

BF904; BF904R

N-channel dual gate MOS-FETs

Rev. 06 — 13 November 2007

Product data sheet

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NXP Semiconductors

N-channel dual gate MOS-FETs

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FEATURES

- Specially designed for use at 5 V supply voltage
- Short channel transistor with high 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 with 3 to 7 V supply voltage such as television tuners and professional communications equipment.

DESCRIPTION

Enhancement type field-effect transistor in a plastic microminiature SOT143B and SOT143R package. The transistor consists of an amplifier MOS-FET with source

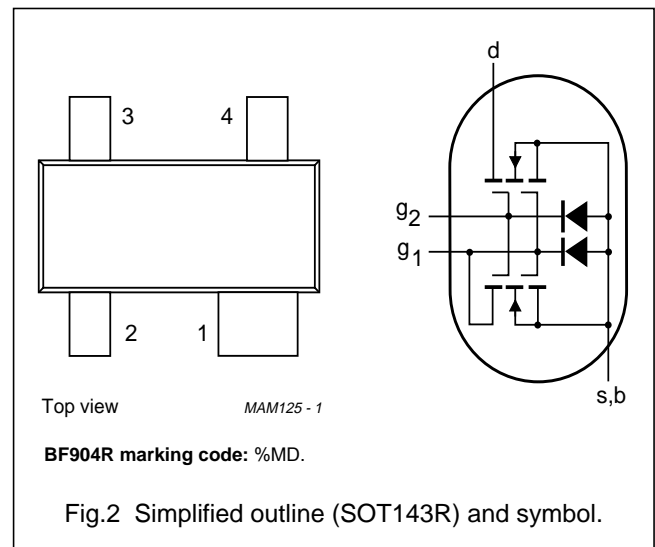
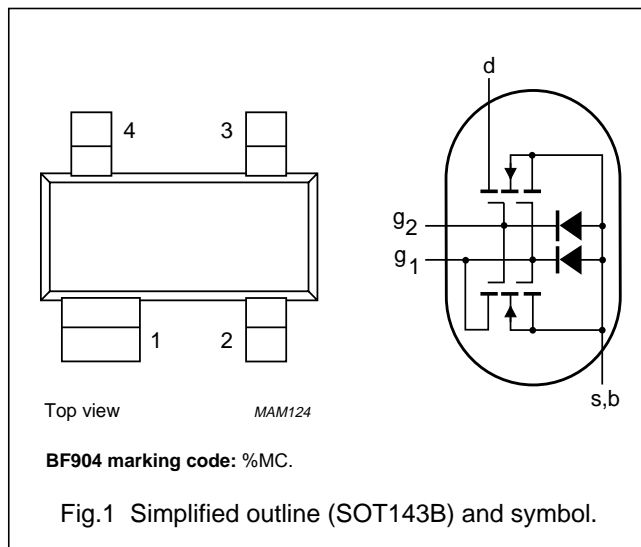
and substrate interconnected and an internal bias circuit to ensure good cross-modulation performance during AGC.

CAUTION

This product is supplied in anti-static packing to prevent damage caused by electrostatic discharge during transport and handling. For further information, refer to Philips specs.: SNW-EQ-608, SNW-FQ-302A and SNW-FQ-302B.

PINNING

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



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 |
| T_j | operating junction temperature | | – | – | 150 | °C |
| $ y_{fs} $ | forward transfer admittance | | 22 | 25 | 30 | mS |
| C_{ig1-s} | input capacitance at gate 1 | | – | 2.2 | 2.6 | pF |
| C_{rs} | reverse transfer capacitance | $f = 1 \text{ MHz}$ | – | 25 | 35 | fF |
| F | noise figure | $f = 800 \text{ MHz}$ | – | 2 | – | dB |

N-channel dual gate MOS-FETs

BF904; BF904R

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 BF904 BF904R | see Fig.3 $T_{amb} \leq 50\text{ °C}$; note 1 $T_{amb} \leq 40\text{ °C}$; note 1 | – – | 200 200 | mW mW |
| T_{stg} | storage temperature | | –65 | +150 | °C |
| T_j | operating junction temperature | | – | 150 | °C |

Note

1. Device mounted on a printed-circuit board.

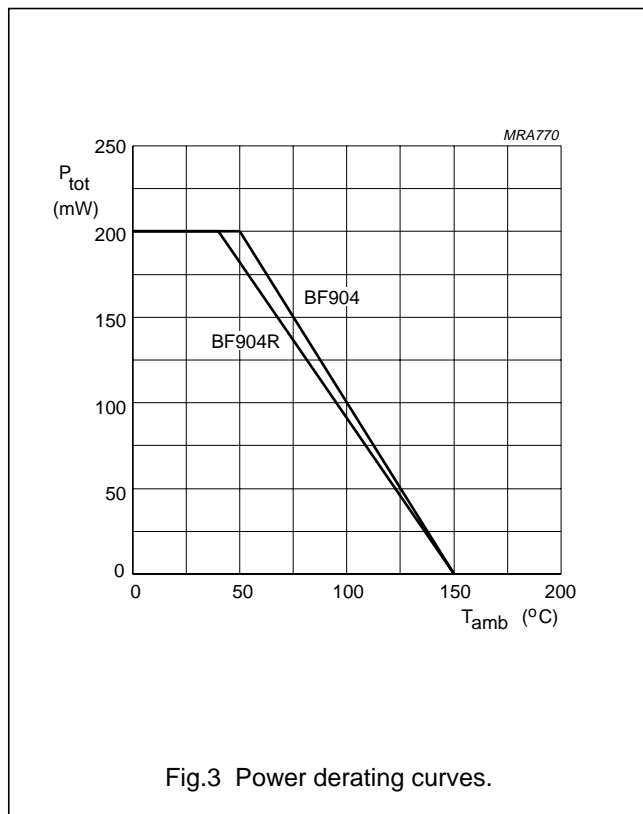


Fig.3 Power derating curves.

