

Low Current, High Performance NPN Silicon Bipolar Transistor

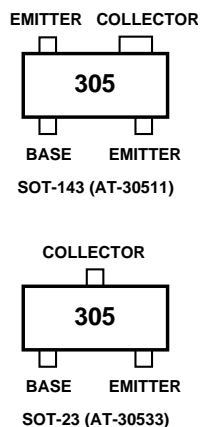
Technical Data

AT-30511 AT-30533

Features

- **High Performance Bipolar Transistor Optimized for Low Current, Low Voltage Operation**
- **900 MHz Performance:**
AT-30511: 1.1 dB NF, 16 dB G_A
AT-30533: 1.1 dB NF, 13 dB G_A
- **Characterized for End-Of-Life Battery Use (2.7 V)**
- **SOT-23 and SOT-143 SMT Plastic Packages**
- **Tape-And-Reel Packaging Option Available^[1]**

Outline Drawing



Note:

1. Refer to "Tape-and-Reel Packaging for Semiconductor Devices".

Description

Hewlett-Packard's AT-30511 and AT-30533 are high performance NPN bipolar transistors that have been optimized for maximum f_T at low voltage operation, making them ideal for use in battery powered applications in wireless markets. The AT-30533 uses the 3 lead SOT-23, while the AT-30511 places the same die in the higher performance 4 lead SOT-143. Both packages are industry standard, and compatible with high volume surface mount assembly techniques.

The 3.2 micron emitter-to-emitter pitch and reduced parasitic design of these transistors yields extremely high performance products that can perform a multiplicity of tasks. The 5 emitter finger interdigitated geometry yields an extremely fast transistor with high gain and low operating currents.

Optimized performance at 2.7 V makes these devices ideal for use in 900 MHz, 1.8 GHz, and 2.4 GHz battery operated systems as an LNA, gain stage, buffer, oscillator, or active mixer. Typical amplifier designs at 900 MHz yield 1.3 dB noise figures with 13 dB or more associated gain at a 2.7 V, 1 mA bias. Voltage breakdowns are high enough for use at 5 volts. High gain capability at 1 V, 1 mA makes these devices a good fit for 900 MHz pager applications.

The AT-3 series bipolar transistors are fabricated using an optimized version of Hewlett-Packard's 10 GHz f_T , 30 GHz f_{MAX} Self-Aligned-Transistor (SAT) process. The die are nitride passivated for surface protection. Excellent device uniformity, performance and reliability are produced by the use of ion-implantation, self-alignment techniques, and gold metalization in the fabrication of these devices.

AT-30511, AT-30533 Absolute Maximum Ratings

| Symbol | Parameter | Units | Absolute Maximum ^[1] |
|-----------|-------------------------------------|-------|---------------------------------|
| V_{EBO} | Emitter-Base Voltage | V | 1.5 |
| V_{CBO} | Collector-Base Voltage | V | 11 |
| V_{CEO} | Collector-Emitter Voltage | V | 5.5 |
| I_C | Collector Current | mA | 8 |
| P_T | Power Dissipation ^{[2][3]} | mW | 100 |
| T_j | Junction Temperature | °C | 150 |
| T_{STG} | Storage Temperature | °C | -65 to 150 |

Thermal Resistance^[2]:

$$\theta_{jc} = 550^\circ\text{C/W}$$

Notes:

1. Operation of this device above any one of these parameters may cause permanent damage.
2. $T_{\text{Mounting Surface}} = 25^\circ\text{C}$.
3. Derate at 1.82 mW/°C for $T_C > 95^\circ\text{C}$.

Electrical Specifications, $T_A = 25^\circ\text{C}$

| Symbol | Parameters and Test Conditions | Units | AT-30511 | | | AT-30533 | | |
|-----------|---|--|---------------|--------------------|--------------------|----------|--------------------|--------------------|
| | | | Min | Typ | Max | Min | Typ | Max |
| NF | Noise Figure $V_{CE} = 2.7\text{ V}, I_C = 1\text{ mA}$ | $f = 0.9\text{ GHz}$ | dB | 1.1 ^[1] | 1.4 ^[1] | | 1.1 ^[2] | 1.4 ^[2] |
| G_A | Associated Gain $V_{CE} = 2.7\text{ V}, I_C = 1\text{ mA}$ | $f = 0.9\text{ GHz}$ | dB | 14 ^[1] | 16 ^[1] | | 11 ^[2] | 13 ^[2] |
| h_{FE} | Forward Current Transfer Ratio | $V_{CE} = 2.7\text{ V}$ $I_C = 1\text{ mA}$ | - | 70 | | 300 | 70 | 300 |
| I_{CBO} | Collector Cutoff Current | $V_{CB} = 3\text{ V}$ | μA | | 0.03 | 0.2 | 0.03 | 0.2 |
| I_{EBO} | Emitter Cutoff Current | $V_{EB} = 1\text{ V}$ | μA | | 0.1 | 1.5 | 0.1 | 1.5 |

Notes:

1. Test circuit B, Figure 1. Numbers reflect device performance de-embedded from circuit losses.
Input loss = 0.4 dB; output loss = 0.4 dB.
2. Test circuit A, Figure 1. Numbers reflect device performance de-embedded from circuit losses.
Input loss = 0.4 dB; output loss = 0.4 dB.

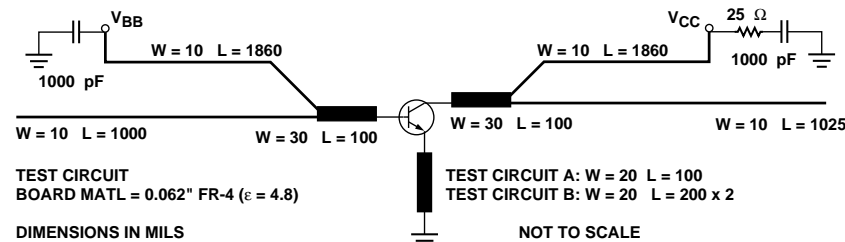


Figure 1. Test Circuit for Noise Figure and Associated Gain. This Circuit is a Compromise Match Between Best Noise Figure, Best Gain, Stability, a Practical, Synthesizable Match, and a Circuit Capable of Matching Both the AT-305 and AT-310 Geometries.

