

# BB501M

Build in Biasing Circuit MOS FET IC  
UHF RF Amplifier

# HITACHI

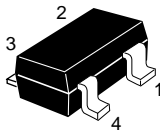
ADE-208-700C (Z)  
4th. Edition  
Nov. 1998

## Features

- Build in Biasing Circuit; To reduce using parts cost & PC board space.
- High gain;  
PG = 21.5 dB typ. at f = 900 MHz
- Low noise;  
NF = 1.85 dB typ. at f = 900 MHz
- 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

Notes: 1. Marking is "AS-".

2. BB501M is individual type number of HITACHI BBFET.

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

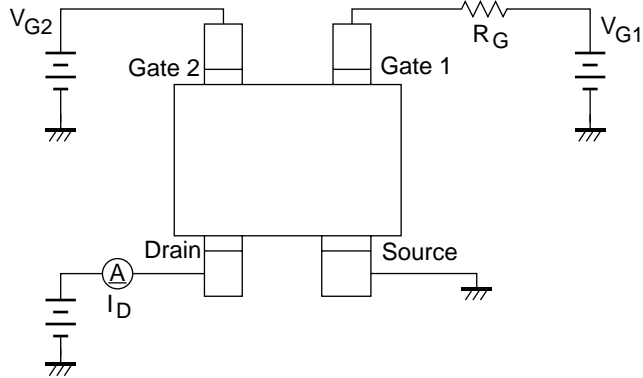
Item	Symbol	Ratings	Unit
Drain to source voltage	$V_{DS}$	6	V
Gate1 to source voltage	$V_{G1S}$	+6 - 0	V
Gate2 to source voltage	$V_{G2S}$	+6 - 0	V
Drain current	$I_D$	20	mA
Channel power dissipation	Pch	150	mW
Channel temperature	Tch	150	°C
Storage temperature	Tstg	-55 to +150	°C

## Electrical Characteristics (Ta = 25°C)

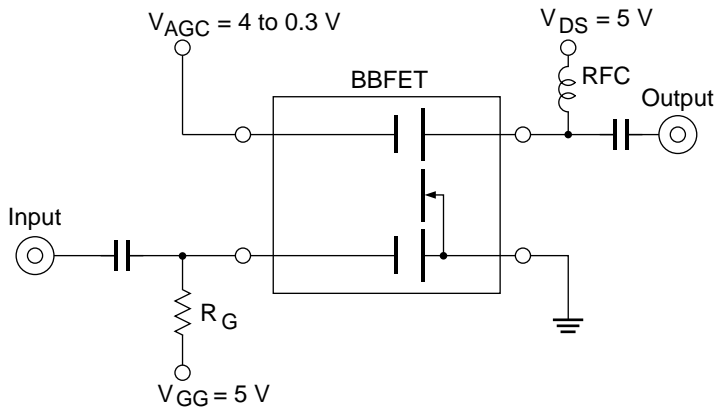
Item	Symbol	Min	Typ	Max	Unit	Test Conditions
Drain to source breakdown voltage	$V_{(BR)DSS}$	6	—	—	V	$I_D = 200\mu A$ $V_{G1S} = V_{G2S} = 0$
Gate1 to source breakdown voltage	$V_{(BR)G1SS}$	+6	—	—	V	$I_{G1} = +10\mu A$ $V_{G2S} = V_{DS} = 0$
Gate2 to source breakdown voltage	$V_{(BR)G2SS}$	+6	—	—	V	$I_{G2} = +10\mu A$ $V_{G1S} = V_{DS} = 0$
Gate1 to source cutoff current	$I_{G1SS}$	—	—	+100	nA	$V_{G1S} = +5V$ $V_{G2S} = V_{DS} = 0$
Gate2 to source cutoff current	$I_{G2SS}$	—	—	+100	nA	$V_{G2S} = +5V$ $V_{G1S} = V_{DS} = 0$
Gate1 to source cutoff voltage	$V_{G1S(off)}$	0.5	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	$V_{DS} = 5V, V_{G1S} = 5V$ $I_D = 100\mu A$
Drain current	$I_{D(op)}$	7	10	13	mA	$V_{DS} = 5V, V_{G1} = 5V$ $V_{G2S} = 4V, R_G = 47k\Omega$
Forward transfer admittance	$ y_{fs} $	19	24	29	mS	$V_{DS} = 5V, V_{G1} = 5V$ $V_{G2S} = 4V$ $R_G = 47k\Omega, f = 1kHz$
Input capacitance	$C_{iss}$	1.4	1.7	2.0	pF	$V_{DS} = 5V, V_{G1} = 5V$
Output capacitance	$C_{oss}$	0.7	1.1	1.5	pF	$V_{G2S} = 4V, R_G = 47k\Omega$
Reverse transfer capacitance	$C_{rss}$	—	0.019	0.04	pF	$f = 1MHz$
Power gain	PG	17	21.5	—	dB	$V_{DS} = 5V, V_{G1} = 5V$ $V_{G2S} = 4V, R_G = 47k\Omega$
Noise figure	NF	—	1.85	2.4	dB	$f = 900MHz$

