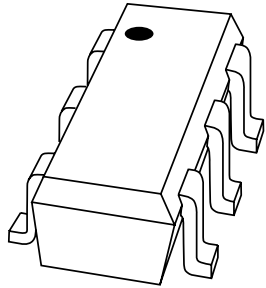


DATA SHEET



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

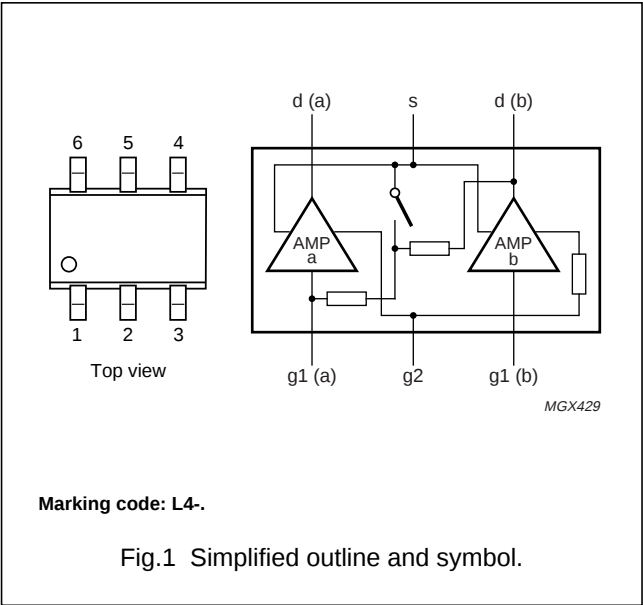
- Gain controlled low noise amplifiers for VHF and UHF applications with 5 V supply voltage, such as digital and analog television tuners and professional communications equipment.

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

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QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Per MOS-FET; unless otherwise specified						
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 μ V
		amp. b: input level for $k = 1\%$ at 40 dB AGC	100	105	–	dB μ 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. For further information, refer to Philips specs.: SNW-EQ-608, SNW-FQ-302A and SNW-FQ-302B.

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		–	10	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	$T_s \leq 102\text{ }^{\circ}\text{C}$; note	–	200	mW
T_{stg}	storage temperature		–65	+150	$^{\circ}\text{C}$
T_j	junction temperature		–	150	$^{\circ}\text{C}$

Note

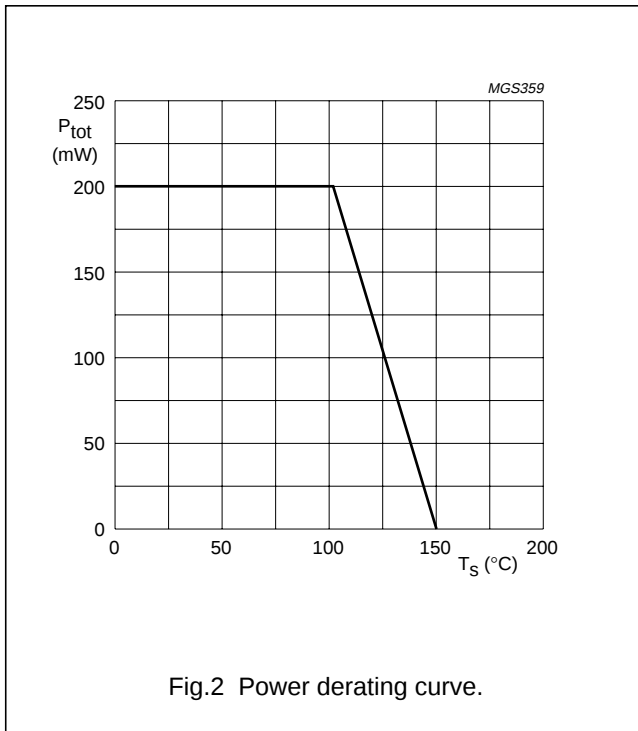
1. T_s is the temperature at the soldering point of the source lead.

THERMAL CHARACTERISTICS

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

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STATIC CHARACTERISTICS

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

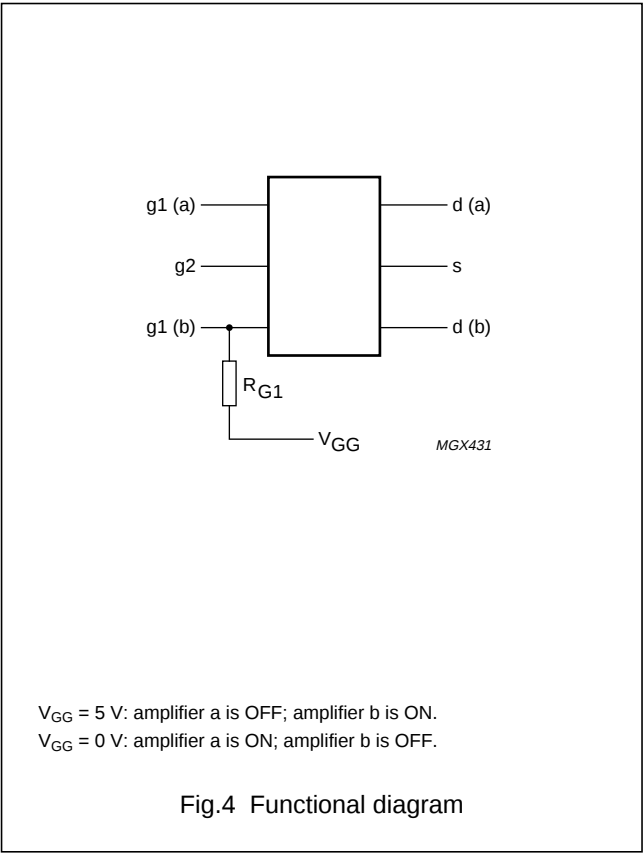
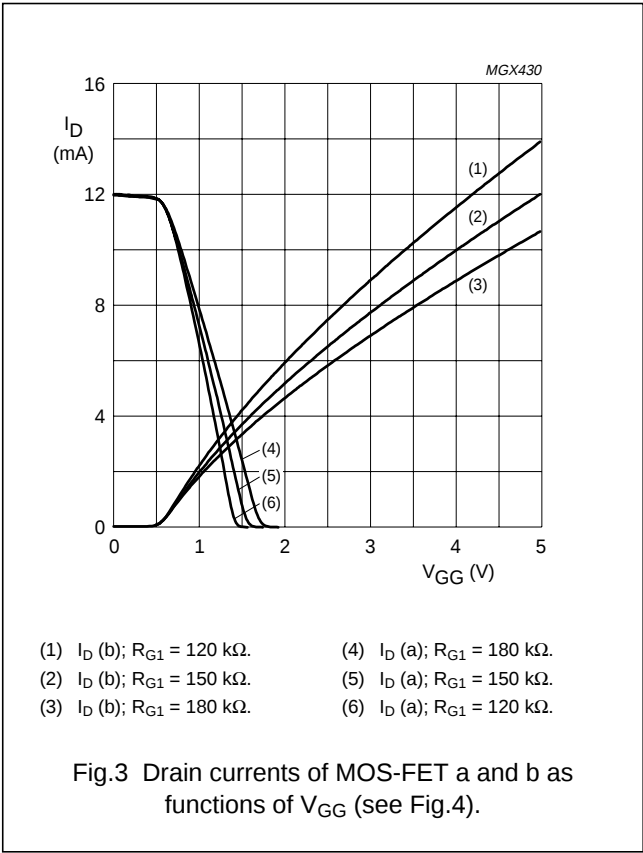
SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
$V_{(BR)DS}$	drain-source breakdown voltage	amp. a: $V_{G1-S} = V_{G2-S} = 0\text{ V}$; $I_D = 10\text{ }\mu\text{A}$	10	–	V
		amp. b: $V_{G1-S} = V_{G2-S} = 0\text{ V}$; $I_D = 10\text{ }\mu\text{A}$	7	–	V
$V_{(BR)G1-SS}$	gate-source breakdown voltage	$V_{GS} = V_{DS} = 0\text{ V}$; $I_{G1-S} = 10\text{ mA}$	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	$V_{DS} = 5\text{ V}$; $V_{G2-S} = 4\text{ V}$; $I_D = 100\text{ }\mu\text{A}$	0.3	1	V
$V_{G2-S(th)}$	gate-source threshold voltage	$V_{DS} = 5\text{ V}$; $V_{G1-S} = 5\text{ V}$; $I_D = 100\text{ }\mu\text{A}$	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

