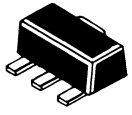
BFQ17

RF TRANSISTOR
NPN SILICON



CASE 345-01, STYLE 1
SOT-89
(TO-243AA TYPE)

3

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	V_{CEO}	25	V
Collector-Emitter Voltage ($R_{BE} \leq 50\ \Omega$)	V_{CER}	40	V
Collector-Base Voltage	V_{CBO}	40	V
Emitter-Base Voltage	V_{EBO}	2.0	V
Collector Current — Continuous	I_C	300	mA
Operating and Storage Junction Temperature Range	T_J, T_{stg}	−55 to +150	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
*Total Device Dissipation, T_A = 25°C Derate above 25°C	P_D	1.0 8.0	Watt mW/°C
Storage Temperature	T_{stg}	150	°C
*Thermal Resistance Junction to Ambient	$R_{\theta JA}$	125	°C/W

*Package mounted on 99.5% alumina 10 x 12 x 0.6 mm.

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

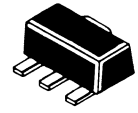
Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS				
Collector-Emitter Breakdown Voltage (I_C = 10 mA)	$V_{(BR)CEO}$	25	—	V
Collector-Base Breakdown Voltage (I_C = 10 μA)	$V_{(BR)CBO}$	40	—	V
Emitter-Base Breakdown Voltage (I_E = 10 μA)	$V_{(BR)EBO}$	2.0	—	V
Collector Cutoff Current (V_{CB} = 20 V) (V_{CB} = 20 V, T_A = 150°C)	I_{CBO}	— —	100 20	nA
Emitter Cutoff Current (V_{EB} = 1.0 V)	I_{EBO}	—	100	nA
ON CHARACTERISTICS				
DC Current Gain (I_C = 50 mA, V_{CE} = 5.0 V) (I_C = 150 mA, V_{CE} = 5.0 V)	h_{FE}	25 25	— —	—
Collector-Emitter Saturation Voltage (I_C = 100 mA, I_B = 10 mA)	$V_{CE(sat)}$	—	0.5	V
SMALL-SIGNAL CHARACTERISTICS				
Current-Gain — Bandwidth Product (V_{CE} = 15 V, I_C = 150 mA, f = 500 MHz)	f_T	1200(1)	—	MHz
Collector-Base Capacitance (V_{CB} = 15 V, f = 1.0 MHz)	C_{cb}	—	4.0	pF
Reverse Transfer Capacitance Common-Emitter (V_{CE} = 15 V, I_C = 10 mA, f = 1.0 MHz)	C_{re}	—	1.9	pF

(1) Typical only

MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

BFQ19

RF TRANSISTOR
NPN SILICON



CASE 345-01, STYLE 1
SOT-89
(TO-243AA TYPE)

3

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	V_{CEO}	15	V
Collector-Base Voltage	V_{CBO}	20	V
Emitter-Base Voltage	V_{EBO}	3.0	V
Collector Current Max (f > 1.0 MHz)	I_{CM}	150	mA
Collector Current — Average	I_{CAV}	75	mA
Operating and Storage Junction Temperature Range	T_J, T_{stg}	−55 to +150	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
*Total Device Dissipation, T_A = 25°C Derate above 25°C	P_D	1.0 8.0	Watt mW/°C
Storage Temperature	T_{stg}	150	°C
*Thermal Resistance Junction to Ambient	$R_{\theta JA}$	125	°C/W

*Package mounted on 99.5% alumina 10 x 12 x 0.6 mm.

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

Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS				
Collector-Emitter Breakdown Voltage (I_C = 10 mA)	$V_{(BR)CEO}$	15	—	V
Collector-Base Breakdown Voltage (I_C = 10 μA)	$V_{(BR)CBO}$	20	—	V
Emitter-Base Breakdown Voltage (I_E = 10 μA)	$V_{(BR)EBO}$	3.0	—	V
Collector Cutoff Current (V_{CB} = 10 V)	I_{CBO}	—	100	nA
Emitter Cutoff Current (V_{EB} = 1.0 V)	I_{EBO}	—	100	nA
ON CHARACTERISTICS				
DC Current Gain (I_C = 50 mA, V_{CE} = 10 V) (I_C = 75 mA, V_{CE} = 10 V)	h_{FE}	 25 25	 — —	—
SMALL-SIGNAL CHARACTERISTICS				
Current-Gain — Bandwidth Product (I_C = 50 mA, V_{CE} = 10 V, f = 500 MHz) (I_C = 75 mA, V_{CE} = 10 V, f = 500 MHz)	f_T	 4.0 4.4	 — —	GHz
Collector-Base Capacitance (V_{CB} = 10 V, f = 1.0 MHz)	C_{cb}	—	1.6	pF
Capacitance Emitter-to-Base (V_{EB} = 0.5 V, f = 1.0 MHz)	C_{eb}	—	5.0	pF
Reverse Transfer Capacitance Common Emitter (V_{CE} = 10 V, I_C = 10 mA, f = 1.0 MHz)	C_{re}	—	1.3	pF
Noise Figure (I_C = 50 mA, V_{CE} = 10 V, f = 500 MHz)	NF	—	3.3	dB

BFR90

The RF Line

NPN SILICON HIGH FREQUENCY TRANSISTOR

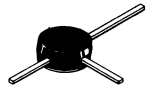
. . . designed primarily for use in high-gain, low-noise, small-signal amplifiers. Also used in applications requiring fast switching times.

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

f_T = 5.0 GHz @ 14 mA

HIGH FREQUENCY TRANSISTOR

NPN SILICON



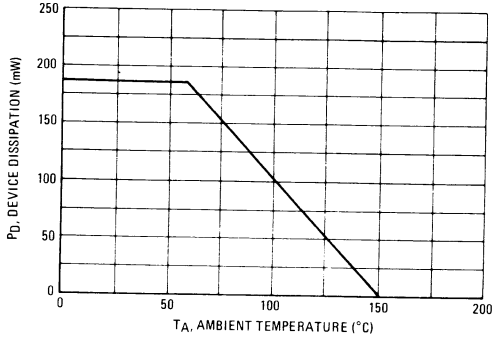
MAXIMUM RATINGS

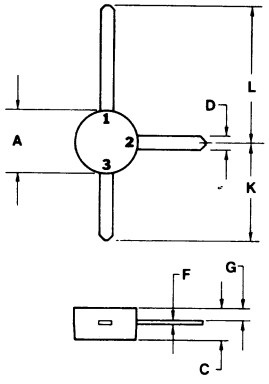
Rating	Symbol	Value	Unit
Collector-Emitter Voltage	V_{CEO}	15	Vdc
Collector-Base Voltage	V_{CBO}	20	Vdc
Emitter-Base Voltage	V_{EBO}	3.0	Vdc
Collector Current – Continuous	I_C	30	mAdc
Total Device Dissipation @ T_A = 60°C	P_D	180	mW
Derate Above 60°C		2.0	mW/°C
Storage Temperature Range	T_{stg}	−65 to +150	°C

THERMAL CHARACTERISTICS

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

FIGURE 1 – POWER DERATING





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

DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	4.44	5.21	0.175	0.205
C	1.90	2.54	0.075	0.100
D	0.94	0.99	0.033	0.039
F	0.20	0.30	0.008	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

