

MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

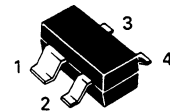
The RF Line
NPN Silicon
High-Frequency Transistor

... designed primarily for use in high-gain, low-noise small-signal amplifiers for operation up to 2.5 GHz. Also usable in applications requiring fast switching times.

- High Current-Gain-Bandwidth Product — $f_T = 3.8$ GHz (Typ) @ $I_C = 15$ mAdc
- Low Noise Figure @ $f = 1$ GHz — $NF_{(matched)} = 1.8$ dB (Typ)
- High Power Gain — $G_{pe(matched)} = 13.5$ dB (Typ) @ $f = 1$ GHz
- Guaranteed RF Parameters
- Surface Mounted SOT-143 Offers Improved RF Performance
 - Lower Package Parasitics
 - High Gain
- Available In Both Standard Profile (MRF9011) and Low Profile (MRF9011L)
- Tape and Reel Packaging Options

MRF9011
MRF9011L

SURFACE MOUNTED
HIGH FREQUENCY
TRANSISTOR
NPN SILICON



CASE 318B-01
SOT-143

MAXIMUM RATINGS

| Rating | Symbol | Value | Unit |
|--|-----------|-------------|------------------------------|
| Collector-Emitter Voltage | V_{CEO} | 15 | Vdc |
| Collector-Base Voltage | V_{CBO} | 25 | Vdc |
| Emitter-Base Voltage | V_{EBO} | 2 | Vdc |
| Collector-Current — Continuous | I_C | 30 | mAdc |
| Total Device Dissipation @ $T_C = 25^\circ\text{C}$ Derate above 25°C | P_D | 0.30 3.3 | Watt mW/ $^\circ\text{C}$ |
| Storage Temperature Range | T_{stg} | -55 to +150 | $^\circ\text{C}$ |

THERMAL CHARACTERISTICS

| Characteristic | Symbol | Max | Unit |
|---|-----------------|-----|--------------------|
| Thermal Resistance, Junction to Ambient | $R_{\theta JA}$ | 300 | $^\circ\text{C/W}$ |

ELECTRICAL CHARACTERISTICS ($T_C = 25^\circ\text{C}$ unless otherwise noted)

| Characteristic | Symbol | Min | Typ | Max | Unit |
|----------------|--------|-----|-----|-----|------|
|----------------|--------|-----|-----|-----|------|

OFF CHARACTERISTICS

| | | | | | |
|--|---------------|----|---|----|------|
| Collector-Emitter Breakdown Voltage ($I_C = 1$ mAdc, $I_E = 0$) | $V_{(BR)CEO}$ | 15 | — | — | Vdc |
| Collector-Base Breakdown Voltage ($I_C = 0.1$ mAdc, $I_E = 0$) | $V_{(BR)CBO}$ | 25 | — | — | Vdc |
| Emitter-Base Breakdown Voltage ($I_E = 0.1$ mAdc, $I_C = 0$) | $V_{(BR)EBO}$ | 2 | — | — | Vdc |
| Collector Cutoff Current ($V_{CB} = 15$ Vdc, $I_E = 0$) | I_{CBO} | — | — | 50 | nAdc |

ON CHARACTERISTICS

| | | | | | |
|--|----------|----|----|-----|---|
| DC Current Gain ($I_C = 5$ mAdc, $V_{CE} = 5$ Vdc) | h_{FE} | 30 | 80 | 200 | — |
|--|----------|----|----|-----|---|

(continued)



ELECTRICAL CHARACTERISTICS — continued ($T_C = 25^\circ\text{C}$ unless otherwise noted.)

| Characteristic | Symbol | Min | Typ | Max | Unit | |
|--|----------|----------|-----|------|------|-----|
| DYNAMIC CHARACTERISTICS | | | | | | |
| Current-Gain-Bandwidth Product ($I_C = 15\text{ mAdc}$, $V_{CE} = 10\text{ Vdc}$, $f = 1\text{ GHz}$) | Figure 6 | f_T | — | 3.8 | — | GHz |
| Collector-Base Capacitance ($V_{CB} = 10\text{ Vdc}$, $I_E = 0$, $f = 1\text{ MHz}$) | Figure 1 | C_{cb} | — | 0.55 | 1 | pF |

