MRF580

CASE 317A-01, STYLE 2

HIGH FREQUENCY TRANSISTOR

NPN SILICON

MRF581

CASE 317-01, STYLE 2

HIGH FREQUENCY TRANSISTOR

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MAXIMUM RATINGS

Rating	Symbol	MRF581	MRF581	Unit
Collector-Emitter Voltage	V_{CEO}	18	18	Vdc
Collector-Base Voltage	V_{CBO}	36	36	Vdc
Emitter-Base Voltage	V_{EBO}	2.5	2.5	Vdc
Collector Current — Continuous	I_C	200	200	mAdc
Total Device Dissipation @ T_C = 50°C(1)	P_D	2.5	2.5	Watts
Derate above T_C = 50°C		25	25	mW/°C
Operating and Storage Junction Temperature Range	T_J, T_{stg}	−65 to +150	−65 to +150	°C

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

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

Characteristic	Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage (I_C = 1.0 mAdc, I_B = 0)	$V_{(BR)CEO}$	18	—	—	Vdc
Collector-Base Breakdown Voltage (I_C = 1.0 mAdc, I_E = 0)	$V_{(BR)CBO}$	36	—	—	Vdc
Emitter-Base Breakdown Voltage (I_E = 0.10 mAdc, I_C = 0)	$V_{(BR)EBO}$	2.5	—	—	Vdc
Collector Cutoff Current (V_{CB} = 15 Vdc, I_E = 0)	I_{CBO}	—	—	100	μAdc
Emitter Cutoff Current (V_{CE} = 2.0 Vdc, V_{BE} = 0)	I_{EBO}	—	—	100	μAdc
ON CHARACTERISTICS					
DC Current Gain(1) (I_C = 50 mAdc, V_{CE} = 5.0 Vdc)	h_{FE}	50	—	200	—
SMALL-SIGNAL CHARACTERISTICS					
Current-Gain — Bandwidth Product (I_C = 75 mAdc, V_{CE} = 10 Vdc, f = 1.0 GHz)	f_T	—	5.0	—	GHz
Collector-Base Capacitance (V_{CB} = 10 Vdc, I_E = 0, f = 1.0 MHz)	C_{cb}	—	1.4	2.0	pF
FUNCTIONAL TESTS					
Noise Figure MRF580/581 (I_C = 50 mAdc, V_{CE} = 10 Vdc, f = 0.5 GHz) Figure 18	NF	—	2.0	3.0	dB
Power Gain at Optimum Noise Figure MRF580 (I_C = 50 mAdc, V_{CE} = 10 Vdc, f = 0.5 GHz) Figure 18	G_{NF}	11	14	—	dB
Power Gain at Optimum Noise Figure MRF581 (I_C = 50 mAdc, V_{CE} = 10 Vdc, f = 0.5 GHz) Figure 18	G_{NF}	13	15.5	—	dB
Maximum Available Power Gain MRF580(2) (I_C = 75 mAdc, V_{CE} = 10 Vdc, f = 0.5 GHz)	G_{max}	—	15	—	dB
Maximum Available Power Gain MRF581(2) (I_C = 75 mAdc, V_{CE} = 10 Vdc, f = 0.5 GHz)	G_{max}	—	17.5	—	dB
Intermodulation Distortion MRF581(3) (V_{CE} = 10 V, I_C = 75 mA, V_{out} = +50 dBmV) Figure 16	IMD(d3)	—	−65	—	dB

(1) 300 μs pulse on Tektronix 576 or equivalent.
(2) Characterized on HP8542 Automatic Network Analyzer.
(3) 2 Tones, f1 = 497 MHz, f2 = 503 MHz, 3rd Order Single Tone reference.

