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MOTOROLA

MRF579T1

NPN Silicon Low Noise Transistors

Motorola's MRF579 is a high performance NPN transistor designed for use in high gain, low noise small–signal amplifiers. The MRF579 is well suited for low voltage portable wireless applications. This device features excellent linearity having a third order IMD ouput power of 30 dBm.

- Low Noise Figure, NF_{min} = 1.4 dB (Typ) @ 1.0 GHz, 6.0 V, 7.0 mA
- High Current Gain–Bandwidth Product, f_τ = 8.0 GHz, 6.0 V, 40 mA
- Maximum Stable Gain, 14 dB @ 1.0 GHz, 6.0 V, 20 mA
- Output Third Order Intercept, Output IP_3 = 33 dBm @ 1.0 GHz, 6.0 V, 25 mA
- Fully Ion–Implanted with Gold Metallization and Nitride Passivation

LOW NOISE TRANSISTORS

f_τ = 8.0 GHz

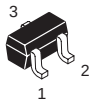
NF_{min} = 1.4 dB

I_{CMAX} = 80 mA

V_{CEO} = 10 V

SEMICONDUCTOR TECHNICAL DATA

Pin 1. Base
2. Emitter
3. Collector



PLASTIC PACKAGE
CASE 463
(SC–90/SC–75, Tape & Reel Only)

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector–Emitter Voltage	V_{CEO}	10	Vdc
Collector–Base Voltage	V_{CBO}	20	Vdc
Emitter–Base Voltage	V_{EBO}	3.0	Vdc
Power Dissipation @ T_C = 75°C Derate linearly above T_C = 75°C at	$P_{D(max)}$	0.156 2.08	W mW/°C
Collector Current – Continuous [Note 3]	I_C	80	mA
Storage Temperature	T_{stg}	–55 to 150	°C
Maximum Junction Temperature	$T_{J(max)}$	150	°C

NOTES: 1. Meets Human Body Model (HBM) ≤300 V and Machine Model (MM) ≤75 V.
2. ESD data available upon request.
3. For MTBF >10 years.

THERMAL CHARACTERISTIC

Characteristics	Symbol	Max	Unit
Thermal Resistance, Junction–to–Case	$R_{\theta JC}$	480	°C/W

NOTE: To calculate the junction temperature use $T_J = (P_D \times R_{\theta JC}) + T_C$. The case temperature is measured on collector lead adjacent to the package body.

ORDERING INFORMATION

Device	Marking	Package
MRF579T1	N1	SC–90/SC–75 Tape & Reel*

*3,000 Units per 8 mm, 7 inch reel.

ELECTRICAL CHARACTERISTICS (T_C = 25°C, unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS [Note 1]					
Collector–Emitter Breakdown Voltage (I_C = 1.0 mA, I_B = 0)	$V_{(BR)CEO}$	10	12	–	Vdc
Collector–Base Breakdown Voltage (I_C = 0.1 mA, I_E = 0)	$V_{(BR)CBO}$	20	–	–	Vdc
Emitter–Base Breakdown Voltage (I_E = 0.05 mA, I_C = 0)	$V_{(BR)EBO}$	2.5	–	–	Vdc
Collector Cutoff Current (V_{CB} = 8.0 V, I_E = 0)	I_{CBO}	–	–	0.1	μA
ON CHARACTERISTICS [Note 1]					
DC Current Gain (V_{CE} = 5.0 V, I_C = 30 mA)	h_{FE}	50	–	300	–
DYNAMIC CHARACTERISTICS					
Collector–Base Capacitance	C_{cb}				pF
(V_{CB} = 1.0 V, I_E = 0, f = 1.0 MHz)		–	1.3	–	
(V_{CB} = 5.0 V, I_E = 0, f = 1.0 MHz)		–	0.84	–	
Current Gain – Bandwidth Product (V_{CE} = 6.0 V, I_C = 40 mA, f = 1.0 GHz)	f_τ	–	8.0	–	GHz
PERFORMANCE CHARACTERISTICS					
Insertion Gain	$\|S_{21}\|^2$				dB
(V_{CE} = 3.0 V, I_C = 3.0 mA, f = 1.0 GHz)		–	7.0	–	
(V_{CE} = 6.0 V, I_C = 15 mA, f = 1.0 GHz)		–	12	–	
Maximum Unilateral Gain [Note 2]	G_{Umax}				dB
(V_{CE} = 3.0 V, I_C = 3.0 mA, f = 1.0 GHz)		–	10	–	
(V_{CE} = 6.0 V, I_C = 15 mA, f = 1.0 GHz)		–	13	–	
Maximum Stable Gain and/or Maximum Available Gain [Note 3]					dB
(V_{CE} = 3.0 V, I_C = 3.0 mA, f = 1.0 GHz)	MSG	–	12	–	
(V_{CE} = 6.0 V, I_C = 15 mA, f = 1.0 GHz)	MAG	–	14	–	
Noise Figure – Minimum	NF_{min}				dB
(V_{CE} = 3.0 V, I_C = 3.0 mA, f = 1.0 GHz)		–	1.5	–	
(V_{CE} = 6.0 V, I_C = 5.0 mA, f = 1.0 GHz)		–	1.4	–	
Noise Resistance	R_N				Ω
(V_{CE} = 3.0 V, I_C = 3.0 mA, f = 1.0 GHz)		–	8.0	–	
(V_{CE} = 6.0 V, I_C = 5.0 mA, f = 1.0 GHz)		–	8.0	–	
Associated Gain at Minimum NF	G_{NF}				dB
(V_{CE} = 3.0 V, I_C = 3.0 mA, f = 1.0 GHz)		–	9.0	–	
(V_{CE} = 6.0 V, I_C = 5.0 mA, f = 1.0 GHz)		–	11	–	
Output Power at 1.0 dB Gain Compression [Note 4] (V_{CE} = 6.0 V, I_C = 15 mA, f = 1.0 GHz)	P_{1dB}	–	11	–	dBm
Output Third Order Intercept [Note 4] (V_{CE} = 6.0 V, I_C = 15 mA, f = 1.0 GHz)	OIP_3	–	31	–	dBm

NOTES: 1. Pulse width ≤300 μs, duty cycle ≤2% pulsed.

