

Common mode filter with ESD protection for MHL/USB2.0/USB3.0 interface

Datasheet - production data

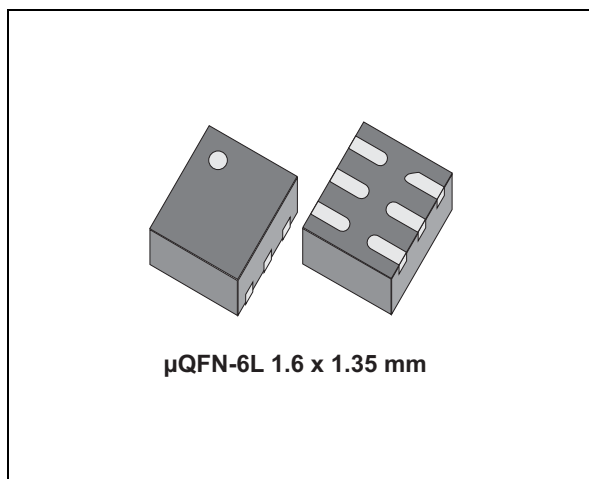
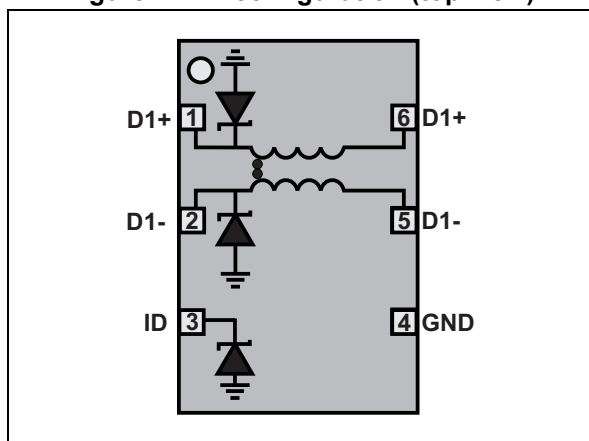


Figure 1. Pin configuration (top view)



Features

- Provides -20 dB attenuation at 700 MHz in LTE bands
- High common mode attenuation:
 - -25 dB at 800 MHz
 - -10 dB at 2 GHz
- Very low PCB space consumption
- Thin package: 0.55 mm max.
- Lead-free package
- High reduction of parasitic elements through integration.

Complies with the following standards:

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

Applications

- Mobile phones
- Notebooks, laptops
- Portable devices
- Wearable devices

Description

This device is a highly integrated common mode filter designed to suppress EMI/RFI common mode noise on high speed differential serial buses and complies with the MHL standard. The device can protect and filter a single differential lane.

1 Characteristics

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

Symbol	Parameter		Value	Unit
V_{PP}	Peak pulse voltage	IEC 61000-4-2		
		Contact discharge (connector side)	8	kV
		Air discharge (connector side)	16	
I_{DC}	Maximum DC current		100	mA
T_{op}	Operating temperature range		-40 to +85	$^{\circ}\text{C}$
T_j	Maximum junction temperature		125	$^{\circ}\text{C}$
T_{stg}	Storage temperature range		- 55 to +150	$^{\circ}\text{C}$

Figure 2. Electrical characteristics (definitions)

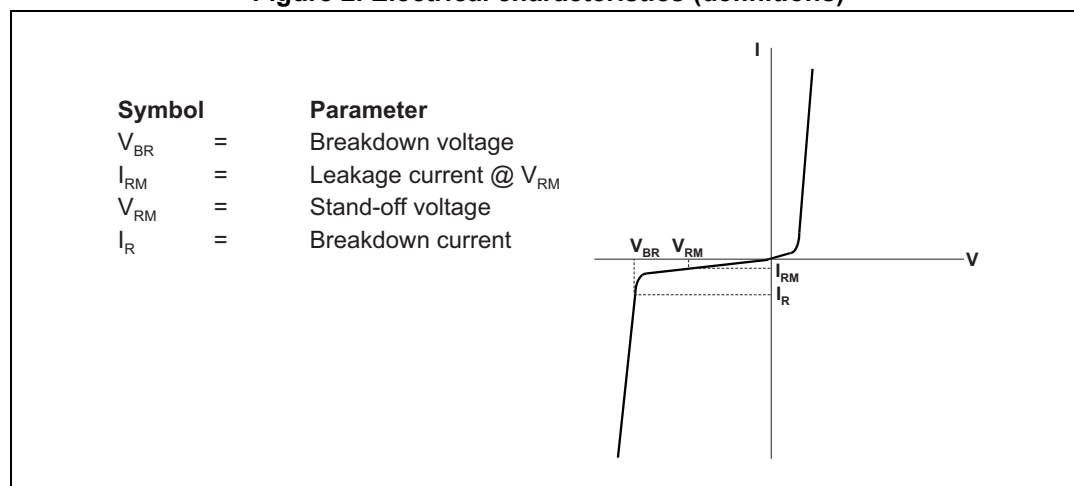


Table 2. Electrical characteristics ($T_{amb} = 25\text{ }^{\circ}\text{C}$)

Symbol	Test conditions	Min.	Typ.	Max.	Unit
V_{BR}	$I_R = 1\text{ mA}$	6			V
I_{RM}	$V_{RM} = 3\text{ V per line}$			100	nA
R_{DC}	DC serial resistance		5		Ω

Figure 3. Differential attenuation versus frequency ($Z_0 \text{ diff} = 100 \Omega$)

