

# 1.5–18 GHz Surface Mount Pseudomorphic HEMT

## Technical Data

### ATF-36163

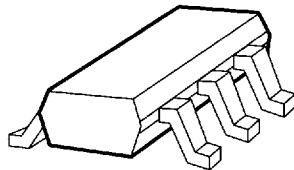
#### Features

- **Low Minimum Noise Figure:**  
1 dB Typical at 12 GHz  
0.6 dB Typical at 4 GHz
- **Associated Gain:**  
9.4 dB Typical at 12 GHz  
15.8 dB Typical at 4 GHz
- **Maximum Available Gain:**  
11 dB Typical at 12 GHz  
17 dB Typical at 4 GHz
- **Low Cost Surface Mount  
Small Plastic Package**
- **Tape-and-Reel Packaging  
Option Available**

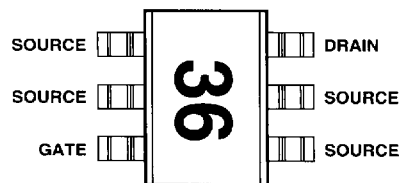
#### Applications

- **12 GHz DBS Downconverters**
- **4 GHz TVRO Downconverters**
- **S or L Band Low Noise  
Amplifiers**

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



#### Pin Connections and Package Marking



**Note:** Package marking provides orientation and identification.

#### Description

The Hewlett-Packard ATF-36163 is a low-noise Pseudomorphic High Electron Mobility Transistor (PHEMT), in the SOT-363 (SC-70) package. When optimally matched to the minimum noise figure, it will provide a noise figure of 1 dB at 12 GHz and 0.6 dB at 4 GHz.

Additionally, the ATF-36163 has low noise-resistance, which reduces the sensitivity of noise performance to variations in input impedance match. This feature makes the design of broad band low noise amplifiers much easier. The performance of the ATF-36163 makes this device the ideal choice for use in the 2nd or 3rd stage of low noise cascades. The repeatable performance and consistency make it appropriate for use in Ku-band Direct Broadcast Satellite (DBS) TV systems, C-band TV Receive Only (TVRO) LNAs, Multichannel Multipoint Distribution Systems (MMDS), X-band Radar detector and other low noise amplifiers operating in the 1.5–18 GHz frequency range.

This GaAs PHEMT device has a nominal 0.2 micron gate length with a total gate periphery (width) of 200 microns. Proven gold-based metallization system and nitride passivation assure rugged, reliable devices.

**ATF-36163 Absolute Maximum Ratings<sup>[1]</sup>**

| Symbol        | Parameter               | Units | Absolute Maximum |
|---------------|-------------------------|-------|------------------|
| $V_{DS}$      | Drain - Source Voltage  | V     | +3               |
| $V_{GS}$      | Gate - Source Voltage   | V     | -3               |
| $V_{GD}$      | Gate Drain Voltage      | V     | -3.5             |
| $I_D$         | Drain Current           | mA    | $I_{DSS}$        |
| $P_T$         | Total Power Dissipation | mW    | 180              |
| $P_{in\ max}$ | RF Input Power          | dBm   | +10              |
| $T_{CH}$      | Channel Temperature     | °C    | 150              |
| $T_{STG}$     | Storage Temperature     | °C    | -65 to 150       |

**Thermal Resistance:**

$$\Theta_{ch-c} = 160^{\circ}\text{C/W}$$

**Note:**

1. Operation of this device above any one of these parameters may cause permanent damage.

**ATF-36163 Electrical Specifications**

$T_C = 25^{\circ}\text{C}$ ,  $Z_O = 50\ \Omega$ ,  $V_{ds} = 1.5\ \text{V}$ ,  $I_{ds} = 10\ \text{mA}$ , (unless otherwise noted).

| Symbol        | Parameters and Test Conditions                                            | Units | Min. | Typ.  | Max.               |
|---------------|---------------------------------------------------------------------------|-------|------|-------|--------------------|
| NF            | Noise Figure <sup>[1]</sup> $f = 12.0\ \text{GHz}$                        | dB    |      | 1.2   | 1.4 <sup>[1]</sup> |
| G             | Gain at NF <sup>[1]</sup> $f = 12.0\ \text{GHz}$                          | dB    | 9    | 10    |                    |
| $g_m$         | Transconductance $V_{DS} = 1.5\ \text{V}$ , $V_{GS} = 0\ \text{V}$        | mS    | 50   | 60    |                    |
| $I_{DSS}$     | Saturated Drain Current $V_{DS} = 1.5\ \text{V}$ , $V_{GS} = 0\ \text{V}$ | mA    | 15   | 25    | 40                 |
| $V_{p\ 10\%}$ | Pinchoff Voltage $V_{DS} = 1.5\ \text{V}$ , $I_{DS} = 10\%$ of $I_{DSS}$  | V     | -1.0 | -0.35 | -0.15              |
| $BV_{GDO}$    | Gate Drain Breakdown Voltage $I_G = 30\ \mu\text{A}$                      | V     |      |       | -3.5               |

**Note:**

1. Measured in a test circuit tuned for a typical device.

**ATF-36163 Typical Parameters**

$T_C = 25^{\circ}\text{C}$ ,  $Z_O = 50\ \Omega$ ,  $V_{ds} = 2\ \text{V}$ ,  $I_{ds} = 15\ \text{mA}$ , (unless otherwise noted).

| Symbol    | Parameters and Test Conditions                                                              | Units                | Typ. |
|-----------|---------------------------------------------------------------------------------------------|----------------------|------|
| $F_{min}$ | Minimum Noise Figure ( $\Gamma_{source} = \Gamma_{opt}$ ) $f = 4\ \text{GHz}$               | dB                   | 0.6  |
|           |                                                                                             | $f = 12\ \text{GHz}$ | 1.0  |
| $G_a$     | Associated Gain $f = 4\ \text{GHz}$                                                         | dB                   | 15.8 |
|           |                                                                                             | $f = 12\ \text{GHz}$ | 9.4  |
| $G_{max}$ | Maximum Available Gain <sup>[1]</sup> $f = 4\ \text{GHz}$                                   | dB                   | 17.2 |
|           |                                                                                             | $f = 12\ \text{GHz}$ | 10.9 |
| $P_{1dB}$ | Output Power at 1 dB Gain Compression under the power matched condition $f = 4\ \text{GHz}$ | dBm                  | 5    |
|           |                                                                                             | $f = 12\ \text{GHz}$ | 5    |
| $V_{GS}$  | Gate to Source Voltage for $I_{DS} = 15\ \text{mA}$ $V_{DS} = 2.0\ \text{V}$                | V                    | -0.2 |

**Note:**

1.  $G_{max} = \text{MAG}$  for  $K > 1$  and  $G_{max} = \text{MSG}$  for  $K \leq 1$ , which is shown on the S-parameters tables.

