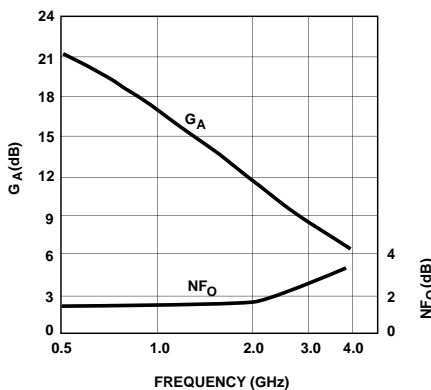


# Low Cost General Purpose Transistors

## Technical Data

### Features

- **Low Noise Figure**  
1.4 dB Typical at 1 GHz  
1.7 dB Typical at 2 GHz
- **High Associated Gain**  
17.0 dB Typical at 1 GHz  
12.5 dB Typical at 2 GHz
- **Low Cost Surface Mount Package**
- **Tape and Reel Option Available**



**Figure 1. AT-41586 Noise Figure and Associated Gain vs. Frequency at  $V_{CE} = 8\text{ V}$ ,  $I_C = 10\text{ mA}$ .**

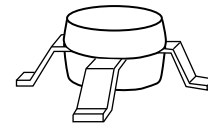
### Description

Hewlett-Packard's AT-41586 is a general purpose NPN bipolar transistor that offers excellent high frequency performance. The AT-41586 is housed in a low cost surface mount .085" diameter plastic package. The 4 micron emitter-to-emitter pitch enables this transistor to be used in many different functions. The 14 emitter finger interdigitated geometry yields an intermediate sized transistor with impedances that are easy to match for low noise and moderate power applications. Applications include use in wireless systems as an LNA, gain stage, buffer, oscillator, and mixer. An optimum noise match near  $50\ \Omega$  in the 1 to 2 GHz frequency range, makes this device easy to use as a low noise amplifier.

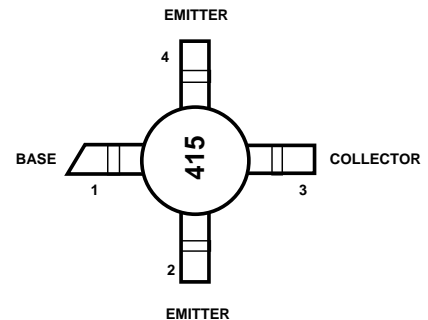
The AT-41586 bipolar transistor is fabricated using Hewlett-Packard's 10 GHz  $f_T$  Self-Aligned-Transistor (SAT) process. The die is nitride passivated for surface protection.

## AT-41586

### 86 Plastic Package



### Pin Connections



Excellent device uniformity, performance and reliability are produced by the use of ion-implantation, self-alignment techniques, and gold metalization in the fabrication of this device.

## AT-41586 Absolute Maximum Ratings<sup>[1]</sup>

| Symbol    | Parameter                        | Units | Absolute Maximum <sup>[1]</sup> |
|-----------|----------------------------------|-------|---------------------------------|
| $V_{EBO}$ | Emitter-Base Voltage             | V     | 1.5                             |
| $V_{CBO}$ | Collector-Base Voltage           | V     | 20                              |
| $V_{CEO}$ | Collector-Emitter Voltage        | V     | 12                              |
| $I_C$     | Collector Current                | mA    | 60                              |
| $P_T$     | Power Dissipation <sup>[2]</sup> | mW    | 500                             |
| $T_j$     | Junction Temperature             | °C    | 150                             |
| $T_{STG}$ | Storage Temperature              | °C    | -65 to 150                      |

Thermal Resistance:<sup>[3]</sup>

$$\theta_{jc} = 165^\circ\text{C/W}$$

### Notes:

1. Operation of this device above any one of these parameters may cause permanent damage.
2.  $T_{CASE} = 25^\circ\text{C}$ .
3. See MEASUREMENTS section, "Thermal Resistance," for more information.

