MMBT3904

NPN GENERAL PURPOSE SWITCHING TRANSISTOR

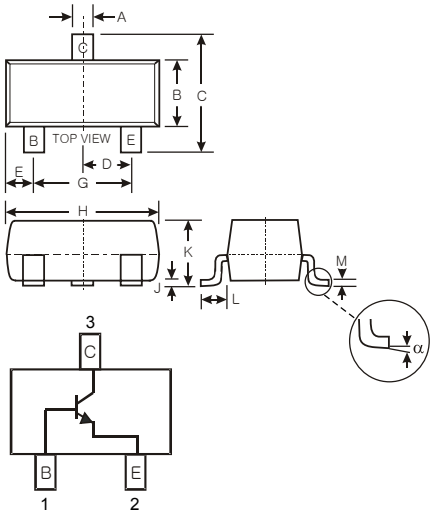
Voltage - 40 Volts Power Dissipation - 300 mWatt

FEATURES

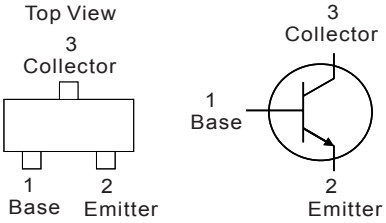
- Epitaxial Planar Die Construction
- Complementary PNP Type Available (MMBT3906)
- Ideal for Medium Power Amplification and Switching

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 (Ta = 25℃)

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°C Derate above 25°C	P_D	225 1.8	mW mW/℃
Thermal Resistance, Junction–to–Ambient(Note 1)	$R_{\Theta JA}$	556	℃/W
Total Device Dissipation, Alumina Substrate (Note 2) @ T_A = 25°C Derate above 25°C	P_D	300 2.4	mW mW/℃
Thermal Resistance, Junction–to–Ambient(Note 2)	$R_{\Theta JA}$	417	℃/W
Junction and Storage temperature	T_J,Tstg	−55~+150	℃

1. FR–5 = 1.0×0.75×0.062 in.
2. Alumina = 0.4×0.3×0.024 in. 99.5% alumina.

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● ELECTRICAL CHARACTERISTICS (Ta = 25℃)

OFF CHARACTERISTICS

Characteristic	Symbol	Min.	Typ.	Max.	Unit
Collector-Emitter Breakdown Voltage (I_C = 1.0 mAdc, I_B = 0)	$V_{BR(CEO)}$	40	–	–	V
Collector-Base Breakdown Voltage (I_C = 10 μAdc, I_E = 0)	$V_{BR(CBO)}$	60	–	–	V
Emitter-Base Breakdown Voltage (I_E = 10 μAdc, I_C = 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	h_{FE}				
(I_C = 0.1 mAdc, V_{CE} = 1.0 Vdc)		40	–	–	
(I_C = 1.0 mAdc, V_{CE} = 1.0 Vdc)		70	–	–	
(I_C = 10 mAdc, V_{CE} = 1.0 Vdc)		100	–	300	
(I_C = 50 mAdc, V_{CE} = 1.0 Vdc)		60	–	–	
(I_C = 100 mAdc, V_{CE} = 1.0 Vdc)		30	–	–	
Collector-Emitter Saturation Voltage(3)	$V_{CE(sat)}$				V
(I_C = 10 mAdc, I_B = 1.0 mAdc)		–	–	0.2	
(I_C = 50mAdc, I_B = 5.0 mAdc)		–	–	0.3	
Base-Emitter Saturation Voltage	$V_{BE(sat)}$				V
(I_C = 10 mAdc, I_B = 1.0 mAdc)		0.65	–	0.85	
(I_C = 50mAdc, I_B = 5.0 mAdc)		–	–	0.95	

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%.

