# BB502C

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

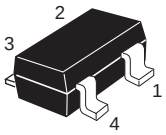
REJ03G0832-0500
(Previous ADE-208-810C)
Rev.5.00
Aug.10.2005

### Features

- Built in Biasing Circuit; To reduce using parts cost & PC board space.
- Low noise; NF = 1.6 dB typ. at f = 900 MHz
- High gain; PG = 22 dB typ. at f = 900 MHz
- Withstanding to ESD;
  Built in ESD absorbing diode. Withstand up to 200V at C=200pF, Rs=0 conditions.
- Provide mini mold packages; CMPAK-4(SOT-343mod)

### Outline

RENESAS Package code: PTSP0004ZA-A
(Package name: CMPAK-4)




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

Notes: 1. Marking is “BS–”.
2. BB502C is individual type number of RENESAS 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 |

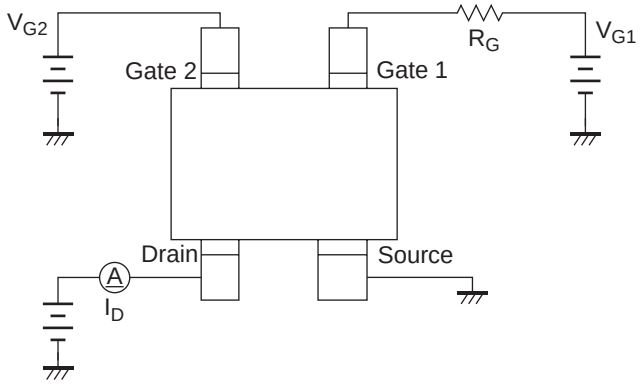
## Electrical Characteristics

(Ta = 25°C)

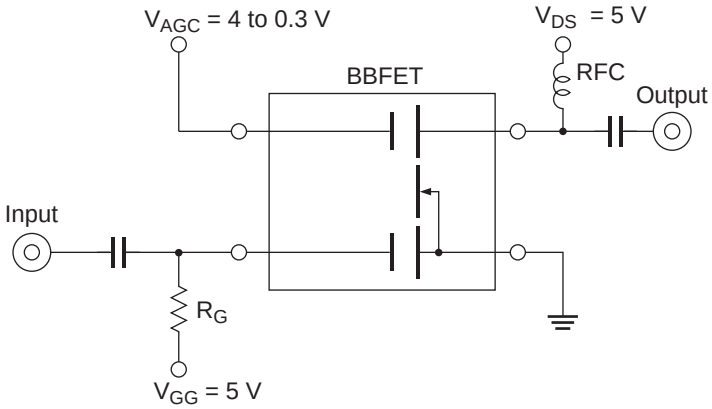
| Item | Symbol | Min | Typ | Max | Unit | Test conditions |
|---|---|---|---|---|---|---|
| Drain to source breakdown voltage | $V_{(BR)DSS}$ | 6 | — | — | V | $I_D$ = 200 µA, $V_{G1S}$ = $V_{G2S}$ = 0 |
| Gate1 to source breakdown voltage | $V_{(BR)G1SS}$ | +6 | — | — | V | $I_{G1}$ = +10 µA, $V_{G2S}$ = $V_{DS}$ = 0 |
| Gate2 to source breakdown voltage | $V_{(BR)G2SS}$ | +6 | — | — | V | $I_{G2}$ = +10 µA, $V_{G1S}$ = $V_{DS}$ = 0 |
| Gate1 to source cutoff current | $I_{G1SS}$ | — | — | +100 | nA | $V_{G1S}$ = +5 V, $V_{G2S}$ = $V_{DS}$ = 0 |
| Gate2 to source cutoff current | $I_{G2SS}$ | — | — | +100 | nA | $V_{G2S}$ = +5 V, $V_{G1S}$ = $V_{DS}$ = 0 |
| Gate1 to source cutoff voltage | $V_{G1S(off)}$ | 0.5 | 0.7 | 1.0 | V | $V_{DS}$ = 5 V, $V_{G2S}$ = 4 V<br>$I_D$ = 100 µA |
| Gate2 to source cutoff voltage | $V_{G2S(off)}$ | 0.5 | 0.7 | 1.0 | V | $V_{DS}$ = 5 V, $V_{G1S}$ = 5 V<br>$I_D$ = 100 µA |
| Drain current | $I_{D(op)}$ | 8 | 11 | 14 | mA | $V_{DS}$ = 5 V, $V_{G1}$ = 5 V<br>$V_{G2S}$ = 4 V, $R_G$ = 180 kΩ |
| Forward transfer admittance | $\|y_{fs}\|$ | 20 | 25 | 30 | mS | $V_{DS}$ = 5 V, $V_{G1}$ = 5 V, $V_{G2S}$ =4 V<br>$R_G$ = 180 kΩ, f = 1 kHz |
| Input capacitance | Ciss | 1.4 | 1.7 | 2.0 | pF | $V_{DS}$ = 5 V, $V_{G1}$ = 5 V<br>$V_{G2S}$ =4 V, $R_G$ = 180 kΩ<br>f = 1 MHz |
| Output capacitance | Coss | 0.7 | 1.1 | 1.5 | pF | |
| Reverse transfer capacitance | Crss | — | 0.02 | 0.05 | pF | |
| Power gain | PG | 17 | 22 | — | dB | $V_{DS}$ = 5 V, $V_{G1}$ = 5 V<br>$V_{G2S}$ =4 V, $R_G$ = 180 kΩ<br>f = 900 MHz |
| Noise figure | NF | — | 1.6 | 2.2 | dB | |

