MRF904

The RF Line

NPN SILICON HIGH-FREQUENCY TRANSISTORS

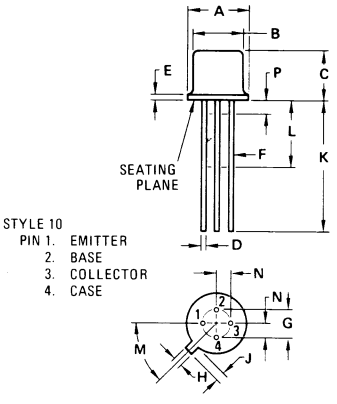
. . . designed for use as low-noise, high-gain, general purpose amplifiers.

- High Current-Gain – Bandwidth Product –
  f_T = 4.0 GHz (Typ) @ I_C = 15 mAdc
- Low Noise Figure –
  NF = 1.5 dB (Typ) @ f = 450 MHz
  = 2.5 dB (Typ) @ f = 1.0 GHz
- High Power Gain –
  G_{max} = 16 dB (Typ) @ f = 450 MHz
  = 10 dB (Typ) @ f = 1.0 GHz
- Excellent Third Order Intercept – +25 dBm (Typ)

HIGH FREQUENCY TRANSISTORS
NPN SILICON

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	V_{CEO}	15	Vdc
Collector-Base Voltage	V_{CBO}	25	Vdc
Emitter-Base Voltage	V_{EBO}	3.0	Vdc
Collector Current – Continuous	I_C	30	mAdc
Total Power Dissipation @ T_A = 25°C Derate above 25°C	P_D	0.2 1.14	Watt mW/°C
Storage Temperature Range	T_{stg}	-65 to +200	°C



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

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	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

ALL JEDEC dimensions and notes apply

CASE 20-03
TO-72

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)	$V_{(BR)CBO}$	25	–	–	Vdc
Emitter-Base Breakdown Voltage (I_E = 0.1 mAdc, I_C = 0)	$V_{(BR)EBO}$	3.0	–	–	Vdc
Collector Cutoff Current (V_{CB} = 15 Vdc, I_E = 0)	I_{CBO}	–	–	50	nAdc
ON CHARACTERISTICS					
DC Current Gain (I_C = 5.0 mAdc, V_{CE} = 5.0 Vdc)	h_{FE}	30	–	200	–
DYNAMIC CHARACTERISTICS					
Current-Gain – Bandwidth Product (I_C = 15 mAdc, V_{CE} = 10 Vdc, f = 1.0 GHz)	f_T	–	4.0	–	GHz
Collector-Base Capacitance (V_{CB} = 10 Vdc, I_E = 0, f = 1.0 MHz)	C_{cb}	–	–	1.0	pF
Noise Figure	NF				dB
(I_C = 5.0 mAdc, V_{CE} = 6.0 Vdc, f = 450 MHz)		–	1.5	–	
(I_C = 5.0 mAdc, V_{CE} = 6.0 Vdc, f = 1.0 GHz)		–	2.5	–	
FUNCTIONAL TEST					
Unilateralized Gain (1)	G_{max}				dB
(I_C = 5.0 mAdc, V_{CE} = 6.0 Vdc, f = 450 MHz)		–	16	–	
(I_C = 5.0 mAdc, V_{CE} = 6.0 Vdc, f = 1.0 GHz)		–	10	–	

