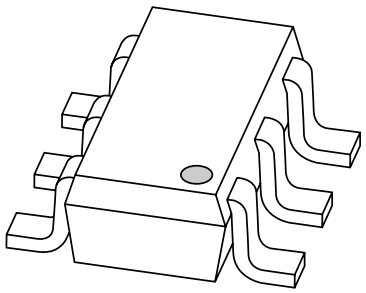
# DATA SHEET



# PMEM4010ND
## NPN transistor/Schottky diode module

Product data sheet
Supersedes data of 2002 Oct 28

2003 Jul 04

NXP founded by Philips

# NPN transistor/Schottky diode module PMEM4010ND

## FEATURES

- 600 mW total power dissipation
- High current capability
- Reduces required PCB area
- Reduced 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.

## APPLICATIONS

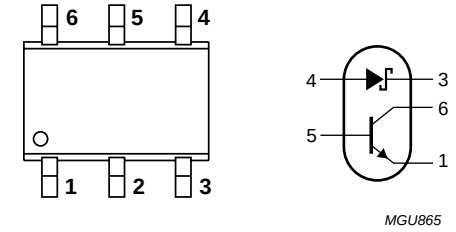
- DC/DC convertors
- Inductive load drivers
- General purpose load drivers
- Reverse polarity protection circuits.

## DESCRIPTION

Combination of an NPN transistor with low $V_{CEsat}$ and high current capability and a planar Schottky barrier diode with an integrated guard ring for stress protection in a SOT457 (SC-74) small plastic package.
PNP complement: PMEM4010PD.

## PINNING

| PIN | DESCRIPTION |
|---|---|
| 1 | emitter |
| 2 | not connected |
| 3 | cathode |
| 4 | anode |
| 5 | base |
| 6 | collector |




**Marking code:** B3.

Fig.1 Simplified outline (SOT457) and symbol.

## 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 |
| $I_C$ | collector current (DC) | | – | 1 | A |
| $I_{CM}$ | peak collector current | | – | 2 | A |
| $I_{BM}$ | peak base current | | – | 1 | A |
| $T_j$ | junction temperature | | – | 150 | °C |
| **Schottky barrier diode** | | | | | |
| $V_R$ | continuous reverse voltage | | – | 20 | V |
| $I_F$ | continuous forward current | | – | 1 | A |
| $I_{FSM}$ | non repetitive peak forward current | t = 8.3 ms half sinewave; JEDEC method | – | 5 | A |
| $T_j$ | junction temperature | | – | 125 | °C |
| **Combined device** | | | | | |
| $P_{tot}$ | total power dissipation | $T_{amb} \leq 25$ °C; note 1 | – | 600 | mW |
| $T_{stg}$ | storage temperature | | −65 | +150 | °C |
| $T_{amb}$ | operating ambient temperature | note 2 | −65 | +125 | °C |

**Notes**

1. Device mounted on a printed-circuit board; single sided copper; tinplated; mounting pad for collector 1 $cm^2$.
2. For Schottky barrier diodes thermal run-away has to be considered, as in some applications the reverse power losses $P_R$ are significant part of the total power losses. Nomograms for determination of the reverse power losses $P_R$ and $I_F$ (AV) rating will be available on request.

## THERMAL CHARACTERISTICS

| SYMBOL | PARAMETER | CONDITIONS | VALUE | UNIT |
|---|---|---|---|---|
| $R_{th\ j\text{-}a}$ | thermal resistance from junction to ambient | in free air; note 1 | 208 | K/W |

**Note**

1. Device mounted on a printed-circuit board; single sided copper; tinplated; mounting pad for collector 1 $cm^2$.

## ELECTRICAL CHARACTERISTICS

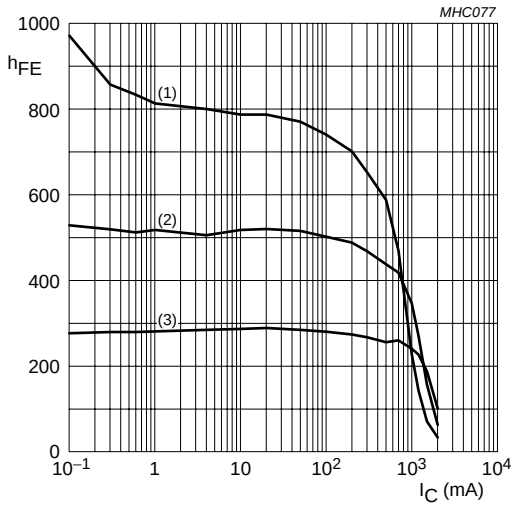
$T_{amb}$ = 25 °C unless otherwise specified.

