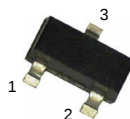


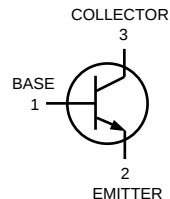
Switching Transistor

NPN Silicon

MMBT4401



SOT-23



MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	V _{CEO}	40	V _{dc}
Collector-Base Voltage	V _{CBO}	60	V _{dc}
Emitter-Base Voltage	V _{EBO}	6.0	V _{dc}
Collector Current-Continuous	I _C	600	mAdc

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max.	Unit
Total Device Dissipation FR-5 Board ⁽¹⁾ T _A =25°C Derate above 25°C	P _D	225 1.8	mW mW / °C
Thermal Resistance Junction to Ambient	R _{θJA}	556	°C / W
Total Device Dissipation Alumina Substrate, ⁽²⁾ T _A =25°C Derate above 25°C	P _D	300 2.4	mW mW / °C
Thermal Resistance Junction to Ambient	R _{θJA}	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
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OFF CHARACTERISTICS

Collector-Emitter Breakdowe Voltage ⁽³⁾ (I _C =1.0mAdc, I _B =0)	V _{(BR)CEO}	40	-	V _{dc}
Collector-Base Breakdowe Voltage (I _C =0.1 mAdc, I _E =0)	V _{(BR)CBO}	60	-	V _{dc}
Emitter-Base Breakdowe Voltage (I _E =0.1 mAdc, I _C =0)	V _{(BR)EBO}	6.0	-	V _{dc}
Base Cutoff Current (V _{CE} =35 Vdc, V _{EB} =0.4 Vdc)	I _{BEV}	-	0.1	nAdc
Collector Cutoff Current (V _{CE} =35 Vdc, V _{EB} =0.4 Vdc)	I _{CEX}	-	0.1	nAdc

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

Characteristic	Symbol	Min.	Max.	Unit
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ON CHARACTERISTICS⁽³⁾

DC Current Gain (IC=0.1 mAdc, VCE=1.0 Vdc) (IC=1.0 mAdc, VCE=1.0 Vdc) (IC=10 mAdc, VCE=1.0 Vdc) (IC=150 mAdc, VCE=1.0 Vdc) (IC=500 mAdc, VCE=2.0 Vdc)	HFE	20 40 80 100 40	- - - 300 -	-
Collector-Emitter Saturation Voltage ⁽³⁾ (IC=150 mAdc, IB=15 mAdc) (IC=500 mAdc, IB=50 mAdc)	VCE(sat)	- -	0.4 0.75	Vdc
Base-Emitter Saturation Voltage ⁽³⁾ (IC=150 mAdc, IB=15 mAdc) (IC=500 mAdc, IB=50 mAdc)	VBE(sat)	0.75 -	0.95 1.2	Vdc

SMALL-SIGNAL CHARACTERISTIC

Current-Gain-Bandwidth Product (IC=20 mAdc, VCE=10 Vdc, f=100 MHz)	fr	250	-	MHz
Collector-Base Capacitance (VCB=5.0 Vdc, IE=0, f=1.0 MHz)	Ccb	-	6.5	pF
Emitter-Base Capacitance (VEB=0.5 Vdc, IC=0, f=1.0 MHz)	Ceb	-	30	pF
Input Impedance (VCE=10 Vdc, IC=1.0 mAdc, f=1.0 kHz)	hie	1.0	15	k ohms
Voltage Feedback Ratio (VCE=10 Vdc, IC=1.0 mAdc, f=1.0 kHz)	hre	0.1	8.0	$\times 10^{-4}$
Small-Signal Current Gain (VCE=10 Vdc, IC=1.0 mAdc, f=1.0 kHz)	hfe	40	500	-
Output Admittance (VCE=10 Vdc, IC=1.0 mAdc, f=1.0 kHz)	hoe	1.0	30	u mhos

SWITCHING CHARACTERISTICS

Delay Time	(VCC=30 Vdc, VBE=2.0 Vdc, IC=150 mAdc, IB1=15 mAdc)	td	-	15	nS
Rise Time		tr	-	20	
Storage Time	(VCC=30 Vdc, IC=150 mAdc, IB1=IB2=15 mAdc)	ts	-	225	nS
Fall Time		tf	-	30	

(1) FR-5=1.0 x 0.75 x 0.062in.

