

# DATA SHEET

## **IP6000 series** USB Upstream port filter with ESD protection

Preliminary specification  
Supersedes data of July 1999  
File under Advanced Ceramics and Modules, ACM4

1999 Aug 09

# USB Upstream port filter with ESD protection

## IP6000 series

### FEATURES

- USB cable line termination
- EMI filtering
- ESD protection for peripheral devices
- Compatible with Philips IP6001 Downstream port filter and IP6002 Quad hub port filter
- Small size TSSOP package.

### APPLICATIONS

Filtering, termination and ESD protection of PC peripherals/devices such as:

- Keyboards
- Mouse
- Scanners
- Printers
- Modems
- Digital camcorders.

### DESCRIPTION

The Philips IP6000 series of Application Specific Integrated Products (ASIPs) is a family of upstream port filters for Universal Serial Bus (USB) peripheral applications. The IP6000 provides line termination and ESD protection of sensitive components within the peripheral along with EMI/RFI filtering of undesired high frequency signals in low or full speed USB applications. Low speed/full speed operation is selected by the host computer by the connection of the resistor R2 between  $V_{Term}$  (typically 3.3 V) and either the D+ or D- line as shown in Figures 2 and 3.

The IP6000 is fabricated using thin film-on-silicon technology and integrates three resistors, two capacitors and two diodes in a single, small size 8-pin TSSOP package.

Resistance and capacitance tracking between inputs using integrated thin film-on-silicon technology is far superior in comparison to RC terminations which use thick film-on-ceramic technique.

The IP6000 series of devices also help maintain signal integrity on digital transmission lines by reducing digital undershoot conditions.

### QUICK REFERENCE DATA

DESCRIPTION	VALUE
<b>Electrical characteristics at 25 °C</b>	
Resistance	±10%; see Table 1
Capacitance	±20%; see Table 1
Operating voltage, $V_{CC}$	0 to +5.5 V
ESD protection, In-Application (between pins 2 or 7 and ground)	IEC 61000-4-2, level 4 (8 kV contact; 15 kV air discharge)
Power rating per channel	100 mW, package limited
<b>Package ratings</b>	
Maximum dissipation	0.30 W
Operating temperature	-25 to +85 °C
Storage temperature	-60 to +150 °C

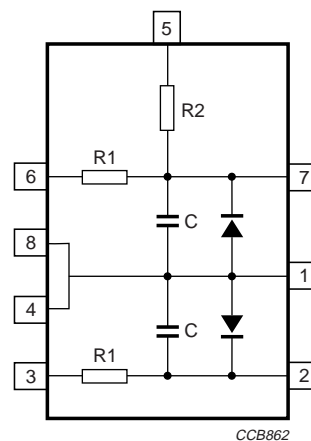


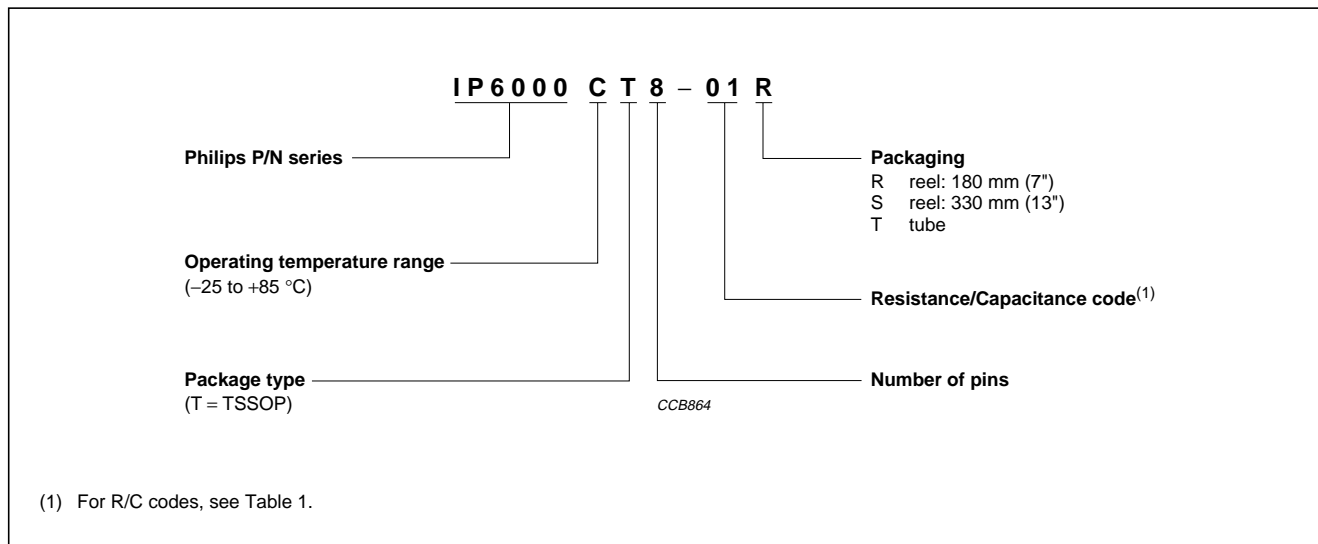
Fig.1 Functional diagram.

