HSP series portfolio overview

High-speed port ESD protection

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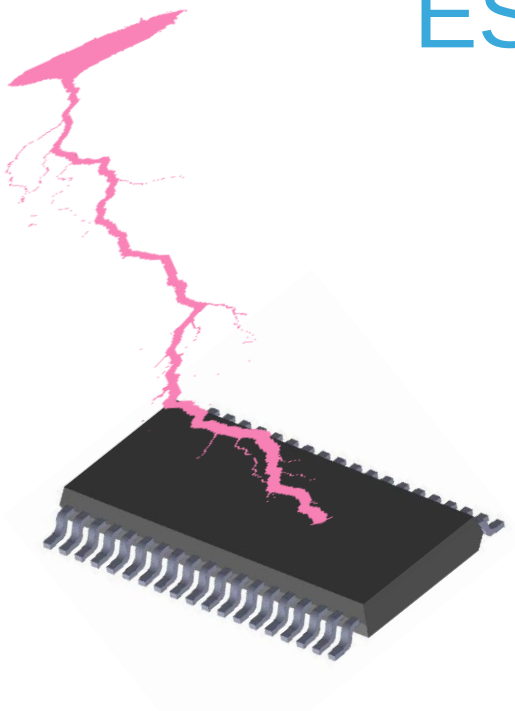
Is this presentation suited for you?

Where do you stand with high-speed port protection?

Beginner?	Intermediate?	Advanced?
I am not familiar with this subject. I am in the discovery phase and would like an overview and a basic understanding of the technology.	I have a basic understanding of this subject. I would like to go deeper in details and tackle more aspects of this subject.	I am very familiar with this subject. I would like to deepen my knowledge and become an expert.
Click here to continue to next slide	Click here to open new presentation	Click here to open new presentation
Overview	**Basic**	**In depth**

ESD protection is needed for



Core ICs such as microcontrollers, micro-processors, transceivers, etc.

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

Integrated electronics systems with **PCBs having a high component density** facilitate ESD **coupling** and **propagation**

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

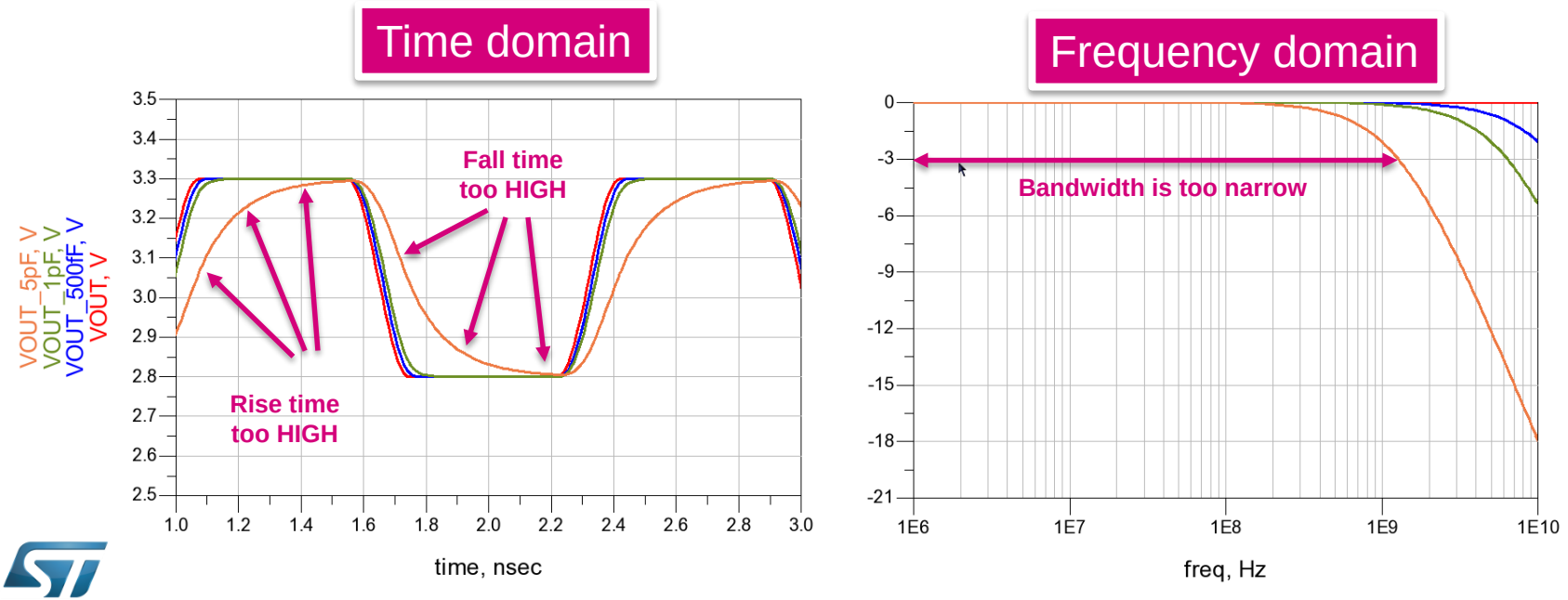
When the **application uses RF** (Wi-Fi or Bluetooth)**,** a **common-mode filter is required,** in addition to ESD protection, to avoid **RF performance decrease** due to the EMI generated by the high-speed link.

