

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 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.

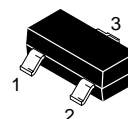
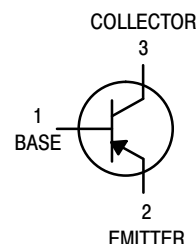
*Transient pulses must not cause the junction temperature to be exceeded.

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.



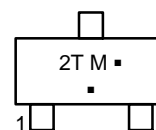
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SOT-23 (TO-236)
CASE 318
STYLE 6

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	μA dc
Collector Cutoff Current	($V_{CE} = -35\text{ Vdc}$, $V_{EB} = -0.4\text{ Vdc}$)	I_{CEX}	-	-0.1	μA dc

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 Ω
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 Vdc, V _{EB} = -2.0 Vdc, I _C = -150 mAdc, I _{B1} = -15 mAdc)	t _d	-	15	ns
Rise Time		t _r	-	20	
Storage Time	(V _{CC} = -30 Vdc, I _C = -150 mAdc, I _{B1} = I _{B2} = -15 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

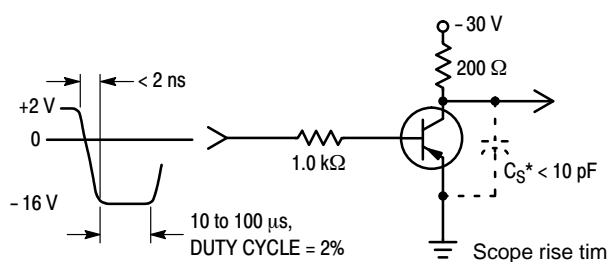


Figure 1. Turn–On Time

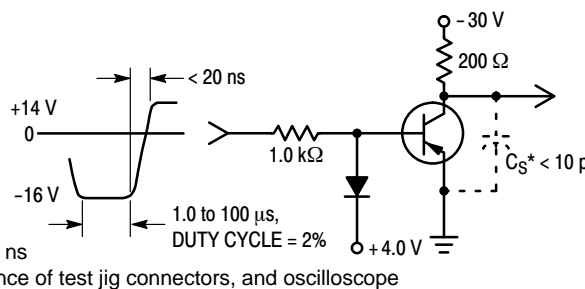


Figure 2. Turn–Off Time

MMBT4403L, SMMBT4403L

TRANSIENT CHARACTERISTICS

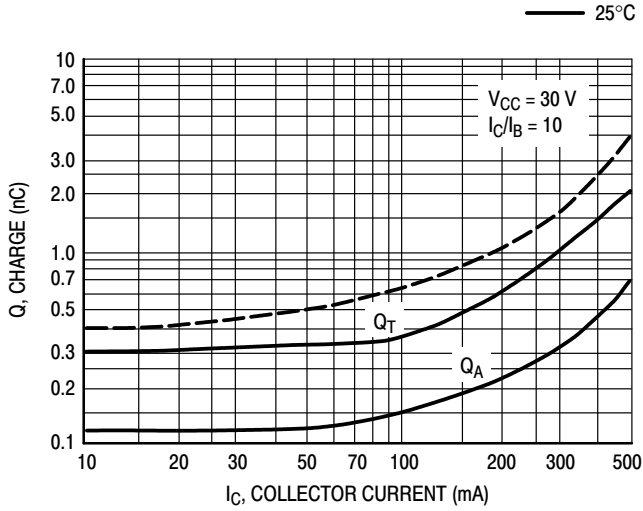


Figure 3. Charge Data

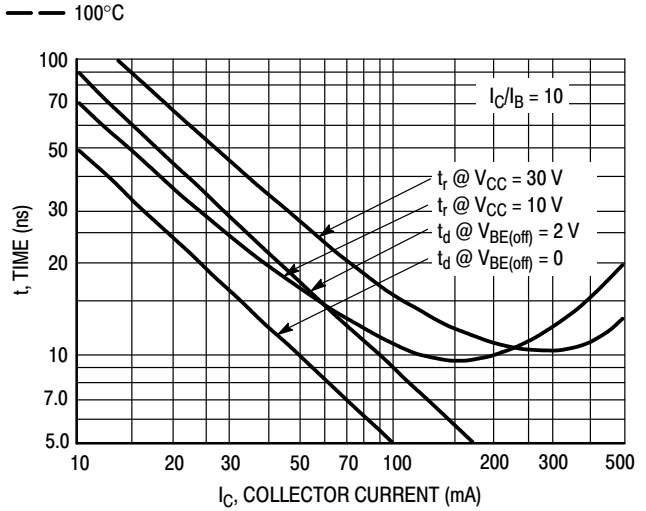


Figure 4. Turn-On Time

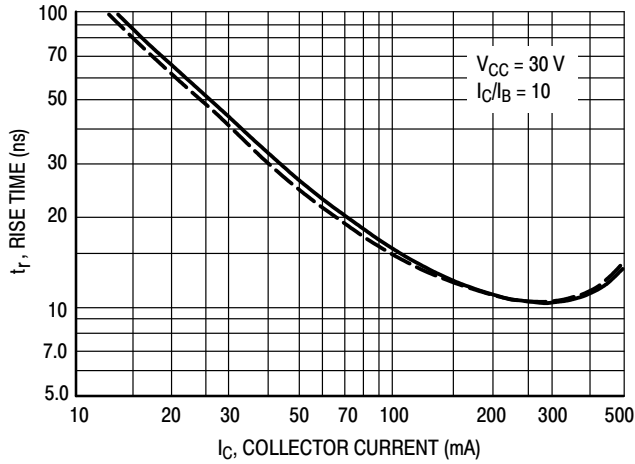


Figure 5. Rise Time

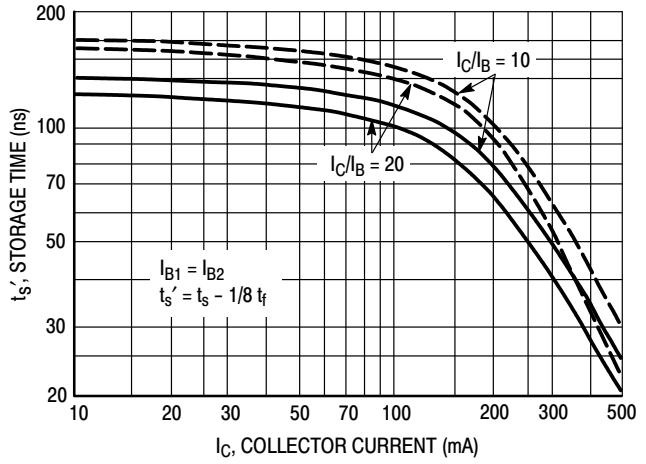


Figure 6. Storage Time

SMALL-SIGNAL CHARACTERISTICS NOISE FIGURE

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

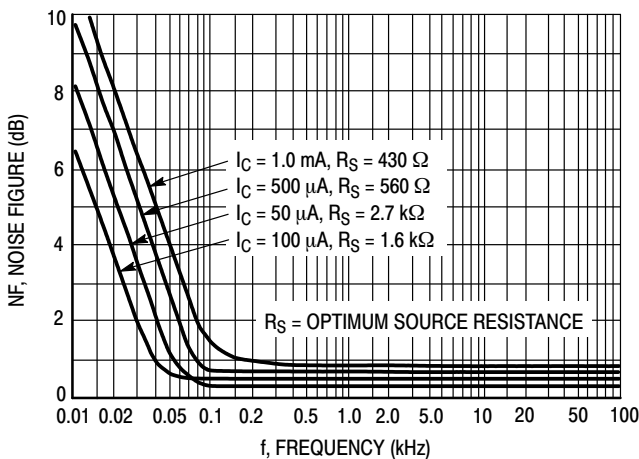


Figure 7. Frequency Effects

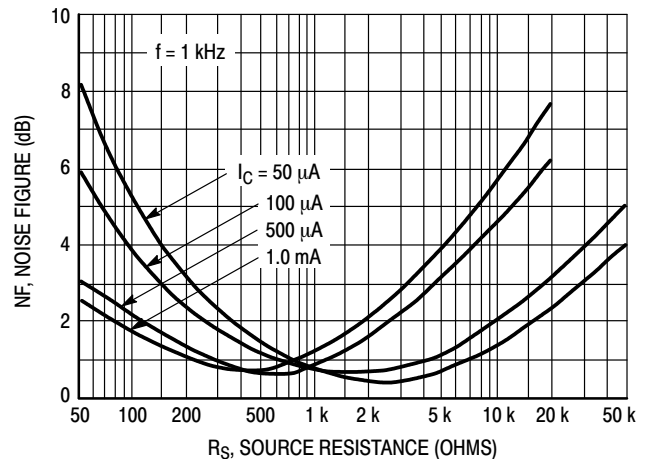


Figure 8. Source Resistance Effects

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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.

