

# Low Current, High Performance NPN Silicon Bipolar Transistor

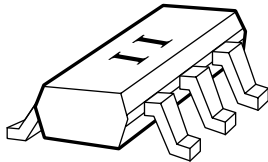
## Technical Data

### AT-32063

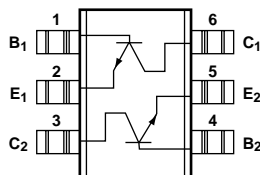
#### Features

- **High Performance Bipolar Transistor Optimized for Low Current, Low Voltage Operation**
- **900 MHz Performance: 1.1 dB NF, 14.5 dB G<sub>A</sub>**
- **Characterized for End-of-Life Battery Use (2.7 V)**
- **SOT-363 (SC-70) Plastic Package**
- **Tape-and-Reel Packaging Option Available <sup>[1]</sup>**

#### Surface Mount Package SOT-363 (SC-70)



#### Pin Connections and Package Marking



#### Description

The AT-32063 contains two high performance NPN bipolar transistors in a single SOT-363 package. The devices are unconnected, allowing flexibility in design. The pin-out is convenient for cascode amplifier designs. The SOT-363 package is an industry standard plastic surface mount package.

The 3.2 micron emitter-to-emitter pitch and reduced parasitic design of the transistor yields extremely high performance products that can perform a multiplicity of tasks. The 20 emitter finger interdigitated geometry yields a transistor that is easy to match to and extremely fast, with moderate power, low noise resistance, and low operating currents.

Optimized performance at 2.7 V makes this device 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 12 dB or more associated gain at a 2.7 V, 5 mA bias, with noise performance being relatively insensitive to input match. High gain capability at 1 V, 1 mA makes this device a good fit for 900 MHz pager applications. Voltage breakdowns are high enough for use at 5 volts.

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 metallization in the fabrication of these devices.

## AT-32063 Absolute Maximum Ratings<sup>[1]</sup>

| Symbol    | Parameter                          | Units | Absolute Maximum |
|-----------|------------------------------------|-------|------------------|
| $V_{EBO}$ | 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    | 40               |
| $P_T$     | Power Dissipation <sup>[2,3]</sup> | mW    | 150              |
| $T_j$     | Junction Temperature               | °C    | 150              |
| $T_{STG}$ | Storage Temperature                | °C    | -65 to 150       |

### Thermal Resistance<sup>[2]</sup>:

$$\theta_{jc} = 370^\circ\text{C/W}$$

#### Notes:

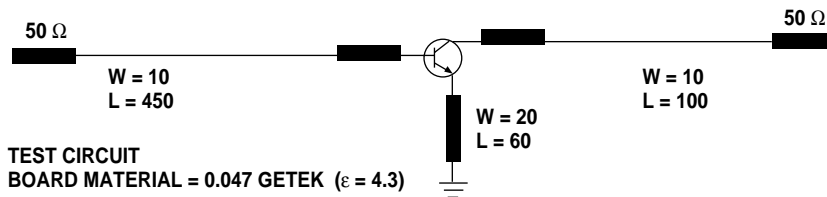
1. Permanent damage may occur if any of these limits are exceeded.
2.  $T_{\text{Mounting Surface}} = 25^\circ\text{C}$ .
3. Derate at 2.7 mW/°C for  $T_C > 94.5^\circ\text{C}$ .
4. 150 mW per device.

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

| Symbol    | Parameters and Test Conditions                                                                                                    | Units         | Min.                | Typ.                | Max.               |
|-----------|-----------------------------------------------------------------------------------------------------------------------------------|---------------|---------------------|---------------------|--------------------|
| NF        | Noise Figure; $V_{CE} = 2.7\text{ V}$ , $I_C = 5\text{ mA}$ <span style="float: right;"><math>f = 0.9\text{ GHz}</math></span>    | dB            |                     | 1.1 <sup>[2]</sup>  | 1.4 <sup>[2]</sup> |
| $G_A$     | Associated Gain; $V_{CE} = 2.7\text{ V}$ , $I_C = 5\text{ mA}$ <span style="float: right;"><math>f = 0.9\text{ GHz}</math></span> | dB            | 12.5 <sup>[2]</sup> | 14.5 <sup>[2]</sup> |                    |
| $h_{FE}$  | Forward Current Transfer Ratio; $V_{CE} = 2.7\text{ V}$ , $I_C = 5\text{ mA}$                                                     | —             | 50                  |                     | 270                |
| $I_{CBO}$ | Collector Cutoff Current; $V_{CB} = 3\text{ V}$                                                                                   | $\mu\text{A}$ |                     |                     | 0.2                |
| $I_{EBO}$ | Noise Figure; $V_{EB} = 1\text{ V}$                                                                                               | $\mu\text{A}$ |                     |                     | 1.5                |

#### Notes:

1. All data is per individual transistor.
2. Test circuit, Figure 1. Numbers reflect device performance de-embedded from circuit losses. Input loss = 0.2 dB; output loss = 0.3 dB.



