

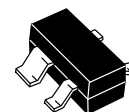
The RF Line NPN Silicon High-Frequency Transistor

MRF9331LT1

Designed primarily for use in low power amplifiers to 1.0 GHz. Ideal for pagers and other battery operated systems where low power consumption is critical.

- Low Power Consumption Characterized for $I_E = 0.1$ to 1.0 mA
- High Current-Gain — Bandwidth Product —
 $f_T = 5.0$ GHz (Typ) @ $I_C = 1.0$ mAdc
- Low Noise Figure and High Power Gain @ $f = 1.0$ GHz —
NF(matched) = 2.5 dB (Typ)
GNF(matched) = 12.5 dB (Typ)
- Guaranteed RF Parameters
- Surface Mounted SOT-143 Offers Improved RF Performance
Lower Package Parasitics
High Gain
- Available in tape and reel packaging:
T1 suffix = 3,000 units per reel

$I_C = 1.0$ mA
SURFACE MOUNTED
HIGH-FREQUENCY
TRANSISTOR
NPN SILICON



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

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	V_{CEO}	8.0	Vdc
Collector-Base Voltage	V_{CBO}	15	Vdc
Emitter-Base Voltage	V_{EBO}	2.0	Vdc
Collector Current — Continuous	I_C	2.0	mAdc
Total Device Dissipation @ $T_C = 100^\circ\text{C}$ (1) Derate above 100°C	P_D	50 1.0	mW mW/ $^\circ\text{C}$
Storage Temperature Range	T_{stg}	-55 to +150	$^\circ\text{C}$

THERMAL CHARACTERISTICS

Characteristic	Symbol	Value	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	1000	$^\circ\text{C}/\text{W}$

DEVICE MARKING

MRF9331LT1 = 05

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 ($I_C = 1.0$ mAdc, $I_B = 0$)	$V_{(BR)CEO}$	8.0	—	—	Vdc
Collector-Base Breakdown Voltage ($I_C = 0.01$ mAdc, $I_E = 0$)	$V_{(BR)CBO}$	15	—	—	Vdc
Emitter-Base Leakage Current ($V_{EB} = 2.0$ Vdc, $I_C = 0$)	I_{EBO}	—	—	0.1	mAdc
Collector Cutoff Current ($V_{CB} = 5.0$ Vdc, $I_E = 0$)	I_{CBO}	—	—	50	nAdc

NOTE:

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

(continued)

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

Characteristic	Symbol	Min	Typ	Max	Unit
ON CHARACTERISTICS					
DC Current Gain ($I_C = 0.5 \text{ mAdc}$, $V_{CE} = 1.0 \text{ Vdc}$)	h_{FE}	30	80	200	—

DYNAMIC CHARACTERISTICS

Current-Gain — Bandwidth Product ($I_C = 1.0 \text{ mAdc}$, $V_{CE} = 1.0 \text{ Vdc}$, $f = 1.0 \text{ GHz}$)	Figure 2	f_T	3.5	5.0	—	GHz
Collector-Base Capacitance ($V_{CB} = 1.0 \text{ Vdc}$, $I_E = 0$, $f = 1.0 \text{ MHz}$)	Figure 1	C_{cb}	—	0.21	0.3	pF

FUNCTIONAL TESTS

Power Gain at Minimum Noise Figure ($V_{CE} = 1.0 \text{ Vdc}$, $I_C = 0.5 \text{ mA}$, $f = 1.0 \text{ GHz}$)	Figures 3, 5	G_{NFmin}	—	12.5	—	dB
Noise Figure ($V_{CE} = 1.0 \text{ Vdc}$, $I_C = 0.5 \text{ mA}$, $f = 1.0 \text{ GHz}$)	Figures 3, 5	NF_{min}	—	2.5	—	dB

