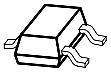
SIEMENS

NPN Silicon RF Transistor

BFR 93P

- For low-distortion broadband amplifiers up to 1 GHz at collector currents from 2 mA to 30 mA.
- CECC-type available: CECC 50002/256.



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ESD: **E**lectro**s**tatic **d**ischarge sensitive device, observe handling precautions!

Type	Marking	Ordering Code (tape and reel)	Pin Configuration 1	 2	 3	Package[1]
BFR 93P	GG	Q62702-F1051	B	E	C	SOT-23

Maximum Ratings

Parameter	Symbol	Values	Unit
Collector-emitter voltage	V_{CE0}	15	V
Collector-base voltage	V_{CB0}	20	
Emitter-base voltage	V_{EB0}	2.5	
Collector current	I_C	50	mA
Base current	I_B	10	
Total power dissipation, $T_S \leq 65$ ˚C[3]	P_{tot}	280	mW
Junction temperature	T_j	150	˚C
Ambient temperature range	T_A	– 65 … + 150	
Storage temperature range	T_{stg}	– 65 … + 150	

Thermal Resistance

Junction - ambient[2]	$R_{th\ JA}$	≤ 385	K/W
Junction - soldering point[3]	$R_{th\ JS}$	≤ 305	

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[1] For detailed information see chapter Package Outlines.

[2] Package mounted on alumina 15 mm × 16.7 mm × 0.7 mm.

[3] T_S is measured on the collector lead at the soldering point to the pcb.

Electrical Characteristics

at T_A = 25 ˚C, unless otherwise specified.

Parameter	Symbol	Values			Unit
		min.	typ.	max.	
DC Characteristics					
Collector-emitter breakdown voltage I_C = 1 mA, I_B = 0	$V_{(BR)CE0}$	15	–	–	V
Collector-base cutoff current V_{CB} = 10 V, I_E = 0 V_{CB} = 20 V, I_E = 0	I_{CB0}	 – –	 – –	 0.05 10	µA
Emitter-base cutoff current V_{EB} = 2.5 V, I_C = 0	I_{EB0}	–	–	100	
DC current gain I_C = 25 mA, V_{CE} = 5 V	h_{FE}	30	100	–	–
Collector-emitter saturation voltage I_C = 50 mA, I_B = 5 mA	V_{CEsat}	–	0.2	0.5	V

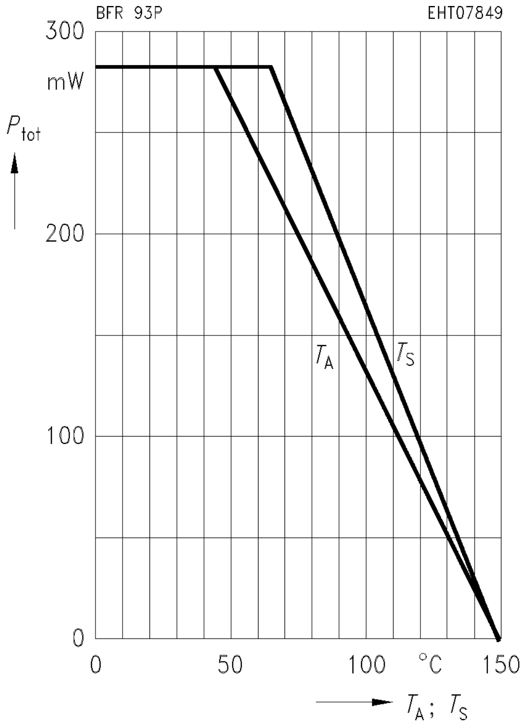
Electrical Characteristics

at T_A = 25 ˚C, unless otherwise specified.