Dedicated to high-speed ports

Ultra-low capacitance

- The parasitic capacitance of ESD protection devices must be low enough to allow high-speed signals to be transmitted without degradation.
- A high parasitic capacitance of the ESD protection devices would increase too much the signal rise/fall time and prevent the communication.

Example of the impact of parasitic capacitance on an HDMI signal simulated with discrete capacitance

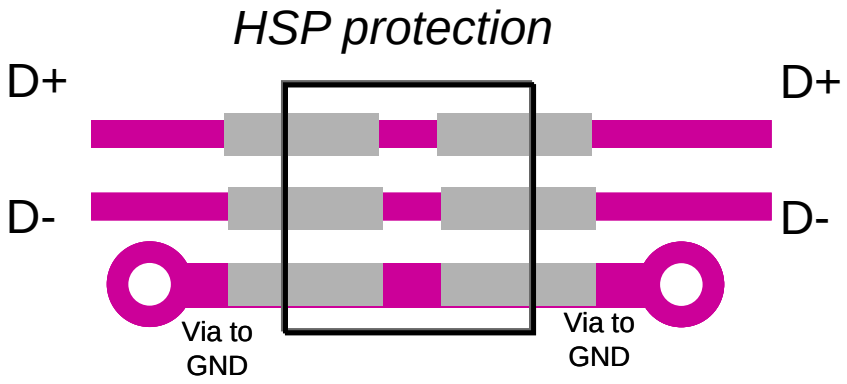


Dedicated to high-speed ports

Flow-through layout

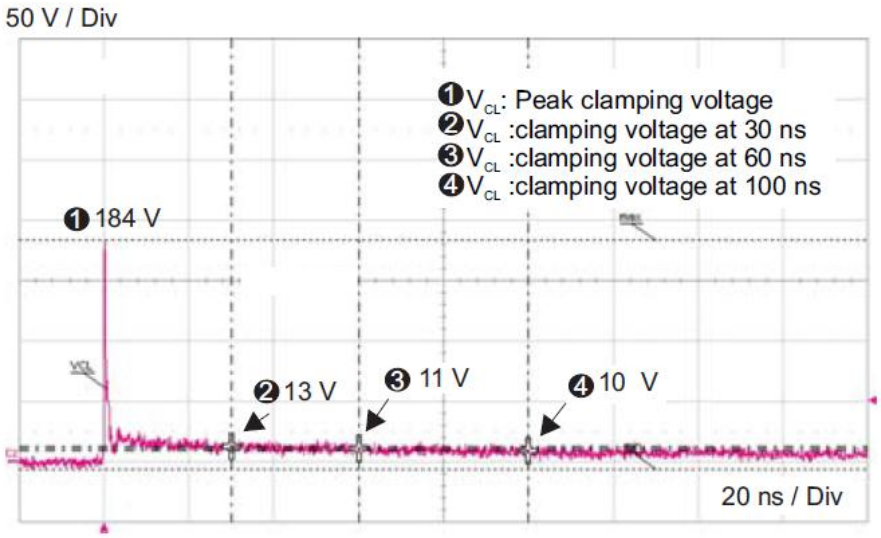
- To make the design and PCB layout **easier and simpler**
- To preserve the **symmetry** between the 2 lines of the differential lane

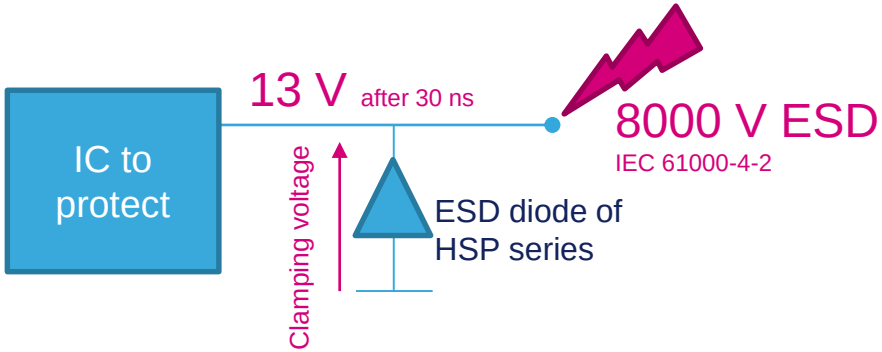
→ **High-speed port protection must be flow-through**



