To all our customers

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Renesas Technology Corp.
Customer Support Dept.
April 1, 2003

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# BB501C

## Build in Biasing Circuit MOS FET IC
## UHF RF Amplifier

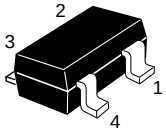
ADE-208-701D (Z)
5th. Edition
Mar. 2001

## 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; CMPAK-4(SOT-343mod)

## Outline

CMPAK-4




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

Notes:
1. Marking is “AS –”.
2. BB501C is individual type number of HITACHI BBFET.

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

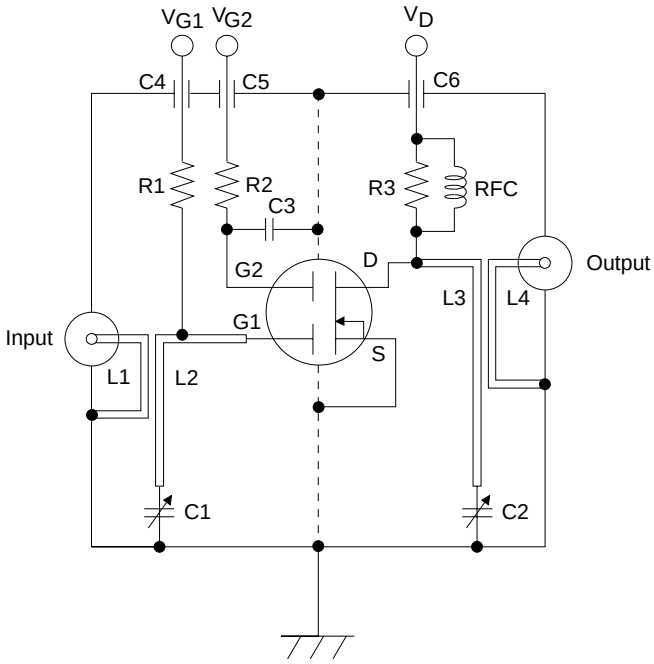
| Item | Symbol | Ratings | Unit |
|---|---|---|---|
| Drain to source voltage | $V_{DS}$ | 6 | V |
| Gate1 to source voltage | $V_{G1S}$ | +6<br>– 0 | V |
| Gate2 to source voltage | $V_{G2S}$ | +6<br>– 0 | V |
| Drain current | $I_D$ | 20 | mA |
| Channel power dissipation | Pch | 100 | mW |
| Channel 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 | $I_D$ = 200µA<br>$V_{G1S} = V_{G2S}$ = 0 |
| Gate1 to source breakdown voltage | $V_{(BR)G1SS}$ | +6 | — | — | V | $I_{G1}$ = +10µA<br>$V_{G2S} = V_{DS}$ = 0 |
| Gate2 to source breakdown voltage | $V_{(BR)G2SS}$ | +6 | — | — | V | $I_{G2}$ = +10µA<br>$V_{G1S} = V_{DS}$ = 0 |
| Gate1 to source cutoff current | $I_{G1SS}$ | — | — | +100 | nA | $V_{G1S}$ = +5V<br>$V_{G2S} = V_{DS}$ = 0 |
| Gate2 to source cutoff current | $I_{G2SS}$ | — | — | +100 | nA | $V_{G2S}$ = +5V<br>$V_{G1S} = V_{DS}$ = 0 |
| Gate1 to source cutoff voltage | $V_{G1S(off)}$ | 0.5 | 0.7 | 1.0 | V | $V_{DS}$ = 5V, $V_{G2S}$ = 4V<br>$I_D$ = 100µA |
| Gate2 to source cutoff voltage | $V_{G2S(off)}$ | 0.5 | 0.7 | 1.0 | V | $V_{DS}$ = 5V, $V_{G1S}$ = 5V<br>$I_D$ = 100µA |
| Drain current | $I_{D(op)}$ | 7 | 10 | 13 | mA | $V_{DS}$ = 5V, $V_{G1}$ = 5V<br>$V_{G2S}$ = 4V, $R_G$ = 47kΩ |
| Forward transfer admittance | $\|y_{fs}\|$ | 19 | 24 | 29 | mS | $V_{DS}$ = 5V, $V_{G1}$ = 5V<br>$V_{G2S}$ =4V<br>$R_G$ = 47kΩ, 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, $R_G$ = 47kΩ |
| 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<br>$V_{G2S}$ =4V, $R_G$ = 47kΩ |
| Noise figure | NF | — | 1.85 | 2.4 | dB | f = 900MHz |

