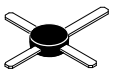
The RF Line
NPN Silicon High-Frequency Transistors

Designed for high current low power amplifiers up to 1.0 GHz.

- Low Noise (2.0 dB @ 500 MHz)
- Low Intermodulation Distortion
- High Gain
- State–of–the–Art Technology
  - Fine Line Geometry
  - Arsenic Emitters
  - Gold Top Metallization
  - Nichrome Thin–Film Ballasting Resistors
- Excellent Dynamic Range
- Fully Characterized
- High Current–Gain Bandwidth Product
- MRF5812 available in tape and reel packaging by adding suffix:
  - R1 suffix = 500 units per reel
  - R2 suffix = 2,500 units per reel

MRF581
MRF5812R1, R2

I_C = 200 mA
LOW NOISE
HIGH–FREQUENCY
TRANSISTORS
NPN SILICON



CASE 317–01, STYLE 2
MRF581

CASE 751–06, STYLE 1
SORF (SO–8)
MRF5812

MAXIMUM RATINGS

Rating		Symbol	MRF581	MRF5812	Unit
Collector–Emitter Voltage		V_{CEO}	18	15	Vdc
Collector–Base Voltage		V_{CBO}	36	30	Vdc
Emitter–Base Voltage		V_{EBO}	2.5		Vdc
Collector Current — Continuous		I_C	200		mAdc
Thermal Resistance θJC (1)	MRF581	$R_{\theta JC}$	40		°C/W
Thermal Resistance θJC (1)	MRF5812	$R_{\theta JC}$	45		°C/W
Total Device Dissipation @ T_C = 75°C (1) Derate above T_C = 75°C	MRF581	P_D	1.88 25		Watts mW/°C
Total Device Dissipation @ T_C = 75°C (1) Derate above T_C = 75°C	MRF5812	P_D	1.67 22.2		Watts mW/°C
Storage Junction Temperature Range		T_{stg}	– 55 to +150		°C
Maximum Junction Temperature		T_{Jmax}	150		°C

DEVICE MARKING

MRF5812 = 5812

NOTE:
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)	MRF581	$V_{(BR)CEO}$	18 15	— —	— —	Vdc
Collector–Emitter Breakdown Voltage (I_C = 5.0 mAdc, I_B = 0)	MRF5812	$V_{(BR)CEO}$	15	—	—	Vdc
Collector–Emitter Breakdown Voltage (I_C = 5.0 mAdc, V_{BE} = 0)	MRF5812	$V_{(BR)CES}$	30	—	—	Vdc
Collector–Base Breakdown Voltage (I_C = 1.0 mAdc, I_E = 0)	MRF581	$V_{(BR)CBO}$	36 30	— —	— —	Vdc
Emitter–Base Breakdown Voltage (I_E = 0.1 mAdc, I_C = 0)	MRF581 MRF5812	$V_{(BR)EBO}$	2.5	—	—	Vdc
Emitter Cutoff Current (V_{EB} = 2.0 Vdc, V_{BE} = 0)	MRF581	I_{EBO}	—	—	100	μAdc
Collector Cutoff Current (V_{CB} = 15 Vdc, I_E = 0)	MRF581	I_{CBO}	—	—	100	μAdc
Collector Cutoff Current (V_{CB} = 15 Vdc, V_{BE} = 0, T_C = 25°C)	MRF5812	I_{CBO}	—	—	0.1	mAdc
ON CHARACTERISTICS						
DC Current Gain (1) (I_C = 50 mAdc, V_{CE} = 5.0 Vdc)	MRF581	h_{FE}	50	—	200	—
DC Current Gain (1) (I_C = 50 mAdc, V_{CE} = 5.0 Vdc)	MRF5812	h_{FE}	30	90	200	—
DYNAMIC CHARACTERISTICS						
Collector–Base Capacitance (V_{CB} = 10 Vdc, I_E = 0, f = 1.0 MHz)	MRF581	C_{ob}	—	1.4	2.0	pF
Collector–Base Capacitance (V_{CB} = 10 Vdc, I_E = 0, f = 1.0 MHz)	MRF5812	C_{cb}	—	1.2	2.0	pF
Current–Gain Bandwidth Product (I_C = 75 mAdc, V_{CE} = 10 Vdc, f = 1.0 GHz)	MRF581	f_T	—	5.0	—	GHz
Current–Gain — Bandwidth Product (I_C = 75 mAdc, V_{CE} = 10 Vdc, f = 1.0 GHz)	MRF5812	f_T	—	5.5	—	GHz
FUNCTIONAL TESTS						
Noise Figure (Minimum) (Figure 11) (I_C = 50 mAdc, V_{CE} = 10 Vdc, f = 0.5 GHz)	MRF581	NF_{min}	—	2.0	3.0	dB
Noise Figure (Minimum) (Figure 11) (I_C = 50 mAdc, V_{CE} = 10 Vdc, f = 0.5 GHz)	MRF5812	NF_{min}	—	2.0	—	dB
Noise Figure (50 Ohm Insertion) (I_C = 50 mAdc, V_{CE} = 10 Vdc, f = 0.5 GHz)	MRF5812	$NF_{50\ \Omega}$	—	2.5	3.0	dB
Power Gain at Optimum Noise Figure (I_C = 50 mAdc, V_{CE} = 10 Vdc, f = 0.5 GHz)	MRF581	G_{NF}	13	15.5	—	dB
Insertion Gain (I_C = 50 mAdc, V_{CE} = 10 Vdc, f = 0.5 GHz)	MRF5812	$\|S_{21}\|^2$	13	15.5	—	dB
Maximum Unilateral Gain (I_C = 75 mAdc, V_{CE} = 10 Vdc, f = 0.5 GHz)		G_{Umax}(2)	—	17	—	dB
Intermodulation Distortion (3) (V_{CE} = 10 V, I_C = 75 mA, V_{out} = +50 dBmV)		IMD(d3)	—	−65	—	dB

