SIEMENS
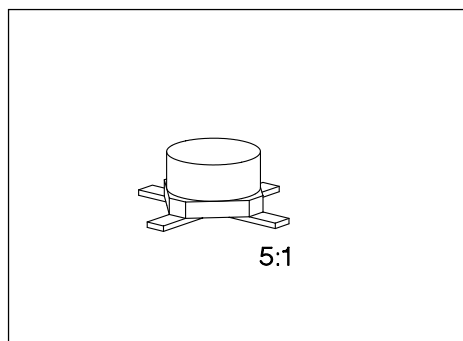
NPN Silicon RF Transistor   BFQ 71

● For broadband amplifiers up to 2 GHz and fast
  non-saturated switches at collector currents from
  1 mA to 20 mA.

● Hermetically sealed ceramic package.

● HiRel/Mil screening available.

● CECC-type available: CECC 50002/260.

5:1

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

Type	Marking	Ordering Code (tape and reel)	Pin Configuration				Package[1]
			1	2	3	4	
BFQ 71	71	Q62702-F775	B	E	C	E	Cerec-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	30	mA
Base current	I_B	4	
Total power dissipation, $T_S \leq 103\ ^\circ C$ [3]	P_{tot}	300	mW
Junction temperature	T_j	175	$^\circ C$
Ambient temperature range	T_A	− 65 … + 175	
Storage temperature range	T_{stg}	− 65 … + 175	

Thermal Resistance

Junction - ambient [2]	$R_{th\ JA}$	≤ 320	K/W
Junction - soldering point [3]	$R_{th\ JS}$	≤ 240	

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[1] For detailed dimensions 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

Parameter	Symbol	min.	typ.	max.	Unit
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 = 5 mA, V_{CE} = 6 V I_C = 20 mA, V_{CE} = 6 V	h_{FE}	 40 40	 90 100	 250 –	–
Collector-emitter saturation voltage I_C = 30 mA, I_B = 3 mA	V_{CEsat}	–	0.16	0.4	V
Base-emitter voltage I_C = 5 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

| Parameter	Symbol	min.	typ.	max.	Unit
Transition frequency $I_C = 5$ mA, $V_{CE} = 6$ V, $f = 200$ MHz $I_C = 20$ mA, $V_{CE} = 6$ V, $f = 200$ MHz	f_T	– 4	4.2 5.2	– –	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}	–	0.4	–	
Input capacitance $V_{EB} = 0.5$ V, $I_C = i_c = 0$, $f = 1$ MHz	C_{ibo}	–	1.2	–	
Output capacitance $V_{CE} = 6$ V, $V_{BE} = v_{be} = 0$, $f = 1$ MHz	C_{obs}	–	0.86	1.2	
Noise figure $I_C = 5$ mA, $V_{CE} = 6$ V, $f = 10$ MHz, $Z_S = 75\ \Omega$ $I_C = 2$ mA, $V_{CE} = 6$ V, $f = 800$ MHz, $Z_S = Z_{Sopt}$ $I_C = 3$ mA, $V_{CE} = 10$ V, $f = 2$ GHz, $Z_S = Z_{Sopt}$	F	– – –	1.4 1.5 3.2	2.2 3 –	dB
Power gain $I_C = 2$ mA, $V_{CE} = 6$ V, $f = 800$ MHz, $Z_S = Z_{Sopt}$, $Z_L = Z_{Lopt}$	G_{pe}	–	15	–	
Transducer gain $I_C = 20$ mA, $V_{CE} = 6$ V, $f = 1$ GHz, $Z_0 = 50\ \Omega$	$\lvert S_{21e}\rvert^2$	–	13.4	–	
Linear output voltage two-tone intermodulation test $I_C = 15$ mA, $V_{CE} = 10$ V, $d_{IM} = 60$ dB, $f_1 = 806$ MHz, $f_2 = 810$ MHz, $Z_S = Z_L = 50\ \Omega$	$V_{o1} = V_{o2}$	–	110	–	mV
Third order intercept point $I_C = 15$ mA, $V_{CE} = 10$ V, $f = 800$ MHz	IP_3	–	23.5	–	dBm

Total power dissipation $P_{tot} = f(T_A*; T_S)$
*Package mounted on alumina
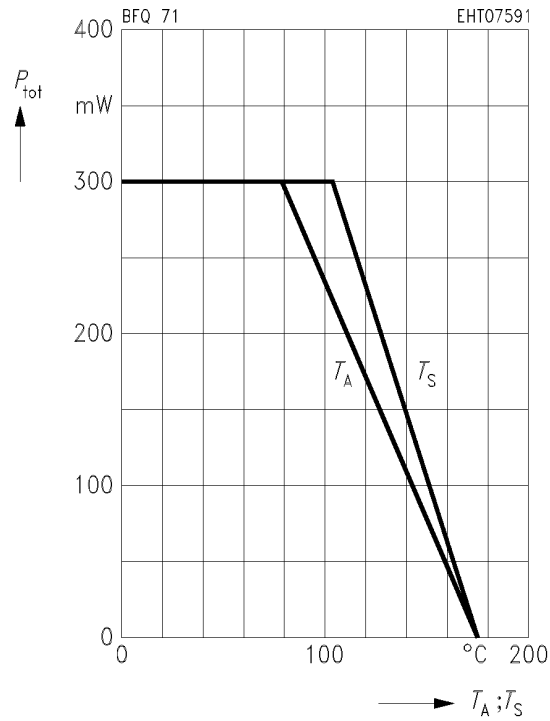
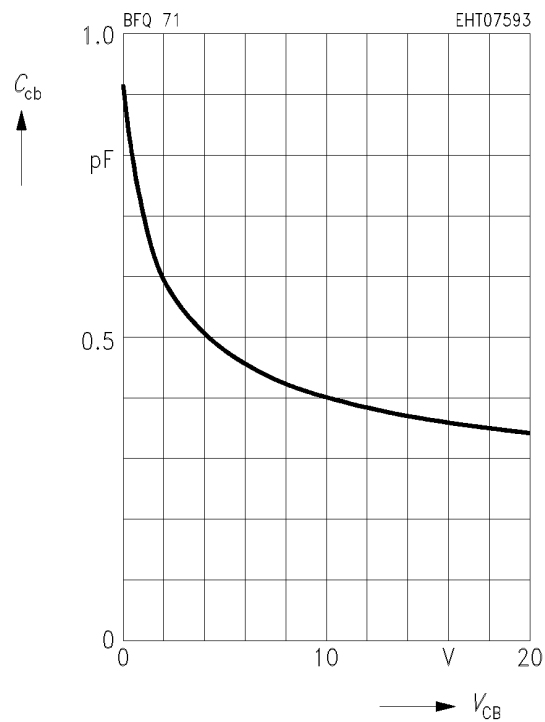**Transition frequency $f_T = f(I_C)$**
$V_{CE} = 6$ V, $f = 200$ MHz
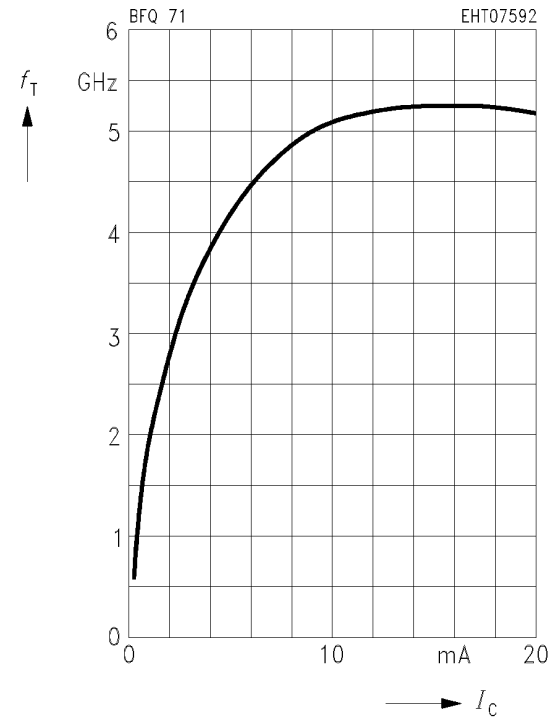
Collector-base capacitance $C_{cb} = f(V_{CB})$
$V_{BE} = v_{be} = 0, f = 1$ MHz