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

3

FIGURE 1 – NOISE FIGURE versus FREQUENCY

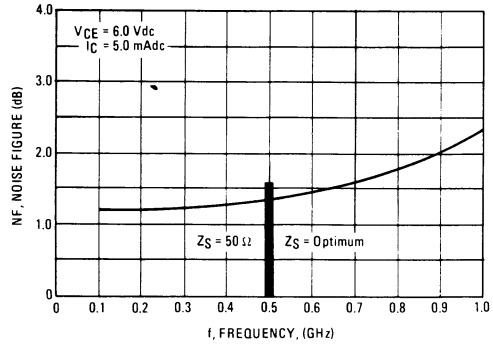


FIGURE 2 – NOISE FIGURE versus COLLECTOR CURRENT

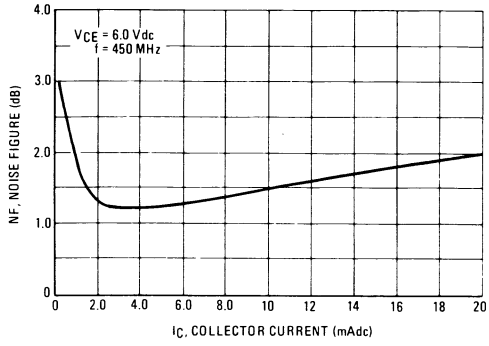


FIGURE 3 – COLLECTOR-BASE CAPACITANCE versus COLLECTOR-BASE VOLTAGE

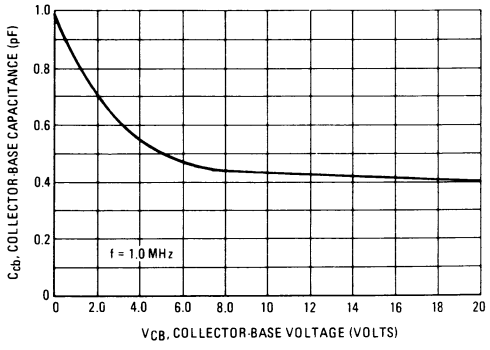


FIGURE 4 – UNILATERALIZED GAIN (G_{max}) versus FREQUENCY

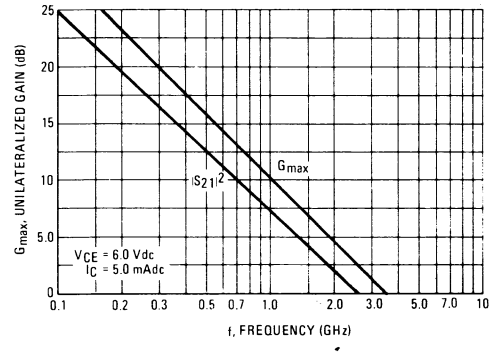


FIGURE 5 – CURRENT-GAIN – BANDWIDTH PRODUCT versus COLLECTOR CURRENT

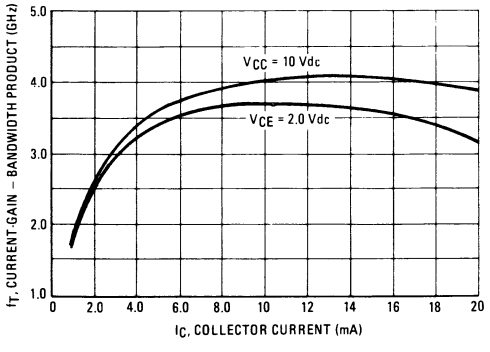


FIGURE 6 – INTERMODULATION DISTORTION versus COLLECTOR CURRENT

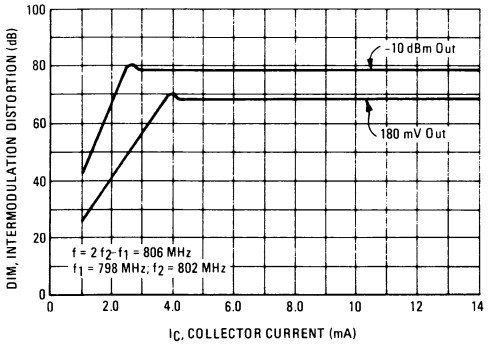


TABLE 1 – S_{11} PARAMETERS

Frequency (MHz)		100		200		500		800		1000	
V_{CC} (Volts)	I_C (mA)	S11	∠ϕ	S11	∠ϕ	S11	∠ϕ	S11	∠ϕ	S11	∠ϕ
1.0	1.0	0.941	-22	0.85	-43	0.57	-91	0.37	-128	0.30	-151
	2.5	0.85	-31	0.67	-57	0.35	-102	0.20	-136	0.14	-157
	5.0	0.69	-44	0.46	-71	0.21	-109	0.10	-144	0.069	-166
	10	0.45	-67	0.28	-94	0.13	-136	0.087	172	0.075	145
	15	0.37	-110	0.31	-145	0.26	170	0.27	139	0.27	122
	30	0.71	-178	0.71	169	0.68	144	0.68	121	0.65	107
3.0	1.0	0.94	-19	0.87	-37	0.61	-80	0.39	-114	0.30	-134
	2.5	0.87	-26	0.71	-47	0.39	-84	0.21	-106	0.15	-115
	5.0	0.74	-34	0.52	-55	0.25	-77	0.13	-82	0.109	-79
	10	0.55	-42	0.35	-58	0.18	-66	0.11	-60	0.105	-55
	15	0.46	-46	0.28	-59	0.15	-64	0.096	-55	0.092	-49
	30	0.28	-95	0.21	-134	0.16	175	0.17	135	0.17	116
6.0	1.0	0.95	-18	0.88	-35	0.63	-76	0.40	-108	0.30	-126
	2.5	0.89	-23	0.74	-43	0.42	-77	0.23	-94	0.17	-100
	5.0	0.77	-31	0.56	-49	0.29	-67	0.18	-69	0.15	-66
	10	0.61	-37	0.40	-50	0.23	-55	0.16	-51	0.16	-50
	15	0.52	-40	0.34	-51	0.20	-52	0.15	-47	0.15	-47
	30	0.36	-55	0.21	-70	0.098	-77	0.037	-59	0.033	-27
10	1.0	0.96	-17	0.89	-33	0.65	-73	0.41	-103	0.31	-121
	2.5	0.89	-22	0.76	-41	0.44	-73	0.25	-88	0.18	-93
	5.0	0.79	-28	0.59	-46	0.32	-63	0.20	-65	0.18	-63
	10	0.64	-34	0.44	-47	0.26	-52	0.19	-49	0.18	-49
	15	0.57	-37	0.38	-48	0.23	-49	0.18	-46	0.17	-46
	30	0.41	-51	0.24	-64	0.12	-67	0.061	-52	0.055	-36

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TABLE 2 – S_{21} PARAMETERS

Frequency (MHz)		100		200		500		800		1000	
V_{CC} (Volts)	I_C (mA)	S21	∠ϕ	S21	∠ϕ	S21	∠ϕ	S21	∠ϕ	S21	∠ϕ
1.0	1.0	5.32	156	3.06	137	2.22	97	1.65	70	1.44	56
	2.5	6.79	146	5.57	124	3.15	86	2.14	64	1.81	52
	5.0	10.97	133	7.60	110	3.62	79	2.38	61	2.00	49
	10	13.16	118	8.07	99	3.60	74	2.35	57	1.96	46
	15	9.84	108	5.66	91	2.44	67	1.63	49	1.38	38
	30	1.65	83	0.88	69	0.47	46	0.43	37	0.45	31
3.0	1.0	3.33	159	3.11	142	2.36	103	1.79	76	1.55	62
	2.5	6.89	150	5.85	129	3.48	92	2.38	70	2.00	58
	5.0	11.49	138	8.34	115	4.12	84	2.70	66	2.25	55
	10	15.71	125	9.82	104	4.39	79	2.85	63	2.34	53
	15	16.97	119	10.05	100	4.39	77	2.83	61	2.34	52
	30	12.66	108	7.02	92	2.98	70	1.94	54	1.61	44
6.0	1.0	3.31	160	3.10	144	2.41	106	1.83	79	1.60	65
	2.5	6.80	151	5.85	131	3.60	94	2.46	77	2.07	60
	5.0	11.44	140	8.54	117	4.28	86	2.83	68	2.33	57
	10	15.85	127	10.14	107	4.61	81	2.96	65	2.46	55
	15	17.20	122	10.47	102	4.60	79	2.96	63	2.45	54
	30	16.37	113	9.38	96	4.00	75	2.58	59	2.14	49
10	1.0	3.25	160	3.08	145	2.40	108	1.83	81	1.61	67
	2.5	6.73	152	5.85	132	3.63	96	2.50	74	2.10	62
	5.0	11.19	142	8.49	119	4.34	88	2.85	69	2.37	59
	10	15.59	129	10.16	108	4.66	82	3.00	66	2.47	56
	15	17.04	124	10.49	104	4.65	80	2.99	64	2.47	55
	30	16.18	115	9.38	98	4.03	96	2.60	60	2.14	50

