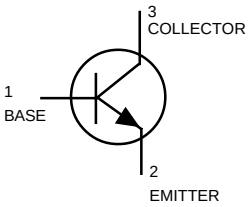
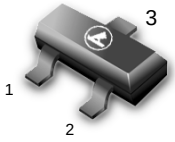
General Purpose Transistors

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°C	P_D	225	mW
Derate above 25°C		1.8	mW/°C
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	556	°C/W
Total Device Dissipation Alumina Substrate, (2) T_A = 25°C	P_D	300	mW
Derate above 25°C		2.4	mW/°C
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	417	°C/W
Junction and Storage Temperature	T_J , T_{stg}	–55 to +150	°C

DEVICE MARKING

MMBT2222LT1 = M1B; MMBT2222ALT1 = 1P;

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

Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS					
Collector–Emitter Breakdown Voltage	MMBT2222	$V_{(BR)CEO}$	30	—	Vdc
(I_C = 10 mAdc, I_B = 0)	MMBT2222A		40	—	
Collector–Base Breakdown Voltage	MMBT2222	$V_{(BR)CBO}$	60	—	Vdc
(I_C = 10 µAdc, I_E = 0)	MMBT2222A		75		
Emitter–Base Breakdown Voltage	MMBT2222	$V_{(BR)EBO}$	5.0	—	Vdc
(I_E = 10 µAdc, I_C = 0)	MMBT2222A		6.0	—	
Collector Cutoff Current	MMBT2222A	I_{CEX}	—	10	nAdc
(V_{CE} = 60 Vdc, $I_{EB(off)}$ = 3.0Vdc)					
Collector Cutoff Current		I_{CBO}			µAdc
(V_{CB} = 50 Vdc, I_E = 0)	MMBT2222		—	0.01	
(V_{CB} = 60 Vdc, I_E = 0)	MMBT2222A		—	0.01	
(V_{CB} = 50 Vdc, I_E = 0, T_A = 125°C)	MMBT2222		—	10	
(V_{CB} = 60 Vdc, I_E = 0, T_A = 125°C)	MMBT2222A		—	10	
Emitter Cutoff Current					
(V_{EB} = 3.0 Vdc, I_C = 0)	MMBT2222A	I_{EBO}	—	100	nAdc
Base Cutoff Current					
(V_{CE} = 60 Vdc, $V_{EB(off)}$ = 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.