**ATF-36163 Typical Scattering Parameters**, Common Source,  $Z_O = 50\ \Omega$ ,  $V_{DS} = 1.5\text{ V}$ ,  $I_D = 10\text{ mA}$ 

| Freq.<br>GHz | $S_{11}$ |      | $S_{21}$ |      |      | $S_{12}$ |      |      | $S_{22}$ |      | K    | $G_{max}^{[1]}$<br>dB |
|--------------|----------|------|----------|------|------|----------|------|------|----------|------|------|-----------------------|
|              | Mag.     | Ang. | dB       | Mag. | Ang. | dB       | Mag. | Ang. | Mag.     | Ang. |      |                       |
| 0.5          | 0.99     | -11  | 12.85    | 4.39 | 168  | -37.72   | 0.01 | 79   | 0.51     | -9   | 0.11 | 25.24                 |
| 1            | 0.98     | -22  | 12.70    | 4.31 | 158  | -31.70   | 0.03 | 71   | 0.50     | -18  | 0.17 | 22.26                 |
| 2            | 0.96     | -42  | 12.48    | 4.21 | 138  | -26.02   | 0.05 | 55   | 0.48     | -36  | 0.24 | 19.28                 |
| 3            | 0.93     | -61  | 12.37    | 4.15 | 118  | -22.73   | 0.07 | 40   | 0.45     | -53  | 0.33 | 17.56                 |
| 4            | 0.87     | -83  | 12.30    | 4.12 | 97   | -20.45   | 0.10 | 23   | 0.40     | -71  | 0.43 | 16.38                 |
| 5            | 0.81     | -106 | 12.16    | 4.06 | 76   | -18.71   | 0.12 | 6    | 0.34     | -92  | 0.51 | 15.43                 |
| 6            | 0.75     | -131 | 11.94    | 3.95 | 55   | -17.52   | 0.13 | -12  | 0.27     | -116 | 0.58 | 14.73                 |
| 7            | 0.67     | -158 | 11.47    | 3.75 | 33   | -16.77   | 0.15 | -30  | 0.18     | -144 | 0.69 | 14.12                 |
| 8            | 0.61     | 176  | 11.01    | 3.55 | 12   | -16.36   | 0.15 | -45  | 0.10     | 174  | 0.79 | 13.69                 |
| 9            | 0.57     | 143  | 10.47    | 3.34 | -10  | -15.97   | 0.16 | -61  | 0.12     | 93   | 0.85 | 13.22                 |
| 10           | 0.57     | 108  | 9.66     | 3.04 | -32  | -15.92   | 0.16 | -77  | 0.22     | 53   | 0.91 | 12.80                 |
| 11           | 0.59     | 76   | 8.53     | 2.67 | -54  | -16.48   | 0.15 | -93  | 0.33     | 28   | 0.99 | 12.50                 |
| 12           | 0.63     | 50   | 7.39     | 2.34 | -74  | -17.14   | 0.14 | -106 | 0.41     | 9    | 1.07 | 10.65                 |
| 13           | 0.67     | 26   | 6.10     | 2.02 | -93  | -18.27   | 0.12 | -119 | 0.49     | -8   | 1.18 | 9.64                  |
| 14           | 0.72     | 6    | 4.81     | 1.74 | -111 | -19.74   | 0.10 | -129 | 0.56     | -22  | 1.30 | 8.99                  |
| 15           | 0.78     | -11  | 3.49     | 1.50 | -128 | -21.41   | 0.09 | -138 | 0.63     | -33  | 1.38 | 8.81                  |
| 16           | 0.82     | -24  | 2.20     | 1.29 | -146 | -23.10   | 0.07 | -144 | 0.67     | -43  | 1.44 | 8.70                  |
| 17           | 0.87     | -38  | 0.59     | 1.07 | -164 | -25.04   | 0.06 | -151 | 0.73     | -53  | 1.46 | 8.79                  |
| 18           | 0.90     | -52  | -1.63    | 0.83 | 178  | -29.12   | 0.04 | -159 | 0.78     | -65  | 1.80 | 8.58                  |

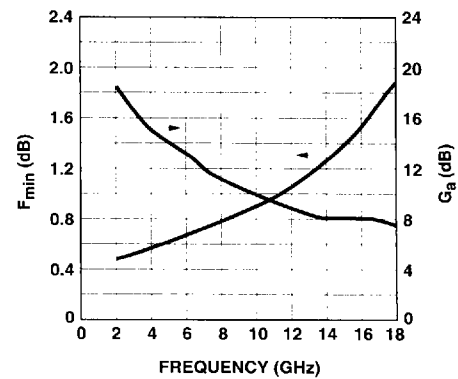
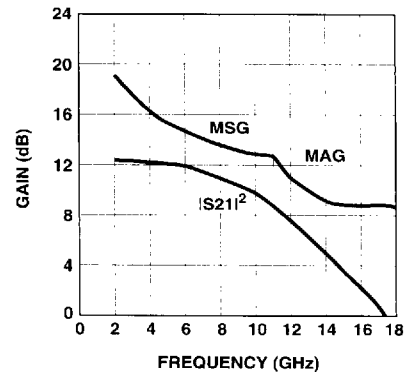
**Note:**

 1.  $G_{max} = \text{MAG}$  for  $K > 1$  and  $G_{max} = \text{MSG}$  for  $K \leq 1$ .

