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MOTOROLA

# MRF959T1

# NPN Silicon Low Noise Transistors

Motorola's MRF959 is a high performance NPN transistor designed for use in high gain, low noise small–signal amplifiers. The MRF959 is well suited for low voltage applications. This device features a 9.0 GHz DC current gain–bandwidth product with excellent linearity.

- Low Noise Figure, $NF_{min}$ = 1.3 dB (Typ) @ 1.0 GHz, 6.0 V, 5.0 mA
- High Current Gain–Bandwidth Product, $f_\tau$ = 9.0 GHz, 6.0 V, 30 mA
- Maximum Stable Gain, 17 dB @ 1.0 GHz, 6.0 V, 10 mA
- Output Third Order Intercept, Output $IP_3$ = 30 dBm @ 1.0 GHz, 6.0 V, 30 mA
- Fully Ion–Implanted with Gold Metallization and Nitride Passivation

**LOW NOISE TRANSISTORS**

**$f_\tau$ = 9.0 GHz**

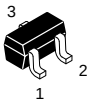
**$NF_{min}$ = 1.3 dB**

**$I_{CMAX}$ = 100 mA**

**$V_{CEO}$ = 10 V**

**SEMICONDUCTOR TECHNICAL DATA**

Pin 1. Base
2. Emitter
3. Collector




PLASTIC PACKAGE
CASE 463
(SC–90/SC–75, Tape & Reel Only)

## MAXIMUM RATINGS

| Rating | Symbol | Value | Unit |
|---|---|---|---|
| Collector–Emitter Voltage | $V_{CEO}$ | 10 | Vdc |
| Collector–Base Voltage | $V_{CBO}$ | 20 | Vdc |
| Emitter–Base Voltage | $V_{EBO}$ | 1.5 | Vdc |
| Power Dissipation @ $T_C$ = 75°C<br>Derate linearly above $T_C$ = 75°C at | $P_{D(max)}$ | 0.15<br>2.0 | W<br>mW/°C |
| Collector Current – Continuous [Note 3] | $I_C$ | 100 | mA |
| Storage Temperature | $T_{stg}$ | –55 to 150 | °C |
| Maximum Junction Temperature | $T_{J(max)}$ | 150 | °C |

**NOTES:** 1. Meets Human Body Model (HBM) ≤300 V and Machine Model (MM) ≤75 V.
2. ESD data available upon request.
3. For MTBF >10 years.

## THERMAL CHARACTERISTIC

| Characteristics | Symbol | Max | Unit |
|---|---|---|---|
| Thermal Resistance, Junction–to–Case | $R_{\theta JC}$ | 500 | °C/W |

**NOTE:** To calculate the junction temperature use $T_J = (P_D \times R_{\theta JC}) + T_C$. The case temperature measured on collector lead adjacent to the package body.

## ORDERING INFORMATION

| Device | Marking | Package |
|---|---|---|
| MRF959T1 | V1 | SC–90/SC–75 Tape & Reel* |

*3,000 Units per 8 mm, 7 inch reel.

## ELECTRICAL CHARACTERISTICS ($T_C$ = 25°C, unless otherwise noted)

| Characteristic | Symbol | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| **OFF CHARACTERISTICS** [Note 1] | | | | | |
| Collector–Emitter Breakdown Voltage ($I_C$ = 0.1 mA, $I_B$ = 0) | $V_{(BR)CEO}$ | 10 | 13 | – | Vdc |
| Collector–Base Breakdown Voltage ($I_C$ = 0.1 mA, $I_E$ = 0) | $V_{(BR)CBO}$ | 20 | 25 | – | Vdc |
| Emitter Cutoff Current ($V_{EB}$ = 1.0 V, $I_C$ = 0) | $I_{EBO}$ | – | – | 0.1 | μA |
| Collector Cutoff Current ($V_{CB}$ = 10 V, $I_E$ = 0) | $I_{CBO}$ | – | – | 0.1 | μA |
| **ON CHARACTERISTICS** [Note 1] | | | | | |
| DC Current Gain ($V_{CE}$ = 6.0 V, $I_C$ = 5.0 mA) | $h_{FE}$ | 75 | – | 150 | – |
| **DYNAMIC CHARACTERISTICS** | | | | | |
| Collector–Base Capacitance | $C_{cb}$ | | | | pF |
| ($V_{CB}$ = 1.0 V, $I_E$ = 0, f = 1.0 MHz) | | – | 0.63 | – | |
| ($V_{CB}$ = 5.0 V, $I_E$ = 0, f = 1.0 MHz) | | – | 0.44 | – | |
| Current Gain – Bandwidth Product ($V_{CE}$ = 6.0 V, $I_C$ = 30 mA, f = 1.0 GHz) | $f_\tau$ | – | 9.0 | – | GHz |
| **PERFORMANCE CHARACTERISTICS** | | | | | |
| Insertion Gain | $\|S_{21}\|^2$ | | | | dB |
| ($V_{CE}$ = 1.0 V, $I_C$ = 1.0 mA, f = 1.0 GHz) | | – | 4.0 | – | |
| ($V_{CE}$ = 6.0 V, $I_C$ = 15 mA, f = 1.0 GHz) | | – | 14 | – | |
| Maximum Unilateral Gain [Note 2] | $G_{Umax}$ | | | | dB |
| ($V_{CE}$ = 1.0 V, $I_C$ = 1.0 mA, f = 1.0 GHz) | | – | 9.0 | – | |
| ($V_{CE}$ = 6.0 V, $I_C$ = 15 mA, f = 1.0 GHz) | | – | 15 | – | |
| Maximum Stable Gain and/or Maximum Available Gain [Note 3] | | | | | dB |
| ($V_{CE}$ = 1.0 V, $I_C$ = 1.0 mA, f = 1.0 GHz) | MSG | – | 10 | – | |
| ($V_{CE}$ = 6.0 V, $I_C$ = 15 mA, f = 1.0 GHz) | MAG | – | 17 | – | |
| Noise Figure – Minimum | $NF_{min}$ | | | | dB |
| ($V_{CE}$ = 1.0 V, $I_C$ = 1.0 mA, f = 1.0 GHz) | | – | 1.6 | – | |
| ($V_{CE}$ = 6.0 V, $I_C$ = 5.0 mA, f = 1.0 GHz) | | – | 1.3 | – | |
| Noise Resistance | $R_N$ | | | | Ω |
| ($V_{CE}$ = 1.0 V, $I_C$ = 1.0 mA, f = 1.0 GHz) | | – | 14 | – | |
| ($V_{CE}$ = 6.0 V, $I_C$ = 5.0 mA, f = 1.0 GHz) | | – | 9.0 | – | |
| Associated Gain at Minimum NF | $G_{NF}$ | | | | dB |
| ($V_{CE}$ = 1.0 V, $I_C$ = 1.0 mA, f = 1.0 GHz) | | – | 8.0 | – | |
| ($V_{CE}$ = 6.0 V, $I_C$ = 5.0 mA, f = 1.0 GHz) | | – | 13 | – | |
| Output Power at 1.0 dB Gain Compression [Note 4] ($V_{CE}$ = 6.0 V, $I_C$ = 15 mA, f = 1.0 GHz) | $P_{1dB}$ | – | 12 | – | dBm |
| Output Third Order Intercept [Note 4] ($V_{CE}$ = 6.0 V, $I_C$ = 15 mA, f = 1.0 GHz) | $OIP_3$ | – | 26 | – | dBm |

