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# NPN switching transistor — BSX20

## FEATURES

- Low current (max. 200 mA)
- Low voltage (max. 15 V).

## APPLICATIONS

- High-speed saturated switching (and HF amplifier applications).

## DESCRIPTION

NPN switching transistor in a TO-18 metal package.

## PINNING

| PIN | DESCRIPTION |
|---|---|
| 1 | emitter |
| 2 | base |
| 3 | collector, connected to case |

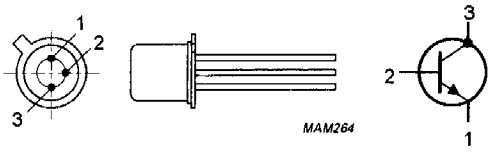


Fig.1 Simplified outline (TO-18) and symbol.

## QUICK REFERENCE DATA

| SYMBOL | PARAMETER | CONDITIONS | MIN. | MAX. | UNIT |
|---|---|---|---|---|---|
| $V_{CBO}$ | collector-base voltage | open emitter | – | 40 | V |
| $V_{CEO}$ | collector-emitter voltage | open base | – | 15 | V |
| $I_C$ | collector current (DC) | | – | 200 | mA |
| $P_{tot}$ | total power dissipation | $T_{amb} \leq 25$ °C | – | 360 | mW |
| $h_{FE}$ | DC current gain | $I_C$ = 10 mA; $V_{CE}$ = 1 V | 40 | 120 | |
| | | $I_C$ = 100 mA; $V_{CE}$ = 2 V | 20 | – | |
| $f_T$ | transition frequency | $I_C$ = 10 mA; $V_{CE}$ = 10 V; f = 100 MHz | 500 | – | MHz |
| $t_{off}$ | turn-off time | $I_{Con}$ = 10 mA; $I_{Bon}$ = 3 mA; $I_{Boff}$ = −1.5 mA | – | 30 | ns |

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## LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 134).

| SYMBOL | PARAMETER | CONDITIONS | MIN. | MAX. | UNIT |
|---|---|---|---|---|---|
| $V_{CBO}$ | collector-base voltage | open emitter | – | 40 | V |
| $V_{CEO}$ | collector-emitter voltage | open base | – | 15 | V |
| $V_{EBO}$ | emitter-base voltage | open collector | – | 4.5 | V |
| $I_C$ | collector current (DC) | | – | 200 | mA |
| $I_{CM}$ | peak collector current | $t \leq 10$ μs | – | 300 | mA |
| $I_{BM}$ | peak base current | | – | 100 | mA |
| $P_{tot}$ | total power dissipation | | – | 360 | mW |
| $T_{stg}$ | storage temperature | | –65 | +150 | °C |
| $T_j$ | junction temperature | | – | 200 | °C |
| $T_{amb}$ | operating ambient temperature | | –65 | +150 | °C |

## THERMAL CHARACTERISTICS

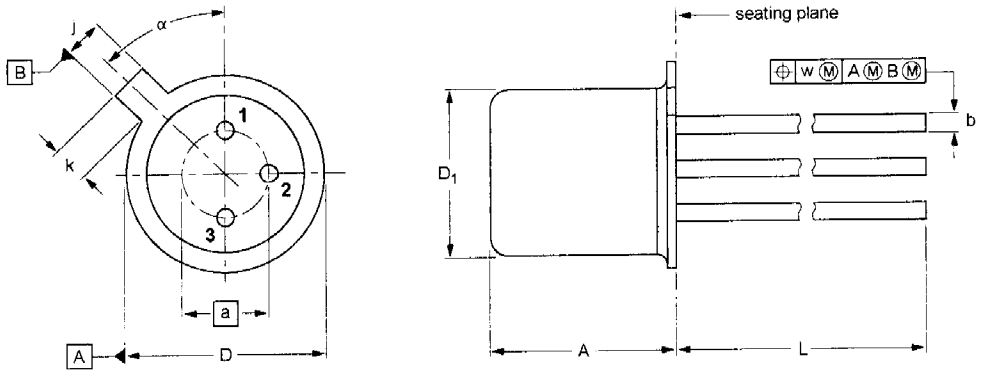
| SYMBOL | PARAMETER | CONDITIONS | VALUE | UNIT |
|---|---|---|---|---|
| $R_{th\ j\text{-}a}$ | thermal resistance from junction to ambient | in free air | 480 | K/W |
| $R_{th\ j\text{-}c}$ | thermal resistance from junction to case | | 150 | K/W |

