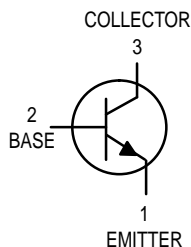


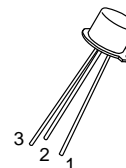
# Switching Transistors

## NPN Silicon



**2N2369**  
**2N2369A\***

\*Motorola Preferred Device



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

### MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector–Emitter Voltage	$V_{CEO}$	15	Vdc
Collector–Emitter Voltage	$V_{CES}$	40	Vdc
Collector–Base Voltage	$V_{CBO}$	40	Vdc
Emitter–Base Voltage	$V_{EBO}$	4.5	Vdc
Collector Current (10 $\mu$ s pulse)	$I_C(\text{Peak})$	500	mA
Collector Current — Continuous	$I_C$	200	mA
Total Device Dissipation @ $T_A = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$	0.36 2.06	Watt mW/ $^\circ\text{C}$
Total Device Dissipation @ $T_C = 100^\circ\text{C}$ Derate above $100^\circ\text{C}$	$P_D$	0.68 6.85	Watts mW/ $^\circ\text{C}$
Operating and Storage Junction Temperature Range	$T_J, T_{stg}$	$-65$ to $+200$	$^\circ\text{C}$

### THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	486	$^\circ\text{C}/\text{W}$
Thermal Resistance, Junction to Case	$R_{\theta JC}$	147	$^\circ\text{C}/\text{W}$

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

Characteristic	Symbol	Min	Max	Unit
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### OFF CHARACTERISTICS

Collector–Emitter Breakdown Voltage ( $I_C = 10 \mu\text{A}$ , $V_{BE} = 0$ )	$V_{(BR)CES}$	40	—	Vdc
Collector–Emitter Sustaining Voltage <sup>(1)</sup> ( $I_C = 10 \text{ mAdc}$ , $I_B = 0$ )	$V_{CEO(sus)}$	15	—	Vdc
Collector–Base Breakdown Voltage ( $I_C = 10 \mu\text{A}$ , $I_B = 0$ )	$V_{(BR)CBO}$	40	—	Vdc
Emitter–Base Breakdown Voltage ( $I_E = 10 \mu\text{Adc}$ , $I_C = 0$ )	$V_{(BR)EBO}$	4.5	—	Vdc
Collector Cutoff Current ( $V_{CB} = 20 \text{ Vdc}$ , $I_E = 0$ ) ( $V_{CB} = 20 \text{ Vdc}$ , $I_E = 0$ , $T_A = 150^\circ\text{C}$ )	$I_{CBO}$	— —	0.4 30	$\mu\text{Adc}$
Collector Cutoff Current ( $V_{CE} = 20 \text{ Vdc}$ , $V_{BE} = 0$ )	$I_{CES}$	—	0.4	$\mu\text{Adc}$
Base Current ( $V_{CE} = 20 \text{ Vdc}$ , $V_{BE} = 0$ )	$I_B$	—	0.4	$\mu\text{Adc}$

1. Pulse Test: Pulse Width  $\leq 300 \mu\text{s}$ , Duty Cycle  $\leq 2.0\%$ .

Preferred devices are Motorola recommended choices for future use and best overall value.

