Integrated 4-, 6- and 8-channel passive filter network with ESD protection to IEC 61000-4-2, level 4

Rev. 03 — 6 May 2009

**Product data sheet** 

### 1. Product profile

### 1.1 General description

The IP425x family consists of 4-, 6- and 8-channel RC low-pass filter arrays which are designed to provide filtering of undesired RF signals on the I/O ports of portable communication or computing devices. In addition, the IP425x family incorporates diodes to provide protection to downstream components from ElectroStatic Discharge (ESD) voltages as high as ±30 kV.

The IP425x family is fabricated using monolithic silicon technology and integrates up to 8 resistors and 16 diodes in a 0.4 mm pitch 8-, 12- or 16-pin MicroPak (compatible with QFN) lead-free plastic package with a height of 0.5 mm only.

#### 1.2 Features

- Pb-free, Restriction of the use of certain Hazardous Substances (RoHS) and dark green compliant
- 4-, 6- and 8-channel integrated  $\pi$ -type RC filter network
- IP4251CZ8/CZ12/CZ16: 100 Ω channel series resistance, 10 pF (at 2.5 V DC) channel capacitance
- IP4252CZ8/CZ12/CZ16: 40 Ω channel series resistance, 12 pF (at 2.5 V DC) channel capacitance
- IP4253CZ8/CZ12/CZ16: 200 Ω channel series resistance, 30 pF (at 2.5 V DC) channel capacitance
- IP4254CZ8/CZ12/CZ16: 100 Ω channel series resistance, 30 pF (at 2.5 V DC) channel capacitance
- ESD protection to ±30 kV contact discharge according to IEC 61000-4-2 standard far exceeding level 4
- MicroPak (QFN compatible) plastic package with 0.4 mm pitch

### **1.3 Applications**

- General purpose ElectroMagnetic Interference (EMI) and Radio-Frequency Interference (RFI) filtering and downstream ESD protection for:
  - Cellular and Personal Communication System (PCS) mobile handsets
  - Cordless telephones
  - Wireless data (WAN/LAN) systems
  - PDAs



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### 2. Pinning information

Pin	Description	Simplified outline	Symbol
CZ8	Description	Simplined outline	Symbol
1 and 8	filter channel 1		
2 and 7	filter channel 2	8 5	R <sub>s(ch)</sub>
			1, 2, 3, 4
3 and 6	filter channel 3		
4 and 5	filter channel 4	1 4	
ground pad	ground	Transparent top view	GND 001aaf978
CZ12			
1 and 12	filter channel 1	12 7	Re(ch)
2 and 11	filter channel 2		R <sub>S(ch)</sub> 1, 2, 3,
3 and 10	filter channel 3		4, 5, 6 $         -$
4 and 9	filter channel 4		
5 and 8	filter channel 5	Transparent top view	ر المراجع GND 001aaf975
6 and 7	filter channel 6	top view	Cite outaint
ground pad	ground		
CZ16			
1 and 16	filter channel 1	-	-
2 and 15	filter channel 2		R <sub>s(ch)</sub> 1, 2, 3, 4, + 9, 10, 11,
3 and 14	filter channel 3		5, 6, 7, 8 $         -$
4 and 13	filter channel 4		
5 and 12	filter channel 5	Transparent top view	GND 001aai
6 and 11	filter channel 6		
7 and 10	filter channel 7		
8 and 9	filter channel 8		
ground pad	ground		