## Electrical Specifications, $T_A = 25^\circ\text{C}$ , $V_{CE} = 8\text{ V}$

| Symbol        | Parameters and Test Conditions                             | Unit          | Min. | Typ. | Max. |
|---------------|--|---------------|------|------|------|
| $NF_o$        | Optimum Noise Figure: $I_C = 10\text{ mA}$                 |               |      |      |      |
|               | $f = 1.0\text{ GHz}$                                       | dB            |      | 1.4  |      |
|               | $f = 2.0\text{ GHz}$                                       |               |      | 1.7  |      |
|               | $f = 4.0\text{ GHz}$                                       |               |      | 3.0  |      |
| $G_A$         | Gain @ $NF_o$ : $I_C = 10\text{ mA}$                       |               |      |      |      |
|               | $f = 1.0\text{ GHz}$                                       | dB            |      | 17.0 |      |
|               | $f = 2.0\text{ GHz}$                                       |               |      | 12.5 |      |
|               | $f = 4.0\text{ GHz}$                                       |               |      | 8.0  |      |
| $ S_{21E} ^2$ | Insertion Power Gain: $I_C = 25\text{ mA}$                 |               |      |      |      |
|               | $f = 1.0\text{ GHz}$                                       | dB            |      | 17.0 |      |
|               | $f = 2.0\text{ GHz}$                                       |               |      | 11.0 |      |
| $P_{1dB}$     | Power Output @ 1 dB Gain Compression: $I_C = 25\text{ mA}$ |               |      |      |      |
|               | $f = 2.0\text{ GHz}$                                       | dBm           |      | 18.0 |      |
| $G_{1dB}$     | 1 dB Compressed Gain: $I_C = 25\text{ mA}$                 |               |      |      |      |
|               | $f = 2.0\text{ GHz}$                                       | dB            |      | 13.0 |      |
| $f_T$         | Gain Bandwidth Product: $I_C = 25\text{ mA}$               |               |      |      |      |
|               |  | GHz           |      | 8.0  |      |
| $h_{FE}$      | Forward Current Transfer Ratio: $I_C = 10\text{ mA}$       |               | 30   | 150  | 270  |
| $I_{CBO}$     | Collector Cutoff Current: $V_{CB} = 8\text{ V}$            |               |      |      |      |
|               |  | $\mu\text{A}$ |      |      | 0.2  |
| $I_{EBO}$     | Emitter Cutoff Current: $V_{EB} = 1\text{ V}$              |               |      |      |      |
|               |  | $\mu\text{A}$ |      |      | 1.0  |

### Note:

1. For more information on outlines 86, refer to "Tape and Reel Packaging for Surface Mount Devices."

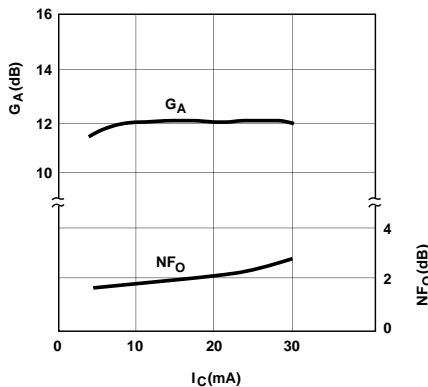


Figure 2. AT-41586 Optimum Noise Figure and Associated Gain vs. Collector Current at  $V_{CE} = 8\text{ V}$ ,  $f = 2.0\text{ GHz}$ .

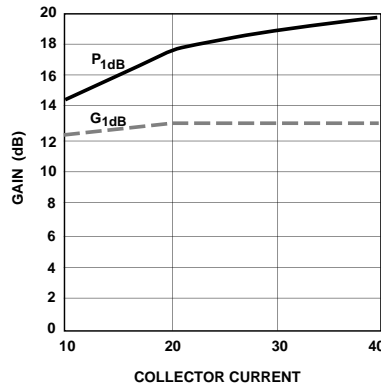


Figure 3. AT-41586  $P_{1dB}$  and  $G_{1dB}$  vs. Collector Current at  $V_{CE} = 8\text{ V}$ ,  $f = 2.0\text{ GHz}$ .

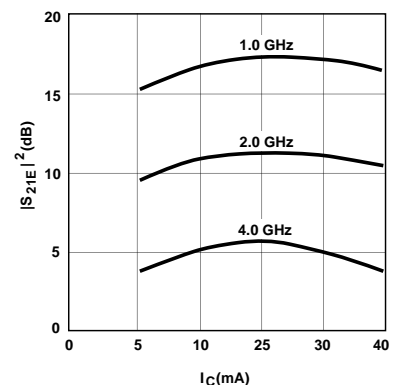


Figure 4. AT-41586 Insertion Power Gain vs. Collector Current and Frequency at  $25^\circ\text{C}$ ,  $V_{CE} = 8\text{ V}$ .

