SEMICONDUCTOR

DATA SHEET

MMBT4401

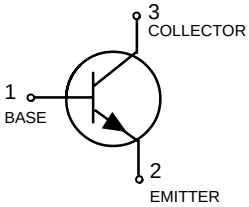
General Purpose Transistor

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

ORDERING INFORMATION

Device	Marking	Shipping
MMBT4401	2X	3000/Tape & Reel

SOT–23



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°C	P_D	225	mW
Derate above 25°C		1.8	mW/°C
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	556	°C/W
Total Device Dissipation Alumina Substrate, (2) T_A = 25°C	P_D	300	mW
Derate above 25°C		2.4	mW/°C
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	417	°C/W
Junction and Storage Temperature	T_J , T_{stg}	–55 to +150	°C

DEVICE MARKING

MMBT4401 = 2X

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

Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS				
Collector–Emitter Breakdown Voltage (3) (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
Collector Cutoff Current (V_{CE} = 35 Vdc, V_{EB} = 0.4 Vdc)	I_{CEX}	—	0.1	µAdc

1. FR–5 = 1.0 x 0.75 x 0.062 in.
2. Alumina = 0.4 x 0.3 x 0.024 in. 99.5% alumina.
3. Pulse Test: Pulse Width ≤300 µs; Duty Cycle ≤2.0%.

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 mAdc, V_{CE} = 1.0 Vdc)		20	—	
(I_C = 1.0 mAdc, V_{CE} = 1.0 Vdc)		40	—	
(I_C = 10 mAdc, V_{CE} = 1.0 Vdc)		80	—	
(I_C = 150 mAdc, V_{CE} = 1.0 Vdc)		100	300	
(I_C = 500 mAdc, V_{CE} = 2.0 Vdc)		40	—	
Collector–Emitter Saturation Voltage	$V_{CE(sat)}$			Vdc
(I_C = 150 mAdc, I_B = 15 mAdc)		—	0.4	
(I_C = 500 mAdc, I_B = 50 mAdc)		—	0.75	
Base–Emitter Saturation Voltage	$V_{BE(sat)}$			Vdc
(I_C = 150 mAdc, I_B = 15 mAdc)		0.75	0.95	
(I_C = 500 mAdc, I_B = 50 mAdc)		—	1.2	

SMALL–SIGNAL CHARACTERISTICS

Current–Gain — Bandwidth Product	f_T			MHz
(I_C = 20 mAdc, V_{CE}= 10Vdc, f = 100 MHz)		250	—	
Collector–Base Capacitance	C_{cb}			pF
(V_{CB}= 5.0 Vdc, I_E = 0, f = 1.0 MHz)		—	6.5	
Emitter–Base Capacitance	C_{eb}			pF
(V_{EB} = 0.5 Vdc, I_C = 0, f = 1.0 MHz)		—	30	
Input Impedance	h_{ie}			kΩ
(V_{CE}= 10 Vdc, I_C = 1.0 mAdc, f = 1.0 kHz)		1.0	15	
Voltage Feedback Ratio	h_{re}			X 10^{-4}
(V_{CE}= 10 Vdc, I_C = 1.0 mAdc, f = 1.0 kHz)		0.1	8.0	
Small–Signal Current Gain	h_{fe}			—
(V_{CE}= 10 Vdc, I_C = 1.0 mAdc, f = 1.0 kHz)		40	500	
Output Admittance	h_{oe}			μmhos
(V_{CE}= 10 Vdc, I_C = 1.0 mAdc, f = 1.0 kHz)		1.0	30	

SWITCHING CHARACTERISTICS

Delay Time	(V_{CC} = 30 Vdc, V_{EB} = 2.0 Vdc	t_d	—	15	
Rise Time	I_C = 150 mAdc, I_{B1} = 15 mAdc)	t_r	—	20	ns
Storage Time	(V_{CC} = 30 Vdc, I_C = 150 mAdc	t_s	—	225	ns
Fall Time	I_{B1} = I_{B2} = 15 mAdc)	t_f	—	30	

