PCMF2DFN1; PCMF3DFN1

Common-mode EMI filter for differential channels with integrated ESD protection

Rev. 2 — 28 April 2014 Product data sheet

1. Product profile

1.1 General description

The devices are common-mode ElectroMagnetic Interference (EMI) filters with integrated ElectroStatic Discharge (ESD) protection for two and three differential channels. The devices are designed to provide low insertion loss for differential high-speed signals on each channel while unwanted common-mode signals are attenuated.

Each differential channel incorporates two signal lines that are coupled by integrated coils. Diodes provide protection to downstream components from ESD voltages up to ±15 kV on each signal line.

Table 1. Product overview

Type number	Number of channels	Package		
		Name	Version	
PCMF2DFN1	2	DFN2520-9	SOT1333-1	XSON9
PCMF3DFN1	3	DFN4020-14	SOT1334-1	XSON14

1.2 Features and benefits

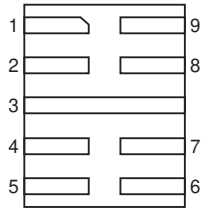
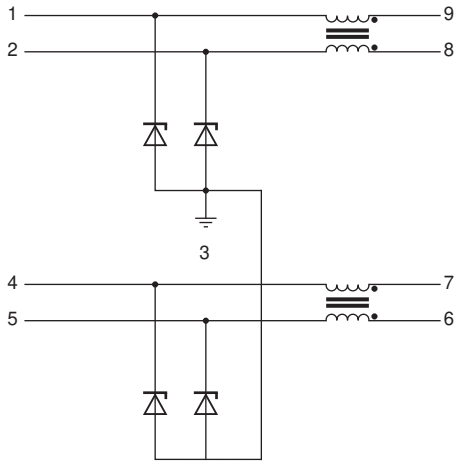
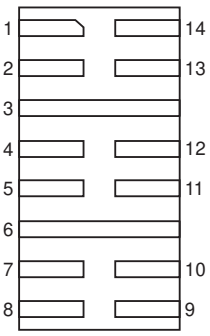
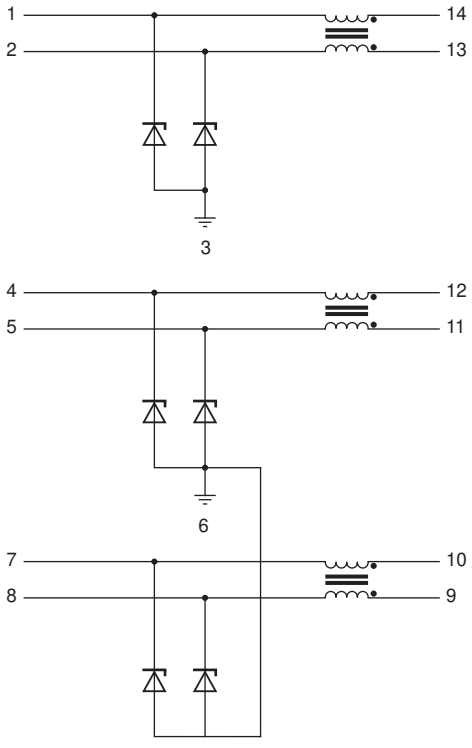
- Two and three differential channels common-mode EMI filter with integrated ESD protection
- Superior common-mode suppression over a wide frequency range
- ESD protection up to ±15 kV contact discharge according to IEC 61000-4-2
- Maximum package height: 0.5 mm

1.3 Applications

- Smartphone, cellular and cordless phone
- MIPI D-PHY as used in Camera Serial Interface (CSI) and Display Serial Interface (DSI)
- General-purpose EMI and Radio-Frequency Interference (RFI) filter and downstream ESD protection
- Tablet PC and Mobile Internet Device (MID)
- High-Definition Multimedia Interface (HDMI)

