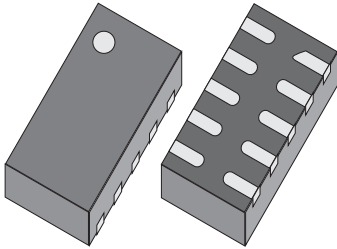
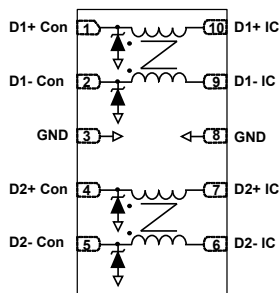


## Common mode filter with ESD protection for high speed serial interface



QFN-10L 2.6 x 1.35 x 0.5



### Product status link

[ECMF04-4HSM10](#)

### Product summary

Order code	ECMF04-4HSM10
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### Features

- Very large differential bandwidth to comply with HDMI Full HD, MIPI, USB2.0, USB3.2 Gen 1, Display Port and other high speed serial interfaces
- Provides -20 dB attenuation at 700 MHz in LTE bands
- High common mode attenuation:- 25 dB between 800 MHz - 900 MHz
- Low PCB space consumption
- Thin package for compact applications: 0.55 mm max.
- High reduction of parasitic elements through integration
- RoHS package

### Complies with the following standards

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

### Applications

- Mobile phones
- Notebook, laptop
- Portable devices
- PND

### Description

The **ECMF04-4HSM10** is a highly integrated common mode filter designed to suppress EMI/RFI common mode noise on high speed differential serial buses like HDMI Full HD, MIPI, Display Port and other high speed serial interfaces.

The device has a very large differential bandwidth to comply with these standards and can protect and filter two differential lanes.

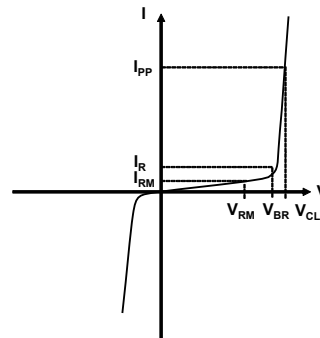
# 1 Characteristics

**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	8	kV
		Air discharge	16	
$I_{RMS}$	Maximum RMS current	100	mA	
$T_{op}$	Operating ambient temperature range	-55 to +125	°C	
$T_j$	Maximum junction temperature	125		
$T_{stg}$	Storage temperature range	-55 to +150		

**Figure 1. Electrical characteristics (definitions)**

- $V_{RM}$  Maximum stand-off voltage
- $V_{CL}$  Clamping voltage at peak pulse current  $I_{PP}$
- $I_{RM}$  Leakage current at  $V_{RM}$
- $I_{PP}$  Peak pulse current
- $V_{BR}$  Breakdown voltage
- $R_{DC}$  DC serial resistance
- $f_C$  Differential cut off frequency


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

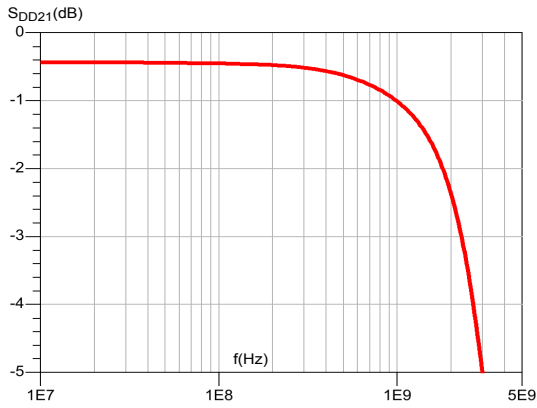
Symbol	Test conditions	Min.	Typ.	Max.	Unit
$V_{BR}$	$I_R = 1\text{ mA}$	6			V
$I_{RM}$	$V_{RM} = 3\text{ V per line}$			100	nA
$R_{DC}$	DC serial resistance		5		$\Omega$