CASE 317A-01

3

ELECTRICAL CHARACTERISTICS (T_C = 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)	$V_{(BR)CEO}$	15	–	–	Vdc
Collector-Base Breakdown Voltage (I_C = 0.1 mAdc, I_E = 0)	$V_{(BR)CBO}$	20	–	–	Vdc
Emitter-Base Breakdown Voltage (I_E = 0.1 mAdc, I_C = 0)	$V_{(BR)EBO}$	3.0	–	–	Vdc
Collector Cutoff Current (V_{CB} = 10 Vdc, I_E = 0)	I_{CBO}	–	–	50	nAdc
ON CHARACTERISTICS					
DC Current Gain (I_C = 14 mAdc, V_{CE} = 10 Vdc)	h_{FE}	25	–	250	–
DYNAMIC CHARACTERTISTICS					
Current-Gain Bandwidth Product (I_C = 14 mAdc, V_{CE} = 10 Vdc, f = 0.5 GHz)	f_T	–	5.0	–	GHz
Collector-Base Capacitance (V_{CB} = 10 Vdc, I_E = 0, f = 1.0 MHz)	C_{cb}	–	0.5	1.0	pF
FUNCTIONAL TESTS					
Noise Figure (I_C = 2.0 mAdc, V_{CE} = 10 Vdc, f = 0.5 GHz)	NF	–	2.4	–	dB
(I_C = 2.0 mAdc, V_{CE} = 10 Vdc, f = 1.0 GHz)		–	3.0	–	
Power Gain at Optimum Noise Figure (I_C = 2.0 mAdc, V_{CE} = 10 Vdc, f = 0.5 GHz)	G_{NF}	–	15	–	dB
(I_C = 2.0 mAdc, V_{CE} = 10 Vdc, f = 1.0 GHz)		–	10	–	
Maximum Available Power Gain (1) (I_C = 14 mAdc, V_{CE} = 10 Vdc, f = 0.5 GHz)	G_{max}	–	18	–	dB
(I_C = 14 mAdc, V_{CE} = 10 Vdc, f = 1.0 GHz)		–	12	–	

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

FIGURE 2 – POWER GAIN AND NOISE FIGURE versus FREQUENCY

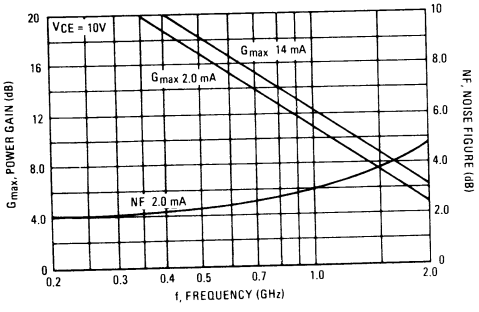


FIGURE 3 – POWER GAIN AND NOISE FIGURE versus COLLECTOR CURRENT

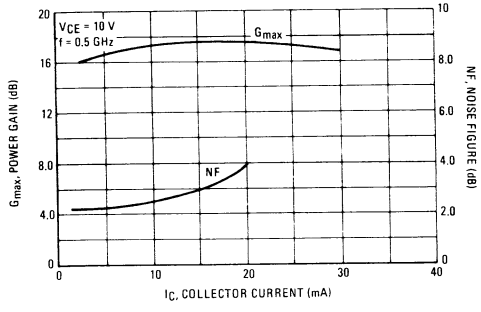


FIGURE 4 – S_{11} PARAMETERS

Frequency (MHz)		200		500		800		1000		1500	
V_{CE} (Volts)	I_C (mA)	S11	∠φ	S11	∠φ	S11	∠φ	S11	∠φ	S11	∠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

FIGURE 5 – S_{22} PARAMETERS

Frequency (MHz)		200		500		800		1000		1500	
V_{CE} (Volts)	I_C (mA)	S22	∠φ	S22	∠φ	S22	∠φ	S22	∠φ	S22	∠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

FIGURE 6 – S_{21} PARAMETERS

Frequency (MHz)		200		500		800		1000		1500	
V_{CE} (Volts)	I_C (mA)	S21	∠φ	S21	∠φ	S21	∠φ	S21	∠φ	S21	∠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

FIGURE 7 – S_{12} PARAMETERS

Frequency (MHz)		200		500		800		1000		1500	
V_{CE} (Volts)	I_C (mA)	S12	∠φ	S12	∠φ	S12	∠φ	S12	∠φ	S12	∠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

BFR91

The RF Line

f_T = 5.0 GHz @ 30 mA

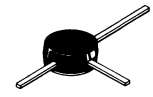
HIGH FREQUENCY TRANSISTOR

NPN SILICON

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 GHz (Typ) @ I_C = 30 mA
- Low Noise Figure –
  NF = 1.9 dB (Typ) @ f = 0.5 GHz
- High Power Gain –
  G_{max} = 16 dB (Typ) @ f = 0.5 GHz



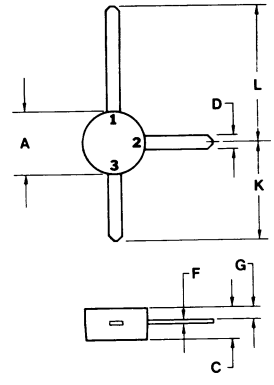
3

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	V_{CEO}	12	Vdc
Collector-Base Voltage	V_{CBO}	15	Vdc
Emitter-Base Voltage	V_{EBO}	3.0	Vdc
Collector Current – Continuous	I_C	35	mAdc
Total Device Dissipation @ T_A = 60°C	P_D	180	mW
Derate Above 60°C		2.0	mW/°C
Storage Temperature Range	T_{stg}	–65 to +150	°C

THERMAL CHARACTERISTICS

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

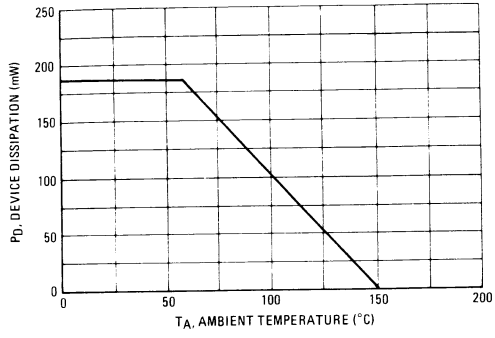


STYLE 2:
PIN 1. COLLECTOR
2. EMITTER
3. BASE

DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	4.44	5.21	0.175	0.205
C	1.90	2.54	0.075	0.100
D	0.94	0.99	0.033	0.039
F	0.20	0.30	0.008	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

