# BB305C

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

HITACHI

ADE-208-608C (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 5 V to 9 V supply voltage.
- Withstanding to ESD;
  Build in ESD absorbing diode. Withstand up to 200V at C = 200 pF, Rs = 0 conditions.
- Provide mini mold packages; CMPAK-4 (SOT-343mod)

### Outline

CMPAK-4


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

Note: 1. Marking is “EW–”.
2. BB305C is individual type number of HITACHI BBFET.

Hitachi semiconductor

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

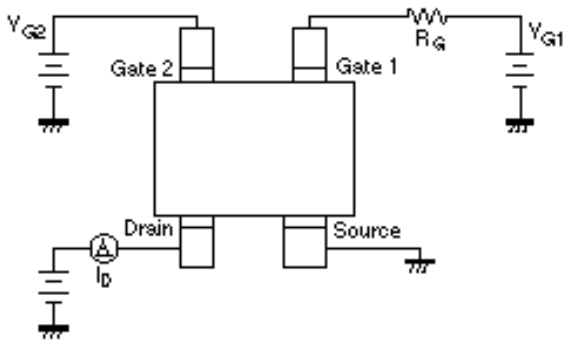
| Item | Symbol | Ratings | Unit |
|---|---|---|---|
| Drain to source voltage | $V_{DS}$ | 12 | V |
| Gate1 to source voltage | $V_{G1S}$ | +10<br>–0 | V |
| Gate2 to source voltage | $V_{G2S}$ | +10 | V |
| Drain current | $I_D$ | 25 | mA |
| Channel power dissipation | Pch | 100 | mW |
| Channel temperature | Tch | 150 | °C |
| Storage temperature | Tstg | –55 to +150 | °C |

## Electrical Characteristics (Ta = 25°C)

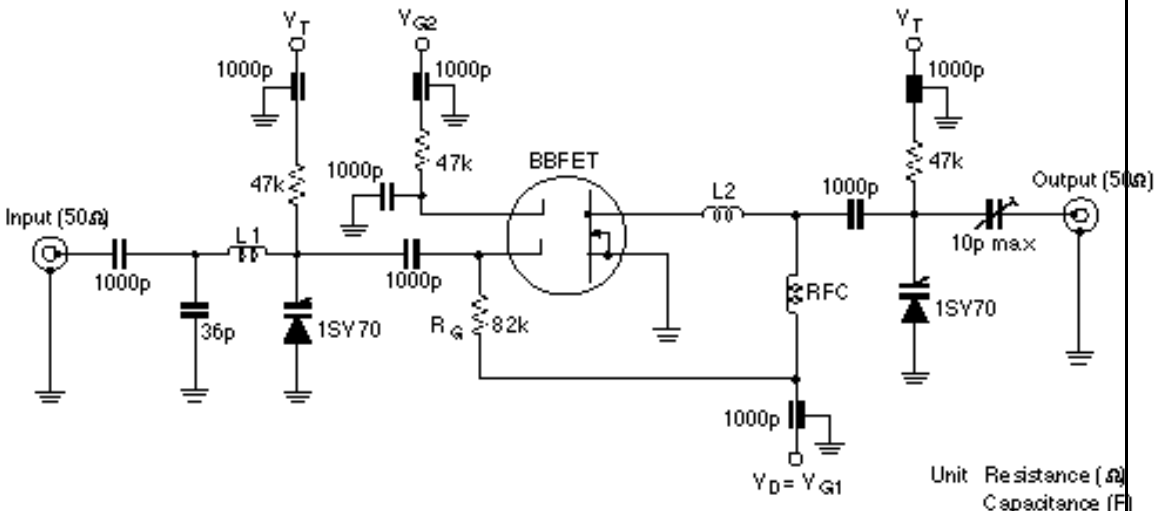
| Item | Symbol | Min | Typ | Max | Unit | Test Conditions |
|---|---|---|---|---|---|---|
| Drain to source breakdown voltage | $V_{(BR)DSS}$ | 12 | — | — | V | $I_D$ = 200µA, $V_{G1S}$ = $V_{G2S}$ = 0 |
| Gate1 to source breakdown voltage | $V_{(BR)G1SS}$ | +10 | — | — | V | $I_{G1}$ = +10µA, $V_{G2S}$ = $V_{DS}$ = 0 |
| Gate2 to source breakdown voltage | $V_{(BR)G2SS}$ | ±10 | — | — | V | $I_{G2}$ = ±10µA, $V_{G1S}$ = $V_{DS}$ = 0 |
| Gate1 to source cutoff current | $I_{G1SS}$ | — | — | +100 | nA | $V_{G1S}$ = +9V, $V_{G2S}$ = $V_{DS}$ = 0 |
| Gate2 to source cutoff current | $I_{G2SS}$ | — | — | ±100 | nA | $V_{G2S}$ = ±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, $I_D$ = 100µA |
| Gate2 to source cutoff voltage | $V_{G2S(off)}$ | 0.4 | — | 1.0 | V | $V_{DS}$ = 5V, $V_{G1S}$ = 5V, $I_D$ = 100µA |
| 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, $R_G$ = 82kΩ |
| 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, $R_G$ = 82kΩ |
| | $I_{D(op)}$ 2 | — | 13 | — | mA | $V_{DS}$ = 9V, $V_{G1}$ = 9V, $V_{G2S}$ =6V, $R_G$ = 220kΩ |
| Forward transfer admittance | $\|y_{fs}\|$1 | 23 | 28 | — | mS | $V_{DS}$ = 5V, $V_{G1}$ = 5V, $V_{G2S}$ =4V $R_G$ =82kΩ, f = 1kHz |
| | $\|y_{fs}\|$2 | — | 28 | — | mS | $V_{DS}$ = 9V, $V_{G1}$ = 9V, $V_{G2S}$ =6V, $R_G$ = 220kΩ, f = 1kHz |
| Power gain | PG1 | 24 | 28 | — | dB | $V_{DS}$ = 5V, $V_{G1}$ = 5V, $V_{G2S}$ =4V, $R_G$ = 82kΩ, f = 200MHz |
| | PG2 | — | 28 | — | dB | $V_{DS}$ = 9V, $V_{G1}$ = 9V, $V_{G2S}$ =6V, $R_G$ = 220kΩ, f = 200MHz |
| Noise figure | NF1 | — | 1.3 | 1.8 | dB | $V_{DS}$ = 5V, $V_{G1}$ = 5V, $V_{G2S}$ =4V, $R_G$ = 82kΩ, f = 200MHz |
| | NF2 | — | 1.3 | — | dB | $V_{DS}$ = 9V, $V_{G1}$ = 9V, $V_{G2S}$ =6V, $R_G$ = 220kΩ, f = 200MHz |

