

# BB404M

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

# HITACHI

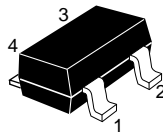
ADE-208-717A (Z)  
2nd. Edition  
Dec. 1998

### 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-4R(SOT-143 var.)

### Outline

MPAK-4R



1. Source
2. Drain
3. Gate2
4. Gate1

Notes: 1. Marking is "DX-".

2. BB404M is individual type number of HITACHI BBFET.

## Absolute Maximum Ratings (Ta = 25°C)

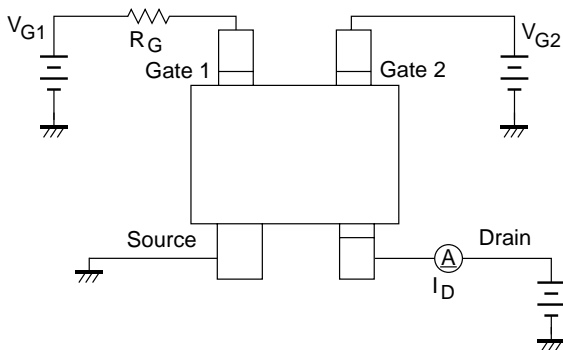
Item	Symbol	Ratings	Unit
Drain to source voltage	$V_{DS}$	12	V
Gate1 to source voltage	$V_{G1S}$	$\pm 10$ - 0	V
Gate2 to source voltage	$V_{G2S}$	$\pm 10$	V
Drain current	$I_D$	25	mA
Channel power dissipation	Pch	150	mW
Channel temperature	Tch	150	°C
Storage temperature	Tstg	-55 to +150	°C

