

# PMEM4030NS

## NPN transistor/Schottky rectifier module

Rev. 02 — 8 July 2005

Product data sheet

## 1. Product profile

### 1.1 General description

Combination of a NPN transistor with low  $V_{CEsat}$  and high current capability and a planar Schottky barrier rectifier with an integrated guard ring for stress protection in a SOT96-1 (SO8/MS-012) small plastic package. PNP complement: PMEM4030PS.

### 1.2 Features

- 1 W total power dissipation
- High current capability up to 2 A
- Reduces Printed-Circuit Board (PCB) area required
- Reduces pick and place costs
- Small plastic Surface Mounted Device (SMD) package
- Transistor
  - ◆ Low collector-emitter saturation voltage
- Diode
  - ◆ High-speed switching
  - ◆ Low forward voltage
  - ◆ Guard ring protected

### 1.3 Applications

- DC-to-DC converters
- Inductive load drivers
- General-purpose load drivers

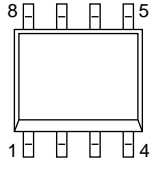
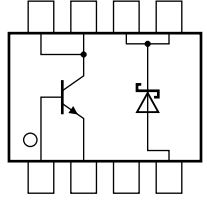
### 1.4 Quick reference data

Table 1: Quick reference data

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>NPN transistor</b>						
$V_{CEO}$	collector-emitter voltage	open base	-	-	50	V
$I_C$	collector current (DC)	continuous	-	-	2	A
<b>Schottky barrier rectifier</b>						
$V_R$	reverse voltage		-	-	40	V
$I_F$	forward current		-	-	1	A

## 2. Pinning information

**Table 2: Pinning**

Pin	Description	Simplified outline	Symbol
1	base		 <p>006aaa405</p>
2	emitter		
3	not connected		
4	anode		
5	cathode		
6	cathode		
7	collector		
8	collector		

## 3. Ordering information

**Table 3: Ordering information**

Type number	Package		
	Name	Description	Version
PMEM4030NS	SO8	plastic small outline package; 8 leads; body width 3.9 mm	SOT96-1

## 4. Marking

**Table 4: Marking codes**

Type number	Marking code
PMEM4030NS	P4030NS

## 5. Limiting values

**Table 5: Limiting values**

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

Symbol	Parameter	Conditions	Min	Max	Unit
<b>NPN transistor</b>					
$V_{CBO}$	collector-base voltage	open emitter	-	50	V
$V_{CEO}$	collector-emitter voltage	open base	-	50	V
$V_{EBO}$	emitter-base voltage	open collector	-	5	V
$I_C$	collector current (DC)	continuous	-	2	A
$I_{CRM}$	repetitive peak collector current	$t_p \leq 100$ ms; $\delta \leq 0.25$	-	3	A
$I_{CM}$	peak collector current		-	5	A
$I_B$	base current (DC)	continuous	-	0.5	A
$P_{tot}$	total power dissipation	$T_{amb} \leq 25$ °C	[1] - [2] -	550 1	mW W
$T_j$	junction temperature		-	150	°C
$T_{amb}$	ambient temperature		-65	+150	°C
<b>Schottky barrier rectifier</b>					
$V_R$	reverse voltage		-	40	V
$I_F$	forward current		-	1	A
$I_{FRM}$	repetitive peak forward current	$t_p \leq 1$ ms; $\delta \leq 0.25$	-	3.5	A
$I_{FSM}$	non-repetitive peak forward current	$t = 8.3$ $\mu$ s; half sine wave; JEDEC method	-	10	A
$I_{RSM}$	non-repetitive peak reverse current	$t_p \leq 100$ $\mu$ s	-	0.5	A
$T_j$	junction temperature		-	125	°C
$T_{amb}$	ambient temperature		-65	+125	°C
<b>Combined device</b>					
$T_{stg}$	storage temperature		-65	+150	°C

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

[2] Device mounted on an FR4 PCB, single-sided copper, tin-plated, mounting pad for collector 1 cm<sup>2</sup>.