Parameter	Symbol	Values			Unit
		min.	typ.	max.	
AC Characteristics					
Transition frequency I_C = 30 mA, V_{CE} = 5 V, f = 200 MHz I_C = 50 mA, V_{CE} = 5 V, f = 200 MHz	f_T	 – –	 5 4.7	 – –	GHz
Collector-base capacitance V_{CB} = 10 V, V_{BE} = v_{be} = 0, f = 1 MHz	C_{cb}	–	0.6	0.75	pF
Collector-emitter capacitance V_{CE} = 10 V, V_{BE} = v_{be} = 0, f = 1 MHz	C_{ce}	–	0.28	–	
Input capacitance V_{EB} = 0.5 V, I_C = i_c = 0, f = 1 MHz	C_{ibo}	–	2.1	–	
Output capacitance V_{CE} = 10 V, V_{BE} = v_{be} = 0, f = 1 MHz	C_{obs}	–	0.9	–	
Noise figure I_C = 10 mA, V_{CE} = 8 V, f = 10 MHz, Z_S = 75 Ω I_C = 5 mA, V_{CE} = 8 V, f = 500 MHz, Z_S = Z_{Sopt} I_C = 10 mA, V_{CE} = 8 V, f = 800 MHz, Z_S = 50 Ω	F	 – – –	 1.7 1.9 2.4	 – – –	dB
Power gain I_C = 25 mA, V_{CE} = 8 V, f = 800 MHz, Z_S = Z_{Sopt}, Z_L = Z_{Lopt}	G_{pe}	–	13	–	
Transducer gain I_C = 25 mA, V_{CE} = 8 V, f = 500 MHz, Z_0 = 50 Ω	$\vert S_{21e}\vert^2$	–	15.8	–	
Linear output voltage two-tone intermodulation test I_C = 25 mA, V_{CE} = 8 V, d_{IM} = 60 dB, f_1 = 806 MHz, f_2 = 810 MHz, Z_S = Z_L = 50 Ω	V_{o1} = V_{o2}	–	240	–	mV
Third order intercept point I_C = 25 mA, V_{CE} = 8 V, f = 800 MHz	IP_3	–	30.5	–	dBm

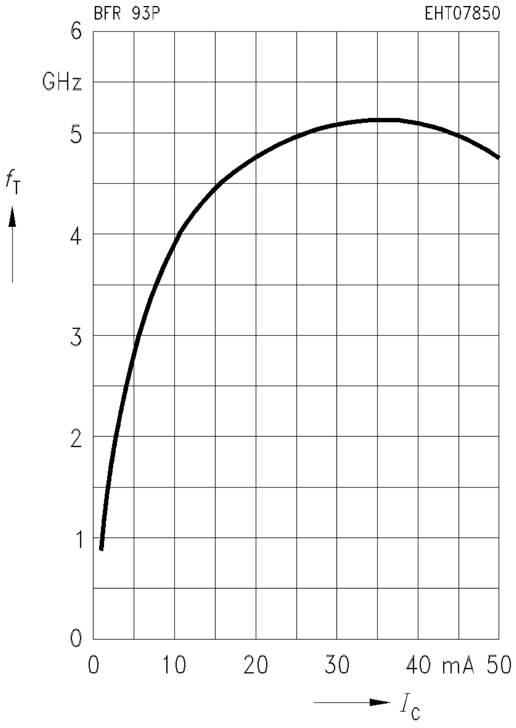
Total power dissipation $P_{tot} = f(T_A{*}; T_S)$

