

# MMBT2369L, MMBT2369AL

## Switching Transistors

### NPN Silicon

#### Features

- S Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC-Q101 Qualified and PPAP Capable
- These Devices are Pb-Free, Halogen Free/BFR Free and are RoHS Compliant\*

#### 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<br>(Note 1) $T_A = 25^\circ\text{C}$<br>Derate above $25^\circ\text{C}$         | $P_D$           | 225<br>1.8  | mW<br>mW/ $^\circ\text{C}$ |
| Thermal Resistance, Junction–to–Ambient                                                                             | $R_{\theta JA}$ | 556         | $^\circ\text{C/W}$         |
| Total Device Dissipation Alumina<br>Substrate, (Note 2) $T_A = 25^\circ\text{C}$<br>Derate above $25^\circ\text{C}$ | $P_D$           | 300<br>2.4  | mW<br>mW/ $^\circ\text{C}$ |
| Thermal Resistance, Junction–to–Ambient                                                                             | $R_{\theta JA}$ | 417         | $^\circ\text{C/W}$         |
| Junction and Storage Temperature                                                                                    | $T_J, T_{stg}$  | –55 to +150 | $^\circ\text{C}$           |

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

1. FR–5 =  $1.0 \times 0.75 \times 0.062$  in.

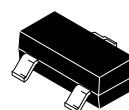
2. Alumina =  $0.4 \times 0.3 \times 0.024$  in. 99.5% alumina.

\*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.



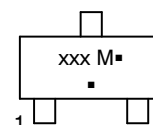
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SOT-23  
CASE 318  
STYLE 6

#### MARKING DIAGRAM



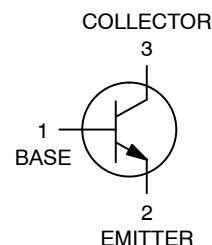
xxx = M1J or 1JA

M = Date Code\*

▪ = Pb-Free Package

(Note: Microdot may be in either location)

\*Date Code orientation and/or overbar may vary depending upon manufacturing location.



#### ORDERING INFORMATION

| Device         | Package             | Shipping†               |
|----------------|---------------------|-------------------------|
| MMBT2369LT1G   | SOT-23<br>(Pb-Free) | 3,000 /<br>Tape & Reel  |
| MMBT2369LT3G   | SOT-23<br>(Pb-Free) | 10,000 /<br>Tape & Reel |
| SMMBT2369LT1G  | SOT-23<br>(Pb-Free) | 3,000 /<br>Tape & Reel  |
| MMBT2369ALT1G  | SOT-23<br>(Pb-Free) | 3,000 /<br>Tape & Reel  |
| SMMBT2369ALT1G | SOT-23<br>(Pb-Free) | 3,000 /<br>Tape & Reel  |

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

# MMBT2369L, MMBT2369AL

## 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 (Note 3)<br>( $I_C = 10\text{ mA}$ , $I_B = 0$ )                                                       | $V_{(BR)CEO}$ | 15     | –      | –         | Vdc           |
| Collector – Emitter Breakdown Voltage<br>( $I_C = 10\text{ }\mu\text{A}$ , $V_{BE} = 0$ )                                                    | $V_{(BR)CES}$ | 40     | –      | –         | Vdc           |
| Collector – Base Breakdown Voltage<br>( $I_C = 10\text{ }\mu\text{A}$ , $I_E = 0$ )                                                          | $V_{(BR)CBO}$ | 40     | –      | –         | Vdc           |
| Emitter – Base Breakdown Voltage<br>( $I_E = 10\text{ }\mu\text{A}$ , $I_C = 0$ )                                                            | $V_{(BR)EBO}$ | 4.5    | –      | –         | Vdc           |
| Collector Cutoff Current<br>( $V_{CB} = 20\text{ Vdc}$ , $I_E = 0$ )<br>( $V_{CB} = 20\text{ Vdc}$ , $I_E = 0$ , $T_A = 150^\circ\text{C}$ ) | $I_{CBO}$     | –<br>– | –<br>– | 0.4<br>30 | $\mu\text{A}$ |
| Collector Cutoff Current<br>MMBT2369A ( $V_{CE} = 20\text{ Vdc}$ , $V_{BE} = 0$ )                                                            | $I_{CES}$     | –      | –      | 0.4       | $\mu\text{A}$ |

