TBB1012

Twin Built in Biasing Circuit MOS FET IC
UHF/VHF RF Amplifier

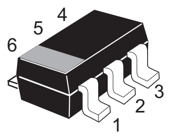
REJ03G1245-0200
Rev.2.00
Aug 22, 2006

Features

- Small SMD package CMPAK-6 built in twin BBFET; To reduce using parts cost & PC board space.
- Very useful for total tuner cost reduction.
- Suitable for World Standard Tuner RF amplifier.
- High gain
- Low noise
- Low output capacitance
- Power supply voltage: 5 V

Outline

RENESAS Package code: PTSP0006JA-A
(Package name: CMPAK-6)



1. Drain(1)
2. Source
3. Drain(2)
4. Gate-1(2)
5. Gate-2
6. Gate-1(1)

Notes: 1. Marking is “MM“.
2. TBB1012 is individual type number of Renesas TWIN 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 –0	V
Gate2 to source voltage	V_{G2S}	+6 –0	V
Drain current	I_D	30	mA
Channel power dissipation	Pch[Note3]	250	mW
Channel temperature	Tch	150	°C
Storage temperature	Tstg	–55 to +150	°C

Notes: 3. Value on the glass epoxy board (50mm × 40mm × 1mm).

Electrical Characteristics

• FET1

(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	0.8	1.1	V	V_{DS} = 5 V, V_{G2S} = 4 V, I_D = 100 μA
Gate2 to source cutoff voltage	$V_{G2S(off)}$	0.4	0.7	1.0	V	V_{DS} = 5 V, V_{G1S} = 5 V, I_D = 100 μA
Drain current	$I_{D(op)}$	12	16	20	mA	V_{DS} = 5 V, V_{G1} = 5 V V_{G2S} = 4 V, R_G = 100 kΩ
Forward transfer admittance	$\|y_{fs}\|$	27	32	38	mS	V_{DS} = 5 V, V_{G1} = 5 V, V_{G2S} = 4 V, f = 1 kHz, R_G = 100 kΩ
Input capacitance	Ciss	1.2	1.6	2.0	pF	V_{DS} = 5 V, V_{G1} = 5 V, V_{G2S} = 4 V, f = 1 MHz, R_G = 100 kΩ
Output capacitance	Coss	0.7	1.1	1.5	pF	
Power gain	PG	15	20.5	25	dB	V_{DS} = 5 V, V_{G1} = 5 V, V_{G2S} = 4 V, R_G = 100 kΩ, f = 900 MHz
Noise figure	NF	—	1.95	2.7	dB	

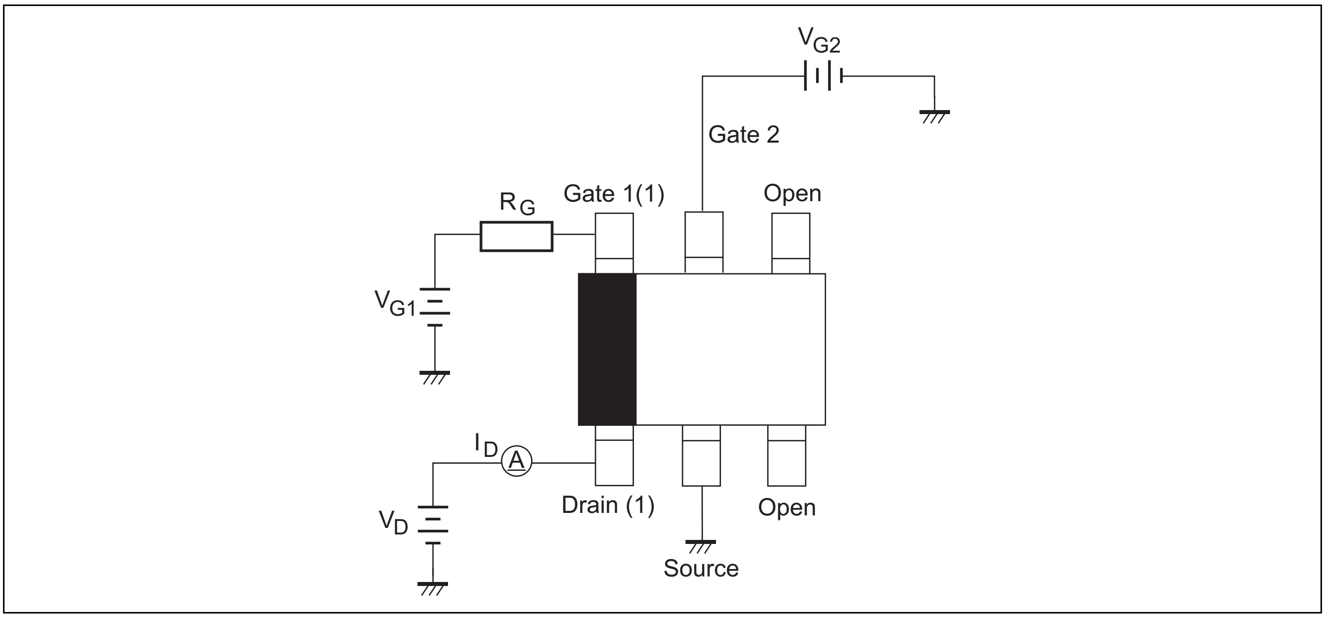
• FET2

(Ta = 25°C)