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**Figure 1. Test circuit for Noise Figure and Associated Gain.**  
This circuit is a compromise match between best noise figure, best gain, stability, and a practical synthesizable match.

## AT-32063 Characterization Information, $T_A = 25^\circ\text{C}$

| Symbol            | Parameters and Test Conditions                                                                                                       | Units | Typ. |
|-------------------|--------------------------------------------------------------------------------------------------------------------------------------|-------|------|
| $P_{1\text{ dB}}$ | Power at 1 dB Gain Compression (opt tuning); $V_{\text{CE}} = 2.7\text{ V}$ , $I_{\text{C}} = 20\text{ mA}$ $f = 0.9\text{ GHz}$     | dBm   | 12   |
| $G_{1\text{ dB}}$ | Gain at 1 dB Gain Compression (opt tuning); $V_{\text{CE}} = 2.7\text{ V}$ , $I_{\text{C}} = 20\text{ mA}$ $f = 0.9\text{ GHz}$      | dB    | 16   |
| $IP_3$            | Output Third Order Intercept Point (opt tuning); $V_{\text{CE}} = 2.7\text{ V}$ , $I_{\text{C}} = 20\text{ mA}$ $f = 0.9\text{ GHz}$ | dBm   | 24   |

### Typical Performance, $T_A = 25^\circ\text{C}$

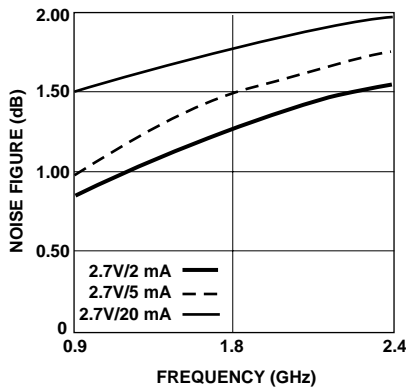


Figure 2. Minimum Noise Figure vs. Frequency and Current at  $V_{\text{CE}} = 2.7\text{ V}$ .

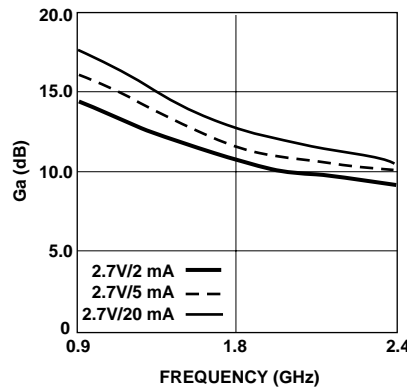


Figure 3. Associated Gain at Optimum Noise Match vs. Frequency and Current at  $V_{\text{CE}} = 2.7\text{ V}$ .

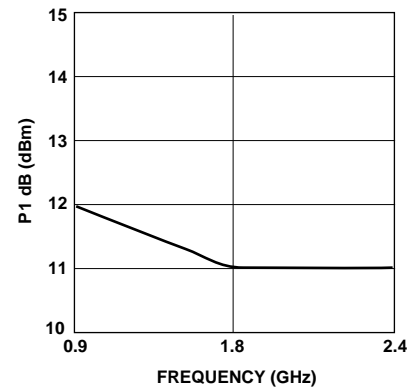


Figure 4. Power at 1 dB Gain Compression vs. Frequency at  $V_{\text{CE}} = 2.7\text{ V}$  and  $I_{\text{C}} = 20\text{ mA}$ .

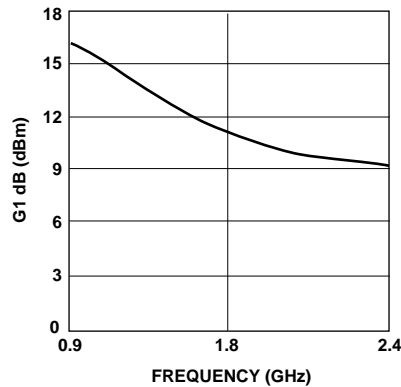


Figure 5. 1 dB Compressed Gain vs. Frequency at  $V_{\text{CE}} = 2.7\text{ V}$  and  $I_{\text{C}} = 20\text{ mA}$ .

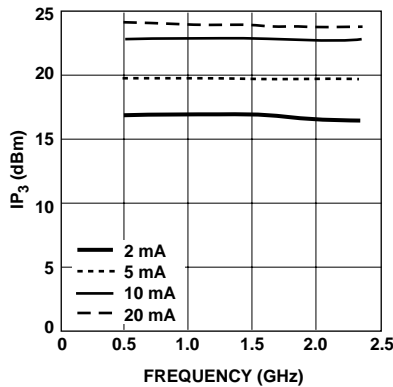


Figure 6. Third Order Intercept vs. Frequency and Bias at  $V_{\text{CE}} = 2.7\text{ V}$ , with Optimal Tuning.

