

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	$^\circ\text{C/W}$
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	$^\circ\text{C/W}$
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.

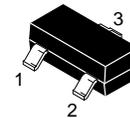
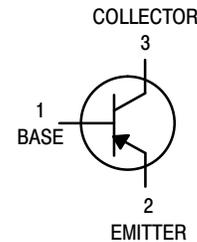
*Transient pulses must not cause the junction temperature to be exceeded.

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.



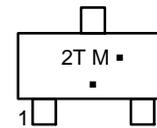
ON Semiconductor®

www.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.

MMBT4403L, SMMBT4403L

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted)

Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS				
Collector–Emitter Breakdown Voltage (Note 3) (I _C = –1.0 mA _{dc} , I _B = 0)	V _{(BR)CEO}	–40	–	V _{dc}
Collector–Base Breakdown Voltage (I _C = –0.1 mA _{dc} , I _E = 0)	V _{(BR)CBO}	–40	–	V _{dc}
Emitter–Base Breakdown Voltage (I _E = –0.1 mA _{dc} , I _C = 0)	V _{(BR)EBO}	–5.0	–	V _{dc}
Base Cutoff Current (V _{CE} = –35 V _{dc} , V _{EB} = –0.4 V _{dc})	I _{BEV}	–	–0.1	μA _{dc}
Collector Cutoff Current (V _{CE} = –35 V _{dc} , V _{EB} = –0.4 V _{dc})	I _{CEX}	–	–0.1	μA _{dc}

ON CHARACTERISTICS

DC Current Gain (Note 3) (Note 3) (Note 3)	(I _C = –0.1 mA _{dc} , V _{CE} = –1.0 V _{dc}) (I _C = –1.0 mA _{dc} , V _{CE} = –1.0 V _{dc}) (I _C = –10 mA _{dc} , V _{CE} = –1.0 V _{dc}) (I _C = –150 mA _{dc} , V _{CE} = –2.0 V _{dc}) (I _C = –500 mA _{dc} , V _{CE} = –2.0 V _{dc})	h _{FE}	30 60 100 100 20	– – – 300 –	–
Collector–Emitter Saturation Voltage (Note 3)	(I _C = –150 mA _{dc} , I _B = –15 mA _{dc}) (I _C = –500 mA _{dc} , I _B = –50 mA _{dc})	V _{CE(sat)}	– –	–0.4 –0.75	V _{dc}
Base–Emitter Saturation Voltage (Note 3)	(I _C = –150 mA _{dc} , I _B = –15 mA _{dc}) (I _C = –500 mA _{dc} , I _B = –50 mA _{dc})	V _{BE(sat)}	–0.75 –	–0.95 –1.3	V _{dc}

SMALL–SIGNAL CHARACTERISTICS

Current–Gain – Bandwidth Product (I _C = –20 mA _{dc} , V _{CE} = –10 V _{dc} , f = 100 MHz)	f _T	200	–	MHz
Collector–Base Capacitance (V _{CB} = –10 V _{dc} , I _E = 0, f = 1.0 MHz)	C _{cb}	–	8.5	pF
Emitter–Base Capacitance (V _{BE} = –0.5 V _{dc} , I _C = 0, f = 1.0 MHz)	C _{eb}	–	30	pF
Input Impedance (I _C = –1.0 mA _{dc} , V _{CE} = –10 V _{dc} , f = 1.0 kHz)	h _{ie}	1.5	15	kΩ
Voltage Feedback Ratio (I _C = –1.0 mA _{dc} , V _{CE} = –10 V _{dc} , f = 1.0 kHz)	h _{re}	0.1	8.0	X 10 ^{–4}
Small–Signal Current Gain (I _C = –1.0 mA _{dc} , V _{CE} = –10 V _{dc} , f = 1.0 kHz)	h _{fe}	60	500	–
Output Admittance (I _C = –1.0 mA _{dc} , V _{CE} = –10 V _{dc} , f = 1.0 kHz)	h _{oe}	1.0	100	μMhos

SWITCHING CHARACTERISTICS

Delay Time	(V _{CC} = –30 V _{dc} , V _{EB} = –2.0 V _{dc} , I _C = –150 mA _{dc} , I _{B1} = –15 mA _{dc})	t _d	–	15	ns
Rise Time		t _r	–	20	
Storage Time	(V _{CC} = –30 V _{dc} , I _C = –150 mA _{dc} , I _{B1} = I _{B2} = –15 mA _{dc})	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 ≤ 300 μs, Duty Cycle ≤ 2.0%.