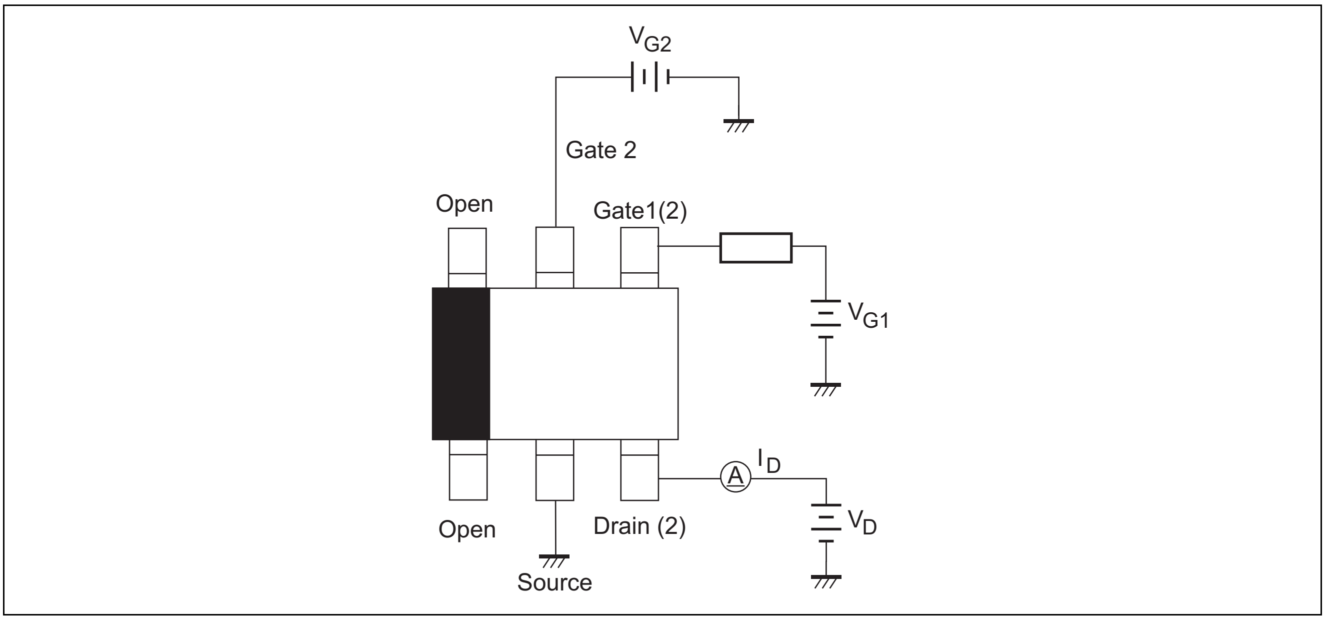
Item	Symbol	Min	Typ	Max	Unit	Test Conditions
Drain to source breakdown voltage	$V_{(BR)DSS}$	6	—	—	V	I_D = 200 μA, V_{G1s} = V_{G2S} = 0
Gate1 to source breakdown voltage	$V_{(BR)G1SS}$	+6	—	—	V	I_{G1} = +10 μA, V_{G2S} = V_{DS} = 0
Gate2 to source breakdown voltage	$V_{(BR)G2SS}$	+6	—	—	V	I_{G2} = +10 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	0.8	1.1	V	V_{DS} = 5 V, V_{G2S} = 4 V, I_D = 100 μA
Gate2 to source cutoff voltage	$V_{G2S(off)}$	0.4	0.7	1.0	V	V_{DS} = 5 V, V_{G1S} = 5 V, I_D = 100 μA
Drain current	$I_{D(op)}$	13	17	21	mA	V_{DS} = 5 V, V_{G1} = 5 V V_{G2S} = 4 V, R_G = 82 kΩ
Forward transfer admittance	$\|y_{fs}\|$	25	30	35	mS	V_{DS} = 5 V, V_{G1} = 5 V, V_{G2S} = 4 V, f = 1 kHz, R_G = 82 kΩ
Input capacitance	Ciss	2.3	2.7	3.1	pF	V_{DS} = 5 V, V_{G1} = 5 V, V_{G2S} = 4 V, f = 1 MHz, R_G = 82 kΩ
Output capacitance	Coss	0.9	1.3	1.7	pF	
Power gain	PG	24	29.5	34	dB	V_{DS} = 5 V, V_{G1} = 5 V, V_{G2S} = 4 V, R_G = 82 kΩ, f = 200 MHz
Noise figure	NF	—	0.95	1.6	dB	

DC Biasing Circuit for Operating Characteristic Items ($I_{D(op)}$, $|y_{fs}|$, Ciss, Coss, NF, PG)

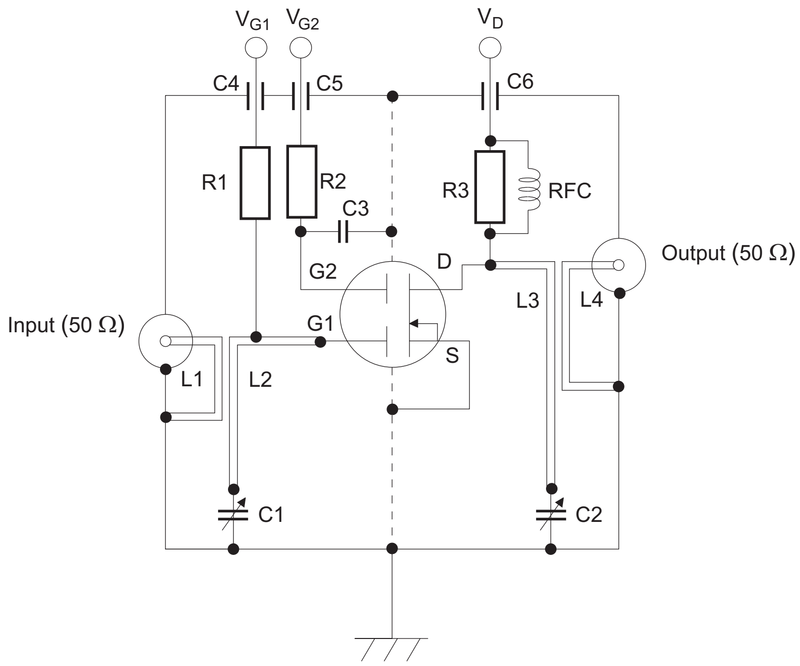
• **Measurement of FET1**



• **Measurement of FET2**

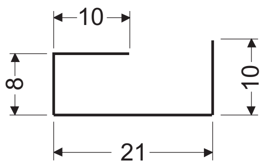


900 MHz Power Gain, Noise Figure Test Circuit

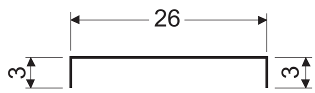


C1, C2 : Variable Capacitor (10 pF MAX)
C3 : Disk Capacitor (1000 pF)
C4 ~ C6 : Air Capacitor (1000 pF)
R1 : 100 kΩ
R2 : 47 kΩ
R3 : 4.7 kΩ

L1:

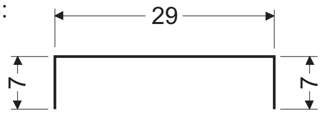


L2:

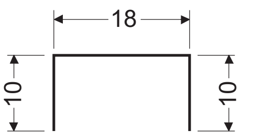


(ϕ 1 mm Copper wire)
Unit: mm

L3:



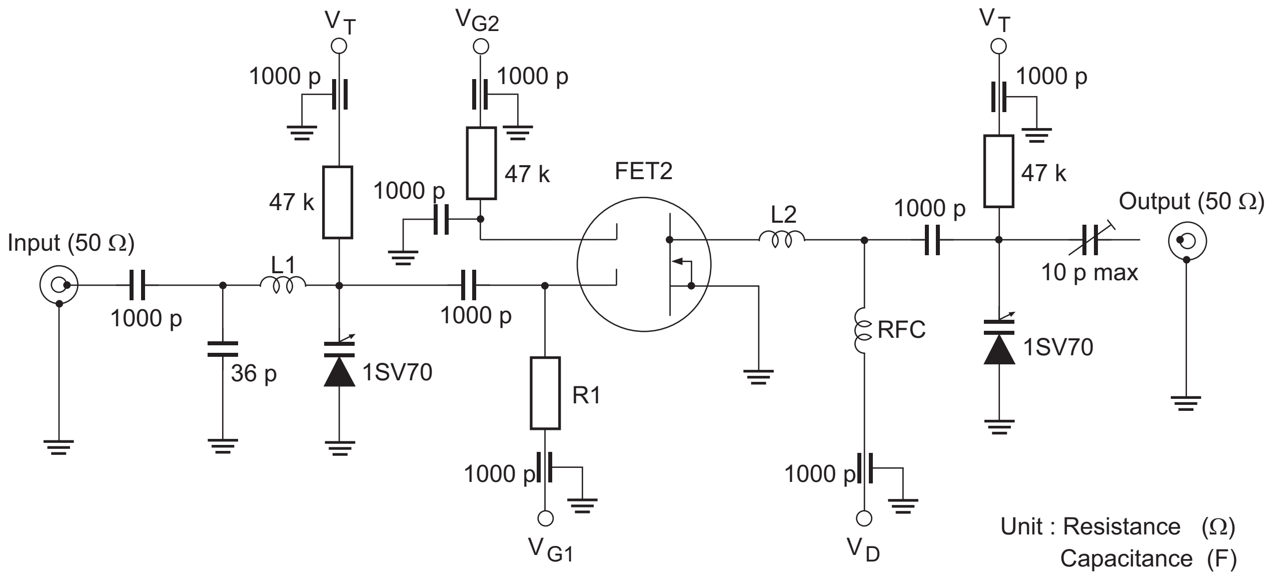
L4:



RFC : ϕ1 mm Copper wire with enamel 4 turns inside dia 6 mm

RENESAS

200 MHz Power Gain, Noise Figure Test Circuit

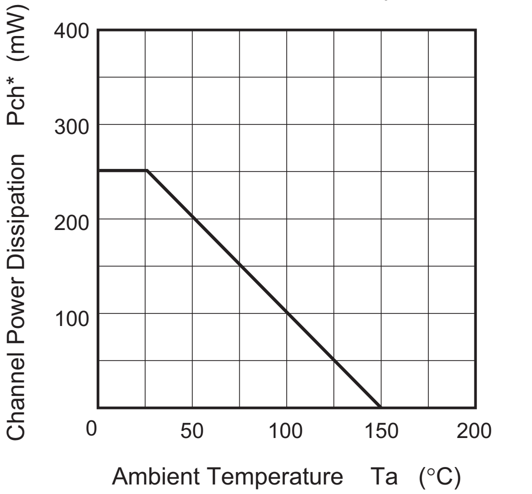


R1 : 82 kΩ
L1 : ϕ1 mm Enameled Copper Wire, Inside dia 10 mm, 2 Turns
L2 : ϕ1 mm Enameled Copper Wire, Inside dia 10 mm, 2 Turns
RFC : ϕ1 mm Enameled Copper Wire, Inside dia 5 mm, 2 Turns

Main Characteristics

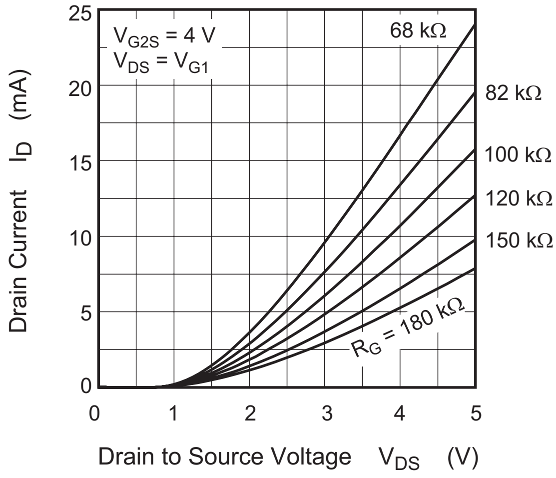
• **FET1**

Maximum Channel Power Dissipation Curve

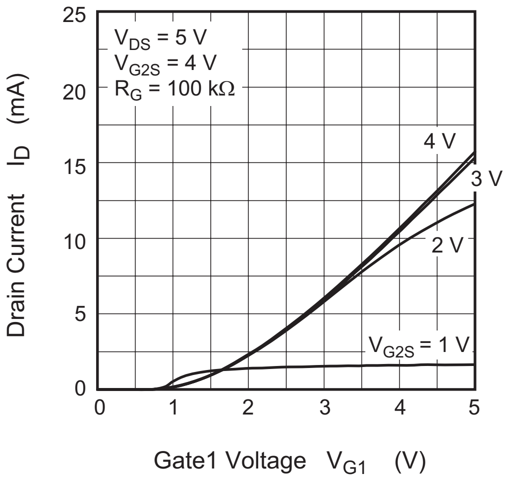


* Value on the glass epoxy board (50 mm × 40 mm × 1 mm)

