

# BB504C

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

# HITACHI

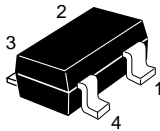
ADE-208-983D (Z)  
5th. Edition  
Dec. 2000

## Features

- Build in Biasing Circuit; To reduce using parts cost & PC board space.
- Low noise; NF = 1.0 dB typ. at f = 200 MHz, NF = 1.75 dB typ. at f = 900 MHz
- High gain; PG = 30 dB typ. at f = 200 MHz, PG = 22 dB typ. at f = 900 MHz
- Withstanding to ESD;  
Build in ESD absorbing diode. Withstand up to 200 V at C = 200 pF, R<sub>s</sub> = 0 conditions.
- Provide mini mold packages; CMPAK-4 (SOT-343mod)

## Outline

CMPAK-4



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

- Notes:
1. Marking is "DS-".
  2. BB504C is individual type number of HITACHI BBFET.

# BB504C

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

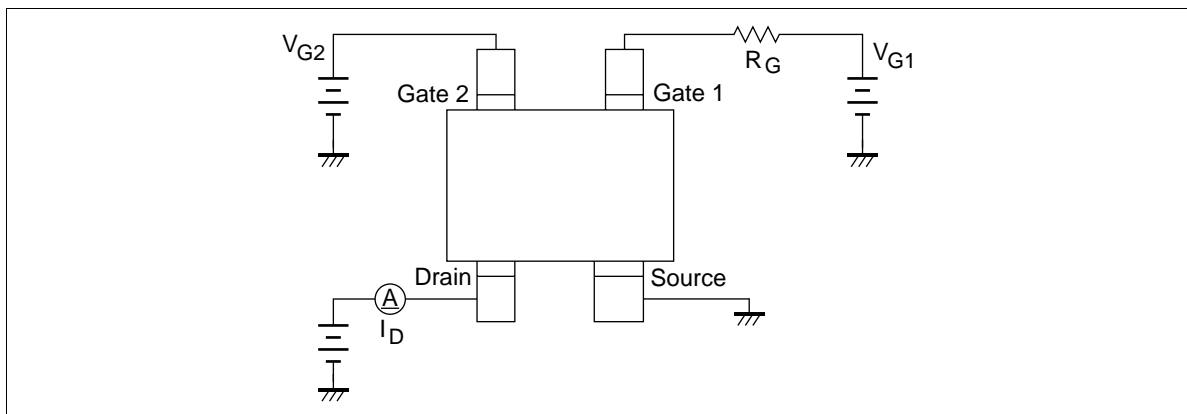
Item	Symbol	Ratings	Unit
Drain to source voltage	$V_{DS}$	6	V
Gate1 to source voltage	$V_{G1S}$	+6 -0	V
Gate2 to source voltage	$V_{G2S}$	+6 -0	V
Drain current	$I_D$	30	mA
Channel power dissipation	Pch	100	mW
Channel temperature	Tch	150	°C
Storage temperature	Tstg	-55 to +150	°C