SWITCHING TIME EQUIVALENT TEST CIRCUIT

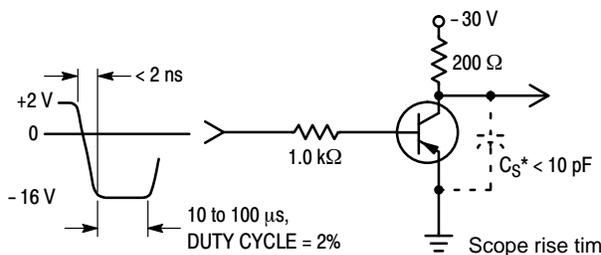


Figure 1. Turn–On Time

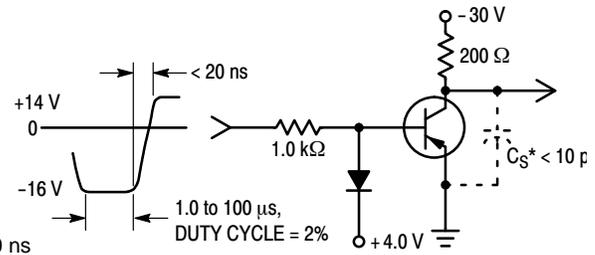


Figure 2. Turn–Off Time

MMBT4403L, SMMBT4403L

TRANSIENT CHARACTERISTICS

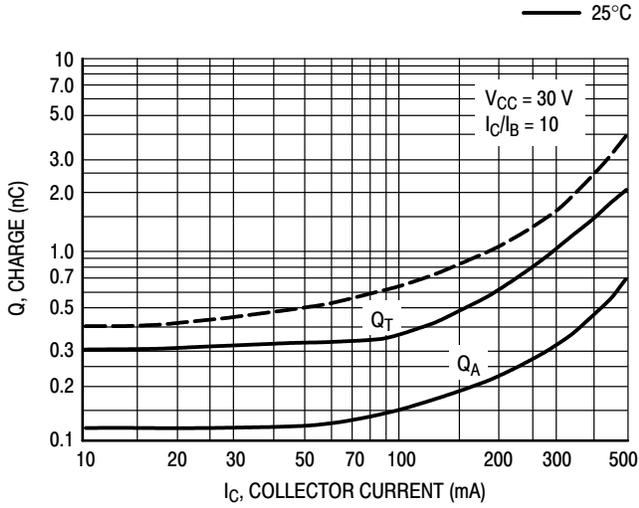


Figure 3. Charge Data

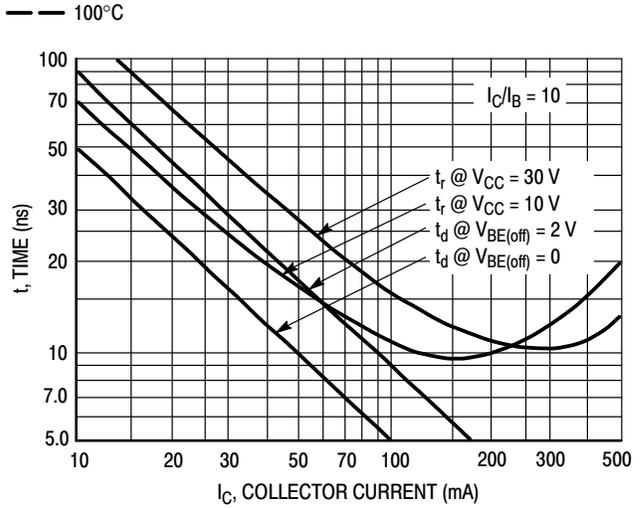


Figure 4. Turn-On Time

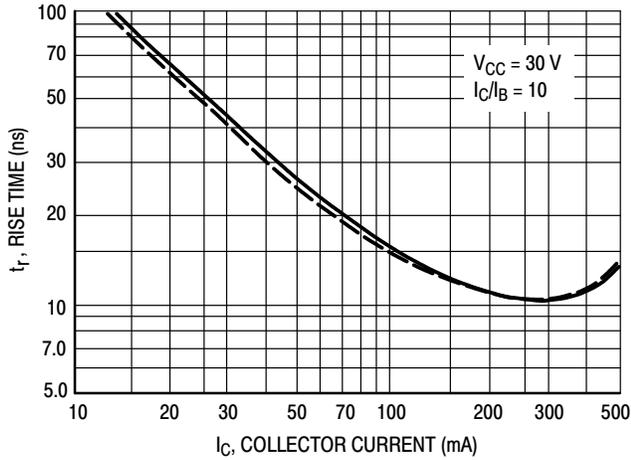