**ATF-36163 Typical Noise Parameters**

 Common Source,  $Z_O = 50\ \Omega$ ,  $V_{DS} = 1.5\text{ V}$ ,  $I_D = 10\text{ mA}$ 

| Freq.<br>GHz | $F_{min}$<br>dB | $G_a$<br>dB | $\Gamma_{opt}$ |      | $R_n/Z_O$<br>- |
|--------------|-----------------|-------------|----------------|------|----------------|
|              |                 |             | Mag.           | Ang. |                |
| 2            | 0.48            | 18.77       | 0.78           | 28   | 0.38           |
| 3            | 0.53            | 16.75       | 0.75           | 41   | 0.32           |
| 4            | 0.57            | 15.17       | 0.68           | 55   | 0.26           |
| 5            | 0.61            | 14.14       | 0.60           | 71   | 0.20           |
| 6            | 0.66            | 13.23       | 0.55           | 88   | 0.15           |
| 7            | 0.71            | 12.06       | 0.48           | 105  | 0.12           |
| 8            | 0.77            | 11.22       | 0.38           | 119  | 0.10           |
| 9            | 0.83            | 10.50       | 0.32           | 138  | 0.07           |
| 10           | 0.89            | 10.02       | 0.23           | 170  | 0.07           |
| 11           | 0.97            | 9.44        | 0.18           | -141 | 0.09           |
| 12           | 1.05            | 8.92        | 0.20           | -92  | 0.13           |
| 13           | 1.14            | 8.45        | 0.26           | -46  | 0.21           |
| 14           | 1.24            | 8.12        | 0.36           | -16  | 0.32           |
| 15           | 1.37            | 8.08        | 0.48           | 4    | 0.44           |
| 16           | 1.51            | 8.11        | 0.59           | 19   | 0.60           |
| 17           | 1.68            | 7.97        | 0.64           | 34   | 0.79           |
| 18           | 1.89            | 7.59        | 0.70           | 51   | 1.15           |


 Figure 1. ATF-36163 Minimum Noise Figure and Associated Gain vs. Frequency for  $V_{DS} = 1.5\text{ V}$ ,  $I_D = 10\text{ mA}$ .

 Figure 2. Maximum Available Gain, Maximum Stable Gain & Insertion Power Gain vs. Frequency for  $V_{DS} = 1.5\text{ V}$ ,  $I_D = 10\text{ mA}$ .

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**ATF-36163 Typical Scattering Parameters, Common Source,  $Z_0 = 50 \Omega$ ,  $V_{DS} = 1.5 \text{ V}$ ,  $I_D = 15 \text{ mA}$** 

| Freq.<br>GHz | $S_{11}$ |      | $S_{21}$ |      |      | $S_{12}$ |      |      | $S_{22}$ |      | K<br>— | $G_{\max}^{(1)}$<br>dB |
|--------------|----------|------|----------|------|------|----------|------|------|----------|------|--------|------------------------|
|              | Mag.     | Ang. | dB       | Mag. | Ang. | dB       | Mag. | Ang. | Mag.     | Ang. |        |                        |
| 0.5          | 0.99     | -12  | 13.56    | 4.76 | 168  | -38.42   | 0.01 | 79   | 0.45     | -9   | 0.12   | 25.82                  |
| 1            | 0.98     | -22  | 13.40    | 4.68 | 157  | -32.40   | 0.02 | 71   | 0.45     | -18  | 0.18   | 22.86                  |
| 2            | 0.96     | -43  | 13.16    | 4.55 | 137  | -26.56   | 0.05 | 56   | 0.43     | -36  | 0.26   | 19.87                  |
| 3            | 0.92     | -63  | 13.00    | 4.47 | 116  | -23.22   | 0.07 | 40   | 0.40     | -52  | 0.35   | 18.13                  |
| 4            | 0.86     | -85  | 12.87    | 4.40 | 96   | -21.01   | 0.09 | 24   | 0.35     | -70  | 0.46   | 16.94                  |
| 5            | 0.80     | -108 | 12.68    | 4.30 | 75   | -19.25   | 0.11 | 7    | 0.28     | -92  | 0.55   | 15.98                  |
| 6            | 0.74     | -133 | 12.38    | 4.16 | 53   | -18.13   | 0.12 | -11  | 0.21     | -116 | 0.62   | 15.25                  |
| 7            | 0.66     | -160 | 11.85    | 3.91 | 31   | -17.39   | 0.14 | -28  | 0.13     | -146 | 0.74   | 14.62                  |
| 8            | 0.59     | 173  | 11.33    | 3.68 | 11   | -16.95   | 0.14 | -42  | 0.06     | 156  | 0.84   | 14.14                  |
| 9            | 0.56     | 141  | 10.74    | 3.44 | -11  | -16.54   | 0.15 | -58  | 0.12     | 73   | 0.90   | 13.63                  |
| 10           | 0.56     | 106  | 9.89     | 3.12 | -33  | -16.42   | 0.15 | -73  | 0.23     | 44   | 0.95   | 13.16                  |
| 11           | 0.59     | 74   | 8.74     | 2.74 | -54  | -16.83   | 0.14 | -88  | 0.34     | 23   | 1.03   | 11.78                  |
| 12           | 0.63     | 49   | 7.59     | 2.40 | -74  | -17.39   | 0.14 | -102 | 0.42     | 6    | 1.10   | 10.62                  |
| 13           | 0.68     | 25   | 6.29     | 2.06 | -93  | -18.42   | 0.12 | -115 | 0.50     | -10  | 1.19   | 9.72                   |
| 14           | 0.73     | 5    | 5.01     | 1.78 | -110 | -19.74   | 0.10 | -124 | 0.57     | -23  | 1.29   | 9.15                   |
| 15           | 0.79     | -12  | 3.70     | 1.53 | -127 | -21.31   | 0.09 | -133 | 0.64     | -34  | 1.35   | 8.99                   |
| 16           | 0.83     | -25  | 2.43     | 1.32 | -144 | -22.85   | 0.07 | -139 | 0.68     | -44  | 1.39   | 8.93                   |
| 17           | 0.87     | -38  | 0.84     | 1.10 | -163 | -24.73   | 0.06 | -148 | 0.73     | -54  | 1.39   | 9.06                   |
| 18           | 0.91     | -53  | -1.33    | 0.86 | 180  | -28.87   | 0.04 | -155 | 0.78     | -66  | 1.67   | 8.92                   |

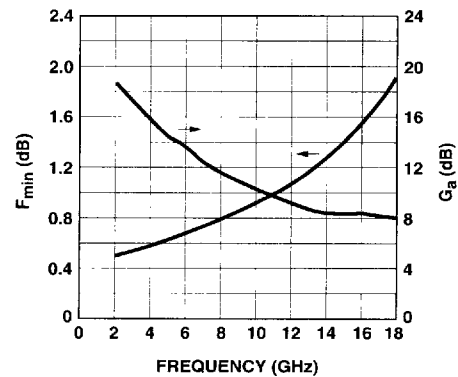
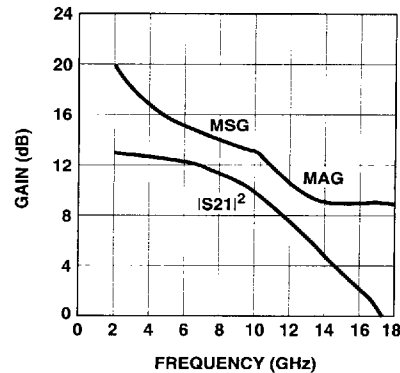
**Note:**

 1.  $G_{\max}$  = MAG for  $K > 1$  and  $G_{\max}$  = MSG for  $K \leq 1$ .

