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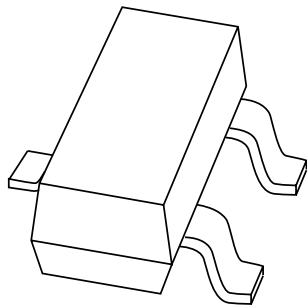
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Kind regards,

Team Nexperia

# DATA SHEET



## **MMBT3904** NPN switching transistor

Product data sheet  
Supersedes data of 2002 Oct 04

2004 Feb 03

NPN switching transistor

MMBT3904

FEATURES

- Collector current capability  $I_C = 200\text{ mA}$
- Collector-emitter voltage  $V_{CEO} = 40\text{ V}$ .

APPLICATIONS

- General switching and amplification.

DESCRIPTION

NPN switching transistor in a SOT23 plastic package.  
PNP complement: MMBT3906.

MARKING

| TYPE NUMBER | MARKING CODE <sup>(1)</sup> |
|-------------|-----------------------------|
| MMBT3904    | 7A*                         |

Note

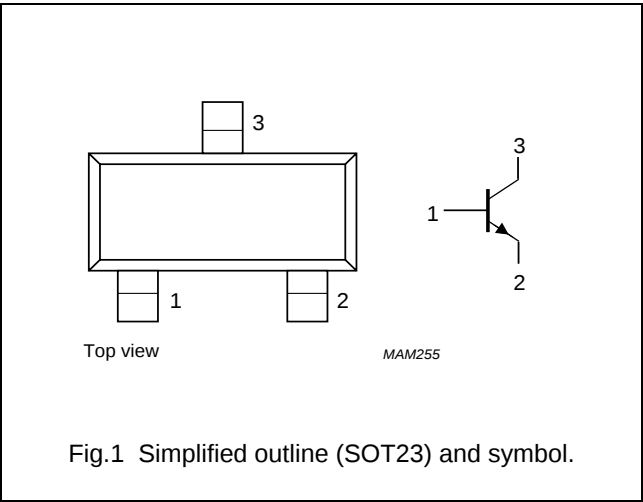
1. \* = p: Made in Hong Kong.  
\* = t: Made in Malaysia.  
\* = W: Made in China.

QUICK REFERENCE DATA

| SYMBOL    | PARAMETER                 | MAX. | UNIT |
|-----------|---------------------------|------|------|
| $V_{CEO}$ | collector-emitter voltage | 40   | V    |
| $I_C$     | collector current (DC)    | 200  | mA   |

PINNING

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



ORDERING INFORMATION

| TYPE NUMBER | PACKAGE |                                          |         |
|-------------|---------|------------------------------------------|---------|
|             | NAME    | DESCRIPTION                              | VERSION |
| MMBT3904    | –       | plastic surface mounted package; 3 leads | SOT23   |

## NPN switching transistor

## MMBT3904

**LIMITING VALUES**

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

| SYMBOL    | PARAMETER                     | CONDITIONS                           | MIN. | MAX. | UNIT |
|-----------|-------------------------------|--------------------------------------|------|------|------|
| $V_{CBO}$ | collector-base voltage        | open emitter                         | –    | 60   | V    |
| $V_{CEO}$ | collector-emitter voltage     | open base                            | –    | 40   | V    |
| $V_{EBO}$ | emitter-base voltage          | open collector                       | –    | 6    | V    |
| $I_C$     | collector current (DC)        |                                      | –    | 200  | mA   |
| $I_{CM}$  | peak collector current        |                                      | –    | 200  | mA   |
| $I_{BM}$  | peak base current             |                                      | –    | 100  | mA   |
| $P_{tot}$ | total power dissipation       | $T_{amb} \leq 25\text{ °C}$ ; note 1 | –    | 250  | mW   |
| $T_{stg}$ | storage temperature           |                                      | –65  | +150 | °C   |
| $T_j$     | junction temperature          |                                      | –    | 150  | °C   |
| $T_{amb}$ | operating ambient temperature |                                      | –65  | +150 | °C   |

