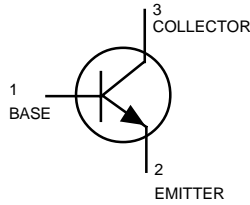


General Purpose Transistors

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°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°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	μAdc
($V_{CB} = 60\text{ Vdc}, I_E = 0$)	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	
ON CHARACTERISTICS					
DC Current Gain (I _C = 0.1 mA _{dc} , V _{CE} = 10 V _{dc})	h _{FE}	35	—	—	
(I _C = 1.0 mA _{dc} , V _{CE} = 10 V _{dc})		50	—	—	
(I _C = 10 mA _{dc} , V _{CE} = 10 V _{dc})		75	—	—	
(I _C = 10 mA _{dc} , V _{CE} = 10 V _{dc} , T _A = -55°C)		MMBT2222A only	35	—	—
(I _C = 150 mA _{dc} , V _{CE} = 10 V _{dc}) (3)		100	300	—	
(I _C = 150 mA _{dc} , V _{CE} = 1.0 V _{dc}) (3)		50	—	—	
(I _C = 500 mA _{dc} , V _{CE} = 10 V _{dc}) (3)		MMBT2222 MMBT2222A	30 40	—	—
Collector–Emitter Saturation Voltage(3) (I _C = 150 mA _{dc} , I _B = 15 mA _{dc})	V _{CE(sat)}	—	0.4	V _{dc}	
		MMBT2222	—	0.3	
(I _C = 500mA _{dc} , I _B = 50 mA _{dc})		MMBT2222	—	1.6	
		MMBT2222A	—	1.0	
Base–Emitter Saturation Voltage (I _C = 150 mA _{dc} , I _B = 15 mA _{dc})	V _{BE(sat)}	—	1.3	V _{dc}	
		MMBT2222	0.6	1.2	
(I _C = 500 mA _{dc} , I _B = 50 mA _{dc})		MMBT2222	—	2.6	
		MMBT2222A	—	2.0	

SMALL–SIGNAL CHARACTERISTICS

Current–Gain — Bandwidth Product(4) (I _C = 20mA _{dc} , V _{CE} = 20V _{dc} , f = 100MHz)	MMBT2222 MMBT2222A	f _T	250 300	—	MHz
Output Capacitance(V _{CB} = 10 V _{dc} , I _E = 0, f = 1.0 MHz)		C _{obo}	—	8.0	pF
Input Capacitance (V _{EB} = 0.5 V _{dc} , I _C = 0, f = 1.0 MHz)	MMBT2222 MMBT2222A	C _{ibo}	—	30 25	pF
Input Impedance(V _{CE} = 10 V _{dc} , I _C = 1.0 mA _{dc} , f = 1.0 kHz)	MMBT2222A	h _{ie}	2.0	8.0	kΩ
(V _{CE} = 10 V _{dc} , I _C = 10 mA _{dc} , f = 1.0 kHz)	MMBT2222A		0.25	1.25	
Voltage Feedback Ratio(V _{CE} = 10 V _{dc} , I _C = 1.0mA _{dc} , f = 1.0kHz)	MMBT2222A	h _{re}	—	8.0	X 10 ⁻⁴
(V _{CE} = 10 V _{dc} , I _C = 10 mA _{dc} , f = 1.0 kHz)	MMBT2222A		—	4.0	
Small–Signal Current Gain(V _{CE} = 10V _{dc} , I _C = 1.0mA _{dc} , f = 1.0kHz)	MMBT2222A	h _{fe}	50	300	—
(V _{CE} = 10 V _{dc} , I _C = 10 mA _{dc} , f = 1.0 kHz)	MMBT2222A		75	375	
Output Admittance(V _{CE} = 10 V _{dc} , I _C = 1.0 mA _{dc} , f = 1.0 kHz)	MMBT2222A	h _{oe}	5.0	35	μmhos
(V _{CE} = 10 V _{dc} , I _C = 10 mA _{dc} , f = 1.0 kHz)	MMBT2222A		25	200	
Current Base Time Constant (V _{CB} = 20 V _{dc} , I _E = 20 mA _{dc} , f = 31.8 MHz)	MMBT2222A	r _b , C _c	—	150	ps
Noise Figure(V _{CE} = 10V _{dc} , I _C = 100μA _{dc} , R _s = 1.0kΩ, f = 1.0kHz)	MMBT2222A	NF	—	4.0	dB

