

The RF Line
NPN Silicon
High-Frequency Transistors

Designed for low noise, wide dynamic range front-end amplifiers and low-noise VCO's. Available in a surface-mountable plastic package, as well as the popular TO-226AA (TO-92) package. This Motorola series of small-signal plastic transistors offers superior quality and performance at low cost.

- High Gain-Bandwidth Product
 $f_T = 8.0 \text{ GHz (Typ) @ } 50 \text{ mA}$
- Low Noise Figure
 $NF_{min} = 1.6 \text{ dB (Typ) @ } f = 1.0 \text{ GHz (MRF5711LT1, MRF571)}$
- High Gain
 $G_{NF} = 17 \text{ dB (Typ) @ } 30 \text{ mA/500 MHz (MMBR571LT1)}$
- High Power Gain
 $G_{pse} \text{ (matched)} = 13.5 \text{ dB (Typ) (MRF5711LT1)}$
- State-of-the-Art Technology
Fine Line Geometry
Ion-Implanted Arsenic Emitters
Gold Top Metallization and Wires
Silicon Nitride Passivation
- Available in tape and reel packaging options:
T1 suffix = 3,000 units per reel

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	V _{CEO}	10	V _{dc}
Collector-Base Voltage	V _{CBO}	20	V _{dc}
Emitter-Base Voltage	V _{EBO}	3.0	V _{dc}
Collector Current — Continuous	I _C	80	mA
Total Device Dissipation @ T _{case} = 75°C MMBR571LT1, MRF5711LT1 Derate linearly above T _{case} = 75°C @	P _{D(max)}	0.33 4.44	W mW/°C
Total Device Dissipation @ T _A = 25°C Derate above 25°C	P _D	0.63 5.0	Watts mW/°C
Total Device Dissipation (1) @ T _C = 75°C Derate above 75°C	P _D	0.58 7.73	Watts mW/°C
Operating and Storage Temperature	T _{stg}	-55 to +150	°C

THERMAL CHARACTERISTICS

Rating	Symbol	Max	Unit
Thermal Resistance, Junction to Ambient	R _{θJA}	200	°C/W
Thermal Resistance, Junction to Case MRF5711LT1, MMBR571LT1	R _{θJC}	225	°C/W
Thermal Resistance, Junction to Case	R _{θJC}	130	°C/W
Maximum Junction Temperature	T _{Jmax}	150	°C

DEVICE MARKING

MMBR571LT1 = 7X	MRF5711LT1 = 02
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NOTE:

1. Case temperature measured on collector lead immediately adjacent to body of package.

MMBR571LT1
MPS571 MRF571
MRF5711LT1

I_C = 80 mA
LOW NOISE
HIGH-FREQUENCY
TRANSISTORS



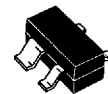
CASE 318-08, STYLE 6
SOT-23
LOW PROFILE
MMBR571LT1



CASE 29-04, STYLE 2
TO-226AA
(TO-92)
MPS571



CASE 317-01, STYLE 2
MACRO-X
MRF571



CASE 318A-05, STYLE 1
SOT-143
LOW PROFILE
MRF5711LT1

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

Characteristic	Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage ($I_C = 1.0\text{ mA}$, $I_B = 0$)	$V_{(BR)CEO}$	10	12	—	Vdc
Collector-Base Breakdown Voltage ($I_C = 0.1\text{ mA}$, $I_E = 0$)	$V_{(BR)CBO}$	20	—	—	Vdc
Emitter-Base Breakdown Voltage ($I_E = 50\text{ }\mu\text{A}$, $I_C = 0$)	$V_{(BR)EBO}$	2.5	—	—	Vdc
Collector Cutoff Current ($V_{CB} = 8.0\text{ Vdc}$, $I_E = 0$)	I_{CBO}	—	—	10	μA

ON CHARACTERISTICS

DC Current Gain ($I_C = 30\text{ mA}$, $V_{CE} = 5.0\text{ Vdc}$)	h_{FE}	50	—	300	—
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DYNAMIC CHARACTERISTICS

Collector-Base Capacitance ($V_{CB} = 10\text{ Vdc}$, $I_E = 0$, $f = 1.0\text{ MHz}$) ($V_{CB} = 6.0\text{ Vdc}$, $I_E = 0$, $f = 1.0\text{ MHz}$)	MPS571, MMBR571LT1 MRF5711LT1, MRF571	C_{cb}	— —	0.7 0.75	1.0 1.0	μF
Current Gain-Bandwidth Product ($V_{CE} = 5.0\text{ Vdc}$, $I_C = 50\text{ mA}$, $f = 1.0\text{ GHz}$) ($V_{CE} = 8.0\text{ Vdc}$, $I_C = 50\text{ mA}$, $f = 1.0\text{ GHz}$)	MPS571 MMBR571LT1 MRF5711LT1, MRF571	f_T	— — —	6.0 8.0 8.0	— — —	GHz

FUNCTIONAL TESTS

Gain @ Noise Figure ($I_C = 10\text{ mA}$, $V_{CE} = 6.0\text{ Vdc}$)	MRF571 MRF571	$f = 0.5\text{ GHz}$ $f = 1.0\text{ GHz}$	G_{NF}	— 10	16.5 12	— —	dB
Noise Figure ($I_C = 10\text{ mA}$, $V_{CE} = 6.0\text{ Vdc}$)	MRF571 MRF571	$f = 0.5\text{ GHz}$ $f = 1.0\text{ GHz}$ $f = 2.0\text{ GHz}$	NF	— — —	1.0 1.5 2.8	— 2.0 —	dB
Gain @ Noise Figure ($I_C = 10\text{ mA}$, $V_{CE} = 5.0\text{ Vdc}$)	MPS571 MMBR571LT1 MRF5711LT1	$f = 0.5\text{ GHz}$ $f = 1.0\text{ GHz}$ $f = 0.5\text{ GHz}$ $f = 1.0\text{ GHz}$ $f = 1.0\text{ GHz}$	G_{NF}	— — — — —	14 9.0 16.5 10.5 13.5	— — — — —	dB
Noise Figure ($I_C = 10\text{ mA}$, $V_{CE} = 5.0\text{ Vdc}$)	MPS571 MMBR571LT1 MRF5711LT1	$f = 0.5\text{ GHz}$ $f = 1.0\text{ GHz}$ $f = 0.5\text{ GHz}$ $f = 1.0\text{ GHz}$ $f = 1.0\text{ GHz}$	NF	— — — — —	2.0 2.6 2.0 2.6 2.2	— — — — —	dB
Noise Figure ($V_{CE} = 6.0\text{ V}$, $I_C = 10\text{ mA}$, $f = 1.0\text{ GHz}$)	MRF5711LT1		NF_{min}	—	1.6	—	dB
Power Gain in 50 Ω System ($V_{CE} = 6.0\text{ V}$, $I_C = 10\text{ mA}$, $f = 1.0\text{ GHz}$)	MRF5711LT1		$ S_{21} ^2$	9.0	10	—	dB

