

# BB304M

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

# HITACHI

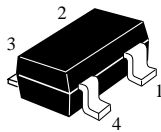
ADE-208-605C (Z)  
4th. Edition  
August 1998

## 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

MPAK-4



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

- Note: 1. Marking is "DW-".  
2. BB304M is individual type number of HITACHI BBFET.

**Absolute Maximum Ratings** ( $T_a = 25^\circ\text{C}$ )

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	$V_{G2S}$	$\pm 10$	V
Drain current	$I_D$	25	mA
Channel power dissipation	Pch	150	mW
Channel temperature	Tch	150	$^\circ\text{C}$
Storage temperature	Tstg	-55 to +150	$^\circ\text{C}$

**Electrical Characteristics** ( $T_a = 25^\circ\text{C}$ )

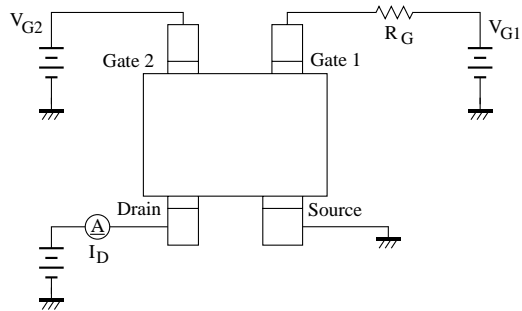
Item	Symbol	Min	Typ	Max	Unit	Test Conditions
Drain to source breakdown voltage	$V_{(BR)DSS}$	12	—	—	V	$I_D = 200\mu\text{A}$ , $V_{G1S} = V_{G2S} = 0$
Gate1 to source breakdown voltage	$V_{(BR)G1SS}$	+10	—	—	V	$I_{G1} = +10\mu\text{A}$ , $V_{G2S} = V_{DS} = 0$
Gate2 to source breakdown voltage	$V_{(BR)G2SS}$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

**Electrical Characteristics (Ta = 25°C)**

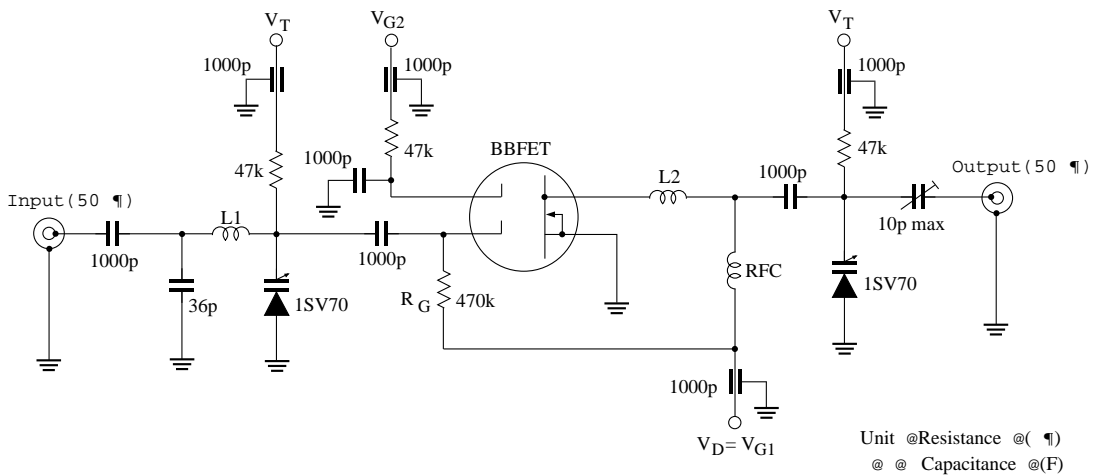
Item	Symbol	Min	Typ	Max	Unit	Test Conditions
Input capacitance	$C_{iss}$	2.3	2.8	3.6	pF	$V_{DS} = 5V, V_{G1} = 5V, V_{G2S} = 4V$
Output capacitance	$C_{oss}$	0.9	1.3	2.0	pF	$R_G = 180k\Omega, f = 1MHz$
Reverse transfer capacitance	$C_{rss}$	0.003	0.02	0.05	pF	
Drain current	$I_{D(op)1}$	9	15	19	mA	$V_{DS} = 5V, V_{G1} = 5V, V_{G2S} = 4V$ $R_G = 180k\Omega$
	$I_{D(op)2}$	—	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 ( $I_{D(op)}$ ,  $y_{fs}$ ,  $C_{iss}$ ,  $C_{oss}$ ,  $C_{rss}$ ,  $NF$ ,  $PG$ )