**ATF-36163 Typical Noise Parameters**

 Common Source,  $Z_0 = 50 \Omega$ ,  $V_{DS} = 1.5 \text{ V}$ ,  $I_D = 15 \text{ mA}$ 

| Freq.<br>GHz | $F_{\min}$<br>dB | $G_a$<br>dB | $\Gamma_{\text{opt}}$ |      | $R_n/Z_0$<br>— |
|--------------|------------------|-------------|-----------------------|------|----------------|
|              |                  |             | Mag.                  | Ang. |                |
| 2            | 0.49             | 18.87       | 0.84                  | 28   | 0.38           |
| 3            | 0.54             | 17.20       | 0.74                  | 42   | 0.31           |
| 4            | 0.58             | 15.75       | 0.66                  | 57   | 0.25           |
| 5            | 0.63             | 14.49       | 0.59                  | 72   | 0.19           |
| 6            | 0.68             | 13.61       | 0.54                  | 90   | 0.15           |
| 7            | 0.73             | 12.36       | 0.46                  | 106  | 0.11           |
| 8            | 0.79             | 11.54       | 0.37                  | 121  | 0.09           |
| 9            | 0.85             | 10.82       | 0.30                  | 140  | 0.08           |
| 10           | 0.91             | 10.32       | 0.21                  | 174  | 0.08           |
| 11           | 0.99             | 9.73        | 0.17                  | -133 | 0.10           |
| 12           | 1.07             | 9.22        | 0.20                  | -83  | 0.14           |
| 13           | 1.17             | 8.68        | 0.26                  | -40  | 0.22           |
| 14           | 1.27             | 8.41        | 0.38                  | -12  | 0.34           |
| 15           | 1.40             | 8.36        | 0.49                  | 7    | 0.46           |
| 16           | 1.54             | 8.37        | 0.60                  | 21   | 0.64           |
| 17           | 1.72             | 8.10        | 0.62                  | 35   | 0.85           |
| 18           | 1.93             | 8.00        | 0.71                  | 52   | 1.18           |


 Figure 3. ATF-36163 Minimum Noise Figure and Associated Gain vs. Frequency for  $V_{DS} = 1.5 \text{ V}$ ,  $I_D = 15 \text{ mA}$ .

 Figure 4. Maximum Available Gain, Maximum Stable Gain & Insertion Power Gain vs. Frequency for  $V_{DS} = 1.5 \text{ V}$ ,  $I_D = 15 \text{ mA}$ .

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**ATF-36163 Typical Scattering Parameters, Common Source,  $Z_0 = 50 \Omega$ ,  $V_{DS} = 2.0 \text{ V}$ ,  $I_D = 10 \text{ mA}$** 

| Freq.<br>GHz | S <sub>11</sub> |      | S <sub>21</sub> |      |      | S <sub>12</sub> |      |      | S <sub>22</sub> |      | K<br>- | Gmax <sup>[1]</sup><br>dB |
|--------------|-----------------|------|-----------------|------|------|-----------------|------|------|-----------------|------|--------|---------------------------|
|              | Mag.            | Ang. | dB              | Mag. | Ang. | dB              | Mag. | Ang. | Mag.            | Ang. |        |                           |
| 0.5          | 0.99            | -11  | 13.06           | 4.50 | 168  | -37.72          | 0.01 | 79   | 0.55            | -9   | 0.11   | 25.46                     |
| 1            | 0.99            | -22  | 12.90           | 4.42 | 158  | -32.04          | 0.03 | 71   | 0.55            | -18  | 0.16   | 22.46                     |
| 2            | 0.96            | -42  | 12.69           | 4.31 | 138  | -26.38          | 0.05 | 56   | 0.53            | -35  | 0.24   | 19.50                     |
| 3            | 0.93            | -62  | 12.57           | 4.25 | 118  | -22.97          | 0.07 | 40   | 0.50            | -52  | 0.32   | 17.77                     |
| 4            | 0.87            | -83  | 12.51           | 4.22 | 97   | -20.72          | 0.09 | 23   | 0.44            | -70  | 0.42   | 16.61                     |
| 5            | 0.81            | -106 | 12.38           | 4.16 | 76   | -18.94          | 0.11 | 6    | 0.38            | -90  | 0.51   | 15.67                     |
| 6            | 0.75            | -131 | 12.15           | 4.05 | 55   | -17.79          | 0.13 | -12  | 0.31            | -112 | 0.58   | 14.98                     |
| 7            | 0.67            | -157 | 11.70           | 3.84 | 33   | -17.08          | 0.14 | -30  | 0.21            | -137 | 0.69   | 14.38                     |
| 8            | 0.60            | 176  | 11.25           | 3.65 | 13   | -16.65          | 0.15 | -44  | 0.13            | -168 | 0.79   | 13.96                     |
| 9            | 0.57            | 144  | 10.73           | 3.44 | -10  | -16.25          | 0.15 | -60  | 0.10            | 115  | 0.85   | 13.50                     |
| 10           | 0.56            | 109  | 9.95            | 3.14 | -32  | -16.25          | 0.15 | -76  | 0.18            | 61   | 0.91   | 13.10                     |
| 11           | 0.58            | 77   | 8.86            | 2.77 | -53  | -16.77          | 0.15 | -91  | 0.29            | 32   | 1.00   | 12.52                     |
| 12           | 0.62            | 50   | 7.75            | 2.44 | -73  | -17.39          | 0.14 | -104 | 0.37            | 12   | 1.08   | 10.82                     |
| 13           | 0.67            | 26   | 6.49            | 2.11 | -93  | -18.56          | 0.12 | -117 | 0.46            | -5   | 1.19   | 9.85                      |
| 14           | 0.72            | 6    | 5.24            | 1.83 | -110 | -19.91          | 0.10 | -126 | 0.53            | -19  | 1.31   | 9.24                      |
| 15           | 0.78            | -10  | 3.96            | 1.58 | -128 | -21.51          | 0.08 | -134 | 0.60            | -30  | 1.38   | 9.07                      |
| 16           | 0.82            | -24  | 2.68            | 1.36 | -146 | -23.10          | 0.07 | -139 | 0.65            | -40  | 1.42   | 9.03                      |
| 17           | 0.87            | -37  | 1.08            | 1.13 | -165 | -24.88          | 0.06 | -147 | 0.71            | -50  | 1.38   | 9.28                      |
| 18           | 0.91            | -52  | -1.16           | 0.88 | 177  | -28.64          | 0.04 | -153 | 0.78            | -63  | 1.63   | 9.06                      |

Note:

1.  $G_{max}$  = MAG for  $K > 1$  and  $G_{max}$  = MSG for  $K \leq 1$ .