3. Pulse Test: Pulse Width ≤300 μs; Duty Cycle ≤2.0%.

SWITCHING TIME EQUIVALENT TEST CIRCUITS

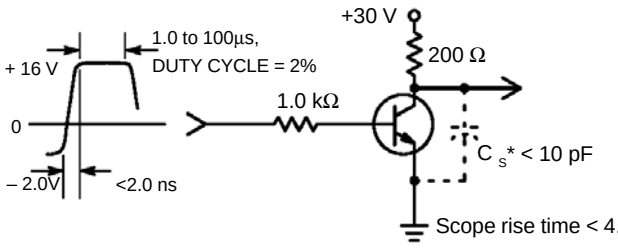


Figure 1. Turn–On Time

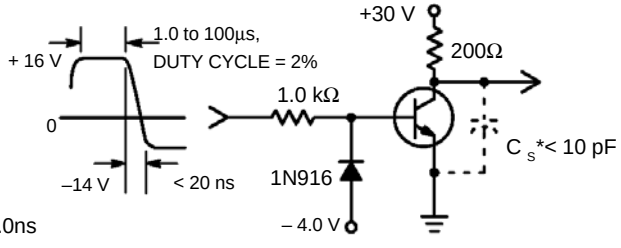


Figure 2. Turn–Off Time

*Total shunt capacitance of test jig connectors, and oscilloscope

DEVICE CHARACTERISTICS

MMBT4401

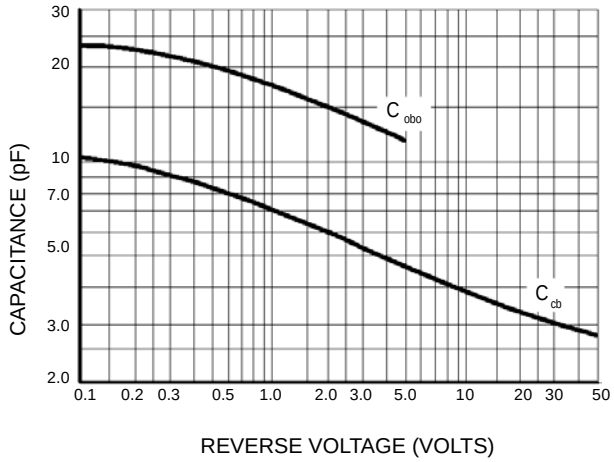


Figure 3. Capacitance

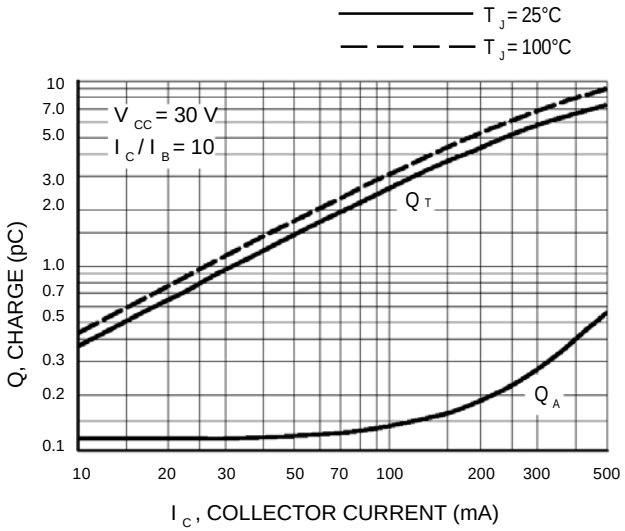


Figure 4. Charge Data

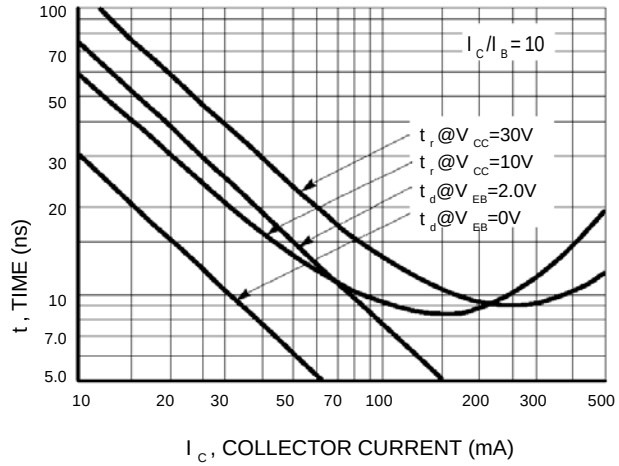


Figure 5. Turn–On Time

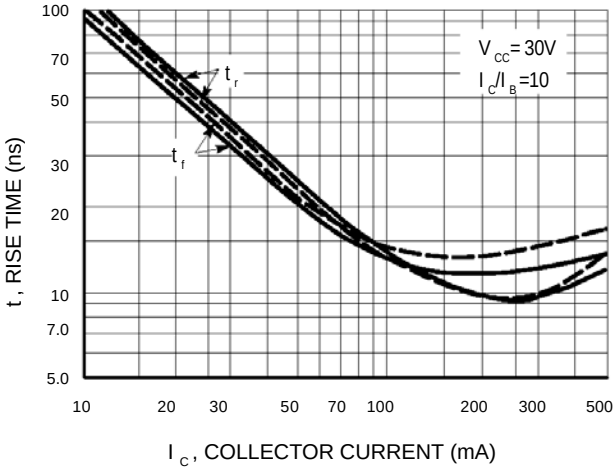


Figure 6. Rise and Fall Time