**NOTES:** 1. Pulse width ≤300 μs, duty cycle ≤2% pulsed.

2. Maximum unilateral gain is:

$$G_{Umax} = \frac{|S_{21}|^2}{(1-|S_{11}|^2)(1-|S_{22}|^2)}$$

3. Maximum Available Gain and Maximum Stable Gain are defined by the K factor as follows:

$$MAG = \left|\frac{S_{21}}{S_{12}}\left(K \pm \sqrt{K^2-1}\right)\right|, \text{ if } K > 1, \quad MSG = \left|\frac{S_{21}}{S_{12}}\right|, \text{ if } K < 1$$

4. $Z_{in}$ = 50 Ω and $Z_{out}$ matched for small signal maximum gain.

## TYPICAL CHARACTERISTICS

**Figure 1. Capacitance versus Voltage**

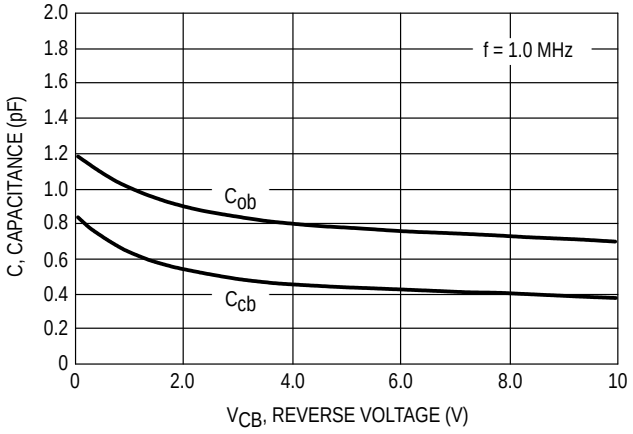



**Figure 2. Input Capacitance versus Voltage**

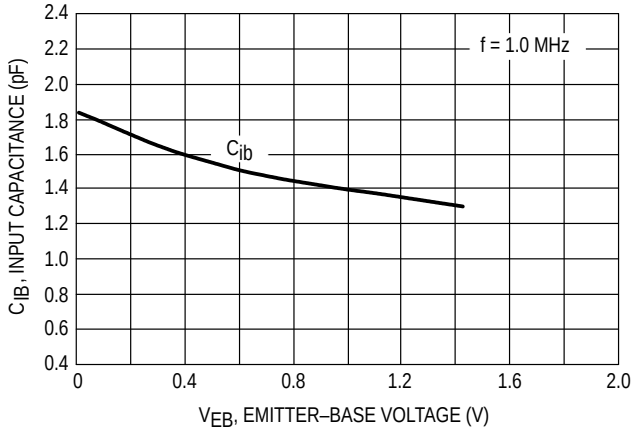



**Figure 3. DC Current Gain versus Collector Current**

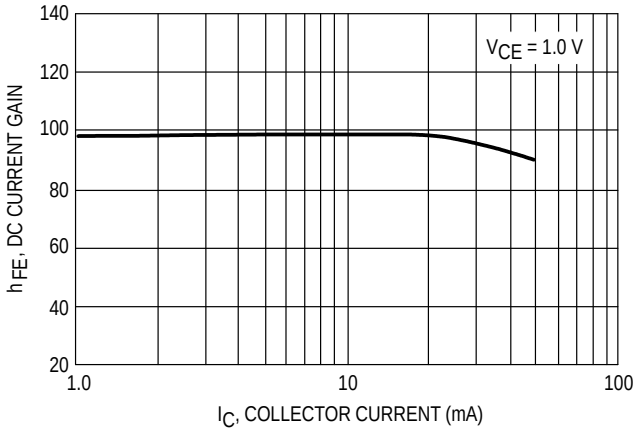



**Figure 4. Gain–Bandwidth Product versus Collector Current**

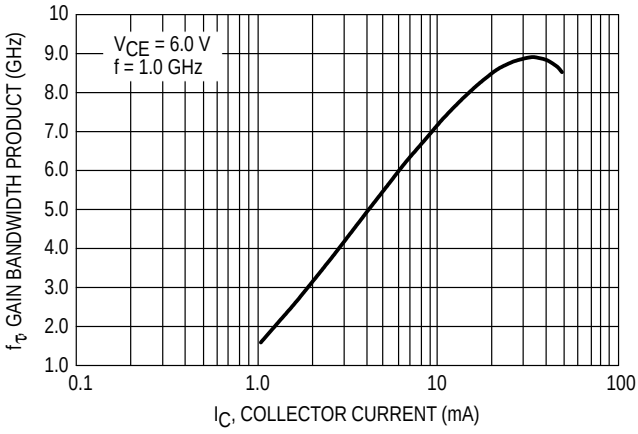
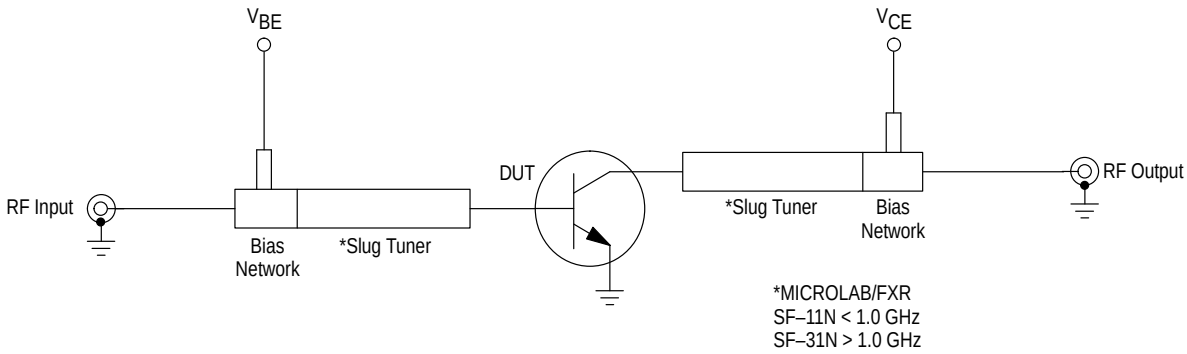



