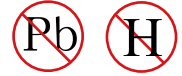




General Purpose Transistor



- We declare that the material of product compliance with RoHS requirements.

ORDERING INFORMATION

Device	Marking	Shipping
MMBT4401	2X	3000/Tape & Reel

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	mAdc

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Total Device Dissipation FR–5 Board, (1) $T_A = 25^\circ\text{C}$ Derate above 25°C	P_D	225	mW
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	556	$^\circ\text{C}/\text{W}$
Total Device Dissipation Alumina Substrate, (2) $T_A = 25^\circ\text{C}$ Derate above 25°C	P_D	300	mW
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	$^\circ\text{C}$

DEVICE MARKING

MMBT4401 = 2X

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

Characteristic	Symbol	Min	Max	Unit
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OFF CHARACTERISTICS

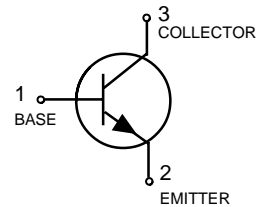
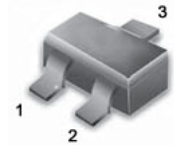
Collector–Emitter Breakdown Voltage (3) ($I_C = 1.0 \text{ mAdc}, I_B = 0$)	$V_{(BR)CEO}$	40	—	Vdc
Collector–Base Breakdown Voltage ($I_C = 0.1 \text{ mAdc}, I_E = 0$)	$V_{(BR)CBO}$	60	—	Vdc
Emitter–Base Breakdown Voltage ($I_E = 0.1 \text{ mAdc}, I_C = 0$)	$V_{(BR)EBO}$	6.0	—	Vdc
Base Cutoff Current ($V_{CE} = 35 \text{ Vdc}, V_{EB} = 0.4 \text{ Vdc}$)	I_{BEV}	—	0.1	μAdc
Collector Cutoff Current ($V_{CE} = 35 \text{ Vdc}, V_{EB} = 0.4 \text{ Vdc}$)	I_{CEX}	—	0.1	μAdc

1. FR–5 = $1.0 \times 0.75 \times 0.062 \text{ in.}$

2. Alumina = $0.4 \times 0.3 \times 0.024 \text{ in.}$ 99.5% alumina.

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

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ELECTRICAL CHARACTERISTICS

MMBT4401

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

Characteristic	Symbol	Min	Max	Unit
ON CHARACTERISTICS (3)				
DC Current Gain	h_{FE}			—
(I _C = 0.1 mA _{dc} , V _{CE} = 1.0 V _{dc})		20	—	
(I _C = 1.0 mA _{dc} , V _{CE} = 1.0 V _{dc})		40	—	
(I _C = 10 mA _{dc} , V _{CE} = 1.0 V _{dc})		80	—	
(I _C = 150 mA _{dc} , V _{CE} = 1.0 V _{dc})		100	300	
(I _C = 500 mA _{dc} , V _{CE} = 2.0 V _{dc})		40	—	
Collector–Emitter Saturation Voltage	V _{CE(sat)}			V _{dc}
(I _C = 150 mA _{dc} , I _B = 15 mA _{dc})		—	0.4	
(I _C = 500 mA _{dc} , I _B = 50 mA _{dc})		—	0.75	
Base–Emitter Saturation Voltage	V _{BE(sat)}			V _{dc}
(I _C = 150 mA _{dc} , I _B = 15 mA _{dc})		0.75	0.95	
(I _C = 500 mA _{dc} , I _B = 50 mA _{dc})		—	1.2	

SMALL-SIGNAL CHARACTERISTICS

Current–Gain — Bandwidth Product	f_T			MHz
(I _C = 20 mA _{dc} , V _{CE} = 10V _{dc} , f = 100 MHz)		250	—	
Collector–Base Capacitance	C _{cb}			pF
(V _{CB} = 5.0 V _{dc} , I _E = 0, f = 1.0 MHz)		—	6.5	
Emitter–Base Capacitance	C _{eb}			pF
(V _{EB} = 0.5 V _{dc} , I _C = 0, f = 1.0 MHz)		—	30	
Input Impedance	h_{ie}			k Ω
(V _{CE} = 10 V _{dc} , I _C = 1.0 mA _{dc} , f = 1.0 kHz)		1.0	15	
Voltage Feedback Ratio	h_{re}			X 10 ⁻⁴
(V _{CE} = 10 V _{dc} , I _C = 1.0 mA _{dc} , f = 1.0 kHz)		0.1	8.0	
Small–Signal Current Gain	h_{fe}			—
(V _{CE} = 10 V _{dc} , I _C = 1.0 mA _{dc} , f = 1.0 kHz)		40	500	
Output Admittance	h_{oe}			μ mhos
(V _{CE} = 10 V _{dc} , I _C = 1.0 mA _{dc} , f = 1.0 kHz)		1.0	30	

