

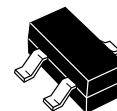
The RF Line NPN Silicon High-Frequency Transistors

Designed for low noise, wide dynamic range front-end amplifiers and low-noise VCO's. Available in a surface-mountable plastic packages. This Motorola series of small-signal plastic transistors offers superior quality and performance at low cost.

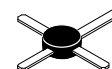
- High Gain-Bandwidth Product
 $f_T = 8.0 \text{ GHz (Typ) @ } 50 \text{ mA}$
- Low Noise Figure
 $NF_{\min} = 1.6 \text{ dB (Typ) @ } f = 1.0 \text{ GHz (MRF5711LT1, MRF571)}$
- High Gain
 $G_{NF} = 17 \text{ dB (Typ) @ } 30 \text{ mA/500 MHz (MMBR571LT1)}$
- High Power Gain
 $G_{pe} \text{ (matched)} = 13.5 \text{ dB (Typ) (MRF5711LT1)}$
- 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

MMBR571LT1
MRF571
MRF5711LT1

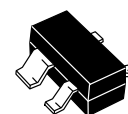
$I_C = 80 \text{ mA}$
LOW NOISE
HIGH-FREQUENCY
TRANSISTORS



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



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 @ $T_{\text{case}} = 75^\circ\text{C}$ MMBR571LT1, MRF5711LT1 Derate linearly above $T_{\text{case}} = 75^\circ\text{C}$ @	$P_{D(\text{max})}$	0.33 4.44	W mW/°C
Total Device Dissipation (1) @ $T_C = 75^\circ\text{C}$ 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 Case MRF5711LT1, MMBR571LT1	$R_{\theta JC}$	225	°C/W
Thermal Resistance, Junction to Case MRF571	$R_{\theta JC}$	130	°C/W
Maximum Junction Temperature	$T_{J\text{max}}$	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.

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

Characteristic	Symbol	Min	Typ	Max	Unit
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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 ($I_E = 50\text{ }\mu\text{Adc}$, $I_C = 0$)	$V_{(BR)EBO}$	2.5	—	—	Vdc
Collector Cutoff Current ($V_{CB} = 8.0\text{ Vdc}$, $I_E = 0$)	I_{CBO}	—	—	10	μAdc

ON CHARACTERISTICS

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

Collector–Base Capacitance ($V_{CB} = 10\text{ Vdc}$, $I_E = 0$, $f = 1.0\text{ MHz}$) ($V_{CB} = 6.0\text{ Vdc}$, $I_E = 0$, $f = 1.0\text{ MHz}$)	C_{cb}	—	0.7 0.75	1.0 1.0	pF
Current Gain–Bandwidth Product ($V_{CE} = 5.0\text{ Vdc}$, $I_C = 50\text{ mAdc}$, $f = 1.0\text{ GHz}$) ($V_{CE} = 8.0\text{ Vdc}$, $I_C = 50\text{ mAdc}$, $f = 1.0\text{ GHz}$)	f_T	—	8.0 8.0	— —	GHz

FUNCTIONAL TESTS

Gain @ Noise Figure ($I_C = 10\text{ mAdc}$, $V_{CE} = 6.0\text{ Vdc}$)	MRF571 MRF571	$f = 0.5\text{ GHz}$ $f = 1.0\text{ GHz}$	G_{NF}	— 10	16.5 12	— —	dB
Noise Figure ($I_C = 10\text{ mAdc}$, $V_{CE} = 6.0\text{ Vdc}$)	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 ($I_C = 10\text{ mAdc}$, $V_{CE} = 5.0\text{ Vdc}$) ($I_C = 10\text{ mA}$, $V_{CE} = 6.0\text{ Vdc}$)	MMBR571LT1 MRF5711LT1	$f = 0.5\text{ GHz}$ $f = 1.0\text{ GHz}$ $f = 1.0\text{ GHz}$	G_{NF}	— — —	16.5 10.5 13.5	— — —	dB
Noise Figure ($I_C = 10\text{ mAdc}$, $V_{CE} = 5.0\text{ Vdc}$) ($I_C = 10\text{ mAdc}$, $V_{CE} = 6.0\text{ Vdc}$)	MMBR571LT1 MRF5711LT1	$f = 0.5\text{ GHz}$ $f = 1.0\text{ GHz}$ $f = 1.0\text{ GHz}$	NF	— — —	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
MMBR571LT1