* Package mounted on alumina



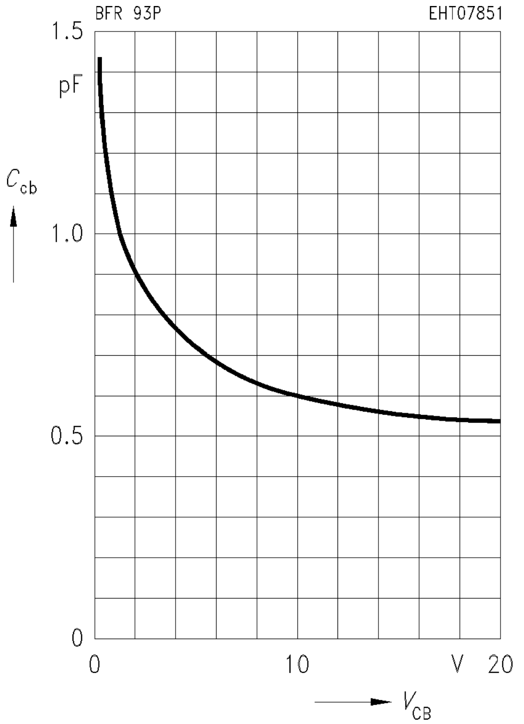
Transition frequency $f_T = f(I_C)$

V_{CE} = 5 V, f = 200 MHz



Collector-base capacitance $C_{cb} = f(V_{CB})$

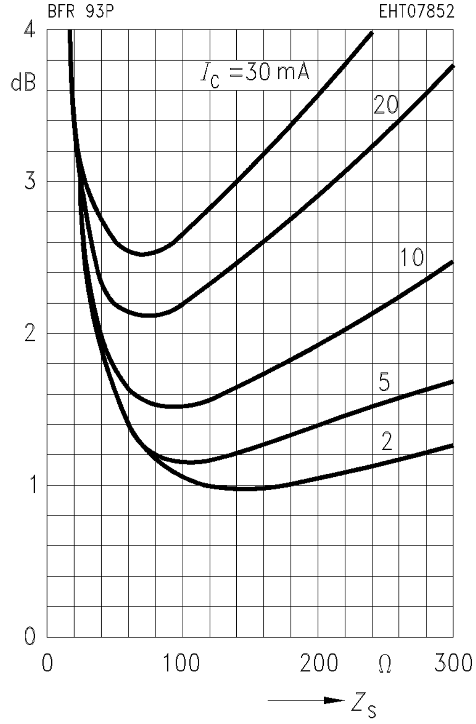
$V_{BE} = v_{be}$ = 0, f = 1 MHz



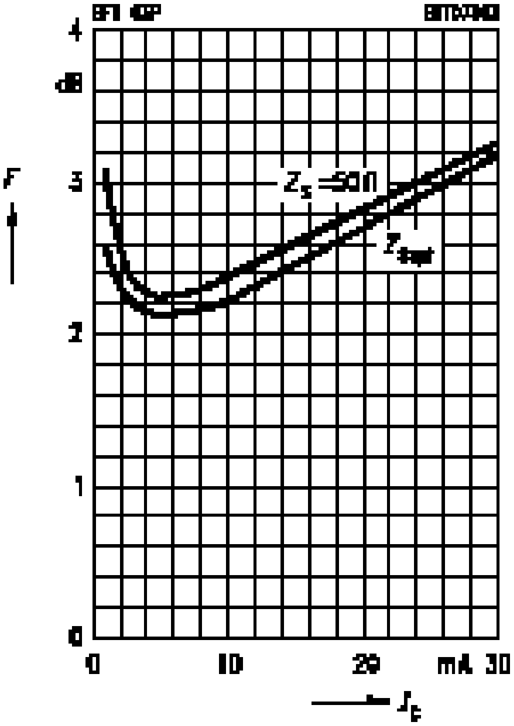
Common Emitter Noise Parameters

f	F_{min}	$G_p(F_{min})$	Γ_{opt}		R_N	N	$F_{50\,\Omega}$	$G_p(F_{50\Omega})$
GHz	dB	dB	MAG	ANG	Ω	–	dB	dB
I_C = 2 mA, V_{CE} = 8 V, Z_0 = 50 Ω								
0.01	1.0	–	(Z_S = 150 Ω)		–	–	1.6	–
I_C = 10 mA, V_{CE} = 8 V, Z_0 = 50 Ω								
0.01	1.5	–	(Z_S = 90 Ω)		–	–	1.7	–
0.8	2.3	–	(Z_S = Z_{Sopt})		–	–	2.4	–