## Main Characteristics

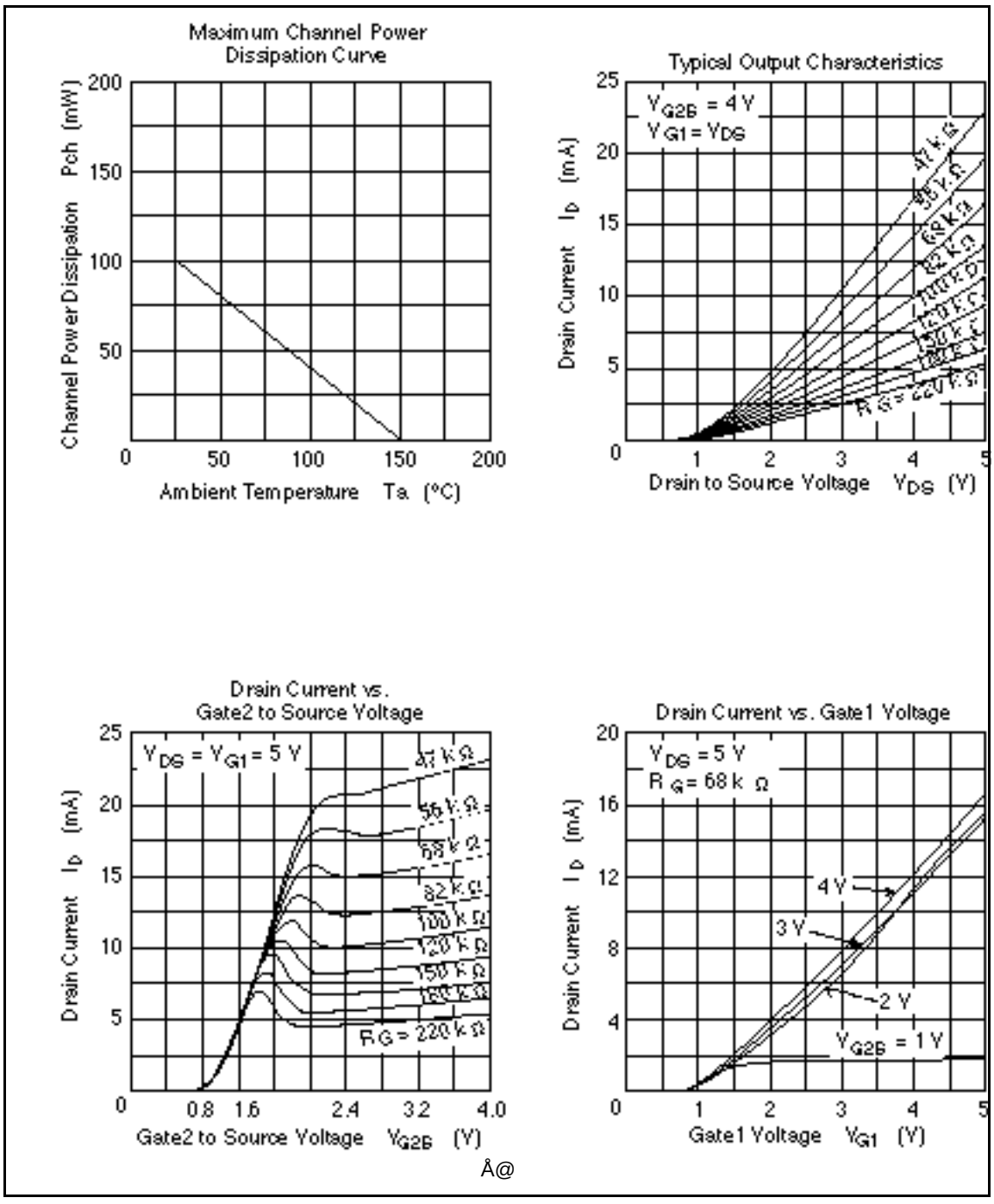
Test Circuit for Operating Items ($I_{D(op)}$, |yfs|, Ciss, Coss, Crss, NF, PG)




Power Gain, Noise Figure Test Circuit




L1 : ϕ1mm Enameled Copper Wire, Inside dia. 10mm, 2Turns
L2 : ϕ1mm Enameled Copper Wire, Inside dia. 10mm, 2Turns
RFC : ϕ1mm Enameled Copper Wire, Inside dia. 5mm, 2Turns


Maximum Channel Power Dissipation Curve
Channel Power Dissipation Pch (mW)
200
150
100
50
0
50
100
150
200
Ambient Temperature Ta (°C)
Typical Output Characteristics
$V_{G2S}$ = 4 V
$V_{G1}$ = $V_{DS}$
47 kΩ
56 kΩ
68 kΩ
82 kΩ
100 kΩ
120 kΩ
150 kΩ
180 kΩ
$R_G$ = 220 kΩ
Drain Current $I_D$ (mA)
25
20
15
10
5
0
1
2
3
4
5
Drain to Source Voltage $V_{DS}$ (V)
Drain Current vs. Gate2 to Source Voltage
$V_{DS}$ = $V_{G1}$ = 5 V
47 kΩ
56 kΩ
68 kΩ
82 kΩ
100 kΩ
120 kΩ
150 kΩ
180 kΩ
$R_G$ = 220 kΩ
Drain Current $I_D$ (mA)
25
20
15
10
5
0
0.8
1.6
2.4
3.2
4.0
Gate2 to Source Voltage $V_{G2S}$ (V)
Drain Current vs. Gate1 Voltage
$V_{DS}$ = 5 V
$R_G$ = 68 kΩ
4 V
3 V
2 V
$V_{G2S}$ = 1 V
Drain Current $I_D$ (mA)
20
16
12
8
4
0
1
2
3
4
5
Gate1 Voltage $V_{G1}$ (V)