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FIGURE 1 — C_{ib} INPUT CAPACITANCE versus VOLTAGE

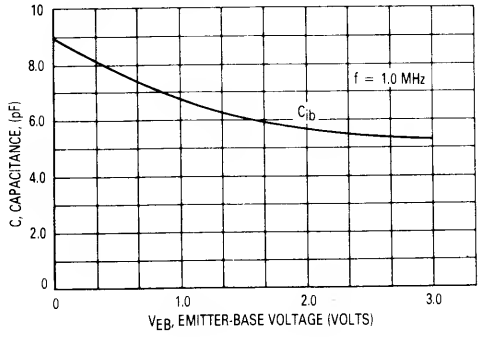


FIGURE 2 — C_{cb}, C_{ob} COLLECTOR-BASE CAPACITANCE versus VOLTAGE

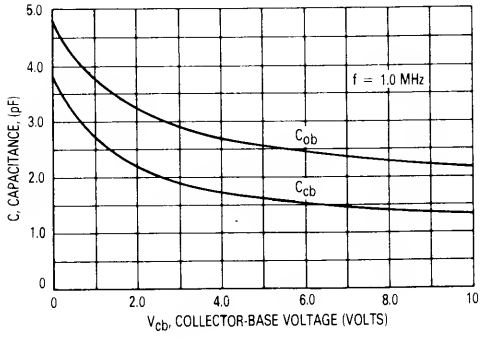


FIGURE 3 — GAIN-BANDWIDTH PRODUCT versus COLLECTOR CURRENT

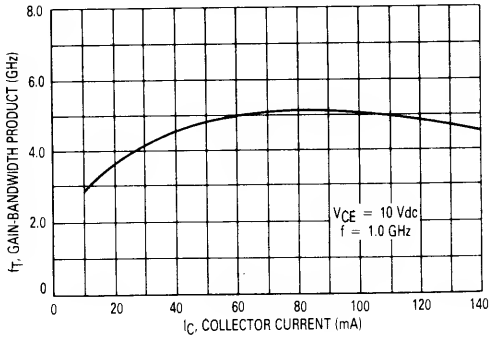
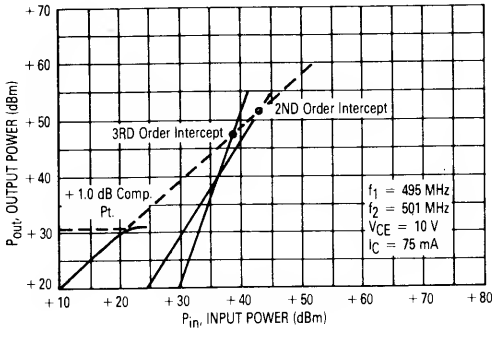


