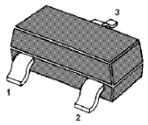
MMBT3904

NPN TRANSISTOR

FEATURES

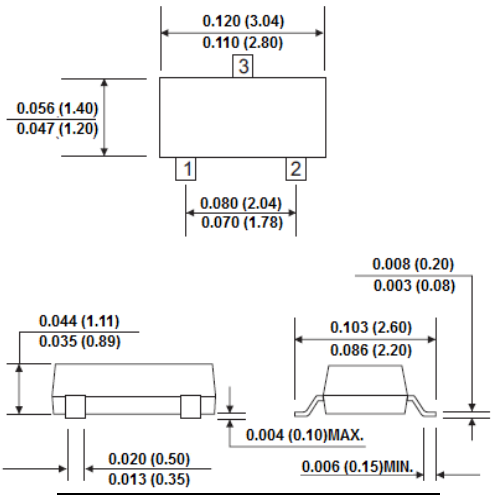
· As complementary types the PNP transistors MMBT3904 is recommended

· Suffix "H" indicates Halogen-free parts, ex. MMBT3904H



1. Base 2. Emitter 3. Collector

SOT-23



Dimensions in inches and (millimeter)

Maximum Ratings(T_A =25 ℃ unless otherwise noted)

Parameter	Symbol	Value	Unit
Collector-Base Voltage	V_{CBO}	60	V
Collector-Emitter Voltage	V_{CEO}	40	V
Emitter-Base Voltage	V_{EBO}	6.0	V
Collector Current	I_C	200	mA
Total Device Dissipation FR– 5 Board[1] Derate above 25℃	P_D	225 1.8	mW mW / ℃
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	556	℃ / W
Total Device Dissipation Alumina Substrate[2]	P_D	300 2.4	mW mW / ℃
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	417	℃ / W
Junction and Storage Temperature Range	T_J,T_{stg}	-55 to +150	℃

(1) Device on FR–5 = 1.0 x 0.75 x 0.062 in.

(2) Device on alumina substrate = 0.4 x 0.3 x 0.024 in. 99.5% alumina.

Electrical Characteristics(T_A =25 ℃ unless otherwise specified)

Parameter	Conditions	Symbol	Min.	Max.	Unit
Collector-base breakdown voltage	I_C= 10μA	$V_{(BR)CBO}$	60	--	V
Collector-emitter breakdown voltage[3]	I_C= 1.0mA	$V_{(BR)CEO}$	40	--	V
Emitter-base breakdown voltage	I_E= 10μA	$V_{(BR)EBO}$	6.0	--	V
Base cut-off current	V_{CE}= 30V, V_{EB}= 3.0V	I_{BL}	--	50	nA
Collector cut-off current	V_{CE}= 30V, V_{EB}= 3.0V	I_{CEX}	--	50	nA
DC current gain	V_{CE}= 1.0V, I_C= 0.1mA	h_{FE}	40	--	--
	V_{CE}= 1.0V, I_C= 1.0mA		70	--	
	V_{CE}= 1.0V, I_C= 10mA		100	300	
	V_{CE}= 1.0V, I_C= 50mA		60	--	
	V_{CE}= 1.0V, I_C= 100mA		30	--	
Collector-emitter saturation voltage[3]	I_C= 10 mA, I_B= 1.0mA	$V_{CE(sat)}$	--	0.2	V
	I_C= 50 mA, I_B= 5.0mA			0.3	
Base-emitter saturation voltage[3]	I_C= 10 mA, I_B= 1.0mA	$V_{BE(sat)}$	0.65	0.85	V
	I_C= 50 mA, I_B= 5.0mA		--	0.95	

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

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Electrical Characteristics(T_A =25 ℃ unless otherwise specified)

