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# Up to 6 GHz Low Noise Silicon Bipolar Transistor

## Technical Data

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### AT-41485

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#### Features

- **Low Noise Figure:**  
1.4 dB Typical at 1.0 GHz  
1.7 dB Typical at 2.0 GHz
- **High Associated Gain:**  
18.5 dB Typical at 1.0 GHz  
13.5 dB Typical at 2.0 GHz
- **High Gain-Bandwidth**  
**Product:** 8.0 GHz Typical  $f_T$

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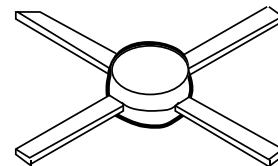
#### Description

Agilent's AT-41485 is a general purpose NPN bipolar transistor that offers excellent high frequency performance. The AT-41485 is housed in a low cost .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 interme-

mediate 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  $50 \Omega$  at 900 MHz, makes this device easy to use as a low noise amplifier.

The AT-41485 bipolar transistor is fabricated using Agilent's 10 GHz  $f_T$  Self-Aligned-Transistor (SAT) process. The die is 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 this device.

#### 85 Plastic Package



## AT-41485 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    | 60                              |
| P <sub>T</sub>   | Power Dissipation <sup>[2,3]</sup> | mW    | 500                             |
| T <sub>j</sub>   | Junction Temperature               | °C    | 150                             |
| T <sub>STG</sub> | Storage Temperature                | °C    | -65 to 150                      |

### Thermal Resistance<sup>[2,4]</sup>:

$$\theta_{jc} = 155^{\circ}\text{C/W}$$

#### Notes:

1. Permanent damage may occur if any of these limits are exceeded.
2. T<sub>CASE</sub> = 25°C.
3. Derate at 6.5 mW/°C for T<sub>C</sub> > 73°C.
4. See MEASUREMENTS section "Thermal Resistance" for more information.

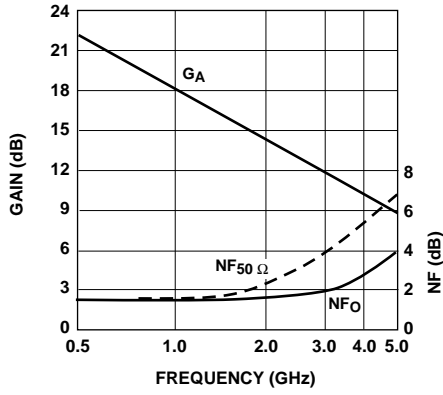
## Electrical Specifications, T<sub>A</sub> = 25°C

| Symbol                          | Parameters and Test Conditions  | Units | Min. | Typ.                | Max. |
|---------------------------------|---|-------|------|---------------------|------|
| S <sub>21E</sub>   <sup>2</sup> | Insertion Power Gain; V <sub>CE</sub> = 8 V, I <sub>C</sub> = 25 mA<br>f = 1.0 GHz<br>f = 2.0 GHz                   | dB    |      | 17.5<br>11.5        |      |
| P <sub>1dB</sub>                | Power Output @ 1 dB Gain Compression<br>V <sub>CE</sub> = 8 V, I <sub>C</sub> = 25 mA<br>f = 2.0 GHz                | dBm   |      | 18.5                |      |
| G <sub>1dB</sub>                | 1 dB Compressed Gain; V <sub>CE</sub> = 8 V, I <sub>C</sub> = 25 mA<br>f = 2.0 GHz                                  | dB    |      | 14.0                |      |
| NF <sub>O</sub>                 | Optimum Noise Figure: V <sub>CE</sub> = 8 V, I <sub>C</sub> = 10 mA<br>f = 1.0 GHz<br>f = 2.0 GHz<br>f = 4.0 GHz    | dB    |      | 1.4<br>1.7<br>3.0   | 1.8  |
| G <sub>A</sub>                  | Gain @ NF <sub>O</sub> ; V <sub>CE</sub> = 8 V, I <sub>C</sub> = 10 mA<br>f = 1.0 GHz<br>f = 2.0 GHz<br>f = 4.0 GHz | dB    | 17.5 | 18.5<br>13.5<br>9.5 |      |
| f <sub>T</sub>                  | Gain Bandwidth Product: V <sub>CE</sub> = 8 V, I <sub>C</sub> = 25 mA   | GHz   |      | 8.0                 |      |
| h <sub>FE</sub>                 | Forward Current Transfer Ratio; V <sub>CE</sub> = 8 V, I <sub>C</sub> = 10 mA                                       | —     | 30   | 150                 | 270  |
| I <sub>CBO</sub>                | Collector Cutoff Current; V <sub>CB</sub> = 8 V   | μA    |      |                     | 0.2  |
| I <sub>EBO</sub>                | Emitter Cutoff Current; V <sub>EB</sub> = 1 V   | μA    |      |                     | 1.0  |
| C <sub>CB</sub>                 | Collector Base Capacitance <sup>[1]</sup> ; V <sub>CB</sub> = 8 V, f = 1 MHz  | pF    |      | 0.25                |      |

