# DATA SHEET

## BF1100WR
Dual-gate MOS-FET

Product specification
File under Discrete Semiconductors, SC07

1995 Apr 25

Philips Semiconductors

PHILIPS

# Dual-gate MOS-FET BF1100WR

## FEATURES

- Specially designed for use at 9 to 12 V supply voltage
- Short channel transistor with high forward transfer admittance to input capacitance ratio
- Low noise gain controlled amplifier up to 1 GHz
- Superior cross-modulation performance during AGC.

## APPLICATIONS

- VHF and UHF applications such as television tuners and professional communications equipment.

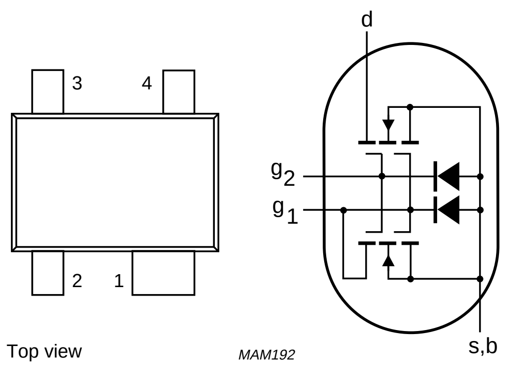
## DESCRIPTION

Enhancement type field-effect transistor in a plastic microminiature SOT343R package. The transistor consists of an amplifier MOS-FET with source and substrate interconnected and an internal bias circuit to ensure good cross-modulation performance during AGC.

| CAUTION |
|---|
| The device is supplied in an antistatic package. The gate-source input must be protected against static discharge during transport or handling. |

## PINNING

| PIN | SYMBOL | DESCRIPTION |
|---|---|---|
| 1 | s, b | source |
| 2 | d | drain |
| 3 | $g_2$ | gate 2 |
| 4 | $g_1$ | gate 1 |




**Marking code:** MF.

Fig.1 Simplified outline (SOT343R) and symbol.

## QUICK REFERENCE DATA

| SYMBOL | PARAMETER | CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| $V_{DS}$ | drain-source voltage | | – | – | 14 | V |
| $I_D$ | drain current | | – | – | 30 | mA |
| $P_{tot}$ | total power dissipation | | – | – | 280 | mW |
| $T_j$ | operating junction temperature | | – | – | 150 | °C |
| $\|y_{fs}\|$ | forward transfer admittance | | 24 | 28 | 33 | mS |
| $C_{ig1-s}$ | input capacitance at gate 1 | | – | 2.2 | 2.6 | pF |
| $C_{rs}$ | reverse transfer capacitance | f = 1 MHz | – | 25 | 35 | fF |
| F | noise figure | f = 800 MHz | – | 2 | – | dB |

## LIMITING VALUES

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

| SYMBOL | PARAMETER | CONDITIONS | MIN. | MAX. | UNIT |
|---|---|---|---|---|---|
| $V_{DS}$ | drain-source voltage | | – | 14 | 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 | see Fig.2; up to $T_{amb}$ = 50 °C; note 1 | – | 280 | mW |
| $T_{stg}$ | storage temperature | | –65 | +150 | °C |
| $T_j$ | operating junction temperature | | – | +150 | °C |

**Note**

1. Device mounted on a printed-circuit board.

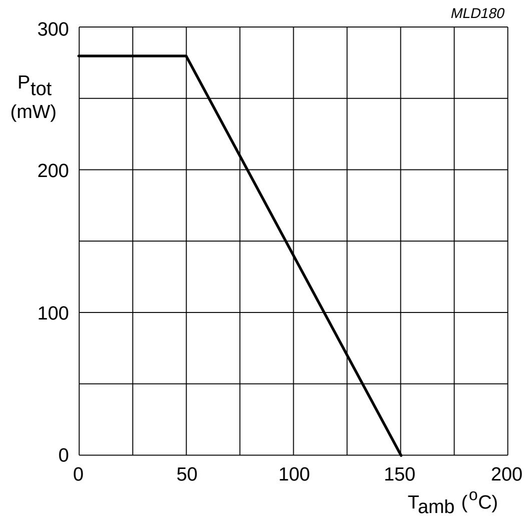



Fig.2 Power derating curve.

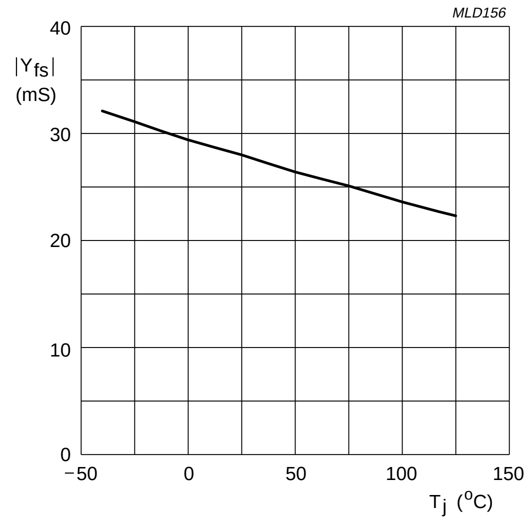



Fig.3 Forward transfer admittance as a function of junction temperature; typical values.

