

MMBT4403L, SMMBT4403L

Switching Transistor

PNP 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} | -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 (Note 1) @ $T_A = 25^\circ\text{C}$ Derate above 25°C | P_D | 225 1.8 | mW mW/ $^\circ\text{C}$ |
| Thermal Resistance, Junction-to-Ambient | $R_{\theta JA}$ | 556 | $^\circ\text{C}/\text{W}$ |
| Total Device Dissipation Alumina Substrate, (Note 2) @ $T_A = 25^\circ\text{C}$ Derate above 25°C | P_D | 300 2.4 | mW 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 Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

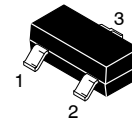
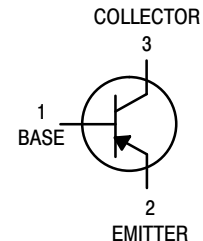
*Transient pulses must not cause the junction temperature to be exceeded.

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.



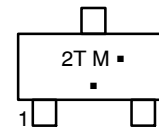
ON Semiconductor®

<http://onsemi.com>



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

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† |
|---------------|---------------------|----------------------|
| MMBT4403LT1G | SOT-23 (Pb-Free) | 3000 / Tape & Reel |
| SMMBT4403LT1G | SOT-23 (Pb-Free) | 3000 / Tape & Reel |
| MMBT4403LT3G | SOT-23 (Pb-Free) | 10,000 / 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.

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

| Characteristic | Symbol | Min | Max | Unit | |
|--|---|---------------|------|------|-----------------|
| OFF CHARACTERISTICS | | | | | |
| Collector-Emitter Breakdown Voltage (Note 3) | $(I_C = -1.0 \text{ mAdc}, I_B = 0)$ | $V_{(BR)CEO}$ | -40 | - | Vdc |
| Collector-Base Breakdown Voltage | $(I_C = -0.1 \text{ mAdc}, I_E = 0)$ | $V_{(BR)CBO}$ | -40 | - | Vdc |
| Emitter-Base Breakdown Voltage | $(I_E = -0.1 \text{ mAdc}, I_C = 0)$ | $V_{(BR)EBO}$ | -5.0 | - | Vdc |
| Base Cutoff Current | $(V_{CE} = -35 \text{ Vdc}, V_{EB} = -0.4 \text{ Vdc})$ | I_{BEV} | - | -0.1 | μAdc |
| Collector Cutoff Current | $(V_{CE} = -35 \text{ Vdc}, V_{EB} = -0.4 \text{ Vdc})$ | I_{CEX} | - | -0.1 | μAdc |

