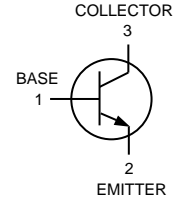
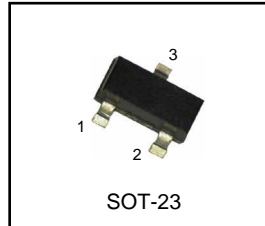


# General Purpose Transistor

## NPN Silicon

### MMBT2222A



### MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	V <sub>CEO</sub>	40	V <sub>dc</sub>
Collector-Base Voltage	V <sub>CBO</sub>	75	V <sub>dc</sub>
Emitter-Base Voltage	V <sub>EBO</sub>	6.0	V <sub>dc</sub>
Collector Current-Continuous	I <sub>C</sub>	600	mAdc

### THERMAL CHARACTERISTICS

Characteristic	Symbol	Max.	Unit
Total Device Dissipation FR-5 Board <sup>(1)</sup> T <sub>A</sub> =25°C Derate above 25°C	P <sub>D</sub>	225 1.8	mW mW / °C
Thermal Resistance Junction to Ambient	R <sub>θJA</sub>	556	°C / W
Total Device Dissipation Alumina Substrate, <sup>(2)</sup> T <sub>A</sub> =25°C Derate above 25°C	P <sub>D</sub>	300 2.4	mW mW / °C
Thermal Resistance Junction to Ambient	R <sub>θJA</sub>	417	°C / W
Junction and Storage Temperature	T <sub>J</sub> ,T <sub>STG</sub>	-55 to +150	°C

### DEVICE MARKING

**MMBT2222A=1P**

### ELECTRICAL CHARACTERISTICS (T<sub>A</sub>=25°C unless otherwise noted)

Characteristic	Symbol	Min.	Max.	Unit
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### OFF CHARACTERISTICS

Collector-Emitter Breakdowe Voltage ( I <sub>C</sub> =10mAdc, I <sub>B</sub> =0 )	V <sub>(BR)CEO</sub>	40	-	V <sub>dc</sub>
Collector-Emitter Breakdowe Voltage ( I <sub>C</sub> =10uAdc, I <sub>E</sub> =0 )	V <sub>(BR)CBO</sub>	75	-	V <sub>dc</sub>
Emitter - Base Breakdowe Voltage ( I <sub>E</sub> =10 uAdc, I <sub>C</sub> =0 )	V <sub>(BR)EBO</sub>	6.0	-	V <sub>dc</sub>
Collector Cutoff Current ( V <sub>CE</sub> =60 Vdc, V <sub>EB</sub> (off)=3.0 Vdc )	I <sub>CEX</sub>	-	10	nAdc
Collector Cutoff Current ( V <sub>CB</sub> =60 Vdc, I <sub>E</sub> =0 ) ( V <sub>CB</sub> =60 Vdc, I <sub>E</sub> =0, T <sub>A</sub> =125°C )	I <sub>CBO</sub>	- -	0.01 10	uAdc
Emitter Cutoff Current ( V <sub>EB</sub> =3.0 Vdc, I <sub>C</sub> =0 )	I <sub>EBO</sub>	-	100	nAdc
Base Cutoff Current ( V <sub>CE</sub> =60 V, V <sub>EB</sub> (off)=3.0 Vdc )	I <sub>BL</sub>	-	20	nAdc

(1) FR-5=1.0 x 0.75 x 0.062in.