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**

$I_C = 2$ mA, $V_{CE} = 6$ V, $Z_0 = 50$ Ω

0.01	1.1	–	($Z_S = 150$ Ω)		–	–	1.6	–

$I_C = 5$ mA, $V_{CE} = 10$ V, $Z_0 = 50$ Ω

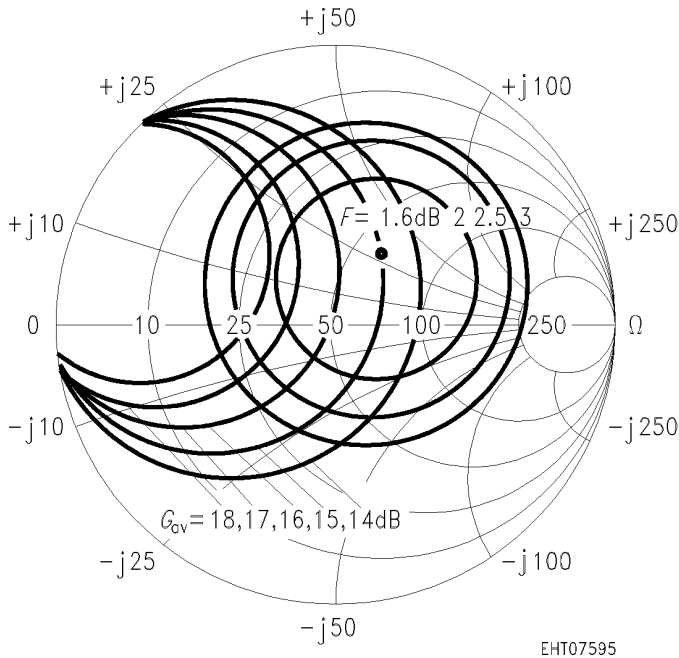|								
0.01	1.3	–	($Z_S = 100$ Ω)		–	–	1.7	–
0.8	1.6	15.3	0.29	56	18.5	0.24	1.8	14.8
2.0	3.1	9	0.12	124.5	30	0.67	–	–

Noise figure $F = f\,(Z_S)$
$V_{CE} = 6$ V, $f = 10$ MHz
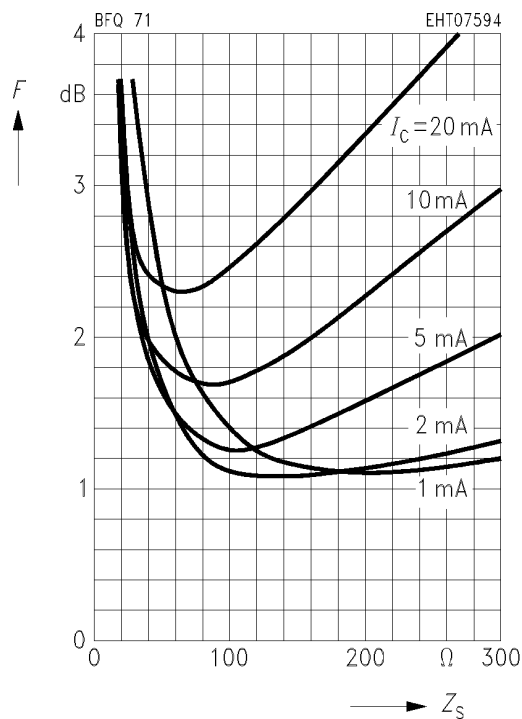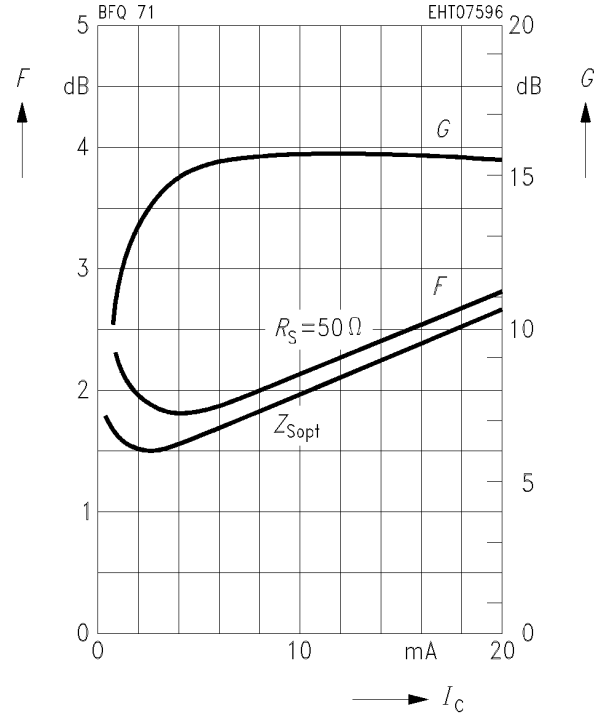
**Circles of constant noise figure $F = f(Z_S)$
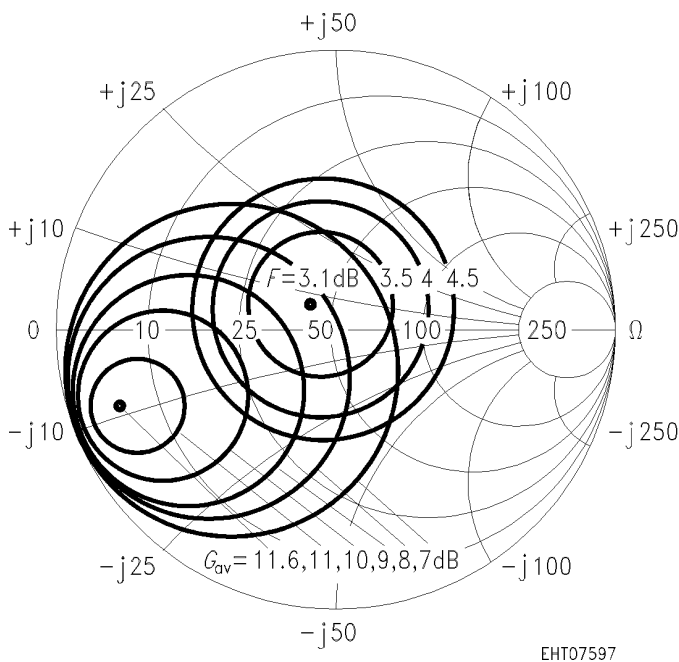and available power gain $G_{av} = f(Z_S)$**
$I_C = 5$ mA, $V_{CE} = 10$ V, $f = 800$ MHz

**Noise figure $F = f(I_C)$
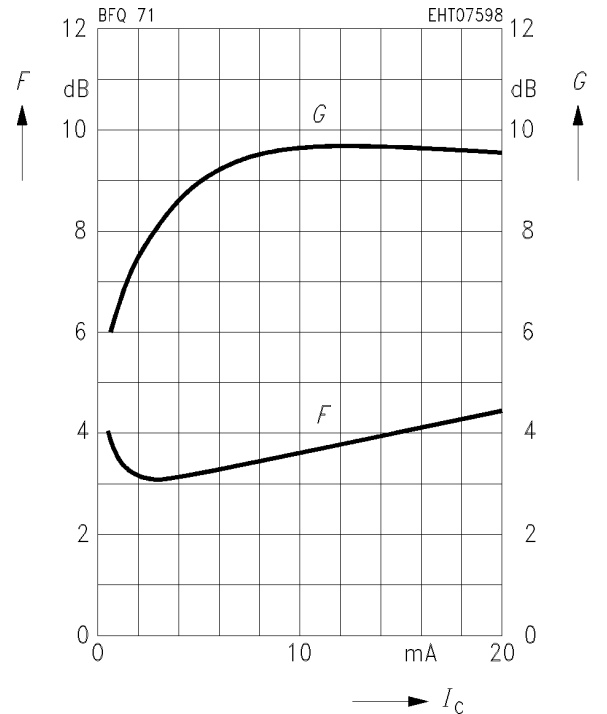Power gain $G = f(I_C)$**
$V_{CE} = 10$ V, $f = 800$ MHz, $Z_{Lopt}(G)$

**Circles of constant noise figure $F = f(Z_S)$
and available power gain $G_{av} = f(Z_S)$**
$I_C = 5$ mA, $V_{CE} = 10$ V, $f = 2$ GHz
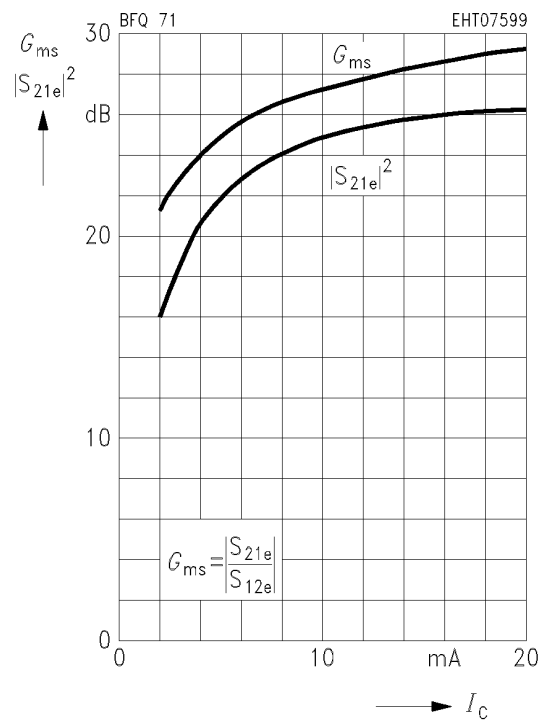

