

The RF Line

NPN Silicon

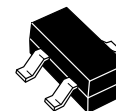
High-Frequency Transistors

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.

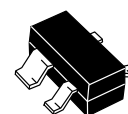
- High Gain-Bandwidth Product
 $f_T = 8.0 \text{ GHz (Typ) @ } 50 \text{ mA}$
- Low Noise Figure
 $NF_{\min} = 1.6 \text{ dB (Typ) @ } f = 1.0 \text{ GHz (MRF5711LT1, MRF571)}$
- High Gain
 $G_{NF} = 17 \text{ dB (Typ) @ } 30 \text{ mA/500 MHz (MMBR571LT1)}$
- High Power Gain
 $G_{pe} \text{ (matched)}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

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



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



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_{CB0}	20	Vdc
Emitter-Base Voltage	V_{EBO}	3.0	Vdc
Collector Current — Continuous	I_C	80	mA
Total Device Dissipation @ $T_{\text{case}} = 75^\circ\text{C}$ Derate linearly above $T_{\text{case}} = 75^\circ\text{C}$ @	$P_{D(\text{max})}$	0.33 4.44	W mW/ $^\circ\text{C}$
Operating and Storage Temperature	T_{stg}	-55 to +150	$^\circ\text{C}$

THERMAL CHARACTERISTICS

Rating	Symbol	Max	Unit
Thermal Resistance, Junction to Case MRF5711LT1, MMBR571LT1	$R_{\theta JC}$	225	$^\circ\text{C/W}$
Maximum Junction Temperature	$T_{J\text{max}}$	150	$^\circ\text{C}$

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 ($V_{CB} = 10\text{ Vdc}$, $I_E = 0$, $f = 1.0\text{ MHz}$) ($V_{CB} = 6.0\text{ Vdc}$, $I_E = 0$, $f = 1.0\text{ MHz}$)	MMBR571LT1 MRF5711LT1,	C_{cb}	— —	0.7 0.75	1.0 1.0	pF
Current Gain–Bandwidth Product ($V_{CE} = 5.0\text{ Vdc}$, $I_C = 50\text{ mAdc}$, $f = 1.0\text{ GHz}$) ($V_{CE} = 8.0\text{ Vdc}$, $I_C = 50\text{ mAdc}$, $f = 1.0\text{ GHz}$)	MMBR571LT1 MRF5711LT1	f_T	— —	8.0 8.0	— —	GHz

FUNCTIONAL TESTS

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	$f = 0.5\text{ GHz}$ $f = 1.0\text{ GHz}$ $f = 1.0\text{ GHz}$	GNF	— — —	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 $50\text{ }\Omega$ 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

