MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

T-31-15

BFX89
BFY90

The RF Line

2

NPN SILICON HIGH-FREQUENCY TRANSISTORS

. . . designed for VHF and UHF applications where high-gain, low-noise and good intermodulation characteristics are required. Particularly suited for wideband MATV amplifiers.

- High Current-Gain — Bandwidth Product — f_T
  1.2 GHz (Min) @ I_C = 25 mAdc — BFX89
  1.3 GHz (Min) @ I_C = 25 mAdc — BFY90
- Low Noise Figure — NF
  6.5 dB (Max) @ f = 500 MHz — BFX89
  5.0 dB (Max) @ f = 500 MHz — BFY90
- High Power Gain — G_{pe}
  19 dB (Min) @ f = 200 MHz — BFX89
  21 dB (Typ) @ f = 200 MHz — BFY90
- JEDEC Equivalents — 2N6304, 2N6305

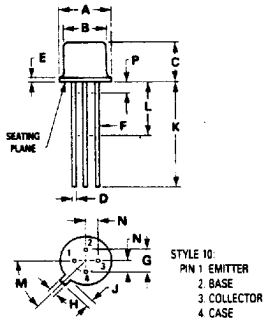
f_T = 2.0 GHz @ 10 mA

HIGH FREQUENCY TRANSISTORS

NPN SILICON

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	V_{CEO}	15	Vdc
Collector-Base Voltage	V_{CBO}	30	Vdc
Emitter-Base Voltage	V_{EBO}	2.5	Vdc
Collector-Current — Continuous	I_C	50	mAdc
Total Continuous Device Dissipation @ T_A = 25°C Derate above 25°C	P_D	200 1.14	mW mW/°C
Storage Temperature Range	T_{stg}	-65 to +200	°C



STYLE 10:
PIN 1. EMITTER
2. BASE
3. COLLECTOR
4. CASE

NOTE: ALL RULES AND NOTES ASSOCIATED WITH TO-72 OUTLINE SHALL APPLY

DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	5.31	5.84	0.209	0.230
B	4.52	4.95	0.178	0.195
C	4.32	5.33	0.170	0.210
D	0.41	0.53	0.016	0.021
E	—	0.76	—	0.030
F	0.41	0.48	0.016	0.019
G	2.54 BSC		0.100 BSC	
H	0.91	1.17	0.036	0.046
J	0.71	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

CASE 20-03
TO-206AF
(TO-72)

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

Characteristic		Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS						
Collector-Emitter Breakdown Voltage (I_C = 10 mAdc, I_B = 0)		$V_{(BR)CEO}$	15	—	—	Vdc
Collector Cutoff Current (V_{CB} = 15 Vdc, I_E = 0)		I_{CBO}	—	—	10	nAdc
ON CHARACTERISTICS						
DC Current Gain		h_{FE}				—
(I_C = 2.0 mAdc, V_{CE} = 1.0 Vdc)			25	—	150	
(I_C = 25 mAdc, V_{CE} = 1.0 Vdc)			20	—	125	
DYNAMIC CHARACTERISTICS						
Collector-Base Capacitance (1)	BFX89	C_{cbo}	—	0.85	1.7	pF
(V_{CB} = 10 Vdc, I_E = 0, f = 1.0 MHz)	BFY90		—	0.85	1.5	
Emitter-Base Capacitance (V_{EB} = 0.5 Vdc, I_C = 0, f = 1.0 MHz)	BFY90	C_{ibo}	—	—	2.0	pF
Current-Gain-Bandwidth Product (2)		f_T				GHz
(I_C = 2.0 mA, V_{CE} = 5.0 Vdc, f = 500 MHz)	BFX89		—	1.0	—	
	BFY90		1.0	—	—	
(I_C = 25 mA, V_{CE} = 5.0 Vdc, f = 500 MHz)	BFX89		1.2	1.7	—	
	BFY90		1.3	—	—	
FUNCTIONAL TEST						
Common-Emitter Amplifier Power Gain (2)	BFX89	G_{pe}	19	—	—	dB
(V_{CE} = 10 Vdc, I_C = 8.0 mA, f = 200 MHz)	BFY90		—	21	—	
Spot Noise Figure (R_S = Optimum) (2)	BFX89	NF	—	2.5	6.5	dB
(V_{CE} = 5.0 Vdc, I_C = 2.0 mA, f = 500 MHz)	BFY90		—	2.5	5.0	