**Noise figure $F = f(I_C)$
Power gain $G = f(I_C)$**
$V_{CE} = 10$ V, $f = 2$ GHz, $Z_{Lopt}(G)$

Common Emitter Power Gain

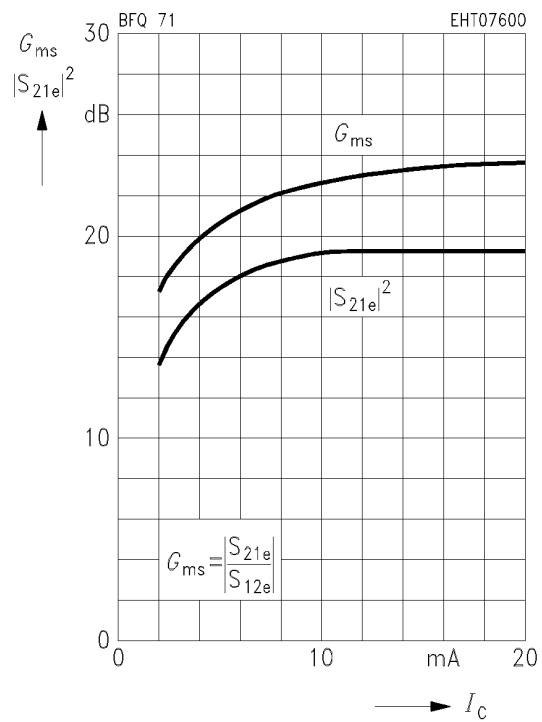**Power gain G_{ms}, $|S_{21e}|^2 = f(I_C)$**
$V_{CE} = 6$ V, $f = 200$ MHz, $Z_0 = 50$ Ω

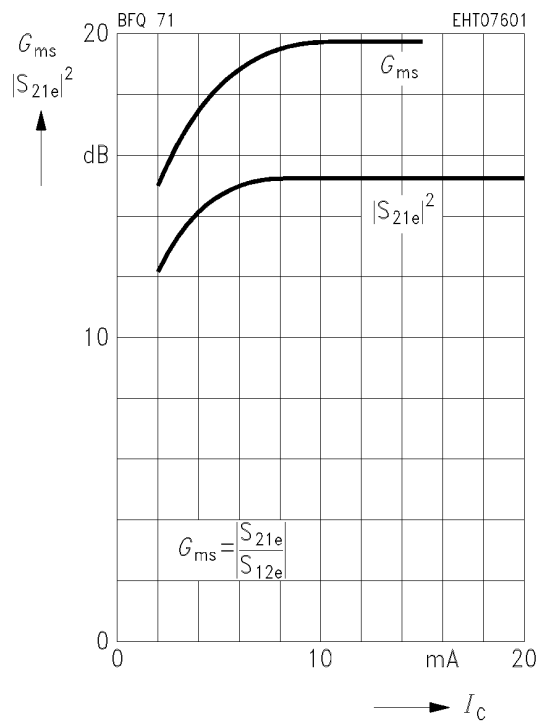BFQ 71   EHT07599

$$G_{ms} = \left|\frac{S_{21e}}{S_{12e}}\right|$$

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

BFQ 71   EHT07600

$$G_{ms} = \left|\frac{S_{21e}}{S_{12e}}\right|$$

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

BFQ 71   EHT07601

$$G_{ms} = \left|\frac{S_{21e}}{S_{12e}}\right|$$

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

BFQ 71   EHT07602

$$G_{ma} = \left|\frac{S_{21e}}{S_{12e}}\right| \left(k - \sqrt{k^2 - 1}\right)$$
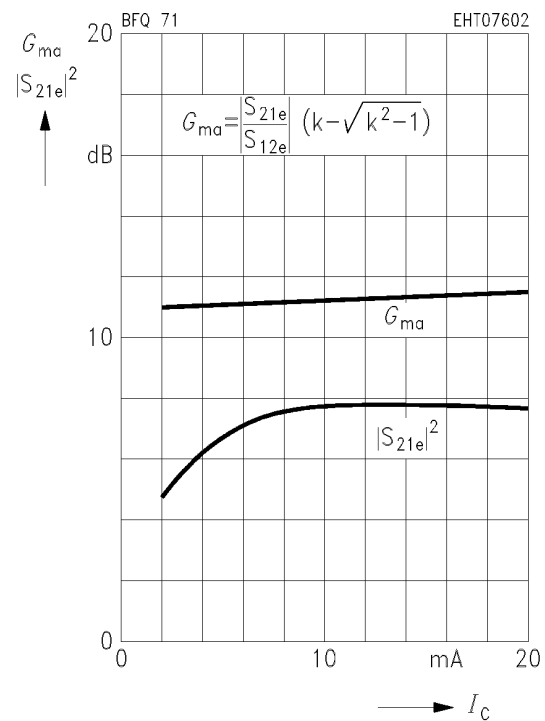
Power gain G_{ms}, $|S_{21e}|^2 = f(f)$
$I_C = 2$ mA, $V_{CE} = 6$ V, $Z_0 = 50$ Ω
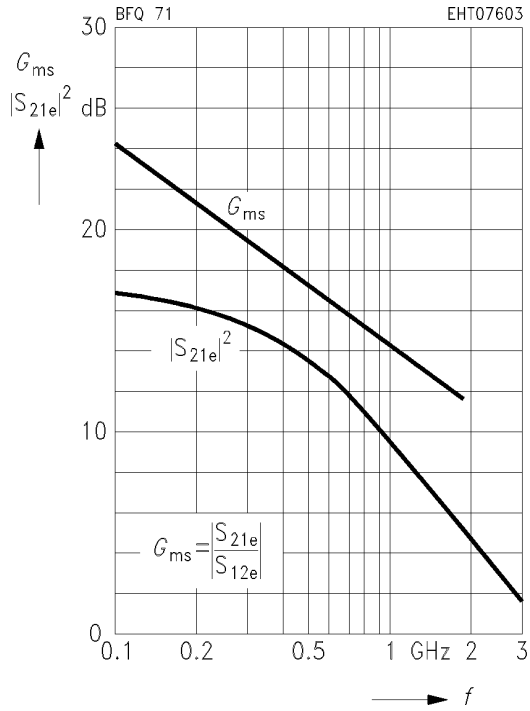
Power gain G_{ma}, G_{ms}, $|S_{21e}|^2 = f(f)$
$I_C = 5$ mA, $V_{CE} = 6$ V, $Z_0 = 50$ Ω
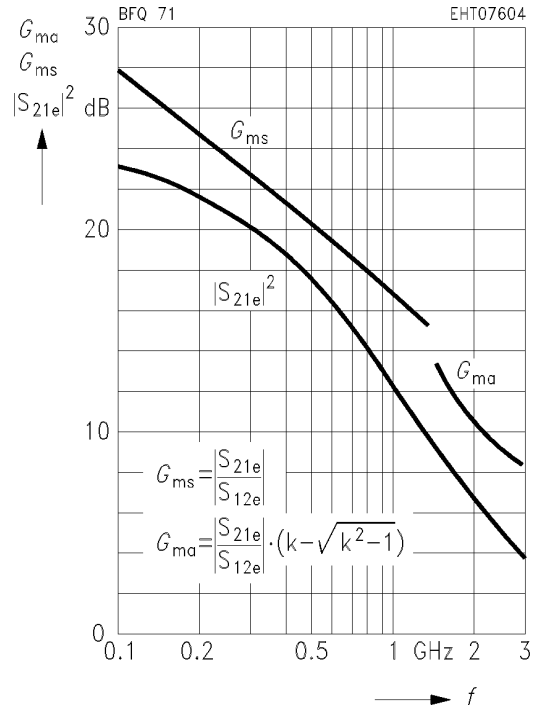
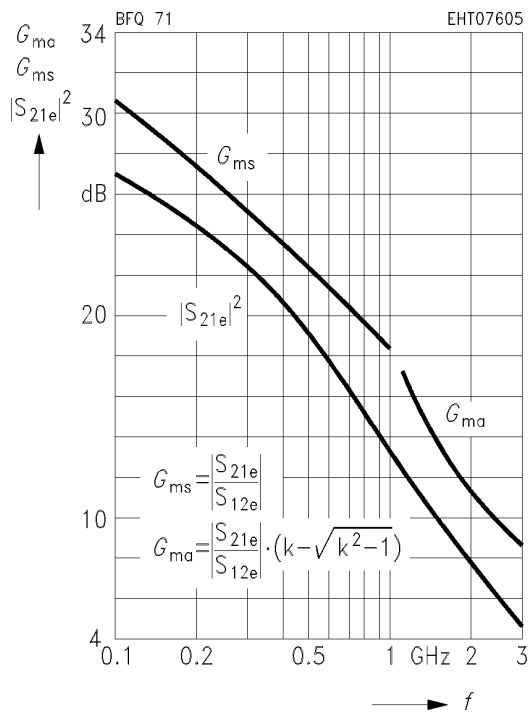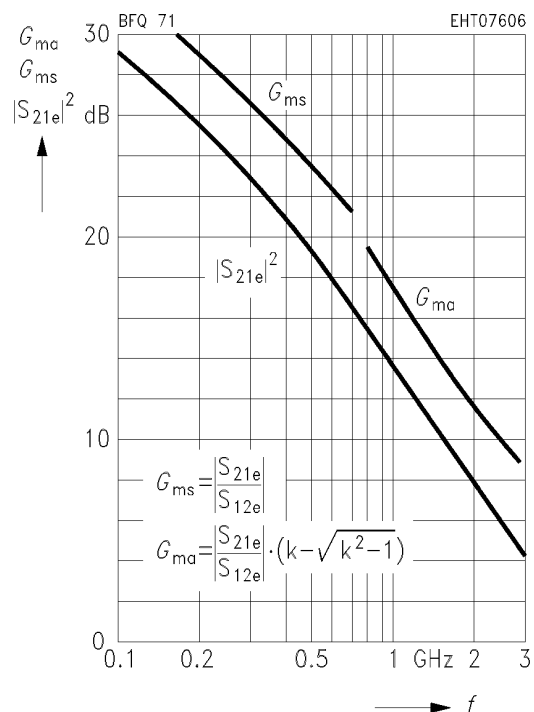
Power gain G_{ma}, G_{ms}, $|S_{21e}|^2 = f(f)$
$I_C = 10$ mA, $V_{CE} = 6$ V, $Z_0 = 50$ Ω