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

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

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	$f = 1\text{ MHz}$	–	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 μ V
		input level for $k = 1\%$ at 10 dB AGC; $f_w = 50\text{ MHz}$; $f_{unw} = 60\text{ MHz}$; note 2	–	90	–	dB μ 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 μ V

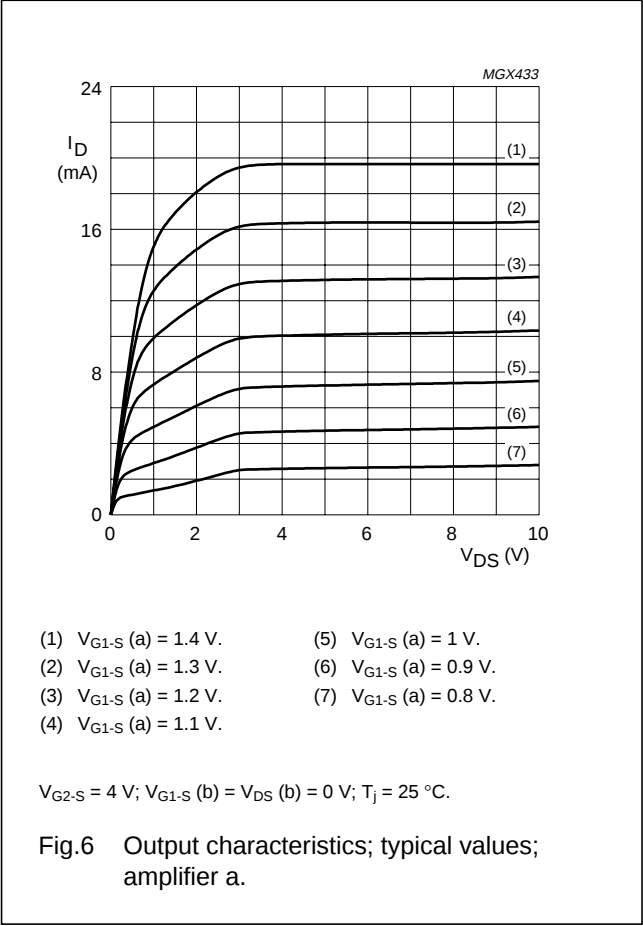
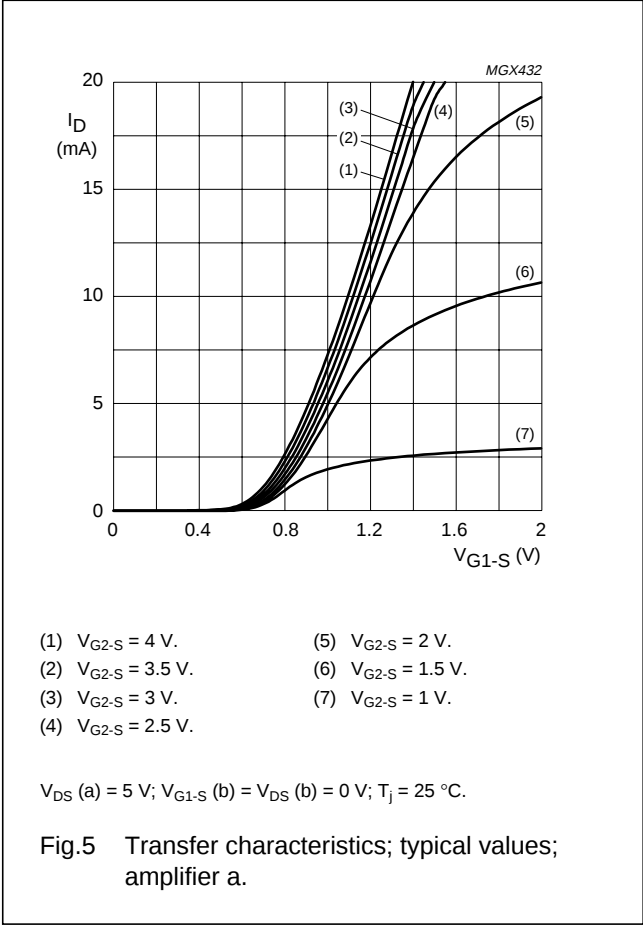
Notes

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

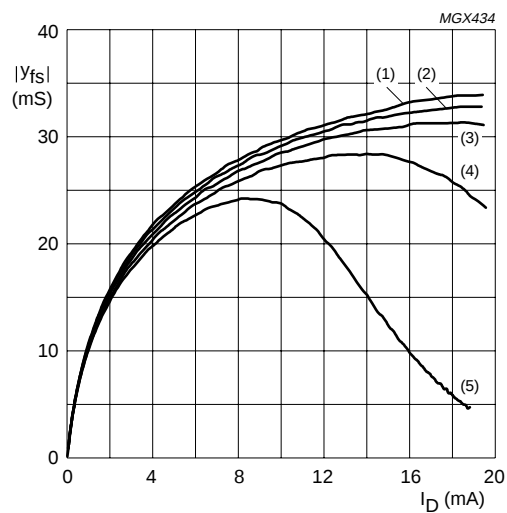
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GRAPHS FOR AMPLIFIER a



Dual N-channel dual gate MOS-FET

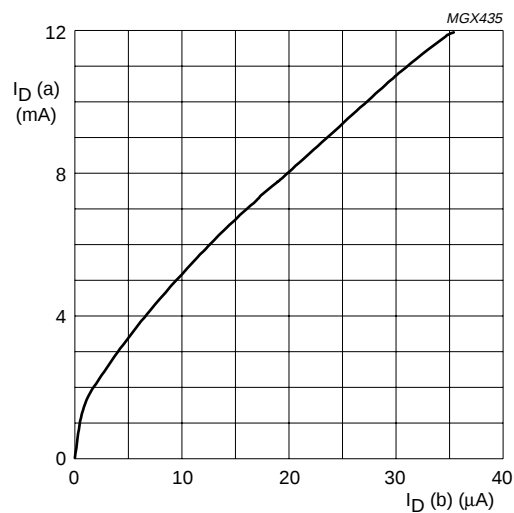
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- (1) $V_{G2-S} = 4\text{ V}$.
- (2) $V_{G2-S} = 3.5\text{ V}$.
- (3) $V_{G2-S} = 3\text{ V}$.
- (4) $V_{G2-S} = 2.5\text{ V}$.
- (5) $V_{G2-S} = 2\text{ V}$.

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

Fig.7 Forward transfer admittance as a function of drain current; typical values; amplifier a.

