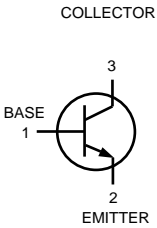
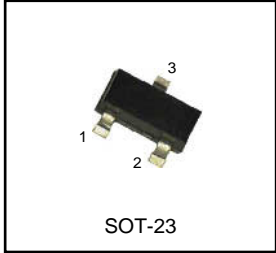


**Switching Transistor**  
**NPN Silicon**  
**Lead free product**  
**Halogen-free type**

**MMBT4401GH**



**MAXIMUM RATINGS**

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	V <sub>CEO</sub>	40	V <sub>dc</sub>
Collector-Base Voltage	V <sub>CB0</sub>	60	V <sub>dc</sub>
Emitter-Base Voltage	V <sub>EB0</sub>	6.0	V <sub>dc</sub>
Collector Current-Continuous	I <sub>C</sub>	600	mA <sub>dc</sub>

**THERMAL CHARACTERISTICS**

Characteristic	Symbol	Max.	Unit
Total Device Dissipation FR-5 Board <sup>(1)</sup> TA=25°C Derate above 25°C	P <sub>D</sub>	225 1.8	mW mW / °C
Thermal Resistance Junction to Ambient	R <sub>θJA</sub>	556	°C / W
Total Device Dissipation Alumina Substrate, <sup>(2)</sup> TA=25°C Derate above 25°C	P <sub>D</sub>	300 2.4	mW mW / °C
Thermal Resistance Junction to Ambient	R <sub>θJA</sub>	417	°C / W
Junction and Storage Temperature	T <sub>J</sub> ,T <sub>STG</sub>	-55 to +150	°C

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

Characteristic	Symbol	Min.	Max.	Unit
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**OFF CHARACTERISTICS**

Collector-Emitter Breakdowe Voltage <sup>(3)</sup> ( I <sub>C</sub> =1.0mA <sub>dc</sub> , I <sub>B</sub> =0 )	V <sub>(BR)CEO</sub>	40	-	V <sub>dc</sub>
Collector-Base Breakdowe Voltage ( I <sub>C</sub> =0.1 mA <sub>dc</sub> , I <sub>E</sub> =0 )	V <sub>(BR)CBO</sub>	60	-	V <sub>dc</sub>
Emitter-Base Breakdowe Voltage ( I <sub>E</sub> =0.1 mA <sub>dc</sub> , I <sub>C</sub> =0 )	V <sub>(BR)EBO</sub>	6.0	-	V <sub>dc</sub>
Base Cutoff Current ( V <sub>CE</sub> =35 V <sub>dc</sub> , V <sub>EB</sub> =0.4 V <sub>dc</sub> )	I <sub>BEV</sub>	-	0.1	uA <sub>dc</sub>
Collector Cutoff Current ( V <sub>CE</sub> =35 V <sub>dc</sub> , V <sub>EB</sub> =0.4 V <sub>dc</sub> )	I <sub>CEX</sub>	-	0.1	uA <sub>dc</sub>

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

Characteristic	Symbol	Min.	Max.	Unit
<b>ON CHARACTERISTICS<sup>(3)</sup></b>				
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 <sup>(3)</sup> ( IC=150 mAdc, IB=15 mAdc ) ( IC=500 mAdc, IB=50 mAdc )	VCE(sat)	- -	0.4 0.75	Vdc
Base-Emitter Saturation Voltage <sup>(3)</sup> ( 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 )	ft	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	X 10 <sup>-4</sup>
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**