Main Characteristics

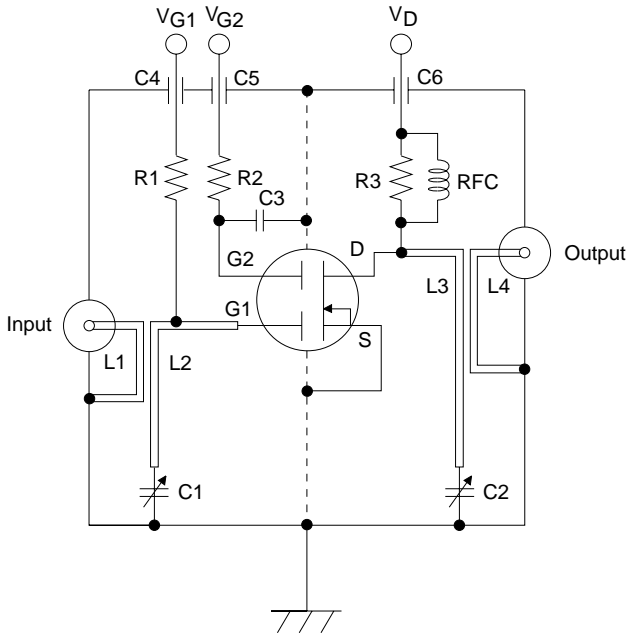
Test Circuit for Operating Items ( $I_{D(op)}$ ,  $|y_{fs}|$ ,  $C_{iss}$ ,  $C_{oss}$ ,  $C_{rss}$ , NF, PG)



Application Circuit

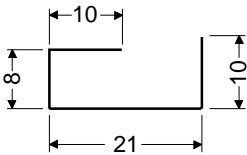


## 900MHz Power Gain, Noise Test Circuit

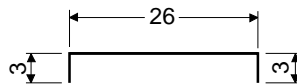


- C1, C2 : Variable Capacitor ( 10pF MAX)
- C3 : Disk Capacitor ( 1000pF)
- C4 ~ C6 : Air Capacitor ( 1000pF)
- R1 : 47 k
- R2 : 47 k
- R3 : 4.7 k

L1 :

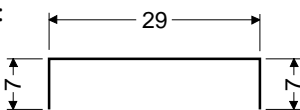


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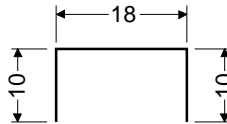


( 1mm Copper wire )  
Unit : mm

L3 :

