BB304M

Build in Biasing Circuit MOS FET IC
UHF/VHF RF Amplifier

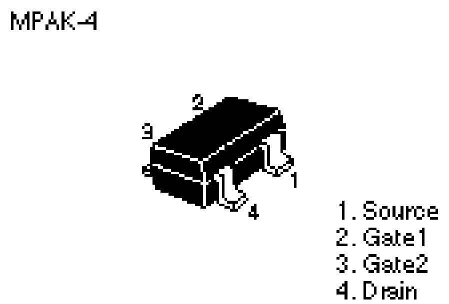
HITACHI

ADE-208-605C (Z)
4th. Edition
August 1998

Features

- Build in Biasing Circuit; To reduce using parts cost & PC board space.
- High gain;
  (PG = 29 dB typ. at f = 200 MHz)
- Low noise characteristics;
  (NF = 1.2 dB typ. at f = 200 MHz)
- Wide supply voltage range;
  Applicable with 5V to 9V supply voltage.
- Withstanding to ESD;
  Build in ESD absorbing diode. Withstand up to 200V at C=200pF, Rs=0 conditions.
  Provide mini mold packages; MPAK-4(SOT-143mod)

Outline



Note: 1. Marking is “DW–”.
2. BB304M is individual type number of HITACHI BBFET.

Hitachi semiconductor

Absolute Maximum Ratings (Ta = 25°C)

Item	Symbol	Ratings	Unit
Drain to source voltage	V_{DS}	12	V
Gate1 to source voltage	V_{G1S}	+10 –0	V
Gate2 to source voltage	V_{G2S}	±10	V
Drain current	I_D	25	mA
Channel power dissipation	Pch	150	mW
Channel temperature	Tch	150	°C
Storage temperature	Tstg	–55 to +150	°C

Electrical Characteristics (Ta = 25°C)

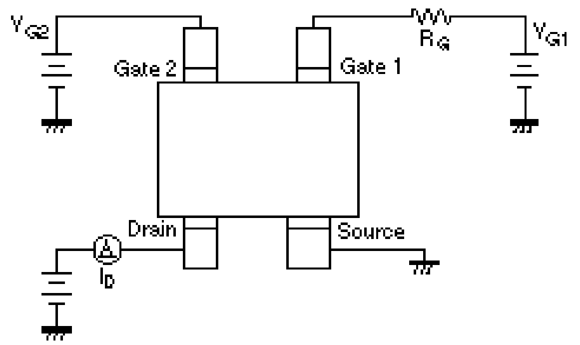
Item	Symbol	Min	Typ	Max	Unit	Test Conditions
Drain to source breakdown voltage	$V_{(BR)DSS}$	12	—	—	V	I_D = 200μA, V_{G1S} = V_{G2S} = 0
Gate1 to source breakdown voltage	$V_{(BR)G1SS}$	+10	—	—	V	I_{G1} = +10μA, V_{G2S} = V_{DS} = 0
Gate2 to source breakdown voltage	$V_{(BR)G2SS}$	±10	—	—	V	I_{G2} = ±10μA, V_{G1S} = V_{DS} = 0
Gate1 to source cutoff current	I_{G1SS}	—	—	+100	nA	V_{G1S} = +9V, V_{G2S} = V_{DS} = 0
Gate2 to source cutoff current	I_{G2SS}	—	—	±100	nA	V_{G2S} = ±9V, V_{G1S} = V_{DS} = 0
Gate1 to source cutoff voltage	$V_{G1S(off)}$	0.4	—	1.0	V	V_{DS} = 5V, V_{G2S} = 4V I_D = 100μA
Gate2 to source cutoff voltage	$V_{G2S(off)}$	0.5	—	1.0	V	V_{DS} = 5V, V_{G1S} = 5V I_D = 100μA

Electrical Characteristics (Ta = 25°C)

