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Protections and Filters application book for: USB-C and Power Delivery

October 2026



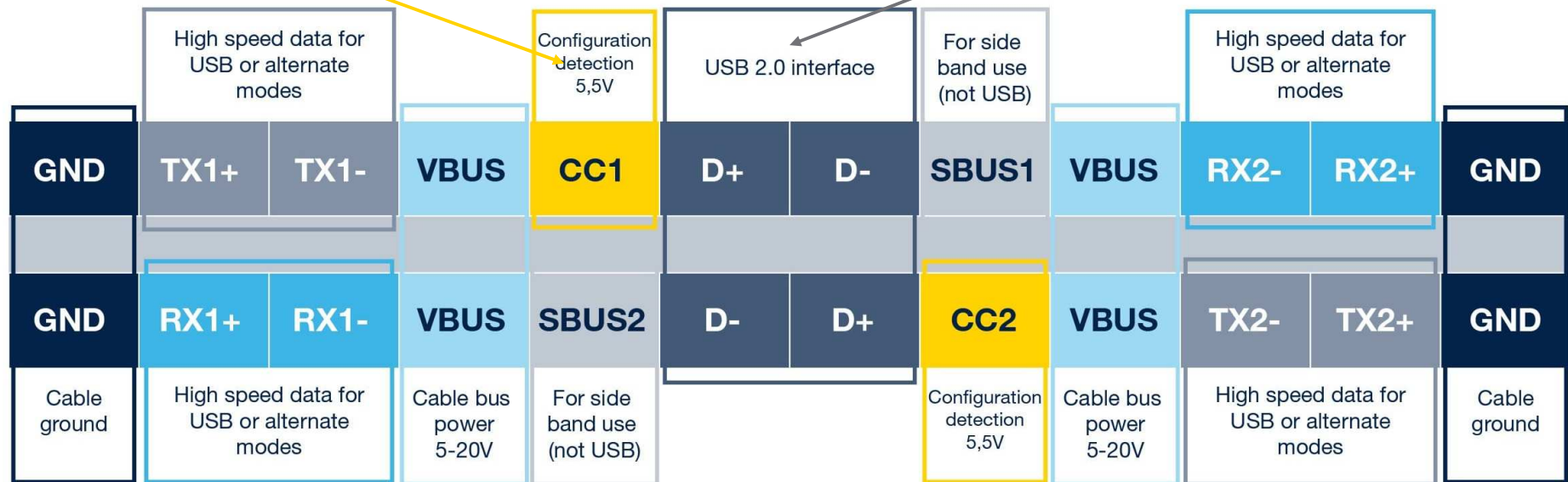
USB Type C

CC lines

Vrm >5V	Vrm >9V	Vrm > 12V	Vrm >20V	Vrm >48V
ESDZV5-1BV2	ESDA141-1BF4*	ESDALC20-1BF4	ESDALC20-1BF4	ESD501-1BF4*
ESDZV053-1BF5		ESDA25P35-1U1M	ESDA25P35-1U1M	
ESDZV5H-1BU2		TVS221SC-1T2	TVS221SC-1T2	
ESDA8P30-1T2				

Data D+ D- :

ESD	ESD+CMF
ESDZV5-1BV2	ECMF2-40A100N6
ESDZV053-1BF5	
ESDZV5-1BF4	



V_{BUS}

Vrm >5V	Vrm >9V	Vrm > 12V	Vrm >20V	Vrm >48V
ESDZV053-1BF5	ESDA13P70-1U1M	ESDA25P35-1U1M	ESDA25P35-1U1M	ESD501-1BF4*
ESD051-1BF4			TVS221SC-1T2	
ESDA5-1F4				
ESDA7P120-1U1M				

V_{BUS} and CC :

Vrm >20V	
SINK	TCPP01-M12
SOURCE	TCPP02-M18
DRP	TCPP03-M20

Data SSRx/SSTx

ESD	ESD + CMF
ESDX011-1BV2*	ECMF2-40A100N6
ESDX011-1BF4*	ECMF4-40A100N10
HSP053-4M5	

(*) under development, please contact your sales representatives



USB Type-C protection V_{BUS} , CC lines and Power delivery

Compatible and reliable up to 100 W (TCPP0 series) Compliant with USB PD 3.2/PPS; USB-IF certification available.