ON CHARACTERISTICS

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

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 | |

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

SWITCHING TIME EQUIVALENT TEST CIRCUIT

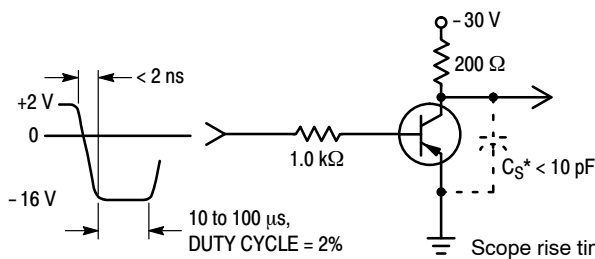


Figure 1. Turn-On Time

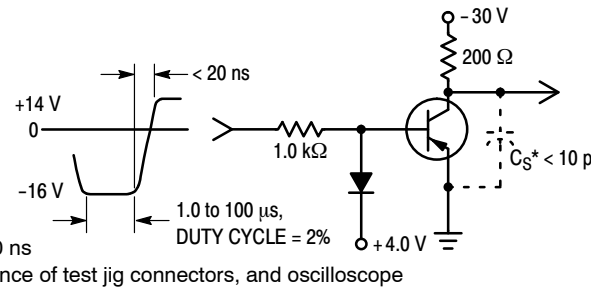


Figure 2. Turn-Off Time

MMBT4403L, SMMBT4403L

TRANSIENT CHARACTERISTICS

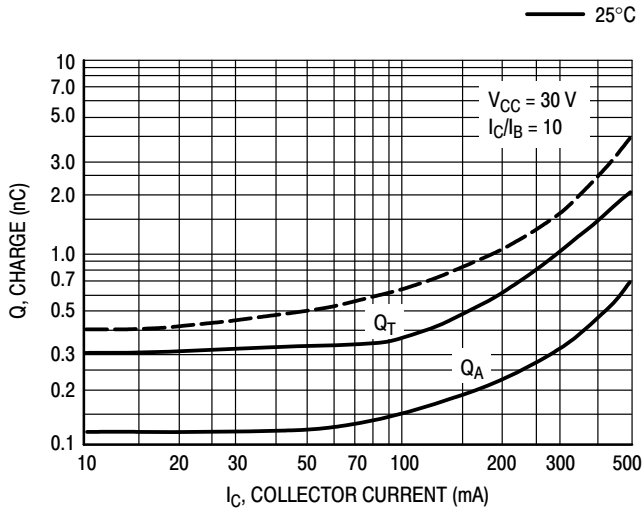


Figure 3. Charge Data

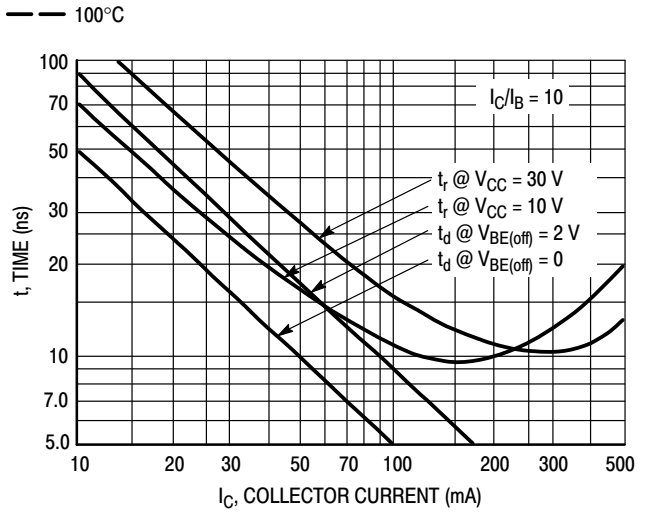


