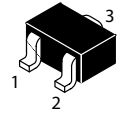
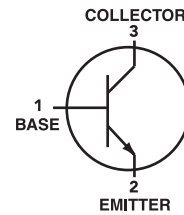


### NPN General Purpose Transistors

 Lead(Pb)-Free



SOT-323(SC-70)

#### MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	$V_{CEO}$	40	Vdc
Collector-Base Voltage	$V_{CBO}$	75	Vdc
Emitter-Base Voltage	$V_{EBO}$	6.0	Vdc
Collector Current-Continuous	$I_C$	600	mAdc

#### THERMAL CHARACTERISTICS

Characteristics	Symbol	Max	Unit
Total Device Dissipation FR-5 Board $T_A=25^\circ\text{C}$	$P_D$	150	mW
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	833	$^\circ\text{C/W}$
Junction and Storage, Temperature	$T_J, T_{stg}$	-55 to+150	$^\circ\text{C}$

#### DEVICE MARKING

MMBT2222AW=P1

#### ELECTRICAL CHARACTERISTICS

Characteristics	Symbol	Min	Max	Unit
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#### OFF CHARACTERISTICS

Collector-Emitter Breakdown Voltage ( $I_C=10\text{ mAdc}, I_B=0$ ) <sup>(1)</sup>	$V_{(BR)CEO}$	40	-	Vdc
Collector-Base Breakdown Voltage ( $I_C=10\text{ }\mu\text{Adc}, I_E=0$ )	$V_{(BR)CBO}$	75	-	Vdc
Emitter-Base Breakdown Voltage ( $I_E=10\text{ }\mu\text{Adc}, I_C=0$ )	$V_{(BR)EBO}$	6.0	-	Vdc
Collector Cutoff Current ( $V_{CE}=60\text{ Vdc}, V_{EB}(\text{off})=3.0\text{ Vdc}$ )	$I_{CEX}$	-	10	nAdc
Collector Cutoff Current ( $V_{CB}=60\text{ Vdc}, I_E=0$ ) ( $V_{CB}=60\text{ Vdc}, I_E=0, T_A=125^\circ\text{C}$ )	$I_{CBO}$	-	0.01 10	$\mu\text{Adc}$
Emitter Cutoff Current ( $V_{EB}=3.0\text{ Vdc}, I_C=0$ )	$I_{EBO}$	-	100	nAdc
Base Cutoff Current ( $V_{CE}=60\text{ Vdc}, V_{EB}(\text{off})=3.0\text{ Vdc}$ )	$I_{BL}$	-	20	nAdc

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

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

Characteristics	Symbol	Min	Max	Unit
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**ON CHARACTERISTICS<sup>(1)</sup>**

DC Current Gain ( $I_C=0.1\text{ mA}$ , $V_{CE}=10\text{ Vdc}$ ) ( $I_C=1.0\text{ mA}$ , $V_{CE}=10\text{ Vdc}$ ) ( $I_C=10\text{ mA}$ , $V_{CE}=10\text{ Vdc}$ ) ( $I_C=150\text{ mA}$ , $V_{CE}=10\text{ Vdc}$ ) ( $I_C=500\text{ mA}$ , $V_{CE}=10\text{ Vdc}$ )	$h_{FE}$	35 50 75 100 40	- - - 300 -	-
Collector-Emitter Saturation Voltage ( $I_C=150\text{ mA}$ , $I_B=15\text{ mA}$ ) ( $I_C=500\text{ mA}$ , $I_B=50\text{ mA}$ )	$V_{CE(sat)}$	- -	0.3 1.0	Vdc
Base-Emitter Saturation Voltage ( $I_C=150\text{ mA}$ , $I_B=15\text{ mA}$ ) ( $I_C=500\text{ mA}$ , $I_B=50\text{ mA}$ )	$V_{BE(sat)}$	0.6 -	1.2 2.0	Vdc