AT-30511, AT-30533 Characterization Information, $T_A = 25^\circ\text{C}$

| Symbol | Parameters and Test Conditions | Units | AT-30511 | AT-30533 |
|--------------------------|--|-------|----------|----------|
| | | | Typ | Typ |
| $P_{1\text{dB}}$ | Power at 1 dB Gain Compression (opt tuning) $V_{\text{CE}} = 2.7\text{ V}, I_{\text{C}} = 5\text{ mA}$ $f = 0.9\text{ GHz}$ | dBm | 7 | 7 |
| $G_{1\text{dB}}$ | Gain at 1 dB Gain Compression (opt tuning) $V_{\text{CE}} = 2.7\text{ V}, I_{\text{C}} = 5\text{ mA}$ $f = 0.9\text{ GHz}$ | dB | 16.5 | 15 |
| IP_3 | Output Third Order Intercept Point, $V_{\text{CE}} = 2.7\text{ V}, I_{\text{C}} = 5\text{ mA}$ (opt tuning) $f = 0.9\text{ GHz}$ | dBm | 17 | 17 |
| $ S_{21} _{\text{dB}}^2$ | Gain in $50\ \Omega$ System; $V_{\text{CE}} = 2.7\text{ V}, I_{\text{C}} = 1\text{ mA}$ $f = 0.9\text{ GHz}$ | dB | 10 | 9 |
| C_{CB} | Collector-Base Capacitance $V_{\text{CB}} = 3\text{ V}, f = 1\text{ MHz}$ | pF | 0.04 | 0.04 |

Typical Performance

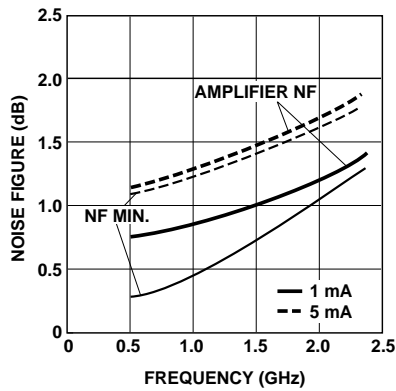


Figure 2. AT-30511 and AT-30533 Minimum Noise Figure and Amplifier NF^[1] vs. Frequency and Current at $V_{\text{CE}} = 2.7\text{ V}$.

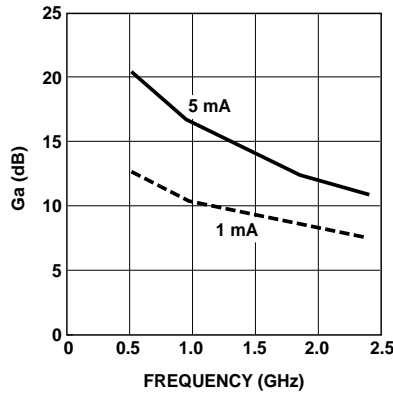


Figure 3. AT-30511 Associated Gain at Optimum Noise Match vs. Frequency and Current at $V_{\text{CE}} = 2.7\text{ V}$.

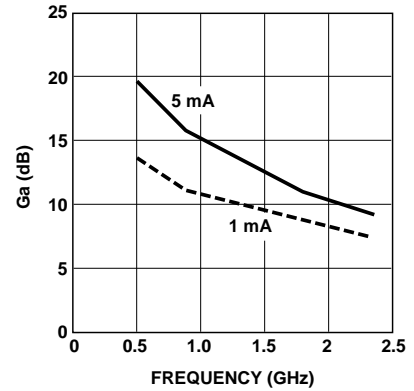


Figure 4. AT-30533 Associated Gain at Optimum Noise Match vs. Frequency and Current at $V_{\text{CE}} = 2.7\text{ V}$.

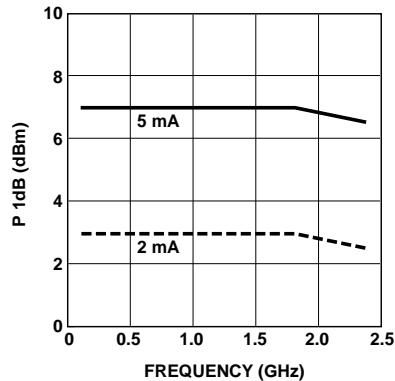


Figure 5. AT-30511 and AT-30533 Power at 1 dB Gain Compression vs. Frequency and Current at $V_{\text{CE}} = 2.7\text{ V}$.

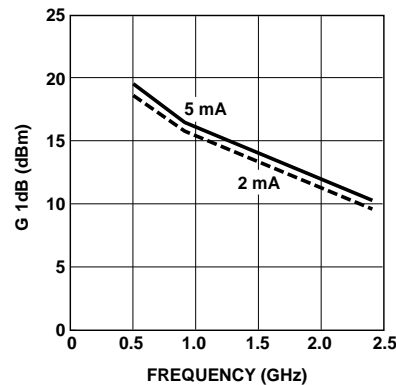


Figure 6. AT-30511 1 dB Compressed Gain vs. Frequency and Current at $V_{\text{CE}} = 2.7\text{ V}$.

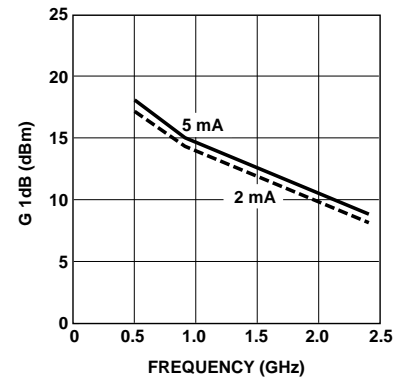


Figure 7. AT-30533 1 dB Compressed Gain vs. Frequency and Current at $V_{\text{CE}} = 2.7\text{ V}$.

Note:

1. Amplifier NF represents the noise figure which can be expected in a real circuit representing reasonable reflection coefficients and including circuit losses.

AT-30511, AT-30533 Typical Performance, continued

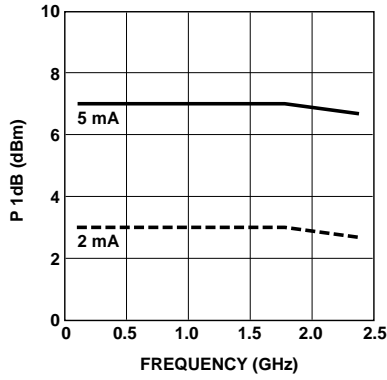


Figure 8. AT-30511 and AT-30533 Power at 1 dB Gain Compression vs. Frequency and Current at $V_{CE} = 5$ V.

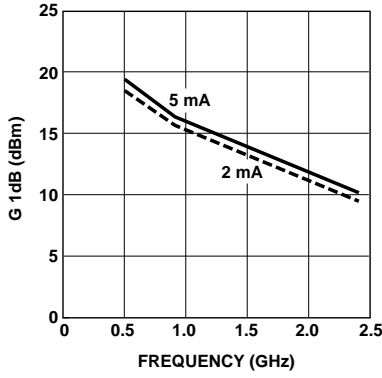


Figure 9. AT-30511 1 dB Compressed Gain vs. Frequency and Current at $V_{CE} = 5$ V.

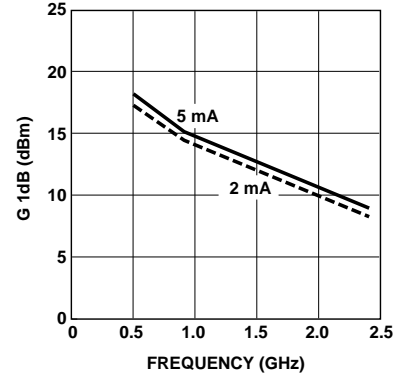


Figure 10. AT-30533 1 dB Compressed Gain vs. Frequency and Current at $V_{CE} = 5$ V.

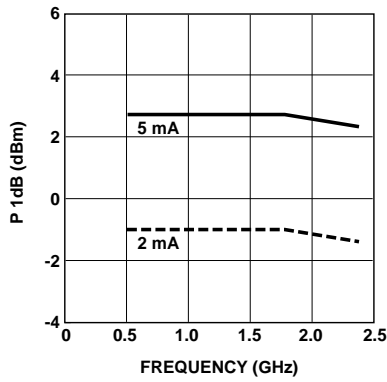


Figure 11. AT-30511 and AT-30533 Power at 1 dB Gain Compression vs. Frequency and Current at $V_{CE} = 1$ V.

