MD4957

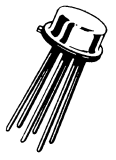
DUAL PNP SILICON ANNULAR 450-MHz AMPLIFIER

. . . designed for high-gain, low-noise amplifier, oscillator, and mixer applications.

- Low Noise Figure — NF = 3.0 dB (typ) @ 450 MHz
  6.0 dB (Typ) @ 1.0 GHz
- High Power Gain — Gpe = 18 dB (Typ) @ 450 MHz
  13 dB (Typ) @ 1.0 GHz
- High Gain-Bandwidth Product — fT = 1500 MHz (Typ)
- Low Collector-Base Capacitance — C_{cb} = 0.8 pF (Typ)

MULTIPLE DEVICES

DUAL PNP SILICON AMPLIFIER



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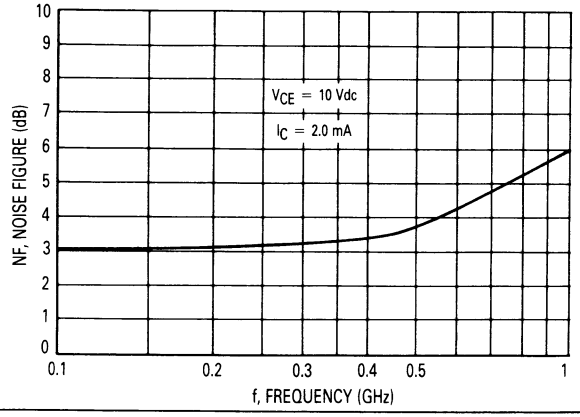
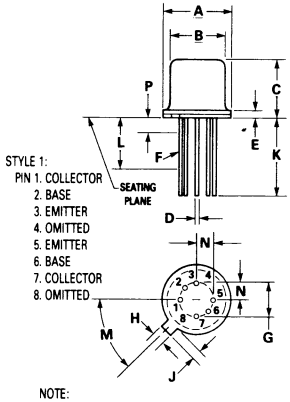
MAXIMUM RATINGS (each side)

Rating	Symbol	Value		Unit
Collector-Emitter Voltage	V_{CEO}	30		Vdc
Collector-Base Voltage	V_{CB}	30		Vdc
Emitter-Base Voltage	V_{EB}	3.0		Vdc
Collector Current	I_C	30		mAdc
Operating and Storage Junction Temperature Range	T_J, T_{stg}	-65 to +200		°C
		One Side	Both Sides	
Total Device Dissipation @ T_A = 25°C	P_D	200	400	mW
Derate above 25°C		1.15	2.3	mW/°C

FIGURE 1 — NOISE FIGURE (TYPICAL) VS FREQUENCY





NOTE:
1. ALL RULES & NOTES ASSOCIATED WITH REFERENCED TO-78 (654-02) OUTLINE SHALL APPLY.

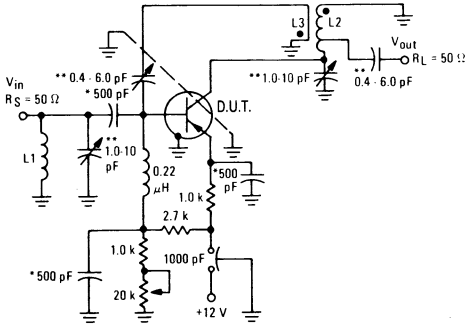
DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	8.51	9.40	0.335	0.370
B	7.75	8.51	0.305	0.335
C	4.19	4.70	0.165	0.185
D	0.41	0.53	0.016	0.021
E	—	1.02	—	0.040
F	0.41	0.48	0.016	0.019
G	5.08 BSC		0.200 BSC	
H	0.71	0.86	0.028	0.034
J	0.74	1.14	0.029	0.045
K	12.70	—	0.500	—
L	6.35	—	0.250	—
M	45° BSC		45° BSC	
N	2.54 BSC		0.100 BSC	
P	—	1.27	—	0.050

CASE 654-02

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)	$V_{(BR)CEO}$	30	-	-	Vdc
Collector-Base Breakdown Voltage (I_C = 100 μAdc, I_E = 0)	$V_{(BR)CBO}$	30	-	-	Vdc
Emitter-Base Breakdown Voltage (I_E = 100 μAdc, I_C = 0)	$V_{(BR)EBO}$	3.0	-	-	Vdc
Collector Cutoff Current (V_{CB} = 20 Vdc, I_E = 0)	I_{CBO}	-	-	0.1	μAdc
ON CHARACTERISTICS					
DC Current Gain (I_C = 2.0 mAdc, V_{CE} = 10 Vdc)	h_{FE}	20	-	150	-
DYNAMIC CHARACTERISTICS					
Current-Gain—Bandwidth Product (I_C = 2.0 mAdc, V_{CE} = 10 Vdc, f = 100 MHz)	f_T	1000	1500	-	MHz
Collector-Base Capacitance (V_{CB} = 10 Vdc, I_E = 0, f = 100 kHz)	C_{cb}	-	0.8	1.5	pF
Small-Signal Current Gain (I_C = 2.0 mAdc, V_{CE} = 10 Vdc, f = 1.0 kHz)	h_{fe}	20	-	200	-
Collector-Base Time Constant (I_E = 2.0 mAdc, V_{CB} = 10 Vdc, f = 63.6 MHz)	$r_b'C_c$	-	10	20	ps
Noise Figure (I_C = 2.0 mAdc, V_{CE} = 10 Vdc, f = 450 MHz) Figure 2	NF	-	3.0	-	dB
(I_C = 2.0 mAdc, V_{CE} = 10 Vdc, R_S = 50 ohms, f = 1.0 GHz)		-	6.0	-	
FUNCTIONAL TESTS					
Common-Emitter Amplifier Power Gain (V_{CE} = 10 Vdc, I_C = 2.0 mAdc, f = 450 MHz)	G_{pe}	-	18	-	dB
(V_{CE} = 10 Vdc, I_C = 2.0 mAdc, R_S = 50 ohms, f = 1.0 GHz)		-	13	-	

FIGURE 2 — NOISE FIGURE AND POWER GAIN TEST CIRCUIT



*Button type capacitors
**Variable air piston type capacitors
1. L1 — silver plated brass bar, 1.0 in. lg by 0.25 in od.
2. L2 — silver plated brass bar, 1.5 in. lg by 0.25 in od. Tap is 0.25 in. from collector
3. L3 — ½ turn of AWG No. 16 wire 0.25 in. from and parallel to L2.
4. The noise source is a hot-cold body (All type 70 or equivalent) with a test receiver (All type 136 or equivalent).
5. Each half of dual transistor tested separately.