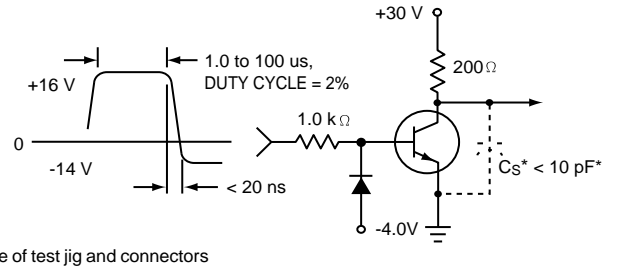
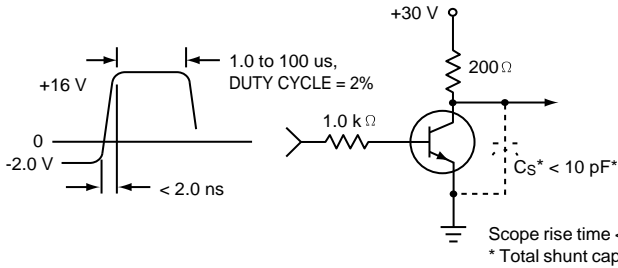
Delay Time	( VCC=30 Vdc, VBE=2.0 Vdc, IC=150 mAdc, IB1=15 mAdc )	td	-	15	nS
Rise Time		tr	-	20	
Storage Time	( VCC=30 Vdc, IC=150 mAdc, IB1=IB2=15 mAdc )	ts	-	225	nS
Fall Time		tf	-	30	

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

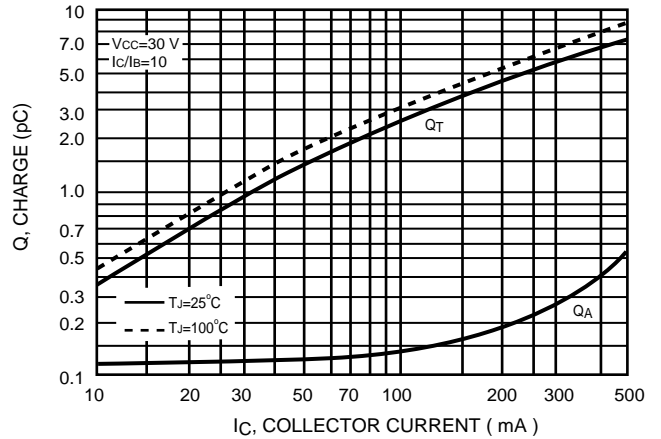
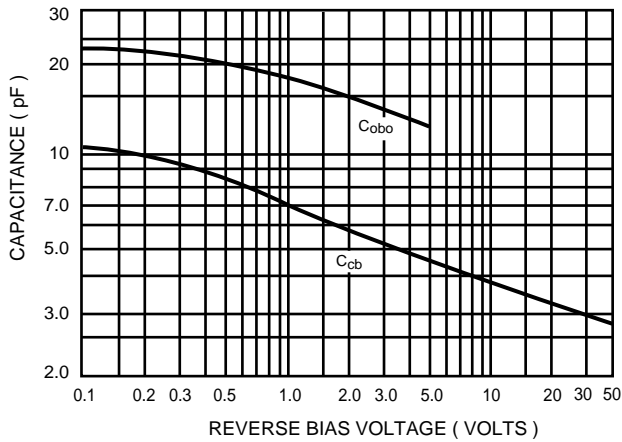
(2) Alumina=0.4 x 0.3 x 0.024in. 99.5% alumina.

(3) Pulse Test : Pulse Width ≤ 300uS, Duty Cycle ≤ 2.0%.

