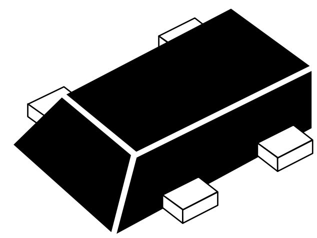
# NEC's NPN SiGe HIGH FREQUENCY TRANSISTOR

# NESG2101M05

## FEATURES

- **HIGH BREAKDOWN VOLTAGE SiGe TECHNOLOGY**
  $V_{CEO}$ = 5 V (Absolute Maximum)
- **HIGH OUTPUT POWER:**
  $P_{1dB}$ = 21 dBm at 2 GHz
- **LOW NOISE FIGURE:**
  NF = 0.9 dB at 2 GHz
- **HIGH MAXIMUM STABLE POWER GAIN:**
  MSG = 17 dB at 2 GHz
- **LOW PROFILE M05 PACKAGE:**
  SOT-343 footprint, with a height of only 0.59 mm
  Flat lead style for better RF performance



M05

## DESCRIPTION

NEC's NESG2101M05 is fabricated using NEC's high voltage Silicon Germanium process (UHS2-HV), and is designed for a wide range of applications including low noise amplifiers, medium power amplifiers, and oscillators

NEC's low profile, flat lead style M05 Package provides high frequency performance for compact wireless designs.

## ELECTRICAL CHARACTERISTICS ($T_A$ = 25°C)

| | | PART NUMBER<br>PACKAGE OUTLINE | NESG2101M05<br>M05 | | | |
|---|---|---|---|---|---|---|
| | SYMBOLS | PARAMETERS AND CONDITIONS | UNITS | MIN | TYP | MAX |
| RF | $P_{1dB}$ | Output Power at 1 dB Compression Point<br>$V_{CE}$ = 3.6 V, $I_{CQ}$ = 10 mA, f = 2 GHz | dBm | | 21 | |
| RF | $G_L$ | Linear Gain, $V_{CE}$ = 3.6 V, $I_{CQ}$ = 10 mA, f = 2 GHz | dB | | 15 | |
| RF | NF | Noise Figure at $V_{CE}$ = 2 V, $I_C$ = 10 mA, f = 2 GHz,<br>$Z_S = Z_{SOPT}$, $Z_L = Z_{LOPT}$ | dB | | 0.9 | 1.2 |
| RF | $G_a$ | Associated Gain at $V_{CE}$ = 2 V, $I_C$ = 10 mA, f = 2 GHz,<br>$Z_S = Z_{SOPT}$, $Z_L = Z_{LOPT}$ | dB | 11.0 | 13.0 | |
| RF | NF | Noise Figure at $V_{CE}$ = 2 V, $I_C$ = 7mA, f = 1 GHz,<br>$Z_S = Z_{SOPT}$, $Z_L = Z_{LOPT}$ | dB | | 0.6 | |
| RF | $G_a$ | Associated Gain at $V_{CE}$ = 2 V, $I_C$ = 7 mA, f = 1 GHz,<br>$Z_S = Z_{SOPT}$, $Z_L = Z_{LOPT}$ | dB | | 19.0 | |
| RF | MSG | Maximum Stable Gain[1] at $V_{CE}$ = 3 V, $I_C$ = 50 mA, f = 2 GHz | dB | 14.5 | 17.0 | |
| RF | $\lvert S_{21E}\rvert^2$ | Insertion Power Gain at $V_{CE}$ = 3 V, $I_C$ = 50 mA, f = 2 GHz | dB | 11.5 | 13.5 | |
| RF | $f_T$ | Gain Bandwidth Product at $V_{CE}$ = 3 V, $I_C$ = 50 mA, f = 2 GHz | GHz | 14 | 17 | |
| RF | $C_{re}$ | Reverse Transfer Capacitance[2] at $V_{CB}$ = 2 V, $I_C$ = 0 mA, f = 1 MHz | pF | | 0.4 | 0.5 |
| DC | $I_{CBO}$ | Collector Cutoff Current at $V_{CB}$ = 5V, $I_E$ = 0 | nA | | | 100 |
| DC | $I_{EBO}$ | Emitter Cutoff Current at $V_{EB}$ = 1 V, $I_C$ = 0 | nA | | | 100 |
| DC | $h_{FE}$ | DC Current Gain[3] at $V_{CE}$ = 2 V, $I_C$ = 15 mA | | 130 | 190 | 260 |

Notes:
1. MSG = $\left|\frac{S_{21}}{S_{12}}\right|$
2. Collector to base capacitance is measured by capacitance meter (automatic balance bridge method) when emitter pin is connected to the guard pin.
3. Pulsed measurement, pulse width ≤ 350 μs, duty cycle ≤ 2 %.

## ABSOLUTE MAXIMUM RATINGS[1] ($T_A$ = 25°C)

| SYMBOLS | PARAMETERS | UNITS | RATINGS |
|---|---|---|---|
| $V_{CBO}$ | Collector to Base Voltage | V | 13.0 |
| $V_{CEO}$ | Collector to Emitter Voltage | V | 5.0 |
| $V_{EBO}$ | Emitter to Base Voltage | V | 1.5 |
| $I_C$ | Collector Current | mA | 100 |
| $P_T$[2] | Total Power Dissipation | mW | 500 |
| $T_J$ | Junction Temperature | °C | 150 |
| $T_{STG}$ | Storage Temperature | °C | -65 to +150 |

Note:
1. Operation in excess of any one of these parameters may result in permanent damage.
2. Mounted on 38 x 38 x 0.4 mm (t) glass epoxy substrate

## THERMAL RESISTANCE

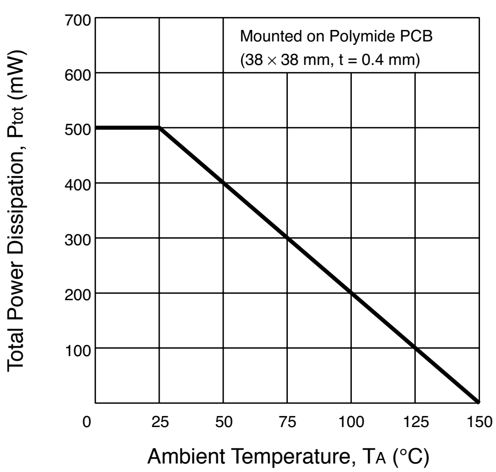
| SYMBOLS | PARAMETERS | UNITS | RATINGS |
|---|---|---|---|
| $R_{th\ j\text{-}c}$ | Junction to Case Resistance | °C/W | TBD |

## ORDERING INFORMATION

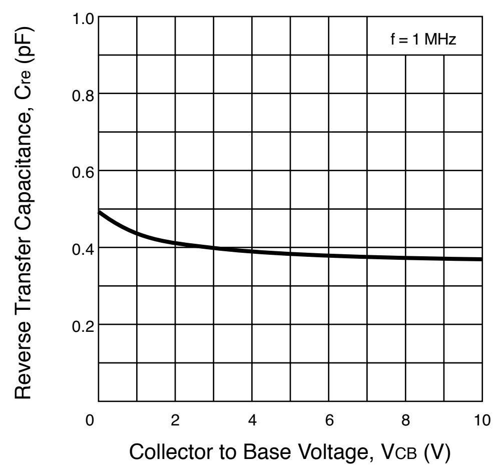
| PART NUMBER | QUANTITY | SUPPLYING FORM |
|---|---|---|
| NESG2101M05-T1-A | 3 kpcs/reel | • Pin 3 (Collector), Pin 4 (Emitter) face the perforation side of the tape<br>• 8 mm wide embossed taping |

## TYPICAL PERFORMANCE CURVES ($T_A$ = 25°C)

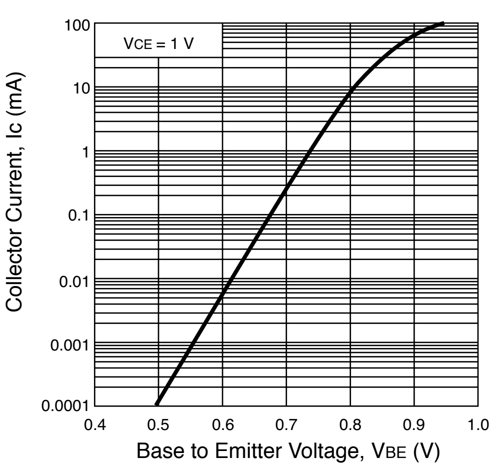
**TOTAL POWER DISSIPATION vs. AMBIENT TEMPERATURE**




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




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

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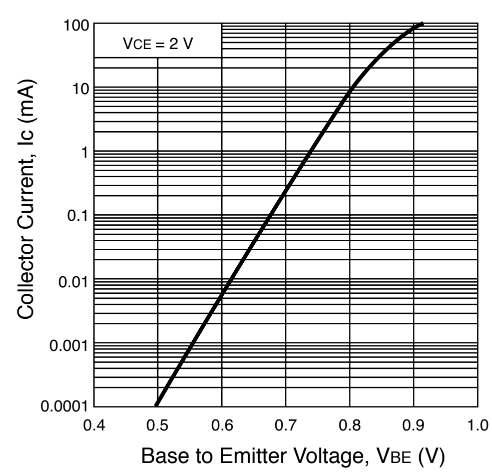