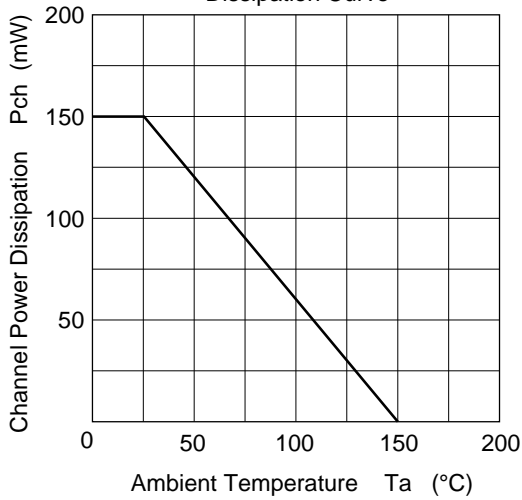


L4 :

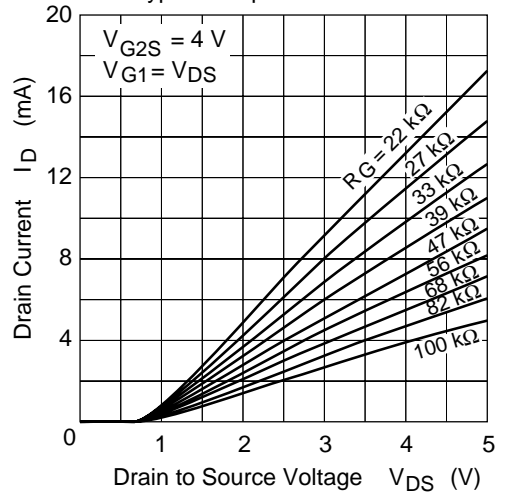


RFC : 1mm Copper wire with enamel 4turns inside dia 6mm

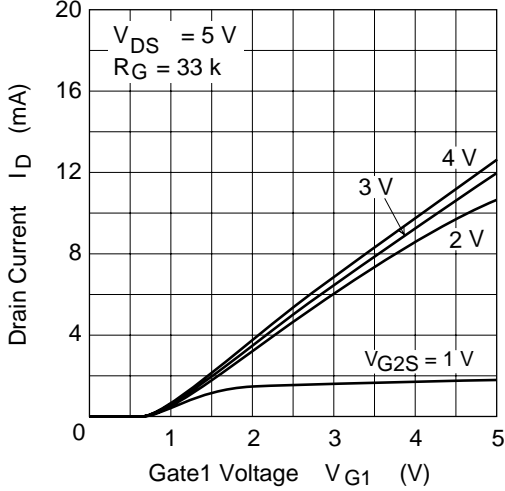
Maximum Channel Power Dissipation Curve