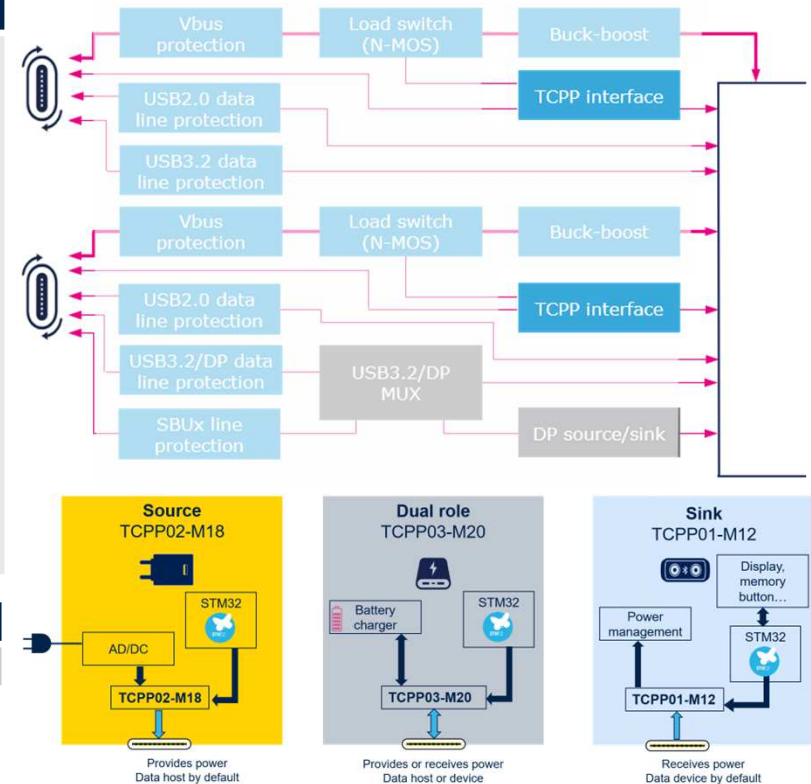
Needs for USB PD management0	Product key parameters	ST solutions
Compliance with USB PD 3.2 specification	USB-IF certification available TCPP01 for Sink → USB-IF-TID: 5205 TCPP02 for source → USB-IF-TID: 7884 TCPP03 for DRP → USB-IF-TID: 6408	TCPP01-M12 TCPP02-M18 TCPP03-M20
Fast charging	Compliant with USB PD 3.1 including PPS up to 20 V, -5 A	
Compatible with all chargers from the market	Vcc = 24 V for TCPP0x	
Able to survive current or voltage surges and short-circuit with Vbus	Overcurrent and overvoltage protection on VBUS, CC lines VThreshold = 6 V on CC lines	
Cost effectiveness	Companion chip of STM32 with UCPD Reuse the STM32 of the application	
Use of low-cost MOSFET	Integrated VBUS load switch gate driver for external N-MOSFET	
IEC 61000-4-2 level 4 (8 kV contact/15 kV air)	Contact discharge: ≥8 kV Air discharge: ≥15 kV	

Expansion boards available

X-NUCLEO-SNK1M1

X-NUCLEO-SRC1M1

X-NUCLEO-DRP1M1

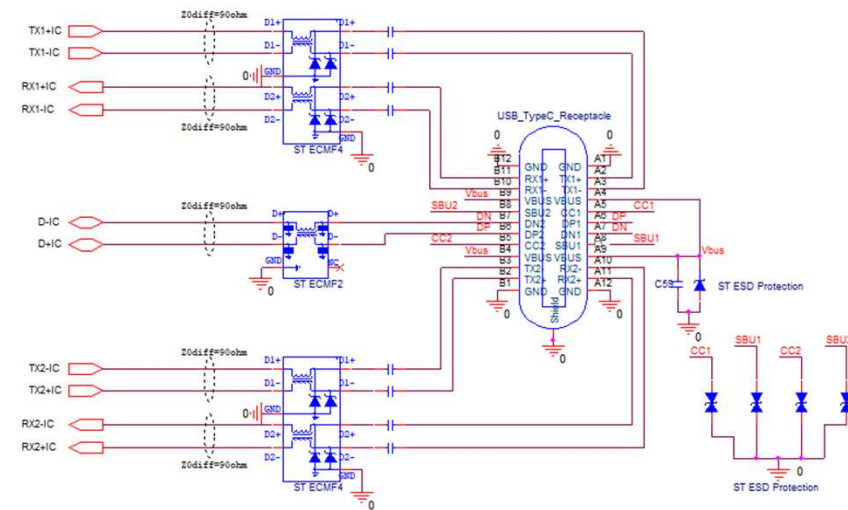




USB Type-C CC lines (ESD protection only)

ESDAxP series can protect CC lines against ESD and surges up to 120 A (8/20 μ s)