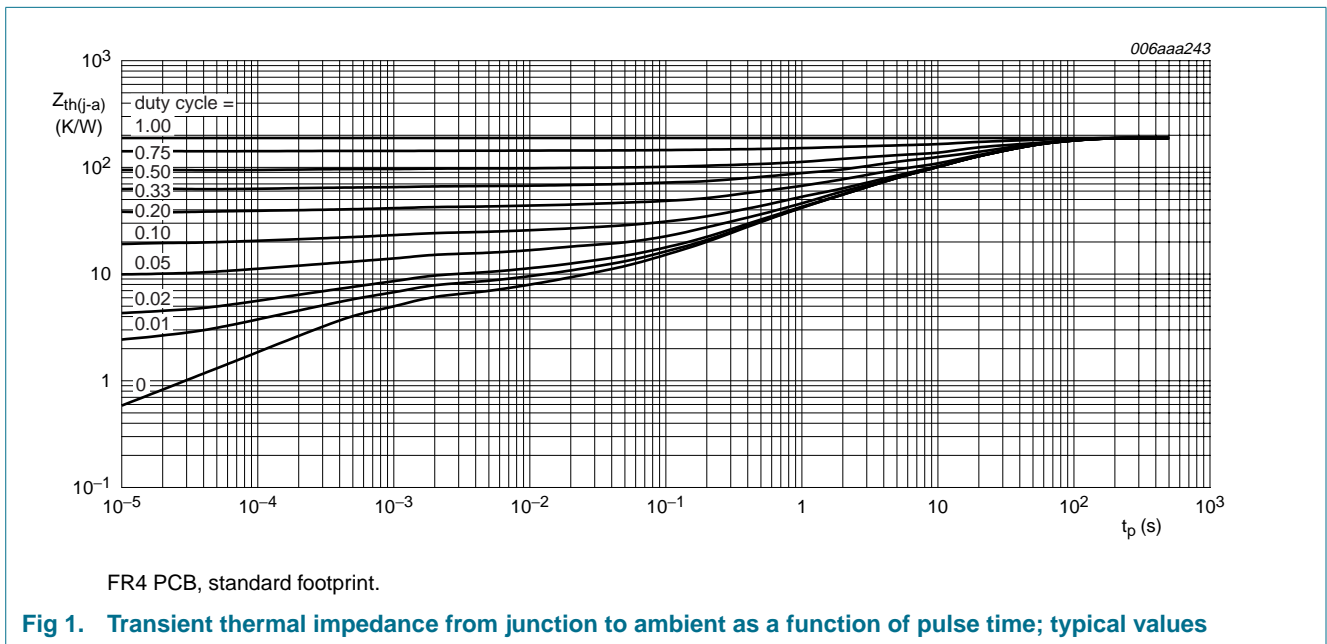
## 6. Thermal characteristics

**Table 6: Thermal characteristics**

Symbol	Parameter	Conditions	Min	Typ	Max	Unit	
$R_{th(j-a)}$	thermal resistance from junction to ambient	in free air	[1]	-	-	225	K/W
			[2]	-	-	125	K/W

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

[2] Device mounted on an FR4 PCB, single-sided copper, tin-plated, mounting pad for collector 1 cm<sup>2</sup>.



