MOTOROLA
**SEMICONDUCTOR**
TECHNICAL DATA

**MRF5812**
**BF433***

*European Part Number

2

## The RF Line
# NPN Silicon RF Low Power Transistor

. . . designed for high current, low power amplifiers up to 2 GHz.

- High Current Gain-Bandwidth Product — $f_T$ = 5.5 GHz (Typ) @ $I_C$ = 75 mA
- Low Noise — 2 dB (Typ) @ 500 MHz
- Low Intermodulation Distortion
- High Gain — 15.5 dB (Typ) @ 500 MHz
- Low Cost SORF Plastic Surface Mount Package
- State-of-the-Art Technology
  - Fine Line Geometry
  - Gold Top Metal and Wires
  - Silicon Nitride Passivated
  - Ion Implanted Arsenic Emitters
- Die Same as MRF581,A

$I_C$ = 200 mA
SURFACE MOUNT
HIGH FREQUENCY
TRANSISTOR
NPN SILICON


CASE 751-03, STYLE 1
SORF
(SO-8)

**MAXIMUM RATINGS**

| Rating | Symbol | Value | Unit |
|---|---|---|---|
| Collector-Emitter Voltage | $V_{CEO}$ | 15 | Vdc |
| Collector-Base Voltage | $V_{CBO}$ | 30 | Vdc |
| Emitter-Base Voltage | $V_{EBO}$ | 2.5 | Vdc |
| Collector-Current — Continuous | $I_C$ | 200 | mAdc |
| Total Device Dissipation @ $T_C$ = 110°C (1)<br>Derate above 110°C | $P_D$ | 1.0<br>25 | Watts<br>mW/°C |
| Total Device Dissipation @ $T_A$ = 25°C<br>Derate above 25°C (2) | $P_D$ | 1.0<br>8.0 | Watts<br>mW/°C |
| Operating Junction and Storage Temperature Range | $T_J$, $T_{stg}$ | −65 to +150 | °C |

**THERMAL CHARACTERISTICS**

| Characteristic | Symbol | Max | Unit |
|---|---|---|---|
| Thermal Resistance, Junction to Case | $R_{\theta JC}$ | 45 | °C/W |
| Thermal Resistance, Junction to Ambient | $R_{\theta JA}$ | 85 | °C/W |

**ELECTRICAL CHARACTERISTICS** ($T_C$ = 25°C unless otherwise noted.)

| Characteristic | Symbol | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| **OFF CHARACTERISTICS** | | | | | |
| Collector-Emitter Breakdown Voltage ($I_C$ = 5 mAdc, $I_B$ = 0) | $V_{(BR)CEO}$ | 15 | — | — | Vdc |
| Collector-Emitter Breakdown Voltage ($I_C$ = 5 mAdc, $V_{BE}$ = 0) | $V_{(BR)CES}$ | 30 | — | — | Vdc |
| Emitter-Base Breakdown Voltage ($I_E$ = 0.1 mAdc, $I_C$ = 0) | $V_{(BR)EBO}$ | 2.5 | — | — | Vdc |
| Collector Cutoff Current ($V_{CB}$ = 15 Vdc, $V_{BE}$ = 0, $T_C$ = 25°C) | $I_{CBO}$ | — | — | 0.1 | mAdc |
| **ON CHARACTERISTICS** | | | | | |
| DC Current Gain ($I_C$ = 50 mAdc, $V_{CE}$ = 10 Vdc) | $h_{FE}$ | 30 | 90 | 200 | — |

(1) Case temperature is measured on the collector lead where the lead contacts the printed circuit board closest to the body of the package.
(2) Free air.

(continued)