Parameter	Conditions	Symbol	Min.	Max.	Unit
Current–gain — bandwidth product	V_{CE}= 20V, I_C= 10mA, f=100MHz	f_T	300	--	MHz
Output capacitance	V_{CB}= 5.0V, I_E= 0, f = 1.0 MHz	C_{obo}	--	4.0	pF
Input capacitance	V_{BE}= 0.5V, I_C= 0, f= 1.0 MHz	C_{ibo}	--	8.0	pF
Input impedancen	V_{CE}= 10V, I_C= 1.0mA, f= 1.0 kHz	h_{ie}	1.0	10	kΩ
Voltage feedback Ratio	V_{CE}= 10V, I_C= 1.0mA, f= 1.0 kHz	h_{re}	0.5	8.0	$\times 10^{-4}$
Small–signal current gain	V_{CE}= 10V, I_C= 1.0mA, f= 1.0 kHz	h_{fe}	100	400	--
Output admittance	V_{CE}= 10V, I_C= 1.0mA, f= 1.0 kHz	h_{oe}	1.0	40	μmhos
Noise figure	V_{CE}= 5.0V, I_C= 100μA, R_S= 1.0k Ω, f= 1.0 kHz	NF	--	5.0	dB
Delay time	V_{CC}= 3.0V, V_{BE}= -0.5V	t_d	--	35	nS
Rise time	I_C= 10mA , I_{B1}= 1.0mA	t_r	--	35	nS
Storage time	V_{CC}= 3.0V, I_C= 10mA	t_s	--	200	nS
Fall time	I_{B1}= I_{B2}= 1.0mA	t_f	--	50	nS