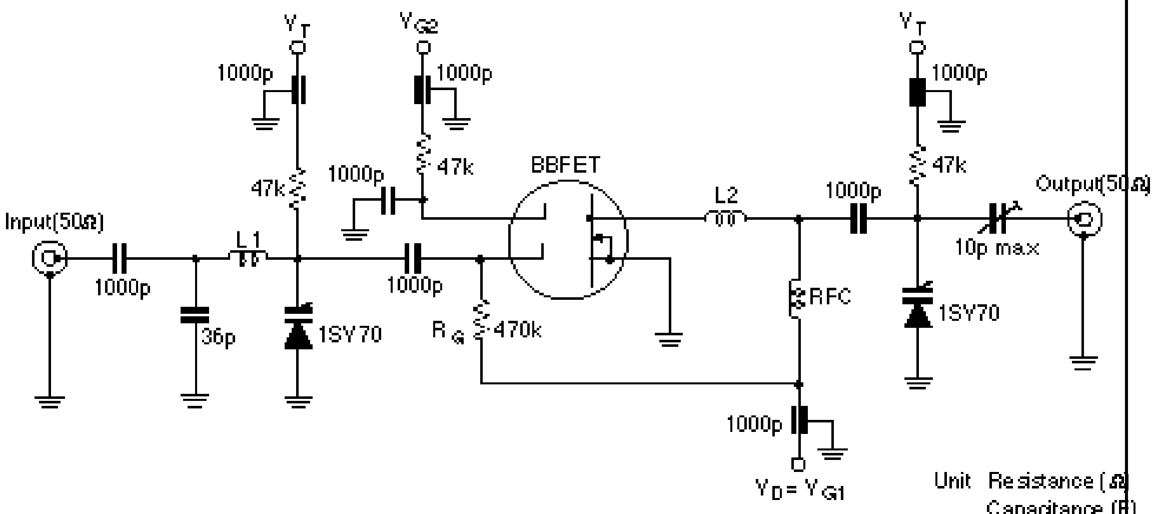
Item	Symbol	Min	Typ	Max	Unit	Test Conditions
Input capacitance	c_{iss}	2.3	2.8	3.6	pF	V_{DS} = 5V, V_{G1} = 5V, V_{G2S} =4V R_G = 180kΩ, f = 1MHz
Output capacitance	c_{oss}	0.9	1.3	2.0	pF	
Reverse transfer capacitance	c_{rss}	0.003	0.02	0.05	pF	
Drain current	$I_{D(op)}$ 1	9	15	19	mA	V_{DS} = 5V, V_{G1} = 5V, V_{G2S} = 4V R_G = 180kΩ
	$I_{D(op)}$ 2	—	13	—	mA	V_{DS} = 9V, V_{G1} = 9V, V_{G2S} =6V R_G = 470kΩ
Forward transfer admittance	$|y_{fs}|$1	22	27	34	mS	V_{DS} = 5V, V_{G1} = 5V, V_{G2S} =4V R_G = 180kΩ, f = 1kHz
	$|y_{fs}|$2	—	27	—	mS	V_{DS} = 9V, V_{G1} = 9V, V_{G2S} =6V R_G = 470kΩ, f = 1kHz
Power gain	PG1	24	29	32	dB	V_{DS} = 5V, V_{G1} = 5V, V_{G2S} =4V R_G = 180kΩ, f = 200MHz
	PG2	—	29	—	dB	V_{DS} = 9V, V_{G1} = 9V, V_{G2S} =6V R_G = 470kΩ, f = 200MHz
Noise figure	NF1	—	1.2	1.9	dB	V_{DS} = 5V, V_{G1} = 5V, V_{G2S} =4V R_G = 180kΩ, f = 200MHz
	NF2	—	1.2	—	dB	V_{DS} = 9V, V_{G1} = 9V, V_{G2S} =6V R_G = 470kΩ, f = 200MHz

Main Characteristics

Test Circuit for Operating Items ($I_{D(op)}$, |yfs|, Ciss, Coss, Crss, NF, PG)