2. Maximum unilateral gain is:

$$G_{Umax} = \frac{|S_{21}|^2}{(1-|S_{11}|^2)(1-|S_{22}|^2)}$$

3. Maximum Available Gain and Maximum Stable Gain are defined by the K factor as follows:

$$MAG = \left|\frac{S_{21}}{S_{12}}\left(K \pm \sqrt{K^2-1}\right)\right|, \text{ if } K > 1, \quad MSG = \left|\frac{S_{21}}{S_{12}}\right|, \text{ if } K < 1$$

4. Z_{in} = 50 Ω and Z_{out} matched for optimum IP_3.

TYPICAL CHARACTERISTICS

Figure 1. Capacitance versus Voltage

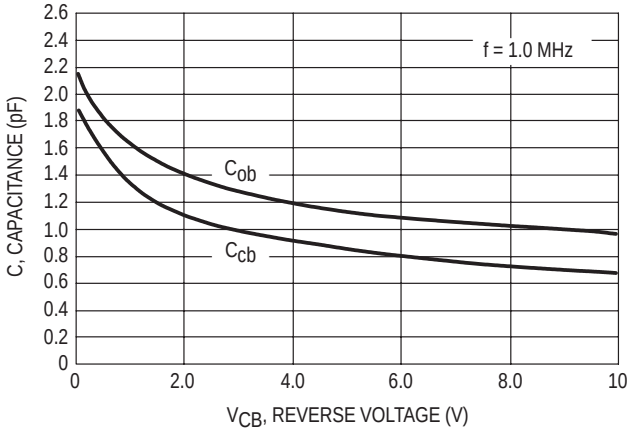


Figure 2. Input Capacitance versus Voltage

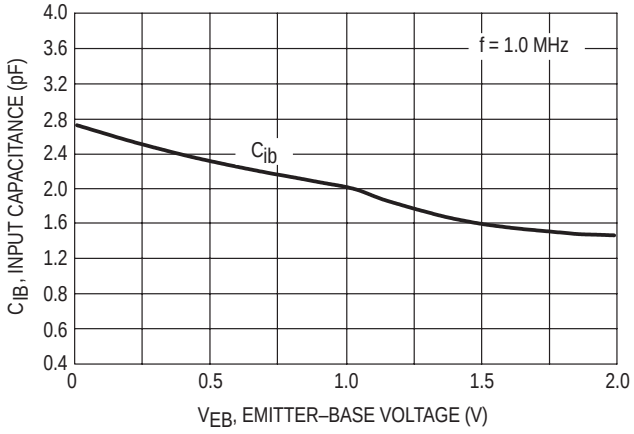


Figure 3. DC Current Gain versus Collector Current

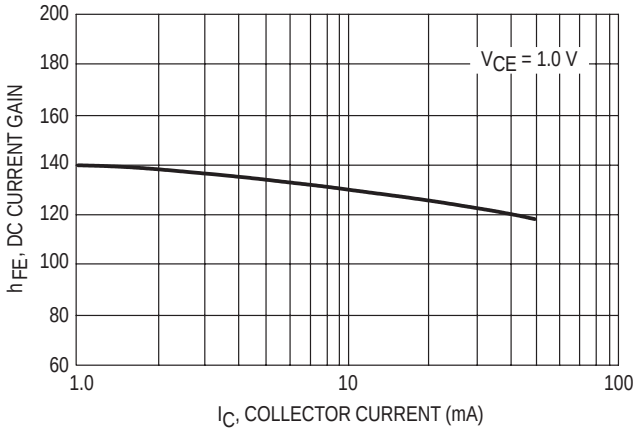


Figure 4. Gain–Bandwidth Product versus Collector Current

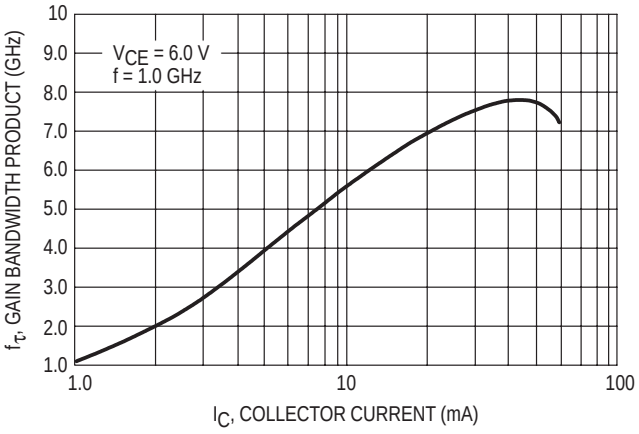
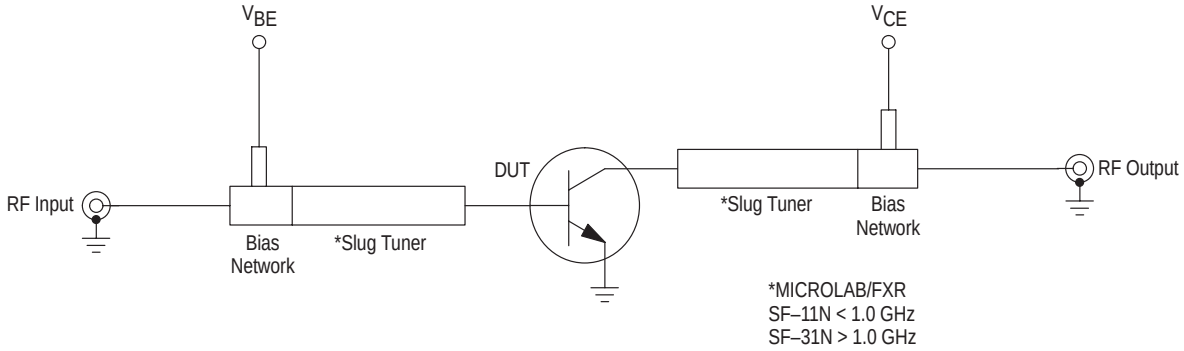


