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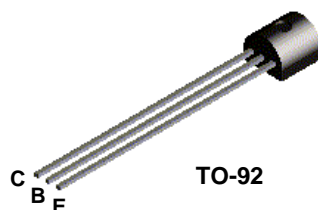
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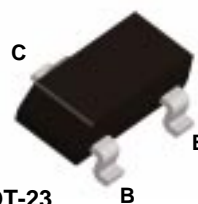
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## 2N4400



TO-92

## MMBT4400



SOT-23  
Mark: 83

### 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 <sub>CEO</sub>	Collector-Emitter Voltage	40	V
V <sub>CBO</sub>	Collector-Base Voltage	60	V
V <sub>EBO</sub>	Emitter-Base Voltage	6.0	V
I <sub>C</sub>	Collector Current - Continuous	600	mA
T <sub>J</sub> , T <sub>stg</sub>	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 <sub>D</sub>	Total Device Dissipation Derate above 25°C	625 5.0	350 2.8	mW mW/°C
R <sub>θJC</sub>	Thermal Resistance, Junction to Case	83.3		°C/W
R <sub>θJA</sub>	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	$I_C = 100 \text{ } \mu\text{A}, I_E = 0$	60		V
$V_{(BR)EBO}$	Emitter-Base Breakdown Voltage	$I_E = 100 \text{ } \mu\text{A}, I_C = 0$	6.0		V
$I_{CEX}$	Collector Cutoff Current	$V_{CE} = 35 \text{ V}, V_{EB} = 0.4 \text{ V}$		0.1	$\mu\text{A}$
$I_{BL}$	Emitter Cutoff Current	$V_{CE} = 35 \text{ V}, V_{EB} = 0.4 \text{ V}$		0.1	$\mu\text{A}$

### 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 20	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
$V_{BE(sat)}$	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 V

### SMALL SIGNAL CHARACTERISTICS

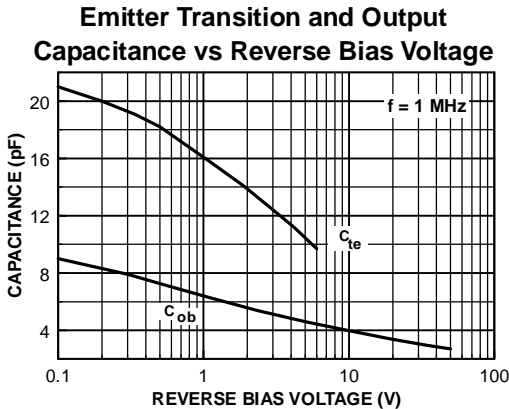
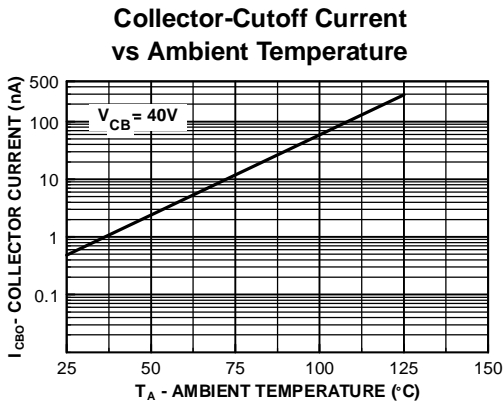
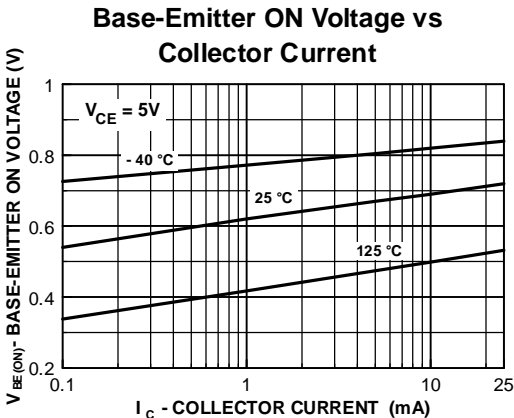
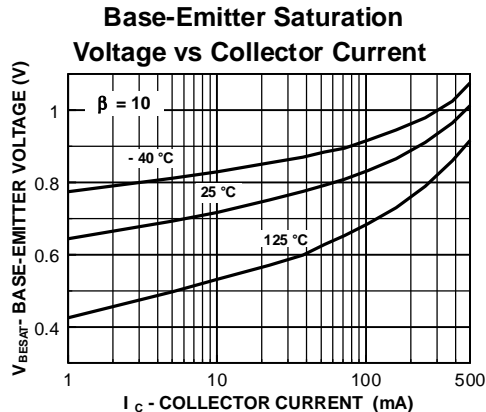
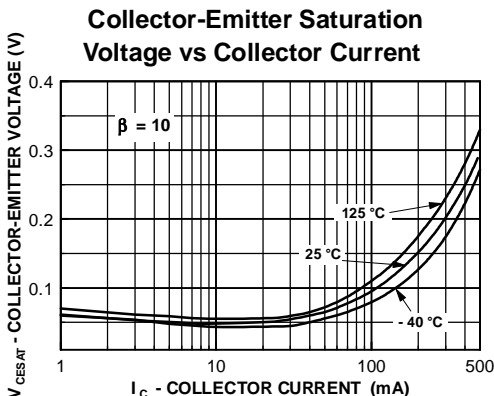
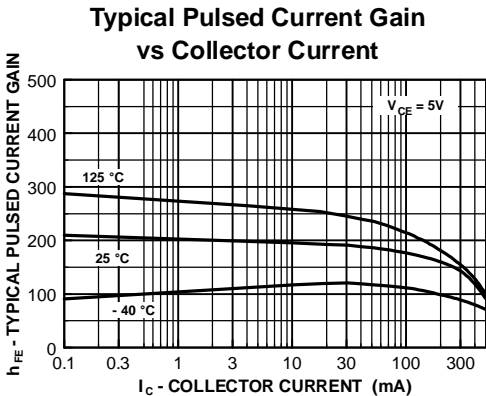
$C_{ob}$	Output Capacitance	$V_{CB} = 5.0 \text{ V}, f = 140 \text{ kHz}$		6.5	pF
$C_{ib}$	Input Capacitance	$V_{EB} = 0.5 \text{ V}, f = 140 \text{ kHz}$		30	pF
$h_{fe}$	Small-Signal Current Gain	$I_C = 20 \text{ mA}, V_{CE} = 10 \text{ V},$ $f = 100 \text{ MHz}$	2.0		
$h_{fe}$	Small-Signal Current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