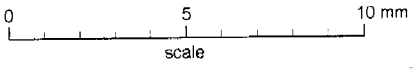
## CHARACTERISTICS

$T_j = 25$ °C unless otherwise specified.

| SYMBOL | PARAMETER | CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| $I_{CBO}$ | collector cut-off current | $I_E = 0$; $V_{CB} = 20$ V | – | – | 400 | nA |
| | | $I_E = 0$; $V_{CB} = 20$ V; $T_j = 150$ °C | – | – | 30 | μA |
| $I_{EBO}$ | emitter cut-off current | $I_C = 0$; $V_{EB} = 4$ V | – | – | 100 | nA |
| $h_{FE}$ | DC current gain | $I_C = 10$ mA; $V_{CE} = 1$ V | 40 | – | 120 | |
| | | $I_C = 10$ mA; $V_{CE} = 1$ V; $T_j = -55$ °C | 20 | – | – | |
| | | $I_C = 100$ mA; $V_{CE} = 2$ V | 20 | – | – | |
| $V_{CEsat}$ | collector-emitter saturation voltage | $I_C = 10$ mA; $I_B = 0.3$ mA | – | – | 300 | mV |
| | | $I_C = 10$ mA; $I_B = 1$ mA | – | – | 250 | mV |
| | | $I_C = 100$ mA; $I_B = 10$ mA | – | – | 600 | mV |
| $V_{BEsat}$ | base-emitter saturation voltage | $I_C = 10$ mA; $I_B = 1$ mA | 700 | – | 850 | mV |
| | | $I_C = 100$ mA; $I_B = 10$ mA | – | – | 1.5 | V |
| $C_c$ | collector capacitance | $I_E = i_e = 0$; $V_{CB} = 5$ V; $f = 1$ MHz | – | – | 4 | pF |
| $C_e$ | emitter capacitance | $I_C = i_c = 0$; $V_{EB} = 1$ V; $f = 1$ MHz | – | – | 4.5 | pF |
| $f_T$ | transition frequency | $I_C = 10$ mA; $V_{CE} = 10$ V; $f = 100$ MHz | 500 | 600 | – | MHz |

| SYMBOL | PARAMETER | CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| **Switching times (between 10% and 90% levels)** | | | | | | |
| $t_{on}$ | turn-on time | $I_{Con}$ = 10 mA; $I_{Bon}$ = 3 mA; $I_{Boff}$ = −1.5 mA; see Fig.2, test conditions A | – | – | 10 | ns |
| $t_d$ | delay time | | – | – | 4 | ns |
| $t_r$ | rise time | | – | – | 6 | ns |
| $t_{off}$ | turn-off time | | – | – | 30 | ns |
| $t_s$ | storage time | | – | – | 15 | ns |
| $t_f$ | fall time | | – | – | 15 | ns |
| $t_{on}$ | turn-on time | $I_{Con}$ = 100 mA; $I_{Bon}$ = 40 mA; $I_{Boff}$ = −20 mA; see Fig.2, test conditions B | – | – | 13 | ns |
| $t_d$ | delay time | | – | – | 3 | ns |
| $t_r$ | rise time | | – | – | 10 | ns |
| $t_{off}$ | turn-off time | | – | – | 35 | ns |
| $t_s$ | storage time | | – | – | 25 | ns |
| $t_f$ | fall time | | – | – | 10 | ns |




**DIMENSIONS (millimetre dimensions are derived from the original inch dimensions)**

| UNIT | A | a | b | D | $D_1$ | j | k | L | w | α |
|---|---|---|---|---|---|---|---|---|---|---|
| mm | 5.31<br>4.74 | 2.54 | 0.47<br>0.41 | 5.45<br>5.30 | 4.70<br>4.55 | 1.03<br>0.94 | 1.1<br>0.9 | 15.0<br>12.7 | 0.40 | 45° |