

# TBB1012

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

REJ03G1245-0200

Rev.2.00

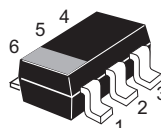
Aug 22, 2006

### 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	$P_{ch}$ <sup>Note3</sup>	250	mW
Channel temperature	$T_{ch}$	150	°C
Storage temperature	$T_{stg}$	-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	$I_D = 200 \mu A, V_{G1S} = V_{G2S} = 0$
Gate1 to source breakdown voltage	$V_{(BR)G1SS}$	+6	—	—	V	$I_{G1} = +10 \mu A, V_{G2S} = V_{DS} = 0$
Gate2 to source breakdown voltage	$V_{(BR)G2SS}$	+6	—	—	V	$I_{G2} = +10 \mu A, V_{G1S} = V_{DS} = 0$
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	$V_{DS} = 5 V, V_{G2S} = 4 V, I_D = 100 \mu A$
Gate2 to source cutoff voltage	$V_{G2S(off)}$	0.4	0.7	1.0	V	$V_{DS} = 5 V, V_{G1S} = 5 V, I_D = 100 \mu A$
Drain current	$I_{D(op)}$	12	16	20	mA	$V_{DS} = 5 V, V_{G1} = 5 V$ $V_{G2S} = 4 V, R_G = 100 k\Omega$
Forward transfer admittance	$ y_{fs} $	27	32	38	mS	$V_{DS} = 5 V, V_{G1} = 5 V, V_{G2S} = 4 V,$ $f = 1 kHz, R_G = 100 k\Omega$
Input capacitance	$C_{iss}$	1.2	1.6	2.0	pF	$V_{DS} = 5 V, V_{G1} = 5 V, V_{G2S} = 4 V,$ $f = 1 MHz, R_G = 100 k\Omega$
Output capacitance	$C_{oss}$	0.7	1.1	1.5	pF	
Power gain	PG	15	20.5	25	dB	$V_{DS} = 5 V, V_{G1} = 5 V, V_{G2S} = 4 V,$ $R_G = 100 k\Omega, f = 900 MHz$
Noise figure	NF	—	1.95	2.7	dB	

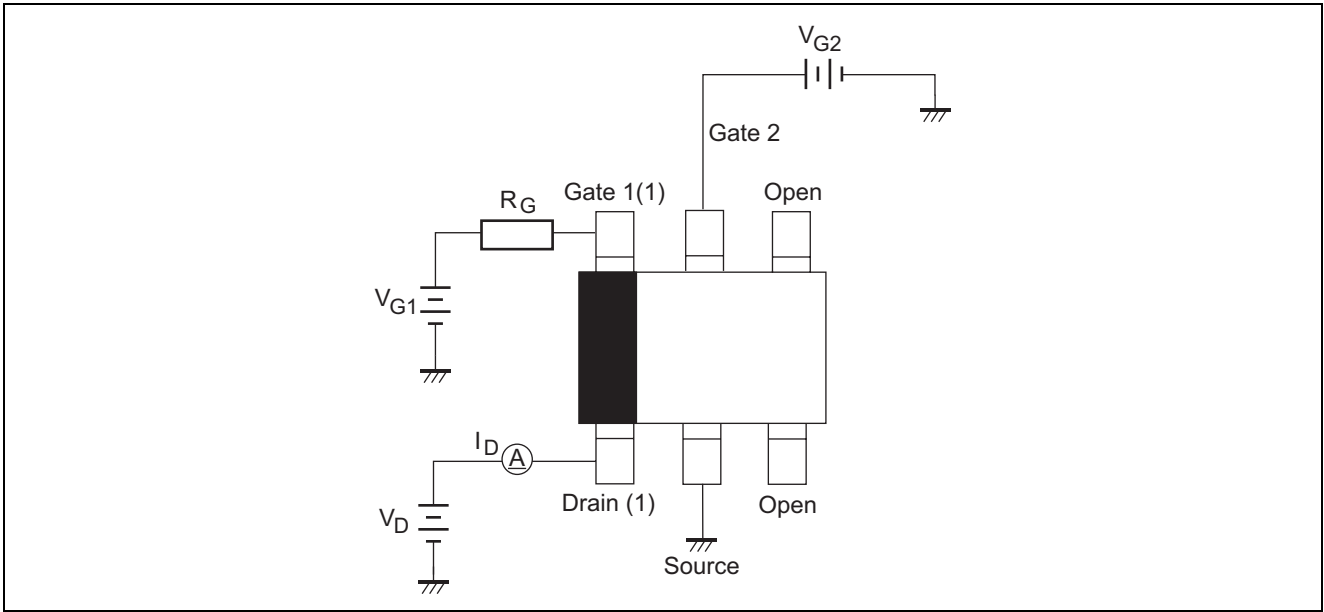
### • FET2

(Ta = 25°C)

