

PNP EPITAXIAL SILICON TRANSISTOR MICROWAVE AMPLIFIER

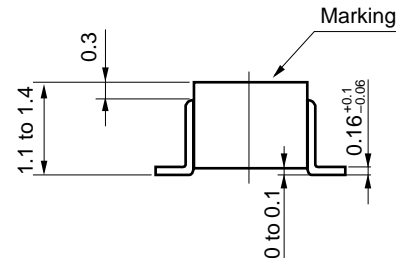
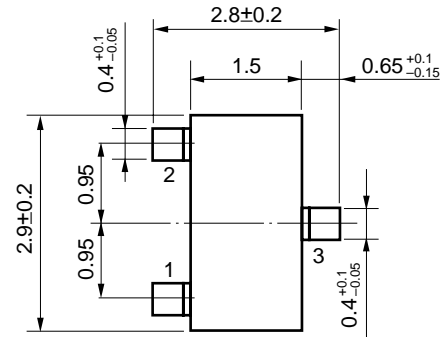
FEATURES

- High f_T
 $f_T = 8.5$ GHz TYP.
- High gain
 $|S_{21e}|^2 = 12.0$ dB TYP. @ $f = 1.0$ GHz, $V_{CE} = -8$ V, $I_C = -20$ mA
- High-speed switching characteristics
- Equivalent NPN transistor is the NE68133 / 2SC3583.

ABSOLUTE MAXIMUM RATINGS ($T_A = 25^\circ\text{C}$)

Parameter	Symbol	Rating	Unit
Collector to Base Voltage	V_{CB0}	-20	V
Collector to Emitter Voltage	V_{CE0}	-12	V
Emitter to Base Voltage	V_{EB0}	-3.0	V
Collector Current	I_C	-50	mA
Total Power Dissipation	P_T	200	mW
Junction Temperature	T_j	150	$^\circ\text{C}$
Storage Temperature	T_{stg}	-65 to +150	$^\circ\text{C}$

PACKAGE DIMENSION (in millimeters)



PIN CONNECTIONS

- 1: Emitter
2: Base
3: Collector Marking: T92

ELECTRICAL CHARACTERISTICS ($T_A = 25^\circ\text{C}$)

Parameter	Symbol	Test Conditions	MIN.	TYP.	MAX.	Unit
Collector Cutoff Current	I_{CB0}	$V_{CB} = -10$ V			-0.1	μA
Emitter Cutoff Current	I_{EB0}	$V_{EB} = -1$ V			-0.1	μA
DC Current Gain	h_{FE}	$V_{CE} = -8$ V, $I_C = -20$ mA	20		100	
Gain Bandwidth Product	f_T	$V_{CE} = -8$ V, $I_C = -20$ mA, $f = 1$ GHz	6.0	8.5		GHz
Collector Capacitance	C_{re}^*	$V_{CB} = -10$ V, $I_E = 0$, $f = 1$ MHz		0.5	1	pF
Insertion Power Gain	$ S_{21e} ^2$	$V_{CE} = -8$ V, $I_C = -20$ mA, $f = 1.0$ GHz	8.0	12.0		dB
Noise Figure	NF	$V_{CE} = -8$ V, $I_C = -3$ mA, $f = 1$ GHz		1.5	3	dB

* Measured by a 3-terminal bridge. Emitter and Case should be connected to the guard terminal.

