

# BB402M

Build in Biasing Circuit MOS FET IC  
VHF RF Amplifier

# HITACHI

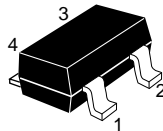
ADE-208-716A (Z)  
2nd. Edition  
Dec. 1998

## Features

- Build in Biasing Circuit; To reduce using parts cost & PC board space.
- Low noise characteristics;  
(NF = 1.7 dB typ. at f = 200 MHz)
- Withstanding to ESD;  
Build in ESD absorbing diode. Withstand up to 240V 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 "BX-".

2. BB402M is individual type number of HITACHI BBFET.

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

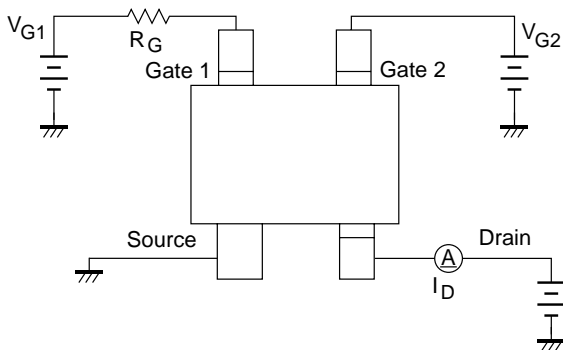
Item	Symbol	Ratings	Unit
Drain to source voltage	$V_{DS}$	12	V
Gate1 to source voltage	$V_{G1S}$	+10 - 0	V
Gate2 to source voltage	$V_{G2S}$	±10	V
Drain current	$I_D$	25	mA
Channel power dissipation	Pch	150	mW
Channel temperature	Tch	150	°C
Storage temperature	Tstg	-55 to +150	°C

## Electrical Characteristics (Ta = 25°C)

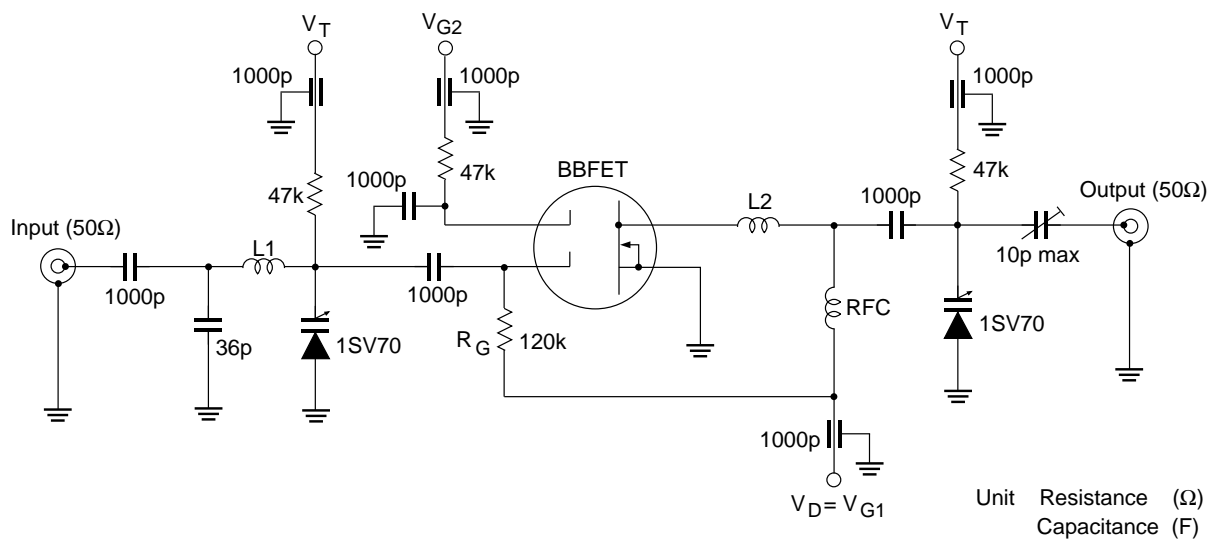
Item	Symbol	Min	Typ	Max	Unit	Test Conditions
Drain to source breakdown voltage	$V_{(BR)DSS}$	12	—	—	V	$I_D = 200\mu A, V_{G1S} = V_{G2S} = 0$
Gate1 to source breakdown voltage	$V_{(BR)G1SS}$	+10	—	—	V	$I_{G1} = +10\mu A, V_{G2S} = V_{DS} = 0$
Gate2 to source breakdown voltage	$V_{(BR)G2SS}$	±10	—	—	V	$I_{G2} = \pm 10\mu A, V_{G1S} = V_{DS} = 0$
Gate1 to source cutoff current	$I_{G1SS}$	—	—	+100	nA	$V_{G1S} = +9V, V_{G2S} = V_{DS} = 0$
Gate2 to source cutoff current	$I_{G2SS}$	—	—	±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	$V_{DS} = 9V, V_{G2S} = 6V, I_D = 100\mu A$
Gate2 to source cutoff voltage	$V_{G2S(off)}$	0.4	0.7	1.0	V	$V_{DS} = 9V, V_{G1S} = 9V, I_D = 100\mu A$
Drain current	$I_{D(op)}$	9	13	18	mA	$V_{DS} = 9V, V_{G1} = 9V, V_{G2S} = 6V$ $R_G = 120k\Omega$
Forward transfer admittance	$ y_{fs} $	15	20	—	mS	$V_{DS} = 9V, V_{G1} = 9V, V_{G2S} = 6V$ $R_G = 120k\Omega, f = 1kHz$
Input capacitance	$C_{iss}$	2.2	3.0	4.0	pF	$V_{DS} = 9V, V_{G1} = 9V$
Output capacitance	$C_{oss}$	0.8	1.1	1.5	pF	$V_{G2S} = 6V, R_G = 120k\Omega$
Reverse transfer capacitance	$C_{rss}$	—	0.017	0.04	pF	$f = 1MHz$
Power gain	PG	22	26	—	dB	$V_{DS} = 9V, V_{G1} = 9V, V_{G2S} = 6V$
Noise figure	NF	—	1.7	2.2	dB	$R_G = 120k\Omega, f = 200MHz$