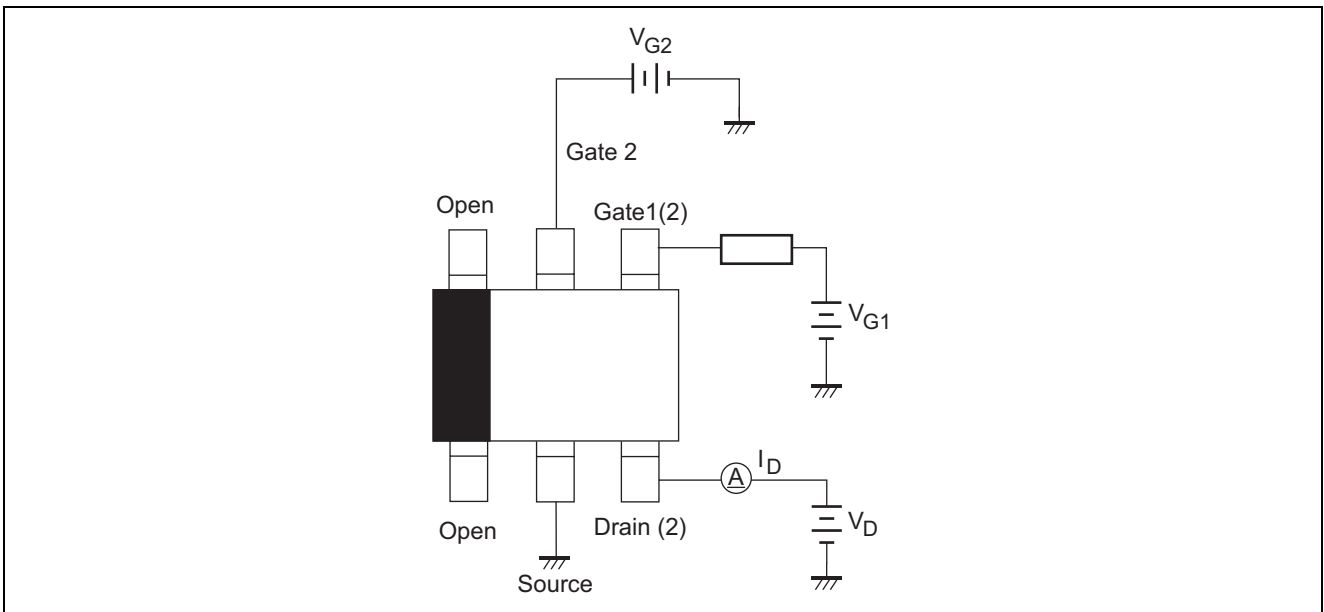
Item	Symbol	Min	Typ	Max	Unit	Test Conditions
Drain to source breakdown voltage	$V_{(BR)DSS}$	6	—	—	V	$I_D = 200 \mu A, V_{G1S} = V_{G2S} = 0$
Gate1 to source breakdown voltage	$V_{(BR)G1SS}$	+6	—	—	V	$I_{G1} = +10 \mu A, V_{G2S} = V_{DS} = 0$
Gate2 to source breakdown voltage	$V_{(BR)G2SS}$	+6	—	—	V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

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

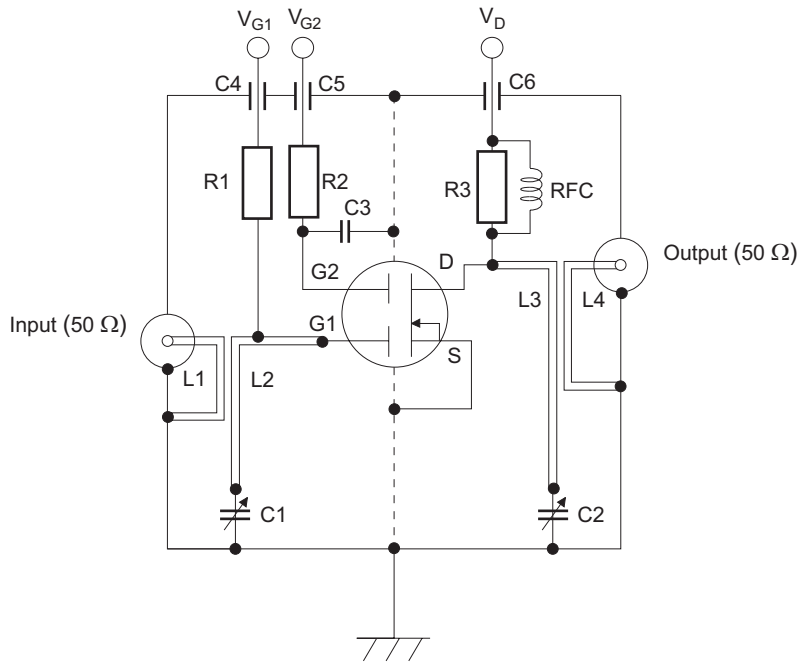
• Measurement of FET1



• Measurement of FET2

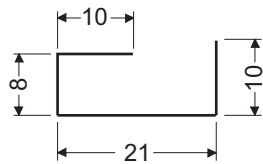


### 900 MHz Power Gain, Noise Figure Test Circuit

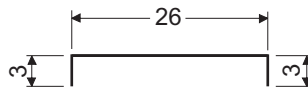


- C1, C2 : Variable Capacitor (10 pF MAX)
- C3 : Disk Capacitor (1000 pF)
- C4 ~ C6 : Air Capacitor (1000 pF)
- R1 : 100 kΩ
- R2 : 47 kΩ
- R3 : 4.7 kΩ

L1:

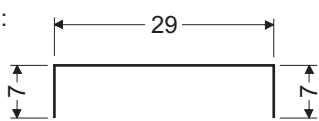


L2:

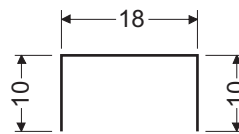


(φ 1 mm Copper wire)  
Unit: mm

L3:

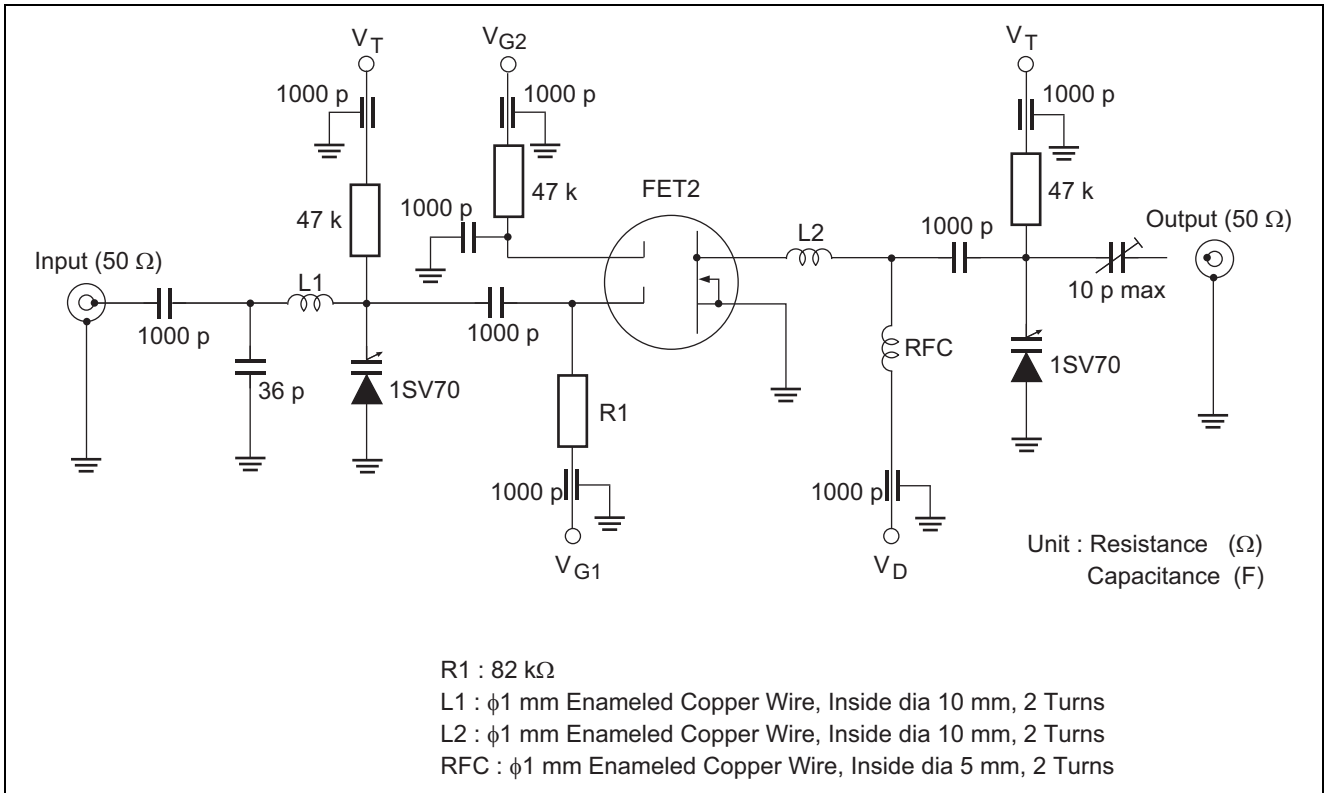


L4:



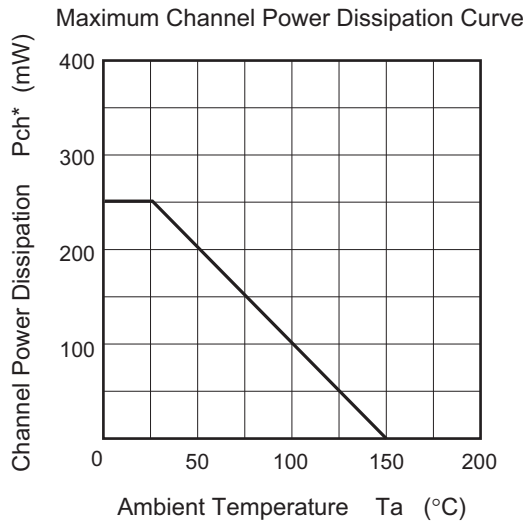
RFC : φ1 mm Copper wire with enamel 4 turns inside dia 6 mm

200 MHz Power Gain, Noise Figure Test Circuit

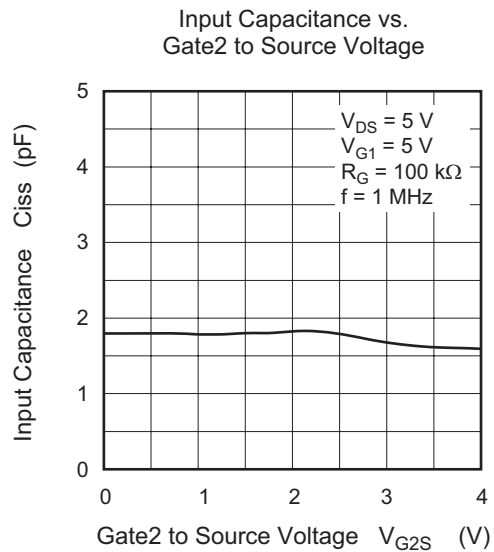
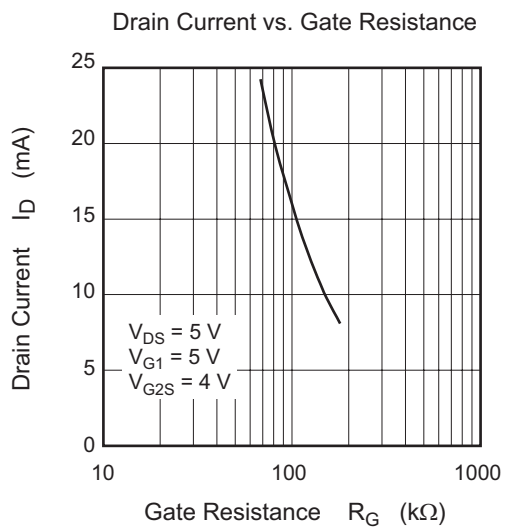
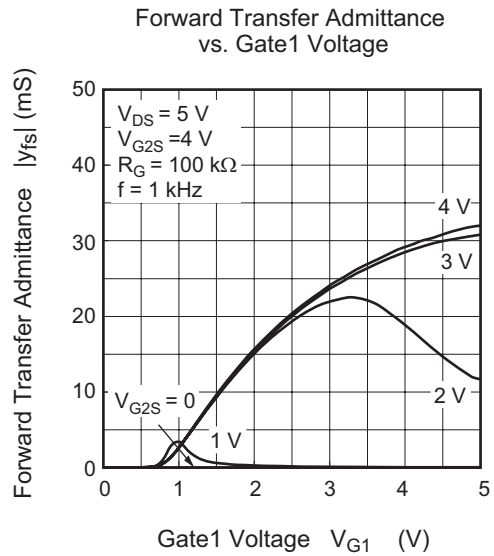
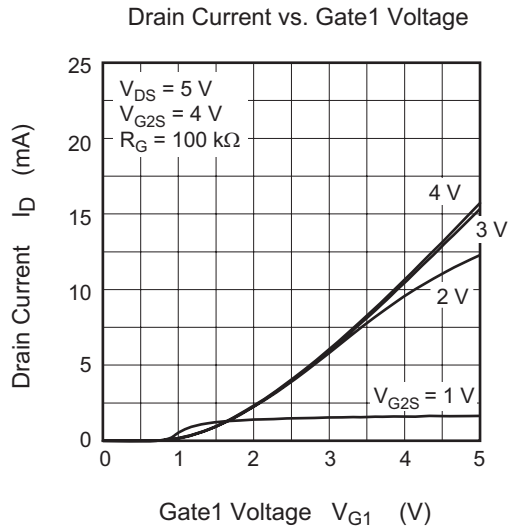
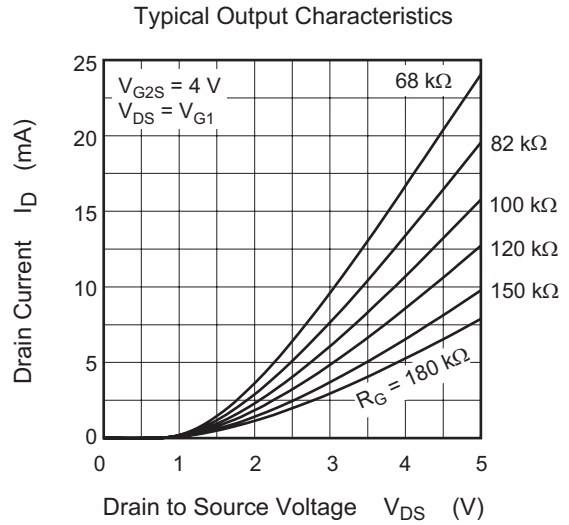


