

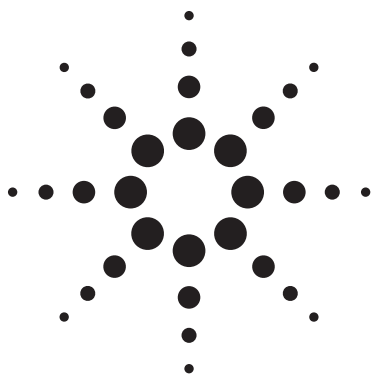
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# Agilent AT-41511, AT-41533 General Purpose, Low Noise NPN Silicon Bipolar Transistors Data Sheet

## Description

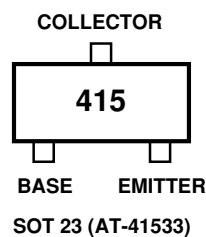
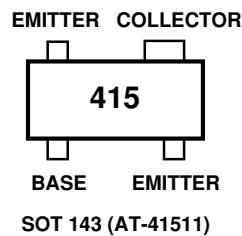
Agilent's AT-41511 and AT-41533 are general purpose NPN bipolar transistors that offer excellent high frequency performance at an economical price. The AT-41533 uses the 3 lead SOT-23, while the AT-41511 places the same die in the lower parasitic 4 lead SOT-143. Both packages are industry standard, and compatible with high volume surface mount assembly techniques.

The 4 micron emitter-to-emitter pitch of these transistors yields high performance products that can perform a multiplicity of tasks. The 14 emitter finger interdigitated geometry yields an intermediate-sized transistor with easy to match to impedances, low noise figure, and moderate power.

Optimized for best performance from a 5 to 8 volt bias supply, these transistors are also good performers at 2.7 V. Applications include use in wireless systems as an LNA, gain stage, buffer, oscillator, or active mixer.

An optimum noise match near 50 ohms at 900 MHz makes these devices particularly easy to use as LNAs. Typical amplifier designs at 900 MHz yield 1 dB noise figures with 15 dB or more

## Outline Drawing



associated gain at a 5 V, 5 mA bias, with good gain and noise figure obtainable at biases as low as 2 mA.

The AT-415 series bipolar transistors are fabricated using Agilent's 10 GHz  $f_T$  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.

## Features

- General Purpose NPN Bipolar Transistor
- 900 MHz Performance:  
 AT-41511: 1 dB NF, 15.5 dB  $G_A$   
 AT-41533: 1 dB NF, 14.5 dB  $G_A$
- Characterized for 3, 5, and 8 Volt Use
- SOT-23 and SOT-143 SMT Plastic Packages
- Tape-and-Reel Packaging Option Available
- Lead-free Option Available



### AT-41511, AT-41533 Absolute Maximum Ratings

| Symbol           | Parameter                          | Units | Absolute Maximum <sup>[1]</sup> |
|------------------|------------------------------------|-------|---------------------------------|
| V <sub>EBO</sub> | Emitter-Base Voltage               | V     | 1.5                             |
| V <sub>CBO</sub> | Collector-Base Voltage             | V     | 20                              |
| V <sub>CEO</sub> | Collector-Emitter Voltage          | V     | 12                              |
| I <sub>C</sub>   | Collector Current                  | mA    | 50                              |
| P <sub>T</sub>   | Power Dissipation <sup>[2,3]</sup> | mW    | 225                             |
| T <sub>j</sub>   | Junction Temperature               | °C    | 150                             |
| T <sub>STG</sub> | Storage Temperature                | °C    | -65 to 150                      |

**Thermal Resistance:<sup>[2]</sup>**  
 $\theta_{jc} = 550^{\circ}\text{C/W}$

**Notes:**

1. Operation of this device above any one of these parameters may cause permanent damage.
2. T<sub>Mounting Surface</sub> = 25°C.
3. Derate at 1.82 mW/°C for T<sub>C</sub> > 26°C.

### Electrical Specifications, T<sub>A</sub> = 25°C

| Symbol           | Parameters and Test Conditions   | Units | AT-41511 |     |     | AT-41533 |     |     |
|------------------|--|-------|----------|-----|-----|----------|-----|-----|
|                  |  |       | Min      | Typ | Max | Min      | Typ | Max |
| h <sub>FE</sub>  | Forward Current Transfer Ratio<br>V <sub>CE</sub> = 5 V<br>I <sub>C</sub> = 5 mA | -     | 30       | 150 | 270 | 30       | 150 | 270 |
| I <sub>CBO</sub> | Collector Cutoff Current<br>V <sub>CB</sub> = 3 V                                | μA    |          |     | 0.2 |          |     | 0.2 |
| I <sub>EBO</sub> | Emitter Cutoff Current<br>V <sub>EB</sub> = 1 V                                  | μA    |          |     | 1.0 |          |     | 1.0 |

### Characterization Information, T<sub>A</sub> = 25°C

| Symbol                          | Parameters and Test Conditions  | Units                      | AT-41511 |             | AT-41533 |             |
|---------------------------------|---|----------------------------|----------|-------------|----------|-------------|
|                                 |   |                            | Min      | Typ         | Min      | Typ         |
| NF                              | Noise Figure<br>V <sub>CE</sub> = 5 V, I <sub>C</sub> = 5 mA                                      | f = 0.9 GHz<br>f = 2.4 GHz |          | 1.0<br>1.7  |          | 1.0<br>1.6  |
| G <sub>A</sub>                  | Associated Gain<br>V <sub>CE</sub> = 5 V, I <sub>C</sub> = 5 mA                                   | f = 0.9 GHz<br>f = 2.4 GHz |          | 15.5<br>11  |          | 14.5<br>9   |
| P <sub>1dB</sub>                | Power at 1 dB Gain Compression (opt tuning)<br>V <sub>CE</sub> = 5 V, I <sub>C</sub> = 25 mA      | f = 0.9 GHz                |          | 14.5        |          | 14.5        |
| G <sub>1dB</sub>                | Gain at 1 dB Gain Compression (opt tuning)<br>V <sub>CE</sub> = 5 V, I <sub>C</sub> = 25 mA       | f = 0.9 GHz                |          | 17.5        |          | 14.5        |
| IP <sub>3</sub>                 | Output Third Order Intercept Point,<br>V <sub>CE</sub> = 5 V, I <sub>C</sub> = 25 mA (opt tuning) | f = 0.9 GHz                |          | 25          |          | 25          |
| S <sub>21E</sub>   <sup>2</sup> | Gain in 50 Ω system; V <sub>CE</sub> = 5 V, I <sub>C</sub> = 5 mA                                 | f = 0.9 GHz<br>f = 2.4 GHz | 13.5     | 15.5<br>7.9 | 10.8     | 12.8<br>5.2 |

**AT-41511, AT-41533 Typical Performance**

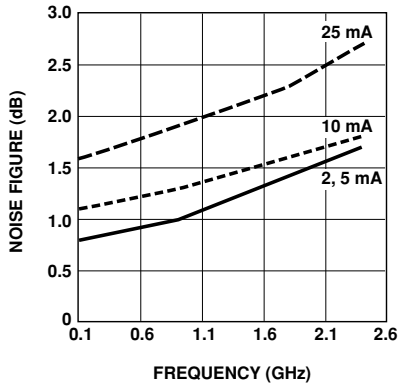


Figure 1. AT-41511 and AT-41533 Minimum Noise Figure vs. Frequency and Current at  $V_{CE} = 2.7$  V.

