HEWLETT PACKARD

# AT-00500
# Up to 4 GHz General Purpose Silicon Bipolar Transistor Chip

## Features

- **16.0 dBm typical $P_{1\,dB}$ at 2.0 GHz**
- **11.5 dB typical $G_{1\,dB}$ at 2.0 GHz**
- **2.5 dB typical $NF_O$ at 2.0 GHz**
- **High Gain-Bandwidth Product: 9.0 GHz typical $f_T$**

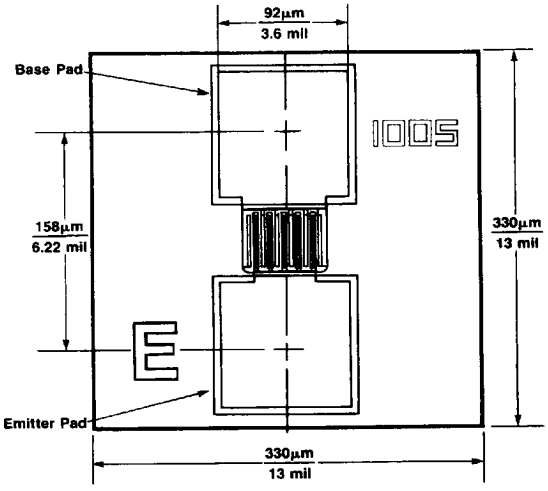
## Description

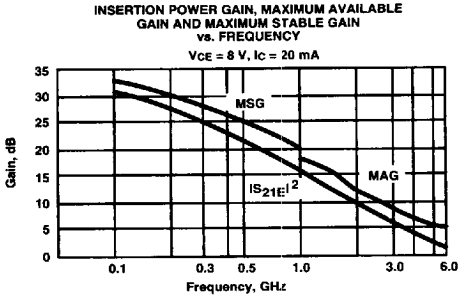
The AT-00500 is a high performance NPN silicon bipolar transistor chip designed for use in wide band amplifier and oscillator applications operating over VHF, UHF and microwave frequencies.

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.

The recommended assembly procedure is gold-eutectic die attach at 400°C and either wedge or ball bonding using 0.7 mil gold wire. See also "Chip Use" in the APPLICATIONS section.

## Chip Outline




## Electrical Specifications, $T_A = 25°C$

| Symbol | Parameters and Test Conditions[1] | | Units | Min. | Typ. | Max. |
|---|---|---|---|---|---|---|
| $\|S_{21E}\|^2$ | Insertion Power Gain: $V_{CE}$ = 8 V, $I_C$ = 20 mA | f = 1.0 GHz<br>f = 2.0 GHz | dB | | 15.5<br>9.5 | |
| $P_{1\,dB}$ | Power Output @ 1 dB Gain Compression: $V_{CE}$ = 8 V, $I_C$ = 20 mA | f = 2.0 GHz | dB | | 16.0 | |
| $G_{1\,dB}$ | 1 dB Compressed Gain: $V_{CE}$ = 8 V, $I_C$ = 20 mA | f = 2.0 GHz | dB | | 11.5 | |
| $NF_O$ | Optimum Noise Figure: $V_{CE}$ = 8 V, $I_C$ = 5 mA | f = 2.0 GHz | dB | | 2.5 | |
| $G_A$ | Gain @ $NF_O$: $V_{CE}$ = 8 V, $I_C$ = 5 mA | f = 2.0 GHz | dB | | 10.5 | |
| $f_T$ | Gain Bandwidth Product: $V_{CE}$ = 8 V, $I_C$ = 20 mA | | GHz | | 9.0 | |
| $h_{FE}$ | Forward Current Transfer Ratio: $V_{CE}$ = 8V, $I_C$ = 20 mA | | | 30 | 150 | 300 |
| $I_{CBO}$ | Collector Cutoff Current: $V_{CB}$ = 8 V | | µA | | | 0.2 |
| $I_{EBO}$ | Emitter Cutoff Current: $V_{EB}$ = 1 V | | µA | | | 1.0 |
| $C_{CB}$ | Collector Base Capacitance[2]: $V_{CB}$ = 8 V, f = 1 MHz | | pF | | 0.45 | |

