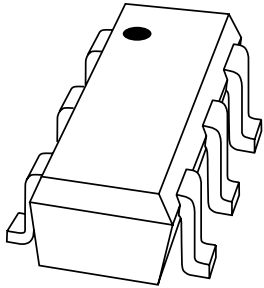


DATA SHEET



BF1203

Dual N-channel dual gate
MOS-FET

Product specification
Supersedes data of 2000 Dec 04

2001 Apr 25

Dual N-channel dual gate MOS-FET

BF1203

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

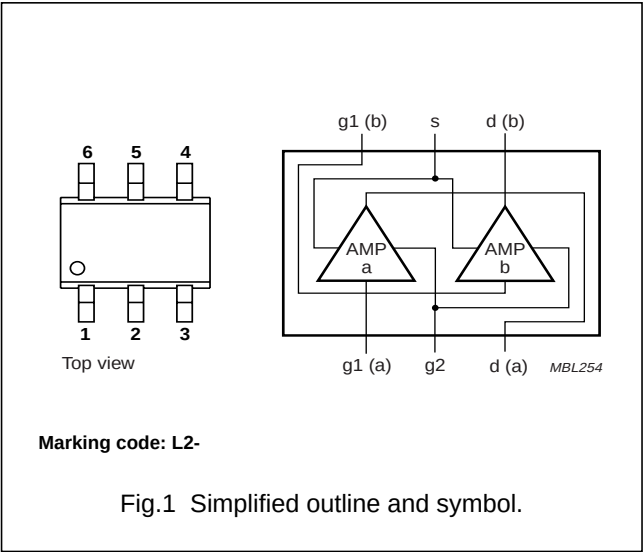
- Gain controlled low noise amplifiers for VHF and UHF applications with 3 to 9 V supply voltage, such as digital and analog television tuners and professional communications equipment.

DESCRIPTION

The BF1203 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 a SOT363 micro-miniature plastic package.

PINNING - SOT363

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



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
$ y_{fs} $	forward transfer admittance	amp. a: $I_D = 15\text{ mA}$	23	28	35	mS
		amp. b: $I_D = 12\text{ mA}$	25	30	40	mS
C_{ig1-s}	input capacitance at gate 1	amp. a: $I_D = 15\text{ mA}$; $f = 1\text{ MHz}$	—	2.6	3.1	pF
		amp. b: $I_D = 12\text{ mA}$; $f = 1\text{ MHz}$	—	1.7	2.2	pF
C_{rss}	reverse transfer capacitance	$f = 1\text{ MHz}$	—	15	—	fF
NF	noise figure	amp. a: $f = 400\text{ MHz}$; $I_D = 15\text{ mA}$	—	1	1.8	dB
		amp. b: $f = 800\text{ MHz}$; $I_D = 12\text{ mA}$	—	1.1	1.8	dB
X_{mod}	cross-modulation	amp. a: input level for $k = 1\%$ at 40 dB AGC	105	—	—	dB μ V
		amp. b: input level for $k = 1\%$ at 40 dB AGC	100	105	—	dB μ V

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.

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LIMITING VALUES

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

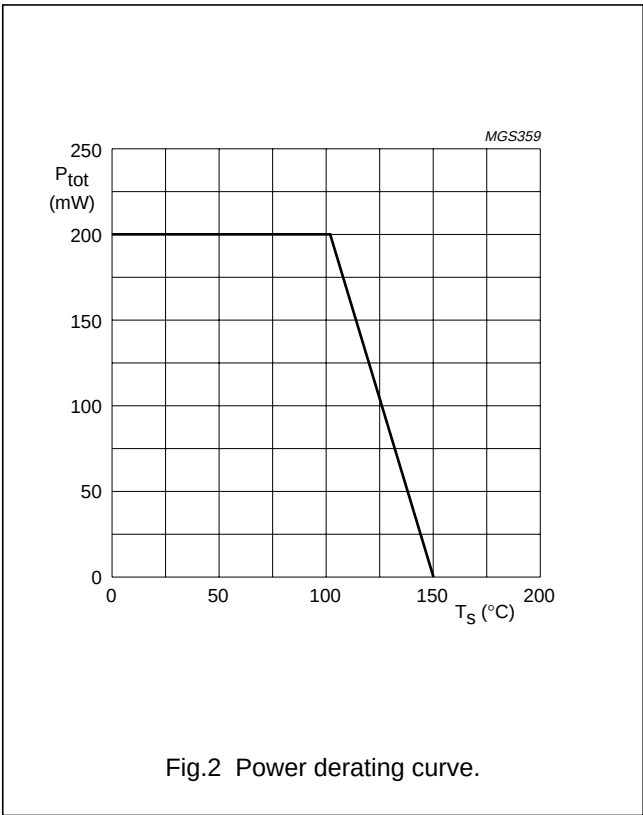
SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
Per MOS-FET unless otherwise specified					
V _{DS}	drain-source voltage		–	10	V
I _D	drain current (DC)		–	30	mA
I _{G1}	gate 1 current		–	±10	mA
I _{G2}	gate 2 current		–	±10	mA
P _{tot}	total power dissipation	T _s ≤ 102 °C; note 1	–	200	mW
T _{stg}	storage temperature		–65	+150	°C
T _j	operating junction temperature		–	150	°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

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
Per MOS-FET unless otherwise specified					
$V_{(BR)DSS}$	drain-source breakdown voltage	$V_{G1-S} = V_{G2-S} = 0$; $I_D = 10\text{ }\mu\text{A}$	10	–	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	$V_{DS} = 5\text{ V}$; $V_{G2-S} = 4\text{ V}$; $I_D = 100\text{ }\mu\text{A}$	0.3	1	V
$V_{G2-S(th)}$	gate-source threshold voltage	$V_{DS} = 5\text{ V}$; $V_{G1-S} = 4\text{ V}$; $I_D = 100\text{ }\mu\text{A}$	0.3	1.2	V
I_{DSX}	drain-source current	amp. a: $V_{G2-S} = 4\text{ V}$; $V_{DS} = 5\text{ V}$; $R_G = 62\text{ k}\Omega$; note 1	11	19	mA
		amp. b: $V_{G2-S} = 4\text{ V}$; $V_{DS} = 5\text{ V}$; $R_G = 120\text{ k}\Omega$; note 1	8	16	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

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

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DYNAMIC CHARACTERISTICS AMPLIFIER aCommon source; $T_{\text{amb}} = 25\text{ °C}$; $V_{G2-S} = 4\text{ V}$; $V_{DS} = 5\text{ V}$; $I_D = 15\text{ mA}$; unless otherwise specified.

