# DATA SHEET

# BF1101; BF1101R; BF1101WR
## N-channel dual-gate MOS-FETs

Product specification
Supersedes data of 1999 Feb 01

1999 May 14

# N-channel dual-gate MOS-FETs

# BF1101; BF1101R; BF1101WR

## FEATURES

- Short channel transistor with high forward transfer admittance to input capacitance ratio
- Low noise gain controlled amplifier up to 1 GHz
- Partly internal self-biasing circuit to ensure good cross-modulation performance during AGC and good DC stabilization.

## APPLICATIONS

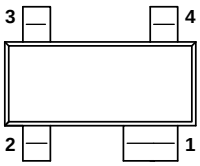
- VHF and UHF applications with 3 to 7 V supply voltage, such as television tuners and professional communications equipment.

## DESCRIPTION

Enhancement type N-channel field-effect transistor with source and substrate interconnected. Integrated diodes between gates and source protect against excessive input voltage surges. The BF1101, BF1101R and BF1101WR are encapsulated in the SOT143B, SOT143R and SOT343R plastic packages respectively.

## PINNING

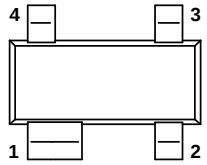
| PIN | DESCRIPTION |
|---|---|
| 1 | source |
| 2 | drain |
| 3 | gate 2 |
| 4 | gate 1 |




Top view MSB035

**BF1101R marking code:** NCp.

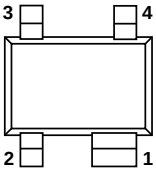
Fig.2 Simplified outline (SOT143R).




Top view MSB014

**BF1101 marking code:** NDp.

Fig.1 Simplified outline (SOT143B).




Top view MSB842

**BF1101WR marking code:** NC.

Fig.3 Simplified outline (SOT343R).

## QUICK REFERENCE DATA

| SYMBOL | PARAMETER | CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| $V_{DS}$ | drain-source voltage | | – | – | 7 | V |
| $I_D$ | drain current | | – | – | 30 | mA |
| $P_{tot}$ | total power dissipation | | – | – | 200 | mW |
| $\lvert y_{fs} \rvert$ | forward transfer admittance | | 25 | 30 | – | mS |
| $C_{ig1\text{-}ss}$ | input capacitance at gate 1 | | – | 2.2 | 2.7 | pF |
| $C_{rss}$ | reverse transfer capacitance | f = 1 MHz | – | 25 | 35 | fF |
| F | noise figure | f = 800 MHz | – | 1.7 | 2.5 | dB |
| $X_{mod}$ | cross-modulation | input level for k = 1% at 40 dB AGC | 100 | – | – | dBμV |
| $T_j$ | operating junction temperature | | – | – | 150 | °C |

**CAUTION**

This product is supplied in anti-static packing to prevent damage caused by electrostatic discharge during transport and handling.

## LIMITING VALUES

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

| SYMBOL | PARAMETER | CONDITIONS | MIN. | MAX. | UNIT |
|---|---|---|---|---|---|
| $V_{DS}$ | drain-source voltage | | – | 7 | V |
| $I_D$ | drain current | | – | 30 | mA |
| $I_{G1}$ | gate 1 current | | – | ±10 | mA |
| $I_{G2}$ | gate 2 current | | – | ±10 | mA |
| $P_{tot}$ | total power dissipation | $T_s \leq 110$ °C; note 1 | – | 200 | mW |
| $T_{stg}$ | storage temperature | | −65 | +150 | °C |
| $T_j$ | operating junction temperature | | – | +150 | °C |

**Note**

1. $T_s$ is the temperature of the soldering point of the source lead.

## THERMAL CHARACTERISTICS

| SYMBOL | PARAMETER | VALUE | UNIT |
|---|---|---|---|
| $R_{th\ j\text{-}s}$ | thermal resistance from junction to soldering point | 200 | K/W |

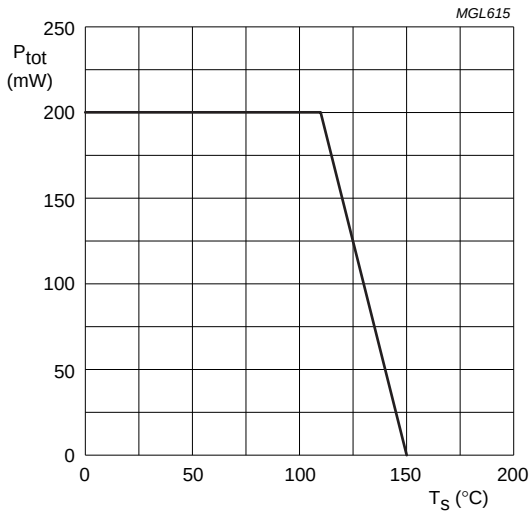



Fig.4 Power derating curve.