## Main Characteristics

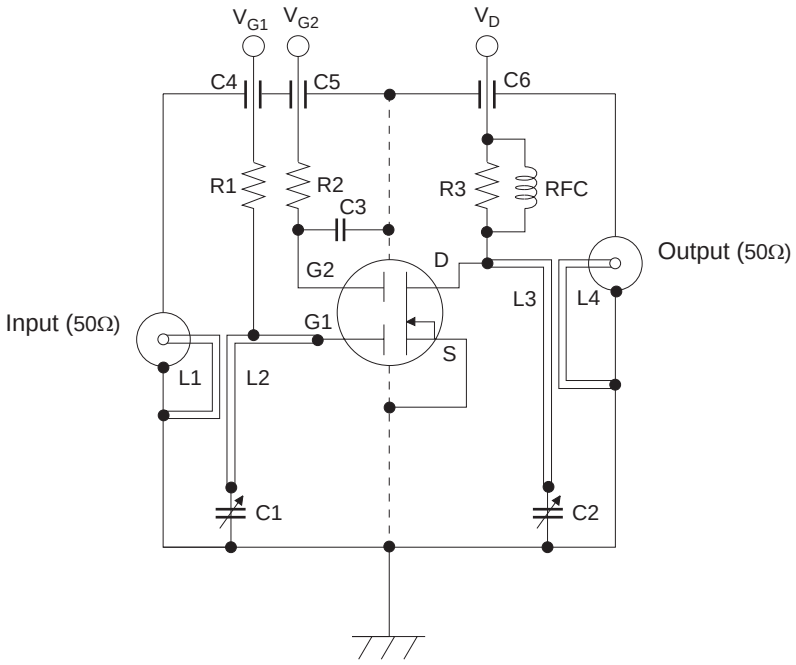
Test Circuit for Operating Items ($I_{D(op)}$ , |yfs|, Ciss, Coss, Crss, NF, PG)




Application Circuit

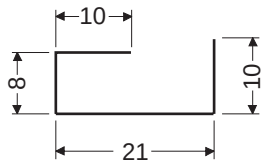


900MHz Power Gain, Noise Figure Test Circuit

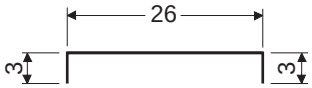



C1, C2: Variable Capacitor (10pF MAX)
C3: Disk Capacitor (1000pF)
C4 to C6: Air Capacitor (1000pF)
R1: 180 kΩ
R2: 47 kΩ
R3: 4.7 kΩ

L1:

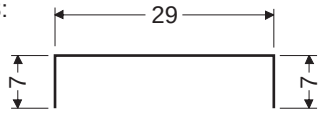



L2:

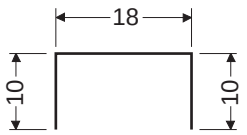



(ϕ1mm Copper wire)
Unit: mm

L3:

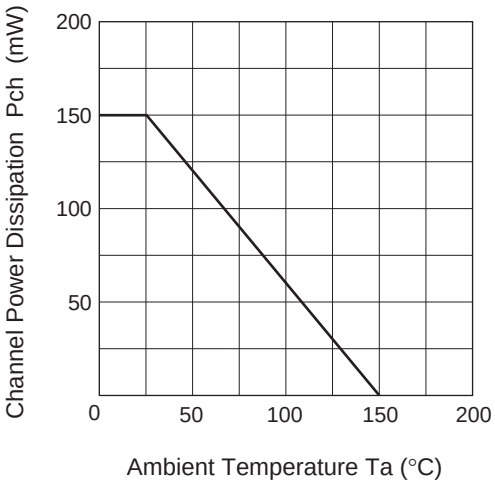



L4:

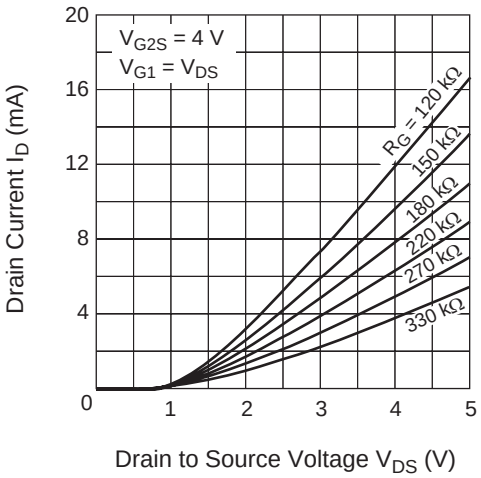



RFC: ϕ1mm Copper wire with enamel 4turns inside dia 6mm

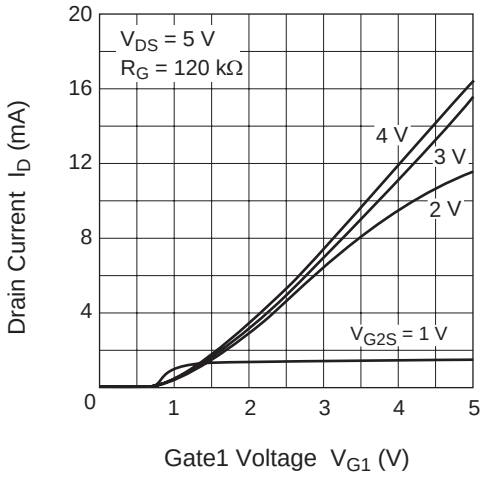
Maximum Channel Power Dissipation Curve



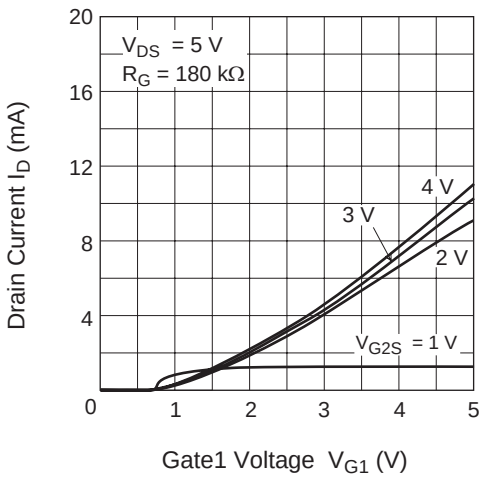

Typical Output Characteristics



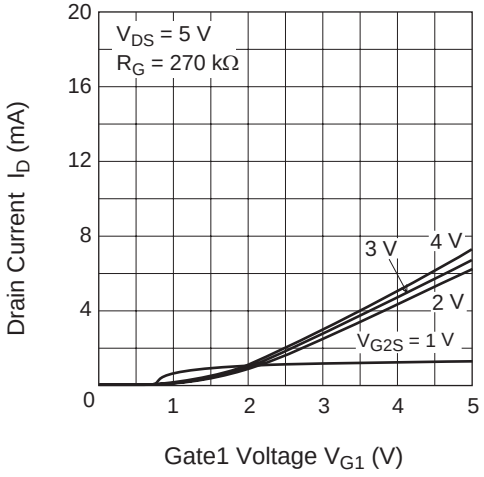