N-channel dual gate MOS-FETs

BF904; BF904R

THERMAL CHARACTERISTICS

| SYMBOL | PARAMETER | CONDITIONS | VALUE | UNIT |
|---------------|-----------------------------------------------------|----------------------|-------|------|
| $R_{th\ j-a}$ | thermal resistance from junction to ambient | note 1 | 500 | K/W |
| | BF904 | | | |
| $R_{th\ j-s}$ | thermal resistance from junction to soldering point | note 2 | 290 | K/W |
| | BF904 | | | |
| | BF904R | $T_s = 78\text{ °C}$ | 360 | 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

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

| SYMBOL | PARAMETER | CONDITIONS | MIN. | MAX. | UNIT |
|-----------------|---------------------------------|---------------------------------------------------------------------------------------------|------|------|------|
| $V_{(BR)G1-SS}$ | gate 1-source breakdown voltage | $V_{G2-S} = V_{DS} = 0$; $I_{G1-S} = 10\text{ mA}$ | 6 | 15 | V |
| $V_{(BR)G2-SS}$ | gate 2-source breakdown voltage | $V_{G1-S} = V_{DS} = 0$; $I_{G2-S} = 10\text{ mA}$ | 6 | 15 | V |
| $V_{(F)S-G1}$ | forward source-gate 1 voltage | $V_{G2-S} = V_{DS} = 0$; $I_{S-G1} = 10\text{ mA}$ | 0.5 | 1.5 | V |
| $V_{(F)S-G2}$ | forward source-gate 2 voltage | $V_{G1-S} = V_{DS} = 0$; $I_{S-G2} = 10\text{ mA}$ | 0.5 | 1.5 | V |
| $V_{G1-S(th)}$ | gate 1-source threshold voltage | $V_{G2-S} = 4\text{ V}$; $V_{DS} = 5\text{ V}$; $I_D = 20\text{ }\mu\text{A}$ | 0.3 | 1 | V |
| $V_{G2-S(th)}$ | gate 2-source threshold voltage | $V_{G1-S} = V_{DS} = 5\text{ V}$; $I_D = 20\text{ }\mu\text{A}$ | 0.3 | 1.2 | V |
| I_{DSX} | drain-source current | $V_{G2-S} = 4\text{ V}$; $V_{DS} = 5\text{ V}$; $R_{G1} = 120\text{ k}\Omega$; note 1 | 8 | 13 | mA |
| I_{G1-SS} | gate 1 cut-off current | $V_{G2-S} = V_{DS} = 0$; $V_{G1-S} = 5\text{ V}$ | – | 50 | nA |
| I_{G2-SS} | gate 2 cut-off current | $V_{G1-S} = V_{DS} = 0$; $V_{G2-S} = 5\text{ V}$ | – | 50 | nA |

Note

1. R_{G1} connects gate 1 to $V_{GG} = 5\text{ V}$; see Fig.20.

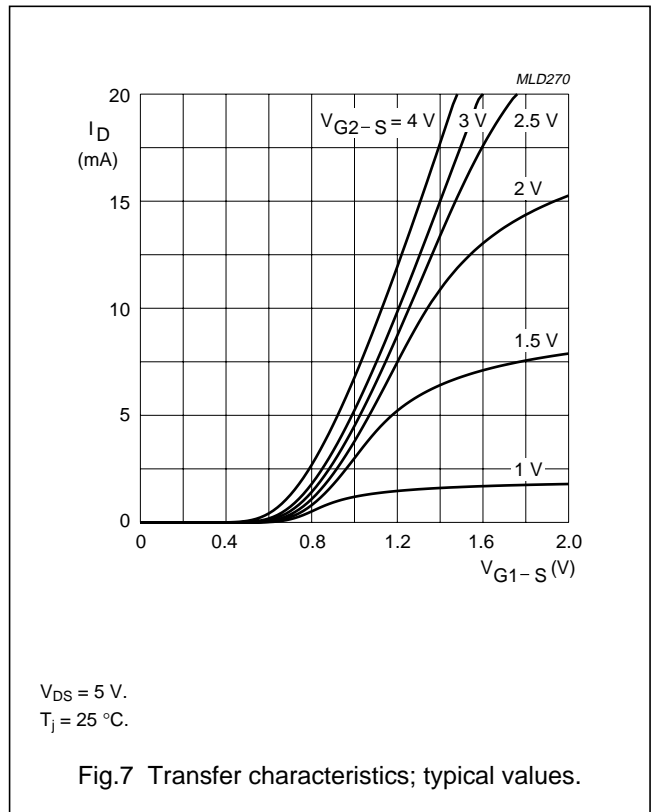
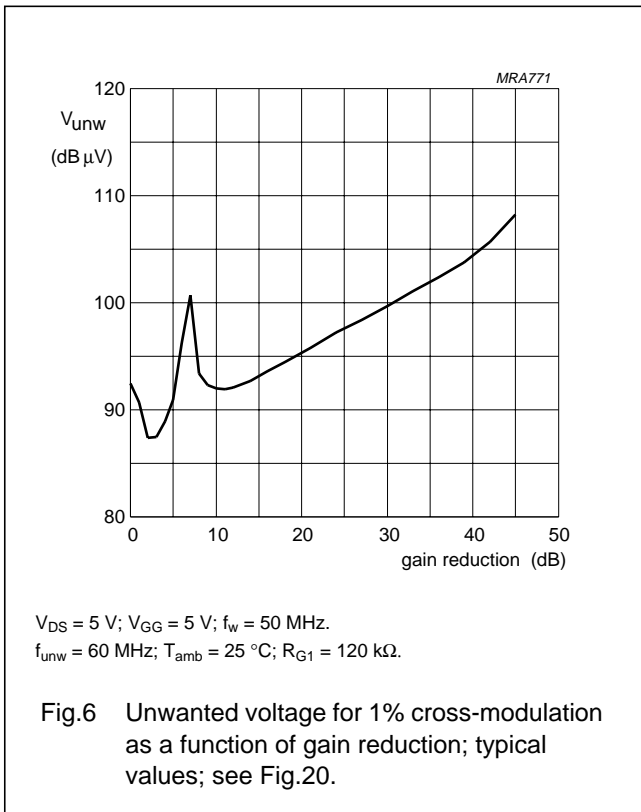
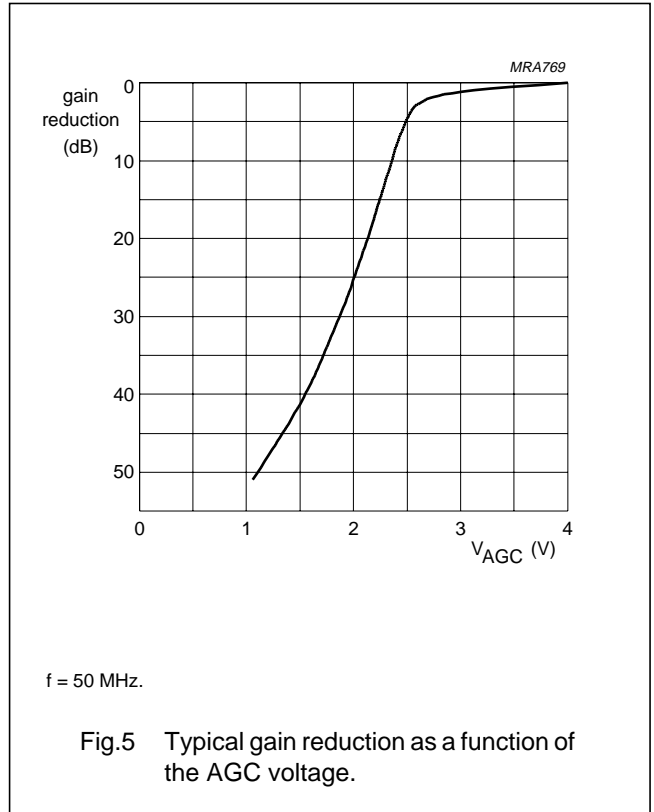
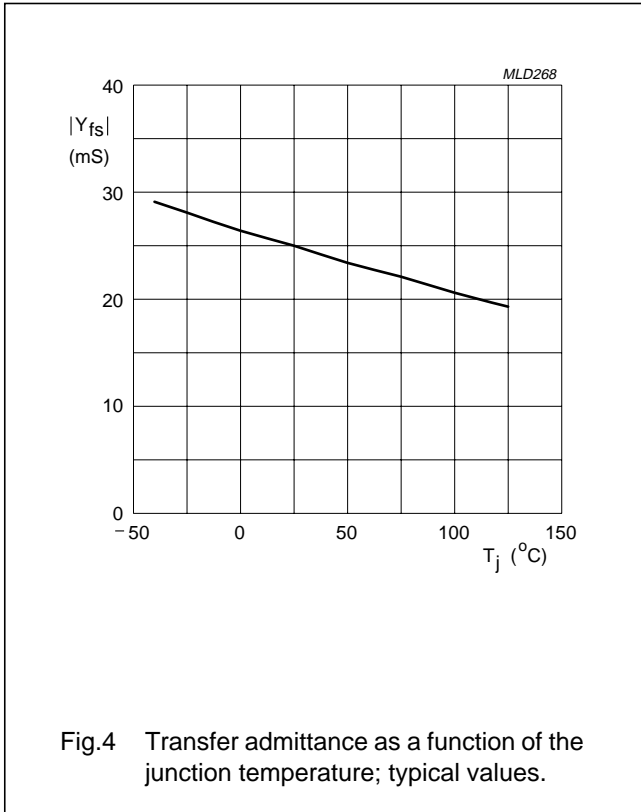
DYNAMIC CHARACTERISTICS