(2) Alumina=0.4 x 0.3 x 0.024in. 99.5% alumina.

(3) Pulse Test : Pulse Width $\leq$ 300uS, Duty Cycle $\leq$ 2.0%.

SWITCHING TIME EQUIVALENT TEST CIRCUITS

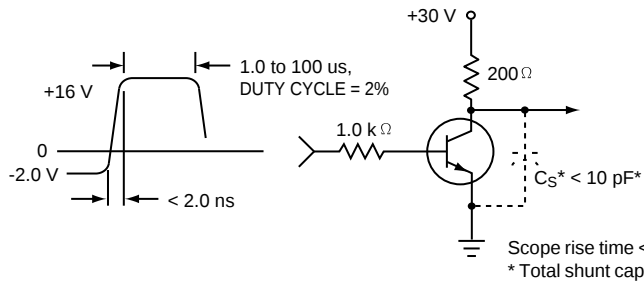


Figure 1. Turn-On Time

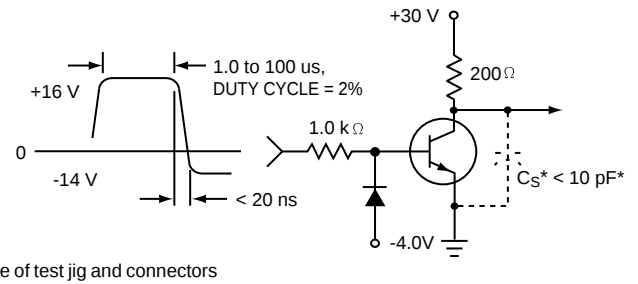


Figure 2. Turn-Off Time

TRANSIENT CHARACTERISTICS

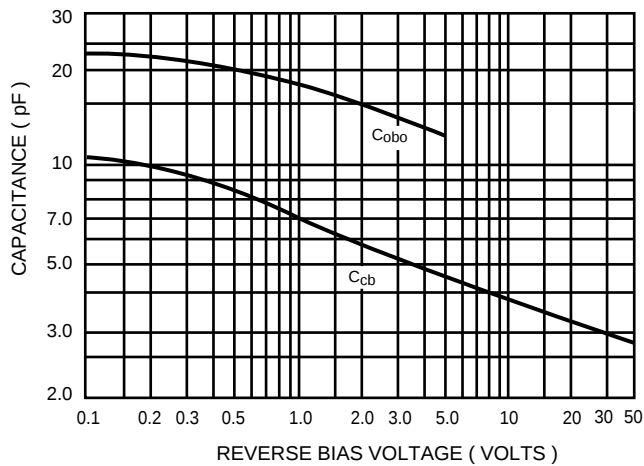


Figure 3. Capacitance

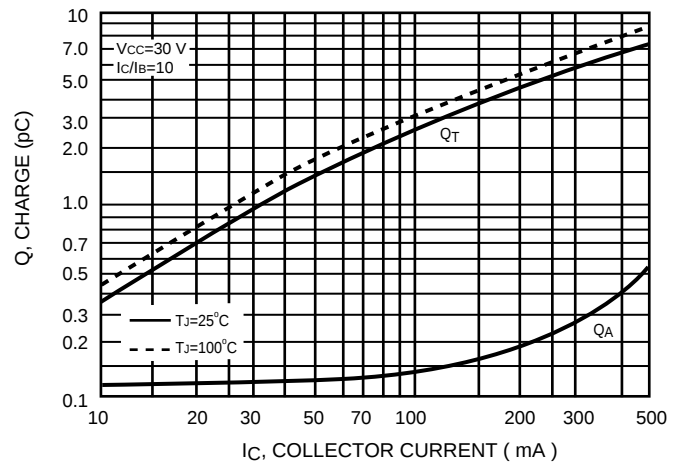


Figure 4. Charge Data



TRANSIENT CHARACTERISTICS

