DATA SHEET

IP6002 series
USB Quad hub port filter with ESD protection

Preliminary specification
File under Advanced Ceramics and Modules, ACM4

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Philips
Components

PHILIPS

USB Quad hub port filter with ESD protection

IP6002 series

FEATURES

- One chip solution
- EMI filtering
- ESD protection of hub/router components
- Compatible with Philips IP6000 Upstream and IP6001 Downstream port filters.

APPLICATIONS

Filtering, termination and ESD protection of USB compatible devices such as:

- Desktop computers
- USB Hubs
- Routers.

DESCRIPTION

The Philips IP6002 series of Application Specific Integrated Products (ASIPs) is a family of combination single upstream quad downstream port filters for Universal Serial Bus (USB) hub applilcations. The IP6002 provides line termination and ESD protection of sensitive components within the USB hub along with EMI/RFI filtering of undesired high frequency signals in low or full speed USB applications.

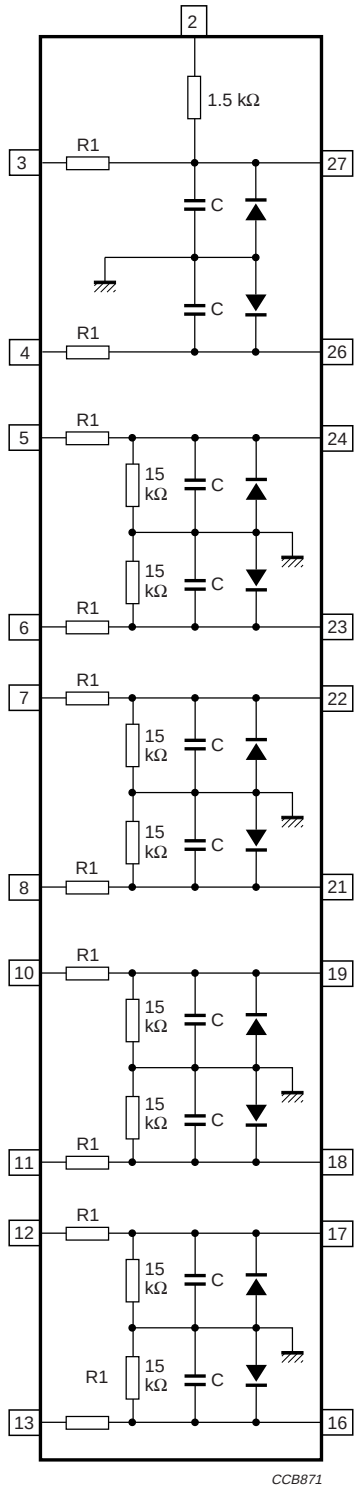
The IP6002 is fabricated using thin film-on-silicon technology and integrates nineteen resistors, ten capacitors and ten diodes in a single, small size 28-pin QSOP package.

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 IP6002 series of devices also help maintain signal integrity on digital transmission lines by reducing digital undershoot conditions.

QUICK REFERENCE DATA

DESCRIPTION	VALUE
Electrical characteristics at 25 °C	
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 16 to 19, 21 to 24, 26, 27 and ground	IEC 61000-4-2, level 4 (8 kV contact; 15 kV air discharge)
Power rating per channel	100 mW, package limited
Package ratings	
Maximum dissipation	1 W
Operating temperature	–25 to +85 °C
Storage temperature	–60 to +150 °C

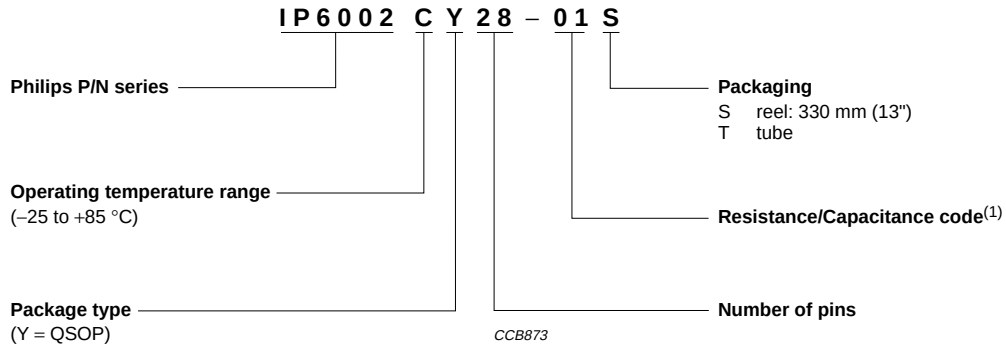


Ground pins: 1, 9, 14, 15, 20 and 28.
No connection: pin 25.