# USB Upstream port filter with ESD protection

IP6000 series

## ORDERING INFORMATION

### Ordering code



**Table 1** Standard R/C values, ordering information and packaging quantities

R/C CODES	RESISTANCE VALUE		CAPACITANCE VALUE (pF)	CATALOGUE NUMBER IP6000CT8-...		
	R1 (Ω)	R2 (kΩ)		7" REEL 1 000 units <sup>(1)</sup>	13" REEL 4 000 units <sup>(1)</sup>	TUBE 100 units
-01	33	1.5	47	01R	01S	01T
-02	27	1.5	47	02R	02S	02T
-03	24	1.5	47	03R	03S	03T
-04	22	1.5	47	04R	04S	04T

**Note**

- Higher quantities per reel are available on request.

# USB Upstream port filter with ESD protection

## IP6000 series

### APPLICATION INFORMATION

The USB is a "plug and play" communication architecture that is designed to support the simultaneous connection of multiple peripherals to a host computer. The USB cable consists of only four wires; two signal lines, D+ and D- along with the power supply lines  $V_{bus}$  and ground.

Two modes of operation are possible: a full speed bit rate of 12 Mb/sec and a low speed mode of 1.5 Mb/sec, with the speed automatically selected by the host computer based upon whether the D+ or D- pin is pulled to a logic high through a 1.5 kΩ resistor. Pull-down 15 kΩ resistors connected to ground at each USB host connector are also used to sense the absence of a peripheral connected to that particular connector. Figs 2 and 3 show the connections at the host end and at the peripheral end for both full speed and low speed modes.