## ON CHARACTERISTICS

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

## SMALL-SIGNAL CHARACTERISTICS

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

## SWITCHING CHARACTERISTICS

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

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

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

## MMBT2369L, MMBT2369AL

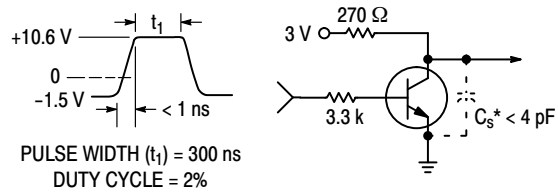


Figure 1.  $t_{on}$  Circuit – 10 mA

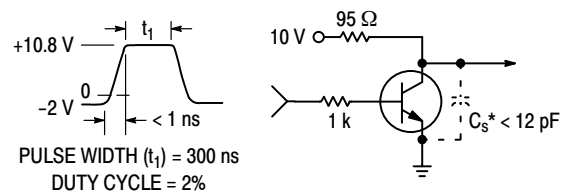


Figure 2.  $t_{on}$  Circuit – 100 mA

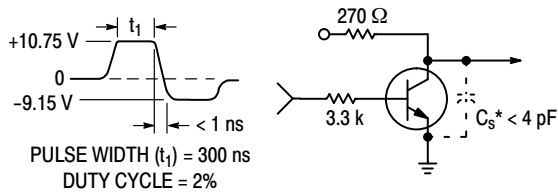


Figure 3.  $t_{off}$  Circuit – 10 mA

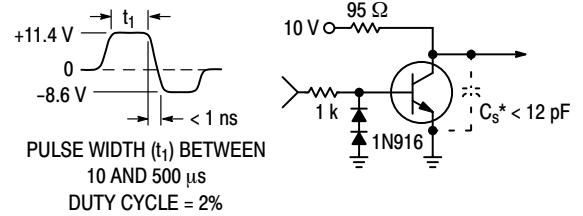


Figure 4.  $t_{off}$  Circuit – 100 mA

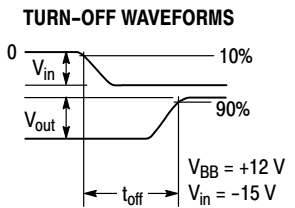
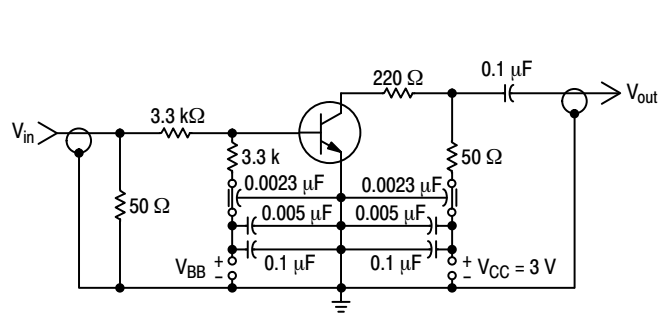
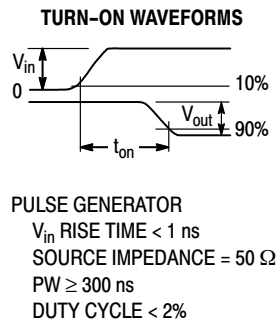