## THERMAL CHARACTERISTICS

| SYMBOL | PARAMETER | CONDITIONS | VALUE | UNIT |
|---|---|---|---|---|
| $R_{th\ j\text{-}a}$ | thermal resistance from junction to ambient | note 1 | 350 | K/W |
| $R_{th\ j\text{-}s}$ | thermal resistance from junction to soldering point | $T_s$ = 91 °C; note 2 | 210 | K/W |

**Notes**

1. Device mounted on a printed-circuit board.
2. $T_s$ is the temperature at the soldering point of the source lead.

## STATIC CHARACTERISTICS

$T_j$ = 25 °C; unless otherwise specified.

| SYMBOL | PARAMETER | CONDITIONS | MIN. | MAX. | UNIT |
|---|---|---|---|---|---|
| $V_{(BR)G1\text{-}SS}$ | gate 1-source breakdown voltage | $V_{G2\text{-}S} = V_{DS} = 0$; $I_{G1\text{-}S}$ = 1 mA | 13.2 | 20 | V |
| $V_{(BR)G2\text{-}SS}$ | gate 2-source breakdown voltage | $V_{G1\text{-}S} = V_{DS} = 0$; $I_{G2\text{-}S}$ = 1 mA | 13.2 | 20 | V |
| $V_{(F)S\text{-}G1}$ | forward source-gate 1 voltage | $V_{G2\text{-}S} = V_{DS} = 0$; $I_{S\text{-}G1}$ = 10 mA | 0.5 | 1.5 | V |
| $V_{(F)S\text{-}G2}$ | forward source-gate 2 voltage | $V_{G1\text{-}S} = V_{DS} = 0$; $I_{S\text{-}G2}$ = 10 mA | 0.5 | 1.5 | V |
| $V_{G1\text{-}S(th)}$ | gate 1-source threshold voltage | $V_{G2\text{-}S}$ = 4 V; $V_{DS}$ = 9 V; $I_D$ = 20 μA | 0.3 | 1 | V |
| | | $V_{G2\text{-}S}$ = 4 V; $V_{DS}$ = 12 V; $I_D$ = 20 μA | 0.3 | 1 | V |
| $V_{G2\text{-}S(th)}$ | gate 2-source threshold voltage | $V_{G1\text{-}S}$ = 4 V; $V_{DS}$ = 9 V; $I_D$ = 20 μA | 0.3 | 1.2 | V |
| | | $V_{G1\text{-}S}$ = 4 V; $V_{DS}$ = 12 V; $I_D$ = 20 μA | 0.3 | 1.2 | V |
| $I_{DSX}$ | drain-source current | $V_{G2\text{-}S}$ = 4 V; $V_{DS}$ = 9 V; $R_{G1}$ = 180 kΩ; note 1 | 8 | 13 | mA |
| | | $V_{G2\text{-}S}$ = 4 V; $V_{DS}$ = 12 V; $R_{G1}$ = 250 kΩ; note 2 | 8 | 13 | mA |
| $I_{G1\text{-}SS}$ | gate 1 cut-off current | $V_{G2\text{-}S} = V_{DS} = 0$; $V_{G1\text{-}S}$ = 12 V | – | 50 | nA |
| $I_{G2\text{-}SS}$ | gate 2 cut-off current | $V_{G1\text{-}S} = V_{DS} = 0$; $V_{G2\text{-}S}$ = 12 V | – | 50 | nA |

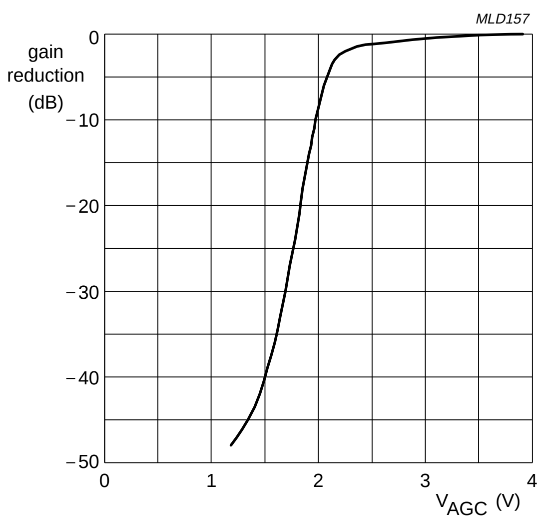
**Notes**

1. $R_{G1}$ connects gate 1 to $V_{GG}$ = 9 V; see Fig.26.
2. $R_{G1}$ connects gate 1 to $V_{GG}$ = 12 V; see Fig.26.

**DYNAMIC CHARACTERISTICS**

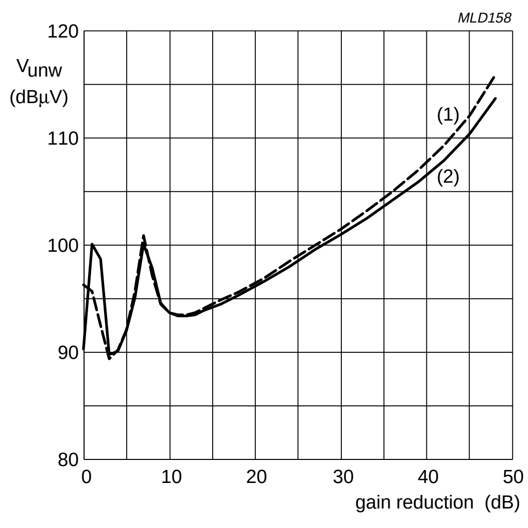
Common source; $T_{amb}$ = 25 °C; $V_{G2\text{-}S}$ = 4 V; $I_D$ = 10 mA; unless otherwise specified.