COMMON EMITTER Y PARAMETER VARIATIONS

Y PARAMETERS VS FREQUENCY

V_{CE} = 10 Vdc

I_C = 2.0 mA

FIGURE 3 — INPUT ADMITTANCE

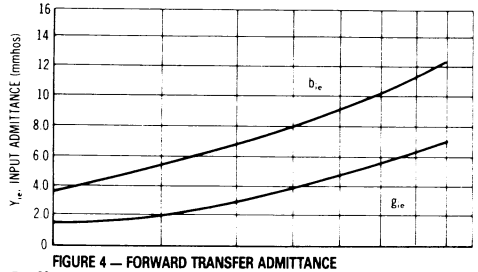


FIGURE 4 — FORWARD TRANSFER ADMITTANCE

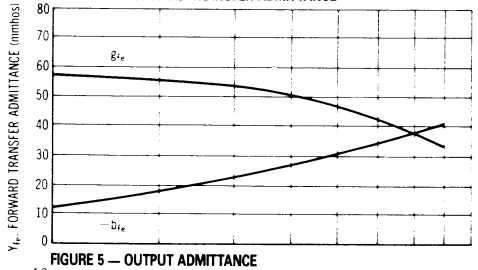


FIGURE 5 — OUTPUT ADMITTANCE

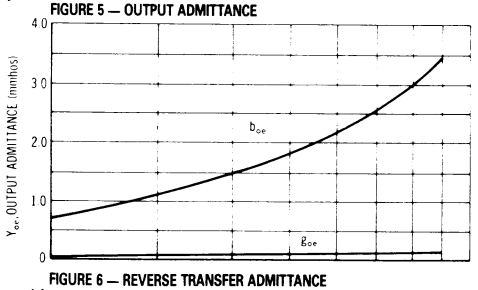
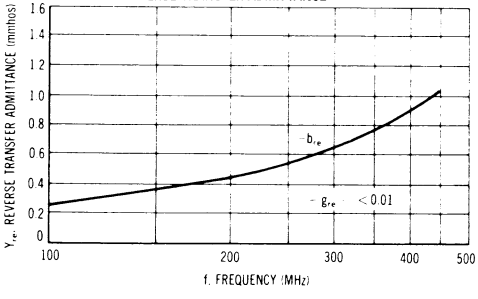


FIGURE 6 — REVERSE TRANSFER ADMITTANCE



Y PARAMETERS VS CURRENT

V_{CE} = 10 Vdc ——— V_{CE} = 15 Vdc — — —

f = 450 MHz

FIGURE 7 — INPUT ADMITTANCE

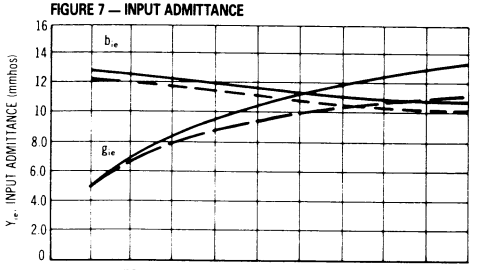


FIGURE 8 — FORWARD TRANSFER ADMITTANCE

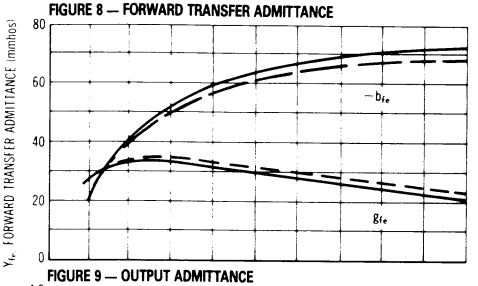


FIGURE 9 — OUTPUT ADMITTANCE

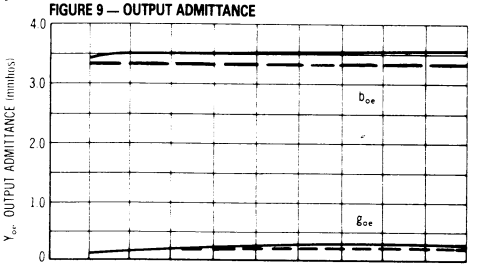
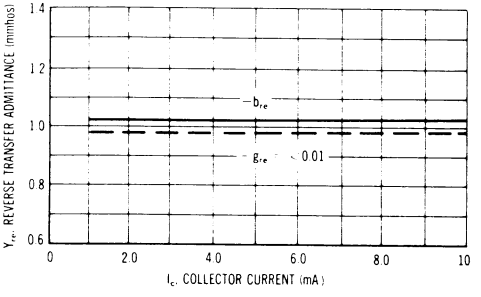


FIGURE 10 — REVERSE TRANSFER ADMITTANCE



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COMMON BASE Y PARAMETER VARIATIONS

Y PARAMETERS versus FREQUENCY

V_{CB} = 10 Vdc

I_C = 2.0 mA

FIGURE 11 — INPUT ADMITTANCE

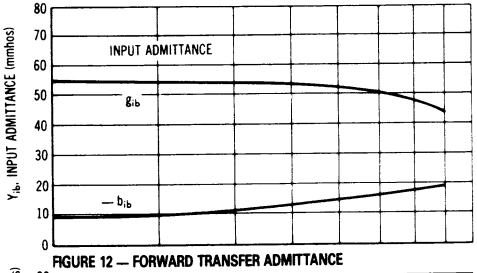


FIGURE 12 — FORWARD TRANSFER ADMITTANCE

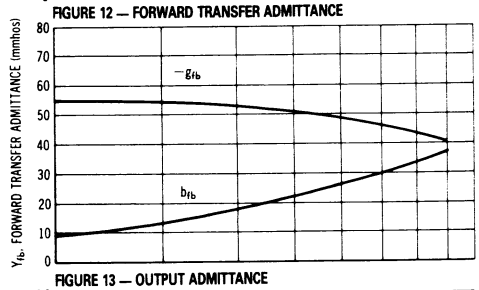


FIGURE 13 — OUTPUT ADMITTANCE

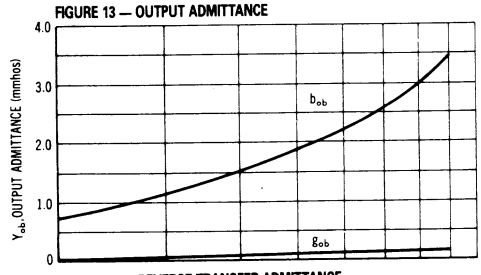
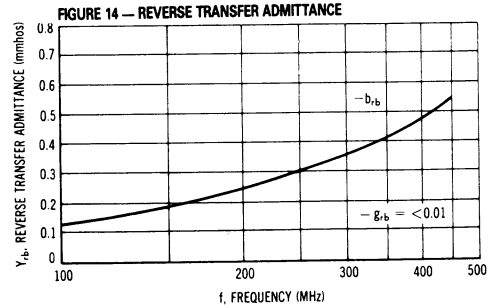