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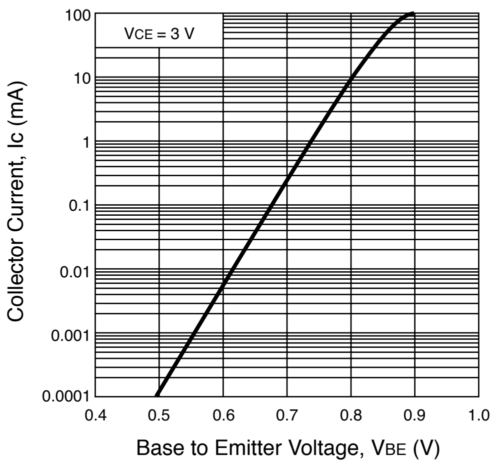
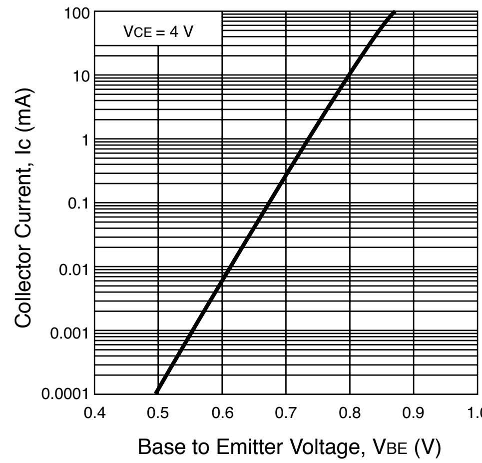
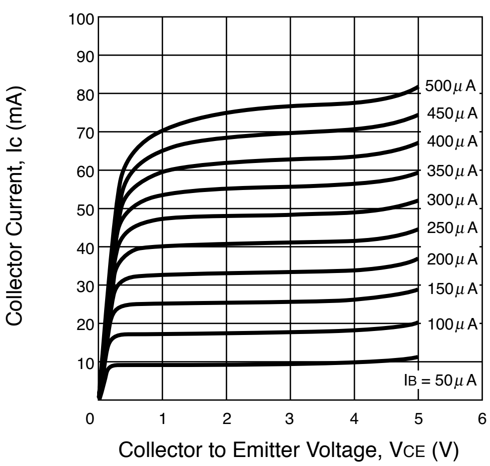


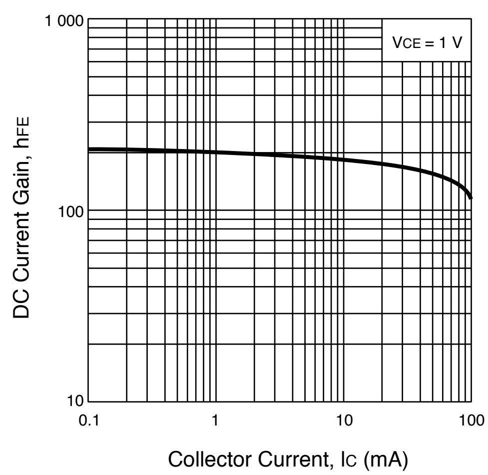

**COLLECTOR CURRENT vs. BASE TO EMITTER VOLTAGE**




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




**DC CURRENT GAIN vs. COLLECTOR CURRENT**

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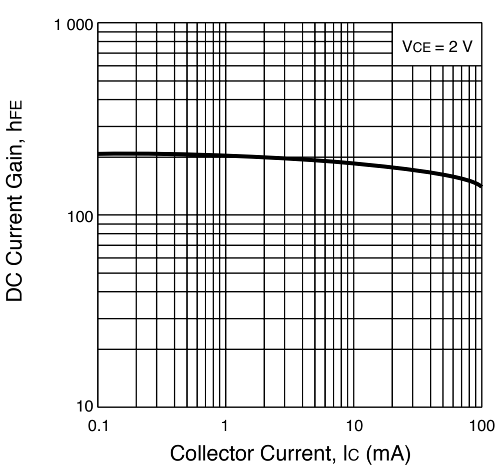


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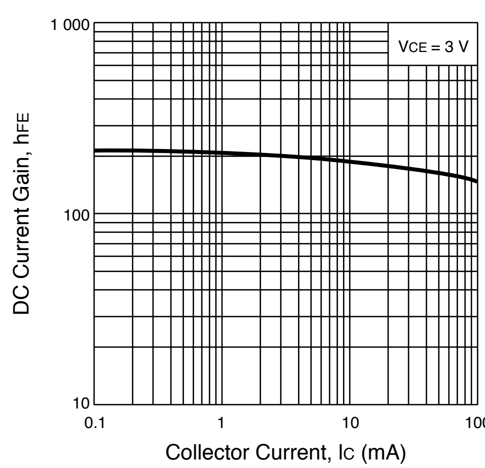
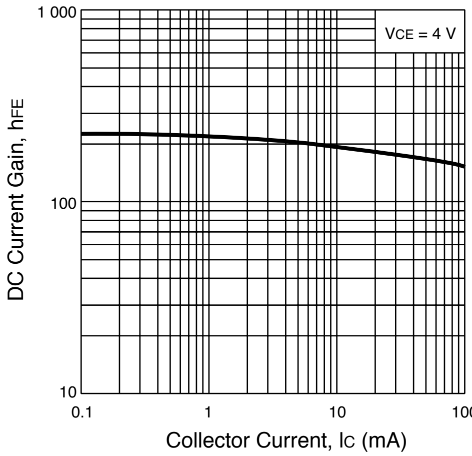
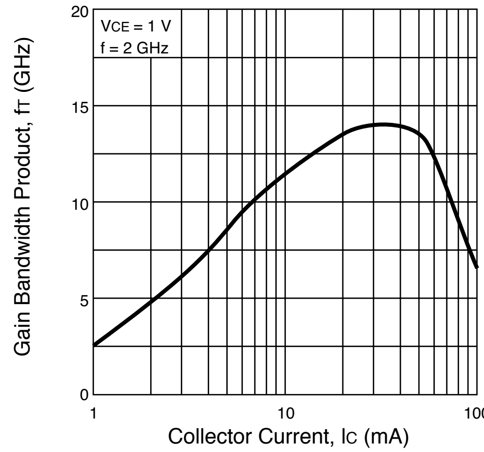


## TYPICAL PERFORMANCE CURVES (TA = 25°C)

**DC CURRENT GAIN vs. COLLECTOR CURRENT**




**GAIN BANDWIDTH PRODUCT vs. COLLECTOR CURRENT**

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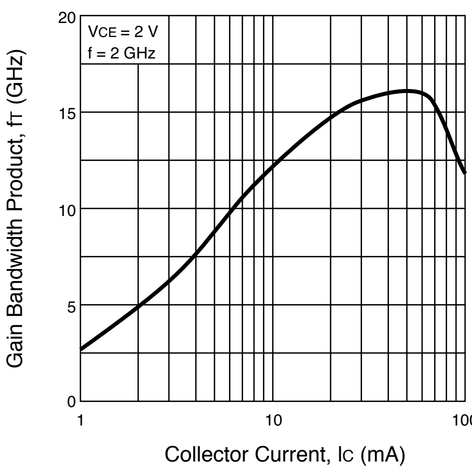


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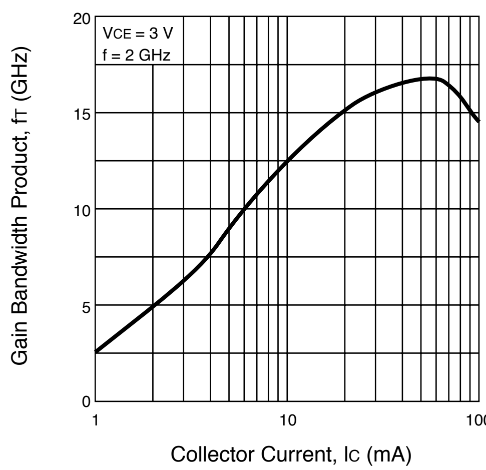
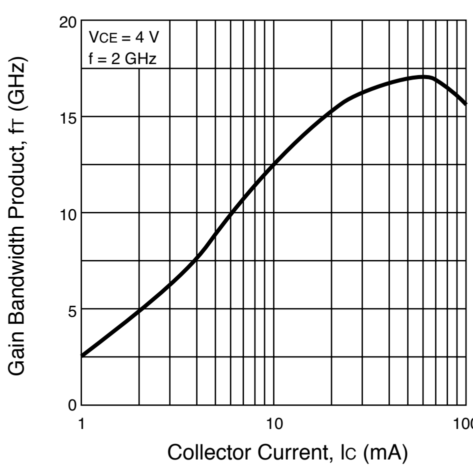
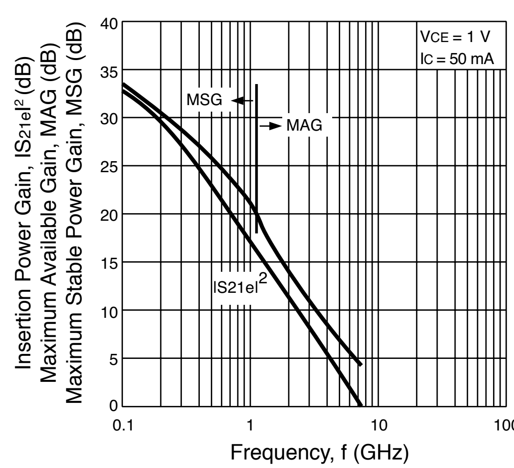



