

# The RF Line

## NPN Silicon

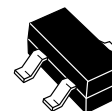
### High-Frequency Transistor

Designed primarily for use in high-gain, low-noise small-signal amplifiers for operation up to 2.5 GHz. Also usable in applications requiring fast switching times.

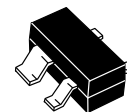
- High Current-Gain — Bandwidth Product
- Low Noise Figure @  $f = 1.0$  GHz —  
 $NF_{(matched)} = 1.8$  dB (Typ) (MRF9011LT1)  
 $= 1.9$  dB (Typ) (MMBR901LT1, T3)
- High Power Gain —  
 $G_{pe(matched)} = 13.5$  dB (Typ) @  $f = 1.0$  GHz (MRF9011LT1)  
 $= 12.0$  dB (Typ) @  $f = 1.0$  GHz (MMBR901LT1, T3)
- Guaranteed RF Parameters (MRF9011LT1)
- Surface Mounted SOT-23 & SOT-143 Offer Improved RF Performance  
 Lower Package Parasitics  
 High Gain
- Available in tape and reel packaging options:  
 T1 suffix = 3,000 units per reel  
 T3 suffix = 10,000 units per reel

**MMBR901LT1, T3**  
**MRF9011LT1**

$I_C = 30$  mA  
SURFACE MOUNTED  
HIGH-FREQUENCY  
TRANSISTOR  
NPN SILICON



CASE 318-08, STYLE 6  
SOT-23  
LOW PROFILE, MMBR901LT1, T3



CASE 318A-05, STYLE 1  
SOT-143  
LOW PROFILE, MRF9011LT1

#### MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	$V_{CEO}$	15	Vdc
Collector-Base Voltage	$V_{CBO}$	25	Vdc
Emitter-Base Voltage	$V_{EBO}$	2.0	Vdc
Collector Current — Continuous	$I_C$	30	mAdc
Power Dissipation @ $T_C = 75^\circ\text{C}$ (1)  Derate above $25^\circ\text{C}$	$P_{D(max)}$	0.300  4.00	Watt  mW/ $^\circ\text{C}$
Storage Temperature Range	$T_{stg}$	-55 to +150	$^\circ\text{C}$
Maximum Junction Temperature	$T_{J(max)}$	150	$^\circ\text{C}$

#### THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Storage Temperature	$T_{stg}$	150	$^\circ\text{C}$
Thermal Resistance, Junction to Case MRF9011LT1, MMBR901LT1, T3	$R_{\theta JC}$	200	$^\circ\text{C}/\text{W}$

#### DEVICE MARKING

MRF9011LT1 = 01	MMBR901LT1, T3 = 7A
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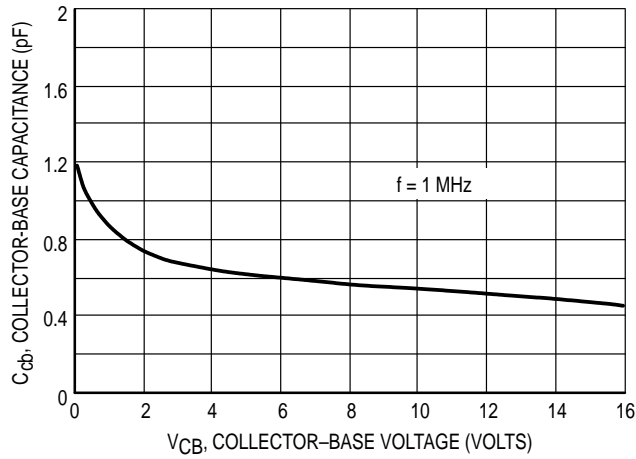
#### NOTE:

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

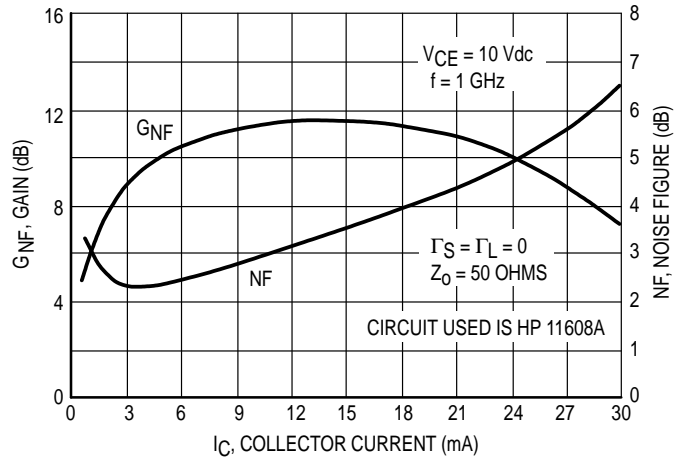
**ELECTRICAL CHARACTERISTICS** ( $T_A = 25^\circ\text{C}$  unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit	
<b>OFF CHARACTERISTICS</b>						
Collector–Emitter Breakdown Voltage ( $I_C = 1.0\text{ mA}$ , $I_B = 0$ )	$V_{(BR)CEO}$	15	—	—	Vdc	
Collector–Base Breakdown Voltage ( $I_C = 0.1\text{ mA}$ , $I_E = 0$ )	$V_{(BR)CBO}$	25	—	—	Vdc	
Emitter–Base Breakdown Voltage ( $I_E = 0.1\text{ mA}$ , $I_C = 0$ )	$V_{(BR)EBO}$	2.0	—	—	Vdc	
Collector Cutoff Current ( $V_{CB} = 15\text{ Vdc}$ , $I_E = 0$ )	$I_{CBO}$	—	—	50	nAdc	
<b>ON CHARACTERISTICS</b>						
DC Current Gain ( $I_C = 5.0\text{ mA}$ , $V_{CE} = 5.0\text{ Vdc}$ )	MMBR901LT1, T3 MRF9011LT1	$h_{FE}$	50 30	— 80	200 200	—
<b>DYNAMIC CHARACTERISTICS</b>						
Current–Gain — Bandwidth Product ( $I_C = 15\text{ mA}$ , $V_{CE} = 10\text{ Vdc}$ , $f = 1.0\text{ GHz}$ )	MRF9011LT1	$f_T$	—	3.8	—	GHz
Collector–Base Capacitance ( $V_{CB} = 10\text{ Vdc}$ , $I_E = 0$ , $f = 1.0\text{ MHz}$ )	MRF9011LT1	$C_{cb}$	—	0.55	1.0	pF
<b>FUNCTIONAL TESTS</b>						
Power Gain at Minimum Noise Figure ( $V_{CE} = 10\text{ Vdc}$ , $I_C = 5.0\text{ mA}$ , $f = 1.0\text{ GHz}$ )	MRF9011LT1	$GN_{Fmin}$	—	13.5	—	dB
Minimum Noise Figure (Figure 3) ( $V_{CE} = 10\text{ Vdc}$ , $I_C = 5.0\text{ mA}$ , $f = 1.0\text{ GHz}$ )	MRF9011LT1	$NF_{min}$	—	1.8	—	dB
Insertion Gain in 50 $\Omega$ System ( $V_{CE} = 10\text{ Vdc}$ , $I_C = 5.0\text{ mA}$ , $f = 1.0\text{ GHz}$ )	MRF9011LT1	$ S_{21} ^2$	9.0	10.2	—	dB
Minimum Noise Figure (Figure 3) ( $V_{CE} = 6.0\text{ Vdc}$ , $I_C = 5.0\text{ mA}$ , $f = 1.0\text{ GHz}$ ) ( $V_{CE} = 10\text{ Vdc}$ , $I_C = 5.0\text{ mA}$ , $f = 1.0\text{ GHz}$ )	MMBR901LT1, T3	$NF_{min}$	—	1.9	—	dB
<b>SMALL–SIGNAL CHARACTERISTICS</b>						
Output Capacitance ( $V_{CB} = 10\text{ Vdc}$ , $I_C = 5.0\text{ mA}$ , $f = 1.0\text{ GHz}$ )	MMBR901LT1	$C_{obo}$	—	—	1.0	pF
Common–Emitter Amplifier Gain ( $V_{CC} = 6.0\text{ Vdc}$ , $I_C = 5.0\text{ mA}$ , $f = 1.0\text{ GHz}$ )	MMBR901LT1	$G_{pe}$	—	12	—	dB

