

# PMEM1505NG

## NPN transistor/Schottky rectifier module

Rev. 01 — 25 May 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 SOT353 (SC-88A) small plastic package. PNP complement: PMEM1505PG.

### 1.2 Features

- 300 mW total power dissipation
- Current capability up to 0.5 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
<b>NPN transistor</b>						
$V_{CEO}$	collector-emitter voltage	open base	-	-	15	V
$I_C$	collector current (DC)	continuous	[1]	-	0.5	A
<b>Schottky barrier rectifier</b>						
$V_R$	continuous reverse voltage		-	-	20	V
$I_F$	continuous forward current		-	-	0.5	A

[1] Mounted on a FR4 printed-circuit board, single-sided copper, tin-plated, standard footprint for SOT353.

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## 2. Pinning information

Table 2: Discrete pinning

Pin	Description	Simplified outline	Symbol
1	anode	<p>Top view</p>	<p>sym023</p>
5	cathode		
4	collector		
2	base		
3	emitter		

## 3. Ordering information

Table 3: Ordering information

Type number	Package		
	Name	Description	Version
PMEM1505NG	-	plastic surface mounted package; 5 leads	SOT353

## 4. Marking

Table 4: Marking

Type number	Marking code <sup>[1]</sup>
PMEM1505NG	L7*

[1] \* = p: made in Hong Kong.

\* = t: made in Malaysia.

\* = W: made in China.

## 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	-	15	V
$V_{CEO}$	collector-emitter voltage	open base	-	15	V
$V_{EBO}$	emitter-base voltage	open collector	-	6	V
$I_C$	collector current (DC)	continuous	<sup>[1]</sup>	0.5	A
		continuous	<sup>[2]</sup>	0.6	A
		continuous; $T_s \leq 55^\circ\text{C}$	<sup>[3]</sup>	1	A
$I_{CM}$	peak collector current		-	1	A
$I_{BM}$	peak base current		-	100	mA

**Table 5: Limiting values ...continued**

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

Symbol	Parameter	Conditions	Min	Max	Unit	
$P_{\text{tot}}$	total power dissipation	$T_{\text{amb}} \leq 25\text{ °C}$	[1]	-	200	mW
		$T_{\text{amb}} \leq 25\text{ °C}$	[2]	-	250	mW
		$T_{\text{s}} \leq 55\text{ °C}$	[3]	-	800	mW
$T_{\text{j}}$	junction temperature		-	150	°C	
<b>Schottky barrier rectifier</b>						
$V_{\text{R}}$	continuous reverse voltage		-	20	V	
$I_{\text{F}}$	continuous forward current		-	0.5	A	
$I_{\text{FSM}}$	non-repetitive peak forward current	$t = 8.3\text{ ms}$ ; square wave	-	5	A	
$P_{\text{tot}}$	total power dissipation	$T_{\text{amb}} \leq 25\text{ °C}$	[1]	-	100	mW
		$T_{\text{amb}} \leq 25\text{ °C}$	[2]	-	200	mW
		$T_{\text{s}} \leq 55\text{ °C}$	[3]	-	800	mW
$T_{\text{j}}$	junction temperature		[2]	-	125	°C
<b>Combined device</b>						
$P_{\text{tot}}$	total power dissipation	$T_{\text{amb}} \leq 25\text{ °C}$	[2]	-	300	mW
$T_{\text{stg}}$	storage temperature		-65	+150	°C	
$T_{\text{amb}}$	operating ambient temperature		[2]	-65	+125	°C

[1] Mounted on a FR4 printed-circuit board, single-sided copper, tin-plated, standard footprint for SOT353.

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

[3] Solder point of collector or cathode tab.

## 6. Thermal characteristics

**Table 6: Thermal characteristics [1]**

Symbol	Parameter	Conditions	Typ	Unit	
<b>Single device</b>					
$R_{\text{th(j-s)}}$	thermal resistance from junction to solder point	in free air	[2]	120	K/W
$R_{\text{th(j-a)}}$	thermal resistance from junction to ambient	in free air	[3]	395	K/W
			[4]	495	K/W
<b>Combined device</b>					
$R_{\text{th(j-a)}}$	thermal resistance from junction to ambient	in free air	[5]	410	K/W

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

[2] Solder point of collector or cathode tab.