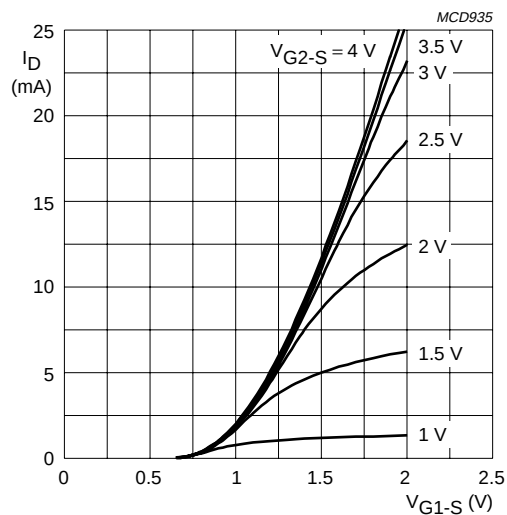
SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$ y_{fs} $	forward transfer admittance	pulsed; $T_j = 25\text{ °C}$	23	28	35	mS
C_{ig1-ss}	input capacitance at gate 1	$f = 1\text{ MHz}$	–	2.6	3.1	pF
C_{ig2-ss}	input capacitance at gate 2	$f = 1\text{ MHz}$	–	3	–	pF
C_{oss}	output capacitance	$f = 1\text{ MHz}$	–	0.9	–	pF
C_{rss}	reverse transfer capacitance	$f = 1\text{ MHz}$	–	15	30	fF
F	noise figure	$f = 10.7\text{ MHz}$; $G_S = 20\text{ mS}$; $B_S = 0$	–	5	7	dB
		$f = 400\text{ MHz}$; $Y_S = Y_{S\text{ opt}}$	–	1	1.8	dB
		$f = 800\text{ MHz}$; $Y_S = Y_{S\text{ opt}}$	–	1.9	2.5	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	–	32.5	–	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	–	27	–	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	–	21	–	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	–	95	–	dB μ V
		at 40 dB AGC	105	–	–	dB μ V

Notes

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

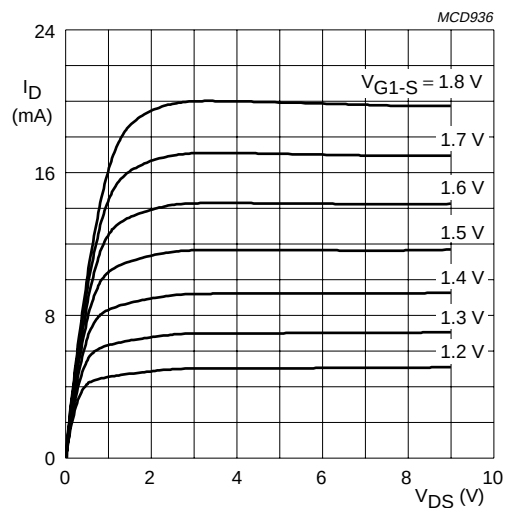
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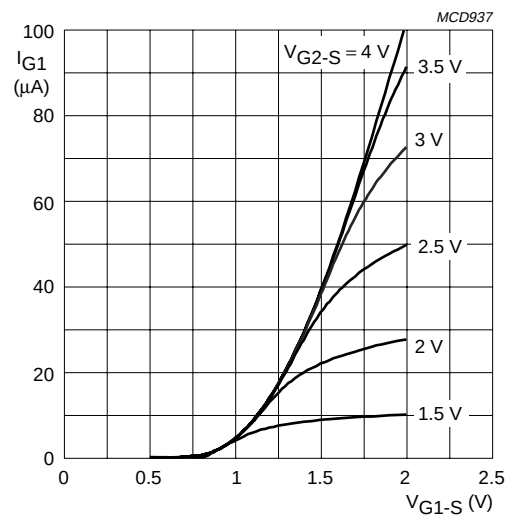
Amplifier a
 $V_{DS} = 5\text{ V.}$
 $T_j = 25\text{ }^{\circ}\text{C.}$

Fig.3 Transfer characteristics; typical values.



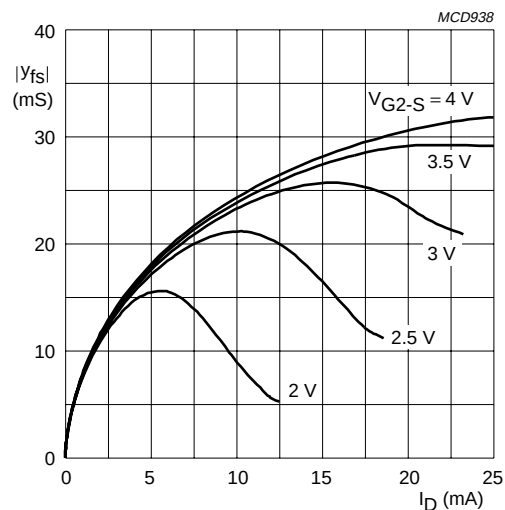
Amplifier a
 $V_{G2-S} = 4\text{ V.}$
 $T_j = 25\text{ }^{\circ}\text{C.}$

Fig.4 Output characteristics; typical values.



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

Fig.5 Gate 1 current as a function of gate 1 voltage; typical values.

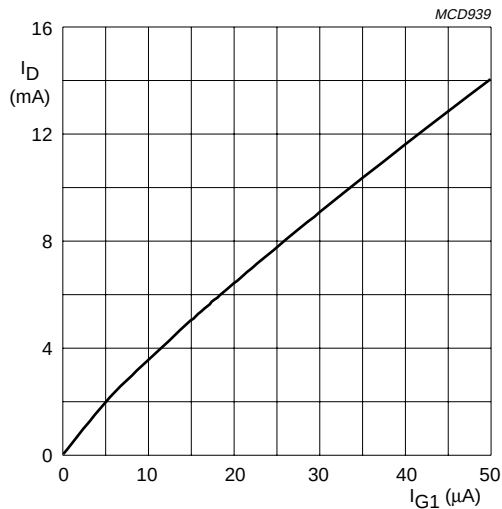


Amplifier a
 $V_{DS} = 5\text{ V.}$
 $T_j = 25\text{ }^{\circ}\text{C.}$

Fig.6 Forward transfer admittance as a function of drain current; typical values.

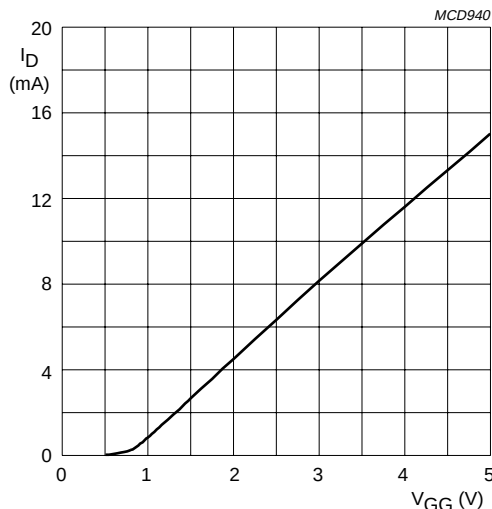
Dual N-channel dual gate MOS-FET

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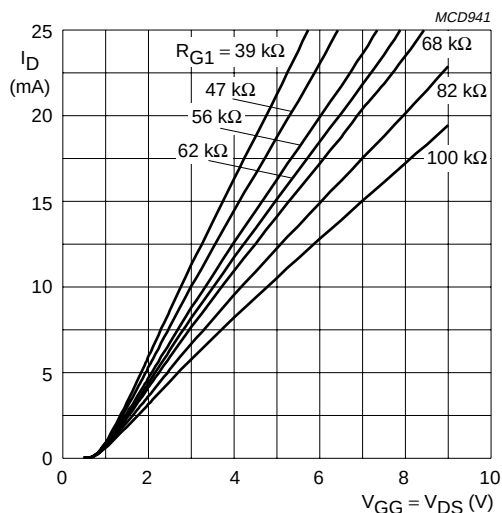
Amplifier a
 $V_{DS} = 5\text{ V}$; $V_{G2-S} = 4\text{ V}$.
 $T_j = 25\text{ }^{\circ}\text{C}$.