## Electrical Characteristics (Ta = 25°C)

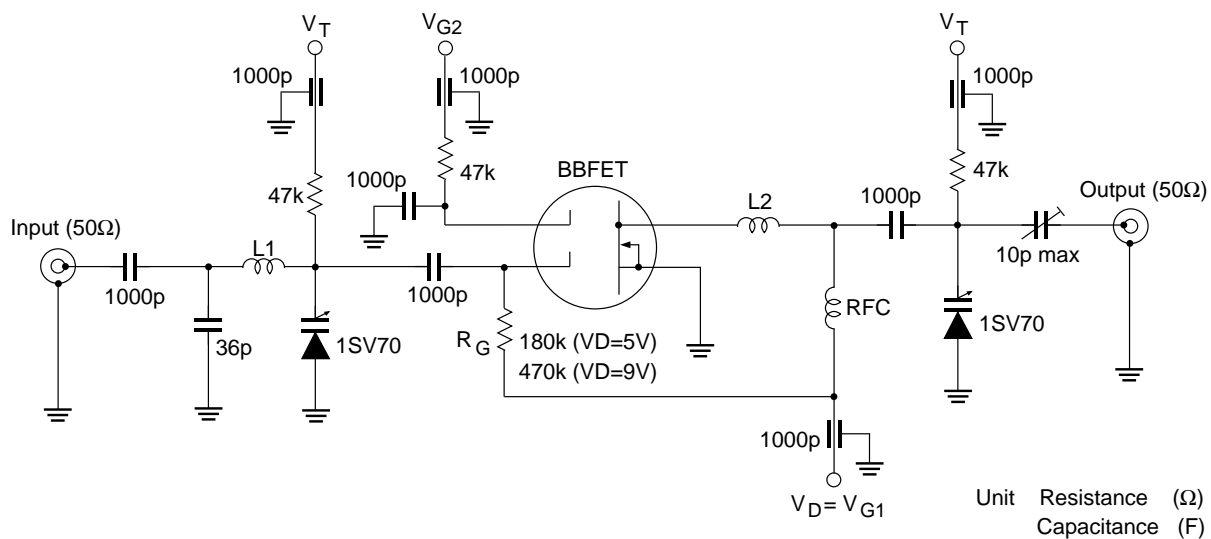
Item	Symbol	Min	Typ	Max	Unit	Test Conditions
Drain to source breakdown voltage	$V_{(BR)DSS}$	12	—	—	V	$I_D = 200\mu A, V_{G1S} = V_{G2S} = 0$
Gate1 to source breakdown voltage	$V_{(BR)G1SS}$	+10	—	—	V	$I_{G1} = +10\mu A, V_{G2S} = V_{DS} = 0$
Gate2 to source breakdown voltage	$V_{(BR)G2SS}$	$\pm 10$	—	—	V	$I_{G2} = \pm 10\mu A, V_{G1S} = V_{DS} = 0$
Gate1 to source cutoff current	$I_{G1SS}$	—	—	+100	nA	$V_{G1S} = +9V, V_{G2S} = V_{DS} = 0$
Gate2 to source cutoff current	$I_{G2SS}$	—	—	$\pm 100$	nA	$V_{G2S} = \pm 9V, V_{G1S} = V_{DS} = 0$
Gate1 to source cutoff voltage	$V_{G1S(off)}$	0.4	0.7	1.0	V	$V_{DS} = 5V, V_{G2S} = 4V, I_D = 100\mu A$
Gate2 to source cutoff voltage	$V_{G2S(off)}$	0.5	0.7	1.0	V	$V_{DS} = 5V, V_{G1S} = 5V, I_D = 100\mu A$
Input capacitance	$C_{iss}$	2.3	2.8	3.6	pF	$V_{DS} = 5V, V_{G1} = 5V$
Output capacitance	$C_{oss}$	0.9	1.3	2.0	pF	$V_{G2S} = 4V, R_G = 180k\Omega$
Reverse transfer capacitance	$C_{rss}$	0.003	0.02	0.05	pF	$f = 1MHz$
Drain current	$I_{D(op) 1}$	9	15	19	mA	$V_{DS} = 5V, V_{G1} = 5V$ $V_{G2S} = 4V, R_G = 180k\Omega$
	$I_{D(op) 2}$	—	13	—	mA	$V_{DS} = 9V, V_{G1} = 9V$ $V_{G2S} = 6V, R_G = 470k\Omega$
Forward transfer admittance	$ y_{fs} 1$	22	27	34	mS	$V_{DS} = 5V, V_{G1} = 5V, V_{G2S} = 4V$ $R_G = 180k\Omega, f = 1kHz$
	$ y_{fs} 2$	—	27	—	mS	$V_{DS} = 9V, V_{G1} = 9V, V_{G2S} = 6V$ $R_G = 470k\Omega, f = 1kHz$
Power gain	PG1	24	29	32	dB	$V_{DS} = 5V, V_{G1} = 5V, V_{G2S} = 4V$ $R_G = 180k\Omega, f = 200MHz$
	PG2	—	29	—	dB	$V_{DS} = 9V, V_{G1} = 9V, V_{G2S} = 6V$ $R_G = 470k\Omega, f = 200MHz$
Noise figure	NF1	—	1.2	1.9	dB	$V_{DS} = 5V, V_{G1} = 5V, V_{G2S} = 4V$ $R_G = 180k\Omega, f = 200MHz$
	NF2	—	1.2	—	dB	$V_{DS} = 9V, V_{G1} = 9V, V_{G2S} = 6V$ $R_G = 470k\Omega, f = 200MHz$

Main Characteristics

Test Circuit for Operating Items ( $I_{D(op)}$ ,  $|y_{fs}|$ ,  $C_{iss}$ ,  $C_{oss}$ ,  $C_{rss}$ , NF, PG)

