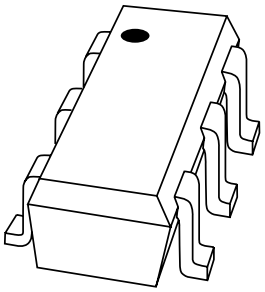
DATA SHEET



BF1203
Dual N-channel dual gate MOS-FET

Product specification
Supersedes data of 2000 Dec 04

2001 Apr 25

Philips Semiconductors

PHILIPS

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

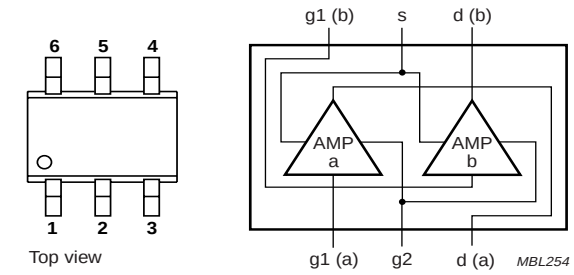
- Gain controlled low noise amplifiers for VHF and UHF applications with 3 to 9 V supply voltage, such as digital and analog television tuners and professional communications equipment.

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)



Marking code: L2-

Fig.1 Simplified outline and symbol.

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

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	$T_s \leq 102$ °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
$R_{th\ j\text{-}s}$	thermal resistance from junction to soldering point	240	K/W

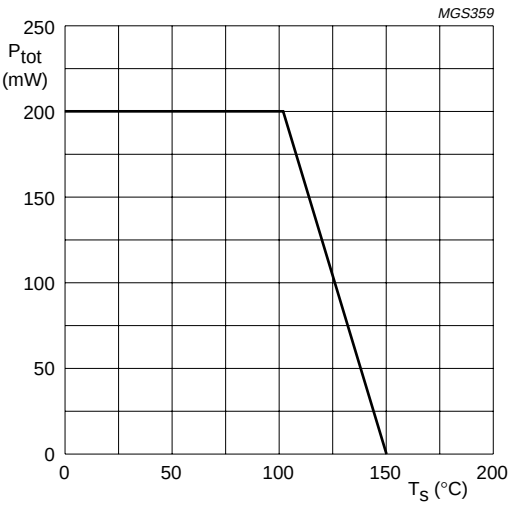


Fig.2 Power derating curve.

STATIC CHARACTERISTICS

T_j = 25 °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 μA	10	–	V
$V_{(BR)G1-SS}$	gate-source breakdown voltage	$V_{GS} = V_{DS} = 0$; I_{G1-S} = 10 mA	6	10	V
$V_{(BR)G2-SS}$	gate-source breakdown voltage	$V_{GS} = V_{DS} = 0$; I_{G2-S} = 10 mA	6	10	V
$V_{(F)S-G1}$	forward source-gate voltage	$V_{G2-S} = V_{DS} = 0$; I_{S-G1} = 10 mA	0.5	1.5	V
$V_{(F)S-G2}$	forward source-gate voltage	$V_{G1-S} = V_{DS} = 0$; I_{S-G2} = 10 mA	0.5	1.5	V
$V_{G1-S(th)}$	gate-source threshold voltage	V_{DS} = 5 V; V_{G2-S} = 4 V; I_D = 100 μA	0.3	1	V
$V_{G2-S(th)}$	gate-source threshold voltage	V_{DS} = 5 V; V_{G1-S} = 4 V; I_D = 100 μA	0.3	1.2	V
I_{DSX}	drain-source current	amp. a: V_{G2-S} = 4 V; V_{DS} = 5 V; R_G = 62 kΩ; note 1	11	19	mA
		amp. b: V_{G2-S} = 4 V; V_{DS} = 5 V; R_G = 120 kΩ; note 1	8	16	mA
I_{G1-S}	gate cut-off current	V_{G1-S} = 5 V; $V_{G2-S} = V_{DS} = 0$	–	50	nA
I_{G2-S}	gate cut-off current	V_{G2-S} = 5 V; $V_{G1-S} = V_{DS} = 0$	–	20	nA

