



DATA SHEET

SEMICONDUCTOR

MMBT2222 & MMBT2222A

General Purpose Transistors

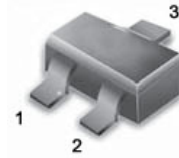


NPN Silicon

- We declare that the material of product compliance with RoHS requirements.

MAXIMUM RATINGS

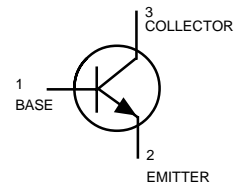
Rating	Symbol	2222	2222A	Unit
Collector–Emitter Voltage	V_{CEO}	30	40	Vdc
Collector–Base Voltage	V_{CBO}	60	75	Vdc
Emitter–Base Voltage	V_{EBO}	5.0	6.0	Vdc
Collector Current — Continuous	I_C	600	600	mAdc



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THERMAL CHARACTERISTICS

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



ORDERING INFORMATION

Device	Marking	Shipping
MMBT2222	M1B	3000/Tape & Reel
MMBT2222A	1P	3000/Tape & Reel

DEVICE MARKING

MMBT2222 = M1B ; MMBT2222A = 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 x 0.75 x 0.062 in.

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

MMBT2222 & MMBT2222A

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}) (I _C = 1.0 mA _{dc} , V _{CE} = 10 V _{dc}) (I _C = 10 mA _{dc} , V _{CE} = 10 V _{dc}) (I _C = 10 mA _{dc} , V _{CE} = 10 V _{dc} , T _A = -55°C) (I _C = 150 mA _{dc} , V _{CE} = 10 V _{dc}) (3) (I _C = 150 mA _{dc} , V _{CE} = 1.0 V _{dc}) (3) (I _C = 500 mA _{dc} , V _{CE} = 10 V _{dc}) (3)	h _{FE}	35 50 75 35 100 50 30 40	— — — — 300 — — —	—
				MMBT2222A only
				MMBT2222
				MMBT2222A
Collector–Emitter Saturation Voltage(3) (I _C = 150 mA _{dc} , I _B = 15 mA _{dc}) (I _C = 500mA _{dc} , I _B = 50 mA _{dc})	V _{CE(sat)}	— — —	0.4 0.3 1.6 1.0	V _{dc}
				MMBT2222
				MMBT2222A
				MMBT2222
				MMBT2222A
Base–Emitter Saturation Voltage (I _C = 150 mA _{dc} , I _B = 15 mA _{dc}) (I _C = 500 mA _{dc} , I _B = 50 mA _{dc})	V _{BE(sat)}	— 0.6 —	1.3 1.2 2.6 2.0	V _{dc}
				MMBT2222
				MMBT2222A
				MMBT2222
				MMBT2222A

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) (V _{CE} = 10 V _{dc} , I _C = 10 mA _{dc} , f = 1.0 kHz)	MMBT2222A MMBT2222A	h _{ie}	2.0 0.25	8.0 1.25	kΩ
Voltage Feedback Ratio(V _{CE} = 10 V _{dc} , I _C = 1.0 mA _{dc} , f = 1.0 kHz) (V _{CE} = 10 V _{dc} , I _C = 10 mA _{dc} , f = 1.0 kHz)	MMBT2222A MMBT2222A	h _{re}	— —	8.0 4.0	X 10 ⁻⁴
Small–Signal Current Gain(V _{CE} = 10 V _{dc} , I _C = 1.0 mA _{dc} , f = 1.0 kHz) (V _{CE} = 10 V _{dc} , I _C = 10 mA _{dc} , f = 1.0 kHz)	MMBT2222A MMBT2222A	h _{fe}	50 75	300 375	—
Output Admittance(V _{CE} = 10 V _{dc} , I _C = 1.0 mA _{dc} , f = 1.0 kHz) (V _{CE} = 10 V _{dc} , I _C = 10 mA _{dc} , f = 1.0 kHz)	MMBT2222A MMBT2222A	h _{oe}	5.0 25	35 200	μmhos
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} = 10 V _{dc} , I _C = 100 μA _{dc} , R _S = 1.0 kΩ, f = 1.0 kHz)	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.

