

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

Datasheet - production data

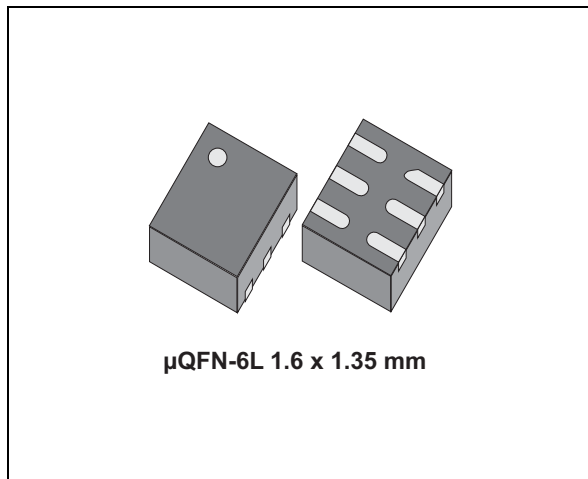
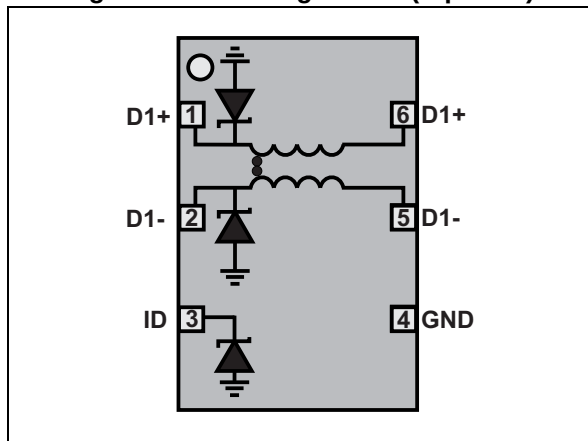


Figure 1. Pin configuration (top view)



### Features

- Provides -20 dB attenuation at 700 MHz in LTE bands
- High common mode attenuation:
  - -25 dB at 800 MHz
  - -10 dB at 2GHz
- 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
- Notebook, laptop
- Portable devices
- PND

### Description

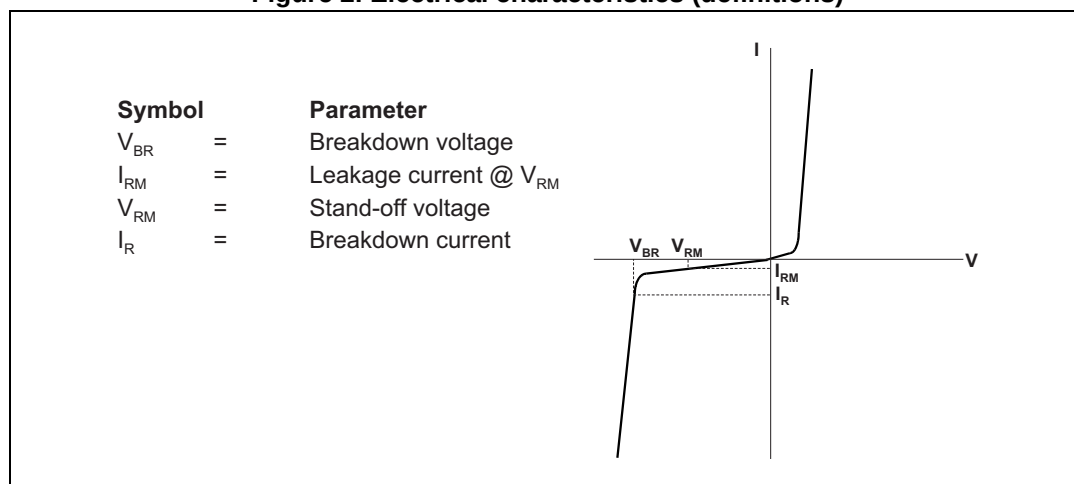
This device is a highly integrated common mode filter designed to suppress EMI/RFI common mode noise on high speed differential serial buses and complies with the MHL standard. The device can protect and filter a single differential lane.

# 1 Characteristics

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

| 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   | °C   |
| $T_j$     | Maximum junction temperature |                                    | 125          | °C   |
| $T_{stg}$ | Storage temperature range    |                                    | - 55 to +150 | °C   |

**Figure 2. Electrical characteristics (definitions)**



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

| 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    |      | $\Omega$ |

Figure 3. Differential attenuation versus frequency ( $Z_{0\text{ diff}} = 100\ \Omega$ )