CASE 317A-01

FIGURE 1 – POWER DERATING



ELECTRICAL CHARACTERISTICS (T_C = 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)	$V_{(BR)CEO}$	12	–	–	Vdc
Collector-Base Breakdown Voltage (I_C = 0.1 mAdc, I_E = 0)	$V_{(BR)CBO}$	15	–	–	Vdc
Emitter-Base Breakdown Voltage (I_E = 0.1 mAdc, I_C = 0)	$V_{(BR)EBO}$	3.0	–	–	Vdc
Collector Cutoff Current (V_{CB} = 5.0 Vdc, I_E = 0)	I_{CBO}	–	–	50	nAdc
ON CHARACTERISTICS					
DC Current Gain (I_C = 30 mAdc, V_{CE} = 5.0 Vdc)	h_{FE}	25	–	250	–
DYNAMIC CHARACTERTISTICS					
Current-Gain Bandwidth Product (I_C = 30 mAdc, V_{CE} = 5.0 Vdc, f = 0.5 GHz)	f_T	–	5.0	–	GHz
Collector-Base Capacitance (V_{CB} = 10 Vdc, I_E = 0, f = 1.0 MHz)	C_{cb}	–	0.7	1.0	pF
FUNCTIONAL TESTS					
Noise Figure	NF				dB
(I_C = 2.0 mAdc, V_{CE} = 5.0 Vdc, f = 0.5 GHz)		–	1.9	–	
(I_C = 2.0 mAdc, V_{CE} = 5.0 Vdc, f = 1.0 GHz)		–	2.5	–	
Power Gain at Optimum Noise Figure	G_{NF}				dB
(I_C = 2.0 mAdc, V_{CE} = 5.0 Vdc, f = 0.5 GHz)		–	11	–	
(I_C = 2.0 mAdc, V_{CE} = 5.0 Vdc, f = 1.0 GHz)		–	8.0	–	
Maximum Available Power Gain (1)	G_{max}				dB
(I_C = 30 mAdc, V_{CE} = 5.0 Vdc, f = 0.5 GHz)		–	16	–	
(I_C = 30 mAdc, V_{CE} = 5.0 Vdc, f = 1.0 GHz)		–	10	–	

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

FIGURE 2 - POWER GAIN AND NOISE FIGURE versus FREQUENCY

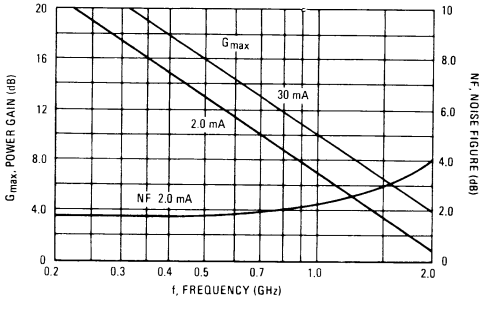


FIGURE 3 - POWER GAIN AND NOISE FIGURE versus COLLECTOR CURRENT

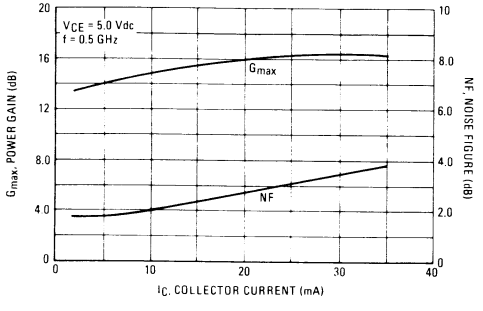


FIGURE 4 – S_{11} PARAMETERS

Frequency (MHz)		200		500		800		1000		1500	
V_{CE} (Volts)	I_C (mA)	S11	∠φ	S11	∠φ	S11	∠φ	S11	∠φ	S11	∠φ
5.0	2.0	0.72	-65	0.51	-125	0.46	-165	0.47	170	0.51	145
	5.0	0.49	-90	0.35	-150	0.34	175	0.36	155	0.41	135
	10	0.34	-110	0.28	-165	0.29	165	0.32	145	0.36	130
	20	0.26	-130	0.24	180	0.27	155	0.30	140	0.34	125
	30	0.24	-145	0.24	175	0.27	155	0.30	140	0.34	125
10	2.0	0.74	-60	0.51	-120	0.45	-160	0.45	170	0.49	150
	5.0	0.52	-80	0.33	-140	0.31	-175	0.32	160	0.37	145
	10	0.36	-95	0.24	-155	0.24	170	0.27	155	0.31	140
	20	0.25	-115	0.19	-170	0.21	160	0.24	145	0.29	130
	30	0.22	-120	0.19	-175	0.21	160	0.25	145	0.20	130

FIGURE 5 – S_{22} PARAMETERS

Frequency (MHz)		200		500		800		1000		1500	
V_{CE} (Volts)	I_C (mA)	S22	∠φ	S22	∠φ	S22	∠φ	S22	∠φ	S22	∠φ
5.0	2.0	0.83	-25	0.62	-35	0.55	-40	0.51	-45	0.49	-60
	5.0	0.66	-30	0.45	-35	0.40	-40	0.37	-40	0.34	-50
	10	0.52	-35	0.36	-35	0.32	-35	0.30	-35	0.27	-50
	20	0.42	-35	0.30	-30	0.27	-30	0.26	-30	0.22	-45
	30	0.38	-35	0.28	-25	0.26	-30	0.25	-30	0.21	-40
10	2.0	0.86	-20	0.67	-30	0.62	-35	0.58	-40	0.56	-50
	5.0	0.71	-25	0.53	-30	0.48	-30	0.45	-35	0.43	-45
	10	0.59	-30	0.45	-25	0.41	-30	0.40	-30	0.37	-40
	20	0.50	-25	0.40	-25	0.38	-25	0.37	-30	0.34	-40
	30	0.47	-25	0.40	-20	0.38	-25	0.37	-30	0.34	-35

FIGURE 6 – S_{21} PARAMETERS

Frequency (MHz)		200		500		800		1000		1500	
V_{CE} (Volts)	I_C (mA)	S21	∠φ	S21	∠φ	S21	∠φ	S21	∠φ	S21	∠φ
5.0	2.0	5.25	130	3.06	95	2.10	75	1.70	65	1.20	50
	5.0	8.72	120	4.34	90	2.84	75	2.30	65	1.60	50
	10	10.85	110	4.92	85	3.22	70	2.60	65	1.80	50
	20	12.13	105	5.34	80	3.44	70	2.75	60	1.90	50
	30	12.50	100	5.42	80	3.47		2.75	60	1.90	50
10	2.0	5.36	135	3.20	95	2.20	80	1.85	65	1.30	50
	5.0	9.05	120	4.55	90	3.00	75	2.45	65	1.65	50
	10	11.37	110	5.22	85	3.40	75	2.65	65	1.85	50
	20	12.83	105	5.64	80	3.63	70	2.75	60	2.00	50
	30	13.10	100	5.62	80	3.63	70	2.75	60	2.00	50

FIGURE 7 – S_{12} PARAMETERS

Frequency (MHz)		200		500		800		1000		1500	
V_{CE} (Volts)	I_C (mA)	S12	∠φ	S12	∠φ	S12	∠φ	S12	∠φ	S12	∠φ
5.0	2.0	0.08	55	0.11	45	0.12	50	0.14	55	0.17	65
	5.0	0.06	55	0.09	60	0.13	65	0.17	65	0.22	65
	10	0.05	60	0.09	65	0.14	70	0.19	65	0.24	65
	20	0.05	70	0.07	70	0.15	70	0.19	70	0.25	65
	30	0.04	75	0.10	75	0.15	70	0.19	70	0.25	65
10	2.0	0.06	60	0.09	45	0.10	50	0.12	60	0.15	70
	5.0	0.05	60	0.08	60	0.11	65	0.15	65	0.19	70
	10	0.05	65	0.08	65	0.12	70	0.16	70	0.21	70
	20	0.04	70	0.08	70	0.13	70	0.17	70	0.22	70
	30	0.04	70	0.08	75	0.13	70	0.17	70	0.22	70

BFR92,A

RF TRANSISTOR
NPN SILICON

CASE 318-02/03, STYLE 6
SOT-23
(TO-236AA/AB)

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	V_{CEO}	15	Vdc
Collector-Base Voltage	V_{CBO}	20	Vdc
Emitter-Base Voltage	V_{EBO}	2.0	Vdc
Collector Current — Continuous	I_C	25	mAdc
Operating and Storage Junction Temperature Range	T_J, T_{stg}	−55 to +150	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
*Total Device Dissipation, T_A = 25°C Derate above 25°C	P_D	350 2.8	mW mW/°C
Storage Temperature	T_{stg}	150	°C
*Thermal Resistance Junction to Ambient	$R_{\theta JA}$	357	°C/W

*Package mounted on 99.5% alumina 10 x 8 x 0.6 mm.

