



# PMBT3904RA

40 V, 200 mA double NPN switching transistor

13 September 2018

Product data sheet

## 1. General description

Double NPN switching transistor in an ultra small DFN1412-6 (SOT1268) leadless Surface-Mounted Device (SMD) plastic package.

## 2. Features and benefits

- Leadless ultra small SMD plastic package
- Reduces component count
- Reduces pick and place costs
- Low package height of 0.5 mm

## 3. Applications

- General-purpose switching and amplification

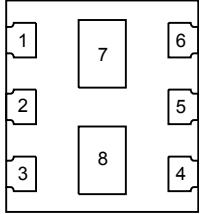
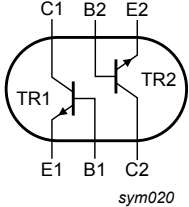
## 4. Quick reference data

Table 1. Quick reference data

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Per transistor</b>						
$V_{CE0}$	collector-emitter voltage	open base	-	-	40	V
$I_C$	collector current		-	-	200	mA
$h_{FE}$	DC current gain	$V_{CE} = 1\text{ V}; I_C = 10\text{ mA}$	100	180	300	

## 5. Pinning information

Table 2. Pinning information

Pin	Symbol	Description	Simplified outline	Graphic symbol
1	E1	emitter TR1	 <p>Transparent top view DFN1412-6 (SOT1268)</p>	 <p>sym020</p>
2	B1	base TR1		
3	C2	collector TR2		
4	E2	emitter TR2		
5	B2	base TR2		
6	C1	collector TR1		
7	C1	collector TR1		
8	C2	collector TR2		

## 6. Ordering information

Table 3. Ordering information

Type number	Package		
	Name	Description	Version
PMBT3904RA	DFN1412-6	plastic, thermal enhanced ultra thin small outline package; no leads; 6 terminals; 1.4 mm x 1.2 mm x 0.47 mm body	SOT1268

