



PMEM4020AND

NPN transistor/Schottky rectifier module

Rev. 01 — 4 October 2004

Product data sheet

1. Product profile

1.1 General description

Combination of an 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 SOT457 (SC-74) small plastic package. PNP complement: PMEM4020APD.

1.2 Features

- 600 mW total power dissipation
- High current capability up to 2 A
- Reduces printed-circuit board area required
- Reduces pick and place costs
- Small plastic SMD package
- Transistor
 - ◆ Low collector-emitter saturation voltage.
- Diode
 - ◆ Ultra high-speed switching
 - ◆ Very low forward voltage
 - ◆ Guard ring protected.

1.3 Applications

- DC-to-DC converters
- Inductive load drivers
- General purpose load drivers
- Reverse polarity protection circuits
- MOSFET drivers.

1.4 Quick reference data

Table 1: Quick reference data

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
NPN transistor						
V_{CEO}	collector-emitter voltage	open base	-	-	40	V
I_C	collector current (DC)	continuous; $T_s \leq 55\text{ °C}$	[1] -	-	2	A

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Table 1: Quick reference data ...continued

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Schottky barrier rectifier						
V_R	continuous reverse voltage		-	-	40	V
I_F	continuous forward current		-	-	1	A

[1] Soldering point of collector or cathode tab.

2. Pinning information

Table 2: Discrete pinning

Pin	Description	Simplified outline	Symbol
1	emitter		<p style="text-align: right;"><i>sym041</i></p>
2	not connected		
3	cathode		
4	anode		
5	base		
6	collector		

3. Ordering information

Table 3: Ordering information

Type number	Package		
	Name	Description	Version
PMEM4020AND	SC-74	plastic surface mounted package; 6 leads	SOT457

4. Marking

Table 4: Marking

Type number	Marking code
PMEM4020AND	D2

5. Limiting values

Table 5: Limiting values

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

Symbol	Parameter	Conditions	Min	Max	Unit
NPN transistor					
V_{CBO}	collector-base voltage	open emitter	-	40	V
V_{CEO}	collector-emitter voltage	open base	-	40	V
V_{EBO}	emitter-base voltage	open collector	-	5	V

Table 5: Limiting values ...continued

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

Symbol	Parameter	Conditions	Min	Max	Unit
I_C	collector current (DC)	continuous	[1] -	0.95	A
		continuous	[2] -	1.30	A
		continuous	[3] -	1.65	A
		continuous; $T_s \leq 55\text{ °C}$	[4] -	2	A
I_{CM}	peak collector current		-	3	A
I_{BM}	peak base current		-	1	A
P_{tot}	total power dissipation	$T_{amb} \leq 25\text{ °C}$	[1] -	295	mW
		$T_{amb} \leq 25\text{ °C}$	[2] -	400	mW
		$T_{amb} \leq 25\text{ °C}$	[3] -	500	mW
		$T_s \leq 55\text{ °C}$	[4] -	1000	mW
T_j	junction temperature		-	150	°C
Schottky barrier rectifier					
V_R	continuous reverse voltage		-	40	V
I_F	continuous forward current		-	1	A
I_{FRM}	repetitive peak forward current	$t_p \leq 1\text{ ms}; \delta \leq 0.5$	-	3.5	A
I_{FSM}	non-repetitive peak forward current	$t = 8\text{ ms}$; square wave	-	10	A
P_{tot}	total power dissipation	$T_{amb} \leq 25\text{ °C}$	[1] -	295	mW
		$T_{amb} \leq 25\text{ °C}$	[2] -	400	mW
		$T_{amb} \leq 25\text{ °C}$	[3] -	500	mW
		$T_s \leq 55\text{ °C}$	[4] -	1000	mW
T_j	junction temperature		[2] -	150	°C
Combined device					
P_{tot}	total power dissipation	$T_{amb} \leq 25\text{ °C}$	[2] -	600	mW
T_{stg}	storage temperature		-65	+150	°C
T_{amb}	ambient temperature		[2] -65	+150	°C

[1] Mounted on a FR4 printed-circuit board, single-sided copper, tin-plated, standard footprint.

[2] Device mounted on a printed-circuit board, single-sided copper, tin-plated, 1 cm² mounting pad for both collector and cathode.

[3] Mounted on a ceramic printed-circuit board, single-sided copper, tin-plated, standard footprint.

[4] Soldering point of collector or cathode tab.