**Figure 5. Functional Circuit Schematic**



## TYPICAL CHARACTERISTICS

**Figure 6. Maximum Stable/Available Gain versus Frequency**

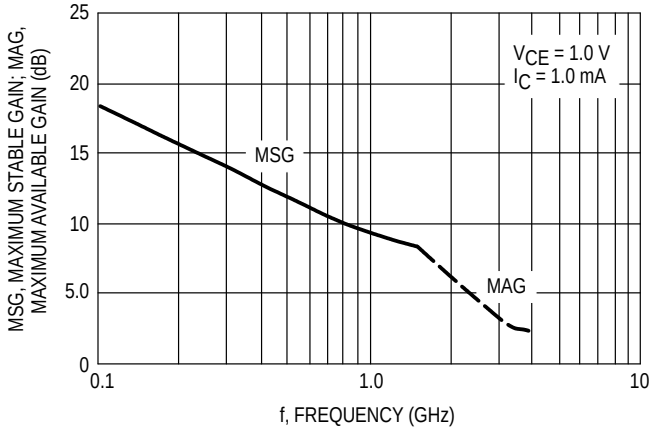



**Figure 7. Maximum Stable/Available Gain versus Frequency**

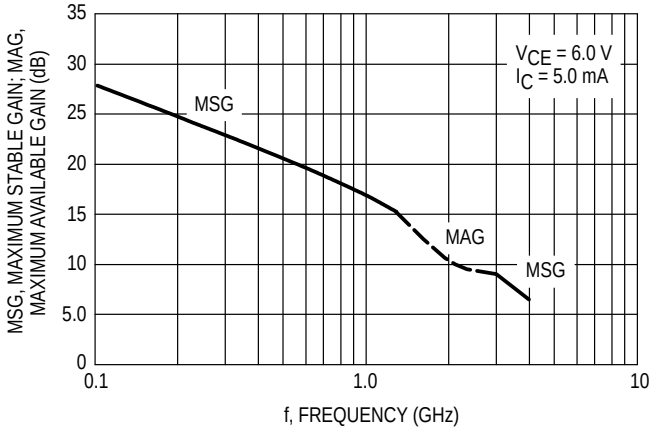



**Figure 8. Maximum Unilateral Gain and Forward Insertion Gain versus Frequency**

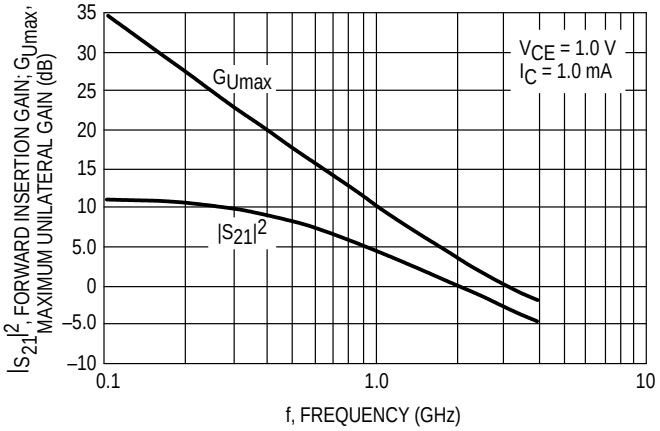



**Figure 9. Maximum Unilateral Gain and Forward Insertion Gain versus Frequency**

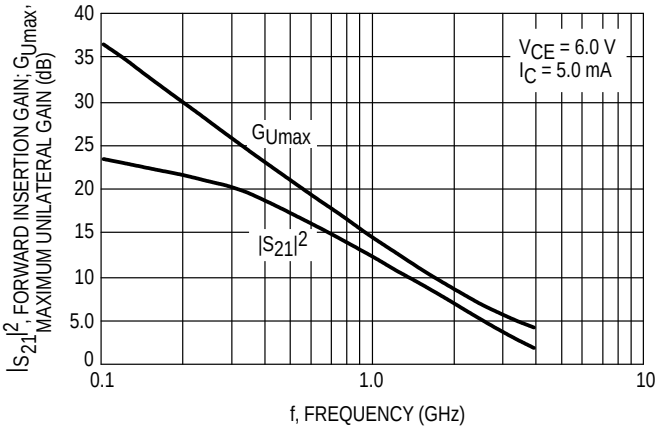



**Figure 10. Maximum Unilateral Gain and Forward Insertion Gain versus Collector Current**

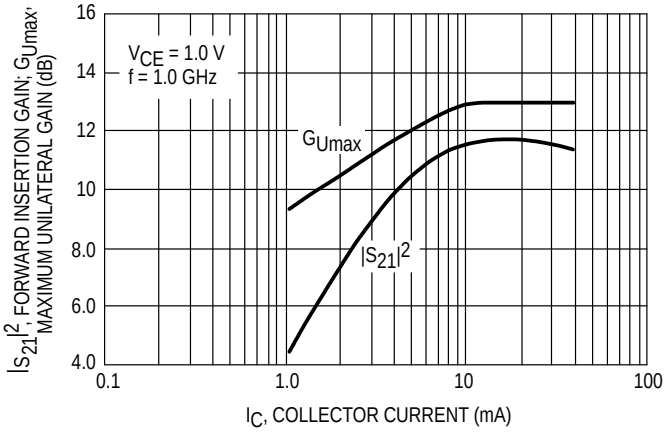
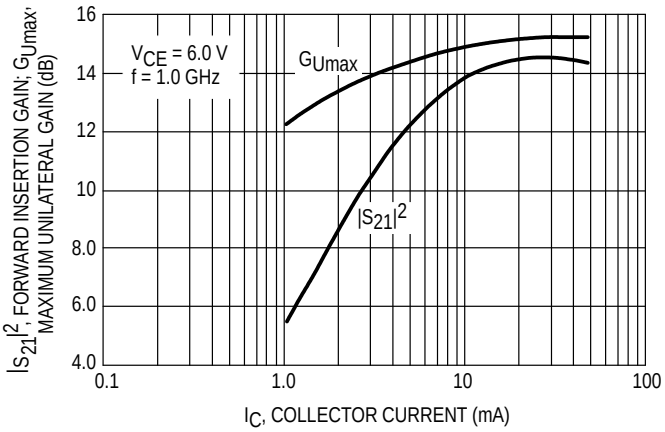