TABLE 3 – S_{12} PARAMETERS

Frequency (MHz)		100		200		500		800		1000	
V_{CC} (Volts)	I_C (mA)	S12	∠Φ	S12	∠Φ	S12	∠Φ	S12	∠Φ	S12	∠Φ
1.0	1.0	0.054	73	0.097	61	0.159	41	0.184	36	0.194	37
	2.5	0.051	69	0.084	58	0.140	50	0.189	48	0.220	46
	5.0	0.046	65	0.072	60	0.137	58	0.201	53	0.239	50
	10	0.041	64	0.067	64	0.142	62	0.215	56	0.256	51
	15	0.043	61	0.070	63	0.152	62	0.230	55	0.277	50
	30	0.058	50	0.093	58	0.209	57	0.311	46	0.372	39
3.0	1.0	0.039	75	0.072	65	0.123	46	0.143	42	0.151	44
	2.5	0.037	72	0.063	62	0.110	54	0.150	53	0.174	52
	5.0	0.033	70	0.055	64	0.108	62	0.160	58	0.190	55
	10	0.030	70	0.050	68	0.109	67	0.165	61	0.199	57
	15	0.028	70	0.049	70	0.109	68	0.167	62	0.200	57
	30	0.026	68	0.046	70	0.105	69	0.165	64	0.200	61
6.0	1.0	0.032	76	0.060	66	0.106	49	0.123	45	0.131	48
	2.5	0.031	73	0.054	64	0.095	57	0.130	56	0.151	55
	5.0	0.028	71	0.048	66	0.094	64	0.139	61	0.165	58
	10	0.026	71	0.043	69	0.094	68	0.144	63	0.172	59
	15	0.024	71	0.042	71	0.093	69	0.144	64	0.172	60
	30	0.021	71	0.037	72	0.086	71	0.134	67	0.162	63
10	1.0	0.028	77	0.053	68	0.095	50	0.109	47	0.116	50
	2.5	0.027	74	0.048	65	0.085	58	0.116	57	0.134	57
	5.0	0.025	73	0.043	67	0.084	64	0.125	62	0.148	60
	10	0.023	72	0.037	69	0.084	69	0.128	64	0.153	61
	15	0.022	73	0.037	70	0.084	69	0.128	65	0.152	62
	30	0.019	72	0.033	72	0.076	72	0.119	68	0.143	66

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TABLE 4 – S_{22} PARAMETERS

Frequency (MHz)		100		200		500		800		1000	
V_{CC} (Volts)	I_C (mA)	S22	∠Φ	S22	∠Φ	S22	∠Φ	S22	∠Φ	S22	∠Φ
1.0	1.0	0.966	-12	0.893	-23	0.693	-41	0.612	-53	0.594	-59
	2.5	0.901	-18	0.760	-29	0.548	-42	0.498	-51	0.494	-56
	5.0	0.793	-24	0.619	-32	0.456	-39	0.429	-49	0.439	-54
	10	0.635	-29	0.486	-32	0.390	-36	0.377	-47	0.389	-53
	15	0.453	-29	0.364	-29	0.313	-34	0.309	-48	0.321	-14
	30	0.048	-78	0.035	-88	0.032	-135	0.031	-162	0.007	-167
3.0	1.0	0.976	-9.0	0.926	-18	0.770	-35	0.702	-46	0.683	-51
	2.5	0.935	-13	0.828	-23	0.648	-35	0.608	-43	0.608	-48
	5.0	0.853	-18	0.712	-25	0.577	-32	0.555	-41	0.565	-46
	10	0.758	-20	0.629	-23	0.539	-29	0.529	-39	0.544	-44
	15	0.711	-20	0.601	-22	0.533	-27	0.526	-38	0.540	-44
	30	0.631	-15	0.576	-16	0.548	-25	0.546	-38	0.558	-45
6.0	1.0	0.982	-8.0	0.939	-16	0.803	-31	0.742	42	0.734	-47
	2.5	0.947	-11	0.861	-20	0.699	-31	0.662	-40	0.660	-45
	5.0	0.882	-15	0.759	-21	0.633	-29	0.617	-31	0.627	-43
	10	0.801	-17	0.684	-20	0.607	-26	0.601	-35	0.610	-41
	15	0.769	-17	0.667	-19	0.602	-25	0.601	-35	0.607	-40
	30	0.737	-14	0.672	-15	0.640	-22	0.641	-33	0.655	-40
10	1.0	0.983	-7.0	0.949	-14	0.830	-29	0.774	-39	0.765	-40
	2.5	0.954	-10	0.880	-18	0.733	-29	0.698	-37	0.702	-42
	5.0	0.901	-13	0.793	-19	0.676	-27	0.659	-35	0.668	-41
	10	0.834	-15	0.725	-18	0.646	-24	0.646	-33	0.658	-39
	15	0.802	-15	0.706	-17	0.645	-23	0.648	-33	0.661	-39
	30	0.776	-13	0.712	-14	0.678	-22	0.686	-32	0.699	-38

MRF905

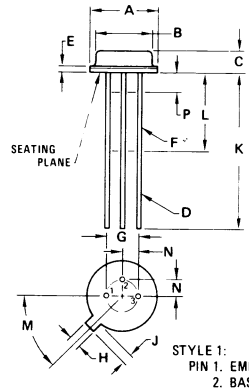
The RF Line

400 mW
RF OSCILLATOR TRANSISTOR
NPN SILICON

NPN SILICON OSCILLATOR TRANSISTOR

. . . designed for microwave communications relay links and low-cost radiosonde service.