**SMALL-SIGNAL CHARACTERISTICS**

Current-Gain-Bandwidth Product ( $I_C=20\text{ mA}$ , $V_{CE}=20\text{ Vdc}$ , $f=100\text{ MHz}$ )	$f_T$	300	-	MHz
Output Capacitance ( $V_{CB}=10\text{ Vdc}$ , $I_E=0$ , $f=1.0\text{ MHz}$ )	$C_{obo}$	-	8.0	pF
Input Capacitance ( $V_{EB}=0.5\text{ Vdc}$ , $I_C=0$ , $f=1.0\text{ MHz}$ )	$C_{ibo}$	-	25	pF
Input Impedance ( $I_C=10\text{ mA}$ , $V_{CE}=10\text{ Vdc}$ , $f=1.0\text{ kHz}$ )	$h_{ie}$	0.25	1.25	$k\Omega$
Voltage Feedback Ratio ( $I_C=10\text{ mA}$ , $V_{CE}=10\text{ Vdc}$ , $f=1.0\text{ kHz}$ )	$h_{re}$	-	4.0	$\times 10^{-4}$
Small-Signal Current Gain ( $I_C=10\text{ mA}$ , $V_{CE}=10\text{ Vdc}$ , $f=1.0\text{ kHz}$ )	$h_{fe}$	75	375	-
Output Admittance ( $I_C=10\text{ mA}$ , $V_{CE}=10\text{ Vdc}$ , $f=1.0\text{ kHz}$ )	$h_{oe}$	25	200	$\mu\text{mhos}$
Collector Base Time Constant ( $I_E=20\text{ mA}$ , $V_{CB}=20\text{ Vdc}$ , $f=31.8\text{ MHz}$ )	$r_b, C_c$	-	150	ps
Noise Figure ( $I_C=100\text{ }\mu\text{A}$ , $V_{CE}=10\text{ Vdc}$ , $R_S=1.0k\Omega$ , $f=1.0\text{ kHz}$ )	NF	-	4.0	dB

## ELECTRICAL CHARACTERISTICS (T<sub>A</sub>=25 °C unless otherwise noted) (Continued)

Characteristics	Symbol	Min	Max	Unit
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### SWITCHING CHARACTERISTICS (MMBT2222A only)

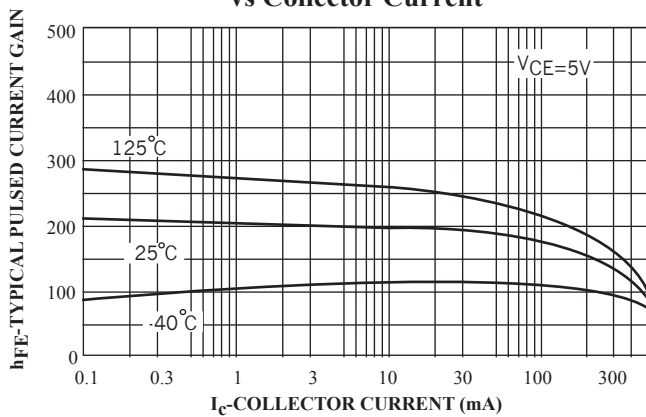
Delay Time	(V <sub>CC</sub> =30 Vdc, V <sub>BE</sub> =(off)=-0.5Vdc, I <sub>C</sub> =150 mA, I <sub>B1</sub> =15 mA)	t <sub>d</sub>	-	10	ns
Rise Time		t <sub>r</sub>	-	25	
Storage Time	(V <sub>CC</sub> =30 Vdc, I <sub>C</sub> =150 mA, I <sub>B1</sub> =I <sub>B2</sub> =15 mA)	t <sub>s</sub>	-	225	ns
Fall Time		t <sub>f</sub>	-	60	

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

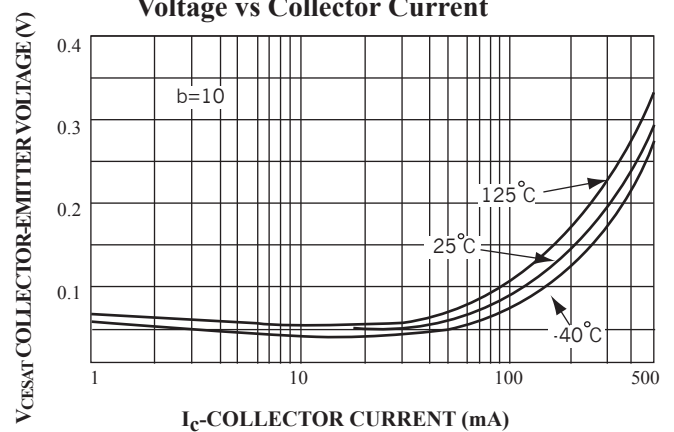
4.  $f_T$  is defined as the frequency at which  $I_{hfe}$  extrapolates to unity.