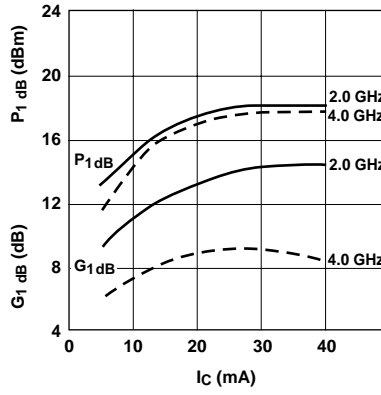
#### Notes:

1. For this test, the emitter is grounded.

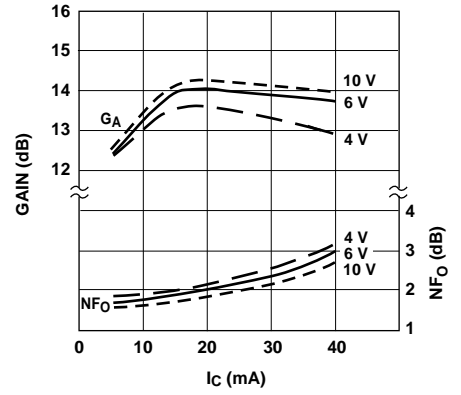
**AT-41485 Typical Performance,  $T_A = 25^\circ\text{C}$**



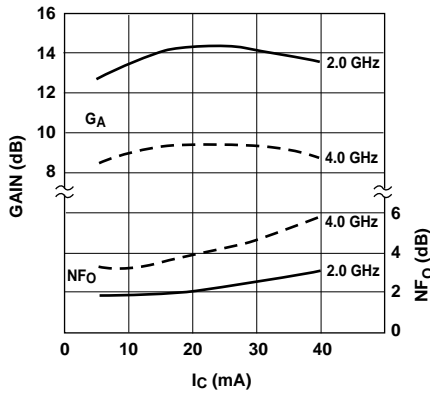
**Figure 1. Noise Figure and Associated Gain vs. Frequency.**  
 $V_{CE} = 8\text{ V}$ ,  $I_C = 10\text{ mA}$ .



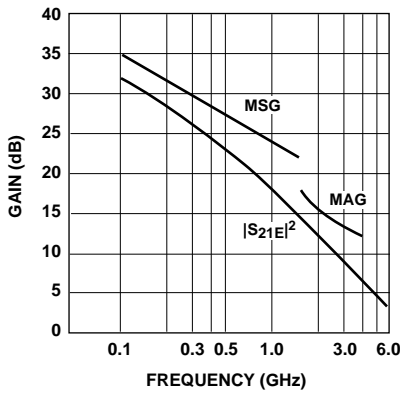
**Figure 2. Output Power and 1 dB Compressed Gain vs. Collector Current and Frequency.**  $V_{CE} = 8\text{ V}$ .