| SYMBOL | PARAMETER | CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|---|---|---|---|---|---|---|
| $\|y_{fs}\|$ | forward transfer admittance | pulsed; $T_j$ = 25 °C | | | | |
| | | $V_{DS}$ = 9 V | 24 | 28 | 33 | mS |
| | | $V_{DS}$ = 12 V | 24 | 28 | 33 | mS |
| $C_{ig1\text{-}s}$ | input capacitance at gate 1 | f = 1 MHz | | | | |
| | | $V_{DS}$ = 9 V | – | 2.2 | 2.6 | pF |
| | | $V_{DS}$ = 12 V | – | 2.2 | 2.6 | pF |
| $C_{ig2\text{-}s}$ | input capacitance at gate 2 | f = 1 MHz | | | | |
| | | $V_{DS}$ = 9 V | – | 1.6 | – | pF |
| | | $V_{DS}$ = 12 V | – | 1.4 | – | pF |
| $C_{os}$ | drain-source capacitance | f = 1 MHz | | | | |
| | | $V_{DS}$ = 9 V | – | 1.4 | 1.8 | pF |
| | | $V_{DS}$ = 12 V | – | 1.1 | 1.5 | pF |
| $C_{rs}$ | reverse transfer capacitance | f = 1 MHz | | | | |
| | | $V_{DS}$ = 9 V | – | 25 | 35 | fF |
| | | $V_{DS}$ = 12 V | – | 25 | 35 | fF |
| F | noise figure | f = 800 MHz; $G_S = G_{Sopt}$; $B_S = B_{Sopt}$ | | | | |
| | | $V_{DS}$ = 9 V | – | 2 | 2.8 | dB |
| | | $V_{DS}$ = 12 V | – | 2 | 2.8 | dB |



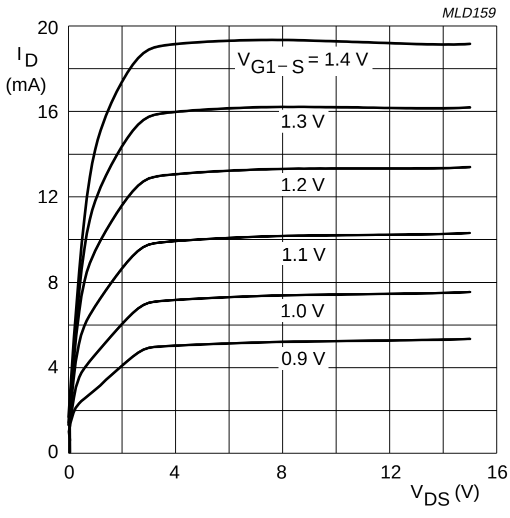

f = 50 MHz.
$T_j$ = 25 °C.

Fig.4 Gain reduction as a function of the AGC voltage; typical values.



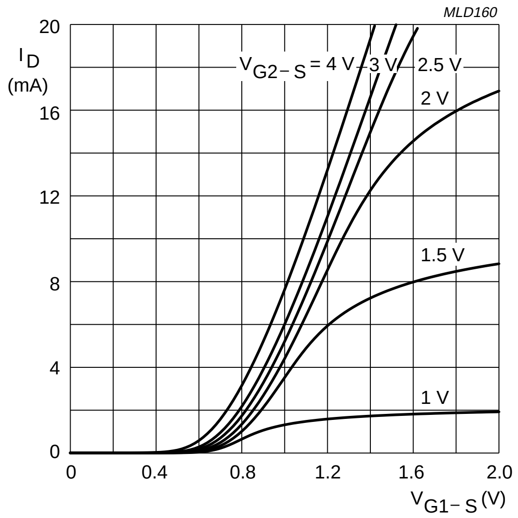

(1) $R_G$ = 250 kΩ to $V_{GG}$ = 12 V.
(2) $R_G$ = 180 kΩ to $V_{GG}$ = 9 V.
$f_w$ = 50 MHz; $f_{unw}$ = 60 MHz; $T_{amb}$ = 25 °C.

Fig.5 Unwanted voltage for 1% cross-modulation as a function of gain reduction; typical values; see Fig.26.



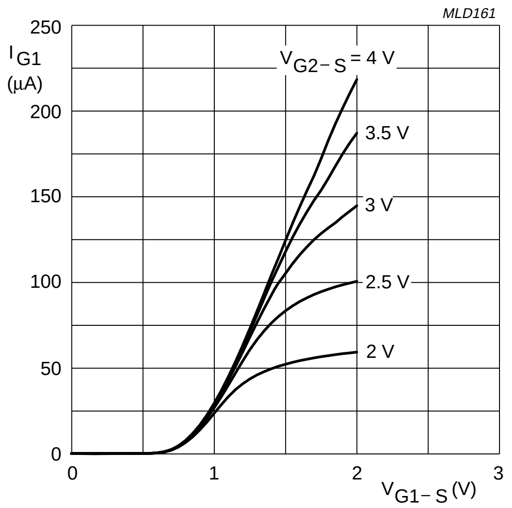

$V_{G2-S}$ = 4 V.
$T_j$ = 25 °C.

Fig.6 Output characteristics; typical values.



