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 BF904; BF904R

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.

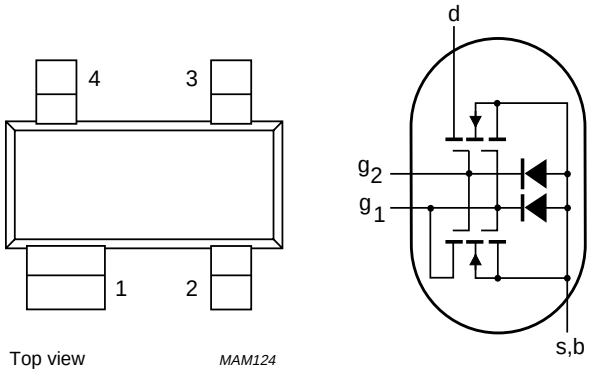
DESCRIPTION

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.

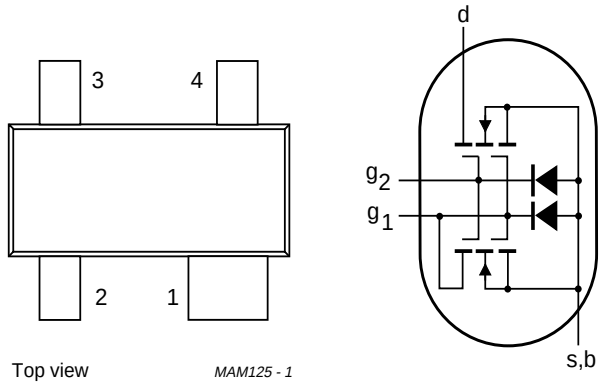
PINNING

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



BF904 marking code: %MC.

Fig.1 Simplified outline (SOT143B) and symbol.



BF904R marking code: %MD.

Fig.2 Simplified outline (SOT143R) and symbol.

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
$\lvert y_{fs} \rvert$	forward transfer admittance		22	25	30	mS
$C_{ig1\text{-}s}$	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		–	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	see Fig.3			
	BF904	$T_{amb} \leq 50$ °C; note 1	–	200	mW
	BF904R	$T_{amb} \leq 40$ °C; note 1	–	200	mW
T_{stg}	storage temperature		–65	+150	°C
T_j	operating junction temperature		–	150	°C

Note

1. Device mounted on a printed-circuit board.

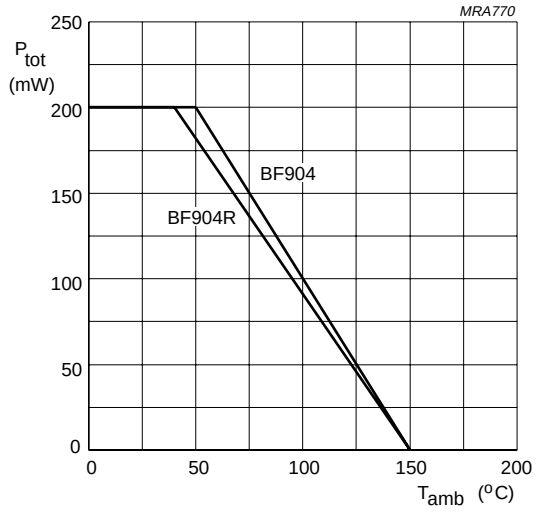


Fig.3 Power derating curves.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient	note 1		
	BF904		500	K/W
	BF904R		550	K/W
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	note 2		
	BF904	T_s = 92 °C	290	K/W
	BF904R	T_s = 78 °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 °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; $I_{G1\text{-}S}$ = 10 mA	6	15	V
$V_{(BR)G2\text{-}SS}$	gate 2-source breakdown voltage	$V_{G1\text{-}S}$ = V_{DS} = 0; $I_{G2\text{-}S}$ = 10 mA	6	15	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} = 5 V; I_D = 20 μA	0.3	1	V
$V_{G2\text{-}S(th)}$	gate 2-source threshold voltage	$V_{G1\text{-}S}$ = V_{DS} = 5 V; I_D = 20 μA	0.3	1.2	V
I_{DSX}	drain-source current	$V_{G2\text{-}S}$ = 4 V; V_{DS} = 5 V; R_{G1} = 120 kΩ; note 1	8	13	mA
$I_{G1\text{-}SS}$	gate 1 cut-off current	$V_{G2\text{-}S}$ = V_{DS} = 0; $V_{G1\text{-}S}$ = 5 V	–	50	nA
$I_{G2\text{-}SS}$	gate 2 cut-off current	$V_{G1\text{-}S}$ = V_{DS} = 0; $V_{G2\text{-}S}$ = 5 V	–	50	nA

