

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

**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	mA <sub>dc</sub>
Power Dissipation @ $T_C = 75^\circ\text{C}$ (1) MMBR901LT1, T3; MRF9011LT1	$P_{D(max)}$	0.300	Watt
Derate above $25^\circ\text{C}$		4.00	mW/ $^\circ\text{C}$
Total Device Dissipation @ $T_C = 75^\circ\text{C}$ (1) Derate above $75^\circ\text{C}$ MPS901	$P_D$	300 4.0	mW mW/ $^\circ\text{C}$
Total Device Dissipation @ $T_C = 75^\circ\text{C}$ (1) Derate above $75^\circ\text{C}$ MRF901	$P_D$	0.375 5.0	Watt mW/ $^\circ\text{C}$
Storage Temperature Range All	$T_{stg}$	-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 MRF901 MRF9011LT1, MMBR901LT1, T3	$R_{\theta JC}$	200 250	$^\circ\text{C}/\text{W}$

**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.

**MMBR901LT1, T3**  
**MPS901 MRF901**  
**MRF9011LT1**

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



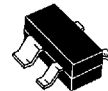
CASE 318-08, STYLE 6  
SOT-23  
LOW PROFILE, MMBR901LT1, T3



CASE 29-04, STYLE 2  
TO-226AA (TO-92)  
MPS901



CASE 317-01, STYLE 2  
MRF901



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

**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

**ON CHARACTERISTICS**

DC Current Gain ( $I_C = 5.0\text{ mA}$ , $V_{CE} = 5.0\text{ Vdc}$ )	MMBR901LT1, T3 MRF9011LT1, MPS901, MRF901	$h_{FE}$	50 30	— 80	200 200	—
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**DYNAMIC CHARACTERISTICS**

Current-Gain — Bandwidth Product ( $I_C = 15\text{ mA}$ , $V_{CE} = 10\text{ Vdc}$ , $f = 1.0\text{ GHz}$ )	MRF9011LT1 MPS901, MRF901	$f_T$	— —	3.8 4.5	— —	GHz
Collector-Base Capacitance ( $V_{CB} = 10\text{ Vdc}$ , $I_E = 0$ , $f = 1.0\text{ MHz}$ )	MRF9011LT1 MPS901 MRF901	$C_{cb}$	— — —	0.55 0.50 0.40	1.0 1.0 1.0	pF

**FUNCTIONAL TESTS**

Power Gain at Minimum Noise Figure ( $V_{CE} = 10\text{ Vdc}$ , $I_C = 5.0\text{ mA}$ , $f = 1.0\text{ GHz}$ )	MRF9011LT1	$GNF_{min}$	—	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
Minimum Noise Figure (Figure 3) ( $I_C = 5.0\text{ mA}$ , $V_{CE} = 10\text{ Vdc}$ , $f = 900\text{ MHz}$ )	MPS901	$NF_{min}$	—	2.4	—	dB
Minimum Noise Figure (Figure 3) ( $I_C = 5.0\text{ mA}$ , $V_{CE} = 6.0\text{ Vdc}$ , $f = 1.0\text{ GHz}$ )	MRF901	$NF_{min}$	—	2.0	2.5	dB

