MMBR571LT1 MPS571 MRF571 MRF5711LT1

I_C = 80 mA
LOW NOISE
HIGH-FREQUENCY
TRANSISTORS

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 GHz (Typ) @ 50 mA
- Low Noise Figure
  NF_{min} = 1.6 dB (Typ) @ f = 1.0 GHz (MRF5711LT1, MRF571)
- High Gain
  G_{NF} = 17 dB (Typ) @ 30 mA/500 MHz (MMBR571LT1)
- High Power Gain
  G_{pe} (matched) = 13.5 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

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

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	V_{CEO}	10	Vdc
Collector-Base Voltage	V_{CBO}	20	Vdc
Emitter-Base Voltage	V_{EBO}	3.0	Vdc
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 MPS571	P_D	0.63 5.0	Watts mW/°C
Total Device Dissipation (1) @ T_C = 75°C Derate above 75°C MRF571	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	MPS571	$R_{\theta JA}$	200	°C/W
Thermal Resistance, Junction to Case MRF5711LT1, MMBR571LT1		$R_{\theta JC}$	225	°C/W
Thermal Resistance, Junction to Case	MRF571	$R_{\theta JC}$	130	°C/W
Maximum Junction Temperature		T_{Jmax}	150	°C

DEVICE MARKING

MMBR571LT1 = 7X MRF5711LT1 = 02

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

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted)

Characteristic			Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS							
Collector–Emitter Breakdown Voltage (I_C = 1.0 mA, I_B = 0)			$V_{(BR)CEO}$	10	12	—	Vdc
Collector–Base Breakdown Voltage (I_C = 0.1 mA, I_E = 0)			$V_{(BR)CBO}$	20	—	—	Vdc
Emitter–Base Breakdown Voltage (I_E = 50 μAdc, I_C = 0)			$V_{(BR)EBO}$	2.5	—	—	Vdc
Collector Cutoff Current (V_{CB} = 8.0 Vdc, I_E = 0)			I_{CBO}	—	—	10	μAdc
ON CHARACTERISTICS							
DC Current Gain (I_C = 30 mAdc, V_{CE} = 5.0 Vdc)			h_{FE}	50	—	300	—
DYNAMIC CHARACTERISTICS							
Collector–Base Capacitance			C_{cb}				pF
(V_{CB} = 10 Vdc, I_E = 0, f = 1.0 MHz)	MPS571, MMBR571LT1			—	0.7	1.0	
(V_{CB} = 6.0 Vdc, I_E = 0, f = 1.0 MHz)	MRF5711LT1, MRF571			—	0.75	1.0	
Current Gain–Bandwidth Product	MPS571		f_T	—	6.0	—	GHz
(V_{CE} = 5.0 Vdc, I_C = 50 mAdc, f = 1.0 GHz)	MMBR571LT1			—	8.0	—	
(V_{CE} = 8.0 Vdc, I_C = 50 mAdc, f = 1.0 GHz)	MRF5711LT1, MRF571			—	8.0	—	
FUNCTIONAL TESTS							
Gain @ Noise Figure	MRF571	f = 0.5 GHz	G_{NF}	—	16.5	—	dB
(I_C = 10 mAdc, V_{CE} = 6.0 Vdc)	MRF571	f = 1.0 GHz		10	12	—	
Noise Figure	MRF571	f = 0.5 GHz	NF	—	1.0	—	dB
(I_C = 10 mAdc, V_{CE} = 6.0 Vdc)	MRF571	f = 1.0 GHz		—	1.5	2.0	
		f = 2.0 GHz		—	2.8	—	
Gain @ Noise Figure			G_{NF}				dB
(I_C = 10 mAdc, V_{CE} = 5.0 Vdc)	MPS571	f = 0.5 GHz		—	14	—	
		f = 1.0 GHz		—	9.0	—	
	MMBR571LT1	f = 0.5 GHz		—	16.5	—	
		f = 1.0 GHz		—	10.5	—	
(I_C = 10 mA, V_{CE} = 6.0 Vdc)	MRF5711LT1	f = 1.0 GHz		—	13.5	—	
Noise Figure			NF				dB
(I_C = 10 mAdc, V_{CE} = 5.0 Vdc)	MPS571	f = 0.5 GHz		—	2.0	—	
		f = 1.0 GHz		—	2.6	—	
	MMBR571LT1	f = 0.5 GHz		—	2.0	—	
		f = 1.0 GHz		—	2.6	—	
(I_C = 10 mAdc, V_{CE} = 6.0 Vdc)	MRF5711LT1	f = 1.0 GHz		—	2.2	—	
Noise Figure			NF_{min}	—	1.6	—	dB
(V_{CE} = 6.0 V, I_C = 10 mA, f = 1.0 GHz)	MRF5711LT1						
Power Gain in 50 Ω System (V_{CE} = 6.0 V, I_C = 10 mA, f = 1.0 GHz)	MRF5711LT1		$\lvert S_{21}\rvert^2$	9.0	10	—	dB

