

RoHS Compliant Product
A suffix of "-C" specifies halogen and lead free

FEATURES

- Switching Transistor

MARKING

2X

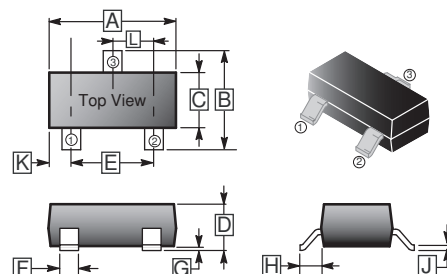
PACKAGE INFORMATION

Package	MPQ	Leader Size
SOT-23	3K	7 inch

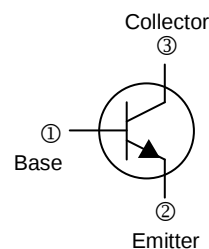
ORDER INFORMATION

Part Number	Type
MMBT4401	Lead (Pb)-free
MMBT4401-C	Lead (Pb)-free and Halogen-free

SOT-23



REF.	Millimeter		REF.	Millimeter	
	Min.	Max.		Min.	Max.
A	2.70	3.10	G	0	0.18
B	2.10	2.95	H	0.55	REF.
C	1.20	1.7	J	0.08	0.20
D	0.89	1.3	K	0.6	REF.
E	1.70	2.3	L	0.95	BSC.
F	0.30	0.50			



ABSOLUTE MAXIMUM RATINGS (T_A=25°C unless otherwise noted)

Parameter	Symbol	Ratings	Unit
Collector-Emitter Voltage	V _{CEO}	40	V
Collector-Base Voltage	V _{CBO}	60	V
Emitter-Base Voltage	V _{EBO}	6	V
Collector Current-Continuous	I _C	600	mA
Total Device Dissipation FR-5 Board ¹ , T _A =25°C	P _D	300	mW
Total Device Dissipation FR-5 Board, Derate above 25°C		1.8	mW/°C
Thermal Resistance, Junction-Ambient	R _{θJA}	556	°C/W
Total Device Dissipation Alumina Substrate ² , T _A =25°C	P _D	300	mW
Total Device Dissipation Alumina Substrate, Derate above 25°C		2.4	mW/°C
Thermal Resistance, Junction-Ambient	R _{θJA}	417	°C/W
Junction, Storage Temperature	T _J , T _{STG}	-55~150	°C

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

Parameter	Symbol	Min.	Typ.	Max.	Unit	Test Conditions
On Characteristics						
Collector-Emitter Breakdown Voltage ³	V _{(BR)CEO}	40	-	-	V	I _C =1mA, I _B =0
Collector-Base Breakdown Voltage	V _{(BR)CBO}	60	-	-	V	I _C =10μA, I _E = 0
Emitter-Base Breakdown Voltage	V _{(BR)EBO}	6	-	-	V	I _E =10μA, I _C =0
Base Cut-off Current	I _{BEV}	-	-	0.1	uA	V _{CE} =35V, V _{EB} =0.4V
Collector Cut-off Current	I _{CEX}	-	-	0.1	uA	V _{CE} =35V, V _{EB} =0.4V
DC Current Gain ³	h _{FE(1)}	20	-	-		I _C =0.1mA, V _{CE} =1V
	h _{FE(2)}	40	-	-		I _C =1mA, V _{CE} =1V
	h _{FE(3)}	80	-	-		I _C =10mA, V _{CE} =1V
	h _{FE(4)}	100	-	300		I _C =150mA, V _{CE} =1V
	h _{FE(5)}	40	-	-		I _C =500mA, V _{CE} =2V
Collector-Emitter Saturation Voltage ³	V _{CE(sat)}	-	-	0.4	V	I _C =150mA, I _B =15mA
		-	-	0.75		I _C =500mA, I _B =50mA
Base-Emitter Saturation Voltage ³	V _{BE(sat)}	-	-	0.95	V	I _C =150mA, I _B =15mA
		-	-	1.2		I _C =500mA, I _B =50mA
Small-Signal Characteristics						
Current-Gain-Bandwidth Product	f _T	250	-	-	MHz	I _C =20mA, V _{CE} =10V, f=100MHz
Collector-Base Capacitance	C _{cb}	-	6.5	-	pF	V _{CB} =5V, I _E =0, f=1MHz
Emitter-Base Capacitance	C _{eb}	-	30	-	pF	V _{EB} =0.5V, I _C =0, f=1MHz
Input Impedance	h _{ie}	1	-	15	kΩ	V _{CE} =10V, I _C =1mA, f=1kHz
Voltage Feedback Radio	h _{re}	0.1	-	8	x10 ⁻⁴	V _{CE} =10V, I _C =1mA, f=1kHz
Small-Signal Current Gain	h _{fe}	40	-	500		V _{CE} =10V, I _C =1mA, f=1kHz
Output Admittance	h _{oe}	1	-	30	μmhos	V _{CE} =10V, I _C =1mA, f=1kHz
Switching Characteristics						
Delay Time	t _d	-	15	-	nS	V _{CC} =30V, V _{EB} =2V
Rise Time	t _r	-	20	-		I _C =150mA, I _{B1} =15mA
Storage Time	t _s	-	225	-		V _{CC} =30V
Fall Time	t _f	-	60	-		I _C =150mA, I _{B1} =I _{B2} =15mA

