

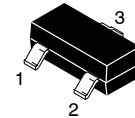
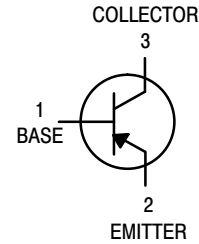
# Switching Transistor

## PNP Silicon

### MMBT4403L, SMMBT4403L

#### 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



SOT-23 (TO-236)  
CASE 318  
STYLE 6

#### MAXIMUM RATINGS

| Rating                         | Symbol    | Value | Unit |
|--------------------------------|-----------|-------|------|
| Collector – Emitter Voltage    | $V_{CEO}$ | -40   | Vdc  |
| Collector – Base Voltage       | $V_{CBO}$ | -40   | Vdc  |
| Emitter – Base Voltage         | $V_{EBO}$ | -5.0  | Vdc  |
| Collector Current – Continuous | $I_C$     | -600  | mAdc |
| Collector Current – Peak       | $I_{CM}$  | -900  | 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         | $^\circ\text{C}/\text{W}$  |
| 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         | $^\circ\text{C}/\text{W}$  |
| Junction and Storage Temperature                                                                                      | $T_J, T_{stg}$  | -55 to +150 | $^\circ\text{C}$           |

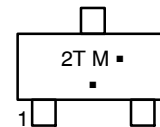
Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

\*Transient pulses must not cause the junction temperature to be exceeded.

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.

#### MARKING DIAGRAM



2T = Specific Device Code\*

M = Date Code\*

■ = Pb-Free Package

(Note: Microdot may be in either location)

\*Specific Device Code, Date Code or overbar orientation and/or location may vary depending upon manufacturing location. This is a representation only and actual devices may not match this drawing exactly.

#### ORDERING INFORMATION

| Device        | Package             | Shipping <sup>†</sup>   |
|---------------|---------------------|-------------------------|
| MMBT4403LT1G  | SOT-23<br>(Pb-Free) | 3000 / Tape &<br>Reel   |
| SMMBT4403LT1G | SOT-23<br>(Pb-Free) | 3000 / Tape &<br>Reel   |
| MMBT4403LT3G  | SOT-23<br>(Pb-Free) | 10,000 / Tape &<br>Reel |

<sup>†</sup>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.

# MMBT4403L, SMMBT4403L

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

| Characteristic                                 | Symbol                                                                            | Min                  | Max  | Unit |                  |
|------------------------------------------------|-----------------------------------------------------------------------------------|----------------------|------|------|------------------|
| OFF CHARACTERISTICS                            |                                                                                   |                      |      |      |                  |
| Collector – Emitter Breakdown Voltage (Note 3) | (I <sub>C</sub> = –1.0 mA <sub>dc</sub> , I <sub>B</sub> = 0)                     | V <sub>(BR)CEO</sub> | –40  | –    | V <sub>dc</sub>  |
| Collector – Base Breakdown Voltage             | (I <sub>C</sub> = –0.1 mA <sub>dc</sub> , I <sub>E</sub> = 0)                     | V <sub>(BR)CBO</sub> | –40  | –    | V <sub>dc</sub>  |
| Emitter – Base Breakdown Voltage               | (I <sub>E</sub> = –0.1 mA <sub>dc</sub> , I <sub>C</sub> = 0)                     | V <sub>(BR)EBO</sub> | –5.0 | –    | V <sub>dc</sub>  |
| Base Cutoff Current                            | (V <sub>CE</sub> = –35 V <sub>dc</sub> , V <sub>EB</sub> = –0.4 V <sub>dc</sub> ) | I <sub>BEV</sub>     | –    | –0.1 | μA <sub>dc</sub> |
| Collector Cutoff Current                       | (V <sub>CE</sub> = –35 V <sub>dc</sub> , V <sub>EB</sub> = –0.4 V <sub>dc</sub> ) | I <sub>CEX</sub>     | –    | –0.1 | μA <sub>dc</sub> |