DEVICE CHARACTERISTICS

MMBT2222 & MMBT2222A

SWITCHING TIME EQUIVALENT TEST CIRCUITS

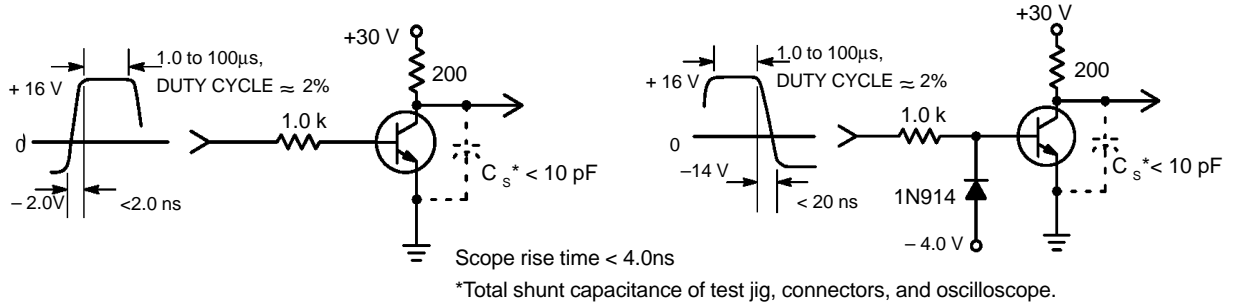


Figure 1. Turn-On Time

Figure 2. Turn-Off Time

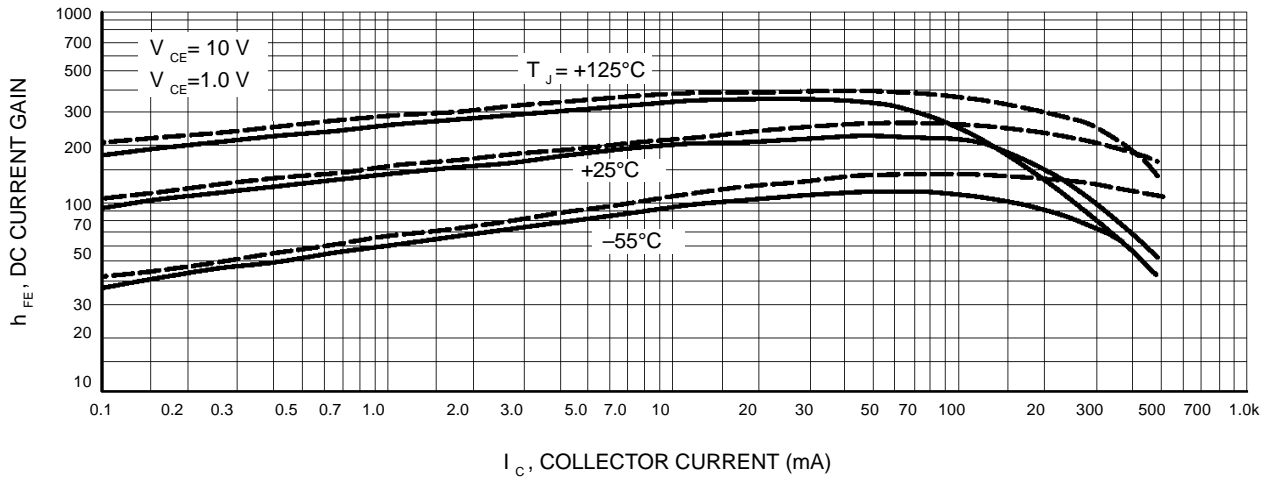


Figure 3. DC Current Gain

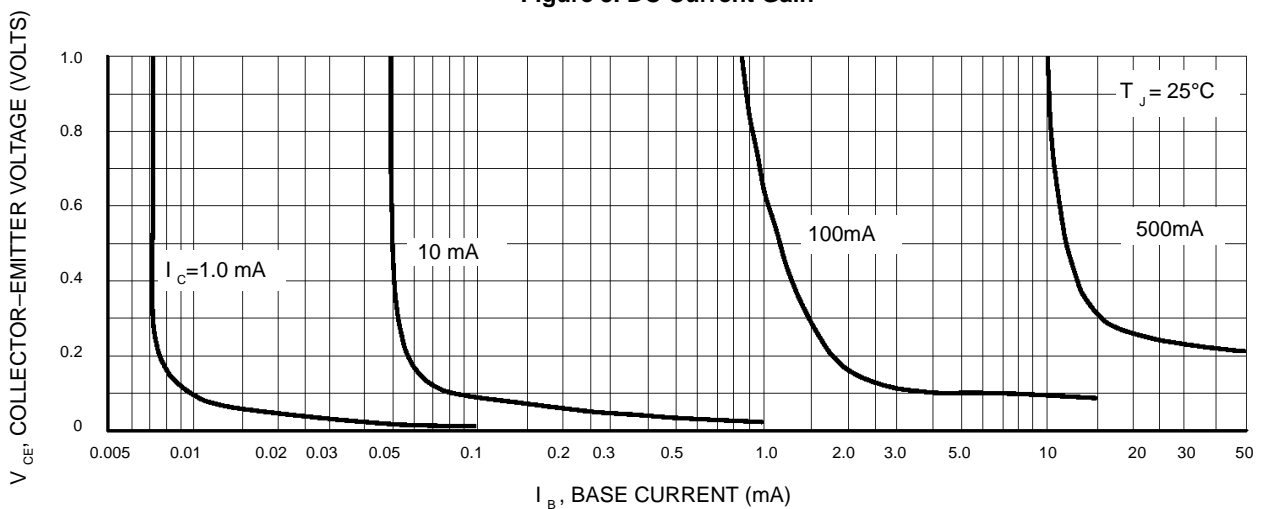


Figure 4. Collector Saturation Region

DEVICE CHARACTERISTICS

MMBT2222 & MMBT2222A

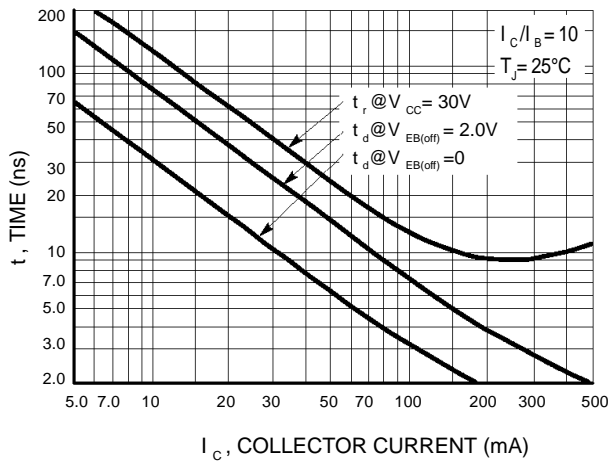