Main Characteristics

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

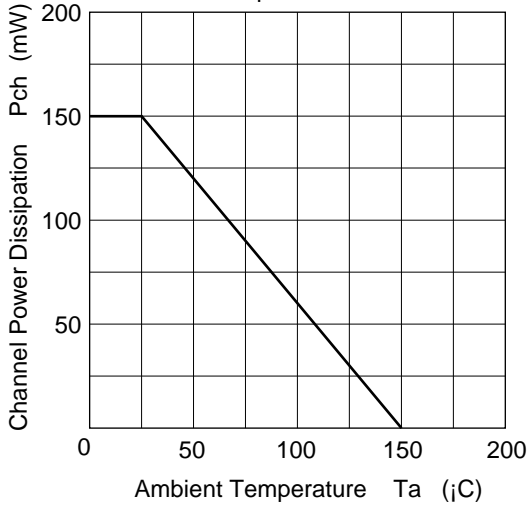


Power Gain, Noise Figure Test Circuit

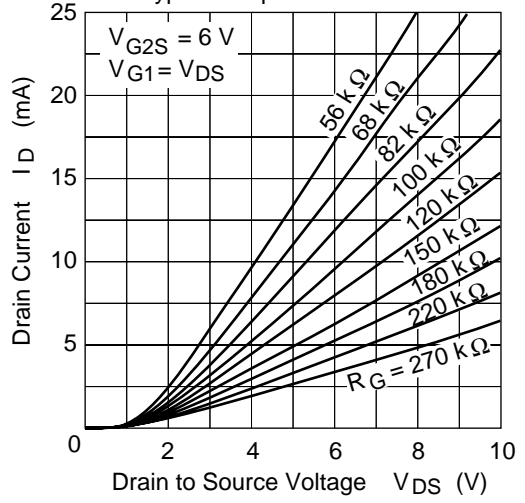


L1:  $\phi$ 1mm Enameled Copper Wire, Inside dia 10mm, 2Turns  
 L2:  $\phi$ 1mm Enameled Copper Wire, Inside dia 10mm, 2Turns  
 RFC:  $\phi$ 1mm Enameled Copper Wire, Inside dia 5mm, 2Turns