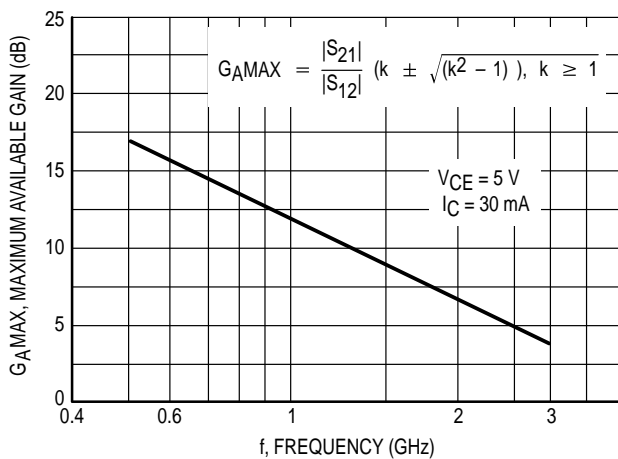


Figure 1. Maximum Available Gain versus Frequency

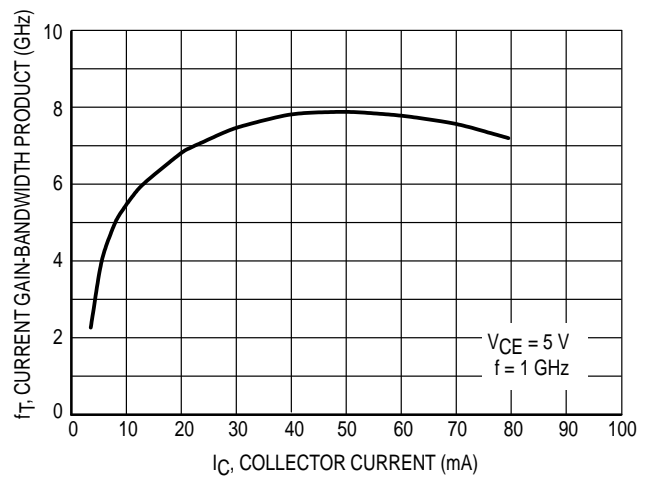


Figure 2. Current Gain–Bandwidth versus Collector Current @ 1.0 GHz

TYPICAL CHARACTERISTICS
MMBR571LT1

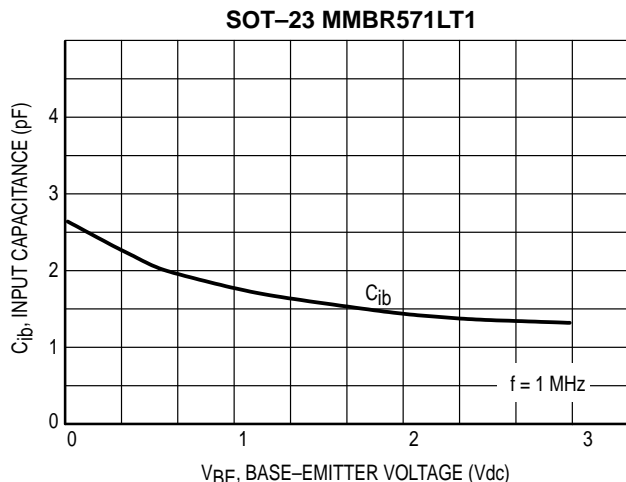


Figure 3. Input Capacitance versus Emitter Base Voltage

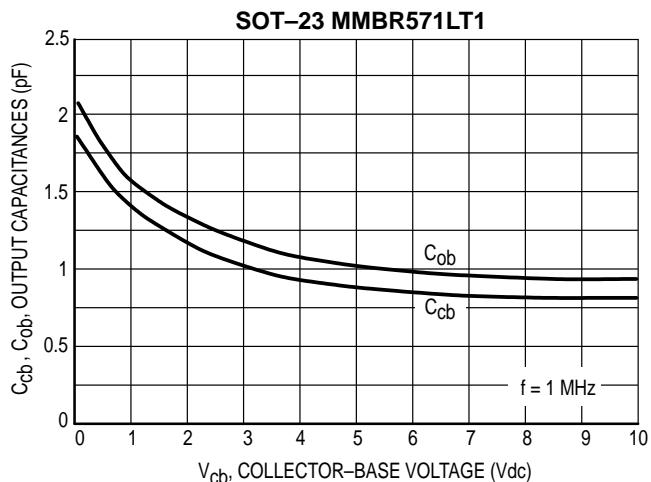


Figure 4. Output Capacitances versus Collector-Base Voltage

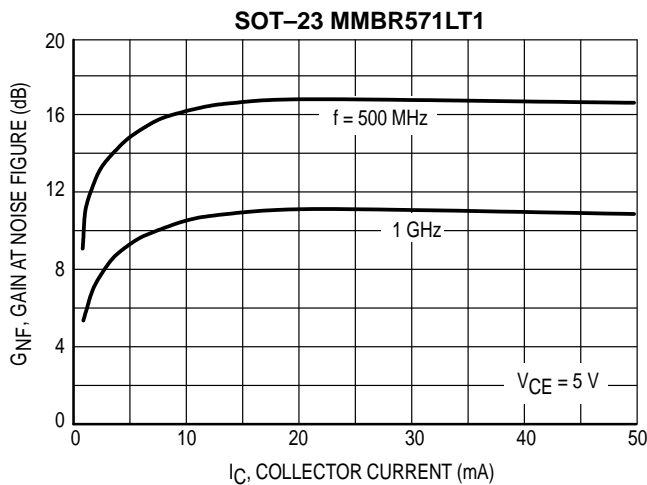


Figure 5. Gain at Noise Figure versus Collector Current

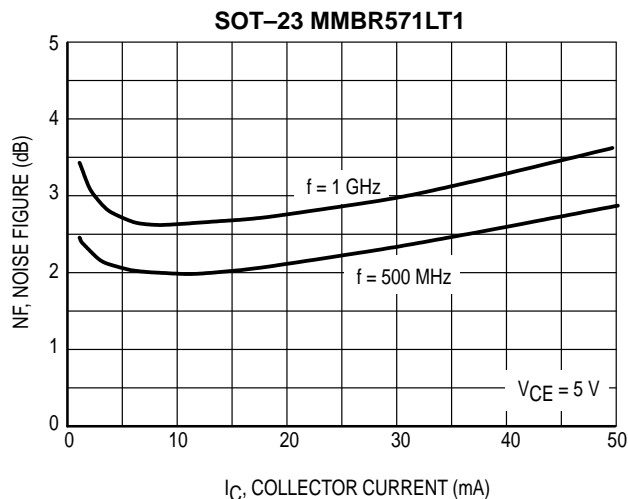


Figure 6. Noise Figure versus Collector Current

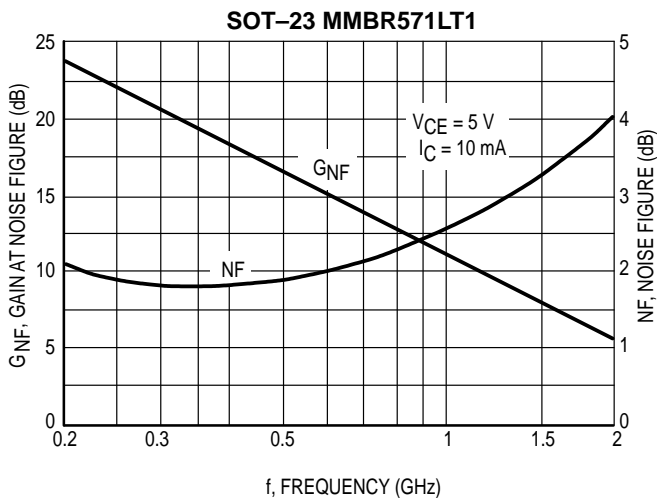