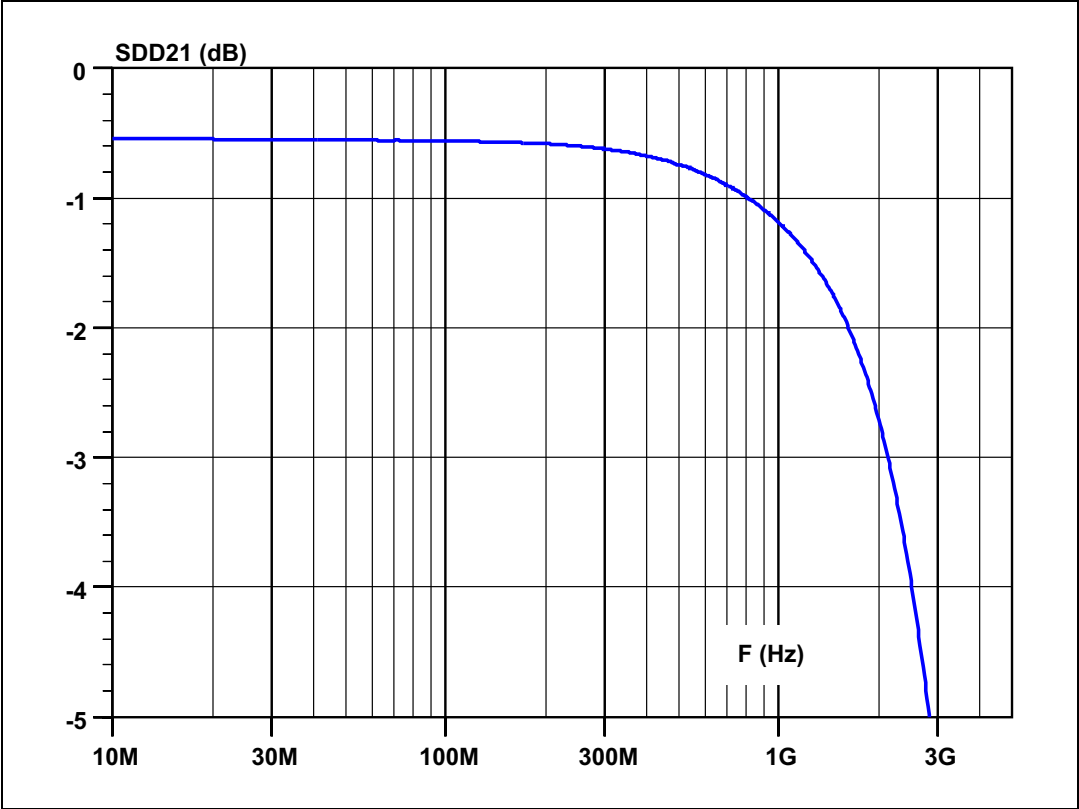


Figure 4. Common mode attenuation versus frequency ( $Z_{0\text{ com}} = 50\ \Omega$ )

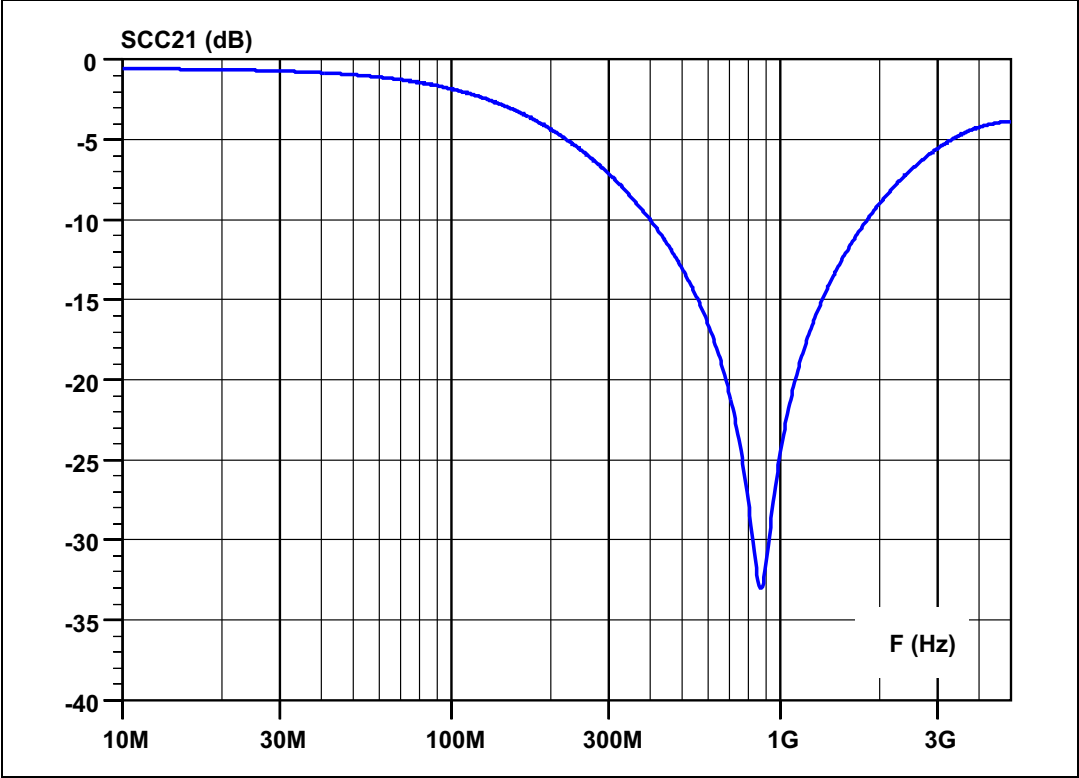


Figure 5. Return loss versus frequency ( $Z_{0\text{ com}} = 50\ \Omega$ )