2. Pinning information

Table 2. Pinning

Pin	Symbol	Description	Simplified outline	Graphic symbol
PCMF2DFN1 (SOT1333-1)				
1	CH1_IN+	input channel 1	 Transparent top view **DFN2520-9**	 *aaa-007385*
2	CH1_IN−	input channel 1		
3	GND	ground		
4	CH2_IN+	input channel 2		
5	CH2_IN−	input channel 2		
6	CH2_OUT−	output channel 2		
7	CH2_OUT+	output channel 2		
8	CH1_OUT−	output channel 1		
9	CH1_OUT+	output channel 1		
PCMF3DFN1 (SOT1334-1)				
1	CH1_IN+	input channel 1	 Transparent top view **DFN4020-14**	 *aaa-007384*
2	CH1_IN−	input channel 1		
3	GND_1	ground 1		
4	CH2_IN+	input channel 2		
5	CH2_IN−	input channel 2		
6	GND_2	ground 2		
7	CH3_IN+	input channel 3		
8	CH3_IN−	input channel 3		
9	CH3_OUT−	output channel 3		
10	CH3_OUT+	output channel 3		
11	CH2_OUT−	output channel 2		
12	CH2_OUT+	output channel 2		
13	CH1_OUT−	output channel 1		
14	CH1_OUT+	output channel 1		

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3. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
PCMF2DFN1	DFN2520-9	plastic extremely thin small outline package; no leads; 9 terminals; body 2 × 2.5 × 0.5 mm	SOT1333-1
PCMF3DFN1	DFN4020-14	plastic extremely thin small outline package; no leads; 14 terminals; body 2 × 4 × 0.5 mm	SOT1334-1

4. Marking

Table 4. Marking codes

Type number	Marking code
PCMF2DFN1	MP1
PCMF3DFN1	CMFMP1

5. Limiting values

Table 5. Limiting values

In accordance with the Absolute Maximum Rating System (IEC 60134).

Symbol	Parameter	Conditions	Min	Max	Unit
V_I	input voltage		−0.5	5	V
V_{ESD}	electrostatic discharge voltage	IEC 61000-4-2, level 4; all input pins to ground			
		contact discharge	−15	15	kV
		air discharge	−15	15	kV
		IEC 61000-4-2, level 4; all output pins to ground			
		contact discharge	−2	2	kV
		air discharge	−2	2	kV
T_{stg}	storage temperature		−55	+125	°C
T_{amb}	ambient temperature		−40	+85	°C

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6. Characteristics

6.1 Channel characteristics

Table 6. Channel characteristics

T_{amb} = 25 °C unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$R_{s(ch)}$	channel series resistance	single line; input to output	-	5	-	Ω
C_d	diode capacitance	f = 1 MHz; V_I = 2.5 V [1]	-	0.6	0.75	pF
I_{RM}	reverse leakage current	per line; V_I = 5 V	-	-	100	nA
V_{BR}	breakdown voltage	I_R = 10 mA	6	-	9	V
V_F	forward voltage	I_F = 10 mA	0.6	-	1.1	V
R_{dyn}	dynamic resistance	TLP [2]				
		positive transient	-	0.6	-	Ω
		negative transient	-	0.6	-	Ω
		surge [3]				
		positive transient	-	0.6	-	Ω
		negative transient	-	0.6	-	Ω
V_{CL}	clamping voltage	positive transient; I_{PP} = 4 A [3]	-	4.8	-	V
		negative transient; I_{PP} = −5 A [3]	-	−3.6	-	V
		TLP; I_{CL} = 8 A	-	8	-	V
		TLP; I_{CL} = 12 A	-	10.5	-	V
		TLP; I_{CL} = 16 A	-	13.4	-	V
		TLP; I_{CL} = −8 A	-	−6	-	V
		TLP; I_{CL} = −12 A	-	−8.4	-	V
		TLP; I_{CL} = −16 A	-	−10.7	-	V

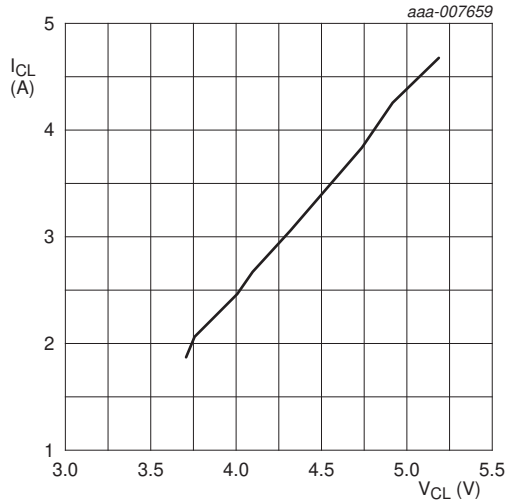
[1] This parameter is guaranteed by design.

