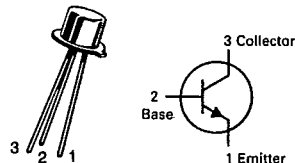


2N4013

2N4014

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



SWITCHING TRANSISTORS

NPN SILICON

MAXIMUM RATINGS

Rating	Symbol	2N4013	2N4014	Unit
Collector-Emitter Voltage	V_{CE0}	30	50	Vdc
Collector-Base Voltage	V_{CBO}	50	80	Vdc
Emitter-Base Voltage	V_{EBO}	6.0		Vdc
Collector Current — Continuous	I_C	1.0		Adc
— Peak		2.0		
Total Device Dissipation @ $T_A = 25^\circ\text{C}$	P_D	0.5		Watt
Derate above 25°C		28.6		
Total Device Dissipation @ $T_C = 25^\circ\text{C}$	P_D	1.4		Watts
Derate above 25°C		6.8		
Operating and Storage Junction Temperature Range	T_J, T_{stg}	-65 to +200		$^\circ\text{C}$

ELECTRICAL CHARACTERISTICS ($T_A = 25^\circ\text{C}$ unless otherwise noted.)

Characteristic	Symbol	Min	Typ	Max	Unit
----------------	--------	-----	-----	-----	------

OFF CHARACTERISTICS

Collector-Emitter Breakdown Voltage(1) ($I_C = 10 \text{ mAdc}, I_B = 0$)	2N4014 2N4013	$V_{(BR)CEO}$	50 30	— —	— —	Vdc	
Collector-Emitter Breakdown Voltage ($I_C = 10 \mu\text{Adc}, V_{BE} = 0$)	2N4014 2N4013	$V_{(BR)CES}$	80 50	— —	— —	Vdc	
Collector-Base Breakdown Voltage ($I_C = 10 \mu\text{Adc}, I_E = 0$)	2N4014 2N4013	$V_{(BR)CBO}$	80 50	— —	— —	Vdc	
Emitter-Base Breakdown Voltage ($I_E = 10 \mu\text{Adc}, I_C = 0$)		$V_{(BR)EBO}$	6.0	—	—	Vdc	
Collector Cutoff Current ($V_{CB} = 60 \text{ Vdc}, I_E = 0$) ($V_{CB} = 40 \text{ Vdc}, I_E = 0$) ($V_{CB} = 60 \text{ Vdc}, I_E = 0, T_A = 100^\circ\text{C}$) ($V_{CB} = 40 \text{ Vdc}, I_E = 0, T_A = 100^\circ\text{C}$)	2N4014 2N4013 2N4014 2N4013	I_{CBO}	— — — —	0.12 0.12 — —	1.7 1.7 120 120	μAdc	
Collector Cutoff Current ($V_{CE} = 80 \text{ Vdc}, V_{EB} = 0$) ($V_{CE} = 50 \text{ Vdc}, V_{EB} = 0$)	2N4014 2N4013		I_{CES}	— —	0.15 0.15	10 10	μAdc

ON CHARACTERISTICS(1)

DC Current Gain ($I_C = 10 \text{ mAdc}, V_{CE} = 1.0 \text{ Vdc}$) ($I_C = 100 \text{ mAdc}, V_{CE} = 1.0 \text{ Vdc}$) ($I_C = 100 \text{ mAdc}, V_{CE} = 1.0 \text{ Vdc}, T_A = -55^\circ\text{C}$) ($I_C = 300 \text{ mAdc}, V_{CE} = 1.0 \text{ Vdc}$) ($I_C = 500 \text{ mAdc}, V_{CE} = 1.0 \text{ Vdc}$) ($I_C = 500 \text{ mAdc}, V_{CE} = 1.0 \text{ Vdc}, T_A = -55^\circ\text{C}$) ($I_C = 800 \text{ mAdc}, V_{CE} = 2.0 \text{ Vdc}$)	2N4014 2N4013 2N4014 2N4013	h_{FE}	30 60 30 40 35 20 20	— — — — — — —	— 150 — — — — —	—
($I_C = 1.0 \text{ Adc}, V_{CE} = 5.0 \text{ Vdc}$)	2N4014 2N4013		25 25 30	— — —	— — —	—

ELECTRICAL CHARACTERISTICS (continued) ($T_A = 25^\circ\text{C}$ unless otherwise noted.)