## 7. Marking

Table 4. Marking codes

Type number	Marking code
PMBT3904RA	C6

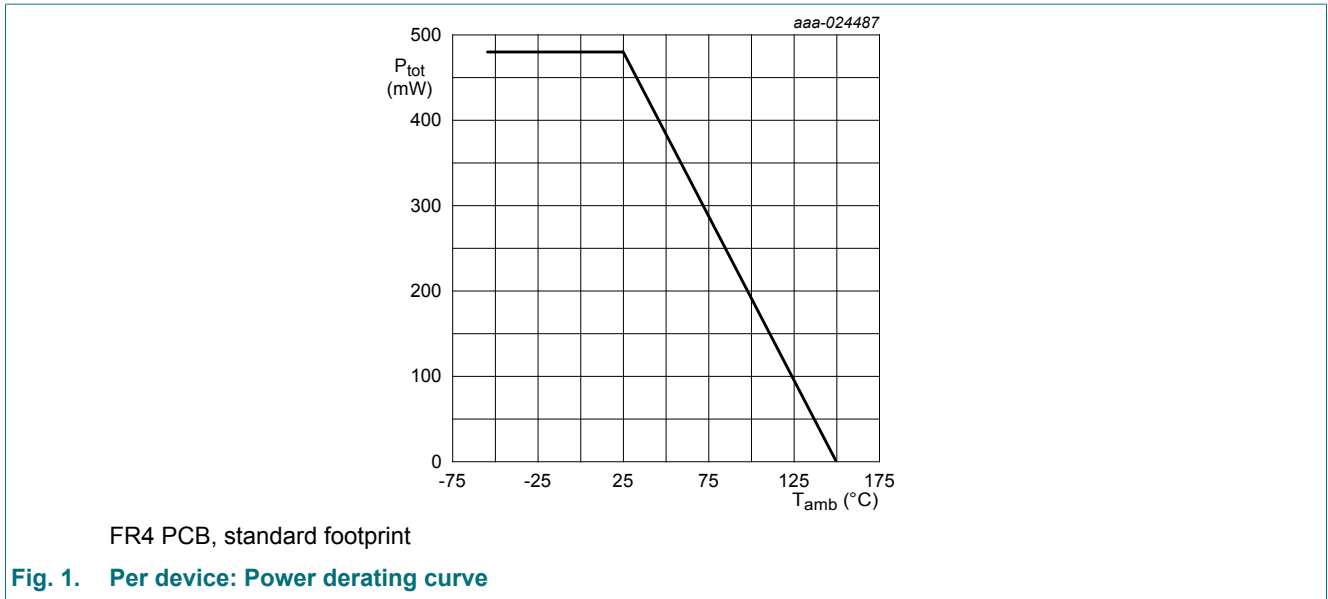
## 8. Limiting values

**Table 5. Limiting values**

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

Symbol	Parameter	Conditions		Min	Max	Unit
<b>Per transistor</b>						
$V_{CBO}$	collector-base voltage	open emitter		-	60	V
$V_{CEO}$	collector-emitter voltage	open base		-	40	V
$V_{EBO}$	emitter-base voltage	open collector		-	6	V
$I_C$	collector current			-	200	mA
$I_{CM}$	peak collector current	single pulse; $t_p \leq 1$ ms		-	200	mA
$I_{BM}$	peak base current			-	100	mA
$P_{tot}$	total power dissipation	$T_{amb} \leq 25$ °C	[1]	-	325	mW
<b>Per device</b>						
$P_{tot}$	total power dissipation	$T_{amb} \leq 25$ °C	[1]	-	480	mW
$T_j$	junction temperature			-	150	°C
$T_{amb}$	ambient temperature			-55	150	°C
$T_{stg}$	storage temperature			-65	150	°C

[1] Device mounted on an FR4 Printed-Circuit Board (PCB), single-sided copper, tin-plated and standard footprint.

