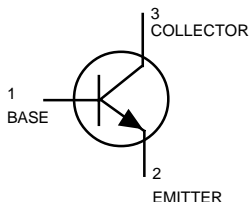
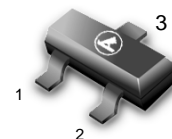


# General Purpose Transistors

## NPN Silicon



**MMBT2222LT1**  
**MMBT2222ALT1**



CASE 318-08, STYLE 6  
SOT-23 (TO-236AB)

### MAXIMUM RATINGS

Rating	Symbol	2222	2222A	Unit
Collector–Emitter Voltage	$V_{CE0}$	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	600	mAdc

### THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board, (1) $T_A = 25^\circ\text{C}$	$P_D$	225	mW
Derate above $25^\circ\text{C}$		1.8	mW/ $^\circ\text{C}$
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	556	$^\circ\text{C}/\text{W}$
Total Device Dissipation Alumina Substrate, (2) $T_A = 25^\circ\text{C}$	$P_D$	300	mW
Derate above $25^\circ\text{C}$		2.4	mW/ $^\circ\text{C}$
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	417	$^\circ\text{C}/\text{W}$
Junction and Storage Temperature	$T_J, T_{stg}$	-55 to +150	$^\circ\text{C}$

### DEVICE MARKING

MMBT2222LT1 = M1B; MMBT2222ALT1 = 1P;

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

Characteristic	Symbol	Min	Max	Unit
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### OFF CHARACTERISTICS

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

1. FR-5 =  $1.0 \times 0.75 \times 0.062\text{ in.}$

2. Alumina =  $0.4 \times 0.3 \times 0.024\text{ in.}$  99.5% alumina.

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**ELECTRICAL CHARACTERISTICS** (T A = 25°C unless otherwise noted) (Continued)

Characteristic	Symbol	Min	Max	Unit	
<b>ON CHARACTERISTICS</b>					
DC Current Gain (I <sub>C</sub> = 0.1 mAdc, V <sub>CE</sub> = 10 Vdc)	h <sub>FE</sub>	35	—	—	
(I <sub>C</sub> = 1.0 mAdc, V <sub>CE</sub> = 10 Vdc)		50	—	—	
(I <sub>C</sub> = 10 mAdc, V <sub>CE</sub> = 10 Vdc)		75	—	—	
(I <sub>C</sub> = 10 mAdc, V <sub>CE</sub> = 10 Vdc, T <sub>A</sub> = -55°C)		MMBT2222A only	35	—	—
(I <sub>C</sub> = 150 mAdc, V <sub>CE</sub> = 10 Vdc) (3)		100	300	—	
(I <sub>C</sub> = 150 mAdc, V <sub>CE</sub> = 1.0 Vdc) (3)		50	—	—	
(I <sub>C</sub> = 500 mAdc, V <sub>CE</sub> = 10 Vdc)(3)		MMBT2222 MMBT2222A	30 40	—	—
Collector–Emitter Saturation Voltage(3) (I <sub>C</sub> = 150 mAdc, I <sub>B</sub> = 15 mAdc)	V <sub>CE(sat)</sub>	—	0.4	Vdc	
		MMBT2222	—	0.3	
(I <sub>C</sub> = 500mAdc, I <sub>B</sub> = 50 mAdc)		MMBT2222	—	1.6	
		MMBT2222A	—	1.0	
Base–Emitter Saturation Voltage (I <sub>C</sub> = 150 mAdc, I <sub>B</sub> = 15 mAdc)	V <sub>BE(sat)</sub>	—	1.3	Vdc	
		MMBT2222	0.6	1.2	
(I <sub>C</sub> = 500 mAdc, I <sub>B</sub> = 50 mAdc)		MMBT2222	—	2.6	
		MMBT2222A	—	2.0	

