

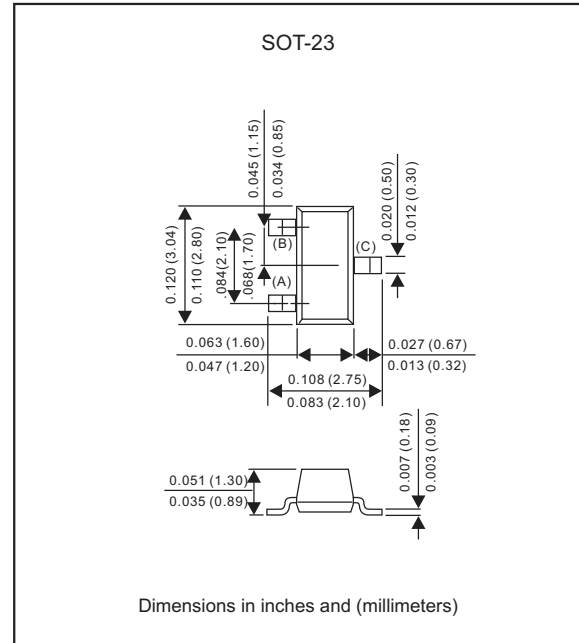
Features

- Epitaxial plana chip construction
- Ideal for medium power application and switching
- Capable of 225mW power dissipation.
- Lead-free parts for green partner, exceeds environmental standards of MIL-STD-19500 /228
- Suffix "-H" dinicates Halogen-free part, ex.MMBT4401-H.

Mechanical data

- Epoxy:UL94-V0 rated flame retardant
- Case : Molded plastic, SOT-23
- Terminals : Solder plated, solderable per MIL-STD-750, Method 2026
- Mounting Position : Any

Package outline



Maximum ratings (AT $T_A=25^\circ\text{C}$ unless otherwise noted)

PARAMETER	CONDITIONS	Symbol	MIN.	TYP.	MAX.	UNIT
Collector-base voltage		V_{CBO}			60	V
Collector-emitter voltage		V_{CEO}			40	V
Emitter-base voltage		V_{EBO}			6.0	V
Collector current		I_C			600	mA
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_{BJA}			1.8	$\text{mW}/^\circ\text{C}$
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_{BJA}			2.4	$\text{mW}/^\circ\text{C}$
Operating junction temperature range		T_J	-55		+150	$^\circ\text{C}$
Storage temperature range		T_{STG}	-55		+150	$^\circ\text{C}$

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.

Electrical characteristics (AT $T_A=25^\circ\text{C}$ unless otherwise noted)

Off characteristics

PARAMETER	CONDITIONS	Symbol	MIN.	TYP.	MAX.	UNIT
Collector-base breakdown voltage	$I_C = 0.1\text{mA}, I_E = 0$	$V_{(BR)CBO}$	60			V
Collector-emitter breakdown voltage	$I_C = 1.0\text{mA}, I_B = 0$	$V_{(BR)CEO}$	40			V
Emitter-base breakdown voltage	$I_E = 0.1\text{mA}, I_C = 0$	$V_{(BR)EBO}$	6.0			V
Base cutoff current	$V_{CE} = 35\text{V}, V_{EB} = 0.4\text{V}$	I_{BEV}			0.1	μA
Collector cutoff current	$V_{CE} = 35\text{V}, V_{EB} = 0.4\text{V}$	I_{CEX}			0.1	μA

On characteristics(3)

PARAMETER	CONDITIONS	Symbol	MIN.	TYP.	MAX.	UNIT
DC current gain	$I_C = 0.1\text{mA}, V_{CE} = 1.0\text{V}$	h_{FE}	20			
	$I_C = 1.0\text{mA}, V_{CE} = 1.0\text{V}$		40			
	$I_C = 10\text{mA}, V_{CE} = 1.0\text{V}$		80			
	$I_C = 150\text{mA}, V_{CE} = 1.0\text{V}$		100		300	
	$I_C = 500\text{mA}, V_{CE} = 2.0\text{V}$		40			
Collector-emitter saturation voltage	$I_C = 150\text{mA}, I_B = 15\text{mA}$	$V_{CE(sat)}$			0.4	V
	$I_C = 500\text{mA}, I_B = 50\text{mA}$				0.75	
Base-emitter saturation voltage	$I_C = 150\text{mA}, I_B = 15\text{mA}$	$V_{BE(sat)}$	0.75		0.95	V
	$I_C = 500\text{mA}, I_B = 50\text{mA}$				1.20	

3.Pulse test : pulse width $\leq 300\mu\text{s}$, duty cycle $\leq 2.0\%$.