Noise figure $F = f(Z_S)$
V_{CE} = 8 V, f = 10 MHz



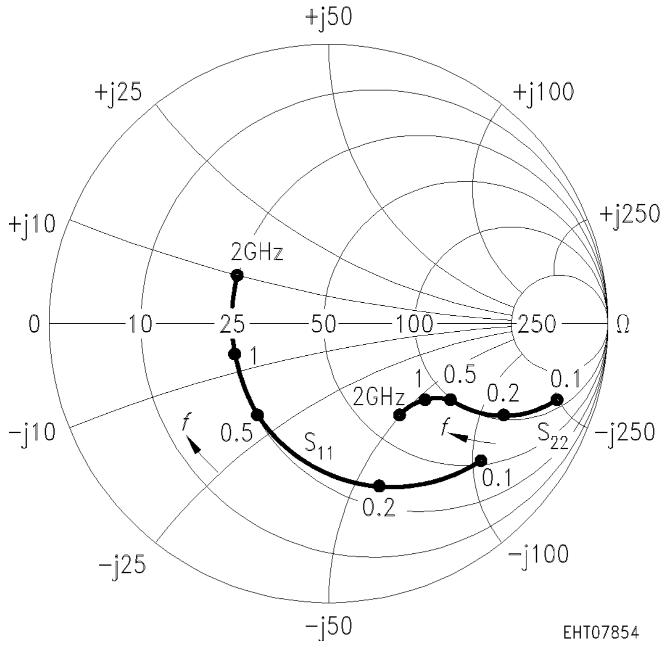
Noise figure $F = f(I_C)$
V_{CE} = 8 V, f = 800 MHz, Z_{Lopt} (G)



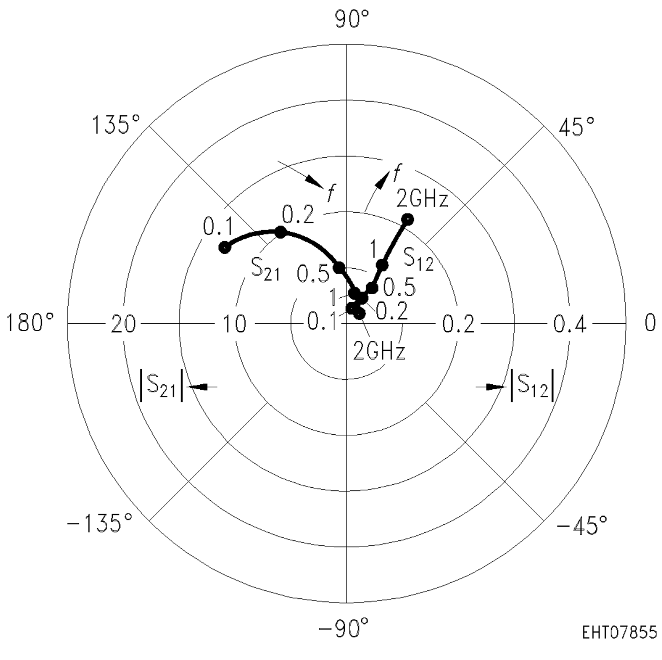
Common Emitter S Parameters

f	S_{11}		S_{21}		S_{12}		S_{22}	
GHz	**MAG**	**ANG**	**MAG**	**ANG**	**MAG**	**ANG**	**MAG**	**ANG**
I_C = 5 mA, V_{CE} = 8 V, Z_0 = 50 Ω								
0.1	0.74	– 34	12.96	143	0.03	70	0.87	– 14
0.3	0.51	– 92	7.50	113	0.06	55	0.65	– 31
0.5	0.40	– 125	5.13	97	0.08	55	0.54	– 33
0.8	0.32	– 157	3.35	78	0.10	57	0.48	– 32
1.0	0.31	– 171	2.71	72	0.12	59	0.48	– 35
1.2	0.31	177	2.32	65	0.14	60	0.46	– 38
1.4	0.31	166	2.05	59	0.16	62	0.45	– 41
1.6	0.32	156	1.84	52	0.18	61	0.45	– 46
1.8	0.33	146	1.64	47	0.20	61	0.45	– 49
2.0	0.35	137	1.52	42	0.22	61	0.44	– 52