Figure 5. Functional Circuit Schematic



TYPICAL CHARACTERISTICS

Figure 6. Maximum Stable/Available Gain versus Frequency

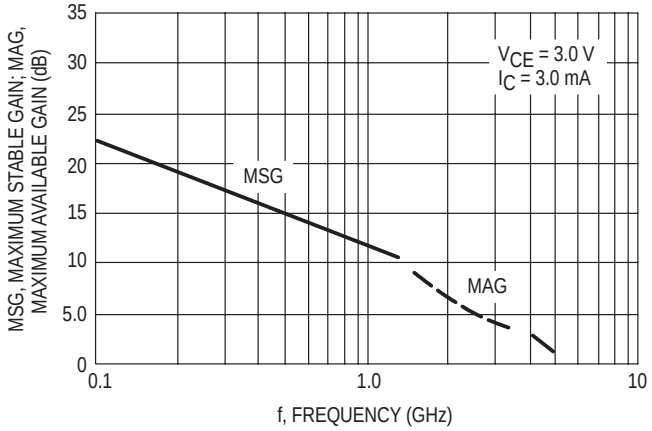


Figure 7. Maximum Stable/Available Gain versus Frequency

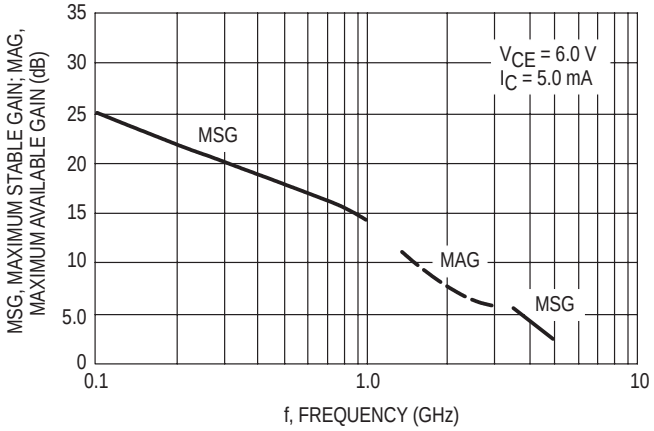


Figure 8. Maximum Unilateral Gain and Forward Insertion Gain versus Frequency

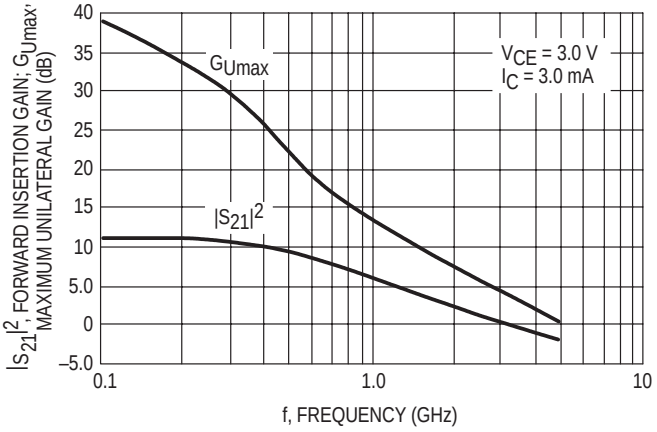


Figure 9. Maximum Unilateral Gain and Forward Insertion Gain versus Frequency

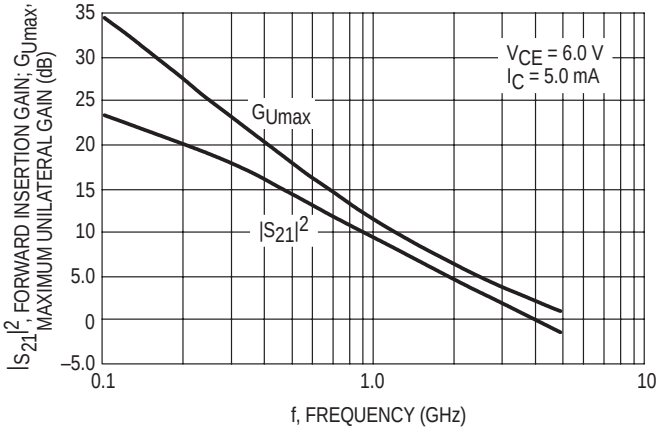


Figure 10. Maximum Unilateral Gain and Forward Insertion Gain versus Collector Current