NOTE:

1. 300 μs pulse on Tektronix 576 or equivalent.
2. $G_{Umax} = \frac{|S_{21}|^2}{(1-|S_{11}|^2)(1-|S_{22}|^2)}$
3. 2 Tones, f1 = 497 MHz, f2 = 503 MHz, 3rd Order Single Tone reference.

TYPICAL CHARACTERISTICS
MRF581

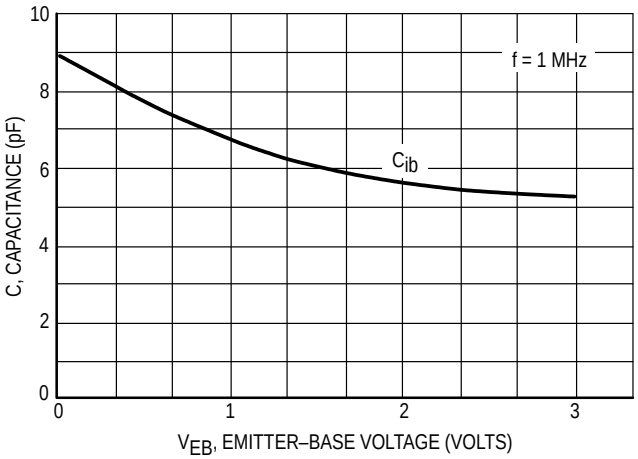


Figure 1. C_{ib} Input Capacitance versus Voltage

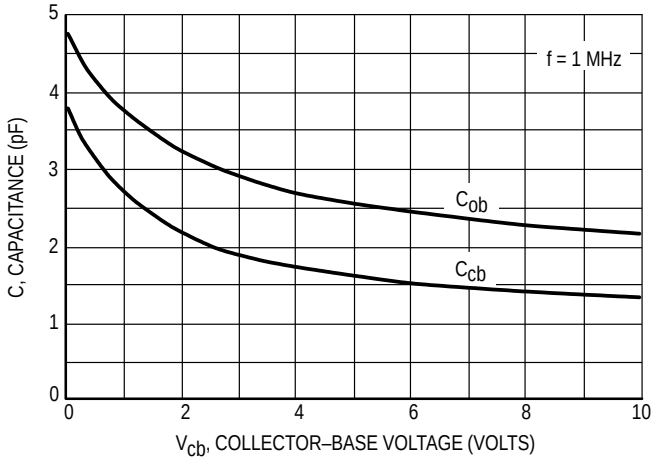


Figure 2. C_{cb}, C_{ob} Collector–Base Capacitance versus Voltage

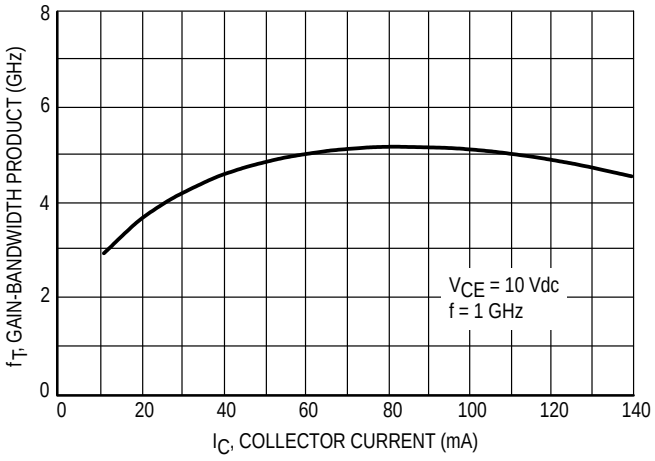


Figure 3. Gain–Bandwidth Product versus Collector Current

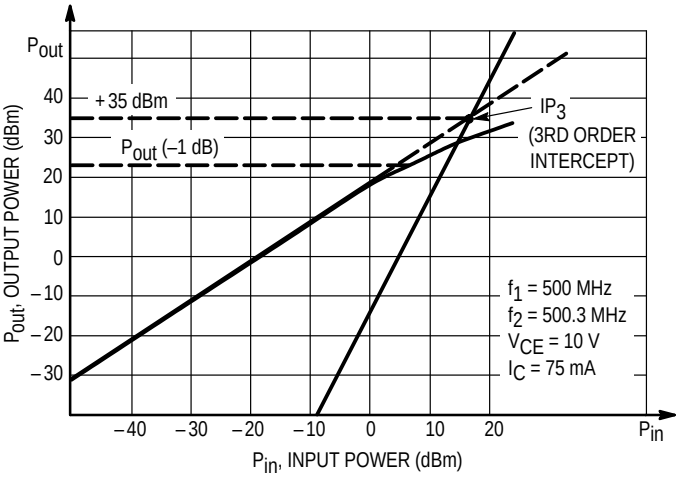


Figure 4. 3rd Order Intercept Point

TYPICAL CHARACTERISTICS
MRF581

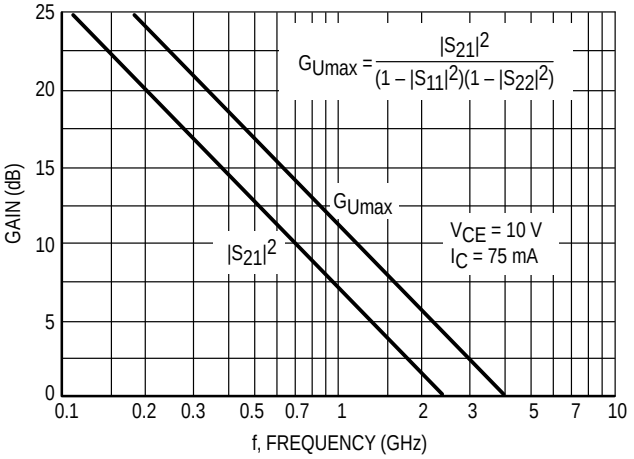


Figure 5. G_{Umax} — Maximum Unilateral Gain, $|S_{21}|^2$ versus Frequency

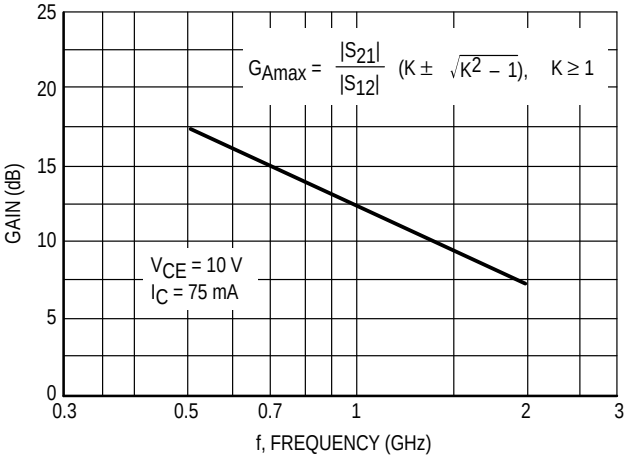


Figure 6. G_{Amax}, Maximum Available Gain versus Frequency

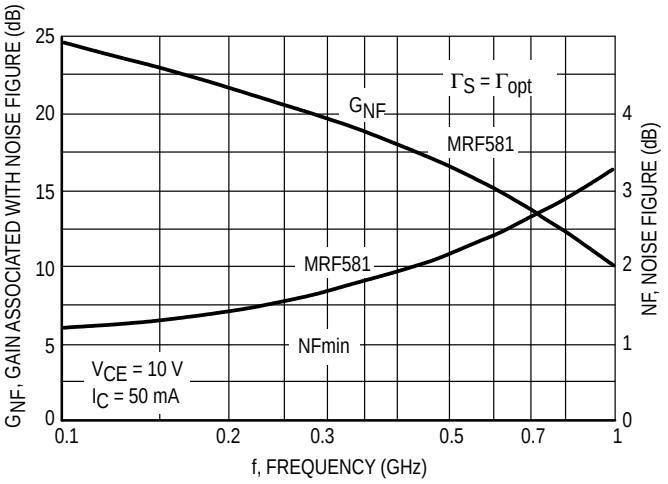


Figure 7. Minimum Noise Figure and Gain Associated with Minimum Noise Figure versus Frequency

