



MMBT3904

NPN GENERAL PURPOSE SWITCHING TRANSISTOR

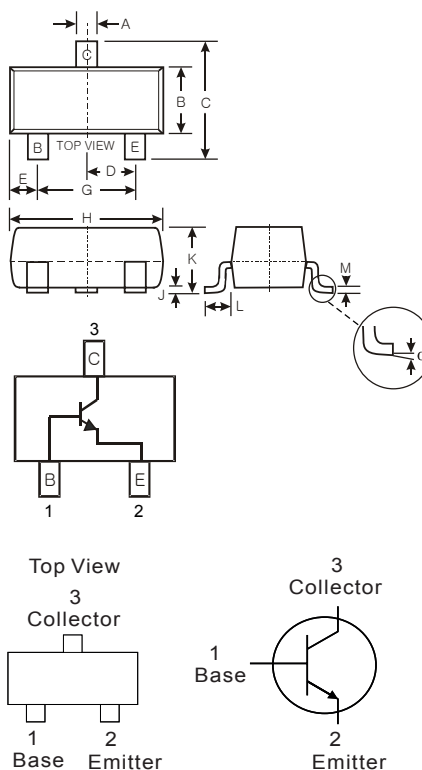
Voltage - 40 Volts Power Dissipation - 300 mWatt

FEATURES

- Epitaxial Planar Die Construction
- Complementary PNP Type Available (MMBT3906)
- Ideal for Medium Power Amplification and Switching

MECHANICAL DATA

- Case: SOT-23, Molded Plastic
- Case Material - UL Flammability Rating Classification 94V-0
- Terminals: Solderable per MIL-STD-202, Method 208
- Marking: Device Code
- Weight: 0.008 grams (approx.)



SOT-23		
Dim	Min	Max
A	0.37	0.51
B	1.20	1.40
C	2.30	2.50
D	0.89	1.03
E	0.45	0.60
G	1.78	2.05
H	2.80	3.00
J	0.013	0.10
K	0.903	1.10
L	0.45	0.61
M	0.085	0.180
α	0°	8°
All Dimensions in mm		

● MAXIMUM RATING ($T_a = 25^\circ\text{C}$)

Parameter	Symbol	Limits	Unit
Collector-Emitter Voltage	V_{CEO}	40	Vdc
Collector-Base Voltage	V_{CBO}	60	Vdc
Emitter-Base Voltage	V_{EBO}	6	Vdc
Collector Current — Continuous	I_C	200	mAdc

● THERMAL CHARACTERISTICS

Total Device Dissipation, FR-5 Board (Note1) @ $T_A = 25^\circ\text{C}$ Derate above 25°C	P_D	225	mW
		1.8	mW/ $^\circ\text{C}$
Thermal Resistance, Junction-to-Ambient(Note 1)	$R_{\theta JA}$	556	$^\circ\text{C}/\text{W}$
Total Device Dissipation, Alumina Substrate (Note 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(Note 2)	$R_{\theta JA}$	417	$^\circ\text{C}/\text{W}$
Junction and Storage temperature	T_J, T_{stg}	$-55 \sim +150$	$^\circ\text{C}$

1. FR-5 = 1.0×0.75×0.062 in.

2. Alumina = 0.4×0.3×0.024 in. 99.5% alumina.



MMBT3904

NPN GENERAL PURPOSE SWITCHING TRANSISTOR

Voltage - 40 Volts Power Dissipation - 300 mWatt

● ELECTRICAL CHARACTERISTICS (Ta = 25°C)

OFF CHARACTERISTICS

Characteristic	Symbol	Min.	Typ.	Max.	Unit
Collector–Emitter Breakdown Voltage (Ic = 1.0 mAdc, I _B = 0)	V _{BR(CEO)}	40	–	–	V
Collector–Base Breakdown Voltage (Ic = 10 µAdc, I _E = 0)	V _{BR(CBO)}	60	–	–	V
Emitter–Base Breakdown Voltage (I _E = 10 µAdc, Ic = 0)	V _{BR(EBO)}	6	–	–	V
Collector Cutoff Current (V _{CE} = 30 Vdc, V _{EB} = 3.0Vdc)	I _{CEx}	–	–	50	nA
Base Cutoff Current (V _{CE} = 30 Vdc, V _{EB} = 3.0 Vdc)	I _{BL}	–	–	50	nA

ON CHARACTERISTICS (Note 3.)