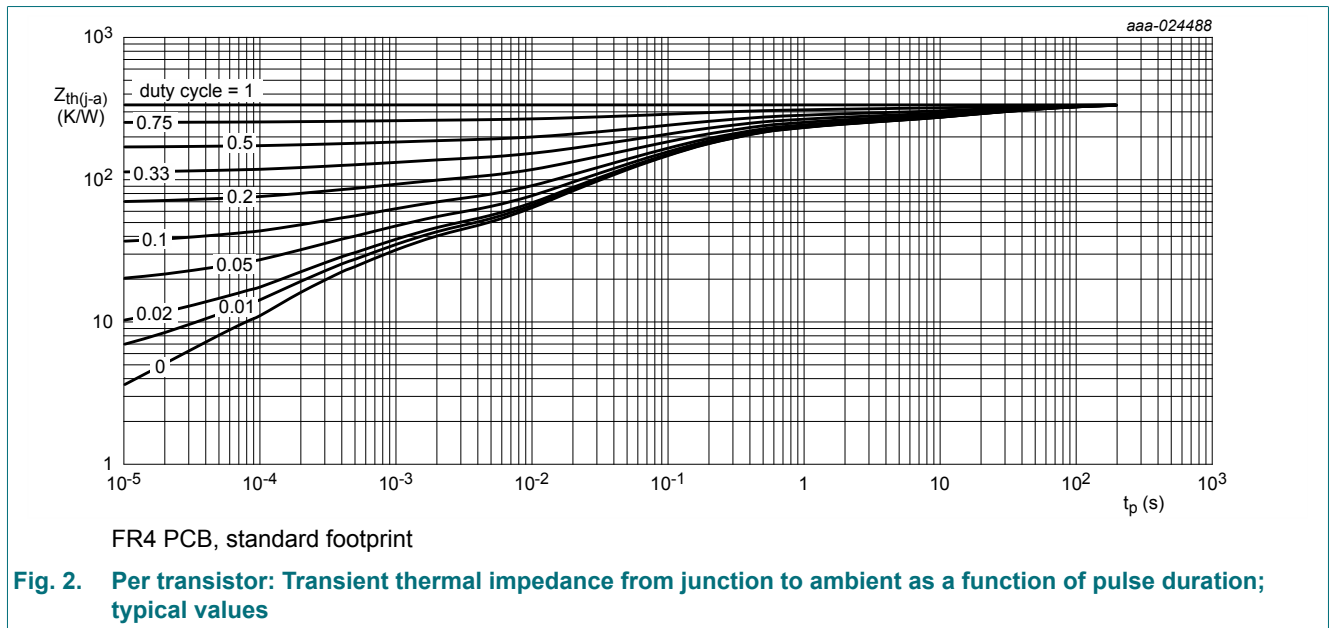


## 9. Thermal characteristics

Table 6. Thermal characteristics

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
<b>Per transistor</b>							
$R_{th(j-a)}$	thermal resistance from junction to ambient	in free air	[1]	-	-	385	K/W
<b>Per device</b>							
$R_{th(j-a)}$	thermal resistance from junction to ambient	in free air	[1]	-	-	261	K/W

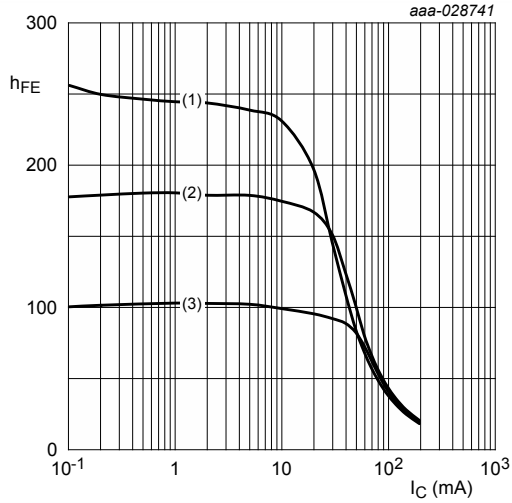
[1] Device mounted on an FR4 PCB, single-sided copper, tin-plated and standard footprint.



## 10. Characteristics

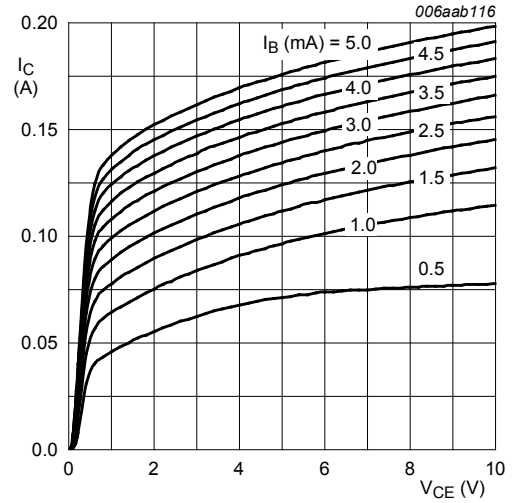
**Table 7. Characteristics**
 $T_{amb} = 25\text{ °C}$  unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Per transistor</b>						
$V_{(BR)CBO}$	collector-base breakdown voltage	$I_C = 100\ \mu\text{A}; I_E = 0\ \text{A}$	60	-	-	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	$I_C = 1\ \text{mA}; I_B = 0\ \text{A}$	40	-	-	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	$I_C = 0\ \text{A}; I_E = 100\ \mu\text{A}$	6	-	-	V
$I_{CBO}$	collector-base cut-off current	$V_{CB} = 30\ \text{V}; I_E = 0\ \text{A}$	-	-	50	nA
$I_{EBO}$	emitter-base cut-off current	$V_{EB} = 6\ \text{V}; I_C = 0\ \text{A}$	-	-	50	nA
$h_{FE}$	DC current gain	$V_{CE} = 1\ \text{V}; I_C = 100\ \mu\text{A}$	60	180	-	
		$V_{CE} = 1\ \text{V}; I_C = 1\ \text{mA}$	80	180	-	
		$V_{CE} = 1\ \text{V}; I_C = 10\ \text{mA}$	100	180	300	
		$V_{CE} = 1\ \text{V}; I_C = 50\ \text{mA}$	60	105	-	
		$V_{CE} = 1\ \text{V}; I_C = 100\ \text{mA};$ pulsed; $t_p \leq 300\ \mu\text{s}; \delta \leq 0.02$	30	50	-	
$V_{CEsat}$	collector-emitter saturation voltage	$I_C = 10\ \text{mA}; I_B = 1\ \text{mA}$	-	75	200	mV
		$I_C = 50\ \text{mA}; I_B = 5\ \text{mA}$	-	120	300	mV
$V_{BEsat}$	base-emitter saturation voltage	$I_C = 10\ \text{mA}; I_B = 1\ \text{mA}$	650	750	850	mV
		$I_C = 50\ \text{mA}; I_B = 5\ \text{mA}$	-	850	950	mV
$t_d$	delay time	$I_C = 10\ \text{mA}; I_{Bon} = 1\ \text{mA}; I_{Boff} = -1\ \text{mA}$	-	-	35	ns
$t_r$	rise time		-	-	35	ns
$t_{on}$	turn-on time		-	-	70	ns
$t_s$	storage time		-	-	200	ns
$t_f$	fall time		-	-	50	ns
$t_{off}$	turn-off time		-	-	250	ns
$C_c$	collector capacitance		$V_{CB} = 5\ \text{V}; I_E = 0\ \text{A}; i_e = 0\ \text{A}; f = 1\ \text{MHz}$	-	-	4
$C_e$	emitter capacitance	$V_{EB} = 0.5\ \text{V}; I_C = 0\ \text{A}; i_c = 0\ \text{A}; f = 1\ \text{MHz}$	-	-	8	pF
$f_T$	transition frequency	$V_{CE} = 20\ \text{V}; I_C = 10\ \text{mA}; f = 100\ \text{MHz}$	300	-	-	MHz



