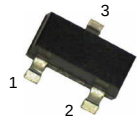
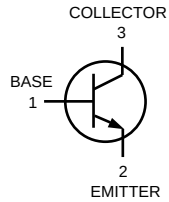
Switching Transistor

NPN Silicon

MMBT4401



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 Derate above 25°C	P_D	225 1.8	mW mW / °C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	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	$R_{\theta JA}$	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 Breakdowe Voltage[3] (I_C=1.0mAdc, I_B=0)	$V_{(BR)CEO}$	40	-	Vdc
Collector-Base Breakdowe Voltage (I_C=0.1 mAdc, I_E=0)	$V_{(BR)CBO}$	60	-	Vdc
Emitter-Base Breakdowe 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	nAdc
Collector Cutoff Current (V_{CE}=35 Vdc, V_{EB}=0.4 Vdc)	I_{CEX}	-	0.1	nAdc

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

Characteristic	Symbol	Min.	Max.	Unit
ON CHARACTERISTICS(3)				
DC Current Gain				
(I_C=0.1 mAdc, V_{CE}=1.0 Vdc)	H_{FE}	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(3)				
(I_C=150 mAdc, I_B=15 mAdc)	V_{CE}(sat)	-	0.4	Vdc
(I_C=500 mAdc, I_B=50 mAdc)		-	0.75	
Base-Emitter Saturation Voltage(3)				
(I_C=150 mAdc, I_B=15 mAdc)	V_{BE}(sat)	0.75	0.95	Vdc
(I_C=500 mAdc, I_B=50 mAdc)		-	1.2	
SMALL-SIGNAL CHARACTERISTIC				
Current-Gain-Bandwidth Product (I_C=20 mAdc, V_{CE}=10 Vdc, f=100 MHz)	f_T	250	-	MHz
Collector-Base Capacitance (V_{CB}=5.0 Vdc, I_E=0, f=1.0 MHz)	Ccb	-	6.5	pF
Emitter-Base Capacitance (V_{EB}=0.5 Vdc, I_C=0, f=1.0 MHz)	Ceb	-	30	pF
Input Impedance (V_{CE}=10 Vdc, I_C=1.0 mAdc, f=1.0 kHz)	hie	1.0	15	k ohms
Voltage Feedback Ratio (V_{CE}=10 Vdc, I_C=1.0 mAdc, f=1.0 kHz)	hre	0.1	8.0	X 10^{-4}
Small-Signal Current Gain (V_{CE}=10 Vdc, I_C=1.0 mAdc, f=1.0 kHz)	hfe	40	500	-
Output Admittance (V_{CE}=10 Vdc, I_C=1.0 mAdc, f=1.0 kHz)	hoe	1.0	30	u mhos

SWITCHING CHARACTERISTICS

Delay Time	(V_{CC}=30 Vdc, V_{BE}=2.0 Vdc, I_C=150 mAdc, I_{B1}=15 mAdc)	td	-	15	nS
Rise Time		tr	-	20	
Storage Time	(V_{CC}=30 Vdc, I_C=150 mAdc, I_{B1}=I_{B2}=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 ≦ 300uS, Duty Cycle ≦ 2.0%.