S_{11}, S_{22} = f (f)
I_C = 5 mA, V_{CE} = 8 V, Z_0 = 50 Ω



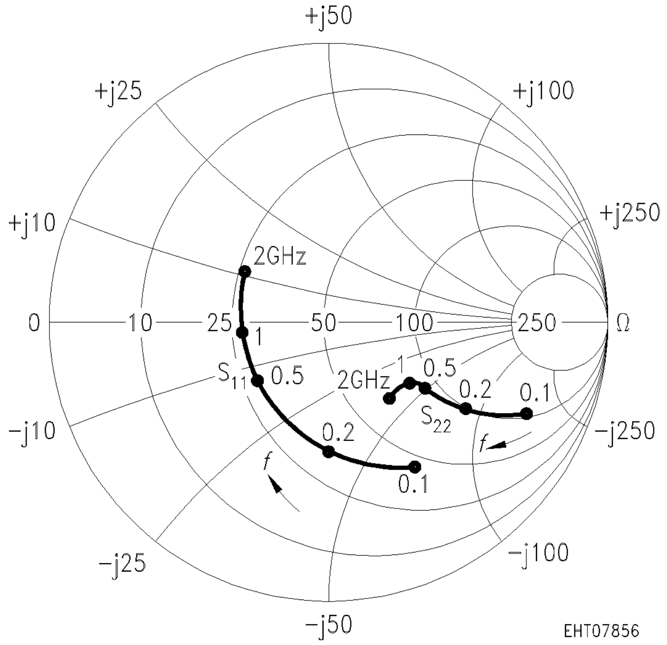
S_{12}, S_{21} = f (f)
I_C = 5 mA, V_{CE} = 8 V, Z_0 = 50 Ω



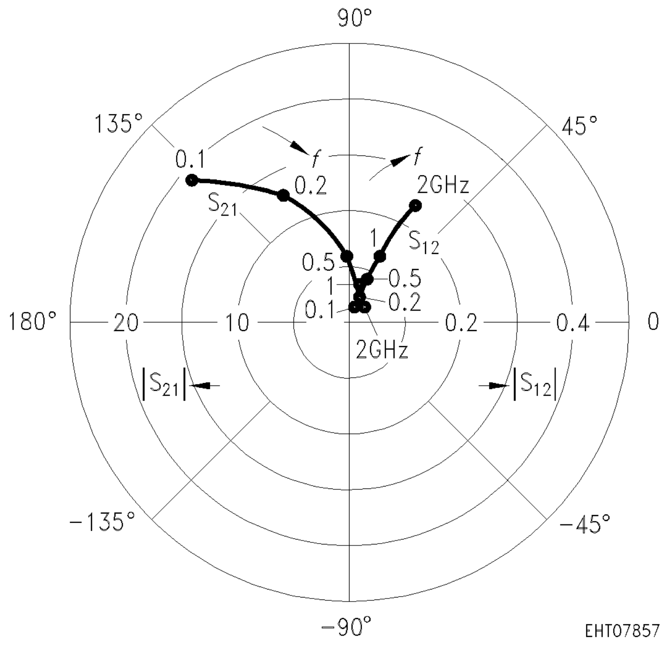
Common Emitter S Parameters (continued)

f	S_{11}		S_{21}		S_{12}		S_{22}	
GHz	**MAG**	**ANG**	**MAG**	**ANG**	**MAG**	**ANG**	**MAG**	**ANG**
I_C = 10 mA, V_{CE} = 8 V, Z_0 = 50 Ω								
0.1	0.58	– 49	18.73	133	0.03	68	0.77	– 19
0.3	0.37	– 108	9.17	105	0.05	60	0.53	– 32
0.5	0.30	– 139	5.92	90	0.07	63	0.45	– 32
0.8	0.25	– 170	3.85	76	0.10	65	0.41	– 31
1.0	0.25	180	3.09	70	0.13	65	0.40	– 34
1.2	0.26	169	2.63	64	0.15	64	0.39	– 37
1.4	0.26	160	2.33	58	0.17	64	0.38	– 40
1.6	0.28	151	2.07	52	0.20	62	0.38	– 44
1.8	0.29	142	1.84	48	0.22	61	0.38	– 47
2.0	0.31	133	1.72	43	0.24	60	0.36	– 49