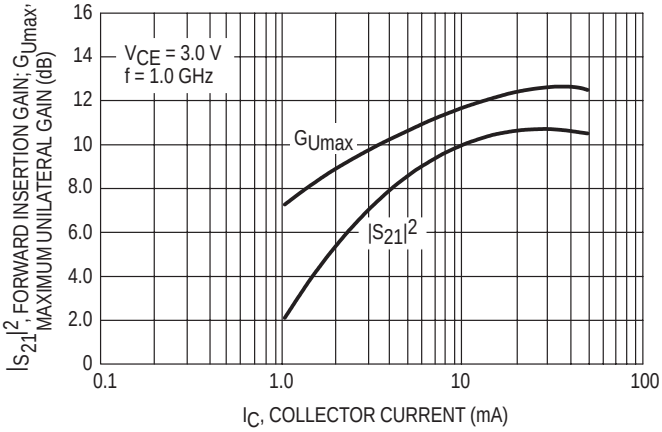
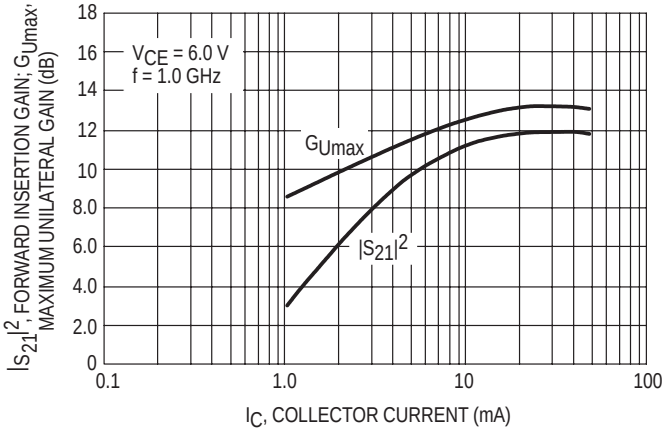


Figure 11. Maximum Unilateral Gain and Forward Insertion Gain versus Collector Current