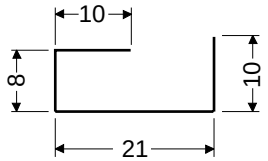
## Main Characteristics

900MHz Power Gain, Noise Figure Test Circuit

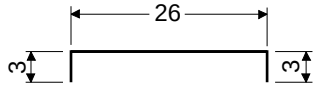



C1, C2 : Variable Capacitor (10pF MAX)
C3 : Disk Capacitor (1000pF)
C4 to C6 : Air Capacitor (1000pF)
R1 : 47 kΩ
R2 : 47 kΩ
R3 : 4.7 kΩ

L1 :

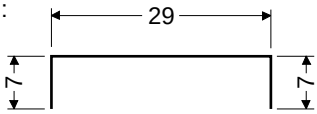



L2 :

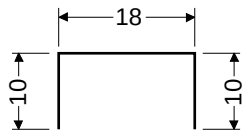



(ϕ1mm Copper wire)
Unit : mm

L3 :

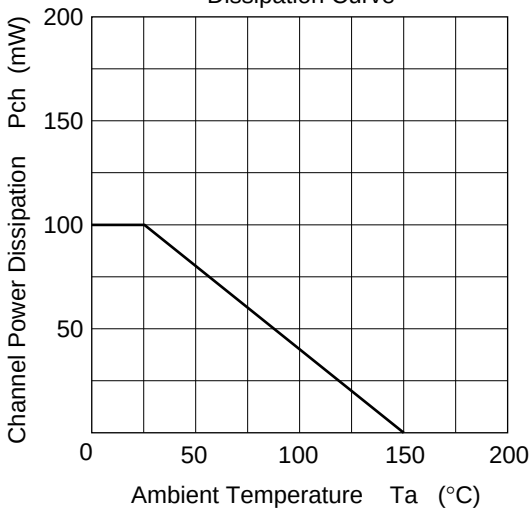



L4 :