Figure 7. Gain at Noise Figure and Noise Figure versus Frequency

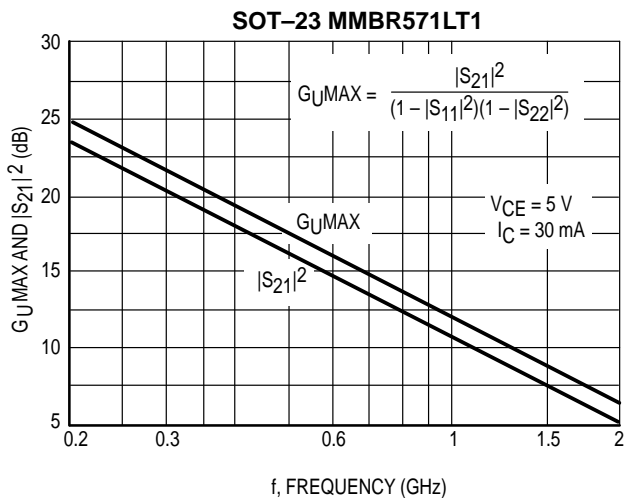


Figure 8. Maximum Unilateral Gain and Insertion Gain versus Frequency

TYPICAL CHARACTERISTICS
MRF5711LT1

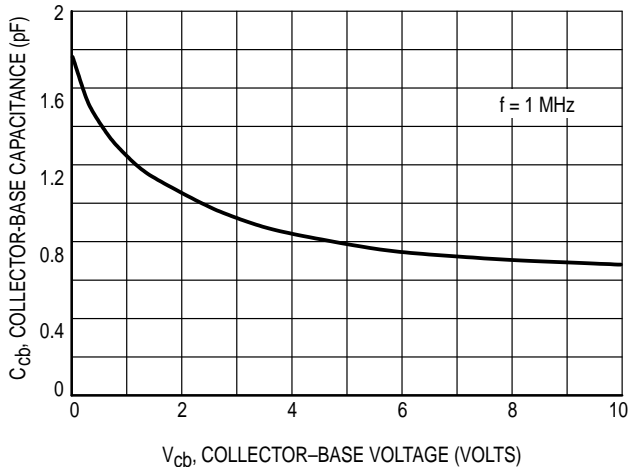


Figure 9. Collector-Base Capacitance versus Collector-Base Voltage

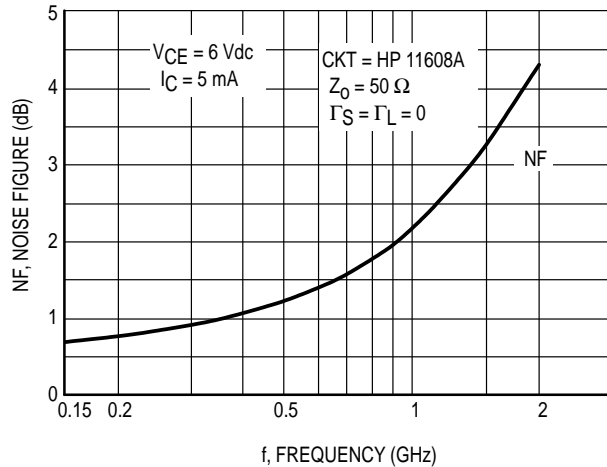


Figure 10. 50 Ω Noise Figure versus Frequency

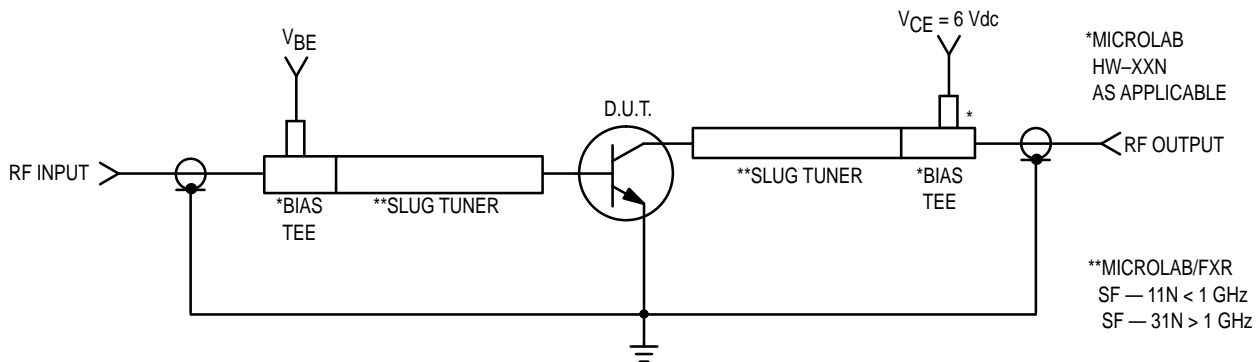


Figure 11. Functional Circuit Schematic

TYPICAL CHARACTERISTICS
MRF5711LT1

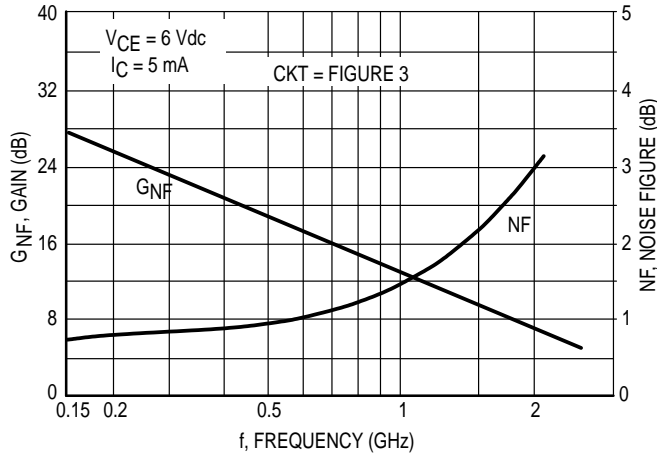


Figure 12. Gain and Noise Figure versus Frequency

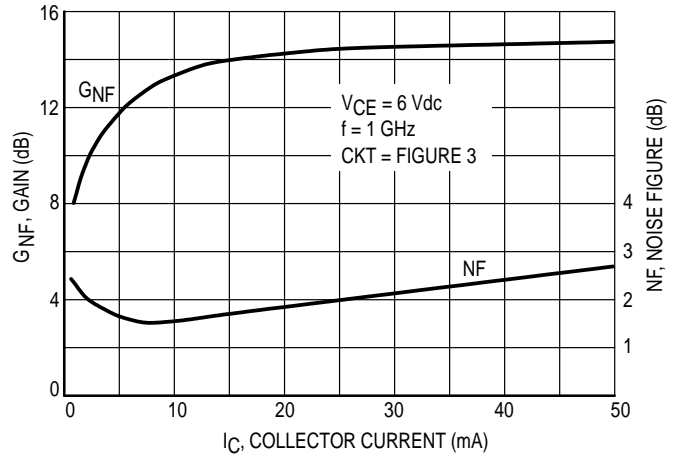