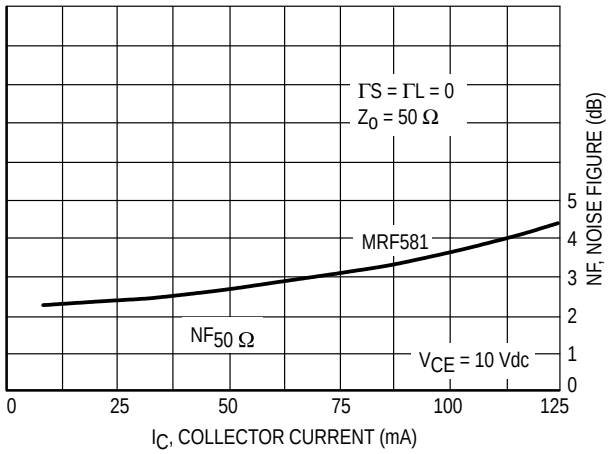


Figure 8. Noise Figure versus Collector Current f = 500 MHz

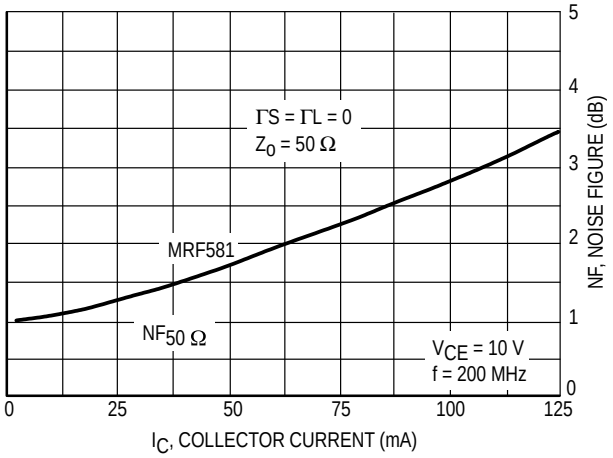


Figure 9. Noise Figure versus Collector Current

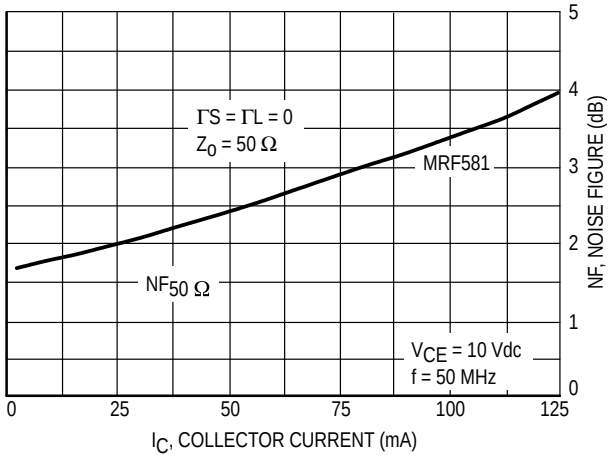


Figure 10. Noise Figure and Gain Associated with Noise Figure versus Collector Current

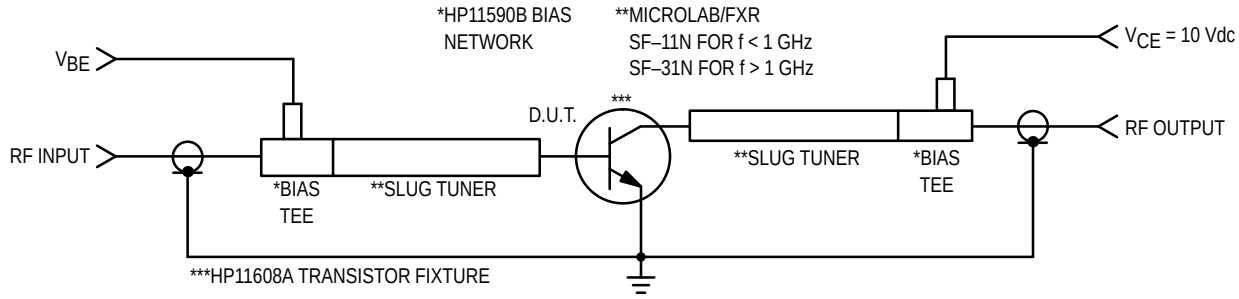


Figure 11. MRF581, MRF5812 Functional Circuit Schematic

TYPICAL CHARACTERISTICS
MRF5812

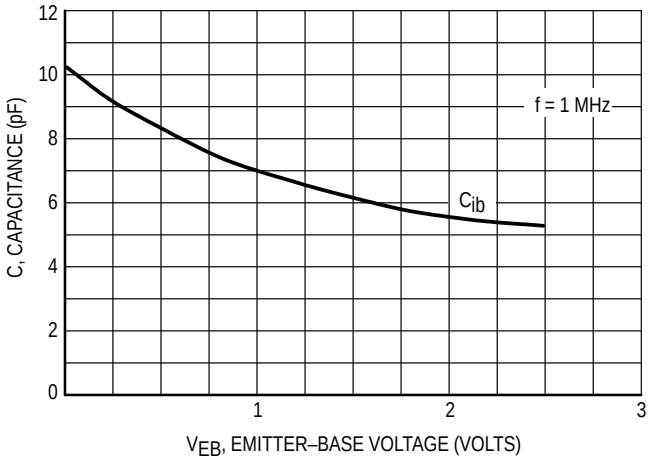


Figure 12. C_{ib} Input Capacitance versus Voltage

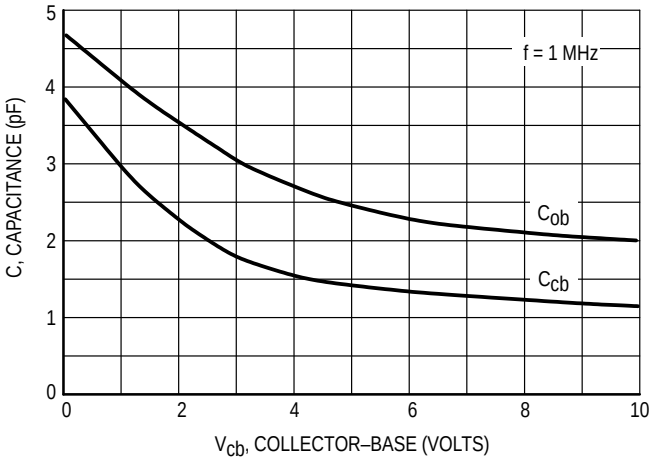


Figure 13. C_{cb}, C_{ob} Collector–Base Capacitance versus Voltage

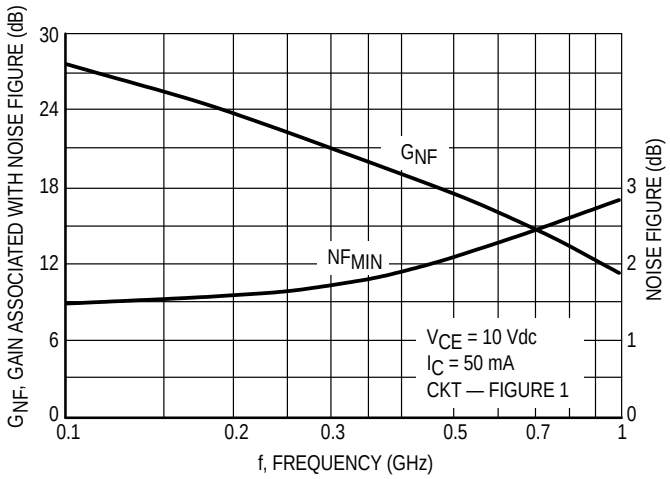


Figure 14. Minimum Noise Figure and Gain Associated with Noise Figure versus Frequency