### AT-41586 Typical Scattering Parameters at $T_A = 25^\circ\text{C}$

$V_{CE} = 8\text{ V}$ ,  $I_C = 10\text{ mA}$ ,  $Z_0 = 50\ \Omega$

| Frequency<br>(GHz) | $S_{11}$ |      | $S_{21}$ |      |      | $S_{12}$ |       |      | $S_{22}$ |      |
|--------------------|----------|------|----------|------|------|----------|-------|------|----------|------|
|                    | Mag.     | Ang. | (dB)     | Mag. | Ang. | (dB)     | Mag.  | Ang. | Mag.     | Ang. |
| 0.100              | 0.78     | -39  | 28.4     | 26.3 | 154  | -36.4    | 0.015 | 71   | 0.91     | -16  |
| 0.200              | 0.71     | -71  | 26.9     | 22.1 | 134  | -31.7    | 0.026 | 59   | 0.79     | -27  |
| 0.300              | 0.65     | -95  | 25.2     | 18.1 | 122  | -29.8    | 0.032 | 50   | 0.67     | -34  |
| 0.400              | 0.61     | -113 | 23.5     | 15.0 | 119  | -28.8    | 0.036 | 44   | 0.58     | -38  |
| 0.500              | 0.59     | -127 | 22.0     | 12.6 | 114  | -28.1    | 0.039 | 43   | 0.52     | -40  |
| 0.600              | 0.57     | -137 | 20.7     | 10.8 | 100  | -27.5    | 0.042 | 43   | 0.47     | -40  |
| 0.700              | 0.56     | -146 | 19.6     | 9.5  | 95   | -27.1    | 0.044 | 43   | 0.44     | -41  |
| 0.800              | 0.56     | -154 | 18.5     | 8.4  | 91   | -26.5    | 0.047 | 43   | 0.42     | -41  |
| 0.900              | 0.55     | -160 | 17.6     | 7.6  | 86   | -26.1    | 0.049 | 44   | 0.40     | -42  |
| 1.000              | 0.55     | -166 | 16.8     | 6.9  | 83   | -25.8    | 0.051 | 47   | 0.38     | -42  |
| 1.500              | 0.55     | 173  | 13.4     | 4.7  | 70   | -23.8    | 0.064 | 49   | 0.34     | -45  |
| 2.000              | 0.57     | 157  | 10.9     | 3.5  | 57   | -22.0    | 0.079 | 49   | 0.32     | -52  |
| 2.500              | 0.59     | 144  | 9.2      | 2.9  | 44   | -20.6    | 0.093 | 48   | 0.31     | -61  |
| 3.000              | 0.62     | 133  | 7.6      | 2.4  | 34   | -19.3    | 0.108 | 47   | 0.30     | -71  |
| 3.500              | 0.64     | 123  | 6.0      | 2.0  | 25   | -18.1    | 0.124 | 45   | 0.30     | -83  |
| 4.000              | 0.67     | 114  | 5.1      | 1.8  | 16   | -17.0    | 0.141 | 42   | 0.31     | -95  |
| 4.500              | 0.70     | 106  | 4.1      | 1.6  | 5    | -15.9    | 0.159 | 39   | 0.32     | -108 |
| 5.000              | 0.73     | 99   | 2.9      | 1.4  | -3   | -15.0    | 0.176 | 35   | 0.32     | -121 |
| 5.500              | 0.76     | 93   | 1.6      | 1.2  | -8   | -14.2    | 0.193 | 31   | 0.34     | -135 |
| 6.000              | 0.78     | 88   | 0.8      | 1.1  | -18  | -13.5    | 0.209 | 31   | 0.36     | -150 |

### AT-41586 Typical Noise Parameters at $T_C = 25^\circ\text{C}$ ,

$Z_0 = 50\ \Omega$ ,  $I_C = 10\text{ mA}$ ,  $V_{CE} = 8\text{ V}$

| Frequency<br>(GHz) | $NF_0$<br>(dB) | $\Gamma_{opt}$<br>Mag. | Ang. | $R_N/50\ \Omega$ |
|--------------------|----------------|------------------------|------|------------------|
| 0.1                | 1.3            | 0.12                   | 3    | 0.17             |
| 0.5                | 1.3            | 0.10                   | 16   | 0.17             |
| 1.0                | 1.4            | 0.04                   | 43   | 0.16             |
| 2.0                | 1.7            | 0.12                   | -145 | 0.16             |

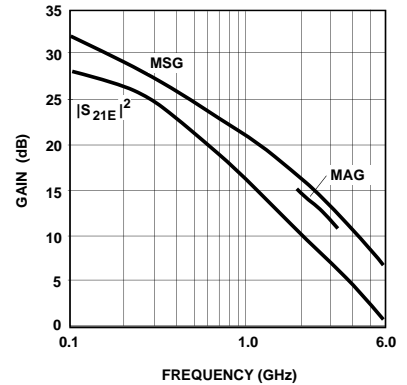


Figure 5. AT-41586 Insertion Power Gain, Maximum Available Gain and Maximum Stable Gain vs. Frequency at  $V_{CE} = 8\text{ V}$ ,  $I_C = 10\text{ mA}$ .

