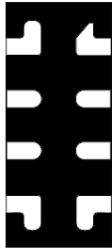
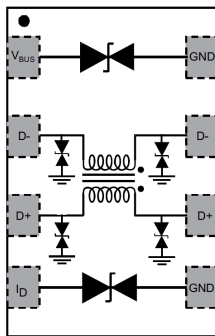


### Common mode filter with ESD protection for USB 2.0 interface



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:
  - $\pm 15$  kV (air discharge)
  - $\pm 8$  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](#)

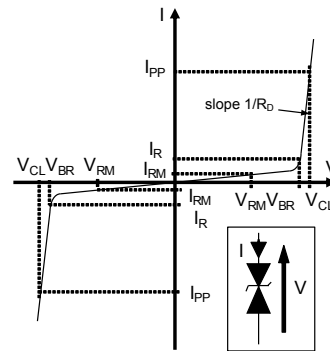
# 1 Characteristics

**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 $\mu$ s) on $V_{BUS}$	150	W
$I_{PP}$	Peak pulse current (8/20 $\mu$ 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)**

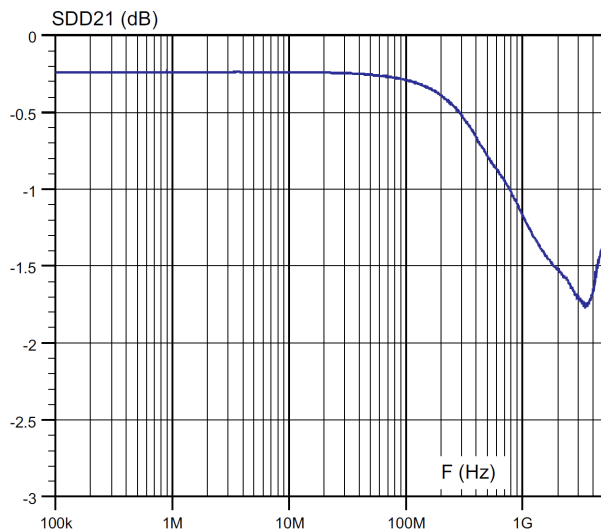
Symbol	Parameter
$V_{BR}$	= Breakdown voltage
$V_{CL}$	= Clamping voltage
$I_{RM}$	= Leakage current @ $V_{RM}$
$V_{RM}$	= Stand-off voltage
$I_{PP}$	= Peak pulse current
$R_D$	= Dynamic resistance
$I_R$	= Breakdown current


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

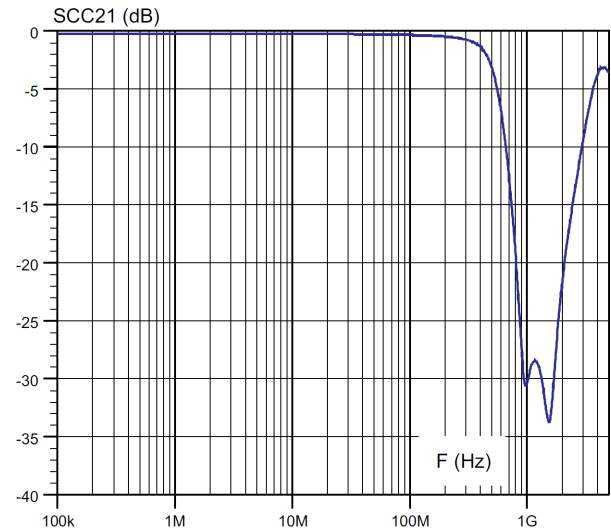
Symbol	Test conditions	Min.	Typ.	Max.	Unit
Data lines					
V <sub>BR</sub>	I <sub>R</sub> = 1 mA	6			V
I <sub>RM</sub>	V <sub>RM</sub> = 5.5 V per line			100	nA
R <sub>DC</sub>	DC serial resistance on data line		3	4	Ω
V <sub>BUS</sub>					
V <sub>BR</sub>	I <sub>R</sub> = 1 mA	15	16.5	18	V
I <sub>RM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