TYPICAL CHARACTERISTICS
MPS571, MMBR571LT1

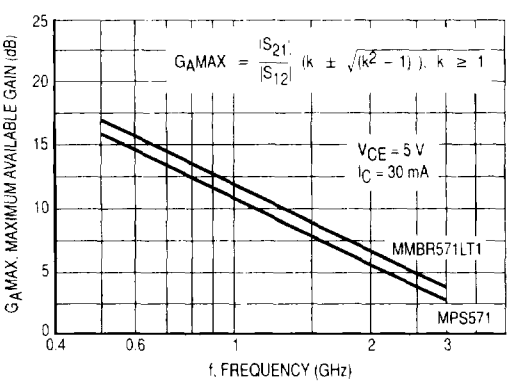


Figure 1. Maximum Available Gain versus Frequency

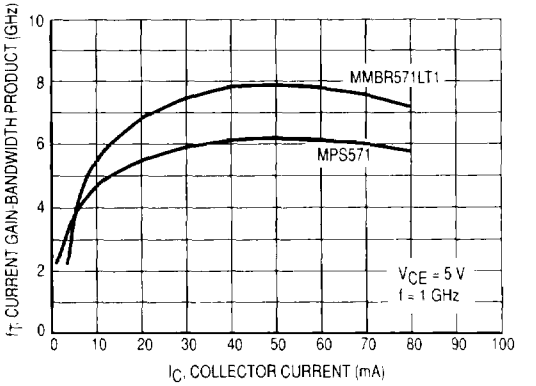


Figure 2. Current Gain–Bandwidth versus Collector Current @ 1.0 GHz

TYPICAL CHARACTERISTICS
MPS571, MMBR571LT1

TO–92 MPS571

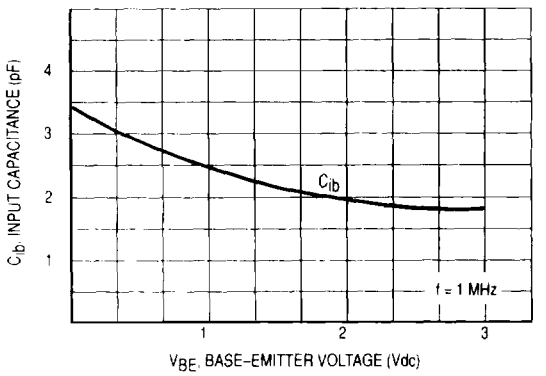


Figure 3. Input Capacitance versus Emitter Base Voltage

SOT–23 MMBR571LT1

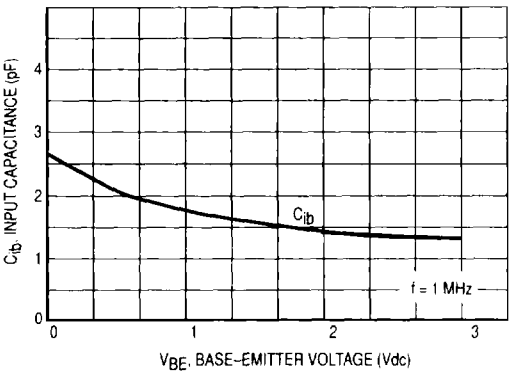


Figure 4. Input Capacitance versus Emitter Base Voltage

TO–92 MPS571

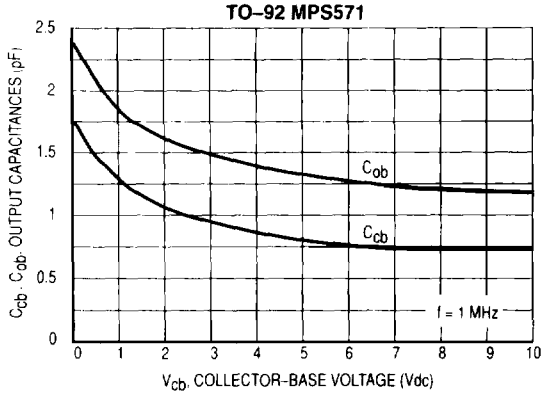


Figure 5. Output Capacitances versus Collector–Base Voltage

SOT–23 MMBR571LT1

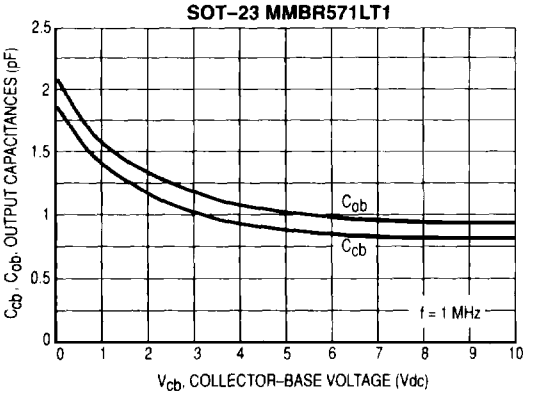


Figure 6. Output Capacitances versus Collector–Base Voltage

TO–92 MPS571

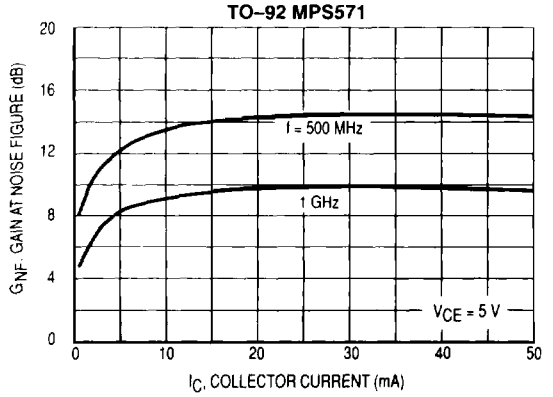