SWITCHING CHARACTERISTICS

Delay Time	(V _{CC} = 30 V _{dc} , V _{EB} = 2.0 V _{dc})	t _d	—	15	ns
Rise Time	(I _C = 150 mA _{dc} , I _{B1} = 15 mA _{dc})	t _r	—	20	
Storage Time	(V _{CC} = 30 V _{dc} , I _C = 150 mA _{dc})	t _s	—	225	ns
Fall Time	(I _{B1} = I _{B2} = 15 mA _{dc})	t _f	—	30	

3. Pulse Test: Pulse Width \leq 300 μ s; Duty Cycle \leq 2.0%.

SWITCHING TIME EQUIVALENT TEST CIRCUITS

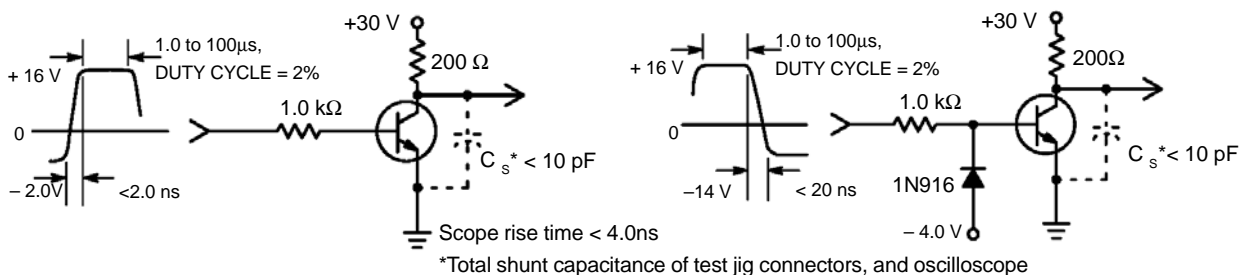
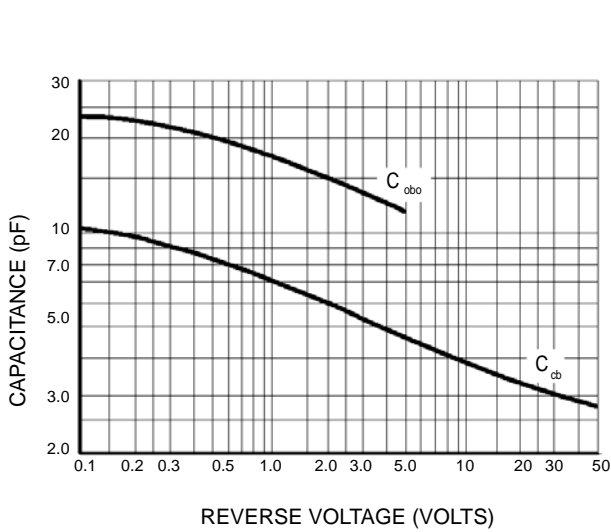