6. Thermal characteristics

Table 6: Thermal characteristics [1]

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Single device						
$R_{th(j-s)}$	thermal resistance from junction to soldering point	in free air	[2] -	-	95	K/W
$R_{th(j-a)}$	thermal resistance from junction to ambient	in free air	[3] -	-	250	K/W
			[4] -	-	315	K/W
			[5] -	-	425	K/W
Combined device						
$R_{th(j-a)}$	thermal resistance from junction to ambient	in free air	[3] -	-	208	K/W

[1] For Schottky barrier rectifiers thermal run-away has to be considered, as in some applications the reverse power losses P_R are a significant part of the total power losses. Nomograms for determining the reverse power losses P_R and $I_{F(AV)}$ rating will be available on request.

[2] Soldering point of collector or cathode tab.

[3] Mounted on a ceramic printed-circuit board, single-sided copper, tin-plated, standard footprint.

[4] Device mounted on a printed-circuit board, single-sided copper, tin-plated, 1 cm² mounting pad for both collector and cathode tab.

[5] Mounted on a FR4 printed-circuit board, single-sided copper, tin-plated, standard footprint.

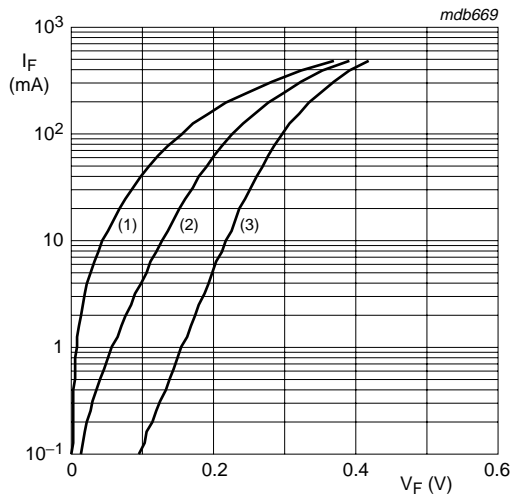
7. Characteristics

Table 7: Characteristics

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

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
NPN transistor						
I_{CBO}	collector-base cut-off current	$V_{CB} = 40\text{ V}; I_E = 0\text{ A}$	-	-	100	nA
		$V_{CB} = 40\text{ V}; I_E = 0\text{ A}; T_j = 150\text{ }^{\circ}\text{C}$	-	-	50	μA
I_{CEO}	collector-emitter cut-off current	$V_{CE} = 30\text{ V}; I_B = 0\text{ A}$	-	-	100	nA
I_{EBO}	emitter-base cut-off current	$V_{EB} = 5\text{ V}; I_C = 0\text{ A}$	-	-	100	nA
h_{FE}	DC current gain	$V_{CE} = 5\text{ V}; I_C = 1\text{ mA}$	300	-	-	
		$V_{CE} = 5\text{ V}; I_C = 500\text{ mA}$	300	-	900	
		$V_{CE} = 5\text{ V}; I_C = 1\text{ A}$	200	-	-	
		$V_{CE} = 5\text{ V}; I_C = 2\text{ A}$	[1] 75	-	-	
V_{CEsat}	collector-emitter saturation voltage	$I_C = 100\text{ mA}; I_B = 1\text{ mA}$	-	-	75	mV
		$I_C = 500\text{ mA}; I_B = 50\text{ mA}$	-	-	100	mV
		$I_C = 1\text{ A}; I_B = 100\text{ mA}$	-	-	190	mV
		$I_C = 2\text{ A}; I_B = 200\text{ mA}$	-	-	400	mV
R_{CEsat}	equivalent on-resistance	$I_C = 1\text{ A}; I_B = 100\text{ mA}$	[1] -	150	190	$\text{m}\Omega$
V_{BEsat}	base-emitter saturation voltage	$I_C = 1\text{ A}; I_B = 100\text{ mA}$	[1] -	-	1.2	V
V_{BEon}	base-emitter turn-on voltage	$V_{CE} = 5\text{ V}; I_C = 1\text{ A}$	[1] -	-	1.1	V
f_T	transition frequency	$V_{CE} = 10\text{ V}; I_C = 50\text{ mA}; f = 100\text{ MHz}$	150	-	-	MHz
C_c	collector capacitance	$V_{CB} = 10\text{ V}; I_E = I_C = 0\text{ A}; f = 1\text{ MHz}$	-	-	10	pF
Schottky barrier rectifier						
V_F	continuous forward voltage	see Figure 1				
		$I_F = 0.1\text{ mA}$	[1] -	95	130	mV
		$I_F = 1\text{ mA}$	[1] -	155	210	mV
		$I_F = 10\text{ mA}$	[1] -	220	270	mV
		$I_F = 100\text{ mA}$	[1] -	295	350	mV
I_R	reverse current	see Figure 2				
		$V_R = 10\text{ V}$	[1] -	7	20	μA
		$V_R = 40\text{ V}$	[1] -	30	100	μA
C_d	diode capacitance	$V_R = 1\text{ V}; f = 1\text{ MHz};$ see Figure 3	-	43	48	pF