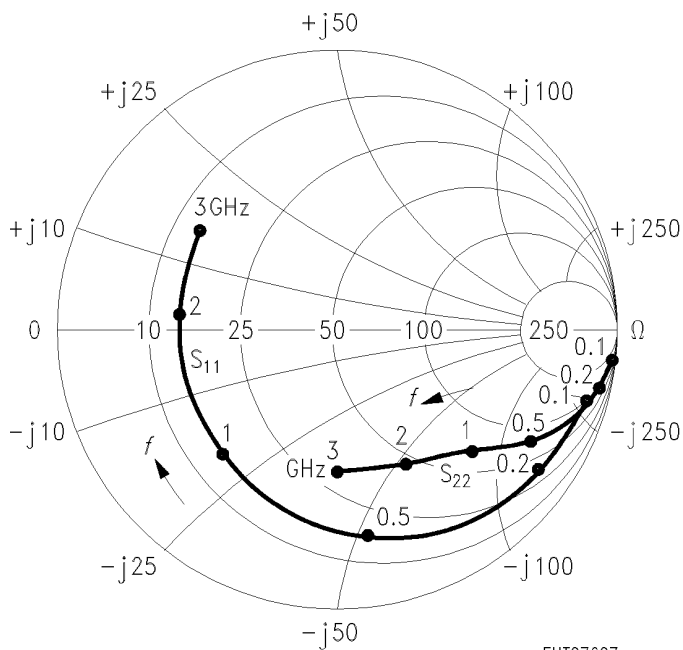**Power gain G_{ma}, G_{ms}, $|S_{21e}|^2 = f(f)$**
$I_C = 20$ mA, $V_{CE} = 6$ V, $Z_0 = 50$ Ω

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	0.90	− 19	6.93	166	0.025	78	0.98	− 8
0.2	0.87	− 37	6.45	152	0.048	68	0.94	− 16
0.3	0.81	− 55	5.85	140	0.068	59	0.88	− 23
0.4	0.77	− 71	5.41	129	0.082	51	0.82	− 28
0.6	0.69	− 97	4.41	112	0.101	40	0.73	− 36
0.8	0.64	− 118	3.64	98	0.112	33	0.65	− 41
1.0	0.61	− 134	3.06	87	0.118	28	0.60	− 45
1.2	0.59	− 147	2.64	79	0.121	25	0.57	− 49
1.5	0.57	− 163	2.19	66	0.125	22	0.54	− 54
1.8	0.57	− 176	1.87	56	0.129	20	0.52	− 60
2.0	0.58	176	1.70	49	0.131	20	0.51	− 65
2.5	0.59	159	1.41	34	0.138	20	0.49	− 78
3.0	0.60	145	1.21	21	0.150	19	0.48	− 92

$S_{11}, S_{22} = f (f)$
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
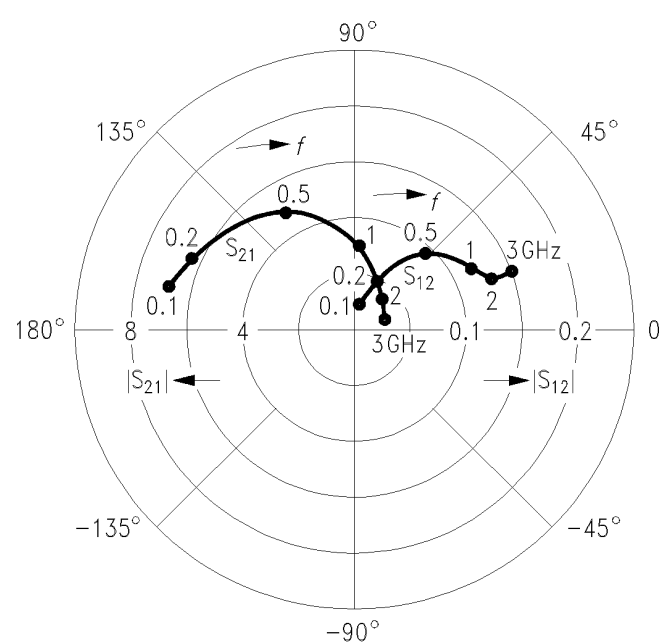
EHT07607

EHT07608

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	0.79	− 31	14.23	160	0.023	76	0.95	− 14
0.2	0.73	− 59	12.37	151	0.040	61	0.84	− 26
0.3	0.66	− 83	10.36	127	0.053	51	0.73	− 33
0.4	0.62	− 102	8.88	115	0.060	45	0.65	− 38
0.6	0.57	− 128	6.56	100	0.071	40	0.53	− 43
0.8	0.55	− 146	5.12	89	0.077	37	0.47	− 46
1.0	0.54	− 160	4.17	80	0.083	37	0.43	− 48
1.2	0.54	− 170	3.55	73	0.089	37	0.40	− 51
1.5	0.54	178	2.89	63	0.099	37	0.38	− 55
1.8	0.54	168	2.43	54	0.110	37	0.37	− 61
2.0	0.56	162	2.20	48	0.117	36	0.36	− 65
2.5	0.57	148	1.81	35	0.137	35	0.34	− 78
3.0	0.59	136	1.55	23	0.158	32	0.34	− 92

$S_{11}, S_{22} = f\,(f)$
$I_C = 5$ mA, $V_{CE} = 6$ V, $Z_0 = 50$ Ω
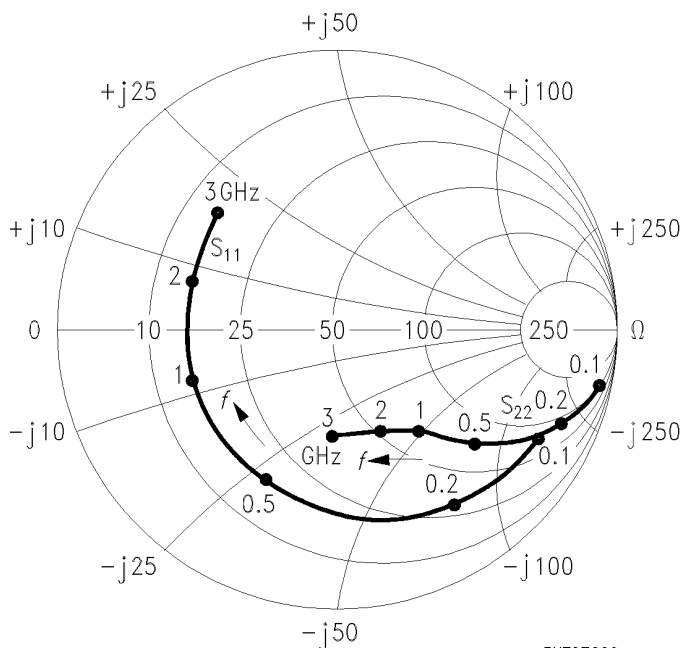
EHT07609