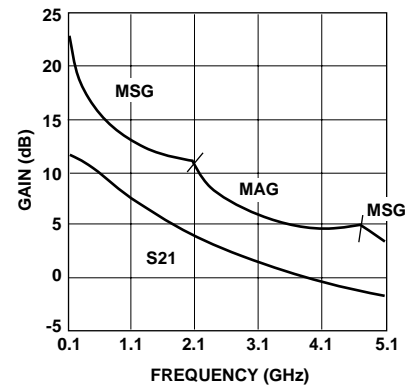
**AT-32063 Typical Scattering Parameters, Common Emitter,  $Z_0 = 50 \Omega$ ,  $V_{CE} = 1 \text{ V}$ ,  $I_C = 1 \text{ mA}$**

| Freq.<br>GHz | $S_{11}$ |      | $S_{21}$ |      |     | $S_{12}$ |      |     | $S_{22}$ |      |
|--------------|----------|------|----------|------|-----|----------|------|-----|----------|------|
|              | Mag      | Ang  | dB       | Mag  | Ang | dB       | Mag  | Ang | Mag      | Ang  |
| 0.1          | 0.98     | -11  | 11.36    | 3.7  | 171 | -34.77   | 0.02 | 83  | 0.99     | -4   |
| 0.5          | 0.86     | -50  | 10.14    | 3.21 | 138 | -22.02   | 0.08 | 59  | 0.91     | -20  |
| 0.9          | 0.72     | -82  | 8.39     | 2.63 | 113 | -18.97   | 0.11 | 43  | 0.82     | -31  |
| 1.0          | 0.69     | -88  | 7.87     | 2.48 | 108 | -18.61   | 0.12 | 41  | 0.8      | -32  |
| 1.5          | 0.58     | -119 | 5.87     | 1.97 | 85  | -17.8    | 0.13 | 31  | 0.73     | -41  |
| 1.8          | 0.52     | -134 | 4.83     | 1.74 | 74  | -17.72   | 0.13 | 28  | 0.7      | -45  |
| 2.0          | 0.49     | -145 | 4.3      | 1.64 | 67  | -17.69   | 0.13 | 28  | 0.68     | -48  |
| 2.4          | 0.45     | -165 | 3.16     | 1.44 | 55  | -17.68   | 0.13 | 30  | 0.67     | -54  |
| 3.0          | 0.41     | 166  | 1.84     | 1.24 | 39  | -16.99   | 0.14 | 37  | 0.64     | -63  |
| 4.0          | 0.42     | 124  | 0.17     | 1.02 | 16  | -13.67   | 0.21 | 45  | 0.6      | -81  |
| 5.0          | 0.47     | 93   | -1.15    | 0.88 | -2  | -9.84    | 0.32 | 38  | 0.54     | -107 |

**AT-32063 Typical Noise Parameters**

Common Emitter,  $Z_0 = 50 \Omega$ ,  $V_{CE} = 1 \text{ V}$ ,  $I_C = 1 \text{ mA}$

| Freq.<br>GHz | $F_{min}$<br>dB | $G_A$<br>dB | $G_{opt}$<br>Mag. | Ang. | $R_n$<br>— |
|--------------|-----------------|-------------|-------------------|------|------------|
| 0.9          | 0.71            | 10.4        | 0.76              | 50   | 0.44       |
| 1.8          | 1.37            | 8.3         | 0.60              | 112  | 0.24       |
| 2.4          | 1.80            | 7.2         | 0.50              | 155  | 0.10       |



**Figure 7. Gain vs. Frequency at  $V_{CE}=1\text{V}$ ,  $I_C = 1\text{mA}$ .**

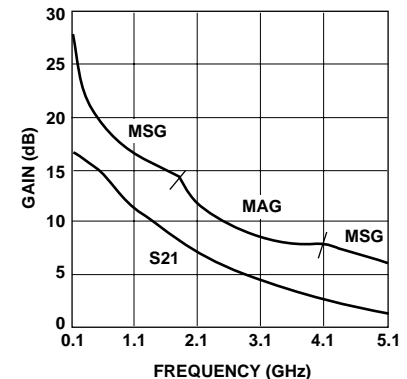
**AT-32063 Typical Scattering Parameters, Common Emitter,  $Z_0 = 50 \Omega$ ,  $V_{CE} = 2.7 \text{ V}$ ,  $I_C = 2 \text{ mA}$**