Notes:

1. FR-5=1x0.75x0.062 in.
2. Alumina=0.4x0.3x0.024 in. 99.5% alumina.
3. Pulse Test: Pulse Width $\leq 300\mu\text{s}$, Duty Cycle $\leq 2\%$.

SWITCHING TIME EQUIVALENT TEST CIRCUITS

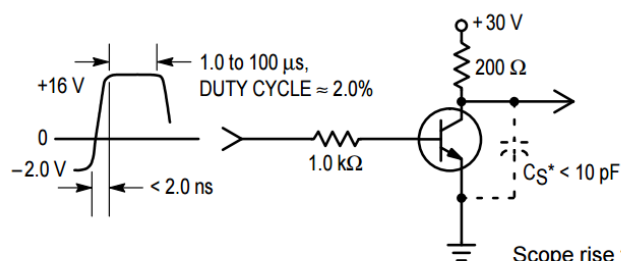


Figure 1. Turn-On Time

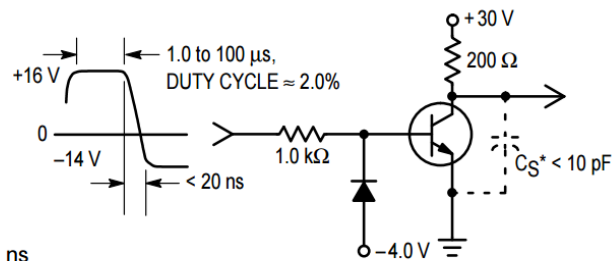


Figure 2. Turn-Off Time

TRANSIENT CHARACTERISTICS

— 25°C — 100°C