Fig.7 Drain current as a function of gate 1 current; typical values.



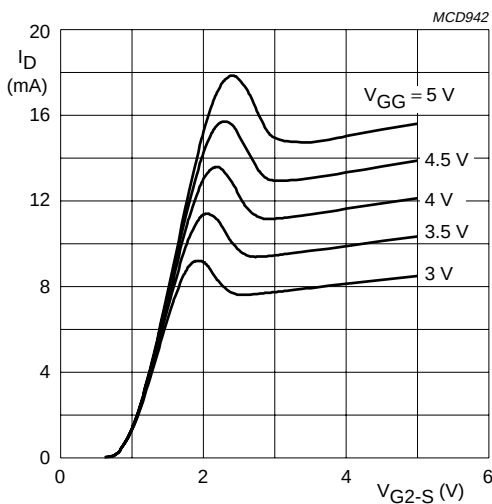
Amplifier a
 $V_{DS} = 5\text{ V}$; $V_{G2-S} = 4\text{ V}$; $T_j = 25\text{ }^{\circ}\text{C}$.
 $R_{G1} = 62\text{ k}\Omega$ (connected to V_{GG}); see Fig.35.

Fig.8 Drain current as a function of gate 1 supply voltage (= V_{GG}); typical values.



Amplifier a
 $V_{G2-S} = 4\text{ V}$; $T_j = 25\text{ }^{\circ}\text{C}$.
 R_{G1} connected to V_{GG} ; see Fig.35.

Fig.9 Drain current as a function of gate 1 (= V_{GG}) and drain supply voltage; typical values.

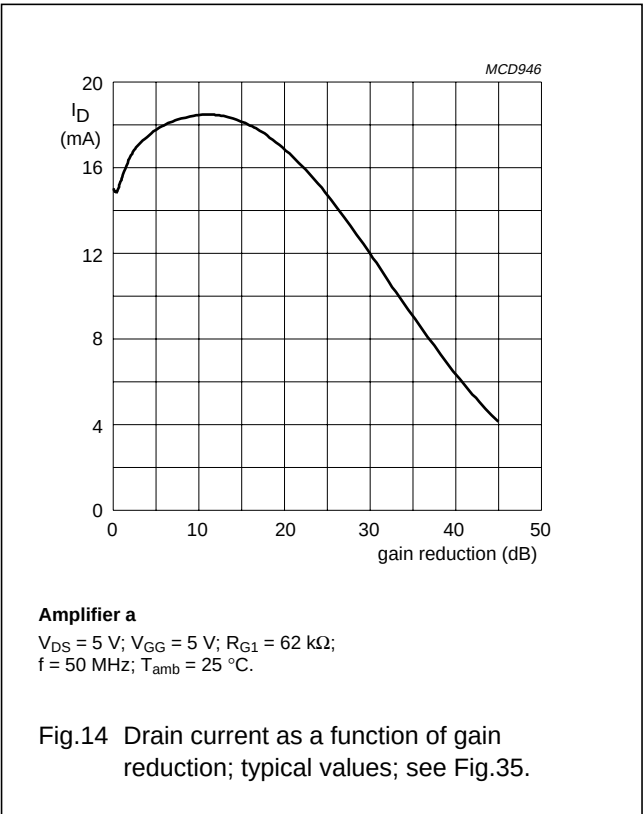
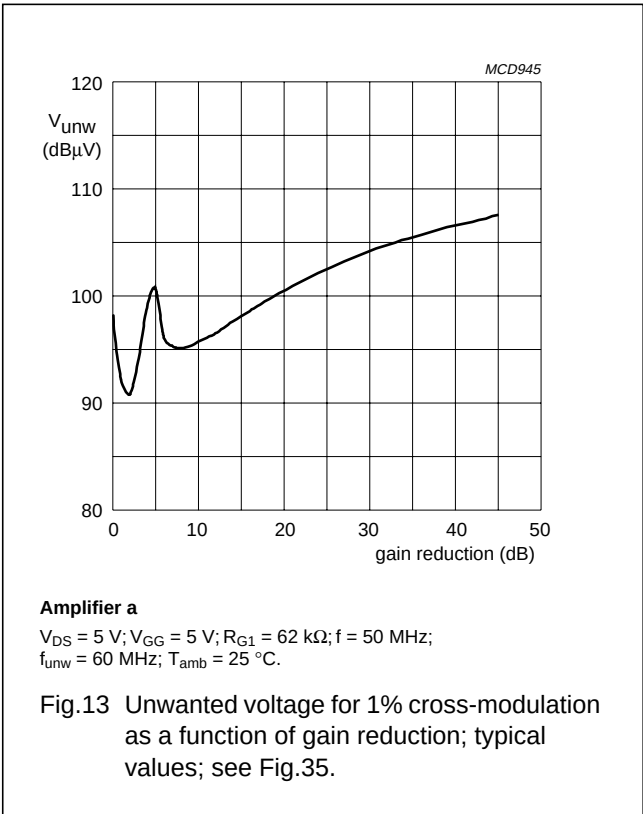
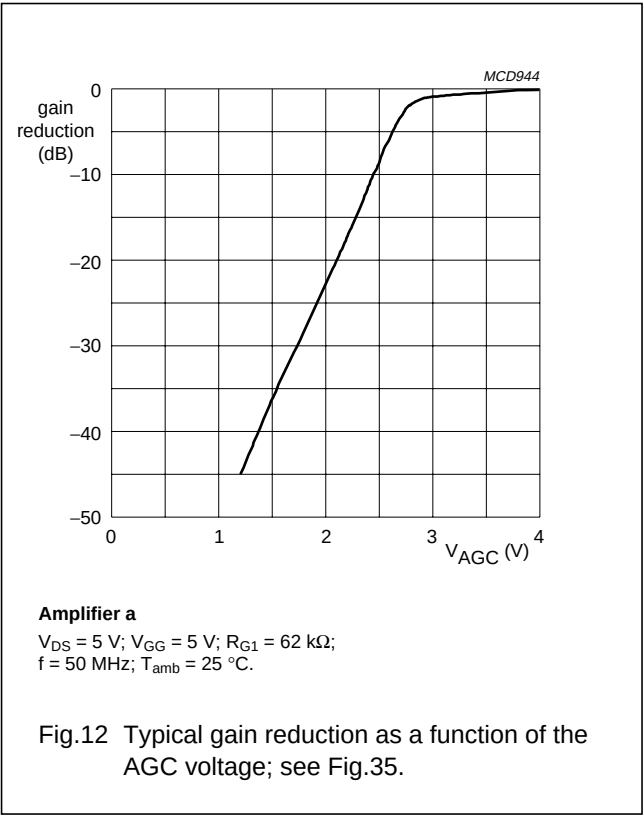
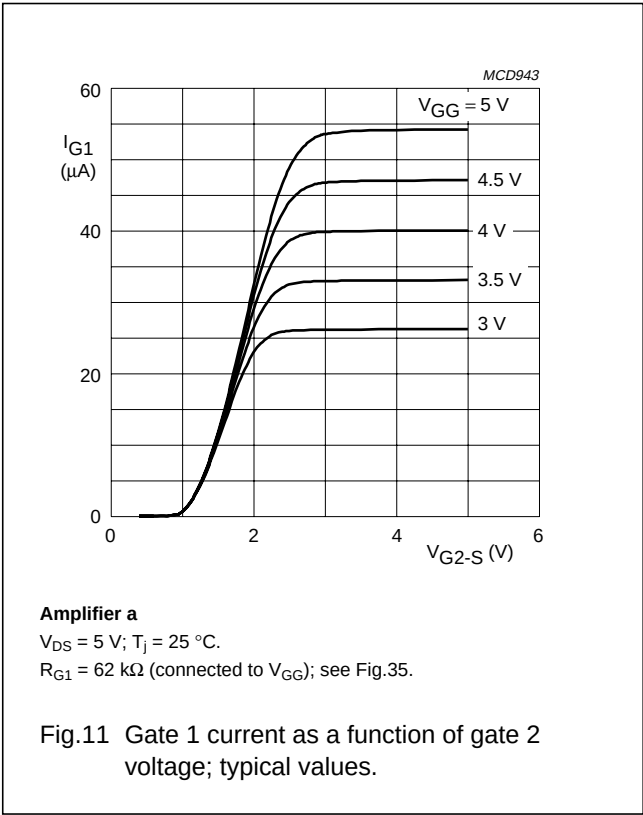