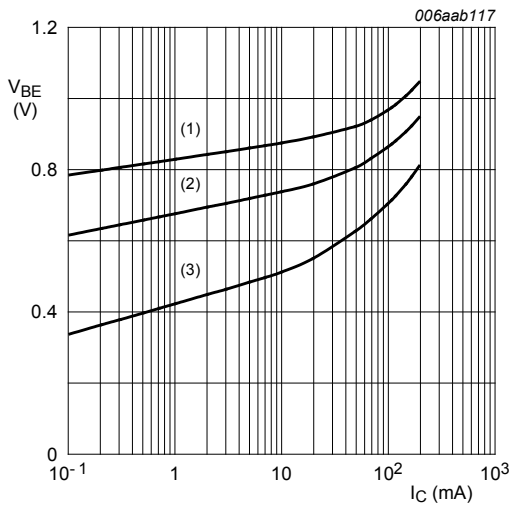
$V_{CE} = 1 V$   
 (1)  $T_{amb} = 100^\circ C$   
 (2)  $T_{amb} = 25^\circ C$   
 (3)  $T_{amb} = -55^\circ C$

Fig. 3. DC current gain as a function of collector current; typical values



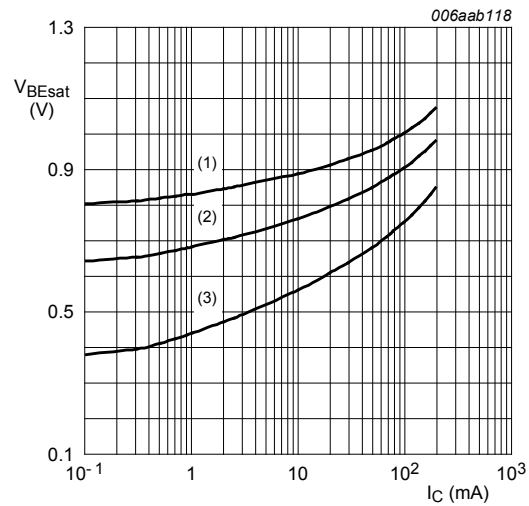
$T_{amb} = 25^\circ C$

Fig. 4. Collector current as a function of collector-emitter voltage; typical values



