

---

# BB305M

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

# HITACHI

ADE-208-607C (Z)  
4th. Edition  
May 1998

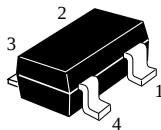
---

## Features

- Build in Biasing Circuit; To reduce using parts cost & PC board space.
- Superior cross modulation characteristics.
- High gain; (PG = 28 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  $C=200\text{pF}$ ,  $R_s=0$  conditions.
- Provide mini mold packages; MPAK-4(SOT-143mod)

## Outline

MPAK-4



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

Note: 1. Marking is “EW—”.  
2. BB305M is individual type number of HITACHI BBFET.

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

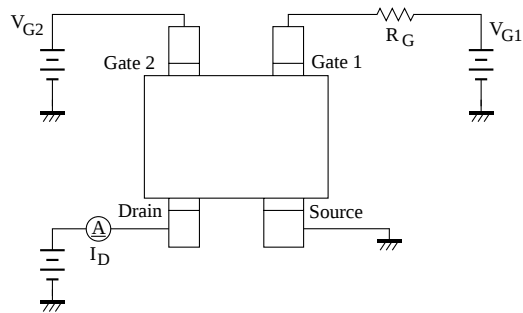
| Item                      | Symbol           | Ratings     | Unit |
|---------------------------|------------------|-------------|------|
| Drain to source voltage   | V <sub>DS</sub>  | 12          | V    |
| Gate1 to source voltage   | V <sub>G1S</sub> | +10<br>−0   | V    |
| Gate2 to source voltage   | V <sub>G2S</sub> | ±10         | V    |
| Drain current             | I <sub>D</sub>   | 25          | mA   |
| Channel power dissipation | P <sub>ch</sub>  | 150         | mW   |
| Channel temperature       | T <sub>ch</sub>  | 150         | °C   |
| Storage temperature       | T <sub>stg</sub> | −55 to +150 | °C   |

## Electrical Characteristics (Ta = 25°C)

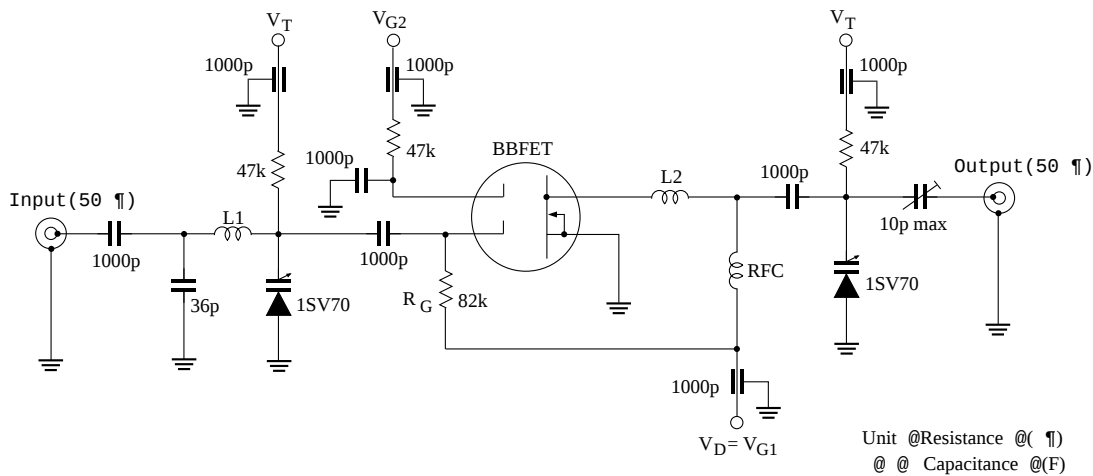
| Item                              | Symbol         | Min      | Typ   | Max       | Unit | Test Conditions                                                                     |
|-----------------------------------|----------------|----------|-------|-----------|------|-------------------------------------------------------------------------------------|
| 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      | —     | 1.0       | V    | $V_{DS} = 5V$ , $V_{G2S} = 4V$ , $I_D = 100\mu A$                                   |
| Gate2 to source cutoff voltage    | $V_{G2S(off)}$ | 0.4      | —     | 1.0       | V    | $V_{DS} = 5V$ , $V_{G1S} = 5V$ , $I_D = 100\mu A$                                   |
| Input capacitance                 | $C_{iss}$      | 2.3      | 2.8   | 3.5       | pF   | $V_{DS} = 5V$ , $V_{G1} = 5V$                                                       |
| Output capacitance                | $C_{oss}$      | 1.1      | 1.5   | 1.9       | pF   | $V_{G2S} = 4V$ , $R_G = 82k\Omega$                                                  |
| Reverse transfer capacitance      | $C_{rss}$      | —        | 0.017 | 0.04      | pF   | $f = 1MHz$                                                                          |
| Drain current                     | $I_{D(op)1}$   | 10       | 15    | 20        | mA   | $V_{DS} = 5V$ , $V_{G1} = 5V$ , $V_{G2S} = 4V$<br>$R_G = 82k\Omega$                 |
|                                   | $I_{D(op)2}$   | —        | 13    | —         | mA   | $V_{DS} = 9V$ , $V_{G1} = 9V$ , $V_{G2S} = 6V$<br>$R_G = 220k\Omega$                |
| Forward transfer admittance       | $ y_{fs} 1$    | 23       | 28    | —         | mS   | $V_{DS} = 5V$ , $V_{G1} = 5V$ , $V_{G2S} = 4V$<br>$R_G = 82k\Omega$ , $f = 1kHz$    |
|                                   | $ y_{fs} 2$    | —        | 28    | —         | mS   | $V_{DS} = 9V$ , $V_{G1} = 9V$ , $V_{G2S} = 6V$<br>$R_G = 220k\Omega$ , $f = 1kHz$   |
| Power gain                        | PG1            | 24       | 28    | —         | dB   | $V_{DS} = 5V$ , $V_{G1} = 5V$ , $V_{G2S} = 4V$<br>$R_G = 82k\Omega$ , $f = 200MHz$  |
|                                   | PG2            | —        | 28    | —         | dB   | $V_{DS} = 9V$ , $V_{G1} = 9V$ , $V_{G2S} = 6V$<br>$R_G = 220k\Omega$ , $f = 200MHz$ |
| Noise figure                      | NF1            | —        | 1.4   | 1.9       | dB   | $V_{DS} = 5V$ , $V_{G1} = 5V$ , $V_{G2S} = 4V$<br>$R_G = 82k\Omega$ , $f = 200MHz$  |
|                                   | NF2            | —        | 1.4   | —         | dB   | $V_{DS} = 9V$ , $V_{G1} = 9V$ , $V_{G2S} = 6V$<br>$R_G = 220k\Omega$ , $f = 200MHz$ |