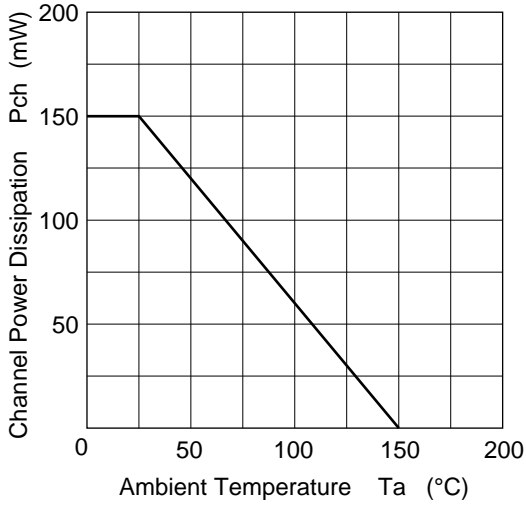


Power Gain, Noise Figure Test Circuit

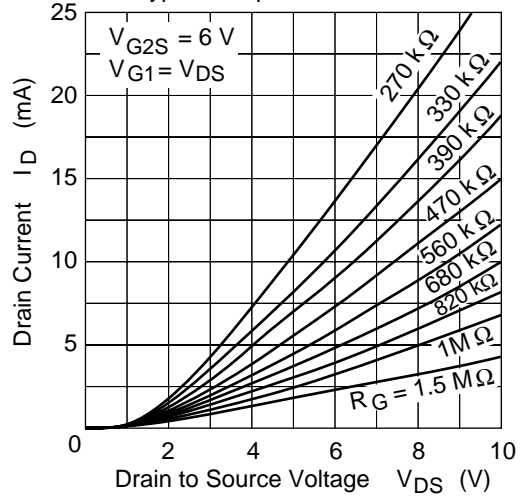


L1 :  $\phi$ 1mm Enameled Copper Wire, Inside dia 10mm, 2Turns  
 L2 :  $\phi$ 1mm Enameled Copper Wire, Inside dia 10mm, 2Turns  
 RFC :  $\phi$ 1mm Enameled Copper Wire, Inside dia 5mm, 2Turns