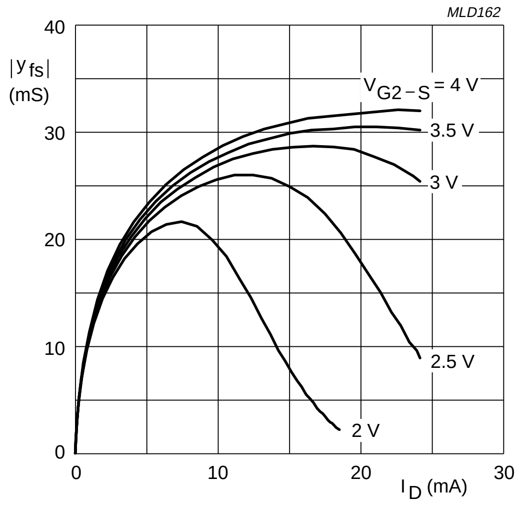

$V_{DS}$ = 9 to 12 V.
$T_j$ = 25 °C.

Fig.7 Transfer characteristics; typical values.



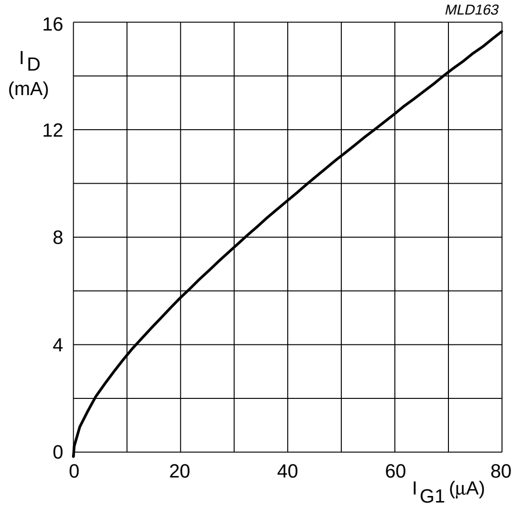

$V_{DS}$ = 9 to 12 V.
$T_j$ = 25 °C.

Fig.8 Gate 1 current as a function of gate 1 voltage; typical values.



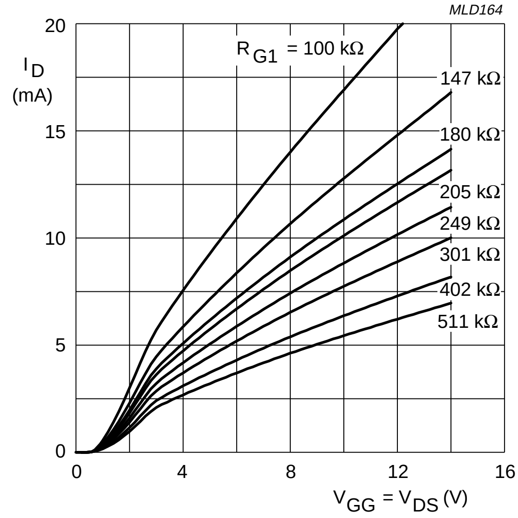

$V_{DS}$ = 9 to 12 V.
$T_j$ = 25 °C.

Fig.9 Forward transfer admittance as a function of drain current; typical values.



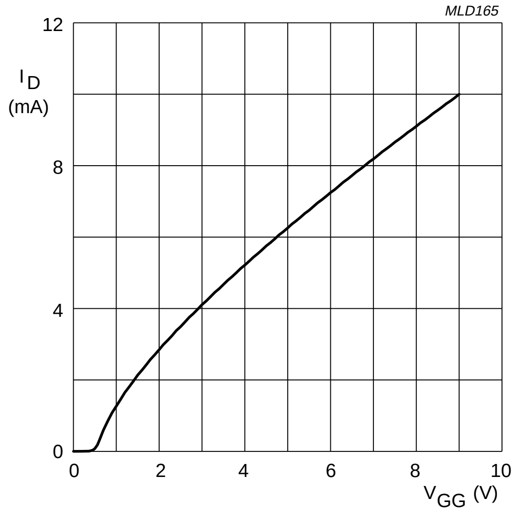

$V_{DS}$ = 9 to 12 V.
$V_{G2\text{-}S}$ = 4 V.
$T_j$ = 25 °C.

Fig.10 Drain current as a function of gate 1 current; typical values.



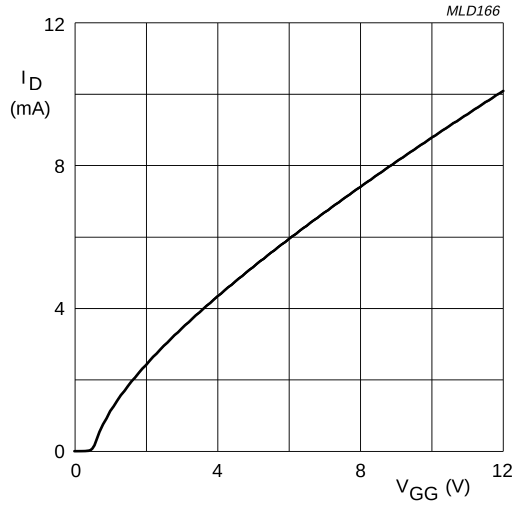

$V_{G2\text{-}S}$ = 4 V.
$R_{G1}$ connected to $V_{GG}$.
$T_j$ = 25 °C.

Fig.11 Drain current as a function of gate 1 supply voltage (= $V_{GG}$) and drain supply voltage; typical values; see Fig.26.