Figure 7. Gain at Noise Figure versus Collector Current

SOT–23 MMBR571LT1

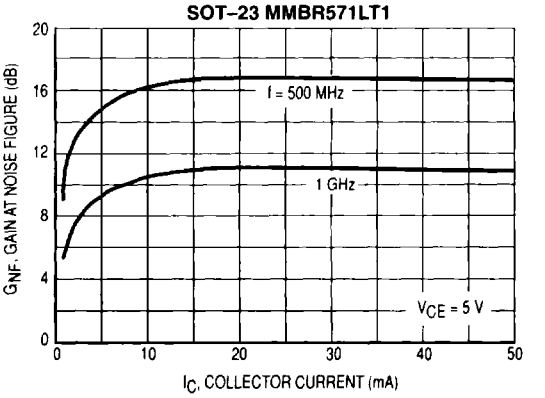


Figure 8. Gain at Noise Figure versus Collector Current

TYPICAL CHARACTERISTICS
MPS571, MMBR571LT1

TO–92 MPS571

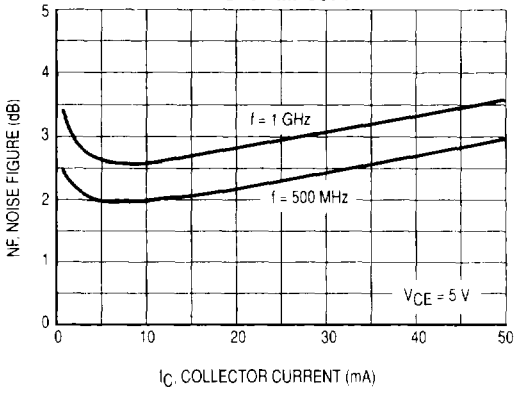


Figure 9. Noise Figure versus Collector Current

SOT–23 MMBR571LT1

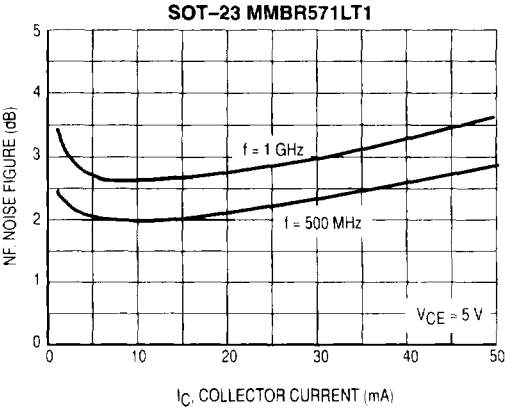


Figure 10. Noise Figure versus Collector Current

TO–92 MPS571

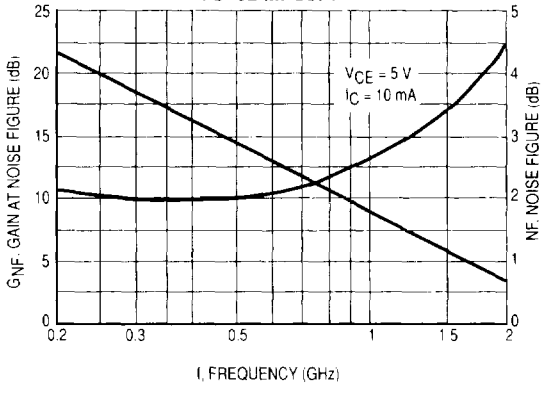


Figure 11. Gain at Noise Figure and Noise Figure versus Frequency

SOT–23 MMBR571LT1

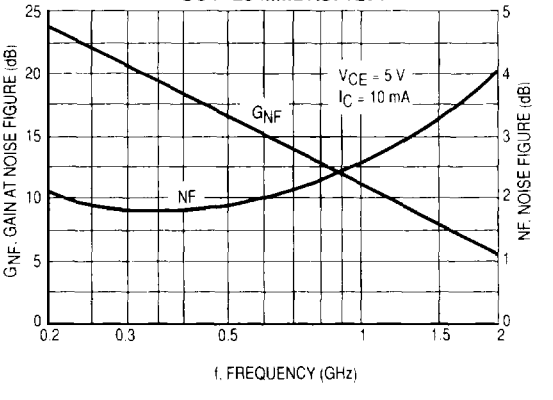


Figure 12. Gain at Noise Figure and Noise Figure versus Frequency

TO–92 MPS571

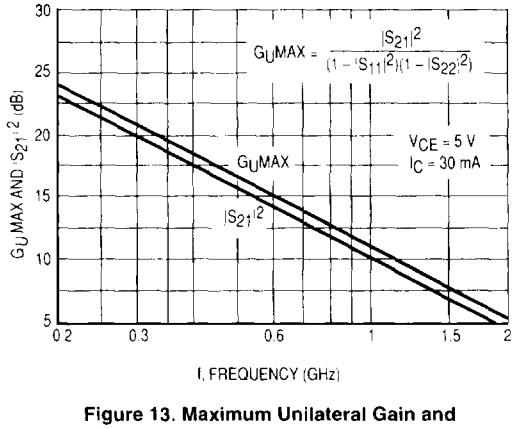


Figure 13. Maximum Unilateral Gain and Insertion Gain versus Frequency

SOT–23 MMBR571LT1

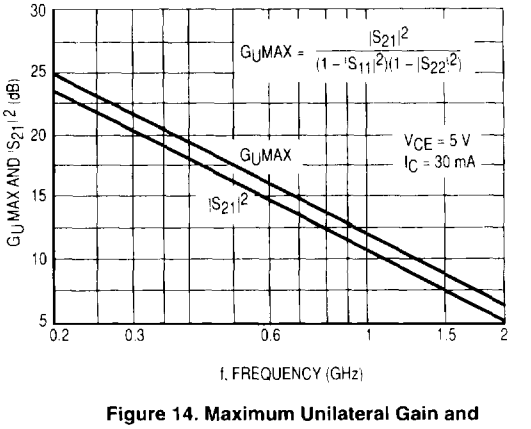