TYPICAL CHARACTERISTICS
MPS571, MMBR571LT1

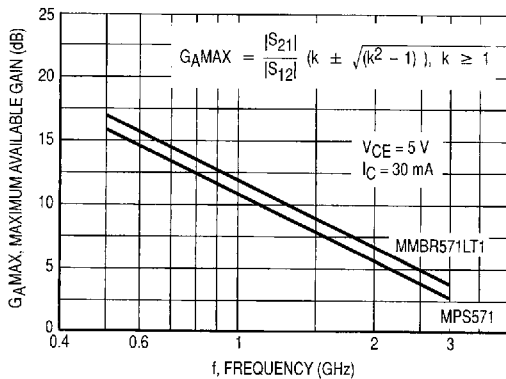


Figure 1. Maximum Available Gain versus Frequency

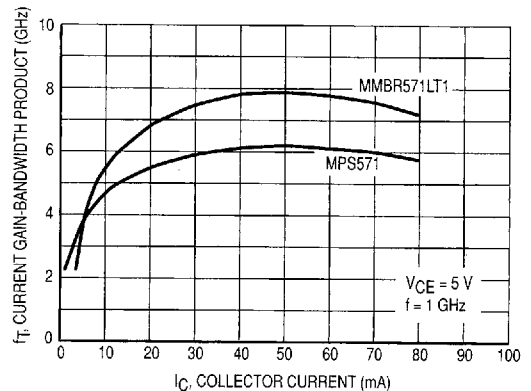


Figure 2. Current Gain-Bandwidth versus Collector Current @ 1.0 GHz

TYPICAL CHARACTERISTICS
MPS571, MMBR571LT1

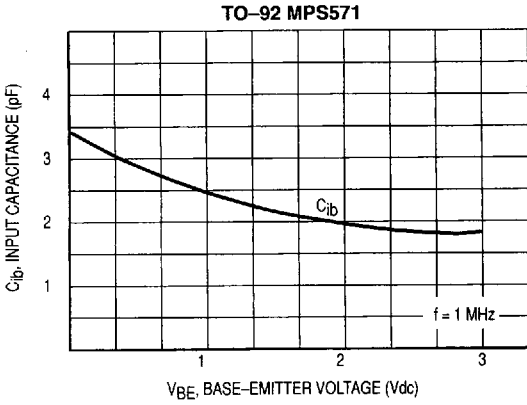


Figure 3. Input Capacitance versus Emitter Base Voltage

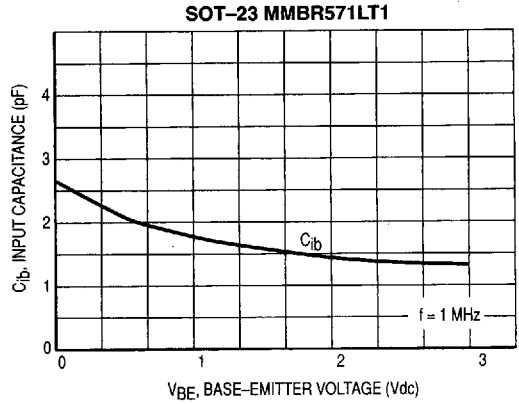


Figure 4. Input Capacitance versus Emitter Base Voltage

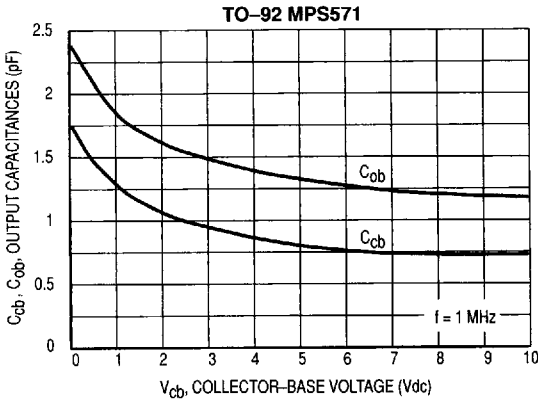


Figure 5. Output Capacitances versus Collector-Base Voltage

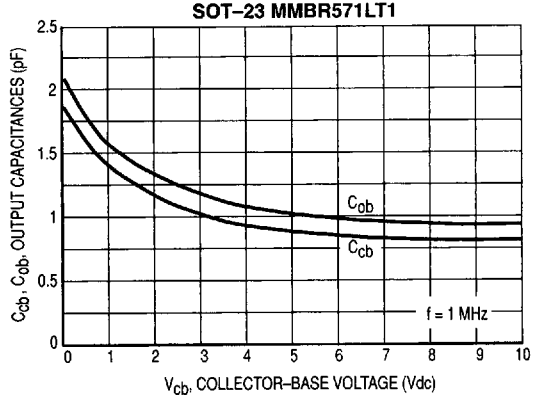


Figure 6. Output Capacitances versus Collector-Base Voltage

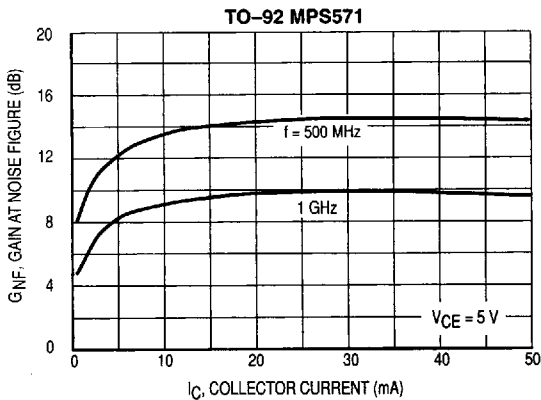


Figure 7. Gain at Noise Figure versus Collector Current

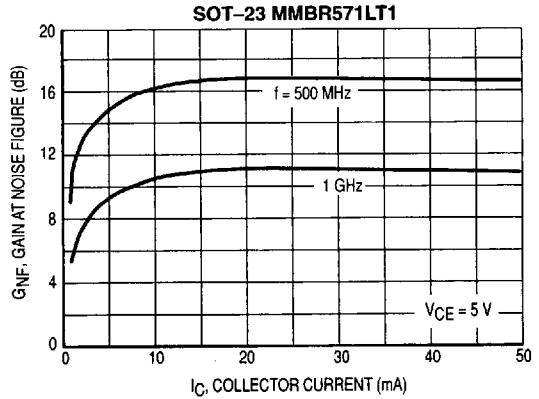


Figure 8. Gain at Noise Figure versus Collector Current

TYPICAL CHARACTERISTICS
MPS571, MMBR571LT1

