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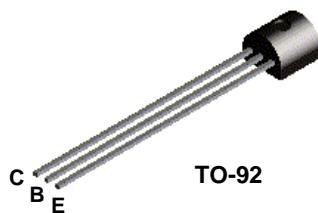
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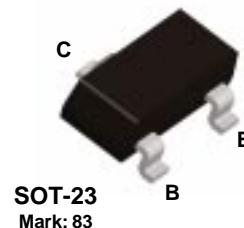
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2N4400



MMBT4400



NPN General Purpose Amplifier

This device is designed for use as general purpose amplifiers and switches requiring collector currents to 500 mA.

Absolute Maximum Ratings*

TA = 25°C unless otherwise noted

Symbol	Parameter	Value	Units
V_{CEO}	Collector-Emitter Voltage	40	V
V_{CBO}	Collector-Base Voltage	60	V
V_{EBO}	Emitter-Base Voltage	6.0	V
I_C	Collector Current - Continuous	600	mA
T_J, T_{stg}	Operating and Storage Junction Temperature Range	-55 to +150	°C

*These ratings are limiting values above which the serviceability of any semiconductor device may be impaired.

NOTES:

- 1) These ratings are based on a maximum junction temperature of 150 degrees C.
- 2) These are steady state limits. The factory should be consulted on applications involving pulsed or low duty cycle operations.

Thermal Characteristics

TA = 25°C unless otherwise noted

Symbol	Characteristic	Max		Units
		2N4400	*MMBT4400	
P_D	Total Device Dissipation Derate above 25°C	625 5.0	350 2.8	mW mW/°C
$R_{\theta JC}$	Thermal Resistance, Junction to Case	83.3		°C/W
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient	200	357	°C/W

NPN General Purpose Amplifier

(continued)

Electrical Characteristics

TA = 25°C unless otherwise noted

Symbol	Parameter	Test Conditions	Min	Max	Units
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OFF CHARACTERISTICS

$V_{(BR)CEO}$	Collector-Emitter Breakdown Voltage*	$I_C = 1.0 \text{ mA}, I_B = 0$	40		V
$V_{(BR)CBO}$	Collector-Base Breakdown Voltage	$I_C = 100 \mu\text{A}, I_E = 0$	60		V
$V_{(BR)EBO}$	Emitter-Base Breakdown Voltage	$I_E = 100 \mu\text{A}, I_C = 0$	6.0		V
I_{CEX}	Collector Cutoff Current	$V_{CE} = 35 \text{ V}, V_{EB} = 0.4 \text{ V}$		0.1	μA
I_{BL}	Emitter Cutoff Current	$V_{CE} = 35 \text{ V}, V_{EB} = 0.4 \text{ V}$		0.1	μA

ON CHARACTERISTICS*

h_{FE}	DC Current Gain	$V_{CE} = 1.0 \text{ V}, I_C = 1.0 \text{ mA}$ $V_{CE} = 1.0 \text{ V}, I_C = 10 \text{ mA}$ $V_{CE} = 1.0 \text{ V}, I_C = 150 \text{ mA}$ $V_{CE} = 2.0 \text{ V}, I_C = 500 \text{ mA}$	20	40	50	150	
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage	$I_C = 150 \text{ mA}, I_B = 15 \text{ mA}$ $I_C = 500 \text{ mA}, I_B = 50 \text{ mA}$			0.40	0.75	V
$V_{BE(sat)}$	Base-Emitter Saturation Voltage	$I_C = 150 \text{ mA}, I_B = 15 \text{ mA}$ $I_C = 500 \text{ mA}, I_B = 50 \text{ mA}$	0.75		0.95	1.2	V