Figure 4. Turn-On Time

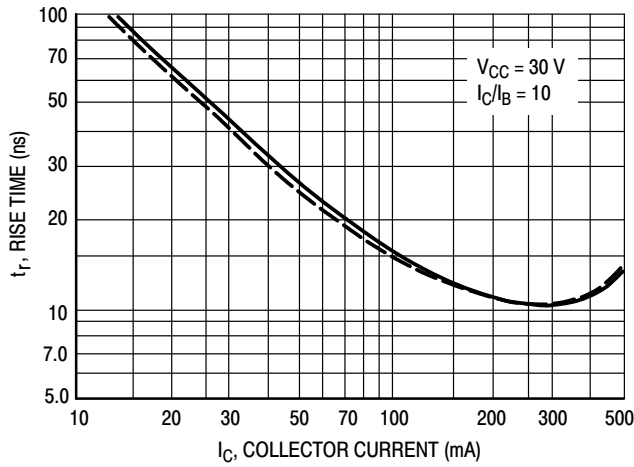


Figure 5. Rise Time

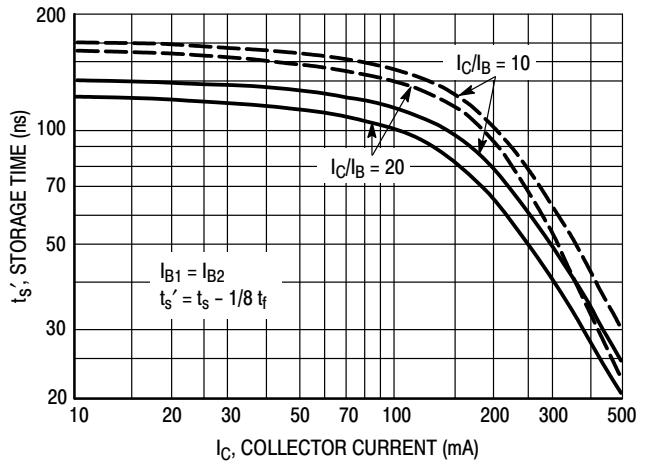


Figure 6. Storage Time

SMALL-SIGNAL CHARACTERISTICS NOISE FIGURE

$V_{CE} = -10$ Vdc, $T_A = 25^\circ\text{C}$; Bandwidth = 1.0 Hz

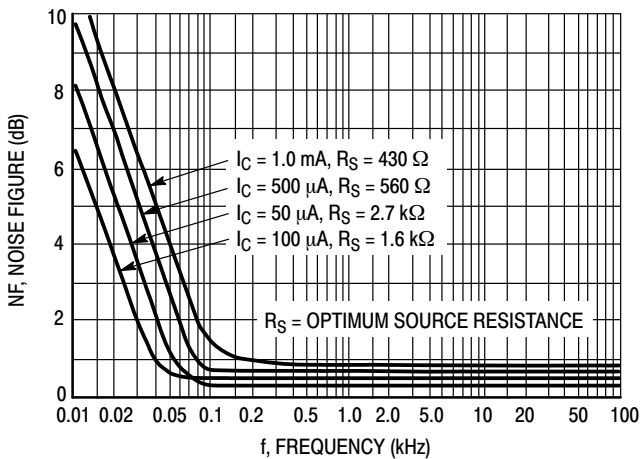


Figure 7. Frequency Effects

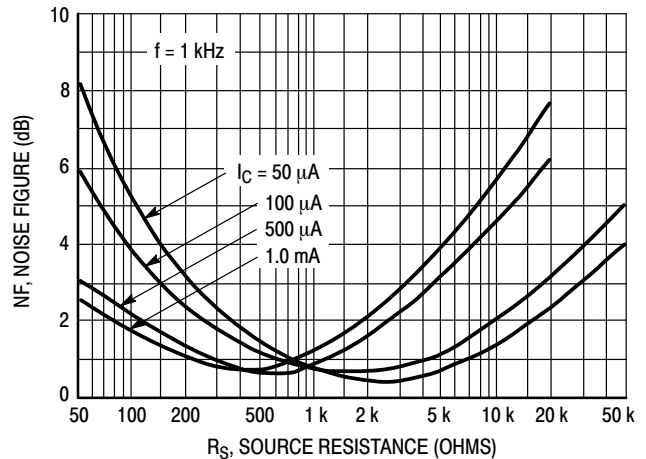


Figure 8. Source Resistance Effects

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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.