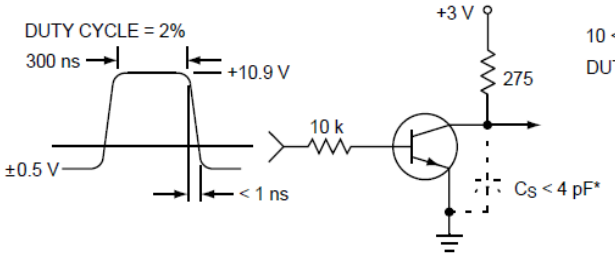


Figure 1. Delay and Rise Time Equivalent Test Circuit

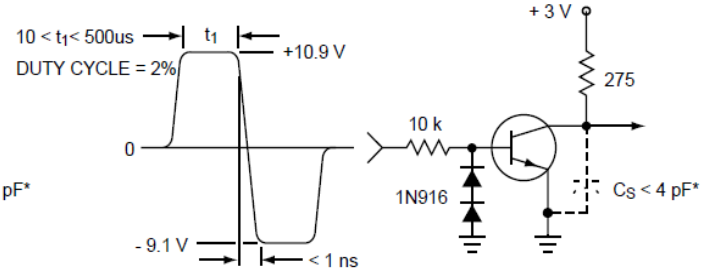


Figure 2. Storage and Fall Time Equivalent Test Circuit

* Total shunt capacitance of test jig and connectors

RATINGS AND CHARACTERISTIC CURVES

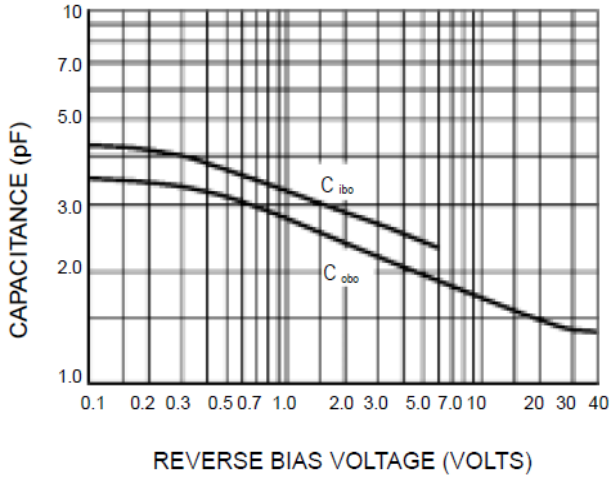


Figure 3. Capacitance

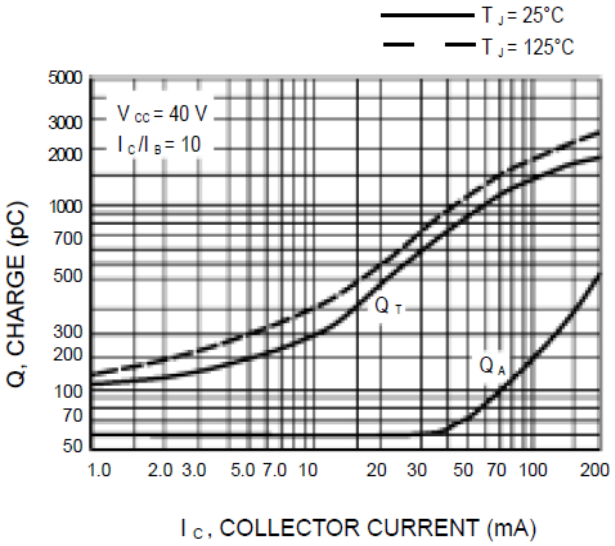


Figure 4. Charge Data

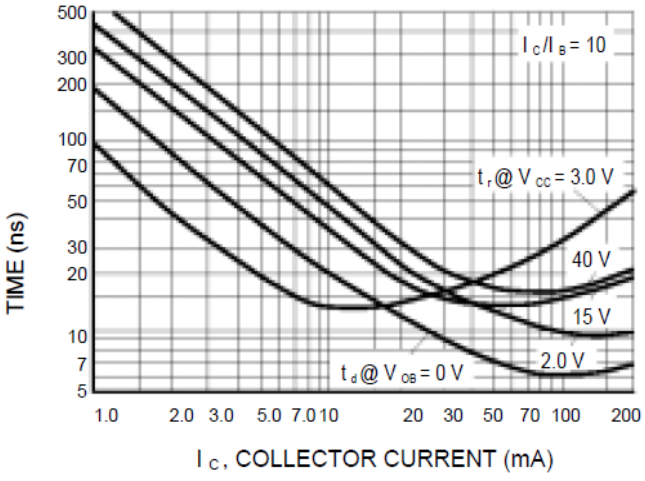


Figure 5. Turn–On Time