**STATIC CHARACTERISTICS**

$T_j$ = 25 °C unless otherwise specified.

| SYMBOL | PARAMETER | CONDITIONS | MIN. | MAX. | UNIT |
|---|---|---|---|---|---|
| $V_{(BR)DSS}$ | drain-source breakdown voltage | $V_{G1-S} = V_{G2-S} = 0$; $I_D$ = 10 μA | 7 | – | V |
| $V_{(BR)G1-SS}$ | gate 1-source breakdown voltage | $V_{G2-S} = V_{DS} = 0$; $I_{G1-S}$ = 10 mA | 7 | 16 | V |
| $V_{(BR)G2-SS}$ | gate 2-source breakdown voltage | $V_{G1-S} = V_{DS} = 0$; $I_{G2-S}$ = 10 mA | 7 | 16 | V |
| $V_{(F)S-G1}$ | forward source-gate 1 voltage | $V_{G2-S} = V_{DS} = 0$; $I_{S-G1}$ = 10 mA | 0.5 | 1.5 | V |
| $V_{(F)S-G2}$ | forward source-gate 2 voltage | $V_{G1-S} = V_{DS} = 0$; $I_{S-G2}$ = 10 mA | 0.5 | 1.5 | V |
| $V_{G1-S\ (th)}$ | gate 1-source threshold voltage | $V_{G2-S}$ = 4 V; $V_{DS}$ = 5 V; $I_D$ = 100 μA | 0.3 | 1.0 | V |
| $V_{G2-S\ (th)}$ | gate 2-source threshold voltage | $V_{G1-S}$ = 5 V; $V_{DS}$ = 5 V; $I_D$ = 100 μA | 0.3 | 1.2 | V |
| $I_{DSX}$ | drain-source current | $V_{G2-S}$ = 4 V; $V_{DS}$ = 5 V; $R_{G1}$ = 120 kΩ; note 1 | 8 | 16 | mA |
| $I_{G1-SS}$ | gate 1 cut-off current | $V_{G2-S} = V_{DS} = 0$; $V_{G1-S}$ = 5 V | – | 50 | nA |
| $I_{G2-SS}$ | gate 2 cut-off current | $V_{G1-S} = V_{DS} = 0$; $V_{G2-S}$ = 4 V | – | 20 | nA |

**Note**

1. $R_{G1}$ connects $G_1$ to $V_{GG}$ = 5 V; see Fig.21.

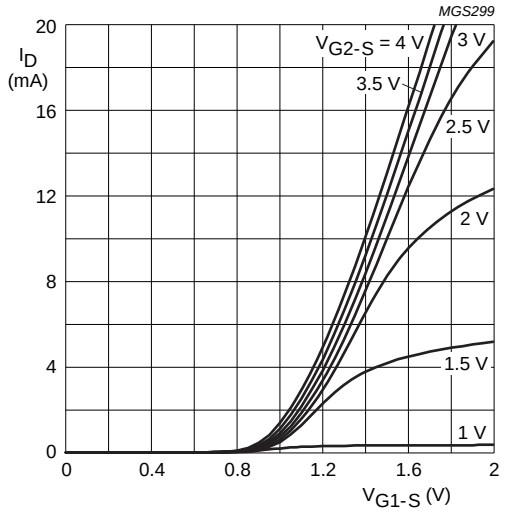
**DYNAMIC CHARACTERISTICS**

Common source; $T_{amb}$ = 25 °C; $V_{G2-S}$ = 4 V; $V_{DS}$ = 5 V; $I_D$ = 12 mA; unless otherwise specified.

| SYMBOL | PARAMETER | CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| $\lvert y_{fs} \rvert$ | forward transfer admittance | pulsed; $T_j$ = 25 °C | 25 | 30 | 40 | mS |
| $C_{ig1-ss}$ | input capacitance at gate 1 | f = 1 MHz | – | 2.2 | 2.7 | pF |
| $C_{ig2-ss}$ | input capacitance at gate 2 | f = 1 MHz | – | 1.6 | – | pF |
| $C_{oss}$ | output capacitance | f = 1 MHz | – | 1.2 | – | pF |
| $C_{rss}$ | reverse transfer capacitance | f = 1 MHz | – | 25 | 35 | fF |
| F | noise figure | f = 800 MHz; $Y_S = Y_{S\ opt}$ | – | 1.7 | 2.5 | dB |
| $X_{mod}$ | cross-modulation | input level for k = 1% at 0 dB AGC; $f_w$ = 50 MHz; $f_{unw}$ = 60 MHz; note 1 | 85 | – | – | dBμV |
| | | input level for k = 1% at 40 dB AGC; $f_w$ = 50 MHz; $f_{unw}$ = 60 MHz; note 1 | 100 | – | – | dBμV |

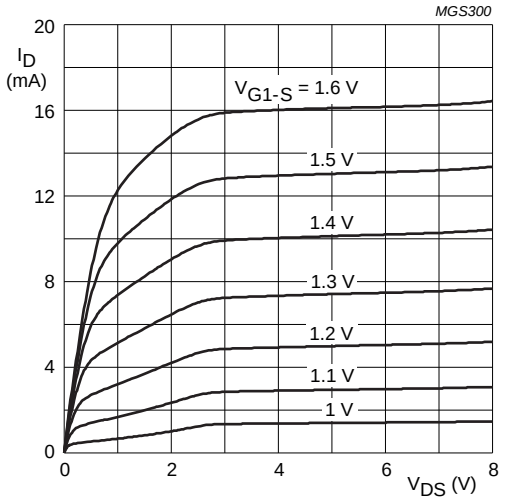
**Note**

1. Measured in test circuit of Fig.21.



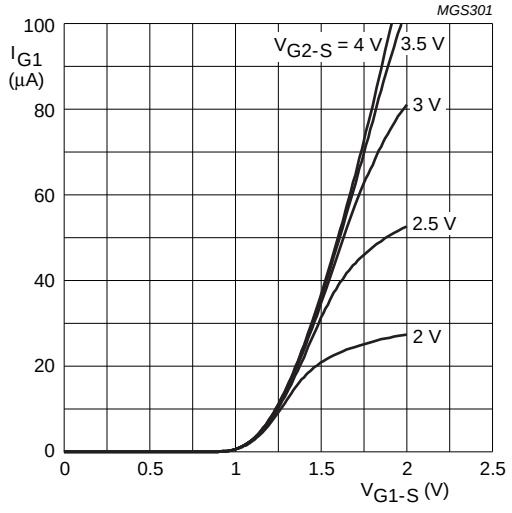

$V_{DS}$ = 5 V.
$T_j$ = 25 °C.

