

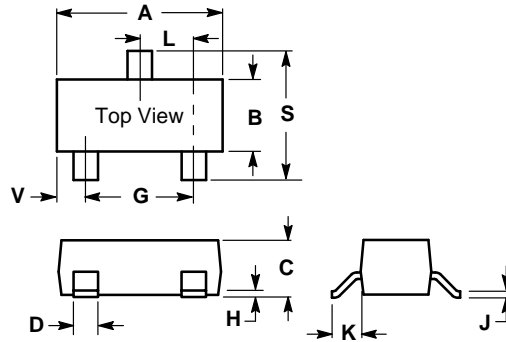
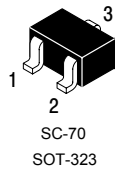
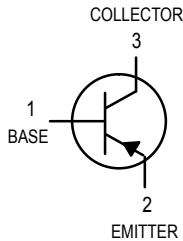
RoHS Compliant Product

A suffix of "-C" specifies halogen & lead-free

FEATURES

- Epitaxial Planar Die Construction
- Complementary NPN Type Available (MMBT3904W)
- Ideal for Medium Power Amplification and Switching

"Lead free is available"



SOT-323(SC-70)		
Dim	Min	Max
A	1.800	2.200
B	1.150	1.350
C	0.800	1.000
D	0.300	0.400
G	1.200	1.400
H	0.000	0.100
J	0.100	0.250
K	0.350	0.500
L	0.590	0.720
S	2.000	2.400
V	0.280	0.420
All Dimension in mm		

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector–Emitter Voltage	V_{CEO}	-40	Vdc
Collector–Base Voltage	V_{CBO}	-40	Vdc
Emitter–Base Voltage	V_{EBO}	-5.0	Vdc
Collector Current — Continuous	I_C	-200	mAdc

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board ⁽¹⁾ $T_A = 25^\circ\text{C}$ Derate above 25°C	P_D	225	mW
		1.8	mW/ $^\circ\text{C}$
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	556	$^\circ\text{C}/\text{W}$
Total Device Dissipation Alumina Substrate, ⁽²⁾ $T_A = 25^\circ\text{C}$ Derate above 25°C	P_D	300	mW
		2.4	mW/ $^\circ\text{C}$
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	417	$^\circ\text{C}/\text{W}$
Junction and Storage Temperature	T_J, T_{stg}	-55 to +150	$^\circ\text{C}$

DEVICE MARKING

MMBT3906W = 2A, K5N

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

Characteristic	Symbol	Min	Max	Unit
----------------	--------	-----	-----	------

OFF CHARACTERISTICS

Collector–Emitter Breakdown Voltage ⁽³⁾ ($I_C = -1.0 \text{ mAdc}, I_B = 0$)	$V_{(BR)CEO}$	-40	—	Vdc
Collector–Base Breakdown Voltage ($I_C = -10 \mu\text{Adc}, I_E = 0$)	$V_{(BR)CBO}$	-40	—	Vdc
Emitter–Base Breakdown Voltage ($I_E = -10 \mu\text{Adc}, I_C = 0$)	$V_{(BR)EBO}$	-5.0	—	Vdc
Base Cutoff Current ($V_{CE} = -30 \text{ Vdc}, V_{EB} = -3.0 \text{ Vdc}$)	I_{BL}	—	-50	nAdc
Collector Cutoff Current ($V_{CE} = -30 \text{ Vdc}, V_{EB} = -3.0 \text{ Vdc}$)	I_{CEX}	—	-50	nAdc

1. FR-5 = $1.0 \times 0.75 \times 0.062 \text{ in.}$
2. Alumina = $0.4 \times 0.3 \times 0.024 \text{ in. } 99.5\% \text{ alumina.}$
3. Pulse Width $\leq 300 \mu\text{s}$, Duty Cycle $\leq 2.0\%$.

REM : Thermal Clad is a trademark of the Bergquist Company.