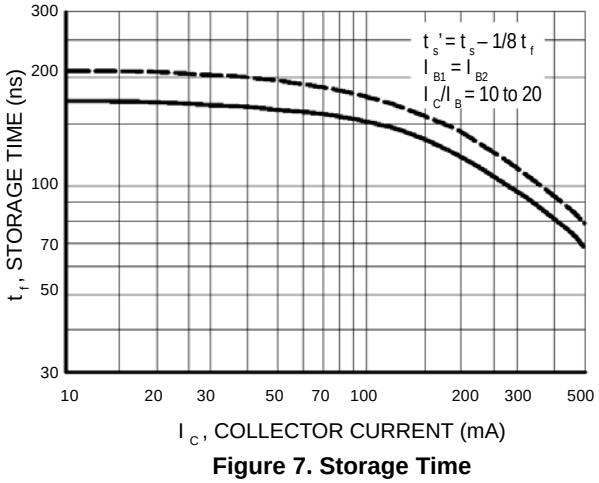


Figure 7. Storage Time

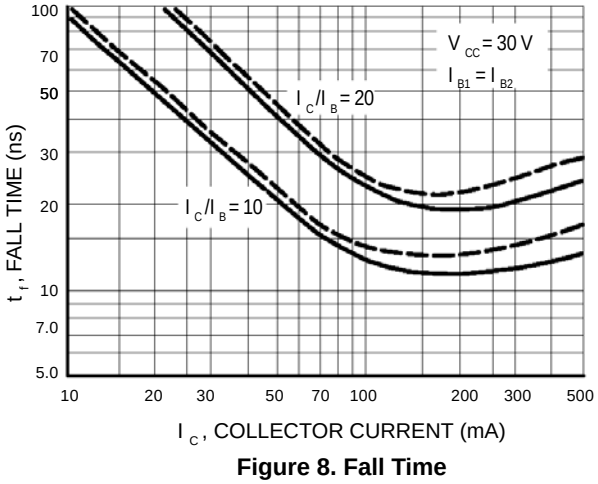


Figure 8. Fall Time

DEVICE CHARACTERISTICS

MMBT4401

SMALL–SIGNAL CHARACTERISTICS

NOISE FIGURE

V_{CE} = 10 Vdc, T_A = 25°C Bandwidth = 1.0 Hz

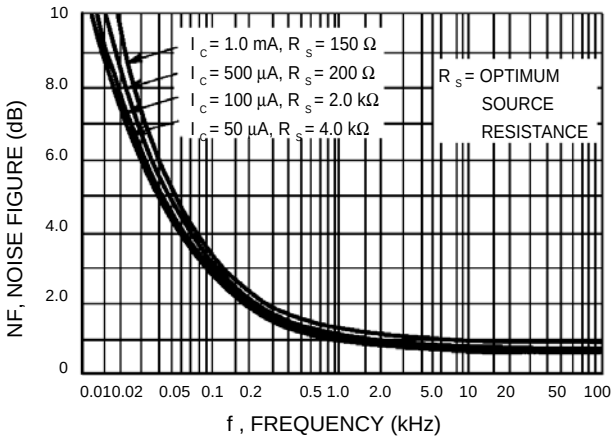


Figure 9. Frequency Effects

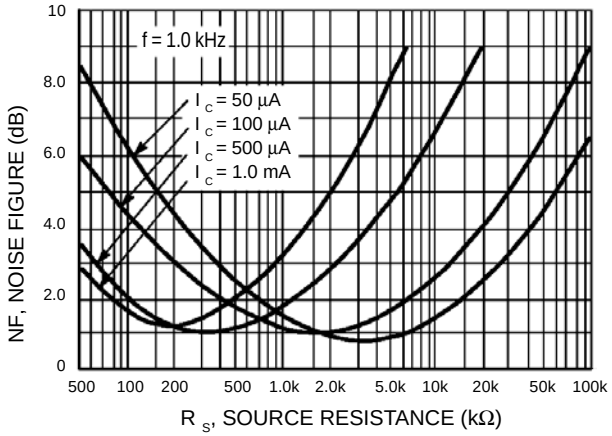


Figure 10. Source Resistance Effects

h PARAMETERS

(V_{CE} = 10 Vdc, f = 1.0 kHz, T_A = 25°C)

This group of graphs illustrates the relationship between h fe and other “h” parameters for this series of ransistors. 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.