[3] Device mounted on a printed-circuit board, single-sided copper, tin-plated, 1 cm<sup>2</sup> mounting pad for both collector and cathode.

[4] Mounted on a FR4 printed-circuit board, single-sided copper, tin-plated, standard footprint for SOT353.

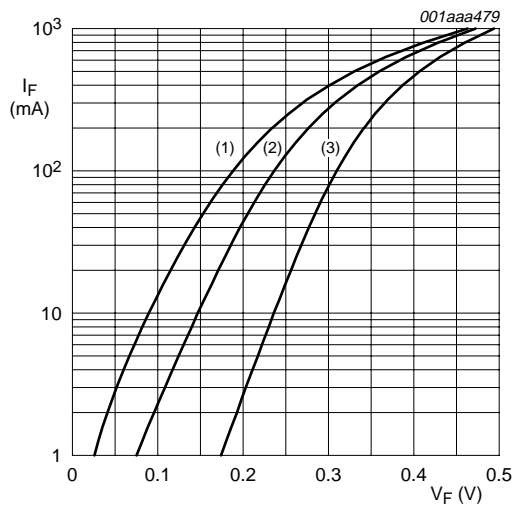
[5] Mounted on a ceramic printed-circuit board, single-sided copper, tin-plated, standard footprint.

## 7. Characteristics

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

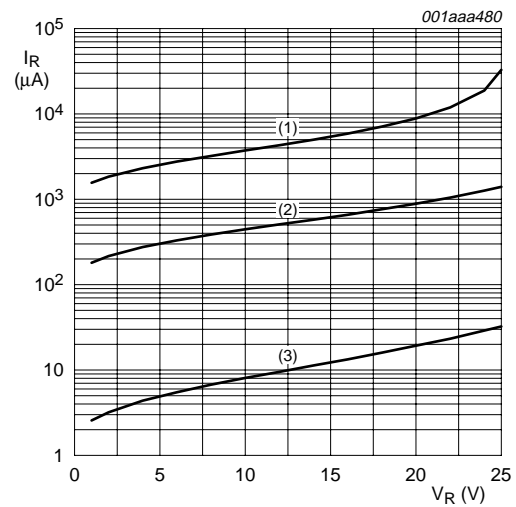
Symbol	Parameter	Conditions	Min	Typ	Max	Unit	
<b>NPN transistor</b>							
$I_{CBO}$	collector-base cut-off current	$V_{CB} = 15\text{ V}; I_E = 0\text{ A}$	-	-	100	nA	
		$V_{CB} = 15\text{ V}; I_E = 0\text{ A}; T_j = 150\text{ }^{\circ}\text{C}$	-	-	50	$\mu\text{A}$	
$I_{EBO}$	emitter-base cut-off current	$V_{EB} = 5\text{ V}; I_C = 0\text{ A}$	-	-	100	nA	
$h_{FE}$	DC current gain	$V_{CE} = 2\text{ V}; I_C = 10\text{ mA}$	200	-	-		
		$V_{CE} = 2\text{ V}; I_C = 100\text{ mA}$	150	-	-		
		$V_{CE} = 2\text{ V}; I_C = 500\text{ mA}$	90	-	-		
$V_{CEsat}$	collector-emitter saturation voltage	$I_C = 10\text{ mA}; I_B = 0.5\text{ mA}$	-	-	25	mV	
		$I_C = 200\text{ mA}; I_B = 10\text{ mA}$	-	-	150	mV	
		$I_C = 500\text{ mA}; I_B = 50\text{ mA}$	-	-	250	mV	
$R_{CEsat}$	equivalent on-resistance	$I_C = 500\text{ mA}; I_B = 50\text{ mA}$	[1]	-	300	$< 500\text{ m}\Omega$	
$V_{BEsat}$	base-emitter saturation voltage	$I_C = 500\text{ mA}; I_B = 50\text{ mA}$	[1]	-	-	1.1 V	
$V_{BEon}$	base-emitter turn-on voltage	$V_{CE} = 2\text{ V}; I_C = 100\text{ mA}$	[1]	-	-	0.9 V	
$f_T$	transition frequency	$V_{CE} = 5\text{ V}; I_C = 100\text{ mA}; f = 100\text{ MHz}$	250	420	-	MHz	
$C_c$	collector capacitance	$V_{CB} = 10\text{ V}; I_E = I_e = 0\text{ A}; f = 1\text{ MHz}$	-	4.4	6	pF	
<b>Schottky barrier rectifier</b>							
$V_F$	continuous forward voltage	see <a href="#">Figure 1</a>					
		$I_F = 10\text{ mA}$	[1]	-	240	270	mV
		$I_F = 100\text{ mA}$	[1]	-	300	350	mV
		$I_F = 500\text{ mA}$	[1]	-	400	460	mV
$I_R$	reverse current	see <a href="#">Figure 2</a>					
		$V_R = 5\text{ V}$	[1]	-	5	10	$\mu\text{A}$
		$V_R = 8\text{ V}$	[1]	-	7	20	$\mu\text{A}$
		$V_R = 15\text{ V}$	[1]	-	10	50	$\mu\text{A}$
$C_d$	diode capacitance	$V_R = 5\text{ V}; f = 1\text{ MHz};$ see <a href="#">Figure 3</a>	-	19	25	pF	