## ON CHARACTERISTICS

|                                                 |                                                                                                                                                                                                                                                                                               |               |                              |                         |     |
|-------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|------------------------------|-------------------------|-----|
| DC Current Gain                                 | $(I_C = -0.1 \text{ mAdc}, V_{CE} = -1.0 \text{ Vdc})$<br>$(I_C = -1.0 \text{ mAdc}, V_{CE} = -1.0 \text{ Vdc})$<br>$(I_C = -10 \text{ mAdc}, V_{CE} = -1.0 \text{ Vdc})$<br>$(I_C = -150 \text{ mAdc}, V_{CE} = -2.0 \text{ Vdc})$<br>$(I_C = -500 \text{ mAdc}, V_{CE} = -2.0 \text{ Vdc})$ | $h_{FE}$      | 30<br>60<br>100<br>100<br>20 | –<br>–<br>–<br>300<br>– | –   |
| Collector – Emitter Saturation Voltage (Note 3) | $(I_C = -150 \text{ mAdc}, I_B = -15 \text{ mAdc})$<br>$(I_C = -500 \text{ mAdc}, I_B = -50 \text{ mAdc})$                                                                                                                                                                                    | $V_{CE(sat)}$ | –<br>–                       | -0.4<br>-0.75           | Vdc |
| Base – Emitter Saturation Voltage (Note 3)      | $(I_C = -150 \text{ mAdc}, I_B = -15 \text{ mAdc})$<br>$(I_C = -500 \text{ mAdc}, I_B = -50 \text{ mAdc})$                                                                                                                                                                                    | $V_{BE(sat)}$ | -0.75<br>–                   | -0.95<br>-1.3           | Vdc |

## SMALL – SIGNAL CHARACTERISTICS

|                                    |                                                                            |          |     |     |                  |
|------------------------------------|----------------------------------------------------------------------------|----------|-----|-----|------------------|
| Current – Gain – Bandwidth Product | $(I_C = -20 \text{ mAdc}, V_{CE} = -10 \text{ Vdc}, f = 100 \text{ MHz})$  | $f_T$    | 200 | –   | MHz              |
| Collector – Base Capacitance       | $(V_{CB} = -10 \text{ Vdc}, I_E = 0, f = 1.0 \text{ MHz})$                 | $C_{cb}$ | –   | 8.5 | pF               |
| Emitter – Base Capacitance         | $(V_{BE} = -0.5 \text{ Vdc}, I_C = 0, f = 1.0 \text{ MHz})$                | $C_{eb}$ | –   | 30  | pF               |
| Input Impedance                    | $(I_C = -1.0 \text{ mAdc}, V_{CE} = -10 \text{ Vdc}, f = 1.0 \text{ kHz})$ | $h_{ie}$ | 1.5 | 15  | k $\Omega$       |
| Voltage Feedback Ratio             | $(I_C = -1.0 \text{ mAdc}, V_{CE} = -10 \text{ Vdc}, f = 1.0 \text{ kHz})$ | $h_{re}$ | 0.1 | 8.0 | $\times 10^{-4}$ |
| Small – Signal Current Gain        | $(I_C = -1.0 \text{ mAdc}, V_{CE} = -10 \text{ Vdc}, f = 1.0 \text{ kHz})$ | $h_{fe}$ | 60  | 500 | –                |
| Output Admittance                  | $(I_C = -1.0 \text{ mAdc}, V_{CE} = -10 \text{ Vdc}, f = 1.0 \text{ kHz})$ | $h_{oe}$ | 1.0 | 100 | $\mu\text{Mhos}$ |

## SWITCHING CHARACTERISTICS

|              |                                                                                                             |       |   |     |    |
|--------------|-------------------------------------------------------------------------------------------------------------|-------|---|-----|----|
| Delay Time   | $(V_{CC} = -30 \text{ Vdc}, V_{EB} = -2.0 \text{ Vdc}, I_C = -150 \text{ mAdc}, I_{B1} = -15 \text{ mAdc})$ | $t_d$ | – | 15  | ns |
| Rise Time    |                                                                                                             | $t_r$ | – | 20  |    |
| Storage Time | $(V_{CC} = -30 \text{ Vdc}, I_C = -150 \text{ mAdc}, I_{B1} = I_{B2} = -15 \text{ mAdc})$                   | $t_s$ | – | 225 | ns |
| Fall Time    |                                                                                                             | $t_f$ | – | 30  |    |

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  $\leq 300 \mu\text{s}$ , Duty Cycle  $\leq 2.0\%$ .