**Figure 11. Maximum Unilateral Gain and Forward Insertion Gain versus Collector Current**



## TYPICAL CHARACTERISTICS

**Figure 12. Maximum Stable/Available Gain versus Collector Current**

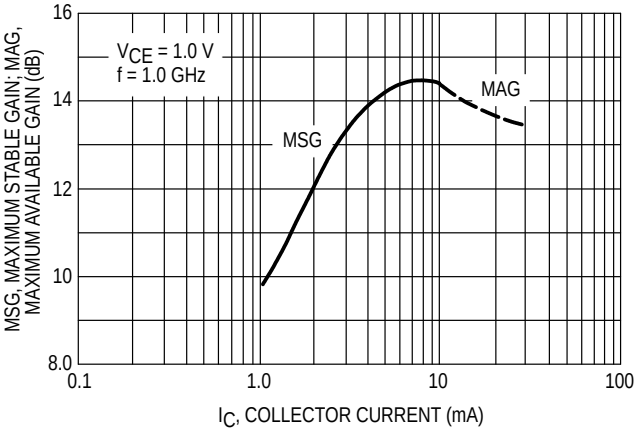



**Figure 13. Maximum Stable/Available Gain versus Collector Current**

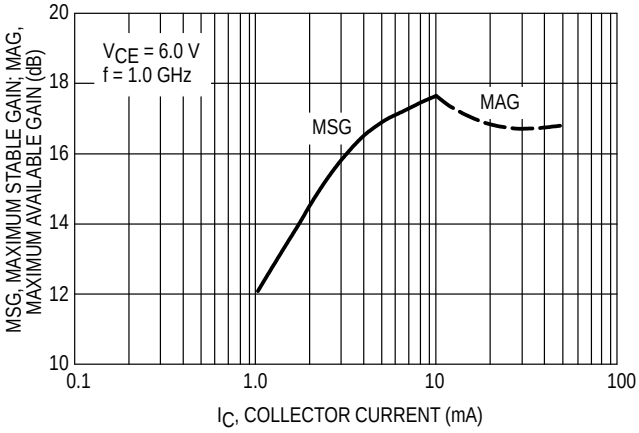



**Figure 14. Minimum Noise Figure and Associated Gain versus Frequency**

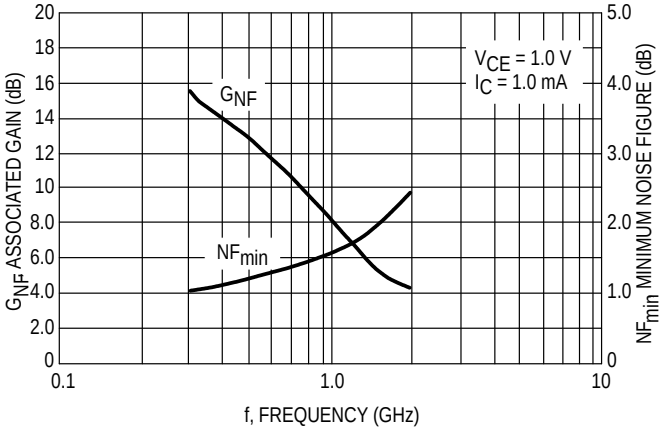



**Figure 15. Minimum Noise Figure and Associated Gain versus Frequency**

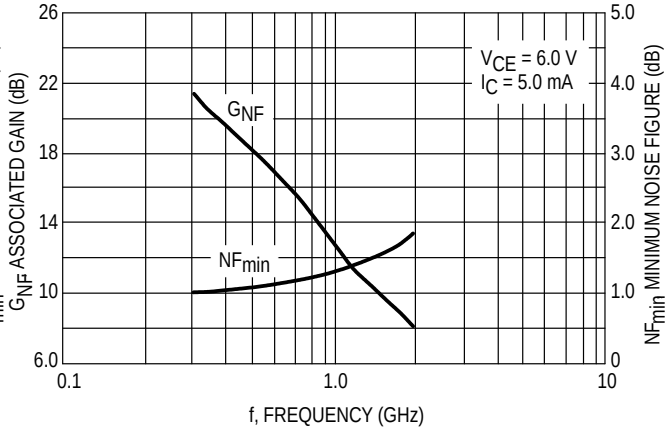



**Figure 16. Minimum Noise Figure and Associated Gain versus Collector Current**

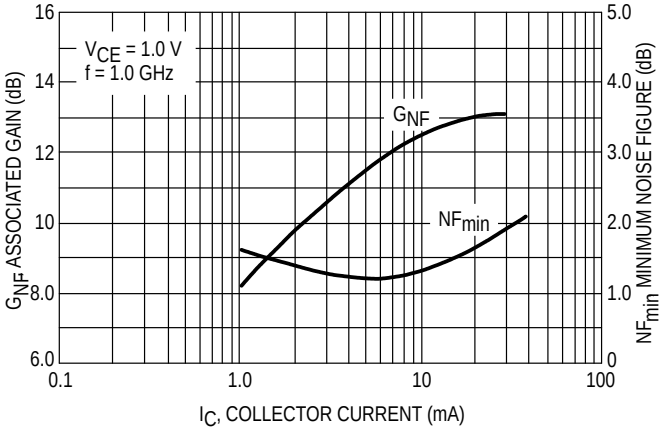
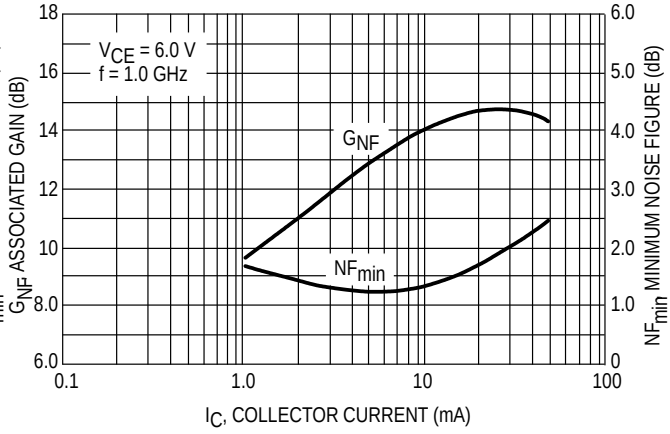