**ELECTRICAL CHARACTERISTICS — continued** ($T_C$ = 25°C unless otherwise noted.)

| Characteristic | Symbol | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| **DYNAMIC CHARACTERISTICS** | | | | | |
| Collector Base Capacitance ($V_{CB}$ = 10 Vdc, $I_E$ = 0, f = 1 MHz) | $C_{cb}$ | — | 1.2 | 2 | pF |
| Current-Gain Bandwidth Product (1) ($I_C$ = 75 mAdc, $V_{CE}$ = 10 Vdc, f = 1 GHz) | $f_T$ | — | 5.5 | — | GHz |
| **FUNCTIONAL TESTS** | | | | | |
| Noise Figure (Minimum) ($I_C$ = 50 mAdc, $V_{CE}$ = 10 Vdc, f = 0.5 GHz) Figure 4 | $NF_{MIN}$ | — | 2 | — | dB |
| Noise Figure (50 Ohm Insertion) ($I_C$ = 50 mAdc, $V_{CE}$ = 10 Vdc, f = 0.5 GHz) Figure 5 | $NF_{50\,\Omega}$ | — | 2.5 | 3 | dB |
| Power Gain Associated with Noise Figure ($I_C$ = 50 mAdc, $V_{CE}$ = 10 Vdc, f = 0.5 GHz) Figure 5 | $\|S_{21}\|^2$ | 13 | 15.5 | — | dB |
| Maximum Unilateral Gain (1) ($I_C$ = 75 mAdc, $V_{CE}$ = 10 Vdc, f = 0.5 GHz) | $G_{Umax}$ | — | 17 | — | dB |
| Intermodulation Distortion (2) Figure 1 ($V_{CE}$ = 10 V, $I_C$ = 75 mA, $V_{out}$ = +50 dBmV) | IMD(d3) | — | −65 | — | dB |

Notes: (1) Characterized on HP8542 Automatic Network Analyzer. $G_{Umax} = \frac{|S_{21}|^2}{(1 - |S_{11}|^2)(1 - |S_{22}|^2)}$

(2) 2 Tones, f1 = 497 MHz, f2 = 503 MHz, 3rd Order Single Tone Reference.

