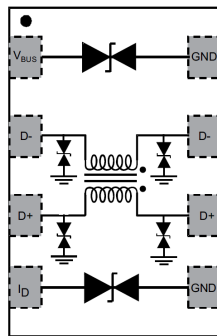


Common mode filter with ESD protection for USB 2.0 interface



Micro QFN-8 L
(pin view)



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.

Product status link

[ECMF02-4CMX8](#)

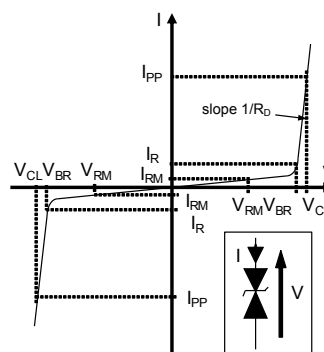
1 Characteristics

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

Symbol	Parameter	Value	Unit
V_{PP}	Peak pulse voltage	IEC 61000-4-2 (level 4):	kV
		Contact discharge on D+/D- pins	
		Contact discharge on V_{BUS} and ID pins	
		Air discharge on all pins	
P_{PP}	Peak pulse power (8/20 μ s) on V_{BUS}	150	W
I_{PP}	Peak pulse current (8/20 μ s) on V_{BUS}	4.8	A
T_{op}	Operating ambient temperature range	-30 to +85	°C
T_j	Maximum junction temperature	-40 to +125	
T_{stg}	Storage temperature range	-55 to +150	

Figure 1. Electrical characteristics (definitions)

Symbol	Parameter
V_{BR}	= Breakdown voltage
V_{CL}	= Clamping voltage
I_{RM}	= Leakage current @ V_{RM}
V_{RM}	= Stand-off voltage
I_{PP}	= Peak pulse current
R_D	= Dynamic resistance
I_R	= Breakdown current


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

Symbol	Test conditions	Min.	Typ.	Max.	Unit
Data lines					
V _{BR}	I _R = 1 mA	6			V
I _{RM}	V _{RM} = 5.5 V per line			100	nA
R _{DC}	DC serial resistance on data line		3	4	Ω
V _{BUS}					
V _{BR}	I _R = 1 mA	15	16.5	18	V
I _{RM}	V _{RM} = 12 V			50	nA
V _{CL}	Clamping voltage, I _{PP} = 1 A, t _p = 8/20 μs			20	V
	Clamping voltage, I _{PP} = 2.5 A, t _p = 8/20 μs			24	
I _D					
V _{BR}	I _R = 1 mA	6			V
I _{RM}	V _{RM} = 1.5 V per line			100	nA

1.1 Characteristics (curves)

Figure 2. SDD21 differential attenuation measurement ($Z_{0 \text{ diff}} = 90 \Omega$) for data lines D+ and D-

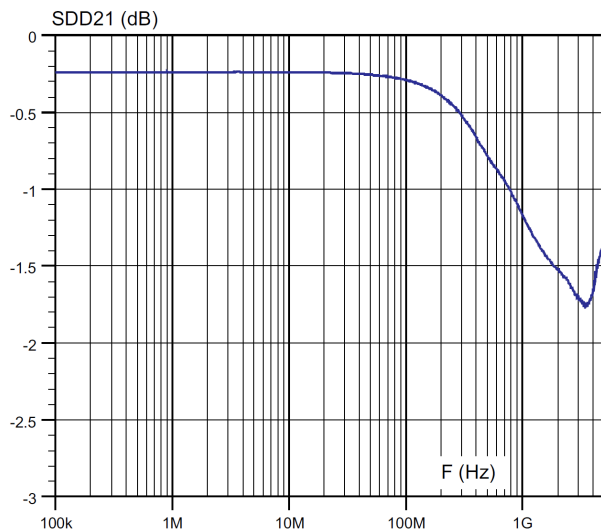


Figure 3. SCC21 common mode attenuation measurement ($Z_{0 \text{ com}} = 45 \Omega$)