## SWITCHING TIME EQUIVALENT TEST CIRCUIT

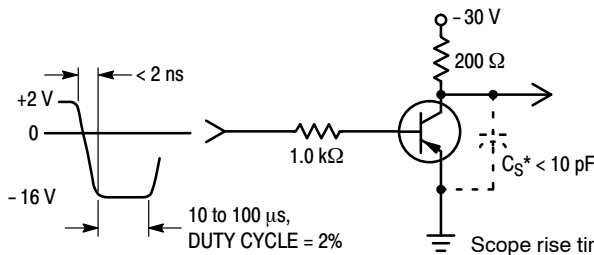


Figure 1. Turn-On Time

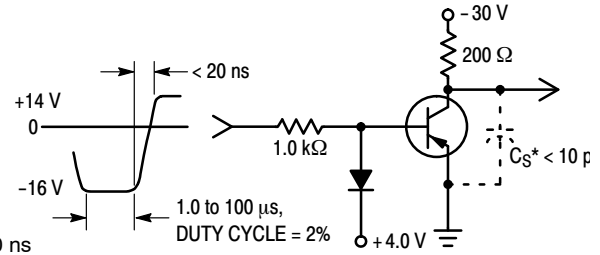


Figure 2. Turn-Off Time

# MMBT4403L, SMMBT4403L

## TRANSIENT CHARACTERISTICS

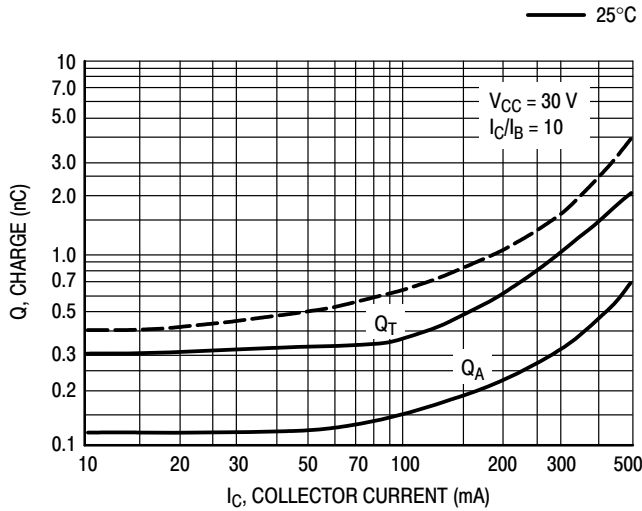


Figure 3. Charge Data

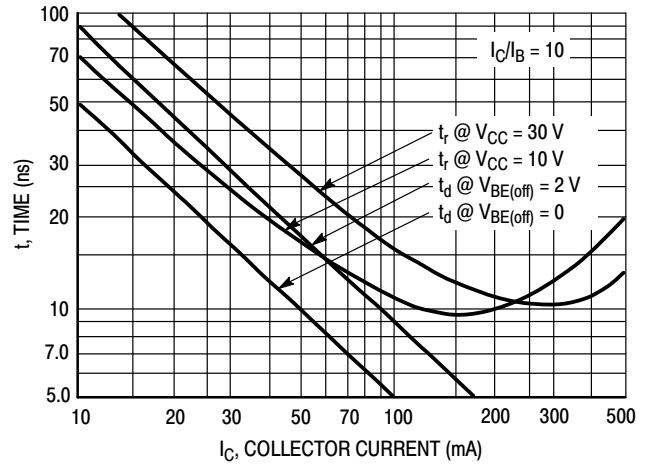


Figure 4. Turn-On Time

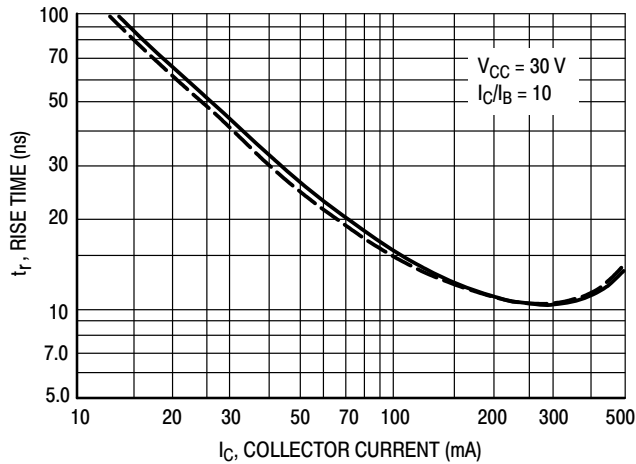


Figure 5. Rise Time

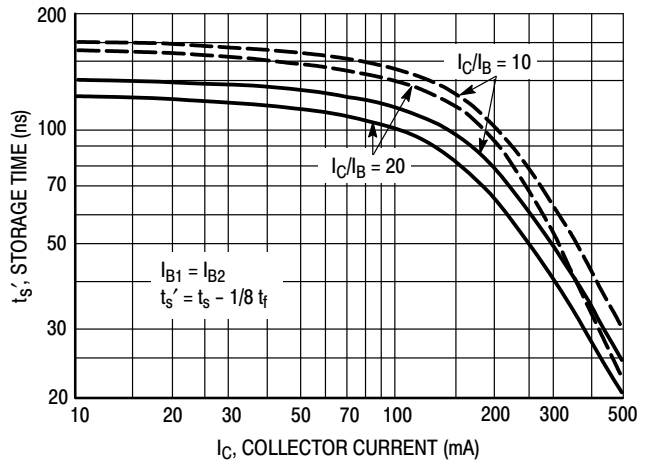


Figure 6. Storage Time

## SMALL-SIGNAL CHARACTERISTICS NOISE FIGURE

V<sub>CE</sub> = -10 Vdc, T<sub>A</sub> = 25°C; Bandwidth = 1.0 Hz