$S_{12}, S_{21} = f\,(f)$
$I_C = 5$ mA, $V_{CE} = 6$ V, $Z_0 = 50$ Ω
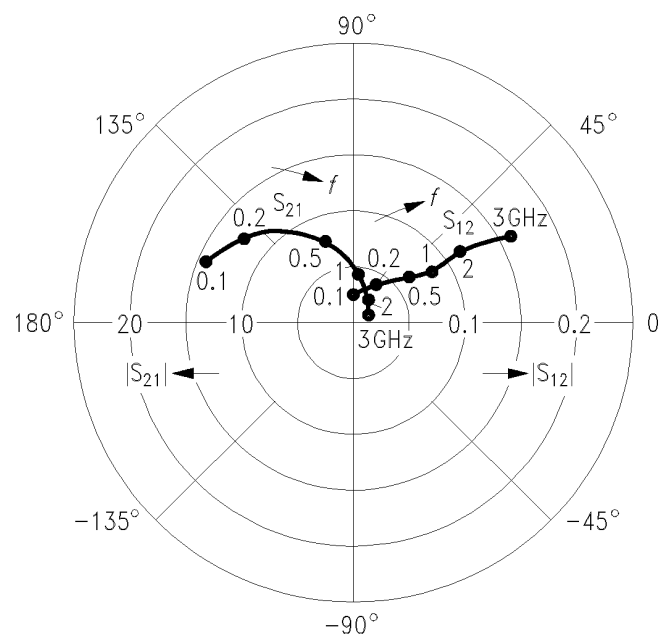
EHT07610

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	0.68	− 47	22.06	152	0.020	70	0.90	− 20
0.2	0.60	− 85	17.31	130	0.032	56	0.73	− 33
0.3	0.55	− 111	13.39	116	0.040	49	0.59	− 39
0.4	0.55	− 128	10.84	106	0.045	46	0.51	− 42
0.6	0.53	− 150	7.60	93	0.053	46	0.41	− 44
0.8	0.53	− 164	5.80	83	0.061	46	0.37	− 46
1.0	0.53	− 174	4.67	76	0.069	47	0.34	− 47
1.2	0.53	178	3.95	70	0.078	48	0.32	− 49
1.5	0.53	168	3.19	60	0.091	48	0.31	− 53
1.8	0.54	160	2.67	52	0.106	47	0.31	− 59
2.0	0.56	155	2.42	47	0.114	46	0.30	− 63
2.5	0.58	143	1.99	34	0.138	43	0.28	− 76
3.0	0.60	132	1.69	23	0.163	38	0.28	− 91

S_{11}, S_{22} = f (f)
I_C = 10 mA, V_{CE} = 6 V, Z_0 = 50 Ω
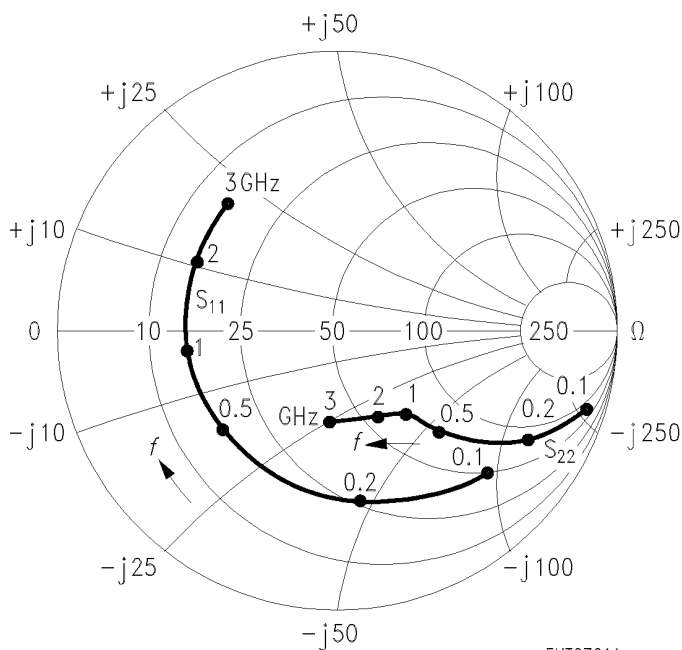
S_{12}, S_{21} = f (f)
I_C = 10 mA, V_{CE} = 6 V, Z_0 = 50 Ω
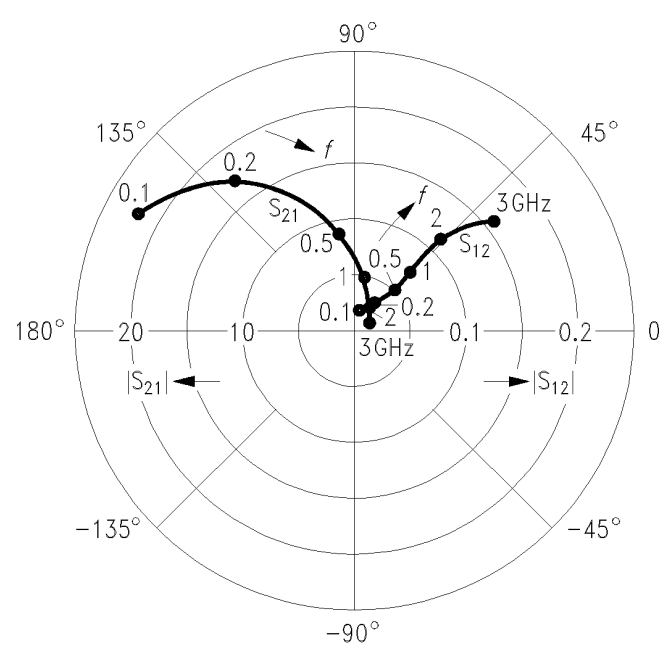
EHT07611

EHT07612

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	0.56	− 57	25.74	145	0.018	69	0.85	− 23
0.2	0.47	− 96	18.17	122	0.028	58	0.65	− 32
0.3	0.42	− 121	13.28	109	0.035	56	0.54	− 35
0.4	0.42	− 137	10.48	100	0.042	57	0.47	− 35
0.6	0.41	− 156	7.19	89	0.054	59	0.41	− 36
0.8	0.40	− 168	5.46	81	0.068	60	0.39	− 37
1.0	0.41	− 177	4.39	74	0.082	60	0.37	− 39
1.2	0.41	176	3.71	68	0.096	60	0.36	− 41
1.5	0.41	169	3.01	59	0.118	58	0.35	− 45
1.8	0.43	161	2.53	52	0.142	56	0.35	− 52
2.0	0.44	156	2.31	47	0.158	53	0.34	− 57
2.5	0.46	147	1.91	35	0.204	47	0.33	− 70
3.0	0.50	137	1.65	24	0.255	38	0.32	− 88