Needs for CC lines when VBUS = 5 V	Product key parameters	ST solutions
Voltage ≤ 5.5 V	$V_{RM} \geq 5.5$ V	<u>ESDZV5-1BV2</u> <u>ESDZV053-1BF5</u> <u>ESDZV5H-1BU2</u> <u>ESDA8P30-1T2</u>
Positive signal	Unidirectional (but bidirectional also suitable)	
Need to withstand 8/20 μ s surge as defined in IEC 61000-4-5	High IPP capability	
IEC 61000-4-2 level 4 (8 kV contact/15 kV air)	Contact discharge: up to 30 kV Air discharge: up to 30 kV	
Needs for CC lines with Power Delivery (PD)	Product key parameters	ST solutions
Voltage ≤ 20 V	$V_{RM} \geq 20$ V	<u>ESDALC20-1BF4</u> <u>ESDA25P35-1U1M</u> <u>TVS221SC-1T2</u>
Positive signal	Unidirectional (but bidirectional also suitable)	
Need to withstand 8/20 μ s surge as defined in IEC 61000-4-5	High-IPP capability	
IEC 61000-4-2 level 4 (8 kV contact/15 kV air)	Contact discharge: up to 20 kV Air discharge: up to 30 kV	



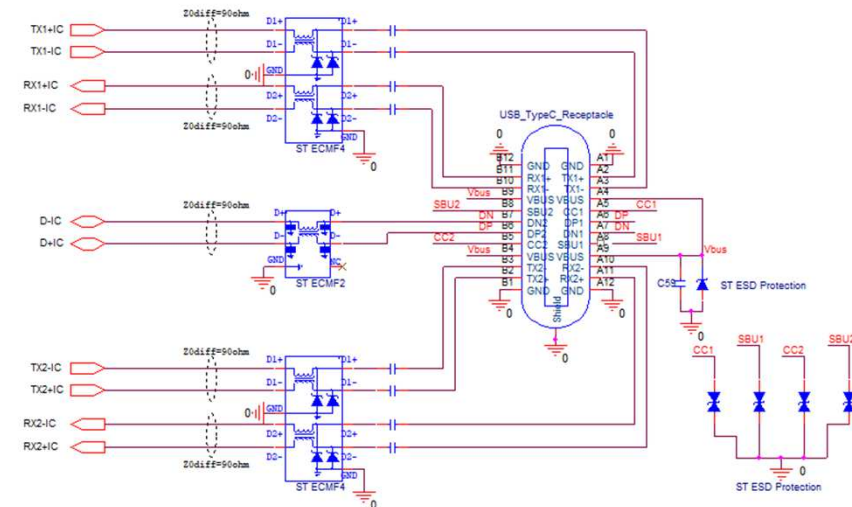


USB Type-C VBUS

ESDAxP series can protect VBUS against ESD and surges up to 150 A (8/20 μ s)

Needs for V_{BUS}	Product key parameters	ST solutions
Voltage ≤ 5.5 V	$V_{RM} \geq 5.5$ V	<u>ESDZV053-1BF5</u> <u>ESD051-1BF4</u> <u>ESDA5-1F4</u> <u>ESDA7P120-1U1M</u>
Positive signal	Unidirectional / Bidirectional	
Need to withstand 8/20 μ s surge as defined in IEC 61000-4-5	High IPP capability	
IEC 61000-4-2 level 4 (8 kV contact/15 kV air)	Contact discharge: up to 30 kV Air discharge: up to 30 kV	

Needs for V_{BUS} with Power Delivery (PD)	Product key parameters	ST solutions
Voltage ≤ 22 V	$V_{RM} \geq 22$ V	<u>ESDA25P35-1U1M</u> <u>TVS221SC-1T2</u>
Positive signal	Unidirectional	
Need to withstand 8/20 μ s surge as defined in IEC 61000-4-5	High IPP capability	
IEC 61000-4-2 level 4 (8 kV contact/15 kV air)	Contact discharge: up to 30 kV Air discharge: up to 30 kV	

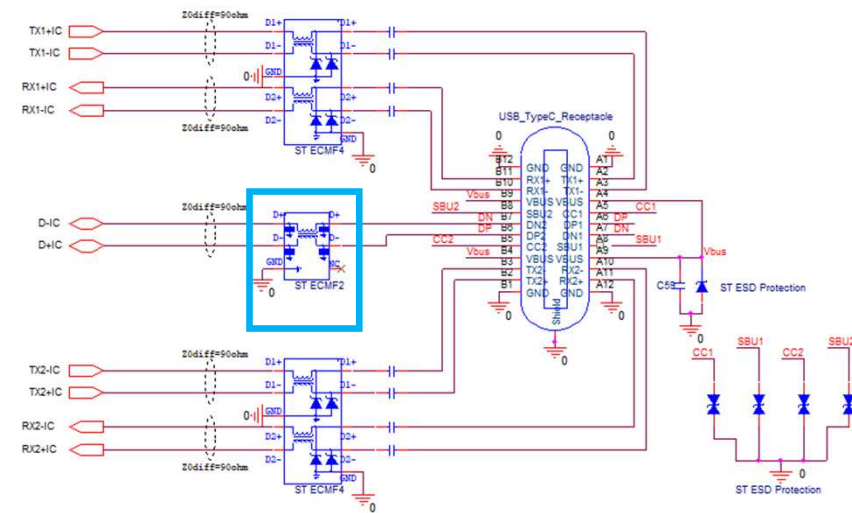




USB Type-C data lines D+/D-

Complete solution portfolio for USB granting flexibility in design
All sockets are ESD protected according to IEC 61000-4-2 level 4