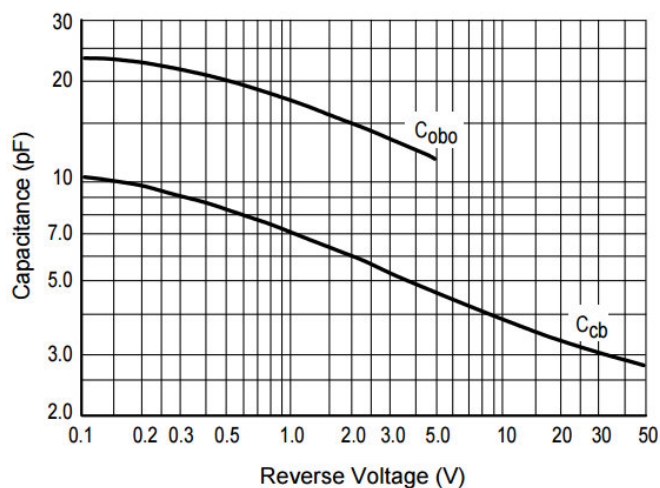


Figure 3. Capacitances

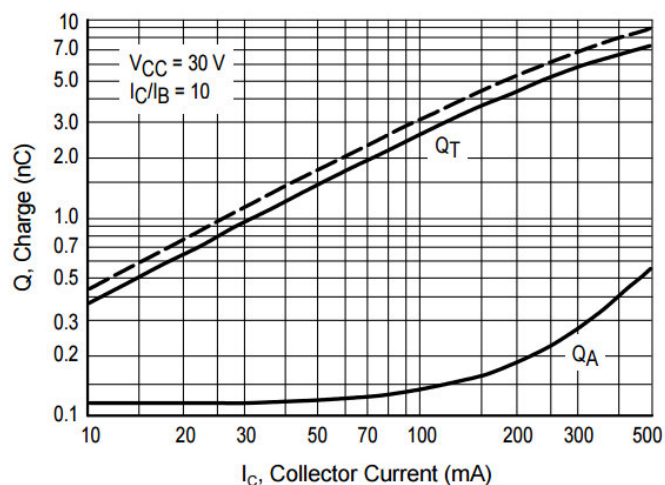


Figure 4. Charge Data

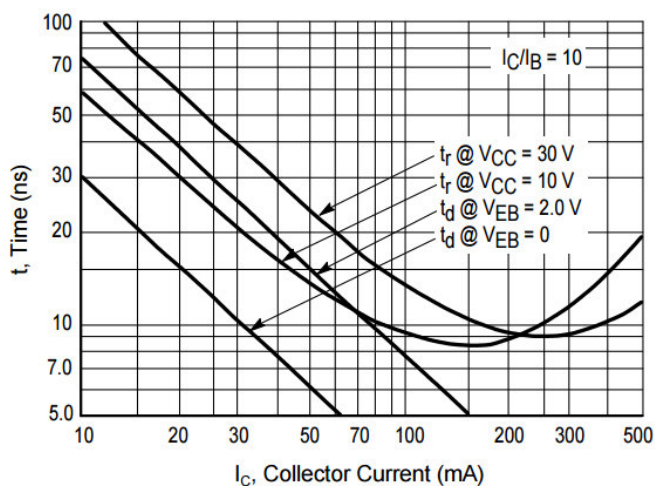


Figure 5. Turn-On Time

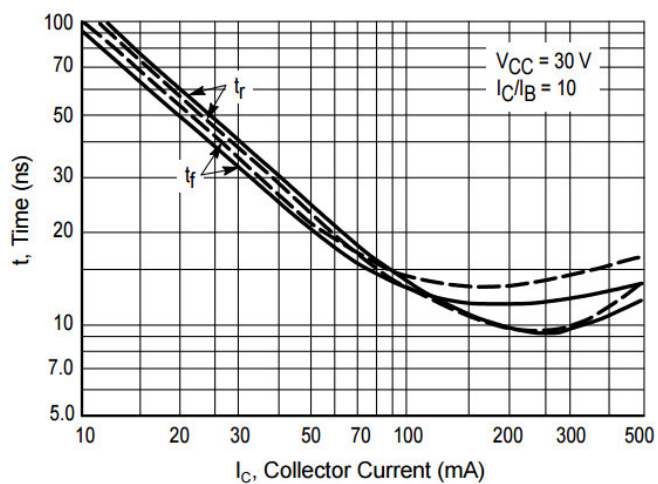


Figure 6. Rise and Fall Times

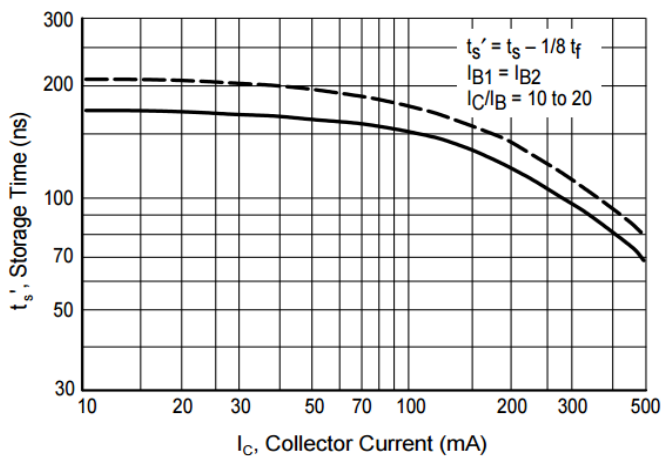


Figure 7. Storage Time

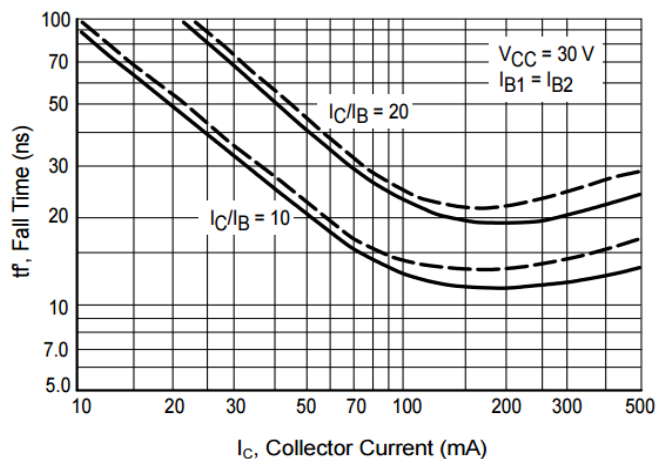