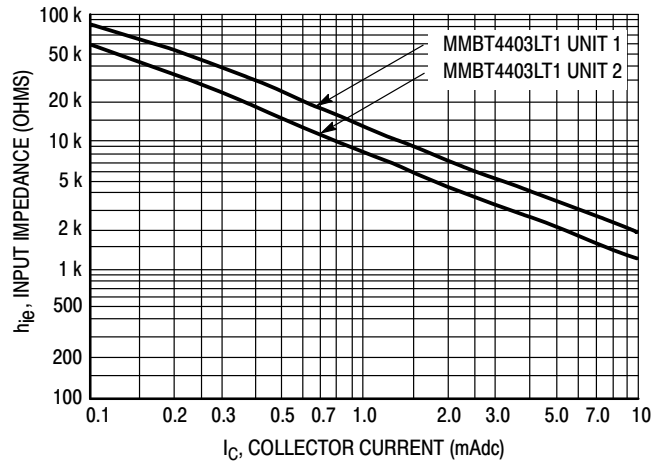


Figure 9. Input Impedance

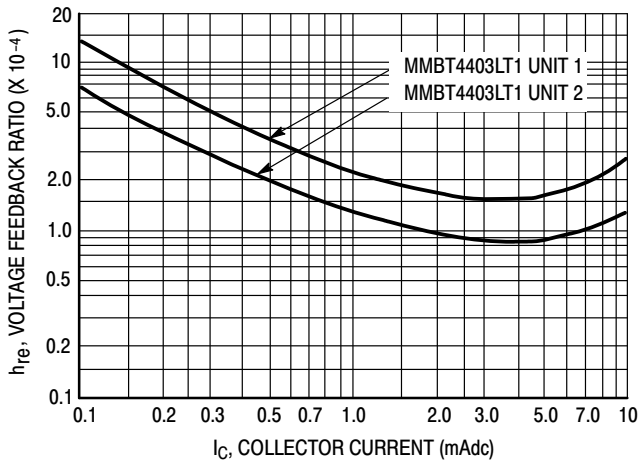


Figure 10. Voltage Feedback Ratio

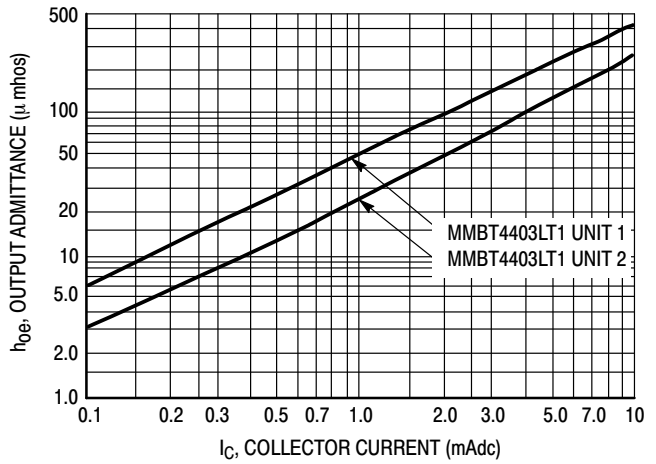


Figure 11. Output Admittance

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STATIC CHARACTERISTICS



Figure 12. DC Current Gain

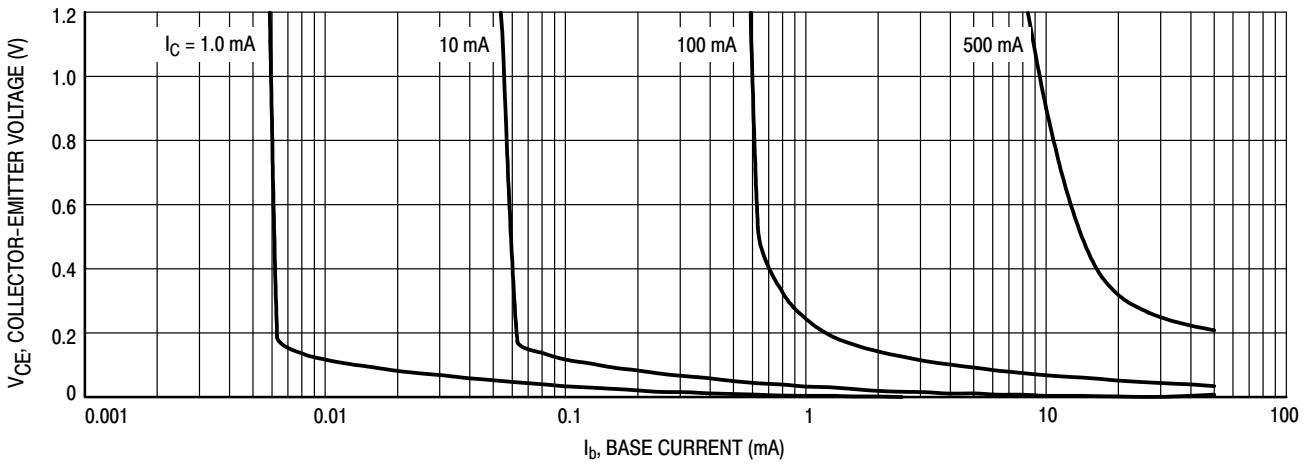


Figure 13. Collector Saturation Region

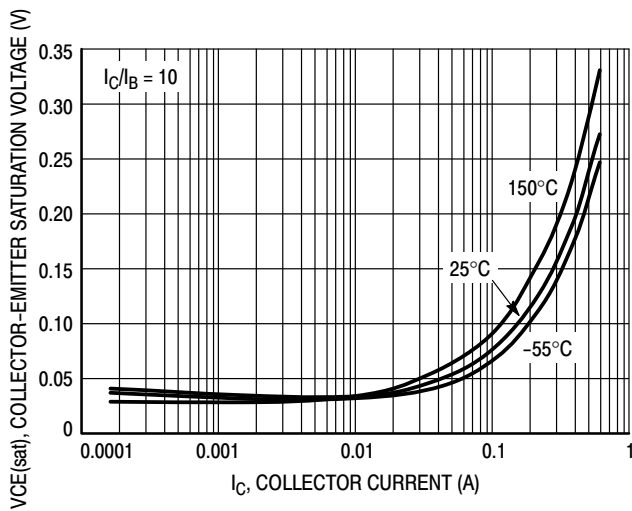


Figure 14. Collector-Emitter Saturation Voltage vs. Collector Current

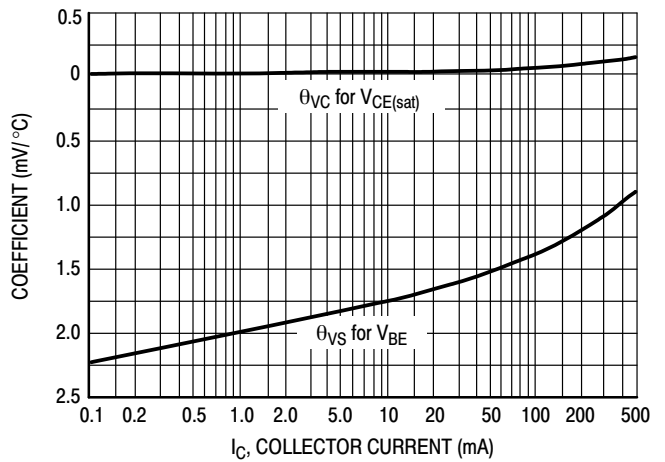


Figure 15. Temperature Coefficients