Main Characteristics

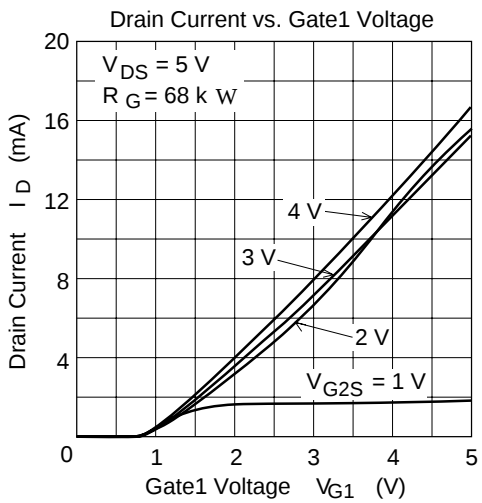
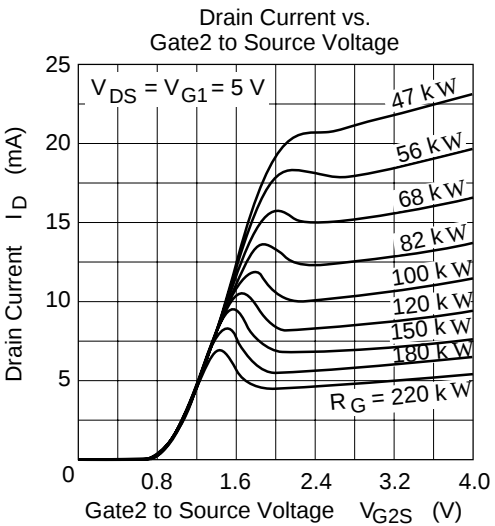
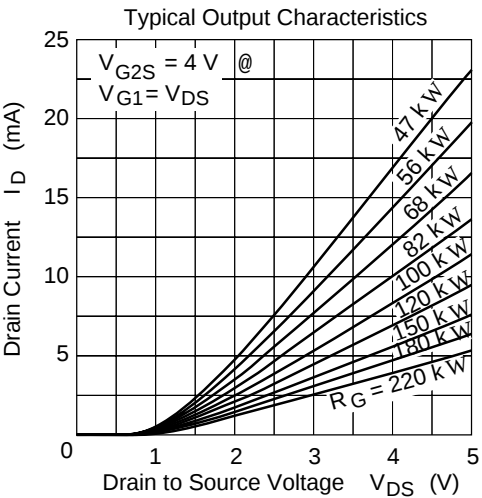
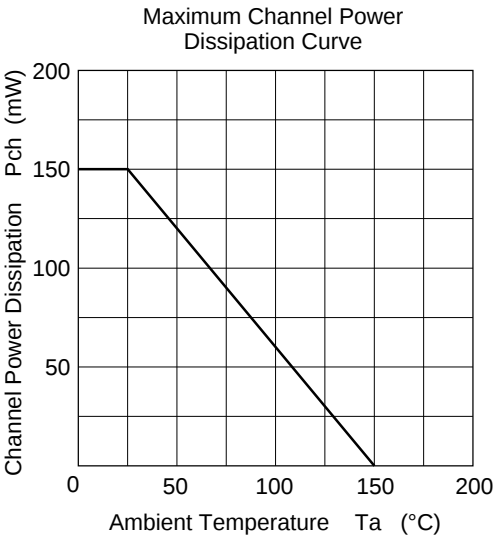
Test Circuit for Operating Items ( $I_{D(op)}$ ,  $y_{fs}$ ,  $C_{iss}$ ,  $C_{oss}$ ,  $C_{rss}$ , NF, PG)