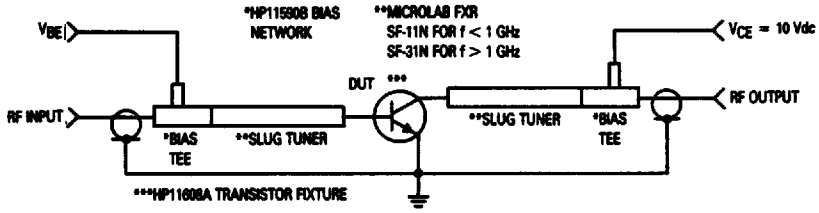


**Figure 1. Functional Circuit Schematic**

## TYPICAL CHARACTERISTICS

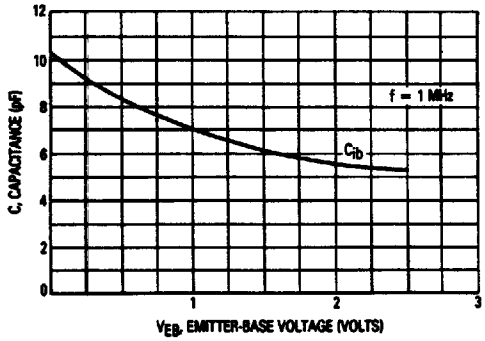


**Figure 2. $C_{ib}$ Input Capacitance versus Voltage**

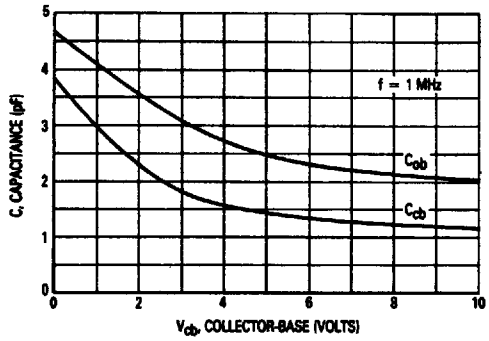


**Figure 3. $C_{cb}$, $C_{ob}$ Collector-Base Capacitance versus Voltage**

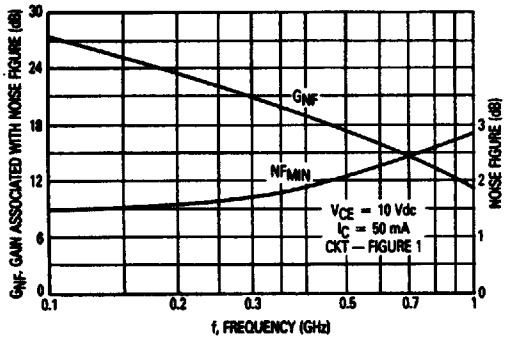


**Figure 4. Noise Figure and Gain Associated with Noise Figure versus Frequency**

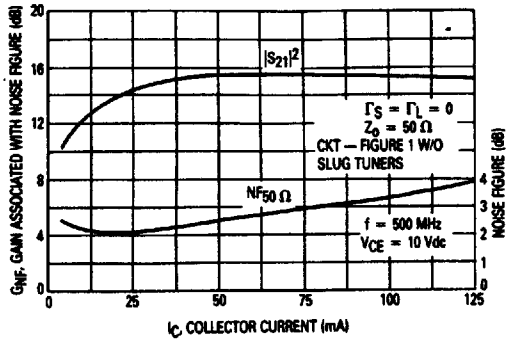


**Figure 5. Noise Figure and Gain Associated with Noise Figure versus Collector Current**

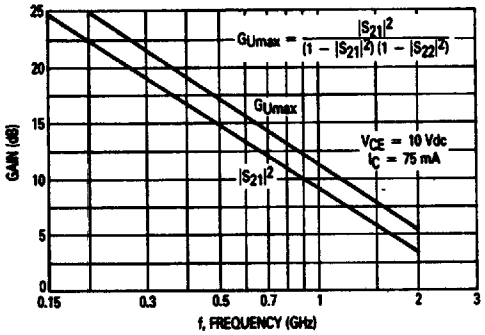


**Figure 6. $G_{Umax}$ — Maximum Unilateral Gain, $|S_{21}|^2$ versus Frequency**

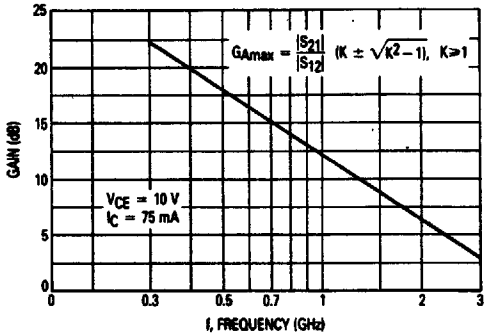


**Figure 7. $G_{Amax}$, Maximum Available Gain versus Frequency**

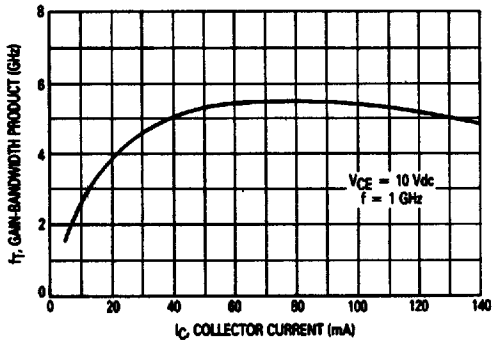


**Figure 8. Gain-Bandwidth Product versus Collector Current**

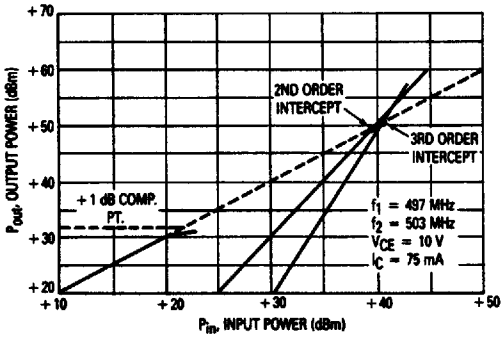


**Figure 9. 2nd and 3rd Order Intercept Points and 1 dB Compression Point**

| $V_{CE}$ (Volts) | $I_C$ (mA) | f (MHz) | $S_{11}$ | | $S_{21}$ | | $S_{12}$ | | $S_{22}$ | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | $\|S_{11}\|$ | $\angle\phi$ | $\|S_{21}\|$ | $\angle\phi$ | $\|S_{12}\|$ | $\angle\phi$ | $\|S_{22}\|$ | $\angle\phi$ |
| 5 | 25 | 100 | 0.66 | −123 | 18.3 | 118 | 0.04 | 43 | 0.53 | −79 |
| | | 300 | 0.66 | −167 | 7 | 92 | 0.06 | 44 | 0.31 | −120 |
| | | 500 | 0.65 | 178 | 4.3 | 81 | 0.08 | 52 | 0.28 | −133 |
| | | 1000 | 0.62 | 154 | 2.2 | 63 | 0.13 | 61 | 0.28 | −141 |
| | | 2000 | 0.57 | 109 | 1.3 | 39 | 0.28 | 57 | 0.31 | −148 |
| | | 3000 | 0.55 | 68 | 1 | 23 | 0.41 | 41 | 0.34 | −164 |
| | 50 | 100 | 0.64 | −133 | 20.2 | 114 | 0.04 | 44 | 0.51 | −93 |
| | | 300 | 0.65 | −171 | 7.6 | 91 | 0.06 | 50 | 0.34 | −137 |
| | | 500 | 0.65 | 175 | 4.6 | 81 | 0.08 | 56 | 0.31 | −148 |
| | | 1000 | 0.61 | 152 | 2.3 | 63 | 0.13 | 63 | 0.28 | −149 |
