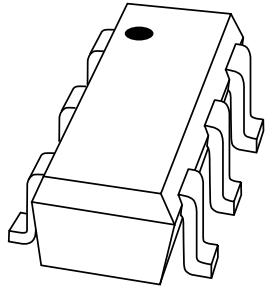


DATA SHEET



BF1206

Dual N-channel dual-gate
MOS-FET

Product specification

2003 Nov 17



Dual N-channel dual-gate MOS-FET

BF1206

FEATURES

- Two low noise gain controlled amplifiers in a single package
- Superior cross-modulation performance during AGC
- High forward transfer admittance
- High forward transfer admittance to input capacitance ratio.

APPLICATIONS

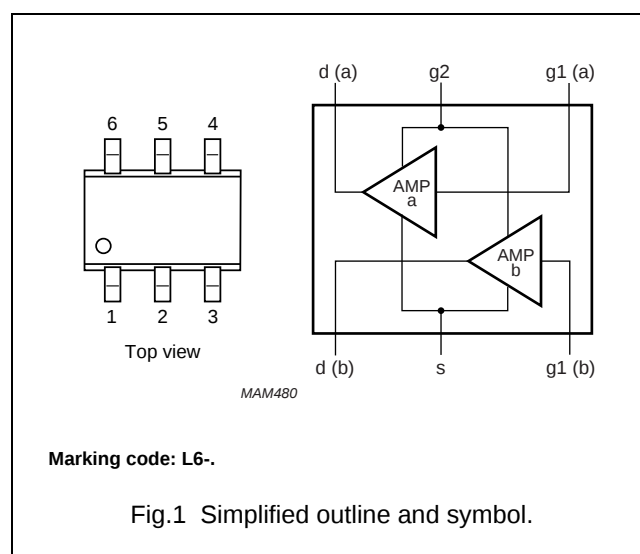
- Gain controlled low noise amplifiers for VHF and UHF applications with 5 V supply voltage, such as digital and analog television tuners.

DESCRIPTION

The BF1206 is a combination of two different dual gate MOS-FET amplifiers with shared source and gate 2 leads. The source and substrate are interconnected. Internal bias circuits enable DC stabilization and a very good cross-modulation performance during AGC. Integrated diodes between the gates and source protect against excessive input voltage surges. The transistor is encapsulated in SOT363 micro-miniature plastic package.

PINNING - SOT363

PIN	DESCRIPTION
1	drain (b)
2	source
3	gate 1 (b)
4	gate 1 (a)
5	gate 2
6	drain (a)



QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Per MOS-FET; unless otherwise specified						
V_{DS}	drain-source voltage		—	—	6	V
I_D	drain current (DC)		—	—	30	mA
$ y_{fs} $	forward transfer admittance	amp. a: $I_D = 18$ mA	33	38	48	mS
		amp. b: $I_D = 12$ mA	29	34	44	mS
C_{ig1-s}	input capacitance at gate 1	amp. a: $I_D = 18$ mA; $f = 1$ MHz	—	2.4	2.9	pF
		amp. b: $I_D = 12$ mA; $f = 1$ MHz	—	1.7	2.2	pF
C_{rss}	reverse transfer capacitance	$f = 1$ MHz	—	15	—	fF
X_{mod}	cross-modulation	amp. a: input level for $k = 1\%$ at 40 dB AGC	102	105	—	dB μ V
		amp. b: input level for $k = 1\%$ at 40 dB AGC	100	103	—	dB μ V
NF	noise figure	amp. a: $f = 400$ MHz; $I_D = 18$ mA	—	1.3	1.9	dB
		amp. b: $f = 800$ MHz; $I_D = 12$ mA	—	1.4	2.0	dB
		amp. a: $f = 11$ MHz; $I_D = 18$ mA	—	3	—	dB
		amp. b: $f = 11$ MHz; $I_D = 12$ mA	—	3.5	—	dB

Dual N-channel dual-gate MOS-FET

BF1206

CAUTION

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

ORDERING INFORMATION

TYPE NUMBER	PACKAGE		
	NAME	DESCRIPTION	VERSION
BF1206	–	plastic surface mounted package; 6 leads	SOT363

LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 60134).

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
Per MOS-FET; unless otherwise specified					
V_{DS}	drain-source voltage		–	6	V
I_D	drain current (DC)		–	30	mA
I_{G1}	gate 1 current		–	± 10	mA
I_{G2}	gate 2 current		–	± 10	mA
P_{tot}	total power dissipation	$T_s \leq 107\text{ }^{\circ}\text{C}$; note 1	–	180	mW
T_{stg}	storage temperature		–65	+150	$^{\circ}\text{C}$
T_j	junction temperature		–	150	$^{\circ}\text{C}$

Note

- T_s is the temperature at the soldering point of the source lead.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	VALUE	UNIT
$R_{th\ j-s}$	thermal resistance from junction to soldering point	240	K/W

Dual N-channel dual-gate MOS-FET

BF1206

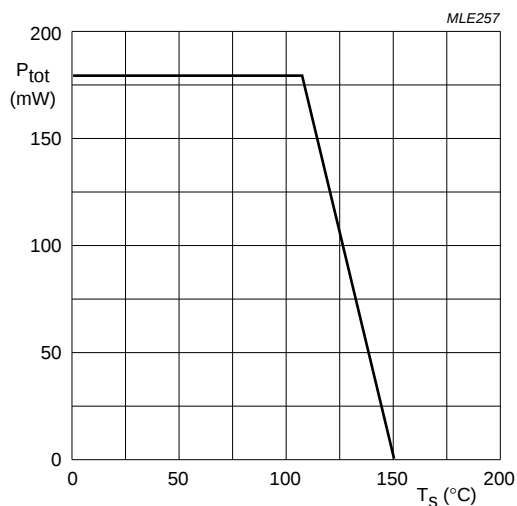


Fig.2 Power derating curve.

STATIC CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
Per MOS-FET unless otherwise specified					
$V_{(BR)DSS}$	drain-source breakdown voltage	$V_{G1-S} = V_{G2-S} = 0$; $I_D = 10\ \mu\text{A}$	6	–	V
$V_{(BR)G1-SS}$	gate-source breakdown voltage	$V_{GS} = V_{DS} = 0$; $I_{G1-S} = 10\ \text{mA}$	6	10	V
$V_{(BR)G2-SS}$	gate-source breakdown voltage	$V_{GS} = V_{DS} = 0$; $I_{G2-S} = 10\ \text{mA}$	6	10	V
$V_{(F)S-G1}$	forward source-gate 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 voltage	$V_{G1-S} = V_{DS} = 0$; $I_{S-G2} = 10\ \text{mA}$	0.5	1.5	V
$V_{G1-S(th)}$	gate-source threshold voltage	$V_{DS} = 5\ \text{V}$; $V_{G2-S} = 4\ \text{V}$; $I_D = 100\ \mu\text{A}$	0.3	1	V
$V_{G2-S(th)}$	gate-source threshold voltage	$V_{DS} = 5\ \text{V}$; $V_{G1-S} = 5\ \text{V}$; $I_D = 100\ \mu\text{A}$	0.35	1	V
I_{DSX}	drain-source current	amp. a: $V_{G2-S} = 4\ \text{V}$; $V_{DS} = 5\ \text{V}$; $R_G = 91\ \text{k}\Omega$; note 1	14	23	mA
		amp. b: $V_{G2-S} = 4\ \text{V}$; $V_{DS} = 5\ \text{V}$; $R_G = 150\ \text{k}\Omega$; note 1	9	17	mA
I_{G1-S}	gate cut-off current	$V_{G1-S} = 5\ \text{V}$; $V_{G2-S} = V_{DS} = 0$	–	50	nA
I_{G2-S}	gate cut-off current	$V_{G2-S} = 5\ \text{V}$; $V_{G1-S} = V_{DS} = 0$	–	20	nA

Note

- R_{G1} connects gate 1 to $V_{GG} = 5\ \text{V}$.