**SMALL–SIGNAL CHARACTERISTICS**

Current–Gain — Bandwidth Product(4) (I <sub>C</sub> = 20mAdc, V <sub>CE</sub> = 20Vdc, f = 100MHz)	MMBT2222 MMBT2222A	f <sub>T</sub>	250 300	—	MHz
Output Capacitance(V <sub>CB</sub> = 10 Vdc, I <sub>E</sub> = 0, f = 1.0 MHz)		C <sub>obo</sub>	—	8.0	pF
Input Capacitance (V <sub>EB</sub> = 0.5 Vdc, I <sub>C</sub> = 0, f = 1.0 MHz)	MMBT2222 MMBT2222A	C <sub>ibo</sub>	—	30 25	pF
Input Impedance(V <sub>CE</sub> = 10 Vdc, I <sub>C</sub> = 1.0 mAdc, f = 1.0 kHz)	MMBT2222A	h <sub>ie</sub>	2.0	8.0	kΩ
(V <sub>CE</sub> = 10 Vdc, I <sub>C</sub> = 10 mAdc, f = 1.0 kHz)	MMBT2222A		0.25	1.25	
Voltage Feedback Ratio(V <sub>CE</sub> = 10 Vdc, I <sub>C</sub> = 1.0mAdc, f = 1.0kHz)	MMBT2222A	h <sub>re</sub>	—	8.0	X 10 <sup>-4</sup>
(V <sub>CE</sub> = 10 Vdc, I <sub>C</sub> = 10 mAdc, f = 1.0 kHz)	MMBT2222A		—	4.0	
Small–Signal Current Gain(V <sub>CE</sub> = 10Vdc, I <sub>C</sub> = 1.0mAdc, f = 1.0kHz)	MMBT2222A	h <sub>fe</sub>	50	300	—
(V <sub>CE</sub> = 10 Vdc, I <sub>C</sub> = 10 mAdc, f = 1.0 kHz)	MMBT2222A		75	375	
Output Admittance(V <sub>CE</sub> = 10 Vdc, I <sub>C</sub> = 1.0 mAdc, f = 1.0 kHz)	MMBT2222A	h <sub>oe</sub>	5.0	35	μmhos
(V <sub>CE</sub> = 10 Vdc, I <sub>C</sub> = 10 mAdc, f = 1.0 kHz)	MMBT2222A		25	200	
Current Base Time Constant (V <sub>CB</sub> = 20 Vdc, I <sub>E</sub> = 20 mAdc, f = 31.8 MHz)	MMBT2222A	r <sub>b</sub> , C <sub>c</sub>	—	150	ps
Noise Figure(V <sub>CE</sub> = 10Vdc, I <sub>C</sub> = 100μAdc, R <sub>s</sub> = 1.0kΩ, f = 1.0kHz)	MMBT2222A	NF	—	4.0	dB

**SWITCHING CHARACTERISTICS**

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

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

4. f<sub>T</sub> is defined as the frequency at which |h<sub>ie</sub>| extrapolates to unity.

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SWITCHING TIME EQUIVALENT TEST CIRCUITS