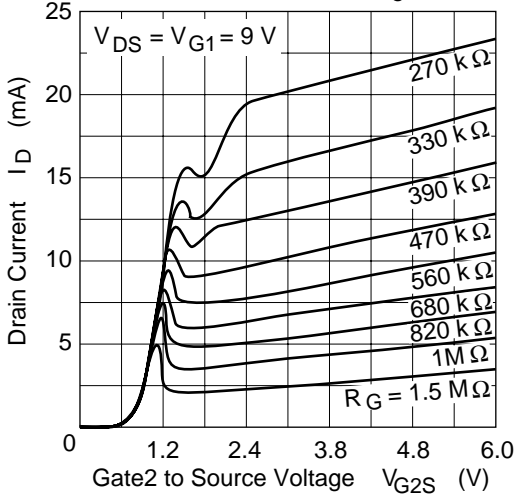
Maximum Channel Power Dissipation Curve



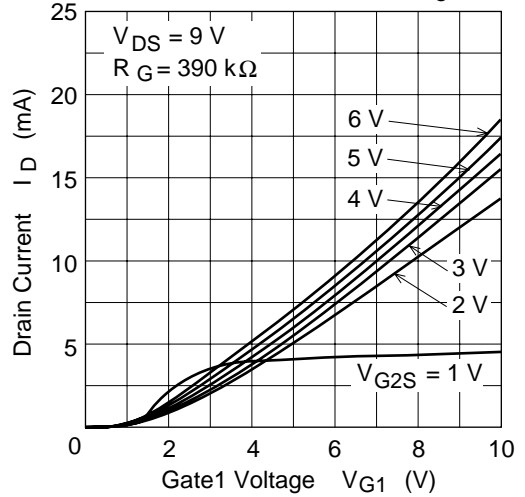
Typical Output Characteristics

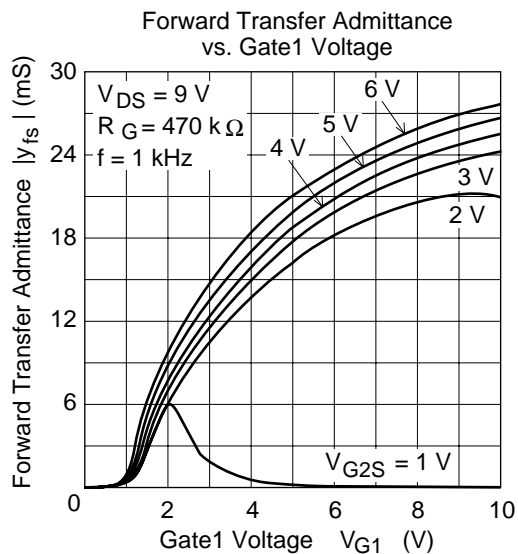
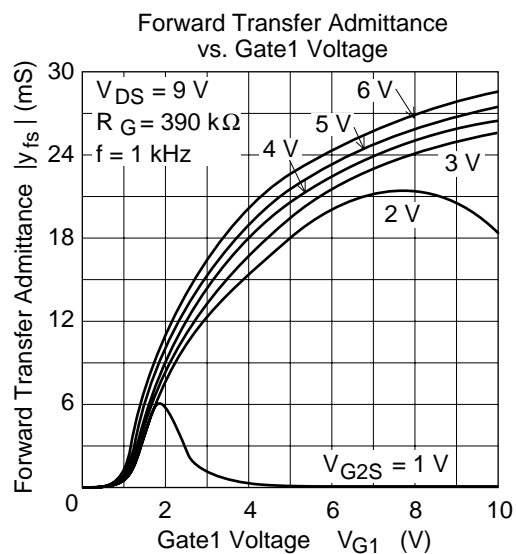
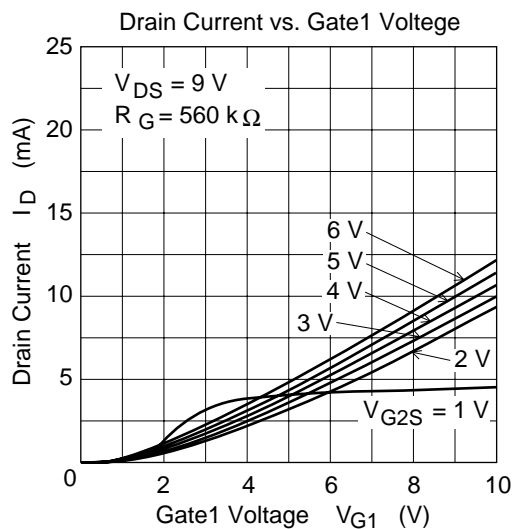
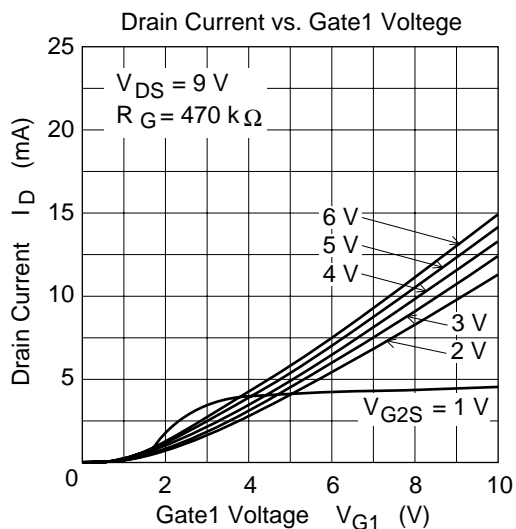