Fig.1 Functional diagram.

ORDERING INFORMATION

Ordering code



(1) For R/C codes, see Table 1.

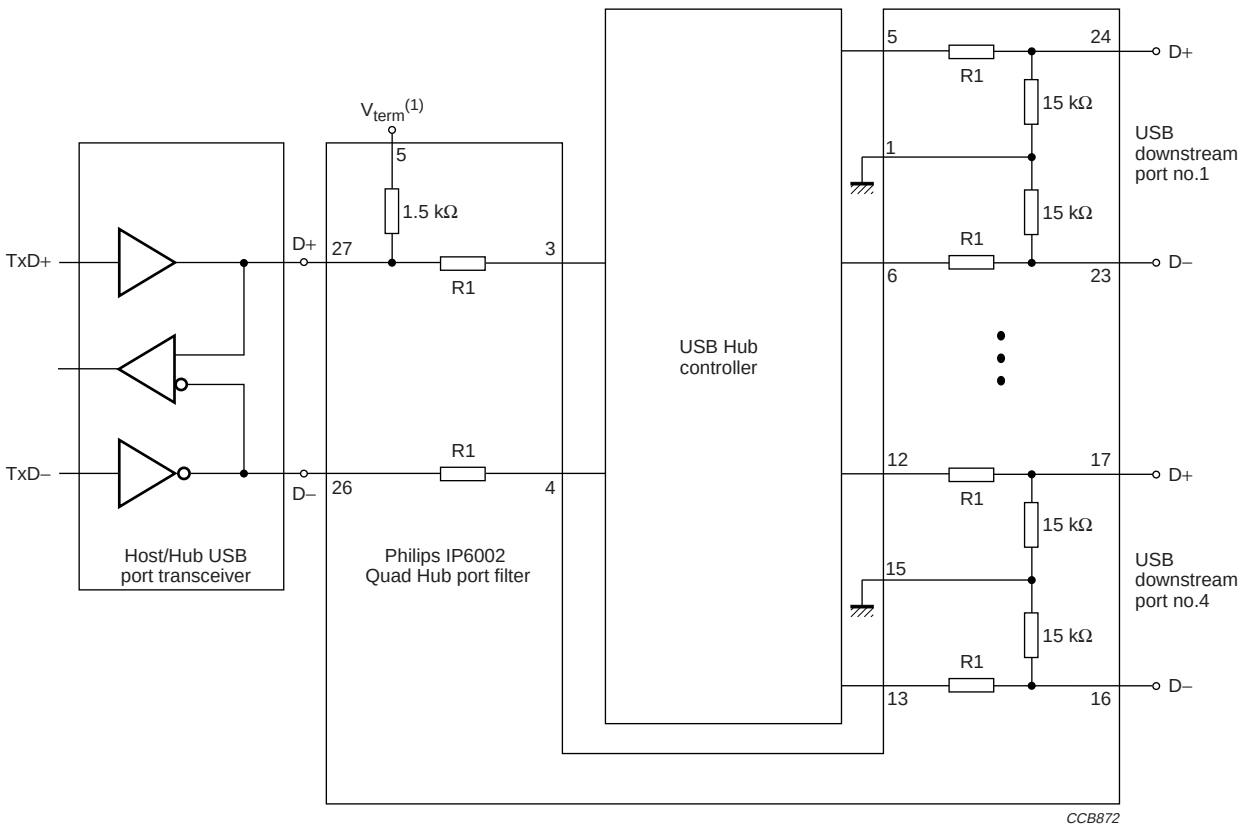
Table 1 Standard R/C values, ordering information and packaging quantities

R/C CODES	RESISTANCE VALUE		CAPACITANCE VALUE (pF)	CATALOGUE NUMBER IP6002CY28-...	
	R1 (Ω)	R2 (kΩ)		13" REEL 1000 units	TUBE 48 units
-01	33	1.5	47	01S	01T
-02	27	1.5	47	02S	02T
-03	24	1.5	47	03S	03T
-04	22	1.5	47	04S	04T

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/hub computer based upon whether the D+ or D– pin is pulled to a 3.3 V logic high through a 1.5 kΩ resistor in the downstream device. Pull-down 15 kΩ resistors connected to ground at each USB downstream port connector are also used to sense the absence of a device connected to that particular connector. Philips IP6002 provides the line termination and the pull-up/pull-down functions needed for a single upstream port and four downstream ports. Figure 2 shows the connections at the host end and at the device end.