FUNCTIONAL TESTS

| | | | | | | |
|---|----------|-------------|---|------|---|----|
| Power Gain at Minimum Noise Figure ($V_{CE} = 10\text{ Vdc}$, $I_C = 5\text{ mA}$, $f = 1\text{ GHz}$) | Figure 5 | GNF_{min} | — | 13.5 | — | dB |
| Noise Figure ($V_{CE} = 10\text{ Vdc}$, $I_C = 5\text{ mA}$, $f = 1\text{ GHz}$) | Figure 5 | NF_{min} | — | 1.8 | — | dB |
| Power Gain in $50\ \Omega$ System ($V_{CE} = 10\text{ Vdc}$, $I_C = 5\text{ mA}$, $f = 1\text{ GHz}$) | Figure 2 | GNF | 9 | 10.2 | — | dB |
| Noise Figure ($V_{CE} = 10\text{ Vdc}$, $I_C = 5\text{ mA}$, $f = 1\text{ GHz}$) | Figure 2 | NF | — | 2.3 | 3 | dB |

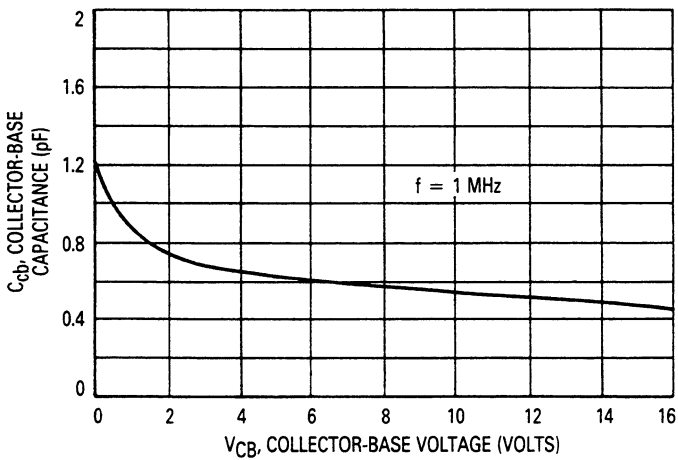


Figure 1. Collector-Base Capacitance versus Collector-Base Voltage

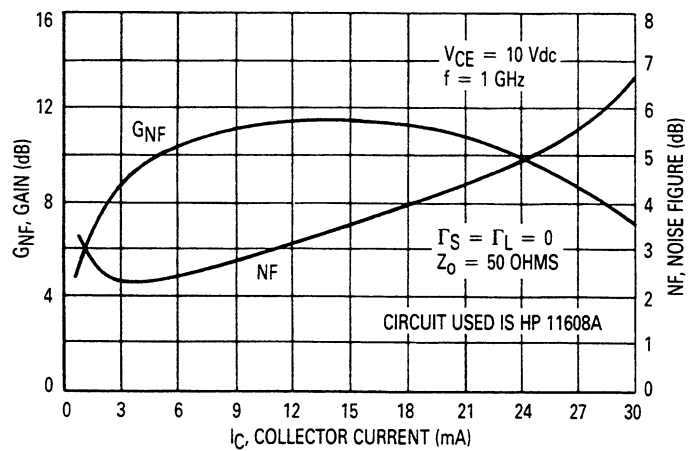


Figure 2. Gain and Noise Figure versus Collector Current

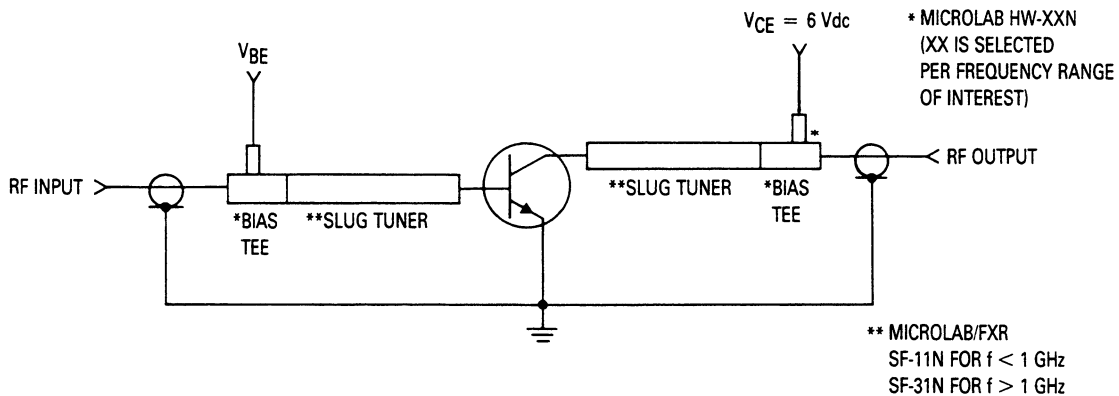


Figure 3. Functional Circuit Schematic

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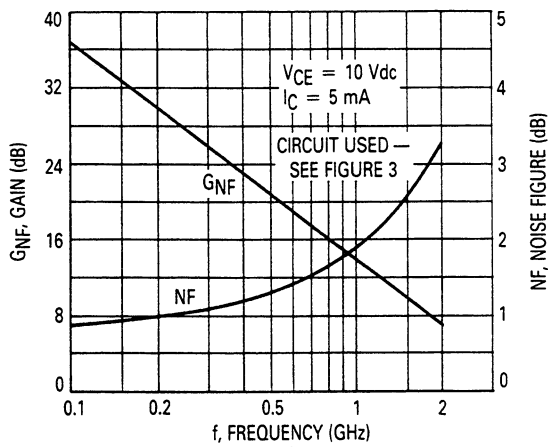