Notes 1. Pin 4 is not grounded.
2. Pin 4 is grounded.
3. $G_U(max)$ is calculated from the S-Parameters using the equation $G_U(max) = \frac{|S_{21}|^2}{(1-|S_{11}|^2)(1-|S_{22}|^2)}$

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FIGURE 1 — POWER GAIN versus FREQUENCY

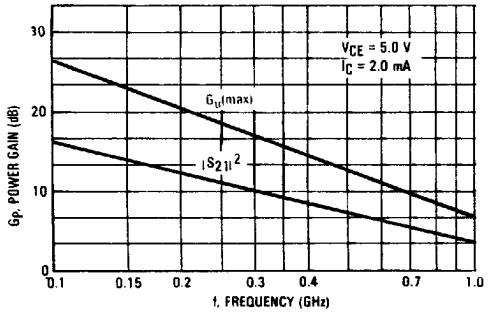

FIGURE 2 — POWER GAIN versus COLLECTOR CURRENT

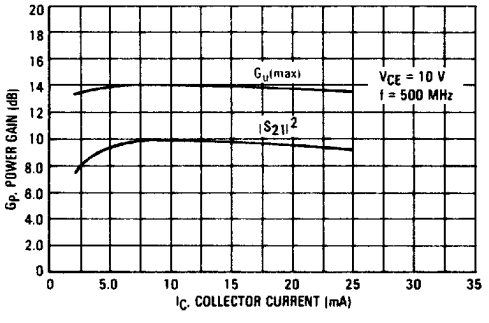

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FIGURE 3 — NOISE FIGURE versus FREQUENCY

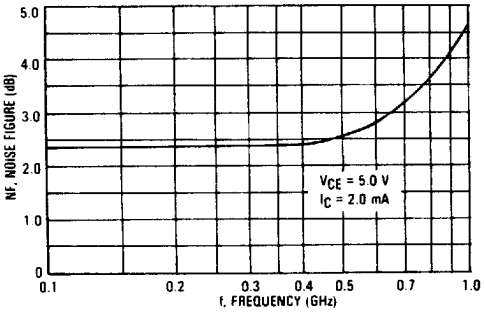


FIGURE 4 — NOISE FIGURE versus COLLECTOR CURRENT

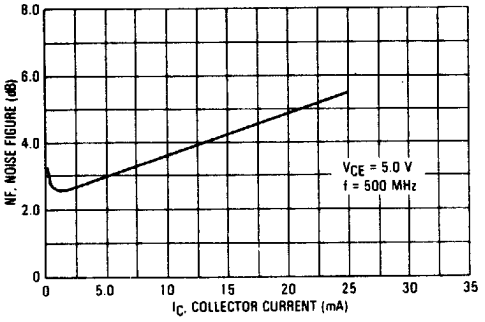


FIGURE 5 — CURRENT GAIN-BANDWIDTH PRODUCT versus COLLECTOR CURRENT

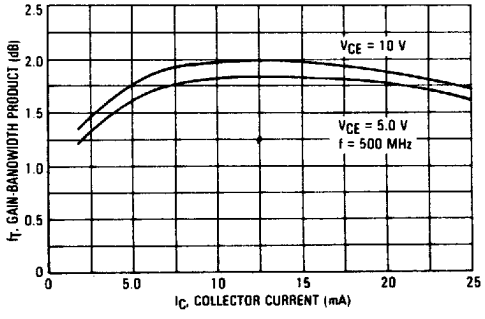
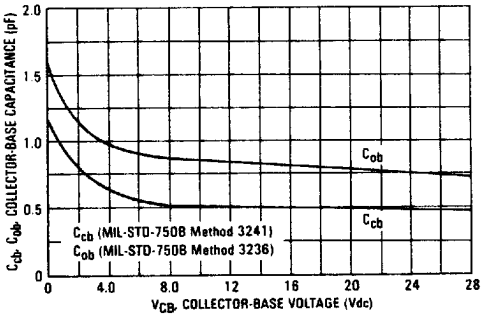
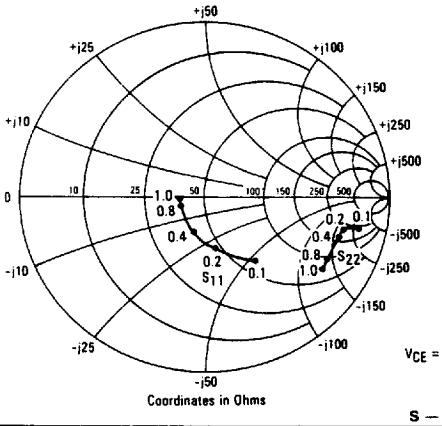