SWITCHING TIME EQUIVALENT TEST CIRCUITS



TRANSIENT CHARACTERISTICS



TRANSIENT CHARACTERISTICS

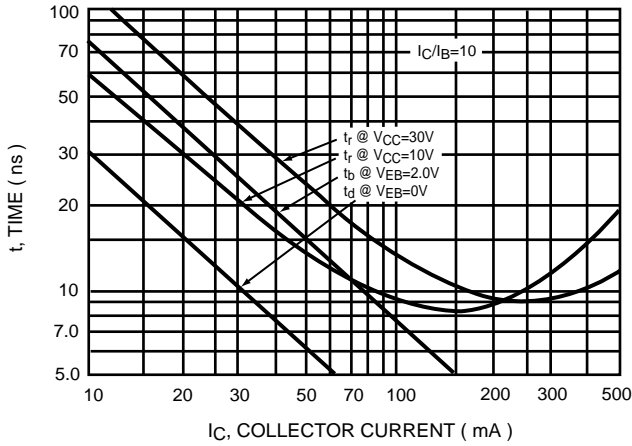


Figure 5. Turn-On Time

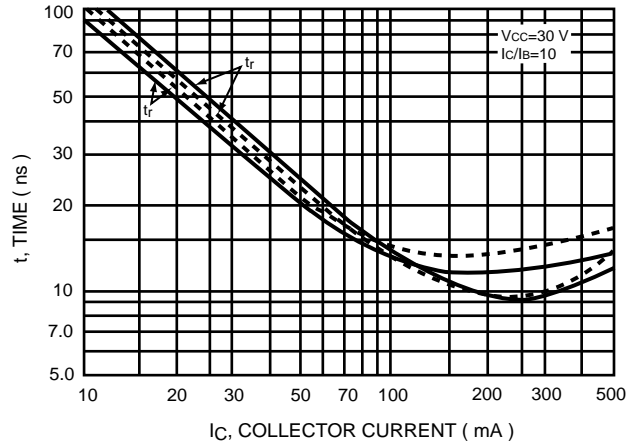


Figure 6. Rise and Fall Times

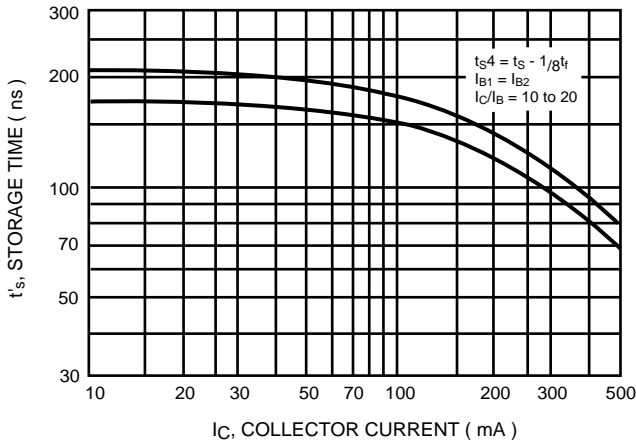


Figure 7. Storage Time

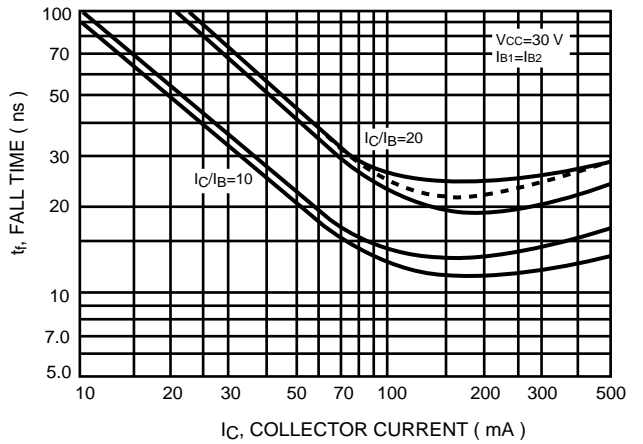


Figure 8. Fall Time

SMALL-SIGNAL CHARACTERISTICS

NOISE FIGURE

V<sub>CE</sub>=10 Vdc, T<sub>A</sub>=25°C  
Bandwidth=1.0HZ

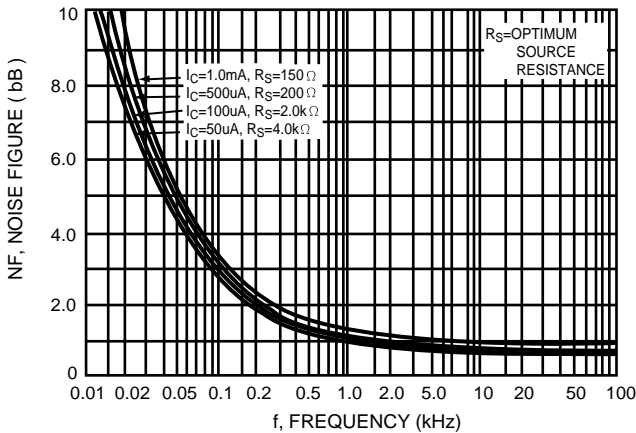


Figure 9. Frequency Effects

