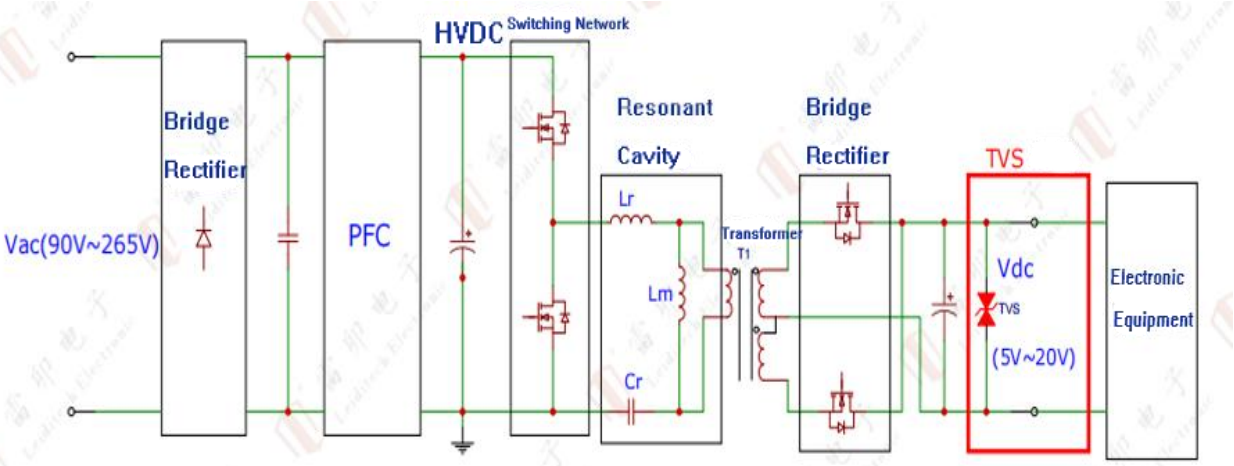
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15.2 USB-PD Fast Charging Power Interface Electrostatic Surge Protection Solution

Solution Advantages: The acceptable input range of this solution is 90 VAC ~ 265 VAC, with an output range of 5 V ~ 20 V and a maximum output power of 65 W. Below is the topology diagram, with a TVS added at the output end, which can provide certain protection against static electricity and surges, protecting downstream electronic equipment. This topology is for reference regarding the placement of the TVS and is not to be used as an actual circuit diagram (the actual circuit is more complex).



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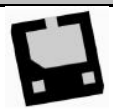
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15.2 USB-PD Fast Charging Power Interface Electrostatic Surge Protection Solution

TVS Selection: Select based on the maximum DC output voltage.

VRWM	Part Number	Description	IPP	Channel	Shape	Packaging
5V	SD0501P4-3	5V Uni 5800W ±30kV(air), ±30kV(contact)	280A	1		DFN2020-3
	USSD0571P6W	5V Uni 1300W ±30kV(air), ±30kV(contact)	110A	1		DFN1610-2
7V	SD070104-3	7V Uni 5400W ±30kV(air), ±30kV(contact)	300A	1		DFN2020-3
	SD0771P6W	7V Uni 1500W ±30kV(air), ±30kV(contact)	、 75A	1		DFN1610-2
9V	SD0971D3W	9V Bi. 2000W ±30kV(air), ±30kV(contact)	90A	1		SOD-323
12V	SD1201P4-3	12V Uni 5800W ±30kV(air), ±30kV(contact)	210A	1		DFN2020-3
	SD1281P6W	12V Bi. 1800W ±30kV(air), ±30kV(contact)	90A	1		DFN1610-2
15V	SD1501P4-3	15V Uni 5700W ±30kV(air), ±30kV(contact)	180A	1		DFN2020-3
24V	SD2401P4-3	24V Bi. 6900W ±30kV(air), ±30kV(contact)	210A	1		DFN2020-3

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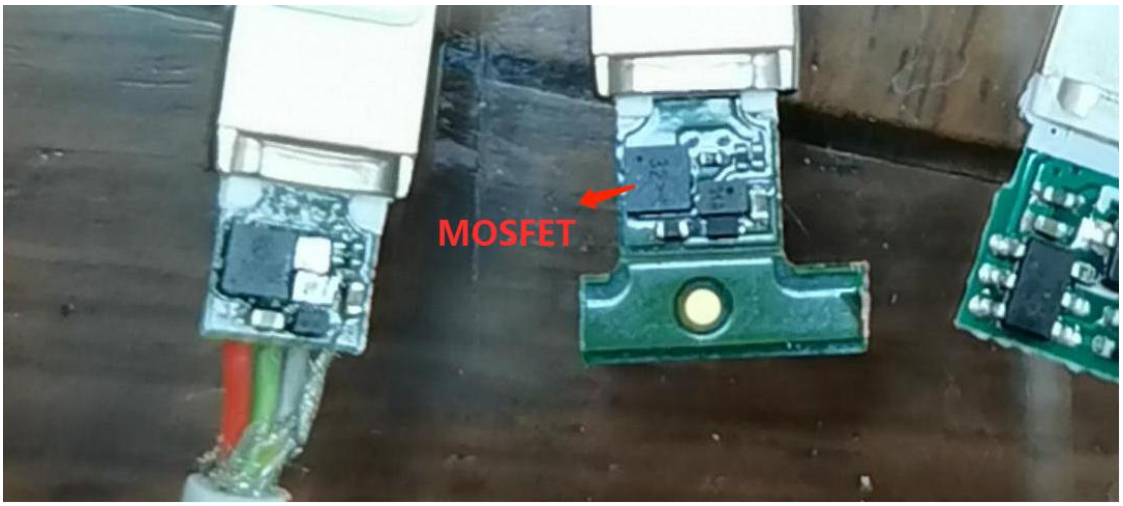
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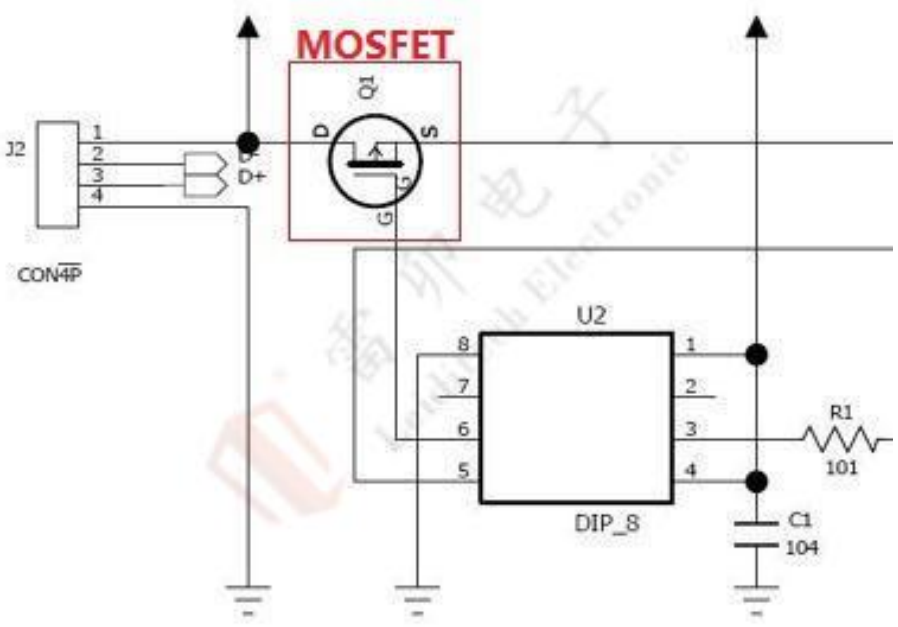
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16.1 Apple Charging Cable Circuit Protection

(Lighting interface circuit board diagram)



(Lighting interface circuit diagram)



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16.1 Apple Charging Cable Circuit Protection

Leiditech Electronics recommends using P-18V MOSFET

Part Number	Description	IPP	Channels	Exterior	Packaging
LM8012P	VDSS:18V VGS:±8V VTH:3mV/℃	8A	P		DFN2020-6

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17.1 Anti-reverse Protection Solution for Low VF Schottky Power Supply

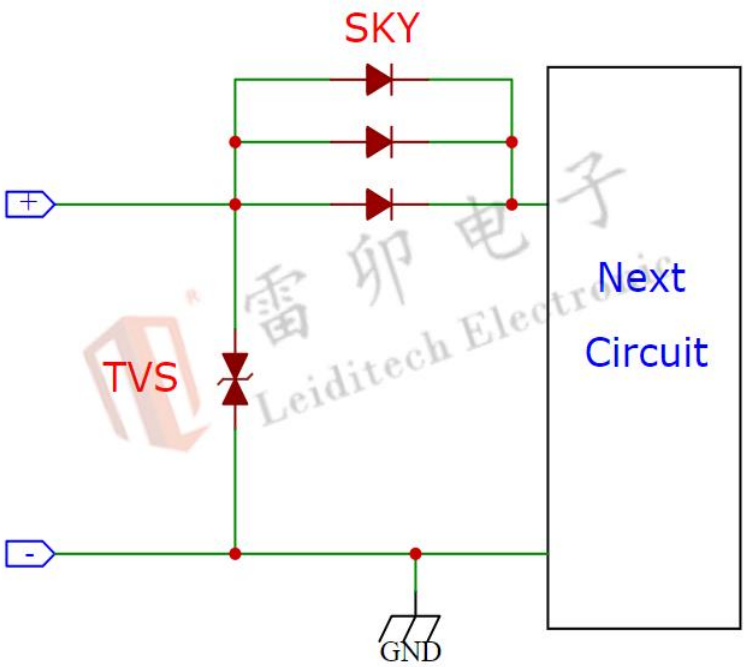
This solution uses 3 low-dropout SKY, which has lower power consumption than only 1 and can prevent the components from overheating (Comparison formula of normal operating loss between the two:

1.Use 1 SS34LVFA: P=VF*IF=0.42V*3A=1.26W

2. Use 3 SS34LVFA:P=VF*IF=0.31V*1A*3=0.93W) For surge protection of DC power interface, TVS and SKY devices can be selected according to the environment where the power supply is located , effectively used for anti-reverse polarity.

Meet ISO61000-4-2 (level 4) contact discharge 30kV, air discharge 30kV.

To meet the IEC61000-4-5 surge high-level test, high-power SMC package devices are selected.