## Typical Characteristics

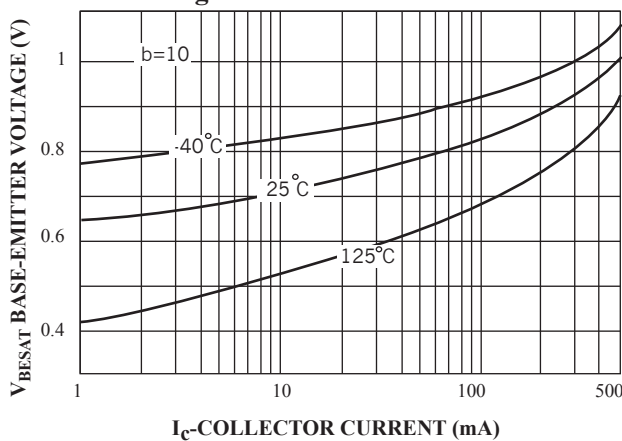
Typical Pulsed Current Gain vs Collector Current



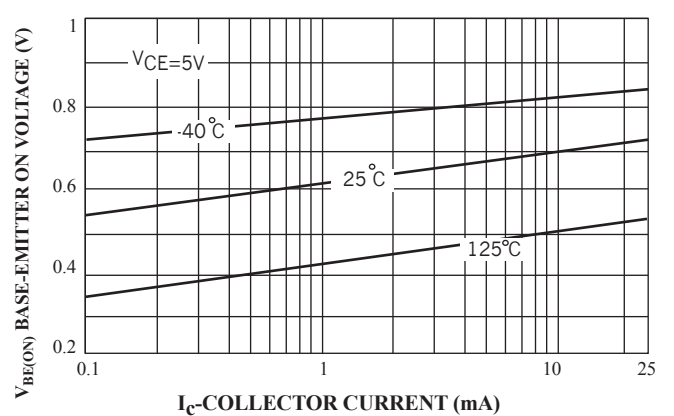
Collector-Emitter Saturation Voltage vs Collector Current



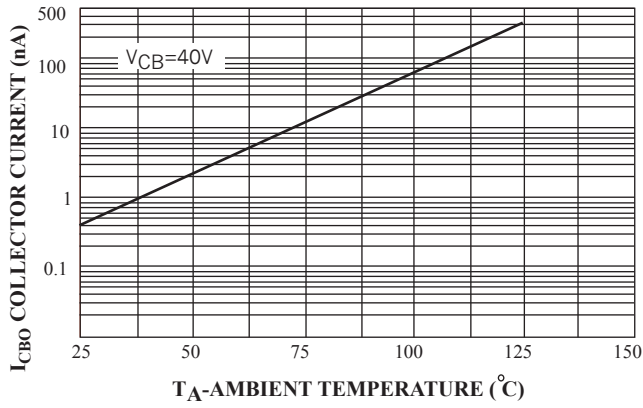
Base-Emitter Saturation Voltage vs Collector Current



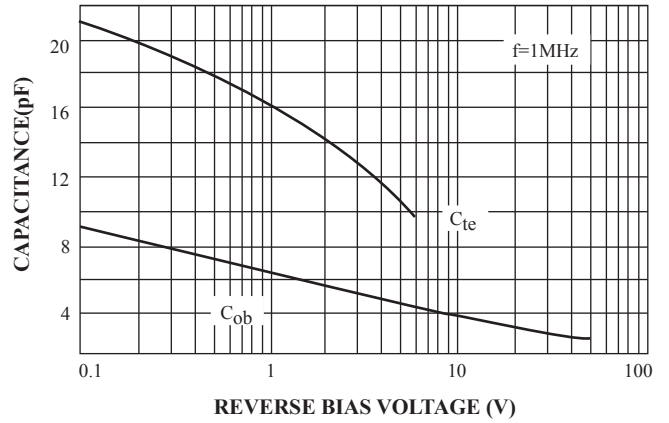
Base-Emitter ON Voltage vs Collector Current