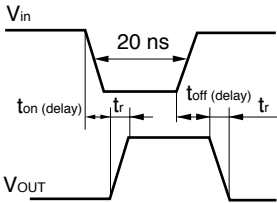
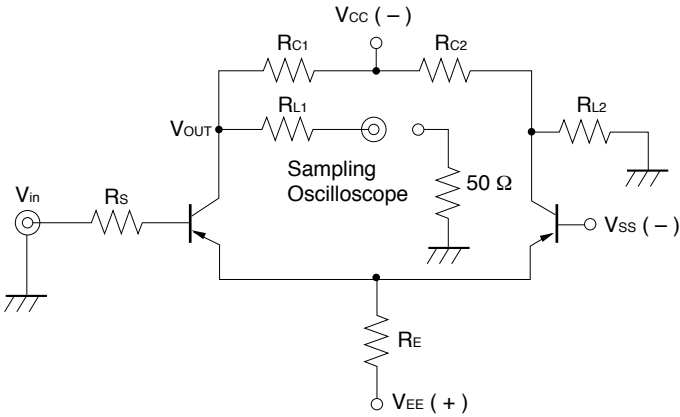
h_{FE} Classification

Rank	FB
Marking	T92
h_{FE}	20 to 100

SWITCHING CHARACTERISTICS

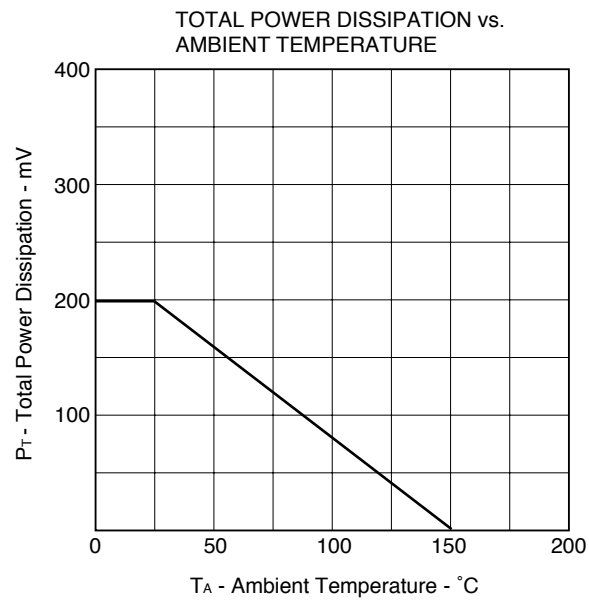
Parameter	Symbol	$V_{in} = 1\text{ V}$	Unit
		TYP.	
Turn-on Delay Time	$t_{on} \text{ (delay)}$	1.08	ns
Rise Time	t_r	0.66	ns
Turn off Delay Time	$t_{off} \text{ (delay)}$	0.32	ns
Fall Time	t_f	0.78	ns

