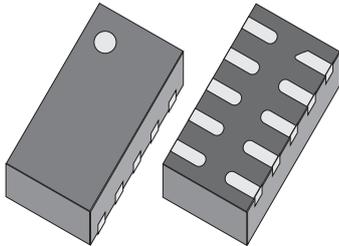
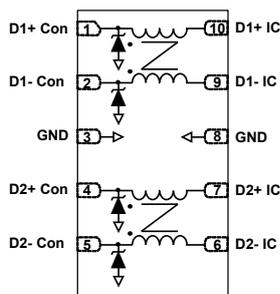


## Common mode filter with ESD protection for high speed serial interface



QFN-10L 2.6 x 1.35 x 0.5



### 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
- High common mode attenuation on WLAN frequencies:
  - 28 dB at 2.4 GHz and -16 dB at 5.0 GHz
- Very good attenuation at LTE, GSM and GPS frequencies
- Large bandwidth: 4.2 GHz
- Low PCB space consumption
- Thin package for compact applications: 0.55 mm max.
- High reduction of parasitic elements through integration
- RoHS package

### Exceed 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 [ECMF04-4HSWM10](#) 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.

#### Product status link

[ECMF04-4HSWM10](#)

#### Product summary

Order code	<a href="#">ECMF04-4HSWM10</a>
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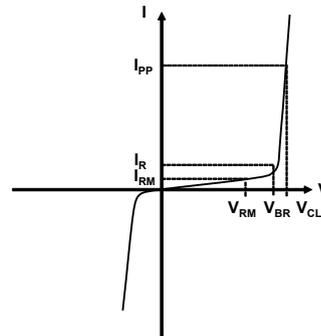
# 1 Characteristics

**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	$^{\circ}\text{C}$	
$T_j$	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 ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ )**

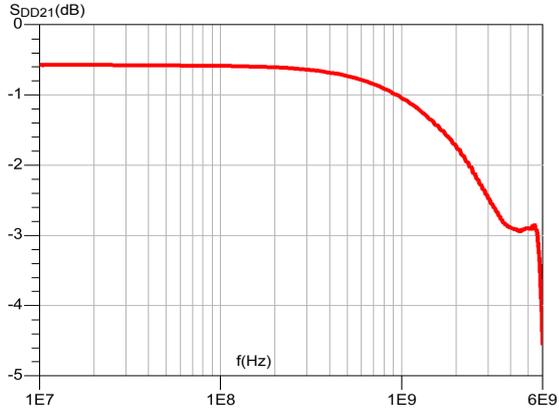
Symbol	Test conditions	Min.	Typ.	Max.	Unit
$V_{BR}$	$I_R = 1\text{ mA}$	4.5	5.5		V
$I_{RM}$	$V_{RM} = 3\text{ V per line}$			100	nA
$R_{DC}$	DC serial resistance		5		$\Omega$
$f_C$	-3 dB differential mode cut-off frequency		4.2		GHz

**Table 3. Pin description**

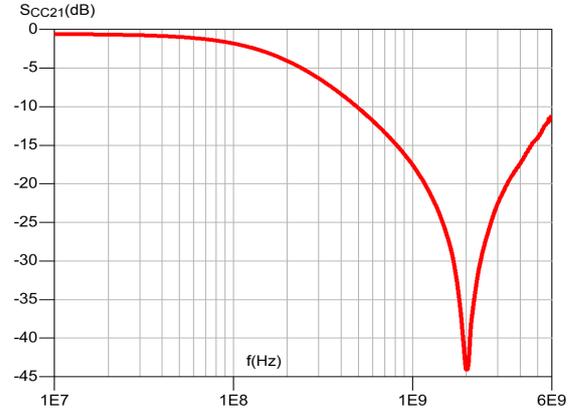
Pin number	Description	Pin number	Description
1	D1+ to connector	6	D2- to IC
2	D1- to connector	7	D2+ to IC
3	GND	8	GND
4	D2+ to connector	9	D1- to IC
5	D2- to connector	10	D1+ to IC