Small-signal characteristics

PARAMETER	CONDITIONS	Symbol	MIN.	TYP.	MAX.	UNIT
Current-gain-bandwidth product	$I_C = 20\text{mA}, V_{CE} = 20\text{V}, f = 100\text{MHz}$	f_T	250			MHz
Collector-base capacitance	$V_{CB} = 5.0\text{V}, I_E = 0, f = 1.0\text{MHz}$	C_{cb}			6.5	pF
Emitter-base capacitance	$V_{EB} = 0.5\text{V}, I_C = 0, f = 1.0\text{MHz}$	C_{eb}			30	pF
Input impedance	$V_{CE} = 10\text{mA}, I_C = 1.0\text{mA}, f = 1.0\text{KHz}$	h_{ie}	1.0		15	k Ω
Voltage feedback ratio	$V_{CE} = 10\text{V}, I_C = 1.0\text{mA}, f = 1.0\text{KHz}$	h_{re}	0.1		8.0	$\times 10^{-4}$
Small-signal current gain	$V_{CE} = 10\text{V}, I_C = 1.0\text{mA}, f = 1.0\text{KHz}$	h_{fe}	40		500	
Output admittance	$V_{CE} = 10\text{V}, I_C = 1.0\text{mA}, f = 1.0\text{KHz}$	h_{oe}	1.0		30	μhos

Switching characteristics

PARAMETER	CONDITIONS	Symbol	MIN.	TYP.	MAX.	UNIT
Delay time	$V_{CC} = 30\text{V}, V_{BE} = 2.0\text{V}, I_C = 150\text{mA}, I_{B1} = 15\text{mA}$	td			15	ns
Rise time		tr			20	
Storage time	$V_{CC} = 30\text{V}, I_C = 150\text{mA}, I_{B1} = I_{B2} = 15\text{mA}$	ts			225	
Fall time		tf			30	