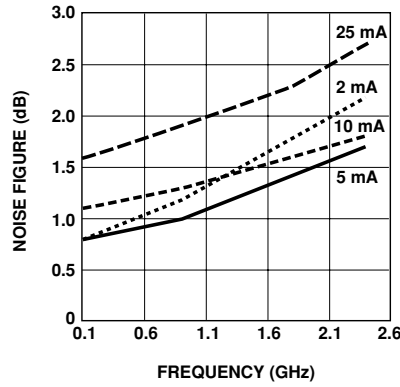


Figure 2. AT-41511 and AT-41533 Minimum Noise Figure vs. Frequency and Current at  $V_{CE} = 5$  V.

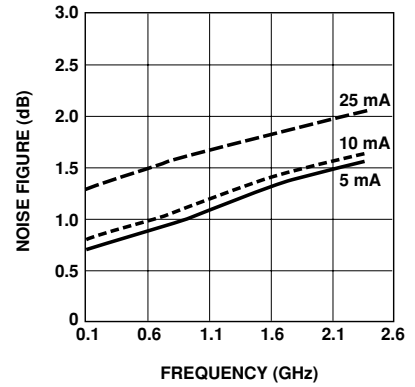


Figure 3. AT-41511 and AT-41533 Minimum Noise Figure vs. Frequency and Current at  $V_{CE} = 8$  V.

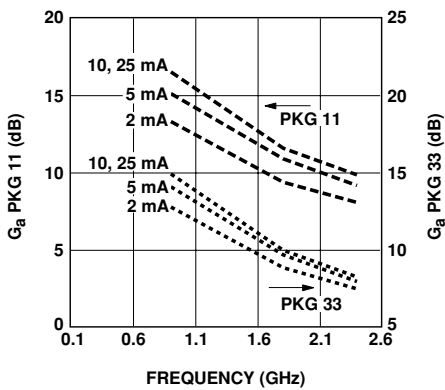


Figure 4. AT-41511 and AT-41533 Associated Gain vs. Frequency and Current at  $V_{CE} = 2.7$  V.

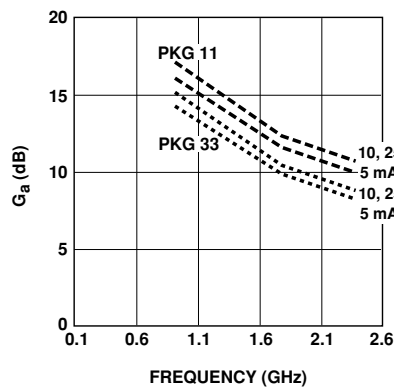


Figure 5. AT-41511 and AT-41533 Associated Gain vs. Frequency and Current at  $V_{CE} = 5$  V.

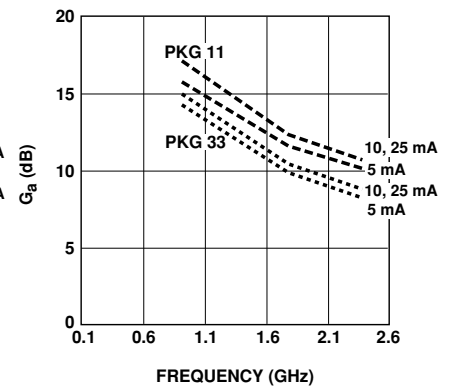


Figure 6. AT-41511 and AT-41533 Associated Gain vs. Frequency and Current at  $V_{CE} = 8$  V.

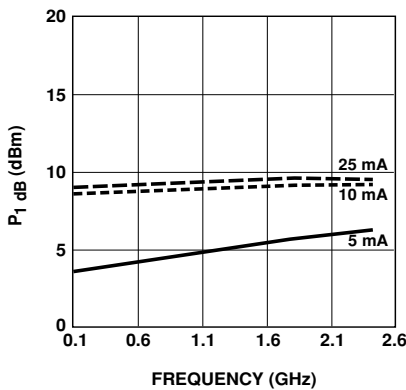


Figure 7. AT-41511 and AT-41533  $P_{1dB}$  vs. Frequency and Bias at  $V_{CE} = 2.7$  V, with Optimal Tuning.

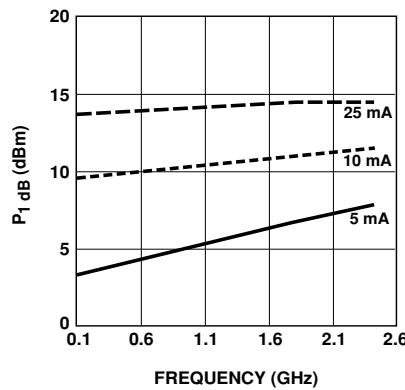


Figure 8. AT-41511 and AT-41533  $P_{1dB}$  vs. Frequency and Bias at  $V_{CE} = 5$  V, with Optimal Tuning.

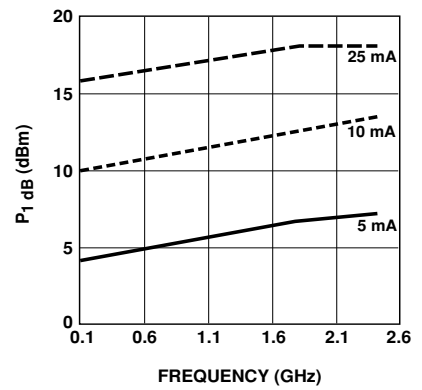


Figure 9. AT-41511 and AT-41533  $P_{1dB}$  vs. Frequency and Bias at  $V_{CE} = 8$  V, with Optimal Tuning.

**AT-41511 Typical Scattering Parameters, Common Emitter,  $Z_o = 50 \Omega$ ,  $V_{CE} = 2.7 V$ ,  $I_C = 5 mA$**

| Freq. GHz | $S_{11}$ |      | $S_{21}$ |        |     | $S_{12}$ |       | $S_{22}$ |      |     |
|-----------|----------|------|----------|--------|-----|----------|-------|----------|------|-----|
|           | Mag      | Ang  | dB       | Mag    | Ang | dB       | Mag   | Ang      | Mag  | Ang |
| 0.1       | 0.84     | -27  | 23.44    | 14.854 | 161 | -34.89   | 0.018 | 76       | 0.95 | -11 |
| 0.5       | 0.59     | -102 | 19.01    | 8.924  | 115 | -24.88   | 0.057 | 48       | 0.65 | -34 |
| 0.9       | 0.49     | -141 | 15.09    | 5.684  | 93  | -22.97   | 0.071 | 43       | 0.51 | -39 |
| 1.0       | 0.48     | -149 | 14.30    | 5.189  | 89  | -22.73   | 0.073 | 43       | 0.49 | -39 |
| 1.5       | 0.46     | -176 | 11.15    | 3.61   | 72  | -21.21   | 0.087 | 44       | 0.44 | -43 |
| 1.8       | 0.46     | 170  | 9.69     | 3.051  | 64  | -20.26   | 0.097 | 45       | 0.43 | -45 |
| 2.0       | 0.46     | 162  | 8.86     | 2.774  | 59  | -19.74   | 0.103 | 45       | 0.42 | -47 |
| 2.4       | 0.47     | 148  | 7.37     | 2.337  | 50  | -18.64   | 0.117 | 46       | 0.42 | -51 |
| 3.0       | 0.5      | 130  | 5.58     | 1.901  | 36  | -17.14   | 0.139 | 45       | 0.41 | -59 |
| 4.0       | 0.56     | 106  | 3.25     | 1.454  | 17  | -14.89   | 0.18  | 42       | 0.4  | -73 |
| 5.0       | 0.61     | 87   | 1.36     | 1.17   | 0   | -12.96   | 0.225 | 37       | 0.4  | -91 |