## 1.1 Characteristics (curves)

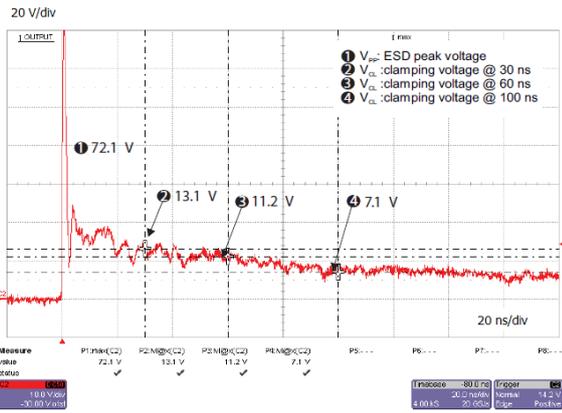
**Figure 2. Differential attenuation versus frequency**  
( $Z_{0\_DIFF} = 100 \Omega$ )



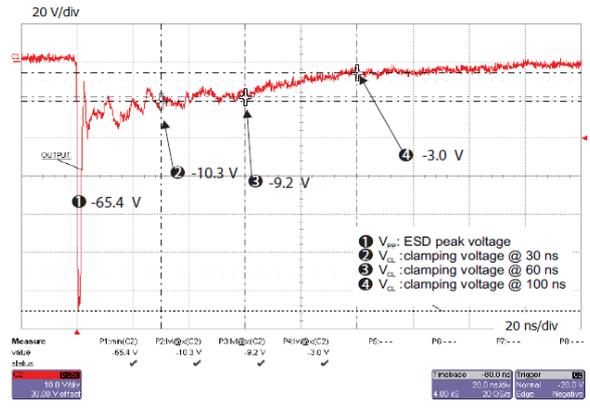
**Figure 3. Common mode attenuation versus frequency**  
( $Z_{0\_COM} = 50 \Omega$ )



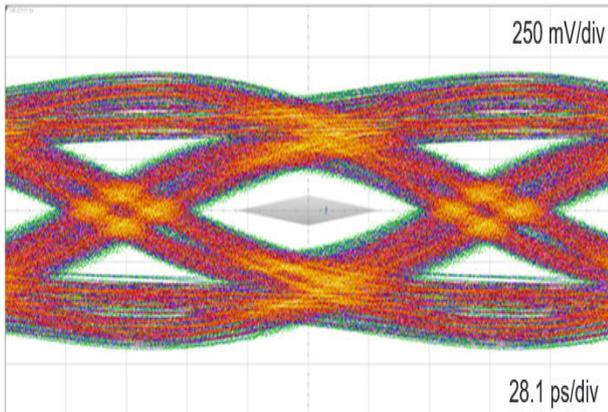
**Figure 4. ESD response to IEC61000-4-2 (+8 kV contact discharge)**



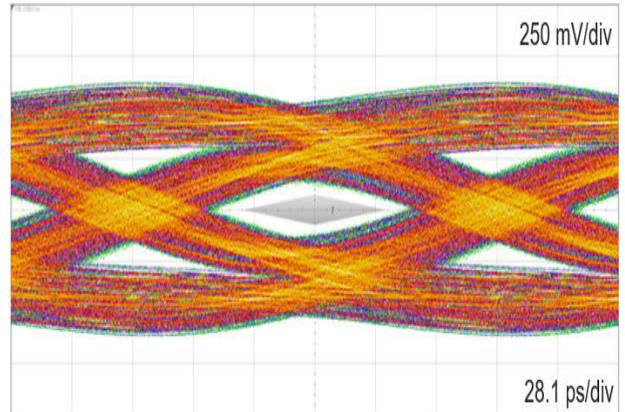
**Figure 5. ESD response to IEC61000-4-2 (-8 kV contact discharge)**



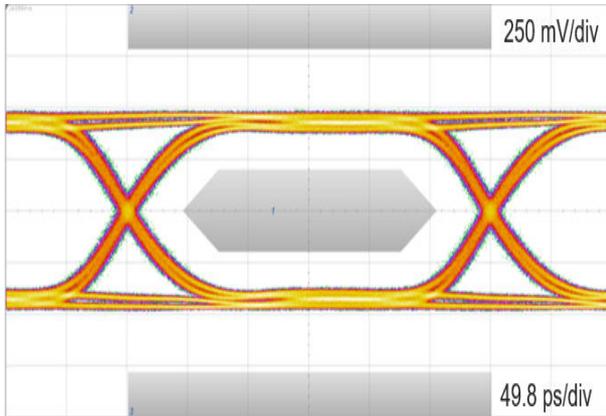
**Figure 6. HDMI2.0 - 5.94 Gbps eye diagram without device**  
(with worst cable and equalizer)