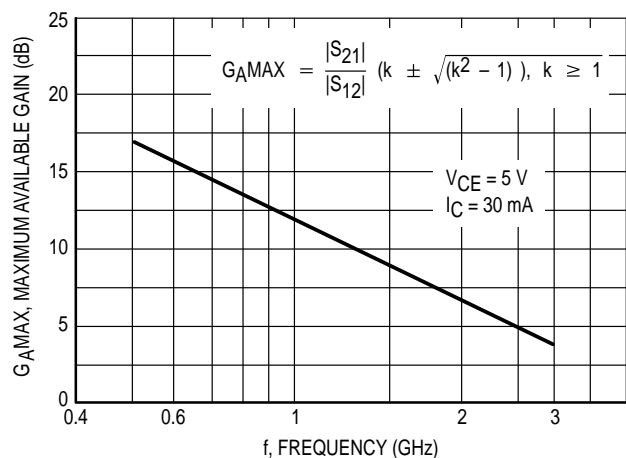


Figure 1. Maximum Available Gain versus Frequency

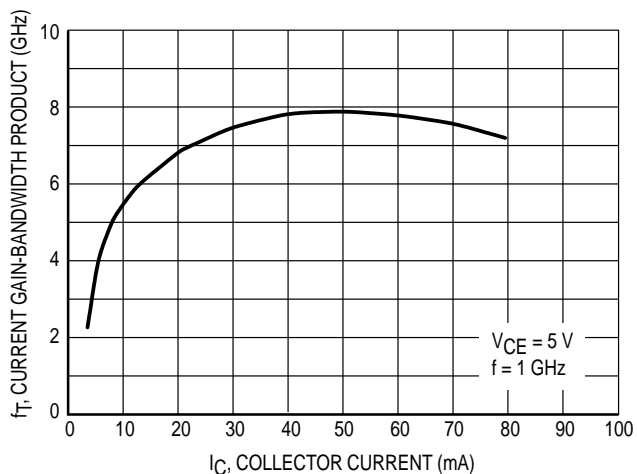


Figure 2. Current Gain–Bandwidth versus Collector Current @ 1.0 GHz

**TYPICAL CHARACTERISTICS
MMBR571LT1**

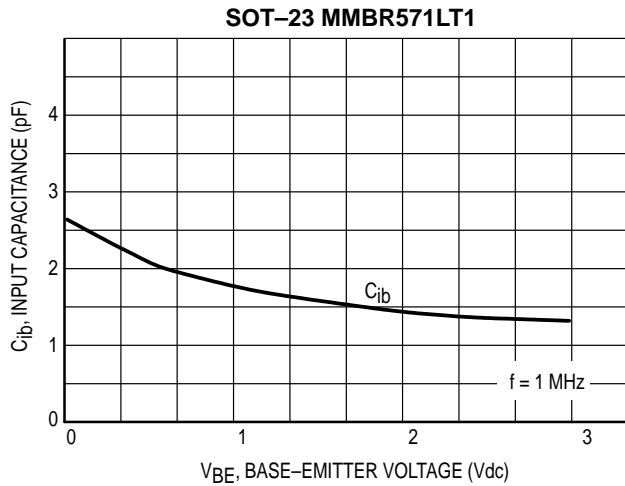


Figure 3. Input Capacitance versus Emitter Base Voltage

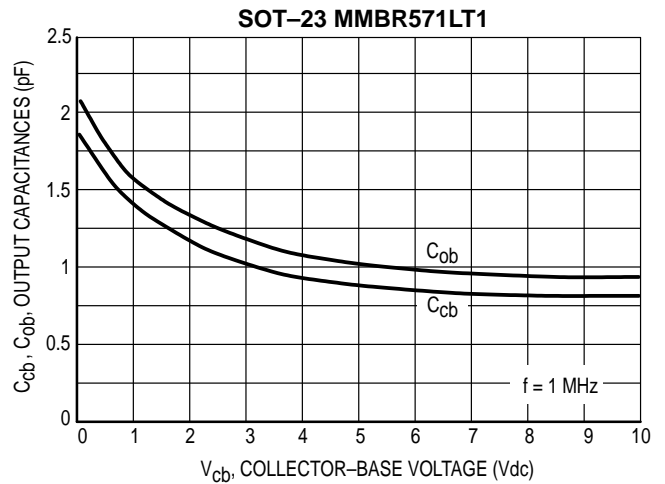