**ATF-36163 Typical Noise Parameters**

Common Source,  $Z_0 = 50 \Omega$ ,  $V_{DS} = 2.0 \text{ V}$ ,  $I_D = 10 \text{ mA}$

| Freq.<br>GHz | $F_{min}$<br>dB | $G_a$<br>dB | $\Gamma_{opt}$ |      | $R_n/Z_0$<br>- |
|--------------|-----------------|-------------|----------------|------|----------------|
|              |                 |             | Mag.           | Ang. |                |
| 2            | 0.46            | 18.60       | 0.84           | 28   | 0.38           |
| 3            | 0.50            | 16.75       | 0.76           | 41   | 0.31           |
| 4            | 0.54            | 15.55       | 0.67           | 56   | 0.25           |
| 5            | 0.59            | 14.20       | 0.61           | 70   | 0.20           |
| 6            | 0.63            | 13.37       | 0.55           | 88   | 0.15           |
| 7            | 0.68            | 12.12       | 0.49           | 103  | 0.12           |
| 8            | 0.74            | 11.35       | 0.39           | 118  | 0.10           |
| 9            | 0.80            | 10.59       | 0.33           | 135  | 0.07           |
| 10           | 0.86            | 10.11       | 0.23           | 165  | 0.07           |
| 11           | 0.94            | 9.57        | 0.17           | -145 | 0.09           |
| 12           | 1.02            | 9.08        | 0.18           | -93  | 0.12           |
| 13           | 1.11            | 8.59        | 0.24           | -47  | 0.19           |
| 14           | 1.22            | 8.30        | 0.34           | -16  | 0.30           |
| 15           | 1.35            | 8.29        | 0.47           | 5    | 0.42           |
| 16           | 1.51            | 8.32        | 0.58           | 19   | 0.57           |
| 17           | 1.69            | 8.07        | 0.60           | 34   | 0.76           |
| 18           | 1.92            | 7.68        | 0.66           | 50   | 1.10           |

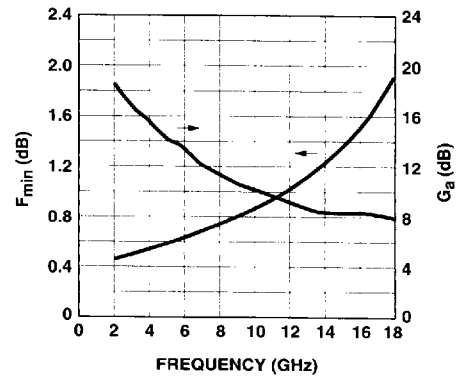


Figure 5. ATF-36163 Minimum Noise Figure and Associated Gain vs. Frequency for  $V_{DS} = 2.0 \text{ V}$ ,  $I_D = 10 \text{ mA}$ .

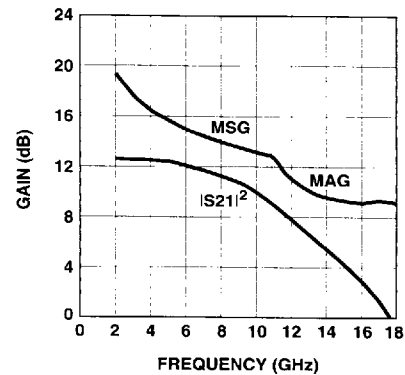


Figure 6. Maximum Available Gain, Maximum Stable Gain & Insertion Power Gain vs. Frequency for  $V_{DS} = 2.0 \text{ V}$ ,  $I_D = 10 \text{ mA}$ .

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**ATF-36163 Typical Scattering Parameters, Common Source,  $Z_0 = 50\ \Omega$ ,  $V_{DS} = 2\text{ V}$ ,  $I_D = 15\text{ mA}$** 

| Freq.<br>GHz | $S_{11}$ |      | $S_{21}$ |      |      | $S_{12}$ |      |      | $S_{22}$ |      | K<br>- | Gmax <sup>[1]</sup><br>dB |
|--------------|----------|------|----------|------|------|----------|------|------|----------|------|--------|---------------------------|
|              | Mag.     | Ang. | dB       | Mag. | Ang. | dB       | Mag. | Ang. | Mag.     | Ang. |        |                           |
| 0.5          | 0.99     | -12  | 13.85    | 4.93 | 168  | -38.42   | 0.01 | 79   | 0.51     | -9   | 0.12   | 26.10                     |
| 1            | 0.98     | -22  | 13.70    | 4.84 | 157  | -32.40   | 0.02 | 71   | 0.50     | -18  | 0.17   | 23.11                     |
| 2            | 0.96     | -43  | 13.45    | 4.70 | 137  | -26.74   | 0.05 | 56   | 0.48     | -35  | 0.26   | 20.13                     |
| 3            | 0.92     | -63  | 13.29    | 4.62 | 117  | -23.48   | 0.07 | 40   | 0.45     | -52  | 0.35   | 18.40                     |
| 4            | 0.86     | -85  | 13.16    | 4.55 | 96   | -21.31   | 0.09 | 24   | 0.40     | -69  | 0.46   | 17.22                     |
| 5            | 0.79     | -108 | 12.96    | 4.45 | 75   | -19.58   | 0.11 | 7    | 0.33     | -90  | 0.55   | 16.26                     |
| 6            | 0.73     | -133 | 12.67    | 4.30 | 53   | -18.42   | 0.12 | -10  | 0.26     | -112 | 0.62   | 15.54                     |
| 7            | 0.65     | -160 | 12.13    | 4.04 | 32   | -17.72   | 0.13 | -28  | 0.17     | -136 | 0.75   | 14.93                     |
| 8            | 0.59     | 173  | 11.63    | 3.81 | 11   | -17.27   | 0.14 | -42  | 0.09     | -171 | 0.84   | 14.46                     |
| 9            | 0.55     | 141  | 11.06    | 3.57 | -11  | -16.83   | 0.14 | -57  | 0.09     | 93   | 0.90   | 13.95                     |
| 10           | 0.56     | 107  | 10.23    | 3.25 | -32  | -16.77   | 0.15 | -72  | 0.19     | 51   | 0.96   | 13.50                     |
| 11           | 0.58     | 75   | 9.11     | 2.86 | -53  | -17.14   | 0.14 | -87  | 0.30     | 27   | 1.04   | 11.93                     |
| 12           | 0.63     | 49   | 8.00     | 2.51 | -73  | -17.72   | 0.13 | -99  | 0.38     | 9    | 1.11   | 10.85                     |
| 13           | 0.68     | 26   | 6.75     | 2.17 | -92  | -18.71   | 0.12 | -112 | 0.47     | -7   | 1.20   | 10.00                     |
| 14           | 0.73     | 6    | 5.49     | 1.88 | -110 | -20.00   | 0.10 | -121 | 0.54     | -20  | 1.30   | 9.45                      |
| 15           | 0.78     | -11  | 4.22     | 1.63 | -127 | -21.41   | 0.09 | -129 | 0.61     | -31  | 1.35   | 9.30                      |
| 16           | 0.83     | -24  | 2.99     | 1.41 | -145 | -22.73   | 0.07 | -135 | 0.66     | -41  | 1.36   | 9.31                      |
| 17           | 0.88     | -38  | 1.42     | 1.18 | -164 | -24.44   | 0.06 | -143 | 0.72     | -51  | 1.31   | 9.56                      |
| 18           | 0.91     | -52  | -0.79    | 0.91 | 178  | -27.96   | 0.04 | -149 | 0.78     | -63  | 1.50   | 9.44                      |

