

### PNP EPITAXIAL SILICON TRANSISTOR MICROWAVE AMPLIFIER

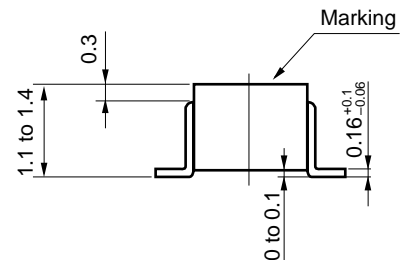
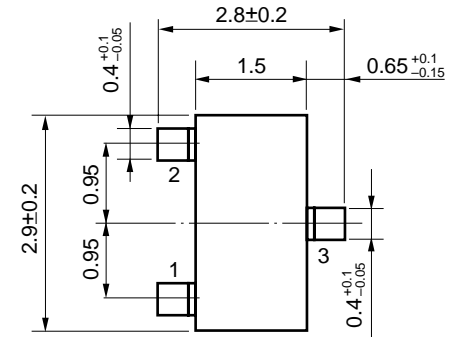
#### FEATURES

- 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 2SC3583.

#### ABSOLUTE MAXIMUM RATINGS ( $T_A = 25$ °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	°C
Storage Temperature	$T_{stg}$	-65 to +150	°C

#### PACKAGE DIMENSION (in millimeters)



#### PIN CONNECTIONS

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

#### ELECTRICAL CHARACTERISTICS ( $T_A = 25$ °C)

Parameter	Symbol	Test Conditions	MIN.	TYP.	MAX.	Unit
Collector Cutoff Current	$I_{CB0}$	$V_{CB} = -10$ V			-0.1	$\mu$ A
Emitter Cutoff Current	$I_{EB0}$	$V_{EB} = -1$ V			-0.1	$\mu$ A
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.

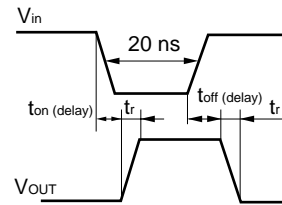
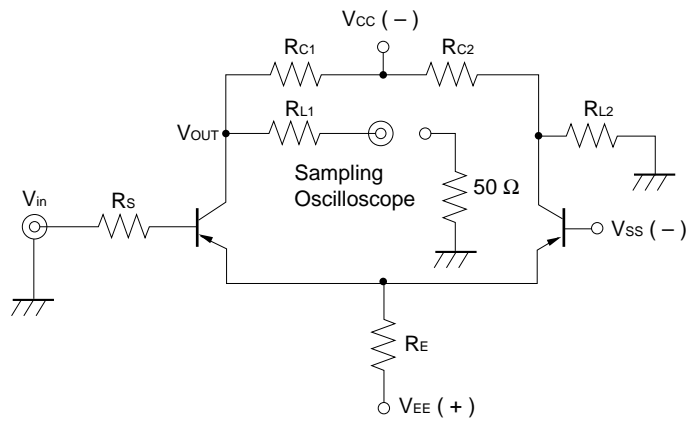
#### $h_{FE}$ Classification

Rank	FB
Marking	T92
$h_{FE}$	20 to 100

**SWITCHING CHARACTERISTICS**

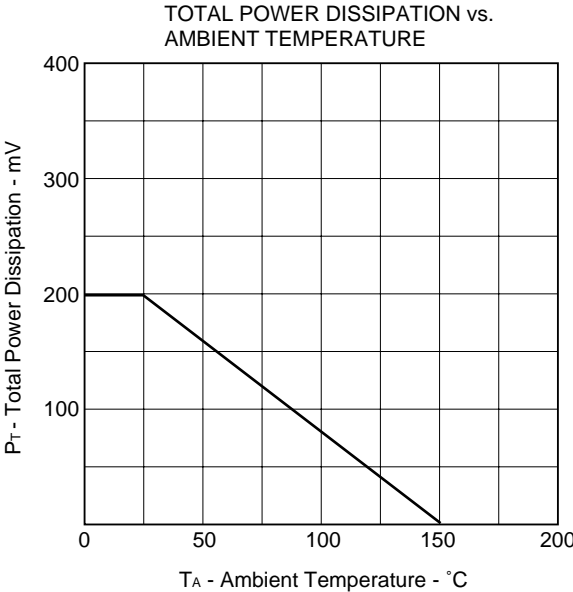
Parameter	Symbol	$V_{in} = 1\text{ V}$	Unit
		TYP.	
Turn-on Delay Time	$t_{on} \text{ (delay)}$	1.08	ns
Rise Time	$t_r$	0.66	ns
Turn off Delay Time	$t_{off} \text{ (delay)}$	0.32	ns
Fall Time	$t_f$	0.78	ns