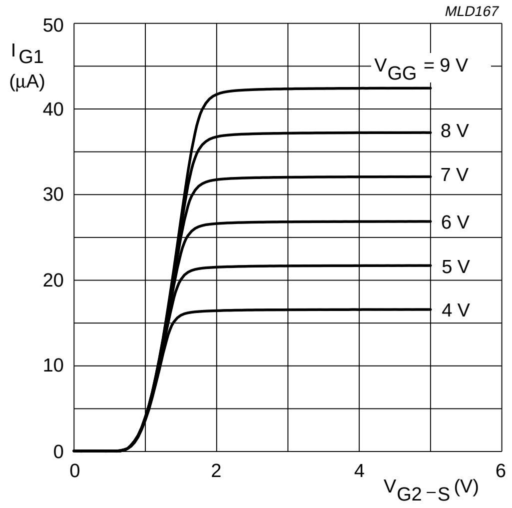

$V_{DS}$ = 9 V; $V_{G2\text{-}S}$ = 4 V.
$R_{G1}$ = 180 kΩ (connected to $V_{GG}$); $T_j$ = 25 °C.

Fig.12 Drain current as a function of gate 1 voltage (= $V_{GG}$); typical values; see Fig.26.



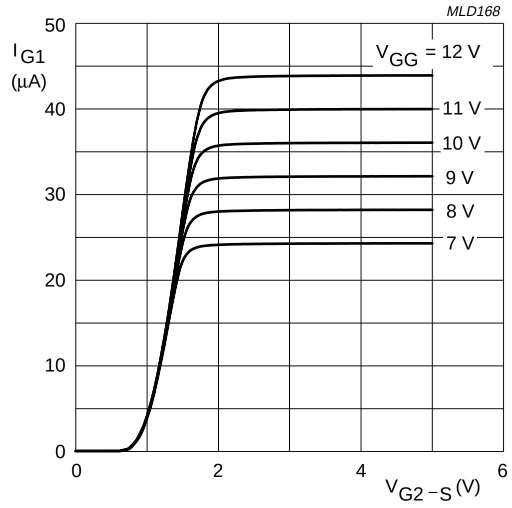

$V_{DS}$ = 12 V; $V_{G2\text{-}S}$ = 4 V.
$R_{G1}$ = 250 kΩ (connected to $V_{GG}$); $T_j$ = 25 °C.

Fig.13 Drain current as a function of gate 1 voltage (= $V_{GG}$); typical values; see Fig.26.



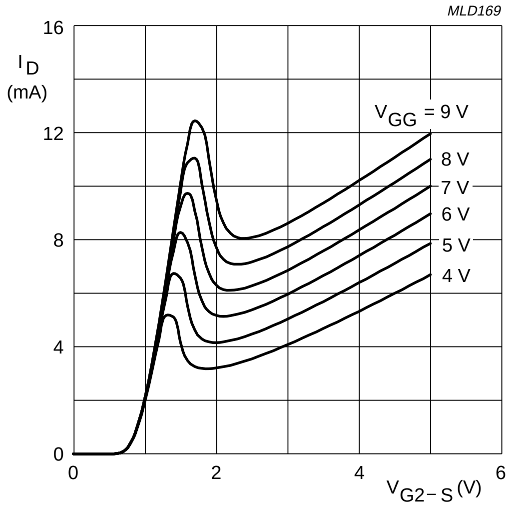

$V_{DS}$ = 9 V.
$R_{G1}$ = 180 kΩ (connected to $V_{GG}$); $T_j$ = 25 °C.

Fig.14 Gate 1 current as a function of gate 2 voltage; typical values.



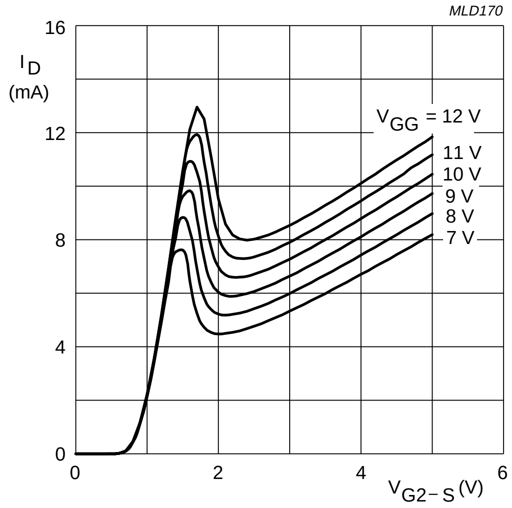

$V_{DS}$ = 12 V.
$R_{G1}$ = 250 kΩ (connected to $V_{GG}$); $T_j$ = 25 °C.

Fig.15 Gate 1 current as a function of gate 2 voltage; typical values.



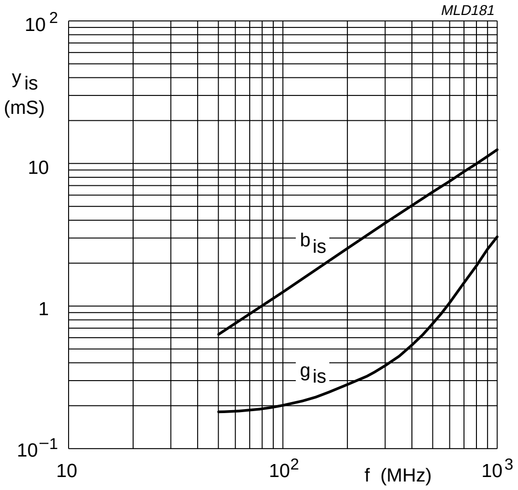

$V_{DS}$ = 9 V.
$R_{G1}$ = 180 kΩ (connected to $V_{GG}$); $T_j$ = 25 °C.