Drain Current vs. Gate1 Voltage



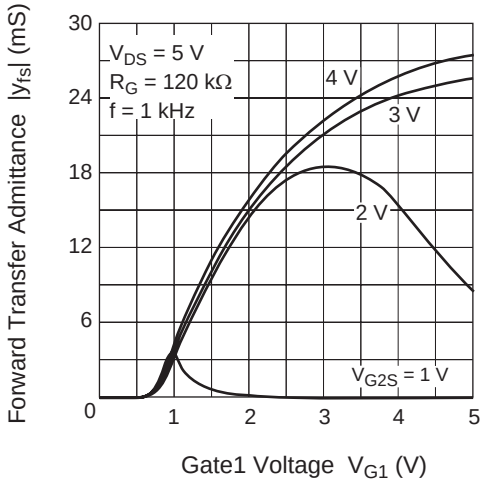

Drain Current vs. Gate1 Voltage



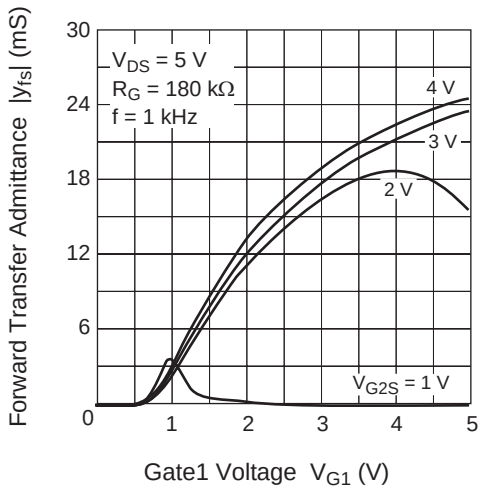

Drain Current vs. Gate1 Voltage



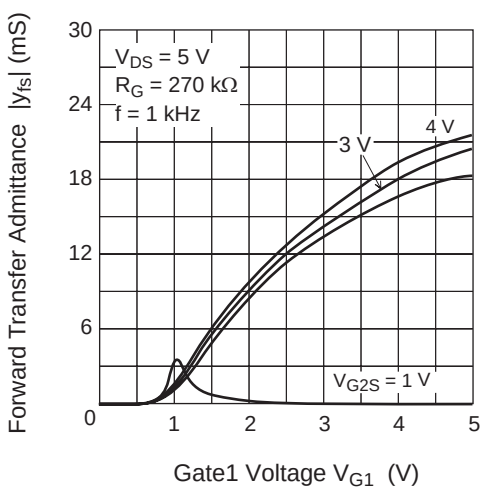

Forward Transfer Admittance vs. Gate1 Voltage



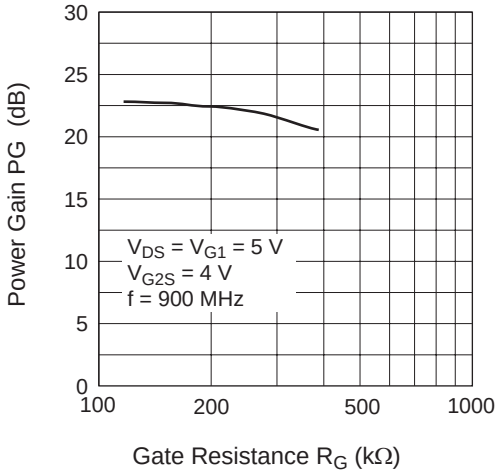
Forward Transfer Admittance vs. Gate1 Voltage



