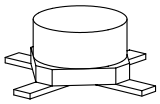
SIEMENS

NPN Silicon RF Transistor — BFQ 70

- For low-noise IF and broadband amplifiers in antenna and telecommunications systems at collector currents from 2 mA to 20 mA.
- Hermetically sealed ceramic package
- HiRel/Mil screening available.



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

Type	Marking	Ordering Code (tape and reel)	Pin Configuration 1	2	3	4	Package[1)]
BFQ 70	70	Q62702-F774	B	E	C	E	Cerex-X

Maximum Ratings

Parameter	Symbol	Values	Unit
Collector-emitter voltage	V_{CE0}	15	V
Collector-emitter voltage, V_{BE} = 0	V_{CES}	20	
Collector-base voltage	V_{CB0}	20	
Emitter-base voltage	V_{EB0}	2.5	
Collector current	I_C	35	mA
Base current	I_B	4	
Total power dissipation, $T_S \leq 121$ °C[3)]	P_{tot}	300	mW
Junction temperature	T_j	175	°C
Ambient temperature range	T_A	– 65 … + 175	
Storage temperature range	T_{stg}	– 65 … + 175	

Thermal Resistance

Junction - ambient[2)]	$R_{th\ JA}$	≤ 260	K/W
Junction - soldering point[3)]	$R_{th\ JS}$	≤ 180	

1) For detailed dimensions see chapter Package Outlines.
2) Package mounted on alumina 16 mm × 25 mm × 0.7 mm.
3) T_S is measured on the collector lead at the soldering point to the pcb.

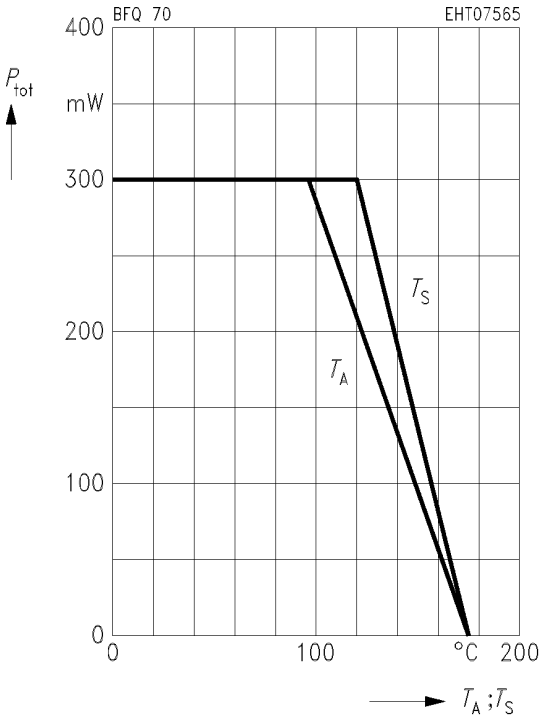
Electrical Characteristics
at T_A = 25 °C, unless otherwise specified.

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	I_{CB0}	–	–	50	nA
Emitter-base cutoff current V_{EB} = 2 V, I_C = 0	I_{EB0}	–	–	10	µA
DC current gain I_C = 3 mA, V_{CE} = 6 V I_C = 10 mA, V_{CE} = 6 V	h_{FE}	 50 50	 – 130	 250 –	–
Collector-emitter saturation voltage I_C = 20 mA, I_B = 1 mA	V_{CEsat}	–	0.1	0.4	V
Base-emitter voltage I_C = 10 mA, V_{CE} = 6 V	V_{BE}	–	0.78	–	

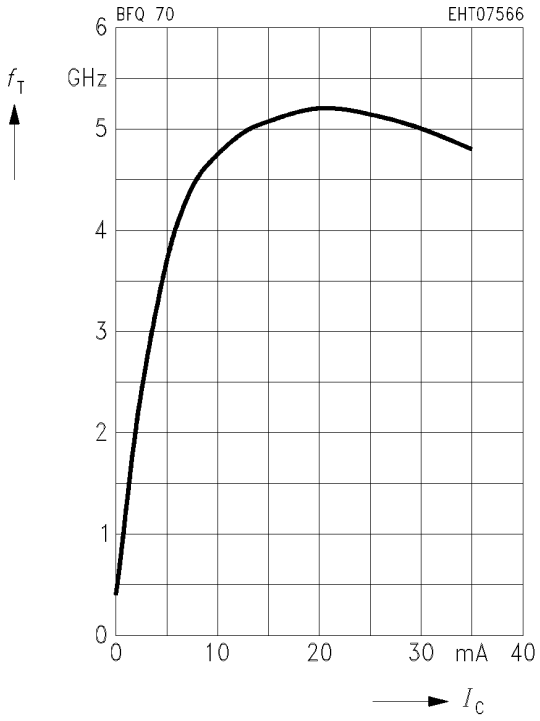
Electrical Characteristics
at T_A = 25 °C, unless otherwise specified.

Parameter	Symbol	Values			Unit
		min.	typ.	max.	
AC Characteristics					
Transition frequency I_C = 3 mA, V_{CE} = 6 V, f = 200 MHz I_C = 20 mA, V_{CE} = 6 V, f = 200 MHz	f_T	 – 3.6	 2.7 5	 – –	GHz
Collector-base capacitance V_{CB} = 6 V, V_{BE} = v_{be} = 0, f = 1 MHz	C_{cb}	–	0.46	0.6	pF
Collector-emitter capacitance V_{CE} = 6 V, V_{BE} = v_{be} = 0, f = 1 MHz	C_{ce}	–	0.41	–	
Input capacitance V_{EB} = 0.5 V, I_C = i_c = 0, f = 1 MHz	C_{ibo}	–	2.2	–	
Output capacitance V_{CE} = 6 V, V_{BE} = v_{be} = 0, f = 1 MHz	C_{obs}	–	0.87	1.3	
Noise figure I_C = 3 mA, V_{CE} = 6 V, f = 10 MHz, Z_S = 75 Ω I_C = 4 mA, V_{CE} = 6 V, f = 800 MHz, Z_S = 50 Ω	F	 – –	 0.9 1.5	 1.2 –	dB
Power gain I_C = 20 mA, V_{CE} = 6 V, f = 800 MHz, Z_S = Z_{Sopt}, Z_L = Z_{Lopt}	G_{pe}	–	18	–	
Transducer gain I_C = 10 mA, V_{CE} = 6 V, f = 1 GHz, Z_0 = 50 Ω	$\lvert S_{21e} \rvert^2$	–	13	–	
Linear output voltage two-tone intermodulation test I_C = 20 mA, V_{CE} = 6 V, d_{IM} = 60 dB, f_1 = 806 MHz, f_2 = 810 MHz, Z_S = Z_L = 50 Ω	V_{o1} = V_{o2}	–	170	–	mV
Third order intercept point I_C = 20 mA, V_{CE} = 6 V, f = 800 MHz	IP_3	–	27.5	–	dBm