**AT-41511 Typical Noise Parameters, Common Emitter,  $Z_o = 50 \Omega$ ,  $V_{CE} = 2.7 V$ ,  $I_C = 5 mA$**

| Freq GHz | $F_{min}$ dB | $\Gamma_{opt}$ |     | $R_n$ |
|----------|--------------|----------------|-----|-------|
| GHz      | dB           | Mag            | Ang | -     |
| 0.1      | 0.8          | 0.45           | 6   | 0.25  |
| 0.9      | 1.0          | 0.39           | 63  | 0.19  |
| 1.8      | 1.4          | 0.32           | 137 | 0.12  |
| 2.4      | 1.7          | 0.40           | 177 | 0.09  |

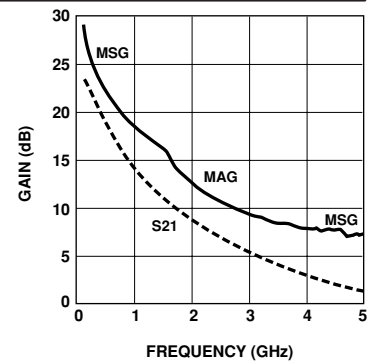


Figure 10. AT-41511 Gains vs. Frequency at  $V_{CE} = 2.7 V$ ,  $I_C = 5 mA$ .

**AT-41533 Typical Scattering Parameters, Common Emitter,  $Z_o = 50 \Omega$ ,  $V_{CE} = 2.7 V$ ,  $I_C = 5 mA$**

| Freq. GHz | $S_{11}$ |      | $S_{21}$ |        |     | $S_{12}$ |       | $S_{22}$ |      |      |
|-----------|----------|------|----------|--------|-----|----------|-------|----------|------|------|
|           | Mag      | Ang  | dB       | Mag    | Ang | dB       | Mag   | Ang      | Mag  | Ang  |
| 0.1       | 0.78     | -30  | 23.43    | 14.834 | 155 | -33.98   | 0.020 | 75       | 0.94 | -12  |
| 0.5       | 0.35     | -99  | 16.91    | 7.004  | 103 | -24.58   | 0.059 | 60       | 0.62 | -28  |
| 0.9       | 0.23     | -144 | 12.50    | 4.219  | 84  | -21.21   | 0.087 | 62       | 0.55 | -30  |
| 1.0       | 0.21     | -154 | 11.65    | 3.826  | 80  | -20.54   | 0.094 | 63       | 0.54 | -31  |
| 1.5       | 0.20     | 162  | 8.50     | 2.661  | 64  | -17.46   | 0.134 | 64       | 0.52 | -36  |
| 1.8       | 0.22     | 144  | 7.09     | 2.261  | 56  | -15.97   | 0.159 | 63       | 0.51 | -40  |
| 2.0       | 0.23     | 134  | 6.30     | 2.065  | 51  | -15.09   | 0.176 | 63       | 0.51 | -42  |
| 2.4       | 0.26     | 118  | 4.97     | 1.773  | 42  | -13.39   | 0.214 | 61       | 0.50 | -48  |
| 3.0       | 0.30     | 101  | 3.45     | 1.488  | 30  | -11.21   | 0.275 | 56       | 0.48 | -58  |
| 4.0       | 0.37     | 80   | 1.66     | 1.211  | 13  | -8.20    | 0.389 | 46       | 0.45 | -80  |
| 5.0       | 0.44     | 62   | 0.35     | 1.041  | -1  | -5.90    | 0.507 | 33       | 0.42 | -104 |

**AT-41533 Typical Noise Parameters, Common Emitter,  $Z_o = 50 \Omega$ ,  $V_{CE} = 2.7 V$ ,  $I_C = 5 mA$**

| Freq GHz | $F_{min}$ dB | $\Gamma_{opt}$ |      | $R_n$ |
|----------|--------------|----------------|------|-------|
| GHz      | dB           | Mag            | Ang  | -     |
| 0.1      | 0.7          | 0.45           | 8    | 0.20  |
| 0.9      | 1.0          | 0.25           | 94   | 0.13  |
| 1.8      | 1.4          | 0.38           | -159 | 0.08  |
| 2.4      | 1.6          | 0.54           | -122 | 0.16  |

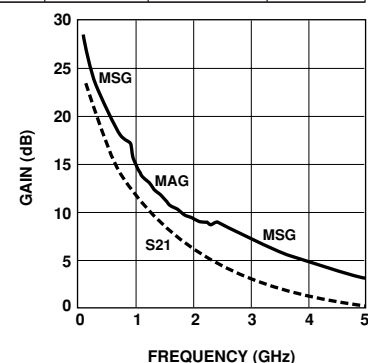


Figure 11. AT-41533 Gains vs. Frequency at  $V_{CE} = 2.7 V$ ,  $I_C = 5 mA$ .

**AT-41511 Typical Scattering Parameters, Common Emitter,  $Z_o = 50 \Omega$ ,  $V_{CE} = 2.7 V$ ,  $I_C = 25 mA$**

| Freq.<br>GHz | $S_{11}$ |      | $S_{21}$ |        |     | $S_{12}$ |       | $S_{22}$ |      |     |
|--------------|----------|------|----------|--------|-----|----------|-------|----------|------|-----|
|              | Mag      | Ang  | dB       | Mag    | Ang | dB       | Mag   | Ang      | Mag  | Ang |
| 0.1          | 0.49     | -91  | 29.26    | 29.048 | 136 | -37.72   | 0.013 | 62       | 0.73 | -22 |
| 0.5          | 0.53     | -168 | 18.55    | 8.459  | 92  | -30.46   | 0.030 | 61       | 0.45 | -23 |
| 0.9          | 0.53     | 172  | 13.62    | 4.798  | 79  | -26.56   | 0.047 | 66       | 0.42 | -26 |
| 1.0          | 0.53     | 169  | 12.73    | 4.330  | 76  | -25.68   | 0.052 | 67       | 0.42 | -27 |
| 1.5          | 0.54     | 153  | 9.34     | 2.932  | 63  | -22.50   | 0.075 | 67       | 0.42 | -34 |
| 1.8          | 0.55     | 145  | 7.86     | 2.473  | 57  | -21.01   | 0.089 | 66       | 0.42 | -38 |
| 2.0          | 0.56     | 140  | 6.97     | 2.232  | 52  | -20.09   | 0.099 | 66       | 0.42 | -41 |
| 2.4          | 0.57     | 129  | 5.47     | 1.877  | 44  | -18.49   | 0.119 | 64       | 0.42 | -48 |
| 3.0          | 0.60     | 116  | 3.67     | 1.525  | 32  | -16.54   | 0.149 | 59       | 0.41 | -58 |
| 4.0          | 0.64     | 95   | 1.30     | 1.162  | 14  | -13.98   | 0.200 | 51       | 0.40 | -75 |
| 5.0          | 0.67     | 79   | -0.58    | 0.935  | -1  | -11.90   | 0.254 | 43       | 0.39 | -96 |

