

## 4-line IPAD™, ultra-large bandwidth ESD protection

### Features

- 4-line 15 kV ESD protection
- Ultra low line capacitance (0.7 pF typ.)
- Ultra-large bandwidth
  - no influence on signal rise and fall times
  - maximized number of signal harmonics
- Flow-through layout with Type C HDMI™ connector
- Low PCB space occupation - 1.76 mm<sup>2</sup> footprint
- Very low leakage current: 0.1 µA max.
- 0.4 mm pitch WLCSP package to minimize parasitic inductances
- RoHS compliant

### Complies with the standards:

- IEC 61000-4-2 Level 4
  - ± 15 kV (air discharge)
  - ± 8 kV (contact discharge)

### Application

- Mobile phones
- HDMI ports at 1.65 Gb/s and up to 3.2 Gb/s
- USB 2.0 ports up to 480 Mb/s (Hi-Speed)
- Video line protection

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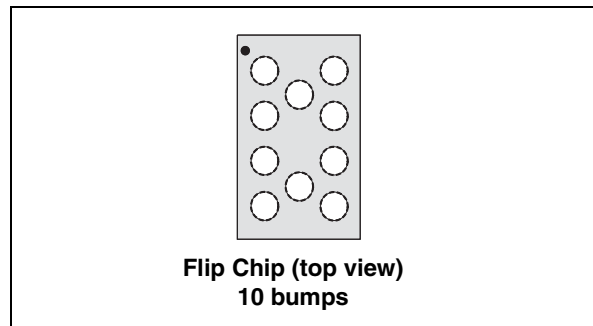
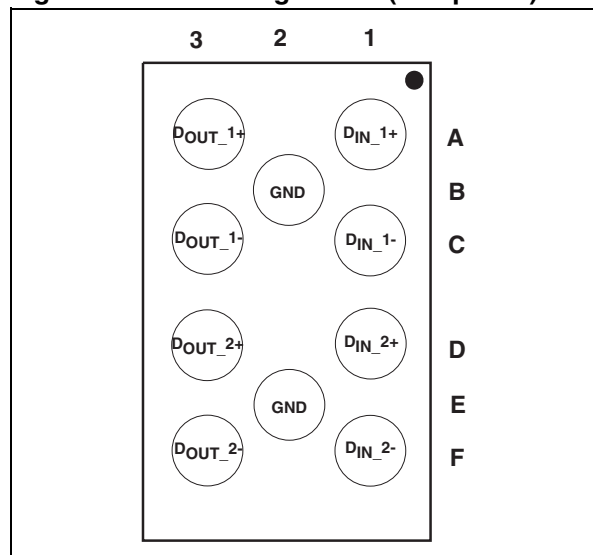


Figure 1. Pin configuration (bump side)



### Description

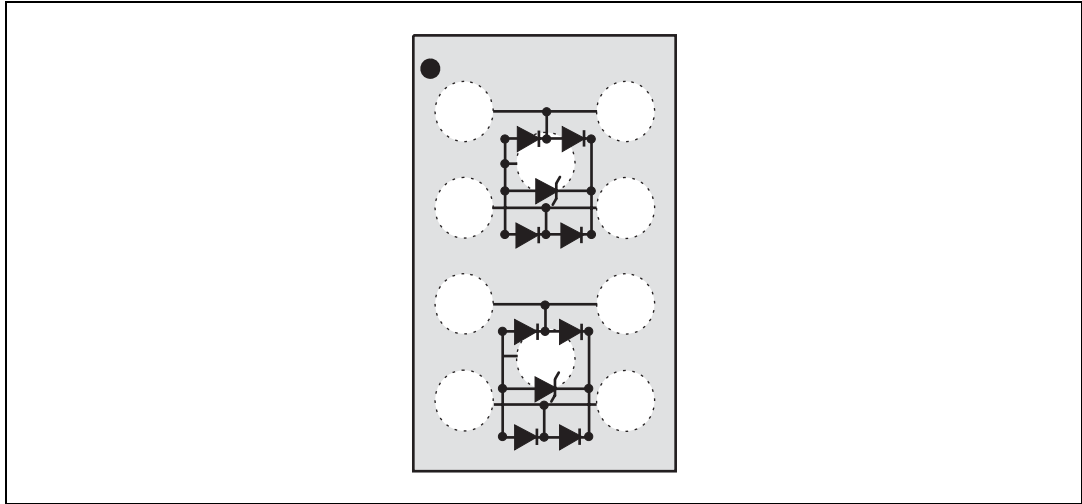
The HDMIULC6-4F3 is a monolithic, application specific discrete device dedicated to ESD protection of the HDMI connection. It also offers the same high level of protection for IEEE 1394a and IEEE 1394b/c, USB 2.0, Ethernet links, and video lines.

