

MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

The RF Line
NPN Silicon
RF Power Transistor

Designed for use in high gain, low noise small-signal amplifiers. This transistor features excellent broadband linearity, in an ultra-small surface mount package suitable for automated assembly.

- Fully Implanted Base and Emitter Structure
- 9 Finger, 1.25 Micron Geometry with Gold Top Metal
- Gold Sintered Back Metal

MRF947T1
MRF947BT1

I_C = 50 mA
LOW NOISE
HIGH-FREQUENCY
TRANSISTOR



CASE 419, STYLE 3

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}	1.5	Vdc
Power Dissipation ⁽¹⁾ T _A = 25°C	P _D	175	mW
Collector Current — Continuous ⁽²⁾	I _C	50	mA
Maximum Junction Temperature	T _{Jmax}	150	°C
Storage Temperature	T _{stg}	-65 to +150	°C
Thermal Resistance, Junction to Ambient	R _{θJA}	714	°C/W

DEVICE MARKING

MRF947T1 = A	MRF947BT1 = H
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ELECTRICAL CHARACTERISTICS (T_C = 25°C unless otherwise noted.)

Characteristic	Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS (3)					
Collector-Emitter Breakdown Voltage (I _C = 0.1 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	23	—	Vdc
Emitter Cutoff Current (V _{EB} = 1.0 V, I _C = 0)	I _{EBO}	—	—	0.1	μAdc
Collector Cutoff Current (V _{CB} = 10 V, I _E = 0)	I _{CBO}	—	—	0.1	μAdc

NOTES:

(continued)

1. To calculate the junction temperature use T_J = P_D × R_{θJA} + T_{AMBIENT}.
2. I_C — Continuous (MTBF = 10 years)
3. Pulse width ≤ 300 μs, duty cycle ≤ 2% pulsed.

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

Characteristic	Symbol	Min	Typ	Max	Unit
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ON CHARACTERISTICS (3)

DC Current Gain ($V_{CE} = 6.0\text{ V}$, $I_C = 5.0\text{ mA}$)	h_{FE1}	50	—	200	—
DC Current Gain ($V_{CE} = 1.0\text{ V}$, $I_C = 500\text{ }\mu\text{A}$) ($V_{CE} = 6.0\text{ V}$, $I_C = 5.0\text{ mA}$)	h_{FE2}	50	—	—	—
	h_{FE3}	100	—	200	—

DYNAMIC CHARACTERISTICS

Collector-Base Capacitance ($V_{CB} = 10\text{ V}$, $I_E = 0$, $f = 1\text{ MHz}$)	C_{cb}	—	0.35	—	pF
Current Gain — Bandwidth Product ($V_{CE} = 6.0\text{ V}$, $I_C = 15\text{ mA}$, $f = 1.0\text{ GHz}$)	f_T	—	8.0	—	GHz

NOTE:

3. Pulse width $\leq 300\text{ }\mu\text{s}$, duty cycle $\leq 2\%$ pulsed.

PERFORMANCE CHARACTERISTICS

Conditions	Symbol	Min	Typ	Max	Unit
Insertion Gain ($V_{CE} = 6.0\text{ V}$, $I_C = 15\text{ mA}$, $f = 1.0\text{ GHz}$) ($V_{CE} = 6.0\text{ V}$, $I_C = 15\text{ mA}$, $f = 1.5\text{ GHz}$)	$ S_{21} ^2$	— —	14 10.8	— —	dB
Maximum Unilateral Gain ⁽¹⁾ ($V_{CE} = 6.0\text{ V}$, $I_C = 15\text{ mA}$, $f = 1.0\text{ GHz}$) ($V_{CE} = 6.0\text{ V}$, $I_C = 15\text{ mA}$, $f = 1.5\text{ GHz}$)	$G_{U\text{ max}}$	— —	14.8 11.6	— —	dB
Noise Figure ($V_{CE} = 6.0\text{ V}$, $I_C = 5.0\text{ mA}$, $f = 1.0\text{ GHz}$) ($V_{CE} = 6.0\text{ V}$, $I_C = 5.0\text{ mA}$, $f = 1.5\text{ GHz}$)	$N_{F\text{ opt}}$	— —	1.8 2.1	— —	dB
Associated Gain at Minimum ($V_{CE} = 6.0\text{ V}$, $I_C = 5.0\text{ mA}$, $f = 1.0\text{ GHz}$) ($V_{CE} = 6.0\text{ V}$, $I_C = 5.0\text{ mA}$, $f = 1.5\text{ GHz}$)	G_{NF}	— —	14 10.5	— —	dB
Noise Figure ($V_{CE} = 6.0\text{ V}$, $I_C = 5\text{ mA}$, $f = 1.0\text{ GHz}$)	$N_{F50\Omega}$	—	1.9	2.8	dB

NOTE: 1. Maximum Unilateral Gain is $G_{U\text{ max}} = \frac{|S_{21}|^2}{(1 - |S_{11}|^2)(1 - |S_{22}|^2)}$

VCE (Vdc)	I _C (mA)	f (MHz)	N _{Fmin} (dB)	Γ_o (MAG, ANGLE)	r _N
6	5	1000	1.8	0.33 \angle 77	0.28
		1500	2.1	0.26 \angle 141	0.3

