# DATA SHEET

# BF510 to 513

## N-channel silicon field-effect transistors

Product specification

December 1997

# N-channel silicon field-effect transistors BF510 to 513

## DESCRIPTION

Asymmetrical N-channel planar epitaxial junction field-effect transistors in the miniature plastic envelope intended for applications up to the v.h.f. range in hybrid thick and thin-film circuits. Special features are the low feedback capacitance and the low noise figure. These features make the product very suitable for applications such as the r.f. stages in f.m. portables (BF510), car radios (BF511) and mains radios (BF512) or the mixer stage (BF513).

## PINNING - SOT23

1 = gate
2 = drain
3 = source

## MARKING CODE

BF510 = S6p
BF511 = S7p
BF512 = S8p
BF513 = S9p

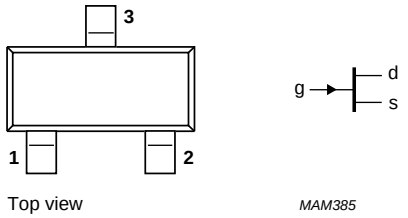



Fig.1 Simplified outline and symbol.

## QUICK REFERENCE DATA

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Drain-source voltage | $V_{DS}$ | max. | | 20 | | | V |
| Drain current (DC or average) | $I_D$ | max. | | 30 | | | mA |
| Total power dissipation | | | | | | | |
| up to $T_{amb}$ = 40 °C | $P_{tot}$ | max. | | 250 | | | mW |
| | | | **BF510** | **511** | **512** | **513** | |
| Drain current | | > | 0.7 | 2.5 | 6 | 10 | mA |
| $V_{DS}$ = 10 V; $V_{GS}$ = 0 | $I_{DSS}$ | < | 3.0 | 7.0 | 12 | 18 | mA |
| Transfer admittance (common source) | | | | | | | |
| $V_{DS}$ = 10 V; $V_{GS}$ = 0; f = 1 kHz | $\lvert y_{fs} \rvert$ | > | 2.5 | 4 | 6 | 7 | mS |
| Feedback capacitance | | | | | | | |
| $V_{DS}$ = 10 V; $V_{GS}$ = 0 | $C_{rs}$ | typ. | 0.3 | 0.3 | – | – | pF |
| $V_{DS}$ = 10 V; $I_D$ = 5 mA | $C_{rs}$ | typ. | – | – | 0.3 | 0.3 | pF |
| Noise figure at optimum source admittance | | | | | | | |
| $G_S$ = 1 mS; $-B_S$ = 3 mS; f = 100 MHz | | | | | | | |
| $V_{DS}$ = 10 V; $V_{GS}$ = 0 | F | typ. | 1.5 | 1.5 | – | – | dB |
| $V_{DS}$ = 10 V; $I_D$ = 5 mA | F | typ. | – | – | 1.5 | 1.5 | dB |

**RATINGS**

Limiting values in accordance with the Absolute Maximum System (IEC 134)

| | | | | |
|---|---|---|---|---|
| Drain-source voltage | $V_{DS}$ | max. | 20 | V |
| Drain-gate voltage (open source) | $V_{DGO}$ | max. | 20 | V |
| Drain current (DC or average) | $I_D$ | max. | 30 | mA |
| Gate current | $\pm I_G$ | max. | 10 | mA |
| Total power dissipation up to $T_{amb}$ = 40 °C (note 1) | $P_{tot}$ | max. | 250 | mW |
| Storage temperature range | $T_{stg}$ | | −65 to + 150 | °C |
| Junction temperature | $T_j$ | max. | 150 | °C |

**THERMAL RESISTANCE**

| | | | | |
|---|---|---|---|---|
| From junction to ambient (note 1) | $R_{th\ j\text{-}a}$ | = | 430 | K/W |