Figure 5. Rise Time

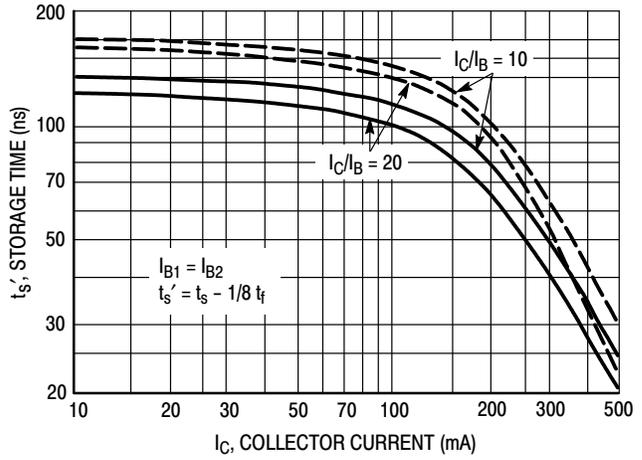


Figure 6. Storage Time

SMALL-SIGNAL CHARACTERISTICS NOISE FIGURE

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

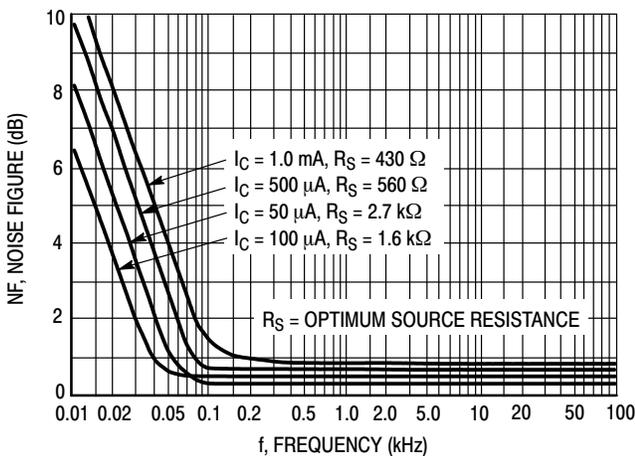


Figure 7. Frequency Effects

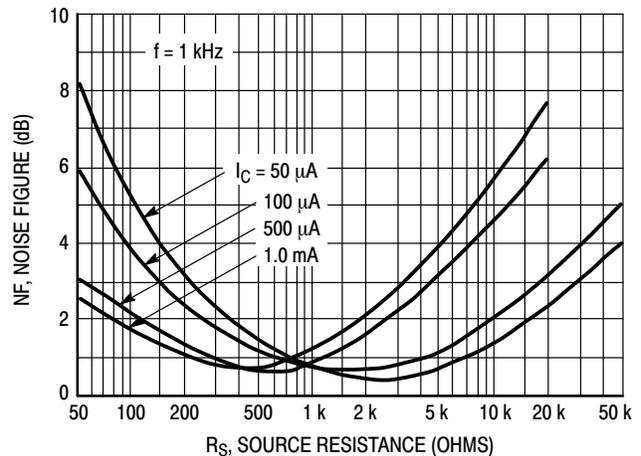


Figure 8. Source Resistance Effects

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.