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

Characteristic	Symbol	Min	Max	Unit
ON CHARACTERISTICS(3)				
DC Current Gain ($I_C = -0.1 \text{ mA}$, $V_{CE} = -1.0 \text{ V}$) ($I_C = -1.0 \text{ mA}$, $V_{CE} = -1.0 \text{ V}$) ($I_C = -10 \text{ mA}$, $V_{CE} = -1.0 \text{ V}$) ($I_C = -50 \text{ mA}$, $V_{CE} = -1.0 \text{ V}$) ($I_C = -100 \text{ mA}$, $V_{CE} = -1.0 \text{ V}$)	H_{FE}	60 80 100 60 30	— — 300 — —	—
Collector–Emitter Saturation Voltage ($I_C = -10 \text{ mA}$, $I_B = -1.0 \text{ mA}$) ($I_C = -50 \text{ mA}$, $I_B = -5.0 \text{ mA}$)	$V_{CE(sat)}$	— —	-0.25 -0.4	Vdc
Base–Emitter Saturation Voltage ($I_C = -10 \text{ mA}$, $I_B = -1.0 \text{ mA}$) ($I_C = -50 \text{ mA}$, $I_B = -5.0 \text{ mA}$)	$V_{BE(sat)}$	-0.65 —	-0.85 -0.95	Vdc

SMALL–SIGNAL CHARACTERISTICS

Current–Gain — Bandwidth Product ($I_C = -10 \text{ mA}$, $V_{CE} = -20 \text{ V}$, $f = 100 \text{ MHz}$)	f_T	250	—	MHz
Output Capacitance ($V_{CB} = -5.0 \text{ V}$, $I_E = 0$, $f = 1.0 \text{ MHz}$)	C_{obo}	—	4.5	pF
Input Capacitance ($V_{EB} = -0.5 \text{ V}$, $I_C = 0$, $f = 1.0 \text{ MHz}$)	C_{ibo}	—	10	pF
Input Impedance ($I_C = -1.0 \text{ mA}$, $V_{CE} = -10 \text{ V}$, $f = 1.0 \text{ kHz}$)	h_{ie}	2.0	12	$k\Omega$
Voltage Feedback Ratio ($I_C = -1.0 \text{ mA}$, $V_{CE} = -10 \text{ V}$, $f = 1.0 \text{ kHz}$)	h_{re}	0.1	10	$\times 10^{-4}$
Small–Signal Current Gain ($I_C = -1.0 \text{ mA}$, $V_{CE} = -10 \text{ V}$, $f = 1.0 \text{ kHz}$)	h_{fe}	100	400	—
Output Admittance ($I_C = -1.0 \text{ mA}$, $V_{CE} = -10 \text{ V}$, $f = 1.0 \text{ kHz}$)	h_{oe}	3.0	60	μhos
Noise Figure ($I_C = -100 \mu\text{A}$, $V_{CE} = -5.0 \text{ V}$, $R_S = 1.0 \text{ k}\Omega$, $f = 1.0 \text{ kHz}$)	NF	—	4.0	dB

SWITCHING CHARACTERISTICS

Delay Time	($V_{CC} = -3.0 \text{ V}$, $V_{BE} = 0.5 \text{ V}$, $I_C = -10 \text{ mA}$, $I_{B1} = -1.0 \text{ mA}$)	t_d	—	35	ns
Rise Time		t_r	—	35	
Storage Time	($V_{CC} = -3.0 \text{ V}$, $I_C = -10 \text{ mA}$, $I_{B1} = I_{B2} = -1.0 \text{ mA}$)	t_s	—	225	ns
Fall Time		t_f	—	75	