Note

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

DYNAMIC CHARACTERISTICS

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

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

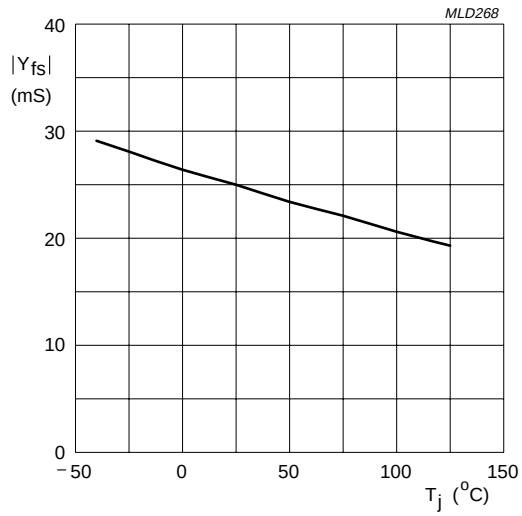
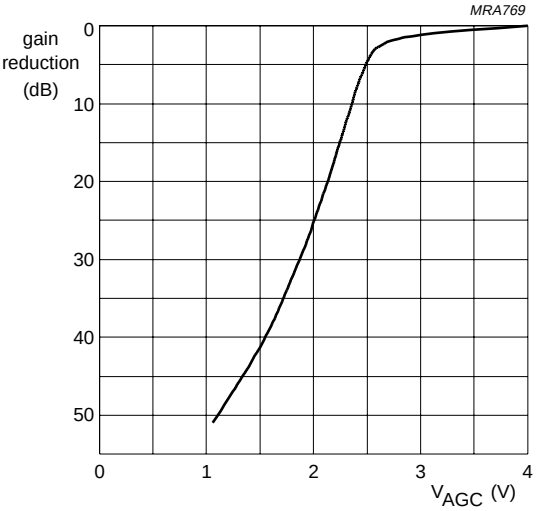
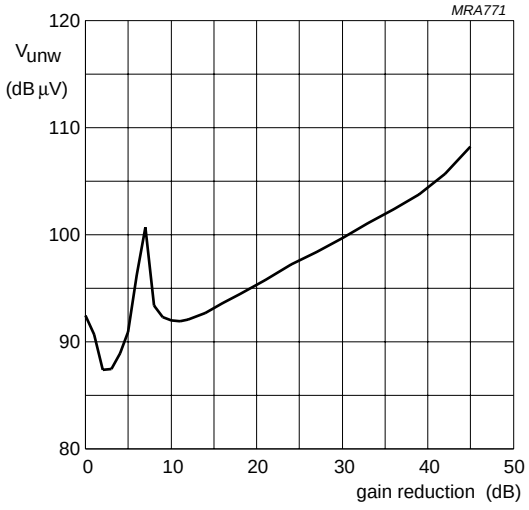


Fig.4 Transfer admittance as a function of the junction temperature; typical values.