**SMALL-SIGNAL CHARACTERISTICS**

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

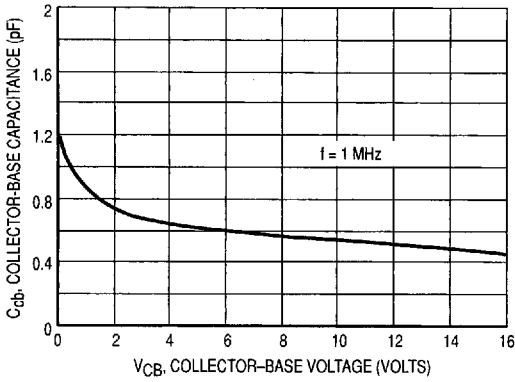


Figure 1. Collector-Base Capacitance versus Collector-Base Voltage

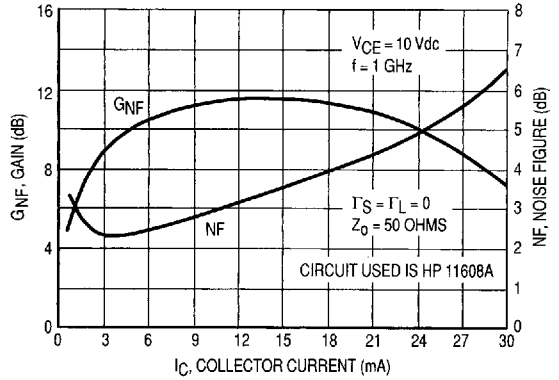


Figure 2. Gain and Noise Figure versus Collector Current

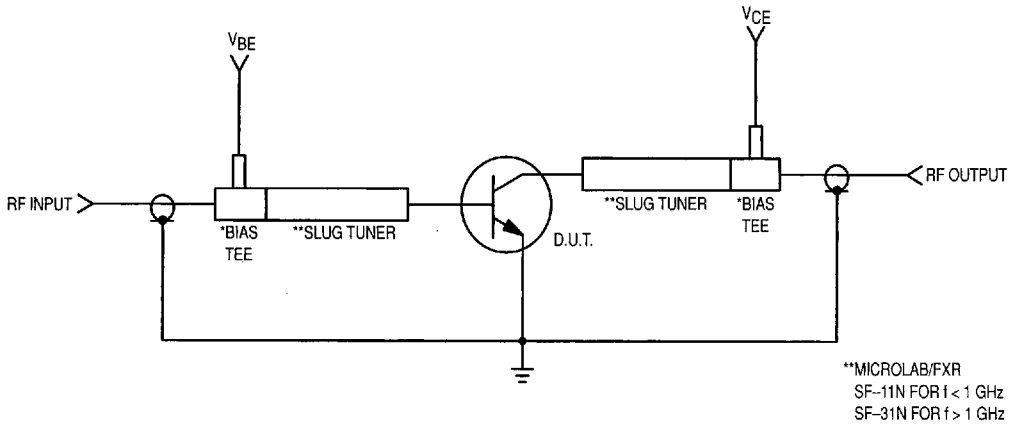


Figure 3. MRF9011LT1 Functional Circuit Schematic

MRF9011LT1

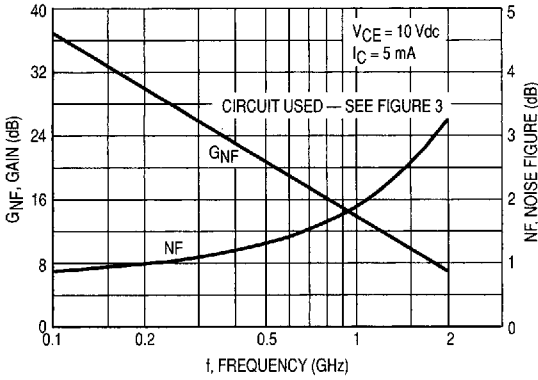


Figure 4. Gain and Noise Figure versus Frequency

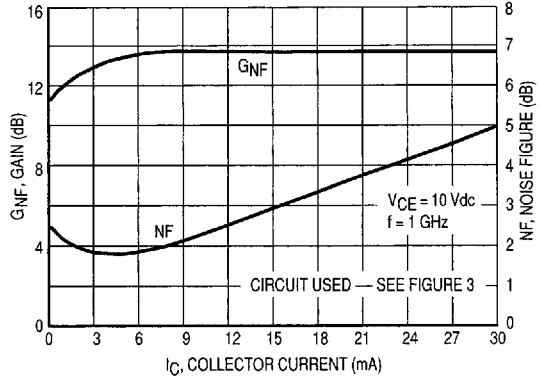


Figure 5. Gain and Noise Figure versus Collector Current