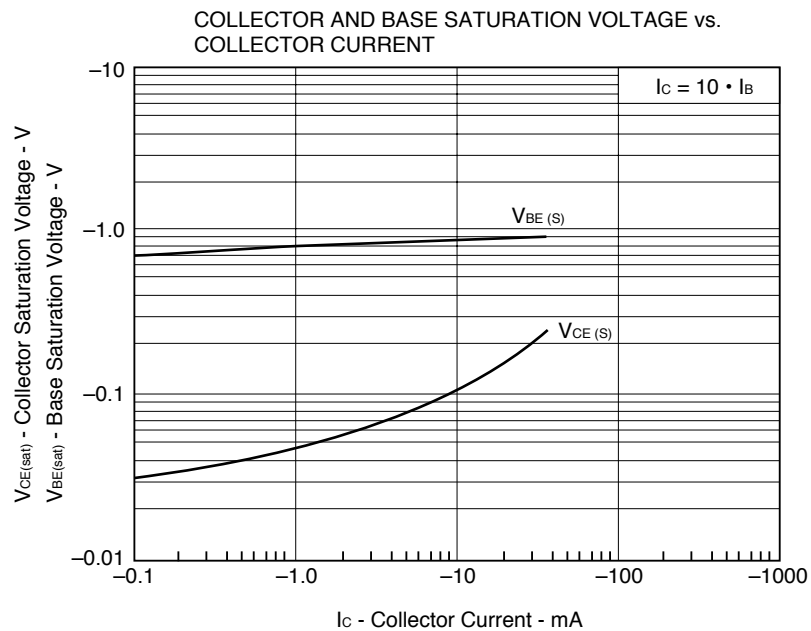
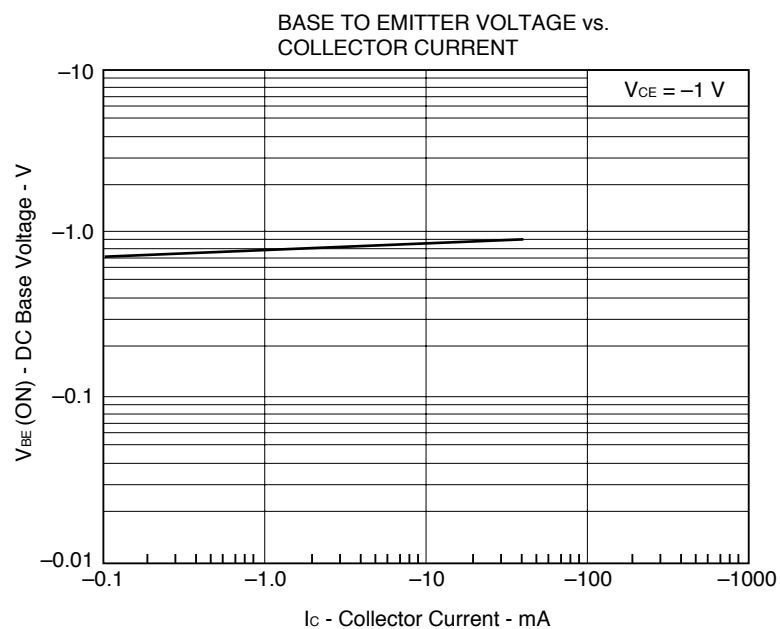
SWITCHING TIME MEASUREMENT CIRCUIT

