2N5190 thru 2N5192 (SILICON)
MJE5190 thru MJE5192

SILICON NPN POWER TRANSISTORS

. . . for use in power amplifier and switching circuits, – excellent safe area limits. Complement to PNP 2N5193, 2N5194, 2N5195 and MJE5193, MJE5194, MJE5195.

4 AMPERE
POWER TRANSISTORS
SILICON NPN

40-80 VOLTS
40 and 60 WATTS

*MAXIMUM RATINGS

Rating	Symbol	2N5190 MJE5190	2N5191 MJE5191	2N5192 MJE5192	Unit
Collector-Emitter Voltage	V_{CEO}	40	60	80	Vdc
Collector-Base Voltage	V_{CB}	40	60	80	Vdc
Emitter-Base Voltage	V_{EB}	← 5.0 →			Vdc
Collector Current	I_C	← 4.0 →			Adc
Base Current	I_B	← 1.0 →			Adc
		2N5190 Series	MJE5190 Series		
Total Device Dissipation @ $T_C = 25°C$ Derate above 25°C	P_D	40 320	60 480		Watts mW/°C
Operating and Storage Junction Temperature Range	T_J, T_{stg}	← -65 to +150 →			°C

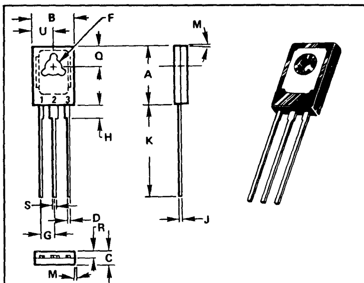
THERMAL CHARACTERISTICS

Characteristic	Symbol	2N5190 Series	MJE5190 Series	Unit
Thermal Resistance, Junction to Case	θ_{JC}	3.12	2.08	°C/W

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

Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Sustaining Voltage (1) ($I_C = 0.1$ Adc, $I_B = 0$)	2N5190,MJE5190 2N5191,MJE5191 2N5192,MJE5192	$V_{CEO(sus)}$	40 60 80	– – –	Vdc
Collector Cutoff Current ($V_{CE} = 40$ Vdc, $I_B = 0$) ($V_{CE} = 60$ Vdc, $I_B = 0$) ($V_{CE} = 80$ Vdc, $I_B = 0$)	2N5190,MJE5190 2N5191,MJE5191 2N5192,MJE5192	I_{CEO}	– – –	1.0 1.0 1.0	mAdc
Collector Cutoff Current ($V_{CE} = 40$ Vdc, $V_{EB(off)} = 1.5$ Vdc) ($V_{CE} = 60$ Vdc, $V_{EB(off)} = 1.5$ Vdc) ($V_{CE} = 80$ Vdc, $V_{EB(off)} = 1.5$ Vdc) ($V_{CE} = 40$ Vdc, $V_{EB(off)} = 1.5$ Vdc, $T_C = 125°C$) ($V_{CE} = 60$ Vdc, $V_{EB(off)} = 1.5$ Vdc, $T_C = 125°C$) ($V_{CE} = 80$ Vdc, $V_{EB(off)} = 1.5$ Vdc, $T_C = 125°C$)	2N5190,MJE5190 2N5191,MJE5191 2N5192,MJE5192 2N5190,MJE5190 2N5191,MJE5191 2N5192,MJE5192	I_{CEX}	– – – – – –	0.1 0.1 0.1 2.0 2.0 2.0	mAdc
Collector Cutoff Current ($V_{CB} = 40$ Vdc, $I_E = 0$) ($V_{CB} = 60$ Vdc, $I_E = 0$) ($V_{CB} = 80$ Vdc, $I_E = 0$)	2N5190,MJE5190 2N5191,MJE5191 2N5192,MJE5192	I_{CBO}	– – –	0.1 0.1 0.1	mAdc
Emitter Cutoff Current ($V_{BE} = 5.0$ Vdc, $I_C = 0$)		I_{EBO}	–	1.0	mAdc
ON CHARACTERISTICS					
DC Current Gain(1) ($I_C = 1.5$ Adc, $V_{CE} = 2.0$ Vdc) ($I_C = 4.0$ Adc, $V_{CE} = 2.0$ Vdc)	2N5190,MJE5190 2N5191,MJE5191 2N5192,MJE5192 2N5190,MJE5190 2N5191,MJE5191 2N5192,MJE5192	h_{FE}	25 25 20 10 10 7.0	100 100 80 – –	–
Collector-Emitter Saturation Voltage(1) ($I_C = 1.5$ Adc, $I_B = 0.15$ Adc) ($I_C = 4.0$ Adc, $I_B = 1.0$ Adc)		$V_{CE(sat)}$	– –	0.6 1.4	Vdc
Base-Emitter On Voltage (1) ($I_C = 1.5$ Adc, $V_{CE} = 2.0$ Vdc)		$V_{BE(on)}$	–	1.2	Vdc
DYNAMIC CHARACTERISTICS					
Current-Gain-Bandwidth Product ($I_C = 1.0$ Adc, $V_{CE} = 10$ Vdc, f = 1.0 MHz)		f_T	2.0	–	MHz