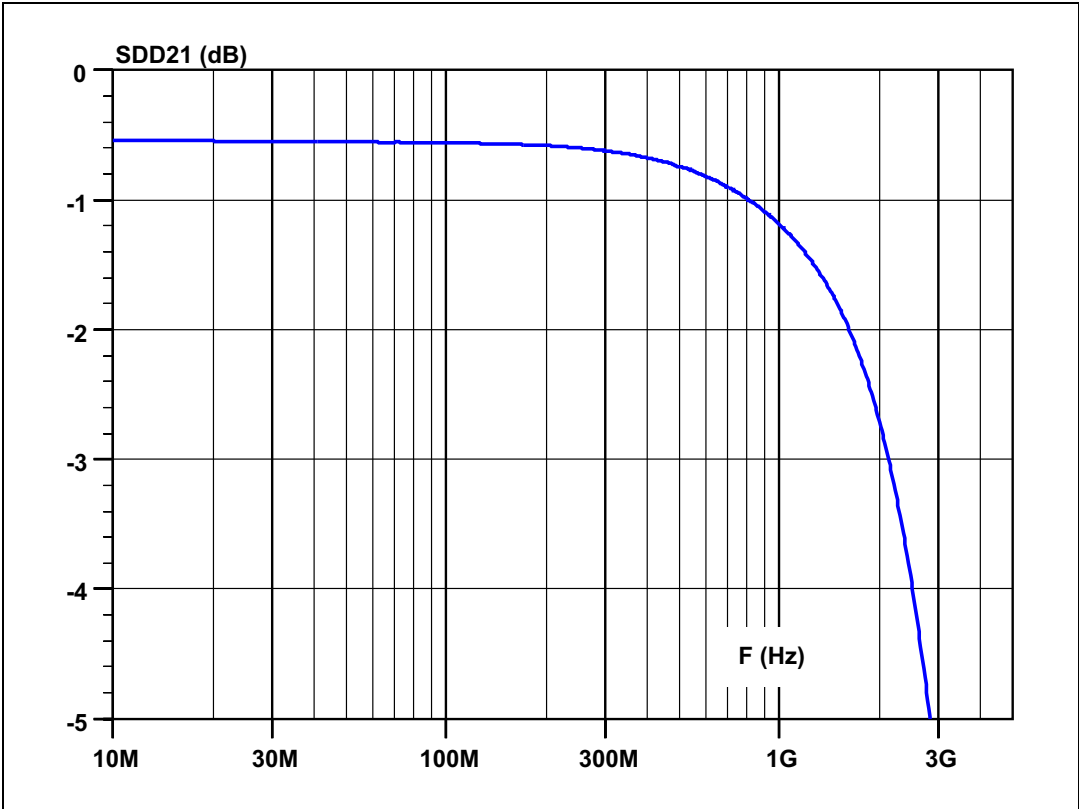


Figure 4. Common mode attenuation versus frequency ($Z_0 \text{ com} = 50 \Omega$)

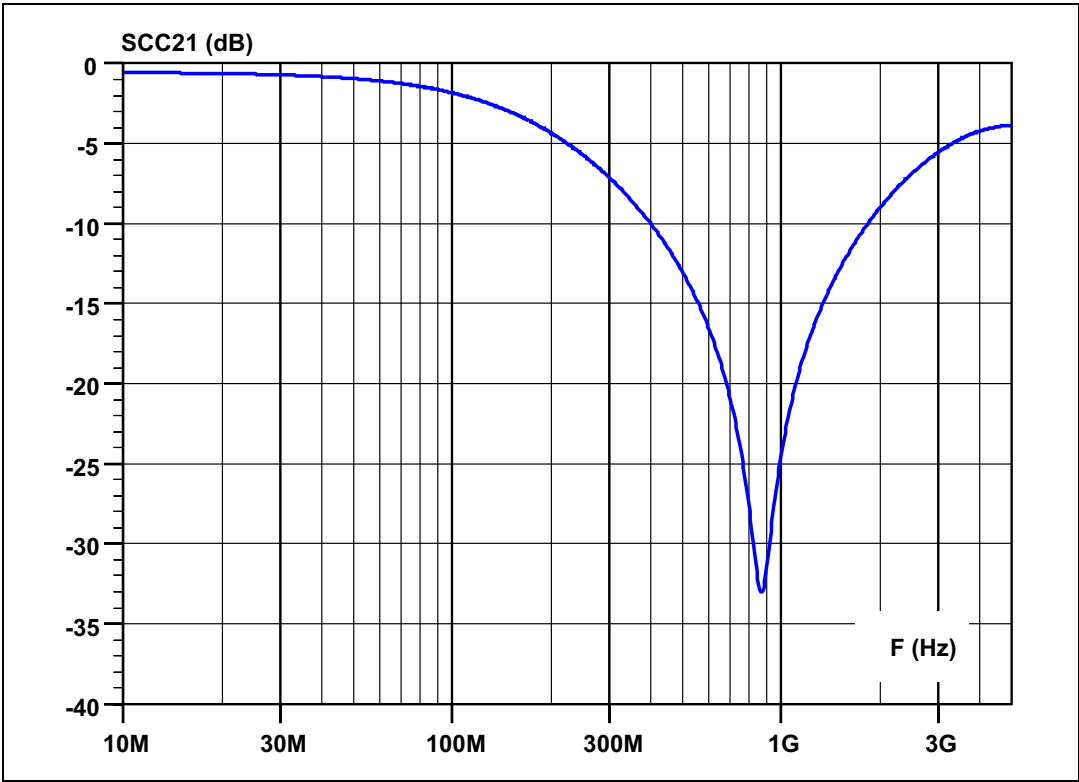


Figure 5. Return loss versus frequency ($Z_0 \text{ com} = 50 \Omega$)