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### 3. Ordering information

Гуре number	Package					
	Name Description					
P4251CZ8-4	HXSON8U	plastic thermal enhanced extremely thin small outline package; no leads; 8 terminals; UTLP based; body $1.35 \times 1.7 \times 0.5$ mm	SOT983-1			
P4251CZ12-6	HXSON12U	plastic thermal enhanced extremely thin small outline package; no leads; 12 terminals; UTLP based; body $1.35 \times 2.5 \times 0.5$ mm	SOT984-1			
P4251CZ16-8	HXSON16U	plastic thermal enhanced extremely thin small outline package; no leads; 16 terminals; UTLP based; body $1.35 \times 3.3 \times 0.5$ mm	SOT985-1			
P4252CZ8-4	HXSON8U	plastic thermal enhanced extremely thin small outline package; no leads; 8 terminals; UTLP based; body $1.35\times1.7\times0.5$ mm	SOT983-1			
P4252CZ12-6	HXSON12U	plastic thermal enhanced extremely thin small outline package; no leads; 12 terminals; UTLP based; body 1.35 $\times$ 2.5 $\times$ 0.5 mm	SOT984-1			
P4252CZ16-8	HXSON16U	plastic thermal enhanced extremely thin small outline package; no leads; 16 terminals; UTLP based; body $1.35 \times 3.3 \times 0.5$ mm	SOT985-1			
P4253CZ8-4	HXSON8U	plastic thermal enhanced extremely thin small outline package; no leads; 8 terminals; UTLP based; body $1.35 \times 1.7 \times 0.5$ mm	SOT983-1			
P4253CZ12-6	HXSON12U	plastic thermal enhanced extremely thin small outline package; no leads; 12 terminals; UTLP based; body $1.35 \times 2.5 \times 0.5$ mm	SOT984-1			
P4253CZ16-8	HXSON16U	plastic thermal enhanced extremely thin small outline package; no leads; 16 terminals; UTLP based; body $1.35 \times 3.3 \times 0.5$ mm	SOT985-1			
P4254CZ8-4	HXSON8U	plastic thermal enhanced extremely thin small outline package; no leads; 8 terminals; UTLP based; body $1.35\times1.7\times0.5$ mm	SOT983-1			
P4254CZ12-6	HXSON12U	plastic thermal enhanced extremely thin small outline package; no leads; 12 terminals; UTLP based; body $1.35 \times 2.5 \times 0.5$ mm	SOT984-1			
P4254CZ16-8	HXSON16U	plastic thermal enhanced extremely thin small outline package; no leads; 16 terminals; UTLP based; body $1.35 \times 3.3 \times 0.5$ mm	SOT985-1			

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### 4. Limiting values

-	num Rating System (IEC 60	134).		
Parameter	Conditions	Min	Max	Unit
supply voltage		-0.5	+5.6	V
electrostatic discharge	all pins to ground			
voltage	contact discharge			
	IP4251 and IP4252	<u>[1][3]</u> –15	+15	kV
	IP4253 and IP4254	<u>[2][3]</u> –30	+30	kV
	air discharge			
	IP4253 and IP4254	<u>[2][3]</u> –30	+30	kV
	IEC 61000-4-2, level 4; all pins to ground			
	contact discharge	-8	+8	kV
	air discharge	-15	+15	kV
channel power dissipation	$T_{amb} = 85 \ ^{\circ}C$	-	60	mW
total power dissipation	$T_{amb} = 85 \ ^{\circ}C$	-	200	mW
storage temperature		-55	+150	°C
ambient temperature		-40	+85	°C
	Parameter supply voltage electrostatic discharge voltage channel power dissipation total power dissipation storage temperature	Parameter Conditions   supply voltage all pins to ground   electrostatic discharge IP4251 and IP4252   Voltage IP4253 and IP4254   air discharge IP4253 and IP4254   lEC 61000-4-2, level 4; all pins to ground contact discharge   channel power dissipation T <sub>amb</sub> = 85 °C   storage temperature Tamb = 85 °C	ParameterMinsupply voltage-0.5electrostatic discharge voltageall pins to ground-0.5electrostatic discharge voltage110 in sto ground-15IP4251 and IP42521113-15IP4253 and IP42541213-30air discharge IP4253 and IP42541213-30IEC 61000-4-2, level 4; all pins to ground110-8air discharge-15-15contact discharge-15IEC 61000-4-2, level 4; all pins to ground-15contact discharge-15contact discharge-15contact discharge-15contact discharge-15contact discharge-25	Parameter   Conditions   Min   Max     supply voltage   -0.5   +5.6     electrostatic discharge voltage   all pins to ground   -0.5   +5.6     IP4251 and IP4252   11[3] -15   +15     IP4251 and IP4254   [2]3] -30   +30     air discharge   1P4253 and IP4254   [2]3] -30   +30     IEC 61000-4-2, level 4; all pins to ground   [2]3] -30   +30     IEC 61000-4-2, level 4; all pins to ground   [2]3] -30   +30     IEC 61000-4-2, level 4; all pins to ground   [2]3] -30   +30     IEC 61000-4-2, level 4; all pins to ground   [2]3] -30   +30     IEC 61000-4-2, level 4; all pins to ground   [2]3] -30   +30     IEC 61000-4-2, level 4; all pins to ground   [2]3] -30   +30     IEC 61000-4-2, level 4; all pins to ground   [2]3] -30   +30     IEC 61000-4-2, level 4; all pins to ground   [2]3] -30   +30     IEC 61000-4-2, level 4; all pins to ground   [2]3] -30   [3]4     IEC 61000-4-2   [2]13] -15   [3]4   [3]4     IEC 61000-4   [3]4   [3]4

 Device is qualified using contact discharges at ±15 kV according IEC 61000-4-2 model, far exceeding level 4.

[2] Device is qualified using contact discharges at ±30 kV according IEC 61000-4-2 model, far exceeding level 4.

[3] A special robust test is performed stressing the devices with ≥ 1000 contact discharges according IEC 61000-4-2 model. All devices far exceed IEC 61000-4-2, level 4.