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17.1 Anti-reverse Protection Solution for Low VF Schottky Power Supply

SKY Part Number	Description	Current IF	Channels	Shape	Packaging
SS2U40WS	40V, VF=0.37V@IF=1.0A VF=0.45V@IF=2.0A	2A	1		SOD-323
DSK34L	40V, VF=0.31V@IF=1.0A VF=0.42V@IF=3.0A	3A	1		SOD-123FL
DSK36L	60V, VF=0.5V@IF=3.0A	3A	1		SOD-123FL
SS34LVFA	40V, VF=0.28V@IF=0.5A VF=0.42V@IF=3.0A	3A	1		SMA
SS34LA	40V, VF=0.45V@IF=3.0A	3A	1		SMA

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17.1 Anti-reverse Protection Solution for Low VF Schottky Power Supply

SKY Part Number	Description	Current IPP	Channel	Shape	Packaging
SDxxCW	5~36V, Bidirectional	8~40A	1		SOD-323
MMFxxCA	3.3~220V, 200W Bidirectional	0.5~27A	1		SOD-123FL
SMAJxxCA	3.3~440V, 400W Bidirectional	0.6~50A	1		SMA
SMBJxxCA	5~440V, 600W Bidirectional	0.8~65A	1		SMB
SMCJxxCA	5~440V, 1500W Bidirectional	2~163A	1		SMC
SMDJxxCA	5~220V, 3000W Bidirectional	8~326A	1		SMC

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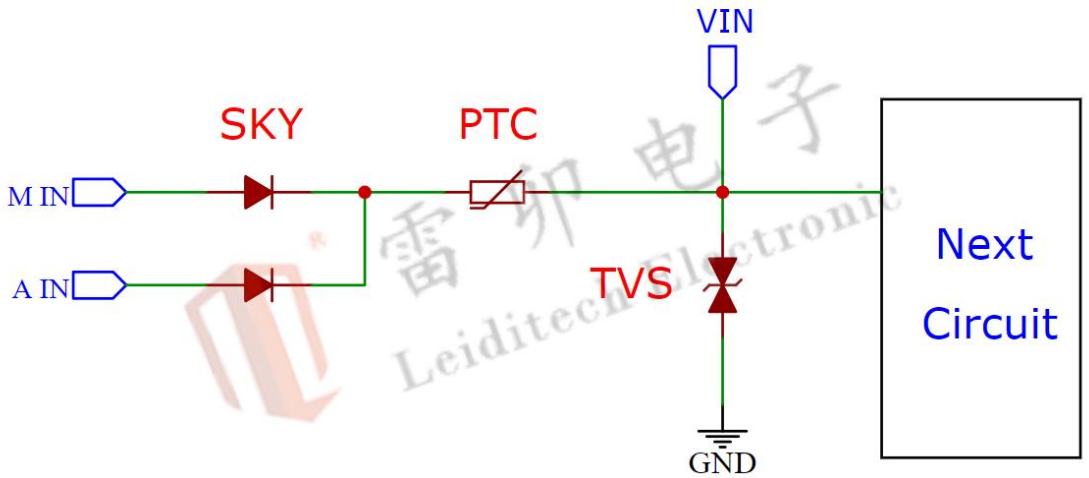
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17.2 Anti-reverse Protection Solution of Low IR Schottky Power Supply

This solution adopts two low leakage current SKY, one for each power line, low leakage current is more energy-saving, and can be applied in switching power supplies with large leakage current.

For surge protection to meet the DC power interface, TVS and SKY devices with suitable protection current can be selected according to the environment in which the power supply is located, and are effectively used for anti-reverse connection. Meet ISO61000-4-2 (level 4) contact discharge 30kV, air discharge 30kV. To meet the IEC61000-4-5 surge high-level test, high-power SMC package devices are selected.



This solution is especially suitable for the battery at one end,
and the anti-reverse connection of charging at one end is particularly energy-saving

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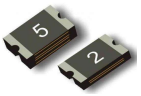
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17.2 Anti-reverse Protection Solution of Low IR Schottky Power Supply

SKY Part Number	Description	Current IR	Channel	Shape	Packaging
DSK26H	60V, VF=0.75V@ IF=2.0A	0.1μA	1		SOD-123FL
SBR26HD	60V, VF=0.75V@ IF=2.0A	0.1μA	1		SOD-123FL

PTC Part Number	Description	Current IH	Channel	Shape	Packaging
SMD1812P050TF	0.5A 0.15Ω 30V	0.5A	1		SMD1812

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17.2 Anti-reverse Protection Solution of Low IR Schottky Power Supply

TVS Part Number	Description	Electric current IPP	Channel	Shape	Packaging
SDxxCW	5~36V, Bidirectional	8~40A	1		SOD-323
MMFxxCA	3.3~220V,200W Bidirectional	0.5~27A	1		SOD-123FL
SMAJxxCA	3.3~440V,400W Bidirectional	0.6~50A	1		SMA
SMBJxxCA	5~440V,600W Bidirectional	0.8~65A	1		SMB
SMCJxxCA	5~440V,1500W Bidirectional	2~163A	1		SMC
SMDJxxCA	5~220V,3000W Bidirectional	8~326A	1		SMC

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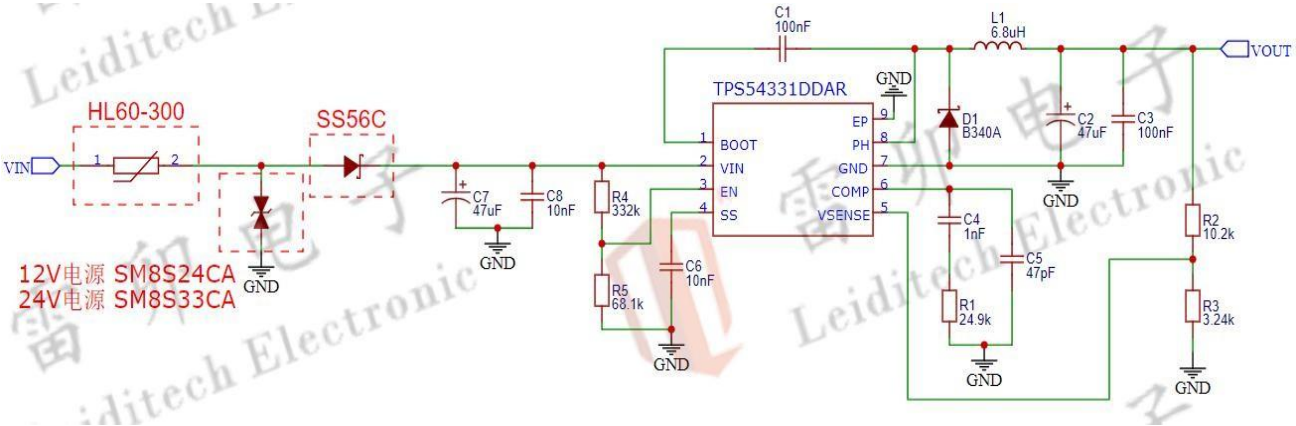
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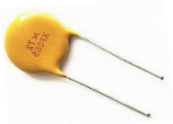
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18.1 Surge Protection Solution for DC-DC Conversion Power Supply

Solution Advantages: Designed for surge protection in DC-DC converters for 12V/24V power supplies, incorporating Schottky diode reverse polarity protection. Select suitable TVS components according to the operational environment of the power supply. Utilize Leiditech SM8S series TVS diodes, featuring high power capacity of 6600W, compliant with IEC61000-4-5 high-level surge testing.



Part Number	Description	IPP	Channels	Shape	Packaging
SS56C	40V, VF=0.7V@ IF=5A	5A	1		SMC
HL60-300	60V, 0.08Ω	3A	1		PTH
SM8S24CA	24V, 6600W, Bidirectional	170A	1		DO-218AB
SM8S33CA	33V, 6600W, Bidirectional	124A	1		DO-218AB

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19.1 Silicon Carbide SIC New Energy Vehicle Charging Pile Solution

Application Background: Electric vehicle charging requires high power, high DC voltage, large capacity, rapid charging of high-voltage batteries, high reliability, high efficiency, and minimal heat generation. Therefore, a component with low loss, fast speed, and high power is needed. Leiditech Silicon Carbide (SiC) diodes and SiC MOSFETs can be applied in critical circuits of EV chargers such as PFC and full-bridge LLC, improving power factor and enhancing system efficiency and reliability.

Solution Advantages: Leiditech SiC diodes feature fast reverse recovery time, high voltage rating, and extremely low switching losses. Leiditech SiC MOSFETs switch rapidly, achieve high voltage ratings with high currents, high efficiency, high power density, small and light modules, and lower costs.

However, when SiC MOSFETs switch rapidly, voltage spikes can occur across the device due to the effect of internal parasitic capacitance and circuit parasitic inductance. These spikes can far exceed the maximum rated voltage of the SiC MOSFET, leading to device damage or performance degradation.

To address the issue of voltage spikes during SiC MOSFET switching, Leiditech connects a TVS diode in parallel with the SiC MOSFET's drain and source. When a voltage spike occurs, the TVS diode quickly turns on to absorb the spike energy, protecting the SiC MOSFET from damage.