Figure 14. Maximum Unilateral Gain and Insertion Gain versus Frequency

TYPICAL CHARACTERISTICS
MRF5711LT1

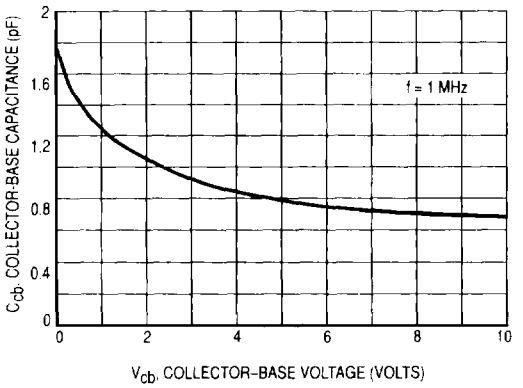


Figure 15. Collector–Base Capacitance versus Collector–Base Voltage

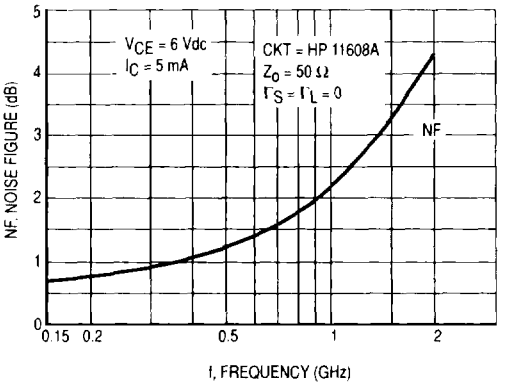


Figure 16. 50 Ω Noise Figure versus Frequency

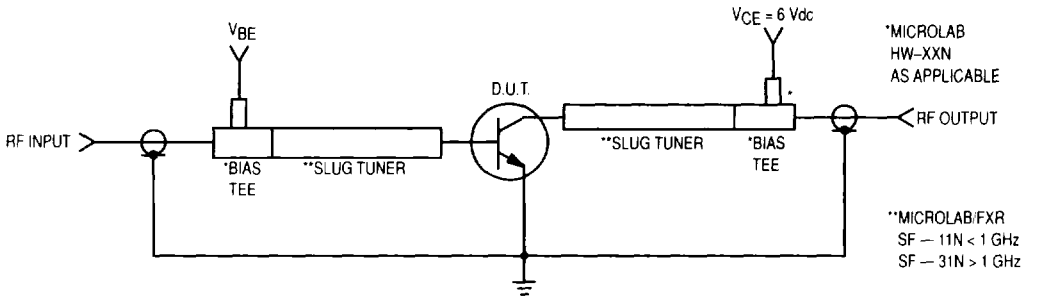


Figure 17. Functional Circuit Schematic

TYPICAL CHARACTERISTICS
MRF5711LT1

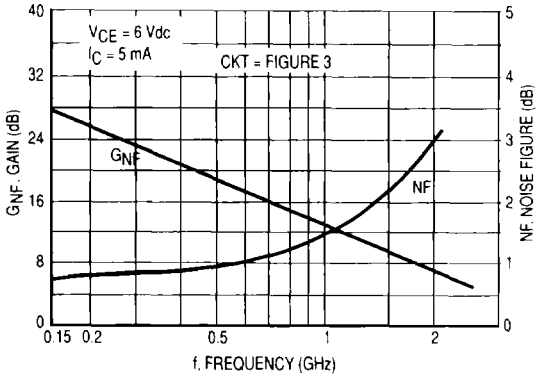


Figure 18. Gain and Noise Figure versus Frequency

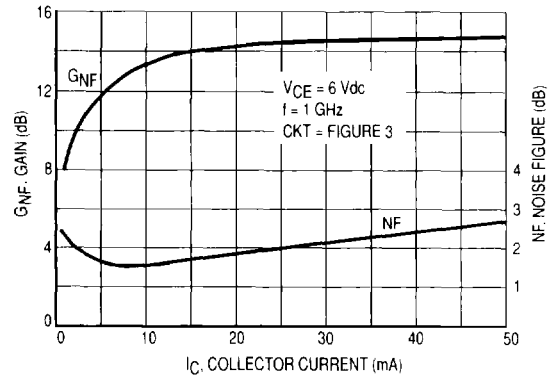


Figure 19. Gain and Noise Figure versus Collector Current

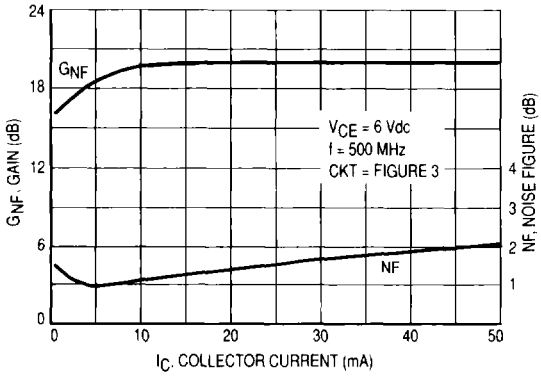


Figure 20. Gain and Noise Figure versus Collector Current

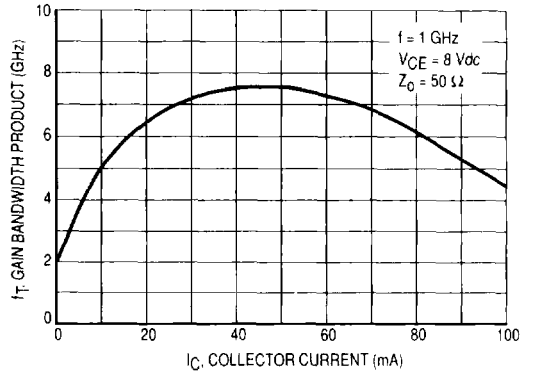


Figure 21. Gain Bandwidth Product versus Collector Current