### 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	$V_{CC} = 30 \text{ V}, I_C = 150 \text{ mA}$		225	ns
$t_f$	Fall Time	$I_{B1} = I_{B2} = 15 \text{ mA}$		30	ns

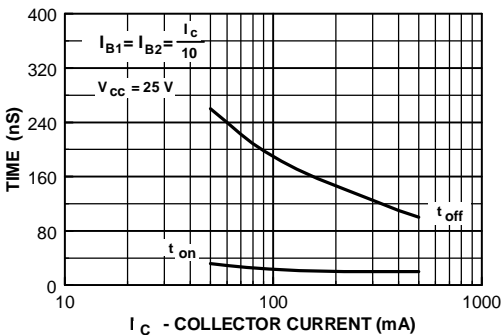
\* Pulse Test: Pulse Width  $\leq 300 \text{ ms}$ , Duty Cycle  $\leq 2.0\%$

Typical Characteristics

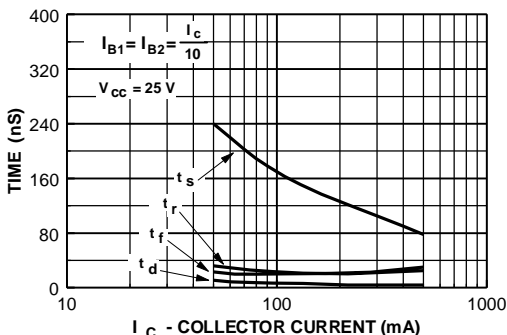


Typical Characteristics (continued)

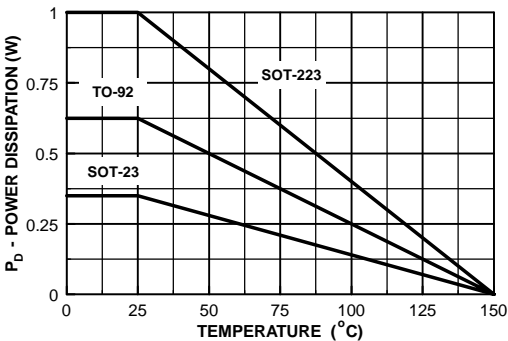
Turn On and Turn Off Times  
vs Collector Current