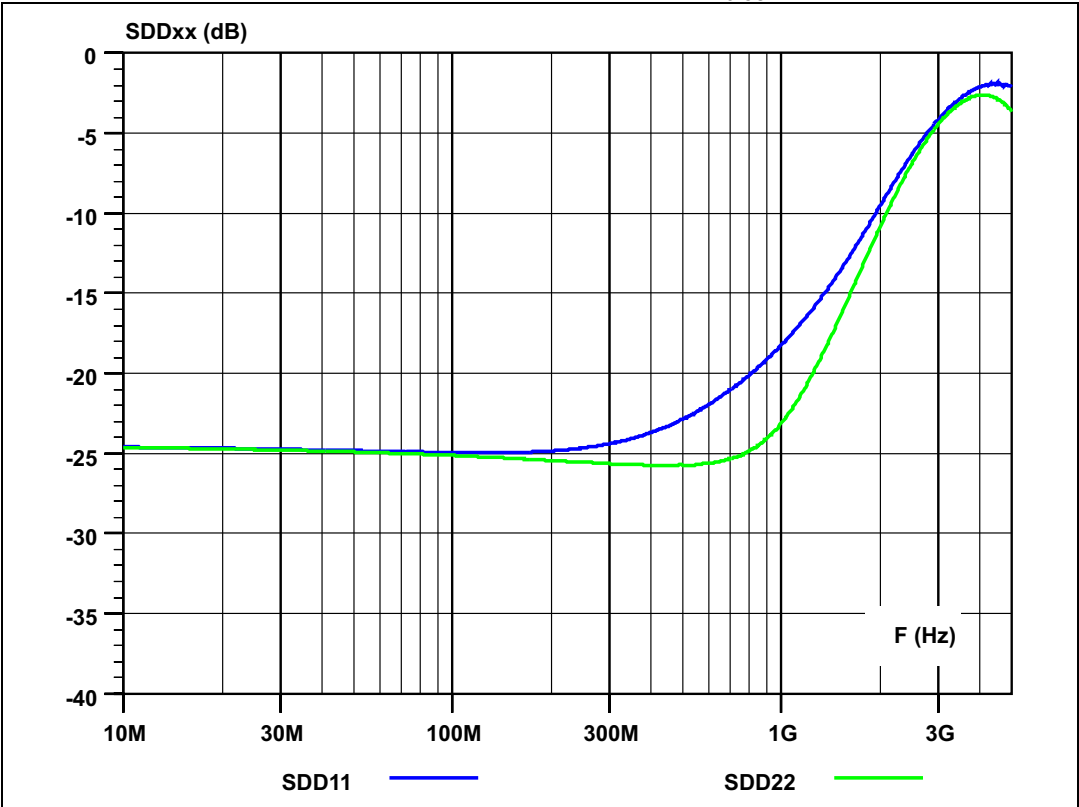


Figure 6. Differential ( $Z_{DD21}$ ) and common mode ( $Z_{CC21}$ ) impedance versus frequency