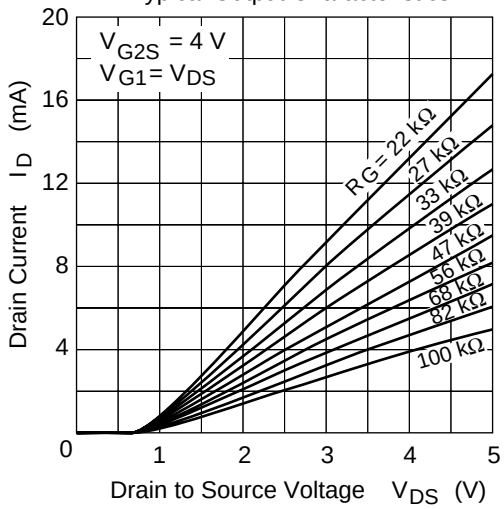



RFC : ϕ1mm Copper wire with enamel 4turns inside dia 6mm

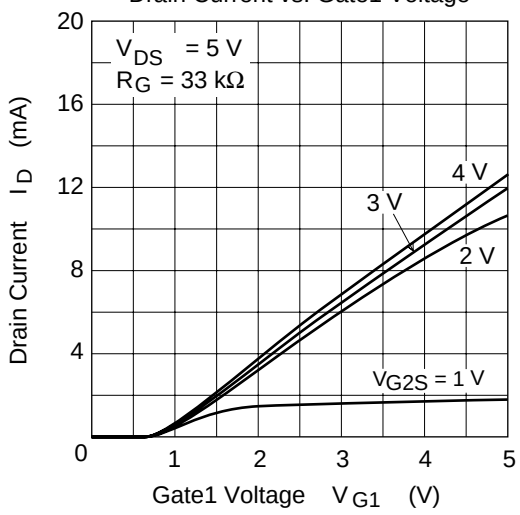
Maximum Channel Power Dissipation Curve



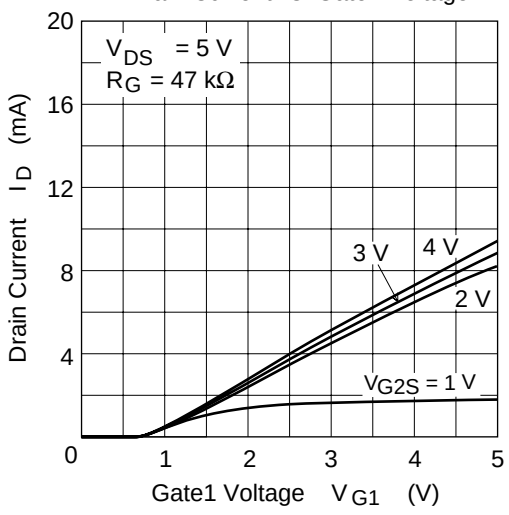

Typical Output Characteristics



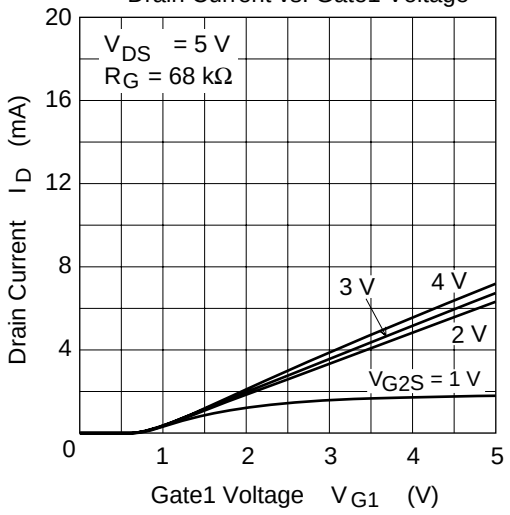

Drain Current vs. Gate1 Voltage



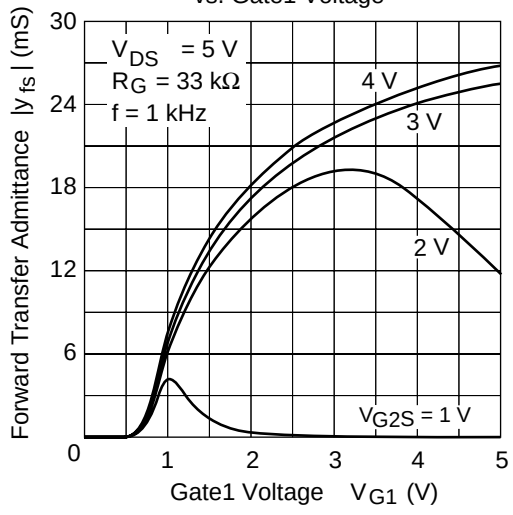

Drain Current vs. Gate1 Voltage



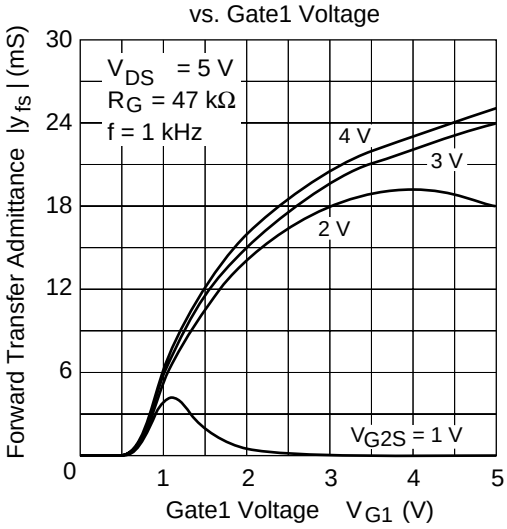
