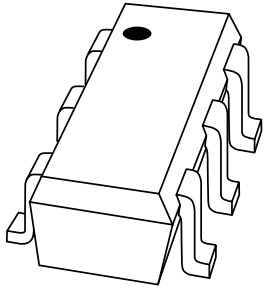


# DATA SHEET



## **BF1205** Dual N-channel dual gate MOS-FET

Product specification

2003 Sep 30



# Dual N-channel dual gate MOS-FET

# BF1205

### FEATURES

- Two low noise gain controlled amplifiers in a single package. One with a fully integrated bias and one with a partly integrated bias
- Internal switch reduces the number of external components
- Superior cross-modulation performance during AGC
- High forward transfer admittance
- High forward transfer admittance to input capacitance ratio.

### APPLICATIONS

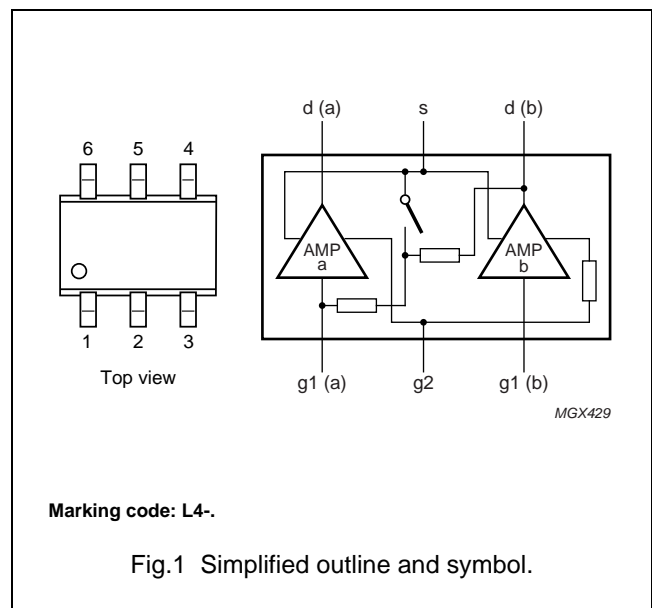
- Gain controlled low noise amplifiers for VHF and UHF applications with 5 V supply voltage, such as digital and analog television tuners and professional communications equipment.

### DESCRIPTION

The BF1205 is a combination of two equal dual gate MOS-FET amplifiers with shared source and gate 2 leads and an integrated switch. The integrated switch is operated by the gate 1 bias of amplifier b. 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	gate 1 (a)
2	gate 2
3	gate 1 (b)
4	drain (b)
5	source
6	drain (a)



### ORDERING INFORMATION

TYPE NUMBER	PACKAGE		
	NAME	DESCRIPTION	VERSION
BF1205	–	Plastic surface mounted package; 6 leads	SOT363

# Dual N-channel dual gate MOS-FET

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## QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
<b>Per MOS-FET; unless otherwise specified</b>						
$V_{DS}$	drain-source voltage		–	–	10	V
$I_D$	drain current (DC)		–	–	30	mA
$P_{tot}$	total power dissipation	$T_s \leq 102\text{ }^\circ\text{C}$ ; temperature at the soldering point of the source lead	–	–	200	mW
$ y_{fs} $	forward transfer admittance	$I_D = 12\text{ mA}$	26	31	40	mS
$C_{ig1-ss}$	input capacitance at gate 1	amp. a: $f = 1\text{ MHz}$	–	1.8	2.3	pF
		amp. b: $f = 1\text{ MHz}$	–	2.0	2.5	pF
$C_{rss}$	reverse transfer capacitance	$f = 1\text{ MHz}$	–	20	–	fF
NF	noise figure	amp. a: $f = 800\text{ MHz}$	–	1.2	1.9	dB
		amp. b: $f = 800\text{ MHz}$	–	1.4	2.1	dB
$X_{mod}$	cross-modulation	amp. a: input level for $k = 1\%$ at 40 dB AGC	98	102	–	dB $\mu$ V
		amp. b: input level for $k = 1\%$ at 40 dB AGC	100	105	–	dB $\mu$ V
$T_j$	junction temperature		–	–	150	$^\circ\text{C}$

### 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 60134).

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
<b>Per MOS-FET; unless otherwise specified</b>					
$V_{DS}$	drain-source voltage		–	10	V
$I_D$	drain current (DC)		–	30	mA
$I_{G1}$	gate 1 current		–	$\pm 10$	mA
$I_{G2}$	gate 2 current		–	$\pm 10$	mA
$P_{tot}$	total power dissipation	$T_s \leq 102\text{ }^\circ\text{C}$ ; note	–	200	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

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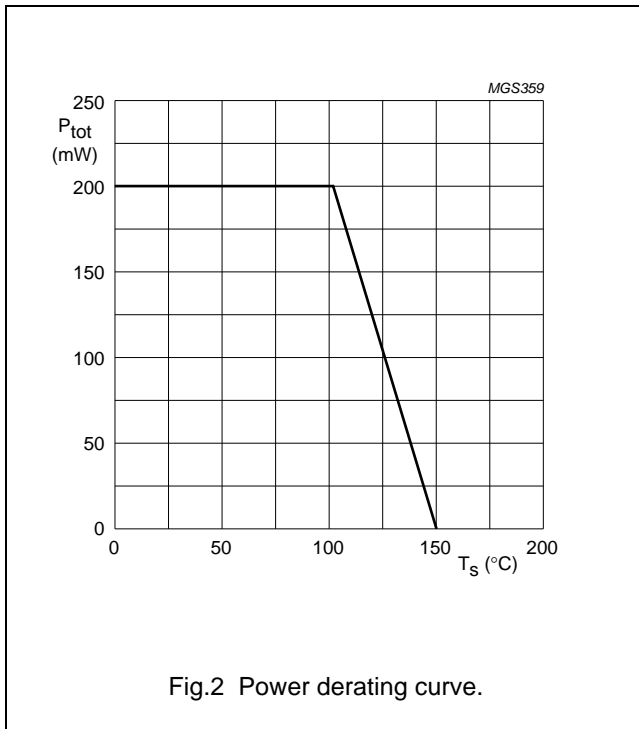


Fig.2 Power derating curve.

**STATIC CHARACTERISTICS**

$T_j = 25\text{ }^{\circ}C$ ; per MOS-FET; unless otherwise specified.

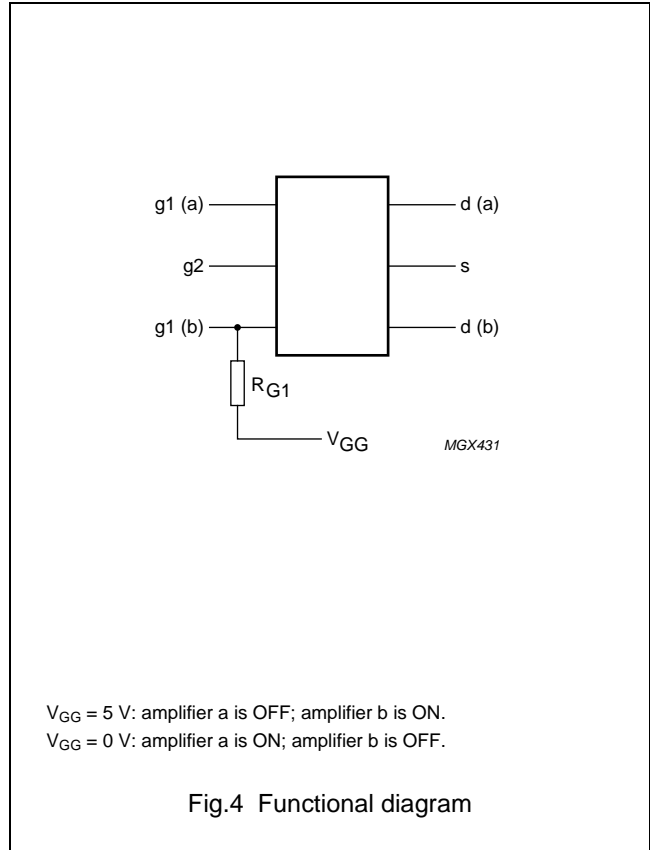
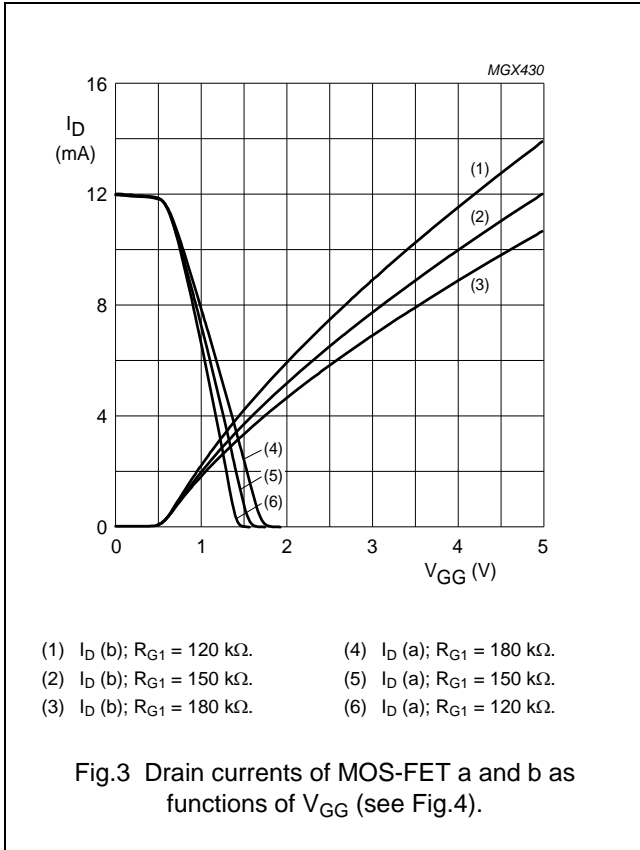
SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
$V_{(BR)DSS}$	drain-source breakdown voltage	amp. a: $V_{G1-S} = V_{G2-S} = 0\text{ V}$ ; $I_D = 10\text{ }\mu A$	10	–	V
		amp. b: $V_{G1-S} = V_{G2-S} = 0\text{ V}$ ; $I_D = 10\text{ }\mu A$	7	–	V
$V_{(BR)G1-SS}$	gate-source breakdown voltage	$V_{GS} = V_{DS} = 0\text{ V}$ ; $I_{G1-S} = 10\text{ mA}$	6	10	V
$V_{(BR)G2-SS}$	gate-source breakdown voltage	$V_{GS} = V_{DS} = 0\text{ V}$ ; $I_{G2-S} = 10\text{ mA}$	6	10	V
$V_{(F)S-G1}$	forward source-gate voltage	$V_{G2-S} = V_{DS} = 0\text{ V}$ ; $I_{S-G1} = 10\text{ mA}$	0.5	1.5	V
$V_{(F)S-G2}$	forward source-gate voltage	$V_{G1-S} = V_{DS} = 0\text{ V}$ ; $I_{S-G2} = 10\text{ mA}$	0.5	1.5	V
$V_{G1-S(th)}$	gate-source threshold voltage	$V_{DS} = 5\text{ V}$ ; $V_{G2-S} = 4\text{ V}$ ; $I_D = 100\text{ }\mu A$	0.3	1	V
$V_{G2-S(th)}$	gate-source threshold voltage	$V_{DS} = 5\text{ V}$ ; $V_{G1-S} = 5\text{ V}$ ; $I_D = 100\text{ }\mu A$	0.4	1.0	V
$I_{DSX}$	drain-source current	amp. a: $V_{G2-S} = 4\text{ V}$ ; $V_{DS} = 5\text{ V}$ ; $R_{G1} = 150\text{ k}\Omega$ ; note 1	8	16	mA
		amp. b: $V_{G2-S} = 4\text{ V}$ ; $V_{DS} = 5\text{ V}$ ; $R_{G1} = 150\text{ k}\Omega$ ; note 2	8	16	mA
$I_{G1-S}$	gate cut-off current	amp. a: $V_{G1-S} = 5\text{ V}$ ; $V_{G2-S} = V_{DS} = 0\text{ V}$	–	50	nA
		amp. b: $V_{G1-S} = 5\text{ V}$ ; $V_{G2-S} = V_{DS} = 0\text{ V}$	–	50	nA
$I_{G2-S}$	gate cut-off current	$V_{G2-S} = 4\text{ V}$ ; $V_{G1-S} = V_{DS} = 0\text{ V}$	–	20	nA