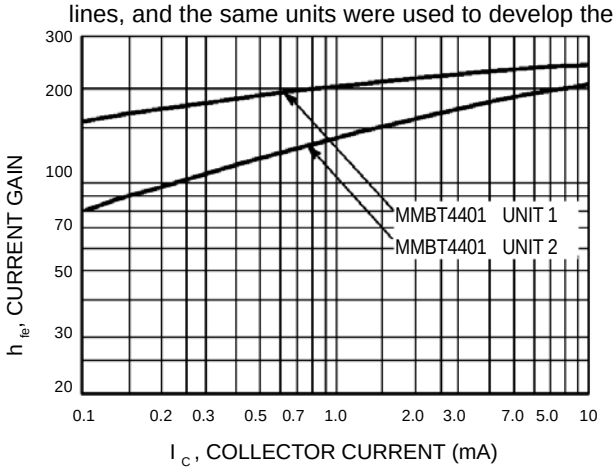


Figure 11. Current Gain

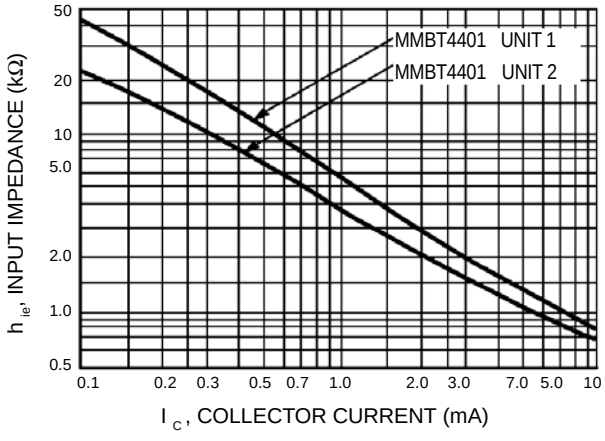


Figure 12. Input Impedance

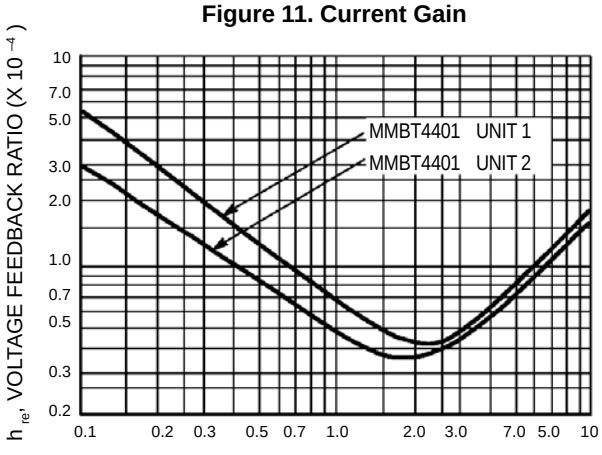


Figure 13. Voltage Feedback Ratio

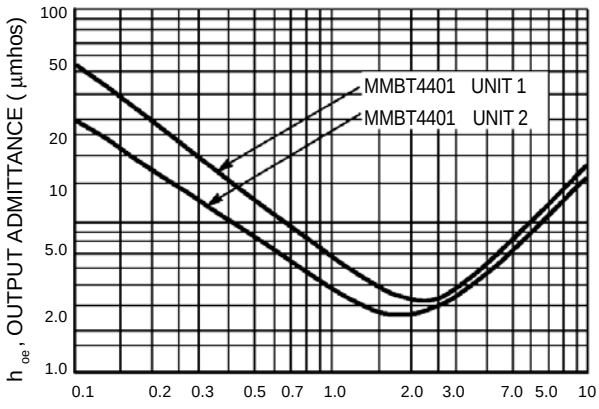