DC Current Gain (I _C = 0.1 mAdc, V _{CE} = 1.0 Vdc) (I _C = 1.0 mAdc, V _{CE} = 1.0 Vdc) (I _C = 10 mAdc, V _{CE} = 1.0 Vdc) (I _C = 50 mAdc, V _{CE} = 1.0 Vdc) (I _C = 100 mAdc, V _{CE} = 1.0 Vdc)	h _{FE}	40 70 100 60 30	– – – – –	– – 300 – –	
Collector–Emitter Saturation Voltage(3) (I _C = 10 mAdc, I _B = 1.0 mAdc) (I _C = 50mAdc, I _B = 5.0 mAdc)	V _{CE(sat)}	– –	– –	0.2 0.3	V
Base–Emitter Saturation Voltage (I _C = 10 mAdc, I _B = 1.0 mAdc) (I _C = 50mAdc, I _B = 5.0 mAdc)	V _{BE(sat)}	0.65 –	– –	0.85 0.95	V

SMALL–SIGNAL CHARACTERISTICS

Characteristic	Symbol	Min.	Typ.	Max.	Unit
Current–Gain — Bandwidth Product (I _C = 10mAdc, V _{CE} = 20Vdc, f = 100MHz)	f _T	300	–	–	MHz
Output Capacitance (V _{CB} = 5.0 Vdc, I _E = 0, f = 1.0 MHz)	C _{obo}	–	–	4	pF
Input Capacitance (V _{EB} = 0.5 Vdc, I _C = 0, f = 1.0 MHz)	C _{ibo}	–	–	8	pF
Input Impedance (V _{CE} = 10 Vdc, I _C = 1.0 mAdc, f = 1.0 kHz)	h _{ie}	1	–	10	kΩ
Voltage Feedback Ratio (V _{CE} = 10 Vdc, I _C = 1.0 mAdc, f = 1.0 kHz)	h _{re}	0.5	–	8	X 10 ^{–4}
Small–Signal Current Gain (V _{CE} = 10 Vdc, I _C = 1.0 mAdc, f = 1.0 kHz)	h _{fe}	100	–	400	
Output Admittance (V _{CE} = 10 Vdc, I _C = 1.0 mAdc, f = 1.0 kHz)	h _{oe}	1	–	40	µmhos
Noise Figure (V _{CE} = 5V, I _C = 100µA, R _S = 1.0kΩ, f = 1.0kHz)	NF	–	–	5	dB

3. Pulse Test: Pulse Width <300 µs, Duty Cycle <2.0%.



MMBT3904

RATINGS AND CHARACTERISTIC CURVES

● ELECTRICAL CHARACTERISTICS ($T_a = 25^\circ\text{C}$)

SWITCHING CHARACTERISTICS

Delay Time	$(V_{CC} = 3.0 \text{ Vdc}, V_{BE} = -0.5 \text{ Vdc}, I_C = 10 \text{ mA}, I_{B1} = 1.0 \text{ mA})$	t_d	—	—	35	ns
Rise Time		t_r	—	—	35	
Storage Time	$(V_{CC} = 3.0 \text{ Vdc}, I_C = 10 \text{ mA}, I_{B1} = I_{B2} = 1.0 \text{ mA})$	t_s	—	—	200	
Fall Time		t_f	—	—	50	