Common source; $T_{amb} = 25\text{ °C}$; $V_{DS} = 5\text{ V}$; $V_{G2-S} = 4\text{ V}$; $I_D = 10\text{ mA}$; unless otherwise specified.

| SYMBOL | PARAMETER | CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|-------------|------------------------------|---------------------------------------------------------------|------|------|------|------|
| $ y_{fs} $ | forward transfer admittance | pulsed; $T_j = 25\text{ °C}$ | 22 | 25 | 30 | mS |
| C_{ig1-s} | input capacitance at gate 1 | $f = 1\text{ MHz}$ | – | 2.2 | 2.6 | pF |
| C_{ig2-s} | input capacitance at gate 2 | $f = 1\text{ MHz}$ | 1 | 1.5 | 2 | pF |
| C_{os} | drain-source capacitance | $f = 1\text{ MHz}$ | 1 | 1.3 | 1.6 | pF |
| C_{rs} | reverse transfer capacitance | $f = 1\text{ MHz}$ | – | 25 | 35 | fF |
| F | noise figure | $f = 200\text{ MHz}$; $G_S = 2\text{ mS}$; $B_S = B_{Sopt}$ | – | 1 | 1.5 | dB |
| | | $f = 800\text{ MHz}$; $G_S = G_{Sopt}$; $B_S = B_{Sopt}$ | – | 2 | 2.8 | dB |