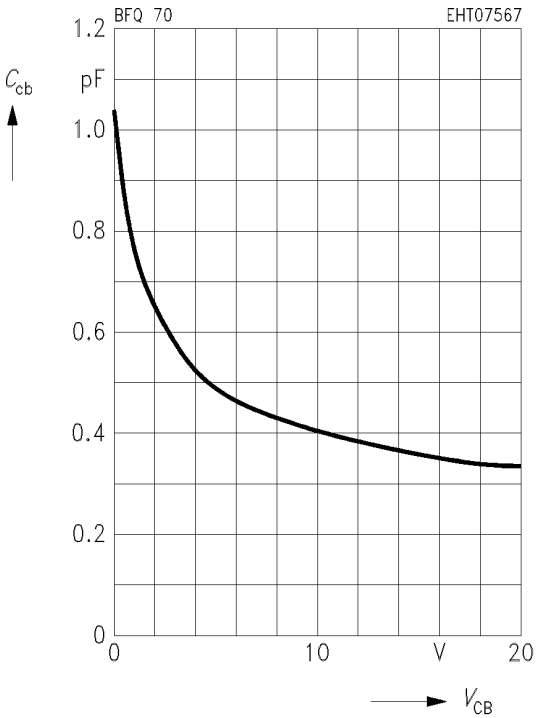
Total power dissipation $P_{tot} = f(T_A^*; T_S)$
*Package mounted on alumina



Transition frequency $f_T = f(I_C)$
V_{CE} = 6 V, f = 200 MHz



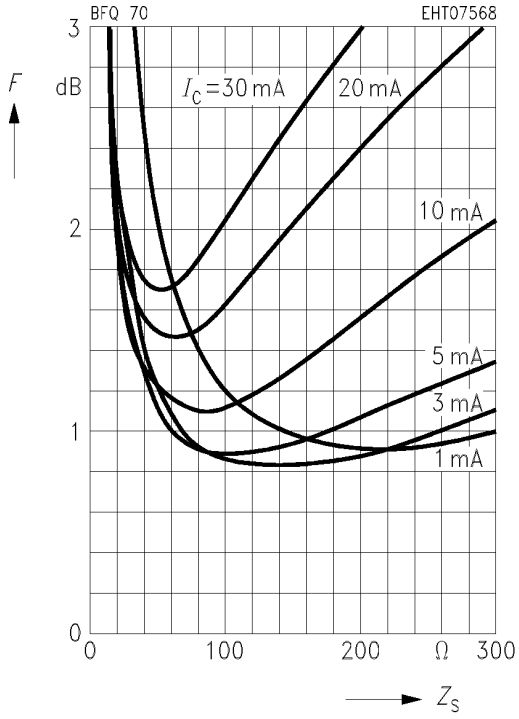
Collector-base capacitance $C_{cb} = f(V_{CB})$
V_{BE} = v_{be} = 0, f = 1 MHz



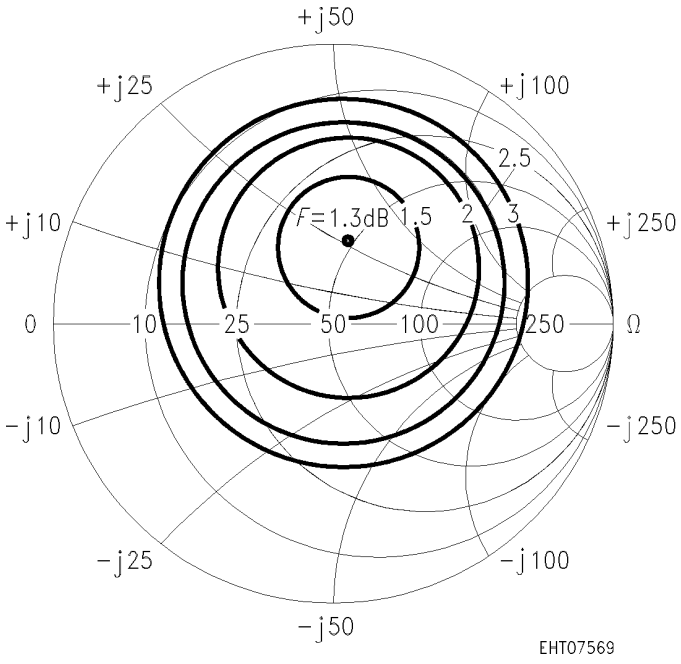
Common Emitter Noise Parameters

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 = 3 mA, V_{CE} = 6 V, Z_0 = 50 Ω								
0.01	0.8	–	(Z_S = 150 Ω)		–	–	1.2	–
I_C = 5 mA, V_{CE} = 6 V, Z_0 = 50 Ω								
0.01	0.85	–	(Z_S = 100 Ω)		–	–	1.1	–
0.8	1.3	15.5	0.28	79	12	0.19	1.5	14.8

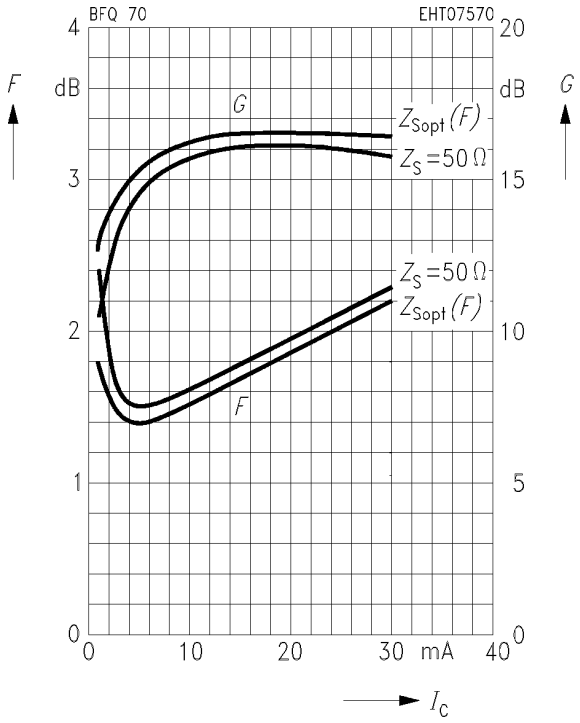
Noise figure $F = f(Z_S)$
V_{CE} = 6 V, f = 10 MHz