Notes. 1. RF performance is determined by packaging and testing 10 devices per wafer
2 For this test, the emitter is grounded

## Absolute Maximum Ratings

| Parameter | Symbol | Absolute Maximum[1] |
|---|---|---|
| Emitter-Base Voltage | $V_{EBO}$ | 1.5 V |
| Collector-Base Voltage | $V_{CBO}$ | 20 V |
| Collector-Emitter Voltage | $V_{CEO}$ | 12 V |
| Collector Current | $I_C$ | 50 mA |
| Power Dissipation[2,3] | $P_T$ | 500 mW |
| Junction Temperature | $T_J$ | 200°C |
| Storage Temperature | $T_{STG}$ | –65°C to 200°C |

Thermal Resistance[2,4]: $\theta_{jc}$ = 75°C/W

**Notes:**

1. Operation of this device above any one of these parameters may cause permanent damage.
2. $T_{CASE}$ = 25°C.
3. Derate at 13.3 mW/°C for $T_C$ > 163°C.
4. The small spot size of this technique results in a higher, though more accurate determination of $\theta_{jc}$ than do alternate methods. See MEASUREMENTS section "Thermal Resistance" for more information.

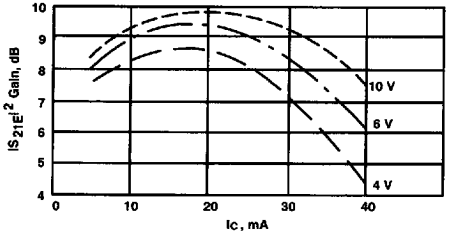
## Part Number Ordering Information

| Part Number | Devices Per Tray |
|---|---|
| AT-00500-GP2 | 10 |
| AT-00500-GP4 | 100 |
| AT-00500-GP6 | up to 300 |

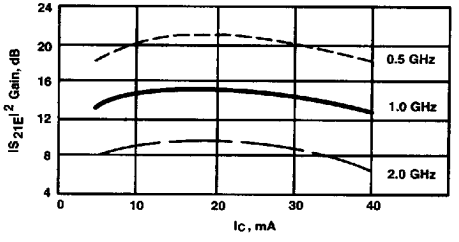
## Typical Performance, $T_A$ = 25°C

(unless otherwise noted)