**GAIN BANDWIDTH PRODUCT vs. COLLECTOR CURRENT**




**INSERTION POWER GAIN, MAG, MSG vs. FREQUENCY**



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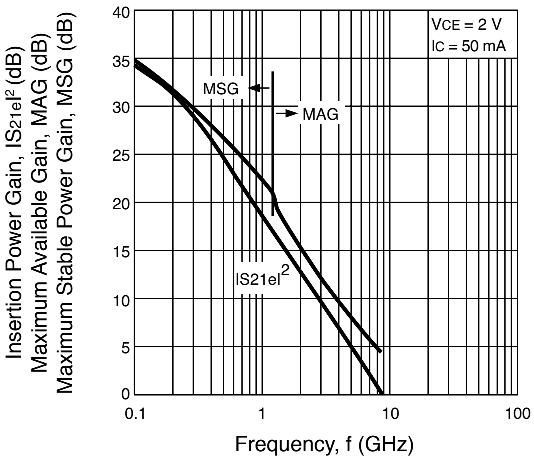


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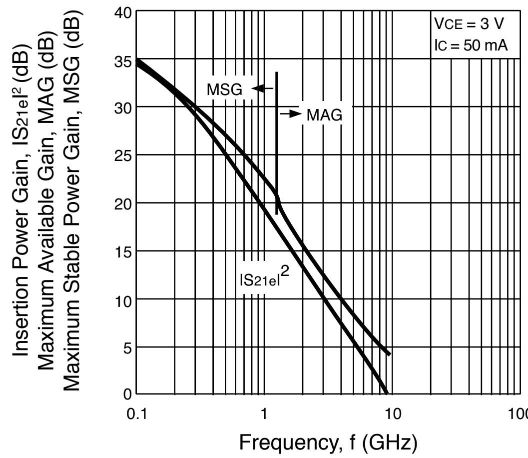


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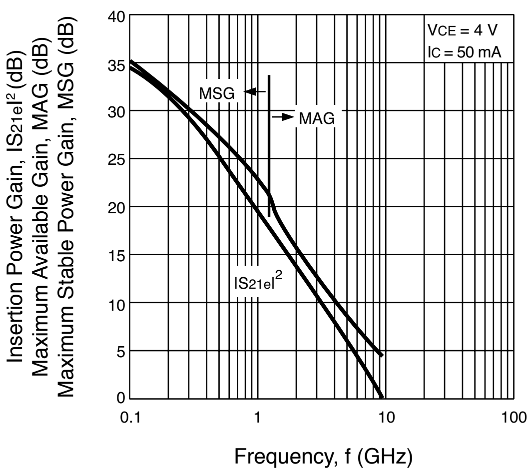


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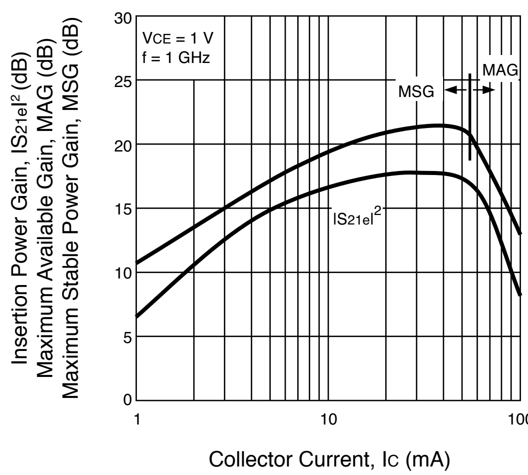


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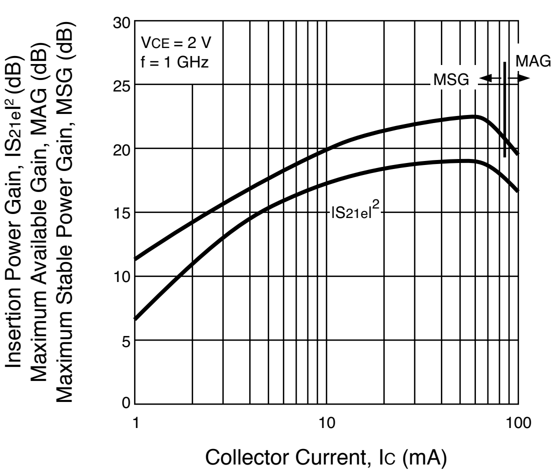


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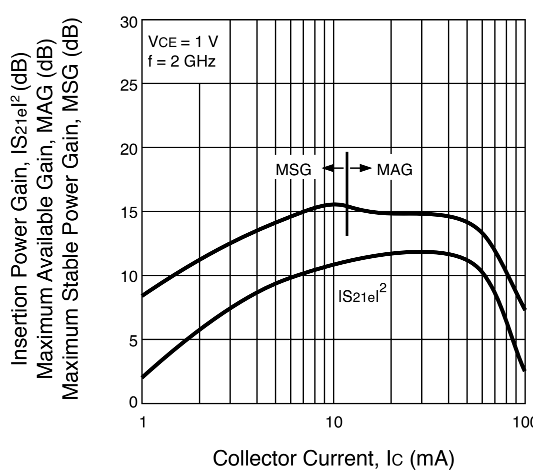

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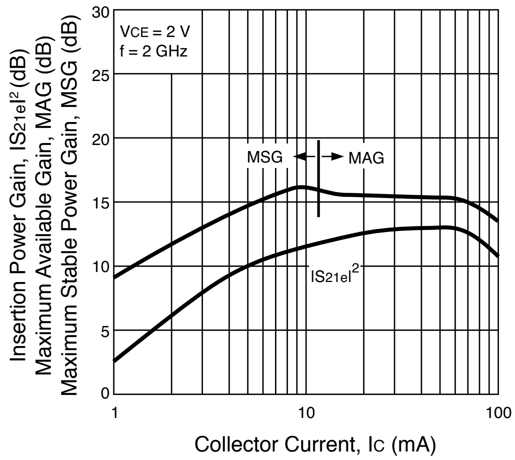


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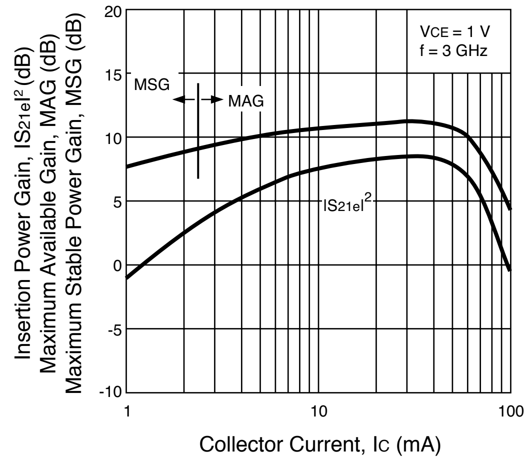


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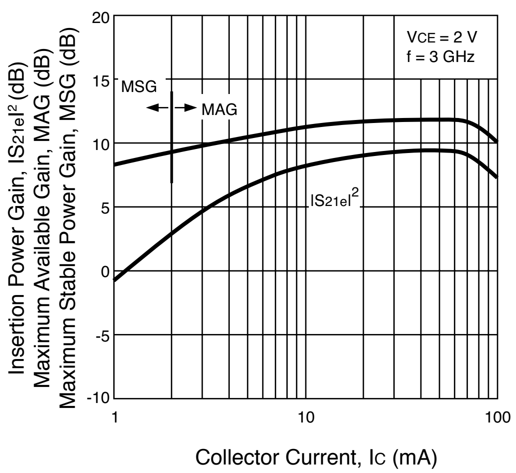


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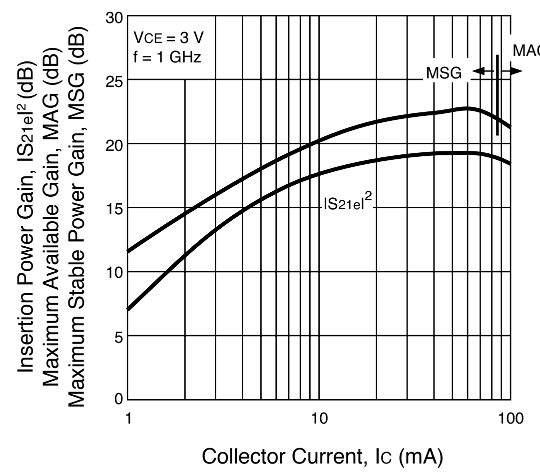


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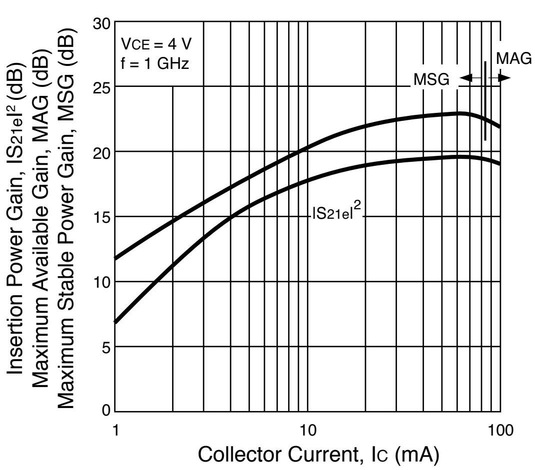
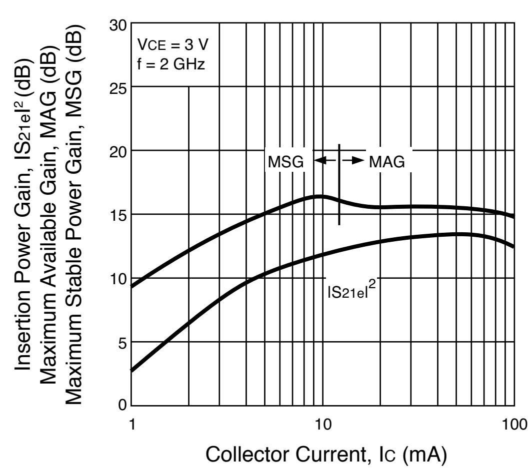