FIGURE 4 — 2ND AND 3RD ORDER INTERCEPT POINTS



MRF580 TYPICAL PERFORMANCE

FIGURE 5 — $G_{U\ max}$-MAXIMUM UNILATERAL GAIN, $|S_{21}|^2$ versus FREQUENCY

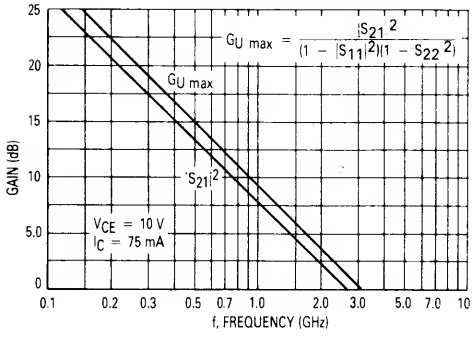


FIGURE 6 — $G_{A\ max}$, MAXIMUM AVAILABLE GAIN versus FREQUENCY

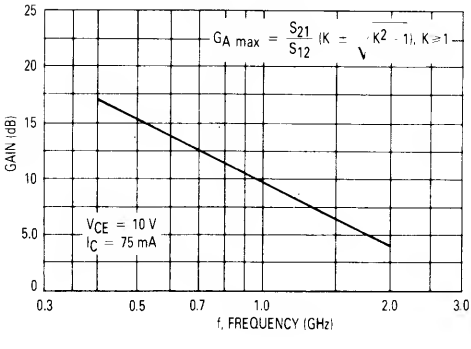


FIGURE 7 — NOISE FIGURE AND GAIN ASSOCIATED WITH NOISE FIGURE versus FREQUENCY

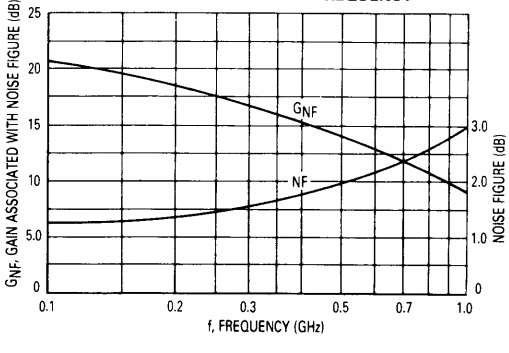


FIGURE 8 — NOISE FIGURE AND GAIN ASSOCIATED WITH NOISE FIGURE versus COLLECTOR CURRENT

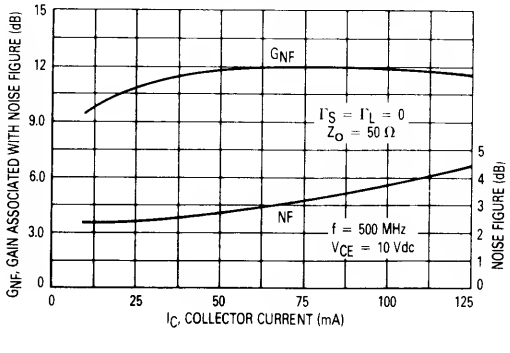
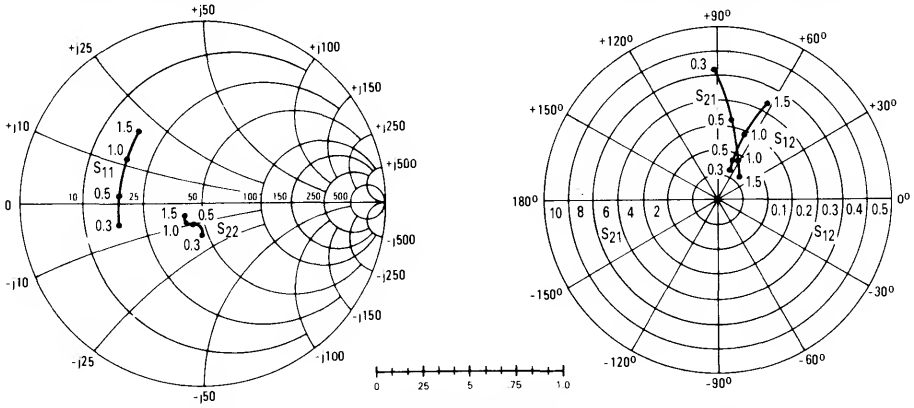