## 1.1 Characteristics (curves)

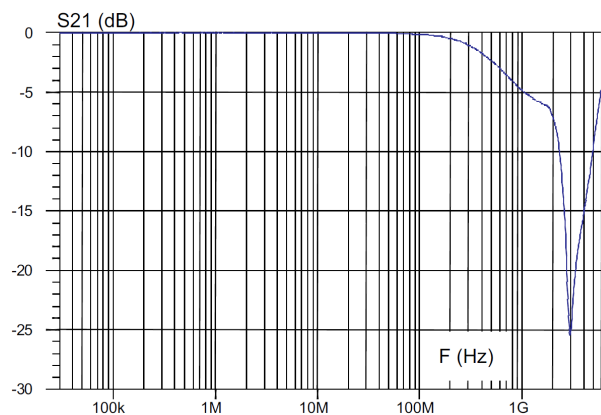
**Figure 2. SDD21 differential attenuation measurement ( $Z_{0 \text{ diff}} = 90 \Omega$ ) for data lines D+ and D-**



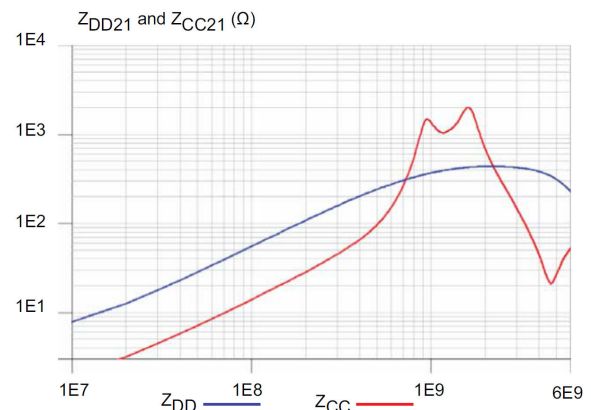
**Figure 3. SCC21 common mode attenuation measurement ( $Z_{0 \text{ com}} = 45 \Omega$ )**



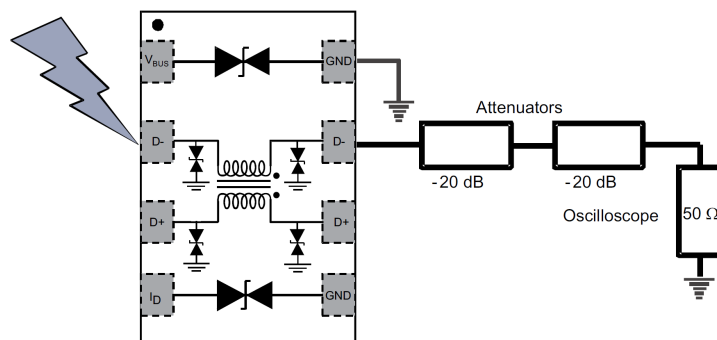
**Figure 4. ID frequency response measurement ( $Z_0 = 75 \Omega$ )**