**OUTPUT POWER, COLLECTOR CURRENT vs. INPUT POWER**



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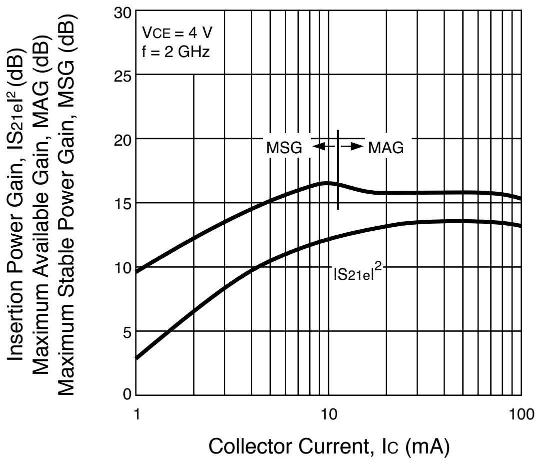


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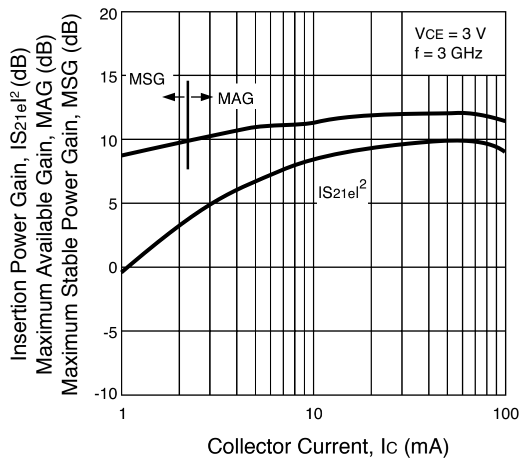


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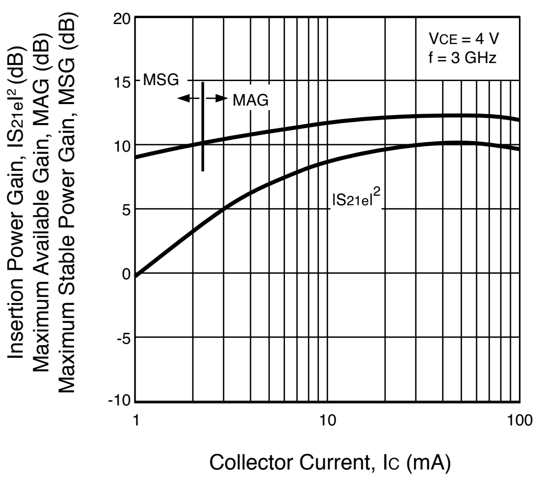
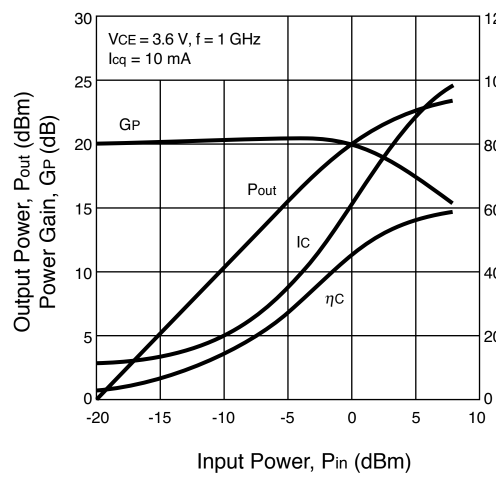



**OUTPUT POWER, POWER GAIN, COLLECTOR CURRENT, COLLECTOR EFFICIENCY vs. INPUT POWER**

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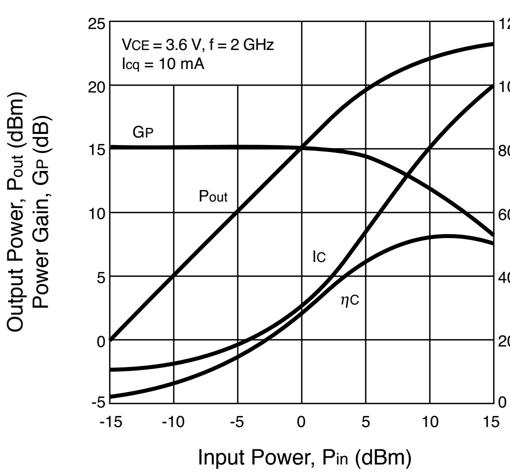


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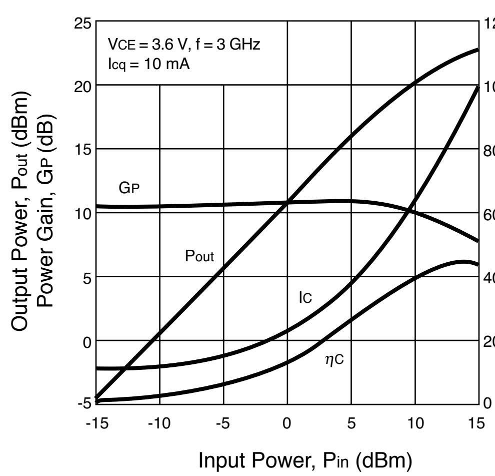
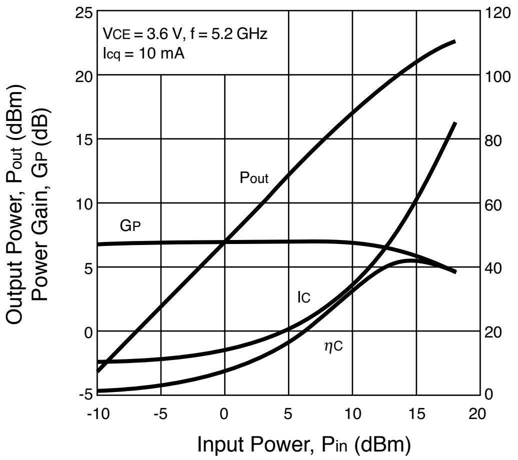
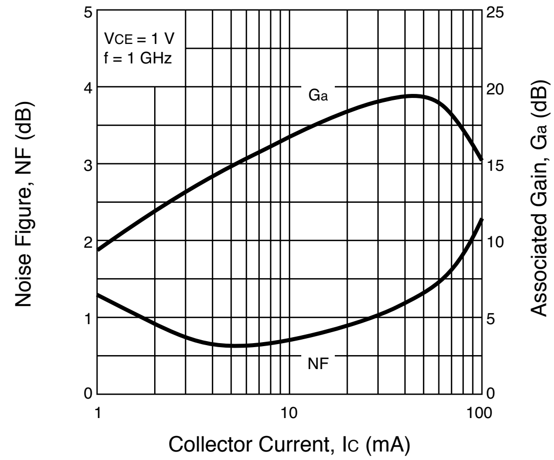


## TYPICAL PERFORMANCE CURVES ($T_A = 25°C$)

**OUTPUT POWER, POWER GAIN, COLLECTOR CURRENT, COLLECTOR EFFICIENCY vs. INPUT POWER**




**NOISE FIGURE, ASSOCIATED GAIN vs. COLLECTOR CURRENT**

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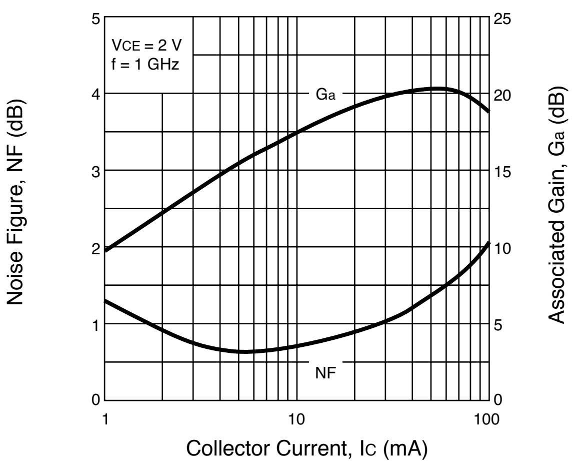


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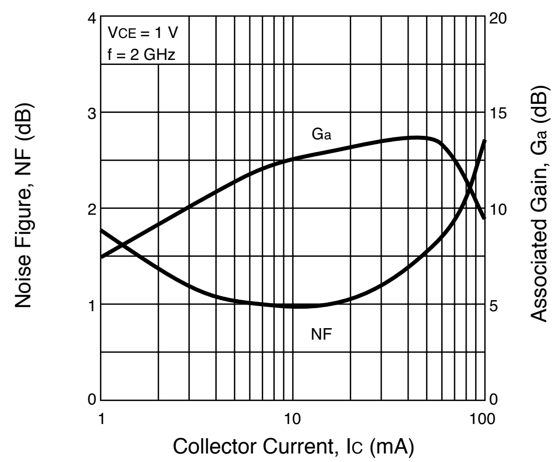


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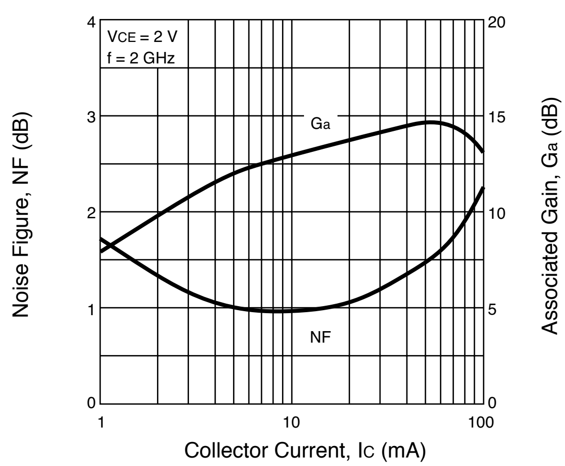