SWITCHING TIME EQUIVALENT TEST CIRCUITS

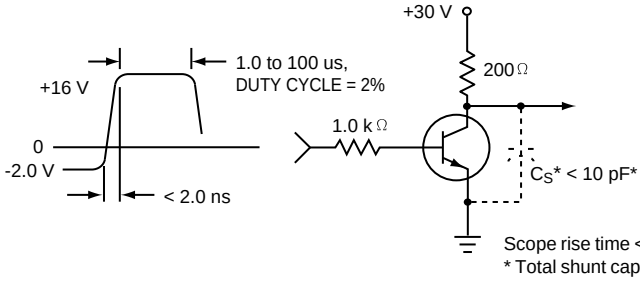


Figure 1. Turn-On Time

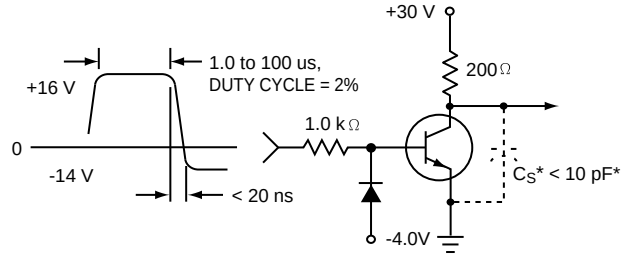


Figure 2. Turn-Off Time

TRANSIENT CHARACTERISTICS

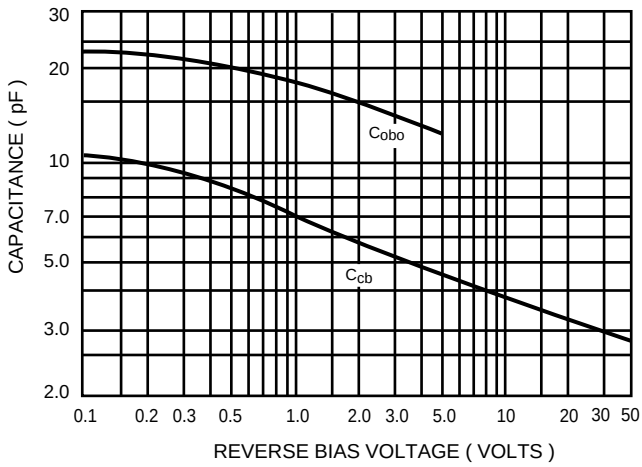


Figure 3. Capacitance

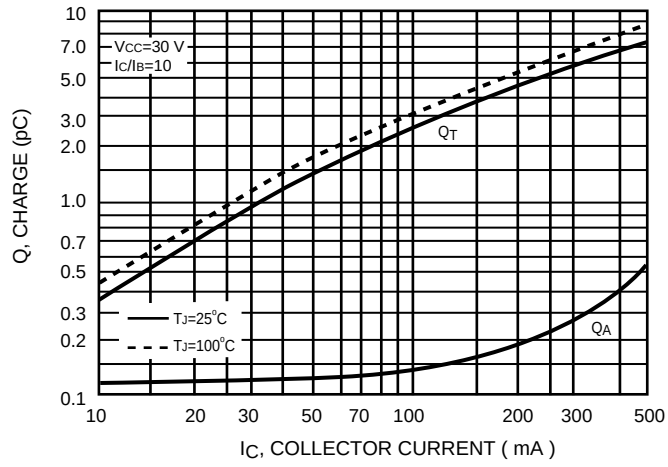


Figure 4. Charge Data

TRANSIENT CHARACTERISTICS

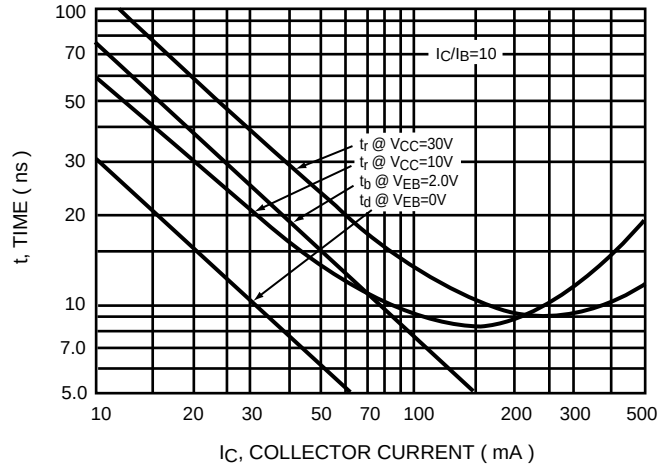


Figure 5. Turn-On Time

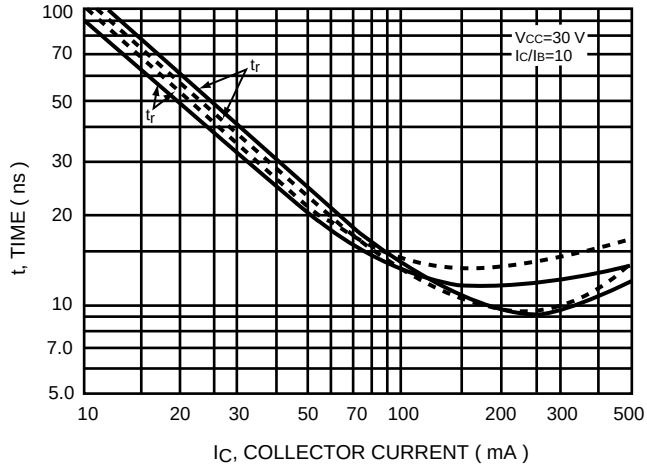


Figure 6. Rise and Fall Times

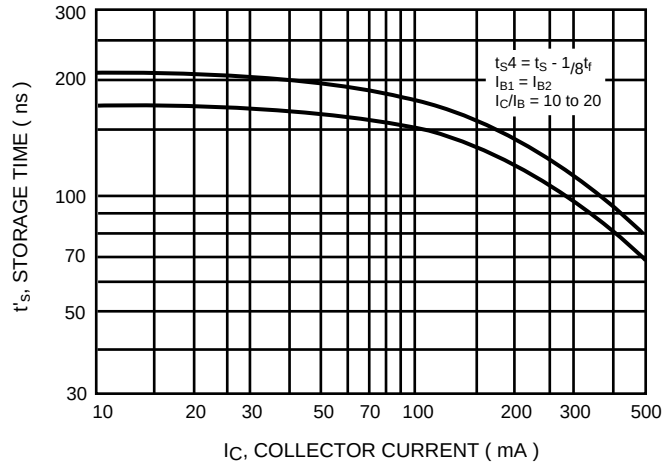