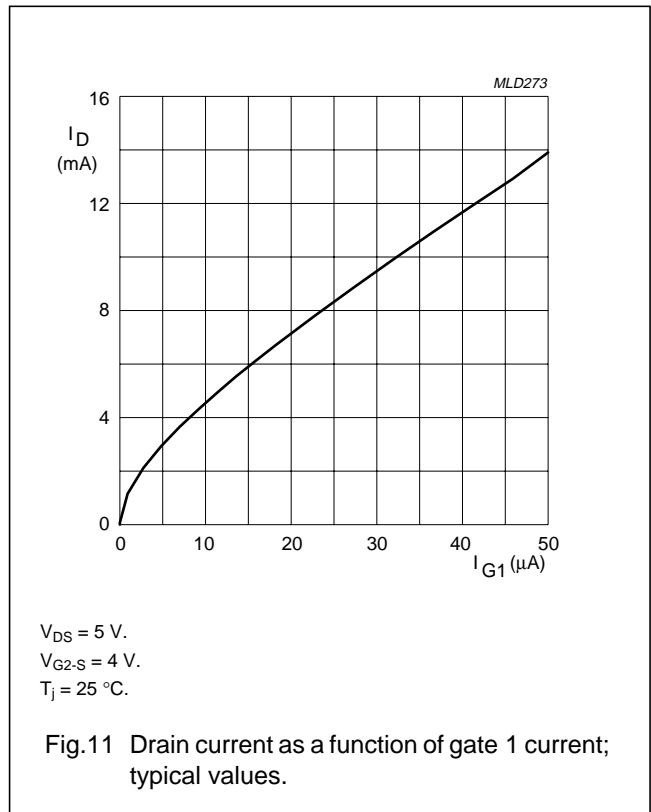
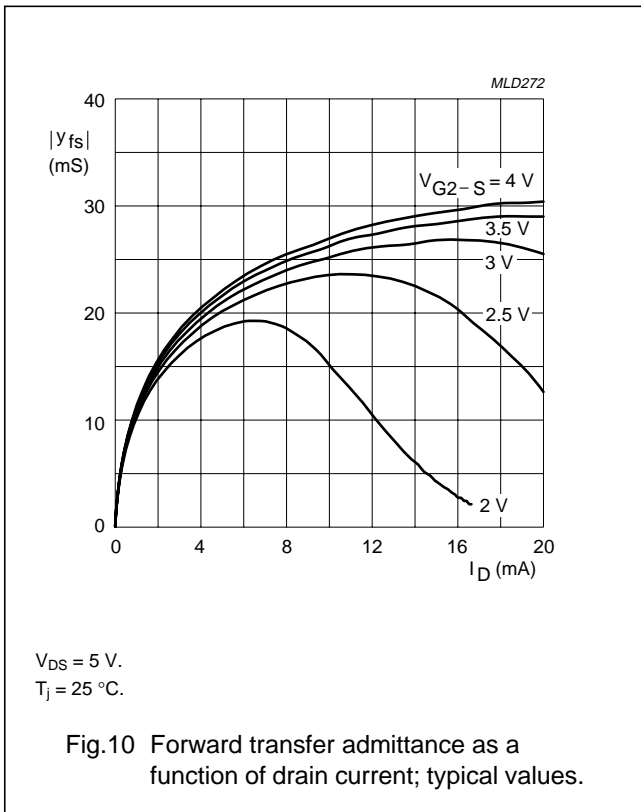
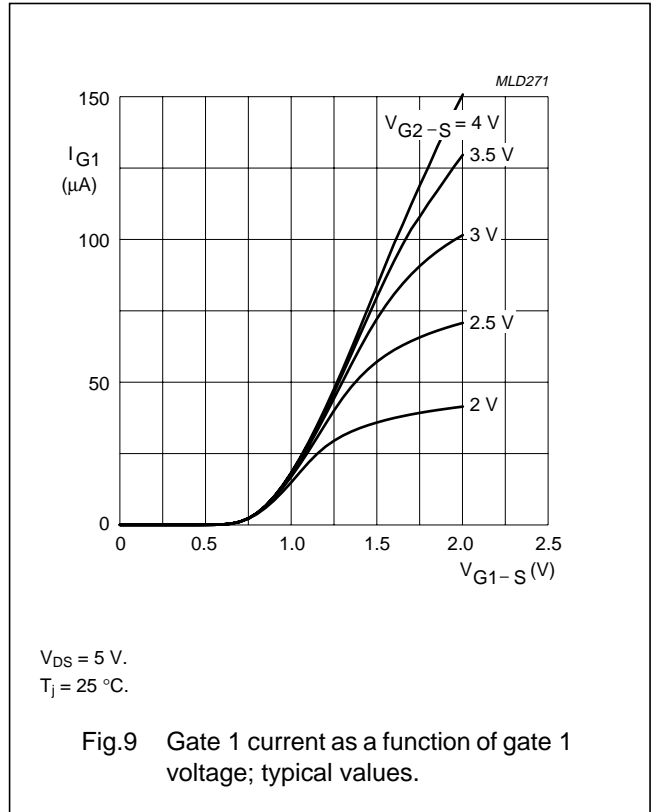
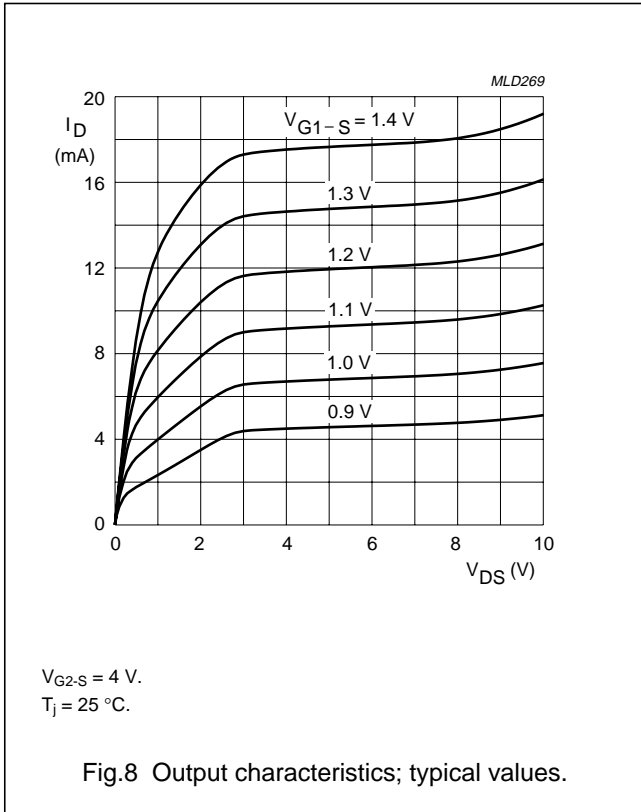
N-channel dual gate MOS-FETs

