



# 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

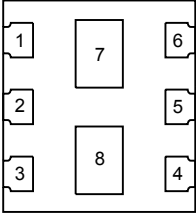
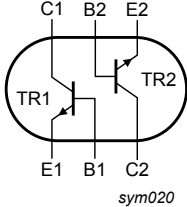
## 4. Quick reference data

Table 1. Quick reference data

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Per transistor						
$V_{CEO}$	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>	
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

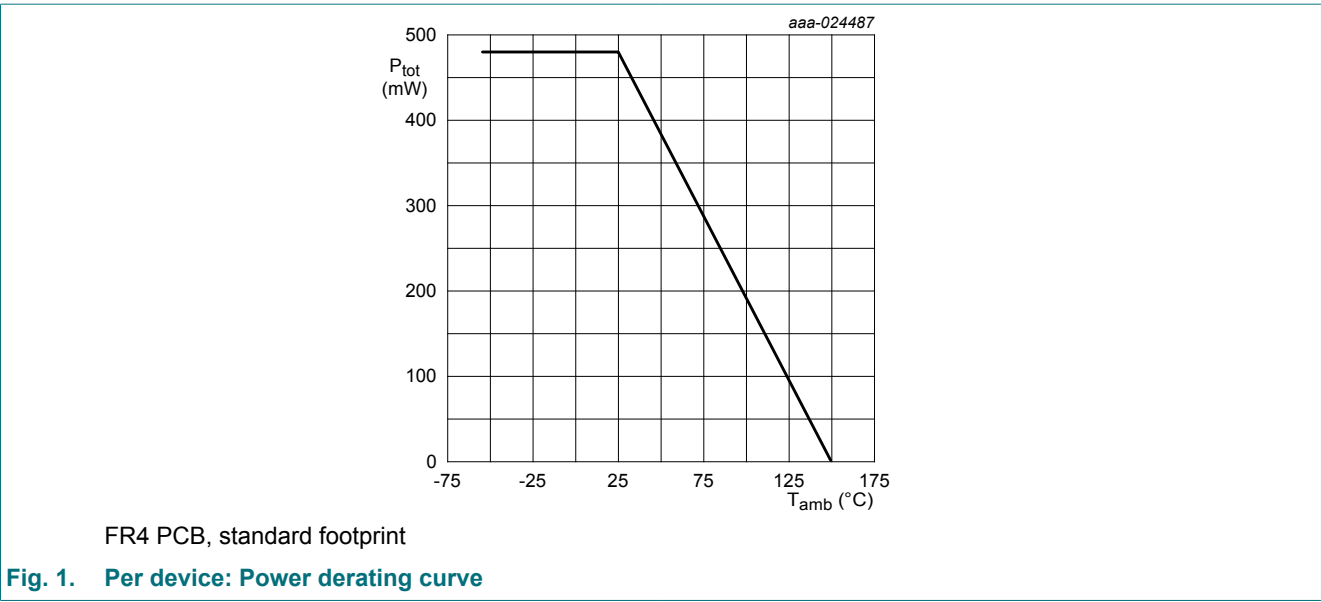
8. Limiting values

Table 5. Limiting values

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

Symbol	Parameter	Conditions		Min	Max	Unit
Per transistor						
V <sub>CBO</sub>	collector-base voltage	open emitter		-	60	V
V <sub>CEO</sub>	collector-emitter voltage	open base		-	40	V
V <sub>EBO</sub>	emitter-base voltage	open collector		-	6	V
I <sub>C</sub>	collector current			-	200	mA
I <sub>CM</sub>	peak collector current	single pulse; t <sub>p</sub> ≤ 1 ms		-	200	mA
I <sub>BM</sub>	peak base current			-	100	mA
P <sub>tot</sub>	total power dissipation	T <sub>amb</sub> ≤ 25 °C	[1]	-	325	mW
Per device						
P <sub>tot</sub>	total power dissipation	T <sub>amb</sub> ≤ 25 °C	[1]	-	480	mW
T <sub>j</sub>	junction temperature			-	150	°C
T <sub>amb</sub>	ambient temperature			-55	150	°C
T <sub>stg</sub>	storage temperature			-65	150	°C