Fig.16 Drain current as a function of the gate 2 voltage; typical values; see Fig.26.



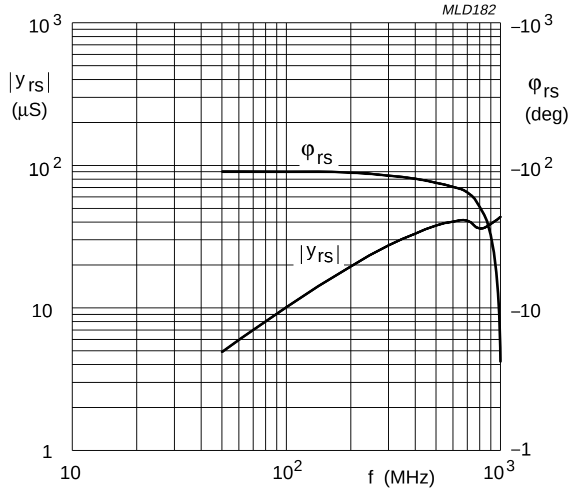

$V_{DS}$ = 12 V.
$R_{G1}$ = 250 kΩ (connected to $V_{GG}$); $T_j$ = 25 °C.

Fig.17 Drain current as a function of the gate 2 voltage; typical values; see Fig.26.



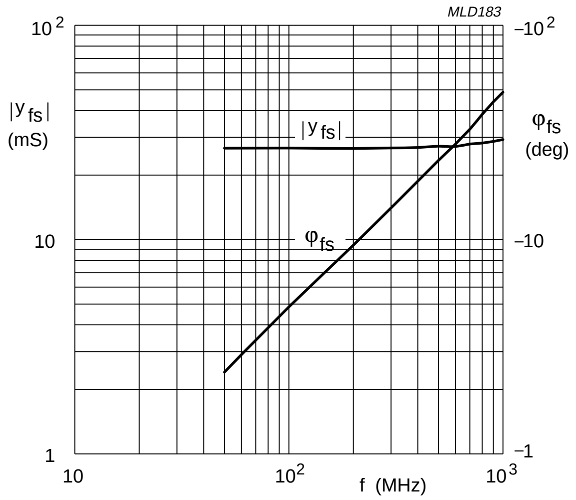

$V_{DS}$ = 9 V; $V_{G2}$ = 4 V.
$I_D$ = 10 mA; $T_{amb}$ = 25 °C.

Fig.18 Input admittance as a function of frequency; typical values.



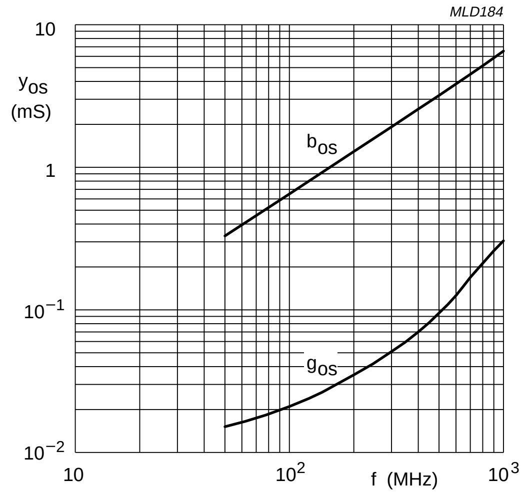

$V_{DS}$ = 9 V; $V_{G2}$ = 4 V.
$I_D$ = 10 mA; $T_{amb}$ = 25 °C.

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



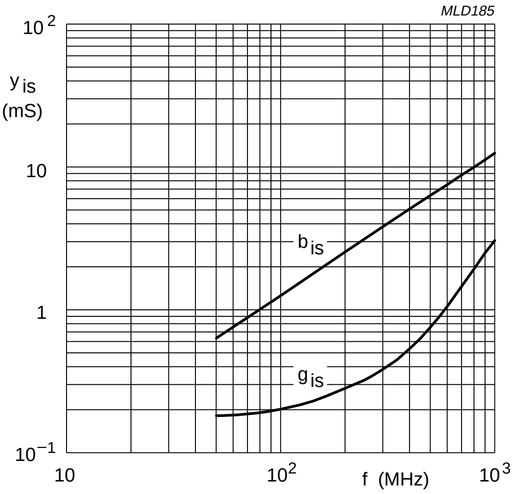

$V_{DS}$ = 9 V; $V_{G2}$ = 4 V.
$I_D$ = 10 mA; $T_{amb}$ = 25 °C.

Fig.20 Forward transfer admittance and phase as a function of frequency; typical values.



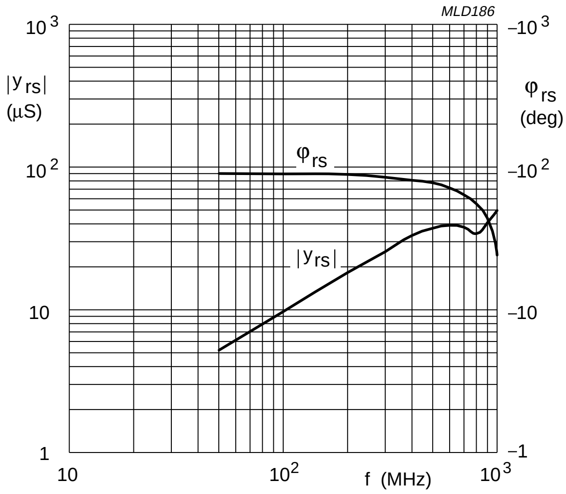

$V_{DS}$ = 9 V; $V_{G2}$ = 4 V.
$I_D$ = 10 mA; $T_{amb}$ = 25 °C.