Figure 8. Fall Time

SMALL-SIGNAL CHARACTERISTICS

NOISE FIGURE

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

Bandwidth = 1.0 Hz

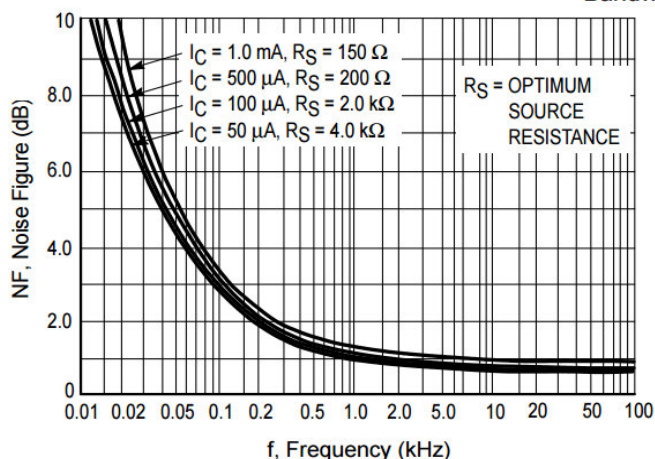


Figure 9. Frequency Effects

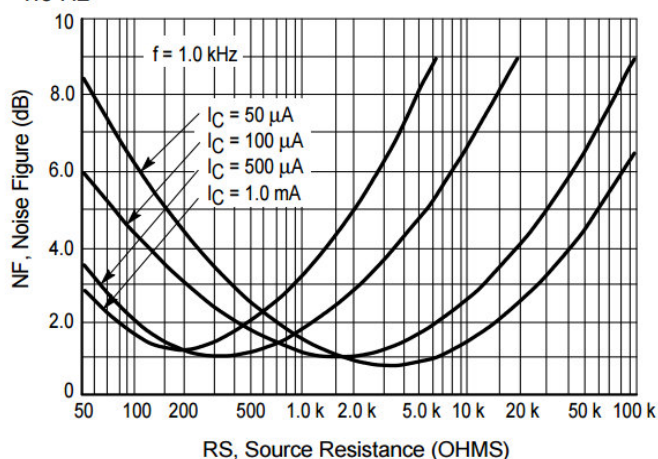


Figure 10. Source Resistance Effects

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.

