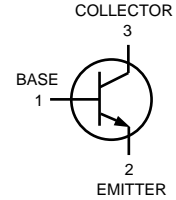
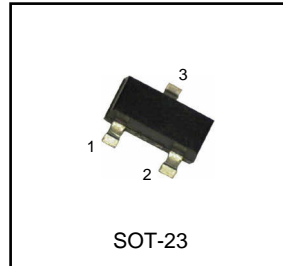


Switching Transistor

NPN Silicon

MMBT4401



MAXIMUM RATINGS

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

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 Breakdown Voltage ⁽³⁾ (I _C =1.0mA _d c, I _B =0)	V _{(BR)CEO}	40	-	V _d c
Collector-Base Breakdown Voltage (I _C =0.1 mA _d c, I _E =0)	V _{(BR)CBO}	60	-	V _d c
Emitter-Base Breakdown Voltage (I _E =0.1 mA _d c, I _C =0)	V _{(BR)EBO}	6.0	-	V _d c
Base Cutoff Current (V _{CE} =35 V _d c, V _{EB} =0.4 V _d c)	I _{BEV}	-	0.1	nA _d c
Collector Cutoff Current (V _{CE} =35 V _d c, V _{EB} =0.4 V _d c)	I _{CEX}	-	0.1	nA _d c

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 mA _{dc} , V _{CE} =1.0 V _{dc}) (IC=1.0 mA _{dc} , V _{CE} =1.0 V _{dc}) (IC=10 mA _{dc} , V _{CE} =1.0 V _{dc}) (IC=150 mA _{dc} , V _{CE} =1.0 V _{dc}) (IC=500 mA _{dc} , V _{CE} =2.0 V _{dc})	HFE	20 40 80 100 40	- - - 300 -	-
Collector-Emitter Saturation Voltage ⁽³⁾ (IC=150 mA _{dc} , I _B =15 mA _{dc}) (IC=500 mA _{dc} , I _B =50 mA _{dc})	V _{CE(sat)}	- -	0.4 0.75	V _{dc}
Base-Emitter Saturation Voltage ⁽³⁾ (IC=150 mA _{dc} , I _B =15 mA _{dc}) (IC=500 mA _{dc} , I _B =50 mA _{dc})	V _{BE(sat)}	0.75 -	0.95 1.2	V _{dc}

SMALL-SIGNAL CHARACTERISTIC

Current-Gain-Bandwidth Product (IC=20 mA _{dc} , V _{CE} =10 V _{dc} , f=100 MHz)	f _T	250	-	MHz
Collector-Base Capacitance (V _{CB} =5.0 V _{dc} , I _E =0, f=1.0 MHz)	C _{cb}	-	6.5	pF
Emitter-Base Capacitance (V _{EB} =0.5 V _{dc} , I _C =0, f=1.0 MHz)	C _{eb}	-	30	pF
Input Impedance (V _{CE} =10 V _{dc} , I _C =1.0 mA _{dc} , f=1.0 kHz)	h _{ie}	1.0	15	k ohms
Voltage Feedback Ratio (V _{CE} =10 V _{dc} , I _C =1.0 mA _{dc} , f=1.0 kHz)	h _{re}	0.1	8.0	X 10 ⁻⁴
Small-Signal Current Gain (V _{CE} =10 V _{dc} , I _C =1.0 mA _{dc} , f=1.0 kHz)	h _{fe}	40	500	-
Output Admittance (V _{CE} =10 V _{dc} , I _C =1.0 mA _{dc} , f=1.0 kHz)	h _{oe}	1.0	30	u mhos

SWITCHING CHARACTERISTICS

Delay Time	(V _{CC} =30 V _{dc} , V _{BE} =2.0 V _{dc} , I _C =150 mA _{dc} , I _{B1} =15 mA _{dc})	t _d	-	15	nS
Rise Time		t _r	-	20	
Storage Time	(V _{CC} =30 V _{dc} , I _C =150 mA _{dc} , I _{B1} =I _{B2} =15 mA _{dc})	t _s	-	225	nS
Fall Time		t _f	-	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