Fig.21 Output admittance as a function of frequency; typical values.



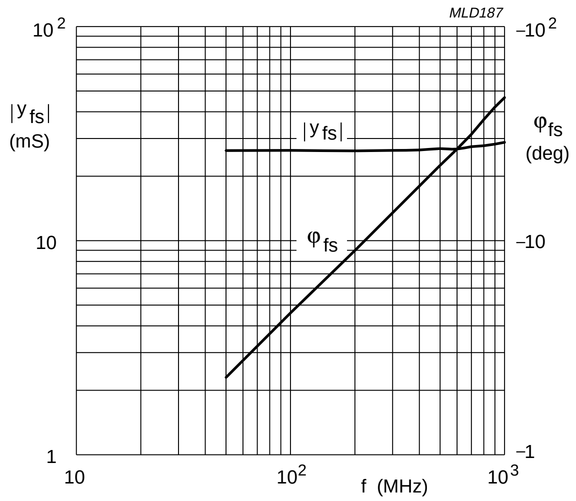

$V_{DS}$ = 12 V; $V_{G2}$ = 4 V.
$I_D$ = 10 mA; $T_{amb}$ = 25 °C.

Fig.22 Input admittance as a function of frequency; typical values.



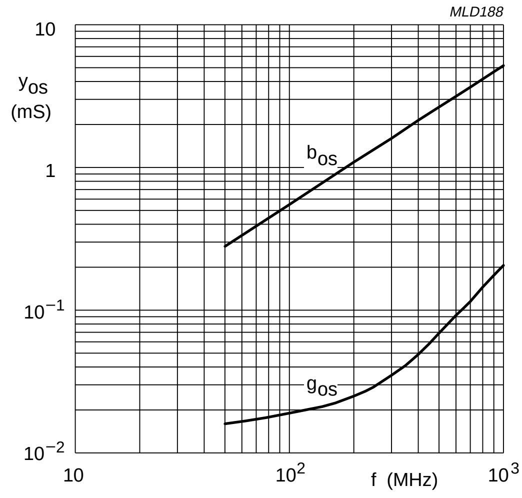

$V_{DS}$ = 12 V; $V_{G2}$ = 4 V.
$I_D$ = 10 mA; $T_{amb}$ = 25 °C.

Fig.23 Reverse transfer admittance and phase as a function of frequency; typical values.



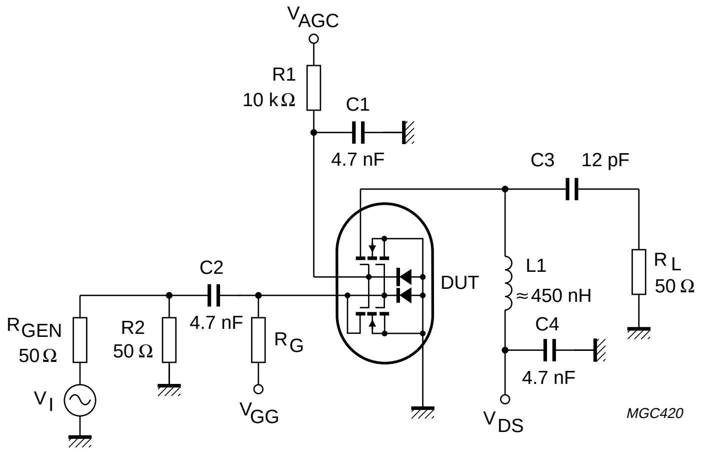

$V_{DS}$ = 12 V; $V_{G2}$ = 4 V.
$I_D$ = 10 mA; $T_{amb}$ = 25 °C.

Fig.24 Forward transfer admittance and phase as a function of frequency; typical values.




$V_{DS}$ = 12 V; $V_{G2}$ = 4 V.
$I_D$ = 10 mA; $T_{amb}$ = 25 °C.

Fig.25 Output admittance as a function of frequency; typical values.




For $V_{GG}$ = $V_{DS}$ = 9 V, $R_{G}$ = 180 kΩ.
For $V_{GG}$ = $V_{DS}$ = 12 V, $R_{G}$ = 250 kΩ.

Fig.26 Cross-modulation test circuit.

**Table 1** Scattering parameters: $V_{DS}$ = 9 V; $V_{G2-S}$ = 4 V; $I_D$ = 10 mA

| 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 | 0.985 | –3.9 | 2.618 | 175.1 | 0.001 | 137.9 | 1.000 | –1.9 |
| 100 | 0.981 | –7.3 | 2.602 | 170.5 | 0.001 | 80.4 | 0.999 | –4.0 |
| 200 | 0.975 | –14.4 | 2.577 | 160.7 | 0.002 | 74.0 | 0.995 | –7.6 |
| 300 | 0.965 | –21.6 | 2.555 | 151.6 | 0.002 | 79.3 | 0.994 | –11.3 |
| 400 | 0.947 | –28.3 | 2.513 | 141.8 | 0.003 | 80.5 | 0.992 | –15.0 |
| 500 | 0.927 | –34.9 | 2.449 | 133.4 | 0.003 | 82.8 | 0.988 | –18.5 |
| 600 | 0.913 | –41.7 | 2.339 | 124.6 | 0.003 | 78.9 | 0.984 | –22.0 |
| 700 | 0.890 | –47.9 | 2.361 | 115.4 | 0.003 | 80.6 | 0.982 | –25.3 |
| 800 | 0.869 | –54.0 | 2.302 | 106.4 | 0.003 | 93.9 | 0.979 | –28.8 |
| 900 | 0.845 | –59.7 | 2.228 | 97.6 | 0.003 | 104.8 | 0.976 | –32.1 |
| 1000 | 0.823 | –65.4 | 2.167 | 89.6 | 0.003 | 129.3 | 0.974 | –35.5 |