Amplifier a
 $V_{DS} = 5\text{ V}$; $T_j = 25\text{ }^{\circ}\text{C}$.
 $R_{G1} = 62\text{ k}\Omega$ (connected to V_{GG}); see Fig.35.

Fig.10 Drain current as a function of gate 2 voltage; typical values.

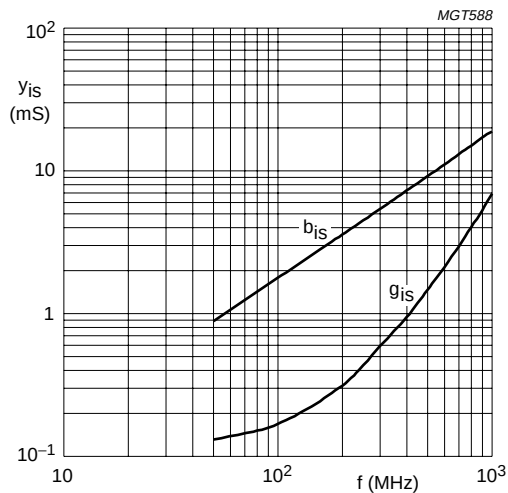
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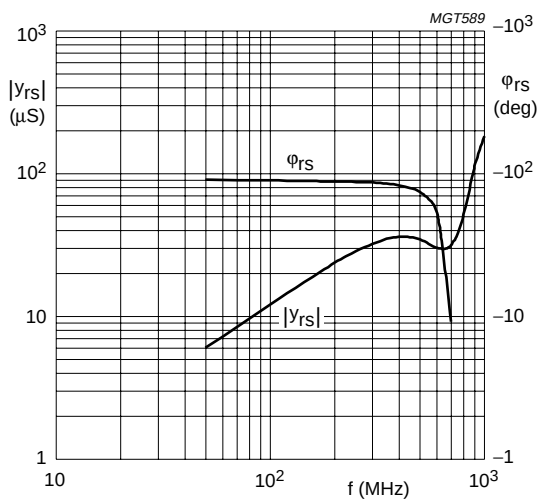
Dual N-channel dual gate MOS-FET

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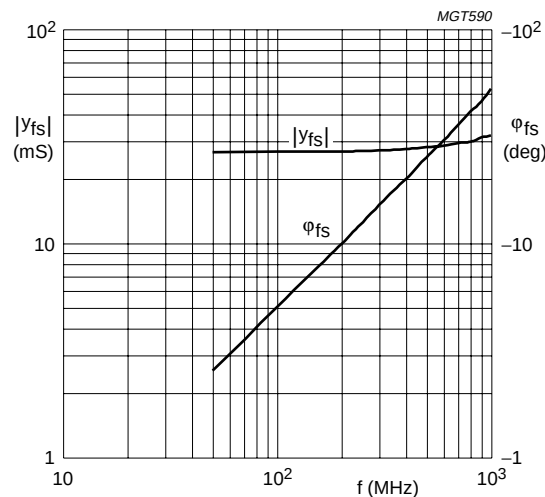
Amplifier a
 $V_{DS} = 5\text{ V}$; $V_{G2} = 4\text{ V}$.
 $I_D = 15\text{ mA}$; $T_{amb} = 25\text{ }^{\circ}\text{C}$.

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



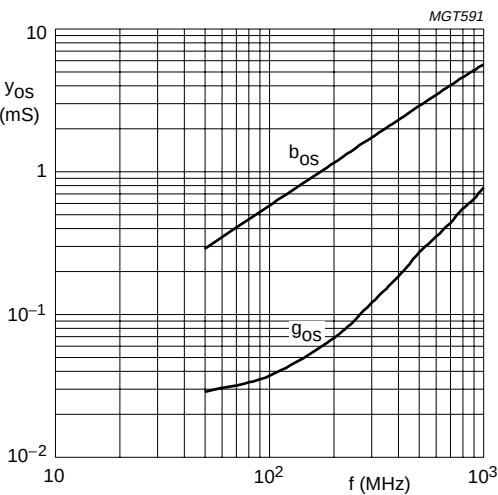
Amplifier a
 $V_{DS} = 5\text{ V}$; $V_{G2} = 4\text{ V}$.
 $I_D = 15\text{ mA}$; $T_{amb} = 25\text{ }^{\circ}\text{C}$.

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



Amplifier a
 $V_{DS} = 5\text{ V}$; $V_{G2} = 4\text{ V}$.
 $I_D = 15\text{ mA}$; $T_{amb} = 25\text{ }^{\circ}\text{C}$.

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



Amplifier a
 $V_{DS} = 5\text{ V}$; $V_{G2} = 4\text{ V}$.
 $I_D = 15\text{ mA}$; $T_{amb} = 25\text{ }^{\circ}\text{C}$.