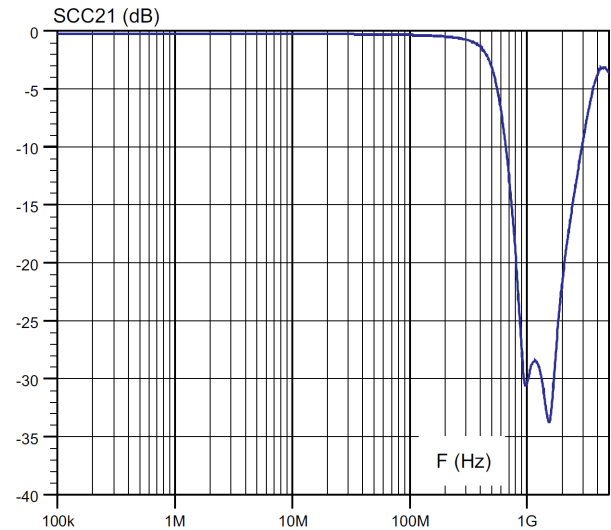


Figure 4. ID frequency response measurement ($Z_0 = 75 \Omega$)

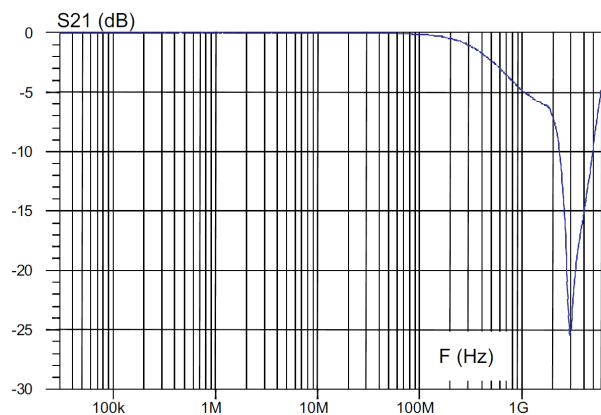


Figure 5. Differential (Z_{DD21}) and common mode (Z_{CC21}) impedance versus frequency