BF904; BF904R



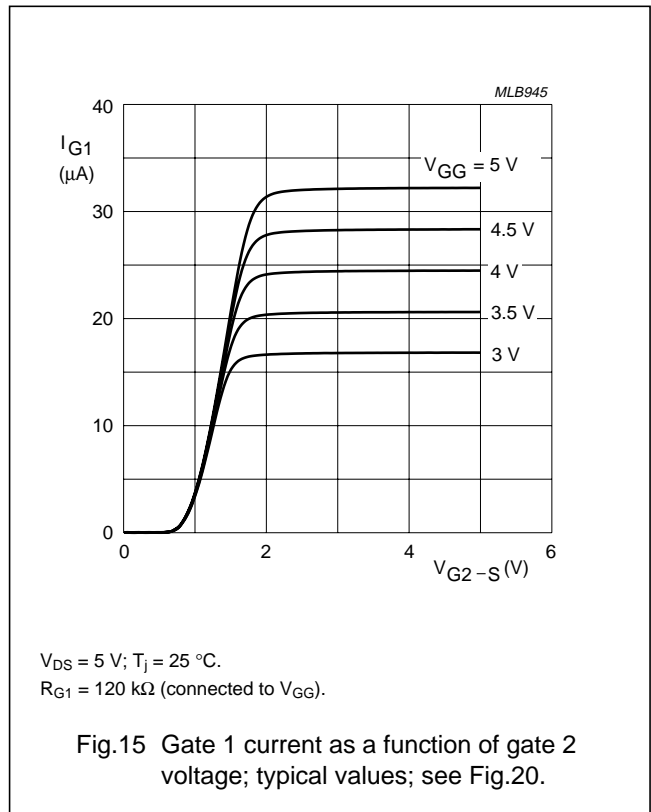
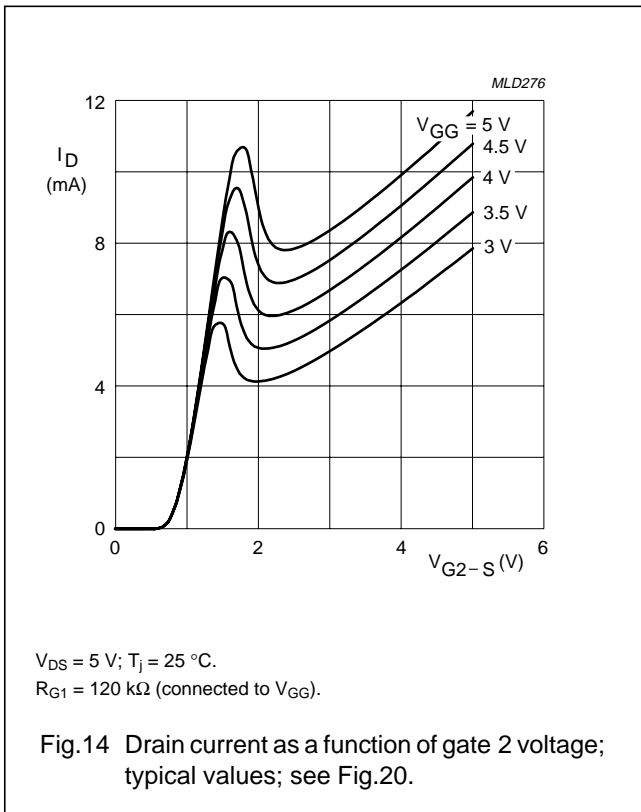
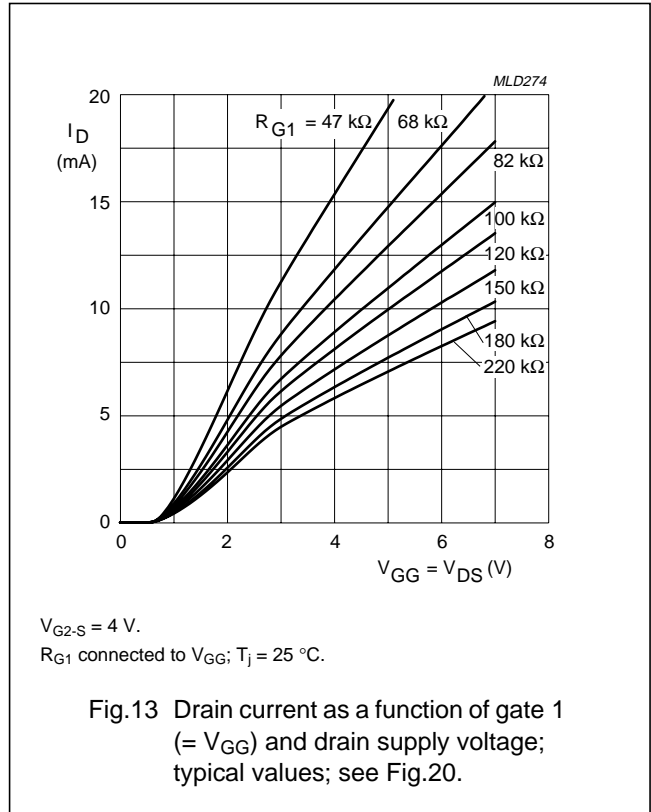
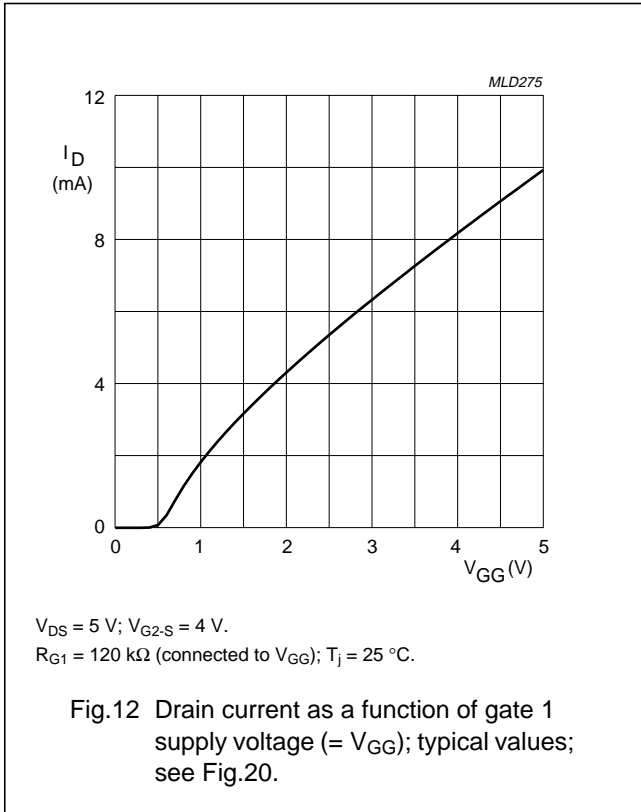
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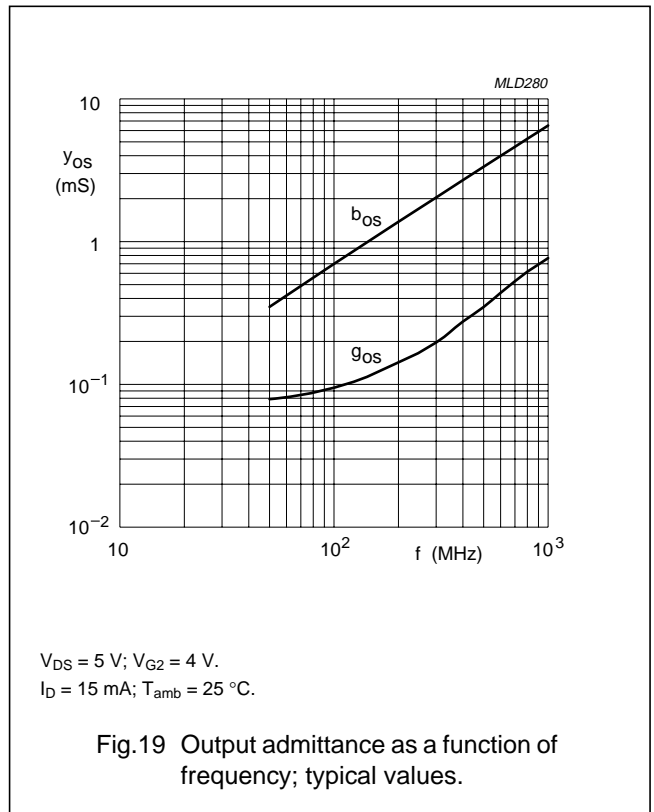