Its ultra high cutoff frequency (7 GHz) secures a high level of signal integrity. The device topology provides this integrity without compromising the complete protection of ICs against the most stringent ESD strikes.

# 1 Characteristics

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**Figure 2. Internal circuit schematic (top view)**

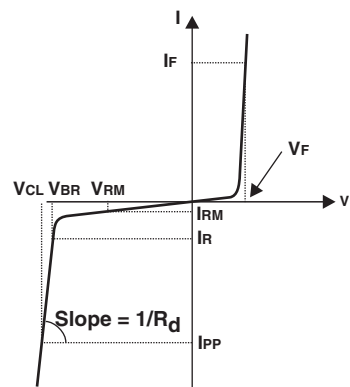


**Table 1. Absolute maximum ratings ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ )**

Symbol	Parameter	Value	Unit
$V_{PP}$	ESD discharge IEC 61000-4-2, level 4		
	Air discharge	$\pm 15$	kV
	Contact discharge	$\pm 15$	
$P_{PP}$	Peak pulse power dissipation (8/20 $\mu\text{s}$ )	70	W
$T_j$	Maximum junction temperature	125	$^{\circ}\text{C}$
$T_{op}$	Operating ambient temperature range	-30 to + 85	$^{\circ}\text{C}$
$T_{stg}$	Storage temperature range	-55 to + 150	$^{\circ}\text{C}$

**Table 2. Electrical characteristics, parameters**

Symbol	Parameters
$V_{BR}$	Breakdown voltage
$I_{RM}$	Leakage current @ $V_{RM}$
$V_{RM}$	Stand-off voltage
$V_{CL}$	Clamping voltage
$R_d$	Dynamic impedance
$I_{PP}$	Peak pulse current
$C_{line}$	Input capacitance per line
$C_{I/O - I/O}$	Capacitance between I/O
$C_{I/O - GND}$	Capacitance between I/O and GND



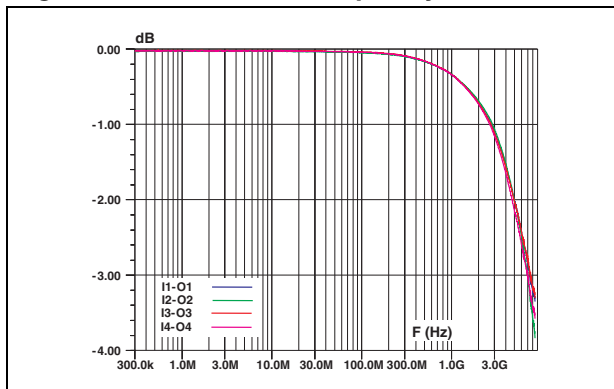
**Table 3. Electrical characteristics, values ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ )**

Symbol	Test condition	Min	Typ	Max	Unit
$V_{BR}$	$I_R = 1\text{ mA}$	6		9	V
$I_{RM}$	$V_{RM} = 3\text{ V}$		3	100	nA
$C_{I/O-GND}^{(1)}$	$V_{line} = 0\text{ V}, V_{osc} = 30\text{ mV}, F = 1\text{ MHz}$		1.3		pF
	$V_{line} = 0\text{ V}, V_{osc} = 30\text{ mV}, F = 825\text{ MHz}$		0.7	0.9	pF
$\Delta C_{I/O-GND}^{(1)}$	$V_{line} = 0\text{ V}, V_{osc} = 30\text{ mV}, F = 1\text{ MHz}$ between two lines of the same lane		0.06		pF
$C_{I/O-I/O}$	$V_{line} = 0\text{ V}, V_{osc} = 30\text{ mV}, F = 1\text{ MHz}$		0.9		pF
	$V_{line} = 0\text{ V}, V_{osc} = 30\text{ mV}, F = 825\text{ MHz}$		0.55	0.65	pF
$\Delta C_{I/O-I/O}$	$V_{line} = 0\text{ V}, V_{osc} = 30\text{ mV}, F = 1\text{ MHz}$		0.05		pF
BW	Bandwidth at -3 dB		7		GHz

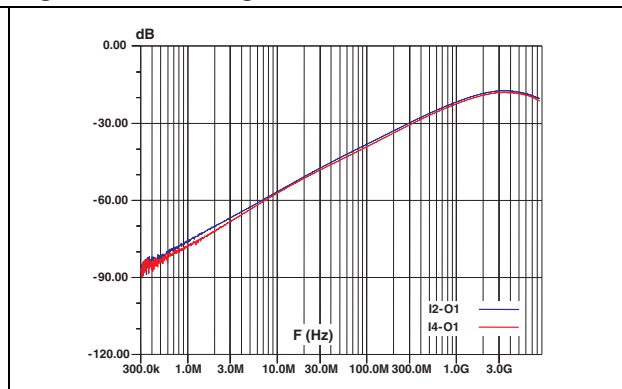
1.  $C_{I/O-GND}$  values are given per line and relative to one GND.