[2] 100 ns Transmission Line Pulse (TLP); 50 Ω; pulser at 70 to 90 ns.

[3] According to IEC 61000-4-5 (8/20 μs).

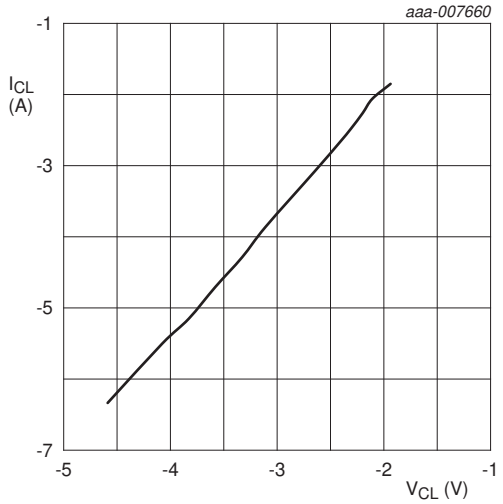
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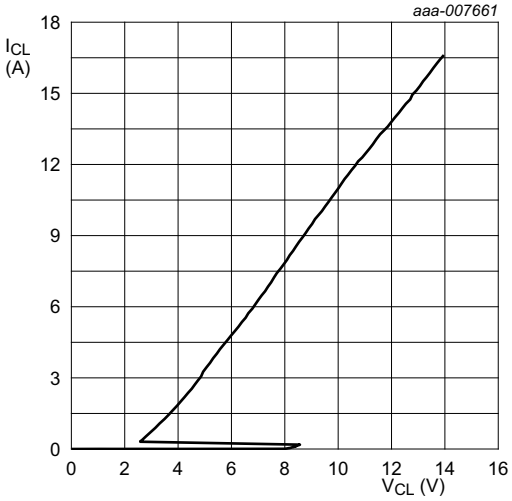
IEC 61000-4-5; t_p = 8/20 μs; positive pulse

Fig 1. Dynamic resistance with positive clamping; typical values



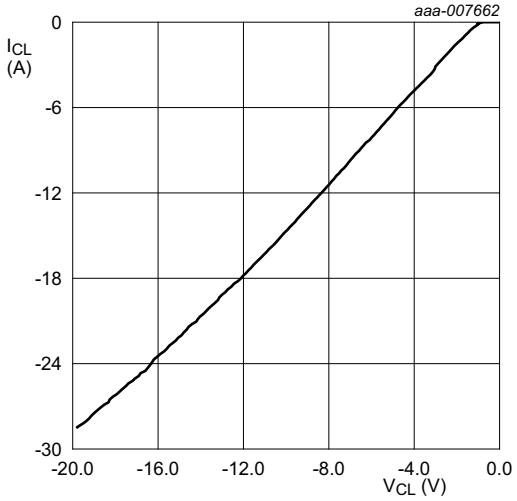
IEC 61000-4-5; t_p = 8/20 μs; negative pulse

Fig 2. Dynamic resistance with negative clamping; typical values



t_p = 100 ns; Transmission Line Pulse (TLP)

Fig 3. Dynamic resistance with positive clamping; typical values



t_p = 100 ns; Transmission Line Pulse (TLP)

Fig 4. Dynamic resistance with negative clamping; typical values

The device uses an advanced clamping structure showing a negative dynamic resistance. This snap-back behavior strongly reduces the clamping voltage to the system behind the ESD protection during an ESD event. Do not connect unlimited DC current sources to the data lines to avoid keeping the ESD protection device in snap-back state after exceeding breakdown voltage (due to an ESD pulse for instance).