Drain Current vs. Gate1 Voltage



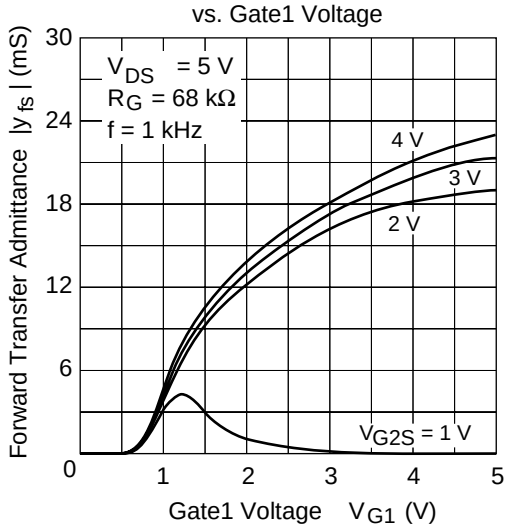

Forward Transfer Admittance vs. Gate1 Voltage



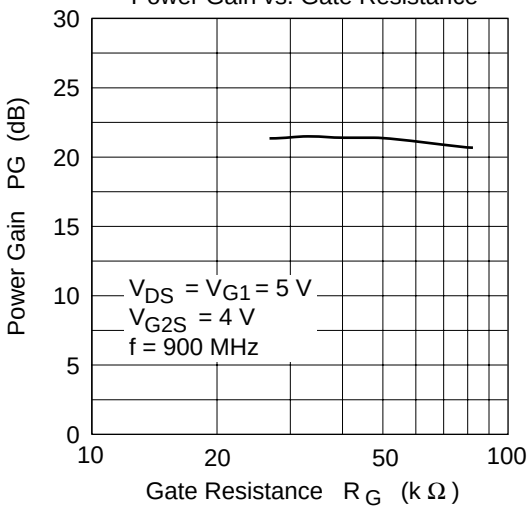

Forward Transfer Admittance vs. Gate1 Voltage



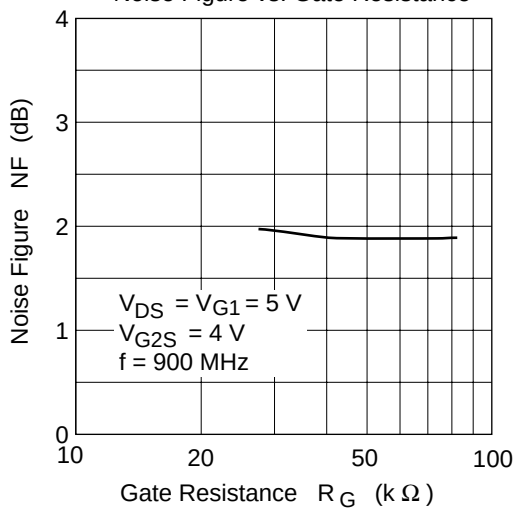

Forward Transfer Admittance vs. Gate1 Voltage



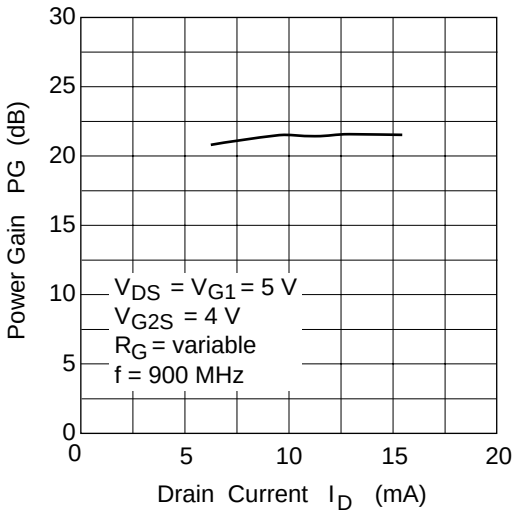
Power Gain vs. Gate Resistance



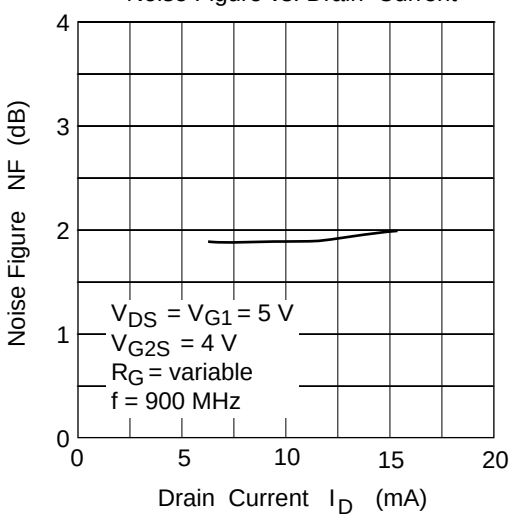

Noise Figure vs. Gate Resistance