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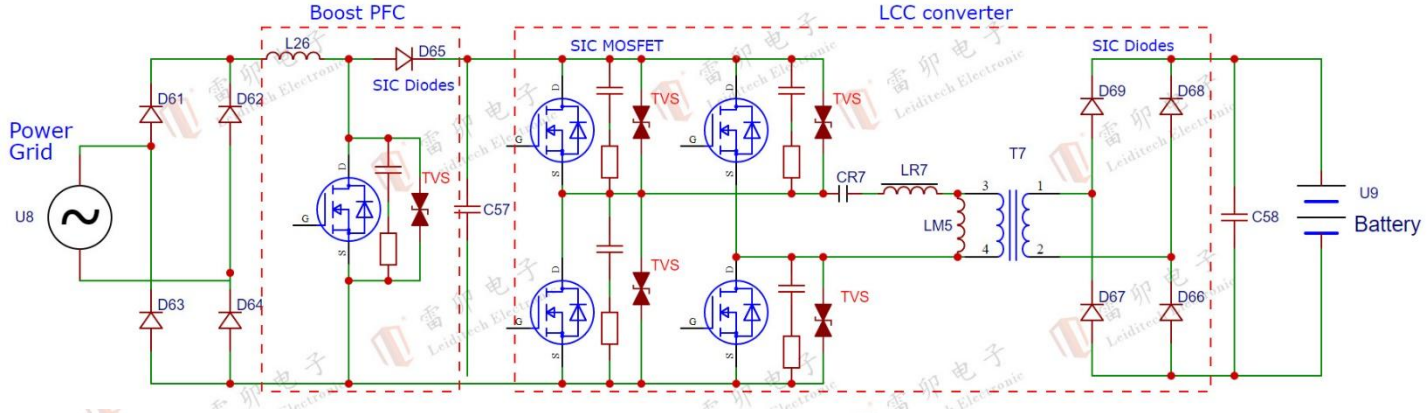
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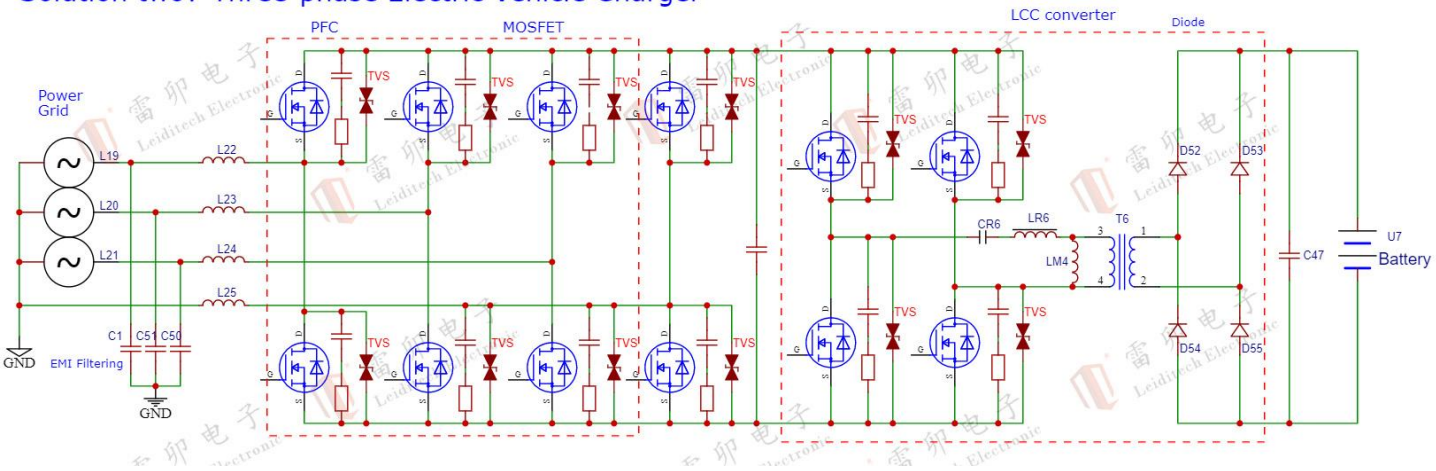
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19.1 Silicon Carbide SIC New Energy Vehicle Charging Pile Solution

Solution one: Single-phase Electric Vehicle Charger



Solution two: Three-phase Electric Vehicle Charger



Shanghai Leiditech Electronics, as a professional electronic component supplier, provides SiC MOSFETs and protection solutions/devices for addressing voltage spikes during SiC MOSFET switching.

The specific TVS model selection is based on the SiC MOSFET's Vdss voltage: Most SiC MOSFETs have a Vdss above 600V, so the following list of TVS models requires two devices to be connected in series. For detailed solution selection, please consult Shanghai Leiditech's experienced EMC engineer.

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19.1 Silicon Carbide SIC New Energy Vehicle Charging Pile Solution

Brand	Part Number	Description	Shape	Packaging
leiditech 雷卯	LMSC10065H	SIC SBD 650V/10A		TO-220-2L
leiditech 雷卯	LMSC20065H	SIC SBD 650V/20A		TO-220-2L
leiditech 雷卯	LMSC040120K	SIC MOS 1200V/40mΩ		TO-247-3L
leiditech 雷卯	LMSC025120K	SIC MOS 1200V/25mΩ		TO-247-3L
leiditech 雷卯	SMCJ400CA	TVS 1500W 400V		SMC
leiditech 雷卯	SMCJ440CA	TVS 1500W 440V		
leiditech 雷卯	SMDJ400CA	TVS 3000W 400V		
leiditech 雷卯	SMDJ440CA	TVS 3000W 440V		
leiditech 雷卯	5.0SMDJ400CA	TVS 5000W400V		
leiditech 雷卯	5.0SMDJ440CA	TVS 5000W 440V		

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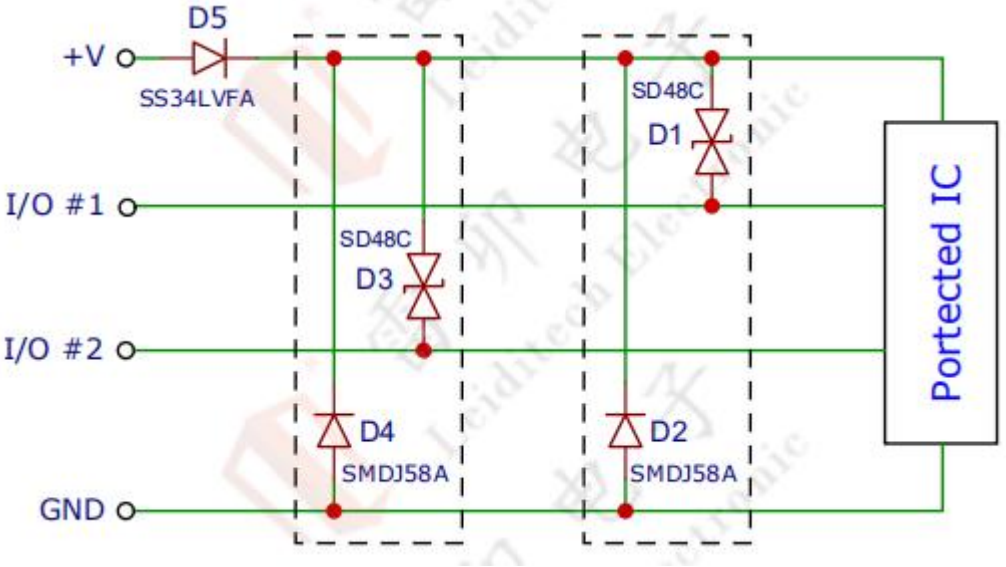
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20.1 Vehicle Ignition System Lighting, Anti-static, Anti-reverse Protection Solution

Solution Advantages: Uses single-path device protection, with capacitance <30pF , ensuring signal integrity and reverse polarity protection, while passing the ESD test. Compiles with IEC61000-4-2 (Class 4) contact discharge 25kV, air discharge 30kV.



Part Number	Description	IPP	Channel	Shape	Packaging
SD48C	48V, Bidirectional , 11pF ±30KV（air） ±25KV((contact)	3A	1		SOD-323
SS34LVFA	40V, 3.0A VF=0.42@IF=3.0A	3A	1		SMA
SMDJ58A	58V, Unidirectional	32.1A	1		SMC

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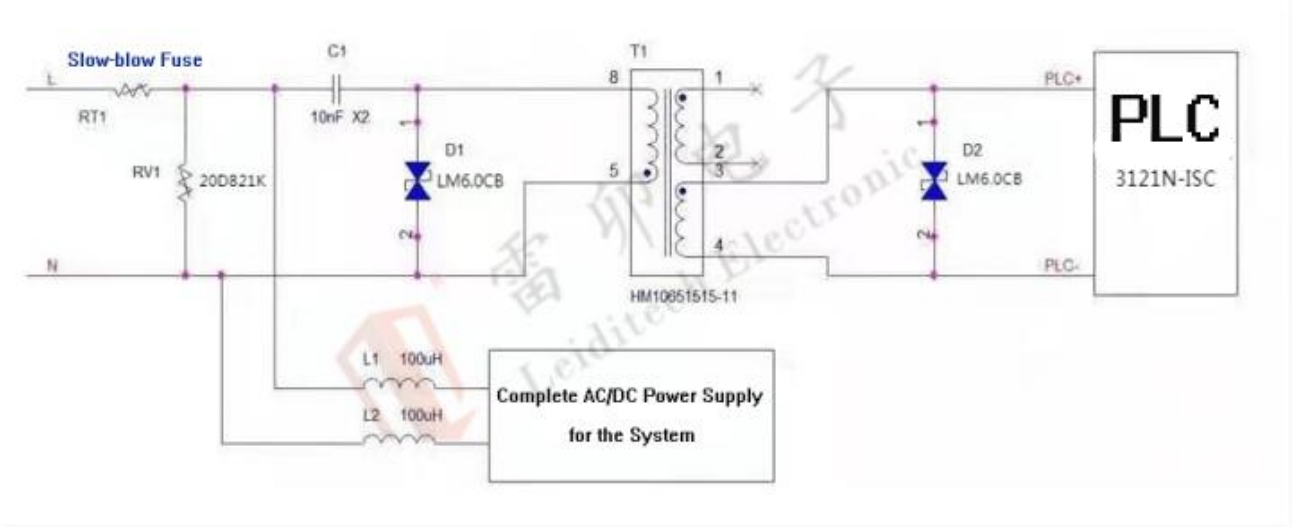
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1.1 Application Solution of Power PLC Module

For the main product design, Leiditech strongly recommend referring to the circuit diagram below for the safety protection design on the L and N lines and the PLC signal coupling design. This will help to reduce the risk of PLC module damage caused by surges and other issues.



Explanation:

The bidirectional TVS protection diodes (D1/D2) for both primary and secondary stages are mandatory components.

The PLC signal connection point on the L and N lines should be placed after the varistor (RV1).

After the PLC signal, two common-mode inductors (L1/L2) need to be connected in series to isolate the PLC signal from the main power supply.

The T1 transformer is a 1:1 transformer.

C1 is a safety capacitor.