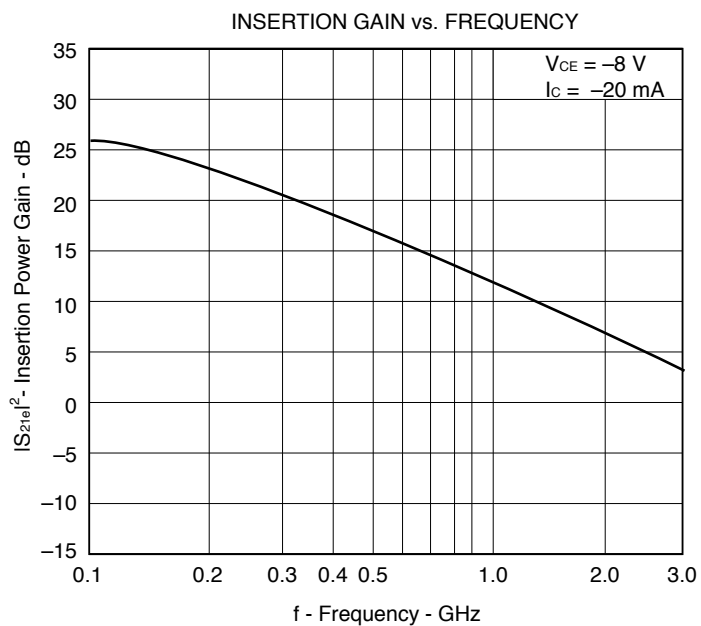
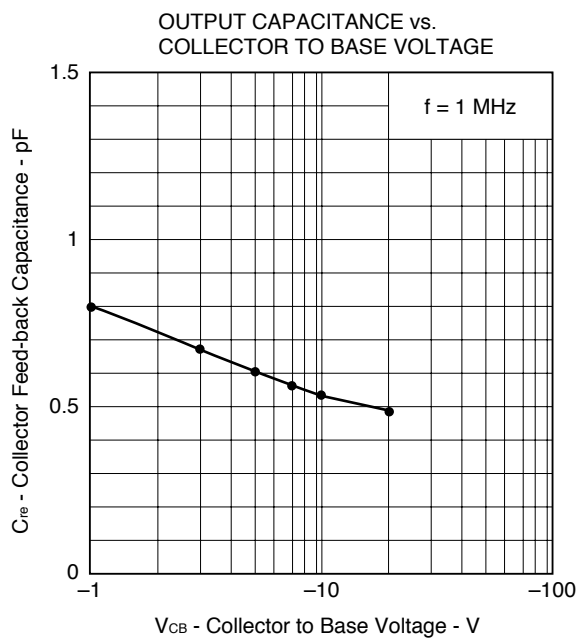
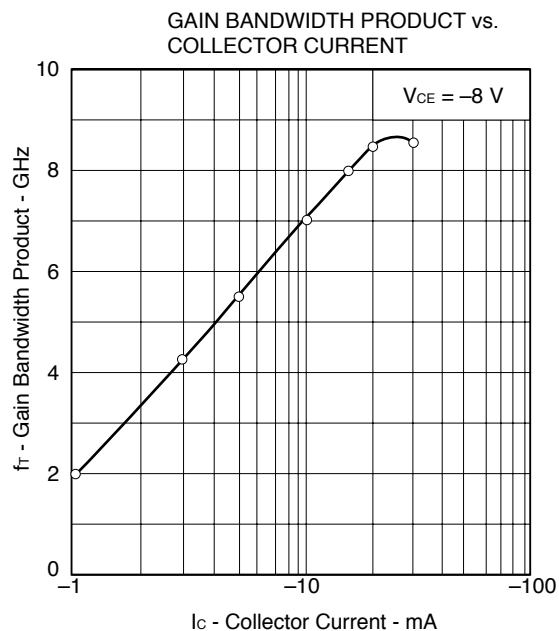
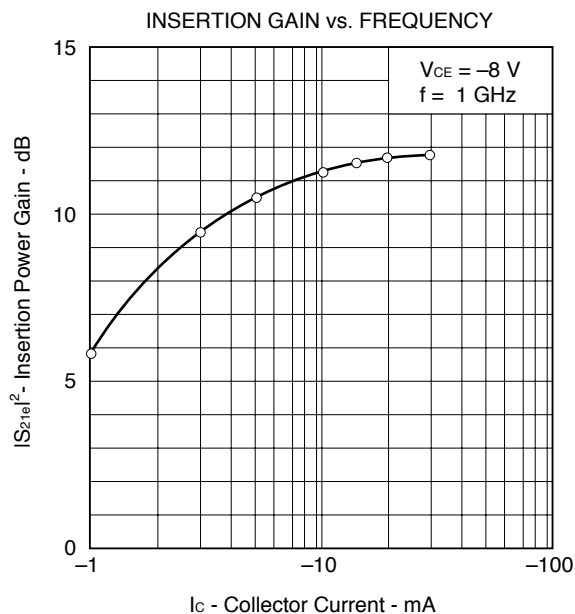