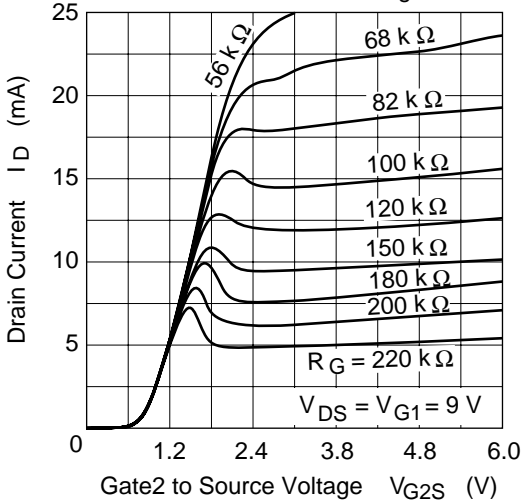
Maximum Channel Power Dissipation Curve



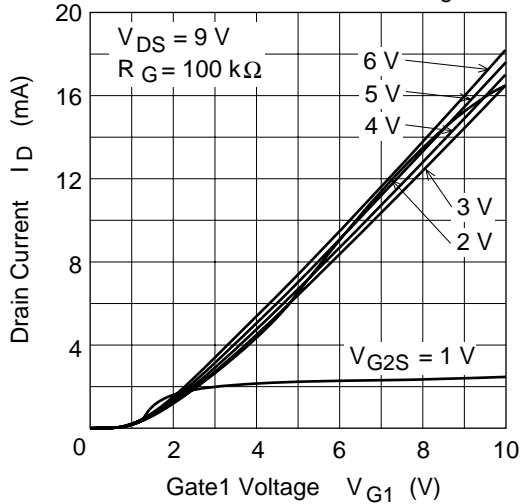
Typical Output Characteristics

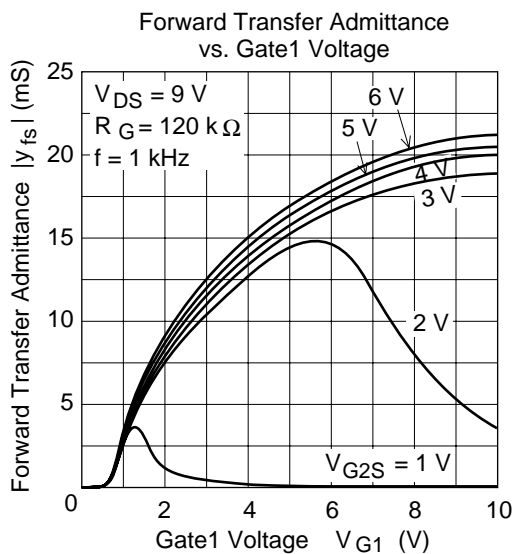
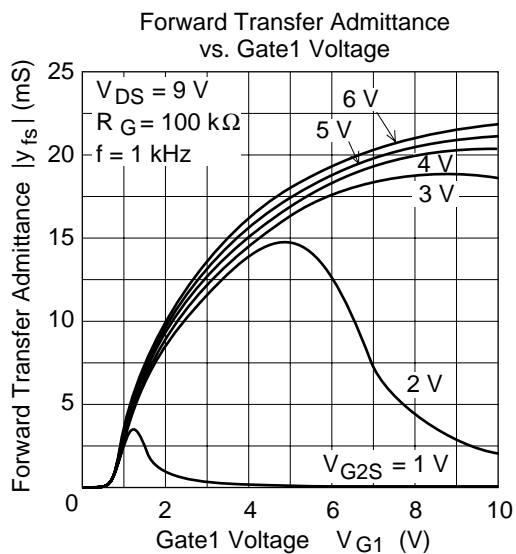
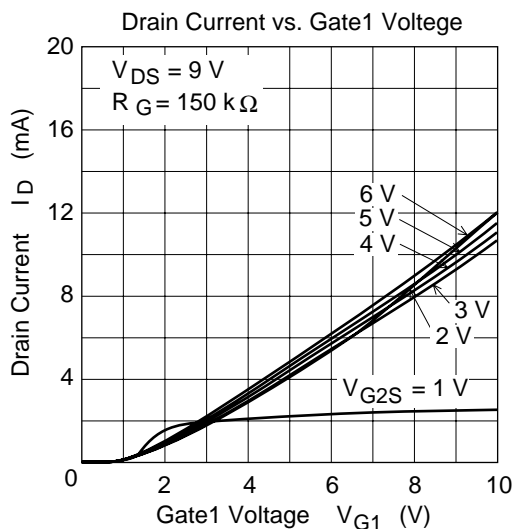
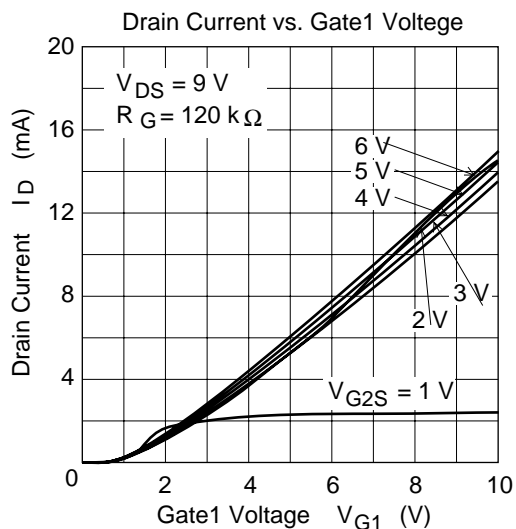