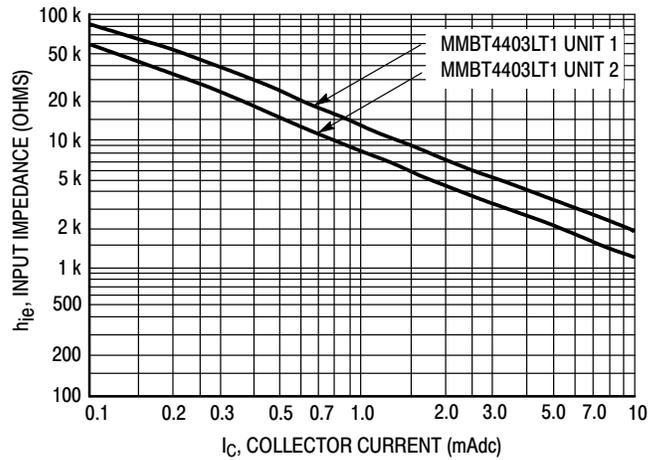


Figure 9. Input Impedance

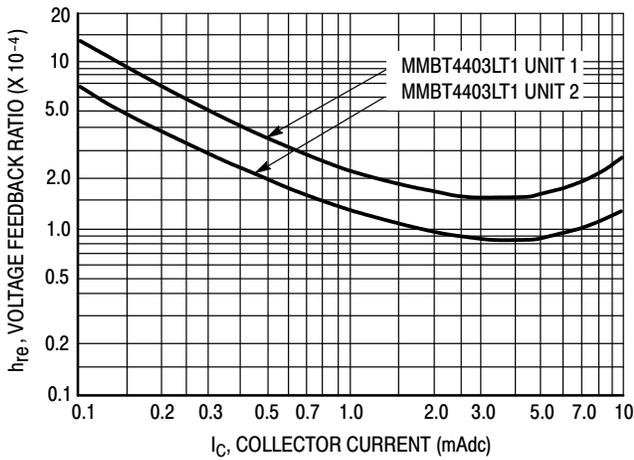


Figure 10. Voltage Feedback Ratio

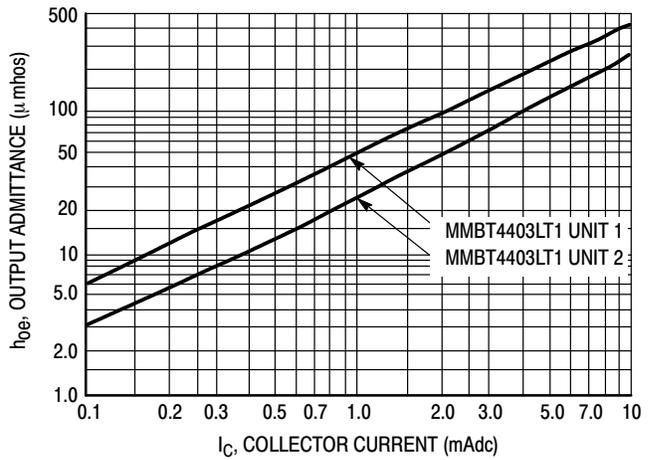


Figure 11. Output Admittance

MMBT4403L, SMMBT4403L

STATIC CHARACTERISTICS

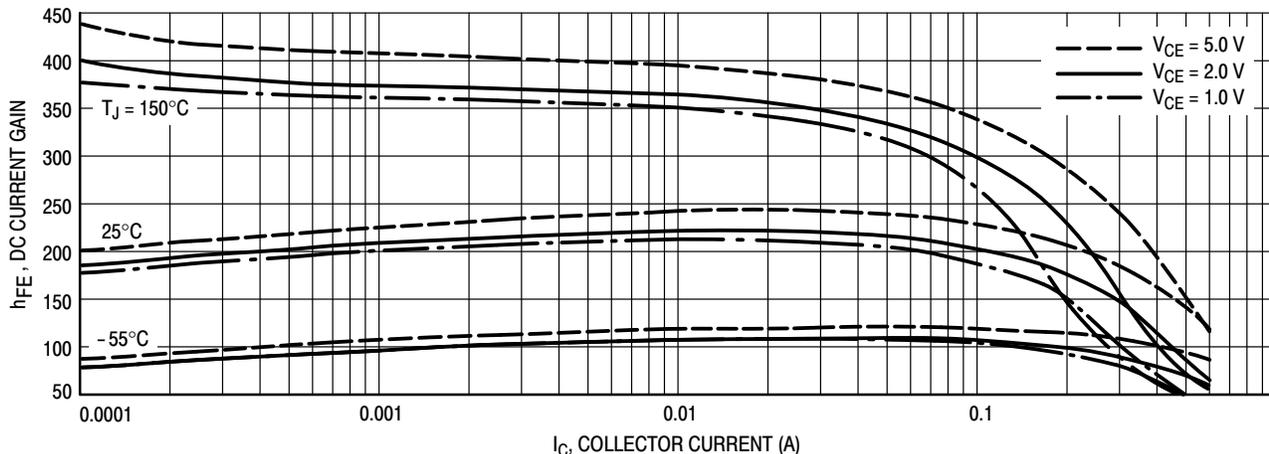


Figure 12. DC Current Gain

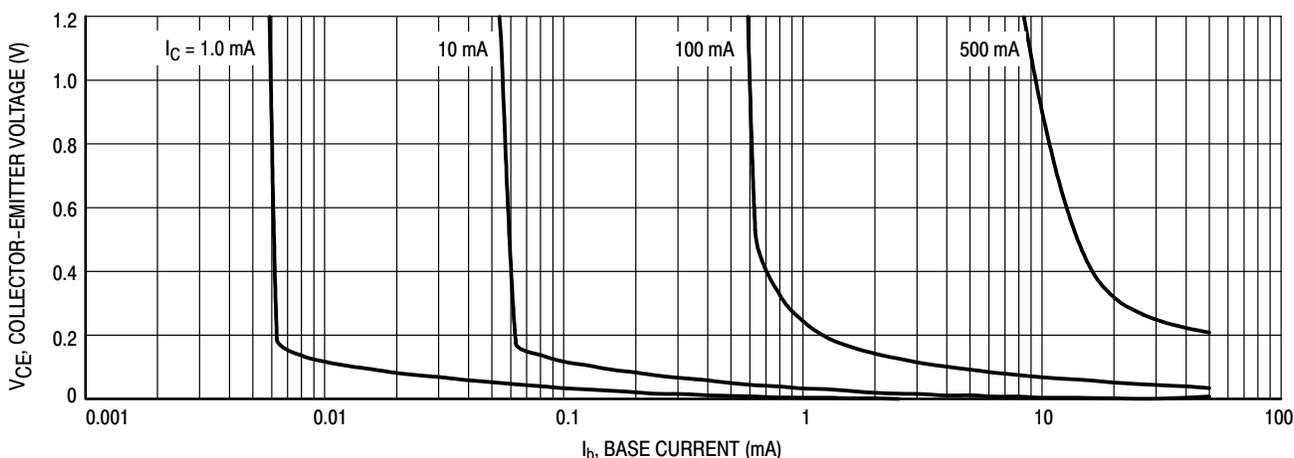


