



# NE662M04 / 2SC5508 JEITA Part No.

**Data Sheet** 

NPN SILICON RF TRANSISTOR FOR LOW-NOISE, HIGH-GAIN AMPLIFICATION FLAT-LEAD 4-PIN THIN-TYPE SUPER MINIMOLD (M04)

R09DS0055EJ0200 Rev.2.00 Mar 5, 2013

#### **FEATURES**

- Ideal for low-noise, high-gain amplification applications
- NF = 1.1 dB TYP.,  $G_a$  = 16 dB TYP. @  $V_{CE}$  = 2 V,  $I_C$  = 5 mA, f = 2 GHz
- Maximum available power gain: MAG = 19 dB TYP. @ V<sub>CE</sub> = 2 V, I<sub>C</sub> = 20 mA, f = 2 GHz
- $f_T = 25$  GHz technology adopted
- Flat-lead 4-pin thin-type super minimold (M04) package

#### ORDERING INFORMATION

Part Number	Order Number	Quantity	Package	Supplying Form	
NE662M04 2SC5508	NE662M04-A 2SC5508-A	50 pcs (Non reel)	Flat-lead 4-pin thin-type super	<ul><li>8 mm wide embossed taping</li><li>Pin 1 (Emitter), Pin 2 (Collector) face</li></ul>	
NE662M04-T2 2SC5508-T2	NE662M04-T2-A 2SC5508-T2-A	3 kpcs/reel	minimold (M04) (Pb-Free)	` ,	the perforation side of the tape
NE662M04-T2B 2SC5508-T2B	NE662M04-T2B-A 2SC5508-T2B-A	15 kpcs/reel			

Remark To order evaluation samples, please contact your nearby sales office.

The unit sample quantity is 50 pcs.

### ABSOLUTE MAXIMUM RATINGS ( $T_C = 25^{\circ}C$ )

Parameter	Symbol	Ratings	Unit
Collector to Base Voltage	$V_{CBO}$	15	V
Collector to Emitter Voltage	$V_{CEO}$	3.3	V
Emitter to Base Voltage	V <sub>EBO</sub>	1.5	V
Collector Current	Ic	35	mA
Total Power Dissipation	P <sub>tot</sub> Note	115	mW
Junction Temperature	Tj	150	°C
Storage Temperature	T <sub>stg</sub>	-65 to +150	°C

Note Free air.

#### THERMAL RESISTANCE

Parameter	Symbol	Ratings	Unit
Junction to Case Resistance	R <sub>th j-c</sub>	150	°C /W
Junction to Ambient Resistance	R <sub>th j-a</sub>	650	°C /W

#### **CAUTION**

Observe precautions when handling because these devices are sensitive to electrostatic discharge.

The mark <R> shows major revised points.

The revised points can be easily searched by copying an "<R>" in the PDF file and specifying it in the "Find what:" field.



### ELECTRICAL CHARACTERISTICS $(T_A = +25 \text{ °C})$

Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
DC Characteristics						
Collector Cut-off Current	I <sub>CBO</sub>	V <sub>CB</sub> = 5 V, I <sub>E</sub> = 0	_	_	200	nA
Emitter Cut-off Current	I <sub>EBO</sub>	V <sub>EB</sub> = 1 V, I <sub>C</sub> = 0	_	_	200	nA
DC Current Gain	h <sub>FE</sub> Note 1	V <sub>CE</sub> = 2 V, I <sub>C</sub> = 5 mA	50	70	100	_
RF Characteristics						
Gain Bandwidth Product	f <sub>T</sub>	V <sub>CE</sub> = 3 V, I <sub>C</sub> = 30 mA, f = 2 GHz	20	25	_	GHz
Insertion Power Gain	$ S_{21e} ^2$	V <sub>CE</sub> = 2 V, I <sub>C</sub> = 20 mA, f = 2 GHz	14	17	_	dB
Noise Figure	NF	$V_{CE} = 2 \text{ V}, I_{C} = 5 \text{ mA}, f = 2 \text{ GHz},$	_	1.1	1.5	dB
		$Z_{S} = Z_{opt}$				
Reverse Transfer Capacitance	C <sub>re</sub> Note 2	$V_{CB} = 2 \text{ V}, I_{E} = 0, f = 1 \text{ MHz}$	_	0.18	0.24	pF
Maximum Available Power Gain	MAG Note 3	$V_{CE} = 2 \text{ V}, I_{C} = 20 \text{ mA}, f = 2 \text{ GHz}$	-	19	-	dB
Maximum Stable Power Gain	MSG Note 4	V <sub>CE</sub> = 2 V, I <sub>C</sub> = 20 mA, f = 2 GHz	_	20	_	dB
Gain 1 dB Compression Output	P <sub>O (1 dB)</sub>	$V_{CE} = 2 \text{ V}, I_{C} = 20 \text{ mA}^{\text{Note 5}}, f = 2 \text{ GHz}$	_	11	_	dBm
Power						
3rd Order Intermodulation	OIP <sub>3</sub>	$V_{CE} = 2 \text{ V}, I_{C} = 20 \text{ mA}^{\text{Note 5}}, f = 2 \text{ GHz}$	_	22	_	dBm
Distortion Output Intercept Point						