S_{11}, $S_{22} = f(f)$
$I_C = 15$ mA, $V_{CE} = 6$ V, $Z_0 = 50$ Ω
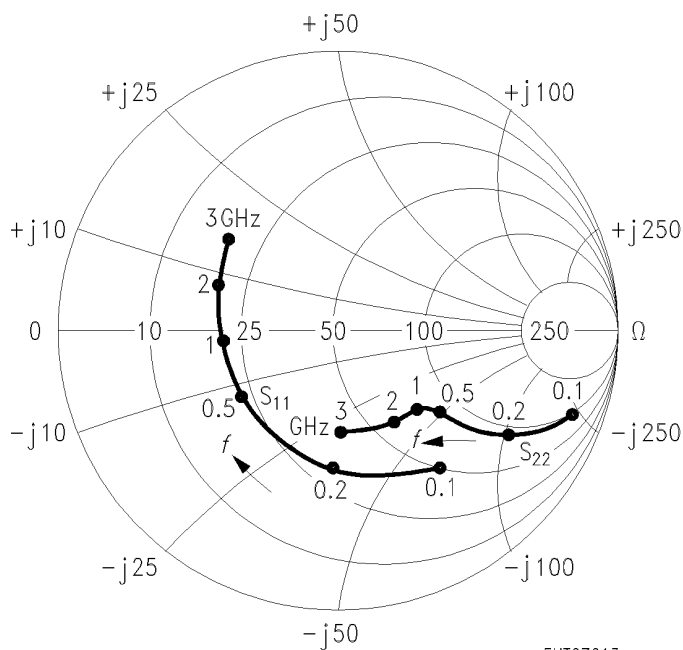
S_{12}, $S_{21} = f(f)$
$I_C = 15$ mA, $V_{CE} = 6$ V, $Z_0 = 50$ Ω
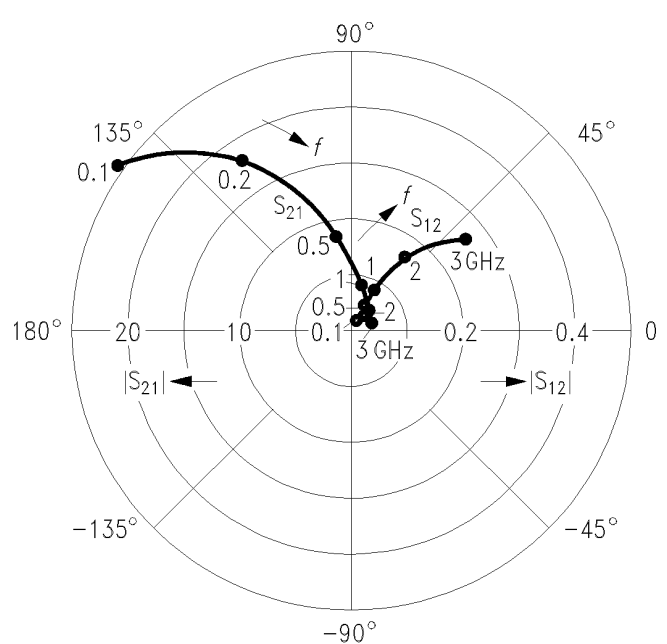
EHT07613

EHT07614

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	0.54	− 71	29.35	142	0.016	66	0.82	− 25
0.2	0.52	− 114	20.19	119	0.025	52	0.60	− 36
0.3	0.51	− 137	14.58	106	0.030	51	0.48	− 39
0.4	0.52	− 150	11.40	98	0.034	51	0.42	− 39
0.6	0.52	− 166	7.77	87	0.043	54	0.36	− 38
0.8	0.53	− 176	5.86	79	0.053	56	0.34	− 39
1.0	0.54	176	4.69	73	0.062	56	0.32	− 41
1.2	0.54	170	3.96	66	0.072	56	0.31	− 43
1.5	0.54	161	3.19	57	0.087	55	0.30	− 47
1.8	0.55	155	2.66	50	0.102	53	0.30	− 54
2.0	0.58	150	2.41	45	0.112	52	0.30	− 59
2.5	0.59	140	1.97	32	0.137	48	0.28	− 72
3.0	0.62	130	1.68	21	0.162	42	0.28	− 87

S_{11}, $S_{22} = f(f)$
$I_C = 20$ mA, $V_{CE} = 6$ V, $Z_0 = 50$ Ω
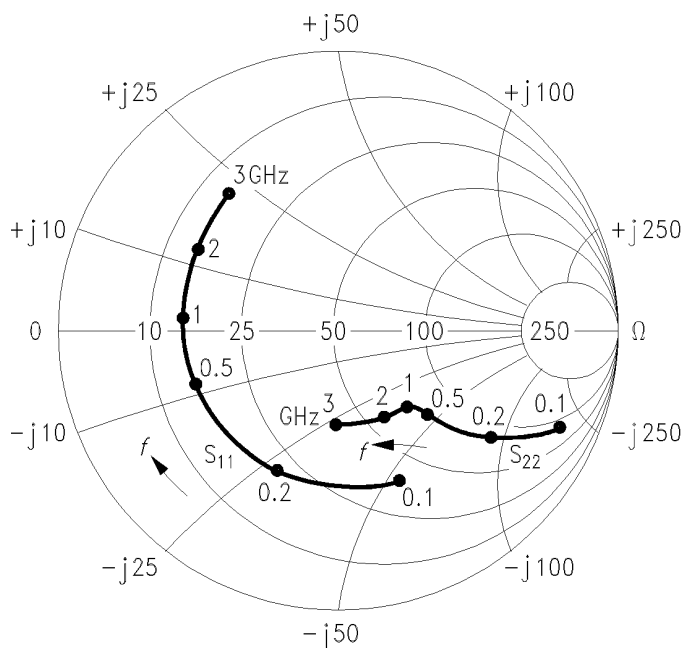
EHT07615

S_{12}, $S_{21} = f(f)$
$I_C = 20$ mA, $V_{CE} = 6$ V, $Z_0 = 50$ Ω
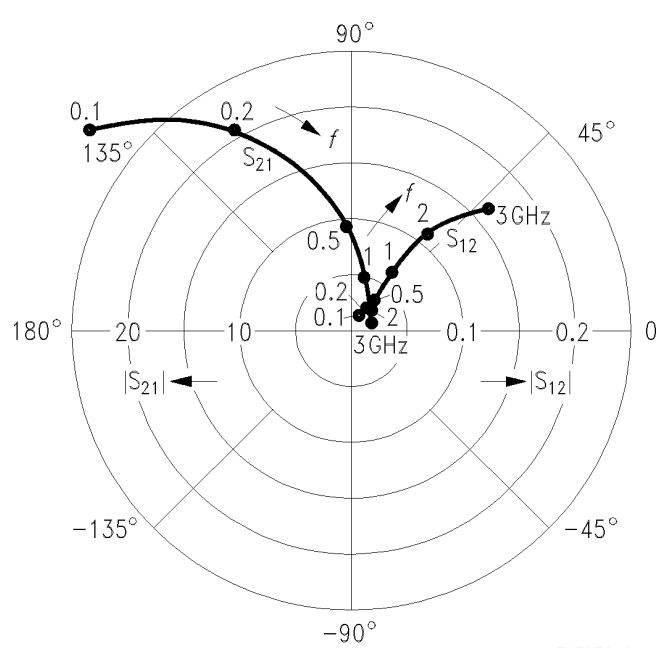
EHT07616

Common Emitter S Parameters (continued)

f	S_{11}		S_{21}		S_{12}		S_{22}	
GHz	**MAG**	**ANG**	**MAG**	**ANG**	**MAG**	**ANG**	**MAG**	**ANG**

$I_C = 2$ mA, $V_{CE} = 10$ V, $Z_0 = 50\ \Omega$

GHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
0.1	0.91	− 17	7.02	166	0.021	78	0.98	− 7
0.2	0.87	− 36	6.57	153	0.042	69	0.95	− 14
0.3	0.82	− 53	5.98	141	0.060	60	0.90	− 20
0.4	0.78	− 69	5.01	130	0.073	53	0.84	− 25
0.6	0.70	− 94	4.54	113	0.090	42	0.75	− 33
0.8	0.64	− 115	3.76	100	0.100	35	0.69	− 38
1.0	0.60	− 132	3.17	89	0.106	30	0.64	− 41
1.2	0.58	− 145	2.74	80	0.109	27	0.61	− 45
1.5	0.56	− 161	2.28	68	0.113	24	0.58	− 50
1.8	0.56	− 174	1.94	57	0.118	23	0.56	− 55
2.0	0.57	177	1.77	51	0.120	23	0.55	− 60
2.5	0.58	160	1.47	36	0.127	23	0.53	− 72
3.0	0.59	146	1.26	22	0.140	23	0.52	− 85

$S_{11}, S_{22} = f\ (f)$
$I_C = 2$ mA, $V_{CE} = 10$ V, $Z_0 = 50\ \Omega$
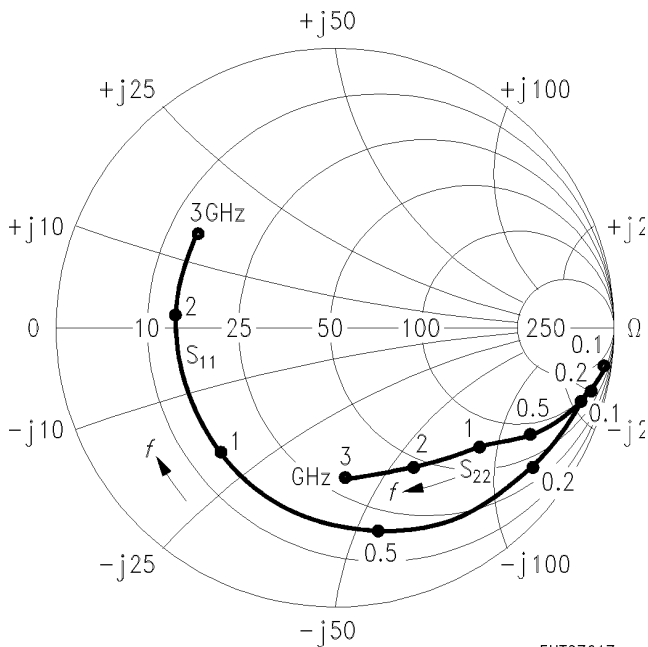
EHT07617