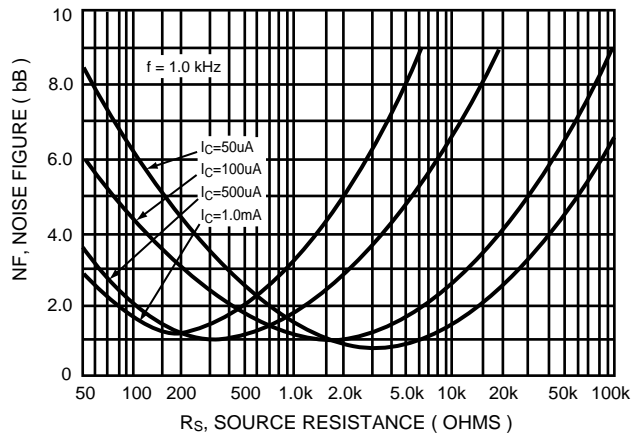


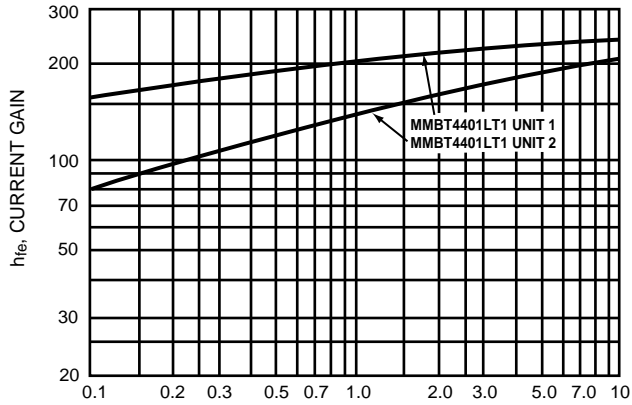
Figure 10. Source Resistance Effects

**h PARAMETERS**

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

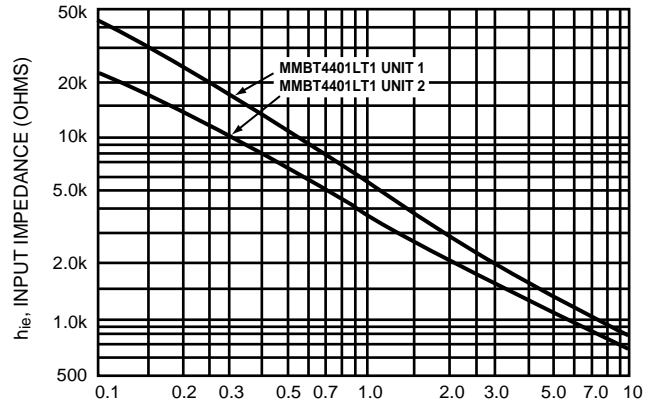
This group of graphs illustrates the relationship between  $h_{fe}$  and other "h" parameters for this series of transistors. To obtain these curves, a high-gain and a low-gain unit were

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



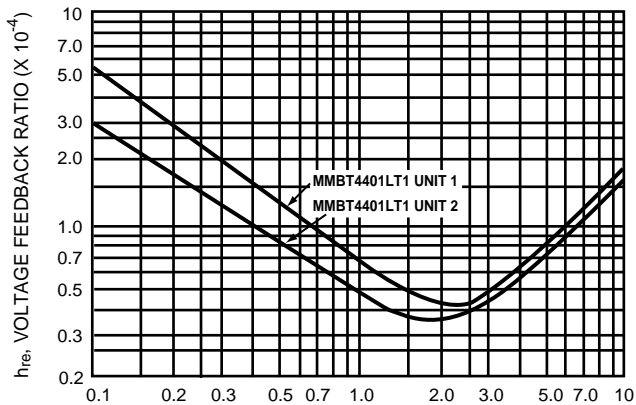
$I_C$ , COLLECTOR CURRENT (mA)