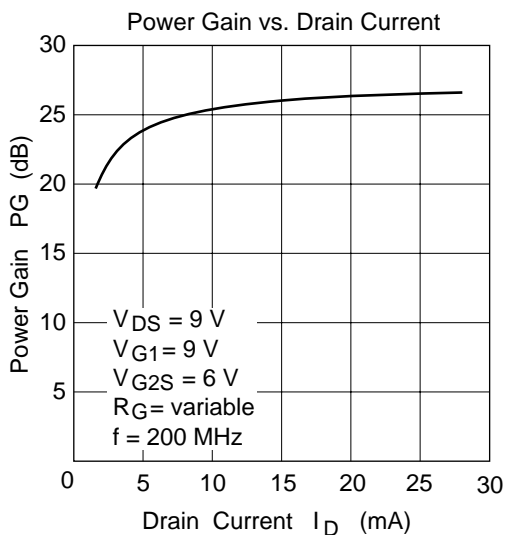
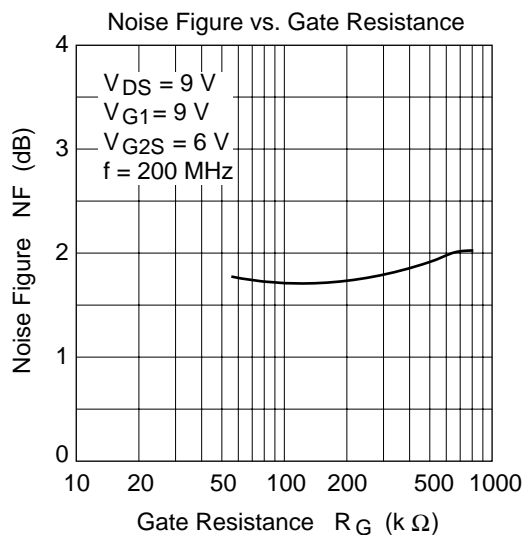
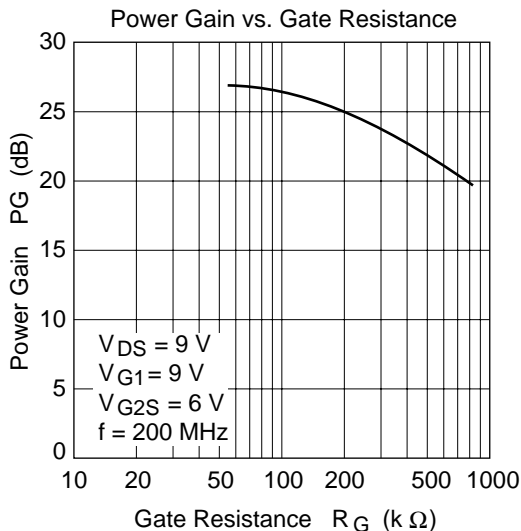
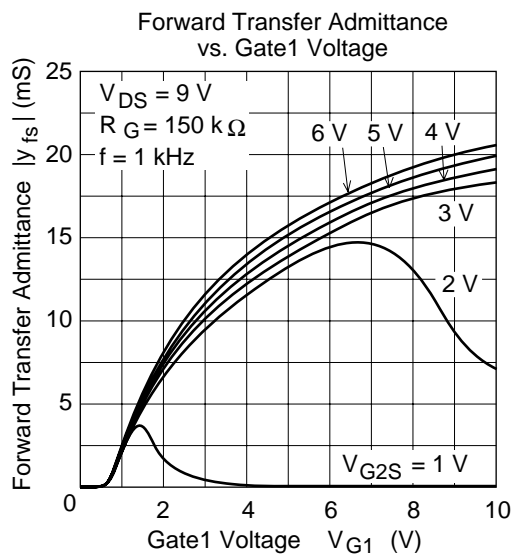
Drain Current vs. Gate2 to Source Voltage