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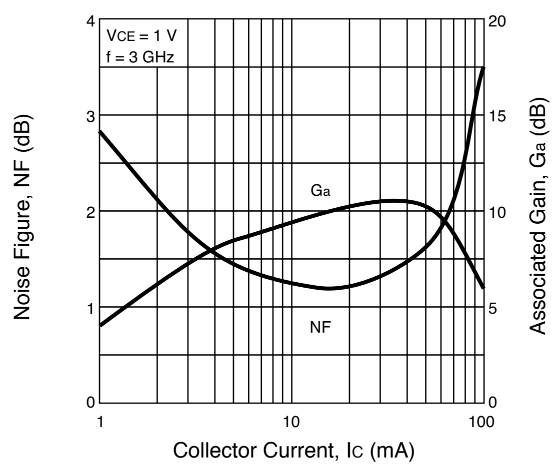
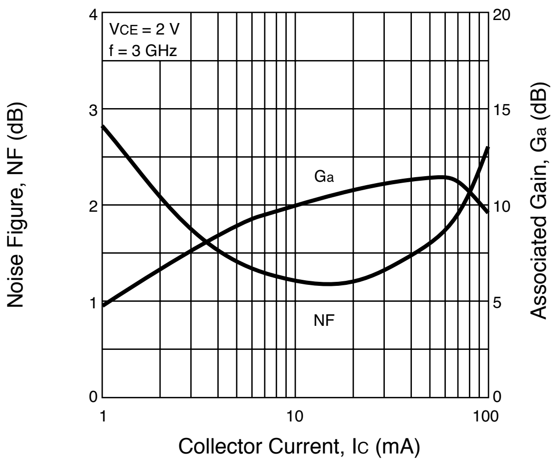


## TYPICAL PERFORMANCE CURVES (TA = 25°C)

**NOISE FIGURE, ASSOCIATED GAIN vs. COLLECTOR CURRENT**

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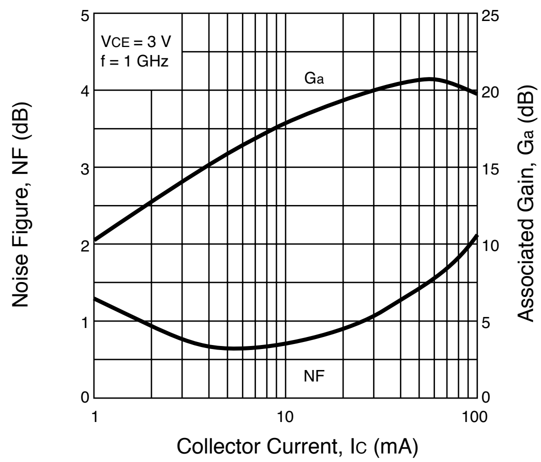


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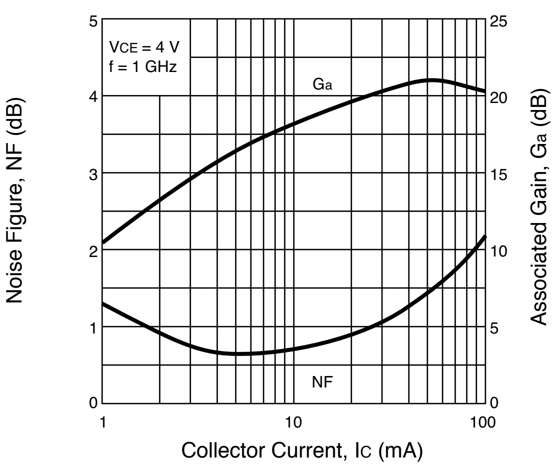


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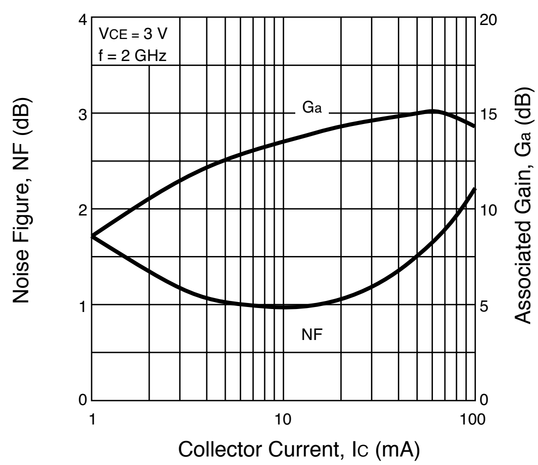


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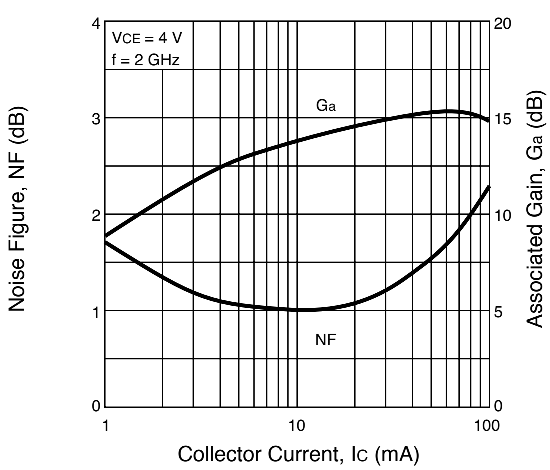
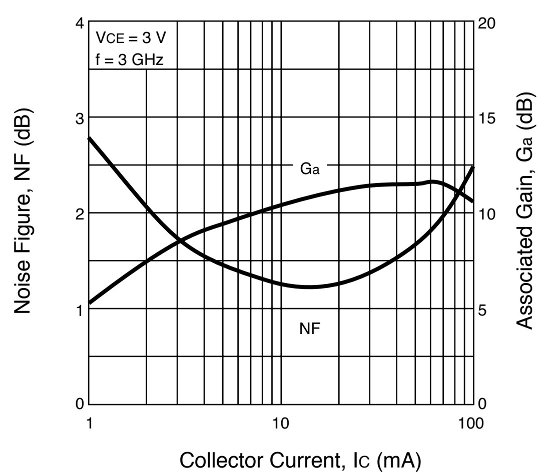



**NOISE FIGURE, ASSOCIATED GAIN vs. COLLECTOR CURRENT**



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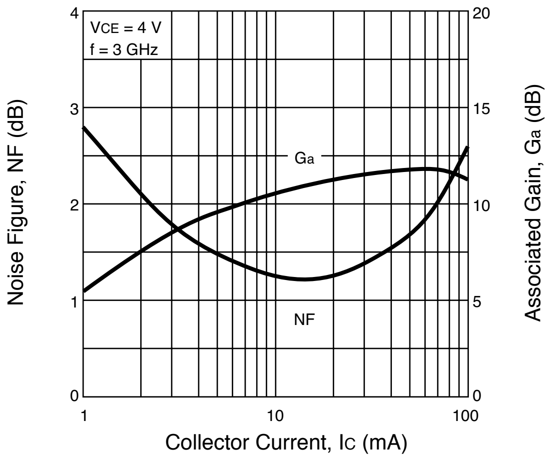
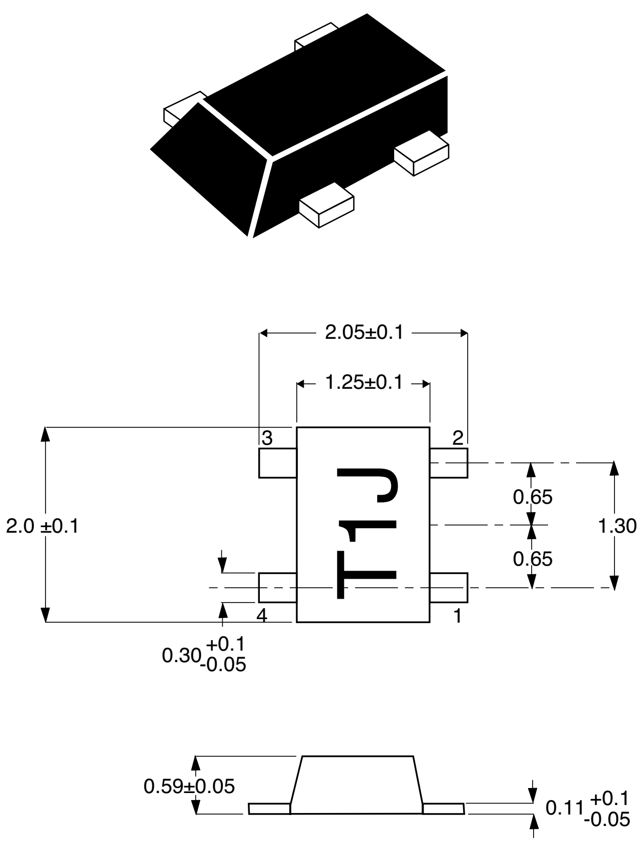
**NOISE FIGURE, ASSOCIATED GAIN vs. COLLECTOR CURRENT**