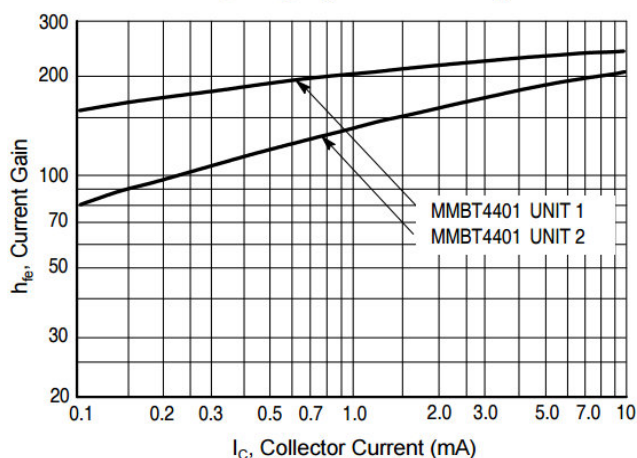


Figure 11. Current Gain

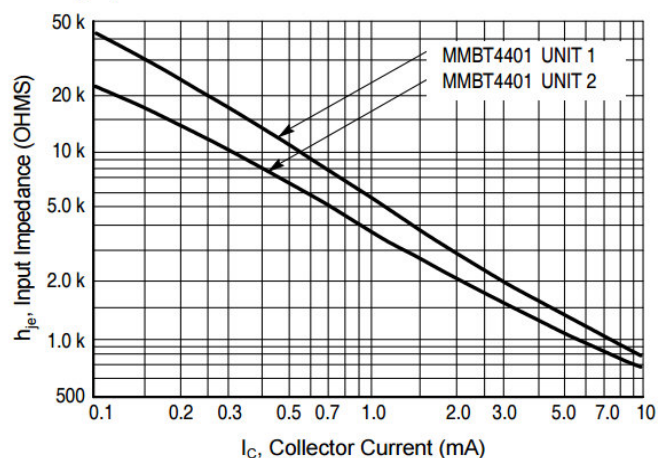


Figure 12. Input Impedance

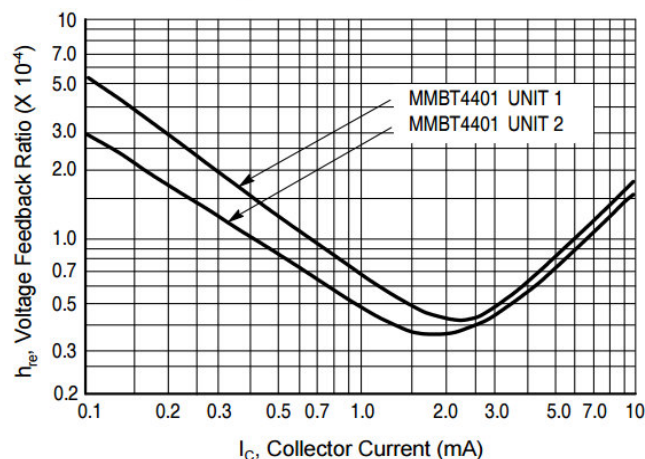


Figure 13. Voltage Feedback Ratio