Circles of constant noise figure $F = f(Z_S)$
in Z_S-plane, I_C = 5 mA, V_{CE} = 6 V, f = 800 MHz

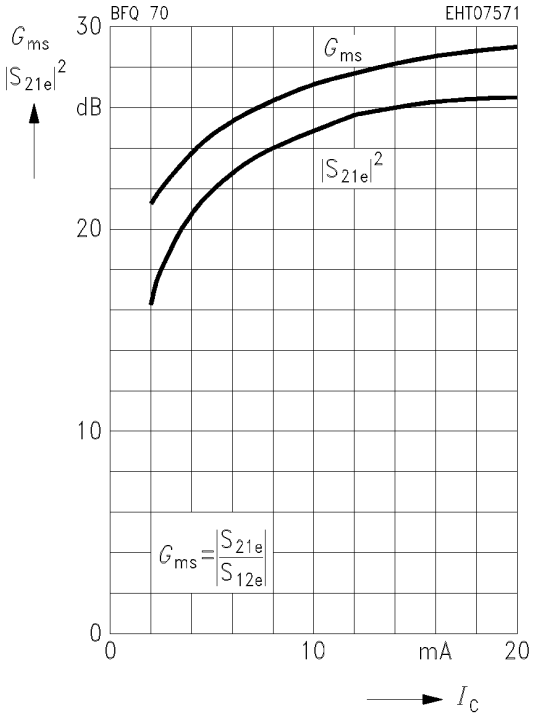


Noise figure $F = f(I_C)$
Power gain $G = f(I_C)$
V_{CE} = 6 V, f = 800 MHz, Z_{Lopt} (G)

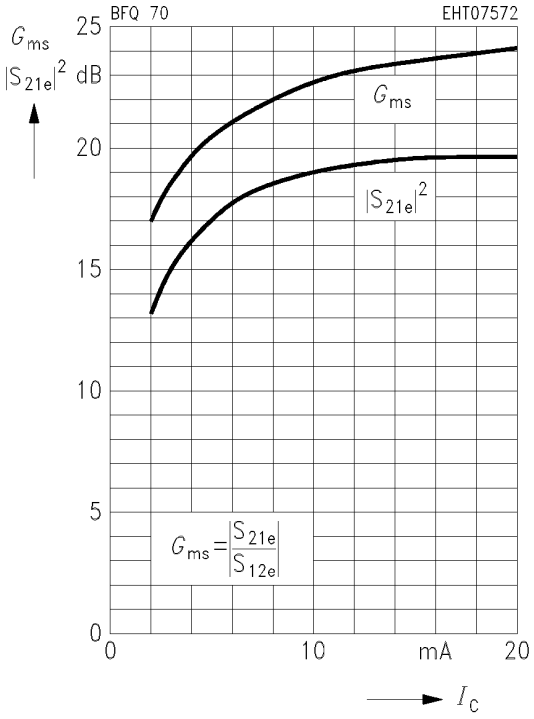


Common Emitter Power Gain

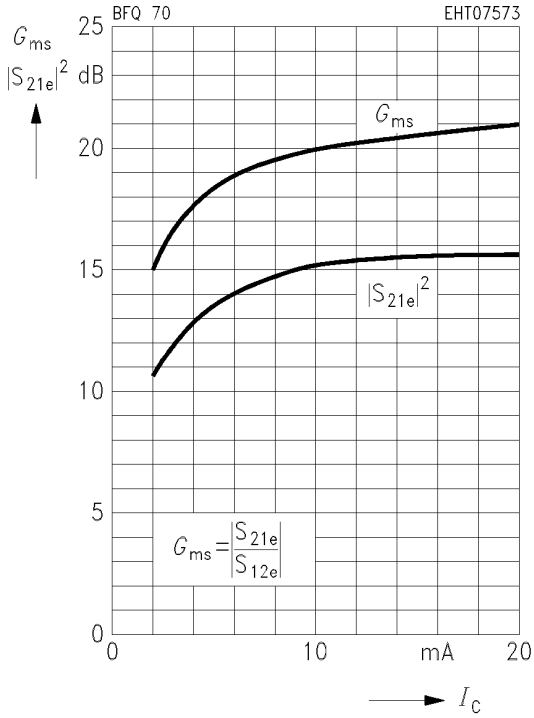
Power gain G_{ms}, $|S_{21e}|^2 = f(I_C)$
V_{CE} = 6 V, f = 200 MHz, Z_0 = 50 Ω



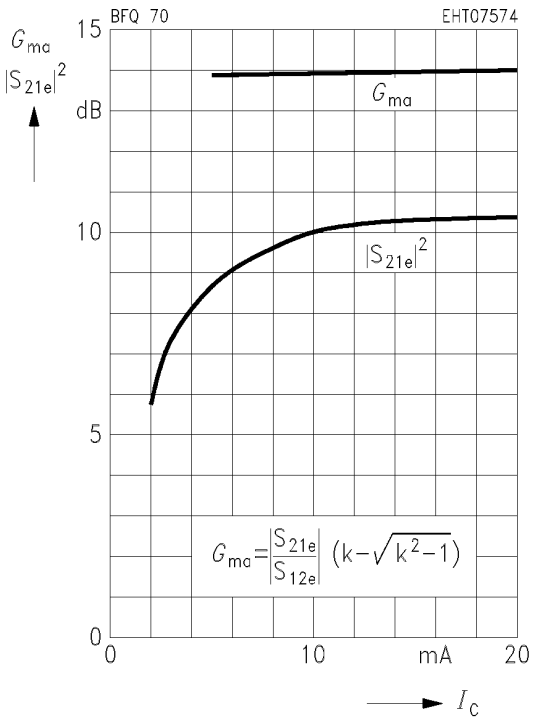
Power gain G_{ms}, $|S_{21e}|^2 = f(I_C)$
V_{CE} = 6 V, f = 500 MHz, Z_0 = 50 Ω