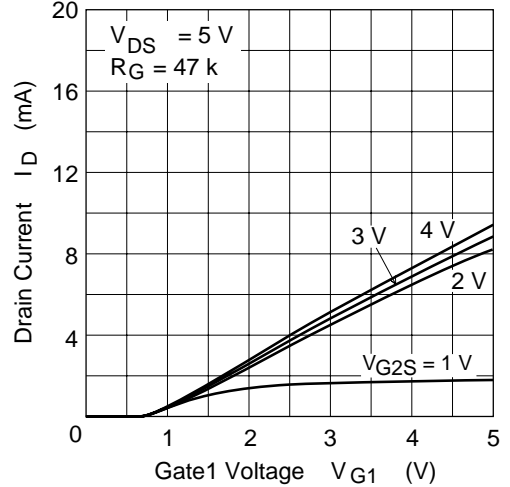
Typical Output Characteristics

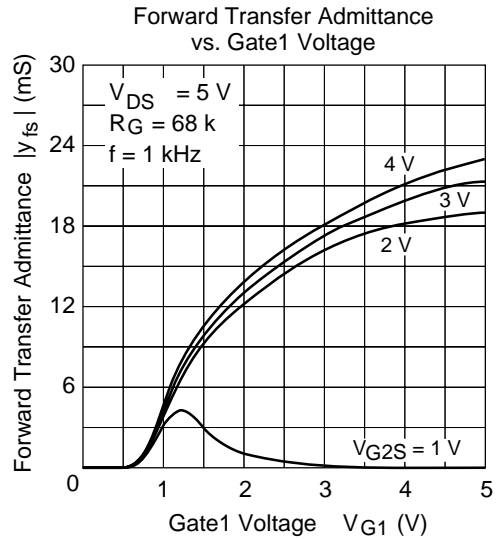
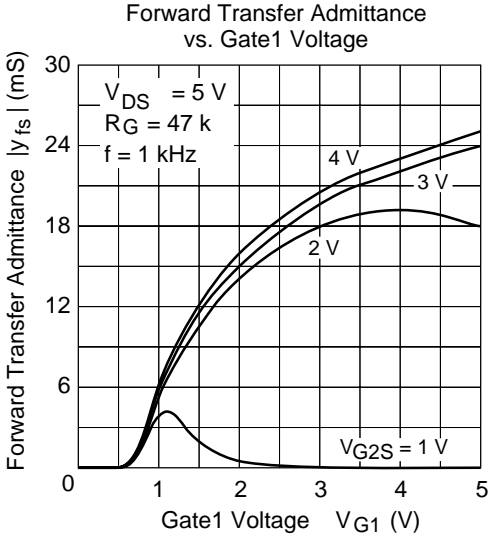
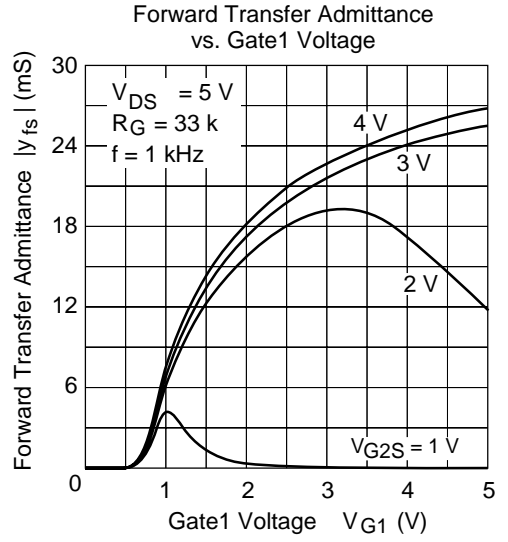
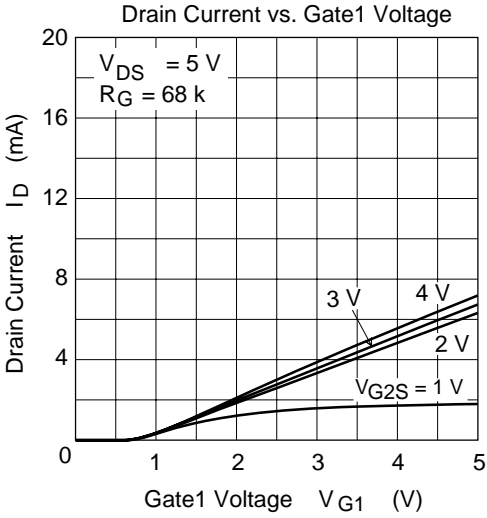