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STATIC CHARACTERISTICS

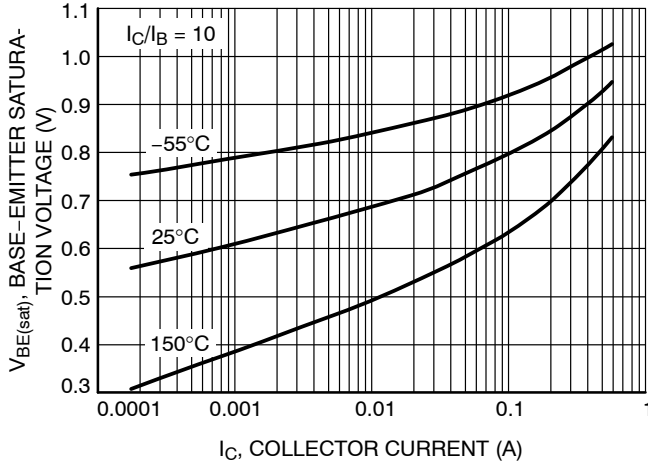


Figure 16. Base-Emitter Saturation Voltage vs. Collector Current

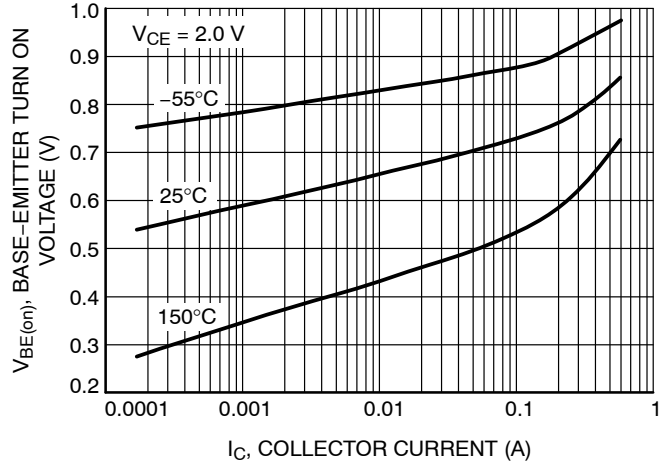


Figure 17. Base-Emitter Turn On Voltage vs. Collector Current

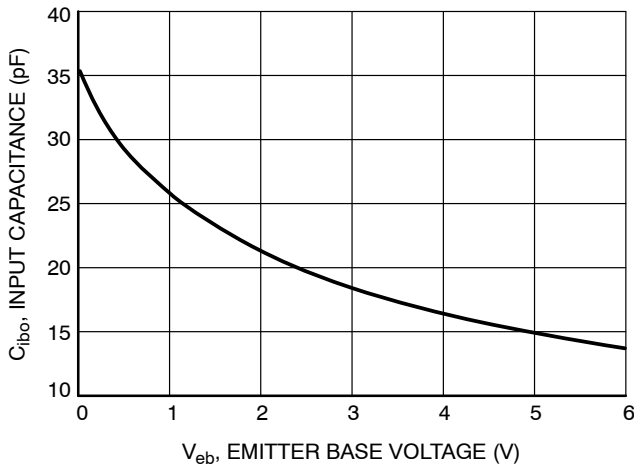


Figure 18. Input Capacitance vs. Emitter Base Voltage

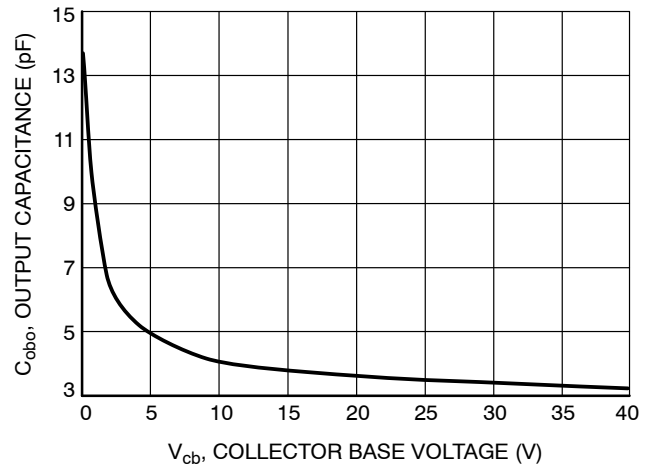


Figure 19. Output Capacitance vs. Collector Base Voltage

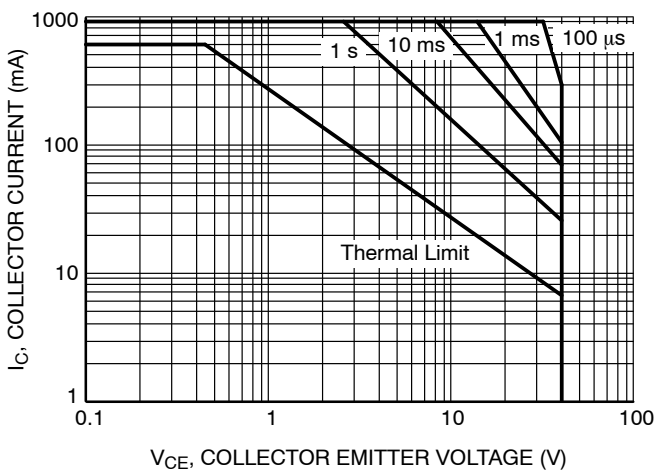


Figure 20. Safe Operating Area

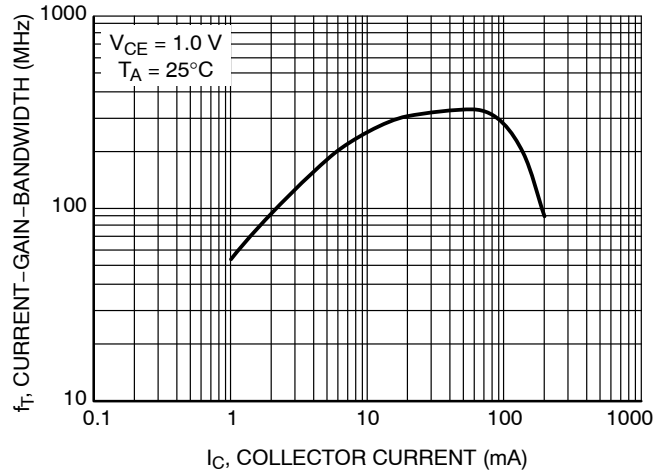
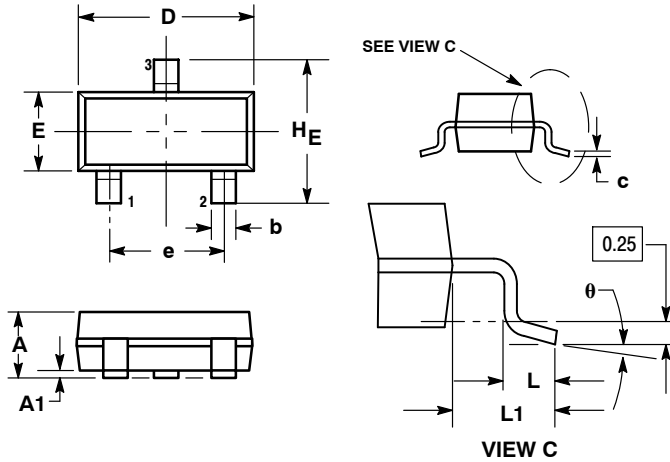