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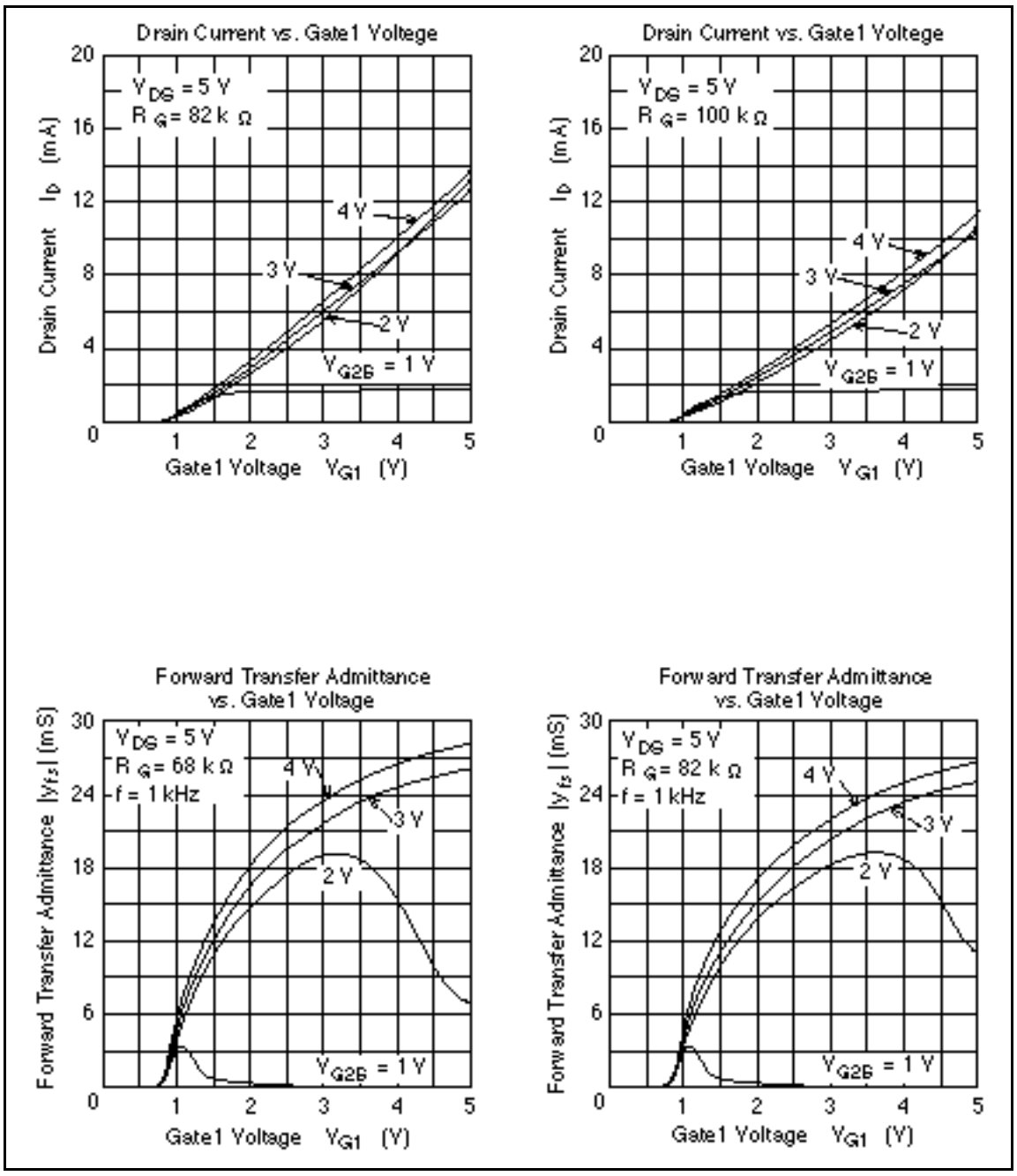
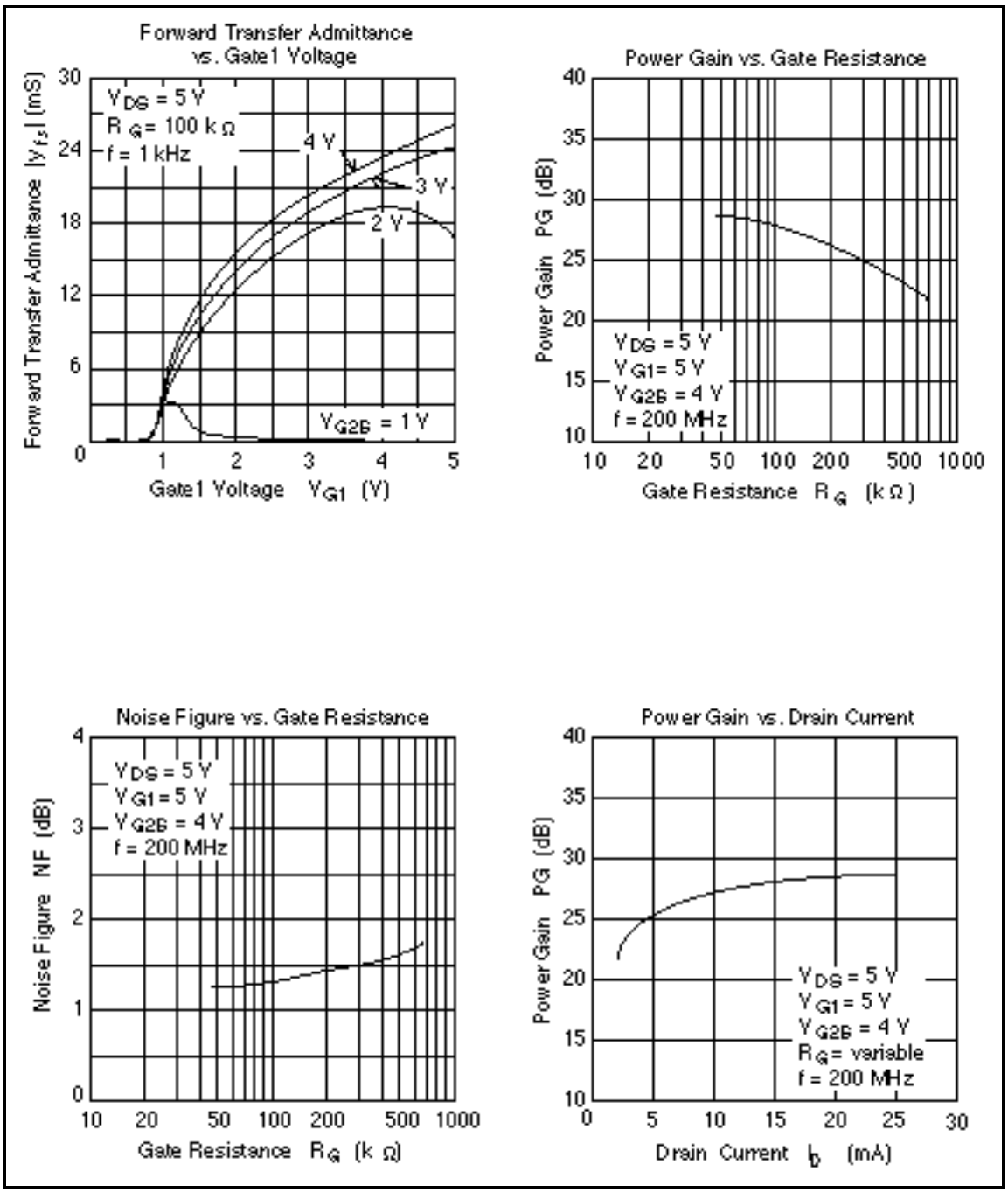