SMALL SIGNAL CHARACTERISTICS

C_{ob}	Output Capacitance	$V_{CB} = 5.0 \text{ V}, f = 140 \text{ kHz}$		6.5	pF	
C_{ib}	Input Capacitance	$V_{EB} = 0.5 \text{ V}, f = 140 \text{ kHz}$		30	pF	
h_{fe}	Small-Signal Current Gain	$I_C = 20 \text{ mA}, V_{CE} = 10 \text{ V}, f = 100 \text{ MHz}$	2.0			
h_{re}	Small-Signal Current Gain	$V_{CE} = 10 \text{ V}, I_C = 1.0 \text{ mA}, f = 1.0 \text{ kHz}$	20	250		
h_{ie}	Input Impedance		0.5	7.5	$\text{K}\Omega$	
h_{re}	Voltage Feedback Ratio		0.1	8.0	$\times 10^{-4}$	
h_{oe}	Output Admittance		1.0	30	μmhos	

SWITCHING CHARACTERISTICS

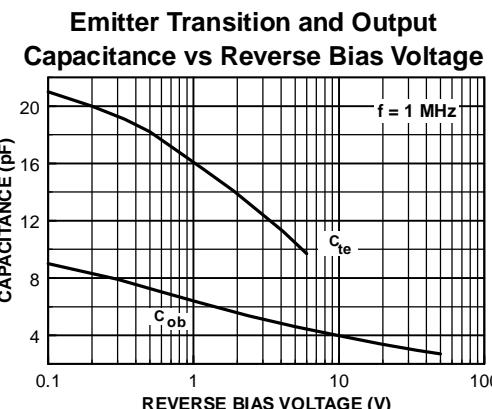
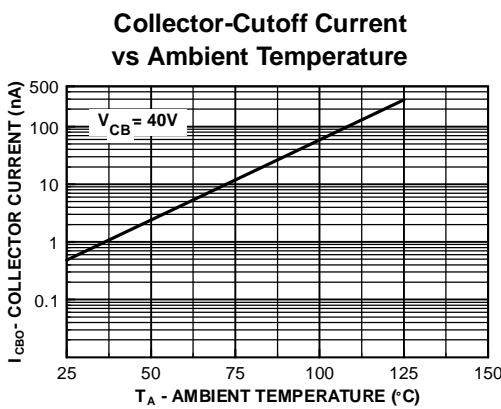
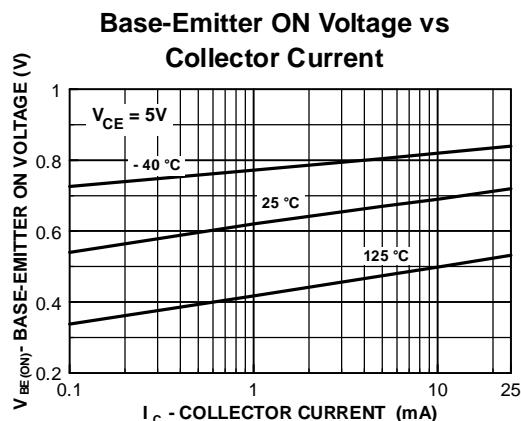
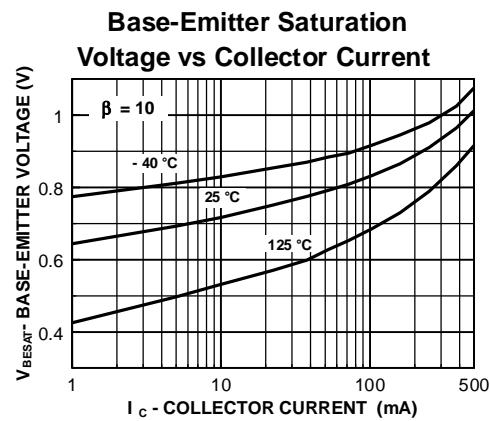
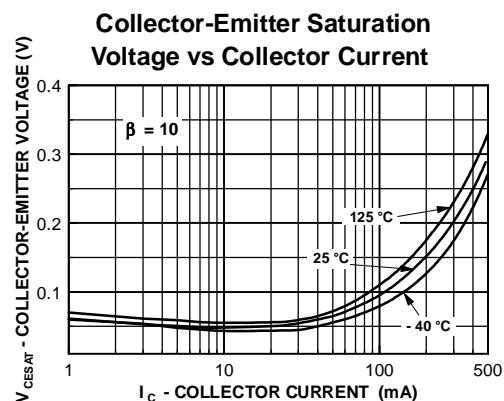
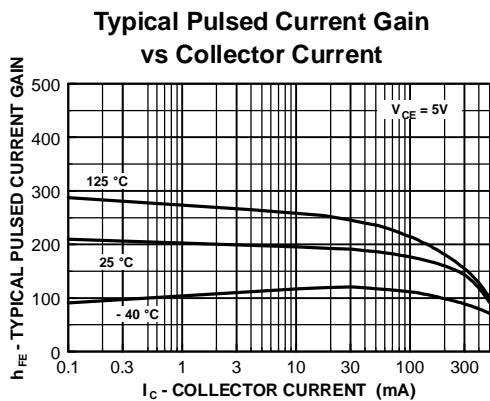
t_d	Delay Time	$V_{CC} = 30 \text{ V}, I_C = 150 \text{ mA}, I_{B1} = 15 \text{ mA}, V_{EB} = 2 \text{ V}$		15	ns	
t_r	Rise Time			20	ns	
t_s	Storage Time	$V_{CC} = 30 \text{ V}, I_C = 150 \text{ mA}, I_{B1} = I_{B2} = 15 \text{ mA}$		225	ns	
t_f	Fall Time			30	ns	