| | | 2000 | 0.56 | 109 | 1.3 | 39 | 0.28 | 57 | 0.3 | −150 |
| | | 3000 | 0.52 | 70 | 1 | 23 | 0.41 | 39 | 0.29 | −169 |
| | 75 | 100 | 0.64 | −137 | 20.8 | 113 | 0.04 | 44 | 0.5 | −99 |
| | | 300 | 0.66 | −173 | 7.7 | 91 | 0.06 | 52 | 0.35 | −142 |
| | | 500 | 0.64 | 174 | 4.7 | 82 | 0.08 | 59 | 0.32 | −154 |
| | | 1000 | 0.61 | 151 | 2.4 | 65 | 0.14 | 64 | 0.3 | −164 |
| | | 2000 | 0.54 | 107 | 1.4 | 42 | 0.3 | 55 | 0.27 | −167 |
| | | 3000 | 0.52 | 69 | 1.1 | 24 | 0.42 | 37 | 0.25 | −172 |
| | 100 | 100 | 0.64 | −140 | 20.8 | 112 | 0.03 | 44 | 0.5 | −103 |
| | | 300 | 0.65 | −174 | 7.6 | 90 | 0.06 | 53 | 0.36 | −145 |
| | | 500 | 0.64 | 173 | 4.7 | 81 | 0.08 | 60 | 0.33 | −156 |
| | | 1000 | 0.61 | 151 | 2.4 | 65 | 0.15 | 64 | 0.31 | −166 |
| | | 2000 | 0.54 | 107 | 1.4 | 42 | 0.3 | 54 | 0.27 | −169 |
| | | 3000 | 0.52 | 65 | 1.1 | 24 | 0.42 | 37 | 0.25 | −174 |
| 10 | 25 | 100 | 0.65 | −112 | 20.2 | 121 | 0.04 | 46 | 0.56 | −62 |
| | | 300 | 0.63 | −162 | 8 | 93 | 0.05 | 46 | 0.29 | −93 |
| | | 500 | 0.62 | −178 | 5 | 82 | 0.07 | 52 | 0.25 | −102 |
| | | 1000 | 0.6 | 157 | 2.5 | 63 | 0.11 | 63 | 0.26 | −112 |
| | | 2000 | 0.55 | 112 | 1.4 | 39 | 0.25 | 61 | 0.35 | −125 |
| | | 3000 | 0.55 | 69 | 1 | 23 | 0.39 | 47 | 0.4 | −145 |
| | 50 | 100 | 0.63 | −122 | 22.9 | 117 | 0.03 | 46 | 0.5 | −74 |
| | | 300 | 0.62 | −167 | 8.8 | 92 | 0.05 | 51 | 0.28 | −112 |
| | | 500 | 0.6 | 178 | 5.3 | 82 | 0.07 | 58 | 0.24 | −122 |
| | | 1000 | 0.58 | 154 | 2.7 | 64 | 0.12 | 65 | 0.23 | −129 |
| | | 2000 | 0.51 | 111 | 1.5 | 40 | 0.26 | 59 | 0.28 | −132 |
| | | 3000 | 0.5 | 70 | 1.2 | 24 | 0.39 | 44 | 0.34 | −144 |
| | 75 | 100 | 0.63 | −126 | 23.8 | 116 | 0.03 | 45 | 0.49 | −80 |
| | | 300 | 0.63 | −168 | 9 | 92 | 0.05 | 51 | 0.28 | −120 |
| | | 500 | 0.62 | 177 | 5.5 | 82 | 0.07 | 58 | 0.24 | −130 |
| | | 1000 | 0.58 | 154 | 2.8 | 65 | 0.12 | 65 | 0.23 | −137 |
| | | 2000 | 0.52 | 111 | 1.5 | 41 | 0.26 | 58 | 0.27 | −135 |