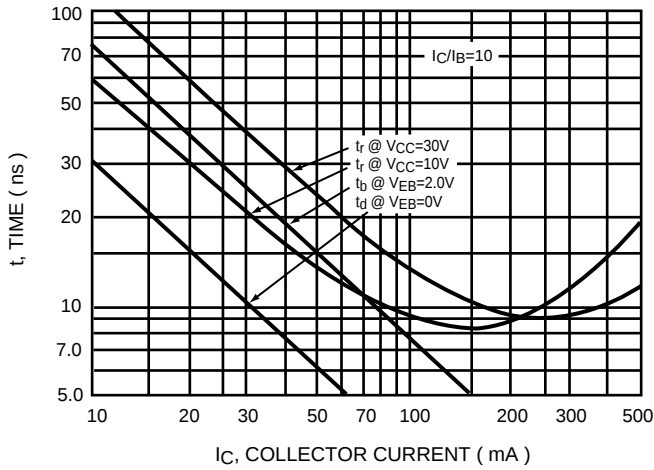


Figure 5. Turn-On Time

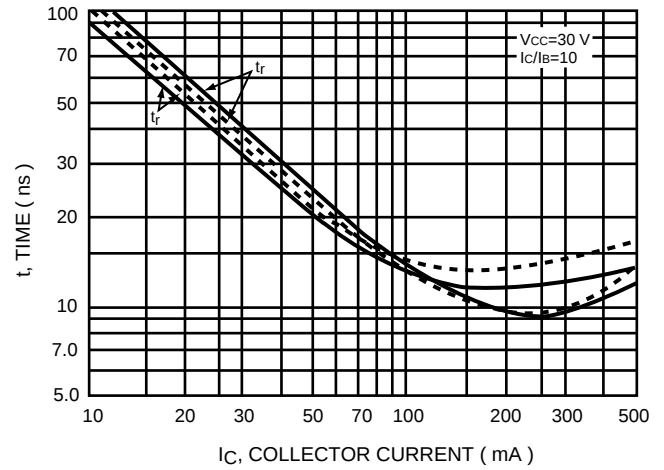


Figure 6. Rise and Fall Times

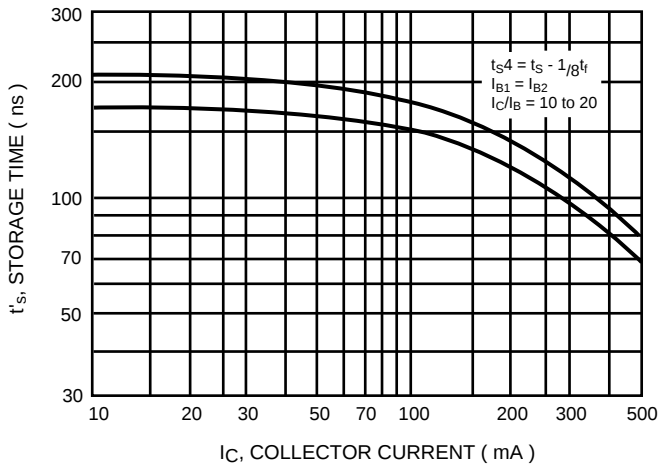


Figure 7. Storage Time

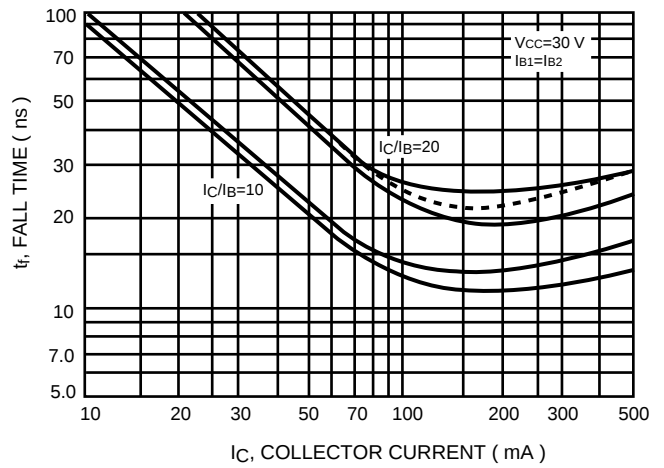


Figure 8. Fall Time

SMALL-SIGNAL CHARACTERISTICS NOISE FIGURE

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

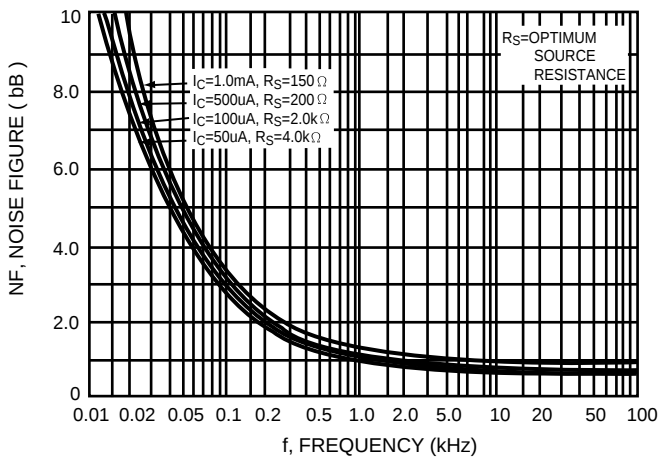


Figure 9. Frequency Effects

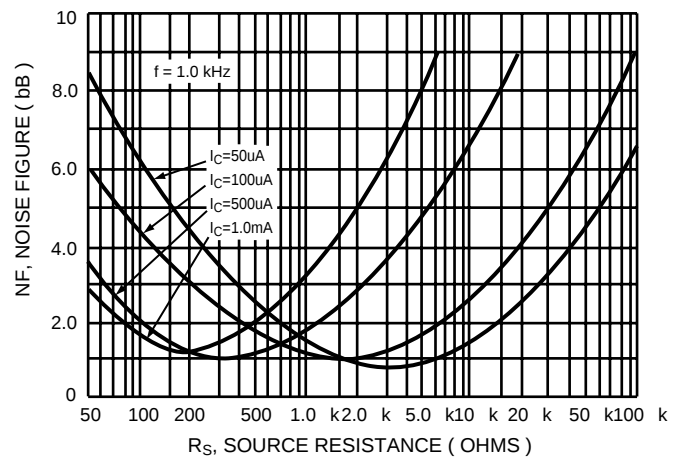


