

# DATA SHEET

# NEC

## NPN SILICON GERMANIUM RF TRANSISTOR

# NESG3033M14

### NPN SiGe RF TRANSISTOR FOR LOW NOISE, HIGH-GAIN AMPLIFICATION 4-PIN LEAD-LESS MINIMOLD (M14, 1208 PKG)

#### FEATURES

- The device is an ideal choice for low noise, high-gain amplification  
NF = 0.6 dB TYP. @  $V_{CE} = 2\text{ V}$ ,  $I_C = 6\text{ mA}$ ,  $f = 2.0\text{ GHz}$
- Maximum stable power gain: MSG = 20.5 dB TYP. @  $V_{CE} = 2\text{ V}$ ,  $I_C = 15\text{ mA}$ ,  $f = 2.0\text{ GHz}$
- SiGe HBT technology (UHS3) adopted:  $f_{max} = 110\text{ GHz}$
- This product is improvement of ESD of NESG3032M14.
- 4-pin lead-less minimold (M14, 1208 PKG)

#### ORDERING INFORMATION

Part Number	Order Number	Package	Quantity	Supplying Form
NESG3033M14	NESG3033M14-A	4-pin lead-less minimold (M14, 1208 PKG) (Pb-Free) <sup>Note</sup>	50 pcs (Non reel)	<ul style="list-style-type: none"> <li>8 mm wide embossed taping</li> <li>Pin 1 (Collector), Pin 4 (Emitter) face the perforation side of the tape</li> </ul>
NESG3033M14-T3	NESG3033M14-T3-A		10 kpcs/reel	

**Note** With regards to terminal solder (the solder contains lead) plated products (conventionally plated), contact your nearby sales office.

**Remark** To order evaluation samples, contact your nearby sales office.  
Unit sample quantity is 50 pcs.

#### ABSOLUTE MAXIMUM RATINGS ( $T_A = +25^\circ\text{C}$ )

Parameter	Symbol	Ratings	Unit
Collector to Base Voltage	$V_{CBO}$ <sup>Note 1</sup>	5.0	V
Collector to Emitter Voltage	$V_{CEO}$	4.3	V
Base Current	$I_B$ <sup>Note 1</sup>	12	mA
Collector Current	$I_C$	35	mA
Total Power Dissipation	$P_{tot}$ <sup>Note 2</sup>	150	mW
Junction Temperature	$T_j$	150	°C
Storage Temperature	$T_{stg}$	-65 to +150	°C

**Notes 1.**  $V_{CBO}$  and  $I_B$  are limited by the permissible current of the protection element.

**2.** Mounted on  $1.08\text{ cm}^2 \times 1.0\text{ mm}$  (t) glass epoxy PWB

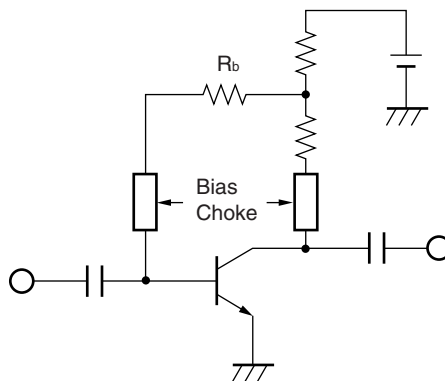
**Caution** Observe precautions when handling because these devices are sensitive to electrostatic discharge.

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**RECOMMENDED OPERATING RANGE ( $T_A = +25^\circ\text{C}$ )**

Parameter	Symbol	MIN.	TYP.	MAX.	Unit
Input Power	$P_{in}$	—	—	0	dBm
Base Feedback Resister	$R_b$	—	—	100	$k\Omega$

**Remark** When the voltage return bias circuit like the figure below is used, a current increase is seen because the ESD protection element is turned on when recommended range of motion in the above table is exceeded. However, there is no influence of reliability, including deterioration.



**ELECTRICAL CHARACTERISTICS (T<sub>A</sub> = +25°C)**

Parameter	Symbol	Test 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 mA	–	–	100	nA
Emitter Cut-off Current	I <sub>EBO</sub>	V <sub>EB</sub> = 1 V, I <sub>C</sub> = 0 mA	–	–	100	nA
DC Current Gain	h <sub>FE</sub> <sup>Note 1</sup>	V <sub>CE</sub> = 2 V, I <sub>C</sub> = 6 mA	220	300	380	–
RF Characteristics						
Insertion Power Gain	S <sub>21e</sub>   <sup>2</sup>	V <sub>CE</sub> = 2 V, I <sub>C</sub> = 15 mA, f = 2.0 GHz	15.0	17.5	–	dB
Noise Figure	NF	V <sub>CE</sub> = 2 V, I <sub>C</sub> = 6 mA, f = 2.0 GHz, Z <sub>S</sub> = Z <sub>Sopt</sub> , Z <sub>L</sub> = Z <sub>Lopt</sub>	–	0.60	0.85	dB
Associated Gain	G <sub>a</sub>	V <sub>CE</sub> = 2 V, I <sub>C</sub> = 6 mA, f = 2.0 GHz, Z <sub>S</sub> = Z <sub>Sopt</sub> , Z <sub>L</sub> = Z <sub>Lopt</sub>	–	17.5	–	dB
Reverse Transfer Capacitance	C <sub>re</sub> <sup>Note 2</sup>	V <sub>CB</sub> = 2 V, I <sub>E</sub> = 0 mA, f = 1 MHz	–	0.15	0.25	pF
Maximum Stable Power Gain	MSG <sup>Note 3</sup>	V <sub>CE</sub> = 2 V, I <sub>C</sub> = 15 mA, f = 2.0 GHz	17.5	20.5	–	dB
Gain 1 dB Compression Output Power	P <sub>O</sub> (1 dB)	V <sub>CE</sub> = 3 V, I <sub>C</sub> (set) = 20 mA, f = 2.0 GHz, Z <sub>S</sub> = Z <sub>Sopt</sub> , Z <sub>L</sub> = Z <sub>Lopt</sub>	–	12.5	–	dBm
3rd Order Intermodulation Distortion Output Intercept Point	OIP <sub>3</sub>	V <sub>CE</sub> = 3 V, I <sub>C</sub> (set) = 20 mA, f = 2.0 GHz, Z <sub>S</sub> = Z <sub>Sopt</sub> , Z <sub>L</sub> = Z <sub>Lopt</sub>	–	24.0	–	dBm