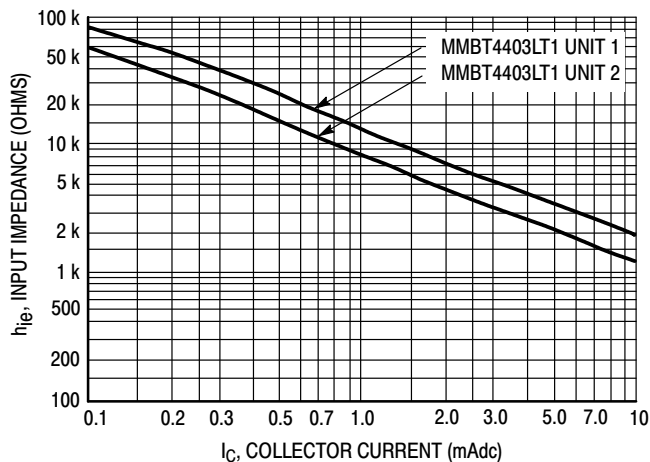


Figure 9. Input Impedance

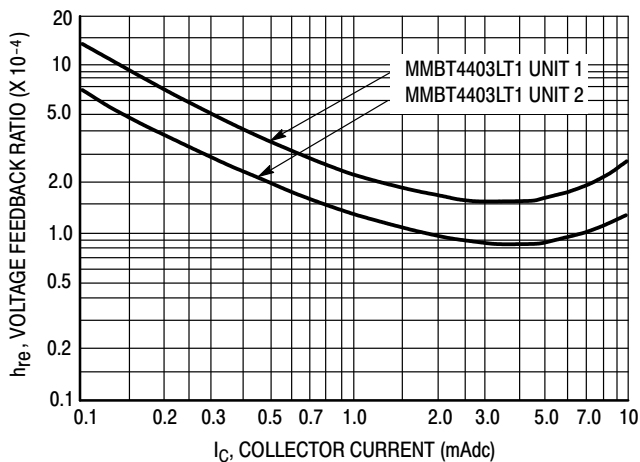


Figure 10. Voltage Feedback Ratio

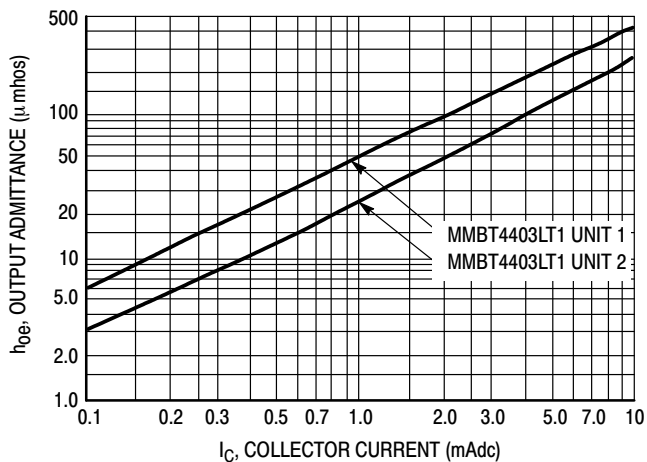


Figure 11. Output Admittance

MMBT4403L, SMMBT4403L

STATIC CHARACTERISTICS

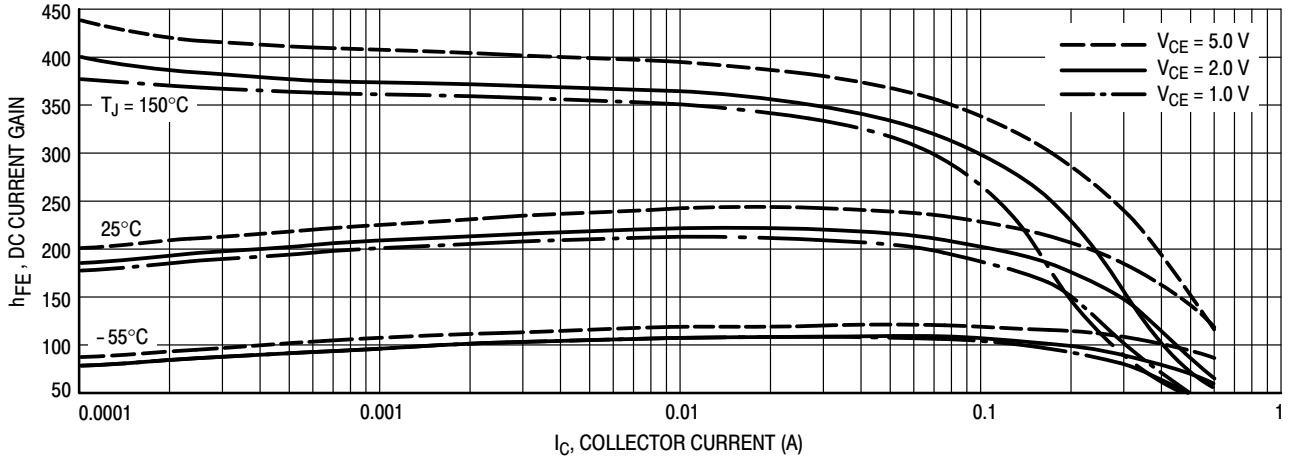


Figure 12. DC Current Gain

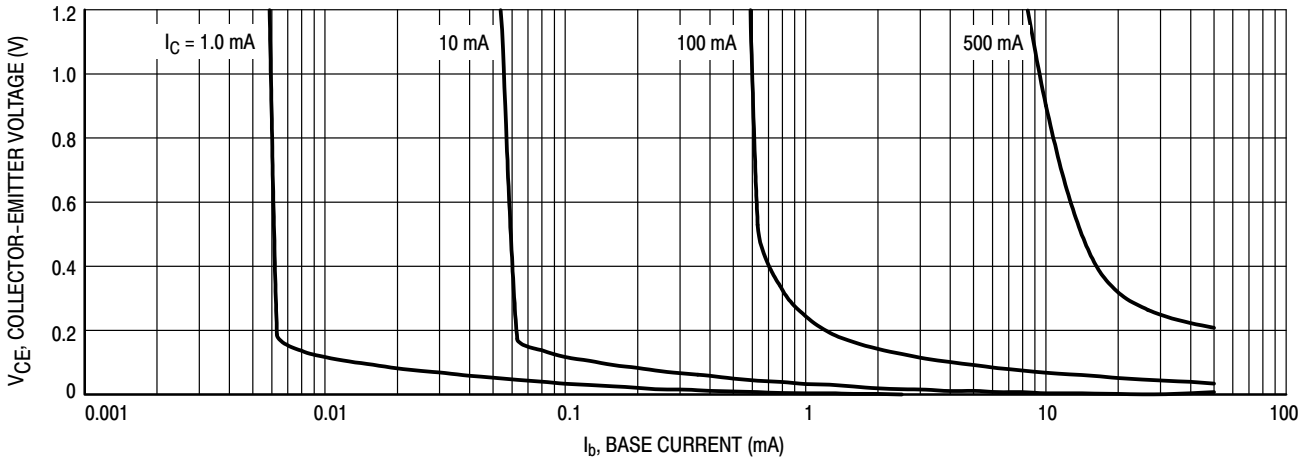


Figure 13. Collector Saturation Region

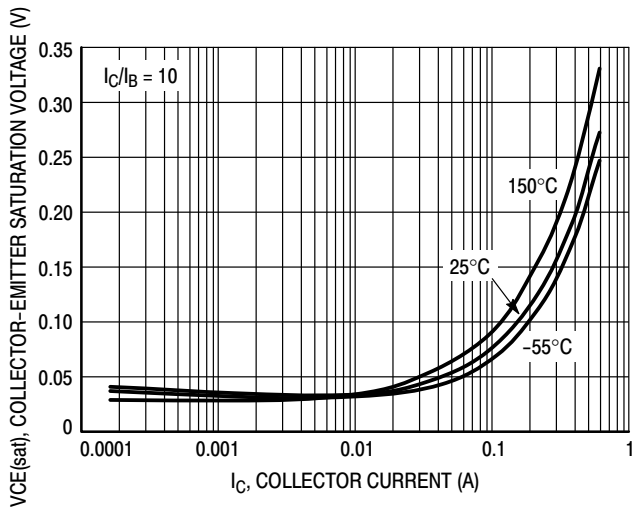


Figure 14. Collector-Emitter Saturation Voltage vs. Collector Current

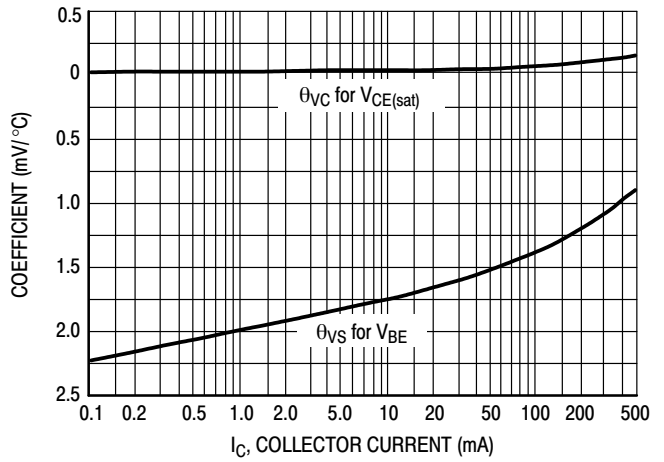