| Freq.<br>GHz | $S_{11}$ |      | $S_{21}$ |      |     | $S_{12}$ |       |     | $S_{22}$ |     |
|--------------|----------|------|----------|------|-----|----------|-------|-----|----------|-----|
|              | Mag      | Ang  | dB       | Mag  | Ang | dB       | Mag   | Ang | Mag      | Ang |
| 0.1          | 0.96     | -12  | 16.46    | 6.66 | 169 | -37.32   | 0.014 | 82  | 0.98     | -5  |
| 0.5          | 0.77     | -55  | 14.73    | 5.45 | 132 | -25.13   | 0.055 | 59  | 0.87     | -21 |
| 0.9          | 0.59     | -87  | 12.37    | 4.15 | 107 | -22.42   | 0.076 | 48  | 0.76     | -29 |
| 1.0          | 0.55     | -93  | 11.74    | 3.86 | 103 | -22.07   | 0.079 | 47  | 0.74     | -30 |
| 1.5          | 0.42     | -121 | 9.26     | 2.90 | 83  | -20.79   | 0.091 | 44  | 0.69     | -36 |
| 1.8          | 0.37     | -135 | 8.01     | 2.52 | 73  | -20.13   | 0.099 | 45  | 0.67     | -39 |
| 2.0          | 0.34     | -145 | 7.35     | 2.33 | 67  | -19.67   | 0.104 | 46  | 0.66     | -41 |
| 2.4          | 0.29     | -164 | 6.05     | 2.01 | 56  | -18.68   | 0.116 | 48  | 0.65     | -46 |
| 3.0          | 0.26     | 167  | 4.54     | 1.69 | 41  | -16.95   | 0.142 | 50  | 0.64     | -53 |
| 4.0          | 0.28     | 124  | 2.73     | 1.37 | 20  | -13.75   | 0.205 | 48  | 0.61     | -68 |
| 5.0          | 0.33     | 94   | 1.36     | 1.17 | 1   | -10.70   | 0.292 | 41  | 0.57     | -89 |

**AT-32063 Typical Noise Parameters**

Common Emitter,  $Z_0 = 50 \Omega$ ,  $V_{CE} = 2.7 \text{ V}$ ,  $I_C = 2 \text{ mA}$

| Freq.<br>GHz | $F_{min}$<br>dB | $G_A$<br>dB | $G_{opt}$<br>Mag. | Ang. | $R_n$<br>— |
|--------------|-----------------|-------------|-------------------|------|------------|
| 0.9          | 0.78            | 14.3        | 0.65              | 50   | 0.31       |
| 1.8          | 1.25            | 10.7        | 0.45              | 105  | 0.20       |
| 2.4          | 1.57            | 9.1         | 0.35              | 145  | 0.13       |



**Figure 8. Gain vs. Frequency at  $V_{CE}=2.7 \text{ V}$ ,  $I_C = 2\text{mA}$ .**

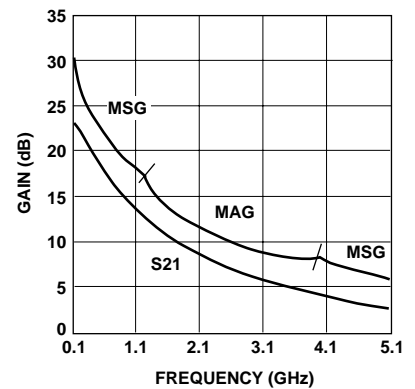
**AT-32063 Typical Scattering Parameters, Common Emitter,  $Z_0 = 50 \Omega$ ,  $V_{CE} = 2.7 \text{ V}$ ,  $I_C = 5 \text{ mA}$**

| Freq.<br>GHz | $S_{11}$ |      | $S_{21}$ |       |     | $S_{12}$ |       |     | $S_{22}$ |     |
|--------------|----------|------|----------|-------|-----|----------|-------|-----|----------|-----|
|              | Mag      | Ang  | dB       | Mag   | Ang | dB       | Mag   | Ang | Mag      | Ang |
| 0.1          | 0.87     | -19  | 23.36    | 14.72 | 162 | -37.77   | 0.013 | 80  | 0.96     | -9  |
| 0.5          | 0.52     | -72  | 19.21    | 9.13  | 116 | -27.03   | 0.045 | 60  | 0.72     | -25 |
| 0.9          | 0.34     | -101 | 15.40    | 5.89  | 94  | -24.01   | 0.063 | 58  | 0.62     | -28 |
| 1.0          | 0.31     | -106 | 14.60    | 5.37  | 90  | -23.41   | 0.067 | 58  | 0.61     | -29 |
| 1.5          | 0.22     | -129 | 11.54    | 3.77  | 74  | -20.85   | 0.091 | 58  | 0.58     | -33 |
| 1.8          | 0.19     | -141 | 10.12    | 3.21  | 66  | -19.52   | 0.106 | 58  | 0.57     | -36 |
| 2.0          | 0.17     | -150 | 9.33     | 2.93  | 61  | -18.72   | 0.116 | 57  | 0.57     | -38 |
| 2.4          | 0.14     | -169 | 7.95     | 2.50  | 52  | -17.22   | 0.138 | 56  | 0.57     | -42 |
| 3.0          | 0.12     | 160  | 6.34     | 2.08  | 39  | -15.25   | 0.173 | 52  | 0.56     | -49 |
| 4.0          | 0.16     | 117  | 4.46     | 1.67  | 20  | -12.40   | 0.240 | 44  | 0.53     | -63 |
| 5.0          | 0.22     | 93   | 3.15     | 1.44  | 2   | -10.03   | 0.315 | 33  | 0.48     | -82 |