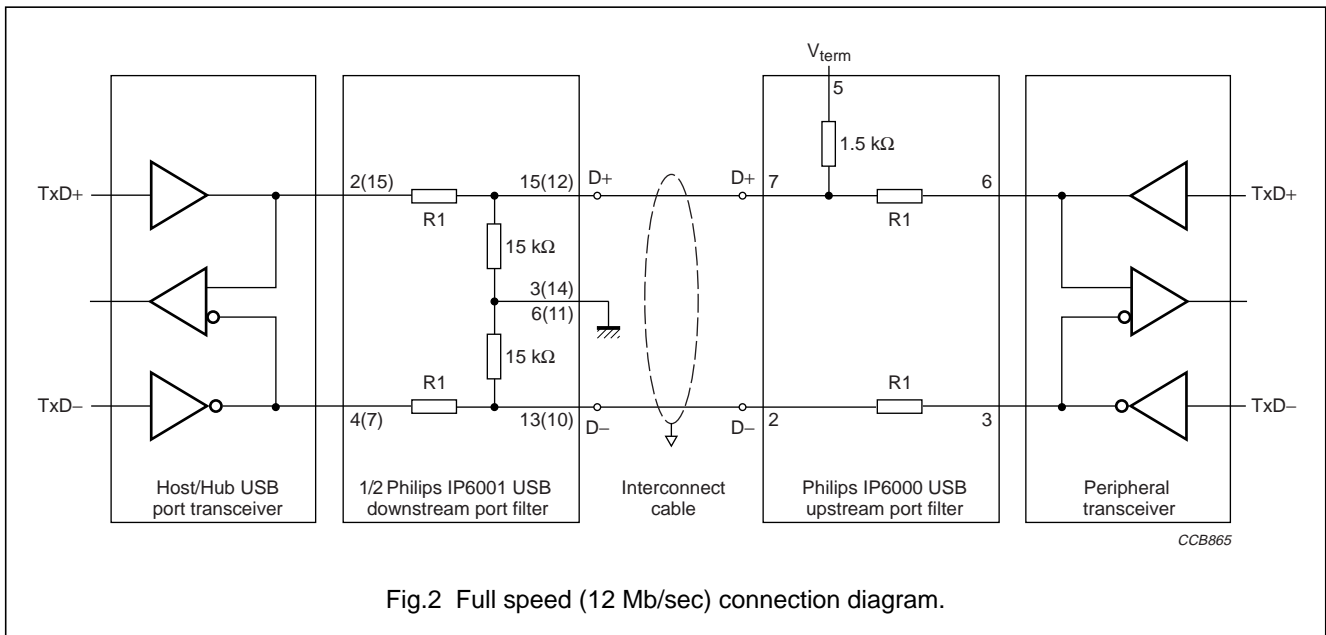


Fig.2 Full speed (12 Mb/sec) connection diagram.