**Note**

1. Mounted on a ceramic substrate of 8 mm × 10 mm × 0.7 mm.

**STATIC CHARACTERISTICS**

$T_{amb}$ = 25 °C

| | | | BF510 | 511 | 512 | 513 | |
|---|---|---|---|---|---|---|---|
| Gate cut-off current | | | | | | | |
| $-V_{GS}$ = 0.2 V; $V_{DS}$ = 0 | $-I_{GSS}$ | < | 10 | 10 | 10 | 10 | nA |
| Gate-drain breakdown voltage | | | | | | | |
| $I_S$ = 0; $-I_D$ = 10 μA | $-V_{(BR)GDO}$ | > | 20 | 20 | 20 | 20 | V |
| Drain current | | | | | | | |
| $V_{DS}$ = 10 V; $V_{GS}$ = 0 | $I_{DSS}$ | > | 0.7 | 2.5 | 6 | 10 | mA |
| | | < | 3.0 | 7.0 | 12 | 18 | mA |
| Gate-source cut-off voltage | | | | | | | |
| $I_D$ = 10 μA; $V_{DS}$ = 10 V | $-V_{(P)GS}$ | typ. | 0.8 | 1.5 | 2.2 | 3 | V |

## DYNAMIC CHARACTERISTICS

**Measuring conditions (common source):** $V_{DS}$ = 10 V; $V_{GS}$ = 0; $T_{amb}$ = 25 °C for BF510 and BF511
$V_{DS}$ = 10 V; $I_D$ = 5 mA; $T_{amb}$ = 25 °C for BF512 and BF513

| **y-parameters (common source)** | | | BF510 | 511 | 512 | 513 | |
|---|---|---|---|---|---|---|---|
| Input capacitance at f = 1 MHz | $C_{is}$ | < | 5 | 5 | 5 | 5 | pF |
| Input conductance at f = 100 MHz | $g_{is}$ | typ. | 100 | 90 | 60 | 50 | μS |
| Feedback capacitance at f = 1 MHz | $C_{rs}$ | typ. | 0.4 | 0.4 | 0.4 | 0.4 | pF |
| | | < | 0.5 | 0.5 | 0.5 | 0.5 | pF |
| Transfer admittance at f = 1 kHz | $\|y_{fs}\|$ | > | 2.5 | 4.0 | 4.0 | 3.5 | mS |
| $V_{GS}$ = 0 instead of $I_D$ = 5 mA | $\|y_{fs}\|$ | > | – | – | 6.0 | 7.0 | mS |
| Transfer admittance at f = 100 MHz | $\|y_{fs}\|$ | typ. | 3.5 | 5.5 | 5.0 | 5.0 | mS |
| Output capacitance at f = 1 MHz | $C_{os}$ | < | 3 | 3 | 3 | 3 | pF |
| Output conductance at f = 1 MHz | $g_{os}$ | < | 60 | 80 | 100 | 120 | μS |
| Output conductance at f = 100 MHz | $g_{os}$ | typ. | 35 | 55 | 70 | 90 | μS |
| **Noise figure** at optimum source admittance $G_S$ = 1 mS; $-B_S$ = 3 mS; f = 100 MHz | F | typ. | 1.5 | 1.5 | 1.5 | 1.5 | dB |

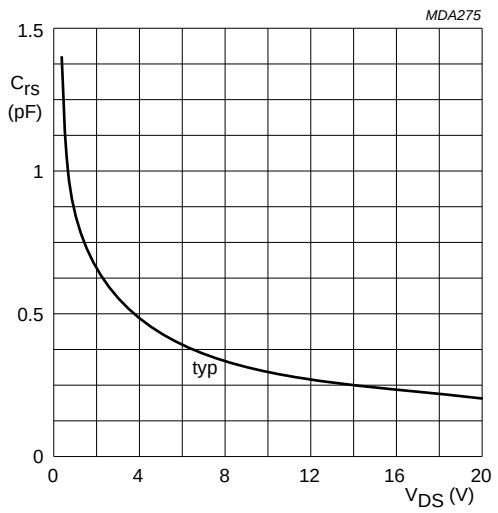



Fig.2 $V_{GS}$ = 0 for BF510 and BF511; $I_D$ = 5 mA for BF512 and BF513; f = 1 MHz; $T_{amb}$ = 25 °C.

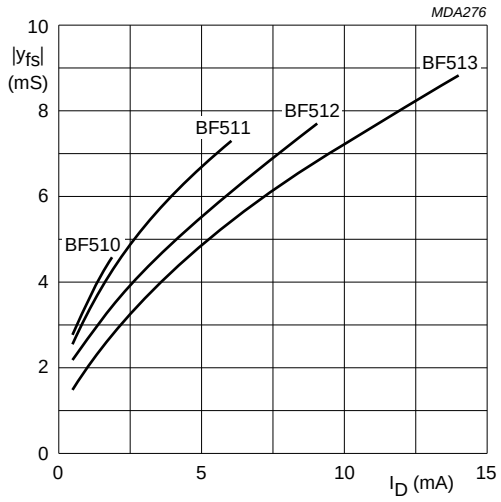



Fig.3 $V_{DS}$ = 10 V; f = 1 kHz; $T_{amb}$ = 25 °C; typical values.