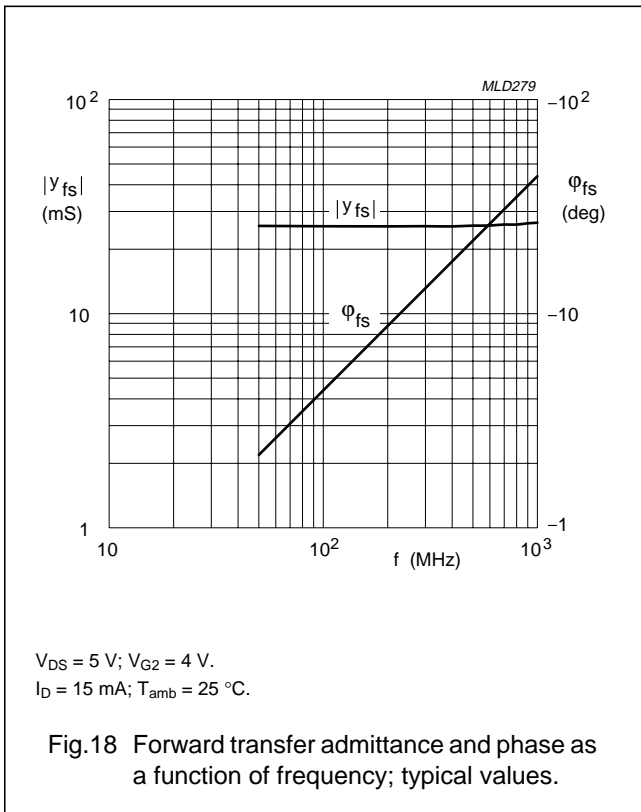
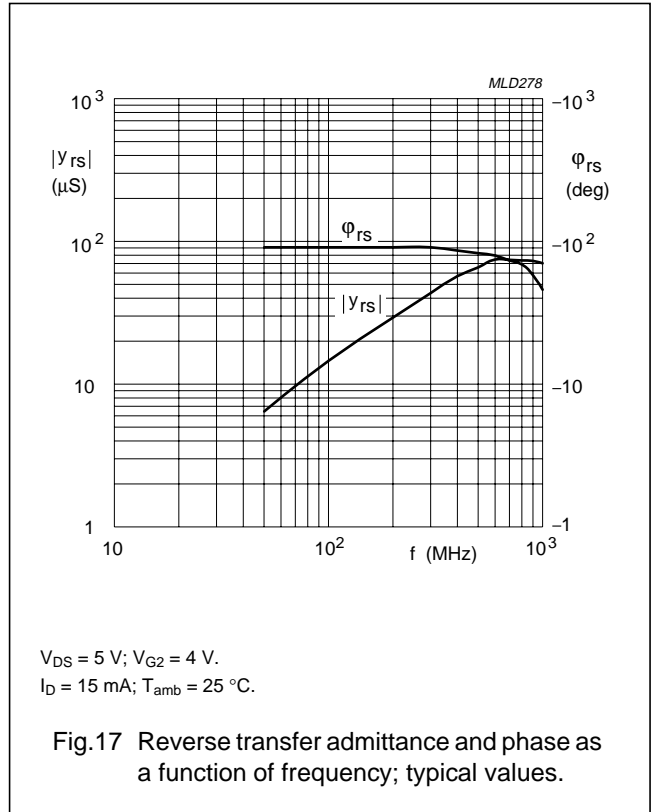
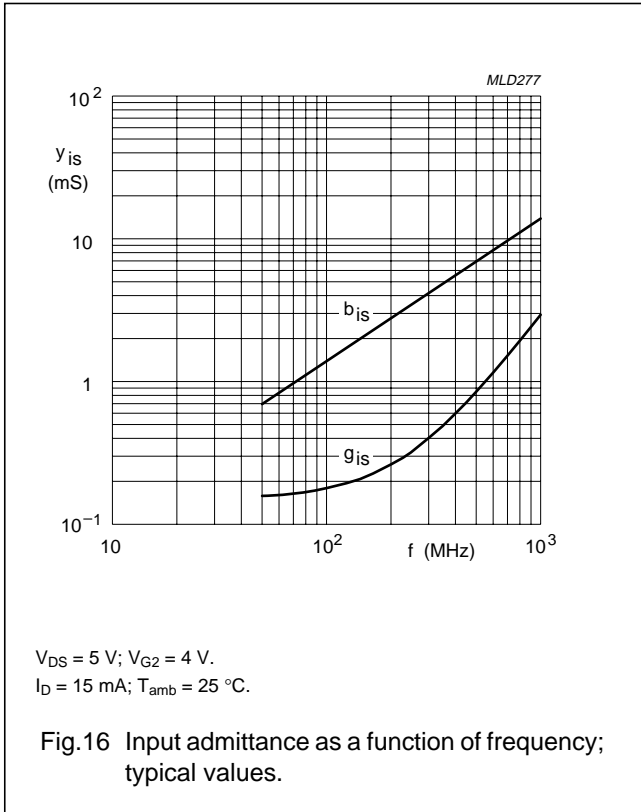
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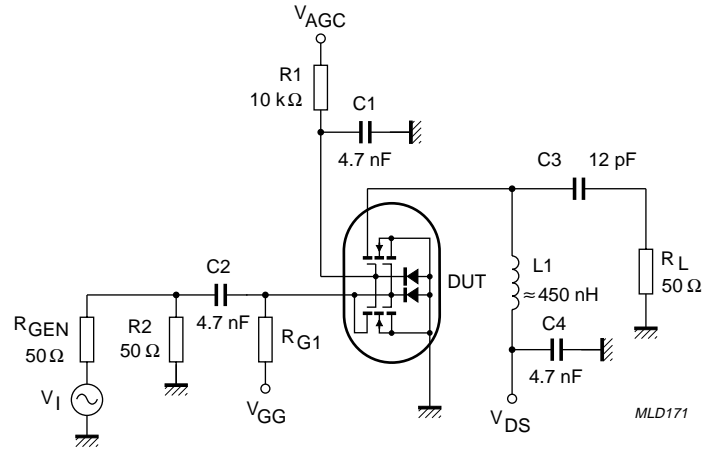