**Note**

- $R_{G1}$  connects gate 1 (b) to  $V_{GG} = 0\text{ V}$  (see Fig.4).
- $R_{G1}$  connects gate 1 (b) to  $V_{GG} = 5\text{ V}$  (see Fig.4).

Dual N-channel dual gate MOS-FET

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## Dual N-channel dual gate MOS-FET

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**DYNAMIC CHARACTERISTICS AMPLIFIER a**Common source;  $T_{amb} = 25\text{ °C}$ ;  $V_{G2-S} = 4\text{ V}$ ;  $V_{DS} = 5\text{ V}$ ;  $I_D = 12\text{ mA}$ ; note 1

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$ y_{fs} $	forward transfer admittance	$T_j = 25\text{ °C}$	26	31	40	mS
$C_{ig1-ss}$	input capacitance at gate 1	$f = 1\text{ MHz}$	–	1.8	2.3	pF
$C_{ig2-ss}$	input capacitance at gate 2	$f = 1\text{ MHz}$	–	3.3	–	pF
$C_{oss}$	output capacitance	$f = 1\text{ MHz}$	–	0.75	–	pF
$C_{rss}$	reverse transfer capacitance	$f = 1\text{ MHz}$	–	20	–	fF
$G_{tr}$	power gain	$f = 200\text{ MHz}$ ; $G_S = 2\text{ mS}$ ; $B_S = B_{S(opt)}$ ; $G_L = 0.5\text{ mS}$ ; $B_L = B_{L(opt)}$	31	35	39	dB
		$f = 400\text{ MHz}$ ; $G_S = 2\text{ mS}$ ; $B_S = B_{S(opt)}$ ; $G_L = 1\text{ mS}$ ; $B_L = B_{L(opt)}$	27	31	35	dB
		$f = 800\text{ MHz}$ ; $G_S = 3.3\text{ mS}$ ; $B_S = B_{S(opt)}$ ; $G_L = 1\text{ mS}$ ; $B_L = B_{L(opt)}$	22	26	30	dB
NF	noise figure	$f = 10.7\text{ MHz}$ ; $G_S = 20\text{ mS}$ ; $B_S = 0$	–	4	–	dB
		$f = 400\text{ MHz}$ ; $Y_S = Y_{S(opt)}$	–	1.1	1.7	dB
		$f = 800\text{ MHz}$ ; $Y_S = Y_{S(opt)}$	–	1.2	1.9	dB
$X_{mod}$	cross-modulation	input level for $k = 1\%$ at 0 dB AGC; $f_w = 50\text{ MHz}$ ; $f_{unw} = 60\text{ MHz}$ ; note 2	90	–	–	dB $\mu$ V
		input level for $k = 1\%$ at 10 dB AGC; $f_w = 50\text{ MHz}$ ; $f_{unw} = 60\text{ MHz}$ ; note 2	–	90	–	dB $\mu$ V
		input level for $k = 1\%$ at 40 dB AGC; $f_w = 50\text{ MHz}$ ; $f_{unw} = 60\text{ MHz}$ ; note 2	98	102	–	dB $\mu$ V

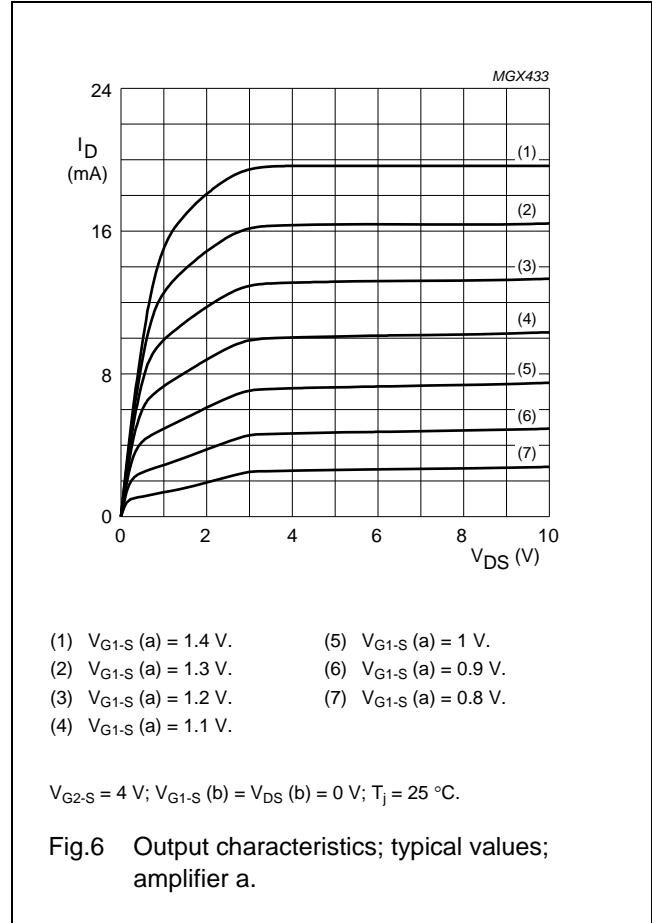
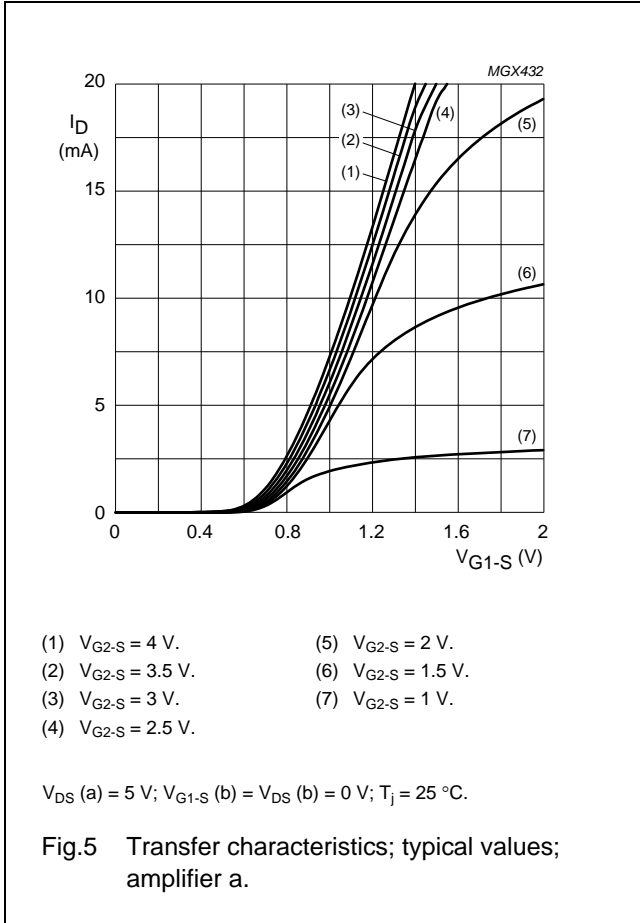
**Notes**

1. For the MOS-FET not in use:  $V_{G1-S} (b) = 0\text{ V}$ ;  $V_{DS} (b) = 0\text{ V}$ .
2. Measured in Fig.13 test circuit.