Note

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

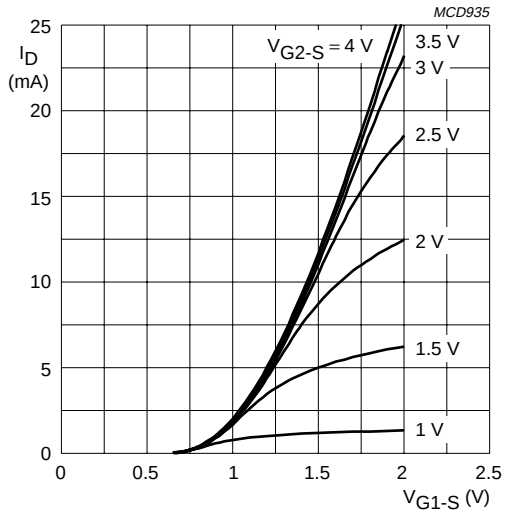
DYNAMIC CHARACTERISTICS AMPLIFIER a

Common source; T_{amb} = 25 °C; V_{G2-S} = 4 V; V_{DS} = 5 V; I_D = 15 mA; unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$\|y_{fs}\|$	forward transfer admittance	pulsed; T_j = 25 °C	23	28	35	mS
C_{ig1-ss}	input capacitance at gate 1	f = 1 MHz	–	2.6	3.1	pF
C_{ig2-ss}	input capacitance at gate 2	f = 1 MHz	–	3	–	pF
C_{oss}	output capacitance	f = 1 MHz	–	0.9	–	pF
C_{rss}	reverse transfer capacitance	f = 1 MHz	–	15	30	fF
F	noise figure	f = 10.7 MHz; G_S = 20 mS; B_S = 0	–	5	7	dB
		f = 400 MHz; $Y_S = Y_{S\ opt}$	–	1	1.8	dB
		f = 800 MHz; $Y_S = Y_{S\ opt}$	–	1.9	2.5	dB
G_{tr}	power gain	f = 200 MHz; G_S = 2 mS; $B_S = B_{S\ opt}$; G_L = 0.5 mS; $B_L = B_{L\ opt}$; note 1	–	32.5	–	dB
		f = 400 MHz; G_S = 2 mS; $B_S = B_{S\ opt}$; G_L = 1 mS; $B_L = B_{L\ opt}$; note 1	–	27	–	dB
		f = 800 MHz; G_S = 3.3 mS; $B_S = B_{S\ opt}$; G_L = 1 mS; $B_L = B_{L\ opt}$; note 1	–	21	–	dB
X_{mod}	cross-modulation	input level for k = 1%; f_w = 50 MHz; f_{unw} = 60 MHz; note 2				
		at 0 dB AGC	90	–	–	dBµV
		at 10 dB AGC	–	95	–	dBµV
		at 40 dB AGC	105	–	–	dBµV

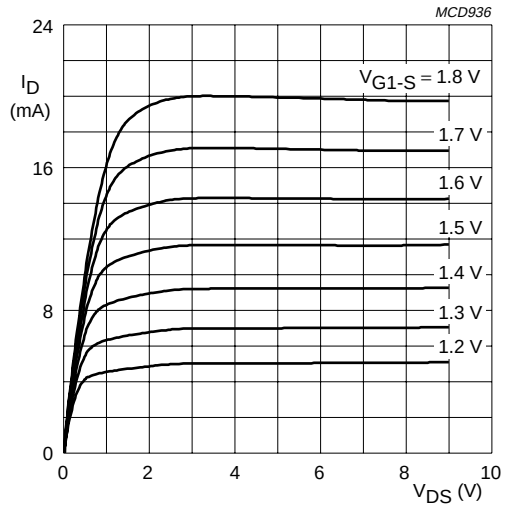
Notes

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



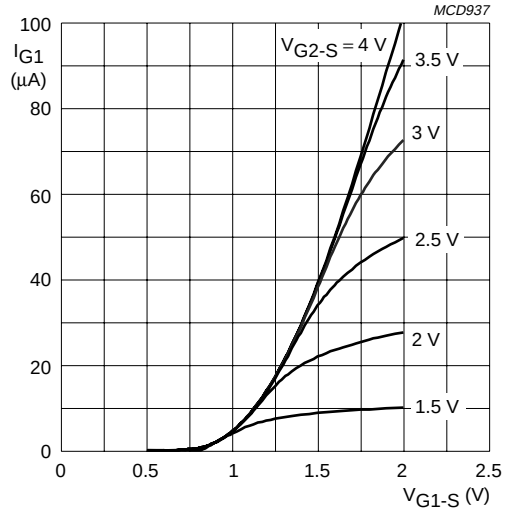
Amplifier a
V_{DS} = 5 V.
T_j = 25 °C.

Fig.3 Transfer characteristics; typical values.



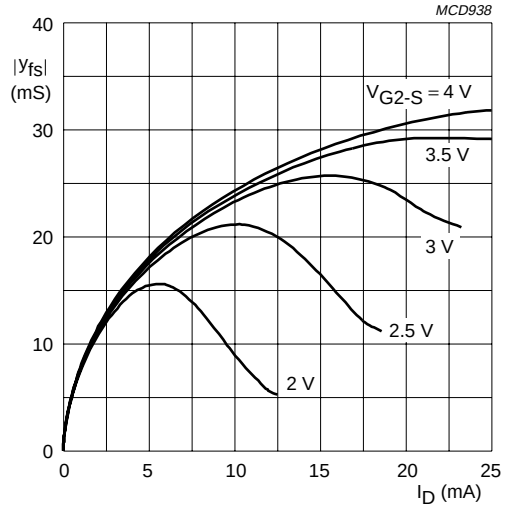
Amplifier a
V_{G2-S} = 4 V.
T_j = 25 °C.

Fig.4 Output characteristics; typical values.



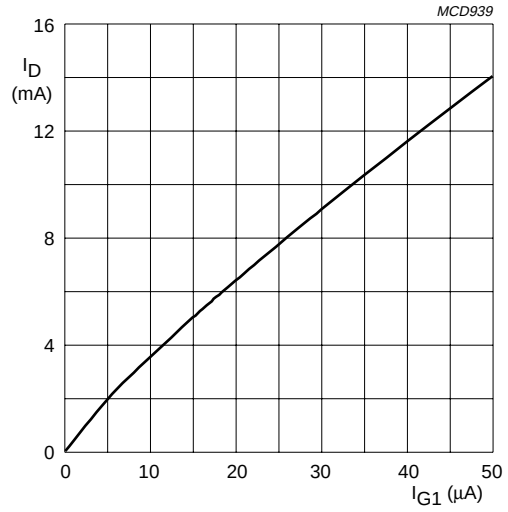
Amplifier a
V_{DS} = 5 V.
T_j = 25 °C.

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



Amplifier a
V_{DS} = 5 V.
T_j = 25 °C.