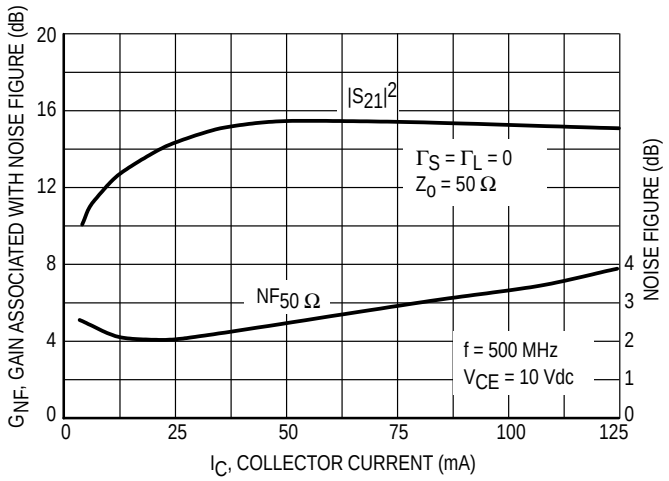


Figure 15. Noise Figure and Insertion Gain versus Collector Current

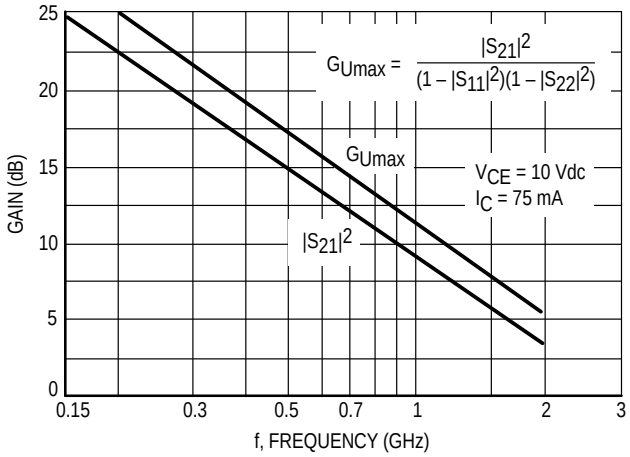


Figure 16. G_{Umax} — Maximum Unilateral Gain, $|S_{21}|^2$ versus Frequency

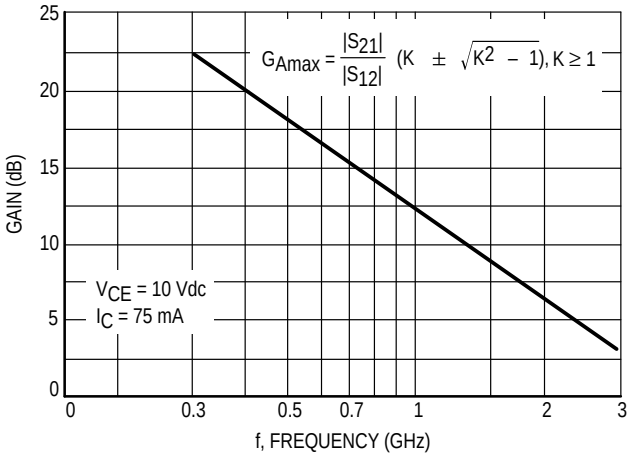


Figure 17. G_{Amax}, Maximum Available Gain versus Frequency

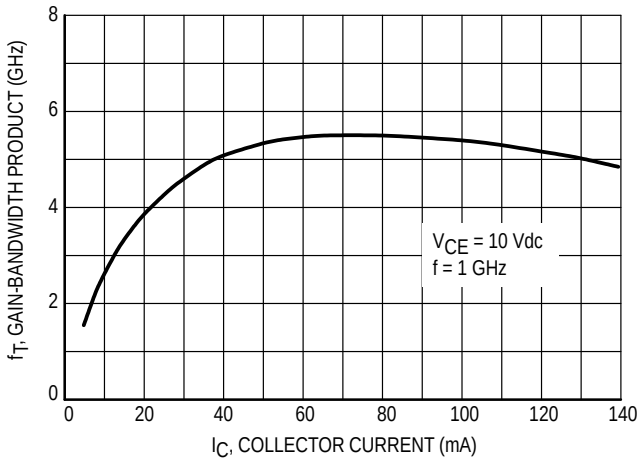


Figure 18. Gain–Bandwidth Product versus Collector Current

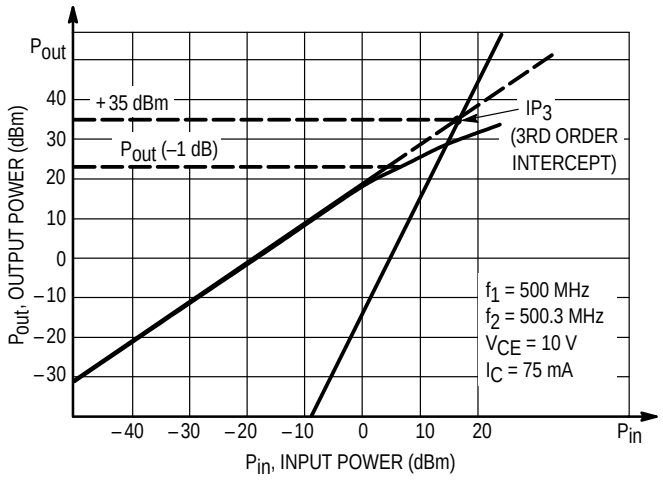


Figure 19. 3rd Order Intercept Point and 1.0 dB Compression Point

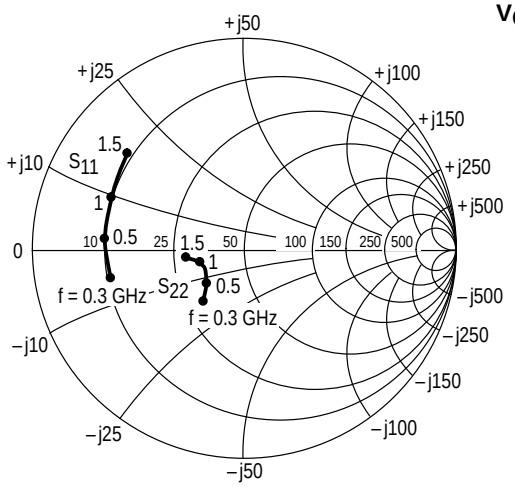