| SYMBOL | PARAMETER | CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| **NPN transistor** | | | | | | |
| $I_{CBO}$ | collector-base cut-off current | $V_{CB}$ = 40 V; $I_E$ = 0 | – | – | 100 | nA |
| | | $V_{CB}$ = 40 V; $I_E$ = 0; $T_{amb}$ = 150 °C | – | – | 50 | μA |
| $I_{CEO}$ | collector-emitter cut-off current | $V_{CE}$ = 30 V; $I_B$ = 0 | – | – | 100 | nA |
| $I_{EBO}$ | emitter-base cut-off current | $V_{EB}$ = 5 V; $I_C$ = 0 | – | – | 100 | nA |
| $h_{FE}$ | DC current gain | $V_{CE}$ = 5 V; $I_C$ = 1 mA | 300 | – | – | |
| | | $V_{CE}$ = 5 V; $I_C$ = 500 mA | 300 | – | 900 | |
| | | $V_{CE}$ = 5 V; $I_C$ = 1 A | 200 | – | – | |
| $V_{CEsat}$ | collector-emitter saturation voltage | $I_C$ = 100 mA; $I_B$ = 1 mA | – | – | 80 | mV |
| | | $I_C$ = 500 mA; $I_B$ = 50 mA | – | – | 110 | mV |
| | | $I_C$ = 1 A; $I_B$ = 100 mA | – | – | 210 | mV |
| $V_{BEsat}$ | base-emitter saturation voltage | $I_C$ = 1 A; $I_B$ = 100 mA | – | – | 1.2 | V |
| $R_{CEsat}$ | equivalent on-resistance | $I_C$ = 500 mA; $I_B$ = 50 mA; note 1 | – | 260 | <220 | mΩ |
| $V_{BEon}$ | base-emitter turn-on voltage | $V_{CE}$ = 5 V; $I_C$ = 1 A | – | – | 1.1 | V |
| $f_T$ | transition frequency | $I_C$ = 50 mA; $V_{CE}$ = 10 V; f = 100 MHz | 150 | – | – | MHz |
| $C_c$ | collector capacitance | $V_{CB}$ = 10 V; $I_E$ = $I_e$ =0 ; f = 1 MHz | – | – | 10 | pF |
| **Schottky barrier diode** | | | | | | |
| $V_F$ | continuous forward voltage | $I_F$ = 10 mA; note 1 | – | 240 | 270 | mV |
| | | $I_F$ = 100 mA; note 1 | – | 300 | 350 | mV |
| | | $I_F$ = 1000 mA; see Fig.7; note 1 | – | 480 | 550 | mV |
| $I_R$ | reverse current | $V_R$ = 5 V; note 1 | – | 5 | 10 | μA |
| | | $V_R$ = 8 V; note 1 | – | 7 | 20 | μA |
| | | $V_R$ = 15 V; see Fig.8; note 1 | – | 10 | 50 | μA |
| $C_d$ | diode capacitance | $V_R$ = 5 V; f = 1 MHz; see Fig.9 | – | 19 | 25 | pF |

**Note**

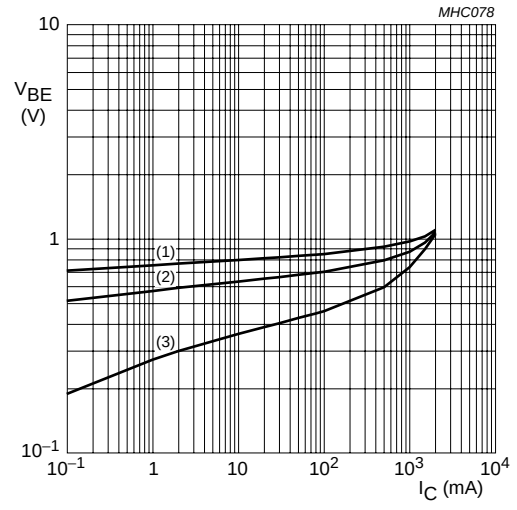
1. Pulse test: $t_p \leq 300$ μs; $\delta \leq 0.02$.