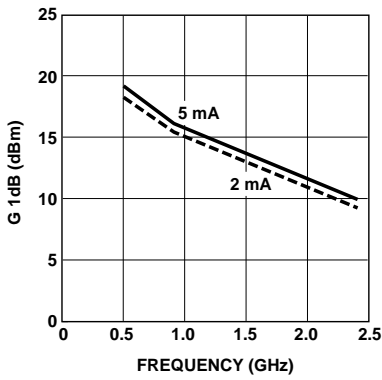


Figure 12. AT-30511 1 dB Compressed Gain vs. Frequency and Current at $V_{CE} = 1$ V.

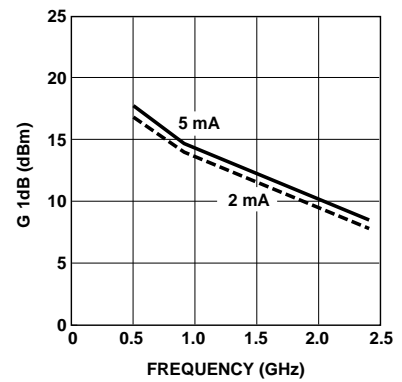


Figure 13. AT-30533 1 dB Compressed Gain vs. Frequency and Current at $V_{CE} = 1$ V.

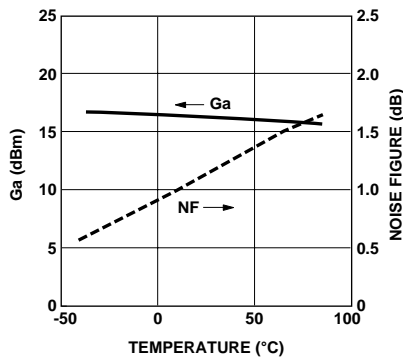


Figure 14. AT-30511 Noise Figure and Associated Gain at $V_{CE} = 2.7$ V, $I_C = 1$ mA vs. Temperature in Test Circuit, Figure 1. (Circuit Losses De-embedded)

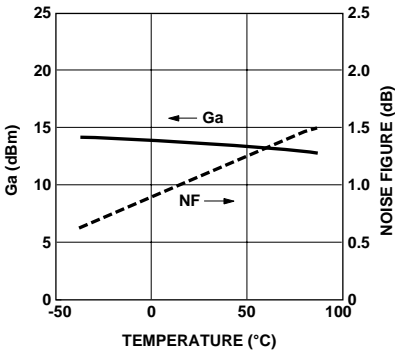


Figure 15. AT-30533 Noise Figure and Associated Gain at $V_{CE} = 2.7$ V, $I_C = 1$ mA vs. Temperature in Test Circuit, Figure 1. (Circuit Losses De-embedded)

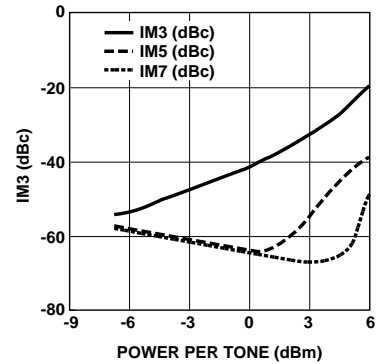


Figure 16. AT-30511 and AT-30533 Intermodulation Products vs. Output Power at $V_{CE} = 2.7$ V, $I_C = 10$ mA, 900 MHz with Optimal Tuning.

AT-30511 Typical Scattering Parameters, $V_{CE} = 1\text{ V}$, $I_C = 1\text{ mA}$, Common Emitter, $Z_O = 50\ \Omega$

| Freq. GHz | S_{11} | | S_{21} | | | S_{12} | | | S_{22} | |
|--------------|----------|------|----------|------|-----|----------|------|-----|----------|-----|
| | Mag | Ang | dB | Mag | Ang | dB | Mag | Ang | Mag | Ang |
| 0.1 | 0.97 | -5 | 10.84 | 3.48 | 175 | -39.42 | 0.01 | 86 | 0.99 | -2 |
| 0.5 | 0.95 | -24 | 10.51 | 3.35 | 155 | -25.87 | 0.05 | 72 | 0.95 | -14 |
| 0.9 | 0.85 | -42 | 9.96 | 3.15 | 137 | -21.46 | 0.08 | 61 | 0.92 | -24 |
| 1.0 | 0.83 | -46 | 9.66 | 3.04 | 133 | -20.71 | 0.09 | 58 | 0.91 | -26 |
| 1.5 | 0.70 | -67 | 8.71 | 2.73 | 113 | -18.44 | 0.12 | 46 | 0.84 | -36 |
| 1.8 | 0.63 | -78 | 8.06 | 2.53 | 102 | -17.69 | 0.13 | 41 | 0.80 | -40 |
| 2.0 | 0.59 | -85 | 7.75 | 2.44 | 96 | -17.27 | 0.14 | 37 | 0.77 | -43 |
| 2.4 | 0.50 | -100 | 6.73 | 2.17 | 84 | -16.79 | 0.14 | 32 | 0.73 | -48 |
| 3.0 | 0.39 | -122 | 5.58 | 1.90 | 67 | -16.32 | 0.15 | 27 | 0.68 | -53 |
| 4.0 | 0.29 | -161 | 3.97 | 1.58 | 45 | -15.87 | 0.16 | 20 | 0.63 | -63 |
| 5.0 | 0.27 | 153 | 2.64 | 1.36 | 25 | -15.47 | 0.17 | 20 | 0.61 | -72 |

AT-30511 Typical Noise Parameters,

Common Emitter, $Z_O = 50\ \Omega$, 1 V , $I_C = 1\text{ mA}$

| Freq GHz | $F_{min}^{[1]}$ dB | Γ_{OPT} | | R_n |
|--------------------|-----------------------|----------------|-----|-------|
| | | Mag | Ang | |
| 0.5 ^[2] | 0.3 | 0.96 | 10 | 1.49 |
| 0.9 | 0.4 | 0.92 | 19 | 1.33 |
| 1.8 | 0.9 | 0.83 | 43 | 0.98 |
| 2.4 | 1.3 | 0.76 | 60 | 0.74 |

Notes:

1. Matching constraints may make F_{min} values associated with high $|\Gamma_{opt}|$ values unachievable in physical circuits. See Fig. 2 for expected performance.
2. 0.5 GHz noise parameter values are extrapolated, not measured.

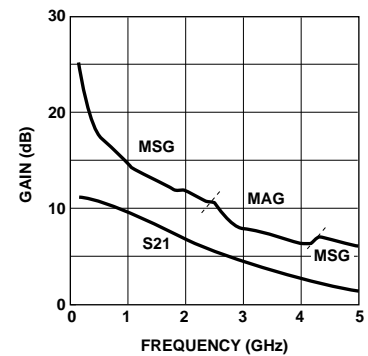


Figure 17. AT-30511 Gains vs. Frequency at $V_{CE} = 1\text{ V}$, $I_C = 1\text{ mA}$.

