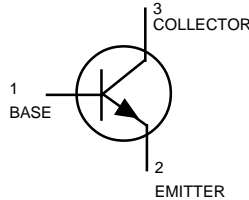


# Switching Transistors

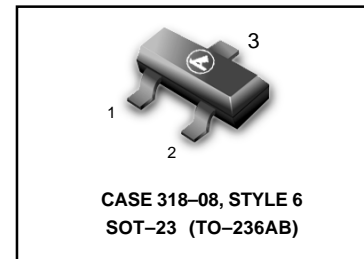
## NPN Silicon



**MMBT2369LT1**  
**MMBT2369ALT1**

### 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 — Continuous	$I_C$	200	mAdc



### THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Total Device Dissipation FR– 5 Board, (1) $T_A = 25^\circ\text{C}$	$P_D$	225	mW
Derate above $25^\circ\text{C}$		1.8	mW/ $^\circ\text{C}$
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	556	$^\circ\text{C}/\text{W}$
Total Device Dissipation Alumina Substrate, (2) $T_A = 25^\circ\text{C}$	$P_D$	300	mW
Derate above $25^\circ\text{C}$		2.4	mW/ $^\circ\text{C}$
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	417	$^\circ\text{C}/\text{W}$
Junction and Storage Temperature	$T_J, T_{stg}$	–55 to +150	$^\circ\text{C}$

### DEVICE MARKING

MMBT2369LT1 = M1J, MMBT2369ALT1 = 1JA

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

Characteristic	Symbol	Min	Typ	Max	Unit
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### OFF CHARACTERISTICS

Collector–Emitter Breakdown Voltage(3) ( $I_C = 10 \text{ mAdc}, I_B = 0$ )	$V_{(BR)CEO}$	15	—	—	Vdc
Collector–Emitter Breakdown Voltage ( $I_C = 10 \mu\text{Adc}, V_{BE} = 0$ )	$V_{(BR)CES}$	40	—	—	Vdc
Collector–Base Breakdown Voltage ( $I_C = 10 \mu\text{Adc}, I_E = 0$ )	$V_{(BR)CBO}$	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	$\mu\text{Adc}$

1. FR–5 = 1.0 x 0.75 x 0.062 in.

2. Alumina = 0.4 x 0.3 x 0.024 in. 99.5% alumina.

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

**MMBT2369LT1 MMBT2369ALT1**
**ELECTRICAL CHARACTERISTICS** ( $T_A = 25^\circ\text{C}$  unless otherwise noted) (Continued)

Characteristic	Symbol	Min	Typ	Max	Unit
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**ON CHARACTERISTICS**

DC Current Gain(3)	$h_{FE}$				—
( $I_C = 10\text{ mAdc}$ , $V_{CE} = 1.0\text{ Vdc}$ )	MMBT2369	40	—	120	
( $I_C = 10\text{ mAdc}$ , $V_{CE} = 1.0\text{ Vdc}$ )	MMBT2369A	—	—	120	
( $I_C = 10\text{ mAdc}$ , $V_{CE} = 0.35\text{ Vdc}$ )	MMBT2369A	40	—	—	
( $I_C = 10\text{ mAdc}$ , $V_{CE} = 0.35\text{ Vdc}$ , $T_A = -55^\circ\text{C}$ )	MMBT2369A	20	—	—	
( $I_C = 30\text{ mAdc}$ , $V_{CE} = 0.4\text{ Vdc}$ )	MMBT2369A	30	—	—	
( $I_C = 100\text{ mAdc}$ , $V_{CE} = 2.0\text{ Vdc}$ )	MMBT2369	20	—	—	
( $I_C = 100\text{ mAdc}$ , $V_{CE} = 1.0\text{ Vdc}$ )	MMBT2369A	20	—	—	
Collector–Emitter Saturation Voltage(3)	$V_{CE(sat)}$				Vdc
( $I_C = 10\text{ mAdc}$ , $I_B = 1.0\text{ mAdc}$ )	MMBT2369	—	—	0.25	
( $I_C = 10\text{ mAdc}$ , $I_B = 1.0\text{ mAdc}$ )	MMBT2369A	—	—	0.20	
( $I_C = 10\text{ mAdc}$ , $I_B = 1.0\text{ mAdc}$ , $T_A = +125^\circ\text{C}$ )	MMBT2369A	—	—	0.30	
( $I_C = 30\text{ mAdc}$ , $I_B = 3.0\text{ mAdc}$ )	MMBT2369A	—	—	0.25	
( $I_C = 100\text{ mAdc}$ , $I_B = 10\text{ mAdc}$ )	MMBT2369A	—	—	0.50	
Base–Emitter Saturation Voltage	$V_{BE(sat)}$				Vdc
( $I_C = 10\text{ mAdc}$ , $I_B = 1.0\text{ mAdc}$ )	MMBT2369A	0.7	—	0.85	
( $I_C = 10\text{ mAdc}$ , $I_B = 1.0\text{ mAdc}$ , $T_A = -55^\circ\text{C}$ )	MMBT2369A	—	—	1.02	
( $I_C = 30\text{ mAdc}$ , $I_B = 3.0\text{ mAdc}$ )	MMBT2369A	—	—	1.15	
( $I_C = 100\text{ mAdc}$ , $I_B = 10\text{ mAdc}$ )	MMBT2369A	—	—	1.60	