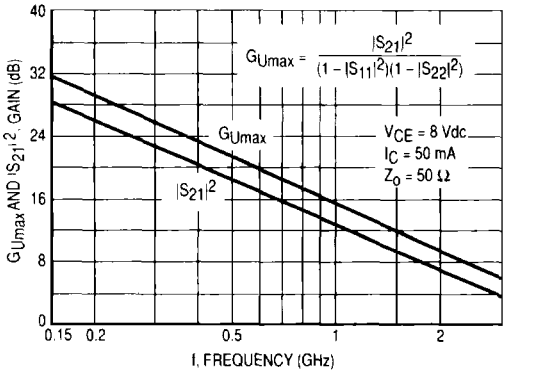


Figure 22. G_{Umax} and $|S_{21}|^2$ versus Frequency

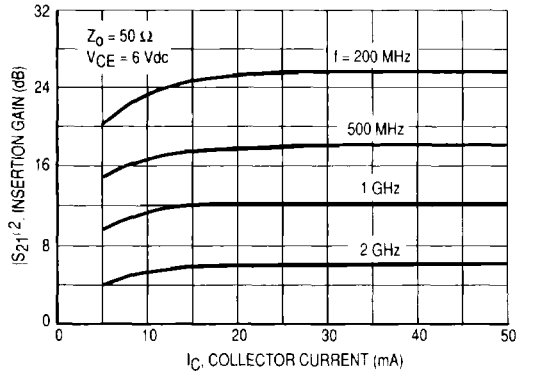


Figure 23. Insertion Gain versus Collector Current

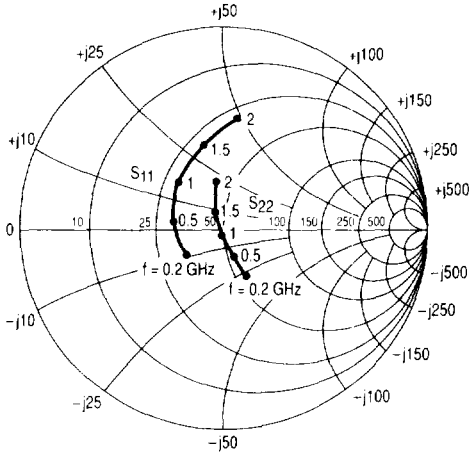


Figure 24. Input/Output Reflection Coefficients versus Frequency
V_{CE} = 5.0 V, I_C = 30 mA

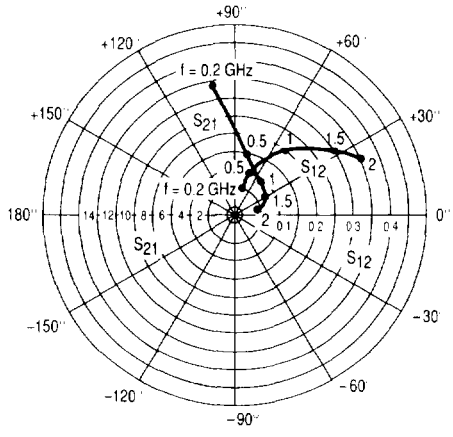


Figure 25. Forward/Reverse Transmission Coefficients versus Frequency
V_{CE} = 5.0 V, I_C = 30 mA

V_{CE} (Volts)	I_C (mA)	f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}	
			$\lvert S_{11}\rvert$	∠ ϕ	$\lvert S_{21}\rvert$	∠ ϕ	$\lvert S_{12}\rvert$	∠ ϕ	$\lvert S_{22}\rvert$	∠ 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

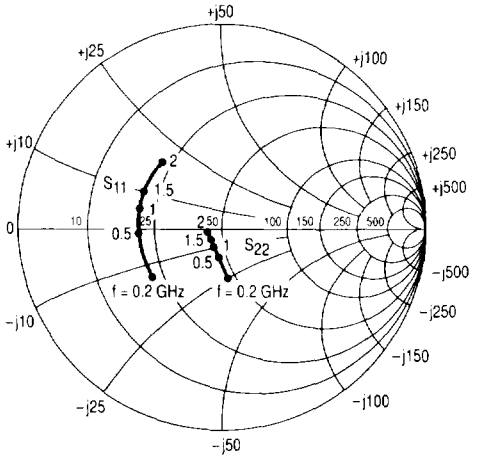


Figure 26. Input/Output Reflection Coefficients versus Frequency
V_{CE} = 5.0 V, I_C = 30 mA