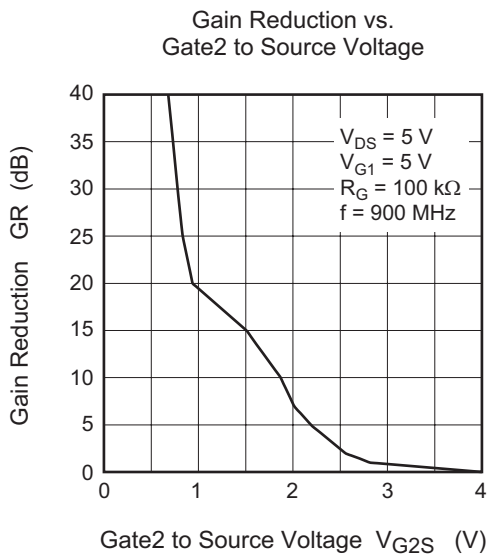
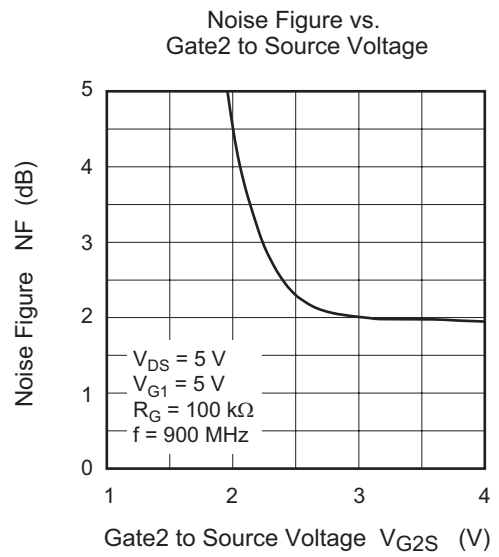
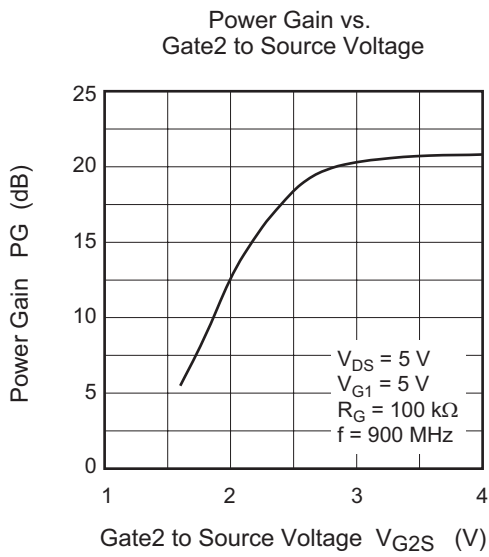
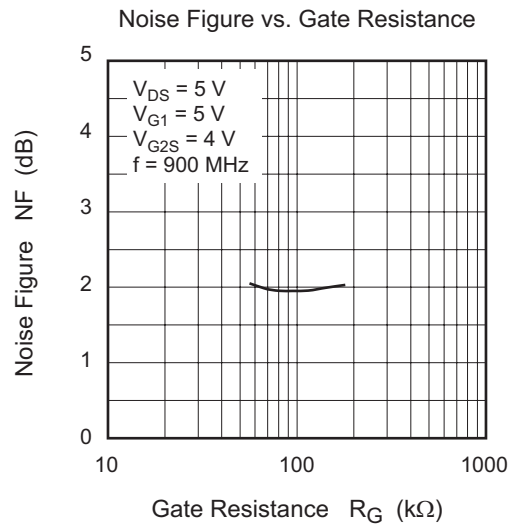
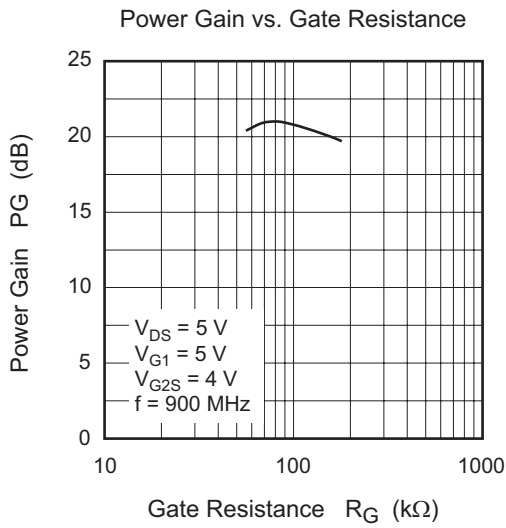
# Main Characteristics