AT-30533 Typical Scattering Parameters, $V_{CE} = 1\text{ V}$, $I_C = 1\text{ mA}$, Common Emitter, $Z_O = 50\ \Omega$

| Freq. GHz | S_{11} | | S_{21} | | | S_{12} | | | S_{22} | |
|--------------|----------|------|----------|------|-----|----------|------|-----|----------|-----|
| | Mag | Ang | dB | Mag | Ang | dB | Mag | Ang | Mag | Ang |
| 0.1 | 0.95 | -5 | 10.90 | 3.51 | 174 | -38.36 | 0.01 | 87 | 0.99 | -3 |
| 0.5 | 0.91 | -25 | 10.32 | 3.28 | 150 | -25.08 | 0.06 | 73 | 0.95 | -14 |
| 0.9 | 0.77 | -41 | 9.44 | 2.97 | 128 | -20.95 | 0.09 | 63 | 0.89 | -24 |
| 1.0 | 0.73 | -45 | 9.03 | 2.83 | 124 | -20.21 | 0.10 | 61 | 0.88 | -25 |
| 1.5 | 0.55 | -62 | 7.75 | 2.44 | 102 | -18.13 | 0.12 | 54 | 0.80 | -33 |
| 1.8 | 0.46 | -71 | 6.94 | 2.22 | 91 | -17.33 | 0.14 | 51 | 0.77 | -36 |
| 2.0 | 0.41 | -76 | 6.51 | 2.12 | 85 | -16.84 | 0.14 | 50 | 0.74 | -38 |
| 2.4 | 0.30 | -85 | 5.45 | 1.87 | 73 | -16.05 | 0.16 | 49 | 0.71 | -41 |
| 3.0 | 0.17 | -95 | 4.26 | 1.63 | 57 | -14.80 | 0.18 | 49 | 0.68 | -46 |
| 4.0 | 0.02 | -139 | 2.71 | 1.37 | 37 | -12.58 | 0.24 | 48 | 0.65 | -57 |
| 5.0 | 0.12 | 61 | 1.56 | 1.20 | 19 | -10.14 | 0.31 | 45 | 0.62 | -69 |

AT-30533 Typical Noise Parameters,

Common Emitter, $Z_O = 50\ \Omega$, 1 V , $I_C = 1\text{ mA}$

| Freq GHz | $F_{min}^{[1]}$ dB | Γ_{OPT} | | R_n |
|--------------------|-----------------------|----------------|-----|-------|
| | | Mag | Ang | |
| 0.5 ^[2] | 0.3 | 0.94 | 7 | 1.02 |
| 0.9 | 0.4 | 0.89 | 16 | 0.86 |
| 1.8 | 0.9 | 0.75 | 43 | 0.58 |
| 2.4 | 1.3 | 0.65 | 65 | 0.38 |

Notes:

1. Matching constraints may make F_{min} values associated with high $|\Gamma_{opt}|$ values unachievable in physical circuits. See Fig. 2 for expected performance.
2. 0.5 GHz noise parameter values are extrapolated, not measured.

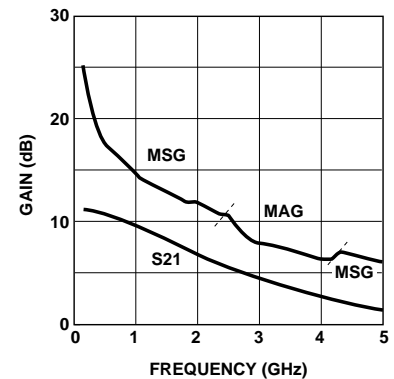


Figure 18. AT-30533 Gains vs. Frequency at $V_{CE} = 2.7\text{ V}$, $I_C = 1\text{ mA}$.

AT-30511 Typical Scattering Parameters, $V_{CE} = 2.7\text{ V}$, $I_C = 1\text{ mA}$, Common Emitter, $Z_O = 50\ \Omega$

| Freq. GHz | S_{11} | | S_{21} | | | S_{12} | | | S_{22} | |
|--------------|----------|------|----------|------|-----|----------|------|-----|----------|-----|
| | Mag | Ang | dB | Mag | Ang | dB | Mag | Ang | Mag | Ang |
| 0.1 | 0.97 | -5 | 10.88 | 3.50 | 175 | -40.13 | 0.01 | 86 | 0.999 | -2 |
| 0.5 | 0.95 | -23 | 10.58 | 3.38 | 156 | -26.71 | 0.05 | 74 | 0.96 | -13 |
| 0.9 | 0.86 | -39 | 10.09 | 3.20 | 139 | -22.28 | 0.08 | 63 | 0.93 | -23 |
| 1.0 | 0.84 | -43 | 9.83 | 3.10 | 135 | -21.51 | 0.08 | 60 | 0.92 | -25 |
| 1.5 | 0.72 | -63 | 8.94 | 2.80 | 115 | -19.15 | 0.11 | 49 | 0.85 | -34 |
| 1.8 | 0.65 | -73 | 8.32 | 2.60 | 105 | -18.28 | 0.12 | 43 | 0.82 | -38 |
| 2.0 | 0.61 | -80 | 8.06 | 2.53 | 99 | -17.83 | 0.13 | 40 | 0.79 | -41 |
| 2.4 | 0.52 | -93 | 7.06 | 2.25 | 86 | -17.29 | 0.14 | 35 | 0.75 | -46 |
| 3.0 | 0.41 | -114 | 5.92 | 1.98 | 70 | -16.72 | 0.15 | 30 | 0.70 | -51 |
| 4.0 | 0.30 | -150 | 4.35 | 1.65 | 48 | -16.13 | 0.16 | 23 | 0.66 | -61 |
| 5.0 | 0.26 | 165 | 3.06 | 1.42 | 28 | -15.65 | 0.16 | 22 | 0.63 | -69 |

AT-30511 Typical Noise Parameters,

Common Emitter, $Z_O = 50\ \Omega$, 2.7 V , $I_C = 1\text{ mA}$

| Freq GHz | $F_{min}^{[1]}$ dB | Γ_{OPT} | | R_n |
|--------------------|-----------------------|----------------|-----|-------|
| | | Mag | Ang | |
| 0.5 ^[2] | 0.3 | 0.96 | 10 | 1.49 |
| 0.9 | 0.4 | 0.92 | 19 | 1.33 |
| 1.8 | 0.9 | 0.83 | 43 | 0.98 |
| 2.4 | 1.3 | 0.76 | 60 | 0.74 |

Notes:

1. Matching constraints may make F_{min} values associated with high $|\Gamma_{opt}|$ values unachievable in physical circuits. See Fig. 2 for expected performance.
2. 0.5 GHz noise parameter values are extrapolated, not measured.

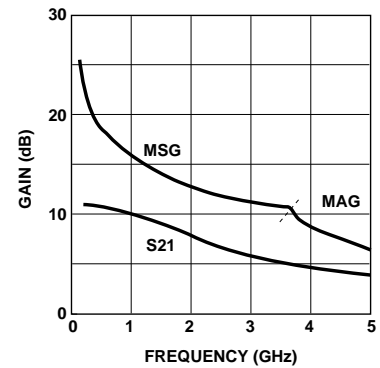


Figure 19. AT-30511 Gains vs. Frequency at $V_{CE} = 2.7\text{ V}$, $I_C = 1\text{ mA}$.