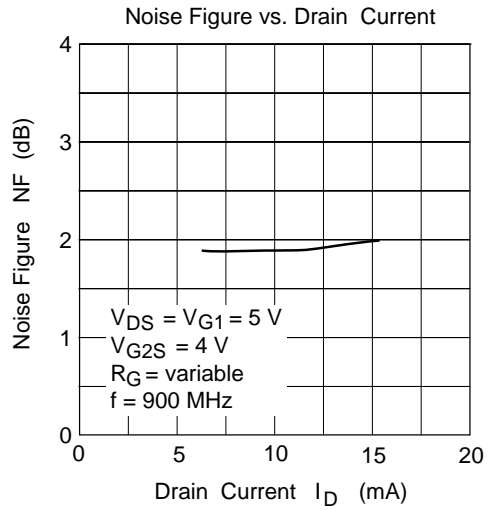
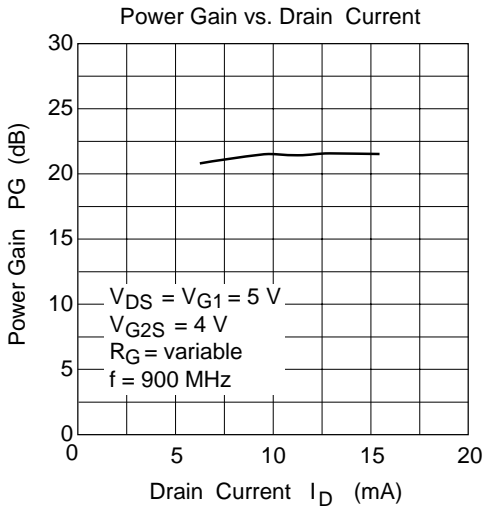
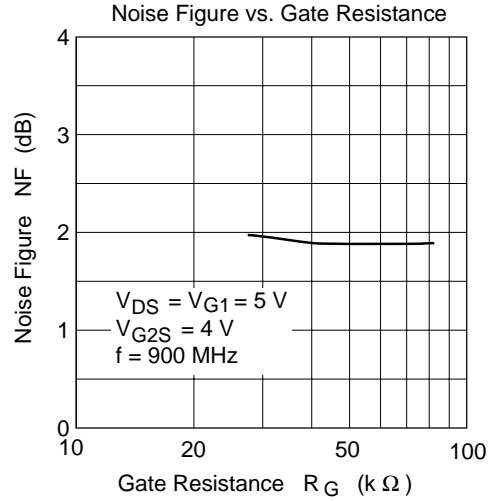
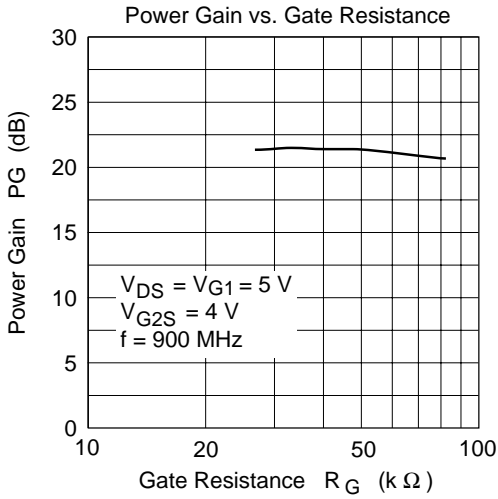
Drain Current vs. Gate1 Voltage