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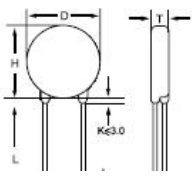
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1.1 Application Solution of Power PLC Module

Material Name	Supplier	Part Number	Description	Location Number
TVS	Leiditech	LM6.0CB	6V，Bi.TVS Protection Device，SMB	D1,D2
MOV	Leiditech	20D821K	AC510V，DC670V，20D	RV1
DM Inductor	For detailed information, please inquire with **FN-LINK TECHNOLOGY LIMITED**			L1,L2
Transformer				T1
				T1
Safety Capacitor				C1
				C1

Part Number	Description	IPP	Channel	Shape	Packaging
LM6.0CB	6V，Bi.TVS	80A	1		SMB
20D821K	AC510V，DC670V	100A	1		20D

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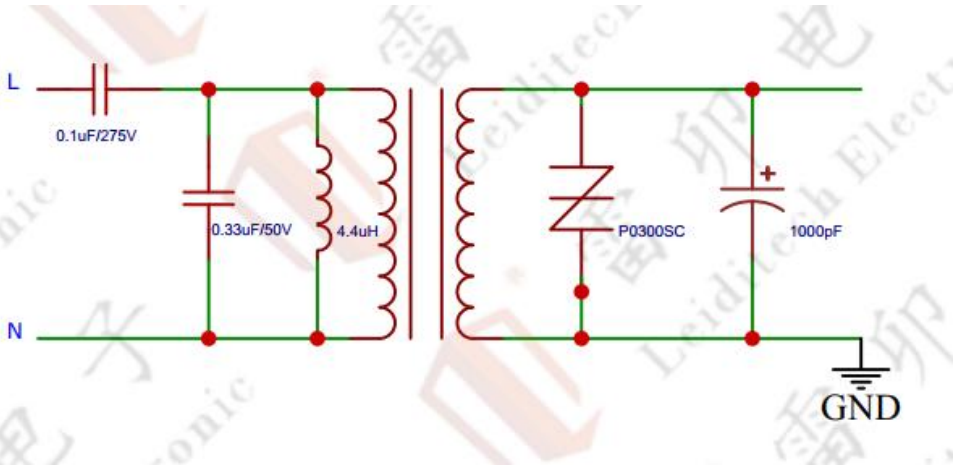
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1.2 Carrier Signal Surge Protection Solution

P0300SC Semiconductor Gas Discharge Tube

Features: Used for carrier coupling signal protection, characterized by ultra-fast response, stable IH value, minimal signal attenuation, and strong continuous interference resistance.

Benefits: Ensures signal integrity while passing surge tests, meeting IEC61000-4-5 10/700μs 6kV requirements.



Part Number	Description	IPP	Channels	Shape	Packaging
P0300SC	25V,Bi., 140PF	100A	1		SMB

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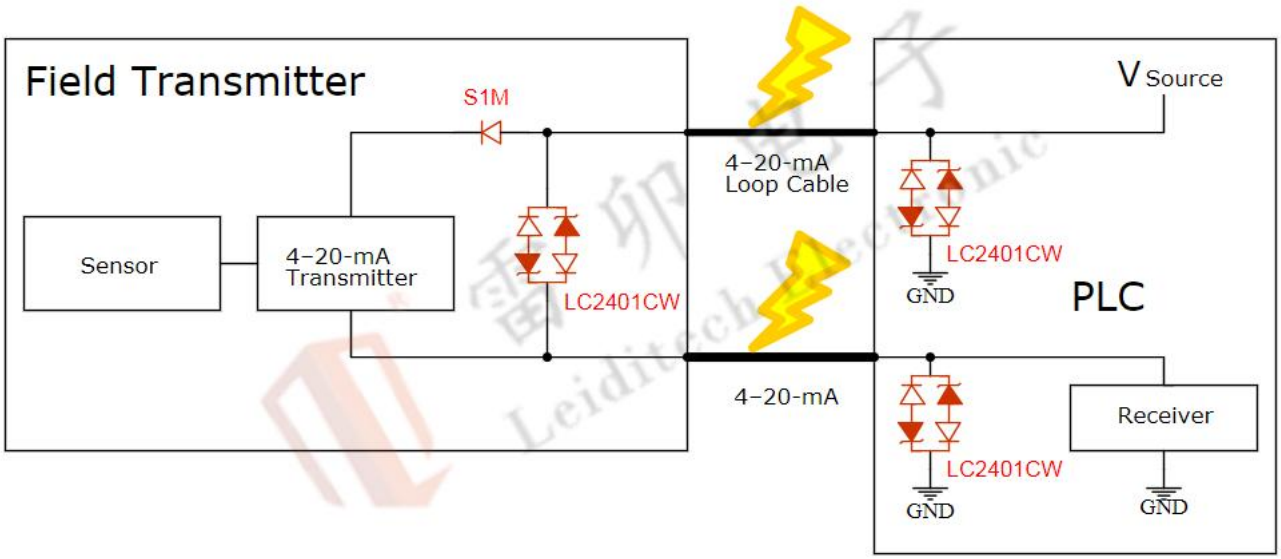
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2.1 Electrostatic Protection Solution for 4-20mA Sensors

Protection for Conventional 4-20mA 24V-Powered Sensitive Sensor Chips
Protection Devices: S1M and LC2401CW.
Advantages: Small packaging, low capacitance, large current protection. Complies with IEC61000-4-2, Level 4, supporting 30kV contact discharge and 30kV air discharge.



Part Number	Description	IPP	Channels	Shape	Packaging
S1M	1000V	1A	1		SMA
LC2401CW	24V, 1pF ±30kV(air), ±30kV(contact)	3A	1		SOD-323

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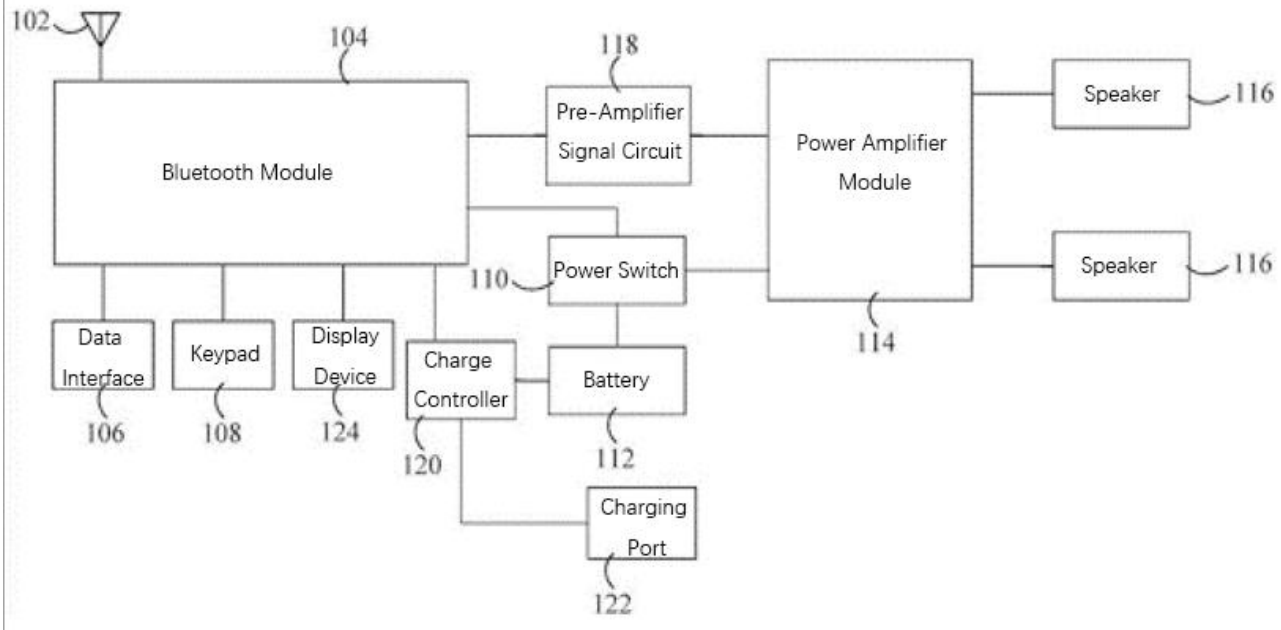
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3.1 Bluetooth Speaker Control Board Electrostatic Surge Protection Solution

Bluetooth speakers often suffer from electrostatic discharge (ESD) issues due to frequent plug-in and removal, which can affect their usability in various ways such as failure to read USB cards, noisy audio playback, power cycling upon plugging in, battery malfunction, and static noise. To address these problems, it is necessary to design circuits that comply with national ESD and Surge Test standards for safety and reliability.

Leiditech recommends various interface protection devices to ensure safe and reliable operation, suitable for USB ports, TF card slots, audio/video interfaces, and DC power/battery ports. Detailed circuit diagrams can be found by visiting the protection solutions section for signal interfaces on our WeChat mini-program.

These solutions meet IEC 61000-4-2 standards at Level 4, capable of handling contact discharge up to 30 kV and air discharge up to 30 kV. For higher-level IEC 61000-4-5 Surge Test compliance, high-power SMC (Silicon Controlled Rectifier)



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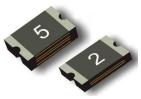
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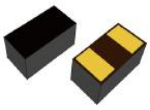
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3.1 Bluetooth Speaker Control Board Electrostatic Surge Protection Solution

USB 2.0 Electrostatic Discharge (ESD) Protection Solution					
Part Number	Description	IPP	Channels	Shape	Packaging
SR05	5V,Uni, 1.2PF ±20kV(air), ±20kV(contact)	3A	3		SOT-143
SMD1206P075TF	0.75A 0.07Ω 6V	0.75A	1		SMD1206

TF Card Electrostatic Discharge (ESD) Protection Solution					
Part Number	Description	IPP	Channels	Shape	Packaging
LC0504F	5V,Uni, 0.8PF ±15kV(air), ±8kV(contact)	5A	6		SOT-363
ULC0511CDN30	5V,Bi., 0.3PF ±30kV(air), ±30kV(contact)	4.5A	1		DFN1006
PESD0542U005	5V,Bi., 0.05PF ±15kV(air), ±8kV(contact)	-	1		0402

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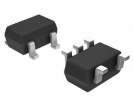
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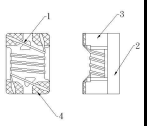
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3.1 Bluetooth Speaker Control Board Electrostatic Surge Protection Solution

Keyboard Key Electrostatic Discharge (ESD) Protection Solution					
Part Number	Description	IPP	Channels	Shape	Packaging
SDA05W5	5V,Uni, 30PF ±15kV(air), ±8kV(contact)	3A	4		SOT-353
ESDA05CP	5V Bi. 10PF ±15kV(air), ±8kV(contact)	5A	1		DFN1006-2

HDMI 2.0 Electrostatic Discharge (ESD) Filtering Protection Solution					
Part Number	Description	IPP	Channels	Shape	Packaging
ULC0524PA	5V,Uni, 0.3PF ±15kV(air), ±8kV(contact)	4A	4		DFN2510P10
USRV05-4	5V,Uni, 0.5PF ±15kV(air), ±8kV(contact)	5A	5		SOT-26
LDWI21-900Y	Dimensions: 2.05*1.25*1.2mm Resistance: 90Ω Frequency: 100MHZ	-	-		0805

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3.1 Bluetooth Speaker Control Board Electrostatic Surge Protection Solution

