

MMBT4401WT1G

Switching Transistor

NPN Silicon

Features

- Moisture Sensitivity Level: 1
- ESD Rating: Human Body Model; 4 kV,
Machine Model; 400 V
- NSV 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}	60	Vdc
Emitter–Base Voltage	V_{EBO}	6.0	Vdc
Collector Current – Continuous	I_C	600	mA dc

THERMAL CHARACTERISTICS

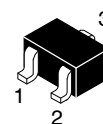
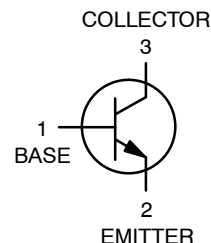
Characteristic	Symbol	Max	Unit
Total Device Dissipation FR–5 Board $T_A = 25^\circ\text{C}$	P_D	150	mW
Thermal Resistance, Junction–to–Ambient	$R_{\theta JA}$	833	$^\circ\text{C}/\text{W}$
Junction and Storage Temperature	T_J, T_{stg}	–55 to +150	$^\circ\text{C}$

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.



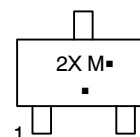
ON Semiconductor®

www.onsemi.com



**SC-70 (SOT-323)
CASE 419
STYLE 3**

MARKING DIAGRAM



(Note: Microdot may be in either location)

*Date Code orientation may vary depending upon manufacturing location.

ORDERING INFORMATION

Device	Package	Shipping†
MMBT4401WT1G	SC-70 (Pb-Free)	3000 / Tape & Reel
NSVMMBT4401WT1G	SC-70 (Pb-Free)	3000 / 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.

MMBT4401WT1G

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

Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS				
Collector–Emitter Breakdown Voltage (Note 1) (I _C = 1.0 mAdc, I _B = 0)	V _{(BR)CEO}	40	–	Vdc
Collector–Base Breakdown Voltage (I _C = 0.1 mAdc, I _E = 0)	V _{(BR)CBO}	60	–	Vdc
Emitter–Base Breakdown Voltage (I _E = 0.1 mAdc, I _C = 0)	V _{(BR)EBO}	6.0	–	Vdc
Base Cutoff Current (V _{CE} = 35 Vdc, V _{EB} = 0.4 Vdc)	I _{BEV}	–	0.1	μAdc

ON CHARACTERISTICS (Note 1)

DC Current Gain (I _C = 0.1 mAdc, V _{CE} = 1.0 Vdc) (I _C = 1.0 mAdc, V _{CE} = 1.0 Vdc) (I _C = 10 mAdc, V _{CE} = 1.0 Vdc) (I _C = 150 mAdc, V _{CE} = 1.0 Vdc) (I _C = 500 mAdc, V _{CE} = 2.0 Vdc)	h _{FE}	20 40 80 100 40	– – – 300 –	–
Collector–Emitter Saturation Voltage (I _C = 150 mAdc, I _B = 15 mAdc) (I _C = 500 mAdc, I _B = 50 mAdc)	V _{CE(sat)}	– –	0.4 0.75	Vdc
Base–Emitter Saturation Voltage (I _C = 150 mAdc, I _B = 15 mAdc) (I _C = 500 mAdc, I _B = 50 mAdc)	V _{BE(sat)}	0.75 –	0.95 1.2	Vdc
Collector Cutoff Current (V _{CE} = 35 Vdc, V _{EB} = 0.4 Vdc)	I _{CEX}	–	0.1	μAdc