- Emitter Ballasted
- Low Current Density for Improved Lifetime
- Collector Connected to Case



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

DIM	MILLIMETERS		INCHES	
	MIN	MAX	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

CASE 26-03
TO-46

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	V_{CEO}	20	Vdc
Collector-Base Voltage	V_{CBO}	35	Vdc
Emitter-Base Voltage	V_{EBO}	3.5	Vdc
Collector Current — Continuous	I_C	150	mAdc
Total Power Dissipation @ T_C = 100°C Derate above 100°C	P_D	.75 7.5	Watts mW/°C
Storage Temperature Range	T_{stg}	-65 to +200	°C

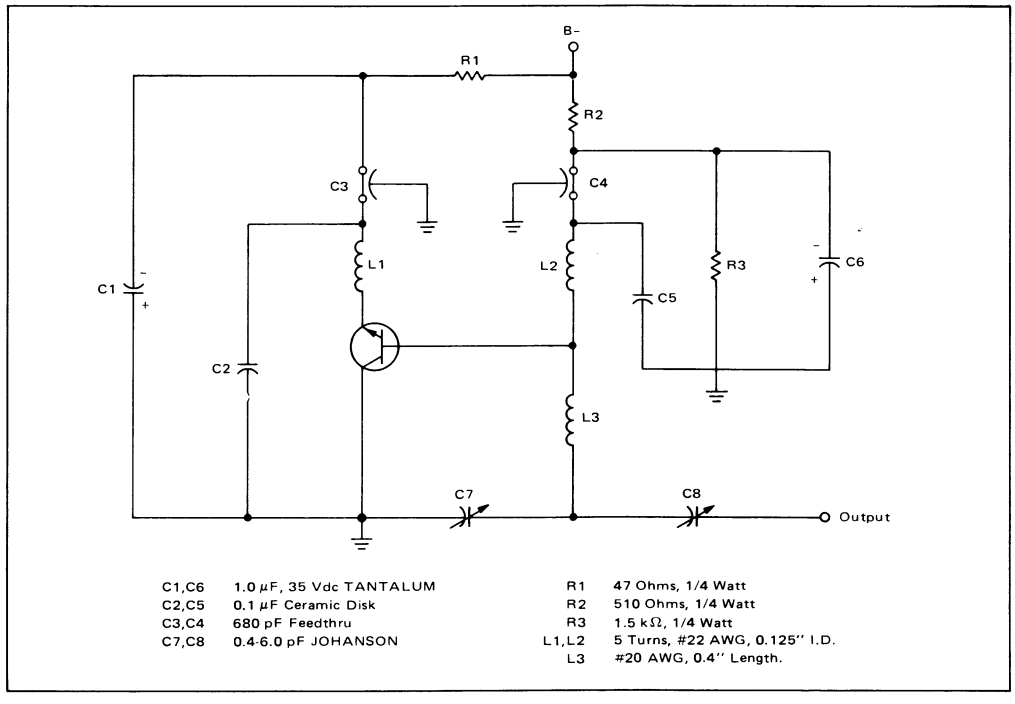
THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	133	°C/W

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

Characteristic	Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage (I_C = 10 mAdc, I_B = 0)	$V_{(BR)CEO}$	20	30	–	Vdc
Collector-Base Breakdown Voltage (I_C = 0.1 mAdc, I_E = 0)	$V_{(BR)CBO}$	35	–	–	Vdc
Emitter-Base Breakdown Voltage (I_E = 0.1 mAdc, I_C = 0)	$V_{(BR)EBO}$	3.5	5.0	–	Vdc
Collector Cutoff Current (V_{CB} = 20 Vdc, I_E = 0)	I_{CBO}	–	–	0.1	mAdc
ON CHARACTERISTICS					
DC Current Gain (I_C = 100 mAdc, V_{CE} = 10 Vdc)	h_{FE}	20	60	150	–
DYNAMIC CHARACTERISTICS					
Current-Gain – Bandwidth Product (I_C = 100 mAdc, V_{CE} = 10 Vdc, f = 200 MHz)	f_T	–	2500	–	MHz
Output Capacitance (V_{CB} = 20 Vdc, I_E = 0, f = 1.0 MHz)	C_{ob}	–	3.0	5.0	pF
FUNCTIONAL TEST					
Common-Collector Oscillator Output Power (V_E = -20 Vdc, $I_E \cong$ 110 mAdc, f ≅ 1.68 GHz)	P_{out}	400	500	–	mW

FIGURE 1 – 1.68 GHz OSCILLATOR TEST CIRCUIT SCHEMATIC



C1,C6	1.0 μF, 35 Vdc TANTALUM	R1	47 Ohms, 1/4 Watt
C2,C5	0.1 μF Ceramic Disk	R2	510 Ohms, 1/4 Watt
C3,C4	680 pF Feedthru	R3	1.5 kΩ, 1/4 Watt
C7,C8	0.4-6.0 pF JOHANSON	L1,L2	5 Turns, #22 AWG, 0.125" I.D.
		L3	#20 AWG, 0.4" Length.

MRF911

The RF Line

NPN SILICON HIGH FREQUENCY TRANSISTOR

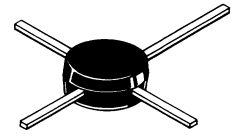
. . . designed primarily for use in high-gain, low-noise tuned and wideband small-signal amplifiers. Excellent in high-speed switching applications.