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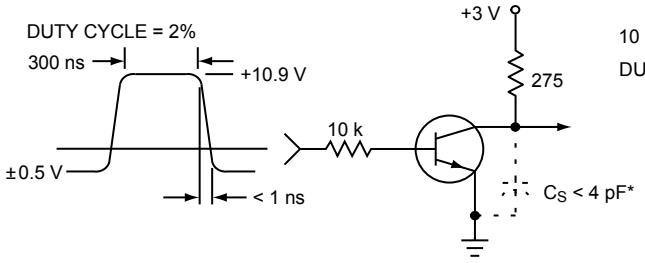
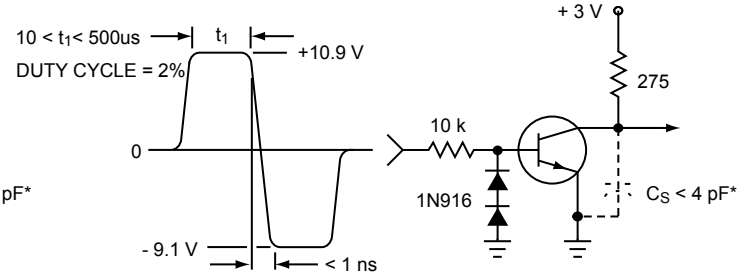
RATINGS AND CHARACTERISTIC CURVES

●ELECTRICAL CHARACTERISTICS (Ta= 25℃)

SWITCHING CHARACTERISTICS

Delay Time	(V_{CC} = 3.0 Vdc, V_{BE} = −0.5 Vdc, I_C= 10 mAdc, I_{B1} =1.0 mAdc)	t_d	–	–	35	ns
Rise Time		t_r	–	–	35	
Storage Time	(V_{CC} = 3.0 Vdc, I_C= 10 mAdc, I_{B1} = I_{B2}= 1.0 mAdc)	t_s	–	–	200	
Fall Time		t_f	–	–	50	





* Total shunt capacitance of test jig and connectors

Figure 1. Delay and Rise Time Equivalent Test Circuit

Figure 2. Storage and Fall Time Equivalent Test Circuit

TYPICAL TRANSIENT CHARACTERISTICS

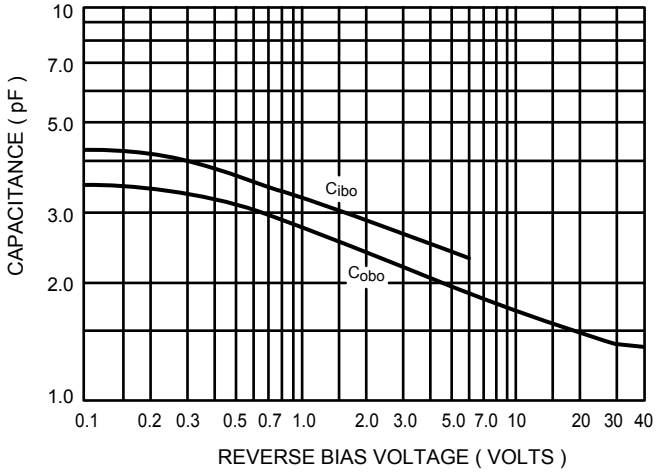


Figure 3. Capacitance

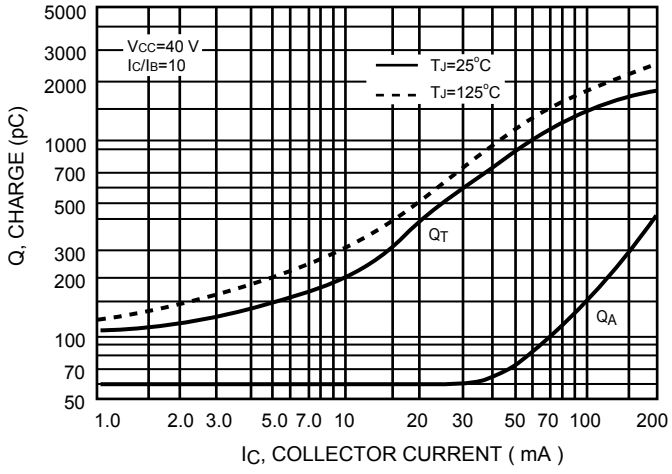


Figure 4. Charge Data

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RATINGS AND CHARACTERISTIC CURVES