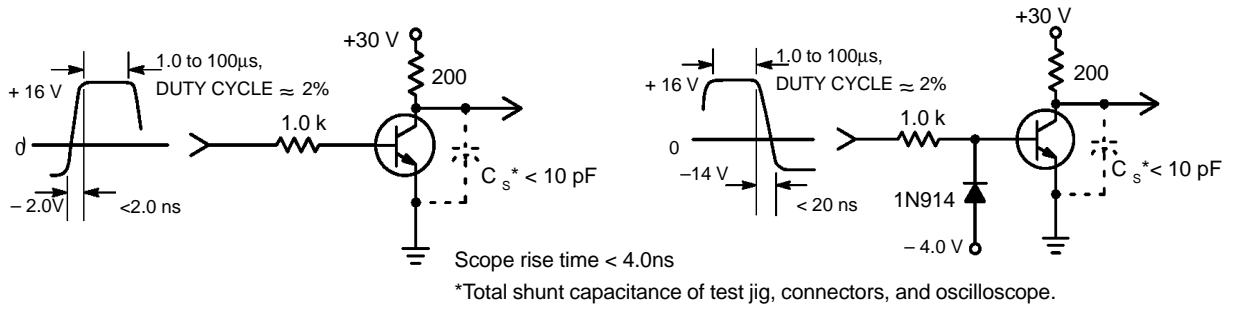


Figure 1. Turn-On Time

Figure 2. Turn-Off Time

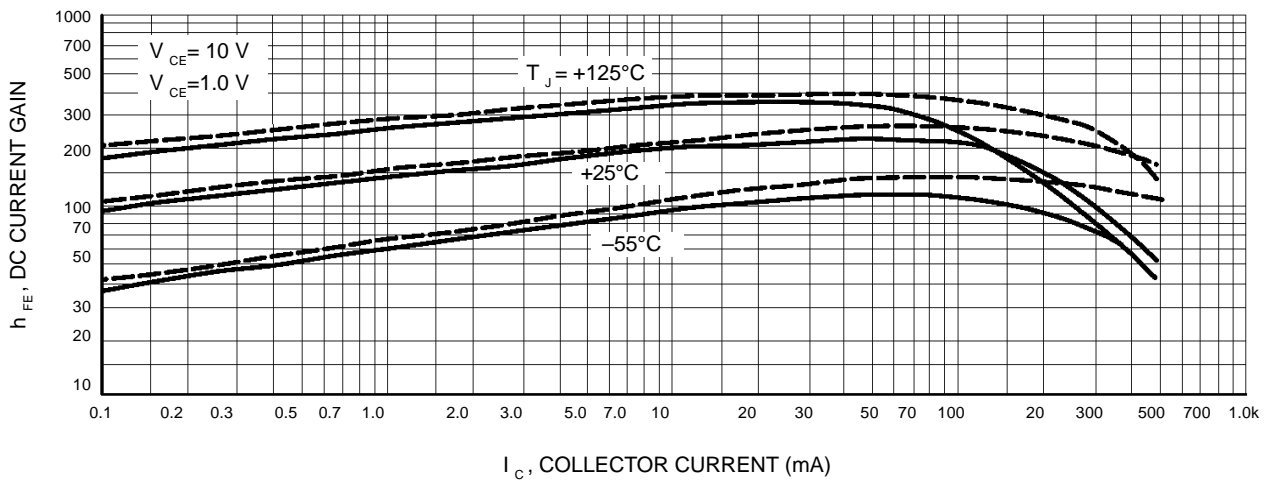


Figure 3. DC Current Gain

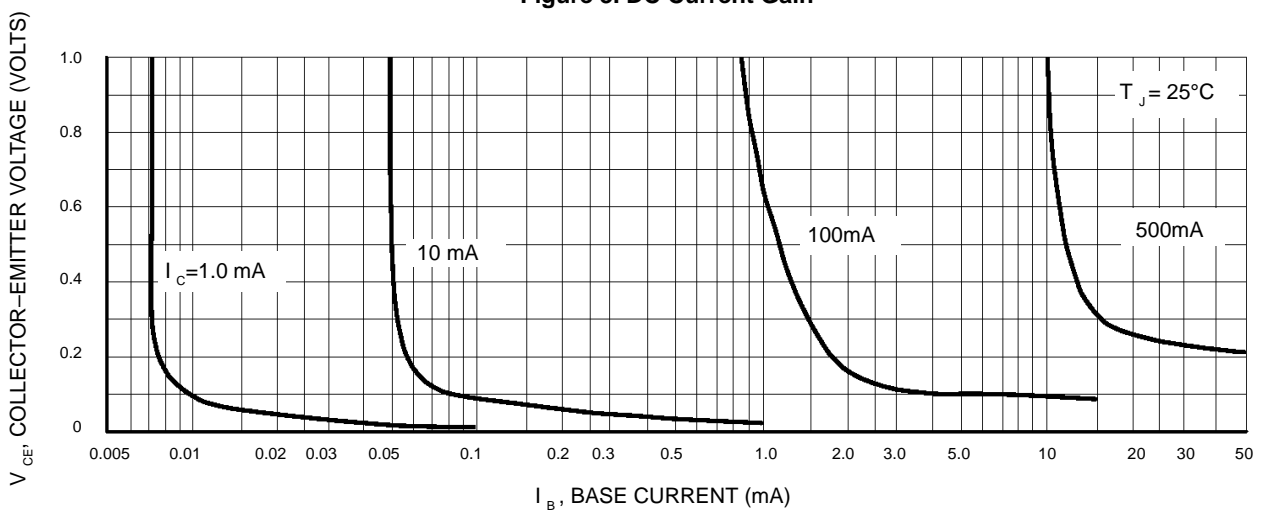
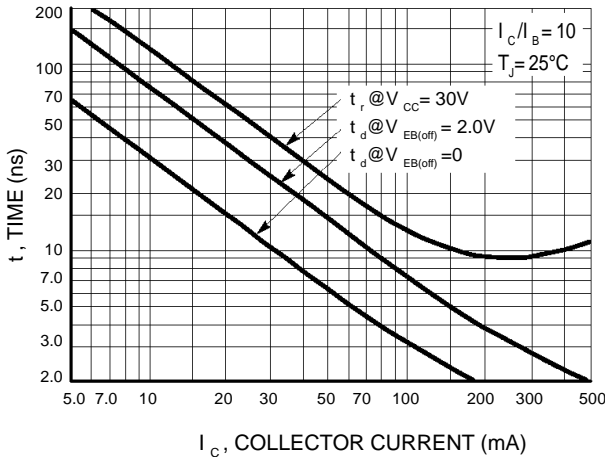