**Table 2** Noise data: $V_{DS}$ = 9 V; $V_{G2-S}$ = 4 V; $I_D$ = 10 mA

| f (MHz) | $F_{min}$ (dB) | $\Gamma_{opt}$ | | $r_n$ |
|---|---|---|---|---|
| | | (ratio) | (deg) | |
| 800 | 2.00 | 0.67 | 43.9 | 0.89 |

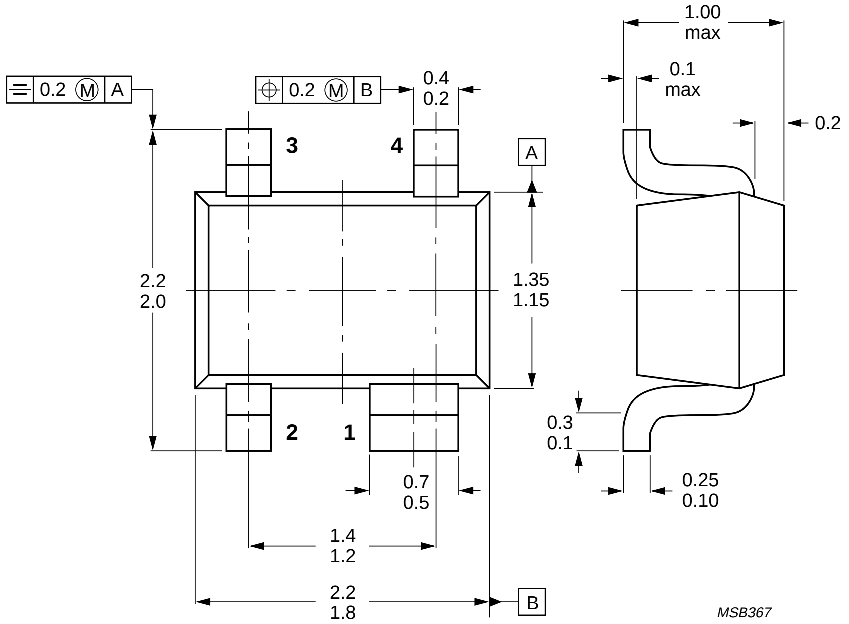
**Table 3** Scattering parameters: $V_{DS}$ = 12 V; $V_{G2-S}$ = 4 V; $I_D$ = 10 mA

| 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 | 0.985 | –3.7 | 2.576 | 175.3 | 0.000 | 125.0 | 1.000 | –1.6 |
| 100 | 0.980 | –7.4 | 2.563 | 170.9 | 0.001 | 111.2 | 1.000 | –3.3 |
| 200 | 0.973 | –14.6 | 2.541 | 161.6 | 0.002 | 83.0 | 0.997 | –6.4 |
| 300 | 0.962 | –21.5 | 2.519 | 152.9 | 0.002 | 85.2 | 0.996 | –9.3 |
| 400 | 0.946 | –28.5 | 2.479 | 143.5 | 0.003 | 79.4 | 0.995 | –12.4 |
| 500 | 0.929 | –35.0 | 2.419 | 135.5 | 0.003 | 78.2 | 0.991 | –15.3 |
| 600 | 0.912 | –41.6 | 2.373 | 127.2 | 0.003 | 80.0 | 0.989 | –18.1 |
| 700 | 0.895 | –47.8 | 2.336 | 118.7 | 0.003 | 83.4 | 0.987 | –20.9 |
| 800 | 0.868 | –53.8 | 2.284 | 110.0 | 0.003 | 91.3 | 0.985 | –23.7 |
| 900 | 0.845 | –59.8 | 2.213 | 101.6 | 0.003 | 95.9 | 0.983 | –26.5 |
| 1000 | 0.823 | –65.7 | 2.160 | 94.1 | 0.003 | 112.2 | 0.981 | –29.3 |

**Table 4** Noise data: $V_{DS}$ = 12 V; $V_{G2-S}$ = 4 V; $I_D$ = 10 mA

| f (MHz) | $F_{min}$ (dB) | $\Gamma_{opt}$ | | $r_n$ |
|---|---|---|---|---|
| | | (ratio) | (deg) | |
| 800 | 2.00 | 0.66 | 43.3 | 0.97 |

## PACKAGE OUTLINE




Dimensions in mm.

Fig.27 SOT343R.

## DEFINITIONS

| Data Sheet Status | |
|---|---|
| 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. |
| **Limiting values** | |
| 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. | |
| **Application information** | |
| Where application information is given, it is advisory and does not form part of the specification. | |

## LIFE SUPPORT APPLICATIONS

These products are not designed for use in life support appliances, devices, or systems where malfunction of these products can reasonably be expected to result in personal injury. Philips customers using or selling these products for use in such applications do so at their own risk and agree to fully indemnify Philips for any damages resulting from such improper use or sale.