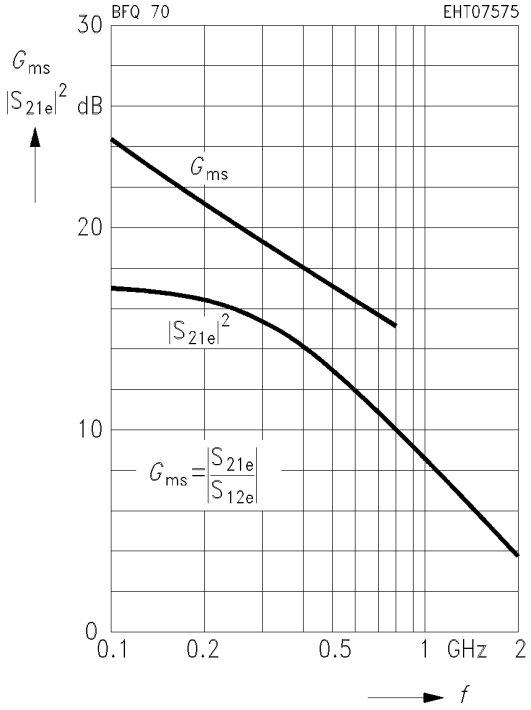
Power gain G_{ms}, $|S_{21e}|^2 = f(I_C)$
V_{CE} = 6 V, f = 800 MHz, Z_0 = 50 Ω



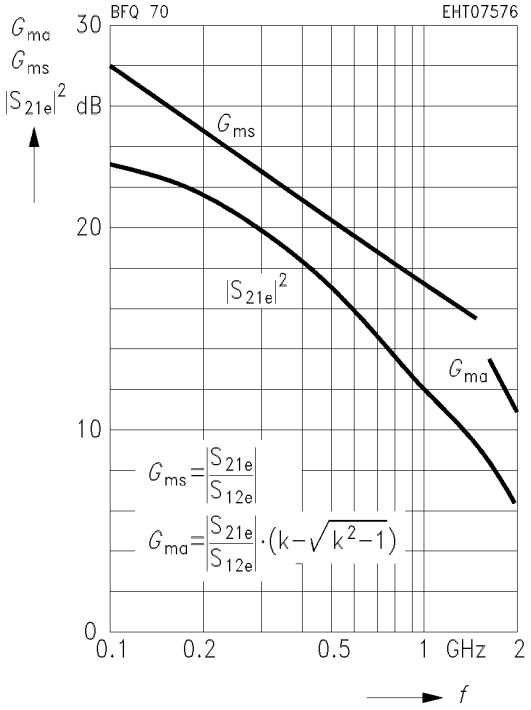
Power gain G_{ma}, $|S_{21e}|^2 = f(I_C)$
V_{CE} = 6 V, f = 1.5 GHz, Z_0 = 50 Ω



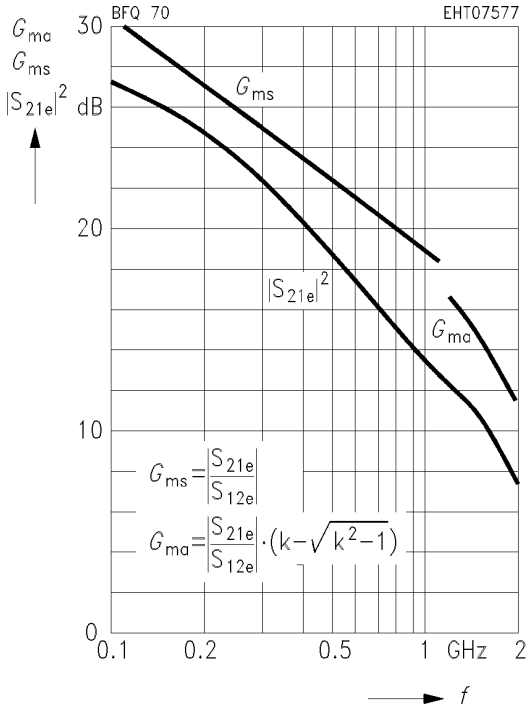
Power gain G_{ms}, $|S_{21e}|^2 = f(f)$
I_C = 2 mA, V_{CE} = 6 V, Z_0 = 50 Ω



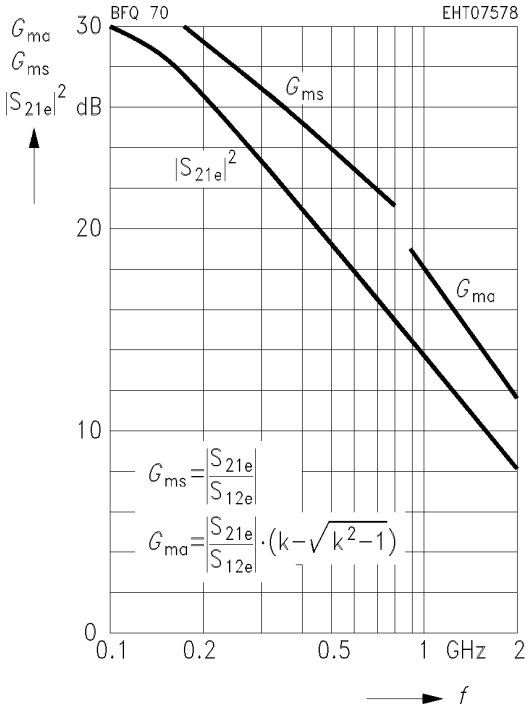
Power gain G_{ma}, G_{ms}, $|S_{21e}|^2 = f(f)$
I_C = 5 mA, V_{CE} = 6 V, Z_0 = 50 Ω



Power gain G_{ma}, G_{ms}, $|S_{21e}|^2 = f(f)$
I_C = 10 mA, V_{CE} = 6 V, Z_0 = 50 Ω



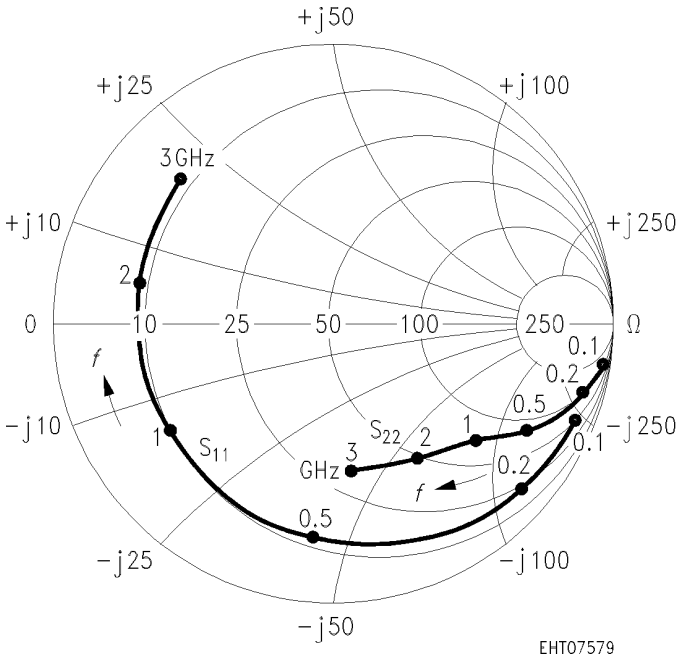
Power gain G_{ma}, G_{ms}, $|S_{21e}|^2 = f(f)$
I_C = 20 mA, V_{CE} = 6 V, Z_0 = 50 Ω