Figure 5. Turn-On and Turn-Off Time Test Circuit

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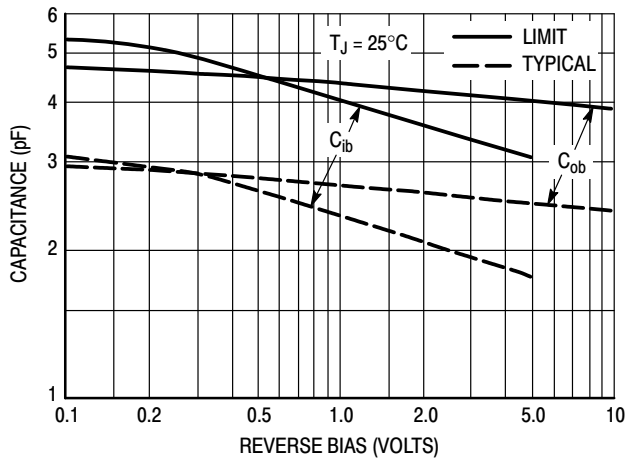


Figure 6. Junction Capacitance Variations

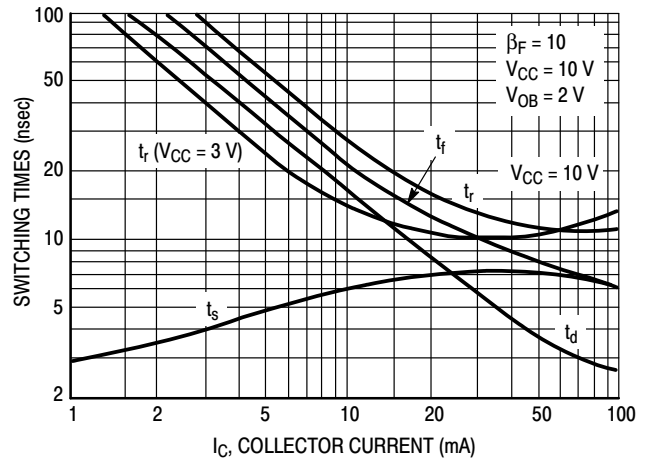


Figure 7. Typical Switching Times

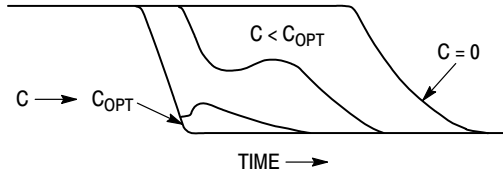


Figure 8. Turn-Off Waveform

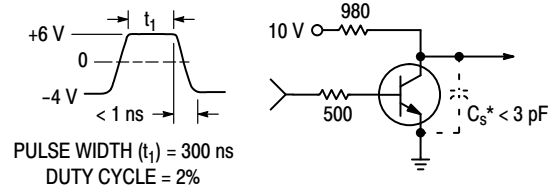


Figure 9. Storage Time Equivalent Test Circuit