**AT-41511 Typical Noise Parameters, Common Emitter,  $Z_o = 50 \Omega$ ,  $V_{CE} = 2.7 V$ ,  $I_C = 25 mA$**

| Freq | $F_{min}$ | $\Gamma_{opt}$ |      | $R_n$ |
|------|-----------|----------------|------|-------|
| GHz  | dB        | Mag            | Ang  | -     |
| 0.1  | 1.6       | 0.13           | 18   | 0.16  |
| 0.9  | 1.9       | 0.24           | -162 | 0.13  |
| 1.8  | 2.3       | 0.40           | -137 | 0.23  |
| 2.4  | 2.7       | 0.50           | -122 | 0.35  |

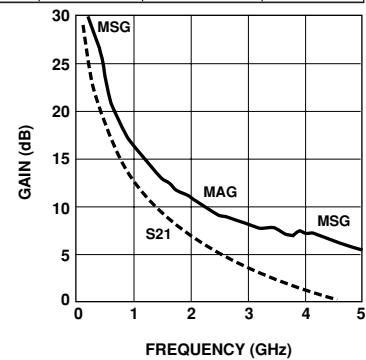


Figure 12. AT-41511 Gains vs. Frequency at  $V_{CE} = 2.7 V$ ,  $I_C = 25 mA$ .

**AT-41533 Typical Scattering Parameters, Common Emitter,  $Z_o = 50 \Omega$ ,  $V_{CE} = 2.7 V$ ,  $I_C = 25 mA$**

| Freq.<br>GHz | $S_{11}$ |      | $S_{21}$ |        |     | $S_{12}$ |       | $S_{22}$ |      |      |
|--------------|----------|------|----------|--------|-----|----------|-------|----------|------|------|
|              | Mag      | Ang  | dB       | Mag    | Ang | dB       | Mag   | Ang      | Mag  | Ang  |
| 0.1          | 0.34     | -75  | 29.37    | 29.404 | 127 | -37.08   | 0.014 | 72       | 0.71 | -21  |
| 0.5          | 0.19     | -168 | 17.63    | 7.614  | 88  | -25.68   | 0.052 | 76       | 0.47 | -20  |
| 0.9          | 0.20     | 161  | 12.73    | 4.329  | 74  | -20.82   | 0.091 | 74       | 0.46 | -24  |
| 1.0          | 0.20     | 154  | 11.84    | 3.909  | 71  | -19.91   | 0.101 | 74       | 0.45 | -26  |
| 1.5          | 0.24     | 132  | 8.56     | 2.679  | 59  | -16.42   | 0.151 | 70       | 0.45 | -33  |
| 1.8          | 0.25     | 121  | 7.12     | 2.271  | 52  | -14.85   | 0.181 | 67       | 0.44 | -38  |
| 2.0          | 0.27     | 115  | 6.32     | 2.071  | 47  | -13.94   | 0.201 | 65       | 0.44 | -41  |
| 2.4          | 0.29     | 105  | 4.99     | 1.777  | 39  | -12.32   | 0.242 | 61       | 0.43 | -48  |
| 3.0          | 0.33     | 93   | 3.46     | 1.489  | 27  | -10.31   | 0.305 | 54       | 0.41 | -59  |
| 4.0          | 0.39     | 76   | 1.69     | 1.215  | 11  | -7.66    | 0.414 | 42       | 0.37 | -81  |
| 5.0          | 0.45     | 60   | 0.40     | 1.047  | -3  | -5.73    | 0.517 | 29       | 0.33 | -106 |

**AT-41533 Typical Noise Parameters, Common Emitter,  $Z_o = 50 \Omega$ ,  $V_{CE} = 2.7 V$ ,  $I_C = 25 mA$**

| Freq | $F_{min}$ | $\Gamma_{opt}$ |      | $R_n$ |
|------|-----------|----------------|------|-------|
| GHz  | dB        | Mag            | Ang  | -     |
| 0.1  | 1.3       | 0.10           | 24   | 0.12  |
| 0.9  | 1.6       | 0.25           | -158 | 0.11  |
| 1.8  | 1.9       | 0.48           | -122 | 0.19  |
| 2.4  | 2.1       | 0.59           | -101 | 0.37  |

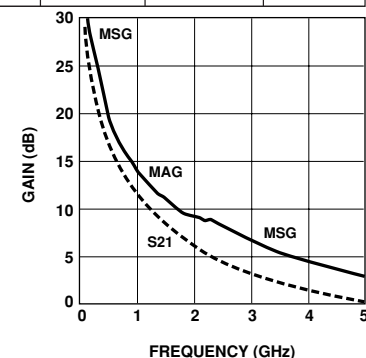


Figure 13. AT-41533 Gains vs. Frequency at  $V_{CE} = 2.7 V$ ,  $I_C = 25 mA$ .

**AT-41511 Typical Scattering Parameters, Common Emitter,  $Z_o = 50 \Omega$ ,  $V_{CE} = 5 V$ ,  $I_C = 5 mA$**

| Freq.<br>GHz | $S_{11}$ |      | $S_{21}$ |        |     | $S_{12}$ |       |     | $S_{22}$ |     |
|--------------|----------|------|----------|--------|-----|----------|-------|-----|----------|-----|
|              | Mag      | Ang  | dB       | Mag    | Ang | dB       | Mag   | Ang | Mag      | Ang |
| 0.1          | 0.88     | -25  | 23.47    | 14.918 | 162 | -34.89   | 0.018 | 77  | 0.95     | -11 |
| 0.5          | 0.61     | -96  | 19.31    | 9.234  | 116 | -25.04   | 0.056 | 49  | 0.66     | -33 |
| 0.9          | 0.50     | -135 | 15.49    | 5.948  | 94  | -23.22   | 0.069 | 44  | 0.52     | -38 |
| 1.0          | 0.48     | -142 | 14.70    | 5.433  | 90  | -22.85   | 0.072 | 43  | 0.50     | -39 |
| 1.5          | 0.45     | -170 | 11.59    | 3.796  | 74  | -21.31   | 0.086 | 44  | 0.45     | -42 |
| 1.8          | 0.45     | 176  | 10.13    | 3.210  | 66  | -20.45   | 0.095 | 45  | 0.44     | -44 |
| 2.0          | 0.45     | 168  | 9.31     | 2.921  | 61  | -19.91   | 0.101 | 46  | 0.43     | -46 |
| 2.4          | 0.45     | 154  | 7.85     | 2.469  | 52  | -18.86   | 0.114 | 46  | 0.42     | -51 |
| 3.0          | 0.48     | 136  | 6.06     | 2.009  | 39  | -17.33   | 0.136 | 46  | 0.42     | -58 |
| 4.0          | 0.53     | 111  | 3.77     | 1.544  | 19  | -15.09   | 0.176 | 43  | 0.40     | -72 |
| 5.0          | 0.58     | 92   | 1.91     | 1.246  | 2   | -13.07   | 0.222 | 39  | 0.40     | -90 |