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

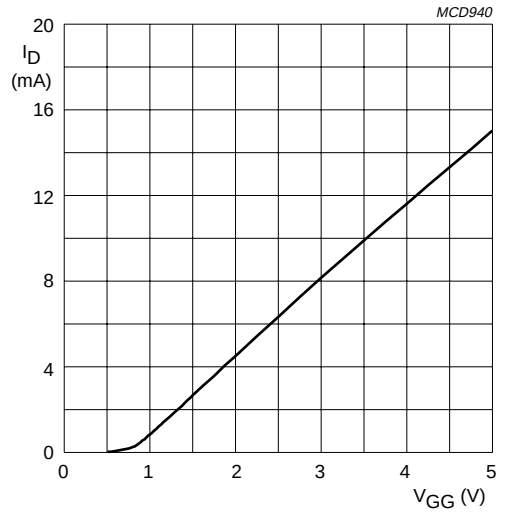


Amplifier a

V_{DS} = 5 V; $V_{G2\text{-}S}$ = 4 V.

T_j = 25 °C.

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

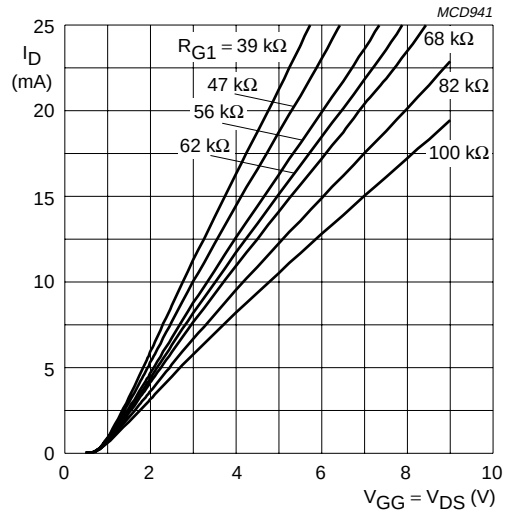


Amplifier a

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

R_{G1} = 62 kΩ (connected to V_{GG}); see Fig.35.

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

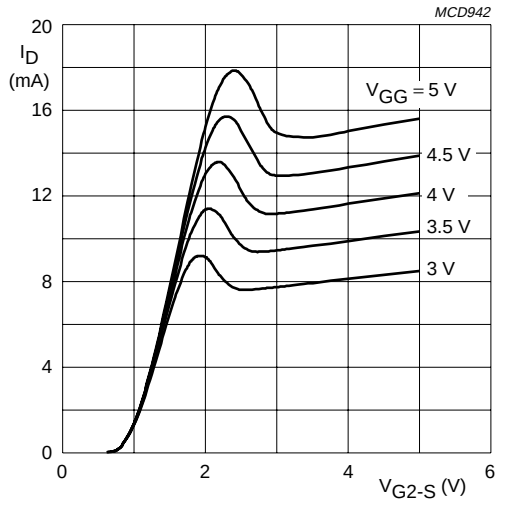


Amplifier a

$V_{G2\text{-}S}$ = 4 V; T_j = 25 °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.

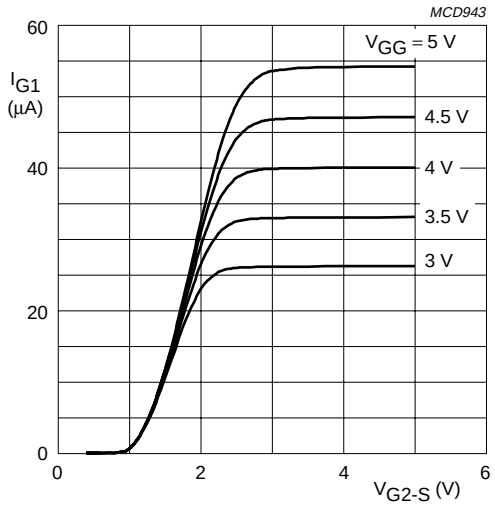


Amplifier a

V_{DS} = 5 V; T_j = 25 °C.

R_{G1} = 62 kΩ (connected to V_{GG}); see Fig.35.

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

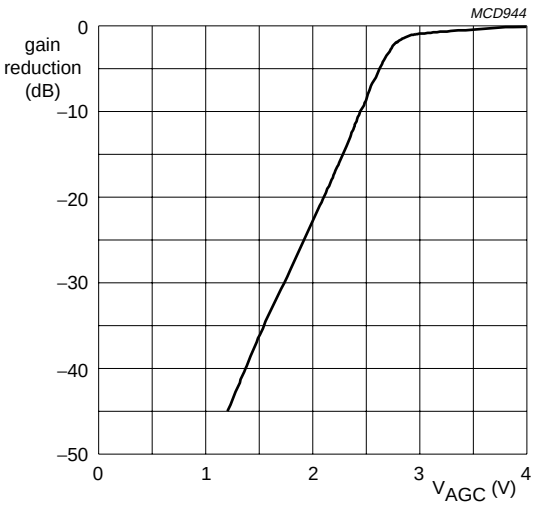


Amplifier a

V_{DS} = 5 V; T_j = 25 °C.

R_{G1} = 62 kΩ (connected to V_{GG}); see Fig.35.

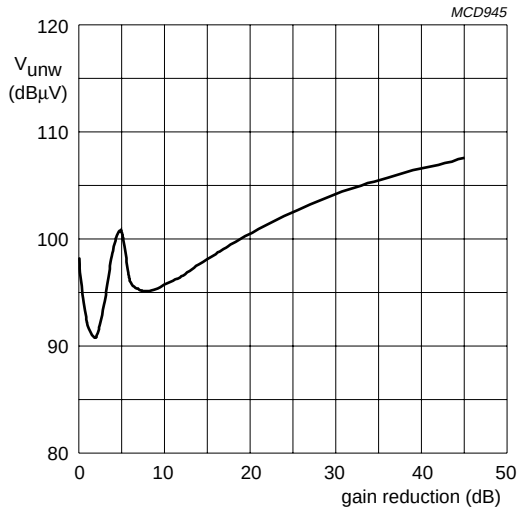
Fig.11 Gate 1 current as a function of gate 2 voltage; typical values.