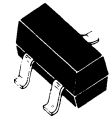
ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage (1) (I_C = 10 mA)		$V_{(BR)CEO}$	15	—	Vdc
Collector-Base Breakdown Voltage (I_C = 100 μA)		$V_{(BR)CBO}$	20	—	Vdc
Emitter-Base Breakdown Voltage (I_C = 100 μA)		$V_{(BR)EBO}$	2.0	—	Vdc
Collector Cutoff Current (V_{CB} = 10 V)	BFR92 BFR92A	I_{CBO}	— —	50 60	nA
ON CHARACTERISTICS					
DC Current Gain (I_C = 500 μA, V_{CE} = 10 V) (I_C = 14 mA, V_{CE} = 10 V)	 BFR92 BFR92A	h_{FE}	 25 40	 — —	—
Collector-Emitter Saturation Voltage (1) (I_C = 25 mA, I_B = 5.0 mA)		$V_{CE(sat)}$	—	0.5	Vdc
Base-Emitter Saturation Voltage (1) (I_C = 25 mA, I_B = 5.0 mA)		$V_{BE(sat)}$	—	1.2	Vdc
SMALL-SIGNAL CHARACTERISTICS					
Current-Gain — Bandwidth Product (I_C = 14 mA, V_{CE} = 10 V, f = 500 MHz)		f_T	3.0	—	GHz
Noise Figure (V_{CE} = 1.5 V, I_C = 3.0 mA, R_S = 50 Ω, f = 500 MHz)		NF	—	3.0 (Typ)	dB
Capacitance-Collector to Base (V_{CB} = 10 Vdc, f = 1.0 MHz)		C_{cb}	—	0.7 (Typ)	pF

(1) Pulse Width ≤ 300 μs, Duty Cycle ≤ 2.0%.

BFR93,A

RF TRANSISTOR
NPN SILICON



CASE 318-02/03, STYLE 6
SOT-23
(TO-236AA/AB)

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	V_{CEO}	12	Vdc
Collector-Base Voltage	V_{CBO}	15	Vdc
Emitter-Base Voltage	V_{EBO}	2.0	Vdc
Collector Current — Continuous	I_C	35	mAdc
Operating and Storage Junction Temperature Range	T_J, T_{stg}	−55 to +150	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
*Total Device Dissipation, T_A = 25°C Derate above 25°C	P_D	350 2.8	mW mW/°C
Storage Temperature	T_{stg}	150	°C
*Thermal Resistance Junction to Ambient	$R_{\theta JA}$	357	°C/W

*Package mounted on 99.5% alumina 10 x 8 x 0.6 mm.

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

Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage (1) (I_C = 10 mA)		$V_{(BR)CEO}$	12	—	Vdc
Collector-Base Breakdown Voltage (I_C = 10 μA)		$V_{(BR)CBO}$	15	—	Vdc
Emitter-Base Breakdown Voltage (I_C = 100 μA)		$V_{(BR)EBO}$	2.0	—	Vdc
Collector Cutoff Current (V_{CE} = 10 V)		I_{CEO}	—	50	nA
Collector Cutoff Current (V_{CB} = 10 V)		I_{CBO}	—	50	nA
ON CHARACTERISTICS					
DC Current Gain (1) (I_C = 30 mA, V_{CE} = 5.0 V) (I_C = 30 mA, V_{CE} = 5.0 V)	BFR93A BFR93	h_{FE}	 40 25	 — —	—
Collector-Emitter Saturation Voltage (1) (I_C = 35 mA, I_B = 7.0 mA)		$V_{CE(sat)}$	—	0.5	Vdc
Base-Emitter Saturation Voltage (1) (I_C = 35 mA, I_B = 7.0 mA)		$V_{BE(sat)}$	—	1.2	Vdc
SMALL-SIGNAL CHARACTERISTICS					
Current-Gain — Bandwidth Product (I_C = 30 mA, V_{CE} = 5.0 V, f = 500 MHz)		f_T	3.0	—	GHz
Noise Figure (V_{CE} = 5.0 V, I_C = 2.0 mA, R_S = 50 Ω, f = 30 MHz)		NF	—	3.0	dB

(1) Pulse Width ≤ 300 μs, Duty Cycle ≤ 2.0%.

BFR96
BFRC96
MRF961
MRF962
MRF965

The RF Line

NPN SILICON HIGH FREQUENCY TRANSISTORS

The BFR96 series transistors use the same state-of-the-art microwave transistor chip which features fine-line geometry, ion-implanted arsenic emitters and gold top metalization. These transistors are intended for low-to-medium power amplifiers requiring high gain, low noise figure, and low intermodulation distortion. The BFR96 and MRF961 are particularly suitable for broadband MATV/CATV amplifiers. The MRF962 uses a hermetic stripline, ceramic package and is intended for high reliability applications up to 2 GHz. The MRF965 makes an excellent VHF/UHF Class C driver amplifier for several hundred milliwatts power output.

f_T = 4.5 GHz @ 50 mA

HIGH FREQUENCY TRANSISTOR

NPN SILICON

3

MAXIMUM RATINGS

Ratings	Symbol	BFRC96 Chip	BFR96 Case 317A-01	MRF961 Case 317-01	MRF962 Case 303-01	MRF965 Case 26-03	Unit
		Values					
Collector-Emitter Voltage	V_{CEO}	15	15	15	15	15	Vdc
Collector-Base Voltage	V_{CBO}	20	20	20	20	20	Vdc
Emitter-Base Voltage	V_{EBO}	3.0	3.0	3.0	3.0	3.0	Vdc
Collector Current — Continuous	I_C	100	100	100	100	100	mAdc
Total Device Dissipation @ T_C = 100°C(1) Derate above T_C = 100°C	P_D	0.75 T_J = 200°C max	0.5 10	0.5 10	0.75 7.5	0.75 7.5	Watts mW/°C
Storage Temperature	T_{stg}	−65 to +200	−65 to +150	−65 to +150	−65 to +200	−65 to +200	°C

