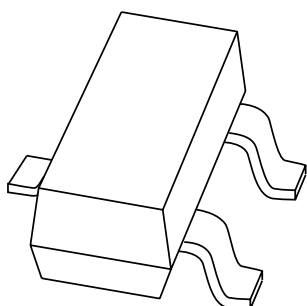


# DATA SHEET



## **MMBT2222A** NPN switching transistor

Product specification

2000 Apr 11

NPN switching transistor

MMBT2222A

FEATURES

- High current (max. 600 mA)
- Low voltage (max. 40 V).

APPLICATIONS

- Switching and linear amplification.

DESCRIPTION

NPN switching transistor in a SOT23 plastic package.  
PNP complement: PMBT2907A.

MARKING

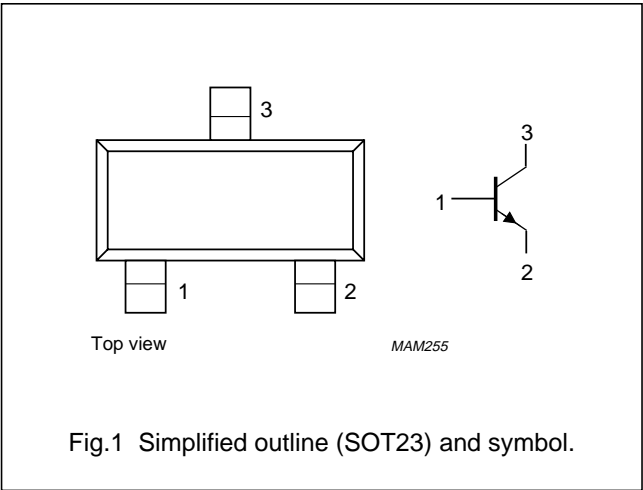
| TYPE NUMBER | MARKING CODE <sup>(1)</sup> |
|-------------|-----------------------------|
| MMBT2222A   | 7C*                         |

Note

1. \* = p: made in Hong Kong.  
      \* = t: made in Malaysia.

PINNING

| PIN | DESCRIPTION |
|-----|-------------|
| 1   | base        |
| 2   | emitter     |
| 3   | collector   |



LIMITING VALUES

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

| SYMBOL           | PARAMETER                     | CONDITIONS                       | MIN. | MAX. | UNIT |
|------------------|-------------------------------|----------------------------------|------|------|------|
| V <sub>CBO</sub> | collector-base voltage        | open emitter                     | –    | 75   | 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 (DC)        |                                  | –    | 600  | mA   |
| I <sub>CM</sub>  | peak collector current        |                                  | –    | 800  | mA   |
| I <sub>BM</sub>  | peak base current             |                                  | –    | 200  | mA   |
| P <sub>tot</sub> | total power dissipation       | T <sub>amb</sub> ≤ 25 °C; note 1 | –    | 250  | mW   |
| T <sub>stg</sub> | storage temperature           |                                  | –65  | +150 | °C   |
| T <sub>j</sub>   | junction temperature          |                                  | –    | 150  | °C   |
| T <sub>amb</sub> | operating ambient temperature |                                  | –65  | +150 | °C   |

Note

1. Transistor mounted on an FR4 printed-circuit board.

## NPN switching transistor

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## THERMAL CHARACTERISTICS

| SYMBOL        | PARAMETER                                   | CONDITIONS | VALUE | UNIT |
|---------------|---|------------|-------|------|
| $R_{th\ j-a}$ | thermal resistance from junction to ambient | note 1     | 500   | K/W  |

## Note

1. Transistor mounted on an FR4 printed-circuit board.

## CHARACTERISTICS

$T_j = 25\text{ °C}$  unless otherwise specified.