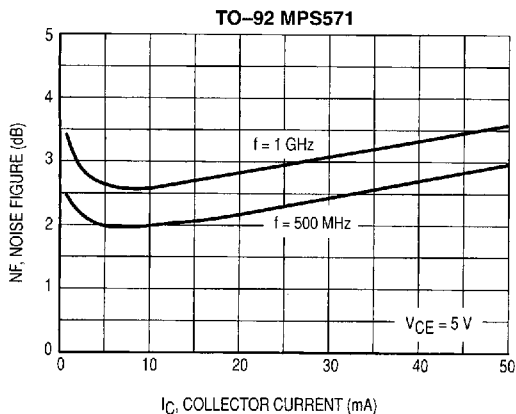


Figure 9. Noise Figure versus Collector Current

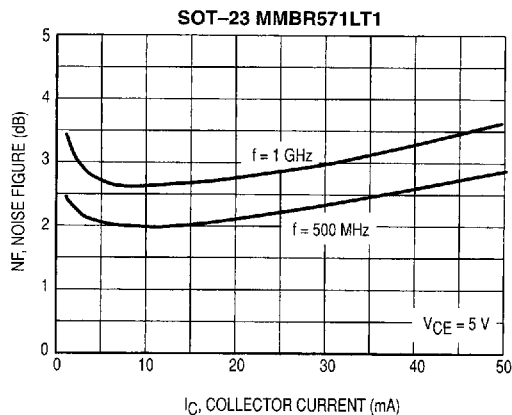


Figure 10. Noise Figure versus Collector Current

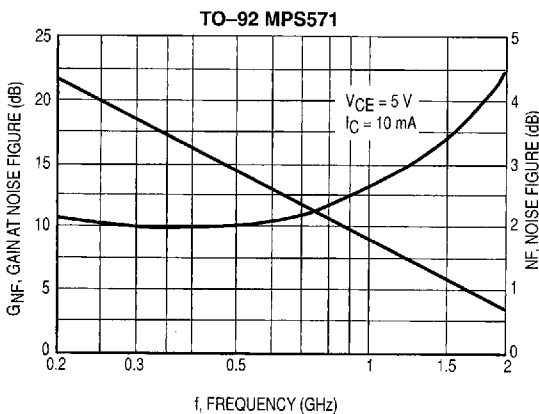


Figure 11. Gain at Noise Figure and Noise Figure versus Frequency

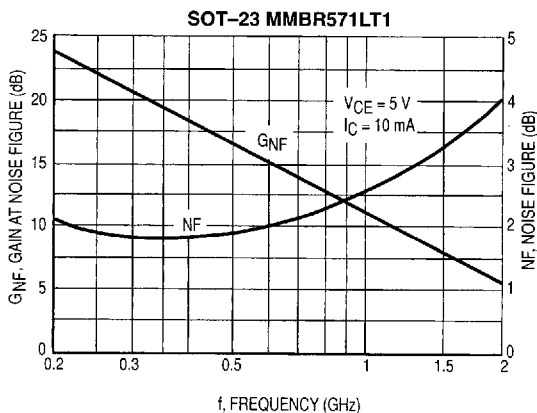


Figure 12. Gain at Noise Figure and Noise Figure versus Frequency

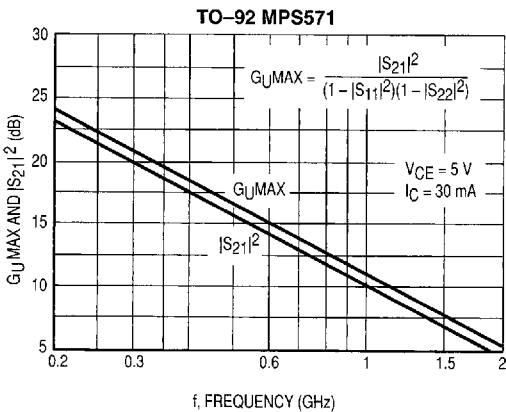


Figure 13. Maximum Unilateral Gain and Insertion Gain versus Frequency

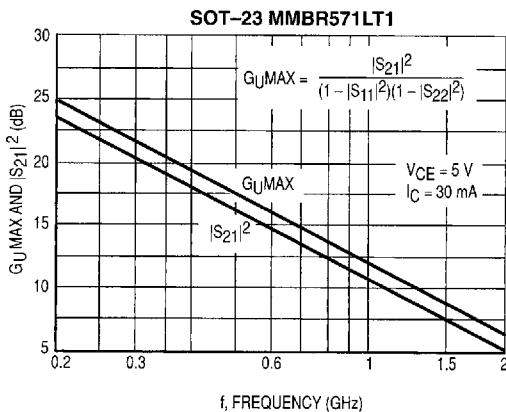


Figure 14. Maximum Unilateral Gain and Insertion Gain versus Frequency

TYPICAL CHARACTERISTICS
MRF5711LT1

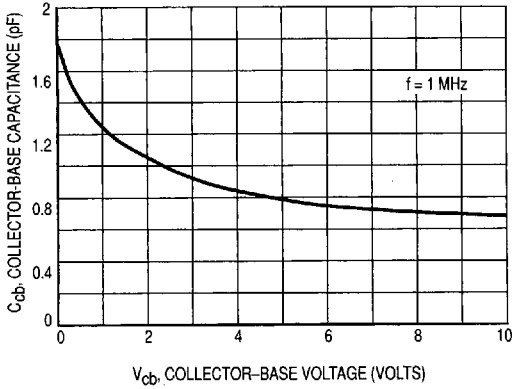


Figure 15. Collector-Base Capacitance versus Collector-Base Voltage

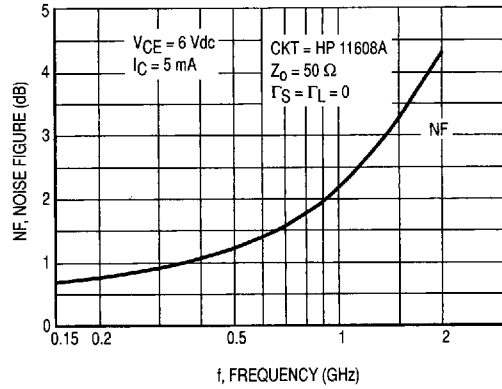


Figure 16. 50 Ω Noise Figure versus Frequency

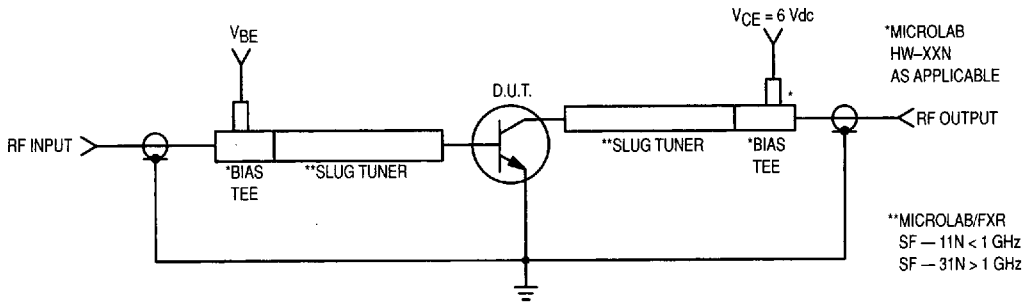


Figure 17. Functional Circuit Schematic