**AT-41511 Typical Noise Parameters, Common Emitter,  $Z_o = 50 \Omega$ ,  $V_{CE} = 5 V$ ,  $I_C = 5 mA$**

| Freq | $F_{min}$ | $\Gamma_{opt}$ |     | $R_n$ |
|------|-----------|----------------|-----|-------|
| GHz  | dB        | Mag            | Ang | -     |
| 0.1  | 0.8       | 0.46           | 5   | 0.30  |
| 0.9  | 1.0       | 0.39           | 60  | 0.22  |
| 1.8  | 1.4       | 0.34           | 130 | 0.13  |
| 2.4  | 1.7       | 0.39           | 173 | 0.09  |

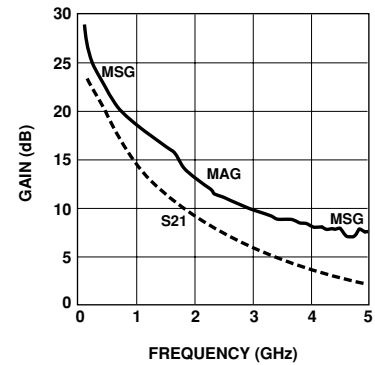


Figure 14. AT-41511 Gains vs. Frequency at  $V_{CE} = 5 V$ ,  $I_C = 5 mA$ .

**AT-41533 Typical Scattering Parameters, Common Emitter,  $Z_o = 50 \Omega$ ,  $V_{CE} = 5 V$ ,  $I_C = 5 mA$**

| Freq.<br>GHz | $S_{11}$ |      | $S_{21}$ |        |     | $S_{12}$ |       |     | $S_{22}$ |     |
|--------------|----------|------|----------|--------|-----|----------|-------|-----|----------|-----|
|              | Mag      | Ang  | dB       | Mag    | Ang | dB       | Mag   | Ang | Mag      | Ang |
| 0.1          | 0.79     | -28  | 23.48    | 14.932 | 155 | -34.89   | 0.018 | 76  | 0.95     | -11 |
| 0.5          | 0.36     | -94  | 17.15    | 7.200  | 104 | -25.35   | 0.054 | 61  | 0.65     | -25 |
| 0.9          | 0.22     | -137 | 12.77    | 4.349  | 84  | -21.94   | 0.080 | 63  | 0.58     | -27 |
| 1.0          | 0.20     | -148 | 11.93    | 3.948  | 81  | -21.21   | 0.087 | 64  | 0.57     | -29 |
| 1.5          | 0.18     | 165  | 8.77     | 2.746  | 65  | -18.20   | 0.123 | 65  | 0.56     | -34 |
| 1.8          | 0.19     | 145  | 7.34     | 2.328  | 58  | -16.65   | 0.147 | 65  | 0.55     | -37 |
| 2.0          | 0.21     | 134  | 6.56     | 2.128  | 53  | -15.70   | 0.164 | 65  | 0.55     | -39 |
| 2.4          | 0.24     | 118  | 5.22     | 1.823  | 44  | -14.02   | 0.199 | 63  | 0.54     | -45 |
| 3.0          | 0.28     | 100  | 3.68     | 1.527  | 32  | -11.77   | 0.258 | 59  | 0.53     | -55 |
| 4.0          | 0.35     | 80   | 1.87     | 1.240  | 14  | -8.61    | 0.371 | 50  | 0.50     | -74 |
| 5.0          | 0.42     | 61   | 0.52     | 1.062  | 0   | -6.18    | 0.491 | 37  | 0.47     | -97 |

**AT-41533 Typical Noise Parameters, Common Emitter,  $Z_o = 50 \Omega$ ,  $V_{CE} = 5 V$ ,  $I_C = 5 mA$**

| Freq | $F_{min}$ | $\Gamma_{opt}$ |      | $R_n$ |
|------|-----------|----------------|------|-------|
| GHz  | dB        | Mag            | Ang  | -     |
| 0.1  | 0.7       | 0.46           | 7    | 0.21  |
| 0.9  | 1.0       | 0.29           | 86   | 0.13  |
| 1.8  | 1.4       | 0.36           | -163 | 0.07  |
| 2.4  | 1.6       | 0.53           | -126 | 0.15  |

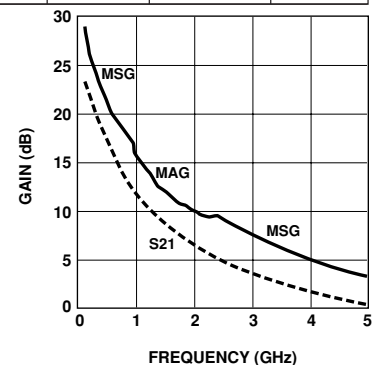


Figure 15. AT-41533 Gains vs. Frequency at  $V_{CE} = 5 V$ ,  $I_C = 5 mA$ .

**AT-41511 Typical Scattering Parameters, Common Emitter,  $Z_o = 50 \Omega$ ,  $V_{CE} = 5 V$ ,  $I_C = 25 mA$**

| Freq.<br>GHz | $S_{11}$ |      | $S_{21}$ |        |     | $S_{12}$ |       | $S_{22}$ |      |     |
|--------------|----------|------|----------|--------|-----|----------|-------|----------|------|-----|
|              | Mag      | Ang  | dB       | Mag    | Ang | dB       | Mag   | Ang      | Mag  | Ang |
| 0.1          | 0.51     | -74  | 30       | 32.792 | 140 | -39      | 0.011 | 65       | 0.80 | -19 |
| 0.5          | 0.46     | -161 | 20       | 10.259 | 95  | -31      | 0.028 | 62       | 0.51 | -21 |
| 0.9          | 0.47     | 177  | 15       | 5.830  | 80  | -27      | 0.043 | 66       | 0.48 | -23 |
| 1.0          | 0.47     | 173  | 14       | 5.257  | 78  | -27      | 0.047 | 67       | 0.48 | -24 |
| 1.5          | 0.48     | 157  | 11       | 3.553  | 65  | -23      | 0.068 | 68       | 0.47 | -30 |
| 1.8          | 0.49     | 148  | 9        | 2.983  | 58  | -22      | 0.081 | 68       | 0.48 | -34 |
| 2.0          | 0.49     | 142  | 9        | 2.692  | 54  | -21      | 0.090 | 67       | 0.48 | -36 |
| 2.4          | 0.51     | 132  | 7        | 2.254  | 46  | -19      | 0.108 | 65       | 0.48 | -42 |
| 3.0          | 0.54     | 118  | 5        | 1.825  | 34  | -17      | 0.135 | 61       | 0.47 | -51 |
| 4.0          | 0.59     | 97   | 3        | 1.386  | 16  | -15      | 0.183 | 54       | 0.46 | -66 |
| 5.0          | 0.63     | 81   | 1        | 1.113  | 0   | -13      | 0.234 | 47       | 0.46 | -84 |

**AT-41511 Typical Noise Parameters, Common Emitter,  $Z_o = 50 \Omega$ ,  $V_{CE} = 5 V$ ,  $I_C = 25 mA$**

| Freq | $F_{min}$ | $\Gamma_{opt}$ |      | $R_n$ |
|------|-----------|----------------|------|-------|
| GHz  | dB        | Mag            | Ang  | -     |
| 0.1  | 1.6       | 0.08           | 14   | 0.18  |
| 0.9  | 1.9       | 0.11           | 165  | 0.16  |
| 1.8  | 2.3       | 0.28           | -153 | 0.18  |
| 2.4  | 2.7       | 0.39           | -134 | 0.22  |

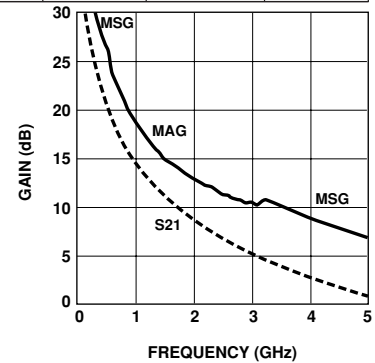


Figure 16. AT-41511 Gains vs. Frequency at  $V_{CE} = 5 V$ ,  $I_C = 25 mA$ .