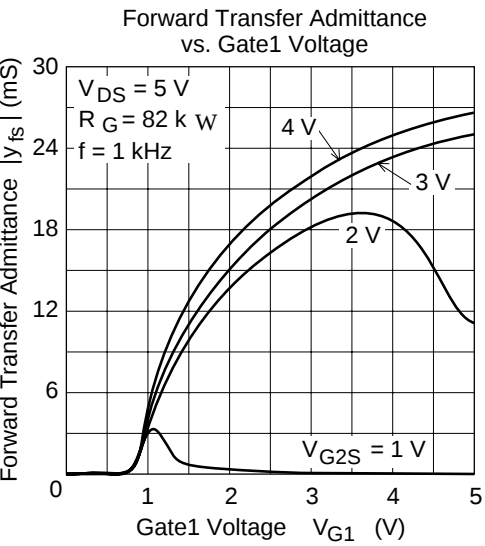
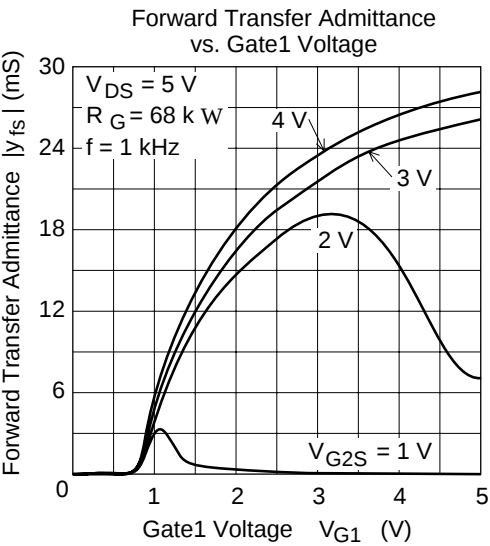
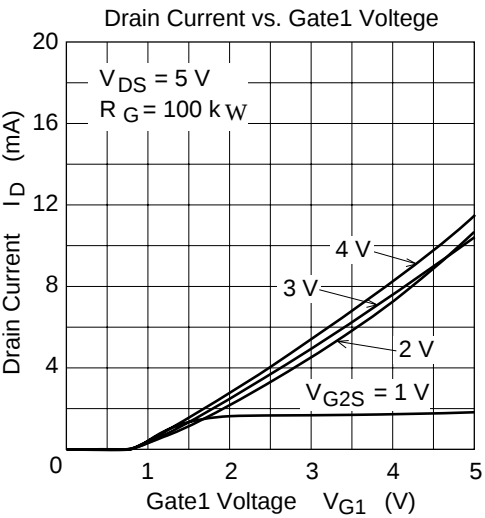
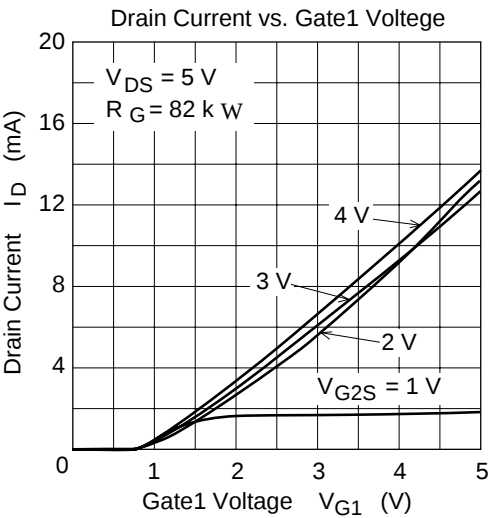
Power Gain, Noise Figure Test Circuit