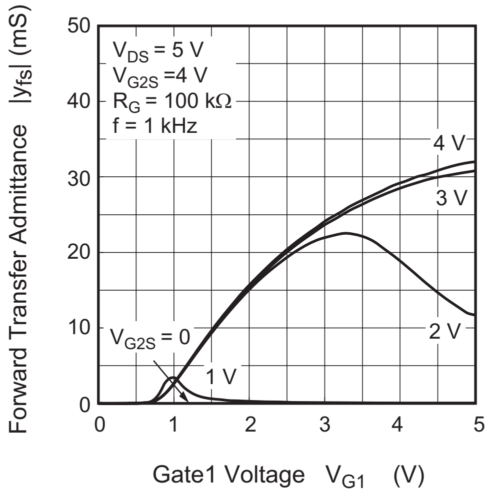
Typical Output Characteristics



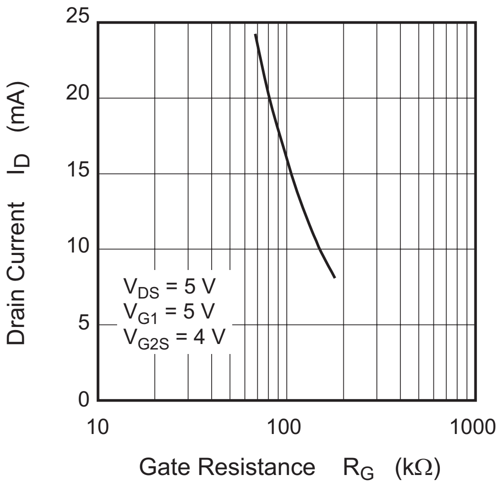
Drain Current vs. Gate1 Voltage



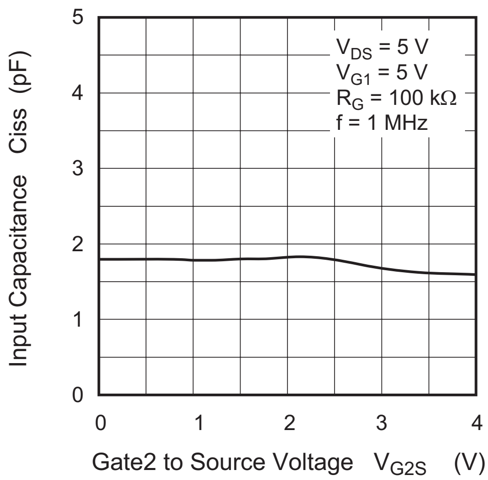
Forward Transfer Admittance vs. Gate1 Voltage



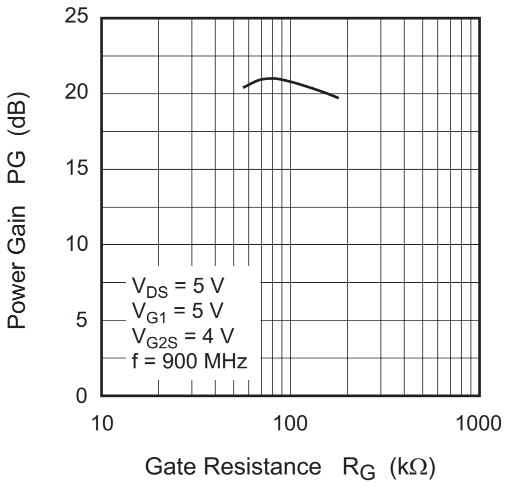
Drain Current vs. Gate Resistance



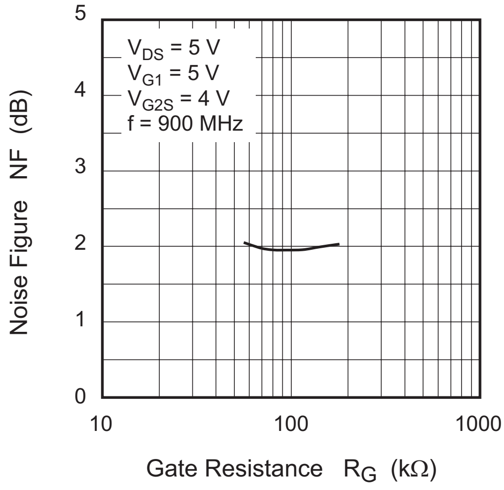
Input Capacitance vs. Gate2 to Source Voltage