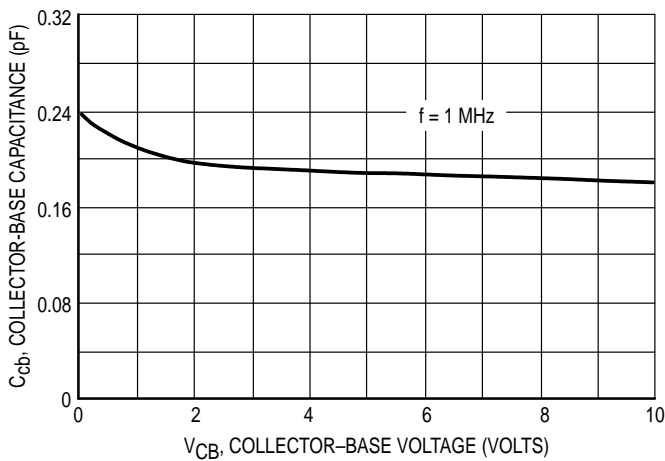


Figure 1. Collector-Base Capacitance versus Collector-Base Voltage

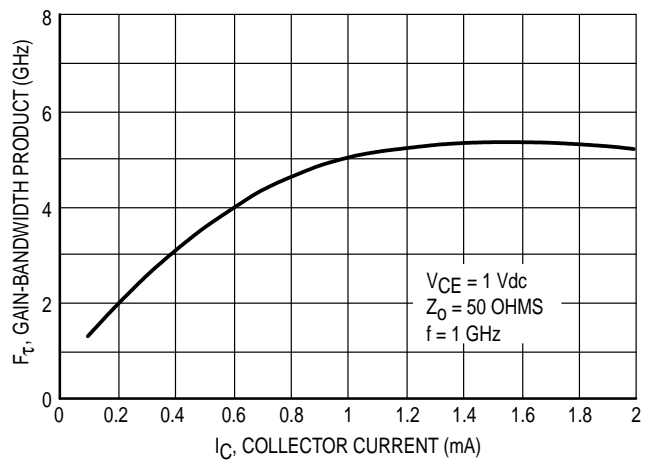


Figure 2. Current Gain-Bandwidth Product versus Collector Current

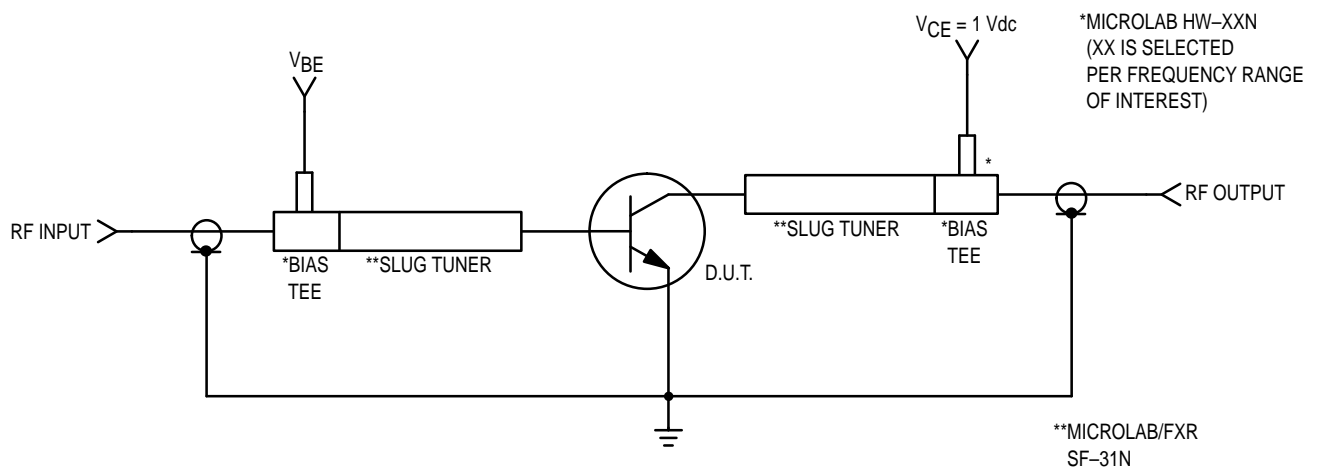


Figure 3. Functional Circuit Schematic

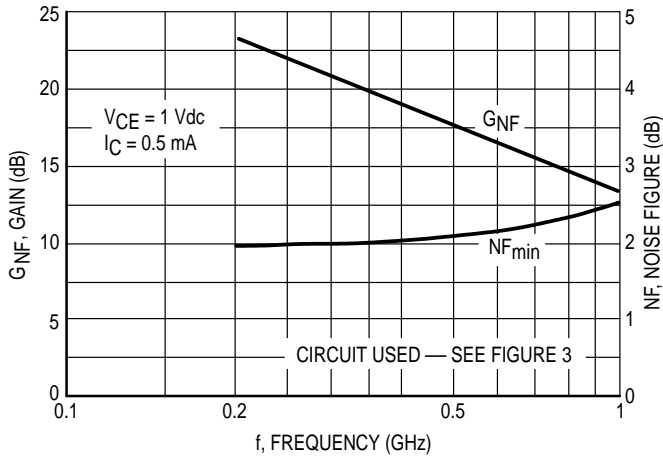


Figure 4. Gain and Minimum Noise Figure versus Frequency

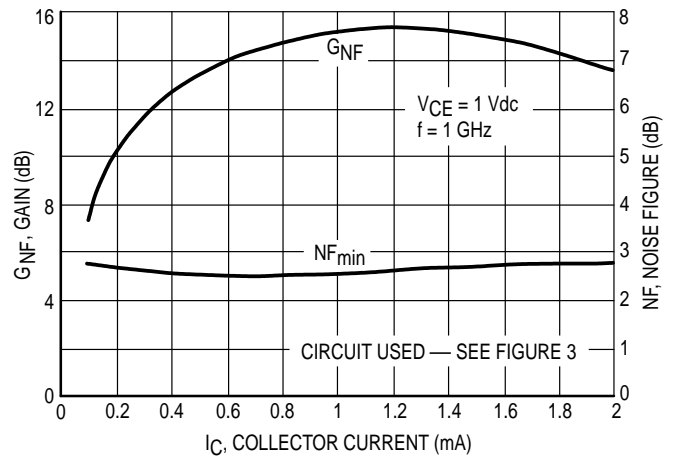


Figure 5. Gain and Minimum Noise Figure versus Collector Current

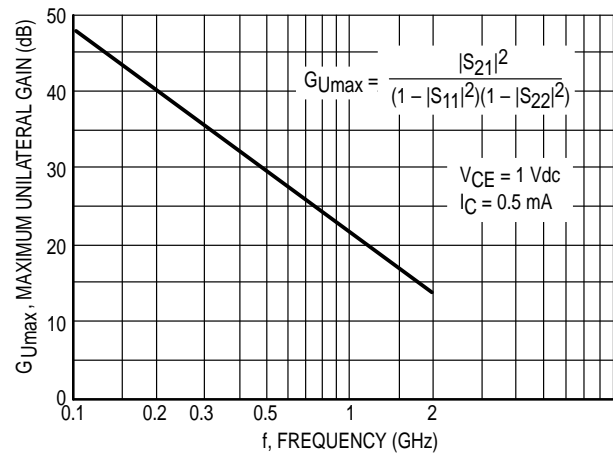


Figure 6. Maximum Unilateral Gain versus Frequency

VCE (Vdc)	IC (mA)	f (MHz)	S11		S21		S12		S22	
			S11	∠φ	S21	∠φ	S12	∠φ	S22	∠φ