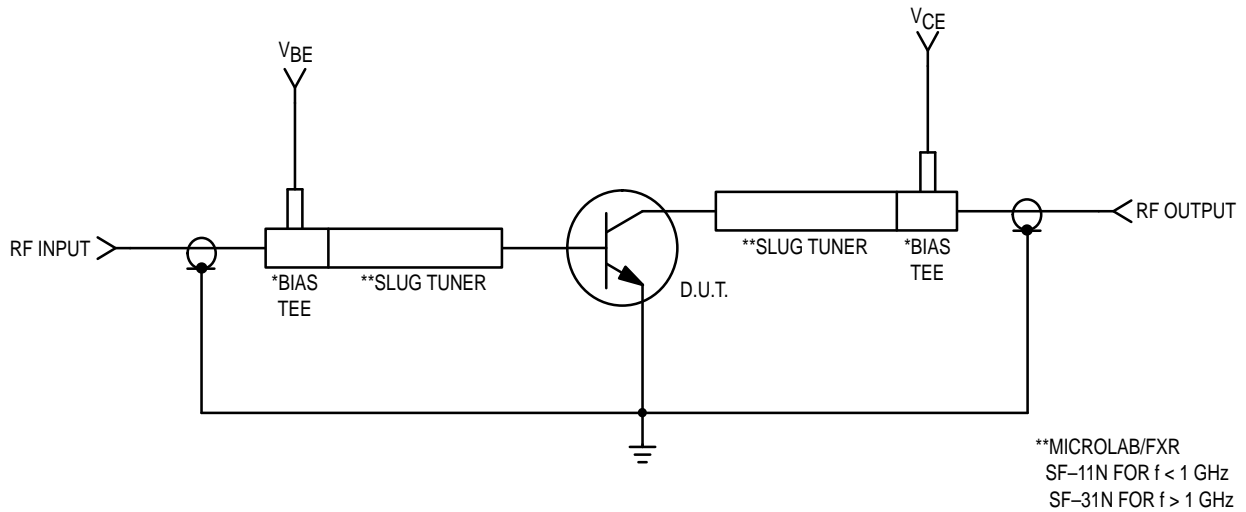
# MRF9011LT1



**Figure 1. Collector-Base Capacitance versus Collector-Base Voltage**



**Figure 2. Gain and Noise Figure versus Collector Current**



**Figure 3. MRF9011LT1 Functional Circuit Schematic**

MRF9011LT1

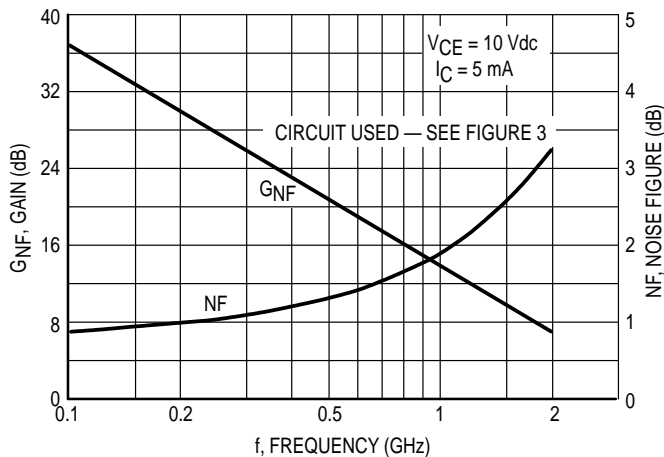


Figure 4. Gain and Noise Figure versus Frequency