**AT-41533 Typical Scattering Parameters, Common Emitter,  $Z_o = 50 \Omega$ ,  $V_{CE} = 5 V$ ,  $I_C = 25 mA$**

| Freq.<br>GHz | $S_{11}$ |      | $S_{21}$ |        |     | $S_{12}$ |       | $S_{22}$ |      |     |
|--------------|----------|------|----------|--------|-----|----------|-------|----------|------|-----|
|              | Mag      | Ang  | dB       | Mag    | Ang | dB       | Mag   | Ang      | Mag  | Ang |
| 0.1          | 0.37     | -62  | 30.00    | 31.606 | 129 | -37.72   | 0.013 | 73       | 0.74 | -19 |
| 0.5          | 0.13     | -153 | 18.46    | 8.375  | 89  | -26.20   | 0.049 | 76       | 0.51 | -19 |
| 0.9          | 0.13     | 163  | 13.56    | 4.764  | 76  | -21.31   | 0.086 | 75       | 0.49 | -23 |
| 1.0          | 0.13     | 154  | 12.68    | 4.305  | 73  | -20.45   | 0.095 | 74       | 0.49 | -25 |
| 1.5          | 0.17     | 128  | 9.38     | 2.945  | 61  | -16.95   | 0.142 | 71       | 0.48 | -31 |
| 1.8          | 0.19     | 117  | 7.93     | 2.493  | 54  | -15.39   | 0.170 | 68       | 0.48 | -35 |
| 2.0          | 0.20     | 111  | 7.14     | 2.274  | 50  | -14.47   | 0.189 | 66       | 0.48 | -38 |
| 2.4          | 0.23     | 102  | 5.80     | 1.949  | 42  | -12.84   | 0.228 | 62       | 0.47 | -44 |
| 3.0          | 0.27     | 90   | 4.25     | 1.632  | 31  | -10.84   | 0.287 | 56       | 0.45 | -54 |
| 4.0          | 0.33     | 76   | 2.48     | 1.331  | 14  | -8.13    | 0.392 | 45       | 0.42 | -74 |
| 5.0          | 0.39     | 60   | 1.19     | 1.147  | -1  | -6.09    | 0.496 | 32       | 0.38 | -97 |

**AT-41533 Typical Noise Parameters, Common Emitter,  $Z_o = 50 \Omega$ ,  $V_{CE} = 5 V$ ,  $I_C = 25 mA$**

| Freq | $F_{min}$ | $\Gamma_{opt}$ |      | $R_n$ |
|------|-----------|----------------|------|-------|
| GHz  | dB        | Mag            | Ang  | -     |
| 0.1  | 1.3       | 0.08           | 13   | 0.12  |
| 0.9  | 1.6       | 0.19           | -170 | 0.10  |
| 1.8  | 1.9       | 0.42           | -126 | 0.16  |
| 2.4  | 2.1       | 0.55           | -105 | 0.32  |

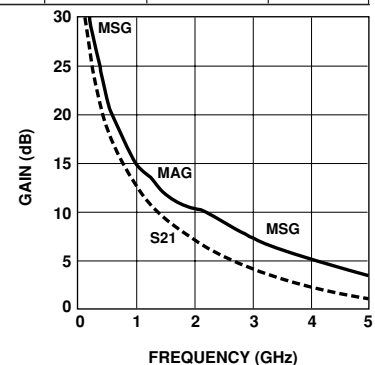


Figure 17. AT-41533 Gains vs. Frequency at  $V_{CE} = 5 V$ ,  $I_C = 25 mA$ .



**AT-41511 Typical Scattering Parameters, Common Emitter,  $Z_o = 50 \Omega$ ,  $V_{CE} = 8V$ ,  $I_C = 10mA$**

| Freq.<br>GHz | $S_{11}$ |      | $S_{21}$ |        |     | $S_{12}$ |       |     | $S_{22}$ |     |
|--------------|----------|------|----------|--------|-----|----------|-------|-----|----------|-----|
|              | Mag      | Ang  | dB       | Mag    | Ang | dB       | Mag   | Ang | Mag      | Ang |
| 0.1          | 0.75     | -36  | 27.71    | 24.305 | 155 | -37.72   | 0.013 | 73  | 0.92     | -13 |
| 0.5          | 0.47     | -119 | 21.24    | 11.535 | 106 | -28.87   | 0.036 | 53  | 0.60     | -27 |
| 0.9          | 0.41     | -155 | 16.80    | 6.921  | 88  | -26.20   | 0.049 | 55  | 0.51     | -28 |
| 1.0          | 0.40     | -161 | 15.96    | 6.281  | 84  | -25.68   | 0.052 | 56  | 0.50     | -29 |
| 1.5          | 0.39     | 174  | 12.66    | 4.294  | 70  | -23.10   | 0.070 | 58  | 0.48     | -32 |
| 1.8          | 0.40     | 162  | 11.16    | 3.615  | 63  | -21.83   | 0.081 | 59  | 0.48     | -35 |
| 2.0          | 0.40     | 155  | 10.29    | 3.269  | 59  | -21.11   | 0.088 | 58  | 0.48     | -37 |
| 2.4          | 0.42     | 143  | 8.77     | 2.745  | 50  | -19.66   | 0.104 | 58  | 0.48     | -41 |
| 3.0          | 0.44     | 126  | 6.95     | 2.226  | 38  | -17.86   | 0.128 | 55  | 0.47     | -48 |
| 4.0          | 0.51     | 104  | 4.60     | 1.698  | 19  | -15.44   | 0.169 | 50  | 0.46     | -61 |
| 5.0          | 0.56     | 87   | 2.73     | 1.370  | 3   | -13.39   | 0.214 | 45  | 0.46     | -76 |

**AT-41511 Typical Noise Parameters, Common Emitter,  $Z_o = 50 \Omega$ ,  $V_{CE} = 8V$ ,  $I_C = 10mA$**

| Freq | $F_{min}$ | $\Gamma_{opt}$ |     | $R_n$ |
|------|-----------|----------------|-----|-------|
| GHz  | dB        | Mag            | Ang | -     |
| 0.1  | 1.1       | 0.40           | 7   | 0.27  |
| 0.9  | 1.3       | 0.33           | 62  | 0.20  |
| 1.8  | 1.6       | 0.27           | 135 | 0.13  |
| 2.4  | 1.8       | 0.35           | 178 | 0.10  |

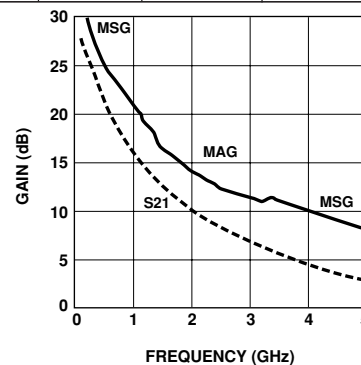


Figure 18. AT-41511 Gains vs. Frequency at  $V_{CE} = 8V$ ,  $I_C = 10mA$ .