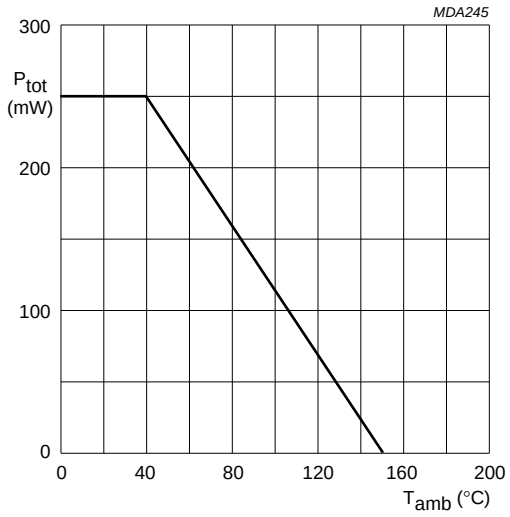
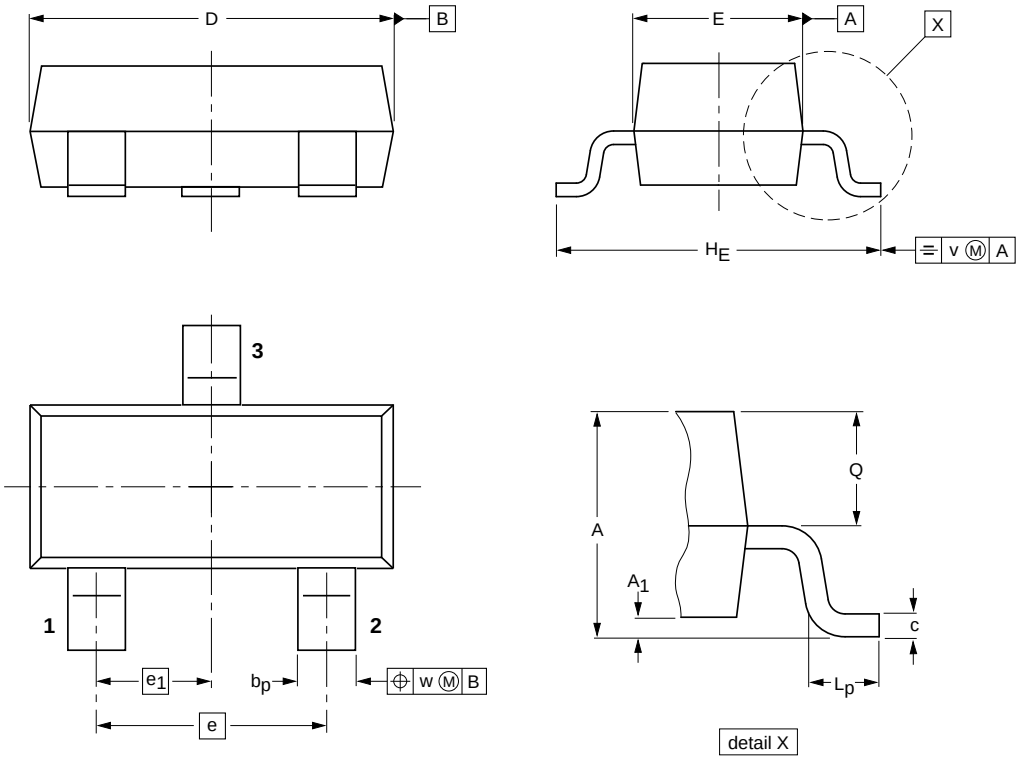



Fig.4 Power derating curve.

## PACKAGE OUTLINE

**Plastic surface-mounted package; 3 leads** **SOT23**




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

| UNIT | A | $A_1$ max. | $b_p$ | c | D | E | e | $e_1$ | $H_E$ | $L_p$ | 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 VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|---|---|---|---|---|---|---|
| | IEC | JEDEC | JEITA | | | |
| SOT23 | | TO-236AB | | | | ~~04-11-04~~<br>06-03-16 |

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| DOCUMENT STATUS[1] | PRODUCT STATUS[2] | 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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