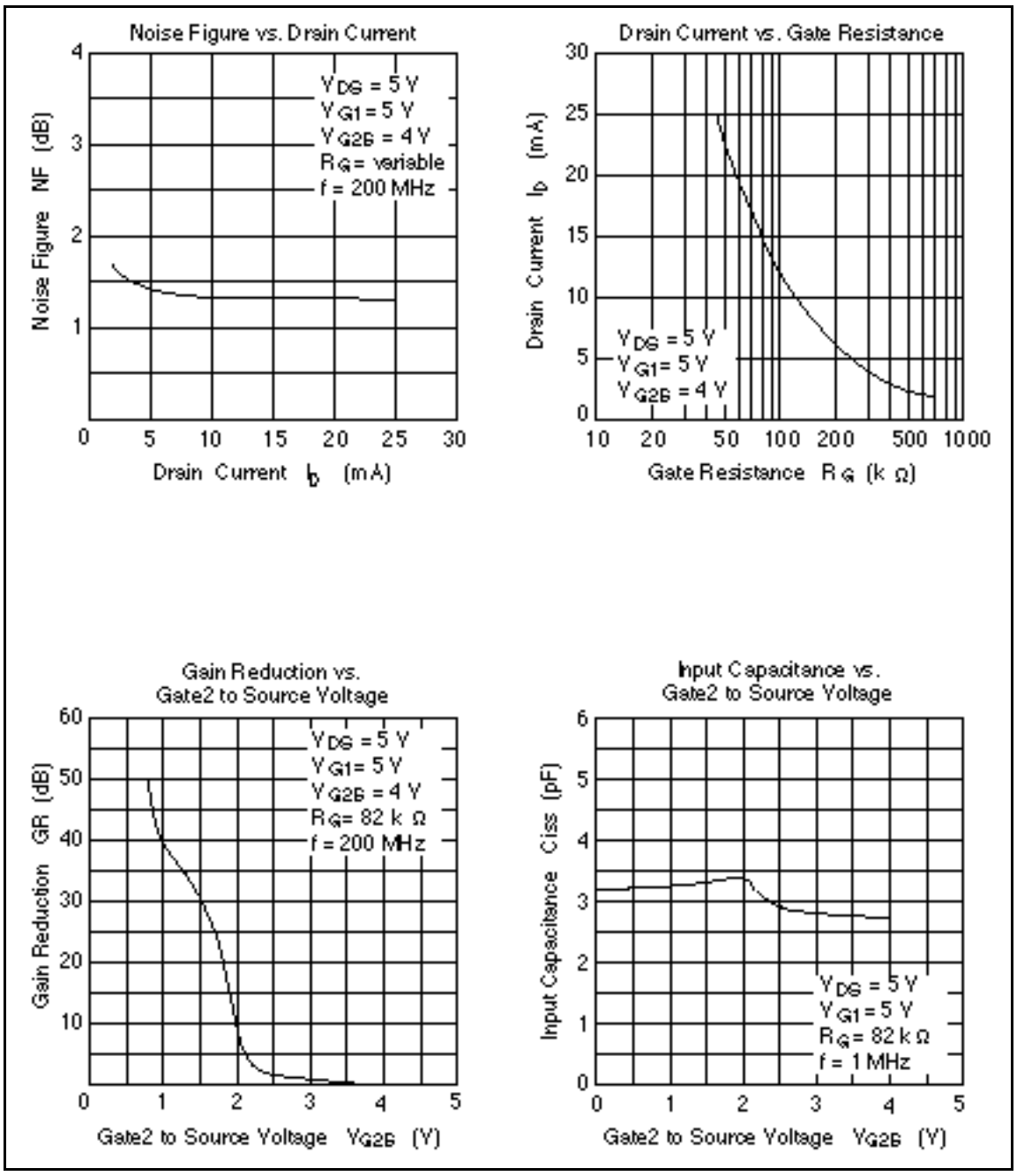
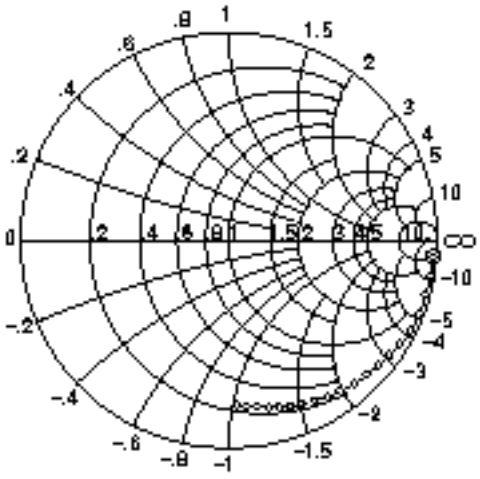