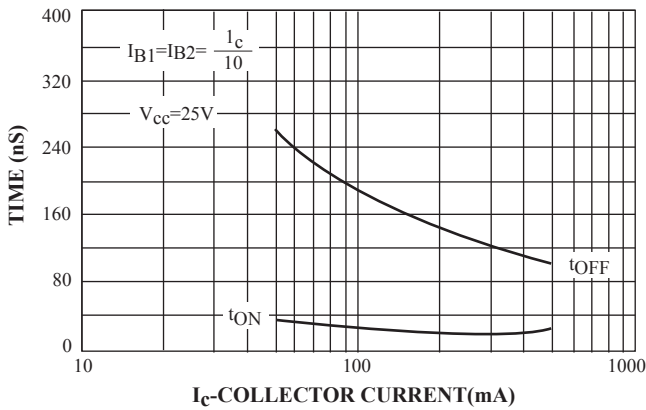
**Collector-Cutoff Current vs Ambient Temperature**



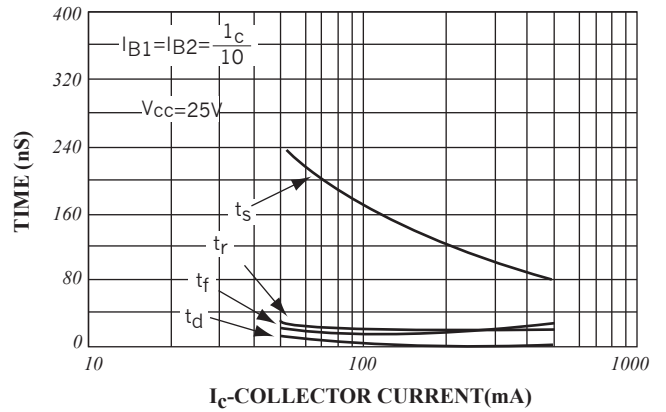
**Emitter Transition and Output Capacitance vs Reverse Bias Voltage**



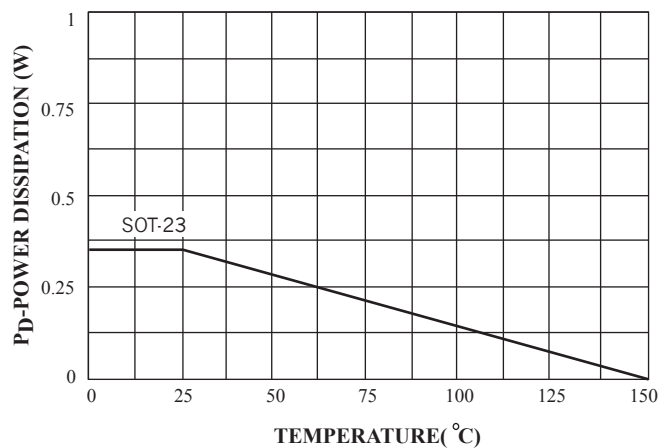
**Turn On and Turn Off Times vs Collector Current**



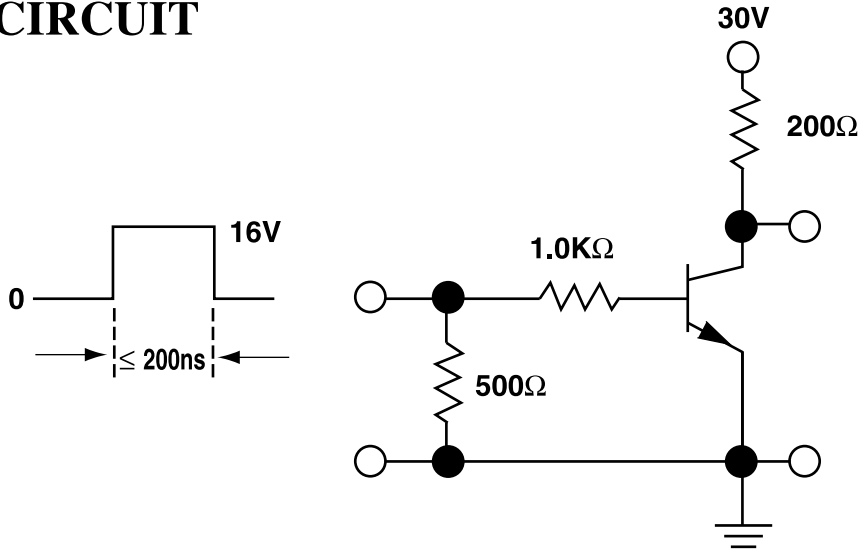
**Switching Times vs Collector Current**