12V DC Power Supply Electrostatic Surge Protection Solution					
Part Number	Description	IPP	Channels	Shape	Packaging
SDA1211CDN	12V, 8PF ±30kV(air), ±30kV(contact)	8A	1		DFN1006
SD12CW	12V, 100PF ±30kV(air), ±30kV(contact)	40A	1		SOD-323
SMF15CA	15V,200W,Bi.	8.2A	1		SOD-123FL
SMAJ15CA	15V,400W,Bi.	16.4A	1		SMA

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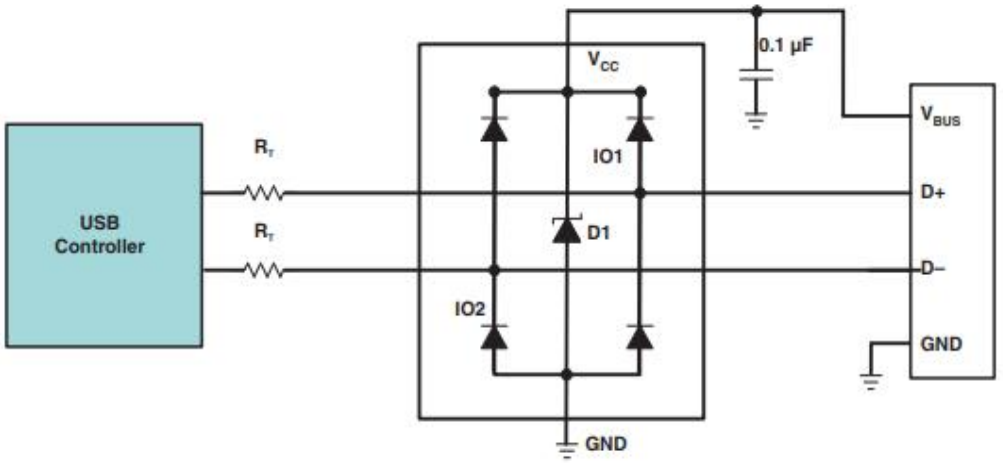
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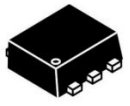
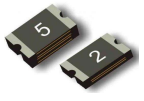
3.2 TWS Wireless Bluetooth Earphone Electrostatic Surge Protection Solution

Due to the small working IPP and compact size of headphones, it is recommended to use the self-resetting fuse part number SMD0603P010 manufactured by Leiditech Electronics. This component can effectively protect against excessive IPP and overheating issues in the charging case.

For electrostatic discharge (ESD) protection, the device LC0542T5 is recommended, which can adequately meet the ESD protection needs for VBUS and IO interfaces.

These recommendations comply with IEC 61000-4-2 standards at Level 4, providing protection against contact discharge up to 14 kV and air discharge up to 17 kV.



Part Number	Description	IPP	Channels	Shape	Packaging
LC0542T5	5V,Uni, 0.7PF ±17kV(air), ±14kV(contact)	4A	3		SOT-553
SMD0603P010TF	16V, 6Ω	0.1A	1		SMD0603

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4.1 Circuit Solution for Radar Module LMXBR202010

The LMXBR202010 radar module application case demonstrates its versatility in smart lighting, smart security, home automation, and intelligent household appliances.

Radar Chip: XBR816

Center Frequency: 9.85 GHz

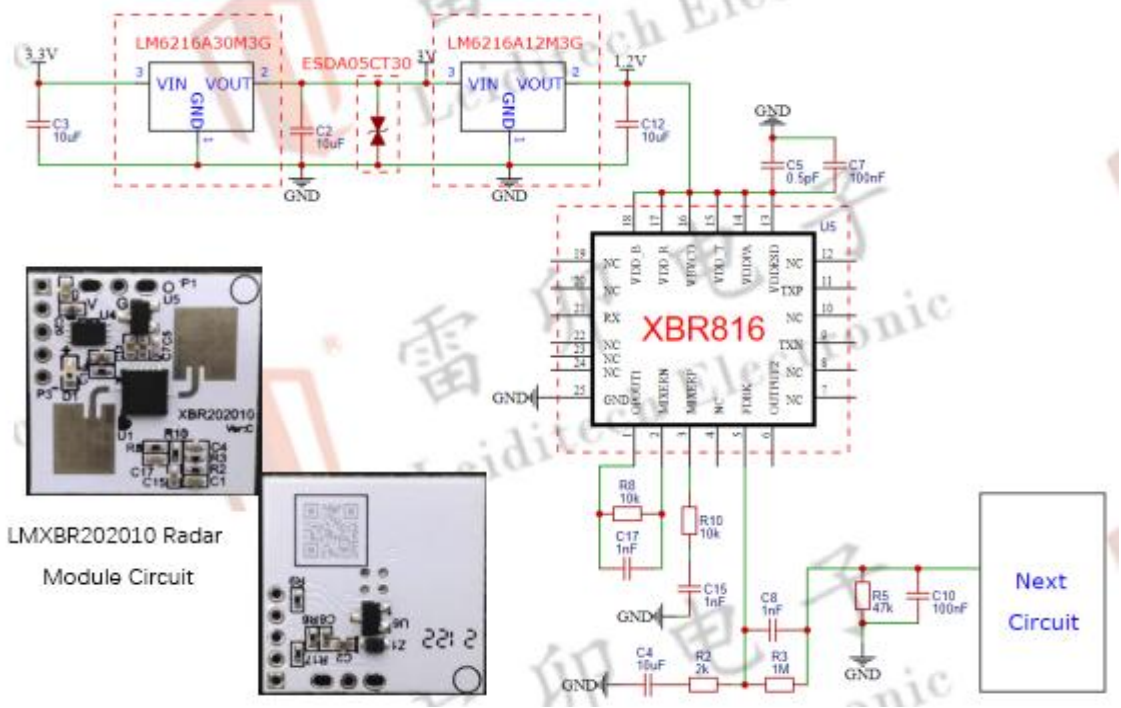
Supply Voltage: 1.2V

Maximum Operating Current (IPP): 50 mA

Buck Converter (DCDC): LM6216A12M3G (Output Voltage: 1.2V), LM6216A30M3G (Output Voltage: 3.3V)

ESD Protection Device: ESDA05CT30 (Working Voltage: 5V)

The components used in this module have a small packaging footprint, saving space in designs. It complies with IEC 61000-4-2 at Level 4, offering protection against ±30 kV contact and air discharge, making it robust against electrostatic discharge events.



LMXBR202010 Radar Module Circuit

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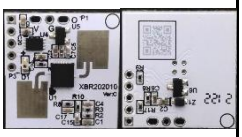
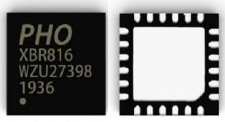
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4.1 Circuit Solution for Radar Module LMXBR202010

Part Number	Description	IPP	Channels	Shape	Packaging
radar module LMXBR202010	3.3V, 9.85GHz	50mA	-		20mm*20mm
XBR816	1.2V, 9.85GHz	50mA	-		4mm*4mm
ESDA05CT30	5V, 15PF ±30kV(air), ±30kV(contact)	8A	1		SOD-523
LM6216A12M3G	VIN=6V VOUT=1.2V	250mA	-		SOT23-3
LM6216A30M3G	VIN=6V VOUT=3V	300mA	-		SOT23-3

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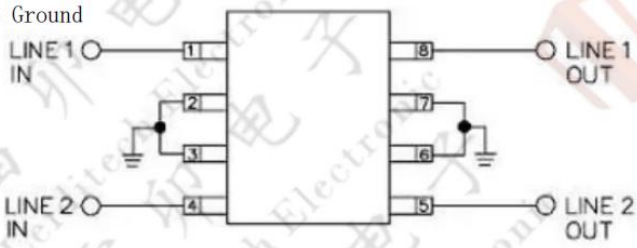
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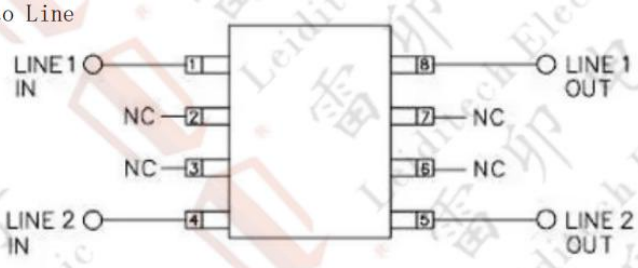
5.1 LC03-6 Application Solution for T1, T3/E3, 10M/100M, High-Speed Drive Circuits, and ISDN-S/U Interface Circuits

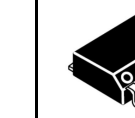
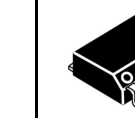
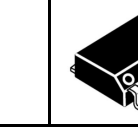
The LC03-6 series is applied to suppress electrostatic surges between two high-speed data lines, capable of withstanding an IPP (peak pulse current) as high as 100A. It can be used for differential mode protection or common mode protection, and it meets the GR-1089 standard.