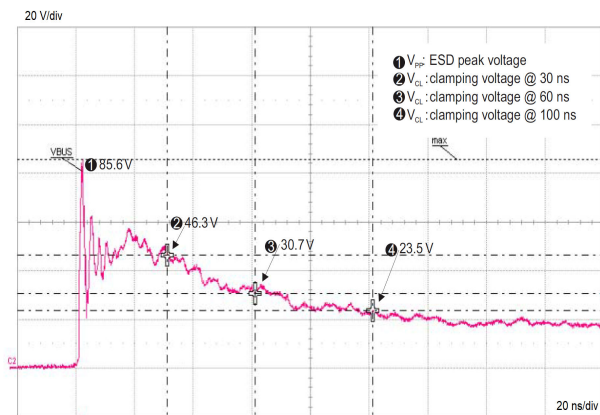
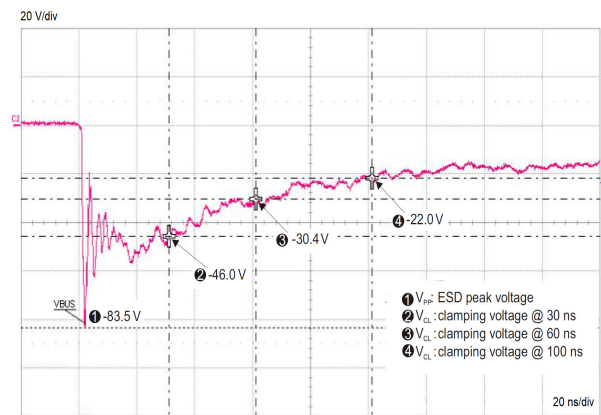
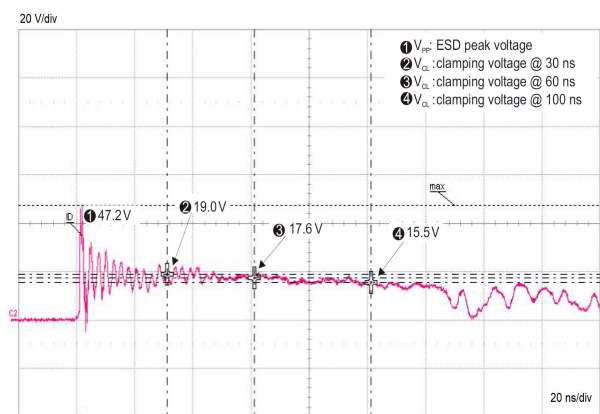
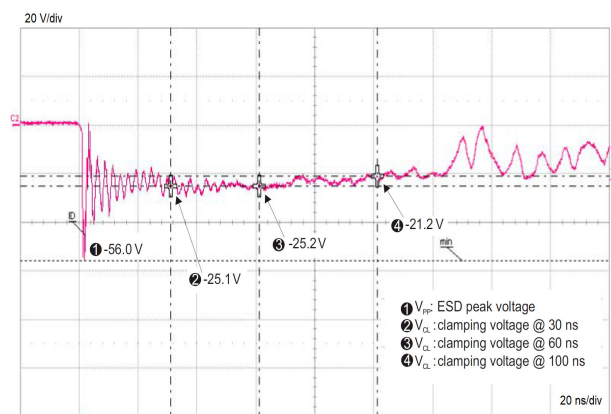
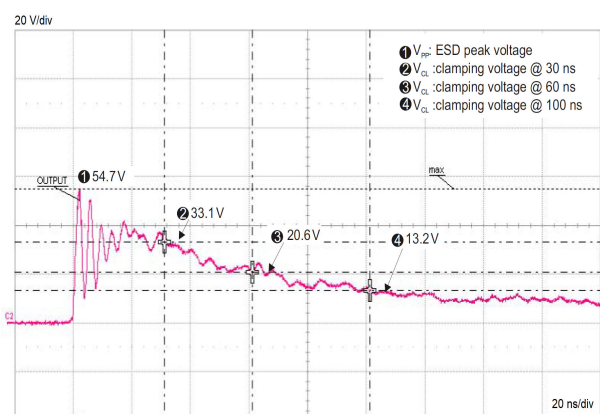
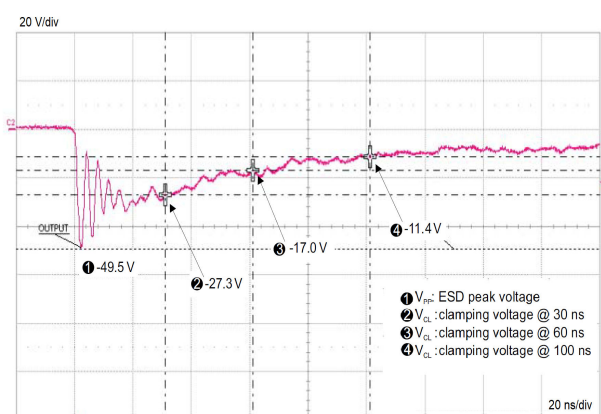