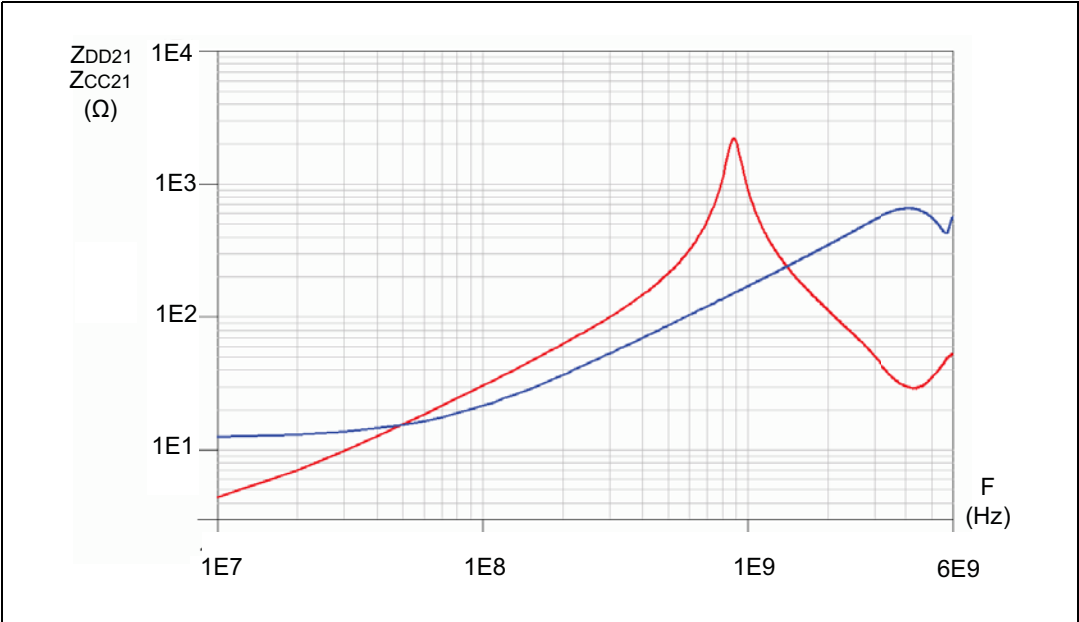


Figure 7. ESD response to IEC61000-4-2 (+8 kV contact discharge) on data lane

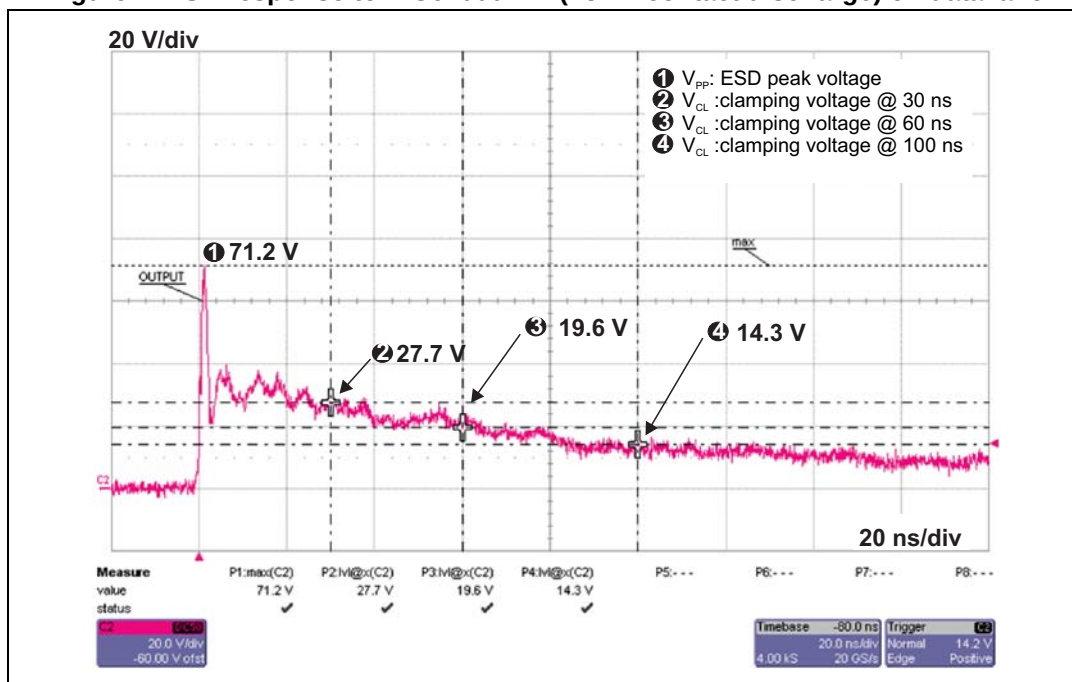


Figure 8. ESD response to IEC61000-4-2 (-8 kV contact discharge) on data lane

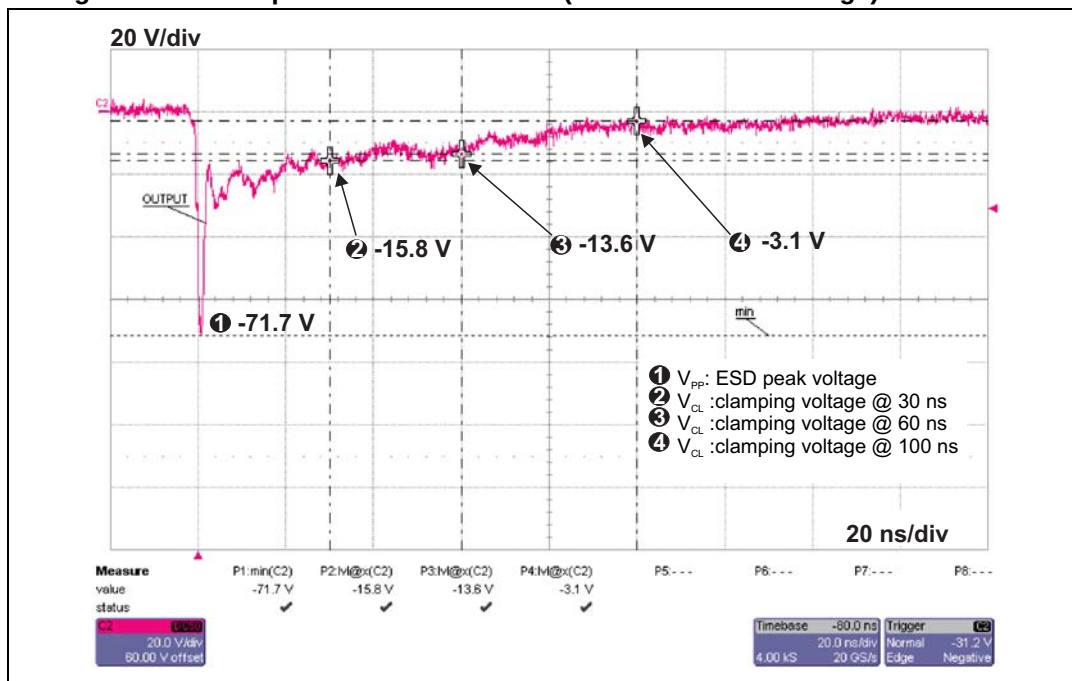


Figure 9. ESD response to IEC61000-4-2 (+8 kV contact discharge) on ID pin

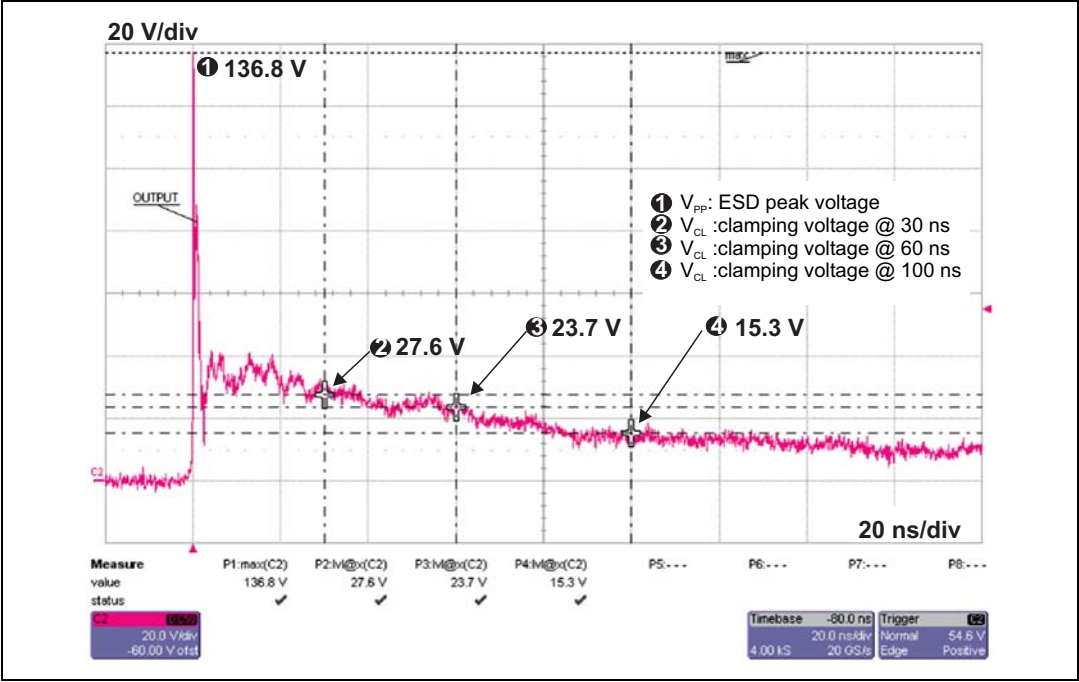