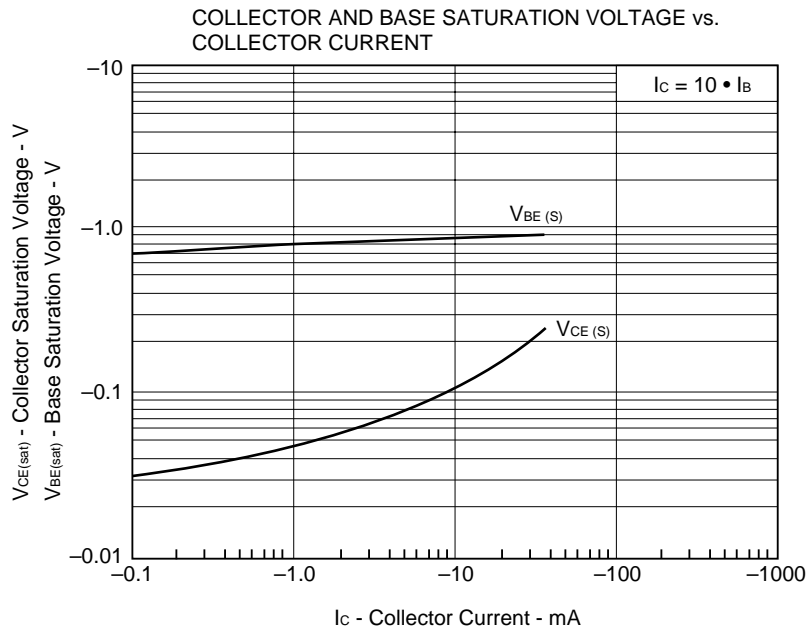
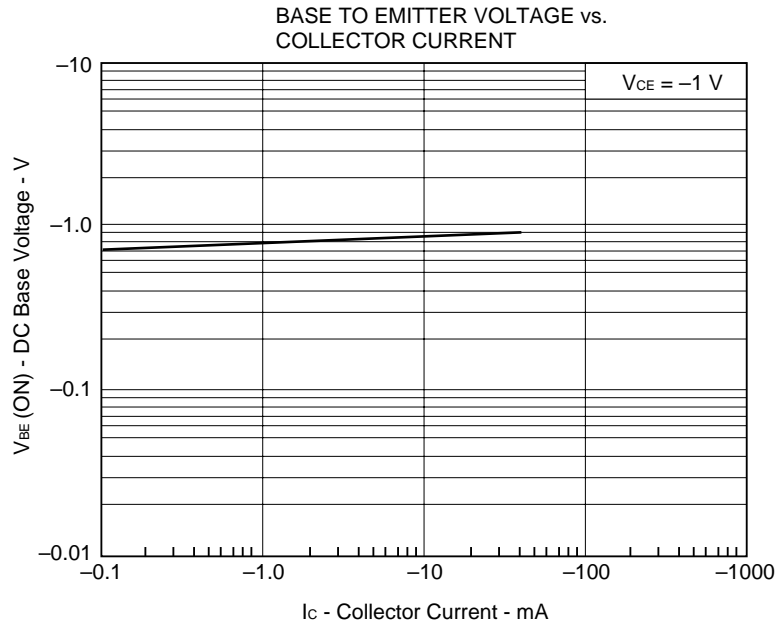
**SWITCHING TIME MEASUREMENT CIRCUIT**

