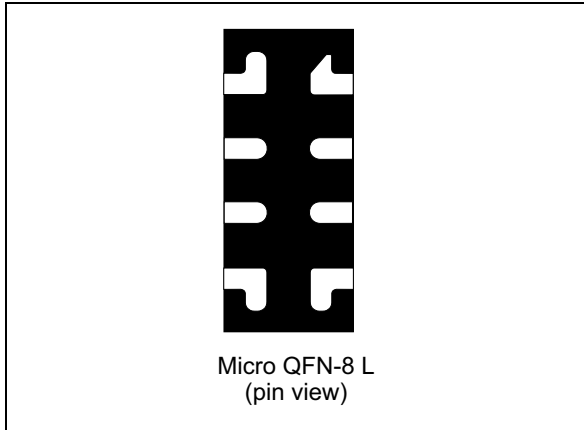


## Common mode filter with ESD protection for USB 2.0 interface

Datasheet – production data



### Features

- Integrated common mode filter
- Differential pair ESD protection
- 16 V  $V_{BUS}$  ESD and EOS protection
- ID pin ESD protection
- Low profile micro QFN-8L package
- High bandwidth: > 6 GHz
- Optimized for high speed USB 2.0
- High common mode attenuation at 900 MHz and 1.8 GHz
- Support for audio over USB 2.0 thanks to bidirectional ESD protection
- Ultra compact, low board space
- Low height: < 0.55 mm

### Complies with the following standards:

- IEC 61000-4-2 level 4:
  - ±15 kV (air discharge)
  - ±8 kV (contact discharge)
- RoHS2 compliant

### Applications

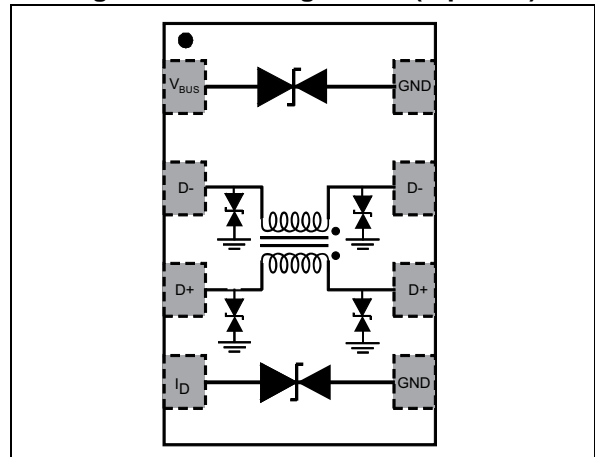
Where transient overvoltage protection in ESD sensitive equipment is required, such as:

- Computers
- Printers
- Communication systems
- Cellular phone handsets and accessories
- Video equipment

### Description

The ECMF02-4CMX8 affords key component integration such as common mode filter D+ and D- lines and ESD protection on all lines. This device offers an optimized flow-through footprint for USB 2.0 applications.

Figure 1. Pin configuration (top view)



# 1 Characteristics

**Table 1. Absolute maximum ratings ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ )**

Symbol	Parameter		Value	Unit
$V_{PP}$	Peak pulse voltage <sup>(1)</sup>	ESD discharge IEC 61000-4-2, level 4		
		Contact discharge on D+/D- pins	10	kV
		Contact discharge on $V_{BUS}$ and $I_D$ pins	20	
		Air discharge on all pins	30	
$P_{PP}$	Peak pulse power (8/20 $\mu$ s) on $V_{BUS}$		150	W
$I_{PP}$	Peak pulse current (8/20 $\mu$ s) on $V_{BUS}$		4.8	A
$T_j$	Maximum operating junction temperature		-40 to +125	$^{\circ}\text{C}$
$T_{stg}$	Storage temperature range		-55 to +150	$^{\circ}\text{C}$

1. Measurements done on IEC 61000-4-2 test bench. For further details see Application note AN3353.

**Figure 2. Electrical characteristics - definitions**

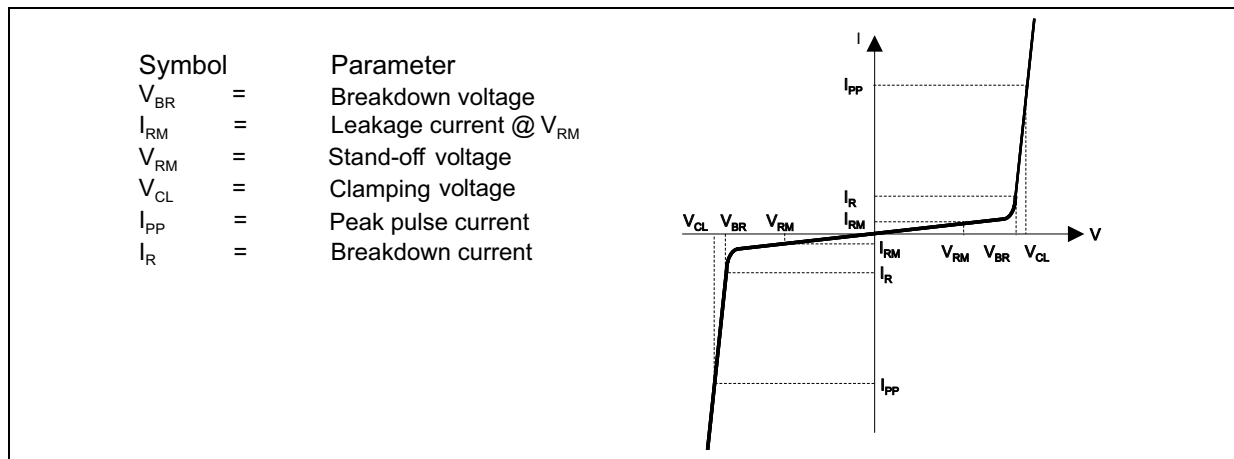


Table 2. Electrical characteristics (values,  $T_{amb} = 25\text{ °C}$ )

Symbol	Test conditions	Min.	Typ.	Max.	Unit
<b>Data lines</b>					
$V_{BR}$	$I_R = 1\text{ mA}$	6			V
$I_{RM}$	$V_{RM} = 5.5\text{ V per line}$			100	nA
$R_{DC}$	DC serial resistance on data line		3	4	$\Omega$
<b><math>V_{BUS}</math></b>					
$V_{BR}$	$I_R = 1\text{ mA}$	15	16.5	18	V
$I_{RM}$	$V_{RM} = 12\text{ V}$			50	nA
$V_{CL}$	Clamping voltage. $I_{PP} = 1\text{ A}$ , $t_p = 8/20\text{ }\mu\text{s}$			20	V
$V_{CL}$	Clamping voltage. $I_{PP} = 2.5\text{ A}$ , $t_p = 8/20\text{ }\mu\text{s}$			24	V
<b><math>I_D</math></b>					
$V_{BR}$	$I_R = 1\text{ mA}$	6			V
$I_{RM}$	$V_{RM} = 1.5\text{ V per line}$			100	nA

Figure 3. SDD21 differential attenuation measurement ( $Z_{0\text{ diff}} = 90 \Omega$ ) for data lines D+ and D-