3. Pulse Test: Pulse Width $\leq 300 \mu\text{s}$, Duty Cycle $\leq 2.0\%$.

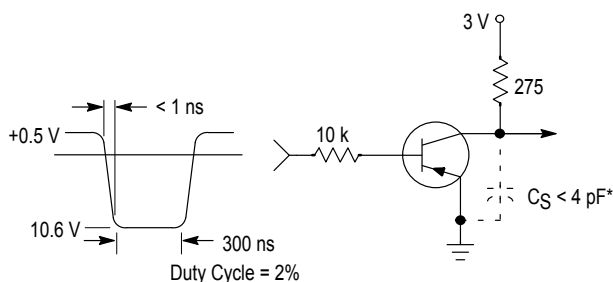


Figure 1. Delay and Rise Time Equivalent Test Circuit

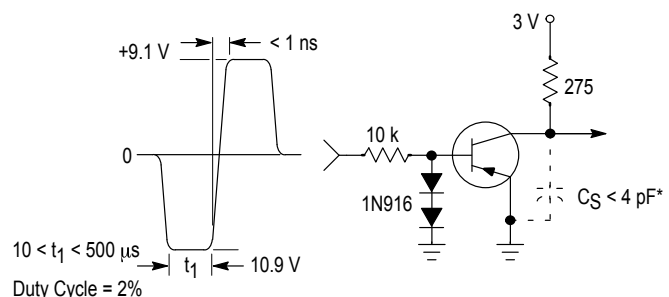


Figure 2. Storage and Fall Time Equivalent Test Circuit

* Total shunt capacitance of test jig and connectors

TYPICAL TRANSIENT CHARACTERISTICS

— $T_J = 25^\circ\text{C}$
- - $T_J = 125^\circ\text{C}$

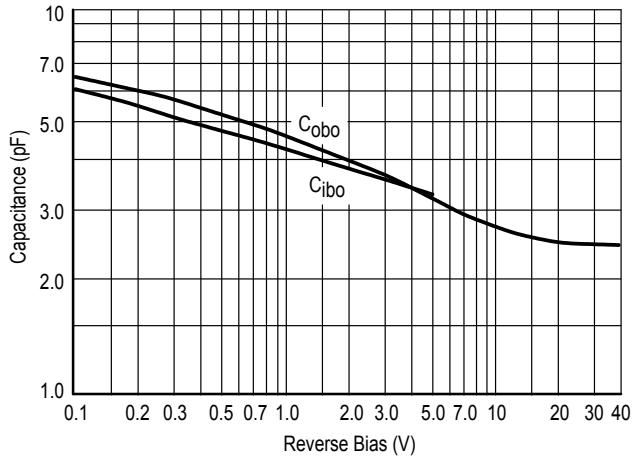


Figure 3. Capacitance

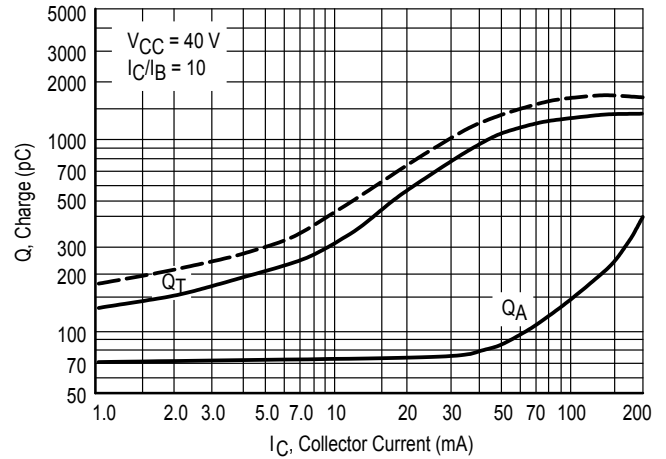


Figure 4. Charge Data

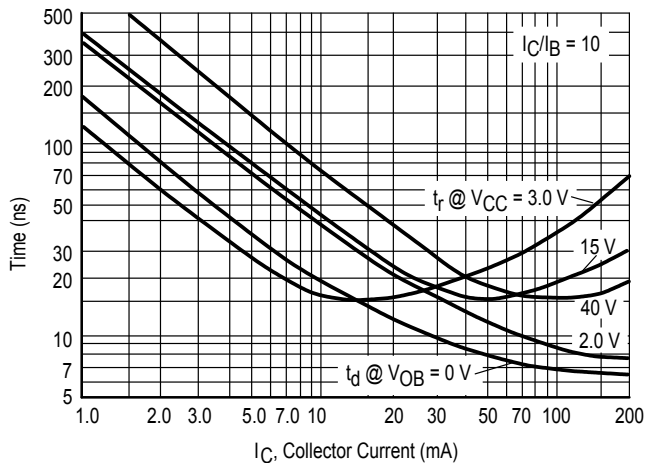


Figure 5. Turn-On Time

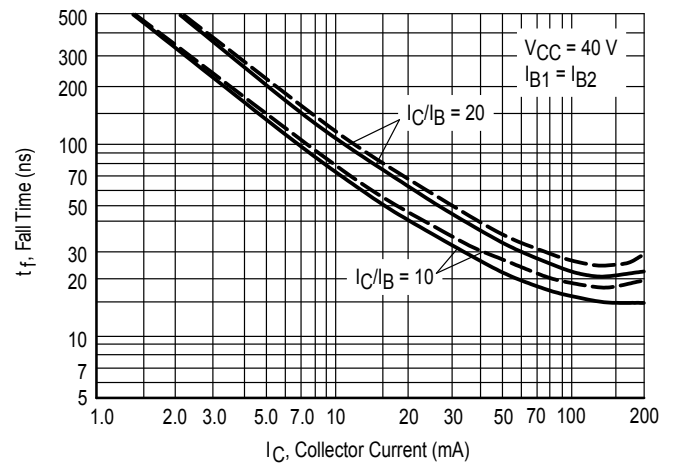


Figure 6. Fall Time

TYPICAL AUDIO SMALL-SIGNAL CHARACTERISTICS
NOISE FIGURE VARIATIONS

($V_{CE} = -5.0$ Vdc, $T_A = 25^\circ\text{C}$, Bandwidth = 1.0 Hz)