| | | 3000 | 0.5 | 70 | 1.2 | 24 | 0.39 | 42 | 0.32 | −145 |
| | 100 | 100 | 0.62 | −128 | 23.8 | 114 | 0.03 | 46 | 0.46 | −82 |
| | | 300 | 0.62 | −169 | 8.9 | 91 | 0.05 | 54 | 0.26 | −120 |
| | | 500 | 0.6 | 176 | 5.4 | 81 | 0.07 | 61 | 0.23 | −130 |
| | | 1000 | 0.57 | 152 | 2.8 | 64 | 0.12 | 66 | 0.21 | −136 |
| | | 2000 | 0.51 | 109 | 1.5 | 40 | 0.27 | 59 | 0.26 | −134 |
| | | 3000 | 0.5 | 68 | 1.2 | 24 | 0.39 | 43 | 0.32 | −145 |
| 15 | 25 | 100 | 0.68 | −106 | 21 | 123 | 0.03 | 47 | 0.57 | −54 |
| | | 300 | 0.63 | −159 | 8.5 | 94 | 0.05 | 46 | 0.3 | −77 |
| | | 500 | 0.61 | −177 | 5.2 | 82 | 0.06 | 52 | 0.26 | −84 |
| | | 1000 | 0.58 | 156 | 2.6 | 62 | 0.11 | 64 | 0.28 | −96 |
| | | 2000 | 0.54 | 110 | 1.4 | 36 | 0.23 | 63 | 0.39 | −115 |
| | | 3000 | 0.56 | 68 | 1 | 22 | 0.37 | 49 | 0.46 | −137 |
| | 50 | 100 | 0.62 | −114 | 24 | 119 | 0.03 | 46 | 0.51 | −64 |
| | | 300 | 0.6 | −163 | 9.2 | 93 | 0.05 | 51 | 0.26 | −92 |
| | | 500 | 0.58 | −179 | 5.7 | 81 | 0.07 | 58 | 0.22 | −100 |
| | | 1000 | 0.56 | 154 | 2.9 | 63 | 0.12 | 66 | 0.23 | −109 |
| | | 2000 | 0.52 | 109 | 1.5 | 39 | 0.25 | 60 | 0.32 | −118 |
| | | 3000 | 0.52 | 67 | 1.1 | 22 | 0.37 | 46 | 0.39 | −137 |
| | 75 | 100 | 0.62 | −118 | 24.6 | 117 | 0.03 | 46 | 0.48 | −67 |
| | | 300 | 0.59 | −165 | 9.4 | 92 | 0.05 | 53 | 0.24 | −96 |
| | | 500 | 0.58 | 179 | 5.7 | 81 | 0.07 | 60 | 0.21 | −104 |
| | | 1000 | 0.56 | 154 | 2.9 | 63 | 0.12 | 66 | 0.22 | −111 |
| | | 2000 | 0.5 | 109 | 1.5 | 38 | 0.25 | 60 | 0.31 | −118 |
| | | 3000 | 0.52 | 67 | 1.1 | 22 | 0.37 | 46 | 0.38 | −136 |
| | 100 | 100 | 0.62 | −121 | 24.8 | 116 | 0.03 | 46 | 0.46 | −68 |
| | | 300 | 0.6 | −165 | 9.3 | 91 | 0.05 | 53 | 0.23 | −96 |
| | | 500 | 0.58 | 179 | 5.7 | 81 | 0.07 | 61 | 0.2 | −102 |
| | | 1000 | 0.56 | 155 | 2.9 | 63 | 0.12 | 65 | 0.22 | −109 |
| | | 2000 | 0.5 | 111 | 1.5 | 39 | 0.25 | 62 | 0.32 | −117 |
| | | 3000 | 0.5 | 68 | 1.1 | 23 | 0.37 | 47 | 0.39 | −136 |

**Figure 10. Common Emitter S-Parameters**