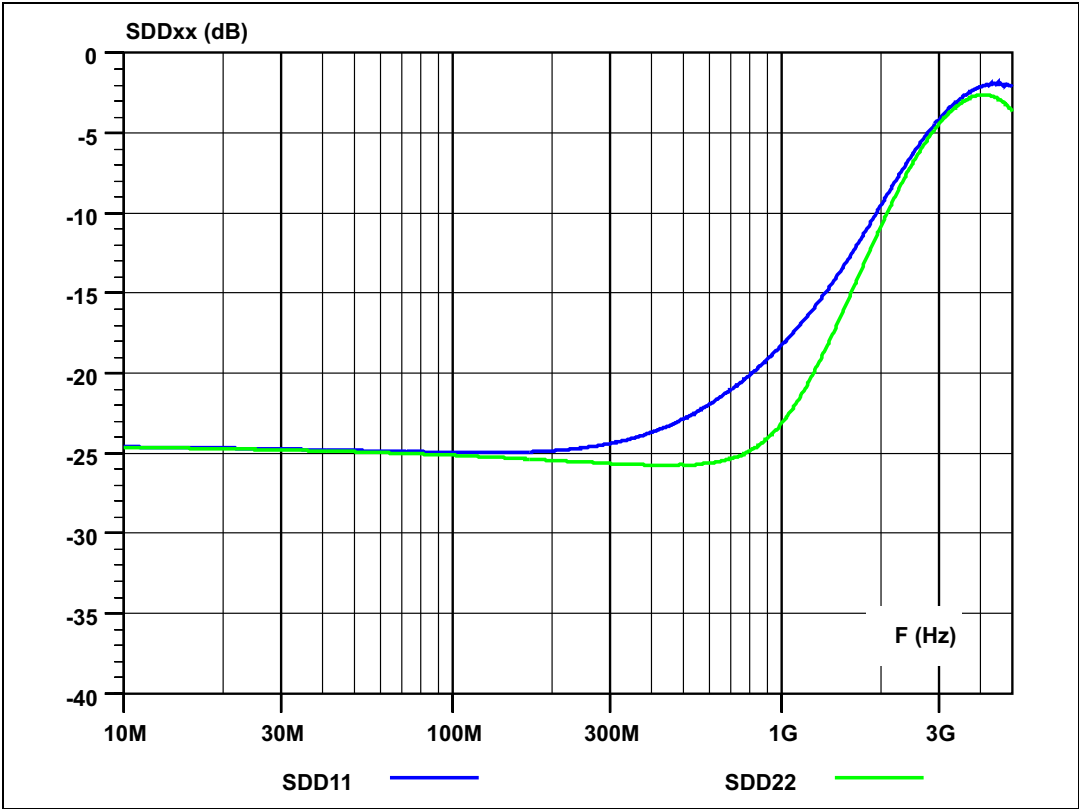


Figure 6. Differential (Z_{DD21}) and common mode (Z_{CC21}) impedance versus frequency