FIGURE 9 — MRF580 COMMON EMITTER S-PARAMETERS

INPUT/OUTPUT REFLECTION COEFFICIENT versus FREQUENCY

V_{CE} = 10 V I_C = 50 mA

FORWARD/REVERSE TRANSMISSION COEFFICIENTS versus FREQUENCY



V_{CE} (Volts)	I_C (mA)	f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}	
			$\|S_{11}\|$	$\angle\phi$	S_{21}	$\angle\phi$	$\|S_{12}\|$	$\angle\phi$	$\|S_{22}\|$	$\angle\phi$
5.0	25	300	0.49	−170	5.97	91	0.083	60	0.24	−108
		500	0.52	171	3.63	78	0.127	64	0.18	−117
		1000	0.53	149	1.98	58	0.24	66	0.13	−154
		1500	0.56	125	1.46	44	0.35	60	0.19	−172
	50	300	0.48	−175	6.35	90	0.08	64	0.24	−126
		500	0.51	168	3.85	79	0.13	67	0.18	−139
		1000	0.51	148	2.10	59	0.25	66	0.16	−178
		1500	0.54	123	1.56	46	0.36	58	0.20	169
	75	300	0.48	−177	6.42	90	0.08	65	0.24	−132
		500	0.51	167	3.88	79	0.13	67	0.19	−145
		1000	0.50	147	2.12	59	0.26	65	0.17	175
		1500	0.53	123	1.57	46	0.36	58	0.21	164
	100	300	0.48	−177	6.41	89	0.08	66	0.24	−134
		500	0.51	167	3.87	78	0.13	68	0.19	−148
		1000	0.51	146	2.114	59	0.26	65	0.17	172
		1500	0.53	123	1.58	46	0.36	58	0.21	162
10	25	300	0.44	−164	6.67	92	0.07	61	0.25	−76
		500	0.47	175	4.08	79	0.11	66	0.19	−75
		1000	0.48	152	2.2	60	0.21	68	0.12	−91
		1500	0.52	126	1.56	45	0.32	64	0.15	−129
	50	300	0.47	−167	7.40	91	0.07	65	0.17	−89
		500	0.47	174	4.53	79	0.11	68	0.12	−112
		1000	0.50	149	2.38	62	0.20	67	0.13	−126
		1500	0.53	131	1.71	47	0.31	63	0.11	−147
	75	300	0.41	−171	7.24	91	0.07	66	0.20	−96
		500	0.45	171	4.39	79	0.12	69	0.13	−99
		1000	0.45	150	2.36	61	0.23	67	0.07	−130
		1500	0.48	125	1.72	47	0.33	61	0.12	−157
	100	300	0.42	−172	7.22	90	0.07	67	0.19	−97
		500	0.45	170	4.38	78	0.12	69	0.14	−98
		1000	0.45	149	2.35	60	0.23	67	0.07	−129
		1500	0.49	125	1.71	46	0.33	62	0.11	−158
15	25	300	0.48	−159	7.28	93	0.06	60	0.24	−55
		500	0.48	−179	4.44	80	0.09	66	0.17	−62
		1000	0.51	153	2.33	62	0.18	68	0.19	−82
		1500	0.54	133	1.67	46	0.27	68	0.17	−97
	50	300	0.39	−165	7.49	0.92	0.07	65	0.23	−71
		500	0.42	174	4.57	80	0.11	69	0.18	−67
		1000	0.43	152	2.44	61	0.21	68	0.11	−74
		1500	0.46	126	1.76	47	0.31	64	0.12	−115
	75	300	0.39	−167	7.57	91	0.07	66	0.21	−74
		500	0.42	173	4.57	79	0.11	70	0.17	−69
		1000	0.42	151	2.45	61	0.21	68	0.09	−75
		1500	0.46	126	1.76	46	0.31	64	0.11	−118
	100	300	0.39	−168	7.46	90	0.07	67	0.20	−72
		500	0.43	172	4.53	78	0.11	70	0.17	−66
		1000	0.43	151	2.41	60	0.21	69	0.10	−71
		1500	0.47	126	1.74	46	0.31	64	0.12	−113