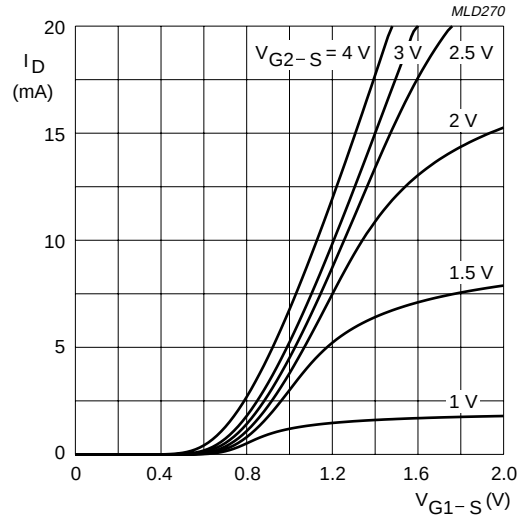
f = 50 MHz.

Fig.5 Typical gain reduction as a function of the AGC voltage.



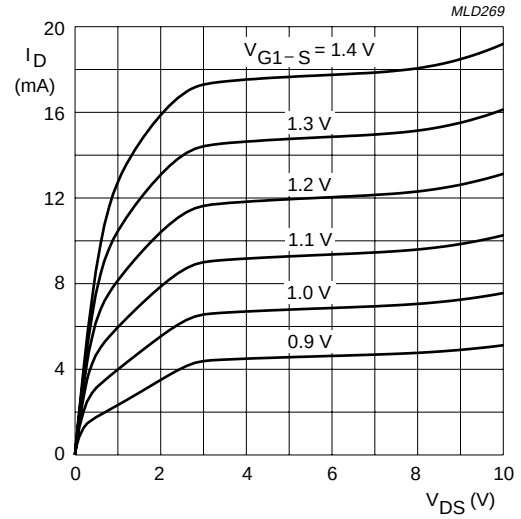
V_{DS} = 5 V; V_{GG} = 5 V; f_w = 50 MHz.
f_{unw} = 60 MHz; T_{amb} = 25 °C; R_{G1} = 120 kΩ.

Fig.6 Unwanted voltage for 1% cross-modulation as a function of gain reduction; typical values; see Fig.20.



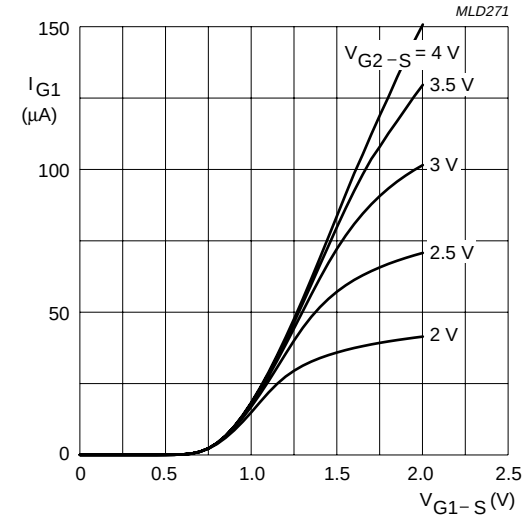
V_{DS} = 5 V.
T_j = 25 °C.

Fig.7 Transfer characteristics; typical values.



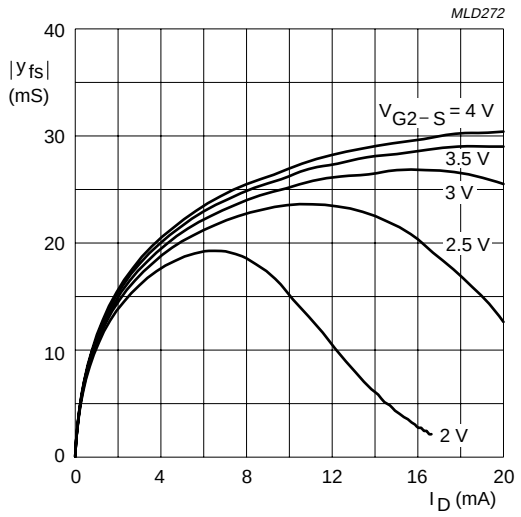
V_{G2-S} = 4 V.
T_j = 25 °C.

Fig.8 Output characteristics; typical values.