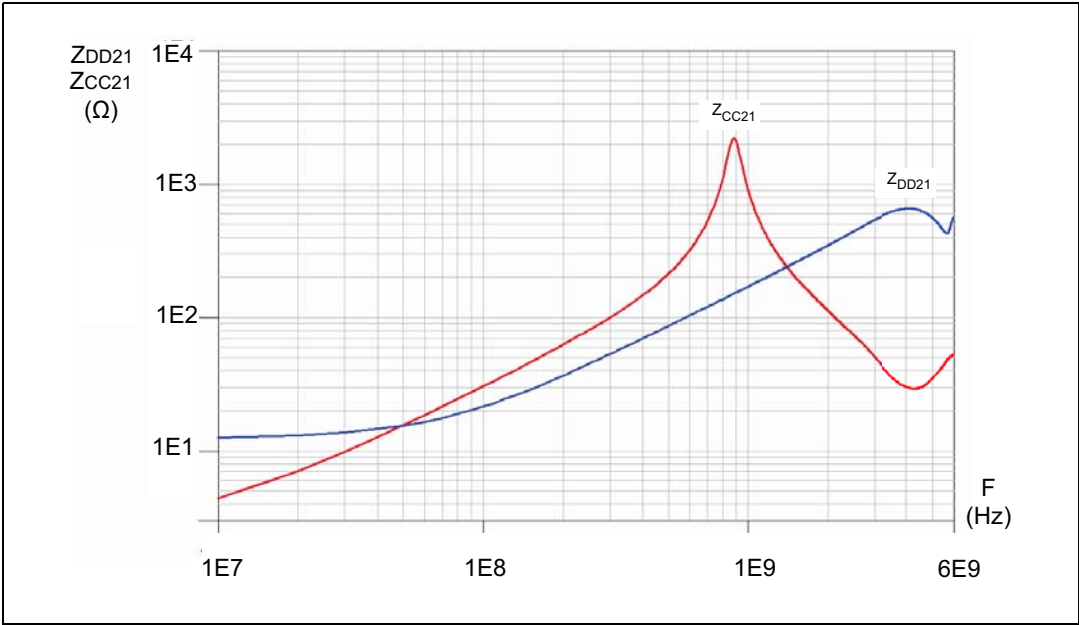


Figure 7. ESD response to IEC61000-4-2 (+8 kV contact discharge) on data lane

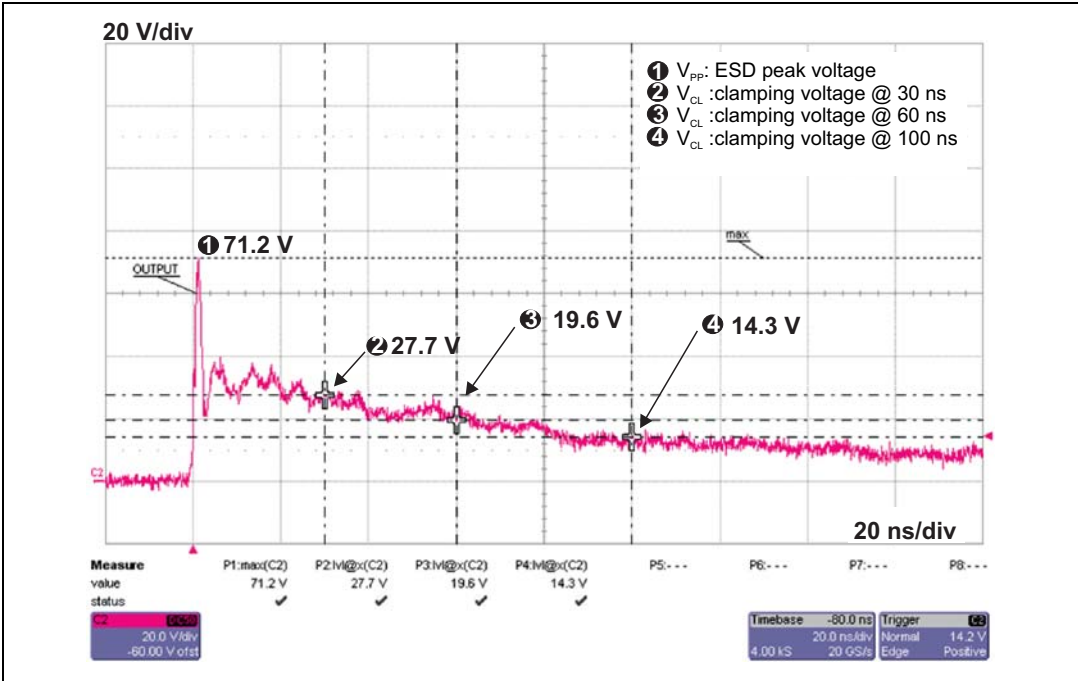


Figure 8. ESD response to IEC61000-4-2 (-8 kV contact discharge) on data lane

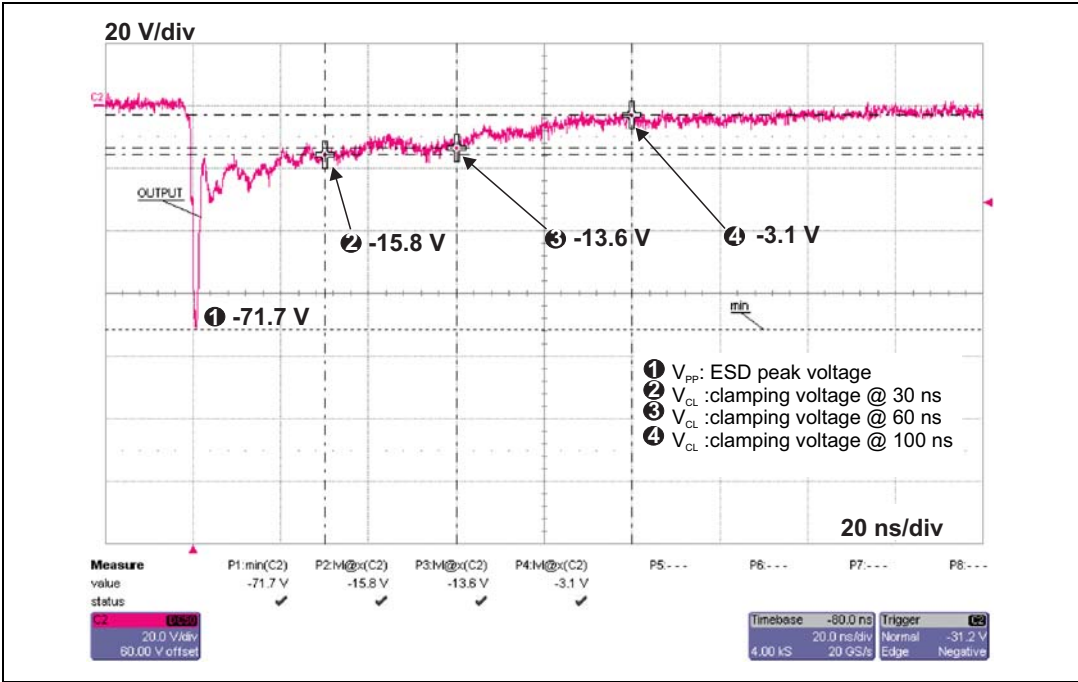


Figure 9. ESD response to IEC61000-4-2 (+8 kV contact discharge) on ID pin

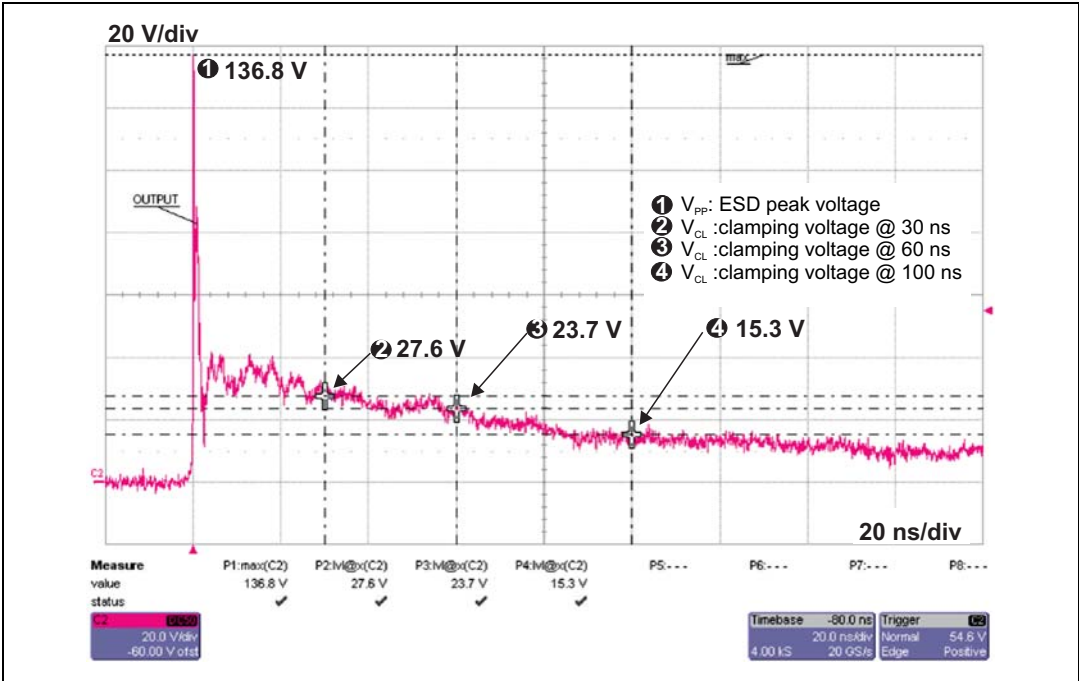


Figure 10. ESD response to IEC61000-4-2 (-8 kV contact discharge) on ID pin

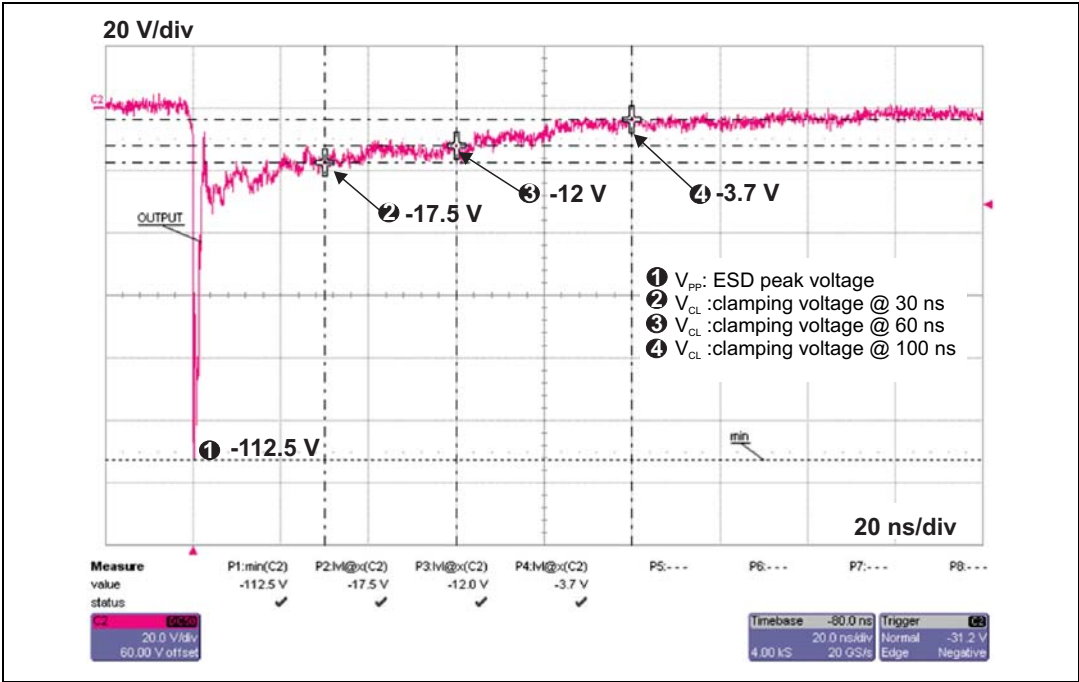


Figure 11. USB2.0 480 Mbps eye diagram without device

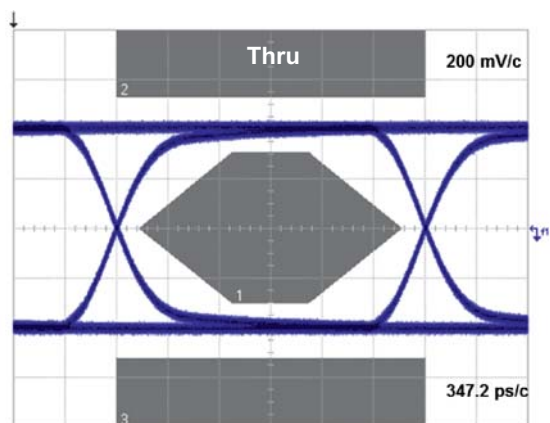