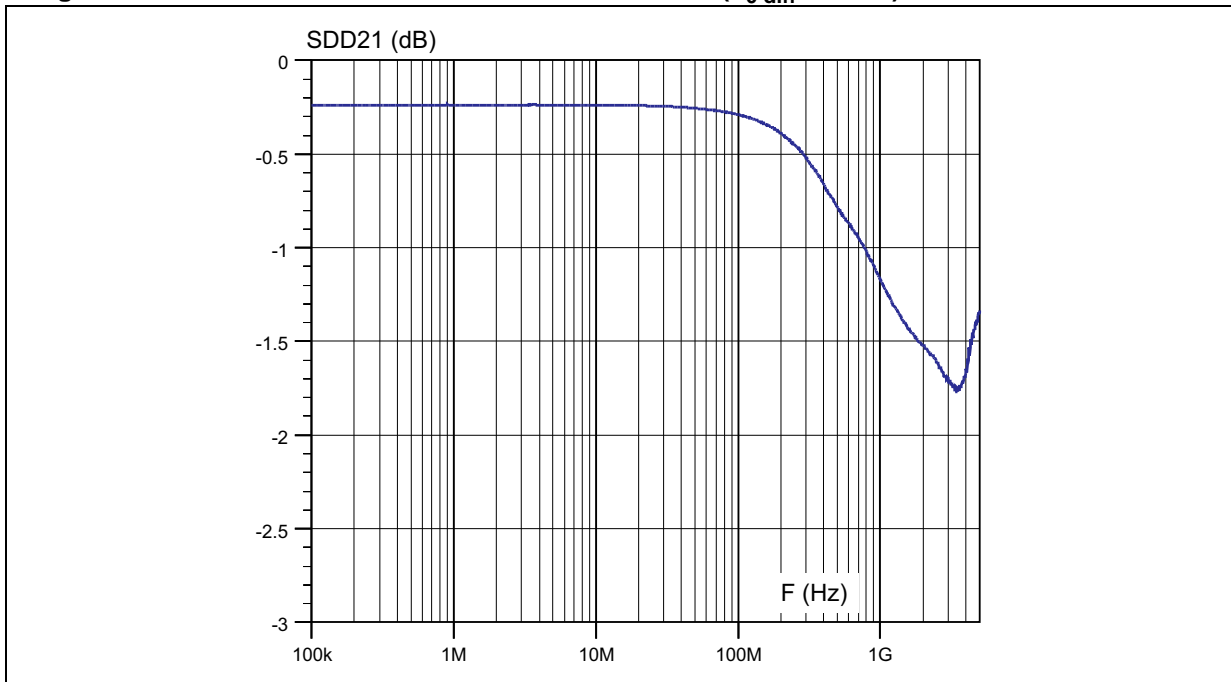


Figure 4. SCC21 common mode attenuation measurement ( $Z_{0\text{ com}} = 45 \Omega$ )

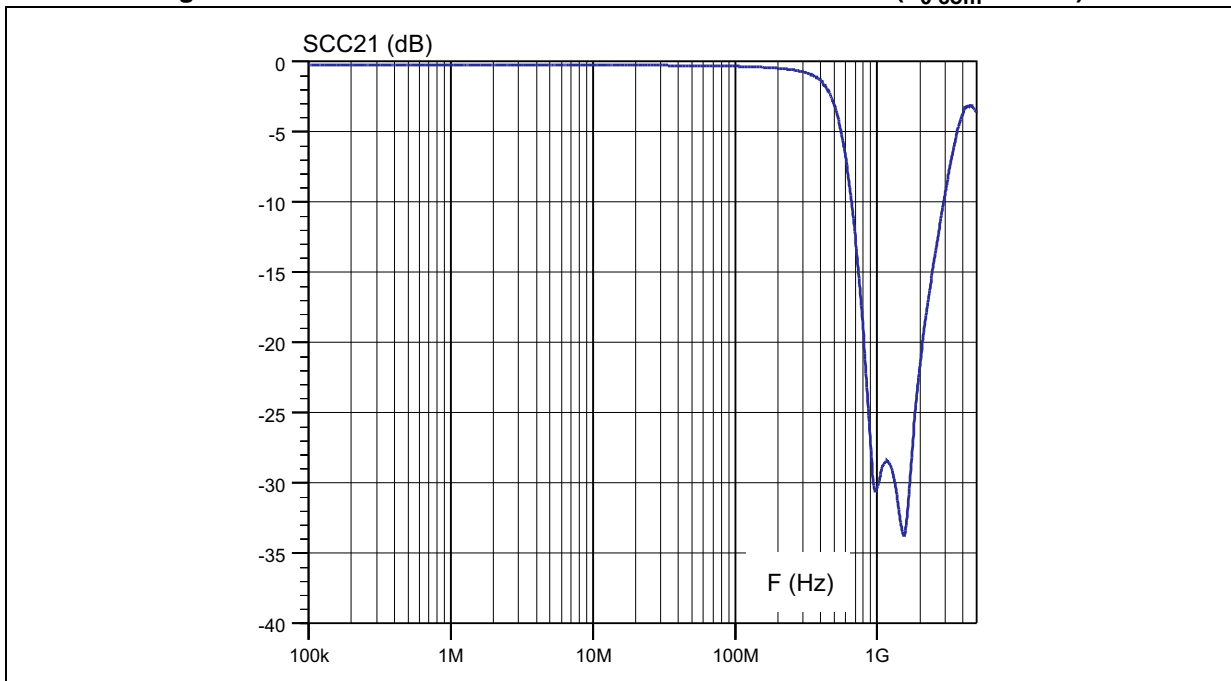


Figure 5. ID frequency response measurement ( $Z_0 = 75 \Omega$ )

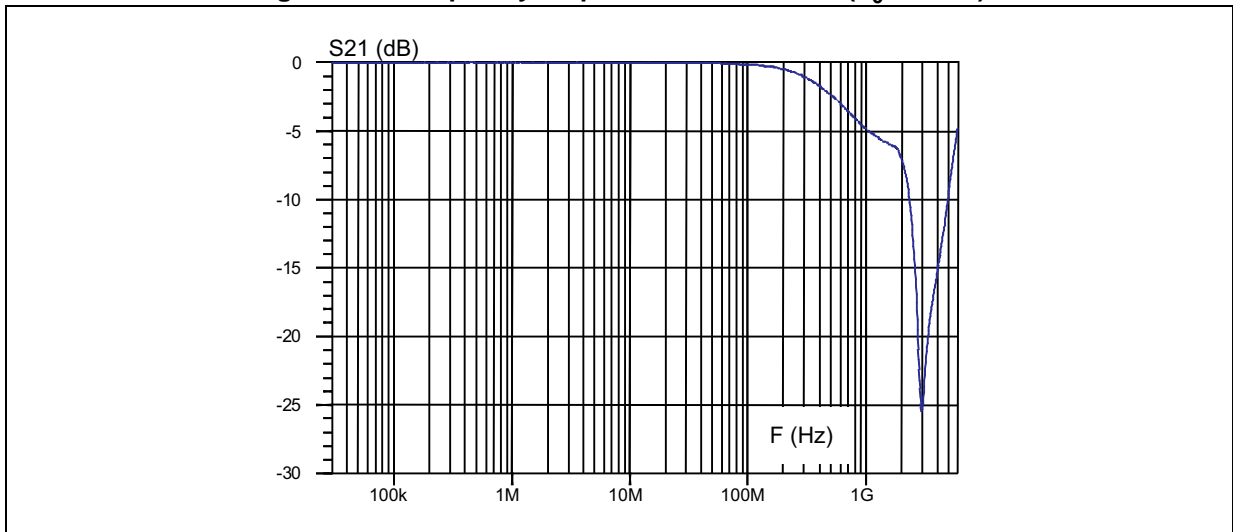


Figure 6. Differential ( $Z_{DD21}$ ) and common mode ( $Z_{CC21}$ ) impedance versus frequency