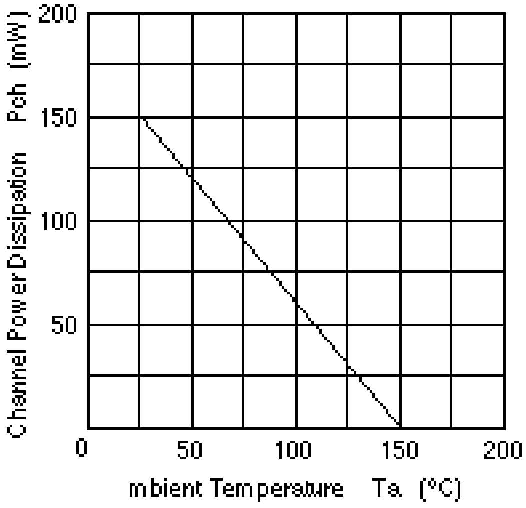


Power Gain, Noise Figure Test Circuit

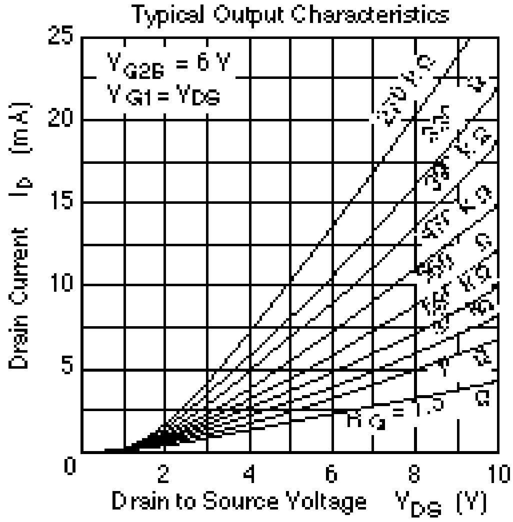


L1 : φ1mm Enameled Copper Wire, Inside dia 10mm, 2Turns
L2 : φ1mm Enameled Copper Wire, Inside dia 10mm, 2Turns
RFC : φ1mm Enameled Copper Wire, Inside dia 5mm, 2Turns