Dual N-channel dual-gate MOS-FET

BF1206

DYNAMIC CHARACTERISTICS AMPLIFIER aCommon source; $T_{amb} = 25\text{ }^{\circ}\text{C}$; $V_{G2-S} = 4\text{ V}$; $V_{DS} = 5\text{ V}$; $I_D = 18\text{ mA}$; unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$ Y_{fs} $	forward transfer admittance	pulsed; $T_j = 25\text{ }^{\circ}\text{C}$	33	38	48	mS
C_{ig1-ss}	input capacitance at gate 1	$f = 1\text{ MHz}$	–	2.4	2.9	pF
C_{ig2-ss}	input capacitance at gate 2	$f = 1\text{ MHz}$	–	3.2	–	pF
C_{oss}	output capacitance	$f = 1\text{ MHz}$	–	1.1	–	pF
C_{rss}	reverse transfer capacitance	$f = 1\text{ MHz}$	–	15	30	fF
NF	noise figure	$f = 11\text{ MHz}$; $G_S = 20\text{ mS}$; $B_S = 0$	–	3	–	dB
		$f = 400\text{ MHz}$; $Y_S = Y_{S\text{ opt}}$	–	1.3	1.9	dB
		$f = 800\text{ MHz}$; $Y_S = Y_{S\text{ opt}}$	–	1.6	2.2	dB
G_{tr}	power gain	$f = 200\text{ MHz}$; $G_S = 2\text{ mS}$; $B_S = B_{S\text{ opt}}$; $G_L = 0.5\text{ mS}$; $B_L = B_{L\text{ opt}}$; note 1	–	35	–	dB
		$f = 400\text{ MHz}$; $G_S = 2\text{ mS}$; $B_S = B_{S\text{ opt}}$; $G_L = 1\text{ mS}$; $B_L = B_{L\text{ opt}}$; note 1	–	30	–	dB
		$f = 800\text{ MHz}$; $G_S = 3.3\text{ mS}$; $B_S = B_{S\text{ opt}}$; $G_L = 1\text{ mS}$; $B_L = B_{L\text{ opt}}$; note 1	–	23	–	dB
X_{mod}	cross-modulation	input level for $k = 1\%$; $f_w = 50\text{ MHz}$; $f_{unw} = 60\text{ MHz}$; note 2				
		at 0 dB AGC	90	–	–	dB μ V
		at 10 dB AGC	–	92	–	dB μ V
		at 40 dB AGC	102	105	–	dB μ V

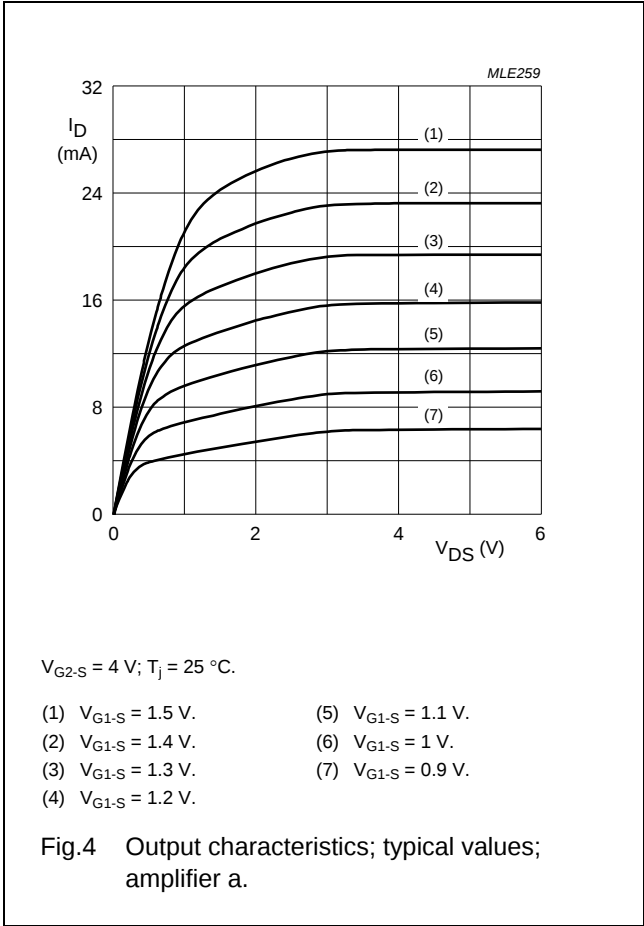
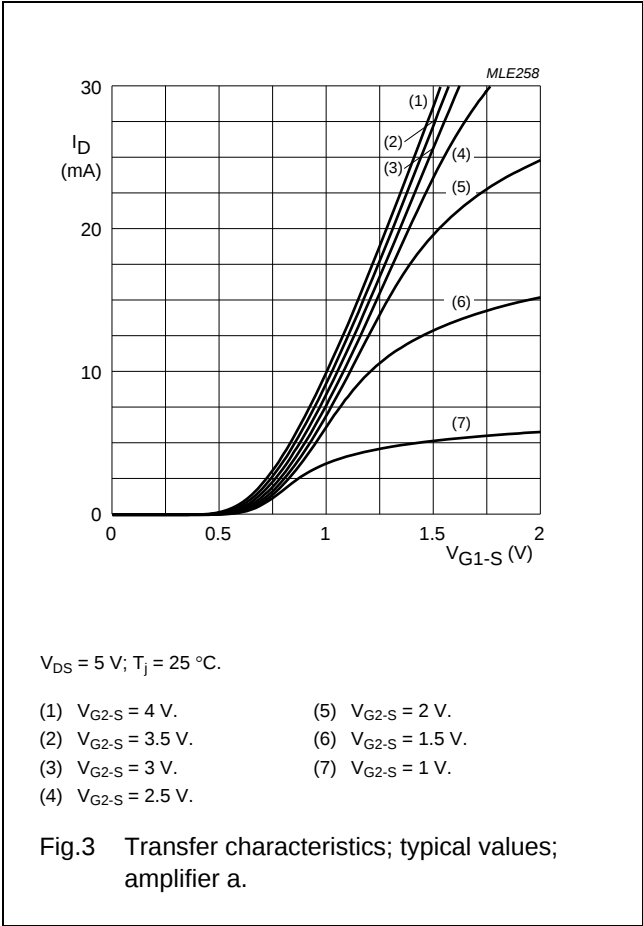
Notes

1. Calculated from measured s-parameters.
2. Measured in Fig.35 test circuit.

Dual N-channel dual-gate MOS-FET

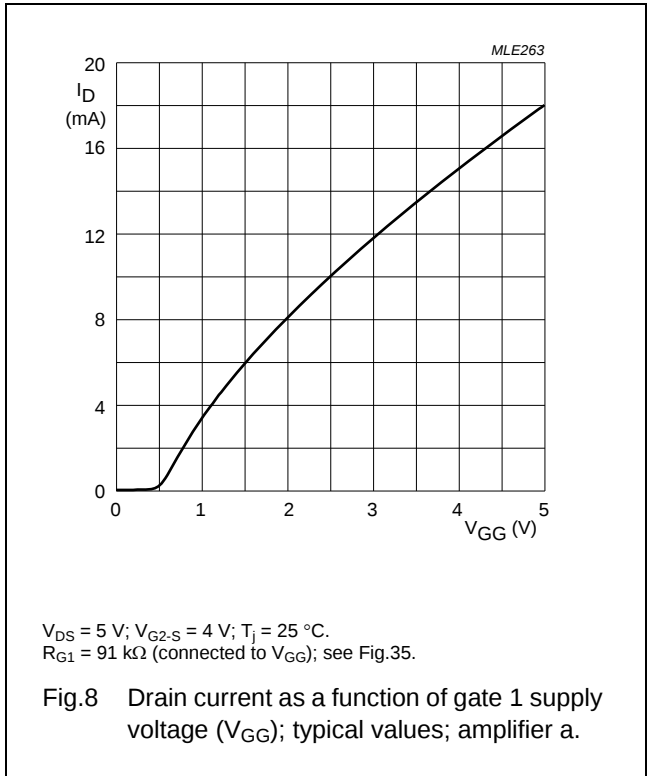
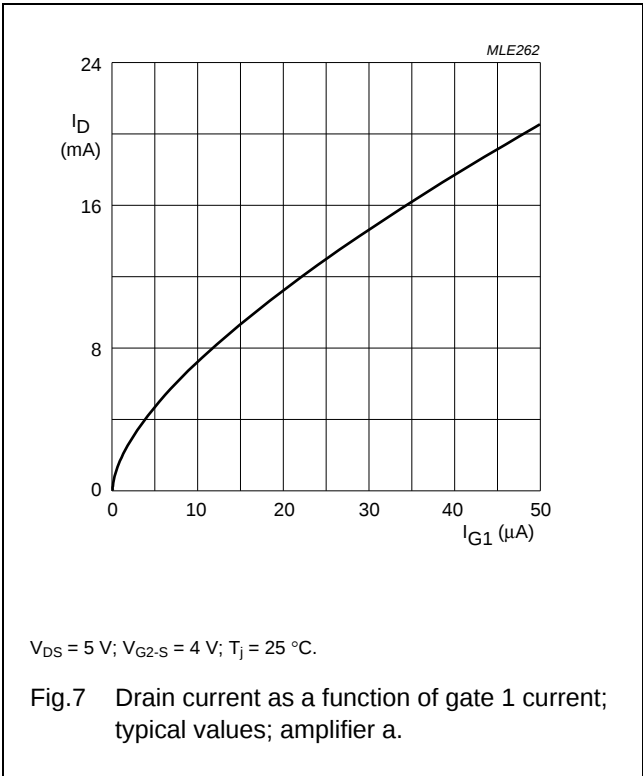
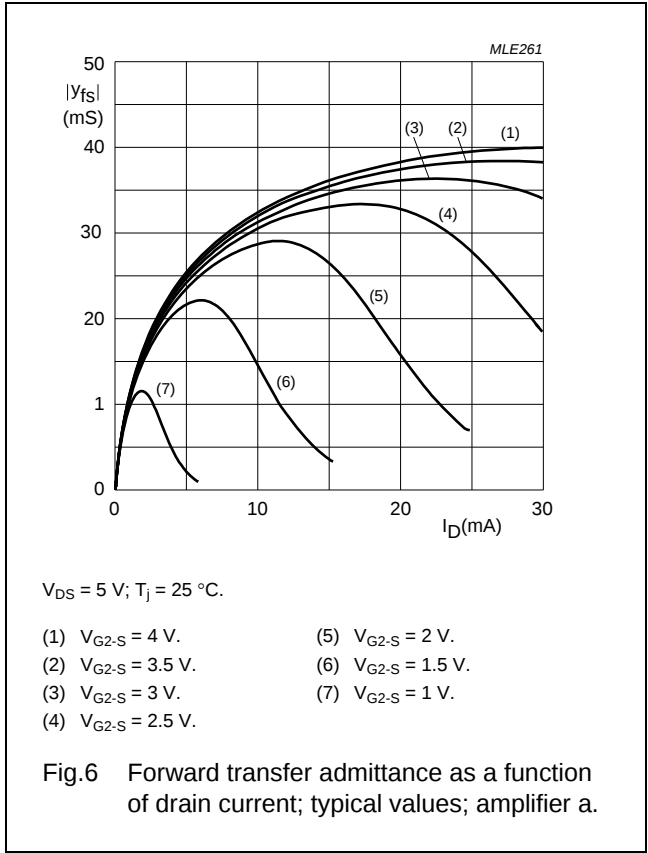
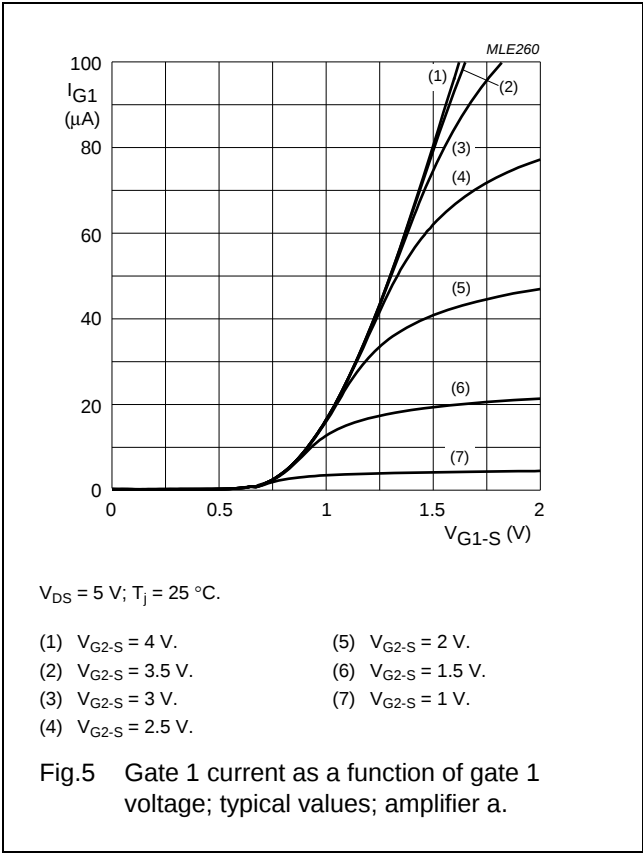
BF1206