Dual N-channel dual gate MOS-FET

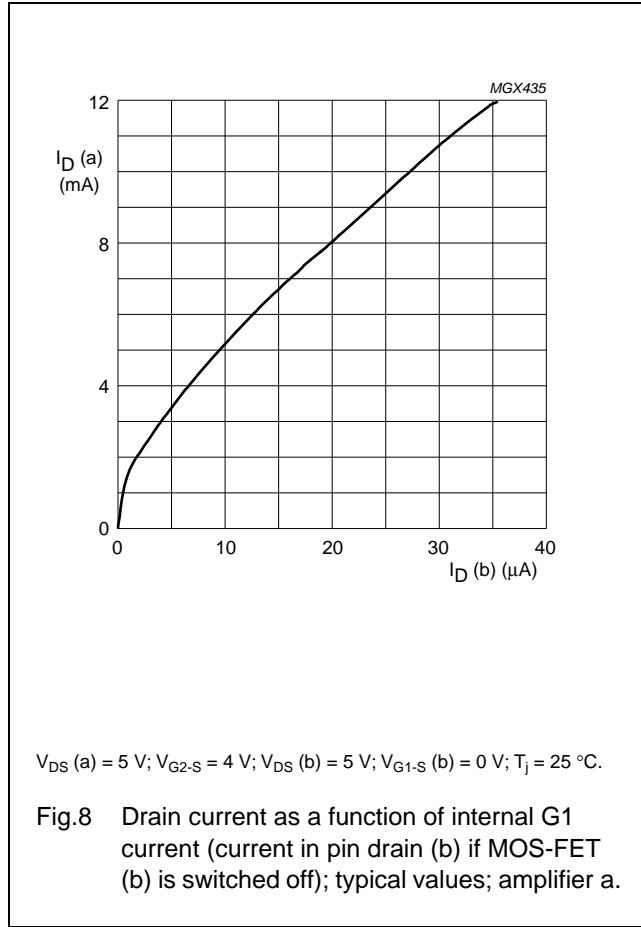
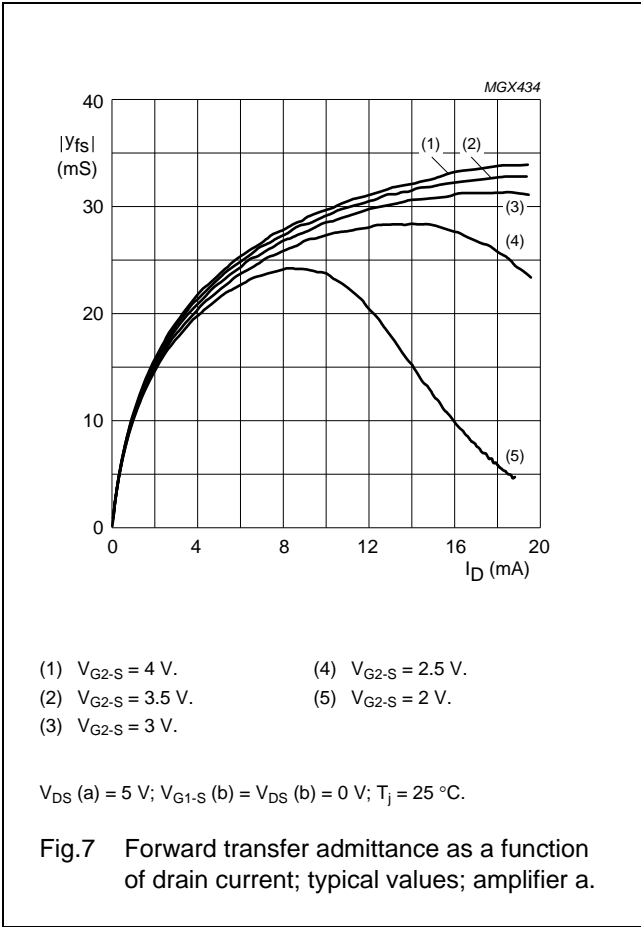
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GRAPHS FOR AMPLIFIER a



# Dual N-channel dual gate MOS-FET

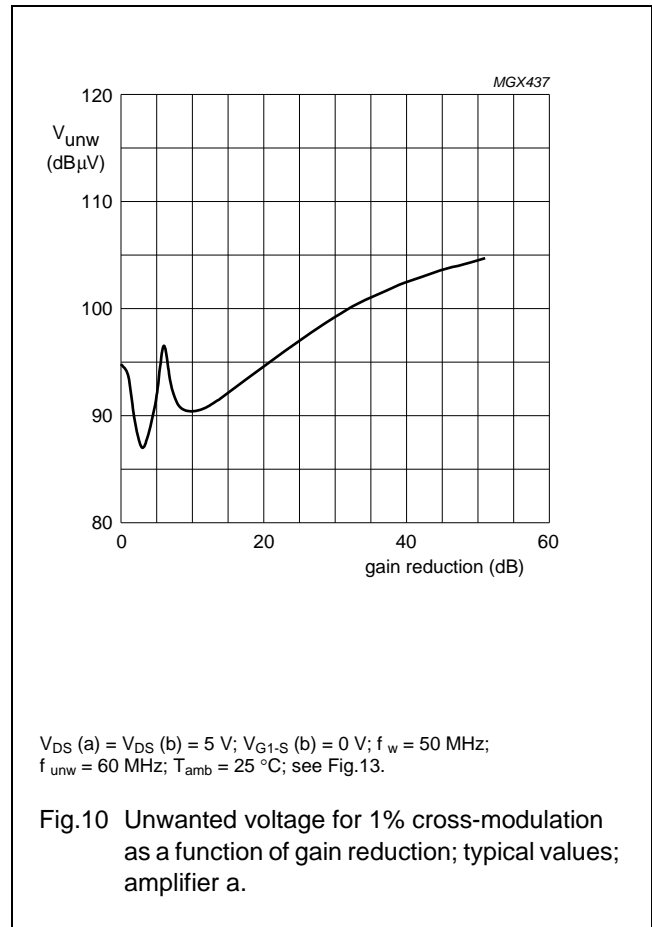
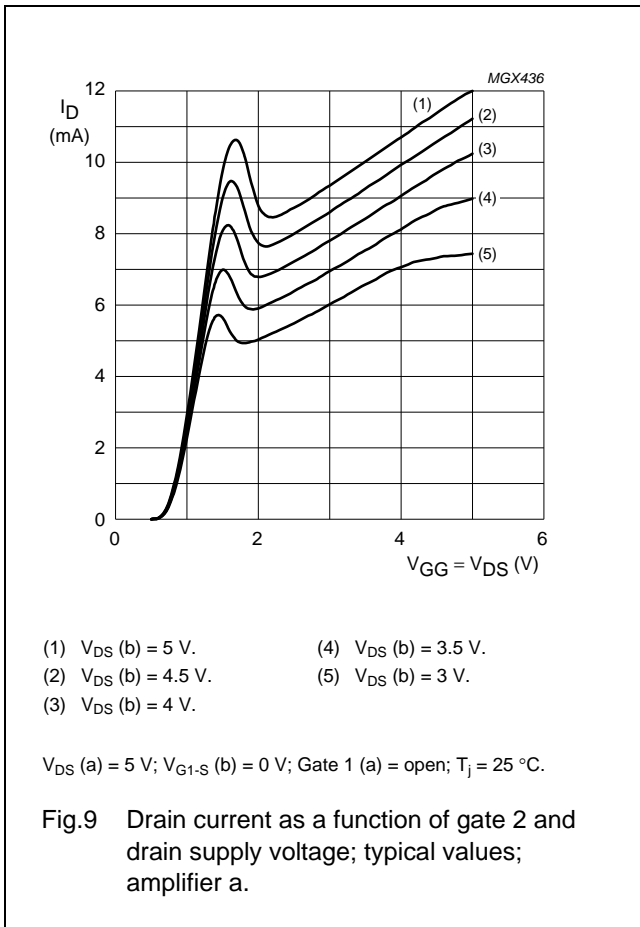
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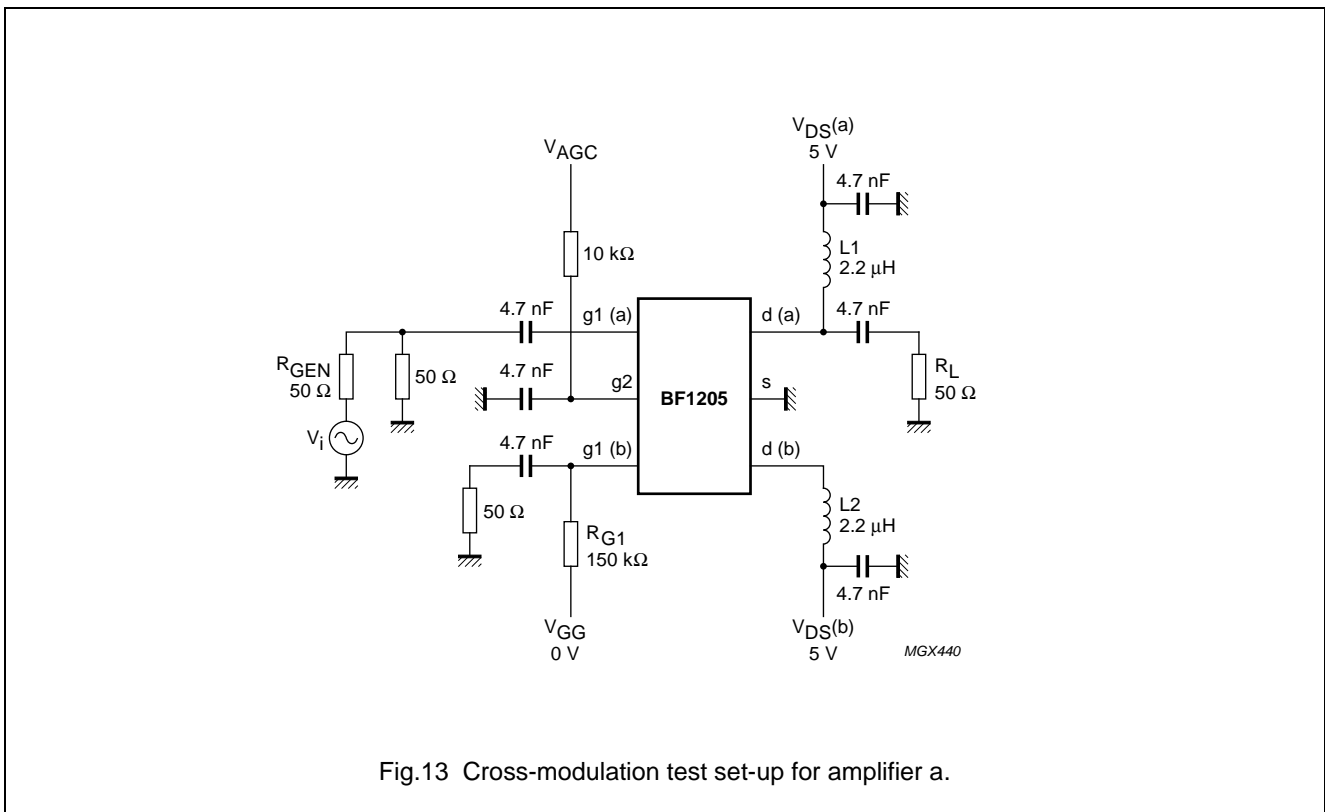
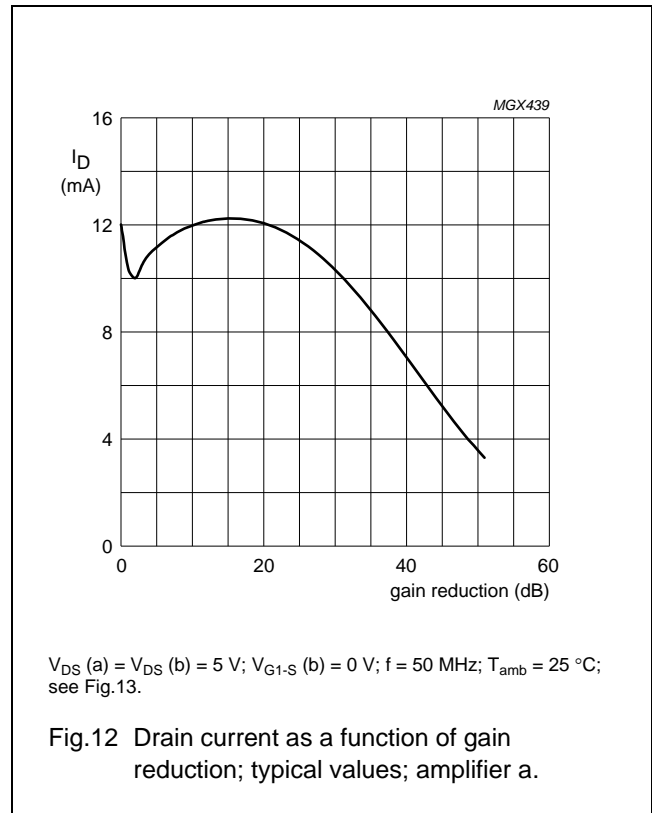
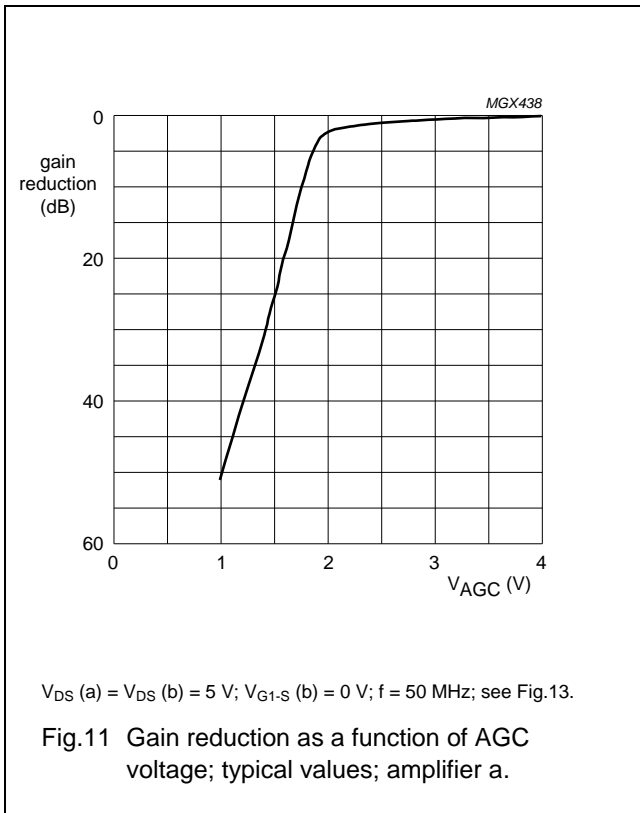
Dual N-channel dual gate MOS-FET