## • FET1

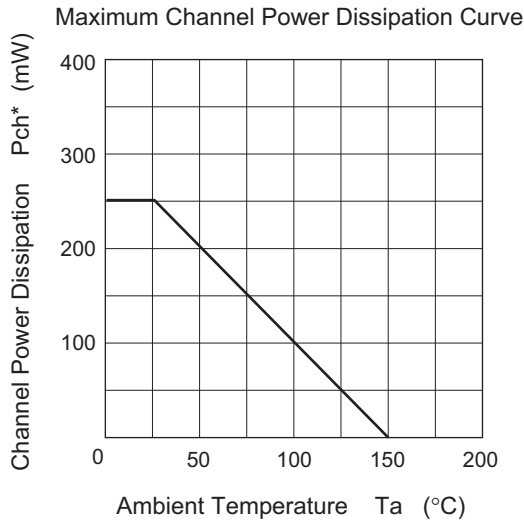


\* Value on the glass epoxy board (50 mm × 40 mm × 1 mm)

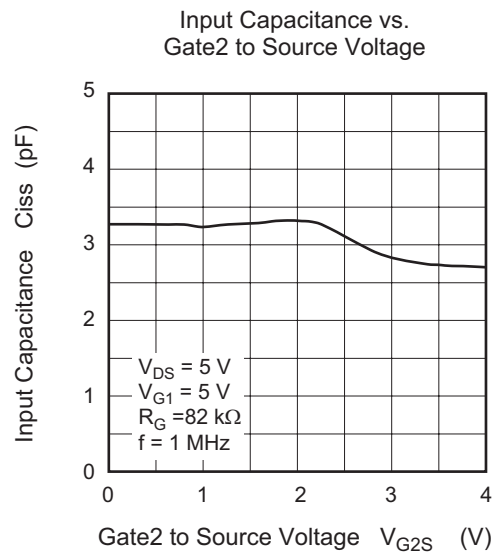
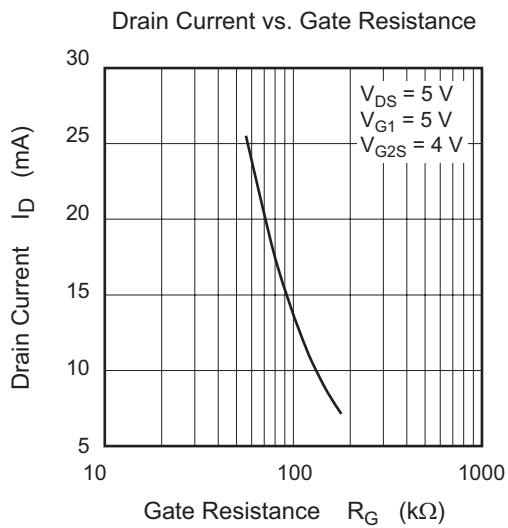
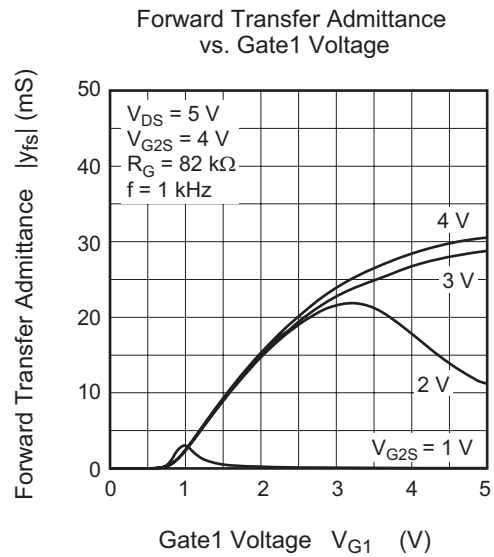
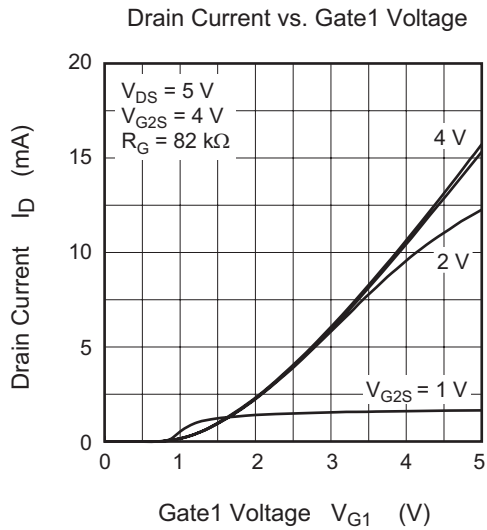
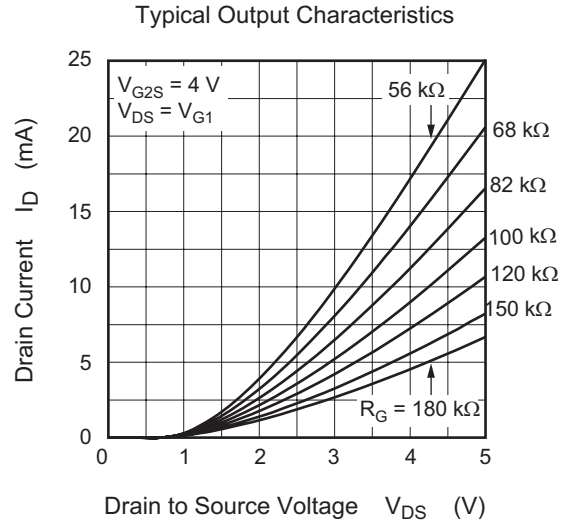