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

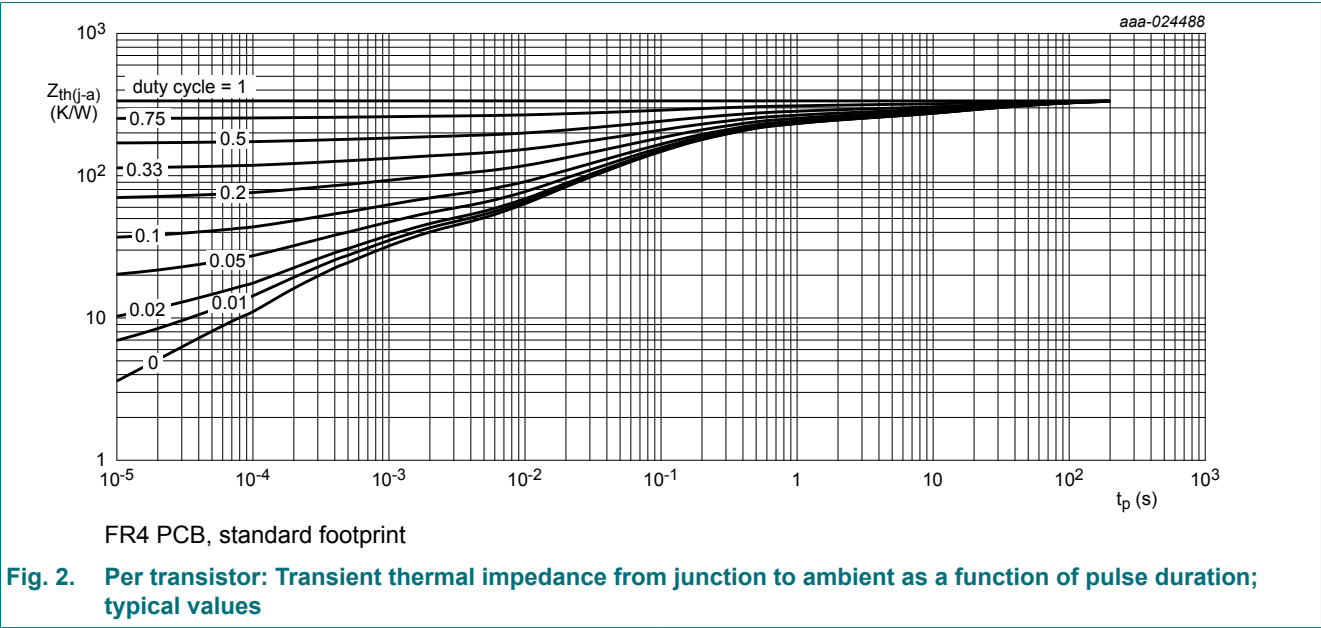


9. Thermal characteristics

Table 6. Thermal characteristics

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

$T_{amb} = 25\text{ }^{\circ}\text{C}$  unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>Per transistor</b>						
$V_{(BR)CBO}$	collector-base breakdown voltage	$I_C = 100\text{ }\mu\text{A}$ ; $I_E = 0\text{ A}$	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	$I_C = 0\text{ A}$ ; $I_E = 100\text{ }\mu\text{A}$	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	$V_{CE} = 1\text{ V}$ ; $I_C = 100\text{ }\mu\text{A}$	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; $t_p \leq 300\text{ }\mu\text{s}$ ; $\delta \leq 0.02$	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	pF
$C_e$	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