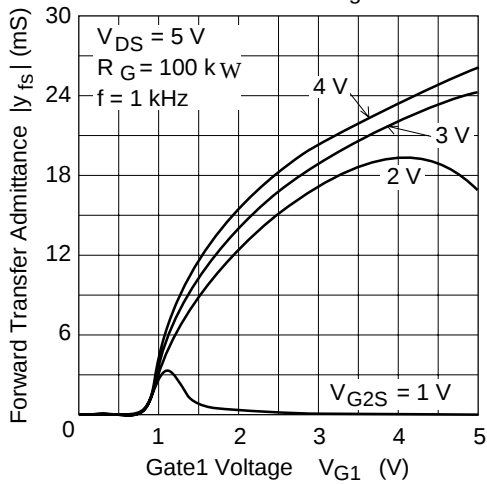
- L1 : 1mm Enameled Copper Wire, Inside dia 10mm, 2Turns
- L2 : 1mm Enameled Copper Wire, Inside dia 10mm, 2Turns
- RFC : 1mm Enameled Copper Wire, Inside dia 5mm, 2Turns



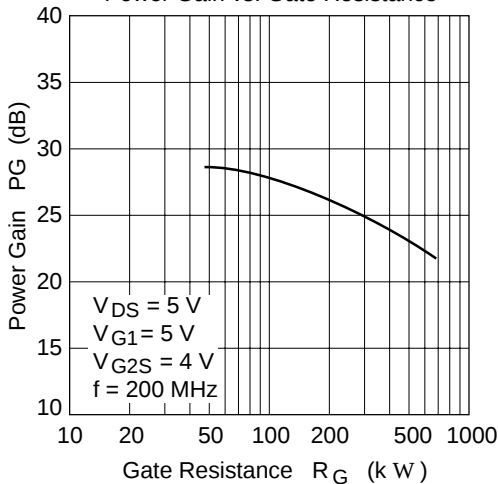
Å@



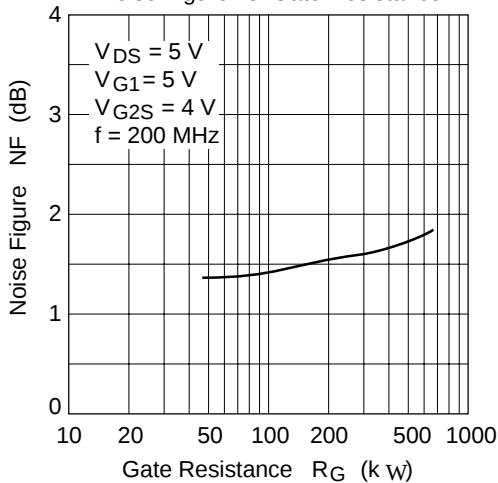
Forward Transfer Admittance  
vs. Gate1 Voltage



