

**MOTOROLA**  
**SEMICONDUCTOR**  
**TECHNICAL DATA**

T-31-01

**MM4049**  
**MMC4049**  
**MRF534**  
**MRF536**

**The RF Line**

**PNP SILICON HIGH-FREQUENCY TRANSISTORS**

... 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 —  
 $f_T = 4.0 \text{ GHz (Min) (at } I_C = -20 \text{ mAdc — MM4049, MRF534}$   
 $f_T = 5.0 \text{ GHz (Min) (at } I_C = -20 \text{ mAdc — MRF536}$
- Low Collector-Base Capacitance —  
 $C_{cb} = 1.25 \text{ pF (Max) (at } V_{CB} = -5.0 \text{ Vdc}$

$I_C = -30 \text{ mA}$   
**HIGH FREQUENCY**  
**TRANSISTORS**  
 PNP SILICON

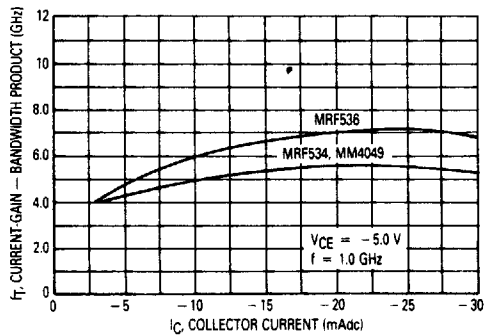
MAXIMUM RATINGS		MMC4049	MM4049	MRF534	MRF536	Unit
		Chip	Case 20-03 TO-206AF Style 10	Case 22-03 TO-206AA Style 1	Case 317-01 Macro-X Style 2	
Ratings	Symbol	Values				
Collector-Emitter Voltage	$V_{CEO}$	-10	-10	-10	-10	Vdc
Collector-Base Voltage	$V_{CBO}$	-15	-15	-15	-15	Vdc
Emitter-Base Voltage	$V_{EBO}$	-4.5	-4.5	-4.5	-4.5	Vdc
Collector Current — Continuous	$I_C$	-30	-30	-30	-30	mAdc
Total Device Dissipation @ $T_A = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$	300 $T_J \text{ max} = 200^\circ\text{C}$	200 1.14	300 1.71	300 2.40	mW mW/ $^\circ\text{C}$
Operating and Storage Junction Temperature Junction	$T_J, T_{stg}$	-65 to +200	-65 to +200	-65 to +200	-65 to +150	$^\circ\text{C}$

2

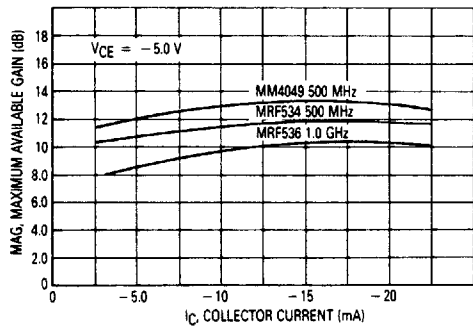
**ELECTRICAL CHARACTERISTICS** ( $T_A = 25^\circ\text{C}$  unless otherwise noted)

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

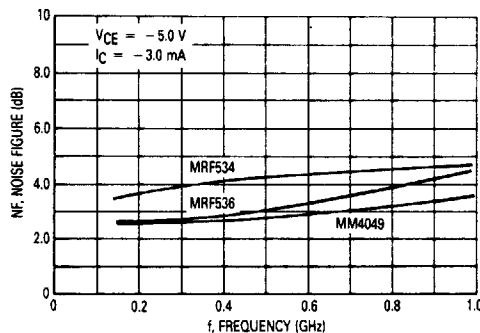
**FIGURE 1 — CURRENT-GAIN — BANDWIDTH PRODUCT versus CURRENT**



**FIGURE 2 — MAXIMUM AVAILABLE GAIN versus COLLECTOR CURRENT**



**FIGURE 3 — NOISE FIGURE versus FREQUENCY**



MRF534 COMMON-EMITTER S-PARAMETERS

VCE (Volts)	IC (mA)	f (MHz)	S11		S21		S12		S22	
			S11	∠φ	S21	∠φ	S12	∠φ	S22	∠φ
-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

VCE (Volts)	IC (mA)	f (MHz)	S11		S21		S12		S22	
			S11	∠φ	S21	∠φ	S12	∠φ	S22	∠φ
-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	0.550	-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	0.600	-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	0.570	-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

MM4049, MMC4049, MRF534, MRF536

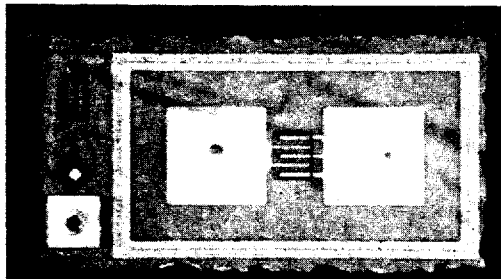
MOTOROLA SC (XSTRS/R F) 46E D ■ 6367254 0094241 4 ■ MOT6

MRF536 COMMON-EMITTER S-PARAMETERS

VCE (Volts)	IC (mA)	f (MHz)	S11		S21		S12		S22	
			S11	∠φ	S21	∠φ	S12	∠φ	S22	∠φ
-5.0	-5.0	400	0.401	-74	5.38	108	0.090	54	0.490	-48
		800	0.181	-102	3.03	86	0.138	51	0.350	-64
		1200	0.136	-157	2.13	70	0.181	48	0.320	-70
		1600	0.151	175	1.68	59	0.210	45	0.270	-80
		2000	0.160	148	1.44	52	0.240	41	0.269	-100
	-10	400	0.289	-94	6.58	103	0.076	56	0.379	-56
		800	0.140	-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	0.185	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	0.330	-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	0.125	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	0.260	-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

2

MMC4049 CHIP TOPOGRAPHY



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