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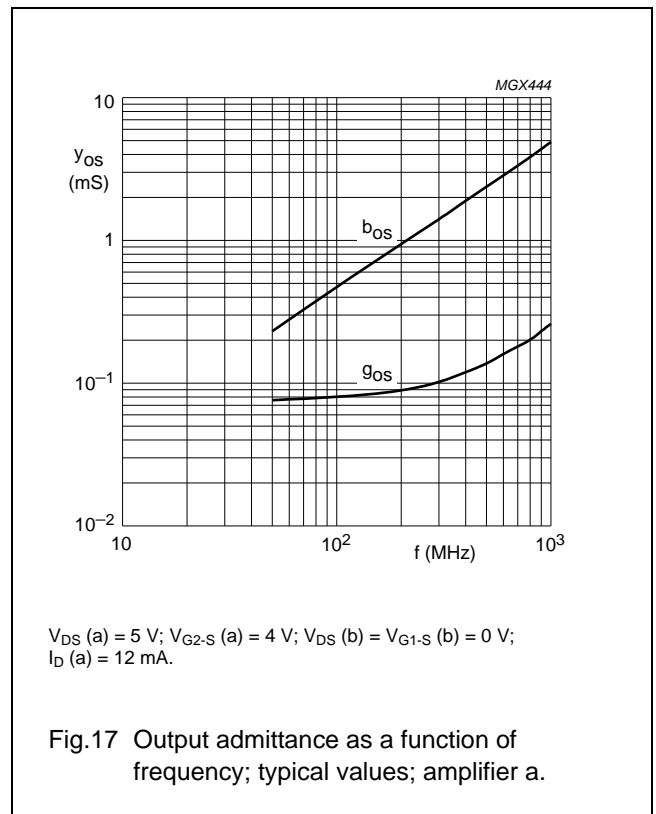
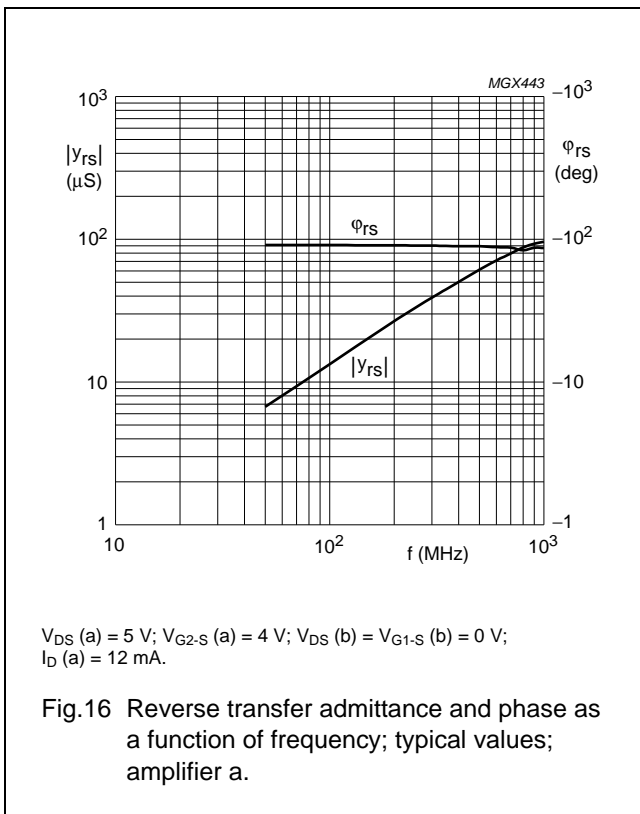
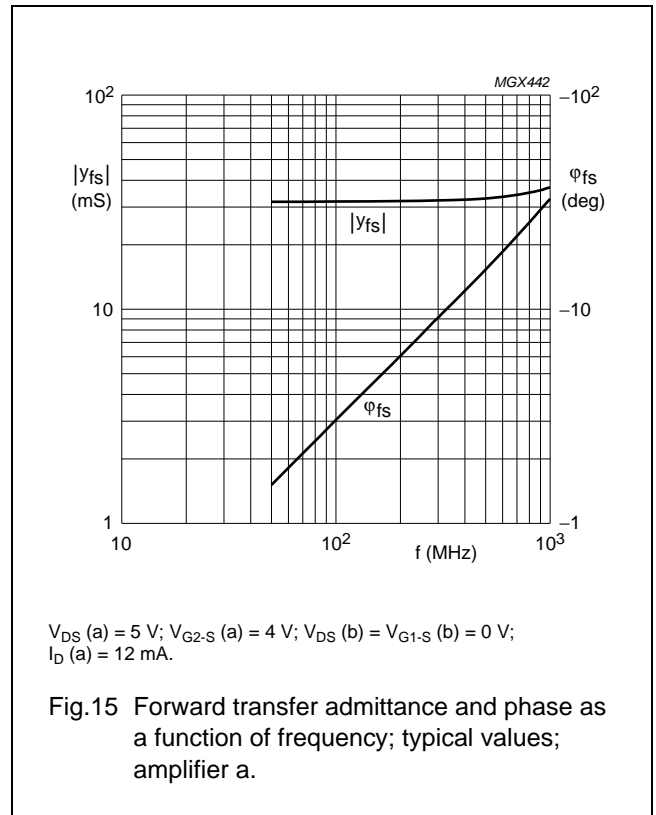
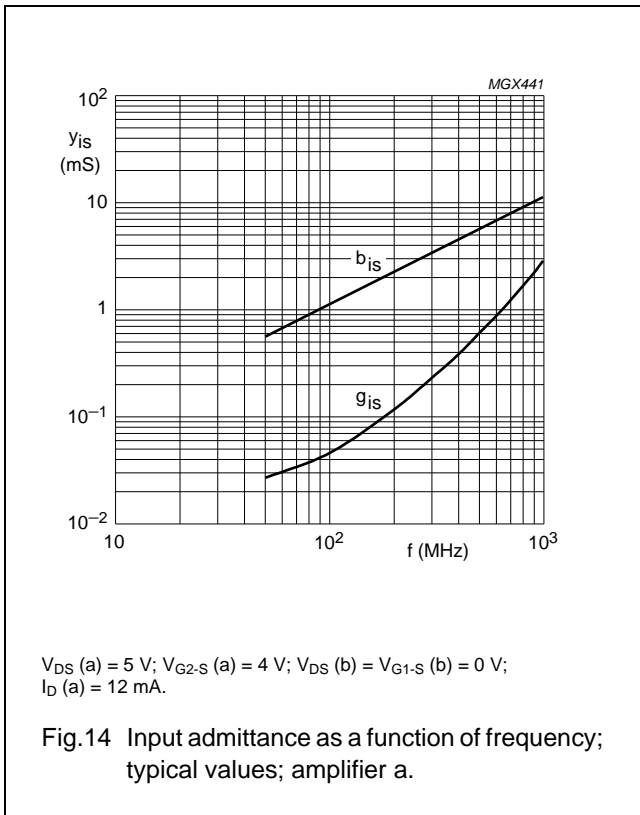
Dual N-channel dual gate MOS-FET

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Dual N-channel dual gate MOS-FET

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## Dual N-channel dual gate MOS-FET

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**Scattering parameters: amplifier a** $V_{DS} (a) = 5 \text{ V}$ ;  $V_{G2-S} = 4 \text{ V}$ ;  $I_D (a) = 12 \text{ mA}$ ;  $V_{DS} (b) = 0 \text{ V}$ ;  $V_{G-1S} (b) = 0 \text{ V}$ ;  $T_{amb} = 25 \text{ }^\circ\text{C}$ 

f (MHz)	S <sub>11</sub>		S <sub>21</sub>		S <sub>12</sub>		S <sub>22</sub>	
	MAGNITUDE (ratio)	ANGLE (deg)	MAGNITUDE (ratio)	ANGLE (deg)	MAGNITUDE (ratio)	ANGLE (deg)	MAGNITUDE (ratio)	ANGLE (deg)
50	0.997	-3.70	3.15	175.99	0.00067	86.39	0.992	-1.38
100	0.995	-7.37	3.15	171.92	0.00132	84.34	0.991	-2.83
200	0.988	-14.64	3.12	163.99	0.00262	79.71	0.990	-5.62
300	0.976	-21.85	3.09	156.06	0.00373	75.29	0.988	-8.40
400	0.963	-28.95	3.04	148.32	0.00471	71.43	0.985	-11.15
500	0.944	-35.98	2.99	140.52	0.00557	66.89	0.982	-13.88
600	0.924	-42.90	2.94	132.88	0.00624	63.52	0.978	-16.65
700	0.900	-49.77	2.87	125.30	0.00669	60.09	0.975	-19.35
800	0.874	-56.61	2.81	117.79	0.00701	59.58	0.972	-22.08
900	0.846	-63.18	2.73	110.29	0.00705	52.42	0.968	-24.87
1000	0.817	-69.84	2.65	102.91	0.00688	49.17	0.965	-27.63