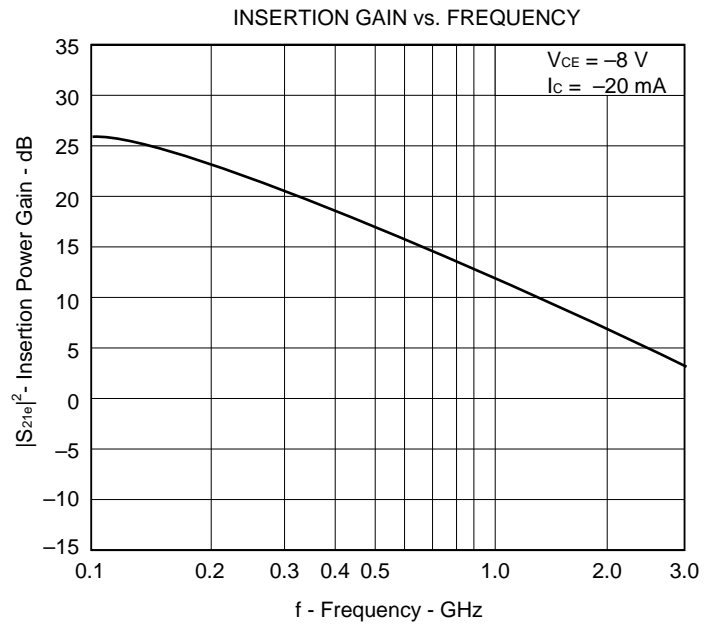
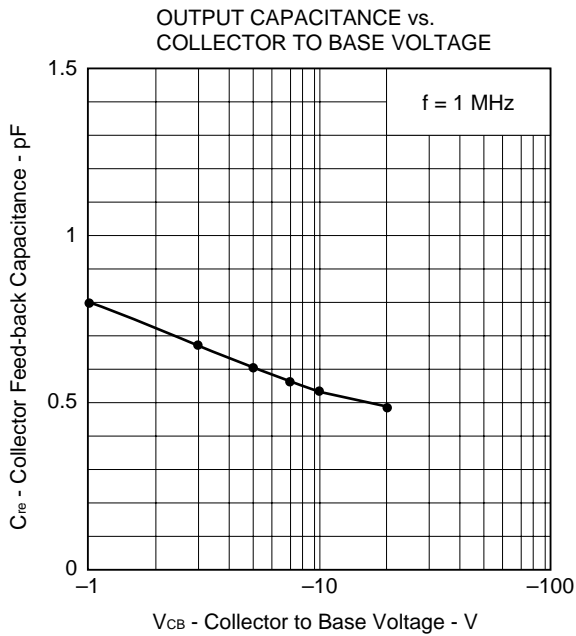
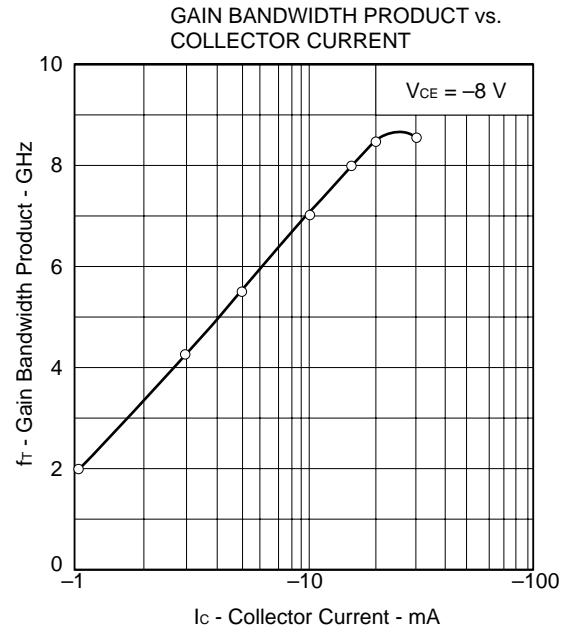
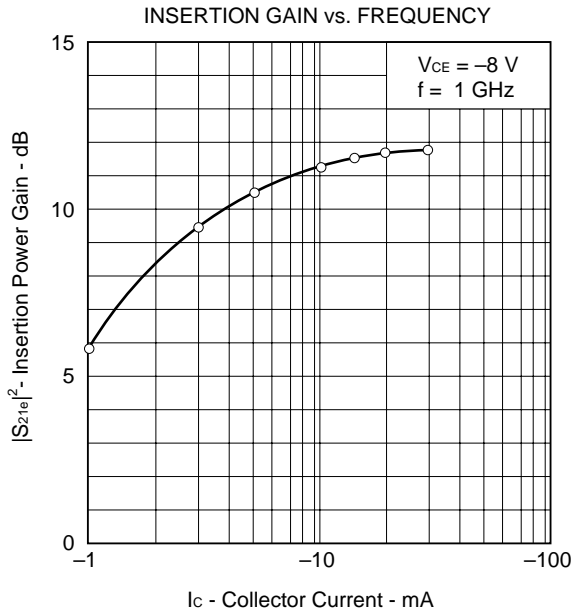