**Figure 11. Current Gain**



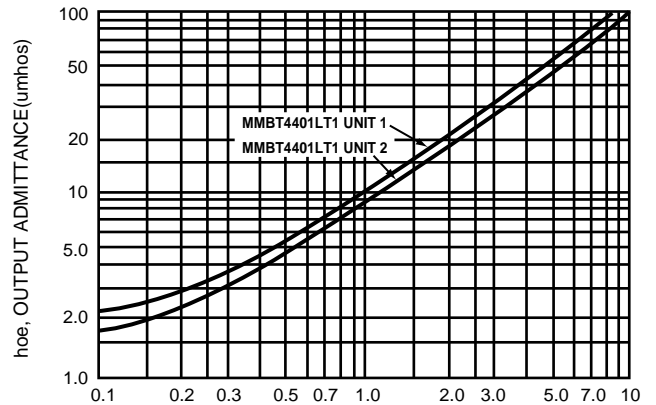
$I_C$ , COLLECTOR CURRENT (mA)

**Figure 12. Input Impedance**



$I_C$ , COLLECTOR CURRENT (mA)

**Figure 13. Voltage Feedback Ratio**



$I_C$ , COLLECTOR CURRENT (mA)

**Figure 14. Output Admittance**

STATIC CHARACTERISTICS