- Notes** 1. Pulse measurement: PW ≤ 350 μs, Duty Cycle ≤ 2%  
2. Collector to base capacitance when the emitter grounded

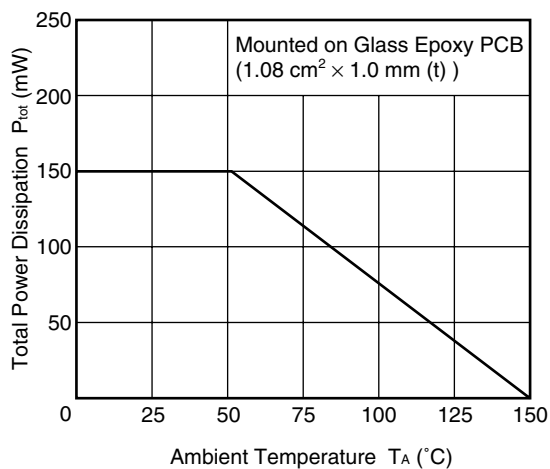
3.  $MSG = \left| \frac{S_{21}}{S_{12}} \right|$

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

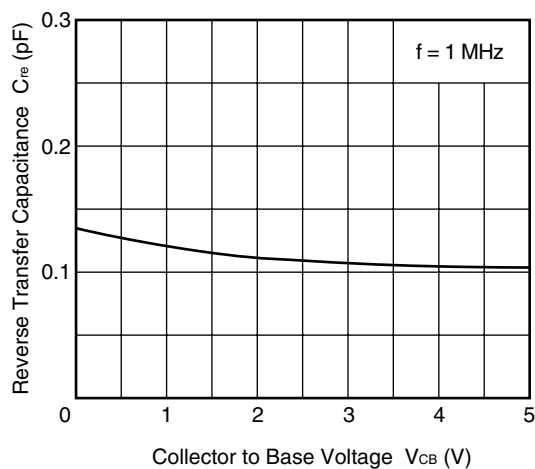
Rank	FB
Marking	zL
h <sub>FE</sub> Value	220 to 380

<R> **TYPICAL CHARACTERISTICS ( $T_A = +25^{\circ}\text{C}$ , unless otherwise specified)**