TYPICAL CHARACTERISTICS

Figure 12. Maximum Stable/Available Gain versus Collector Current

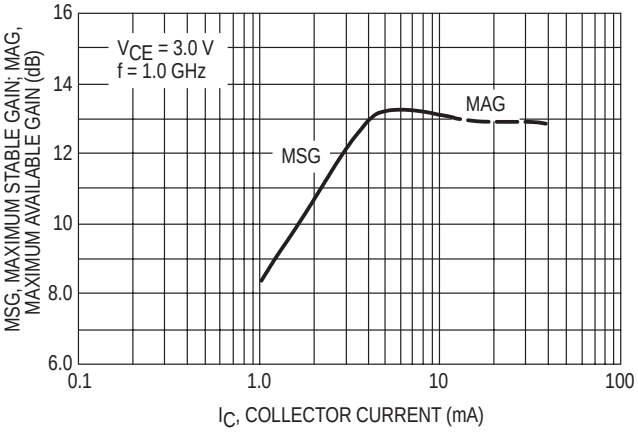


Figure 13. Maximum Stable/Available Gain versus Collector Current

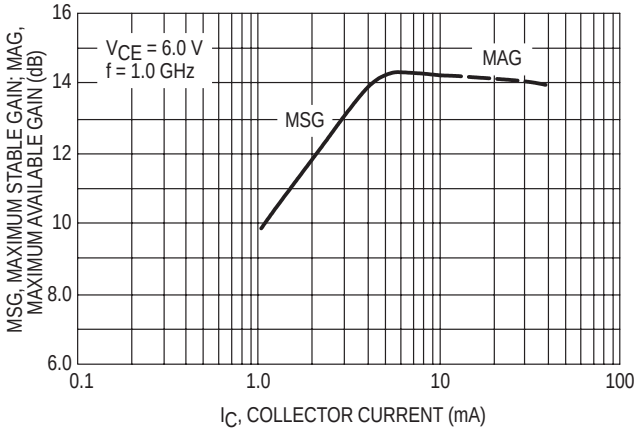


Figure 14. Minimum Noise Figure and Associated Gain versus Frequency

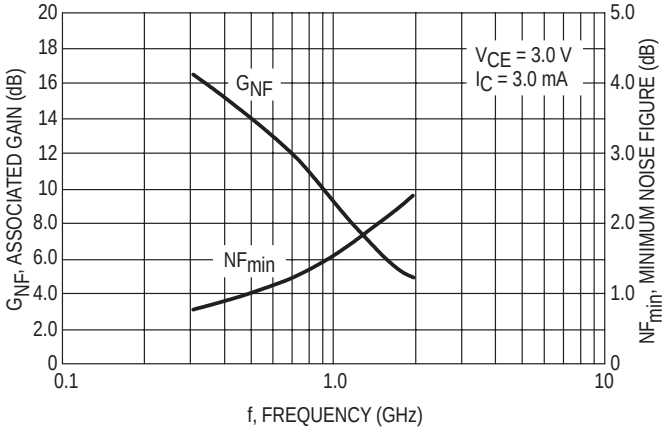


Figure 15. Minimum Noise Figure and Associated Gain versus Frequency

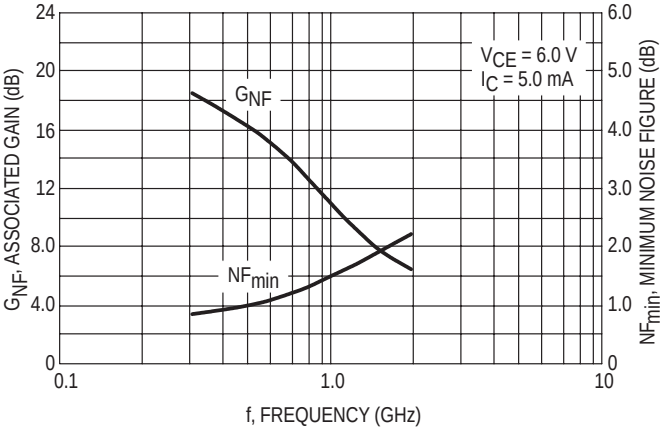


Figure 16. Minimum Noise Figure and Associated Gain versus Collector Current

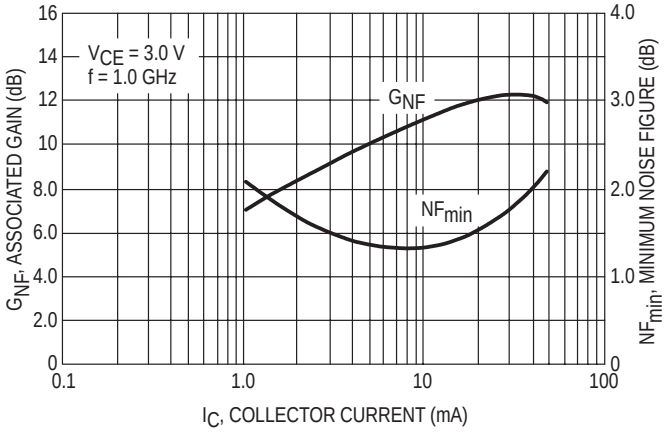
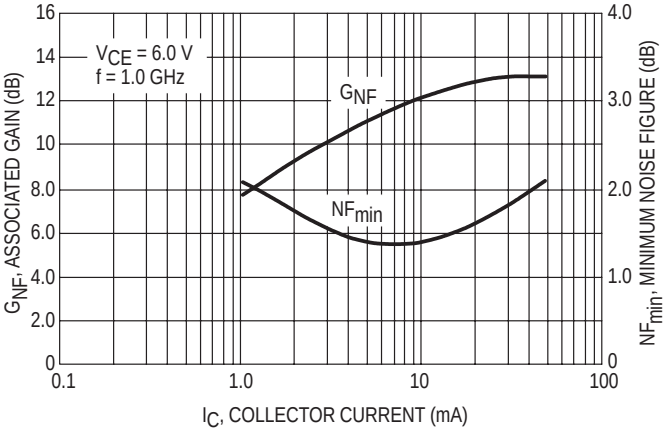


Figure 17. Minimum Noise Figure and Associated Gain versus Collector Current



TYPICAL CHARACTERISTICS

Figure 18. Output Third Order Intercept and Output Power at 1.0 dB Gain Compression versus Collector Current

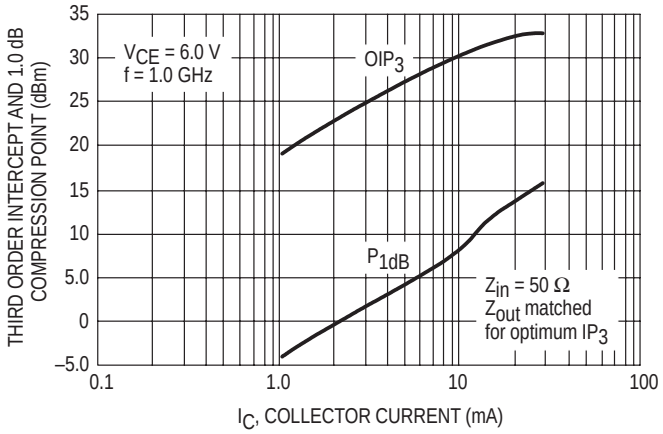


Table 1. Common Emitter S–Parameters

V_{CE} (Vdc)	I_C (mA)	f (GHz)	S_{11}		S_{21}		S_{12}		S_{22}	
			$\|S_{11}\|$	∠ ϕ	$\|S_{21}\|$	∠ ϕ	$\|S_{12}\|$	∠ ϕ	$\|S_{22}\|$	∠ ϕ
1.0	1.0	0.1	0.948	–35	3.45	156	0.095	70	0.948	–17
		0.3	0.847	–88	2.55	119	0.206	40	0.752	–41
		0.5	0.762	–117	1.85	97	0.238	24	0.615	–51
		0.7	0.729	–137	1.45	81	0.244	15	0.544	–60
		0.9	0.714	–152	1.18	69	0.239	9	0.511	–68
		1.0	0.713	–157	1.09	63	0.234	6	0.504	–71
		1.3	0.715	–171	0.89	49	0.212	3	0.494	–82
		1.5	0.722	–178	0.79	42	0.197	2	0.502	–91
		2.0	0.739	166	0.62	29	0.159	12	0.534	–110
		2.5	0.762	152	0.51	21	0.163	33	0.570	–128
		3.0	0.768	141	0.45	20	0.219	46	0.605	–146
		3.5	0.769	130	0.43	22	0.295	48	0.632	–161
		4.0	0.760	120	0.44	23	0.372	44	0.644	–176
		4.5	0.747	111	0.48	22	0.441	37	0.644	170
		5.0	0.735	103	0.51	19	0.497	31	0.646	158
	3.0	0.1	0.859	–56	8.94	145	0.084	60	0.848	–36
		0.3	0.736	–119	5.06	108	0.143	33	0.513	–73
		0.5	0.673	–144	3.32	92	0.156	26	0.368	–87
		0.7	0.661	–160	2.47	81	0.161	24	0.306	–98
		0.9	0.655	–170	1.97	72	0.165	25	0.282	–107
		1.0	0.657	–174	1.79	68	0.167	25	0.276	–110
		1.3	0.660	175	1.43	58	0.174	28	0.271	–121
		1.5	0.665	170	1.27	52	0.181	30	0.281	–127
		2.0	0.677	158	1.01	39	0.204	36	0.312	–140
		2.5	0.695	146	0.85	29	0.238	40	0.355	–151
		3.0	0.702	137	0.75	22	0.285	42	0.397	–162
		3.5	0.708	128	0.68	17	0.336	40	0.437	–173
		4.0	0.709	120	0.63	13	0.391	37	0.469	176
		4.5	0.709	111	0.61	10	0.443	33	0.494	165
		5.0	0.707	104	0.6	8	0.491	27	0.519	155
	5.0	0.1	0.790	–74	12.72	137	0.074	54	0.762	–51
		0.3	0.696	–135	6.18	103	0.111	33	0.427	–97
		0.5	0.651	–156	3.92	89	0.124	32	0.311	–114
		0.7	0.646	–169	2.88	80	0.134	34	0.274	–128
		0.9	0.645	–178	2.28	72	0.146	36	0.261	–137
		1.0	0.647	179	2.07	69	0.152	37	0.258	–141
		1.3	0.650	170	1.65	60	0.172	40	0.260	–150
		1.5	0.654	165	1.46	54	0.186	41	0.268	–154
		2.0	0.663	154	1.16	42	0.226	43	0.292	–163
		2.5	0.677	143	0.98	33	0.269	43	0.322	–170
		3.0	0.679	135	0.87	25	0.314	41	0.354	–178
		3.5	0.684	126	0.79	18	0.361	38	0.385	174
		4.0	0.687	119	0.74	13	0.408	35	0.413	166
		4.5	0.688	111	0.70	9	0.452	30	0.436	158
		5.0	0.689	104	0.67	5	0.493	25	0.462	149
3.0	3.0	0.1	0.884	–44	9.32	152	0.058	67	0.901	–24
		0.3	0.751	–103	6.00	116	0.112	40	0.612	–50
		0.5	0.668	–131	4.06	99	0.126	32	0.457	–58
		0.7	0.643	–149	3.05	87	0.133	30	0.379	–64
		0.9	0.633	–162	2.44	78	0.137	29	0.340	–69
		1.0	0.632	–167	2.22	74	0.139	30	0.329	–71
		1.3	0.633	–179	1.77	63	0.145	33	0.306	–78
		1.5	0.637	175	1.56	58	0.152	36	0.305	–84