(1) Some USB Hub controllers, such as Philips PDIUSBH11A, have the 1.5 kΩ pull-up resistor integrated internally. In that case, this pin should be left open.

Fig.2 USB Hub connection diagram.

Series resistance value

The USB specification requires that for full speed operation the driver impedance must be between 28 Ω and 44 Ω. 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 Ω to 44 Ω.

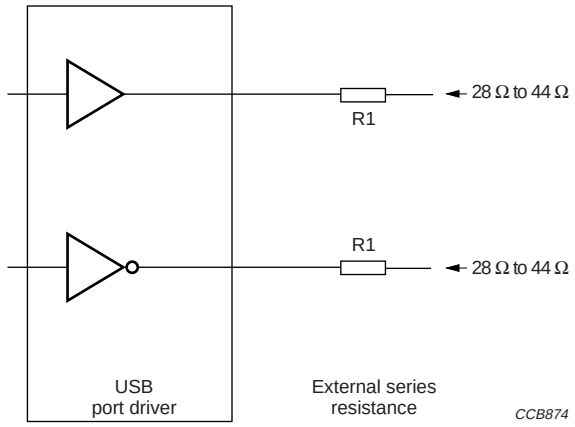


Fig.3 Full speed driver impedance requirements.

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.3. For a listing of values, see Table 1.

EMI capacitance filtering

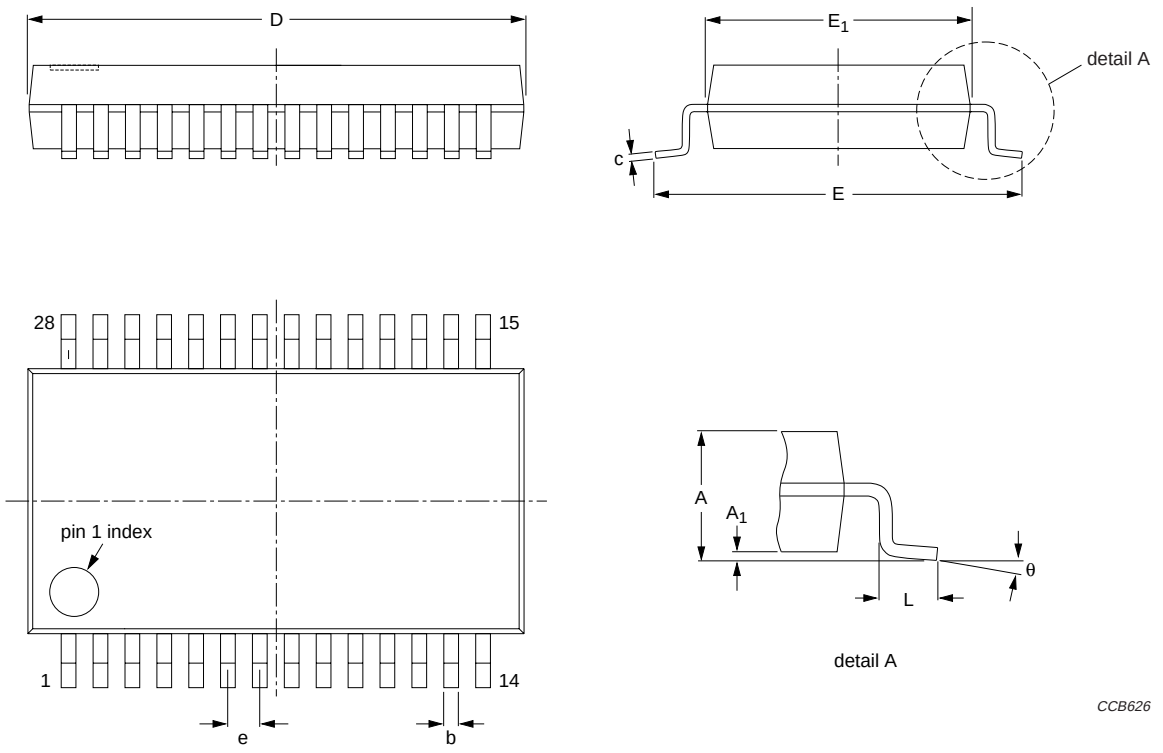
To reduce the emission of high frequency signals, capacitors have been added to the port filters; see Fig.1. These capacitors serve to filter unwanted clock harmonics and spurious high frequency signals which could cause problems in meeting EMI specifications imposed by various regulatory agencies. Refer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