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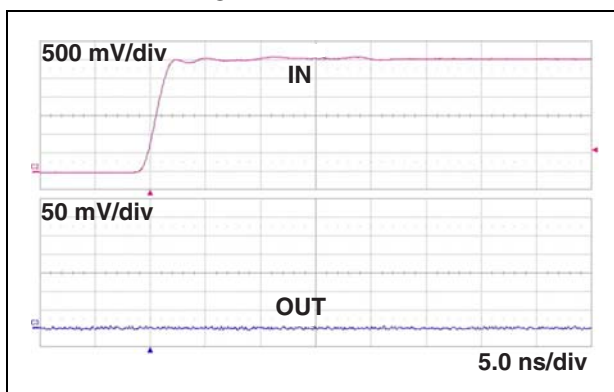
**Figure 3. S21 versus frequency**



**Figure 4. Analog crosstalk measurements**



**Figure 5. Digital crosstalk measurements I1 - O2**



**Figure 6. Digital crosstalk measurements I2 - O3**

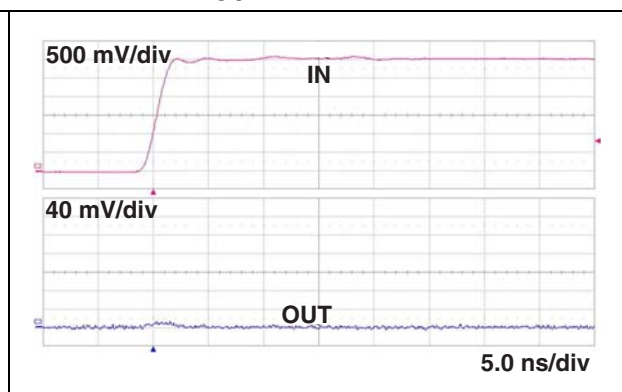


Figure 7. Step response attenuation I1 - O1

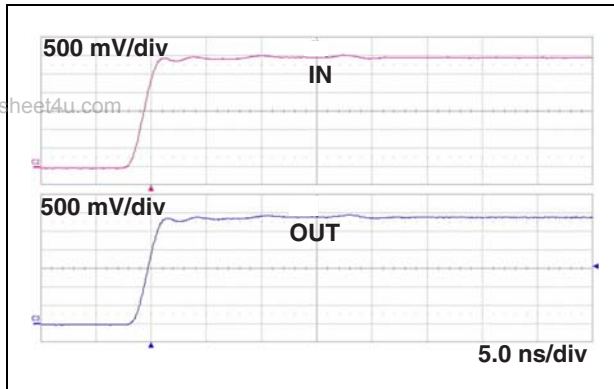


Figure 8. Step response attenuation I2 - O2