Table 1. Common Emitter S–Parameters (continued)

V_{CE} (Vdc)	I_C (mA)	f (GHz)	S_{11}		S_{21}		S_{12}		S_{22}	
			$\|S_{11}\|$	∠ ϕ	$\|S_{21}\|$	∠ ϕ	$\|S_{12}\|$	∠ ϕ	$\|S_{22}\|$	∠ ϕ
3.0	3.0	2.0	0.649	161	1.22	44	0.173	43	0.313	–99
		2.5	0.667	149	1.01	33	0.207	48	0.337	–114
		3.0	0.676	140	0.88	25	0.253	50	0.367	–128
		3.5	0.686	130	0.78	19	0.306	49	0.400	–142
		4.0	0.691	122	0.71	14	0.364	46	0.428	–155
		4.5	0.692	113	0.67	11	0.422	41	0.451	–168
		5.0	0.694	105	0.64	8	0.477	36	0.474	179
	5.0	0.1	0.813	–58	13.99	145	0.053	62	0.831	–34
		0.3	0.681	–120	7.72	109	0.090	40	0.483	–66
		0.5	0.615	–144	5.01	95	0.103	37	0.335	–75
		0.7	0.602	–160	3.70	85	0.113	38	0.267	–83
		0.9	0.597	–170	2.93	77	0.123	40	0.234	–89
		1.0	0.598	–175	2.66	74	0.129	42	0.225	–91
		1.3	0.602	175	2.10	64	0.146	45	0.207	–100
		1.5	0.606	170	1.85	59	0.159	46	0.207	–106
		2.0	0.617	158	1.45	47	0.196	49	0.217	–119
		2.5	0.636	147	1.20	36	0.236	49	0.242	–131
		3.0	0.641	138	1.05	28	0.280	48	0.271	–143
		3.5	0.652	129	0.94	21	0.327	46	0.302	–154
		4.0	0.658	122	0.85	14	0.376	42	0.332	–165
		4.5	0.666	114	0.79	9	0.425	38	0.359	–175
		5.0	0.671	106	0.75	5	0.472	33	0.387	174
	10.0	0.1	0.696	–82	21.04	133	0.043	55	0.699	–52
		0.3	0.613	–141	9.54	102	0.066	44	0.353	–93
		0.5	0.572	–160	5.98	90	0.082	48	0.240	–106
		0.7	0.569	–172	4.35	82	0.099	51	0.199	–120
		0.9	0.569	–180	3.42	76	0.116	54	0.183	–129
		1.0	0.571	177	3.10	73	0.126	54	0.178	–132
		1.3	0.575	169	2.44	65	0.153	55	0.174	–143
		1.5	0.581	164	2.14	60	0.172	55	0.177	–148
		2.0	0.592	154	1.67	49	0.219	53	0.189	–158
		2.5	0.607	143	1.39	39	0.264	51	0.209	–165
		3.0	0.612	135	1.22	31	0.309	47	0.230	–172
		3.5	0.620	128	1.09	23	0.352	43	0.252	–178
		4.0	0.626	121	1.00	17	0.394	39	0.273	175
		4.5	0.634	113	0.93	11	0.435	35	0.294	167
		5.0	0.643	106	0.87	5	0.474	30	0.318	160
6.0	5.0	0.1	0.839	–49	14.26	149	0.043	66	0.866	–26
		0.3	0.682	–110	8.46	114	0.078	43	0.546	–51
		0.5	0.597	–136	5.57	98	0.090	40	0.401	–55
		0.7	0.576	–153	4.14	87	0.099	41	0.330	–58
		0.9	0.567	–164	3.28	80	0.109	43	0.294	–61
		1.0	0.567	–169	2.98	76	0.113	44	0.283	–62
		1.3	0.569	–180	2.36	67	0.129	47	0.259	–67
		1.5	0.574	174	2.07	61	0.141	49	0.255	–72
		2.0	0.586	162	1.61	49	0.174	52	0.251	–84
		2.5	0.605	150	1.33	38	0.210	53	0.263	–97
		3.0	0.616	141	1.15	29	0.252	53	0.281	–111
		3.5	0.629	133	1.01	21	0.297	51	0.305	–124
		4.0	0.642	125	0.91	15	0.346	48	0.329	–137
		4.5	0.653	117	0.83	9	0.397	44	0.352	–149
		5.0	0.663	109	0.77	5	0.449	40	0.376	–163