PACKAGING

Package outline



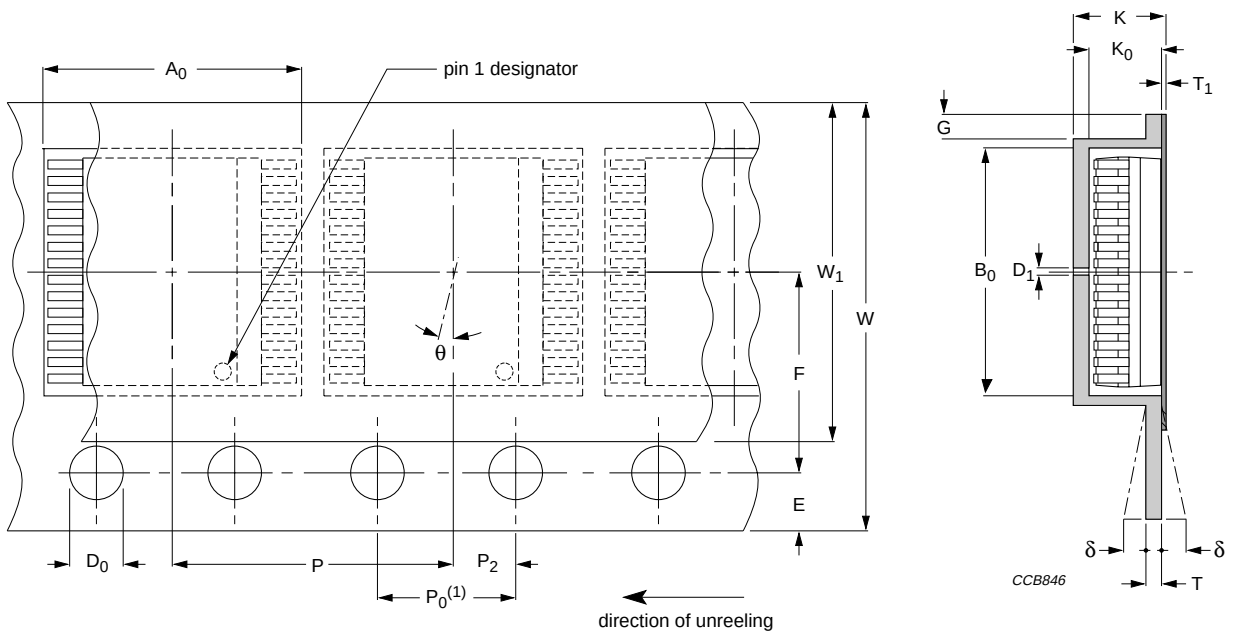
For dimensions see Table 2.

Fig.4 QSOP28 plastic shrink small outline package; 28 leads; narrow body width 3.9 mm.

Table 2 Package dimensions; see Fig.4

DIMENSION	VALUE		UNIT
	MIN.	MAX.	
A	1.35	1.75	mm
A_1	0.10	0.25	mm
b	0.20	0.30	mm
c	0.18	0.25	mm
D	9.80	10.0	mm
E	5.79	6.20	mm
E_1	3.80	3.99	mm
e	0.635 NOM.		mm
L	0.40	1.27	mm
θ	0	8	deg

Blister tape specifications



K_0: so chosen that the orientation of the component cannot change.
For dimensions see Table 3.
(1) Pocket position relative to sprocket hole measured as true position of pocket, not pocket hole.

Fig.5 Blister tape.