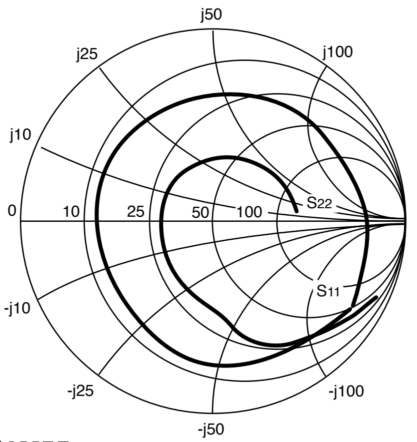

## OUTLINE DIMENSIONS (Units in mm)

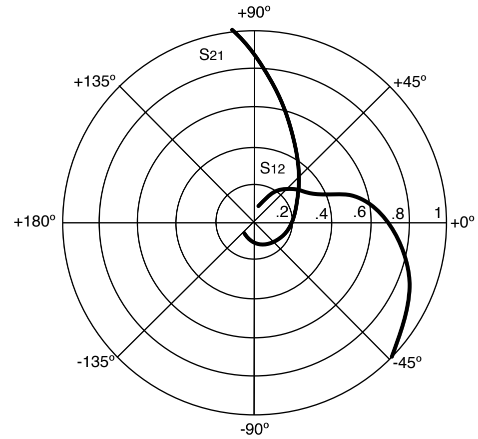
**PACKAGE OUTLINE M05**
**FLAT LEAD 4-PIN THIN TYPE SUPER MINIMOLD**




PIN CONNECTIONS
1. Base
2. Emitter
3. Collector
4. Emitter

## TYPICAL SCATTERING PARAMETERS ($T_A$ = 25°C)




### NESG2101M05
### $V_C$ = 2 V, $I_C$ = 10 mA

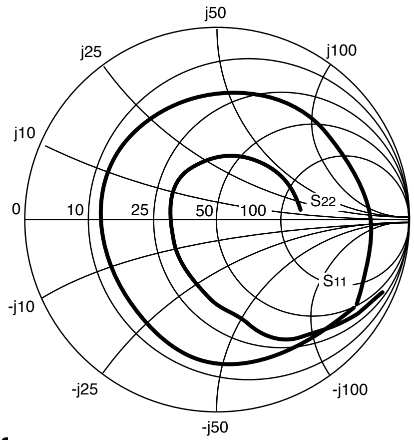
| FREQUENCY | S11 | | S21 | | S12 | | S22 | | K | MAG[1] |
|---|---|---|---|---|---|---|---|---|---|---|
| GHz | MAG | ANG | MAG | ANG | MAG | ANG | MAG | ANG | | (dB) |
| 0.200 | 0.789 | -60.55 | 22.546 | 143.21 | 0.038 | 57.24 | 0.827 | -44.95 | 0.112 | 27.77 |
| 0.400 | 0.728 | -101.35 | 16.859 | 119.77 | 0.055 | 40.53 | 0.640 | -74.08 | 0.191 | 24.83 |
| 0.600 | 0.640 | -126.85 | 12.438 | 105.88 | 0.061 | 32.65 | 0.469 | -90.20 | 0.384 | 23.06 |
| 0.800 | 0.625 | -144.45 | 9.872 | 95.71 | 0.066 | 28.51 | 0.394 | -104.59 | 0.481 | 21.73 |
| 0.900 | 0.623 | -151.37 | 8.927 | 91.52 | 0.068 | 27.07 | 0.370 | -110.30 | 0.522 | 21.16 |
| 1.000 | 0.618 | -157.17 | 8.141 | 87.71 | 0.070 | 25.95 | 0.349 | -116.15 | 0.569 | 20.67 |
| 1.100 | 0.616 | -162.79 | 7.468 | 84.22 | 0.072 | 25.14 | 0.332 | -121.03 | 0.613 | 20.19 |
| 1.200 | 0.615 | -167.45 | 6.893 | 80.93 | 0.073 | 24.39 | 0.320 | -125.84 | 0.651 | 19.74 |
| 1.300 | 0.613 | -171.88 | 6.401 | 77.88 | 0.075 | 23.86 | 0.308 | -130.30 | 0.694 | 19.33 |
| 1.400 | 0.612 | -176.14 | 5.971 | 74.92 | 0.076 | 23.41 | 0.300 | -134.44 | 0.731 | 18.94 |
| 1.500 | 0.613 | -179.93 | 5.595 | 72.08 | 0.078 | 22.92 | 0.292 | -138.47 | 0.766 | 18.56 |
| 1.600 | 0.613 | 176.51 | 5.262 | 69.40 | 0.080 | 22.49 | 0.287 | -142.03 | 0.797 | 18.19 |
| 1.700 | 0.612 | 173.28 | 4.969 | 66.77 | 0.081 | 22.12 | 0.282 | -145.38 | 0.830 | 17.85 |
| 1.800 | 0.612 | 170.36 | 4.710 | 64.19 | 0.083 | 21.73 | 0.279 | -148.48 | 0.856 | 17.52 |
| 1.900 | 0.612 | 167.10 | 4.470 | 61.72 | 0.085 | 21.34 | 0.276 | -151.73 | 0.887 | 17.21 |
| 2.000 | 0.613 | 164.14 | 4.260 | 59.24 | 0.087 | 20.76 | 0.274 | -154.58 | 0.910 | 16.91 |
| 2.100 | 0.613 | 161.30 | 4.067 | 56.96 | 0.089 | 20.30 | 0.272 | -157.43 | 0.933 | 16.61 |
| 2.200 | 0.617 | 158.82 | 3.883 | 54.51 | 0.091 | 19.87 | 0.269 | -159.83 | 0.948 | 16.31 |
| 2.300 | 0.616 | 155.93 | 3.723 | 52.25 | 0.092 | 19.47 | 0.268 | -162.52 | 0.975 | 16.05 |
| 2.400 | 0.616 | 153.29 | 3.575 | 49.92 | 0.094 | 18.90 | 0.268 | -164.76 | 0.995 | 15.79 |
| 2.500 | 0.618 | 150.71 | 3.437 | 47.73 | 0.096 | 18.25 | 0.268 | -167.14 | 1.012 | 14.87 |
| 2.600 | 0.620 | 148.00 | 3.311 | 45.48 | 0.098 | 17.72 | 0.267 | -169.01 | 1.025 | 14.31 |
| 2.700 | 0.618 | 145.67 | 3.195 | 43.27 | 0.100 | 17.10 | 0.268 | -171.14 | 1.042 | 13.77 |
| 2.800 | 0.621 | 143.19 | 3.088 | 41.06 | 0.103 | 16.52 | 0.266 | -172.97 | 1.053 | 13.38 |
| 2.900 | 0.621 | 140.77 | 2.983 | 38.89 | 0.104 | 15.93 | 0.267 | -174.99 | 1.069 | 12.95 |
| 3.000 | 0.623 | 138.24 | 2.889 | 36.77 | 0.106 | 15.02 | 0.267 | -176.60 | 1.079 | 12.63 |
| 3.200 | 0.626 | 133.27 | 2.718 | 32.52 | 0.111 | 13.69 | 0.268 | -179.91 | 1.098 | 12.00 |
| 3.400 | 0.626 | 128.35 | 2.568 | 28.32 | 0.115 | 12.16 | 0.270 | 177.06 | 1.118 | 11.41 |
| 3.600 | 0.630 | 123.52 | 2.436 | 24.16 | 0.119 | 10.49 | 0.270 | 174.03 | 1.129 | 10.93 |
| 3.800 | 0.633 | 118.84 | 2.316 | 20.02 | 0.124 | 8.76 | 0.271 | 171.13 | 1.139 | 10.46 |
| 4.000 | 0.637 | 113.84 | 2.209 | 15.92 | 0.128 | 6.86 | 0.273 | 168.42 | 1.147 | 10.05 |
| 5.000 | 0.657 | 91.22 | 1.801 | -4.45 | 0.149 | -3.74 | 0.280 | 153.64 | 1.166 | 8.36 |
| 6.000 | 0.684 | 69.73 | 1.516 | -24.91 | 0.168 | -16.26 | 0.288 | 134.59 | 1.170 | 7.07 |
| 7.000 | 0.711 | 52.77 | 1.296 | -43.46 | 0.183 | -28.22 | 0.302 | 116.54 | 1.172 | 6.00 |
| 8.000 | 0.735 | 35.04 | 1.130 | -61.62 | 0.195 | -40.47 | 0.313 | 97.12 | 1.186 | 5.02 |

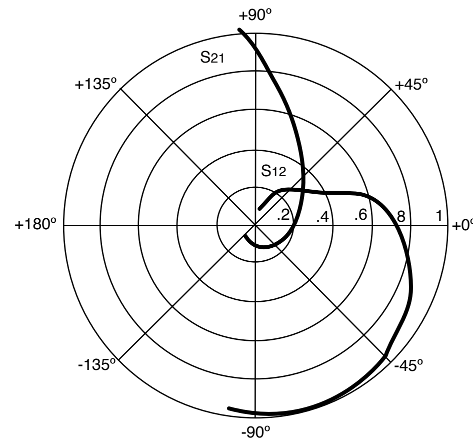
Note:
1. Gain Calculations:

MAG = $\frac{|S_{21}|}{|S_{12}|}\left(K \sqrt{K^2-1}\right)$. When K ≤ 1, MAG is undefined and MSG values are used. MSG = $\frac{|S_{21}|}{|S_{12}|}$, K = $\frac{1+|\Delta|^2-|S_{11}|^2-|S_{22}|^2}{2\,|S_{12}\,S_{21}|}$, $\Delta = S_{11}\,S_{22} - S_{21}\,S_{12}$