Figure 13. Gain and Noise Figure versus Collector Current

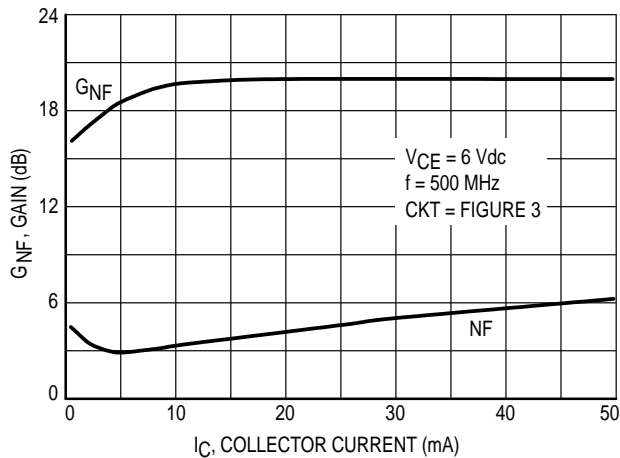


Figure 14. Gain and Noise Figure versus Collector Current

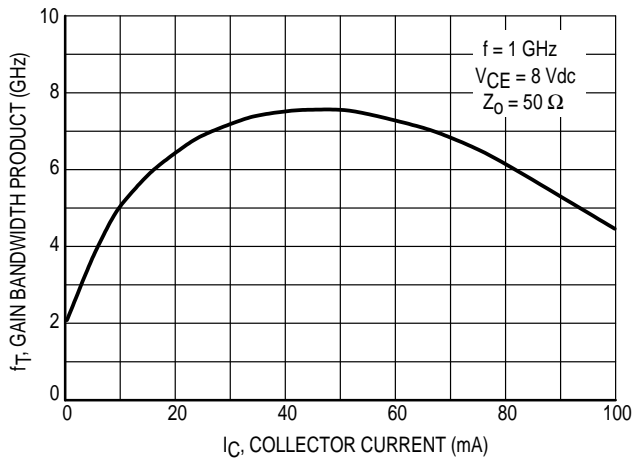


Figure 15. Gain Bandwidth Product versus Collector Current

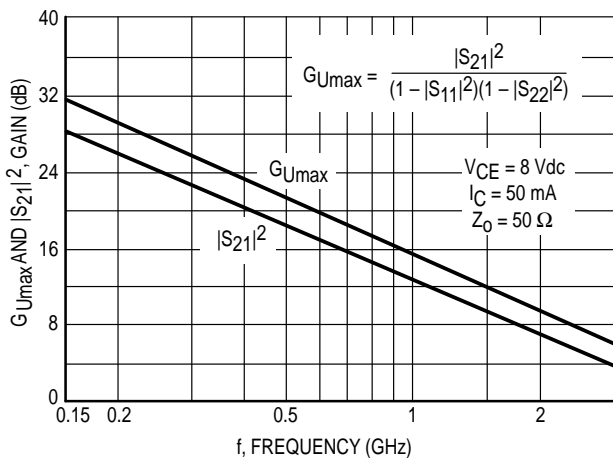


Figure 16. G_{Ummax} and $|S_{21}|^2$ versus Frequency

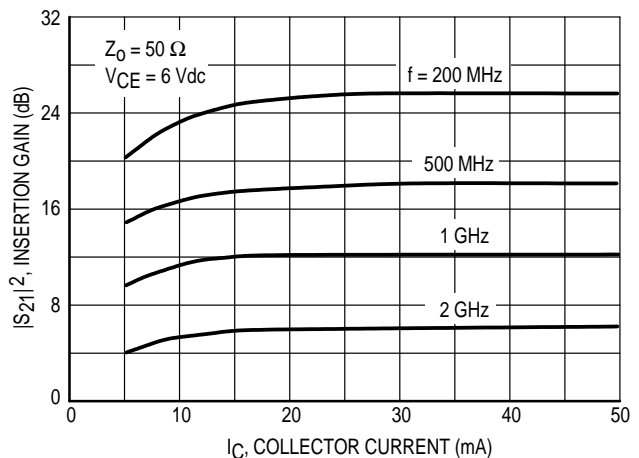


Figure 17. Insertion Gain versus Collector Current

MMBR571LT1

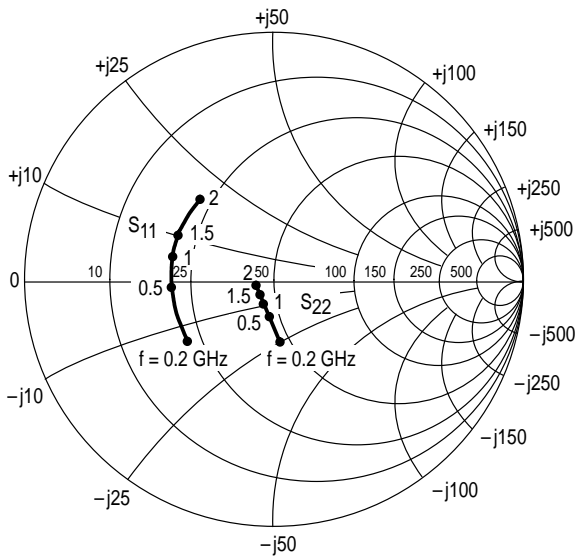


Figure 18. Input/Output Reflection Coefficients versus Frequency
 $V_{CE} = 5.0 \text{ V}$, $I_C = 30 \text{ mA}$

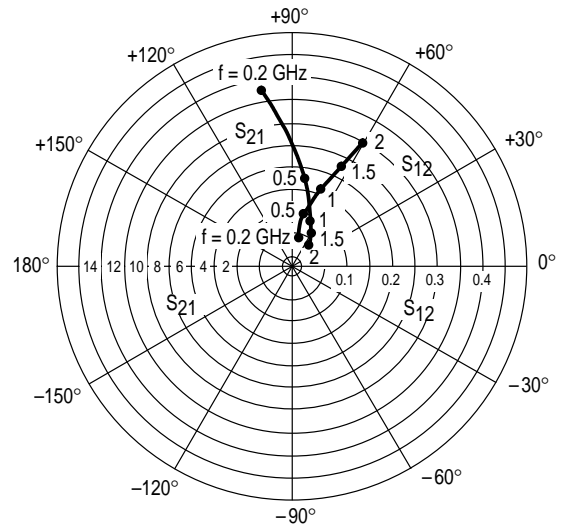
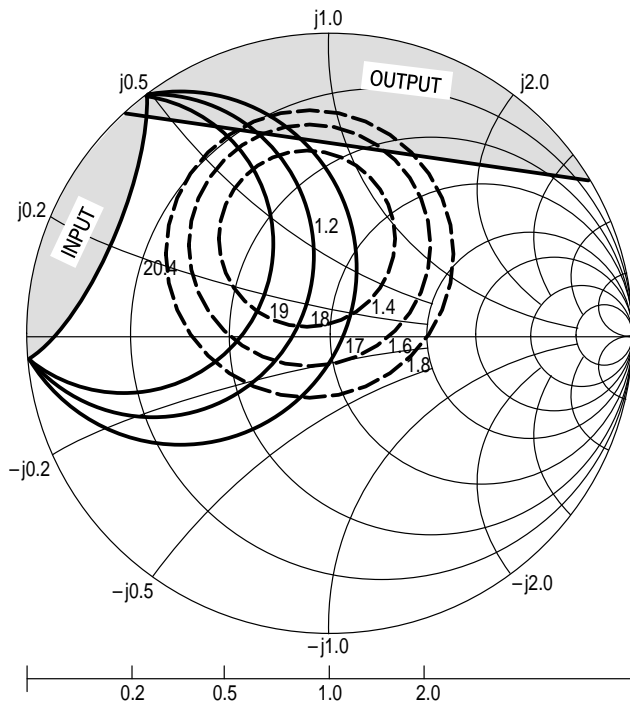