SWITCHING TIME EQUIVALENT TEST CIRCUITS

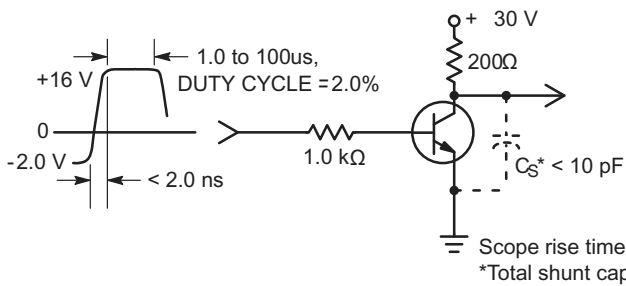


Figure 1. Turn-On Time

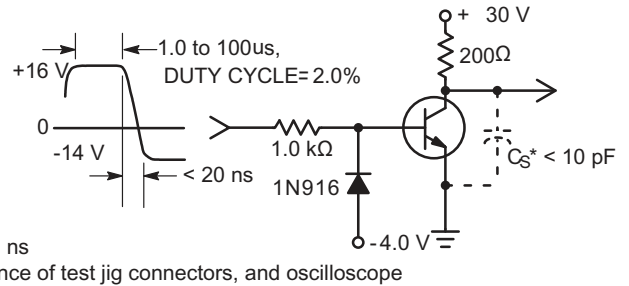


Figure 2. Turn-Off Time

TRANSIENT CHARACTERISTICS

— 25°C - - - 105°C

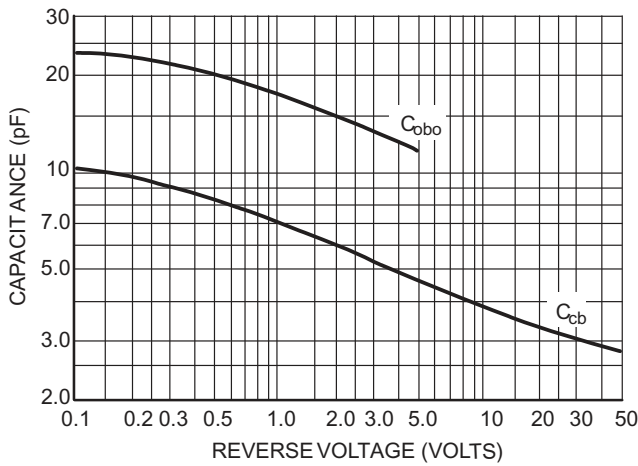


Figure 3. Capacitances

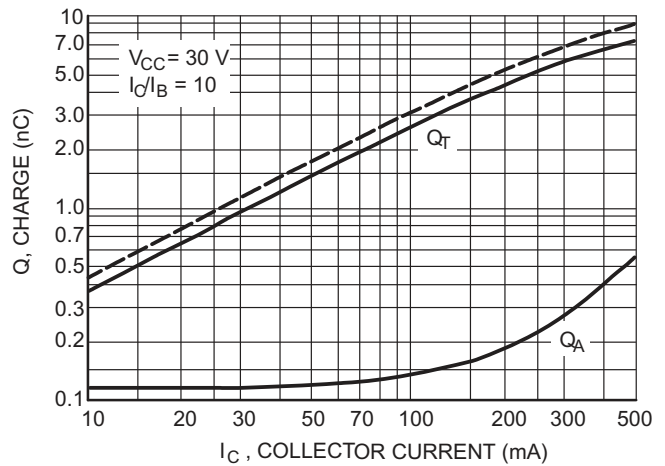


Figure 4. Charge Data

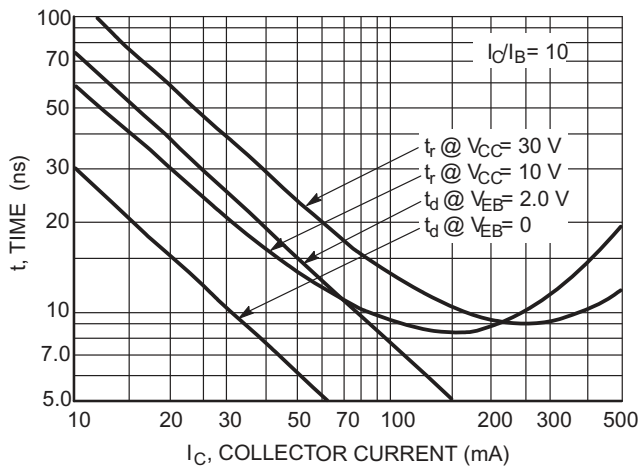


Figure 5. Turn-On Time

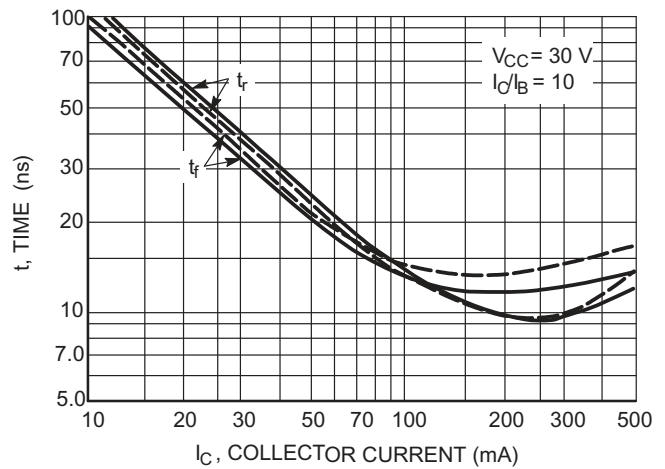


Figure 6. Rise and Fall Times

Rating and characteristic curves (MMBT4401)