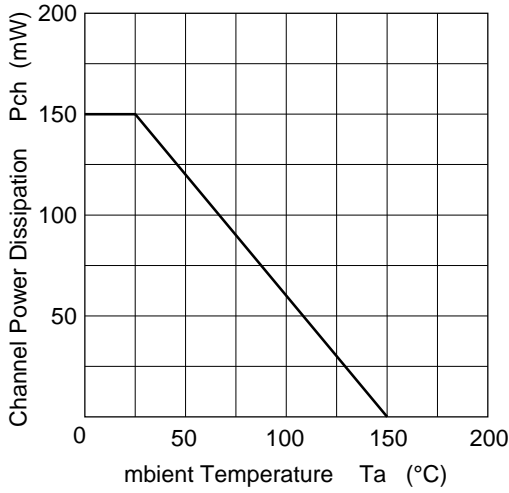


Power Gain, Noise Figure Test Circuit

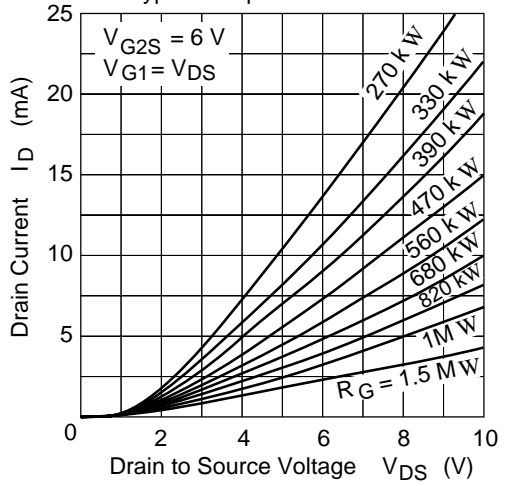


- L1 : 1mm Enameled Copper Wire, Inside dia 10mm, 2Turns
- L2 : 1mm Enameled Copper Wire, Inside dia 10mm, 2Turns
- RFC : 1mm Enameled Copper Wire, Inside dia 5mm, 2Turns