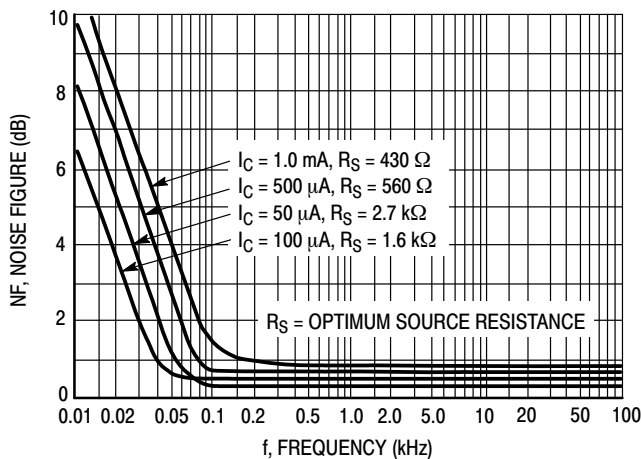


Figure 7. Frequency Effects

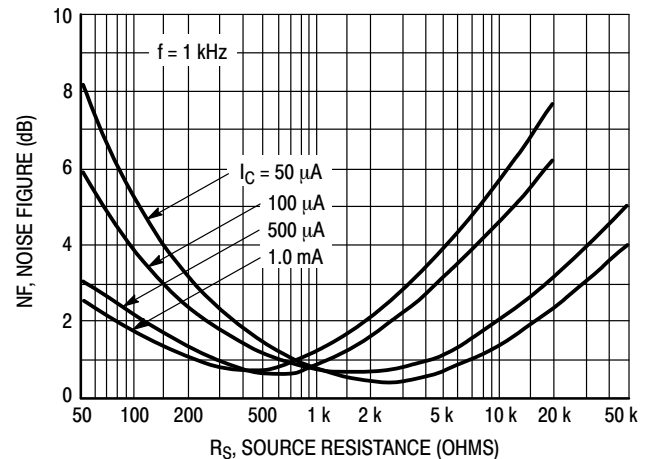


Figure 8. Source Resistance Effects

# MMBT4403L, SMMBT4403L

## h PARAMETERS

$V_{CE} = 10 \text{ Vdc}$ ,  $f = 1.0 \text{ kHz}$ ,  $T_A = 25^\circ\text{C}$

This group of graphs illustrates the relationship between  $h_{fe}$  and other “h” parameters for this series of transistors. To obtain these curves, a high-gain and a low-gain unit were selected from the MMBT4403LT1 lines, and the same units were used to develop the correspondingly numbered curves on each graph.