Table 1. Typical Noise Parameters

TYPICAL CHARACTERISTICS

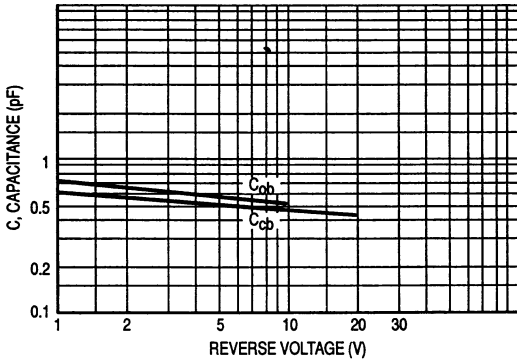


Figure 1. Capacitance versus Voltage

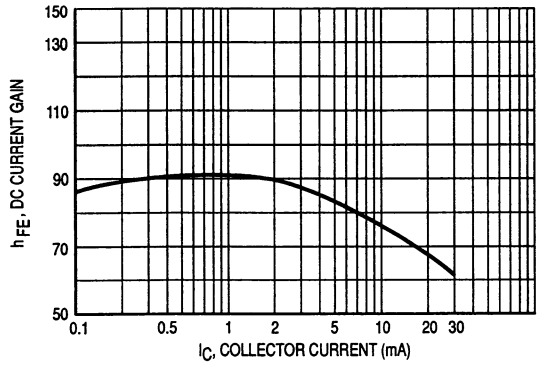


Figure 2. DC Current Gain versus Collector Current

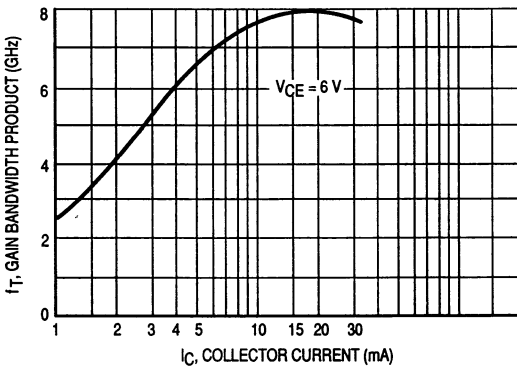


Figure 3. Gain-Bandwidth Product versus Collector Current

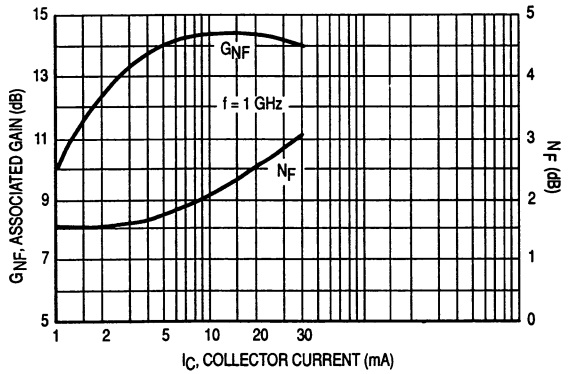


Figure 4. Associated Gain and Noise Figure versus Collector Current

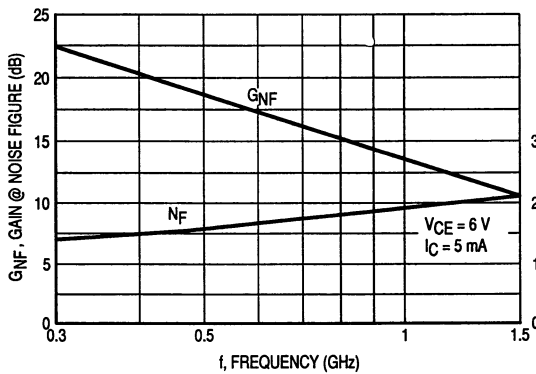


Figure 5. Noise Figure and Associated Gain versus Frequency

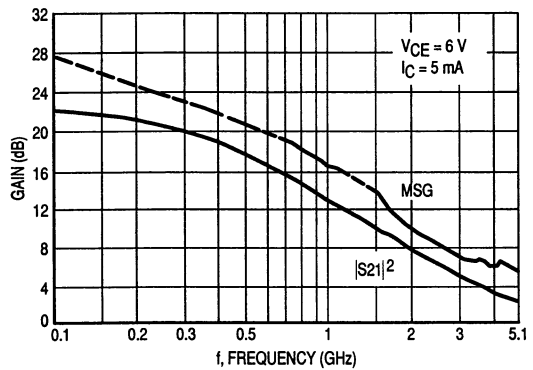


Figure 6. Forward Insertion Gain and Maximum Stable Power Gain versus Frequency

$V_{CE} = 6\text{ V}$
 $I_C = 5\text{ mA}$

f (GHz)	NF OPT	Γ_O	R_N	K
1.0	1.8 dB	$0.33 \angle 77^\circ$	14	0.89

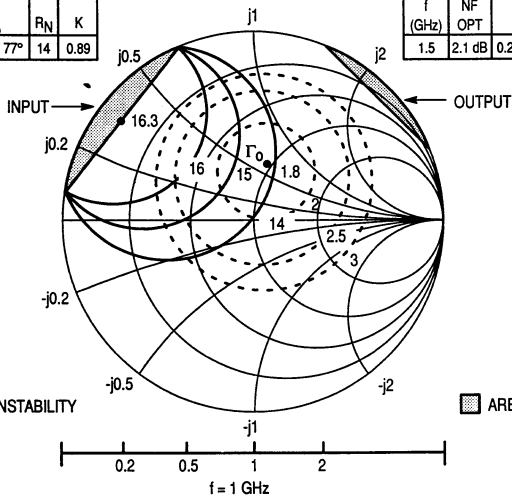


Figure 7. Constant Gain and Noise Figure Contours

$V_{CE} = 6\text{ V}$
 $I_C = 5\text{ mA}$

f (GHz)	NF OPT	Γ_O	R_N	K
1.5	2.1 dB	$0.26 \angle 141^\circ$	15	0.96

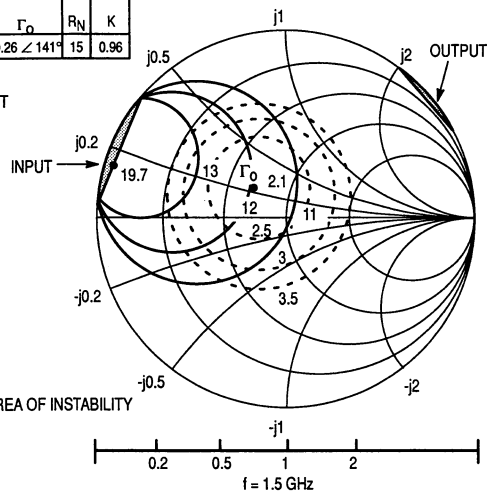


Figure 8. Constant Gain and Noise Figure Contours

$V_{CE} = 1\text{ V}$
 $I_C = 0.5\text{ mA}$

f (GHz)	NF OPT	Γ_{MS} NF OPT	R_n	K
1.0	1.95 dB	$0.59 \angle 72^\circ$	30	0.50

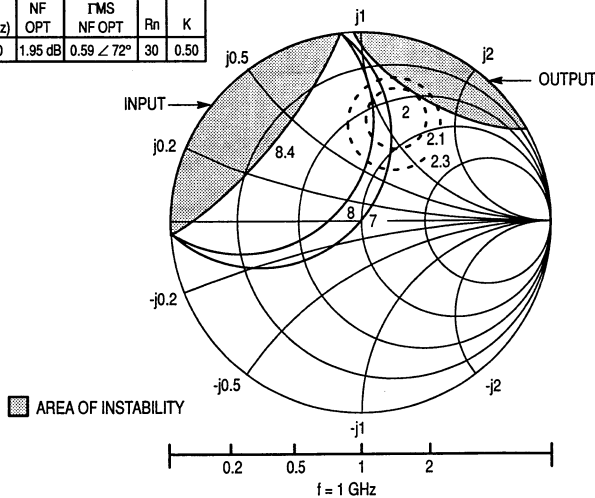


Figure 9. Constant Gain and Noise Figure Contours

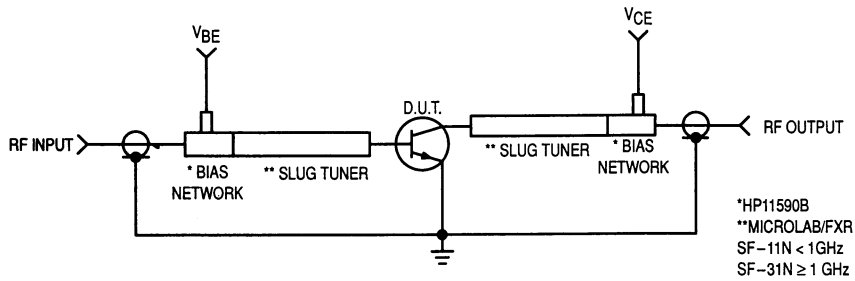


Figure 10. Functional Circuit Schematic

VCE (Volts)	IC (mA)	f (MHz)	S11		S21		S12		S22	
			Mag	∠φ	Mag	∠φ	Mag	∠φ	Mag	∠φ
1.0	0.5	100	0.966	-11.46	1.776	170.10	0.031	82.57	0.998	-4.70
		200	0.956	-23.02	1.735	160.72	0.061	75.42	0.991	-9.25
		500	0.892	-54.71	1.587	132.34	0.135	54.85	0.923	-21.14
		900	0.749	-91.29	1.355	104.19	0.185	35.43	0.827	-33.53
		1000	0.720	-100.07	1.300	98.21	0.190	31.61	0.808	-35.99
		1500	0.637	-134.17	1.057	72.77	0.196	18.05	0.743	-47.18
		2000	0.587	-163.82	0.883	53.17	0.176	12.30	0.708	-58.12
	3000	0.572	149.42	0.672	27.46	0.149	33.04	0.680	-81.83	
	1.0	100	0.941	-14.07	3.391	168.35	0.031	81	0.991	-6.46
		200	0.921	-28.11	3.285	157.61	0.060	73	0.974	-12.40
		500	0.806	-64.76	2.844	127.72	0.123	51.40	0.852	-26.69
		900	0.638	-103.89	2.196	100.55	0.158	35.25	0.717	-38.67