(1) Pulse Test: Pulse Width ≤300 μs, Duty Cycle ≤2.0%.
*Indicates JEDEC Registered Data for 2N5190 Series.

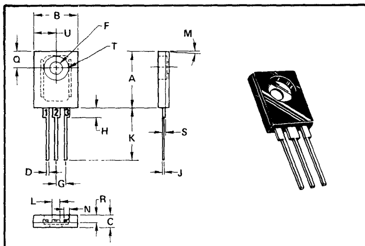


STYLE 1
PIN 1. EMITTER
2. COLLECTOR
3. BASE

2N5190
2N5191
2N5192

CASE 77-03

DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	10.80	11.05	0.425	0.435
B	7.49	7.75	0.295	0.305
C	2.41	2.67	0.095	0.105
D	0.51	0.66	0.020	0.026
F	2.92	3.00	0.115	0.118
G	2.36 BSC		0.093 BSC	
H	2.16	2.41	0.085	0.095
J	0.38	0.64	0.015	0.025
K	15.38	16.64	0.605	0.655
M	3° TYP		3° TYP	
Q	3.76	4.01	0.148	0.158
R	1.14	1.40	0.045	0.055
S	0.64	0.89	0.025	0.035
U	3.68	3.94	0.145	0.155



STYLE 1
PIN 1 BASE
2 COLLECTOR
3 EMITTER

MJE5190
MJE5191
MJE5192

CASE 199-04

DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	16.08	16.33	0.633	0.643
B	12.57	12.83	0.495	0.505
C	3 18	3 43	0 125	0.135
D	0 51	0 76	0 020	0.030
F	3.61	3.86	0 142	0 152
G	2 54 BSC		0.100 BSC	
H	2.67	2.92	0.105	0 115
J	0.43	0.69	0 017	0.027
K	14 73	14 99	0 580	0.590
L	2.16	2.41	0 085	0.095
M	3° TYP		3° TYP	
N	1.47	1.73	0.058	0.068
Q	4.78	5.03	0 188	0.198
R	1 91	2.16	0.075	0 085
S	0.81	0.86	0.032	0.034
T	6 99	7 24	0 275	0.285
U	6 22	6 48	0 245	0.255