GRAPHS FOR AMPLIFIER a



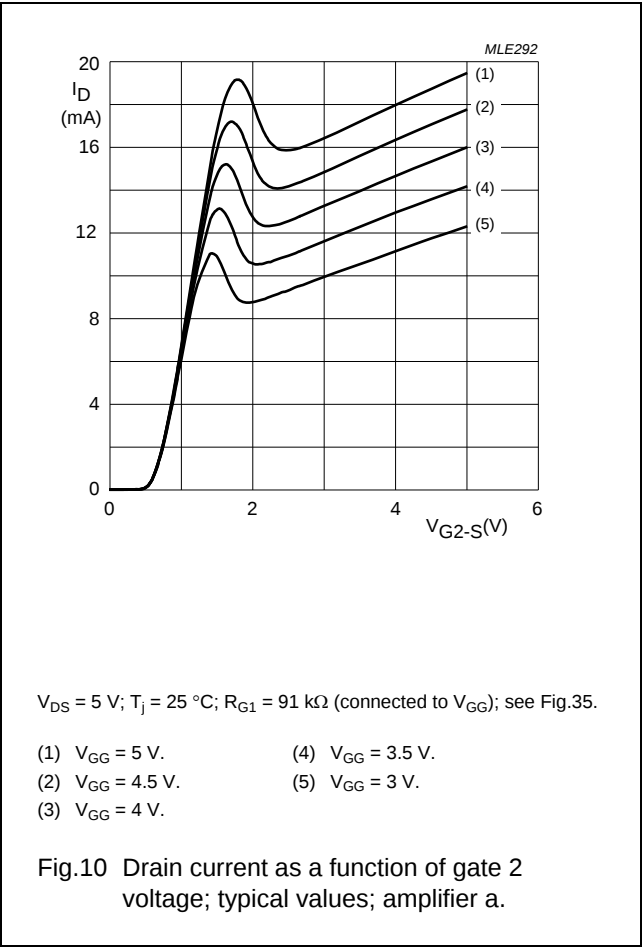
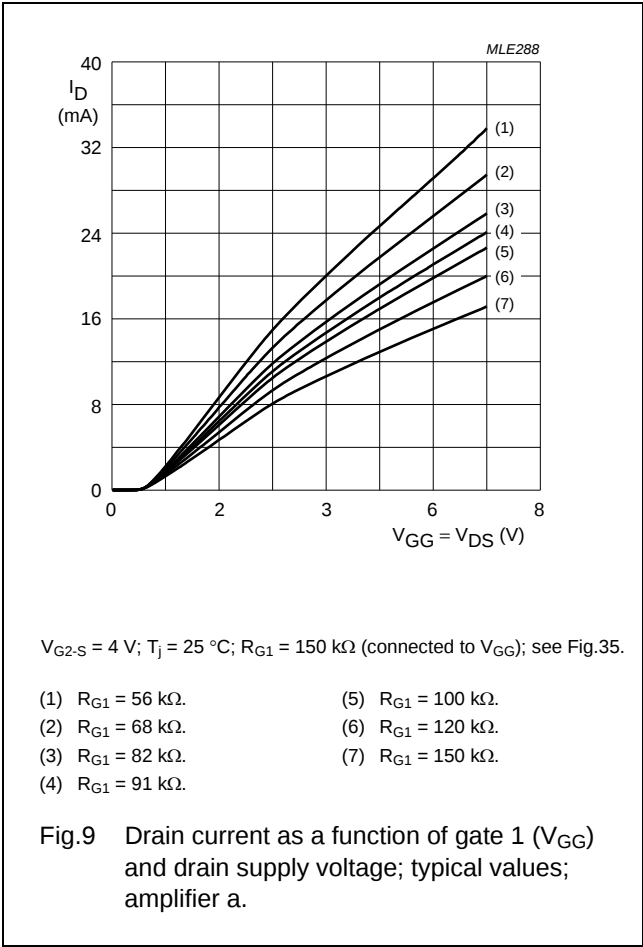
Dual N-channel dual-gate MOS-FET