MMBT2222LT1 MMBT2222ALT1

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

Characteristic		Symbol	Min	Max	Unit
ON CHARACTERISTICS					
DC Current Gain		h_{FE}			—
(I_C = 0.1 mAdc, V_{CE} = 10 Vdc)			35	—	
(I_C = 1.0 mAdc, V_{CE} = 10 Vdc)			50	—	
(I_C = 10 mAdc, V_{CE} = 10 Vdc)			75	—	
(I_C = 10 mAdc, V_{CE} = 10 Vdc,T_A = –55°C)	MMBT2222A only		35	—	
(I_C = 150 mAdc, V_{CE} = 10 Vdc) (3)			100	300	
(I_C = 150 mAdc, V_{CE} = 1.0 Vdc) (3)			50	—	
(I_C = 500 mAdc, V_{CE} = 10 Vdc)(3)	MMBT2222		30	—	
	MMBT2222A		40	—	
Collector–Emitter Saturation Voltage(3)		$V_{CE(sat)}$			Vdc
(I_C = 150 mAdc, I_B = 15 mAdc)	MMBT2222		—	0.4	
	MMBT2222A		—	0.3	
(I_C = 500mAdc, I_B = 50 mAdc)	MMBT2222		—	1.6	
	MMBT2222A		—	1.0	
Base–Emitter Saturation Voltage		$V_{BE(sat)}$			Vdc
(I_C = 150 mAdc, I_B = 15 mAdc)	MMBT2222		—	1.3	
	MMBT2222A		0.6	1.2	
(I_C = 500 mAdc, I_B = 50 mAdc)	MMBT2222		—	2.6	
	MMBT2222A		—	2.0	
SMALL–SIGNAL CHARACTERISTICS					
Current–Gain — Bandwidth Product(4)	MMBT2222	f_T	250	—	MHz
(I_C = 20mAdc, V_{CE}= 20Vdc, f = 100MHz)	MMBT2222A		300	—	
Output Capacitance(V_{CB} = 10 Vdc, I_E = 0, f = 1.0 MHz)		C_{obo}	—	8.0	pF
Input Capacitance	MMBT2222	C_{ibo}	—	30	pF
(V_{EB} = 0.5 Vdc, I_C = 0, f = 1.0 MHz)	MMBT2222A		—	25	
Input Impedance(V_{CE}= 10 Vdc, I_C = 1.0 mAdc, f = 1.0 kHz)	MMBT2222A	h_{ie}	2.0	8.0	kΩ
(V_{CE}= 10 Vdc, I_C = 10 mAdc, f = 1.0 kHz)	MMBT2222A		0.25	1.25	
Voltage Feedback Ratio(V_{CE}=10 Vdc, I_C= 1.0mAdc, f =1.0kHz)	MMBT2222A	h_{re}	–-	8.0	X 10^{-4}
(V_{CE}= 10 Vdc, I_C = 10 mAdc, f = 1.0 kHz)	MMBT2222A		—	4.0	
Small–Signal Current Gain(V_{CE}=10Vdc,I_C=1.0mAdc, f=1.0kHz)	MMBT2222A	h_{fe}	50	300	—
(V_{CE}= 10 Vdc, I_C = 10 mAdc, f = 1.0 kHz)	MMBT2222A		75	375	
Output Admittance(V_{CE}=10 Vdc, I_C = 1.0 mAdc,f =1.0 kHz)	MMBT2222A	h_{oe}	5.0	35	µmhos
(V_{CE}= 10 Vdc, I_C = 10 mAdc, f = 1.0 kHz)	MMBT2222A		25	200	
Curren Base Time Comstant					
(V_{CB}= 20 Vdc, I_E = 20 mAdc, f = 31.8 MHz)	MMBT2222A	rb, 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	
Rise Time	I_C = 150 mAdc, I_{B1} = 15 mAdc)	t_r	—	25	ns
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 $|h_{fe}|$ extrapolates to unity.

MMBT2222LT1 MMBT2222ALT1

SWITCHING TIME EQUIVALENT TEST CIRCUITS

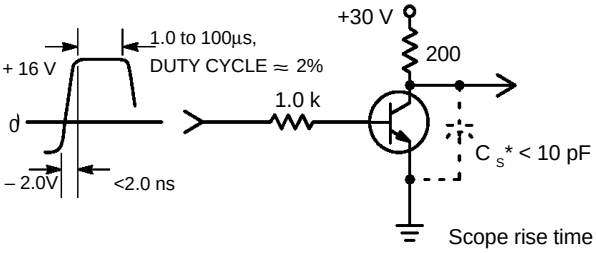


Figure 1. Turn–On Time

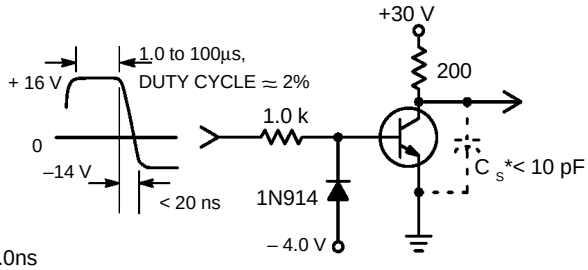


Figure 2. Turn–Off Time

Scope rise time < 4.0ns

*Total shunt capacitance of test jig, connectors, and oscilloscope.