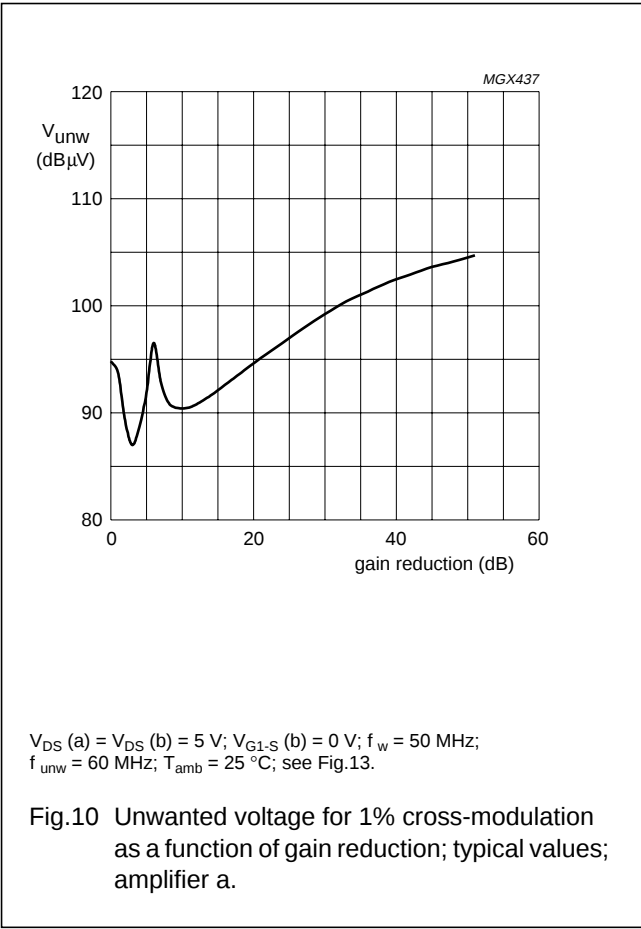
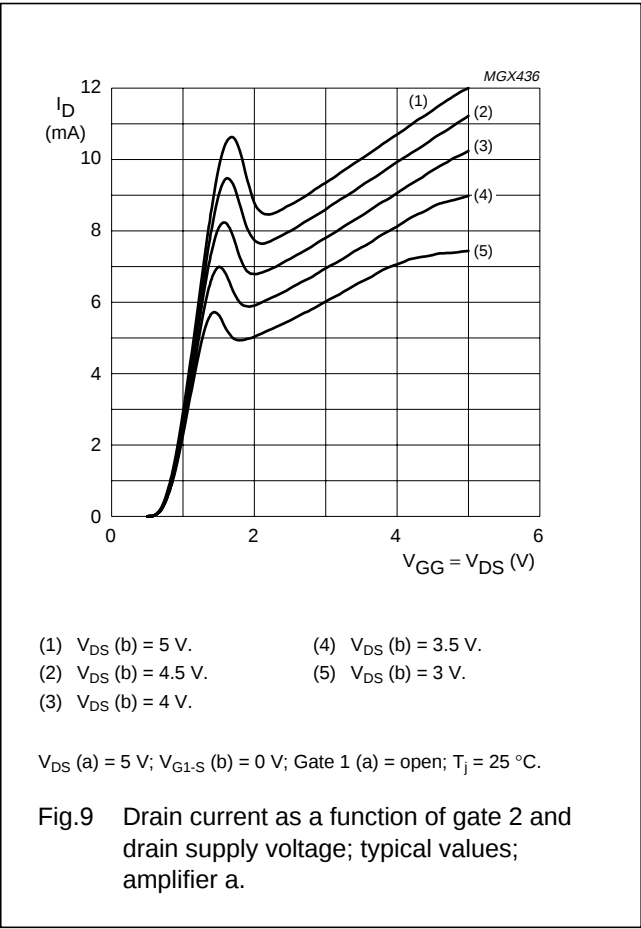


$V_{DS} (a) = 5\text{ V}$; $V_{G2-S} = 4\text{ V}$; $V_{DS} (b) = 5\text{ V}$; $V_{G1-S} (b) = 0\text{ V}$; $T_j = 25\text{ }^{\circ}\text{C}$.

Fig.8 Drain current as a function of internal G1 current (current in pin drain (b) if MOS-FET (b) is switched off); typical values; amplifier a.

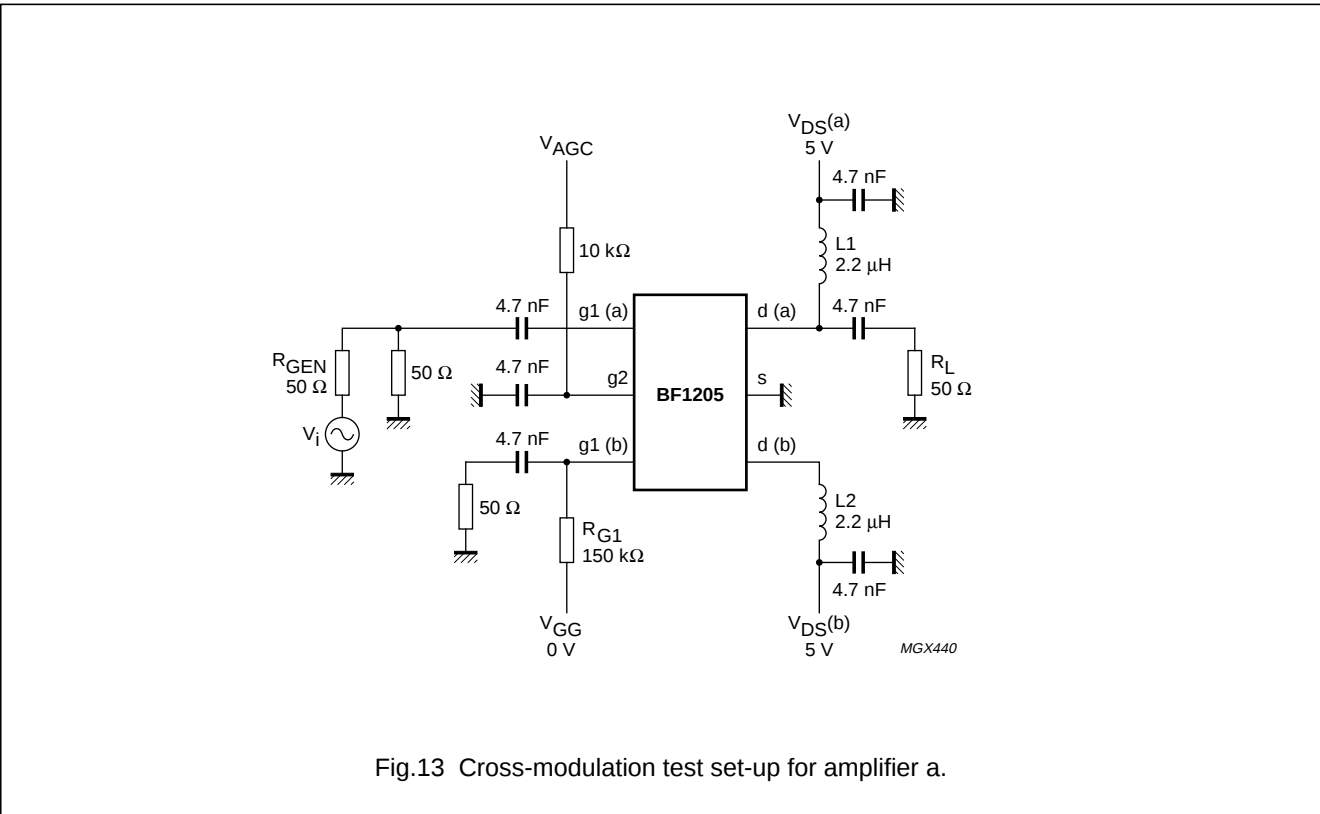
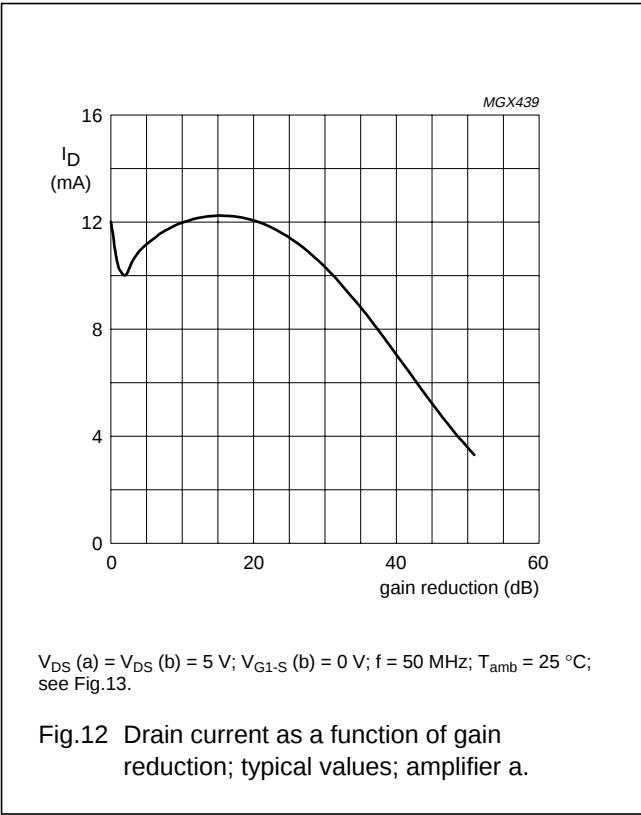
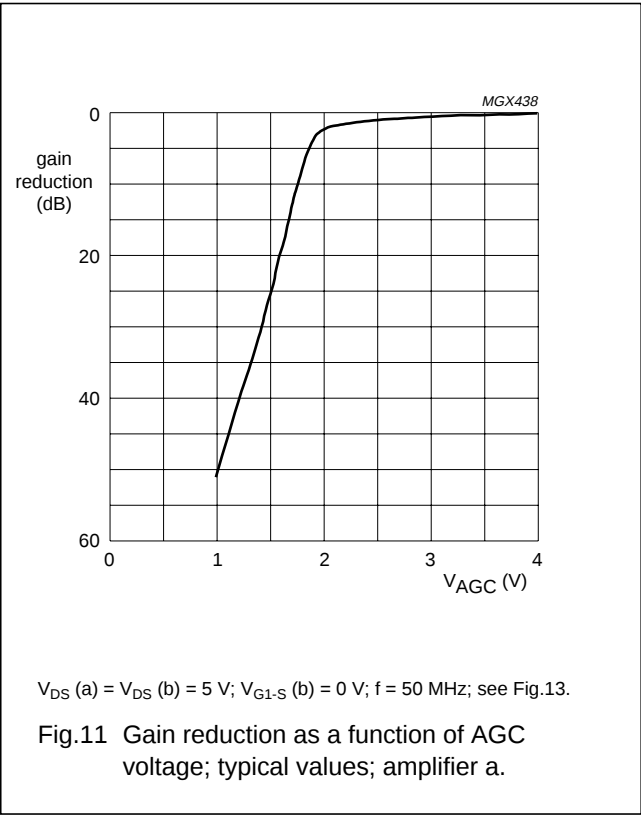
Dual N-channel dual gate MOS-FET