TYPICAL CHARACTERISTICS
MRF5711LT1

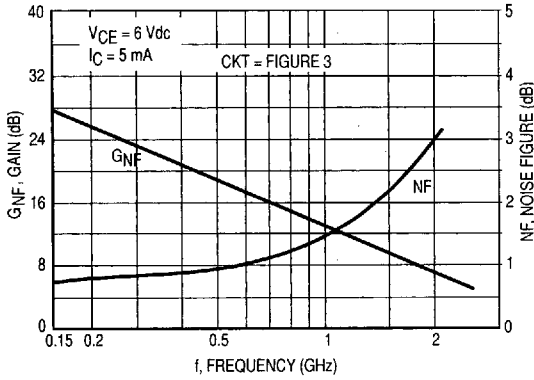


Figure 18. Gain and Noise Figure versus Frequency

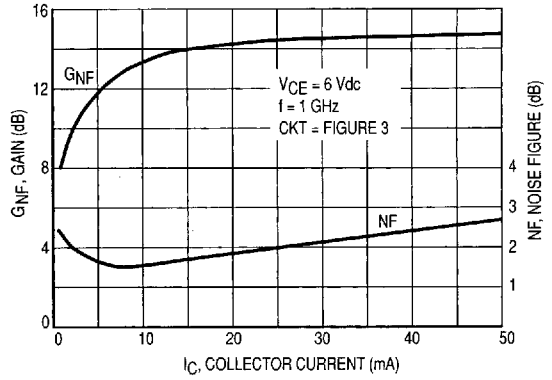


Figure 19. Gain and Noise Figure versus Collector Current

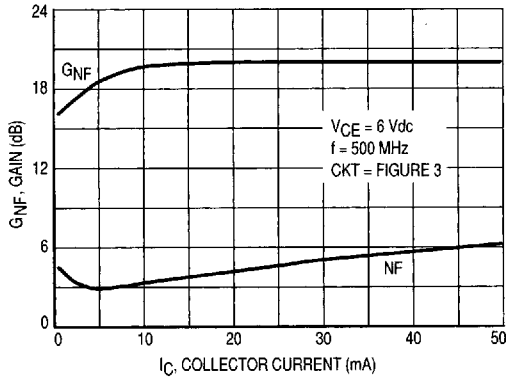


Figure 20. Gain and Noise Figure versus Collector Current

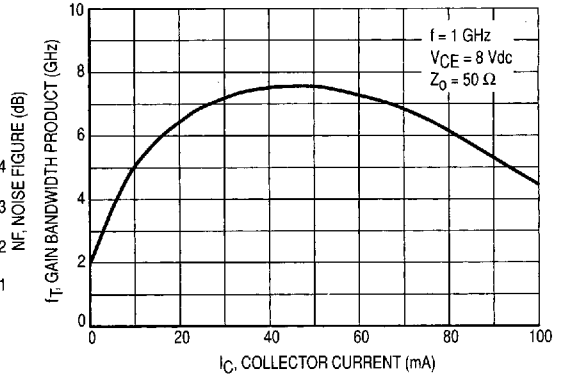


Figure 21. Gain Bandwidth Product versus Collector Current

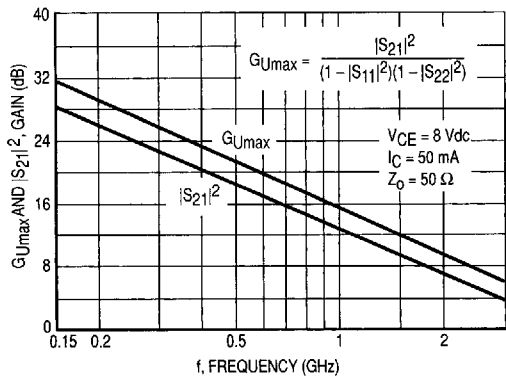


Figure 22. G_{Ummax} and $|S_{21}|^2$ versus Frequency

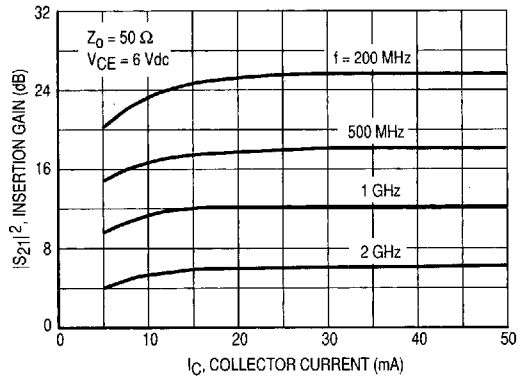


Figure 23. Insertion Gain versus Collector Current

MPS571

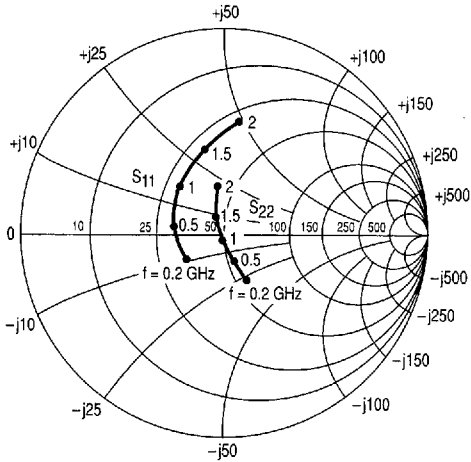


Figure 24. Input/Output Reflection Coefficients versus Frequency
 $V_{CE} = 5.0 \text{ V}$, $I_C = 30 \text{ mA}$

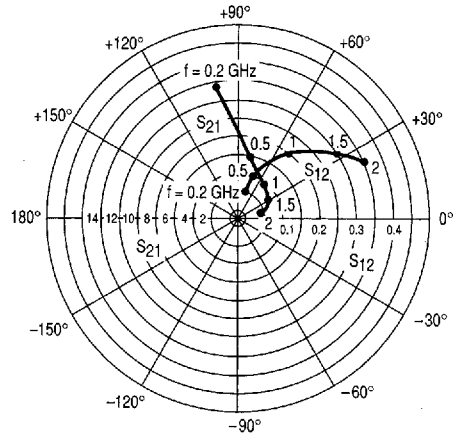


Figure 25. Forward/Reverse Transmission Coefficients versus Frequency
 $V_{CE} = 5.0 \text{ V}$, $I_C = 30 \text{ mA}$