Figure 7. ESD test conditions

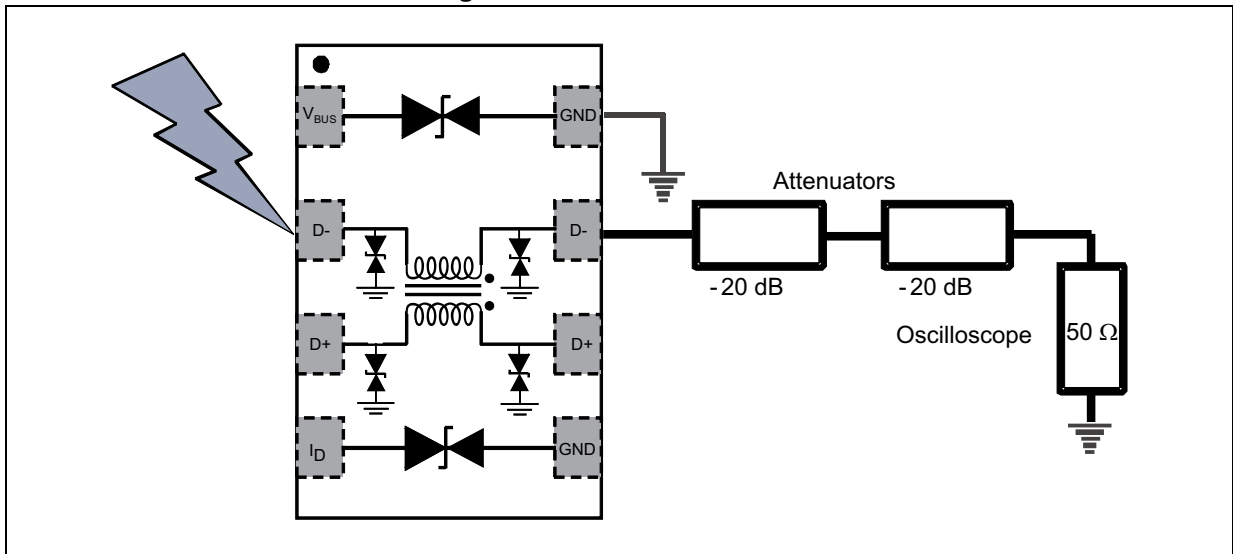


Figure 8. ESD response to IEC 61000-4-2 (+8 kV contact discharge) on V<sub>BUS</sub>

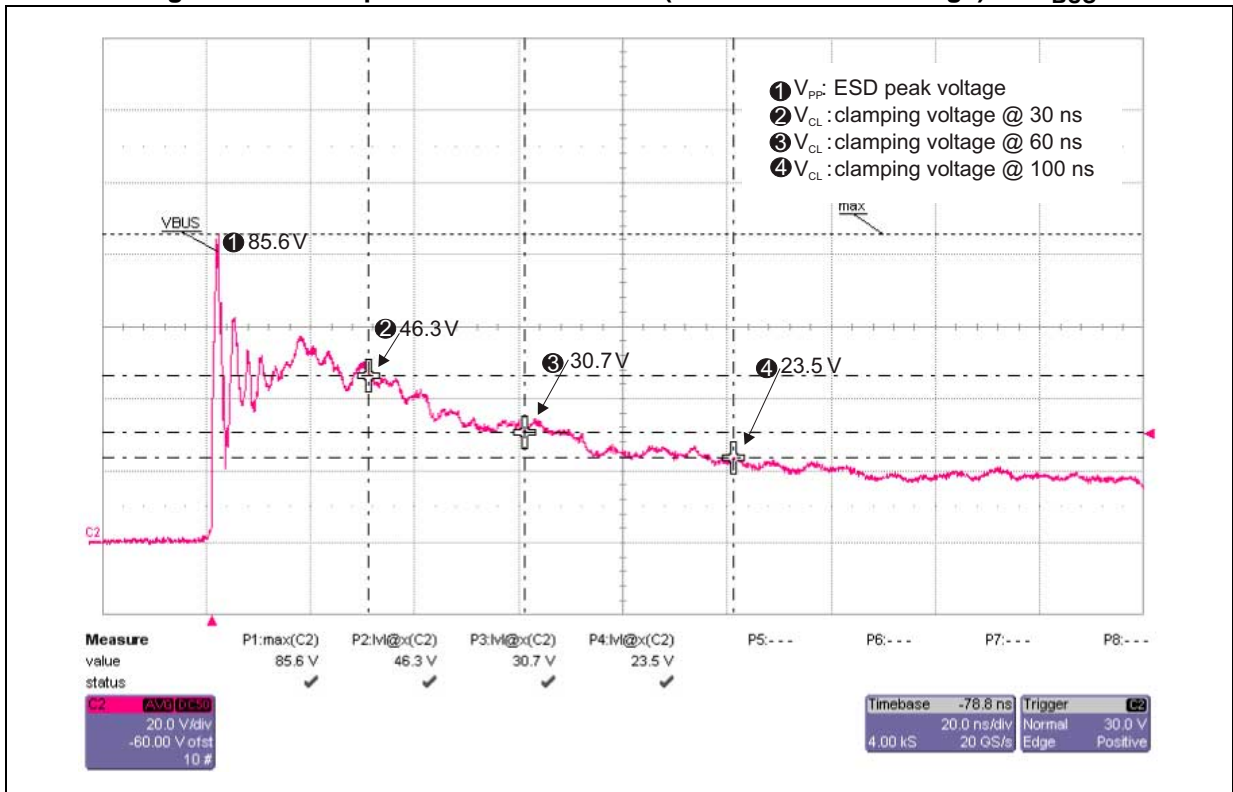


Figure 9. ESD response to IEC 61000-4-2 (-8 kV contact discharge) on V<sub>BUS</sub>

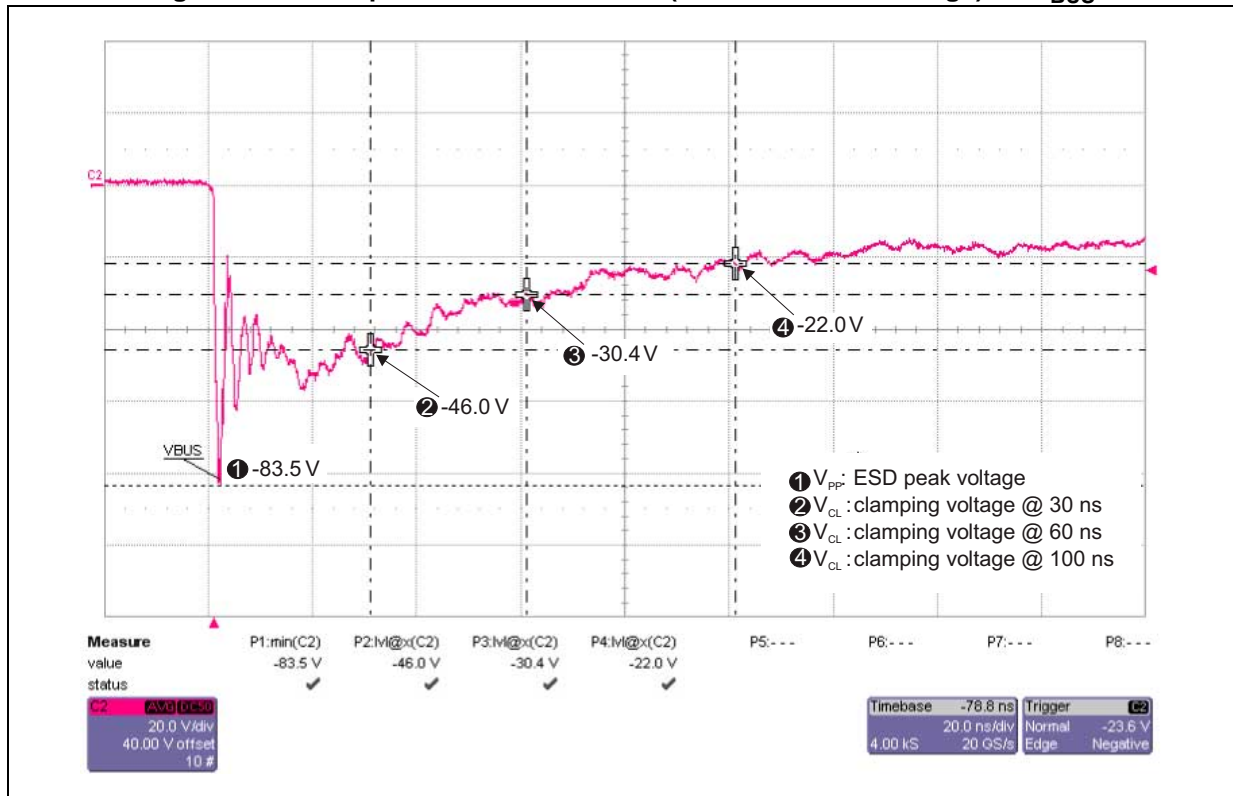


Figure 10. ESD response to IEC 61000-4-2 (+8 kV contact discharge) on I<sub>D</sub>