Amplifier a

V_{DS} = 5 V; V_{GG} = 5 V; R_{G1} = 62 kΩ;
f = 50 MHz; T_{amb} = 25 °C.

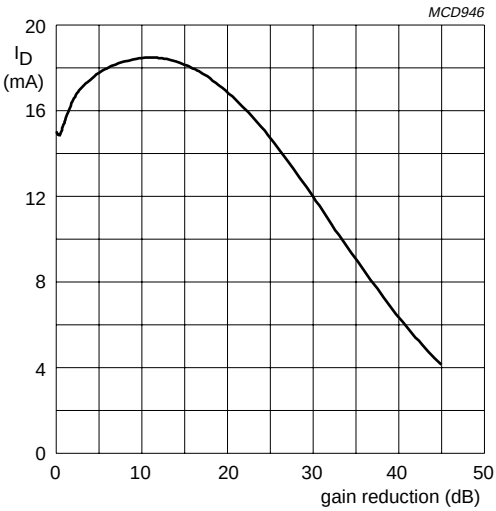
Fig.12 Typical gain reduction as a function of the AGC voltage; see Fig.35.



Amplifier a

V_{DS} = 5 V; V_{GG} = 5 V; R_{G1} = 62 kΩ; f = 50 MHz;
f_{unw} = 60 MHz; T_{amb} = 25 °C.

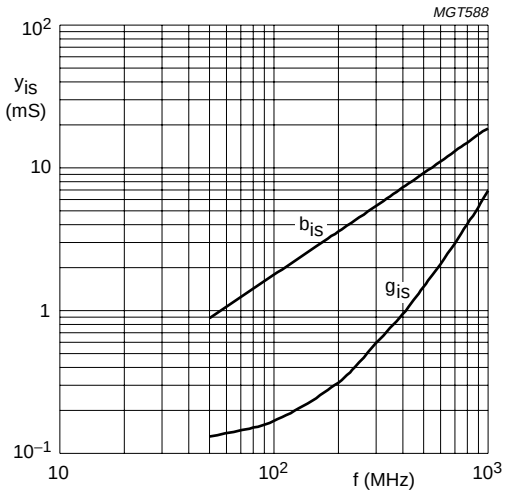
Fig.13 Unwanted voltage for 1% cross-modulation as a function of gain reduction; typical values; see Fig.35.



Amplifier a

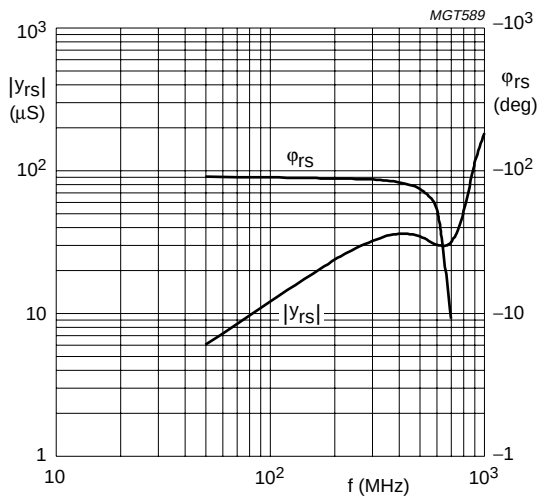
V_{DS} = 5 V; V_{GG} = 5 V; R_{G1} = 62 kΩ;
f = 50 MHz; T_{amb} = 25 °C.

Fig.14 Drain current as a function of gain reduction; typical values; see Fig.35.



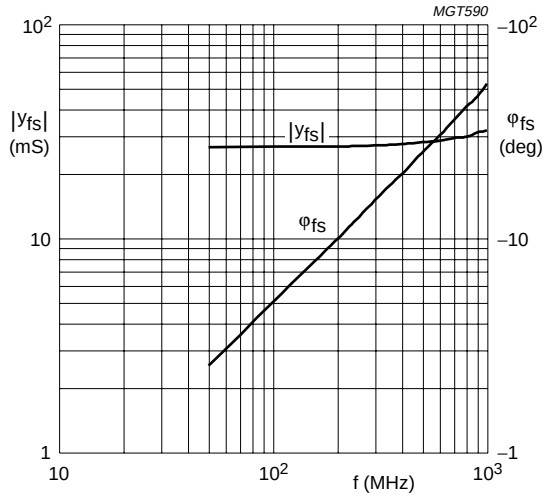
Amplifier a
V_{DS} = 5 V; V_{G2} = 4 V.
I_D = 15 mA; T_{amb} = 25 °C.

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



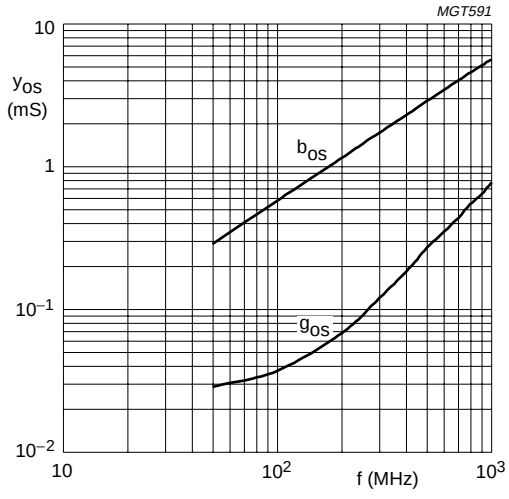
Amplifier a
V_{DS} = 5 V; V_{G2} = 4 V.
I_D = 15 mA; T_{amb} = 25 °C.

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 = 15 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 = 15 mA; T_{amb} = 25 °C.