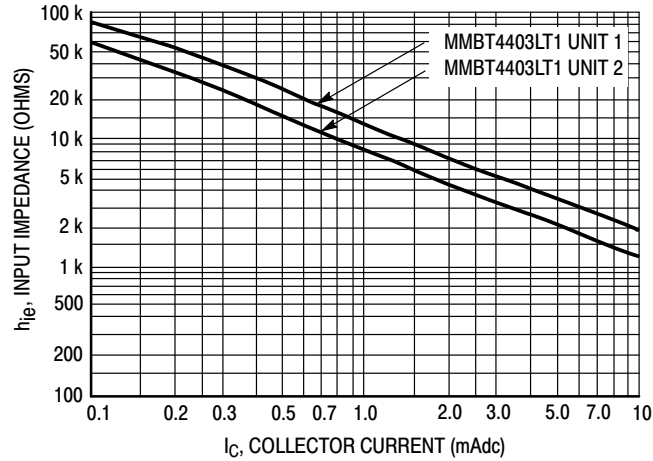


Figure 9. Input Impedance

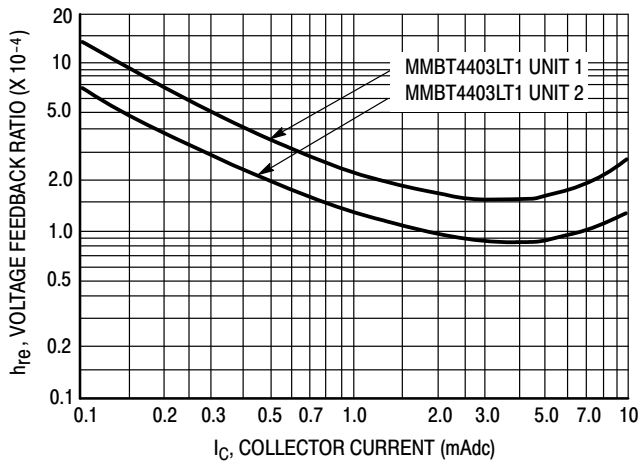


Figure 10. Voltage Feedback Ratio

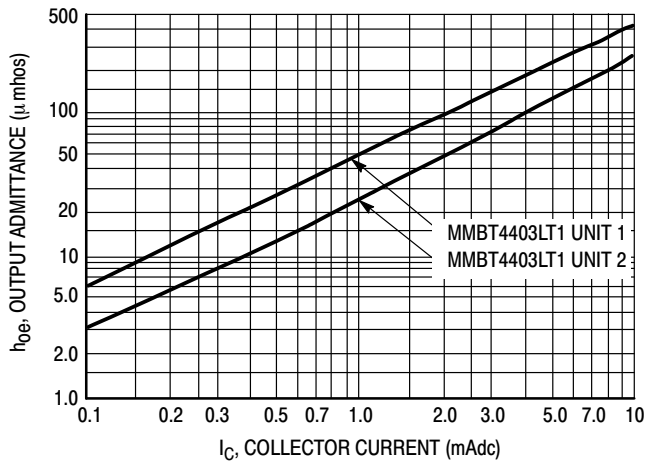


Figure 11. Output Admittance

# MMBT4403L, SMMBT4403L

## STATIC CHARACTERISTICS



Figure 12. DC Current Gain

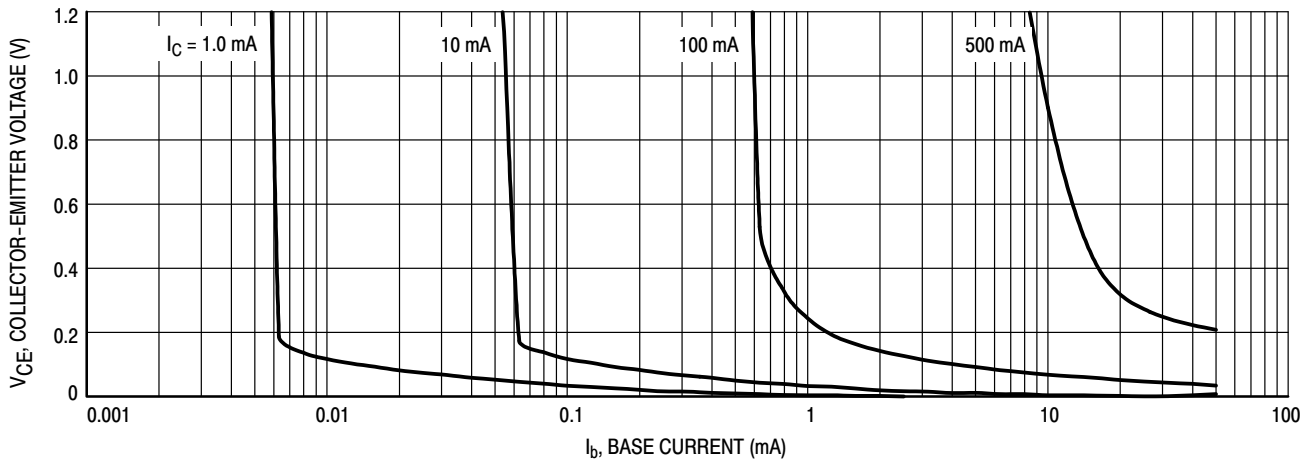


Figure 13. Collector Saturation Region

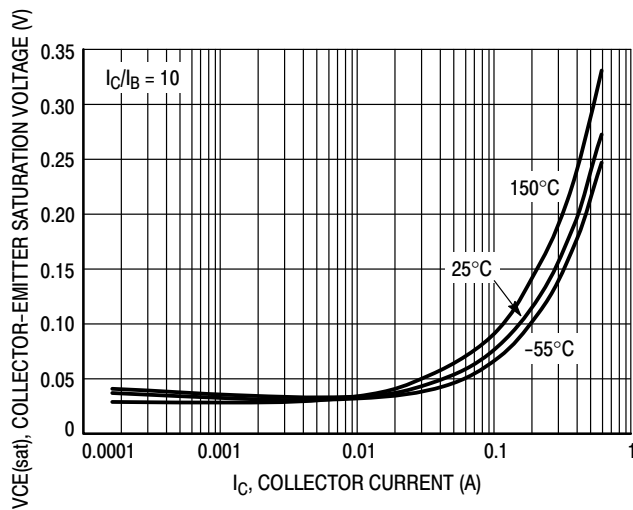