Fig.5 Transfer characteristics; typical values.



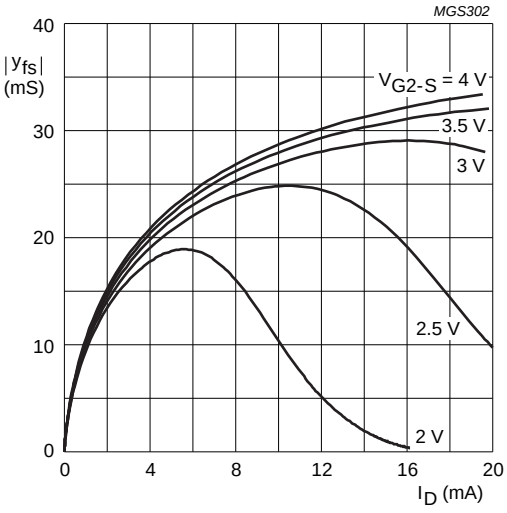

$V_{G2-S}$ = 4 V.
$T_j$ = 25 °C.

Fig.6 Output characteristics; typical values.



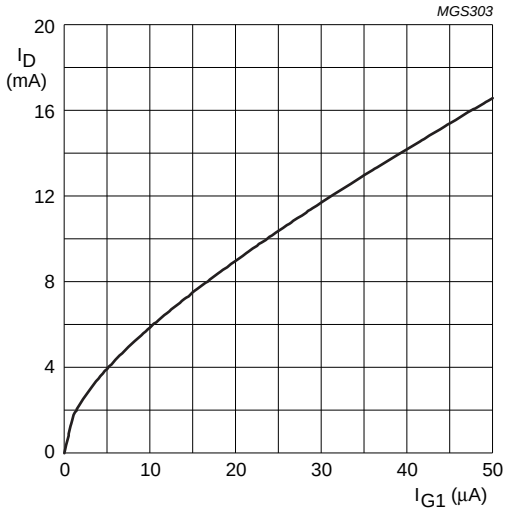

$V_{DS}$ = 5 V.
$T_j$ = 25 °C.

Fig.7 Gate 1 current as a function of gate 1 voltage; typical values.



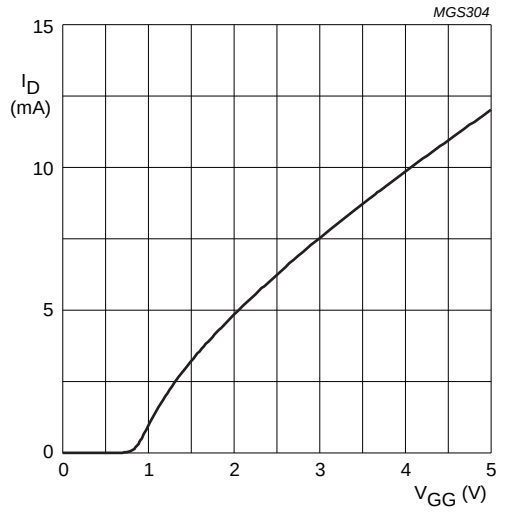

$V_{DS}$ = 5 V.
$T_j$ = 25 °C.

Fig.8 Forward transfer admittance as a function of drain current; typical values.



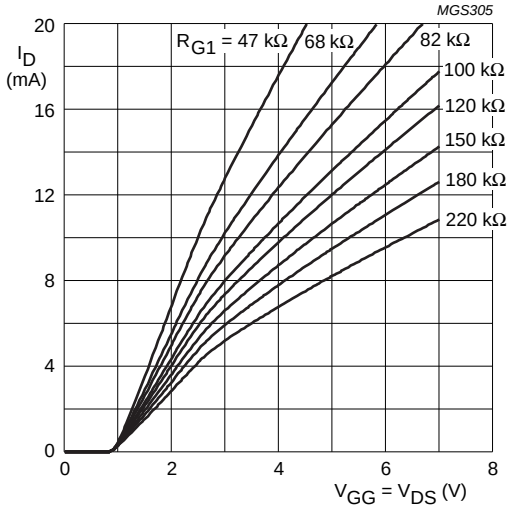

$V_{DS}$ = 5 V.
$V_{G2\text{-}S}$ = 4 V.
$T_j$ = 25 °C.

Fig.9 Drain current as a function of gate 1 current; typical values.