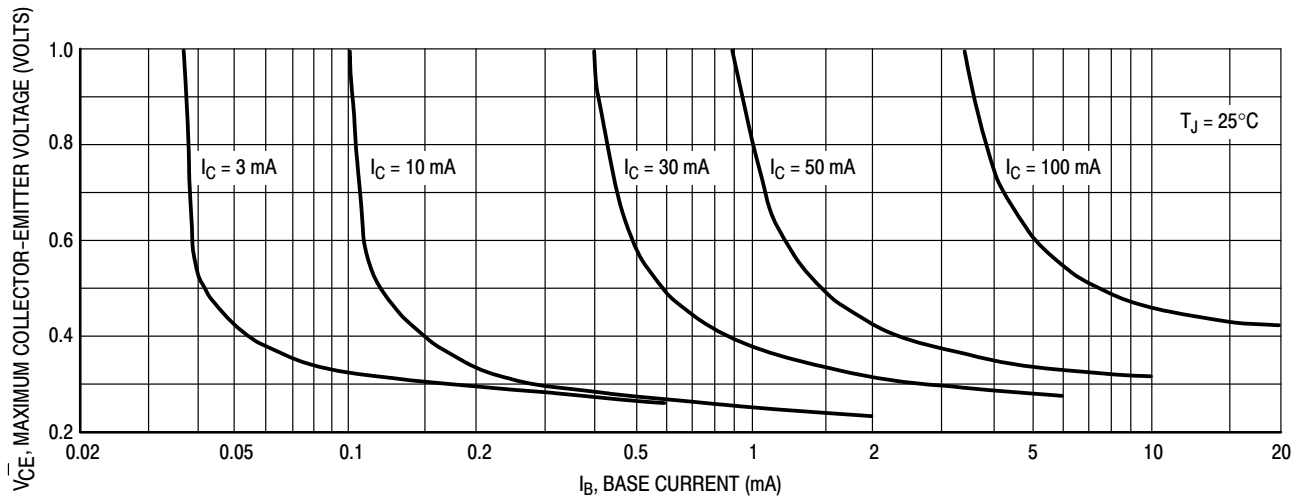
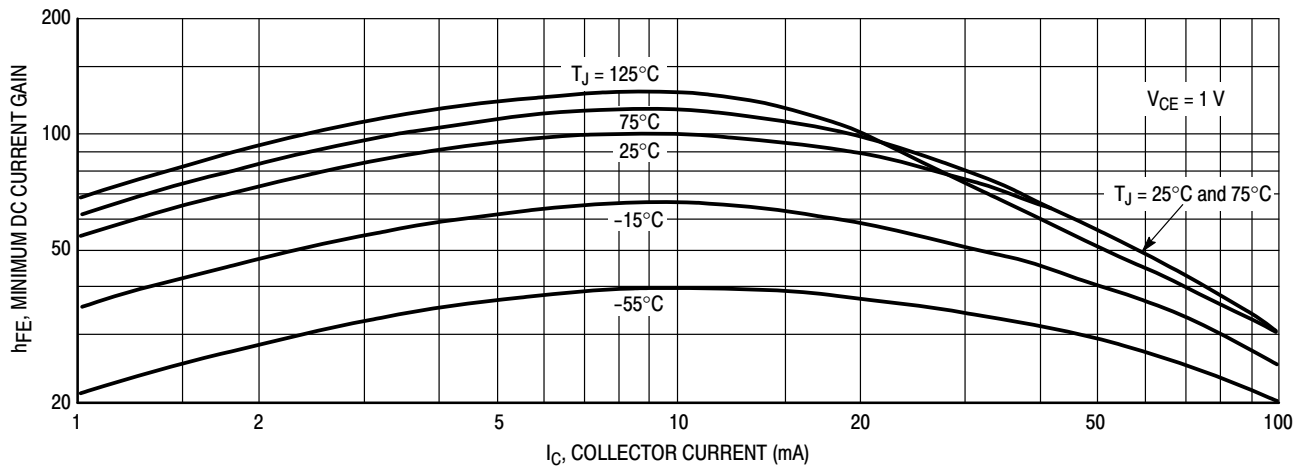
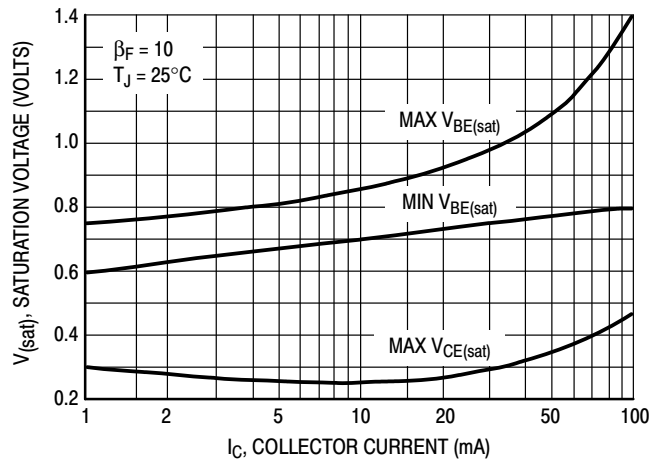


Figure 10. Maximum Collector Saturation Voltage Characteristics

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**Figure 11. Minimum Current Gain Characteristics**



**Figure 12. Saturation Voltage Limits**

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