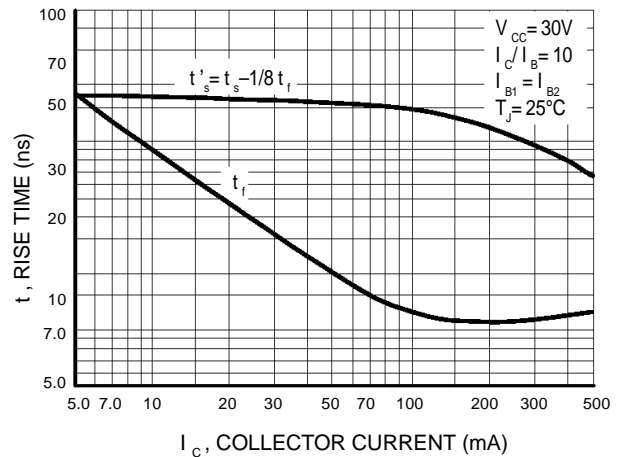


Figure 4. Collector Saturation Region

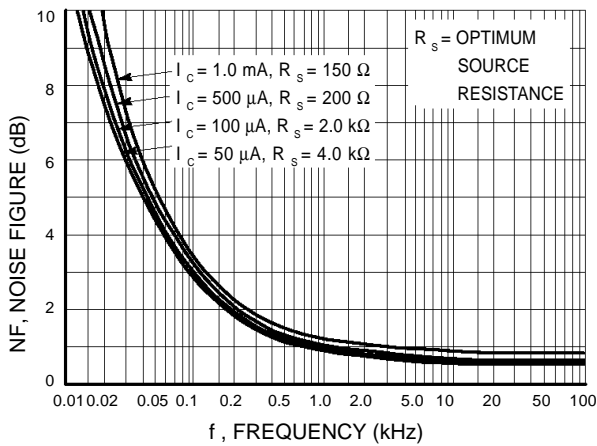
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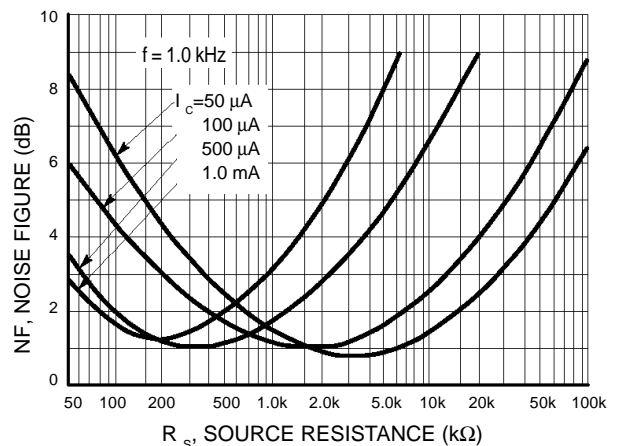
**Figure 5. Turn-On Time**