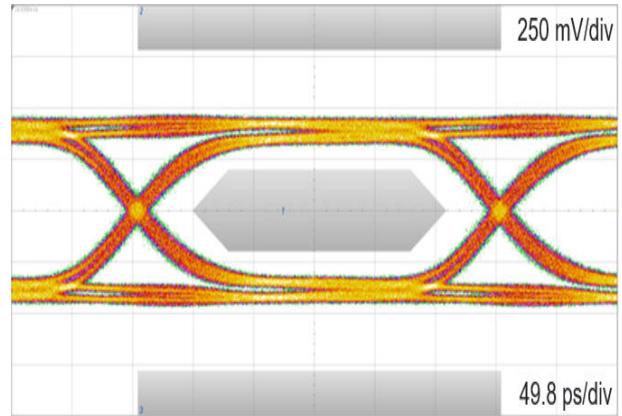
**Figure 7. HDMI2.0 - 5.94 Gbps eye diagram with device**  
(with worst cable and equalizer)



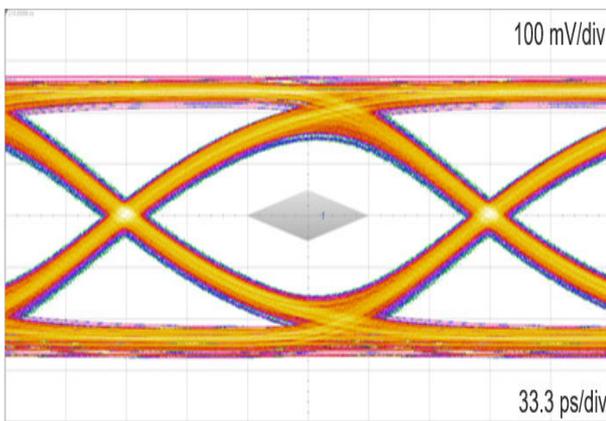
**Figure 8. HDMI1.4 3.35 Gbps eye diagram without ECMF04-4HSWM10**



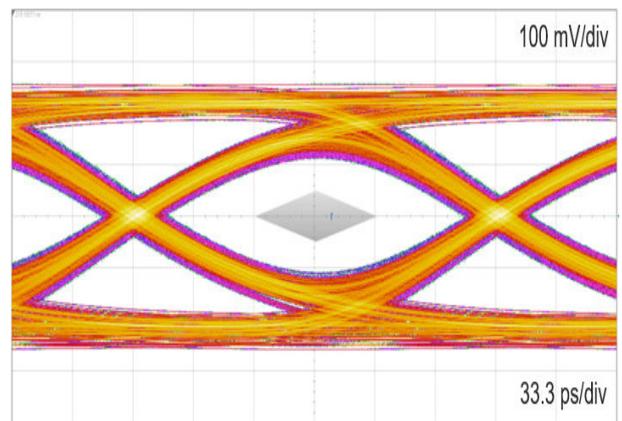
**Figure 9. HDMI1.4 3.35 Gbps eye diagram with ECMF04-4HSWM10**



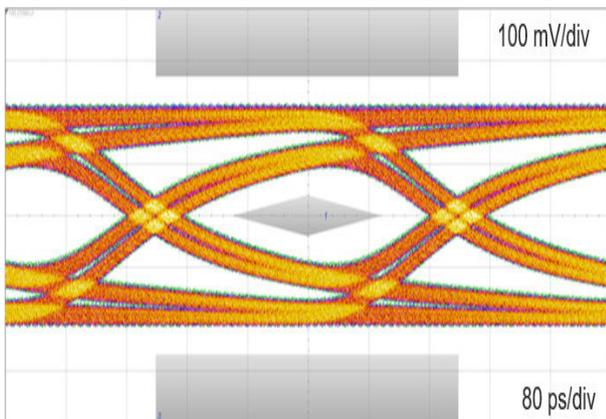
**Figure 10. USB3.2 Gen 1 5.0 Gbps eye diagram without ECMF04-4HSWM10 (with worst cable and equalizer)**