**Table 3. Pin description**

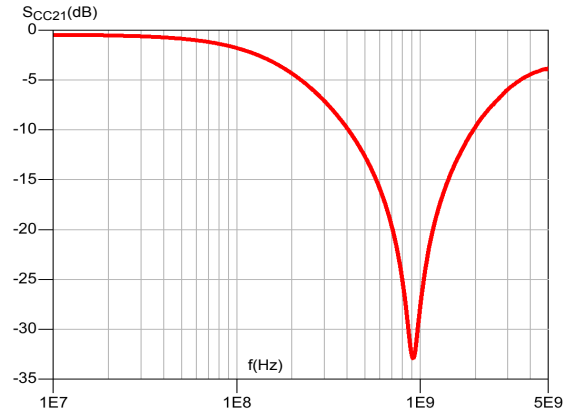
Pin number	Description	Pin number	Description
1	D1+ to connector	6	D2- to IC
2	D1- to connector	7	D2+ to IC
3	GND	8	GND
4	D2+ to connector	9	D1- to IC
5	D2- to connector	10	D1+ to IC

## 1.1 Characteristics (curves)

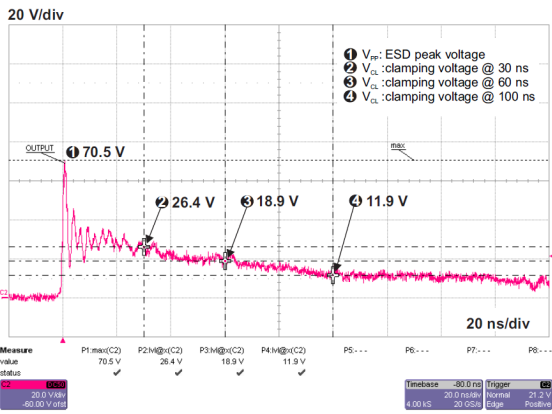
**Figure 2. Differential attenuation versus frequency**  
( $Z_{0\_DIFF} = 100 \Omega$ )



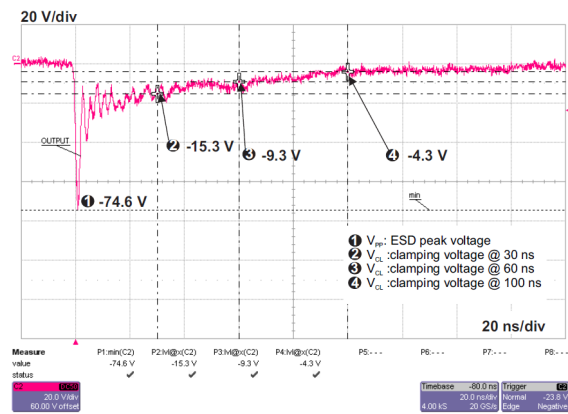
**Figure 3. Common mode attenuation versus frequency**  
( $Z_{0\_COM} = 50 \Omega$ )



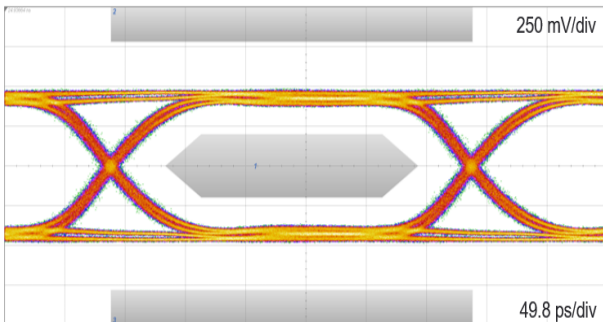
**Figure 4. ESD response to IEC61000-4-2 (+8 kV contact discharge)**



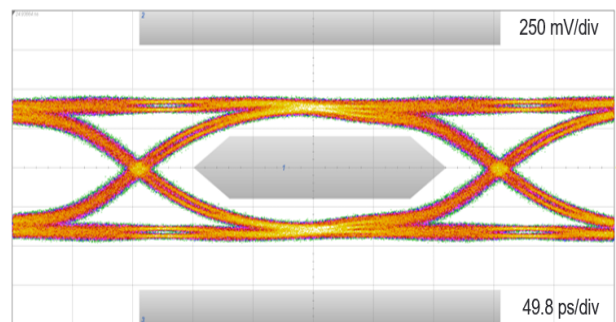
**Figure 5. ESD response to IEC61000-4-2 (-8 kV contact discharge)**



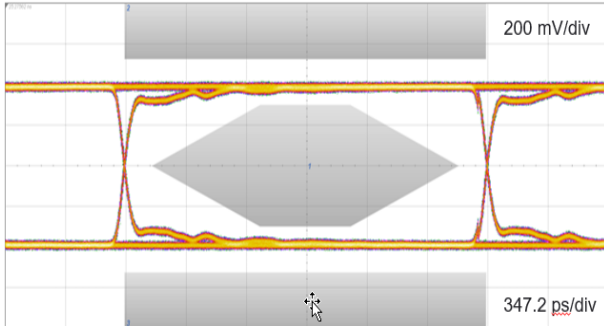
**Figure 6. HDMI1.4 3.35 Gbps eye diagram without ECMF04-4HSM10**