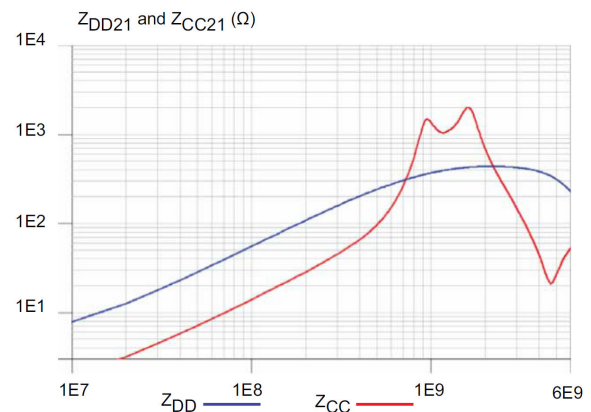


Figure 6. ESD test conditions

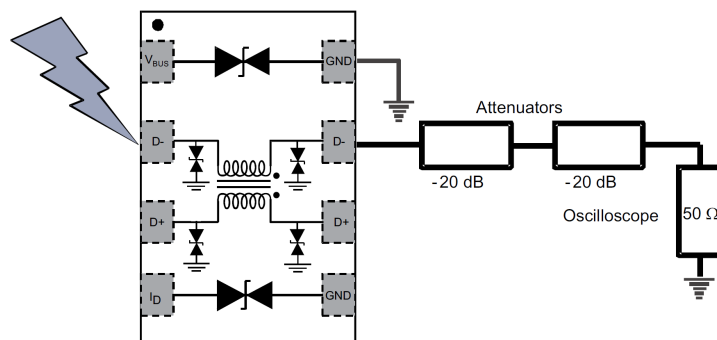


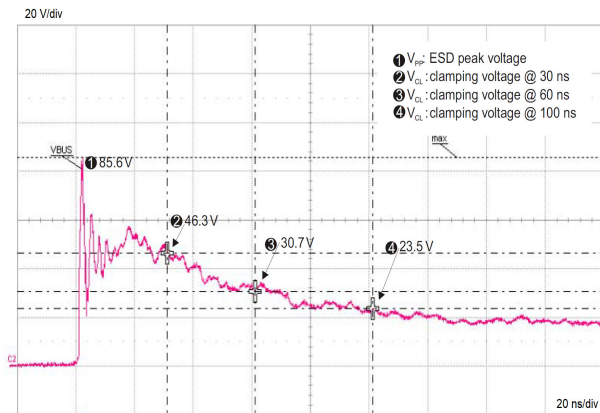
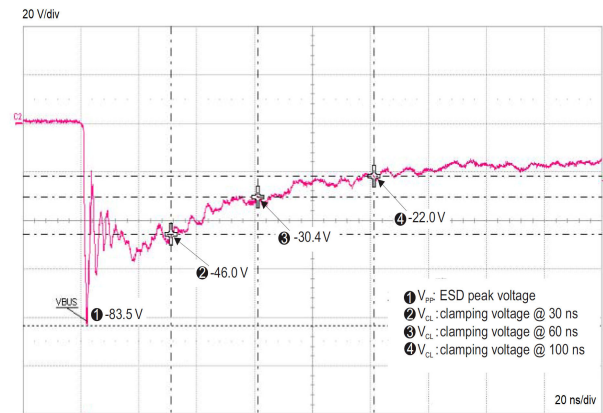
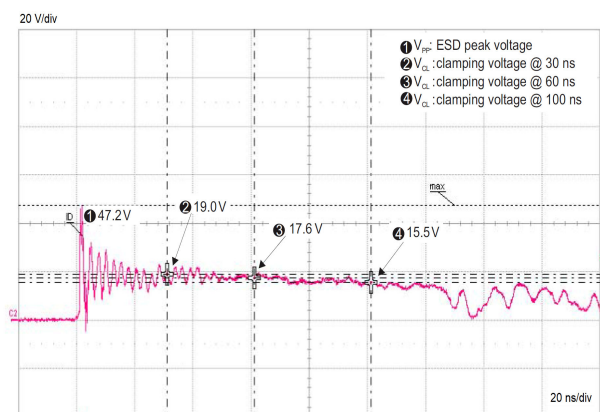