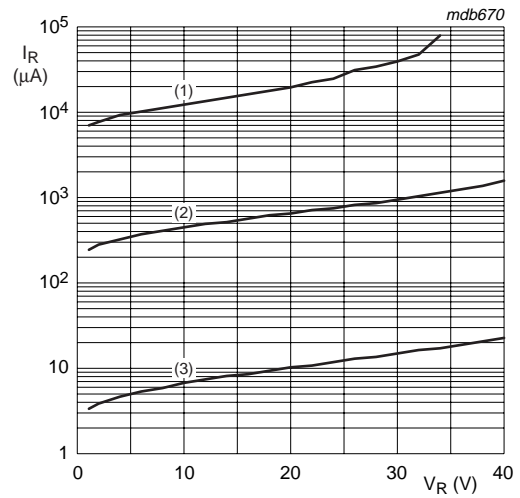
[1] Pulse test: $t_p \leq 300\text{ }\mu\text{s}; \delta \leq 0.02$.



Schottky barrier rectifier.

- (1) $T_{amb} = 150\text{ }^{\circ}\text{C}.$
- (2) $T_{amb} = 85\text{ }^{\circ}\text{C}.$
- (3) $T_{amb} = 25\text{ }^{\circ}\text{C}.$

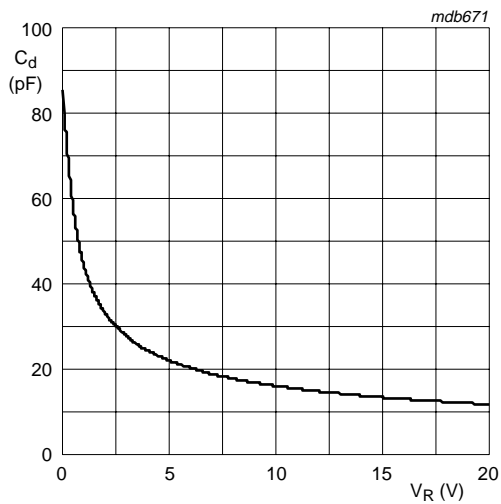
Fig 1. Forward current as a function of forward voltage; typical values.



Schottky barrier rectifier.

- (1) $T_{amb} = 150\text{ }^{\circ}\text{C}.$
- (2) $T_{amb} = 85\text{ }^{\circ}\text{C}.$
- (3) $T_{amb} = 25\text{ }^{\circ}\text{C}.$

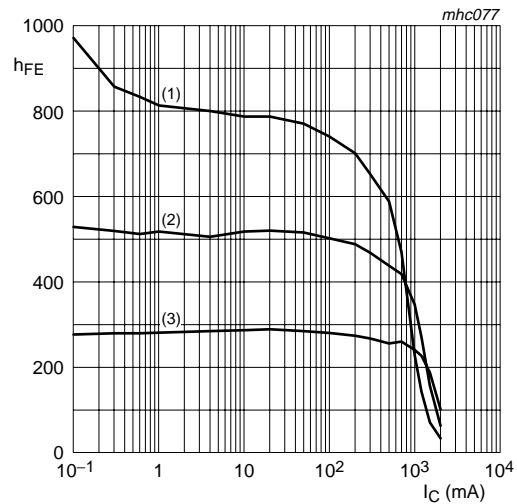
Fig 2. Reverse current as a function of reverse voltage; typical values.



Schottky barrier rectifier;

$T_{amb} = 25\text{ }^{\circ}\text{C}; f = 1\text{ MHz}.$

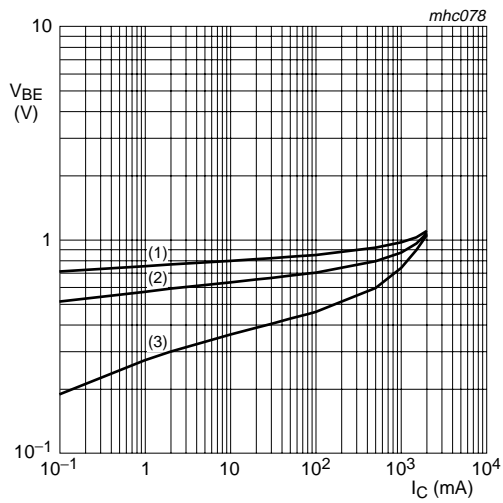
Fig 3. Diode capacitance as a function of reverse voltage; typical values.