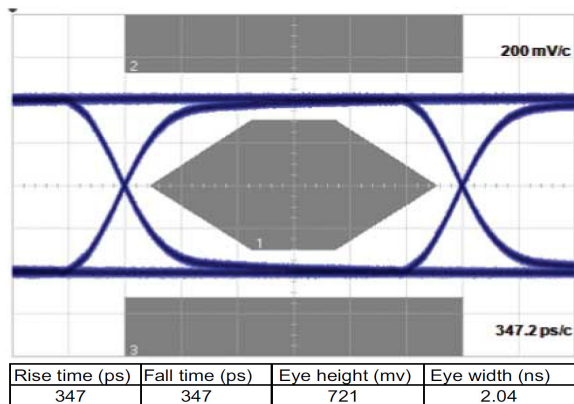
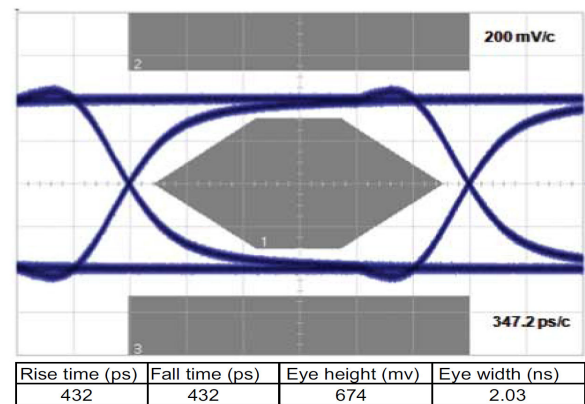
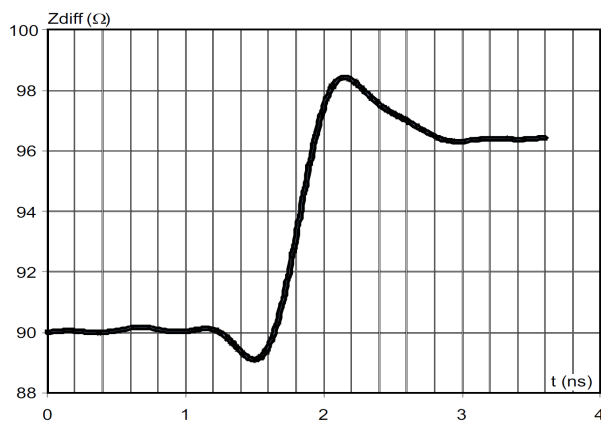
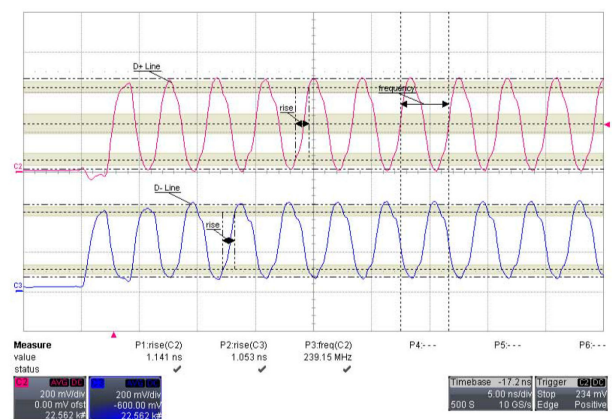
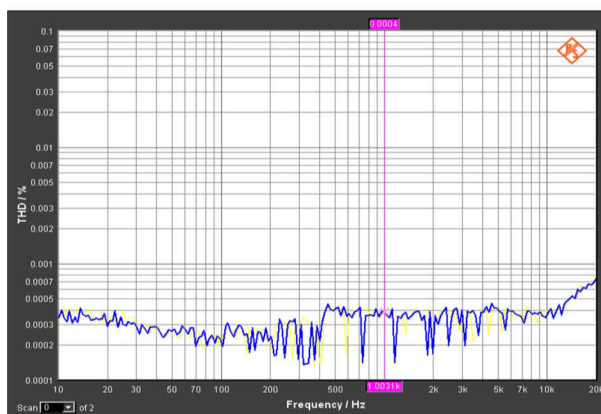
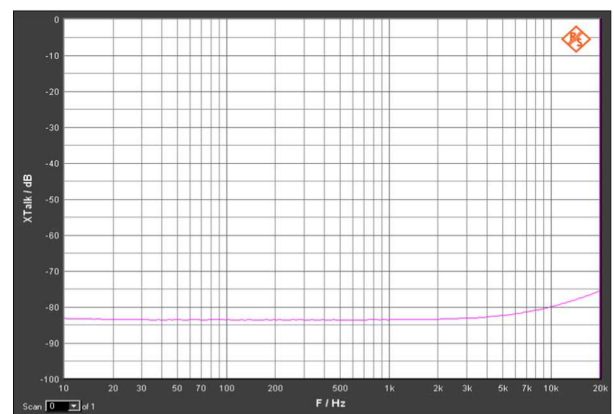
**Figure 5. Differential ( $Z_{DD21}$ ) and common mode ( $Z_{CC21}$ ) impedance versus frequency**