FIGURE 14 — REVERSE TRANSFER ADMITTANCE



Y PARAMETERS versus CURRENT

V_{CB} = 10 Vdc —— V_{CB} = 15 Vdc — — —

f = 450 MHz

FIGURE 15 — INPUT ADMITTANCE

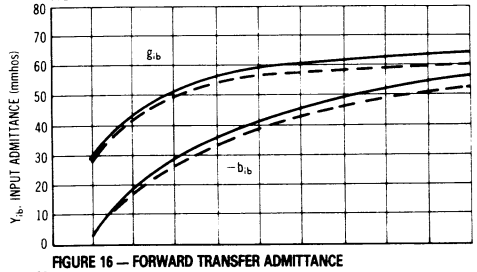


FIGURE 16 — FORWARD TRANSFER ADMITTANCE

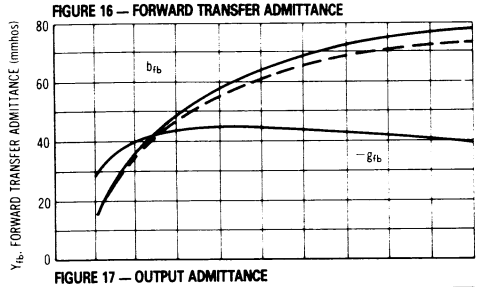


FIGURE 17 — OUTPUT ADMITTANCE

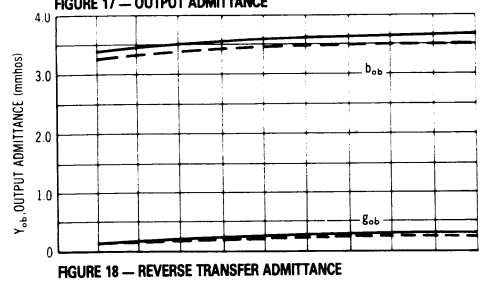
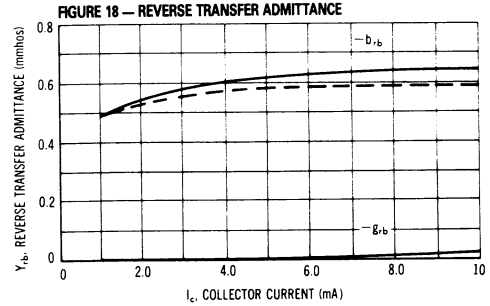


FIGURE 18 — REVERSE TRANSFER ADMITTANCE



MM4018

The RF Line

PNP SILICON RF POWER TRANSISTOR

. . . designed for amplifier, frequency multiplier or oscillator applications in military and industrial equipment. Suitable for use as Class A, B, or C driver, or pre-driver stages in VHF applications.

- Power Output – P_{out} = 0.5 W (Min) @ f = 175 MHz
- High Current-Gain – Bandwidth Product – f_T = 900 MHz (Typ) @ I_C = 50 mAdc

PNP SILICON
RF POWER
TRANSISTOR

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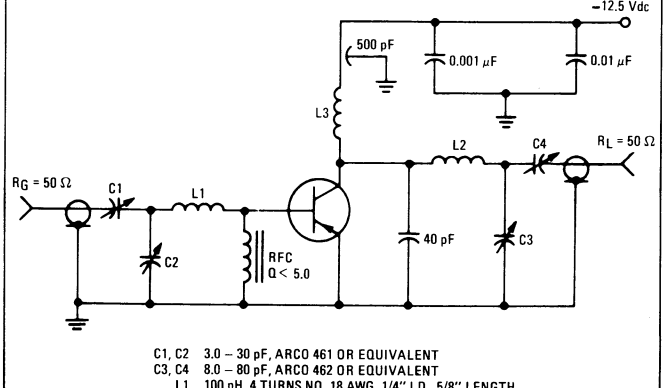
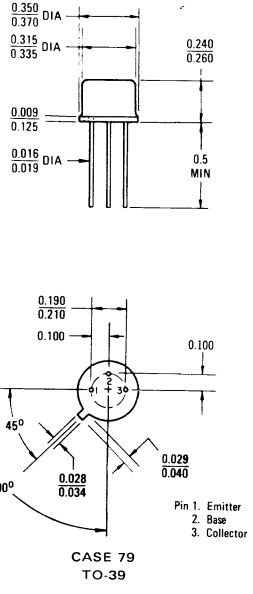
MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	V_{CEO}	20	Vdc
Collector-Base Voltage	V_{CB}	40	Vdc
Emitter-Base Voltage	V_{EB}	4.0	Vdc
Collector Current – Continuous	I_C	0.4	Adc
Total Device Dissipation @ T_C = 25°C Derate above 25°C	P_D	5.0 28.6	Watts mW/°C
Operating and Storage Junction Temperature Range	T_J, T_{stg}	−65 to +200	°C

FIGURE 1 – 175 MHz OUTPUT POWER TEST CIRCUIT



C1, C2 3.0 – 30 pF, ARCO 461 OR EQUIVALENT
C3, C4 8.0 – 80 pF, ARCO 462 OR EQUIVALENT
L1 100 nH, 4 TURNS NO. 18 AWG, 1/4" I.D., 5/8" LENGTH
L2 40 nH, 2 TURNS NO. 18 AWG, 1/4" I.D., 1/2" LENGTH
L3 200 nH, 8 TURNS NO. 18 AWG, 1/4" I.D., 7/8" LENGTH



CASE 79
TO-39

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

Characteristic	Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage (I_C = 5.0 mAdc, I_B = 0)	$V_{(BR)CEO}$	20	–	–	Vdc
Collector-Base Breakdown Voltage (I_C = 5.0 mAdc, I_E = 0)	$V_{(BR)CBO}$	40	–	–	Vdc
Emitter-Base Breakdown Voltage (I_E = 1.0 mAdc, I_C = 0)	$V_{(BR)EBO}$	4.0	–	–	Vdc
Collector Cutoff Current (V_{CE} = 15 Vdc, I_B = 0)	I_{CEO}	–	–	20	μAdc
Collector Cutoff Current (V_{CE} = 40 Vdc, V_{BE} = 0)	I_{CES}	–	–	0.1	mAdc
Collector Cutoff Current (V_{CB} = 15 Vdc, I_E = 0)	I_{CBO}	–	–	10	μAdc
ON CHARACTERISTICS					
DC Current Gain (I_C = 50 mAdc, V_{CE} = 5.0 Vdc)	h_{FE}	10	–	–	–
DYNAMIC CHARACTERISTICS					
Current-Gain – Bandwidth Product (I_C = 50 mAdc, V_{CE} = 15 Vdc, f = 100 MHz)	f_T	–	900	–	MHz
Output Capacitance (V_{CB} = 12.5 Vdc, I_E = 0, f = 100 kHz)	C_{ob}	–	3.5	–	pF
FUNCTIONAL TEST					
Power Output (Figure 1) (P_{in} = 50 mW, V_{CC} = 12.5 Vdc, f = 175 MHz)	P_{out}	0.5	–	–	Watt
Collector Efficiency (Figure 1) (P_{in} = 50 mW, V_{CC} = 12.5 Vdc, f = 175 MHz)	η	45	55	–	%

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FIGURE 2 – POWER OUTPUT versus POWER INPUT