Figure 15. Temperature Coefficients

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STATIC CHARACTERISTICS

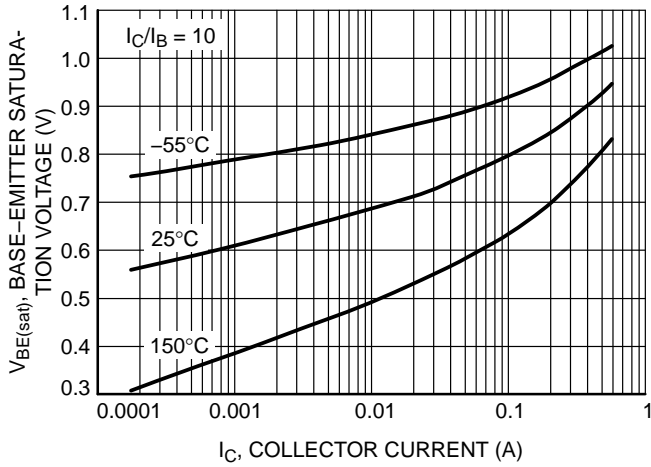


Figure 16. Base-Emitter Saturation Voltage vs. Collector Current

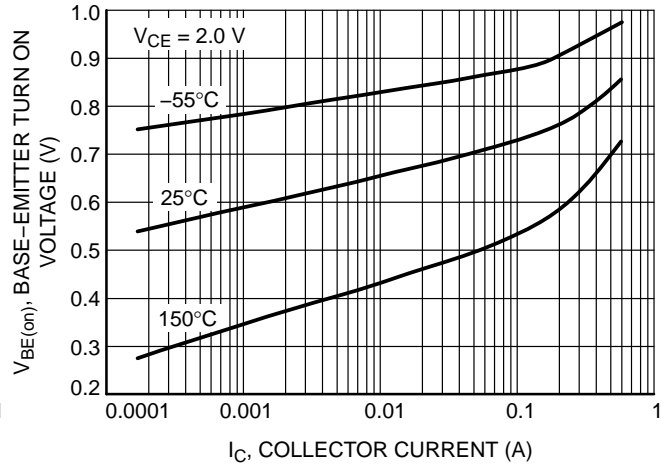


Figure 17. Base-Emitter Turn On Voltage vs. Collector Current

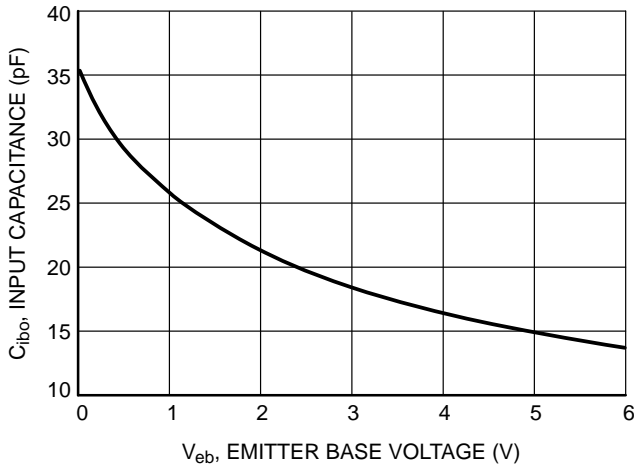


Figure 18. Input Capacitance vs. Emitter Base Voltage

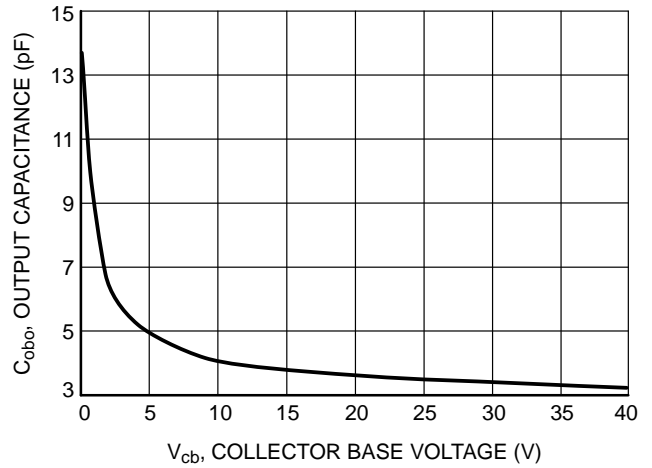


Figure 19. Output Capacitance vs. Collector Base Voltage

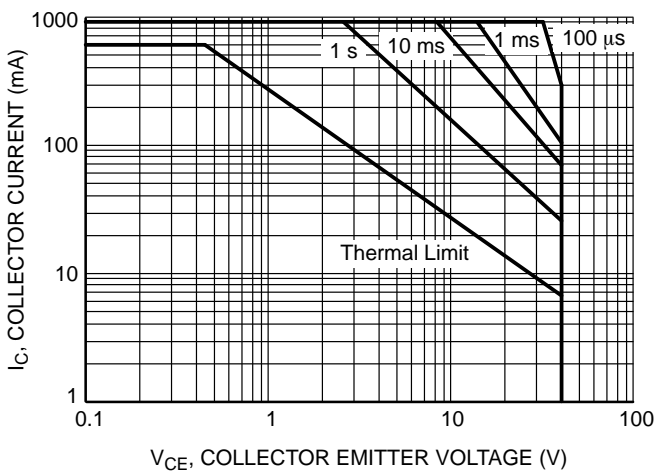


Figure 20. Safe Operating Area