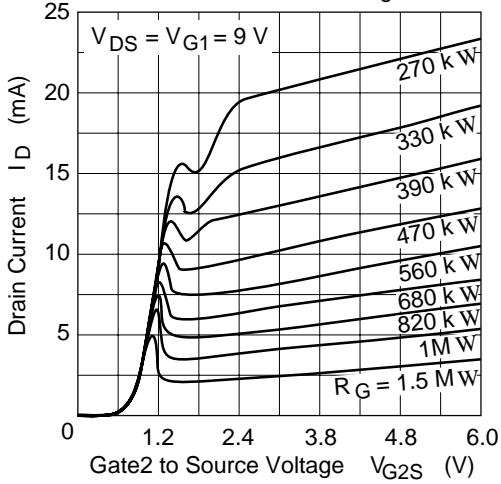
Maximum Channel Power Dissipation Curve



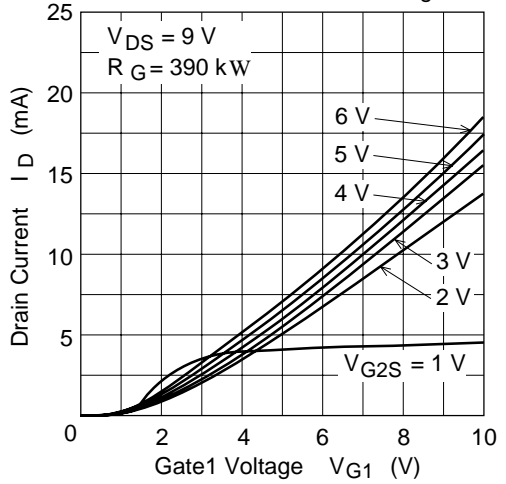
Typical Output Characteristics

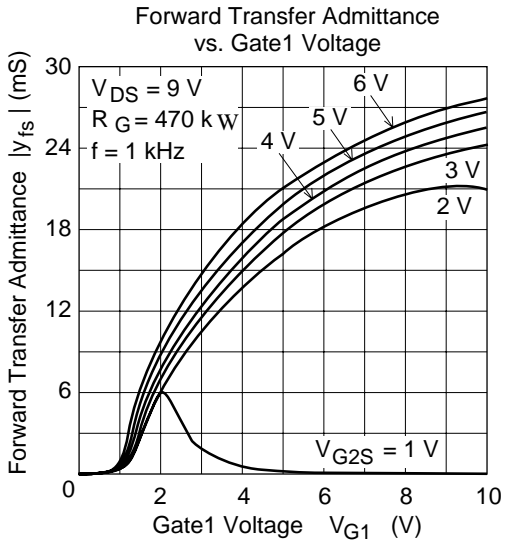
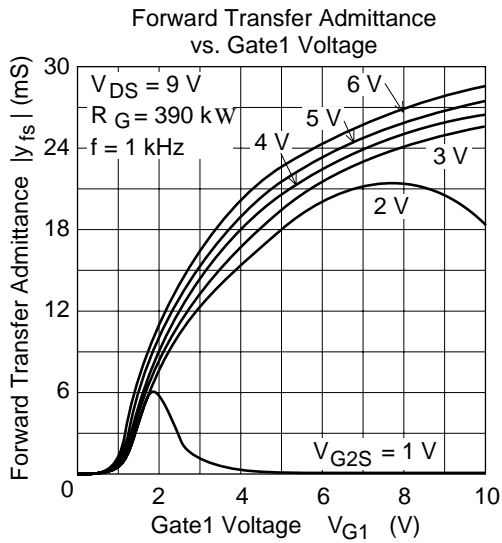
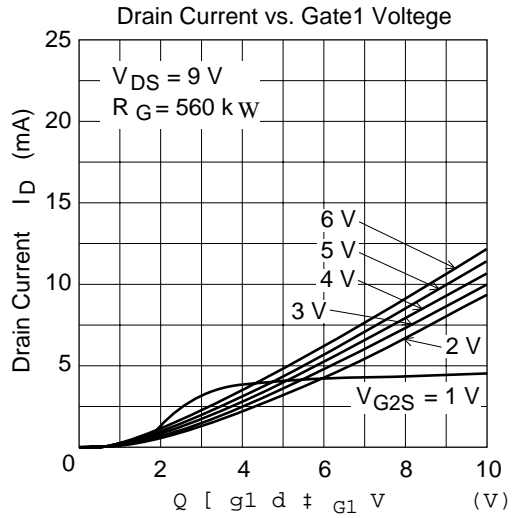
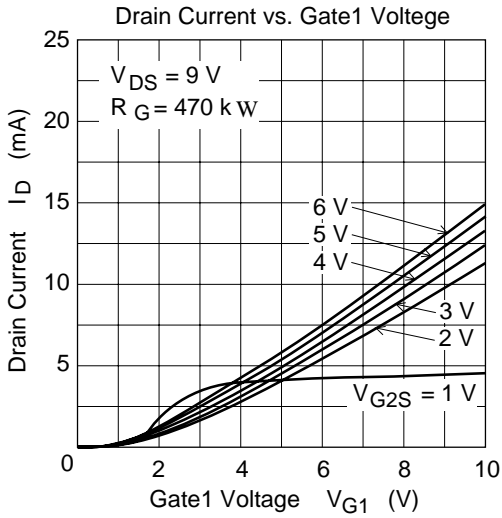