Figure 4. Output Capacitances versus Collector-Base Voltage

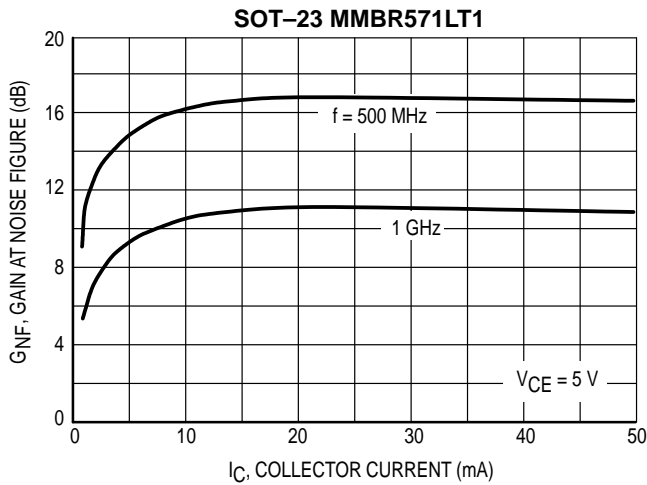


Figure 5. Gain at Noise Figure versus Collector Current

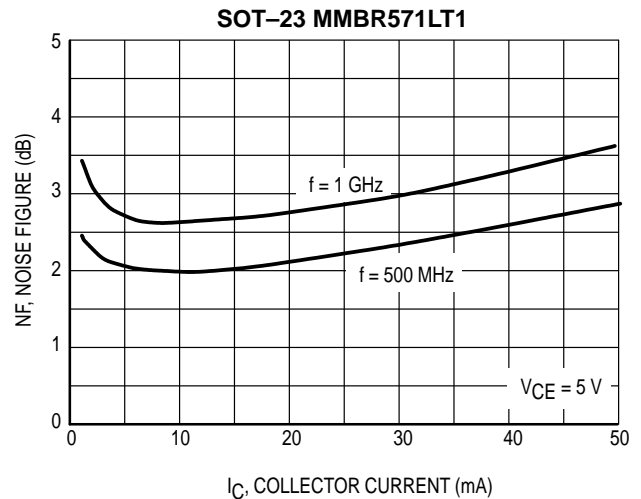


Figure 6. Noise Figure versus Collector Current

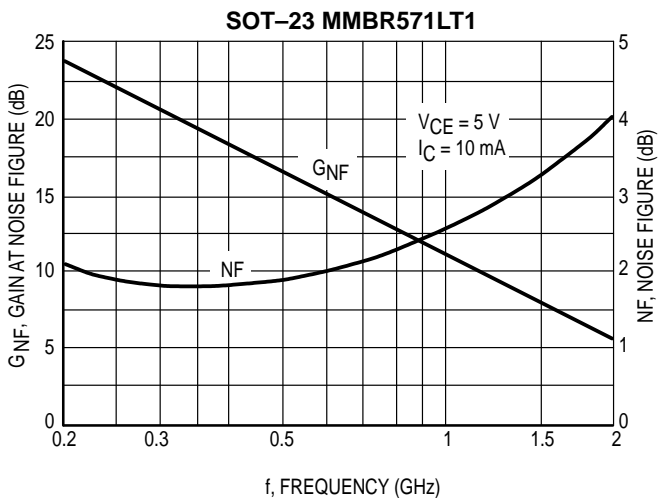


Figure 7. Gain at Noise Figure and Noise Figure versus Frequency

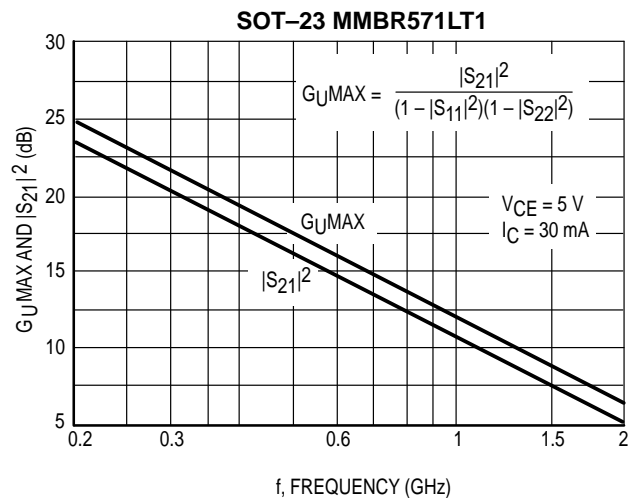