1. Line to Ground



2. Line to Line



Part Number	Description	IPP	Channels	Shape	Packaging
LC03-3.3L	3.3V, 3PF ±30kV(air), ±30kV(contact)	75A	8		SOP-8
LC03-3.3	3.3V, 8PF ±30kV(air), ±30kV(contact)	100A	8		SOP-8
LC03-6	6V, 8PF ±30kV(air), ±30kV(contact)	100A	8		SOP-8

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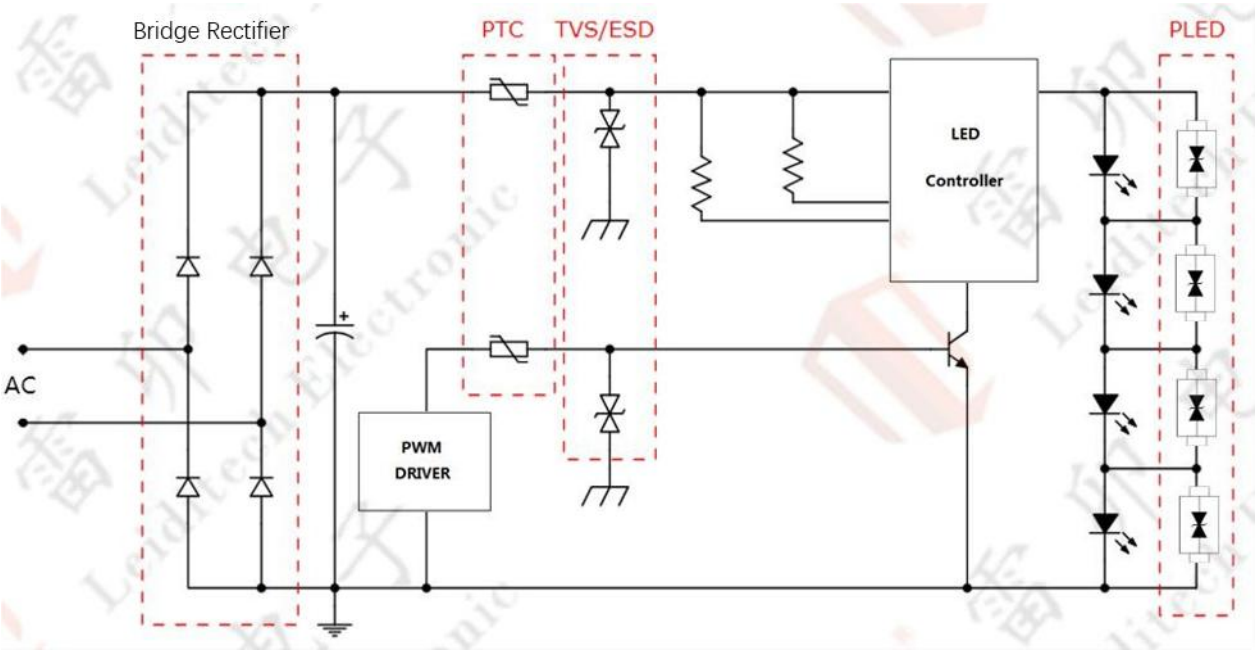
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6.1 Power Module and Open-circuit Protection Solution for Smart LED Lighting



Components utilized from Leiditech include:

1,.Rectifier Bridge: Leiditech rectifier bridges are known for their smallest packaging dimensions in the industry. The IBS packaging rectifier bridge, IB-S series, is specifically recommended for the LED lighting sector.

2.Polymeric Positive Temperature Coefficient (PTC) Resettable Fuses: These are used to provide overcurrent protection and reset automatically once the fault condition has been cleared.

3.Transient Voltage Suppression (TVS) Diodes: They effectively safeguard sensitive components in electronic circuits from damage caused by various types of surge pulses, ensuring the integrity of the circuit under transient overvoltage conditions.

4.Electrostatic Discharge (ESD) Protection Devices: In the lighting industry, especially in applications involving 5V, 12V, 24V, and 36V lamps, compact ESD protection elements are recommended to save space in the circuit design.

5.LED Open Circuit Protection Devices (PLED): These are specifically designed for circuits where LED bulbs are connected in series. When one LED bulb fails or opens, it does not affect the operation of the other LEDs, maintaining circuit functionality. Additionally, they offer overvoltage protection, allowing LEDs to withstand momentary lightning strikes. With features such as low conduction voltage, rapid response, and the ability to self-recover after fault clearance, these devices significantly enhance the stability and reliability of LED circuits.

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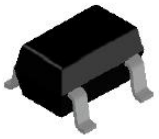
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6.1 Power Module and Open-circuit Protection Solution for Smart LED Lighting

Part Number	Description	IPP	Channels	Shape	Packaging
PLED6~36CA/B	6~36V, Bi.	-	1		SMA/B
IB034~0310S	400~1000V	IF=0.3A	-		IBS
SD12CW	12V, 75pF ±30kV(air), ±30kV(contact)	20A	1		SOD-323

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7.1 Electrostatic Protection Solution for Screen Flickering and Malfunctioning

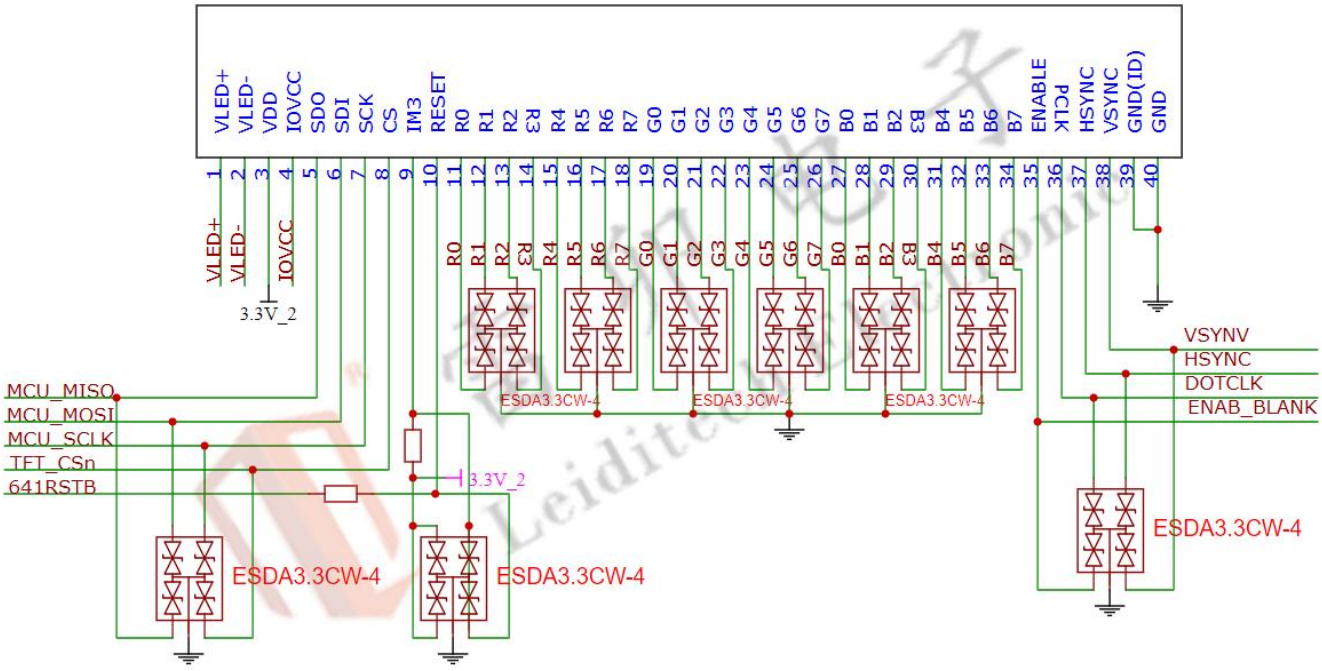
All display screens have a baseband, which contains an IC that maintains the normal operation of the screen. Static electricity can intrude from the casing or any point on the PCBA board, affecting the normal operation of the baseband IC. The rated operating voltage of these ICs is typically around 3V, and they operate at relatively fast frequencies.

Here are some issues faced by customers:

1.Household Appliance Display Client: Upon subjecting the display to 20kV air discharge static, the screen would frequently freeze, only to recover upon restart. Analysis of the circuit board by Leiditech revealed that although the client had already incorporated numerous ESD components, the voltage ratings were incorrect, and the capacitance values were too high. Leiditech recommended using ESDA3.3CW-4 to resolve the ESD issue.

2.Workshop Tablet Control Device: The client previously chose SD03C components with excessively high capacitance. Despite the client's painstaking efforts to load additional capacitors, the results remained unsatisfactory. Leiditech suggested directly replacing them with GBLC03C without altering the PCB layout. Alternatively, if the PCB modification is an option, ESDA3.3CW-4 could be the preferred choice, replacing four GBLC03C components and eliminating the need for four SD03C components and four capacitors altogether.

3.Automotive Dashcam: Static and lightning pulses from striking the casing would lead to the screen freezing. Given the automotive context, the test grades are higher. ESDA3.3CW-4, GBLC03C, or SD03C could be added for protection. However, overall EMC (Electromagnetic Compatibility) improvements are also required, which is a topic for discussion with the EMC correction engineers.



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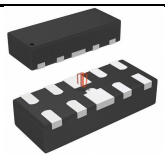
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7.1 Electrostatic Protection Solution for Screen Flickering and Malfunctioning

Part Number	Description	IPP	Channels	Shape	Packaging
ESDA3.3CW-4	3.3V, Bi., 13PF ±15kV(air), ±8kV(contact)	2.5A	4		SOT-353
GBLC03C	3.3V, Bi., 1PF ±30kV(air), ±30kV(contact)	16A	1		SOD-323
ULC332510P10	3.3V, Uni, 0.6PF ±30kV(air), ±25kV(contact)	5A	4		DFN2510P10

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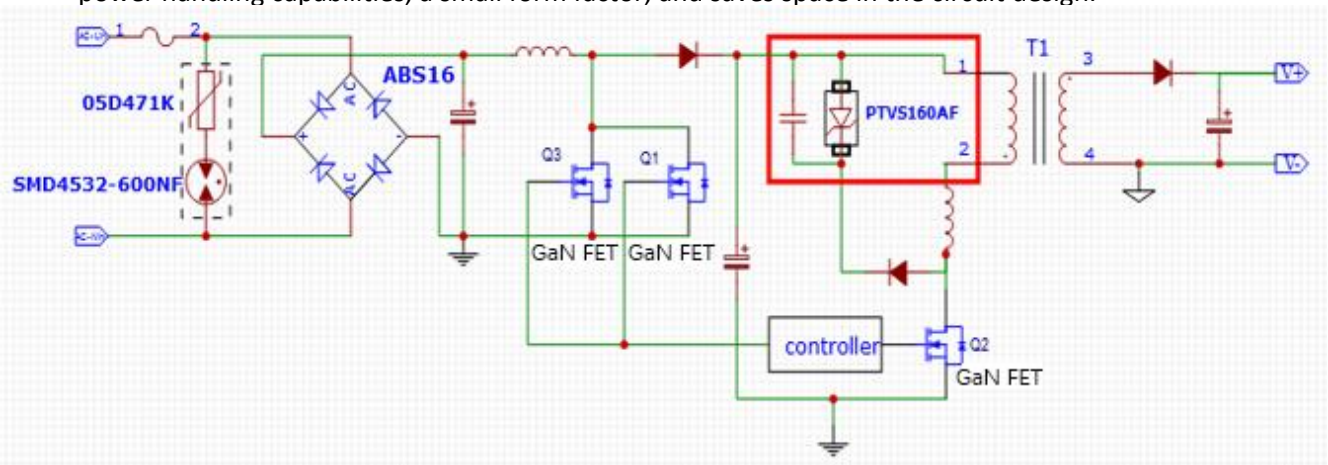
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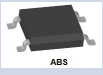
8.1 GaN Electrostatic Surge Protection Solution

Background: Gallium Nitride (GaN) does not inherently possess the capability to absorb transient surges. During circuit switching transients and lightning-induced surges, the overcurrent and overvoltage must not exceed the rated capacity of the GaN device.