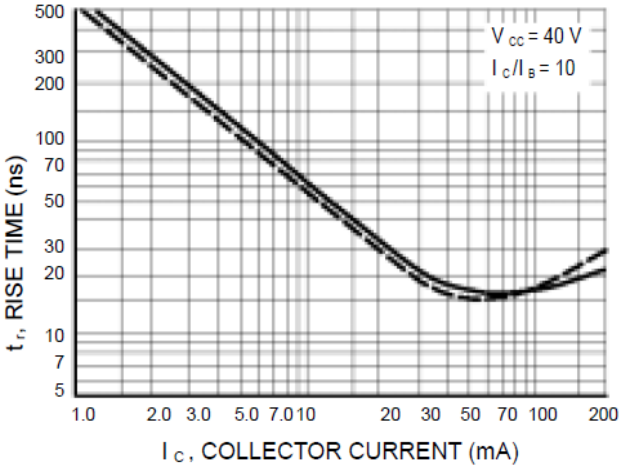


Figure 6. Rise Time

RATINGS AND CHARACTERISTIC CURVES

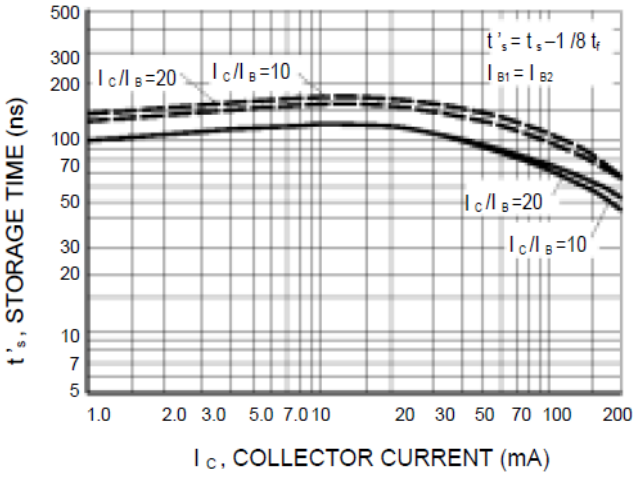


Figure 7. Storage Time

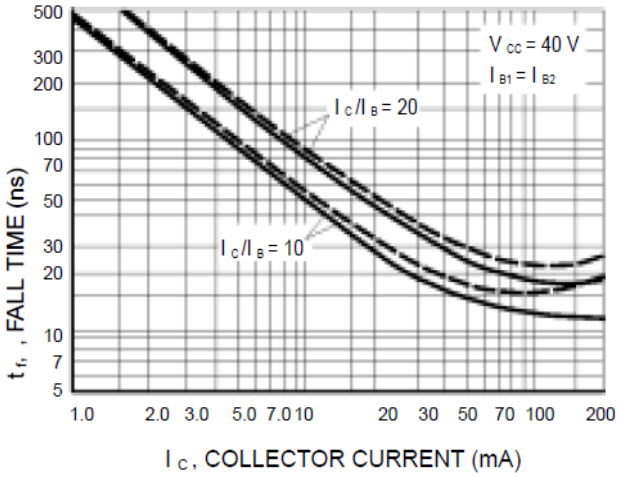


Figure 8. Fall Time

TYPICAL AUDIO SMALL–SIGNAL CHARACTERISTICS

NOISE FIGURE VARIATIONS

(V_{CE} = 5.0 V, T_A = 25°C, Bandwidth = 1.0 Hz)

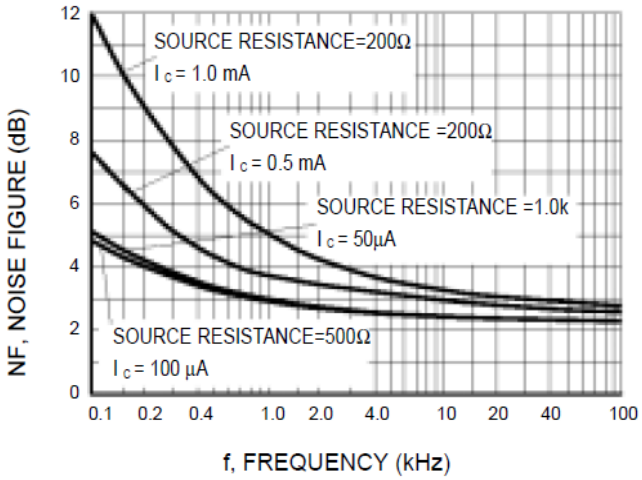


Figure 9.

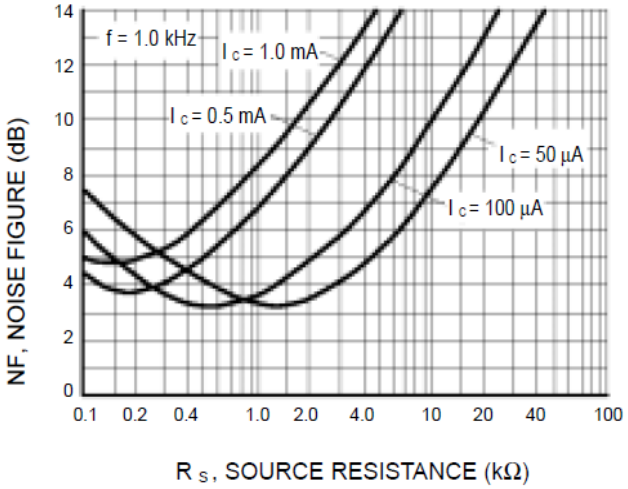


Figure 10.

h PARAMETERS

(V_{CE} = 10 V, f = 1.0 kHz, T_A = 25°C)