V _{CE} (Volts)	I _C (mA)	f (MHz)	S ₁₁		S ₂₁		S ₁₂		S ₂₂	
			S ₁₁	∠φ	S ₂₁	∠φ	S ₁₂	∠φ	S ₂₂	∠φ
5.0	5.0	200	0.62	-80	8.22	122	0.07	56	0.63	-44
		500	0.40	-148	4.52	87	0.11	50	0.36	-58
		1000	0.39	155	2.51	54	0.16	48	0.23	-78
		1500	0.46	122	1.86	32	0.23	42	0.15	-114
		2000	0.59	100	1.50	14	0.31	33	0.14	173
	15	200	0.33	-121	12.88	105	0.05	67	0.37	-59
		500	0.28	-175	5.62	79	0.10	65	0.18	-67
		1000	0.32	143	2.99	53	0.19	55	0.08	-94
		1500	0.40	117	2.14	32	0.27	42	0.07	171
		2000	0.55	95	1.74	17	0.35	30	0.198	117
	30	200	0.23	-143	13.65	99	0.05	75	0.26	-62
		500	0.23	169	5.75	76	0.11	70	0.13	-68
		1000	0.30	130	3.05	50	0.21	55	0.04	-136
		1500	0.41	106	2.11	28	0.29	38	0.12	130
		2000	0.56	85	1.70	11	0.36	23	0.26	102
50	200	0.21	-158	13.96	96	0.05	79	0.21	-61	
	500	0.23	162	5.82	75	0.11	72	0.11	-66	
	1000	0.30	128	3.09	49	0.21	56	0.03	-149	
	1500	0.41	105	2.11	28	0.29	39	0.12	127	
	2000	0.56	84	1.70	11	0.36	23	0.27	100	

Table 1. MPS571 Common Emitter S-Parameters

MMBR571LT1, T3

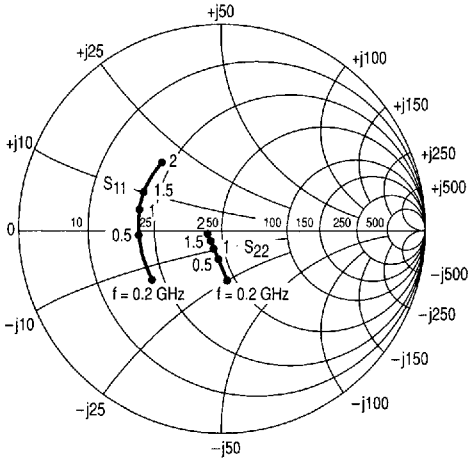


Figure 26. Input/Output Reflection Coefficients versus Frequency
 $V_{CE} = 5.0 \text{ V}$, $I_C = 30 \text{ mA}$

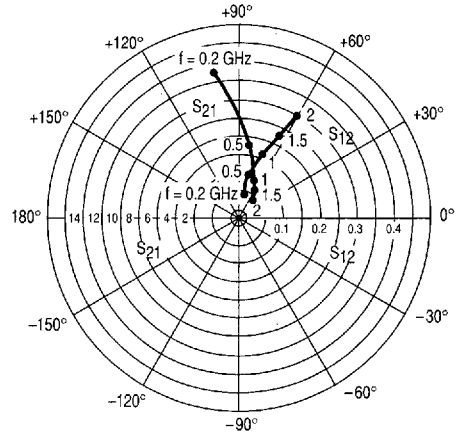
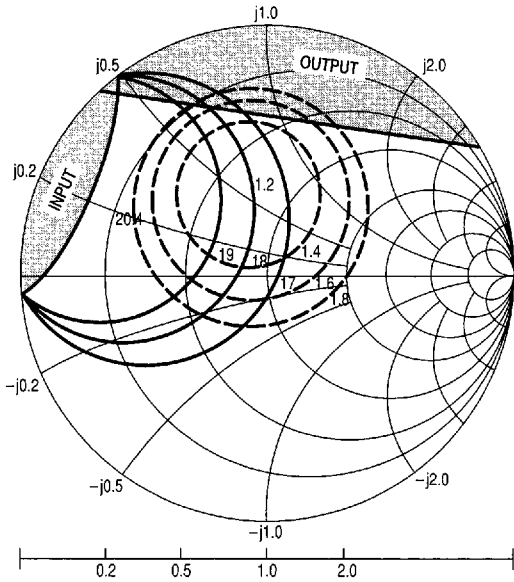


Figure 27. Forward/Reverse Transmission Coefficients versus Frequency
 $V_{CE} = 5.0 \text{ V}$, $I_C = 30 \text{ mA}$

V _{CE} (Volts)	I _C (mA)	f (MHz)	S ₁₁		S ₂₁		S ₁₂		S ₂₂	
			S ₁₁	∠φ	S ₂₁	∠φ	S ₁₂	∠φ	S ₂₂	∠φ
5.0	5.0	200	0.68	-82	8.41	126	0.07	53	0.61	-45
		500	0.52	-142	4.62	93	0.10	46	0.35	-60
		1000	0.50	179	2.57	72	0.14	53	0.26	-71
		1500	0.51	161	1.82	57	0.19	58	0.24	-77
		2000	0.52	143	1.48	45	0.24	59	0.22	-86
	15	200	0.46	-125	13.65	108	0.05	60	0.35	-73
		500	0.43	-169	6.03	86	0.09	66	0.17	-94
		1000	0.44	168	3.20	72	0.16	67	0.14	-111
		1500	0.45	152	2.21	58	0.22	64	0.11	-118
		2000	0.46	137	1.80	48	0.29	59	0.10	-131
	30	200	0.42	-148	14.79	102	0.04	68	0.26	-87
		500	0.41	-177	6.31	84	0.09	72	0.14	-115
		1000	0.42	165	3.35	71	0.16	70	0.12	-135
		1500	0.44	151	2.29	59	0.23	65	0.11	-144
		2000	0.44	135	1.84	48	0.30	60	0.10	-157
	50	200	0.41	-159	15.14	98	0.04	73	0.21	-96
		500	0.42	179	6.38	83	0.09	75	0.13	-124
		1000	0.43	163	3.35	70	0.16	71	0.12	-143
		1500	0.44	148	2.32	58	0.23	66	0.10	-151
		2000	0.45	134	1.84	48	0.30	60	0.09	-163