Advantages of the Solution: A TVS (Transient Voltage Suppression) diode placed at the primary side of a fly back power transformer can effectively absorb the energy of overvoltage spikes generated by FET switching transients. It reacts quickly, exhibits low clamping voltage, and is controllable.

In this solution, the PTVS160AF single component is utilized for protection. This device boasts high power handling capabilities, a small form factor, and saves space in the circuit design.



Part Number	Description	Vc@Ipp	Ipp 10/1000us	Shape	Packaging
PTVS160AF	VRMW 160V 200W	259V	0.7A		SOD-123FL
Part Number	**Description**	Ipp	Vc	Shape	Packaging
05D471K	V1mA 470V Vac 300V	5A	810V		PTH
Part Number	Description	8/20us	1KV/us	Shape	Packaging
SMD4532-600NF	600V±30% （100V/s）	3KA	<1200V		4.5*3.2*2.7
Part Number	Description	If (AV)	If sm	Shape	Packaging
ABS10	Vr MAX 1000V	0.5A	20A		ABS

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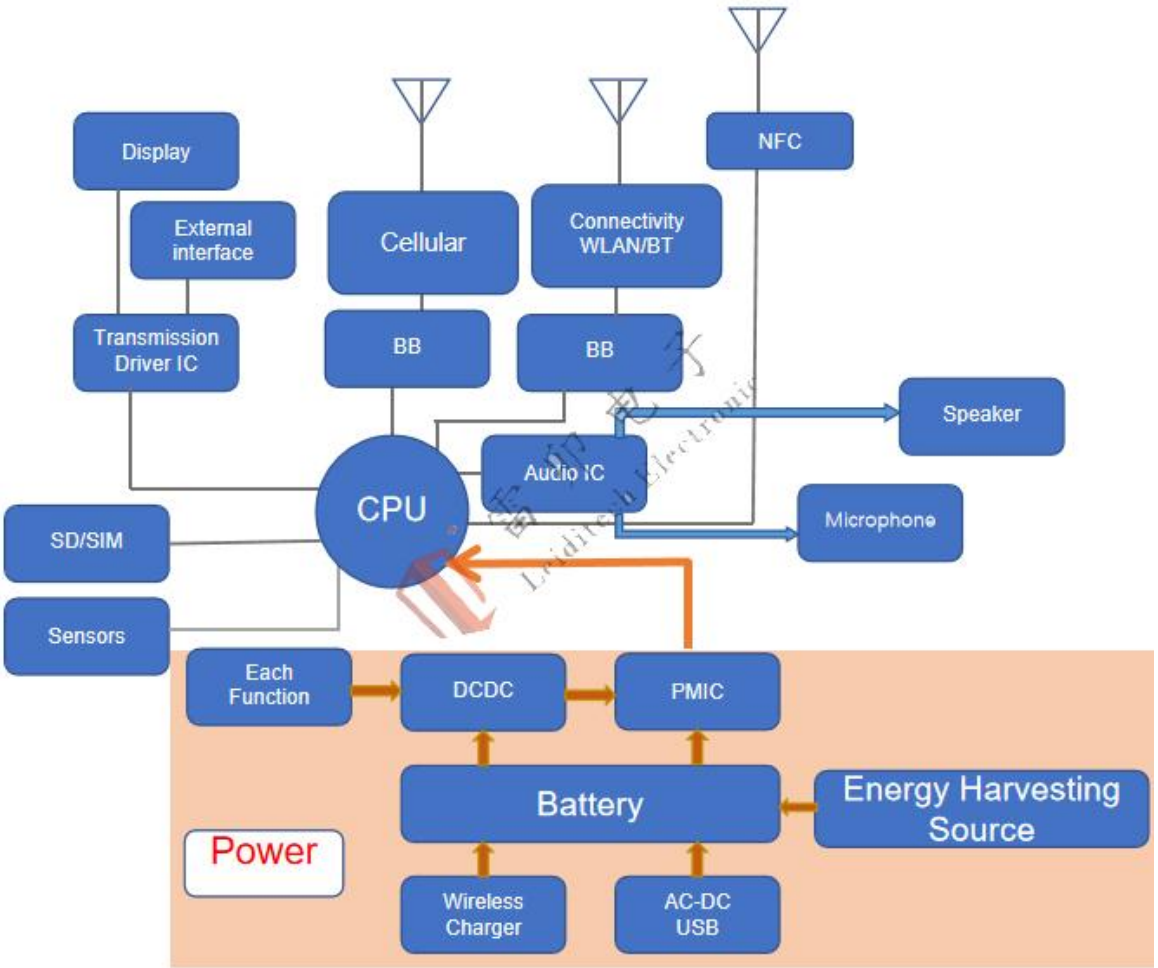
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9.1 Smart Watch Activity Tracker Solution

Smartwatches and activity trackers, also known as fitness trackers, are wearable devices designed to monitor and track fitness-related metrics. These devices can be used to supervise children's location, measure walking or running distances, track calories burned, and, in some cases, monitor heart rate, thereby enabling judgments on the frequency and intensity of physical activities as well as the wearer's overall health status.



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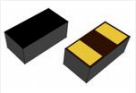
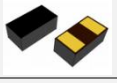
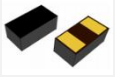
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9.1 Smart Watch Activity Tracker solution

Leiditech Products Recommended for Smart Watches

Part Number	Interface Location	Description	IPP	Channel	Shape	Packaging
PESD0542U005	Antenna Sensors	5V, Bi., 0.05PF ±15KV（air） ±8KV（contact）	-	1		DFN1006
ULC1811CDN	NFC	18V, Bi., 0.3PF ±25KV（air） ±15KV（contact）	2A	1		DFN1006
USRV05-4	SIM	5V, Uni, 0.5PF ±15KV（air） ±8KV（contact）	5A	5		SOT-26
ULC3311CDN	BLUETOOTH	3.3V, Bi., 0.45PF ±25KV（air） ±20KV（contact）	4A	1		DFN1006
ULC0524P	LCD	5V, **4-channel** Uni, 0.3PF ±30KV（air） ±25KV（contact）	5A	4		DNF2510P10
ESDA05CP30	GPIO	5V, Bi., 15PF ±30KV（air） ±30KV（contact）	8A	1		DFN1006
ULC0511CDN	Speaker Microphone	5V, Bi., 0.3PF ±20KV（air） ±15KV（contact）	3.8A	1		DFN1006
SMBJ20CA	Power DC5V	20V	18.6A	1		SMB
LRB520S-30T1G	Battery	30V VR	1A IFSM	1		SOD-523
PTC SMD0603P050TF	Battery	12V VMAX	35A IMAX	1		0603
MOS LM3400	Charger	N-MOS,30V , ±12V	20A	1		SOT-23

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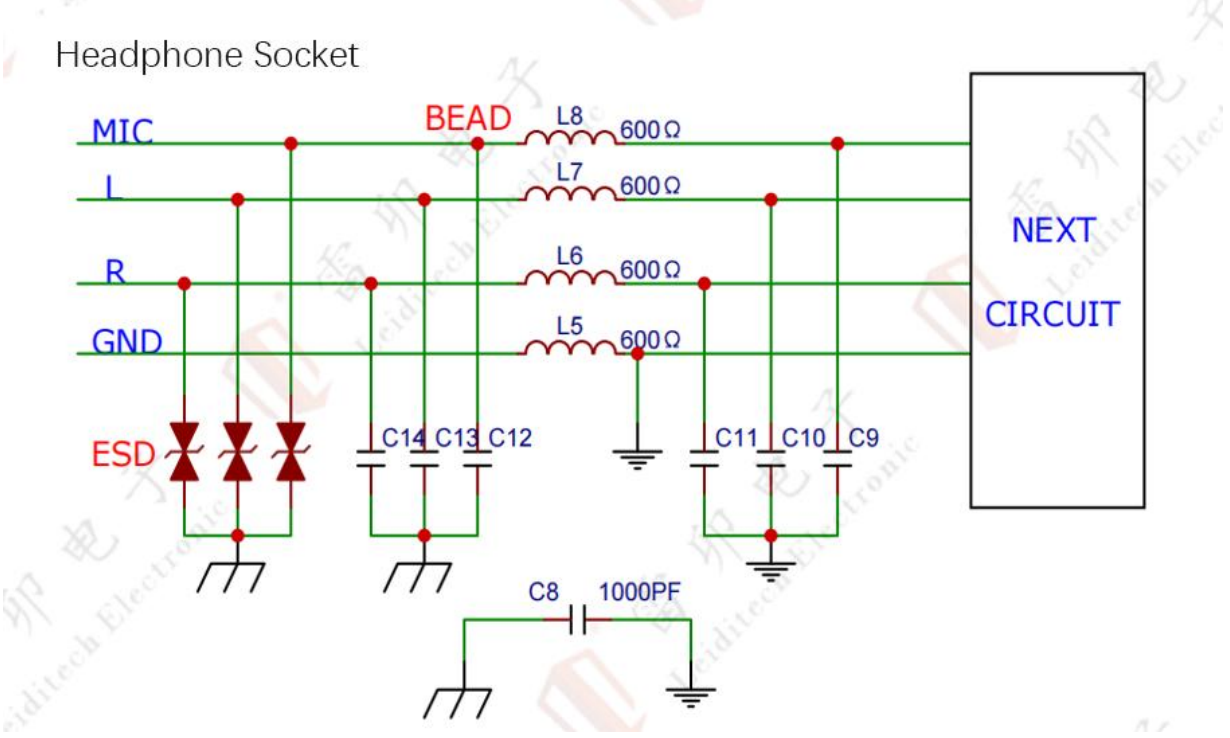
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10.1 Earphone Interface Electrostatic Protection Solution

Solution Advantages: Placing ESD diodes on the left and right audio channels as well as the MIC signal lines provides protection for downstream chips. Depending on the situation, additional ferrite beads can be added to filter out noise. You can choose ESD diodes rated at 3.3V or 5V, ensuring signal integrity while passing ESD tests. This solution meets the following standards:
IEC 61000-4-2, with contact discharge up to 30kV and air discharge up to 30kV,
ISO 10605-2 Level 4.