SMALL–SIGNAL CHARACTERISTICS

Current–Gain – Bandwidth Product (I _C = 20 mAdc, V _{CE} = 10 Vdc, f = 100 MHz)	f _T	250	–	MHz
Collector–Base Capacitance (V _{CB} = 5.0 Vdc, I _E = 0, f = 1.0 MHz)	C _{cb}	–	6.5	pF
Emitter–Base Capacitance (V _{EB} = 0.5 Vdc, I _C = 0, f = 1.0 MHz)	C _{eb}	–	30	pF
Input Impedance (I _C = 1.0 mAdc, V _{CE} = 10 Vdc, f = 1.0 kHz)	h _{ie}	1.0	15	kΩ
Voltage Feedback Ratio (I _C = 1.0 mAdc, V _{CE} = 10 Vdc, f = 1.0 kHz)	h _{re}	0.1	8.0	X 10 ^{–4}
Small–Signal Current Gain (I _C = 1.0 mAdc, V _{CE} = 10 Vdc, f = 1.0 kHz)	h _{fe}	40	500	–
Output Admittance (I _C = 1.0 mAdc, V _{CE} = 10 Vdc, f = 1.0 kHz)	h _{oe}	1.0	30	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	

1. Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2.0%.

SWITCHING TIME EQUIVALENT TEST CIRCUITS

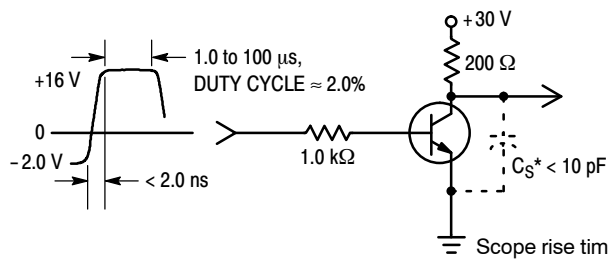


Figure 1. Turn–On Time

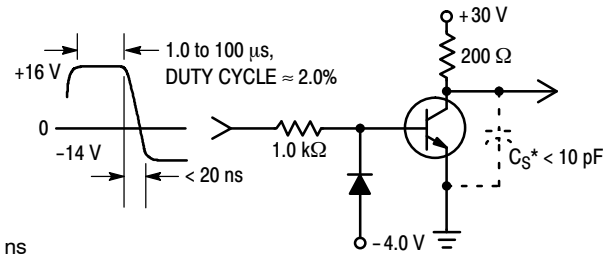


Figure 2. Turn–Off Time

MMBT4401WT1G

TRANSIENT CHARACTERISTICS

— 25°C — 100°C

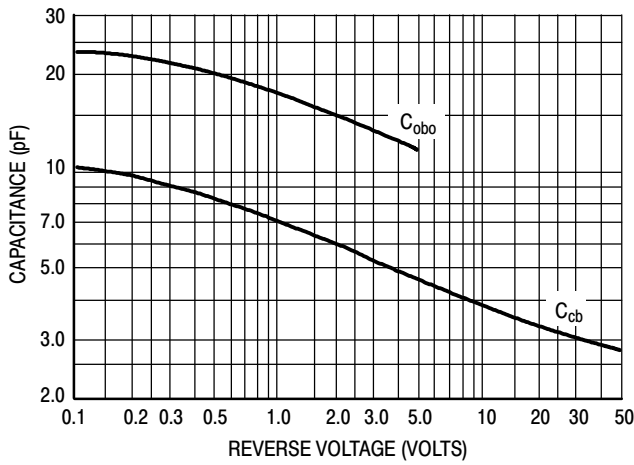


Figure 3. Capacitances

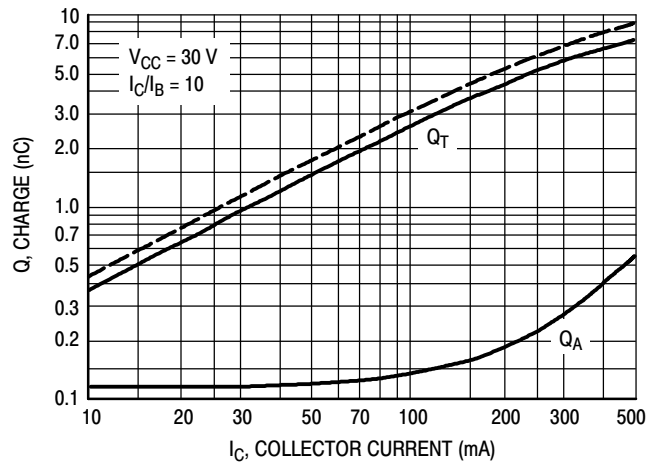


Figure 4. Charge Data

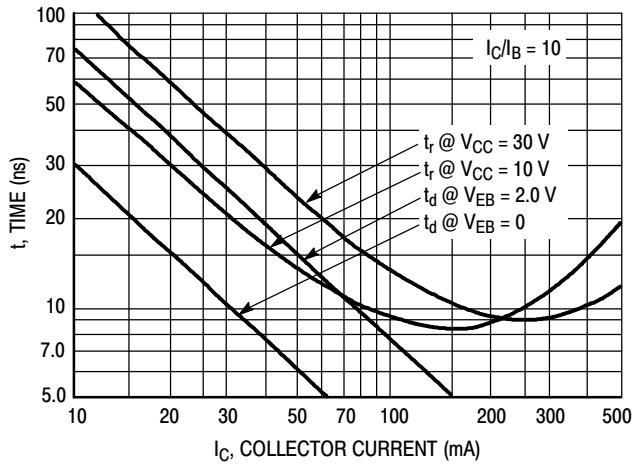


Figure 5. Turn-On Time

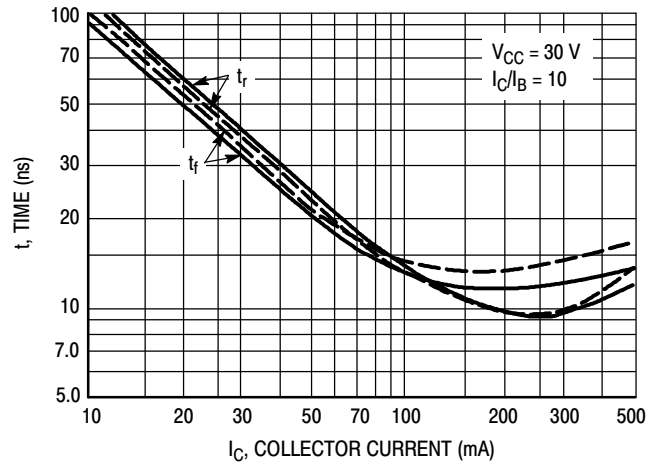


