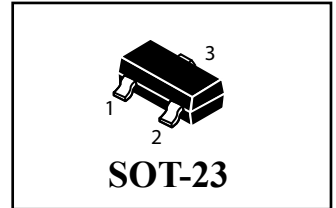
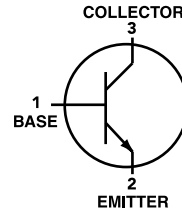


## NPN General Purpose Transistors

 Lead(Pb)-Free



### MAXIMUM RATINGS

Rating	Symbol	2222	2222A	Unit
Collector-Emitter Voltage	$V_{CEO}$	30	40	Vdc
Collector-Base Voltage	$V_{CBO}$	60	75	Vdc
Emitter-Base Voltage	$V_{EBO}$	5.0	6.0	Vdc
Collector Current-Continuous	$I_C$	600		mAdc

### THERMAL CHARACTERISTICS

Characteristics	Symbol	Max	Unit
Total Device Dissipation FR-5 Board (1) TA=25°C Derate above 25°C	$P_D$	225	mW
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	556	°C/W
Total Device Dissipation Alumina Substrate, (2) TA=25°C Derate above 25°C	$P_D$	300	mW
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	417	°C/W
Junction and Storage, Temperature	$T_{J,Tstg}$	-55 to +150	°C

### DEVICE MARKING

MMBT 2222=M1B; MMBT2222A=1P

### ELECTRICAL CHARACTERISTICS

Characteristics	Symbol	Min	Max	Unit
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### OFF CHARACTERISTICS

Collector-Emitter Breakdown Voltage ( $I_C=10$ mAdc, $I_B=0$ )	MMBT2222 MMBT2222A	$V_{(BR)CEO}$	30 40	- -	Vdc
Collector-Base Breakdown Voltage ( $I_C=10$ $\mu$ Adc, $I_E=0$ )	MMBT2222 MMBT2222A	$V_{(BR)CBO}$	60 75	- -	Vdc
Emitter-Base Breakdown Voltage ( $I_E=10$ $\mu$ Adc, $I_C=0$ )	MMBT2222 MMBT2222A	$V_{(BR)EBO}$	5.0 6.0	- -	Vdc
Collector Cutoff Current ( $V_{CE}=60$ Vdc, $V_{EB}(\text{off})=3.0$ Vdc)	MMBT2222A	$I_{CEX}$	-	10	nAdc
Collector Cutoff Current ( $V_{CB}=50$ Vdc, $I_E=0$ ) ( $V_{CB}=60$ Vdc, $I_E=0$ ) ( $V_{CB}=50$ Vdc, $I_E=0$ , $T_A=125$ °C) ( $V_{CB}=60$ Vdc, $I_E=0$ , $T_A=125$ °C)	MMBT2222 MMBT2222A MMBT2222 MMBT2222A	$I_{CBO}$	- - - -	0.01 0.01 10 10	$\mu$ Adc
Emitter Cutoff Current ( $V_{EB}=3.0$ Vdc, $I_C=0$ )	MMBT2222A	$I_{EBO}$	-	100	nAdc
Base Cutoff Current ( $V_{CE}=60$ Vdc, $V_{EB}(\text{off})=3.0$ Vdc)	MMBT2222A	$I_{BL}$	-	20	nAdc

1.FR-5=1.0 x 0.75 x 0.062 in

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

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

Characteristics	Symbol	Min	Max	Unit
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**ON CHARACTERISTICS**

DC Current Gain ( $I_C=0.1\text{ mA}$ , $V_{CE}=10\text{ Vdc}$ ) ( $I_C=1.0\text{ mA}$ , $V_{CE}=10\text{ Vdc}$ ) ( $I_C=10\text{ mA}$ , $V_{CE}=10\text{ Vdc}$ ) ( $I_C=10\text{ mA}$ , $V_{CE}=10\text{ Vdc}$ , $T_A=-55^{\circ}\text{C}$ ) ( $I_C=150\text{ mA}$ , $V_{CE}=10\text{ Vdc}$ ) (3) ( $I_C=150\text{ mA}$ , $V_{CE}=1.0\text{ Vdc}$ ) (3) ( $I_C=500\text{ mA}$ , $V_{CE}=10\text{ Vdc}$ ) (3)	MMBT2222A ONLY      MMBT2222 MMBT2222A	$h_{FE}$	35 50 75 35 100 50 30 40	- - - - 300 - - -	-
Collector-Emitter Saturation Voltage (3) ( $I_C=150\text{ mA}$ , $I_B=15\text{ mA}$ )  ( $I_C=500\text{ mA}$ , $I_B=50\text{ mA}$ )	MMBT2222 MMBT2222A  MMBT2222 MMBT2222A	$V_{CE(sat)}$	- - - -	0.4 0.3 1.6 1.0	Vdc
Base-Emitter Saturation Voltage (3) ( $I_C=150\text{ mA}$ , $I_B=15\text{ mA}$ )  ( $I_C=500\text{ mA}$ , $I_B=50\text{ mA}$ )	MMBT2222 MMBT2222A  MMBT2222 MMBT2222A	$V_{BE(sat)}$	- 0.6 - -	1.3 1.2 2.6 2.0	Vdc