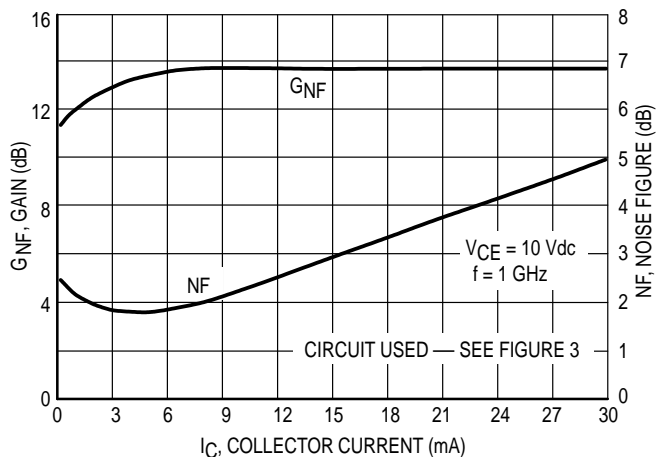


Figure 5. Gain and Noise Figure versus Collector Current

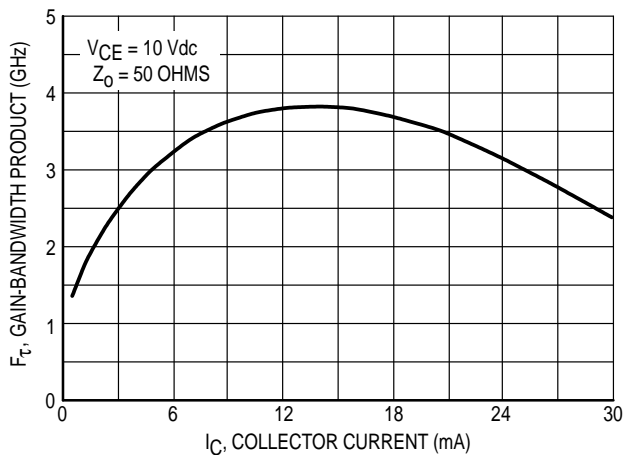


Figure 6. Gain-Bandwidth Product versus Collector Current

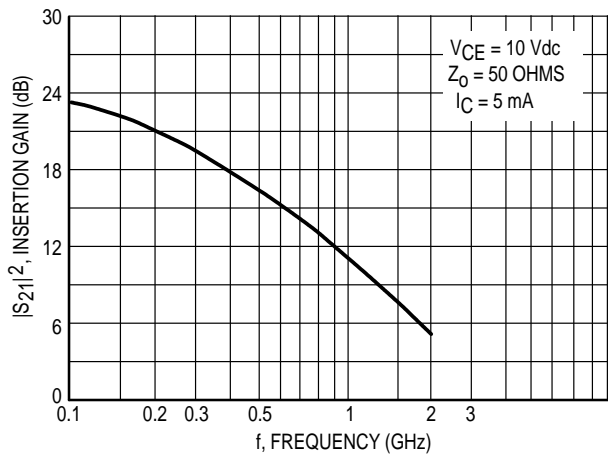


Figure 7. Insertion Gain versus Frequency

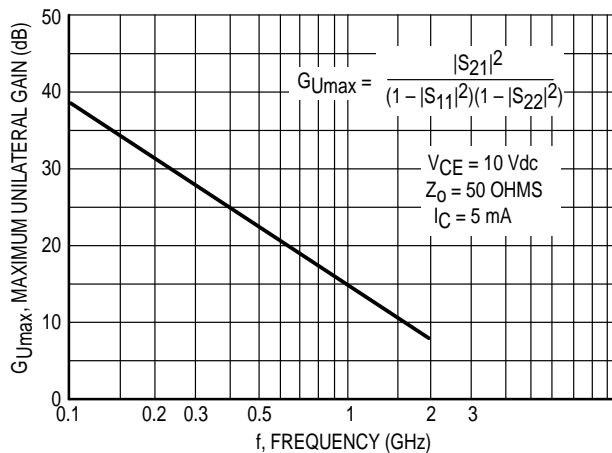
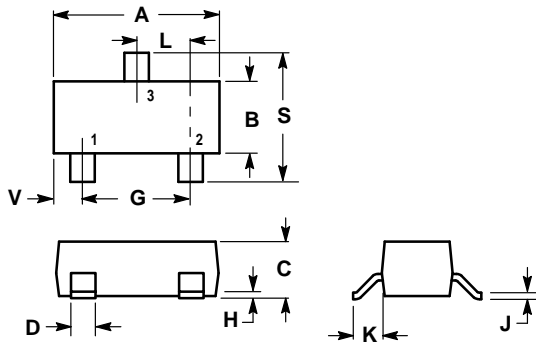


