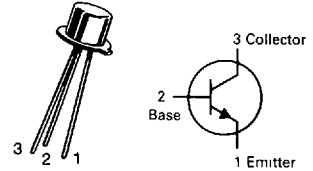


# 2N4014

CASE 22-03, STYLE 1  
TO-18 (TO-206AA)



## SWITCHING TRANSISTOR

NPN SILICON

### MAXIMUM RATINGS

Rating	Symbol	2N4014	Unit
Collector-Emitter Voltage	$V_{CE0}$	40	Vdc
Collector-Base Voltage	$V_{CBO}$	80	Vdc
Emitter-Base Voltage	$V_{EBO}$	6.0	Vdc
Collector Current — Continuous — Peak	$I_C$	1.0 2.0	Adc
Total Device Dissipation @ $T_A = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$	0.5 2.86	Watts mW/°C
Total Device Dissipation @ $T_C = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$	1.4 8.0	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 Ambient	$R_{\theta JA}$	350	°C/W
Thermal Resistance, Junction to Case	$R_{\theta JC}$	125	°C/W

### 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 (1) ( $I_C = 10 \text{ mAdc}, I_B = 0$ )	$V_{(BR)CEO}$	40	—	—	Vdc
Collector-Emitter Breakdown Voltage ( $I_C = 10 \mu\text{Adc}, V_{BE} = 0$ )	$V_{(BR)CES}$	80	—	—	Vdc
Collector-Base Breakdown Voltage ( $I_C = 10 \mu\text{Adc}, I_E = 0$ )	$V_{(BR)CBO}$	80	—	—	Vdc
Emitter-Base Breakdown Voltage ( $I_E = 10 \mu\text{Adc}, I_C = 0$ )	$V_{(BR)EBO}$	6.0	—	—	Vdc
Collector Cutoff Current ( $V_{CB} = 60 \text{ Vdc}, I_E = 0$ ) ( $V_{CB} = 60 \text{ Vdc}, I_E = 0, T_A = 100^\circ\text{C}$ )	$I_{CBO}$	— —	0.12	1.7 120	$\mu\text{Adc}$
Collector Cutoff Current ( $V_{CE} = 80 \text{ Vdc}, V_{EB} = 0$ )	$I_{CES}$	—	0.15	10	$\mu\text{Adc}$

### ON CHARACTERISTICS(1)

DC Current Gain ( $I_C = 10 \text{ mAdc}, V_{CE} = 1.0 \text{ Vdc}$ ) ( $I_C = 100 \text{ mAdc}, V_{CE} = 1.0 \text{ Vdc}$ ) ( $I_C = 100 \text{ mAdc}, V_{CE} = 1.0 \text{ Vdc}, T_A = -55^\circ\text{C}$ ) ( $I_C = 300 \text{ mAdc}, V_{CE} = 1.0 \text{ Vdc}$ ) ( $I_C = 500 \text{ mAdc}, V_{CE} = 1.0 \text{ Vdc}$ ) ( $I_C = 500 \text{ mAdc}, V_{CE} = 1.0 \text{ Vdc}, T_A = -55^\circ\text{C}$ ) ( $I_C = 800 \text{ mAdc}, V_{CE} = 2.0 \text{ Vdc}$ ) ( $I_C = 1.0 \text{ Adc}, V_{CE} = 5.0 \text{ Vdc}$ )	$h_{FE}$	30	—	—	—
		60	—	150	—
		30	—	—	—
		40	—	—	—
		35	—	—	—
		20	—	—	—
		20	—	—	—
		25	—	—	—

(continued)

6367254 0103863 147

**ELECTRICAL CHARACTERISTICS** (continued) (T<sub>A</sub> = 25°C unless otherwise noted.)

Characteristic	Symbol	Min	Typ	Max	Unit
Collector-Emitter Saturation Voltage (I <sub>C</sub> = 10 mAdc, I <sub>B</sub> = 1.0 mAdc) (I <sub>C</sub> = 100 mAdc, I <sub>B</sub> = 10 mAdc) (I <sub>C</sub> = 300 mAdc, I <sub>B</sub> = 30 mAdc) (I <sub>C</sub> = 500 mAdc, I <sub>B</sub> = 50 mAdc) (I <sub>C</sub> = 800 mAdc, I <sub>B</sub> = 80 mAdc) (I <sub>C</sub> = 1.0 mAdc, I <sub>B</sub> = 100 mAdc)	V <sub>CE(sat)</sub>	—	0.17 0.19 0.25 0.30 0.43 0.55	0.25 0.26 0.40 0.52 0.80 0.95	Vdc
Base-Emitter Saturation Voltage (I <sub>C</sub> = 10 mAdc, I <sub>B</sub> = 1.0 mAdc) (I <sub>C</sub> = 100 mAdc, I <sub>B</sub> = 10 mAdc) (I <sub>C</sub> = 300 mAdc, I <sub>B</sub> = 30 mAdc) (I <sub>C</sub> = 500 mAdc, I <sub>B</sub> = 50 mAdc) (I <sub>C</sub> = 800 mAdc, I <sub>B</sub> = 80 mAdc) (I <sub>C</sub> = 1.0 Adc, I <sub>B</sub> = 100 mAdc)	V <sub>BE(sat)</sub>	— — 0.8 — — —	— — — — — —	0.76 0.86 1.1 1.1 1.5 1.7	Vdc