Figure 14. Output Admittance

DEVICE CHARACTERISTICS

MMBT4401

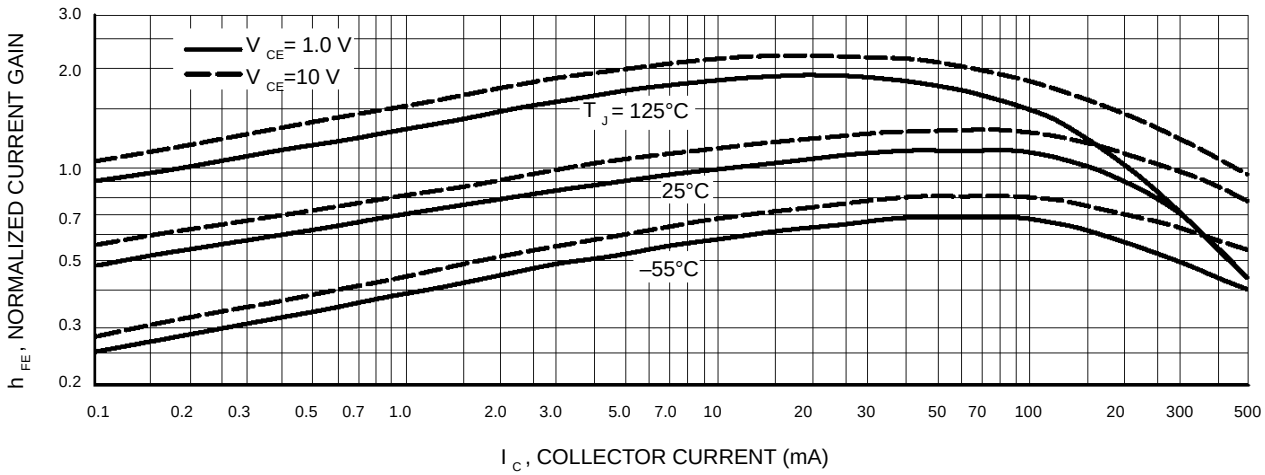


Figure 15. DC Current Gain

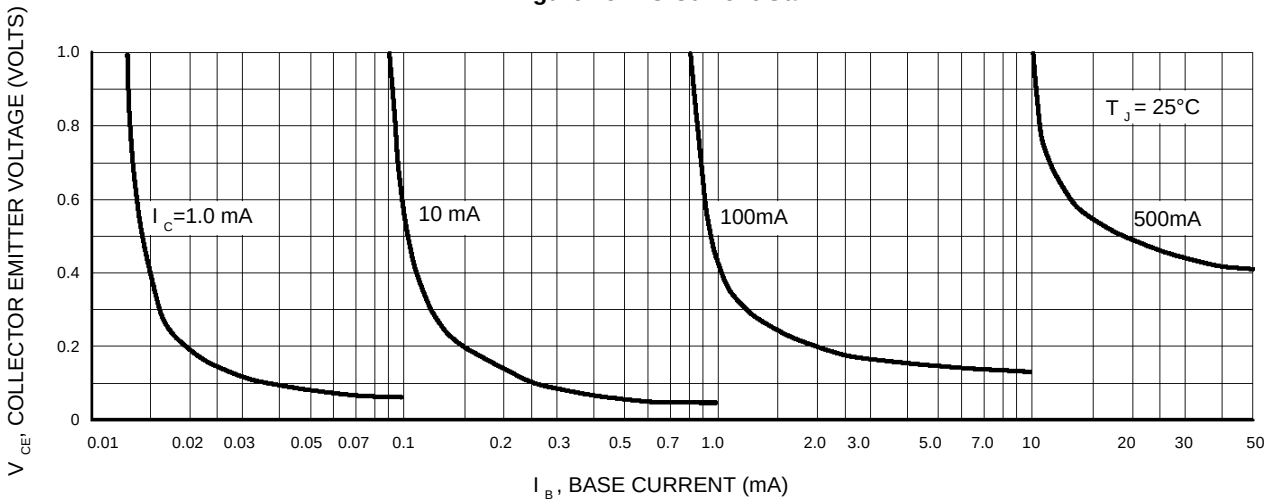


Figure 16. Collector Saturation Region

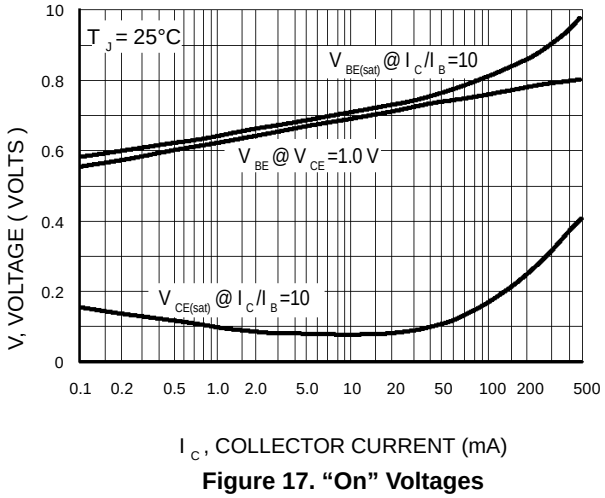