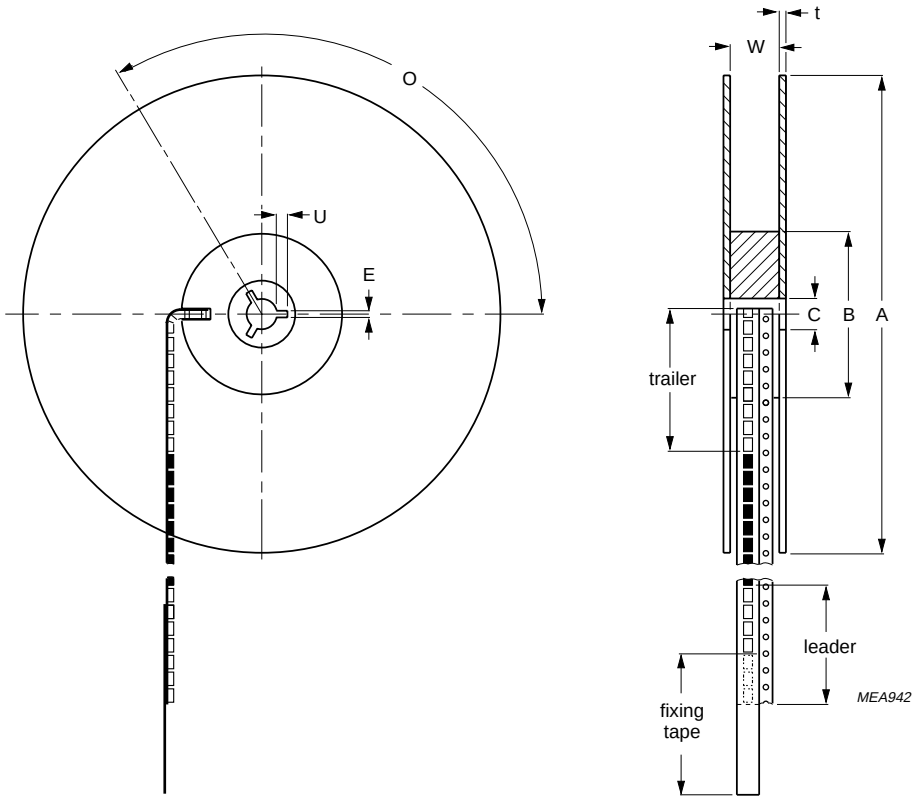
Table 3 Dimensions of blister tape; see Fig.5

PARAMETER	DIMENSION (mm)	TOLERANCE (mm)
A_0 nominal clearance; note 1	6.5	±0.1
B_0 nominal clearance; note 1	10.2	±0.1
K_0 minimum clearance; note 1	2.3	±0.1
K	<2.4	–
G	>0.75	–
Θ	<15°	–
δ	<0.3	–
W	16.0	±0.3
E	1.75	±0.1
F	7.5	±0.1
D_0	1.5	+0.1/–0.0
$D_{1\ min}$	1.5	–
P_0; note 2	4.0	±0.1
P	12.0	±0.1
P_2	2.0	±0.1
T	<0.35	–
T_1	<0.1	–

Notes

1. Typical displacement in pocket.
2. P_0 pitch tolerance over any 10 pitches is ±0.2 mm.

Reel specifications



For dimensions see Table 4.
Minimum trailer length: 160 mm.
Minimum leader length: 390 mm.

Fig.6 Reel.

Table 4 Reel dimensions; see Fig.6

TAPE WIDTH (mm)	A NOM. (mm)	t (mm)	W (mm)	B (mm)	C (mm)	E MIN. (mm)	U MIN. (mm)	O
16	330	3 +0.0/–1.5	16.4 +2.0/–0.0	101 ±1.5	13 +0.5/–0.2	1.5	3.6	120°

QUALITY AND RELIABILITY

Wafer fabrication and packaging technology

Philips integrated passive devices 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 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 integrated passive components 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 (≥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; ΔR/R max.: ±1%; ΔC/C max.: ±1%
A102-B	autoclave (pressure pot)	336 hours: 121 °C, 100% RH	no visible damage; ΔR/R max.: ±1%; ΔC/C max.: ±1%
A101-B	temperature; humidity; bias	1000 hours: 85 °C; 85% RH; reverse voltage bias	no visible damage; ΔR/R max.: ±1%; ΔC/C max.: ±1%
A108-A	high temperature reverse bias	1000 hours: 125 °C; reverse voltage bias	no visible damage; ΔR/R max.: ±1%; ΔC/C max.: ±1%
A108-A	high temperature operating life	1000 hours: 125 °C; Seach channel with maximum power per spec.	no visible damage; ΔR/R max.: ±1%; ΔC/C max.: ±1%

DEFINITIONS

Data sheet status	
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.
Application information	
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.