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

ELECTRICAL CHARACTERISTICS (T_C = 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)	$V_{(BR)CEO}$	15	–	–	Vdc
Collector-Base Breakdown Voltage (I_C = 100 μAdc, I_E = 0)	$V_{(BR)CBO}$	20	–	–	Vdc
Emitter-Base Breakdown Voltage (I_E = 100 μAdc, I_C = 0)	$V_{(BR)EBO}$	3.0	–	–	Vdc
Collector Cutoff Current (V_{CB} = 10 Vdc, I_E = 0)	I_{CBO}	–	–	100	nAdc
ON CHARACTERISTICS					
DC Current Gain (I_C = 50 mAdc, V_{CE} = 10 Vdc)	h_{FE}	30	–	200	–
DYNAMIC CHARACTERISTICS					
Current-Gain Bandwidth Product (I_C = 50 mAdc, V_{CE} = 10 Vdc, f = 0.5 GHz)	f_T	–	4.5	–	GHz
Collector-Base Capacitance (V_{CB} = 10 Vdc, Emitter Guarded)	C_{cb}				pF
BFR96, MRF961, MRF962		–	1.2	1.5	
MRF965		–	1.6	2.0	
FUNCTIONAL TESTS					
Noise Figure (I_C = 10 mAdc, V_{CE} = 10 Vdc, f = 0.5 GHz)	NF	–	2.0	–	dB
Maximum Unilateral Gain/Insertion Gain (I_C = 50 mAdc, V_{CE} = 10 Vdc, f = 0.5 GHz)	$G_U(max)$/ $\lvert S_{21}\rvert^2$				dB
BFR96, MRF965		–/12	14.5/13	–	
MRF961		–/13.5	17/15	–	
MRF962		–/15	20.5/16.5	–	

NOTE 1. $G_U(max) = \dfrac{\lvert S_{21}\rvert^2}{(1-\lvert S_{11}\rvert^2)(1-\lvert S_{22}\rvert^2)}$

3

FIGURE 1 – MAXIMUM UNILATERAL GAIN versus FREQUENCY

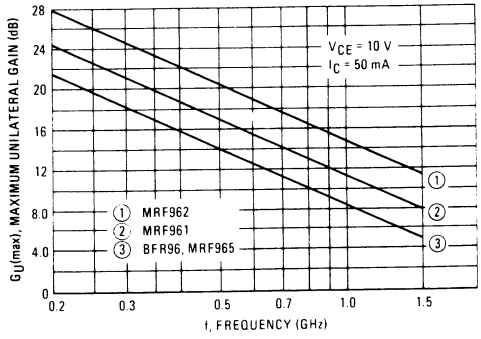


FIGURE 2 – $\lvert S_{21}\rvert^2$ versus FREQUENCY

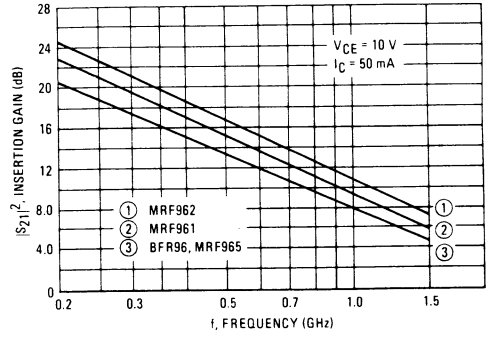


FIGURE 3 – MAXIMUM UNILATERAL GAIN versus COLLECTOR CURRENT

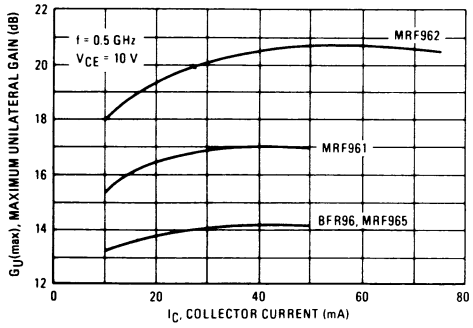


FIGURE 4 – GAIN-BANDWIDTH PRODUCT versus COLLECTOR CURRENT

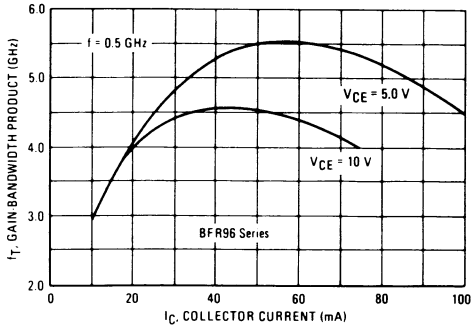


FIGURE 5 – NOISE FIGURE versus FREQUENCY

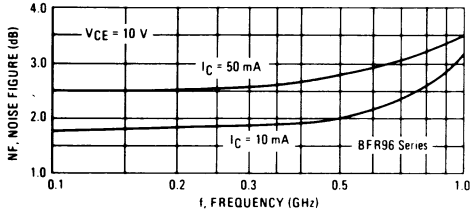


FIGURE 6 – NOISE FIGURE versus COLLECTOR CURRENT

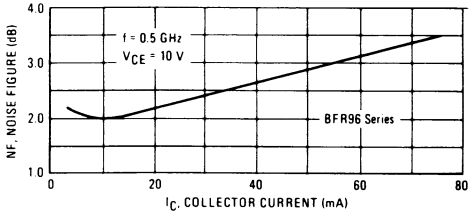


FIGURE 7 – COLLECTOR-BASE CAPACITANCE versus COLLECTOR-BASE VOLTAGE

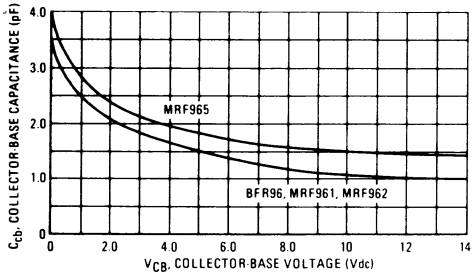


FIGURE 8 – OUTPUT POWER AND EFFICIENCY versus INPUT POWER (MRF965)

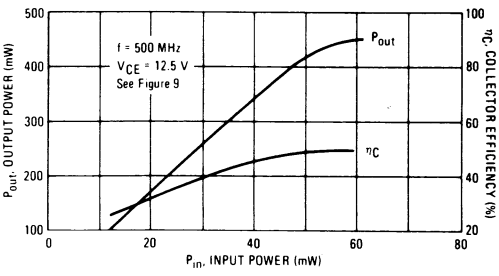
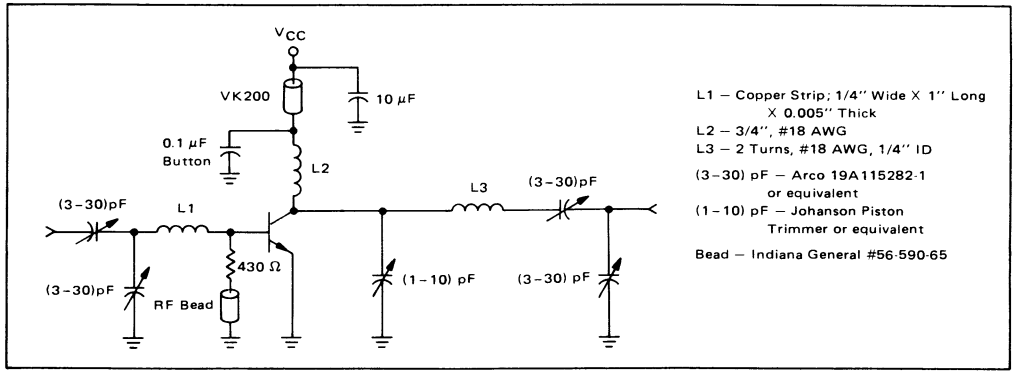