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

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Amplifier a scattering parameters

 $V_{DS} = 5\text{ V}$; $V_{G2-S} = 4\text{ V}$; $I_D = 15\text{ mA}$; $T_{amb} = 25\text{ °C}$

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	0.987	-5.12	2.67	174.07	0.0006	85.79	0.997	-1.72
100	0.983	-10.24	2.66	168.16	0.0012	83.27	0.996	-3.42
200	0.976	-20.37	2.61	156.64	0.0023	78.22	0.992	-6.77
300	0.946	-30.36	2.54	145.05	0.0030	73.26	0.986	-10.12
400	0.919	-40.15	2.47	134.13	0.0032	71.40	0.980	-13.33
500	0.885	-49.55	2.37	132.32	0.0029	74.34	0.972	-16.56
600	0.851	-58.50	2.26	113.25	0.0024	90.33	0.965	-19.74
700	0.815	-67.28	2.15	103.20	0.0023	129.94	0.960	-22.90
800	0.778	-75.03	2.02	93.78	0.0035	172.18	0.950	-26.05
900	0.747	-83.30	1.95	84.84	0.0070	171.55	0.951	-29.10
1000	0.710	-90.47	1.83	75.92	0.0104	172.88	0.947	-32.25

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

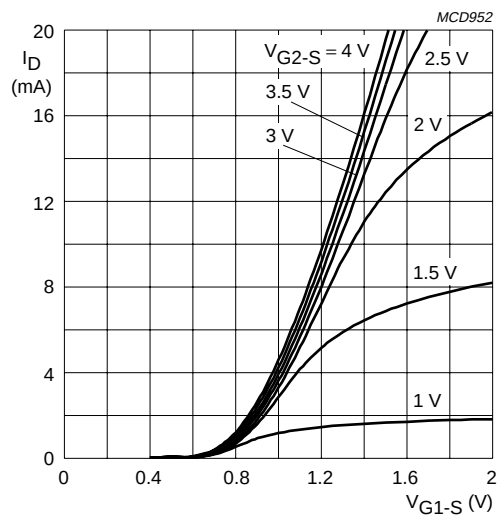
SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$ y_{\text{fs}} $	forward transfer admittance	pulsed; $T_j = 25\text{ }^{\circ}\text{C}$	25	30	40	mS
$C_{\text{ig1-ss}}$	input capacitance at gate 1	$f = 1\text{ MHz}$	–	1.7	2.2	pF
$C_{\text{ig2-ss}}$	input capacitance at gate 2	$f = 1\text{ MHz}$	–	4	–	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	$f = 10.7\text{ MHz}$; $G_{\text{S}} = 20\text{ mS}$; $B_{\text{S}} = 0$	–	9	11	dB
		$f = 400\text{ MHz}$; $Y_{\text{S}} = Y_{\text{S opt}}$	–	0.9	1.5	dB
		$f = 800\text{ MHz}$; $Y_{\text{S}} = Y_{\text{S opt}}$	–	1.1	1.8	dB
G_{tr}	power gain	$f = 200\text{ MHz}$; $G_{\text{S}} = 2\text{ mS}$; $B_{\text{S}} = B_{\text{S opt}}$; $G_{\text{L}} = 0.5\text{ mS}$; $B_{\text{L}} = B_{\text{L opt}}$; note 1	–	34	–	dB
		$f = 400\text{ MHz}$; $G_{\text{S}} = 2\text{ mS}$; $B_{\text{S}} = B_{\text{S opt}}$; $G_{\text{L}} = 1\text{ mS}$; $B_{\text{L}} = B_{\text{L opt}}$; note 1	–	30	–	dB
		$f = 800\text{ MHz}$; $G_{\text{S}} = 3.3\text{ mS}$; $B_{\text{S}} = B_{\text{S opt}}$; $G_{\text{L}} = 1\text{ mS}$; $B_{\text{L}} = B_{\text{L opt}}$; note 1	–	25	–	dB
X_{mod}	cross-modulation	input level for $k = 1\%$; $f_{\text{w}} = 50\text{ MHz}$; $f_{\text{unw}} = 60\text{ MHz}$; note 2				
		at 0 dB AGC	90	–	–	dB μ V
		at 10 dB AGC	–	92	–	dB μ V
		at 40 dB AGC	100	105	–	dB μ V

Notes

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

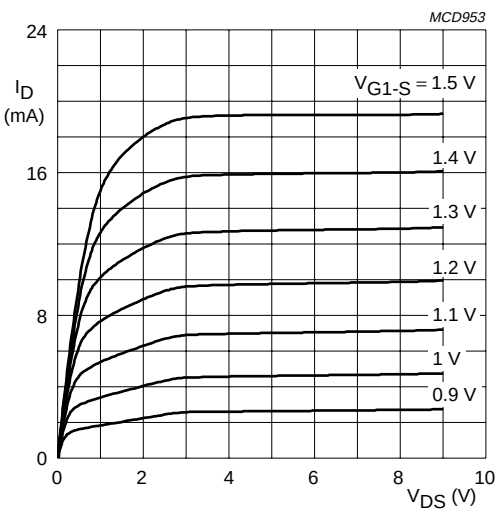
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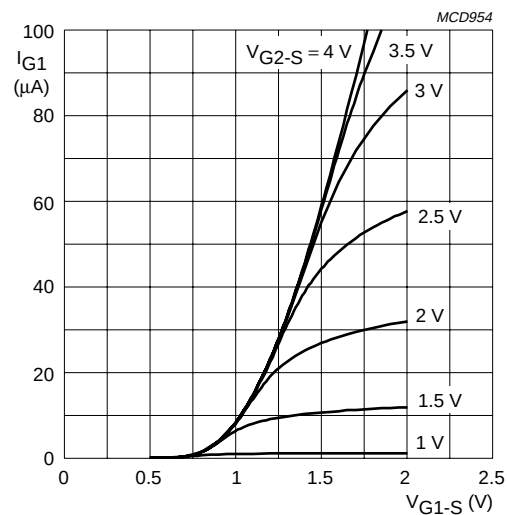
Amplifier b
 $V_{DS} = 5\text{ V.}$
 $T_j = 25\text{ }^\circ\text{C.}$

Fig.19 Transfer characteristics; typical values.



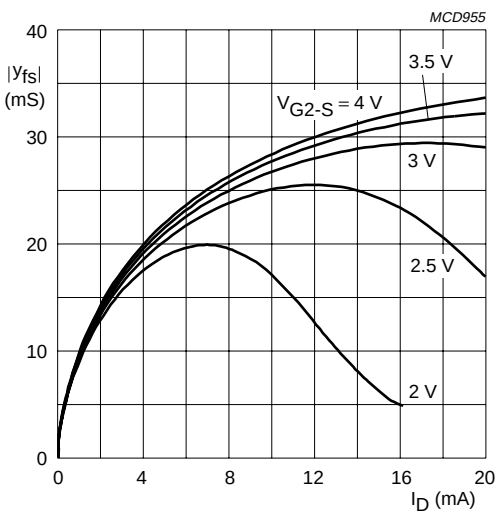
Amplifier b
 $V_{G2-S} = 4\text{ V.}$
 $T_j = 25\text{ }^\circ\text{C.}$

Fig.20 Output characteristics; typical values.