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6.2 Frequency characteristics

Table 7. Frequency characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Common mode: S_{21cc}						
α_{il}	insertion loss	[1]				
		f = 400 MHz	-	15	-	dB
		f = 800 MHz	-	30	-	dB
		f = 5 GHz	-	21	-	dB
Differential mode: S_{21dd}						
α_{il}	insertion loss	f = 1MHz [1]	-	0.6	-	dB
f_{-3dB}	cut-off frequency	[1][2]	-	2.2	-	GHz

[1] Measured with 4-port network analyzer; R_{gen} = 50 Ω; R_L = 50 Ω.

[2] Normalized to attenuation at 1 MHz.

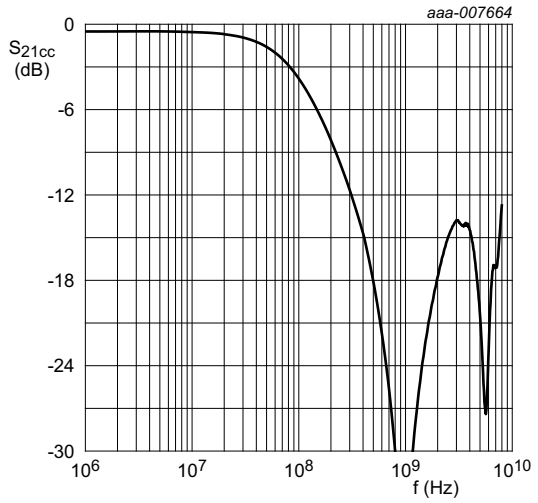


Fig 5. Common-mode insertion loss; typical values

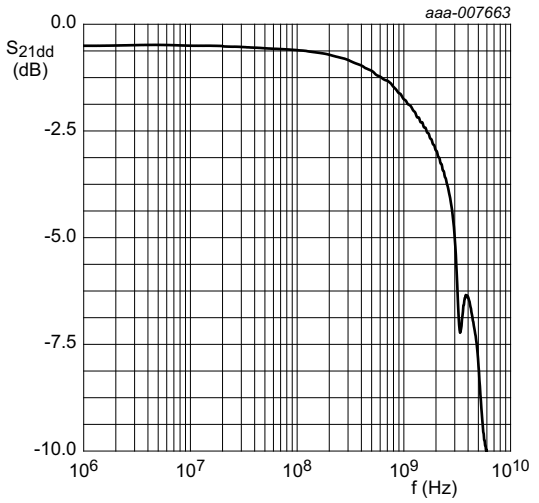


Fig 6. Differential-mode insertion loss; typical values

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7. Application information

7.1 Application diagram

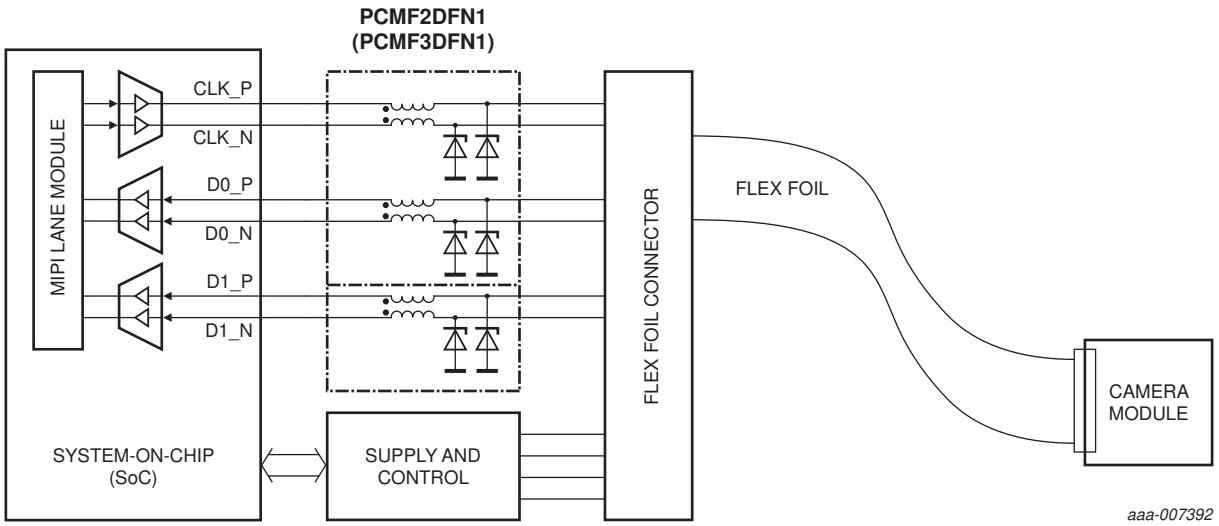


Fig 7. Application diagram for MIPI D-PHY CSI

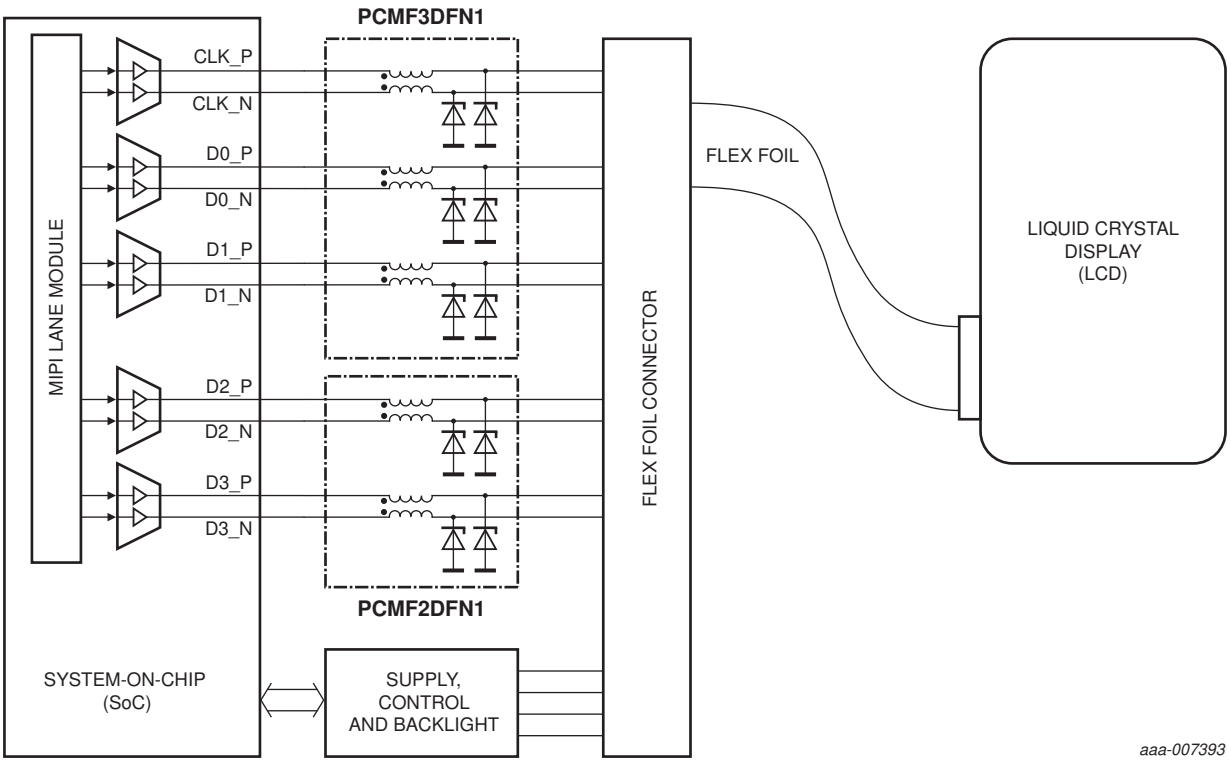
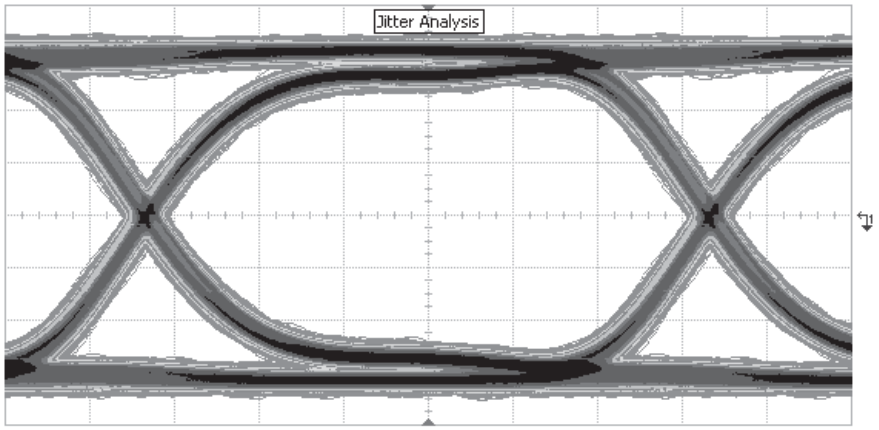