FIGURE 6 — OUTPUT CAPACITANCE versus VOLTAGE



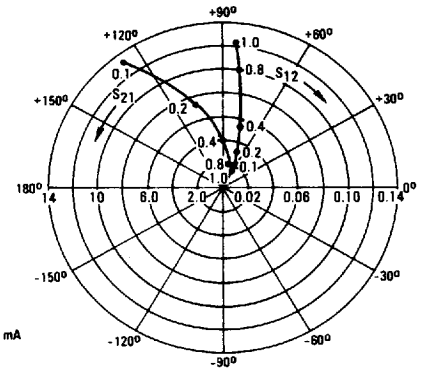
COMMON EMITTER SCATTERING PARAMETERS

FIGURE 7 — INPUT AND OUTPUT REFLECTION COEFFICIENTS versus FREQUENCY



Coordinates in Ohms

FIGURE 8 — FORWARD AND REVERSE TRANSMISSION COEFFICIENTS versus FREQUENCY



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

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S — PARAMETERS

V_{CE} (Volts)	I_C (mA)	Frequency (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	2.0	100	0.81	-37	5.76	148	0.031	72	0.95	-11
		200	0.64	-66	4.56	127	0.050	63	0.87	-17
		400	0.41	-105	2.91	102	0.071	62	0.79	-23
		800	0.26	-157	1.63	77	0.105	74	0.75	-34
		1000	0.23	179	1.38	68	0.129	80	0.74	-41
	5.0	100	0.60	-54	9.73	133	0.026	68	0.87	-13
		200	0.41	-84	6.33	112	0.040	66	0.78	-17
		400	0.26	-121	3.54	92	0.064	72	0.73	-21
		800	0.19	-169	1.89	72	0.112	80	0.72	-31
		1000	0.17	168	1.59	64	0.140	82	0.71	-39
	10	100	0.71	-66	12.13	122	0.022	70	0.81	-14
		200	0.28	-96	7.11	104	0.036	71	0.73	-15
		400	0.19	-133	3.85	88	0.064	77	0.70	-19
		800	0.18	-178	2.00	69	0.115	83	0.71	-30
		1000	0.17	160	1.66	61	0.143	84	0.70	-37
	25	100	0.26	-88	12.79	112	0.019	73	0.76	-13
		200	0.20	-122	7.04	97	0.034	76	0.71	-13
		400	0.20	-156	3.68	83	0.062	81	0.70	-18
		800	0.23	165	1.88	65	0.114	86	0.71	-30
		1000	0.24	146	1.56	58	0.145	88	0.70	-38
10	2.0	100	0.83	-34	5.82	150	0.025	73	0.96	-9
		200	0.66	-61	4.60	129	0.042	65	0.89	-15
		400	0.42	-97	2.98	104	0.059	64	0.83	-20
		800	0.25	-147	1.69	79	0.088	77	0.80	-31
		1000	0.20	-172	1.42	70	0.108	82	0.79	-38
	5.0	100	0.63	-48	9.94	135	0.021	70	0.90	-11
		200	0.43	-76	6.54	114	0.034	68	0.82	-15
		400	0.26	-108	3.72	94	0.054	73	0.77	-19
		800	0.16	-155	1.98	74	0.095	83	0.77	-24
		1000	0.14	180	1.65	66	0.119	85	0.76	-36
	10	100	0.47	-57	12.42	125	0.019	70	0.85	-12
		200	0.30	-83	7.43	106	0.031	72	0.78	-14
		400	0.19	-113	4.04	90	0.054	78	0.75	-18
		800	0.14	-160	2.09	71	0.098	84	0.75	-28
		1000	0.13	173	1.73	64	0.121	86	0.75	-35
	25	100	0.32	-71	13.05	114	0.017	72	0.81	-11
		200	0.21	-99	7.27	99	0.029	76	0.77	-12
		400	0.16	-135	3.81	85	0.052	81	0.76	-16
		800	0.17	177	1.96	68	0.096	87	0.76	-28
		1000	0.18	154	1.62	61	0.120	89	0.76	-35