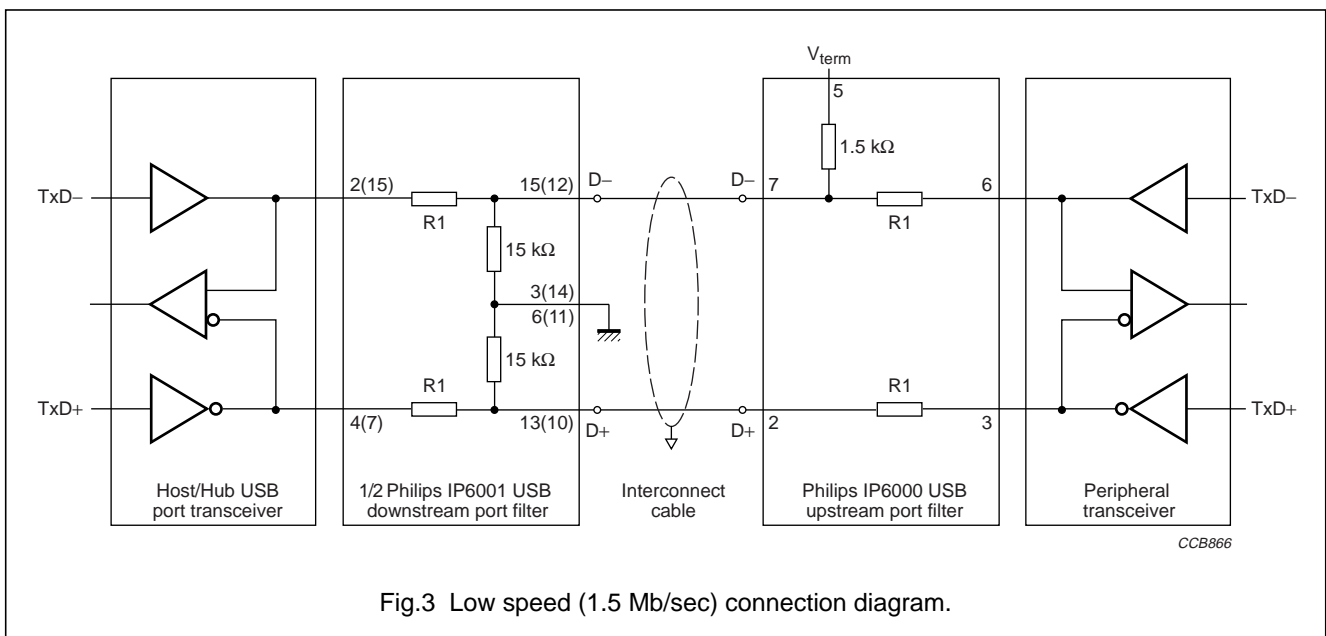


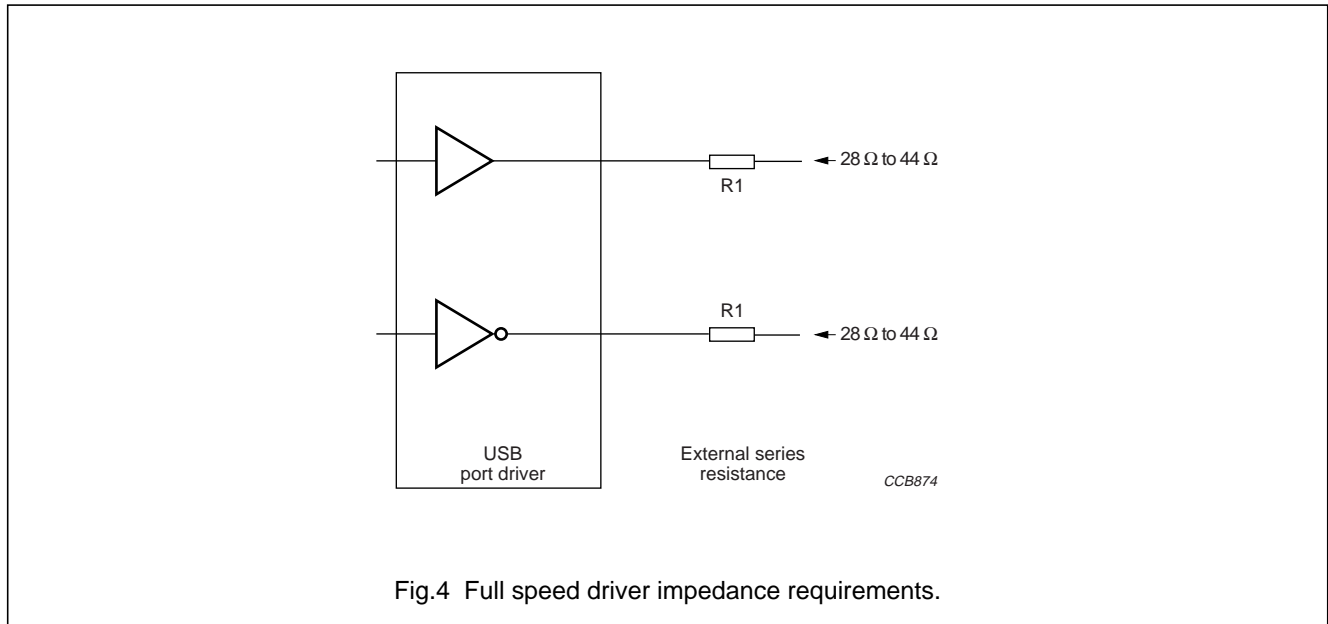
Fig.3 Low speed (1.5 Mb/sec) connection diagram.

# USB Upstream port filter with ESD protection

## IP6000 series

### Series resistance value

The USB specification requires that for full speed operation the driver impedance must be between  $28\ \Omega$  and  $44\ \Omega$ . Since most CMOS drivers available have output impedance significantly less than this resistance, an external resistance is to be added to the driver output to result in an overall impedance of  $28\ \Omega$  to  $44\ \Omega$ .



Manufacturers of USB interface devices recommend different values of external series resistance depending upon the characteristics of their particular driver. Because of this, Philips offers a range of resistance values chosen to provide the USB driver impedance requirements as shown in Fig.4. For a listing of values, see Table 1.

### EMI capacitance filtering

To reduce the emission of high frequency signals, capacitors have been added to the port filters; see Fig.1. These capacitors serve to filter unwanted clock harmonics and spurious high frequency signals which could cause problems in meeting EMI specifications imposed by various regulatory agencies. Refer to Table 1 for the value of the shunt capacitors.