Figure 5. Turn-On Time

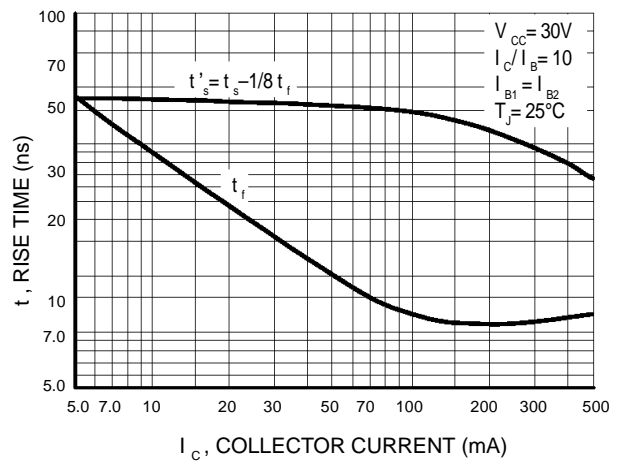


Figure 6. Turn - Off Time

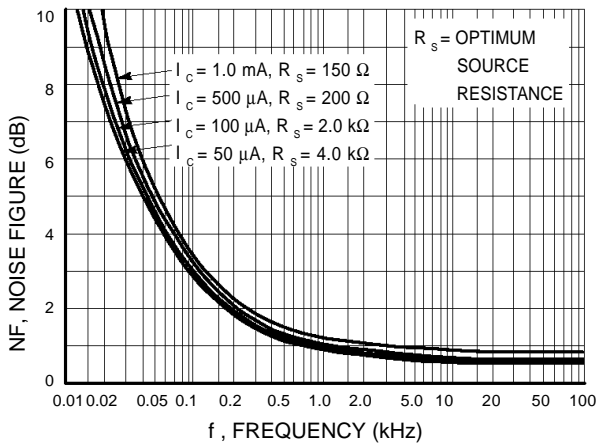


Figure 7. Frequency Effects

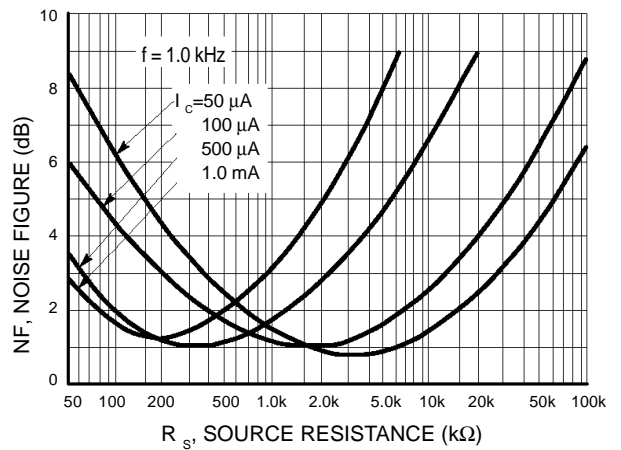


Figure 8. Source Resistance Effects

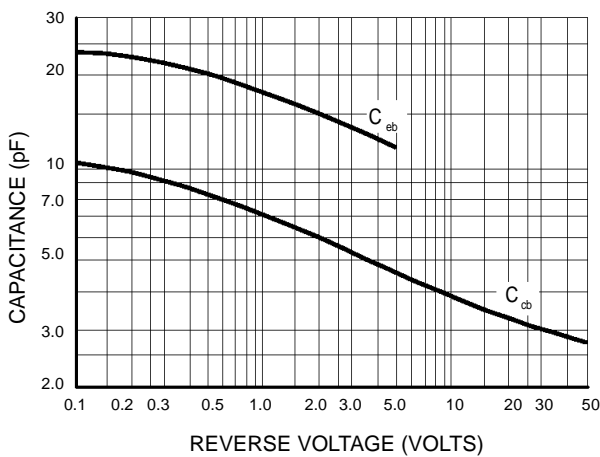


Figure 9. Capacitance

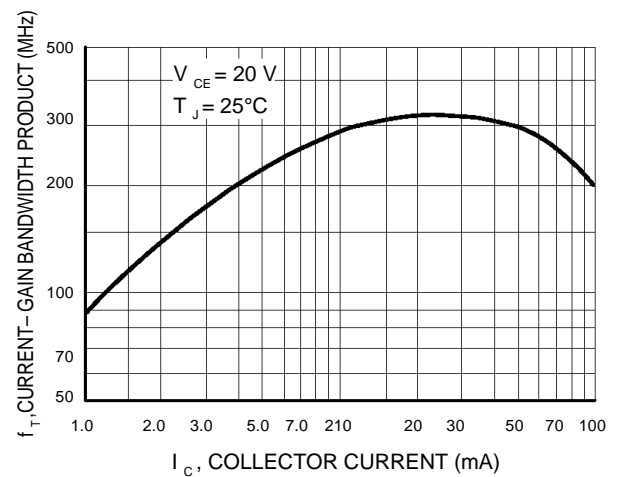
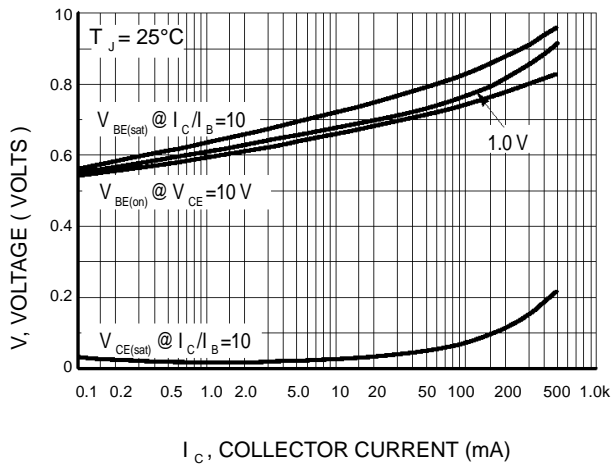