**Note**

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

**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.

## NPN switching transistor

## MMBT3904

## CHARACTERISTICS

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

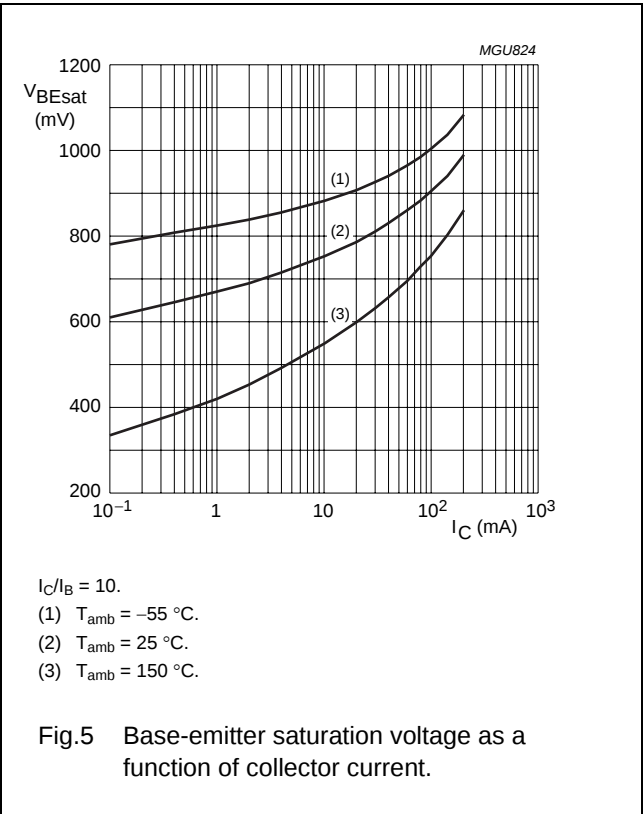
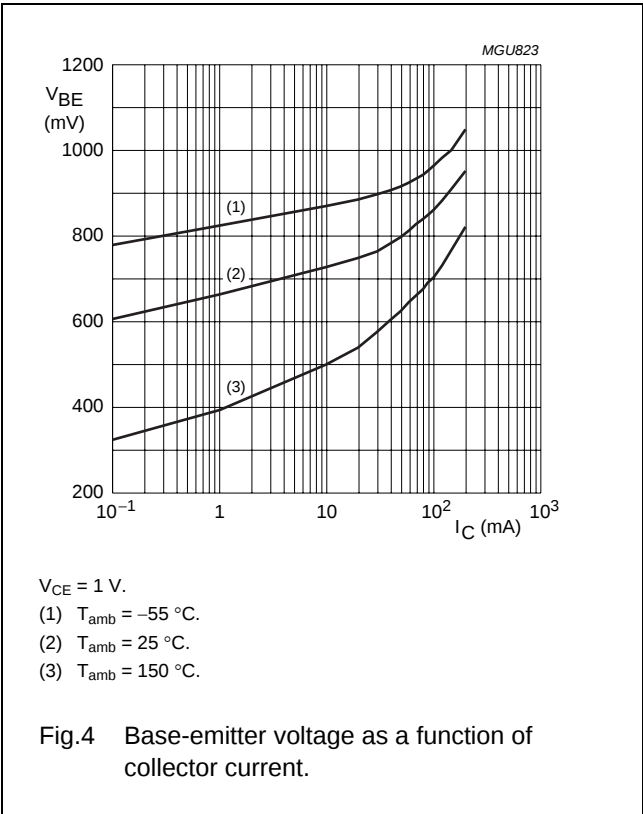
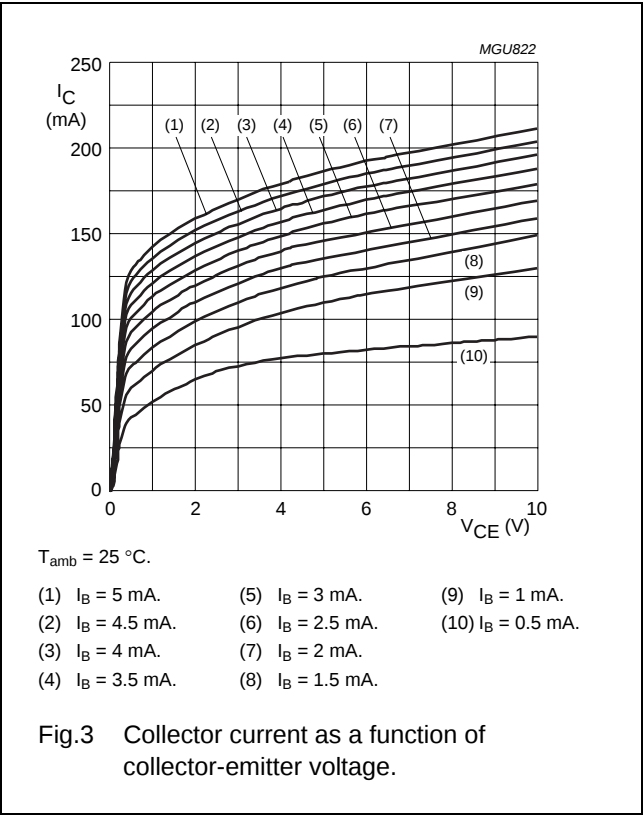
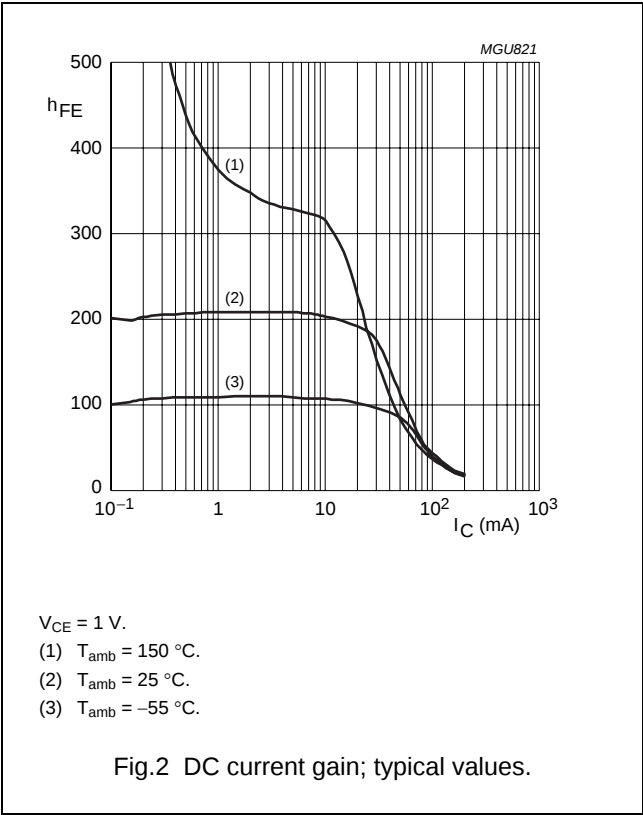
| SYMBOL                                                         | PARAMETER                            | CONDITIONS                                                                                                                                                         | MIN.                        | MAX.                    | UNIT |
|----------------------------------------------------------------|--------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|-------------------------|------|
| $I_{CBO}$                                                      | collector cut-off current            | $I_E = 0$ ; $V_{CB} = 30\text{ V}$                                                                                                                                 | –                           | 50                      | nA   |
| $I_{EBO}$                                                      | emitter cut-off current              | $I_C = 0$ ; $V_{EB} = 6\text{ V}$                                                                                                                                  | –                           | 50                      | nA   |
| $h_{FE}$                                                       | DC current gain                      | $V_{CE} = 1\text{ V}$ ; see Fig.2; note 1<br>$I_C = 0.1\text{ mA}$<br>$I_C = 1\text{ mA}$<br>$I_C = 10\text{ mA}$<br>$I_C = 50\text{ mA}$<br>$I_C = 100\text{ mA}$ | 60<br>80<br>100<br>60<br>30 | –<br>–<br>300<br>–<br>– |      |
| $V_{CEsat}$                                                    | collector-emitter saturation voltage | $I_C = 10\text{ mA}$ ; $I_B = 1\text{ mA}$                                                                                                                         | –                           | 200                     | mV   |
|                                                                |                                      | $I_C = 50\text{ mA}$ ; $I_B = 5\text{ mA}$                                                                                                                         | –                           | 300                     | mV   |
| $V_{BEsat}$                                                    | base-emitter saturation voltage      | $I_C = 10\text{ mA}$ ; $I_B = 1\text{ mA}$                                                                                                                         | 650                         | 850                     | mV   |
|                                                                |                                      | $I_C = 50\text{ mA}$ ; $I_B = 5\text{ mA}$                                                                                                                         | –                           | 950                     | mV   |