Figure 4. Gain and Noise Figure versus Frequency

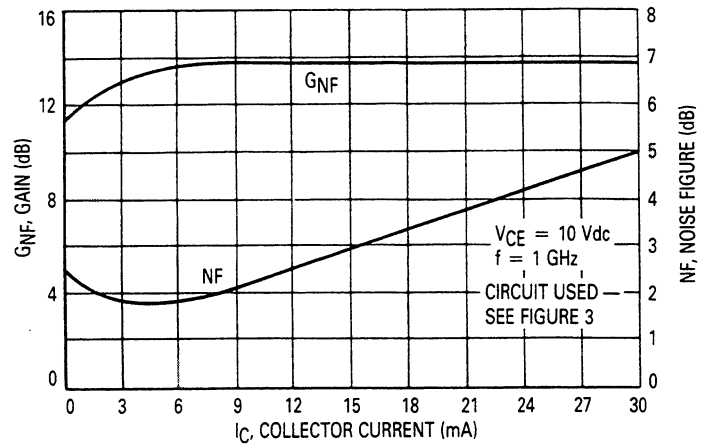


Figure 5. Gain and Noise Figure versus Collector Current

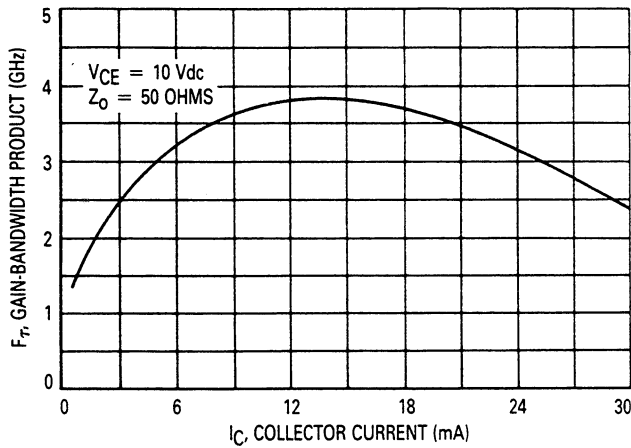


Figure 6. Gain-Bandwidth Product versus Collector Current

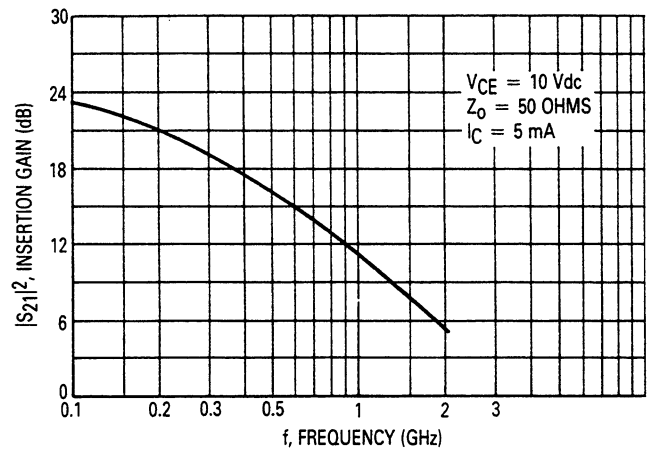


Figure 7. Insertion Gain versus Frequency

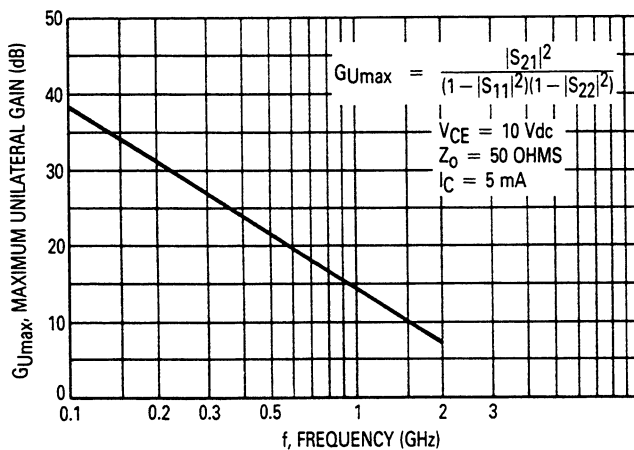
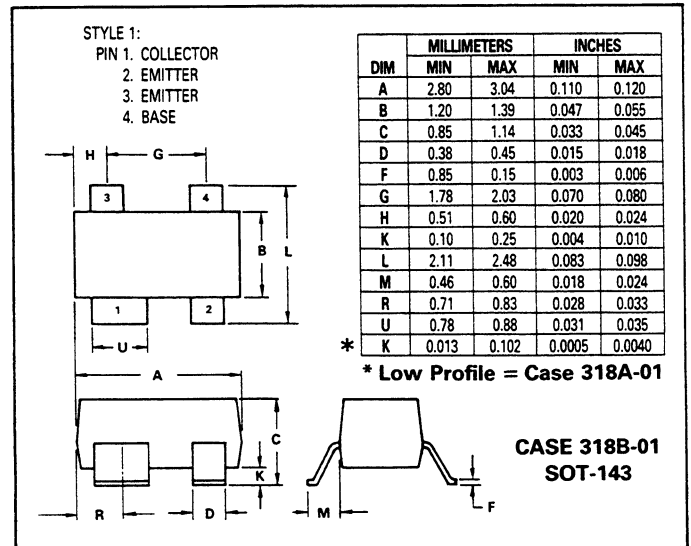