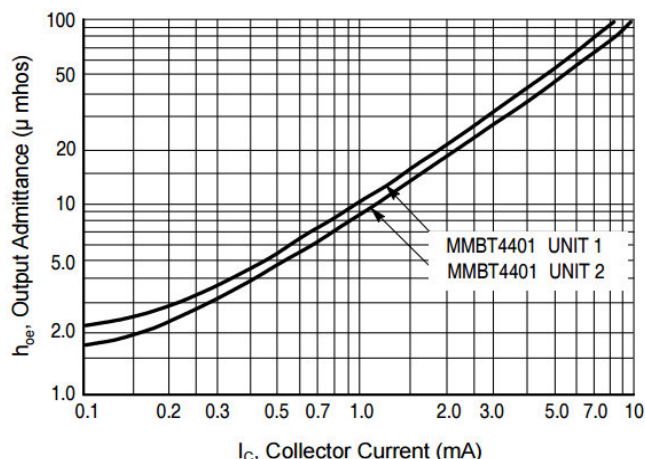


Figure 14. Output Admittance

STATIC CHARACTERISTICS

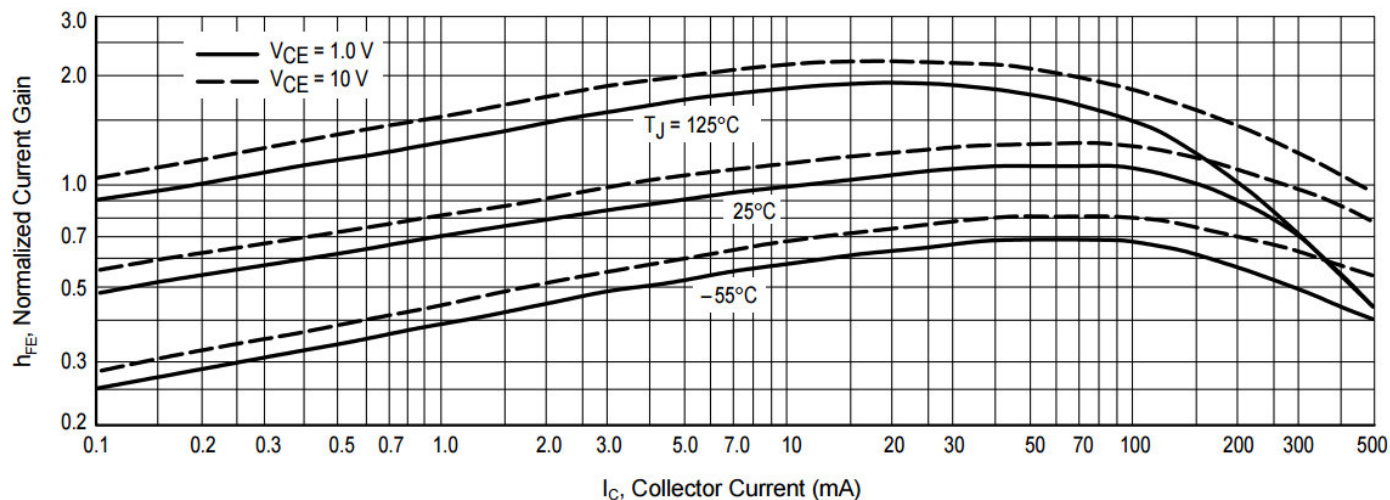


Figure 15. DC Current Gain

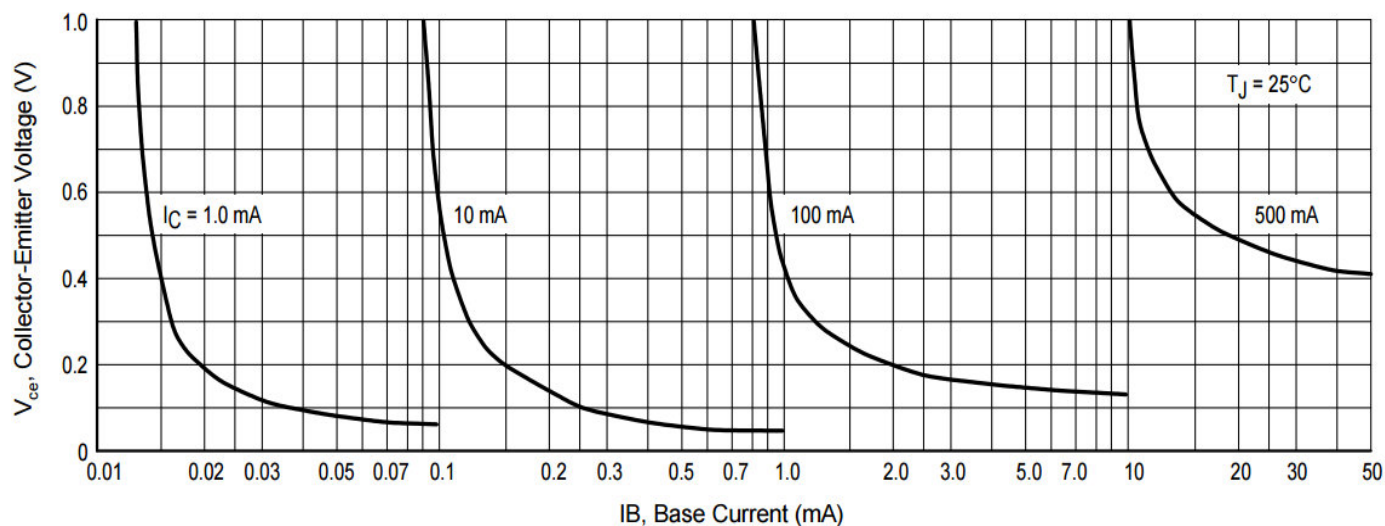