BF1206



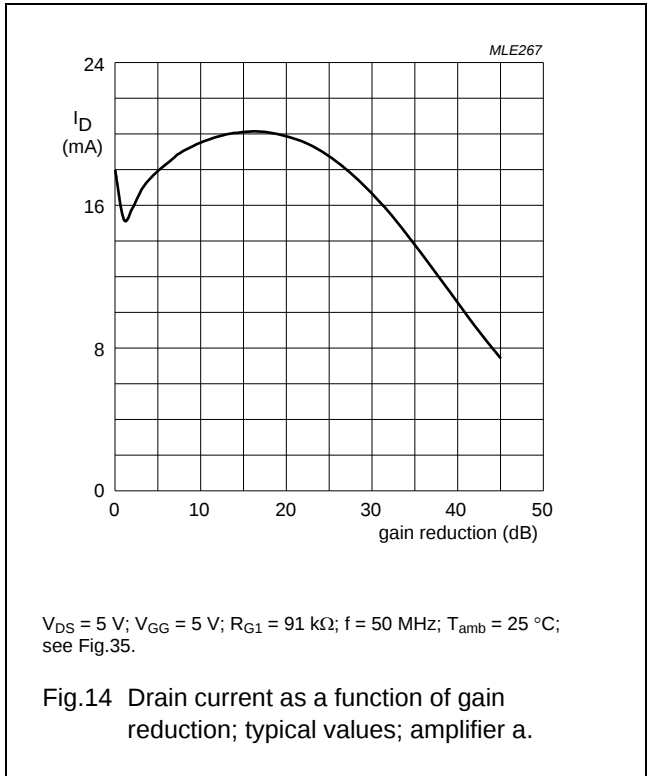
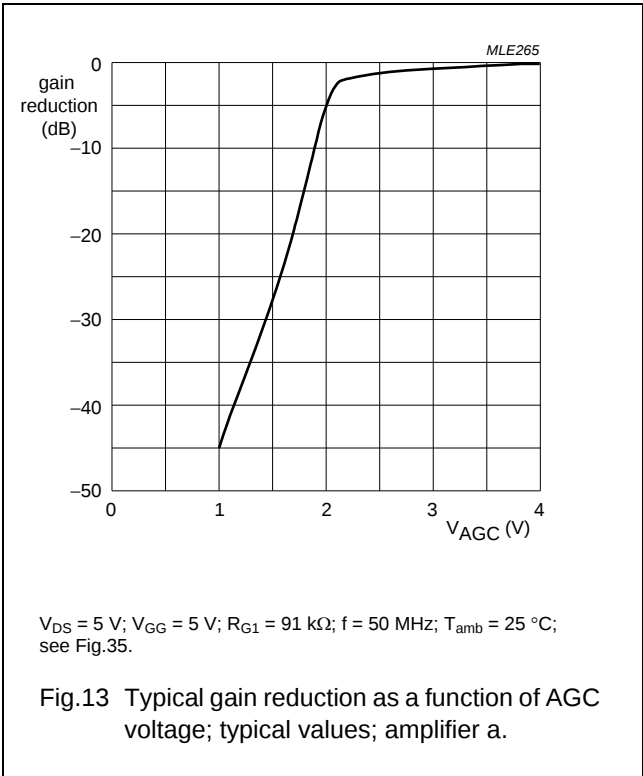
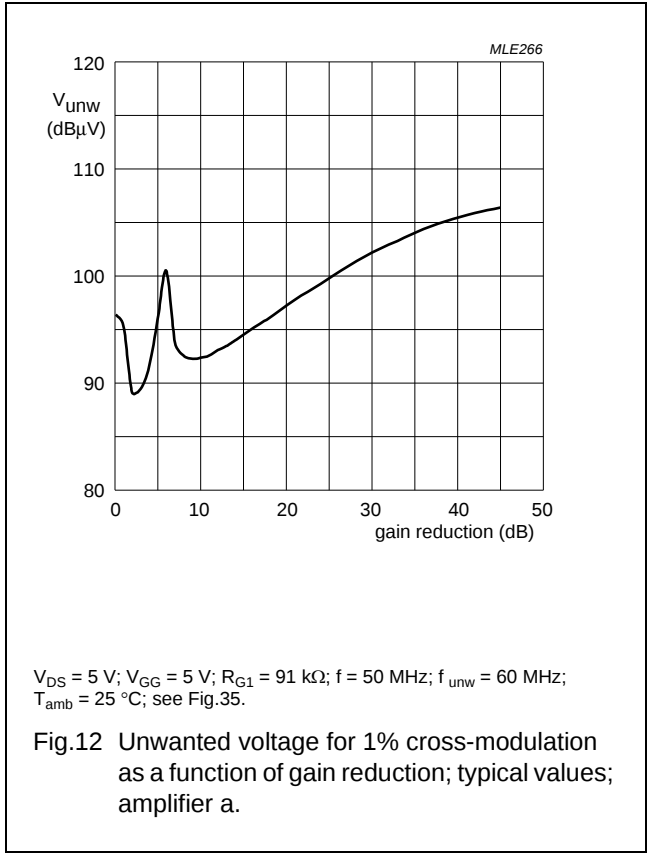
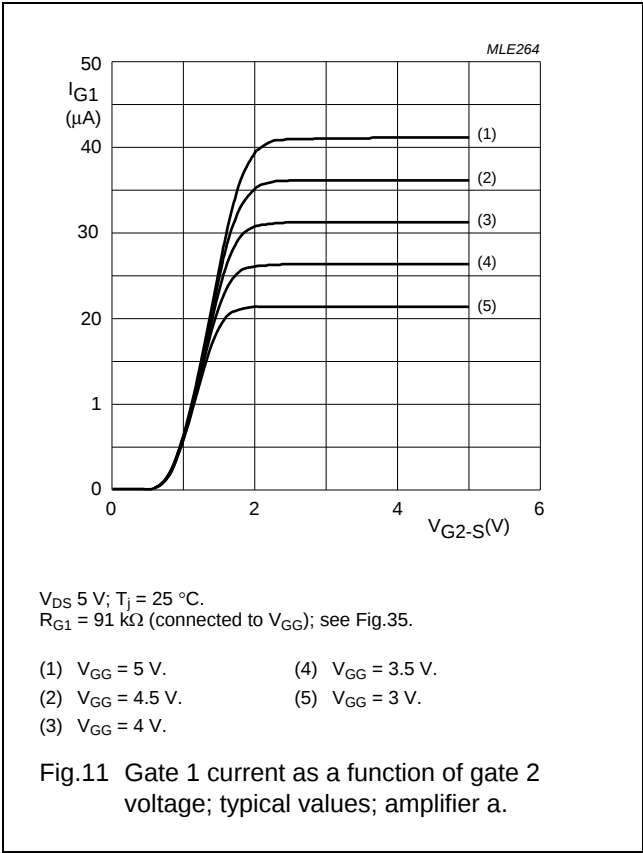
Dual N-channel dual-gate MOS-FET

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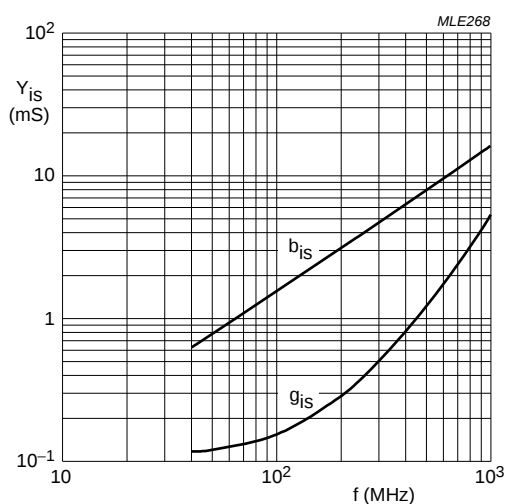
Dual N-channel dual-gate MOS-FET

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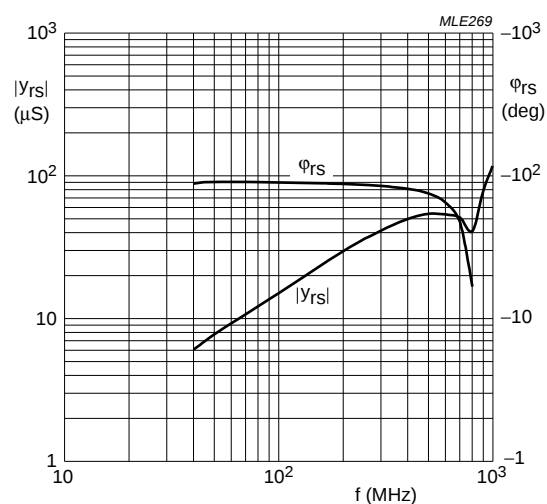
Dual N-channel dual-gate MOS-FET

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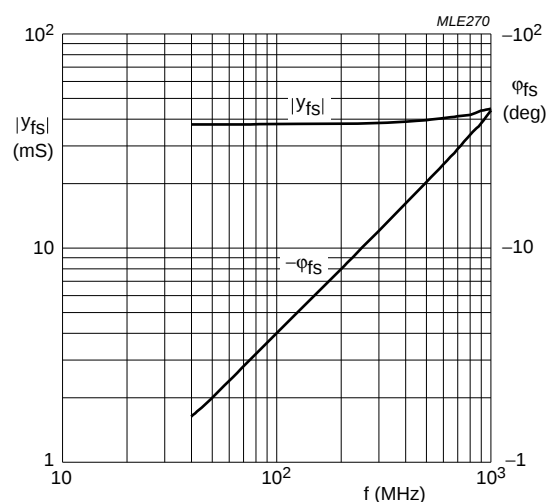
$V_{DS} = 5$ V; $V_{G2} = 4$ V; $I_D = 18$ mA; $T_{amb} = 25$ °C.

Fig.15 Input admittance as a function of frequency; typical values; amplifier a.



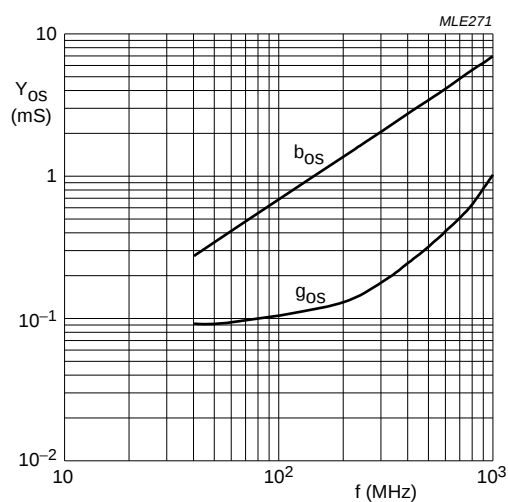
$V_{DS} = 5$ V; $V_{G2} = 4$ V; $I_D = 18$ mA; $T_{amb} = 25$ °C.

Fig.16 Reverse transfer admittance and phase as a function of frequency; typical values; amplifier a.



$V_{DS} = 5$ V; $V_{G2} = 4$ V; $I_D = 18$ mA; $T_{amb} = 25$ °C.

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



$V_{DS} = 5$ V; $V_{G2} = 4$ V; $I_D = 18$ mA; $T_{amb} = 25$ °C.