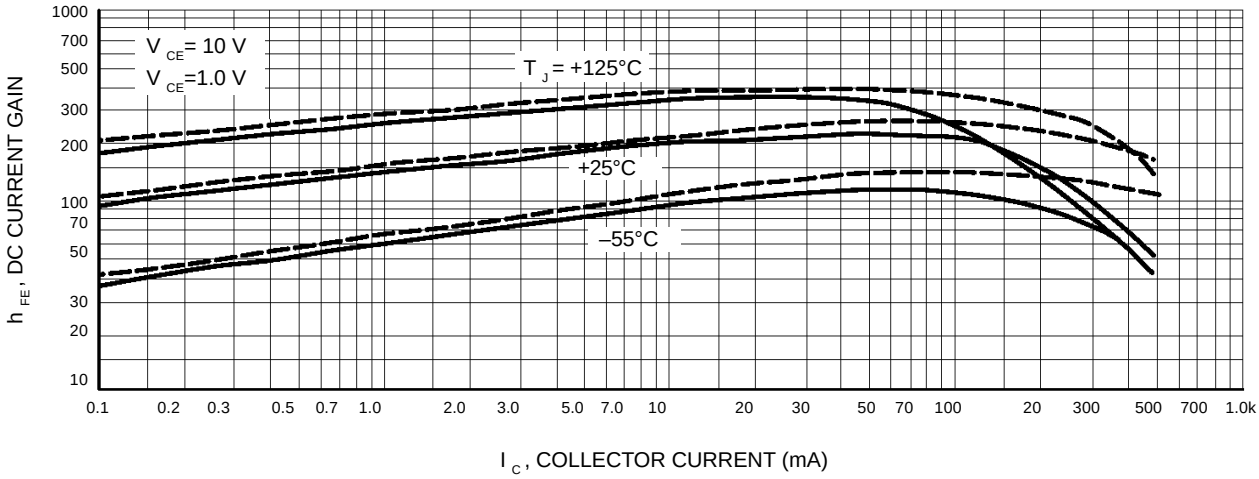


Figure 3. DC Current Gain

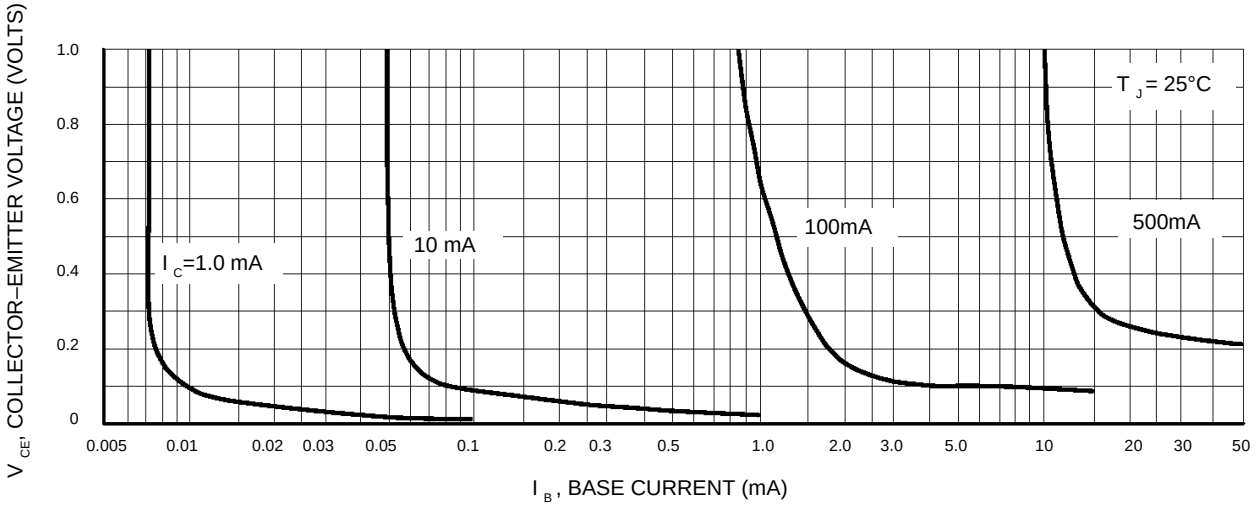


Figure 4. Collector Saturation Region

MMBT2222LT1 MMBT2222ALT1

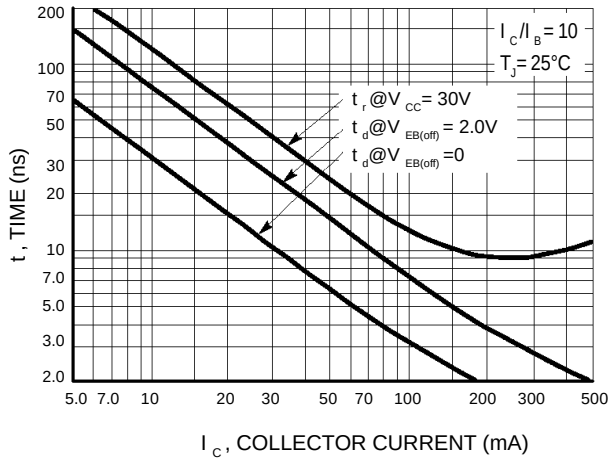


Figure 5. Turn–On Time

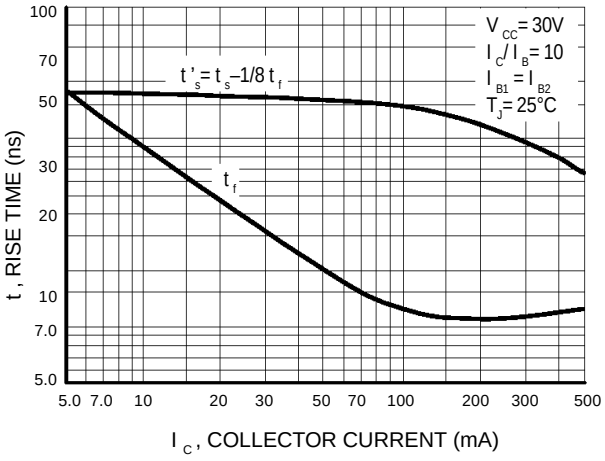