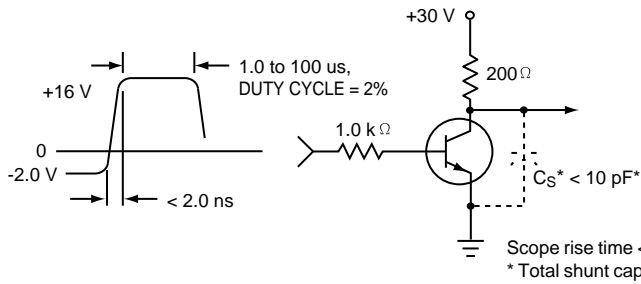


Figure 1. Turn-On Time

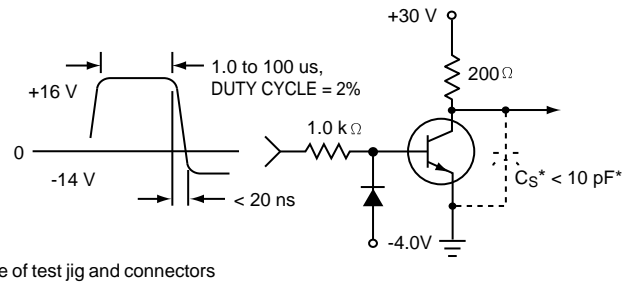


Figure 2. Turn-Off Time

TRANSIENT CHARACTERISTICS

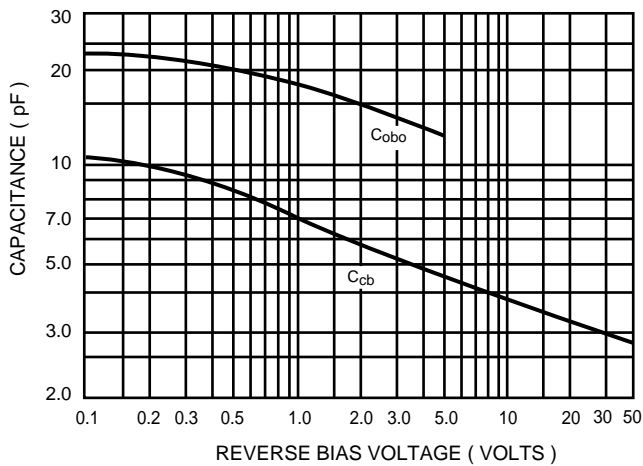


Figure 3. Capacitance

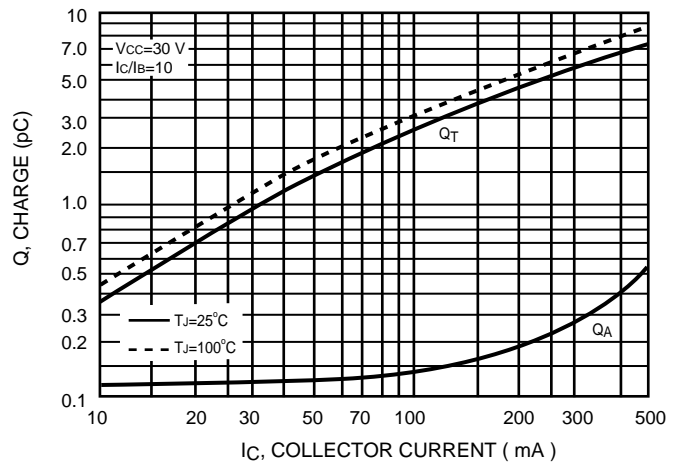


Figure 4. Charge Data

TRANSIENT CHARACTERISTICS