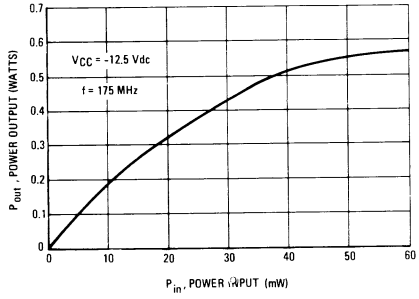


FIGURE 3 – PARALLEL EQUIVALENT OUTPUT CAPACITANCE versus FREQUENCY

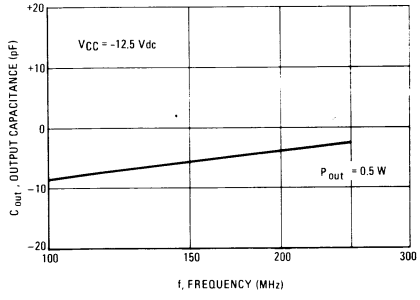


FIGURE 4 – PARALLEL EQUIVALENT INPUT RESISTANCE versus FREQUENCY

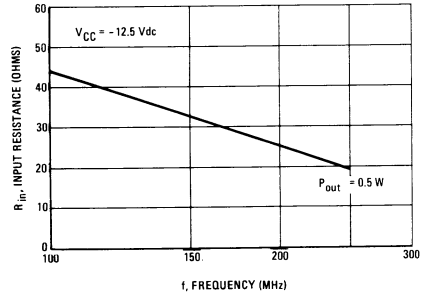
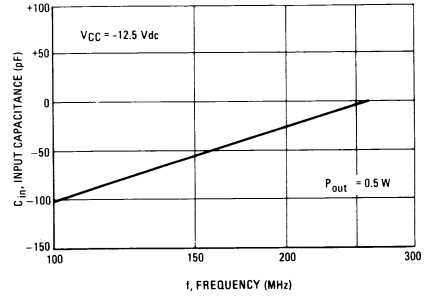


FIGURE 5 – PARALLEL EQUIVALENT INPUT CAPACITANCE versus FREQUENCY



MM4019

The RF Line

2.5 W – 175 MHz

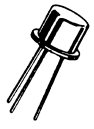
HIGH FREQUENCY TRANSISTOR

PNP SILICON

PNP SILICON HIGH FREQUENCY TRANSISTOR

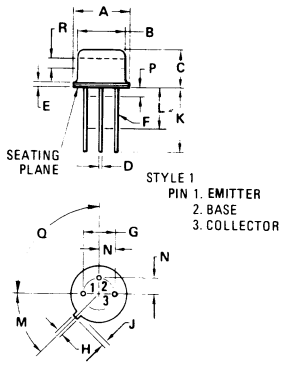
. . . designed for amplifier and oscillator applications in military and industrial equipment. Suitable for use as output, driver or pre-driver stages in UHF and VHF equipment.

- Specified 175 MHz, 28 Vdc Characteristics –
  Output Power = 2.5 Watts
  Efficiency = 50%



MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	V_{CEO}	40	Vdc
Collector-Base Voltage	V_{CB}	60	Vdc
Emitter-Base Voltage	V_{EB}	4.0	Vdc
Collector Current – Continuous	I_C	1.0	Adc
Total Device Dissipation @ $T_C = 25^oC$ Derate above 25^oC	P_D	5.0 28.6	Watts $mW/^oC$
Operating and Storage Junction Temperature Range	T_J, T_{stg}	-65 to +200	^oC



DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	8.89	9.40	0.350	0.370
B	8.00	8.51	0.315	0.335
C	6.10	6.60	0.240	0.260
D	0.406	0.533	0.016	0.021
E	0.229	3.18	0.009	0.125
F	0.406	0.483	0.016	0.019
G	4.83	5.33	0.190	0.210
H	0.711	0.864	0.028	0.034
J	0.737	1.02	0.029	0.040
K	12.70	–	0.500	–
L	6.35	–	0.250	–
M	45^o NOM		45^o NOM	
P	–	1.27	–	0.050
Q	90^o NOM		90^o NOM	
R	2.54	–	0.100	–

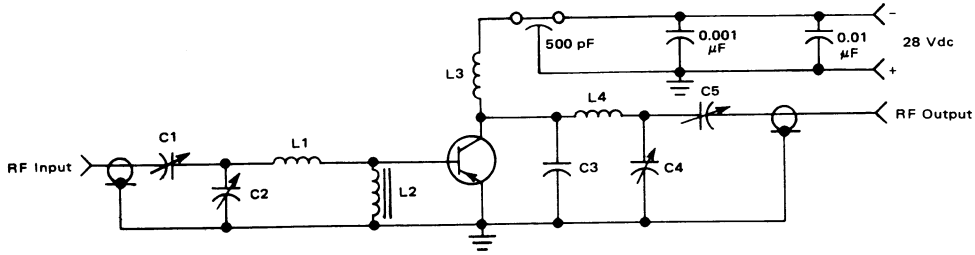
All JEDEC dimensions and notes apply.

CASE 79-02
TO-39

ELECTRICAL CHARACTERISTICS (T_A = 25° unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage (I_C = 10 mAdc, $I_B \geq 0$)	$V_{(BR)CEO}$	40	–	–	Vdc
Collector-Base Breakdown Voltage (I_C = 10 mAdc, I_E = 0)	$V_{(BR)CBO}$	60	–	–	Vdc
Emitter-Base Breakdown Voltage (I_E = 0.1 Adc, I_C = 0)	$V_{(BR)EBO}$	4.0	–	–	Vdc
Collector Cutoff Current (V_{CE} = 30 Vdc, I_B = 0)	I_{CEO}	–	–	0.1	mAdc
Emitter Cutoff Current (V_{BE} = 4.0 Vdc, I_C = 0)	I_{EBO}	–	–	0.1	mAdc
ON CHARACTERISTICS					
DC Current Gain (I_C = 250 mAdc, V_{CE} = 5.0 Vdc)	h_{FE}	10	–	–	–
Collector-Emitter Saturation Voltage (I_C = 250 mAdc, I_B = 50 mAdc)	$V_{CE(sat)}$	–	–	1.0	Vdc
DYNAMIC CHARACTERISTICS					
Current-Gain–Bandwidth Product (I_C = 100 mAdc, V_{CE} = 28 Vdc, f = 100 MHz)	f_T	–	750	–	MHz
Output Capacitance (V_{CB} = 30 Vdc, I_E = 0, f = 100 kHz)	C_{ob}	–	7.5	–	pF
FUNCTIONAL TEST					
Power Input (P_{out} = 2.5 W, V_{CC} = 28 Vdc, f = 175 MHz)	P_{in}	–	–	0.25	Watt
Power Output (P_{in} = 0.5 W, V_{CC} = 28 Vdc, f = 400 MHz)	P_{out}	–	2.0	–	Watts
Collector Efficiency (P_{out} = 2.5 W, V_{CC} = 28 Vdc, f = 175 MHz)	η	50	–	–	%

FIGURE 1 – 175 MHz TEST CIRCUIT



C1,C2 3.0-30 pF, ARCO 461 or equivalent.
C3 40 pF
C4,C5 5.0-80 pF, ARCO 462 or equivalent.
L1 80 nH, 3 Turns #18 AWG, 1/4" I.D., 1/4" Length
L2 Ferrite Choke, VK-200 Ferroxcube, Q < 5
L3 0.15 µH, RF Choke
L4 27 nH, 2 Turns #18 AWG, 1/4" I.D., 3/8" Length

MM4049
MMC4049
MRF534
MRF536

The RF Line

PNP SILICON HIGH-FREQUENCY TRANSISTOR

. . . designed for use as a high-frequency current mode switch. Because of the extremely high Current-Gain — Bandwidth this transistor also makes an excellent RF amplifier and oscillator.