Figure 6. Turn - Off Time

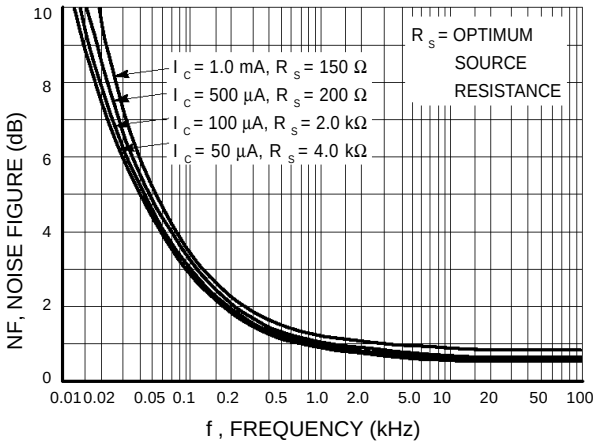


Figure 7. Frequency Effects

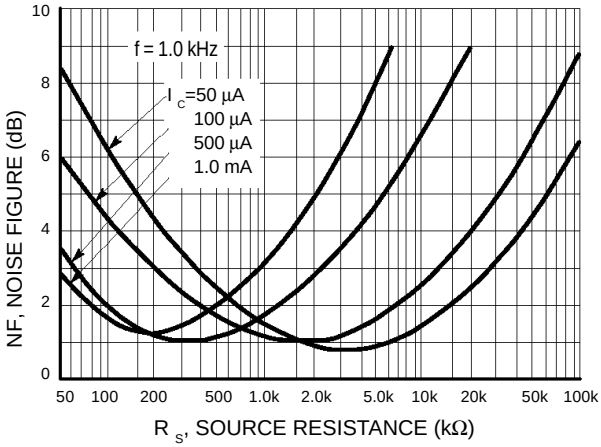


Figure 8. Source Resistance Effects

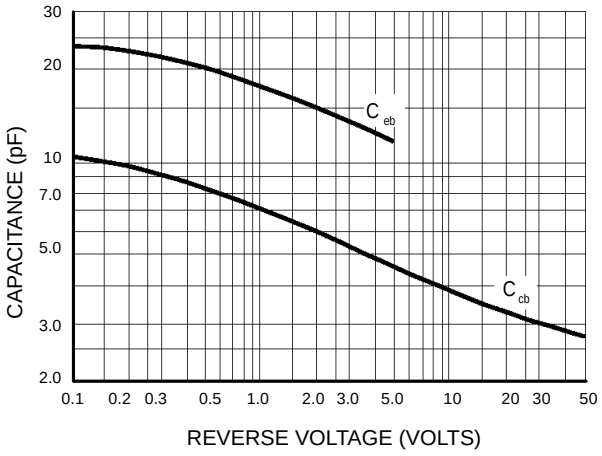


Figure 9. Capacitance