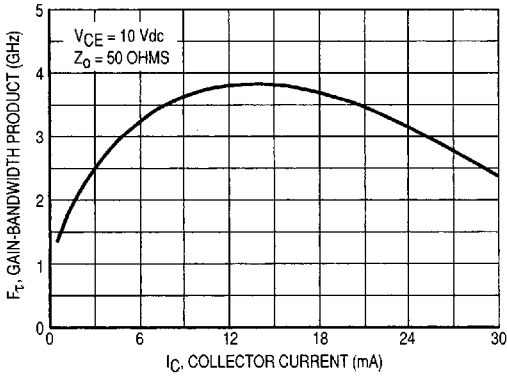


Figure 6. Gain-Bandwidth Product versus Collector Current

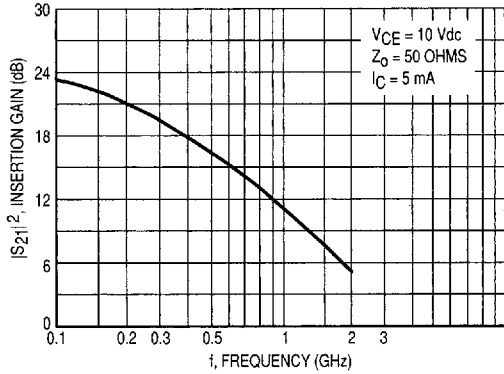


Figure 7. Insertion Gain versus Frequency

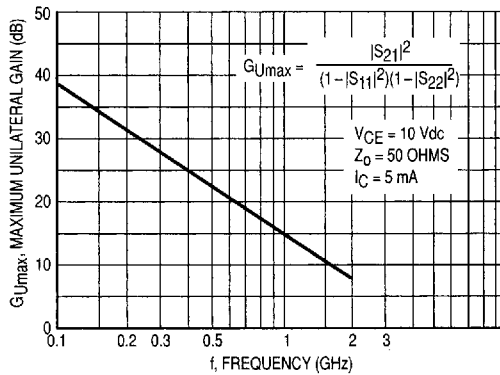
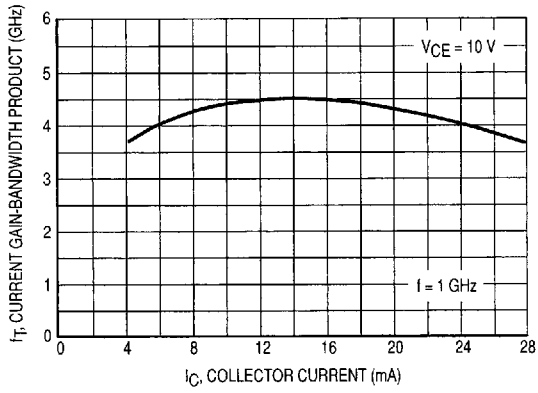


Figure 8. Maximum Unilateral Gain versus Frequency

V <sub>CE</sub> (Vdc)	I <sub>C</sub> (mA)	f (MHz)	S <sub>11</sub>		S <sub>21</sub>		S <sub>12</sub>		S <sub>22</sub>	
			S <sub>11</sub>	∠φ	S <sub>21</sub>	∠φ	S <sub>12</sub>	∠φ	S <sub>22</sub>	∠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