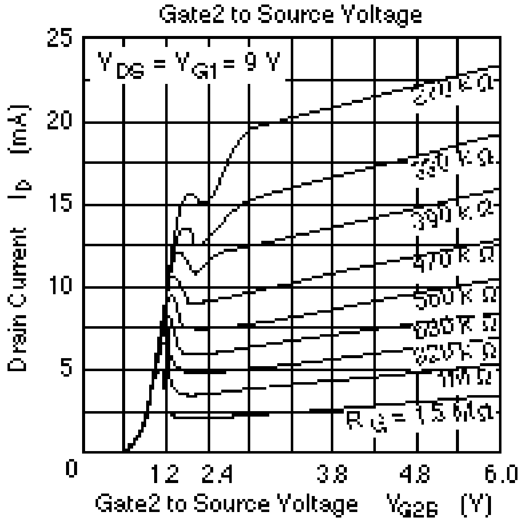
Maximum Channel Power Dissipation Curve



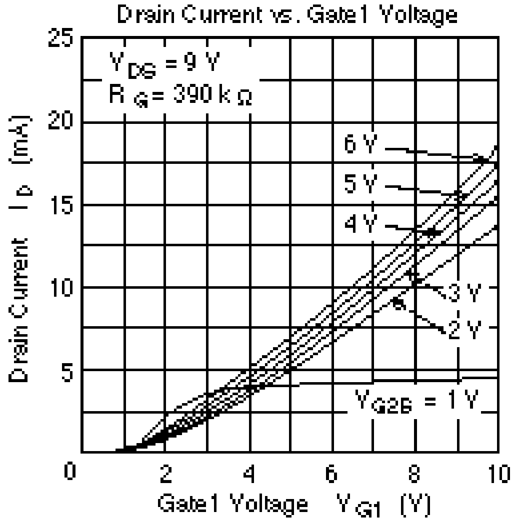
Typical Output Characteristics

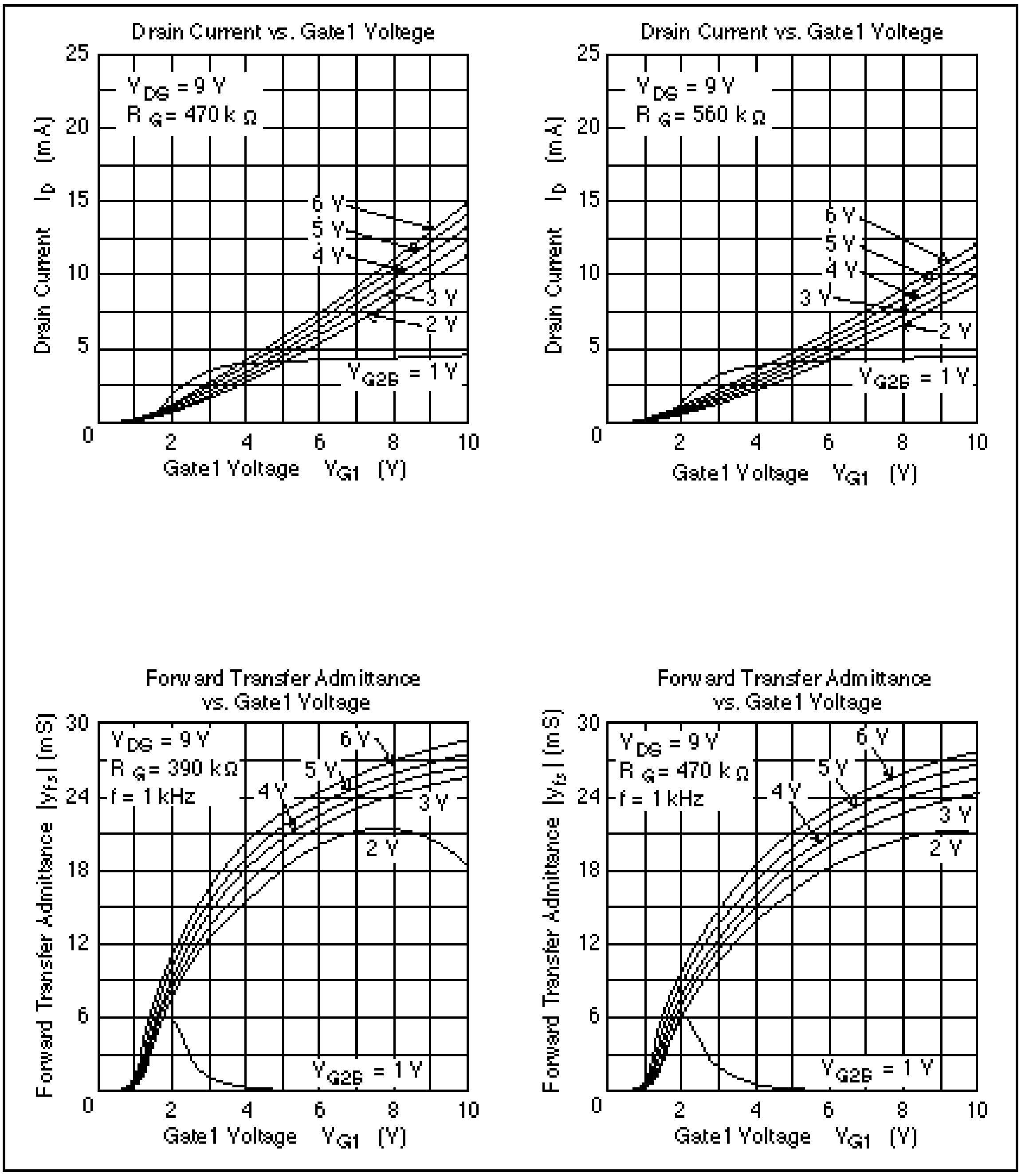


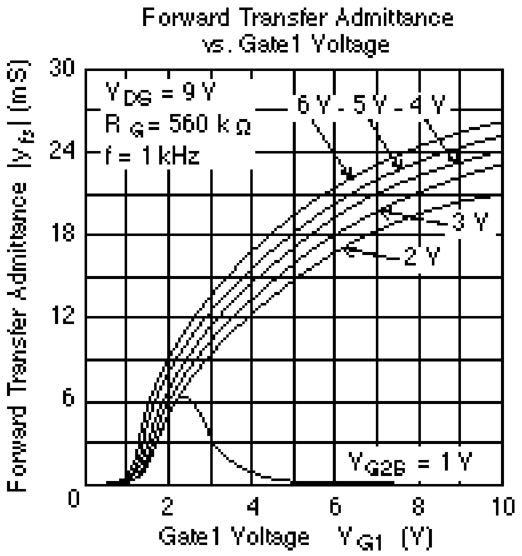
Drain Current vs. Gate2 to Source Voltage