*Pulse Test: Pulse Width $\leq 300 \text{ ms}$, Duty Cycle $\leq 2.0\%$

NPN General Purpose Amplifier

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Typical Characteristics

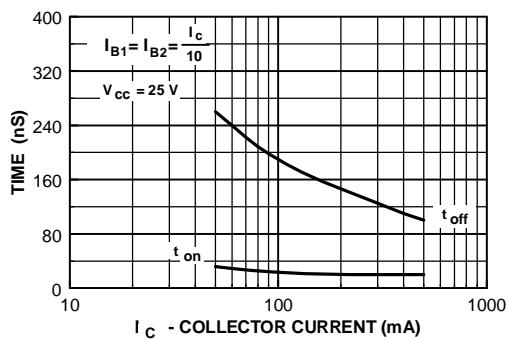


NPN General Purpose Amplifier

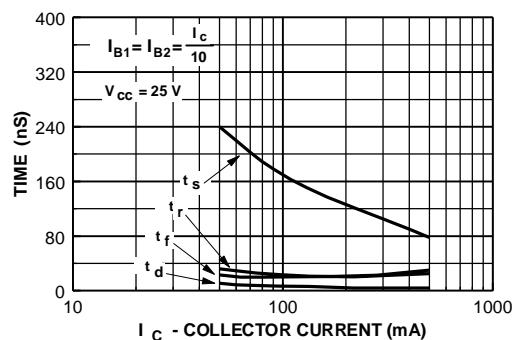
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Typical Characteristics (continued)

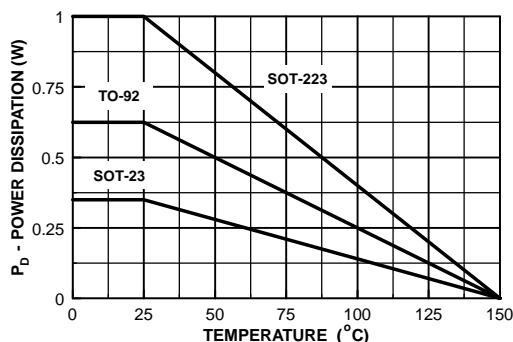
Turn On and Turn Off Times
vs Collector Current