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

Dual N-channel dual-gate MOS-FET

BF1206

Amplifier a scattering parameters

 $V_{DS} = 5\text{ V}$; $V_{G2-S} = 4\text{ V}$; $I_D = 18\text{ mA}$; $T_{amb} = 25\text{ °C}$

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	0.988	-4.62	3.72	174.72	0.0008	86.73	0.991	-2.07
100	0.984	-9.23	3.71	169.42	0.0015	84.39	0.989	-4.16
200	0.971	-18.33	3.66	159.05	0.0029	79.96	0.986	-8.24
300	0.951	-27.32	3.58	148.77	0.0038	76.62	0.980	-12.32
400	0.926	-36.04	3.47	138.74	0.0044	74.42	0.973	-16.33
500	0.896	-44.50	3.36	129.05	0.0046	74.84	0.965	-20.25
600	0.865	-52.63	3.23	119.67	0.0043	79.73	0.958	-24.20
700	0.832	-60.47	3.09	110.43	0.0038	92.63	0.951	-28.14
800	0.797	-67.66	2.91	101.40	0.0028	118.47	0.937	-32.14
900	0.769	-75.01	2.83	93.09	0.0051	146.61	0.940	-35.76
1000	0.732	-81.73	2.67	84.05	0.0071	159.78	0.937	-39.86

Noise data

 $V_{DS} = 5\text{ V}$; $V_{G2-S} = 4\text{ V}$; $I_D = 18\text{ mA}$; $T_{amb} = 25\text{ °C}$

f (MHz)	F _{min} (dB)	Γ _{opt}		R _n (Ω)
		(ratio)	(deg)	
400	1.3	0.618	22.7	26.7
800	1.6	0.593	44.1	29.7

Dual N-channel dual-gate MOS-FET

BF1206

DYNAMIC CHARACTERISTICS AMPLIFIER bCommon source; $T_{amb} = 25\text{ °C}$; $V_{G2-S} = 4\text{ V}$; $V_{DS} = 5\text{ V}$; $I_D = 12\text{ mA}$; unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$ Y_{fs} $	forward transfer admittance	pulsed; $T_j = 25\text{ °C}$	29	34	44	mS
C_{ig1-ss}	input capacitance at gate 1	$f = 1\text{ MHz}$	–	1.7	2.2	pF
C_{ig2-ss}	input capacitance at gate 2	$f = 1\text{ MHz}$	–	4.2	–	pF
C_{oss}	output capacitance	$f = 1\text{ MHz}$	–	0.85	–	pF
C_{rss}	reverse transfer capacitance	$f = 1\text{ MHz}$	–	15	30	fF
F	noise figure	$f = 11\text{ MHz}$; $G_S = 20\text{ mS}$; $B_S = 0$	–	3.5	–	dB
		$f = 400\text{ MHz}$; $Y_S = Y_{S\text{ opt}}$	–	1.3	1.9	dB
		$f = 800\text{ MHz}$; $Y_S = Y_{S\text{ opt}}$	–	1.4	2	dB
G_{tr}	power gain	$f = 200\text{ MHz}$; $G_S = 2\text{ mS}$; $B_S = B_{S\text{ opt}}$; $G_L = 0.5\text{ mS}$; $B_L = B_{L\text{ opt}}$; note 1	–	35	–	dB
		$f = 400\text{ MHz}$; $G_S = 2\text{ mS}$; $B_S = B_{S\text{ opt}}$; $G_L = 1\text{ mS}$; $B_L = B_{L\text{ opt}}$; note 1	–	31	–	dB
		$f = 800\text{ MHz}$; $G_S = 3.3\text{ mS}$; $B_S = B_{S\text{ opt}}$; $G_L = 1\text{ mS}$; $B_L = B_{L\text{ opt}}$; note 1	–	27	–	dB
X_{mod}	cross-modulation	input level for $k = 1\%$; $f_w = 50\text{ MHz}$; $f_{unw} = 60\text{ MHz}$; note 2				
		at 0 dB AGC	90	–	–	dB μ V
		at 10 dB AGC	–	90	–	dB μ V
		at 40 dB AGC	100	103	–	dB μ V

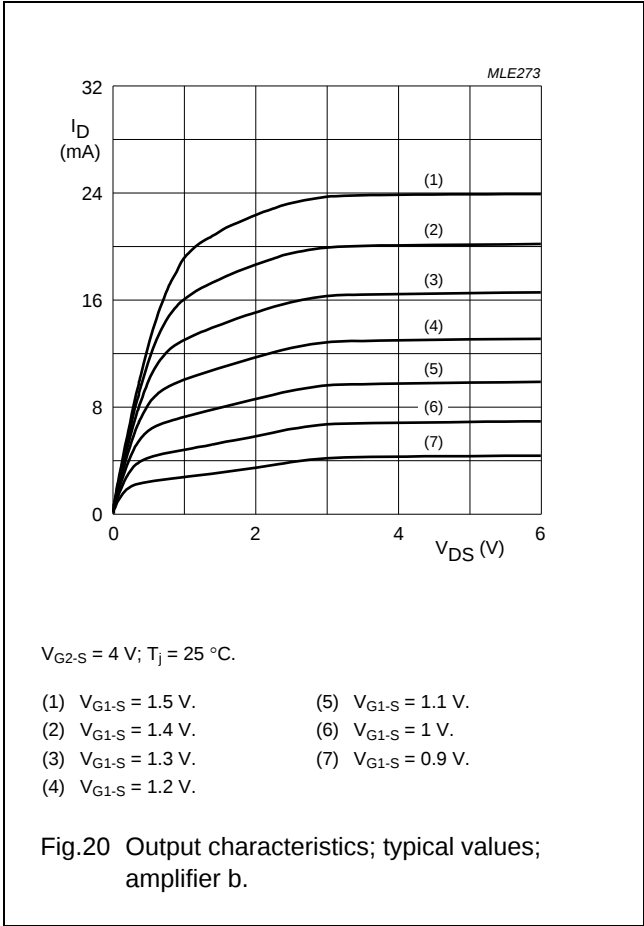
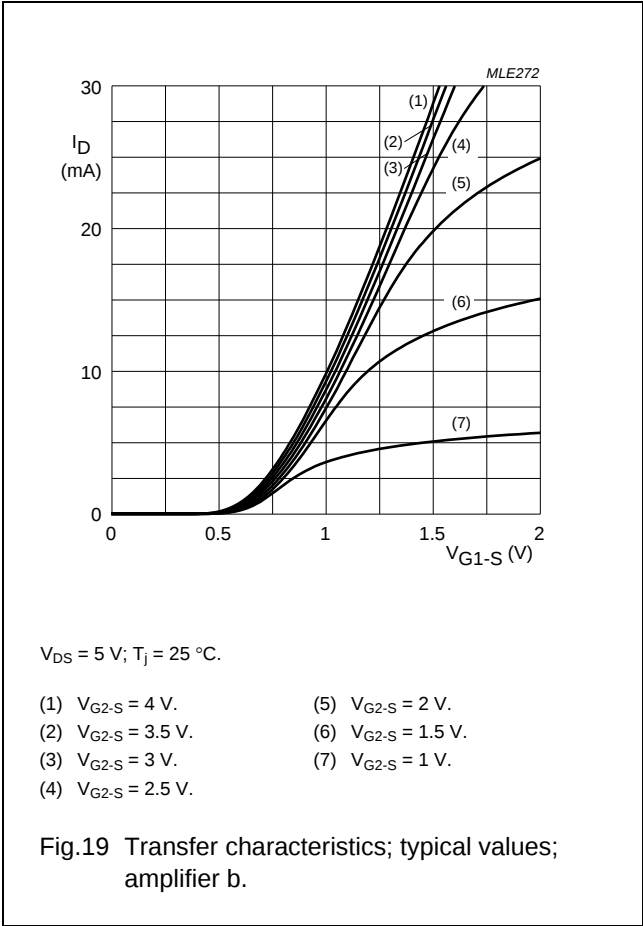
Notes

1. Calculated from measured s-parameters.
2. Measured in Fig.35 test circuit.

Dual N-channel dual-gate MOS-FET

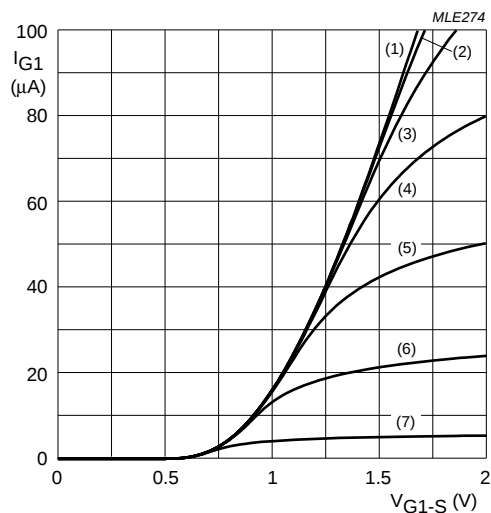
BF1206

GRAPHS FOR AMPLIFIER b



Dual N-channel dual-gate MOS-FET

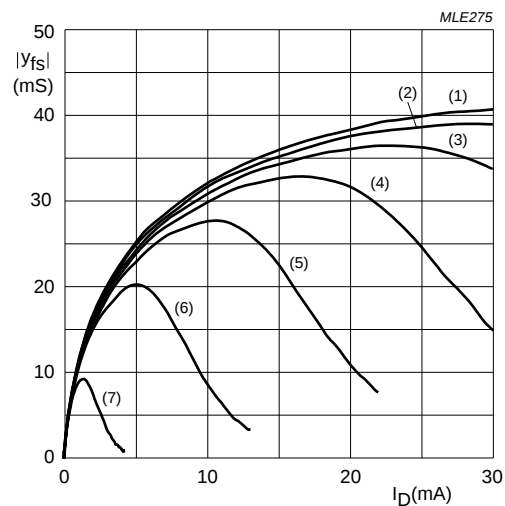
BF1206



$V_{DS} = 5 \text{ V}$; $T_j = 25 \text{ }^{\circ}\text{C}$.