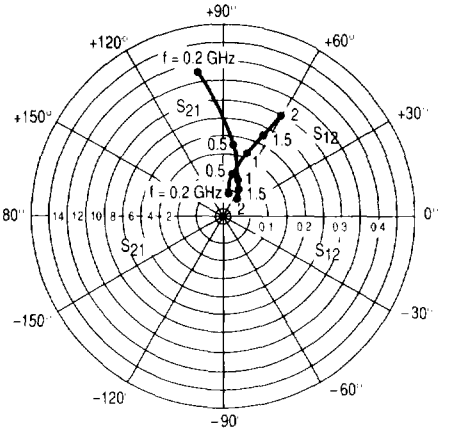
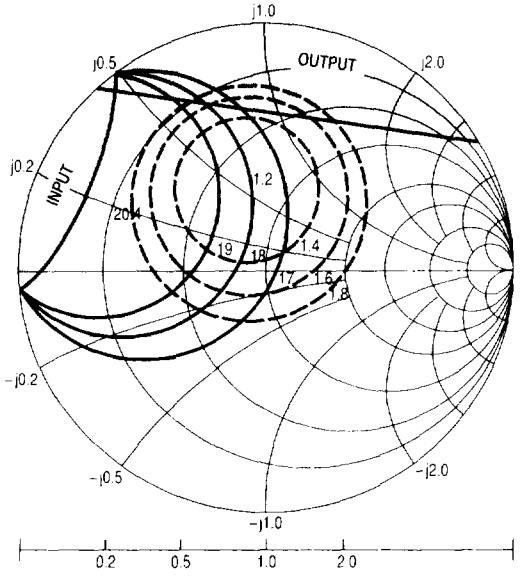


Figure 27. Forward/Reverse Transmission Coefficients versus Frequency
V_{CE} = 5.0 V, I_C = 30 mA

V_{CE} (Volts)	I_C (mA)	f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}	
			$\lvert S_{11}\rvert$	$\angle\phi$	$\lvert S_{21}\rvert$	$\angle\phi$	$\lvert S_{12}\rvert$	$\angle\phi$	$\lvert S_{22}\rvert$	$\angle\phi$
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

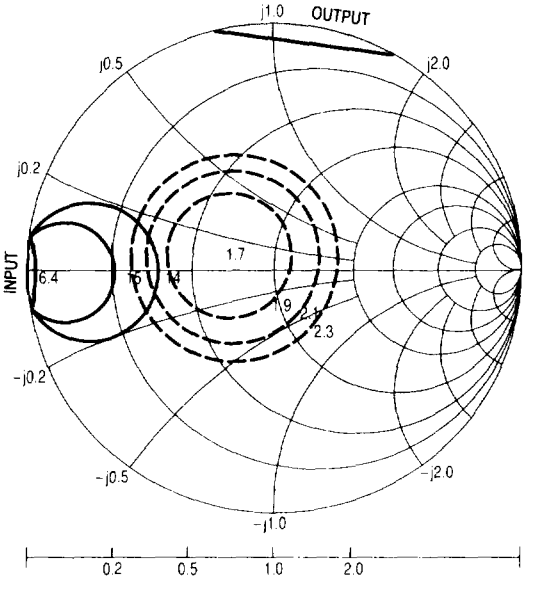
Table 2. MMBR571LT1 Common Emitter S–Parameters



V_{CE} = 5 V
I_C = 10 mA
☐ = Area of Instability

f (GHz)	NF OPT	MS NF OPT	Rn	K
0.5	1.20 dB	0.36 ∠ 104°	7	0.63

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



V_{CE} = 5 V
I_C = 10 mA
☐ = Area of Instability

f (GHz)	NF OPT	MS NF OPT	Rn	K
1.0	1.70 dB	0.20 ∠ 162°	8	0.94

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

V_{CE} (Vdc)	I_C (mA)	f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}	
			$\|S_{11}\|$	$\angle\phi$	$\|S_{21}\|$	$\angle\phi$	$\|S_{12}\|$	$\angle\phi$	$\|S_{22}\|$	$\angle\phi$
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