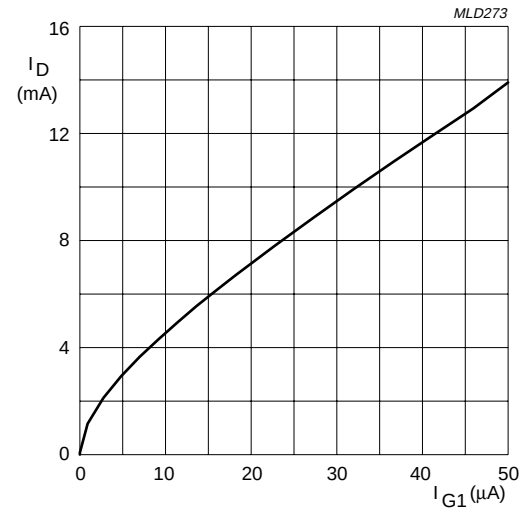
V_{DS} = 5 V.
T_j = 25 °C.

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



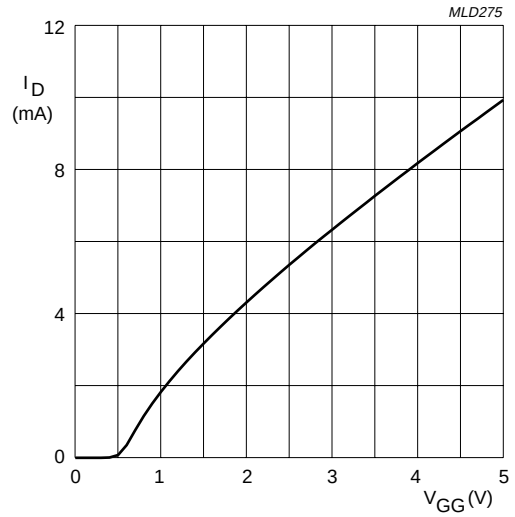
V_{DS} = 5 V.
T_j = 25 °C.

Fig.10 Forward transfer admittance as a function of drain current; typical values.



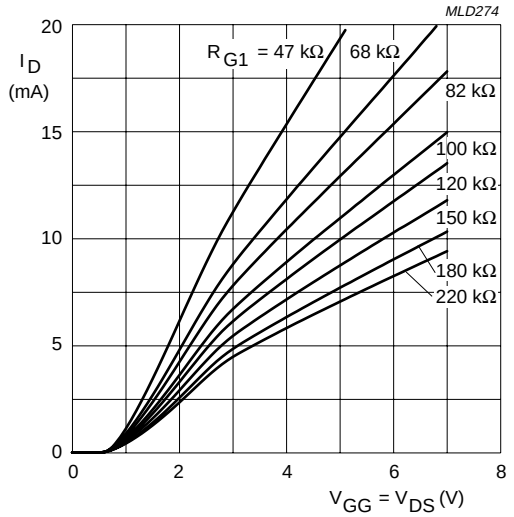
V_{DS} = 5 V.
V_{G2-S} = 4 V.
T_j = 25 °C.

Fig.11 Drain current as a function of gate 1 current; typical values.



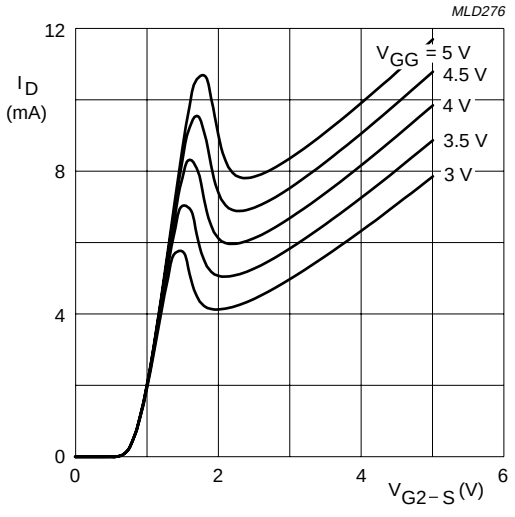
V_{DS} = 5 V; $V_{G2\text{-}S}$ = 4 V.
R_{G1} = 120 kΩ (connected to V_{GG}); T_j = 25 °C.