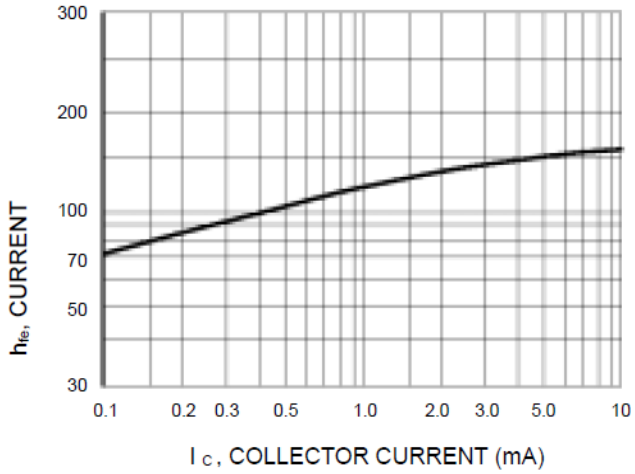


Figure 11. Current Gain

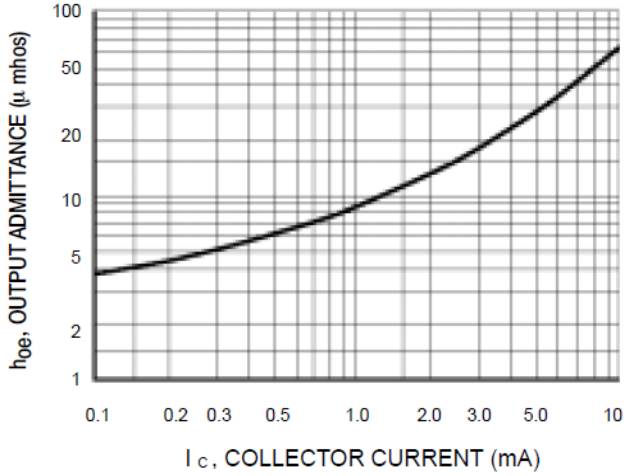


Figure 12. Output Admittance

RATINGS AND CHARACTERISTIC CURVES

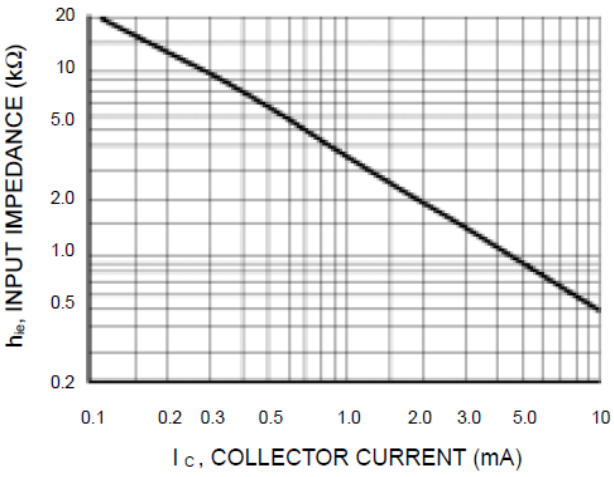


Figure 13. Input Impedance

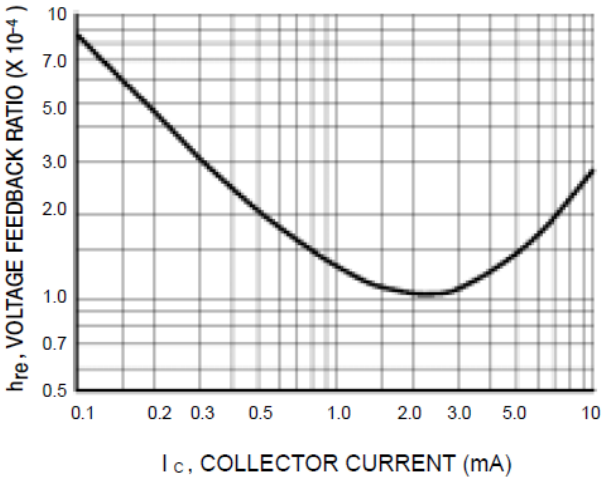


Figure 14. Voltage Feedback Ratio

TYPICAL STATIC CHARACTERISTICS