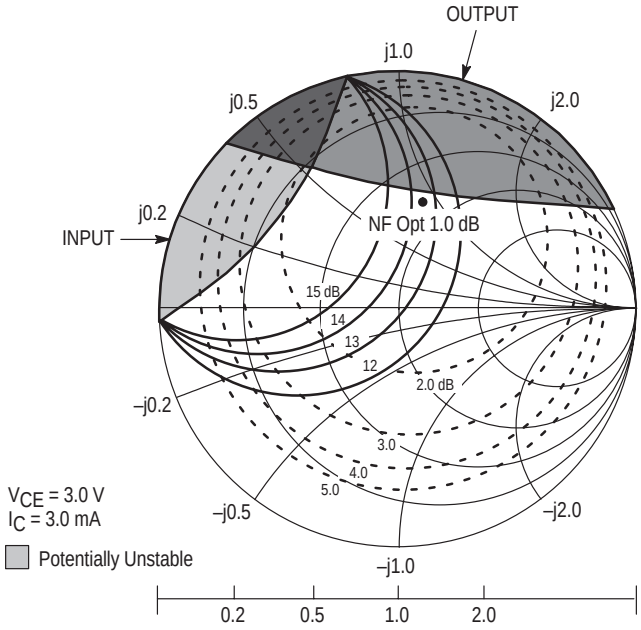
Table 1. Common Emitter S–Parameters (continued)

V_{CE} (Vdc)	I_C (mA)	f (GHz)	S_{11}		S_{21}		S_{12}		S_{22}	
			$\|S_{11}\|$	∠ ϕ	$\|S_{21}\|$	∠ ϕ	$\|S_{12}\|$	∠ ϕ	$\|S_{22}\|$	∠ ϕ
6.0	15.0	0.1	0.654	–83	26.76	131	0.032	57	0.660	–49
		0.3	0.551	–141	11.75	101	0.051	51	0.311	–81
		0.5	0.507	–160	7.32	90	0.068	56	0.202	–86
		0.7	0.504	–171	5.31	83	0.086	59	0.158	–95
		0.9	0.505	–179	4.17	77	0.104	61	0.136	–102
		1.0	0.507	178	3.78	74	0.114	61	0.129	–104
		1.3	0.512	170	2.96	67	0.141	61	0.118	–114
		1.5	0.520	166	2.59	62	0.160	60	0.116	–120
		2.0	0.533	156	2.01	52	0.206	58	0.121	–133
		2.5	0.551	146	1.66	42	0.249	54	0.137	–143
		3.0	0.559	138	1.44	33	0.291	51	0.154	–151
		3.5	0.573	131	1.28	26	0.332	47	0.172	–159
		4.0	0.584	124	1.17	18	0.371	43	0.191	–167
		4.5	0.595	117	1.07	12	0.410	38	0.210	–175
		5.0	0.609	110	1.00	6	0.449	34	0.233	177
	30.0	0.1	0.559	–107	32.48	121	0.025	55	0.512	–65
		0.3	0.517	–155	12.68	96	0.044	60	0.231	–100
		0.5	0.485	–169	7.80	87	0.064	65	0.149	–109
		0.7	0.489	–178	5.63	81	0.085	67	0.124	–121
		0.9	0.492	176	4.41	76	0.106	67	0.114	–131
		1.0	0.495	173	3.98	73	0.116	66	0.111	–134
		1.3	0.500	167	3.12	66	0.147	65	0.110	–145
		1.5	0.507	163	2.72	62	0.167	63	0.112	–150
		2.0	0.521	153	2.11	52	0.215	59	0.123	–161
		2.5	0.540	144	1.74	43	0.260	55	0.137	–167
		3.0	0.548	137	1.51	35	0.303	50	0.153	–173
		3.5	0.559	130	1.34	27	0.343	46	0.168	–178
		4.0	0.570	123	1.22	20	0.382	41	0.182	176
		4.5	0.582	117	1.13	13	0.418	37	0.197	170
		5.0	0.596	110	1.05	7	0.454	32	0.218	163

Table 2. Common Emitter Noise Parameters

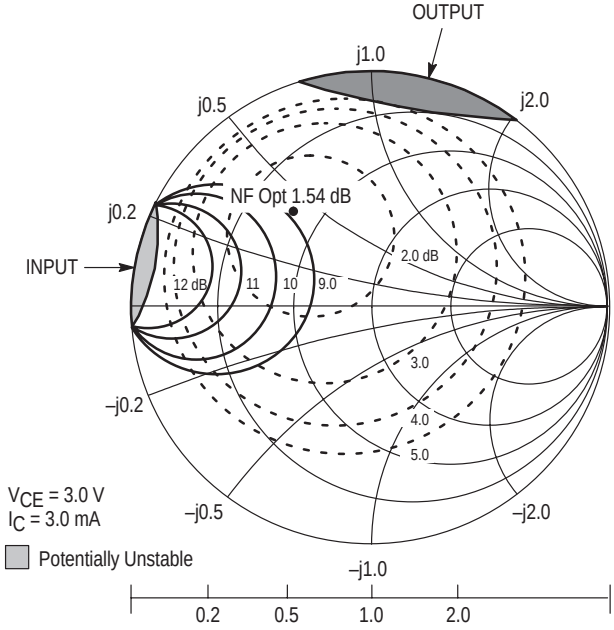
V_{CE} (Vdc)	I_C (mA)	f (GHz)	NF_{min} (dB)	Γ_o		R_N (Ω)	r_n	G_{NF} (dB)
				Magnitude	Angle			
1.0	1.0	0.3	0.94	0.65	63	16	0.31	12.1
		0.5	1.27	0.64	88	17	0.34	9.7
		0.7	1.59	0.64	110	16	0.31	7.5
		0.9	1.88	0.64	129	13	0.25	5.7
		1.0	2.02	0.64	138	11	0.21	4.9
		1.5	2.63	0.67	173	4.0	0.08	2.1
		2.0	3.10	0.74	–168	5.0	0.10	1.3
3.0	3.0	0.3	0.76	0.48	53	9.0	0.18	16.6
		0.5	1.00	0.47	78	10	0.20	13.8
		0.7	1.22	0.46	101	10	0.20	11.9
		0.9	1.44	0.47	121	9.0	0.17	10.0
		1.0	1.54	0.47	131	8.0	0.16	9.0
		1.5	2.01	0.53	168	5.0	0.10	6.0
		2.0	2.41	0.63	–170	5.0	0.09	4.8
6.0	5.0	0.3	0.81	0.41	48	9.0	0.17	18.7
		0.5	1.00	0.40	73	10	0.19	15.8
		0.7	1.18	0.39	96	9.0	0.18	13.8
		0.9	1.36	0.40	116	9.0	0.17	11.8
		1.0	1.45	0.41	125	8.0	0.16	10.9
		1.5	1.87	0.47	163	6.0	0.11	7.7
		2.0	2.26	0.58	–174	5.0	0.09	6.3