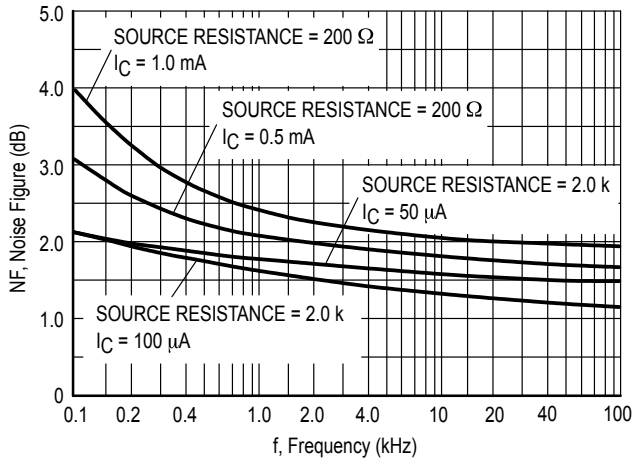


Figure 7.

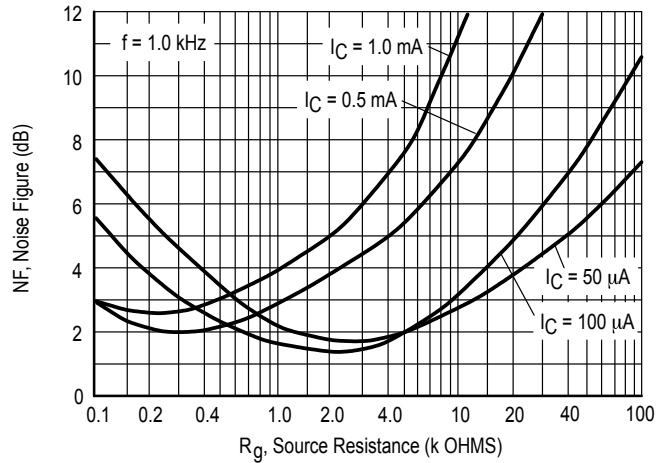


Figure 8.