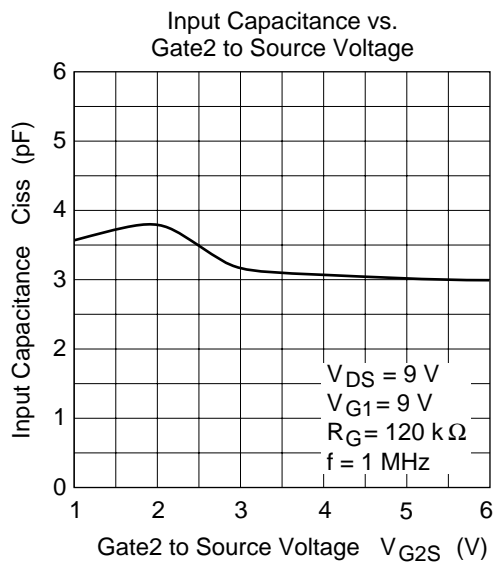
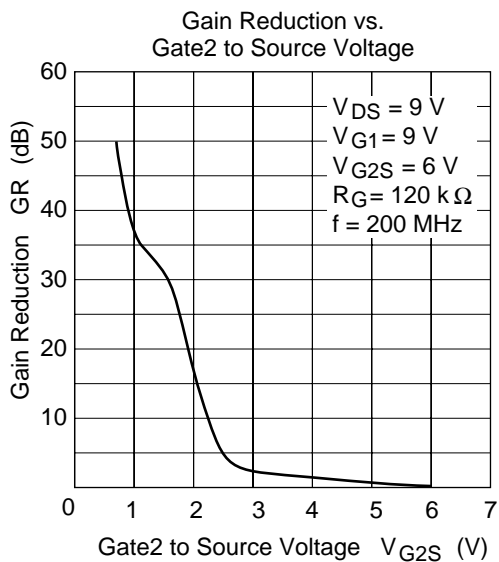
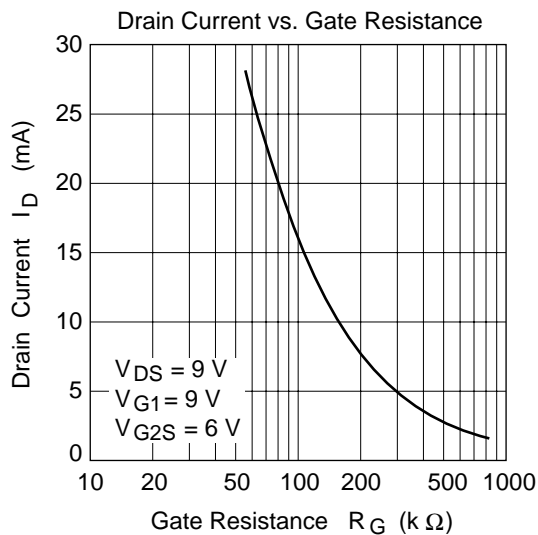
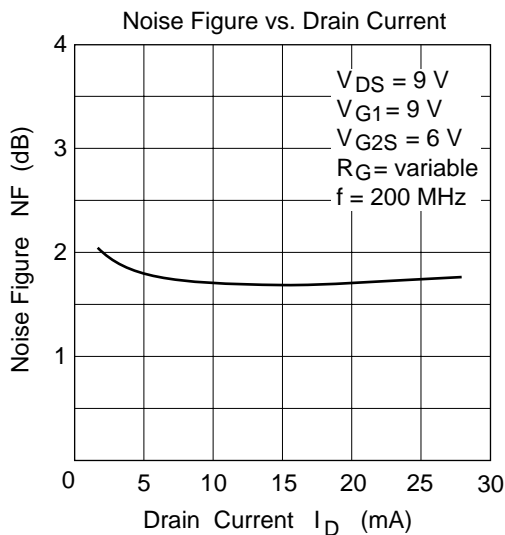