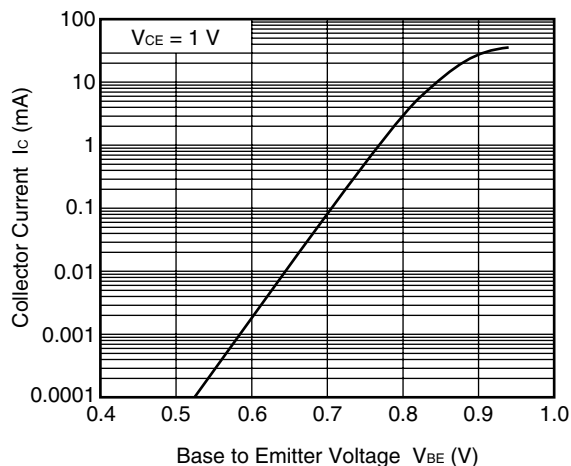
**TOTAL POWER DISSIPATION  
vs. AMBIENT TEMPERATURE**



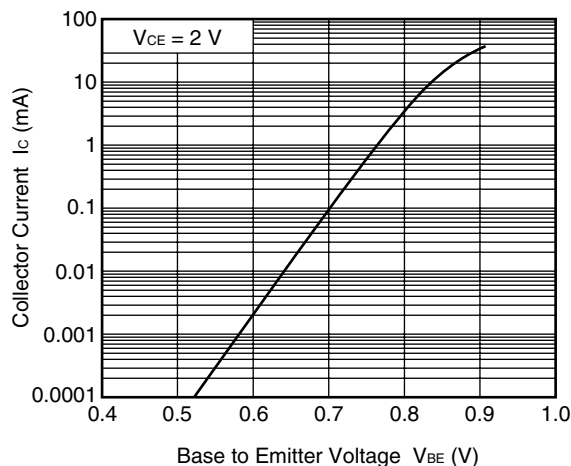
**REVERSE TRANSFER CAPACITANCE  
vs. COLLECTOR TO BASE VOLTAGE**



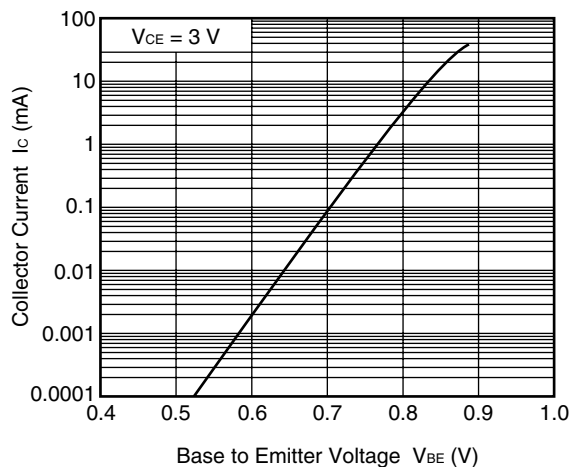
**COLLECTOR CURRENT vs.  
BASE TO EMITTER VOLTAGE**



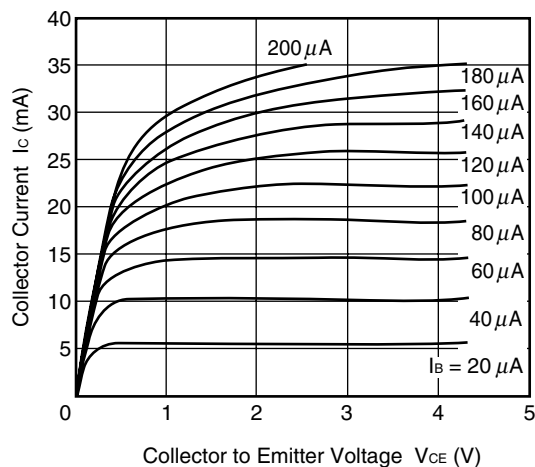
**COLLECTOR CURRENT vs.  
BASE TO EMITTER VOLTAGE**



**COLLECTOR CURRENT vs.  
BASE TO EMITTER VOLTAGE**

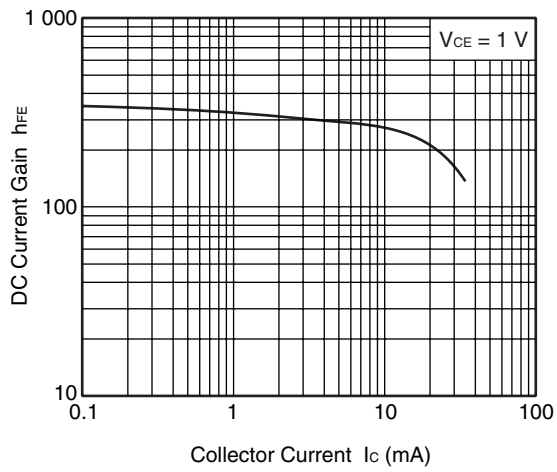


**COLLECTOR CURRENT vs.  
COLLECTOR TO EMITTER VOLTAGE**

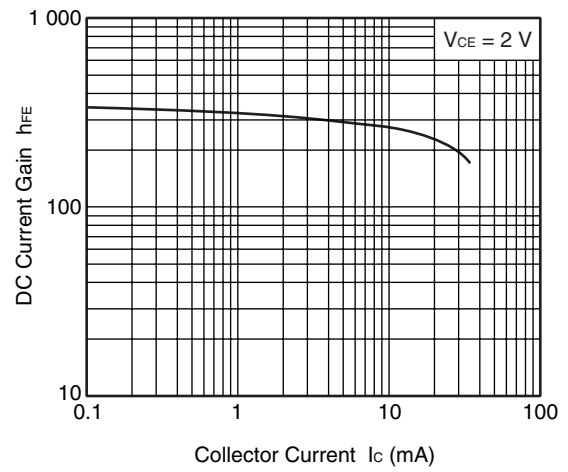


**Remark** The graphs indicate nominal characteristics.

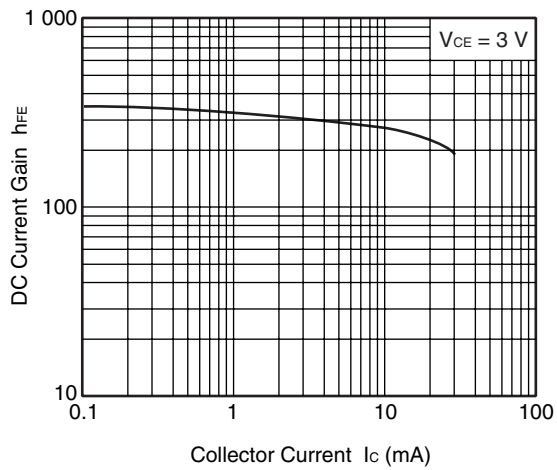
DC CURRENT GAIN vs.  
COLLECTOR CURRENT



DC CURRENT GAIN vs.  
COLLECTOR CURRENT

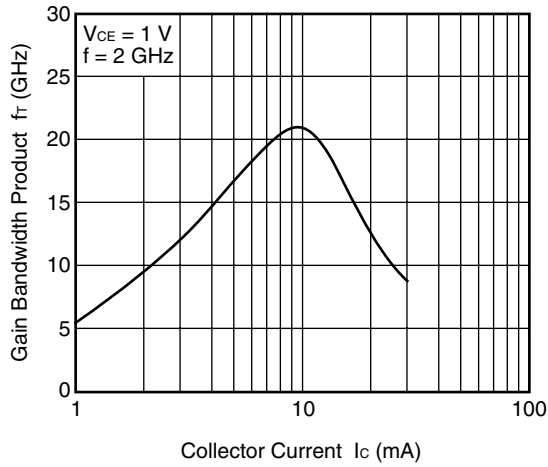


DC CURRENT GAIN vs.  
COLLECTOR CURRENT

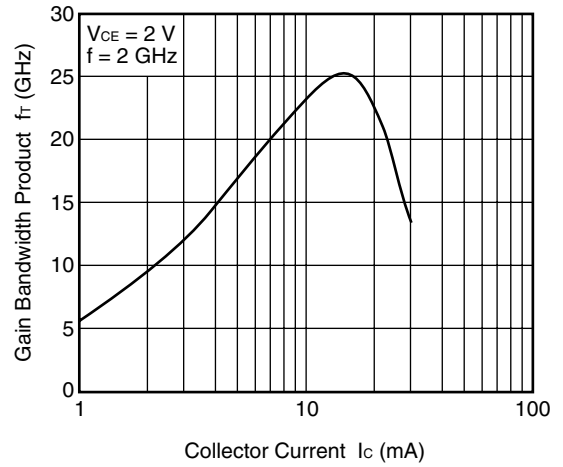


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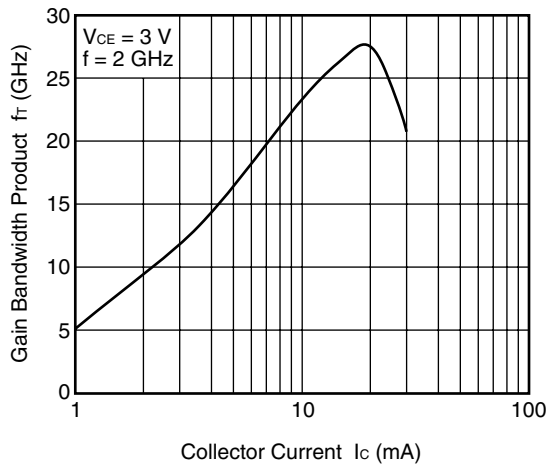
GAIN BANDWIDTH PRODUCT  
vs. COLLECTOR CURRENT