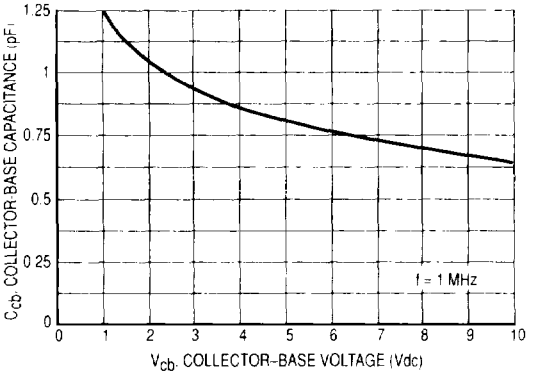


Figure 30. C_{cb}, Collector–Base Capacitance versus Voltage

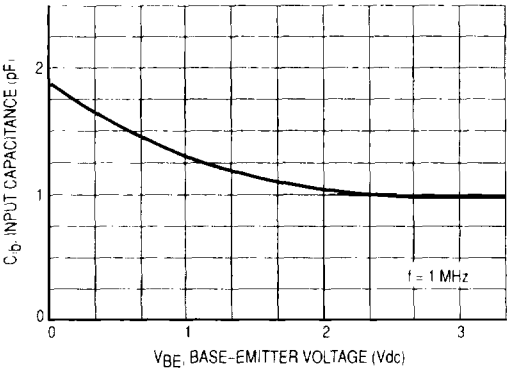


Figure 31. C_{ib}, Input Capacitance versus Emitter Base Voltage

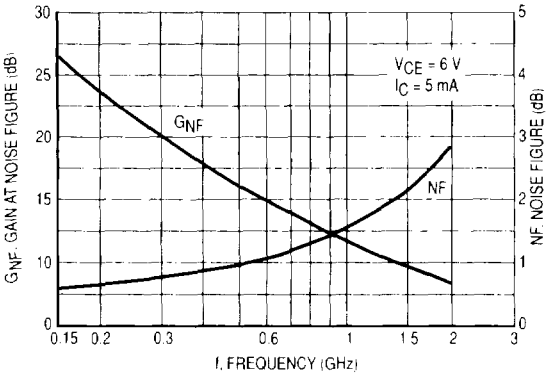


Figure 32. Gain at Noise Figure and Noise Figure versus Frequency

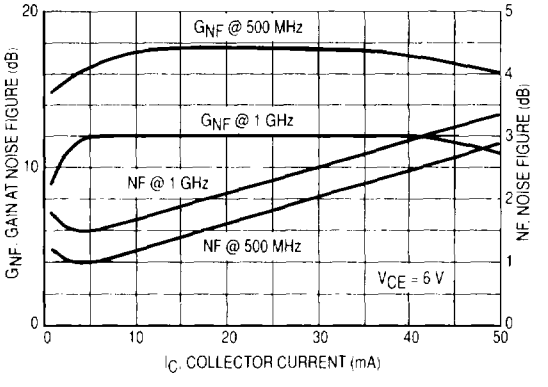


Figure 33. Gain at Noise Figure and Noise Figure versus Collector Current

TYPICAL CHARACTERISTICS
MRF571

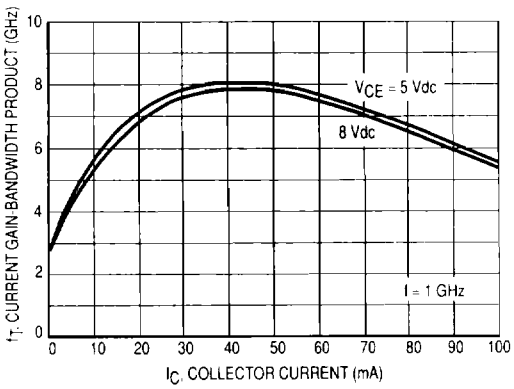


Figure 34. f_T, Current Gain–Bandwidth Product versus Collector Current

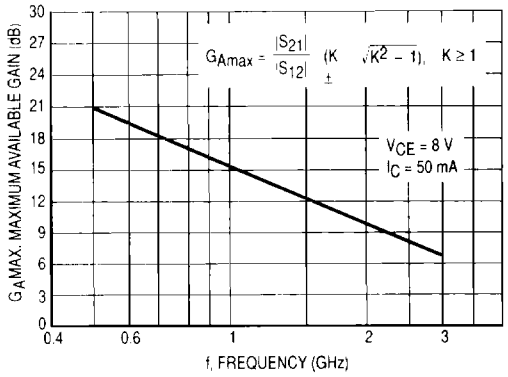


Figure 35. G_{Amax}, Maximum Available Gain versus Frequency

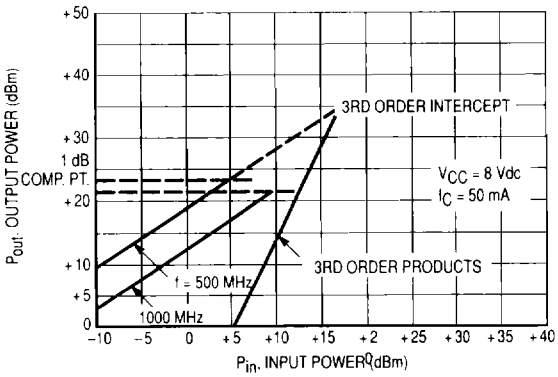


Figure 36. 1.0 dB Compression Point and Third Order Intercept

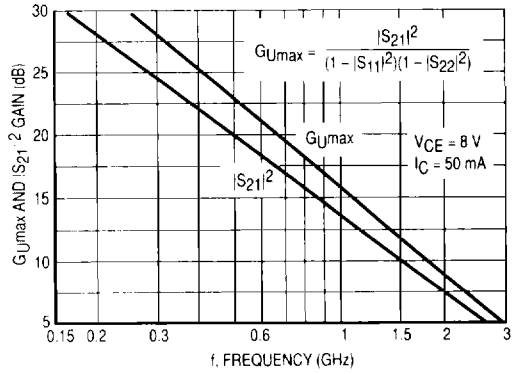


Figure 37. G_{Umax} and $|S_{21}|^2$ versus Frequency

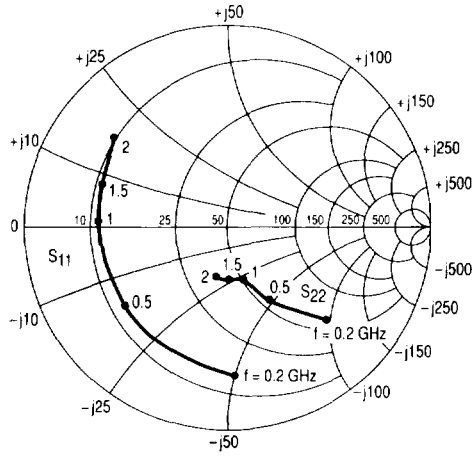


Figure 38. Input/Output Reflection Coefficients versus Frequency (GHz) V_{CE} = 6.0 V, I_C = 5.0 mA