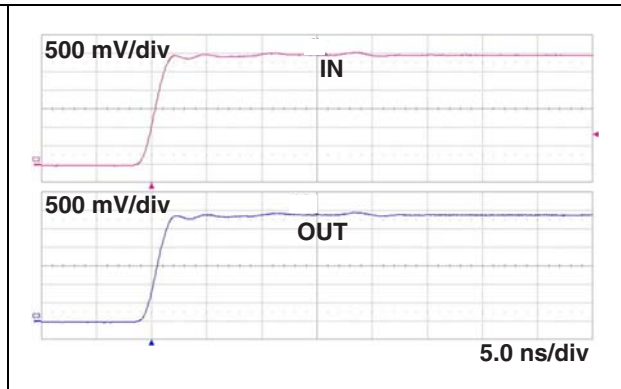


Figure 9. ESD response to IEC 61000-4-2 (+8 kV contact discharge) on I1 - O1

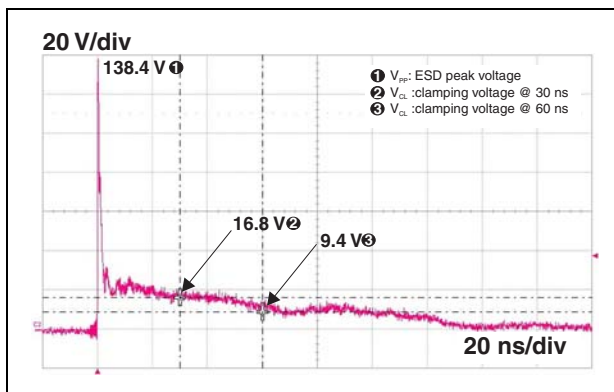


Figure 10. EESD response to IEC 61000-4-2 (-8 kV contact discharge) on I1 - O1

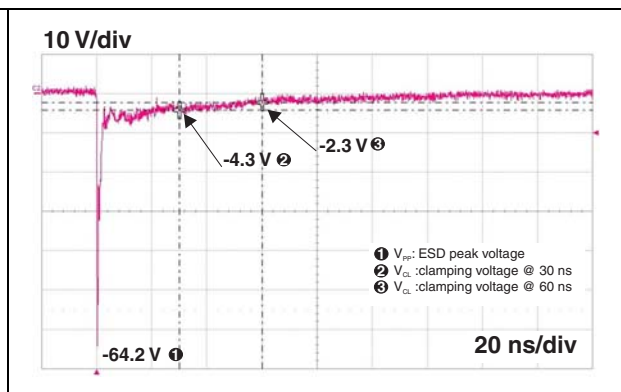


Figure 11. ESD response to IEC 61000-4-2 (+8 kV contact discharge) on I2 - O2

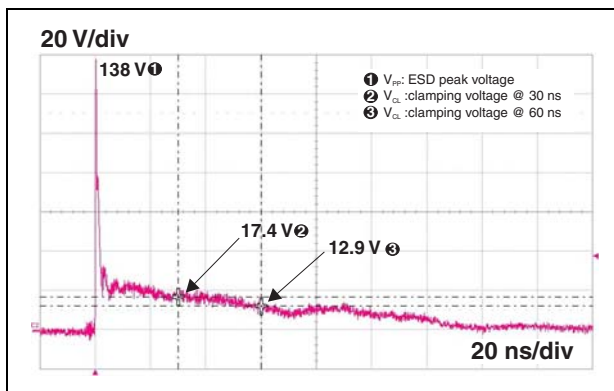


Figure 12. ESD response to IEC 61000-4-2 (-8 kV contact discharge) on I2 - O2