- | | |
|----------------------------------|----------------------------------|
| (1) $V_{G2-S} = 4 \text{ V}$. | (5) $V_{G2-S} = 2 \text{ V}$. |
| (2) $V_{G2-S} = 3.5 \text{ V}$. | (6) $V_{G2-S} = 1.5 \text{ V}$. |
| (3) $V_{G2-S} = 3 \text{ V}$. | (7) $V_{G2-S} = 1 \text{ V}$. |
| (4) $V_{G2-S} = 2.5 \text{ V}$. | |

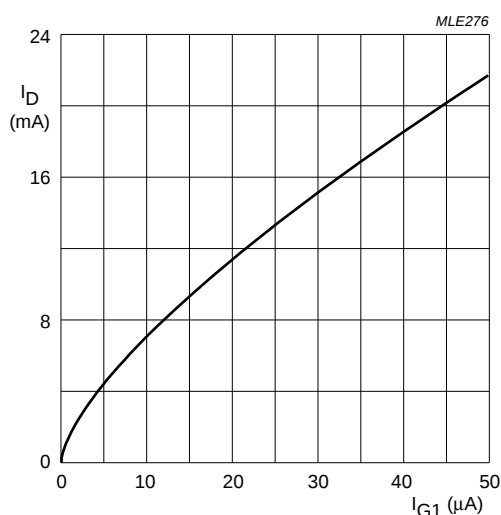
Fig.21 Gate 1 current as a function of gate 1 voltage; typical values; amplifier b.



$V_{DS} = 5 \text{ V}$; $T_j = 25 \text{ }^{\circ}\text{C}$.

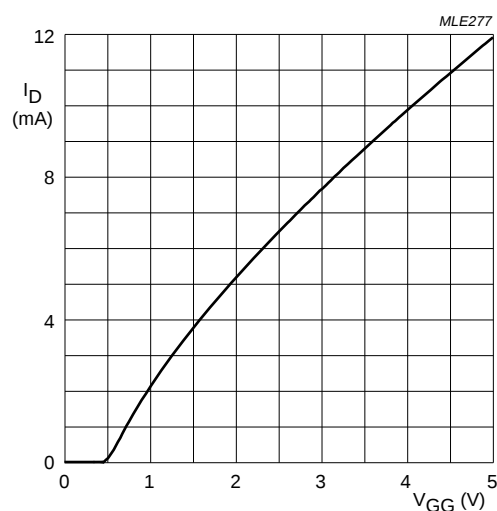
- | | |
|----------------------------------|----------------------------------|
| (1) $V_{G2-S} = 4 \text{ V}$. | (5) $V_{G2-S} = 2 \text{ V}$. |
| (2) $V_{G2-S} = 3.5 \text{ V}$. | (6) $V_{G2-S} = 1.5 \text{ V}$. |
| (3) $V_{G2-S} = 3 \text{ V}$. | (7) $V_{G2-S} = 1 \text{ V}$. |
| (4) $V_{G2-S} = 2.5 \text{ V}$. | |

Fig.22 Forward transfer admittance as a function of drain current; typical values; amplifier b.



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

Fig.23 Drain current as a function of gate 1 current; typical values; amplifier b.

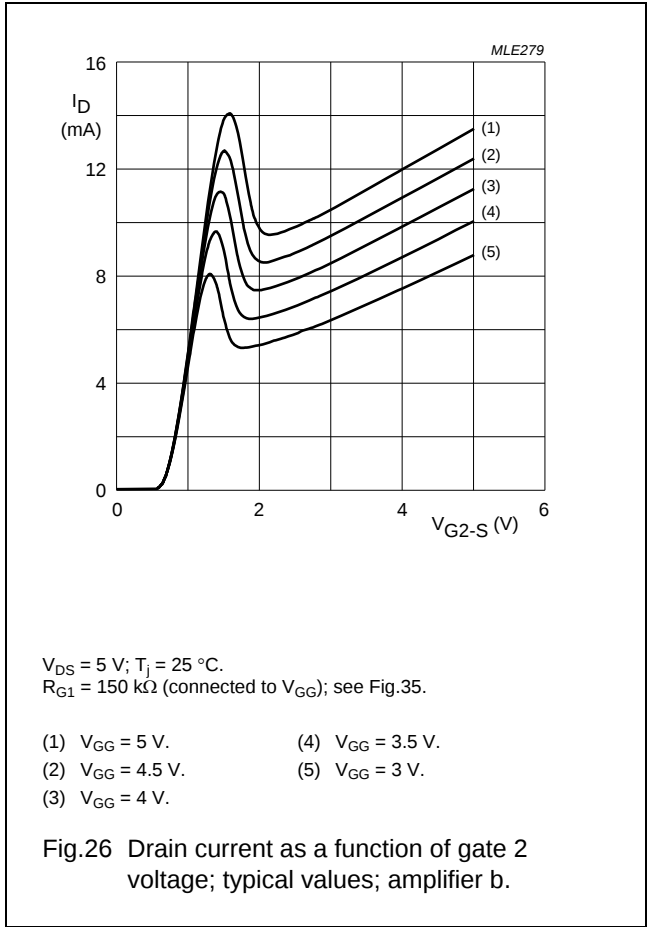
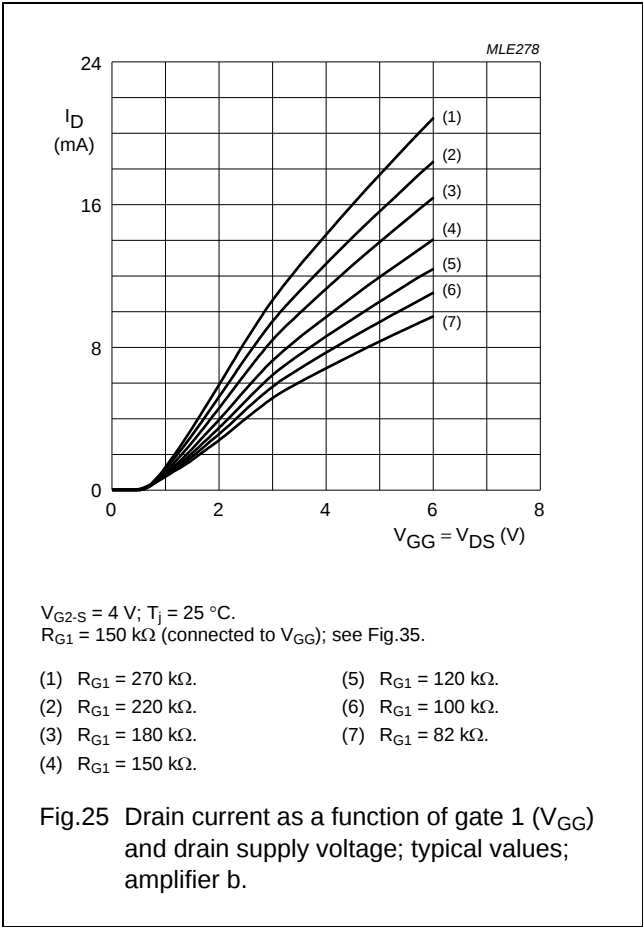


$V_{DS} = 5 \text{ V}$; $V_{G2-S} = 4 \text{ V}$; $T_j = 25 \text{ }^{\circ}\text{C}$.
 $R_{G1} = 150 \text{ k}\Omega$ (connected to V_{GG}); see Fig.35.

Fig.24 Drain current as a function of gate 1 supply voltage (V_{GG}); typical values; amplifier b.