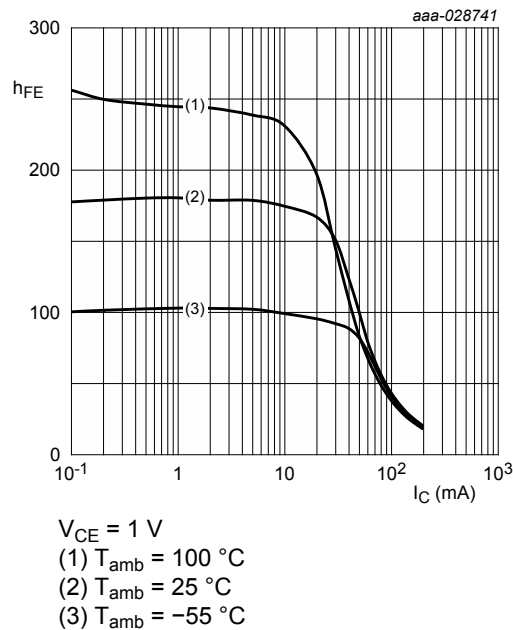


Fig. 3. DC current gain as a function of collector current; typical values

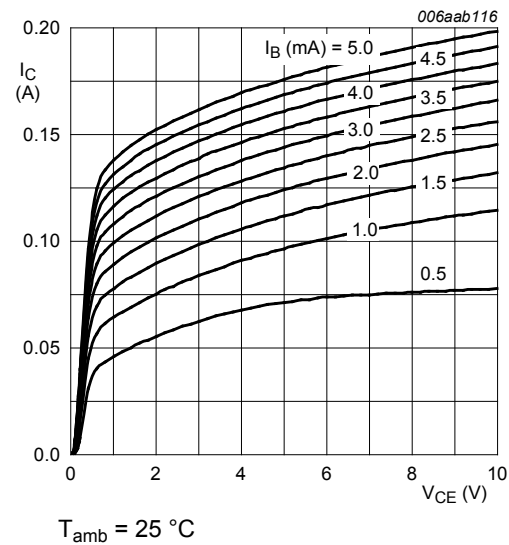


Fig. 4. Collector current as a function of collector-emitter voltage; typical values

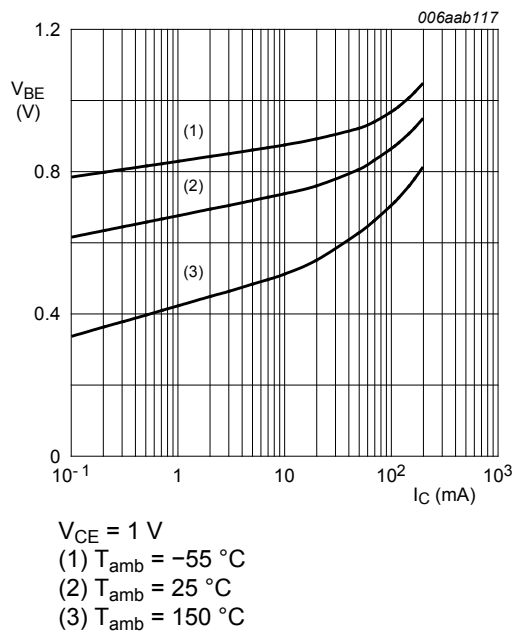


Fig. 5. Base-emitter voltage as a function of collector current; typical values

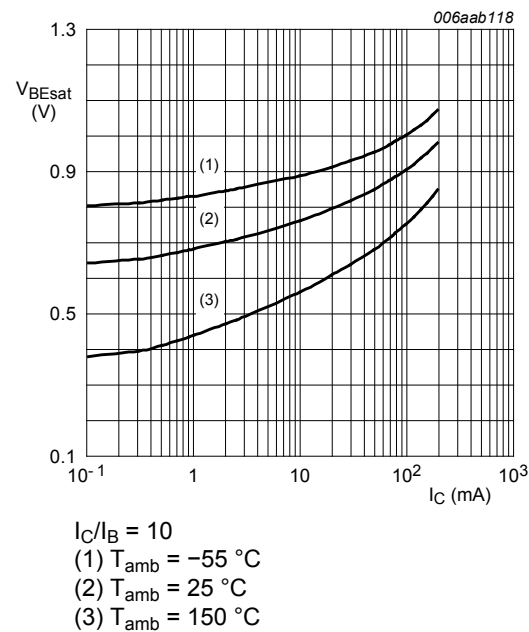
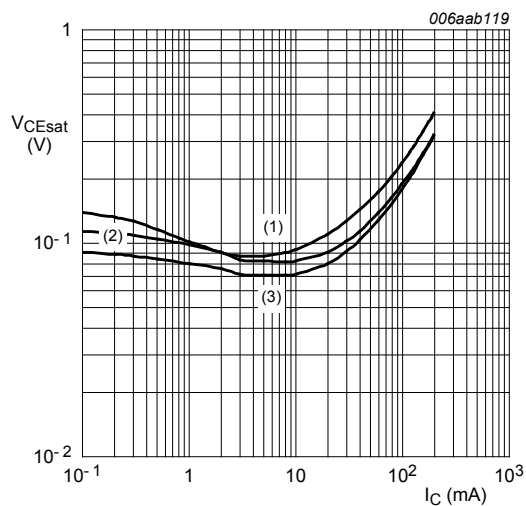