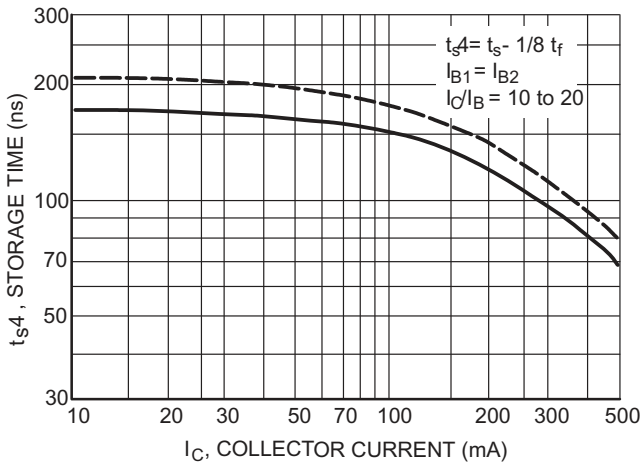


Figure 7. Storage Time

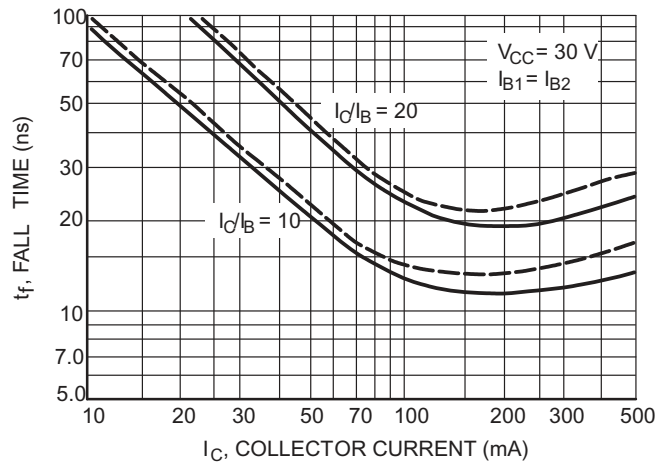


Figure 8. Fall Time

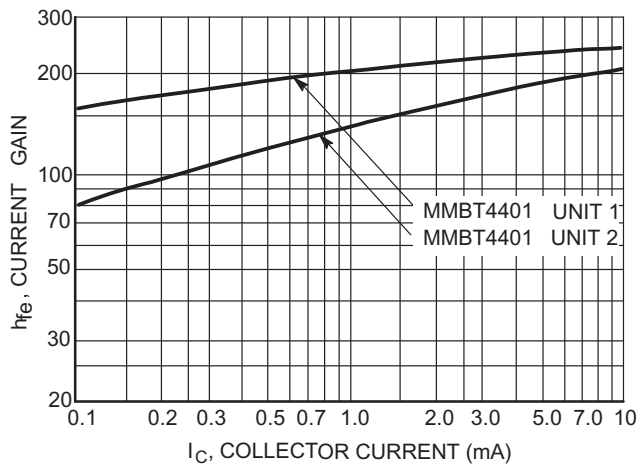


Figure 9. Current Gain

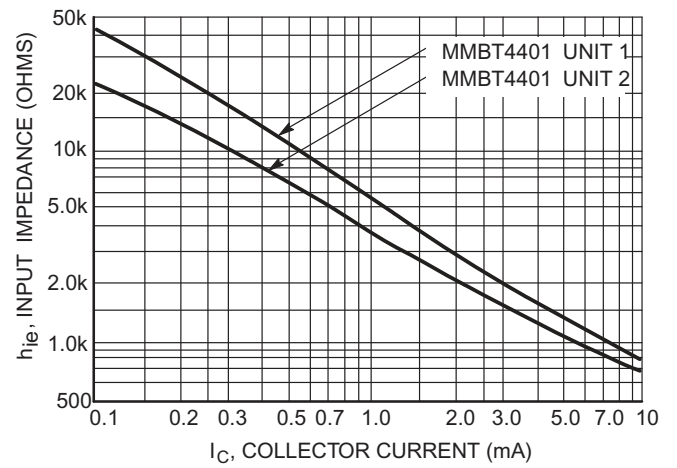


Figure 10. Input Impedance

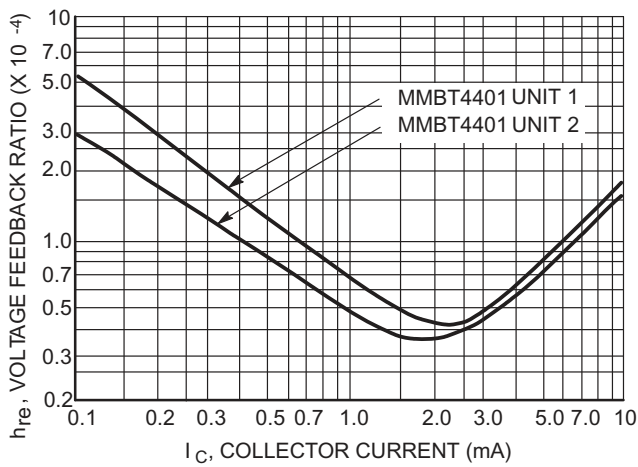


Figure 11. Voltage Feedback Ratio

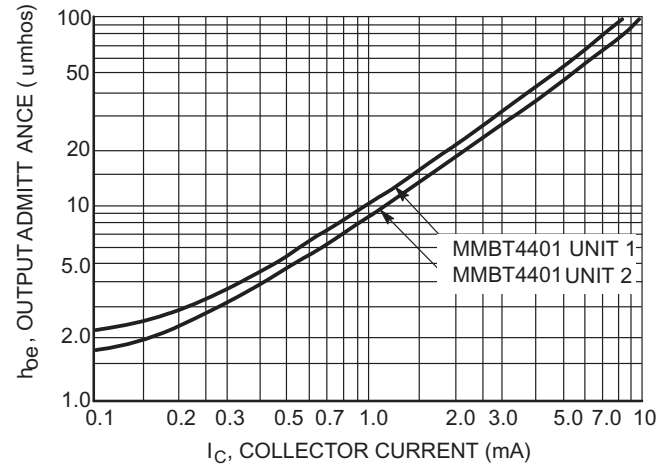


Figure 12. Output Admittance



Rating and characteristic curves (MMBT4401)