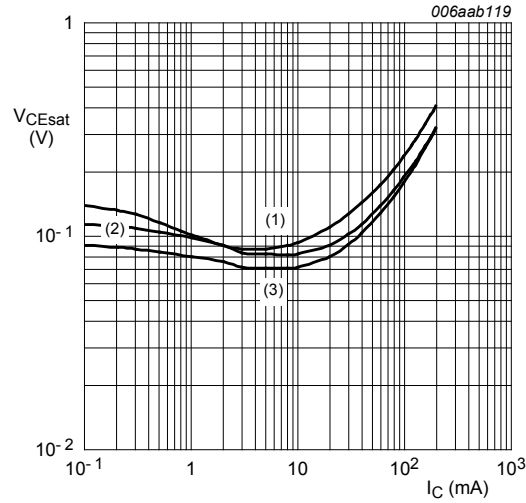
$V_{CE} = 1 V$   
 (1)  $T_{amb} = -55^\circ C$   
 (2)  $T_{amb} = 25^\circ C$   
 (3)  $T_{amb} = 150^\circ C$

Fig. 5. Base-emitter voltage as a function of collector current; typical values



$I_C/I_B = 10$   
 (1)  $T_{amb} = -55^\circ C$   
 (2)  $T_{amb} = 25^\circ C$   
 (3)  $T_{amb} = 150^\circ C$

Fig. 6. Base-emitter saturation voltage as a function of collector current; typical values



$I_C/I_B = 10$   
 (1)  $T_{amb} = 150\text{ }^\circ\text{C}$   
 (2)  $T_{amb} = 25\text{ }^\circ\text{C}$   
 (3)  $T_{amb} = -55\text{ }^\circ\text{C}$