**Figure 11. USB3.2 Gen 1 5.0 Gbps eye diagram with ECMF04-4HSWM10 (with worst cable and equalizer)**



**Figure 12. MIPI D-PHY 2.5 Gbps long reference channel eye diagram without ECMF04-4HSWM10**



**Figure 13. MIPI D-PHY 2.5 Gbps long reference channel eye diagram with ECMF04-4HSWM10**

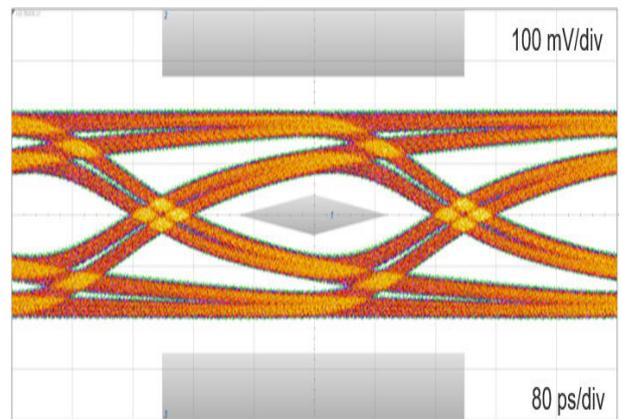
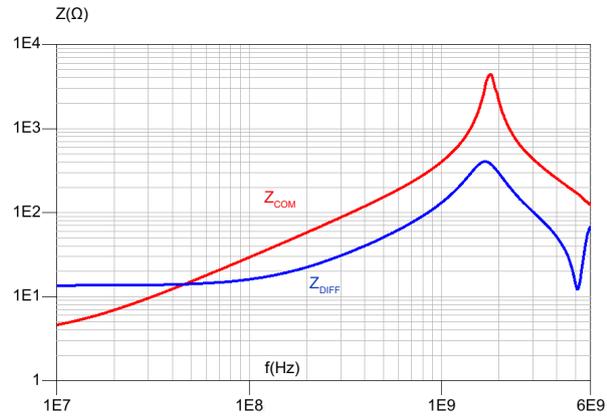
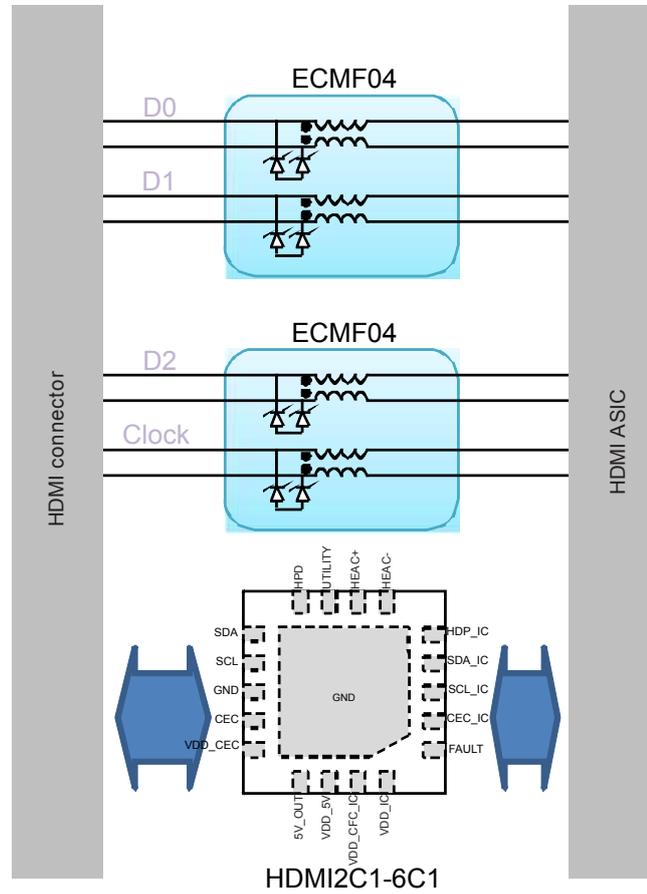