Clamping voltage

ESD response to IEC 61000-4-2 (+8 kV contact discharge)
Example of HSP051-4M10





- The quality of protection lies in the clamping voltage of the ESD diodes
- It is measured after 30 ns (the first peak voltage is in the nanosecond range; too fast to be significant)
- HSP protection devices can clamp 8000 V ESD strikes down to 13 V !

Main selection criteria

- **V_{BR}** Breakdown voltage higher than operating signal
  Above this voltage, the ESD protection devices will enter Clamping mode
- **f_c** Cut-off frequency higher than high-speed signal bandwidth defined by the rise time value
- **$C_{I/O\ to\ GND}$** Low parasitic capacitance (a consequence of high bandwidth) minimizing the impact on transmission line impedance
- **R_d** Dynamic resistance & **V_{CL}** Clamping voltage to keep the protected IC safe

Example of HSP051-4M10

Symbol	Test conditions		Min.	Typ.	Max.	Unit
V_{BR}	I_R = 1 mA		4.5	5.8		V
I_{RM}	V_{RM} = 3.6 V			10	100	nA
V_{CL}	I_{PP} = 1 A, 8/20 µs				10	V
V_{CL}	IEC 61000-4-2, +8 kV contact (I_{PP} = 16 A), measured at 30 ns			13		V
Rd	Dynamic resistance, pulse duration 100 ns	I/O to GND		0.48		Ω
		GND to I/O		0.96		
$C_{I/O - I/O}$	$V_{I/O}$ = 0 V, F = 200 MHz to 9 GHz			0.2	0.3	pF
$C_{I/O - GND}$	$V_{I/O}$ = 0 V	F = 200 MHz to 2.5 GHz		0.4	0.55	pF
		F = 2.5 GHz to 9 GHz		0.35	0.45	pF
f_C	-3dB			10		GHz
Z_{diff}	Time domain reflectometry: t_r = 200 ps (10 - 90%), Z_0 = 100 Ω		85	100	115	Ω

High-speed port protection package offer

1 mm² 2 mm² 5 mm²

2-line packages

0.8 mm²

1.45 mm²

2.56 mm²

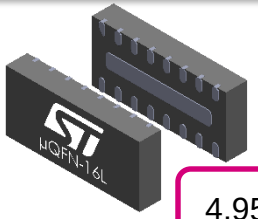
4-line packages

0.72 mm²

1.9 mm²

2.5 mm²

8-line package



4.95 mm²

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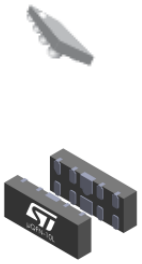
High-speed port protection portfolio

2 lines

HSP061-2N4	*µQFN-4L 400-µm pitch* *Size: 1 x 0.8 x 0.5 mm*
HSP062-2M6	*µQFN-6L 500-µm pitch* *Size: 1 x 1.45 x 0.55 mm*
HSP062-2P6	*SOT-666* *Size: 1.6 x 1.6 x 0.52 mm*

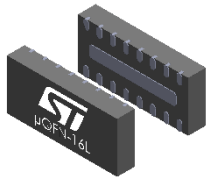
4 lines

HSP061-4F4	*Flip Chip /* WLCSP *6 bumps – 300-µm pitch* *Size: 0.6 x 1.2 x 0.38 mm*
HSP051-4N10	*DFN-10L 400-µm pitch* *Size: 1 x 1.9 x 0.3 mm*
HSP051-4M10	*DFN-10L 500-µm pitch* *Size: 1 x 2.5 x 0.48 mm*



8 lines

HSP061-8M16	*DFN-16L 400-µm pitch* *Size: 1.5 x 3.3 x 0.55 mm*



Let’s go further

Basic presentation

Intermediate product presentation soon available: ‘Understanding ST’s HSP series specification’

In-depth information

Application Notes:

- HSP06x-2 high-speed line protection on HDMI 1.4 link (AN4138)
- HSP061-8M16 high-speed line protection on HDMI 1.4 link (AN3357)
- TVS short-pulse dynamic resistance measurement ... (AN4022)
- IEC 61000-4-2 standard testing (AN3353)

Selection

- Selection guide [pdf]
- www.st.com/hsp-protection

Thank you