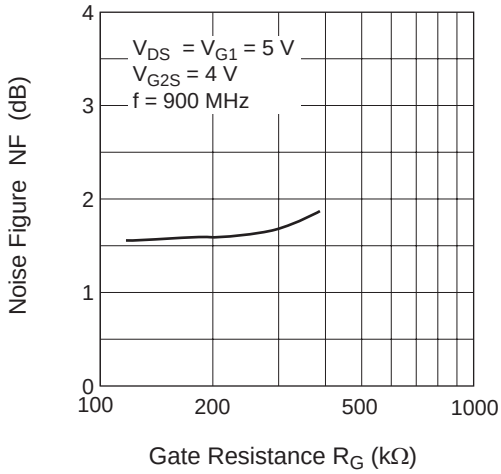

Forward Transfer Admittance vs. Gate1 Voltage



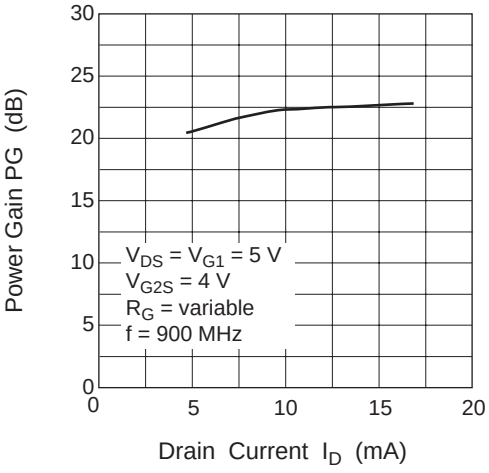

Power Gain vs. Gate Resistance



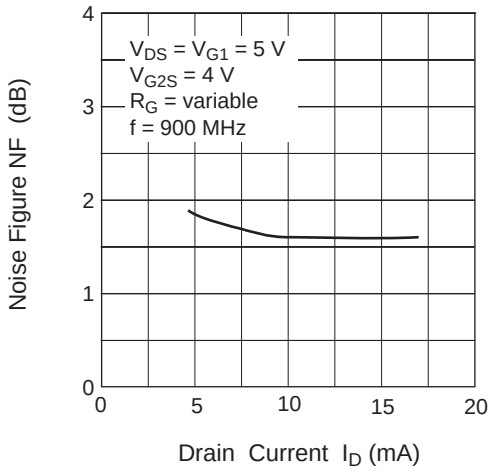

Noise Figure vs. Gate Resistance



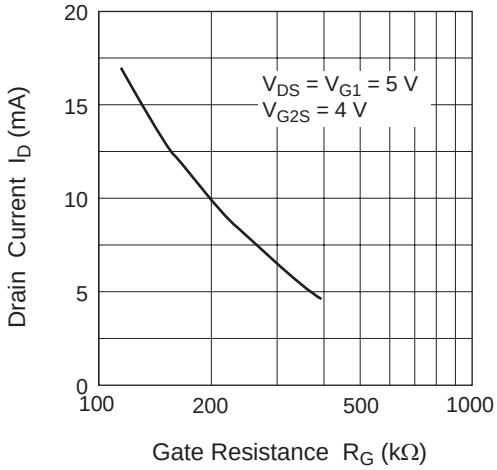

Power Gain vs. Drain Current



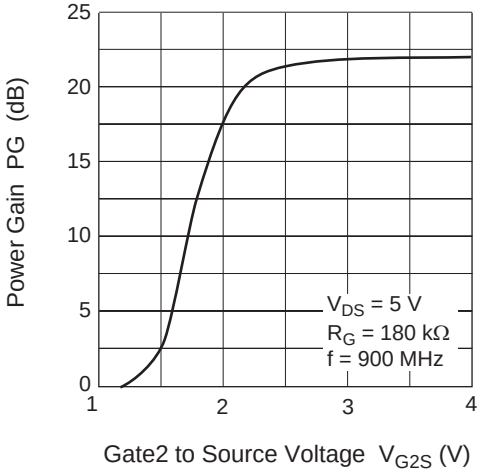

Noise Figure vs. Drain Current



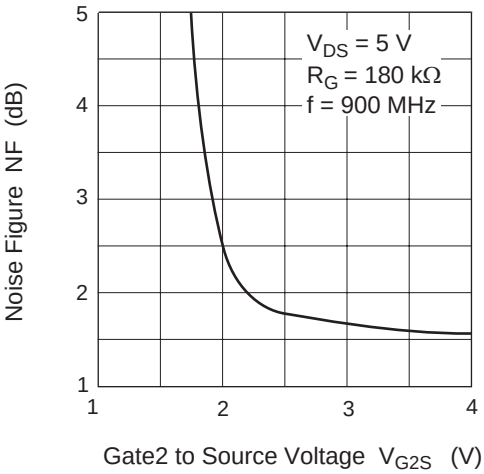
Drain Current vs. Gate Resistance



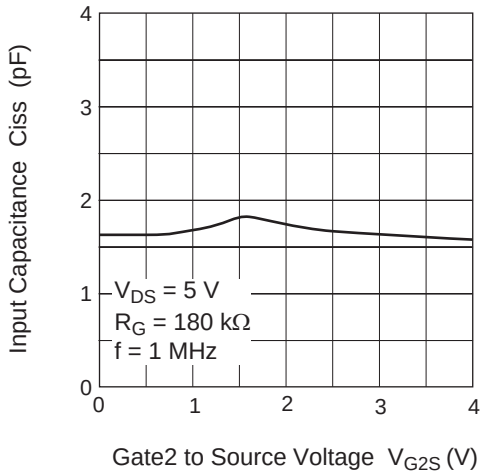

Power Gain vs.
Gate2 to Source Voltage



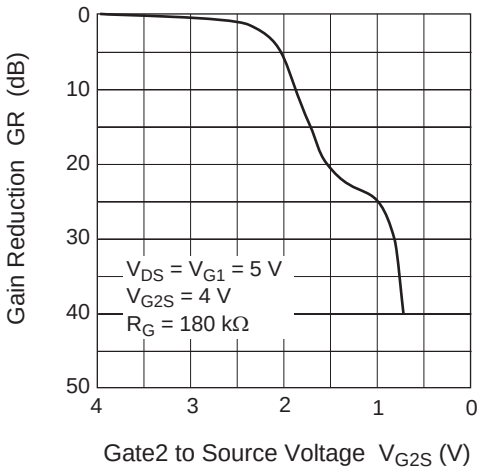