Drain Current vs. Gate1 Voltege
$V_{DS}$ = 5 V
$R_G$ = 82 k Ω
4 V
3 V
2 V
$V_{G2S}$ = 1 V
Drain Current $I_D$ (mA)
Gate1 Voltage $V_{G1}$ (V)
Drain Current vs. Gate1 Voltege
$V_{DS}$ = 5 V
$R_G$ = 100 k Ω
4 V
3 V
2 V
$V_{G2S}$ = 1 V
Drain Current $I_D$ (mA)
Gate1 Voltage $V_{G1}$ (V)
Forward Transfer Admittance vs. Gate1 Voltage
$V_{DS}$ = 5 V
$R_G$ = 68 k Ω
f = 1 kHz
4 V
3 V
2 V
$V_{G2S}$ = 1 V
Forward Transfer Admittance $|y_{fs}|$ (mS)
Gate1 Voltage $V_{G1}$ (V)
Forward Transfer Admittance vs. Gate1 Voltage
$V_{DS}$ = 5 V
$R_G$ = 82 k Ω
f = 1 kHz
4 V
3 V
2 V
$V_{G2S}$ = 1 V
Forward Transfer Admittance $|y_{fs}|$ (mS)
Gate1 Voltage $V_{G1}$ (V)


Forward Transfer Admittance vs. Gate1 Voltage
Forward Transfer Admittance |Yfs| (mS)
VDS = 5 V
RG = 100 kΩ
f = 1 kHz
4 V
3 V
2 V
VG2B = 1 V
Gate1 Voltage VG1 (V)
Power Gain vs. Gate Resistance
Power Gain PG (dB)
VDS = 5 V
VG1 = 5 V
VG2B = 4 V
f = 200 MHz
Gate Resistance RG (kΩ)
Noise Figure vs. Gate Resistance
Noise Figure NF (dB)
VDS = 5 V
VG1 = 5 V
VG2B = 4 V
f = 200 MHz
Gate Resistance RG (kΩ)
Power Gain vs. Drain Current
Power Gain PG (dB)
VDS = 5 V
VG1 = 5 V
VG2B = 4 V
RG = variable
f = 200 MHz
Drain Current ID (mA)