Figure 19. Forward/Reverse Transmission Coefficients versus Frequency
 $V_{CE} = 5.0 \text{ V}$, $I_C = 30 \text{ mA}$

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

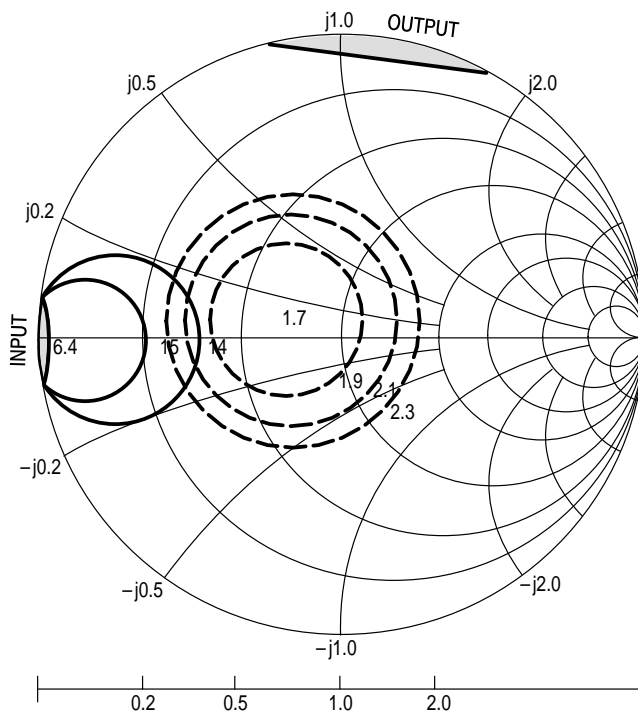
Table 1. MMBR571LT1 Common Emitter S-Parameters



$V_{CE} = 5\text{ V}$
 $I_C = 10\text{ mA}$
 □ = 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 20. MRF5711LT1 Constant Gain and Noise Figure Contours (f = 0.5 GHz)



$V_{CE} = 5\text{ V}$
 $I_C = 10\text{ mA}$
 □ = 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 21. 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	∠φ	S ₂₁	∠φ	S ₁₂	∠φ	S ₂₂	∠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 2. MRF5711LT1 Common Emitter S-Parameters