Fig. 6. Base-emitter saturation voltage as a function of collector current; typical values



$$I_C/I_B = 10$$

(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

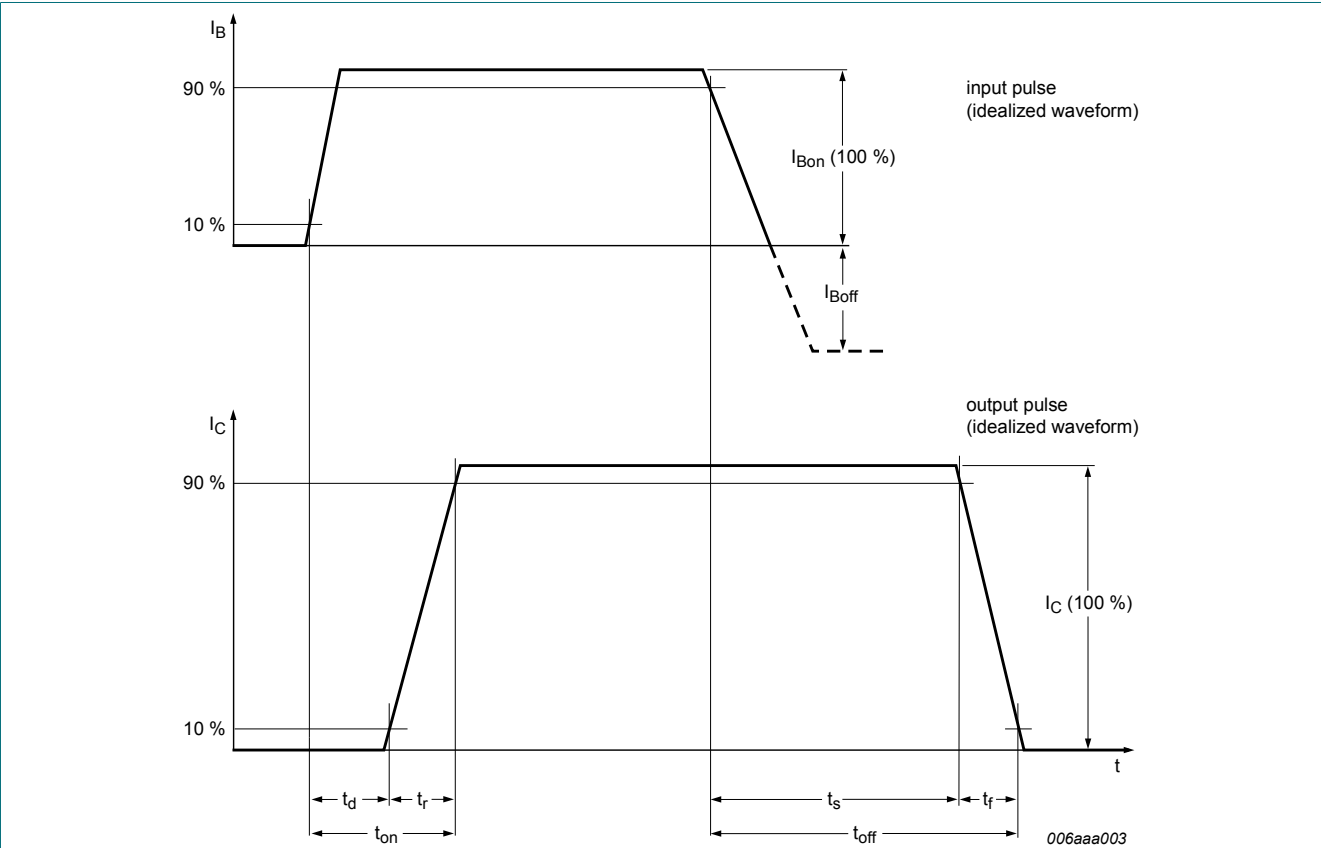