Note:

1.  $G_{\max} = \text{MAG}$  for  $K > 1$  and  $G_{\max} = \text{MSG}$  for  $K \leq 1$ .

**ATF-36163 Typical Noise Parameters**

Common Source,  $Z_0 = 50\ \Omega$ ,  $V_{DS} = 2.0\text{ V}$ ,  $I_D = 15\text{ mA}$

| Freq.<br>GHz | $F_{\min}$<br>dB | $G_a$<br>dB | $\Gamma_{\text{opt}}$ |      | $R_n/Z_0$<br>- |
|--------------|------------------|-------------|-----------------------|------|----------------|
|              |                  |             | Mag.                  | Ang. |                |
| 2            | 0.48             | 18.97       | 0.83                  | 28   | 0.37           |
| 3            | 0.52             | 17.27       | 0.74                  | 41   | 0.31           |
| 4            | 0.56             | 15.75       | 0.67                  | 56   | 0.25           |
| 5            | 0.61             | 14.54       | 0.60                  | 71   | 0.19           |
| 6            | 0.65             | 13.68       | 0.55                  | 89   | 0.15           |
| 7            | 0.70             | 12.47       | 0.46                  | 104  | 0.11           |
| 8            | 0.76             | 11.66       | 0.37                  | 118  | 0.09           |
| 9            | 0.82             | 10.94       | 0.31                  | 136  | 0.08           |
| 10           | 0.88             | 10.44       | 0.21                  | 168  | 0.07           |
| 11           | 0.95             | 9.88        | 0.15                  | -137 | 0.09           |
| 12           | 1.03             | 9.38        | 0.18                  | -85  | 0.13           |
| 13           | 1.12             | 8.90        | 0.25                  | -41  | 0.21           |
| 14           | 1.23             | 8.63        | 0.36                  | -13  | 0.32           |
| 15           | 1.35             | 8.59        | 0.48                  | 7    | 0.44           |
| 16           | 1.49             | 8.63        | 0.58                  | 20   | 0.60           |
| 17           | 1.65             | 8.68        | 0.65                  | 34   | 0.79           |
| 18           | 1.86             | 8.32        | 0.70                  | 51   | 1.10           |

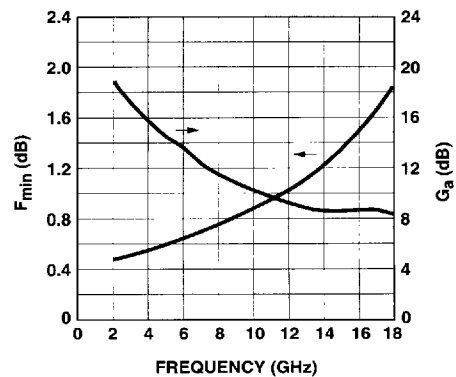


Figure 7. ATF-36163 Minimum Noise Figure and Associated Gain vs. Frequency for  $V_{DS} = 2\text{ V}$ ,  $I_D = 15\text{ mA}$ .

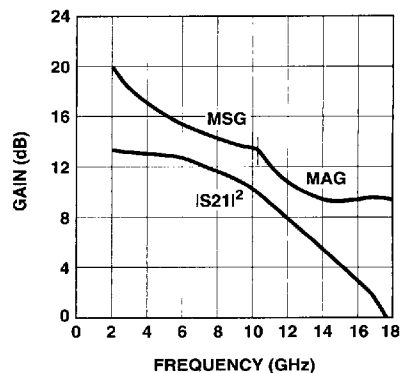


Figure 8. Maximum Available Gain, Maximum Stable Gain & Insertion Power Gain vs. Frequency for  $V_{DS} = 2\text{ V}$ ,  $I_D = 15\text{ mA}$ .

**ATF-36163 Typical “Off” Scattering Parameters, Common Source,  $Z_0 = 50\ \Omega$ ,  $V_{DS} = 0\text{ V}$ ,  $V_{GS} = 0\text{ V}$**