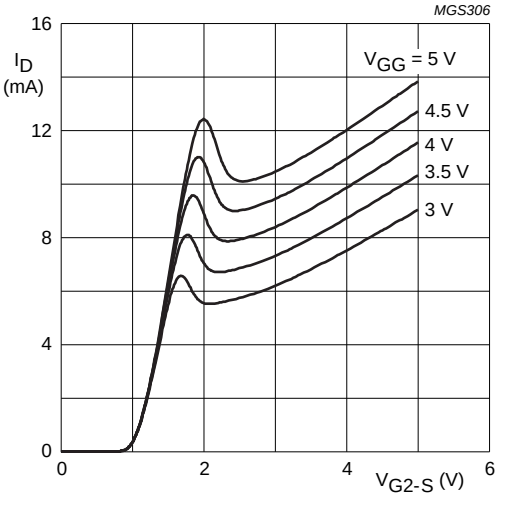

$V_{DS}$ = 5 V; $V_{G2\text{-}S}$ = 4 V; $T_j$ = 25 °C.
$R_{G1}$ = 120 kΩ (connected to $V_{GG}$); see Fig.21.

Fig.10 Drain current as a function of gate 1 supply voltage (= $V_{GG}$); typical values.



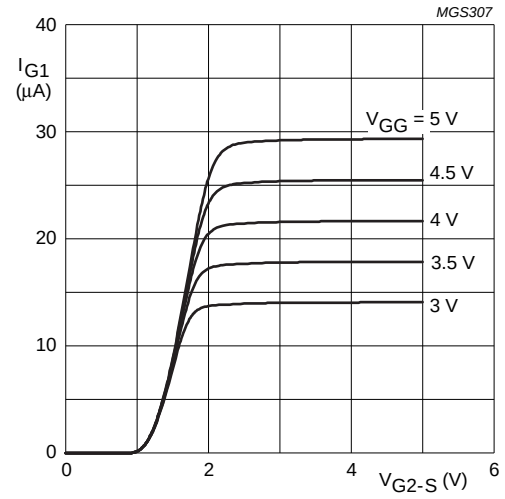

$V_{G2\text{-}S}$ = 4 V; $T_j$ = 25 °C.
$R_{G1}$ connected to $V_{GG}$; see Fig.21.

Fig.11 Drain current as a function of gate 1 (= $V_{GG}$) and drain supply voltage; typical values.



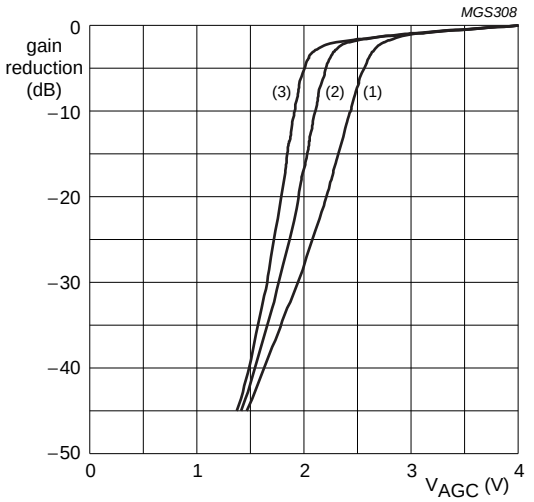

$V_{DS}$ = 5 V; $T_j$ = 25 °C.
$R_{G1}$ = 120 kΩ (connected to $V_{GG}$); see Fig.21.

Fig.12 Drain current as a function of gate 2 voltage; typical values.



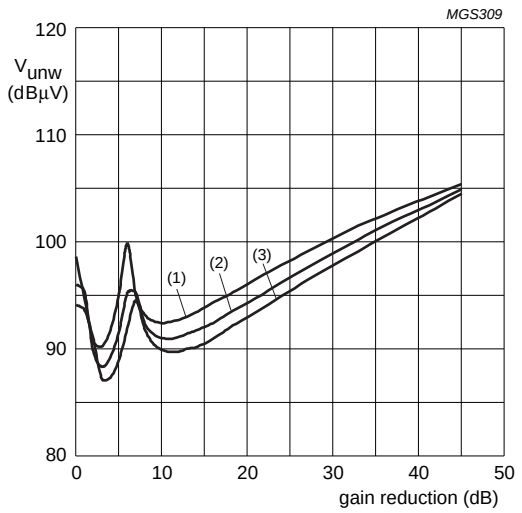

$V_{DS}$ = 5 V; $T_j$ = 25 °C.
$R_{G1}$ = 120 kΩ (connected to $V_{GG}$); see Fig.21.

Fig.13 Gate 1 current as a function of gate 2 voltage; typical values.



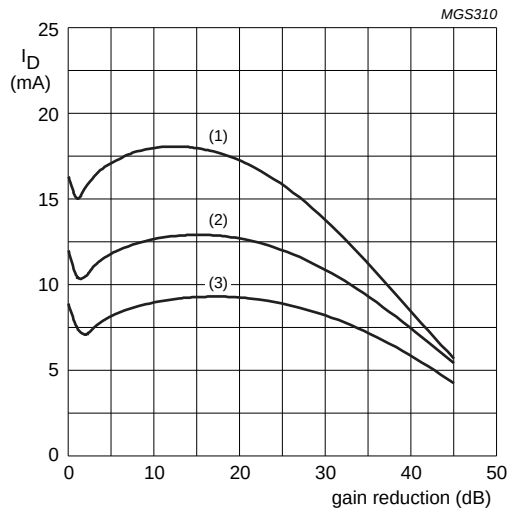

$V_{DS}$ = 5 V; $V_{GG}$ = 5 V; f = 50 MHz; $T_{amb}$ = 25 °C.
(1) $R_{G1}$ = 68 kΩ. (2) $R_{G1}$ = 120 kΩ. (3) $R_{G1}$ = 180 kΩ.