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

**Schottky barrier rectifier.**

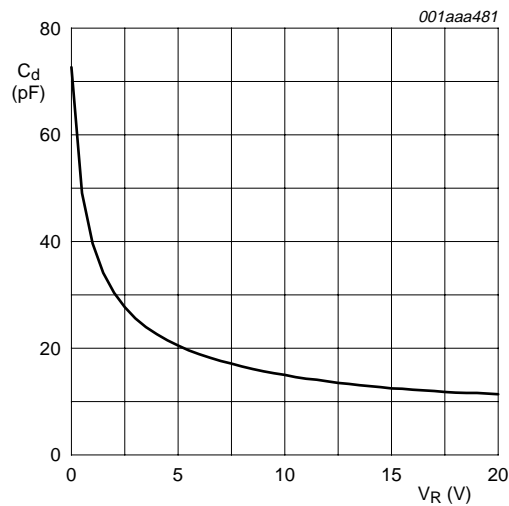
- (1)  $T_{amb} = 125\text{ °C.}$
- (2)  $T_{amb} = 85\text{ °C.}$
- (3)  $T_{amb} = 25\text{ °C.}$

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

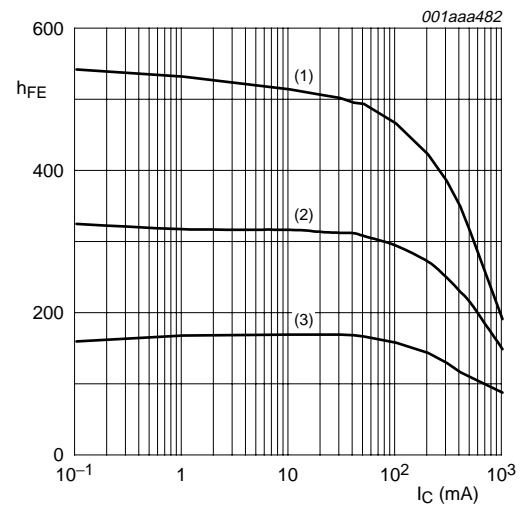
**Schottky barrier rectifier.**

- (1)  $T_{amb} = 125\text{ °C.}$
- (2)  $T_{amb} = 85\text{ °C.}$
- (3)  $T_{amb} = 25\text{ °C.}$