**Figure 17. Minimum Noise Figure and Associated Gain versus Collector Current**



## TYPICAL CHARACTERISTICS

**Figure 18. Output Third Order Intercept and Output Power at 1.0 dB Gain Compression versus Collector Current**

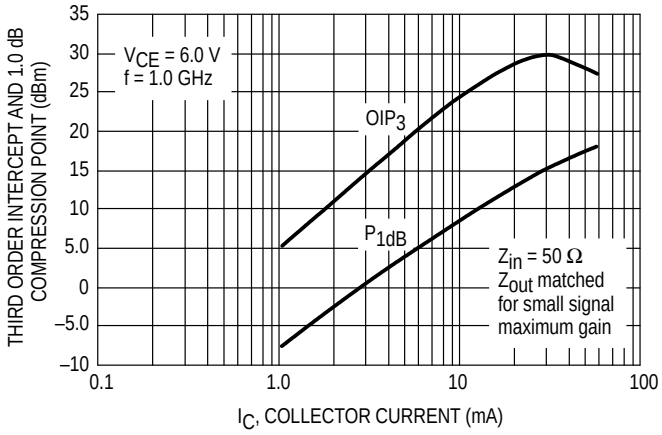


**Table 1. Common Emitter S–Parameters**

| $V_{CE}$ (Vdc) | $I_C$ (mA) | f (GHz) | $S_{11}$ | | $S_{21}$ | | $S_{12}$ | | $S_{22}$ | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | $\|S_{11}\|$ | ∠ ϕ | $\|S_{21}\|$ | ∠ ϕ | $\|S_{12}\|$ | ∠ ϕ | $\|S_{22}\|$ | ∠ ϕ |
| 1.0 | 1.0 | 0.1 | 0.946 | –21 | 3.53 | 165 | 0.047 | 78 | 0.980 | –9 |
| | | 0.3 | 0.888 | –60 | 3.08 | 139 | 0.122 | 56 | 0.889 | –24 |
| | | 0.5 | 0.801 | –89 | 2.49 | 118 | 0.160 | 41 | 0.778 | –32 |
| | | 0.7 | 0.748 | –111 | 2.06 | 102 | 0.177 | 30 | 0.698 | –39 |
| | | 0.9 | 0.711 | –128 | 1.74 | 90 | 0.183 | 24 | 0.646 | –45 |
| | | 1.0 | 0.700 | –135 | 1.62 | 85 | 0.182 | 21 | 0.629 | –47 |
| | | 1.3 | 0.688 | –153 | 1.33 | 72 | 0.174 | 17 | 0.591 | –54 |
| | | 1.5 | 0.682 | –163 | 1.18 | 64 | 0.166 | 15 | 0.579 | –59 |
| | | 2.0 | 0.680 | 179 | 0.94 | 49 | 0.141 | 21 | 0.571 | –73 |
| | | 2.5 | 0.702 | 163 | 0.77 | 37 | 0.135 | 39 | 0.568 | –90 |
| | | 3.0 | 0.713 | 152 | 0.67 | 30 | 0.172 | 56 | 0.582 | –104 |
| | | 3.5 | 0.712 | 138 | 0.59 | 26 | 0.235 | 62 | 0.596 | –118 |
| | | 4.0 | 0.727 | 127 | 0.55 | 25 | 0.312 | 60 | 0.603 | –132 |
| | | 4.5 | 0.710 | 117 | 0.54 | 24 | 0.393 | 55 | 0.602 | –145 |
| | | 5.0 | 0.705 | 108 | 0.55 | 23 | 0.463 | 48 | 0.598 | –160 |
| | 3.0 | 0.1 | 0.850 | –34 | 9.36 | 158 | 0.044 | 72 | 0.934 | –18 |
| | | 0.3 | 0.736 | –86 | 6.84 | 126 | 0.096 | 49 | 0.707 | –42 |
| | | 0.5 | 0.640 | –117 | 4.86 | 107 | 0.115 | 39 | 0.532 | –51 |
| | | 0.7 | 0.606 | –137 | 3.74 | 95 | 0.123 | 35 | 0.436 | –56 |
| | | 0.9 | 0.584 | –151 | 3.01 | 86 | 0.129 | 35 | 0.385 | –61 |
| | | 1.0 | 0.578 | –156 | 2.76 | 82 | 0.132 | 35 | 0.370 | –63 |
| | | 1.3 | 0.581 | –170 | 2.20 | 72 | 0.140 | 37 | 0.331 | –68 |
| | | 1.5 | 0.580 | –178 | 1.93 | 66 | 0.146 | 39 | 0.321 | –73 |
| | | 2.0 | 0.581 | 168 | 1.51 | 53 | 0.167 | 45 | 0.315 | –85 |
| | | 2.5 | 0.611 | 156 | 1.25 | 42 | 0.195 | 50 | 0.316 | –101 |
| | | 3.0 | 0.619 | 147 | 1.09 | 33 | 0.237 | 53 | 0.336 | –113 |
| | | 3.5 | 0.621 | 135 | 0.96 | 26 | 0.285 | 53 | 0.358 | –124 |
| | | 4.0 | 0.645 | 127 | 0.87 | 20 | 0.338 | 51 | 0.381 | –136 |
| | | 4.5 | 0.638 | 118 | 0.81 | 16 | 0.397 | 47 | 0.400 | –147 |
| | | 5.0 | 0.65 | 110 | 0.758 | 12 | 0.45 | 43 | 0.415 | –160 |
| | 5.0 | 0.1 | 0.650 | –53 | 23.10 | 147 | 0.025 | 68 | 0.844 | –27 |
| | | 0.3 | 0.535 | –114 | 13.19 | 114 | 0.048 | 53 | 0.513 | –50 |
| | | 0.5 | 0.474 | –140 | 8.59 | 100 | 0.060 | 54 | 0.359 | –52 |
| | | 0.7 | 0.465 | –156 | 6.34 | 91 | 0.072 | 57 | 0.290 | –53 |
| | | 0.9 | 0.459 | –166 | 5.01 | 84 | 0.084 | 59 | 0.256 | –55 |
| | | 1.0 | 0.456 | –170 | 4.55 | 81 | 0.091 | 60 | 0.247 | –56 |
| | | 1.3 | 0.467 | 180 | 3.56 | 74 | 0.112 | 62 | 0.220 | –58 |
| | | 1.5 | 0.469 | 174 | 3.11 | 69 | 0.126 | 62 | 0.212 | –61 |
| | | 2.0 | 0.473 | 163 | 2.40 | 59 | 0.162 | 62 | 0.203 | –71 |
| | | 2.5 | 0.509 | 152 | 1.96 | 49 | 0.198 | 61 | 0.189 | –86 |
| | | 3.0 | 0.514 | 146 | 1.69 | 41 | 0.237 | 58 | 0.202 | –95 |
| | | 3.5 | 0.518 | 135 | 1.49 | 33 | 0.276 | 56 | 0.214 | –105 |
| | | 4.0 | 0.544 | 129 | 1.35 | 26 | 0.316 | 53 | 0.230 | –115 |
| | | 4.5 | 0.543 | 122 | 1.24 | 20 | 0.358 | 49 | 0.247 | –123 |
| | | 5.0 | 0.568 | 114 | 1.14 | 14 | 0.398 | 45 | 0.255 | –136 |
| 3.0 | 3.0 | 0.1 | 0.866 | –28 | 9.71 | 161 | 0.031 | 75 | 0.954 | –13 |
| | | 0.3 | 0.760 | –76 | 7.57 | 131 | 0.072 | 54 | 0.782 | –31 |
| | | 0.5 | 0.653 | –106 | 5.59 | 113 | 0.089 | 43 | 0.630 | –37 |
| | | 0.7 | 0.607 | –127 | 4.37 | 100 | 0.097 | 39 | 0.541 | –40 |
| | | 0.9 | 0.578 | –142 | 3.55 | 91 | 0.102 | 38 | 0.491 | –43 |
| | | 1.0 | 0.569 | –148 | 3.26 | 87 | 0.105 | 38 | 0.475 | –45 |
| | | 1.3 | 0.566 | –163 | 2.60 | 77 | 0.111 | 41 | 0.437 | –48 |
| | | 1.5 | 0.562 | –172 | 2.28 | 71 | 0.116 | 43 | 0.425 | –51 |