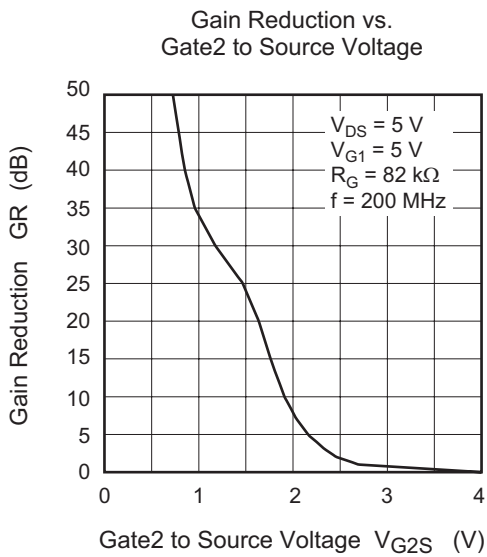
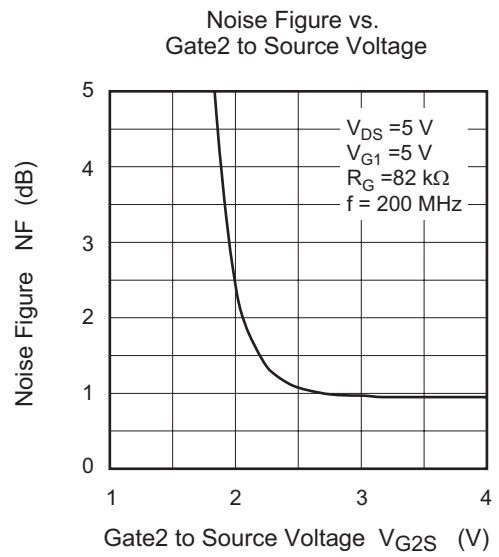
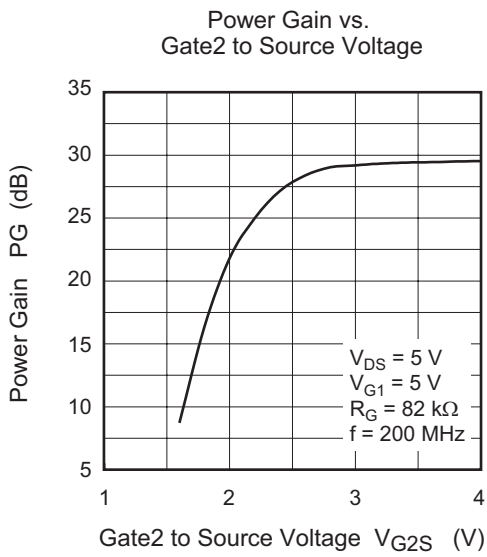
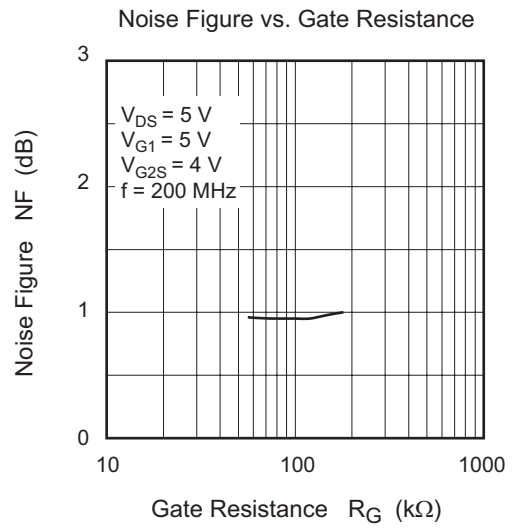
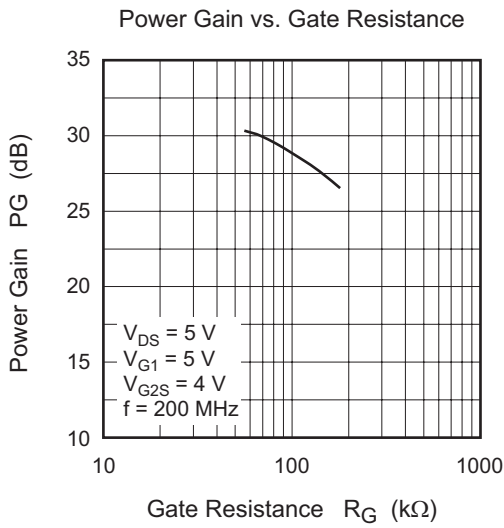
• FET2