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

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

Characteristic	Symbol	Min.	Max.	Unit
<b>ON CHARACTERISTICS<sup>(3)</sup></b>				
DC Current Gain ( IC=0.1 mA <sub>dc</sub> , V <sub>CE</sub> =10 V <sub>dc</sub> ) ( IC=1.0 mA <sub>dc</sub> , V <sub>CE</sub> =10 V <sub>dc</sub> ) ( IC=10 mA <sub>dc</sub> , V <sub>CE</sub> =10 V <sub>dc</sub> ) ( IC=10 mA <sub>dc</sub> , V <sub>CE</sub> =10 V <sub>dc</sub> , T <sub>A</sub> =-55°C ) ( IC=150 mA <sub>dc</sub> , V <sub>CE</sub> =10 V <sub>dc</sub> ) <sup>(3)</sup> ( IC=150 mA <sub>dc</sub> , V <sub>CE</sub> =1.0 V <sub>dc</sub> ) <sup>(3)</sup> ( IC=500 mA <sub>dc</sub> , V <sub>CE</sub> =10 V <sub>dc</sub> ) <sup>(3)</sup>	HFE	35 50 75 35 100 50 40	- - - - 300 - -	-
Collector-Emitter Saturation Voltage <sup>(3)</sup> ( IC=150 mA <sub>dc</sub> , I <sub>B</sub> =15 mA <sub>dc</sub> ) ( IC=500 mA <sub>dc</sub> , I <sub>B</sub> =50 mA <sub>dc</sub> )	V <sub>CE(sat)</sub>	- -	0.3 1.0	V <sub>dc</sub>
Base-Emitter Saturation Voltage <sup>(3)</sup> ( IC=150 mA <sub>dc</sub> , I <sub>B</sub> =15 mA <sub>dc</sub> ) ( IC=500 mA <sub>dc</sub> , I <sub>B</sub> =50 mA <sub>dc</sub> )	V <sub>BE(sat)</sub>	0.6 -	1.2 2.0	V <sub>dc</sub>

**SMALL-SIGNAL CHARACTERISTIC**

Current-Gain-Bandwidth Product <sup>(4)</sup> ( IC=20 mA <sub>dc</sub> , V <sub>CE</sub> =20 V <sub>dc</sub> , f=100 MHz )	f <sub>T</sub>	300	-	MHz
Output Capacitance ( V <sub>CB</sub> =10 V <sub>dc</sub> , I <sub>E</sub> =0, f=1.0 MHz )	C <sub>obo</sub>	-	8.0	pF
Input Capacitance ( V <sub>EB</sub> =0.5 V <sub>dc</sub> , I <sub>C</sub> =0, f=1.0 MHz )	C <sub>ibo</sub>	-	25	pF
Input Impedance ( V <sub>CE</sub> =10 V <sub>dc</sub> , I <sub>C</sub> =1.0 mA <sub>dc</sub> , f=1.0 kHz ) ( V <sub>CE</sub> =10 V <sub>dc</sub> , I <sub>C</sub> =10 mA <sub>dc</sub> , f=1.0 kHz )	h <sub>ie</sub>	2.0 0.25	8.0 1.25	k ohms
Voltage Feedback Ratio ( V <sub>CE</sub> =10 V <sub>dc</sub> , I <sub>C</sub> =1.0 mA <sub>dc</sub> , f=1.0 kHz ) ( V <sub>CE</sub> =10 V <sub>dc</sub> , I <sub>C</sub> =10 mA <sub>dc</sub> , f=1.0 kHz )	h <sub>re</sub>	- -	8.0 4.0	X 10 <sup>-4</sup>
Small-Signal Current Gain ( V <sub>CE</sub> =10 V <sub>dc</sub> , I <sub>C</sub> =1.0 mA <sub>dc</sub> , f=1.0 kHz ) ( V <sub>CE</sub> =10 V <sub>dc</sub> , I <sub>C</sub> =10 mA <sub>dc</sub> , f=1.0 kHz )	h <sub>fe</sub>	50 75	300 375	-
Output Admittance ( V <sub>CE</sub> =10 V <sub>dc</sub> , I <sub>C</sub> =1.0 mA <sub>dc</sub> , f=1.0 kHz ) ( V <sub>CE</sub> =10 V <sub>dc</sub> , I <sub>C</sub> =10 mA <sub>dc</sub> , f=1.0 kHz )	h <sub>oe</sub>	5.0 25	35 200	u mhos
Collector Base Time Constant ( V <sub>CB</sub> =10 V <sub>dc</sub> , I <sub>C</sub> =100 uA <sub>dc</sub> , R <sub>s</sub> = 1.0 k ohms, f=1.0 kHz )	r <sub>b</sub> , C <sub>c</sub>	-	150	ps
Noise Figure ( V <sub>CE</sub> =10 V <sub>dc</sub> , I <sub>C</sub> =100 uA <sub>dc</sub> , R <sub>s</sub> =1.0 k ohm, f=1.0 kHz )	NF	-	4.0	dB