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

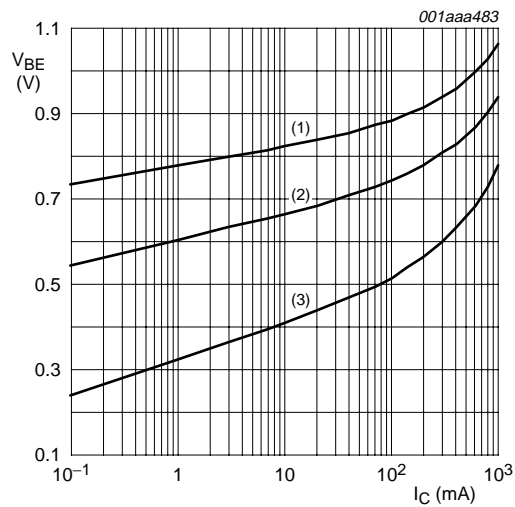
**Schottky barrier rectifier;  $f = 1\text{ MHz}$ ;  $T_{amb} = 25\text{ °C.}$** 

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

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

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

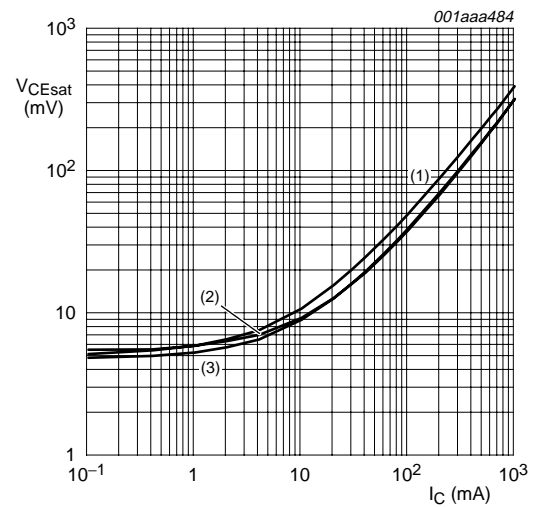
**Fig 4. DC current gain as a function of collector current; typical values.**



NPN transistor;  $V_{CE} = 2$  V.

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

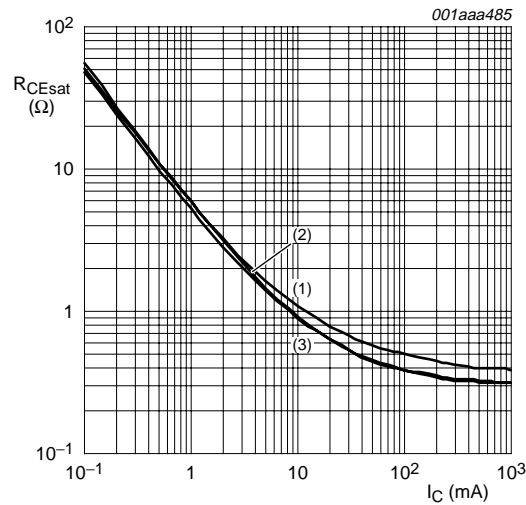
Fig 5. Base-emitter voltage as a function of collector current; typical values.



NPN transistor;  $I_C/I_B = 20$ .

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

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



NPN transistor;  $I_C/I_B = 20$ .

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

Fig 7. Equivalent on-resistance as a function of collector current; typical values.

## 8. Application information

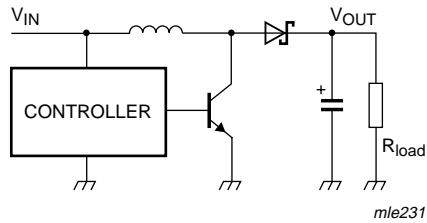


Fig 8. DC-to-DC converter.

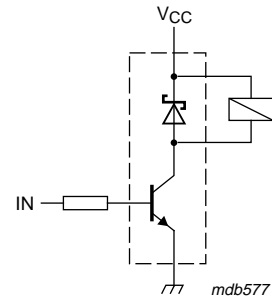


Fig 9. Inductive load driver (relays, motors and buzzers) with free-wheeling diode.