## Electrical Characteristics (Ta = 25°C)

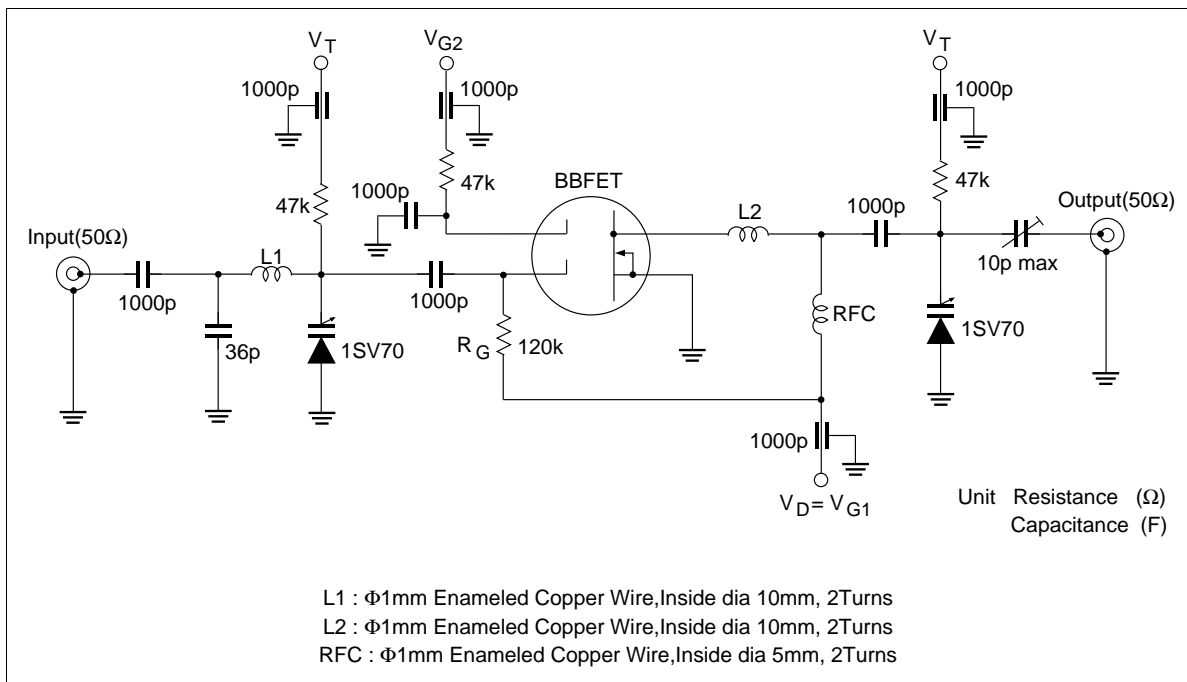
Item	Symbol	Min	Typ	Max	Unit	Test Conditions
Drain to source breakdown voltage	$V_{(BR)DSS}$	6	—	—	V	$I_D = 200\mu A, V_{G1S} = V_{G2S} = 0$
Gate1 to source breakdown voltage	$V_{(BR)G1SS}$	+6	—	—	V	$I_{G1} = +10\mu A, V_{G2S} = V_{DS} = 0$
Gate2 to source breakdown voltage	$V_{(BR)G2SS}$	+6	—	—	V	$I_{G2} = +10\mu A, V_{G1S} = V_{DS} = 0$
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	$V_{G1S(off)}$	0.6	0.85	1.1	V	$V_{DS} = 5V, V_{G2S} = 4V, I_D = 100\mu A$
Gate2 to source cutoff voltage	$V_{G2S(off)}$	0.6	0.85	1.1	V	$V_{DS} = 5V, V_{G1S} = 5V, I_D = 100\mu A$
Drain current	$I_{D(op)}$	13	16	19	mA	$V_{DS} = 5V, V_{G1} = 5V$ $V_{G2S} = 4V, R_G = 120k\Omega$
Forward transfer admittance	$ y_{fs} $	24	29	34	mS	$V_{DS} = 5V, V_{G1} = 5V, V_{G2S} = 4V$ $R_G = 120k\Omega, f = 1kHz$
Input capacitance	$C_{iss}$	1.7	2.1	2.5	pF	$V_{DS} = 5V, V_{G1} = 5V$
Output capacitance	$C_{oss}$	1.0	1.4	1.8	pF	$V_{G2S} = 4V, R_G = 120k\Omega$
Reverse transfer capacitance	$C_{rss}$	—	0.027	0.05	pF	$f = 1MHz$
Power gain (1)	PG	25	30	—	dB	$V_{DS} = 5V, V_{G1} = 5V$ $V_{G2S} = 4V, R_G = 120k\Omega$
Noise figure (1)	NF	—	1.0	1.8	dB	$f = 200MHz$
Power gain (2)	PG	17	22	—	dB	$V_{DS} = 5V, V_{G1} = 5V$ $V_{G2S} = 4V, R_G = 120k\Omega$
Noise figure (2)	NF	—	1.75	2.3	dB	$f = 900MHz$

