2N5859

CASE 79-02, STYLE 1
TO-39 (TO-205AD)

SWITCHING TRANSISTOR

NPN SILICON

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MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	V_{CEO}	40	Vdc
Collector-Base Voltage	V_{CBO}	80	Vdc
Emitter-Base Voltage	V_{EBO}	6.0	Vdc
Collector Current — Continuous	I_C	2.0	Adc
Total Device Dissipation @ T_A = 25°C Derate above 25°C	P_D	1.0 6.0	Watt mW/°C
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

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	35	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	175	°C/W

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

Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS				
Collector-Emitter Breakdown Voltage(1) (I_C = 10 mAdc, I_B = 0)	$V_{(BR)CEO}$	40	—	Vdc
Collector-Base Breakdown Voltage (I_C = 100 μAdc, I_E = 0)	$V_{(BR)CBO}$	80	—	Vdc
Emitter-Base Breakdown Voltage (I_E = 10 μAdc, I_C = 0)	$V_{(BR)EBO}$	6.0	—	Vdc
Collector Cutoff Current (V_{CE} = 50 Vdc, $V_{BE(off)}$ = 2.0 Vdc) (V_{CE} = 50 Vdc, $V_{BE(off)}$ = 2.0 Vdc, T_A = 75°C)	I_{CEX}	— —	0.2 5.0	μAdc
Collector Cutoff Current (V_{CB} = 50 Vdc, I_E = 0) (V_{CB} = 50 Vdc, I_E = 0, T_A = 75°C)	I_{CBO}	— —	0.25 5.0	μAdc
Emitter Cutoff Current (V_{BE} = 5.0 Vdc, I_C = 0)	I_{EBO}	—	0.1	μAdc
ON CHARACTERISTICS				
DC Current Gain (I_C = 500 mAdc, V_{CE} = 1.0 Vdc) (I_C = 1.0 Adc, V_{CE} = 1.0 Vdc) (I_C = 1.0 Adc, V_{CE} = 1.0 Vdc, T_A = −55°C)	h_{FE}	30 15 10	120 100 —	—
Collector-Emitter Saturation Voltage (I_C = 500 mAdc, I_B = 50 mAdc) (I_C = 1.0 Adc, I_B = 100 mAdc)	$V_{CE(sat)}$	— —	0.4 0.7	Vdc
Base-Emitter Saturation Voltage (I_C = 500 mAdc, I_B = 50 mAdc) (I_C = 1.0 Adc, I_B = 100 mAdc)	$V_{BE(sat)}$	0.8 0.9	1.0 1.25	Vdc
SMALL-SIGNAL CHARACTERISTICS				
Current-Gain — Bandwidth Product (I_C = 50 mAdc, V_{CE} = 10 Vdc, f = 100 MHz)	f_T	250	—	MHz
Collector-Base Capacitance (V_{CB} = 10 Vdc, I_E = 0, f = 100 kHz)	C_{cb}	—	7.0	pF
Emitter-Base Capacitance (V_{EB} = 0.5 Vdc, I_C = 0, f = 100 kHz)	C_{eb}	—	60	pF
SWITCHING CHARACTERISTICS				
Delay Time (V_{CC} = 30 Vdc, $V_{BE(off)}$ = 2.0 Vdc, I_C = 1.0 Adc, I_{B1} = 100 mAdc) (Figures 8 and 10)	t_d	—	6.0	ns
Rise Time (V_{CC} = 30 Vdc, $V_{BE(off)}$ = 2.0 Vdc, I_C = 1.0 Adc, I_{B1} = 100 mAdc) (Figures 8 and 10)	t_r	—	30	ns
Storage Time (V_{CC} = 30 Vdc, I_C = 1.0 Adc, I_{B1} = I_{B2} = 100 mAdc) (Figures 9 and 11)	t_s	—	35	ns
Fall Time (V_{CC} = 30 Vdc, I_C = 1.0 Adc, I_{B1} = I_{B2} = 100 mAdc) (Figures 9 and 11)	t_f	—	35	ns