**Notes 1.** Pulse measurement: PW  $\leq$  350  $\mu$ s, Duty Cycle  $\leq$  2%

2. Collector to base capacitance when the emitter grounded

3. MAG = 
$$\left| \frac{S_{21}}{S_{12}} \right| (K - \sqrt{(K^2 - 1)})$$

**4.** MSG = 
$$\frac{S_{21}}{S_{12}}$$

5. Collector current when  $P_{O\,(1\,dB)}$  is output

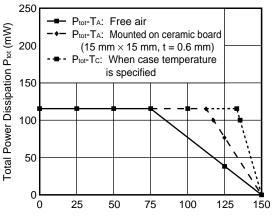
### **h**<sub>FE</sub> CLASSIFICATION

Rank	FB/YFB
Marking	T79
h <sub>FE</sub> Value	50 to 100

### TYPICAL CHARACTERISTICS (T<sub>A</sub> = +25°C, unless otherwise specified)

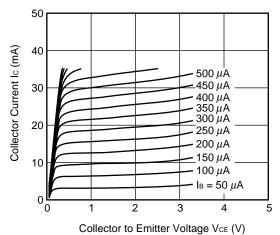
#### Thermal/DC Characteristics

## TOTAL POWER DISSIPATION vs. AMBIENT TEMPERATURE, CASE TEMPERATURE



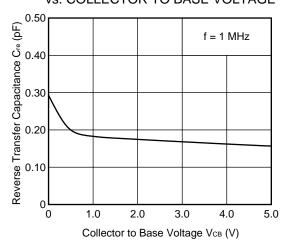
Ambient Temperature TA (°C), Case Temperature Tc (°C)

## COLLECTOR CURRENT vs. COLLECTOR TO EMITTER VOLTAGE



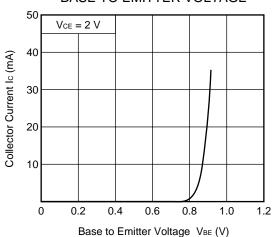
#### Capacitance/f<sub>T</sub> Characteristics

# REVERSE TRANSFER CAPACITANCE vs. COLLECTOR TO BASE VOLTAGE

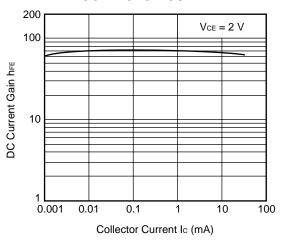


Remark The graphs indicate nominal characteristics.

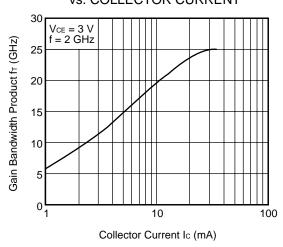
## COLLECTOR CURRENT vs. BASE TO EMITTER VOLTAGE



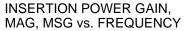
## DC CURRENT GAIN vs. COLLECTOR CURRENT