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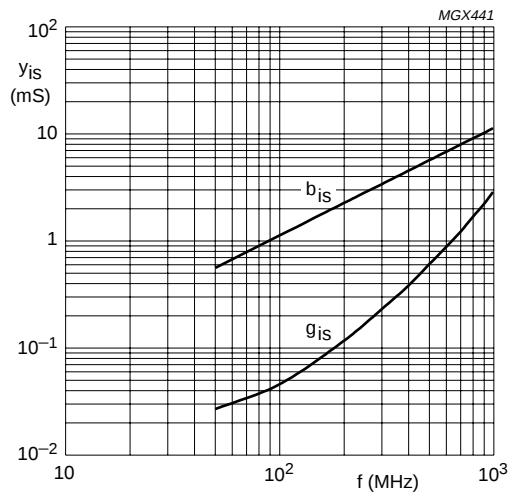
Dual N-channel dual gate MOS-FET

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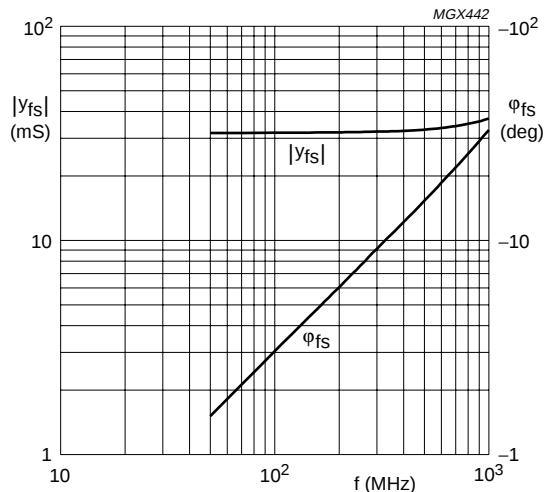
Dual N-channel dual gate MOS-FET

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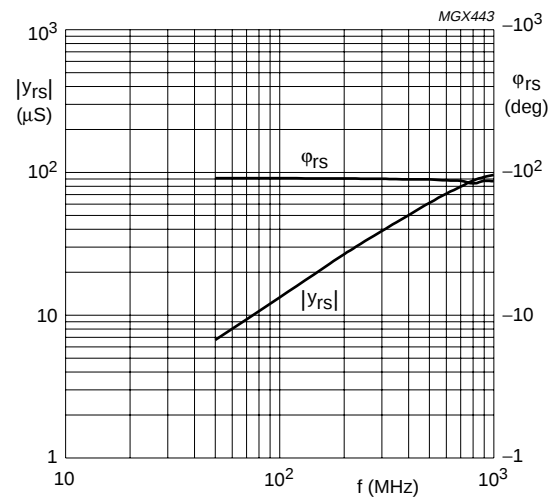
V_{DS} (a) = 5 V; V_{G2-S} (a) = 4 V; V_{DS} (b) = V_{G1-S} (b) = 0 V;
 I_D (a) = 12 mA.

Fig.14 Input admittance as a function of frequency; typical values; amplifier a.



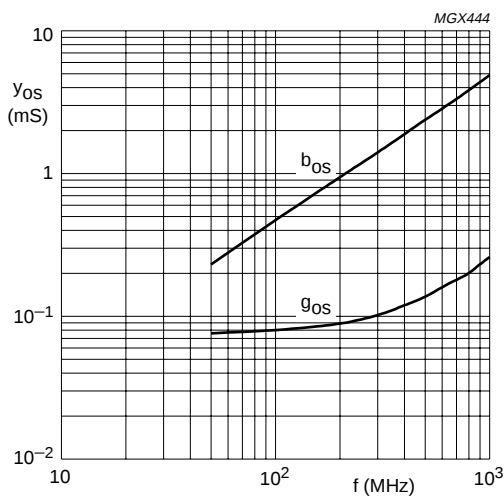
V_{DS} (a) = 5 V; V_{G2-S} (a) = 4 V; V_{DS} (b) = V_{G1-S} (b) = 0 V;
 I_D (a) = 12 mA.

Fig.15 Forward transfer admittance and phase as a function of frequency; typical values; amplifier a.



V_{DS} (a) = 5 V; V_{G2-S} (a) = 4 V; V_{DS} (b) = V_{G1-S} (b) = 0 V;
 I_D (a) = 12 mA.

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



V_{DS} (a) = 5 V; V_{G2-S} (a) = 4 V; V_{DS} (b) = V_{G1-S} (b) = 0 V;
 I_D (a) = 12 mA.

Fig.17 Output admittance as a function of frequency; typical values; amplifier a.