Figure 7. Storage Time

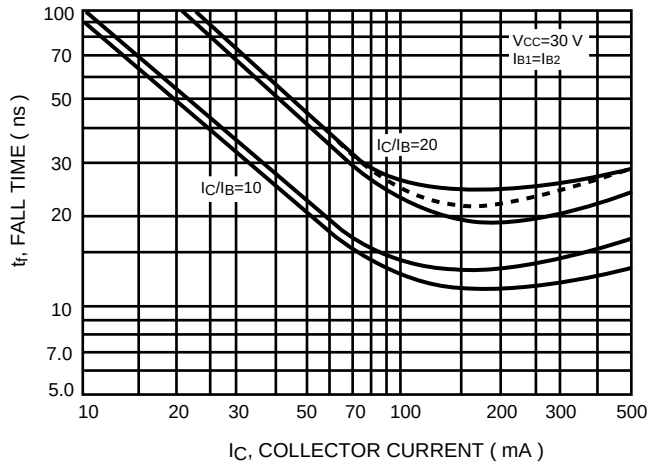


Figure 8. Fall Time

SMALL-SIGNAL CHARACTERISTICS
NOISE FIGURE

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

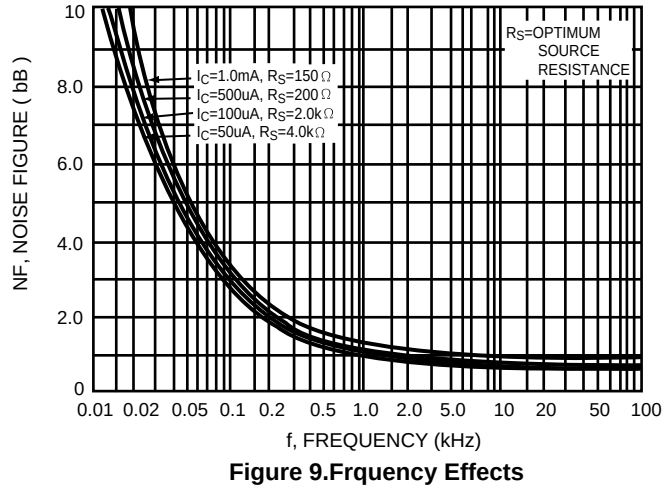


Figure 9.Frquency Effects

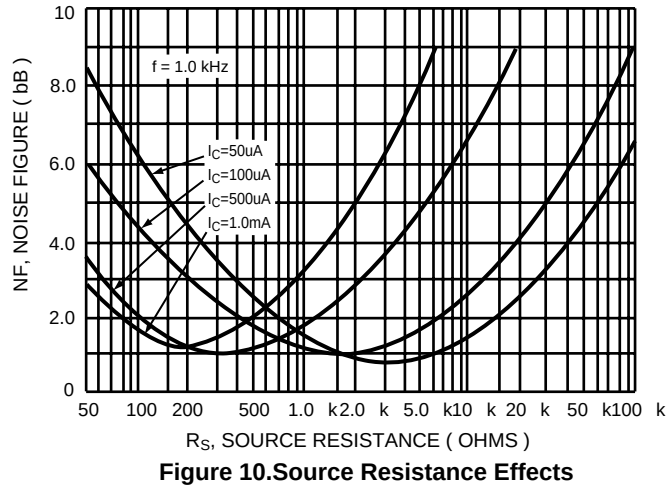


Figure 10.Source Resistance Effects

h PARAMETERS

V_{CE} = 10 Vdc, f = 1.0 kH_Z, T_A = 25°C

This group of graphs illustrates the relationship between hfe and 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.