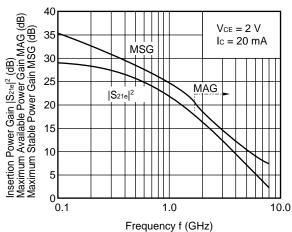


# GAIN BANDWIDTH PRODUCT vs. COLLECTOR CURRENT

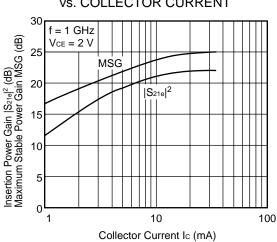


#### **Gain Characteristics**

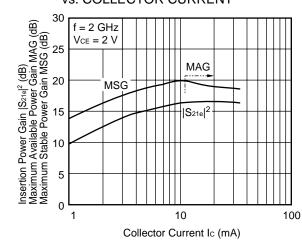




## INSERTION POWER GAIN, MSG vs. COLLECTOR CURRENT

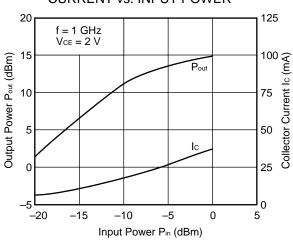


## INSERTION POWER GAIN, MAG, MSG vs. COLLECTOR CURRENT

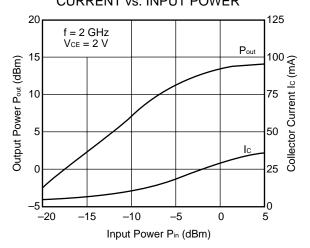


#### **Output Characteristics**

# OUTPUT POWER, COLLECTOR CURRENT vs. INPUT POWER

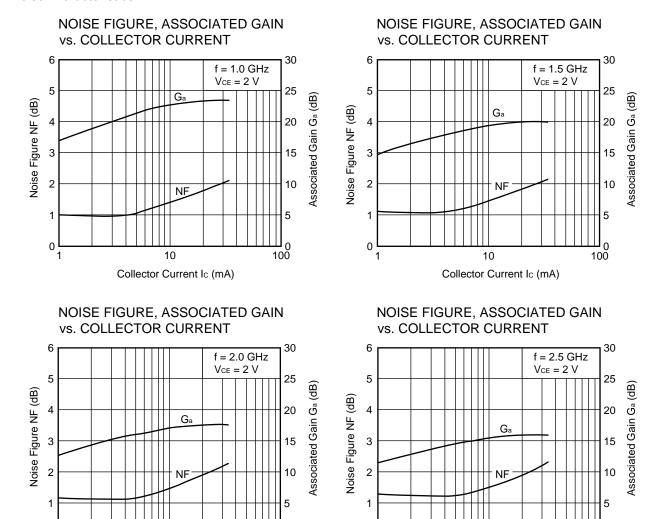


OUTPUT POWER, COLLECTOR CURRENT vs. INPUT POWER



Remark The graphs indicate nominal characteristics.

#### **Noise Characteristics**



Remark The graphs indicate nominal characteristics.

Collector Current Ic (mA)

#### <r> S-PARAMETERS

0

S-parameters and noise parameters are provided on our web site in a form (S2P) that enables direct import of the parameters to microwave circuit simulators without the need for keyboard inputs.

0

10

Collector Current Ic (mA)

0

100

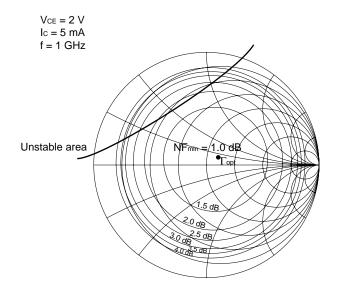
Click here to download S-parameters.

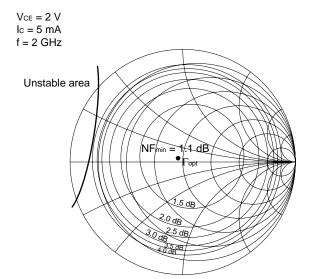
[Products] → [RF Devices] → [Device Parameters]