# MPS901



**Figure 9. Current Gain-Bandwidth Product versus Collector Current**

MPS901

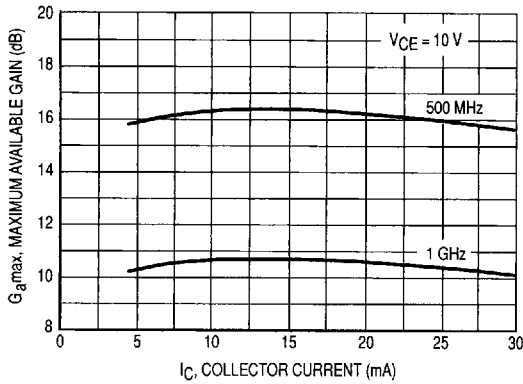


Figure 10. Maximum Available Gain versus Collector Current

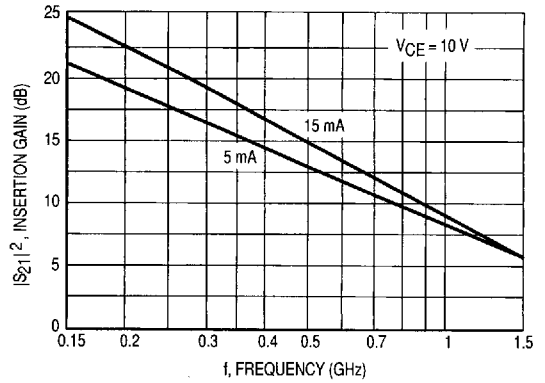


Figure 11.  $|S_{21}|^2$  versus Frequency

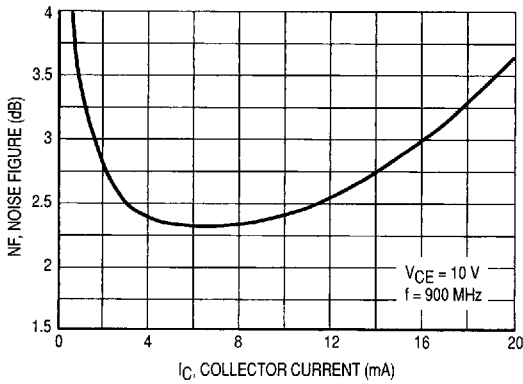


Figure 12. Noise Figure versus Collector Current

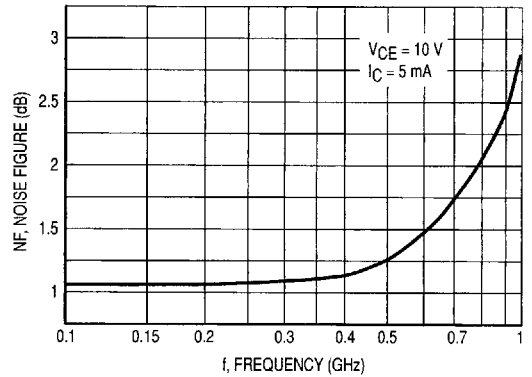


Figure 13. Noise Figure versus Frequency

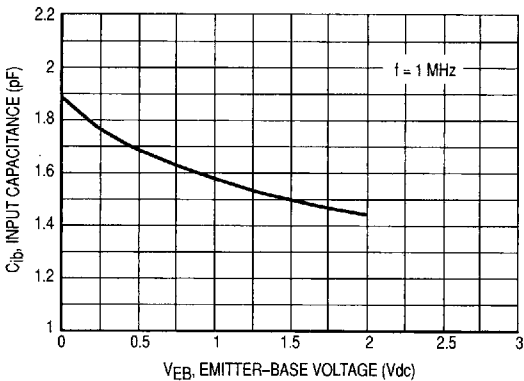


Figure 14. Input Capacitance versus Emitter-Base Voltage

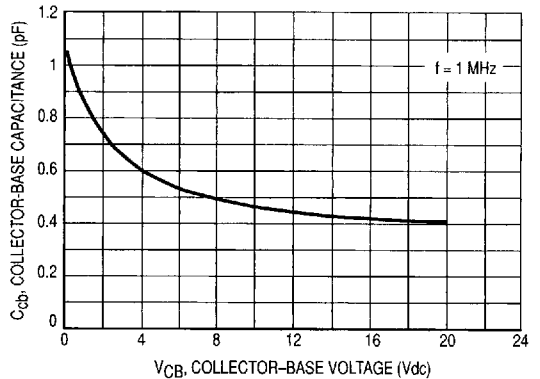


Figure 15. Collector-Base Capacitance versus Collector-Base Voltage

MPS901

V <sub>CE</sub> (Volts)	I <sub>C</sub> (mA)	f (MHz)	S <sub>11</sub>		S <sub>21</sub>		S <sub>12</sub>		S <sub>22</sub>	
			S <sub>11</sub>	∠φ	S <sub>21</sub>	∠φ	S <sub>12</sub>	∠φ	S <sub>22</sub>	∠φ
5.0	5.0	100	0.76	-35	9.42	142	0.03	67	0.85	-18
		200	0.60	-63	7.98	122	0.05	58	0.70	-26
		500	0.28	-127	4.79	84	0.09	55	0.53	-35
		1000	0.27	148	2.71	50	0.15	51	0.42	-51
		1500	0.43	113	2.02	23	0.21	42	0.28	-79
	10	100	0.57	-51	14.80	131	0.03	65	0.75	-22
		200	0.36	-87	10.80	108	0.04	62	0.60	-26
		500	0.18	-151	5.23	77	0.08	62	0.48	-31
		1000	0.25	136	2.86	47	0.15	55	0.39	-48
		1500	0.42	109	2.12	22	0.22	42	0.25	-75
	15	100	0.42	-67	17.80	123	0.02	66	0.69	-22
		200	0.26	-105	11.50	101	0.04	66	0.56	-23
		500	0.17	-169	5.27	74	0.08	66	0.47	-28
		1000	0.26	131	2.86	46	0.15	57	0.39	-47
		1500	0.43	108	2.12	21	0.22	44	0.25	-73
	20	100	0.33	-82	18.66	117	0.02	67	0.66	-21
		200	0.22	-120	11.54	98	0.03	68	0.55	-21
		500	0.17	-171	5.16	72	0.08	67	0.48	-27
		1000	0.28	129	2.80	45	0.15	58	0.40	-45
		1500	0.45	107	2.07	19	0.22	45	0.27	-71
25	100	0.28	-103	18.11	113	0.02	68	0.64	-20	
	200	0.22	-138	11.03	95	0.03	70	0.55	-19	
	500	0.20	169	4.94	71	0.08	68	0.50	-25	
	1000	0.32	128	2.68	43	0.15	60	0.42	-44	
	1500	0.49	106	1.98	17	0.22	47	0.30	-71	
30	100	0.31	-127	16.10	109	0.02	67	0.64	-16	
	200	0.28	-156	9.69	93	0.03	70	0.57	-16	
	500	0.28	160	4.32	69	0.07	70	0.53	-25	
	1000	0.39	125	2.37	41	0.14	63	0.46	-44	
	1500	0.55	104	1.73	15	0.21	51	0.34	-72	