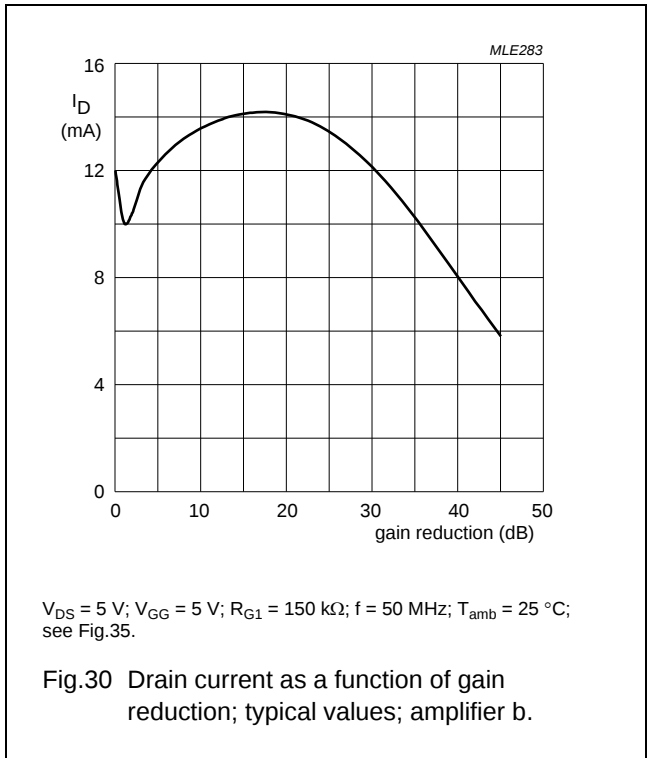
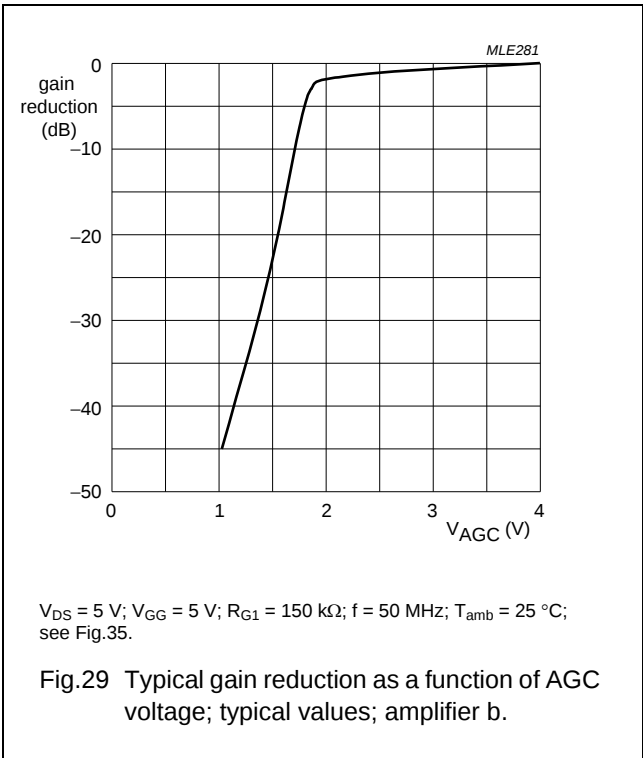
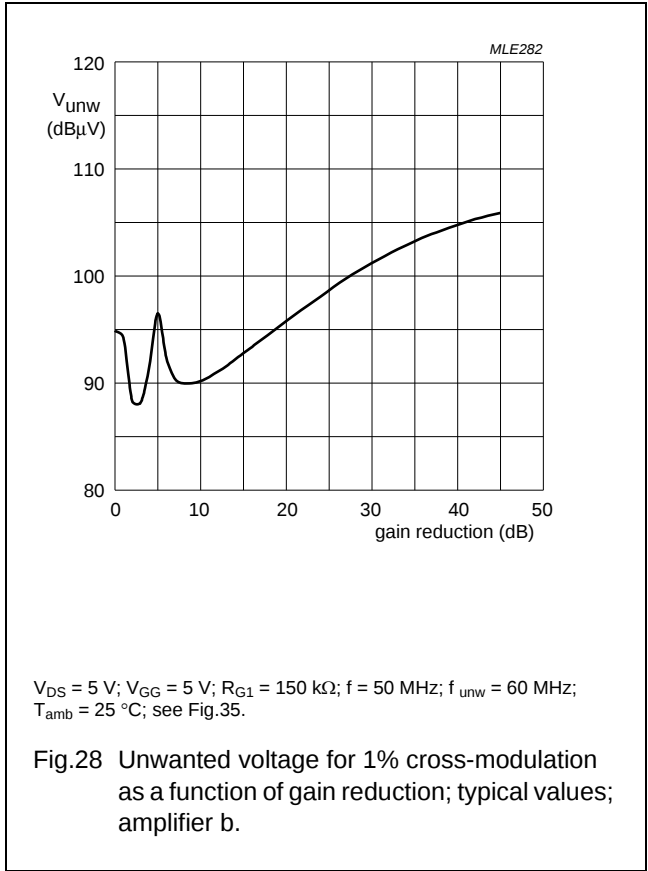
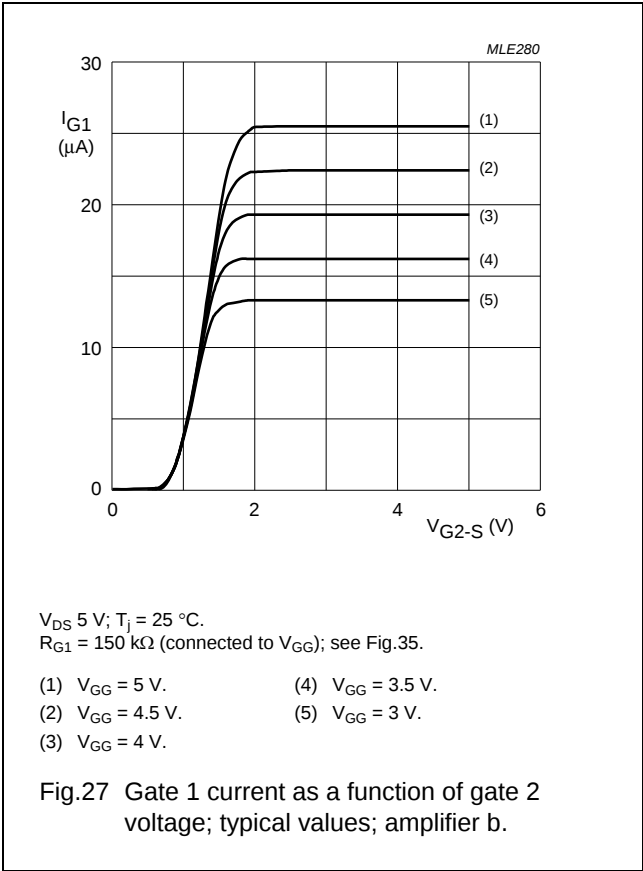
Dual N-channel dual-gate MOS-FET

BF1206



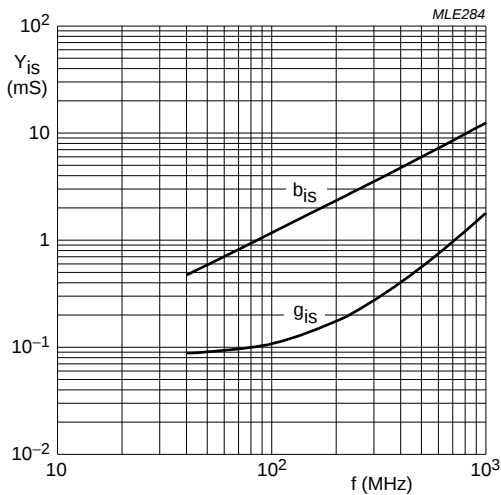
Dual N-channel dual-gate MOS-FET

BF1206



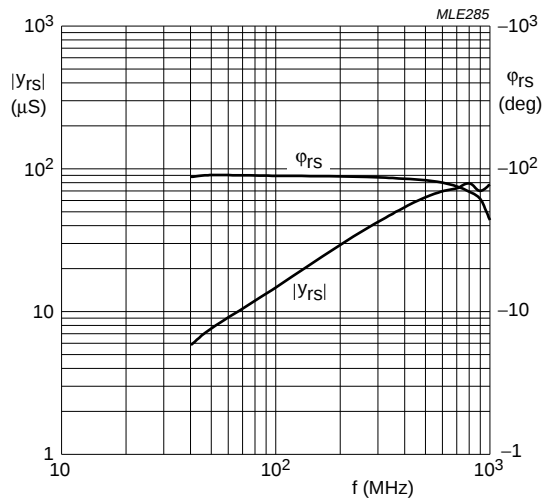
Dual N-channel dual-gate MOS-FET

BF1206



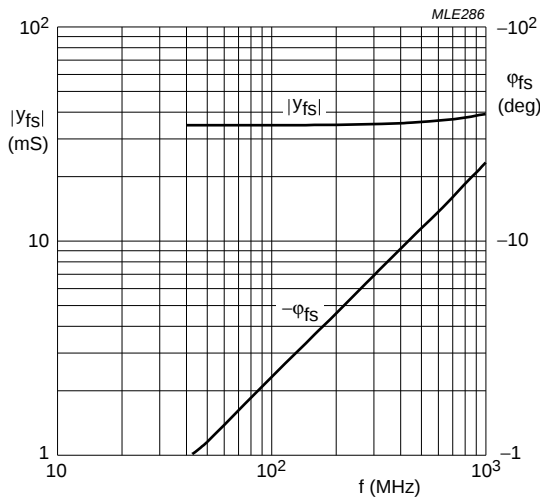
$V_{DS} = 5\text{ V}$; $V_{G2} = 4\text{ V}$; $I_D = 12\text{ mA}$; $T_{amb} = 25\text{ }^{\circ}\text{C}$.

Fig.31 Input admittance as a function of frequency; typical values; amplifier b.



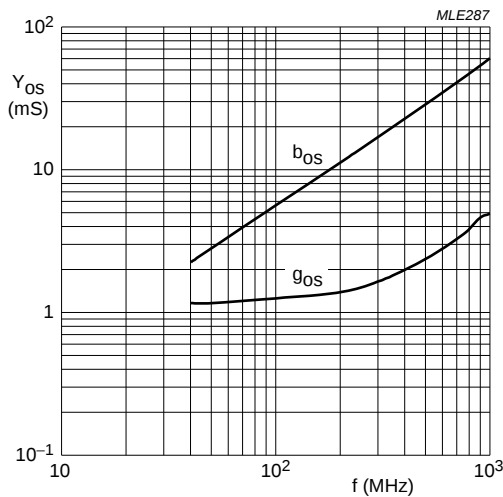
$V_{DS} = 5\text{ V}$; $V_{G2} = 4\text{ V}$; $I_D = 12\text{ mA}$; $T_{amb} = 25\text{ }^{\circ}\text{C}$.