MAG = Maximum Available Gain
MSG = Maximum Stable Gain

## TYPICAL SCATTERING PARAMETERS ($T_A$ = 25°C)




**NESG2101M05**
**$V_C$ = 3 V, $I_C$ = 50 mA**

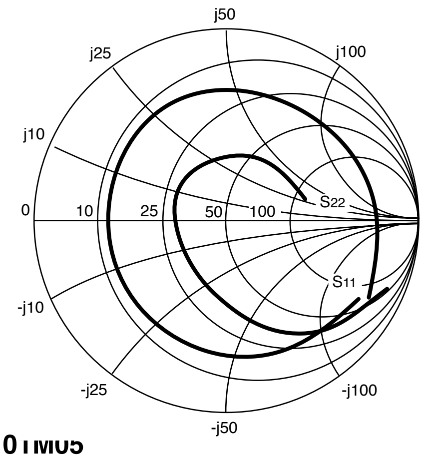
| FREQUENCY | $S_{11}$ | | $S_{21}$ | | $S_{12}$ | | $S_{22}$ | | K | MAG[1] |
|---|---|---|---|---|---|---|---|---|---|---|
| GHz | MAG | ANG | MAG | ANG | MAG | ANG | MAG | ANG | | (dB) |
| 0.200 | 0.572 | -113.11 | 40.843 | 122.65 | 0.022 | 47.89 | 0.622 | -81.31 | 0.326 | 32.65 |
| 0.400 | 0.588 | -146.82 | 24.097 | 102.66 | 0.029 | 43.32 | 0.465 | -115.51 | 0.535 | 29.25 |
| 0.600 | 0.565 | -164.47 | 16.568 | 93.61 | 0.034 | 45.52 | 0.366 | -135.31 | 0.766 | 26.89 |
| 0.800 | 0.571 | -174.66 | 12.645 | 86.36 | 0.040 | 47.14 | 0.344 | -148.51 | 0.864 | 25.01 |
| 0.900 | 0.575 | -178.62 | 11.301 | 83.26 | 0.043 | 47.40 | 0.338 | -153.30 | 0.896 | 24.21 |
| 1.000 | 0.574 | 177.67 | 10.218 | 80.41 | 0.046 | 47.66 | 0.334 | -157.83 | 0.929 | 23.47 |
| 1.100 | 0.578 | 174.15 | 9.319 | 77.77 | 0.049 | 47.88 | 0.331 | -161.79 | 0.952 | 22.77 |
| 1.200 | 0.579 | 171.23 | 8.556 | 75.23 | 0.052 | 47.76 | 0.329 | -165.34 | 0.972 | 22.13 |
| 1.300 | 0.580 | 168.24 | 7.916 | 72.83 | 0.056 | 47.49 | 0.327 | -168.83 | 0.990 | 21.52 |
| 1.400 | 0.582 | 165.28 | 7.362 | 70.48 | 0.059 | 47.26 | 0.327 | -171.79 | 1.005 | 20.55 |
| 1.500 | 0.584 | 162.68 | 6.879 | 68.16 | 0.062 | 46.69 | 0.327 | -174.83 | 1.017 | 19.65 |
| 1.600 | 0.586 | 160.14 | 6.455 | 65.95 | 0.066 | 46.07 | 0.328 | -177.28 | 1.026 | 18.95 |
| 1.700 | 0.585 | 157.81 | 6.087 | 63.80 | 0.069 | 45.35 | 0.328 | -179.74 | 1.035 | 18.31 |
| 1.800 | 0.586 | 155.73 | 5.759 | 61.61 | 0.072 | 44.60 | 0.328 | 177.91 | 1.041 | 17.76 |
| 1.900 | 0.586 | 153.15 | 5.462 | 59.51 | 0.076 | 43.97 | 0.329 | 175.52 | 1.051 | 17.21 |
| 2.000 | 0.588 | 150.78 | 5.196 | 57.39 | 0.079 | 42.87 | 0.330 | 173.57 | 1.056 | 16.75 |
| 2.100 | 0.590 | 148.53 | 4.960 | 55.46 | 0.082 | 41.96 | 0.330 | 171.41 | 1.059 | 16.31 |
| 2.200 | 0.594 | 146.68 | 4.730 | 53.32 | 0.086 | 40.87 | 0.329 | 169.50 | 1.060 | 15.93 |
| 2.300 | 0.593 | 144.30 | 4.533 | 51.36 | 0.089 | 39.88 | 0.331 | 167.46 | 1.067 | 15.49 |
| 2.400 | 0.593 | 142.02 | 4.351 | 49.30 | 0.092 | 38.91 | 0.331 | 165.70 | 1.071 | 15.11 |
| 2.500 | 0.595 | 139.86 | 4.182 | 47.40 | 0.095 | 37.77 | 0.334 | 163.93 | 1.075 | 14.75 |
| 2.600 | 0.598 | 137.53 | 4.025 | 45.40 | 0.098 | 36.70 | 0.333 | 162.52 | 1.076 | 14.44 |
| 2.700 | 0.596 | 135.56 | 3.883 | 43.42 | 0.102 | 35.46 | 0.335 | 160.76 | 1.080 | 14.09 |
| 2.800 | 0.598 | 133.38 | 3.750 | 41.47 | 0.105 | 34.20 | 0.334 | 159.24 | 1.080 | 13.80 |
| 2.900 | 0.599 | 131.30 | 3.623 | 39.50 | 0.108 | 33.05 | 0.335 | 157.55 | 1.083 | 13.48 |
| 3.000 | 0.601 | 128.98 | 3.510 | 37.60 | 0.111 | 31.78 | 0.335 | 156.19 | 1.084 | 13.22 |
| 3.200 | 0.604 | 124.58 | 3.300 | 33.78 | 0.118 | 29.38 | 0.336 | 153.36 | 1.087 | 12.68 |
| 3.400 | 0.604 | 120.05 | 3.118 | 29.94 | 0.124 | 26.78 | 0.338 | 150.81 | 1.090 | 12.17 |
| 3.600 | 0.608 | 115.64 | 2.957 | 26.15 | 0.130 | 24.08 | 0.337 | 148.07 | 1.089 | 11.75 |
| 3.800 | 0.609 | 111.42 | 2.812 | 22.38 | 0.136 | 21.31 | 0.339 | 145.42 | 1.090 | 11.31 |
| 4.000 | 0.613 | 106.64 | 2.684 | 18.56 | 0.142 | 18.59 | 0.340 | 142.94 | 1.090 | 10.93 |
| 5.000 | 0.630 | 85.56 | 2.191 | -0.52 | 0.169 | 4.19 | 0.345 | 128.61 | 1.089 | 9.30 |
| 6.000 | 0.655 | 65.39 | 1.847 | -20.04 | 0.191 | -11.37 | 0.357 | 110.41 | 1.089 | 8.03 |
| 7.000 | 0.681 | 49.45 | 1.588 | -37.86 | 0.208 | -25.62 | 0.369 | 92.60 | 1.094 | 6.97 |
| 8.000 | 0.706 | 32.47 | 1.394 | -55.46 | 0.219 | -39.67 | 0.379 | 73.61 | 1.105 | 6.06 |

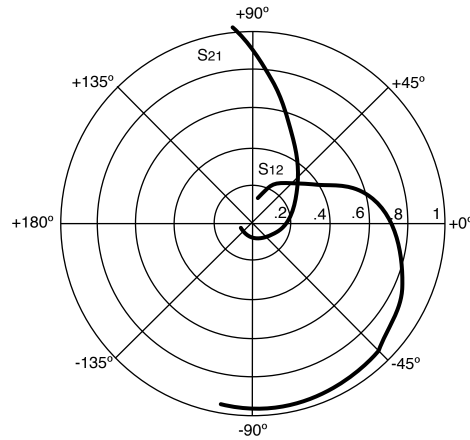
Note:
1. Gain Calculations:

MAG = $\frac{|S_{21}|}{|S_{12}|}\left(K\ \sqrt{K^2-1}\right)$. When K ≤ 1, MAG is undefined and MSG values are used. MSG = $\frac{|S_{21}|}{|S_{12}|}$, K = $\frac{1 + |\Delta|^2 - |S_{11}|^2 - |S_{22}|^2}{2\ |S_{12}\ S_{21}|}$, $\Delta = S_{11}\ S_{22} - S_{21}\ S_{12}$

