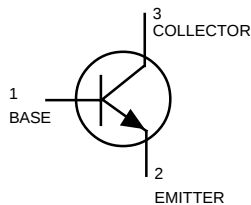


General Purpose Transistors

NPN Silicon



MMBT2222LT1
MMBT2222ALT1



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

MAXIMUM RATINGS

Rating	Symbol	2222	2222A	Unit
Collector–Emitter Voltage	V_{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	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	$^\circ\text{C/W}$
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	$^\circ\text{C/W}$
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	$V_{(BR)CEO}$	30	—	Vdc
	MMBT2222A		40	—	
Collector–Base Breakdown Voltage ($I_C = 10\text{ }\mu\text{Adc}, I_E = 0$)	MMBT2222	$V_{(BR)CBO}$	60	—	Vdc
	MMBT2222A		75	—	
Emitter–Base Breakdown Voltage ($I_E = 10\text{ }\mu\text{Adc}, I_C = 0$)	MMBT2222	$V_{(BR)EBO}$	5.0	—	Vdc
	MMBT2222A		6.0	—	
Collector Cutoff Current ($V_{CE} = 60\text{ Vdc}, I_{E(off)} = 3.0\text{ Vdc}$)	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.

MMBT2222LT1 MMBT2222ALT1

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted) (Continued)

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

SMALL-SIGNAL CHARACTERISTICS

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

SWITCHING CHARACTERISTICS

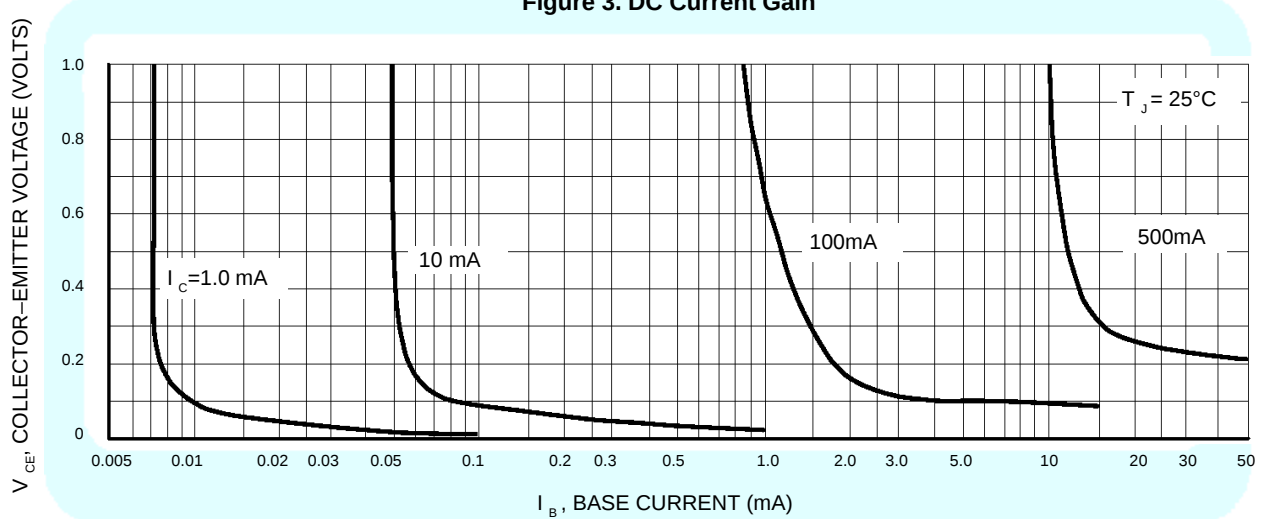
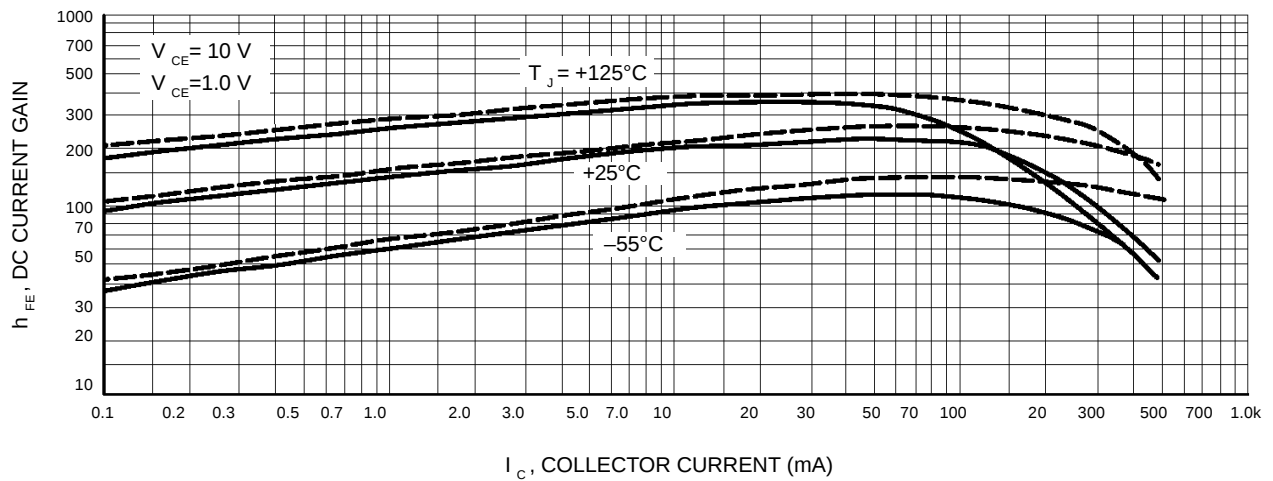
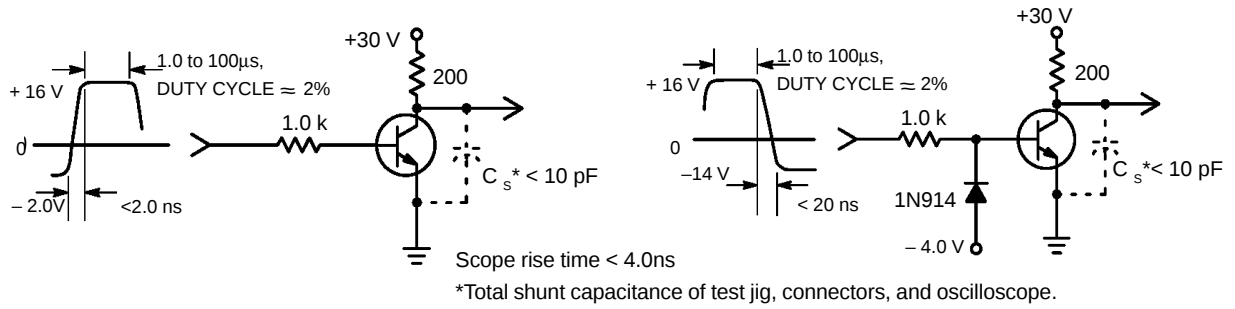
Delay Time	(V _{CC} = 30 Vdc, V _{EB(off)} = -0.5 Vdc)	t _d	—	10	ns
Rise Time	I _C = 150 mAdc, I _{B1} = 15 mAdc)	t _r	—	25	
Storage Time	(V _{CC} = 30 Vdc, I _C = 150 mAdc)	t _s	—	225	ns
Fall Time	I _{B1} = I _{B2} = 15 mAdc)	t _f	—	60	