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

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

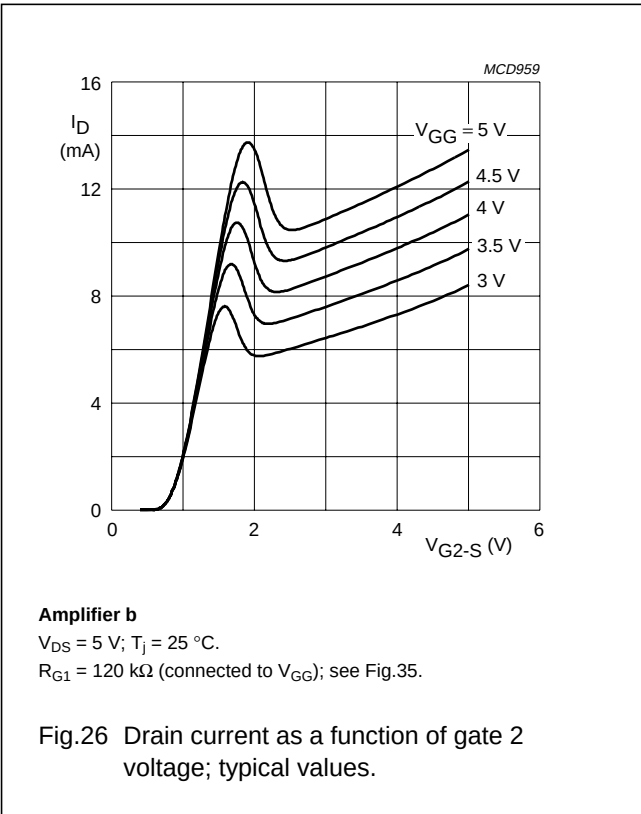
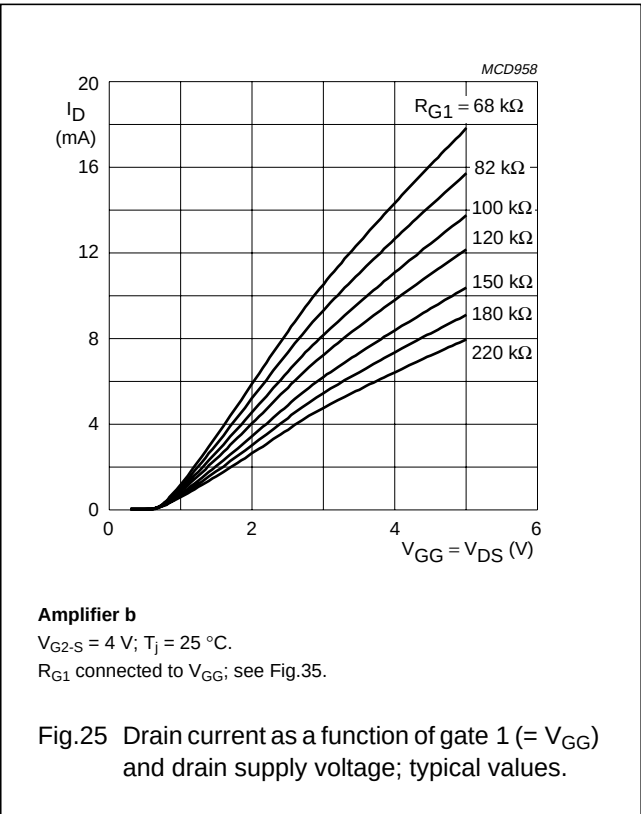
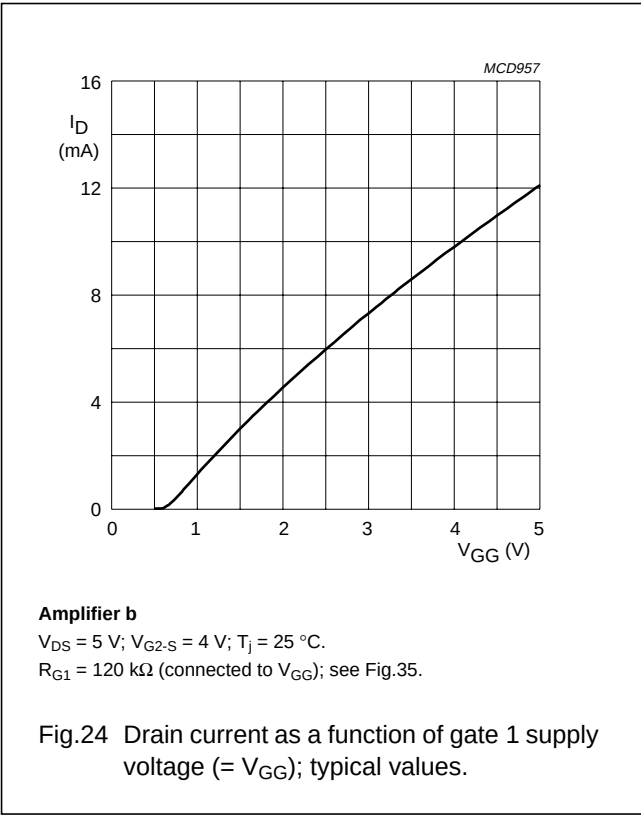
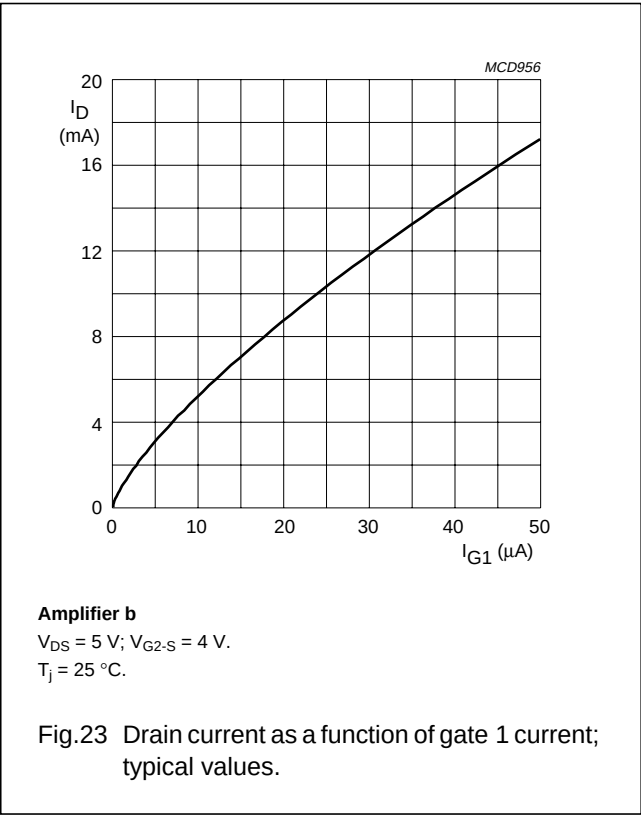