**AT-32063 Typical Noise Parameters**

Common Emitter,  $Z_0 = 50 \Omega$ ,  $V_{CE} = 2.7 \text{ V}$ ,  $I_C = 5 \text{ mA}$

| Freq.<br>GHz | $F_{min}$<br>dB | $G_A$<br>dB | $G_{opt}$<br>Mag. | Ang. | $R_n$<br>— |
|--------------|-----------------|-------------|-------------------|------|------------|
| 0.9          | 0.98            | 16.4        | 0.45              | 51   | 0.23       |
| 1.8          | 1.50            | 11.6        | 0.29              | 100  | 0.16       |
| 2.4          | 1.77            | 10.1        | 0.33              | 153  | 0.11       |



**Figure 9. Gain vs. Frequency at  $V_{CE}=2.7 \text{ V}$ ,  $I_C = 5 \text{ mA}$ .**

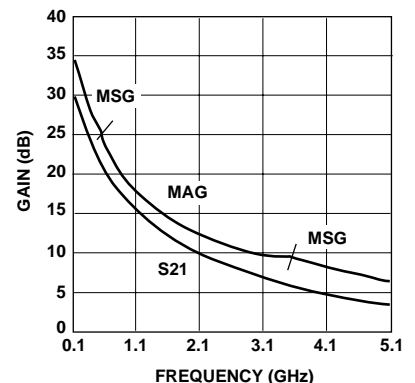
**AT-32063 Typical Scattering Parameters, Common Emitter,  $Z_0 = 50 \Omega$ ,  $V_{CE} = 2.7 \text{ V}$ ,  $I_C = 20 \text{ mA}$**

| 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     | -41  | 30.48    | 33.40 | 143 | -39.81   | 0.010 | 74  | 0.83     | -15 |
| 0.5          | 0.20     | -107 | 21.24    | 11.53 | 97  | -29.18   | 0.035 | 72  | 0.56     | -20 |
| 0.9          | 0.13     | -137 | 16.48    | 6.66  | 82  | -24.63   | 0.059 | 72  | 0.53     | -22 |
| 1.0          | 0.13     | -141 | 15.60    | 6.02  | 79  | -23.79   | 0.065 | 71  | 0.53     | -22 |
| 1.5          | 0.10     | -164 | 12.26    | 4.10  | 67  | -20.43   | 0.095 | 68  | 0.52     | -27 |
| 1.8          | 0.09     | -178 | 10.78    | 3.46  | 60  | -18.88   | 0.114 | 66  | 0.53     | -31 |
| 2.0          | 0.09     | 172  | 9.93     | 3.14  | 56  | -17.98   | 0.126 | 64  | 0.53     | -34 |
| 2.4          | 0.08     | 152  | 8.52     | 2.67  | 48  | -16.39   | 0.151 | 60  | 0.53     | -39 |
| 3.0          | 0.10     | 127  | 6.85     | 2.20  | 36  | -14.4    | 0.191 | 54  | 0.52     | -47 |
| 4.0          | 0.15     | 101  | 4.92     | 1.76  | 18  | -11.68   | 0.261 | 43  | 0.48     | -61 |
| 5.0          | 0.21     | 86   | 3.59     | 1.51  | 0   | -9.52    | 0.334 | 31  | 0.44     | -79 |

**AT-32063 Typical Noise Parameters**

Common Emitter,  $Z_0 = 50 \Omega$ ,  $V_{CE} = 2.7 \text{ V}$ ,  $I_C = 20 \text{ mA}$

| Freq.<br>GHz | $F_{min}$<br>dB | $G_A$<br>dB | $G_{opt}$<br>Mag. | Ang. | $R_n$<br>— |
|--------------|-----------------|-------------|-------------------|------|------------|
| 0.9          | 1.51            | 17.9        | 0.13              | 88   | 0.20       |
| 1.8          | 1.78            | 12.7        | 0.20              | 178  | 0.13       |
| 2.4          | 1.96            | 10.6        | 0.28              | 235  | 0.08       |