Figure 13. Collector Saturation Region

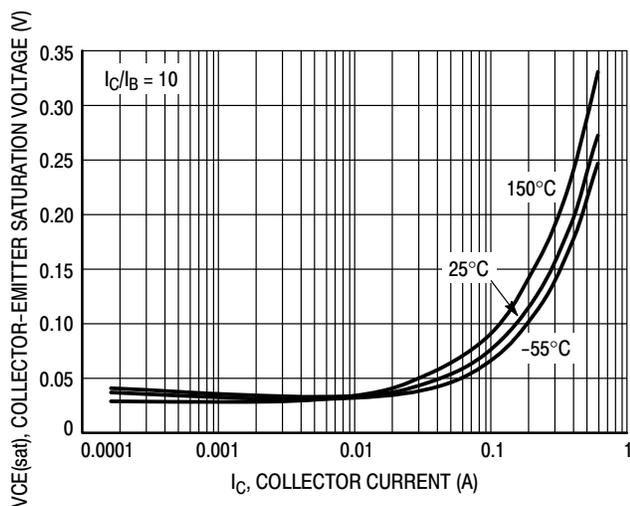


Figure 14. Collector-Emitter Saturation Voltage vs. Collector Current

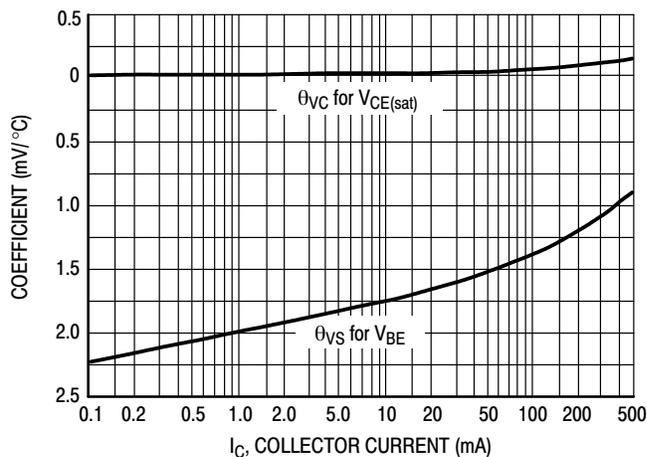


Figure 15. Temperature Coefficients

MMBT4403L, SMMBT4403L

STATIC CHARACTERISTICS

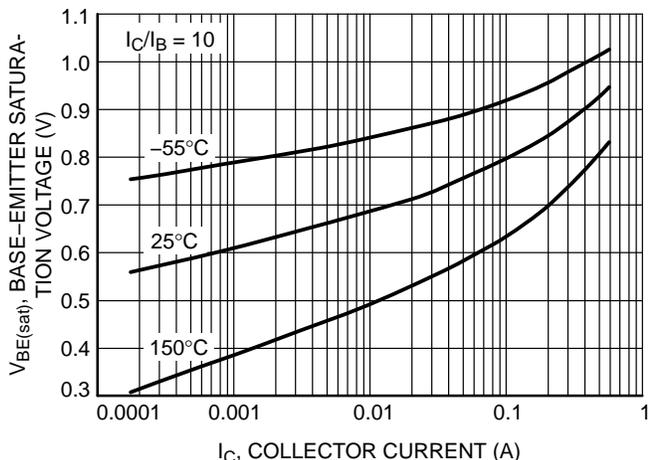


Figure 16. Base-Emitter Saturation Voltage vs. Collector Current