TYPICAL CHARACTERISTICS
MRF571

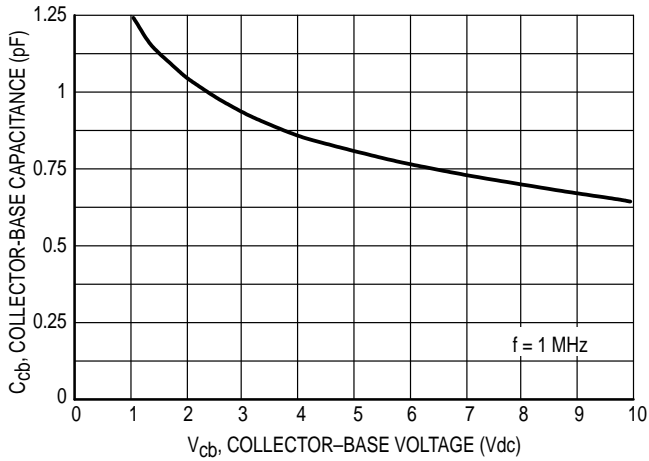


Figure 22. C_{cb} , Collector-Base Capacitance versus Voltage

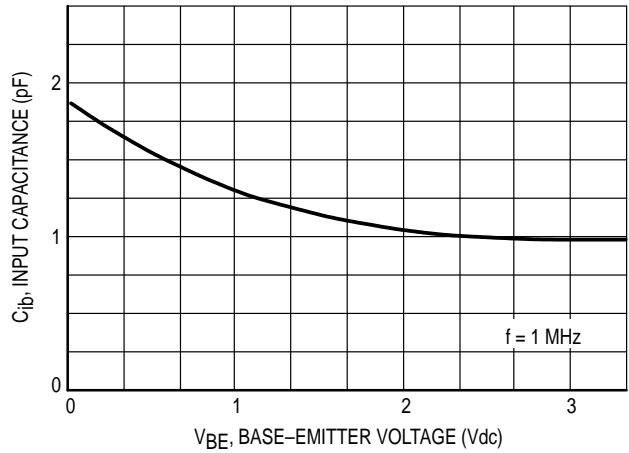


Figure 23. C_{ib} , Input Capacitance versus Emitter Base Voltage

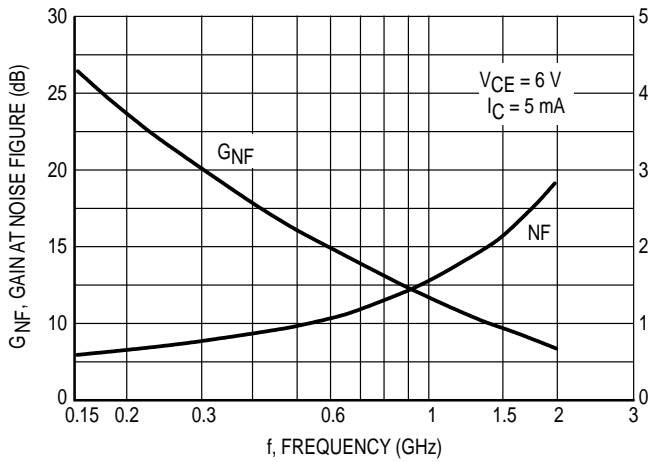


Figure 24. Gain at Noise Figure and Noise Figure versus Frequency

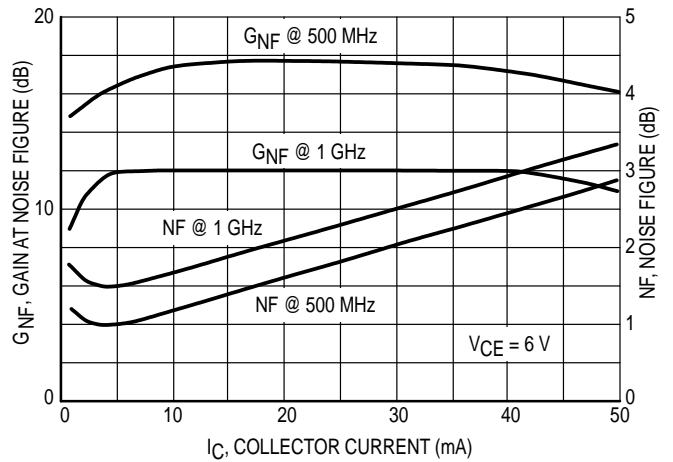


Figure 25. Gain at Noise Figure and Noise Figure versus Collector Current

TYPICAL CHARACTERISTICS MRF571

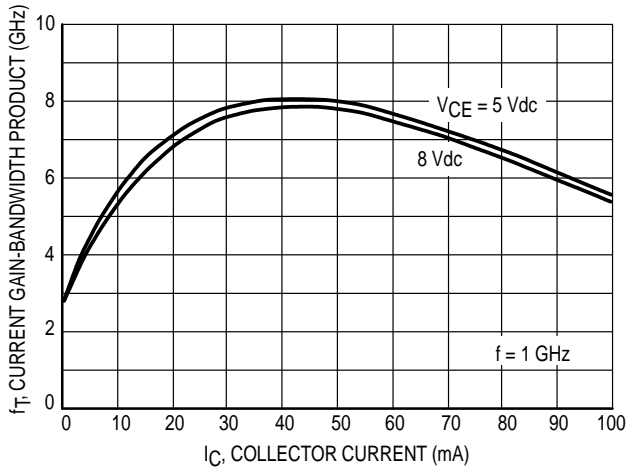


Figure 26. f_T , Current Gain–Bandwidth Product versus Collector Current

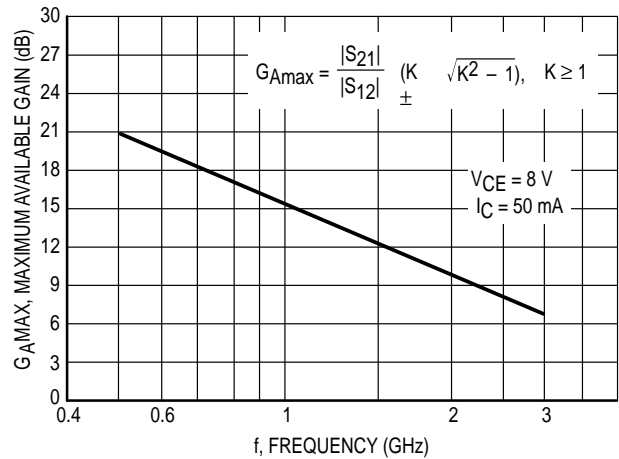


Figure 27. G_{Amax} , Maximum Available Gain versus Frequency

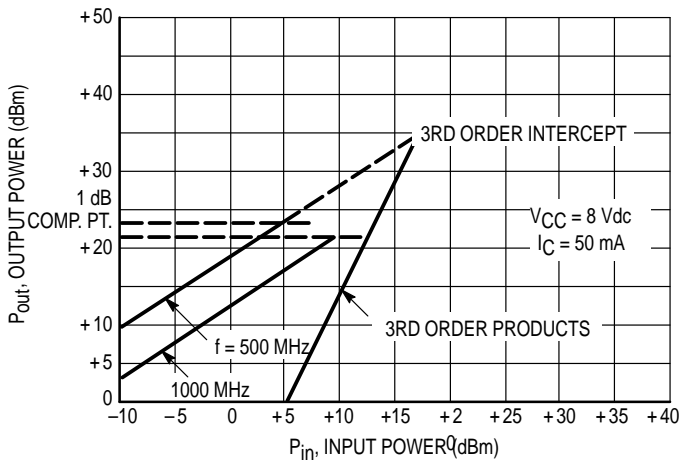


Figure 28. 1.0 dB Compression Point and Third Order Intercept

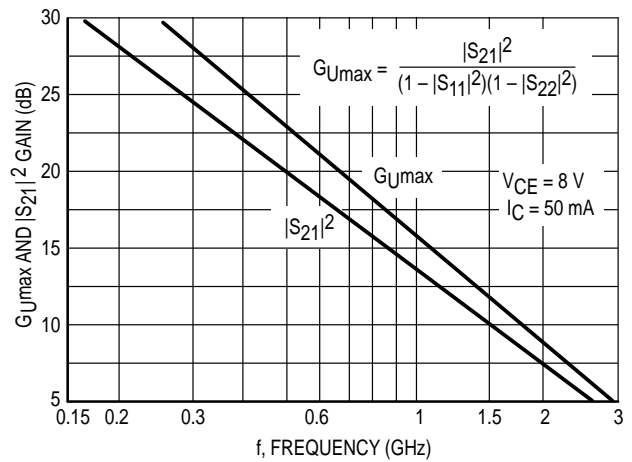


Figure 29. G_{Umax} and $|S_{21}|^2$ versus Frequency

MRF571

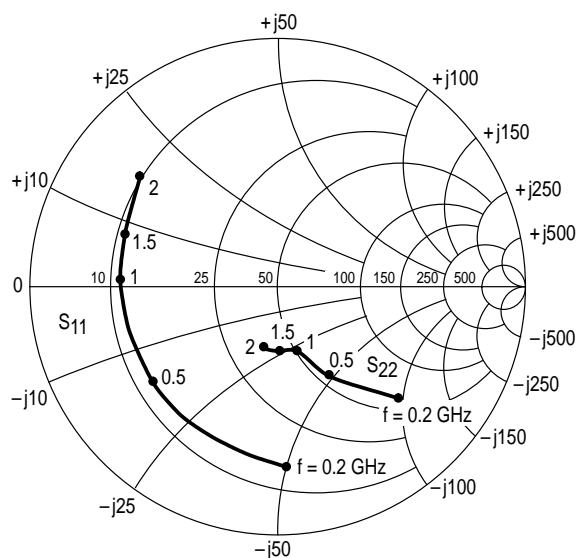


Figure 30. Input/Output Reflection Coefficients versus Frequency (GHz)
 VCE = 6.0 V, IC = 5.0 mA