- High Current-Gain — Bandwidth Product —
  f_T = 4.0 GHz (Min) @ I_C = 20 mAdc — MM4049, MRF534
  f_T = 5.0 GHz (Min) @ I_C = 20 mAdc — MRF536
- Low Collector-Base Capacitance —
  C_{cb} = 1.25 pF (Max) @ V_{CB} = 5.0 Vdc

4.0 GHz @ 20 mAdc

HIGH FREQUENCY TRANSISTOR

PNP SILICON

3

MAXIMUM RATINGS

Ratings	Symbol	MMC4049 Chip	MM4049 Case 20-03 TO-206AF	MRF534 Case 22-03 TO-206AA	MRF536 Case 317-01 Macro-X	Unit
				Values		
Collector-Emitter Voltage	V_{CEO}	10	10	10	10	Vdc
Collector-Base Voltage	V_{CBO}	15	15	15	15	Vdc
Emitter-Base Voltage	V_{EBO}	4.5	4.5	4.5	4.5	Vdc
Collector Current — Continuous	I_C	30	30	30	30	mAdc
Total Device Dissipation @ T_A = 25°C Derate above 25°C	P_D	300 $T_{J\ max}$=200°C	200 1.14	300 1.71	300 2.40	mW mW/°C
Operating and Storage Junction Temperature Junction	T_J, T_{stg}	-65 to +200	-65 to +200	-65 to +200	-65 to +150	°C

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

Characteristic	Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage (I_C = 2.0 mAdc, I_B = 0)	$V_{(BR)CEO}$	10	—	—	Vdc
Collector-Base Breakdown Voltage (I_C = 100 μAdc, I_E = 0)	$V_{(BR)CBO}$	15	—	—	Vdc
Emitter-Base Breakdown Voltage (I_E = 100 μAdc, I_C = 0)	$V_{(BR)EBO}$	4.5	—	—	Vdc
Collector Cutoff Current (V_{CB} = 10 Vdc, I_E = 0)	I_{CBO}	—	—	10	nAdc
ON CHARACTERISTICS					
DC Current Gain (I_C = 25 mAdc, V_{CE} = 2.0 Vdc)	h_{FE}	20	—	200	—
DYNAMIC CHARACTERISTICS					
Current-Gain Bandwidth Product (I_C = 20 mAdc, V_{CE} = 5.0 Vdc, f = 500 MHz) MRF534, MM4049	f_T	4.0	—	—	GHz
Current-Gain Bandwidth Product (I_C = 20 mAdc, V_{CE} = 5.0 Vdc, f = 500 MHz) MRF536	f_T	5.0	—	—	GHz
Collector-Base Capacitance (V_{CB} = 5.0 Vdc, I_E = 0, f = 1.0 MHz)	C_{cb}	—	—	1.3	pF
FUNCTIONAL TESTS					
Maximum Available Gain (I_C = 15 mAdc, V_{CE} = 5.0 Vdc, f = 500 MHz) MRF534	MAG	10	12	—	dB
Maximum Available Gain (I_C = 15 mAdc, V_{CE} = 5.0 Vdc, f = 500 MHz) MM4049	MAG	11.5	13	—	dB
Maximum Available Gain (I_C = 15 mAdc, V_{CE} = 5.0 Vdc, f = 1.0 GHz) MRF536	MAG	8.5	10	—	dB

FIGURE 1 — CURRENT GAIN — BANDWIDTH PRODUCT versus CURRENT

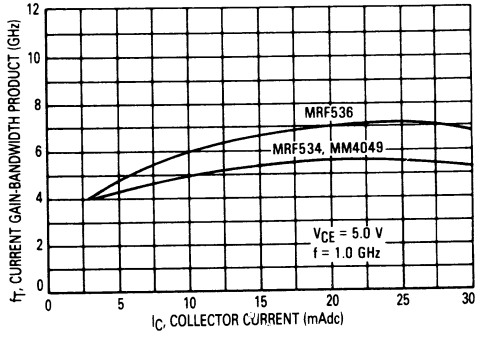


FIGURE 2 — MAXIMUM AVAILABLE GAIN versus COLLECTOR CURRENT

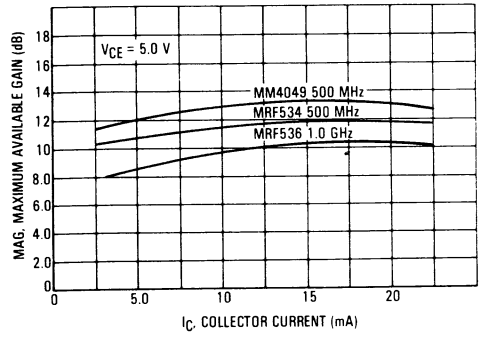
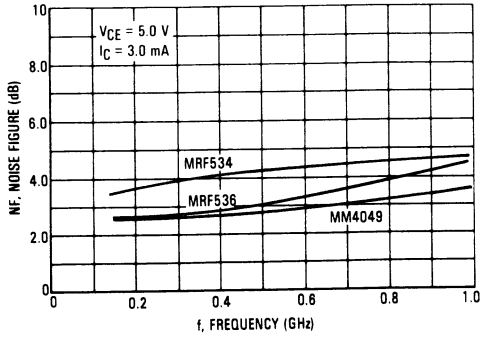


FIGURE 3 — NOISE FIGURE versus FREQUENCY



MRF534 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	5.0	200	0.734	-22	3.70	126	0.066	66	0.507	-39
		400	0.580	-28	2.56	108	0.116	65	0.409	-48
		600	0.444	-37	2.09	95	0.158	62	0.403	-52
		800	0.400	-47	1.80	86	0.195	56	0.364	-56
		1000	0.366	-47	1.55	79	0.234	51	0.348	-69
	10	200	0.645	-27	5.36	124	0.058	69	0.394	-43
		400	0.503	-33	3.44	106	0.109	71	0.316	-52
		600	0.376	-43	2.68	93	0.153	69	0.323	-52
		800	0.333	-54	2.24	84	0.192	65	0.290	-55
		1000	0.295	-54	1.91	77	0.233	61	0.276	-71
	20	200	0.586	-28	5.90	122	0.053	70	0.338	-52
		400	0.454	-34	3.73	105	0.099	73	0.259	-60
		600	0.329	-46	2.87	93	0.143	72	0.267	-58
		800	0.289	-59	2.38	85	0.181	68	0.240	-59
		1000	0.248	-58	2.04	77	0.221	65	0.235	-75
10	5.0	200	0.752	-21	4.28	125	0.066	70	0.550	-28
		400	0.624	-26	2.77	107	0.123	68	0.495	-38
		600	0.512	-34	2.19	94	0.168	65	0.503	-44
		800	0.476	-44	1.86	86	0.207	60	0.464	-51
		1000	0.447	-45	1.60	79	0.246	55	0.443	-64
	10	200	0.685	-24	5.47	123	0.060	71	0.442	-33
		400	0.553	-28	3.46	105	0.113	71	0.385	-42
		600	0.433	-37	2.68	93	0.156	68	0.397	-46
		800	0.391	-49	2.25	85	0.194	63	0.362	-51
		1000	0.359	-47	1.92	78	0.233	59	0.342	-65
	20	200	0.621	-26	6.38	121	0.055	71	0.372	-40
		400	0.488	-31	3.97	104	0.103	72	0.316	-48
		600	0.365	-41	3.04	93	0.145	70	0.332	-50
		800	0.323	-52	2.51	85	0.182	66	0.301	-54
		1000	0.290	-50	2.13	79	0.219	63	0.288	-68