**SMALL-SIGNAL CHARACTERISTICS**

Current-Gain-Bandwidth Product (4) ( $I_C=20\text{ mA}$ , $V_{CE}=20\text{ Vdc}$ , $f=100\text{ MHz}$ )	MMBT2222 MMBT2222A	$f_T$	250 300	- -	MHz
Output Capacitance ( $V_{CB}=10\text{ Vdc}$ , $I_E=0$ , $f=1.0\text{ MHz}$ )	MMBT2222 MMBT2222A	$C_{obo}$	-	8.0	pF
Input Capacitance ( $V_{EB}=0.5\text{ Vdc}$ , $I_C=0$ , $f=1.0\text{ MHz}$ )	MMBT2222 MMBT2222A	$C_{ibo}$	- -	30 25	pF
Input Impedance ( $I_C=1.0\text{ mA}$ , $V_{CE}=10\text{ Vdc}$ , $f=1.0\text{ kHz}$ ) ( $I_C=10\text{ mA}$ , $V_{CE}=10\text{ Vdc}$ , $f=1.0\text{ kHz}$ )	MMBT2222A MMBT2222A	$h_{ie}$	2.0 0.25	8.0 1.25	k $\Omega$
Voltage Feedback Ratio ( $I_C=1.0\text{ mA}$ , $V_{CE}=10\text{ Vdc}$ , $f=1.0\text{ kHz}$ ) ( $I_C=10\text{ mA}$ , $V_{CE}=10\text{ Vdc}$ , $f=1.0\text{ kHz}$ )	MMBT2222A MMBT2222A	$h_{re}$	- -	8.0 4.0	$\times 10^{-4}$
Small-Signal Current Gain ( $I_C=1.0\text{ mA}$ , $V_{CE}=10\text{ Vdc}$ , $f=1.0\text{ kHz}$ ) ( $I_C=10\text{ mA}$ , $V_{CE}=10\text{ Vdc}$ , $f=1.0\text{ kHz}$ )	MMBT2222A MMBT2222A	$h_{fe}$	50 75	300 375	-
Output Admittance ( $I_C=1.0\text{ mA}$ , $V_{CE}=10\text{ Vdc}$ , $f=1.0\text{ kHz}$ ) ( $I_C=10\text{ mA}$ , $V_{CE}=10\text{ Vdc}$ , $f=1.0\text{ kHz}$ )	MMBT2222A MMBT2222A	$h_{oe}$	5.0 25	35 200	$\mu\text{mhos}$
Collector Base Time Constant ( $I_E=20\text{ mA}$ , $V_{CB}=20\text{ Vdc}$ , $f=31.8\text{ MHz}$ )	MMBT2222A	$r_b, C_C$	-	150	ps
Noise Figure ( $I_C=100\text{ }\mu\text{A}$ , $V_{CE}=10\text{ Vdc}$ , $R_S=1.0\text{ k}\Omega$ , $f=1.0\text{ kHz}$ )	MMBT2222A	NF	-	4.0	dB

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

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

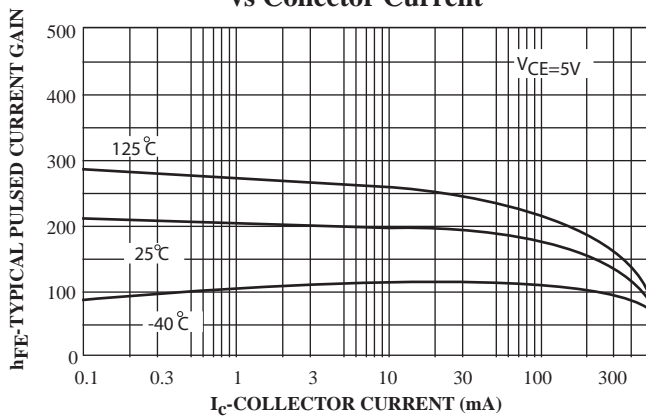
Delay Time	$(V_{CC}=30\text{ Vdc}, V_{BE}=\text{(off)}=-0.5\text{ Vdc}, I_C=150\text{ mA}, I_{B1}=15\text{ mA})$	$t_d$	-	10	ns
Rise Time		$t_r$	-	25	
Storage Time	$(V_{CC}=30\text{ Vdc}, I_C=150\text{ mA}, I_{B1}=I_{B2}=15\text{ mA})$	$t_s$	-	225	ns
Fall Time		$t_f$	-	60	