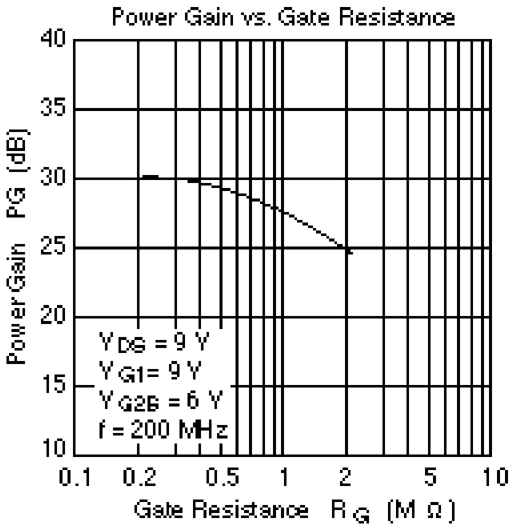


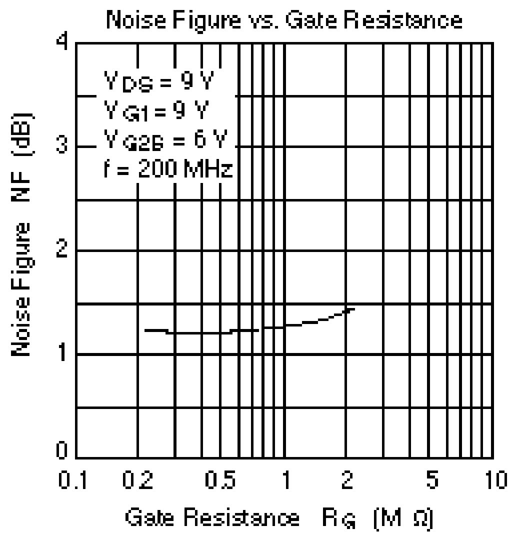
Drain Current vs. Gate1 Voltage

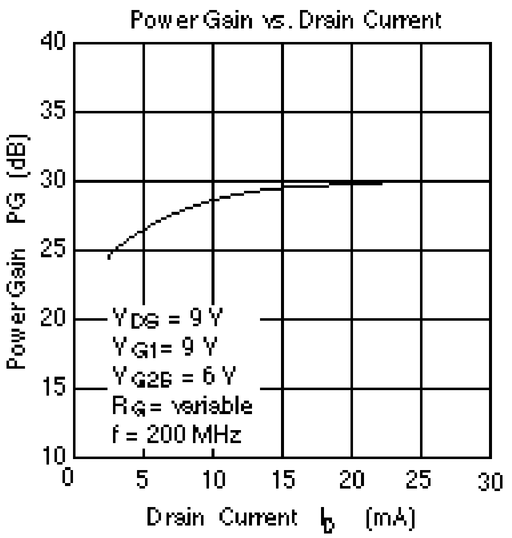


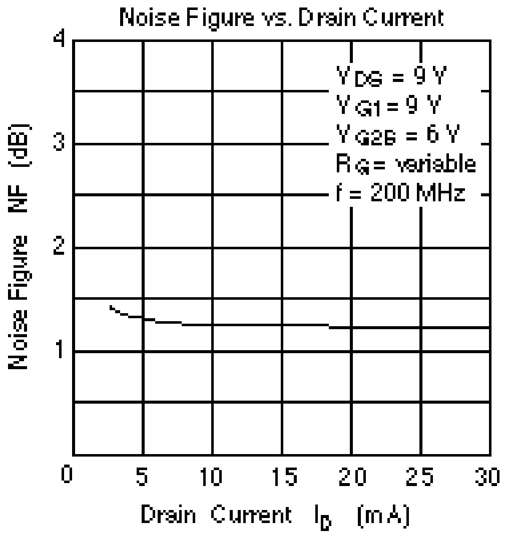

Drain Current vs. Gate1 Voltege
V_DS = 9 V
R_G = 470 k Ω
6 V
5 V
4 V
3 V
2 V
V_G2S = 1 V
Drain Current I_D (mA)
Gate1 Voltage V_G1 (V)
Drain Current vs. Gate1 Voltege
V_DS = 9 V
R_G = 560 k Ω
6 V
5 V
4 V
3 V
2 V
V_G2S = 1 V
Drain Current I_D (mA)
Gate1 Voltage V_G1 (V)
Forward Transfer Admittance vs. Gate1 Voltage
V_DS = 9 V
R_G = 390 k Ω
f = 1 kHz
6 V
5 V
4 V
3 V
2 V
V_G2S = 1 V
Forward Transfer Admittance |y_fs| (mS)
Gate1 Voltage V_G1 (V)
Forward Transfer Admittance vs. Gate1 Voltage
V_DS = 9 V
R_G = 470 k Ω
f = 1 kHz
6 V
5 V
4 V
3 V
2 V
V_G2S = 1 V
Forward Transfer Admittance |y_fs| (mS)
Gate1 Voltage V_G1 (V)

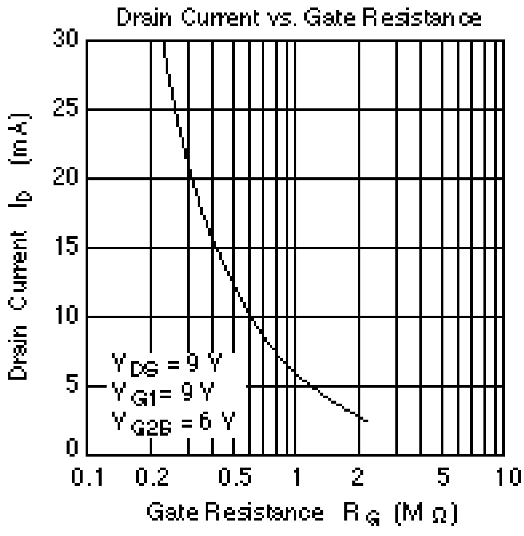

Forward Transfer Admittance vs. Gate1 Voltage
Forward Transfer Admittance |yfs| (mS)
Gate1 Voltage VG1 (V)
VDS = 9 V
RG = 560 kΩ
f = 1 kHz
6 V
5 V
4 V
3 V
2 V
VG2S = 1 V
0
6
12
18
24
30
2
4
6
8
10