Figure 10. ESD response to IEC61000-4-2 (-8 kV contact discharge) on ID pin

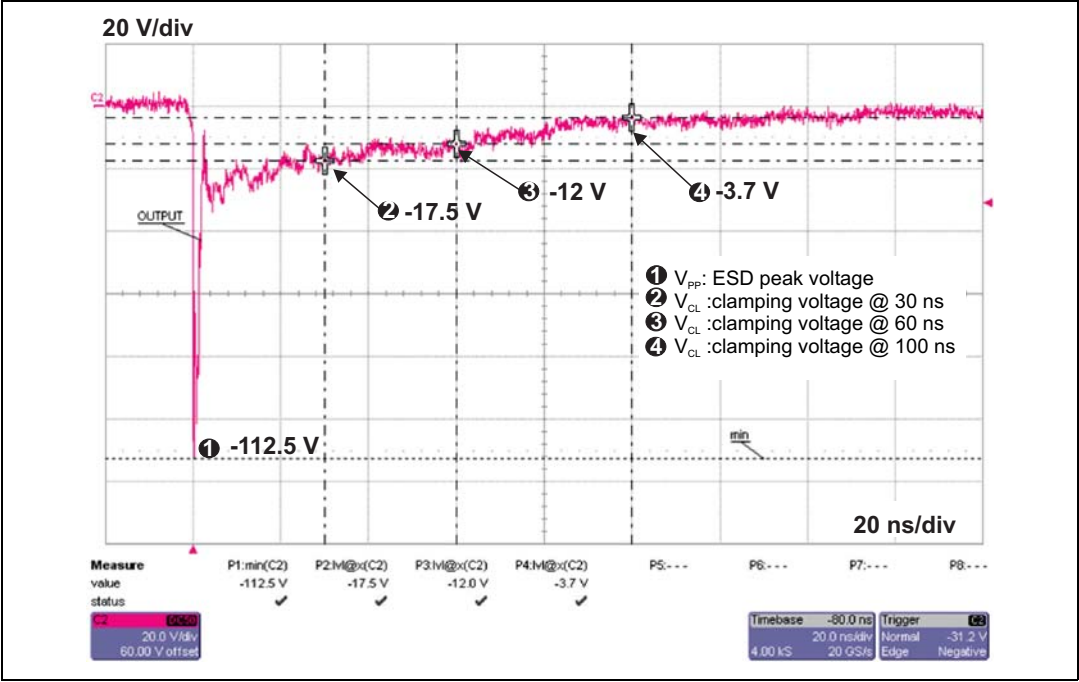


Figure 11. USB2.0 480 Mbps eye diagram without device

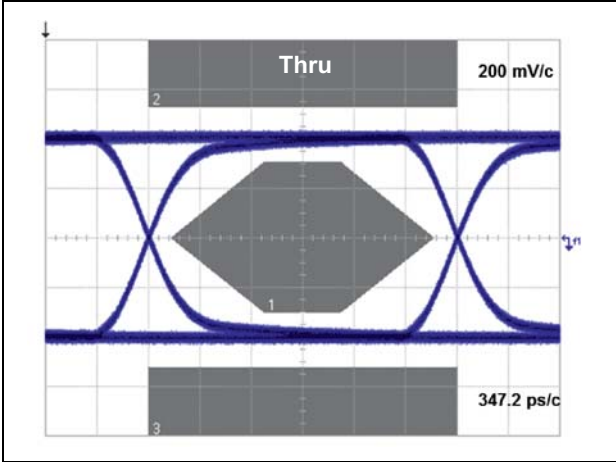


Figure 12. USB2.0 480 Mbps eye diagram with device

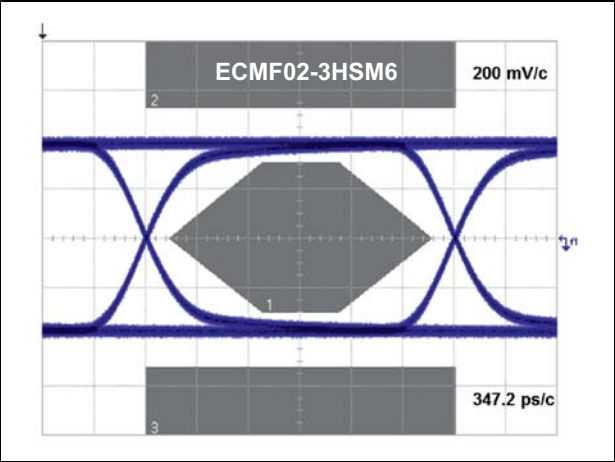


Figure 13. USB3.0 5 Gbps eye diagram without device