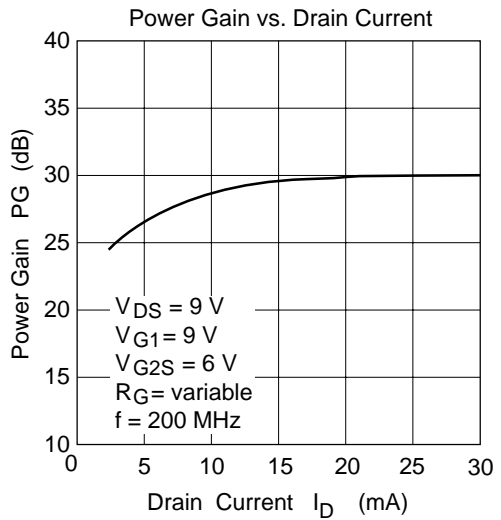
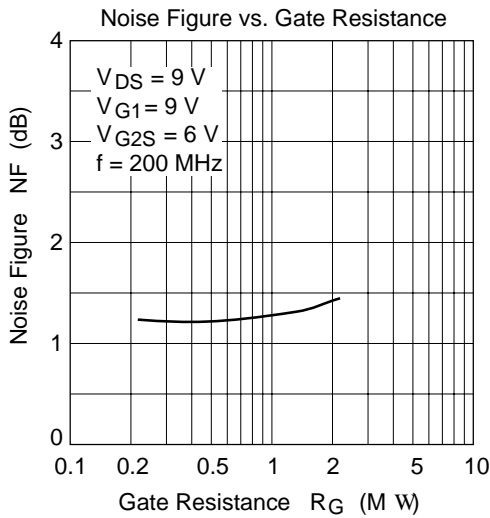
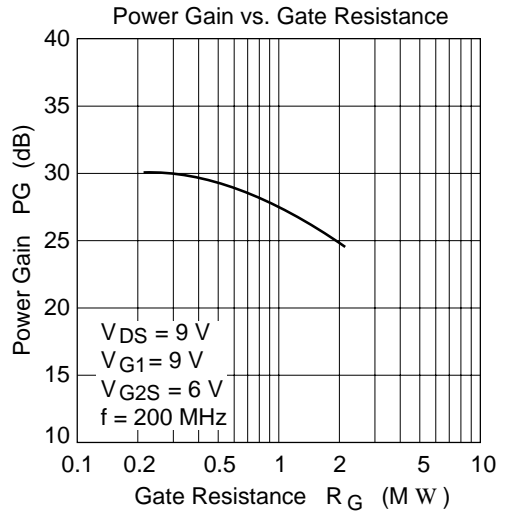
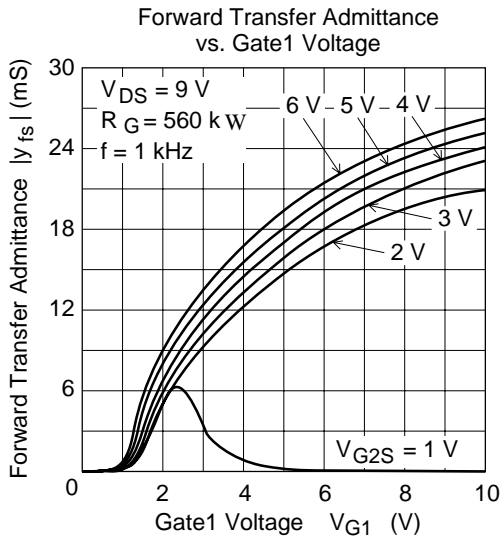
Drain Current vs. Gate2 to Source Voltage