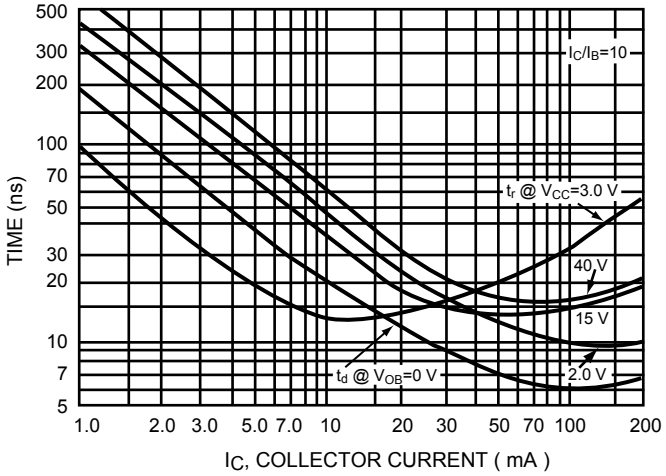

Figure 5. Turn-On Time

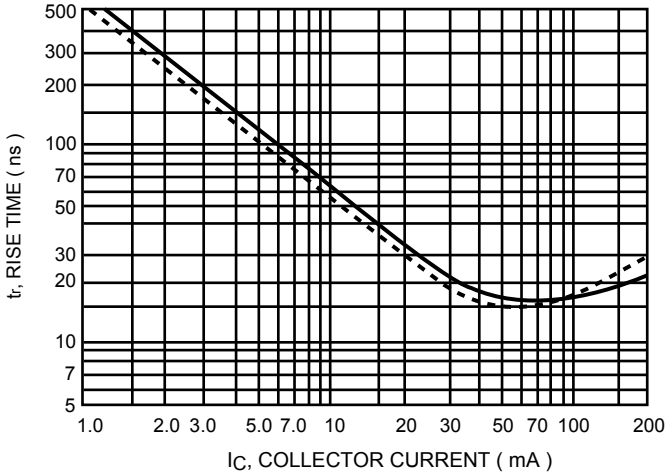

Figure 6. Rise Time

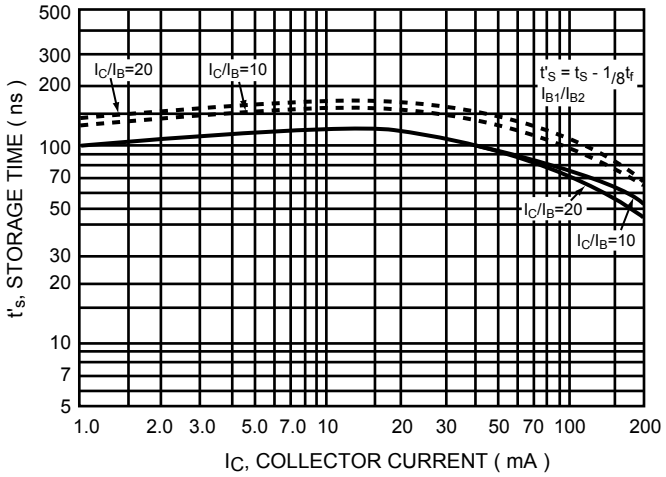

Figure 7. Storage Time

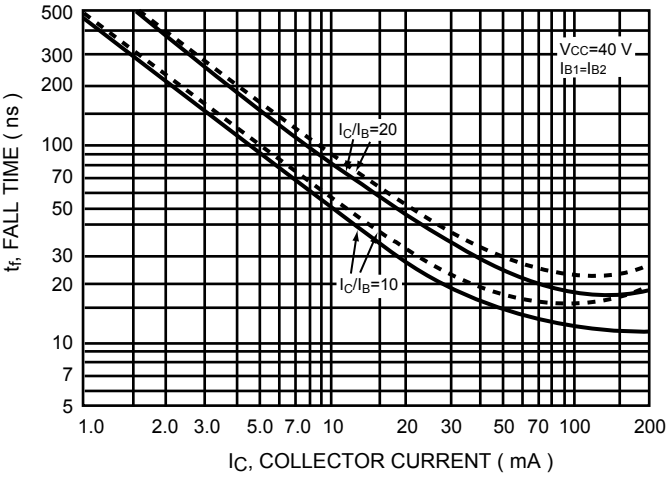