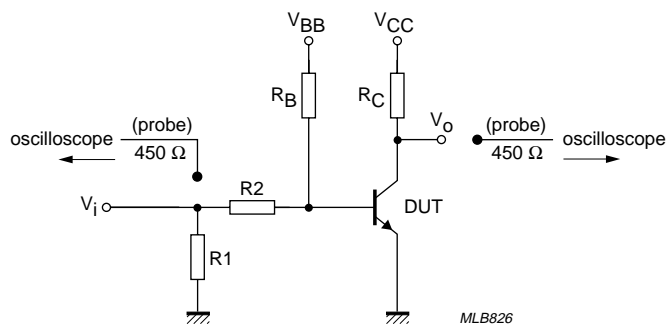
| SYMBOL   | PARAMETER                            | CONDITIONS  | MIN. | MAX. | UNIT          |
|--|--------------------------------------|---|------|------|---------------|
| $I_{CBO}$  | collector cut-off current            | $I_E = 0$ ; $V_{CB} = 60\text{ V}$  | –    | 10   | nA            |
|  |                                      | $I_E = 0$ ; $V_{CB} = 60\text{ V}$ ; $T_j = 125\text{ °C}$  | –    | 10   | $\mu\text{A}$ |
| $I_{EBO}$  | emitter cut-off current              | $I_C = 0$ ; $V_{EB} = 5\text{ V}$   | –    | 10   | nA            |
| $h_{FE}$   | DC current gain                      | $I_C = 0.1\text{ mA}$ ; $V_{CE} = 10\text{ V}$  | 35   | –    |               |
|  |                                      | $I_C = 1\text{ mA}$ ; $V_{CE} = 10\text{ V}$  | 50   | –    |               |
|  |                                      | $I_C = 10\text{ mA}$ ; $V_{CE} = 10\text{ V}$   | 75   | –    |               |
|  |                                      | $I_C = 10\text{ mA}$ ; $V_{CE} = 10\text{ V}$ ;<br>$T_{amb} = -55\text{ °C}$                              | 35   | –    |               |
|  |                                      | $I_C = 150\text{ mA}$ ; $V_{CE} = 10\text{ V}$  | 100  | 300  |               |
|  |                                      | $I_C = 150\text{ mA}$ ; $V_{CE} = 1\text{ V}$   | 50   | –    |               |
|  |                                      | $I_C = 500\text{ mA}$ ; $V_{CE} = 10\text{ V}$  | 40   | –    |               |
| $V_{CEsat}$  | collector-emitter saturation voltage | $I_C = 150\text{ mA}$ ; $I_B = 15\text{ mA}$ ; note 1   | –    | 300  | mV            |
|  |                                      | $I_C = 500\text{ mA}$ ; $I_B = 50\text{ mA}$ ; note 1   | –    | 1    | V             |
| $V_{BEsat}$  | base-emitter saturation voltage      | $I_C = 150\text{ mA}$ ; $I_B = 15\text{ mA}$ ; note 1   | 0.6  | 1.2  | V             |
|  |                                      | $I_C = 500\text{ mA}$ ; $I_B = 50\text{ mA}$ ; note 1   | –    | 2    | V             |
| $C_c$  | collector capacitance                | $I_E = i_e = 0$ ; $V_{CB} = 10\text{ V}$ ;<br>$f = 1\text{ MHz}$  | –    | 8    | pF            |
| $C_e$  | emitter capacitance                  | $I_C = i_c = 0$ ; $V_{EB} = 500\text{ mV}$ ;<br>$f = 1\text{ MHz}$  | –    | 25   |               |
| $f_T$  | transition frequency                 | $I_C = 20\text{ mA}$ ; $V_{CE} = 20\text{ V}$ ;<br>$f = 100\text{ MHz}$                                   | 300  | –    | MHz           |
| F  | noise figure                         | $I_C = 100\text{ }\mu\text{A}$ ; $V_{CE} = 5\text{ V}$ ;<br>$R_S = 1\text{ k}\Omega$ ; $f = 1\text{ kHz}$ | –    | 4    | dB            |
| <b>Switching times (between 10% and 90% levels); (see Fig.2)</b> |                                      |   |      |      |               |
| $t_{on}$   | turn-on time                         | $I_{Con} = 150\text{ mA}$ ; $I_{Bon} = 15\text{ mA}$ ;<br>$I_{Boff} = -15\text{ mA}$                      | –    | 35   | ns            |
| $t_d$  | delay time                           |   | –    | 15   | ns            |
| $t_r$  | rise time                            |   | –    | 20   | ns            |
| $t_{off}$  | turn-off time                        |   | –    | 250  | ns            |
| $t_s$  | storage time                         |   | –    | 200  | ns            |
| $t_f$  | fall time                            |   | –    | 60   | ns            |

## Note

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

## NPN switching transistor

## MMBT2222A



$V_i = 9.5 \text{ V}$ ;  $T = 500 \text{ } \mu\text{s}$ ;  $t_p = 10 \text{ } \mu\text{s}$ ;  $t_r = t_f \leq 3 \text{ ns}$ .  
 $R1 = 68 \text{ } \Omega$ ;  $R2 = 325 \text{ } \Omega$ ;  $R_B = 325 \text{ } \Omega$ ;  $R_C = 160 \text{ } \Omega$ .  
 $V_{BB} = -3.5 \text{ V}$ ;  $V_{CC} = 29.5 \text{ V}$ .  
 Oscilloscope: input impedance  $Z_i = 50 \text{ } \Omega$ .

Fig.2 Test circuit for switching times.