- High Current-Gain – Bandwidth Product –
  f_T = 5.0 GHz (Typ) @ f = 1.0 GHz
- High Power Gain –
  G_{max} = 12.5 dB (Typ) @ f = 1.0 GHz

f_T = 5.0 GHz @ 30 mA

HIGH FREQUENCY TRANSISTOR

NPN SILICON



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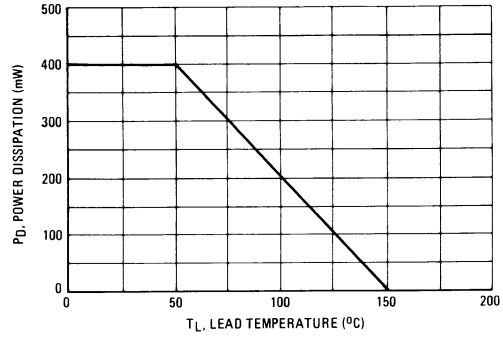
MAXIMUM RATINGS

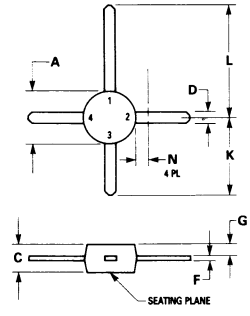
Rating	Symbol	Value	Unit
Collector-Emitter Voltage	V_{CEO}	12	Vdc
Collector-Base Voltage	V_{CBO}	20	Vdc
Emitter-Base Voltage	V_{EBO}	3.0	Vdc
Collector Current – Peak	I_C	40	mAdc
Total Device Dissipation @ T_L = 50°C Derate Above 50°C	P_D	400 4.0	mW mW/°C
Storage Temperature Range	T_{stg}	-65 to +150	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Lead	$R_{\theta JL}$	250	°C/W

FIGURE 1 – POWER DERATING





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

NOTE:
DIMENSION D NOT APPLICABLE IN ZONE N.

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	0.84	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
N	—	1.65	—	0.065

CASE 317-01

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)	$V_{(BR)CBO}$	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} = 15 Vdc, I_E = 0)	I_{CBO}	–	–	50	nAdc
ON CHARACTERISTICS					
DC Current Gain (I_C = 30 mAdc, V_{CE} = 10 Vdc)	h_{FE}	30	–	200	–
DYNAMIC CHARACTERISTICS					
Current-Gain Bandwidth Product (I_C = 30 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}	–	0.6	1.0	pF
FUNCTIONAL TESTS					
Noise Figure	NF				dB
(I_C = 5.0 mAdc, V_{CE} = 10 Vdc, f = 1.0 GHz)		–	2.5	–	
(I_C = 5.0 mAdc, V_{CE} = 10 Vdc, f = 2.0 GHz)		–	4.0	–	
Power Gain at Optimum Noise Figure	G_{NF}				dB
(I_C = 5.0 mAdc, V_{CE} = 10 Vdc, f = 1.0 GHz)		–	10	–	
(I_C = 5.0 mAdc, V_{CE} = 10 Vdc, f = 2.0 GHz)		–	6.0	–	
Maximum Available Power Gain (1)	G_{max}				dB
(I_C = 30 mAdc, V_{CE} = 10 Vdc, f = 1.0 GHz)		–	12.5	–	
(I_C = 30 mAdc, V_{CE} = 10 Vdc, f = 2.0 GHz)		–	7.5	–	

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

3

FIGURE 2 – POWER GAIN AND NOISE FIGURE versus FREQUENCY

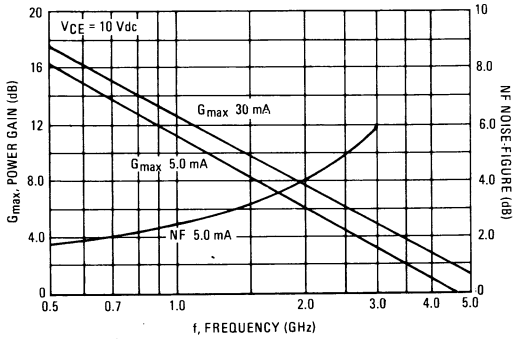


FIGURE 3 – POWER GAIN AND NOISE FIGURE versus COLLECTOR CURRENT

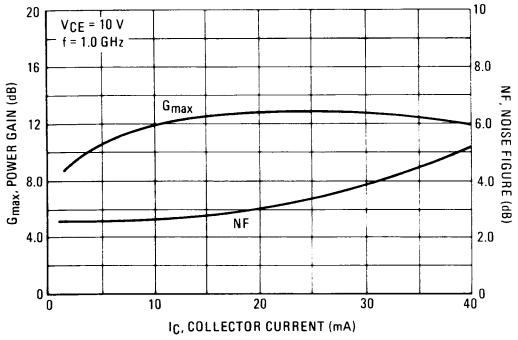


FIGURE 4 – S_{11} PARAMETERS

Frequency (MHz)		500		1000		1500		2000	
V_{CE} (Volts)	I_C (mA)	S_{11}	∠Φ	S_{11}	∠Φ	S_{11}	∠Φ	S_{11}	∠Φ
5.0	2.0	0.66	-125	0.64	-175	0.68	160	0.73	140
	5.0	0.57	-150	0.58	170	0.62	150	0.66	135
	10	0.54	-165	0.57	160	0.60	145	0.64	130
	20	0.54	-180	0.57	155	0.60	140	0.64	125
	30	0.54	175	0.57	155	0.61	140	0.65	125
10	2.0	0.66	-120	0.63	-170	0.67	160	0.71	140
	5.0	0.56	-145	0.56	175	0.60	150	0.64	135
	10	0.51	-160	0.53	165	0.57	145	0.61	130
	20	0.49	-175	0.52	160	0.57	145	0.60	130
	30	0.49	-175	0.53	160	0.57	145	0.61	130