STATIC CHARACTERISTICS

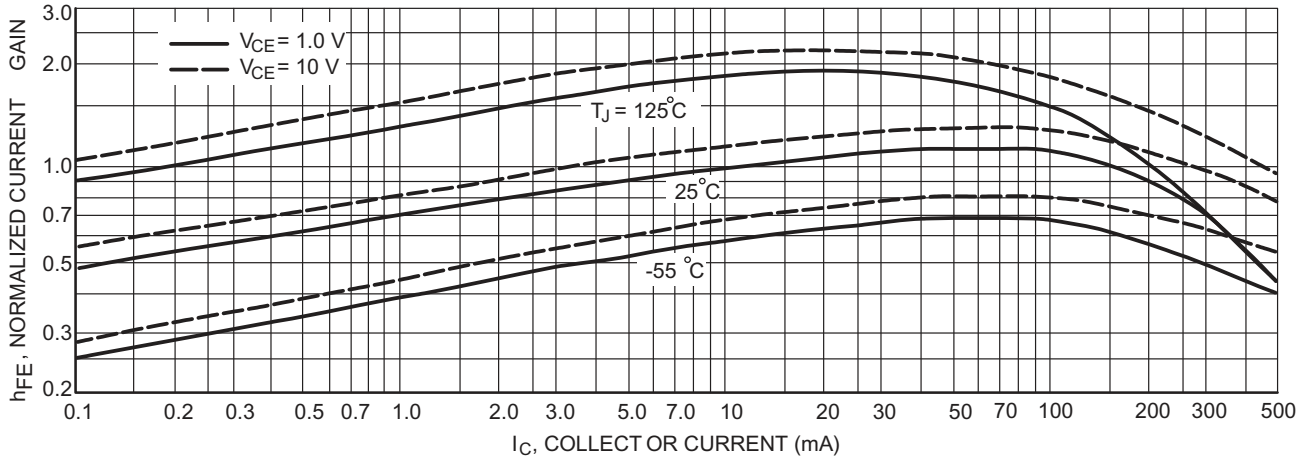


Figure 13. DC Current Gain

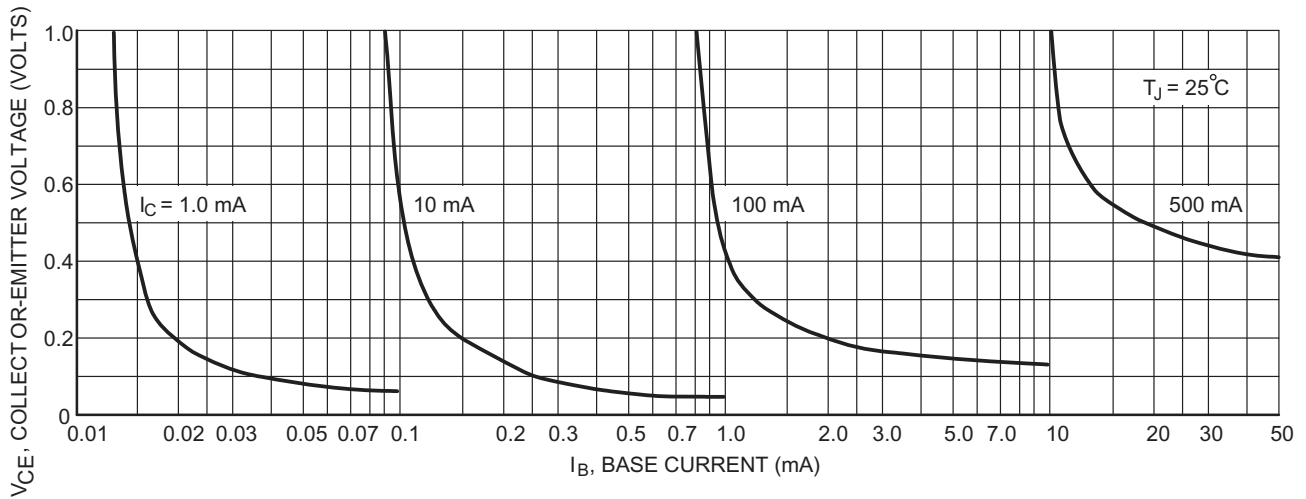


Figure 14. Collector Saturation Region

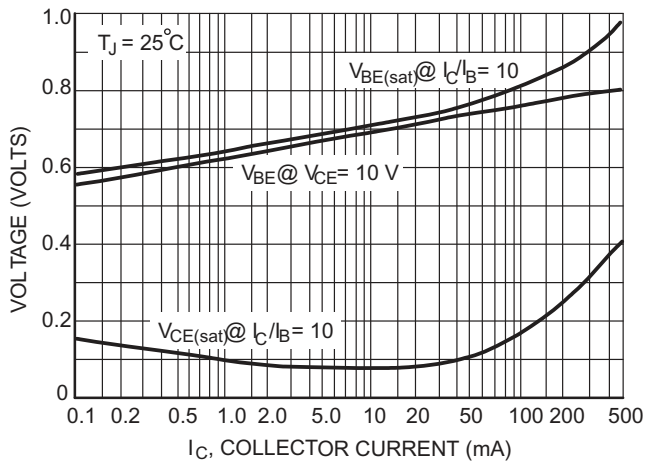


Figure 15. "On" Voltages

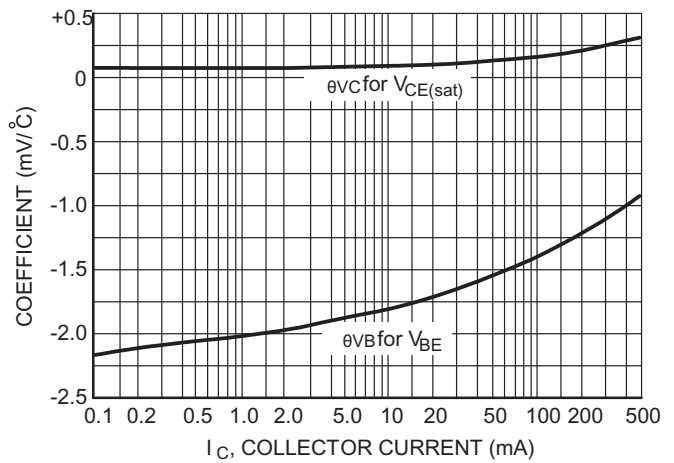
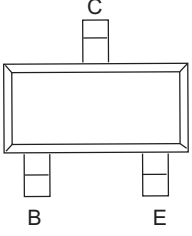
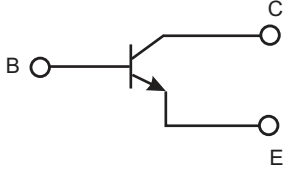


Figure 16. Temperature Coefficients

Pinning information

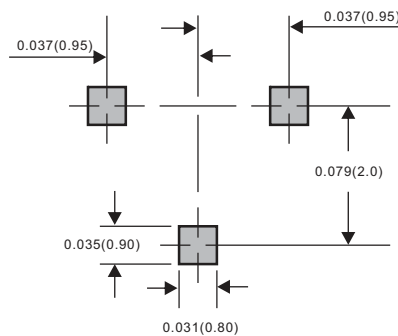
Pin	Simplified outline	Symbol
PinB Base PinC Collector PinE Emitter		

Marking

Type number	Marking code
MMBT4401	2X

Suggested solder pad layout

SOT-23



Dimensions in inches and (millimeters)