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

Characteristic	Symbol	Min	Max	Unit
<b>ON CHARACTERISTICS</b>				
DC Current Gain <sup>(1)</sup> ( $I_C = 10\text{ mAdc}$ , $V_{CE} = 1.0\text{ Vdc}$ )	$h_{FE}$	40	120	—
2N2369		—	120	
2N2369A		—	120	
( $I_C = 10\text{ mAdc}$ , $V_{CE} = 1.0\text{ Vdc}$ , $T_A = -55^\circ\text{C}$ )		20	—	
( $I_C = 10\text{ mAdc}$ , $V_{CE} = 0.35\text{ Vdc}$ , $T_A = -55^\circ\text{C}$ )		20	—	
( $I_C = 30\text{ mAdc}$ , $V_{CE} = 0.4\text{ Vdc}$ )		30	—	
( $I_C = 100\text{ mAdc}$ , $V_{CE} = 1.0\text{ Vdc}$ )		20	—	
( $I_C = 100\text{ mAdc}$ , $V_{CE} = 2.0\text{ Vdc}$ )		20	—	
Collector–Emitter Saturation Voltage <sup>(1)</sup> ( $I_C = 10\text{ mAdc}$ , $I_B = 1.0\text{ mAdc}$ )	$V_{CE(sat)}$	—	0.25	Vdc
2N2369		—	0.20	
2N2369A		—	0.20	
( $I_C = 10\text{ mAdc}$ , $I_B = 1.0\text{ mAdc}$ , $T_A = +125^\circ\text{C}$ )		—	0.30	
( $I_C = 30\text{ mAdc}$ , $I_B = 3.0\text{ mAdc}$ )		—	0.25	
( $I_C = 100\text{ mAdc}$ , $I_B = 10\text{ mAdc}$ )		—	0.50	
Base–Emitter Saturation Voltage <sup>(1)</sup> ( $I_C = 10\text{ mAdc}$ , $I_B = 1.0\text{ mAdc}$ )	$V_{BE(sat)}$	0.70	0.85	Vdc
( $I_C = 10\text{ mAdc}$ , $I_B = 1.0\text{ mAdc}$ , $T_A = +125^\circ\text{C}$ )		0.59	—	
( $I_C = 10\text{ mAdc}$ , $I_B = 1.0\text{ mAdc}$ , $T_A = -55^\circ\text{C}$ )		—	1.02	
( $I_C = 30\text{ mAdc}$ , $I_B = 3.0\text{ mAdc}$ )		—	1.15	
( $I_C = 100\text{ mAdc}$ , $I_B = 10\text{ mAdc}$ )		—	1.60	

**SMALL–SIGNAL CHARACTERISTICS**

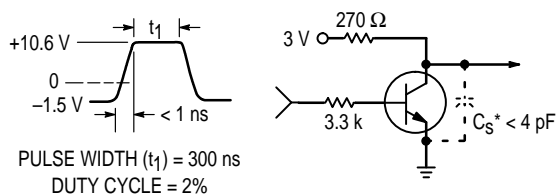
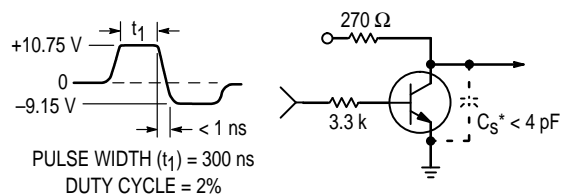
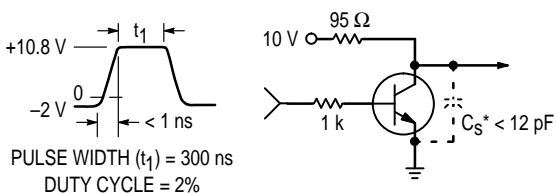
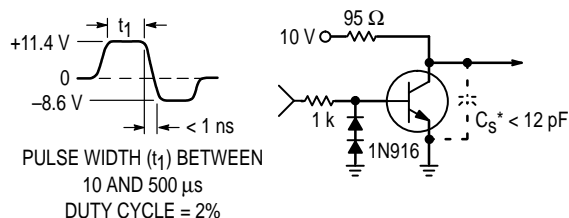
Current–Gain — Bandwidth Product ( $I_C = 10\text{ mAdc}$ , $V_{CE} = 10\text{ Vdc}$ , $f = 100\text{ MHz}$ )	$f_T$	500	—	MHz
Output Capacitance ( $V_{CB} = 5.0\text{ Vdc}$ , $I_E = 0$ , $f = 1.0\text{ MHz}$ )	$C_{obo}$	—	4.0	pF
Input Capacitance ( $V_{EB} = 1.0\text{ Vdc}$ , $I_C = 0$ , $f = 1.0\text{ MHz}$ )	$C_{ibo}$	—	4.0	pF