**Fig 1. Transient thermal impedance from junction to ambient as a function of pulse time; typical values**

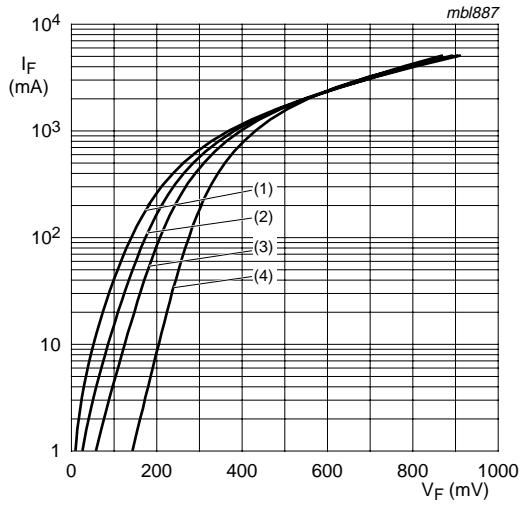
## 7. Characteristics

**Table 7: Characteristics**

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

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>NPN transistor</b>						
$I_{CBO}$	collector-base cut-off current	$V_{CB} = 50\text{ V}; I_E = 0\text{ A}$	-	-	100	nA
		$V_{CB} = 50\text{ V}; I_E = 0\text{ A}; T_j = 150\text{ }^{\circ}\text{C}$	-	-	50	$\mu\text{A}$
$I_{EBO}$	emitter-base cut-off current	$V_{EB} = 5\text{ V}; I_C = 0\text{ A}$	-	-	100	nA
$h_{FE}$	DC current gain	$V_{CE} = 2\text{ V}; I_C = 100\text{ mA}$	200	-	-	
		$V_{CE} = 2\text{ V}; I_C = 500\text{ mA}$	200	-	-	
		$V_{CE} = 2\text{ V}; I_C = 1\text{ A}$	[1] 200	-	450	
		$V_{CE} = 2\text{ V}; I_C = 2\text{ A}$	[1] 130	-	-	
		$V_{CE} = 2\text{ V}; I_C = 3\text{ A}$	[1] 80	-	-	
$V_{CEsat}$	collector-emitter saturation voltage	$I_C = 500\text{ mA}; I_B = 50\text{ mA}$	-	-	80	mV
		$I_C = 1\text{ A}; I_B = 50\text{ mA}$	-	-	160	mV
		$I_C = 2\text{ A}; I_B = 100\text{ mA}$	[1] -	-	280	mV
		$I_C = 2\text{ A}; I_B = 200\text{ mA}$	[1] -	-	260	mV
		$I_C = 3\text{ A}; I_B = 300\text{ mA}$	[1] -	-	370	mV
$R_{CEsat}$	collector-emitter saturation resistance	$I_C = 2\text{ A}; I_B = 200\text{ mA}$	[1] -	100	130	$\text{m}\Omega$
$V_{BEsat}$	base-emitter saturation voltage	$I_C = 2\text{ A}; I_B = 100\text{ mA}$	[1] -	-	1.1	V
		$I_C = 3\text{ A}; I_B = 300\text{ mA}$	[1] -	-	1.2	V
$V_{BEon}$	base-emitter turn-on voltage	$V_{CE} = 2\text{ V}; I_C = 1\text{ A}$	[1] 1.1	-	-	V
$f_T$	transition frequency	$V_{CE} = 5\text{ V}; I_C = 100\text{ mA}; f = 100\text{ MHz}$	100	-	-	MHz
$C_c$	collector capacitance	$V_{CB} = 10\text{ V}; I_E = I_e = 0\text{ A}; f = 1\text{ MHz}$	-	-	25	pF
<b>Schottky barrier rectifier</b>						
$V_F$	forward voltage	$I_F = 100\text{ mA}$	[1] -	280	330	mV
		$I_F = 1\text{ A}$	[1] -	460	500	mV
$I_R$	reverse current	$V_R = 10\text{ V}$	[1] -	15	40	$\mu\text{A}$
		$V_R = 40\text{ V}$	[1] -	60	300	$\mu\text{A}$
$C_d$	diode capacitance	$V_R = 4\text{ V}; f = 1\text{ MHz};$	-	65	80	pF