**Fig. 7. Collector-emitter saturation voltage as a function of collector current; typical values**

### 11. Test information

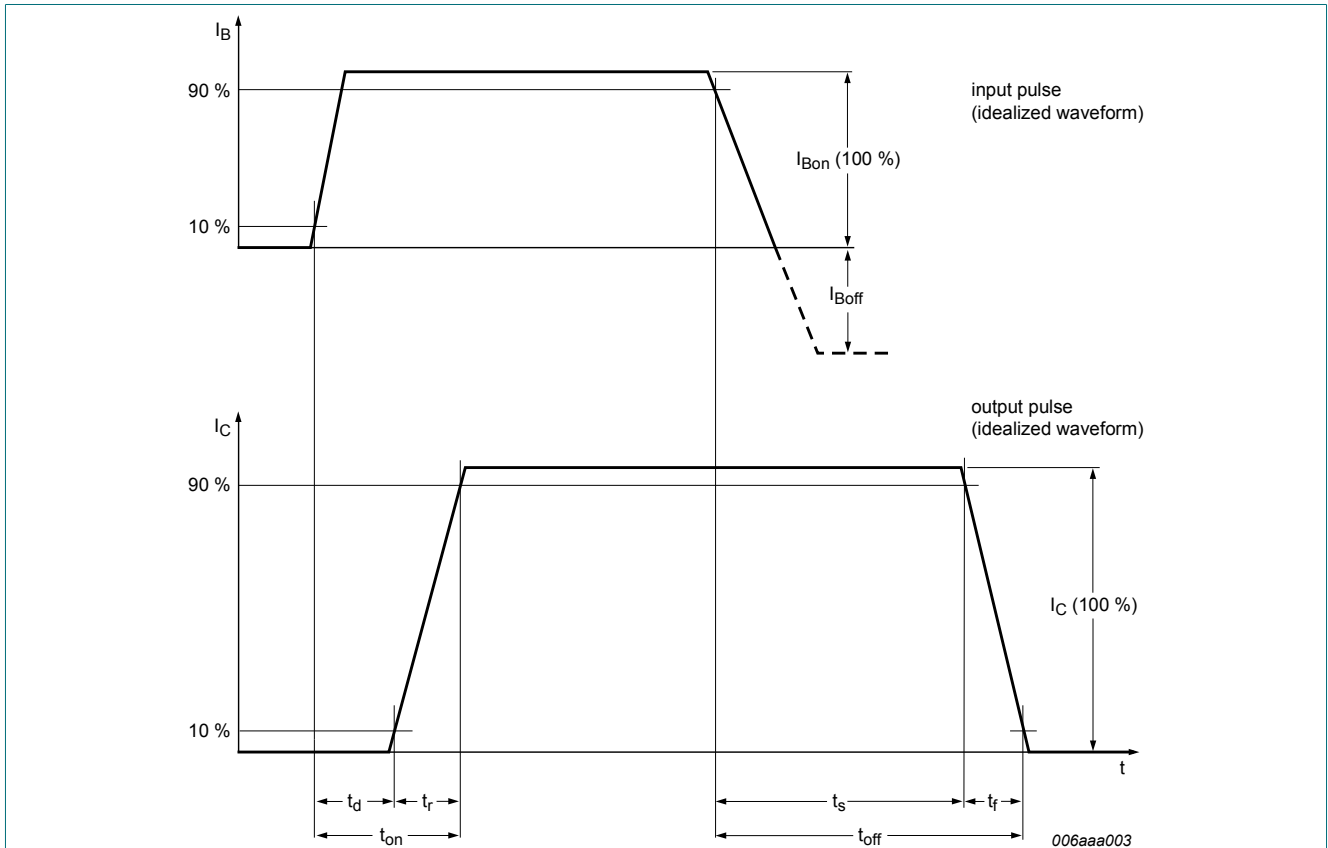


Fig. 8. Transistor switching time definition

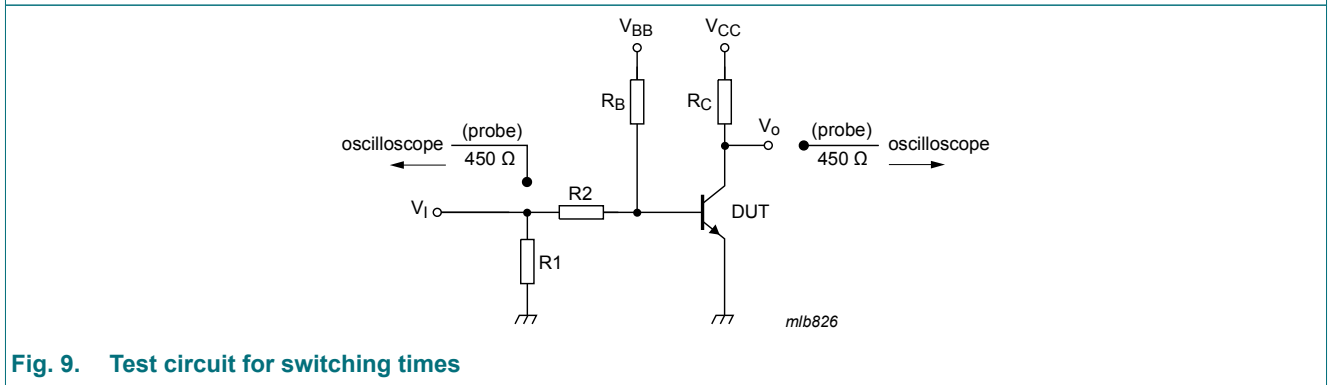


Fig. 9. Test circuit for switching times



## 12. Package outline

DFN1412-6: plastic thermal enhanced ultra thin small outline package; no leads; 6 terminals; body: 1.4 x 1.2 x 0.47 mm