Figure 1. Turn–On Time

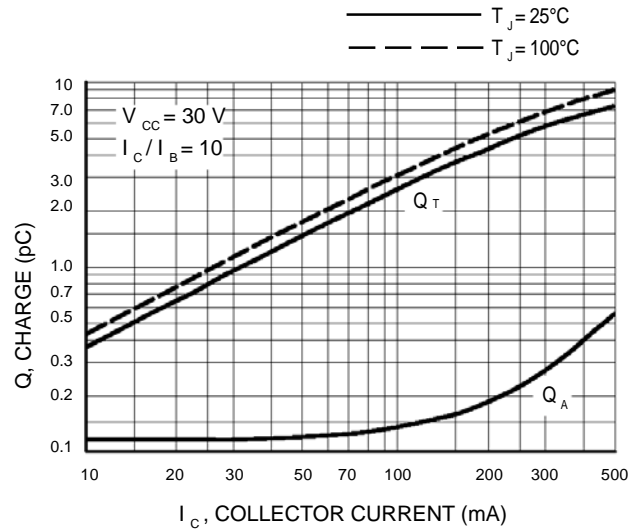
Figure 2. Turn–Off Time

DEVICE CHARACTERISTICS

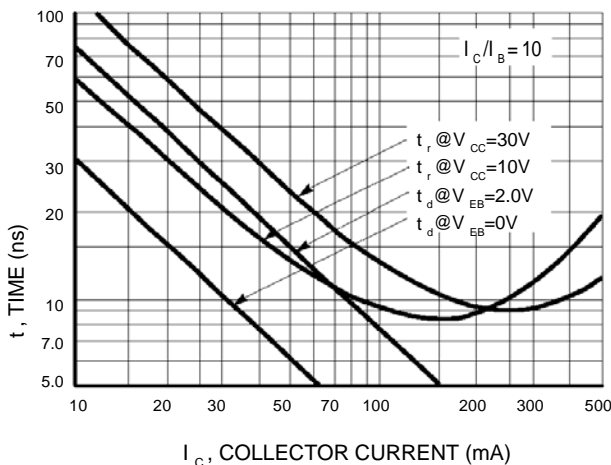
MMBT4401



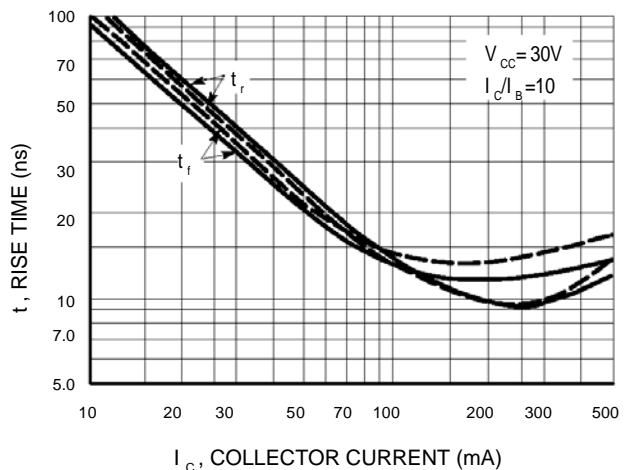
REVERSE VOLTAGE (VOLTS)
Figure 3. Capacitance



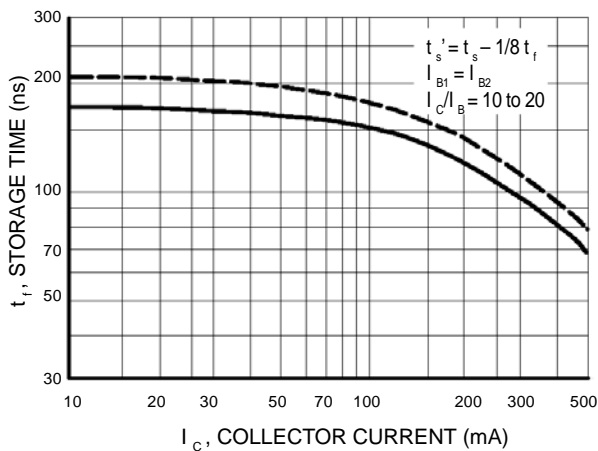
I_C , COLLECTOR CURRENT (mA)
Figure 4. Charge Data



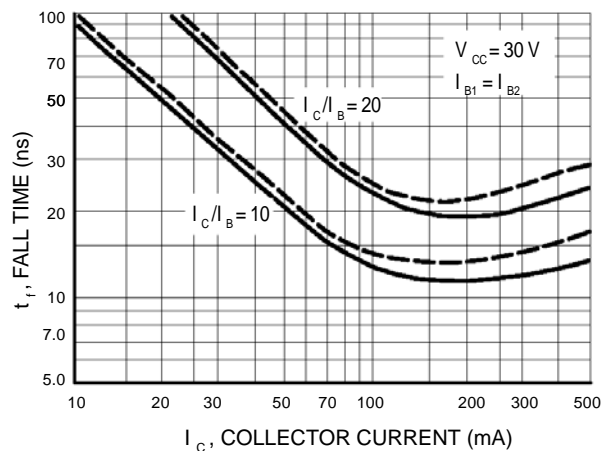
I_C , COLLECTOR CURRENT (mA)
Figure 5. Turn-On Time



I_C , COLLECTOR CURRENT (mA)
Figure 6. Rise and Fall Time



I_C , COLLECTOR CURRENT (mA)
Figure 7. Storage Time



I_C , COLLECTOR CURRENT (mA)
Figure 8. Fall Time

DEVICE CHARACTERISTICS

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SMALL-SIGNAL CHARACTERISTICS