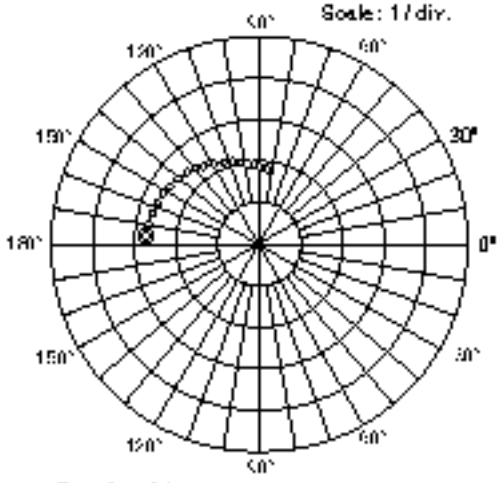

Noise Figure vs. Drain Current
Noise Figure NF (dB)
Drain Current $I_D$ (mA)
$V_{DS}$ = 5 V
$V_{G1}$ = 5 V
$V_{G2S}$ = 4 V
$R_G$ = variable
f = 200 MHz
Drain Current vs. Gate Resistance
Drain Current $I_D$ (mA)
Gate Resistance $R_G$ (k Ω)
$V_{DS}$ = 5 V
$V_{G1}$ = 5 V
$V_{G2S}$ = 4 V
Gain Reduction vs.
Gate2 to Source Voltage
Gain Reduction GR (dB)
Gate2 to Source Voltage $V_{G2S}$ (V)
$V_{DS}$ = 5 V
$V_{G1}$ = 5 V
$V_{G2S}$ = 4 V
$R_G$ = 82 k Ω
f = 200 MHz
Input Capacitance vs.
Gate2 to Source Voltage
Input Capacitance Ciss (pF)
Gate2 to Source Voltage $V_{G2S}$ (V)
$V_{DS}$ = 5 V
$V_{G1}$ = 5 V
$R_G$ = 82 k Ω
f = 1 MHz

S11 Parameter vs. Frequency



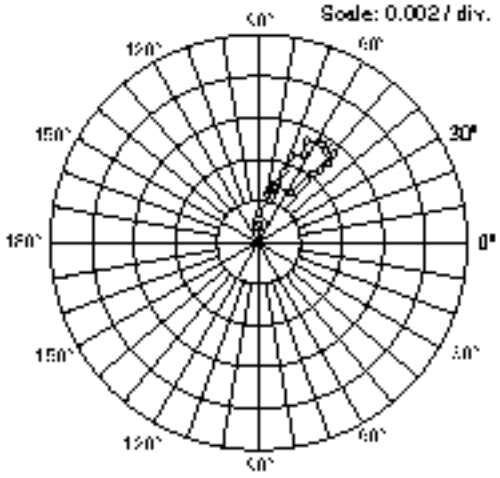
Test Condition : $V_{DS}$ = 5 V , $V_{G1}$ = 5 V
$V_{G2S}$ = 4 V , $R_G$ = 82 k Ω
50 to 1000 MHz (50 MHz step)