1.0	0.1	100	0.99	-1.0	0.35	174	0.01	87	0.99	-1.0
		200	0.99	-3.0	0.35	171	0.03	86	0.99	-4.0
		500	0.97	-9.0	0.34	156	0.07	81	0.99	-9.0
		1000	0.98	-19	0.38	134	0.13	72	0.99	-21
		2000	0.98	-36	0.45	103	0.22	59	0.99	-38
	0.25	100	0.99	-1.0	0.77	175	0.01	86	0.99	-1.0
		200	0.99	-4.0	0.77	173	0.03	86	0.99	-4.0
		500	0.96	-11	0.73	160	0.06	79	0.99	-11
		1000	0.96	-23	0.75	140	0.13	70	0.98	-23
		2000	0.94	-42	0.77	110	0.21	56	0.93	-42
	0.5	100	0.99	-2.0	1.43	174	0.01	86	0.99	-1.0
		200	0.99	-5.0	1.42	172	0.03	84	0.99	-5.0
		500	0.95	-13	1.33	158	0.06	77	0.99	-12
		1000	0.92	-28	1.30	137	0.13	67	0.95	-25
		2000	0.83	-51	1.20	107	0.19	54	0.91	-43

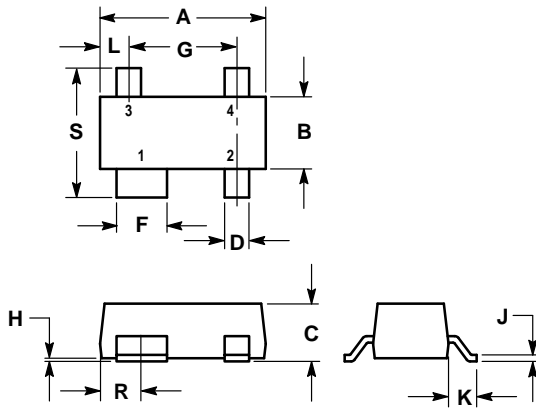
(continued)