Fig.20 Cross-modulation test set-up.

N-channel dual gate MOS-FETs

BF904; BF904R

Table 1 Scattering parameters: $V_{DS} = 5\text{ V}$; $V_{G2-S} = 4\text{ V}$; $I_D = 10\text{ mA}$

| 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) |
| 40 | 0.989 | -3.4 | 2.420 | 175.7 | 0.000 | 79.9 | 0.993 | -1.6 |
| 100 | 0.985 | -8.3 | 2.414 | 169.1 | 0.001 | 78.3 | 0.992 | -3.9 |
| 200 | 0.976 | -16.4 | 2.368 | 158.8 | 0.003 | 80.3 | 0.987 | -7.8 |
| 300 | 0.958 | -24.1 | 2.301 | 148.5 | 0.004 | 73.7 | 0.980 | -11.4 |
| 400 | 0.942 | -32.0 | 2.251 | 138.8 | 0.005 | 70.7 | 0.974 | -15.2 |
| 500 | 0.918 | -39.3 | 2.170 | 129.5 | 0.005 | 67.2 | 0.966 | -18.7 |
| 600 | 0.899 | -46.0 | 2.080 | 120.7 | 0.005 | 67.8 | 0.958 | -22.2 |
| 700 | 0.876 | -52.6 | 2.001 | 112.1 | 0.005 | 68.6 | 0.951 | -25.5 |
| 800 | 0.852 | -58.8 | 1.924 | 103.2 | 0.005 | 72.9 | 0.944 | -28.9 |
| 900 | 0.823 | -64.9 | 1.829 | 94.7 | 0.005 | 78.7 | 0.937 | -32.1 |
| 1000 | 0.800 | -70.9 | 1.747 | 86.5 | 0.005 | 88.3 | 0.933 | -35.2 |
| 1200 | 0.750 | -82.4 | 1.621 | 70.7 | 0.005 | 120.5 | 0.928 | -41.7 |
| 1400 | 0.719 | -92.7 | 1.535 | 54.6 | 0.008 | 139.8 | 0.930 | -48.4 |
| 1600 | 0.682 | -102.5 | 1.424 | 39.4 | 0.010 | 137.8 | 0.924 | -54.9 |
| 1800 | 0.642 | -109.8 | 1.349 | 22.5 | 0.013 | 156.8 | 0.928 | -62.9 |
| 2000 | 0.602 | -116.5 | 1.283 | 1.1 | 0.018 | 175.1 | 0.928 | -73.1 |
| 2200 | 0.547 | -124.9 | 1.130 | -15.1 | 0.014 | 172.6 | 0.887 | -81.0 |
| 2400 | 0.596 | -128.7 | 1.018 | -49.1 | 0.040 | -163.9 | 0.837 | -95.8 |
| 2600 | 0.682 | -132.6 | 0.979 | -79.4 | 0.077 | -164.0 | 0.778 | -109.6 |
| 2800 | 0.771 | -142.5 | 0.804 | -116.2 | 0.120 | 178.8 | 0.629 | -119.5 |
| 3000 | 0.793 | -157.5 | 0.541 | -153.5 | 0.149 | 158.3 | 0.479 | -119.9 |

Table 2 Noise data: $V_{DS} = 5\text{ V}$; $V_{G2-S} = 4\text{ V}$; $I_D = 10\text{ mA}$

| f (MHz) | F _{min} (dB) | Γ _{opt} | | r _n |
|------------|--------------------------|------------------|-------|----------------|
| | | (ratio) | (deg) | |
| 800 | 2.00 | 0.686 | 49.6 | 50.40 |

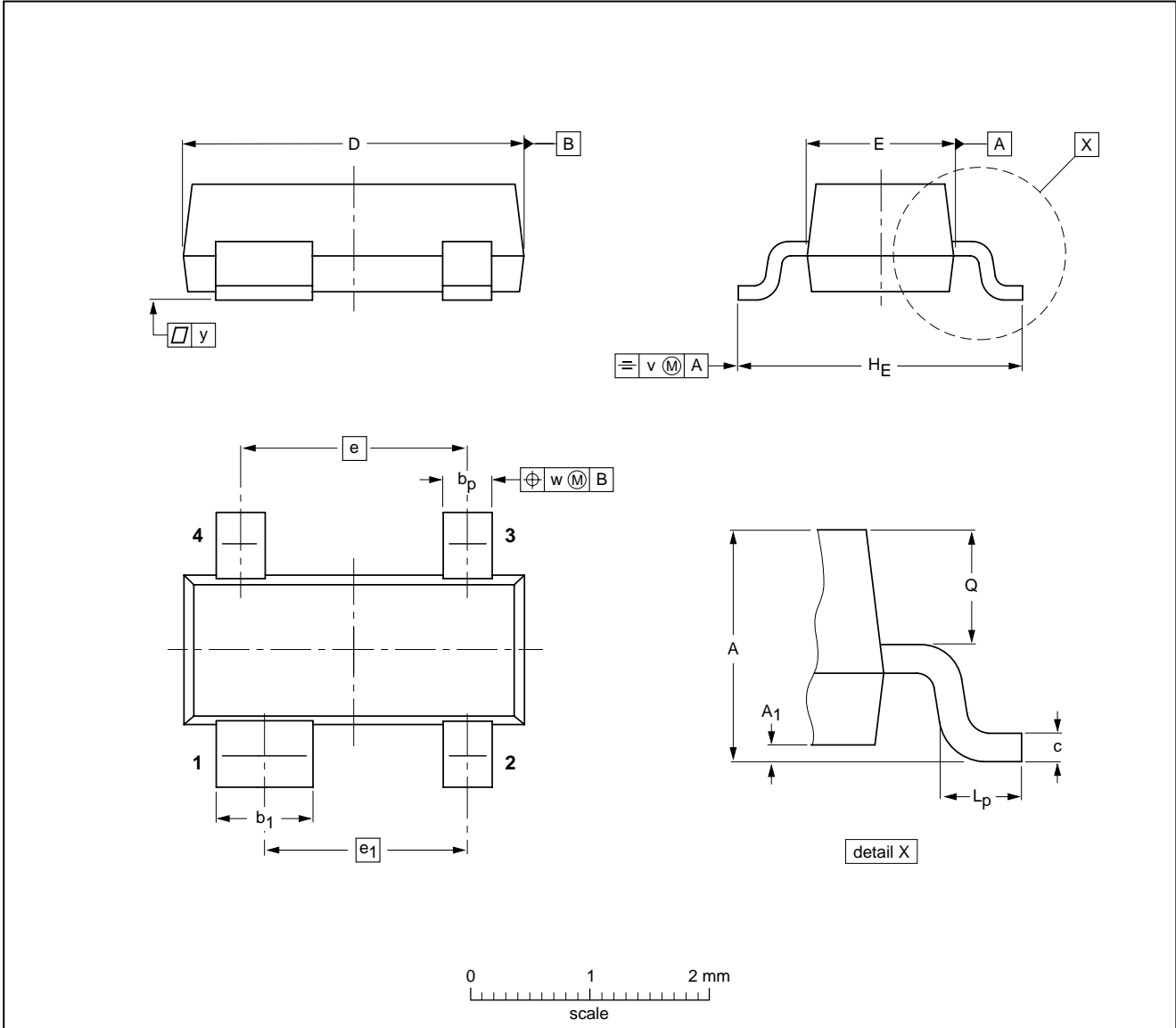
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BF904; BF904R