Fig.14 Typical gain reduction as a function of the AGC voltage; see Fig.21.



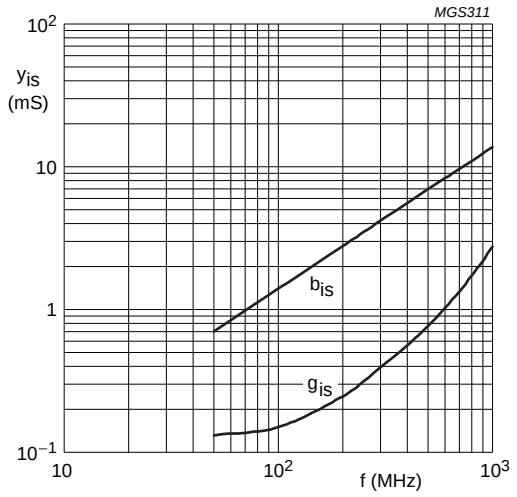

$V_{DS}$ = 5 V; $V_{GG}$ = 5 V; f = 50 MHz; $f_{unw}$ = 60 MHz; $T_{amb}$ = 25 °C.
(1) $R_{G1}$ = 68 kΩ. (2) $R_{G1}$ = 120 kΩ. (3) $R_{G1}$ = 180 kΩ.

Fig.15 Unwanted voltage for 1% cross-modulation as a function of gain reduction; typical values; see Fig.21.



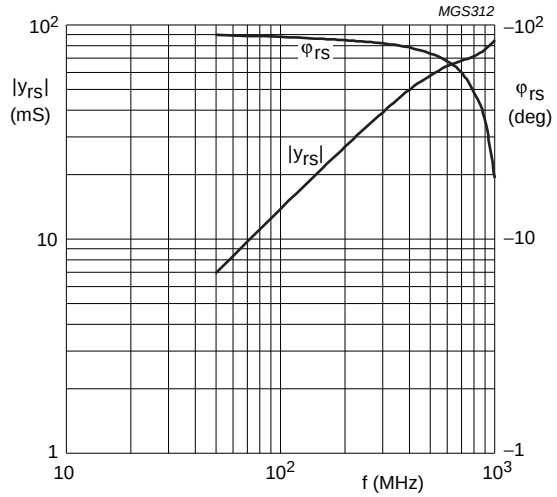

$V_{DS}$ = 5 V; $V_{GG}$ = 5 V; f = 50 MHz; $T_{amb}$ = 25 °C.
(1) $R_{G1}$ = 68 kΩ. (2) $R_{G1}$ = 120 kΩ. (3) $R_{G1}$ = 180 kΩ.

Fig.16 Drain current as a function of gain reduction; typical values; see Fig.21.



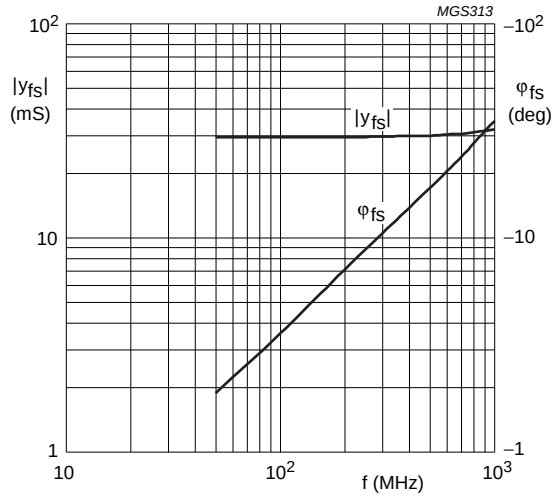

$V_{DS}$ = 5 V; $V_{G2}$ = 4 V.
$I_D$ = 12 mA; $T_{amb}$ = 25 °C.

Fig.17 Input admittance as a function of frequency; typical values.



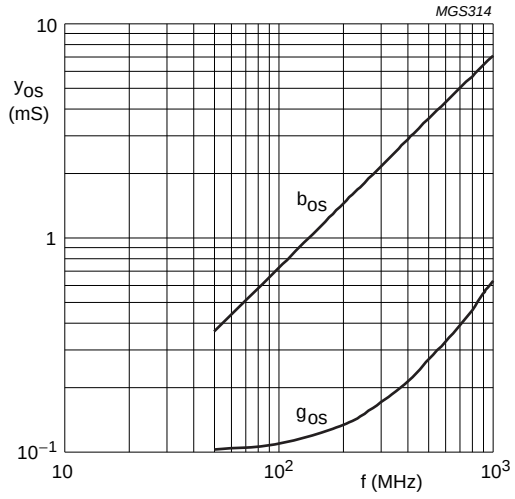

$V_{DS}$ = 5 V; $V_{G2}$ = 4 V.
$I_D$ = 12 mA; $T_{amb}$ = 25 °C.

Fig.18 Reverse transfer admittance and phase as a function of frequency; typical values.




$V_{DS}$ = 5 V; $V_{G2}$ = 4 V.
$I_D$ = 12 mA; $T_{amb}$ = 25 °C.

Fig.19 Forward transfer admittance and phase as a function of frequency; typical values.




$V_{DS}$ = 5 V; $V_{G2}$ = 4 V.
$I_D$ = 12 mA; $T_{amb}$ = 25 °C.