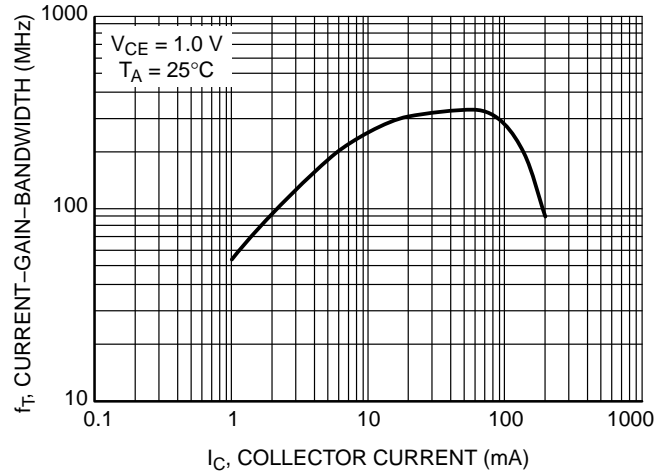


Figure 21. Current-Gain-Bandwidth Product

MECHANICAL CASE OUTLINE PACKAGE DIMENSIONS



SOT-23 (TO-236)
CASE 318
ISSUE AT

DATE 01 MAR 2023

SCALE 4:1



NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M,1994.
2. CONTROLLING DIMENSION: 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.

DIM	MILLIMETERS			INCHES		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A	0.89	1.00	1.11	0.035	0.039	0.044
A1	0.01	0.06	0.10	0.000	0.002	0.004
b	0.37	0.44	0.50	0.015	0.017	0.020
c	0.08	0.14	0.20	0.003	0.006	0.008
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	0.080
L	0.30	0.43	0.55	0.012	0.017	0.022
L1	0.35	0.54	0.69	0.014	0.021	0.027
H _E	2.10	2.40	2.64	0.083	0.094	0.104
T	0°	---	10°	0°	---	10°

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 ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

STYLES ON PAGE 2

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**MECHANICAL CASE OUTLINE
PACKAGE DIMENSIONS**



**SOT-23 (TO-236)
CASE 318
ISSUE AT**

DATE 01 MAR 2023

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

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