**SMALL-SIGNAL CHARACTERISTICS**

Current-Gain — Bandwidth Product(2) (I <sub>C</sub> = 50 mAdc, V <sub>CE</sub> = 10 Vdc, f = 100 MHz)	f <sub>T</sub>	300	—	—	MHz
Output Capacitance (V <sub>CB</sub> = 10 Vdc, I <sub>E</sub> = 0, f = 1.0 MHz)	C <sub>obo</sub>	—	—	10	pF
Input Capacitance (V <sub>EB</sub> = 0.5 Vdc, I <sub>C</sub> = 0, f = 1.0 MHz)	C <sub>ibo</sub>	—	—	55	pF

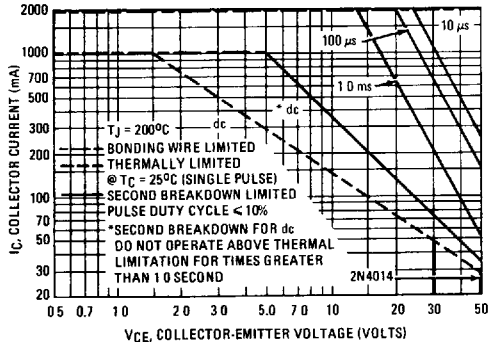
**SWITCHING CHARACTERISTICS**

Delay Time	(V <sub>CC</sub> = 30 Vdc, V <sub>BE(off)</sub> = 3.8 Vdc, I <sub>C</sub> = 500 mAdc, I <sub>B1</sub> = 50 mAdc) (Figures 8,10)	t <sub>d</sub>	—	5.0	10	ns
Rise Time		t <sub>r</sub>	—	15	30	
Storage Time	(V <sub>CC</sub> = 30 Vdc, I <sub>C</sub> = 500 mAdc, I <sub>B1</sub> = I <sub>B2</sub> = 50 mAdc) (Figures 9,10)	t <sub>s</sub>	—	30	50	ns
Fall Time		t <sub>f</sub>	—	20	25	ns
Turn-On Time	(V <sub>CC</sub> = 30 Vdc, V <sub>BE(off)</sub> = 3.8 Vdc, I <sub>C</sub> = 500 mAdc, I <sub>B1</sub> = 50 mAdc) (Figures 8, 10)	t <sub>on</sub>	—	20	35	ns
Turn-Off Time	(V <sub>CC</sub> = 30 Vdc, I <sub>C</sub> = 500 mAdc, I <sub>B1</sub> = I <sub>B2</sub> = 50 mAdc) (Figures 9, 10)	t <sub>off</sub>	—	50	60	ns

(1) Pulse Test: Pulse Width = 300 μs, Duty Cycle = 1.0%.

(2) f<sub>T</sub> = |h<sub>fe</sub>| • f<sub>test</sub>.