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MRF581 TYPICAL PERFORMANCE

FIGURE 10 — $G_{U\ max}$ — MAXIMUM UNILATERAL GAIN, $|S_{21}|^2$ versus FREQUENCY

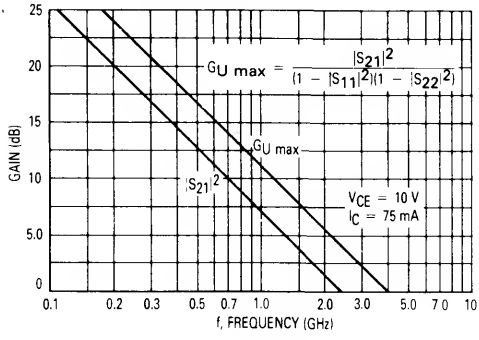

FIGURE 11 — $G_{A\ max}$, MAXIMUM AVAILABLE GAIN versus FREQUENCY

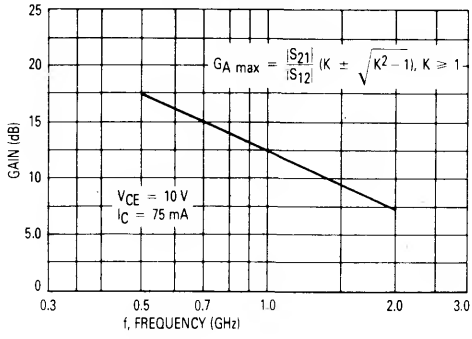

FIGURE 12 — NOISE FIGURE AND GAIN ASSOCIATED WITH NOISE FIGURE versus FREQUENCY

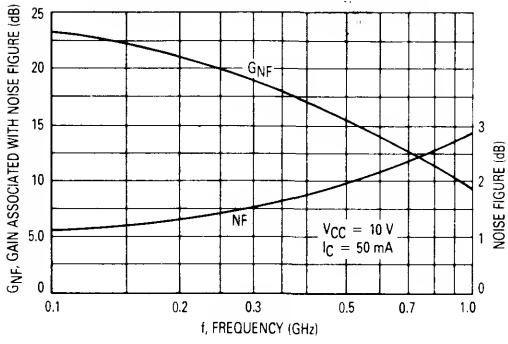

FIGURE 13 — NOISE FIGURE AND GAIN ASSOCIATED WITH NOISE FIGURE versus COLLECTOR CURRENT

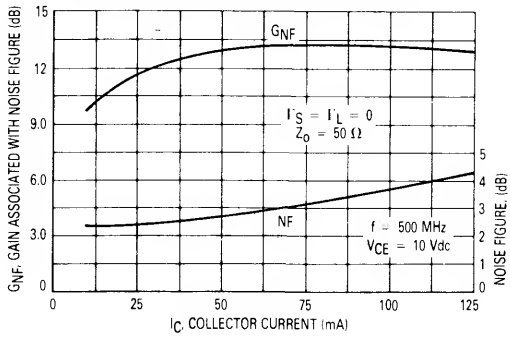

