HEWLETT PACKARD

AT-60500
Up to 6 GHz Low Noise Silicon Bipolar Transistor Chip

Features

- **Low Bias Current Operation**
- **Low Noise Figure: 1.8 dB typical at 2.0 GHz**
  2.8 dB typical at 4.0 GHz
- **High Associated Gain: 12.5 dB typical at 2.0 GHz**
  8.0 dB typical at 4.0 GHz
- **High Gain-Bandwidth Product: 9.0 GHz typical f_T**

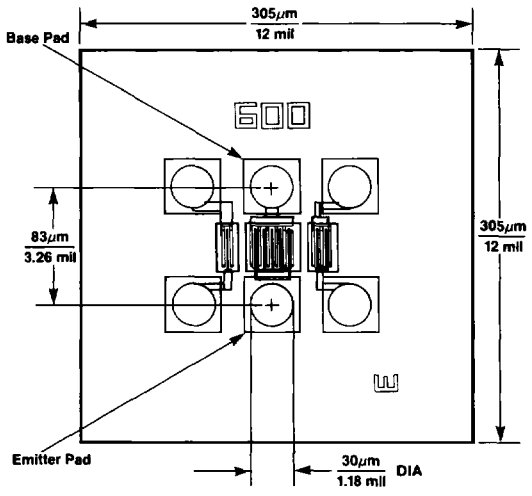
Description

The AT-60500 is a high performance NPN silicon bipolar transistor chip designed for use low noise, wide band amplifier and oscillator applications operating over VHF, UHF and microwave frequencies.

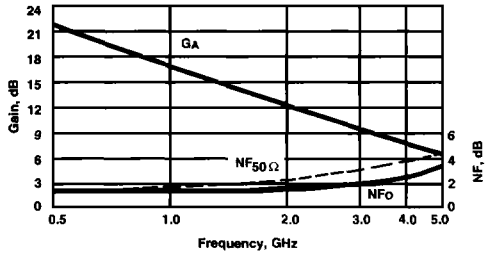
The die are nitride-passivated for surface protection. Excellent device uniformity, performance and reliability are produced by the use of ion-implanation, self-alignment techniques, and gold metallization in the fabrication of these devices.

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[1]



NOISE FIGURE AND ASSOCIATED GAIN vs. FREQUENCY
V_{CE} = 8 V, I_C = 2 mA



Noise Parameters: V_{CE} = 8 V, I_C = 2 mA

Freq. GHz	NF_O dB	Gamma Opt Mag	Gamma Opt Ang	$R_N/50$
1.0	1.4	.58	44	0.20
2.0	1.8	.48	90	0.24
4.0	2.8	.50	155	0.20

Electrical Specifications, T_A = 25°C

Symbol	Parameters and Test Conditions[1,2]		Units	Min.	Typ.	Max.
NF_O	Optimum Noise Figure: V_{CE} = 8 V, I_C = 2 mA	f = 1.0 GHz f = 2.0 GHz f = 4.0 GHz	dB		1.4 1.8 2.8	
G_A	Gain @ NF_O: V_{CE} = 8 V, I_C = 2 mA	f = 1.0 GHz f = 2.0 GHz f = 4.0 GHz	dB		16.5 12.5 8.0	
$\|S_{21E}\|^2$	Insertion Power Gain: V_{CE} = 8 V, I_C = 10 mA	f = 2.0 GHz f = 4.0 GHz	dB		12.0 6.5	
$P_{1\,dB}$	Power Output @ 1 dB Gain Compression: V_{CE} = 8 V, I_C = 10 mA	f = 2.0 GHz	dBm		16.0	
	1 dB Compressed Gain: V_{CE} = 8 V, I_C = 10 mA	f = 2.0 GHz	dB		12.5	
f_T	Gain Bandwidth Product: V_{CE} = 8 V, I_C = 10 mA		GHz		9.0	
h_{FE}	Forward Current Transfer Ratio: V_{CE} = 8 V, I_C = 10 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[3]: V_{CB} = 8 V, f = 1 MHz		pF		0.11	

Notes: 1. This chip contains 3 active devices. The performance specified applies only to the device whose base and emitter pads are indicated on the chip outline.
2. RF performance is determined by packaging and testing 10 devices per wafer.
3. For this test, the emitter is grounded.

Absolute Maximum Ratings

Parameter	Symbol	Absolute Maximum
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	40 mA
Power Dissipation[2,3]	P_T	400 mW
Junction Temperature	T_j	200°C
Storage Temperature	T_{STG}	−65°C to 200°C

Thermal Resistance[2,4]: θ_{jc} = 120°C/W

Notes:

1. Operation of this device above any one of these parameters may cause permanent damage.
2. $T_{MOUNTING\ SURFACE}$ = 25°C.
3. Derate at 8.3 mW/°C for $T_{MOUNTING\ SURFACE}$ > 152°C.
4. The small spot size of this technique results in a higher, though more accurate determination of θ_{jc} than do alternate methods. See MEASUREMENTS section "Thermal Resistance" for more information.