**Figure 10. Gain vs. Frequency at  $V_{CE}=2.7 \text{ V}$ ,  $I_C = 20 \text{ mA}$ .**

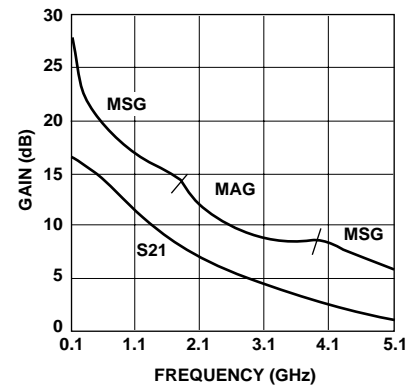
**AT-32063 Typical Scattering Parameters, Common Emitter,  $Z_o = 50 \Omega$ ,  $V_{CE} = 5 \text{ V}$ ,  $I_C = 2 \text{ mA}$**

| Freq.<br>GHz | $S_{11}$ |      | $S_{21}$ |      |     | $S_{12}$ |       |     | $S_{22}$ |     |
|--------------|----------|------|----------|------|-----|----------|-------|-----|----------|-----|
|              | Mag      | Ang  | dB       | Mag  | Ang | dB       | Mag   | Ang | Mag      | Ang |
| 0.1          | 0.96     | -12  | 16.50    | 6.69 | 169 | -38.44   | 0.012 | 82  | 0.98     | -5  |
| 0.5          | 0.78     | -53  | 14.84    | 5.52 | 133 | -26.20   | 0.049 | 60  | 0.88     | -19 |
| 0.9          | 0.59     | -84  | 12.5     | 4.23 | 108 | -23.4    | 0.068 | 50  | 0.79     | -27 |
| 1.0          | 0.56     | -90  | 11.92    | 3.94 | 104 | -23.04   | 0.070 | 49  | 0.77     | -28 |
| 1.5          | 0.42     | -117 | 9.46     | 2.97 | 84  | -21.71   | 0.082 | 46  | 0.72     | -33 |
| 1.8          | 0.36     | -131 | 8.21     | 2.57 | 74  | -21.04   | 0.089 | 47  | 0.70     | -36 |
| 2.0          | 0.33     | -140 | 7.55     | 2.38 | 68  | -20.56   | 0.094 | 48  | 0.69     | -39 |
| 2.4          | 0.28     | -159 | 6.24     | 2.05 | 57  | -19.54   | 0.105 | 50  | 0.69     | -43 |
| 3.0          | 0.24     | 171  | 4.72     | 1.72 | 43  | -17.76   | 0.129 | 53  | 0.68     | -50 |
| 4.0          | 0.25     | 126  | 2.88     | 1.39 | 21  | -14.47   | 0.189 | 52  | 0.66     | -64 |
| 5.0          | 0.31     | 95   | 1.49     | 1.19 | 3   | -11.32   | 0.272 | 45  | 0.63     | -83 |

**AT-32063 Typical Noise Parameters**

Common Emitter,  $Z_o = 50 \Omega$ ,  $V_{CE} = 5 \text{ V}$ ,  $I_C = 2 \text{ mA}$

| Freq.<br>GHz | $F_{min}$<br>dB | $G_A$<br>dB | $G_{opt}$<br>Mag. | Ang. | $R_n$<br>— |
|--------------|-----------------|-------------|-------------------|------|------------|
| 0.9          | 0.75            | 13.7        | 0.74              | 47   | 0.37       |
| 1.8          | 1.26            | 10.8        | 0.55              | 101  | 0.22       |
| 2.4          | 1.60            | 9.6         | 0.45              | 139  | 0.13       |



**Figure 11. Gain vs. Frequency at  $V_{CE}=5 \text{ V}$ ,  $I_C = 2 \text{ mA}$ .**

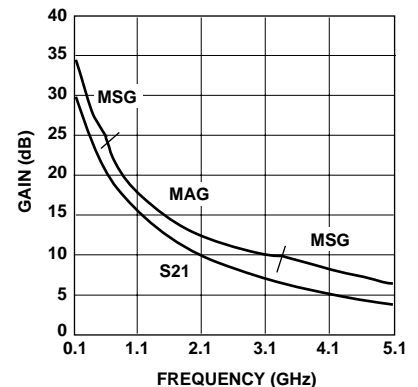
**AT-32063 Typical Scattering Parameters, Common Emitter,  $Z_o = 50 \Omega$ ,  $V_{CE} = 5 \text{ V}$ ,  $I_C = 20 \text{ mA}$**

