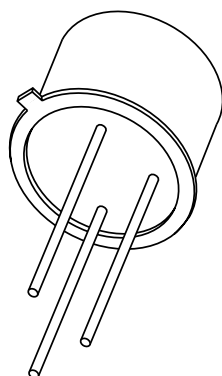


# DATA SHEET



**BSX20**

**NPN switching transistor**

Product specification  
Supersedes data of September 1994  
File under Discrete Semiconductors, SC04

1997 May 14

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 |

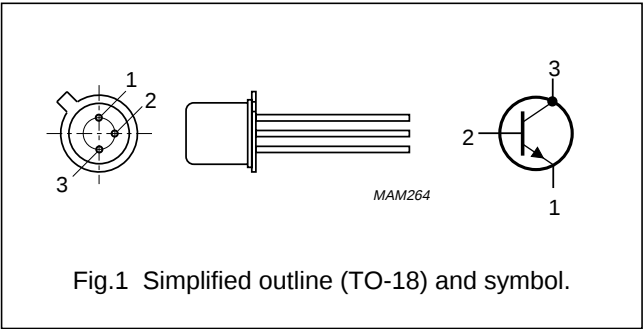


Fig.1 Simplified outline (TO-18) and symbol.

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   | $T_{amb} \leq 25\text{ }^{\circ}\text{C}$                                  | —    | 360  | mW   |
| $h_{FE}$  | DC current gain           | $I_C = 10\text{ mA}; V_{CE} = 1\text{ V}$                                  | 40   | 120  |      |
|           |                           | $I_C = 100\text{ mA}; V_{CE} = 2\text{ V}$                                 | 20   | —    |      |
| $f_T$     | transition frequency      | $I_C = 10\text{ mA}; V_{CE} = 10\text{ V}; f = 100\text{ MHz}$             | 500  | —    | MHz  |
| $t_{off}$ | turn-off time             | $I_{Con} = 10\text{ mA}; I_{Bon} = 3\text{ mA}; I_{Boff} = -1.5\text{ mA}$ | —    | 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        | $t \leq 10 \mu s$ | –    | 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 |
|---------------|---------------------------------------------|-------------|-------|------|
| $R_{th\ j-a}$ | thermal resistance from junction to ambient | in free air | 480   | K/W  |
| $R_{th\ j-c}$ | thermal resistance from junction to case    |             | 150   | K/W  |

## CHARACTERISTICS

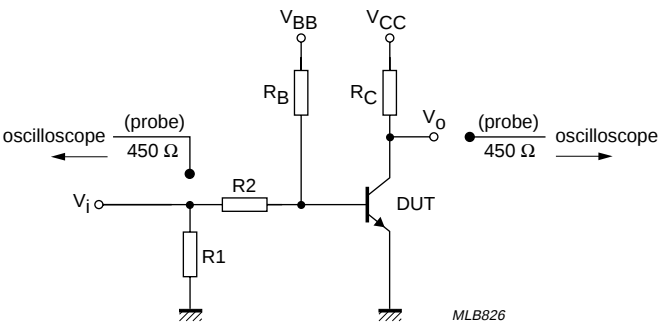
$T_j = 25\text{ °C}$  unless otherwise specified.

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

NPN switching transistor

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| SYMBOL                                       | PARAMETER     | CONDITIONS                                                                                                       | MIN. | TYP. | MAX. | UNIT |
|----------------------------------------------|---------------|------------------------------------------------------------------------------------------------------------------|------|------|------|------|
| Switching times (between 10% and 90% levels) |               |                                                                                                                  |      |      |      |      |
| t <sub>on</sub>                              | turn-on time  | I <sub>Con</sub> = 10 mA; I <sub>Bon</sub> = 3 mA;<br>I <sub>Boff</sub> = -1.5 mA; see Fig.2, test conditions A  | —    | —    | 10   | ns   |
| t <sub>d</sub>                               | delay time    |                                                                                                                  | —    | —    | 4    | ns   |
| t <sub>r</sub>                               | rise time     |                                                                                                                  | —    | —    | 6    | ns   |
| t <sub>off</sub>                             | turn-off time |                                                                                                                  | —    | —    | 30   | ns   |
| t <sub>s</sub>                               | storage time  |                                                                                                                  | —    | —    | 15   | ns   |
| t <sub>f</sub>                               | fall time     |                                                                                                                  | —    | —    | 15   | ns   |
| t <sub>on</sub>                              | turn-on time  | I <sub>Con</sub> = 100 mA; I <sub>Bon</sub> = 40 mA;<br>I <sub>Boff</sub> = -20 mA; see Fig.2, test conditions B | —    | —    | 13   | ns   |
| t <sub>d</sub>                               | delay time    |                                                                                                                  | —    | —    | 3    | ns   |
| t <sub>r</sub>                               | rise time     |                                                                                                                  | —    | —    | 10   | ns   |
| t <sub>off</sub>                             | turn-off time |                                                                                                                  | —    | —    | 35   | ns   |
| t <sub>s</sub>                               | storage time  |                                                                                                                  | —    | —    | 25   | ns   |
| t <sub>f</sub>                               | fall time     |                                                                                                                  | —    | —    | 10   | ns   |