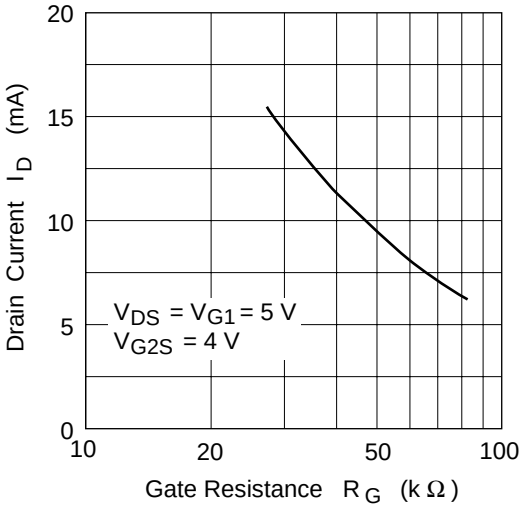

Power Gain vs. Drain Current



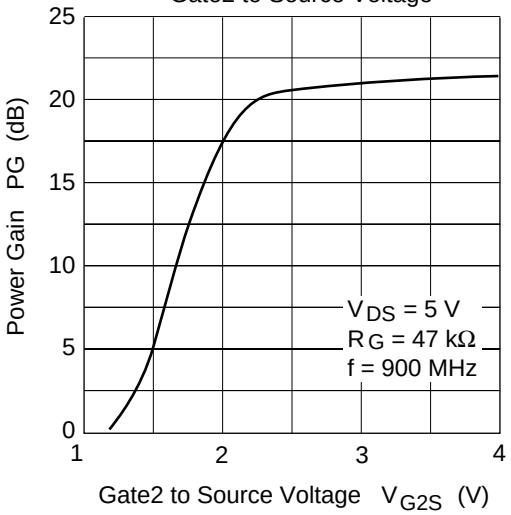

Noise Figure vs. Drain Current



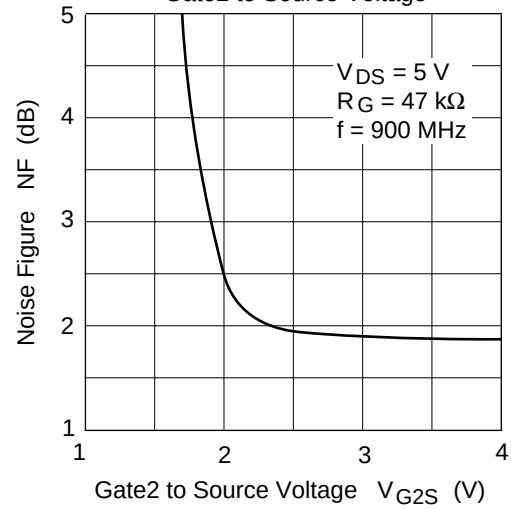
Drain Current vs. Gate Resistance



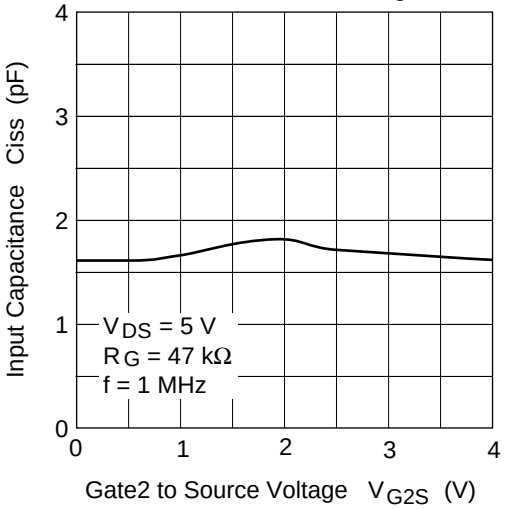

Power Gain vs.
Gate2 to Source Voltage

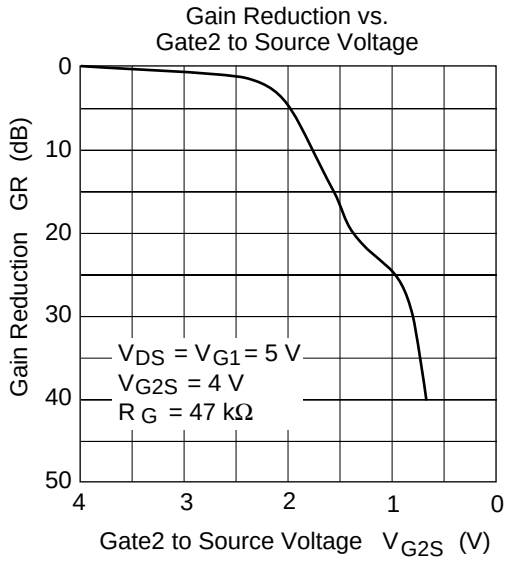



Noise Figure vs.
Gate2 to Source Voltage

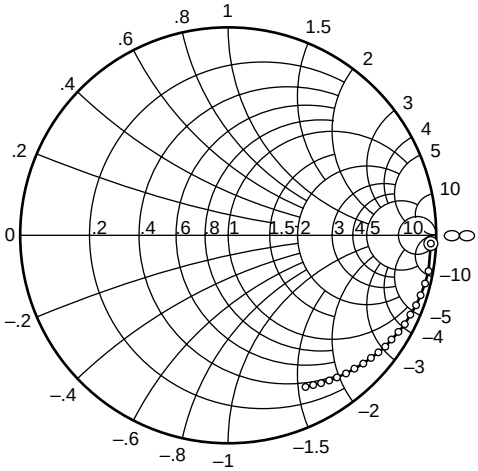