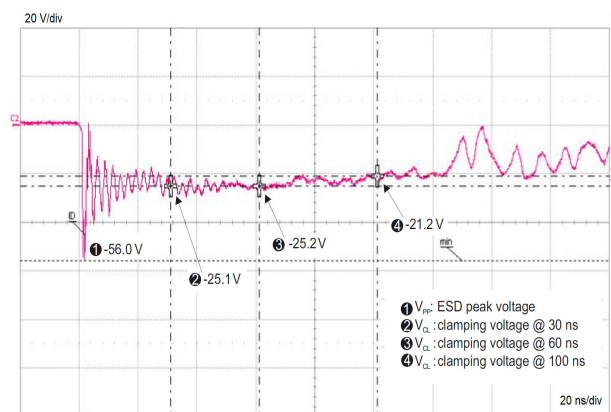
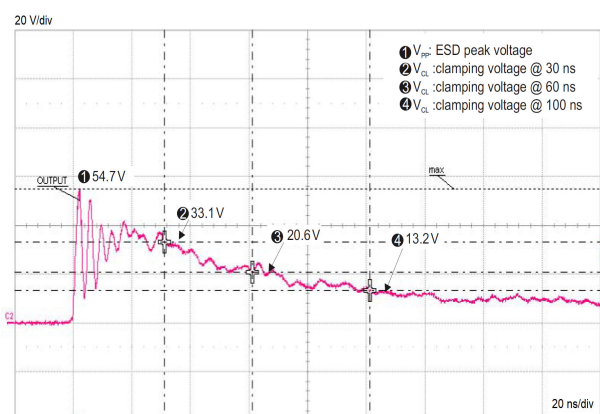
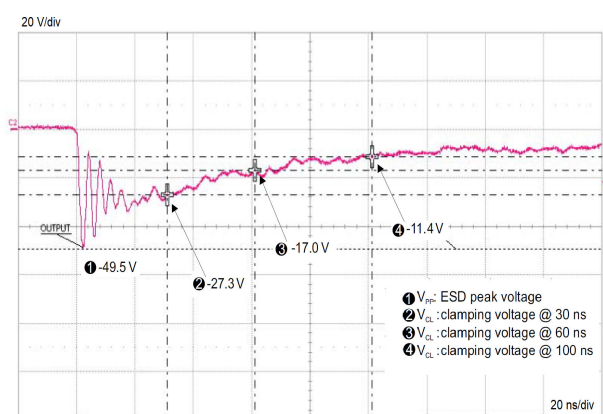
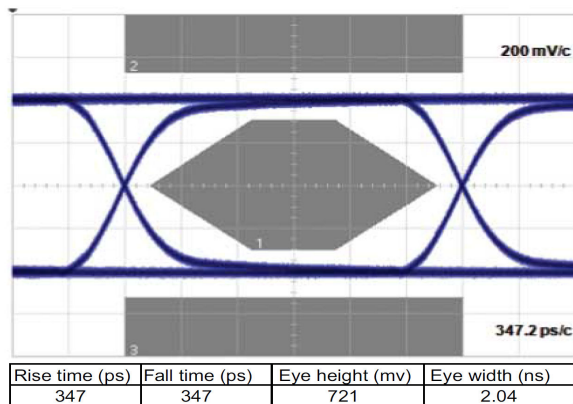
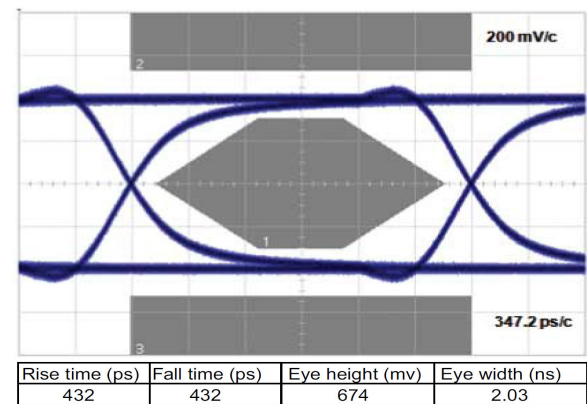
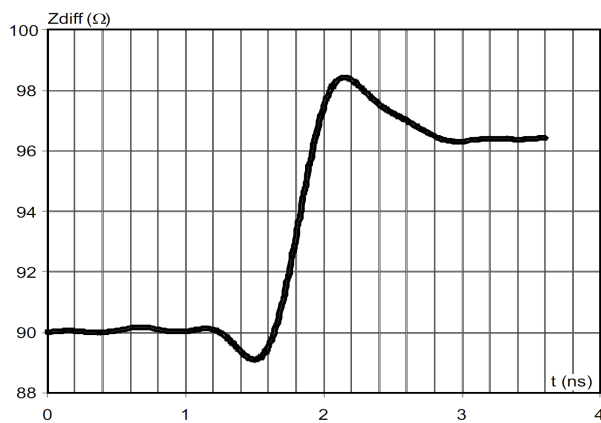