SOT1268

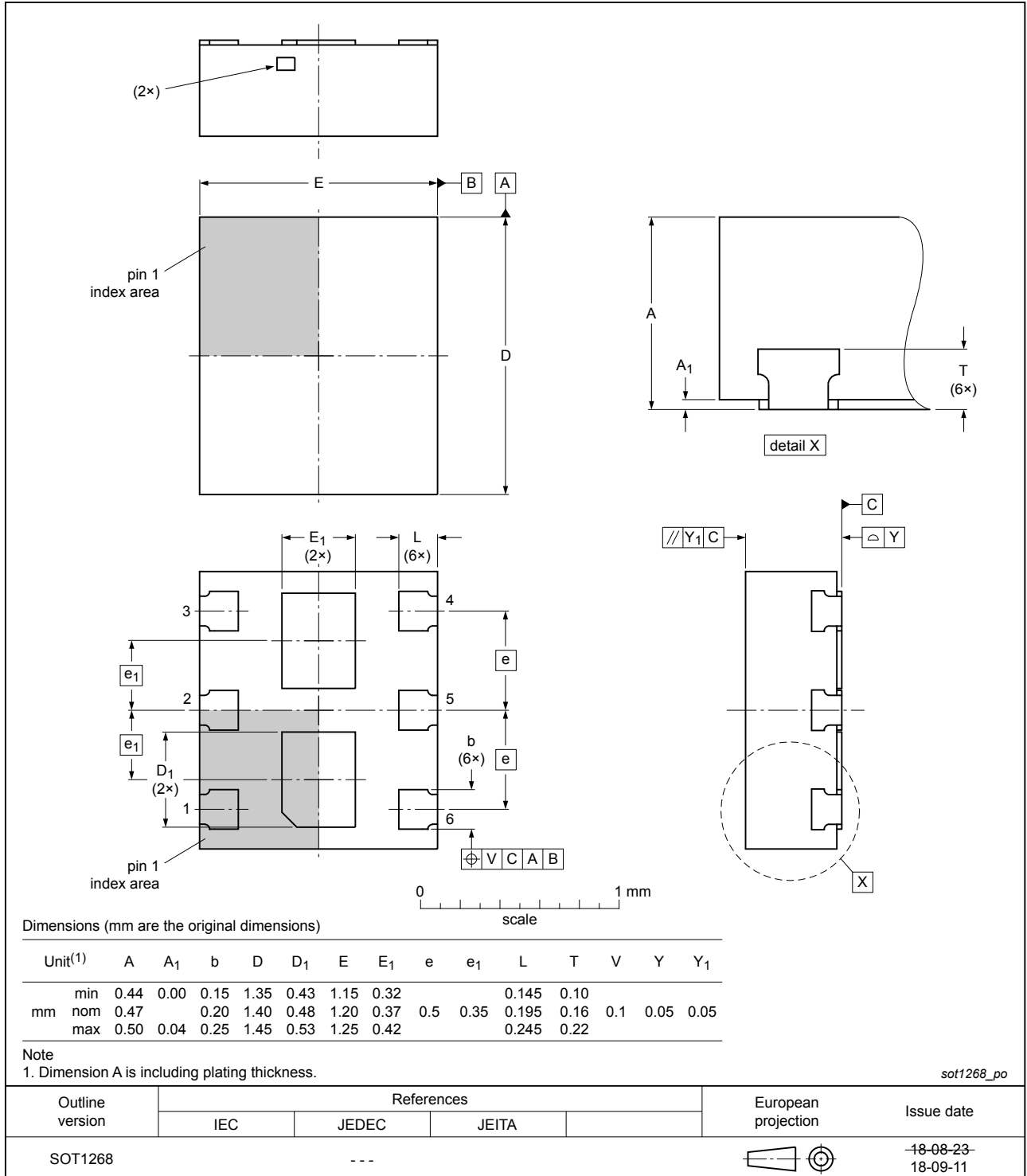


Fig. 10. Package outline DFN1412-6 (SOT1268)