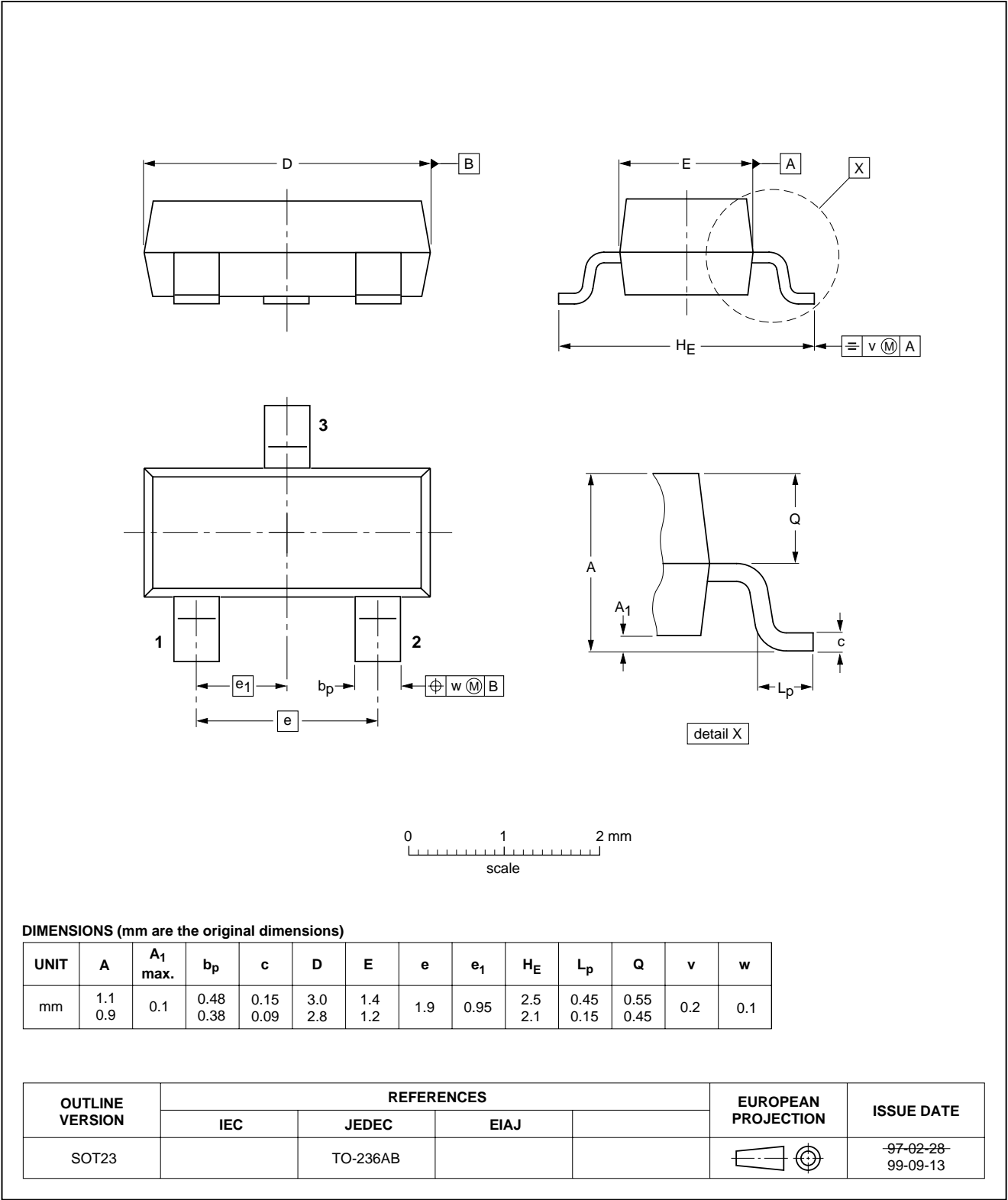
NPN switching transistor

MMBT2222A

PACKAGE OUTLINE

Plastic surface mounted package; 3 leads

SOT23



## NPN switching transistor

## MMBT2222A

## DATA SHEET STATUS

| DATA SHEET STATUS         | PRODUCT STATUS | DEFINITIONS <sup>(1)</sup>   |
|---------------------------|----------------|--|
| Objective specification   | Development    | This data sheet contains the design target or goal specifications for product development. Specification may change in any manner without notice.  |
| Preliminary specification | Qualification  | This data sheet contains preliminary data, and supplementary data will be published at a later date. Philips Semiconductors reserves the right to make changes at any time without notice in order to improve design and supply the best possible product. |
| Product specification     | Production     | This data sheet contains final specifications. Philips Semiconductors reserves the right to make changes at any time without notice in order to improve design and supply the best possible product.   |

## Note

1. Please consult the most recently issued data sheet before initiating or completing a design.

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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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NPN switching transistor

MMBT2222A

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