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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 ₁₁		S ₂₁		S ₁₂		S ₂₂	
	MAGNITUDE (ratio)	ANGLE (deg)	MAGNITUDE (ratio)	ANGLE (deg)	MAGNITUDE (ratio)	ANGLE (deg)	MAGNITUDE (ratio)	ANGLE (deg)
50	0.997	-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 (Ω)
		(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

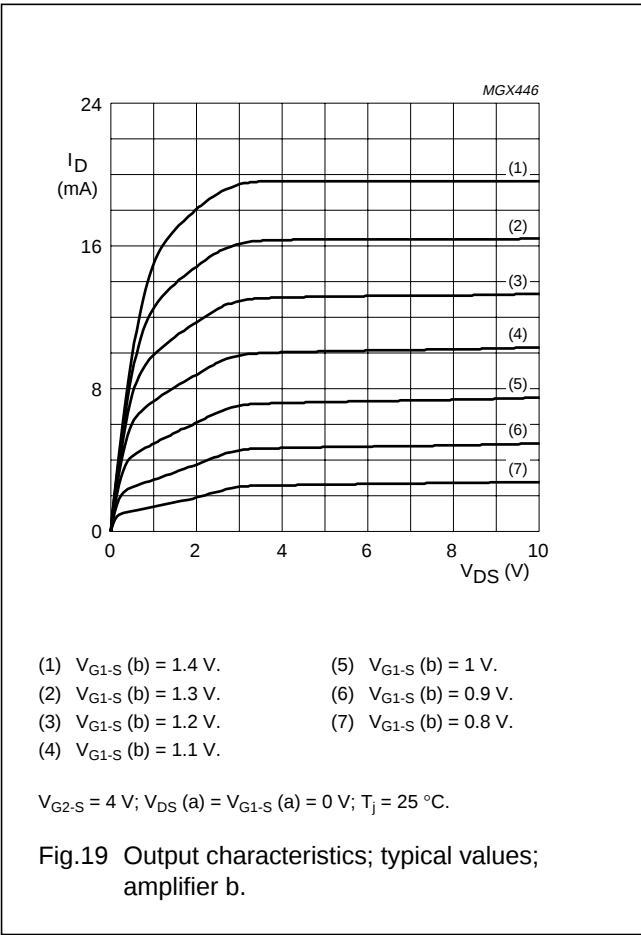
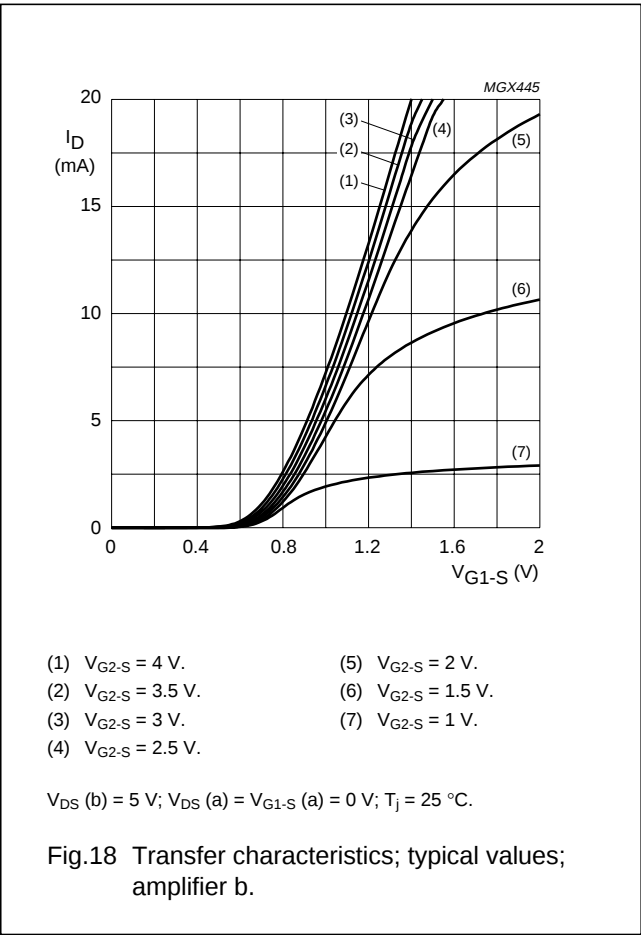
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SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
X _{mod}	cross-modulation	input level for k = 1% at 0 dB AGC; f _w = 50 MHz; f _{unw} = 60 MHz; note 2	90	–	–	dBμV
		input level for k = 1% at 10 dB AGC; f _w = 50 MHz; f _{unw} = 60 MHz; note 2	–	92	–	dBμV
		input level for k = 1% at 40 dB AGC; f _w = 50 MHz; f _{unw} = 60 MHz; note 2	100	105	–	dBμV

Notes

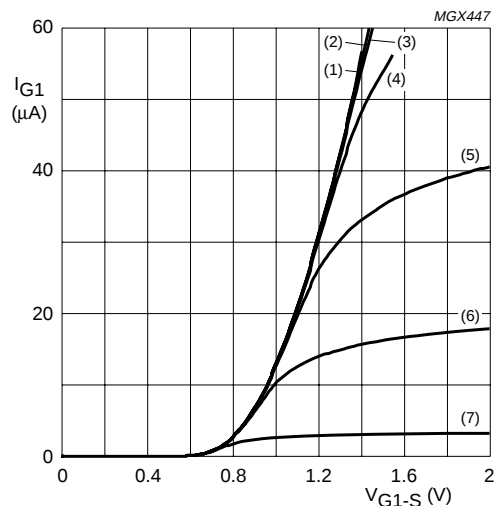
1. For the MOS-FET not in use: V_{G1-S} (a) = 0; V_{DS} (a) = 0.
2. Measured in test circuit Fig.30.

GRAPHS FOR AMPLIFIER b



Dual N-channel dual gate MOS-FET

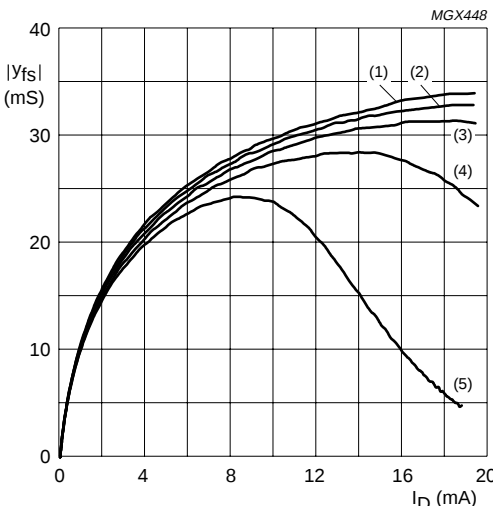
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- (1) $V_{G2-S} = 4 \text{ V.}$
- (2) $V_{G2-S} = 3.5 \text{ V.}$
- (3) $V_{G2-S} = 3 \text{ V.}$
- (4) $V_{G2-S} = 2.5 \text{ V.}$
- (5) $V_{G2-S} = 2 \text{ V.}$
- (6) $V_{G2-S} = 1.5 \text{ V.}$
- (7) $V_{G2-S} = 1 \text{ V.}$

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

Fig.20 Gate 1 current as a function of gate 1 voltage; typical values; amplifier b.



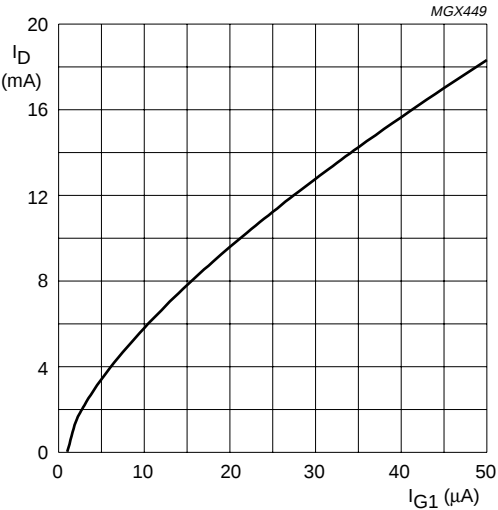
- (1) $V_{G2-S} = 4 \text{ V.}$
- (2) $V_{G2-S} = 3.5 \text{ V.}$
- (3) $V_{G2-S} = 3 \text{ V.}$
- (4) $V_{G2-S} = 2.5 \text{ V.}$
- (5) $V_{G2-S} = 2 \text{ V.}$

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

Fig.21 Forward transfer admittance as a function of drain current; typical values; amplifier b.