Figure 8. Maximum Unilateral Gain versus Frequency

OUTLINE DIMENSIONS



COMMON EMITTER S-PARAMETERS

| VCE (Vdc) | IC (mA) | f (MHz) | S11 | | S21 | | S12 | | S22 | | |
|--------------|------------|------------|------|------|-------|-------|------|------|------|------|-----|
| | | | S11 | ∠φ | S21 | ∠φ | S12 | ∠φ | S22 | ∠φ | |
| 5 | 5 | 100 | 0.85 | -41 | 13.64 | 153 | 0.03 | 65 | 0.93 | -17 | |
| | | 200 | 0.78 | -76 | 10.77 | 134 | 0.05 | 54 | 0.80 | -29 | |
| | | 500 | 0.71 | -131 | 6.10 | 102 | 0.08 | 35 | 0.55 | -42 | |
| | | 1000 | 0.66 | -169 | 3.22 | 77 | 0.08 | 33 | 0.45 | -48 | |
| | | 2000 | 0.60 | 152 | 1.65 | 47 | 0.11 | 46 | 0.47 | -63 | |
| | 10 | 100 | 0.72 | -59 | 20.01 | 145 | 0.03 | 62 | 0.87 | -23 | |
| | | 200 | 0.70 | -100 | 14.31 | 123 | 0.04 | 49 | 0.67 | -36 | |
| | | 500 | 0.66 | -150 | 7.03 | 94 | 0.06 | 38 | 0.44 | -43 | |
| | | 1000 | 0.63 | 179 | 3.57 | 73 | 0.07 | 45 | 0.37 | -46 | |
| | | 2000 | 0.58 | 147 | 1.79 | 46 | 0.11 | 57 | 0.41 | -60 | |
| | 15 | 100 | 0.65 | -75 | 23.44 | 138 | 0.02 | 57 | 0.81 | -27 | |
| | | 200 | 0.66 | -118 | 15.56 | 116 | 0.04 | 46 | 0.59 | -38 | |
| | | 500 | 0.65 | -159 | 7.10 | 90 | 0.05 | 42 | 0.40 | -40 | |
| | | 1000 | 0.63 | 174 | 3.57 | 71 | 0.06 | 52 | 0.35 | -43 | |
| | | 2000 | 0.59 | 144 | 1.77 | 45 | 0.11 | 62 | 0.40 | -58 | |
| | 20 | 100 | 0.61 | -89 | 24.32 | 133 | 0.02 | 51 | 0.77 | -28 | |
| | | 200 | 0.66 | -130 | 15.11 | 111 | 0.03 | 43 | 0.55 | -35 | |
| | | 500 | 0.66 | -166 | 6.68 | 88 | 0.04 | 46 | 0.41 | -34 | |
| | | 1000 | 0.65 | 171 | 3.32 | 69 | 0.06 | 56 | 0.39 | -39 | |
| | | 2000 | 0.61 | 143 | 1.65 | 43 | 0.10 | 65 | 0.44 | -56 | |
| | 30 | 100 | 0.63 | -132 | 13.18 | 118 | 0.02 | 47 | 0.72 | -15 | |
| | | 200 | 0.68 | -157 | 7.07 | 104 | 0.02 | 44 | 0.66 | -16 | |
| | | 500 | 0.69 | -177 | 3.23 | 90 | 0.03 | 55 | 0.62 | -24 | |