SWITCHING CHARACTERISTICS

Delay Time	(V _{CC} = 30 V _{dc} , V _{EB(off)} = -0.5 V _{dc})	t _d	—	10	ns
Rise Time	I _C = 150 mA _{dc} , I _{B1} = 15 mA _{dc})	t _r	—	25	
Storage Time	(V _{CC} = 30 V _{dc} , I _C = 150 mA _{dc})	t _s	—	225	ns
Fall Time	I _{B1} = I _{B2} = 15 mA _{dc})	t _f	—	60	

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

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

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SWITCHING TIME EQUIVALENT TEST CIRCUITS

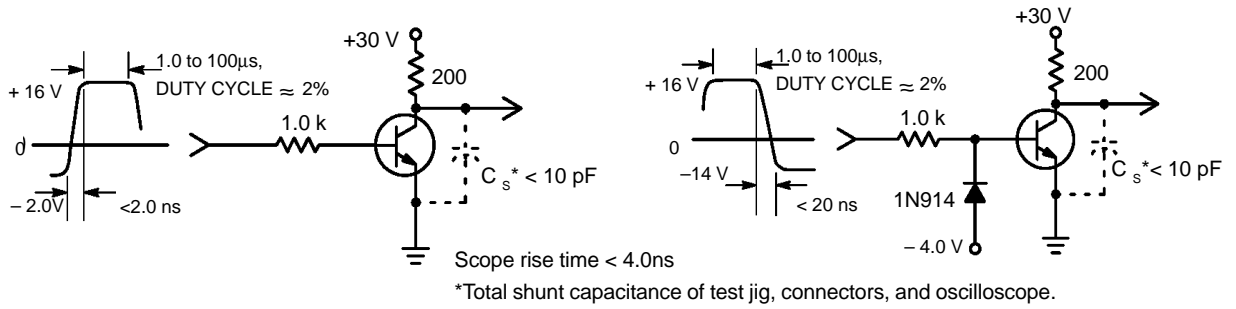


Figure 1. Turn-On Time

Figure 2. Turn-Off Time

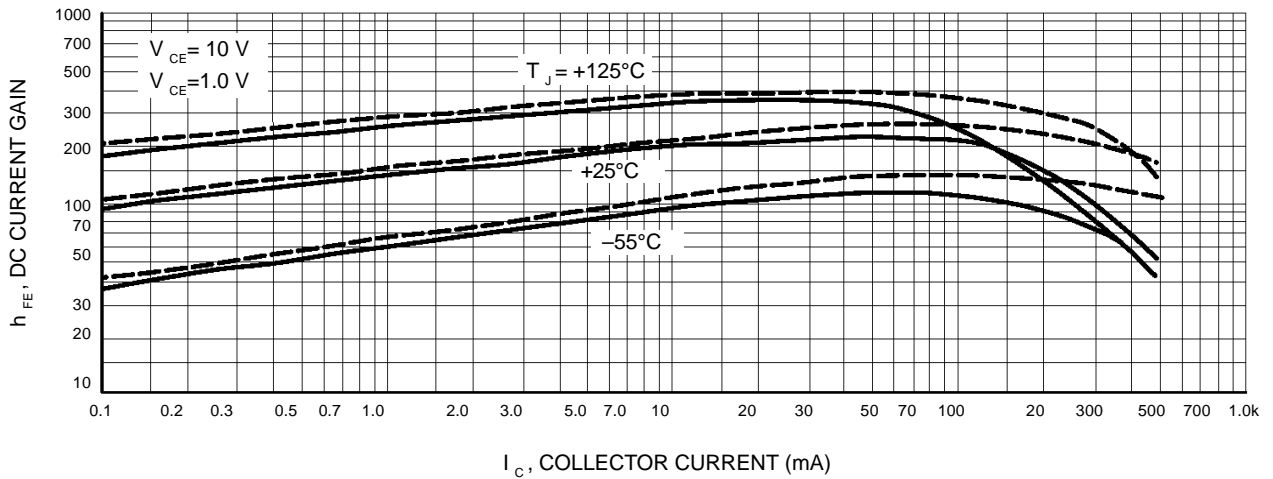


Figure 3. DC Current Gain

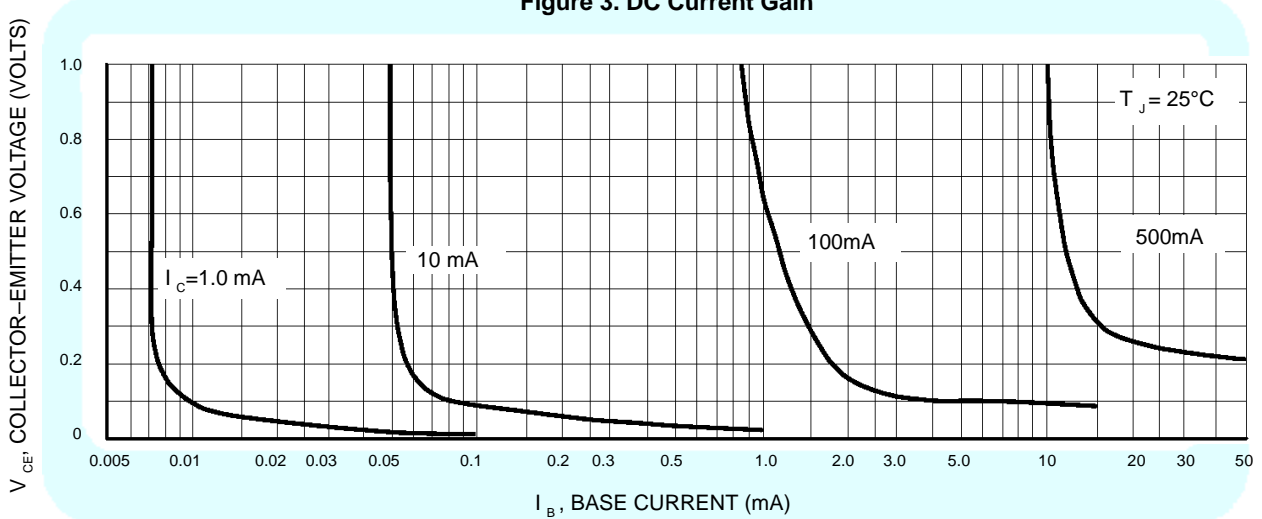


Figure 4. Collector Saturation Region

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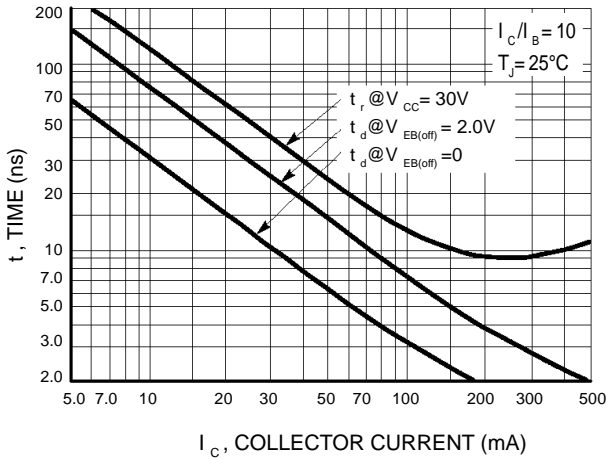