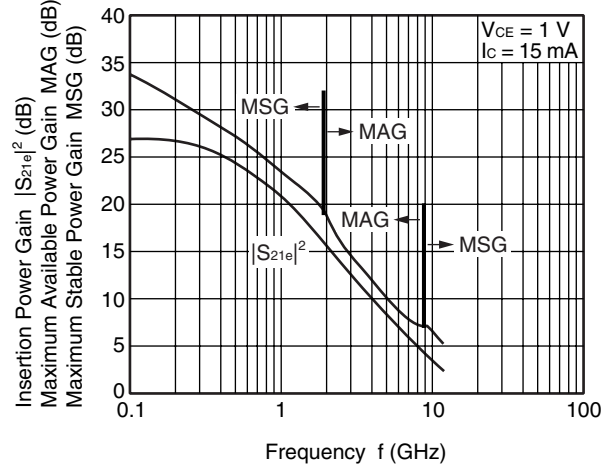
GAIN BANDWIDTH PRODUCT  
vs. COLLECTOR CURRENT



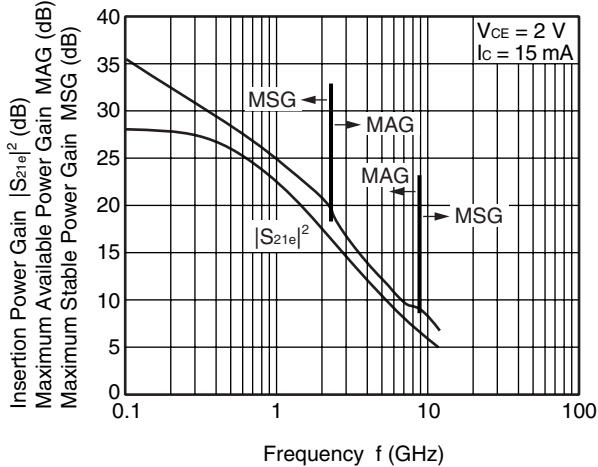
GAIN BANDWIDTH PRODUCT  
vs. COLLECTOR CURRENT



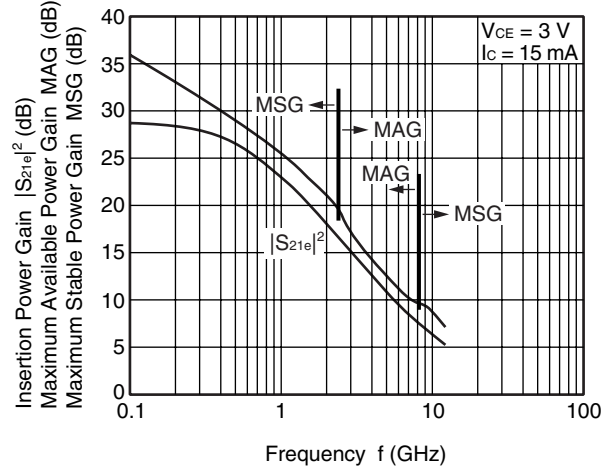
INSERTION POWER GAIN,  
MAG, MSG vs. FREQUENCY