Figure 14. Differential and common mode impedance versus frequency



## 2 Application information

Figure 15. 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

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 16. QFN10L package outline

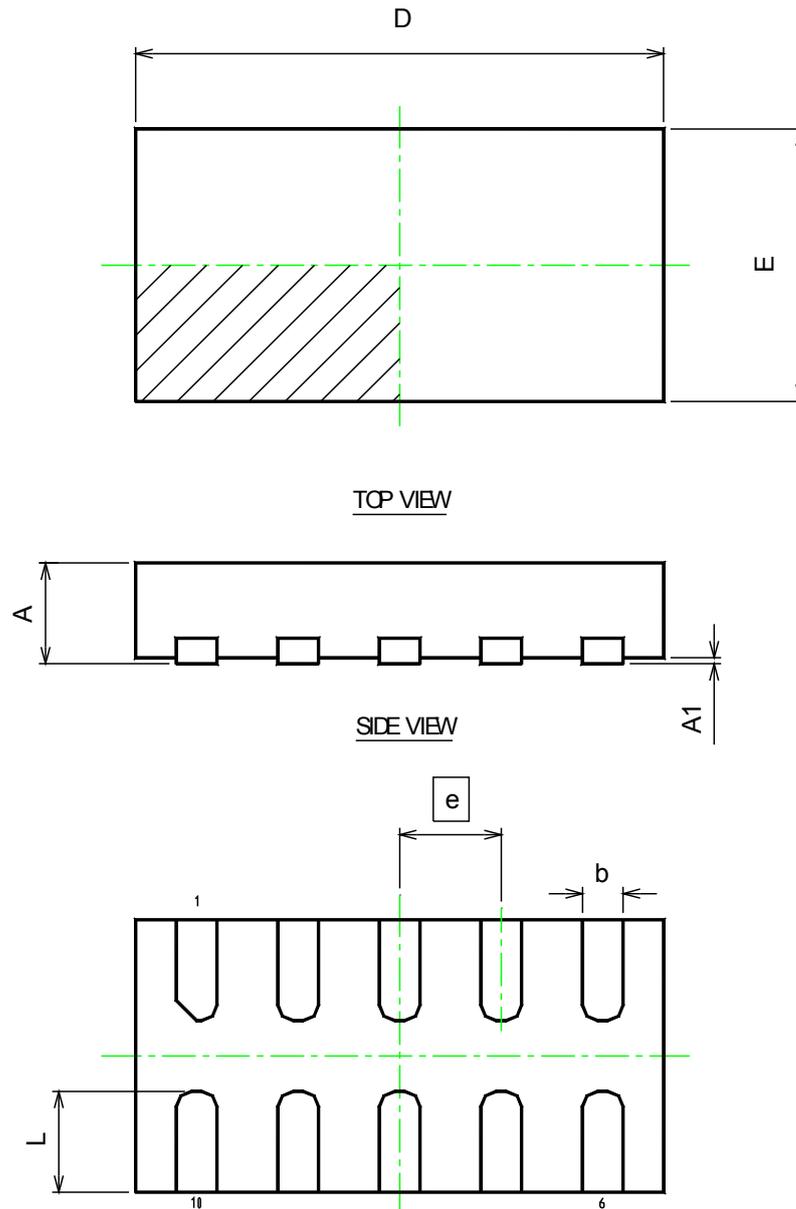
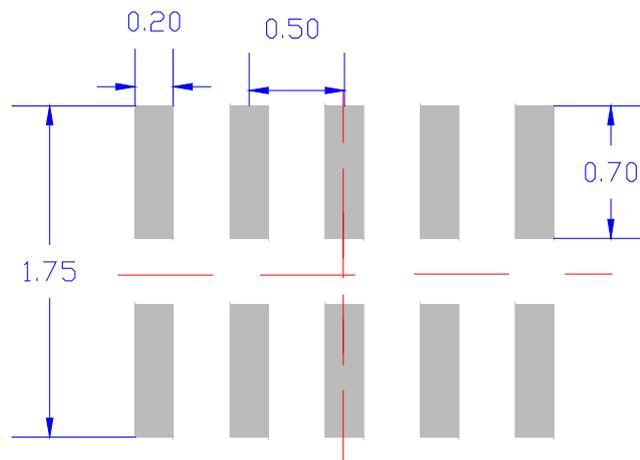


Table 4. QFN10L package mechanical data

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 17. Footprint recommendations (mm)