		1500	0.533	-145.86	1.580	72.45	0.168	25.20	0.619	-50.31
		2000	0.495	-173.94	1.281	54.58	0.164	25.37	0.581	-59.87
3000		0.494	143.54	0.956	28.72	0.187	39.10	0.554	-81.37	
2.0	0.5	100	0.979	-9.26	1.827	172.62	0.030	84.74	0.996	-4.04
		200	0.960	-18.37	1.909	164.83	0.060	79.81	0.991	-8.55
		500	0.920	-42.91	1.652	143.57	0.132	64.52	0.940	-18.86
		1000	0.749	-77.43	1.451	116.35	0.196	46.87	0.842	-32.38
		1500	0.674	-104.70	1.190	93.78	0.214	35.67	0.774	-39.43
		2000	0.548	-128.41	1.077	79.19	0.189	33.18	0.692	-43.43
		3000	0.480	-177.94	0.808	60.10	0.153	35.52	0.625	-52.49
	2.0	100	0.907	-16.39	6.640	167.45	0.029	80.99	0.977	-8.61
		200	0.846	-31.62	6.419	155.54	0.054	72.92	0.944	-16.93
		500	0.711	-67.85	4.874	128.23	0.104	57.29	0.770	-31.67
		1000	0.495	-106.45	3.178	102.77	0.138	49.89	0.603	-41.27
		1500	0.405	-131.24	2.358	86.49	0.157	52.19	0.542	-44.76
		2000	0.314	-154.66	1.910	75.22	0.173	58.26	0.490	-43.65
		3000	0.296	157.52	1.394	59.09	0.228	67.66	0.454	-47.05
	5.0	100	0.780	-27.85	14.100	158.94	0.027	77.86	0.932	-15.42
		200	0.676	-51.21	12.219	141.68	0.046	66.87	0.831	-27.35
		500	0.470	-94.63	7.373	112.66	0.078	58.67	0.568	-39.84
		1000	0.327	-131.66	4.148	92.48	0.114	62.28	0.436	-42.57
		1500	0.271	-152.62	2.921	80.85	0.151	66.45	0.413	-44.18
		2000	0.218	-177.42	2.295	71.76	0.188	69.38	0.394	-40.58
		3000	0.237	138.31	1.661	58.25	0.265	70.37	0.372	-42.71

(continued)

Table 2. Common Emitter S-Parameters

VCE (Volts)	Ic (mA)	f (MHz)	S ₁₁		S ₂₁		S ₁₂		S ₂₂	
			Mag	∠φ	Mag	∠φ	Mag	∠φ	Mag	∠φ
2.0	10	100	0.608	-43.09	21.812	149.09	0.022	71.64	0.859	-22.70
		200	0.488	-73.47	16.618	128.80	0.038	64.60	0.689	-35.49
		500	0.330	-118.69	8.427	103.30	0.065	66.23	0.438	-41.16
		1000	0.262	-152.10	4.484	87.25	0.109	70.70	0.354	-40.02
		1500	0.227	-168.95	3.114	77.14	0.155	72.85	0.358	-41.98
		2000	0.197	166.15	2.423	69.47	0.198	73.10	0.355	-37.94
		3000	0.233	128.04	1.755	57.14	0.281	71.04	0.338	-40.40
	30	100	0.353	-99.56	25.543	130.99	0.018	69.51	0.653	-28.97
		200	0.353	-134.75	15.823	111.86	0.026	68.27	0.484	-33.62
		500	0.346	-163.46	6.979	93.31	0.054	75.98	0.367	-28.62
		1000	0.337	177.40	3.637	80.00	0.103	78.84	0.351	-30.05