**Noise data** $V_{DS} (a) = 5 \text{ V}$ ;  $V_{G2-S} = 4 \text{ V}$ ;  $I_D (a) = 12 \text{ mA}$ ;  $V_{DS} (b) = 0 \text{ V}$ ;  $V_{G-1S} (b) = 0 \text{ V}$ ;  $T_{amb} = 25 \text{ }^\circ\text{C}$ 

f (MHz)	F MIN (dB)	GAMMA OPT		Rn ( $\Omega$ )
		(ratio)	(deg)	
400	1.1	0.719	16.16	31.18
800	1.2	0.628	32.7	29.74

**DYNAMIC CHARACTERISTICS AMPLIFIER b**Common source;  $T_{amb} = 25 \text{ }^\circ\text{C}$ ;  $V_{G2-S} = 4 \text{ V}$ ;  $V_{DS} = 5 \text{ V}$ ;  $I_D = 12 \text{ mA}$ 

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$ y_{fs} $	forward transfer admittance	$T_j = 25 \text{ }^\circ\text{C}$	26	31	40	mS
$C_{ig1-ss}$	input capacitance at gate 1	$f = 1 \text{ MHz}$	–	2.0	2.5	pF
$C_{ig2-ss}$	input capacitance at gate 2	$f = 1 \text{ MHz}$	–	3.3	–	pF
$C_{oss}$	output capacitance	$f = 1 \text{ MHz}$	–	0.85	–	pF
$C_{rss}$	reverse transfer capacitance	$f = 1 \text{ MHz}$	–	20	–	fF
$G_{tr}$	power gain	$f = 200 \text{ MHz}$ ; $G_S = 2 \text{ mS}$ ; $B_S = B_{S(opt)}$ ; $G_L = 0.5 \text{ mS}$ ; $B_L = B_{L(opt)}$ ; note 1	30	34	38	dB
		$f = 400 \text{ MHz}$ ; $G_S = 2 \text{ mS}$ ; $B_S = B_{S(opt)}$ ; $G_L = 1 \text{ mS}$ ; $B_L = B_{L(opt)}$ ; note 1	27	31	35	dB
		$f = 800 \text{ MHz}$ ; $G_S = 3.3 \text{ mS}$ ; $B_S = B_{S(opt)}$ ; $G_L = 1 \text{ mS}$ ; $B_L = B_{L(opt)}$ ; note 1	22	26	30	dB
NF	noise figure	$f = 10.7 \text{ MHz}$ ; $G_S = 20 \text{ mS}$ ; $B_S = 0$	–	4	–	dB
		$f = 400 \text{ MHz}$ ; $Y_S = Y_{S(opt)}$	–	1.3	1.9	dB
		$f = 800 \text{ MHz}$ ; $Y_S = Y_{S(opt)}$	–	1.4	2.1	dB

Dual N-channel dual gate MOS-FET

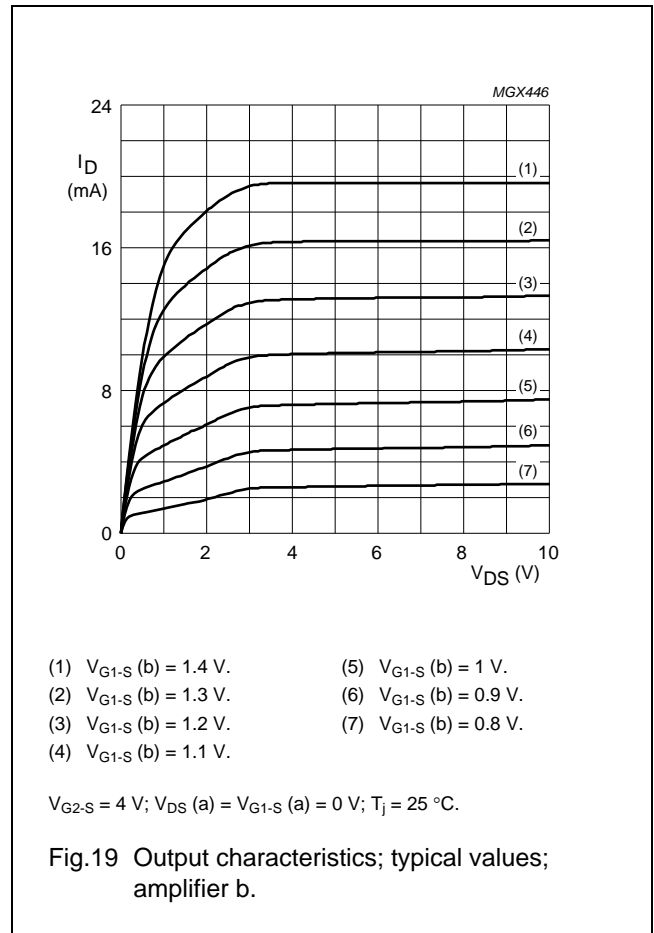
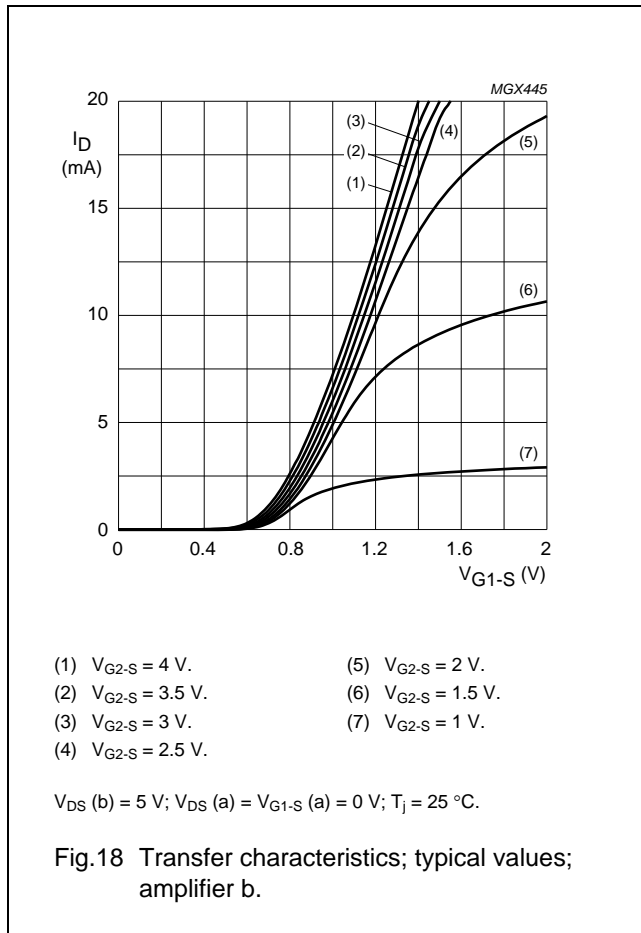
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SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$X_{mod}$	cross-modulation	input level for $k = 1\%$ at 0 dB AGC; $f_w = 50$ MHz; $f_{unw} = 60$ MHz; note 2	90	–	–	$\text{dB}\mu\text{V}$
		input level for $k = 1\%$ at 10 dB AGC; $f_w = 50$ MHz; $f_{unw} = 60$ MHz; note 2	–	92	–	$\text{dB}\mu\text{V}$
		input level for $k = 1\%$ at 40 dB AGC; $f_w = 50$ MHz; $f_{unw} = 60$ MHz; note 2	100	105	–	$\text{dB}\mu\text{V}$

Notes

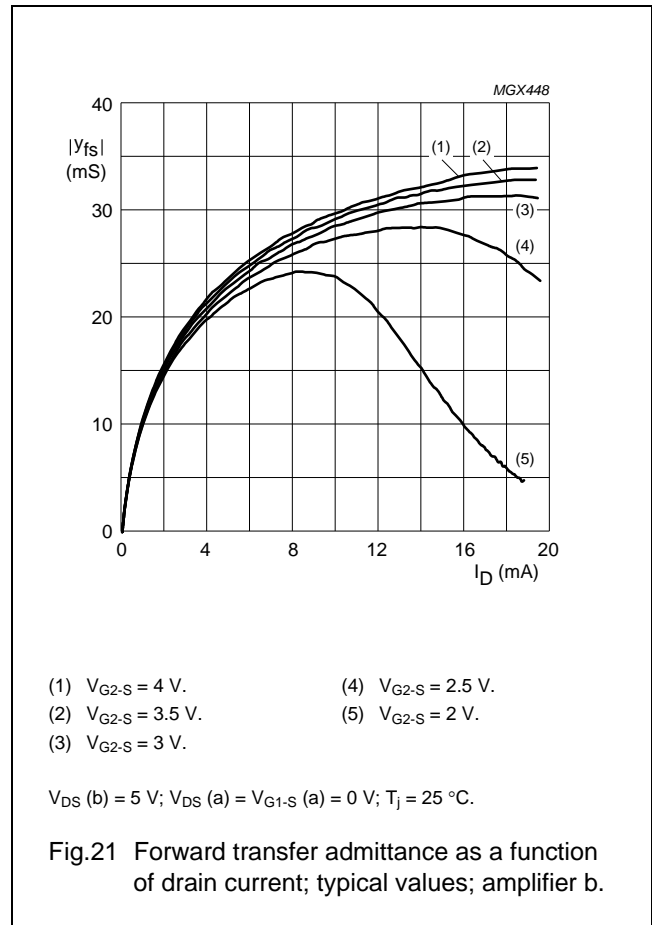
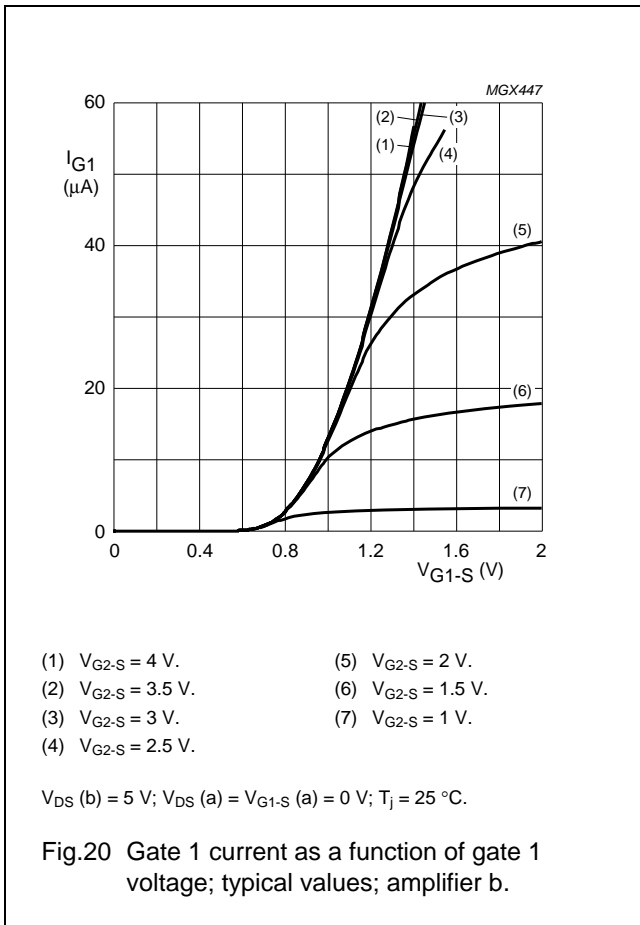
- For the MOS-FET not in use:  $V_{G1-S} (a) = 0$ ;  $V_{DS} (a) = 0$ .
- Measured in test circuit Fig.30.