Fig.20 Output admittance as a function of frequency; typical values.

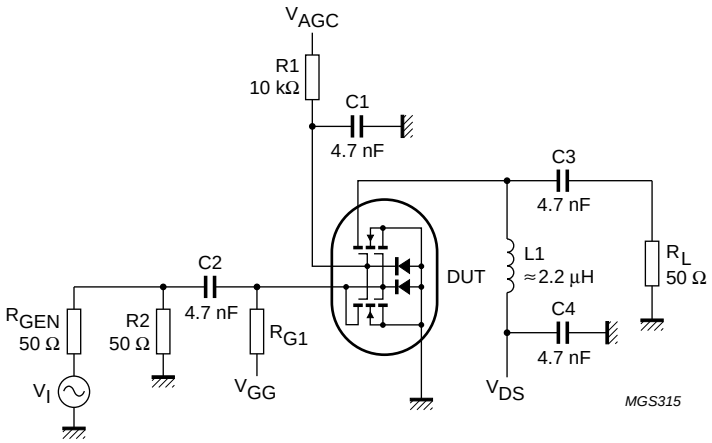



Fig.21 Cross-modulation test set-up.

**Table 1** Scattering parameters: $V_{DS}$ = 5 V; $V_{G2\text{-}S}$ = 4 V; $I_D$ = 12 mA; $T_{amb}$ = 25 °C

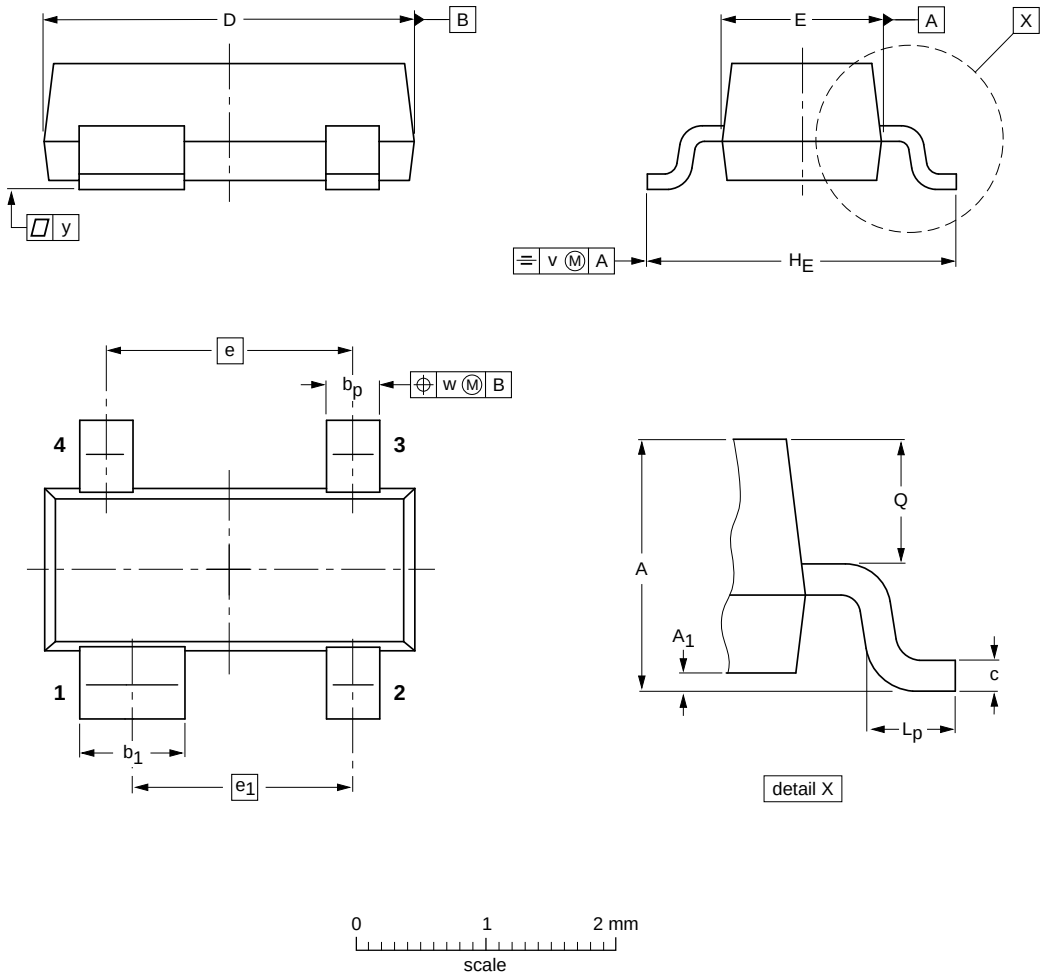
| f (MHz) | $S_{11}$ | | $S_{21}$ | | $S_{12}$ | | $S_{22}$ | |
|---|---|---|---|---|---|---|---|---|
| | MAGNITUDE (ratio) | ANGLE (deg) | MAGNITUDE (ratio) | ANGLE (deg) | MAGNITUDE (ratio) | ANGLE (deg) | MAGNITUDE (ratio) | ANGLE (deg) |
| 50 | 0.987 | −4.1 | 2.922 | 175.0 | 0.001 | 87.6 | 0.990 | −2.2 |
| 100 | 0.985 | −8.1 | 2.908 | 170.3 | 0.001 | 86.1 | 0.989 | −4.3 |
| 200 | 0.976 | −16.1 | 2.875 | 160.8 | 0.003 | 83.3 | 0.985 | −8.5 |
| 300 | 0.963 | −23.9 | 2.820 | 157.6 | 0.004 | 80.4 | 0.982 | −12.6 |
| 400 | 0.949 | −31.6 | 2.762 | 142.6 | 0.005 | 78.2 | 0.977 | −16.8 |
| 500 | 0.933 | −38.8 | 2.665 | 134.1 | 0.005 | 77.8 | 0.972 | −20.8 |
| 600 | 0.916 | −45.7 | 2.591 | 125.7 | 0.005 | 78.9 | 0.967 | −24.7 |
| 700 | 0.897 | −52.2 | 2.498 | 117.7 | 0.006 | 81.8 | 0.961 | −28.5 |
| 800 | 0.877 | −58.4 | 2.410 | 109.6 | 0.005 | 89.1 | 0.957 | −32.2 |
| 900 | 0.856 | −64.5 | 2.318 | 101.6 | 0.006 | 97.1 | 0.950 | −35.8 |
| 1000 | 0.832 | −70.3 | 2.214 | 94.2 | 0.006 | 110.4 | 0.946 | −39.6 |

