MOTOROLA

2N5039

NPN SILICON POWER TRANSISTOR

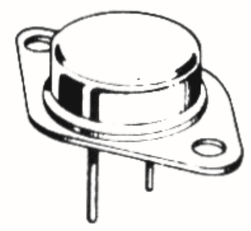
. . . fast switching speeds and high current capacity ideally suit these parts for use in switching regulators, inverters, wideband amplifiers and power oscillators in industrial and commercial applications.

- High speed T_F max. = 0.5 μs
- Low saturation $V_{CE(sat)}$ = 1.0 V (max.) @ Ic = 10 A

20 AMPERES

NPN SILICON POWER METAL TRANSISTOR

75 VOLTS
140 WATTS



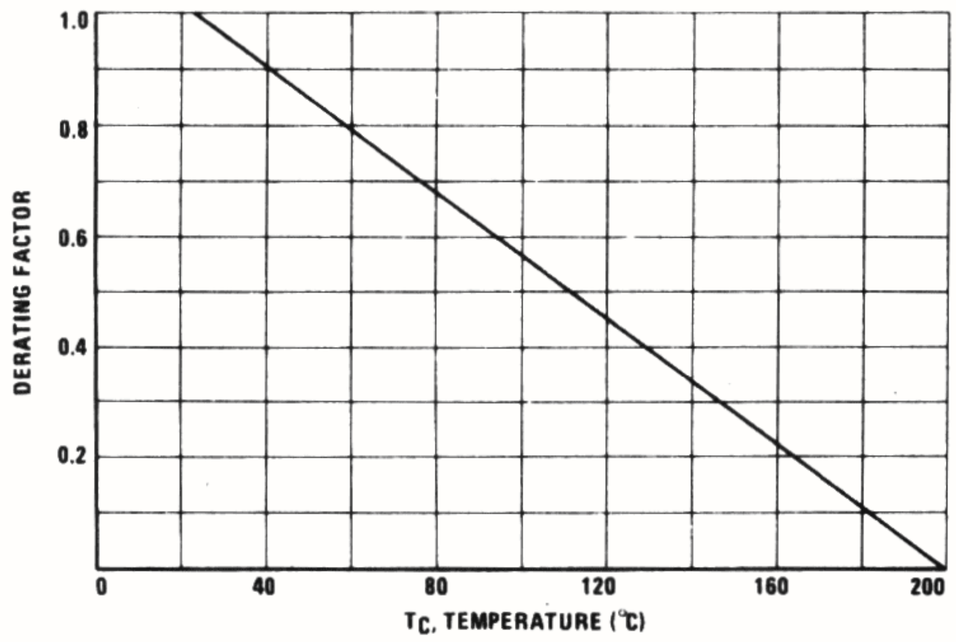
MAXIMUM RATINGS

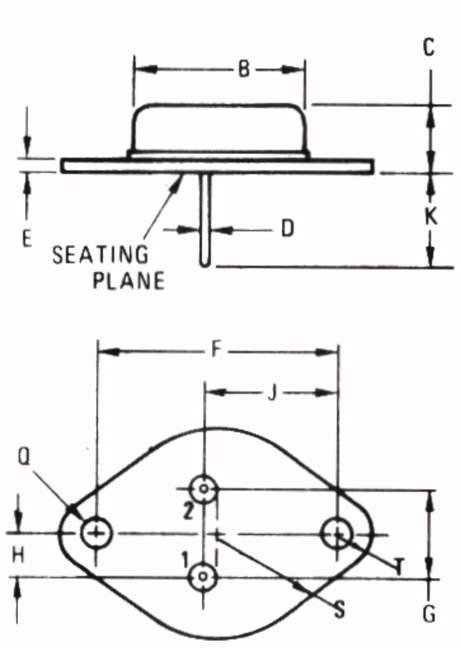
Rating	Symbol	Value	Unit
Collector-Emitter Voltage	$V_{CEO(sus)}$	75	Vdc
Collector-Base Voltage	V_{CBO}	120	Vdc
Emitter-Base Voltage	V_{EBO}	7	Vdc
Collector-Emitter Voltage (V_{BE} = –1.5 V)	V_{CEX}	120	Vdc
Collector-Current — continuous — peak (pw ≤ 10 ms)	I_C I_{CM}	20 30	Adc Apk
Base-Current continuous	I_B	5	Adc
Total Power Dissipation @ T_C = 25°C	P_D	140	Watts
Operating and Storage Junction Temperature Range	T_J, T_{stg}	–65 to 200	°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max.	Unit
Thermal Resistance, Junction to Case	θ_{JC}	1.25	°C/W