Noise Figure vs.
Gate2 to Source Voltage



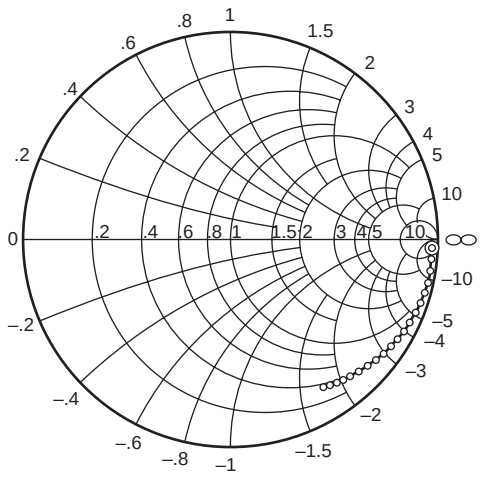

Input Capacitance vs.
Gate2 to Source Voltage




Gain Reduction vs.
Gate2 to Source Voltage



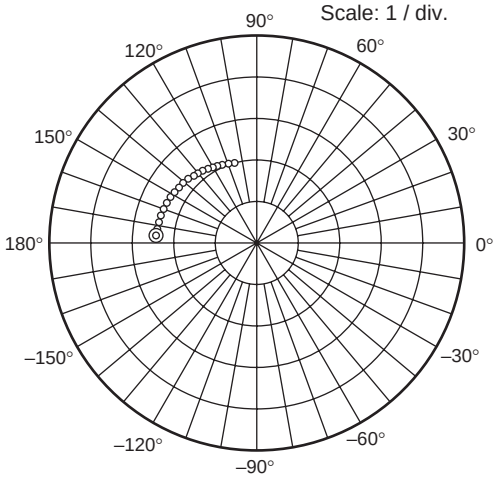
S11 Parameter vs. Frequency




Test Condition; $V_{DS}$ = 5 V , $V_{G1}$ = 5 V
$V_{G2S}$ = 4 V , $R_G$ = 180 kΩ ,
Zo = 50Ω

50 to 1000 MHz (50 MHz step)

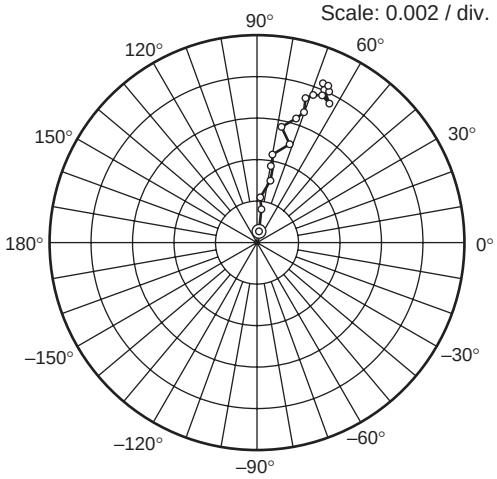
S21 Parameter vs. Frequency




Test Condition: $V_{DS}$ = 5 V , $V_{G1}$ = 5 V
$V_{G2S}$ = 4 V , $R_G$ = 180 kΩ ,
Zo = 50Ω

50 to 1000 MHz (50 MHz step)