Fig.32 Reverse transfer admittance and phase as a function of frequency; typical values; amplifier b.



$V_{DS} = 5\text{ V}$; $V_{G2} = 4\text{ V}$; $I_D = 12\text{ mA}$; $T_{amb} = 25\text{ }^{\circ}\text{C}$.

Fig.33 Forward transfer admittance and phase as a function of frequency; typical values; amplifier b.

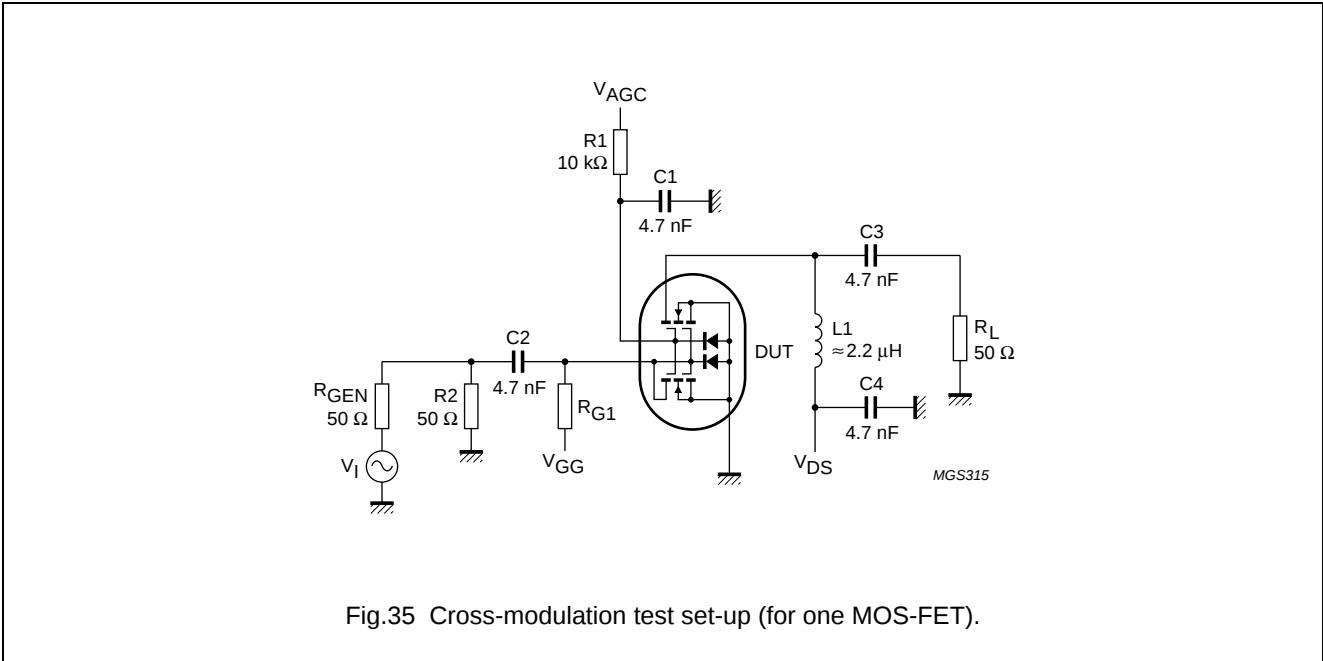


$V_{DS} = 5\text{ V}$; $V_{G2} = 4\text{ V}$; $I_D = 12\text{ mA}$; $T_{amb} = 25\text{ }^{\circ}\text{C}$.

Fig.34 Output admittance as a function of frequency; typical values; amplifier b.

Dual N-channel dual-gate MOS-FET

BF1206



Amplifier b scattering parameters

$V_{DS} = 5\text{ V}$; $V_{G2-S} = 4\text{ V}$; $I_D = 12\text{ mA}$; $T_{amb} = 25\text{ }^{\circ}\text{C}$

f (MHz)	S11		S21		S12		S22	
	MAGNITUDE (ratio)	ANGLE (deg)	MAGNITUDE (ratio)	ANGLE (deg)	MAGNITUDE (ratio)	ANGLE (deg)	MAGNITUDE (ratio)	ANGLE (deg)
50	0.991	-3.43	3.44	176.33	0.0008	86.54	0.988	-1.69
100	0.989	-6.84	3.43	172.66	0.0015	84.92	0.987	-3.38
200	0.982	-13.61	3.41	165.44	0.0029	80.95	0.985	-6.72
300	0.973	-20.37	3.38	158.20	0.0041	77.63	0.982	-10.08
400	0.961	-27.05	3.34	151.04	0.0051	74.43	0.978	-13.46
500	0.947	-33.68	3.29	144.02	0.0058	71.86	0.973	-16.83
600	0.933	-40.17	3.23	137.12	0.0062	70.28	0.969	-20.25
700	0.919	-46.54	3.16	130.22	0.0063	70.72	0.965	-23.68
800	0.905	-52.86	3.09	123.22	0.0065	72.37	0.960	-27.22
900	0.890	-58.60	3.02	116.84	0.0055	75.91	0.958	-30.57
1000	0.881	-64.34	2.94	110.20	0.0058	89.82	0.958	-34.14

Noise data

$V_{DS} = 5\text{ V}$; $V_{G2-S} = 4\text{ V}$; $I_D = 12\text{ mA}$; $T_{amb} = 25\text{ }^{\circ}\text{C}$

f (MHz)	F_{min} (dB)	Γ_{opt}		R_n (Ω)
		(ratio)	(deg)	
400	1.3	0.648	14.4	28.8
800	1.4	0.604	31.1	27.9

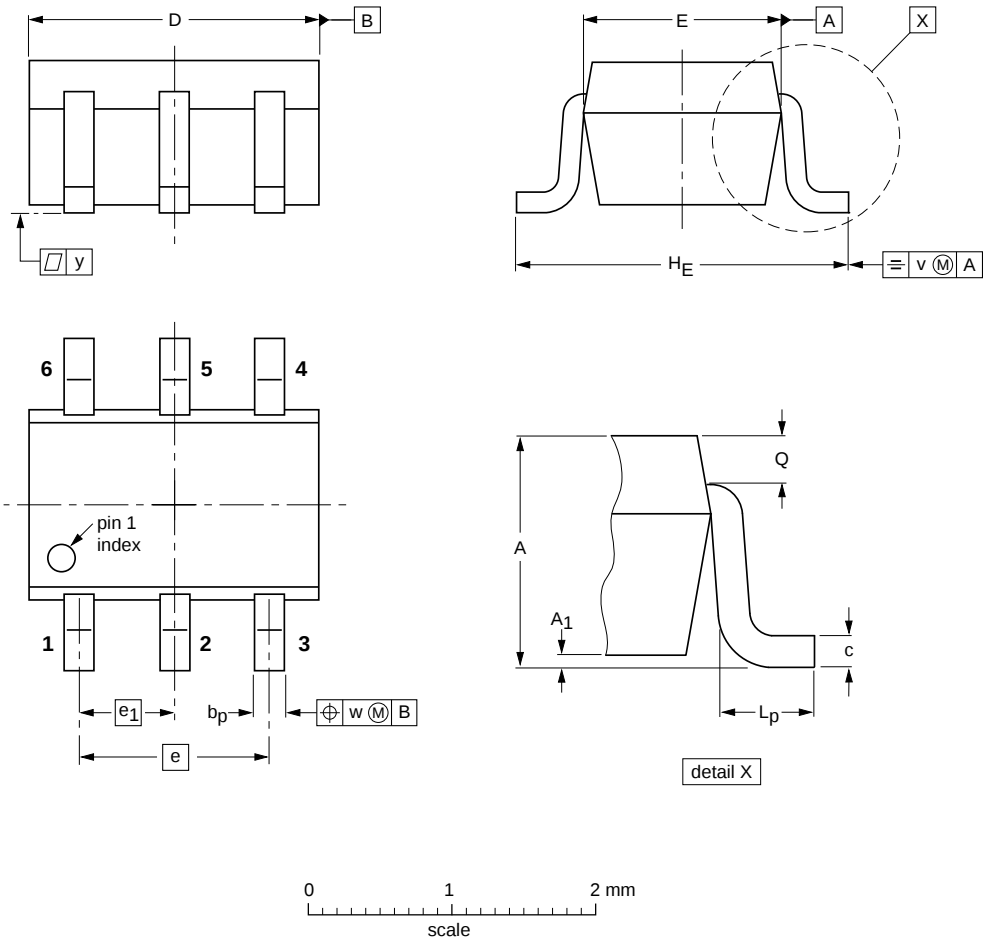
Dual N-channel dual-gate MOS-FET

BF1206

PACKAGE OUTLINE

Plastic surface-mounted package; 6 leads

SOT363



DIMENSIONS (mm are the original dimensions)

UNIT	A	A1 max	bp	c	D	E	e	e1	HE	Lp	Q	v	w	y
mm	1.1 0.8	0.1	0.30 0.20	0.25 0.10	2.2 1.8	1.35 1.15	1.3	0.65	2.2 2.0	0.45 0.15	0.25 0.15	0.2	0.2	0.1

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT363			SC-88			04-11-08 06-03-16

Dual N-channel dual-gate MOS-FET

BF1206

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.

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Dual N-channel dual-gate MOS-FET

BF1206

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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

For additional information please visit: <http://www.nxp.com>

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