INSERTION POWER GAIN,  
MAG, MSG vs. FREQUENCY

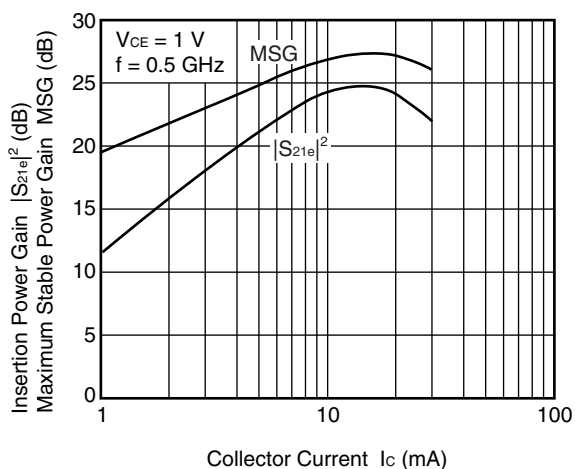


INSERTION POWER GAIN,  
MAG, MSG vs. FREQUENCY

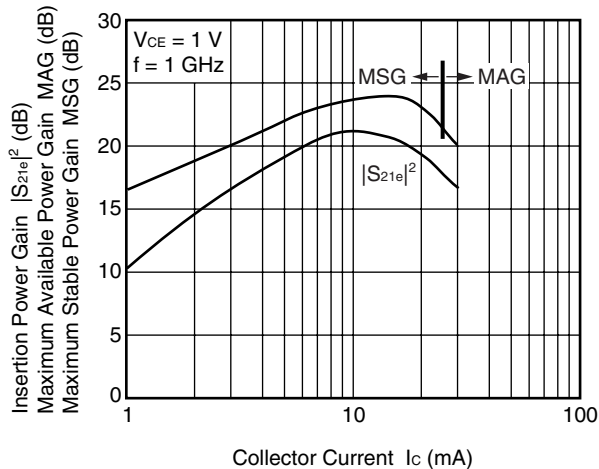


**Remark** The graphs indicate nominal characteristics.

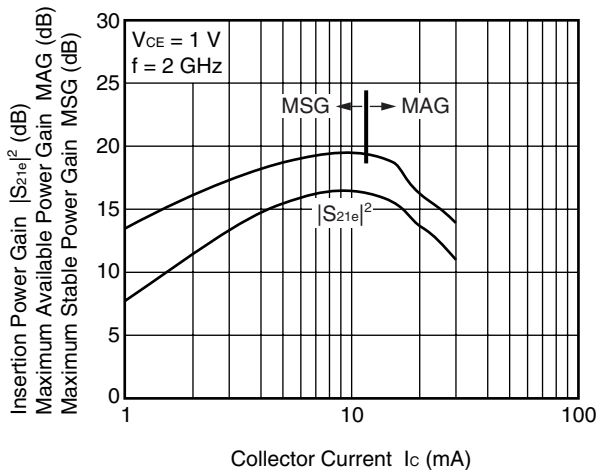
INSERTION POWER GAIN, MSG  
vs. COLLECTOR CURRENT



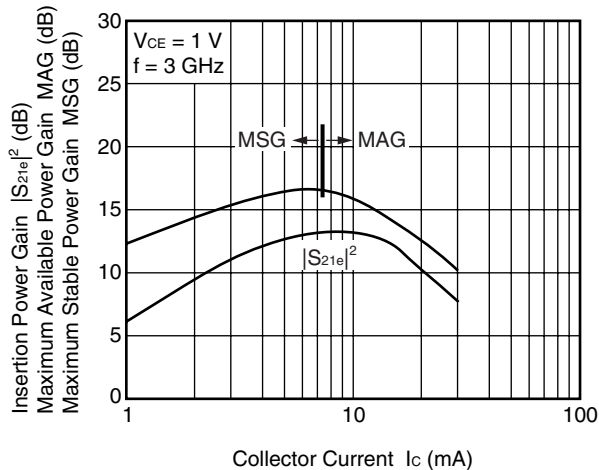
INSERTION POWER GAIN, MAG, MSG  
vs. COLLECTOR CURRENT



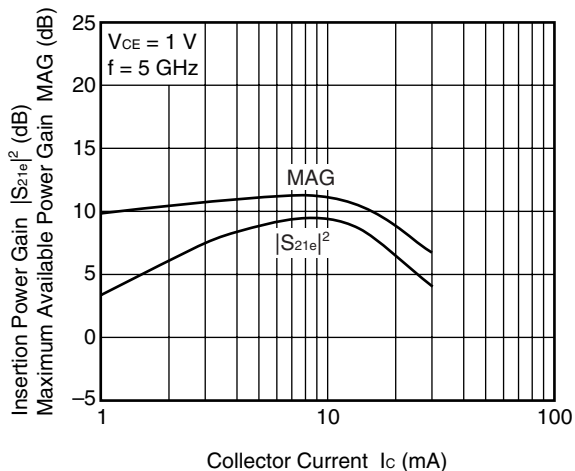
INSERTION POWER GAIN, MAG, MSG  
vs. COLLECTOR CURRENT



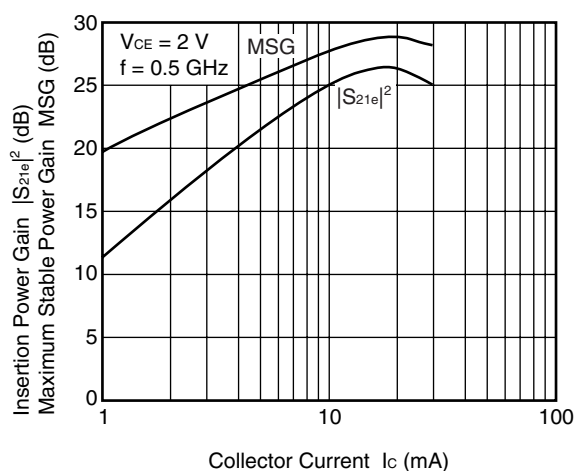
INSERTION POWER GAIN, MAG, MSG  
vs. COLLECTOR CURRENT



INSERTION POWER GAIN, MAG  
vs. COLLECTOR CURRENT

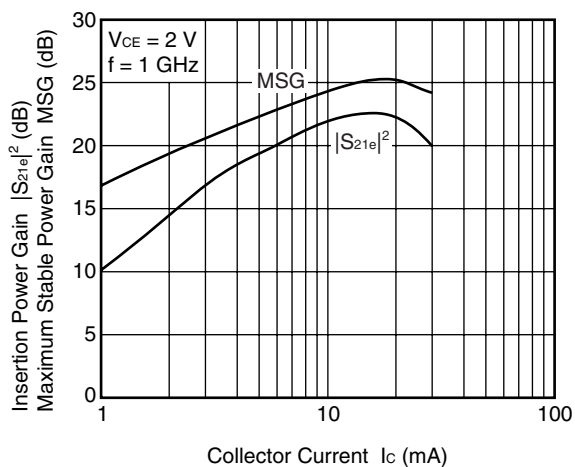


INSERTION POWER GAIN, MSG  