### ESD protection

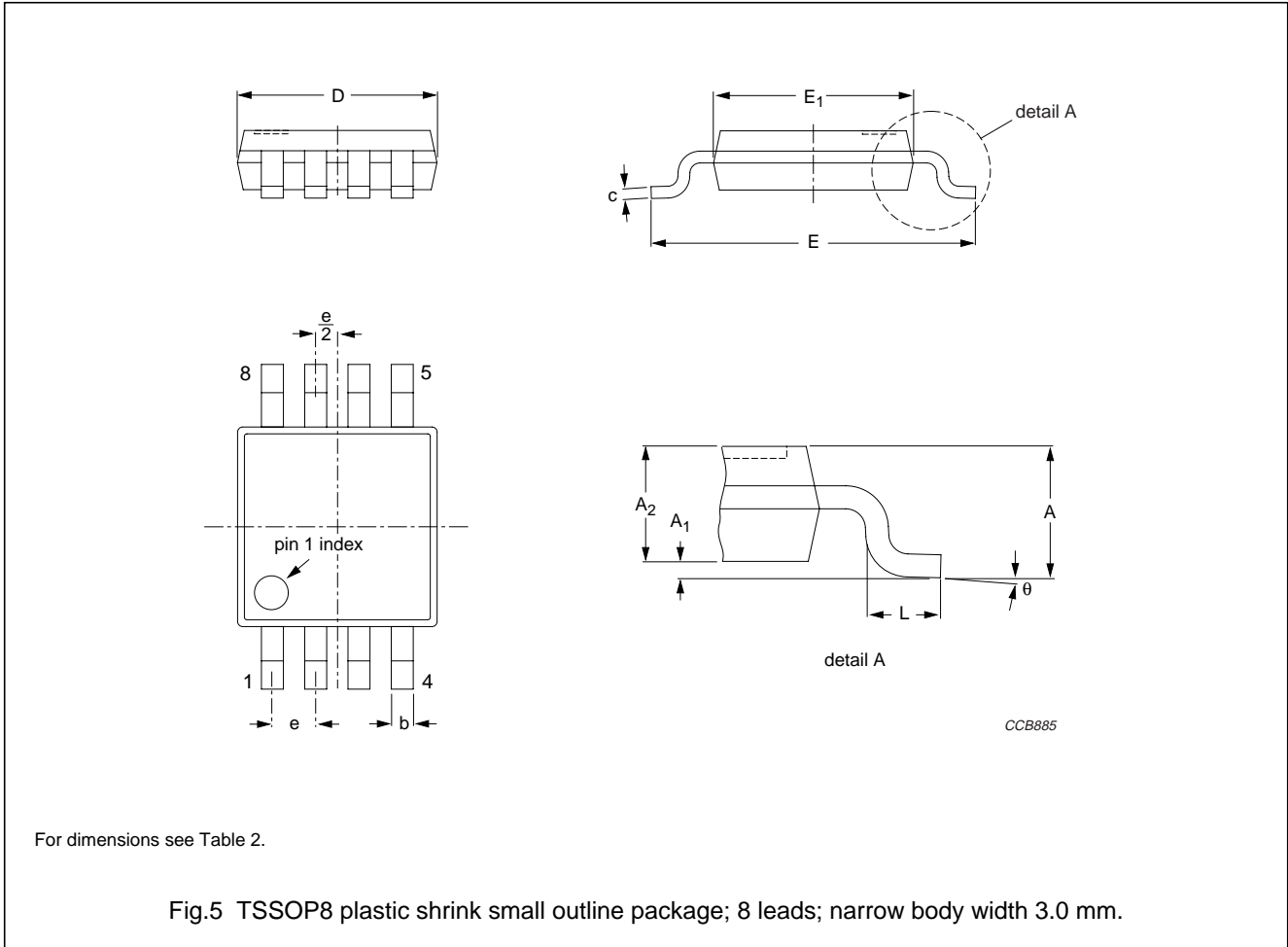
Philips line of USB port filters can provide system protection from Electrostatic Discharge (ESD) on the D+ and D- external pins in accordance with "IEC 61000-4-2" Level 4. This corresponds to a 8 kV contact and 15 kV air discharge condition. While testing done at the component level may be an indicator that the system passes Level 4 compliance testing, because of the influence of a particular system design and layout, testing must be done to ensure that the system passes that level.