Figure 5. Turn-On Time

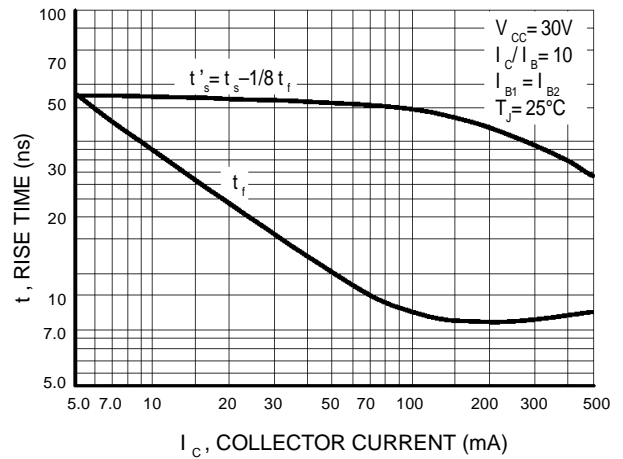


Figure 6. Turn - Off Time

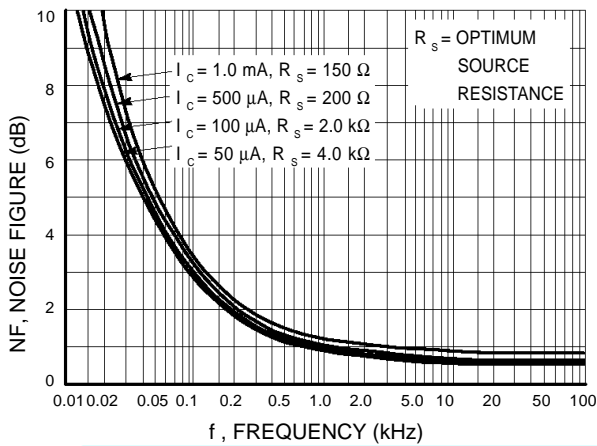


Figure 7. Frequency Effects

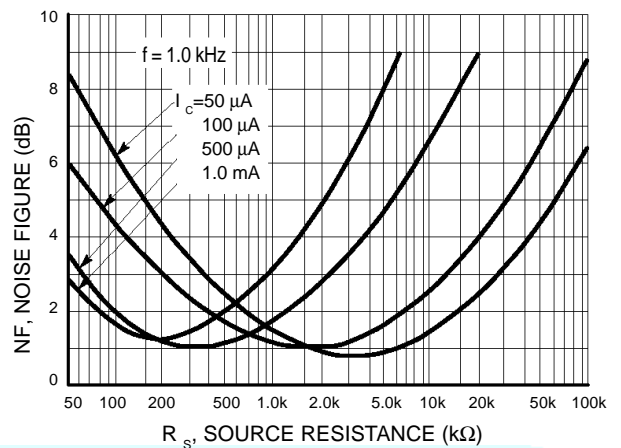


Figure 8. Source Resistance Effects

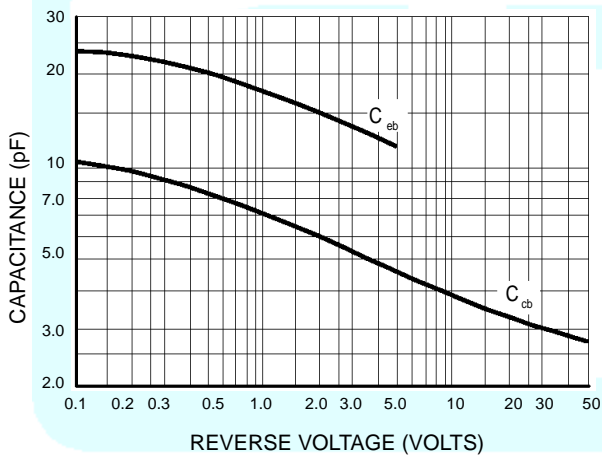


Figure 9. Capacitance

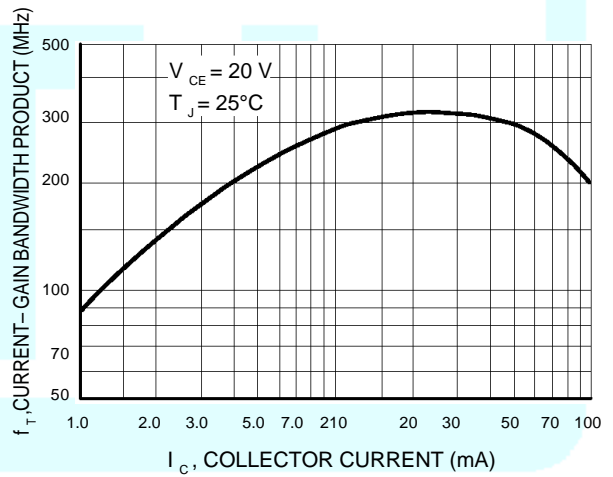
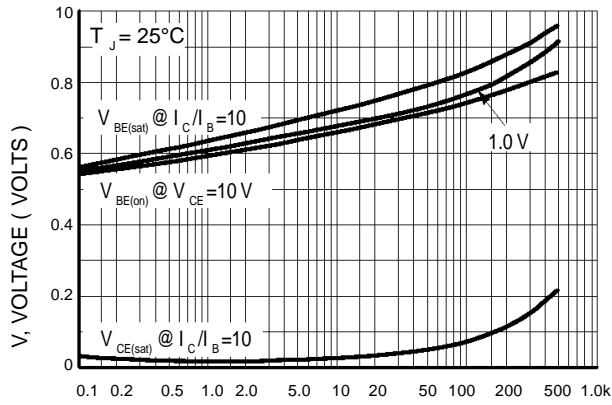


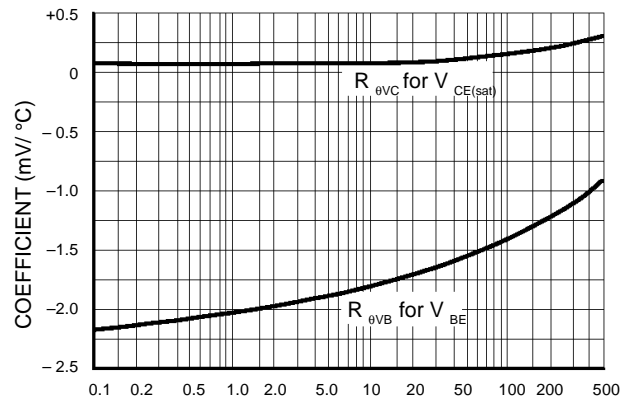
Figure 10. Current-Gain Bandwidth Product

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I_C , COLLECTOR CURRENT (mA)

Figure 11. "On" Voltages



I_C , COLLECTOR CURRENT (mA)

Figure 12. Temperature Coefficients