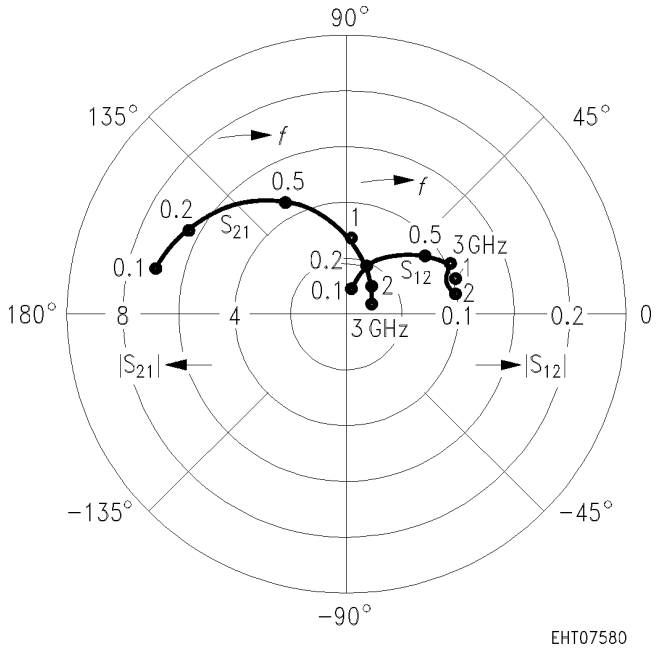
Common Emitter S Parameters

f	S_{11}		S_{21}		S_{12}		S_{22}	
GHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
I_C = 2 mA, V_{CE} = 6 V, Z_0 = 50 Ω								
0.1	0.92	– 23	7.00	165	0.025	77	0.98	– 8
0.2	0.89	– 45	6.42	150	0.049	65	0.93	– 16
0.3	0.84	– 65	5.74	137	0.068	55	0.87	– 22
0.4	0.80	– 82	5.21	126	0.081	46	0.81	– 28
0.6	0.74	– 110	4.14	109	0.096	34	0.71	– 34
0.8	0.71	– 130	3.35	95	0.103	26	0.65	– 38
1.0	0.69	– 146	2.78	85	0.105	20	0.61	– 41
1.2	0.68	– 158	2.39	76	0.105	17	0.58	– 44
1.5	0.67	– 174	1.96	64	0.104	14	0.55	– 49
1.8	0.68	174	1.66	53	0.102	13	0.54	– 55
2.0	0.69	167	1.51	47	0.100	14	0.53	– 60
2.5	0.70	152	1.24	33	0.100	19	0.51	– 73
3.0	0.72	138	1.05	20	0.107	24	0.51	– 87

S_{11}, S_{22} = f (f)
I_C = 2 mA, V_{CE} = 6 V, Z_0 = 50 Ω



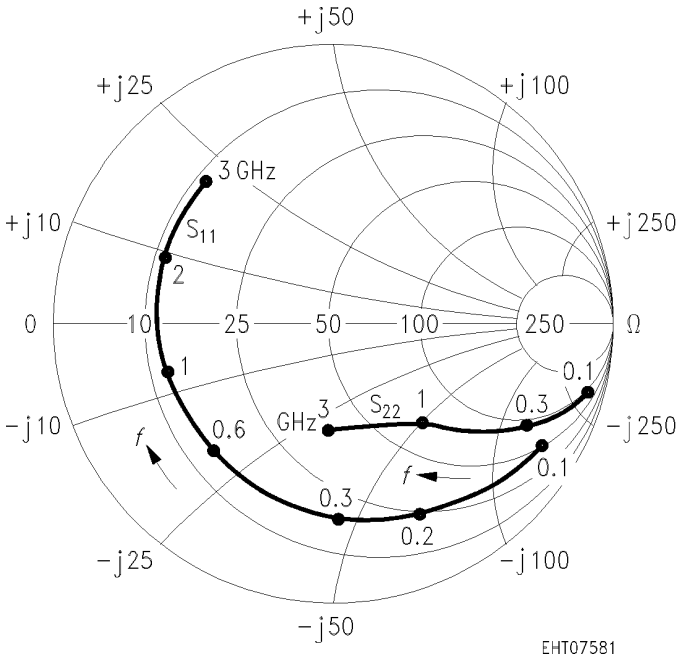
S_{12}, S_{21} = f (f)
I_C = 2 mA, V_{CE} = 6 V, Z_0 = 50 Ω



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 = 5 mA, V_{CE} = 6 V, Z_0 = 50 Ω								
0.1	0.84	– 35	14.47	159	0.023	73	0.95	– 14
0.2	0.78	– 66	12.38	139	0.042	58	0.83	– 26
0.3	0.72	– 90	10.21	125	0.053	47	0.72	– 33
0.4	0.69	– 109	8.66	114	0.060	40	0.63	– 37
0.6	0.65	– 135	6.32	99	0.068	34	0.52	– 42
0.8	0.63	– 152	4.90	88	0.072	31	0.46	– 44
1.0	0.63	– 165	3.97	79	0.075	30	0.43	– 45
1.2	0.63	– 175	3.38	72	0.079	30	0.40	– 47
1.5	0.63	173	2.74	62	0.083	31	0.38	– 51
1.8	0.63	164	2.29	53	0.090	33	0.37	– 56
2.0	0.65	158	2.07	48	0.095	34	0.36	– 61
2.5	0.66	145	1.70	35	0.109	36	0.34	– 73
3.0	0.69	133	1.44	23	0.127	36	0.34	– 87