URL http://www.renesas.com/products/microwave/

100

### **EQUAL NF CIRCLE**





### **NOISE PARAMETERS**

 $V_{CE}$  = 2 V,  $I_{C}$  = 3 mA

f	NF <sub>min</sub>	Ga	$G_a$ $\Gamma_{opt}$		D=/50
(GHz)	(dB)	(dB)	MAG.	ANG.	Rn/50
0.8	0.78	21.4	0.26	31.7	0.17
0.9	0.80	20.7	0.26	32.7	0.17
1.0	0.82	20.0	0.26	34.7	0.17
1.5	0.93	17.0	0.23	57.0	0.16
1.8	1.00	15.6	0.20	78.0	0.14
1.9	1.02	15.2	0.19	86.0	0.14
2.0	1.04	14.8	0.19	94.2	0.13
2.5	1.15	13.5	0.20	138.3	0.10

 $V_{CE}$  = 2 V,  $I_{C}$  = 5 mA

f	NF <sub>min</sub>	Ga	Γα	opt	D=/50
(GHz)	(dB)	(dB)	MAG.	ANG.	Rn/50
8.0	0.93	22.5	0.12	28.1	0.15
0.9	0.94	21.8	0.12	28.8	0.15
1.0	0.96	21.1	0.12	31.7	0.15
1.5	1.03	18.1	0.09	71.1	0.14
1.8	1.07	16.7	0.08	106.2	0.13
1.9	1.09	16.3	0.08	118.5	0.13
2.0	1.10	15.9	0.08	130.5	0.12
2.5	1.17	14.3	0.14	-179.7	0.11

 $V_{CE}$  = 2 V,  $I_{C}$  = 10 mA

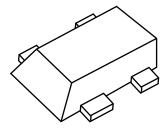
f	NF <sub>min</sub>	Ga	Γ	$\Gamma_{opt}$	
(GHz)	(dB)	(dB)	MAG.	ANG.	Rn/50
8.0	1.28	23.7	0.07	-159.4	0.13
0.9	1.29	23.0	0.07	-157.5	0.13
1.0	1.30	22.3	0.08	-155.7	0.13
1.5	1.37	19.3	0.13	-149.2	0.13
1.8	1.41	17.8	0.16	-146.1	0.13
1.9	1.43	17.3	0.17	-145.0	0.13
2.0	1.44	16.9	0.19	-143.9	0.13
2.5	1.51	15.3	0.25	-136.7	0.13

 $V_{CE}$  = 2 V,  $I_{C}$  = 20 mA

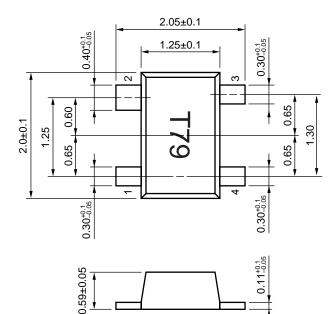
Ī	f	NF <sub>min</sub>	Ga	$\Gamma_{opt}$		Rn/50
	(GHz)	(dB)	(dB)	MAG.	ANG.	KII/30
	0.8	1.59	24.5	0.26	-158.1	0.12
	0.9	1.61	23.7	0.26	-155.5	0.13
	1.0	1.63	23.0	0.27	-153.1	0.13
	1.5	1.72	19.9	0.30	-142.6	0.14
	1.8	1.78	18.3	0.33	-137.3	0.15
	1.9	1.79	17.9	0.34	-135.7	0.06
	2.0	1.81	17.5	0.35	-134.1	0.16
	2.5	1.90	15.8	0.40	-126.5	0.18

### <R> PACKAGE DIMENSIONS

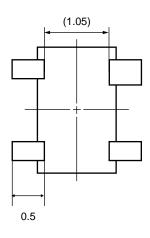
### FLAT-LEAD 4-PIN THIN-TYPE SUPER MINIMOLD (M04) PACKAGE (UNIT: mm)



(Top View)



### (Bottom View)



#### PIN CONNECTIONS

- 1. Emitter
- 2. Collector
- 3. Emitter
- 4. Base

**Revision History** 

### NE662M04 / 2SC5508 Data Sheet

		Description			
Rev.	Date	Page	Summary		
1.00	Sep 9, 2004	-	First edition issued		
2.00	Mar 5, 2013	Throughout	Throughout Renesas format is applied to this data sheet.		
		p.1	p.1 ORDERING INFORMATION is modified.		
		p.5	Up to date S-PARAMETERS.		
		p.8	Added a drawing backside to PACKAGE DIMENSIONS.		

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