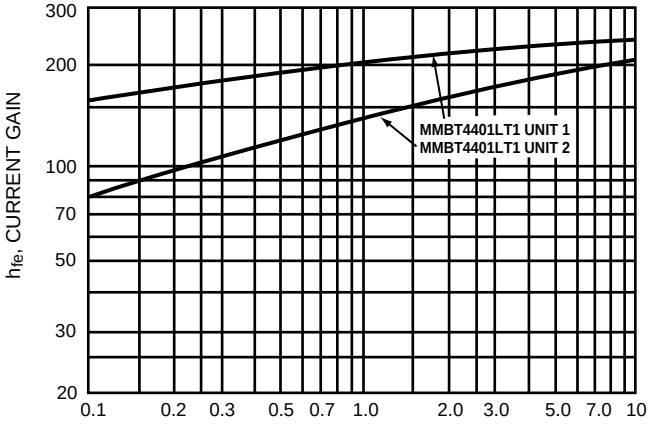


Figure 11. Current Gain

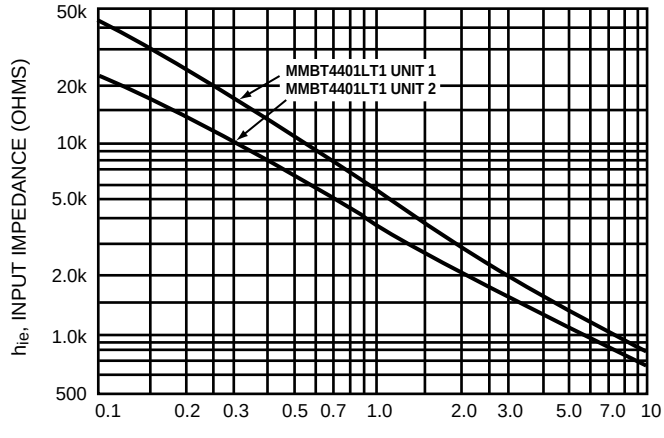


Figure 12. Input Impedance

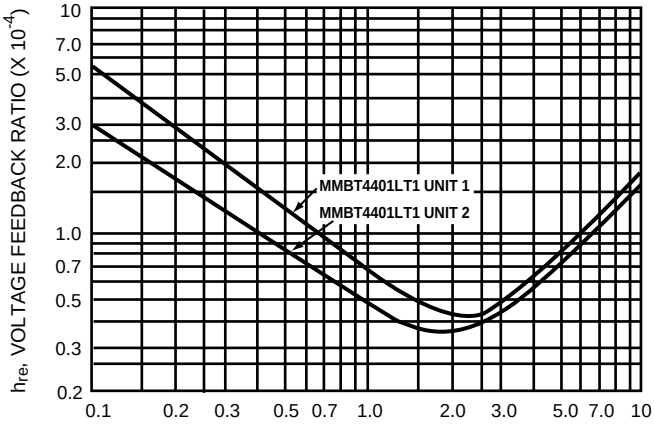


Figure 13. Voltage Feedback Ratio