| Freq.<br>GHz | $S_{11}$ |      | dB     | $S_{21}$ |      | dB     | $S_{12}$ |      | $S_{22}$ |      |
|--------------|----------|------|--------|----------|------|--------|----------|------|----------|------|
|              | Mag.     | Ang. |        | Mag.     | Ang. |        | Mag.     | Ang. | Mag.     | Ang. |
| 0.5          | 0.998    | -10  | -46.02 | 0.01     | 80   | -46.02 | 0.01     | 86   | 0.703    | 170  |
| 1            | 0.993    | -20  | -39.17 | 0.01     | 81   | -39.17 | 0.01     | 83   | 0.701    | 160  |
| 2            | 0.99     | -37  | -32.77 | 0.02     | 75   | -32.77 | 0.02     | 76   | 0.70     | 139  |
| 3            | 0.98     | -55  | -28.64 | 0.04     | 67   | -28.64 | 0.04     | 68   | 0.71     | 119  |
| 4            | 0.96     | -74  | -25.35 | 0.05     | 56   | -25.19 | 0.06     | 57   | 0.73     | 99   |
| 5            | 0.94     | -95  | -22.62 | 0.07     | 42   | -22.50 | 0.08     | 42   | 0.74     | 81   |
| 6            | 0.92     | -118 | -20.45 | 0.10     | 27   | -20.45 | 0.10     | 27   | 0.75     | 63   |
| 7            | 0.89     | -142 | -18.79 | 0.12     | 11   | -18.71 | 0.12     | 11   | 0.77     | 46   |
| 8            | 0.86     | -168 | -17.02 | 0.14     | -6   | -17.02 | 0.14     | -5   | 0.78     | 30   |
| 9            | 0.84     | 162  | -15.70 | 0.16     | -24  | -15.70 | 0.16     | -24  | 0.81     | 16   |
| 10           | 0.83     | 128  | -14.85 | 0.18     | -44  | -14.85 | 0.18     | -44  | 0.83     | 3    |
| 11           | 0.83     | 94   | -14.66 | 0.19     | -64  | -14.66 | 0.19     | -64  | 0.84     | -10  |
| 12           | 0.85     | 64   | -14.85 | 0.18     | -83  | -14.85 | 0.18     | -83  | 0.85     | -22  |
| 13           | 0.86     | 36   | -15.76 | 0.16     | -101 | -15.76 | 0.16     | -101 | 0.87     | -34  |
| 14           | 0.87     | 12   | -17.14 | 0.14     | -116 | -17.08 | 0.14     | -115 | 0.89     | -44  |
| 15           | 0.90     | -8   | -18.71 | 0.12     | -129 | -18.71 | 0.12     | -129 | 0.89     | -53  |
| 16           | 0.93     | -24  | -20.45 | 0.10     | -140 | -20.45 | 0.10     | -140 | 0.90     | -62  |
| 17           | 0.93     | -39  | -23.35 | 0.07     | -154 | -23.10 | 0.07     | -152 | 0.90     | -71  |
| 18           | 0.93     | -53  | -27.96 | 0.04     | -161 | -28.18 | 0.04     | -161 | 0.90     | -81  |

**ATF-36163 Typical “Off” Scattering Parameters, Common Source,  $Z_0 = 50\ \Omega$ ,  $V_{DS} = 2.0\text{ V}$ ,  $V_{GS} = -1.5\text{ V}$**

| Freq.<br>GHz | $S_{11}$ |      | dB     | $S_{21}$ |      | dB     | $S_{12}$ |      | $S_{22}$ |      |
|--------------|----------|------|--------|----------|------|--------|----------|------|----------|------|
|              | Mag.     | Ang. |        | Mag.     | Ang. |        | Mag.     | Ang. | Mag.     | Ang. |
| 0.5          | 0.97     | -8   | -34.89 | 0.02     | 82   | -34.89 | 0.02     | 81   | 0.999    | -7   |
| 1            | 0.98     | -16  | -28.87 | 0.04     | 74   | -28.87 | 0.04     | 73   | 0.998    | -14  |
| 2            | 0.99     | -30  | -22.85 | 0.07     | 59   | -22.97 | 0.07     | 59   | 0.995    | -29  |
| 3            | 0.98     | -43  | -19.33 | 0.11     | 44   | -19.33 | 0.11     | 44   | 0.98     | -43  |
| 4            | 0.97     | -57  | -16.71 | 0.15     | 29   | -16.71 | 0.15     | 30   | 0.97     | -57  |
| 5            | 0.96     | -72  | -14.42 | 0.19     | 14   | -14.47 | 0.19     | 14   | 0.95     | -74  |
| 6            | 0.94     | -87  | -12.62 | 0.23     | -2   | -12.65 | 0.23     | -2   | 0.94     | -91  |
| 7            | 0.92     | -103 | -10.90 | 0.29     | -20  | -10.96 | 0.28     | -20  | 0.92     | -107 |
| 8            | 0.89     | -119 | -9.60  | 0.33     | -37  | -9.63  | 0.33     | -37  | 0.89     | -125 |
| 9            | 0.85     | -136 | -8.09  | 0.39     | -56  | -8.09  | 0.39     | -56  | 0.83     | -148 |
| 10           | 0.79     | -158 | -6.73  | 0.46     | -79  | -6.73  | 0.46     | -79  | 0.79     | -174 |
| 11           | 0.74     | 177  | -5.85  | 0.51     | -106 | -5.87  | 0.51     | -106 | 0.75     | 156  |
| 12           | 0.72     | 149  | -5.71  | 0.52     | -136 | -5.71  | 0.52     | -136 | 0.73     | 123  |
| 13           | 0.71     | 114  | -6.54  | 0.47     | -170 | -6.52  | 0.47     | -170 | 0.74     | 86   |
| 14           | 0.75     | 74   | -8.95  | 0.36     | 155  | -8.92  | 0.36     | 156  | 0.79     | 50   |
| 15           | 0.82     | 35   | -12.80 | 0.23     | 123  | -12.69 | 0.23     | 123  | 0.85     | 18   |
| 16           | 0.89     | 5    | -18.49 | 0.12     | 94   | -18.20 | 0.12     | 95   | 0.90     | -8   |
| 17           | 0.91     | -21  | -24.88 | 0.06     | 79   | -24.44 | 0.06     | 84   | 0.91     | -30  |
| 18           | 0.92     | -42  | -27.54 | 0.04     | 70   | -27.96 | 0.04     | 69   | 0.90     | -50  |

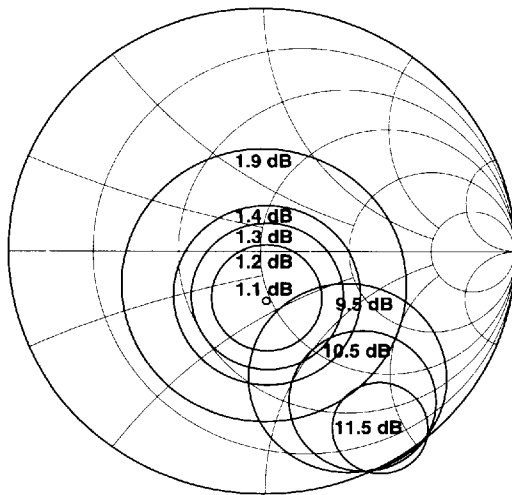


Figure 9. Smith Chart with Noise Figure and Available Gain Circles at 12 GHz,  $V_{DS} = 1.5$  V,  $I_D = 10$  mA.