### 13. Soldering

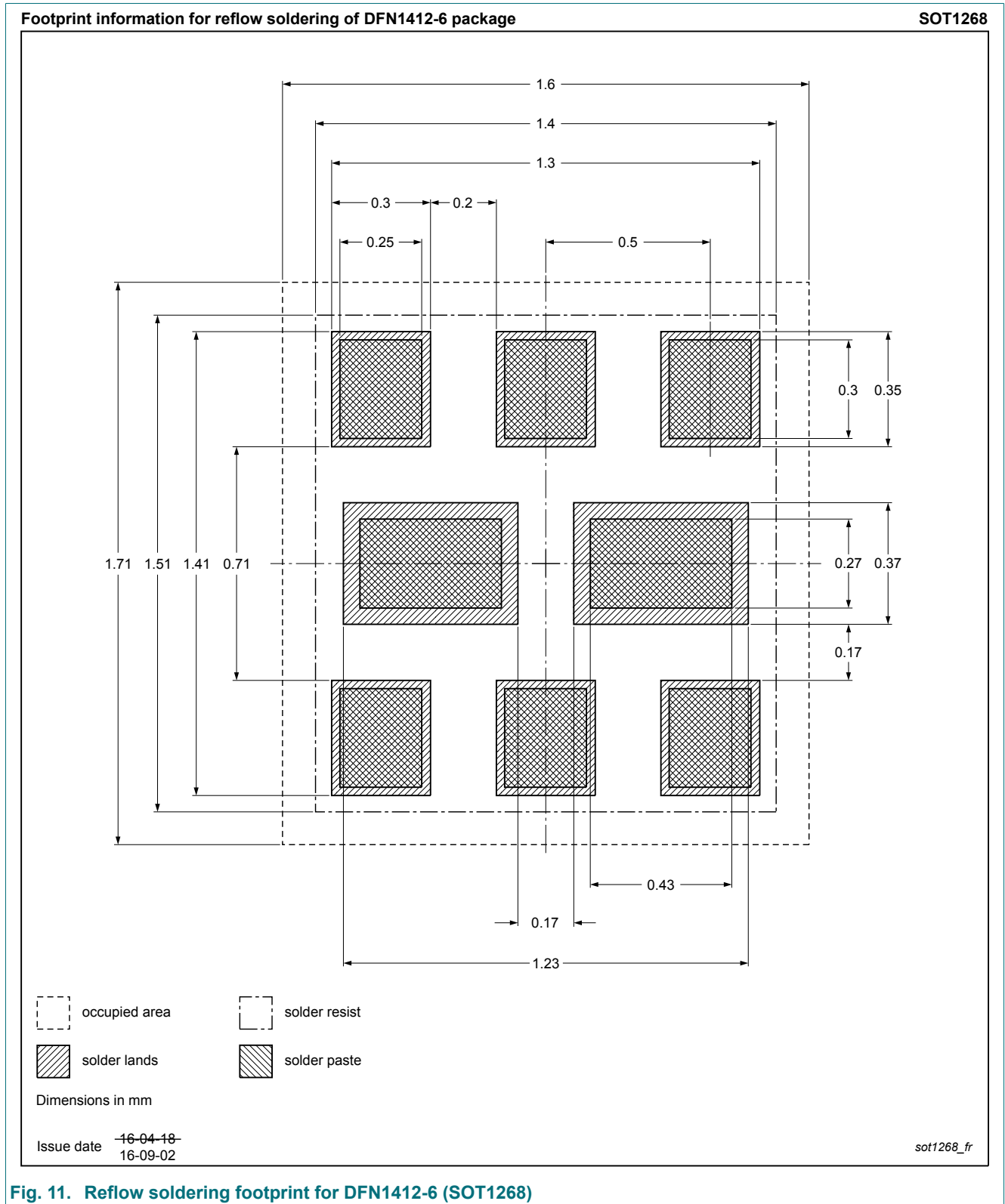


Fig. 11. Reflow soldering footprint for DFN1412-6 (SOT1268)

## 14. Revision history

Table 8. Revision history

Data sheet ID	Release date	Data sheet status	Change notice	Supersedes
PMBT3904RA v.1	20180913	Product data sheet	-	-

## 15. Legal information

### Data sheet status

Document status [1][2]	Product status [3]	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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## Contents

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1. General description.....	1
2. Features and benefits.....	1
3. Applications.....	1
4. Quick reference data.....	1
5. Pinning information.....	2
6. Ordering information.....	2
7. Marking.....	2
8. Limiting values.....	3
9. Thermal characteristics.....	4
10. Characteristics.....	5
11. Test information.....	8
12. Package outline.....	9
13. Soldering.....	10
14. Revision history.....	11
15. Legal information.....	12

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