## AT-41586 Typical Scattering Parameters at $T_A = 25^\circ\text{C}$

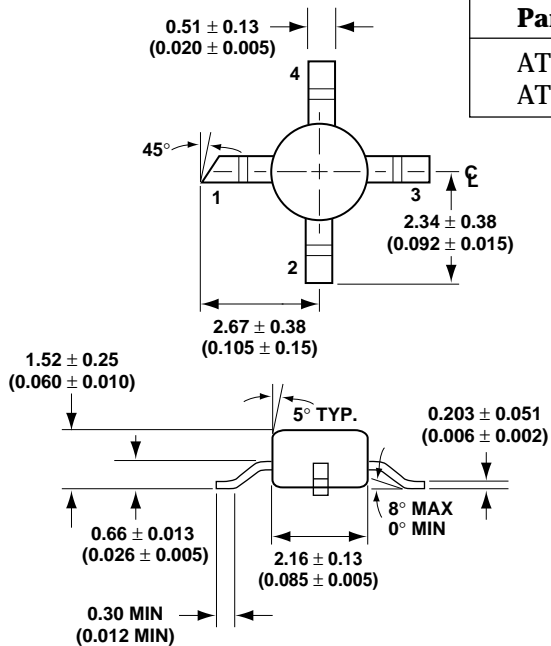
$V_{CE} = 8\text{ V}$ ,  $I_C = 25\text{ mA}$ ,  $Z_o = 50\ \Omega$

| Frequency<br>(GHz) | $S_{11}$ |      | $S_{21}$ |      |      | $S_{12}$ |       |      | $S_{22}$ |      |
|--------------------|----------|------|----------|------|------|----------|-------|------|----------|------|
|                    | Mag.     | Ang. | (dB)     | Mag. | Ang. | (dB)     | Mag.  | Ang. | Mag.     | Ang. |
| 0.100              | 0.64     | -61  | 31.9     | 39.4 | 154  | -37.0    | 0.014 | 64   | 0.82     | -24  |
| 0.200              | 0.59     | -101 | 29.2     | 28.7 | 169  | -33.1    | 0.022 | 53   | 0.64     | -35  |
| 0.300              | 0.56     | -125 | 26.6     | 21.4 | 124  | -31.7    | 0.026 | 49   | 0.53     | -38  |
| 0.400              | 0.55     | -140 | 24.6     | 17.0 | 111  | -30.4    | 0.030 | 49   | 0.47     | -39  |
| 0.500              | 0.54     | -151 | 22.9     | 14.0 | 104  | -29.6    | 0.033 | 50   | 0.43     | -38  |
| 0.600              | 0.54     | -159 | 21.4     | 11.7 | 97   | -28.8    | 0.036 | 52   | 0.40     | -38  |
| 0.700              | 0.54     | -166 | 20.1     | 10.1 | 91   | -28.1    | 0.039 | 53   | 0.40     | -37  |
| 0.800              | 0.54     | -171 | 19.0     | 8.9  | 86   | -27.5    | 0.042 | 55   | 0.38     | -37  |
| 0.900              | 0.54     | -176 | 18.0     | 7.9  | 81   | -26.9    | 0.045 | 56   | 0.37     | -37  |
| 1.000              | 0.55     | 177  | 17.1     | 7.2  | 77   | -26.3    | 0.048 | 57   | 0.36     | -37  |
| 1.500              | 0.57     | 164  | 13.6     | 4.8  | 64   | -23.8    | 0.064 | 59   | 0.34     | -42  |
| 2.000              | 0.57     | 152  | 11.1     | 3.6  | 55   | -21.9    | 0.080 | 57   | 0.32     | -49  |
| 2.500              | 0.60     | 141  | 9.2      | 2.9  | 44   | -20.0    | 0.100 | 55   | 0.31     | -58  |
| 3.000              | 0.62     | 132  | 7.6      | 2.4  | 34   | -18.4    | 0.120 | 52   | 0.31     | -68  |
| 3.500              | 0.64     | 124  | 6.4      | 2.1  | 24   | -17.0    | 0.140 | 49   | 0.31     | -80  |
| 4.000              | 0.67     | 116  | 5.6      | 1.9  | 18   | -14.8    | 0.180 | 45   | 0.32     | -94  |
| 4.500              | 0.70     | 109  | 4.1      | 1.6  | 9    | -15.9    | 0.160 | 45   | 0.30     | -109 |
| 5.000              | 0.73     | 102  | 3.5      | 1.5  | 1    | -15.3    | 0.170 | 42   | 0.30     | -123 |
| 5.500              | 0.77     | 96   | 2.3      | 1.3  | -7   | -14.4    | 0.190 | 38   | 0.32     | -138 |
| 6.000              | 0.76     | 90   | 1.6      | 1.2  | -14  | -13.9    | 0.200 | 33   | 0.35     | -152 |