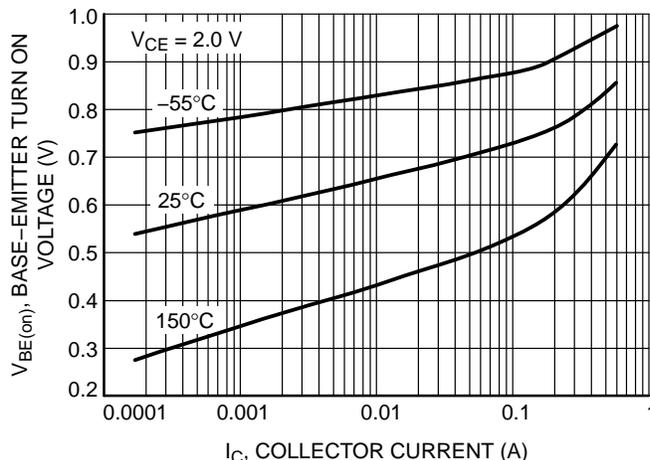


Figure 17. Base-Emitter Turn On Voltage vs. Collector Current

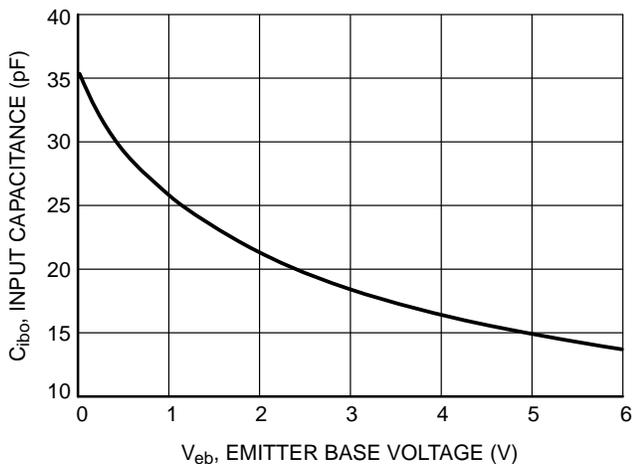


Figure 18. Input Capacitance vs. Emitter Base Voltage

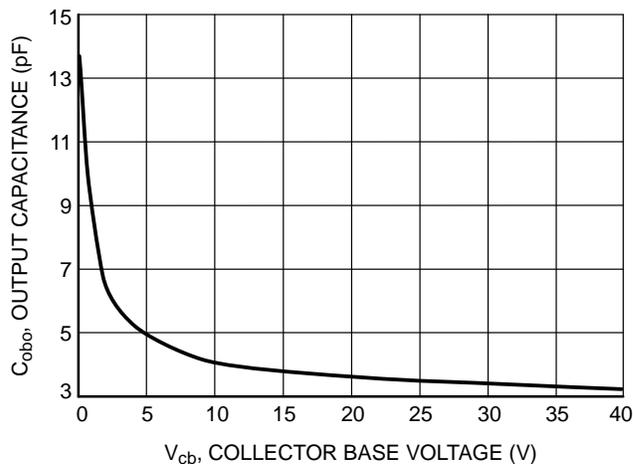


Figure 19. Output Capacitance vs. Collector Base Voltage

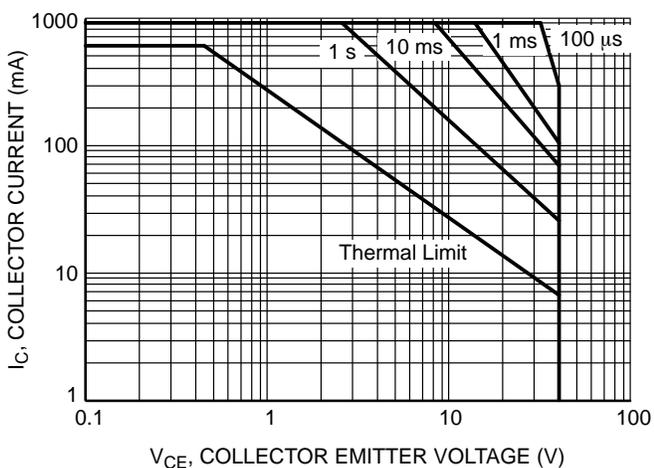


Figure 20. Safe Operating Area