9. Package outline

Plastic surface mounted package; 5 leads

SOT353

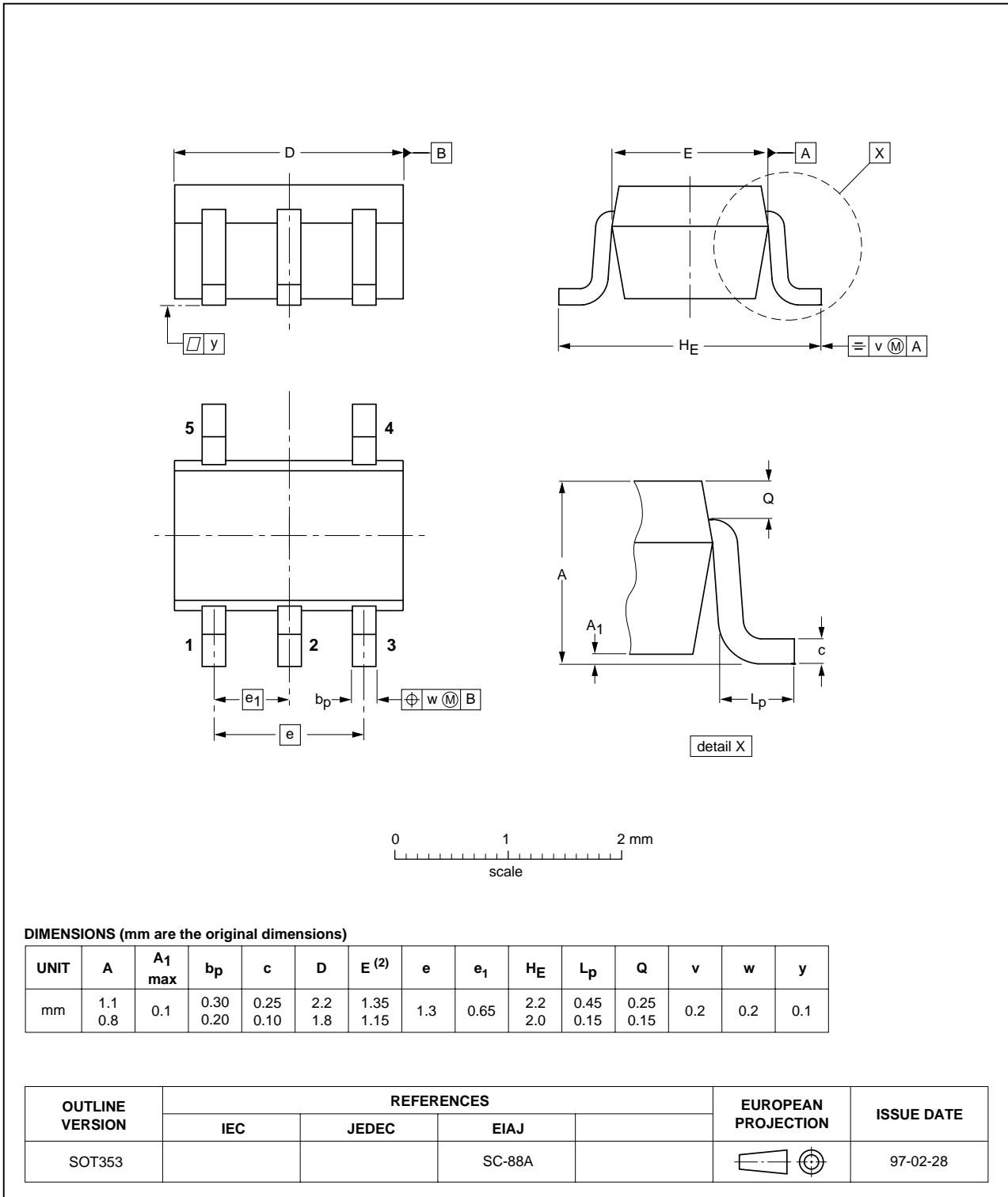


Fig 10. Package outline.



## 10. Revision history

**Table 8: Revision history**

Document ID	Release date	Data sheet status	Change notice	Order number	Supersedes
PMEM1505NG_1	20040525	Product data	-	9397 750 12752	-

## 11. Data sheet status

Level	Data sheet status <sup>[1]</sup>	Product status <sup>[2]</sup> <sup>[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.
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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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