| Freq.<br>GHz | $S_{11}$ |      | $S_{21}$ |       |     | $S_{12}$ |      |     | $S_{22}$ |     |
|--------------|----------|------|----------|-------|-----|----------|------|-----|----------|-----|
|              | Mag      | Ang  | dB       | Mag   | Ang | dB       | Mag  | Ang | Mag      | Ang |
| 0.1          | 0.61     | -36  | 30.56    | 33.74 | 145 | -40.46   | 0.01 | 75  | 0.86     | -14 |
| 0.5          | 0.22     | -91  | 21.75    | 12.23 | 98  | -29.90   | 0.03 | 72  | 0.6      | -19 |
| 0.9          | 0.13     | -115 | 17.02    | 7.10  | 83  | -25.40   | 0.05 | 72  | 0.57     | -21 |
| 1.0          | 0.12     | -118 | 16.14    | 6.41  | 81  | -24.56   | 0.06 | 71  | 0.57     | -21 |
| 1.5          | 0.08     | -137 | 12.80    | 4.36  | 68  | -21.23   | 0.09 | 69  | 0.57     | -26 |
| 1.8          | 0.06     | -148 | 11.31    | 3.68  | 62  | -19.69   | 0.10 | 66  | 0.57     | -30 |
| 2.0          | 0.06     | -159 | 10.46    | 3.33  | 58  | -18.79   | 0.12 | 65  | 0.57     | -32 |
| 2.4          | 0.04     | 175  | 9.02     | 2.83  | 50  | -17.21   | 0.14 | 61  | 0.57     | -37 |
| 3.0          | 0.05     | 131  | 7.35     | 2.33  | 39  | -15.22   | 0.17 | 56  | 0.56     | -45 |
| 4.0          | 0.10     | 99   | 5.39     | 1.86  | 21  | -12.48   | 0.24 | 46  | 0.54     | -58 |
| 5.0          | 0.16     | 86   | 4.05     | 1.6   | 3   | -10.27   | 0.31 | 34  | 0.50     | -75 |

**AT-32063 Typical Noise Parameters**

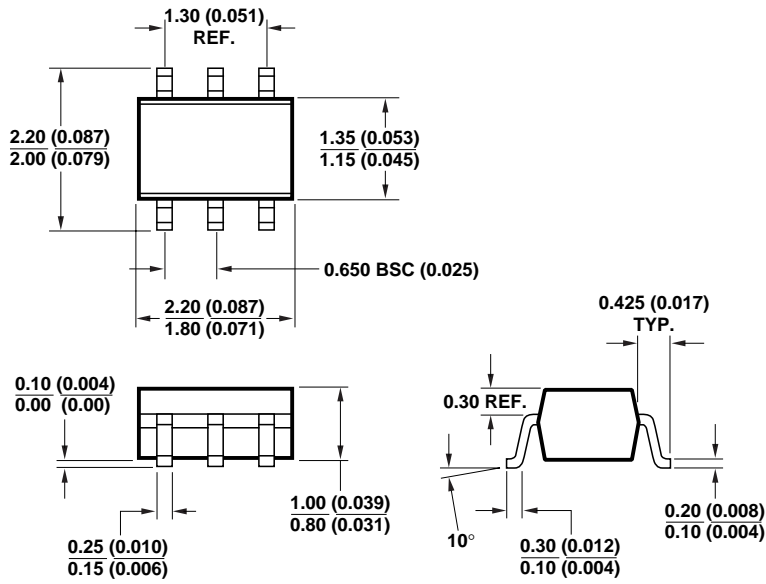
Common Emitter,  $Z_o = 50 \Omega$ ,  $V_{CE} = 5 \text{ V}$ ,  $I_C = 20 \text{ mA}$

| Freq.<br>GHz | $F_{min}$<br>dB | $G_A$<br>dB | $G_{opt}$<br>Mag. | Ang. | $R_n$<br>— |
|--------------|-----------------|-------------|-------------------|------|------------|
| 0.9          | 1.50            | 18.6        | 0.18              | 74   | 0.20       |
| 1.8          | 1.78            | 13.3        | 0.19              | 147  | 0.16       |
| 2.4          | 1.96            | 11.3        | 0.24              | 198  | 0.14       |