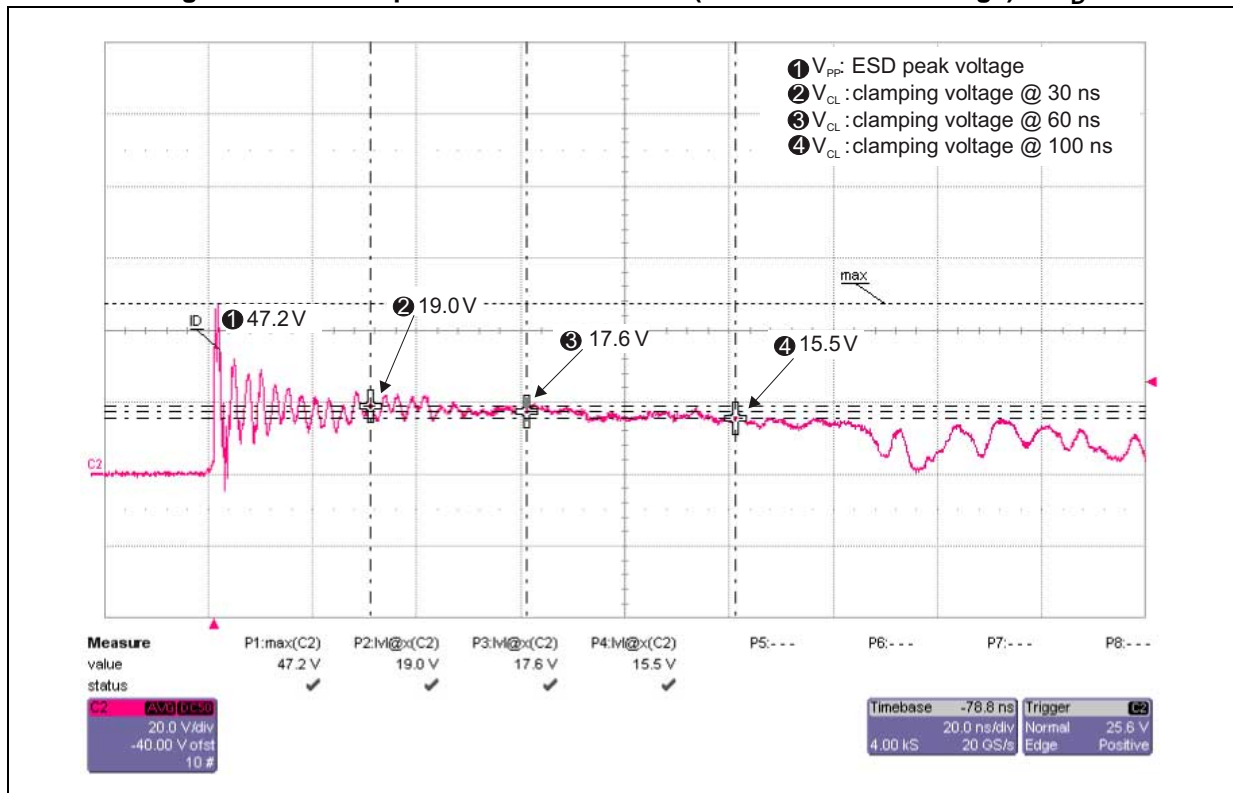


Figure 11. ESD response to IEC 61000-4-2 (-8 kV contact discharge) on I<sub>D</sub>

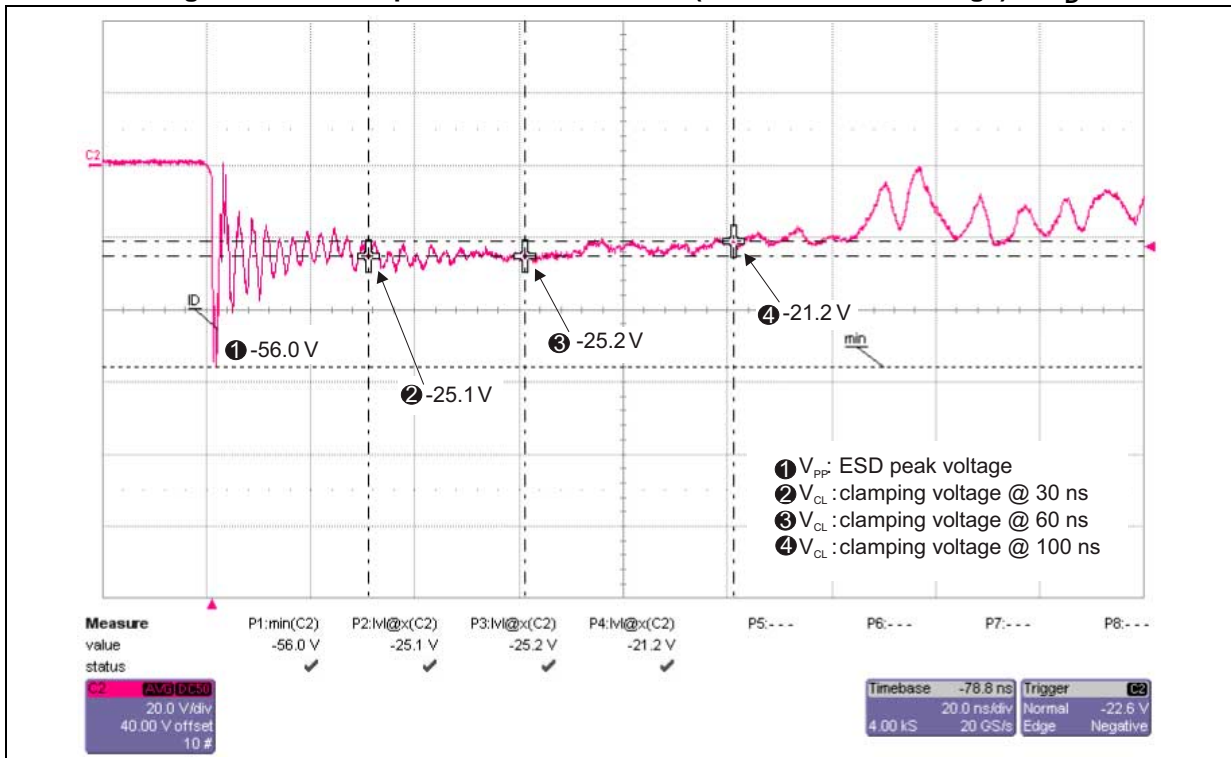


Figure 12. ESD response to IEC 61000-4-2 (+8 kV contact discharge) on differential lane