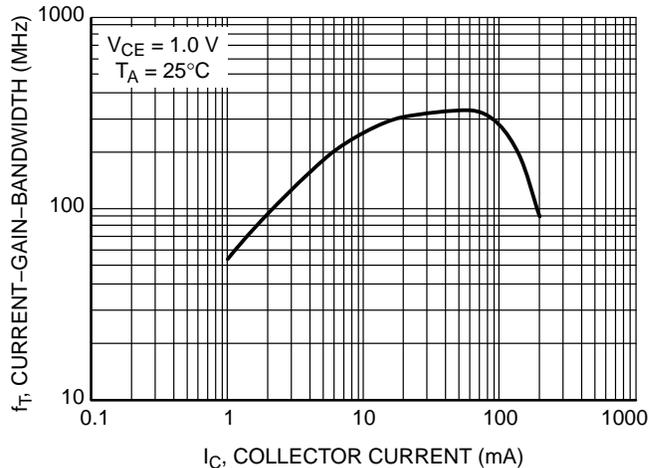
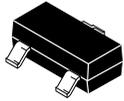


Figure 21. Current-Gain-Bandwidth Product

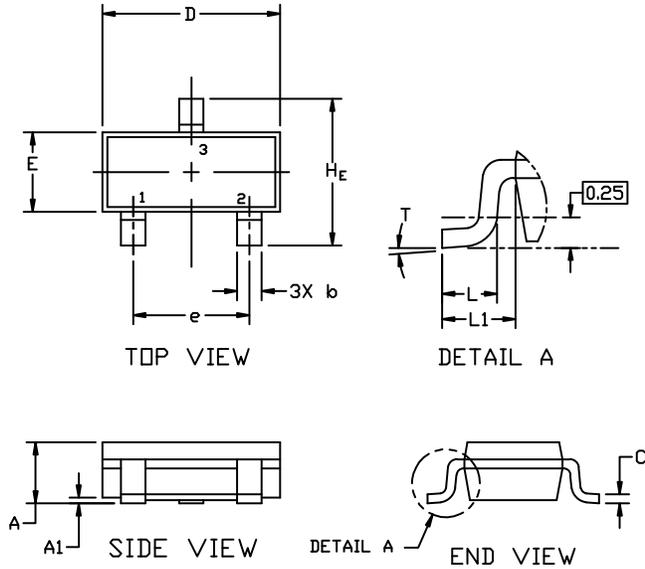
MECHANICAL CASE OUTLINE PACKAGE DIMENSIONS



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

DATE 01 MAR 2023

SCALE 4:1

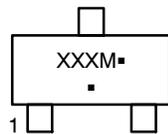


NOTES:

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.