| $C_c$                                                          | collector capacitance                | $I_E = I_e = 0$ ; $V_{CB} = 5\text{ V}$ ; $f = 1\text{ MHz}$                                                                                                       | –                           | 4                       | pF   |
| $C_e$                                                          | emitter capacitance                  | $I_C = I_c = 0$ ; $V_{BE} = 500\text{ mV}$ ; $f = 1\text{ MHz}$                                                                                                    | –                           | 8                       | pF   |
| $f_T$                                                          | transition frequency                 | $I_C = 10\text{ mA}$ ; $V_{CE} = 20\text{ V}$ ; $f = 100\text{ MHz}$                                                                                               | 300                         | –                       | MHz  |
| F                                                              | noise figure                         | $I_C = 100\text{ }\mu\text{A}$ ; $V_{CE} = 5\text{ V}$ ; $R_S = 1\text{ k}\Omega$ ; $f = 10\text{ Hz to }15.7\text{ kHz}$                                          | –                           | 5                       | dB   |
| <b>Switching times (between 10% and 90% levels); see Fig.3</b> |                                      |                                                                                                                                                                    |                             |                         |      |
| $t_d$                                                          | delay time                           | $I_{Con} = 10\text{ mA}$ ; $I_{Bon} = 1\text{ mA}$ ; $I_{Boff} = -1\text{ mA}$                                                                                     | –                           | 35                      | ns   |
| $t_r$                                                          | rise time                            |                                                                                                                                                                    | –                           | 35                      | ns   |
| $t_s$                                                          | storage time                         |                                                                                                                                                                    | –                           | 200                     | ns   |
| $t_f$                                                          | fall time                            |                                                                                                                                                                    | –                           | 50                      | ns   |