Figure 14. Collector-Emmitter Saturation Voltage vs. Collector Current

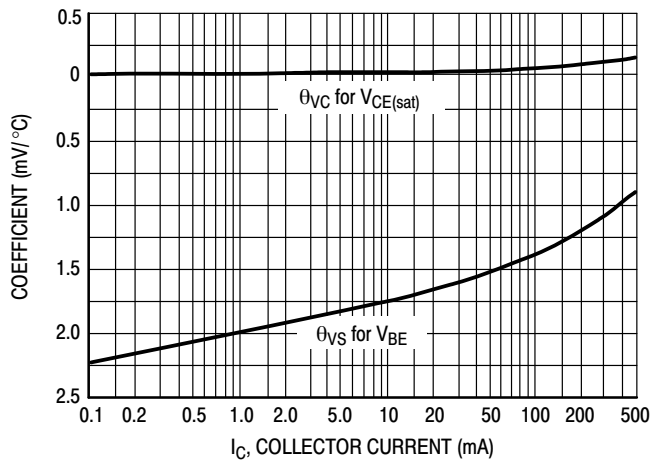


Figure 15. Temperature Coefficients

## STATIC CHARACTERISTICS

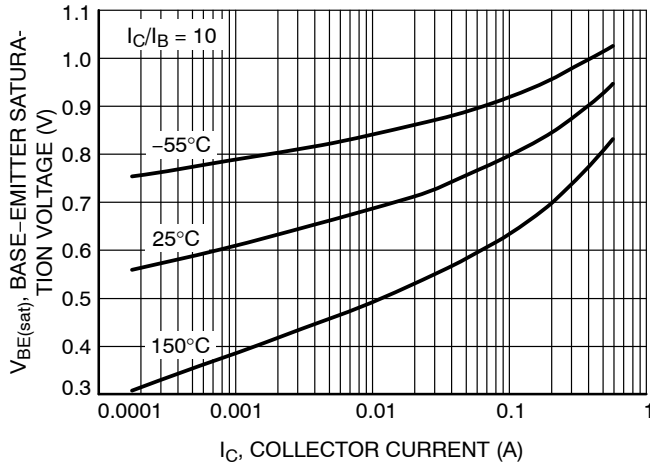


Figure 16. Base-Emitter Saturation Voltage vs. Collector Current

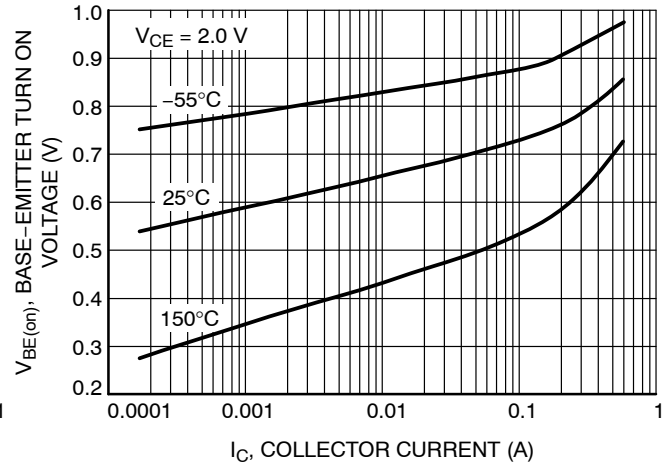


Figure 17. Base-Emitter Turn On Voltage vs. Collector Current

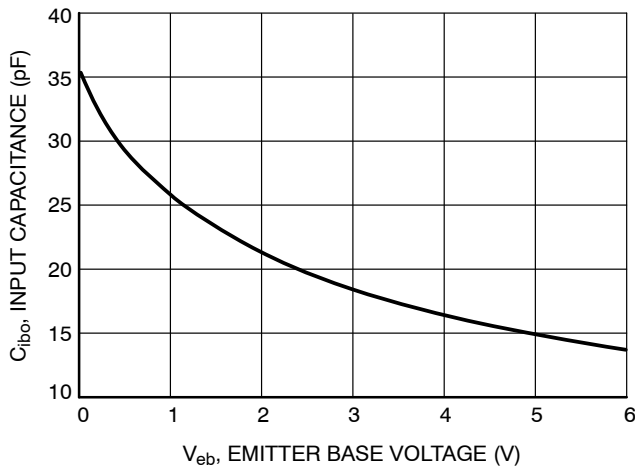


