

2N4400 (SILICON)
2N4401



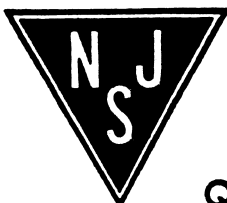
NPN silicon annular transistors designed for general purpose switching and amplifier applications and for complementary circuitry with PNP types 2N4402 and 2N4403. Features one - piece, injection - molded plastic package for high reliability.

MAXIMUM RATINGS ($T_A = 25^\circ\text{C}$ unless otherwise noted)

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	V_{CEO}	40	Vdc
Collector-Base Voltage	V_{CB}	60	Vdc
Emitter-Base Voltage	V_{EB}	6.0	Vdc
Collector Current - Continuous	I_C	600	mA dc
Total Device Dissipation $T_A = 25^\circ\text{C}$	P_D	350	mW
Derate above 25°C		2.73	mW/ $^\circ\text{C}$
Operating & Storage Junction Temperature Range	T_J, T_{stg}	-55 to +150	$^\circ\text{C}$

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	θ_{JC}	0.137	$^\circ\text{C}/\text{mW}$
Thermal Resistance, Junction to Ambient	θ_{JA}	0.357	$^\circ\text{C}/\text{mW}$



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2N4400, 2N4401 (continued)

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

Characteristic	Fig. No.	Symbol	Min	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage* ($I_C = 1 \text{ mAdc}$, $I_B = 0$)		BV_{CEO}	40	—	Vdc
Collector-Base Breakdown Voltage ($I_C = 0.1 \text{ mAdc}$, $I_E = 0$)		BV_{CBO}	60	—	Vdc
Emitter-Base Breakdown Voltage ($I_E = 0.1 \text{ mAdc}$, $I_C = 0$)		BV_{EBO}	6.0	—	Vdc
Collector Cutoff Current ($V_{CE} = 30 \text{ Vdc}$, $V_{EB}(\text{off}) = 0.4 \text{ Vdc}$)		I_{CEX}	—	0.1	μA
Base Cutoff Current ($V_{CE} = 30 \text{ Vdc}$, $V_{EB}(\text{off}) = 0.4 \text{ Vdc}$)		I_{BL}	—	0.1	μA

ON CHARACTERISTICS

DC Current Gain ($I_C = 0.1 \text{ mAdc}$, $V_{CE} = 1 \text{ Vdc}$)	2N4401	15	h_{FE}	20	—	—
($I_C = 1 \text{ mAdc}$, $V_{CE} = 1 \text{ Vdc}$)	2N4400 2N4401			20 40	—	—
($I_C = 10 \text{ mAdc}$, $V_{CE} = 1 \text{ Vdc}$)	2N4400 2N4401			40 80	—	—
($I_C = 150 \text{ mAdc}$, $V_{CE} = 1 \text{ Vdc}$)*	2N4400 2N4401			50 100	150 300	—
($I_C = 500 \text{ mAdc}$, $V_{CE} = 2 \text{ Vdc}$)*	2N4400 2N4401			20 40	—	—
Collector-Emitter Saturation Voltage* ($I_C = 150 \text{ mAdc}$, $I_B = 15 \text{ mAdc}$)		16, 17, 18	$V_{CE}(\text{sat})$	—	0.4	Vdc
($I_C = 500 \text{ mAdc}$, $I_B = 50 \text{ mAdc}$)				—	0.75	—
Base-Emitter Saturation Voltage* ($I_C = 150 \text{ mAdc}$, $I_B = 15 \text{ mAdc}$)		17, 18	$V_{BE}(\text{sat})$	0.75	0.95	Vdc
($I_C = 500 \text{ mAdc}$, $I_B = 50 \text{ mAdc}$)				—	1.2	—

SMALL-SIGNAL CHARACTERISTICS

Current-Gain — Bandwidth Product ($I_C = 20 \text{ mAdc}$, $V_{CE} = 10 \text{ Vdc}$, $f = 100 \text{ MHz}$)	2N4400 2N4401		f_T	200 250	—	MHz
Collector-Base Capacitance ($V_{CB} = 5 \text{ Vdc}$, $I_E = 0$, $f = 100 \text{ kHz}$, emitter guarded)		3	C_{cb}	—	6.5	pF
Emitter-Base Capacitance ($V_{BE} = 0.5 \text{ Vdc}$, $I_C = 0$, $f = 100 \text{ kHz}$, collector guarded)		3	C_{eb}	—	30	pF
Input Impedance ($I_C = 1 \text{ mAdc}$, $V_{CE} = 10 \text{ Vdc}$, $f = 1 \text{ kHz}$)	2N4400 2N4401	12	h_{ie}	0.5 1.0	7.5 15	k ohms
Voltage Feedback Ratio ($I_C = 1 \text{ mAdc}$, $V_{CE} = 10 \text{ Vdc}$, $f = 1 \text{ kHz}$)		13	h_{re}	0.1	5.0	$\times 10^{-4}$
Small-Signal Current Gain ($I_C = 1 \text{ mAdc}$, $V_{CE} = 10 \text{ Vdc}$, $f = 1 \text{ kHz}$)	2N4400 2N4401	11	h_{fe}	20 40	250 500	—
Output Admittance ($I_C = 1 \text{ mAdc}$, $V_{CE} = 10 \text{ Vdc}$, $f = 1 \text{ kHz}$)		14	h_{oe}	1.0	30	μmhos

SWITCHING CHARACTERISTICS

Delay Time	$V_{CC} = 30 \text{ Vdc}$, $V_{EB}(\text{off}) = 2 \text{ Vdc}$, $I_C = 150 \text{ mAdc}$, $I_{B1} = 15 \text{ mAdc}$	1, 5	t_d	—	15	ns
Rise Time		1, 5, 6	t_r	—	20	ns
Storage Time	$V_{CC} = 30 \text{ Vdc}$, $I_C = 150 \text{ mAdc}$, $I_{B1} = I_{B2} = 15 \text{ mAdc}$	2, 7	t_s	—	230	ns
Fall Time		2, 8	t_f	—	30	ns

*Pulse Test: Pulse Width $\leq 300 \mu\text{s}$, Duty Cycle $\leq 2\%$

SWITCHING TIME EQUIVALENT TEST CIRCUITS

FIGURE 1 — TURN-ON TIME

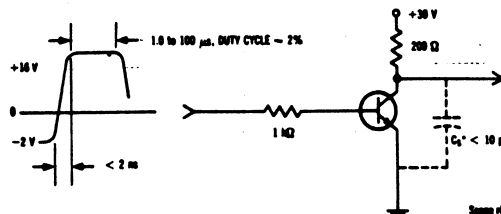
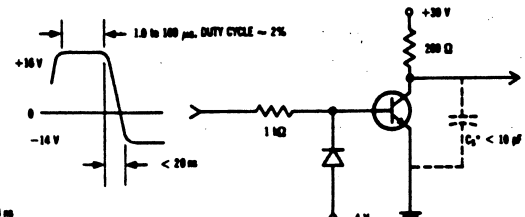
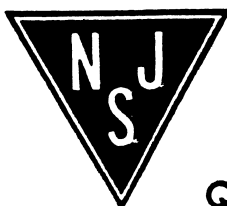


FIGURE 2 — TURN-OFF TIME



Slope rise time $< 4 \text{ ns}$
*Total circuit capacitance of test jig, connectors, and oscilloscope



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