Fig. 8. Transistor switching time definition

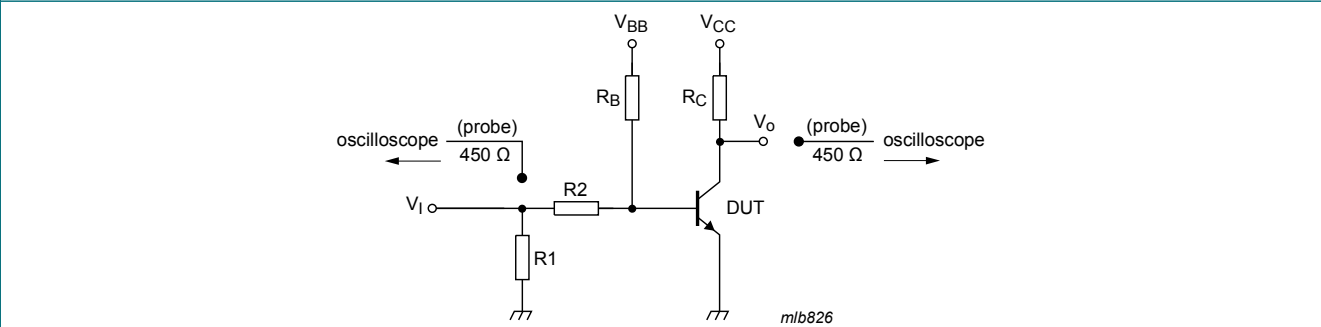


Fig. 9. Test circuit for switching times



12. Package outline

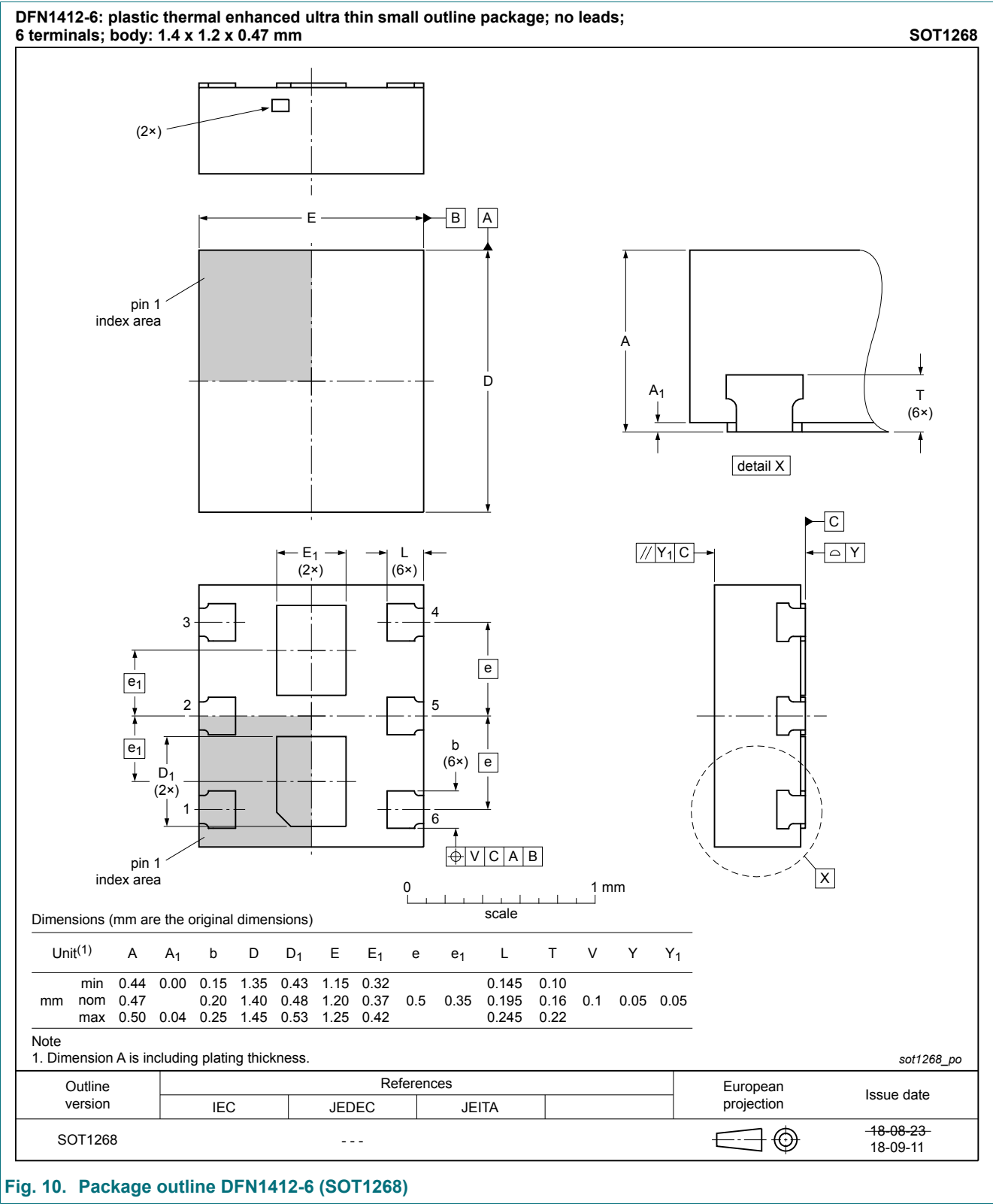


Fig. 10. Package outline DFN1412-6 (SOT1268)