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

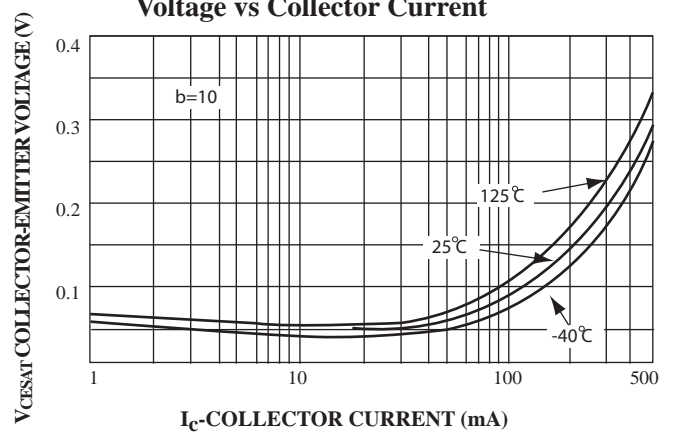
4.  $f_T$  is defined as the frequency at which  $|h_{fe}|$  extrapolates to unity.

**Typical Characteristics**

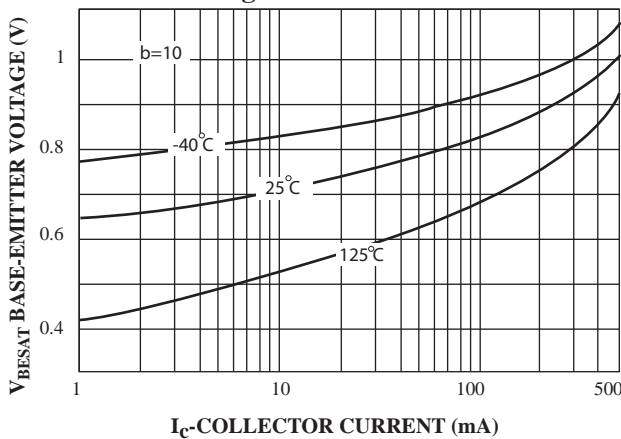
**Typical Pulsed Current Gain vs Collector Current**



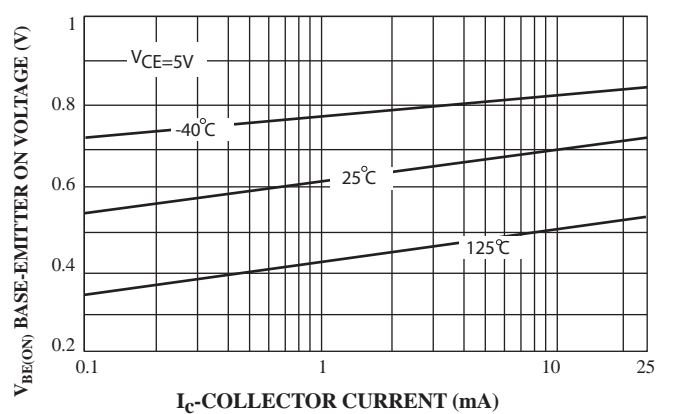
**Collector- Emitter Saturation Voltage vs Collector Current**



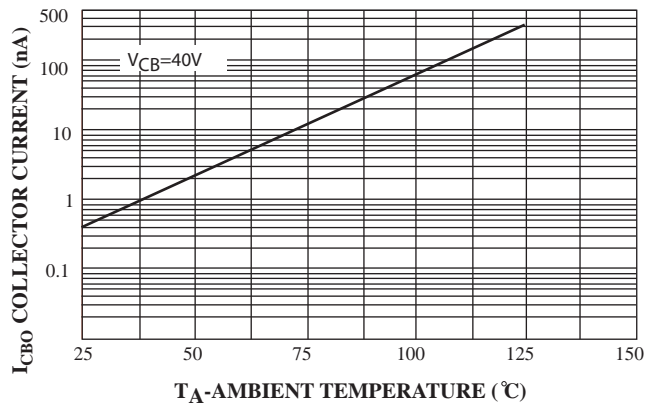
**Base-Emitter Saturation Voltage vs Collector Current**