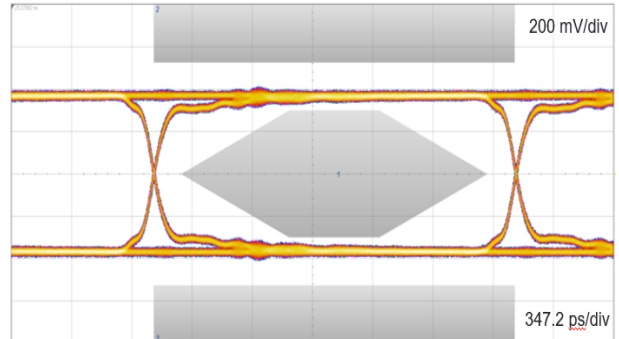
**Figure 7. HDMI1.4 3.35 Gbps eye diagram with ECMF04-4HSM10**



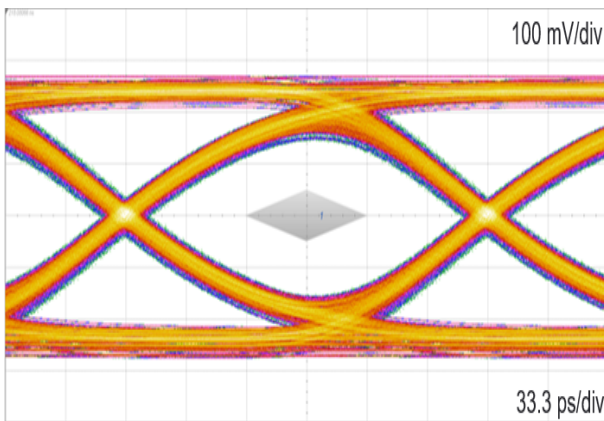
**Figure 8. USB2.0 480 Mbps eye diagram without device**



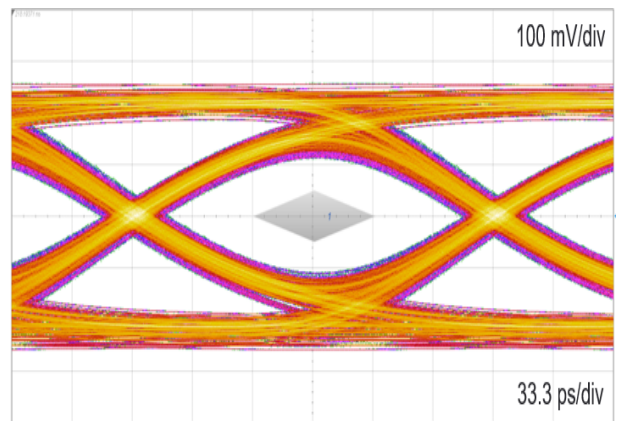
**Figure 9. USB2.0 480 Mbps eye diagram with device**



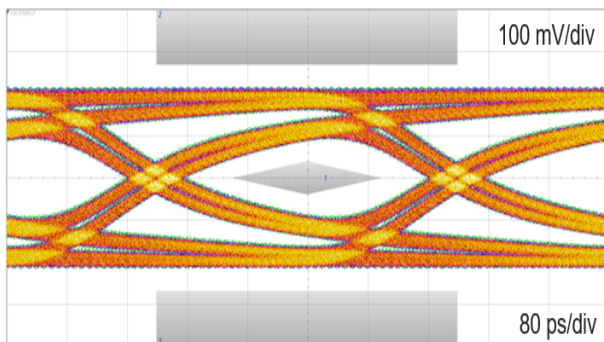
**Figure 10. USB3.2 Gen 1 5.0 Gbps eye diagram without ECMF04-4HSM10 (with worst cable and equalizer)**