## 4 PCB assembly recommendation

### 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 18. Marking

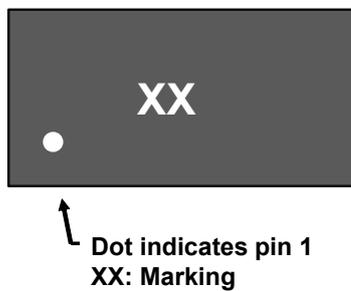


Figure 19. Package orientation in reel

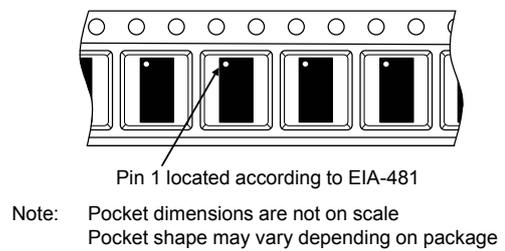


Figure 20. Tape and reel orientation

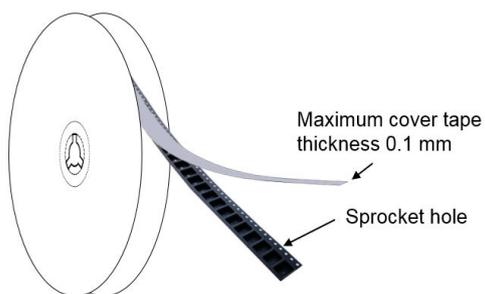


Figure 21. Reel dimensions (mm)

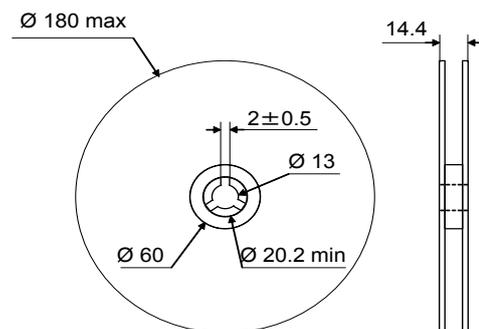


Figure 22. Inner box dimensions (mm)

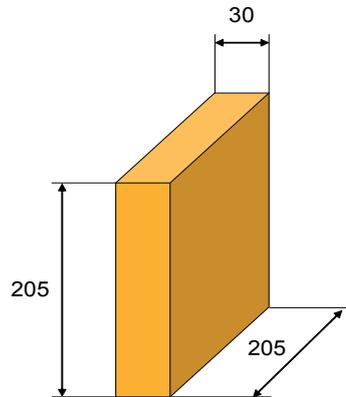
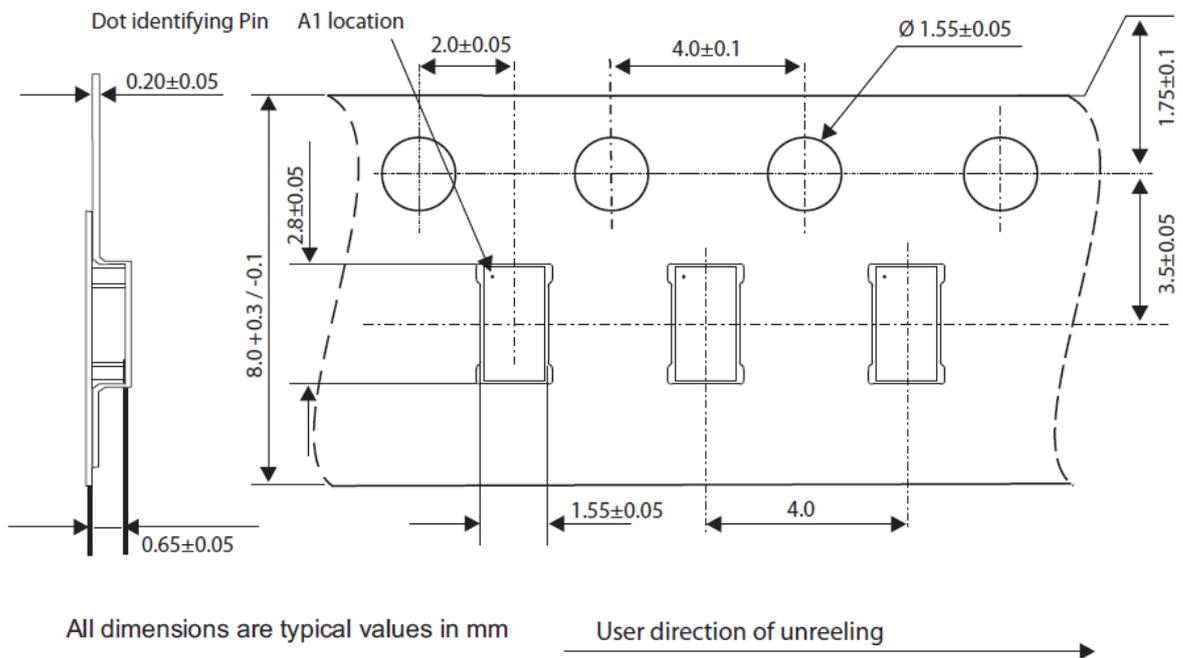
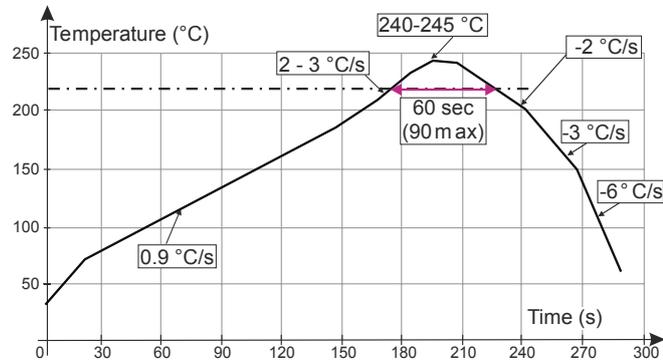