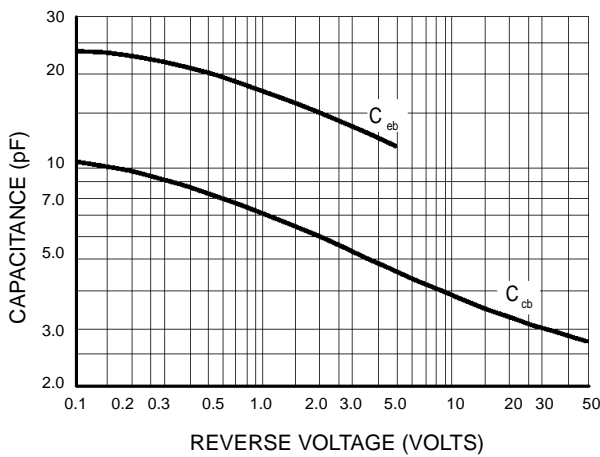
**Figure 6. Turn - Off Time**



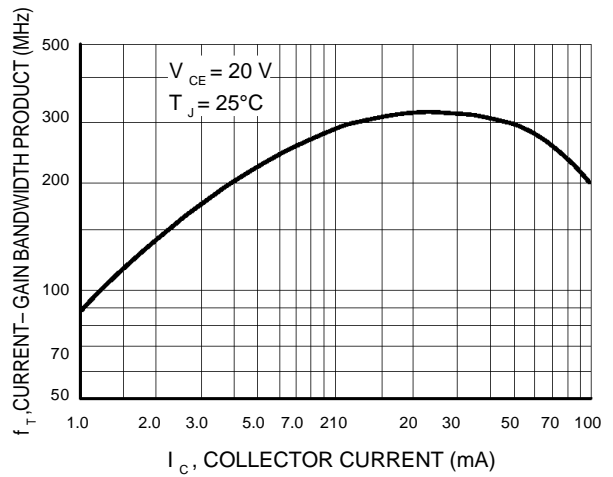
**Figure 7. Frequency Effects**



**Figure 8. Source Resistance Effects**

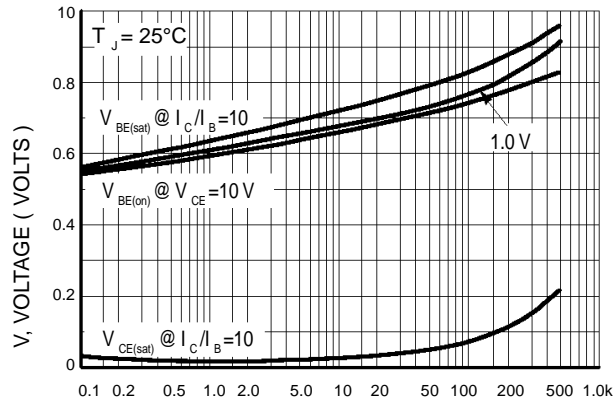


**Figure 9. Capacitance**

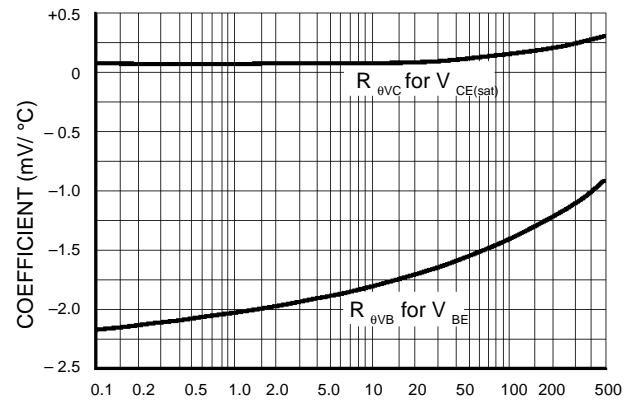


**Figure 10. Current-Gain Bandwidth Product**

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$I_C$ , COLLECTOR CURRENT (mA)  
Figure 11. "On" Voltages



$I_C$ , COLLECTOR CURRENT (mA)  
Figure 12. Temperature Coefficients