## Note

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

NPN switching transistor

MMBT3904



## NPN switching transistor

MMBT3904

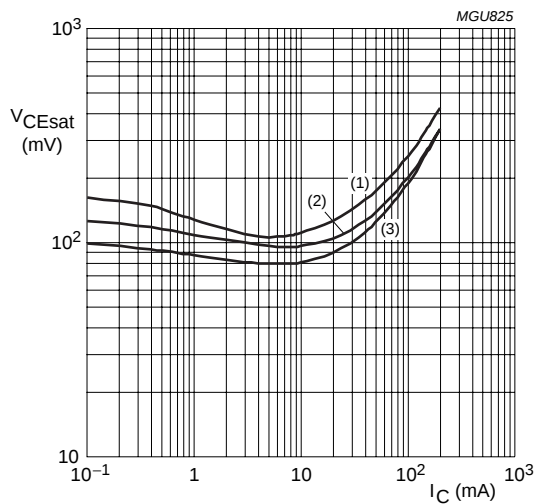
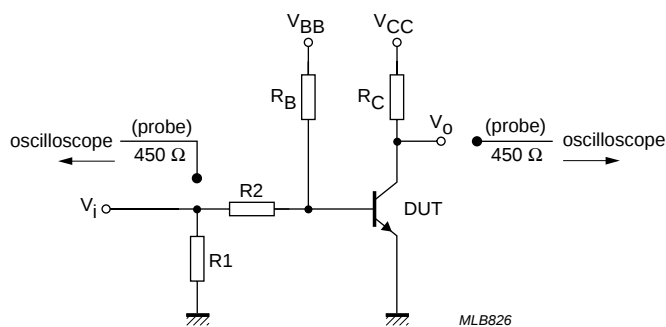

 $I_C/I_B = 10$ .
(1)  $T_{amb} = 150\text{ }^{\circ}\text{C}$ .(2)  $T_{amb} = 25\text{ }^{\circ}\text{C}$ .(3)  $T_{amb} = -55\text{ }^{\circ}\text{C}$ .

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


 $V_i = 5\text{ V}$ ;  $T = 500\text{ }\mu\text{s}$ ;  $t_p = 10\text{ }\mu\text{s}$ ;  $t_r = t_f \leq 3\text{ ns}$ .

 $R1 = 56\text{ }\Omega$ ;  $R2 = 2.5\text{ k}\Omega$ ;  $R_B = 3.9\text{ k}\Omega$ ;  $R_C = 270\text{ }\Omega$ .

 $V_{BE} = -1.9\text{ V}$ ;  $V_{CE} = 3\text{ V}$ .
Oscilloscope: input impedance  $Z_i = 50\text{ }\Omega$ .

Fig.7 Test circuit for switching times.