FIGURE 14 — OUTPUT POWER versus INPUT POWER f = 470 MHz

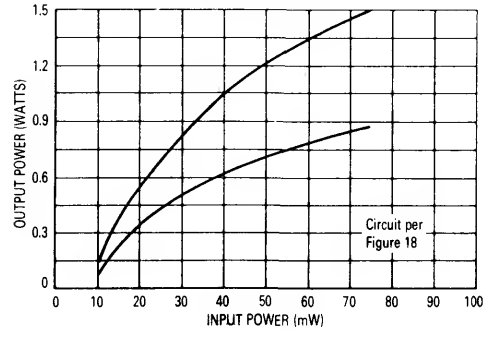

FIGURE 15 — OUTPUT POWER versus INPUT POWER f = 870 MHz

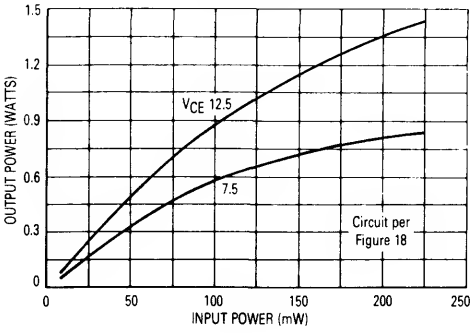

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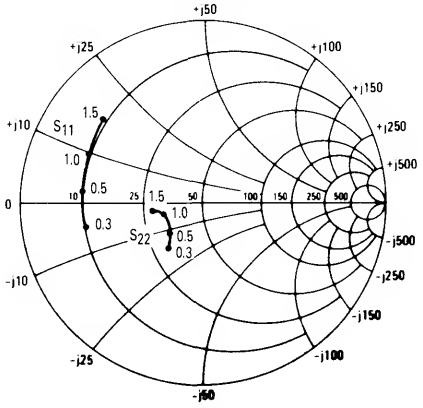
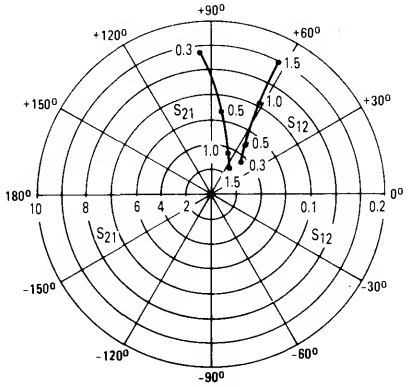
FIGURE 16 — MRF581 COMMON EMITTER S-PARAMETERS

INPUT/OUTPUT REFLECTION COEFFICIENT versus FREQUENCY

V_{CE} = 10 V, I_C = 50 mA

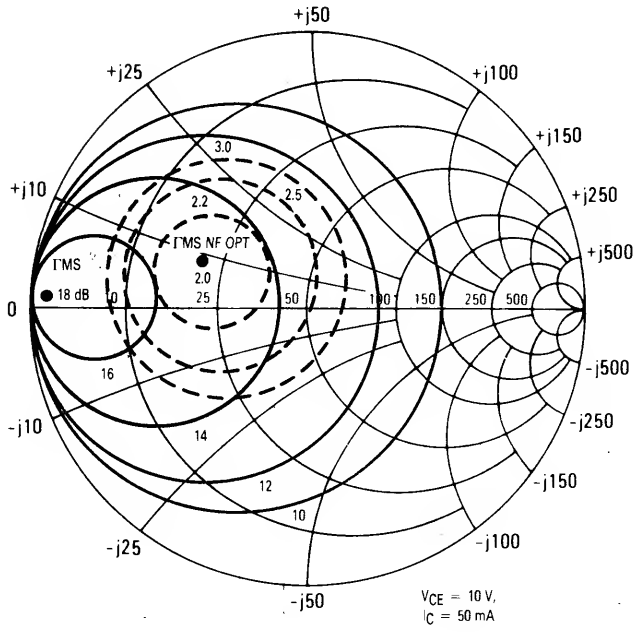
FORWARD/REVERSE TRANSMISSION COEFFICIENTS versus FREQUENCY