**SMALL–SIGNAL CHARACTERISTICS**

Output Capacitance ( $V_{CB} = 5.0\text{ Vdc}$ , $I_E = 0$ , $f = 1.0\text{ MHz}$ )	$C_{obo}$	—	—	4.0	pF
Small–Signal Current Gain ( $V_{CE} = 10\text{ Vdc}$ , $I_C = 10\text{ mAdc}$ , $f = 100\text{ MHz}$ )	$h_{fe}$	5.0	—	—	—

**SWITCHING CHARACTERISTICS**

Storage Time ( $I_{B1} = I_{B2} = I_C = 10\text{ mAdc}$ )	$t_s$	—	5.0	13	ns
Turn–On Time ( $V_{CC} = 3.0\text{ Vdc}$ , $I_C = 10\text{ mAdc}$ , $I_{B1} = 3.0\text{ mAdc}$ )	$t_{on}$	—	8.0	12	ns
Turn–Off Time ( $V_{CC} = 3.0\text{ Vdc}$ , $I_C = 10\text{ mAdc}$ , $I_{B1} = 3.0\text{ mAdc}$ , $I_{B2} = 1.5\text{ mAdc}$ )	$t_{off}$	—	10	18	ns

 3. Pulse Test: Pulse Width  $\leq 300\text{ ms}$ , Duty Cycle  $\leq 2.0\%$ .