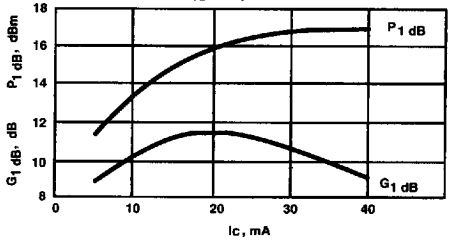
INSERTION POWER GAIN
vs. COLLECTOR CURRENT AND COLLECTOR VOLTAGE
f = 2.0 GHz



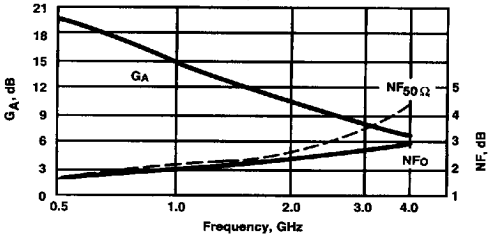

INSERTION POWER GAIN
vs. COLLECTOR CURRENT AND FREQUENCY
$V_{CE}$ = 8 V




OUTPUT POWER AND 1 dB COMPRESSED GAIN
vs. COLLECTOR CURRENT
$V_{CE}$ = 8 V, f = 2.0 GHz




NOISE FIGURE AND ASSOCIATED GAIN
vs.FREQUENCY
$V_{CE}$ = 8 V, $I_C$ = 5 mA



**Typical Scattering Parameters: Common Emitter, $Z_O = 50\ \Omega$** $T_A = 25°C$, $V_{CE} = 8$ V, $I_C = 5$ mA

| Freq. GHz | $S_{11}$ | | $S_{21}$ | | | $S_{12}$ | | | $S_{22}$ | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Mag | Ang | dB | Mag | Ang | dB | Mag | Ang | Mag | Ang |
| 0.1 | .87 | −29 | 23.2 | 14.43 | 161 | −32.4 | .024 | 76 | .96 | −14 |
| 0.5 | .66 | −103 | 18.2 | 8.17 | 116 | −23.2 | .069 | 45 | .61 | −42 |
| 1.0 | .57 | −142 | 13.6 | 4.78 | 94 | −21.4 | .085 | 40 | .44 | −47 |
| 1.5 | .54 | −162 | 10.2 | 3.24 | 81 | −20.4 | .096 | 44 | .39 | −50 |
| 2.0 | .54 | −176 | 8.0 | 2.51 | 72 | −19.4 | .107 | 49 | .38 | −53 |
| 2.5 | .54 | 178 | 6.1 | 2.02 | 64 | −18.6 | .118 | 52 | .38 | −55 |
| 3.0 | .56 | 171 | 4.8 | 1.73 | 55 | −17.5 | .134 | 53 | .39 | −59 |
| 3.5 | .56 | 163 | 3.6 | 1.52 | 51 | −16.5 | .149 | 58 | .40 | −63 |
| 4.0 | .58 | 158 | 2.5 | 1.33 | 44 | −15.9 | .160 | 59 | .43 | −66 |
| 4.5 | .59 | 153 | 1.6 | 1.20 | 39 | −15.1 | .176 | 60 | .46 | −71 |
| 5.0 | .59 | 149 | 0.6 | 1.07 | 33 | −14.2 | .194 | 61 | .48 | −76 |
| 5.5 | .60 | 144 | −0.1 | 0.99 | 29 | −13.8 | .204 | 62 | .50 | −83 |
| 6.0 | .62 | 141 | −1.1 | 0.88 | 23 | −13.4 | .215 | 63 | .54 | −88 |
| $T_A = 25°C$, $V_{CE} = 8$ V, $I_C = 20$ mA | | | | | | | | | | |
| 0.1 | .64 | −66 | 30.4 | 33.05 | 145 | −35.4 | .017 | 65 | .82 | −29 |
| 0.5 | .56 | −149 | 21.1 | 11.31 | 99 | −28.4 | .038 | 52 | .34 | −53 |
| 1.0 | .55 | −172 | 15.5 | 5.96 | 86 | −24.9 | .057 | 61 | .25 | −52 |
| 1.5 | .55 | 178 | 11.9 | 3.95 | 77 | −22.3 | .077 | 66 | .24 | −54 |
| 2.0 | .56 | 169 | 9.6 | 3.03 | 70 | −20.3 | .097 | 68 | .25 | −56 |
| 2.5 | .55 | 165 | 7.6 | 2.41 | 64 | −18.8 | .115 | 69 | .26 | −59 |
| 3.0 | .57 | 160 | 6.3 | 2.06 | 57 | −17.3 | .136 | 69 | .27 | −63 |
| 3.5 | .57 | 155 | 5.1 | 1.81 | 53 | −16.2 | .155 | 70 | .28 | −67 |
| 4.0 | .59 | 150 | 3.9 | 1.57 | 47 | −15.4 | .170 | 69 | .32 | −70 |
| 4.5 | .60 | 146 | 3.1 | 1.42 | 43 | −14.3 | .192 | 69 | .35 | −75 |
| 5.0 | .60 | 144 | 2.1 | 1.27 | 38 | −13.7 | .207 | 62 | .37 | −79 |
| 5.5 | .62 | 139 | 1.4 | 1.18 | 33 | −13.1 | .221 | 68 | .39 | −85 |
| 6.0 | .62 | 136 | 0.4 | 1.05 | 29 | −12 5 | .237 | 68 | .43 | −90 |

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