NOTES
1 DIM "G" IS TO CENTER OF LEADS

FIGURE 1 – DC CURRENT GAIN

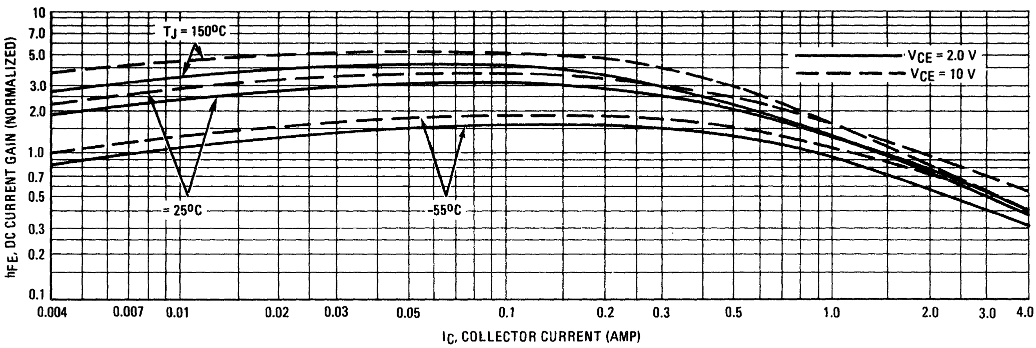


FIGURE 2 – COLLECTOR SATURATION REGION

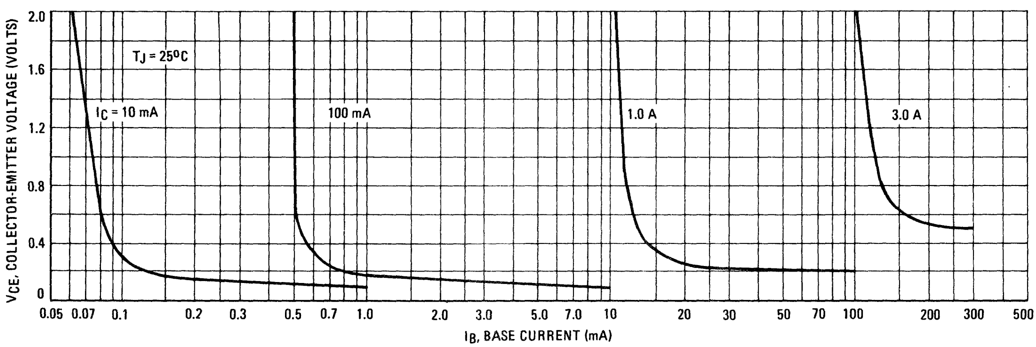


FIGURE 3 – "ON" VOLTAGES

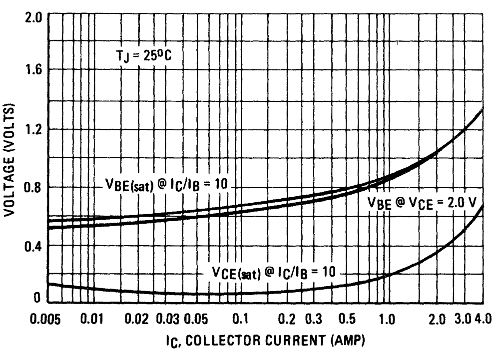


FIGURE 4 – TEMPERATURE COEFFICIENTS

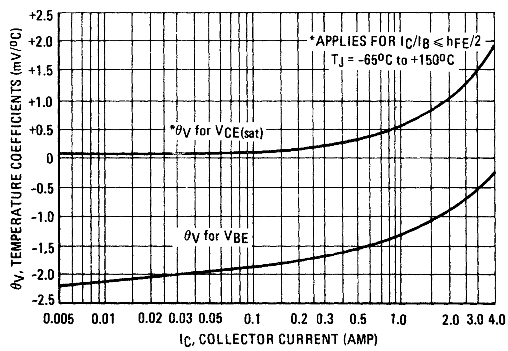


FIGURE 5 – COLLECTOR CUT-OFF REGION