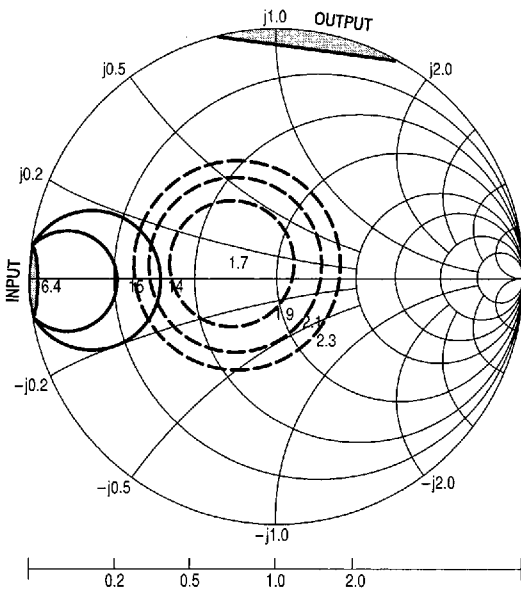
Table 2. MMBR571LT1 Common Emitter S-Parameters



$V_{CE} = 5\text{ V}$
 $I_C = 10\text{ mA}$
 [Shaded Box] = Area of Instability

f (GHz)	NF OPT	Γ_{MS} NF OPT	Rn	K
0.5	1.20 dB	$0.36 \angle 104^\circ$	7	0.63

Figure 28. MRF5711LT1 Constant Gain and Noise Figure Contours (f = 0.5 GHz)



$V_{CE} = 5\text{ V}$
 $I_C = 10\text{ mA}$
 [Shaded Box] = Area of Instability

f (GHz)	NF OPT	Γ_{MS} NF OPT	Rn	K
1.0	1.70 dB	$0.20 \angle 162^\circ$	8	0.94

Figure 29. MRF5711LT1 Constant Gain and noise Figure Contours (f = 1.0 GHz)

VCE (Vdc)	IC (mA)	f (MHz)	S11		S21		S12		S22	
			S11	∠φ	S21	∠φ	S12	∠φ	S22	∠φ
6.0	5.0	200	0.79	-90	10.9	128	0.06	46	0.70	-45
		500	0.72	-144	5.7	96	0.08	28	0.42	-66
		1000	0.69	-177	3.0	75	0.09	28	0.31	-77
		1500	0.66	164	2.0	59	0.10	32	0.34	-89
		2000	0.65	147	1.6	47	0.12	38	0.32	-94
	10	200	0.72	-115	15.2	118	0.05	41	0.55	-66
		500	0.69	-160	6.9	92	0.06	34	0.30	-92
		1000	0.67	174	3.6	74	0.08	42	0.21	-108
		1500	0.64	159	2.4	60	0.10	46	0.23	-114
		2000	0.64	143	1.8	49	0.12	50	0.20	-116
	50	200	0.67	-159	20	102	0.02	48	0.33	-111
		500	0.67	179	8.2	85	0.04	58	0.33	-142
		1000	0.66	174	3.8	72	0.07	65	0.21	-158
		1500	0.63	151	2.7	61	0.10	64	0.22	-158
		2000	0.58	138	2.1	51	0.14	62	0.17	-165
8.0	5.0	200	0.80	-87	11.1	130	0.06	47	0.71	-42
		500	0.72	-141	5.9	97	0.08	30	0.44	-60
		1000	0.70	-177	3.1	75	0.09	28	0.33	-68
		1500	0.66	166	2.1	60	0.10	32	0.35	-80
		2000	0.61	149	1.6	47	0.12	39	0.35	-85
	10	200	0.72	-113	15.6	119	0.05	42	0.56	-61
		500	0.68	-159	7.2	92	0.06	34	0.31	-82
		1000	0.66	175	3.7	74	0.08	41	0.21	-92
		1500	0.64	160	2.5	61	0.09	47	0.23	-101
		2000	0.60	144	2.0	49	0.13	50	0.21	-103
	50	200	0.66	-156	20.9	103	0.02	48	0.31	-101
		500	0.65	-179	8.6	85	0.04	58	0.19	-128
		1000	0.64	164	4.3	72	0.07	65	0.16	-144
		1500	0.61	153	2.9	61	0.10	65	0.17	-142
		2000	0.58	137	2.3	51	0.13	64	0.14	-145