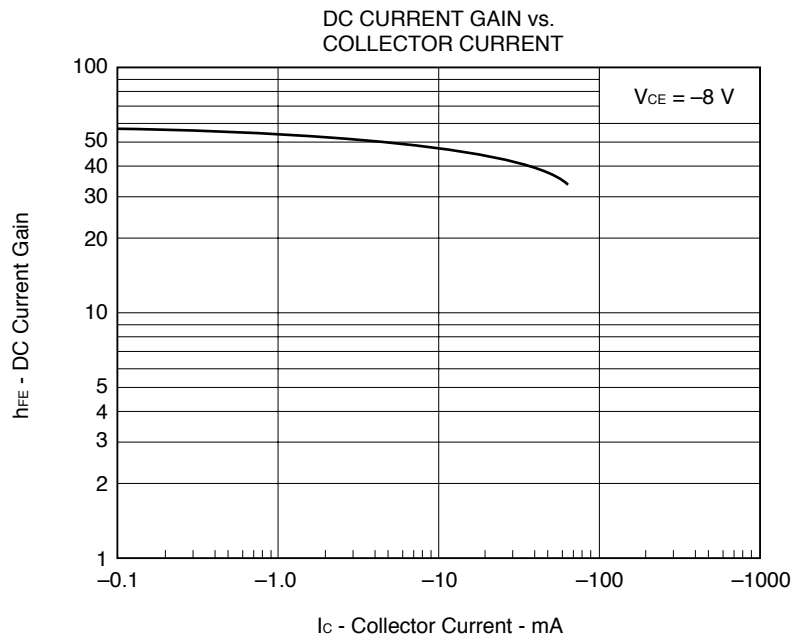
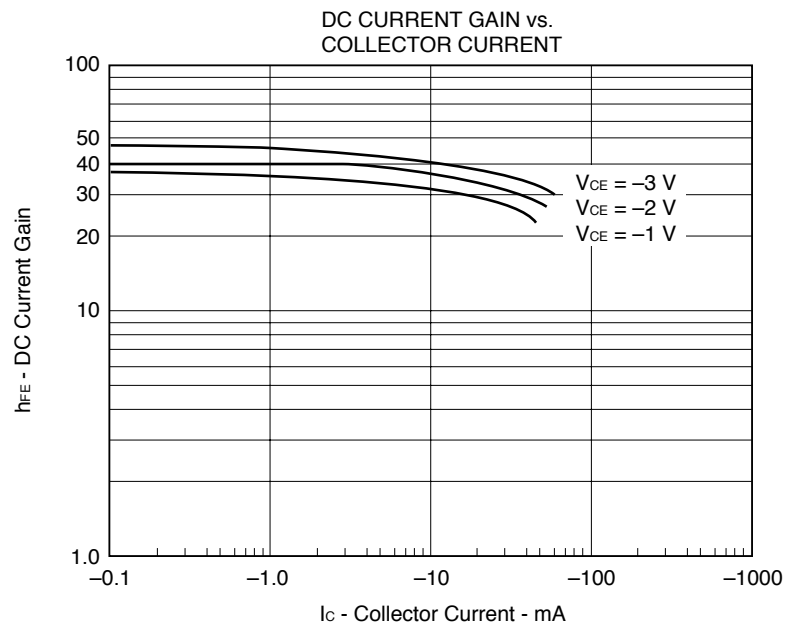
$V_{in} = 1\text{ V}, V_{BB} = -0.5\text{ V}, R_{C1} = R_{C2}$						
R_S (Ω)	R_C (Ω)	R_{L1} (Ω)	R_{L2} (Ω)	R_E (Ω)	V_{EE} (V)	V_{CC} (V)
160	1 k	200	250	2.7 k	27	26.3