Drain Current vs. Gate1 Voltage

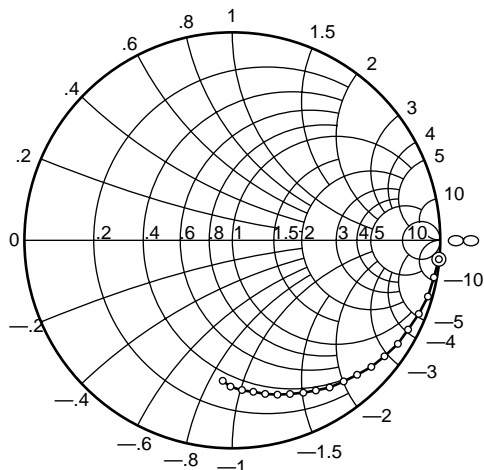








**S11 Parameter vs. Frequency**

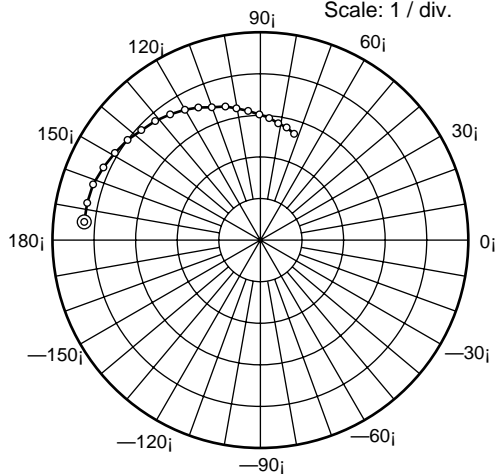


Test Condition :  $V_{DS}=9\text{ V}$ ,  $V_{G1}=9\text{ V}$   
 $V_{G2S}=6\text{ V}$ ,  $R_G=120\text{ k}\Omega$   
 50 1000 MHz (50 MHz step)



**S21 Parameter vs. Frequency**

Scale: 1 / div.