		1500	0.324	165.83	2.518	71.06	0.150	79.14	0.372	-35.60
		2000	0.319	148.22	1.975	62.92	0.197	78.29	0.378	-34.91
		3000	0.374	122.07	1.441	50.52	0.290	74.82	0.363	-41.67
6.0	0.5	100	0.978	-8.66	1.791	173.27	0.024	85.89	0.995	-3.57
		200	0.964	-16.94	1.889	166.10	0.049	79.87	0.994	-7.32
		500	0.932	-40.03	1.643	146.36	0.110	66.84	0.953	-16.19
		1000	0.765	-72.66	1.473	120.56	0.165	50.45	0.869	-28.01
		1500	0.688	-99.80	1.206	98.40	0.184	39.36	0.812	-34.63
		2000	0.554	-123.40	1.099	83.59	0.162	38.05	0.735	-38.23
		3000	0.463	-174.05	0.823	63.88	0.136	63.33	0.671	-46.47
	2.0	100	0.918	-14.76	6.614	168.34	0.023	83.55	0.983	-7.19
		200	0.862	-28.56	6.456	157.28	0.045	75.14	0.956	-14.02
		500	0.729	-62.16	5.010	131.12	0.089	60.10	0.809	-26.64
		1000	0.504	-98.85	3.344	105.76	0.121	53.16	0.654	-35.06
		1500	0.397	-123.02	2.485	89.51	0.137	55.48	0.599	-38.01
		2000	0.295	-145.96	2.013	78.14	0.152	61.91	0.553	-37.03
		3000	0.257	161.75	1.452	61.78	0.202	72.72	0.523	-40.30
	5.0	100	0.806	-24.38	14.025	160.52	0.022	78.28	0.947	-12.67
		200	0.704	-45.03	12.425	144.30	0.040	70.14	0.861	-22.52
		500	0.487	-85.18	7.751	115.51	0.068	61.61	0.627	-32.81
		1000	0.316	-120.17	4.399	95.11	0.101	64.59	0.505	-34.64
		1500	0.245	-140.68	3.112	83.14	0.134	69.35	0.488	-36.12
		2000	0.177	-166.20	2.447	74.39	0.167	72.13	0.473	-33.43
		3000	0.185	139.55	1.743	60.74	0.237	74.04	0.457	-35.82
	10	100	0.657	-36.69	22.098	151.43	0.019	74.63	0.888	-18.25
		200	0.526	-63.52	17.304	131.70	0.033	67.90	0.741	-28.80
		500	0.328	-104.79	9.028	105.89	0.056	66.80	0.509	-32.64
		1000	0.228	-138.09	4.844	89.49	0.096	72.77	0.438	-31.28
		1500	0.184	-156.11	3.359	79.89	0.138	75.02	0.440	-33.55
		2000	0.140	175.01	2.591	72.03	0.175	76.11	0.441	-30.73
		3000	0.172	126.26	1.852	59.99	0.249	74.64	0.430	-33.31
	20	100	0.492	-53.13	28.934	141.62	0.017	72.00	0.808	-22.96
		200	0.372	-85.00	19.971	121.25	0.028	69.78	0.630	-30.71
500		0.249	-126.97	9.335	99.50	0.053	73.73	0.454	-28.28	
1000		0.201	-156.11	4.878	86.00	0.094	77.63	0.418	-26.90	
1500		0.174	-171.44	3.358	77.41	0.138	78.54	0.432	-30.20	
2000		0.149	160.61	2.580	70.07	0.177	78.20	0.444	-28.32	
3000		0.193	120.90	1.852	58.27	0.253	75.92	0.435	-31.73	