**SWITCHING CHARACTERISTICS**

Delay Time	( V <sub>CC</sub> =30 V <sub>dc</sub> , V <sub>BE</sub> (off) = -0.5 V <sub>dc</sub> , I <sub>C</sub> =150 mA <sub>dc</sub> , I <sub>B1</sub> = 15 mA <sub>dc</sub> )	t <sub>d</sub>	-	10	nS
Rise Time		t <sub>r</sub>	-	25	
Storage Time	( V <sub>CC</sub> =30 V <sub>dc</sub> , I <sub>C</sub> = 150 mA <sub>dc</sub> , I <sub>B1</sub> =I <sub>B2</sub> = 15 mA <sub>dc</sub> )	t <sub>s</sub>	-	225	nS
Fall Time		t <sub>f</sub>	-	60	

(3) Pulse Test : Pulse Width ≤ 300 uS, Duty Cycle ≤ 2.0%.

(2) f<sub>T</sub> is defined as the frequency at which h<sub>fe</sub> extrapolates to unity.

SWITCHING TIME EQUIVALENT TEST CIRCUITS

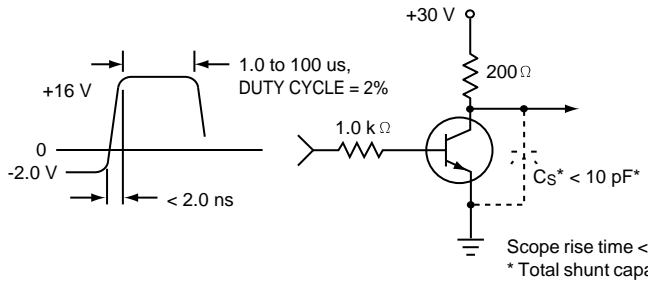


Figure 1. Turn-On Time

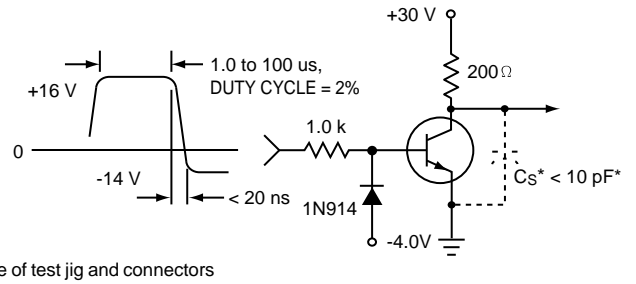