***S*11, *S*22 = *f* (*f*)**
I_C = 5 mA, V_{CE} = 6 V, Z_0 = 50 Ω



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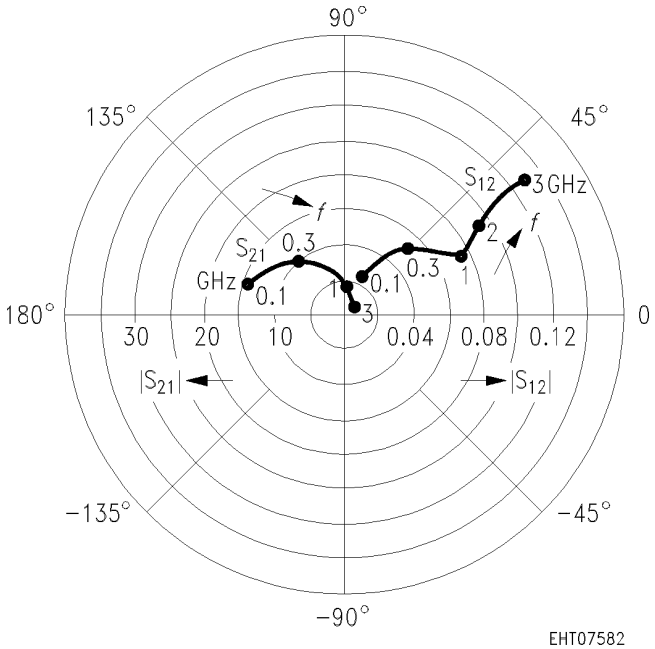
***S*12, *S*21 = *f* (*f*)**
I_C = 5 mA, V_{CE} = 6 V, Z_0 = 50 Ω



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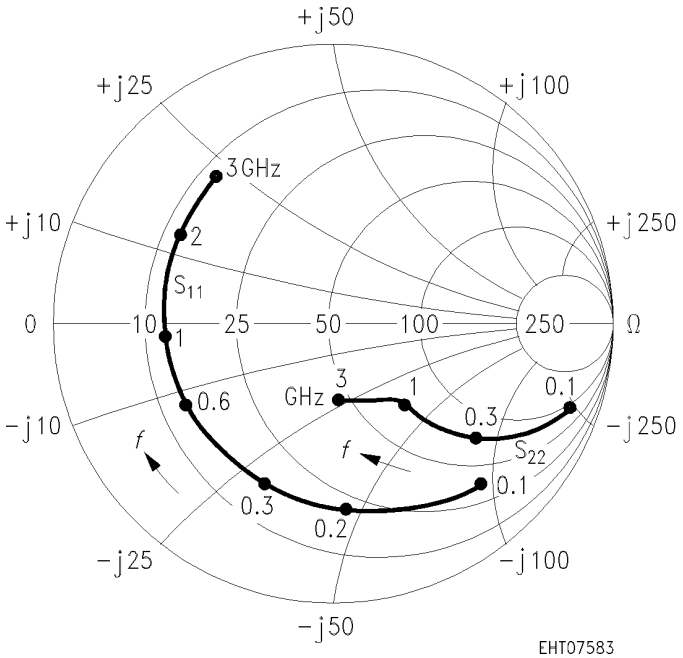
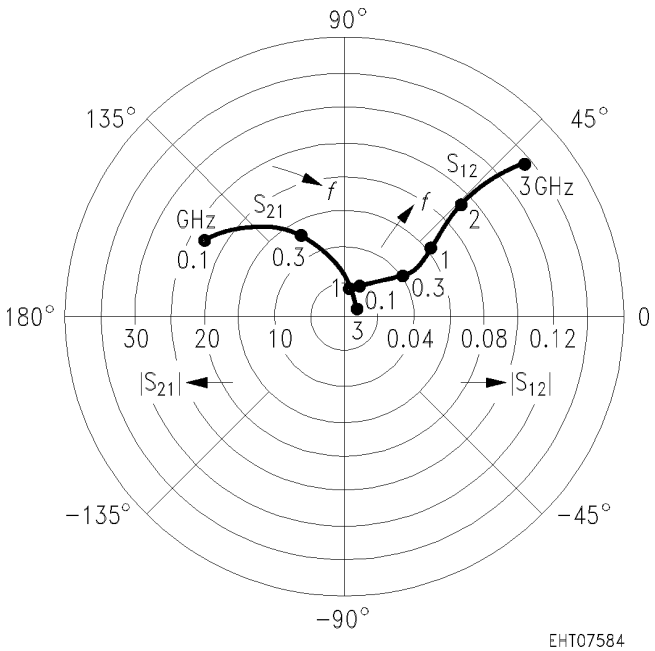
Common Emitter S Parameters (continued)

f	S_{11}		S_{21}		S_{12}		S_{22}	
GHz	**MAG**	**ANG**	**MAG**	**ANG**	**MAG**	**ANG**	**MAG**	**ANG**
I_C = 10 mA, V_{CE} = 6 V, Z_0 = 50 Ω								
0.1	0.73	– 50	22.77	151	0.021	65	0.89	– 21
0.2	0.67	– 89	17.57	129	0.034	52	0.71	– 34
0.3	0.63	– 114	13.44	115	0.041	43	0.57	– 41
0.4	0.62	– 132	10.84	105	0.045	41	0.49	– 44
0.6	0.60	– 153	7.56	92	0.051	39	0.39	– 45
0.8	0.60	– 167	5.75	83	0.057	40	0.35	– 46
1.0	0.61	– 177	4.62	76	0.062	41	0.32	– 47
1.2	0.61	175	3.90	70	0.068	43	0.30	– 48
1.5	0.61	165	3.15	60	0.078	44	0.29	– 51
1.8	0.62	157	2.62	52	0.089	44	0.28	– 56
2.0	0.64	152	2.37	47	0.096	44	0.27	– 61
2.5	0.65	141	1.94	35	0.117	44	0.25	– 73
3.0	0.68	130	1.65	24	0.138	41	0.25	– 88