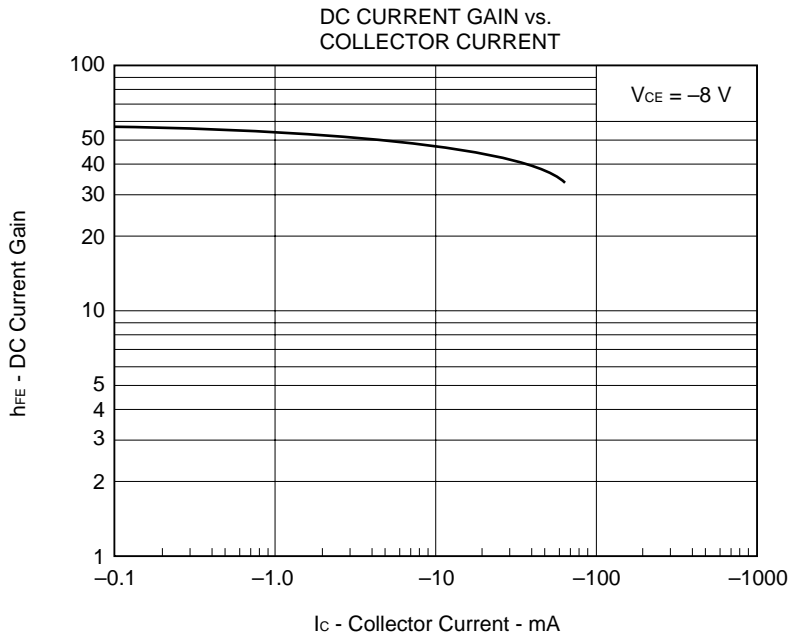
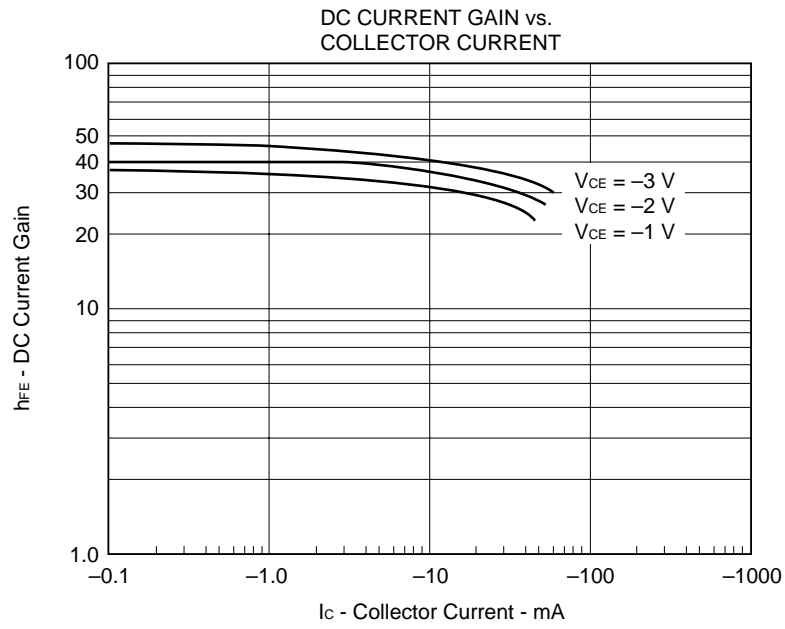
$V_{in} = 1\text{ V}, V_{BB} = -0.5\text{ V}, R_{C1} = R_{C2}$						
$R_s$	$R_C$	$R_{L1}$	$R_{L2}$	$R_E$	$V_{EE}$	$V_{CC}$
( $\Omega$ )	( $\Omega$ )	( $\Omega$ )	( $\Omega$ )	( $\Omega$ )	(V)	(V)
160	1 k	200	250	2.7 k	27	26.3