Table 2. MPS901 Common Emitter S-Parameters, V<sub>CE</sub> = 5.0 V

V <sub>CE</sub> (Volts)	I <sub>C</sub> (mA)	f (MHz)	S <sub>11</sub>		S <sub>21</sub>		S <sub>12</sub>		S <sub>22</sub>	
			S <sub>11</sub>	∠φ	S <sub>21</sub>	∠φ	S <sub>12</sub>	∠φ	S <sub>22</sub>	∠φ
10	5.0	100	0.79	-33	9.36	144	0.03	68	0.88	-15
		200	0.63	-58	7.97	124	0.04	58	0.74	-22
		500	0.28	-117	4.87	86	0.07	57	0.60	-31
		1000	0.23	153	2.80	53	0.13	56	0.50	-46
		1500	0.38	116	2.09	26	0.19	48	0.38	-69
	10	100	0.60	-48	14.87	132	0.02	66	0.79	-18
		200	0.39	-79	11.06	110	0.03	63	0.65	-21
		500	0.16	-135	5.38	79	0.07	64	0.56	-28
		1000	0.20	138	2.97	50	0.13	59	0.47	-44
		1500	0.37	111	2.21	25	0.20	49	0.36	-66
	15	100	0.46	-61	18.20	124	0.02	66	0.74	-18
		200	0.28	-94	11.94	102	0.03	66	0.62	-19
		500	0.14	-154	5.45	76	0.07	67	0.55	-26
		1000	0.22	131	2.97	48	0.13	61	0.48	-42
		1500	0.38	109	2.21	24	0.20	50	0.36	-64
	20	100	0.37	-72	19.38	119	0.02	67	0.71	-17
		200	0.23	-105	11.97	99	0.03	68	0.61	-18
		500	0.14	-172	5.36	74	0.07	69	0.56	-24
		1000	0.23	128	2.91	47	0.13	62	0.48	-41
		1500	0.40	108	2.16	22	0.20	51	0.37	-64
	25	100	0.32	-86	19.40	115	0.02	68	0.70	-16
		200	0.22	-119	11.67	97	0.03	69	0.61	-16
		500	0.19	-176	5.28	74	0.06	70	0.57	-23
		1000	0.26	127	2.82	46	0.13	63	0.50	-41
		1500	0.43	107	2.09	21	0.19	53	0.40	-63
	30	100	0.29	-103	18.29	112	0.02	68	0.70	-14
		200	0.22	-135	10.86	95	0.03	70	0.62	-15
		500	0.20	165	4.82	72	0.06	72	0.59	-22
		1000	0.31	125	2.63	44	0.12	66	0.53	-41
		1500	0.47	106	1.95	19	0.19	55	0.43	-64