S_{11}, S_{22} = *f* (*f*)
I_C = 10 mA, V_{CE} = 8 V, Z_0 = 50 Ω



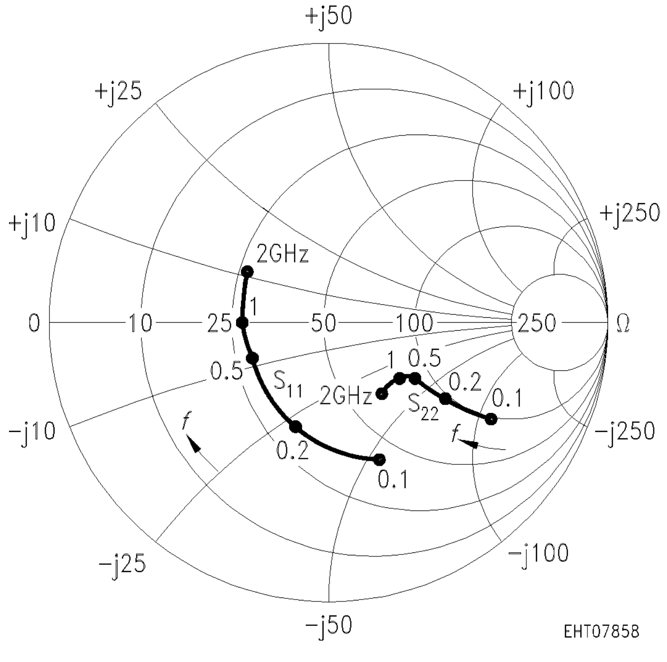
S_{12}, S_{21} = *f* (*f*)
I_C = 10 mA, V_{CE} = 8 V, Z_0 = 50 Ω



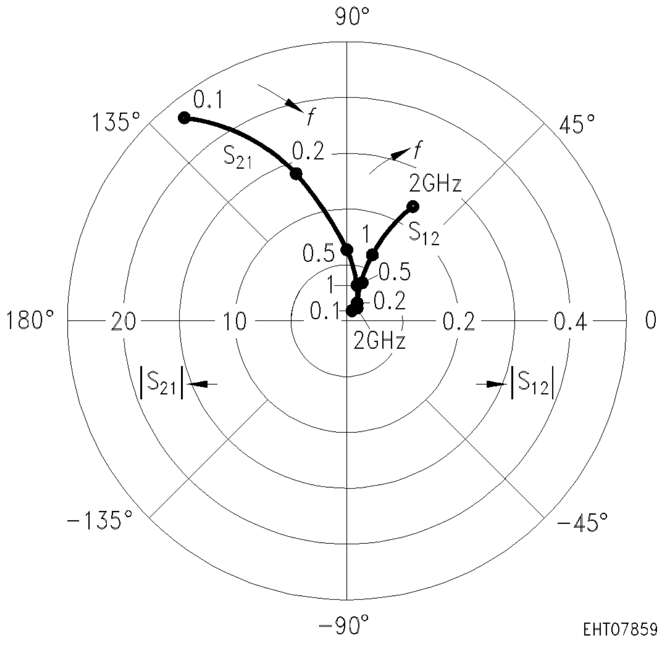
Common Emitter S Parameters (continued)