Figure 2. Turn-Off Time

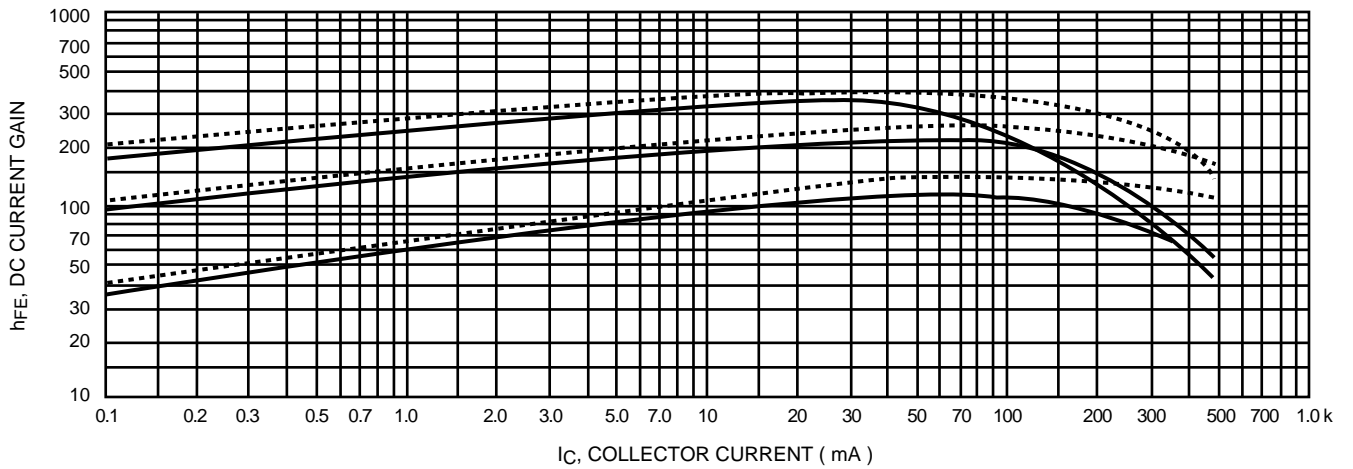


Figure 3. DC Current Gain

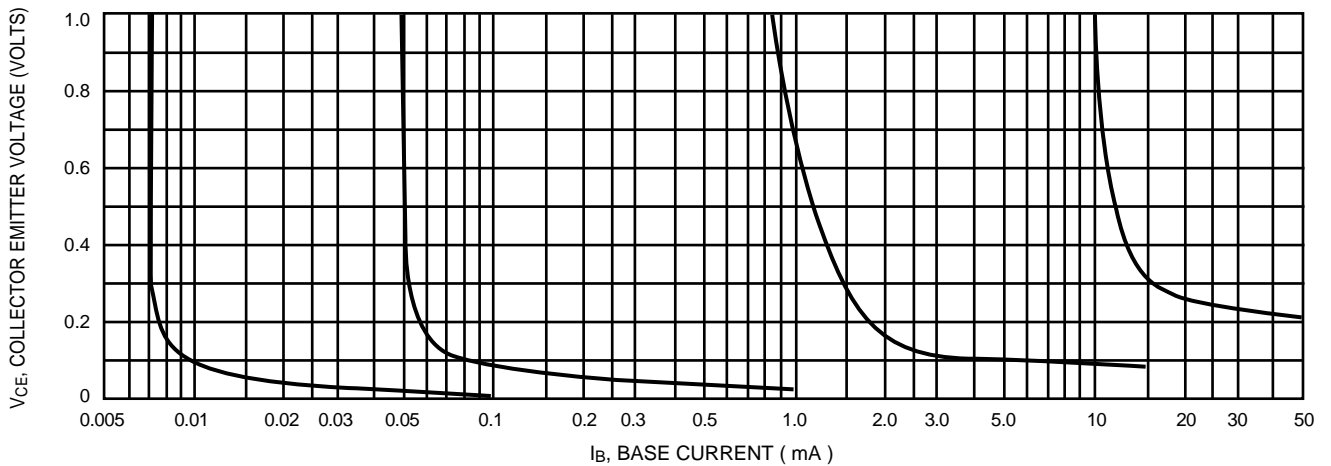


Figure 4. Collector Saturation Region

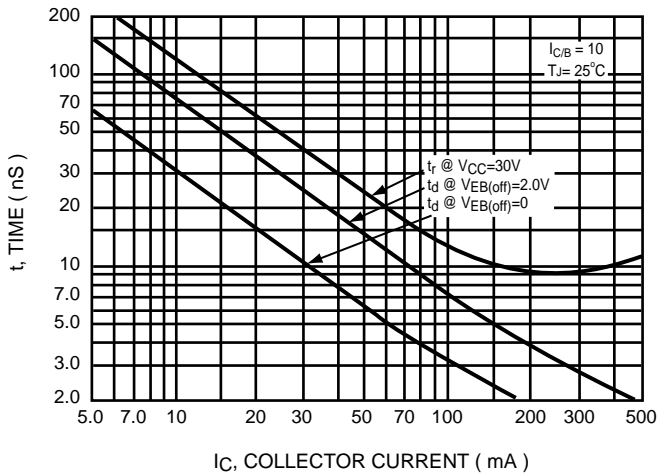


Figure 5. Turn - On Time

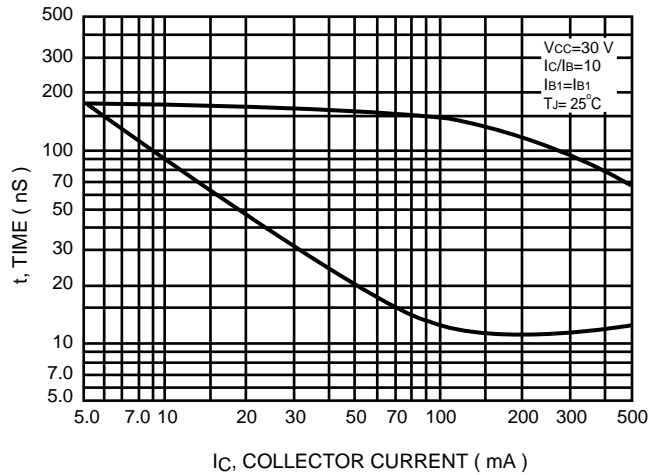


Figure 6. Turn - Off Time

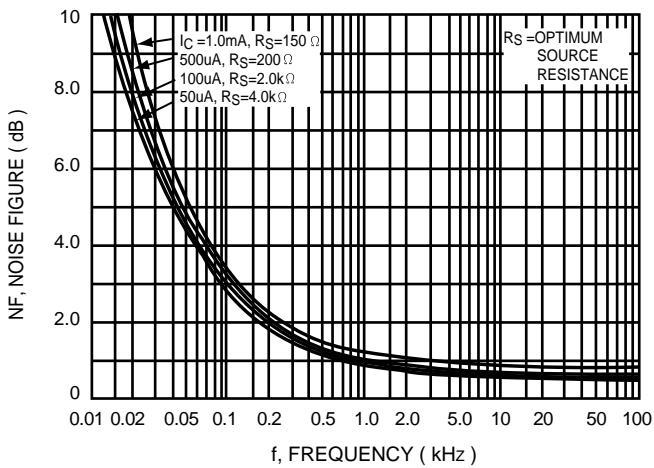


Figure 7. Frequency Effects