Figure 12. USB2.0 480 Mbps eye diagram with device

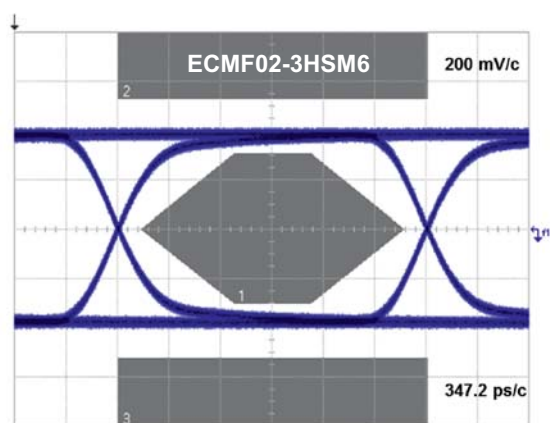


Figure 13. USB3.0 5 Gbps eye diagram without device

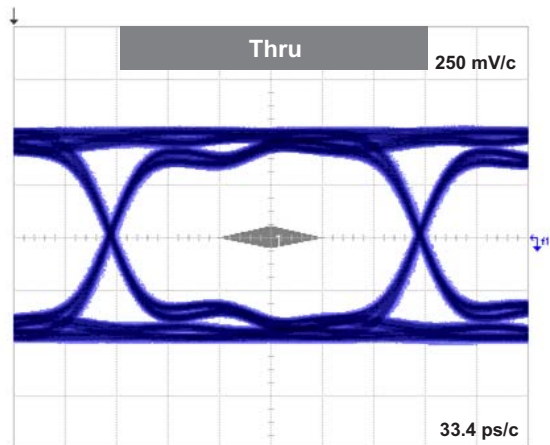


Figure 14. USB3.0 5 Gbps eye diagram with device

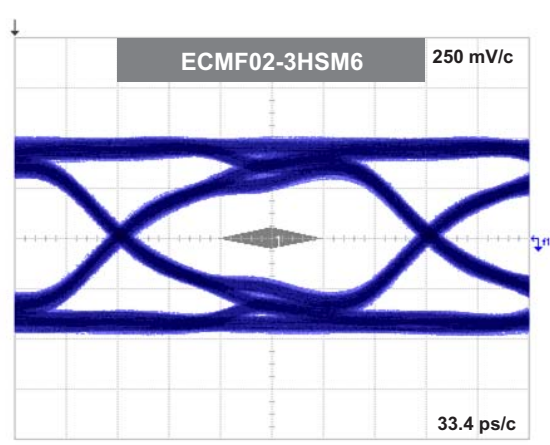


Figure 15. MHL 2.25 Mbps eye diagram without device

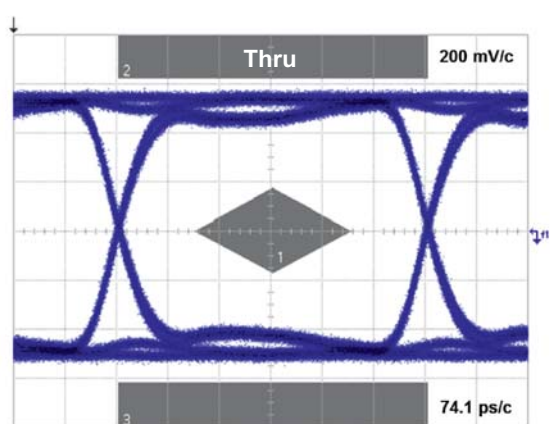


Figure 16. MHL 2.25 Mbps eye diagram with device

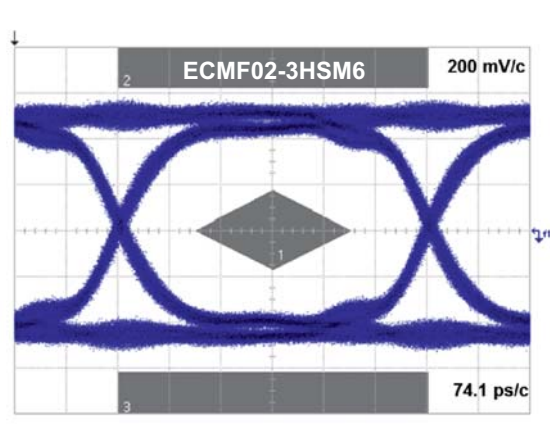
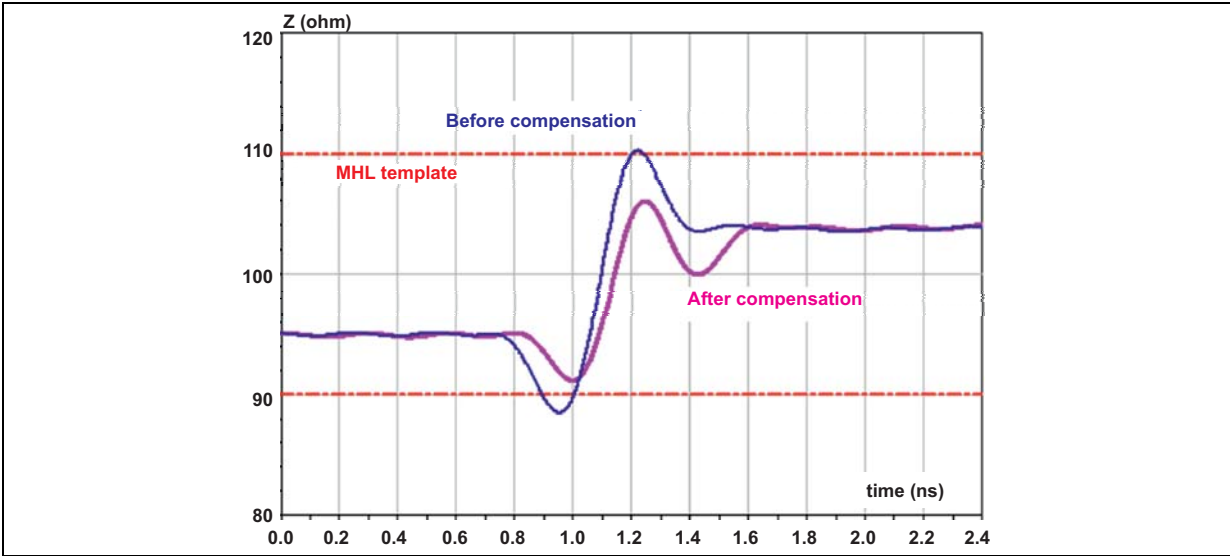
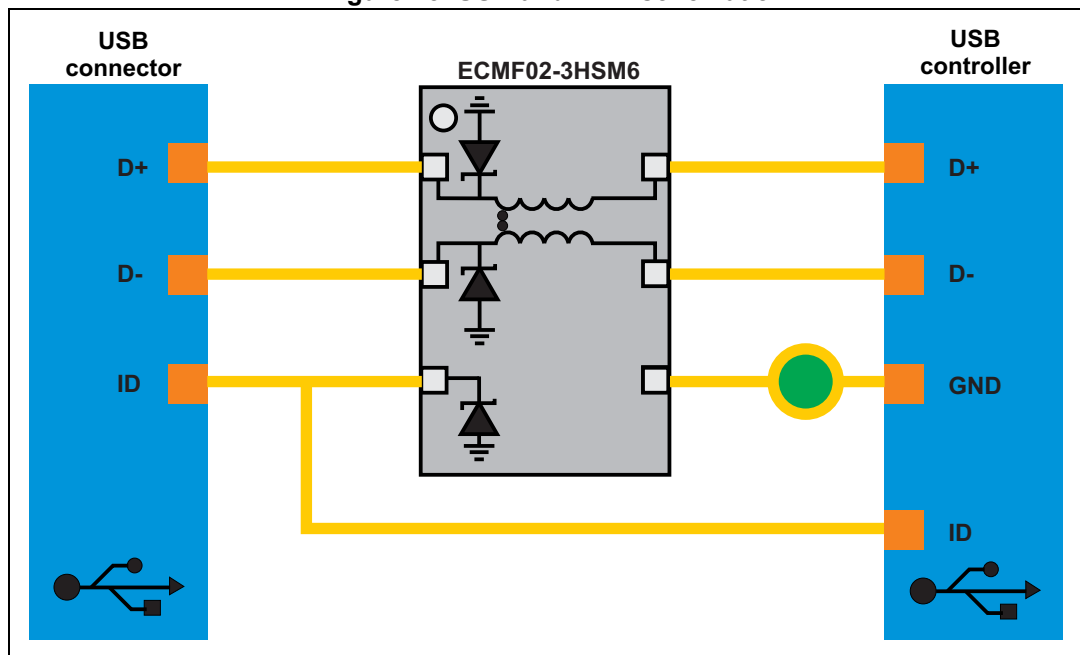


Figure 17. TDR



2 Application information