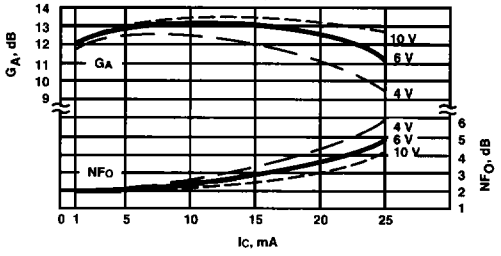
Part Number Ordering Information

Part Number	Devices Per Tray
AT-60500-GP2	10
AT-60600-GP4	100
AT-60500-GP6	up to 300

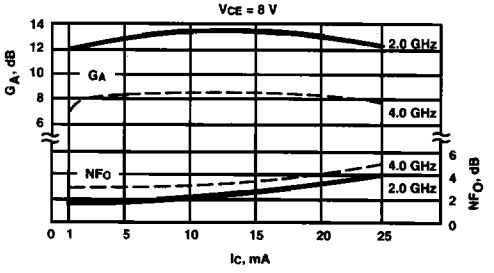
Typical Performance, T_A = 25°C

(unless otherwise noted)

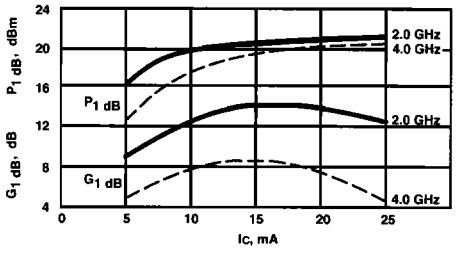
OPTIMUM NOISE FIGURE AND ASSOCIATED GAIN vs. COLLECTOR CURRENT AND COLLECTOR VOLTAGE
f = 2.0 GHz



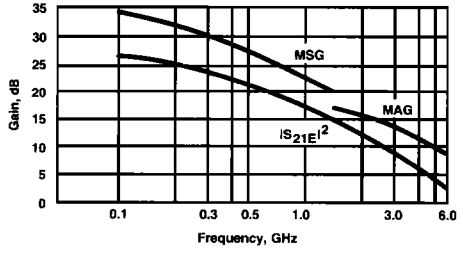
OPTIMUM NOISE FIGURE AND ASSOCIATED GAIN vs. COLLECTOR CURRENT AND FREQUENCY
VCE = 8 V



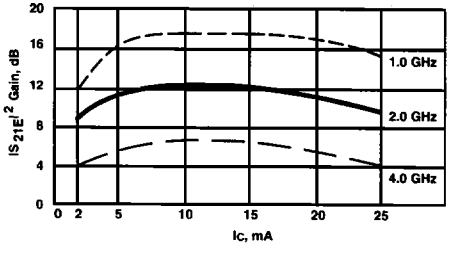
OUTPUT POWER AND 1 dB COMPRESSED GAIN vs. COLLECTOR CURRENT AND FREQUENCY
VCE = 8 V



INSERTION POWER GAIN, MAXIMUM AVAILABLE GAIN AND MAXIMUM STABLE GAIN vs. FREQUENCY
VCE = 8 V, IC = 10 mA



INSERTION POWER GAIN vs. COLLECTOR CURRENT AND FREQUENCY
VCE = 8 V



Typical Scattering Parameters: Common Emitter, $Z_O = 50\ \Omega$ $T_A = 25°C$, $V_{CE} = 8$ V, $I_C = 2$ mA

Freq. GHz	S_{11}		S_{21}			S_{12}			S_{22}	
	Mag	Ang	dB	Mag	Ang	dB	Mag	Ang	Mag	Ang
0.1	.97	–6	16.7	6.86	176	–40.0	.010	85	.92	–7
0.5	.88	–34	14.3	5.17	149	–27.3	.043	71	.95	–13
1.0	.74	–72	12.0	4.00	127	–23.3	.068	55	.84	–16
1.5	.60	–101	10.2	3.22	112	–22.6	.074	48	.76	–19
2.0	.57	–123	9.0	2.83	97	–21.6	.083	43	.71	–22
2.5	.53	–140	7.7	2.43	88	–21.4	.085	45	.69	–23
3.0	.49	–158	6.5	2.11	79	–21.4	.085	50	.67	–24
3.5	.50	–167	5.3	1.85	73	–21.0	.089	51	.66	–26
4.0	.50	–176	4.2	1.63	68	–20.6	.093	56	.66	–28
4.5	.50	174	3.1	1.43	61	–20.5	.095	58	.67	–30
5.0	.50	166	2.3	1.30	56	–20.0	.100	64	.68	–32
5.5	.52	158	1.7	1.22	50	–19.4	.107	67	.67	–36
6.0	.50	148	0.8	1.10	45	–18.9	.114	70	.69	–39

$T_A = 25°C$, $V_{CE} = 8$ V, $I_C = 10$ mA

0.1	.68	–21	26.9	22.02	166	–40.9	.009	80	.95	–7
0.5	.55	–93	22.5	13.27	123	–31.7	.026	60	.74	–20
1.0	.46	–137	17.8	7.73	101	–28.9	.036	58	.63	–17
1.5	.44	–160	14.7	5.41	90	–27.1	.044	65	.58	–16
2.0	.44	–173	12.2	4.05	82	–25.5	.053	68	.57	–17
2.5	.45	178	10.5	3.36	77	–23.9	.064	72	.57	–18
3.0	.45	169	9.1	2.84	71	–22.5	.075	76	.56	–20
3.5	.46	163	7.8	2.45	66	–21.4	.085	78	.56	–22
4.0	.46	157	6.7	2.16	63	–20.4	.096	81	.57	–24
4.5	.47	150	5.5	1.88	56	–19.5	.106	80	.58	–27
5.0	.47	144	4.7	1.72	53	–18.6	117	83	.59	–28
5.5	.50	140	4.0	1.58	48	–17.8	.129	83	.59	–32
6.0	.49	132	3.1	1.43	43	–17.1	.139	82	.61	–36

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