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

Amplifier a scattering parameters

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

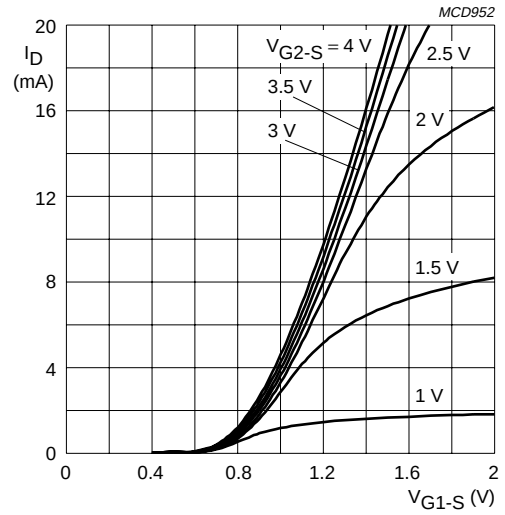
DYNAMIC CHARACTERISTICS AMPLIFIER b

Common source; T_{amb} = 25 °C; V_{G2-S} = 4 V; V_{DS} = 5 V; I_D = 12 mA; unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$\|y_{fs}\|$	forward transfer admittance	pulsed; T_j = 25 °C	25	30	40	mS
C_{ig1-ss}	input capacitance at gate 1	f = 1 MHz	–	1.7	2.2	pF
C_{ig2-ss}	input capacitance at gate 2	f = 1 MHz	–	4	–	pF
C_{oss}	output capacitance	f = 1 MHz	–	0.85	–	pF
C_{rss}	reverse transfer capacitance	f = 1 MHz	–	15	30	fF
F	noise figure	f = 10.7 MHz; G_S = 20 mS; B_S = 0	–	9	11	dB
		f = 400 MHz; $Y_S = Y_{S\ opt}$	–	0.9	1.5	dB
		f = 800 MHz; $Y_S = Y_{S\ opt}$	–	1.1	1.8	dB
G_{tr}	power gain	f = 200 MHz; G_S = 2 mS; $B_S = B_{S\ opt}$; G_L = 0.5 mS; $B_L = B_{L\ opt}$; note 1	–	34	–	dB
		f = 400 MHz; G_S = 2 mS; $B_S = B_{S\ opt}$; G_L = 1 mS; $B_L = B_{L\ opt}$; note 1	–	30	–	dB
		f = 800 MHz; G_S = 3.3 mS; $B_S = B_{S\ opt}$; G_L = 1 mS; $B_L = B_{L\ opt}$; note 1	–	25	–	dB
X_{mod}	cross-modulation	input level for k = 1%; f_w = 50 MHz; f_{unw} = 60 MHz; note 2				
		at 0 dB AGC	90	–	–	dBµV
		at 10 dB AGC	–	92	–	dBµV
		at 40 dB AGC	100	105	–	dBµV

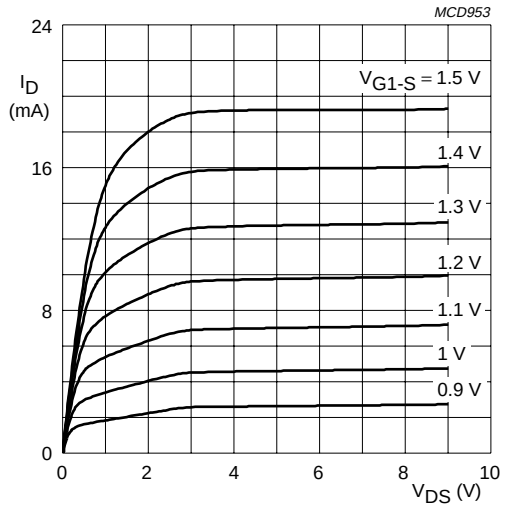
Notes

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



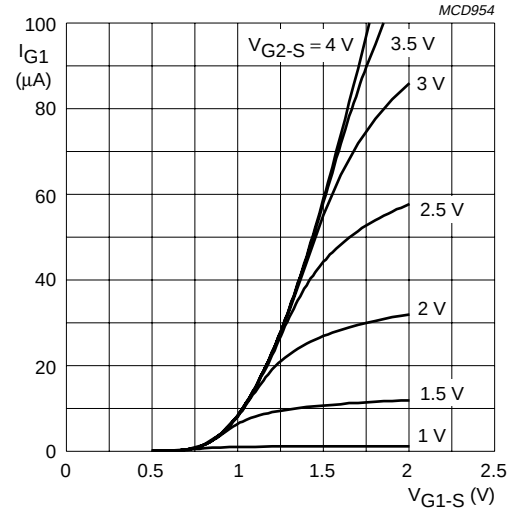
Amplifier b
V_{DS} = 5 V.
T_j = 25 °C.

Fig.19 Transfer characteristics; typical values.



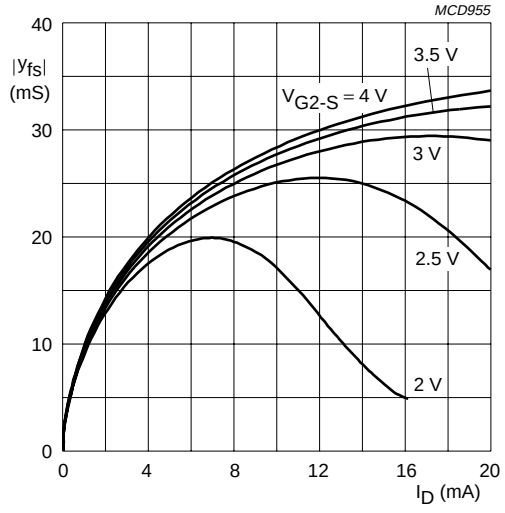
Amplifier b
V_{G2-S} = 4 V.
T_j = 25 °C.