GRAPHS FOR AMPLIFIER b



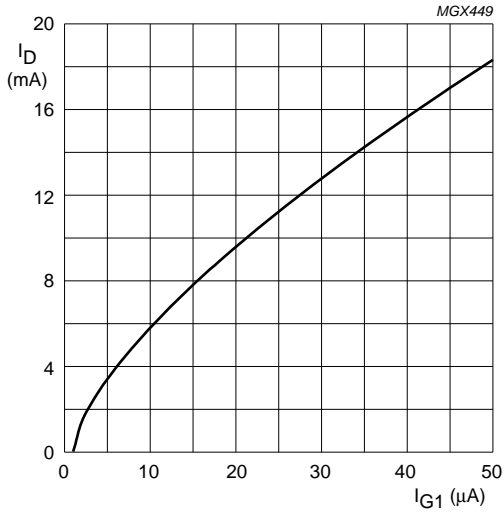
Dual N-channel dual gate MOS-FET

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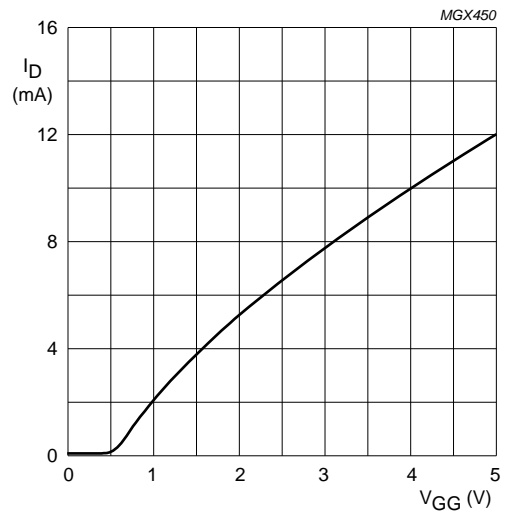
Dual N-channel dual gate MOS-FET

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$V_{DS} (b) = 5 V$ ;  $V_{G2-S} = 4 V$ ;  $V_{DS} (a) = V_{G1-S} (a) = 0 V$ ;  $T_j = 25^\circ C$ .

Fig.22 Drain current as a function of gate 1 current; typical values; amplifier b.

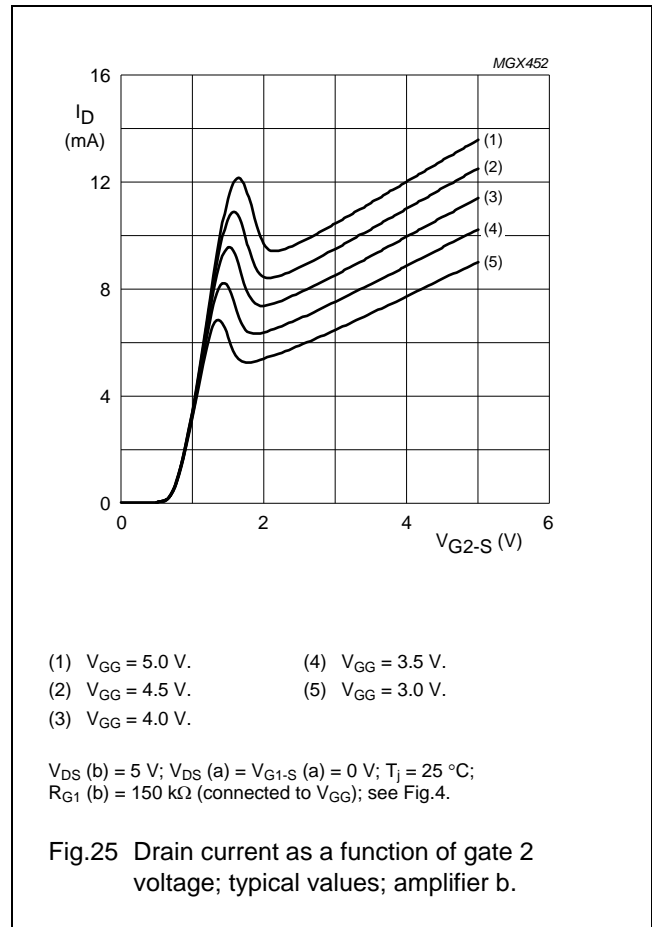
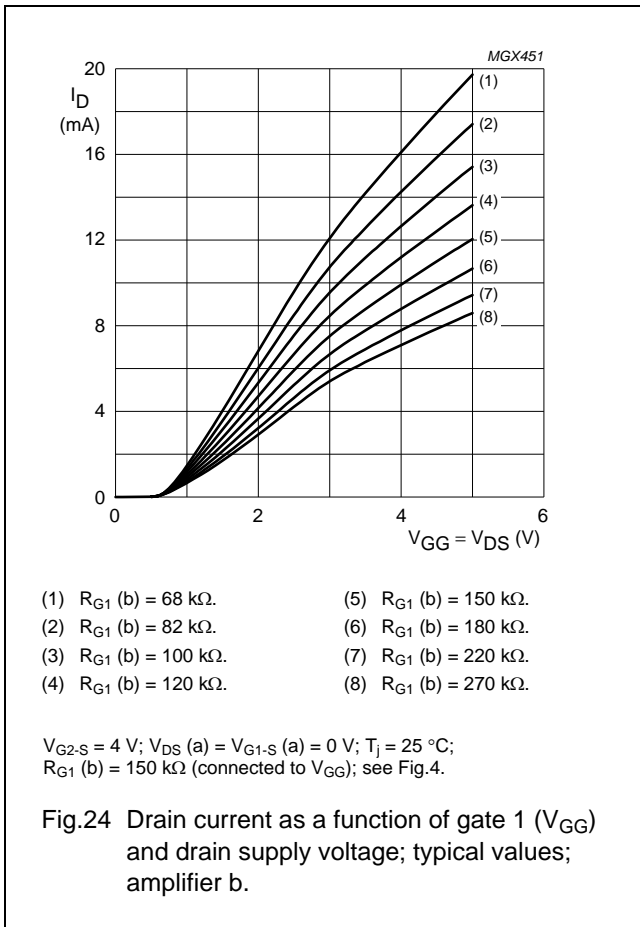


$V_{DS} (b) = 5 V$ ;  $V_{G2-S} = 4 V$ ;  $V_{DS} (a) = V_{G1-S} (a) = 0 V$ ;  
 $T_j = 25^\circ C$ ;  $R_{G1} (b) = 150 k\Omega$  (connected to  $V_{GG}$ ); see Fig.4.

Fig.23 Drain current as a function of gate 1 supply voltage ( $V_{GG}$ ); typical values; amplifier b.