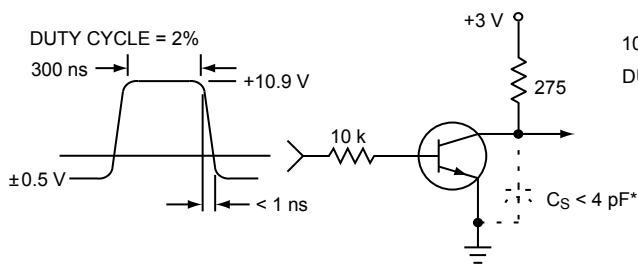


Figure 1. Delay and Rise Time
Equivalent Test Circuit

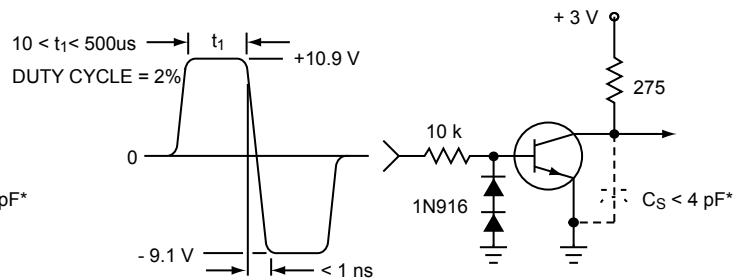


Figure 2. Storage and Fall Time
Equivalent Test Circuit

TYPICAL TRANSIENT CHARACTERISTICS

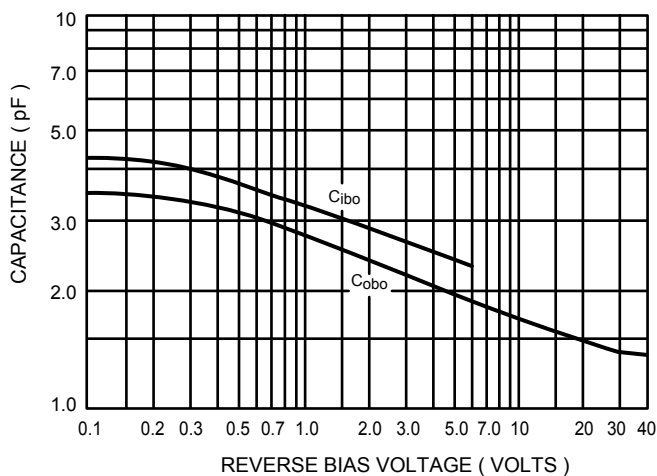


Figure 3. Capacitance

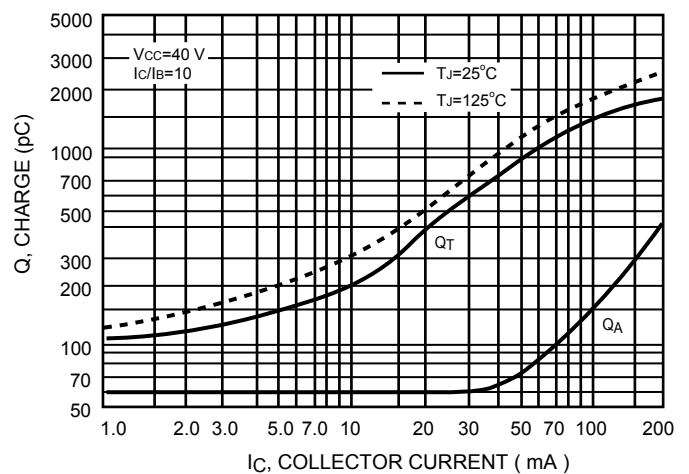


Figure 4. Charge Data