Figure 10. Source Resistance Effects



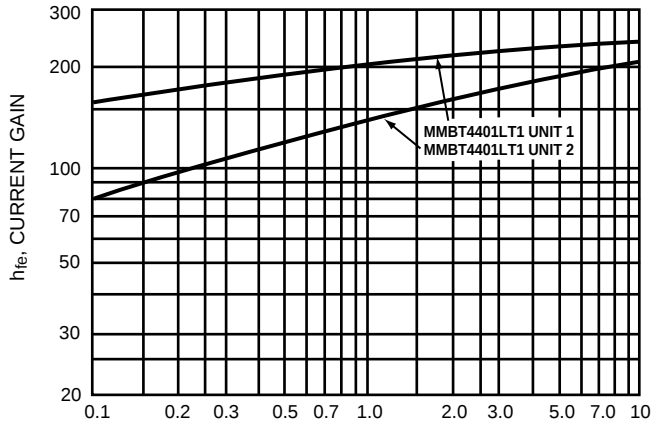


h PARAMETERS

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

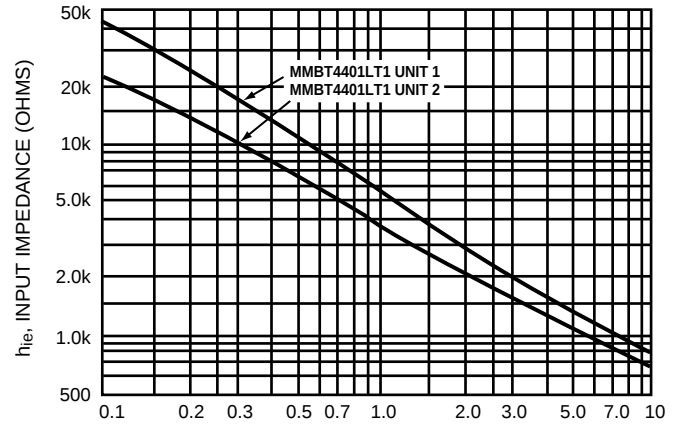
This group of graphs illustrates the relationship between h_{fe} and other "h" parameters for this series of transistors. To obtain these curves, a high-gain and a low-gain unit were

selected from the MMBT4401LT1 lines, and the same units were used to develop the correspondingly numbered curves on each graph.