FIGURE 1 — ACTIVE-REGION SAFE OPERATING AREA



TYPICAL DC CHARACTERISTICS

FIGURE 2 – DC CURRENT GAIN

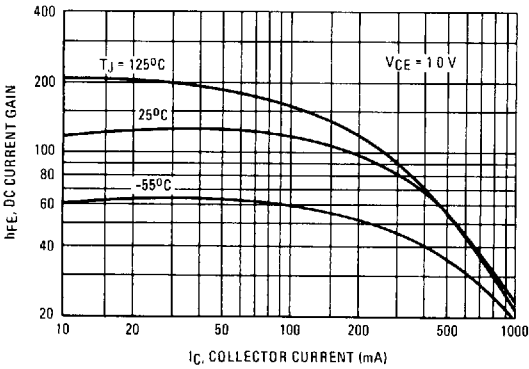


FIGURE 3 – "ON" VOLTAGES

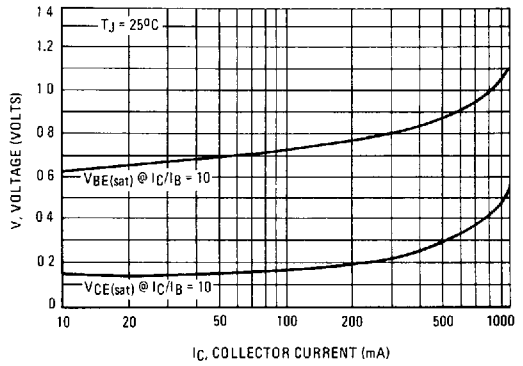


FIGURE 4 – COLLECTOR SATURATION REGION

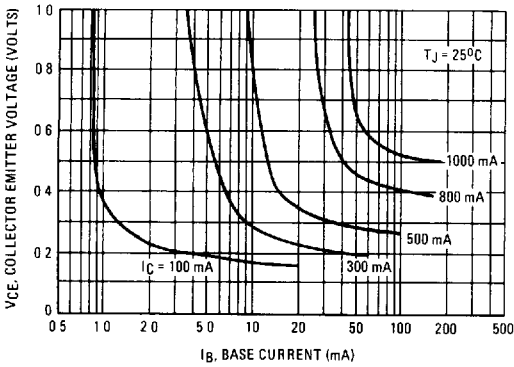
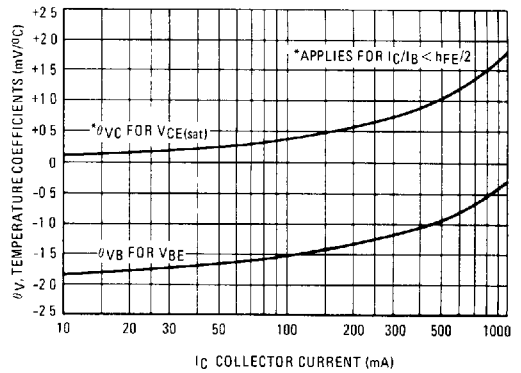


FIGURE 5 – TEMPERATURE COEFFICIENTS



TYPICAL DYNAMIC CHARACTERISTICS

FIGURE 6 – CURRENT-GAIN – BANDWIDTH PRODUCT

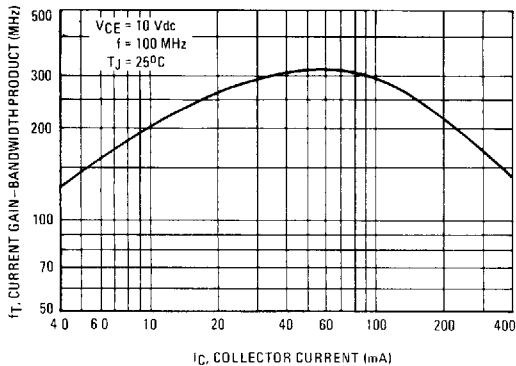


FIGURE 7 – CAPACITANCE

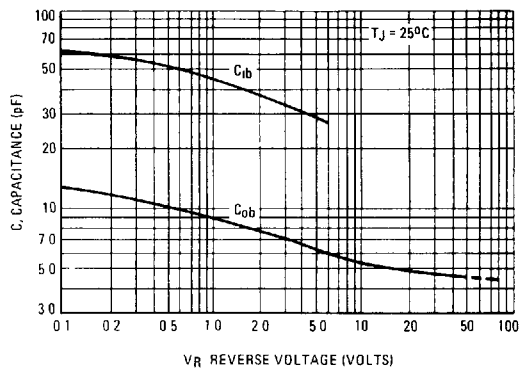


FIGURE 8 – TURN-ON TIME

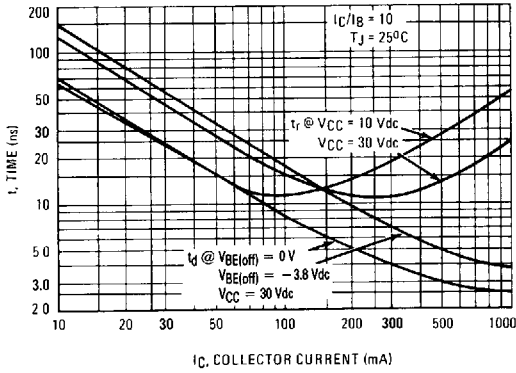


FIGURE 9 – TURN OFF TIME

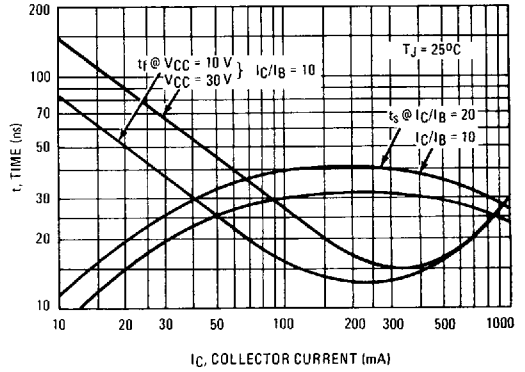


FIGURE 10 – SWITCHING TIME TEST CIRCUIT

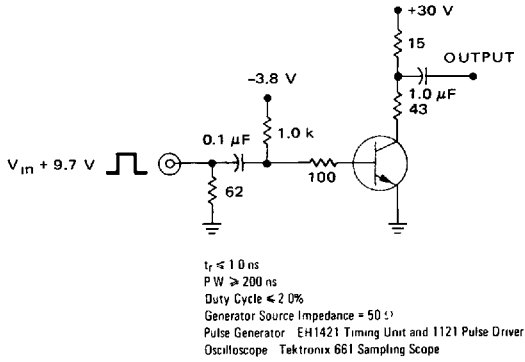


FIGURE 11 – COLLECTOR CUTOFF CURRENT