MMBT3904

RATINGS AND CHARACTERISTIC CURVES

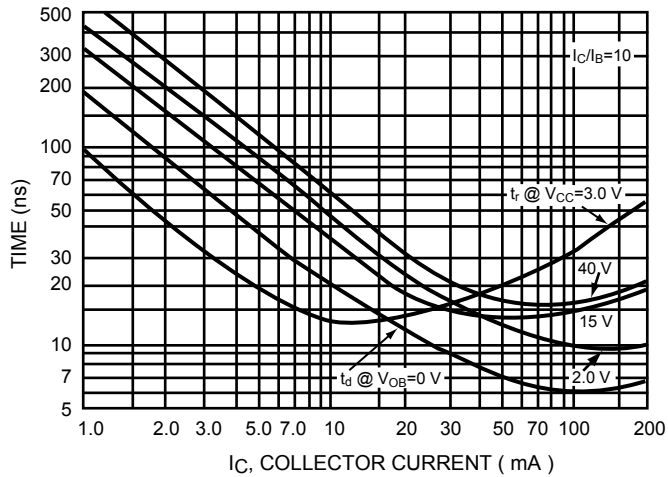


Figure 5. Turn-On Time

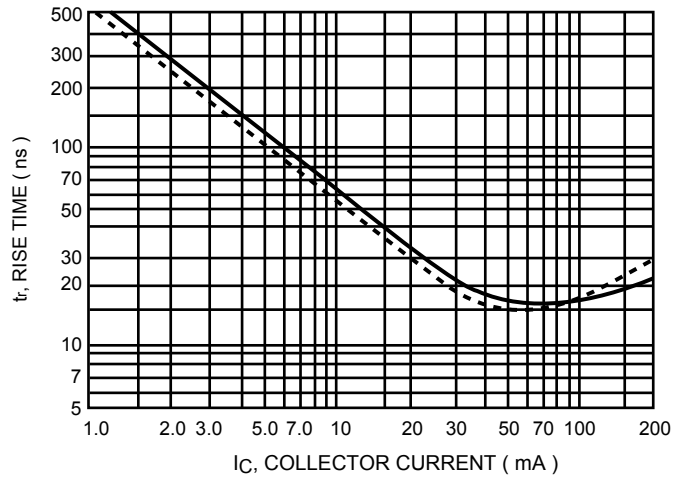


Figure 6. Rise Time

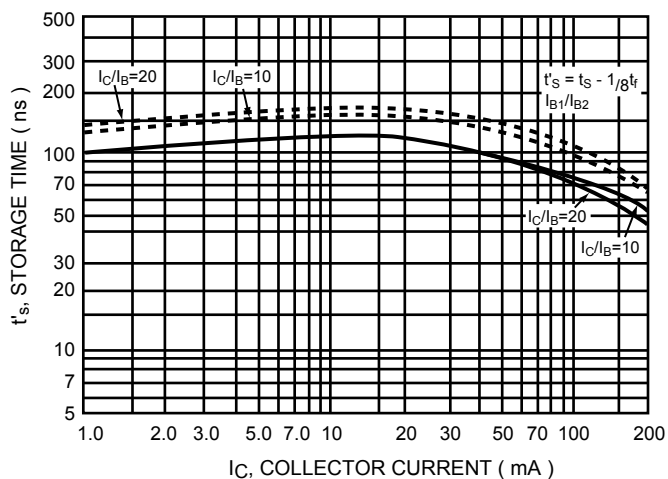


Figure 7. Storage Time

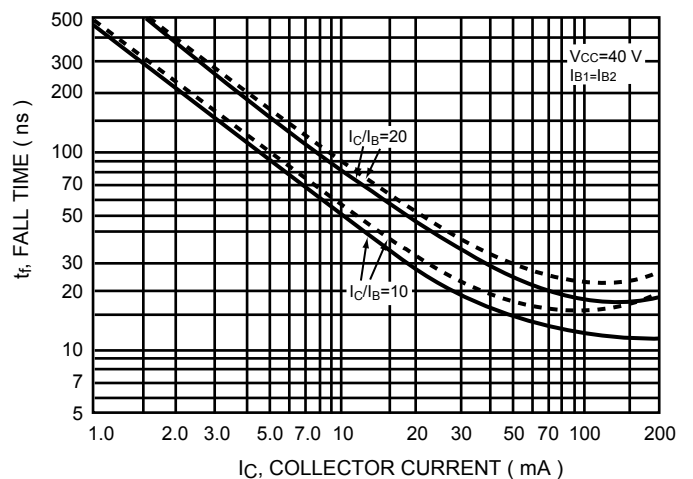


Figure 8. Fall Time

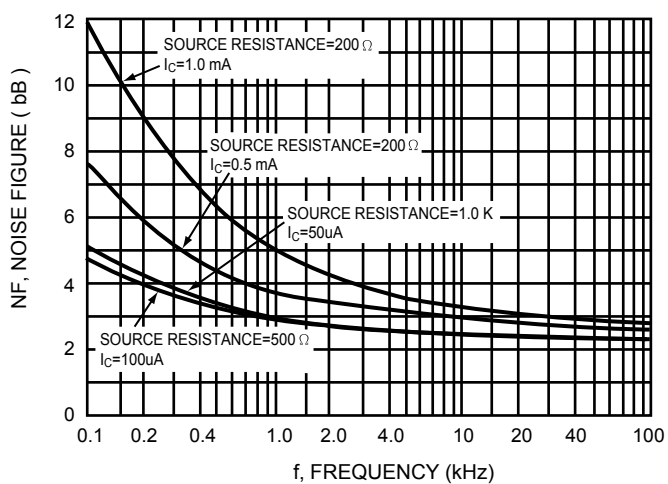


Figure 9.