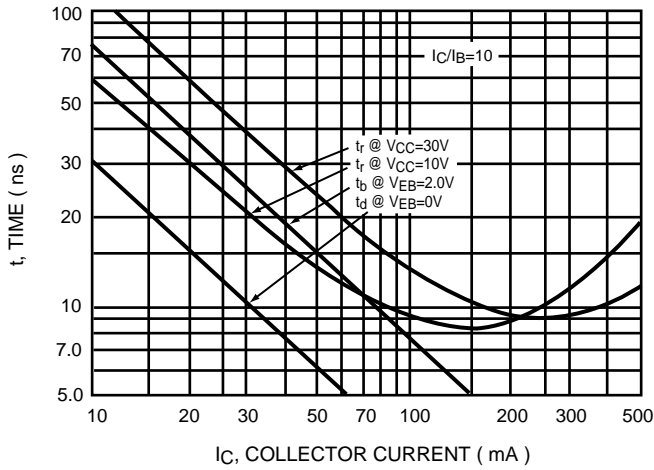


Figure 5. Turn-On Time

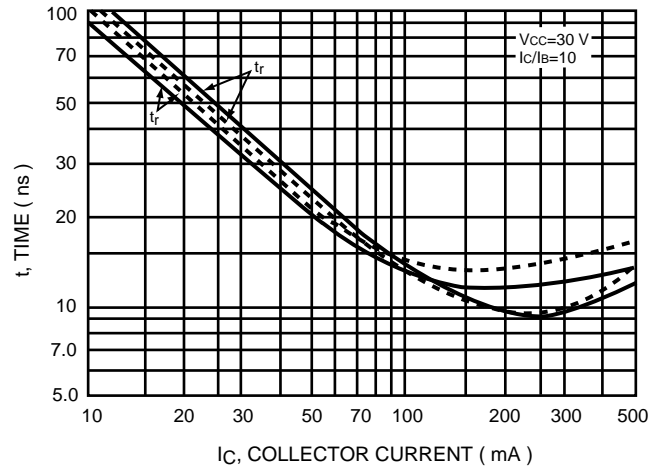


Figure 6. Rise and Fall Times

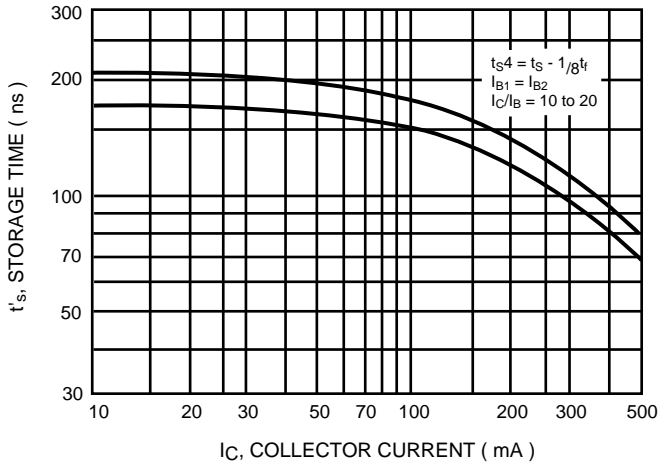


Figure 7. Storage Time

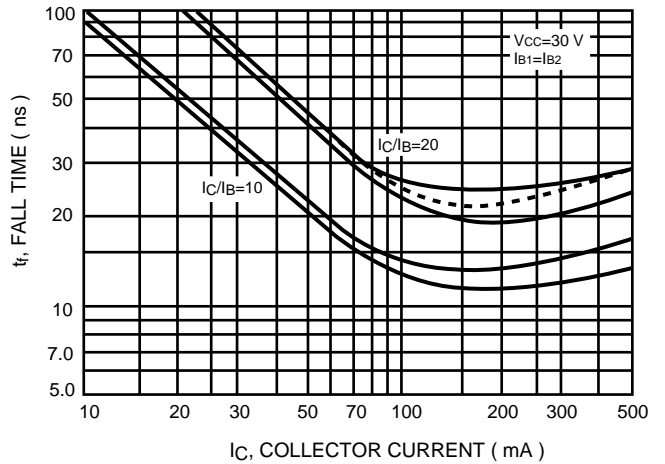


Figure 8. Fall Time

SMALL-SIGNAL CHARACTERISTICS
NOISE FIGURE

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