## GRAPHICAL DATA



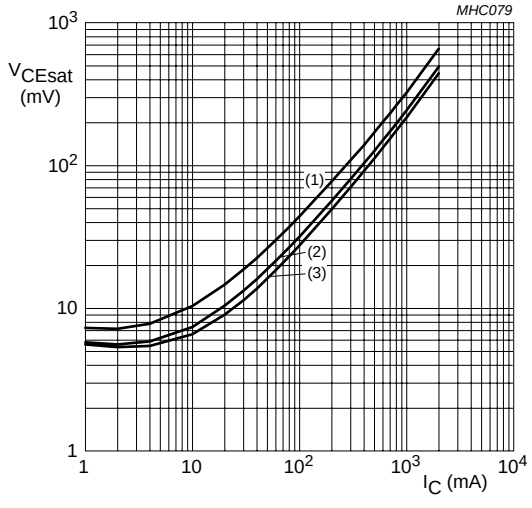

**NPN transistor;** $V_{CE}$ = 5 V.
(1) $T_{amb}$ = 150 °C.
(2) $T_{amb}$ = 25 °C.
(3) $T_{amb}$ = −55 °C.

Fig.2 DC current gain as a function of collector current; typical values.



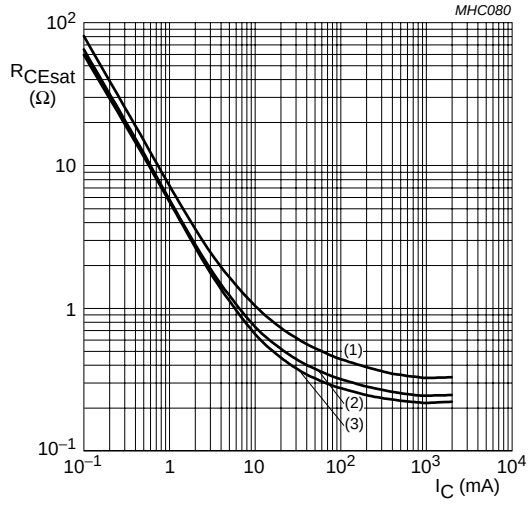

**NPN transistor;** $V_{CE}$ = 5 V.
(1) $T_{amb}$ = −55 °C.
(2) $T_{amb}$ = 25 °C.
(3) $T_{amb}$ = 150 °C.

Fig.3 Base-emitter voltage as a function of collector current; typical values.