### Phase Reference Planes

The positions of the reference planes used to measure S-Parameters and to specify  $\Gamma_{opt}$  for the Noise Parameters are shown in Figure 10. As seen in the illustration, the reference planes are located at the extremities of the package leads.

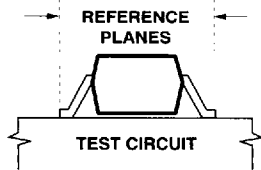


Figure 10. Reference Planes.

### SOT-363 PCB Layout

A PCB pad layout for the miniature SOT-363 (SC-70) package used by the ATF-36163 is shown in Figure 11 (dimensions are in inches). This layout provides ample allowance for package placement by automated assembly equipment. The layout is shown with a nominal SOT-363 package footprint superimposed on the PCB pads.

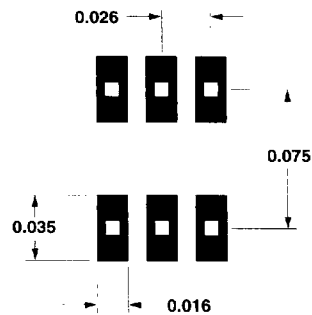
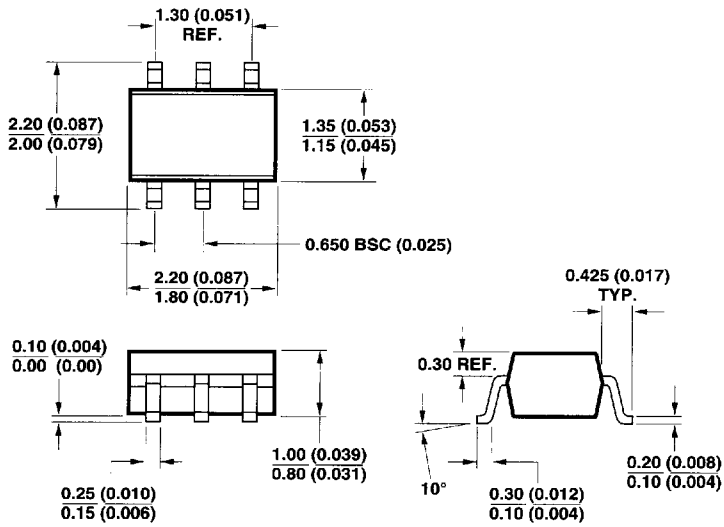


Figure 11. PCB Pad Layout (Dimensions in Inches).



## Package Dimensions

### Outline 63 (SOT-363/SC-70)



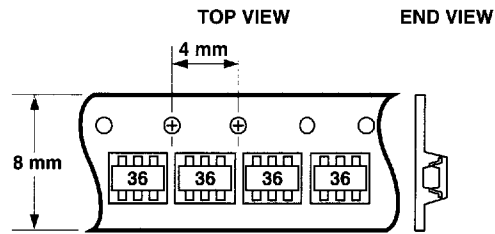
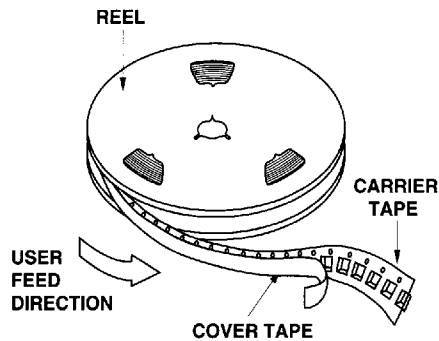
DIMENSIONS ARE IN MILLIMETERS (INCHES)

## Part Number Ordering Information

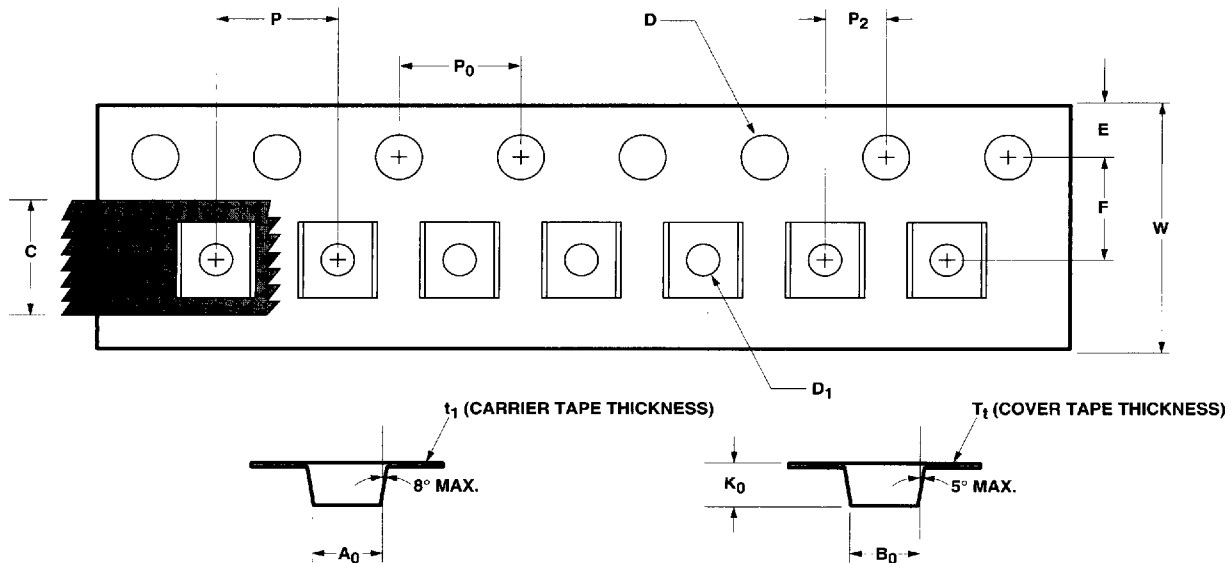
| Part Number   | No. of Devices | Container      |
|---------------|----------------|----------------|
| ATF-36163-TR1 | 3000           | 7" Reel        |
| ATF-36163-BLK | 100            | antistatic bag |

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## Device Orientation



## Tape Dimensions and Product Orientation 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   |
| COVER TAPE   | WIDTH                                    | C              | 5.4 ± 0.10    | 0.205 ± 0.004    |
|              | TAPE THICKNESS                           | T <sub>t</sub> | 0.062 ± 0.001 | 0.0025 ± 0.00004 |
| 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    |

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