FIGURE 5 – S_{22} PARAMETERS

Frequency (MHz)		500		1000		1500		2000	
V_{CE} (Volts)	I_C (mA)	S_{22}	∠Φ	S_{22}	∠Φ	S_{22}	∠Φ	S_{22}	∠Φ
5.0	2.0	0.61	-45	0.50	-60	0.48	-80	0.50	-100
	5.0	0.40	-55	0.31	-65	0.30	-85	0.32	-100
	10	0.27	-60	0.20	-70	0.20	-90	0.23	-105
	20	0.19	-70	0.13	-75	0.14	-95	0.17	-110
	30	0.16	-70	0.11	-75	0.13	-95	0.16	-110
10	2.0	0.66	-35	0.55	-50	0.53	-70	0.54	-90
	5.0	0.47	-45	0.38	-50	0.37	-70	0.38	-75
	10	0.35	-45	0.28	-50	0.27	-65	0.29	-85
	20	0.26	-45	0.22	-50	0.22	-65	0.24	-80
	30	0.25	-40	0.21	-45	0.22	-60	0.24	-80

FIGURE 6 – S_{21} PARAMETERS

Frequency (MHz)		500		1000		1500		2000	
V_{CE} (Volts)	I_C (mA)	S_{21}	∠Φ	S_{21}	∠Φ	S_{21}	∠Φ	S_{21}	∠Φ
5.0	2.0	3.24	100	1.84	70	1.23	50	0.96	35
	5.0	4.85	90	2.60	70	1.76	50	1.38	40
	10	5.78	85	3.04	70	2.05	50	1.61	40
	20	6.40	85	3.30	65	2.23	50	1.24	40
	30	6.47	80	3.35	65	2.26	50	1.76	40
10	2.0	3.42	100	1.95	70	1.31	50	1.01	35
	5.0	5.20	95	2.80	70	1.89	50	1.45	40
	10	6.22	90	3.28	70	2.20	55	1.71	40
	20	6.82	85	3.55	65	2.37	55	1.84	40
	30	6.90	85	3.55	65	2.36	50	1.81	40

FIGURE 7 – S_{12} PARAMETERS

Frequency (MHz)		500		1000		1500		2000	
V_{CE} (Volts)	I_C (mA)	S_{12}	∠Φ	S_{12}	∠Φ	S_{12}	∠Φ	S_{12}	∠Φ
5.0	2.0	0.11	30	0.12	25	0.11	35	0.13	50
	5.0	0.08	40	0.10	45	0.13	55	0.17	55
	10	0.07	50	0.10	55	0.14	60	0.19	60
	20	0.06	60	0.11	65	0.15	65	0.20	60
	30	0.06	65	0.11	65	0.15	65	0.20	60
10	2.0	0.10	35	0.10	30	0.10	40	0.12	55
	5.0	0.07	40	0.09	45	0.12	55	0.15	60
	10	0.06	50	0.09	55	0.13	60	0.17	60
	20	0.06	60	0.10	65	0.13	65	0.18	60
	30	0.06	60	0.10	65	0.14	65	0.18	65

MRF914

The RF Line

f_T = 4.5 GHz @ 20 mA

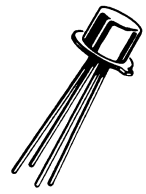
HIGH FREQUENCY TRANSISTOR

NPN SILICON

NPN SILICON HIGH FREQUENCY TRANSISTOR

. . . designed for applications requiring high-gain, low-noise and low distortion. Also excellent for high speed switching applications.

- Low Noise Figure –
  NF = 2.0 dB (Typ) @ f = 0.5 GHz
  = 2.5 dB (Typ) @ f = 1.0 GHz
- High Power Gain –
  G_{max} = 15 dB (Typ) @ f = 0.5 GHz
  = 10 dB (Typ) @ f = 1.0 GHz



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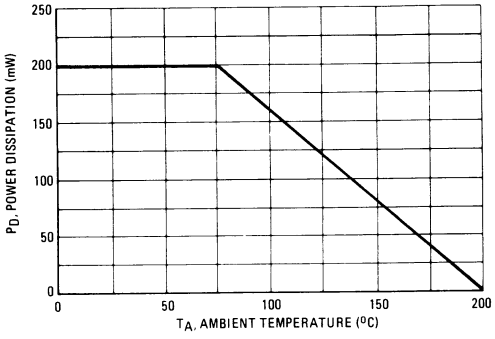
MAXIMUM RATINGS

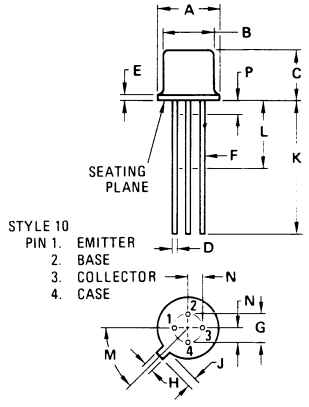
Rating	Symbol	Value	Unit
Collector-Emitter Voltage	V_{CEO}	12	Vdc
Collector-Base Voltage	V_{CBO}	20	Vdc
Emitter-Base Voltage	V_{EBO}	3.0	Vdc
Collector Current – Peak	I_C	40	mAdc
Total Device Dissipation @ T_A = 75°C Derate Above 75°C	P_D	200 1.6	mW mW/°C
Storage Temperature Range	T_{stg}	-65 to +200	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	625	°C/W

FIGURE 1 – POWER DERATING





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

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

ALL JEDEC dimensions and notes apply
CASE 20-03
TO-72

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)	$V_{(BR)CBO}$	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} = 15 Vdc, I_E = 0)	I_{CBO}	–	–	50	nAdc
ON CHARACTERISTICS					
DC Current Gain (I_C = 20 mAdc, V_{CE} = 10 Vdc)	h_{FE}	30	–	200	–
DYNAMIC CHARACTERISTICS					
Current-Gain Bandwidth Product (I_C = 20 mAdc, V_{CE} = 10 Vdc, f = 0.5 GHz)	f_T	–	4.5	–	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 = 5.0 mAdc, V_{CE} = 10 Vdc, f = 0.5 GHz)		–	2.0	–	
(I_C = 5.0 mAdc, V_{CE} = 10 Vdc, f = 1.0 GHz)		–	2.5	–	
Power Gain at Optimum Noise Figure	G_{NF}				dB
(I_C = 5.0 mAdc, V_{CE} = 10 Vdc, f = 0.5 GHz)		–	12	–	
(I_C = 5.0 mAdc, V_{CE} = 10 Vdc, f = 1.0 GHz)		–	7.0	–	
Maximum Available Power Gain (1)	G_{max}				dB
(I_C = 20 mAdc, V_{CE} = 10 Vdc, f = 0.5 GHz)		–	15	–	
(I_C = 20 mAdc, V_{CE} = 10 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