NOISE FIGURE

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

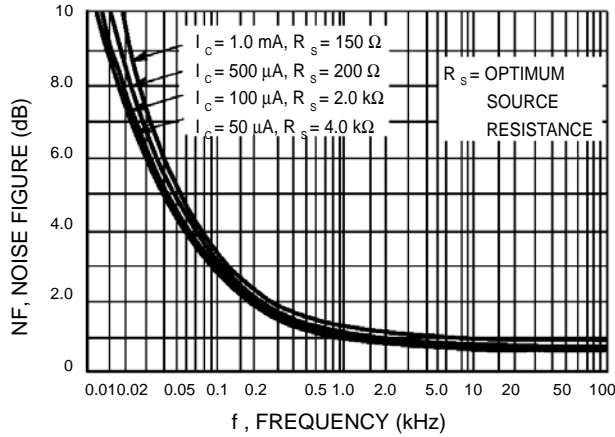


Figure 9. Frequency Effects

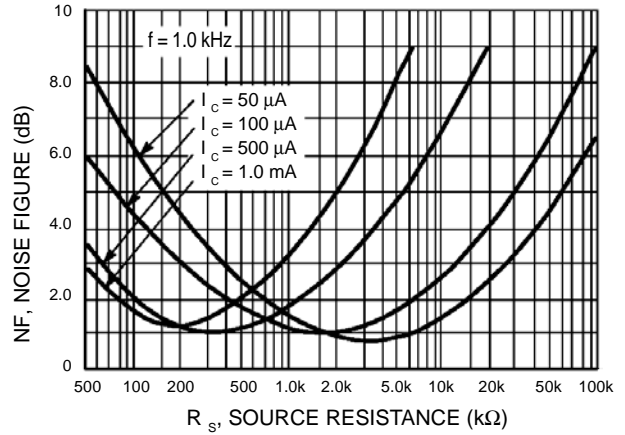


Figure 10. Source Resistance Effects

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 MMBT4401 lines, and the same units were used to develop the correspondingly numbered curves on each graph.