Figure 20. MRF581 Input/Output Reflection Coefficient versus Frequency

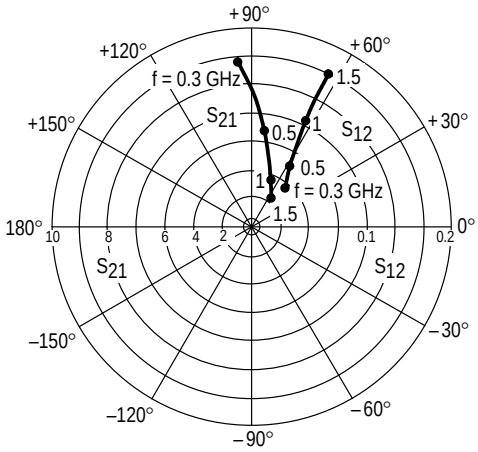


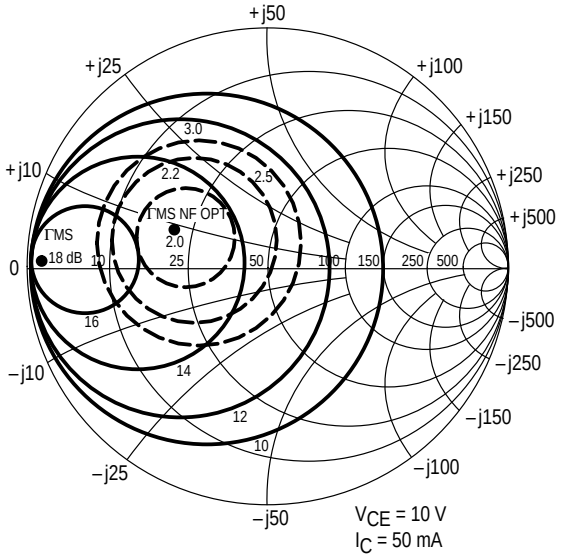
Figure 21. MRF581 Forward/Reverse Transmission Coefficients versus Frequency

V_{CE} (Volts)	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
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	0.37	−161
		1000	0.72	155	2.28	65	0.13	63	0.30	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	0.36	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	0.11	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	0.06	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