Fig 8. Application diagram for MIPI D-PHY DSI

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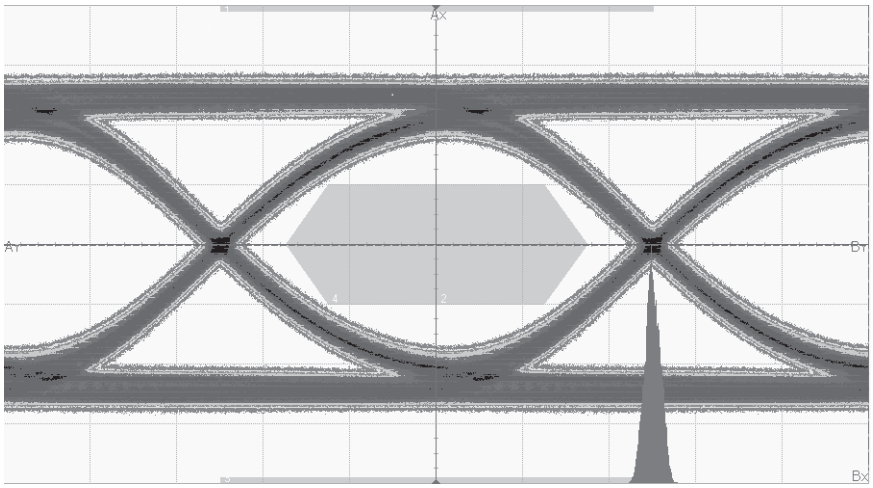
7.2 Eye diagram



aaa-007649

Data rate: 1.5 Gbit/s
Vertical scale = 28.7 mV/div
Horizontal scale = 100 ps/div

Fig 9. MIPI D-PHY eye diagram



aaa-007648

Data rate: 3.4 Gbit/s
Vertical scale = 200 mV/div
Horizontal scale = 58.9 ps/div

Fig 10. HDMI eye diagram

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8. Package outline

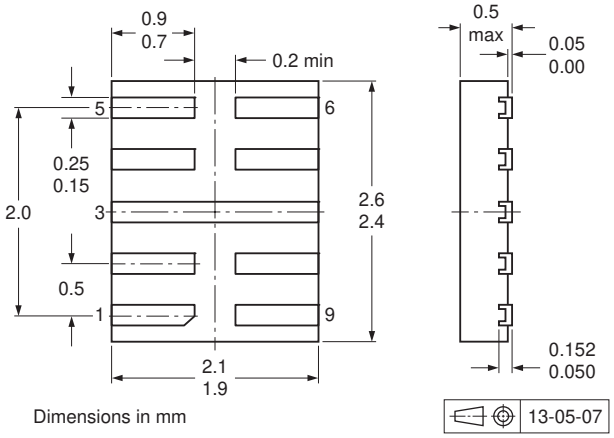


Fig 11. Package outline DFN2520-9 (SOT1333-1)