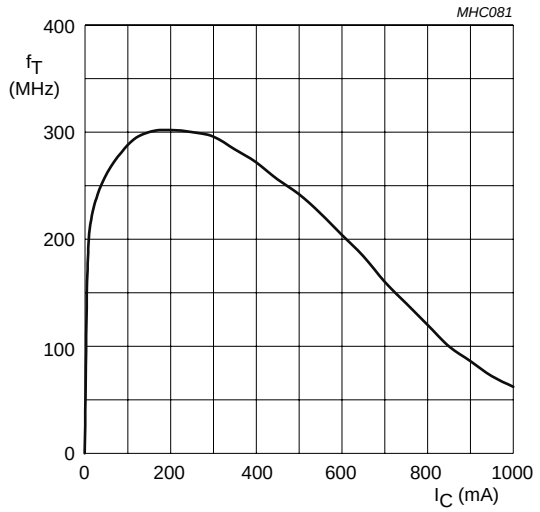

**NPN transistor;** $I_C/I_B$ = 10.
(1) $T_{amb}$ = 150 °C.
(2) $T_{amb}$ = 25 °C.
(3) $T_{amb}$ = −55 °C.

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



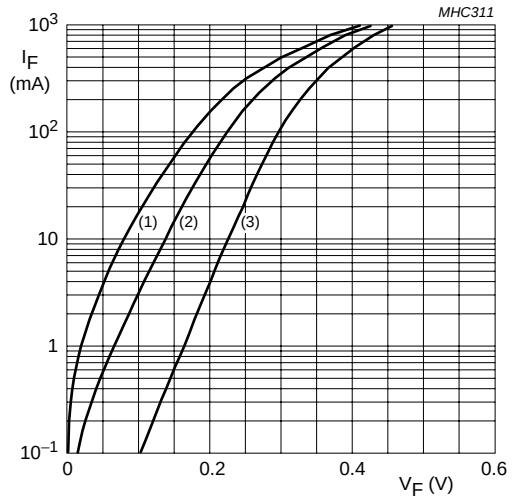

**NPN transistor;** $I_C/I_B$ = 10.
(1) $T_{amb}$ = 150 °C.
(2) $T_{amb}$ = 25 °C.
(3) $T_{amb}$ = −55 °C.

Fig.5 Equivalent on-resistance as a function of collector current; typical values.




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

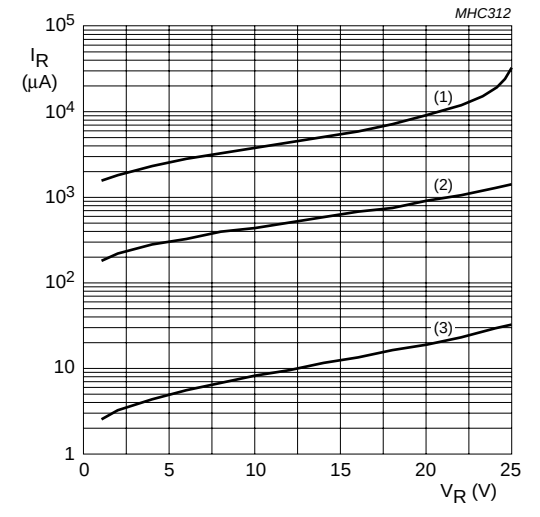
Fig.6 Transition frequency as a function of collector current.




**Schottky barrier diode.**

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

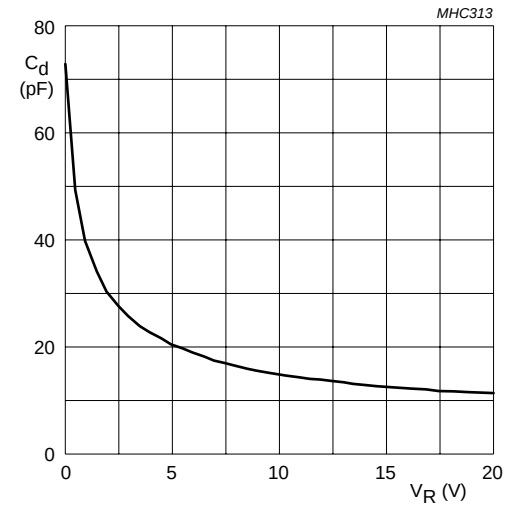
Fig.7 Forward current as a function of forward voltage; typical values.




**Schottky barrier diode.**

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

Fig.8 Reverse current as a function of reverse voltage; typical values.




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

Fig.9 Diode capacitance as a function of reverse voltage; typical values.

**APPLICATION INFORMATION**

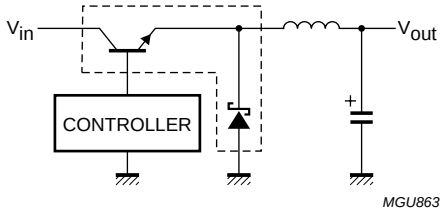



Fig.10 DC/DC convertor.