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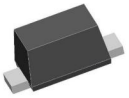
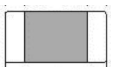
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10.1 Earphone Interface Electrostatic Protection Solution

Part Number	Description	IPP	Channels	Shape	Packaging
ESDA33CP30	3.3V,Bi., 12PF ±30kV(air), ±30kV(contact)	8A	1		DFN1006
ESDA05CP30	5V,Bi., 15PF ±30kV(air), ±30kV(contact)	8A	1		
ESDA33CT30	3.3V,Bi., 10.3PF ±30kV(air), ±30kV(contact)	9A	1		SOD-523
ESDA05CT30	5V,Bi., 15PF ±30kV(air), ±30kV(contact)	8A	1		
LMPY160808T-601Y-N	600Ω,RDC 0.2Ω	1A	1		0603 (160808)

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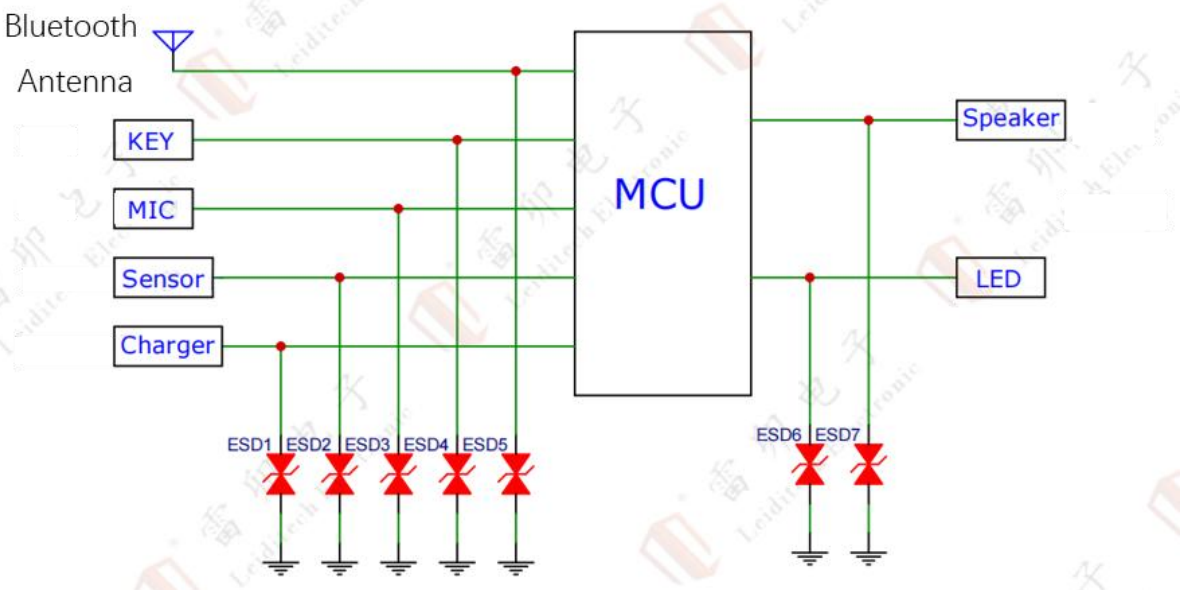
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10.2 Electrostatic Protection Solution of TWS Wireless Bluetooth Headset

Advantages of the Solution: This solution encompasses both the True Wireless Stereo (TWS) Bluetooth earbuds and their charging case. Given the spatial constraints of TWS earbuds and their portable nature, our protection solution is designed to be compact, featuring low capacitance, low leakage current, and high stability. For the power port, Leiditech utilize high-power, small-package ESD and EOS protection devices. For high-frequency signal lines, we use ESD protection devices with low junction capacitance. All ESD protection devices feature IR (leakage current) less than 0.1uA. Consequently, this solution is highly suitable for TWS Bluetooth earbuds and other wearable products.
This solution ensures signal integrity while passing ESD tests, meeting the following standards:
IEC 61000-4-2, with contact discharge up to 30kV and air discharge up to 30kV,
ISO 10605-2 Level 4.

TWS Bluetooth Earbuds ESD & EOS Protection Solution



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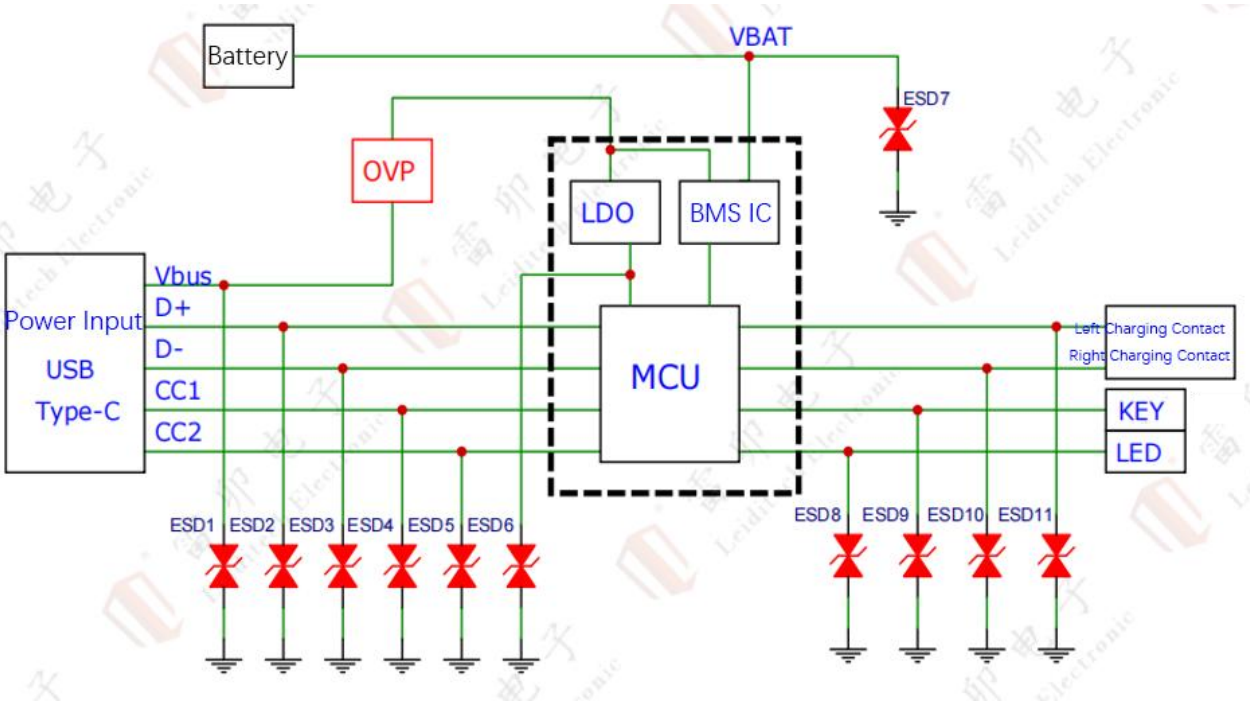
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10.2 Electrostatic Protection Solution of TWS Wireless Bluetooth Headset

Shanghai Leidiitech's Recommended Model List for the Overall ESD@EOS Protection Solution for TWS Bluetooth Headsets

Interface	Element Position	Part Number	Description	IPP	Packaging	Notes
Charger	ESD1	ESD0521CW	5V,±30kV/±30kV,25PF	17A	DFN0603	Bi. 5V/7V
		ESDA07CP30H	7V,±30kV/±30kV,140PF	40A	DFN1006	
Sensor MIC KEY	ESD2/ESD3/ESD4	ESD0521CH	5V,±30kV/±30kV,15PF	9A	DFN0603	Bi. These three can be selected as the same model; you can choose either 3.3V or 5V.
		ESDA05CP30	5V,±30kV/±30kV,15PF	8A	DFN1006	
		ESD3321C	3.3V,±30kV/±30kV,20PF	8A	DFN0603	
		ESDA05CP30	3.3V,±30kV/±30kV,12PF	8A	DFN1006	
Bluetooth Antenna	ESD5	ULC0521C	5V,±30kV/±30kV,0.26PF	5A	DFN0603	Bi. 5V
		ULC0542C	5V,±30kV/±30kV,0.3PF	4A	DFN1006	
		ULC0322P10LV	3.3V,±30kV/±30kV,0.6PF	10A	DFN0603	Bi. ,Snap back 3.3V
		ULC0342P	3.3V,±30kV/±30kV,0.6PF	10A	DFN1006	
LED Speaker	ESD6/ESD7	ESD0521CH	5V,±30kV/±30kV,15PF	9A	DFN0603	Bi. These two can be selected as the same model; you can choose either 3.3V or 5V.
		ESDA05CP30	5V,±30kV/±30kV,15PF	8A	DFN1006	
		ESD3321C	3.3V,±30kV/±30kV,20PF	8A	DFN0603	
		ESDA05CP30	3.3V,±30kV/±30kV,12PF	8A	DFN1006	

2. TWS Headset Charging Case ESD & EOS Comprehensive Protection Solution



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10.2 Electrostatic Protection Solution of TWS Wireless Bluetooth Headset

Shanghai Leiditech TWS Earphone Charging Case ESD & EOS Protection Comprehensive Solution Model Recommendation Table

Interface	Element Position	Part Number	Description	IPP	Packaging	Notes
VBUS	ESD1	SD0581P6W	5V,±30kV/±30kV	95A	DFN1610	5V Bi.
		SD0771P6W	7V,±30kV/±30kV	75A	DFN1610	7V Uni
		SD1281P6W	12V,±30kV/±30kV	90A	DFN1610	12V Bi.
		SD2471P6HW	24V,±30kV/±30kV	80	DFN1610	24V Bi.
D+/D-	ESD2-ESD5	ULC0521C	5V,±30kV/±30kV,0.26PF	5A	DFN0603	5V Bi.
CC1/CC2		ULC0542C	5V,±30kV/±30kV,0.3PF	4A	DFN1006	
VCC	ESD6	ESDA05CPX	5V,±30kV/±30kV	18A	DFN1006	5V Bi.
charge contacts	ESD10/ESD11	ESDA05CP30	5V,±30kV/±30kV,15PF	8A	DFN1006	5V Bi.
		ESDA07CP30H	7V,±30kV/±30kV,15PF	8A	DFN1006	7V Bi.
key, LED	ESD8/ ESD9	ESDA05CP30	5V,±30kV/±30kV,15PF	8A	DFN1006	5V Bi.
VBAT	ESD7	ESDA05CPX	5V,±30kV/±30kV	18A	DFN1006	5V Bi.
		ESDA07CP30H	7V,±30kV/±30kV	40A	DFN1006	7V Bi.
OVP		LMOVP3605	input voltage2.8-32V	4A	DFN2X2-6	overvoltage protection.

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