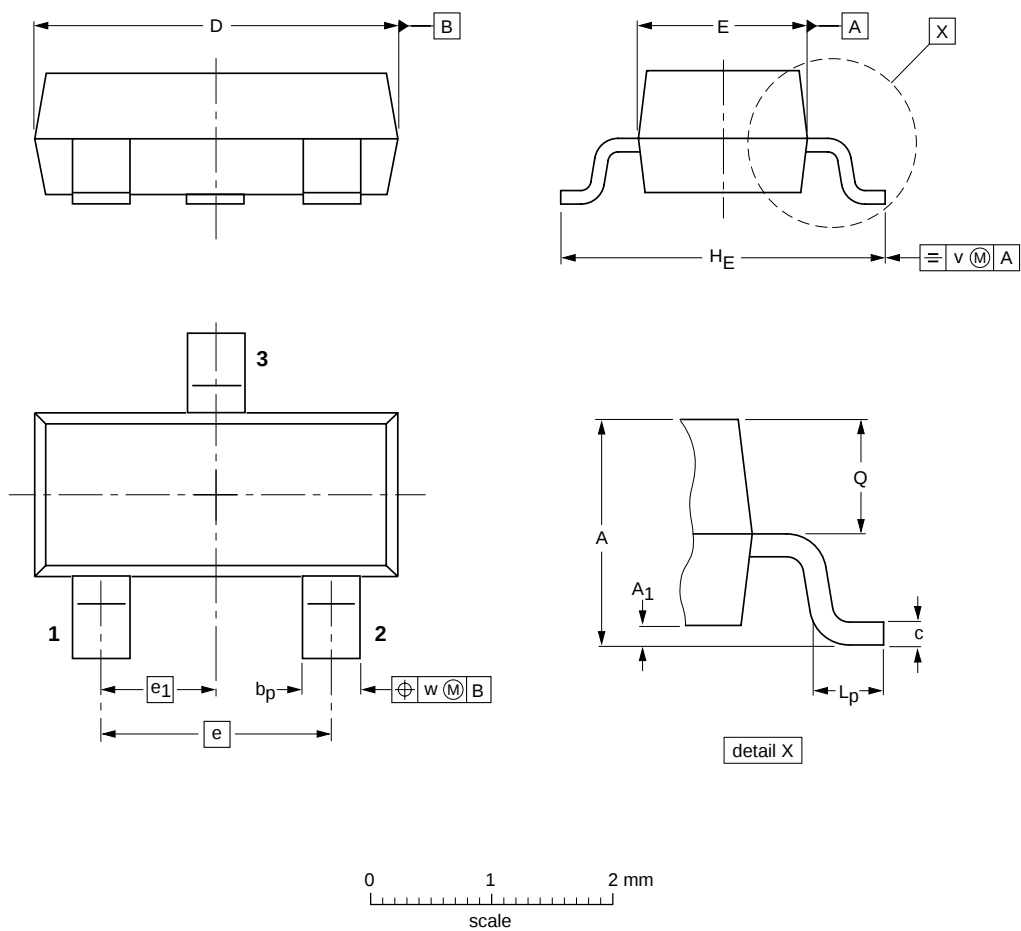
NPN switching transistor

MMBT3904

PACKAGE OUTLINE

Plastic surface-mounted package; 3 leads

SOT23



DIMENSIONS (mm are the original dimensions)

| UNIT | A          | A <sub>1</sub><br>max. | b <sub>p</sub> | c            | D          | E          | e   | e <sub>1</sub> | H <sub>E</sub> | L <sub>p</sub> | Q            | v   | w   |
|------|------------|------------------------|----------------|--------------|------------|------------|-----|----------------|----------------|----------------|--------------|-----|-----|
| mm   | 1.1<br>0.9 | 0.1                    | 0.48<br>0.38   | 0.15<br>0.09 | 3.0<br>2.8 | 1.4<br>1.2 | 1.9 | 0.95           | 2.5<br>2.1     | 0.45<br>0.15   | 0.55<br>0.45 | 0.2 | 0.1 |

| OUTLINE<br>VERSION | REFERENCES |          |       |  | EUROPEAN<br>PROJECTION | ISSUE DATE           |
|--------------------|------------|----------|-------|--|------------------------|----------------------|
|                    | IEC        | JEDEC    | JEITA |  |                        |                      |
| SOT23              |            | TO-236AB |       |  |                        | 04-11-04<br>06-03-16 |

## NPN switching transistor

MMBT3904

## DATA SHEET STATUS

| DOCUMENT STATUS <sup>(1)</sup> | PRODUCT STATUS <sup>(2)</sup> | DEFINITION                                                                            |
|--------------------------------|-------------------------------|---------------------------------------------------------------------------------------|
| Objective data sheet           | Development                   | This document contains data from the objective specification for product development. |
| Preliminary data sheet         | Qualification                 | This document contains data from the preliminary specification.                       |
| Product data sheet             | Production                    | This document contains the product specification.                                     |

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## **Contact information**

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