Figure 17. "On" Voltages

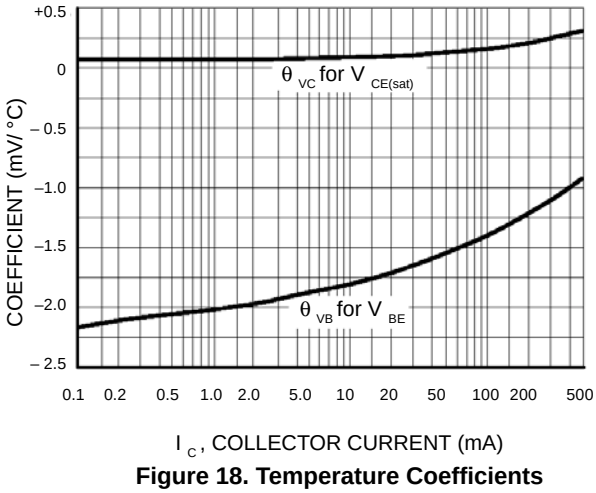
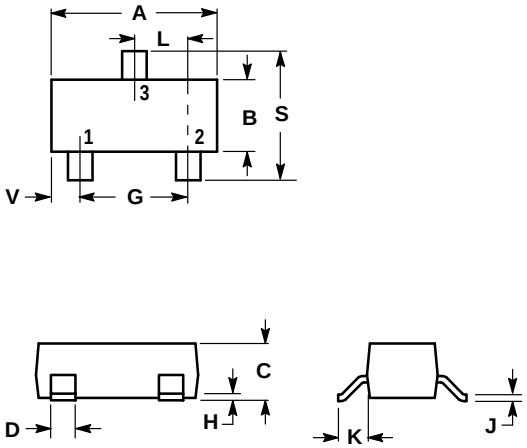


Figure 18. Temperature Coefficients

PACKAGE OUTLINE & DIMENSIONS

MMBT4401

SOT-23



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