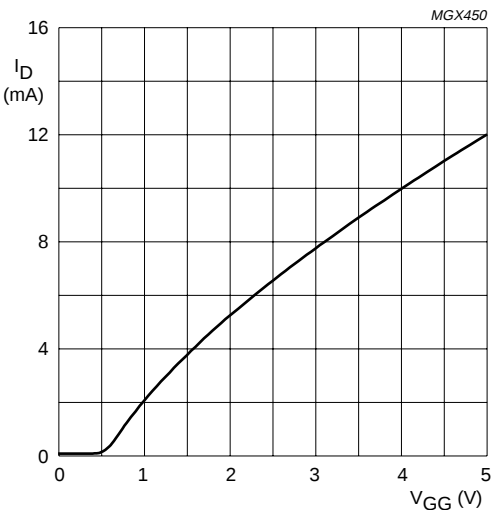
Dual N-channel dual gate MOS-FET

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

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

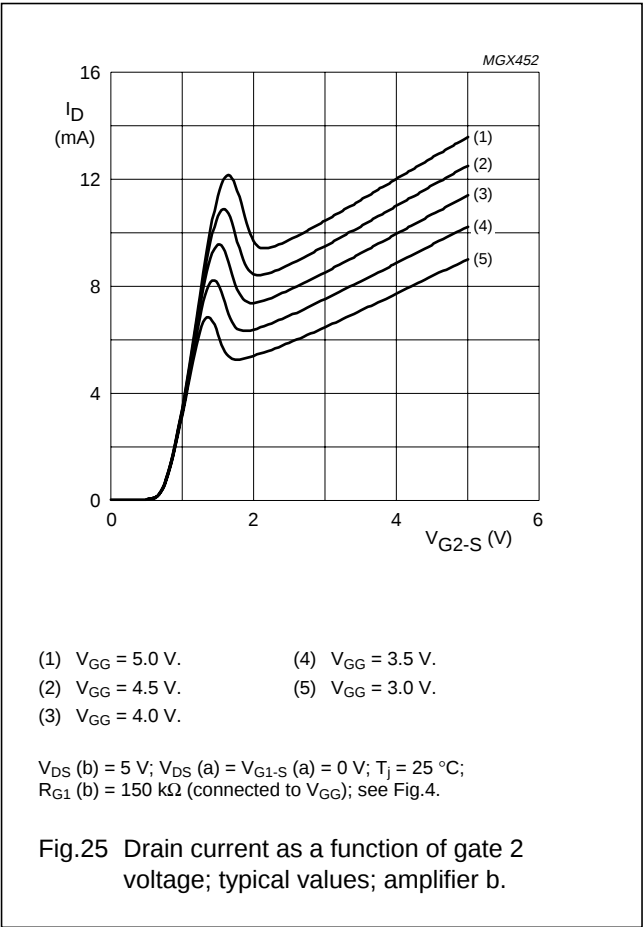
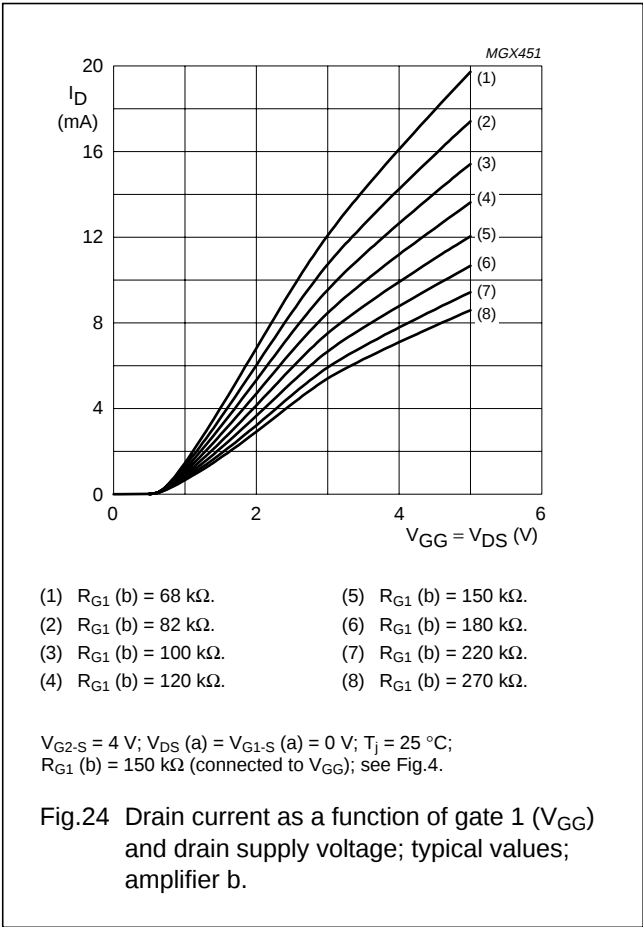


$V_{DS} (b) = 5\text{ V}$; $V_{G2-S} = 4\text{ V}$; $V_{DS} (a) = V_{G1-S} (a) = 0\text{ V}$;
 $T_j = 25\text{ }^{\circ}\text{C}$; $R_{G1} (b) = 150\text{ k}\Omega$ (connected to V_{GG}); see Fig.4.