NPN transistor; $V_{CE} = 5\text{ V}.$

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

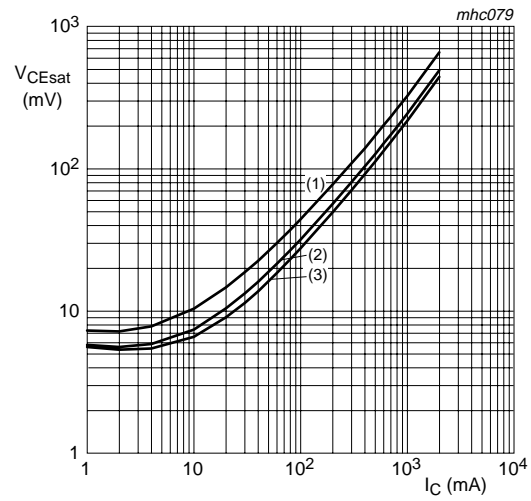
Fig 4. DC current gain as a function of collector current; typical values.



NPN transistor; $V_{CE} = 5 \text{ V}$.

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

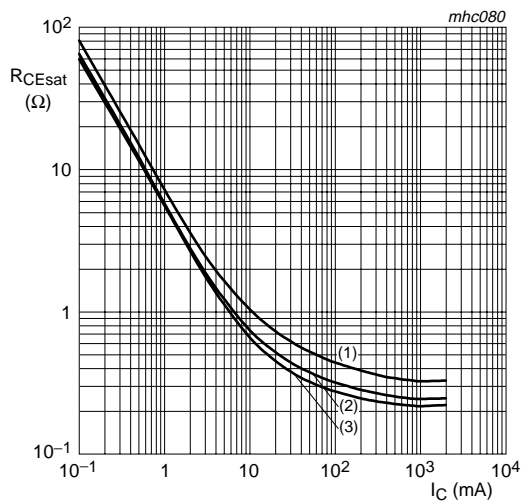
Fig 5. Base-emitter voltage as a function of collector current; typical values.



NPN transistor; $I_C/I_B = 10$.

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

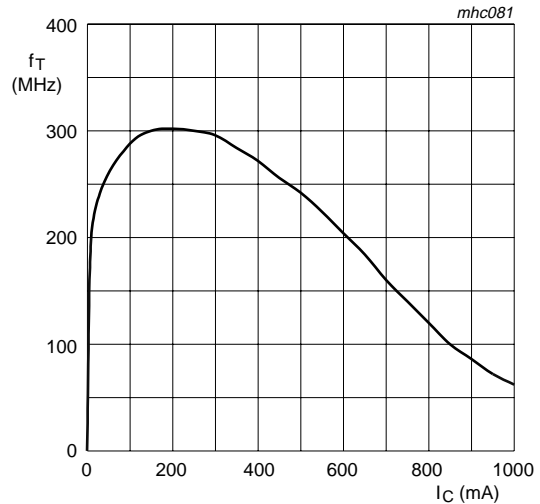
Fig 6. Collector-emitter saturation voltage as a function of collector current; typical values.



NPN transistor; $I_C/I_B = 10$.

- (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. Equivalent on-resistance as a function of collector current; typical values.



NPN transistor; $V_{CE} = 10 \text{ V}$.

Fig 8. Transition frequency as a function of collector current.

8. Application information

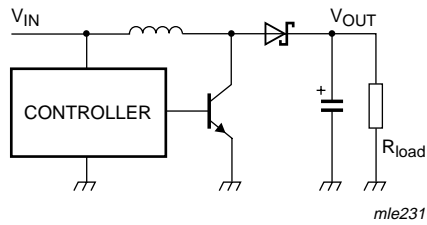


Fig 9. DC-to-DC converter.

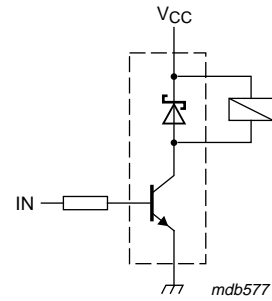


Fig 10. Inductive load driver (relays, motors and buzzers) with free-wheeling diode.