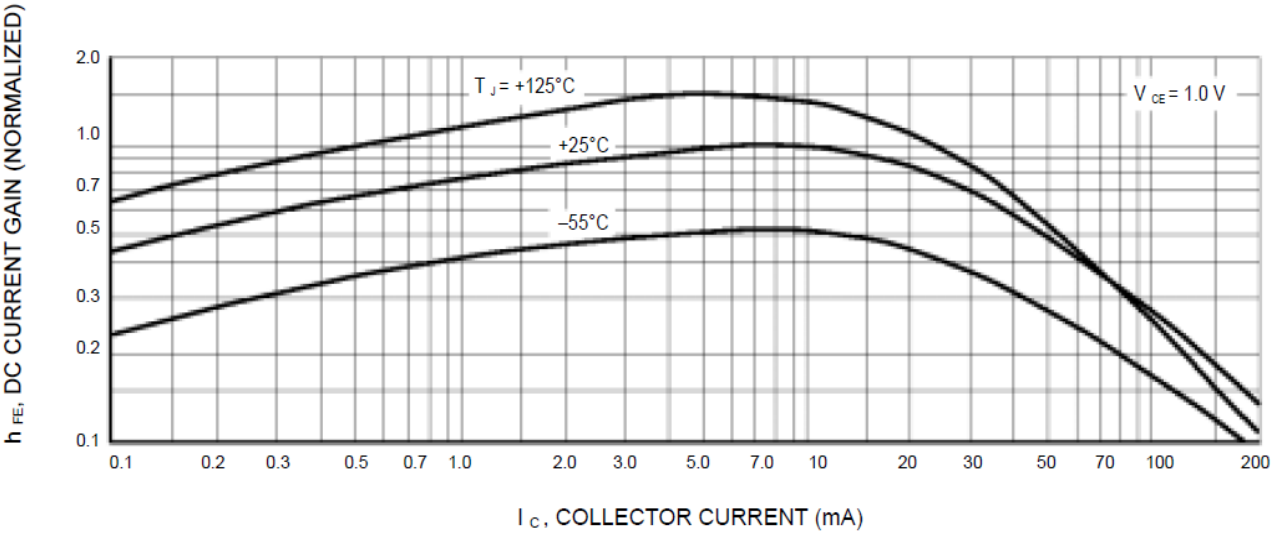


Figure 15. DC Current Gain

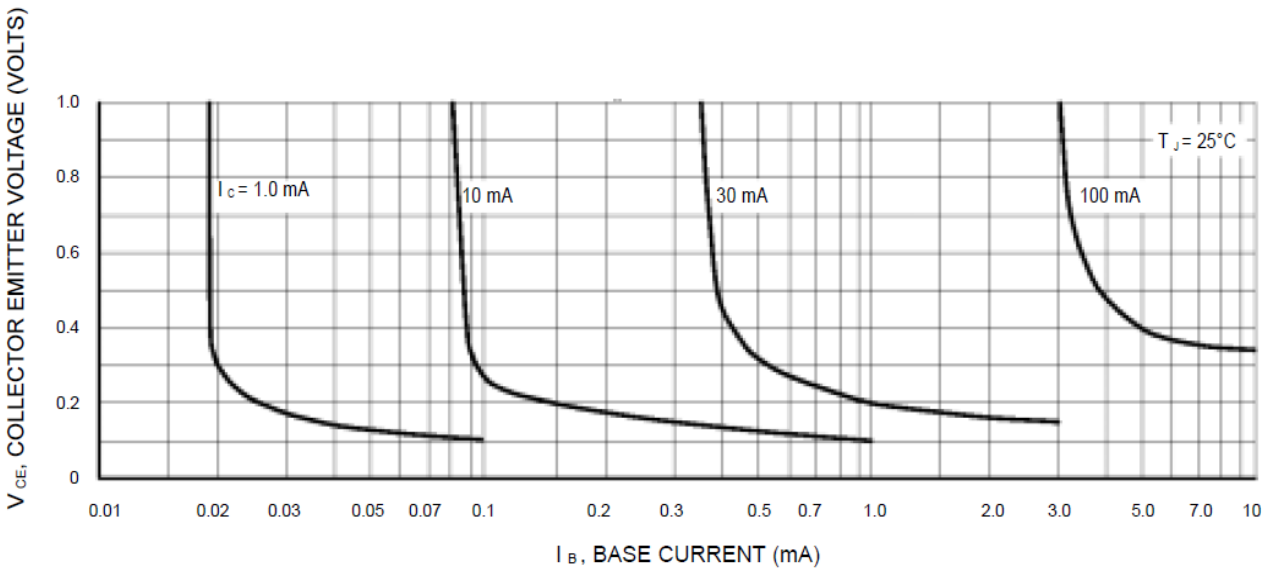


Figure 16. Collector Saturation Region

RATINGS AND CHARACTERISTIC CURVES

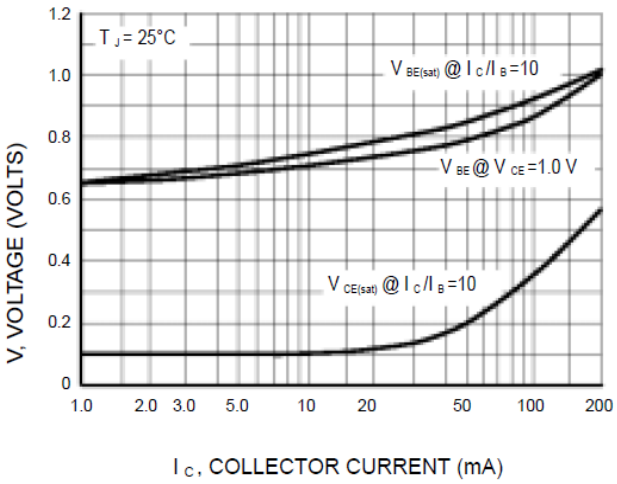


Figure 17. "ON" Voltages

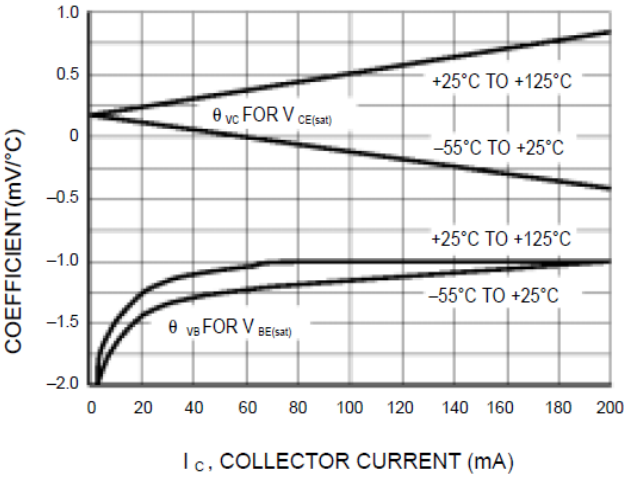
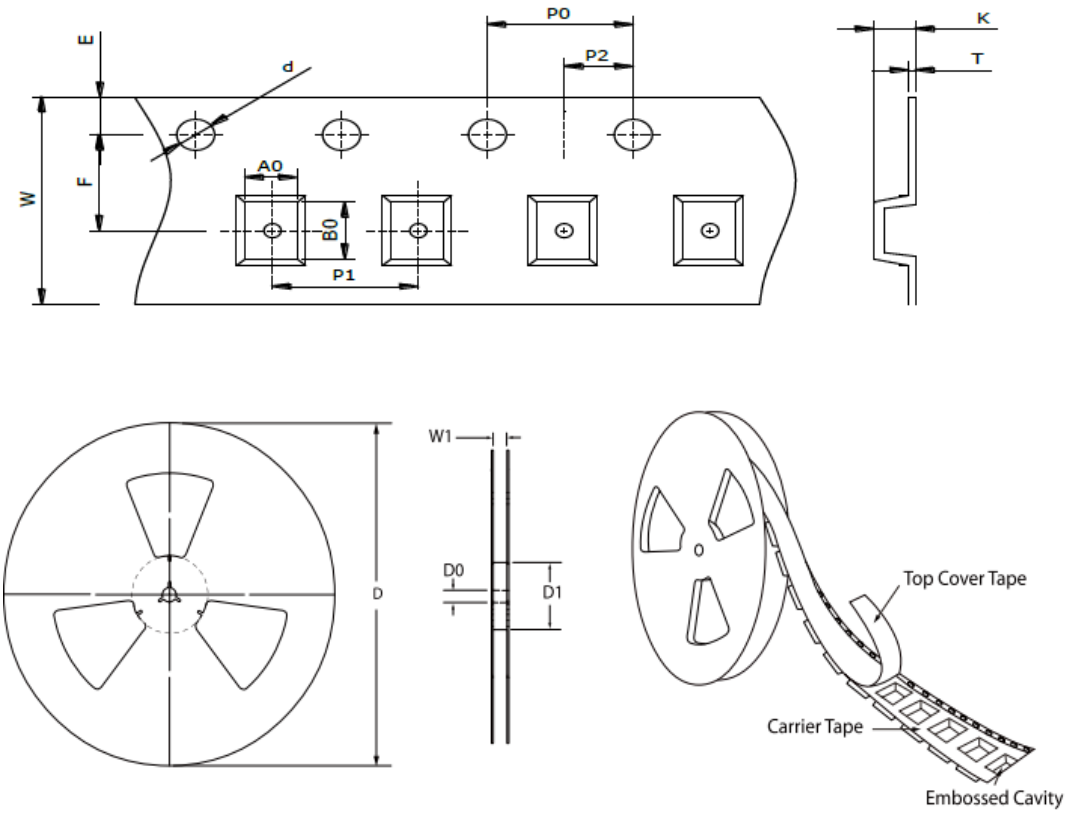


Figure 18. Temperature Coefficients