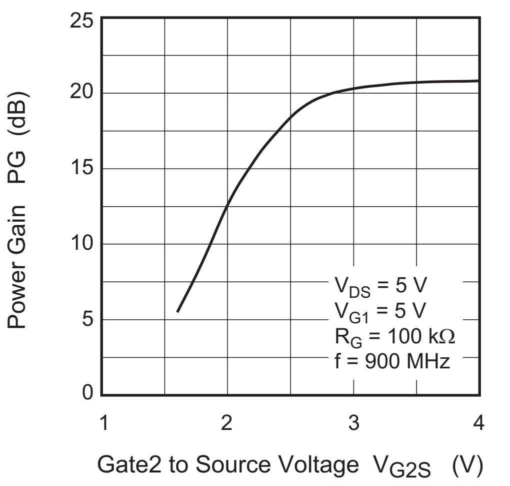
Power Gain vs. Gate Resistance



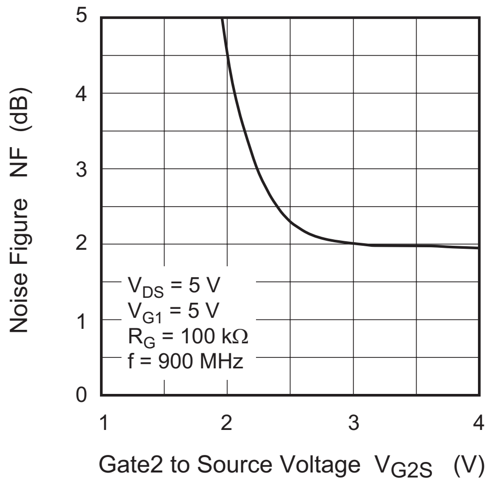
Noise Figure vs. Gate Resistance



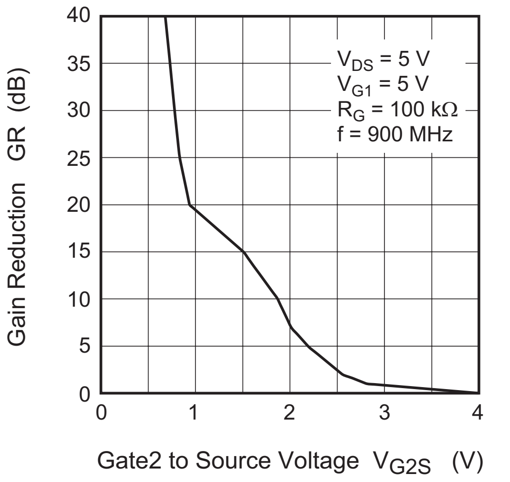
Power Gain vs.
Gate2 to Source Voltage



Noise Figure vs.
Gate2 to Source Voltage

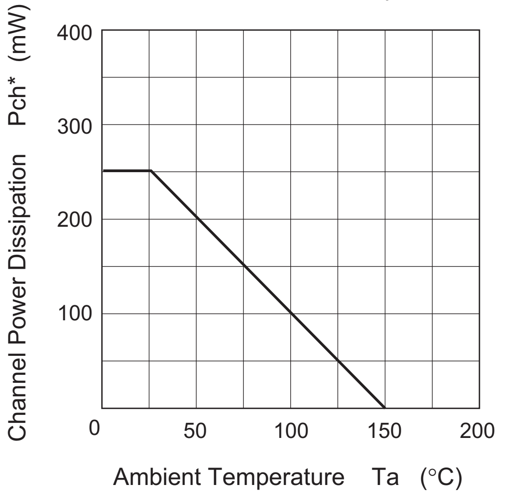


Gain Reduction vs.
Gate2 to Source Voltage



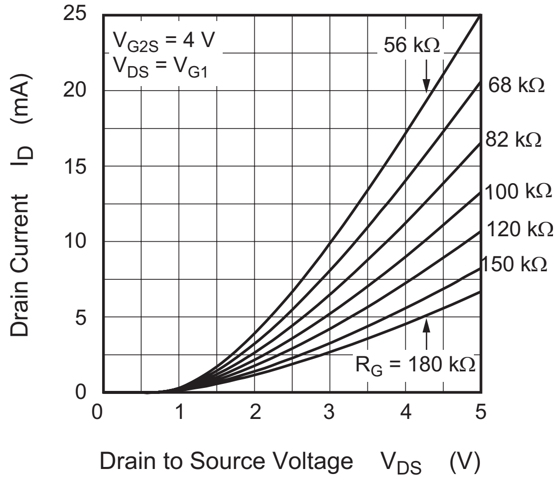
• **FET2**

Maximum Channel Power Dissipation Curve

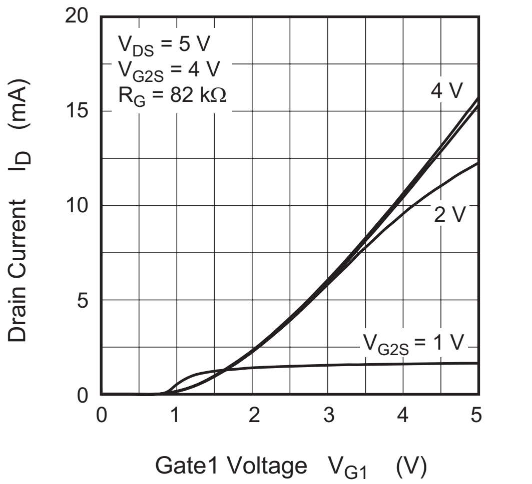


* Value on the glass epoxy board (50 mm × 40 mm × 1 mm)

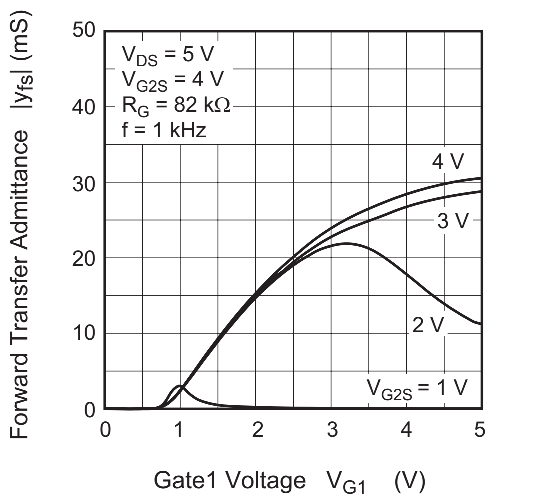
Typical Output Characteristics



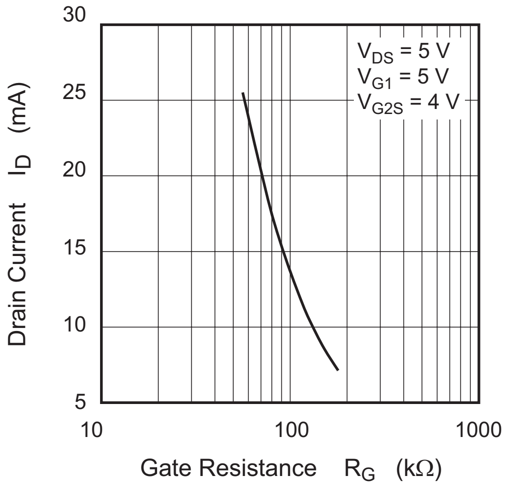
Drain Current vs. Gate1 Voltage



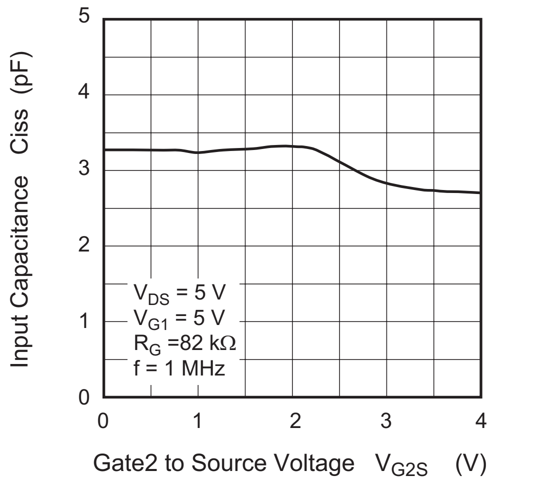
Forward Transfer Admittance vs. Gate1 Voltage