USB Upstream port filter  
with ESD protection

IP6000 series

**PACKAGING**

**Package outline**



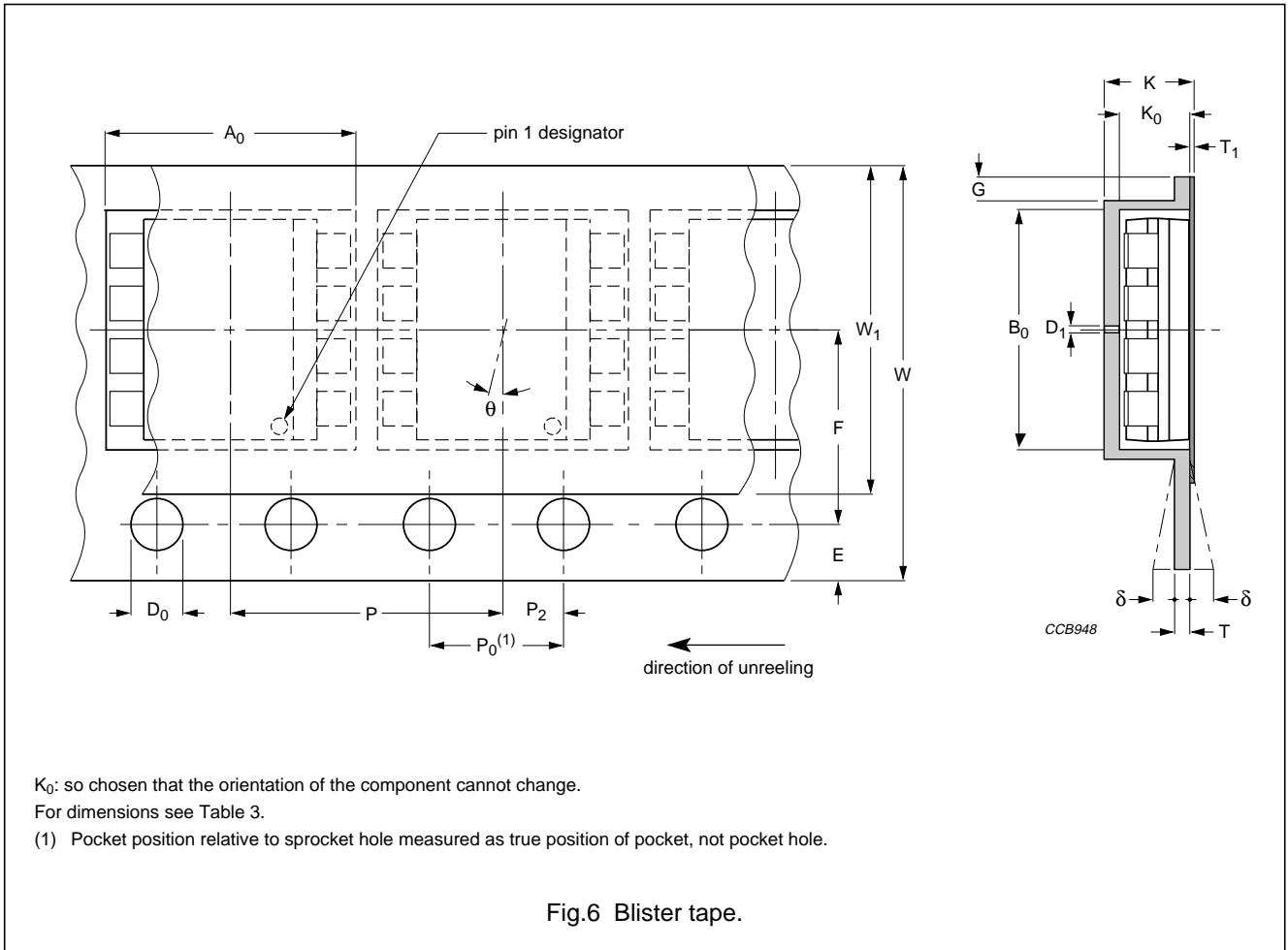
**Table 2** Package dimensions; see Fig.5

DIMENSION	VALUE		UNIT
	MIN.	MAX.	
A	–	1.10	mm
A <sub>1</sub>	0.05	0.15	mm
A <sub>2</sub>	0.80	0.96	mm
b	0.25	0.40	mm
c	0.13	0.23	mm
D	2.90	3.10	mm
E	4.90 NOM.		mm
E <sub>1</sub>	2.90	3.10	mm
e	0.65 NOM.		mm
L	0.40	0.70	mm
θ	0	6	deg