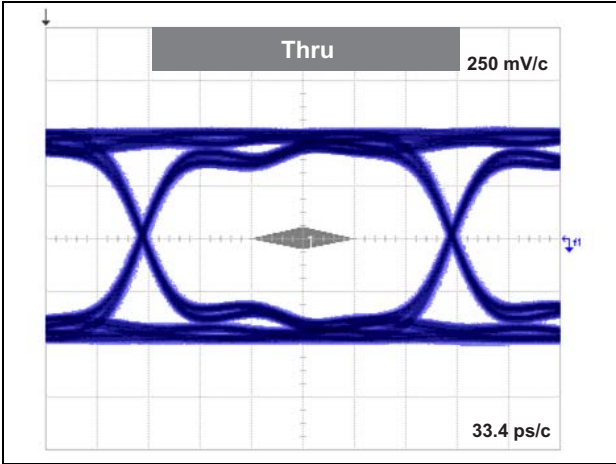


Figure 14. USB3.0 5 Gbps eye diagram with device

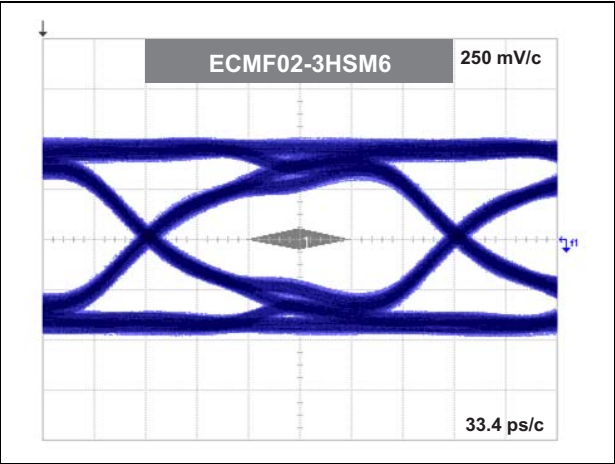


Figure 15. MHL 2.25 Mbps eye diagram without device

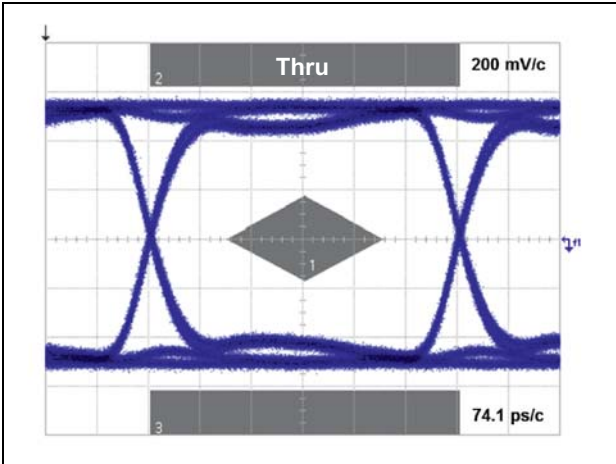


Figure 16. MHL 2.25 Mbps eye diagram with device

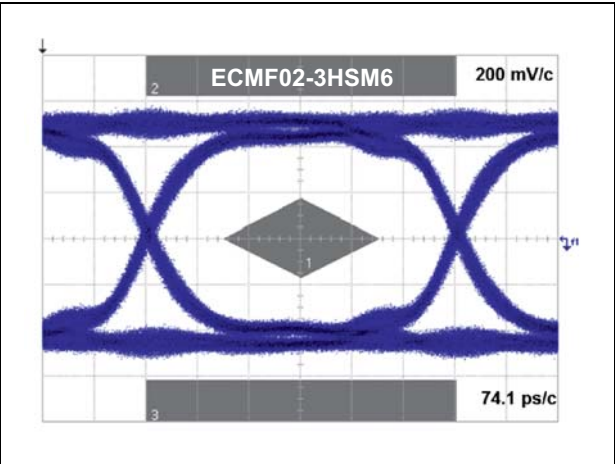
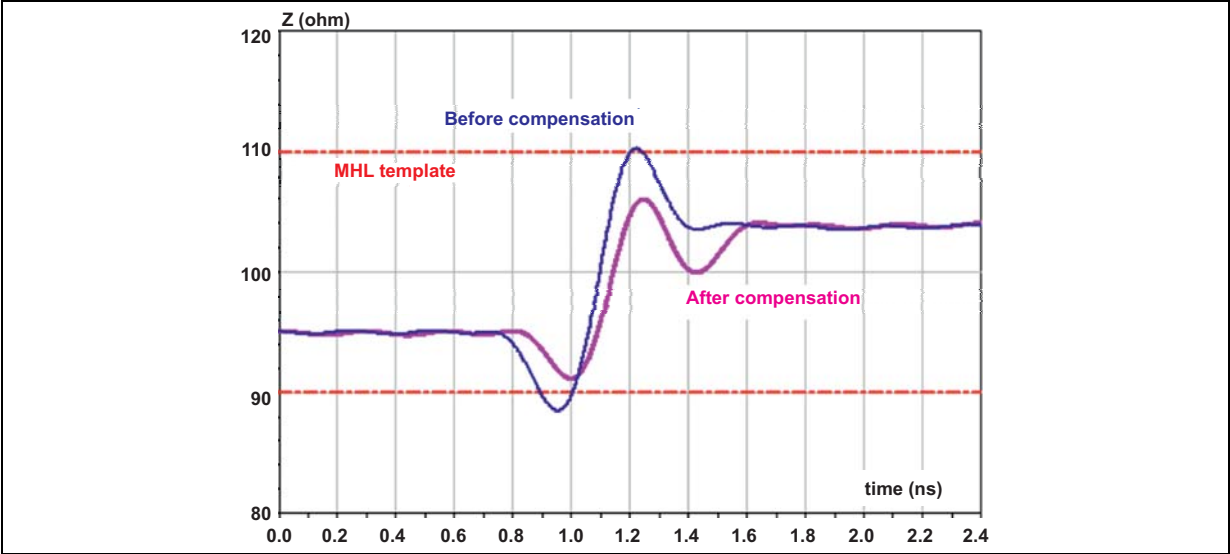
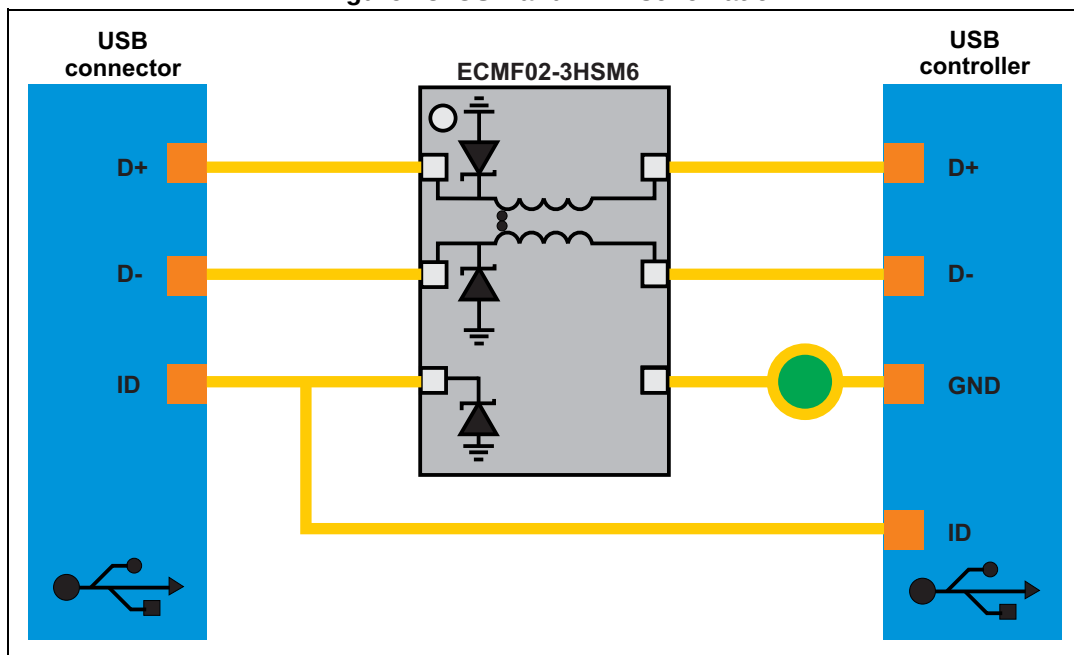