AT-30533 Typical Scattering Parameters, $V_{CE} = 2.7\text{ V}$, $I_C = 1\text{ mA}$, Common Emitter, $Z_O = 50\ \Omega$

| Freq. GHz | S_{11} | | S_{21} | | | S_{12} | | | S_{22} | |
|--------------|----------|-----|----------|------|-----|----------|------|-----|----------|-----|
| | Mag | Ang | dB | Mag | Ang | dB | Mag | Ang | Mag | Ang |
| 0.1 | 0.95 | -5 | 10.76 | 3.45 | 174 | -39.49 | 0.01 | 87 | 0.999 | -2 |
| 0.5 | 0.92 | -23 | 10.21 | 3.24 | 151 | -26.05 | 0.05 | 74 | 0.95 | -13 |
| 0.9 | 0.78 | -39 | 9.42 | 2.96 | 130 | -21.78 | 0.08 | 64 | 0.91 | -22 |
| 1.0 | 0.75 | -42 | 9.04 | 2.83 | 126 | -21.05 | 0.09 | 63 | 0.90 | -23 |
| 1.5 | 0.58 | -59 | 7.83 | 2.46 | 105 | -18.88 | 0.11 | 55 | 0.83 | -31 |
| 1.8 | 0.49 | -66 | 7.04 | 2.25 | 94 | -18.08 | 0.12 | 53 | 0.79 | -34 |
| 2.0 | 0.44 | -71 | 6.64 | 2.15 | 88 | -17.58 | 0.13 | 52 | 0.77 | -36 |
| 2.4 | 0.33 | -79 | 5.59 | 1.90 | 76 | -16.77 | 0.15 | 51 | 0.74 | -39 |
| 3.0 | 0.21 | -87 | 4.40 | 1.66 | 60 | -15.50 | 0.17 | 51 | 0.71 | -44 |
| 4.0 | 0.05 | -88 | 2.87 | 1.39 | 40 | -13.20 | 0.22 | 52 | 0.68 | -54 |
| 5.0 | 0.09 | 47 | 1.72 | 1.22 | 22 | -10.67 | 0.29 | 49 | 0.66 | -66 |

AT-30533 Typical Noise Parameters,

Common Emitter, $Z_O = 50\ \Omega$, 2.7 V , $I_C = 1\text{ mA}$

| Freq GHz | $F_{min}^{[1]}$ dB | Γ_{OPT} | | R_n |
|--------------------|-----------------------|----------------|-----|-------|
| | | Mag | Ang | |
| 0.5 ^[2] | 0.3 | 0.94 | 7 | 1.02 |
| 0.9 | 0.4 | 0.89 | 16 | 0.88 |
| 1.8 | 0.9 | 0.75 | 43 | 0.58 |
| 2.4 | 1.3 | 0.65 | 65 | 0.38 |

Notes:

1. Matching constraints may make F_{min} values associated with high $|\Gamma_{opt}|$ values unachievable in physical circuits. See Fig. 2 for expected performance.
2. 0.5 GHz noise parameter values are extrapolated, not measured.

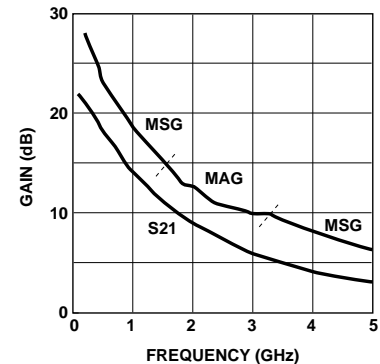


Figure 20. AT-30511- Gains vs. Frequency at $V_{CE} = 2.7\text{ V}$, $I_C = 1\text{ mA}$.

AT-30511 Typical Scattering Parameters, $V_{CE} = 2.7\text{ V}$, $I_C = 5\text{ mA}$, Common Emitter, $Z_O = 50\ \Omega$

| Freq. GHz | S_{11} | | S_{21} | | | S_{12} | | | S_{22} | |
|--------------|----------|------|----------|-------|-----|----------|------|-----|----------|-----|
| | Mag | Ang | dB | Mag | Ang | dB | Mag | Ang | Mag | Ang |
| 0.1 | 0.88 | -11 | 22.49 | 13.32 | 169 | -40.50 | 0.01 | 83 | 0.97 | -5 |
| 0.5 | 0.70 | -48 | 20.42 | 10.49 | 134 | -28.45 | 0.04 | 64 | 0.82 | -22 |
| 0.9 | 0.49 | -72 | 17.77 | 7.73 | 111 | -25.24 | 0.05 | 57 | 0.70 | -30 |
| 1.0 | 0.46 | -77 | 17.09 | 7.15 | 107 | -24.70 | 0.06 | 55 | 0.69 | -31 |
| 1.5 | 0.30 | -100 | 14.44 | 5.27 | 89 | -22.62 | 0.07 | 53 | 0.62 | -35 |
| 1.8 | 0.24 | -112 | 13.10 | 4.52 | 81 | -21.65 | 0.08 | 52 | 0.59 | -37 |
| 2.0 | 0.21 | -120 | 12.31 | 4.13 | 76 | -21.05 | 0.09 | 52 | 0.58 | -39 |
| 2.4 | 0.16 | -140 | 10.94 | 3.52 | 67 | -20.01 | 0.10 | 50 | 0.57 | -42 |
| 3.0 | 0.13 | -172 | 9.18 | 2.88 | 55 | -18.55 | 0.12 | 48 | 0.55 | -46 |
| 4.0 | 0.15 | 137 | 7.03 | 2.25 | 38 | -16.57 | 0.15 | 44 | 0.53 | -55 |
| 5.0 | 0.21 | 106 | 5.44 | 1.87 | 22 | -14.88 | 0.18 | 39 | 0.52 | -64 |

AT-30511 Typical Noise Parameters,

Common Emitter, $Z_O = 50\ \Omega$, 2.7 V , $I_C = 5\text{ mA}$

| Freq GHz | $F_{min}^{[1]}$ dB | Γ_{OPT} | | R_n |
|--------------------|-----------------------|----------------|-----|-------|
| | | Mag | Ang | |
| 0.5 ^[2] | 1.1 | 0.77 | 9 | 1.10 |
| 0.9 | 1.2 | 0.71 | 18 | 0.96 |
| 1.8 | 1.5 | 0.60 | 45 | 0.66 |
| 2.4 | 1.8 | 0.51 | 65 | 0.47 |

Notes:

1. Matching constraints may make F_{min} values associated with high $|\Gamma_{opt}|$ values unachievable in physical circuits. See Fig. 2 for expected performance.
2. 0.5 GHz noise parameter values are extrapolated, not measured.

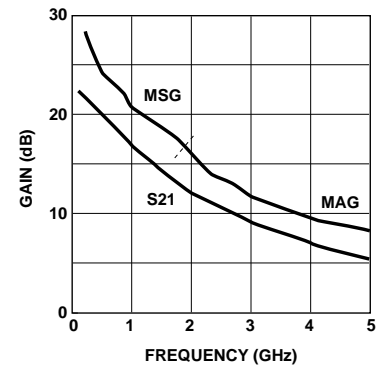


Figure 21. AT-30511 Gains vs. Frequency at $V_{CE} = 2.7\text{ V}$, $I_C = 5\text{ mA}$.