Table 2. Common Emitter S-Parameters (continued)

The RF Line
NPN Silicon
Low Noise, High-Frequency
Transistor

Designed for use in high gain, low noise small-signal amplifiers. This transistor features excellent broadband linearity and is offered in an ultra-small surface mount package suitable for automated assembly.

- Fully Implanted Base and Emitter Structure
- 18 Finger, 1.25 Micron Geometry with Gold Top Metal
- Gold Sintered Back Metal

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}	1.5	Vdc
Power Dissipation (1)	P _D	175	mW
Collector Current — Continuous (2)	I _C	100	mA
Maximum Junction Temperature	T _{Jmax}	150	°C
Storage Temperature	T _{stg}	-65 to +150	°C
Thermal Resistance, Junction to Case	R _{θJC}	714	°C/W

DEVICE MARKING

MRF957T1 = B

ELECTRICAL CHARACTERISTICS (T_C = 25°C unless otherwise noted.)

Characteristic	Symbol	Min	Typ	Max	Unit
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OFF CHARACTERISTICS (3)

Collector-Emitter Breakdown Voltage (I _C = 0.1 mA, I _B = 0)	V _{(BR)CEO}	10	13	—	Vdc
Collector-Base Breakdown Voltage (I _C = 0.1 mA, I _E = 0)	V _{(BR)CBO}	20	25	—	Vdc
Emitter Cutoff Current (V _{EB} = 1.0 V, I _C = 0)	I _{EBO}	—	—	0.1	μAdc
Collector Cutoff Current (V _{CB} = 10 V, I _E = 0)	I _{CBO}	—	—	0.1	μAdc

ON CHARACTERISTICS (3)

DC Current Gain (V _{CE} = 6.0 V, I _C = 5.0 mA)	h _{FE}	50	—	200	—
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DYNAMIC CHARACTERISTICS

Collector-Base Capacitance (V _{CB} = 10 V, I _E = 0, f = 1.0 MHz)	C _{cb}	—	0.45	—	pF
Current Gain — Bandwidth Product (V _{CE} = 8.0 V, I _C = 30 mA, f = 1.0 GHz)	f _T	—	8.0	—	GHz

NOTES:

1. Case Temperature is measured on the collector lead where it first contacts the printed circuit board closest to the package. To calculate the junction temperature use T_J = P_D × R_{θJC} + T_{CASE}.
2. I_C — Continuous (MTBF = 10 years)
3. Pulse width ≤ 300 μs, duty cycle ≤ 2% pulsed.