***S*11, *S*22 = *f* (*f*)**
I_C = 10 mA, V_{CE} = 6 V, Z_0 = 50 Ω



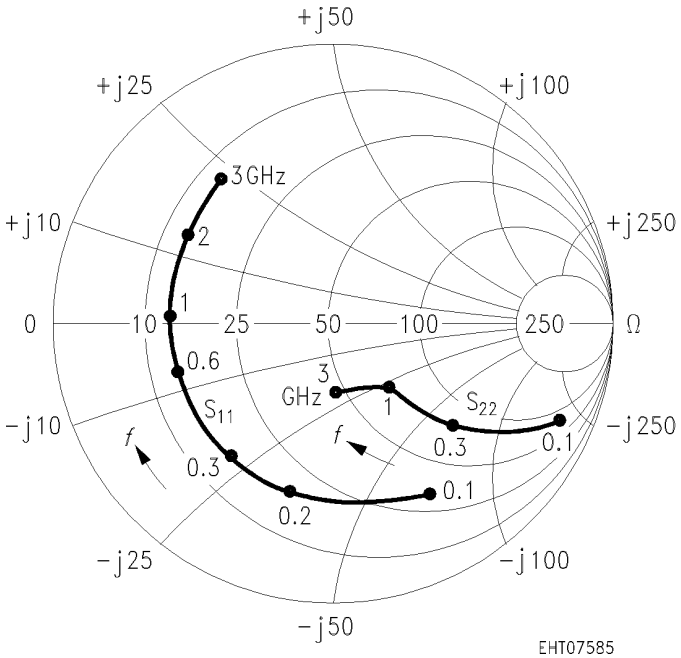
***S*12, *S*21 = *f* (*f*)**
I_C = 10 mA, V_{CE} = 6 V, Z_0 = 50 Ω



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 = 15 mA, V_{CE} = 6 V, Z_0 = 50 Ω								
0.1	0.67	– 62	27.86	146	0.019	64	0.84	– 25
0.2	0.62	– 104	20.01	123	0.029	49	0.63	– 38
0.3	0.59	– 128	14.73	110	0.035	44	0.50	– 43
0.4	0.60	– 143	11.63	101	0.038	43	0.42	– 44
0.6	0.59	– 162	7.97	89	0.045	44	0.34	– 45
0.8	0.59	– 173	6.02	81	0.051	46	0.30	– 45
1.0	0.60	178	4.82	75	0.058	48	0.28	– 45
1.2	0.60	171	4.07	68	0.065	49	0.27	– 47
1.5	0.61	162	3.28	60	0.077	50	0.25	– 50
1.8	0.62	154	2.73	52	0.090	49	0.25	– 55
2.0	0.63	150	2.47	47	0.097	49	0.24	– 60
2.5	0.65	139	2.02	35	0.120	47	0.22	– 72
3.0	0.68	128	1.71	24	0.142	43	0.22	– 87

***S*11, *S*22 = *f* (*f*)**
I_C = 15 mA, V_{CE} = 6 V, Z_0 = 50 Ω



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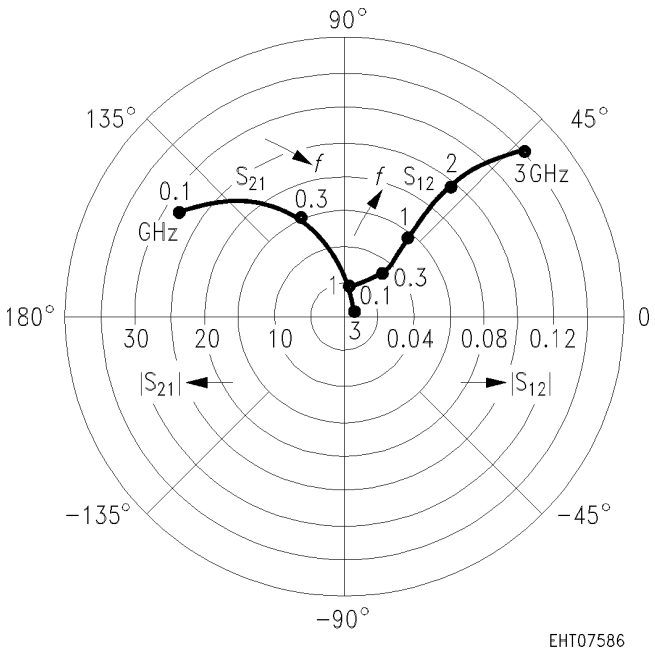
***S*12, *S*21 = *f* (*f*)**
I_C = 15 mA, V_{CE} = 6 V, Z_0 = 50 Ω



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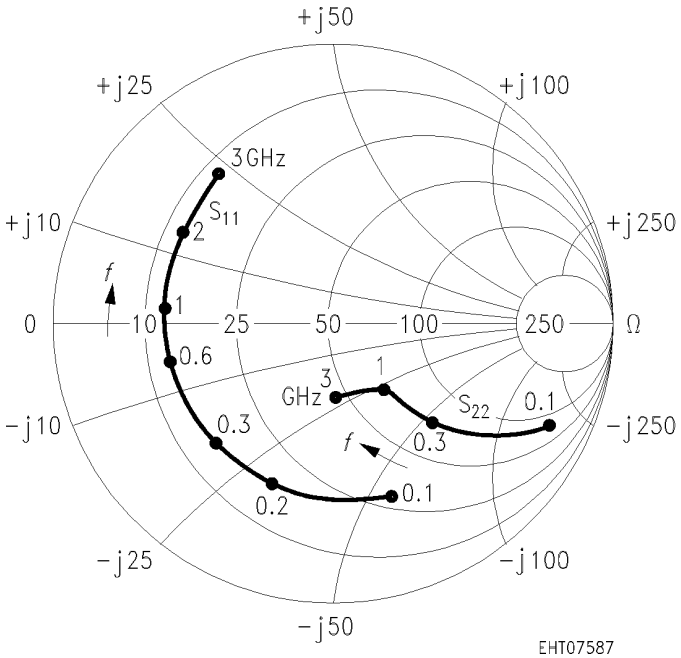
Common Emitter S Parameters (continued)

f	S_{11}		S_{21}		S_{12}		S_{22}	
GHz	**MAG**	**ANG**	**MAG**	**ANG**	**MAG**	**ANG**	**MAG**	**ANG**
I_C = 20 mA, V_{CE} = 6 V, Z_0 = 50 Ω								
0.1	0.63	– 71	31.01	142	0.017	59	0.81	– 28
0.2	0.60	– 113	21.18	119	0.026	48	0.58	– 40
0.3	0.58	– 136	15.24	107	0.031	45	0.45	– 43
0.4	0.59	– 150	11.90	98	0.034	45	0.38	– 44
0.6	0.59	– 166	8.08	88	0.041	47	0.32	– 43
0.8	0.59	– 177	6.09	80	0.048	50	0.29	– 43
1.0	0.60	175	4.87	74	0.056	52	0.27	– 44
1.2	0.60	169	4.11	68	0.064	53	0.26	– 45
1.5	0.61	160	3.31	59	0.076	53	0.25	– 48
1.8	0.62	153	2.75	51	0.089	52	0.24	– 54
2.0	0.64	149	2.49	47	0.098	51	0.23	– 58
2.5	0.65	138	2.03	35	0.120	49	0.21	– 70
3.0	0.68	128	1.72	24	0.143	44	0.21	– 86