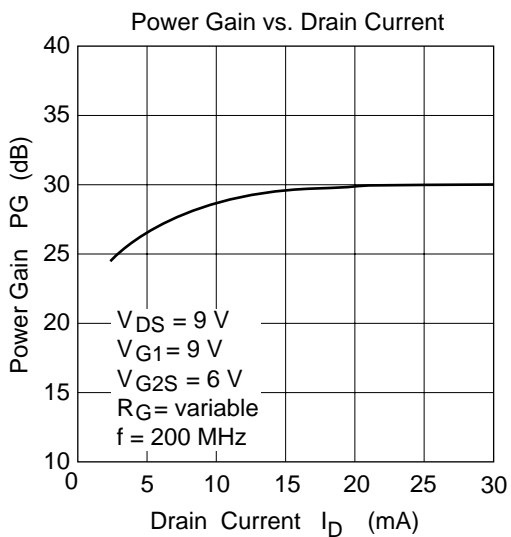
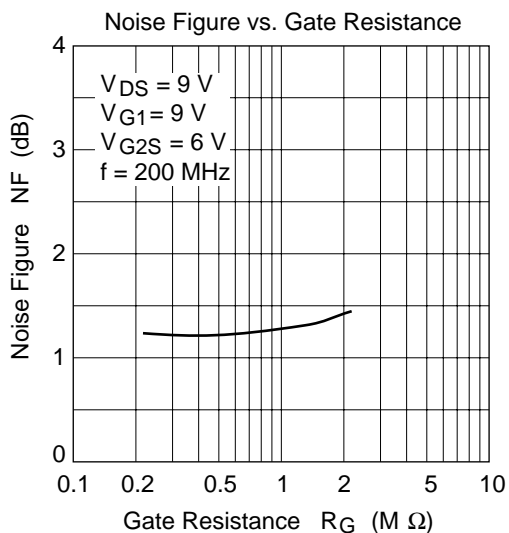
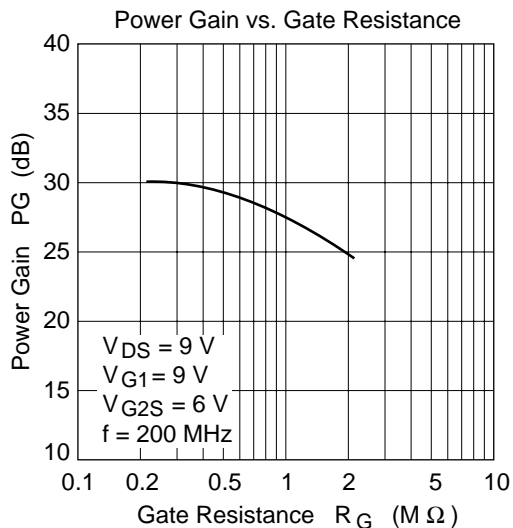
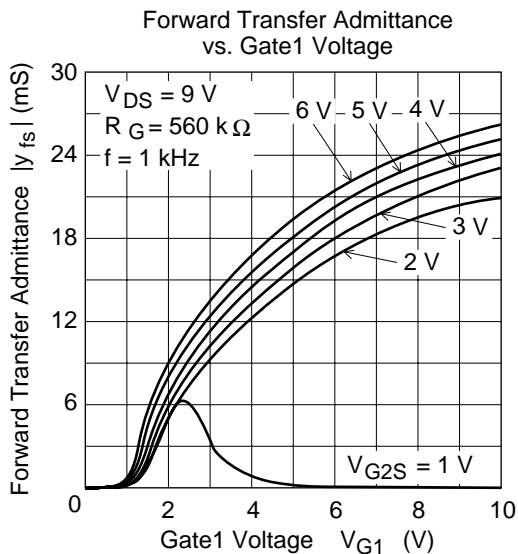
Drain Current vs. Gate2 to Source Voltage