**Table 2** Noise data: $V_{DS}$ = 5 V; $V_{G2\text{-}S}$ = 4 V; $I_D$ = 12 mA; $T_{amb}$ = 25 °C

| f (MHz) | $F_{min}$ (dB) | $\Gamma_{opt}$ | | $R_n$ (Ω) |
|---|---|---|---|---|
| | | (ratio) | (deg) | |
| 800 | 1.5 | 0.715 | 58.3 | 37.85 |

## PACKAGE OUTLINES

**Plastic surface-mounted package; 4 leads** **SOT143B**

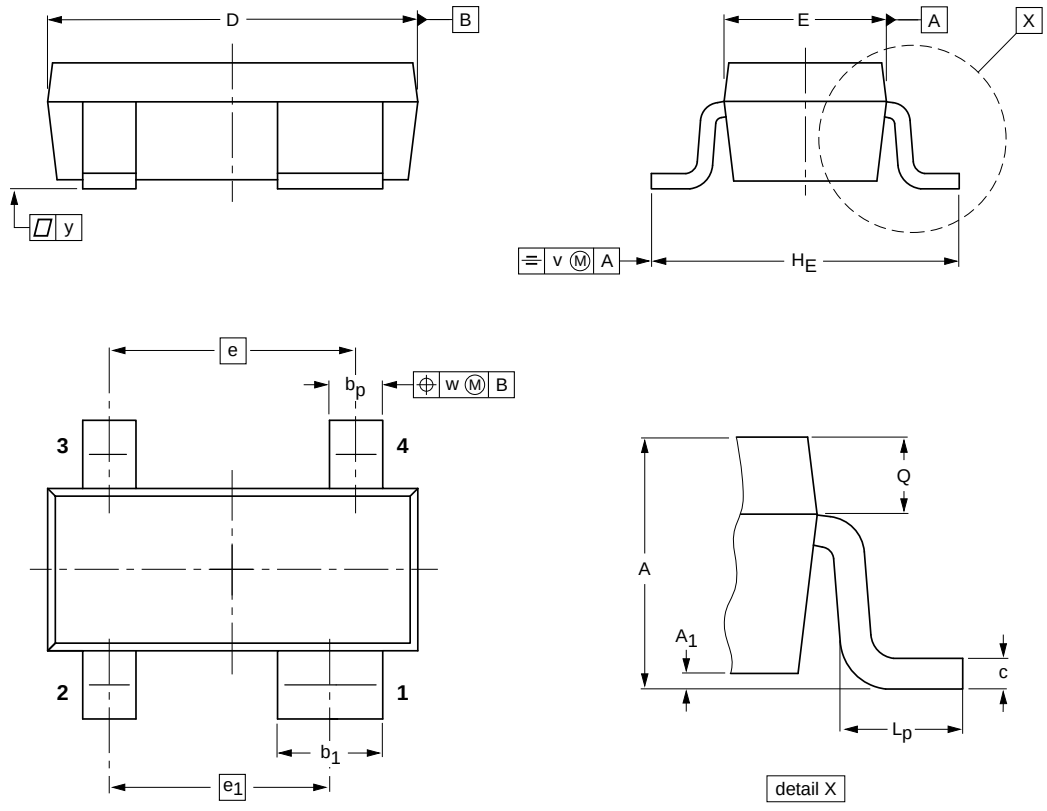



**DIMENSIONS (mm are the original dimensions)**

| UNIT | A | $A_1$ max | $b_p$ | $b_1$ | c | D | E | e | $e_1$ | $H_E$ | $L_p$ | Q | v | w | y |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | 1.1<br>0.9 | 0.1 | 0.48<br>0.38 | 0.88<br>0.78 | 0.15<br>0.09 | 3.0<br>2.8 | 1.4<br>1.2 | 1.9 | 1.7 | 2.5<br>2.1 | 0.45<br>0.15 | 0.55<br>0.45 | 0.2 | 0.1 | 0.1 |

| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|---|---|---|---|---|---|---|
| | IEC | JEDEC | JEITA | | | |
| SOT143B | | | | | | ~~04-11-16~~<br>06-03-16 |