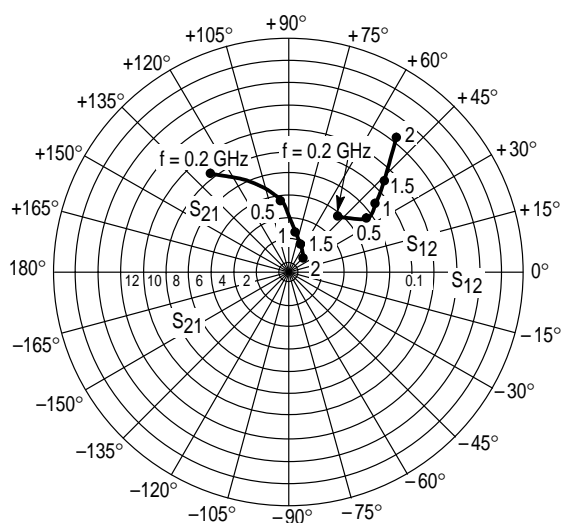
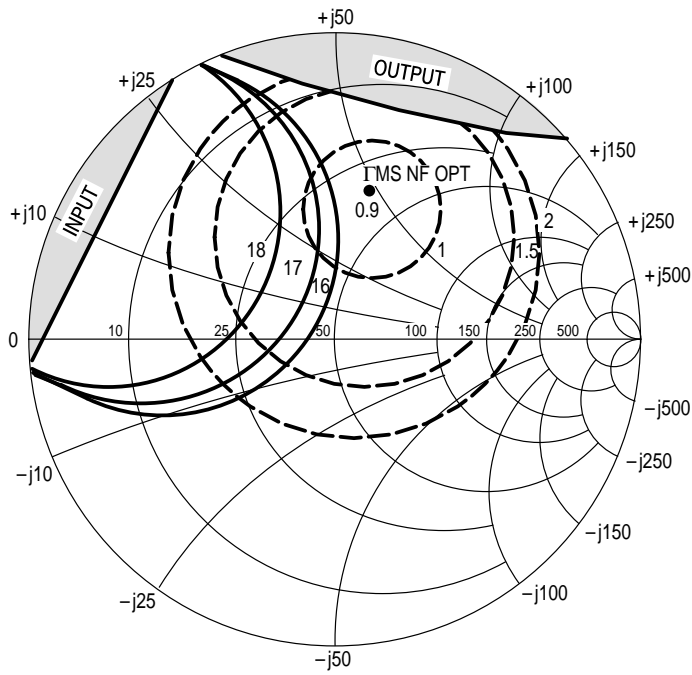


Figure 31. Forward/Reverse Transmission Coefficients versus Frequency (GHz)
 VCE = 6.0 V, IC = 5.0 mA

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

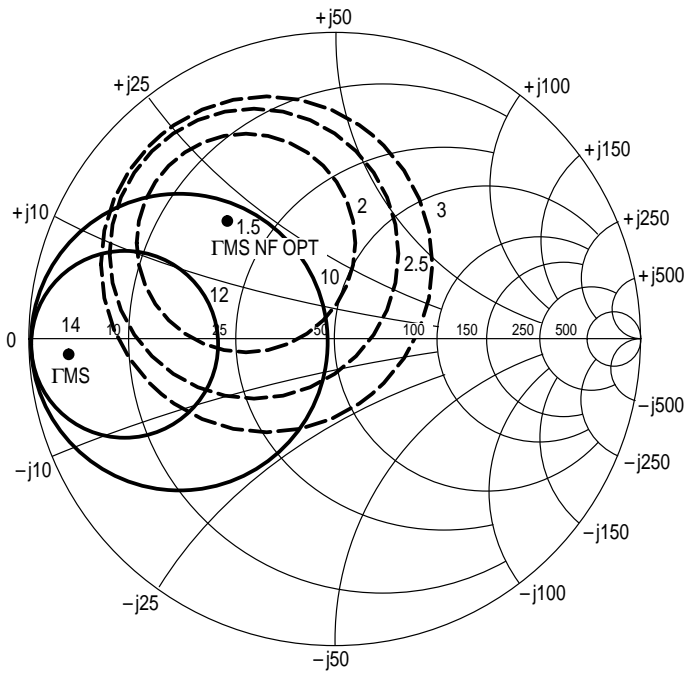
Table 3. MRF571 Common Emitter S-Parameters