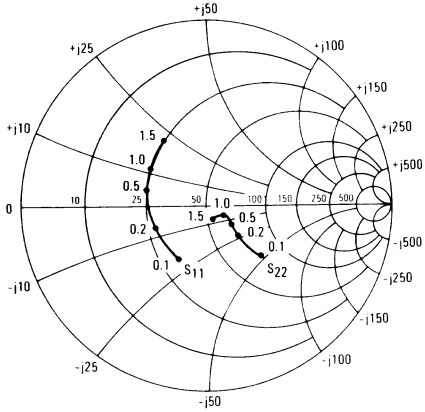
FIGURE 9 – MRF965 CLASS C AMPLIFIER @ 500 MHz, 400 mW



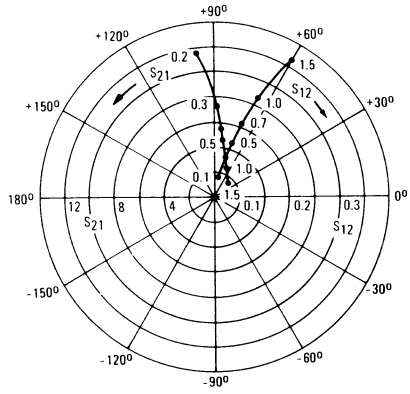
L1 – Copper Strip; 1/4" Wide X 1" Long X 0.005" Thick
L2 – 3/4", #18 AWG
L3 – 2 Turns, #18 AWG, 1/4" ID
(3-30) pF – Arco 19A115282-1 or equivalent
(1-10) pF – Johanson Piston Trimmer or equivalent
Bead – Indiana General #56-590-65

BFR96 COMMON-EMITTER S-PARAMETERS

INPUT/OUTPUT REFLECTION COEFFICIENTS versus FREQUENCY (V_{CE} = 10 V, I_C = 50 mA)



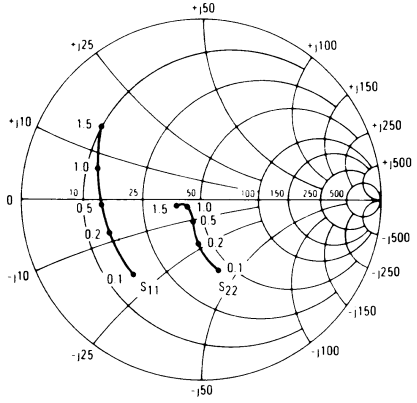
FORWARD/REVERSE TRANSMISSION COEFFICIENTS versus FREQUENCY (V_{CE} = 10 V, I_C = 50 mA)



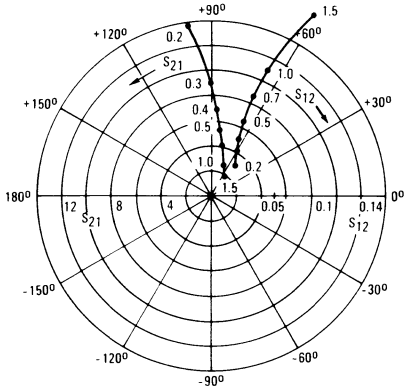
V_{CE} (Volts)	I_C (mA)	f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}	
			$\|S_{11}\|$	$\angle\phi$	$\|S_{21}\|$	$\angle\phi$	$\|S_{12}\|$	$\angle\phi$	$\|S_{22}\|$	$\angle\phi$
5.0	10	100	0.51	-95	15.04	121	0.047	54	0.58	-48
		300	0.43	-163	5.87	92	0.082	58	0.26	-63
		500	0.46	174	3.61	79	0.120	63	0.19	-63
		700	0.48	162	2.65	68	0.161	63	0.15	-64
		1000	0.48	146	1.92	57	0.220	63	0.12	-79
		1500	0.54	121	1.40	43	0.320	58	0.13	-118
	25	100	0.39	-122	19.41	112	0.037	60	0.42	-68
		300	0.39	-176	6.81	89	0.079	68	0.16	-94
		500	0.42	166	4.11	78	0.129	70	0.10	-103
		700	0.44	156	3.05	69	0.176	68	0.06	-119
		1000	0.44	142	2.20	59	0.244	64	0.06	-159
		1500	0.49	118	1.62	45	0.348	57	0.10	177
	50	100	0.35	-140	21.10	106	0.032	64	0.33	-81
		300	0.38	176	7.11	88	0.081	72	0.13	-116
		500	0.42	162	4.28	78	0.133	72	0.09	-136
		700	0.43	153	3.16	70	0.183	69	0.07	-163
		1000	0.42	140	2.28	60	0.252	65	0.08	165
		1500	0.47	116	1.66	47	0.357	57	0.12	155
10	10	100	0.53	-83	15.96	124	0.039	58	0.65	-36
		300	0.38	-154	6.44	94	0.070	59	0.35	-41
		500	0.41	-179	3.98	81	0.102	64	0.30	-39
		700	0.42	166	2.94	70	0.138	65	0.27	-39
		1000	0.42	151	2.12	60	0.191	66	0.24	-47
		1500	0.49	125	1.50	44	0.278	63	0.22	-72
	25	100	0.38	-104	20.85	115	0.032	60	0.48	-48
		300	0.32	-169	7.54	91	0.070	68	0.23	-48
		500	0.35	170	4.61	80	0.109	71	0.19	-43
		700	0.37	160	3.37	70	0.152	69	0.16	-39
		1000	0.37	146	2.43	61	0.210	67	0.13	-44
		1500	0.43	121	1.73	47	0.304	61	0.10	-74
	50	100	0.33	-119	22.59	109	0.029	63	0.39	-51
		300	0.30	-176	7.74	88	0.069	72	0.19	-47
		500	0.34	166	4.70	79	0.113	73	0.16	-40
		700	0.36	158	3.45	70	0.156	70	0.14	-35
		1000	0.36	144	2.46	61	0.217	66	0.11	-39
		1500	0.42	119	1.75	47	0.310	60	0.08	-72

MRF961 COMMON-EMITTER S-PARAMETERS

INPUT/OUTPUT REFLECTION COEFFICIENTS versus FREQUENCY (V_{CE} = 10 V, I_C = 50 mA)



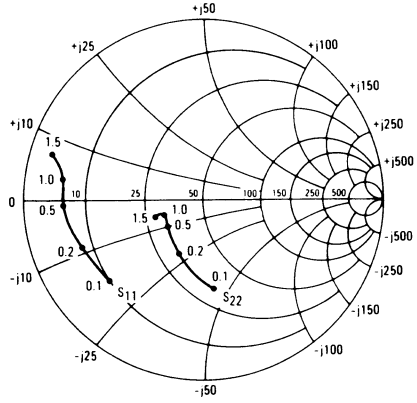
FORWARD/REVERSE TRANSMISSION COEFFICIENTS versus FREQUENCY (V_{CE} = 10 V, I_C = 50 mA)