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

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

MMBT2222LT1 MMBT2222ALT1

SWITCHING TIME EQUIVALENT TEST CIRCUITS



MMBT2222LT1 MMBT2222ALT1

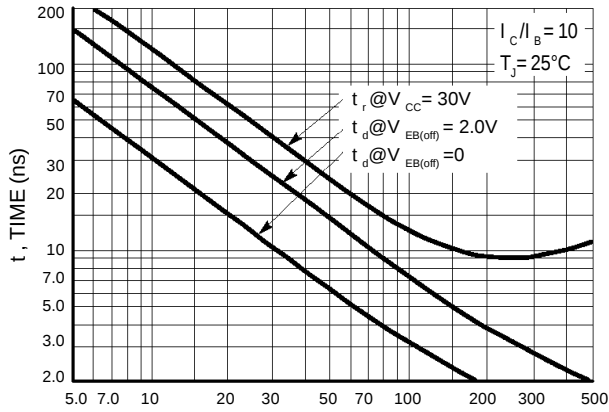


Figure 5. Turn-On Time

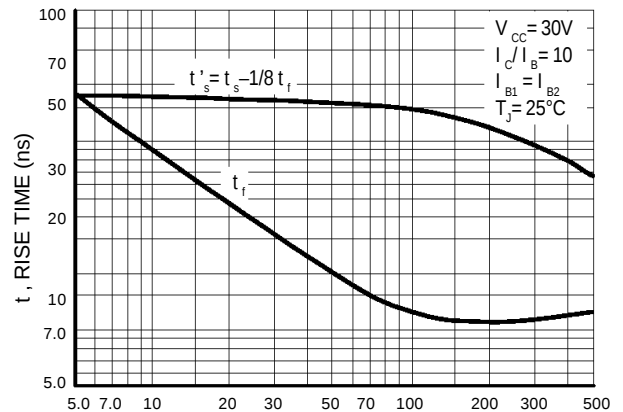


Figure 6. Turn - Off Time

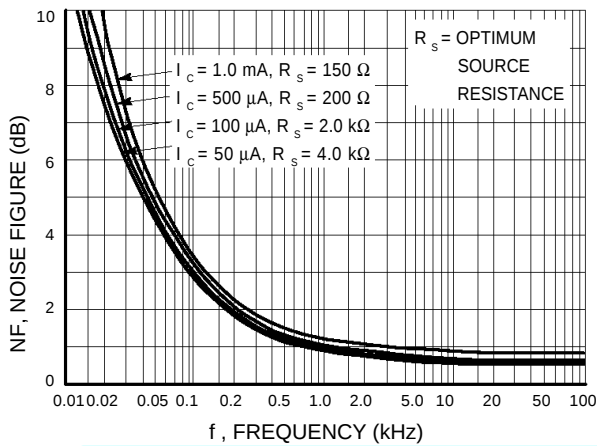


Figure 7. Frequency Effects