Table 1. Common Emitter S–Parameters (continued)

| $V_{CE}$ (Vdc) | $I_C$ (mA) | f (GHz) | $S_{11}$ | | $S_{21}$ | | $S_{12}$ | | $S_{22}$ | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | $\|S_{11}\|$ | ∠ ϕ | $\|S_{21}\|$ | ∠ ϕ | $\|S_{12}\|$ | ∠ ϕ | $\|S_{22}\|$ | ∠ ϕ |
| 3.0 | 3.0 | 2.0 | 0.561 | 173 | 1.77 | 58 | 0.131 | 50 | 0.411 | –61 |
| | | 2.5 | 0.588 | 160 | 1.45 | 47 | 0.155 | 56 | 0.396 | –73 |
| | | 3.0 | 0.598 | 151 | 1.26 | 38 | 0.190 | 60 | 0.406 | –84 |
| | | 3.5 | 0.603 | 139 | 1.10 | 30 | 0.233 | 61 | 0.419 | –95 |
| | | 4.0 | 0.629 | 130 | 0.98 | 23 | 0.282 | 60 | 0.433 | –106 |
| | | 4.5 | 0.626 | 122 | 0.90 | 18 | 0.338 | 57 | 0.447 | –117 |
| | | 5.0 | 0.644 | 113 | 0.83 | 13 | 0.394 | 53 | 0.452 | –130 |
| | 5.0 | 0.1 | 0.792 | –36 | 14.53 | 156 | 0.029 | 72 | 0.921 | –18 |
| | | 0.3 | 0.663 | –90 | 10.09 | 124 | 0.062 | 52 | 0.676 | –39 |
| | | 0.5 | 0.566 | –120 | 7.01 | 107 | 0.074 | 46 | 0.510 | –43 |
| | | 0.7 | 0.535 | –139 | 5.32 | 96 | 0.083 | 45 | 0.425 | –46 |
| | | 0.9 | 0.517 | –153 | 4.25 | 88 | 0.091 | 47 | 0.380 | –48 |
| | | 1.0 | 0.510 | –158 | 3.89 | 84 | 0.096 | 48 | 0.367 | –49 |
| | | 1.3 | 0.515 | –171 | 3.06 | 75 | 0.109 | 51 | 0.333 | –52 |
| | | 1.5 | 0.515 | –178 | 2.69 | 70 | 0.118 | 53 | 0.322 | –55 |
| | | 2.0 | 0.516 | 169 | 2.08 | 58 | 0.146 | 56 | 0.310 | –64 |
| | | 2.5 | 0.548 | 156 | 1.70 | 48 | 0.176 | 58 | 0.294 | –77 |
| | | 3.0 | 0.556 | 149 | 1.47 | 39 | 0.213 | 59 | 0.306 | –87 |
| | | 3.5 | 0.559 | 137 | 1.29 | 31 | 0.253 | 58 | 0.319 | –97 |
| | | 4.0 | 0.587 | 130 | 1.16 | 24 | 0.296 | 56 | 0.334 | –108 |
| | | 4.5 | 0.586 | 122 | 1.06 | 18 | 0.345 | 53 | 0.351 | –117 |
| | | 5.0 | 0.608 | 114 | 0.98 | 12 | 0.393 | 49 | 0.358 | –130 |
| | 10.0 | 0.1 | 0.823 | –24 | 14.80 | 161 | 0.018 | 77 | 0.952 | –13 |
| | | 0.3 | 0.666 | –63 | 11.47 | 131 | 0.045 | 60 | 0.790 | –29 |
| | | 0.5 | 0.514 | –87 | 8.47 | 113 | 0.058 | 53 | 0.653 | –34 |
| | | 0.7 | 0.425 | –108 | 6.60 | 100 | 0.069 | 51 | 0.577 | –38 |
| | | 0.9 | 0.366 | –124 | 5.37 | 91 | 0.078 | 50 | 0.532 | –40 |
| | | 1.0 | 0.347 | –132 | 4.91 | 86 | 0.083 | 50 | 0.512 | –42 |
| | | 1.3 | 0.309 | –152 | 3.91 | 75 | 0.098 | 50 | 0.479 | –44 |
| | | 1.5 | 0.295 | –163 | 3.44 | 70 | 0.108 | 49 | 0.465 | –48 |
| | | 2.0 | 0.284 | 172 | 2.65 | 55 | 0.134 | 48 | 0.449 | –55 |
| | | 2.5 | 0.277 | 151 | 2.18 | 43 | 0.161 | 45 | 0.442 | –63 |
| | | 3.0 | 0.291 | 134 | 1.87 | 31 | 0.190 | 42 | 0.440 | –71 |
| | | 3.5 | 0.298 | 118 | 1.63 | 20 | 0.221 | 37 | 0.441 | –82 |
| | | 4.0 | 0.299 | 108 | 1.46 | 11 | 0.245 | 32 | 0.431 | –92 |
| | | 4.5 | 0.343 | 96 | 1.35 | 1 | 0.278 | 29 | 0.430 | –102 |
| | | 5.0 | 0.373 | 82 | 1.24 | –8 | 0.313 | 23 | 0.436 | –113 |
| 6.0 | 5.0 | 0.1 | 0.809 | –32 | 14.52 | 158 | 0.024 | 74 | 0.934 | –15 |
| | | 0.3 | 0.665 | –83 | 10.44 | 126 | 0.053 | 55 | 0.721 | –32 |
| | | 0.5 | 0.550 | –112 | 7.37 | 109 | 0.065 | 49 | 0.572 | –35 |
| | | 0.7 | 0.507 | –132 | 5.63 | 98 | 0.074 | 49 | 0.493 | –37 |
| | | 0.9 | 0.482 | –146 | 4.52 | 90 | 0.082 | 50 | 0.452 | –38 |
| | | 1.0 | 0.472 | –152 | 4.12 | 86 | 0.086 | 51 | 0.440 | –39 |
| | | 1.3 | 0.471 | –166 | 3.27 | 77 | 0.098 | 55 | 0.409 | –41 |
| | | 1.5 | 0.469 | –174 | 2.87 | 72 | 0.108 | 57 | 0.398 | –44 |
| | | 2.0 | 0.469 | 172 | 2.22 | 60 | 0.135 | 61 | 0.385 | –52 |
| | | 2.5 | 0.502 | 160 | 1.82 | 50 | 0.166 | 63 | 0.364 | –62 |
| | | 3.0 | 0.512 | 151 | 1.57 | 41 | 0.203 | 64 | 0.372 | –72 |
| | | 3.5 | 0.514 | 140 | 1.38 | 33 | 0.244 | 63 | 0.381 | –81 |
| | | 4.0 | 0.548 | 132 | 1.24 | 25 | 0.289 | 61 | 0.391 | –92 |
| | | 4.5 | 0.545 | 124 | 1.13 | 19 | 0.341 | 58 | 0.404 | –102 |
| | | 5.0 | 0.571 | 117 | 1.04 | 13 | 0.394 | 54 | 0.403 | –114 |