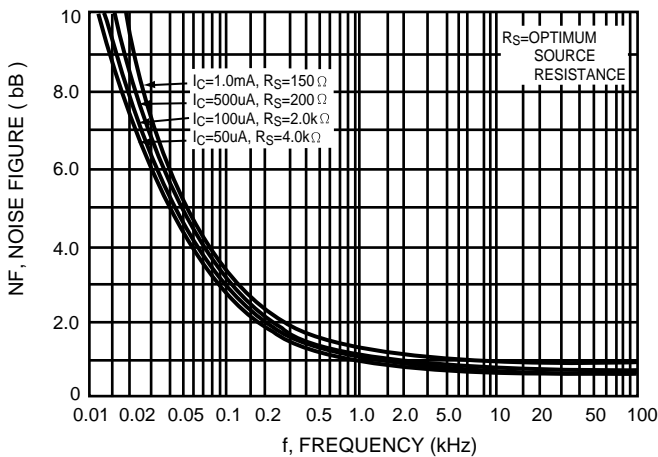


Figure 9. Frequency Effects

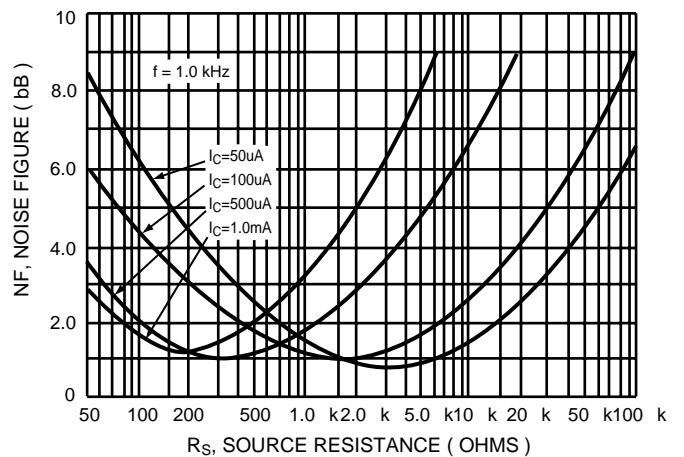


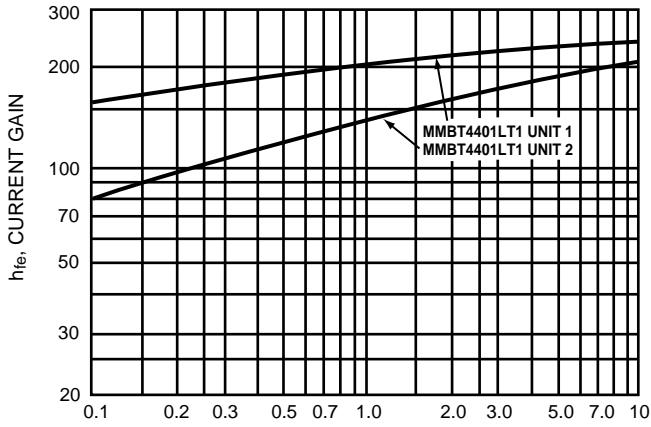
Figure 10. Source Resistance Effects

h PARAMETERS

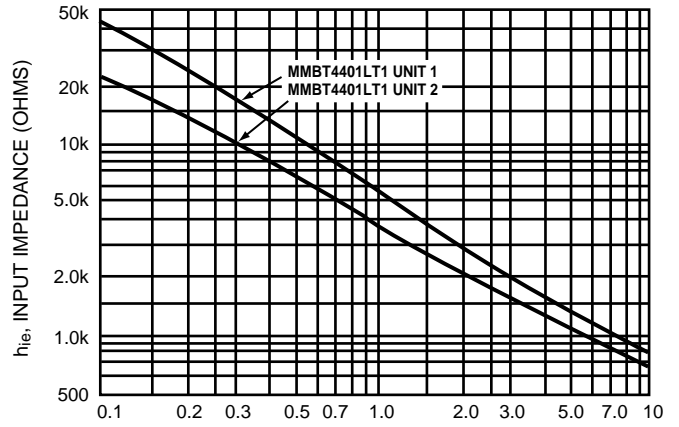
$V_{CE} = 10 \text{ Vdc}$, $f = 1.0 \text{ kHz}$, $T_A = 25^\circ\text{C}$