Fig.12 Drain current as a function of gate 1 supply voltage (= V_{GG}); typical values; see Fig.20.



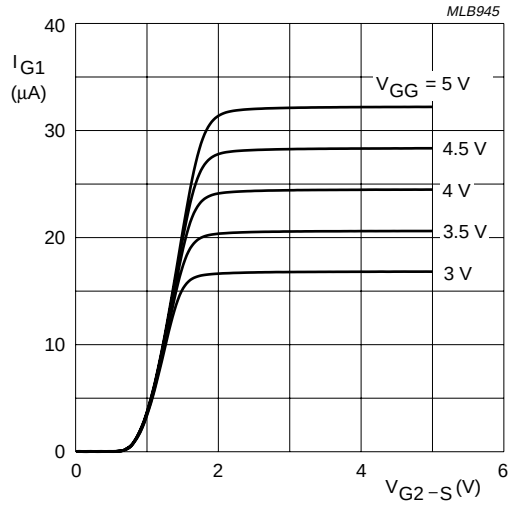
$V_{G2\text{-}S}$ = 4 V.
R_{G1} connected to V_{GG}; T_j = 25 °C.

Fig.13 Drain current as a function of gate 1 (= V_{GG}) and drain supply voltage; typical values; see Fig.20.



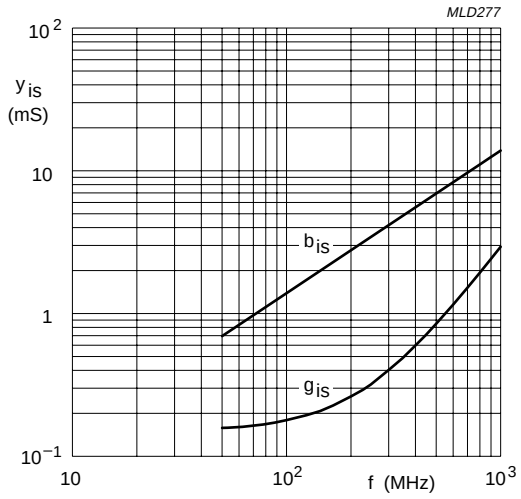
V_{DS} = 5 V; T_j = 25 °C.
R_{G1} = 120 kΩ (connected to V_{GG}).

Fig.14 Drain current as a function of gate 2 voltage; typical values; see Fig.20.



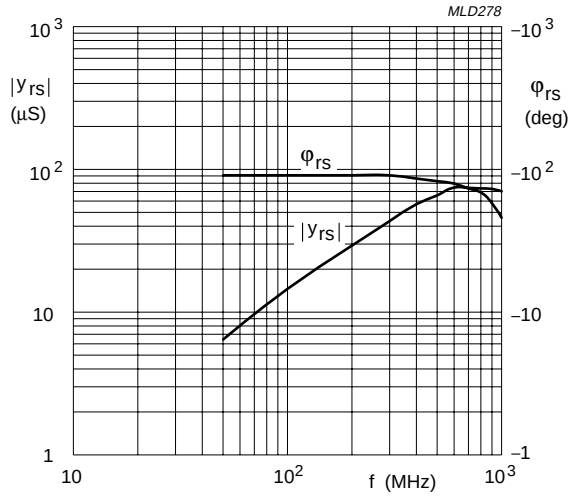
V_{DS} = 5 V; T_j = 25 °C.
R_{G1} = 120 kΩ (connected to V_{GG}).

Fig.15 Gate 1 current as a function of gate 2 voltage; typical values; see Fig.20.