**Figure 11. USB3.2 Gen 1 5.0 Gbps eye diagram with ECMF04-4HSM10 (with worst cable and equalizer)**



**Figure 12. MIPI D-PHY 2.5 Gbps long reference channel eye diagram without ECMF04-4HSM10**



**Figure 13. MIPI D-PHY 2.5 Gbps long reference channel eye diagram with ECMF04-4HSM10**

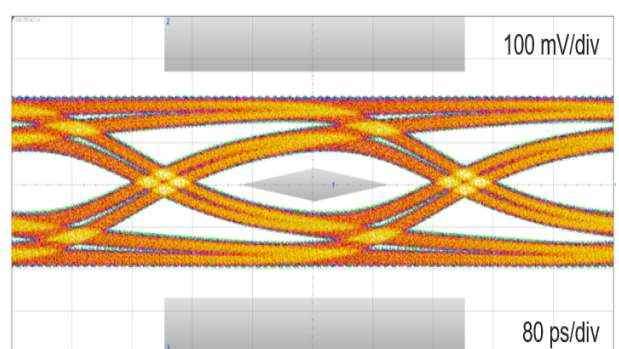


Figure 14. TDR

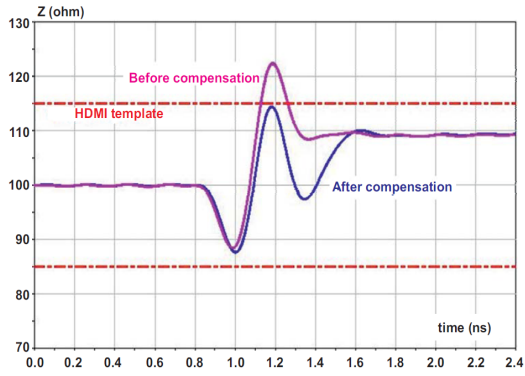
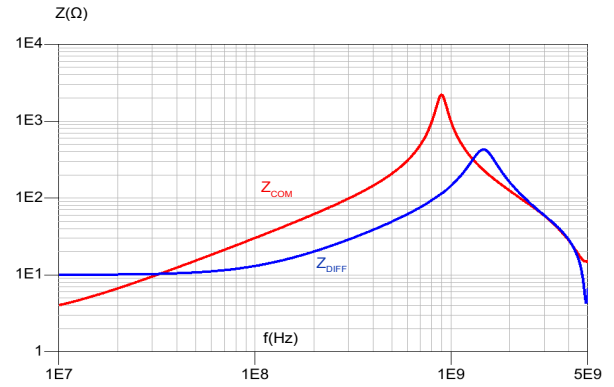
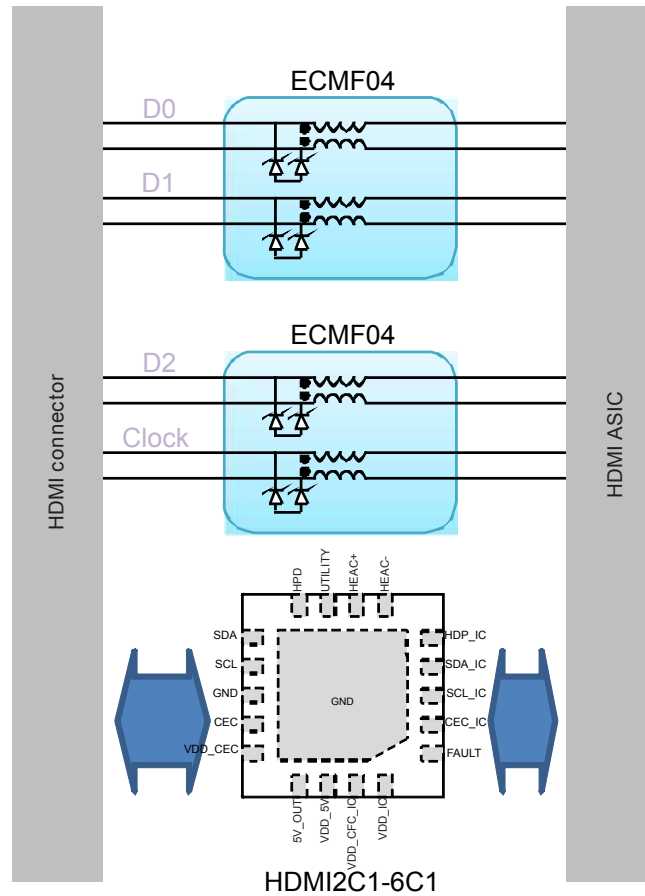


Figure 15. Differential and common mode impedance versus frequency



## 2 Application information

Figure 16. HDMI schematic



More application information available in following AN:

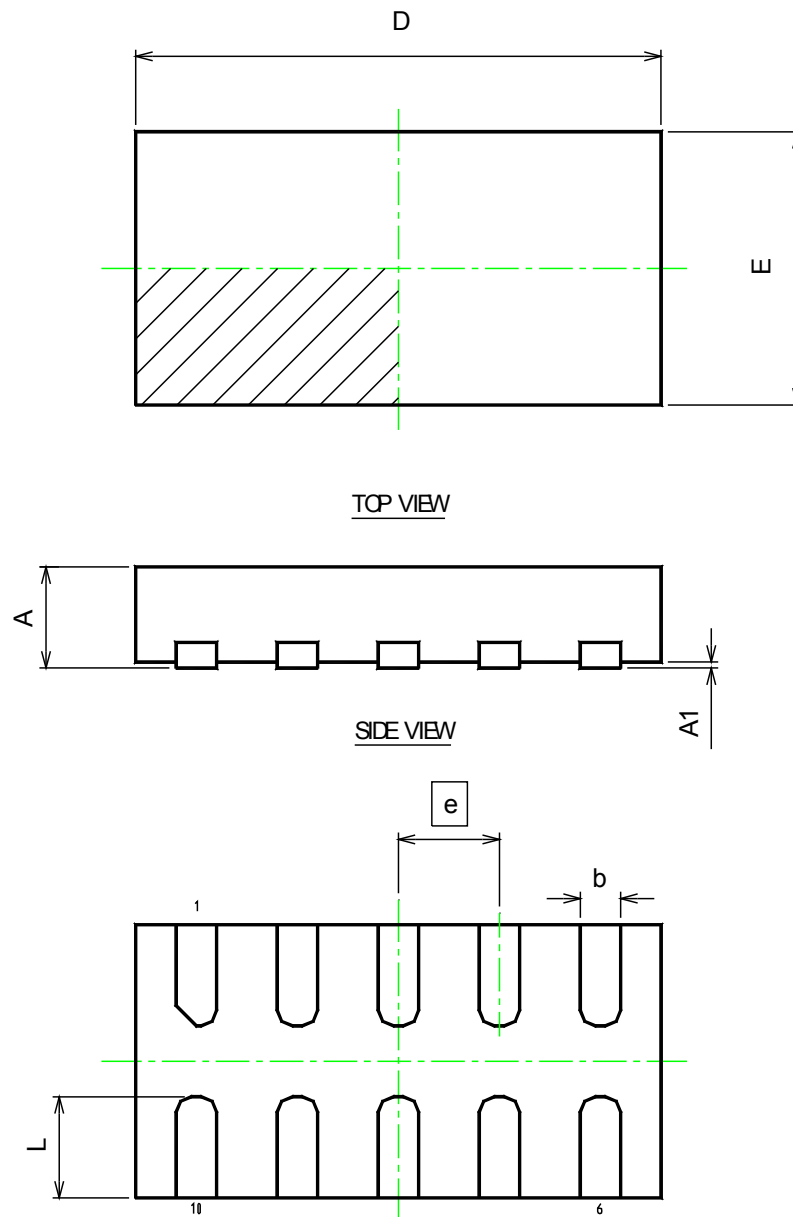
- [AN4356](#): "Antenna desense on handheld equipment"
- [AN4511](#): "Common mode filters"
- [AN4540](#): "MHL link filtering and protection"

### 3 Package information

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 QFN-10L package information

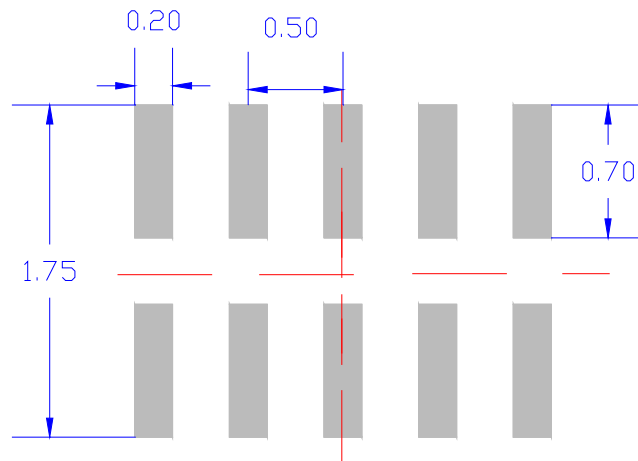
Figure 17. QFN10L package outline



**Table 4. QFN10L package mechanical data**

Ref.	Dimensions		
	Millimeters		
	Min.	Typ.	Max.
A	0.45	0.50	0.55
A1	0.00	0.02	0.05
b	0.15	0.20	0.25
D	2.55	2.60	2.65
E	1.30	1.35	1.40
e		0.50	
L	0.40	0.50	0.60