Figure 6. Rise and Fall Times

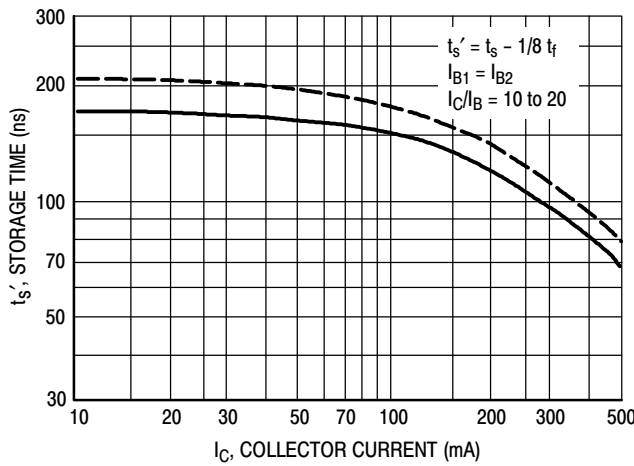


Figure 7. Storage Time

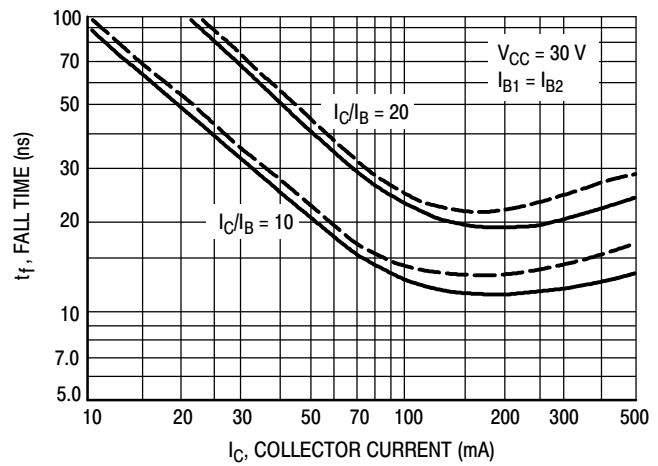


Figure 8. Fall Time

MMBT4401WT1G

SMALL-SIGNAL CHARACTERISTICS NOISE FIGURE

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

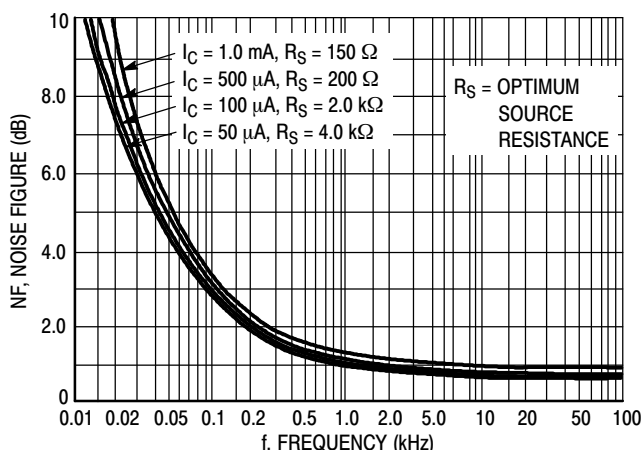


Figure 9. Frequency Effects

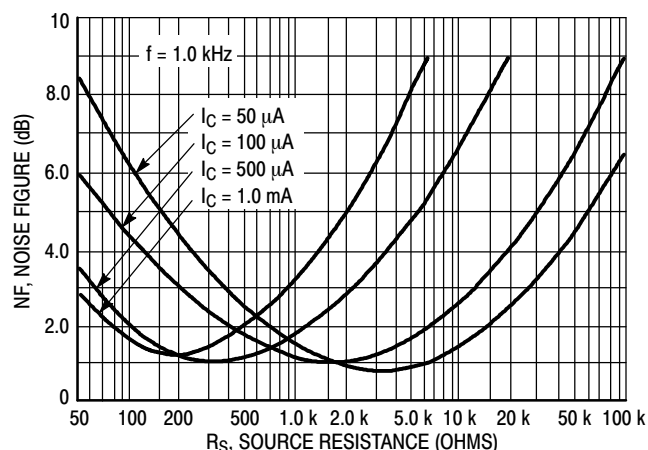


Figure 10. Source Resistance Effects

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 MMBT4401WT1 lines, and the same units were used to develop the correspondingly numbered curves on each graph.