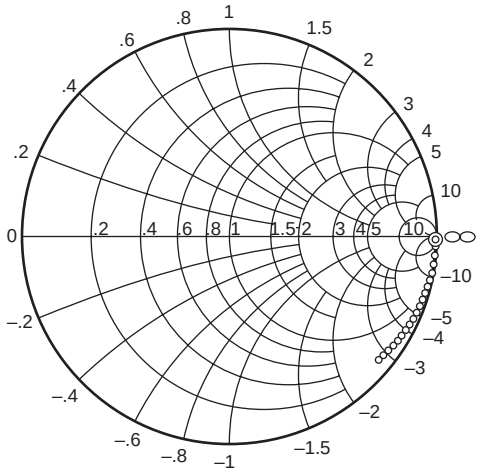
S12 Parameter vs. Frequency




Test Condition: $V_{DS}$ = 5 V , $V_{G1}$ = 5 V
$V_{G2S}$ = 4 V , $R_G$ = 180 kΩ ,
Zo = 50Ω

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 , $R_G$ = 180 kΩ ,
Zo = 50Ω

50 to 1000 MHz (50 MHz step)

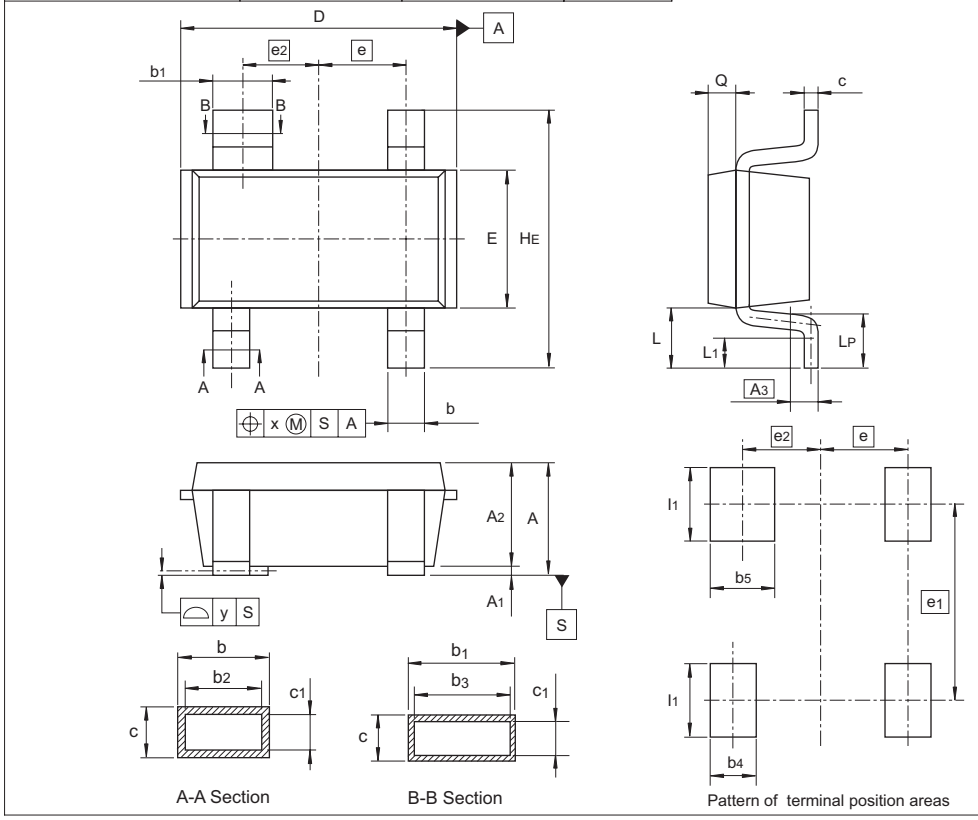
## S Parameter

($V_{DS}$ = $V_{G1}$ = 5V, $V_{G2S}$ = 4V, $R_G$ = 180kΩ, Zo = 50Ω)