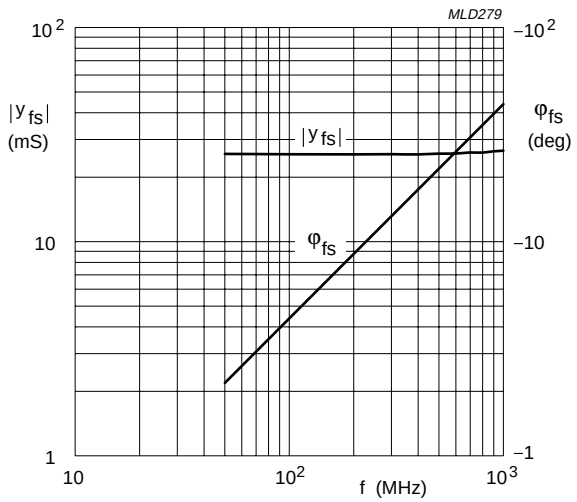
V_{DS} = 5 V; V_{G2} = 4 V.
I_D = 15 mA; T_{amb} = 25 °C.

Fig.16 Input admittance as a function of frequency; typical values.



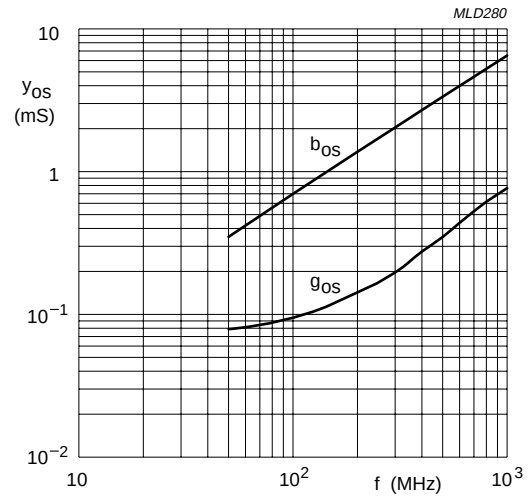
V_{DS} = 5 V; V_{G2} = 4 V.
I_D = 15 mA; T_{amb} = 25 °C.

Fig.17 Reverse transfer admittance and phase as a function of frequency; typical values.



V_{DS} = 5 V; V_{G2} = 4 V.
I_D = 15 mA; T_{amb} = 25 °C.

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



V_{DS} = 5 V; V_{G2} = 4 V.
I_D = 15 mA; T_{amb} = 25 °C.

Fig.19 Output admittance as a function of frequency; typical values.

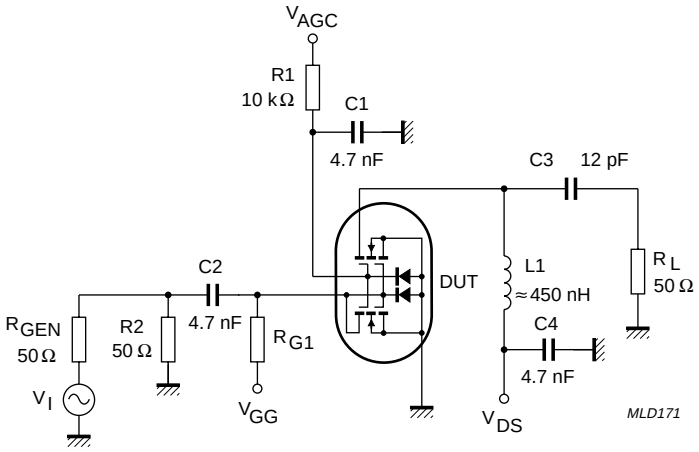


Fig.20 Cross-modulation test set-up.