**Figure 18. Footprint recommendations (mm)**





## 4 PCB assembly recommendation

Figure 19. Recommended PCB layout

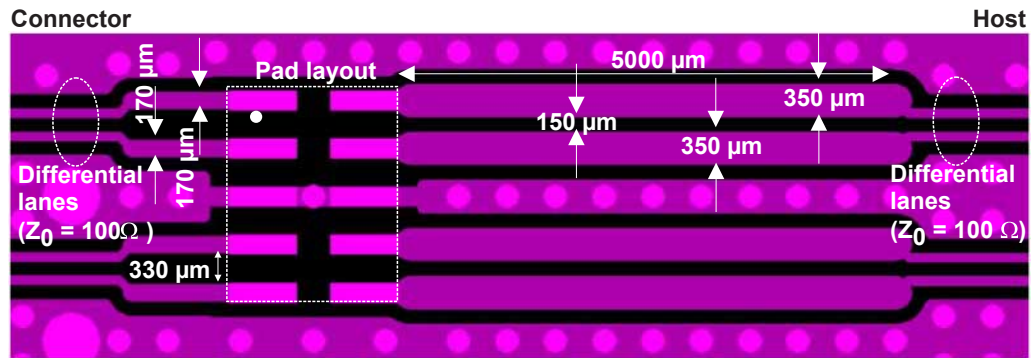
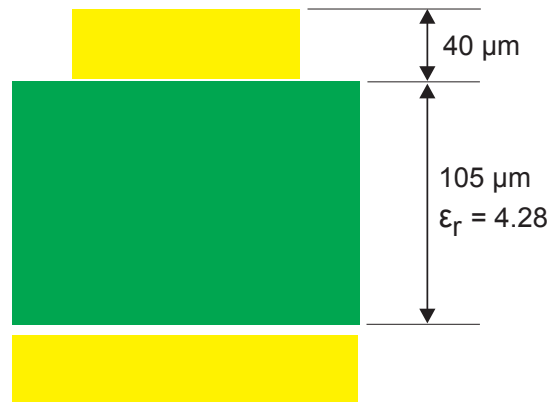


Figure 20. PCB stack dimensions



### 4.1 Solder paste

1. Halide-free flux qualification ROL0 according to ANSI/J-STD-004.
2. "No clean" solder paste is recommended.
3. Offers a high tack force to resist component movement during high speed.
4. Use solder paste with fine particles: powder particle size is 20-38  $\mu\text{m}$ .

## 4.2 QFN-10L packing information

Figure 21. Marking

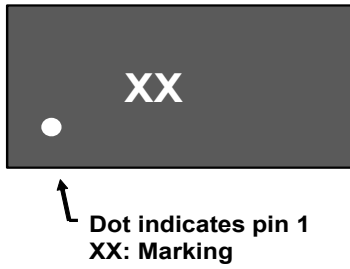


Figure 22. Package orientation in reel

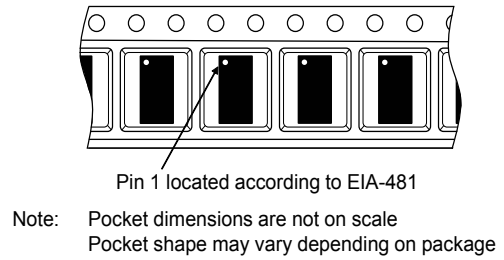


Figure 23. Tape and reel orientation

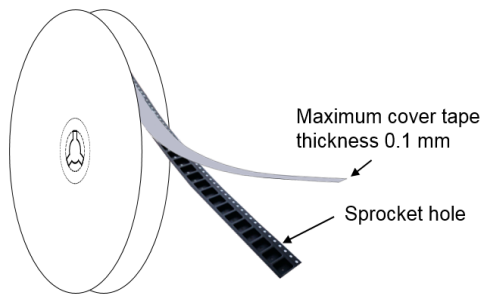


Figure 24. Reel dimensions (mm)