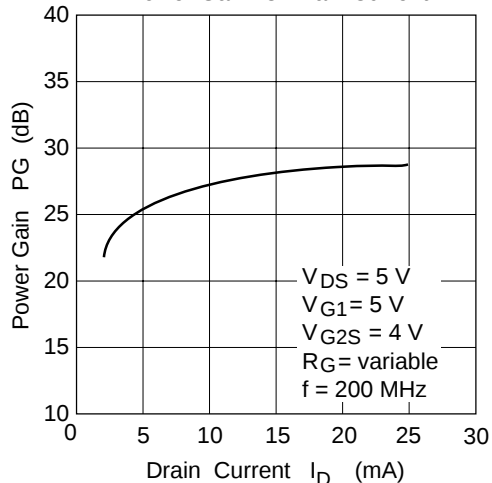
Power Gain vs. Gate Resistance

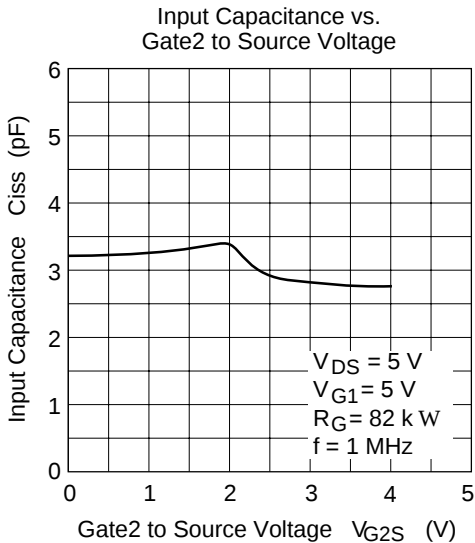
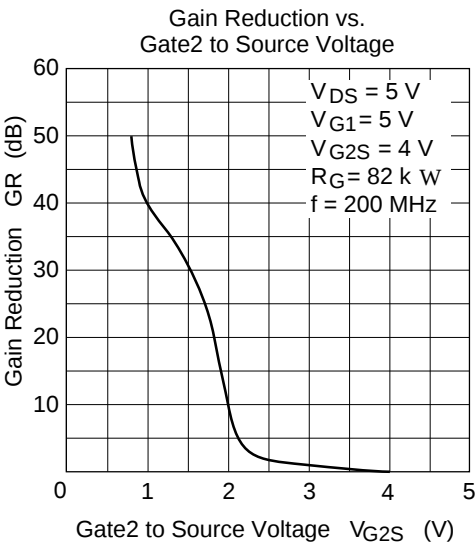
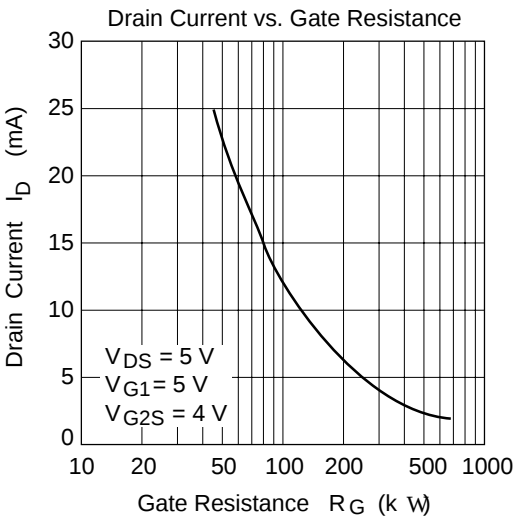
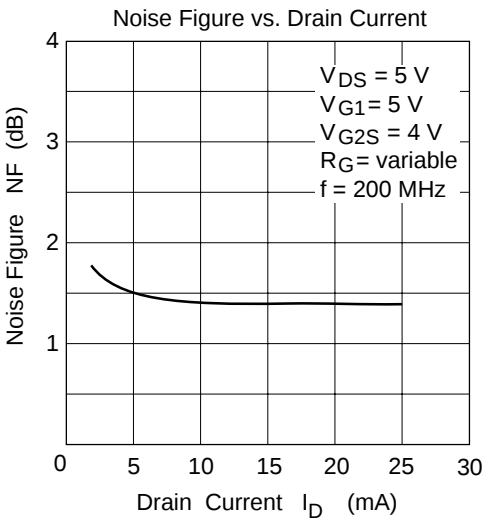