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SWITCHING TIME EQUIVALENT TEST CIRCUITS FOR 2N2369, 2N3227

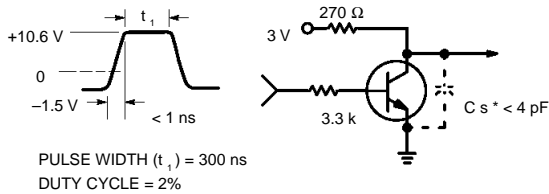


Figure 1.  $t_{on}$  Circuit — 10 mA

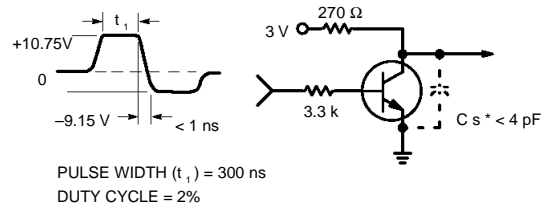


Figure 3.  $t_{off}$  Circuit — 10 mA

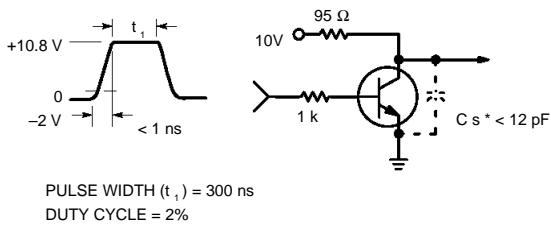


Figure 2.  $t_{on}$  Circuit — 100 mA

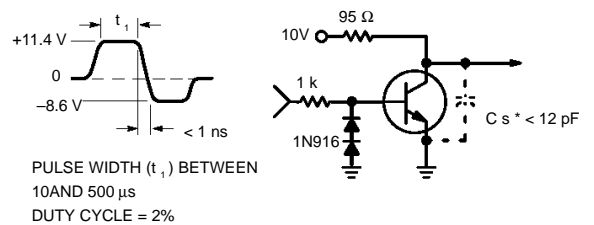


Figure 4.  $t_{off}$  Circuit — 100 mA

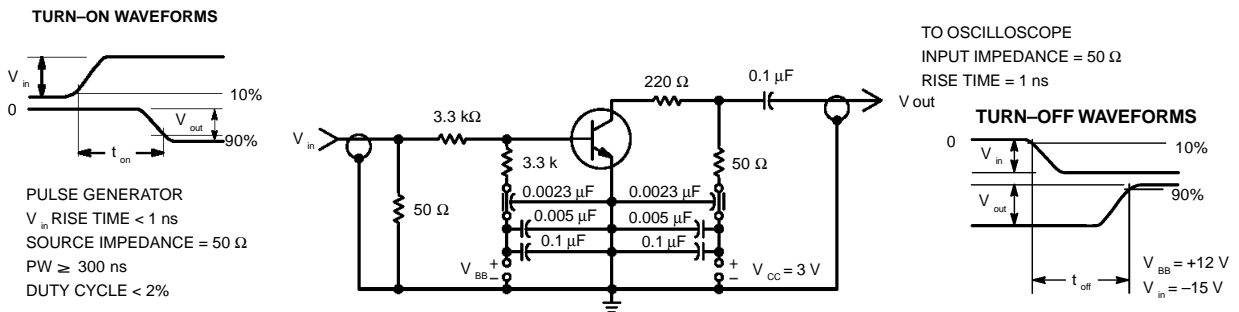


Figure 5. Turn-On and Turn-Off Time Test Circuit

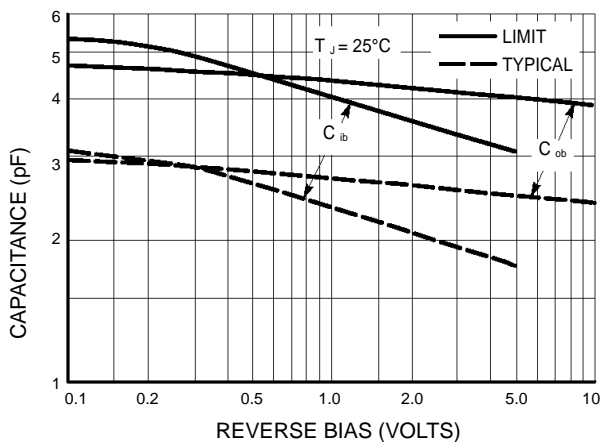


Figure 6. Junction Capacitance Variations

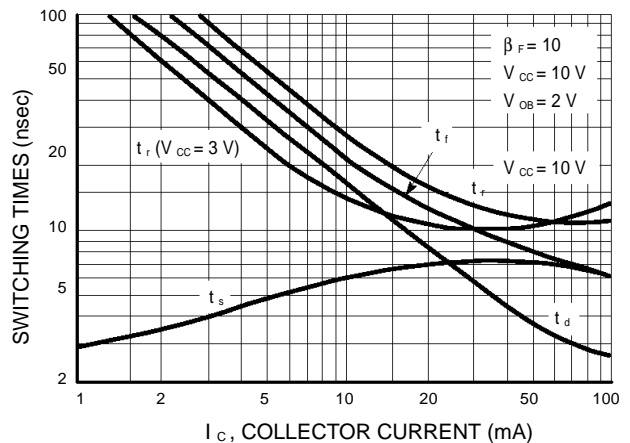


Figure 7. Typical Switching Times

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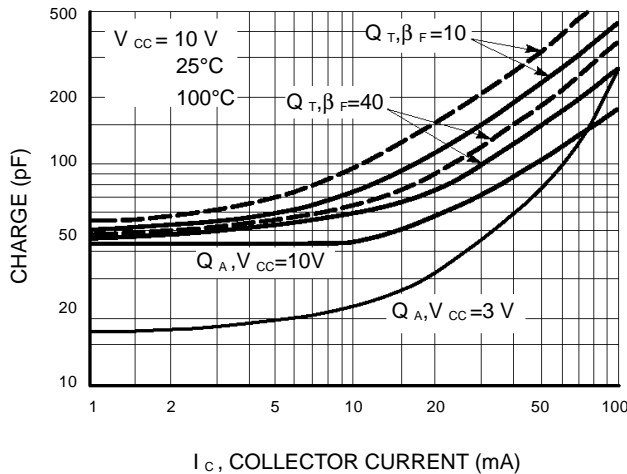