V_{CE} (Volts)	I_C (mA)	f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}	
			$\|S_{11}\|$	$\angle\phi$	S_{21}	$\angle\phi$	$\|S_{12}\|$	$\angle\phi$	S_{22}	$\angle\phi$
5.0	25	300	0.69	−169	6.57	93	0.06	39	0.34	−129
		500	0.72	176	3.95	82	0.07	47	0.29	−142
		1000	0.73	157	2.10	62	0.12	60	0.27	−165
		1500	0.76	139	1.47	50	0.17	61	0.33	172
	50	300	0.70	−173	7.14	93	0.05	45	0.38	−144
		500	0.72	173	4.27	82	0.07	53	0.34	157
		1000	0.72	157	2.24	65	0.13	62	0.33	179
		1500	0.76	138	1.61	53	0.18	61	0.37	173
	75	300	0.70	−175	7.26	92	0.05	48	0.40	−148
		500	0.72	172	4.33	82	0.07	55	0.36	−161
		1000	0.72	155	2.28	65	0.13	63	0.35	176
		1500	0.76	138	1.64	53	0.19	61	0.39	170
	100	300	0.70	−176	7.30	92	0.05	48	0.40	−151
		500	0.72	172	4.34	82	0.07	56	0.37	−163
		1000	0.72	155	2.28	65	0.13	63	0.362	175
		1500	0.75	137	1.64	53	0.19	61	0.39	168
10	25	300	0.66	−165	7.58	95	0.05	40	0.29	−106
		500	0.69	178	4.56	82	0.07	48	0.23	−116
		1000	0.70	159	2.39	64	0.11	61	0.19	−141
		1500	0.74	141	1.65	50	0.16	64	0.26	−153
	50	300	0.65	−169	8.25	94	0.05	46	0.30	126
		500	0.68	175	4.96	82	0.07	54	0.24	−138
		1000	0.69	157	2.60	65	0.12	63	0.22	−164
		1500	0.72	139	1.82	52	0.17	63	0.27	−171
	75	300	0.66	−171	8.49	93	0.05	48	0.30	−132
		500	0.68	175	5.06	82	0.07	55	0.25	−145
		1000	0.69	157	2.64	65	0.12	64	0.23	170
		1500	0.72	139	1.86	53	0.17	63	0.27	−176
	100	300	0.66	−172	8.46	93	0.05	49	0.30	−134
		500	0.68	174	5.06	82	0.07	56	0.25	−147
		1000	0.68	157	2.64	65	0.12	64	0.23	−172
		1500	0.72	139	1.86	52	0.17	63	0.27	−177
15	25	300	0.65	−163	7.96	95	0.05	40	0.28	−92
		500	0.67	179	4.82	82	0.06	48	0.21	−98
		1000	0.68	160	2.51	63	0.10	62	0.17	−119
		1500	0.72	141	1.73	49	0.16	65	0.24	−137
	50	300	0.64	−167	8.76	94	0.0	46	0.26	−112
		500	0.66	177	5.37	82	0.06	54	0.20	−122
		1000	0.67	159	2.75	65	0.11	64	0.16	−148
		1500	0.71	141	1.91	51	0.16	64	0.22	−157
	75	300	0.64	−168	8.93	93	0.05	47	0.25	−117
		500	0.66	176	5.34	82	0.06	55	0.20	−128
		1000	0.69	158	2.78	65	0.11	65	0.16	−154
		1500	0.70	140	1.93	51	0.16	64	0.22	−162
	100	300	0.64	−169	8.91	93	0.05	48	0.25	−117
		500	0.66	176	5.33	82	0.6	56	0.19	−129
		1000	0.67	158	2.78	64	0.11	65	0.16	−154
		1500	0.70	140	1.93	51	0.16	64	0.21	−160