Figure 16. Collector Saturation Region

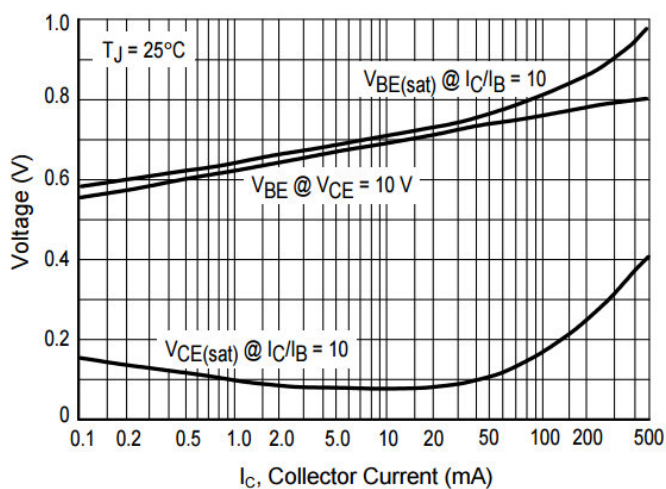


Figure 17. "On" Voltages

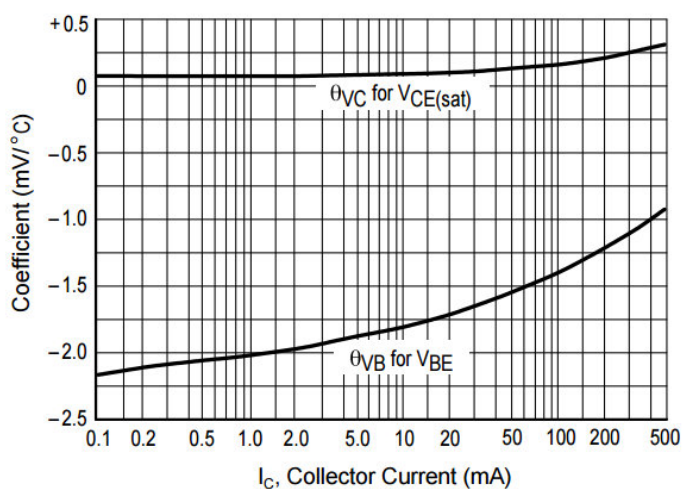


Figure 18. Temperature Coefficients