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

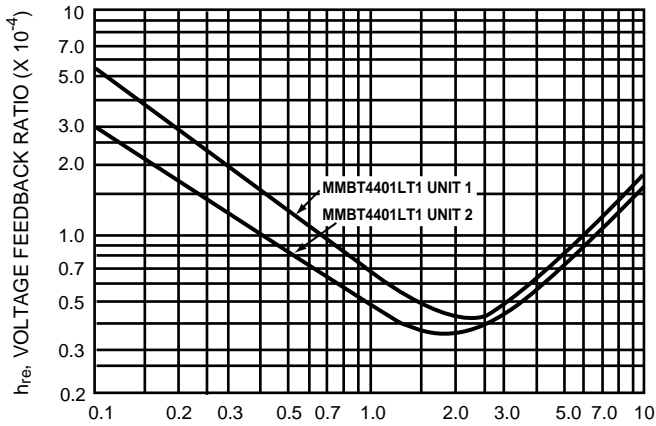
selected from the MMBT4401LT1 lines, and the same units were used to develop the correspondingly numbered curves on each graph.



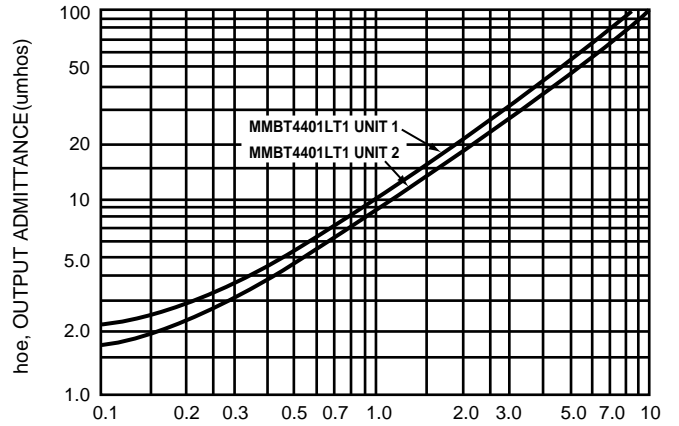
I_C , COLLECTOR CURRENT (mA)
Figure 11. Current Gain