Figure 23. Tape and reel outline



### 4.3 Solder reflow

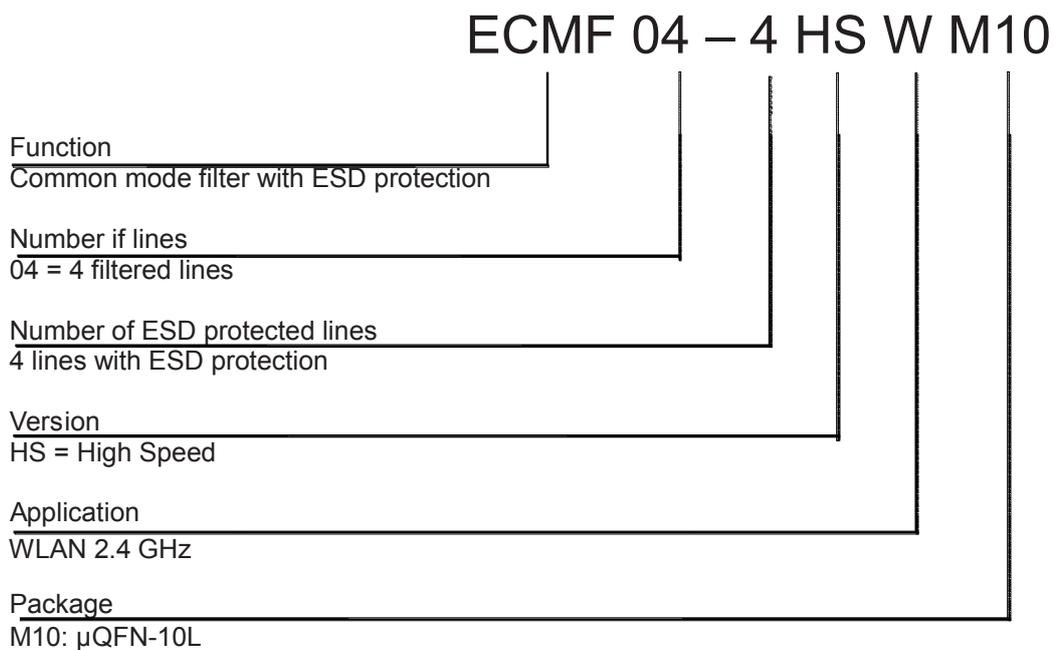
Figure 24. ST ECOPACK® recommended soldering reflow profile for PCB mounting



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 25. Ordering information scheme



Order code	Marking	Package	Weight	Base qty.	Delivery mode
ECMF04-4HSWM10	KW <sup>(1)</sup>	$\mu$ QFN-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
10-Jun-2014	1	Initial release.
08-Jan-2018	2	Updated Table 1.
04-Jun-2021	3	Updated <i>Figure 8</i> and <i>Figure 9</i> . Added <i>Figure 10</i> , <i>Figure 11</i> and <i>Figure 15</i> .
27-Jan-2025	4	Removed TDR figure, and removed PCB recommendation figures.
25-Feb-2025	5	Updated <a href="#">Section Functional schematic</a> .

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