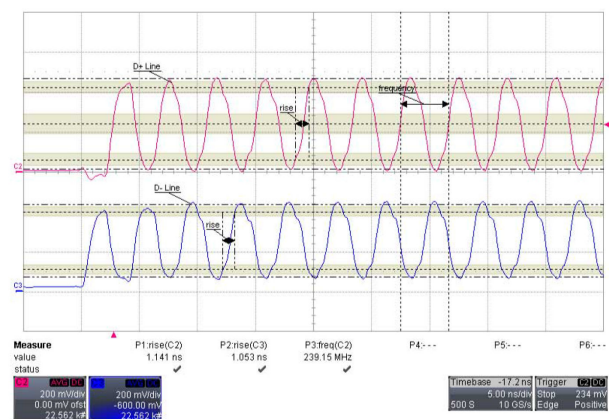
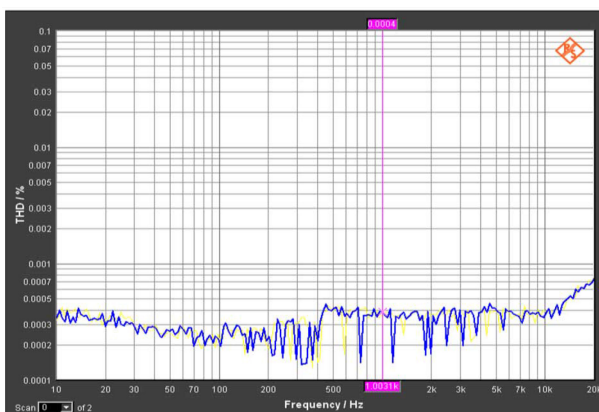
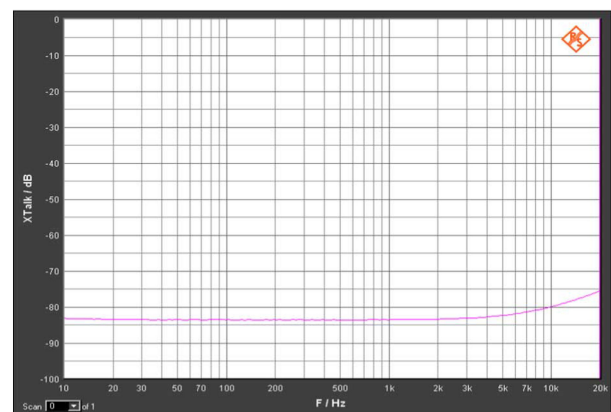
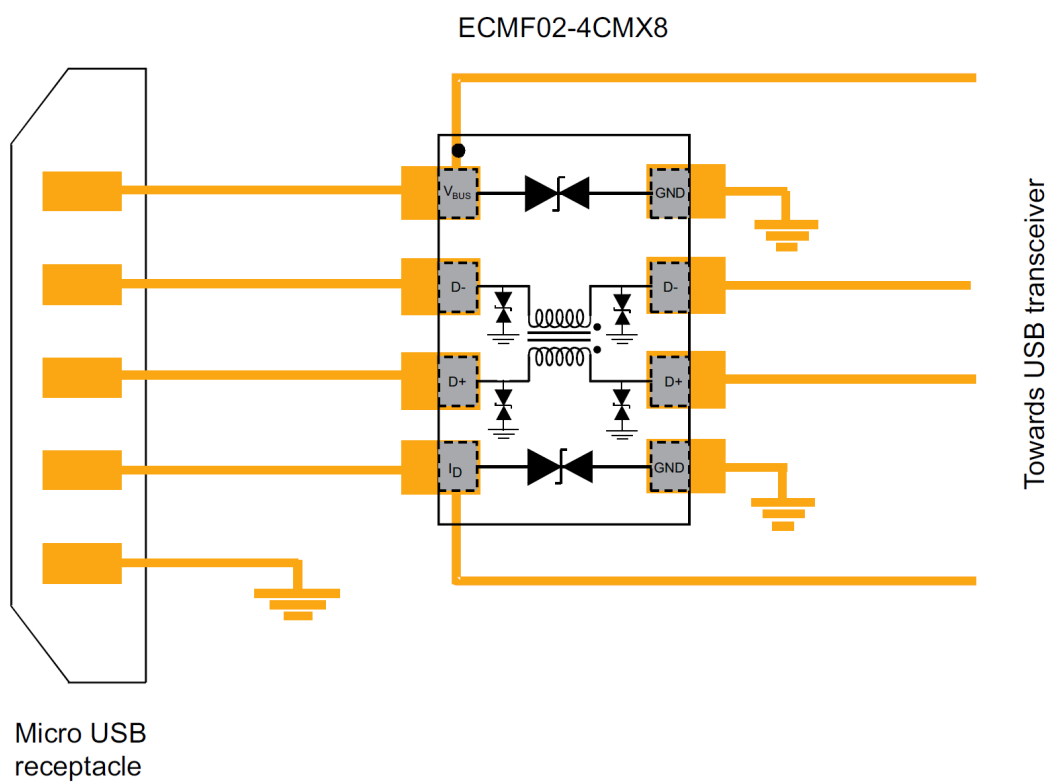
Figure 7. ESD response to IEC 61000-4-2 (+8 kV contact discharge) on V_{BUS}