Figure 17. TDR



## 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

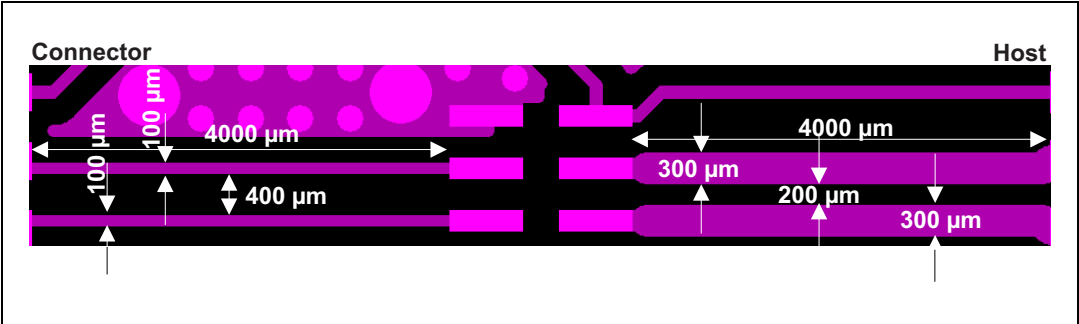
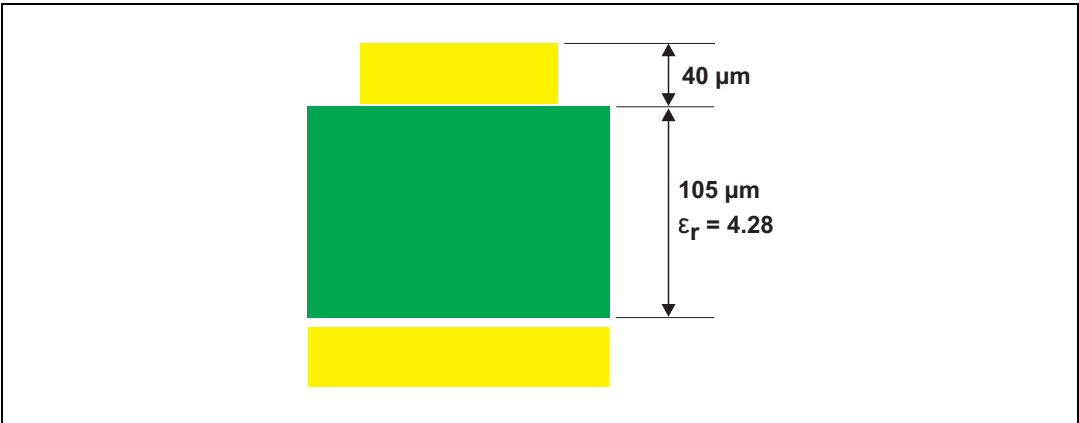


Figure 20. PCB stack dimensions

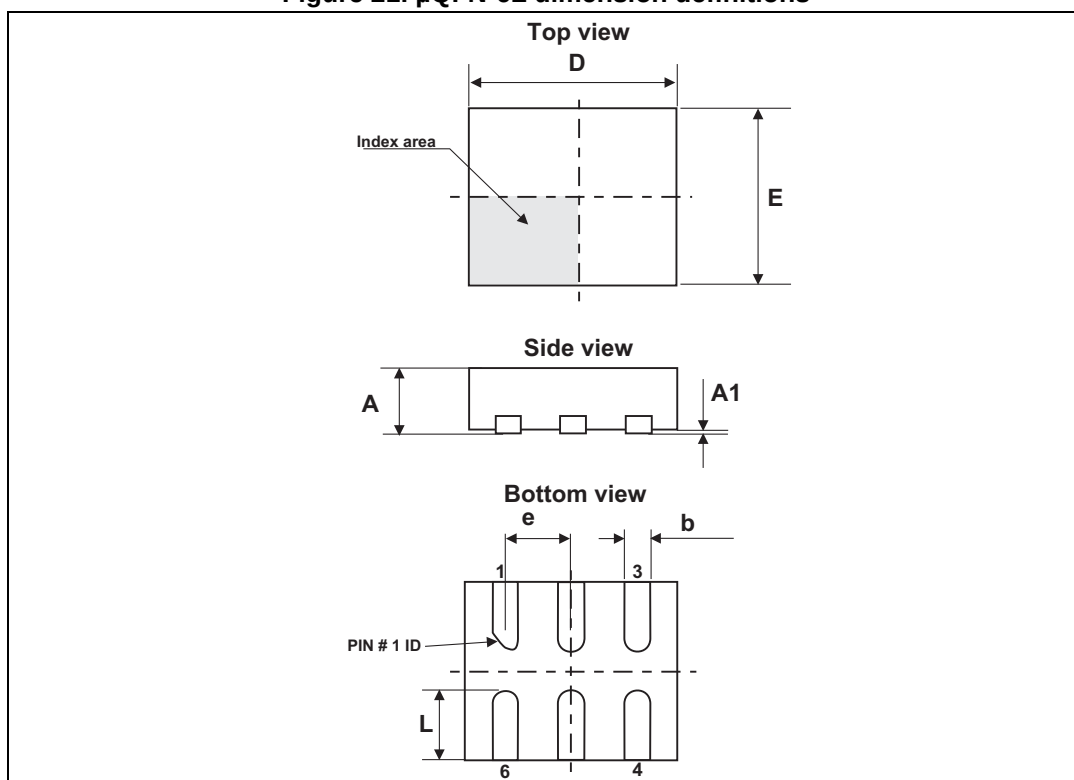


## 4 Package information

- Epoxy meets UL94, V0
- Lead-free package

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK<sup>®</sup> packages, depending on their level of environmental compliance. ECOPACK<sup>®</sup> specifications, grade definitions and product status are available at: [www.st.com](http://www.st.com). ECOPACK<sup>®</sup> is an ST trademark.