Table 3. MPS901 Common Emitter S-Parameters, V<sub>CE</sub> = 10 V



# MRF901

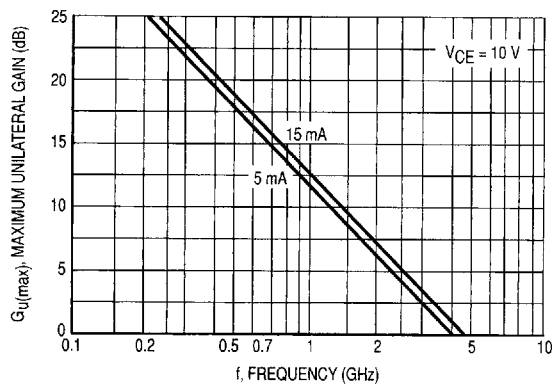


Figure 16. Maximum Unilateral Gain versus Frequency

MRF901

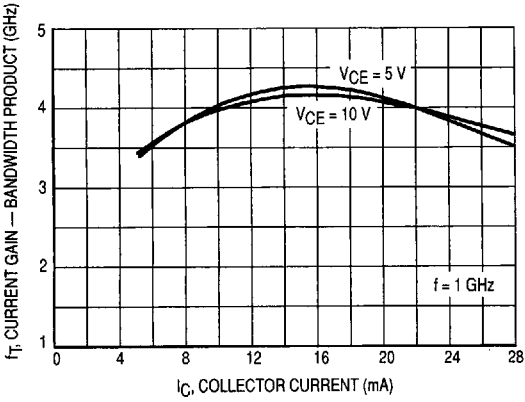


Figure 17. Current Gain — Bandwidth Product versus Collector Current

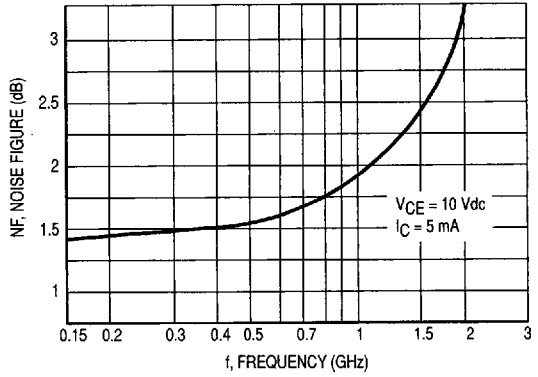


Figure 18. Noise Figure versus Frequency

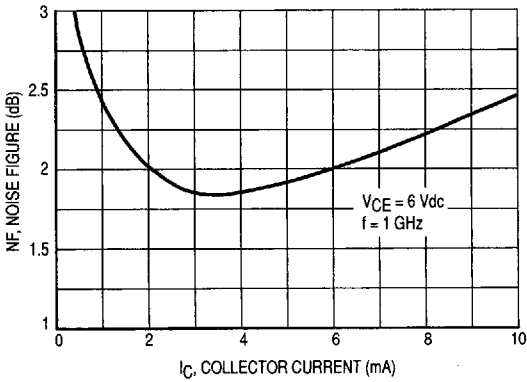


Figure 19. Noise Figure versus Collector Current

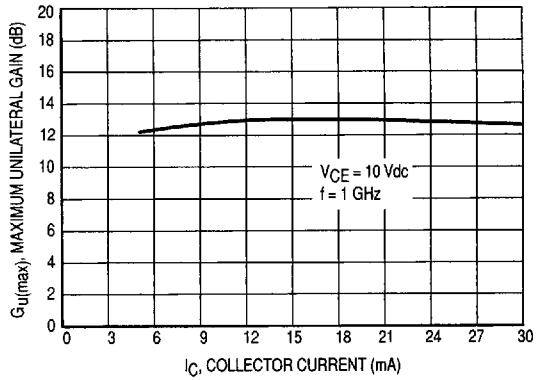


Figure 20. Maximum Unilateral Gain versus Collector Current

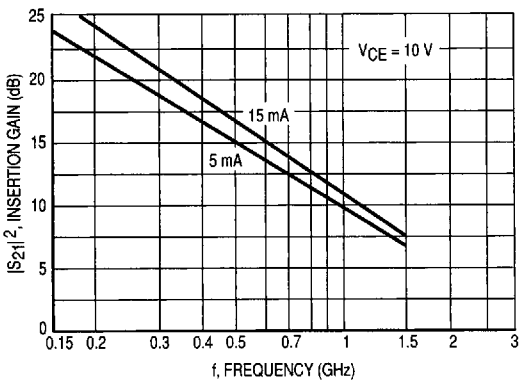


Figure 21.  $|S_{21}|^2$  versus Frequency

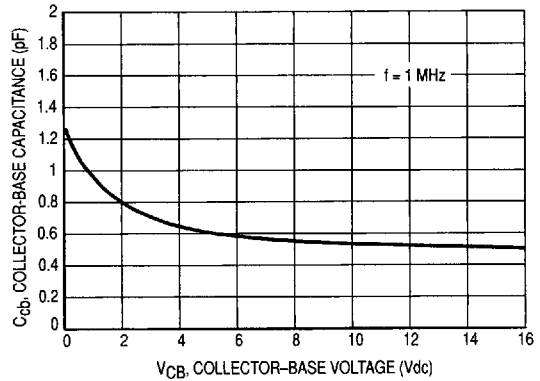


Figure 22. Collector-Base Capacitance versus Collector-Base Voltage

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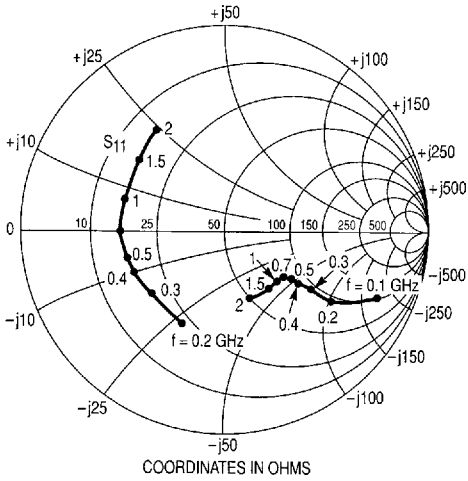