S21 Parameter vs. Frequency



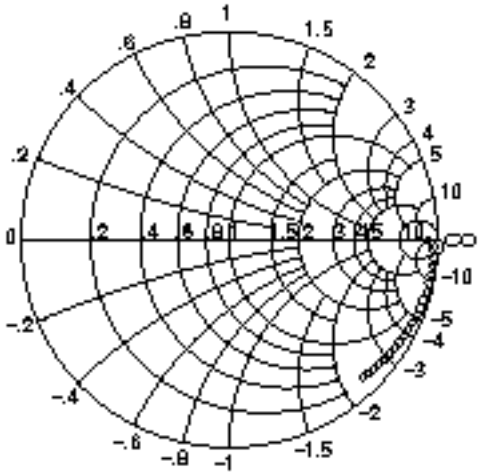

Test Condition : $V_{DS}$ = 5 V , $V_{G1}$ = 5 V
$V_{G2S}$ = 4 V , $R_G$ = 82 k Ω
50 to 1000 MHz (50 MHz step)

S12 Parameter vs. Frequency




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

S22 Parameter vs. Frequency



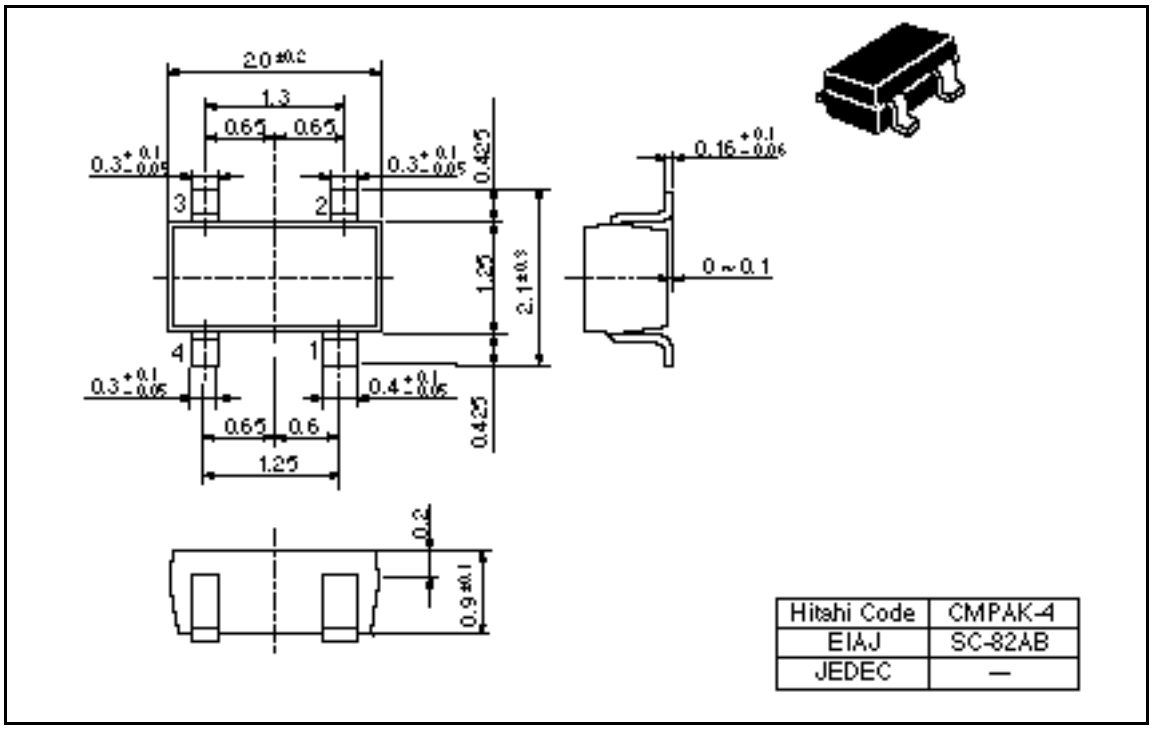
Test Condition : $V_{DS}$ = 5 V , $V_{G1}$ = 5 V
$V_{G2S}$ = 4 V , $R_G$ = 82 k Ω
50 to 1000 MHz (50 MHz step)

**Sparameter** ($V_{DS}$ = $V_{G1}$ = 5V, $V_{G2S}$ = 4V, $R_G$ = 82kΩ, Zo = 50Ω)

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



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