Figure 8. Maximum Unilateral Gain and Insertion Gain versus Frequency

TYPICAL CHARACTERISTICS
MRF5711LT1

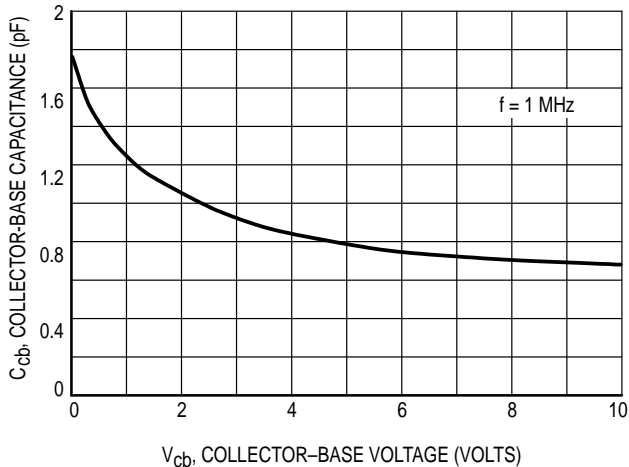


Figure 9. Collector-Base Capacitance versus Collector-Base Voltage

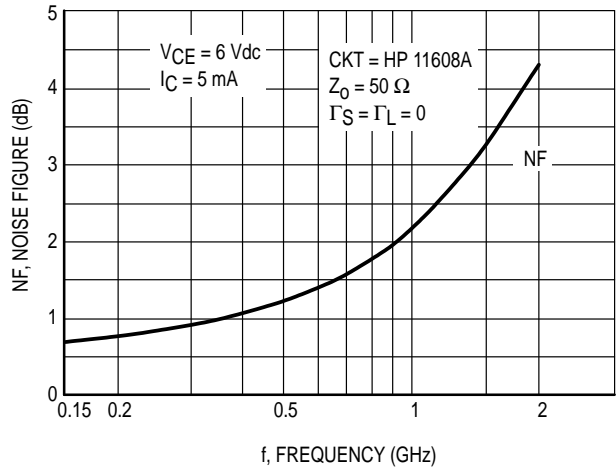


Figure 10. 50 Ω Noise Figure versus Frequency

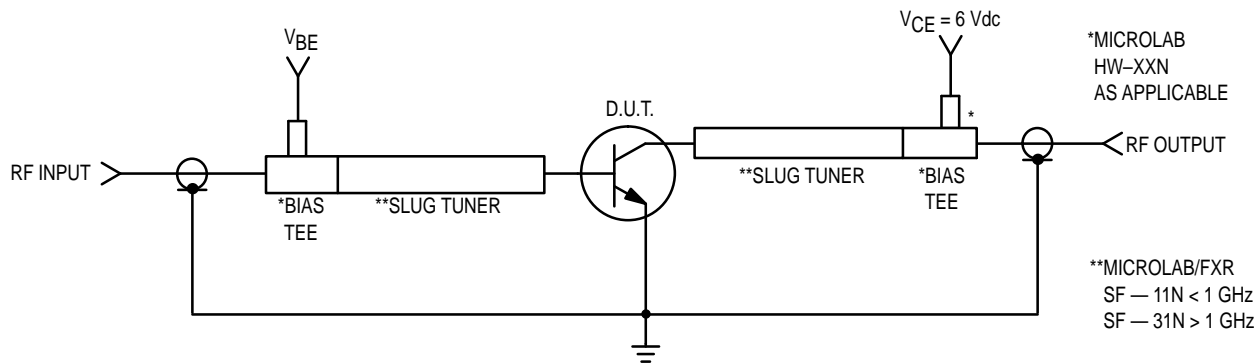


Figure 11. Functional Circuit Schematic

TYPICAL CHARACTERISTICS MRF5711LT1