vs. COLLECTOR CURRENT

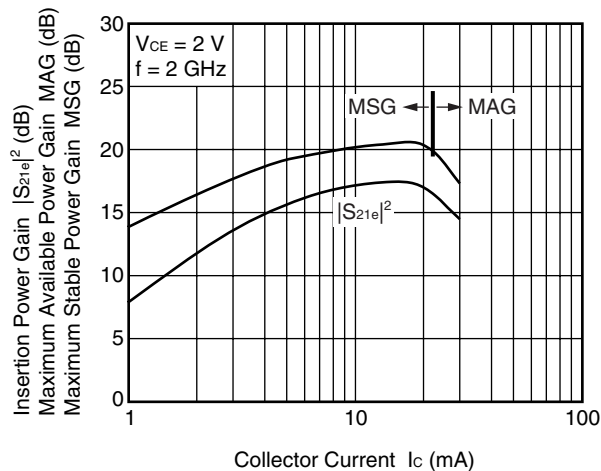


**Remark** The graphs indicate nominal characteristics.

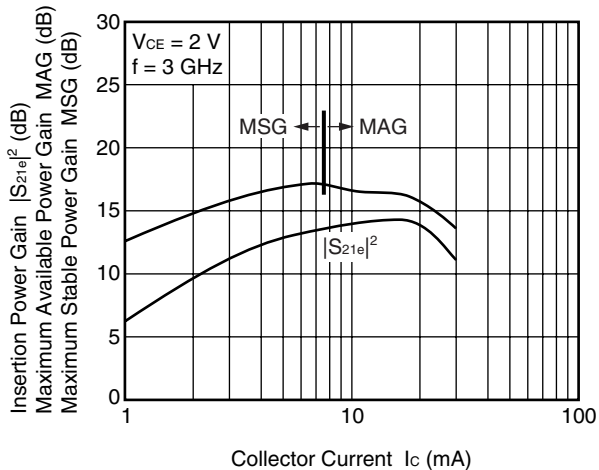
INSERTION POWER GAIN, MSG  
vs. COLLECTOR CURRENT



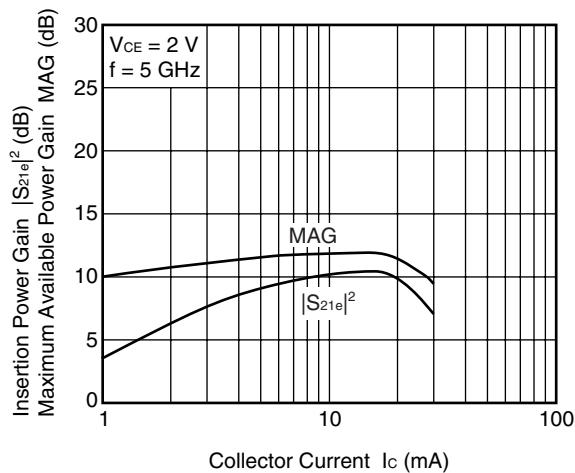
INSERTION POWER GAIN, MAG, MSG  
vs. COLLECTOR CURRENT



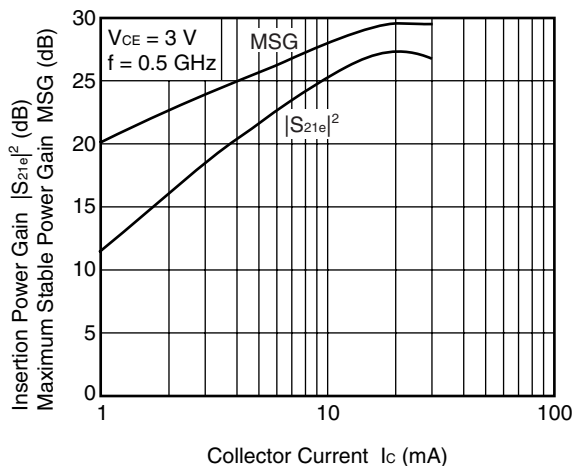
INSERTION POWER GAIN, MAG, MSG  
vs. COLLECTOR CURRENT



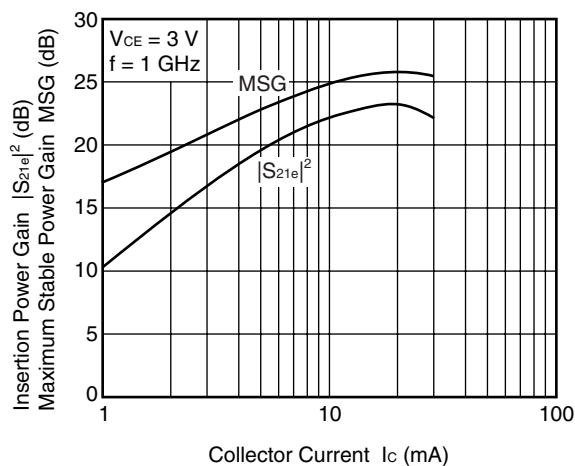
INSERTION POWER GAIN, MAG  
vs. COLLECTOR CURRENT



INSERTION POWER GAIN, MSG  
vs. COLLECTOR CURRENT



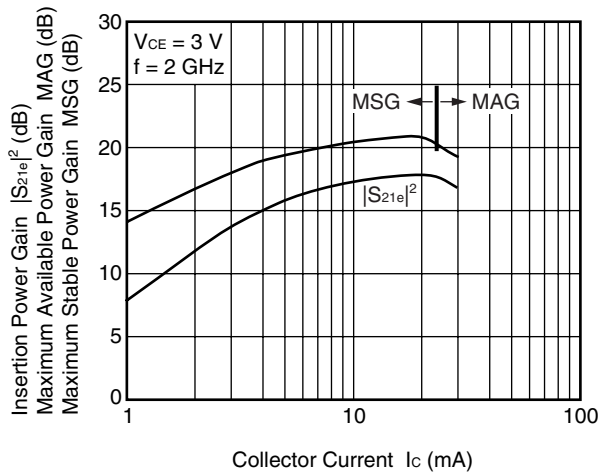
INSERTION POWER GAIN, MSG  
vs. COLLECTOR CURRENT



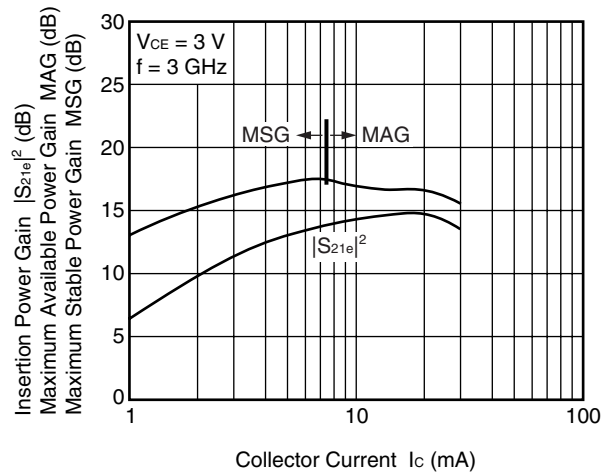
**Remark** The graphs indicate nominal characteristics.