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

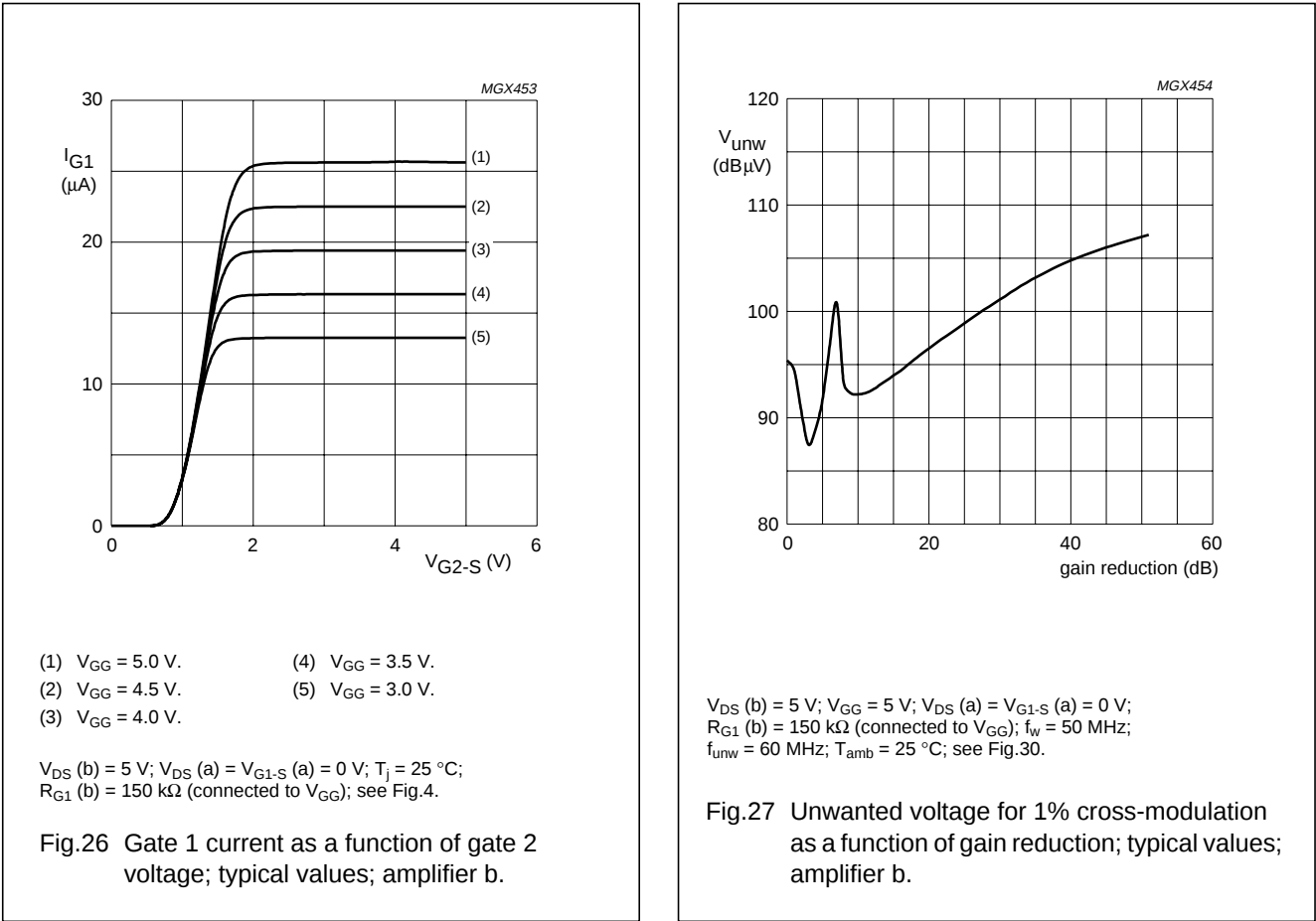
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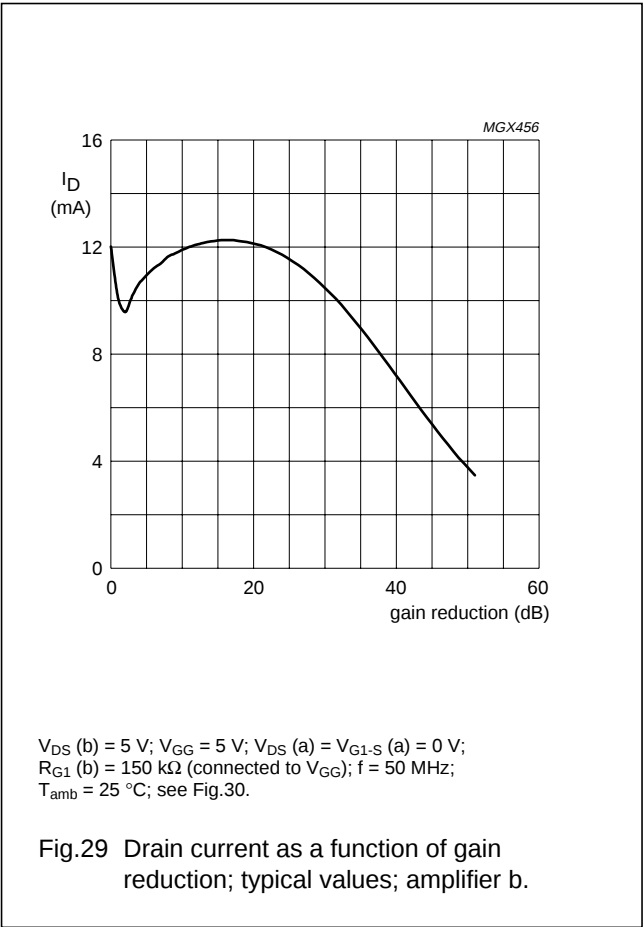
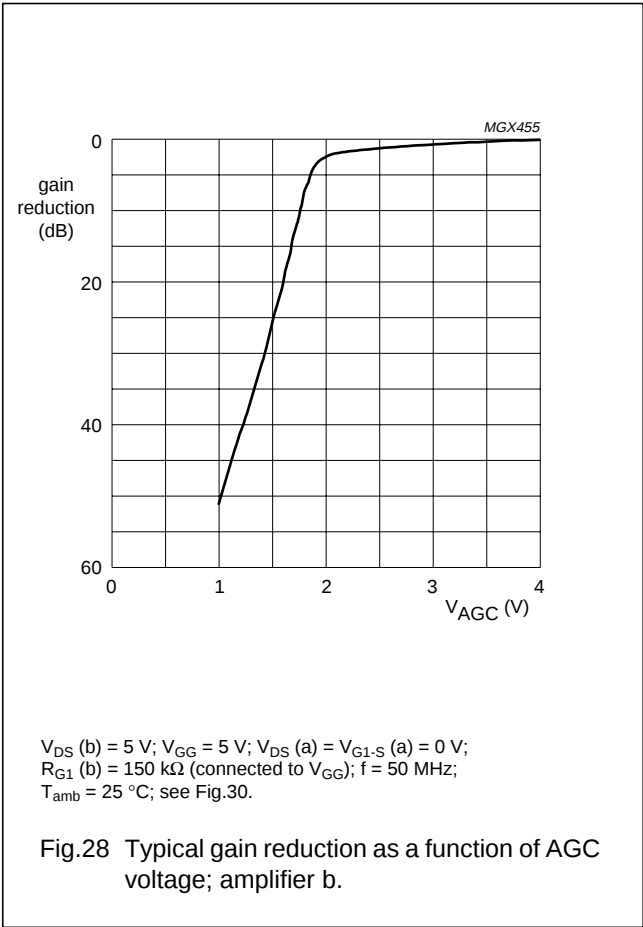
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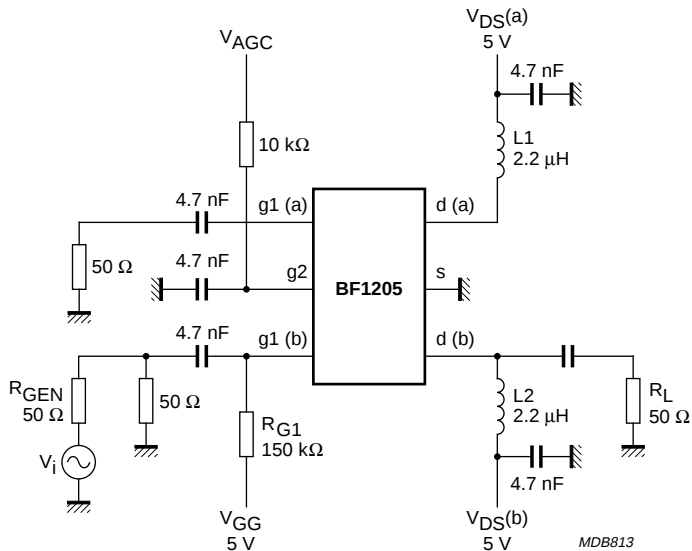
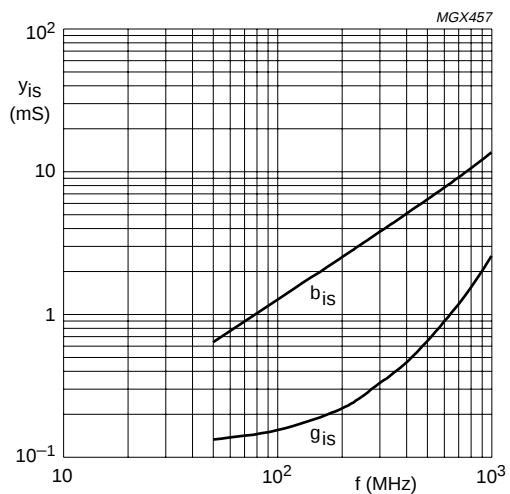
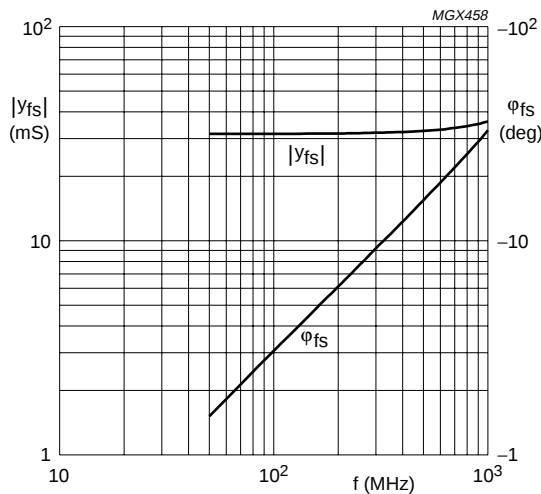


Fig.30 Cross-modulation test set-up for amplifier b.



$V_{DS}(b) = 5\text{ V}$; $V_{G2-S} = 4\text{ V}$; $V_{DS}(a) = V_{G1-S}(a) = 0\text{ V}$;
 $I_D(b) = 12\text{ mA}$.