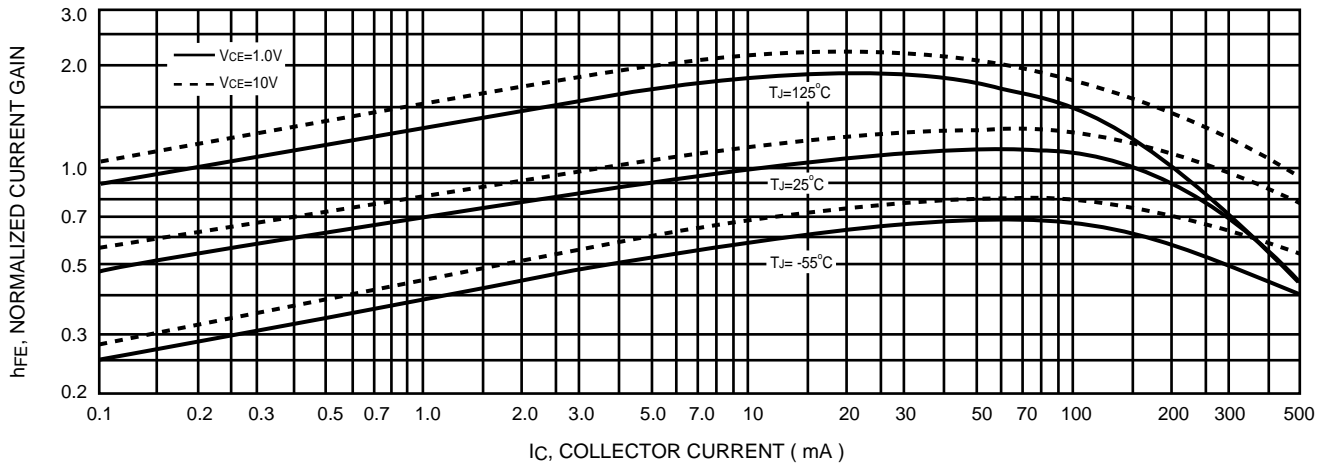


Figure 15. DC Current Gain

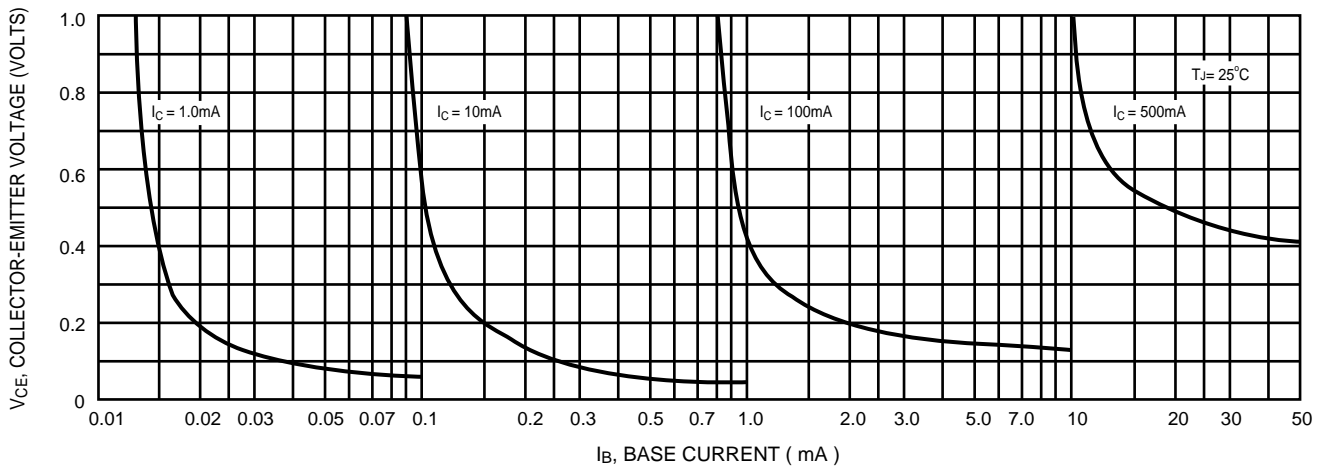


Figure 16. Collector Saturation Region

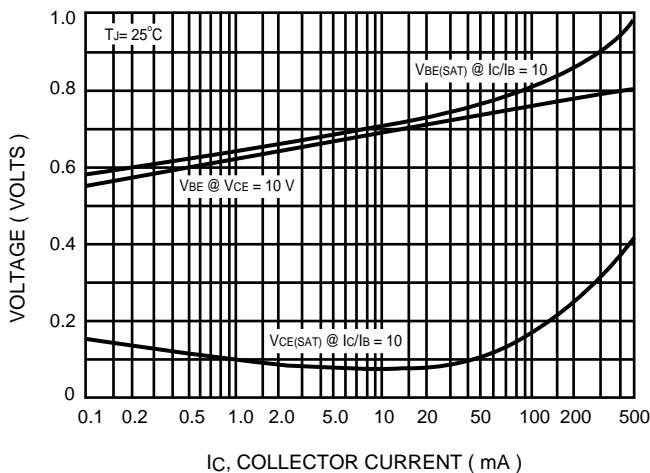


Figure 17. " ON " Voltage

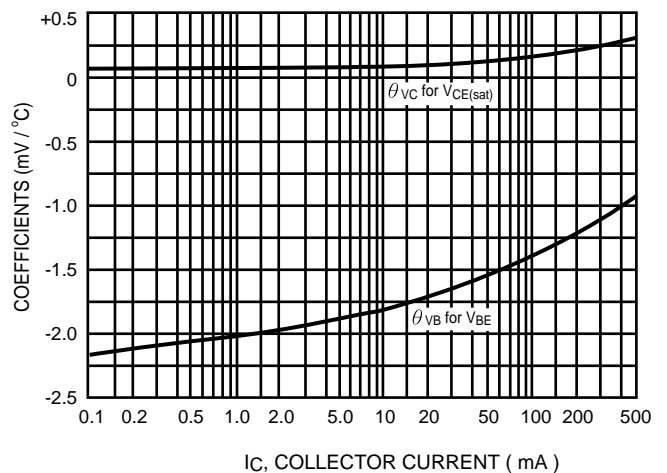


Figure 18. Temperature Coefficients