Noise Figure vs. Gate Resistance

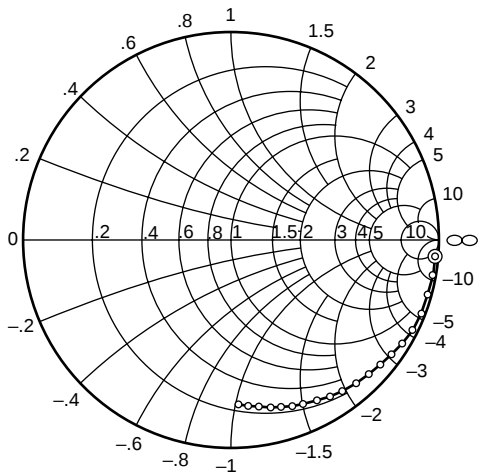


Power Gain vs. Drain Current





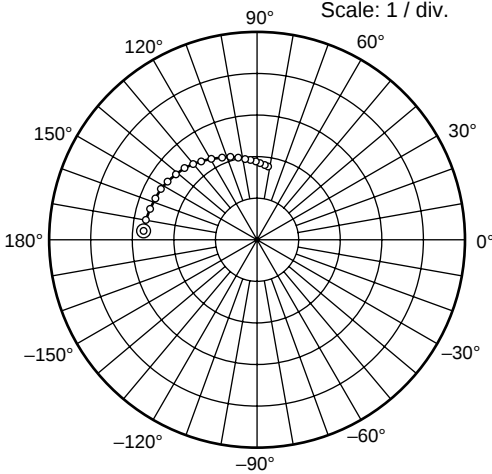
S11 Parameter vs. Frequency



Test Condition :  $V_{DS} = 5\text{ V}$ ,  $V_{G1} = 5\text{ V}$   
 $V_{G2S} = 4\text{ V}$ ,  $R_G = 82\text{ k}\Omega$   
50 ' 1000 MHz (50 MHz step)



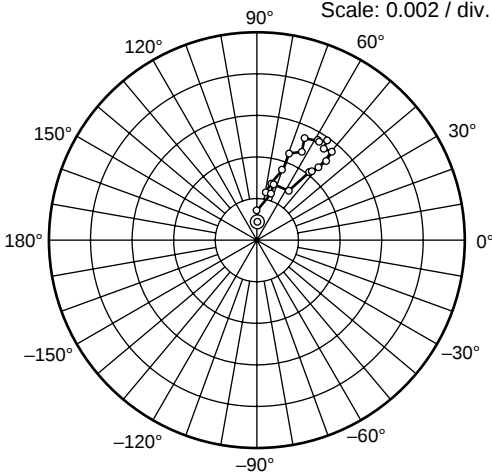
S21 Parameter vs. Frequency



Test Condition :  $V_{DS} = 5\text{ V}$ ,  $V_{G1} = 5\text{ V}$   
 $V_{G2S} = 4\text{ V}$ ,  $R_G = 82\text{ k}\Omega$   
50 ' 1000 MHz (50 MHz step)



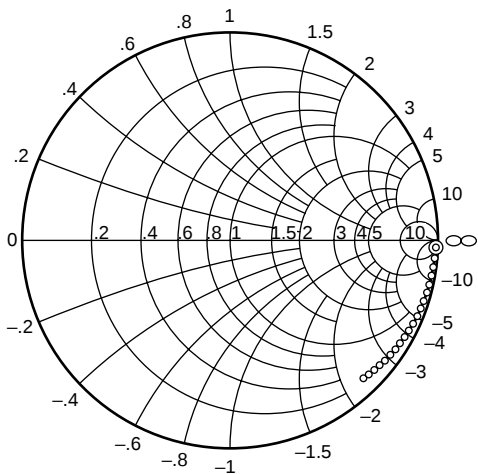
S12 Parameter vs. Frequency



Test Condition :  $V_{DS} = 5\text{ V}$ ,  $V_{G1} = 5\text{ V}$   
 $V_{G2S} = 4\text{ V}$ ,  $R_G = 82\text{ k}\Omega$   
50 ' 1000 MHz (50 MHz step)



S22 Parameter vs. Frequency



Test Condition :  $V_{DS} = 5\text{ V}$ ,  $V_{G1} = 5\text{ V}$   
 $V_{G2S} = 4\text{ V}$ ,  $R_G = 82\text{ k}\Omega$   
50 ' 1000 MHz (50 MHz step)

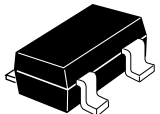
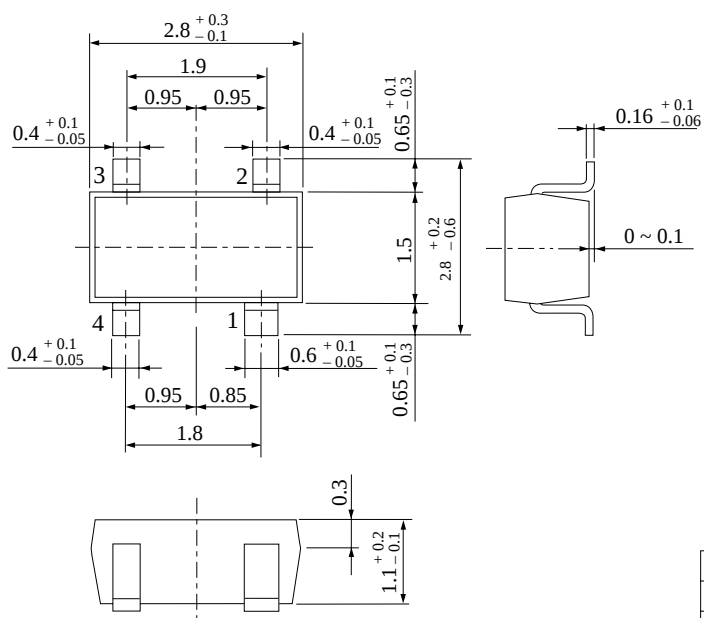