**Figure 6. ESD test conditions**

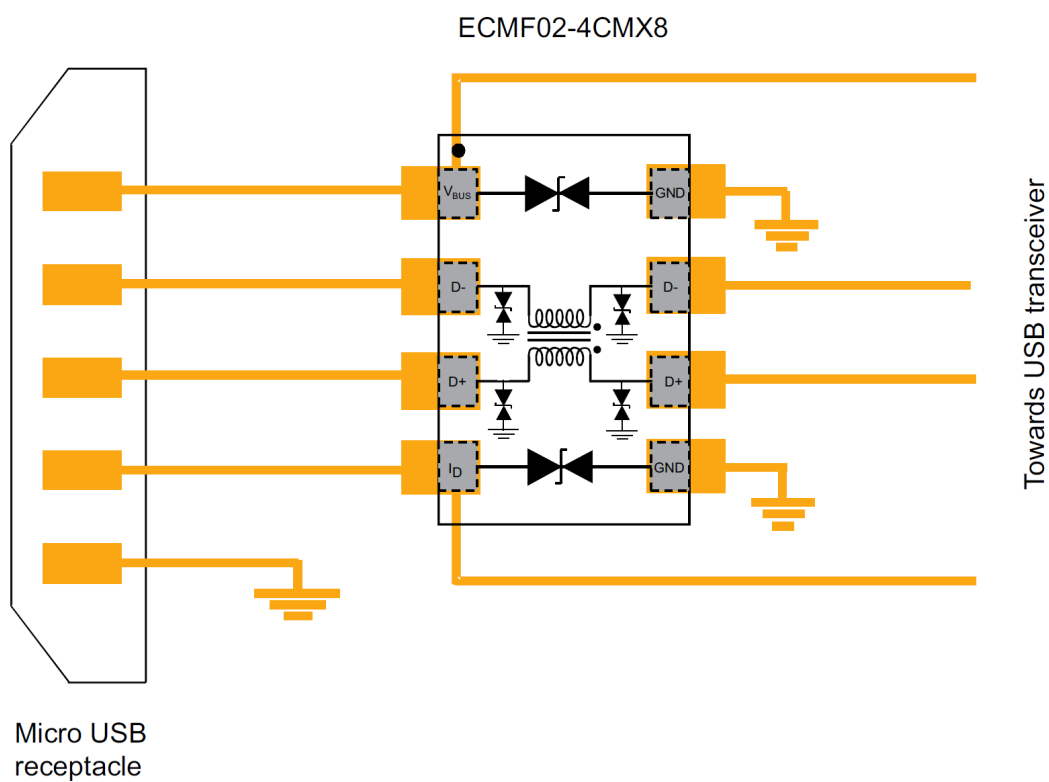


**Figure 7. ESD response to IEC 61000-4-2 (+8 kV contact discharge) on  $V_{BUS}$** 

**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

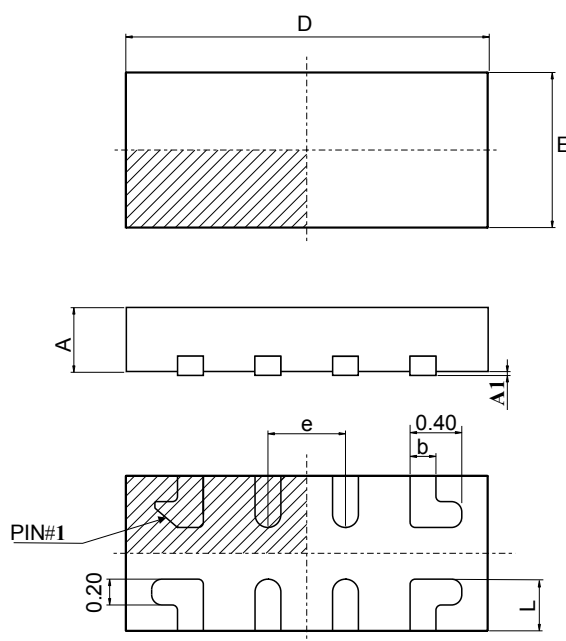


### 3 Package information

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](http://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