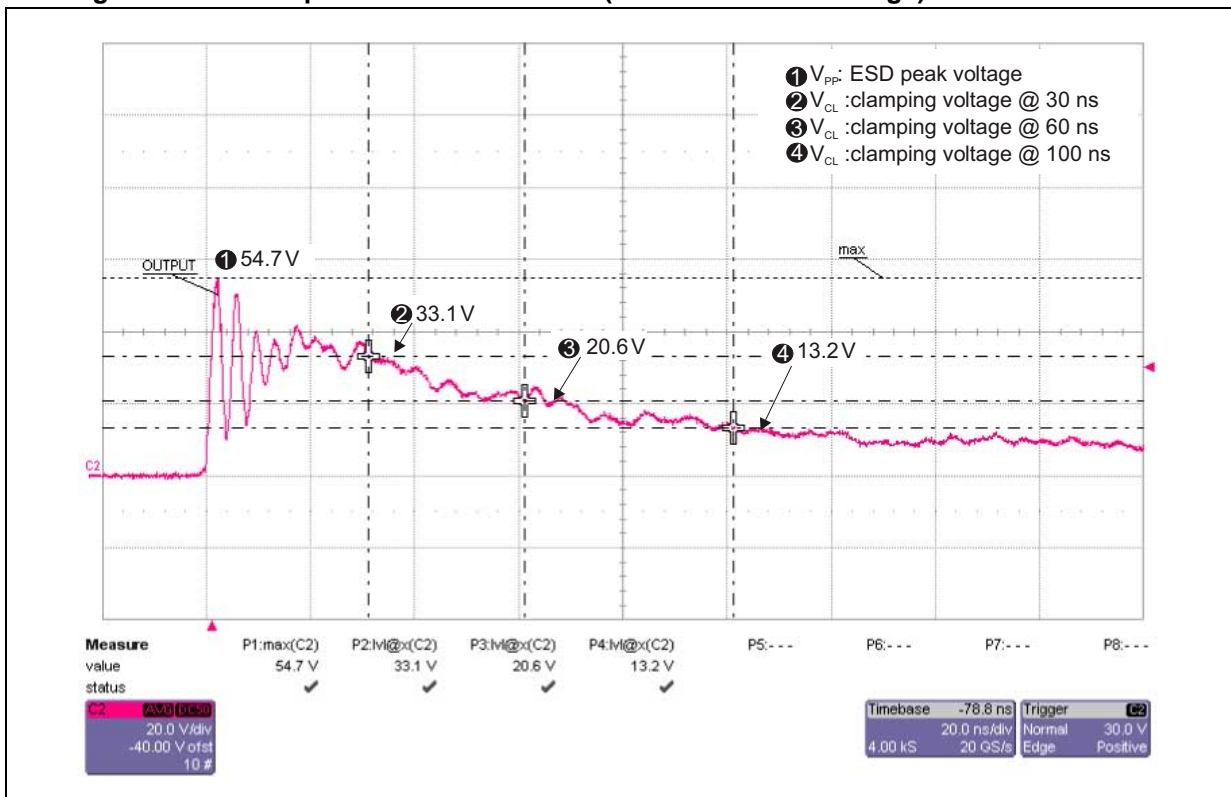




Figure 13. ESD response to IEC 61000-4-2 (-8 kV contact discharge) on differential lane

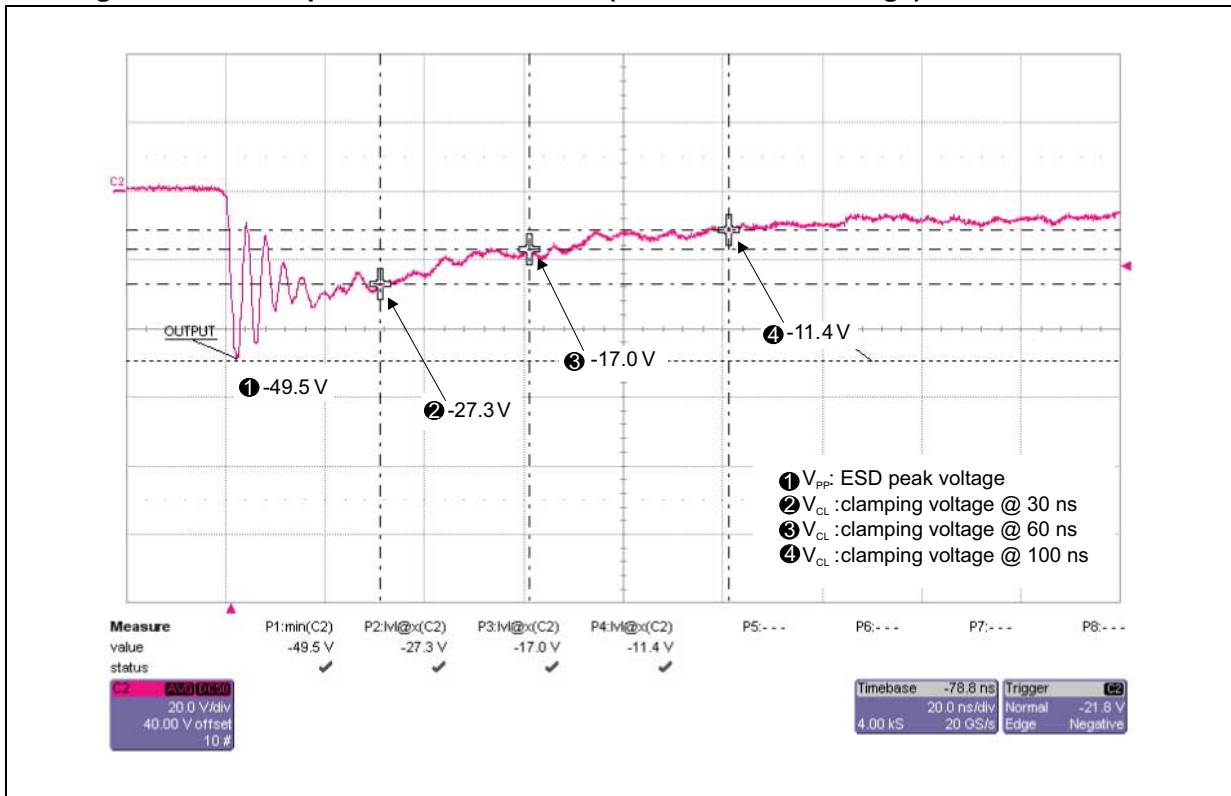


Figure 14. Eye diagram (loaded by  $Z_{diff} = 90 \Omega$ ) with USB2.0 [mask 1] board only

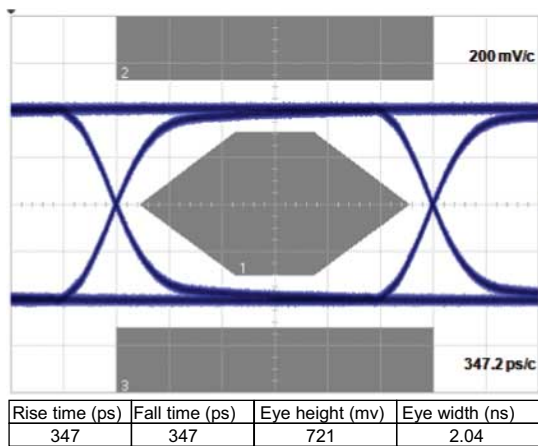


Figure 15. Eye diagram (loaded by  $Z_{diff} = 90 \Omega$ ) with USB2.0 [mask 1] board with ECM02-4CMX8

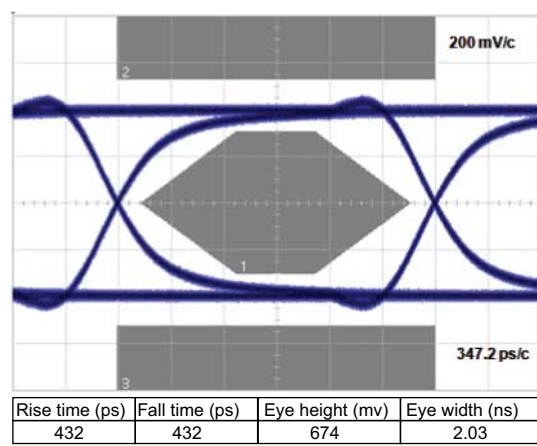


Figure 16. TDR measurement (loaded by  $Z_{diff} = 90 \Omega$ ), rise time 400 ps