TYPICAL CHARACTERISTICS

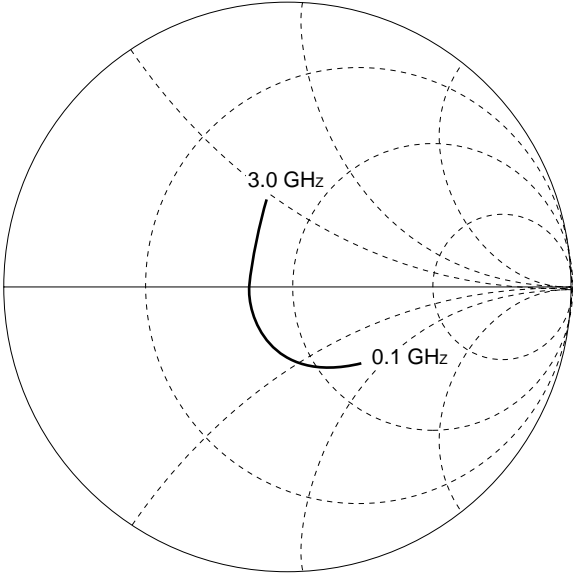






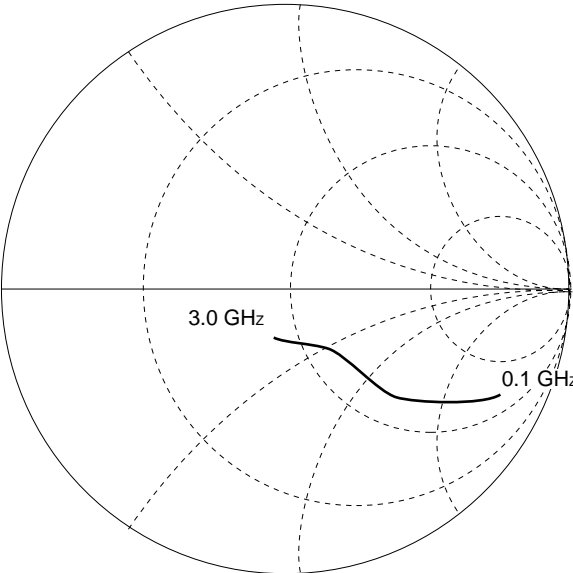


S<sub>11</sub>



V<sub>CE</sub> = -8 V  
I<sub>c</sub> = -20 mA

S<sub>22</sub>



V<sub>CE</sub> = -8 V  
I<sub>c</sub> = -20 mA

S-PARAMETER

( $V_{CE} = 1\text{ V}$ ,  $I_C = 5\text{ mA}$ ,  $Z_o = 50\ \Omega$ )

f MHz	S <sub>11</sub>		S <sub>21</sub>		S <sub>12</sub>		S <sub>22</sub>	
	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**

( $V_{CE} = 3\text{ V}$ ,  $I_C = 5\text{ mA}$ ,  $Z_o = 50\ \Omega$ )

f MHz	S <sub>11</sub>		S <sub>21</sub>		S <sub>12</sub>		S <sub>22</sub>	
	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

( $V_{CE} = 8\text{ V}$ ,  $I_C = 5\text{ mA}$ ,  $Z_o = 50\ \Omega$ )

f MHz	S <sub>11</sub>		S <sub>21</sub>		S <sub>12</sub>		S <sub>22</sub>	
	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**

( $V_{CE} = 8\text{ V}$ ,  $I_C = 20\text{ mA}$ ,  $Z_o = 50\ \Omega$ )

f MHz	S <sub>11</sub>		S <sub>21</sub>		S <sub>12</sub>		S <sub>22</sub>	
	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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