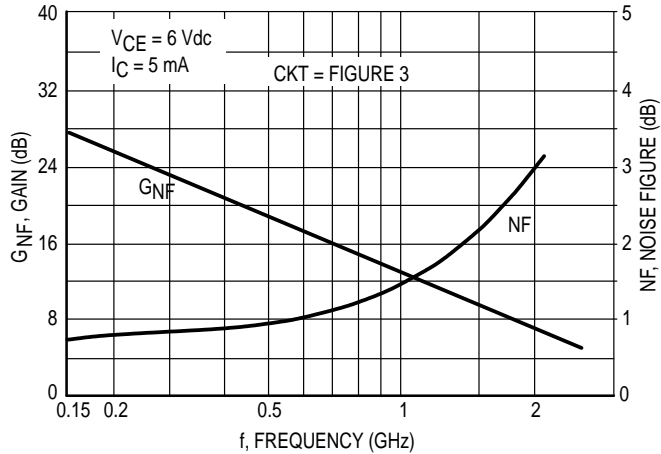


Figure 12. Gain and Noise Figure versus Frequency

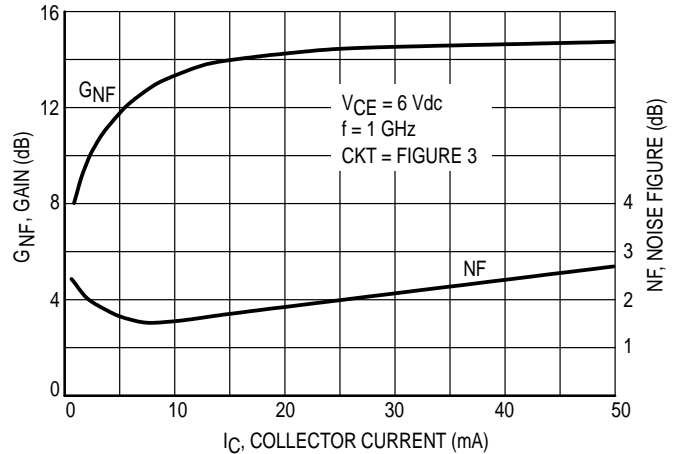


Figure 13. Gain and Noise Figure versus Collector Current

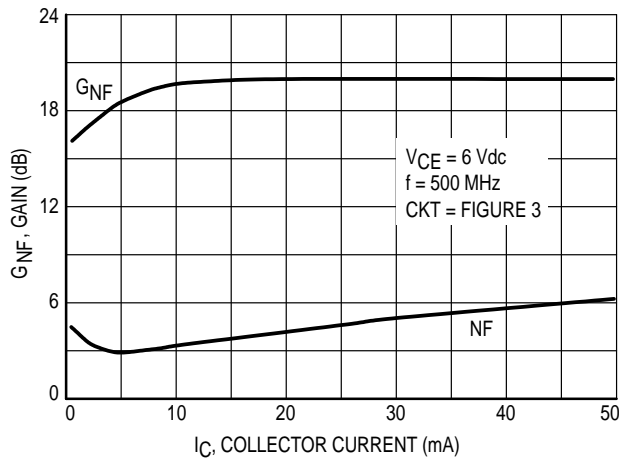


Figure 14. Gain and Noise Figure versus Collector Current

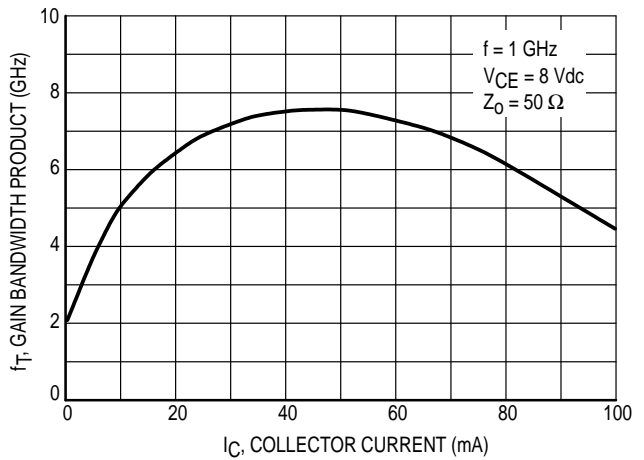


Figure 15. Gain Bandwidth Product versus Collector Current