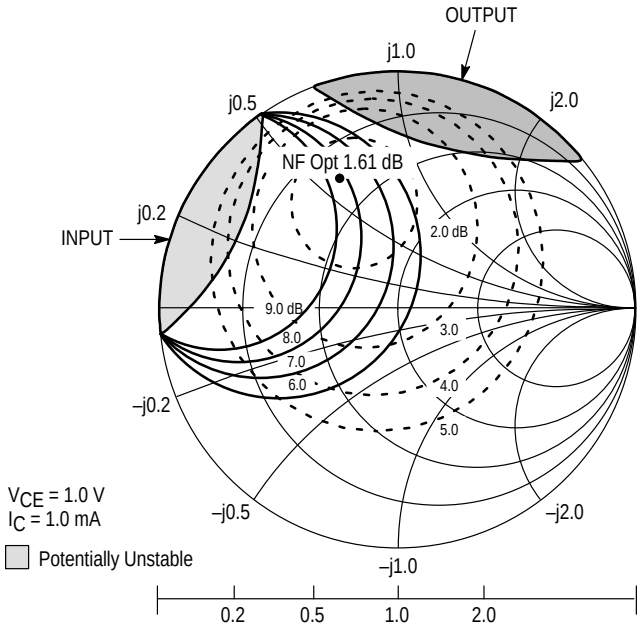
**Table 1. Common Emitter S–Parameters (continued)**

| $V_{CE}$ (Vdc) | $I_C$ (mA) | f (GHz) | $S_{11}$ | | $S_{21}$ | | $S_{12}$ | | $S_{22}$ | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | $\|S_{11}\|$ | ∠ ϕ | $\|S_{21}\|$ | ∠ ϕ | $\|S_{12}\|$ | ∠ ϕ | $\|S_{22}\|$ | ∠ ϕ |
| 6.0 | 15.0 | 0.1 | 0.598 | –56 | 28.57 | 144 | 0.020 | 68 | 0.814 | –26 |
| | | 0.3 | 0.458 | –115 | 15.28 | 111 | 0.038 | 59 | 0.491 | –43 |
| | | 0.5 | 0.396 | –141 | 9.78 | 98 | 0.050 | 62 | 0.367 | –40 |
| | | 0.7 | 0.387 | –156 | 7.18 | 90 | 0.063 | 64 | 0.315 | –39 |
| | | 0.9 | 0.381 | –166 | 5.67 | 84 | 0.077 | 66 | 0.290 | –39 |
| | | 1.0 | 0.377 | –170 | 5.12 | 81 | 0.084 | 67 | 0.284 | –40 |
| | | 1.3 | 0.389 | –179 | 4.01 | 74 | 0.106 | 68 | 0.264 | –41 |
| | | 1.5 | 0.394 | 174 | 3.51 | 70 | 0.120 | 68 | 0.257 | –44 |
| | | 2.0 | 0.397 | 164 | 2.71 | 60 | 0.157 | 66 | 0.247 | –52 |
| | | 2.5 | 0.436 | 154 | 2.21 | 51 | 0.194 | 65 | 0.224 | –64 |
| | | 3.0 | 0.443 | 148 | 1.91 | 43 | 0.233 | 62 | 0.233 | –73 |
| | | 3.5 | 0.448 | 138 | 1.68 | 35 | 0.272 | 59 | 0.240 | –82 |
| | | 4.0 | 0.479 | 131 | 1.52 | 28 | 0.311 | 56 | 0.250 | –92 |
| | | 4.5 | 0.474 | 125 | 1.39 | 21 | 0.353 | 53 | 0.265 | –101 |
| | | 5.0 | 0.506 | 118 | 1.29 | 15 | 0.395 | 49 | 0.263 | –113 |
| | 30.0 | 0.1 | 0.476 | –76 | 36.18 | 135 | 0.017 | 66 | 0.706 | –33 |
| | | 0.3 | 0.396 | –134 | 16.55 | 104 | 0.032 | 65 | 0.387 | –44 |
| | | 0.5 | 0.364 | –156 | 10.31 | 94 | 0.046 | 69 | 0.296 | –38 |
| | | 0.7 | 0.365 | –167 | 7.50 | 87 | 0.061 | 71 | 0.261 | –36 |
| | | 0.9 | 0.364 | –175 | 5.88 | 81 | 0.077 | 72 | 0.245 | –36 |
| | | 1.0 | 0.360 | –178 | 5.23 | 79 | 0.085 | 72 | 0.242 | –37 |
| | | 1.3 | 0.376 | 175 | 4.16 | 73 | 0.108 | 71 | 0.228 | –39 |
| | | 1.5 | 0.382 | 170 | 3.63 | 69 | 0.124 | 71 | 0.222 | –41 |
| | | 2.0 | 0.387 | 161 | 2.79 | 59 | 0.163 | 68 | 0.215 | –50 |
| | | 2.5 | 0.428 | 152 | 2.28 | 51 | 0.200 | 65 | 0.193 | –63 |
| | | 3.0 | 0.436 | 146 | 1.96 | 43 | 0.240 | 62 | 0.202 | –72 |
| | | 3.5 | 0.440 | 136 | 1.73 | 35 | 0.279 | 59 | 0.210 | –82 |
| | | 4.0 | 0.473 | 130 | 1.56 | 28 | 0.317 | 55 | 0.219 | –92 |
| | | 4.5 | 0.470 | 124 | 1.43 | 21 | 0.359 | 52 | 0.234 | –101 |
| | | 5.0 | 0.499 | 118 | 1.32 | 15 | 0.400 | 48 | 0.233 | –113 |

**Table 2. Common Emitter Noise Parameters**

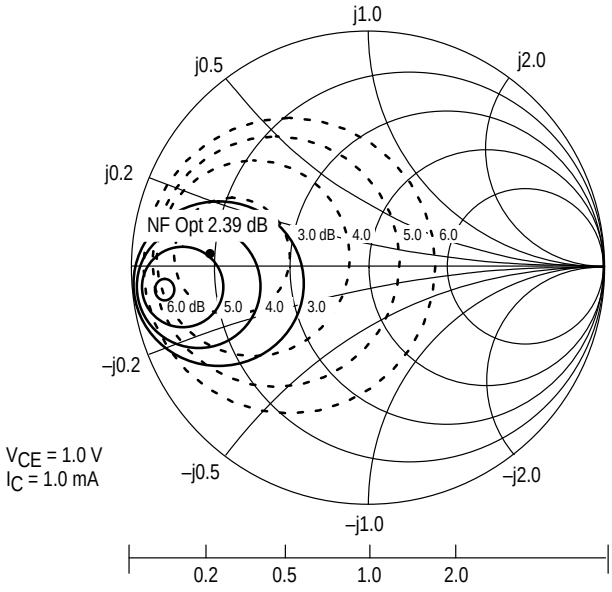
| $V_{CE}$ (Vdc) | $I_C$ (mA) | f (GHz) | $NF_{min}$ (dB) | $\Gamma_o$ | | $R_N$ (Ω) | $r_n$ | $G_{NF}$ (dB) |
|---|---|---|---|---|---|---|---|---|
| | | | | Magnitude | Angle | | | |
| 1.0 | 1.0 | 0.3 | 0.97 | 0.58 | 38 | 18 | 0.35 | 15.6 |
| | | 0.5 | 1.16 | 0.56 | 62 | 18 | 0.36 | 13.1 |
| | | 0.7 | 1.35 | 0.54 | 83 | 17 | 0.34 | 10.9 |
| | | 0.9 | 1.52 | 0.53 | 102 | 15 | 0.30 | 9.0 |
| | | 1.0 | 1.61 | 0.53 | 111 | 14 | 0.28 | 8.2 |
| | | 1.5 | 2.02 | 0.56 | 149 | 8 | 0.16 | 5.2 |
| | | 2.0 | 2.39 | 0.64 | 175 | 4 | 0.08 | 4.5 |
| 3.0 | 3.0 | 0.3 | 0.93 | 0.37 | 37 | 10 | 0.20 | 19.8 |
| | | 0.5 | 1.03 | 0.36 | 59 | 10 | 0.20 | 17.0 |
| | | 0.7 | 1.13 | 0.36 | 80 | 10 | 0.20 | 14.6 |
| | | 0.9 | 1.24 | 0.37 | 99 | 9 | 0.18 | 12.4 |
| | | 1.0 | 1.29 | 0.37 | 108 | 9 | 0.18 | 11.4 |
| | | 1.5 | 1.59 | 0.43 | 146 | 7 | 0.13 | 8.6 |
| | | 2.0 | 1.92 | 0.53 | 172 | 4 | 0.08 | 6.8 |
| 6.0 | 5.0 | 0.3 | 0.98 | 0.29 | 34 | 10 | 0.19 | 21.4 |
| | | 0.5 | 1.05 | 0.29 | 56 | 10 | 0.19 | 18.5 |
| | | 0.7 | 1.12 | 0.29 | 76 | 9 | 0.19 | 16.0 |
| | | 0.9 | 1.20 | 0.30 | 95 | 9 | 0.18 | 13.9 |
| | | 1.0 | 1.28 | 0.31 | 104 | 9 | 0.17 | 13.0 |
| | | 1.5 | 1.51 | 0.37 | 142 | 7 | 0.13 | 10.1 |
| | | 2.0 | 1.84 | 0.47 | 170 | 5 | 0.10 | 8.2 |