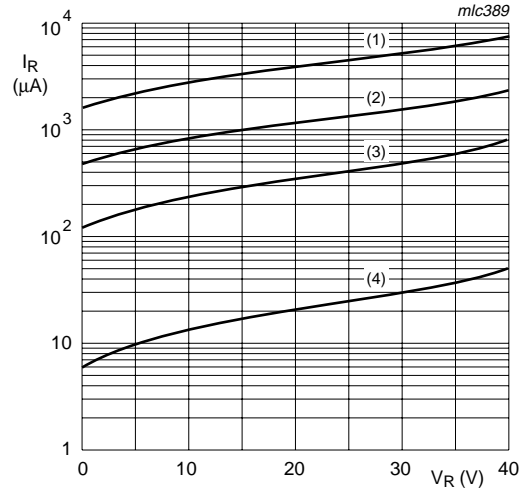
[1] Pulse test:  $t_p \leq 300\text{ }\mu\text{s}; \delta \leq 0.02$ .



**Schottky barrier rectifier**

- (1)  $T_{amb} = 125\text{ °C}$
- (2)  $T_{amb} = 100\text{ °C}$
- (3)  $T_{amb} = 75\text{ °C}$
- (4)  $T_{amb} = 25\text{ °C}$

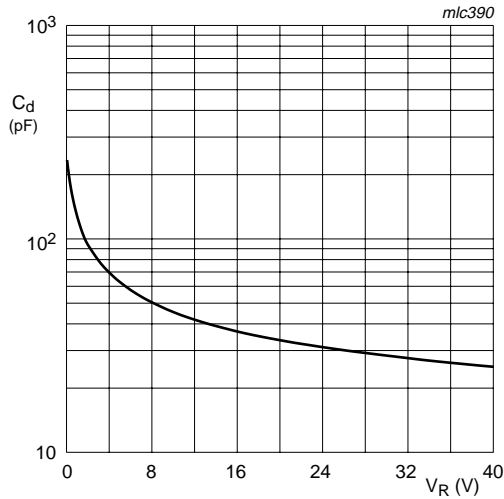
**Fig 2. Forward current as a function of forward voltage; typical values**



**Schottky barrier rectifier**

- (1)  $T_{amb} = 125\text{ °C}$
- (2)  $T_{amb} = 100\text{ °C}$
- (3)  $T_{amb} = 75\text{ °C}$
- (4)  $T_{amb} = 25\text{ °C}$

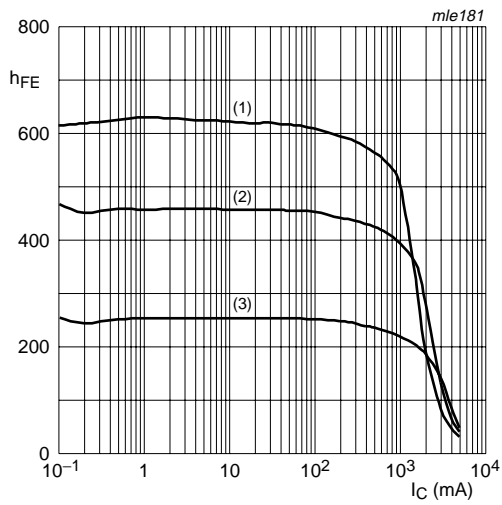
**Fig 3. Reverse current as a function of reverse voltage; typical values**



**Schottky barrier rectifier**

$f = 1\text{ MHz}$

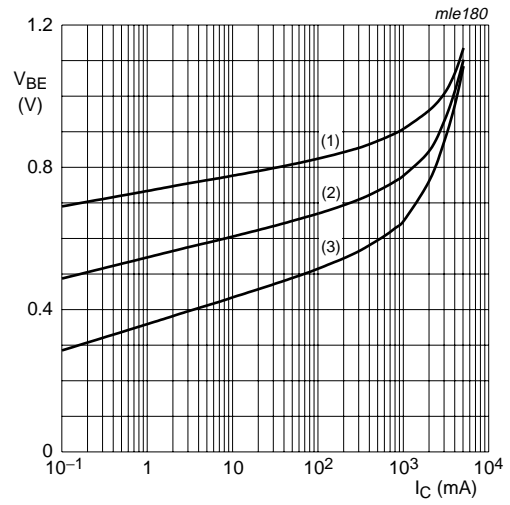
**Fig 4. Diode capacitance as a function of reverse voltage; typical values**