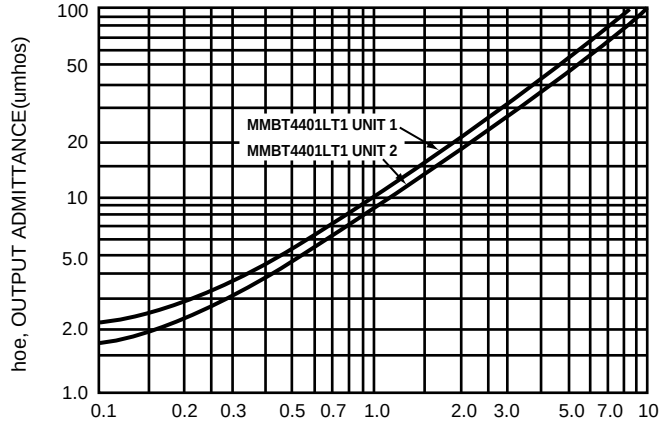


Figure 14. Output Admittance

STATIC CHARACTERISTICS

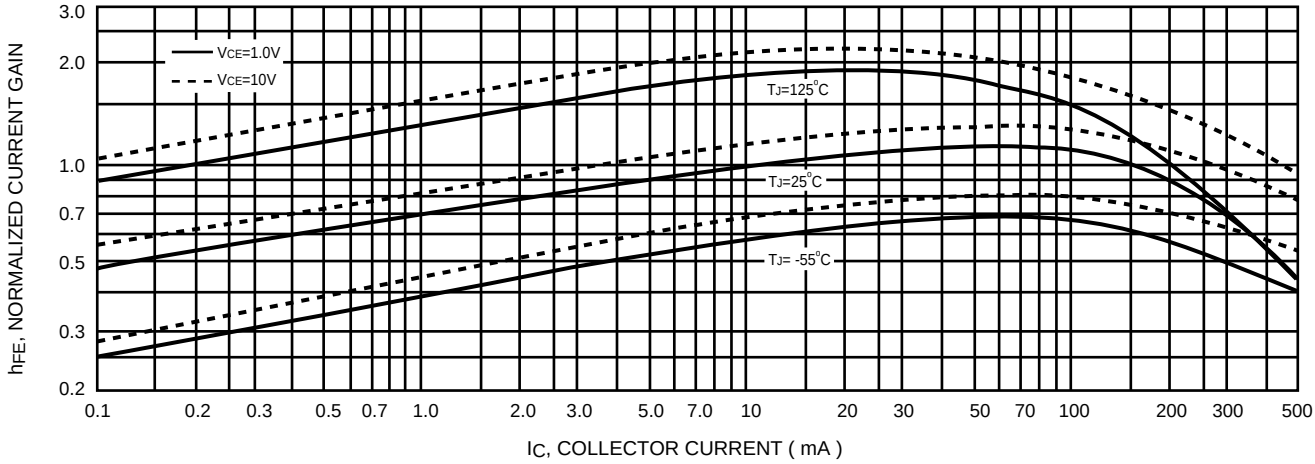


Figure 15. DC Current Gain

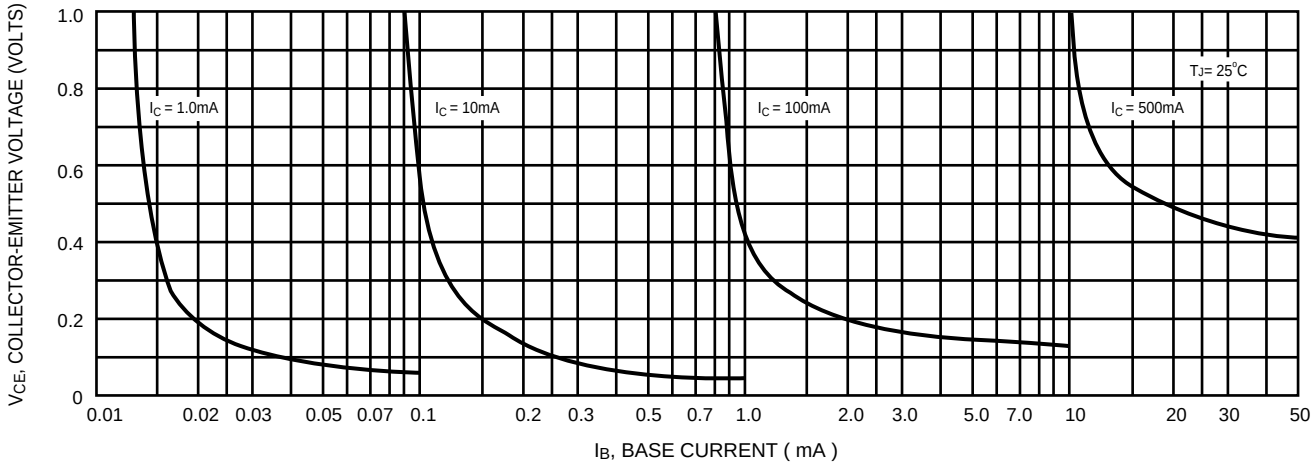