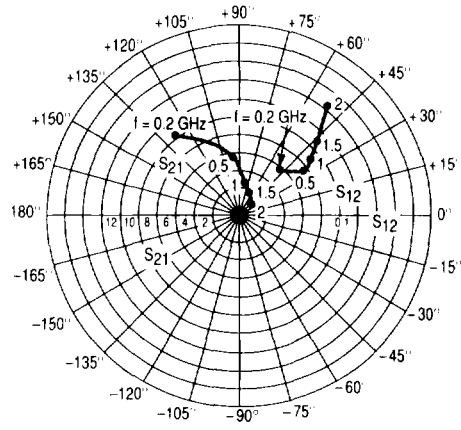
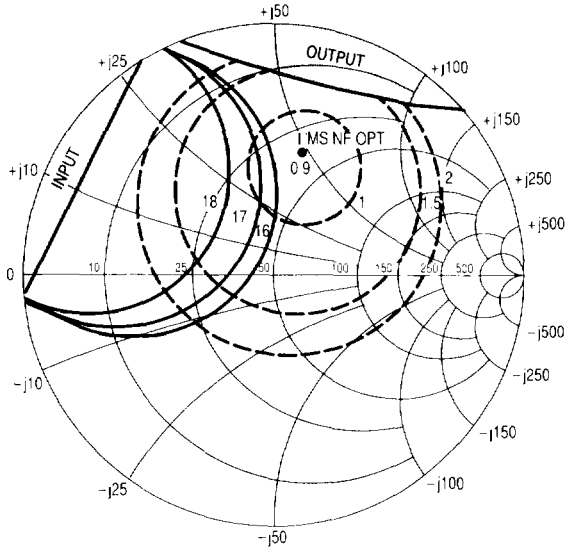


Figure 39. Forward/Reverse Transmission Coefficients versus Frequency (GHz) V_{CE} = 6.0 V, I_C = 5.0 mA

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
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

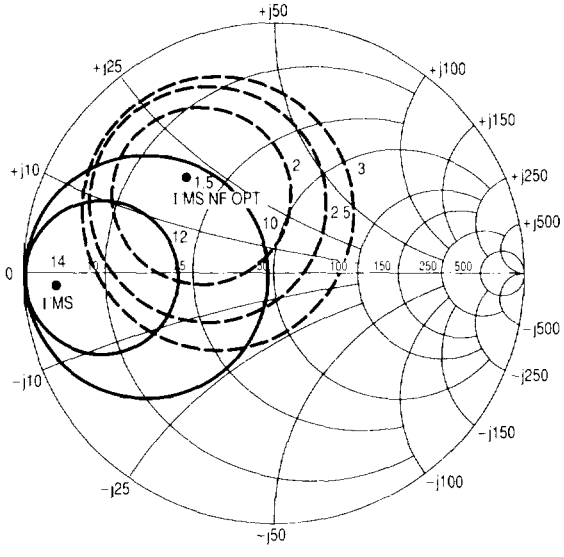
Table 4. MRF571 Common Emitter S–Parameters



V_{CE} = 6.0 V, I_C = 5.0 mA
f = 500 MHz
☐ — REGION OF INSTABILITY

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

I MS NF OPT	K
0.49 ∠ 74	0.58

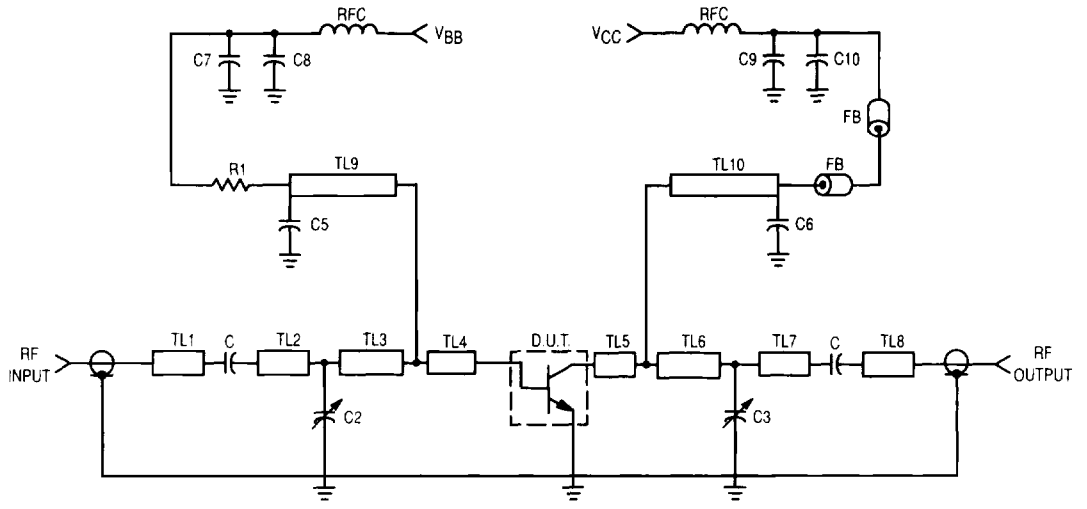


V_{CE} = 6.0 V, I_C = 5.0 mA
f = 1.0 GHz

f (GHz)	NF OPT (dB)	Rn (Ω)	NF50 Ω (dB)	I MS NF OPT
1.0	1.5	7.5	2.2	0.48 ∠ 134°

I MS	I ML
0.89 ∠ −179	0.81 ∠ 66°

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 μF 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, ε_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