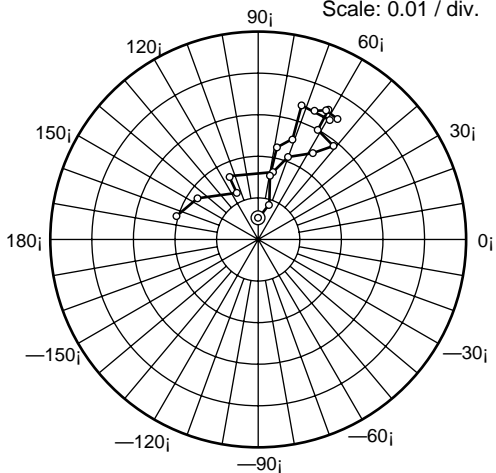


Test Condition :  $V_{DS}=9\text{ V}$ ,  $V_{G1}=9\text{ V}$   
 $V_{G2S}=6\text{ V}$ ,  $R_G=120\text{ k}\Omega$   
 50 1000 MHz (50 MHz step)



**S12 Parameter vs. Frequency**

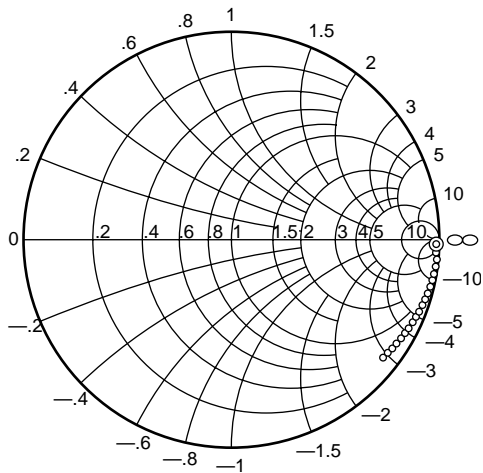
Scale: 0.01 / div.



Test Condition :  $V_{DS}=9\text{ V}$ ,  $V_{G1}=9\text{ V}$   
 $V_{G2S}=6\text{ V}$ ,  $R_G=120\text{ k}\Omega$   
 50 1000 MHz (50 MHz step)



**S22 Parameter vs. Frequency**



Test Condition :  $V_{DS}=9\text{ V}$ ,  $V_{G1}=9\text{ V}$   
 $V_{G2S}=6\text{ V}$ ,  $R_G=120\text{ k}\Omega$   
 50 1000 MHz (50 MHz step)





**Sparameter** ( $V_{DS} = V_{G1} = 9V$ ,  $V_{G2S} = 6V$ ,  $R_G = 120k\Omega$ ,  $Z_0 = 50\Omega$ )

f (MHz)	S11		S21		S12		S22	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
50	0.988	-5.2	2.13	174.1	0.00052	90.0	0.985	-1.3
100	0.986	-10.4	2.13	167.9	0.00087	72.5	0.993	-3.6
150	0.979	-16.0	2.12	161.6	0.00156	79.4	0.992	-5.5
200	0.964	-21.5	2.08	155.2	0.00226	78.4	0.990	-7.5
250	0.948	-26.9	2.04	149.1	0.00254	71.0	0.987	-9.6
300	0.939	-32.0	2.00	143.0	0.00339	72.0	0.985	-11.4
350	0.920	-37.3	1.95	137.3	0.00335	59.0	0.982	-13.3
400	0.904	-42.3	1.91	131.5	0.00338	66.3	0.978	-15.3
450	0.885	-47.1	1.86	125.7	0.00351	62.2	0.974	-17.1
500	0.864	-51.7	1.81	120.1	0.00347	56.6	0.970	-18.9
550	0.848	-56.5	1.76	115.1	0.00355	61.5	0.966	-21.0
600	0.826	-60.9	1.70	110.1	0.00300	61.4	0.961	-22.7
650	0.808	-65.0	1.66	104.7	0.00289	51.1	0.957	-24.5
700	0.789	-69.4	1.61	100.3	0.00246	57.6	0.952	-26.6
750	0.773	-73.7	1.56	95.4	0.00211	70.0	0.947	-28.3
800	0.755	-77.9	1.51	90.5	0.00166	77.5	0.943	-30.2
850	0.735	-82.1	1.47	85.9	0.00165	114.5	0.937	-32.2
900	0.721	-86.3	1.42	81.3	0.00123	114.5	0.933	-34.1
950	0.703	-90.7	1.39	76.9	0.00176	145.8	0.927	-35.9
1000	0.677	-93.9	1.34	72.4	0.00204	164.0	0.923	-37.9



## Cautions

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