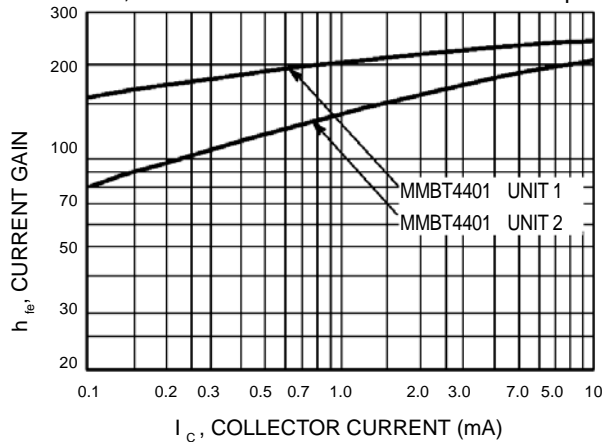


Figure 11. Current Gain

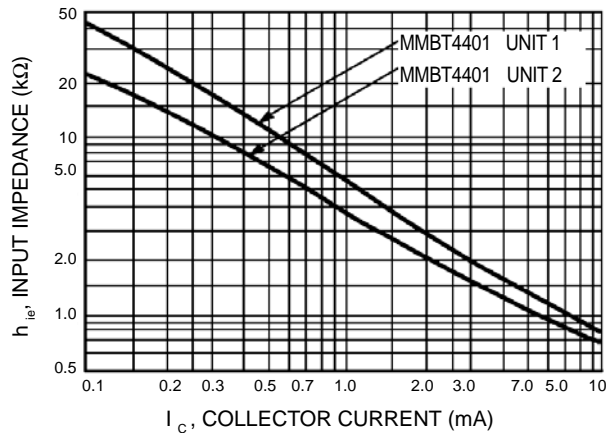


Figure 12. Input Impedance

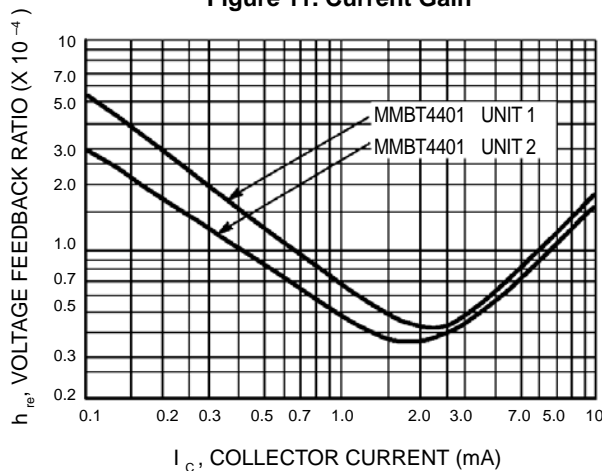


Figure 13. Voltage Feedback Ratio

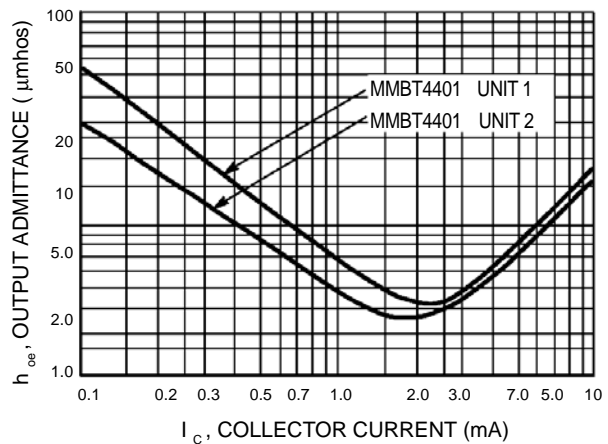


Figure 14. Output Admittance

DEVICE CHARACTERISTICS

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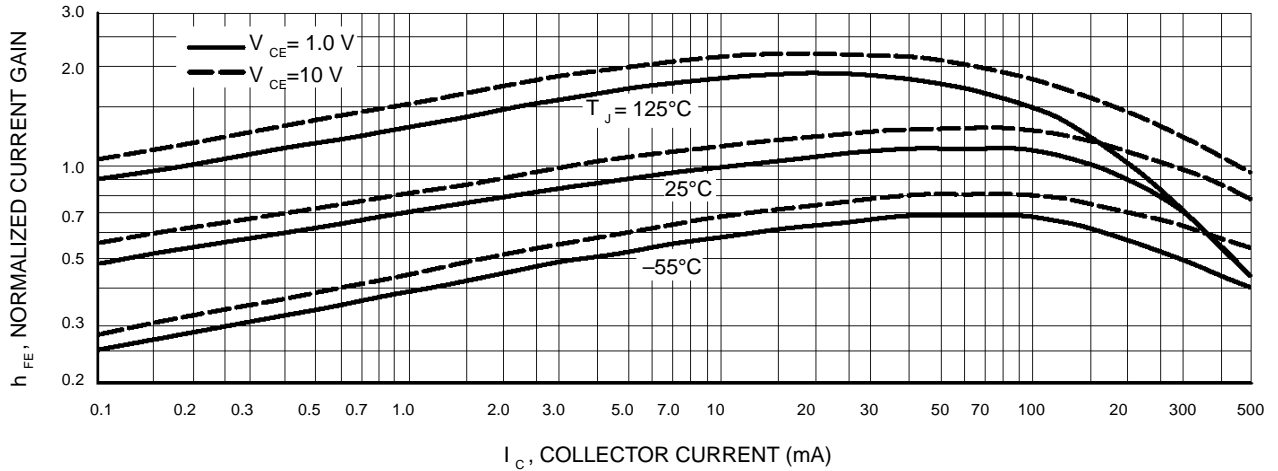