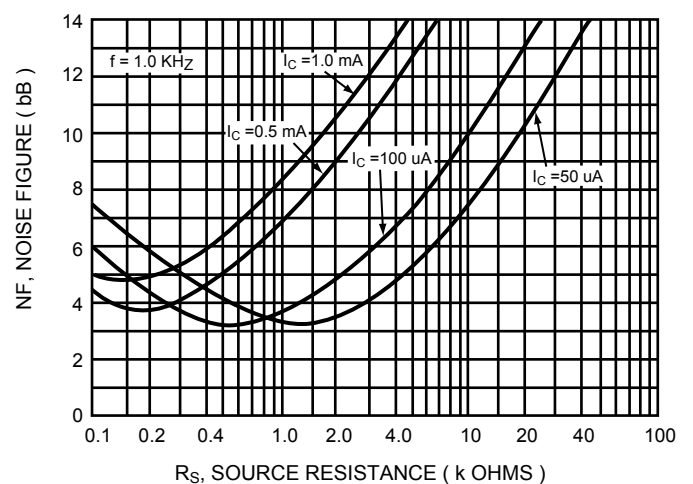


Figure 10.



MMBT3904

RATINGS AND CHARACTERISTIC CURVES

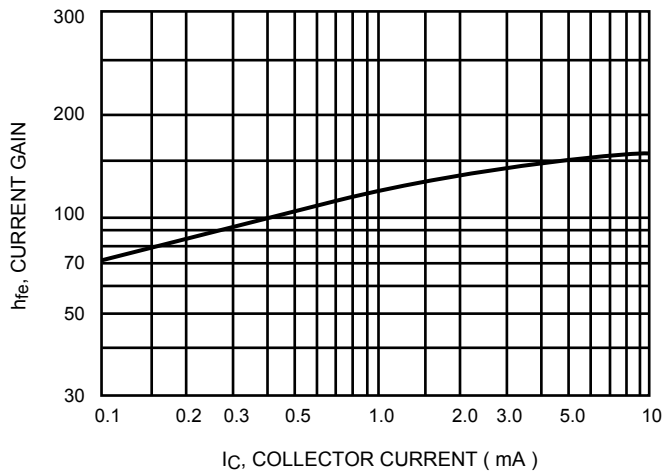


Figure 11. Current Gain

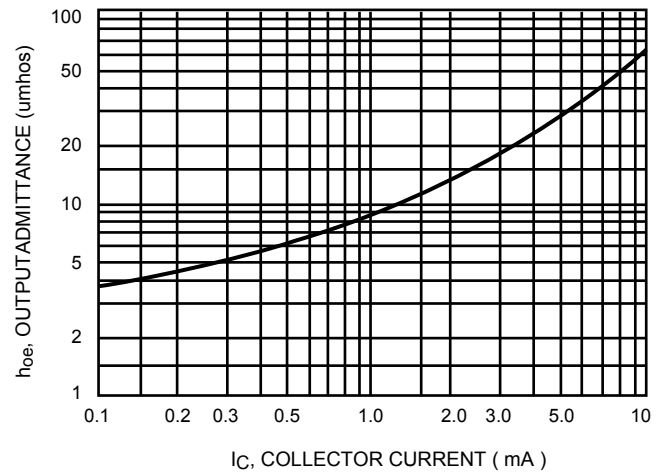


Figure 12. Output Admittance