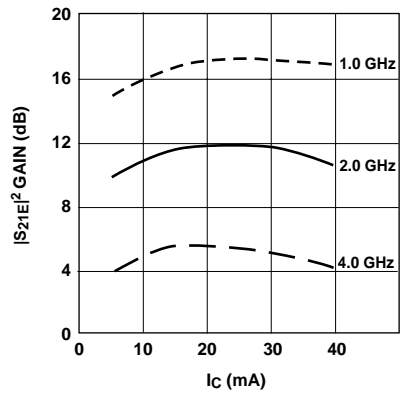
**Figure 3. Optimum Noise Figure and Associated Gain vs. Collector Current and Collector Voltage.**  $f = 2.0\text{ GHz}$ .



**Figure 4. Optimum Noise Figure and Associated Gain vs. Collector Current and Frequency.**  $V_{CE} = 8\text{ V}$ .



**Figure 5. Insertion Power Gain, Maximum Available Gain and Maximum Stable Gain vs. Frequency.**  
 $V_{CE} = 8\text{ V}$ ,  $I_C = 25\text{ mA}$ .



**Figure 6. Insertion Power Gain vs. Collector Current and Frequency.**  
 $V_{CE} = 8\text{ V}$ .

**AT-41485 Typical Scattering Parameters, Common Emitter,** $Z_O = 50 \Omega$ ,  $T_A = 25^\circ\text{C}$ ,  $V_{CE} = 8 \text{ V}$ ,  $I_C = 10 \text{ mA}$ 

| Freq.<br>GHz | $S_{11}$ |      | dB   | $S_{21}$ |      | dB    | $S_{12}$ |      | $S_{22}$ |      |
|--------------|----------|------|------|----------|------|-------|----------|------|----------|------|
|              | Mag.     | Ang. |      | Mag.     | Ang. |       | Mag.     | Ang. | Mag.     | Ang. |
| 0.1          | .74      | -40  | 28.2 | 25.80    | 156  | -35.6 | .017     | 81   | .93      | -14  |
| 0.5          | .61      | -126 | 21.9 | 12.46    | 108  | -29.2 | .035     | 44   | .57      | -31  |
| 1.0          | .57      | -161 | 16.6 | 6.80     | 87   | -27.9 | .040     | 38   | .46      | -33  |
| 1.5          | .57      | -180 | 13.4 | 4.67     | 75   | -25.7 | .052     | 47   | .43      | -34  |
| 2.0          | .58      | 166  | 11.0 | 3.55     | 64   | -24.5 | .060     | 54   | .41      | -38  |
| 2.5          | .59      | 160  | 9.3  | 2.92     | 59   | -23.3 | .068     | 58   | .40      | -39  |
| 3.0          | .61      | 150  | 7.7  | 2.42     | 50   | -21.9 | .080     | 63   | .39      | -46  |
| 3.5          | .62      | 142  | 6.4  | 2.09     | 41   | -20.8 | .091     | 61   | .41      | -54  |
| 4.0          | .62      | 134  | 5.3  | 1.84     | 32   | -19.5 | .106     | 59   | .42      | -62  |
| 4.5          | .62      | 125  | 4.3  | 1.65     | 24   | -18.4 | .120     | 57   | .43      | -67  |
| 5.0          | .63      | 115  | 3.5  | 1.50     | 15   | -17.2 | .138     | 54   | .44      | -73  |
| 5.5          | .65      | 103  | 2.7  | 1.37     | 6    | -16.1 | .157     | 49   | .43      | -78  |
| 6.0          | .69      | 92   | 1.8  | 1.24     | -4   | -15.3 | .172     | 46   | .40      | -86  |

**AT-41485 Typical Scattering Parameters, Common Emitter,** $Z_O = 50 \Omega$ ,  $T_A = 25^\circ\text{C}$ ,  $V_{CE} = 8 \text{ V}$ ,  $I_C = 25 \text{ mA}$ 