AT-30533 Typical Scattering Parameters, $V_{CE} = 2.7\text{ V}$, $I_C = 5\text{ mA}$, Common Emitter, $Z_O = 50\ \Omega$

| Freq. GHz | S_{11} | | S_{21} | | | S_{12} | | | S_{22} | |
|--------------|----------|-----|----------|-------|-----|----------|------|-----|----------|-----|
| | Mag | Ang | dB | Mag | Ang | dB | Mag | Ang | Mag | Ang |
| 0.1 | 0.84 | -12 | 22.26 | 12.98 | 164 | -39.96 | 0.01 | 82 | 0.98 | -5 |
| 0.5 | 0.57 | -39 | 18.54 | 8.46 | 121 | -28.03 | 0.04 | 71 | 0.80 | -18 |
| 0.9 | 0.37 | -46 | 14.97 | 5.60 | 100 | -24.09 | 0.06 | 70 | 0.73 | -22 |
| 1.0 | 0.34 | -46 | 14.20 | 5.13 | 96 | -23.32 | 0.07 | 69 | 0.72 | -22 |
| 1.5 | 0.23 | -43 | 11.24 | 3.65 | 81 | -20.30 | 0.10 | 68 | 0.69 | -26 |
| 1.8 | 0.20 | -38 | 9.85 | 3.11 | 73 | -18.88 | 0.11 | 67 | 0.68 | -28 |
| 2.0 | 0.19 | -35 | 9.05 | 2.84 | 69 | -18.02 | 0.13 | 66 | 0.68 | -30 |
| 2.4 | 0.17 | -27 | 7.70 | 2.43 | 61 | -16.50 | 0.15 | 64 | 0.67 | -33 |
| 3.0 | 0.15 | -17 | 6.12 | 2.02 | 50 | -14.57 | 0.19 | 61 | 0.66 | -39 |
| 4.0 | 0.15 | -2 | 4.30 | 1.64 | 34 | -11.90 | 0.25 | 55 | 0.64 | -49 |
| 5.0 | 0.17 | 11 | 3.07 | 1.42 | 19 | -9.66 | 0.33 | 47 | 0.61 | -61 |

AT-30533 Typical Noise Parameters,

Common Emitter, $Z_O = 50\ \Omega$, 2.7 V , $I_C = 5\text{ mA}$

| Freq GHz | $F_{min}^{[1]}$ dB | Γ_{OPT} | | R_n |
|--------------------|-----------------------|----------------|-----|-------|
| | | Mag | Ang | |
| 0.5 ^[2] | 1.1 | 0.71 | 8 | 0.78 |
| 0.9 | 1.2 | 0.61 | 16 | 0.66 |
| 1.8 | 1.5 | 0.42 | 39 | 0.41 |
| 2.4 | 1.8 | 0.28 | 57 | 0.25 |

Notes:

1. Matching constraints may make F_{min} values associated with high $|\Gamma_{opt}|$ values unachievable in physical circuits. See Fig. 2 for expected performance.
2. 0.5 GHz noise parameter values are extrapolated, not measured.

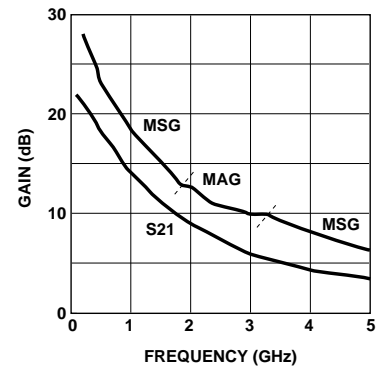


Figure 22. AT-30533 Gains vs. Frequency at $V_{CE} = 2.7\text{ V}$, $I_C = 5\text{ mA}$.

AT-30511 Typical Scattering Parameters, $V_{CE} = 5\text{ V}$, $I_C = 1\text{ mA}$, Common Emitter, $Z_0 = 50\ \Omega$

| Freq. GHz | S_{11} | | S_{21} | | | S_{12} | | | S_{22} | |
|--------------|----------|------|----------|------|-----|----------|------|-----|----------|-----|
| | Mag | Ang | dB | Mag | Ang | dB | Mag | Ang | Mag | Ang |
| 0.1 | 0.98 | -5 | 10.56 | 3.37 | 175 | -40.34 | 0.01 | 87 | 0.999 | -2 |
| 0.5 | 0.96 | -21 | 10.30 | 3.27 | 157 | -26.99 | 0.04 | 74 | 0.96 | -13 |
| 0.9 | 0.88 | -37 | 9.83 | 3.10 | 139 | -22.52 | 0.07 | 64 | 0.93 | -22 |
| 1.0 | 0.85 | -41 | 9.57 | 3.01 | 136 | -21.75 | 0.08 | 62 | 0.92 | -24 |
| 1.5 | 0.74 | -59 | 8.71 | 2.73 | 116 | -19.23 | 0.11 | 51 | 0.86 | -33 |
| 1.8 | 0.67 | -69 | 8.13 | 2.55 | 106 | -18.34 | 0.12 | 45 | 0.82 | -38 |
| 2.0 | 0.63 | -75 | 7.88 | 2.48 | 100 | -17.85 | 0.13 | 42 | 0.80 | -41 |
| 2.4 | 0.55 | -88 | 6.90 | 2.21 | 87 | -17.23 | 0.14 | 37 | 0.77 | -45 |
| 3.0 | 0.43 | -106 | 5.79 | 1.95 | 71 | -16.53 | 0.15 | 31 | 0.72 | -50 |
| 4.0 | 0.31 | -138 | 4.29 | 1.64 | 49 | -15.83 | 0.16 | 23 | 0.67 | -60 |
| 5.0 | 0.25 | 178 | 3.04 | 1.42 | 29 | -15.38 | 0.17 | 20 | 0.64 | -69 |

AT-30511 Typical Noise Parameters, Common Emitter, $Z_0 = 50\ \Omega$, 5 V , $I_C = 1\text{ mA}$

| Freq GHz | $F_{min}^{[1]}$ dB | Γ_{OPT} | | R_n |
|--------------------|-----------------------|----------------|-----|-------|
| | | Mag | Ang | |
| 0.5 ^[2] | 0.3 | 0.96 | 10 | 1.49 |
| 0.9 | 0.4 | 0.92 | 19 | 1.33 |
| 1.8 | 0.9 | 0.83 | 43 | 0.98 |
| 2.4 | 1.3 | 0.76 | 60 | 0.74 |

Notes:

1. Matching constraints may make F_{min} values associated with high $|\Gamma_{opt}|$ values unachievable in physical circuits. See Fig. 2 for expected performance.
2. 0.5 GHz noise parameter values are extrapolated, not measured.

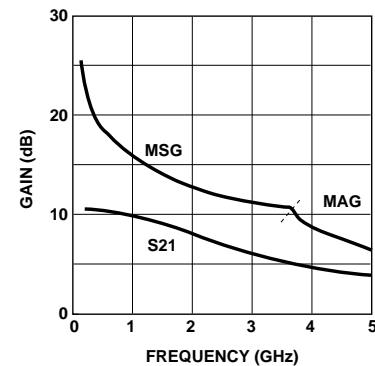


Figure 23. AT-30511 Gains vs. Frequency at $V_{CE} = 5\text{ V}$, $I_C = 1\text{ mA}$.