$S_{12}, S_{21} = f\ (f)$
$I_C = 2$ mA, $V_{CE} = 10$ V, $Z_0 = 50\ \Omega$
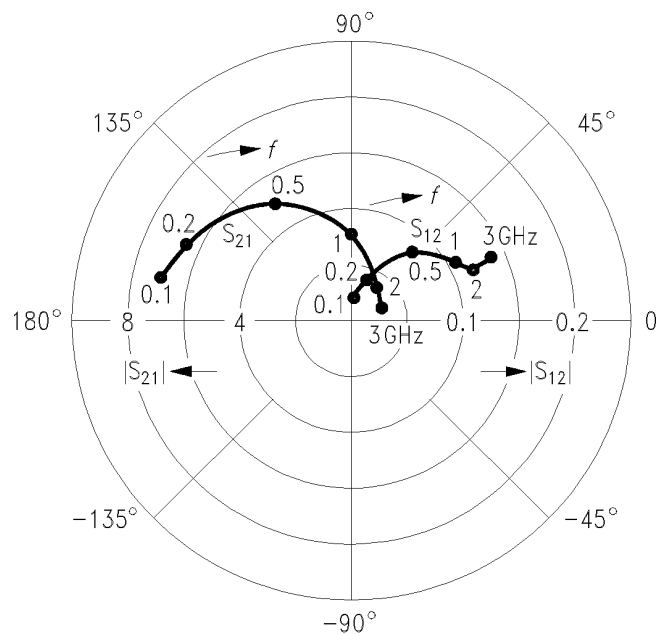
EHT07618

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} = 10 V, Z_0 = 50 Ω								
0.1	0.80	− 28	14.24	160	0.020	71	0.95	− 13
0.2	0.73	− 57	12.50	142	0.036	61	0.86	− 23
0.3	0.67	− 79	10.55	128	0.047	53	0.76	− 29
0.4	0.63	− 98	9.10	117	0.055	47	0.68	− 34
0.6	0.57	− 125	6.78	101	0.064	41	0.58	− 38
0.8	0.54	− 143	5.31	90	0.071	39	0.52	− 41
1.0	0.53	− 157	4.33	81	0.076	38	0.48	− 43
1.2	0.52	− 168	3.69	74	0.082	38	0.46	− 45
1.5	0.52	180	3.00	63	0.091	39	0.44	− 49
1.8	0.53	170	2.52	54	0.101	39	0.43	− 55
2.0	0.54	163	2.29	49	0.108	39	0.42	− 59
2.5	0.56	150	1.89	36	0.127	38	0.40	− 70
3.0	0.58	137	1.61	23	0.148	35	0.40	− 84

S_{11}, S_{22} = f (f)
I_C = 5 mA, V_{CE} = 10 V, Z_0 = 50 Ω
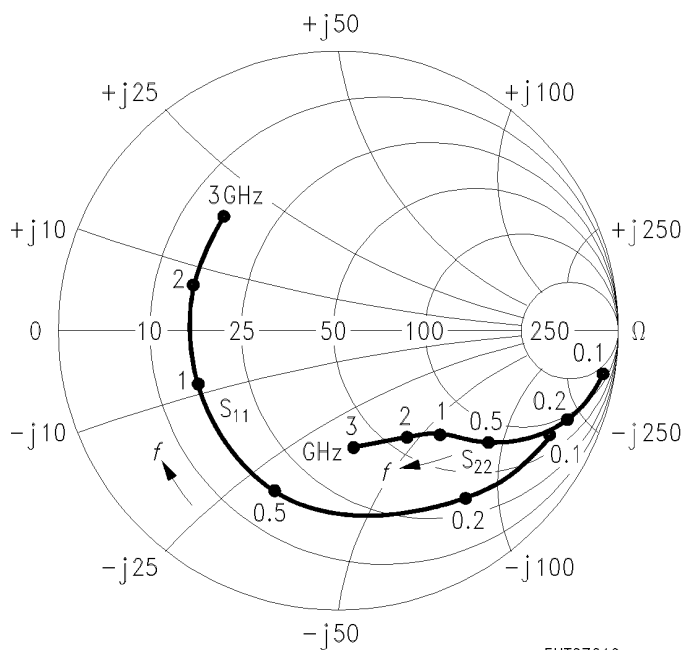
EHT07619

S_{12}, S_{21} = f (f)
I_C = 5 mA, V_{CE} = 10 V, Z_0 = 50 Ω
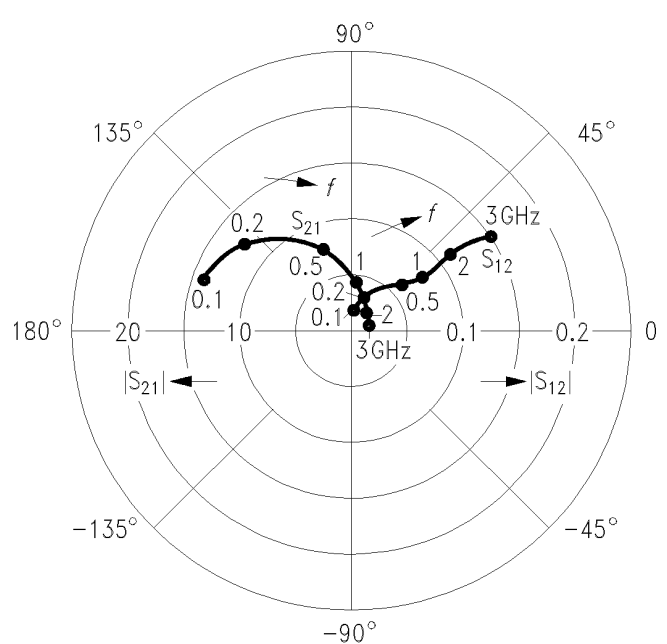
EHT07620

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	0.68	− 43	21.82	153	0.018	71	0.91	− 17
0.2	0.60	− 78	17.39	131	0.030	58	0.76	− 29
0.3	0.56	− 105	13.60	117	0.037	50	0.64	− 34
0.4	0.54	− 123	11.10	107	0.042	47	0.56	− 36
0.6	0.51	− 146	7.83	94	0.050	46	0.47	− 38
0.8	0.51	− 161	5.99	84	0.057	47	0.43	− 39
1.0	0.51	− 171	4.83	77	0.064	48	0.41	− 41
1.2	0.51	180	4.08	70	0.072	49	0.39	− 43
1.5	0.51	170	3.30	61	0.084	49	0.38	− 48
1.8	0.52	162	2.77	53	0.098	48	0.38	− 52
2.0	0.54	156	2.51	48	0.106	47	0.37	− 56
2.5	0.56	145	2.06	35	0.129	45	0.35	− 67
3.0	0.58	134	1.75	23	0.152	40	0.35	− 81

$S_{11}, S_{22} = f (f)$
$I_C = 10$ mA, $V_{CE} = 10$ V, $Z_0 = 50$ Ω
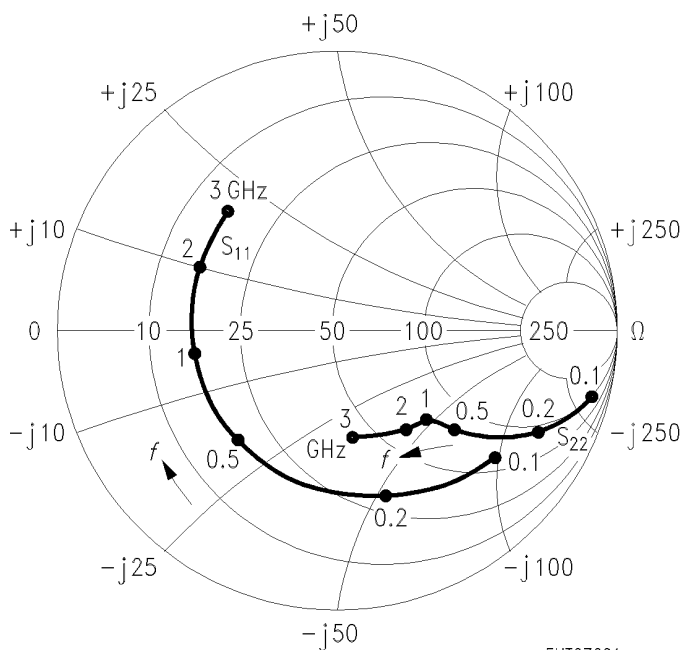
EHT07621