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

Characteristic	Symbol	Min	Max	Unit
Turn-On Time (V_{CC} = 30 Vdc, $V_{BE(off)}$ = 2.0 Vdc, I_C = 1.0 Adc, I_{B1} = 100 mAdc) (Figures 8 and 10)	t_{on}	—	35	ns
Turn-Off Time (V_{CC} = 30 Vdc, I_C = 1.0 Adc, I_{B1} = I_{B2} = 100 mAdc) (Figures 9 and 11)	t_{off}	—	60	ns

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

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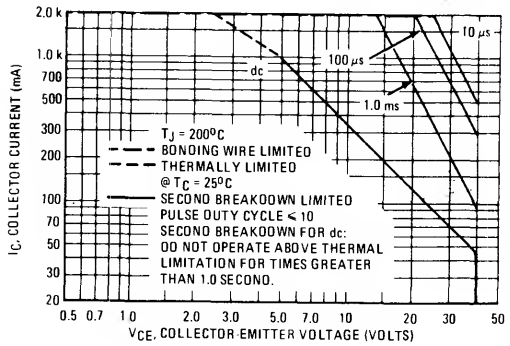
FIGURE 1 – ACTIVE-REGION SAFE OPERATING AREA



There are two limitations on the power handling ability of a transistor: 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 1 is based on $T_{J(pk)}$ = 200°C; T_C is variable depending on conditions. Pulse curves are valid for duty cycles of 10% provided $T_{J(pk)} \leq 200°C$. At high case temperatures, thermal limitations will reduce the power that can be handled to values less than the limitations imposed by second breakdown.

TYPICAL DC CHARACTERISTICS

FIGURE 2 – DC CURRENT GAIN

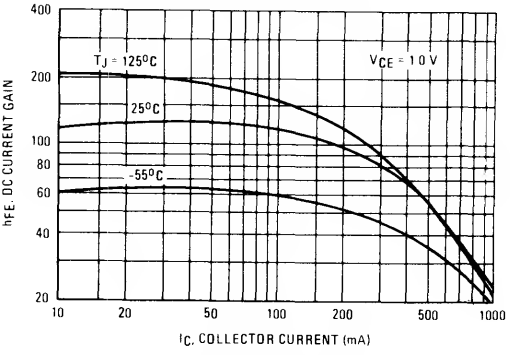


FIGURE 3 – "ON" VOLTAGES

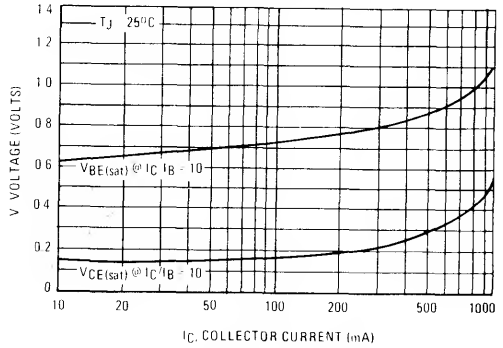


FIGURE 4 – COLLECTOR SATURATION REGION

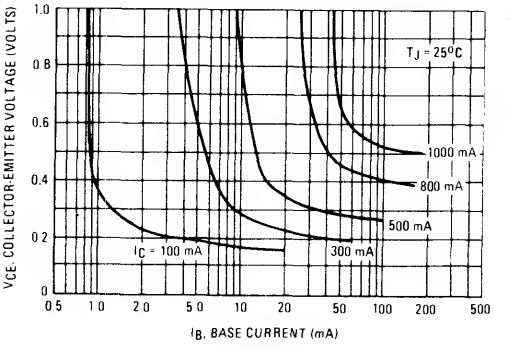
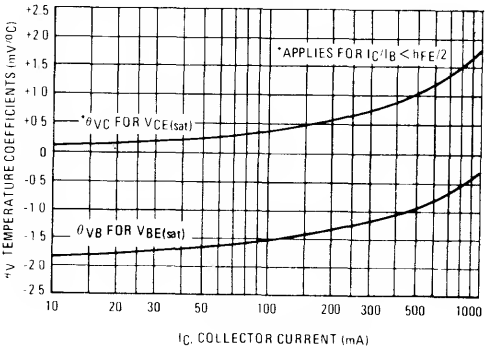