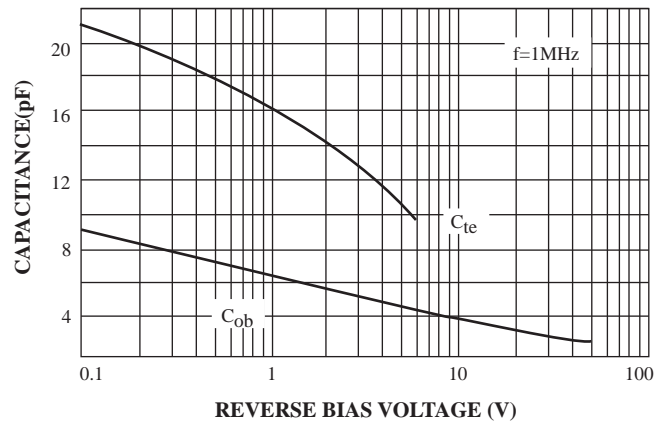
**Base-Emitter ON Voltage vs Collector Current**



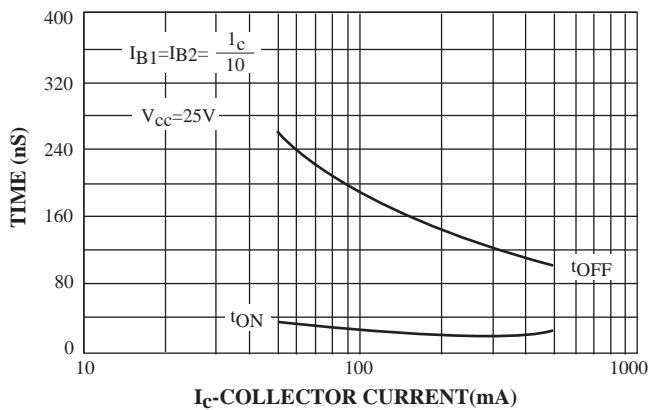
**Collector-Cutoff Current vs Ambient Temperature**



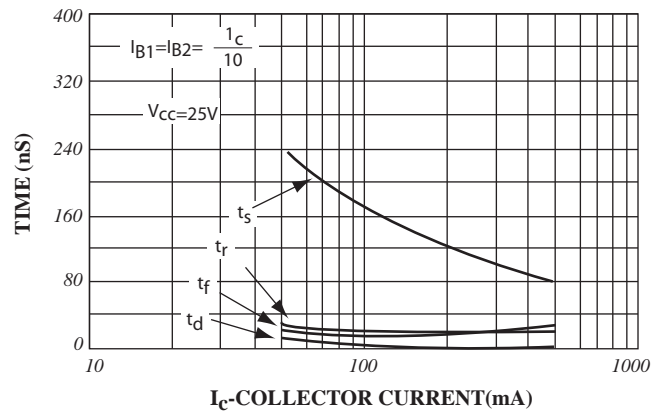
**Emitter Transition and Output Capacitance vs Reverse Bias Voltage**



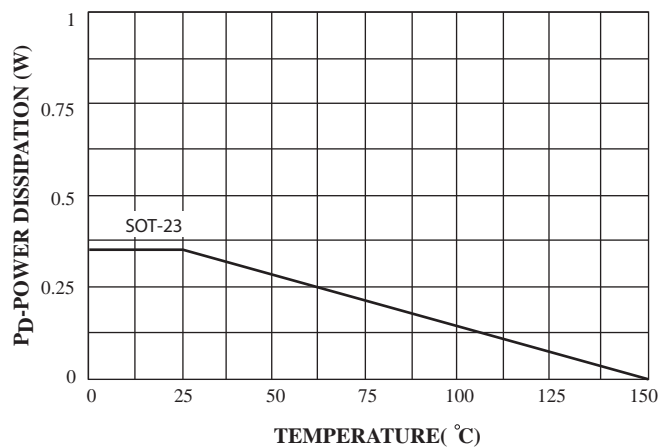
**Turn On and Turn Off Times vs Collector Current**