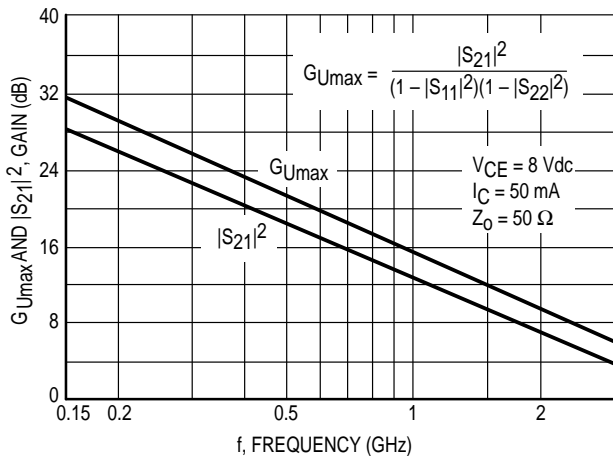


Figure 16. G_{UmAx} and $|S_{21}|^2$ versus Frequency

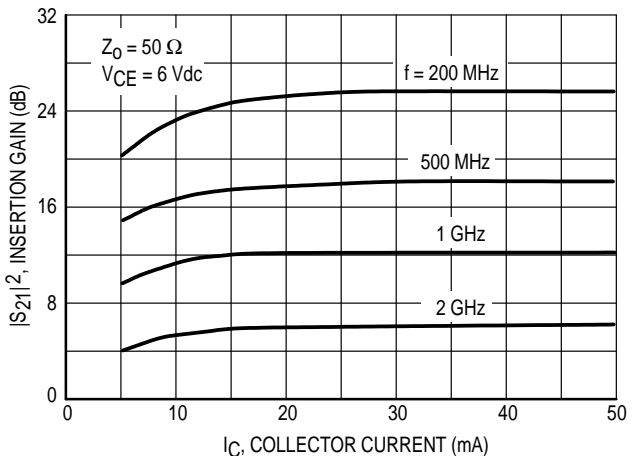


Figure 17. Insertion Gain versus Collector Current

MMBR571LT1

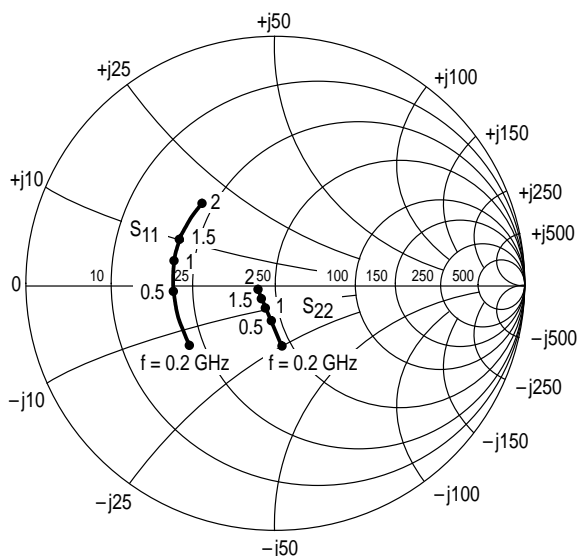


Figure 18. Input/Output Reflection Coefficients versus Frequency
 VCE = 5.0 V, IC = 30 mA

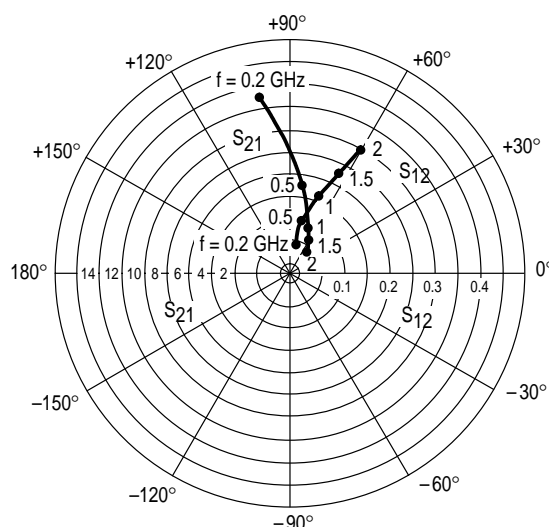
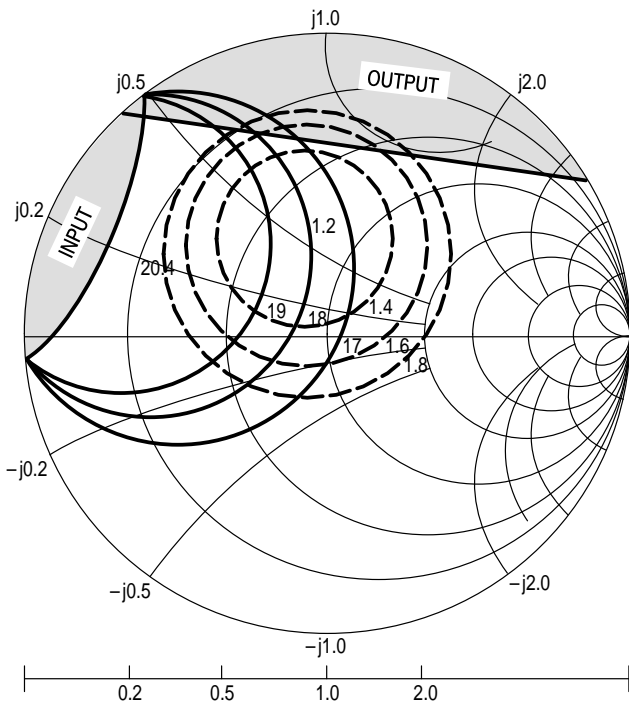