**SWITCHING CHARACTERISTICS**

Storage Time ( $I_C = I_{B1} = 10\text{ mAdc}$ , $I_{B2} = -10\text{ mAdc}$ )	$t_s$	—	13	ns
Turn–On Time ( $I_C = 10\text{ mAdc}$ , $I_{B1} = 3.0\text{ mA}$ , $I_{B2} = -1.5\text{ mA}$ , $V_{CC} = 3.0\text{ Vdc}$ )	$t_{on}$	—	12	ns
Turn–Off Time ( $I_C = 10\text{ mAdc}$ , $I_{B1} = 3.0\text{ mA}$ , $I_{B2} = -1.5\text{ mA}$ , $V_{CC} = 3.0\text{ Vdc}$ )	$t_{off}$	—	18	ns

1. Pulse Test: Pulse Width  $\leq 300\text{ }\mu\text{s}$ , Duty Cycle  $\leq 2.0\%$ .

## SWITCHING TIME EQUIVALENT TEST CIRCUITS FOR 2N2369, 2N3227

Figure 1.  $t_{on}$  Circuit — 10 mAFigure 3.  $t_{off}$  Circuit — 10 mAFigure 2.  $t_{on}$  Circuit — 100 mAFigure 4.  $t_{off}$  Circuit — 100 mA

\* Total shunt capacitance of test jig and connectors.