Figure 18. USB and MHL schematic



More application information available in following AN:

- Application Note AN4356: "Antenna desense on handheld equipment"
- Application Note AN4511: "Common Mode filters"
- Application Note AN4540: "MHL link filtering and protection"

3 PCB layout recommendations

Figure 19. PCB layout recommendations

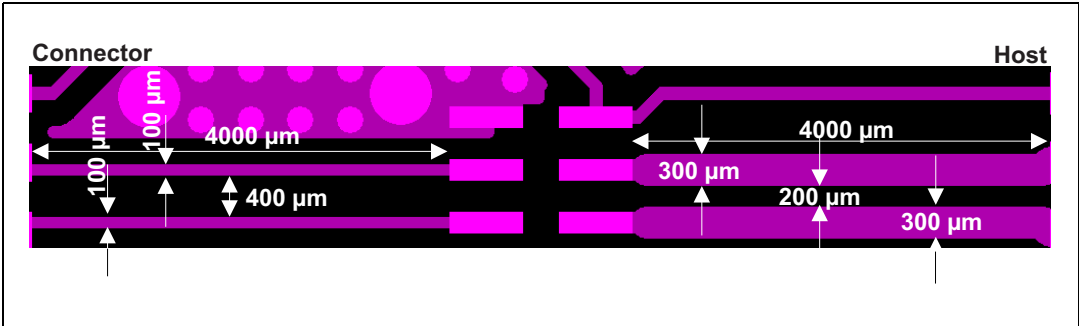
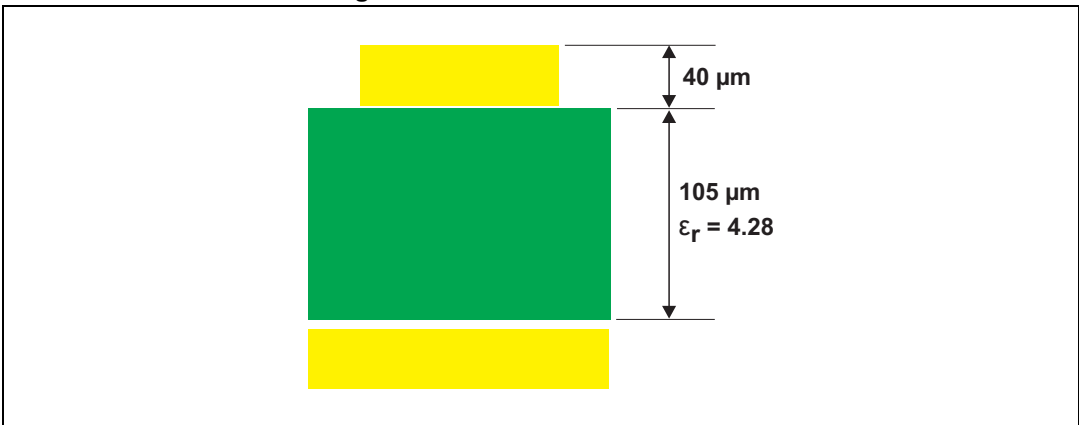


Figure 20. PCB stack dimensions



4 Package information

- Epoxy meets UL94, V0
- Lead-free package

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. ECOPACK[®] is an ST trademark.