FIGURE 5 – TEMPERATURE COEFFICIENTS



TYPICAL DYNAMIC CHARACTERISTICS

FIGURE 6 – CURRENT-GAIN–BANDWIDTH PRODUCT

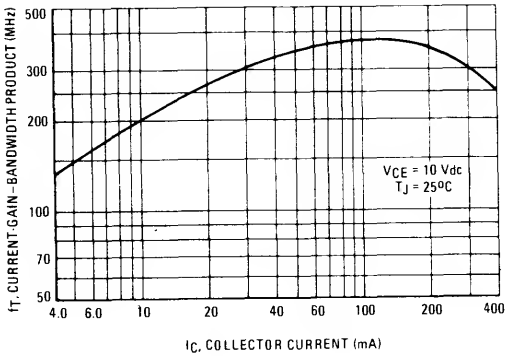


FIGURE 7 – CAPACITANCE

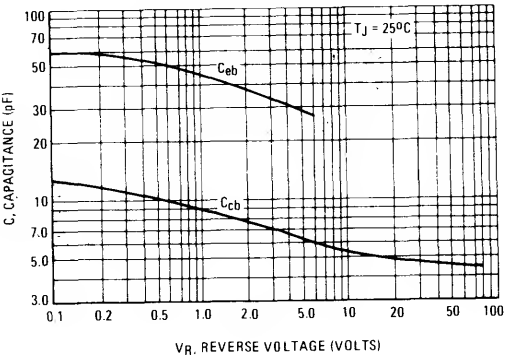


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FIGURE 8 – TURN-ON TIME

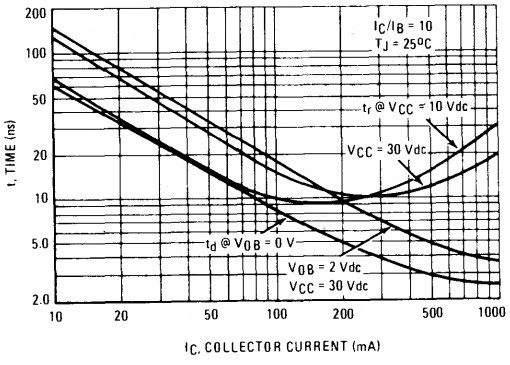

FIGURE 9 – TURN-OFF TIME

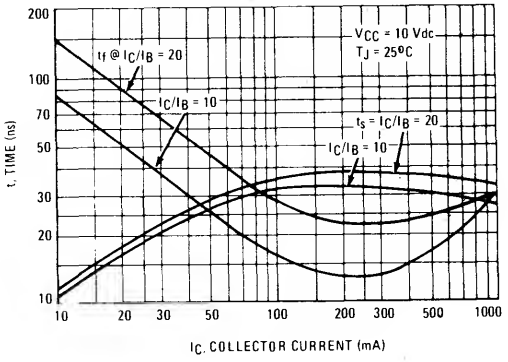

FIGURE 10 – TURN-ON TIME TEST CIRCUIT

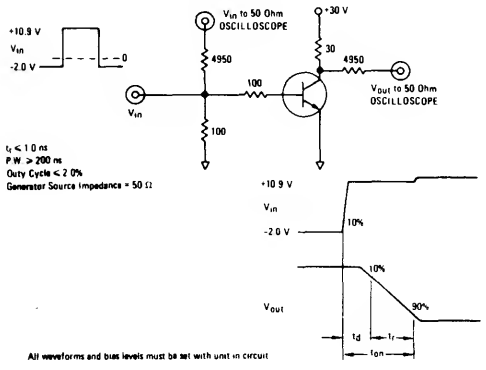

FIGURE 11 – TURN-OFF TIME TEST CIRCUIT