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 0.9 | 0.1 | 0.48 0.38 | 0.88 0.78 | 0.15 0.09 | 3.0 2.8 | 1.4 1.2 | 1.9 | 1.7 | 2.5 2.1 | 0.45 0.15 | 0.55 0.45 | 0.2 | 0.1 | 0.1 |

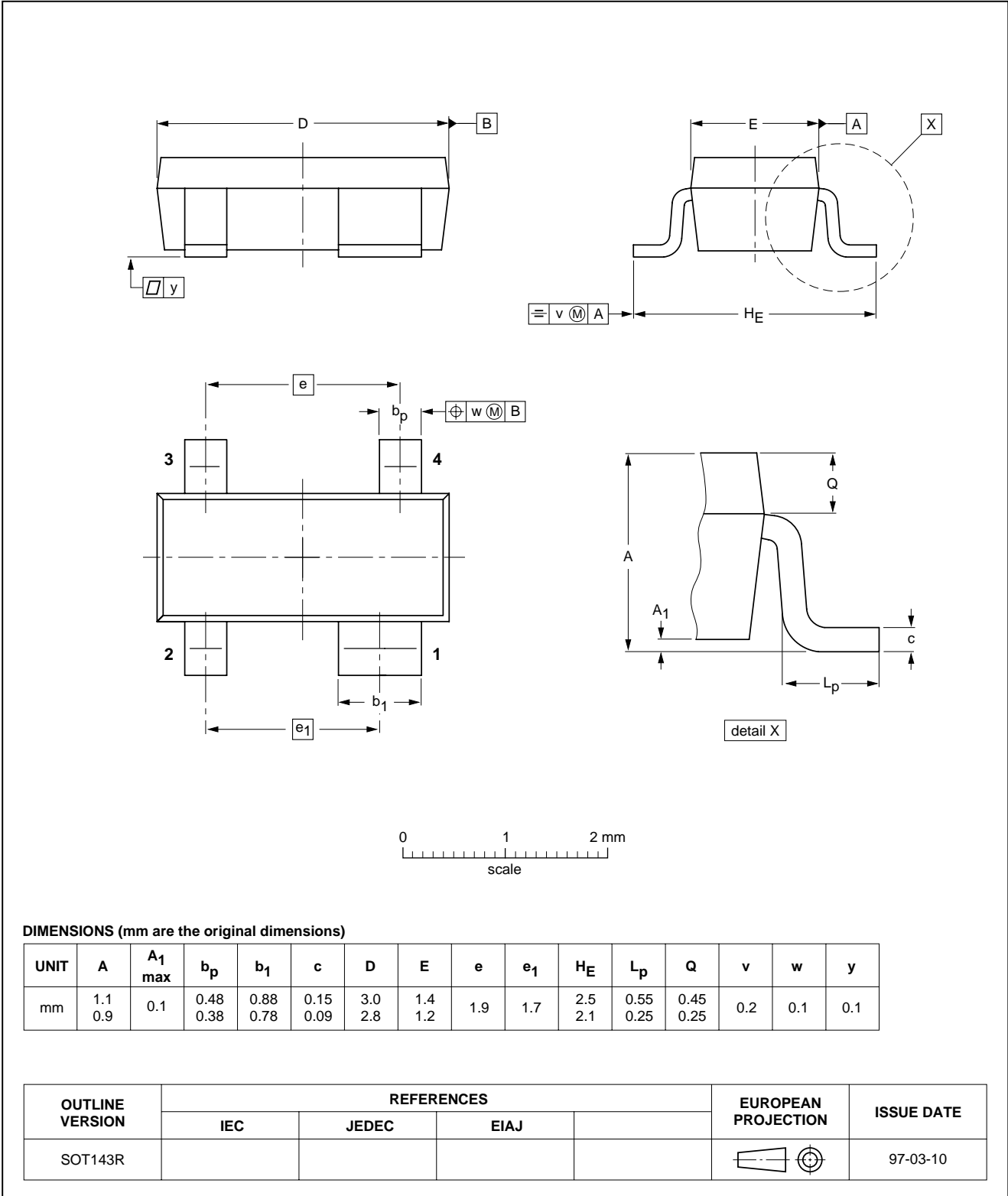
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| SOT143B | | | | | | 97-02-28 |

N-channel dual gate MOS-FETs

BF904; BF904R

Plastic surface mounted package; reverse pinning; 4 leads

SOT143R



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|-----------------------------------|-------------------------------|---------------------------------------------------------------------------------------|
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Revision history

Revision history

| Document ID | Release date | Data sheet status | Change notice | Supersedes |
|----------------------------------|-------------------------------------------------------------------------------------------------|-----------------------|---------------|--------------|
| BF904_904R_N_6 | 20071113 | Product data sheet | - | BF904_904R_5 |
| Modifications: | <ul style="list-style-type: none"> • Fig. 1 and 2 on page 2; Figure note changed | | | |
| BF904_904R_5 (9397 750 05898) | 19990517 | Product specification | - | BF904R_4 |
| BF904R_4 (9397 750 02668) | 19970905 | Product specification | - | BF904R_3 |
| BF904R_3 | 19950425 | Product specification | - | BF904R_2 |
| BF904R_2 | - | - | - | BF904R_1 |
| BF904R_1 | - | - | - | - |

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Date of release: 13 November 2007

Document identifier: BF904_904R_N_6