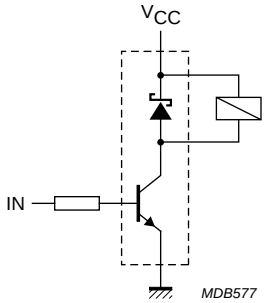
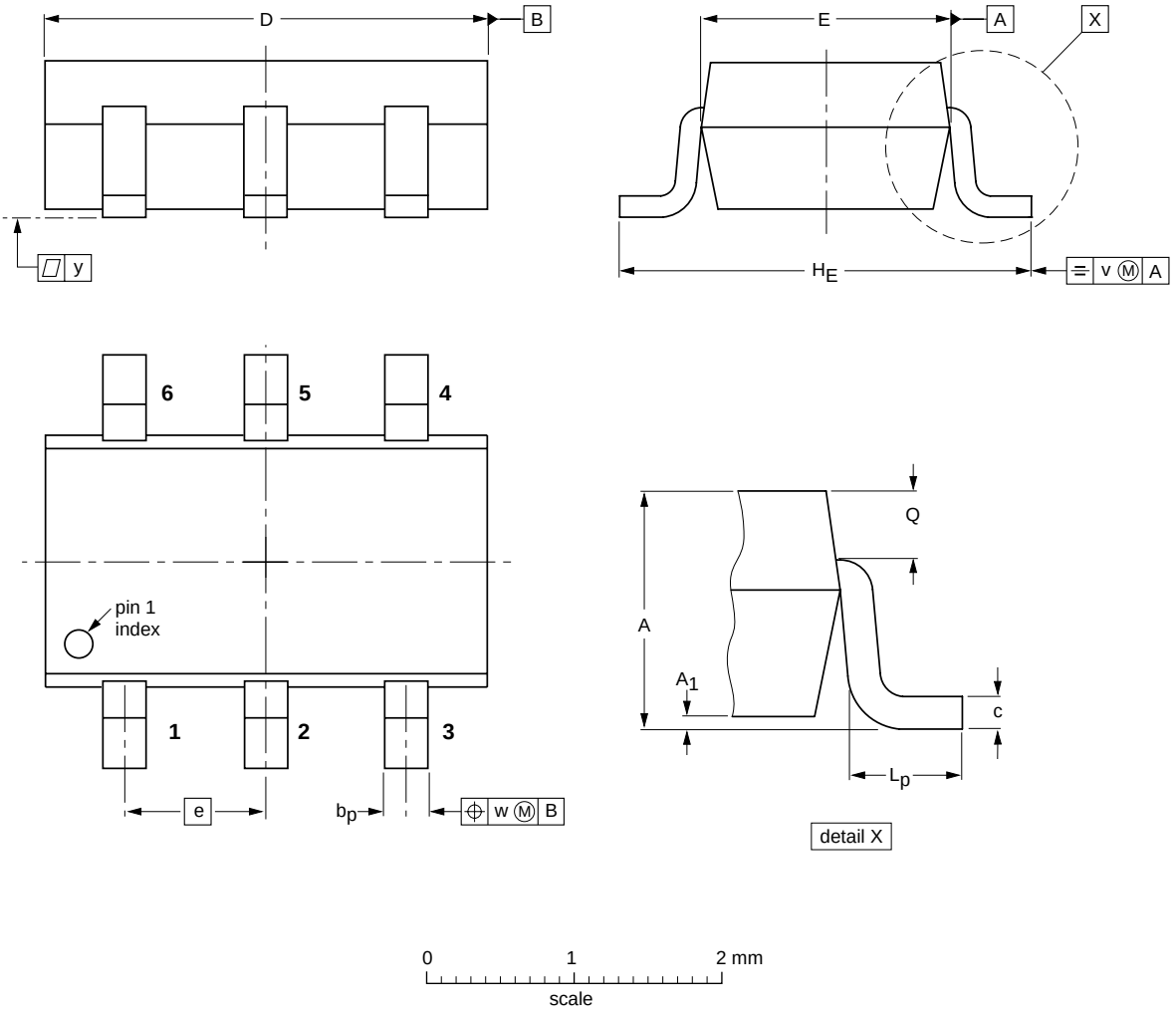



Fig.11 Inductive load driver (relays, motors, buzzers) with free-wheeling diode.

## PACKAGE OUTLINE

**Plastic surface mounted package; 6 leads** **SOT457**




**DIMENSIONS (mm are the original dimensions)**

| UNIT | A | $A_1$ | $b_p$ | c | D | E | e | $H_E$ | $L_p$ | Q | v | w | y |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | 1.1<br>0.9 | 0.1<br>0.013 | 0.40<br>0.25 | 0.26<br>0.10 | 3.1<br>2.7 | 1.7<br>1.3 | 0.95 | 3.0<br>2.5 | 0.6<br>0.2 | 0.33<br>0.23 | 0.2 | 0.2 | 0.1 |

| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|---|---|---|---|---|---|---|
| | IEC | JEDEC | EIAJ | | | |
| SOT457 | | | SC-74 | | | ~~97-02-28~~<br>01-05-04 |

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