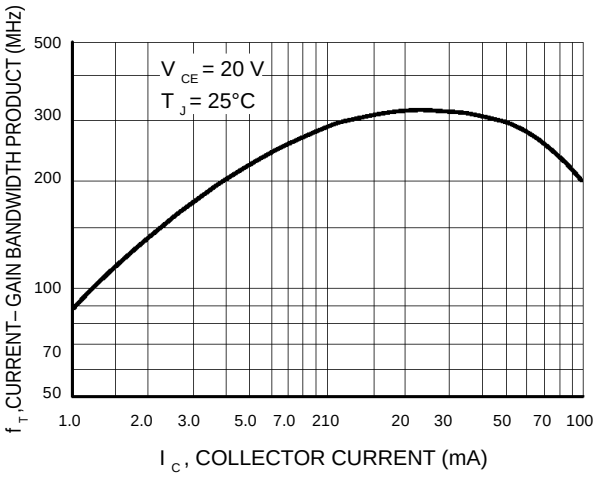
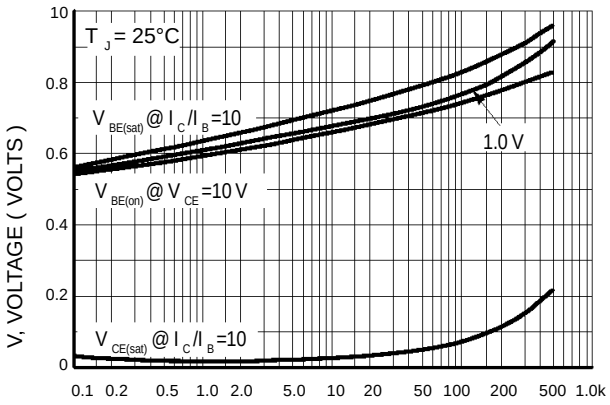
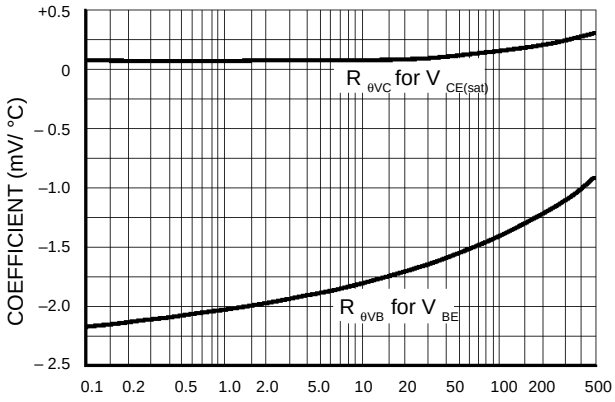


Figure 10. Current– Gain Bandwidth Product



I C , COLLECTOR CURRENT (mA)

Figure 11. “On” Voltages



I C , COLLECTOR CURRENT (mA)

Figure 12. Temperature Coefficients