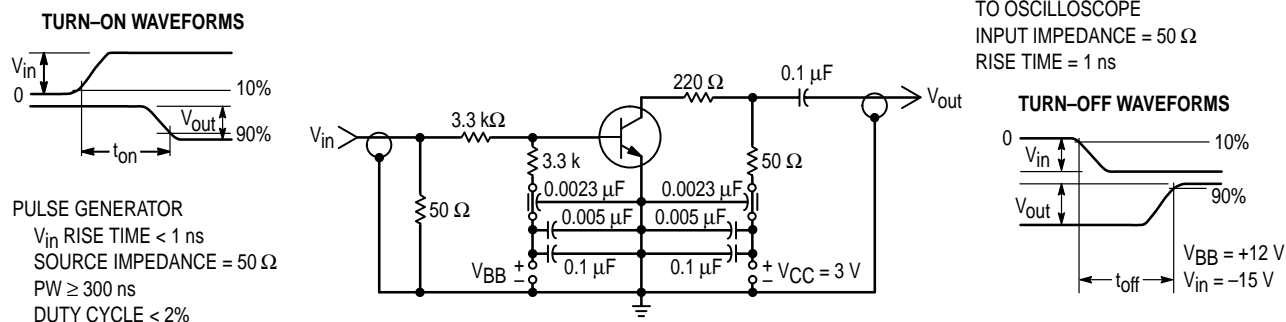


Figure 5. Turn-On and Turn-Off Time Test Circuit

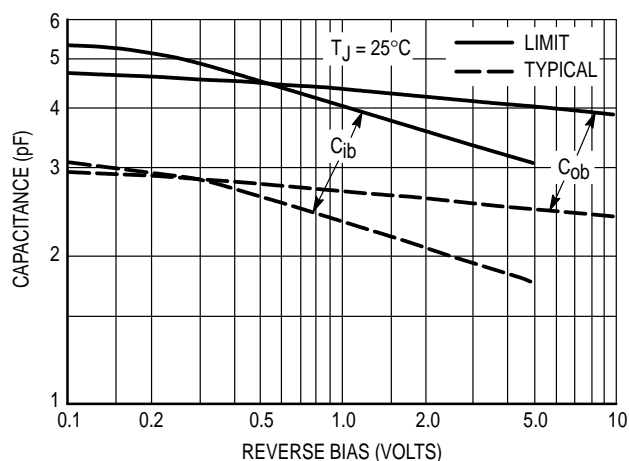


Figure 6. Junction Capacitance Variations

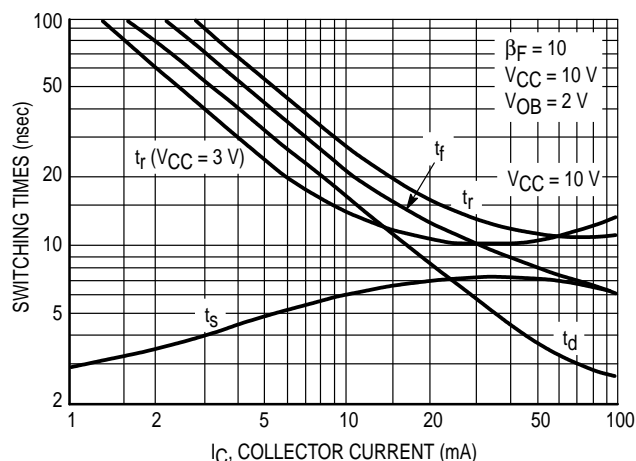


Figure 7. Typical Switching Times

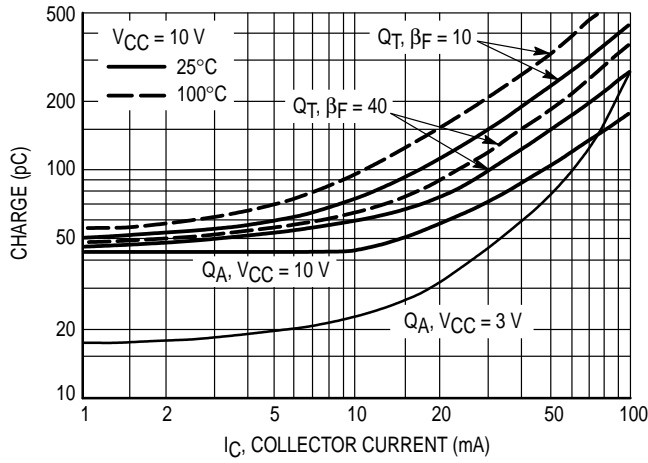


Figure 8. Maximum Charge Data

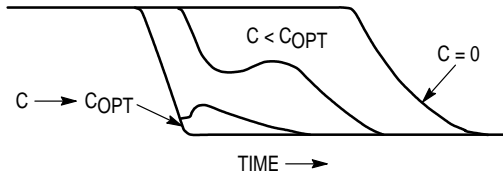


Figure 10. Turn-Off Waveform

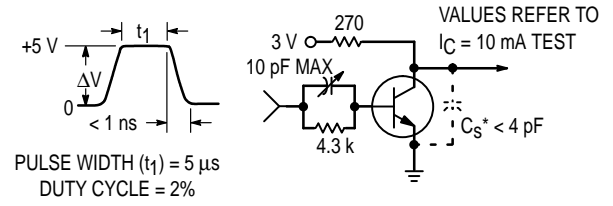


Figure 9.  $Q_T$  Test Circuit

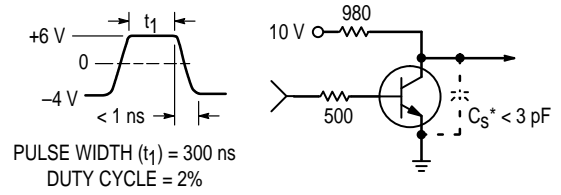


Figure 11. Storage Time Equivalent Test Circuit

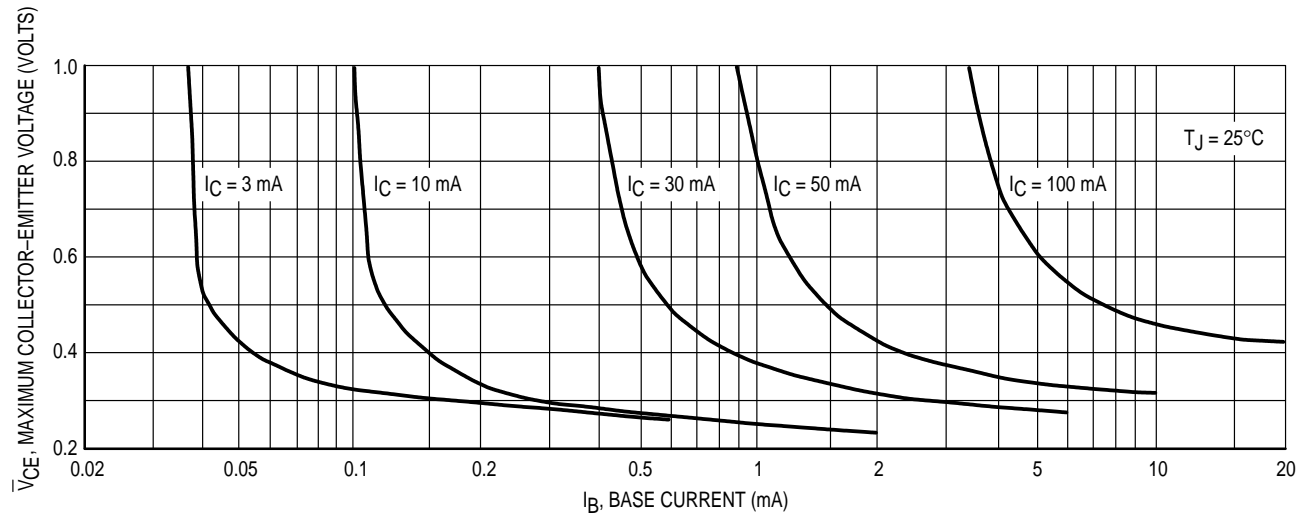