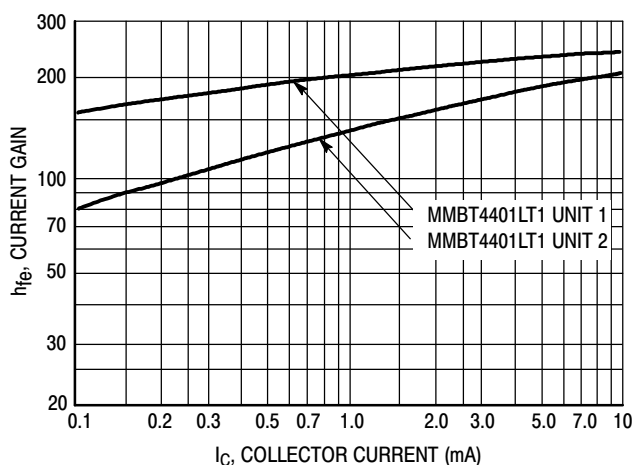


Figure 11. Current Gain

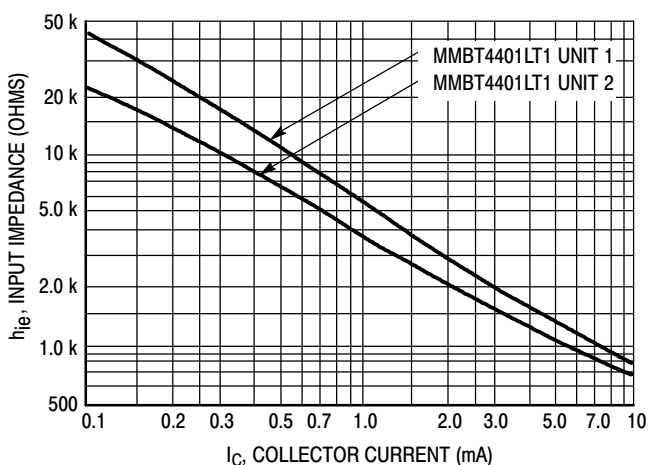


Figure 12. Input Impedance

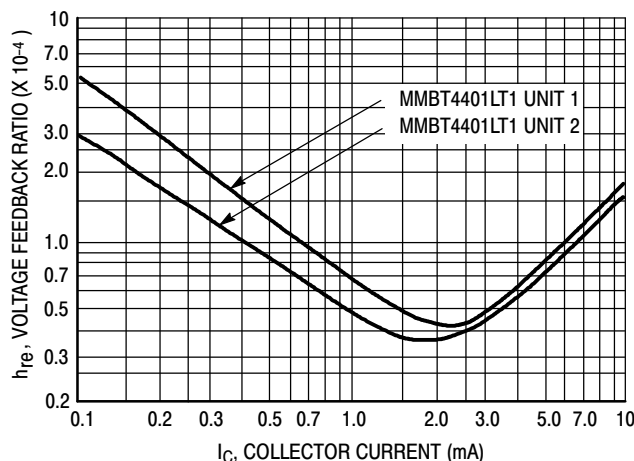


Figure 13. Voltage Feedback Ratio

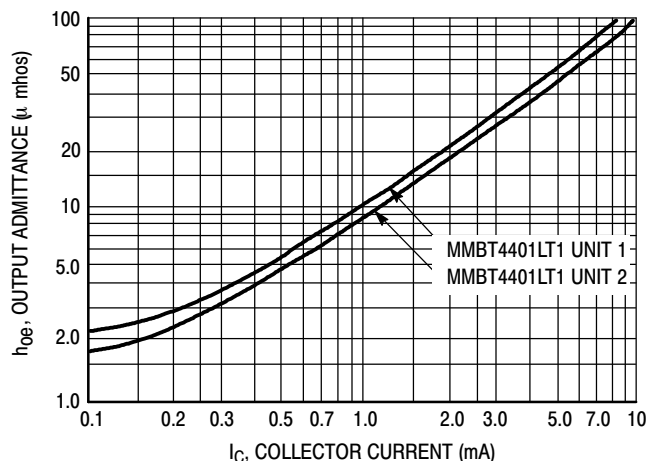


Figure 14. Output Admittance

STATIC CHARACTERISTICS

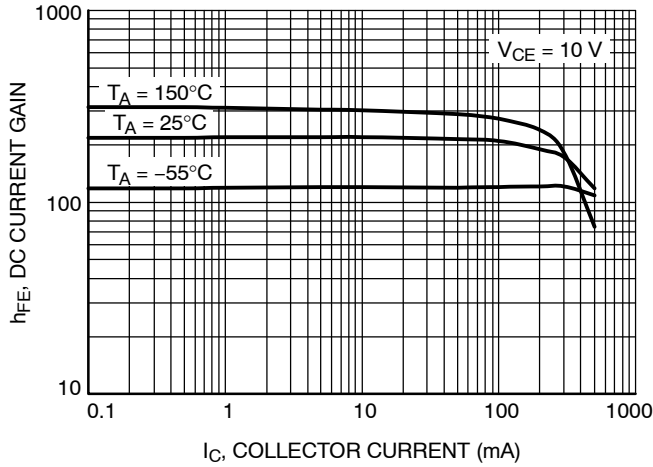


Figure 15. DC Current Gain vs. Collector Current

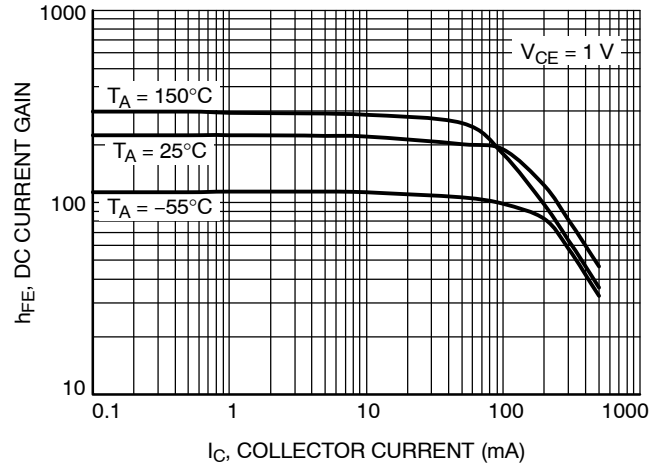


Figure 16. DC Current Gain vs. Collector Current

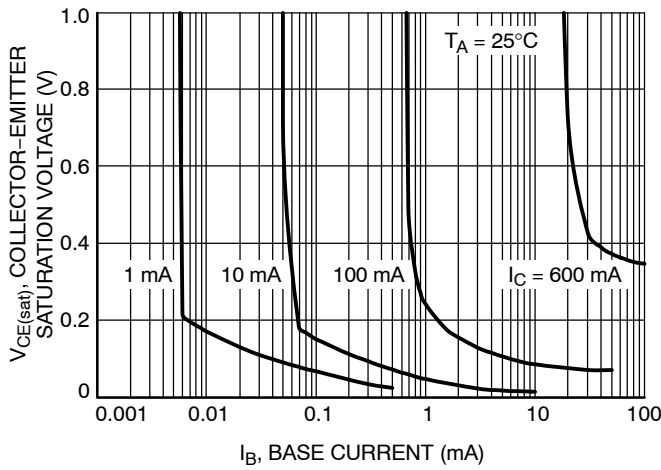


Figure 17. Saturation Region

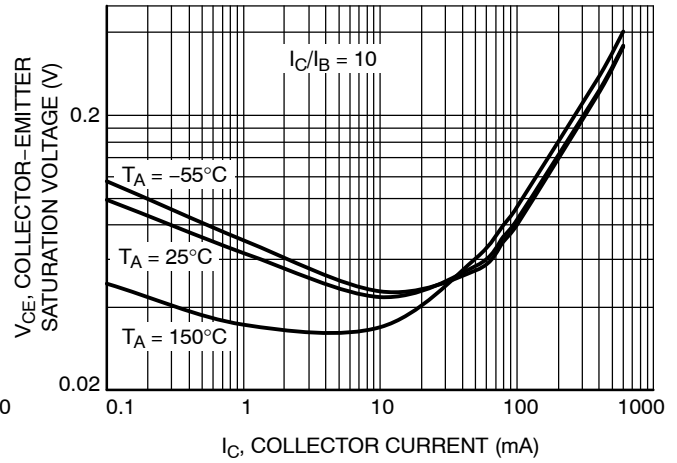


Figure 18. Collector Emitter Saturation Voltage vs. Collector Current

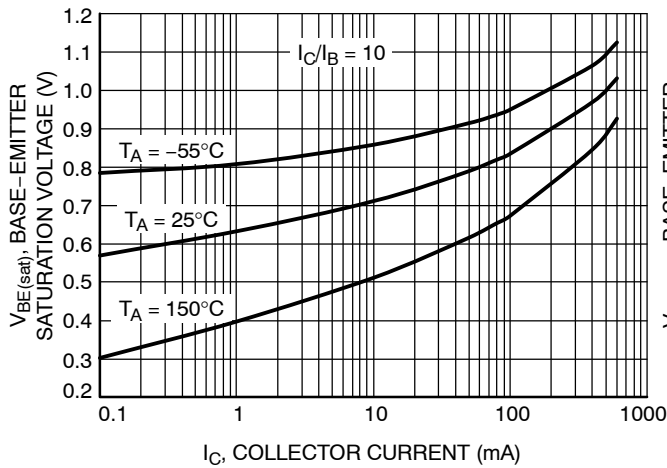


Figure 19. Base Emitter Saturation Voltage vs. Collector Current

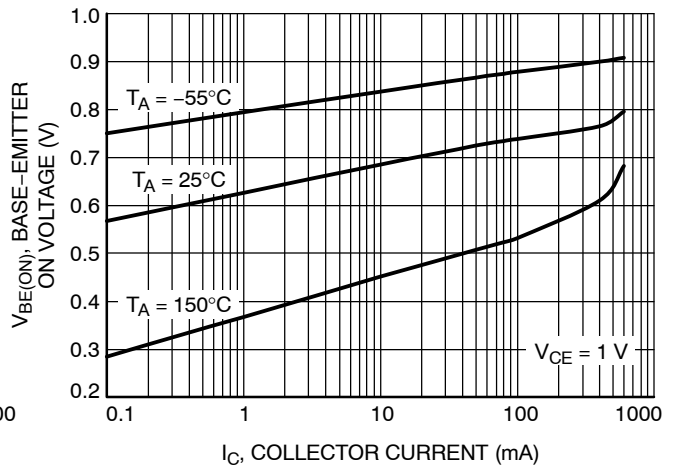


Figure 20. Base Emitter Turn-ON Voltage vs. Collector Current

MMBT4401WT1G