h PARAMETERS

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

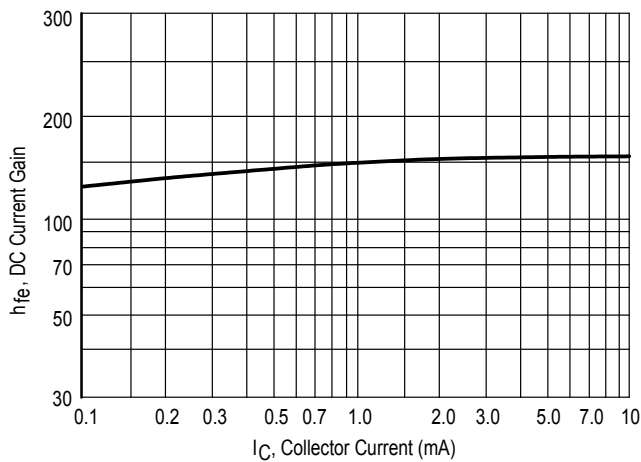


Figure 9. Current Gain

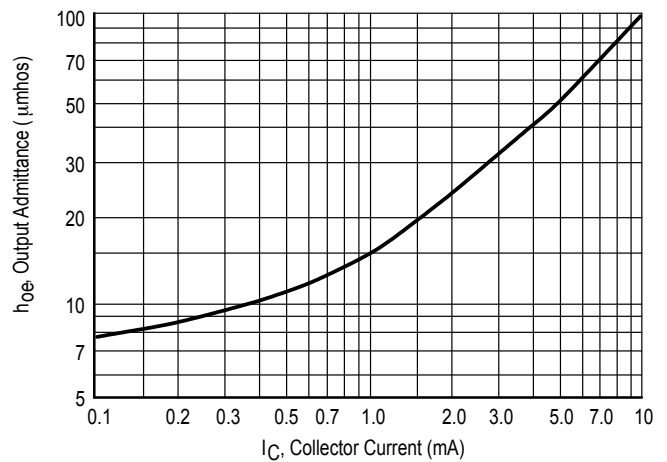


Figure 10. Output Admittance

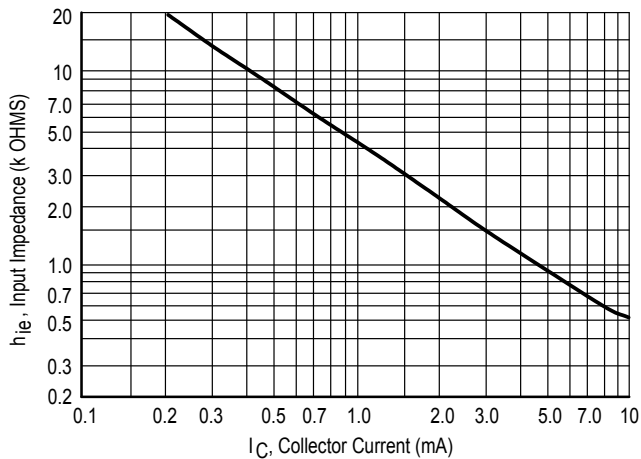


Figure 11. Input Impedance

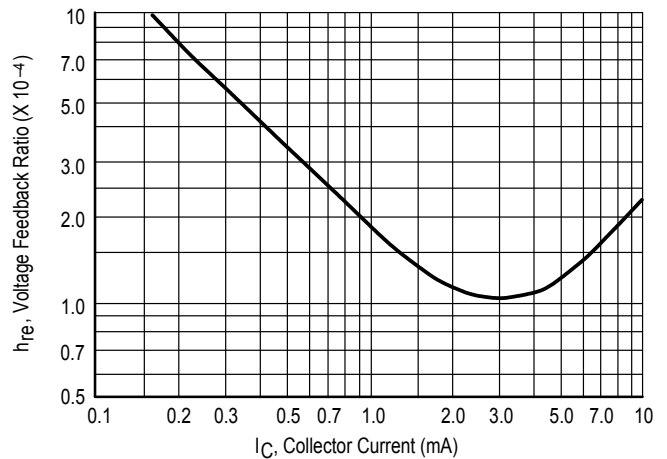


Figure 12. Voltage Feedback Ratio