TYPICAL CHARACTERISTICS

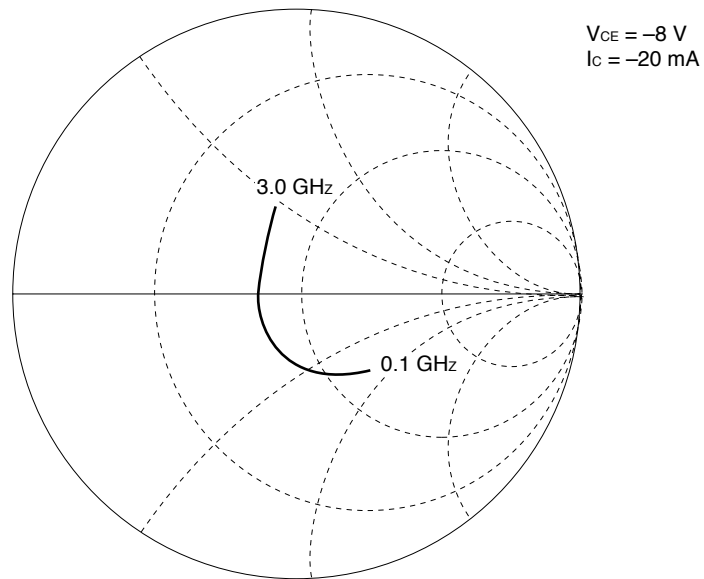




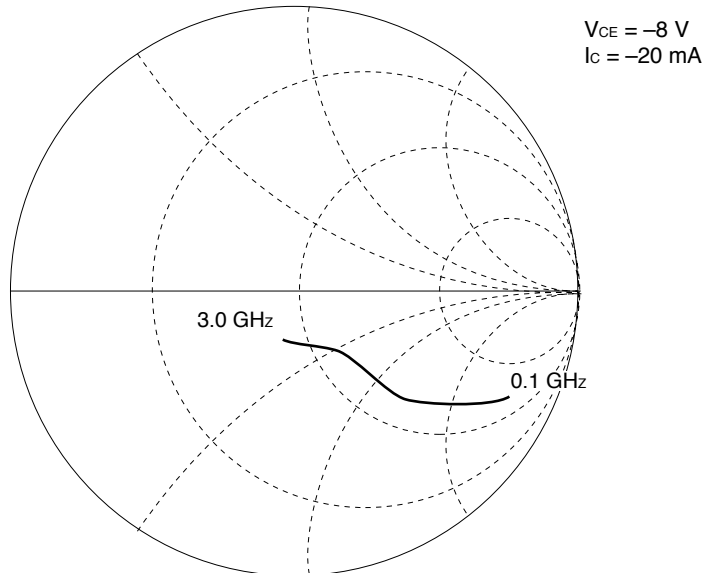




S_{11}



S_{22}



S-PARAMETER(V_{CE} = 1 V, I_C = 5 mA, Z_o = 50 Ω)

f MHz	S ₁₁		S ₂₁		S ₁₂		S ₂₂	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100	0.553	- 43.7	11.03	150.	0.423	71.2	0.666	- 25.0
200	0.460	- 78.2	8.780	129.	0.691	59.4	0.696	- 42.2
300	0.427	- 104	7.003	115.	0.857	54.4	0.556	- 52.9
400	0.393	- 123	5.700	105.	0.983	52.7	0.461	- 59.5
500	0.377	- 138	4.74	97.6	0.109	52.2	0.392	- 64.2
600	0.367	- 149	4.053	91.2	0.120	52.5	0.341	- 67.4
700	0.362	- 159	3.549	85.9	0.131	52.9	0.307	- 70.5
800	0.363	- 168	3.151	61.3	0.143	53.1	0.280	- 73.7
900	0.364	- 175	2.847	77.0	0.154	53.8	0.258	- 76.1
1000	0.365	178	2.603	73.0	0.165	54.0	0.241	- 78.8
1100	0.369	172	2.391	69.3	0.176	54.4	0.227	- 82.0
1200	0.375	166	2.219	66.8	0.188	54.2	0.217	- 84.8
1300	0.376	162	2.070	62.7	0.200	54.4	0.207	- 88.4
1400	0.384	157	1.940	59.4	0.213	54.1	0.200	- 92.0
1500	0.391	153	1.838	56.3	0.225	53.8	0.192	- 94.9
1600	0.399	149	1.744	53.5	0.238	53.4	0.188	- 99.1
1700	0.405	146	1.659	50.8	0.250	52.9	0.184	- 102
1800	0.411	142	1.584	48.2	0.264	52.3	0.184	- 107
1900	0.418	139	1.520	45.6	0.277	51.7	0.182	- 111
2000	0.423	135	1.461	43.1	0.290	51.1	0.181	- 115
2100	0.429	132	1.408	40.9	0.302	50.2	0.180	- 119
2200	0.438	130	1.361	38.6	0.314	49.4	0.182	- 125
2300	0.444	127	1.316	36.4	0.328	48.5	0.181	- 128
2400	0.450	124	1.276	34.2	0.341	47.6	0.187	- 132
2500	0.457	122	1.239	32.3	0.353	46.5	0.188	- 137