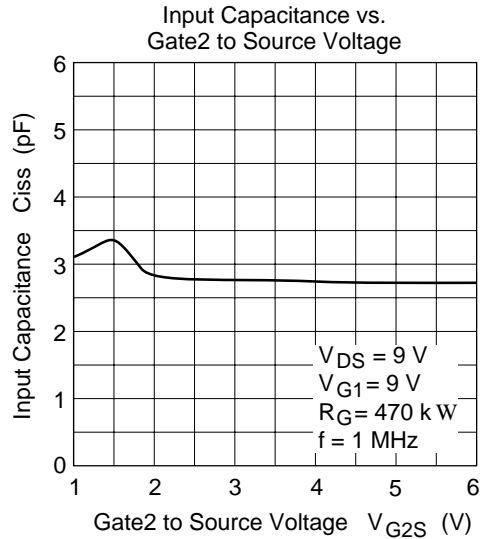
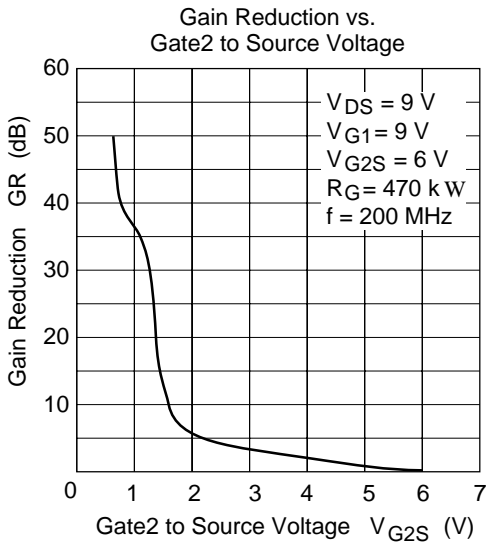
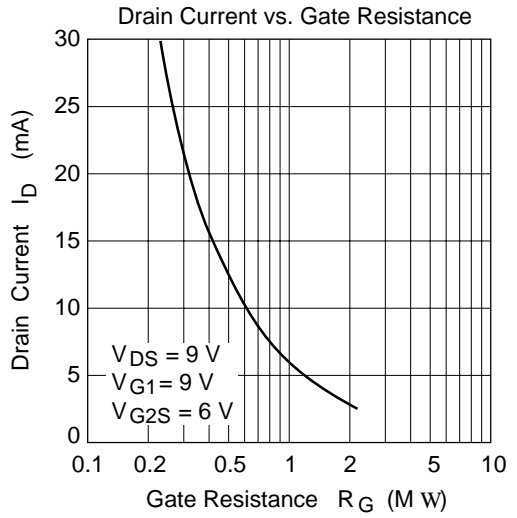
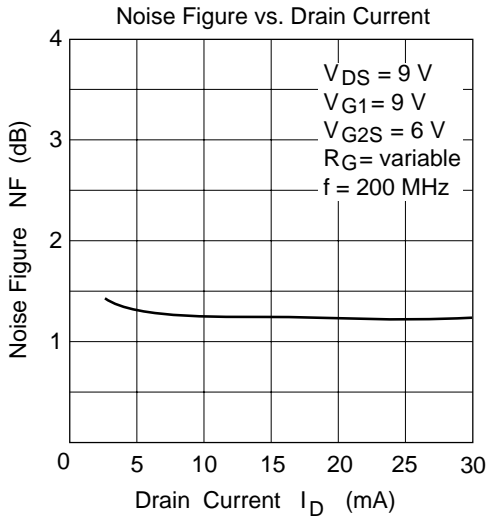