$S_{12}, S_{21} = f (f)$
$I_C = 10$ mA, $V_{CE} = 10$ V, $Z_0 = 50$ Ω
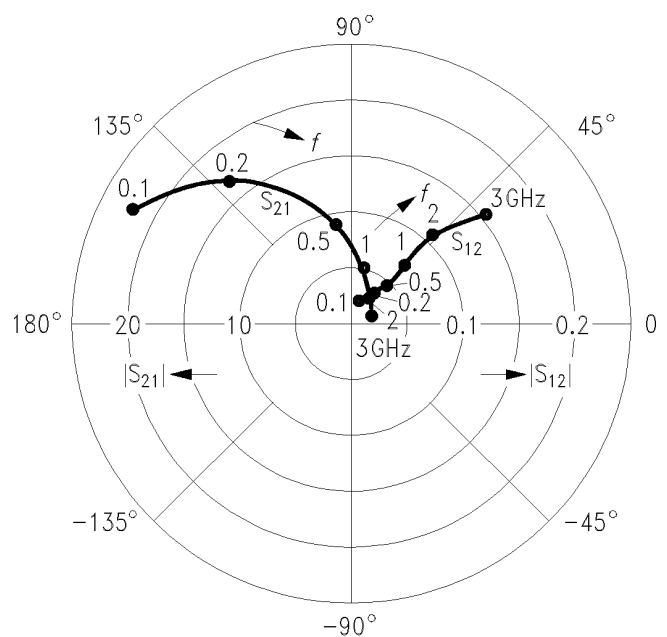
EHT07622

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} = 10 V, Z_0 = 50 Ω

GHz	MAG	ANG	MAG	ANG	MAG	ANG	MAG	ANG
0.1	0.62	− 55	26.35	148	0.017	69	0.88	− 20
0.2	0.55	− 94	19.54	125	0.026	55	0.69	− 31
0.3	0.52	− 119	14.64	112	0.031	50	0.57	− 34
0.4	0.51	− 136	11.66	102	0.036	50	0.50	− 35
0.6	0.50	− 156	8.06	90	0.044	51	0.44	− 35
0.8	0.50	− 169	6.12	82	0.052	52	0.41	− 36
1.0	0.51	− 178	4.91	75	0.061	53	0.39	− 38
1.2	0.51	175	4.15	68	0.069	54	0.38	− 40
1.5	0.51	166	3.35	59	0.082	53	0.37	− 44
1.8	0.53	158	2.80	51	0.097	52	0.37	− 50
2.0	0.54	153	2.53	47	0.106	51	0.36	− 54
2.5	0.57	143	2.07	34	0.129	48	0.34	− 65
3.0	0.59	132	1.77	23	0.153	43	0.34	− 80

S_{11}, S_{22} = f (f)
I_C = 15 mA, V_{CE} = 10 V, Z_0 = 50 Ω
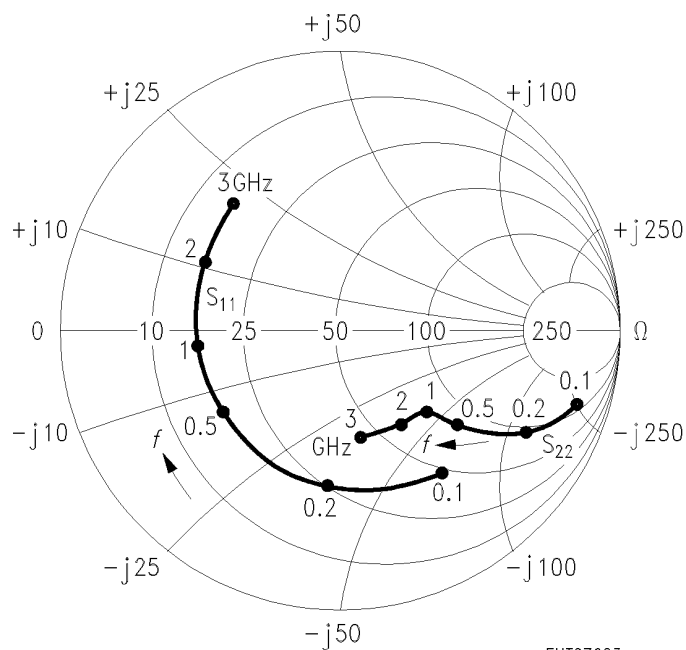
EHT07623

S_{12}, S_{21} = f (f)
I_C = 15 mA, V_{CE} = 10 V, Z_0 = 50 Ω
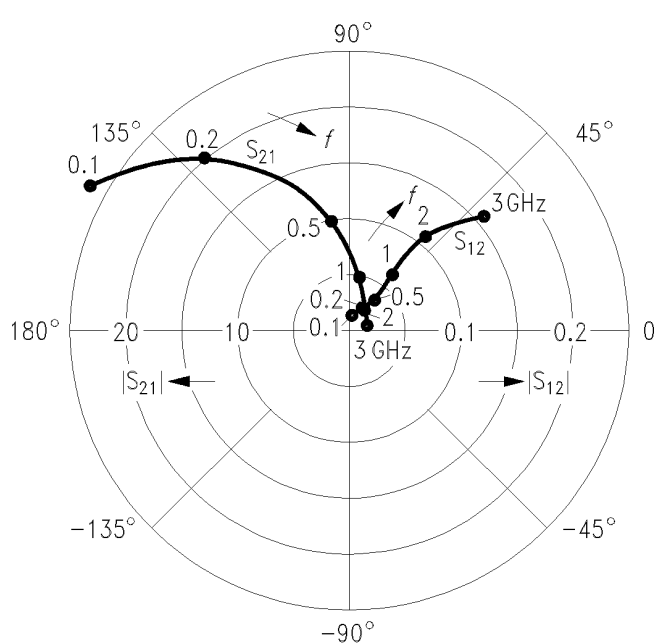
EHT07624

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, $V_{CE} = 10$ V, $Z_0 = 50$ Ω

0.1	0.57	− 63	28.86	144	0.015	65	0.84	− 21
0.2	0.52	− 106	20.30	121	0.024	54	0.65	− 30
0.3	0.50	− 130	14.82	108	0.029	50	0.54	− 32
0.4	0.51	− 144	11.65	99	0.033	52	0.49	− 32
0.6	0.50	− 162	7.97	88	0.041	54	0.43	− 32
0.8	0.51	− 173	6.02	80	0.050	56	0.41	− 33
1.0	0.52	179	4.83	73	0.058	56	0.40	− 35
1.2	0.52	172	4.08	67	0.068	57	0.38	− 38
1.5	0.52	163	3.29	58	0.081	56	0.38	− 42
1.8	0.53	156	2.74	50	0.096	54	0.38	− 48
2.0	0.55	152	2.49	46	0.104	53	0.37	− 53
2.5	0.57	141	2.04	33	0.128	50	0.36	− 64
3.0	0.60	131	1.73	22	0.152	44	0.36	− 79

$S_{11}, S_{22} = f(f)$
$I_C = 20$ mA, $V_{CE} = 10$ V, $Z_0 = 50$ Ω
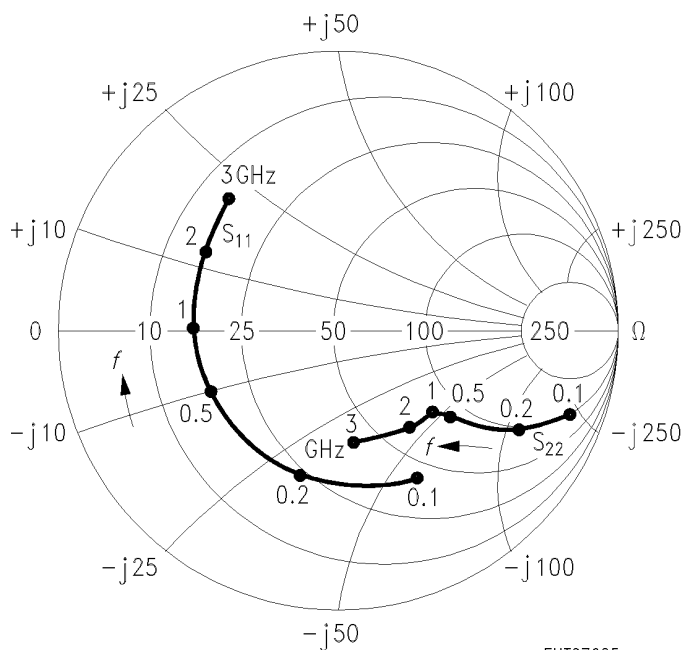
EHT07625

$S_{12}, S_{21} = f(f)$
$I_C = 20$ mA, $V_{CE} = 10$ V, $Z_0 = 50$

EHT07626