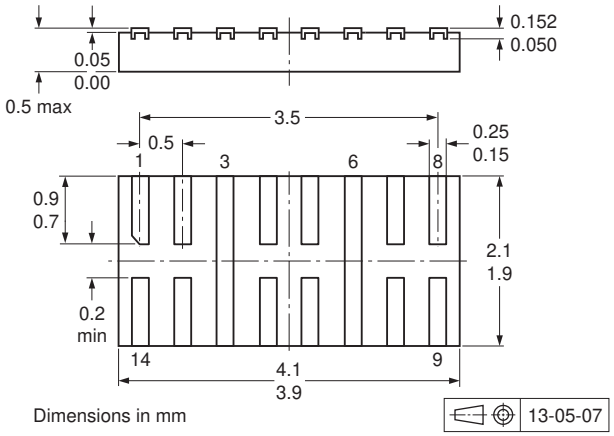


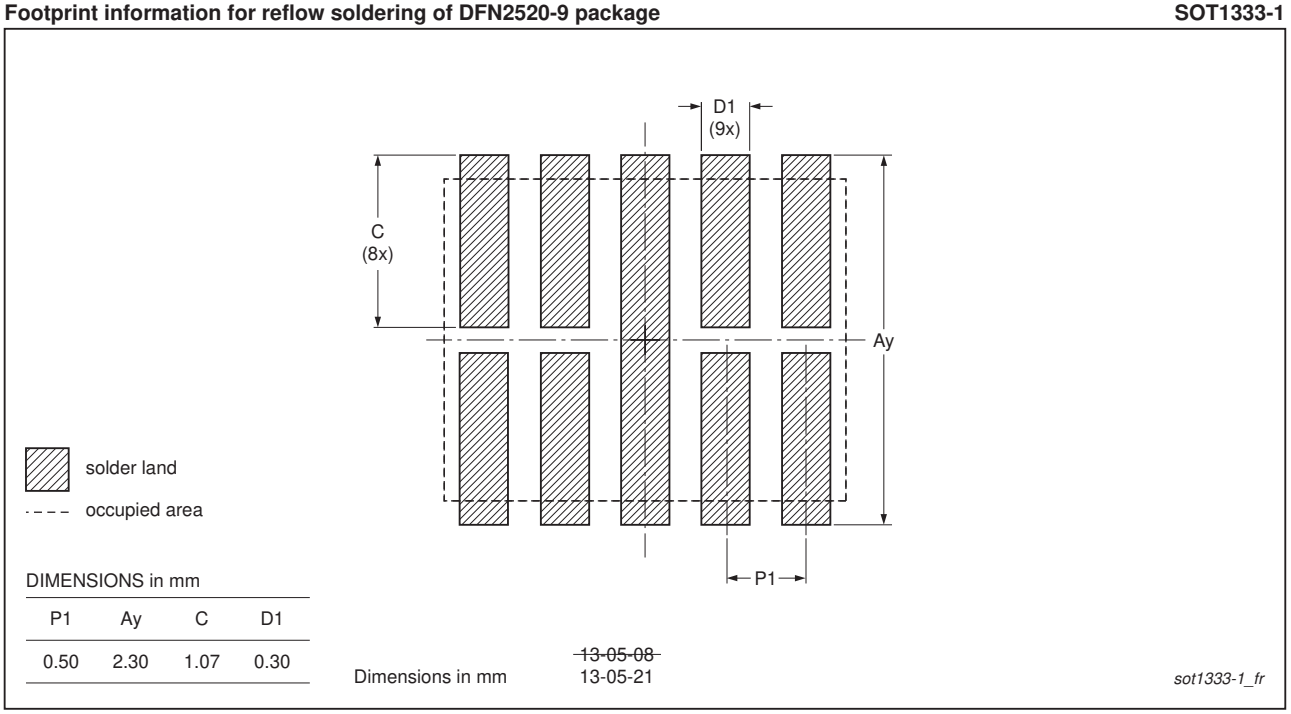
Fig 12. Package outline DFN4020-14 (SOT1334-1)