### 5. Thermal characteristics

Table 4.	Thermal characteristics			
Symbol	Parameter	Conditions	Тур	Unit
R <sub>th(j-pcb)</sub>	thermal resistance from junction to printed-circuit board	2 layer printed-circuit board	120 <mark>[1]</mark>	K/W

[1] Depends on layout details.

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### 6. Characteristics

<b>Table 5.</b> <i>T<sub>amb</sub> = 25</i> <sup>•</sup>	Channel resistance °C unless otherwise specifie	ed.				
Symbol	Parameter	Conditions	Min	Тур	Max	Unit
R <sub>s(ch)</sub>	channel series resistance	IP4251CZ8/CZ12/CZ16	80	100	120	Ω
		IP4252CZ8/CZ12/CZ16	32	40	48	Ω
		IP4253CZ8/CZ12/CZ16	160	200	240	Ω
		IP4254CZ8/CZ12/CZ16	80	100	120	Ω

# Table 6.Channel characteristics $T_{amb} = 25 \degree C$ unless otherwise specified.

Symbol	Parameter	Conditions	Min	Тур	Max	Unit
C <sub>ch</sub>	channel capacitance	for the total channel; f = 100 kHz				
		$V_{bias(DC)} = 2.5 V$				
		IP4251	-	10	-	pF
		IP4252	-	12	-	pF
	IP4253 and IP4254	-	30	-	pF	
		$V_{bias(DC)} = 0 V$				
		IP4251	<u>[1]</u> -	15	-	pF
		IP4252	<u>[1]</u> -	18	-	pF
		IP4253 and IP4254	<u>[1]</u> -	45	-	pF
I <sub>LR</sub>	reverse leakage current	per channel; $V_I = 3.5 V$	-	-	0.1	μΑ
$V_{BR}$	breakdown voltage	positive clamp; $I_I = 1 \text{ mA}$	5.8	-	9	V
V <sub>F</sub>	forward voltage	negative clamp; $I_F = 1 \text{ mA}$	0.4	-	1.5	V

[1] Guaranteed by design.

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Symbol	Parameter	Conditions	Min	Тур	Max	Unit
IP4251C2	28/CZ12/CZ16					
$\alpha_{il}$	insertion loss	$R_{source} = 50 \ \Omega; R_{L} = 50 \ \Omega$				
		800 MHz < f < 3 GHz	-	16	-	dB
		f = 1 GHz	-	20	-	dB
$\alpha_{ct}$	crosstalk attenuation	$R_{source}$ = 50 $\Omega$ ; $R_{L}$ = 50 $\Omega$ ; 800 MHz < f < 3 GHz	-	30	-	dB
IP4252C2	28/CZ12/CZ16					
$\alpha_{il}$	insertion loss	$R_{source} = 50 \ \Omega; R_L = 50 \ \Omega$				
		800 MHz < f < 3 GHz	-	12	-	dB
		f = 1 GHz	-	14	-	dB
$\alpha_{ct}$	crosstalk attenuation	$R_{source}$ = 50 Ω; $R_{L}$ = 50 Ω; 800 MHz < f < 3 GHz	-	40	-	dB
IP4253C2	28/CZ12/CZ16					
$\alpha_{il}$	insertion loss	$R_{source} = 50 \ \Omega; R_{L} = 50 \ \Omega$				
		800 MHz < f < 3 GHz	-	33	-	dB
		f = 1 GHz	35	-	-	dB
$\alpha_{ct}$	crosstalk attenuation	$R_{source}$ = 50 Ω; $R_{L}$ = 50 Ω; 800 MHz < f < 3 GHz	-	30	-	dB
IP4254C2	28/CZ12/CZ16					
$\alpha_{il}$	insertion loss	$R_{source} = 50 \ \Omega; R_{L} = 50 \ \Omega$				
		800 MHz < f < 3 GHz	-	28	-	dB
		f = 1 GHz	30	-	-	dB
$\alpha_{ct}$	crosstalk attenuation	$R_{source} = 50 \Omega; R_{L} = 50 \Omega;$ 800 MHz < f < 3 GHz	-	30	-	dB

#### Table 7. **Frequency characteristics**

### $T_{amb} = 25 \circ C$ unless otherwise specified

#### **Application information** 7.

### 7.1 Insertion loss

The IP425x family is mainly designed as EMI/RFI filters for multi-channel interfaces. The measured insertion loss in a 50  $\Omega$  system for IP4251, IP4253 and IP4254 and the simulated insertion loss for IP4252 is depicted in Figure 2.

The insertion loss was measured using the test set-up as depicted in Figure 1.