Figure 15. DC Current Gain

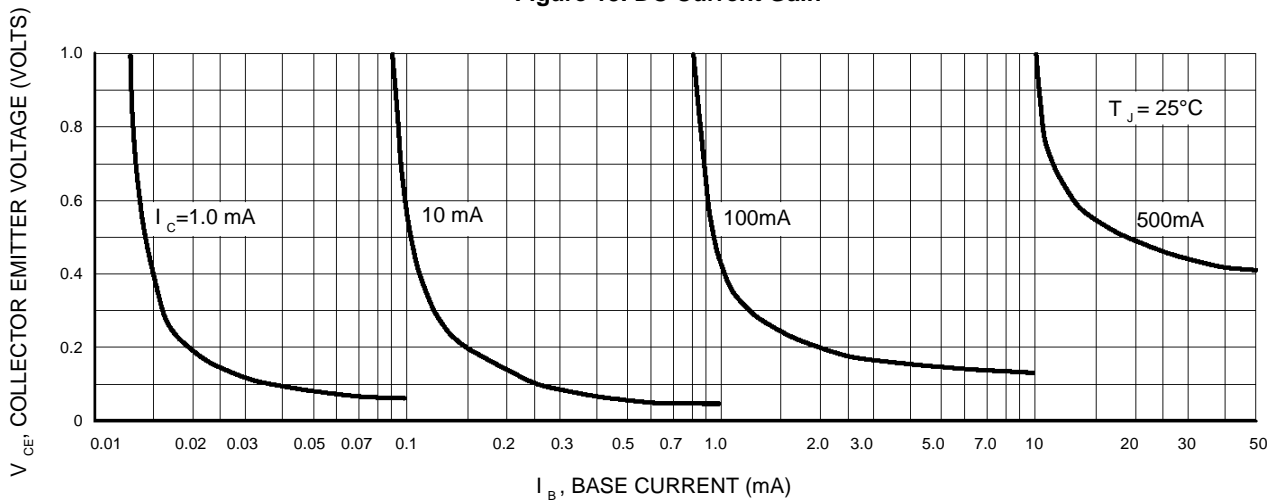


Figure 16. Collector Saturation Region

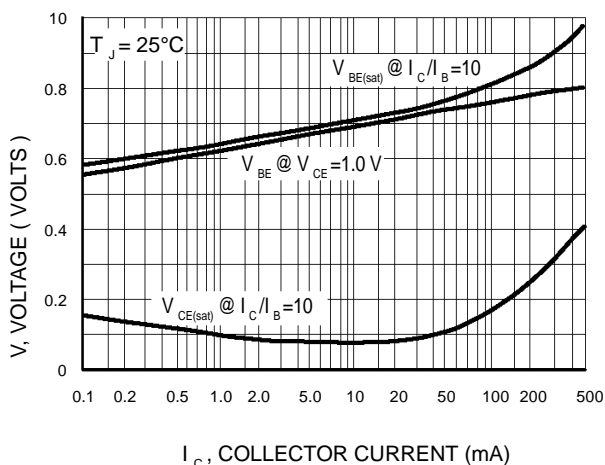


Figure 17. "On" Voltages

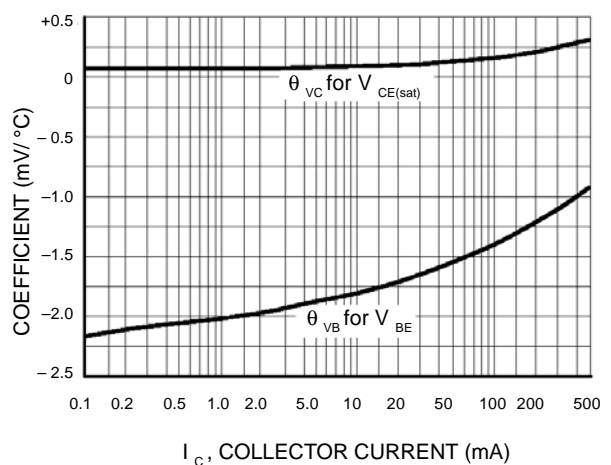
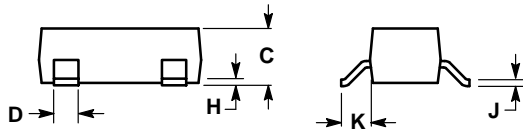
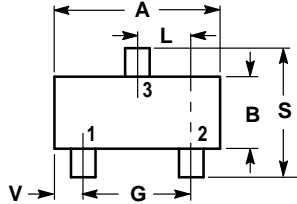


Figure 18. Temperature Coefficients

PACKAGE OUTLINE & DIMENSIONS

MMBT4401

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NOTES:

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

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.1102	0.1197	2.80	3.04
B	0.0472	0.0551	1.20	1.40
C	0.0350	0.0440	0.89	1.11
D	0.0150	0.0200	0.37	0.50
G	0.0701	0.0807	1.78	2.04
H	0.0005	0.0040	0.013	0.100
J	0.0034	0.0070	0.085	0.177
K	0.0140	0.0285	0.35	0.69
L	0.0350	0.0401	0.89	1.02
S	0.0830	0.1039	2.10	2.64
V	0.0177	0.0236	0.45	0.60

- PIN 1. BASE
 2. EMITTER
 3. COLLECTOR