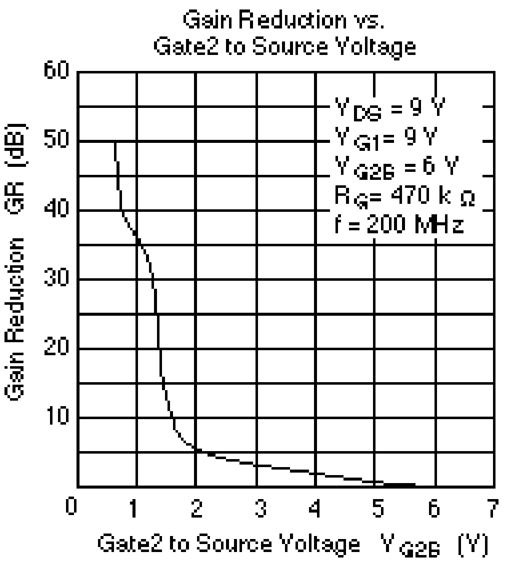

Power Gain vs. Gate Resistance
Power Gain PG (dB)
Gate Resistance RG (M Ω)
VDS = 9 V
VG1 = 9 V
VG2S = 6 V
f = 200 MHz
10
15
20
25
30
35
40
0.1
0.2
0.5
1
2
5
10

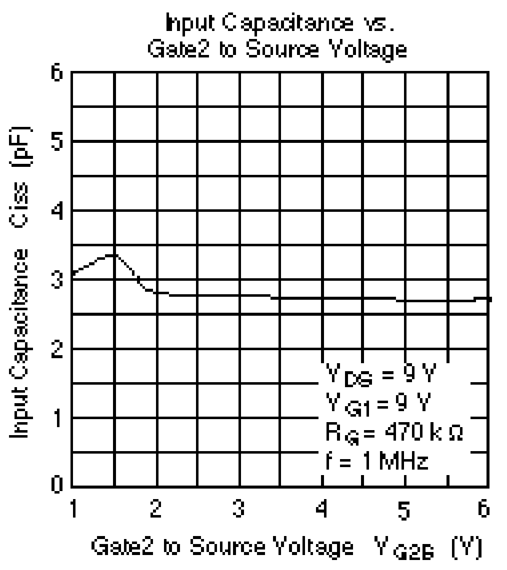

Noise Figure vs. Gate Resistance
Noise Figure NF (dB)
Gate Resistance RG (M Ω)
VDS = 9 V
VG1 = 9 V
VG2S = 6 V
f = 200 MHz
0
1
2
3
4
0.1
0.2
0.5
1
2
5
10


Power Gain vs. Drain Current
Power Gain PG (dB)
Drain Current ID (mA)
VDS = 9 V
VG1 = 9 V
VG2S = 6 V
RG = variable
f = 200 MHz
10
15
20
25
30
35
40
0
5
10
15
20
25
30

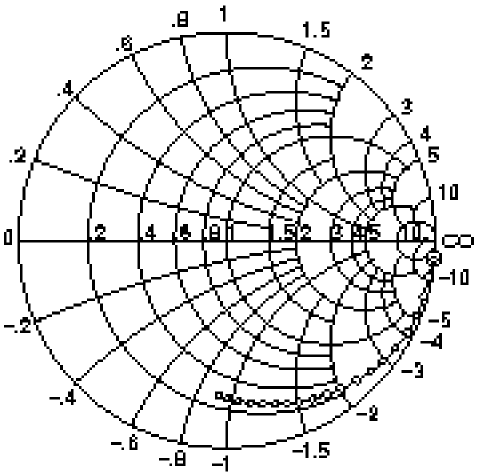

Noise Figure vs. Drain Current
Noise Figure NF (dB)
Drain Current ID (mA)
VDS = 9 V
VG1 = 9 V
VG2S = 6 V
RG = variable
f = 200 MHz
0
1
2
3
4
5
10
15
20
25
30


Drain Current vs. Gate Resistance
Drain Current ID (mA)
Gate Resistance RG (M Ω)
VDS = 9 V
VG1 = 9 V
VG2S = 6 V
0
5
10
15
20
25
30
0.1
0.2
0.5
1
2
5
10


Gain Reduction vs.
Gate2 to Source Voltage
Gain Reduction GR (dB)
Gate2 to Source Voltage VG2S (V)
VDS = 9 V
VG1 = 9 V
VG2S = 6 V
RG = 470 k Ω
f = 200 MHz
0
10
20
30
40
50
60
1
2
3
4
5
6
7