Table 1. Common Emitter S-Parameters

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
1.0	1.0	100	0.97	-3.0	2.68	173	0.01	85	0.99	-2.0
		200	0.97	-8.0	2.68	169	0.03	83	0.98	-6.0
		500	0.91	-19	2.42	152	0.06	74	0.96	-15
		1000	0.82	-37	2.22	128	0.11	62	0.89	-29
		2000	0.63	-59	1.74	97	0.17	53	0.80	-46
	2.0	100	0.93	-6.0	4.55	169	0.01	84	0.99	-4.0
		200	0.92	-13	4.3	163	0.03	81	0.98	-9.0
		500	0.81	-29	3.8	142	0.06	69	0.91	-19
		1000	0.62	-52	3.1	115	0.10	59	0.81	-31
		2000	0.40	-66	2.0	85	0.14	55	0.75	-44
3.0	0.1	100	0.99	-1.0	0.34	175	0.01	88	0.99	-1.0
		200	0.99	-3.0	0.34	172	0.03	86	0.99	-3.0
		500	0.99	-8.0	0.32	157	0.06	81	0.99	-9.0
		1000	0.99	-18	0.36	137	0.11	73	0.99	-20
		2000	0.99	-34	0.43	107	0.20	61	0.99	-37
	0.25	100	0.99	-1.0	0.76	175	0.01	86	0.99	-1.0
		200	0.99	-4.0	0.76	173	0.03	86	0.99	-4.0
		500	0.98	-10	0.72	161	0.06	80	0.99	-10
		1000	0.98	-21	0.75	143	0.11	72	0.99	-22
		2000	0.97	-40	0.75	113	0.19	59	0.98	-39
	0.5	100	0.99	-2.0	1.4	175	0.01	86	0.99	-1.0
		200	0.99	-5.0	1.42	172	0.03	84	0.99	-4.0
		500	0.96	-12	1.3	159	0.06	78	0.99	-11
		1000	0.93	-25	1.3	141	0.11	68	0.96	-23
		2000	0.87	-47	1.2	111	0.18	57	0.93	-41
	1.0	100	0.97	-3.0	2.67	174	0.01	85	0.99	-2.0
		200	0.98	-7.0	2.67	170	0.02	84	0.98	-6.0
		500	0.93	-17	2.42	154	0.06	76	0.97	-14
		1000	0.84	-34	2.29	133	0.10	65	0.91	-26
		2000	0.67	-55	1.82	101	0.16	56	0.85	-43
	2.0	100	0.95	-5.0	4.64	172	0.01	85	0.99	-3.0
		200	0.94	-10	4.62	166	0.02	81	0.99	-8.0
		500	0.85	-25	4.0	147	0.05	72	0.94	-17
		1000	0.69	-44	3.4	122	0.09	63	0.84	-29
2000		0.48	-61	2.3	91	0.13	57	0.78	-42	
5.0	0.1	100	0.99	0	0.36	175	0.01	85	0.99	-1.0
		200	0.99	-3.0	0.34	172	0.02	87	0.99	-3.0
		500	0.99	-8.0	0.32	158	0.06	82	0.99	-9.0
		1000	0.99	-17	0.36	138	0.11	74	0.99	-19
		2000	0.94	-35	0.42	108	0.20	63	0.99	-36
	0.25	100	0.99	-1.0	0.76	176	0.01	86	0.99	-1.0
		200	0.99	-3.0	0.76	174	0.02	86	0.99	-4.0
		500	0.97	-9.0	0.71	161	0.06	80	0.99	-10
		1000	0.97	-20	0.74	143	0.11	73	0.99	-21
		2000	0.97	-38	0.75	115	0.18	61	0.99	-38
	0.5	100	0.99	-1.0	1.4	175	0.01	86	0.99	-1.0
		200	0.99	-5.0	1.41	173	0.02	85	0.99	-4.0
		500	0.98	-12	1.3	159	0.06	79	0.99	-11
		1000	0.93	-25	1.3	141	0.10	70	0.97	-23
		2000	0.87	-45	1.2	111	0.17	58	0.94	-40
	1.0	100	0.98	-3.0	2.7	174	0.01	86	0.99	-2.0
		200	0.98	-7.0	2.7	170	0.02	84	0.99	-5.0
		500	0.93	-17	2.42	155	0.05	76	0.97	-13
		1000	0.85	-33	2.3	134	0.09	66	0.92	-26
		2000	0.67	-55	2.0	103	0.15	57	0.85	-42
	2.0	100	0.95	-4.0	4.6	172	0.01	86	0.99	-3.0
		200	0.94	-10	4.6	166	0.02	83	0.98	-7.0
		500	0.86	-24	3.9	148	0.05	73	0.94	-16
		1000	0.70	-43	3.4	123	0.09	64	0.86	-28
2000		0.50	-60	2.3	92	0.13	59	0.80	-40	

Table 1. Common Emitter S-Parameters (continued)

PACKAGE DIMENSIONS




- NOTES:
 1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
 2. 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
E	0.79	0.93	0.031	0.037
F	1.78	2.03	0.070	0.080
G	0.013	0.10	0.0005	0.004
H	0.08	0.15	0.003	0.006
J	0.46	0.60	0.018	0.024
K	0.445	0.60	0.0175	0.024
L	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 J**

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MRF9331LT1/D