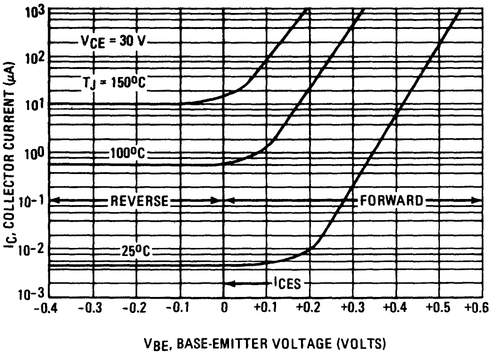


FIGURE 6 – EFFECTS OF BASE-EMITTER RESISTANCE

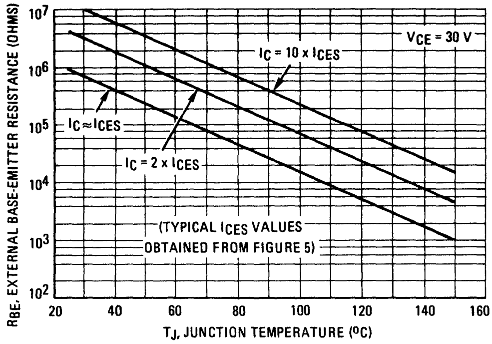


FIGURE 7 – SWITCHING TIME EQUIVALENT CIRCUIT

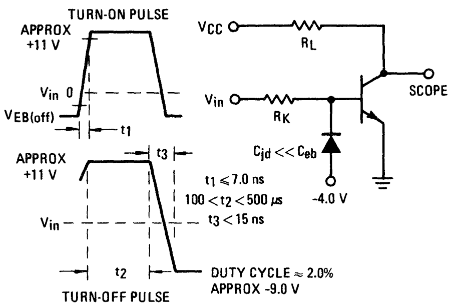


FIGURE 8 – CAPACITANCE

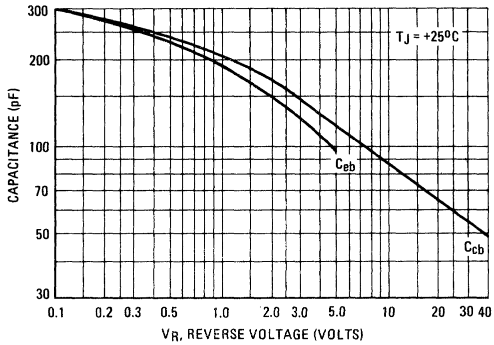


FIGURE 9 – TURN-ON TIME

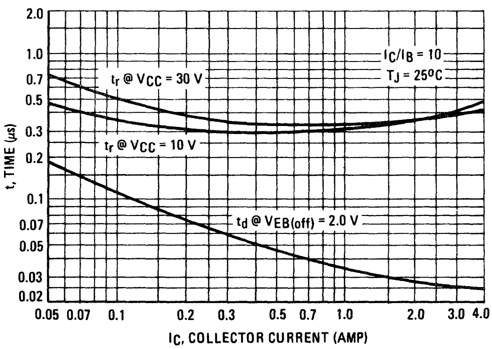
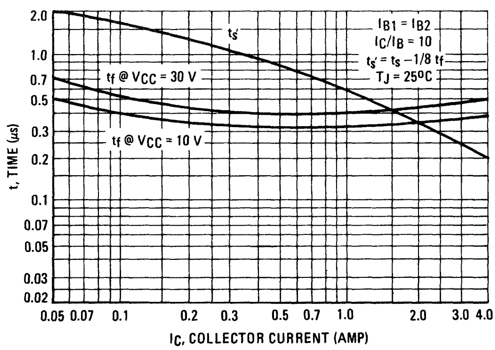