Figure 8. Maximum Unilateral Gain versus Frequency

VCE (Vdc)	IC (mA)	f (MHz)	S11		S21		S12		S22	
			S11	∠φ	S21	∠φ	S12	∠φ	S22	∠φ
5.0	5.0	100	0.85	-41	13.64	153	0.03	65	0.93	-17
		200	0.78	-76	10.77	134	0.05	54	0.80	-29
		500	0.71	-131	6.10	102	0.08	35	0.55	-42
		1000	0.66	-169	3.22	77	0.08	33	0.45	-48
		2000	0.60	152	1.65	47	0.11	46	0.47	-63
	10	100	0.72	-59	20.01	145	0.03	62	0.87	-23
		200	0.70	-100	14.31	123	0.04	49	0.67	-36
		500	0.66	-150	7.03	94	0.06	38	0.44	-43
		1000	0.63	179	3.57	73	0.07	45	0.37	-46
		2000	0.58	147	1.79	46	0.11	57	0.41	-60
	15	100	0.65	-75	23.44	138	0.02	57	0.81	-27
		200	0.66	-118	15.56	116	0.04	46	0.59	-38
		500	0.65	-159	7.10	90	0.05	42	0.40	-40
		1000	0.63	174	3.57	71	0.06	52	0.35	-43
		2000	0.59	144	1.77	45	0.11	62	0.40	-58
	20	100	0.61	-89	24.32	133	0.02	51	0.77	-28
		200	0.66	-130	15.11	111	0.03	43	0.55	-35
		500	0.66	-166	6.68	88	0.04	46	0.41	-34
		1000	0.65	171	3.32	69	0.06	56	0.39	-39
		2000	0.61	143	1.65	43	0.10	65	0.44	-56
30	100	0.63	-132	13.18	118	0.02	47	0.72	-15	
	200	0.68	-157	7.07	104	0.02	44	0.66	-16	
	500	0.69	-177	3.23	90	0.03	55	0.62	-24	
	1000	0.70	165	1.78	71	0.05	65	0.59	-38	
	2000	0.66	138	0.93	42	0.09	79	0.62	-62	
10	5.0	100	0.85	-38	13.67	155	0.03	70	0.93	-14
		200	0.80	-71	10.97	136	0.05	56	0.83	-24
		500	0.70	-126	6.35	104	0.07	37	0.60	-35
		1000	0.65	-166	3.39	78	0.07	36	0.51	-40
		2000	0.58	154	1.74	48	0.10	50	0.54	-55
	10	100	0.75	-55	20.12	147	0.02	66	0.88	-19
		200	0.71	-94	14.60	125	0.04	50	0.72	-30
		500	0.65	-145	7.33	96	0.05	39	0.50	-35
		1000	0.62	-177	3.74	74	0.06	46	0.45	-38
		2000	0.57	149	1.88	47	0.10	60	0.49	-53
	15	100	0.68	-68	23.53	140	0.02	61	0.85	-22
		200	0.67	-110	15.90	119	0.03	49	0.65	-31
		500	0.64	-155	7.45	92	0.04	42	0.47	-32
		1000	0.62	177	3.74	71	0.06	53	0.44	-35
		2000	0.58	146	1.90	45	0.09	65	0.50	-51
	20	100	0.64	-79	24.77	135	0.02	56	0.81	-23
		200	0.64	-122	15.81	114	0.03	46	0.62	-29
		500	0.64	-161	7.10	89	0.04	46	0.48	-28
		1000	0.62	174	3.53	79	0.05	56	0.46	-33
		2000	0.59	145	1.75	44	0.09	68	0.53	-50
30	100	0.61	-114	16.25	123	0.01	48	0.79	-15	
	200	0.63	-147	9.10	107	0.02	49	0.71	-15	
	500	0.65	-172	4.22	90	0.03	53	0.66	-22	
	1000	0.66	168	2.27	71	0.05	63	0.63	-33	
	2000	0.63	140	1.15	41	0.08	79	0.67	-53	

Table 1. MRF9011LT1 Common Emitter S-Parameters

## PACKAGE DIMENSIONS

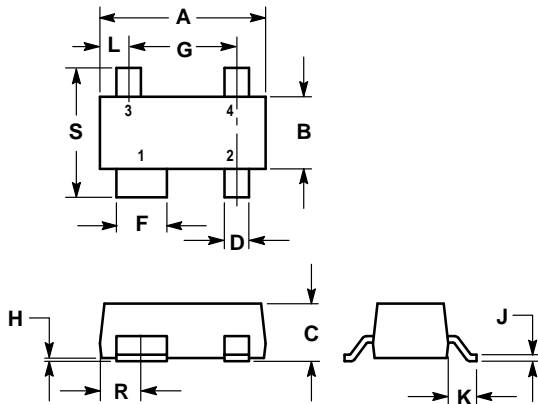


- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
  2. CONTROLLING DIMENSION: INCH.
  3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH THICKNESS. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIAL.

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  
 MMBR901LT1, T3**




- 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  
 MRF9011LT1**

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