4.1 μ QFN-6L package information

Figure 21. μ QFN-6L package outline

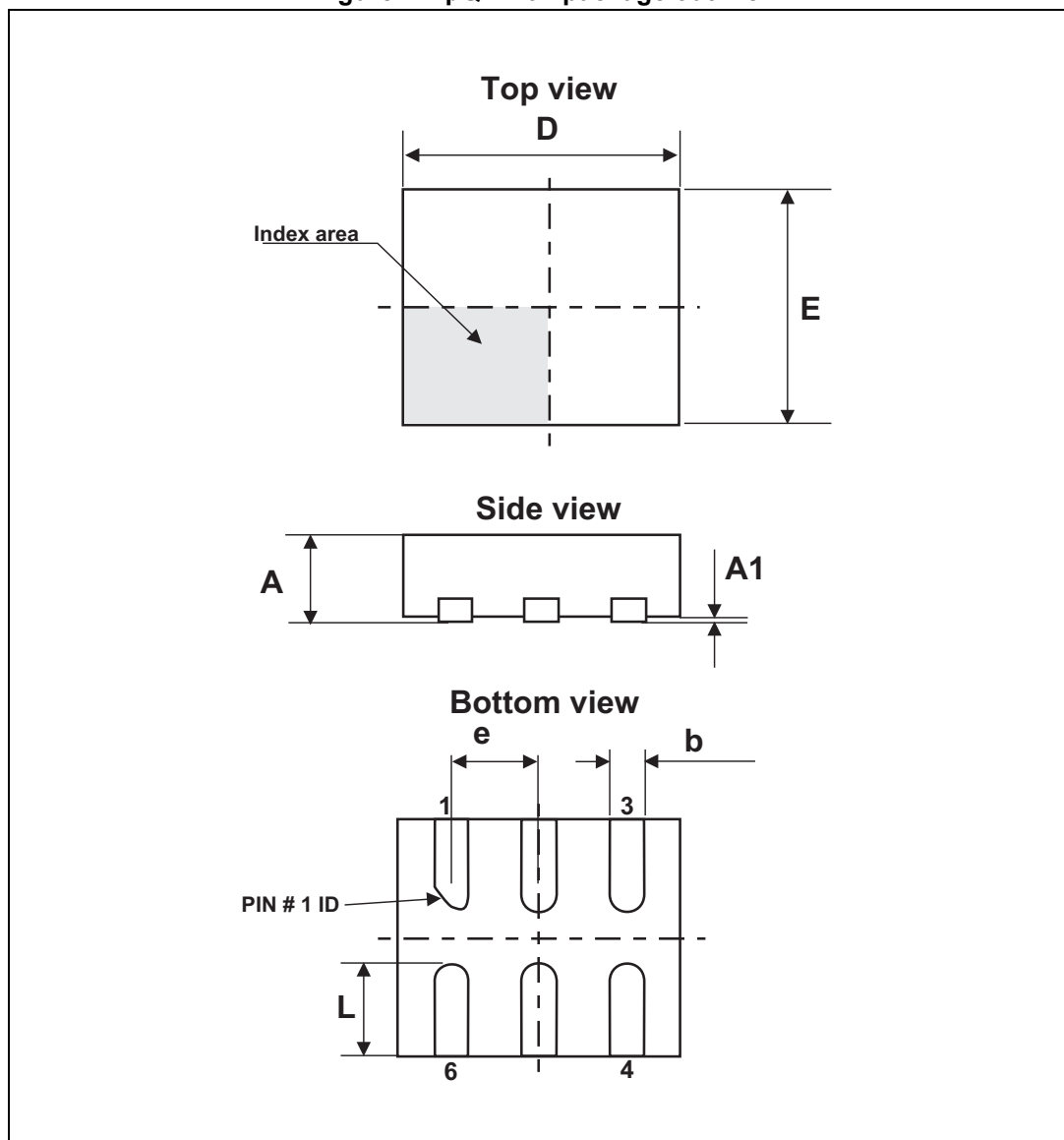
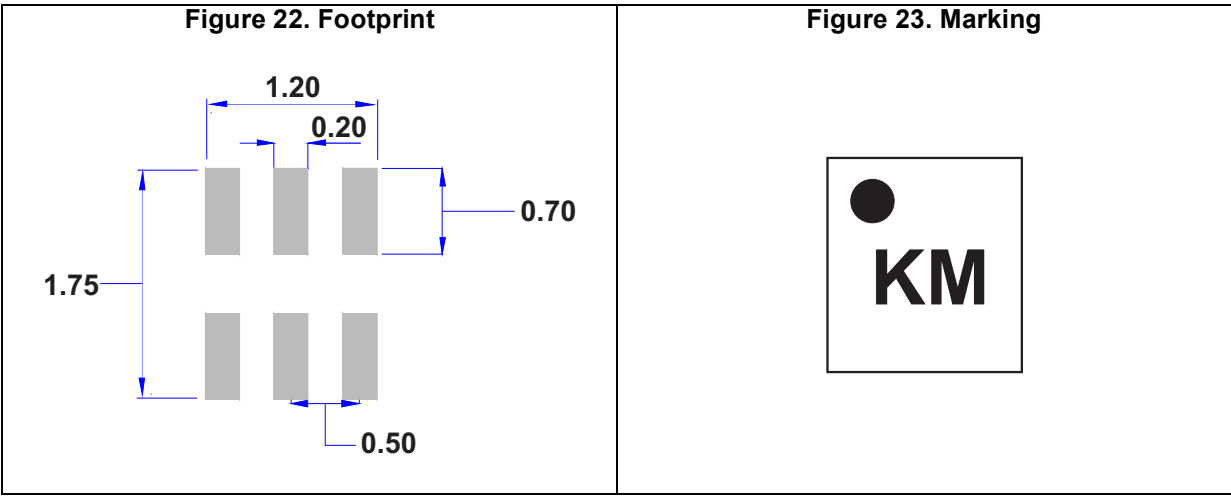