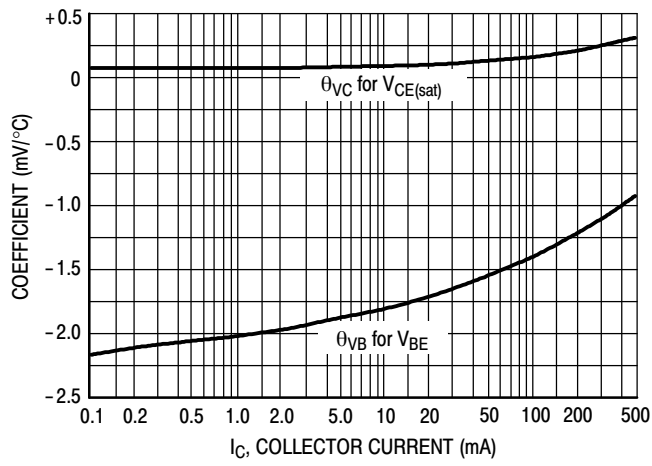


Figure 21. Temperature Coefficients

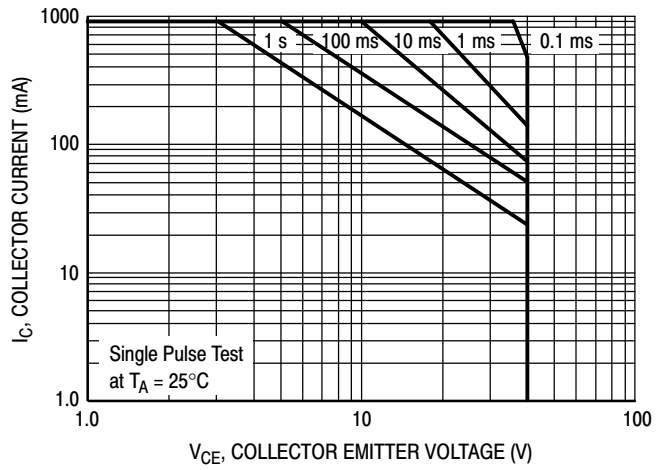


Figure 22. Safe Operating Area

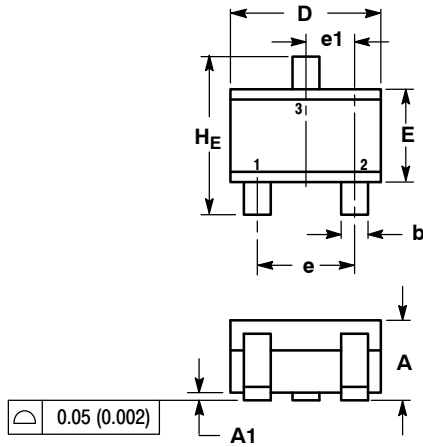
MMBT4401WT1G

PACKAGE DIMENSIONS

SC-70 (SOT-323)

CASE 419-04

ISSUE N



NOTES:

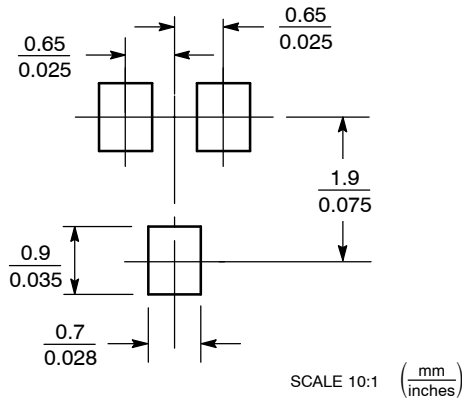
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.

DIM	MILLIMETERS			INCHES		
	MIN	NOM	MAX	MIN	NOM	MAX
A	0.80	0.90	1.00	0.032	0.035	0.040
A1	0.00	0.05	0.10	0.000	0.002	0.004
A2	0.70 REF			0.028 REF		
b	0.30	0.35	0.40	0.012	0.014	0.016
c	0.10	0.18	0.25	0.004	0.007	0.010
D	1.80	2.10	2.20	0.071	0.083	0.087
E	1.15	1.24	1.35	0.045	0.049	0.053
e	1.20	1.30	1.40	0.047	0.051	0.055
e1	0.65 BSC			0.026 BSC		
L	0.20	0.38	0.56	0.008	0.015	0.022
He	2.00	2.10	2.40	0.079	0.083	0.095

STYLE 3:

- PIN 1. BASE
- EMITTER
- 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.