Figure 8. Maximum Charge Data

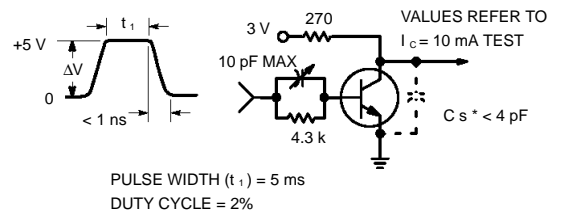


Figure 9. Q T Test Circuit

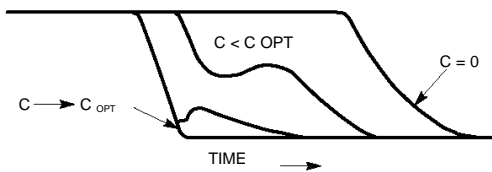


Figure 10. Turn-Off Waveform

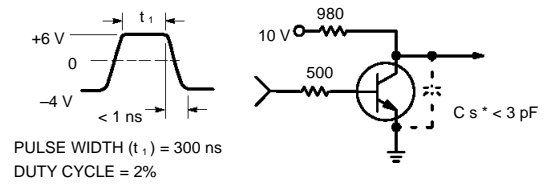


Figure 11. Storage Time Equivalent Test Circuit

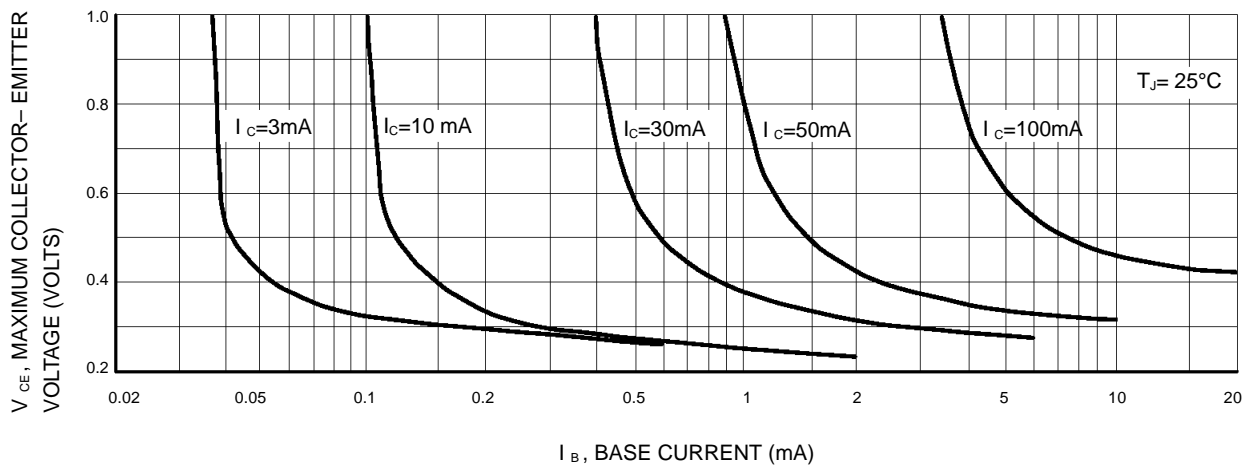


Figure 12. Maximum Collector Saturation Voltage Characteristics