Dual N-channel dual gate MOS-FET

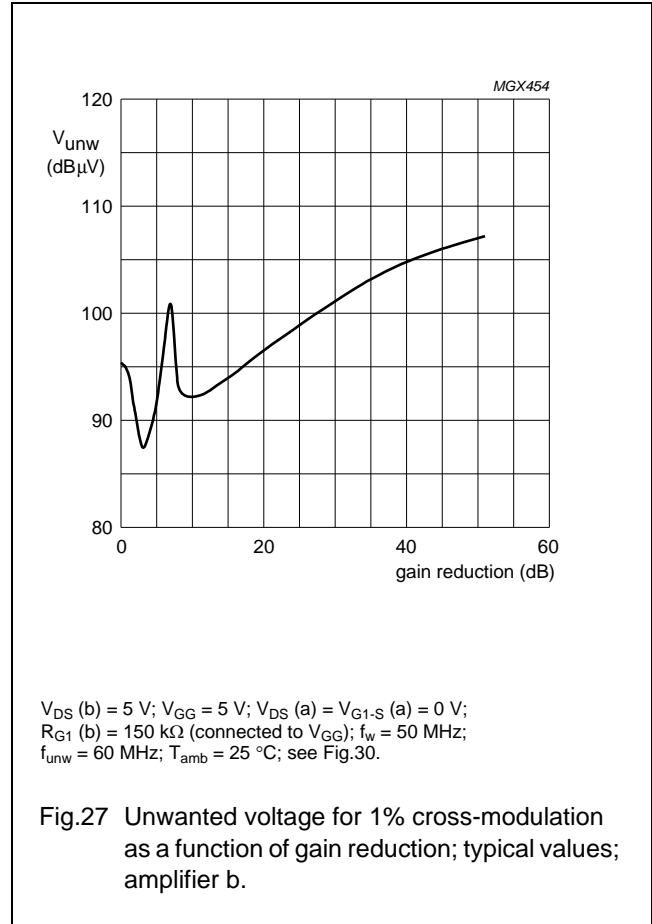
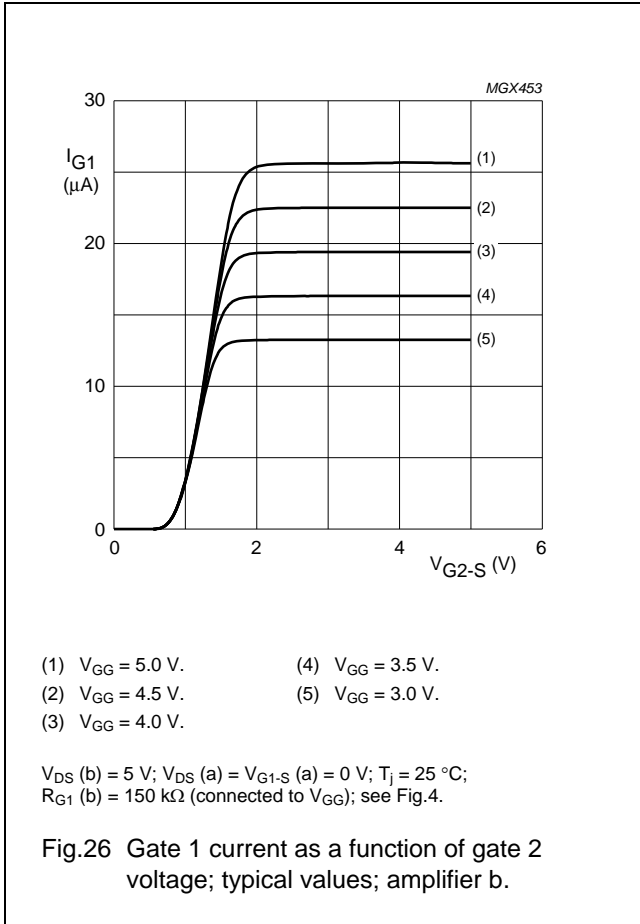
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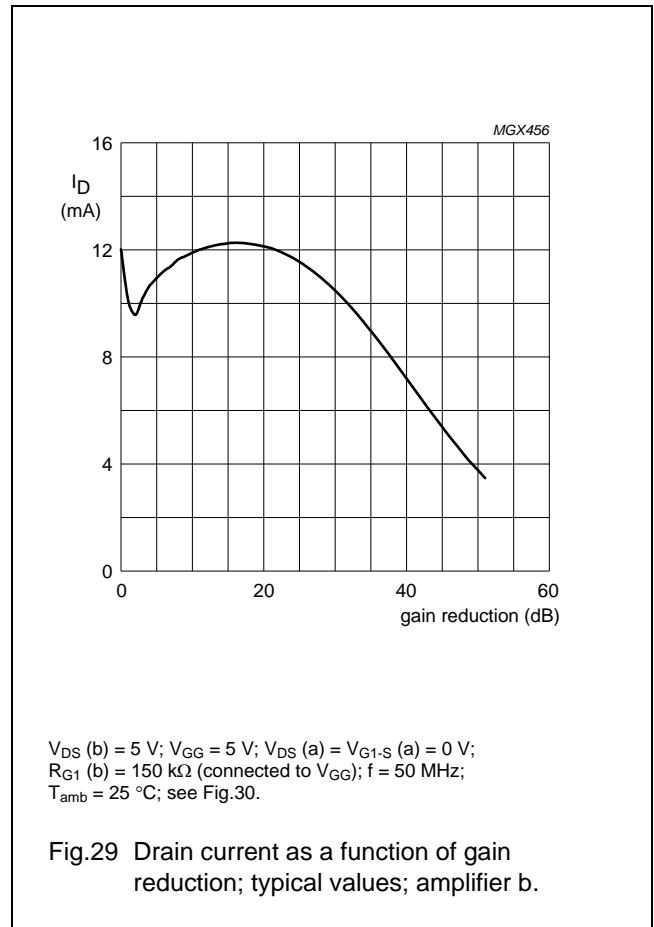
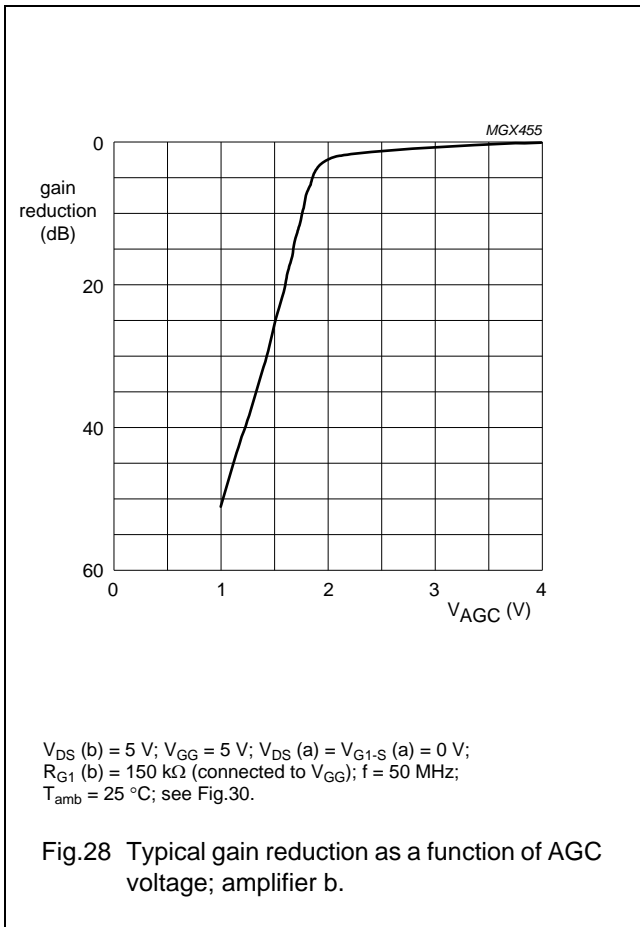
Dual N-channel dual gate MOS-FET

BF1205



Dual N-channel dual gate MOS-FET

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Dual N-channel dual gate MOS-FET

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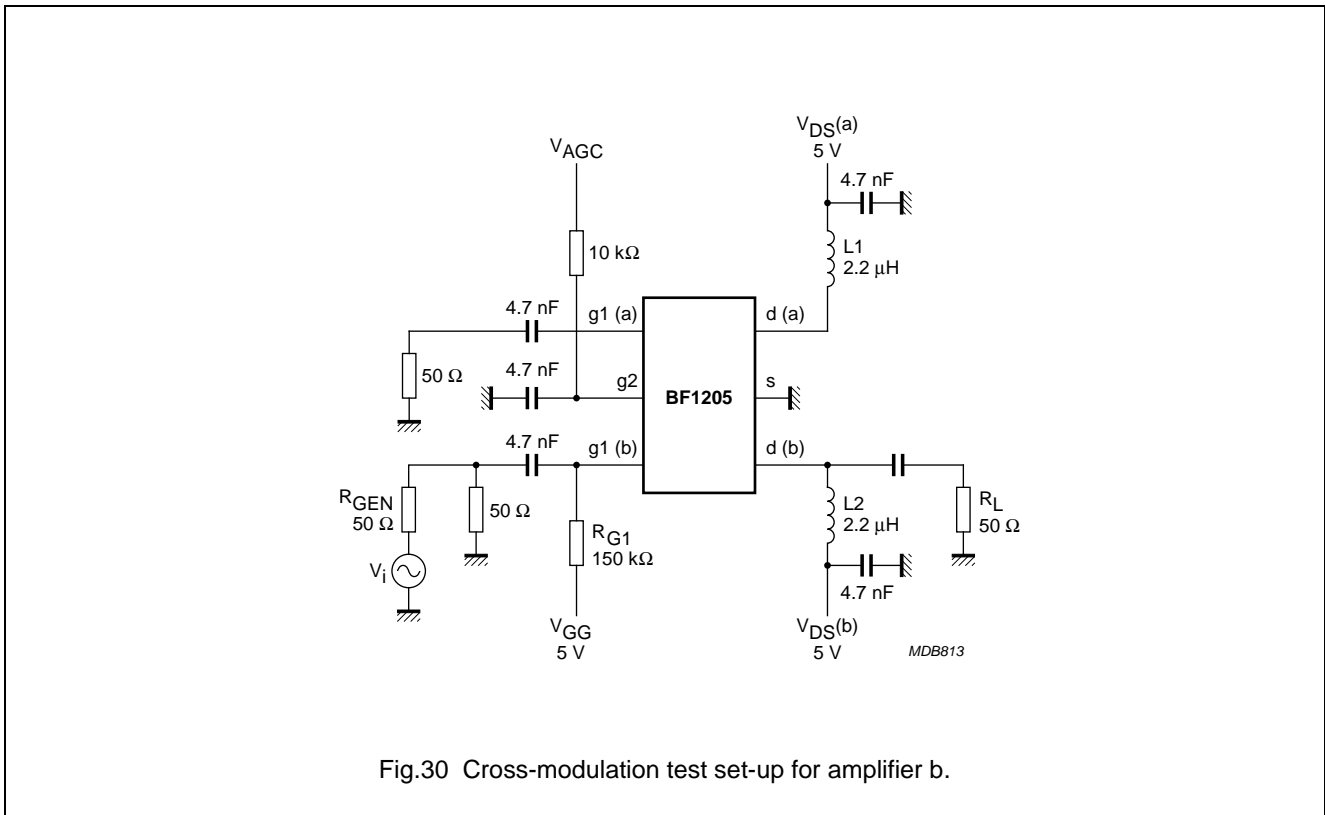
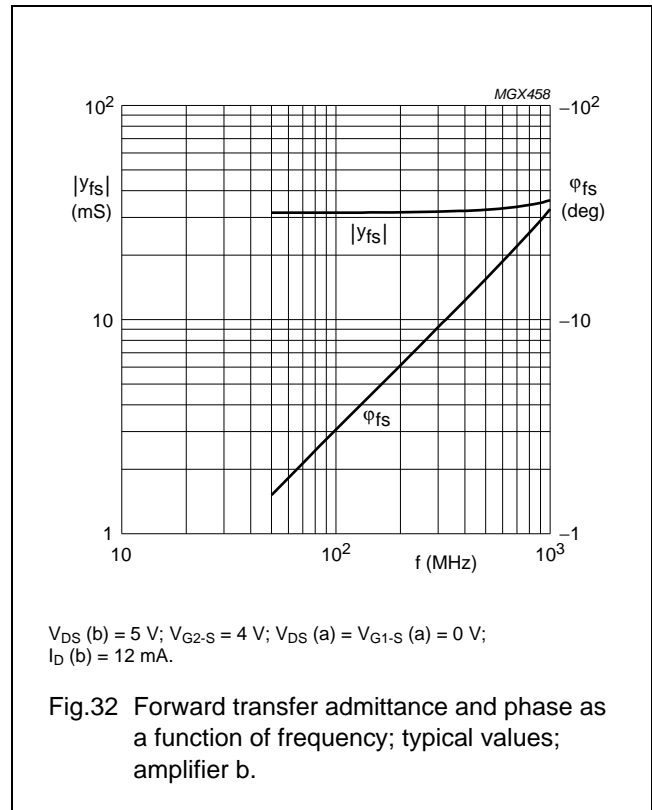
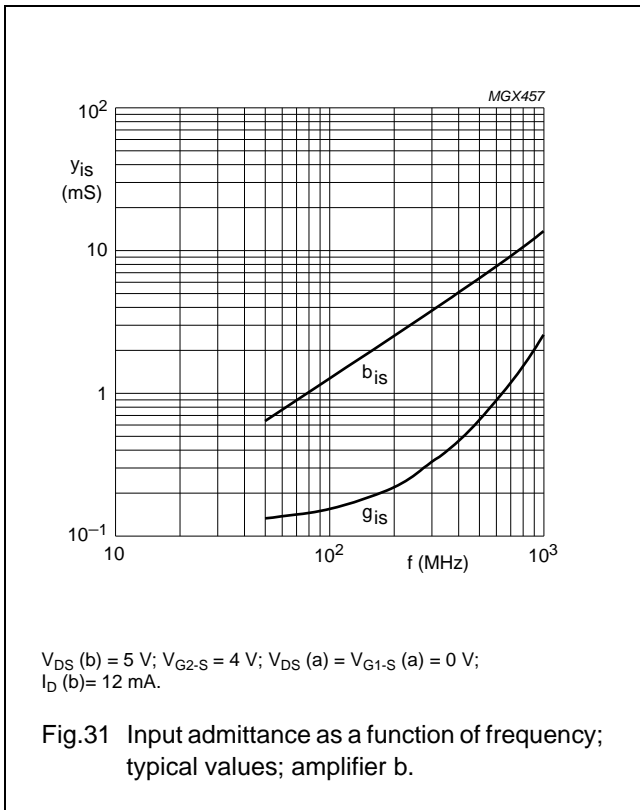
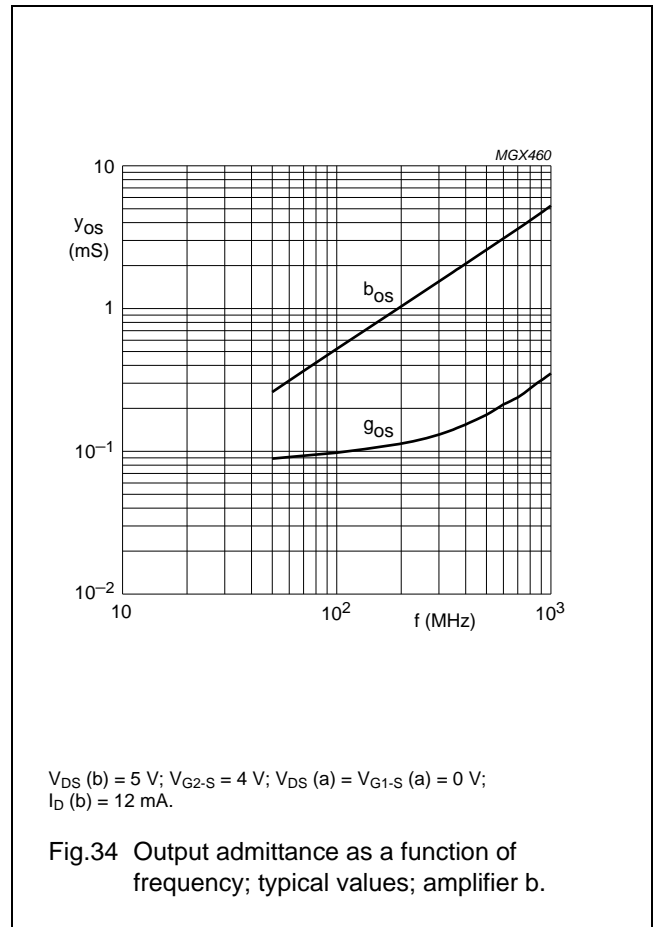
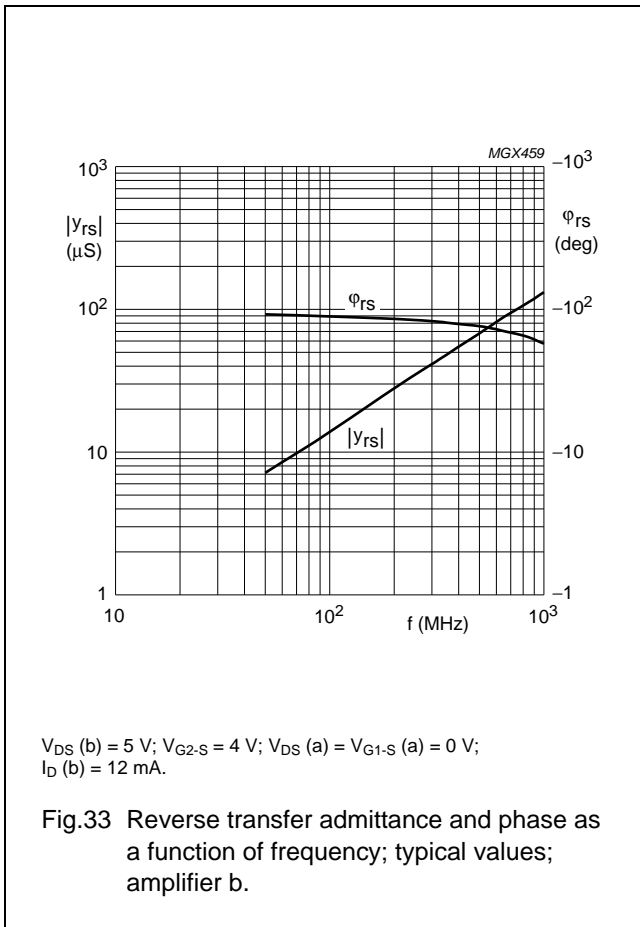