Figure 23. Input and Output Reflection Coefficients versus Frequency  
( $V_{CE} = 10\text{ V}$ ,  $I_C = 15\text{ mA}$ )

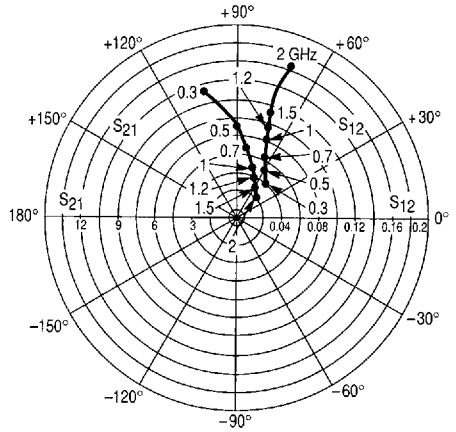


Figure 24. Forward/Reverse Transmission Coefficients versus Frequency  
( $V_{CE} = 10\text{ V}$ ,  $I_C = 15\text{ mA}$ )

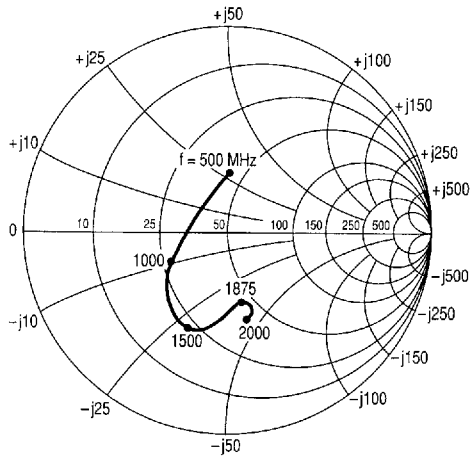
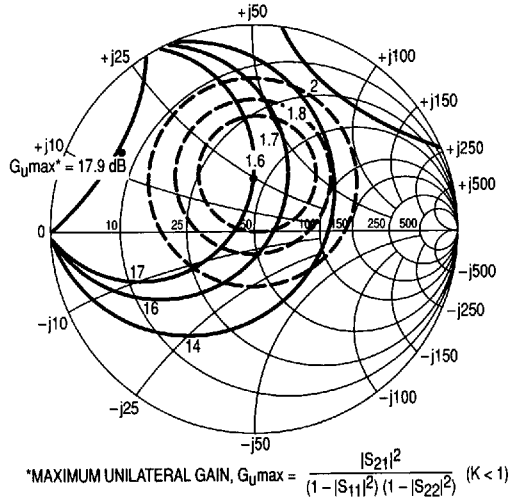
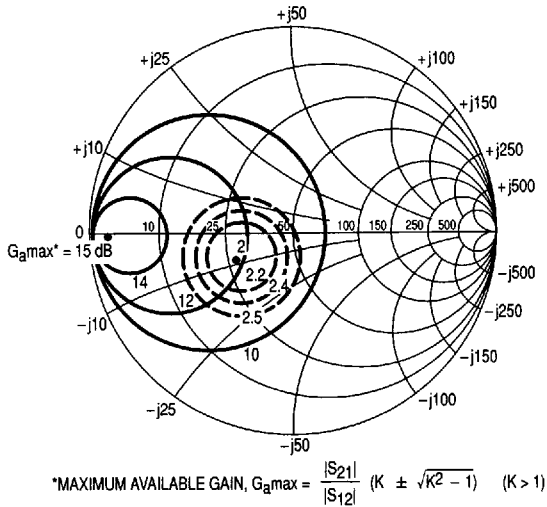


Figure 25. Source Impedance ( $\Gamma_{ms}$ ) for Optimum Noise Figure versus Frequency  
( $V_{CE} = 10\text{ V}$ ,  $I_C = 5.0\text{ mA}$ )

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**Figure 26. Constant Gain and Noise Figure Contours**  
**(V<sub>CE</sub> = 10 Vdc, I<sub>C</sub> = 5.0 mA, f = 500 MHz)**