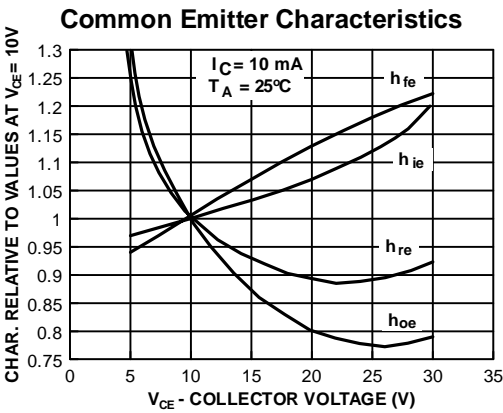
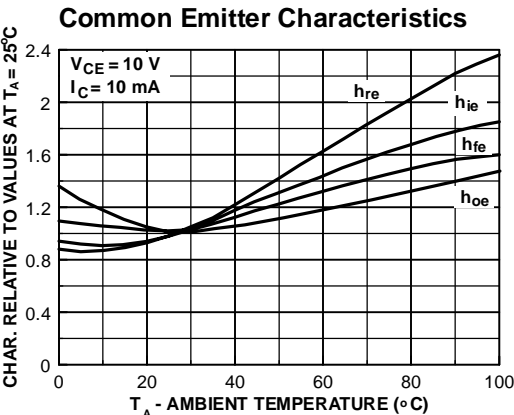
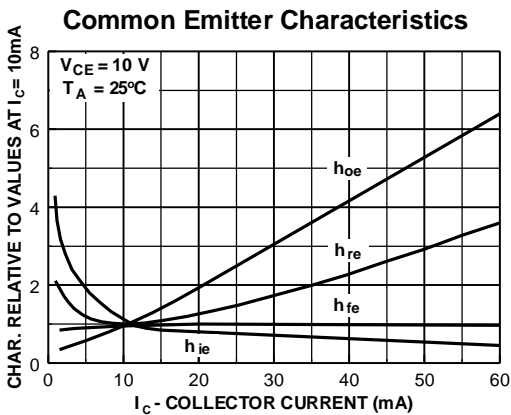
Switching Times  
vs Collector Current



Power Dissipation vs  
Ambient Temperature



Typical Common Emitter Characteristics (f = 1.0kHz)



Test Circuits

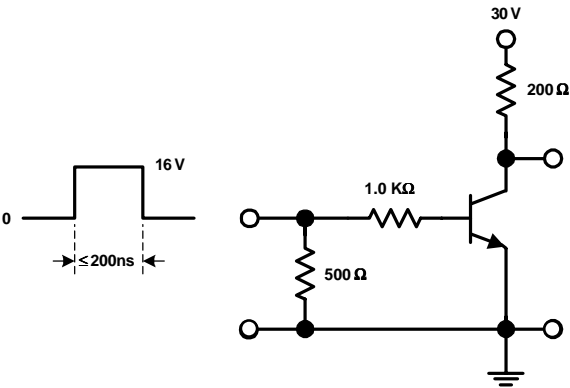


FIGURE 1: Saturated Turn-On Switching Timer

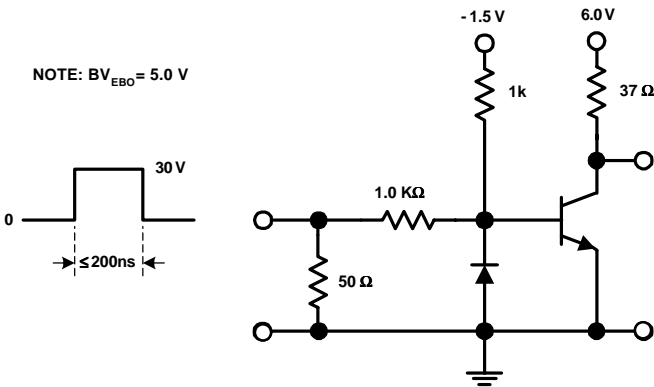


FIGURE 2: Saturated Turn-Off Switching Time

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