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

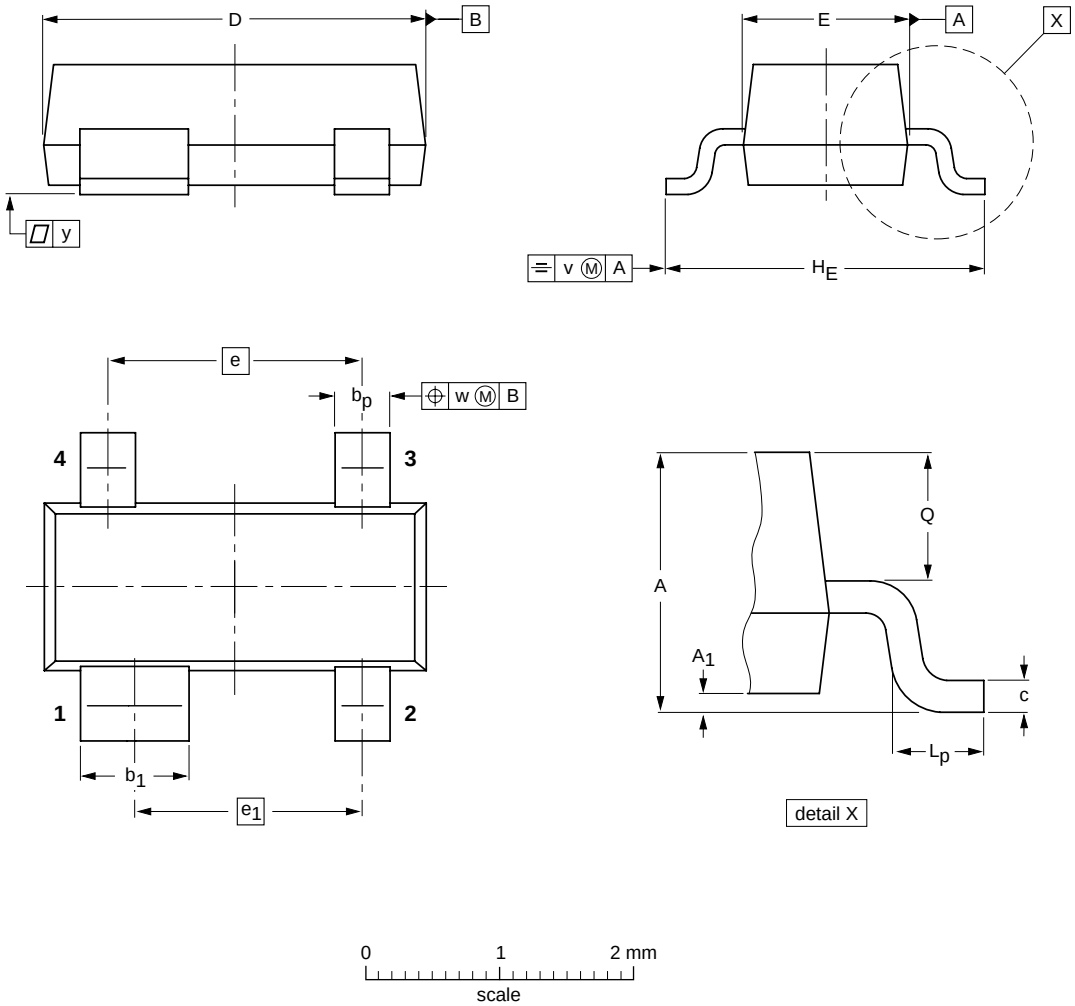
f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}	
	MAGNITUDE (ratio)	ANGLE (deg)	MAGNITUDE (ratio)	ANGLE (deg)	MAGNITUDE (ratio)	ANGLE (deg)	MAGNITUDE (ratio)	ANGLE (deg)
40	0.989	–3.4	2.420	175.7	0.000	79.9	0.993	–1.6
100	0.985	–8.3	2.414	169.1	0.001	78.3	0.992	–3.9
200	0.976	–16.4	2.368	158.8	0.003	80.3	0.987	–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 V; $V_{G2\text{-}S}$ = 4 V; I_D = 10 mA