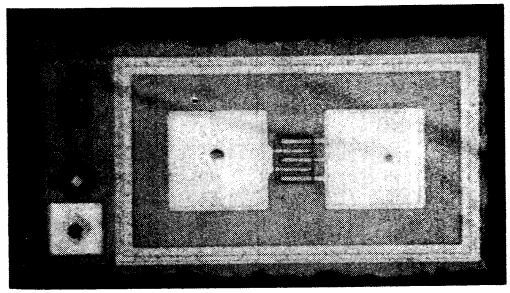
MM4049 COMMON-EMITTER S-PARAMETERS

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	5.0	200	0.634	-31	6.37	120	0.060	69	0.711	-23
		400	0.469	-34	3.95	93	0.107	65	0.602	-30
		600	0.379	-40	2.90	77	0.147	62	0.587	-33
		800	0.368	-51	2.32	65	0.183	56	0.55	-36
		1000	0.381	-54	1.93	55	0.223	50	0.528	-44
	10	200	0.523	-29	7.79	112	0.056	72	0.632	-23
		400	0.418	-28	3.74	89	0.104	68	0.543	-29
		600	0.344	-34	3.20	74	0.146	65	0.542	-32
		800	0.345	-46	2.54	64	0.184	58	0.513	-34
		1000	0.366	-50	2.09	54	0.225	52	0.493	-42
	20	200	0.454	-25	8.43	106	0.065	73	0.584	-21
		400	0.390	-23	4.67	85	0.105	70	0.513	-27
		600	0.325	-30	3.31	72	0.148	66	0.620	-30
		800	0.327	-44	2.61	62	0.188	59	0.497	-32
		1000	0.351	-48	2.15	52	0.231	52	0.476	-41
10	5.0	200	0.731	-25	5.83	121	0.053	70	0.736	-18
		400	0.589	-30	3.65	95	0.096	67	0.654	-26
		600	0.502	-38	2.71	79	0.132	64	0.645	-29
		800	0.496	-49	2.21	68	0.164	57	0.612	-33
		1000	0.499	-54	1.83	58	0.198	51	0.592	-42
	10	200	0.643	-25	7.37	114	0.051	71	0.668	-18
		400	0.542	-27	4.28	90	0.094	69	0.060	-25
		600	0.466	-34	3.10	76	0.132	65	0.603	-28
		800	0.465	-46	2.49	66	0.166	59	0.577	-31
		1000	0.476	-51	2.05	57	0.202	53	0.557	-40
	20	200	0.57	-23	8.44	109	0.049	73	0.621	-18
		400	0.496	-24	4.73	88	0.093	71	0.562	-24
		600	0.427	-31	3.38	75	0.131	67	0.572	-27
		800	0.427	-43	2.69	66	0.165	60	0.551	-30
		1000	0.445	-47	2.21	57	0.203	54	0.532	-38

MRF536 COMMON-EMITTER S-PARAMETERS

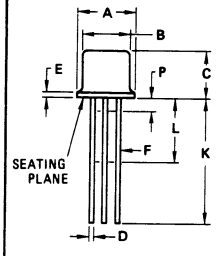
V_{CE} (Volts)	I_C (mA)	f (MHz)	S_{11}		S_{21}		S_{12}		S_{22}	
			$\|S_{11}\|$	$\angle\phi$	$\|S_{21}\|$	$\angle\phi$	$\|S_{12}\|$	$\angle\phi$	$\|S_{22}\|$	$\angle\phi$
5.0	5.0	400	0.401	-74	5.38	108	0.09	54	0.49	-48
		800	0.181	-102	3.03	86	0.138	51	0.35	-64
		1200	0.136	-157	2.13	70	0.181	48	0.32	-70
		1600	0.151	175	1.68	59	0.21	45	0.27	-80
		2000	0.16	148	1.44	52	0.24	41	0.269	-100
	10	400	0.289	-94	6.58	103	0.076	56	0.379	-56
		800	0.14	-137	3.55	84	0.122	55	0.266	-73
		1200	0.174	169	2.46	70	0.165	53	0.238	-77
		1600	0.196	154	1.93	60	0.196	50	0.198	-87
		2000	0.227	130	1.65	51	0.230	46	0.202	-110
	20	400	0.233	-118	7.28	99	0.066	60	0.296	-65
		800	0.163	-169	3.88	82	0.110	59	0.204	-84
		1200	0.233	156	2.65	69	0.153	57	0.179	-84
		1600	0.253	144	2.06	59	0.186	55	0.143	-96
		2000	0.290	123	1.75	50	0.220	51	0.160	-121
10	5.0	400	0.478	-54	5.14	109	0.086	58	0.535	-39
		800	0.279	-66	2.90	88	0.141	53	0.420	-55
		1200	0.166	-97	2.08	73	0.184	48	0.388	-62
		1600	0.151	-123	1.67	64	0.209	44	0.33	-72
		2000	0.110	-158	1.44	55	0.243	39	0.313	-90
	10	400	0.356	-67	6.59	105	0.075	59	0.418	-47
		800	0.182	-84	3.59	86	0.124	56	0.311	-62
		1200	0.119	-141	2.53	73	0.166	52	0.284	-67
		1600	0.131	-166	2.00	62	0.193	49	0.230	-76
		2000	0.135	154	1.72	55	0.226	45	0.222	-98
	20	400	0.26	-85	7.66	101	0.066	61	0.328	-53
		800	0.124	122	4.09	84	0.111	59	0.236	-69
		1200	0.148	172	2.83	72	0.152	56	0.216	-71
		1600	0.172	158	2.22	62	0.182	54	0.172	-80
		2000	0.201	130	1.88	54	0.214	50	0.171	-104

MMC4049 CHIP TOPOGRAPHY



Nominal Chip Size: 12 × 22 mils
Front Metalization: Aluminum
Back Metalization: Aluminum
Emitter/Base Bond Pad: 4.0 × 4.0 mils
#Emitter Fingers: 2
#Base Fingers: 3

OUTLINE DIMENSIONS

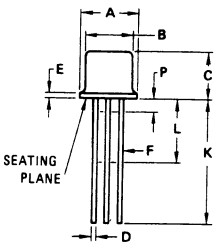


STYLE 1:
PIN 1. EMITTER
2. BASE
3. COLLECTOR

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	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

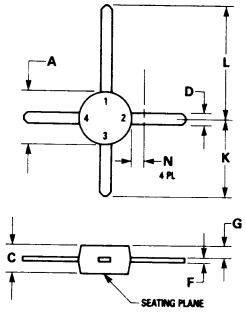


STYLE 1:
PIN 1. EMITTER
2. BASE
3. COLLECTOR

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	4.32	5.33	0.170	0.210
D	0.406	0.533	0.016	0.021
E	–	0.762	–	0.030
F	0.406	0.483	0.016	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 notes and dimensions apply.

CASE 22-03



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

NOTE:
DIMENSION D NOT APPLICABLE IN ZONE N.

DIM	MILLIMETERS		INCHES	
	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	0.008	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

3

MM8000
MM8001

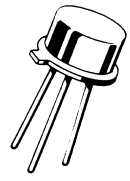
The RF Line

NPN SILICON
AMPLIFIER
TRANSISTORS

NPN SILICON HIGH-FREQUENCY TRANSISTOR

. . . designed for high-frequency C.A.T.V. amplifier applications. Suitable for use as output driver or pre-driver stages in VHF and UHF equipment.