USB2.0 (D+/D-) needs	Product key parameters	ST solutions
Voltage ≤ 3.0 V	$V_{RM} = 5.25$ V	<u>ESDZV5-1BV2</u> <u>ESDZV053-1BF5</u> <u>ESDZV5-1BF4</u>
Positive signal	Bidirectional	
Data rate: 480 Mbps Maximum equivalent frequency 240 MHz	Bandwidth 3.0 GHz Compliant with eye diagram	
IEC 61000-4-2 level 4 8 kV contact/15 kV air	Contact discharge: ≥ 8 kV Air discharge: ≥ 15 kV	<u>ECMF2-40A100N6</u>
Avoid Wi-Fi antenna desense (2.4/5 GHz)	CMF rejection ≥ -15 dB (2.4 GHz to 6.5 GHz)	
IEC 61000-4-2 level 4 8 kV contact/15 kV air	Contact discharge: ≥ 8 kV Air discharge: ≥ 15 kV	

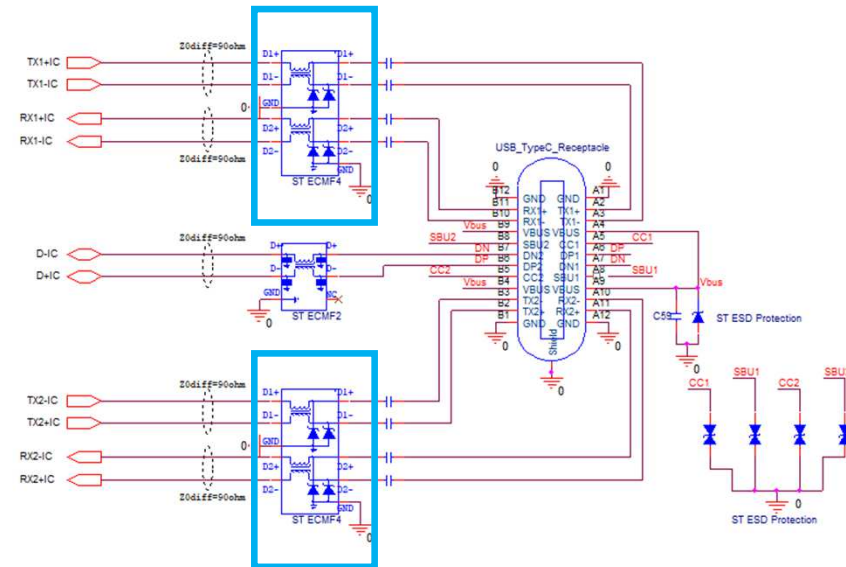




USB Type-C data lines SSRx/SSTx

Best ESD clamping performance in small footprint package

SSRx/SSTx lines	Product key parameters	ST solutions
Voltage < 2.5 V	$V_{RM} = 3.6 \text{ V}$	ESDX011-1BV2* ESDX011-1BF4* HSP053-4M5
Positive signal	Unidirectional / bidirectional	
Data rate: 10 Gbps	$C_{IO/GND \text{ max}} = 0.2 \text{ pF @ } 10 \text{ GHz}$	
Avoid disturbing Wi-Fi/BT/5G	Rejection @ 2.4 GHz → -15 dB, rejection @ 5 GHz → -20 dB Rejection @ 6 GHz: -17 dB	ECMF2-40A100N6
Avoid disturbing Wi-Fi/BT	Rejection @ 2.4 GHz: -15 dB Rejection @ 5 GHz: -20 dB	ECMF4-40A100N10



Glossary

- **CC:** Configuration channel pin of USB Type-C
- **DRD:** Dual role data
- **DRP:** Dual role power
- **CMF:** Common-mode filter
- **ECMF:** ESD protection and CMF
- **EMCA:** Electronically marked cable
- **EOS:** Electrical overstress
- **EPR:** Extended power range
- **ESD:** Electrostatic discharge
- **TCP:** USB Type-C Port Protection
- **HSP:** High speed protection
- **PD:** Power delivery
- **PDO:** Power delivery object
- **SPR:** Standard power range
- **SBU:** Sideband use pin of USB-C
- **SSRx:** SuperSpeed receive
- **SSTx:** SuperSpeed transmit
- **TVS:** Transient voltage suppressor diode
- **UCPD:** USB Type-C Power Delivery (STM32 embedded USB-C PD controller)
- **USB:** Universal serial bus

Our technology starts with You



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