Fig.30 Cross-modulation test set-up for amplifier b.



Dual N-channel dual gate MOS-FET

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## Dual N-channel dual gate MOS-FET

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**Scattering parameters: amplifier b** $V_{DS}(b) = 5\text{ V}$ ;  $V_{G2-S} = 4\text{ V}$ ;  $I_D(b) = 12\text{ mA}$ ;  $V_{DS}(a) = 0\text{ V}$ ;  $V_{G1-S}(a) = 0\text{ V}$ ;  $T_{amb} = 25\text{ °C}$ 

f (MHz)	S <sub>11</sub>		S <sub>21</sub>		S <sub>12</sub>		S <sub>22</sub>	
	MAGNITUDE (ratio)	ANGLE (deg)	MAGNITUDE (ratio)	ANGLE (deg)	MAGNITUDE (ratio)	ANGLE (deg)	MAGNITUDE (ratio)	ANGLE (deg)
50	0.987	-3.76	3.12	175.87	0.00071	85.43	0.991	-1.56
100	0.985	-7.38	3.11	171.77	0.00136	86.06	0.989	-3.11
200	0.978	-14.63	3.09	163.72	0.00272	84.25	0.988	-6.16
300	0.968	-21.82	3.06	155.67	0.00396	82.63	0.986	-9.17
400	0.956	-28.92	3.01	147.79	0.00509	81.35	0.983	-12.17
500	0.941	-35.99	2.95	139.86	0.00616	79.46	0.973	-15.16
600	0.924	-42.93	2.89	132.06	0.00710	78.57	0.975	-18.15
700	0.905	-49.89	2.83	124.31	0.00791	77.88	0.972	-21.07
800	0.884	-56.57	2.75	116.69	0.00848	76.72	0.968	-24.08
900	0.861	-63.36	2.67	108.97	0.00900	76.55	0.964	-27.03
1000	0.837	-70.05	2.59	101.39	0.00941	76.67	0.959	-30.02

**Noise data** $V_{DS}(b) = 5\text{ V}$ ;  $V_{G2-S} = 4\text{ V}$ ;  $I_D(b) = 12\text{ mA}$ ;  $V_{DS}(a) = 0\text{ V}$ ;  $V_{G1-S}(a) = 0\text{ V}$ ;  $T_{amb} = 25\text{ °C}$ 

f (MHz)	F MIN (dB)	F MIN (dB)		R <sub>n</sub> (Ω)
		(ratio)	(deg)	
400	1.3	0.662	16.76	31.55
800	1.4	0.578	33.97	30.53

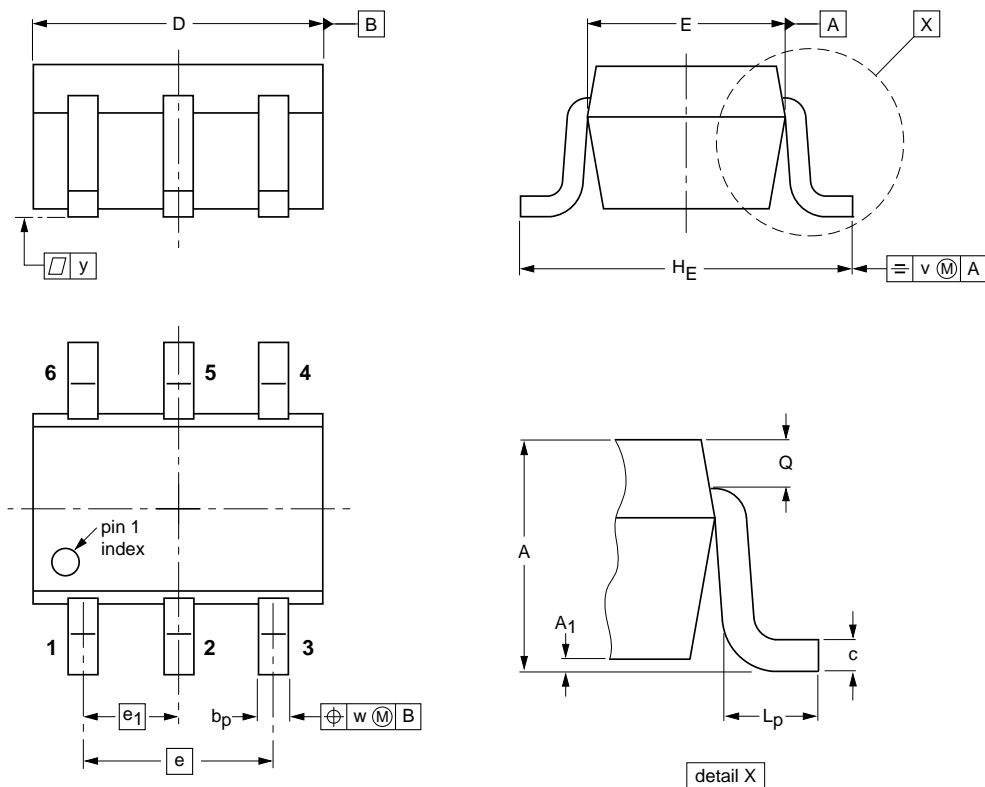
# Dual N-channel dual gate MOS-FET

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## PACKAGE OUTLINE

Plastic surface-mounted package; 6 leads

SOT363



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

UNIT	A	A <sub>1</sub> max	b <sub>p</sub>	c	D	E	e	e <sub>1</sub>	H <sub>E</sub>	L <sub>p</sub>	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

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## DATA SHEET STATUS

DOCUMENT STATUS <sup>(1)</sup>	PRODUCT STATUS <sup>(2)</sup>	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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