Amplifier b
 $V_{DS} = 5\text{ V.}$
 $T_j = 25\text{ }^\circ\text{C.}$

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

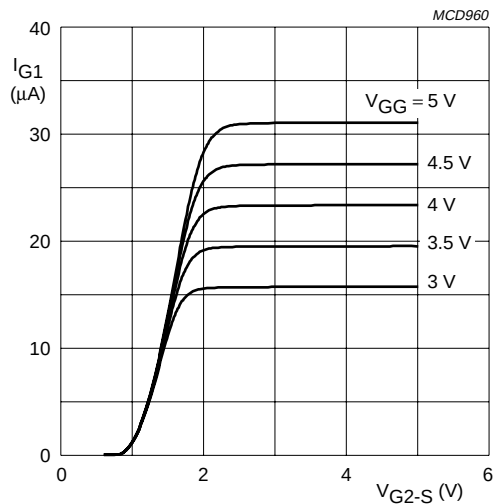
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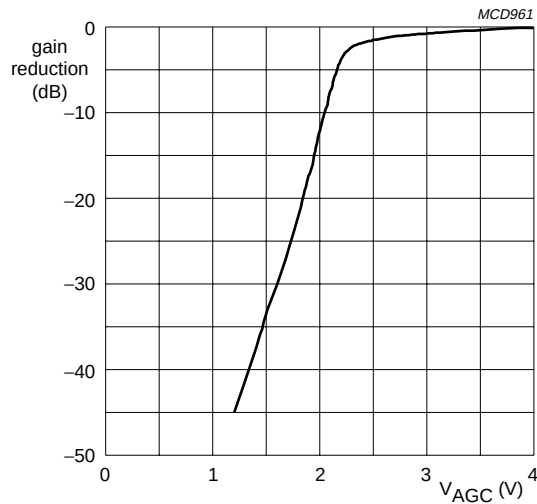
Dual N-channel dual gate MOS-FET

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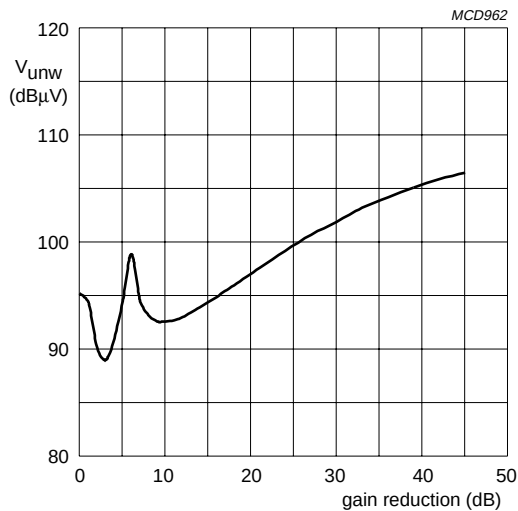
Amplifier b
 $V_{DS} = 5 V$; $T_j = 25^\circ C$.
 $R_{G1} = 120 k\Omega$ (connected to V_{GG}); see Fig.35.

Fig.27 Gate 1 current as a function of gate 2 voltage; typical values.



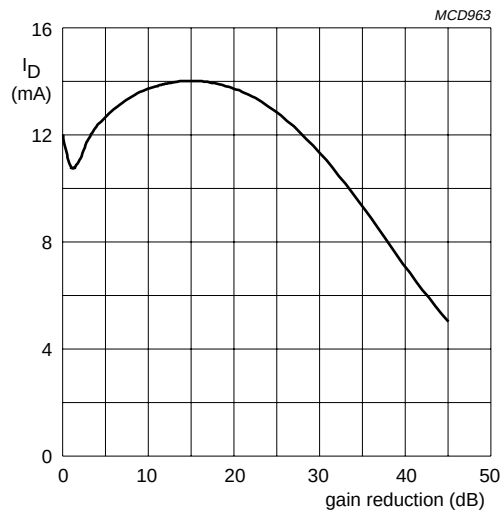
Amplifier b
 $V_{DS} = 5 V$; $V_{GG} = 5 V$; $R_{G1} = 120 k\Omega$;
 $f = 50 MHz$; $T_{amb} = 25^\circ C$.

Fig.28 Typical gain reduction as a function of the AGC voltage; see Fig.35.



Amplifier b
 $V_{DS} = 5 V$; $V_{GG} = 5 V$; $R_{G1} = 120 k\Omega$;
 $f = 50 MHz$; $f_{unw} = 60 MHz$; $T_{amb} = 25^\circ C$.

Fig.29 Unwanted voltage for 1% cross-modulation as a function of gain reduction; typical values; see Fig.35.

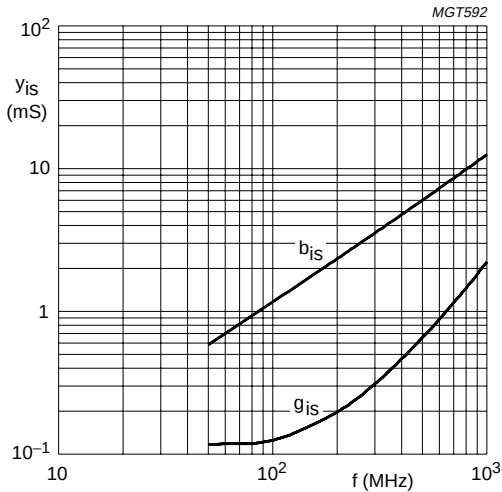


Amplifier b
 $V_{DS} = 5 V$; $V_{GG} = 5 V$; $R_{G1} = 120 k\Omega$;
 $f = 50 MHz$; $T_{amb} = 25^\circ C$.

Fig.30 Drain current as a function of gain reduction; typical values; see Fig.35.

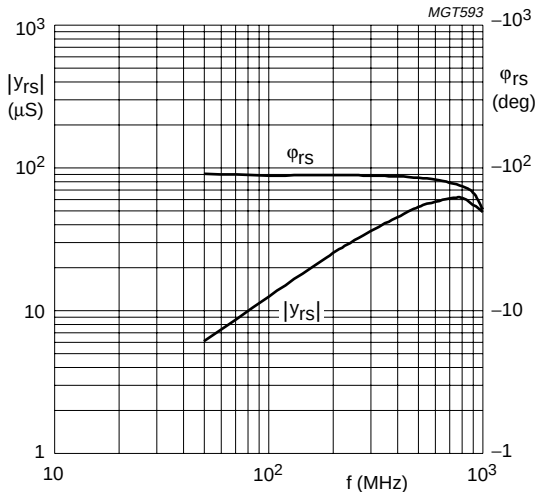
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BF1203



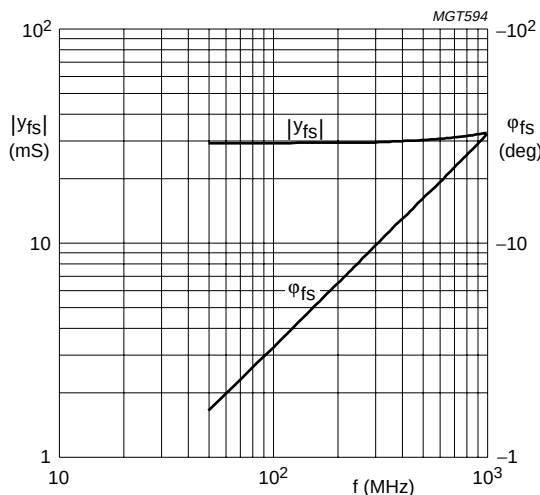
Amplifier b
 $V_{DS} = 5\text{ V}$; $V_{G2} = 4\text{ V}$.
 $I_D = 12\text{ mA}$; $T_{amb} = 25\text{ }^{\circ}\text{C}$.