Switching Times
vs Collector Current

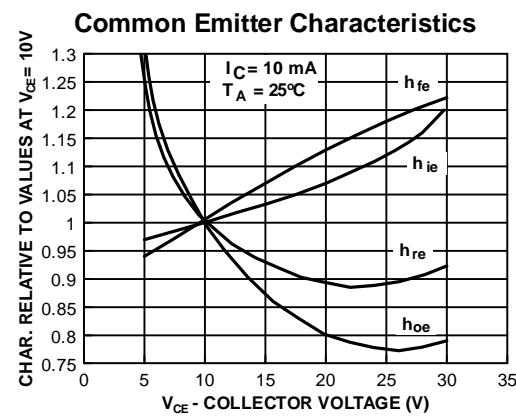
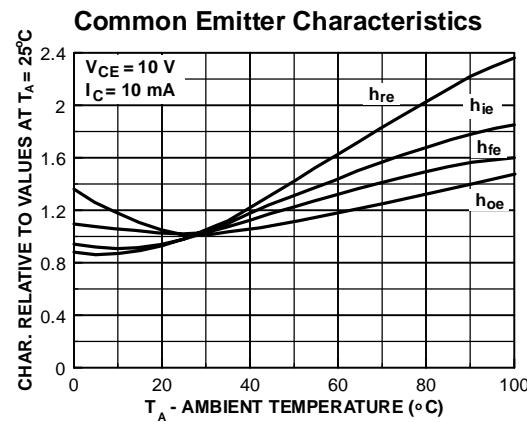
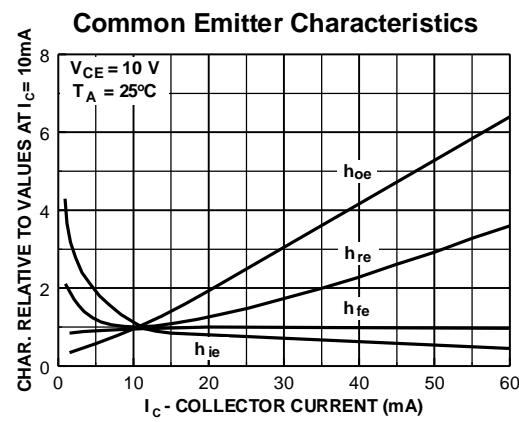


Power Dissipation vs
Ambient Temperature



NPN General Purpose Amplifier

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Typical Common Emitter Characteristics ($f = 1.0\text{kHz}$)

NPN General Purpose Amplifier

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Test Circuits

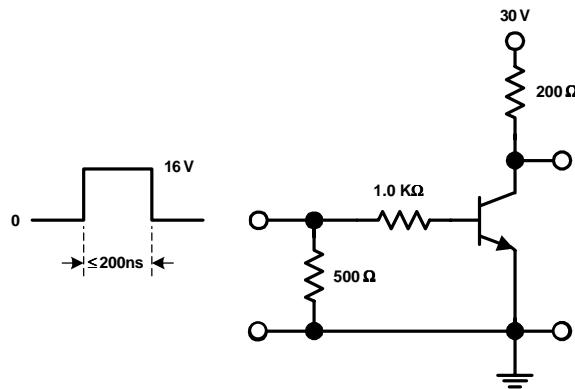


FIGURE 1: Saturated Turn-On Switching Timer

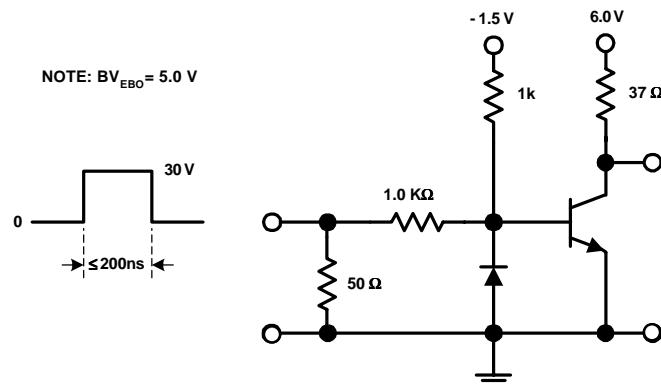


FIGURE 2: Saturated Turn-Off Switching Time

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