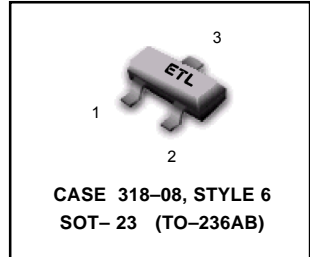
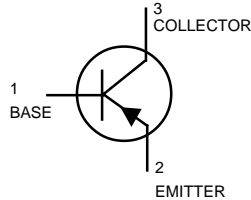


# Chopper Transistor

PNP Silicon

**MMBT404ALT1**



## MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	$V_{CEO}$	-35	Vdc
Collector-Base Voltage	$V_{CBO}$	-40	Vdc
Emitter-Base Voltage	$V_{EBO}$	-25	Vdc
Collector Current — Continuous	$I_C$	-150	mAdc

## THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board,(1) $T_A = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$	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 $25^\circ\text{C}$	$P_D$	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	$^\circ\text{C}$

## DEVICE MARKING

MMBT404ALT1 = 2N

## ELECTRICAL CHARACTERISTICS ( $T_A = 25^\circ\text{C}$ unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
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## OFF CHARACTERISTICS

Collector-Emitter Breakdown Voltage ( $I_C = -10\text{ mAdc}, I_B = 0$ )	$V_{(BR)CEO}$	-35	—	—	Vdc
Collector-Emitter Breakdown Voltage ( $I_C = -10\ \mu\text{Adc}, I_E = 0$ )	$V_{(BR)CBO}$	-40	—	—	Vdc
Emitter-Base Breakdown Voltage ( $I_E = -10\ \mu\text{Adc}, I_C = 0$ )	$V_{(BR)EBO}$	-25	—	—	Vdc
Collector Cutoff Current ( $V_{CE} = -10\text{Vdc}, I_E = 0$ )	$I_{CBO}$	—	—	-100	nAdc
Emitter Cutoff Current ( $V_{EB} = -10\text{Vdc}, I_C = 0$ )	$I_{EBO}$	—	—	-100	nAdc

1. FR-5 =  $1.0 \times 0.75 \times 0.062$  in.

2. Alumina =  $0.4 \times 0.3 \times 0.024$  in. 99.5% alumina.

**ELECTRICAL CHARACTERISTICS** ( $T_A = 25^\circ\text{C}$  unless otherwise noted) (Continued)

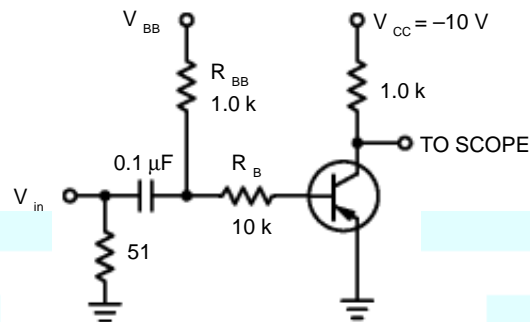
Characteristic	Symbol	Min	Typ	Max	Unit
<b>ON CHARACTERISTICS</b>					
DC Current Gain ( $I_C = -12\text{mA}$ , $V_{CE} = -0.15\text{Vdc}$ )	$h_{FE}$	100	—	400	—
Collector–Emitter Saturation Voltage ( $I_C = -12\text{mA}$ , $I_B = -0.4\text{mA}$ ) ( $I_C = -24\text{mA}$ , $I_B = -1.0\text{mA}$ )	$V_{CE(sat)}$	—	—	-0.15 -0.20	Vdc
Base–Emitter Saturation Voltage ( $I_C = -12\text{mA}$ , $I_B = -0.4\text{mA}$ ) ( $I_C = -24\text{mA}$ , $I_B = -1.0\text{mA}$ )	$V_{BE(sat)}$	—	—	-0.85 -1.00	Vdc

**SMALL–SIGNAL CHARACTERISTICS**

Output Capacitance ( $V_{CB} = -6.0\text{Vdc}$ , $I_E = 0$ , $f = 1.0\text{MHz}$ )	$C_{obo}$	—	—	20	pF
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**SWITCHING CHARACTERISTICS**

Delay Time ( $V_{CC} = -10\text{Vdc}$ , $I_C = -10\text{mA}$ ) (Figure 1)	$t_d$	—	43	—	ns
Rise Time ( $I_{B1} = -1.0\text{mA}$ , $I_{BE(off)} = -14\text{Vdc}$ )	$t_r$	—	180	—	ns
Storage Time ( $V_{CC} = -10\text{Vdc}$ , $I_C = -10\text{mA}$ )	$t_s$	—	675	—	ns
Fall Time ( $I_{B1} = I_{B2} = -1.0\text{mA}$ ) (Figure 1)	$t_f$	—	160	—	ns



	$V_{in}$ (Volts)	$V_{BB}$ (Volts)
$t_{on}$ , $t_d$ , $t_r$	-12	+1.4
$t_{off}$ , $t_s$ and $t_f$	+20.6	-11.6

Voltages and resistor values shown are for  $I_C = 10\text{mA}$ ,  $I_C/I_B = 10$  and  $I_{B1} = I_{B2}$

**Figure 1. Switching Time Test Circuit**