HEWLETT PACKARD

AT-60535
Up to 6 GHz Low Noise Silicon Bipolar Transistor

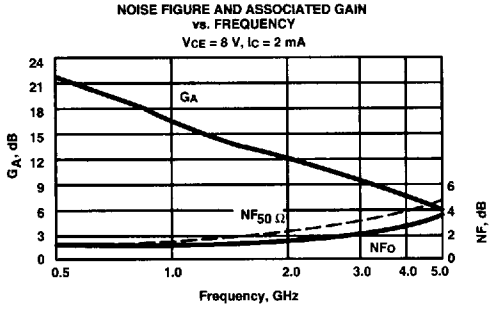
Features

- **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: 12.0 dB typical at 2.0 GHz**
  7.5 dB typical at 4.0 GHz
- **High Gain-Bandwidth Product: 8.0 GHz typical f_T**
- **Cost Effective Ceramic Microstrip Package**

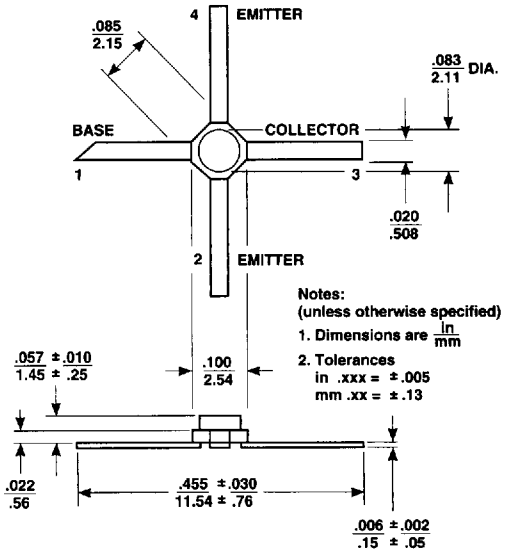
Description

The AT-60535 is a high performance NPN silicon bipolar transistor housed in a cost-effective, microstrip package. This device is designed for use in low noise, wide band amplifier and oscillator applications operating over VHF, UHF and microwave frequencies.

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.



35 micro-X Package



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

Freq. GHz	NFO dB	Gamma Opt Mag	Gamma Opt Ang	RN/50
1.0	1.4	.50	55	0.32
2.0	1 8	40	114	0.38
4.0	2.8	.38	−153	0.40

Electrical Specifications, T_A = 25°C

Symbol	Parameters and Test Conditions		Units	Min.	Typ.	Max.
NFO	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	2.1
GA	Gain @ NFO: V_{CE} = 8 V, I_C = 2 mA	f = 1.0 GHz f = 2.0 GHz f = 4.0 GHz	dB	11.0	16.5 12.0 7.5	
$\|S_{21E}\|^2$	Insertion Power Gain: V_{CE} = 8 V, I_C = 10 mA	f = 2.0 GHz f = 4.0 GHz	dB		11.5 6.0	
$P_{1\,dB}$	Power Output @ 1 dB Gain Compression. V_{CE} = 8 V, I_C = 10 mA	f = 2.0 GHz	dBm		16.0	
$G_{1\,dB}$	1 dB Compressed Gain: V_{CE} = 8 V, I_C = 10 mA	f = 2.0 GHz	dB		11.5	
f_T	Gain Bandwidth Product: V_{CE} = 8 V, I_C = 10 mA		GHz		8.0	
hFE	Forward Current Transfer Ratio. V_{CE} = 8 V, I_C = 10 mA			30	150	300
ICBO	Collector Cutoff Current: V_{CB} = 8 V		µA			0.2
IEBO	Emitter Cutoff Current: V_{EB} = 1 V		µA			1.0
CCB	Collector Base Capacitance[1]: V_{CB} = 8 V, f = 1 MHz		pF		0.15	

Note 1 For this test the emitter is grounded

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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	40 mA
Power Dissipation[2,3]	P_T	400 mW
Junction Temperature	T_J	200°C
Storage Temperature[4]	T_{STG}	–65°C to 200°C

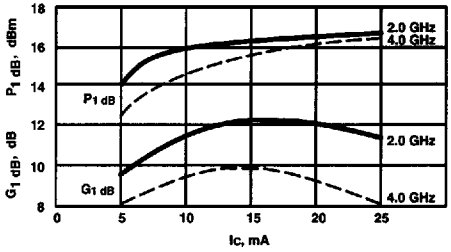
Thermal Resistance[2,5]: θ_{jC} = 225°C/W

Notes:

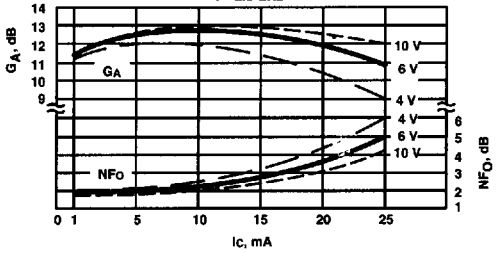
1. Operation of this device above any one of these parameters may cause permanent damage.
2. T_{CASE} = 25°C.
3. Derate at 4.4 mW/°C for T_C > 110°C.
4. Storage above +150°C may tarnish the leads of this package making it difficult to solder into a circuit. After a device has been soldered into a circuit, it may be safely stored up to 200°C.
5. 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.