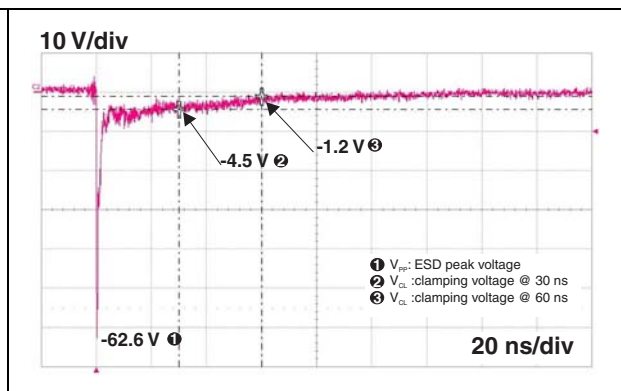


Figure 13. ESD response to IEC 61000-4-2 (+8 kV contact discharge) on I3 - O3

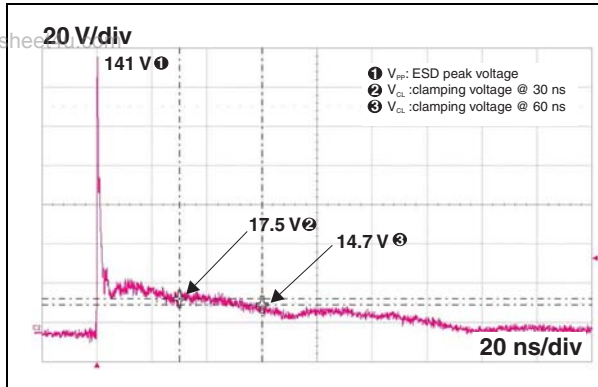


Figure 14. ESD response to IEC 61000-4-2 (-8 kV contact discharge) on I3 - O3

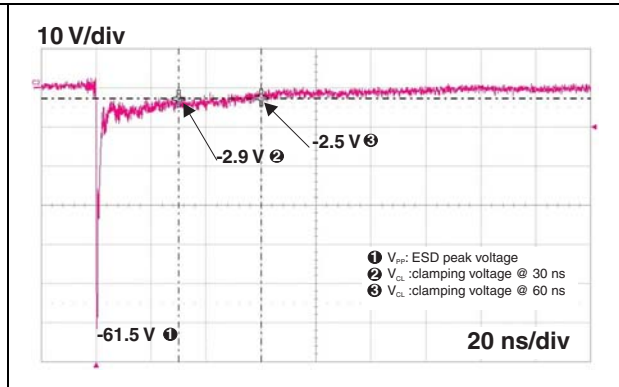
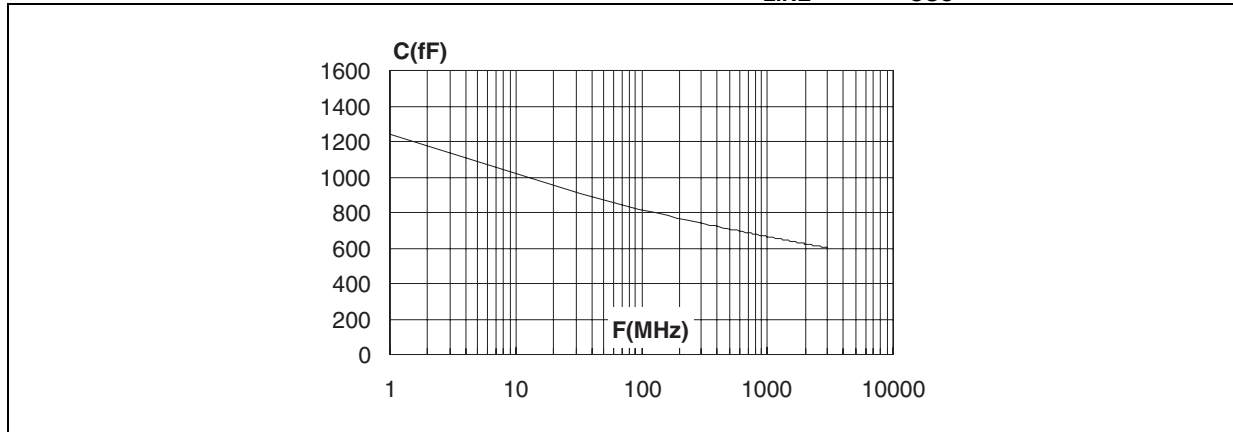


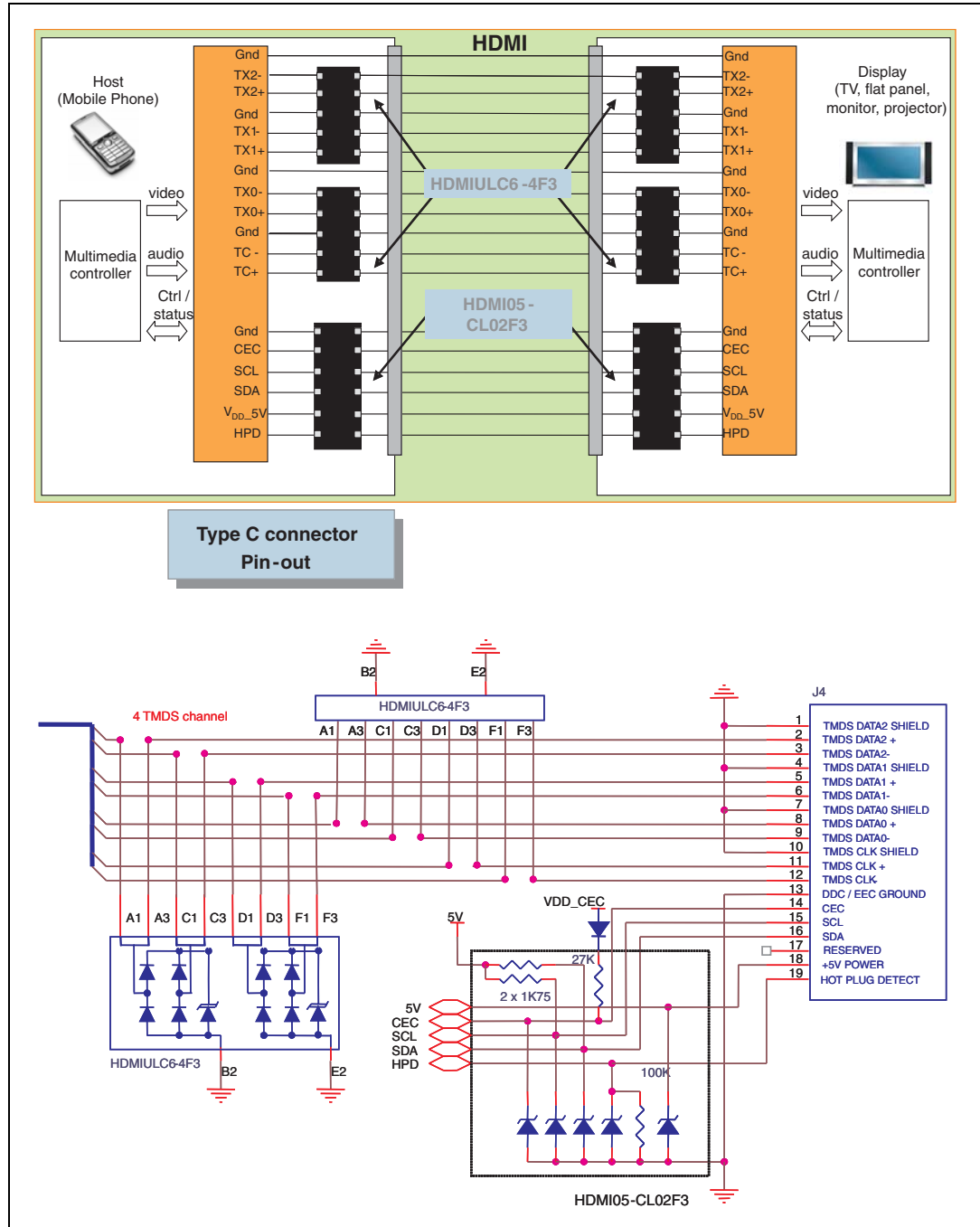
Figure 15. Line to ground capacitance versus frequency,  $V_{LINE} = 0$  V,  $V_{OSC} = 30$  mV