Test Circuits

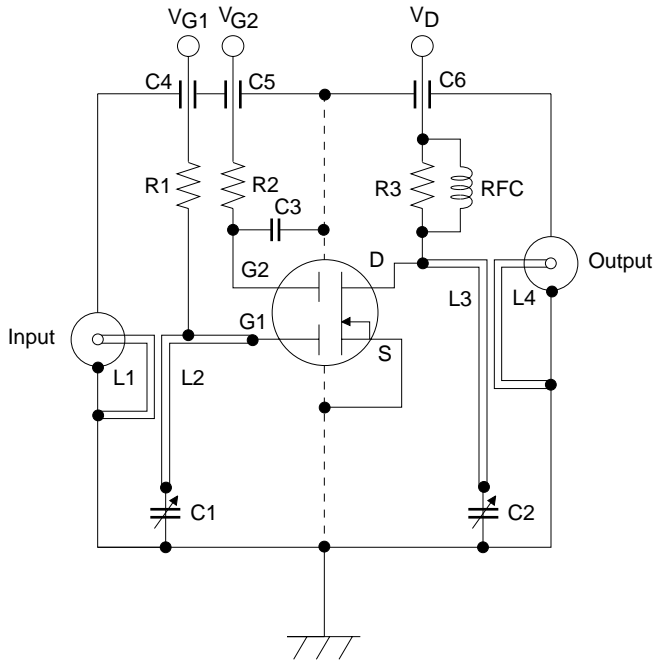
- DC Biasing Circuit for Operating Characteristics Items ( $I_{D(op)}$ ,  $|y_{fs}|$ ,  $C_{iss}$ ,  $C_{oss}$ ,  $C_{rss}$ ,  $NF$ ,  $PG$ )



- 200MHz Power Gain, Noise Figure Test Circuit

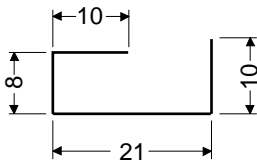


## • 900 MHz Power Gain, Noise Figure Test Circuit

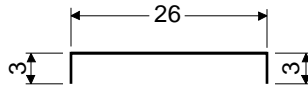


- C1, C2 : Variable Capacitor (10pF MAX)
- C3 : Disk Capacitor (1000pF)
- C4 to C6 : Air Capacitor (1000pF)
- R1 : 120 k $\Omega$
- R2 : 47 k $\Omega$
- R3 : 4.7 k $\Omega$

L1:

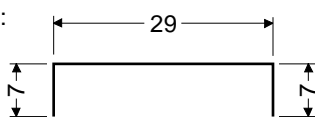


L2:

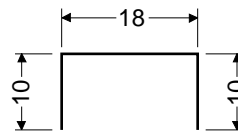


( $\Phi$ 1mm Copper wire)  
Unit:mm

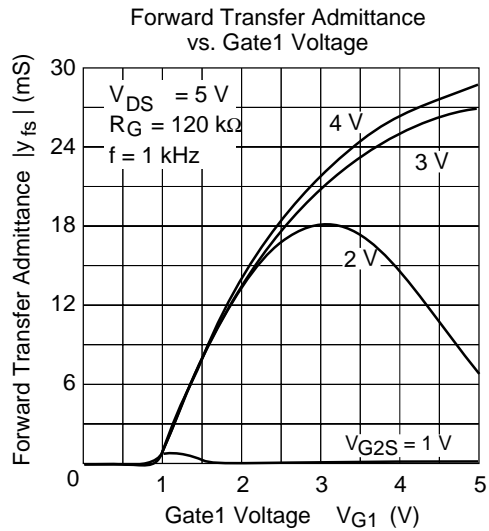
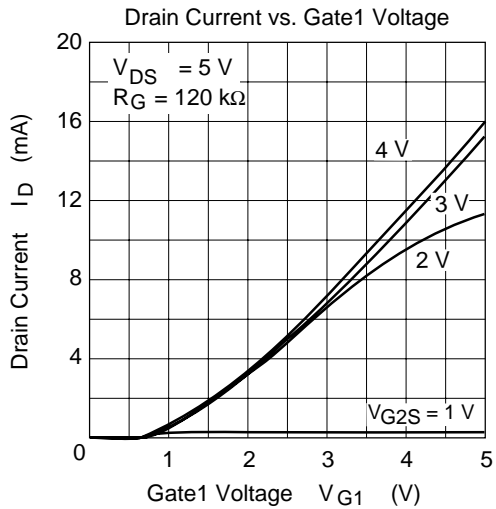
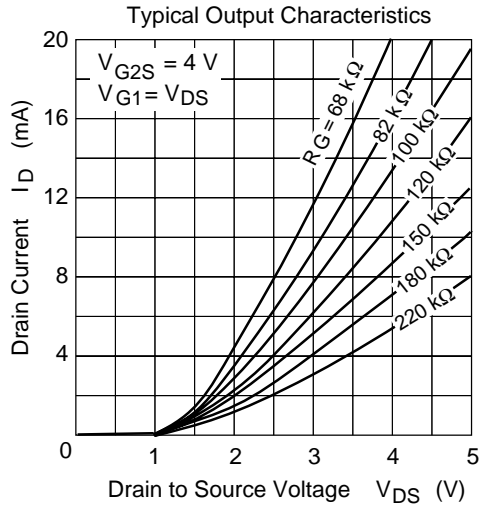
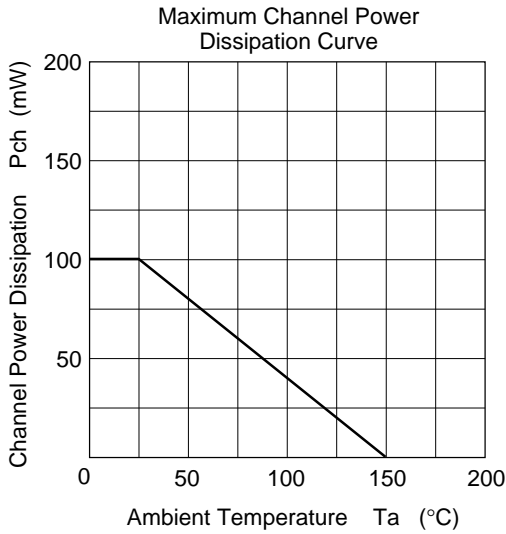
L3:

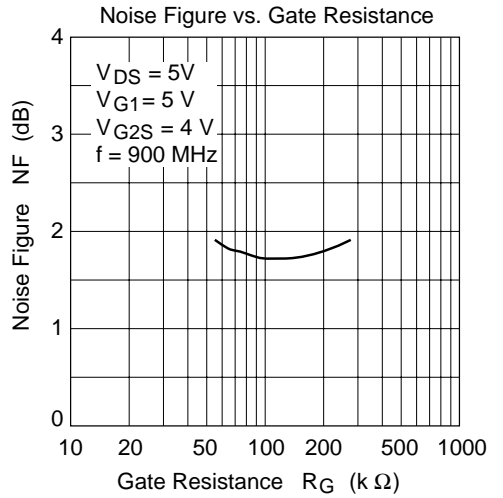
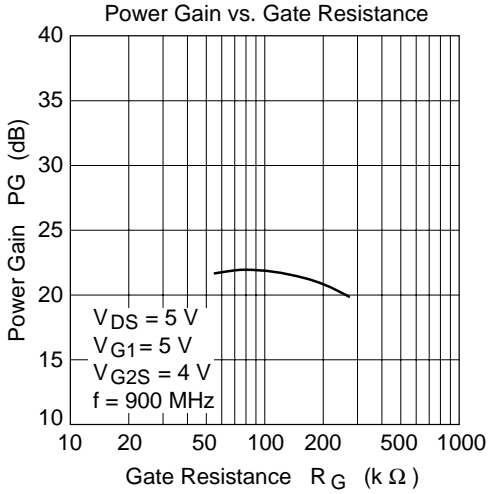
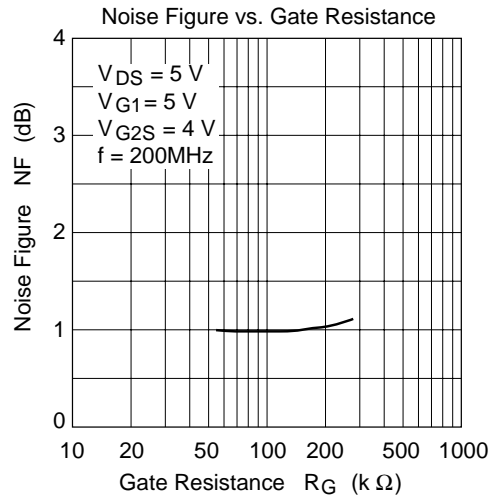
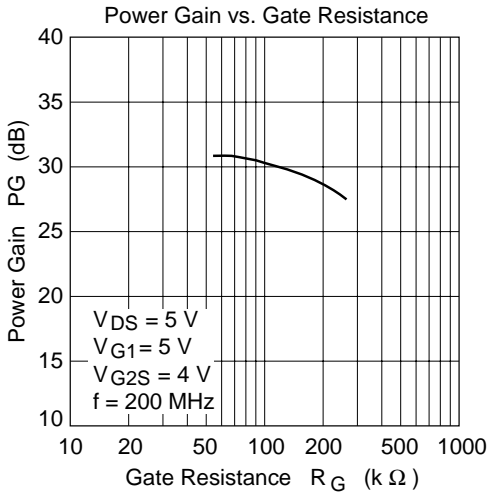