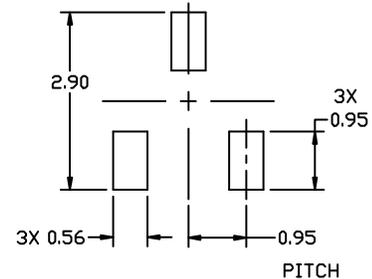
DIM	MILLIMETERS			INCHES		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A	0.89	1.00	1.11	0.035	0.039	0.044
A1	0.01	0.06	0.10	0.000	0.002	0.004
b	0.37	0.44	0.50	0.015	0.017	0.020
c	0.08	0.14	0.20	0.003	0.006	0.008
D	2.80	2.90	3.04	0.110	0.114	0.120
E	1.20	1.30	1.40	0.047	0.051	0.055
e	1.78	1.90	2.04	0.070	0.075	0.080
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

DOCUMENT NUMBER:	98ASB42226B	Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red.
DESCRIPTION:	SOT-23 (TO-236)	PAGE 1 OF 2

onsemi and ONSEMI are trademarks of Semiconductor Components Industries, LLC dba onsemi or its subsidiaries in the United States and/or other countries. onsemi reserves the right to make changes without further notice to any products herein. onsemi makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does onsemi assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. onsemi does not convey any license under its patent rights nor the rights of others.

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 | | | | |

DOCUMENT NUMBER:	98ASB42226B	Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red.
DESCRIPTION:	SOT-23 (TO-236)	PAGE 2 OF 2

onsemi and **ONSEMI** are trademarks of Semiconductor Components Industries, LLC dba **onsemi** or its subsidiaries in the United States and/or other countries. **onsemi** reserves the right to make changes without further notice to any products herein. **onsemi** makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does **onsemi** assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. **onsemi** does not convey any license under its patent rights nor the rights of others.

onsemi, **Onsemi**, and other names, marks, and brands are registered and/or common law trademarks of Semiconductor Components Industries, LLC dba "**onsemi**" or its affiliates and/or subsidiaries in the United States and/or other countries. **onsemi** owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of **onsemi**'s product/patent coverage may be accessed at www.onsemi.com/site/pdf/Patent-Marking.pdf. **onsemi** reserves the right to make changes at any time to any products or information herein, without notice. The information herein is provided "as-is" and **onsemi** makes no warranty, representation or guarantee regarding the accuracy of the information, product features, availability, functionality, or suitability of its products for any particular purpose, nor does **onsemi** assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. Buyer is responsible for its products and applications using **onsemi** products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by **onsemi**. "Typical" parameters which may be provided in **onsemi** data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. **onsemi** does not convey any license under any of its intellectual property rights nor the rights of others. **onsemi** products are not designed, intended, or authorized for use as a critical component in life support systems or any FDA Class 3 medical devices or medical devices with a same or similar classification in a foreign jurisdiction or any devices intended for implantation in the human body. Should Buyer purchase or use **onsemi** products for any such unintended or unauthorized application, Buyer shall indemnify and hold **onsemi** and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that **onsemi** was negligent regarding the design or manufacture of the part. **onsemi** is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

PUBLICATION ORDERING INFORMATION

LITERATURE FULFILLMENT:

Email Requests to: orderlit@onsemi.com

onsemi Website: www.onsemi.com

TECHNICAL SUPPORT

North American Technical Support:

Voice Mail: 1 800-282-9855 Toll Free USA/Canada

Phone: 011 421 33 790 2910

Europe, Middle East and Africa Technical Support:

Phone: 00421 33 790 2910

For additional information, please contact your local Sales Representative