Figure 8. Fall Time

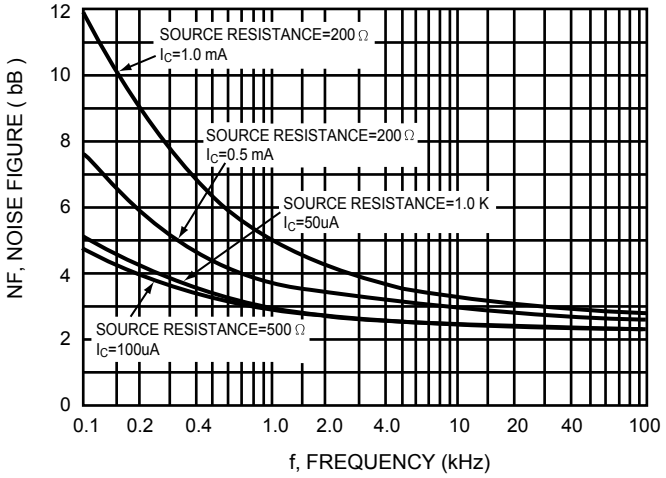

Figure 9.

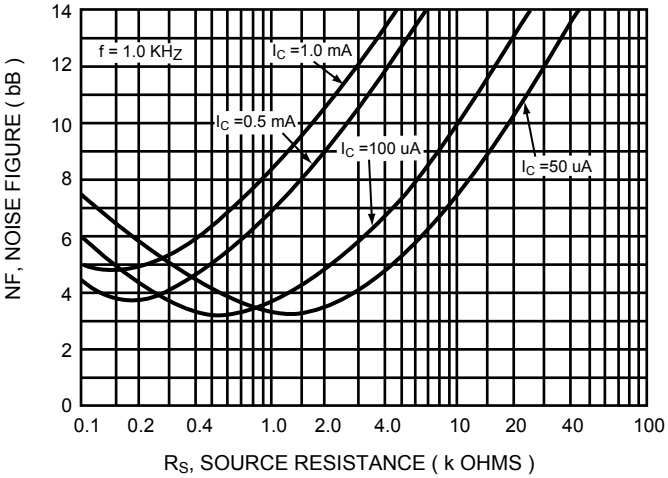

Figure 10.

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RATINGS AND CHARACTERISTIC CURVES