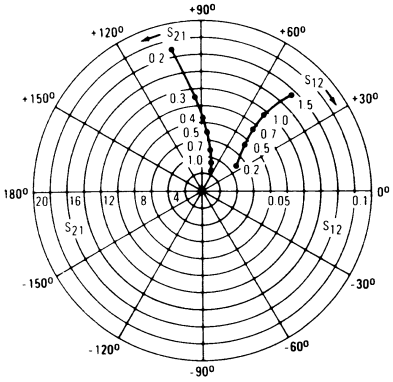
V_{CE} (Volts)	I_C (mA)	f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}	
			$\|S_{11}\|$	∠φ	S_{21}	∠φ	S_{12}	∠φ	S_{22}	∠φ
5.0	10	100	0.65	-101	16.61	125	0.047	46	0.61	-56
		300	0.64	-160	6.61	96	0.064	39	0.27	-87
		500	0.66	-178	4.01	83	0.078	45	0.19	-98
		700	0.68	171	2.93	73	0.093	49	0.16	-108
		1000	0.68	160	2.07	63	0.119	53	0.16	-124
		1500	0.72	143	1.43	50	0.158	54	0.21	-141
	25	100	0.60	-129	22.41	115	0.034	44	0.49	-84
		300	0.63	-172	7.94	93	0.049	50	0.26	-132
		500	0.66	174	4.78	83	0.071	58	0.21	-150
		700	0.67	166	3.45	75	0.092	60	0.20	-164
		1000	0.67	156	2.46	66	0.124	61	0.21	-177
		1500	0.71	140	1.73	54	0.173	60	0.24	175
	50	100	0.59	-147	25.12	109	0.025	46	0.42	-104
		300	0.64	-178	8.47	91	0.046	60	0.28	-151
		500	0.67	171	5.05	83	0.070	65	0.26	-167
		700	0.68	164	3.67	75	0.093	65	0.25	-178
		1000	0.67	154	2.60	67	0.128	65	0.26	170
		1500	0.72	138	1.83	56	0.178	62	0.29	163
10	10	100	0.65	-90	17.47	128	0.040	50	0.67	-41
		300	0.61	-154	7.31	97	0.057	41	0.33	-57
		500	0.62	-174	4.46	84	0.069	46	0.25	-58
		700	0.64	175	3.27	74	0.084	50	0.22	-60
		1000	0.64	163	2.33	64	0.106	54	0.20	-72
		1500	0.69	145	1.56	50	0.140	57	0.22	-96
	25	100	0.57	-116	24.36	119	0.030	48	0.51	-62
		300	0.58	-167	8.10	94	0.045	52	0.20	-89
		500	0.61	178	5.43	83	0.070	58	0.14	-97
		700	0.63	169	3.93	75	0.084	60	0.10	-106
		1000	0.62	159	2.78	66	0.112	61	0.09	-124
		1500	0.67	142	1.91	53	0.156	60	0.12	-140
	50	100	0.55	-132	26.97	112	0.024	47	0.40	-73
		300	0.57	-173	9.32	91	0.042	59	0.16	-104
		500	0.60	174	5.58	82	0.064	64	0.11	-115
		700	0.62	167	4.04	74	0.086	64	0.08	-128
		1000	0.61	158	2.85	66	0.115	64	0.08	-149
		1500	0.67	141	1.96	55	0.158	61	0.12	-158

MRF962 COMMON-EMITTER S-PARAMETERS

INPUT/OUTPUT REFLECTION COEFFICIENTS versus FREQUENCY (V_{CE} = 10 V, I_C = 50 mA)



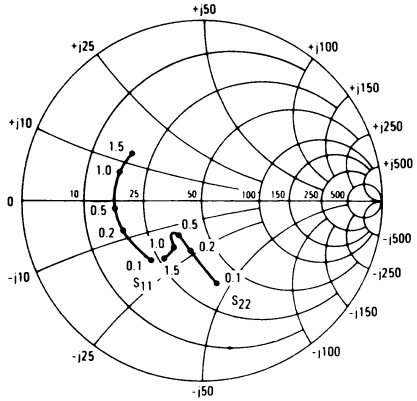
FORWARD/REVERSE TRANSMISSION COEFFICIENTS versus FREQUENCY (V_{CE} = 10 V, I_C = 50 mA)



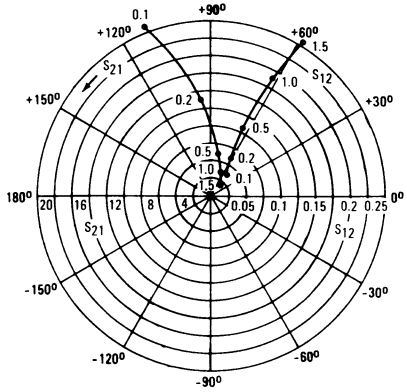
V_{CE} (Volts)	I_C (mA)	f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}	
			$\|S_{11}\|$	$\angle\phi$	$\|S_{21}\|$	$\angle\phi$	$\|S_{12}\|$	$\angle\phi$	$\|S_{22}\|$	$\angle\phi$
5.0	10	100	0.70	-102	17.42	128	0.044	43	0.65	-57
		300	0.75	-156	7.11	98	0.058	24	0.32	-97
		500	0.78	-170	4.36	86	0.064	25	0.26	-110
		700	0.78	-176	3.16	77	0.071	26	0.23	-117
		1000	0.78	176	2.26	67	0.078	27	0.24	-126
		1500	0.79	167	1.51	54	0.092	29	0.31	-133
	25	100	0.69	-131	24.24	118	0.029	38	0.56	-87
		300	0.77	-167	8.76	95	0.039	32	0.35	-137
		500	0.79	-176	5.26	85	0.046	36	0.32	-150
		700	0.80	178	3.82	78	0.055	40	0.31	-158
		1000	0.79	173	2.72	70	0.067	42	0.32	-164
		1500	0.81	164	1.82	59	0.086	42	0.34	-167
	50	100	0.71	-147	27.72	113	0.021	37	0.53	-107
		300	0.78	-173	9.59	94	0.030	40	0.41	-152
		500	0.81	179	5.72	85	0.038	46	0.39	-163
		700	0.81	176	4.09	78	0.048	50	0.38	-169
		1000	0.81	171	2.89	71	0.061	51	0.38	-175
		1500	0.82	163	1.96	62	0.082	49	0.40	-177
10	10	100	0.71	-92	18.77	131	0.037	47	0.70	-44
		300	0.74	-150	8.09	100	0.051	28	0.34	-69
		500	0.75	-166	5.01	87	0.056	28	0.27	-75
		700	0.76	-174	3.62	78	0.064	28	0.24	-79
		1000	0.76	179	2.58	69	0.071	30	0.24	-88
		1500	0.77	168	1.72	55	0.085	31	0.31	-104
	25	100	0.67	-120	27.10	122	0.027	42	0.57	-68
		300	0.73	-163	10.27	97	0.035	36	0.27	-110
		500	0.76	-174	6.21	86	0.043	39	0.22	-124
		700	0.77	-179	4.48	78	0.051	41	0.20	-132
		1000	0.77	175	3.19	71	0.062	43	0.20	-139
		1500	0.78	166	2.13	59	0.080	42	0.25	-142
	50	100	0.68	-137	31.53	116	0.020	37	0.49	-85
		300	0.74	-169	11.17	95	0.028	40	0.27	-131
		500	0.77	-177	6.69	85	0.037	46	0.24	-144
		700	0.77	178	4.82	78	0.047	48	0.23	-152
		1000	0.77	173	3.42	71	0.059	50	0.23	-158
		1500	0.79	165	2.30	61	0.078	47	0.27	-159

