

The RF Line
NPN Silicon
High-Frequency Transistor

Designed primarily for use in high-gain, low-noise, small-signal amplifiers. Also used in applications requiring fast switching times.

- High Current-Gain — Bandwidth Product —
 $f_T = 5.0 \text{ GHz (Typ) @ } I_C = 14 \text{ mA}$
- Low Noise Figure —
NF = 2.4 dB (Typ) @ $f = 0.5 \text{ GHz}$
= 3.0 dB (Typ) @ $f = 1.0 \text{ GHz}$
- High Power Gain —
 $G_{\text{max}} = 18 \text{ dB (Typ) @ } f = 0.5 \text{ GHz}$
= 12 dB (Typ) @ $f = 1.0 \text{ GHz}$

BFR90

$f_T = 5.0 \text{ GHz @ } 14 \text{ mA}$
HIGH-FREQUENCY
TRANSISTOR
NPN SILICON



CASE 317A-01, STYLE 2

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	V_{CE0}	15	Vdc
Collector-Base Voltage	V_{CBO}	20	Vdc
Emitter-Base Voltage	V_{EBO}	3.0	Vdc
Collector Current — Continuous	I_C	30	mAdc
Total Device Dissipation @ $T_A = 25^\circ\text{C}$ (1) Derate above 25°C	P_D	250 2.0	mW mW/°C
Storage Temperature Range	T_{stg}	-55 to +150	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	500	°C/W

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 ($I_C = 1.0 \text{ mAdc}$, $I_B = 0$)	$V_{(BR)CEO}$	15	—	—	Vdc
Collector-Base Breakdown Voltage ($I_C = 0.1 \text{ mAdc}$, $I_E = 0$)	$V_{(BR)CBO}$	20	—	—	Vdc
Emitter-Base Breakdown Voltage ($I_E = 0.1 \text{ mAdc}$, $I_C = 0$)	$V_{(BR)EBO}$	3.0	—	—	Vdc
Collector Cutoff Current ($V_{CB} = 10 \text{ Vdc}$, $I_E = 0$)	I_{CBO}	—	—	50	nAdc

ON CHARACTERISTICS

DC Current Gain ($I_C = 14 \text{ mAdc}$, $V_{CE} = 10 \text{ Vdc}$)	h_{FE}	25	—	250	—
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(continued)

NOTE:

1. Device mounted on .062" 2 oz. copper G10 board material, collector pad area 110 X 700 mils.

REV 1

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

Characteristic	Symbol	Min	Typ	Max	Unit
DYNAMIC CHARACTERISTICS					
Current-Gain — Bandwidth Product ($I_C = 14\text{ mA}$, $V_{CE} = 10\text{ Vdc}$, $f = 0.5\text{ GHz}$)	f_T	—	5.0	—	GHz
Collector-Base Capacitance ($V_{CB} = 10\text{ Vdc}$, $I_E = 0$, $f = 1.0\text{ MHz}$)	C_{cb}	—	0.5	1.0	pF

FUNCTIONAL TESTS

Noise Figure ($I_C = 2.0\text{ mA}$, $V_{CE} = 10\text{ Vdc}$, $f = 0.5\text{ GHz}$) ($I_C = 2.0\text{ mA}$, $V_{CE} = 10\text{ Vdc}$, $f = 1.0\text{ GHz}$)	NF	— —	2.4 3.0	— —	dB
Power Gain at Optimum Noise Figure ($I_C = 2.0\text{ mA}$, $V_{CE} = 10\text{ Vdc}$, $f = 0.5\text{ GHz}$) ($I_C = 2.0\text{ mA}$, $V_{CE} = 10\text{ Vdc}$, $f = 1.0\text{ GHz}$)	G_{NF}	— —	15 10	— —	dB
Maximum Available Power Gain (1) ($I_C = 14\text{ mA}$, $V_{CE} = 10\text{ Vdc}$, $f = 0.5\text{ GHz}$) ($I_C = 14\text{ mA}$, $V_{CE} = 10\text{ Vdc}$, $f = 1.0\text{ GHz}$)	G_{max}	— —	18 12	— —	dB

