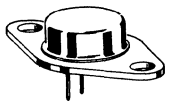
2N4231 thru 2N4233 (SILICON)

Medium-power NPN silicon transistors designed for driver circuits, switching, and amplifier applications.



CASE 80
(TO-66)

Collector connected to case

MAXIMUM RATINGS

Rating	Symbol	2N4231	2N4232	2N4233	Unit
Collector-Emitter Voltage	V_{CEO}	40	60	80	Vdc
Collector-Base Voltage	V_{CB}	50	70	90	Vdc
Emitter-Base Voltage	V_{EB}	5.0			Vdc
Collector Current - Continuous*	I_C*	3.0 5.0			Adc
Base Current	I_B	1.0			Adc
Total Device Dissipation T_C = 25°C Derate above 25°C	P_D	35 0.2			Watts W/°C
Operating & Storage Junction Temperature Range	T_J, T_{stg}	-55 to +200			°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	θ_{JC}	5.0	°C/W

* The 3.0 Amp maximum I_C value is based upon JEDEC current gain requirements.
The 5.0 Amp maximum value is based upon actual current-handling capability of the device.

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

Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Sustaining Voltage[1] (I_C = 100 mAdc, I_B = 0)	2N4231 2N4232 2N4233	$BV_{CEO(sus)}$	40 60 80	- - -	Vdc
Collector Cutoff Current (V_{CE} = 30 Vdc, I_B = 0) (V_{CE} = 50 Vdc, I_B = 0) (V_{CE} = 70 Vdc, I_B = 0)	 2N4231 2N4232 2N4233	I_{CEO}	 - - -	 1.0 1.0 1.0	mA
Collector Cutoff Current (V_{CE} @ rated V_{CEO}, $V_{EB(off)}$ = 1.5 Vdc) (V_{CE} @ rated V_{CEO}, $V_{EB(off)}$ = 1.5 Vdc, T_C = 150°C)		I_{CEX}	 - -	 0.1 1.0	mA
Collector Cutoff Current (V_{CB} @ rated V_{CB}, I_E = 0)		I_{CBO}	-	0.05	mA
Emitter Cutoff Current (V_{BE} = 5.0 V dc, I_C = 0)		I_{EBO}	-	500	μA
ON CHARACTERISTICS					
DC Current Gain[1] (I_C = 0.5 Adc, V_{CE} = 2.0 Vdc) (I_C = 1.5 Adc, V_{CE} = 2.0 Vdc) (I_C = 3.0 Adc, V_{CE} = 2.0 Vdc)		h_{FE}	 40 25 10	 - 100 -	-
Collector-Emitter Saturation Voltage[1] (I_C = 1.5 Adc, I_B = 0.15 Adc) (I_C = 3.0 Adc, I_B = 0.3 Adc)		$V_{CE(sat)}$	 - -	 0.7 2.0	Vdc
Base-Emitter Voltage[1] (I_C = 1.5 Adc, V_{CE} = 2.0 Vdc)		$V_{BE(on)}$	-	1.4	Vdc

[1] Pulse Test, PW ≈ 300 μs, Duty Cycle ≈ 2.0%

2N4231 thru 2N4233 (continued)

ELECTRICAL CHARACTERISTICS (continued)

Characteristic	Symbol	Min	Max	Unit
SMALL-SIGNAL CHARACTERISTICS				
Current-Gain–Bandwidth Product (I_C = 0.5 Adc, V_{CE} = 10 Vdc, f = 1.0 MHz)	f_T	4.0	-	MHz
Output Capacitance (V_{CB} = 10 Vdc, I_E = 0, f = 1.0 kHz)	C_{ob}	-	200	pF
Small-Signal Current Gain (I_C = 0.5 Adc, V_{CE} = 10 Vdc, f = 1.0 kHz)	h_{fe}	20	-	-