Table 3. MRF5711LT1 Common Emitter S-Parameters

TYPICAL CHARACTERISTICS
MRF571

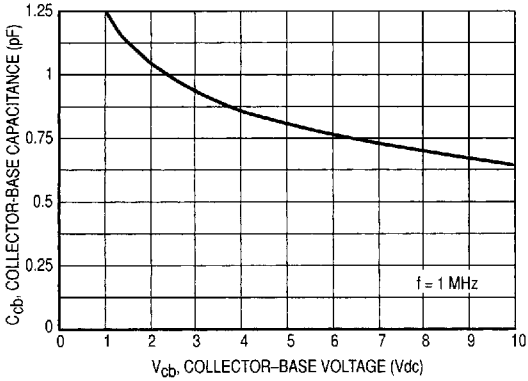


Figure 30. C_{cb} , Collector-Base Capacitance versus Voltage

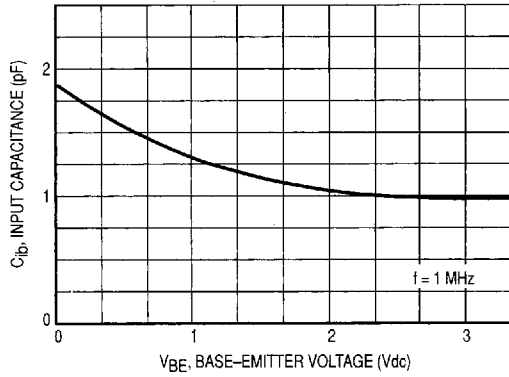


Figure 31. C_{ib} , Input Capacitance versus Emitter Base Voltage

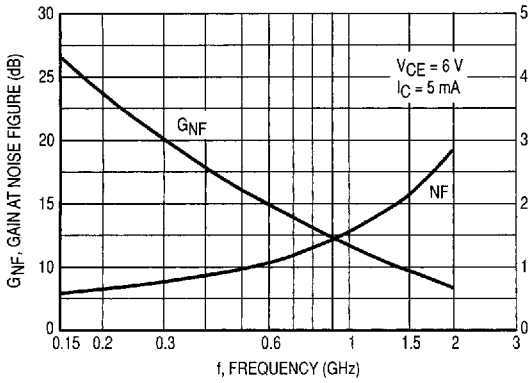


Figure 32. Gain at Noise Figure and Noise Figure versus Frequency

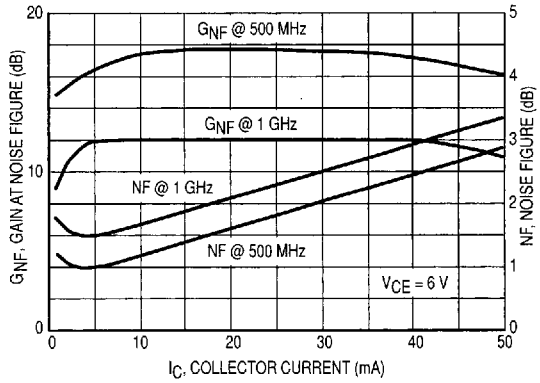


Figure 33. Gain at Noise Figure and Noise Figure versus Collector Current

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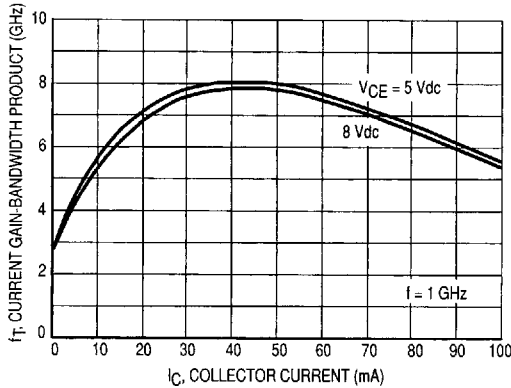


Figure 34. f_T , Current Gain-Bandwidth Product versus Collector Current

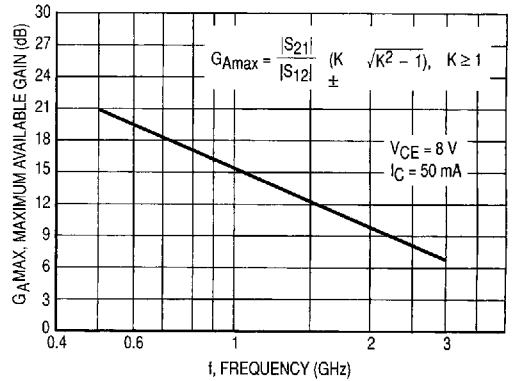


Figure 35. G_{Amax} , Maximum Available Gain versus Frequency

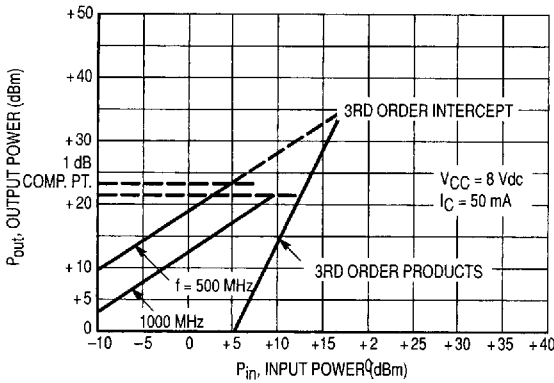


Figure 36. 1.0 dB Compression Point and Third Order Intercept

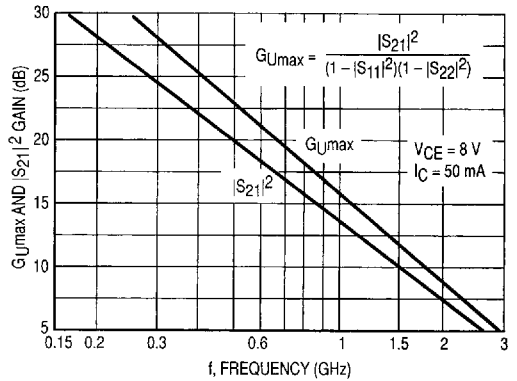


Figure 37. G_{Umax} and $|S_{21}|^2$ versus Frequency

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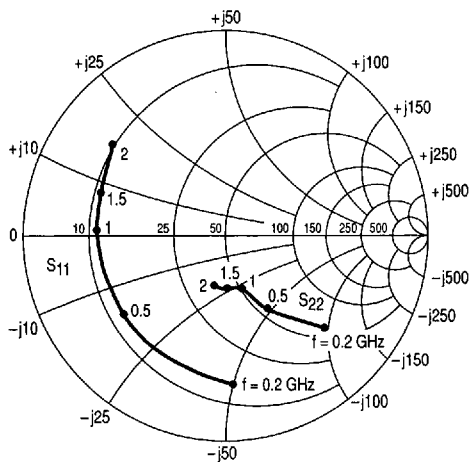


Figure 38. Input/Output Reflection Coefficients versus Frequency (GHz)
VCE = 6.0 V, IC = 5.0 mA

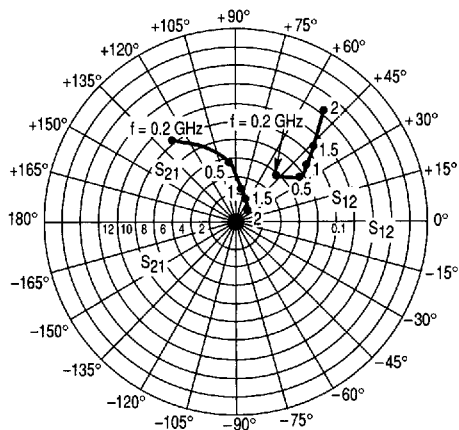
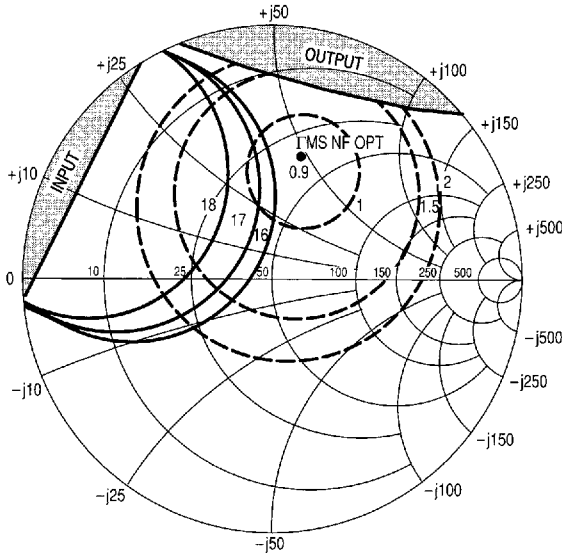


Figure 39. Forward/Reverse Transmission Coefficients versus Frequency (GHz)
VCE = 6.0 V, IC = 5.0 mA