MAG = Maximum Available Gain
MSG = Maximum Stable Gain

## TYPICAL SCATTERING PARAMETERS ($T_A$ = 25°C)




**NESG2101M05**
**$V_C$ = 3.6 V, $I_C$ = 10 mA**

| FREQUENCY | $S_{11}$ | | $S_{21}$ | | $S_{12}$ | | $S_{22}$ | | K | MAG[1] |
|---|---|---|---|---|---|---|---|---|---|---|
| GHz | MAG | ANG | MAG | ANG | MAG | ANG | MAG | ANG | | (dB) |
| 0.200 | 0.789 | -57.89 | 22.895 | 144.36 | 0.036 | 58.70 | 0.837 | -42.54 | 0.116 | 28.04 |
| 0.400 | 0.726 | -98.15 | 17.340 | 121.13 | 0.053 | 42.11 | 0.649 | -70.19 | 0.195 | 25.14 |
| 0.600 | 0.634 | -123.23 | 12.889 | 106.94 | 0.059 | 34.42 | 0.476 | -85.69 | 0.388 | 23.37 |
| 0.800 | 0.619 | -141.61 | 10.285 | 96.59 | 0.064 | 30.25 | 0.397 | -99.12 | 0.481 | 22.04 |
| 0.900 | 0.612 | -148.55 | 9.304 | 92.38 | 0.066 | 29.03 | 0.369 | -104.66 | 0.529 | 21.48 |
| 1.000 | 0.607 | -154.90 | 8.480 | 88.48 | 0.068 | 27.89 | 0.345 | -110.32 | 0.576 | 20.96 |
| 1.100 | 0.606 | -160.48 | 7.794 | 84.91 | 0.070 | 27.18 | 0.328 | -114.99 | 0.616 | 20.49 |
| 1.200 | 0.603 | -165.23 | 7.205 | 81.64 | 0.071 | 26.60 | 0.313 | -119.56 | 0.658 | 20.04 |
| 1.300 | 0.605 | -169.91 | 6.687 | 78.44 | 0.073 | 25.96 | 0.301 | -124.08 | 0.692 | 19.63 |
| 1.400 | 0.603 | -173.86 | 6.244 | 75.51 | 0.075 | 25.57 | 0.291 | -128.11 | 0.731 | 19.23 |
| 1.500 | 0.603 | -177.86 | 5.852 | 72.66 | 0.076 | 25.20 | 0.283 | -132.00 | 0.765 | 18.86 |
| 1.600 | 0.601 | 178.57 | 5.509 | 69.92 | 0.078 | 24.82 | 0.276 | -135.75 | 0.800 | 18.51 |
| 1.700 | 0.603 | 175.17 | 5.203 | 67.24 | 0.079 | 24.50 | 0.270 | -139.12 | 0.828 | 18.16 |
| 1.800 | 0.603 | 172.01 | 4.923 | 64.71 | 0.081 | 24.11 | 0.266 | -142.52 | 0.858 | 17.82 |
| 1.900 | 0.602 | 168.75 | 4.677 | 62.23 | 0.083 | 23.81 | 0.262 | -145.54 | 0.887 | 17.51 |
| 2.000 | 0.603 | 165.91 | 4.459 | 59.76 | 0.085 | 23.47 | 0.259 | -148.55 | 0.911 | 17.21 |
| 2.100 | 0.605 | 162.98 | 4.256 | 57.44 | 0.086 | 23.03 | 0.257 | -151.41 | 0.933 | 16.92 |
| 2.200 | 0.605 | 160.18 | 4.067 | 55.01 | 0.088 | 22.63 | 0.255 | -154.00 | 0.956 | 16.63 |
| 2.300 | 0.605 | 157.54 | 3.898 | 52.69 | 0.090 | 22.17 | 0.253 | -156.55 | 0.977 | 16.36 |
| 2.400 | 0.605 | 154.92 | 3.743 | 50.39 | 0.092 | 21.67 | 0.252 | -158.93 | 0.996 | 16.09 |
| 2.500 | 0.606 | 152.29 | 3.600 | 48.17 | 0.094 | 21.18 | 0.252 | -161.10 | 1.014 | 15.11 |
| 2.600 | 0.608 | 149.78 | 3.468 | 45.89 | 0.096 | 20.62 | 0.251 | -163.46 | 1.028 | 14.56 |
| 2.700 | 0.607 | 147.22 | 3.345 | 43.72 | 0.098 | 20.15 | 0.251 | -165.49 | 1.047 | 14.02 |
| 2.800 | 0.609 | 144.76 | 3.233 | 41.51 | 0.100 | 19.59 | 0.250 | -167.54 | 1.060 | 13.61 |
| 2.900 | 0.610 | 142.18 | 3.127 | 39.34 | 0.102 | 19.01 | 0.250 | -169.39 | 1.073 | 13.23 |
| 3.000 | 0.611 | 139.97 | 3.027 | 37.20 | 0.104 | 18.16 | 0.251 | -171.29 | 1.084 | 12.89 |
| 3.200 | 0.613 | 134.84 | 2.849 | 32.93 | 0.108 | 16.95 | 0.251 | -174.61 | 1.104 | 12.26 |
| 3.400 | 0.616 | 130.04 | 2.690 | 28.73 | 0.112 | 15.48 | 0.252 | -177.81 | 1.122 | 11.69 |
| 3.600 | 0.617 | 125.12 | 2.552 | 24.58 | 0.116 | 13.94 | 0.253 | 179.23 | 1.138 | 11.17 |
| 3.800 | 0.621 | 120.40 | 2.427 | 20.47 | 0.120 | 12.13 | 0.255 | 176.30 | 1.146 | 10.73 |
| 4.000 | 0.624 | 115.57 | 2.315 | 16.31 | 0.124 | 10.28 | 0.256 | 173.50 | 1.156 | 10.31 |
| 5.000 | 0.645 | 92.70 | 1.886 | -4.08 | 0.144 | -0.33 | 0.264 | 158.38 | 1.180 | 8.62 |
| 6.000 | 0.674 | 71.09 | 1.587 | -24.60 | 0.161 | -12.96 | 0.271 | 139.17 | 1.186 | 7.33 |
| 7.000 | 0.703 | 54.11 | 1.354 | -43.38 | 0.174 | -25.46 | 0.286 | 120.42 | 1.192 | 6.25 |
| 8.000 | 0.730 | 36.29 | 1.179 | -61.88 | 0.185 | -38.34 | 0.296 | 100.19 | 1.206 | 5.30 |

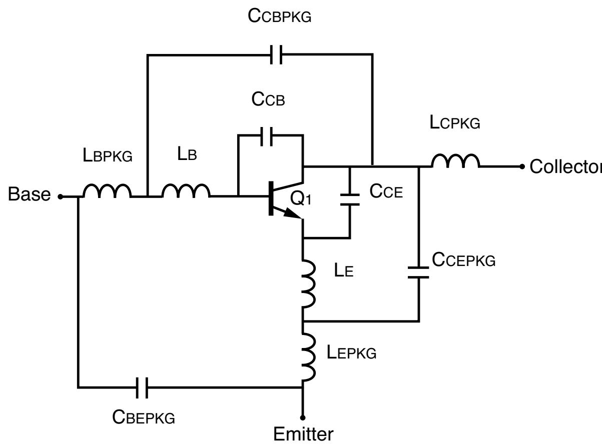
Note:
1. Gain Calculations:

$\text{MAG} = \frac{|S_{21}|}{|S_{12}|}\left(K \ \sqrt{K^2-1}\right)$. When K ≤ 1, MAG is undefined and MSG values are used. $\text{MSG} = \frac{|S_{21}|}{|S_{12}|}$, $K = \frac{1 + |\Delta|^2 - |S_{11}|^2 - |S_{22}|^2}{2\,|S_{12}\,S_{21}|}$, $\Delta = S_{11}\,S_{22} - S_{21}\,S_{12}$

MAG = Maximum Available Gain
MSG = Maximum Stable Gain

## NONLINEAR MODEL

## SCHEMATIC




## BJT NONLINEAR MODEL PARAMETERS(1)

| Parameters | Q1 | Parameters | Q1 |
|---|---|---|---|
| IS | 3.64e-15 | MJC | 0.149 |
| BF | 309.7 | XCJC | 1 |
| NF | 1.079 | CJS | 0 |
| VAF | 56 | VJS | 0.75 |
| IKF | 233.9 | MJS | 0 |
| ISE | 11.67e-15 | FC | 0.8 |
| NE | 1.648 | TF | 4e-12 |
| BR | 20.01 | XTF | 10 |
| NR | 1.080 | VTF | 5 |
| VAR | 2.782 | ITF | 0.5 |
| IKR | 54.57e-3 | PTF | 20 |
| ISC | 1.024e-18 | TR | 0 |
| NC | 1.35 | EG | 1.11 |
| RE | 1.6 | XTB | 1.3 |
| RB | 2.2 | XTI | 5.2 |
| RBM | 0.05 | KF | 0 |
| IRB | 1e-4 | AF | 1 |
| RC | 4.8 | | |
| CJE | 1.461e-12 | | |
| VJE | 0.798 | | |
| MJE | 0.137 | | |
| CJC | 489.9e-15 | | |
| VJC | 0.605 | | |

(1) Gummel-Poon Model

## ADDITIONAL PARAMETERS

| Parameters | NESG2101M05 |
|---|---|
| $C_{CB}$ | 0.01 pF |
| $C_{CE}$ | 0.2 pF |
| $L_B$ | 0.16 nH |
| $L_E$ | 0.17 nH |
| $C_{CBPKG}$ | 0.45 pF |
| $C_{CEPKG}$ | 0.02 pF |
| $C_{BEPKG}$ | 0.05 pF |
| $L_{BPKG}$ | 0.8 nH |
| $L_{CPKG}$ | 1.2 nH |
| $L_{EPKG}$ | 0.15 nH |

MODEL TEST CONDITIONS
Frequency: 0.1 to 6 GHz
Bias: $V_{CE}$ = 2 V, $I_C$ = 5 mA to 40 mA
Date: 09/2003



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Subject: Compliance with EU Directives

CEL certifies, to its knowledge, that semiconductor and laser products detailed below are compliant with the requirements of European Union (EU) Directive 2002/95/EC Restriction on Use of Hazardous Substances in electrical and electronic equipment (RoHS) and the requirements of EU Directive 2003/11/EC Restriction on Penta and Octa BDE.

CEL Pb-free products have the same base part number with a suffix added. The suffix –A indicates that the device is Pb-free. The –AZ suffix is used to designate devices containing Pb which are exempted from the requirement of RoHS directive (*). In all cases the devices have Pb-free terminals. All devices with these suffixes meet the requirements of the RoHS directive.

This status is based on CEL's understanding of the EU Directives and knowledge of the materials that go into its products as of the date of disclosure of this information.

| Restricted Substance per RoHS | Concentration Limit per RoHS (values are not yet fixed) | Concentration contained in CEL devices | |
|---|---|---|---|
| | | -A | -AZ |
| Lead (Pb) | < 1000 PPM | Not Detected | (*) |
| Mercury | < 1000 PPM | Not Detected | |
| Cadmium | < 100 PPM | Not Detected | |
| Hexavalent Chromium | < 1000 PPM | Not Detected | |
| PBB | < 1000 PPM | Not Detected | |
| PBDE | < 1000 PPM | Not Detected | |

If you should have any additional questions regarding our devices and compliance to environmental standards, please do not hesitate to contact your local representative.