S-PARAMETER(V_{CE} = 3 V, I_C = 5 mA, Z_o = 50 Ω)

f MHz	S ₁₁		S ₂₁		S ₁₂		S ₂₂	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100	0.595	– 34.2	11.62	154.	0.0328	74.9	0.902	– 19.4
200	0.511	– 62.8	9.618	134.	0.0573	64.8	0.760	– 33.2
300	0.432	– 86.0	7.920	120.	0.0734	58.5	0.633	– 41.9
400	0.362	– 104	6.575	110.	0.0852	57.1	0.542	– 47.3
500	0.345	– 119	5.511	102.	0.0964	55.9	0.471	– 50.3
600	0.323	– 132	4.749	95.9	0.106	56.4	0.420	– 52.2
700	0.308	– 143	4.177	90.5	0.116	56.6	0.383	– 54.1
800	0.300	– 153	3.712	85.8	0.126	57.1	0.355	– 55.7
900	0.297	– 162	3.359	81.5	0.137	57.3	0.332	– 57.2
1000	0.295	– 170	3.064	77.6	0.147	57.9	0.315	– 58.9
1100	0.297	– 177	2.818	74.0	0.158	57.9	0.299	– 60.6
1200	0.300	176	2.617	70.6	0.169	58.3	0.287	– 62.1
1300	0.303	170	2.439	67.4	0.181	58.1	0.276	– 64.6
1400	0.308	164	2.284	64.2	0.192	58.1	0.266	– 66.5
1500	0.314	160	2.159	61.2	0.203	57.8	0.258	– 68.5
1600	0.322	155	2.046	58.4	0.215	57.5	0.250	– 71.4
1700	0.328	151	1.944	55.7	0.227	57.3	0.243	– 73.6
1800	0.335	147	1.855	53.0	0.240	56.5	0.241	– 76.9
1900	0.341	143	1.774	50.5	0.252	56.1	0.233	– 80.3
2000	0.349	140	1.705	48.1	0.264	55.5	0.230	– 83.1
2100	0.355	136	1.638	45.7	0.276	54.7	0.226	– 86.5
2200	0.364	133	1.583	43.5	0.289	54.2	0.222	– 90.7
2300	0.372	130	1.53	41.2	0.302	53.2	0.218	– 93.6
2400	0.378	128	1.479	39.0	0.314	52.5	0.218	– 97.5
2500	0.386	125	1.439	37.0	0.326	51.7	0.215	– 101.

S-PARAMETER(V_{CE} = 8 V, I_C = 5 mA, Z_o = 50 Ω)