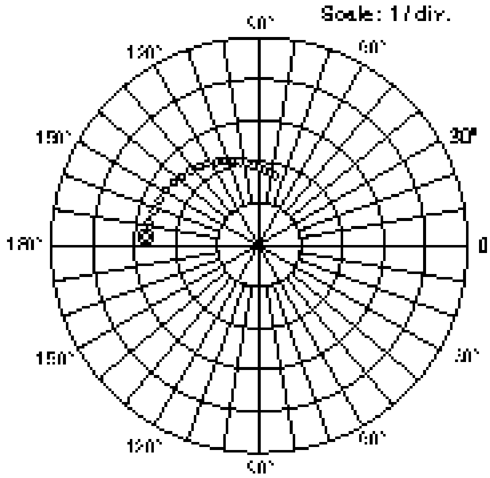

Input Capacitance vs.
Gate2 to Source Voltage
Input Capacitance Ciss (pF)
Gate2 to Source Voltage VG2S (V)
VDS = 9 V
VG1 = 9 V
RG = 470 k Ω
f = 1 MHz
0
1
2
3
4
5
6
1
2
3
4
5
6

S11 Parameter vs. Frequency



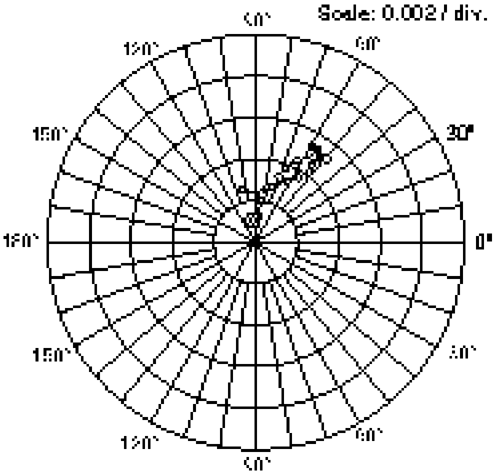
Test Condition : V_{DS} = 9 V , V_{G1} = 9 V
V_{G2S} = 6 V , R_G = 470 k Ω
50 to 1000 MHz (50 MHz step)

S21 Parameter vs. Frequency



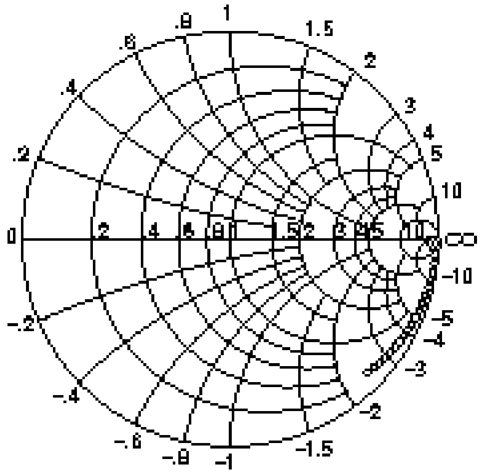
Test Condition : V_{DS} = 9 V , V_{G1} = 9 V
V_{G2S} = 6 V , R_G = 470 k Ω
50 to 1000 MHz (50 MHz step)

S12 Parameter vs. Frequency



Test Condition : V_{DS} = 9 V , V_{G1} = 9 V
V_{G2S} = 6 V , R_G = 470 k Ω
50 to 1000 MHz (50 MHz step)

S22 Parameter vs. Frequency



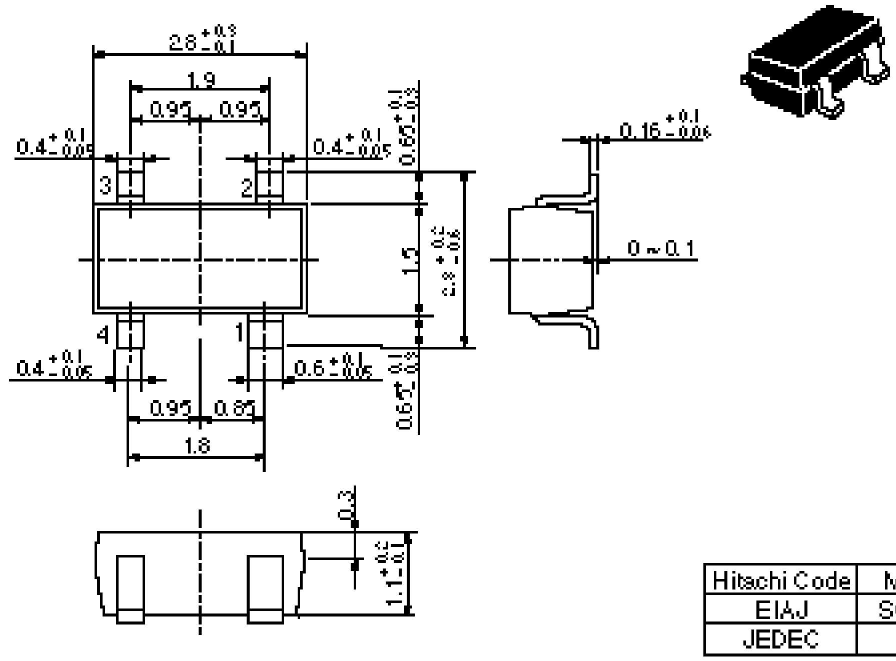
Test Condition : V_{DS} = 9 V , V_{G1} = 9 V
V_{G2S} = 6 V , R_G = 470 k Ω
50 to 1000 MHz (50 MHz step)