**NPN transistor;  $V_{CE} = 2\text{ V}$**

- (1)  $T_{amb} = 100\text{ °C}$
- (2)  $T_{amb} = 25\text{ °C}$
- (3)  $T_{amb} = -55\text{ °C}$

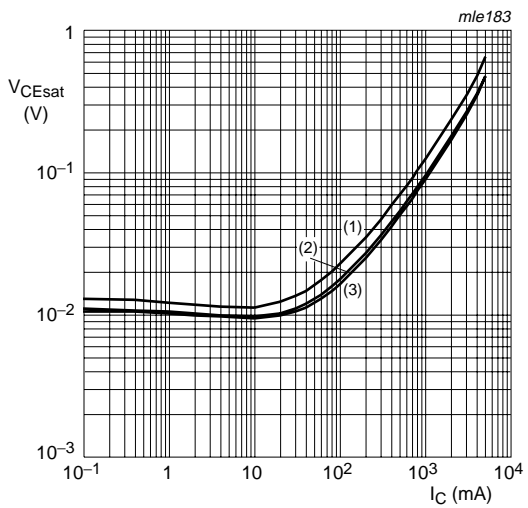
**Fig 5. DC current gain as a function of collector current; typical values**



**NPN transistor;  $V_{CE} = 2\text{ V}$**

- (1)  $T_{amb} = -55\text{ °C}$
- (2)  $T_{amb} = 25\text{ °C}$
- (3)  $T_{amb} = 100\text{ °C}$

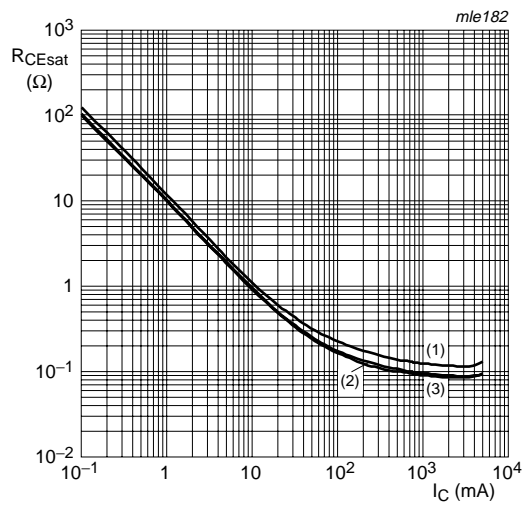
**Fig 6. Base-emitter voltage as a function of collector current; typical values**



**NPN transistor;  $I_C/I_B = 20$**

- (1)  $T_{amb} = 100\text{ °C}$
- (2)  $T_{amb} = 25\text{ °C}$
- (3)  $T_{amb} = -55\text{ °C}$

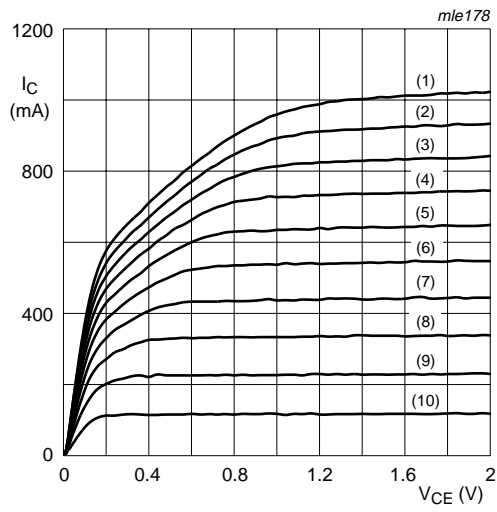
**Fig 7. Collector-emitter saturation voltage as a function of collector current; typical values**



**NPN transistor;  $I_C/I_B = 20$**

- (1)  $T_{amb} = 150\text{ °C}$
- (2)  $T_{amb} = 25\text{ °C}$
- (3)  $T_{amb} = -55\text{ °C}$