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

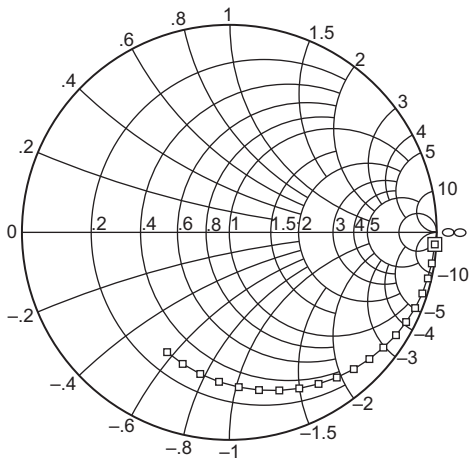






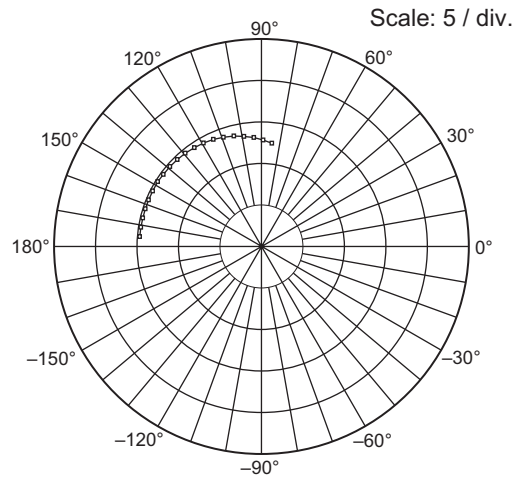
• FET1

S11 Parameter vs. Frequency



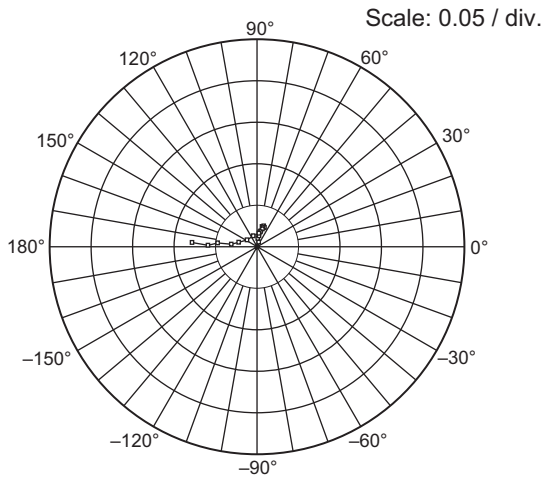
Test condition:  $V_{DS} = 5\text{ V}$ ,  $V_{G1} = 5\text{ V}$ ,  
 $V_{G2S} = 4\text{ V}$ ,  $R_G = 100\text{ k}\Omega$   
 0.05 to 1.05 GHz (0.05 GHz step)

S21 Parameter vs. Frequency



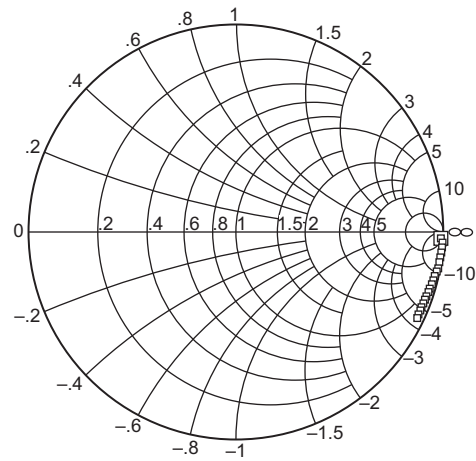
Test condition:  $V_{DS} = 5\text{ V}$ ,  $V_{G1} = 5\text{ V}$ ,  
 $V_{G2S} = 4\text{ V}$ ,  $R_G = 100\text{ k}\Omega$   
 0.05 to 1.05 GHz (0.05 GHz step)

S12 Parameter vs. Frequency



Test condition:  $V_{DS} = 5\text{ V}$ ,  $V_{G1} = 5\text{ V}$ ,  
 $V_{G2S} = 4\text{ V}$ ,  $R_G = 100\text{ k}\Omega$   
 0.05 to 1.05 GHz (0.05 GHz step)

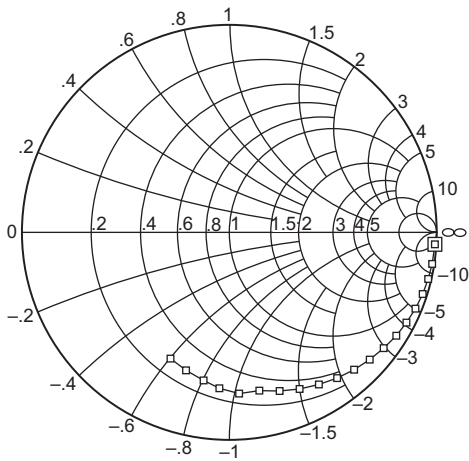
S22 Parameter vs. Frequency



Test condition:  $V_{DS} = 5\text{ V}$ ,  $V_{G1} = 5\text{ V}$ ,  
 $V_{G2S} = 4\text{ V}$ ,  $R_G = 100\text{ k}\Omega$   
 0.05 to 1.05 GHz (0.05 GHz step)

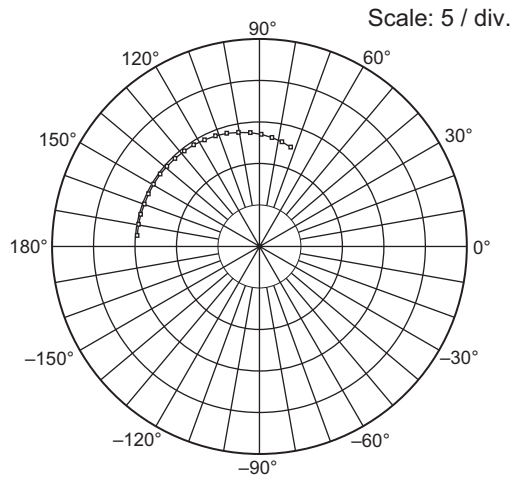
• FET2

S11 Parameter vs. Frequency



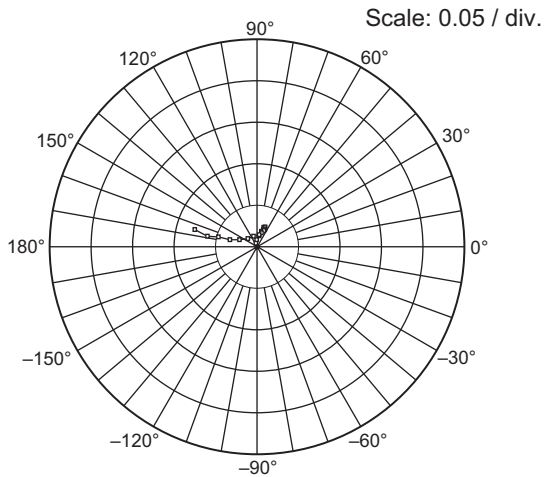
Test condition:  $V_{DS} = 5\text{ V}$ ,  $V_{G1} = 5\text{ V}$ ,  
 $V_{G2S} = 4\text{ V}$ ,  $R_G = 82\text{ k}\Omega$   
 0.05 to 1.05 GHz (0.05 GHz step)