ON Semiconductor and  are trademarks of Semiconductor Components Industries, LLC dba ON Semiconductor or its subsidiaries in the United States and/or other countries. ON Semiconductor owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of ON Semiconductor's product/patent coverage may be accessed at www.onsemi.com/site/pdf/Patent-Marketing.pdf. ON Semiconductor reserves the right to make changes without further notice to any products herein. ON Semiconductor makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does ON Semiconductor 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 ON Semiconductor products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by ON Semiconductor. "Typical" parameters which may be provided in ON Semiconductor 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. ON Semiconductor does not convey any license under its patent rights nor the rights of others. ON Semiconductor 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 ON Semiconductor products for any such unintended or unauthorized application, Buyer shall indemnify and hold ON Semiconductor 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 ON Semiconductor was negligent regarding the design or manufacture of the part. ON Semiconductor 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:

Literature Distribution Center for ON Semiconductor
19521 E. 32nd Pkwy, Aurora, Colorado 80011 USA
Phone: 303-675-2175 or 800-344-3860 Toll Free USA/Canada
Fax: 303-675-2176 or 800-344-3867 Toll Free USA/Canada
Email: orderlit@onsemi.com

N. American Technical Support: 800-282-9855 Toll Free
USA/Canada
Europe, Middle East and Africa Technical Support:
Phone: 421 33 790 2910

ON Semiconductor Website: www.onsemi.com

Order Literature: <http://www.onsemi.com/orderlit>

For additional information, please contact your local Sales Representative