Test conditions A.

Vi = 0.5 to 4.2 V; T = 500 μs; tp = 10 μs; tr = tf ≤ 1 ns.  
R1 = 56 Ω; R2 = 1 kΩ; RB = 1 kΩ; RC = 270 Ω.  
VBB = 0.2 V; VCC = 2.7 V.

Test conditions B.

Vi = 0.5 to 4.52 V; T = 200 μs; tp = 10 μs; tr = tf ≤ 1 ns.  
R1 = 100 Ω; R2 = 68 Ω; RB = 390 Ω; RC = 47 Ω.  
VBB = -3 V; VCC = 4.6 V.

Fig.2 Test circuit for switching times.

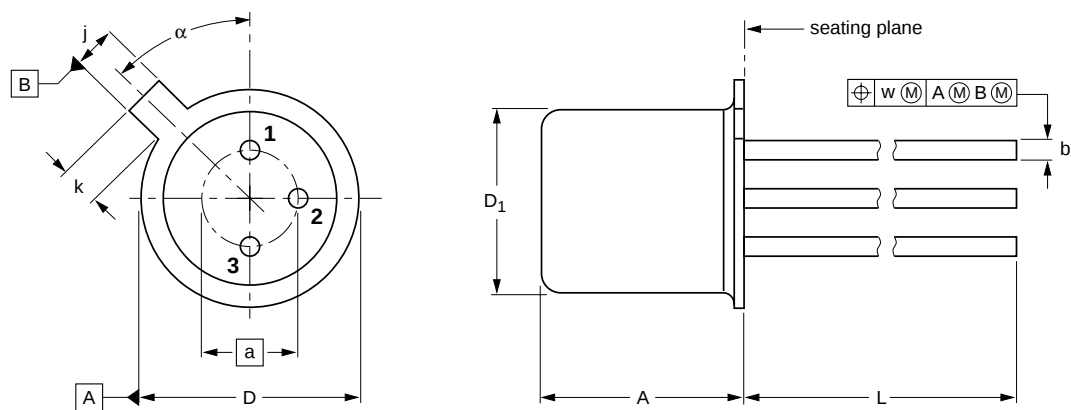
NPN switching transistor

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PACKAGE OUTLINE

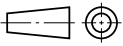
Metal-can cylindrical single-ended package; 3 leads

SOT18/13



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

| UNIT | A            | a    | b            | D            | D <sub>1</sub> | 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° |

| OUTLINE<br>VERSION | REFERENCES    |       |      |  | EUROPEAN<br>PROJECTION                                                                | ISSUE DATE |
|--------------------|---------------|-------|------|--|---------------------------------------------------------------------------------------|------------|
|                    | IEC           | JEDEC | EIAJ |  |                                                                                       |            |
| SOT18/13           | B11/C7 type 3 | TO-18 |      |  |  | 97-04-18   |

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NPN switching transistor

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**DEFINITIONS**

| <b>Data sheet status</b>                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                       |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| Objective specification                                                                                                                                                                                                                                                                                                                                                                                                                                   | This data sheet contains target or goal specifications for product development.       |
| Preliminary specification                                                                                                                                                                                                                                                                                                                                                                                                                                 | This data sheet contains preliminary data; supplementary data may be published later. |
| Product specification                                                                                                                                                                                                                                                                                                                                                                                                                                     | This data sheet contains final product specifications.                                |
| <b>Limiting values</b>                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                       |
| Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 134). 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. |                                                                                       |
| <b>Application information</b>                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                       |
| Where application information is given, it is advisory and does not form part of the specification.                                                                                                                                                                                                                                                                                                                                                       |                                                                                       |

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