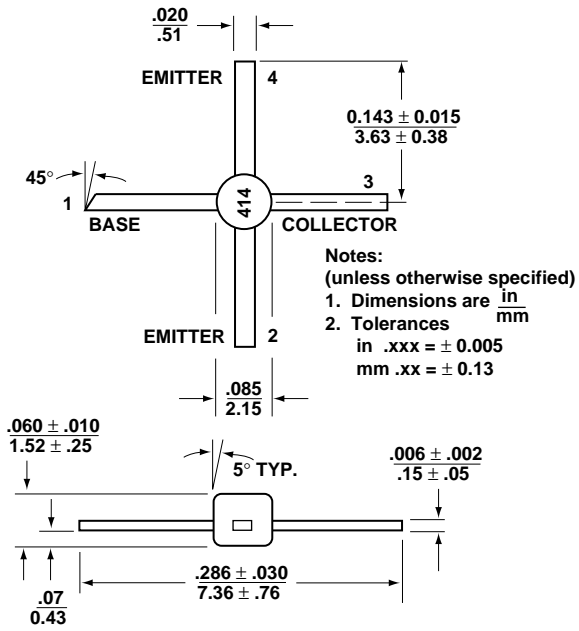
| Freq.<br>GHz | $S_{11}$ |      | dB   | $S_{21}$ |      | dB    | $S_{12}$ |      | $S_{22}$ |      |
|--------------|----------|------|------|----------|------|-------|----------|------|----------|------|
|              | Mag.     | Ang. |      | Mag.     | Ang. |       | Mag.     | Ang. | Mag.     | Ang. |
| 0.1          | .55      | -68  | 32.0 | 40.01    | 146  | -40.9 | .009     | 57   | .85      | -19  |
| 0.5          | .58      | -153 | 23.1 | 14.20    | 99   | -32.7 | .023     | 52   | .47      | -29  |
| 1.0          | .58      | -177 | 17.4 | 7.39     | 82   | -29.8 | .032     | 63   | .41      | -28  |
| 1.5          | .58      | 169  | 14.0 | 5.01     | 71   | -27.3 | .043     | 60   | .39      | -30  |
| 2.0          | .60      | 158  | 11.6 | 3.78     | 61   | -24.6 | .059     | 64   | .38      | -36  |
| 2.5          | .60      | 153  | 9.8  | 3.09     | 58   | -23.7 | .065     | 71   | .36      | -39  |
| 3.0          | .63      | 147  | 8.1  | 2.55     | 48   | -21.7 | .082     | 68   | .35      | -47  |
| 3.5          | .64      | 140  | 6.9  | 2.21     | 39   | -20.7 | .092     | 67   | .37      | -56  |
| 4.0          | .64      | 133  | 5.8  | 1.94     | 31   | -19.4 | .107     | 65   | .39      | -64  |
| 4.5          | .64      | 125  | 4.8  | 1.74     | 23   | -18.1 | .125     | 63   | .40      | -71  |
| 5.0          | .64      | 115  | 4.0  | 1.58     | 14   | -17.1 | .140     | 56   | .41      | -78  |
| 5.5          | .66      | 105  | 3.2  | 1.45     | 5    | -15.9 | .160     | 50   | .40      | -82  |
| 6.0          | .70      | 94   | 2.4  | 1.32     | -5   | -15.1 | .175     | 47   | .37      | -91  |

A model for this device is available in the DEVICE MODELS section.

**AT-41485 Noise Parameters:  $V_{CE} = 8 \text{ V}$ ,  $I_C = 10 \text{ mA}$** 

| Freq.<br>GHz | $NF_O$<br>dB | $\Gamma_{opt}$ |      | $R_N/50$ |
|--------------|--------------|----------------|------|----------|
|              |              | Mag            | Ang  |          |
| 0.1          | 1.3          | .12            | 5    | 0.17     |
| 0.5          | 1.3          | .10            | 25   | 0.17     |
| 1.0          | 1.4          | .06            | 50   | 0.16     |
| 2.0          | 1.7          | .25            | 172  | 0.16     |
| 4.0          | 3.0          | .48            | -131 | 0.24     |

## 85 Plastic Package Dimensions





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