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9. Soldering

Footprint information for reflow soldering of DFN2520-9 package **SOT1333-1**



DIMENSIONS in mm

P1	Ay	C	D1
0.50	2.30	1.07	0.30

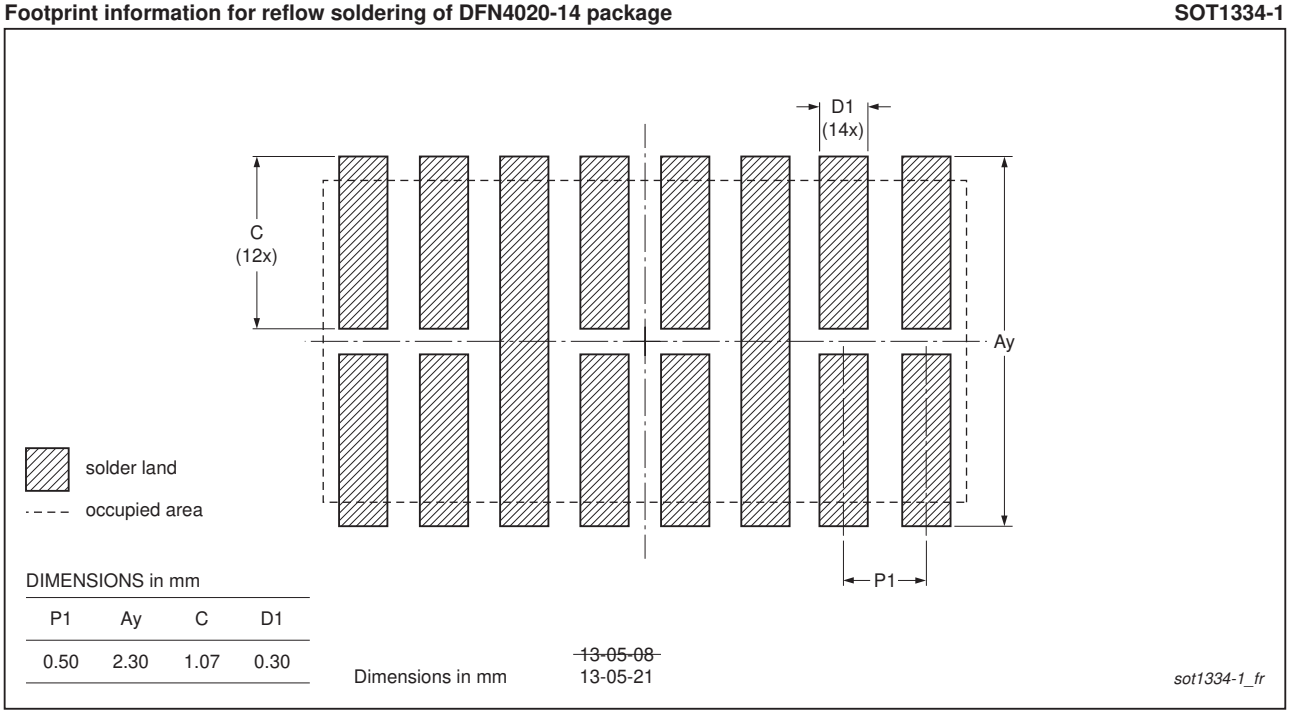
Dimensions in mm

~~13-05-08~~
13-05-21

sot1333-1_fr

Fig 13. Reflow soldering footprint DFN2520-9 (SOT1333-1)

Footprint information for reflow soldering of DFN4020-14 package **SOT1334-1**



DIMENSIONS in mm

P1	Ay	C	D1
0.50	2.30	1.07	0.30

Dimensions in mm

~~13-05-08~~
13-05-21

sot1334-1_fr

Fig 14. Reflow soldering footprint DFN4020-14 (SOT1334-1)

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10. Revision history

Table 8. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
PCMF2DFN1_PCMF3DFN1 v.2	20140428	Product data sheet	-	PCMF2DFN1_PCMF3DFN1 v.1
Modification:	• Surge rating adapted			
PCMF2DFN1_PCMF3DFN1 v.1	20130606	Product data sheet	-	-

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