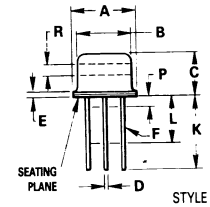
- High Current-Gain—Bandwidth Product —
  f_T = 900 MHz (Min) @ I_C = 50 mAdc (MM8001)
- Low Output Capacitance —
  C_{ob} = 3.5 pF (Max) @ V_{CB} = 30 Vdc
- Low Noise Figure —
  NF = 2.7 dB (Typ) @ I_C = 10 mAdc



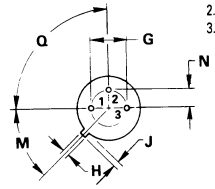
3

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	V_{CEO}	30	Vdc
Collector-Base Voltage	V_{CB}	40	Vdc
Emitter-Base Voltage	V_{EB}	3.5	Vdc
Collector Current	I_C	0.4	Adc
Total Device Dissipation @ T_C = 25°C Derate above 25°C	P_D	3.5 20	Watts mW/°C
Operating and Storage Junction Temperature Range	T_J, T_{stg}	-65 to +200	°C



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



DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	8.89	9.40	0.350	0.370
B	8.00	8.51	0.315	0.335
C	6.10	6.60	0.240	0.260
D	0.406	0.533	0.016	0.021
E	0.229	3.18	0.009	0.125
F	0.406	0.483	0.016	0.019
G	4.83	5.33	0.190	0.210
H	0.711	0.864	0.028	0.034
J	0.737	1.02	0.029	0.040
K	12.70	—	0.500	—
L	6.35	—	0.250	—
M	45° NOM		45° NOM	
P	—	1.27	—	0.050
Q	90° NOM		90° NOM	
R	2.54	—	0.100	—

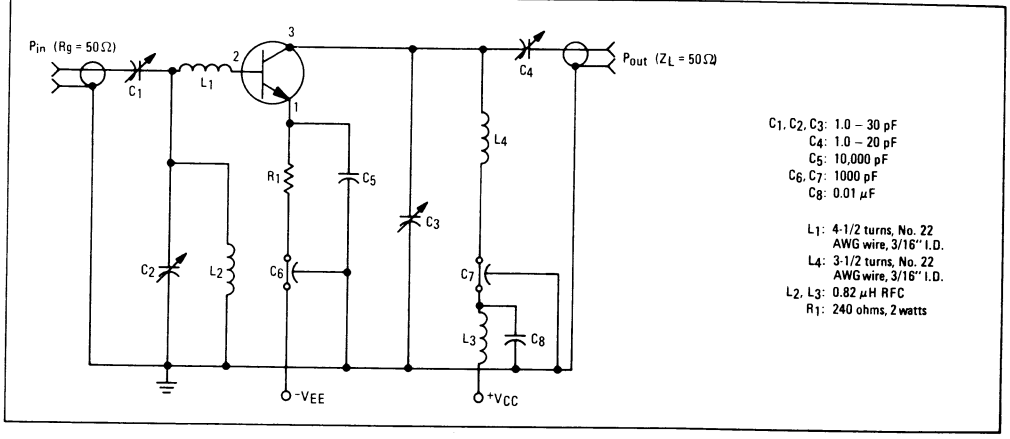
All JEDEC Dimensions and Notes Apply.

CASE 79-02

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

Characteristic		Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS						
Collector-Emitter Sustaining Voltage (I_C = 5.0 mAdc, I_B = 0)		$V_{(BR)CEO(sus)}$	30	—	—	Vdc
Collector-Base Breakdown Voltage (I_C = 0.1 mAdc, I_E = 0)		$V_{(BR)CBO}$	40	—	—	Vdc
Emitter-Base Breakdown Voltage (I_E = 0.1 mAdc, I_C = 0)		$V_{(BR)EBO}$	3.5	—	—	Vdc
Collector Cutoff Current (V_{CE} = 28 Vdc, I_B = 0)		I_{CEO}	—	—	20	μAdc
ON CHARACTERISTICS						
DC Current Gain (I_C = 50 mAdc, V_{CE} = 15 Vdc)		h_{FE}	30	—	—	—
DYNAMIC CHARACTERISTICS						
Current-Gain — Bandwidth Product		f_T				MHz
(I_C = 25 mAdc, V_{CE} = 15 Vdc, f = 200 MHz)	MM8000		550	—	—	
	MM8001		700	—	—	
(I_C = 50 mAdc, V_{CE} = 15 Vdc, f = 200 MHz)	MM8000		700	—	—	
	MM8001		900	—	—	
(I_C = 100 mAdc, V_{CE} = 15 Vdc, f = 200 MHz)	MM8000		700	—	—	
	MM8001		900	—	—	
Output Capacitance (V_{CB} = 30 Vdc, I_E = 0, f = 1.0 MHz)		C_{ob}	—	—	3.5	pF
Noise Figure Figure 1 (I_C = 10 mAdc, V_{CE} = 15 Vdc, f = 200 MHz)		NF	—	2.7	—	dB
FUNCTIONAL TESTS						
Common-Emitter Amplifier Power Gain Figure 1 (I_C = 10 mAdc, V_{CE} = 15 Vdc, f = 200 MHz)		G_{pe}	—	11.4	—	dB

FIGURE 1 – 200 MHz TEST CIRCUIT



MM8009

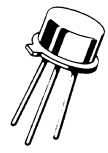
The RF Line

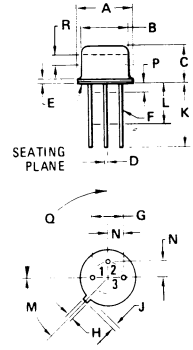
0.9 W – 1.0 GHz
RF POWER
TRANSISTOR
NPN SILICON

NPN SILICON RF POWER TRANSISTOR

. . . designed for amplifier, frequency multiplier, or oscillator applications in military and industrial equipment. Suitable for use as output, driver, or pre-driver stages in UHF equipment and as a fundamental frequency oscillator at 1.68 GHz.

- High Output Power – P_{out} = 0.9 Watt (Min) @ f = 1.0 GHz
- High Current-Gain–Bandwidth Product – f_T = 1000 MHz (Min) @ I_C = 50 mAdc
- Ideal for Radiosonde Applications – P_{out} (Oscillator) = 300 mW (Typ) @ f = 1.68 GHz





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

DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	8.89	9.40	0.350	0.370
B	8.00	8.51	0.315	0.335
C	6.10	6.60	0.240	0.260
D	0.406	0.533	0.016	0.021
E	0.229	3.18	0.009	0.125
F	0.406	0.483	0.016	0.019
G	4.83	5.33	0.190	0.210
H	0.711	0.864	0.028	0.034
J	0.737	1.02	0.029	0.040
K	12.70	–	0.500	–
L	6.35	–	0.250	–
M	45° NOM		45° NOM	
P	–	1.27	–	0.050
Q	90° NOM		90° NOM	
R	2.54	–	0.100	–

All JEDEC dimensions and notes apply.