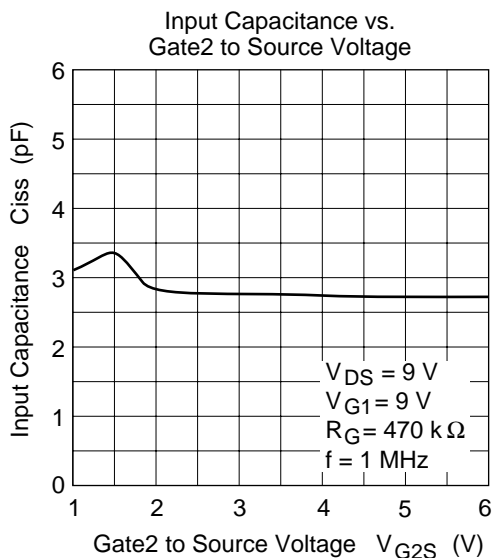
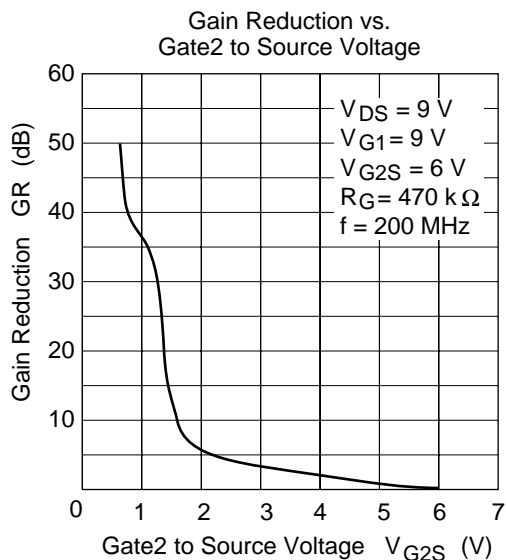
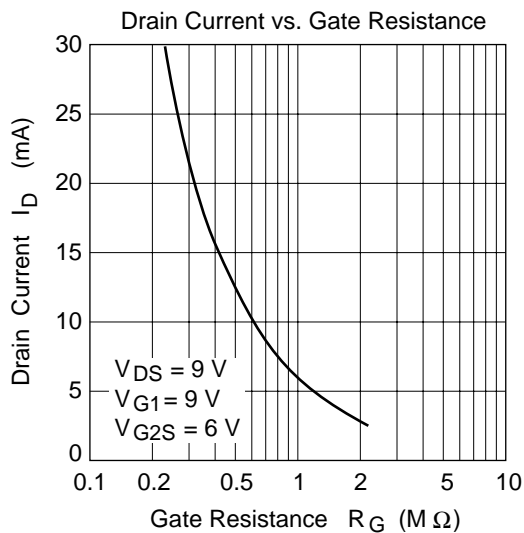
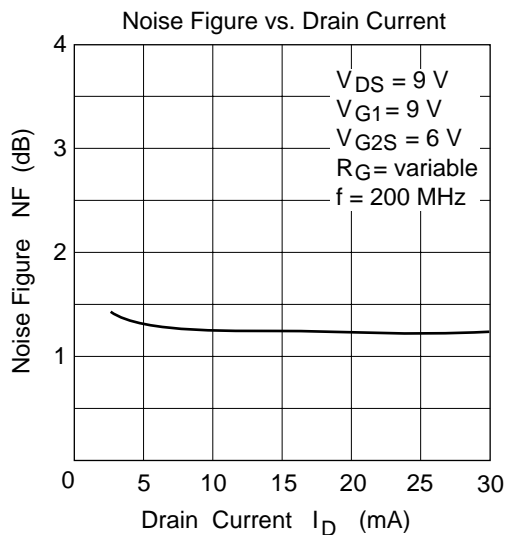


Drain Current vs. Gate1 Voltage

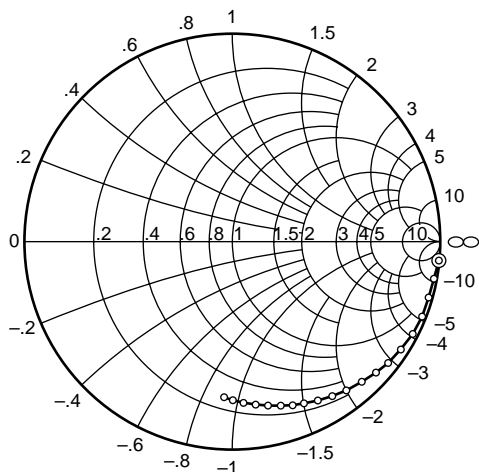








**S11 Parameter vs. Frequency**

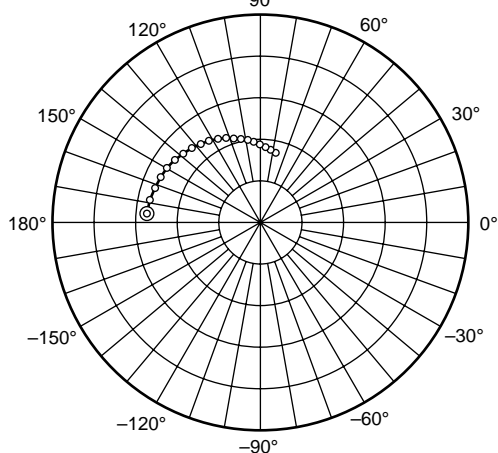


Test Condition :  $V_{DS} = 9\text{ V}$ ,  $V_{G1} = 9\text{ V}$   
 $V_{G2S} = 6\text{ V}$ ,  $R_G = 470\text{ k}\Omega$   
 50—1000 MHz (50 MHz step)



**S21 Parameter vs. Frequency**

Scale: 1 / div.