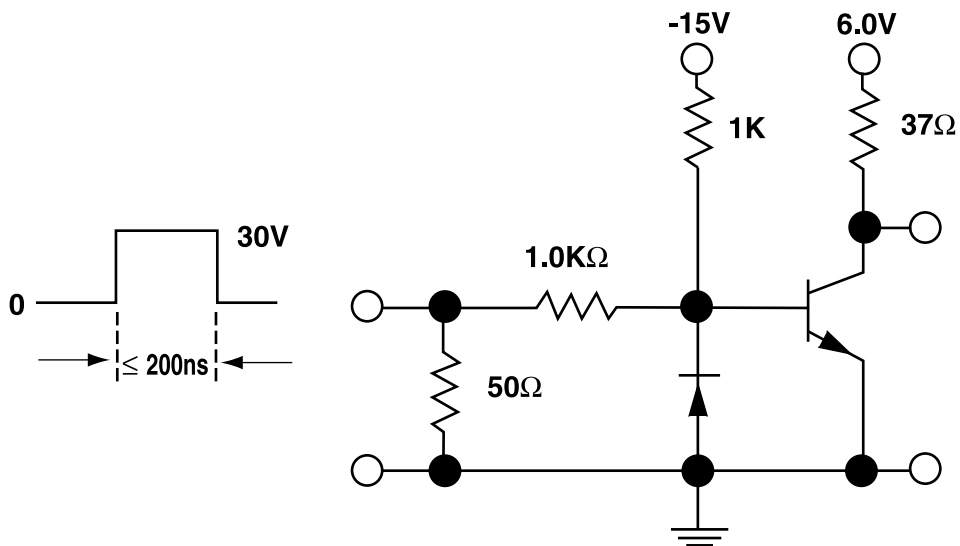
**Power Dissipation vs Ambient Temperature**



## TEST CIRCUIT



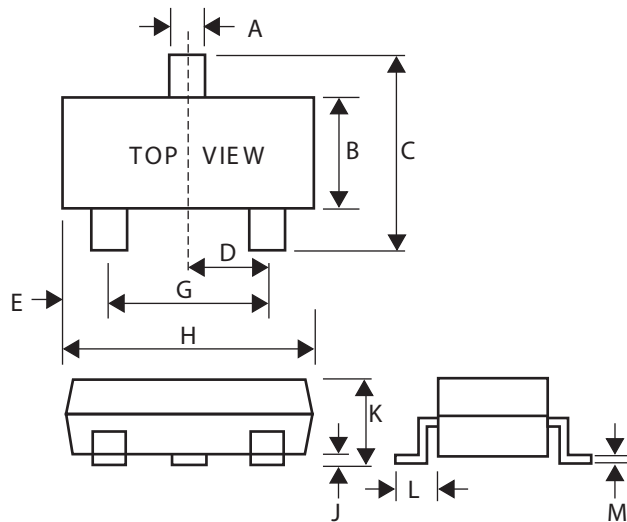
FIGURT 1: Saturated Turn-On Switching Time



FIGURT 2: Saturated Turn-Off Switching Time

## SOT-323 Outline Demensions

Unit:mm



SOT-323		
Dim	Min	Max
A	0.30	0.40
B	1.15	1.35
C	2.00	2.40
D	-	0.65
E	0.30	0.40
G	1.20	1.40
H	1.80	2.20
J	0.00	0.10
K	0.80	1.00
L	0.42	0.53
M	0.10	0.25