VCE (Volts)	IC (mA)	f (MHz)	S11		S21		S12		S22	
			S11	∠ φ	S21	∠ φ	S12	∠ φ	S22	∠ φ
6.0	5	200	0.74	-86	10.5	129	0.06	48	0.69	-42
		500	0.62	-143	5.5	97	0.08	33	0.41	-59
		1000	0.61	178	3.0	78	0.09	37	0.28	-69
		1500	0.65	158	2.0	62	0.11	44	0.26	-88
		2000	0.70	140	1.6	51	0.14	51	0.27	-99
	10	200	0.64	-111	15	118	0.04	44	0.53	-59
		500	0.58	-160	6.9	93	0.06	42	0.27	-77
		1000	0.59	168	3.7	77	0.09	52	0.16	-91
		1500	0.63	151	2.5	64	0.12	56	0.16	-113
		2000	0.67	134	2.0	53	0.16	57	0.16	-118
	50	200	0.56	-160	20.4	102	0.02	57	0.27	-98
		500	0.57	176	8.4	86	0.05	67	0.14	-130
1000		0.60	156	4.4	75	0.09	70	0.11	-164	
1500		0.62	152	2.9	64	0.13	68	0.13	-175	
2000		0.66	127	2.4	53	0.18	62	0.11	-178	
8.0	5	200	0.75	-83	10.7	129	0.06	49	0.71	-39
		500	0.62	-140	5.1	98	0.08	34	0.43	-54
		1000	0.60	-179	3.7	78	0.09	38	0.31	-62
		1500	0.64	159	2.1	62	0.10	45	0.29	-80
		2000	0.69	141	1.7	52	0.13	52	0.29	-91
	10	200	0.64	-99	15.1	120	0.05	46	0.54	-60
		500	0.52	-152	7.1	94	0.07	45	0.32	-75
		1000	0.52	170	3.7	76	0.10	54	0.15	-82
		1500	0.52	150	2.5	62	0.13	56	0.16	-108
		2000	0.57	133	2.0	51	0.18	55	0.16	-107
	50	200	0.52	-153	19.6	102	0.03	56	0.28	-92
		500	0.52	178	8.1	86	0.05	67	0.16	-98
		1000	0.56	157	4.1	73	0.10	70	0.06	-130
		1500	0.54	139	2.8	62	0.13	68	0.11	-146
		2000	0.59	126	2.2	52	0.19	63	0.10	-137

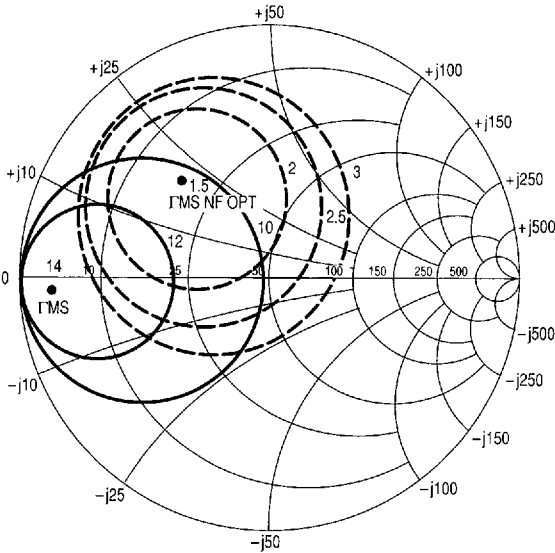
Table 4. MRF571 Common Emitter S-Parameters



$V_{CE} = 6.0 \text{ V}$, $I_C = 5.0 \text{ mA}$
 $f = 500 \text{ MHz}$
 [Shaded Area] — REGION OF INSTABILITY

f (GHz)	NF OPT (dB)	R _n (Ω)	NF50 Ω (dB)
0.5	0.9	9.3	1.3

Γ _{MS} NF OPT	K
$0.49 \angle 74^\circ$	0.58

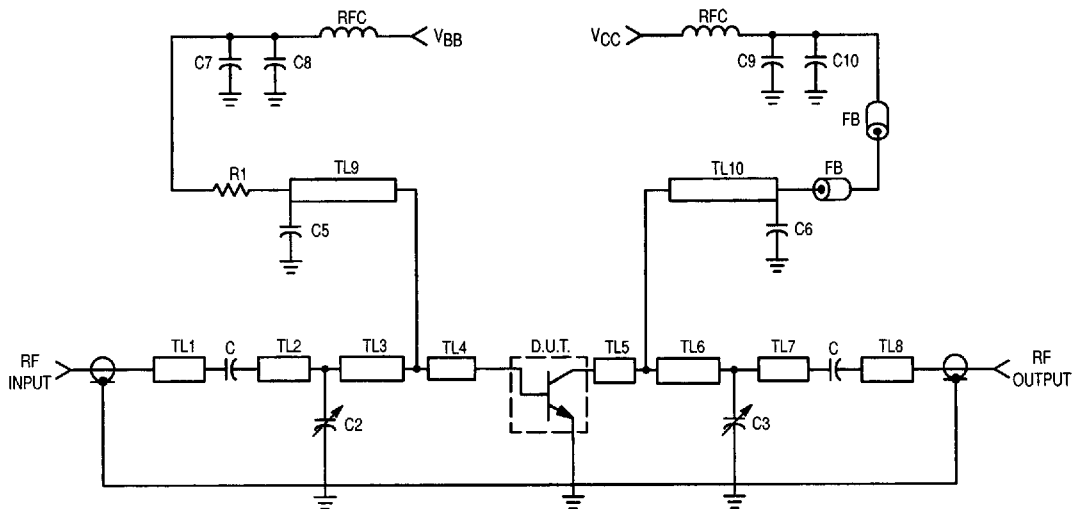


$V_{CE} = 6.0 \text{ V}$, $I_C = 5.0 \text{ mA}$
 $f = 1.0 \text{ GHz}$

f (GHz)	NF OPT (dB)	R _n (Ω)	NF50 Ω (dB)	Γ _{MS} NF OPT
1.0	1.5	7.5	2.2	$0.48 \angle 134^\circ$

Γ _{MS}	Γ _{ML}
$0.89 \angle -179^\circ$	$0.81 \angle 66^\circ$

Figure 40. MRF571 Constant Gain and Noise Figure Contours



C1, C4, C5, C6, C8, C9 — 100 pF Chip Capacitor
 C2, C3 — 0.8–8.0 pF Johanson Capacitor
 C7, C10 — 10 μ F Tantalum Capacitor
 R1 — 1.0 kOhms Res.
 RFC — VK-200, Ferroxcube
 FB — Ferrite Bead, Ferroxcube 56-590-65/3B
 Board Material — 0.0625" Glass Teflon, $\epsilon_r = 2.55$

TL1, TL7, TL8 — Microstrip 0.162" x 0.600"
 TL2 — Microstrip 0.162" x 1.060"
 TL3 — Microstrip 0.162" x 0.700"
 TL4, TL5 — Microstrip 0.162" x 0.440"
 TL6 — Microstrip 0.162" x 1.140"
 TL8, TL9 — Microstrip 0.020" x 2.130"

Figure 41. MRF571 Test Circuit Schematic