Input Capacitance vs.
Gate2 to Source Voltage




Gain Reduction vs.
Gate2 to Source Voltage
0
10
20
30
40
50
Gain Reduction GR (dB)
VDS = VG1 = 5 V
VG2S = 4 V
R G = 47 kΩ
4
3
2
1
0
Gate2 to Source Voltage VG2S (V)

S11 Parameter vs. Frequency

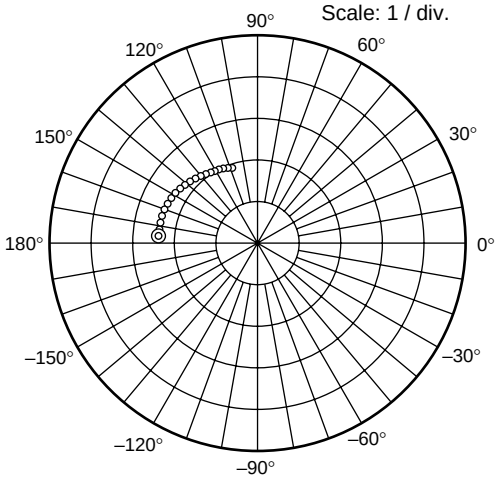



Test Condition: $V_{DS}$ = 5 V , $V_{G1}$ = 5 V
$V_{G2S}$ = 4 V , $R_G$ = 47 k Ω ,
Zo = 50 Ω

50 to 1000 MHz (50 MHz step)

S21 Parameter vs. Frequency

Scale: 1 / div.