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

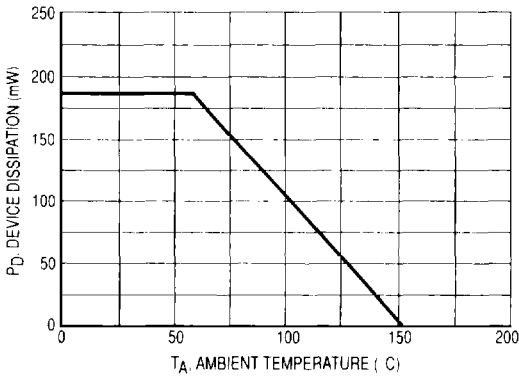


Figure 1. Power Derating

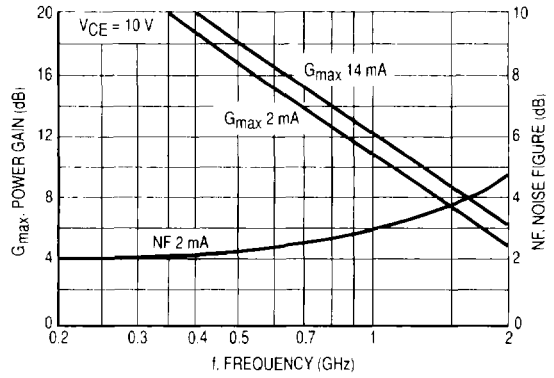


Figure 2. Power Gain and Noise Figure versus Frequency

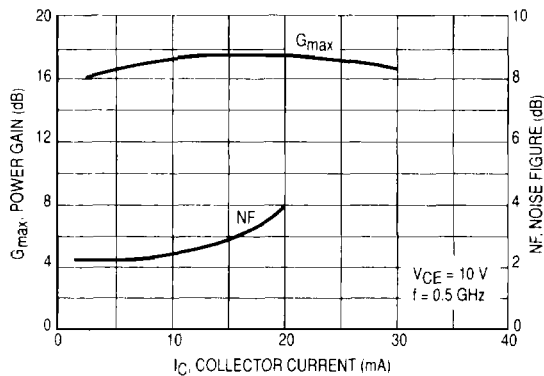


Figure 3. Power Gain and Noise Figure versus Collector Current

Frequency (MHz)		200		500		800		1000		1500	
VCE (Volts)	IC (mA)	S ₁₁	∠φ	S ₁₁	∠φ	S ₁₁	∠φ	S ₁₁	∠φ	S ₁₁	∠φ
5.0	2.0	0.77	-45	0.48	-90	0.33	-125	0.27	-160	0.28	170
	5.0	0.52	-60	0.25	-110	0.18	-150	0.18	170	0.21	145
	10	0.33	-75	0.15	-125	0.13	-175	0.15	150	0.20	130
	20	0.20	-95	0.12	-155	0.14	165	0.17	145	0.22	130
	30	0.17	-116	0.14	-170	0.17	160	0.21	145	0.26	130
10	2.0	0.79	-40	0.50	-80	0.33	-115	0.26	-150	0.25	175
	5.0	0.56	-55	0.27	-95	0.16	-135	0.13	-175	0.17	150
	10	0.39	-65	0.16	-105	0.10	-150	0.10	165	0.15	140
	20	0.25	-75	0.10	-120	0.09	-175	0.12	150	0.18	130
	30	0.25	-75	0.10	-120	0.09	-175	0.12	150	0.18	130

Table 1. S₁₁ Parameters

Frequency (MHz)		200		500		800		1000		1500	
VCE (Volts)	IC (mA)	S ₂₂	∠φ	S ₂₂	∠φ	S ₂₂	∠φ	S ₂₂	∠φ	S ₂₂	∠φ
5.0	2.0	0.89	-20	0.69	-30	0.61	-35	0.55	-35	0.52	-45
	5.0	0.75	-25	0.55	-30	0.50	-30	0.47	-30	0.43	-40
	10	0.64	-25	0.49	-25	0.45	-25	0.43	-30	0.40	-35
	20	0.57	-25	0.47	-20	0.44	-25	0.43	-25	0.40	-35
	30	0.55	-20	0.47	-20	0.46	-20	0.44	-25	0.42	-35
10	2.0	0.91	-15	0.74	-25	0.66	-30	0.62	-35	0.59	-40
	5.0	0.79	-20	0.61	-25	0.56	-25	0.54	-30	0.51	-35
	10	0.70	-20	0.56	-20	0.53	-25	0.51	-25	0.48	-35
	20	0.63	-20	0.54	-25	0.53	-20	0.51	-25	0.49	-35
	30	0.63	-15	0.56	-15	0.55	-20	0.54	-25	0.52	-35

Table 2. S₂₂ Parameters

Frequency (MHz)		200		500		800		1000		1500	
VCE (Volts)	IC (mA)	S ₂₁	∠φ	S ₂₁	∠φ	S ₂₁	∠φ	S ₂₁	∠φ	S ₂₁	∠φ
5.0	2.0	5.76	140	3.81	105	2.73	90	2.20	75	1.70	60
	5.0	9.92	125	5.24	95	3.50	80	2.80	70	2.10	60
	10	12.33	115	5.82	90	3.79	75	2.90	65	2.20	55
	20	13.62	105	6.00	85	3.88	75	2.95	65	2.25	55
	30	13.41	105	5.80	80	3.74	75	2.85	65	2.15	55
10	2.0	5.77	145	3.88	110	2.80	90	2.25	75	1.75	60
	5.0	10.05	130	5.42	95	3.60	80	2.85	70	2.10	60
	10	12.56	115	6.00	90	3.90	80	3.05	70	2.25	55
	20	13.77	110	6.13	85	3.92	75	3.05	65	2.20	55
	30	13.23	105	5.79	85	3.70	75	2.85	65	2.15	55

Table 3. S₂₁ Parameters

Frequency (MHz)		200		500		800		1000		1500	
VCE (Volts)	IC (mA)	S ₁₂	∠φ	S ₁₂	∠φ	S ₁₂	∠φ	S ₁₂	∠φ	S ₁₂	∠φ
5.0	2.0	0.06	65	0.10	55	0.12	55	0.14	55	0.17	60
	5.0	0.05	65	0.08	65	0.12	65	0.15	65	0.19	65
	10	0.04	65	0.08	70	0.12	70	0.15	70	0.20	65
	20	0.04	75	0.08	75	0.12	75	0.15	70	0.20	70
	30	0.03	75	0.07	75	0.11	75	0.15	75	0.19	70
10	2.0	0.05	70	0.03	55	0.11	55	0.12	55	0.15	60
	5.0	0.04	65	0.07	65	0.10	65	0.13	65	0.17	70
	10	0.04	65	0.07	70	0.10	70	0.13	70	0.17	70
	20	0.03	70	0.07	75	0.10	75	0.13	75	0.17	70
	30	0.03	75	0.06	75	0.10	75	0.13	75	0.17	70

Table 4. S₁₂ Parameters