# USB Upstream port filter with ESD protection

IP6000 series

## Blister tape specifications



# USB Upstream port filter with ESD protection

## IP6000 series

**Table 3** Dimensions of blister tape; see Fig.6

PARAMETER	DIMENSION (mm)	TOLERANCE (mm)
A <sub>0</sub> nominal clearance; note 1	6.5	±0.1
B <sub>0</sub> nominal clearance; note 1	5.3	±0.1
K <sub>0</sub> minimum clearance; note 1	2.3	±0.1
K	<2.4	–
G	>0.75	–
Θ	<15°	–
δ	<0.3	–
W	12.0	±0.3
E	1.75	±0.1
F	7.5	±0.1
D <sub>0</sub>	1.5	+0.1/–0.0
D <sub>1 min</sub>	1.5	–
P <sub>0</sub> ; note 2	4.0	±0.1
P	8.0	±0.1
P <sub>2</sub>	2.0	±0.1
T	<0.35	–
T <sub>1</sub>	<0.1	–

### Notes

1. Typical displacement in pocket.
2. P<sub>0</sub> pitch tolerance over any 10 pitches is ±0.2 mm.



USB Upstream port filter  
with ESD protection

IP6000 series

Reel specifications

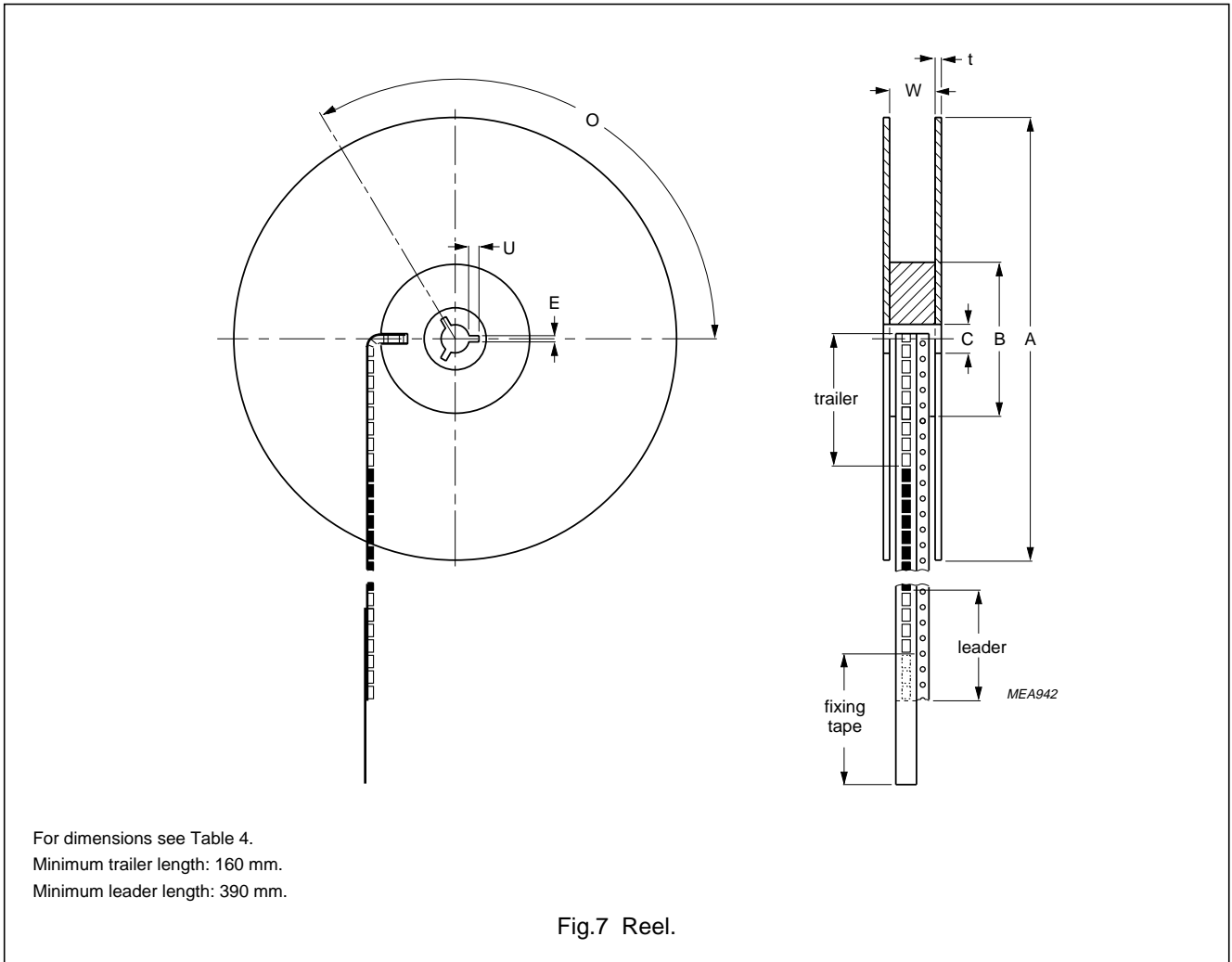


Table 4 Reel dimensions; see Fig.7

TAPE WIDTH (mm)	A NOM. (mm)	t (mm)	W (mm)	B (mm)	C (mm)	E MIN. (mm)	U MIN. (mm)	O
12	180	3 +0.0/-1.5	12.4 +2.0/-0.0	62 ±1.5	13 +0.5/-0.2	1.5	3.6	120°
12	330	3 +0.0/-1.5	12.4 +2.0/-0.0	101 ±1.5	13 +0.5/-0.2	1.5	3.6	120°

# USB Upstream port filter with ESD protection

IP6000 series

## QUALITY AND RELIABILITY

### Wafer fabrication and packaging technology

Philips ASIPs use well-proven semiconductor industry thin film-on-silicon fabrication and packaging technologies. Wafers are processed in a clean room wafer fabrication environment with circuit elements defined using a photolithography process. Metal disposition is performed by precision sputter process. Finished wafers are diced, assembled and tested in a state-of-the-art assembly and packaging facility fully compliant with ISO 9002.

### Tests and requirements

The following tests have been conducted on representative samples of Philips ASIPs in QSOP (SSOP), SOIC and similar industry standard plastic packages in accordance with the appropriate IEC, EIA and EIAJ requirements.

**Table 5** Test procedures and requirements

EIA/JESD22 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS
B102-A	solderability (after ageing)	8 hours steam; immersed for 5 s in a solder bath at 215 °C	good tinning ( $\geq 95\%$ covered); no visible damage
A113-A	SMD sequential stress	preconditioning; 5 cycles: $-55$ to $+125$ °C; 24 hours bake; temperature and humidity soak; 3 cycles of IR convection reflow at maximum 220 °C	device functional; no visible damage; SAT inspection
A104-A	temperature cycling	1000 cycles: 10 minutes minimum at $-65$ °C 10 minutes minimum at $+150$ °C	no visible damage; $\Delta R/R$ max.: $\pm 1\%$ ; $\Delta C/C$ max.: $\pm 1\%$
A102-B	autoclave (pressure pot)	336 hours: 121 °C, 100% RH	no visible damage; $\Delta R/R$ max.: $\pm 1\%$ ; $\Delta C/C$ max.: $\pm 1\%$
A101-B	temperature; humidity; bias	1000 hours: 85 °C; 85% RH; reverse voltage bias	no visible damage; $\Delta R/R$ max.: $\pm 1\%$ ; $\Delta C/C$ max.: $\pm 1\%$
A108-A	high temperature reverse bias	1000 hours: 125 °C; reverse voltage bias	no visible damage; $\Delta R/R$ max.: $\pm 1\%$ ; $\Delta C/C$ max.: $\pm 1\%$
A108-A	high temperature operating life	1000 hours: 125 °C; each channel with maximum power per spec.	no visible damage; $\Delta R/R$ max.: $\pm 1\%$ ; $\Delta C/C$ max.: $\pm 1\%$

---

**USB Upstream port filter  
with ESD protection**

---

**IP6000 series**

---

**DEFINITIONS**

<b>Data sheet status</b>	
Objective specification	This data sheet contains target or goal specifications for product development.
Preliminary specification	This data sheet contains preliminary data; supplementary data may be published later.
Product specification	This data sheet contains final product specifications.
<b>Application information</b>	
Where application information is given, it is advisory and does not form part of the specification.	

**LIFE SUPPORT APPLICATIONS**

These products are not designed for use in life support appliances, devices, or systems where malfunction of these products can reasonably be expected to result in personal injury. Philips customers using or selling these products for use in such applications do so at their own risk and agree to fully indemnify Philips for any damages resulting from such improper use or sale.