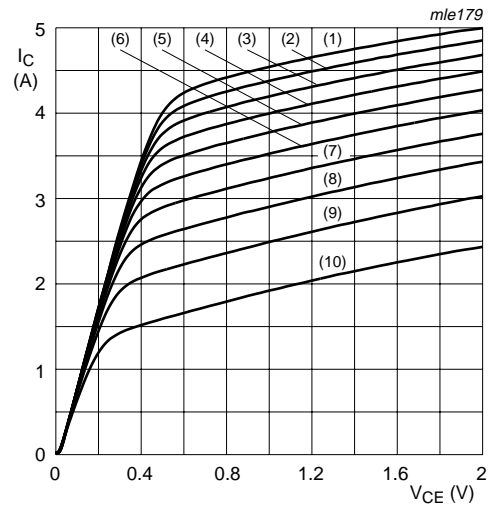
**Fig 8. Collector-emitter saturation resistance as a function of collector current; typical values**



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

- (1)  $I_B = 2600\text{ }\mu\text{A}$
- (2)  $I_B = 2340\text{ }\mu\text{A}$
- (3)  $I_B = 2080\text{ }\mu\text{A}$
- (4)  $I_B = 1820\text{ }\mu\text{A}$
- (5)  $I_B = 1560\text{ }\mu\text{A}$
- (6)  $I_B = 1300\text{ }\mu\text{A}$
- (7)  $I_B = 1040\text{ }\mu\text{A}$
- (8)  $I_B = 780\text{ }\mu\text{A}$
- (9)  $I_B = 520\text{ }\mu\text{A}$
- (10)  $I_B = 260\text{ }\mu\text{A}$

**Fig 9. Collector current as a function of collector-emitter voltage; typical values**

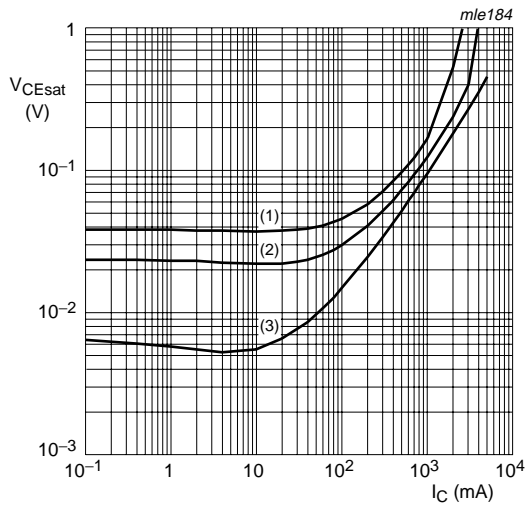


$T_{amb} = 25\text{ }^{\circ}\text{C}$

- (1)  $I_B = 120\text{ mA}$
- (2)  $I_B = 108\text{ mA}$
- (3)  $I_B = 96\text{ mA}$
- (4)  $I_B = 84\text{ mA}$
- (5)  $I_B = 72\text{ mA}$
- (6)  $I_B = 60\text{ mA}$
- (7)  $I_B = 48\text{ mA}$
- (8)  $I_B = 36\text{ mA}$
- (9)  $I_B = 24\text{ mA}$
- (10)  $I_B = 12\text{ mA}$

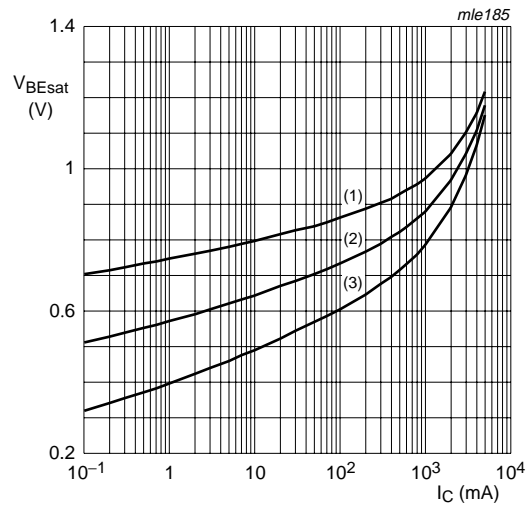
**Fig 10. Collector current as a function of collector-emitter voltage; typical values**