Figure 12. Maximum Collector Saturation Voltage Characteristics

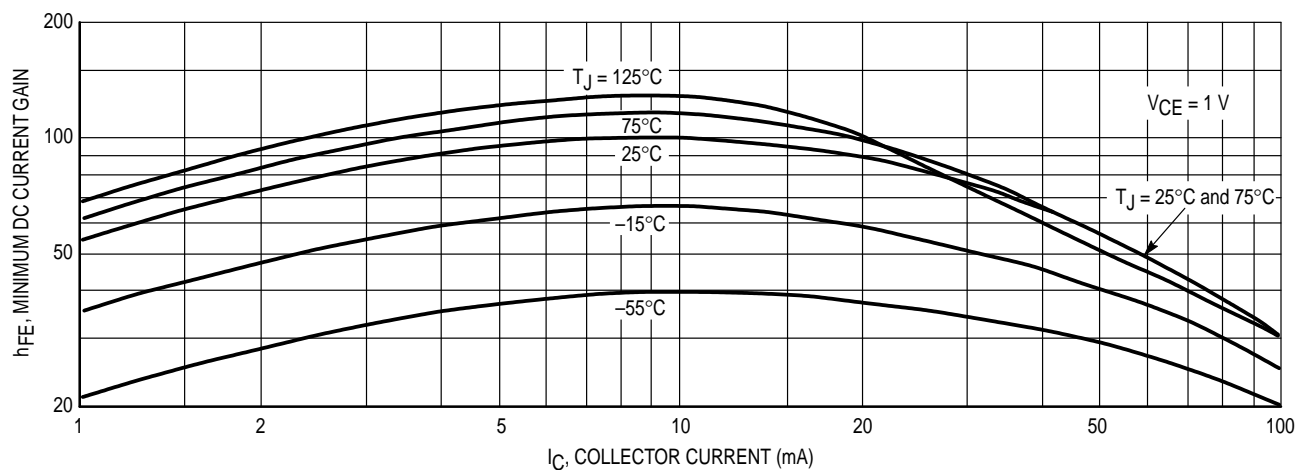


Figure 13. Minimum Current Gain Characteristics

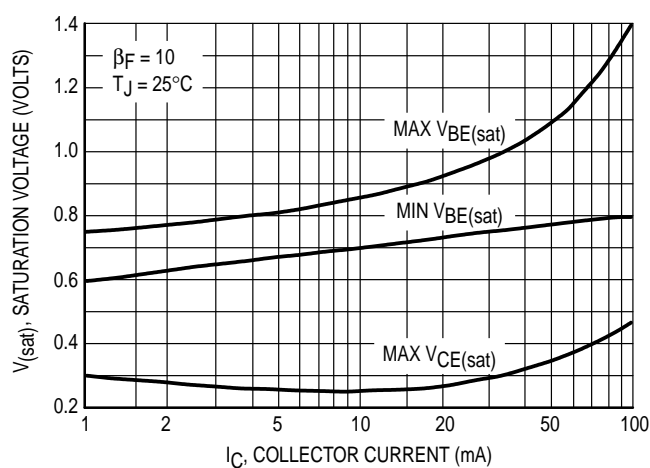


Figure 14. Saturation Voltage Limits

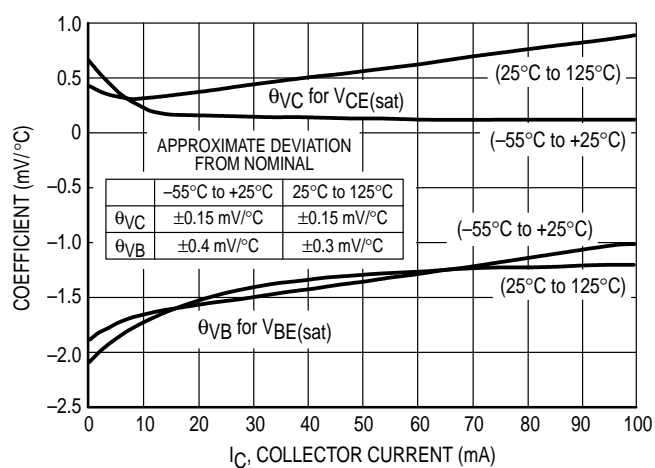
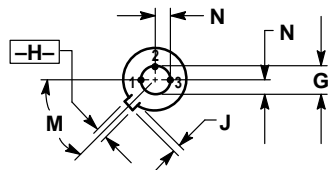
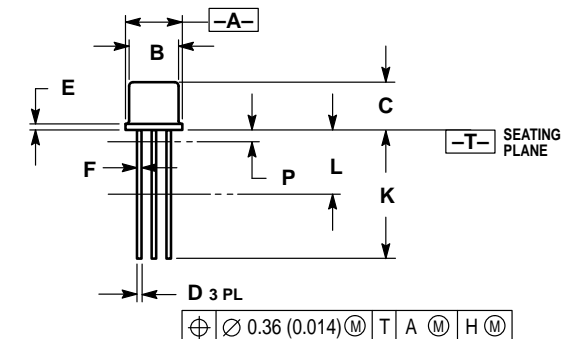


Figure 15. Typical Temperature Coefficients

## PACKAGE DIMENSIONS




**CASE 22-03  
(TO-206AA)  
ISSUE R**

## NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION J MEASURED FROM DIMENSION A MAXIMUM.
4. DIMENSION F APPLIES BETWEEN DIMENSION P AND L. DIMENSION D APPLIES BETWEEN DIMENSION L AND K MINIMUM. LEAD DIAMETER IS UNCONTROLLED IN DIMENSION P AND BEYOND DIMENSION K MINIMUM.
5. DIMENSION E INCLUDES THE TAB THICKNESS. (TAB THICKNESS IS 0.01(0.002) MAXIMUM).

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.209	0.230	5.31	5.84
B	0.178	0.195	4.52	4.95
C	0.170	0.210	4.32	5.33
D	0.016	0.021	0.406	0.533
E	—	0.030	—	0.762
F	0.016	0.019	0.406	0.483
G	0.100 BSC	—	2.54 BSC	—
H	0.036	0.046	0.914	1.17
J	0.028	0.048	0.711	1.22
K	0.500	—	12.70	—
L	0.250	—	6.35	—
M	45° BSC	—	45° BSC	—
N	0.050 BSC	—	1.27 BSC	—
P	—	0.050	—	1.27

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