**Figure 21.  $\mu$ QFN-6L dimension definitions**



**Table 3.  $\mu$ QFN-6L dimension values**

| 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 |

Figure 22. Footprint

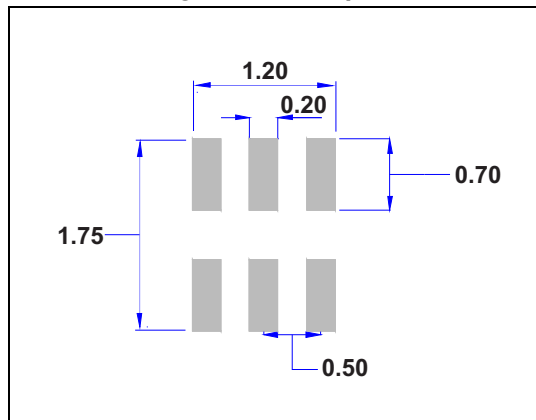
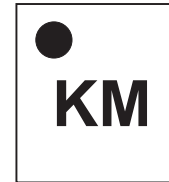
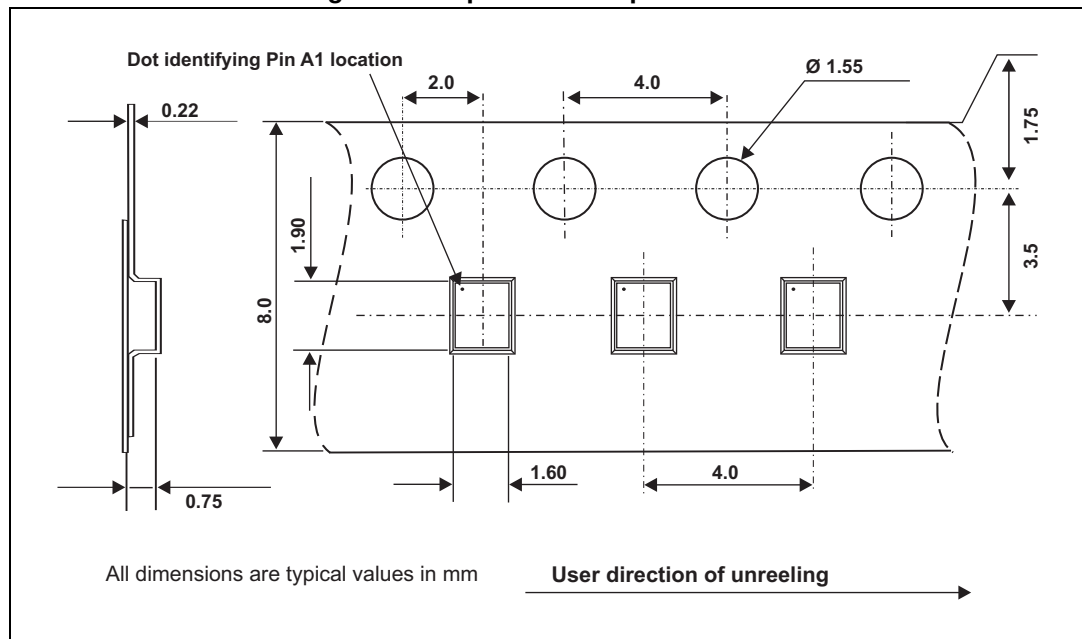


Figure 23. Marking



**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.

Figure 24. Tape and reel specifications



## 5 Ordering information

Figure 25. Ordering information scheme

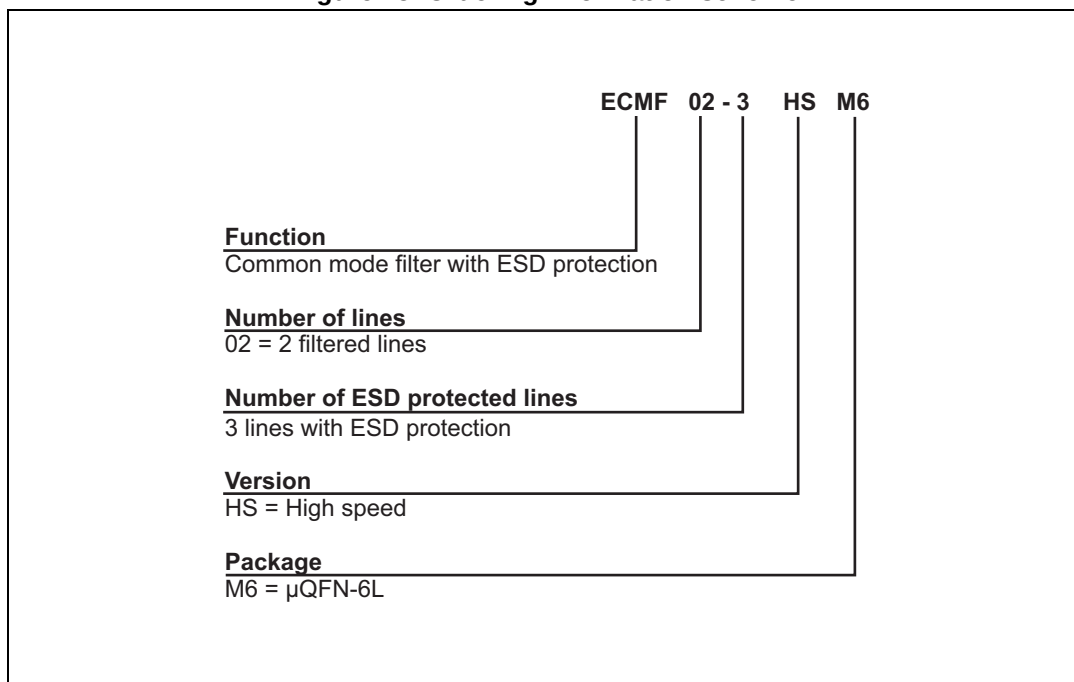


Table 4. Ordering information

| Order code   | Marking <sup>(1)</sup> | Package      | Weight  | Base qty | Delivery mode |
|--------------|------------------------|--------------|---------|----------|---------------|
| ECMF02-3HSM6 | KM                     | $\mu$ 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 <a href="#">Figure 6: Differential (ZDD21) and common mode (ZCC21) impedance versus frequency.</a> |

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