FIGURE 10 – TURN-OFF TIME



RATING AND THERMAL DATA
ACTIVE-REGION SAFE OPERATING AREA

FIGURE 11 – 2N5190, 2N5191, 2N5192

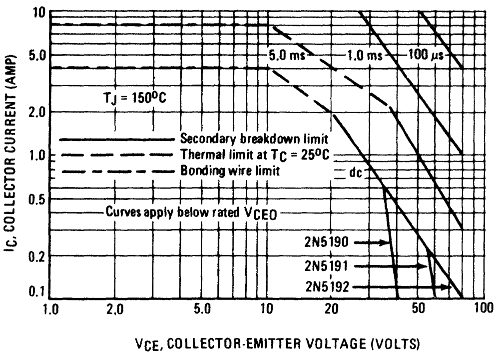
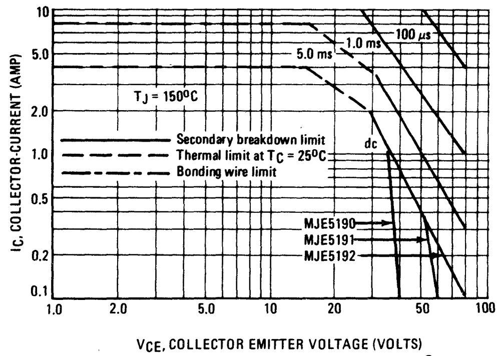


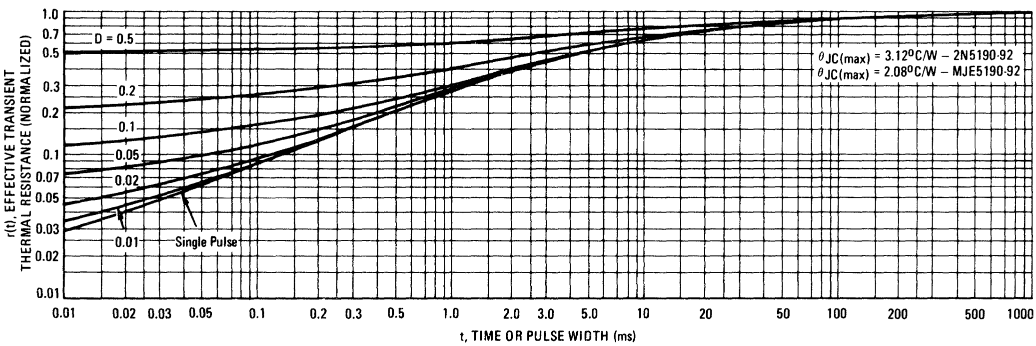
FIGURE 12 – MJE5190, MJE5191, MJE5192



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.

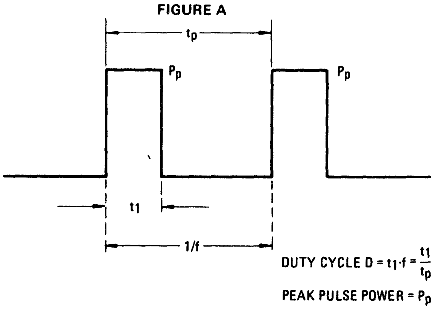
The data of Figures 11 and 12 is based on $T_{J(pk)} = 150^oC$; T_C is variable depending on conditions. Second breakdown pulse limits are valid for duty cycles to 10% provided $T_{J(pk)} \leq 150^oC$. At high case temperatures, thermal limitations will reduce the power that can be handled to values less than the limitations imposed by second breakdown. (See AN-415)

FIGURE 13 – THERMAL RESPONSE



DESIGN NOTE: USE OF TRANSIENT THERMAL RESISTANCE DATA

FIGURE A



A train of periodical power pulses can be represented by the model shown in Figure A. Using the model and the device thermal response, the normalized effective transient thermal resistance of Figure 13 was calculated for various duty cycles.

To find $\theta_{JC}(t)$, multiply the value obtained from Figure 13 by the steady state value θ_{JC}.

Example:

The 2N5190 is dissipating 50 watts under the following conditions: $t_1 = 0.1$ ms, $tp = 0.5$ ms. ($D = 0.2$).

Using Figure 13, at a pulse width of 0.1 ms and D = 0.2, the reading of $r(t_1, D)$ is 0.27.

The peak rise in junction temperature is therefore:

$$\Delta T = r(t) \times P_P \times \theta_{JC} = 0.27 \times 50 \times 3.12 = 42.2^oC$$