MRF957T1

I_C = 100 mA
LOW NOISE
HIGH-FREQUENCY
TRANSISTOR



CASE 419, STYLE 3

PERFORMANCE CHARACTERISTICS

Conditions	Symbol	Min	Typ	Max	Unit
Insertion Gain (VCE = 5.0 V, IC = 30 mA, f = 1.0 GHz) (VCE = 5.0 V, IC = 30 mA, f = 1.5 GHz)	$ S_{21} ^2$	—	13.3 10.1	—	dB
Maximum Unilateral Gain (1) (VCE = 5.0 V, IC = 30 mA, f = 1.0 GHz) (VCE = 5.0 V, IC = 30 mA, f = 1.5 GHz)	$G_{U \max}$	—	14 10.8	—	dB
Noise Figure (VCE = 6.0 V, IC = 5.0 mA, f = 1.0 GHz) (VCE = 6.0 V, IC = 5.0 mA, f = 1.5 GHz)	N_{Fopt}	—	1.7 2.0	—	dB
Associated Gain at Minimum (VCE = 6.0 V, IC = 5.0 mA, f = 1.0 GHz) (VCE = 6.0 V, IC = 5.0 mA, f = 1.5 GHz)	G_{NF}	—	11.8 9.0	—	dB
Noise Figure (VCE = 6.0 V, IC = 5.0 mA, f = 1.0 GHz)	$N_{F50\Omega}$	—	1.9	2.8	dB

NOTE: 1. Maximum Unilateral Gain is $G_{U \max} = \frac{|S_{21}|^2}{(1 - |S_{11}|^2)(1 - |S_{22}|^2)}$

VCE (Vdc)	IC (mA)	f (MHz)	NFmin (dB)	Γ_o (MAG, ANG)	rN (ohms)
6.0	5.0	1000	1.7	0.27 \angle 97	0.2
		1500	2.0	0.21 \angle 54	0.28