Drain Current vs. Gate1 Voltage



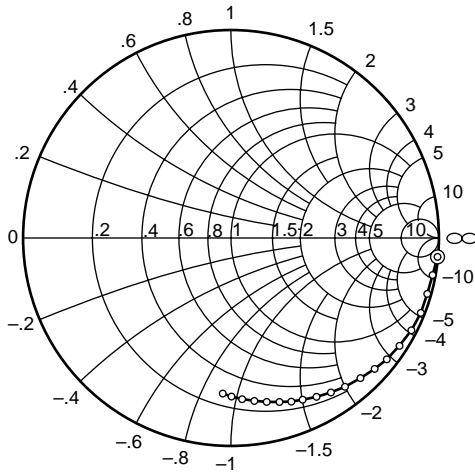






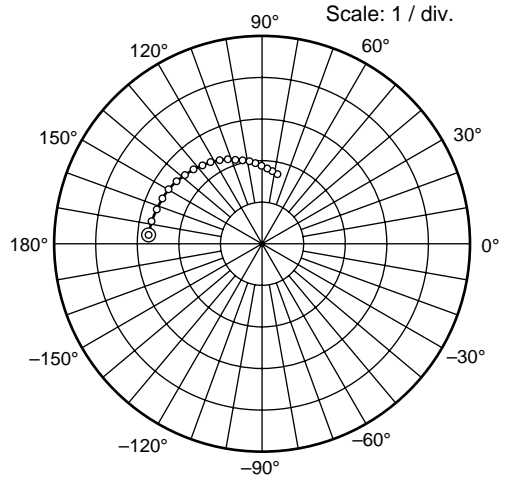


S11 Parameter vs. Frequency



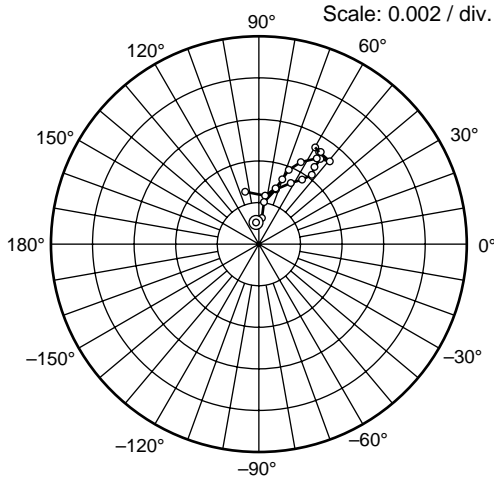
Test Condition :  $V_{DS} = 9\text{ V}$ ,  $V_{G1} = 9\text{ V}$   
 $V_{G2S} = 6\text{ V}$ ,  $R_G = 470\text{ k}\Omega$   
 50 ~ 1000 MHz (50 MHz step)

S21 Parameter vs. Frequency



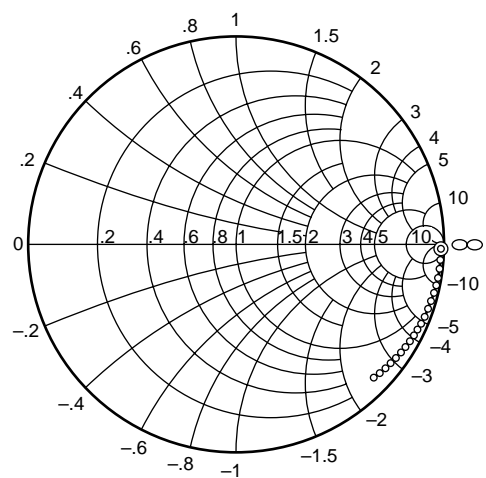
Test Condition :  $V_{DS} = 9\text{ V}$ ,  $V_{G1} = 9\text{ V}$   
 $V_{G2S} = 6\text{ V}$ ,  $R_G = 470\text{ k}\Omega$   
 50 ~ 1000 MHz (50 MHz step)

S12 Parameter vs. Frequency



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)

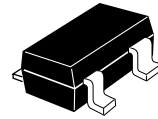
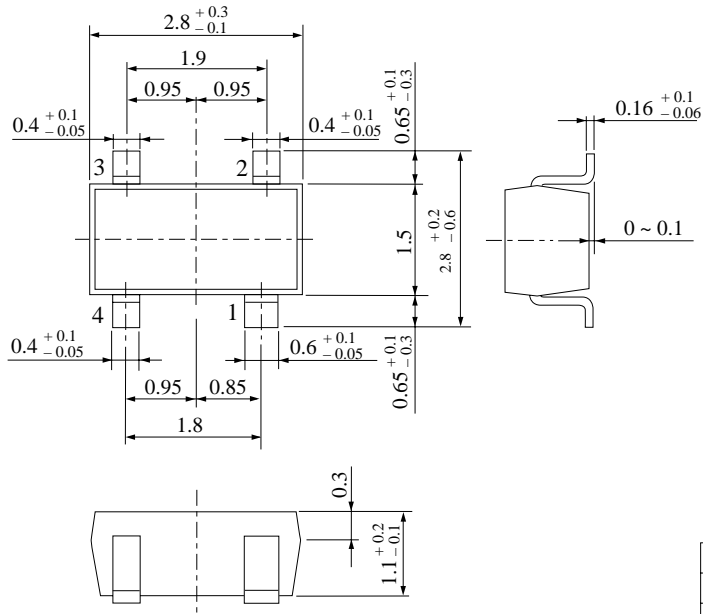
# BB304M

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-4
EIAJ	SC-61AA
JEDEC	—

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