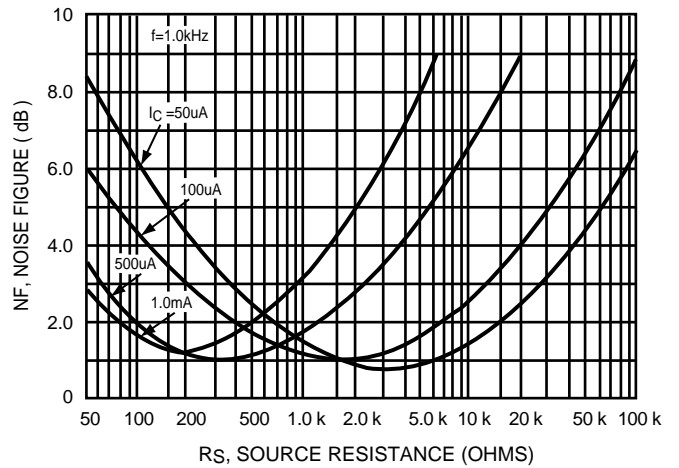


Figure 8. Source Resistance Effects

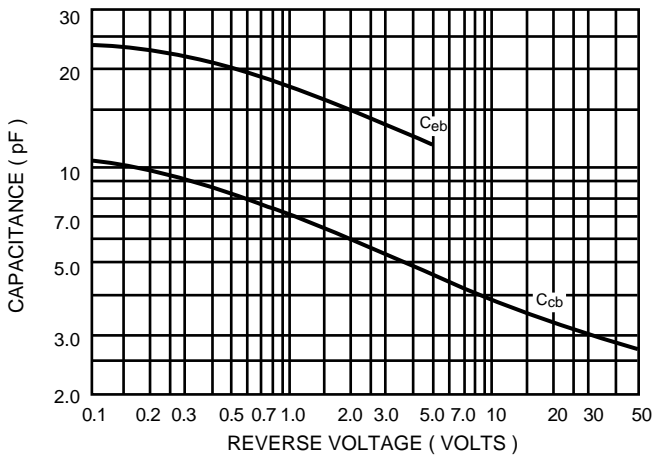


Figure 9. Capacitances

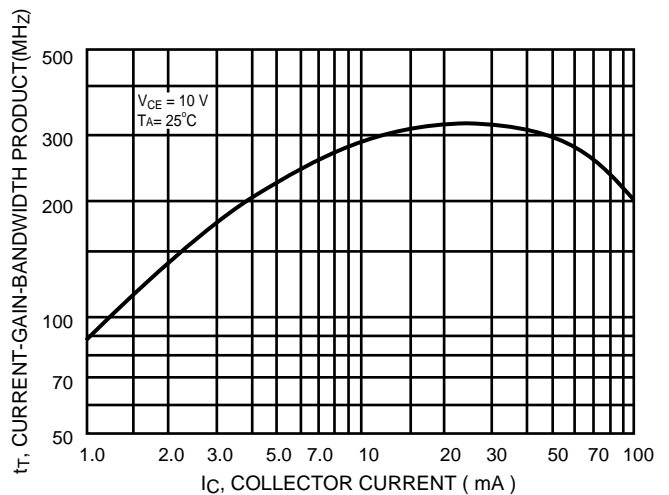
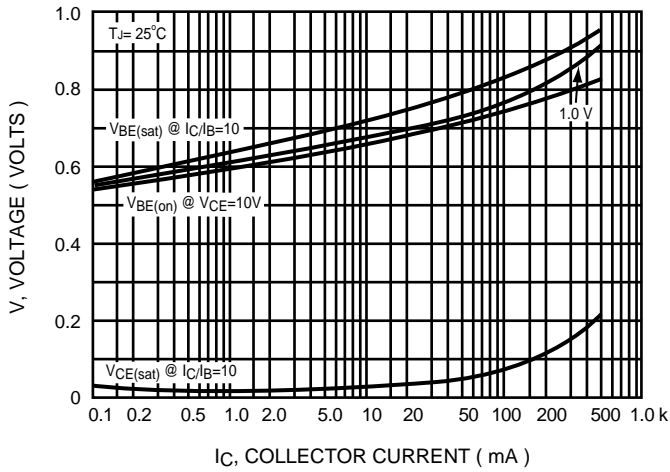
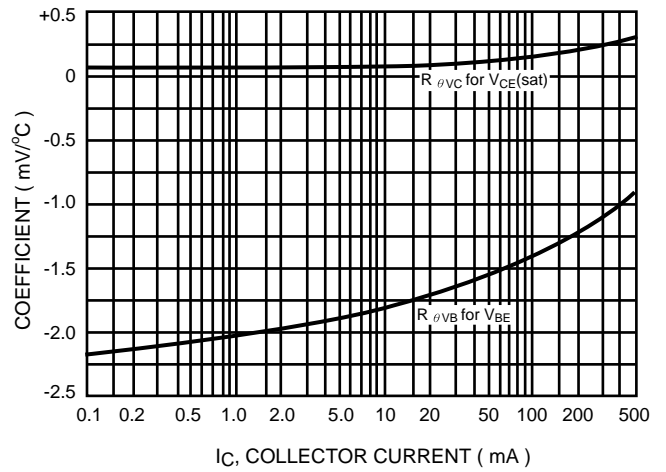


Figure 10. Current-Gain Bandwidth Product



**Figure 11. " On " Voltage**



**Figure 12. Temperature Coefficients**