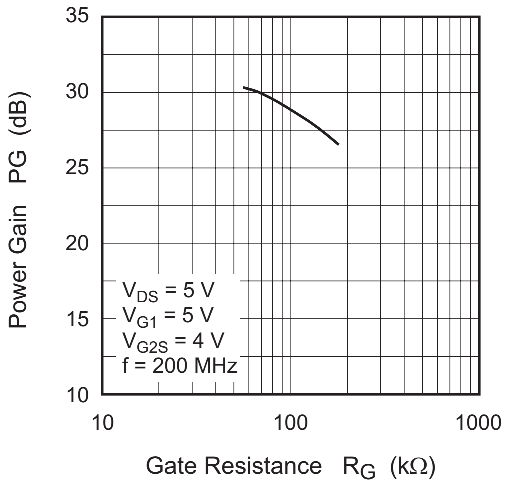


Drain Current vs. Gate Resistance

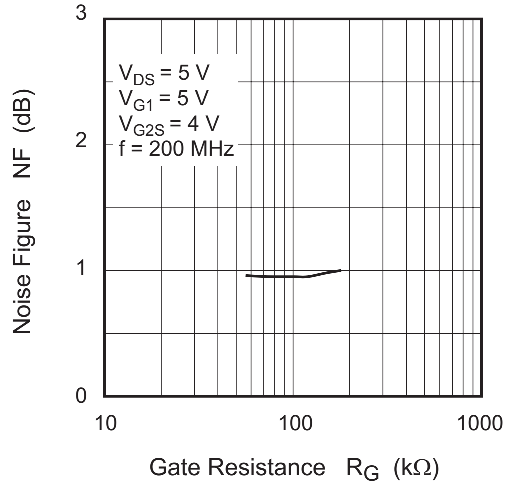


Input Capacitance vs. Gate2 to Source Voltage

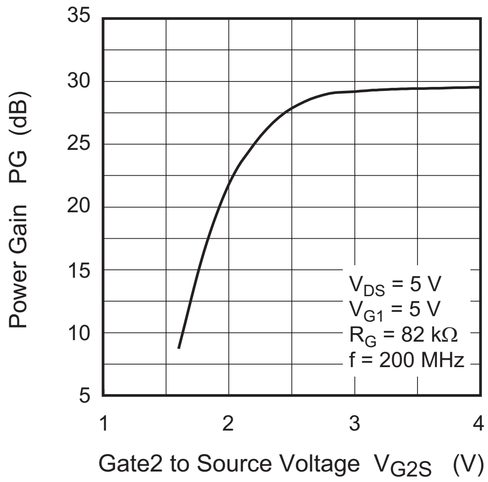




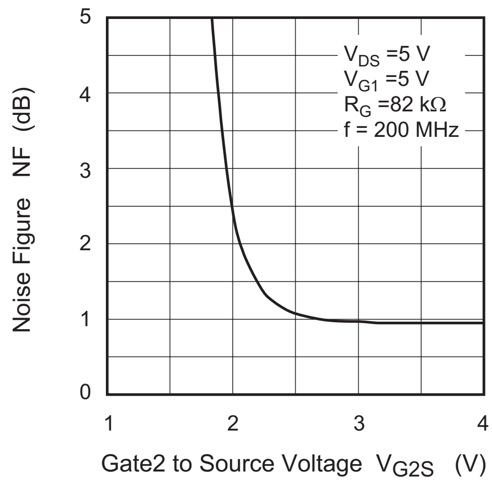
Power Gain vs. Gate Resistance



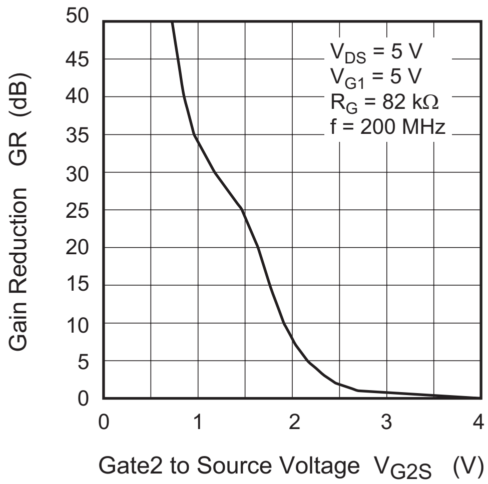
Noise Figure vs. Gate Resistance



Power Gain vs. Gate2 to Source Voltage



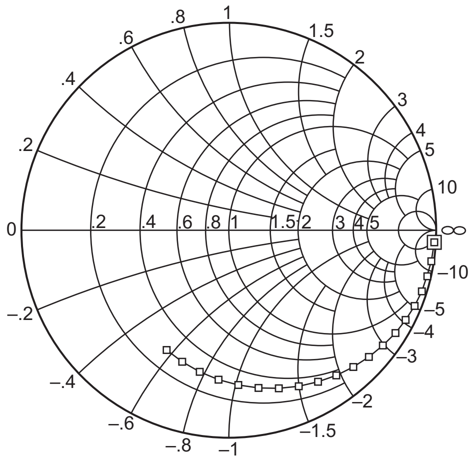
Noise Figure vs. Gate2 to Source Voltage



Gain Reduction vs. Gate2 to Source Voltage

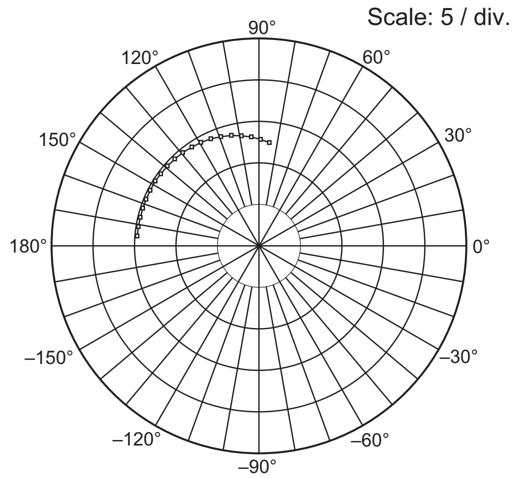
• **FET1**

S_{11} Parameter vs. Frequency



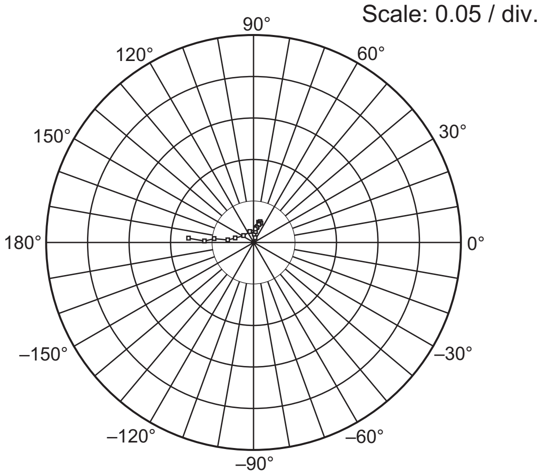
Test condition: V_{DS} = 5 V, V_{G1} = 5 V,
V_{G2S} = 4 V, R_G = 100 kΩ
0.05 to 1.05 GHz (0.05 GHz step)