TAPE & REEL SPECIFICATION

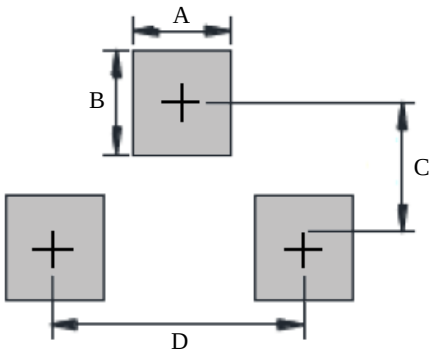


Item	Symbol	SOT-23
Carrier width	A_0	3.10 ± 0.10
Carrier length	B_0	2.70 ± 0.10
Carrier depth	K	1.15 ± 0.10
Sprocket hole	d	1.50 ± 0.10
Reel outside diameter	D	178.00 ± 2.00
Feed hole width	D_0	13.00 ± 0.20
Reel inner diameter	D_1	MIN. 54.00
Sprocke hole position	E	1.75 ± 0.10
Punch hole position	F	3.50 ± 0.10
Sprocke hole pitch	P_0	4.00 ± 0.10
Punch hole pitch	P_1	4.00 ± 0.10
Embossment center	P_2	2.00 ± 0.10
Overall tape thickness	T	0.20 ± 0.05
Tape width	W	8.00 ± 0.20
Reel width	W1	MAX. 13.50

ORDER INFORMATION

Package	Reel Size	Quantity
SOT-23	7"	3,000

SUGGESTED SOLDER PAD LAYOUT



Unit : mm

PACKAGE	A	B	C	D
SOT-23	0.80	0.80	2.02	1.90