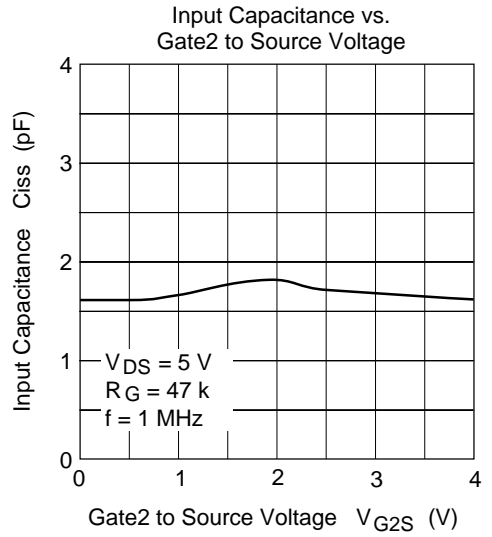
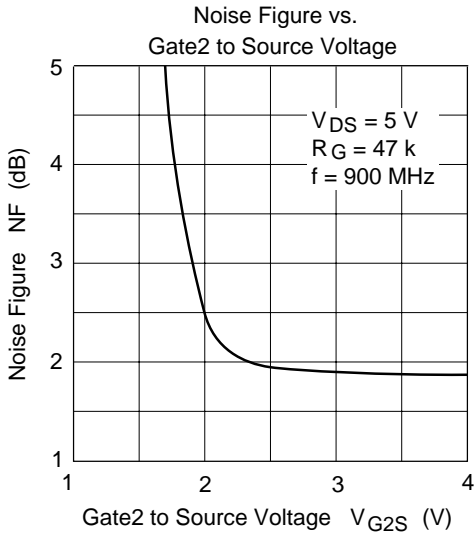
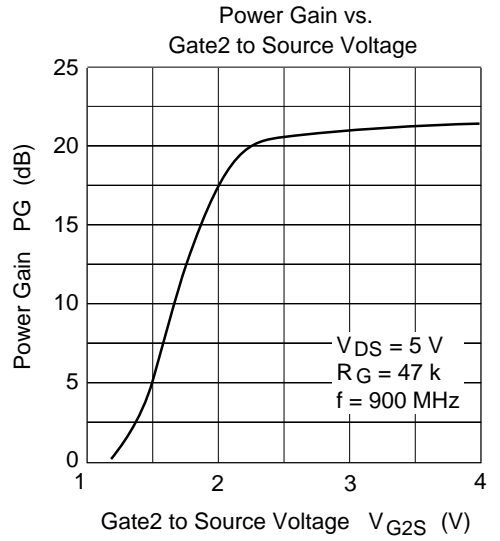
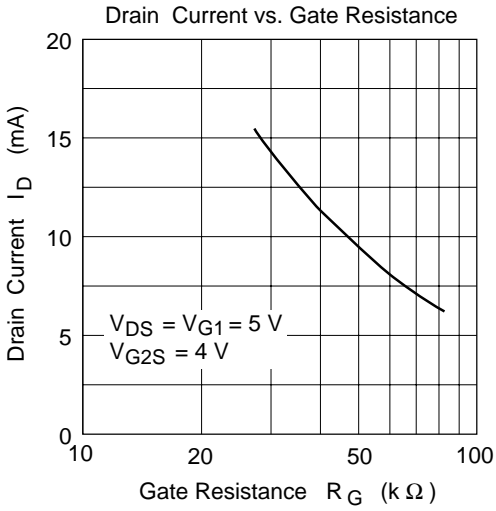