S_{21} Parameter vs. Frequency



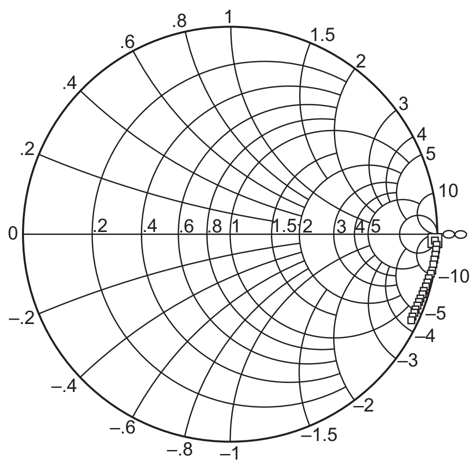
Test condition: V_{DS} = 5 V, V_{G1} = 5 V,
V_{G2S} = 4 V, R_G = 100 kΩ
0.05 to 1.05 GHz (0.05 GHz step)

S_{12} Parameter vs. Frequency



Test condition: V_{DS} = 5 V, V_{G1} = 5 V,
V_{G2S} = 4 V, R_G = 100 kΩ
0.05 to 1.05 GHz (0.05 GHz step)

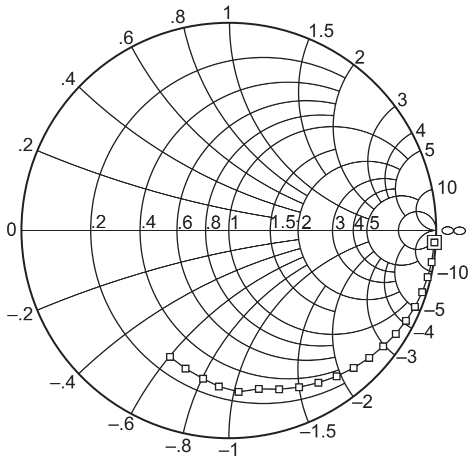
S_{22} Parameter vs. Frequency



Test condition: V_{DS} = 5 V, V_{G1} = 5 V,
V_{G2S} = 4 V, R_G = 100 kΩ
0.05 to 1.05 GHz (0.05 GHz step)

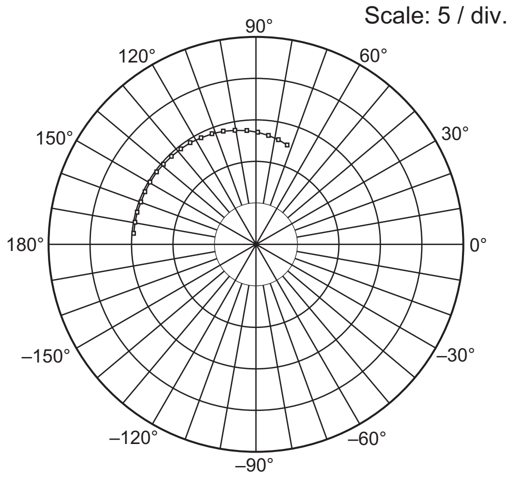
- **FET2**

S11 Parameter vs. Frequency



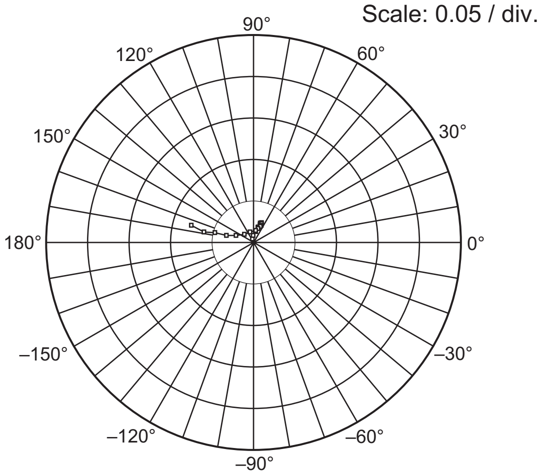
Test condition: V_{DS} = 5 V, V_{G1} = 5 V,
V_{G2S} = 4 V, R_G = 82 kΩ
0.05 to 1.05 GHz (0.05 GHz step)

S21 Parameter vs. Frequency



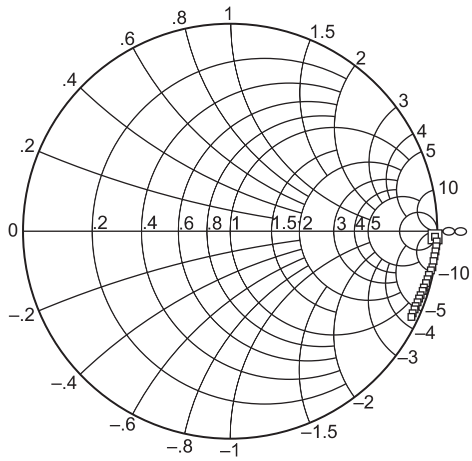
Test condition: V_{DS} = 5 V, V_{G1} = 5 V,
V_{G2S} = 4 V, R_G = 82 kΩ
0.05 to 1.05 GHz (0.05 GHz step)

S12 Parameter vs. Frequency



Test condition: V_{DS} = 5 V, V_{G1} = 5 V,
V_{G2S} = 4 V, R_G = 82 kΩ
0.05 to 1.05 GHz (0.05 GHz step)

S22 Parameter vs. Frequency



Test condition: V_{DS} = 5 V, V_{G1} = 5 V,
V_{G2S} = 4 V, R_G = 82 kΩ
0.05 to 1.05 GHz (0.05 GHz step)

S parameter

• FET1

(V_{DS} = 5 V, V_{G1} = 5 V, V_{G2S} = 4 V, R_G = 100 kΩ, Zo = 50 Ω)

Freq. (MHz)	S11		S21		S12		S22	
	Mag	Deg	Mag	Deg	Mag	Deg	Mag	Deg
50	0.994	-4.3	2.97	175.6	0.001	74.4	0.999	-1.3
100	0.990	-8.8	2.97	171.1	0.002	89.6	0.998	-2.8
150	0.985	-13.1	2.97	166.7	0.002	81.5	0.997	-4.2
200	0.978	-17.6	2.97	162.2	0.003	81.6	0.995	-5.6
250	0.970	-22.2	2.97	157.8	0.004	77.8	0.993	-7.0
300	0.958	-26.9	2.96	153.1	0.005	76.9	0.992	-8.3
350	0.946	-31.7	2.97	148.1	0.005	73.8	0.991	-10.1
400	0.930	-36.8	2.96	143.8	0.005	72.9	0.987	-11.0
450	0.913	-42.1	2.95	139.0	0.005	69.4	0.982	-12.4
500	0.894	-47.7	2.94	134.2	0.004	73.3	0.980	-13.6
550	0.873	-53.4	2.93	129.4	0.004	73.7	0.978	-14.8
600	0.850	-59.5	2.91	124.3	0.003	78.4	0.973	-16.2
650	0.826	-65.8	2.89	119.4	0.003	83.8	0.972	-17.2
700	0.801	-72.4	2.85	114.4	0.003	113.5	0.969	-18.5
750	0.775	-79.2	2.81	109.4	0.003	151.7	0.968	-19.6
800	0.749	-86.4	2.77	104.3	0.005	169.5	0.967	-20.7
850	0.723	-93.8	2.71	99.3	0.006	176.7	0.965	-22.0
900	0.698	-101.4	2.66	94.4	0.010	176.0	0.966	-22.9
950	0.674	-109.3	2.59	89.4	0.012	179.6	0.965	-24.2
1000	0.651	-117.2	2.52	84.7	0.016	177.3	0.967	-25.3