Fig.20 Output characteristics; typical values.



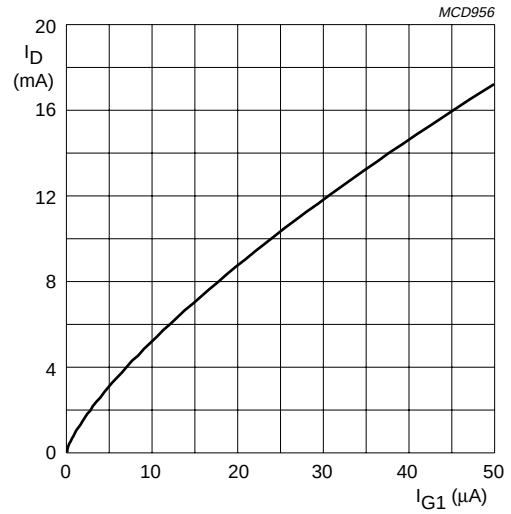
Amplifier b
V_{DS} = 5 V.
T_j = 25 °C.

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



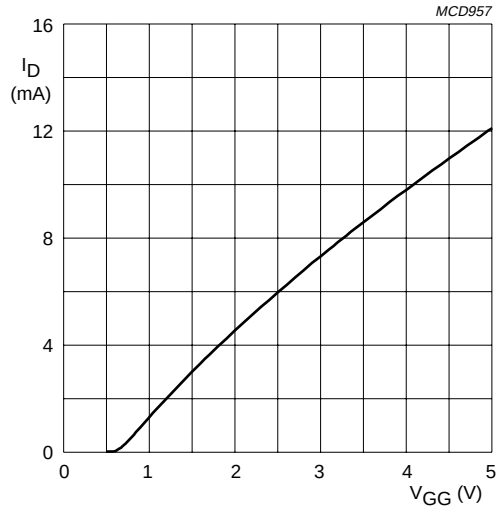
Amplifier b
V_{DS} = 5 V.
T_j = 25 °C.

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



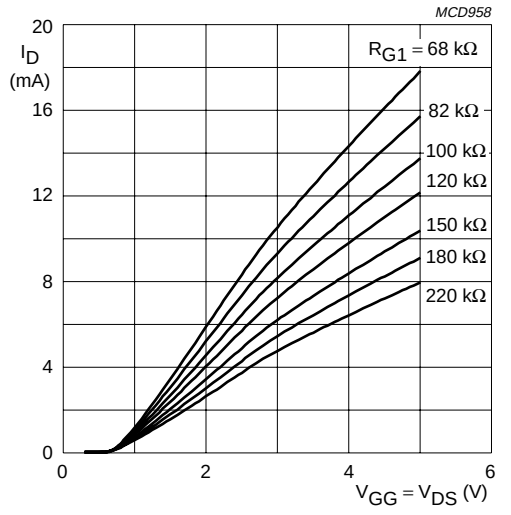
Amplifier b
V_{DS} = 5 V; $V_{G2\text{-}S}$ = 4 V.
T_j = 25 °C.

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



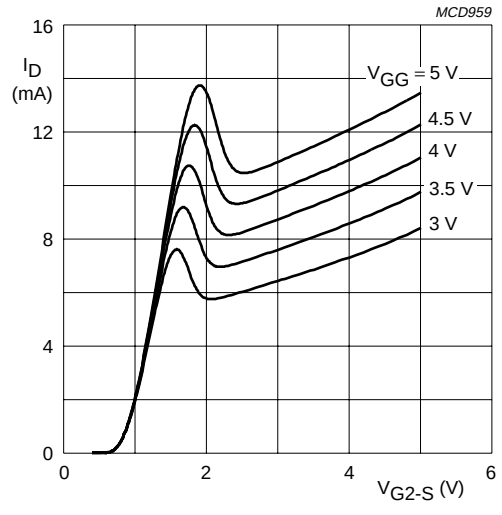
Amplifier b
V_{DS} = 5 V; $V_{G2\text{-}S}$ = 4 V; T_j = 25 °C.
R_{G1} = 120 kΩ (connected to V_{GG}); see Fig.35.

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



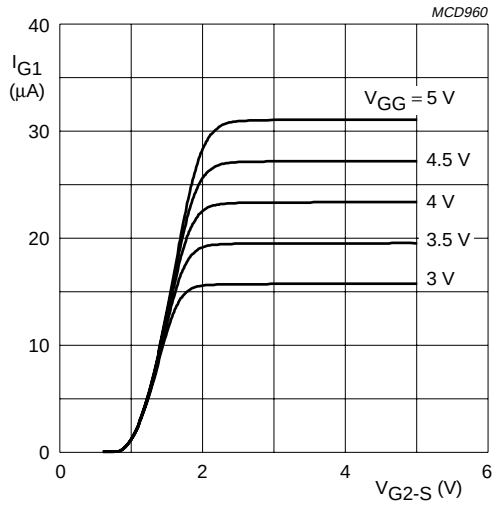
Amplifier b
$V_{G2\text{-}S}$ = 4 V; T_j = 25 °C.
R_{G1} connected to V_{GG}; see Fig.35.

Fig.25 Drain current as a function of gate 1 (= V_{GG}) and drain supply voltage; typical values.



Amplifier b
V_{DS} = 5 V; T_j = 25 °C.
R_{G1} = 120 kΩ (connected to V_{GG}); see Fig.35.

Fig.26 Drain current as a function of gate 2 voltage; typical values.