$T_{amb} = 25\text{ }^{\circ}\text{C}$   
 (1)  $I_C/I_B = 100$   
 (2)  $I_C/I_B = 50$   
 (3)  $I_C/I_B = 10$

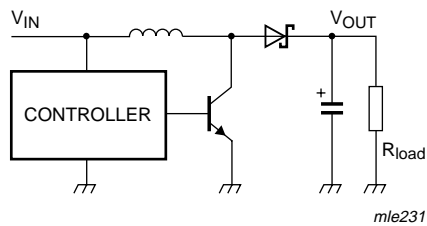
**Fig 11. Collector-emitter saturation voltage as a function of collector current; typical values**



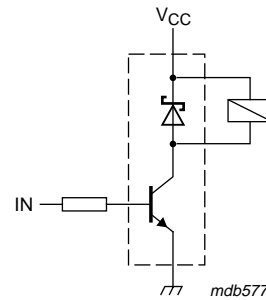
$I_C/I_B = 20$   
 (1)  $T_{amb} = -55\text{ }^{\circ}\text{C}$   
 (2)  $T_{amb} = 25\text{ }^{\circ}\text{C}$   
 (3)  $T_{amb} = 100\text{ }^{\circ}\text{C}$

**Fig 12. Base-emitter saturation voltage as a function of collector current; typical values**

## 8. Application information



**Fig 13. DC-to-DC converter**



**Fig 14. Inductive load driver (relays, motors and buzzers) with free-wheeling diode**

**9. Package outline**

SO8: plastic small outline package; 8 leads; body width 3.9 mm

SOT96-1



Fig 15. Package outline SOT96-1 (SO8/MS-012)

## 10. Packing information

**Table 8: Packing methods**

The indicated -xxx are the last three digits of the 12NC ordering code. [1]

Type number	Package	Description	Packing quantity	
			1000	2500
PMEM4030NS	SOT96-1	8 mm pitch, 12 mm tape and reel	-115	-118

[1] For further information and the availability of packing methods, see [Section 16](#).

## 11. Revision history

**Table 9: Revision history**

Document ID	Release date	Data sheet status	Change notice	Doc. number	Supersedes
PMEM4030NS_2	20050708	Product data sheet	-	-	PMEM4030NS_1
Modifications:	<ul style="list-style-type: none"><li>• <a href="#">Table 5 "Limiting values"</a>: <math>I_{CRP}</math> repetitive pulsed collector current renamed to <math>I_{CRM}</math> repetitive peak collector current</li></ul>				
PMEM4030NS_1	20050525	Product data sheet	-	9397 750 15065	-

## 12. Data sheet status

Level	Data sheet status <sup>[1]</sup>	Product status <sup>[2] [3]</sup>	Definition
I	Objective data	Development	This data sheet contains data from the objective specification for product development. Philips Semiconductors reserves the right to change the specification in any manner without notice.
II	Preliminary data	Qualification	This data sheet contains data from the preliminary specification. Supplementary data will be published at a later date. Philips Semiconductors reserves the right to change the specification without notice, in order to improve the design and supply the best possible product.
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[2] The product status of the device(s) described in this data sheet may have changed since this data sheet was published. The latest information is available on the Internet at URL <http://www.semiconductors.philips.com>.

[3] For data sheets describing multiple type numbers, the highest-level product status determines the data sheet status.

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**Limiting values definition** — Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 60134). Stress above one or more of the limiting values may cause permanent damage to the device. These are stress ratings only and operation of the device at these or at any other conditions above those given in the Characteristics sections of the specification is not implied. Exposure to limiting values for extended periods may affect device reliability.

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