AT-30533 Typical Scattering Parameters, $V_{CE} = 5\text{ V}$, $I_C = 1\text{ mA}$, Common Emitter, $Z_0 = 50\ \Omega$

| Freq. GHz | S_{11} | | S_{21} | | | S_{12} | | | S_{22} | |
|--------------|----------|-----|----------|------|-----|----------|------|-----|----------|-----|
| | Mag | Ang | dB | Mag | Ang | dB | Mag | Ang | Mag | Ang |
| 0.1 | 0.96 | -5 | 10.59 | 3.38 | 174 | -39.38 | 0.01 | 85 | 0.999 | -2 |
| 0.5 | 0.92 | -22 | 10.07 | 3.19 | 151 | -26.22 | 0.05 | 74 | 0.95 | -13 |
| 0.9 | 0.79 | -37 | 9.32 | 2.92 | 131 | -21.99 | 0.08 | 65 | 0.91 | -21 |
| 1.0 | 0.77 | -41 | 8.94 | 2.80 | 127 | -21.21 | 0.09 | 63 | 0.90 | -23 |
| 1.5 | 0.60 | -57 | 7.76 | 2.44 | 106 | -19.02 | 0.11 | 56 | 0.83 | -30 |
| 1.8 | 0.51 | -64 | 7.01 | 2.24 | 95 | -18.16 | 0.12 | 54 | 0.80 | -33 |
| 2.0 | 0.46 | -69 | 6.61 | 2.14 | 89 | -17.66 | 0.13 | 52 | 0.78 | -35 |
| 2.4 | 0.35 | -76 | 5.59 | 1.90 | 77 | -16.85 | 0.14 | 51 | 0.75 | -39 |
| 3.0 | 0.23 | -83 | 4.43 | 1.66 | 61 | -15.58 | 0.17 | 51 | 0.72 | -43 |
| 4.0 | 0.07 | -85 | 2.92 | 1.40 | 41 | -13.34 | 0.22 | 52 | 0.69 | -53 |
| 5.0 | 0.07 | 38 | 1.79 | 1.23 | 23 | -10.85 | 0.29 | 49 | 0.67 | -65 |

AT-30533 Typical Noise Parameters, Common Emitter, $Z_0 = 50\ \Omega$, 5 V , $I_C = 1\text{ mA}$

| Freq GHz | $F_{min}^{[1]}$ dB | Γ_{OPT} | | R_n |
|--------------------|-----------------------|----------------|-----|-------|
| | | Mag | Ang | |
| 0.5 ^[2] | 0.3 | 0.94 | 7 | 1.02 |
| 0.9 | 0.4 | 0.89 | 16 | 0.98 |
| 1.8 | 0.9 | 0.75 | 43 | 0.58 |
| 2.4 | 1.3 | 0.65 | 65 | 0.38 |

Notes:

1. Matching constraints may make F_{min} values associated with high $|\Gamma_{opt}|$ values unachievable in physical circuits. See Figure 2 for expected performance.
2. 0.5 GHz noise parameter values are extrapolated, not measured.

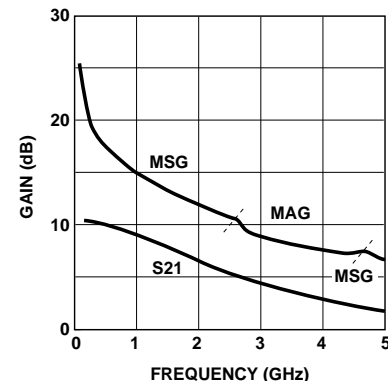


Figure 24. AT-30533 Gains vs. Frequency at $V_{CE} = 5\text{ V}$, $I_C = 1\text{ mA}$.

AT-30511 Typical Scattering Parameters, $V_{CE} = 5\text{ V}$, $I_C = 5\text{ mA}$, Common Emitter, $Z_O = 50\ \Omega$

| Freq. GHz | S_{11} | | S_{21} | | | S_{12} | | | S_{22} | |
|--------------|----------|------|----------|-------|-----|----------|------|-----|----------|-----|
| | Mag | Ang | dB | Mag | Ang | dB | Mag | Ang | Mag | Ang |
| 0.1 | 0.90 | -10 | 22.26 | 12.98 | 170 | -40.75 | 0.01 | 82 | 0.97 | -5 |
| 0.5 | 0.74 | -43 | 20.41 | 10.49 | 136 | -28.46 | 0.04 | 66 | 0.83 | -22 |
| 0.9 | 0.53 | -66 | 17.93 | 7.88 | 113 | -25.18 | 0.06 | 58 | 0.72 | -30 |
| 1.0 | 0.49 | -70 | 17.28 | 7.31 | 109 | -24.53 | 0.06 | 57 | 0.70 | -31 |
| 1.5 | 0.33 | -89 | 14.72 | 5.45 | 91 | -22.46 | 0.08 | 54 | 0.63 | -36 |
| 1.8 | 0.27 | -99 | 13.41 | 4.68 | 83 | -21.45 | 0.08 | 53 | 0.60 | -38 |
| 2.0 | 0.24 | -105 | 12.64 | 4.29 | 78 | -20.87 | 0.09 | 52 | 0.59 | -39 |
| 2.4 | 0.18 | -120 | 11.27 | 3.66 | 69 | -19.79 | 0.10 | 50 | 0.57 | -42 |
| 3.0 | 0.12 | -147 | 9.54 | 3.00 | 57 | -18.34 | 0.12 | 48 | 0.55 | -46 |
| 4.0 | 0.11 | 154 | 7.41 | 2.35 | 40 | -16.45 | 0.15 | 43 | 0.53 | -55 |
| 5.0 | 0.17 | 114 | 5.86 | 1.96 | 24 | -14.84 | 0.18 | 38 | 0.52 | -63 |

AT-30511 Typical Noise Parameters,

Common Emitter, $Z_O = 50\ \Omega$, 5 V , $I_C = 5\text{ mA}$

| Freq GHz | $F_{min}^{[1]}$ dB | Γ_{OPT} | | R_n |
|--------------------|-----------------------|----------------|-----|-------|
| | | Mag | Ang | |
| 0.5 ^[2] | 1.1 | 0.77 | 9 | 1.10 |
| 0.9 | 1.2 | 0.71 | 18 | 0.96 |
| 1.8 | 1.5 | 0.60 | 45 | 0.66 |
| 2.4 | 1.8 | 0.51 | 65 | 0.47 |

Notes:

1. Matching constraints may make F_{min} values associated with high $|\Gamma_{opt}|$ values unachievable in physical circuits. See Fig. 2 for expected performance.
2. 0.5 GHz noise parameter values are extrapolated, not measured.