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

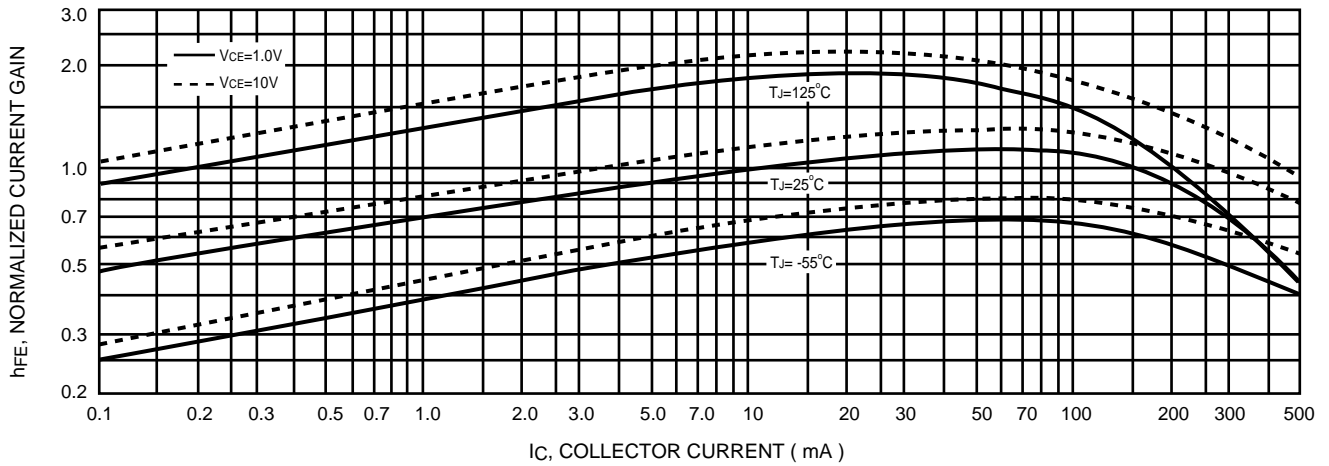


Figure 15. DC Current Gain

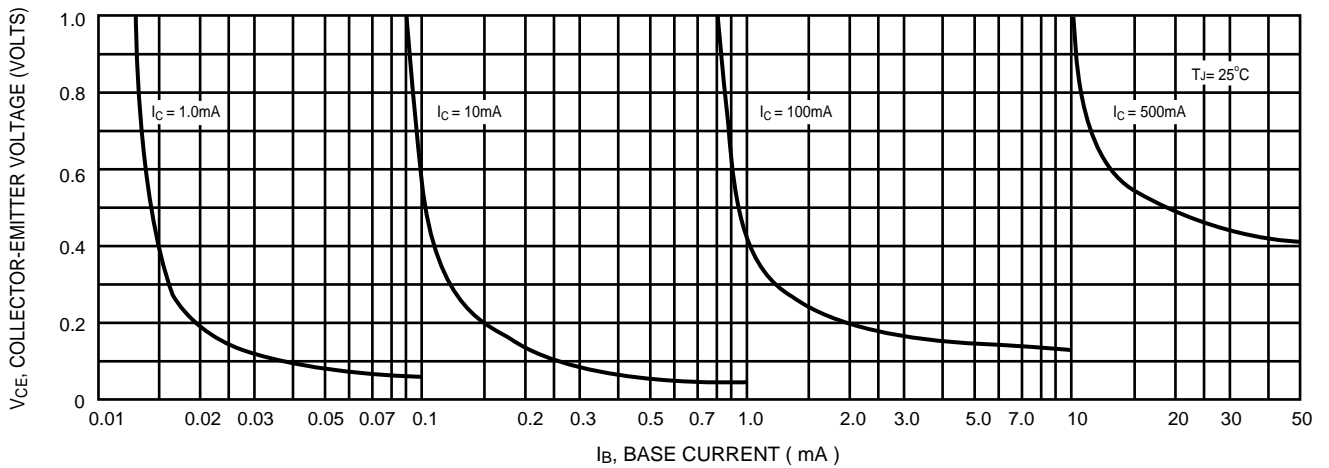


Figure 16. Collector Saturation Region

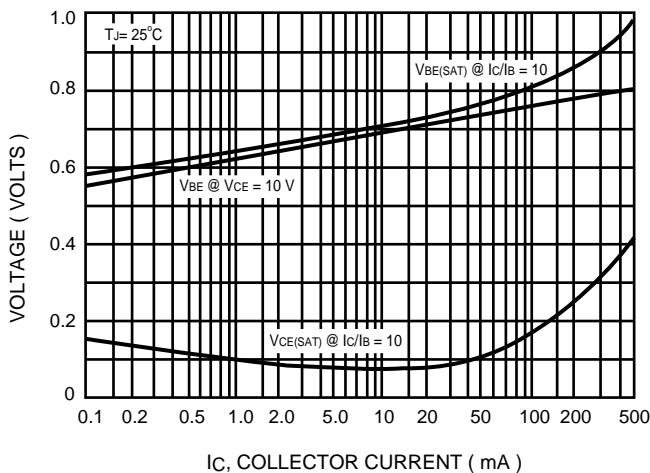


Figure 17. " ON " Voltage

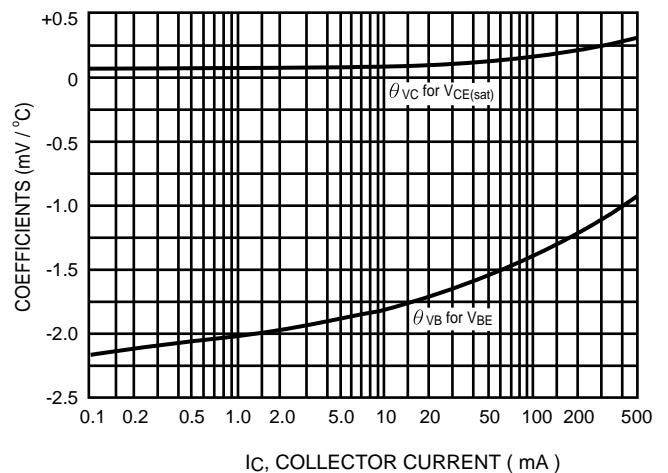


Figure 18. Temperature Coefficients