S21 Parameter vs. Frequency



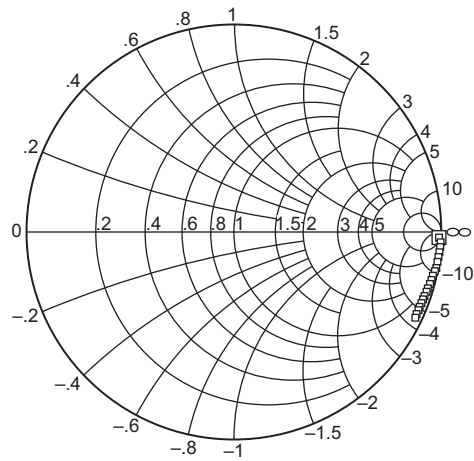
Test condition:  $V_{DS} = 5\text{ V}$ ,  $V_{G1} = 5\text{ V}$ ,  
 $V_{G2S} = 4\text{ V}$ ,  $R_G = 82\text{ k}\Omega$   
 0.05 to 1.05 GHz (0.05 GHz step)

S12 Parameter vs. Frequency



Test condition:  $V_{DS} = 5\text{ V}$ ,  $V_{G1} = 5\text{ V}$ ,  
 $V_{G2S} = 4\text{ V}$ ,  $R_G = 82\text{ k}\Omega$   
 0.05 to 1.05 GHz (0.05 GHz step)

S22 Parameter vs. Frequency



Test condition:  $V_{DS} = 5\text{ V}$ ,  $V_{G1} = 5\text{ V}$ ,  
 $V_{G2S} = 4\text{ V}$ ,  $R_G = 82\text{ k}\Omega$   
 0.05 to 1.05 GHz (0.05 GHz step)

## S parameter

## • FET1

(V<sub>DS</sub> = 5 V, V<sub>G1</sub> = 5 V, V<sub>G2S</sub> = 4 V, R<sub>G</sub> = 100 kΩ, Z<sub>o</sub> = 50 Ω)

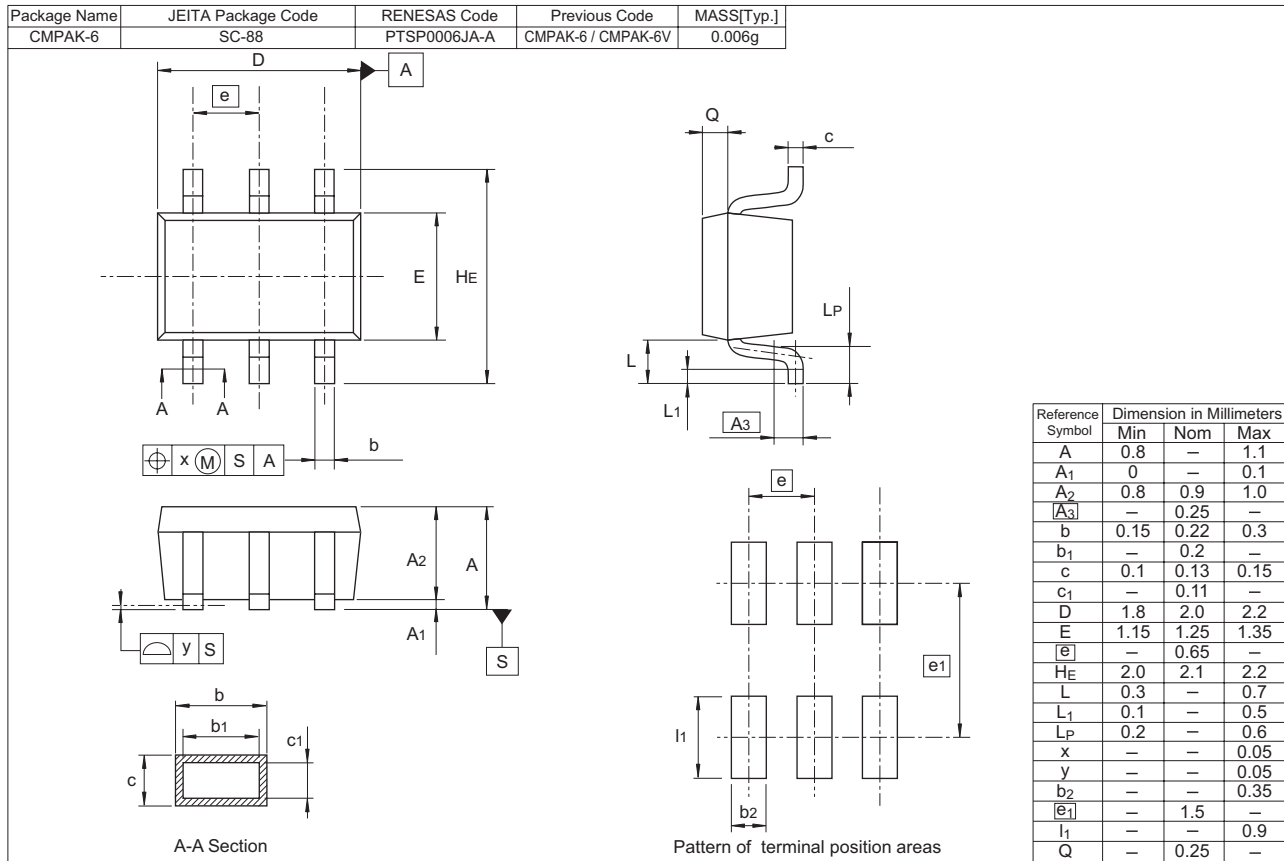
Freq. (MHz)	S11		S21		S12		S22	
	Mag	Deg	Mag	Deg	Mag	Deg	Mag	Deg
50	0.994	-4.3	2.97	175.6	0.001	74.4	0.999	-1.3
100	0.990	-8.8	2.97	171.1	0.002	89.6	0.998	-2.8
150	0.985	-13.1	2.97	166.7	0.002	81.5	0.997	-4.2
200	0.978	-17.6	2.97	162.2	0.003	81.6	0.995	-5.6
250	0.970	-22.2	2.97	157.8	0.004	77.8	0.993	-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<sub>DS</sub> = 5 V, V<sub>G1</sub> = 5 V, V<sub>G2S</sub> = 4 V, R<sub>G</sub> = 82 kΩ, Z<sub>o</sub> = 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



### Ordering Information

Part Name	Quantity	Shipping Container
TBB1012MRTL-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.

**Keep safety first in your circuit designs!**

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