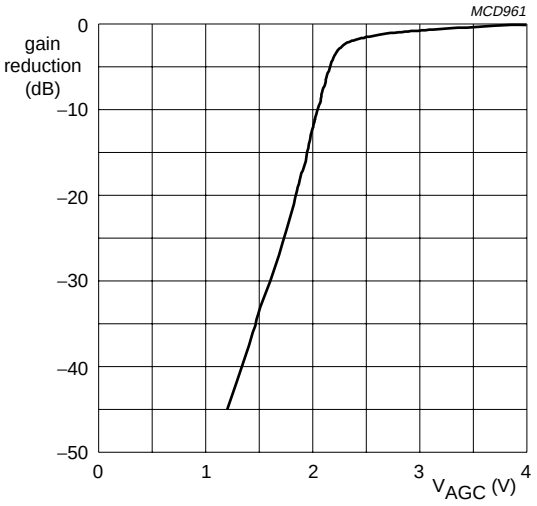


Amplifier b

V_{DS} = 5 V; T_j = 25 °C.

R_{G1} = 120 kΩ (connected to V_{GG}); see Fig.35.

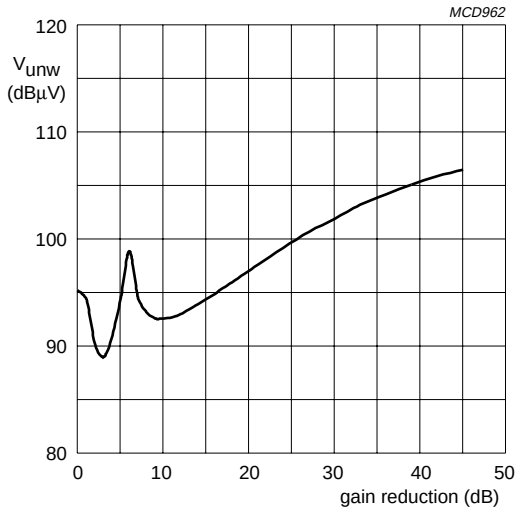
Fig.27 Gate 1 current as a function of gate 2 voltage; typical values.



Amplifier b

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

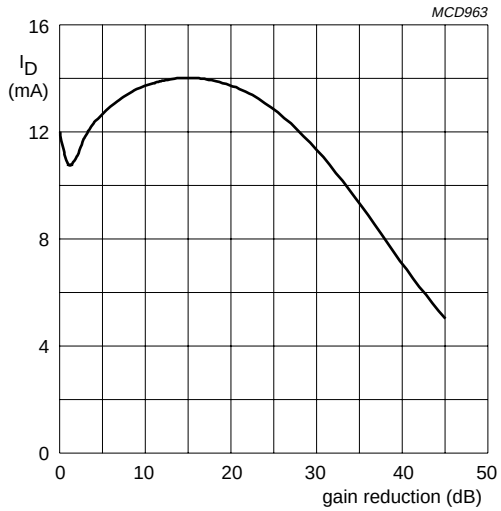
Fig.28 Typical gain reduction as a function of the AGC voltage; see Fig.35.



Amplifier b

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

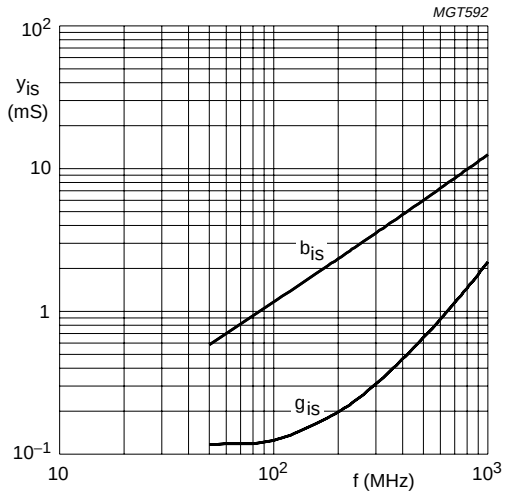
Fig.29 Unwanted voltage for 1% cross-modulation as a function of gain reduction; typical values; see Fig.35.



Amplifier b

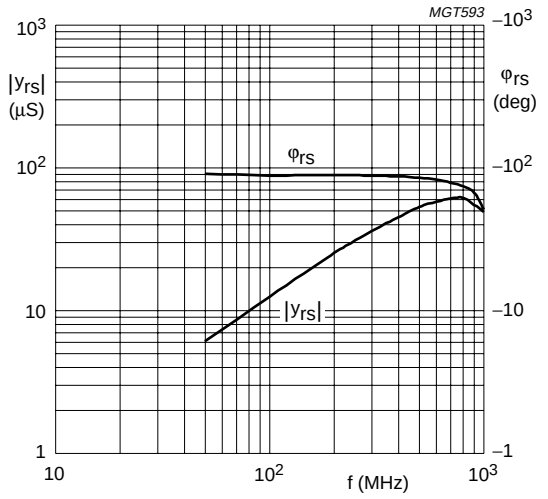
V_{DS} = 5 V; V_{GG} = 5 V; R_{G1} = 120 kΩ;
f = 50 MHz; T_{amb} = 25 °C.

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



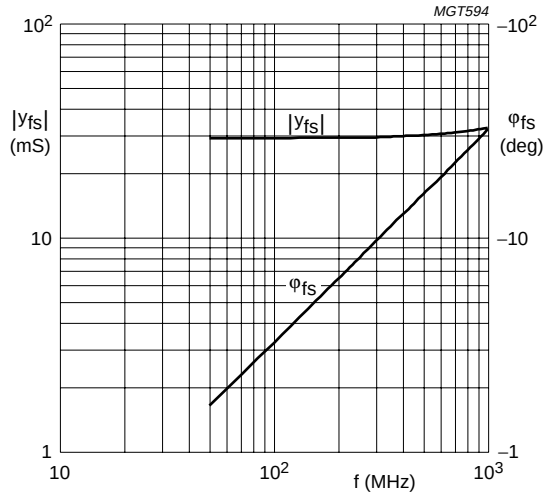
Amplifier b
V_{DS} = 5 V; V_{G2} = 4 V.
I_D = 12 mA; T_{amb} = 25 °C.