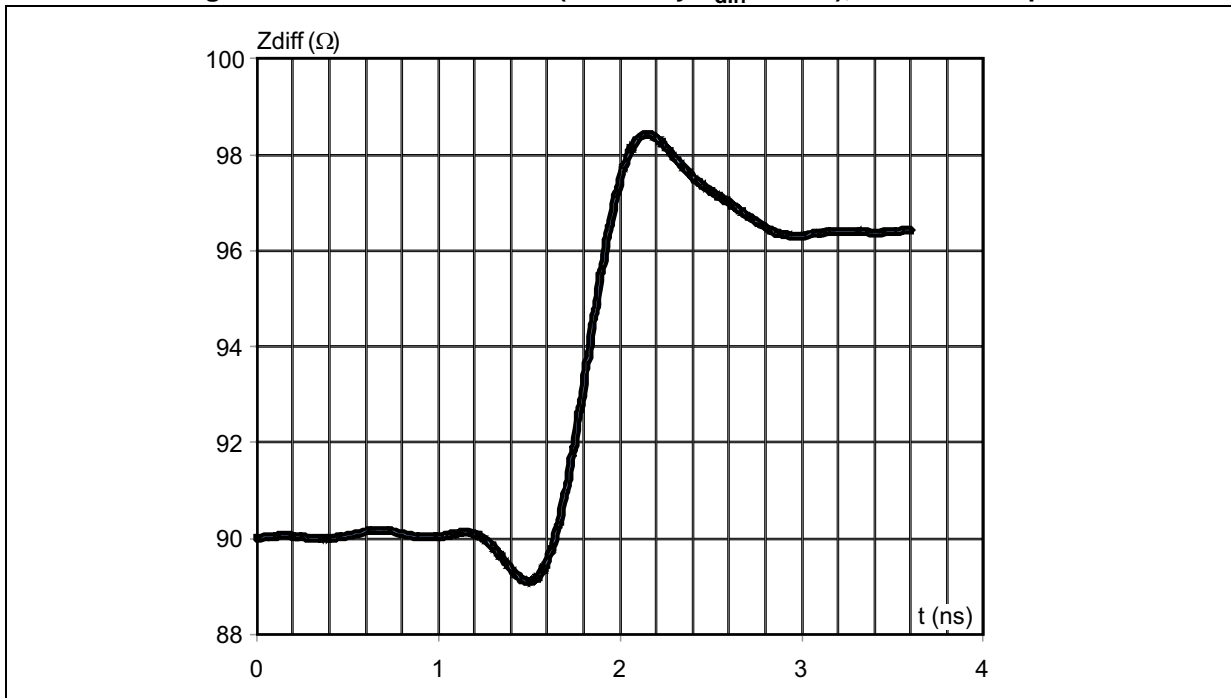


Figure 17. HS sync

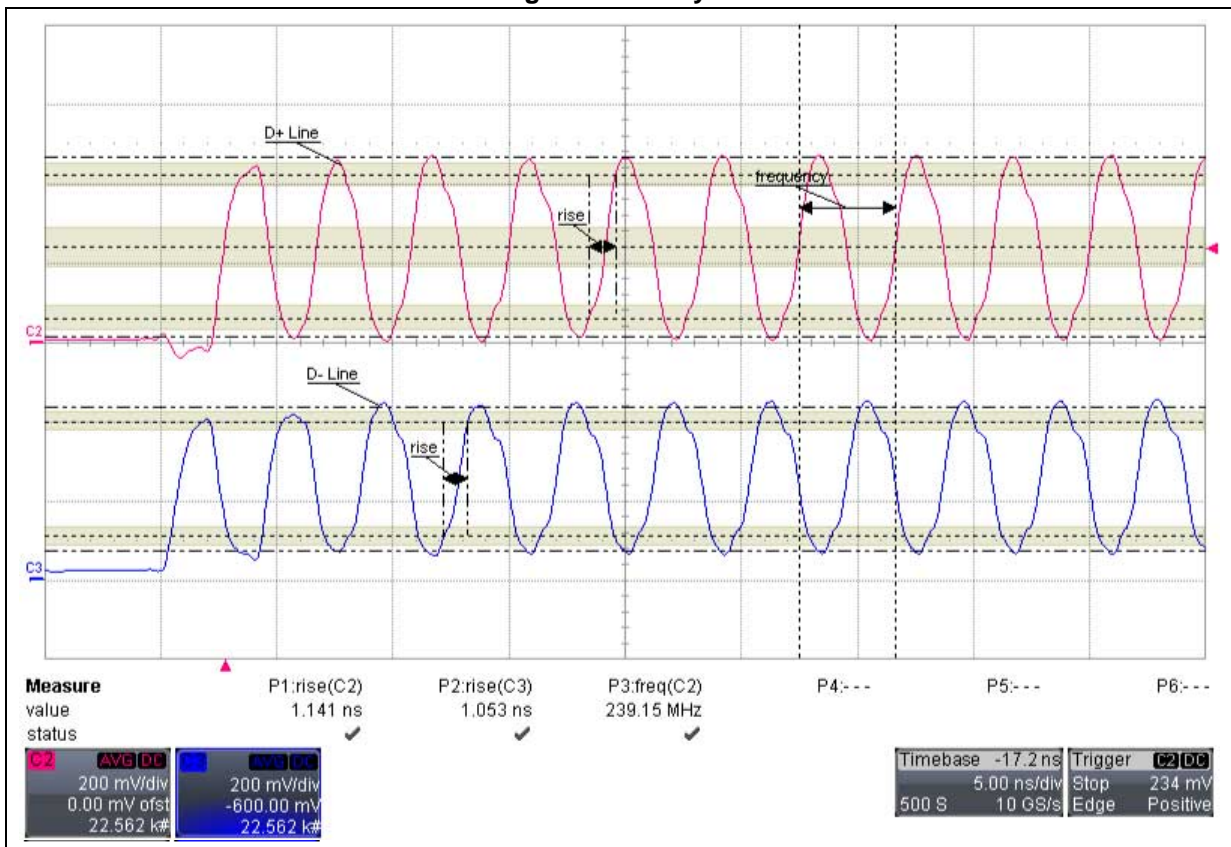


Figure 18. Total harmonic distortion on differential lanes

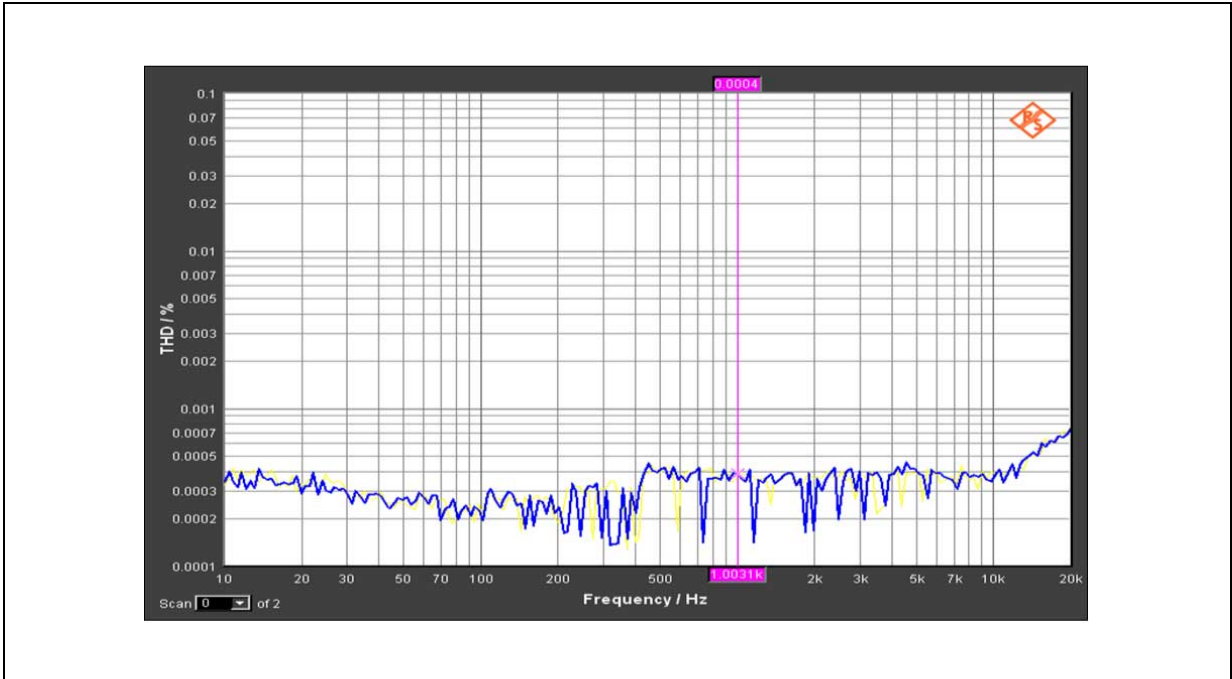
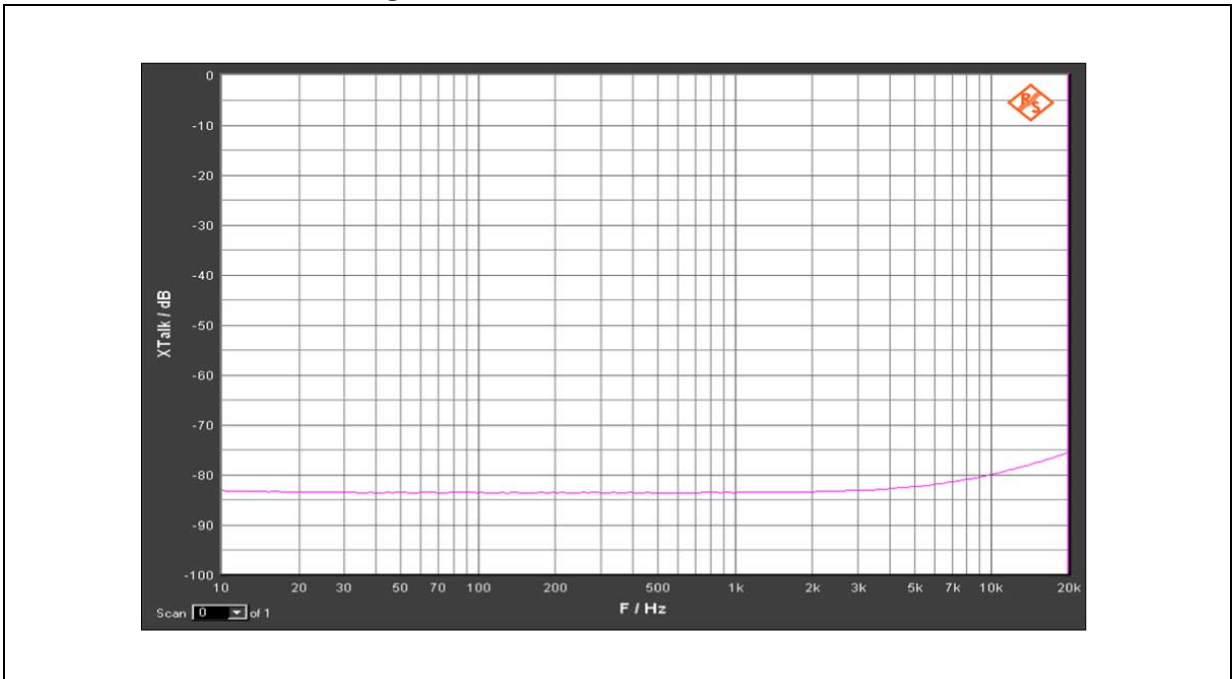
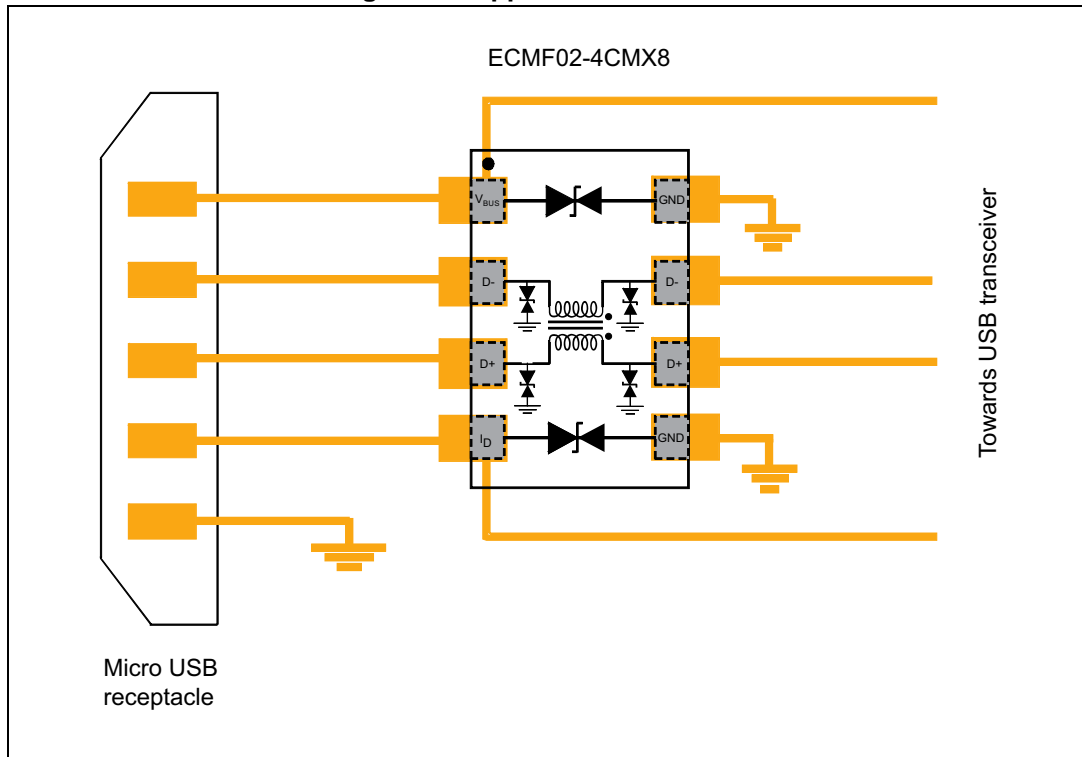


Figure 19. Crosstalk on differential lanes



## 2 Application schematic

Figure 20. Application schematic



### 3 Package information

- Epoxy meets UL94, V0
- Lead-free packages

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK® packages, depending on their level of environmental