Figure 16. Collector Saturation Region

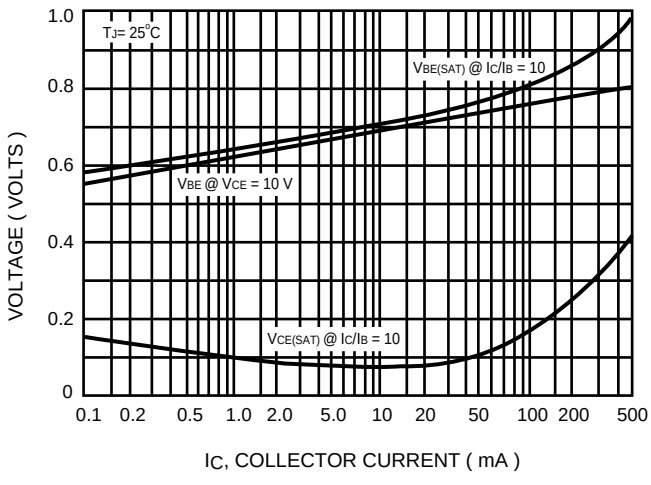


Figure 17. " ON " Voltage

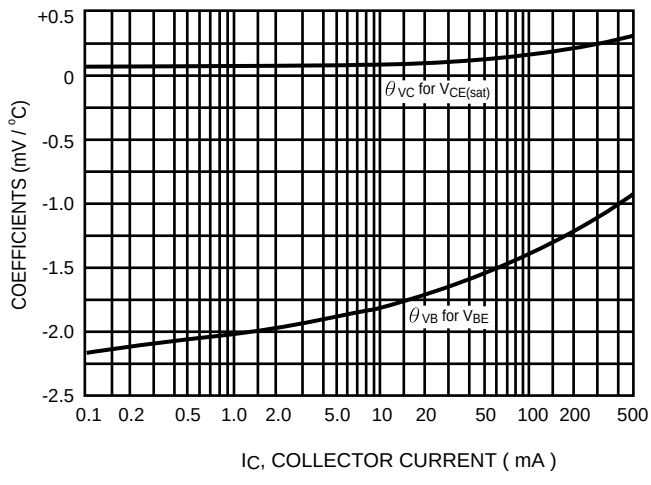


Figure 18. Temperature Coefficients