**AT-41533 Typical Scattering Parameters, Common Emitter,  $Z_o = 50 \Omega$ ,  $V_{CE} = 8V$ ,  $I_C = 10mA$**

| Freq.<br>GHz | $S_{11}$ |      | $S_{21}$ |        |     | $S_{12}$ |       |     | $S_{22}$ |     |
|--------------|----------|------|----------|--------|-----|----------|-------|-----|----------|-----|
|              | Mag      | Ang  | dB       | Mag    | Ang | dB       | Mag   | Ang | Mag      | Ang |
| 0.1          | 0.65     | -37  | 27.45    | 23.576 | 145 | -35.92   | 0.016 | 73  | 0.88     | -15 |
| 0.5          | 0.20     | -100 | 18.60    | 8.509  | 97  | -26.20   | 0.049 | 69  | 0.57     | -23 |
| 0.9          | 0.11     | -146 | 13.89    | 4.947  | 81  | -21.83   | 0.081 | 71  | 0.54     | -25 |
| 1.0          | 0.09     | -161 | 13.03    | 4.482  | 78  | -20.92   | 0.090 | 70  | 0.53     | -26 |
| 1.5          | 0.11     | 144  | 9.77     | 3.081  | 64  | -17.59   | 0.132 | 69  | 0.52     | -32 |
| 1.8          | 0.13     | 125  | 8.34     | 2.611  | 58  | -16.03   | 0.158 | 67  | 0.51     | -35 |
| 2.0          | 0.14     | 116  | 7.53     | 2.379  | 53  | -15.09   | 0.176 | 65  | 0.51     | -38 |
| 2.4          | 0.17     | 104  | 6.20     | 2.041  | 45  | -13.47   | 0.212 | 62  | 0.50     | -43 |
| 3.0          | 0.22     | 91   | 4.66     | 1.710  | 33  | -11.40   | 0.269 | 57  | 0.49     | -52 |
| 4.0          | 0.28     | 77   | 2.90     | 1.396  | 16  | -8.61    | 0.371 | 47  | 0.46     | -71 |
| 5.0          | 0.35     | 62   | 1.61     | 1.204  | 1   | -6.45    | 0.476 | 35  | 0.43     | -92 |

**AT-41533 Typical Noise Parameters, Common Emitter,  $Z_o = 50 \Omega$ ,  $V_{CE} = 8V$ ,  $I_C = 10mA$**

| Freq | $F_{min}$ | $\Gamma_{opt}$ |      | $R_n$ |
|------|-----------|----------------|------|-------|
| GHz  | dB        | Mag            | Ang  | -     |
| 0.1  | 0.8       | 0.40           | 13   | 0.18  |
| 0.9  | 1.1       | 0.20           | 93   | 0.12  |
| 1.8  | 1.5       | 0.32           | -154 | 0.09  |
| 2.4  | 1.7       | 0.49           | -121 | 0.17  |

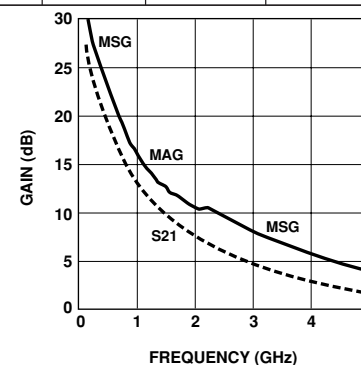


Figure 19. AT-41533 Gains vs. Frequency at  $V_{CE} = 8V$ ,  $I_C = 10mA$ .

**AT-41511 Typical Scattering Parameters, Common Emitter,  $Z_o = 50 \Omega$ ,  $V_{CE} = 8 V$ ,  $I_C = 25 mA$**

| Freq.<br>GHz | $S_{11}$ |      | $S_{21}$ |        |     | $S_{12}$ |       |     | $S_{22}$ |     |
|--------------|----------|------|----------|--------|-----|----------|-------|-----|----------|-----|
|              | Mag      | Ang  | dB       | Mag    | Ang | dB       | Mag   | Ang | Mag      | Ang |
| 0.1          | 0.55     | -65  | 30.44    | 33.264 | 142 | -39.17   | 0.011 | 66  | 0.82     | -17 |
| 0.5          | 0.44     | -155 | 20.69    | 10.832 | 96  | -31.37   | 0.027 | 61  | 0.54     | -21 |
| 0.9          | 0.44     | -179 | 15.83    | 6.190  | 81  | -27.54   | 0.042 | 66  | 0.50     | -22 |
| 1.0          | 0.44     | 176  | 14.95    | 5.588  | 78  | -26.74   | 0.046 | 67  | 0.50     | -23 |
| 1.5          | 0.45     | 159  | 11.55    | 3.779  | 66  | -23.61   | 0.066 | 67  | 0.49     | -29 |
| 1.8          | 0.46     | 150  | 10.03    | 3.173  | 59  | -22.16   | 0.078 | 67  | 0.50     | -32 |
| 2.0          | 0.46     | 144  | 9.14     | 2.865  | 55  | -21.31   | 0.086 | 66  | 0.50     | -35 |
| 2.4          | 0.48     | 133  | 7.61     | 2.401  | 46  | -19.66   | 0.104 | 65  | 0.50     | -40 |
| 3.0          | 0.51     | 119  | 5.78     | 1.945  | 35  | -17.72   | 0.130 | 61  | 0.49     | -48 |
| 4.0          | 0.57     | 99   | 3.39     | 1.477  | 17  | -15.09   | 0.176 | 55  | 0.49     | -63 |
| 5.0          | 0.61     | 83   | 1.49     | 1.187  | 1   | -12.92   | 0.226 | 48  | 0.48     | -80 |

**AT-41511 Typical Noise Parameters, Common Emitter,  $Z_o = 50 \Omega$ ,  $V_{CE} = 8 V$ ,  $I_C = 25 mA$**

| Freq | $F_{min}$ | $\Gamma_{opt}$ |      | $R_n$ |
|------|-----------|----------------|------|-------|
| GHz  | dB        | Mag            | Ang  | -     |
| 0.1  | 1.6       | 0.08           | 10   | 0.20  |
| 0.9  | 1.9       | 0.10           | 100  | 0.19  |
| 1.8  | 2.3       | 0.22           | -170 | 0.18  |
| 2.4  | 2.7       | 0.32           | -147 | 0.18  |

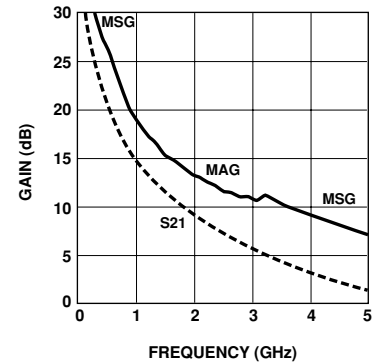


Figure 20. AT-41511 Gains vs. Frequency at  $V_{CE} = 8 V$ ,  $I_C = 25 mA$ .