Figure 21. Current-Gain-Bandwidth Product

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PACKAGE DIMENSIONS

SOT-23 (TO-236)
CASE 318-08
ISSUE AP



NOTES:

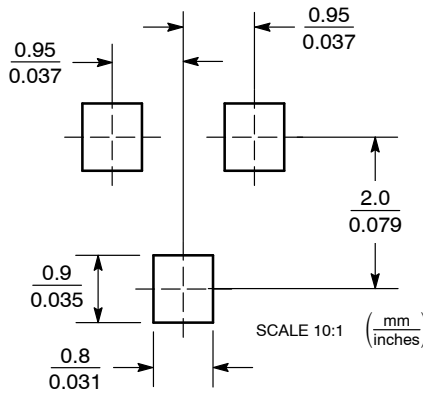
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH THICKNESS. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIAL.
4. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS.

| DIM | MILLIMETERS | | | INCHES | | |
|-----|-------------|------|------|--------|-------|-------|
| | MIN | NOM | MAX | MIN | NOM | MAX |
| A | 0.89 | 1.00 | 1.11 | 0.035 | 0.040 | 0.044 |
| A1 | 0.01 | 0.06 | 0.10 | 0.001 | 0.002 | 0.004 |
| b | 0.37 | 0.44 | 0.50 | 0.015 | 0.018 | 0.020 |
| c | 0.09 | 0.13 | 0.18 | 0.003 | 0.005 | 0.007 |
| D | 2.80 | 2.90 | 3.04 | 0.110 | 0.114 | 0.120 |
| E | 1.20 | 1.30 | 1.40 | 0.047 | 0.051 | 0.055 |
| e | 1.78 | 1.90 | 2.04 | 0.070 | 0.075 | 0.081 |
| L | 0.10 | 0.20 | 0.30 | 0.004 | 0.008 | 0.012 |
| L1 | 0.35 | 0.54 | 0.69 | 0.014 | 0.021 | 0.029 |
| HE | 2.10 | 2.40 | 2.64 | 0.083 | 0.094 | 0.104 |
| θ | 0° | --- | 10° | 0° | --- | 10° |

STYLE 6:

1. PIN 1. BASE
2. EMITTER
3. COLLECTOR

SOLDERING FOOTPRINT*



*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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