Figure 19. Constant Gain and Noise Figure Contours (f = 0.5 GHz)



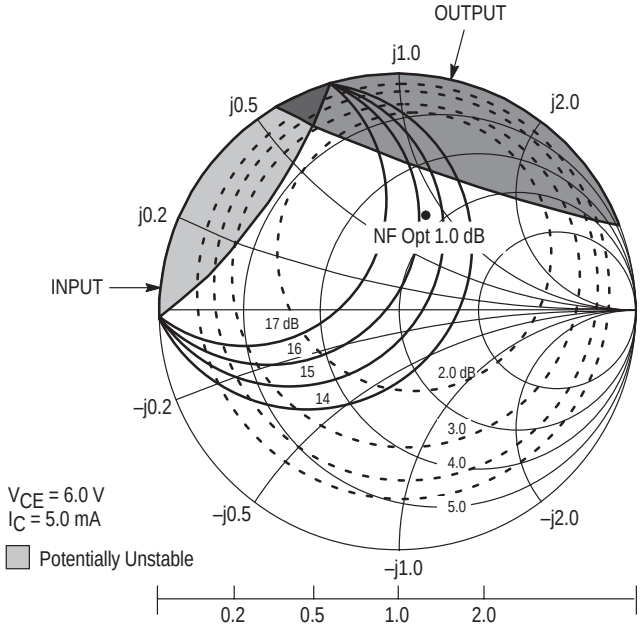
f (GHz)	NF Opt (dB)	Γ_o	Rn	K
0.5	1.0	0.47 ∠ 78°	10	0.45

Figure 20. Constant Gain and Noise Figure Contours (f = 1.0 GHz)



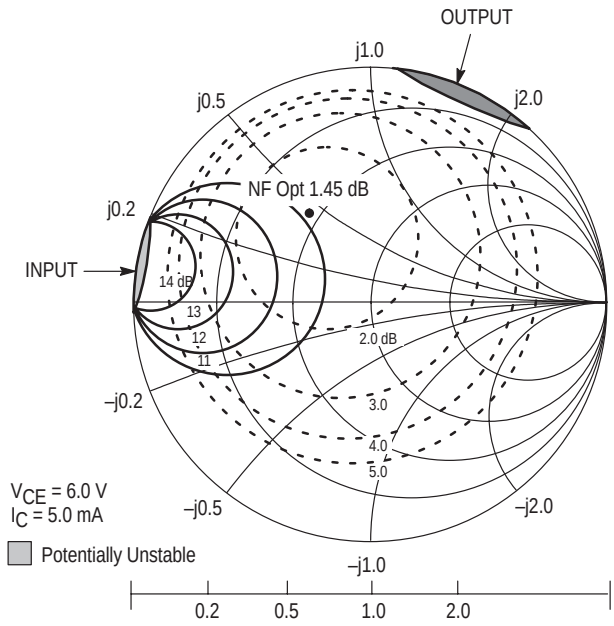
f (GHz)	NF Opt (dB)	Γ_o	Rn	K
1.0	1.54	0.47 ∠ 131°	8.0	0.82

Figure 21. Constant Gain and Noise Figure Contours (f = 0.5 GHz)



f (GHz)	NF Opt (dB)	Γ_o	Rn	K
0.5	1.0	0.4 ∠ 73°	9.5	0.59

Figure 22. Constant Gain and Noise Figure Contours (f = 1.0 GHz)



f (GHz)	NF Opt (dB)	Γ_o	Rn	K
1.0	1.45	0.41 ∠ 125°	8.0	0.94

OUTLINE DIMENSIONS

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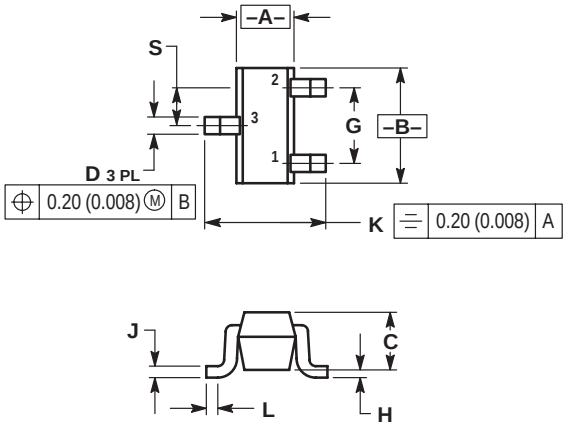

NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	0.70	0.80	0.028	0.031
B	1.40	1.80	0.055	0.071
C	0.60	0.90	0.024	0.035
D	0.15	0.30	0.006	0.012
G	1.00 BSC		0.039 BSC	
H	—	0.10	—	0.004
J	0.10	0.25	0.004	0.010
K	1.45	1.75	0.057	0.069
L	0.10	0.20	0.004	0.008
S	0.50 BSC		0.020 BSC	

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