compliance. ECOPACK® specifications, grade definitions and product status are available at: [www.st.com](http://www.st.com). ECOPACK® is an ST trademark.

#### 3.1 Micro QFN-8L package information

Figure 21. Micro QFN-8L package outline

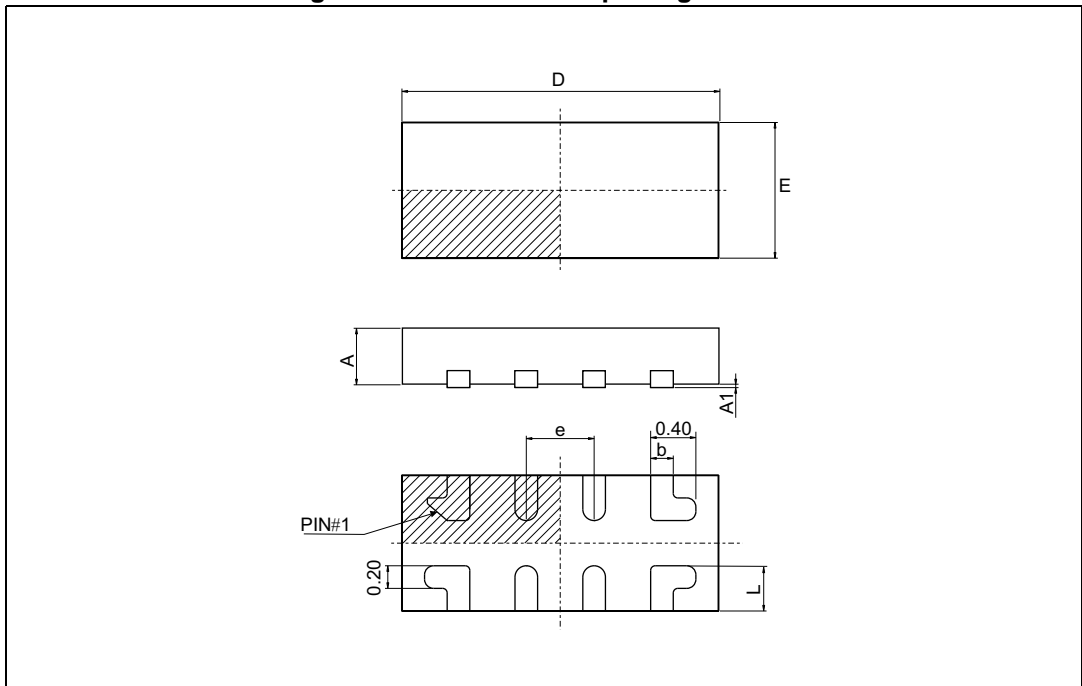


Table 3. Micro QFN-8L package mechanical data

Ref.	Dimensions					
	Millimeters			Inches <sup>(1)</sup>		
	Typ.	Min.	Max.	Typ.	Min.	Max.
A	0.50	0.45	0.55	0.020	0.018	0.022
A1	0.02	0.00	0.05	0.0008	0.00	0.002
b	0.20	0.15	0.25	0.008	0.006	0.010
D	2.50	2.45	2.55	0.098	0.096	0.100
E	1.20	1.15	1.25	0.047	0.045	0.049