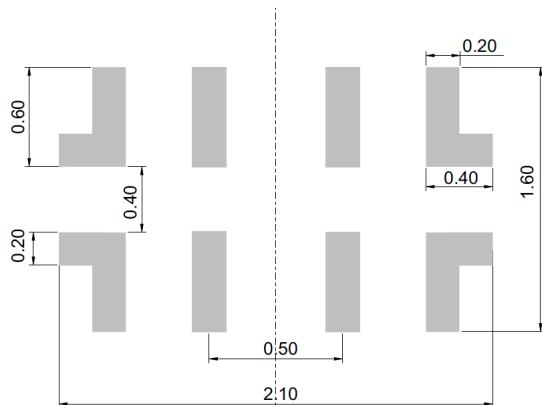


Figure 22. Marking

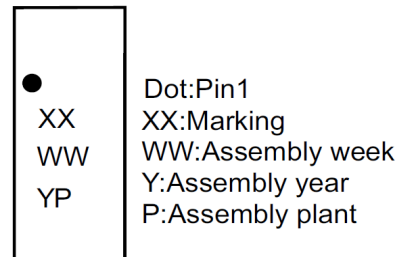
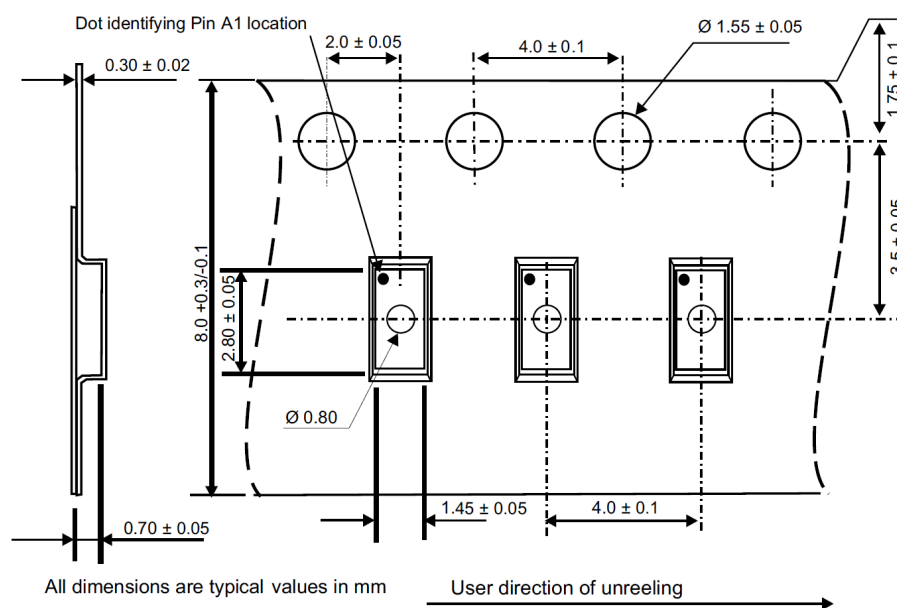


Figure 23. Tape outline

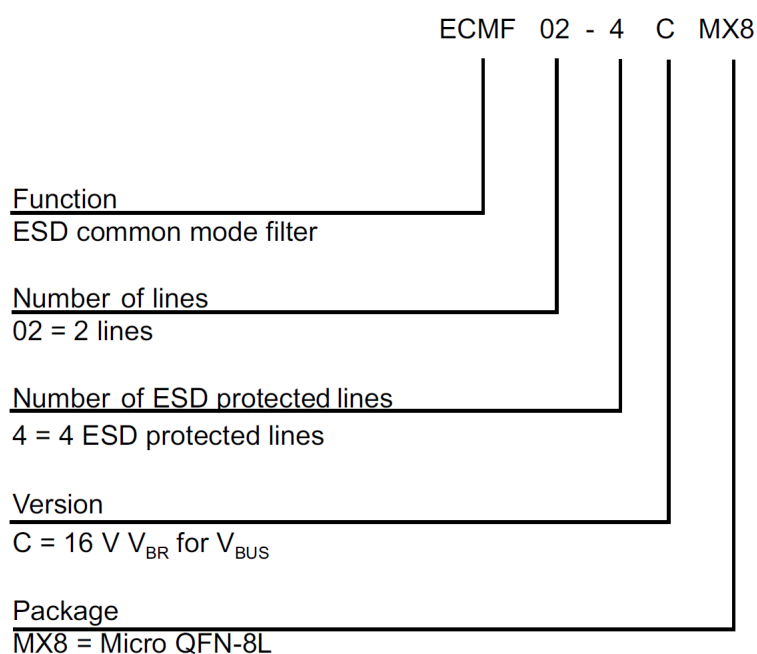


Note: More packing information is available in the AN1751: "EMI Filters: Recommendations and measurements"



## 4 Ordering information

**Figure 24. Ordering information scheme**



**Table 4. Ordering information**

Order code	Marking	Package	Weight	Base qty.	Delivery mode
ECMF02-4CMX8	KG	$\mu$ 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 <a href="#">Table 1</a> . Minor text changes.

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