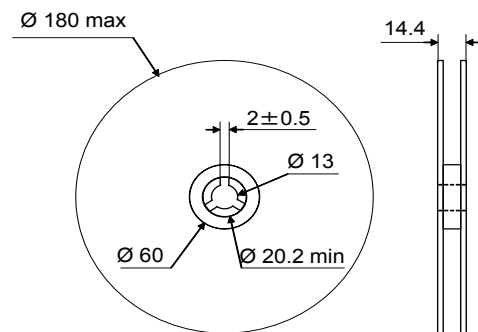
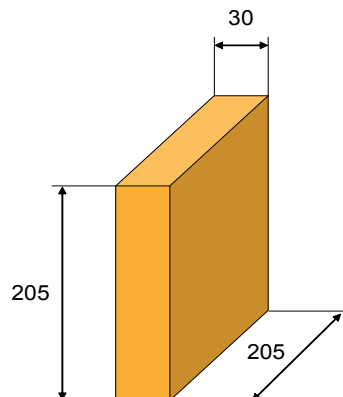
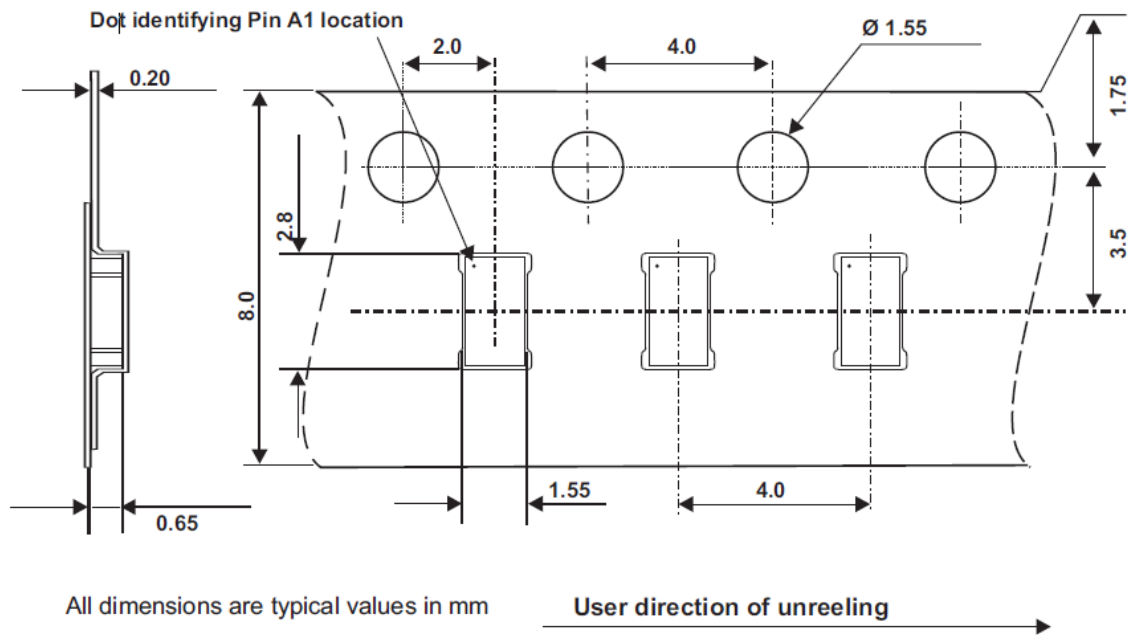
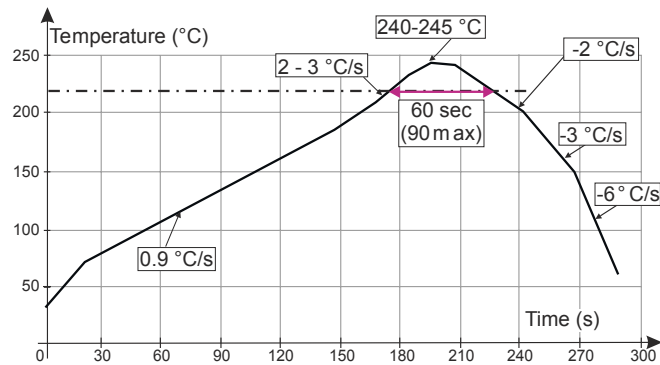


Figure 25. Inner box dimensions (mm)