**Figure 19. Constant Gain and Noise Figure Contours (f = 1.0 GHz)**



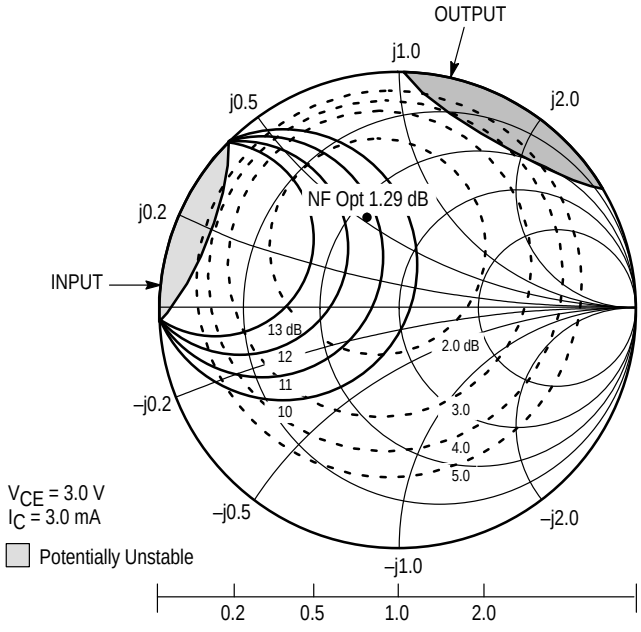

| f (GHz) | NF Opt (dB) | $\Gamma_o$ | Rn | K |
|---|---|---|---|---|
| 1.0 | 1.61 | 0.53 ∠ 111.4° | 14 | 0.53 |

**Figure 20. Constant Gain and Noise Figure Contours (f = 2.0 GHz)**



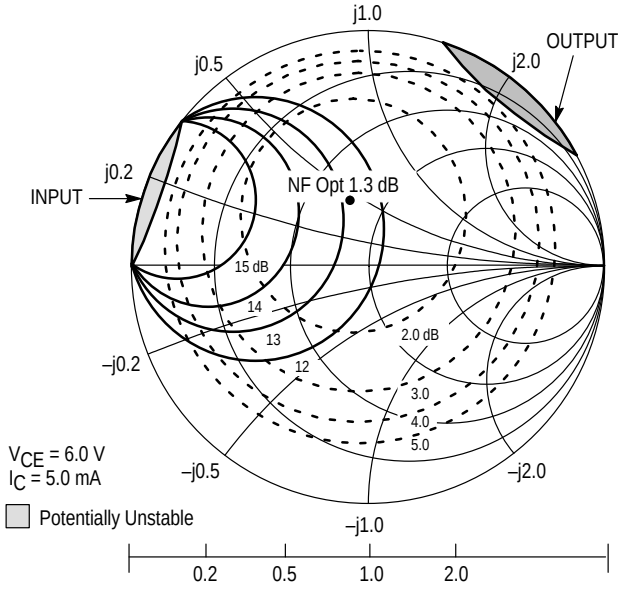

| f (GHz) | NF Opt (dB) | $\Gamma_o$ | Rn | K |
|---|---|---|---|---|
| 2.0 | 2.39 | 0.64 ∠ 174.6° | 4.0 | 1.12 |

**Figure 21. Constant Gain and Noise Figure Contours (f = 1.0 GHz)**




| f (GHz) | NF Opt (dB) | $\Gamma_o$ | Rn | K |
|---|---|---|---|---|
| 1.0 | 1.29 | 0.37 ∠ 108° | 9.0 | 0.73 |

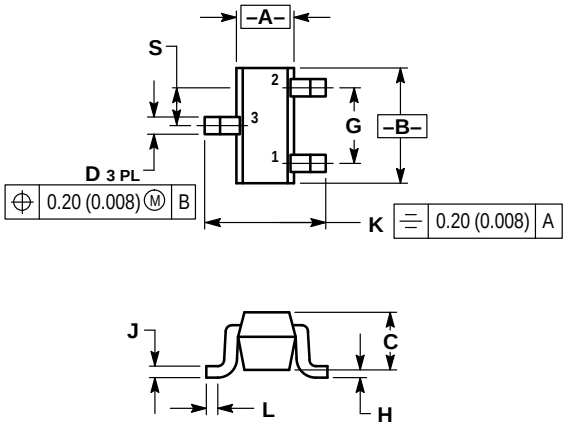
**Figure 22. Constant Gain and Noise Figure Contours (f = 1.0 GHz)**




| f (GHz) | NF Opt (dB) | $\Gamma_o$ | Rn | K |
|---|---|---|---|---|
| 1.0 | 1.3 | 0.31 ∠ 104° | 8.5 | 0.88 |

## OUTLINE DIMENSIONS

PLASTIC PACKAGE
CASE 463-01
(SC–90/SC–75)
ISSUE A







NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.

| | MILLIMETERS | | INCHES | |
|---|---|---|---|---|
| DIM | MIN | MAX | MIN | MAX |
| A | 0.70 | 0.80 | 0.028 | 0.031 |
| B | 1.40 | 1.80 | 0.055 | 0.071 |
| C | 0.60 | 0.90 | 0.024 | 0.035 |
| D | 0.15 | 0.30 | 0.006 | 0.012 |
| G | 1.00 BSC | | 0.039 BSC | |
| H | — | 0.10 | — | 0.004 |
| J | 0.10 | 0.25 | 0.004 | 0.010 |
| K | 1.45 | 1.75 | 0.057 | 0.069 |
| L | 0.10 | 0.20 | 0.004 | 0.008 |
| S | 0.50 BSC | | 0.020 BSC | |





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