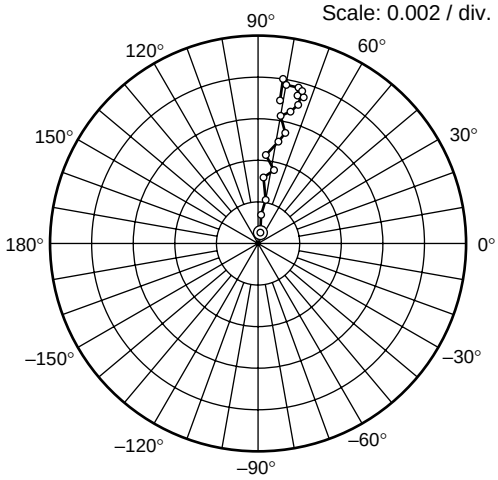



Test Condition: $V_{DS}$ = 5 V , $V_{G1}$ = 5 V
$V_{G2S}$ = 4 V , $R_G$ = 47 k Ω ,
Zo = 50 Ω

50 to 1000 MHz (50 MHz step)

S12 Parameter vs. Frequency

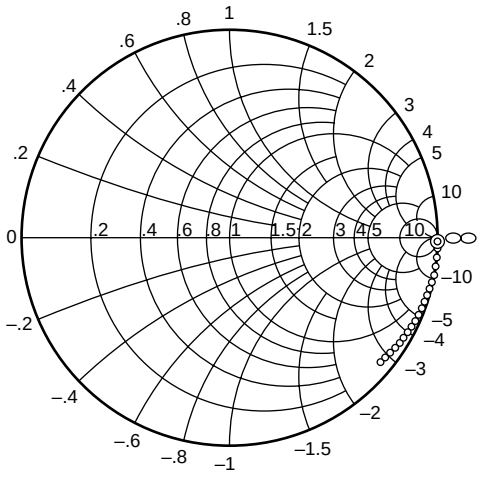
Scale: 0.002 / div.




Test Condition: $V_{DS}$ = 5 V , $V_{G1}$ = 5 V
$V_{G2S}$ = 4 V , $R_G$ = 47 k Ω ,
Zo = 50 Ω

50 to 1000 MHz (50 MHz step)

S22 Parameter vs. Frequency




Test Condition: $V_{DS}$ = 5 V , $V_{G1}$ = 5 V
$V_{G2S}$ = 4 V , $R_G$ = 47 k Ω ,
Zo = 50 Ω

50 to 1000 MHz (50 MHz step)

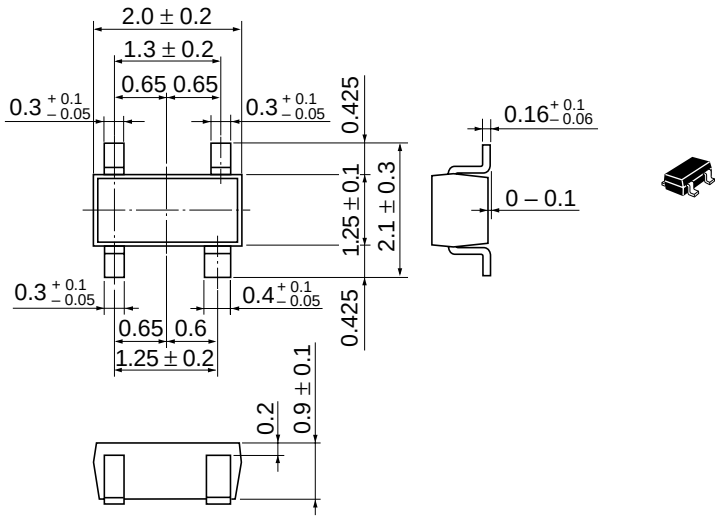
**Sparameter** ($V_{DS}$ = $V_{G1}$ = 5V, $V_{G2S}$ = 4V, $R_G$ = 47kΩ, Zo = 50Ω)

| | S11 | | S21 | | S12 | | S22 | |
|---|---|---|---|---|---|---|---|---|
| f (MHz) | 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

As of January, 2001

Unit: mm




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

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