| | | 1000 | 0.70 | 165 | 1.78 | 71 | 0.05 | 65 | 0.59 | -38 | |
| | | 2000 | 0.66 | 138 | 0.93 | 42 | 0.09 | 79 | 0.62 | -62 | |
| | 10 | 5 | 100 | 0.85 | -38 | 13.67 | 155 | 0.03 | 70 | 0.93 | -14 |
| | | | 200 | 0.80 | -71 | 10.97 | 136 | 0.05 | 56 | 0.83 | -24 |
| | | | 500 | 0.70 | -126 | 6.35 | 104 | 0.07 | 37 | 0.60 | -35 |
| | | | 1000 | 0.65 | -166 | 3.39 | 78 | 0.07 | 36 | 0.51 | -40 |
| | | | 2000 | 0.58 | 154 | 1.74 | 48 | 0.10 | 50 | 0.54 | -55 |
| 10 | | 100 | 0.75 | -55 | 20.12 | 147 | 0.02 | 66 | 0.88 | -19 | |
| | | 200 | 0.71 | -94 | 14.60 | 125 | 0.04 | 50 | 0.72 | -30 | |
| | | 500 | 0.65 | -145 | 7.33 | 96 | 0.05 | 39 | 0.50 | -35 | |
| | | 1000 | 0.62 | -177 | 3.74 | 74 | 0.06 | 46 | 0.45 | -38 | |
| | | 2000 | 0.57 | 149 | 1.88 | 47 | 0.10 | 60 | 0.49 | -53 | |
| 15 | | 100 | 0.68 | -68 | 23.53 | 140 | 0.02 | 61 | 0.85 | -22 | |
| | | 200 | 0.67 | -110 | 15.90 | 119 | 0.03 | 49 | 0.65 | -31 | |
| | | 500 | 0.64 | -155 | 7.45 | 92 | 0.04 | 42 | 0.47 | -32 | |
| | | 1000 | 0.62 | 177 | 3.74 | 71 | 0.06 | 53 | 0.44 | -35 | |
| | | 2000 | 0.58 | 146 | 1.90 | 45 | 0.09 | 65 | 0.50 | -51 | |
| 20 | | 100 | 0.64 | -79 | 24.77 | 135 | 0.02 | 56 | 0.81 | -23 | |
| | | 200 | 0.64 | -122 | 15.81 | 114 | 0.03 | 46 | 0.62 | -29 | |
| | | 500 | 0.64 | -161 | 7.10 | 89 | 0.04 | 46 | 0.48 | -28 | |
| | | 1000 | 0.62 | 174 | 3.53 | 70 | 0.05 | 56 | 0.46 | -33 | |
| | | 2000 | 0.59 | 145 | 1.75 | 44 | 0.09 | 68 | 0.53 | -50 | |
| 30 | | 100 | 0.61 | -114 | 16.25 | 123 | 0.01 | 48 | 0.79 | -15 | |
| | | 200 | 0.63 | -147 | 9.10 | 107 | 0.02 | 49 | 0.71 | -15 | |
| | | 500 | 0.65 | -172 | 4.22 | 90 | 0.03 | 53 | 0.66 | -22 | |
| | | 1000 | 0.66 | 168 | 2.27 | 71 | 0.05 | 63 | 0.63 | -33 | |
| | | 2000 | 0.63 | 140 | 1.15 | 41 | 0.08 | 79 | 0.67 | -53 | |



MOTOROLA

MRF9011 • MRF9011L

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