## 2 Typical application schematic

Figure 16. Implementation with HDMI type C connector

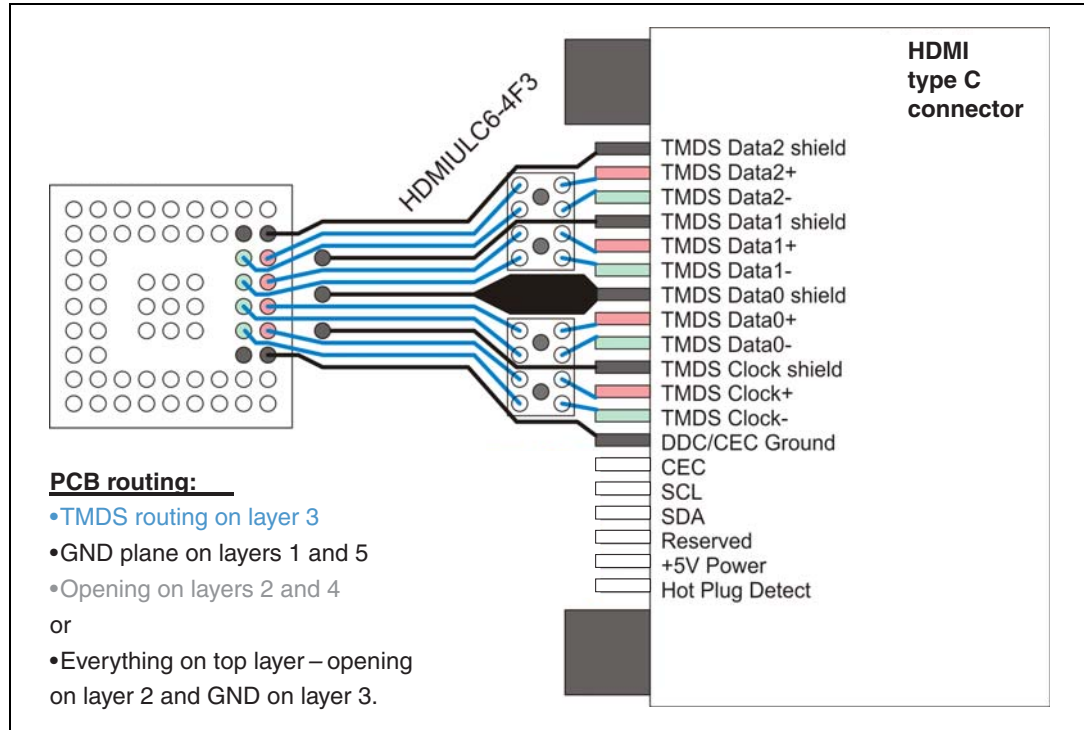
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### 3 Layout recommendations

