

## AT-41500

### Up to 6 GHz Low Noise Silicon Bipolar Transistor Chip



## Data Sheet

### Description/Applications

The AT-41500 of Avago Technologies is a general purpose NPN bipolar transistor chip that offers excellent high frequency performance. The 4 micron emitter-to-emitter pitch enables this transistor to be used in many different functions. The 15 emitter fingers interdigitated geometry yields an intermediate sized transistor with impedances that are easy to match for low noise and moderate power applications. This device is designed for use in low noise, wideband amplifier, mixer and oscillator applications in the VHF, UHF, and microwave frequencies. An optimum noise match near  $50 \Omega$  at 1GHz, makes this device easy to use as a low noise amplifier.

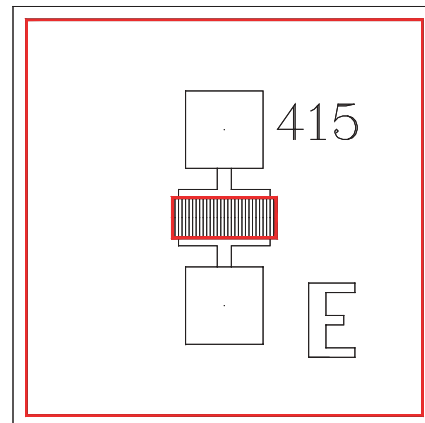
The AT-41500 bipolar transistor is fabricated using Avago Technologies' 10 GHz fT Self-Aligned-Transistor (SAT) process. The die is nitride passivated for surface protection. Excellent device uniformity, performance and reliability are produced by the use of ion implantation, self-alignment techniques, and gold metallization in the fabrication of this device.

### Features

Performance in 86 plastic package:

- 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 1GHz  
12.5 dB typical at 2 GHz
- High Gain-Bandwidth Product  
8.0 GHz typical  $f_T$

### Chip Outline



**Table 1. Absolute Maximum Ratings** <sup>[1]</sup>

Symbol	Parameter	Unit	Max Rating
$V_{EBO}$	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, 3]</sup>	mW	500
$T_J$	Junction Temperature	°C	200
$T_{STG}$	Storage Temperature	°C	-60 to 200
$\theta_{jc}$	Thermal Resistance <sup>[2, 4]</sup>	°C/W	95

Notes:

1. Operation in excess of any one of these conditions may result in permanent damage to the device.
2.  $T_{MOUNTING SURFACE} = 25\text{ }^{\circ}\text{C}$
3. Derate at  $10.5\text{ mW}/^{\circ}\text{C}$  for  $T_{MOUNTING SURFACE} > 153\text{ }^{\circ}\text{C}$ .
4. The small spot size of this technique results in a higher, though more accurate determination of  $\theta_{jc}$  than do the alternate method.

**Table 2. Electrical Specifications at  $T_A = +25^{\circ}\text{C}$ ,  $V_{CE}=8\text{V}$** 

Symbol	Parameter and Test Condition	Units	Min.	Typ.	Max.	
NFo	Optimum Noise Figure: $I_C = 10\text{ mA}$	$f = 1.0\text{ GHz}$	dB	1.40		
		$f = 2.0\text{ GHz}$	dB	1.70		
		$f = 4.0\text{ GHz}$	dB	3.00		
GA	Gain @ NFo ; $I_C=10\text{mA}$	$f = 1.0\text{ GHz}$	dB	17.0		
		$f = 2.0\text{ GHz}$	dB	12.5		
		$f = 4.0\text{ GHz}$	dB	8.0		
$ S_{21E} ^2$	Insertion Power Gain : $I_C = 25\text{ mA}$	$f = 1.0\text{ GHz}$	dB	17.0		
		$f = 2.0\text{ GHz}$	dB	11.0		
P1dB	Power Output @1dB Gain Compression: $I_C=25\text{ mA}$	$f = 2.0\text{ GHz}$	dBm	18.0		
G1dB	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: $V_{CB} = 8\text{ V}$		uA		0.2	
$I_{EBO}$	Emitter Cutoff Current: $V_{EB} = 1\text{ V}$		uA		1	

Notes:

1. RF performance is determined by packaging and testing 10 devices per wafer.
2. RF performance is measured in 86 plastic packages.

### Typical Performance Curves at Tc = +25°C

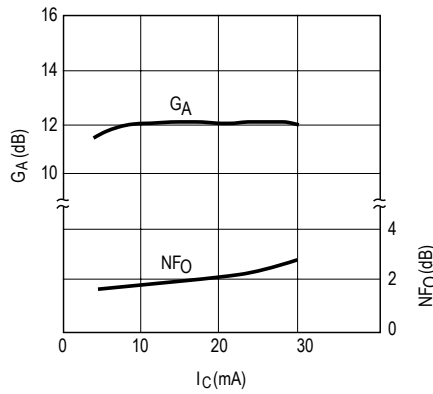


Figure 3. AT-41586 P1dB and G1dB vs. Collector Current at VCE = 8 V, f = 2.0 GHz.

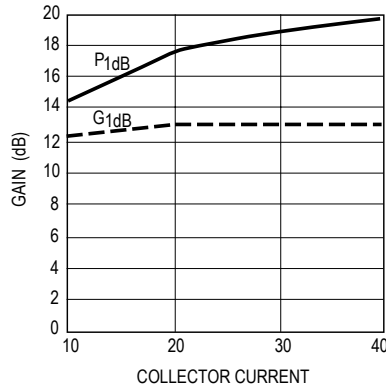


Figure 2. AT-41586 Optimum Noise Figure and Associated Gain vs. Collector Current at VCE = 8 V, f = 2.0 GHz.