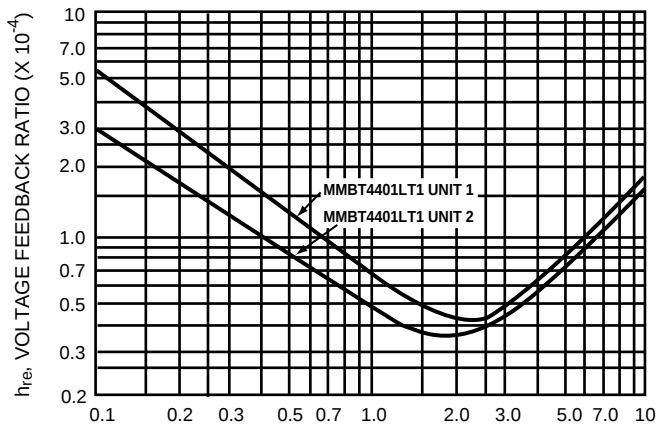
IC, COLLECTOR CURRENT (mA)

Figure 11. Current Gain



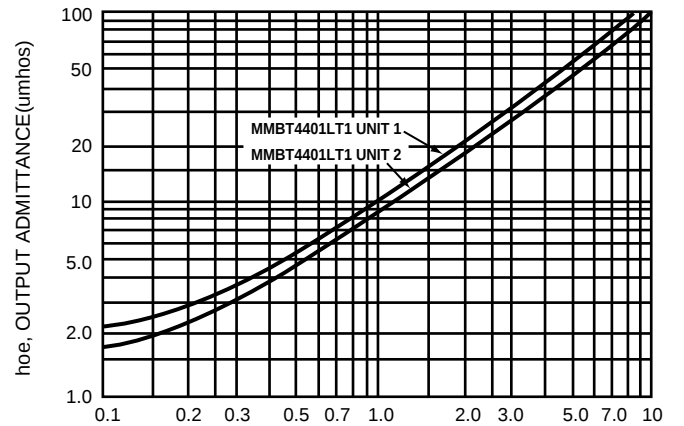
IC, COLLECTOR CURRENT (mA)

Figure 12. Input Impedance



IC, COLLECTOR CURRENT (mA)

Figure 13. Voltage Feedback Ratio



IC, COLLECTOR CURRENT (mA)