13. Soldering

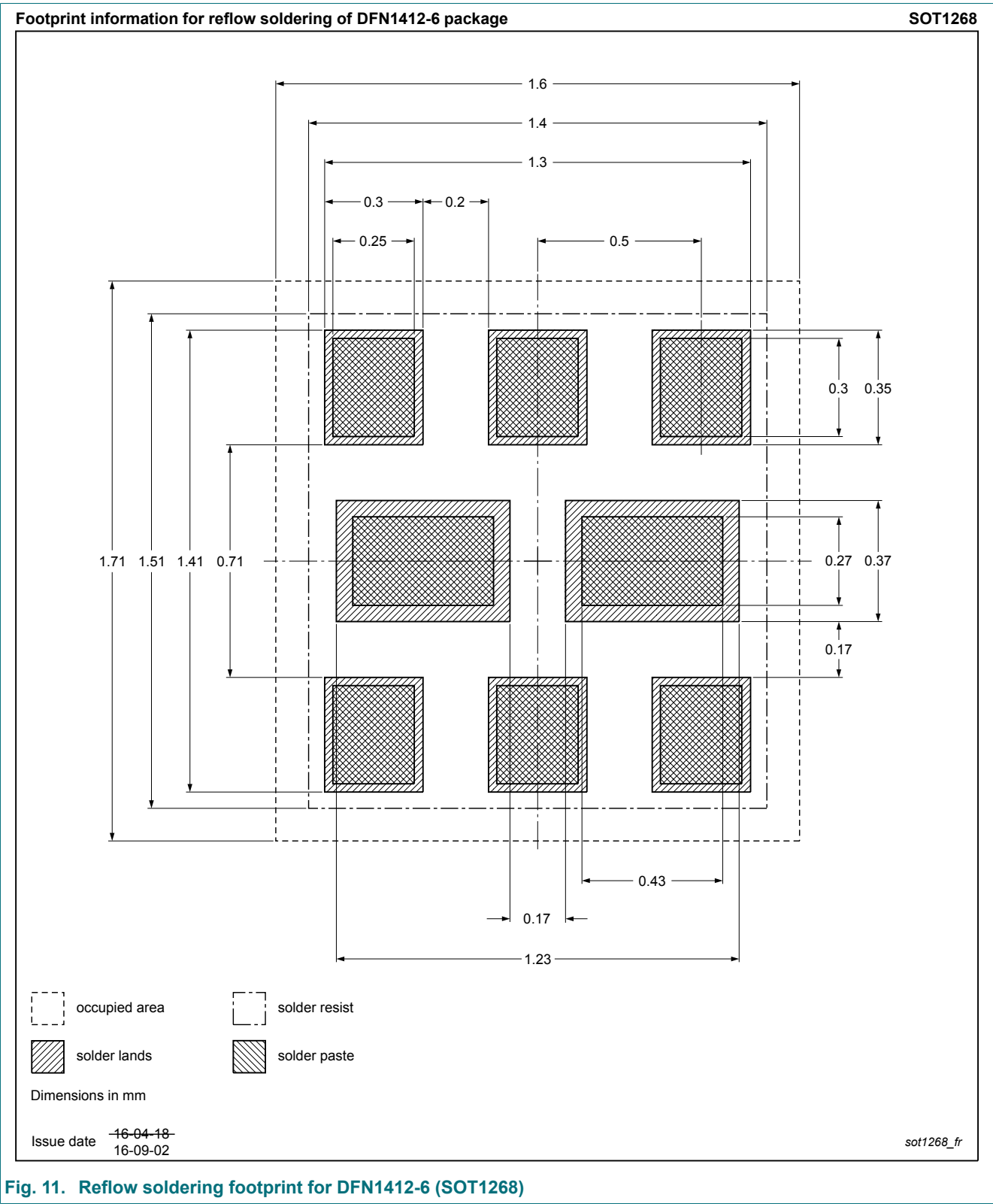


Fig. 11. Reflow soldering footprint for DFN1412-6 (SOT1268)

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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