FIGURE 17 — MRF581 CONSTANT GAIN CONTOURS NOISE FIGURE CONTOURS



f(MHz)	ΓMS	ΓML	ΓMS NF OPT	$G_{A}MAX$ (dB)	Rn (Ω)	NF OPT	NF (50 Ω)
500	0.91/176°	0.78/77°	0.39/159°	18	10.5	2.0	2.5

Circuit Per Figure 20

FIGURE 18 — FUNCTIONAL CIRCUIT SCHEMATIC

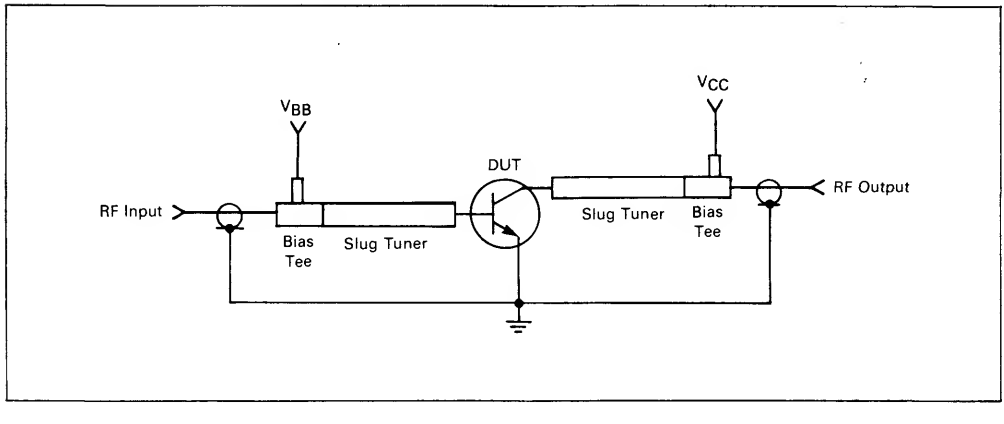
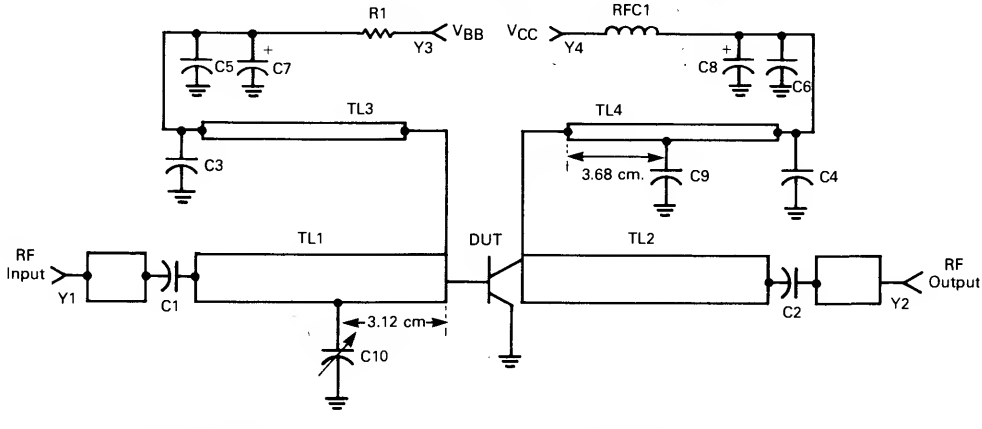


FIGURE 19 — Z_{in} AND Z_{OL} versus COLLECTOR VOLTAGE, INPUT POWER AND FREQUENCY

P_{in} (mW)	f MHz	Z_{in} Ohms		Z_{OL}* Ohms	
		7.5 V	12.5 V	7.5 V	12.5 V
50	420	9.8 − j12.0	10.3 − j11.1	27.5 − j2.7	54.5 + j5.7
	470	14.2 − j11.1	10.2 − j10.2	28.6 − j2.9	30.8 − j26.3
	520	13.6 − j8.6	8.2 − j7.7	27.0 − j5.0	30.4 − j26.0
75	806	7.6 + j1.3	7.7 + j0.8	16.4 − j22.7	22.3 − j34.0
	870	7.7 − j1.7	7.7 − j2.1	18.4 − j19.2	25.1 − j28.1
	960	6.0 + j4.3	5.9 + j2.5	21 − j17.1	24.5 − j20.4

*Z_{OL} = Conjugate of the optimum load impedance into which the device output operates at a given output power, voltage and frequency.

FIGURE 20 — MRF580/581 TEST FIXTURE SCHEMATIC
500 MHz



C1, C2 — 470 pF Chip (Ceramic)
C3, C4 — 0.018 μF Chip Capacitor
C5, C6 — 0.1 μF Mylar
C7, C8 — 1.0 μF, 25 Vdc Electrolytic
C9 — 91 pF Mini-Unelco (C9 Taped 3.68 cm from Collector Connection on TL4 as shown)
C10 — 35–45 pF Johanson Ceramic Capacitor, JMC 5801 or Equivalent (C10 Taped 3.12 cm from Base Connection on TL1)

R1 — 2.7 kΩ, 1½ W
RFC1 — 0.15 μH Molded Choke
TL1, TL2 — Z_o = 26 Ω, 0.0625 TFG as shown in Photomaster
TL3, TL4 — λ/4 Microstrip, Z_0 = 100 Ω
Y1, Y2 — N-Type Connection (Female)
Y3, Y4 — BNC-Type Connector (Female)
Board Material — 0.0625" Thick Glass Teflon ϵ_r = 2.5

FIGURE 21 — PC BOARD PHOTOMASTER