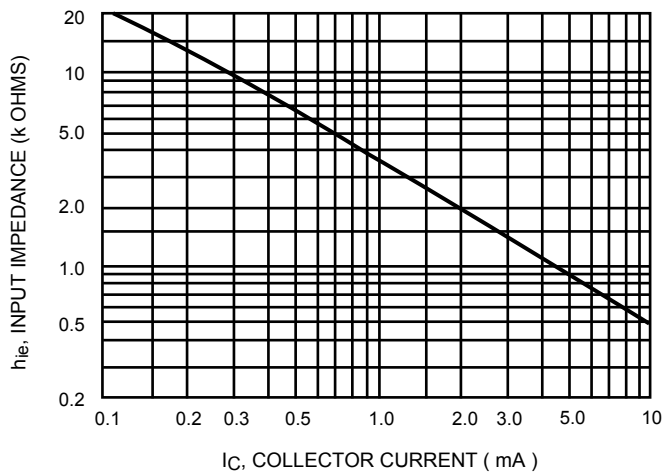


Figure 13. Input Impedance

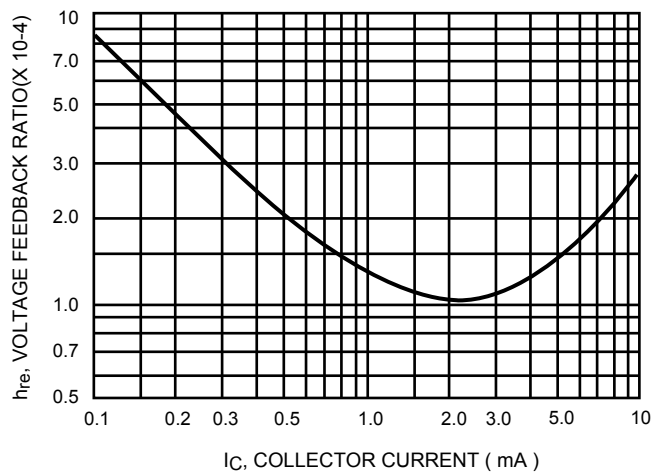


Figure 14. Voltage Feedback Ratio

TYPICAL STATIC CHARACTERISTICS

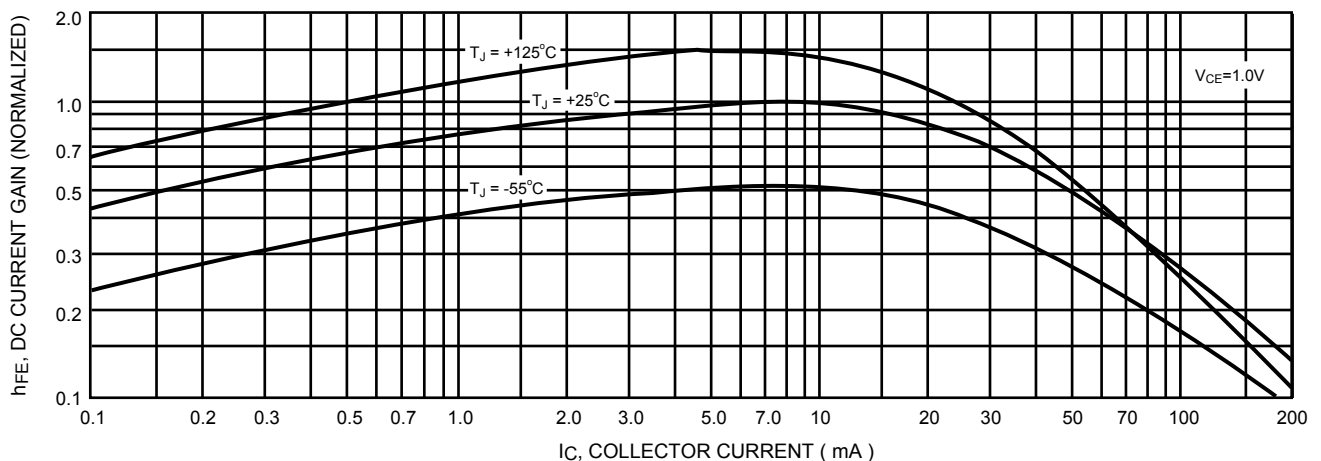


Figure 15. DC Current Gain



MMBT3904