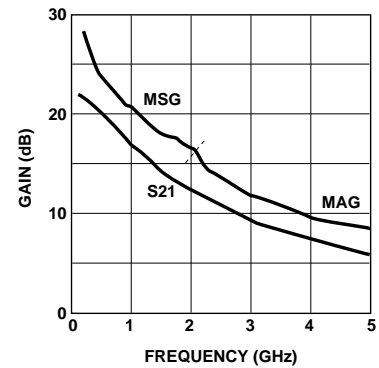


Figure 25. AT-30511 Gains vs. Frequency at $V_{CE} = 5\text{ V}$, $I_C = 5\text{ mA}$.

AT-30533 Typical Scattering Parameters, $V_{CE} = 5\text{ V}$, $I_C = 5\text{ mA}$, Common Emitter, $Z_O = 50\ \Omega$

| Freq. GHz | S_{11} | | S_{21} | | | S_{12} | | | S_{22} | |
|--------------|----------|-----|----------|-------|-----|----------|------|-----|----------|-----|
| | Mag | Ang | dB | Mag | Ang | dB | Mag | Ang | Mag | Ang |
| 0.1 | 0.86 | -11 | 22.22 | 12.92 | 165 | -40.16 | 0.01 | 83 | 0.98 | -5 |
| 0.5 | 0.59 | -37 | 18.69 | 8.60 | 122 | -28.05 | 0.04 | 72 | 0.81 | -18 |
| 0.9 | 0.40 | -43 | 15.19 | 5.75 | 101 | -24.14 | 0.06 | 70 | 0.74 | -22 |
| 1.0 | 0.37 | -43 | 14.43 | 5.27 | 97 | -23.37 | 0.07 | 70 | 0.73 | -22 |
| 1.5 | 0.27 | -40 | 11.49 | 3.75 | 82 | -20.30 | 0.10 | 68 | 0.70 | -26 |
| 1.8 | 0.24 | -37 | 10.11 | 3.20 | 75 | -18.88 | 0.11 | 67 | 0.69 | -28 |
| 2.0 | 0.23 | -35 | 9.33 | 2.93 | 70 | -18.05 | 0.13 | 66 | 0.68 | -30 |
| 2.4 | 0.20 | -30 | 7.97 | 2.50 | 62 | -16.55 | 0.15 | 64 | 0.67 | -33 |
| 3.0 | 0.18 | -24 | 6.40 | 2.09 | 51 | -14.64 | 0.19 | 61 | 0.66 | -38 |
| 4.0 | 0.17 | -14 | 4.58 | 1.70 | 36 | -12.00 | 0.25 | 54 | 0.64 | -49 |
| 5.0 | 0.16 | -2 | 3.37 | 1.47 | 21 | -9.83 | 0.32 | 46 | 0.61 | -60 |

AT-30533 Typical Noise Parameters,

Common Emitter, $Z_O = 50\ \Omega$, 5 V , $I_C = 5\text{ mA}$

| Freq GHz | $F_{min}^{[1]}$ dB | Γ_{OPT} | | R_n |
|--------------------|-----------------------|----------------|-----|-------|
| | | Mag | Ang | |
| 0.5 ^[2] | 1.1 | 0.71 | 8 | 0.78 |
| 0.9 | 1.2 | 0.61 | 16 | 0.66 |
| 1.8 | 1.5 | 0.42 | 39 | 0.41 |
| 2.4 | 1.8 | 0.28 | 57 | 0.25 |

Notes:

1. Matching constraints may make F_{min} values associated with high $|\Gamma_{opt}|$ values unachievable in physical circuits. See Fig. 2 for expected performance.
2. 0.5 GHz noise parameter values are extrapolated, not measured.

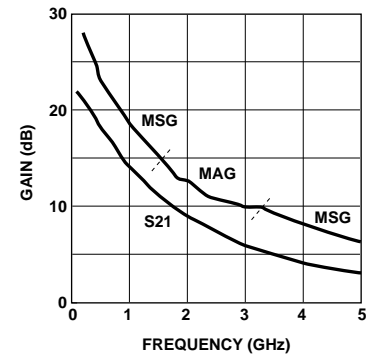


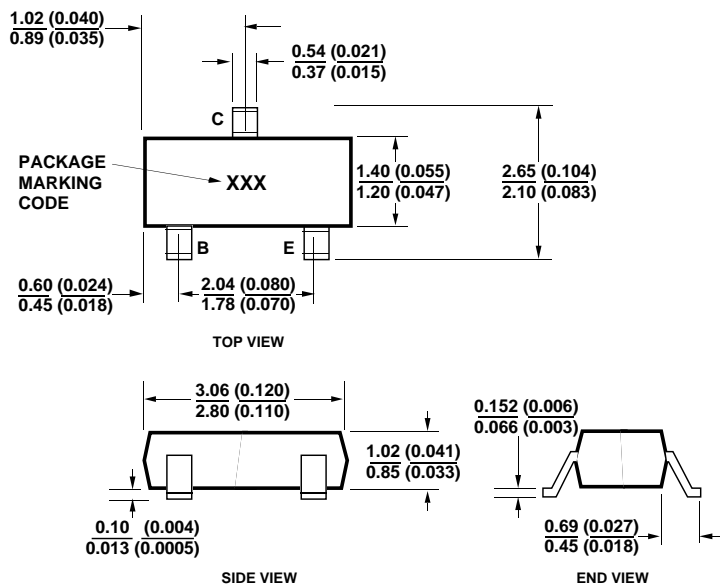
Figure 26. AT-30533 Gains vs. Frequency at $V_{CE} = 5\text{ V}$, $I_C = 5\text{ mA}$.

Ordering Information

| Part Number | Increment | Comments |
|--------------|-----------|----------|
| AT-30511-BLK | 100 | Bulk |
| AT-30511-TR1 | 3000 | 7" Reel |
| AT-30533-BLK | 100 | Bulk |
| AT-30533-TR1 | 3000 | 7" Reel |

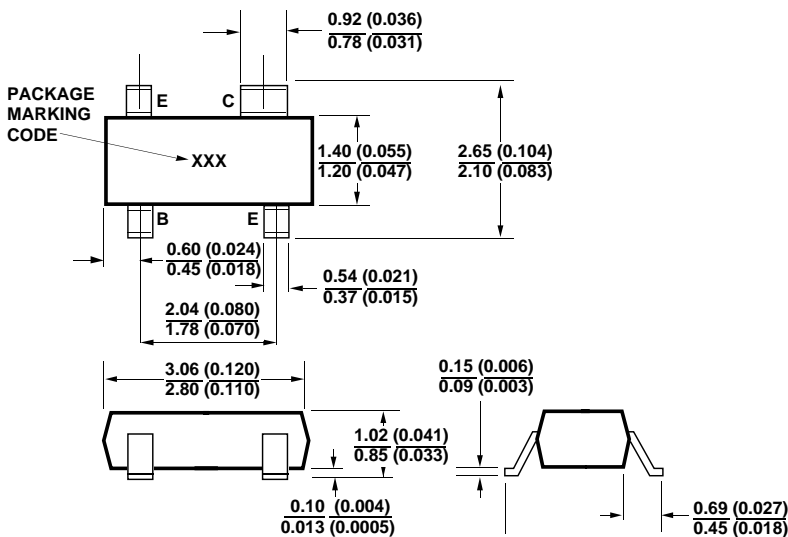
Package Dimensions

SOT-23 Plastic Package



DIMENSIONS ARE IN MILLIMETERS (INCHES)

SOT-143 Plastic Package



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