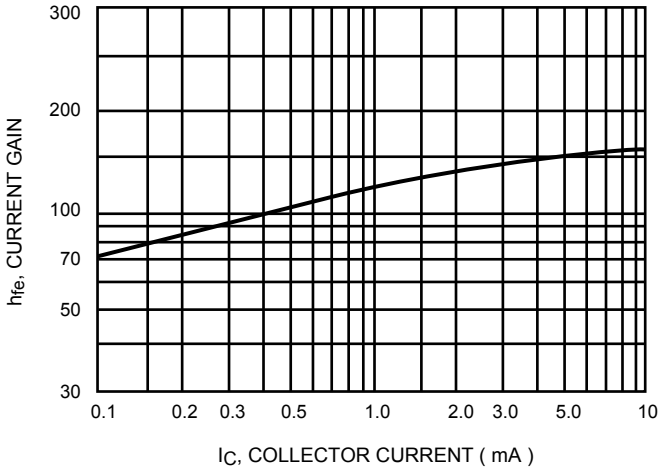

Figure 11. Current Gain

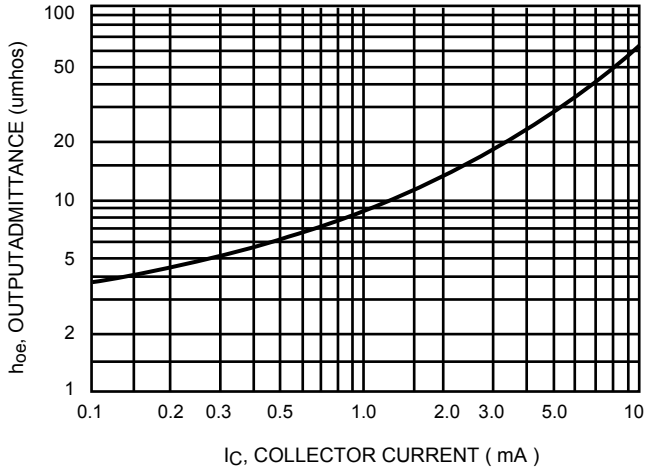

Figure 12. Output Admittance

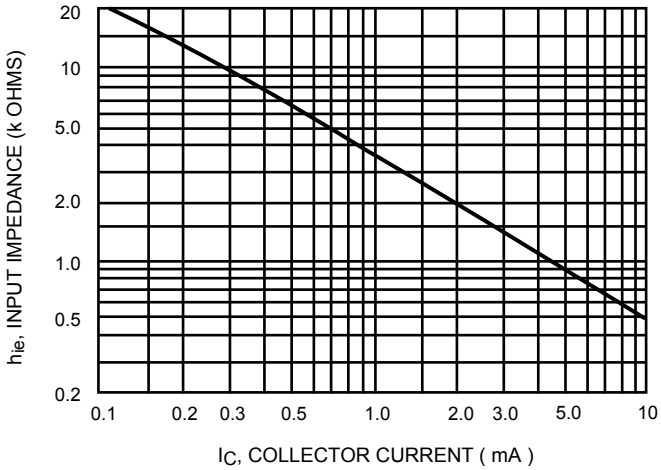

Figure 13. Input Impedance

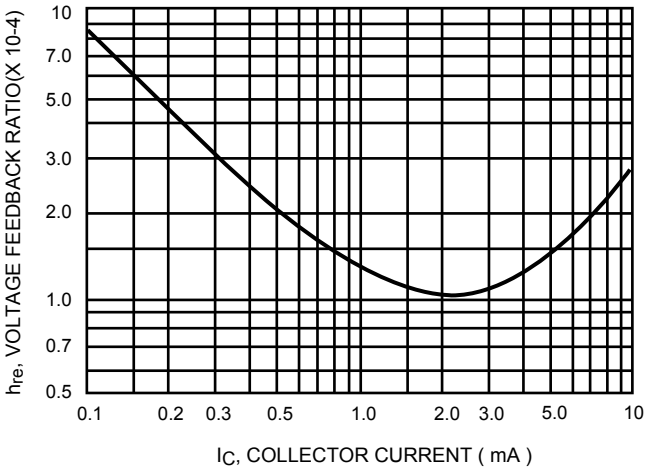

Figure 14. Voltage Feedback Ratio

TYPICAL STATIC CHARACTERISTICS

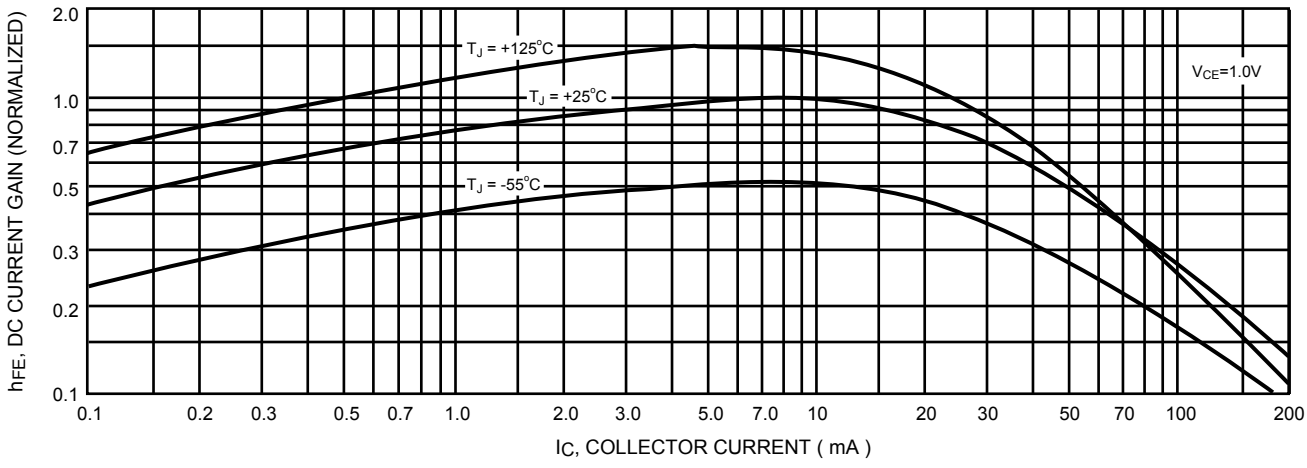

Figure 15. DC Current Gain

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RATINGS AND CHARACTERISTIC CURVES