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



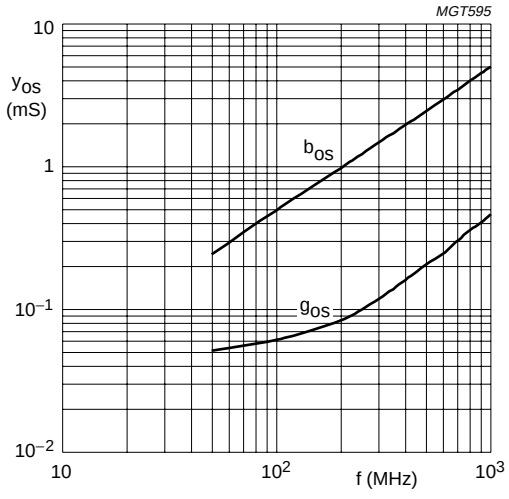
Amplifier b
V_{DS} = 5 V; V_{G2} = 4 V.
I_D = 12 mA; T_{amb} = 25 °C.

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



Amplifier b
V_{DS} = 5 V; V_{G2} = 4 V.
I_D = 12 mA; T_{amb} = 25 °C.

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



Amplifier b
V_{DS} = 5 V; V_{G2} = 4 V.
I_D = 12 mA; T_{amb} = 25 °C.

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

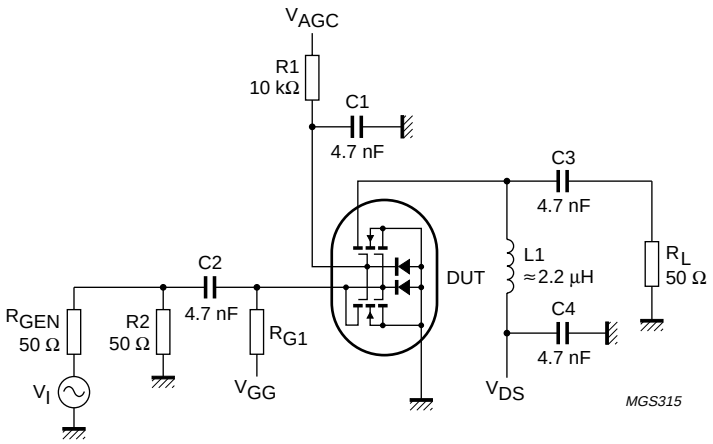


Fig.35 Cross-modulation test set-up (for one MOS-FET).

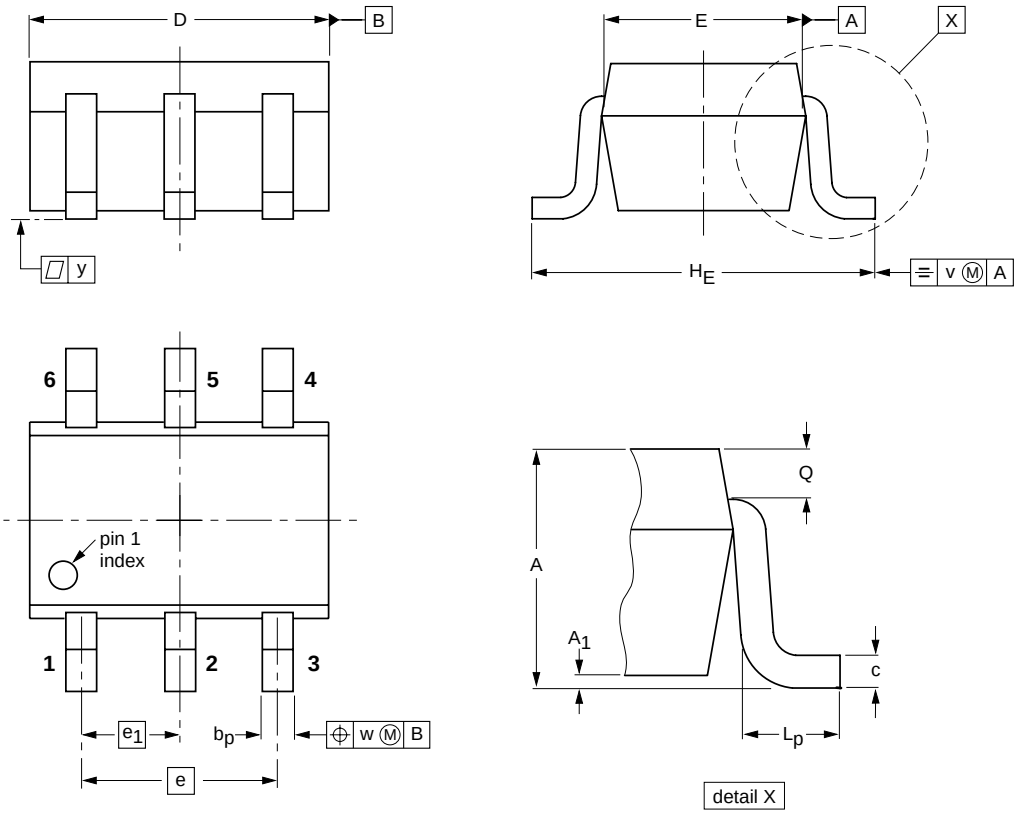
Amplifier b scattering parameters

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

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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