Drain Current vs. Gate1 Voltage

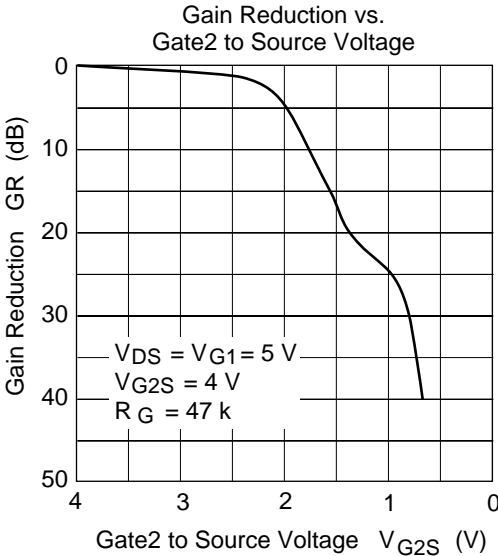




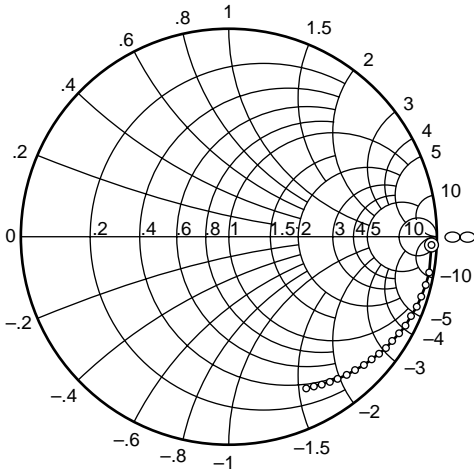








**S11 Parameter vs. Frequency**

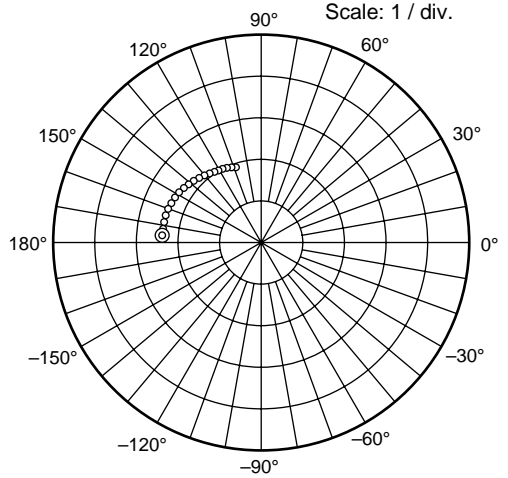


Test Condition:  $V_{DS} = 5\text{ V}$ ,  $V_{G1} = 5\text{ V}$   
 $V_{G2S} = 4\text{ V}$ ,  $R_G = 47\text{ k}\Omega$ ,  
 $Z_0 = 50\ \Omega$

50 ~ 1000 MHz (50 MHz step)



**S21 Parameter vs. Frequency**

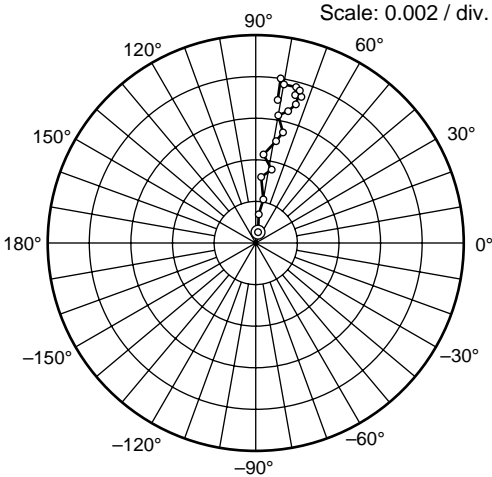


Test Condition:  $V_{DS} = 5\text{ V}$ ,  $V_{G1} = 5\text{ V}$   
 $V_{G2S} = 4\text{ V}$ ,  $R_G = 47\text{ k}\Omega$ ,  
 $Z_0 = 50\ \Omega$

50 ~ 1000 MHz (50 MHz step)



**S12 Parameter vs. Frequency**

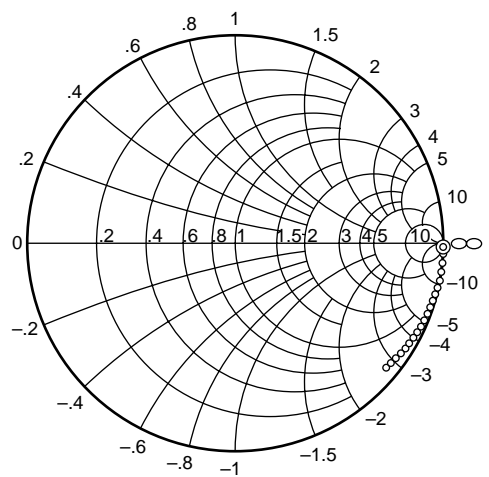


Test Condition:  $V_{DS} = 5\text{ V}$ ,  $V_{G1} = 5\text{ V}$   
 $V_{G2S} = 4\text{ V}$ ,  $R_G = 47\text{ k}\Omega$ ,  
 $Z_0 = 50\ \Omega$

50 ~ 1000 MHz (50 MHz step)



**S22 Parameter vs. Frequency**



Test Condition:  $V_{DS} = 5\text{ V}$ ,  $V_{G1} = 5\text{ V}$   
 $V_{G2S} = 4\text{ V}$ ,  $R_G = 47\text{ k}\Omega$ ,  
 $Z_0 = 50\ \Omega$