FIGURE 1 — NORMALIZED DC CURRENT GAIN

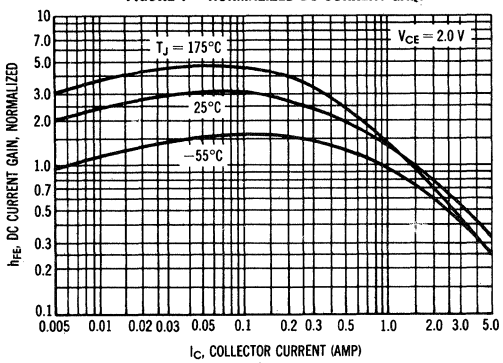


FIGURE 2 — COLLECTOR SATURATION REGION

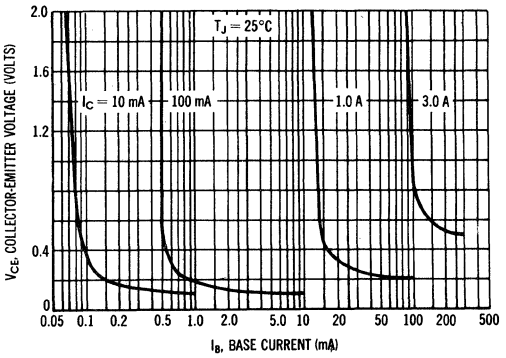


FIGURE 3 — "ON" VOLTAGES

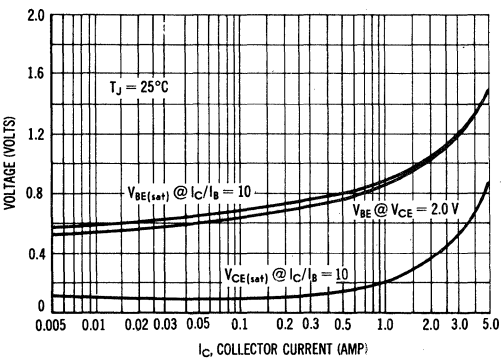


FIGURE 4 — TEMPERATURE COEFFICIENTS

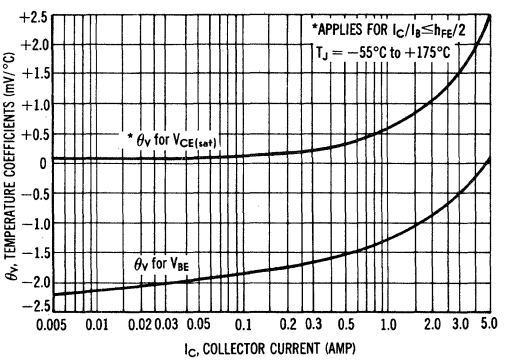


FIGURE 5 — SWITCHING TIME EQUIVALENT CIRCUIT

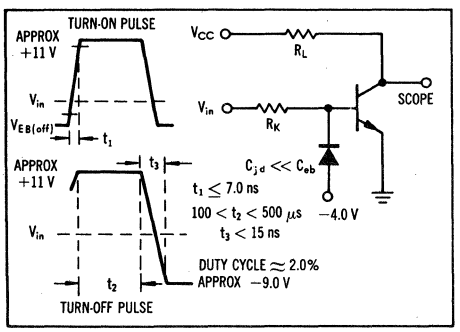


FIGURE 6 — CAPACITANCE

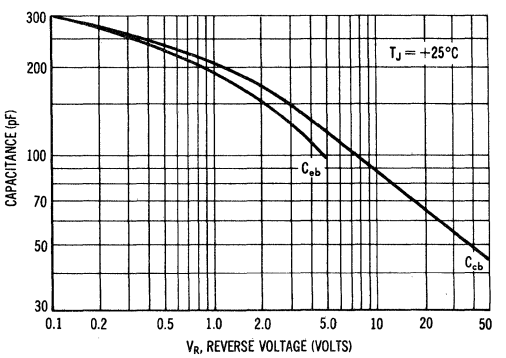


FIGURE 7 —TURN-ON TIME

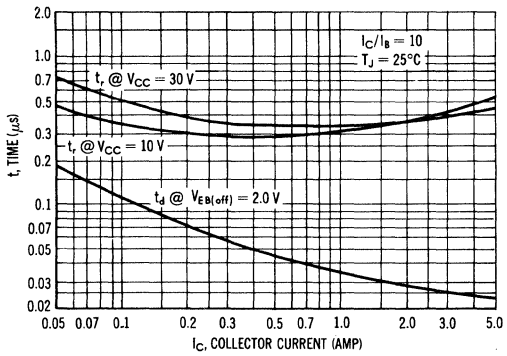
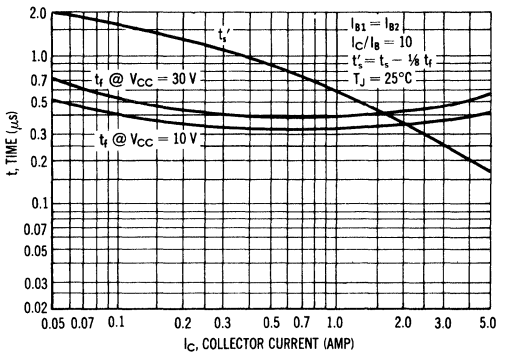


FIGURE 8 — TURN-OFF TIME



TYPICAL "OFF" REGION CHARACTERISTICS

FIGURE 9 — CUT-OFF REGION

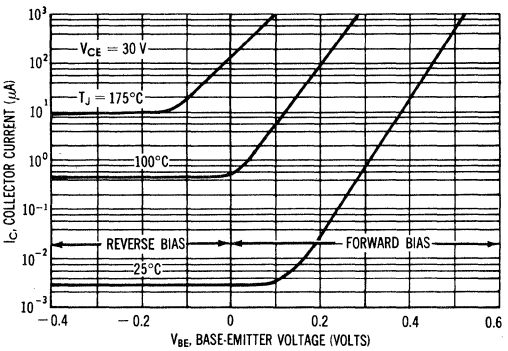