Table 1. MRF581 Common Emitter S–Parameters

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	100	0.66	−123	18.3	118	0.04	43	0.53	−79
		300	0.66	−167	7.0	92	0.06	44	0.31	−120
		500	0.65	178	4.3	81	0.08	52	0.28	−133
		1000	0.62	154	2.2	63	0.13	61	0.28	−141
		2000	0.57	109	1.3	39	0.28	57	0.31	−148
		3000	0.55	68	1.0	23	0.41	41	0.34	−164
	50	100	0.64	−133	20.2	114	0.04	44	0.51	−93
		300	0.65	−171	7.6	91	0.06	50	0.34	−137
		500	0.65	175	4.6	81	0.08	56	0.31	−148
		1000	0.61	152	2.3	63	0.13	63	0.28	−149
		2000	0.56	109	1.3	39	0.28	57	0.30	−150
		3000	0.52	70	1.0	23	0.41	39	0.29	−169
	75	100	0.64	−137	20.8	113	0.04	44	0.50	−99
		300	0.66	−173	7.7	91	0.06	52	0.35	−142
		500	0.64	174	4.7	82	0.08	59	0.32	−154
		1000	0.61	151	2.4	65	0.14	64	0.30	−164
		2000	0.54	107	1.4	42	0.30	55	0.27	−167
		3000	0.52	69	1.1	24	0.42	37	0.25	−172
	100	100	0.64	−140	20.8	112	0.03	44	0.50	−103
		300	0.65	−174	7.6	90	0.06	53	0.36	−145
		500	0.64	173	4.7	81	0.08	60	0.33	−156
		1000	0.61	151	2.4	65	0.15	64	0.31	−166
		2000	0.54	107	1.4	42	0.30	54	0.27	−169
		3000	0.52	65	1.1	24	0.42	37	0.25	−174
10	25	100	0.65	−112	20.2	121	0.04	46	0.56	−62
		300	0.63	−162	8.0	93	0.05	46	0.29	−93
		500	0.62	−178	5.0	82	0.07	52	0.25	−102
		1000	0.60	157	2.5	63	0.11	63	0.26	−112
		2000	0.55	112	1.4	39	0.25	61	0.35	−125
		3000	0.55	69	1.0	23	0.39	47	0.40	−145
	50	100	0.63	−122	22.9	117	0.03	46	0.50	−74
		300	0.62	−167	8.8	92	0.05	51	0.28	−112
		500	0.60	178	5.3	82	0.07	58	0.24	−122
		1000	0.58	154	2.7	64	0.12	65	0.23	−129
		2000	0.51	111	1.5	40	0.26	59	0.28	−132
		3000	0.50	70	1.2	24	0.39	44	0.34	−144