TYPICAL STATIC CHARACTERISTICS

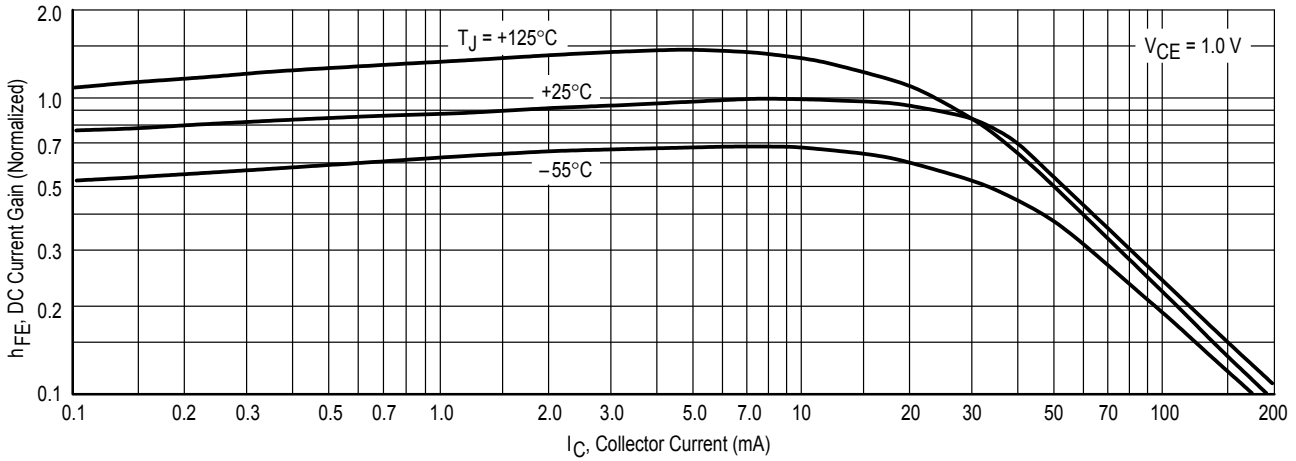


Figure 13. DC Current Gain

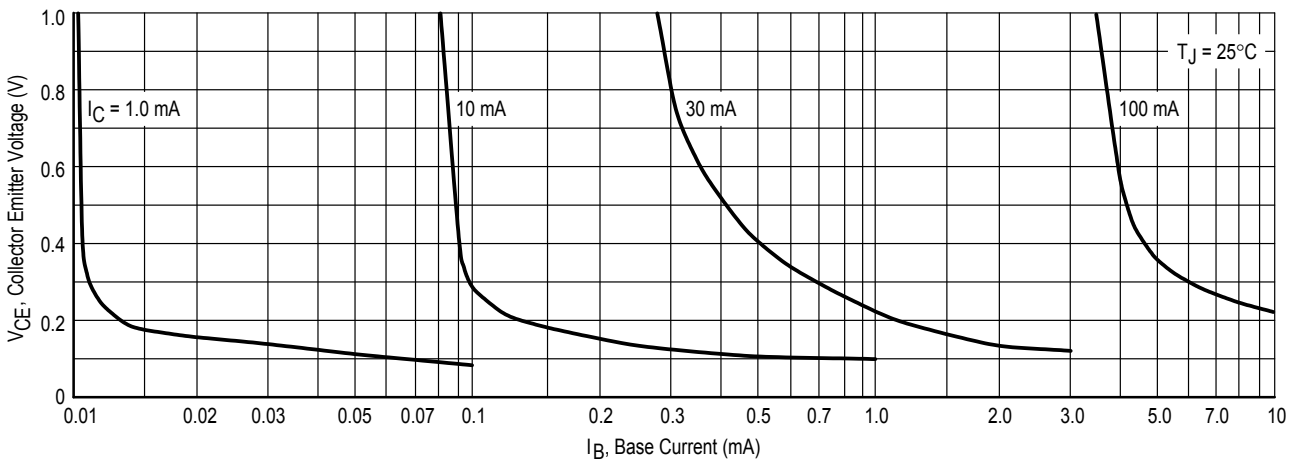


Figure 14. Collector Saturation Region

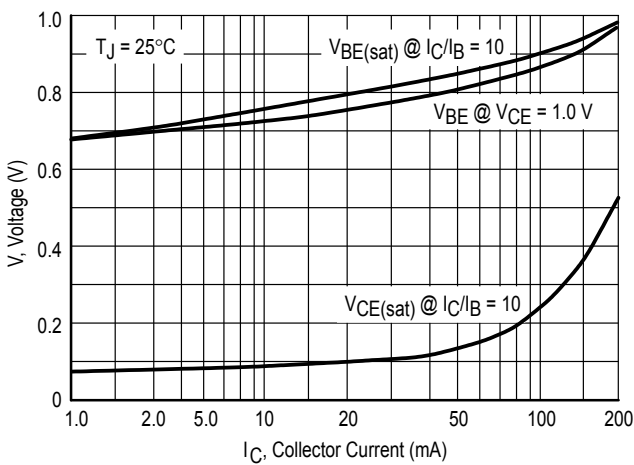


Figure 15. "ON" Voltages

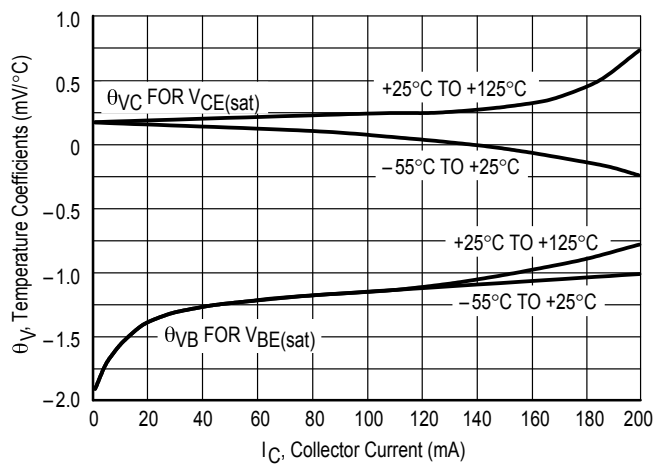


Figure 16. Temperature Coefficients