f	S_{11}		S_{21}		S_{12}		S_{22}	
GHz	**MAG**	**ANG**	**MAG**	**ANG**	**MAG**	**ANG**	**MAG**	**ANG**
I_C = 20 mA, V_{CE} = 8 V, Z_0 = 50 Ω								
0.1	0.41	– 64	22.91	123	0.02	67	0.67	– 22
0.3	0.28	– 123	9.89	98	0.05	66	0.46	– 30
0.5	0.25	– 151	6.24	86	0.07	68	0.40	– 30
0.8	0.23	– 179	4.03	74	0.11	68	0.37	– 28
1.0	0.23	172	3.22	69	0.13	68	0.37	– 32
1.2	0.25	164	2.74	63	0.16	66	0.35	– 35
1.4	0.25	155	2.41	57	0.18	66	0.35	– 38
1.6	0.27	147	2.14	51	0.20	63	0.35	– 43
1.8	0.28	139	1.92	47	0.23	61	0.35	– 46
2.0	0.30	131	1.79	42	0.25	60	0.33	– 48

S_{11}, S_{22} = *f* (*f*)
I_C = 20 mA, V_{CE} = 8 V, Z_0 = 50 Ω



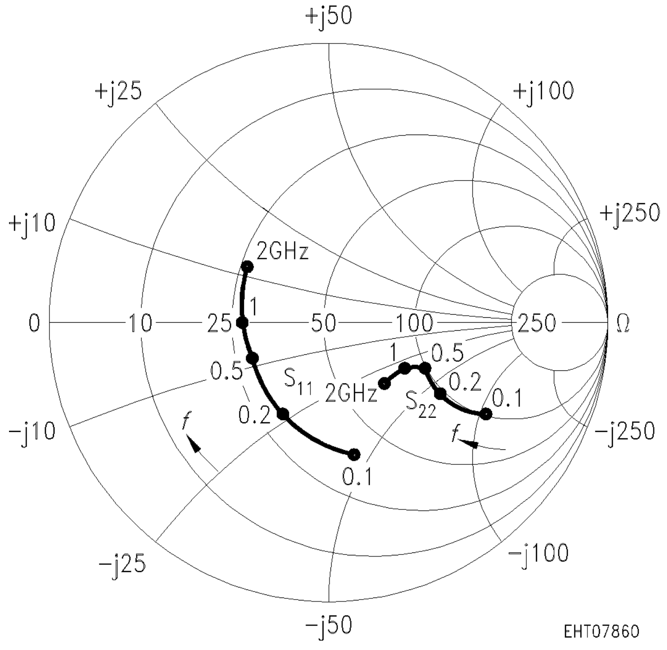
S_{12}, S_{21} = *f* (*f*)
I_C = 20 mA, V_{CE} = 8 V, Z_0 = 50 Ω



Common Emitter S Parameters (continued)

f	S_{11}		S_{21}		S_{12}		S_{22}	
GHz	**MAG**	**ANG**	**MAG**	**ANG**	**MAG**	**ANG**	**MAG**	**ANG**
I_C = 25 mA, V_{CE} = 8 V, Z_0 = 50 Ω								
0.1	0.37	– 68	23.71	120	0.02	67	0.64	– 22
0.3	0.26	– 127	9.89	97	0.05	67	0.44	– 29
0.5	0.24	– 154	6.20	85	0.07	70	0.39	– 28
0.8	0.22	179	3.98	73	0.11	69	0.37	– 27
1.0	0.23	170	3.18	68	0.13	68	0.37	– 31
1.2	0.24	162	2.71	62	0.16	66	0.36	– 35
1.4	0.25	153	2.37	57	0.18	66	0.36	– 37
1.6	0.27	146	2.11	51	0.20	63	0.35	– 42
1.8	0.28	138	1.89	47	0.23	62	0.35	– 46
2.0	0.30	130	1.77	42	0.25	60	0.34	– 48

S_{11}, S_{22} = *f* (*f*)
I_C = 25 mA, V_{CE} = 8 V, Z_0 = 50 Ω



S_{12}, S_{21} = *f* (*f*)
I_C = 25 mA, V_{CE} = 8 V, Z_0 = 50 Ω