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



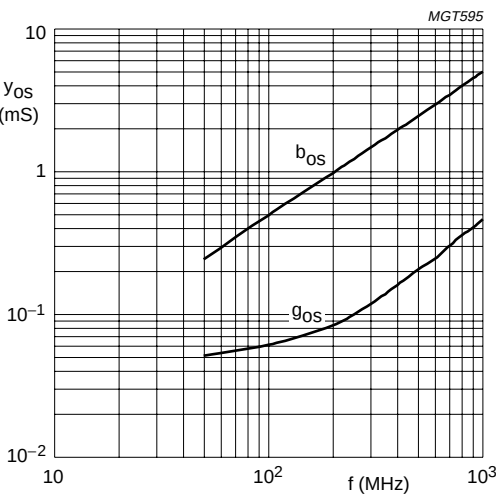
Amplifier b
 $V_{DS} = 5\text{ V}$; $V_{G2} = 4\text{ V}$.
 $I_D = 12\text{ mA}$; $T_{amb} = 25\text{ }^{\circ}\text{C}$.

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.

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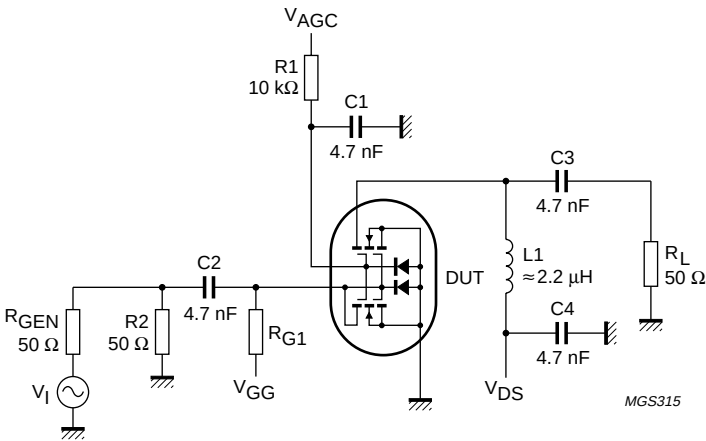


Fig.35 Cross-modulation test set-up (for one MOS-FET).

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	0.988	−3.30	2.93	166.05	0.0006	87.62	0.994	−1.45
100	0.987	−6.60	2.92	172.11	0.0013	86.02	0.993	−2.92
200	0.981	−13.19	2.90	164.49	0.0025	82.03	0.990	−5.72
300	0.969	−19.81	2.87	156.59	0.0036	76.76	0.986	−8.57
400	0.957	−26.42	2.84	149.17	0.0045	73.59	0.981	−11.32
500	0.941	−33.04	2.79	141.47	0.0051	71.13	0.975	−14.22
600	0.925	−39.44	2.73	134.25	0.0054	69.07	0.971	−17.04
700	0.907	−45.89	2.67	126.81	0.0055	68.03	0.966	−19.92
800	0.889	−51.93	2.60	119.56	0.0055	68.55	0.958	−22.77
900	0.827	−57.82	2.54	112.70	0.0048	69.87	0.957	−25.54
1000	0.853	−63.24	2.46	105.72	0.0042	78.19	0.954	−28.41

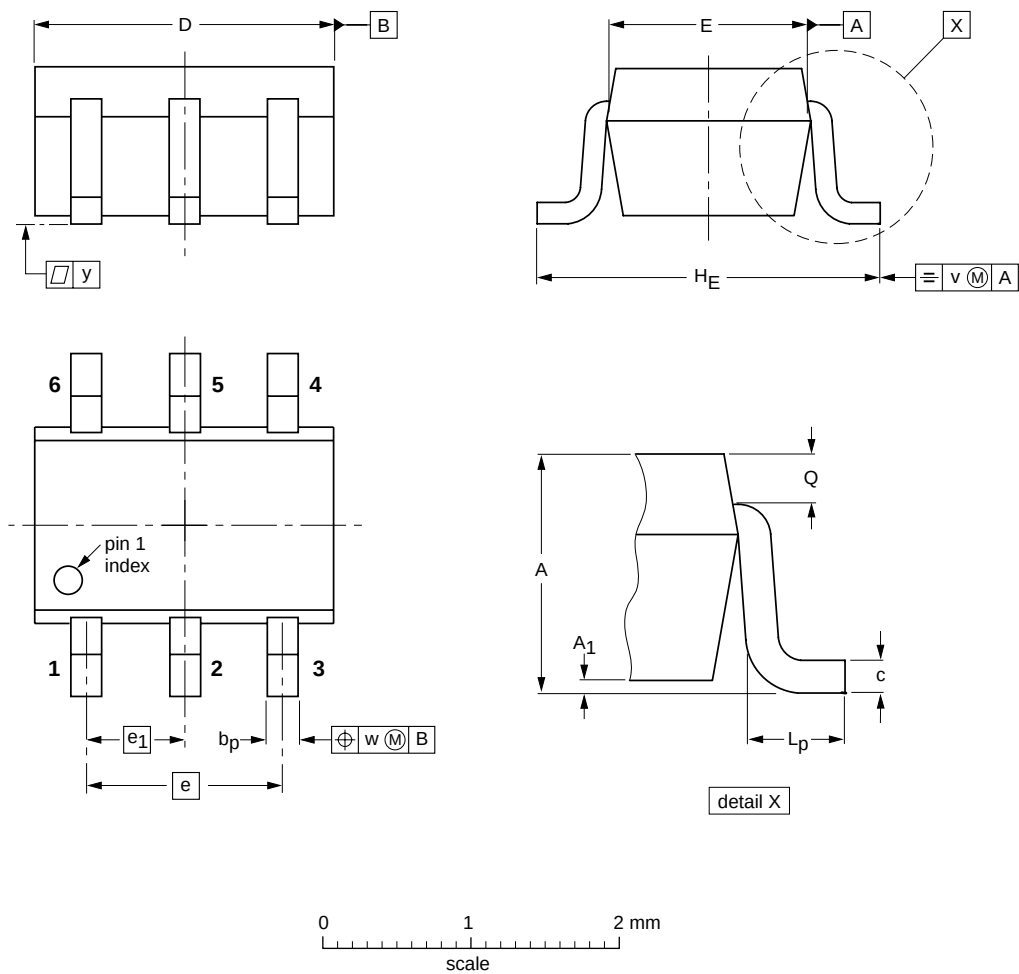
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PACKAGE OUTLINE

Plastic surface mounted package; 6 leads

SOT363



DIMENSIONS (mm are the original dimensions)

UNIT	A	A ₁ max	b _p	c	D	E	e	e ₁	H _E	L _p	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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DATA SHEET STATUS ⁽¹⁾	PRODUCT STATUS ⁽²⁾	DEFINITIONS
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