**Plastic surface-mounted package; reverse pinning; 4 leads** **SOT143R**

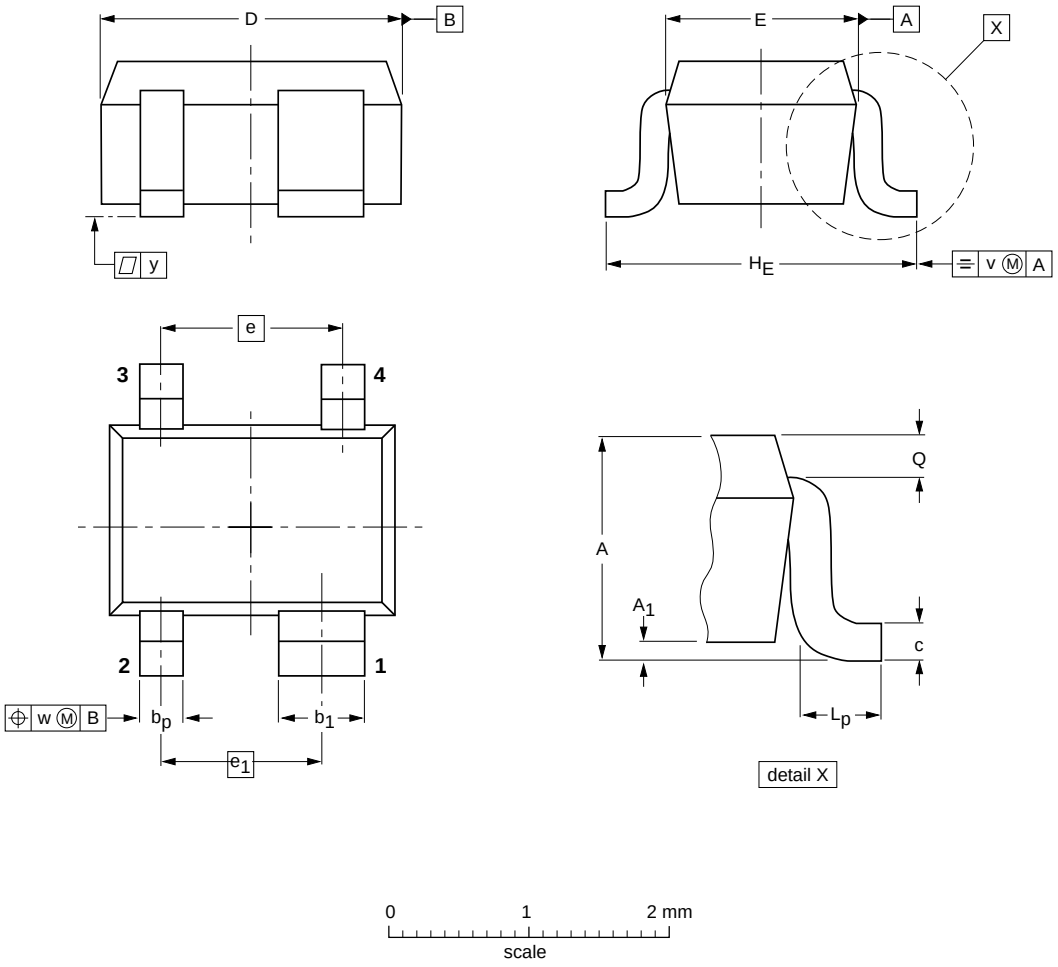



**DIMENSIONS (mm are the original dimensions)**

| UNIT | A | $A_1$ max | $b_p$ | $b_1$ | c | D | E | e | $e_1$ | $H_E$ | $L_p$ | Q | v | w | y |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | 1.1<br>0.9 | 0.1 | 0.48<br>0.38 | 0.88<br>0.78 | 0.15<br>0.09 | 3.0<br>2.8 | 1.4<br>1.2 | 1.9 | 1.7 | 2.5<br>2.1 | 0.55<br>0.25 | 0.45<br>0.25 | 0.2 | 0.1 | 0.1 |

| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|---|---|---|---|---|---|---|
| | IEC | JEDEC | JEITA | | | |
| SOT143R | | | SC-61AA | | | ~~04-11-16~~<br>06-03-16 |

**Plastic surface-mounted package; reverse pinning; 4 leads** **SOT343R**




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

| UNIT | A | $A_1$ max | $b_p$ | $b_1$ | c | D | E | e | $e_1$ | $H_E$ | $L_p$ | Q | v | w | y |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | 1.1<br>0.8 | 0.1 | 0.4<br>0.3 | 0.7<br>0.5 | 0.25<br>0.10 | 2.2<br>1.8 | 1.35<br>1.15 | 1.3 | 1.15 | 2.2<br>2.0 | 0.45<br>0.15 | 0.23<br>0.13 | 0.2 | 0.2 | 0.1 |

| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|---|---|---|---|---|---|---|
| | IEC | JEDEC | EIAJ | | | |
| SOT343R | | | | | | ~~97-05-21~~<br>06-03-16 |

**DATA SHEET STATUS**

| 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. |

**Notes**

1. Please consult the most recently issued document before initiating or completing a design.
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## *provides High Performance Mixed Signal and Standard Product solutions that leverage its leading RF, Analog, Power Management, Interface, Security and Digital Processing expertise*

**Customer notification**

This data sheet was changed to reflect the new company name NXP Semiconductors, including new legal definitions and disclaimers. No changes were made to the technical content, except for package outline drawings which were updated to the latest version.

**Contact information**

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