**Figure 26. Tape and reel outline**


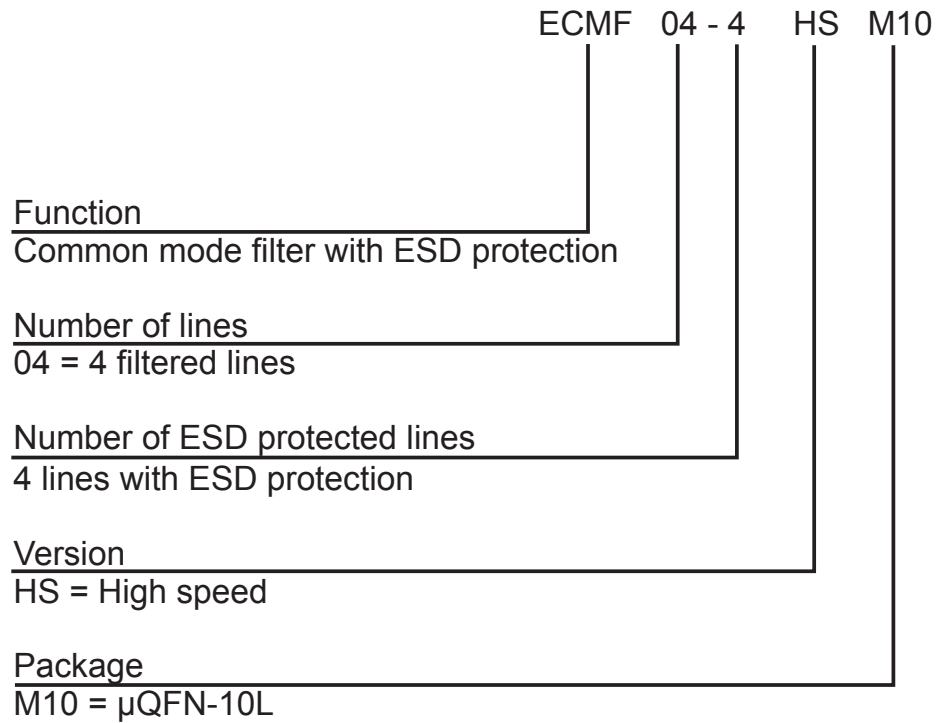
### 4.3 Solder reflow

**Figure 27. ST ECOPACK<sup>®</sup> recommended soldering reflow profile for PCB mounting**


*Note:* Minimize air convection currents in the reflow oven to avoid component movement. Maximum soldering profile corresponds to the latest IPC/JEDEC J-STD-020.

## 5 Ordering information

Figure 28. Ordering information scheme



Order code	Marking	Package	Weight	Base qty.	Delivery mode
ECMF04-4HSM10	KK <sup>(1)</sup>	μQFN-10L	5 mg	3000	Tape and reel

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

## Revision history

**Table 5. Document revision history**

Date	Version	Changes
03-Oct-2013	1	Initial release.
25-Aug-2014	2	Added Figure 5: Differential (ZDD21) and common mode (ZCC21) impedance versus frequency.
13-Dec-2017	3	Updated Table 1.
09-Nov-2020	4	Updated Figure 6, Figure 7, Figure 8, Figure 9, Figure 10 and Figure 11. Added Figure 12 and Figure 13.

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[P6KE8.2A](#) [SA110CA](#) [SA60CA](#) [SA64CA](#) [SMBJ12CATR](#) [SMBJ8.0A](#) [SMLJ30CA-TP](#) [ESD101-B1-02ELS E6327](#) [ESD112-B1-02EL E6327](#)  
[ESD119B1W01005E6327XTSA1](#) [ESD5V0J4-TP](#) [ESD5V0L1B02VH6327XTSA1](#) [ESD7451N2T5G](#) [19180-510](#) [CPDT-5V0USP-HF](#)  
[3.0SMCJ33CA-F](#) [3.0SMCJ36A-F](#) [HSPC16701B02TP](#) [D3V3Q1B2DLP3-7](#) [D55V0M1B2WS-7](#) [DESD5V0U1BL-7B](#) [DRTR5V0U4SL-7](#)  
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[82350120560](#) [82356240030](#) [VESD12A1A-HD1-GS08](#) [CPDUR5V0R-HF](#) [CPDUR24V-HF](#) [CPDQC5V0U-HF](#) [CPDQC5V0USP-HF](#)  
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