MRF965 COMMON-EMITTER S-PARAMETERS

INPUT/OUTPUT REFLECTION COEFFICIENTS versus FREQUENCY (V_{CE} = 10 V, I_C = 50 mA)

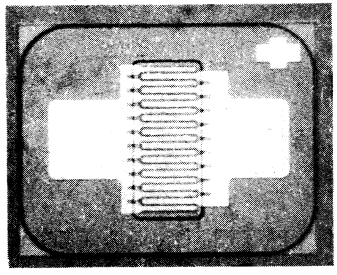


FORWARD/REVERSE TRANSMISSION COEFFICIENTS versus FREQUENCY (V_{CE} = 10 V, I_C = 50 mA)



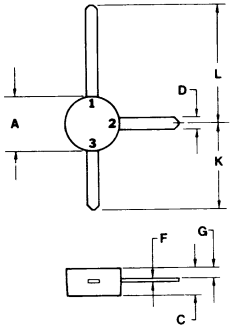
V_{CE} (Volts)	I_C (mA)	f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}	
			$\|S_{11}\|$	$\angle\phi$	$\|S_{21}\|$	$\angle\phi$	$\|S_{12}\|$	$\angle\phi$	$\|S_{22}\|$	$\angle\phi$
5.0	10	100	0.56	-102	13.87	121	0.054	48	0.58	-62
		300	0.57	-158	5.47	90	0.084	46	0.32	-94
		500	0.56	-169	3.40	77	0.110	52	0.27	-106
		700	0.52	178	2.53	69	0.136	54	0.39	-115
		1000	0.55	167	1.79	57	0.181	56	0.35	-112
		1500	0.54	150	1.27	42	0.242	57	0.43	-122
	25	100	0.48	-129	17.61	112	0.041	51	0.47	-85
		300	0.55	-169	6.38	89	0.076	57	0.30	-125
		500	0.54	-176	3.97	77	0.111	62	0.27	-138
		700	0.50	172	2.94	71	0.114	61	0.30	-143
		1000	0.53	162	2.08	61	0.198	60	0.32	-135
		1500	0.50	146	1.50	47	0.267	57	0.37	-140
	50	100	0.47	-144	19.34	107	0.035	56	0.42	-100
		300	0.55	-173	6.72	87	0.073	63	0.31	-138
		500	0.53	-179	4.17	77	0.112	66	0.29	-150
		700	0.50	168	3.10	71	0.147	64	0.33	-153
		1000	0.53	159	2.19	62	0.206	61	0.32	-146
		1500	0.50	143	1.59	49	0.277	58	0.36	-149
10	10	100	0.56	-92	14.67	123	0.047	50	0.63	-50
		300	0.53	-152	6.00	92	0.077	47	0.34	-73
		500	0.53	-165	3.74	78	0.100	53	0.29	-82
		700	0.49	-177	2.76	70	0.124	56	0.31	-93
		1000	0.52	170	1.96	57	0.166	58	0.38	-94
		1500	0.51	153	1.36	42	0.221	59	0.46	-108
	25	100	0.46	-117	19.10	115	0.036	53	0.49	-68
		300	0.50	-164	7.09	90	0.071	57	0.26	-99
		500	0.49	-172	4.39	78	0.102	62	0.23	-110
		700	0.45	175	3.25	71	0.133	61	0.25	-119
		1000	0.49	164	2.28	60	0.181	61	0.30	-112
		1500	0.47	148	1.61	46	0.246	59	0.37	-120
	50	100	0.42	-131	20.99	110	0.033	56	0.41	-79
		300	0.49	-169	7.46	88	0.069	62	0.24	-111
		500	0.48	-175	4.63	78	0.103	65	0.21	-123
		700	0.45	172	3.40	71	0.136	64	0.25	-129
		1000	0.48	162	2.39	61	0.188	62	0.29	-119
		1500	0.45	146	1.70	48	0.251	59	0.35	-126

BFRC96 CHIP TOPOGRAPHY



Nominal Chip Size: 0.014" X 0.016" X 0.005"
Front Metalization: Gold
Back Metalization: Gold
Emitter/Base Bond Pad: 2.8 mil Dia.
#Emitter Fingers: 10
#Base Fingers: 11
Emitter Diffusion: Ion-Implanted Arsenic

3-LEAD PLASTIC MACRO-T

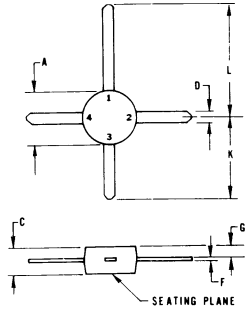


DIM	MILLIMETERS MIN	MAX	INCHES MIN	MAX
A	4.44	5.21	0.175	0.205
C	1.90	2.54	0.075	0.100
D	0.94	0.99	0.033	0.039
F	0.20	0.30	0.008	0.012
G	0.76	1.14	0.030	0.045
K	7.24	8.13	0.285	0.320
L	10.54	11.43	0.415	0.450

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

CASE 317A-01

4 LEAD PLASTIC MACRO-T

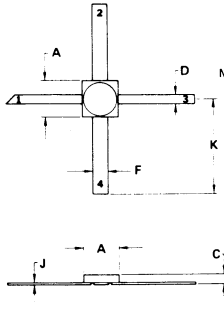


DIM	MILLIMETERS MIN	MAX	INCHES MIN	MAX
A	4.44	5.21	0.175	0.205
C	1.90	2.54	0.075	0.100
D	0.84	0.99	0.033	0.039
F	0.20	0.30	0.008	0.012
G	0.76	1.14	0.030	0.045
K	7.24	8.13	0.285	0.320
L	10.54	11.43	0.415	0.450

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

CASE 317-01

0.100" CERAMIC STRIPLINE



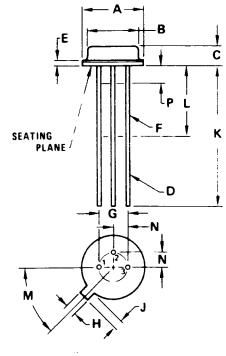
DIM	MILLIMETERS MIN	MAX	INCHES MIN	MAX
A	2.29	2.67	0.090	0.105
C	0.89	1.40	0.035	0.055
D	0.41	0.61	0.016	0.024
F	0.89	1.09	0.035	0.043
J	0.08	0.15	0.003	0.006
K	4.45	5.84	0.175	0.230

NOTE:
1. DIMENSION K APPLIES TO ALL LEADS.

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

CASE 303-01

TO-46



DIM	MILLIMETERS MIN	MAX	INCHES MIN	MAX
A	5.31	5.84	0.209	0.230
B	4.52	4.95	0.178	0.195
C	1.65	2.16	0.065	0.085
D	0.406	0.533	0.016	0.021
E	–	1.02	–	0.040
F	0.305	0.483	0.012	0.019
G	2.54 BSC		0.100 BSC	
H	0.914	1.17	0.036	0.046
J	0.711	1.22	0.028	0.048
K	12.70	–	0.500	–
L	6.35	–	0.250	–
M	45° BSC		45° BSC	
N	1.27 BSC		0.050 BSC	
P	–	1.27	–	0.050

All JEDEC dimensions and notes apply

PIN 1. EMITTER
2. BASE
3. COLLECTOR

CASE 26-03