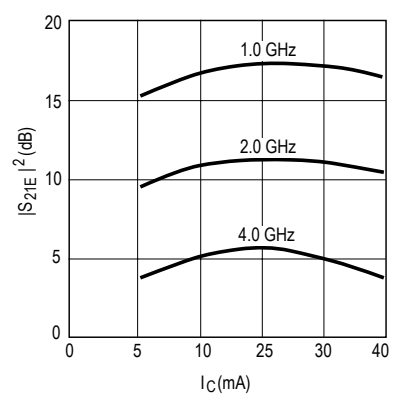


Figure 4. AT-41586 Insertion Power Gain vs. Collector Current and Frequency at 25°C, VCE = 8 V.

### Typical Scattering Parameters at Tc = +25°C

VCE=8V, IC = 10mA, Zo=50 Ohm

Frequency (GHz)	S <sub>11</sub>		S <sub>21</sub>			S <sub>12</sub>			S <sub>22</sub>	
	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

### Typical Noise Parameters at Tc = +25°C

V<sub>CE</sub>=8V, I<sub>c</sub> = 10mA, Z<sub>o</sub>=50 Ohm

Frequency (GHz)	NF <sub>o</sub> (dB)	Γ <sub>opt</sub> Mag.	Ang.	R <sub>N</sub> /50 Ω
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

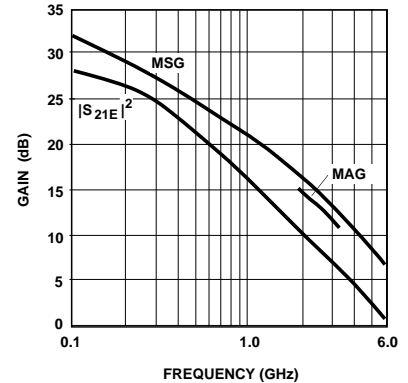


Figure 5. AT-41586 Insertion Power Gain, Maximum Available Gain and Maximum Stable Gain vs. Frequency at V<sub>CE</sub> = 8 V, I<sub>C</sub> = 10 mA.

### Typical Scattering Parameters at Tc = +25°C

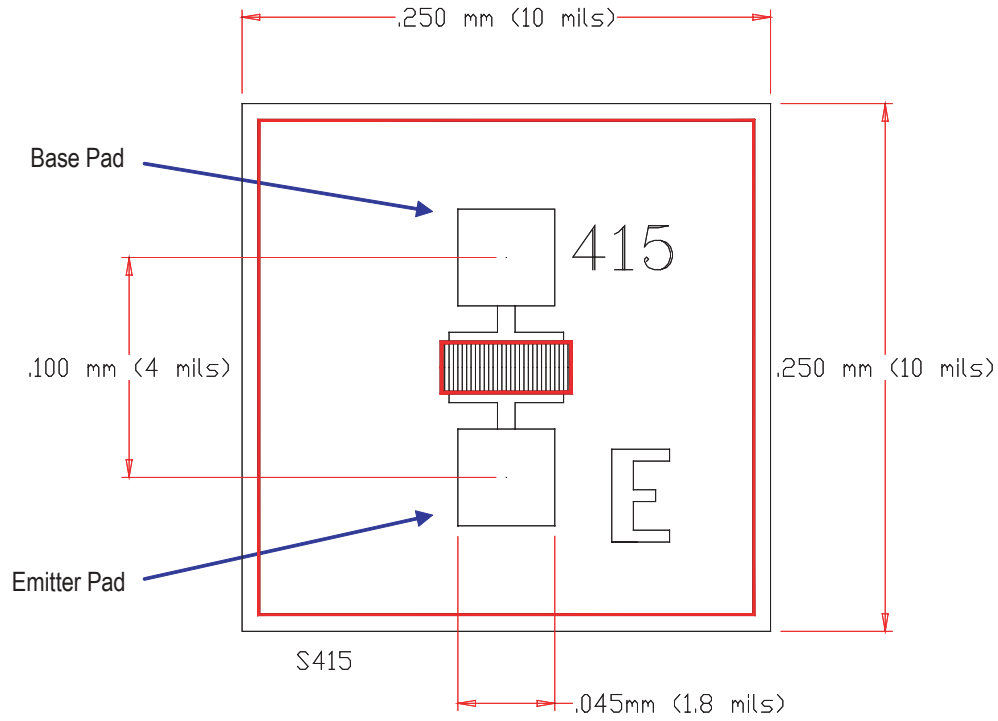
V<sub>CE</sub>=8V, I<sub>c</sub> = 25mA, Z<sub>o</sub>=50 Ohm

Frequency (GHz)	S <sub>11</sub>		S <sub>21</sub>			S <sub>12</sub>		S <sub>22</sub>		
	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

## Part Number Ordering Information

Part number	Devices Per Tray
AT-41500-GP4	100

## AT-41500 Chip Dimensions



Note : Die Thickness is 5 ~ 6 mils

For product information and a complete list of distributors, please go to our web site: [www.avagotech.com](http://www.avagotech.com)

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