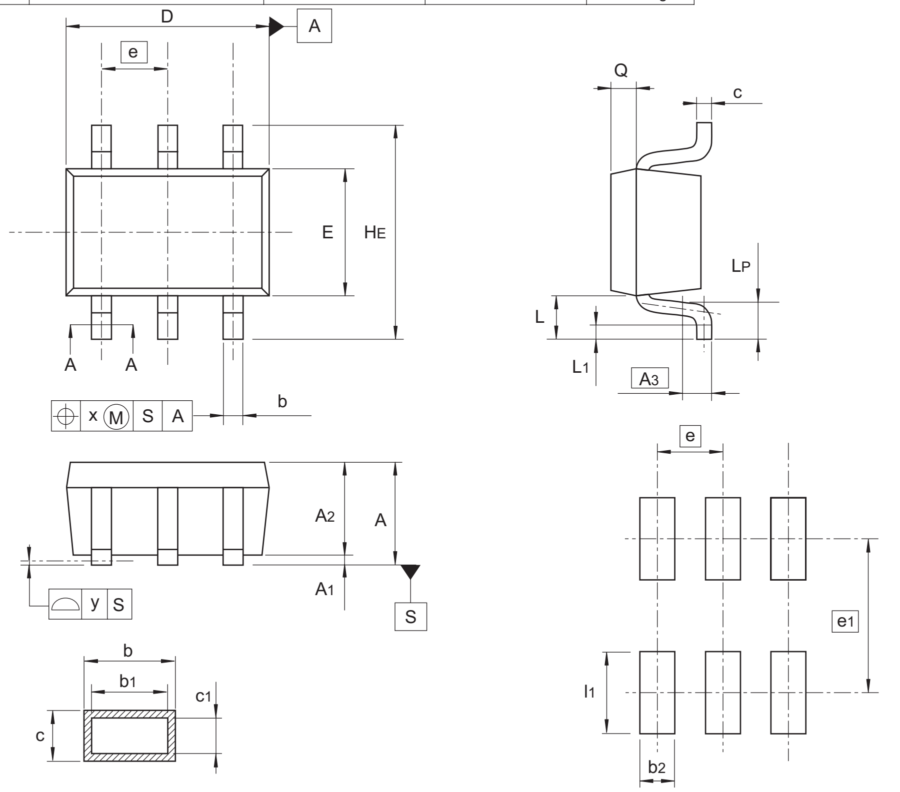
• FET2

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

Freq (MHz)	S11		S21		S12		S22	
	Mag	Deg	Mag	Deg	Mag	Deg	Mag	Deg
50	0.986	-4.8	2.96	175.1	0.001	109.6	1.000	-1.9
100	0.983	-10.1	2.96	169.9	0.002	93.5	0.998	-4.0
150	0.979	-14.9	2.96	165.0	0.003	77.5	0.998	-5.9
200	0.971	-20.0	2.95	159.9	0.004	73.2	0.995	-8.0
250	0.963	-25.2	2.96	154.7	0.004	72.4	0.994	-9.9
300	0.951	-30.4	2.96	149.6	0.004	69.1	0.992	-11.9
350	0.937	-35.9	2.96	143.9	0.005	70.2	0.991	-14.2
400	0.923	-41.6	2.95	139.0	0.005	67.3	0.987	-15.7
450	0.905	-47.4	2.95	133.8	0.005	66.2	0.982	-17.7
500	0.887	-53.7	2.93	128.2	0.004	64.6	0.981	-19.5
550	0.868	-60.0	2.92	122.9	0.004	65.8	0.977	-21.4
600	0.843	-66.6	2.90	117.3	0.003	71.3	0.973	-23.3
650	0.821	-73.6	2.88	111.6	0.003	79.4	0.972	-25.0
700	0.796	-80.6	2.85	106.1	0.003	109.7	0.969	-26.9
750	0.769	-88.1	2.80	100.5	0.003	139.9	0.967	-28.6
800	0.744	-95.9	2.76	94.7	0.004	159.6	0.966	-30.3
850	0.719	-103.8	2.71	89.2	0.007	166.6	0.964	-32.2
900	0.692	-112.2	2.65	83.6	0.010	166.5	0.965	-33.7
950	0.669	-120.7	2.58	78.0	0.012	168.6	0.964	-35.6
1000	0.646	-129.1	2.51	72.8	0.015	165.0	0.966	-37.3

Package Dimensions

Package Name	JEITA Package Code	RENESAS Code	Previous Code	MASS[Typ.]
CMPAK-6	SC-88	PTSP0006JA-A	CMPAK-6 / CMPAK-6V	0.006g



A-A Section

Pattern of terminal position areas

Reference Symbol	Dimension in Millimeters		
	Min	Nom	Max
A	0.8	–	1.1
A_1	0	–	0.1
A_2	0.8	0.9	1.0
A_3	–	0.25	–
b	0.15	0.22	0.3
b_1	–	0.2	–
c	0.1	0.13	0.15
c_1	–	0.11	–
D	1.8	2.0	2.2
E	1.15	1.25	1.35
e	–	0.65	–
H_E	2.0	2.1	2.2
L	0.3	–	0.7
L_1	0.1	–	0.5
L_P	0.2	–	0.6
x	–	–	0.05
y	–	–	0.05
b_2	–	–	0.35
e_1	–	1.5	–
l_1	–	–	0.9
Q	–	0.25	–

Ordering Information

Part Name	Quantity	Shipping Container
TBB1012MMTL-E	3000 pcs	ϕ178mm reel, 8mm 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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