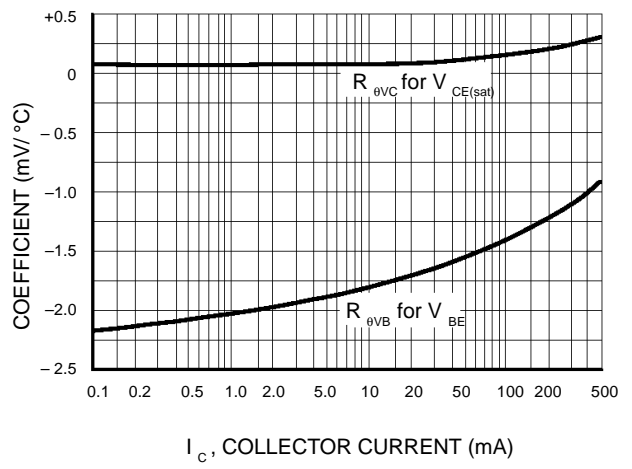
Figure 10. Current-Gain Bandwidth Product

DEVICE CHARACTERISTICS

MMBT2222 & MMBT2222A



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



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

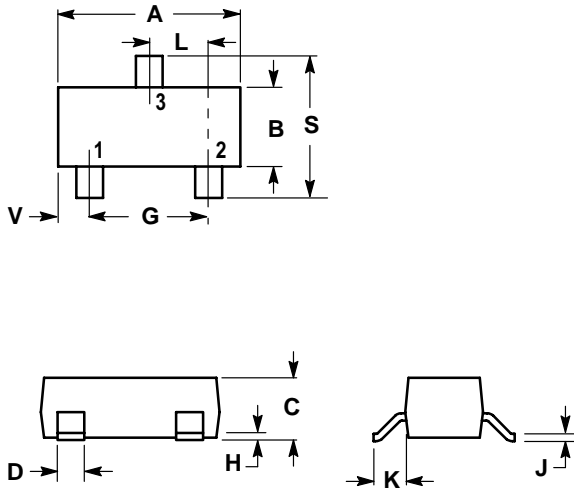
PACKAGE OUTLINE & DIMENSIONS

MMBT2222 & MMBT2222A

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NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982
2. CONTROLLING DIMENSION: INCH.



DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.1102	0.1197	2.80	3.04
B	0.0472	0.0551	1.20	1.40
C	0.0350	0.0440	0.89	1.11
D	0.0150	0.0200	0.37	0.50
G	0.0701	0.0807	1.78	2.04
H	0.0005	0.0040	0.013	0.100
J	0.0034	0.0070	0.085	0.177
K	0.0140	0.0285	0.35	0.69
L	0.0350	0.0401	0.89	1.02
S	0.0830	0.1039	2.10	2.64
V	0.0177	0.0236	0.45	0.60