Sparameter ( $V_{DS} = V_{G1} = 5V$ ,  $V_{G2S} = 4V$ ,  $R_G = 82k\Omega$ ,  $Z_o = 50\Omega$ )

| f (MHz) | S11   |       | S21  |       | S12     |      | S22   |       |
|---------|-------|-------|------|-------|---------|------|-------|-------|
|         | MAG   | ANG   | MAG  | ANG   | MAG     | ANG  | MAG   | ANG   |
| 50      | 0.991 | −4.8  | 2.69 | 174.9 | 0.00090 | 91.4 | 0.991 | −2.2  |
| 100     | 0.991 | −9.9  | 2.68 | 169.3 | 0.00153 | 90.5 | 0.992 | −4.8  |
| 150     | 0.982 | −15.4 | 2.66 | 163.4 | 0.00243 | 73.8 | 0.991 | −7.5  |
| 200     | 0.975 | −20.7 | 2.62 | 157.5 | 0.00293 | 74.9 | 0.989 | −9.9  |
| 250     | 0.972 | −25.6 | 2.60 | 152.0 | 0.00370 | 70.1 | 0.985 | −12.6 |
| 300     | 0.956 | −30.6 | 2.54 | 146.3 | 0.00444 | 69.0 | 0.981 | −15.0 |
| 350     | 0.942 | −35.5 | 2.47 | 140.9 | 0.00478 | 63.7 | 0.977 | −17.3 |
| 400     | 0.928 | −40.1 | 2.42 | 135.7 | 0.00535 | 64.8 | 0.973 | −19.7 |
| 450     | 0.920 | −44.9 | 2.38 | 130.5 | 0.00551 | 56.8 | 0.967 | −22.0 |
| 500     | 0.906 | −49.2 | 2.32 | 125.7 | 0.00549 | 58.6 | 0.962 | −24.5 |
| 550     | 0.894 | −53.6 | 2.25 | 120.8 | 0.00584 | 54.4 | 0.957 | −26.9 |
| 600     | 0.880 | −57.8 | 2.18 | 116.2 | 0.00542 | 53.3 | 0.952 | −29.2 |
| 650     | 0.868 | −62.1 | 2.12 | 111.5 | 0.00562 | 49.5 | 0.944 | −31.5 |
| 700     | 0.854 | −66.2 | 2.06 | 106.8 | 0.00509 | 48.6 | 0.939 | −33.8 |
| 750     | 0.842 | −70.3 | 2.00 | 102.5 | 0.00465 | 49.7 | 0.933 | −36.1 |
| 800     | 0.835 | −73.9 | 1.94 | 98.4  | 0.00427 | 51.6 | 0.927 | −38.3 |
| 850     | 0.820 | −77.7 | 1.89 | 94.0  | 0.00416 | 53.3 | 0.921 | −40.5 |
| 900     | 0.802 | −81.5 | 1.83 | 89.6  | 0.00289 | 57.9 | 0.915 | −42.7 |
| 950     | 0.801 | −84.7 | 1.78 | 85.6  | 0.00288 | 72.9 | 0.909 | −44.9 |
| 1000    | 0.789 | −87.9 | 1.73 | 82.1  | 0.00241 | 78.9 | 0.904 | −47.1 |