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

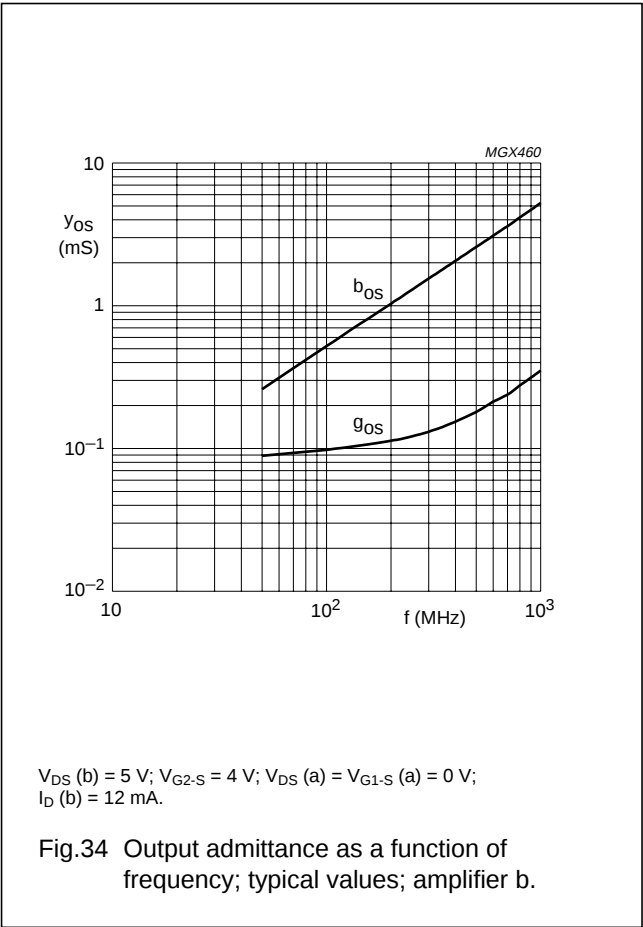
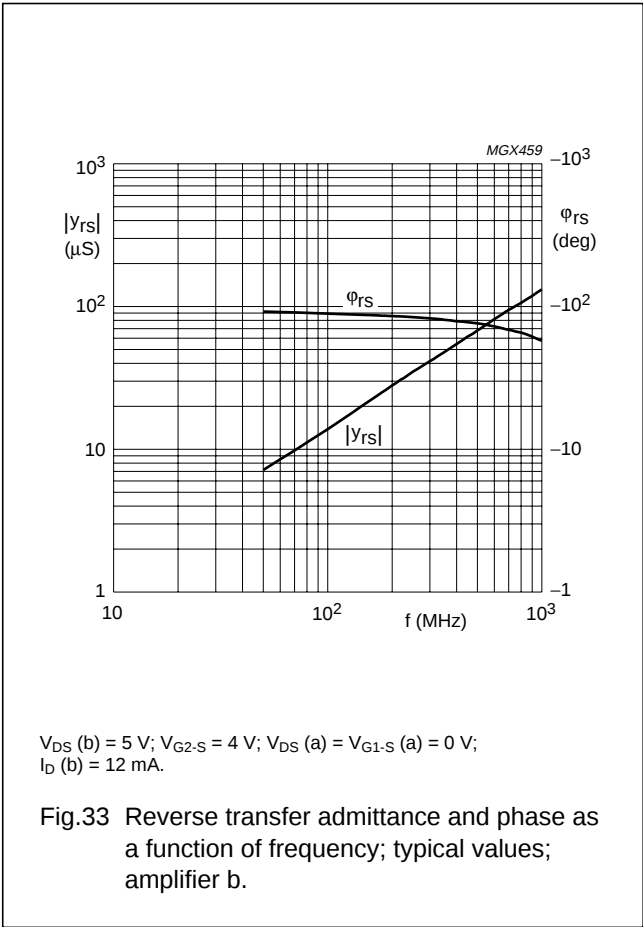


$V_{DS}(b) = 5\text{ V}$; $V_{G2-S} = 4\text{ V}$; $V_{DS}(a) = V_{G1-S}(a) = 0\text{ V}$;
 $I_D(b) = 12\text{ mA}$.

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

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Scattering parameters: amplifier b

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

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	0.987	-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

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

f (MHz)	F MIN (dB)	F MIN (dB)		R _n (Ω)
		(ratio)	(deg)	
400	1.3	0.662	16.76	31.55
800	1.4	0.578	33.97	30.53

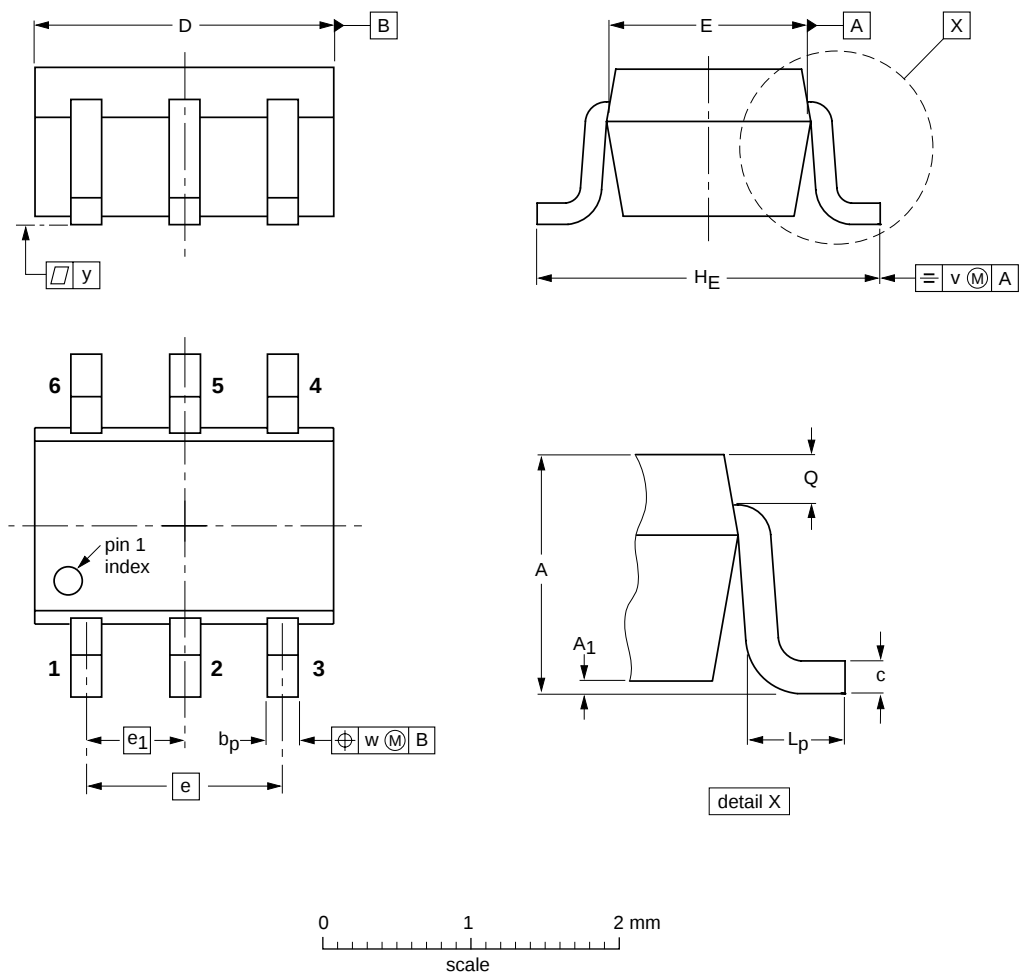
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PACKAGE OUTLINE

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	EIAJ			
SOT363			SC-88			97-02-28

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LEVEL	DATA SHEET STATUS ⁽¹⁾	PRODUCT STATUS ⁽²⁾⁽³⁾	DEFINITION
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