**Figure 12. Gain vs. Frequency at  $V_{CE}=5 \text{ V}$ ,  $I_C = 20 \text{ mA}$ .**

**Package Dimensions**  
**Outline 63 (SOT-363/SC-70)**

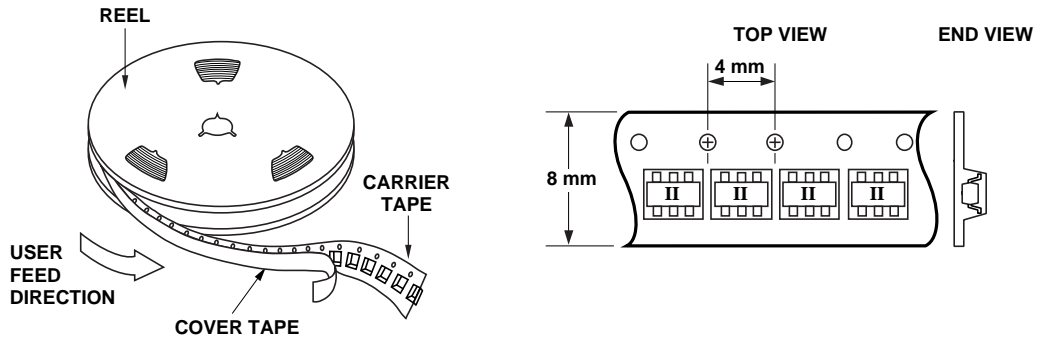


DIMENSIONS ARE IN MILLIMETERS (INCHES)

**Part Number Ordering Information**

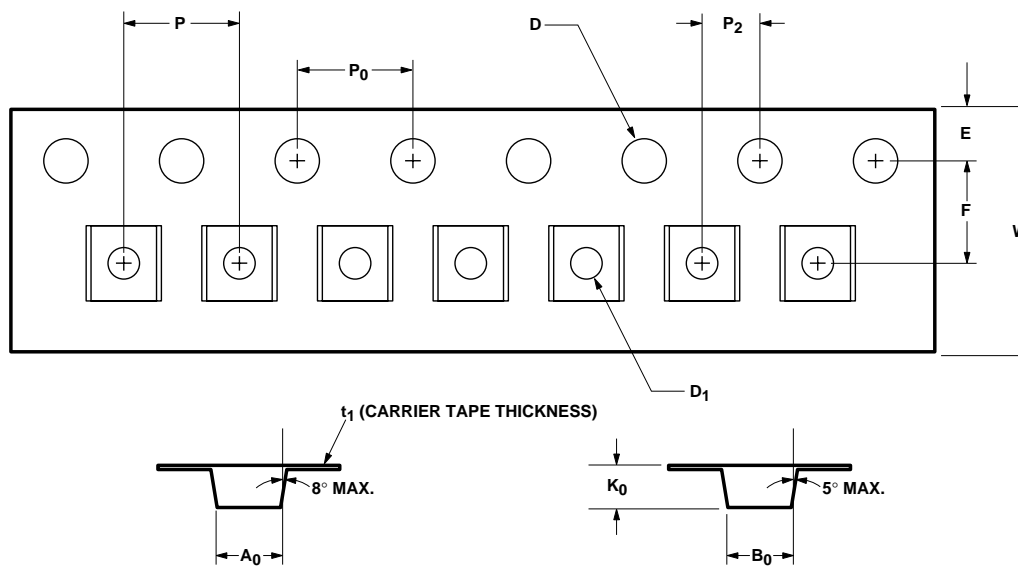
| Part Number  | No. of Devices | Container      |
|--------------|----------------|----------------|
| AT-32063-TR1 | 3000           | 7" Reel        |
| AT-32063-BLK | 100            | antistatic bag |

## Device Orientation



## Tape Dimensions

For Outline 63



| DESCRIPTION  |                                          | SYMBOL         | SIZE (mm)     | SIZE (INCHES)  |
|--------------|------------------------------------------|----------------|---------------|----------------|
| CAVITY       | LENGTH                                   | A <sub>0</sub> | 2.24 ± 0.10   | 0.088 ± 0.004  |
|              | WIDTH                                    | B <sub>0</sub> | 2.34 ± 0.10   | 0.092 ± 0.004  |
|              | DEPTH                                    | K <sub>0</sub> | 1.22 ± 0.10   | 0.048 ± 0.004  |
|              | PITCH                                    | P              | 4.00 ± 0.10   | 0.157 ± 0.004  |
|              | BOTTOM HOLE DIAMETER                     | D <sub>1</sub> | 1.00 + 0.25   | 0.039 + 0.010  |
| PERFORATION  | DIAMETER                                 | D              | 1.55 ± 0.05   | 0.061 ± 0.002  |
|              | PITCH                                    | P <sub>0</sub> | 4.00 ± 0.10   | 0.157 ± 0.004  |
|              | POSITION                                 | E              | 1.75 ± 0.10   | 0.069 ± 0.004  |
| CARRIER TAPE | WIDTH                                    | W              | 8.00 ± 0.30   | 0.315 ± 0.012  |
|              | THICKNESS                                | t <sub>1</sub> | 0.255 ± 0.013 | 0.010 ± 0.0005 |
| DISTANCE     | CAVITY TO PERFORATION (WIDTH DIRECTION)  | F              | 3.50 ± 0.05   | 0.138 ± 0.002  |
|              | CAVITY TO PERFORATION (LENGTH DIRECTION) | P <sub>2</sub> | 2.00 ± 0.05   | 0.079 ± 0.002  |