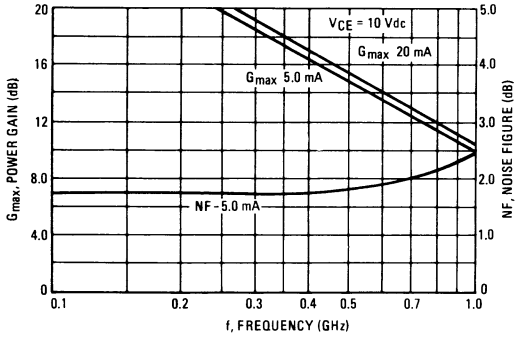


FIGURE 3 – POWER GAIN AND NOISE FIGURE versus COLLECTOR CURRENT

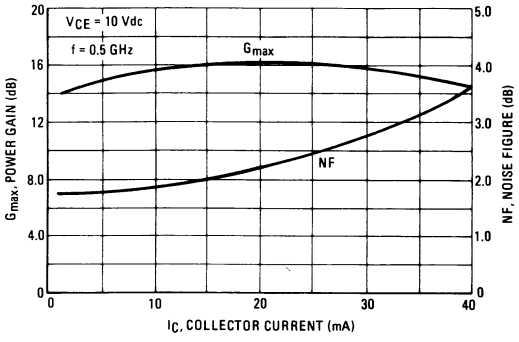


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FIGURE 4 – S_{11} PARAMETERS

Frequency (MHz)		100		300		500		700		1000	
V_{CE} (Volts)	I_C (mA)	S11	∠φ	S11	∠φ	S11	∠φ	S11	∠φ	S11	∠φ
5.0	2.0	0.84	-35	0.57	-80	0.42	-115	0.34	-140	0.27	-166
	5.0	0.65	-45	0.34	-85	0.23	-115	0.18	-130	0.16	-150
	10	0.48	-50	0.32	-85	0.14	-105	0.12	-115	0.09	-120
	20	0.33	-50	0.15	-75	0.10	-90	0.09	-100	0.09	-101
	30	0.27	-50	0.13	-70	0.09	-85	0.09	-100	0.09	-101
10	2.0	0.86	-30	0.59	-75	0.42	-105	0.34	-130	0.25	-155
	5.0	0.70	-40	0.37	-75	0.24	-95	0.18	-110	0.13	-125
	10	0.55	-45	0.26	-70	0.17	-80	0.14	-90	0.13	-90
	20	0.41	-45	0.21	-60	0.15	-65	0.13	-75	0.14	-80
	30	0.36	-45	0.19	-55	0.14	-65	0.13	-75	0.13	-80

FIGURE 5 – S_{22} PARAMETERS

Frequency (MHz)		100		300		500		700		1000	
V_{CE} (Volts)	I_C (mA)	S22	∠φ	S22	∠φ	S22	∠φ	S22	∠φ	S22	∠φ
5.0	2.0	0.94	-15	0.77	-25	0.68	-30	0.66	-35	0.64	-45
	5.0	0.85	-20	0.63	-30	0.57	-30	0.55	-35	0.55	-45
	10	0.75	-25	0.55	-25	0.51	-30	0.50	-35	0.50	-40
	20	0.66	-25	0.50	-25	0.47	-30	0.47	-35	0.48	-40
	30	0.62	-25	0.49	-25	0.46	-25	0.46	-30	0.47	-40
10	2.0	0.95	-10	0.81	-20	0.74	-30	0.72	-35	0.71	-40
	5.0	0.87	-15	0.69	-25	0.64	-25	0.63	-30	0.63	-40
	10	0.80	-20	0.63	-20	0.59	-25	0.59	-30	0.60	-40
	20	0.72	-20	0.59	-20	0.57	-23	0.57	-30	0.58	-35
	30	0.70	-20	0.59	-20	0.57	-20	0.57	-30	0.58	-35

FIGURE 6 – S_{21} PARAMETERS

Frequency (MHz)		100		300		500		700		1000	
V_{CE} (Volts)	I_C mA	S21	∠φ	S21	∠φ	S21	∠φ	S21	∠φ	S21	∠φ
5.0	2.0	5.99	150	4.06	110	2.90	90	2.27	75	1.71	55
	5.0	11.38	135	5.91	100	3.90	80	2.93	70	2.17	55
	10	15.21	125	6.78	95	4.34	80	3.23	70	2.38	55
	20	17.98	115	7.27	90	4.58	75	3.40	65	2.50	50
	30	18.78	110	7.37	85	4.64	75	3.42	65	2.50	50
10	2.0	6.05	150	4.20	115	3.04	90	2.37	75	1.75	55
	5.0	11.46	135	6.17	100	4.06	85	3.08	70	2.26	55
	10	15.45	127	7.08	95	4.56	80	3.41	70	2.50	55
	20	18.35	120	7.57	90	4.80	75	3.58	65	2.61	55
	30	19.12	115	7.63	90	4.79	75	3.56	65	2.60	55