Typical Performance, T_A = 25°C
(unless otherwise noted)

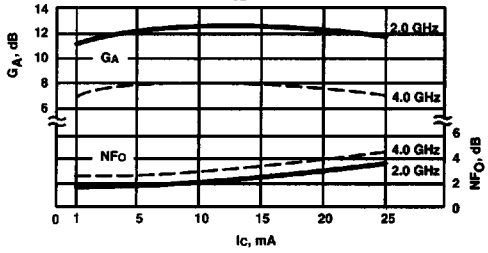
OUTPUT POWER AND 1 dB COMPRESSED GAIN vs. COLLECTOR CURRENT AND FREQUENCY
V_{CE} = 8 V



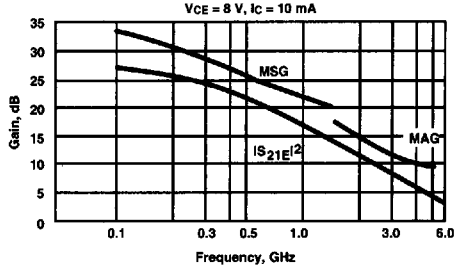
OPTIMUM NOISE FIGURE AND ASSOCIATED GAIN vs. COLLECTOR CURRENT AND COLLECTOR VOLTAGE
f = 2.0 GHz



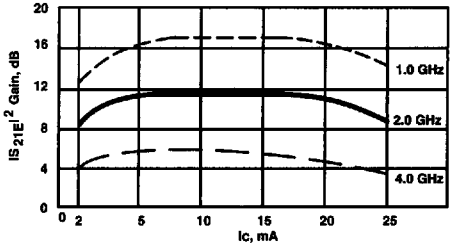
OPTIMUM NOISE FIGURE AND ASSOCIATED GAIN vs. COLLECTOR CURRENT AND FREQUENCY
V_{CE} = 8 V



INSERTION POWER GAIN, MAXIMUM AVAILABLE GAIN AND MAXIMUM STABLE GAIN vs. FREQUENCY
V_{CE} = 8 V, I_C = 10 mA



INSERTION POWER GAIN vs. COLLECTOR CURRENT AND FREQUENCY
V_{CE} = 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	.94	−10	16.6	6.77	171	−39.2	.011	92	.99	−4
0.5	.83	−47	15.3	5.80	139	−27.6	.042	63	.92	−17
1.0	.64	−84	12.7	4.33	109	−23.8	.065	44	.81	−27
1.5	.50	−111	10.6	3.38	90	−22.4	.075	41	.74	−33
2.0	.42	−137	8.7	2.73	74	−21.6	.083	37	.70	−38
2.5	.37	−156	7.5	2.33	64	−21.0	.090	38	.67	−40
3.0	.37	−177	7.4	2.02	51	−20.8	.092	43	.66	−47
3.5	.37	164	5.0	1.77	39	−19.7	.103	41	.66	−56
4.0	.36	148	4.0	1.57	27	−19.2	.110	42	.67	−64
4.5	.37	131	3.0	1.42	17	−18.3	.121	42	.69	−70
5.0	.38	113	2.2	1.29	6	−17.1	.140	43	.69	−76
5.5	.43	93	1.5	1.19	−3	−15.9	.159	39	.69	−82
6.0	.50	80	0.8	1.09	−14	−15.0	.178	36	.66	−91

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

0.1	.77	−24	27.0	22.31	160	−41.0	.009	76	.96	−8
0.5	.47	−90	22.0	12.51	113	−31.0	.028	58	.72	−22
1.0	.33	−131	17.0	7.08	89	−27.2	.044	60	.63	−25
1.5	.28	−159	13.8	4.90	74	−25.0	.056	57	.60	−28
2.0	.27	176	11.5	3.77	63	−23.0	.070	58	.59	−33
2.5	.28	162	9.9	3.11	56	−21.6	.083	62	.57	−35
3.0	.30	149	8.4	2.64	46	−20.4	.096	60	.56	−43
3.5	.32	136	7.2	2.31	36	−19.1	.111	57	.57	−52
4.0	.33	124	6.2	2.04	26	−17.8	.129	53	.58	−60
4.5	.34	110	5.2	1.83	16	−16.7	.147	50	.60	−67
5.0	.36	95	4.4	1.67	6	−15.6	.166	45	.61	−73
5.5	.41	81	3.7	1.53	−2	−14.9	.180	40	.61	−79
6.0	.49	72	3.0	1.41	−12	−14.2	.196	36	.57	−87

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