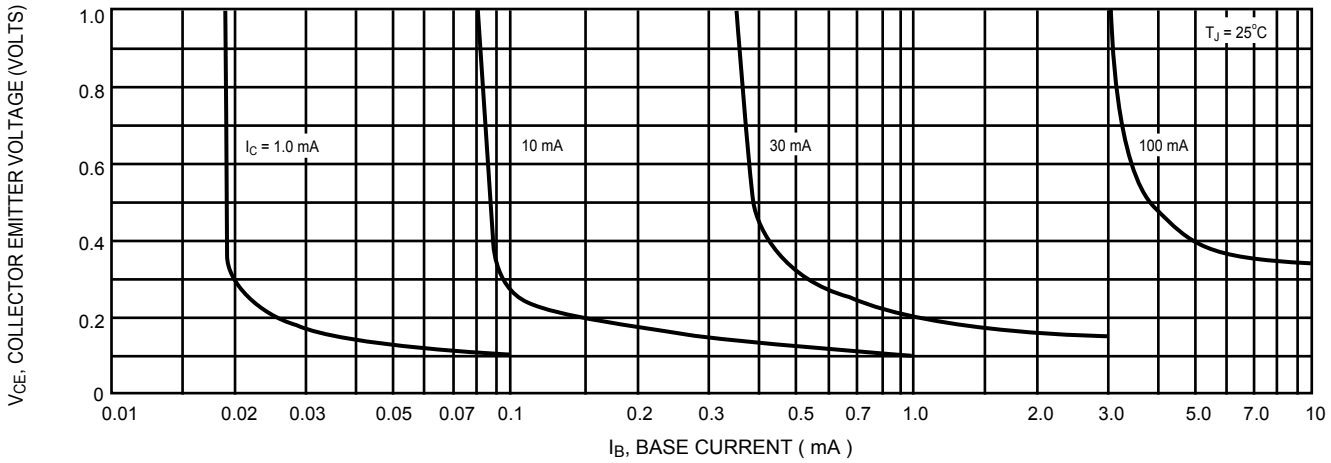

Figure 16. Collector Saturation Region

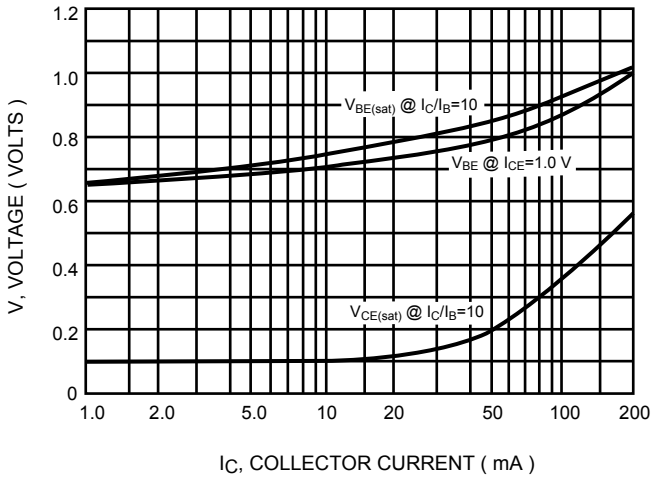

Figure 17. " ON " Voltage

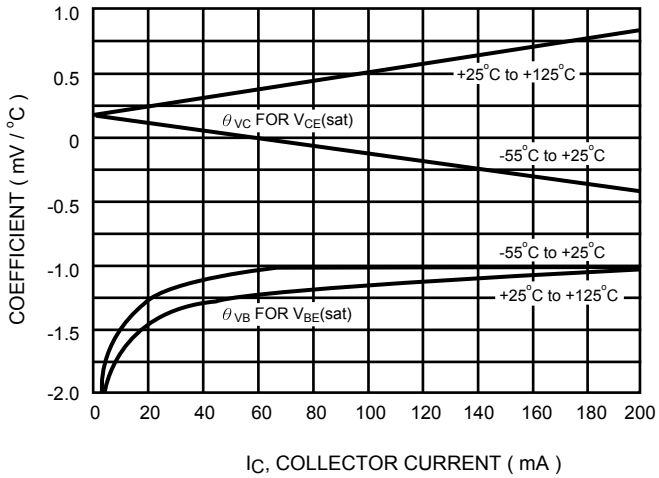

Figure 18. Temperature Coefficients