| f(MHz) | S11 | | S21 | | S12 | | S22 | |
|---|---|---|---|---|---|---|---|---|
| | MAG. | ANG. | MAG. | ANG. | MAG. | ANG. | MAG. | ANG. |
| 50 | 0.994 | –2.8 | 2.52 | 176.2 | 0.00072 | 88.6 | 0.995 | –2.2 |
| 100 | 0.994 | –5.7 | 2.51 | 172.4 | 0.00161 | 80.9 | 0.998 | –4.0 |
| 150 | 0.991 | –9.2 | 2.50 | 168.1 | 0.00230 | 86.6 | 0.997 | –6.2 |
| 200 | 0.985 | –12.5 | 2.47 | 164.1 | 0.00297 | 78.0 | 0.996 | –8.2 |
| 250 | 0.985 | –15.5 | 2.46 | 160.0 | 0.00374 | 78.9 | 0.994 | –10.2 |
| 300 | 0.975 | –18.7 | 2.43 | 156.4 | 0.00436 | 80.6 | 0.992 | –12.2 |
| 350 | 0.969 | –22.0 | 2.40 | 152.3 | 0.00507 | 70.9 | 0.990 | –14.2 |
| 400 | 0.962 | –24.9 | 2.38 | 148.6 | 0.00557 | 77.3 | 0.989 | –16.3 |
| 450 | 0.954 | –27.7 | 2.35 | 144.6 | 0.00625 | 72.4 | 0.987 | –18.5 |
| 500 | 0.945 | –30.8 | 2.31 | 141.0 | 0.00663 | 70.0 | 0.984 | –20.4 |
| 550 | 0.935 | –33.8 | 2.28 | 136.7 | 0.00721 | 70.5 | 0.981 | –22.4 |
| 600 | 0.925 | –36.6 | 2.25 | 133.4 | 0.00747 | 68.4 | 0.978 | –24.3 |
| 650 | 0.918 | –39.5 | 2.21 | 130.3 | 0.00761 | 65.6 | 0.975 | –26.4 |
| 700 | 0.909 | –42.5 | 2.18 | 126.1 | 0.00807 | 65.6 | 0.972 | –28.3 |
| 750 | 0.898 | –45.0 | 2.14 | 122.9 | 0.00828 | 67.6 | 0.969 | –30.2 |
| 800 | 0.887 | –47.8 | 2.09 | 119.5 | 0.00801 | 65.1 | 0.965 | –32.2 |
| 850 | 0.874 | –50.6 | 2.07 | 116.0 | 0.00815 | 63.6 | 0.961 | –34.2 |
| 900 | 0.862 | –53.0 | 2.03 | 112.7 | 0.00832 | 65.1 | 0.958 | –36.1 |
| 950 | 0.855 | –55.5 | 1.99 | 109.4 | 0.00738 | 61.8 | 0.954 | –37.9 |
| 1000 | 0.845 | –58.1 | 1.95 | 108.1 | 0.00802 | 65.8 | 0.951 | –39.8 |

## Package Dimensions

| JEITA Package Code | RENESAS Code | Package Name | MASS[Typ.] |
|---|---|---|---|
| SC-61AA | PLSP0004ZA-A | MPAK-4 / MPAK-4V | 0.013g |




| Reference Symbol | Dimension in Millimeters | | |
|---|---|---|---|
| | Min | Nom | Max |
| A | 1.0 | – | 1.3 |
| $A_1$ | 0 | – | 0.1 |
| $A_2$ | 1.0 | 1.1 | 1.2 |
| $A_3$ | – | 0.25 | – |
| b | 0.35 | 0.42 | 0.5 |
| $b_1$ | 0.55 | 0.62 | 0.7 |
| $b_2$ | – | 0.4 | – |
| $b_3$ | – | 0.6 | – |
| c | 0.1 | 0.13 | 0.15 |
| $c_1$ | – | 0.11 | – |
| D | 2.7 | – | 3.1 |
| E | 1.35 | 1.5 | 1.65 |
| e | – | 0.95 | – |
| $e_2$ | – | 0.85 | – |
| $H_E$ | 2.2 | 2.8 | 3.0 |
| L | 0.35 | – | 0.75 |
| $L_1$ | 0.15 | – | 0.55 |
| $L_P$ | 0.25 | – | 0.65 |
| x | – | – | 0.05 |
| y | – | – | 0.05 |
| $b_4$ | – | – | 0.55 |
| $b_5$ | – | – | 0.75 |
| $e_1$ | – | 1.95 | – |
| $I_1$ | – | – | 1.05 |
| Q | – | 0.3 | – |

## Ordering Information

| Part Name | Quantity | Shipping Container |
|---|---|---|
| BB502CBS-TL-E | 3000 | ϕ 178 mm Reel, 8 mm Emboss Taping |

Note: For some grades, production may be terminated. Please contact the Renesas sales office to check the state of production before ordering the product.

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## RENESAS SALES OFFICES

http://www.renesas.com

Refer to "**http://www.renesas.com/en/network**" for the latest and detailed information.

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Colophon .3.0