Figure 14. Output Admittance





STATIC CHARACTERISTICS

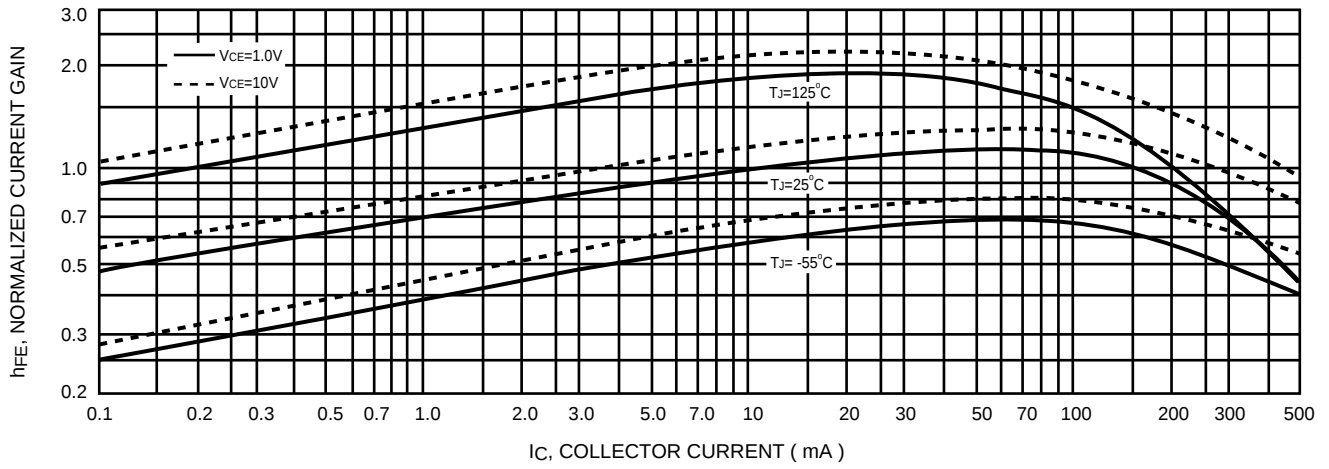


Figure 15. DC Current Gain

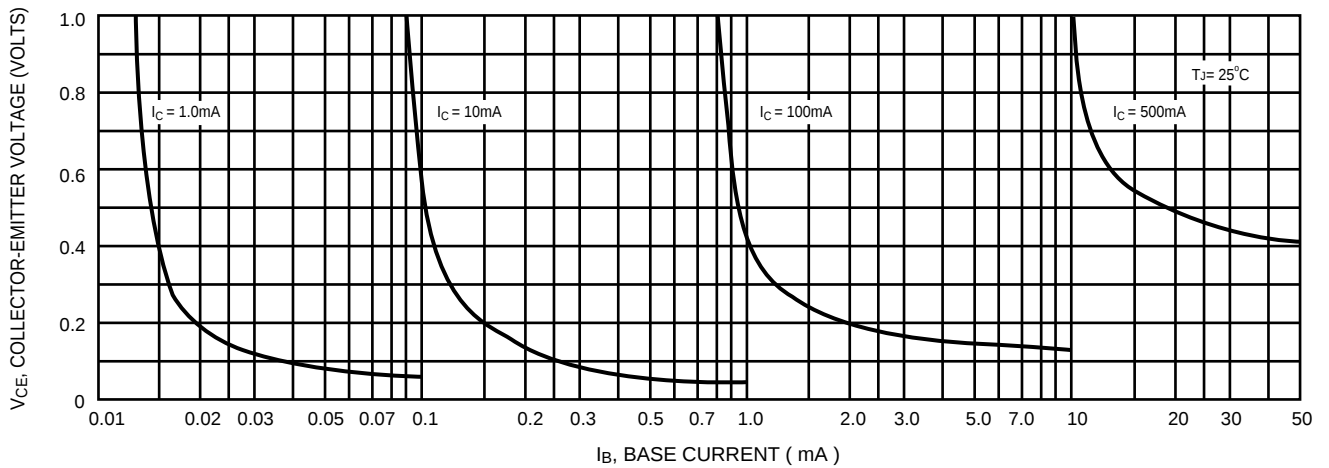


Figure 16. Collector Saturation Region

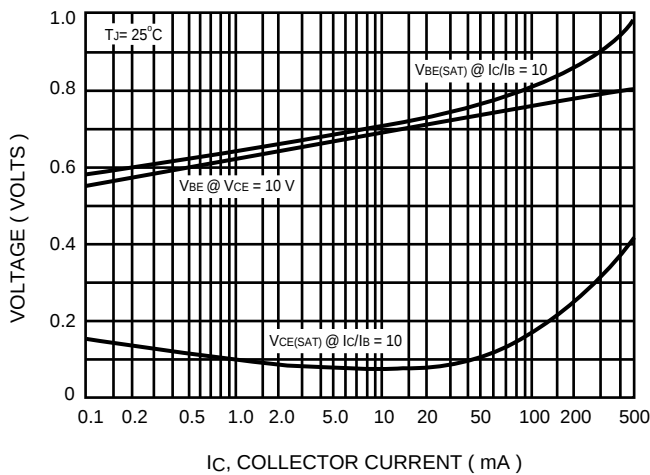


Figure 17. " ON " Voltage

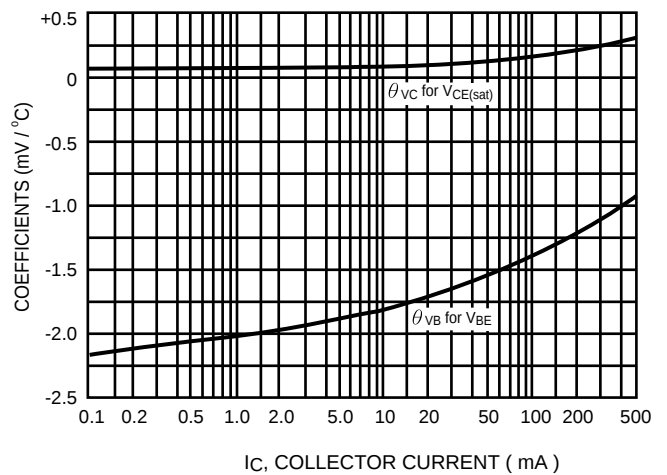


Figure 18. Temperature Coefficients