FIGURE 1 – POWER DERATING





STYLE 1:
PIN 1. BASE
2. EMITTER
CASE-COLLECTOR

DIM	MILLIMETERS MIN	MAX	INCHES MIN	MAX
B	—	22.23	—	0.875
C	6.35	11.43	0.250	0.450
D	0.97	1.09	0.038	0.043
E	—	3.43	—	0.135
F	29.90	30.40	1.177	1.197
G	10.67	11.18	0.420	0.440
H	5.21	5.72	0.205	0.225
J	16.64	17.15	0.655	0.675
K	7.92	—	0.312	—
Q	3.84	4.09	0.151	0.161
S	—	13.34	—	0.525
T	—	4.78	—	0.188

All JEDEC dimensions and notes apply

CASE 1-03
(TO-3)

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

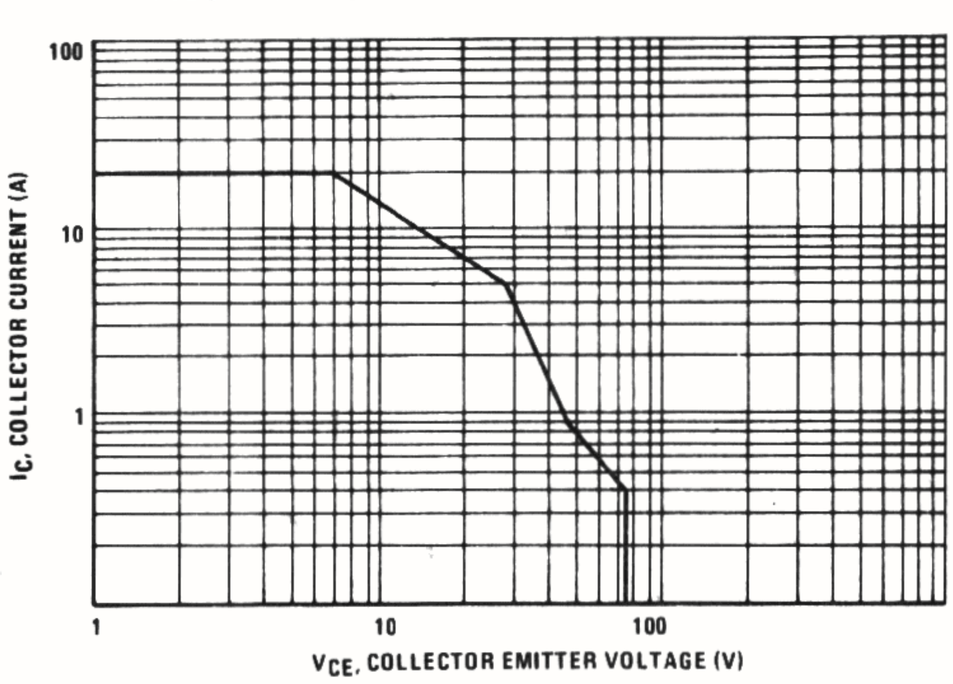
Characteristic	Symbol	Min.	Max.	Unit
OFF CHARACTERISTICS				
Collector-Emitter Sustaining Voltage (I_C = 200 mA, I_B = 0, L = 15 mH) (I_C = 200 mA, V_{BE} = −1.5 V, R_{BE} = 100 Ω,, L = 2 mH) (I_C = 200 mA, R_{BE} = 50 Ω, L = 15 mH)	 $V_{CEO(sus)}$ $V_{CEX(sus)}$ $V_{CER(sus)}$	 75 120 95		Vdc
Collector Cutoff Current at Reverse Bias: (V_{CE} = 140 V, V_{BE} = −1.5 V) (V_{CE} = 100 V, V_{BE} = −1.5 V, T_C = 150°C)	I_{CEX}	 50 10		mAdc
Collector-Emitter Cutoff Current (V_{CE} = 70 V)	I_{CEO}	 20		mAdc
Emitter-Base Reverse Voltage (I_E = 50 mA)	V_{EBO}	 7.0		V
Emitter-Cutoff Current (V_{EB} = 5 V)	I_{EBO}	 15		mAdc
SECOND BREAKDOWN				
Second Breakdown Collector Current with Base Forward Biased (V_{CE} = 28 V, t = 1 s) (V_{CE} = 45 V, t = 1 s)	$I_{S/b}$	 5 0.9		Adc
Second Breakdown Energy (V_{BE} = 4 V, R_{BE} = 20 Ω) (I_c = 12 A, L = 180 μH)	$E_{S/b}$	 13		mj
ON CHARACTERISTICS				
DC Current Gain (I_C = 2 Adc, V_{CE} = 5 V) (I_C = 10 Adc, V_{CE} = 5 V)	h_{FE}	 50 20	 250 100	—
Collector-Emitter Saturation Voltage (I_C = 10 Adc, I_B = 1 A) (I_C = 20 Adc, I_B = 1 A)	$V_{CE(sat)}$		 1.0 2.5	Vdc
Base-Emitter Saturation Voltage (I_C = 20 Adc, I_B = 5 A)	$V_{BE(sat)}$		 3.3	Vdc
DYNAMIC CHARACTERISTICS				
Forward Current Transfert Ratio (V_{CE} = 10 V, I_C = 2 A, f = 5 MHz)	$\lvert h_{FE} \rvert$	 12		
Output Capacitance (V_{CB} = 10 V, F = 1 MHz)			 300	pF