f (MHz)	F_{min} (dB)	Γ_{opt}		r_n
		(ratio)	(deg)	
800	2.00	0.686	49.6	50.40

PACKAGE OUTLINES

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

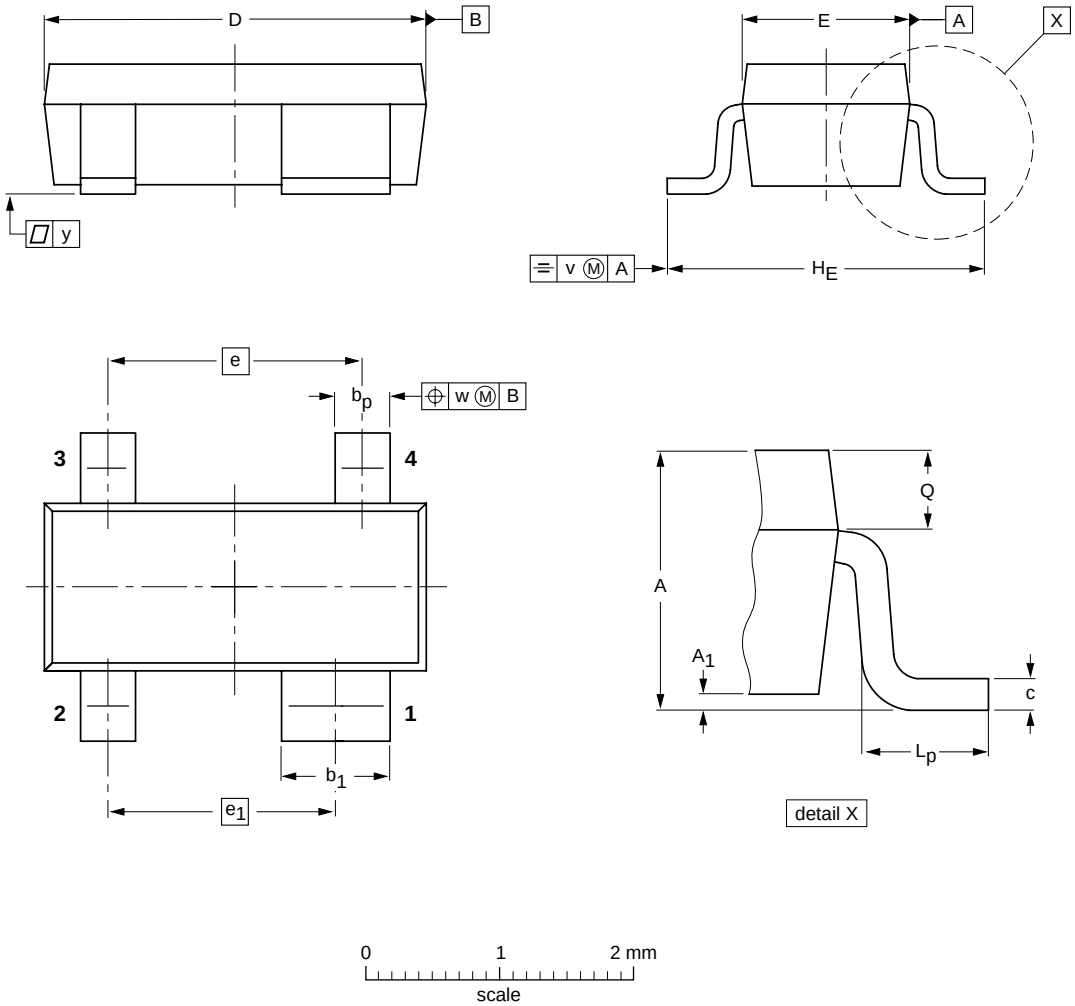


DIMENSIONS (mm are the original dimensions)

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

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT143B						97-02-28

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 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	0.55 0.25	0.45 0.25	0.2	0.1	0.1

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT143R						97-03-10

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Data sheet status

Document status[1][2]	Product status[3]	Definition
Objective [short] data sheet	Development	This document contains data from the objective specification for product development.
Preliminary [short] data sheet	Qualification	This document contains data from the preliminary specification.
Product [short] data sheet	Production	This document contains the product specification.

[1] Please consult the most recently issued document before initiating or completing a design.

[2] The term 'short data sheet' is explained in section "Definitions".

[3] The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the Internet at URL http://www.nxp.com.

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Revision history

Revision history

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BF904_904R_N_6	20071113	Product data sheet	-	BF904_904R_5
Modifications:	• 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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