Table 3. μ QFN-6L package mechanical data

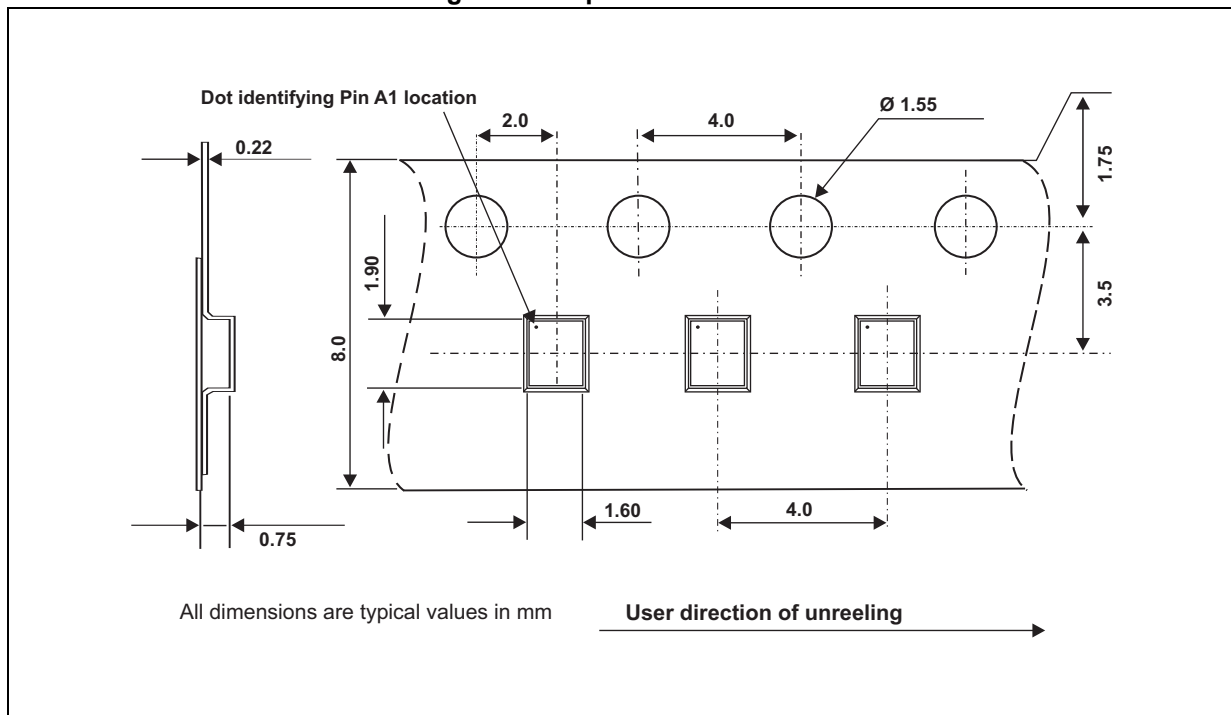
Ref.	Dimensions					
	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A	0.45	0.50	0.55	0.018	0.020	0.022
A1	0.00	0.02	0.05	0.00	0.0008	0.002
b	0.15	0.20	0.25	0.006	0.008	0.010
D	1.55	1.60	1.65	0.061	0.063	0.065
E	1.30	1.35	1.40	0.051	0.053	0.055
e	0.45	0.50	0.55	0.018	0.020	0.022
L	0.40	0.50	0.60	0.016	0.020	0.024



Note: Product marking may be rotated by multiples of 90° for assembly plant differentiation. In no case should this product marking be used to orient the component for its placement on a PCB. Only pin 1 mark is to be used for this purpose.

4.2 Packing information

Figure 24. Tape and reel outline



5 Ordering information

Figure 25. Ordering information scheme

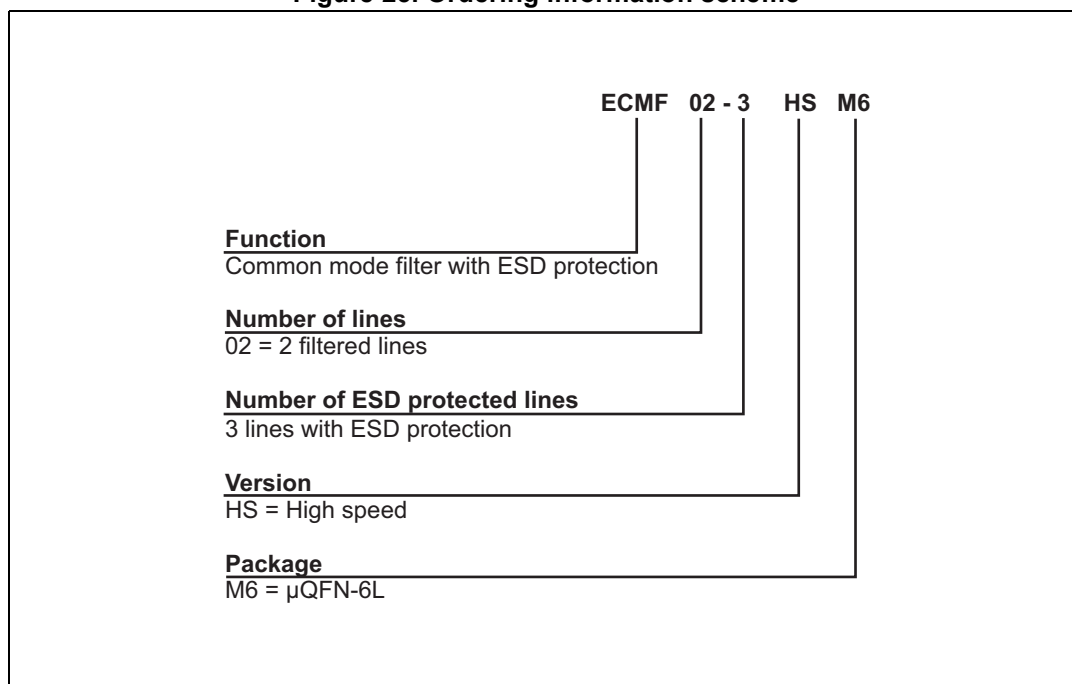


Table 4. Ordering information

Order code	Marking ⁽¹⁾	Package	Weight	Base qty	Delivery mode
ECMF02-3HSM6	KM	μ QFN-6L	3.03 mg	3000	Tape and reel

1. The marking can be rotated by multiples of 90° to differentiate assembly location

6 Revision history

Table 5. Document revision history

Date	Revision	Changes
02-Oct-2013	1	Initial release.
25-Aug-2014	2	Added Figure 6: Differential (ZDD21) and common mode (ZCC21) impedance versus frequency.
12-Nov-2015	3	Updated Figure 6 and reformatted to current standard.

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