Characteristic	Symbol	Min	Typ	Max	Unit	
Collector-Emitter Saturation Voltage ($I_C = 10\text{ mAdc}$, $I_B = 1.0\text{ mAdc}$)	$V_{CE(sat)}$	—	0.17	0.25	Vdc	
		—	0.17	0.25		
	($I_C = 100\text{ mAdc}$, $I_B = 10\text{ mAdc}$)	2N4014	—	0.19		0.26
		2N4013	—	0.19		0.20
	($I_C = 300\text{ mAdc}$, $I_B = 30\text{ mAdc}$)	2N4014	—	0.25		0.40
		2N4013	—	0.25		0.32
	($I_C = 500\text{ mAdc}$, $I_B = 50\text{ mAdc}$)	2N4014	—	0.30		0.52
		2N4013	—	0.30		0.42
	($I_C = 800\text{ mAdc}$, $I_B = 80\text{ mAdc}$)	2N4014	—	0.43		0.80
		2N4013	—	0.43		0.65
	($I_C = 1.0\text{ Adc}$, $I_B = 100\text{ mAdc}$)	2N4014	—	0.55		0.95
		2N4013	—	0.55		0.75
Base-Emitter Saturation Voltage ($I_C = 10\text{ mAdc}$, $I_B = 1.0\text{ mAdc}$)	$V_{BE(sat)}$	—	—	0.76	Vdc	
		—	—	0.86		
		—	—	1.1		
		—	—	1.1		
		0.8	—	1.1		
		—	—	1.5		
		—	—	1.7		

SMALL-SIGNAL CHARACTERISTICS

Current-Gain — Bandwidth Product(2) ($I_C = 50\text{ mAdc}$, $V_{CE} = 10\text{ Vdc}$, $f = 100\text{ MHz}$)	f_T	300	—	—	MHz
Output Capacitance ($V_{CB} = 10\text{ Vdc}$, $I_E = 0$, $f = 1.0\text{ MHz}$)	C_{obo}	—	—	10	pF
Input Capacitance ($V_{EB} = 0.5\text{ Vdc}$, $I_C = 0$, $f = 1.0\text{ MHz}$)	C_{ibo}	—	—	55	pF

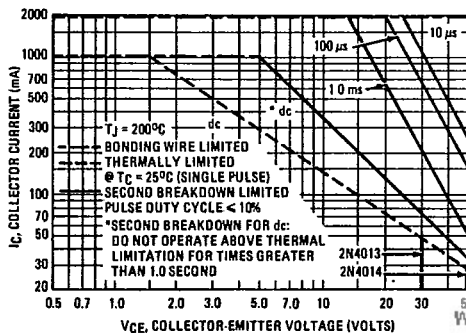
SWITCHING CHARACTERISTICS

Delay Time	$(V_{CC} = 30\text{ Vdc}$, $V_{BE(off)} = 3.8\text{ Vdc}$, $I_C = 500\text{ mAdc}$, $I_{B1} = 50\text{ mAdc}$) (Figures 8, 10)	2N4014 2N4013	t_d	—	5.0	10	ns
Rise Time			t_r	—	15	30	ns
Storage Time	$(V_{CC} = 30\text{ Vdc}$, $I_C = 500\text{ mAdc}$, $I_{B1} = I_{B2} = 50\text{ mAdc}$) (Figures 9, 10)	2N4014 2N4013	t_s	—	30	50	ns
Fall Time			t_f	—	20	25	30
Turn-On Time	$(V_{CC} = 30\text{ Vdc}$, $V_{BE(off)} = 3.8\text{ Vdc}$, $I_C = 500\text{ mAdc}$, $I_{B1} = 50\text{ mAdc}$) (Figures 8, 10)		t_{on}	—	20	35	ns
Turn-Off Time	$(V_{CC} = 30\text{ Vdc}$, $I_C = 500\text{ mAdc}$, $I_{B1} = I_{B2} = 50\text{ mAdc}$) (Figures 9, 10)	2N4014 2N4013	t_{off}	—	50	60	ns

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

(2) $f_T = |h_{fe}| \cdot f_{test}$.