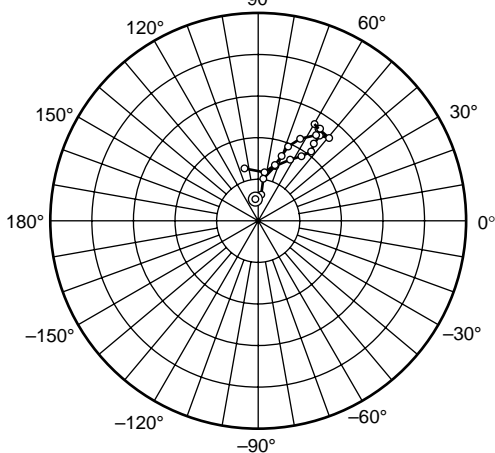


Test Condition :  $V_{DS} = 9\text{ V}$ ,  $V_{G1} = 9\text{ V}$   
 $V_{G2S} = 6\text{ V}$ ,  $R_G = 470\text{ k}\Omega$   
 50—1000 MHz (50 MHz step)



**S12 Parameter vs. Frequency**

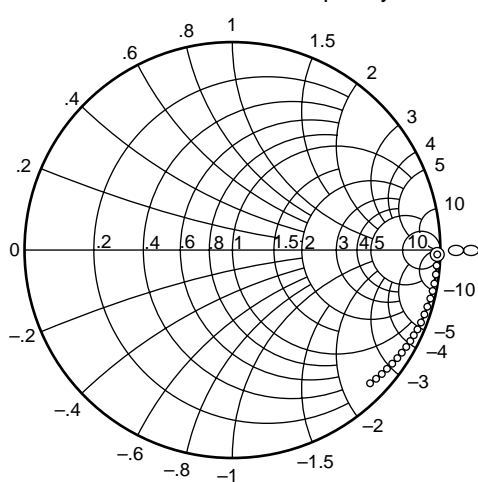
Scale: 0.002 / div.



Test Condition :  $V_{DS} = 9\text{ V}$ ,  $V_{G1} = 9\text{ V}$   
 $V_{G2S} = 6\text{ V}$ ,  $R_G = 470\text{ k}\Omega$   
 50—1000 MHz (50 MHz step)



**S22 Parameter vs. Frequency**



Test Condition :  $V_{DS} = 9\text{ V}$ ,  $V_{G1} = 9\text{ V}$   
 $V_{G2S} = 6\text{ V}$ ,  $R_G = 470\text{ k}\Omega$   
 50—1000 MHz (50 MHz step)



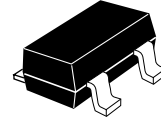
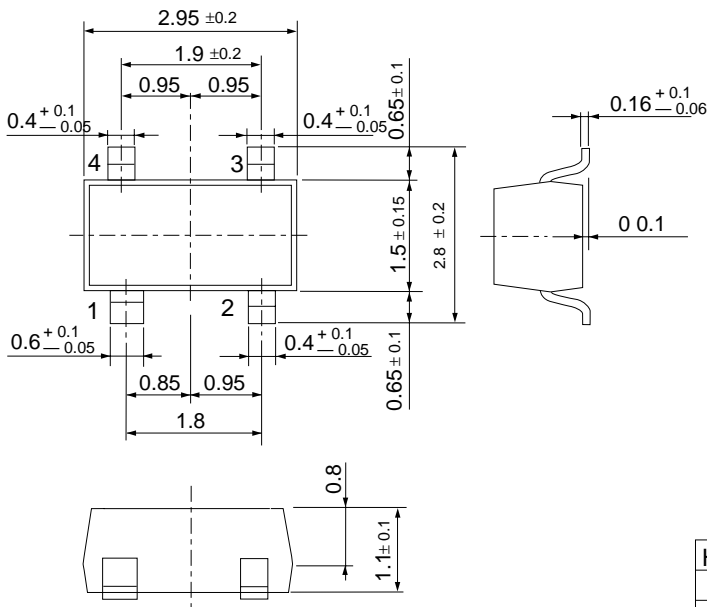


**Sparameter** ( $V_{DS} = V_{G1} = 9V$ ,  $V_{G2S} = 6V$ ,  $R_G = 470k\Omega$ ,  $Z_0 = 50\Omega$ )

f (MHz)	S11		S21		S12		S22	
	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



Hitachi Code	MPAK—4R
EIAJ	
JEDEC	

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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

URL      NorthAmerica      : <http://semiconductor.hitachi.com/>  
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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

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