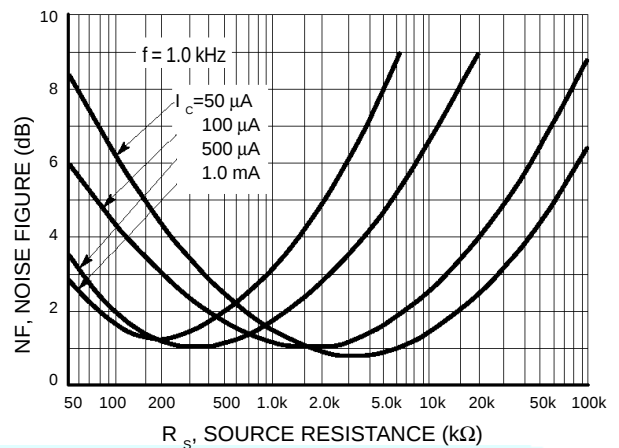


Figure 8. Source Resistance Effects

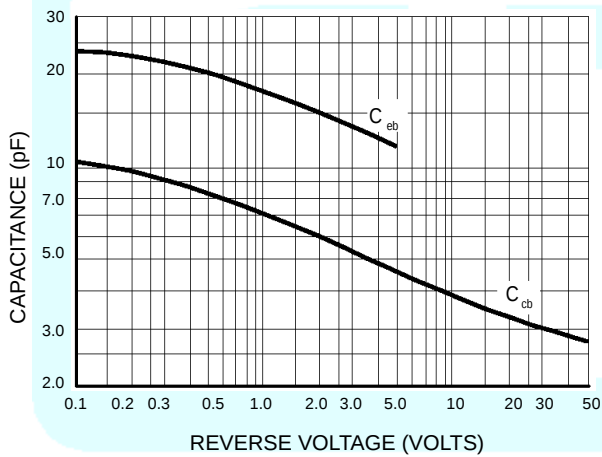


Figure 9. Capacitance

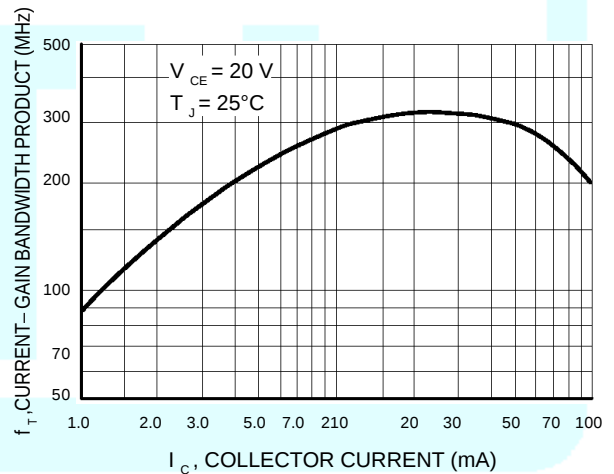
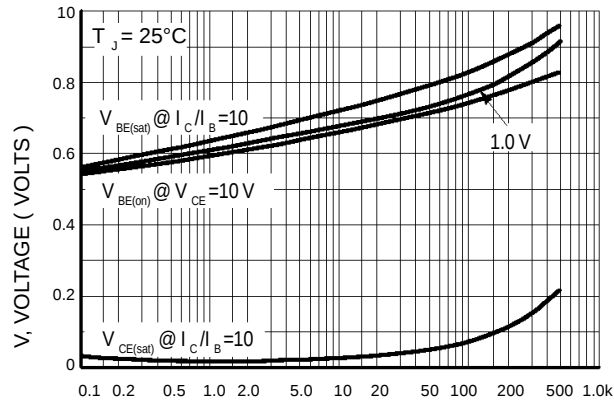
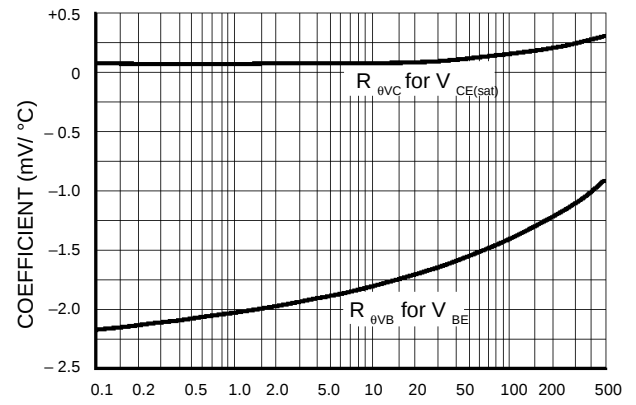


Figure 10. Current-Gain Bandwidth Product

MMBT2222LT1 MMBT2222ALT1



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



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