9. Package outline

Plastic surface mounted package; 6 leads

SOT457

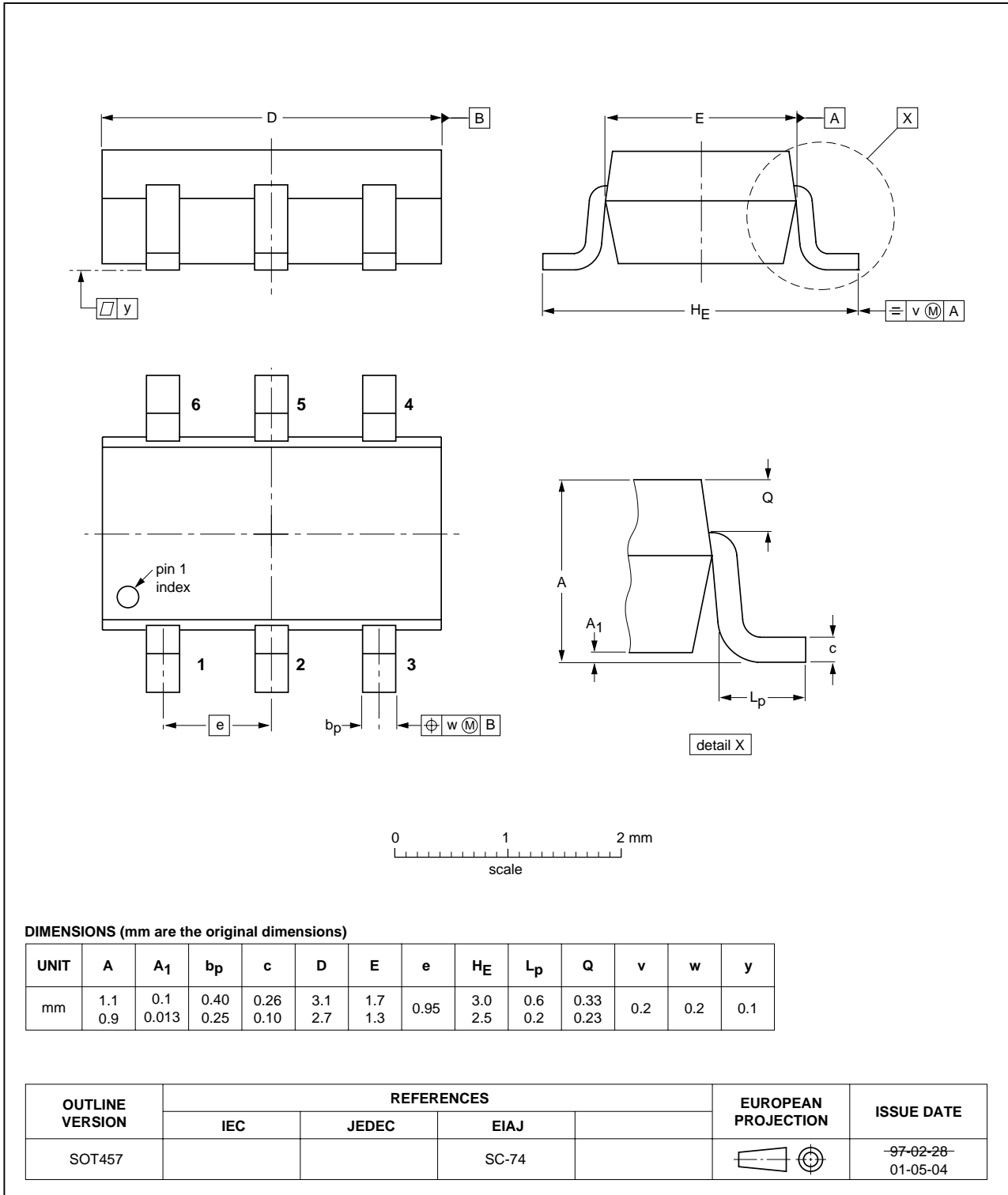


Fig 11. Package outline SOT457 (SC-74).

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	
			3000	10000
PMEM4020AND	SOT457	4 mm pitch, 8 mm tape and reel; T1	-115	-135
		4 mm pitch, 8 mm tape and reel; T2	-125	-165

[1] For further information and the availability of packing methods, see [Section 15](#).



11. Revision history

Table 9: Revision history

Document ID	Release date	Data sheet status	Change notice	Order number	Supersedes
PMEM4020AND_1	20041004	Product data sheet	-	9397 750 13708	-

12. Data sheet status

Level	Data sheet status ^[1]	Product status ^[2] ^[3]	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.
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[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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