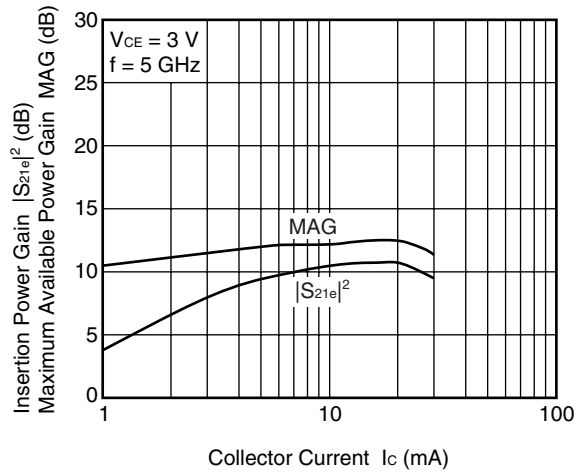
INSERTION POWER GAIN, MAG, MSG  
vs. COLLECTOR CURRENT



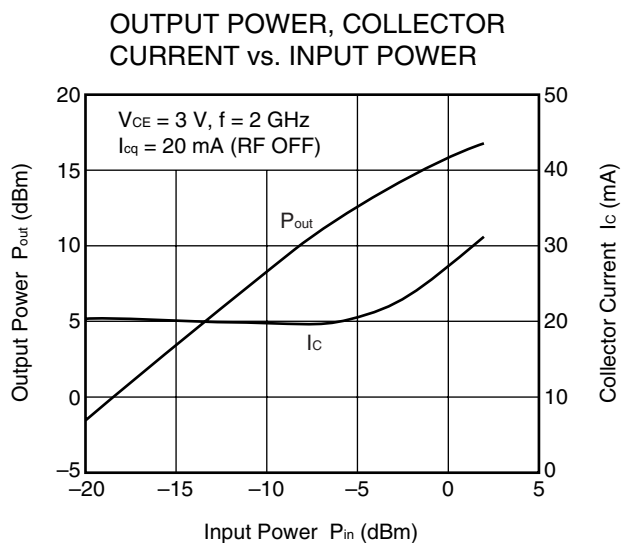
INSERTION POWER GAIN, MAG, MSG  
vs. COLLECTOR CURRENT



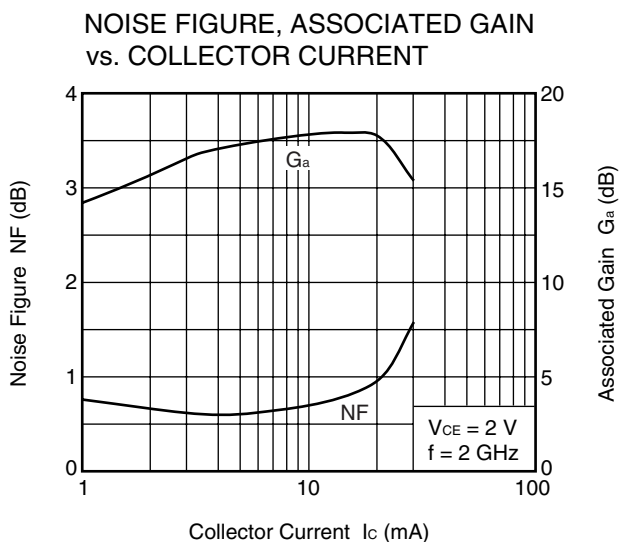
INSERTION POWER GAIN, MAG  
vs. COLLECTOR CURRENT



**Remark** The graphs indicate nominal characteristics.



Measuring method : Measured at power matched with external sleeve tuner. (The load resistance is not inserted between the base DC power supply and Bias Tee.)



**Remark** The graphs indicate nominal characteristics.

## <R> S-PARAMETERS

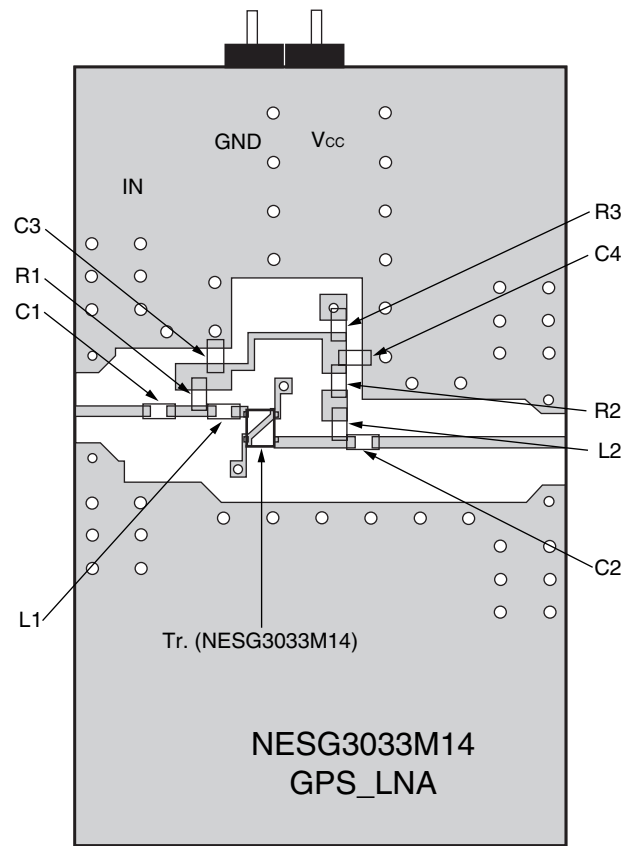
S-parameters/Noise parameters are provided on our web site in a form (S2P) that enables direct import to a microwave circuit simulator without keyboard input.

Click here to download S-parameters.

[RF and Microwave] → [Device Parameters]