**Figure 27. Constant Gain and Noise Figure Contours**  
**(V<sub>CE</sub> = 10 Vdc, I<sub>C</sub> = 5.0 mA, f = 1.0 GHz)**

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VCE (Volts)	IC (mA)	f (MHz)	S11		S21		S12		S22	
			S11	∠φ	S21	∠φ	S12	∠φ	S22	∠φ
5.0	5.0	100	0.71	-38	11.30	153	0.03	68	0.92	-17
		200	0.62	-75	9.48	133	0.05	55	0.76	-29
		500	0.54	-141	5.40	100	0.07	43	0.48	-44
		1000	0.53	178	2.93	76	0.09	48	0.40	-56
		2000	0.59	130	1.51	48	0.16	62	0.35	-85
	10	100	0.57	-58	16.95	145	0.03	63	0.85	-23
		200	0.51	-103	12.61	123	0.04	53	0.64	-35
		500	0.52	-161	6.24	93	0.06	50	0.38	-45
		1000	0.52	166	3.24	73	0.09	61	0.33	-54
		2000	0.59	125	1.66	47	0.17	67	0.29	-84
	15	100	0.48	-75	20.08	139	0.02	61	0.80	-27
		200	0.47	-121	13.89	117	0.04	53	0.57	-38
		500	0.53	-170	6.44	91	0.05	56	0.34	-44
		1000	0.53	162	3.33	72	0.09	66	0.31	-52
		2000	0.60	123	1.70	46	0.18	68	0.28	-82
	20	100	0.44	-88	21.62	136	0.02	60	0.76	-28
		200	0.47	-132	14.33	114	0.03	54	0.53	-38
		500	0.53	-175	6.45	89	0.05	60	0.32	-41
		1000	0.53	159	3.31	70	0.09	68	0.31	-50
		2000	0.61	122	1.69	45	0.18	70	0.28	-80
30	100	0.43	-112	21.45	130	0.02	58	0.72	-28	
	200	0.50	-148	13.38	109	0.03	57	0.51	-33	
	500	0.57	178	5.82	86	0.05	65	0.35	-34	
	1000	0.57	156	2.99	68	0.08	73	0.35	-46	
	2000	0.65	121	1.50	42	0.18	74	0.33	-78	

Table 4. MRF901 Common Emitter S-Parameters, VCE = 5.0 V

VCE (Volts)	IC (mA)	f (MHz)	S11		S21		S12		S22	
			S11	∠φ	S21	∠φ	S12	∠φ	S22	∠φ
10	5.0	100	0.73	-35	11.32	154	0.03	69	0.93	-14
		200	0.63	-69	9.69	135	0.05	57	0.79	-25
		500	0.53	-135	5.65	101	0.07	43	0.54	-38
		1000	0.51	-177	3.11	77	0.08	50	0.47	-48
		2000	0.57	132	1.58	48	0.14	66	0.41	-75
	10	100	0.59	-52	17.06	147	0.02	64	0.87	-19
		200	0.52	-95	13.06	125	0.04	54	0.69	-30
		500	0.49	-156	6.58	95	0.05	51	0.45	-37
		1000	0.50	170	3.44	74	0.08	62	0.41	-45
		2000	0.57	126	1.75	47	0.16	70	0.36	-72
	15	100	0.51	-66	20.36	141	0.02	63	0.83	-22
		200	0.47	-112	14.48	119	0.03	54	0.63	-31
		500	0.50	-166	6.81	92	0.05	57	0.41	-35
		1000	0.50	164	3.54	72	0.08	67	0.39	-43
		2000	0.58	124	1.78	46	0.16	72	0.35	-70
	20	100	0.47	-78	22.08	138	0.02	61	0.80	-23
		200	0.46	-123	15.07	116	0.03	55	0.60	-30
		500	0.50	-171	6.84	90	0.05	60	0.40	-32
		1000	0.51	162	3.51	71	0.08	69	0.39	-41
		2000	0.59	123	1.77	45	0.17	73	0.35	-68
30	100	0.44	-98	22.70	133	0.02	59	0.76	-23	
	200	0.47	-139	14.47	111	0.03	55	0.57	-27	
	500	0.53	-177	6.33	87	0.04	65	0.43	-28	
	1000	0.54	158	3.26	69	0.07	74	0.43	-39	
	2000	0.62	122	1.61	42	0.16	77	0.39	-68	

Table 5. MRF901 Common Emitter S-Parameters, VCE = 10 V

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