RATINGS AND CHARACTERISTIC CURVES

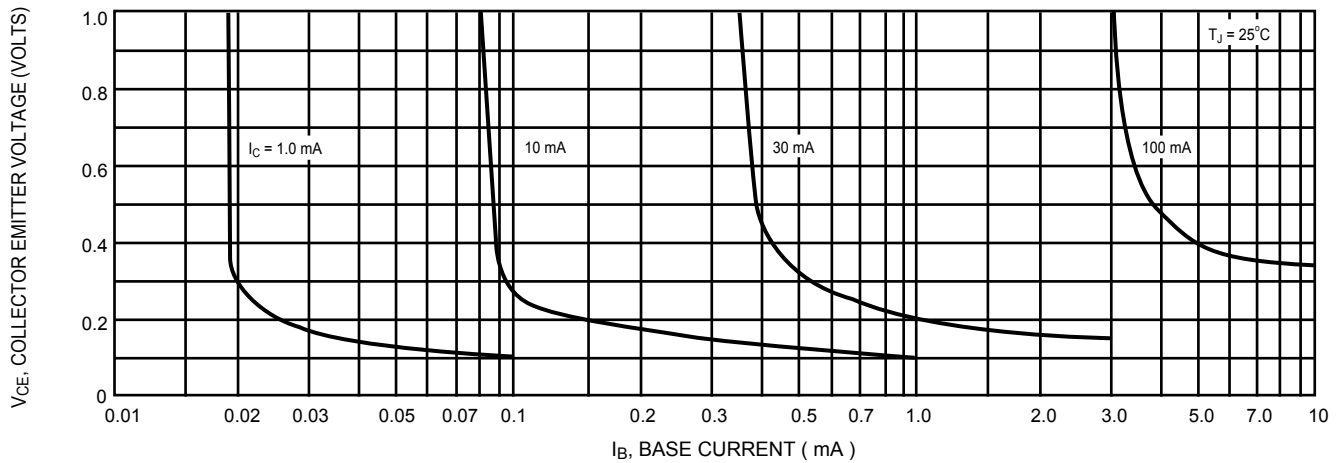


Figure 16. Collector Saturation Region

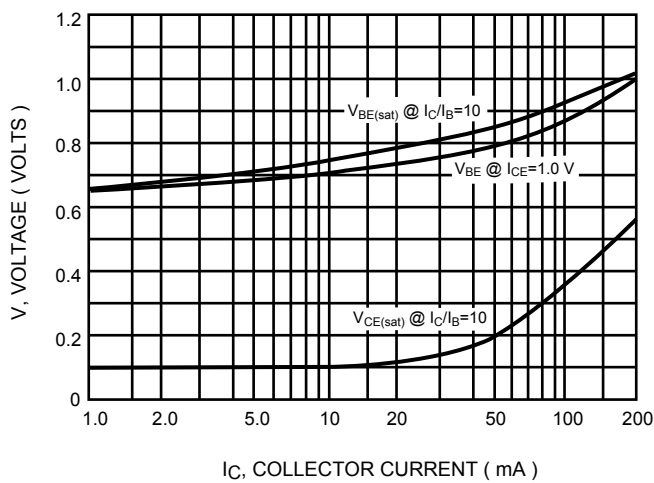


Figure 17. "ON" Voltage

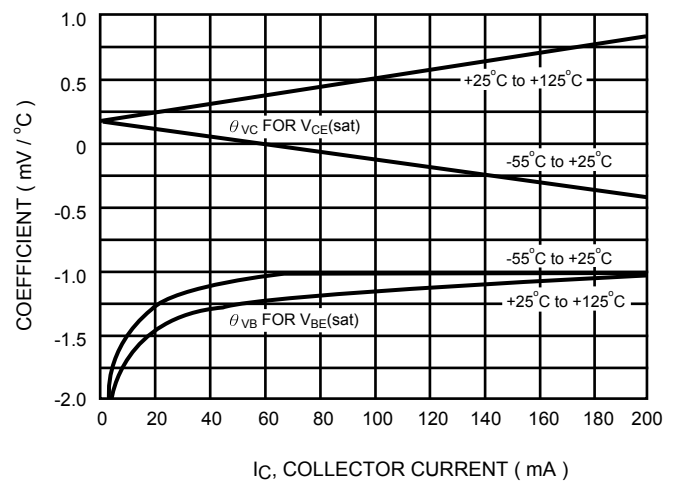


Figure 18. Temperature Coefficients