### Outline 86 Dimensions

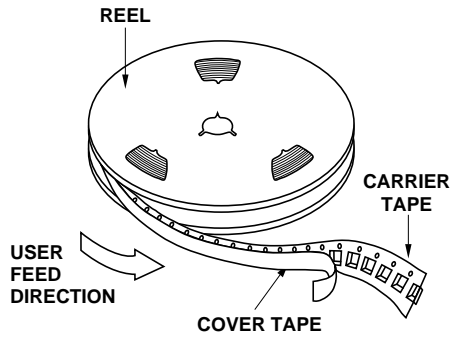
### AT-41586 Ordering Information

| Part Number  | Increment | Comments |
|--------------|-----------|----------|
| AT-41586-BLK | 100       | Bulk     |
| AT-41586-TR1 | 1000      | 7" Reel  |

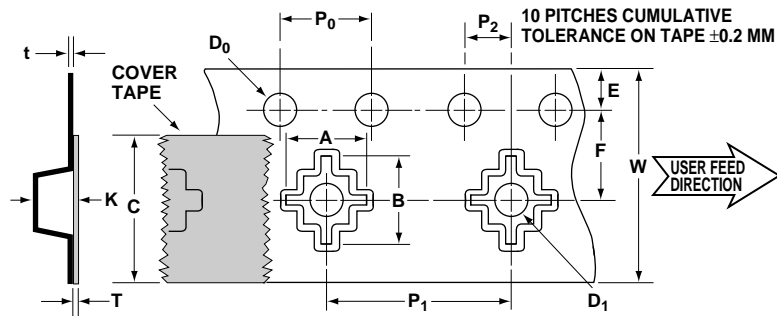


DIMENSIONS ARE IN MILLIMETERS (INCHES)

## Device Orientation



## Tape Dimensions and Product Orientation



| DESCRIPTION                 |  | SYMBOL | SIZE (mm)         | SIZE (INCHES)       |
|-----------------------------|--|--------|-------------------|---------------------|
| CAVITY                      | LENGTH                                   | $A_0$  | $6.45 \pm 0.10$   | $0.254 \pm 0.004$   |
|                             | WIDTH                                    | $B_0$  | $5.13 \pm 0.10$   | $0.202 \pm 0.004$   |
|                             | DEPTH                                    | $K_0$  | $2.11 \pm 0.10$   | $0.083 \pm 0.004$   |
|                             | PITCH                                    | $P_1$  | $8.00 \pm 0.10$   | $0.315 \pm 0.004$   |
|                             | BOTTOM HOLE DIAMETER                     | $D_1$  | 1.50 min.         | 0.059 min.          |
| PERFORATION                 | DIAMETER                                 | $D_0$  | $1.50 + 0.10/-0$  | $0.059 + 0.004/-0$  |
|                             | PITCH                                    | $P_0$  | $4.00 \pm 0.10$   | $0.157 \pm 0.004$   |
|                             | POSITION                                 | $E$    | $1.75 \pm 0.10$   | $0.069 \pm 0.004$   |
| CARRIER TAPE                | WIDTH                                    | $W$    | $8.00 \pm 0.30$   | $0.315 \pm 0.012$   |
|                             | THICKNESS                                | $t$    | $0.255 \pm 0.013$ | $0.0100 \pm 0.0005$ |
| COVER TAPE                  | WIDTH                                    | $C$    | $9.19 \pm 0.10$   | $0.362 \pm 0.004$   |
|                             | TAPE THICKNESS                           | $T_t$  | $0.051 \pm 0.010$ | $0.0020 \pm 0.0004$ |
| DISTANCE BETWEEN CENTERLINE | CAVITY TO PERFORATION (WIDTH DIRECTION)  | $F$    | $5.51 \pm 0.05$   | $0.217 \pm 0.002$   |
|                             | CAVITY TO PERFORATION (LENGTH DIRECTION) | $P_2$  | $2.00 \pm 0.05$   | $0.079 \pm 0.002$   |