Sparameter (V_{DS} = V_{G1} = 9V, V_{G2S} = 6V, R_G = 470kΩ, Zo = 50Ω)

	S11		S21		S12		S22	
f (MHz)	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
50	0.996	–5.3	2.74	174.0	0.00096	98.6	0.985	–1.9
100	0.993	–10.9	2.73	168.0	0.00130	84.4	0.991	–4.5
150	0.987	–16.6	2.68	162.3	0.00203	83.6	0.990	–6.5
200	0.978	–21.9	2.66	156.3	0.00285	72.3	0.988	–9.4
250	0.972	–27.4	2.63	150.4	0.00335	69.7	0.985	–11.6
300	0.954	–33.2	2.57	144.3	0.00385	68.3	0.982	–14.0
350	0.943	–38.2	2.50	138.7	0.00455	63.2	0.979	–16.2
400	0.925	–43.2	2.43	133.3	0.00488	55.4	0.975	–18.4
450	0.910	–48.0	2.37	128.0	0.00526	59.8	0.971	–21.0
500	0.893	–52.5	2.30	122.6	0.00522	56.1	0.967	–23.0
550	0.880	–57.4	2.24	117.5	0.00498	53.2	0.962	–25.2
600	0.861	–62.1	2.17	112.7	0.00512	49.1	0.957	–27.3
650	0.847	–66.1	2.10	108.1	0.00497	53.4	0.952	–29.4
700	0.829	–69.9	2.02	103.6	0.00455	53.6	0.947	–31.6
750	0.816	–74.1	1.96	99.1	0.00418	51.6	0.943	–33.7
800	0.804	–78.2	1.91	94.8	0.00372	55.7	0.937	–35.8
850	0.791	–82.4	1.85	80.4	0.00329	62.4	0.933	–38.0
900	0.779	–86.1	1.79	86.3	0.00275	73.0	0.928	–40.0
950	0.764	–89.5	1.73	82.2	0.00233	82.4	0.921	–42.1
1000	0.753	–92.4	1.68	78.3	0.00258	105.1	0.918	–44.2

Package Dimensions

Unit: mm



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HITACHI

Hitachi, Ltd.
Semiconductor & IC Div.
Nippon Bldg., 2-6-2, Ohte-machi, Chiyoda-ku, Tokyo 100-0004, Japan
Tel: Tokyo (03) 3270-2111 Fax: (03) 3270-5109

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For further information write to:

Hitachi Semiconductor (America) Inc.
2000 Sierra Point Parkway
Brisbane, CA. 94005-1897
Tel: <1> (800) 285-1601
Fax: <1> (303) 297-0447

Hitachi Europe GmbH
Electronic components Group
Dornacher Straße 3
D-85622 Feldkirchen, Munich
Germany
Tel: <49> (89) 9 9180-0
Fax: <49> (89) 9 29 30 00

Hitachi Europe Ltd.
Electronic Components Group.
Whitebrook Park
Lower Cookham Road
Maidenhead
Berkshire SL6 8YA, United Kingdom
Tel: <44> (1628) 585000
Fax: <44> (1628) 778322

Hitachi Asia Pte Ltd.
16 Collyer Quay #20-00
Hitachi Tower
Singapore 049318
Tel: 535-2100
Fax: 535-1533

Hitachi Asia Ltd.
Taipei Branch Office
3F, Hung Kuo Building. No.167,
Tun-Hwa North Road, Taipei (105)
Tel: <886> (2) 2718-3666
Fax: <886> (2) 2718-8180

Hitachi Asia (Hong Kong) Ltd.
Group III (Electronic Components)
7/F., North Tower, World Finance Centre,
Harbour City, Canton Road, Tsim Sha Tsui,
Kowloon, Hong Kong
Tel: <852> (2) 735 9218
Fax: <852> (2) 730 0281
Telex: 40815 HITEC HX