Figure 18. Input Capacitance vs. Emitter Base Voltage

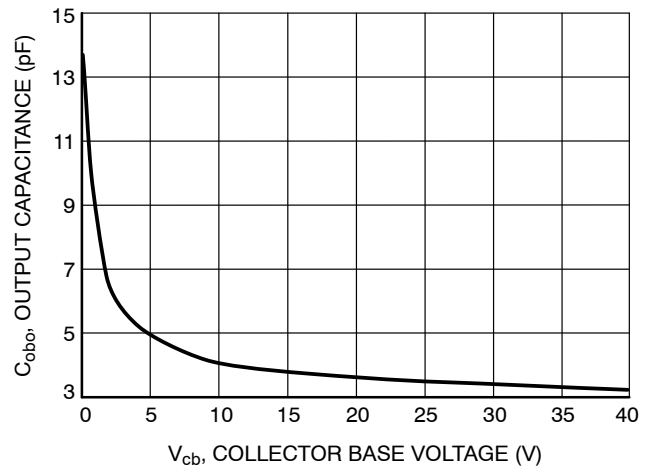


Figure 19. Output Capacitance vs. Collector Base Voltage

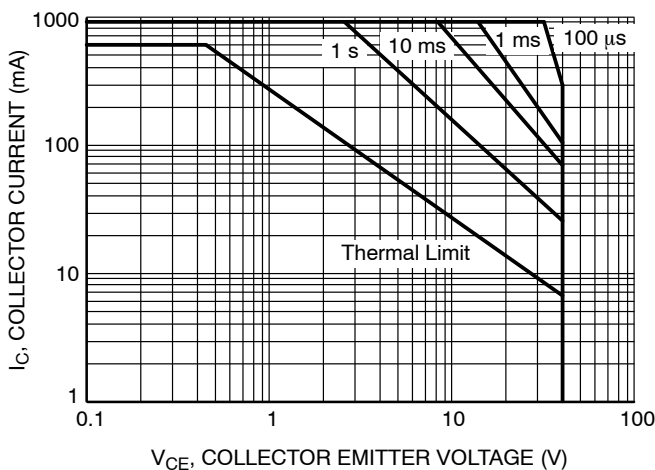


Figure 20. Safe Operating Area

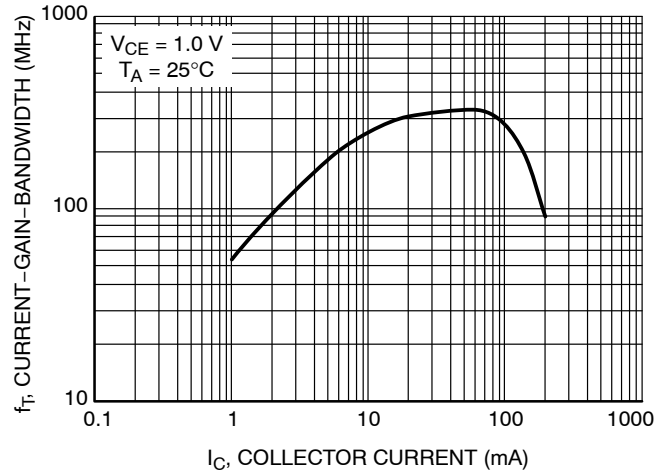


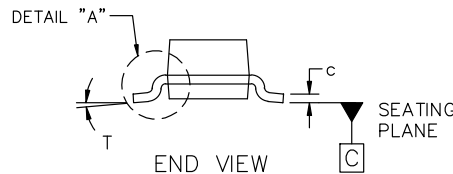
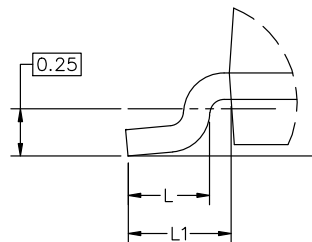
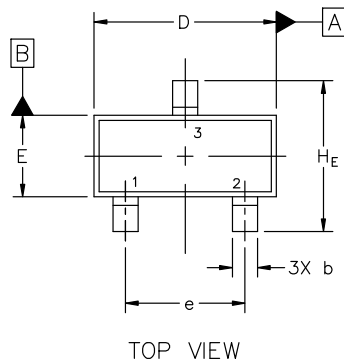
Figure 21. Current-Gain-Bandwidth Product