Package Dimensions

Unit: mm



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

## Cautions

1. Hitachi neither warrants nor grants licenses of any rights of Hitachi's or any third party's patent, copyright, trademark, or other intellectual property rights for information contained in this document. Hitachi bears no responsibility for problems that may arise with third party's rights, including intellectual property rights, in connection with use of the information contained in this document.
2. Products and product specifications may be subject to change without notice. Confirm that you have received the latest product standards or specifications before final design, purchase or use.
3. Hitachi makes every attempt to ensure that its products are of high quality and reliability. However, contact Hitachi's sales office before using the product in an application that demands especially high quality and reliability or where its failure or malfunction may directly threaten human life or cause risk of bodily injury, such as aerospace, aeronautics, nuclear power, combustion control, transportation, traffic, safety equipment or medical equipment for life support.
4. Design your application so that the product is used within the ranges guaranteed by Hitachi particularly for maximum rating, operating supply voltage range, heat radiation characteristics, installation conditions and other characteristics. Hitachi bears no responsibility for failure or damage when used beyond the guaranteed ranges. Even within the guaranteed ranges, consider normally foreseeable failure rates or failure modes in semiconductor devices and employ systemic measures such as fail-safes, so that the equipment incorporating Hitachi product does not cause bodily injury, fire or other consequential damage due to operation of the Hitachi product.
5. This product is not designed to be radiation resistant.
6. No one is permitted to reproduce or duplicate, in any form, the whole or part of this document without written approval from Hitachi.
7. Contact Hitachi's sales office for any questions regarding this document or Hitachi semiconductor products.

# HITACHI

## Hitachi, Ltd.

Semiconductor & Integrated Circuits.  
Nippon Bldg., 2-6-2, Ohte-machi, Chiyoda-ku, Tokyo 100-0004, Japan  
Tel: Tokyo (03) 3270-2111 Fax: (03) 3270-5109

|     |                  |                                                                                                                       |
|-----|------------------|-----------------------------------------------------------------------------------------------------------------------|
| URL | NorthAmerica     | : <a href="http://semiconductor.hitachi.com/">http://semiconductor.hitachi.com/</a>                                   |
|     | Europe           | : <a href="http://www.hitachi-eu.com/hel/ecg">http://www.hitachi-eu.com/hel/ecg</a>                                   |
|     | Asia (Singapore) | : <a href="http://www.has.hitachi.com.sg/grp3/sicd/index.htm">http://www.has.hitachi.com.sg/grp3/sicd/index.htm</a>   |
|     | Asia (Taiwan)    | : <a href="http://www.hitachi.com.tw/E/Product/SICD_Frame.htm">http://www.hitachi.com.tw/E/Product/SICD_Frame.htm</a> |
|     | Asia (HongKong)  | : <a href="http://www.hitachi.com.hk/eng/bo/grp3/index.htm">http://www.hitachi.com.hk/eng/bo/grp3/index.htm</a>       |
|     | Japan            | : <a href="http://www.hitachi.co.jp/Sicd/indx.htm">http://www.hitachi.co.jp/Sicd/indx.htm</a>                         |

## For further information write to:

|                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                         |
|--------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Hitachi Semiconductor (America) Inc.<br>179 East Tasman Drive,<br>San Jose, CA 95134<br>Tel: <1> (408) 433-1990<br>Fax: <1> (408) 433-0223 | Hitachi Europe GmbH<br>Electronic components Group<br>Dornacher Straße 3<br>D-85622 Feldkirchen, Munich<br>Germany<br>Tel: <49> (89) 9 9180-0<br>Fax: <49> (89) 9 29 30 00<br><br>Hitachi Europe Ltd.<br>Electronic Components Group.<br>Whitebrook Park<br>Lower Cookham Road<br>Maidenhead<br>Berkshire SL6 8YA, United Kingdom<br>Tel: <44> (1628) 585000<br>Fax: <44> (1628) 778322 |
|--------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

|                                                                                                                                                                                                                                                                                                        |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Hitachi Asia Pte. Ltd.<br>16 Collyer Quay #20-00<br>Hitachi Tower<br>Singapore 049318<br>Tel: 535-2100<br>Fax: 535-1533<br><br>Hitachi Asia Ltd.<br>Taipei Branch Office<br>3F, Hung Kuo Building, No.167,<br>Tun-Hwa North Road, Taipei (105)<br>Tel: <886> (2) 2718-3666<br>Fax: <886> (2) 2718-8180 |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

|                                                                                                                                                                                                                                                                  |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Hitachi Asia (Hong Kong) Ltd.<br>Group III (Electronic Components)<br>7/F., North Tower, World Finance Centre,<br>Harbour City, Canton Road, Tsim Sha Tsui,<br>Kowloon, Hong Kong<br>Tel: <852> (2) 735 9218<br>Fax: <852> (2) 730 0281<br>Telex: 40815 HITEC HX |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

Copyright ' Hitachi, Ltd., 1999. All rights reserved. Printed in Japan.