FIGURE 1 — ACTIVE-REGION SAFE OPERATING AREA



www.DataSheet4U.com

TYPICAL DC CHARACTERISTICS

FIGURE 2 — DC CURRENT GAIN

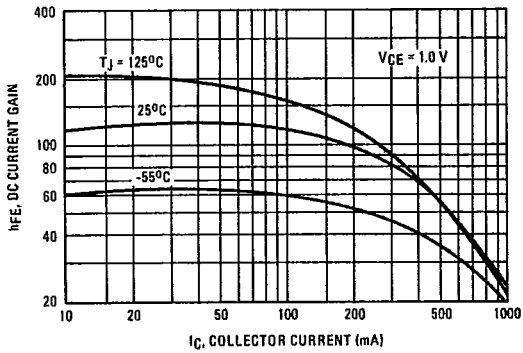


FIGURE 3 — "ON" VOLTAGES

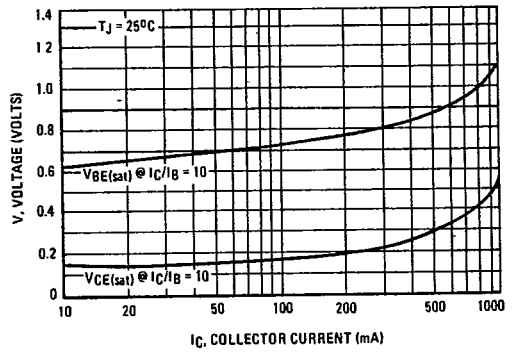


FIGURE 4 — COLLECTOR SATURATION REGION

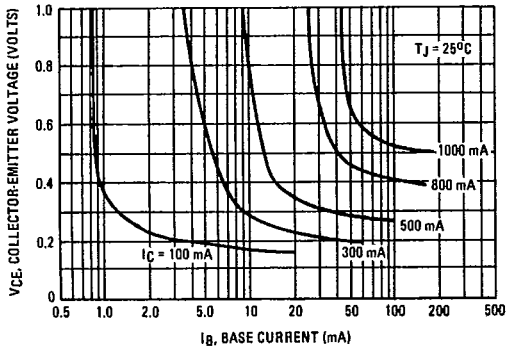
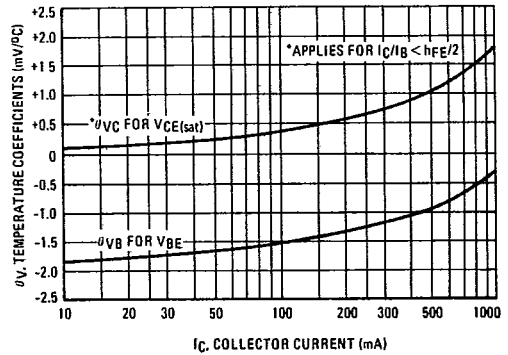


FIGURE 5 — TEMPERATURE COEFFICIENTS



TYPICAL DYNAMIC CHARACTERISTICS

FIGURE 6 — CURRENT-GAIN — BANDWIDTH PRODUCT

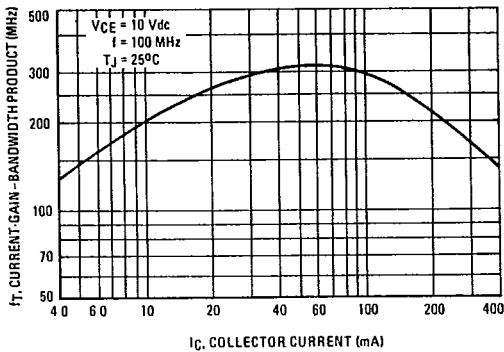
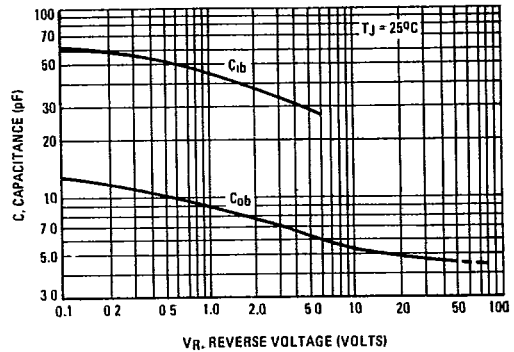
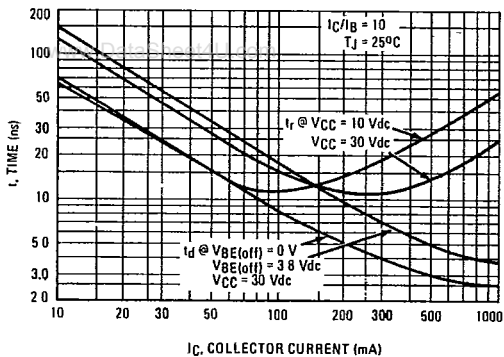
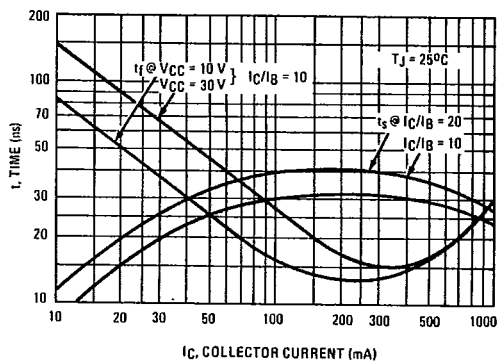
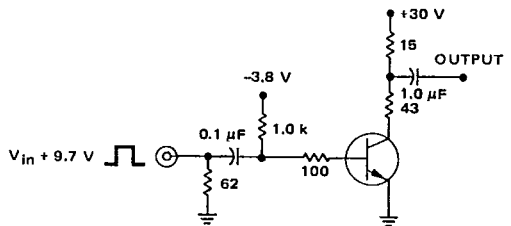


FIGURE 7 — CAPACITANCE



www.DataSheet4U.com

FIGURE 8 – TURN-ON TIME

FIGURE 9 – TURN-OFF TIME

FIGURE 10 – SWITCHING TIME TEST CIRCUIT


$t_r < 10$ ns
 $PW > 200$ ns
 Duty Cycle ≤ 2 0%
 Generator Source Impedance = 50 Ω
 Pulse Generator EH1421 Timing Unit and 1121 Pulse Driver
 Oscilloscope Tektronix 661 Sampling Scope

FIGURE 11 – COLLECTOR CUTOFF CURRENT