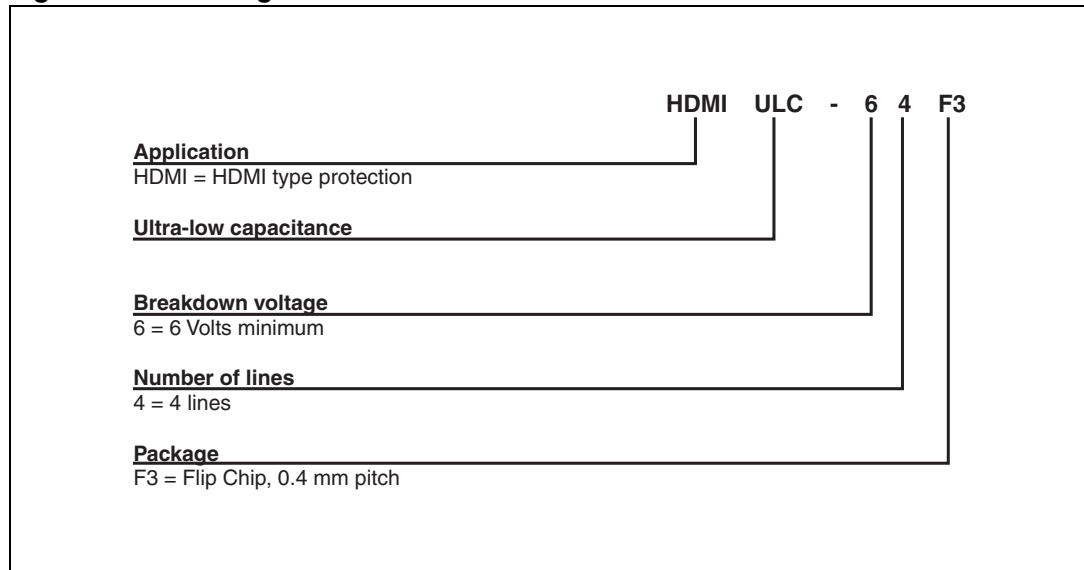
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Figure 17. Layout recommendations



### 4 Ordering information scheme

Figure 18. Ordering information scheme



# 5 Package information

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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.