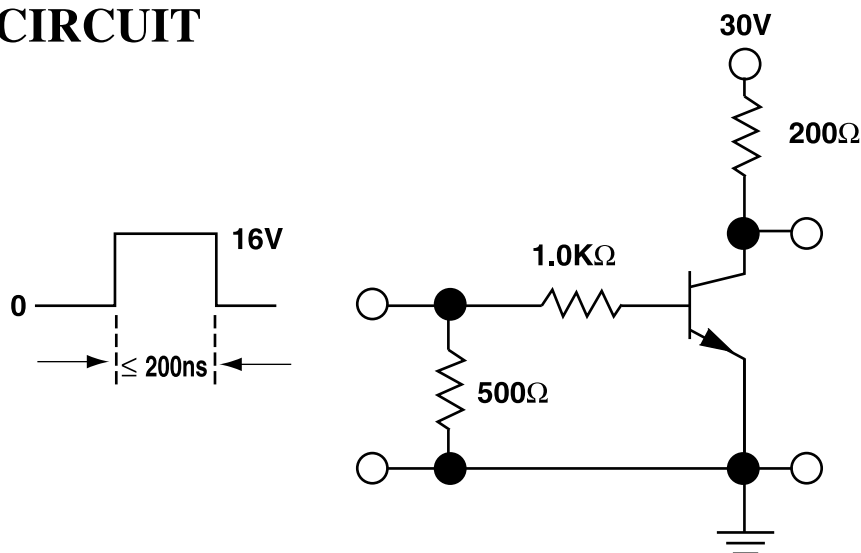
**Switching Times vs Collector Current**



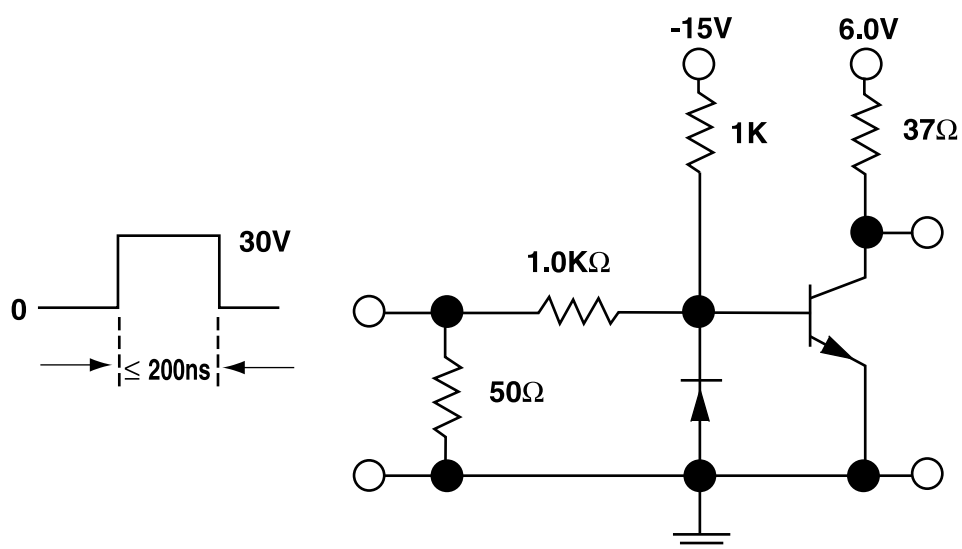
**Power Dissipation vs Ambient Temperature**



## TEST CIRCUIT



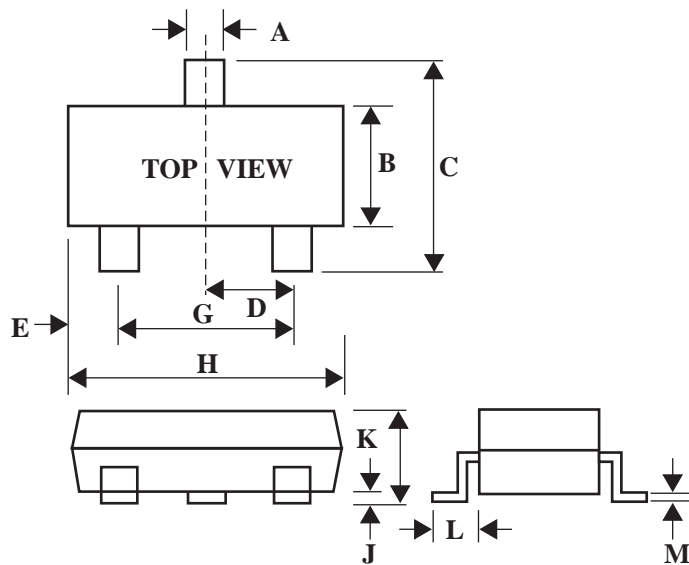
FIGURT 1: Saturated Turn-On Switching Time



FIGURT 2: Saturated Turn-Off Switching Time

**SOT-23 Outline Dimensions**

Unit:mm



Dim	Min	Max
A	0.35	0.51
B	1.19	1.40
C	2.10	3.00
D	0.85	1.05
E	0.46	1.00
G	1.70	2.10
H	2.70	3.10
J	0.01	0.13
K	0.89	1.10
L	0.30	0.61
M	0.076	0.25