SWITCHING CHARACTERISTICS (Resistive Load)

Rise Time	(V_{CC} = 30 Vdc, I_C = 10 A, I_{B1} = 1.0 A, I_{B2} = 1.0 A)	t_{on}	—	0.5	μs
Storage Time		t_s	—	1.5	
Fall Time		t_f	—	0.5	

(1) Pulse Test: Pulse Width ⩽ 300 μs, Duty Cycle ⩽ 2.0%.

FIGURE 2 – ACTIVE REGION SAFE OPERATING AREA



There are two limitations on the power handling ability of a transistor: average junction temperature and second breakdown. Safe operating area curves indicate I_C-V_{CE} limits of the transistor that must be observed for reliable operation i.e., the transistor must not be subjected to greater dissipation than the curves indicate.

The data of figure 2 is based on $T_C = 25°C$; $T_{J(pk)}$ is variable depending on power level. Second breakdown limitations do not derate the same as thermal limitations.

At high case temperatures, thermal limitations will reduce the power that can handled to values less than the limitations imposed by second breakdown. (See AN415A)

FIGURE 3 – "ON" VOLTAGES

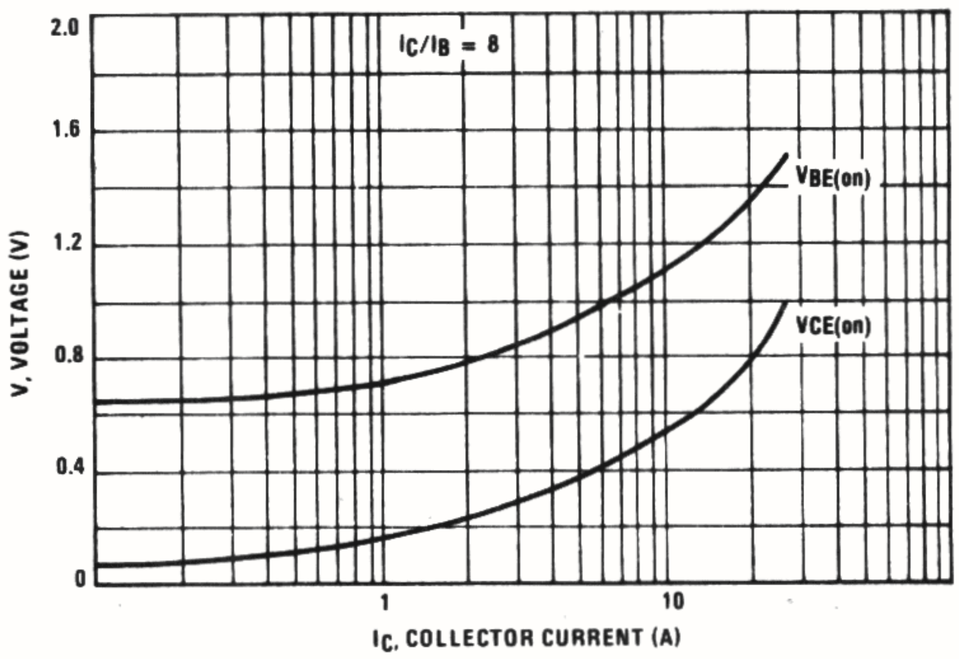


FIGURE 4 – DC CURRENT GAIN

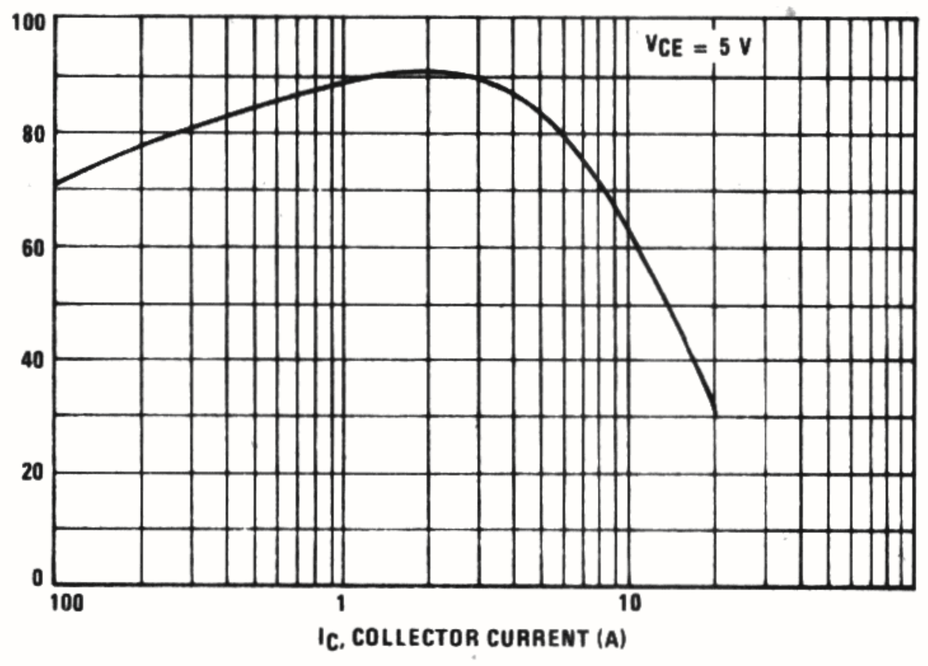


FIGURE 5 – RESISTIVE SWITCHING PERFORMANCE

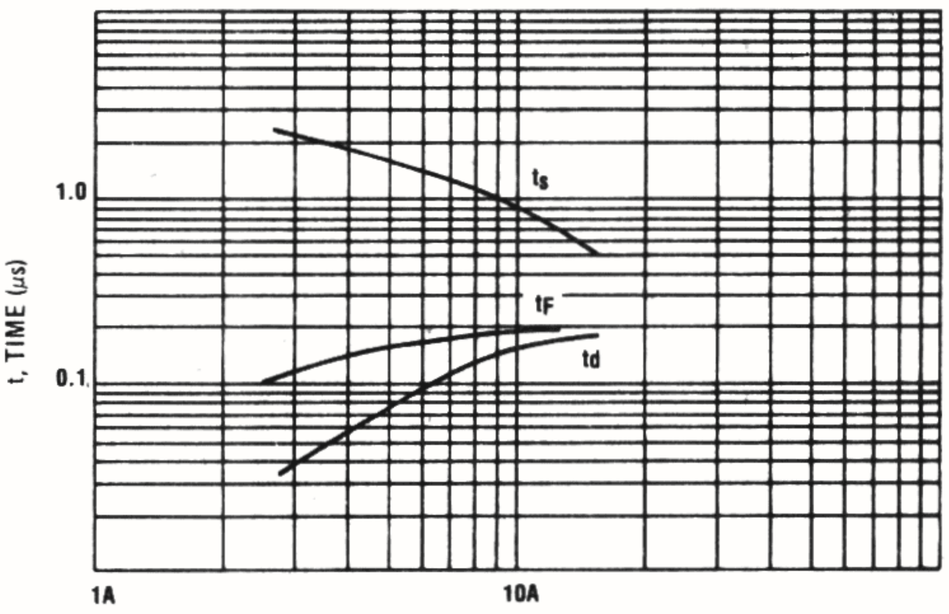


FIGURE 6 – SWITCHING TIMES TEST CIRCUIT