SCALE 4:1

SOT-23 (TO-236) 2.90x1.30x1.00 1.90P  
CASE 318  
ISSUE AU

DATE 14 AUG 2024



| MILLIMETERS |      |      |      |
|-------------|------|------|------|
| DIM         | MIN  | NOM  | MAX  |
| A           | 0.89 | 1.00 | 1.11 |
| A1          | 0.01 | 0.06 | 0.10 |
| b           | 0.37 | 0.44 | 0.50 |
| c           | 0.08 | 0.14 | 0.20 |
| D           | 2.80 | 2.90 | 3.04 |
| E           | 1.20 | 1.30 | 1.40 |
| e           | 1.78 | 1.90 | 2.04 |
| L           | 0.30 | 0.43 | 0.55 |
| L1          | 0.35 | 0.54 | 0.69 |
| HE          | 2.10 | 2.40 | 2.64 |
| T           | 0°   | ---  | 10°  |

NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 2018.
2. CONTROLLING DIMENSIONS: MILLIMETERS.
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF THE BASE MATERIAL.
4. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS.

GENERIC  
MARKING DIAGRAM\*



XXX = Specific Device Code  
M = Date Code  
▪ = Pb-Free Package

\*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "▪", may or may not be present. Some products may not follow the Generic Marking.



RECOMMENDED  
MOUNTING FOOTPRINT

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

STYLES ON PAGE 2

|                  |                                      |                                                                                                                                                                                     |
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**SOT-23 (TO-236) 2.90x1.30x1.00 1.90P**  
**CASE 318**  
**ISSUE AU**

DATE 14 AUG 2024

|                                                         |                                                       |                                                             |                                                             |                                                             |                                                             |
|---------------------------------------------------------|-------------------------------------------------------|-------------------------------------------------------------|-------------------------------------------------------------|-------------------------------------------------------------|-------------------------------------------------------------|
| STYLE 1 THRU 5:<br>CANCELLED                            | STYLE 6:<br>PIN 1. BASE<br>2. EMITTER<br>3. COLLECTOR | STYLE 7:<br>PIN 1. EMITTER<br>2. BASE<br>3. COLLECTOR       | STYLE 8:<br>PIN 1. ANODE<br>2. NO CONNECTION<br>3. CATHODE  |                                                             |                                                             |
| STYLE 9:<br>PIN 1. ANODE<br>2. ANODE<br>3. CATHODE      | STYLE 10:<br>PIN 1. DRAIN<br>2. SOURCE<br>3. GATE     | STYLE 11:<br>PIN 1. ANODE<br>2. CATHODE<br>3. CATHODE-ANODE | STYLE 12:<br>PIN 1. CATHODE<br>2. CATHODE<br>3. ANODE       | STYLE 13:<br>PIN 1. SOURCE<br>2. DRAIN<br>3. GATE           | STYLE 14:<br>PIN 1. CATHODE<br>2. GATE<br>3. ANODE          |
| STYLE 15:<br>PIN 1. GATE<br>2. CATHODE<br>3. ANODE      | STYLE 16:<br>PIN 1. ANODE<br>2. CATHODE<br>3. CATHODE | STYLE 17:<br>PIN 1. NO CONNECTION<br>2. ANODE<br>3. CATHODE | STYLE 18:<br>PIN 1. NO CONNECTION<br>2. CATHODE<br>3. ANODE | STYLE 19:<br>PIN 1. CATHODE<br>2. ANODE<br>3. CATHODE-ANODE | STYLE 20:<br>PIN 1. CATHODE<br>2. ANODE<br>3. GATE          |
| STYLE 21:<br>PIN 1. GATE<br>2. SOURCE<br>3. DRAIN       | STYLE 22:<br>PIN 1. RETURN<br>2. OUTPUT<br>3. INPUT   | STYLE 23:<br>PIN 1. ANODE<br>2. ANODE<br>3. CATHODE         | STYLE 24:<br>PIN 1. GATE<br>2. DRAIN<br>3. SOURCE           | STYLE 25:<br>PIN 1. ANODE<br>2. CATHODE<br>3. GATE          | STYLE 26:<br>PIN 1. CATHODE<br>2. ANODE<br>3. NO CONNECTION |
| STYLE 27:<br>PIN 1. CATHODE<br>2. CATHODE<br>3. CATHODE | STYLE 28:<br>PIN 1. ANODE<br>2. ANODE<br>3. ANODE     |                                                             |                                                             |                                                             |                                                             |

|                  |                                      |                                                                                                                                                                                     |
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| DESCRIPTION:     | SOT-23 (TO-236) 2.90x1.30x1.00 1.90P | PAGE 2 OF 2                                                                                                                                                                         |

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