FIGURE 10 — EFFECTS OF BASE-EMITTER RESISTANCE

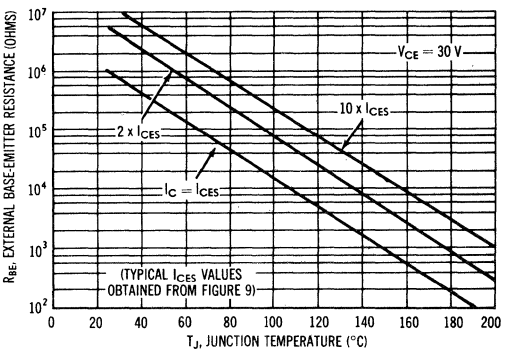
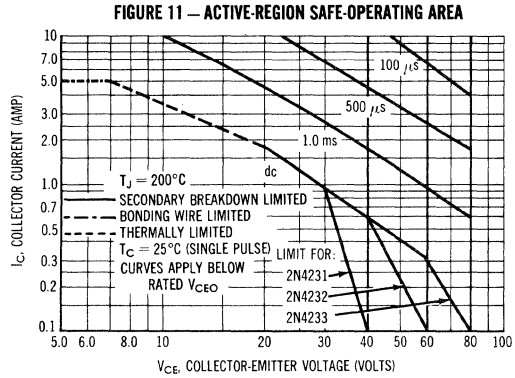


FIGURE 11 — ACTIVE-REGION SAFE-OPERATING AREA



There are two limitations on the power handling ability of a transistor: junction temperature and secondary 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 Figure11 is based on $T_{J(pk)} = 200°C$; T_C is variable depending on conditions. Pulse curves are valid for duty cycles to 10% provided $T_{J(pk)} < 200°C$. $T_{J(pk)}$ may be calculated from the data in Figure 12. At high case temperatures, thermal limitations will reduce the power that can be handled to values less than the limitations imposed by secondary breakdown.

FIGURE 12 — THERMAL RESPONSE