	75	100	0.63	−126	23.8	116	0.03	45	0.49	−80
		300	0.63	−168	9.0	92	0.05	51	0.28	−120
		500	0.62	177	5.5	82	0.07	58	0.24	−130
		1000	0.58	154	2.8	65	0.12	65	0.23	−137
		2000	0.52	111	1.5	41	0.26	58	0.27	−135
		3000	0.50	70	1.2	24	0.39	42	0.32	−145
	100	100	0.62	−128	23.8	114	0.03	46	0.46	−82
		300	0.62	−169	8.9	91	0.05	54	0.26	−120
		500	0.60	176	5.4	81	0.07	61	0.23	−130
		1000	0.57	152	2.8	64	0.12	66	0.21	−136
		2000	0.51	109	1.5	40	0.27	59	0.26	−134
		3000	0.50	68	1.2	24	0.39	43	0.32	−145
15	25	100	0.66	−106	21	123	0.03	47	0.57	−54
		300	0.63	−159	8.5	94	0.05	46	0.30	−77
		500	0.61	−177	5.2	82	0.06	52	0.26	−84
		1000	0.58	156	2.6	62	0.11	64	0.28	−96
		2000	0.54	110	1.4	36	0.23	63	0.39	−115
		3000	0.56	68	1.0	22	0.37	49	0.46	−137
	50	100	0.62	−114	24	119	0.03	46	0.51	−64
		300	0.60	−163	9.2	93	0.05	51	0.26	−92
		500	0.58	−179	5.7	81	0.07	58	0.22	−100
		1000	0.56	154	2.9	63	0.12	66	0.23	−109
		2000	0.52	109	1.5	39	0.25	60	0.32	−118
		3000	0.52	67	1.1	22	0.37	46	0.39	−137
	75	100	0.62	−118	24.6	117	0.03	46	0.48	−67
		300	0.59	−165	9.4	92	0.05	53	0.24	−96
		500	0.58	179	5.7	81	0.07	60	0.21	−104
		1000	0.56	154	2.9	63	0.12	66	0.22	−111
		2000	0.50	109	1.5	38	0.25	60	0.31	−118
		3000	0.52	67	1.1	22	0.37	46	0.38	−136
	100	100	0.62	−121	24.8	116	0.03	46	0.46	−68
		300	0.60	−165	9.3	91	0.05	53	0.23	−96
		500	0.58	179	5.7	81	0.07	61	0.20	−102
		1000	0.56	155	2.9	63	0.12	65	0.22	−109
		2000	0.50	111	1.5	39	0.25	62	0.32	−117
		3000	0.50	68	1.1	23	0.37	47	0.39	−136

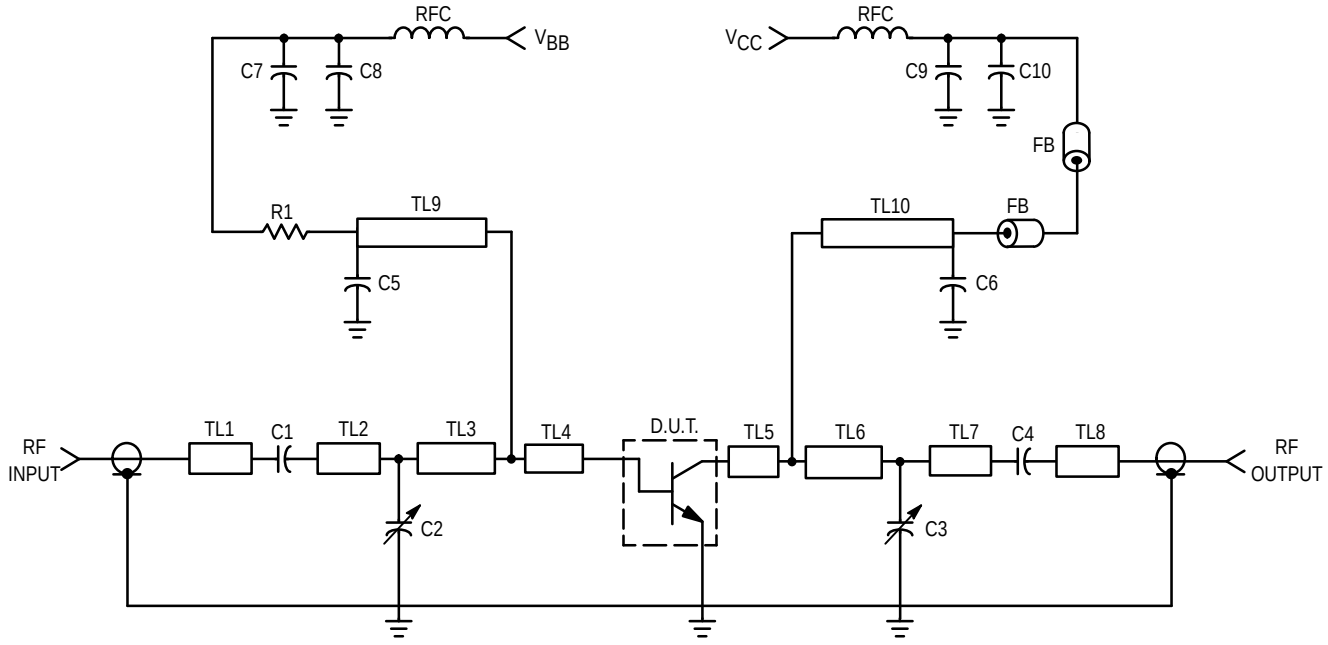
Table 2. MRF5812 Common Emitter S–Parameters