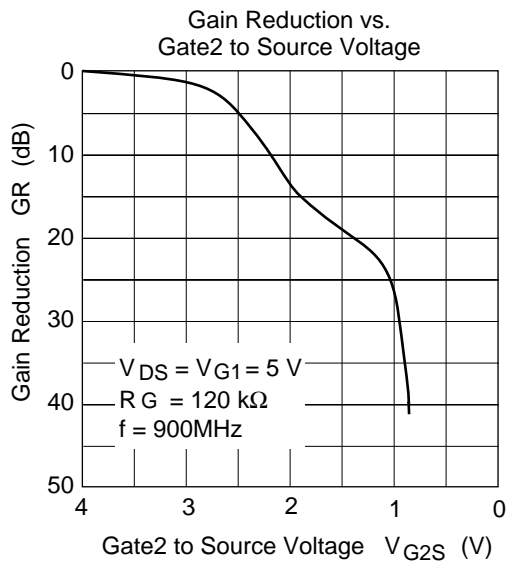
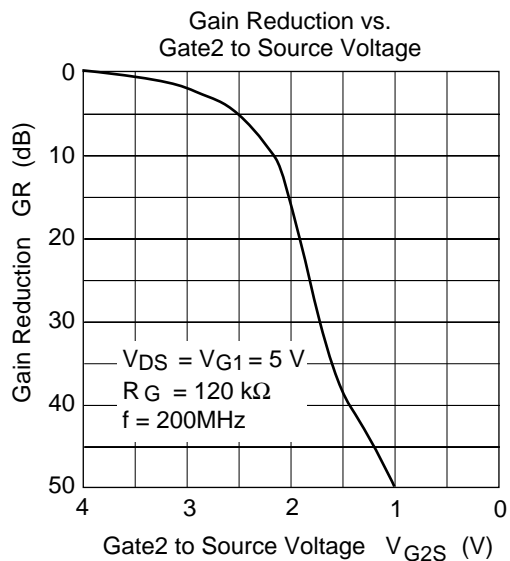
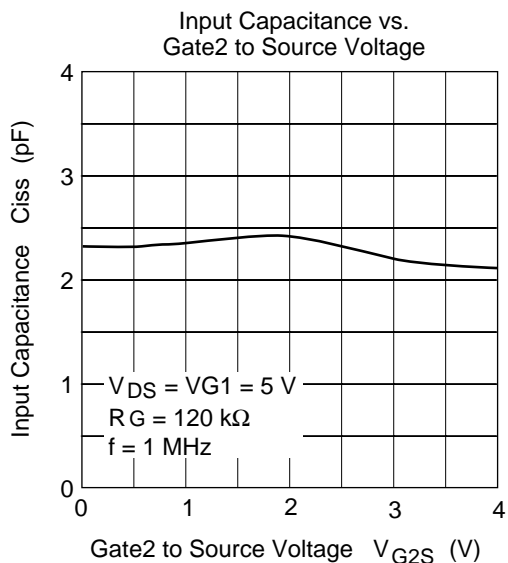
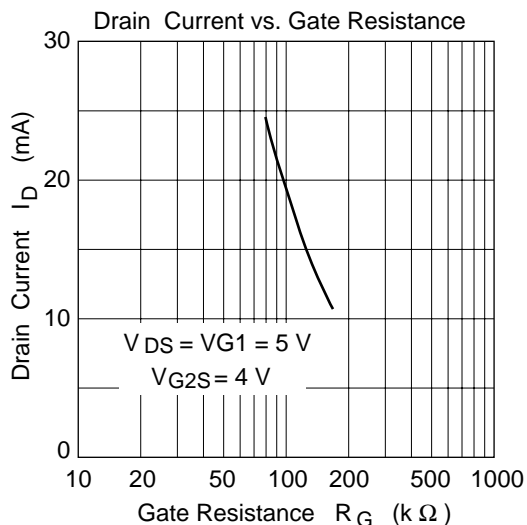
L4:



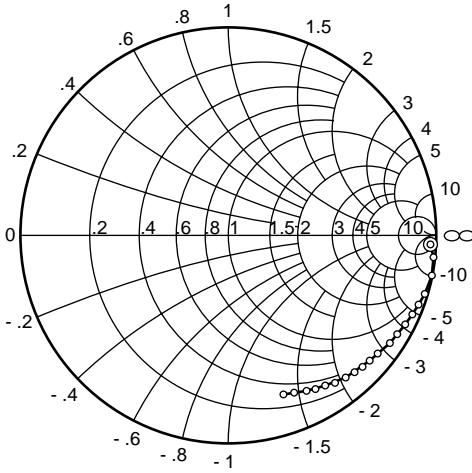
RFC :  $\Phi$ 1mm Copper wire with enamel 4turns inside dia 6mm







**S11 Parameter vs. Frequency**

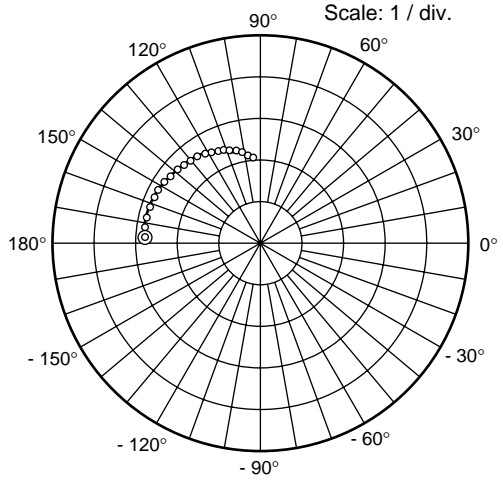


Test Condition:  $V_{DS} = 5\text{ V}$ ,  $V_{G1} = 5\text{ V}$   
 $V_{G2S} = 4\text{ V}$ ,  $R_G = 120\text{ k}\Omega$ ,  
 $Z_o = 50\ \Omega$

50 to 1000 MHz (50 MHz step)

⊙—○

**S21 Parameter vs. Frequency**

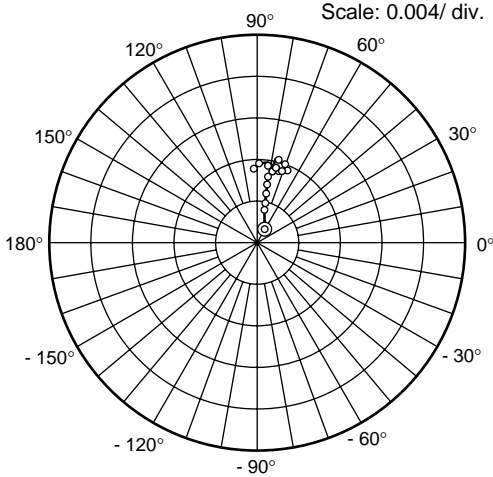


Test Condition:  $V_{DS} = 5\text{ V}$ ,  $V_{G1} = 5\text{ V}$   
 $V_{G2S} = 4\text{ V}$ ,  $R_G = 120\text{ k}\Omega$ ,  
 $Z_o = 50\ \Omega$

50 to 1000 MHz (50 MHz step)

⊙—○

**S12 Parameter vs. Frequency**

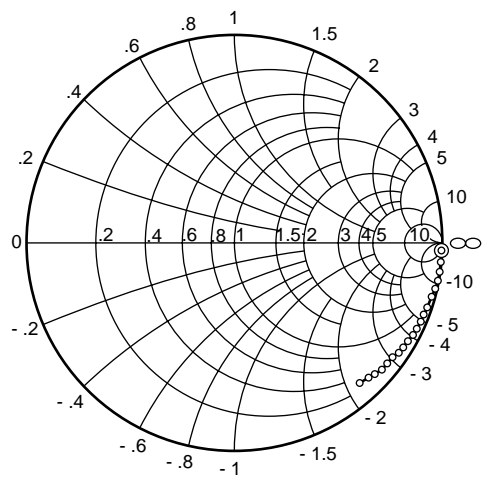


Test Condition:  $V_{DS} = 5\text{ V}$ ,  $V_{G1} = 5\text{ V}$   
 $V_{G2S} = 4\text{ V}$ ,  $R_G = 120\text{ k}\Omega$ ,  
 $Z_o = 50\ \Omega$