f MHz	S ₁₁		S ₂₁		S ₁₂		S ₂₂	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100	0.679	– 27.6	11.75	156.	0.0289	76.9	0.918	– 15.9
200	0.586	– 51.4	10.01	138.	0.0508	66.6	0.802	– 27.7
300	0.491	– 71.0	8.453	124.	0.0670	61.8	0.690	– 35.3
400	0.417	– 87.3	7.152	114.	0.0780	58.9	0.603	– 39.9
500	0.362	– 100	6.040	106.	0.0886	58.3	0.534	– 42.5
600	0.323	– 113	5.245	99.6	0.0984	57.9	0.485	– 44.0
700	0.293	– 124	4.627	94.2	0.107	58.0	0.448	– 45.5
800	0.274	– 135	4.124	89.4	0.117	58.4	0.419	– 46.6
900	0.261	– 145	3.734	85.0	0.126	58.6	0.396	– 47.7
1000	0.251	– 154	3.419	81.2	0.135	59.4	0.377	– 48.8
1100	0.247	– 162	3.150	77.6	0.145	59.6	0.361	– 50.2
1200	0.245	– 170	2.919	74.2	0.155	59.6	0.350	– 51.4
1300	0.245	– 177	2.720	71.0	0.166	59.8	0.339	– 53.2
1400	0.247	175	2.551	67.8	0.176	59.9	0.327	– 54.6
1500	0.251	169	2.410	64.8	0.187	59.7	0.320	– 56.1
1600	0.258	164	2.283	62.1	0.198	59.5	0.311	– 58.2
1700	0.263	159	2.169	59.3	0.209	59.4	0.305	– 59.8
1800	0.269	154	2.067	56.7	0.221	58.9	0.299	– 62.4
1900	0.276	150	1.977	54.4	0.232	58.6	0.292	– 64.9
2000	0.283	146	1.898	51.8	0.243	58.1	0.287	– 67.0
2100	0.290	142	1.824	49.5	0.256	57.5	0.283	– 69.6
2200	0.298	138	1.762	47.2	0.267	57.0	0.277	– 72.9
2300	0.307	135	1.701	44.9	0.279	56.1	0.272	– 75.1
2400	0.314	132	1.645	42.8	0.291	55.4	0.270	– 78.7
2500	0.321	129	1.597	40.6	0.304	54.7	0.264	– 81.3

S-PARAMETER(V_{CE} = 8 V, I_C = 20 mA, Z_o = 50 Ω)

f MHz	S ₁₁		S ₂₁		S ₁₂		S ₂₂	
	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
100	0.310	- 47.6	20.39	144.	0.0218	77.0	0.798	- 25.2
200	0.243	- 82.1	14.87	123.	0.0375	72.7	0.611	- 37.8
300	0.205	- 107	11.25	111.	0.0514	71.4	0.488	- 43.1
400	0.165	- 125	8.95	102.	0.0643	71.6	0.417	- 45.1
500	0.172	- 140	7.329	96.6	0.0777	71.5	0.365	- 45.7
600	0.169	- 153	6.232	91.6	0.0909	71.5	0.331	- 45.8
700	0.166	- 163	5.414	87.5	0.104	71.0	0.308	- 46.5
800	0.169	- 173	4.778	83.5	0.117	70.6	0.289	- 47.3
900	0.172	179	4.3	80.2	0.130	70.0	0.274	- 47.9
1000	0.176	172	3.902	77.1	0.143	69.3	0.262	- 49.1
1100	0.182	166	3.576	74.1	0.156	68.6	0.251	- 50.4
1200	0.188	160	3.310	71.2	0.169	67.7	0.244	- 51.5
1300	0.194	156	3.080	68.7	0.182	66.7	0.235	- 53.7
1400	0.202	151	2.875	66.0	0.195	66.0	0.227	- 55.6
1500	0.209	147	2.711	63.4	0.208	64.9	0.221	- 57.0
1600	0.217	144	2.564	61.0	0.221	63.9	0.213	- 59.5
1700	0.224	140	2.431	58.6	0.234	62.8	0.209	- 61.7
1800	0.233	137	2.315	56.4	0.247	61.7	0.204	- 64.7
1900	0.240	134	2.212	54.2	0.259	60.8	0.197	- 67.9
2000	0.247	132	2.123	52.0	0.272	59.8	0.193	- 70.0
2100	0.255	129	2.037	49.8	0.284	58.3	0.188	- 73.3
2200	0.263	126	1.965	47.7	0.296	57.2	0.183	- 77.5
2300	0.272	124	1.896	45.7	0.309	56.1	0.179	- 80.1
2400	0.278	122	1.833	43.7	0.321	54.8	0.177	- 84.0
2500	0.286	120	1.778	41.7	0.332	53.7	0.171	- 87.7

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