f (MHz)	ΓMS	ΓML	ΓMS NF OPT	G_AMAX (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 14

Figure 22. MRF581 Constant Gain Contours Noise Figure Contours

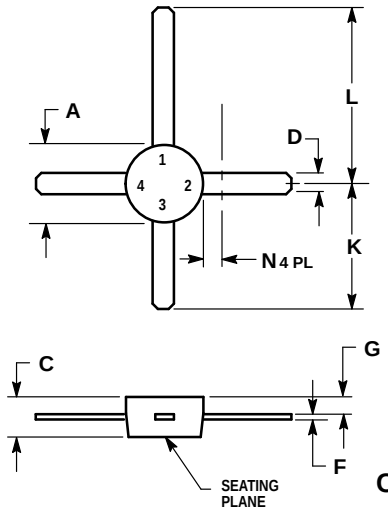


C1, C4, C5, C6, C8, C9 — 1000 pF, Chip Capacitor
C2, C3 — 1.0–10 pF, Johanson Capacitor
C7, C10 — 10 μF, Tantalum Capacitor
R1 — 1.0 kΩ Res.
RFC — VK–200, Ferroxcube
FB — Ferrite Bead, Ferroxcube, 56–590–65/3B
Board Material — 0.0625″ Thick Glass Teflon ε_r = 2.55

TL1, TL7, TL8 — Microstrip 0.162″ x 0.600″
TL2 — Microstrip 0.162″ x 1.000″
TL3 — Microstrip 0.162″ x 0.800″
TL4 — Microstrip 0.162″ x 0.440″
TL5 — Microstrip 0.120″ x 0.440″
TL6 — Microstrip 0.120″ x 1.160″
TL9, TL10 — Microstrip 0.025″ x 4.250″

Figure 23. MRF581 Test Fixture Schematic

PACKAGE DIMENSIONS

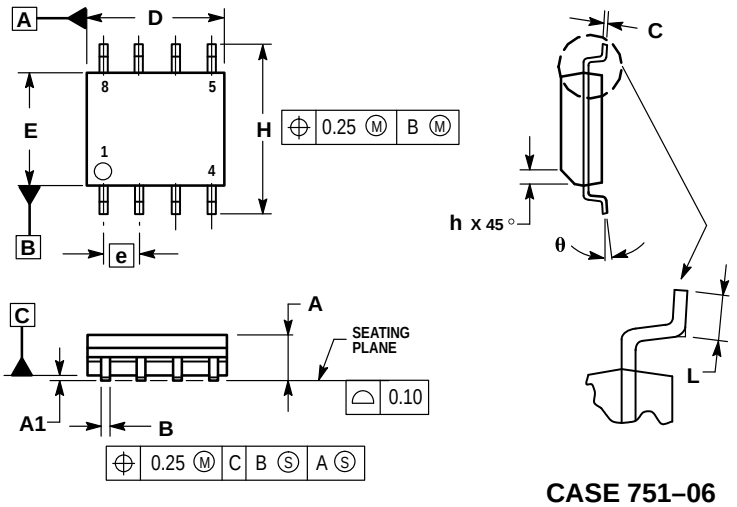


NOTES:
1. DIMENSION D NOT APPLICABLE IN ZONE N.

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	4.44	5.21	0.175	0.205
C	1.90	2.54	0.075	0.100
D	0.84	0.99	0.033	0.039
F	0.20	0.30	0.080	0.012
G	0.76	1.14	0.030	0.045
K	7.24	8.13	0.285	0.320
L	10.54	11.43	0.415	0.450
N	—	1.65	—	0.065

STYLE 2:
PIN 1. COLLECTOR
2. EMITTER
3. BASE
4. EMITTER

CASE 317–01
ISSUE E
MRF581



NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. DIMENSIONS ARE IN MILLIMETER.
3. DIMENSION D AND E DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 PER SIDE.
5. DIMENSION B DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 TOTAL IN EXCESS OF THE B DIMENSION AT MAXIMUM MATERIAL CONDITION.

	MILLIMETERS	
DIM	MIN	MAX
A	1.35	1.75
A1	0.10	0.25
B	0.35	0.49
C	0.19	0.25
D	4.80	5.00
E	3.80	4.00
e	1.27 BSC	
H	5.80	6.20
h	0.25	0.50
L	0.40	1.25
θ	0 °	7 °

STYLE 1:
PIN 1. EMITTER
2. COLLECTOR
3. COLLECTOR
4. EMITTER
5. EMITTER
6. BASE
7. BASE
8. EMITTER

CASE 751–06
ISSUE T
MRF5812

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