Figure 8. ESD response to IEC 61000-4-2 (-8 kV contact discharge) on V_{BUS}

Figure 9. ESD response to IEC 61000-4-2 (+8 kV contact discharge) on I_D

Figure 10. ESD response to IEC 61000-4-2 (-8 kV contact discharge) on I_D

Figure 11. ESD response to IEC 61000-4-2 (+8 kV contact discharge) on differential lane

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


Figure 13. Eye diagram (loaded by $Z_{diff} = 90 \Omega$) with USB2.0 [mask 1] board only

Figure 14. Eye diagram (loaded by $Z_{diff} = 90 \Omega$) with USB2.0 [mask 1] board with ECMF02-4CMX8

Figure 15. TDR measurement (loaded by $Z_{diff} = 90 \Omega$), rise time 400 ps

Figure 16. HS sync

Figure 17. Total harmonic distortion on differential lanes

Figure 18. Crosstalk on differential lane


2 Application schematic

Figure 19. Application schematic



3 Package information

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.

3.1 QFN-8L package information

Figure 20. QFN-8L package outline

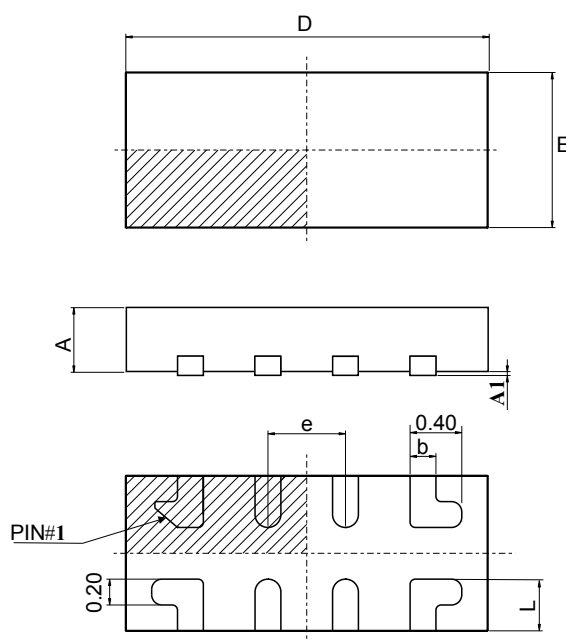


Table 3. QFN-8L mechanical data

Symbol	Dimesions					
	Milimeters			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	0.000	0.0008	0.002
b	0.15	0.20	0.25	0.006	0.008	0.10
D	2.45	2.50	2.55	0.096	0.098	0.100
E	1.15	1.20	1.25	0.045	0.047	0.049
e	0.45	0.50	0.55	0.018	0.020	0.022
L	0.30	0.40	0.50	0.012	0.016	0.020