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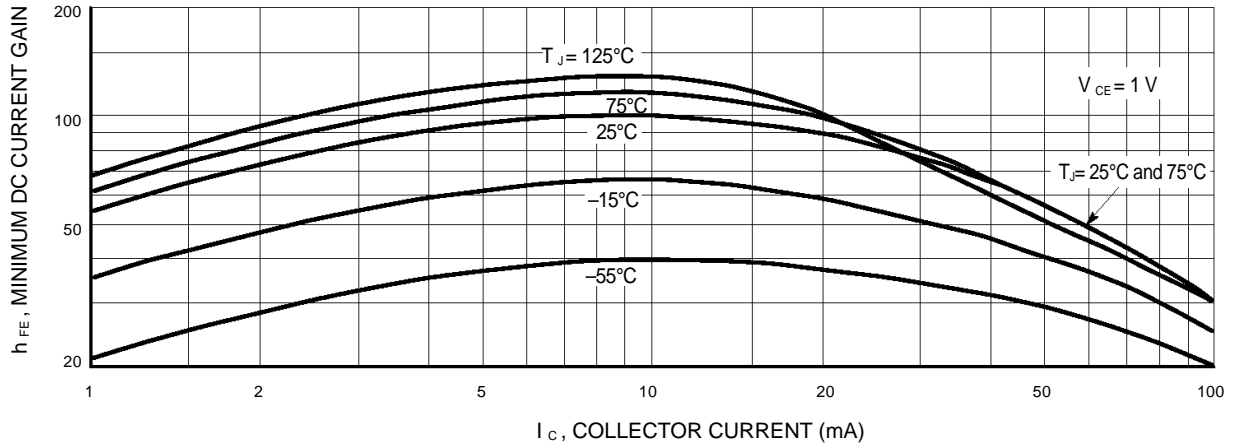


Figure 13. Minimum Current Gain Characteristics

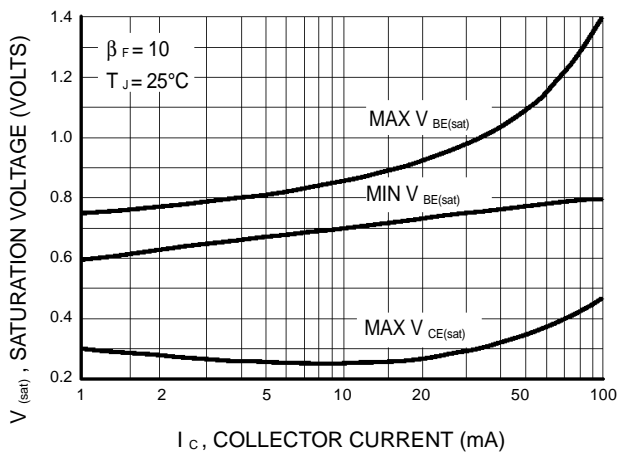


Figure 14. Saturation Voltage Limits

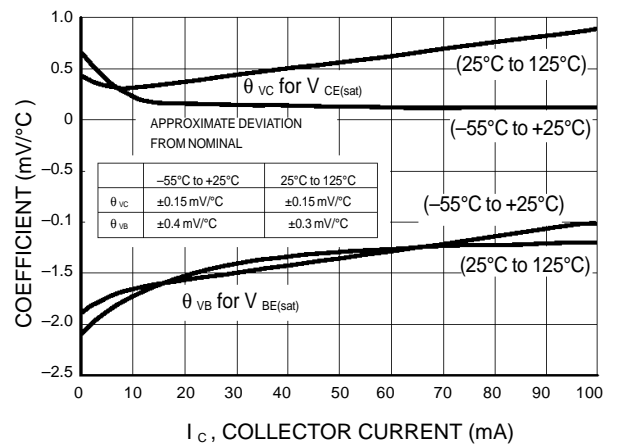


Figure 15. Typical Temperature Coefficients