**AT-41533 Typical Scattering Parameters, Common Emitter,  $Z_o = 50 \Omega$ ,  $V_{CE} = 8 V$ ,  $I_C = 25 mA$**

| Freq.<br>GHz | $S_{11}$ |      | $S_{21}$ |        |     | $S_{12}$ |       |     | $S_{22}$ |     |
|--------------|----------|------|----------|--------|-----|----------|-------|-----|----------|-----|
|              | Mag      | Ang  | dB       | Mag    | Ang | dB       | Mag   | Ang | Mag      | Ang |
| 0.1          | 0.41     | -57  | 30.11    | 32.026 | 130 | -37.72   | 0.013 | 73  | 0.76     | -18 |
| 0.5          | 0.11     | -138 | 18.75    | 8.664  | 90  | -26.38   | 0.048 | 76  | 0.52     | -19 |
| 0.9          | 0.10     | 168  | 13.87    | 4.938  | 77  | -21.51   | 0.084 | 75  | 0.50     | -22 |
| 1.0          | 0.10     | 156  | 12.99    | 4.460  | 74  | -20.63   | 0.093 | 74  | 0.50     | -24 |
| 1.5          | 0.14     | 126  | 9.70     | 3.054  | 62  | -17.14   | 0.139 | 71  | 0.49     | -31 |
| 1.8          | 0.16     | 115  | 8.25     | 2.585  | 55  | -15.60   | 0.166 | 68  | 0.49     | -34 |
| 2.0          | 0.17     | 108  | 7.45     | 2.359  | 51  | -14.66   | 0.185 | 66  | 0.49     | -37 |
| 2.4          | 0.20     | 99   | 6.11     | 2.020  | 43  | -13.03   | 0.223 | 62  | 0.48     | -43 |
| 3.0          | 0.24     | 89   | 4.56     | 1.691  | 32  | -11.03   | 0.281 | 56  | 0.46     | -53 |
| 4.0          | 0.30     | 75   | 2.80     | 1.380  | 15  | -8.31    | 0.384 | 45  | 0.43     | -72 |
| 5.0          | 0.37     | 61   | 1.51     | 1.190  | 0   | -6.25    | 0.487 | 33  | 0.39     | -94 |

**AT-41533 Typical Noise Parameters, Common Emitter,  $Z_o = 50 \Omega$ ,  $V_{CE} = 8 V$ ,  $I_C = 25 mA$**

| Freq | $F_{min}$ | $\Gamma_{opt}$ |      | $R_n$ |
|------|-----------|----------------|------|-------|
| GHz  | dB        | Mag            | Ang  | -     |
| 0.1  | 1.3       | 0.07           | 18   | 0.16  |
| 0.9  | 1.6       | 0.12           | 164  | 0.12  |
| 1.8  | 1.9       | 0.36           | -134 | 0.15  |
| 2.4  | 2.1       | 0.51           | -109 | 0.28  |

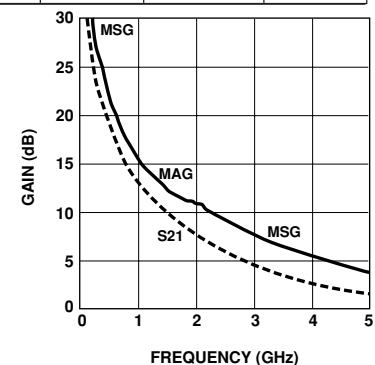


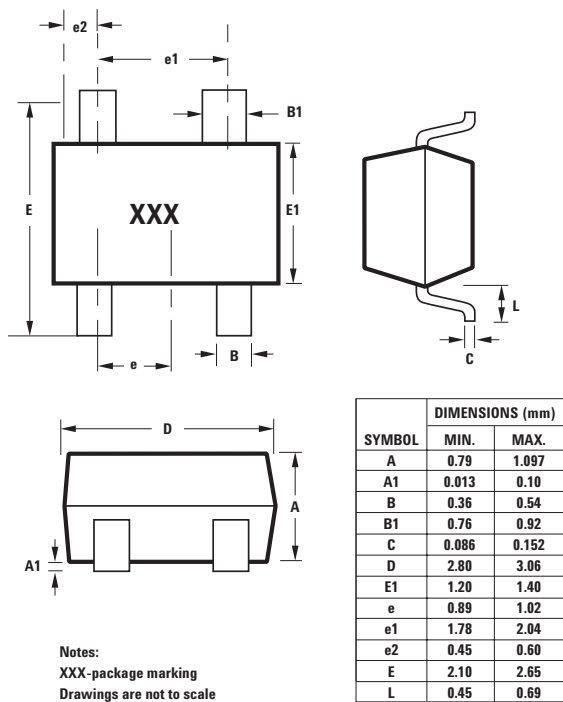
Figure 21. AT-41533 Gains vs. Frequency at  $V_{CE} = 8 V$ ,  $I_C = 25 mA$ .

### Ordering Information

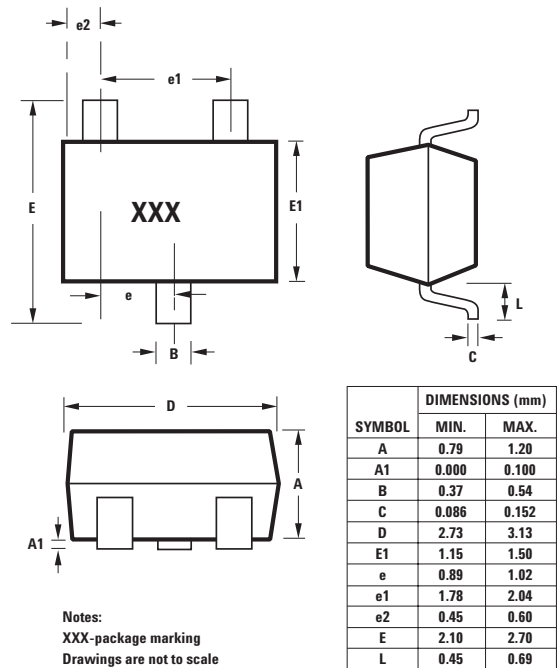
| Part Numbers  |               | No. of Devices | Comments |
|---------------|---------------|----------------|----------|
| AT-41511-BLK  | AT-41533-BLK  | 100            | Bulk     |
| AT-41511-BLKG | AT-41533-BLKG | 100            | Bulk     |
| AT-41511-TR1  | AT-41533-TR1  | 3000           | 7" Reel  |
| AT-41511-TR1G | AT-41533-TR1G | 3000           | 7" Reel  |
| AT-41511-TR2  | AT-41533-TR2  | 10000          | 13" Reel |
| AT-41511-TR2G | AT-41533-TR2G | 10000          | 13" Reel |

Note: Order part number with a "G" suffix if lead-free option is desired.

### Package Dimensions SOT-143 Plastic Package



### SOT-23 Plastic Package



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