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

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

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

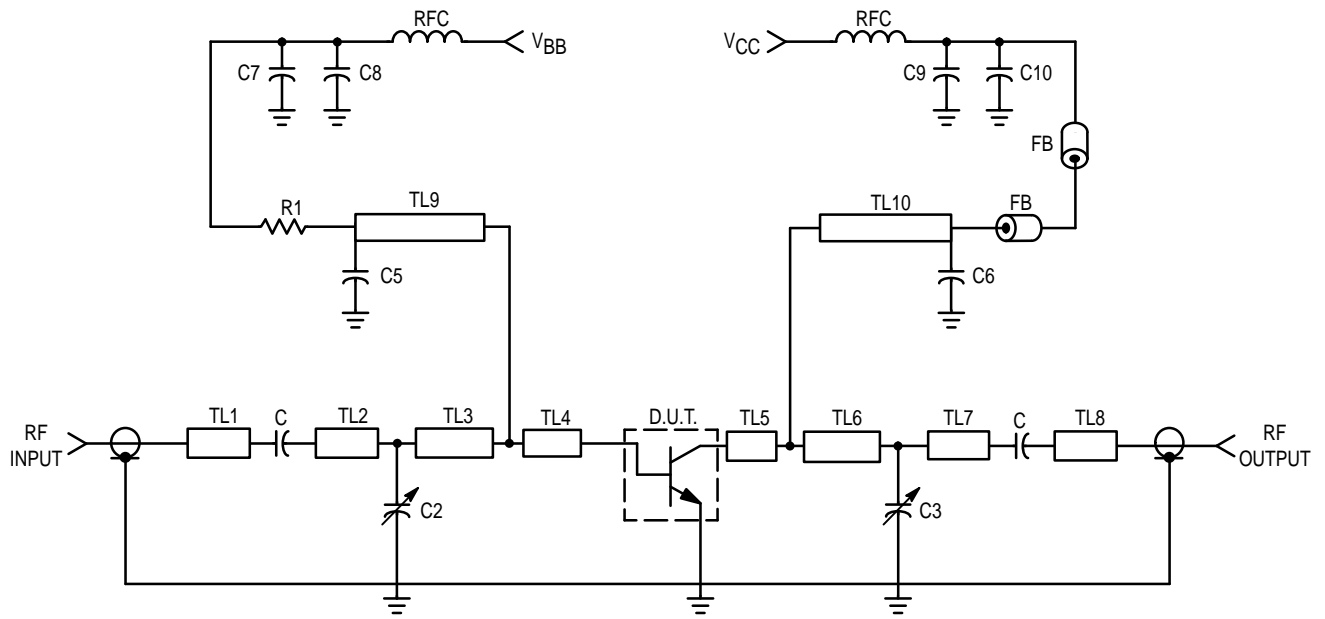


$V_{CE} = 6.0 \text{ V}$, $I_C = 5.0 \text{ mA}$
 $f = 1.0 \text{ GHz}$

f (GHz)	NF OPT (dB)	Rn (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}
$0.89 \angle -179^\circ$	$0.81 \angle 66^\circ$

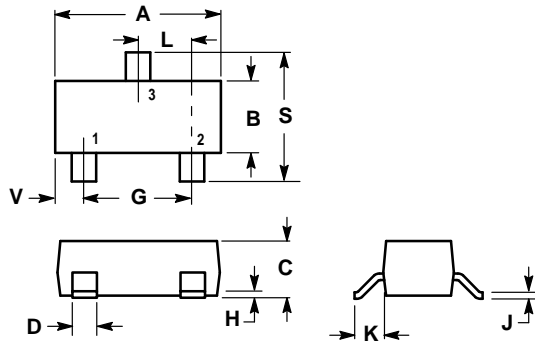
Figure 32. MRF571 Constant Gain and Noise Figure Contours



- | | |
|--|--|
| C1, C4, C5, C6, C8, C9 — 100 pF Chip Capacitor | TL1, TL7, TL8 — Microstrip 0.162" x 0.600" |
| C2, C3 — 0.8–8.0 pF Johanson Capacitor | TL2 — Microstrip 0.162" x 1.060" |
| C7, C10 — 10 μ F Tantalum Capacitor | TL3 — Microstrip 0.162" x 0.700" |
| R1 — 1.0 kOhms Res. | TL4, TL5 — Microstrip 0.162" x 0.440" |
| RFC — VK-200, Ferroxcube | TL6 — Microstrip 0.162" x 1.140" |
| FB — Ferrite Bead, Ferroxcube 56–590–65/3B | TL8, TL9 — Microstrip 0.020" x 2.130" |
| Board Material — 0.0625" Glass Teflon, $\epsilon_r = 2.55$ | |

Figure 33. MRF571 Test Circuit Schematic

PACKAGE DIMENSIONS



NOTES:

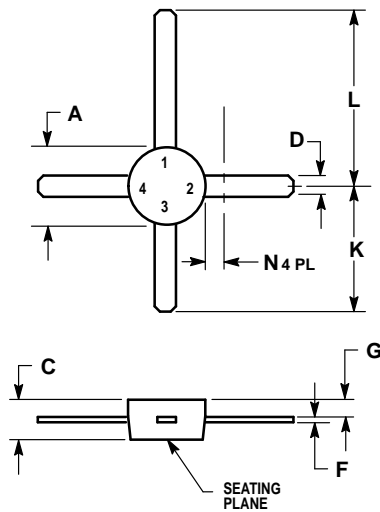
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH THICKNESS. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIAL.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.1102	0.1197	2.80	3.04
B	0.0472	0.0551	1.20	1.40
C	0.0350	0.0440	0.89	1.11
D	0.0150	0.0200	0.37	0.50
G	0.0701	0.0807	1.78	2.04
H	0.0005	0.0040	0.013	0.100
J	0.0034	0.0070	0.085	0.177
K	0.0140	0.0285	0.35	0.69
L	0.0350	0.0401	0.89	1.02
S	0.0830	0.1039	2.10	2.64
V	0.0177	0.0236	0.45	0.60

STYLE 6:

- PIN 1: BASE
 2. EMITTER
 3. COLLECTOR

**CASE 318-08
 ISSUE AF
 MMR571LT1**



NOTES:

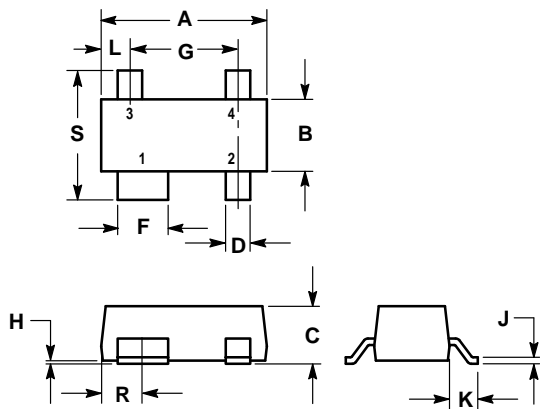
1. DIMENSION D NOT APPLICABLE IN ZONE N.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4.44	5.21	0.175	0.205
C	1.90	2.54	0.075	0.100
D	0.84	0.99	0.033	0.039
F	0.20	0.30	0.080	0.012
G	0.76	1.14	0.030	0.045
K	7.24	8.13	0.285	0.320
L	10.54	11.43	0.415	0.450
N	—	1.65	—	0.065

STYLE 2:

- PIN 1: COLLECTOR
 2. EMITTER
 3. BASE
 4. EMITTER

**CASE 317-01
 ISSUE E
 MRF571**




- NOTES:
4. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
 5. CONTROLLING DIMENSION: MILLIMETER.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	2.80	3.04	0.110	0.120
B	1.20	1.39	0.047	0.055
C	0.84	1.14	0.033	0.045
D	0.39	0.50	0.015	0.020
F	0.79	0.93	0.031	0.037
G	1.78	2.03	0.070	0.080
H	0.013	0.10	0.0005	0.004
J	0.08	0.15	0.003	0.006
K	0.46	0.60	0.018	0.024
L	0.445	0.60	0.0175	0.024
R	0.72	0.83	0.028	0.033
S	2.11	2.48	0.083	0.098

- STYLE 1:
 PIN 1. COLLECTOR
 2. EMITTER
 3. EMITTER
 4. BASE

**CASE 318A-05
 ISSUE R
 MRF5711LT1**

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