3.2 Packing information

Figure 21. Footprint

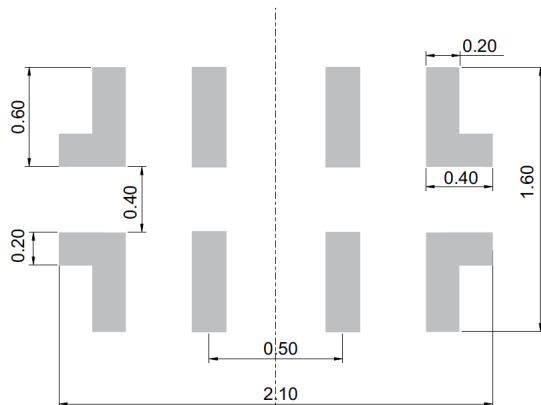


Figure 22. Marking

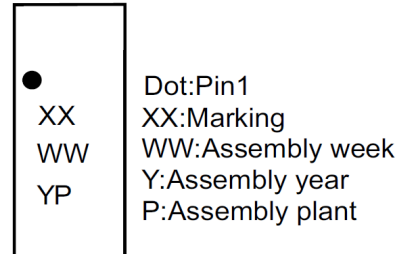
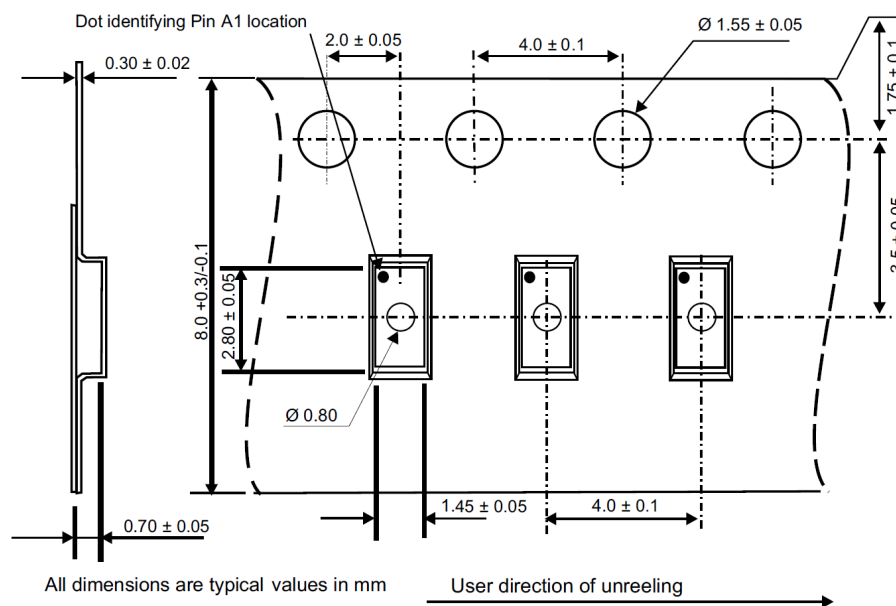


Figure 23. Tape outline



Note: More packing information is available in the AN1751: "EMI Filters: Recommendations and measurements"

4 Ordering information

Figure 24. Ordering information scheme

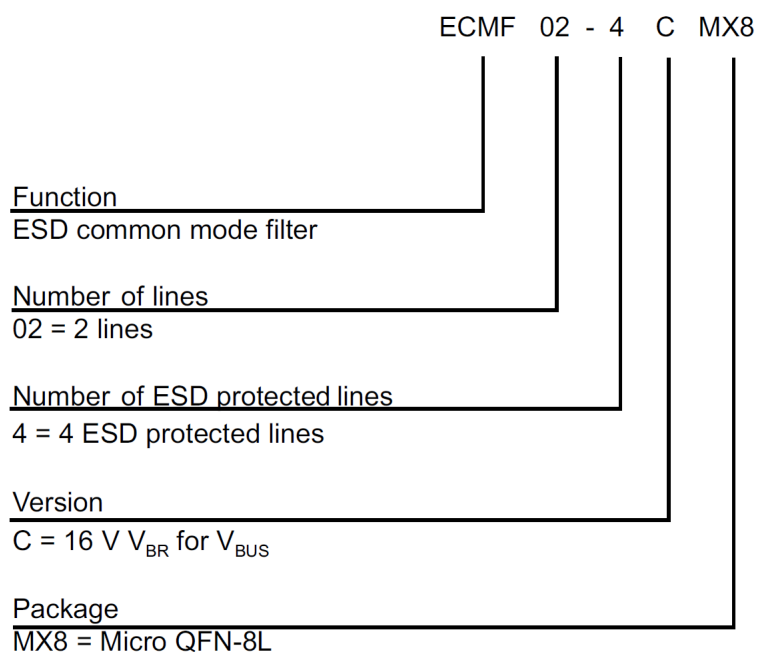


Table 4. Ordering information

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

Revision history

Table 5. Document revision history

Date	Version	Changes
19-Sep-2012	1	Initial release.
27-May-2014	2	Updated <i>Figure 24</i> , <i>Figure 25</i> and reformatted the document.
05-May-2015	3	Added <i>Figure 6</i> . Updated <i>Table 1</i> . Format updated to current standard.
03-Mar-2025	4	Updated Table 1 . Minor text changes.

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