FIGURE 7 – S_{12} PARAMETERS

Frequency (MHz)		100		300		500		700		1000	
V_{CE} (Volts)	I_C (mA)	S12	∠φ	S12	∠φ	S12	∠φ	S12	∠φ	S12	∠φ
5.0	2.0	0.04	70	0.09	50	0.11	50	0.12	50	0.16	50
	5.0	0.04	70	0.07	60	0.11	60	0.14	60	0.19	55
	10	0.03	70	0.07	70	0.11	65	0.15	65	0.20	55
	20	0.03	75	0.07	70	0.12	70	0.15	65	0.21	55
	30	0.03	75	0.07	70	0.12	70	0.16	65	0.21	57
10	2.0	0.03	70	0.07	55	0.09	50	0.10	50	0.13	55
	5.0	0.03	70	0.06	60	0.09	65	0.12	60	0.15	60
	10	0.03	70	0.06	65	0.09	65	0.12	65	0.17	60
	20	0.03	75	0.06	70	0.09	70	0.13	65	0.18	60
	30	0.03	75	0.06	70	0.10	70	0.13	65	0.17	60

MRF931

The RF Line

NPN SILICON HIGH-FREQUENCY TRANSISTOR

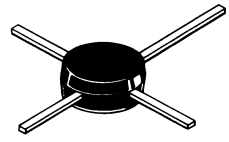
. . . designed primarily for use in low-power amplifiers to 1.0 GHz. Ideal for pagers and other battery operated systems where low-power consumption is critical.

- Low-Power Consumption Characterized for I_E = 0.1 to 1.0 mA
- High Current-Gain – Bandwidth Product – f_T = 3.0 GHz (Typ)
- Stripline Design for Optimum Performance

LOW CURRENT

HIGH FREQUENCY TRANSISTOR

NPN SILICON



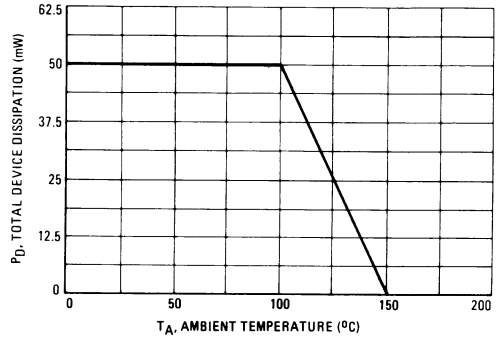
MAXIMUM RATINGS

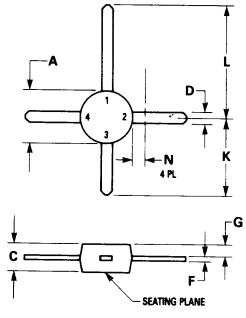
Rating	Symbol	Value	Unit
Collector-Emitter Voltage	V_{CEO}	5.0	Vdc
Collector-Base Voltage	V_{CBO}	10	Vdc
Emitter-Base Voltage	V_{EBO}	2.0	Vdc
Collector Current – Peak	I_C	5.0	mAdc
Total Device Dissipation @ T_A = 100°C Derate Above 100°C	P_D	50 1.0	mW mW/°C
Junction Temperature	T_J	+150	°C
Storage Temperature 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
4. EMITTER

NOTE:
DIMENSION D NOT APPLICABLE IN ZONE N.

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	0.84	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
N	—	1.65	—	0.065

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

Characteristic	Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage (I_C = 0.1 mAdc, I_B = 0)	$V_{(BR)CEO}$	5.0	–	–	Vdc
Collector-Base Breakdown Voltage (I_C = 0.01 mAdc, I_E = 0)	$V_{(BR)CBO}$	10	–	–	Vdc
Emitter-Base Breakdown Voltage (I_E = 0.1 mAdc, I_C = 0)	$V_{(BR)EBO}$	2.0	–	–	Vdc
Collector Cutoff Current (V_{CB} = 5.0 Vdc, I_E = 0)	I_{CBO}	–	–	50	nAdc
ON CHARACTERISTICS					
DC Current Gain (I_C = 0.25 mAdc, V_{CE} = 1.0 Vdc)	h_{FE}	30	–	150	–
DYNAMIC CHARACTERISTICS					
Current-Gain Bandwidth Product (I_E = 1.0 mAdc, V_{CE} = 1.0 Vdc, f = 1.0 GHz)	f_T	–	3.0	–	GHz
Collector-Base Capacitance (V_{CB} = 1.0 Vdc, I_E = 0, f = 1.0 MHz)	C_{cb}	–	0.35	0.5	pF
FUNCTIONAL TESTS					
Noise Figure	NF				dB
(I_E = 0.25 mAdc, V_{CE} = 1.0 Vdc, f = 0.5 GHz)		–	3.8	–	
(I_E = 0.25 mAdc, V_{CE} = 1.0 Vdc, f = 1.0 GHz)		–	4.3	–	
Power Gain at Optimum Noise Figure	G_{NF}				dB
(I_E = 0.25 mAdc, V_{CE} = 1.0 Vdc, f = 0.5 GHz)		–	16	–	
(I_E = 0.25 mAdc, V_{CE} = 1.0 Vdc, f = 1.0 GHz)		–	10	–	
Transducer Power Gain	G_T				dB
(I_E = 0.5 mAdc, V_{CE} = 1.0 Vdc, f = 0.5 GHz)		–	18	–	
(I_E = 0.5 mAdc, V_{CE} = 1.0 Vdc, f = 1.0 GHz)		–	12	–	

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FIGURE 2 – TRANSDUCER POWER GAIN AND NOISE FIGURE versus FREQUENCY

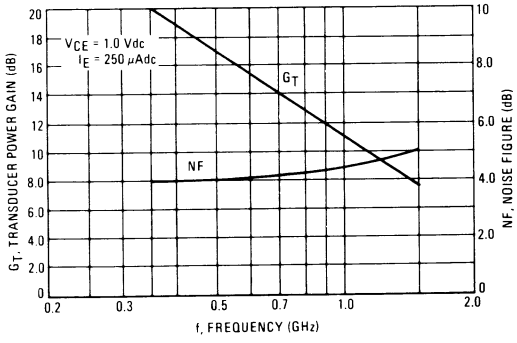

FIGURE 3 – TRANSDUCER POWER GAIN AND NOISE FIGURE versus EMITTER CURRENT