Table 1. Typical Noise Parameters

TYPICAL CHARACTERISTICS

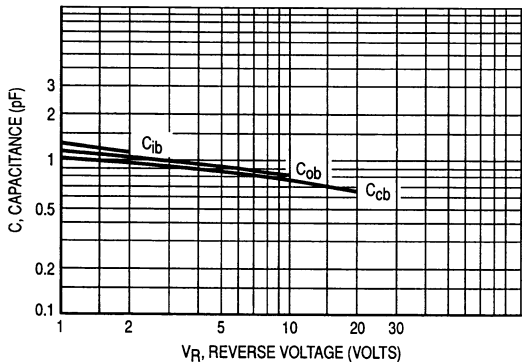


Figure 1. Capacitance versus Voltage

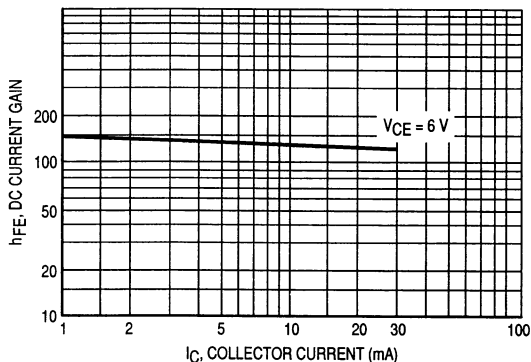


Figure 2. DC Current Gain versus Collector Current

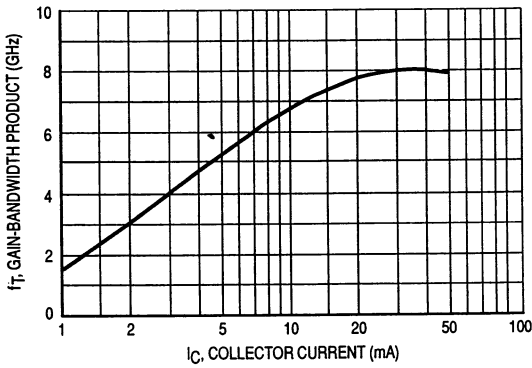


Figure 3. Gain-Bandwidth Product versus Collector Current

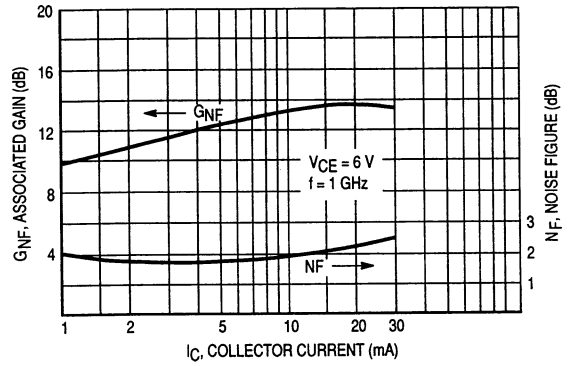


Figure 4. Associated Gain versus Collector Current

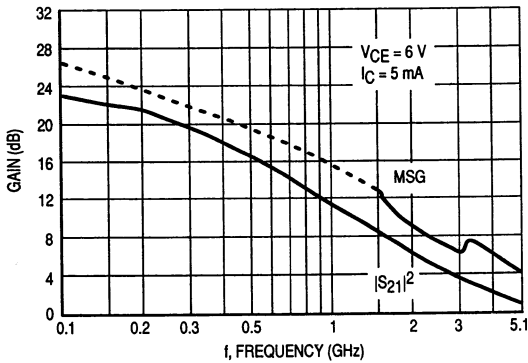


Figure 5. Insertion Gain and Maximum Stable Power Gain versus Frequency

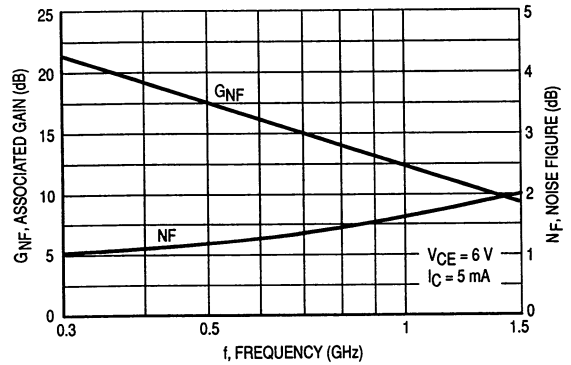


Figure 6. Noise Figure and Associated Gain versus Frequency

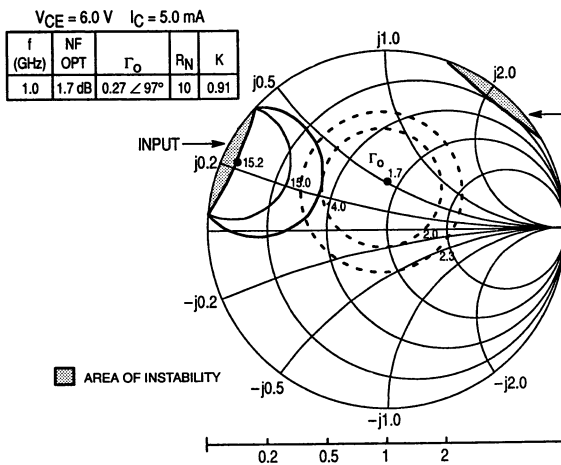


Figure 7. Constant Gain and Noise Figure Contours $f = 1.0\text{ GHz}$

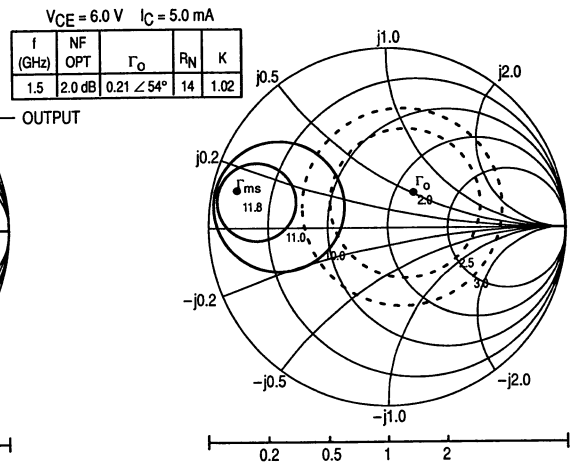
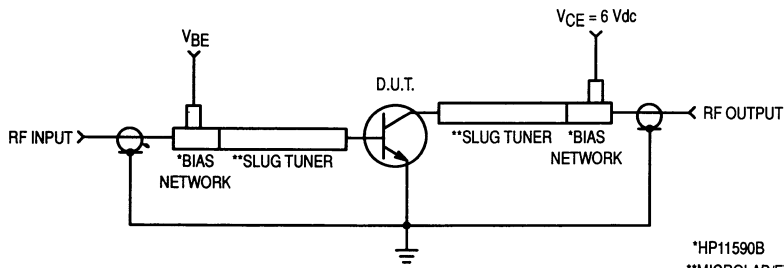


Figure 8. Constant Gain and Noise Figure Contours $f = 1.5\text{ GHz}$



*HP11590B
 **MICROLAB/FXR
 SF-11N < 1.0 GHz
 SF-31N ≥ 1.0 GHz

Figure 9. Functional Circuit Schematic

VCE (Vdc)	IC (mA)	f (MHz)	S11		S21		S12		S22	
			S11	∠φ	S21	∠φ	S12	∠φ	S22	∠φ
2.0	1.0	100	0.959	-19.22	3.518	166.25	0.044	78.43	0.986	-8.12
		200	0.922	-38.32	3.482	153.75	0.079	69.06	0.948	-15.98
		500	0.825	-81.94	2.614	122.98	0.146	44.99	0.803	-30.02
		1000	0.690	-125.83	1.737	93.40	0.167	30.15	0.662	-41.41
		2000	0.600	-174.02	1.079	63.65	0.131	44.93	0.576	-51.42
		3000	0.640	147.15	0.791	50.62	0.196	80.39	0.517	-64.42
		2.0	200	0.862	-48.55	6.598	162.54	0.042	75.55	0.967
500	0.713	-96.45	4.140	116.09	0.123	43.92	0.671	-38.55		
1000	0.586	-137.24	2.483	90.37	0.140	38.71	0.524	-46.93		
2000	0.506	-179.54	1.462	64.47	0.158	57.00	0.456	-51.97		
3000	0.546	144.80	1.079	49.98	0.232	74.13	0.416	-61.22		
5.0	100	0.815	-39.45	14.163	153.09	0.038	70.19	0.895	-22.63	
	200	0.708	-71.89	11.635	133.50	0.061	58.57	0.739	-38.46	
	500	0.541	-121.43	6.284	104.78	0.090	49.12	0.454	-52.31	
	1000	0.461	-155.05	3.428	85.44	0.123	54.90	0.337	-56.38	
	2000	0.406	-169.75	1.921	65.04	0.198	65.80	0.304	-54.16	
	3000	0.438	139.42	1.424	51.41	0.282	69.61	0.276	-57.77	
10	100	0.667	-57.75	22.121	142.36	0.032	64.38	0.788	-34.26	
	200	0.559	-95.89	15.709	121.54	0.048	57.27	0.574	-52.06	
	500	0.447	-140.52	7.417	98.06	0.075	58.00	0.317	-63.32	
	1000	0.405	-166.70	3.921	82.59	0.123	66.07	0.235	-65.49	
	2000	0.360	-162.90	2.155	65.25	0.222	69.45	0.220	-57.93	
	3000	0.390	134.95	1.597	52.60	0.311	68.14	0.196	-57.79	
30	100	0.435	-99.80	31.662	125.82	0.023	62.49	0.570	-51.69	
	200	0.421	-135.04	18.696	108.07	0.034	64.74	0.360	-68.74	
	500	0.398	-162.97	8.025	91.81	0.069	71.43	0.192	-75.85	
	1000	0.382	-179.33	4.163	79.67	0.127	74.17	0.151	-77.73	
	2000	0.347	-155.68	2.269	64.55	0.240	72.04	0.155	-63.30	
	3000	0.379	130.21	1.686	52.60	0.336	67.80	0.132	-60.40	
60	100	0.442	-131.87	26.755	118.52	0.021	62.60	0.422	-56.23	
	200	0.483	-155.78	15.086	103.17	0.032	66.87	0.261	-70.51	
	500	0.484	-173.89	6.390	88.79	0.067	74.30	0.154	-73.64	
	1000	0.472	-172.69	3.317	76.81	0.127	76.73	0.140	-74.96	
	2000	0.452	-149.80	1.834	60.68	0.243	72.97	0.155	-66.57	
	3000	0.496	126.23	1.393	48.59	0.345	68.81	0.131	-71.10	