50 to 1000 MHz (50 MHz step)

⊙—○

**S22 Parameter vs. Frequency**



Test Condition:  $V_{DS} = 5\text{ V}$ ,  $V_{G1} = 5\text{ V}$   
 $V_{G2S} = 4\text{ V}$ ,  $R_G = 120\text{ k}\Omega$ ,  
 $Z_o = 50\ \Omega$

50 to 1000 MHz (50 MHz step)

⊙—○



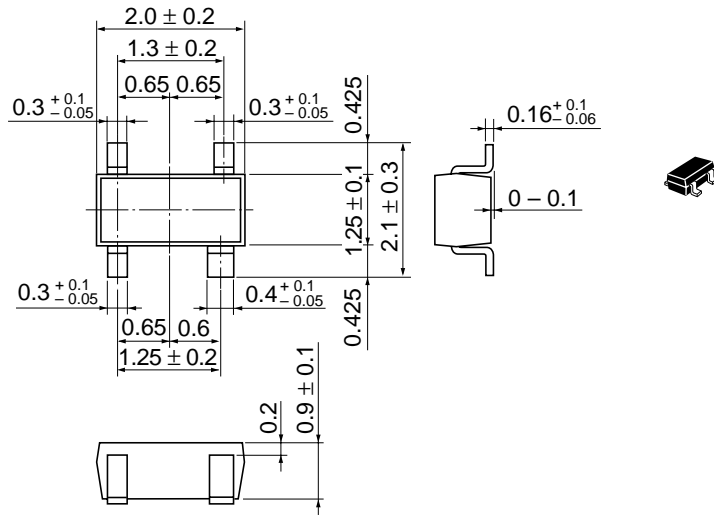
**Sparameter** ( $V_{DS} = V_{G1} = 5V$ ,  $V_{G2S} = 4V$ ,  $R_G = 120k\Omega$ ,  $Z_O = 50\Omega$ )

f (MHz)	S11		S21		S12		S22	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
50	1.000	-3.3	2.80	175.9	0.00106	58.8	0.990	-2.4
100	0.993	-7.2	2.78	170.9	0.00171	75.7	0.992	-4.7
150	0.991	-10.9	2.77	166.1	0.00253	75.1	0.991	-7.2
200	0.984	-15.0	2.74	161.2	0.00356	77.4	0.987	-9.6
250	0.978	-19.0	2.72	156.5	0.00442	78.2	0.985	-12.2
300	0.970	-22.8	2.68	151.8	0.00485	80.0	0.982	-14.7
350	0.958	-26.7	2.64	147.2	0.00576	74.7	0.978	-17.1
400	0.954	-30.3	2.60	142.7	0.00642	71.7	0.973	-19.6
450	0.945	-33.8	2.56	138.6	0.00689	73.3	0.968	-22.0
500	0.932	-37.5	2.50	134.1	0.00712	71.8	0.963	-24.2
550	0.920	-40.6	2.46	129.8	0.00765	70.7	0.958	-26.7
600	0.910	-44.3	2.41	125.7	0.00804	69.9	0.952	-28.9
650	0.900	-47.5	2.37	121.6	0.00798	69.1	0.947	-31.3
700	0.887	-50.9	2.31	117.8	0.00787	67.8	0.942	-33.4
750	0.870	-54.4	2.27	113.6	0.00785	70.8	0.936	-35.8
800	0.863	-57.6	2.22	110.0	0.00758	73.3	0.929	-37.9
850	0.853	-60.9	2.18	105.8	0.00721	75.2	0.924	-40.3
900	0.839	-63.6	2.12	102.2	0.00694	75.8	0.917	-42.5
950	0.827	-66.5	2.07	98.6	0.00716	88.1	0.912	-44.5
1000	0.819	-70.1	2.04	94.9	0.00667	92.7	0.906	-46.7

**Package Dimensions**

As of January, 2001

Unit: mm



Hitachi Code	CMPAK-4(T)
JEDEC	—
EIAJ	Conforms
Mass (reference value)	0.006 g

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