Figure 19. Flip Chip dimensions

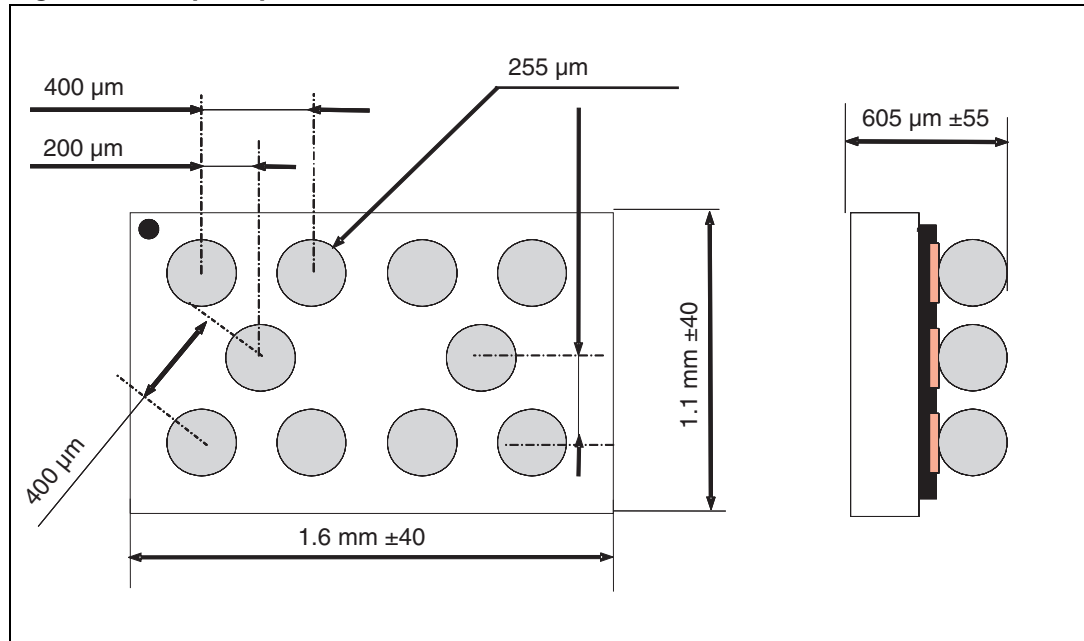


Figure 20. Footprint recommendations

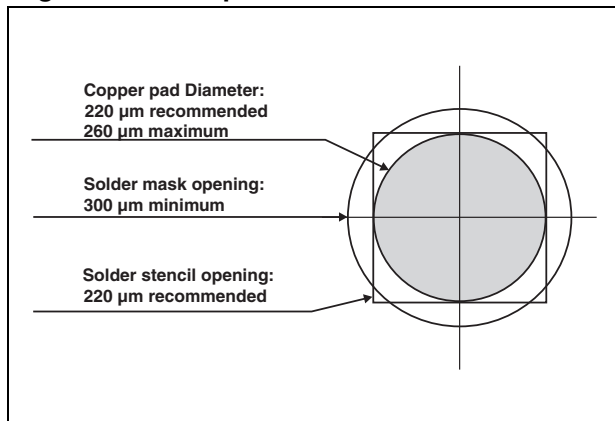


Figure 21. Marking

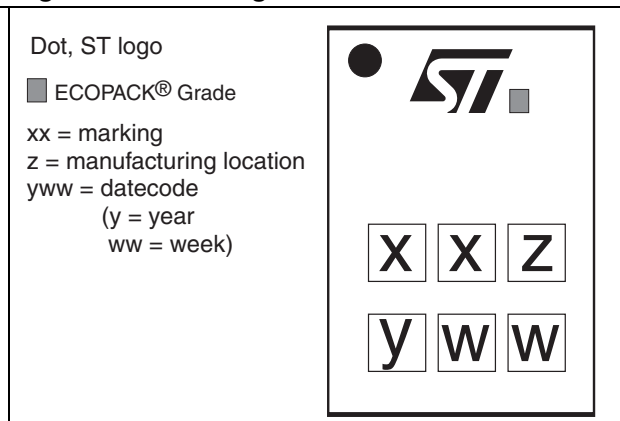
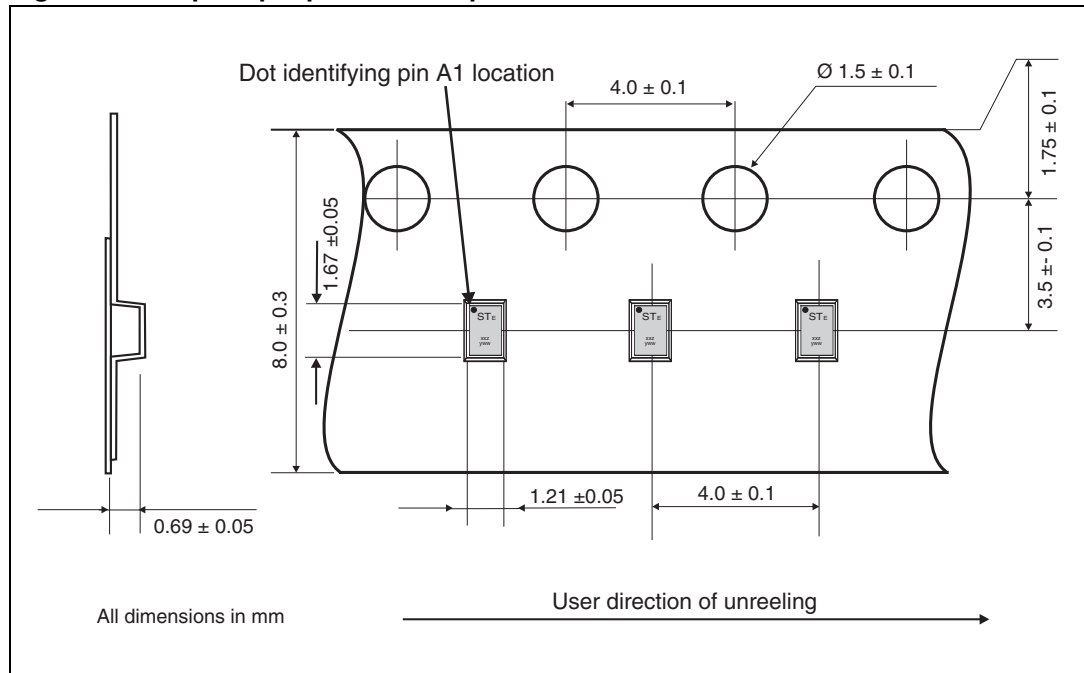




Figure 22. Flip Chip tape and reel specification



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## 6 Ordering information

Table 4. Ordering information

Order code	Marking	Package	Weight	Base qty	Delivery mode
HDMIULC6-4F3	EP	Flip Chip	2.6 mg	5000	Tape and reel (7")

## 7 Revision history

Table 5. Document revision history

Date	Revision	Changes
24-Mar-2009	1	First issue.

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