50 ~ 1000 MHz (50 MHz step)

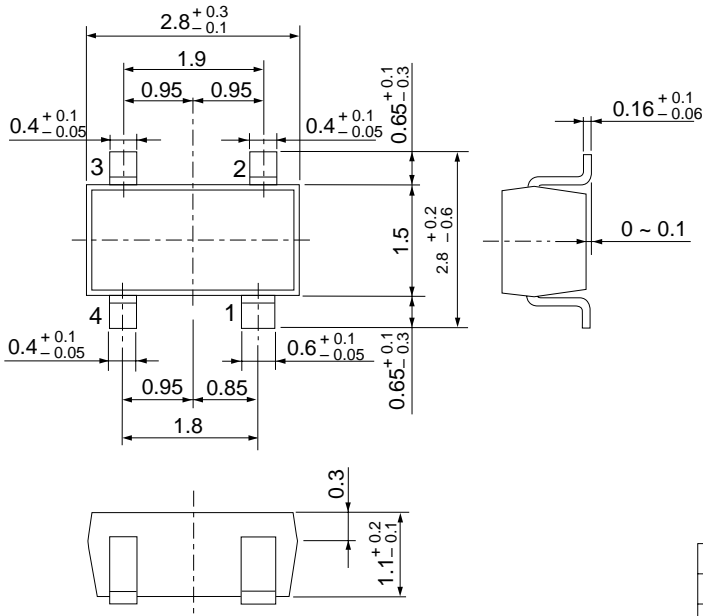


Sparameter ( $V_{DS} = V_{G1} = 5V$ ,  $V_{G2S} = 4V$ ,  $R_G = 47k\Omega$ ,  $Z_0 = 50\Omega$ )

f (MHz)	S11		S21		S12		S22	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
50	0.974	-2.8	2.40	176.4	0.00057	78.1	0.997	-2.0
100	0.974	-10.0	2.38	172.2	0.00144	82.4	0.998	-4.2
150	0.974	-13.6	2.38	168.4	0.00211	78.7	0.997	-6.0
200	0.965	-16.5	2.37	164.1	0.00316	84.8	0.995	-8.1
250	0.963	-20.0	2.35	160.4	0.00358	76.3	0.994	-10.2
300	0.953	-23.7	2.32	156.8	0.00431	84.0	0.992	-12.2
350	0.947	-26.8	2.30	152.9	0.00503	79.0	0.990	-14.2
400	0.942	-29.6	2.28	148.6	0.00545	76.6	0.987	-16.2
450	0.929	-32.8	2.26	144.9	0.00630	80.3	0.984	-18.1
500	0.923	-35.4	2.21	141.2	0.00646	76.1	0.981	-20.2
550	0.912	-38.5	2.19	137.6	0.00693	73.7	0.977	-22.1
600	0.903	-41.2	2.15	134.2	0.00732	72.9	0.974	-24.1
650	0.886	-44.2	2.12	130.6	0.00729	74.6	0.971	-26.0
700	0.879	-46.8	2.08	127.4	0.00733	72.0	0.967	-27.8
750	0.873	-49.2	2.06	124.3	0.00762	74.5	0.962	-29.7
800	0.859	-52.4	2.03	120.8	0.00756	73.7	0.959	-31.7
850	0.846	-55.4	2.00	117.3	0.00772	75.5	0.955	-33.6
900	0.836	-58.0	1.96	114.3	0.00775	79.6	0.951	-35.5
950	0.827	-60.4	1.93	111.0	0.00801	81.7	0.946	-37.3
1000	0.815	-62.8	1.89	108.0	0.00704	81.0	0.942	-39.4

**Package Dimensions**

Unit: mm



Hitachi Code	MPAK-4
EIAJ	SC-61AA
JEDEC	—

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