Table 3. Micro QFN-8L package mechanical data (continued)

Ref.	Dimensions					
	Millimeters			Inches <sup>(1)</sup>		
	Typ.	Min.	Max.	Typ.	Min.	Max.
e	0.50	0.45	0.55	0.020	0.018	0.022
L	0.40	0.30	0.50	0.016	0.012	0.020

1. Values in inches are converted from mm and rounded to 4 decimal digits.

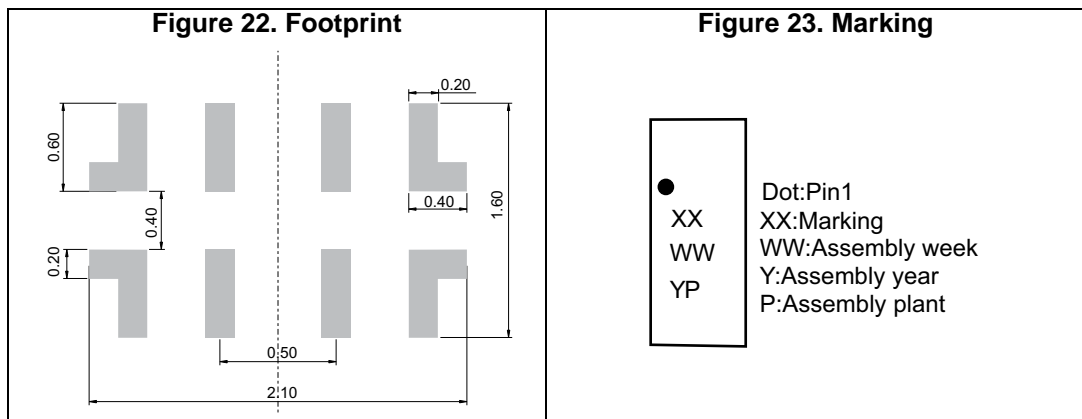
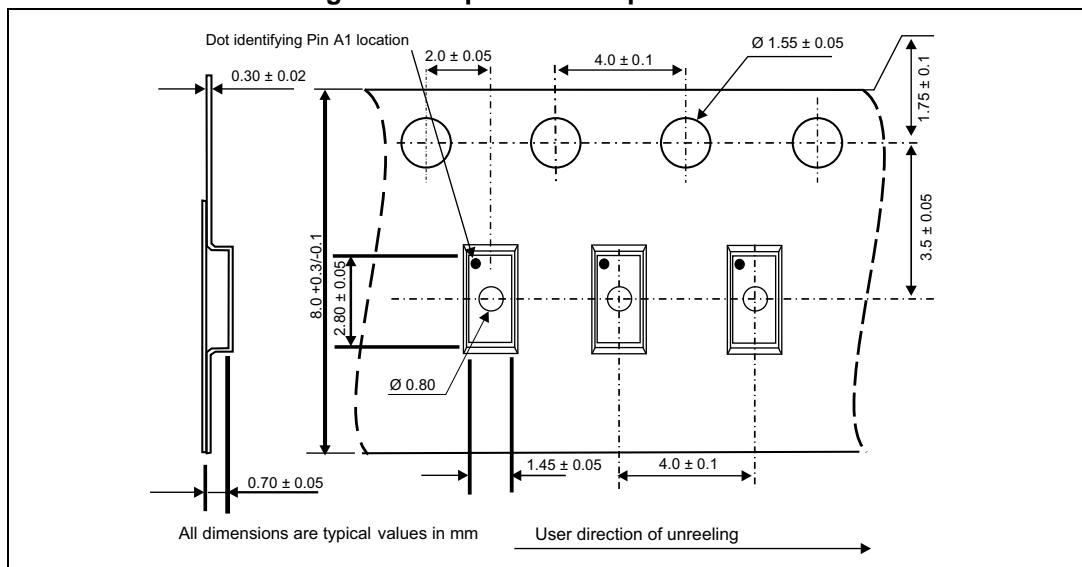


Figure 24. Tape and reel specifications



Note: More packing information is available in the application notes: AN1751: “EMI Filters: Recommendations and measurements”

## 4 Ordering information

Figure 25. Ordering information scheme

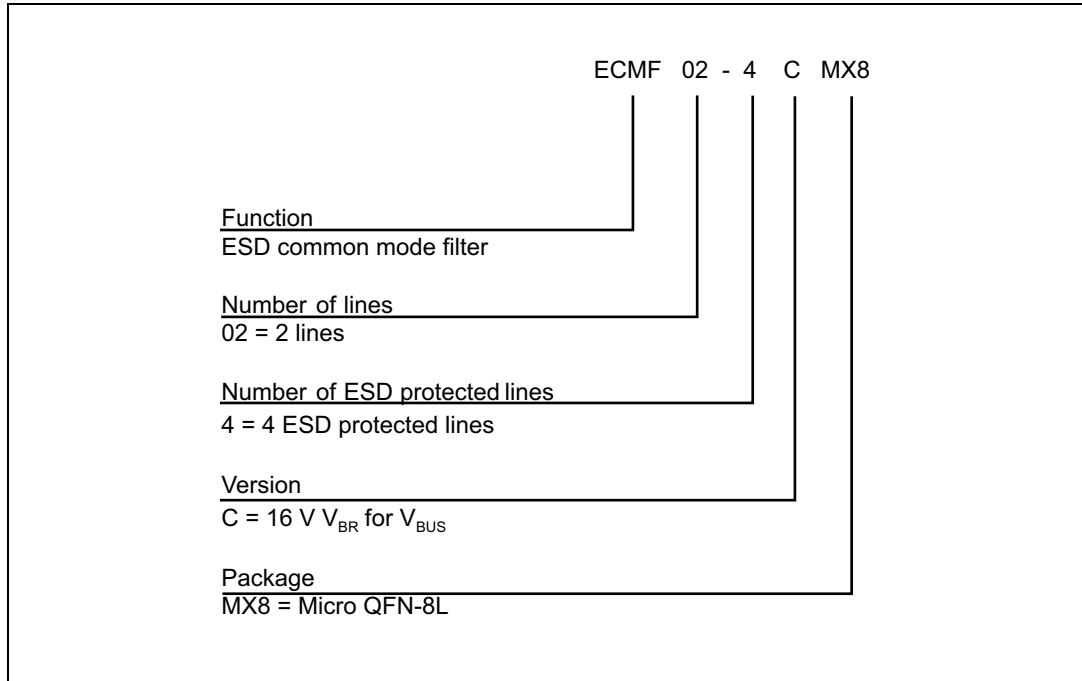


Table 4. Ordering information

Order code	Marking	Package	Weight	Base qty	Delivery mode
ECMF02-4CMX8	KG	Micro QFN-8L	3.7 mg	3000	Tape and reel

For the latest information on available order codes see the product pages on: [www.st.com](http://www.st.com).

## 5 Revision history

Table 5. Document revision history

Date	Revision	Changes
19-Sep-2012	1	Initial release.
27-May-2014	2	Updated <a href="#">Figure 24</a> , <a href="#">Figure 25</a> and reformatted the document.
05-May-2015	3	Added <a href="#">Figure 6</a> . Updated <a href="#">Table 1</a> . Format updated to current standard.

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