(continued)

Table 2. Typical Common Emitter S-Parameters

VCE (Vdc)	IC (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	1.0	100	0.965	-17.73	3.508	167.36	0.035	78.18	0.990	-6.80
		200	0.931	-35.39	3.495	155.78	0.065	71.66	0.958	-13.35
		500	0.835	-77.08	2.680	126.50	0.122	48.12	0.839	-25.23
		1000	0.694	-120.78	1.820	97.22	0.143	33.67	0.713	-35.51
		2000	0.583	-170.80	1.133	67.35	0.115	50.88	0.629	-44.48
		3000	0.615	148.45	0.813	53.19	0.182	85.71	0.565	-55.47
	2.0	100	0.932	-22.38	6.532	164.05	0.034	77.81	0.975	-9.92
		200	0.875	-44.00	6.217	150.00	0.061	67.15	0.914	-18.98
		500	0.726	-89.77	4.314	119.58	0.106	47.42	0.724	-31.79
		1000	0.582	-131.10	2.638	93.76	0.122	41.23	0.586	-39.20
		2000	0.483	-176.30	1.544	67.35	0.140	60.85	0.521	-43.55
		3000	0.515	146.92	1.117	52.27	0.208	78.88	0.479	-51.26
	5.0	100	0.836	-34.35	14.112	155.49	0.031	71.72	0.920	-18.06
		200	0.731	-63.59	11.971	137.05	0.052	61.40	0.785	-31.06
		500	0.539	-112.00	6.737	107.93	0.080	51.32	0.522	-41.63
		1000	0.438	-147.18	3.710	88.06	0.110	57.59	0.408	-43.94
		2000	0.364	175.10	2.050	67.58	0.175	68.31	0.383	-42.49
		3000	0.392	142.26	1.501	53.59	0.251	73.36	0.357	-45.46
	10	100	0.704	-49.02	22.526	145.79	0.027	67.46	0.831	-27.03
		200	0.577	-83.93	16.647	125.23	0.042	59.78	0.634	-41.45
		500	0.421	-129.59	8.120	100.71	0.069	60.52	0.385	-47.31
		1000	0.361	-158.62	4.290	84.82	0.109	67.54	0.305	-46.57
		2000	0.307	168.57	2.330	67.52	0.196	71.46	0.305	-42.00
		3000	0.332	137.50	1.706	54.85	0.277	71.05	0.288	-42.21
	20	100	0.559	-66.34	30.018	136.00	0.023	64.88	0.720	-35.45
		200	0.453	-103.91	19.598	116.12	0.036	61.80	0.501	-48.64
		500	0.358	-143.87	8.835	96.19	0.064	68.23	0.298	-49.15
		1000	0.324	-167.05	4.595	83.08	0.112	72.95	0.247	-47.12
		2000	0.278	163.88	2.462	67.27	0.208	72.96	0.263	-41.09
		3000	0.306	133.94	1.809	55.45	0.291	70.31	0.249	-39.38
30	100	0.492	-73.65	32.055	131.68	0.022	64.17	0.669	-37.70	
	200	0.412	-110.53	20.121	113.25	0.033	64.60	0.459	-49.28	
	500	0.345	-147.89	8.900	94.88	0.062	69.52	0.278	-48.58	
	1000	0.319	-169.39	4.646	82.13	0.113	74.20	0.234	-46.64	
	2000	0.277	162.38	2.492	67.55	0.210	73.10	0.255	-40.63	
	3000	0.305	133.57	1.821	55.24	0.295	70.42	0.239	-38.73	

Table 2. Typical Common Emitter S-Parameters (continued)