***S*11, *S*22 = *f* (*f*)**
I_C = 20 mA, V_{CE} = 6 V, Z_0 = 50 Ω



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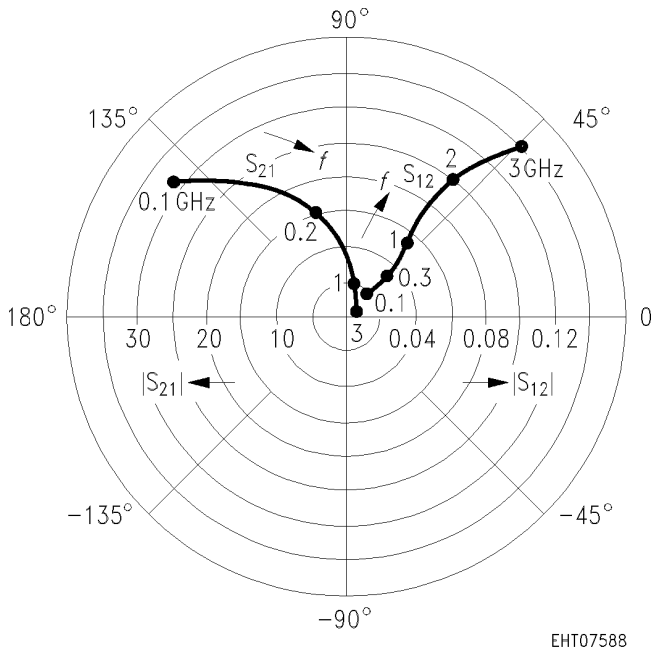
***S*12, *S*21 = *f* (*f*)**
I_C = 20 mA, V_{CE} = 6 V, Z_0 = 50 Ω



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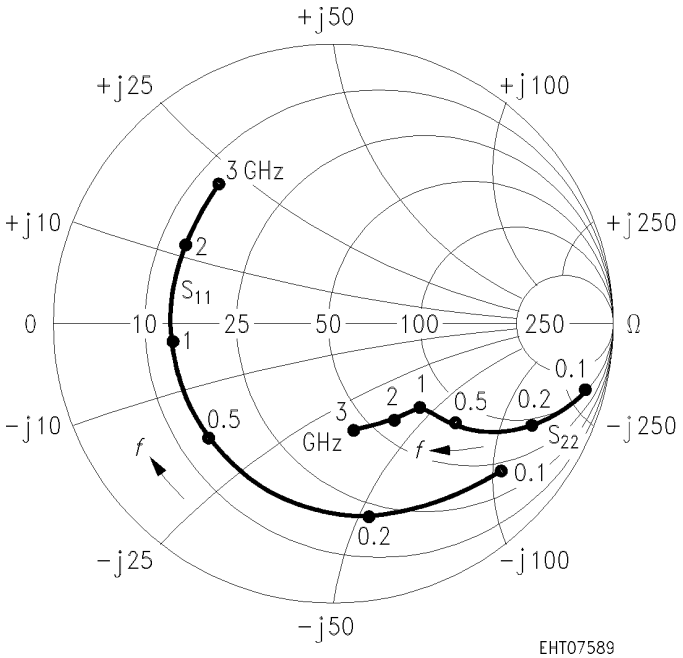
Common Emitter S Parameters (continued)

f	S_{11}		S_{21}		S_{12}		S_{22}	
GHz	**MAG**	**ANG**	**MAG**	**ANG**	**MAG**	**ANG**	**MAG**	**ANG**
I_C = 10 mA, V_{CE} = 10 V, Z_0 = 50 Ω								
0.1	0.75	– 45	22.64	153	0.018	67	0.91	– 18
0.2	0.69	– 83	17.84	131	0.030	53	0.75	– 29
0.3	0.63	– 109	13.82	117	0.037	45	0.63	– 34
0.4	0.62	– 127	11.23	107	0.041	42	0.55	– 36
0.6	0.59	– 149	7.88	93	0.046	40	0.46	– 37
0.8	0.59	– 164	6.01	84	0.051	41	0.42	– 37
1.0	0.59	– 174	4.83	77	0.056	43	0.40	– 38
1.2	0.59	178	4.09	70	0.061	44	0.38	– 40
1.5	0.59	167	3.29	61	0.070	46	0.37	– 43
1.8	0.60	159	2.75	53	0.080	47	0.37	– 48
2.0	0.62	153	2.49	48	0.087	47	0.36	– 52
2.5	0.63	142	2.03	36	0.106	47	0.34	– 62
3.0	0.66	131	1.73	25	0.126	45	0.33	– 75

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



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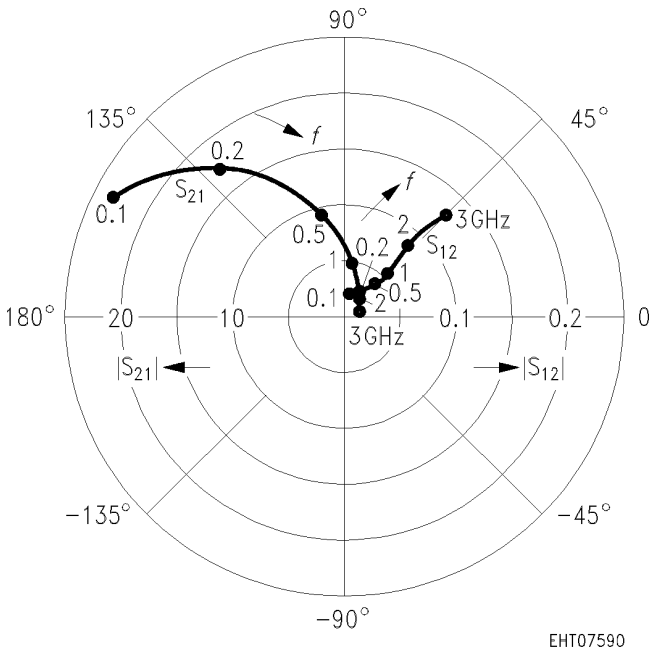
***S*12, *S*21 = *f* (*f*)**
I_C = 10 mA, V_{CE} = 10 V, Z_0 = 50 Ω



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