URL <http://www.ncsd.necel.com/microwave/index.html>

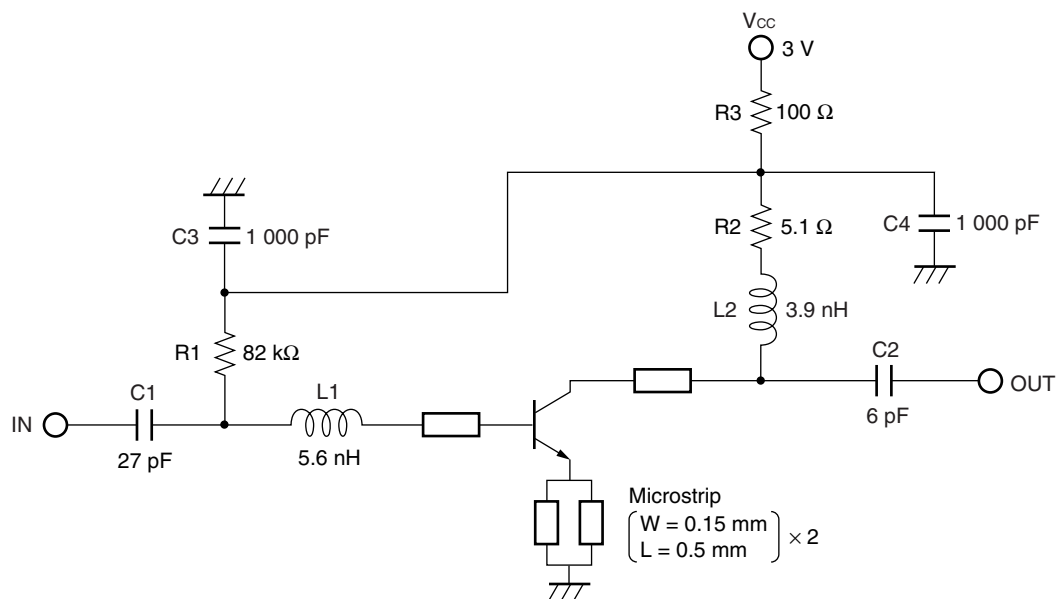
<R> EVALUATION CIRCUIT EXAMPLE (f = 1.575 GHz LNA)



**Notes**

1. 15 × 24 mm, t = 0.2 mm double sided copper clad glass epoxy PWB.
2. Au plated on pattern
3. ○ : Through holes

<R> EVALUATION CIRCUIT (f = 1.575 GHz LNA)



The application circuits and their parameters are for reference only and are not intended for use in actual design-ins.

<R> COMPONENT LIST

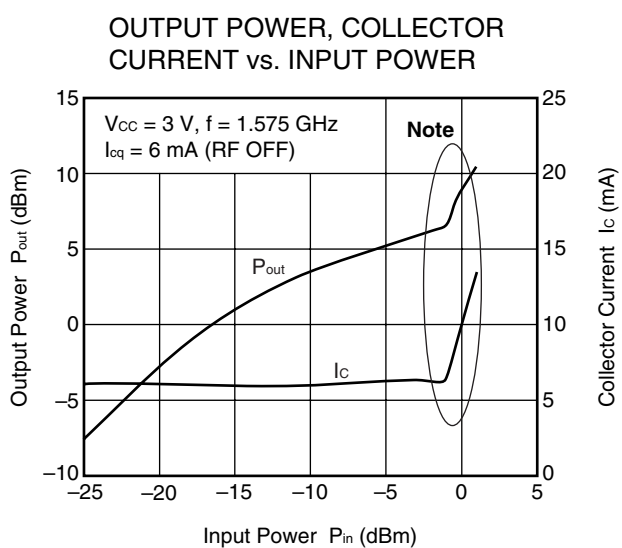
Symbol	Parts	Part Number	Maker	Value
C1	Chip Capacitor	GRM1552C1H270JZ01	Murata	27 pF
C2	Chip Capacitor	GRM1552C1H6R0JZ01	Murata	6 pF
C3, C4	Chip Capacitor	GRM155B11H102KA01	Murata	1 000 pF
L1	Chip Inductor	AML1005H5N6STS	FDK	5.6 nH
L2	Chip Inductor	AML1005H3N9STS	FDK	3.9 nH
R1	Chip Resistor	MCR01MZPJ823	ROHM	82 kΩ
R2	Chip Resistor	MCR01MZPJ5R1	ROHM	5.1 Ω
R3	Chip Resistor	MCR01MZPJ101	ROHM	100 Ω

<R> EXAMPLE OF CHARACTERISTICS FOR 1.575 GHz LNA EVALUATION BOARD

ELECTRICAL CHARACTERISTICS ( $T_A = +25^\circ\text{C}$ ,  $V_{CC} = 3\text{ V}$ ,  $I_C = 6.1\text{ mA}$ ,  $f = 1.575\text{ GHz}$ )

Parameter	Symbol	Value	Unit
Noise Figure	NF	0.65	dB
Gain	$G_a$	17.4	dB
Input Return Loss	$RL_{in}$	10.1	dB
Output Return Loss	$RL_{out}$	14.4	dB
Gain 1 dB Compression Output Power	$P_O (1\text{ dB})$	0.7	dBm

TYPICAL CHARACTERISTICS ( $T_A = +25^\circ\text{C}$ , unless otherwise specified)

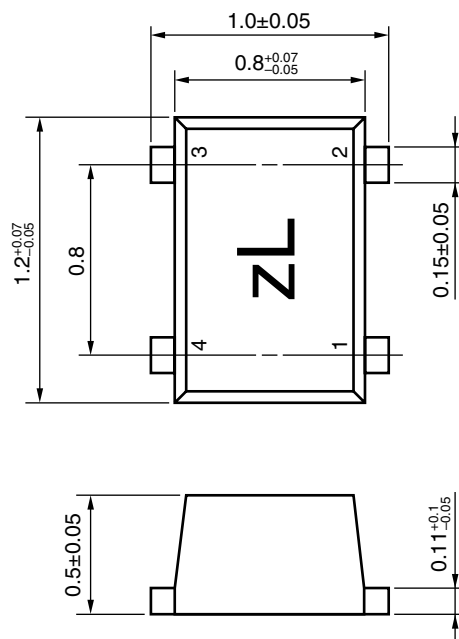


**Note** A current increase is seen because the ESD protection element is turned on. However, there is no influence of deterioration etc. on reliability.

**Remark** The graph indicates nominal characteristics.

# PACKAGE DIMENSIONS

## 4-PIN LEAD-LESS MINIMOLD (M14, 1208 PKG) (UNIT: mm)



## PIN CONNECTIONS

1. Collector
2. Emitter
3. Base
4. NC (Connected with Pin 2) <sup>Note</sup>

<R> **Note** A NC pin is Non-connection in the mold package (When NC-pin is open state, It will get an influences of floating capacitance. Therefore, we recommend connect to NC pin and Emitter pin).

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