CASE 79-02
TO-39

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	V_{CEO}	35	Vdc
Collector-Base Voltage	V_{CB}	45	Vdc
Emitter-Base Voltage	V_{EB}	3.0	Vdc
Collector Current – Continuous	I_C	400	mAdc
Total Device Dissipation @ T_A = 25°C Derate above 25°C	P_D	1.0 5.71	Watt mW/°C
Total Device Dissipation @ T_C = 25°C Derate above 25°C	P_D	3.5 20	Watts mW/°C
Operating and Storage Junction Temperature Range	T_J, T_{stg}	-65 to +200	°C

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

Characteristic	Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS					
Collector-Base Breakdown Voltage (I_C = 100 μAdc, I_E = 0)	$V_{(BR)CBO}$	45	–	–	Vdc
Emitter-Base Breakdown Voltage (I_E = 100 μAdc, I_C = 0)	$V_{(BR)EBO}$	3.0	–	–	Vdc
Collector Cutoff Current (V_{CE} = 15 Vdc, I_B = 0)	I_{CEO}	–	–	100	μAdc
Collector Cutoff Current (V_{CE} = 35 Vdc, V_{BE} = 0)	I_{CES}	–	–	10	μAdc
ON CHARACTERISTICS					
DC Current Gain (I_C = 100 mAdc, V_{CE} = 5.0 Vdc)	h_{FE}	20	–	–	–
DYNAMIC CHARACTERISTICS					
Current-Gain–Bandwidth Product (I_C = 50 mAdc, V_{CE} = 15 Vdc, f = 100 MHz)	f_T	1000	–	–	MHz
Output Capacitance (V_{CB} = 30 Vdc, I_E = 0, f = 1.0 MHz)	C_{ob}	–	2.3	3.0	pF
FUNCTIONAL TEST					
Power Output (Figure 1) (P_{in} = 316 mW, V_{CE} = 28 Vdc, f = 1.0 GHz)	P_{out}	0.9	–	–	Watt
Power Output (Oscillator) (Figure 2) (V_{CE} = 20 Vdc, V_{EB} = 1.5 Vdc, f = 1.68 GHz) (Minimum Efficiency = 15%)	P_{out}	–	0.3	–	Watt
Collector Efficiency (P_{in} = 316 mW, V_{CE} = 28 Vdc, f = 1.0 GHz)	η	35	–	–	%

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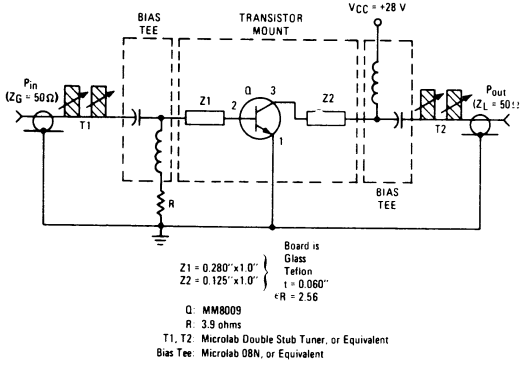
FIGURE 1 – 1.0 GHz POWER AMPLIFIER TEST CIRCUIT



Q: MM8009
R: 3.9 ohms
T1, T2: Microlab Double Stub Tuner, or Equivalent
Bias Tee: Microlab OBN, or Equivalent

FIGURE 2 – 1.68 GHz POWER OSCILLATOR TEST CIRCUIT

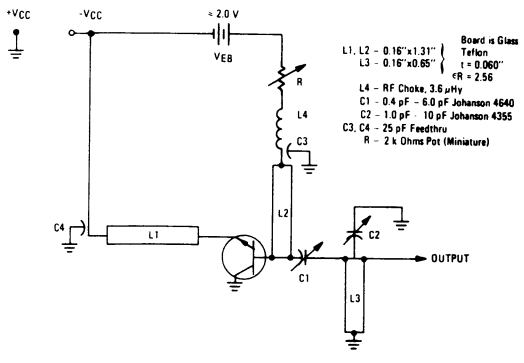


FIGURE 3 – POWER OUTPUT versus POWER INPUT

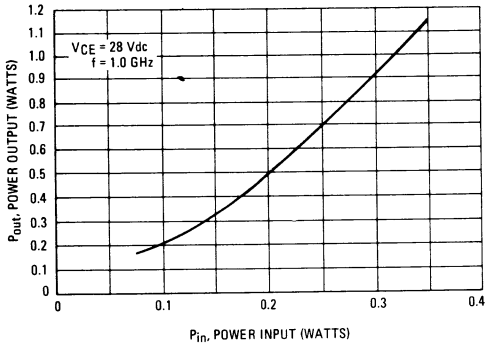


FIGURE 4 – POWER OUTPUT versus FREQUENCY

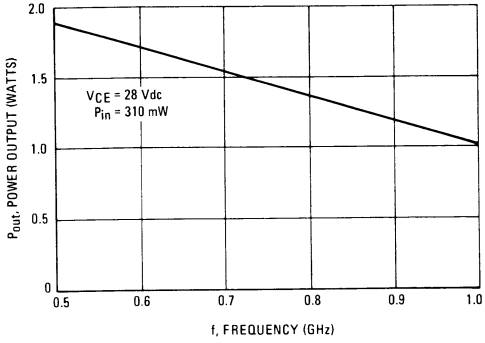


FIGURE 5 – POWER OUTPUT versus VOLTAGE

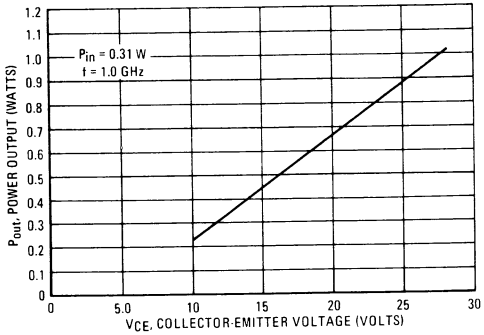


FIGURE 6 – OSCILLATOR POWER OUTPUT versus CURRENT

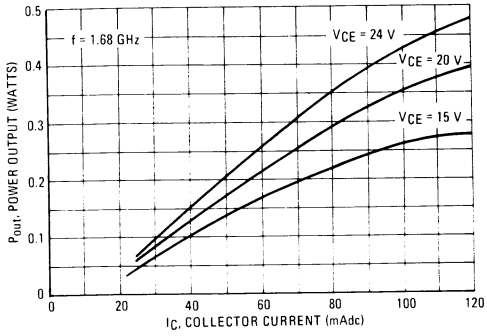


FIGURE 7 – CURRENT-GAIN–BANDWIDTH PRODUCT

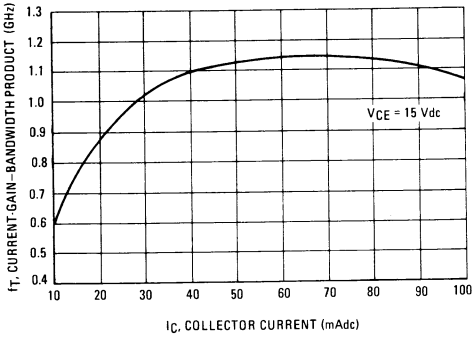


FIGURE 8 – OUTPUT CAPACITANCE versus VOLTAGE