Figure 19. Forward/Reverse Transmission Coefficients versus Frequency
 VCE = 5.0 V, IC = 30 mA

VCE (Volts)	IC (mA)	f (MHz)	S11		S21		S12		S22	
			S11	φ	S21	φ	S12	φ	S22	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

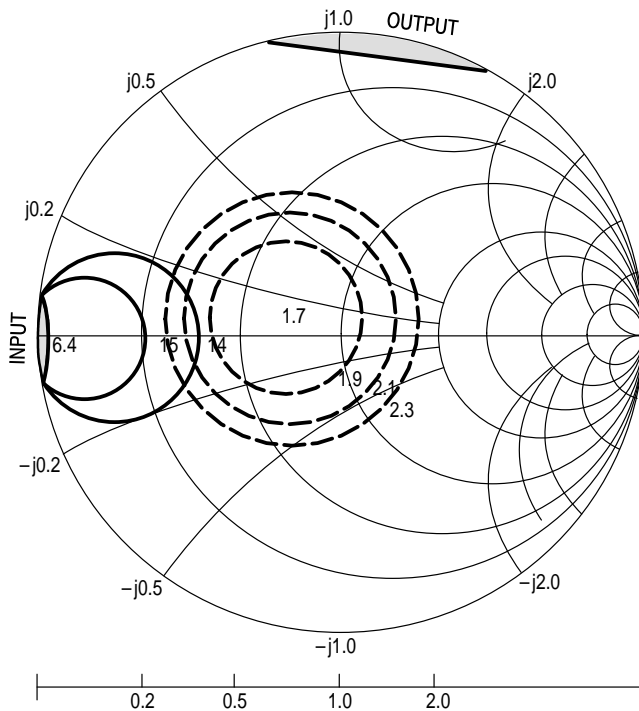
Table 1. MMBR571LT1 Common Emitter S-Parameters



$V_{CE} = 5\text{ V}$
 $I_C = 10\text{ mA}$
 □ = Area of Instability

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

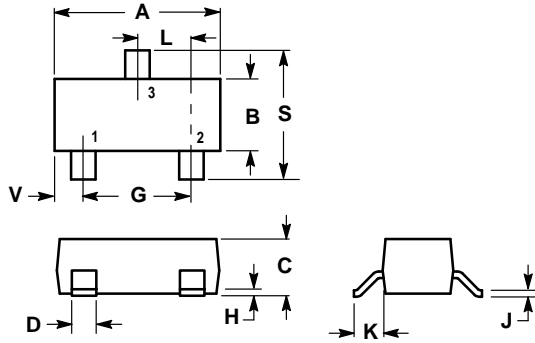
Figure 20. MRF5711LT1 Constant Gain and Noise Figure Contours (f = 0.5 GHz)



V _{CE} (Vdc)	I _C (mA)	f (MHz)	S ₁₁		S ₂₁		S ₁₂		S ₂₂	
			S ₁₁	∠	S ₂₁	∠	S ₁₂	∠	S ₂₂	∠
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

PACKAGE DIMENSIONS



NOTES:

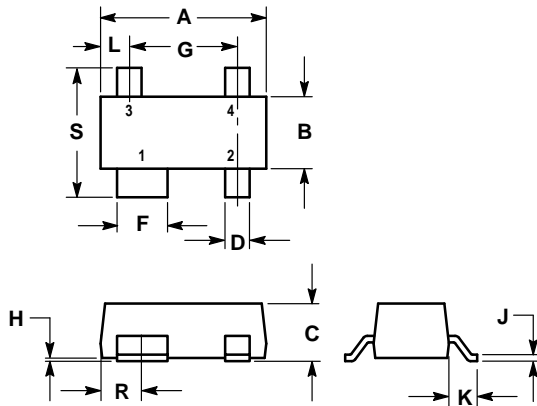
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH THICKNESS. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIAL.

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
MMBR571LT1**



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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MMBR571LT1/D