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Due to the optimized silicon dice and package design, all channels in a single package show a very good matching performance as the insertion loss for a channel at the package side (e.g. ch1 to ch16) is nearly identical with the center channels (e.g. ch4 to ch13). Typical measurements results are shown in Figure 3 to Figure 6 for the different devices.

#### 7.2 Selection

The IP425x family is mainly designed as EMI/RFI filters for multi-channel interfaces. The selection of one of the filter devices has to be performed dependent on the maximum clock frequency, driver strength, capacitive load of the sink, and also the maximum applicable rise and fall times.

#### 7.2.1 SD(HC) and MMC memory interface

The Secure Digital High Capacity (SDHC) memory card interface standard specification and the MultiMediaCard (MMC) (JESD 84A43) standard specification recommend a rise and fall time of 25 % to 62.5 % (62.5 % to 25 % respectively) of 3 ns or less for the input signal of the receiving interface side.

Assuming a typical capacitance of about 20 pF for the SDHC memory card itself, and approximately 4 pF to 7 pF for the PCB and the card holder, IP4252CZ12-6 (6 channels,  $R_{s(ch)} = 40 \Omega$ ,  $C_{ch} = 12 \text{ pF}$  at  $V_{bias(DC)} = 2.5 \text{ V}$ ) is a matching selection to filter and protect all relevant interface pins such as CLK, CMD, and DAT0 to DAT3/CD. Please refer to Figure 7 for a general example of the implementation of the IP4252 in an SD(HC) card interface.

In case additional channels such as write-protect or a mechanical card detection switch are used, the IP4252CZ16-8 (8 channels,  $R_{s(ch)} = 40 \ \Omega$ ,  $C_{ch} = 12 \ pF$  at  $V_{bias(DC)} = 2.5 \ V$ ) offers two additional channels.

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The capacitance values specified for the signal channels of the MMC interface differ from the SD(HC) specification. The MMC card side interface is specified to have an intrinsic capacitance of 12 pF to 18 pF and the total channel is limited according the specification to 30 pF only. Therefore, any filter device capacitance is limited to a maximum of up to 18 pF, including the card holder and PCB traces.

Please refer to Figure 8 for a general example of the implementation of the IP4252 in a MultiMediaCard interface application.

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To generate SDHC- and MMC-compliant digital signals, the driver strength should not significantly undercut 8 mA.

#### 7.2.2 LCD interfaces, medium-speed interfaces

For digital interfaces such as LCD display interfaces running at clock speeds between 10 MHz and 25 MHz or more, IP4251, IP4252, or IP4254 can be used in dependency of the sink load, clock speed, driver strength and rise and fall time requirements. Also the minimum EMI filter requirements may be a decision-making factor.

#### 7.2.3 Keypad, low-speed interfaces

Especially for lower-speed interfaces such as keypads, low-speed serial interfaces (e.g. RS232) and low-speed control signals, IP4253 ( $R_{s(ch)} = 200 \Omega$ ,  $C_{ch} = 30 \text{ pF}$  at  $V_{bias(DC)} = 2.5 \text{ V}$ ) offers a very robust ESD protection and strong suppression of unwanted frequencies (EMI-filtering).

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### 8. Package outline



#### Fig 9. Package outline SOT983-1 (HXSON8U)

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HXSON12U: plastic thermal enhanced extremely thin small outline package; no leads; 12 terminals; UTLP based; body 1.35 x 2.5 x 0.5 mm

Fig 10. Package outline SOT984-1 (HXSON12U)

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# HXSON16U: plastic thermal enhanced extremely thin small outline package; no leads; 16 terminals; UTLP based; body 1.35 x 3.3 x 0.5 mm

Fig 11. Package outline SOT985-1 (HXSON16U)

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### 9. Revision history

Table 8.Revision history				
Document ID	Release date	Data sheet status	Change notice	Supersedes
IP4251_52_53_54_3	20090506	Product data sheet	-	IP4253_54_CZ8_CZ12_CZ16_2
Modifications:	•	ict types IP4251x and I er <u>Section 7 "Application</u>		<u>on"</u> .
IP4253_54_CZ8_CZ12_CZ16_2	20071108	Product data sheet	-	IP4253_54_CZ8_CZ12_CZ16_1
IP4253_54_CZ8_CZ12_CZ16_1	20070209	Objective data sheet	-	-

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### **10. Legal information**

### **10.1** Data sheet status

Document status[1][2]	Product status <sup>[3]</sup>	Definition
Objective [short] data sheet	Development	This document contains data from the objective specification for product development.
Preliminary [short] data sheet	Qualification	This document contains data from the preliminary specification.
Product [short] data sheet	Production	This document contains the product specification.

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[2] The term 'short data sheet' is explained in section "Definitions".

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