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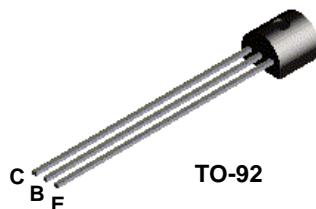
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## 2N4402



### PNP 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	40	V
$V_{EBO}$	Emitter-Base Voltage	5.0	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
		2N4402	
$P_D$	Total Device Dissipation Derate above 25°C	625 5.0	mW mW/°C
$R_{\theta JC}$	Thermal Resistance, Junction to Case	83.3	°C/W
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient	200	°C/W

## PNP 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	$I_C = 100 \mu\text{A}, I_E = 0$	40		V
$V_{(BR)EBO}$	Emitter-Base Breakdown Voltage	$I_E = 100 \mu\text{A}, I_C = 0$	5.0		V
$I_{CEX}$	Collector Cutoff Current	$V_{CE} = 35 \text{ V}, V_{EB} = 0.4 \text{ V}$		0.1	$\mu\text{A}$
$I_{BL}$	Base 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	$V_{CE} = 1.0 \text{ V}, I_C = 1.0 \text{ mA}$ $V_{CE} = 1.0 \text{ V}, I_C = 10 \text{ mA}$ $V_{CE} = 2.0 \text{ V}, I_C = 150 \text{ mA}$ $V_{CE} = 2.0 \text{ V}, I_C = 500 \text{ mA}$	30	50	150	
$V_{CE(\text{sat})}$	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
$V_{BE(\text{sat})}$	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	1.30	V

## SMALL SIGNAL CHARACTERISTICS

$C_{ob}$	Output Capacitance	$V_{CB} = 10 \text{ V}, f = 140 \text{ kHz}$		8.5	pF
$C_{ib}$	Input Capacitance	$V_{EB} = 0.5 \text{ V}, f = 140 \text{ kHz}$		30	pF
$h_{fe}$	Small-Signal Current Gain	$I_C = 20 \text{ mA}, V_{CE} = 10 \text{ V}, f = 100 \text{ MHz}$	1.5		
$h_{fe}$	Small-Signal Current Gain	$I_C = 1.0 \text{ mA}, V_{CE} = 10 \text{ V}, f = 1.0 \text{ kHz}$	30	250	
$h_{ie}$	Input Impedance		0.75	7.5	k $\Omega$
$h_{re}$	Voltage Feedback Ratio		0.10	8.0	$\times 10^{-4}$
$h_{oe}$	Output Admittance		1.0	100	$\mu\text{mhos}$

## SWITCHING CHARACTERISTICS

$t_d$	Delay Time	$V_{CC} = 30 \text{ V}, I_C = 150 \text{ mA}, I_{B1} = 15 \text{ mA}, V_{BE(\text{off})} = 2.0 \text{ V}$		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

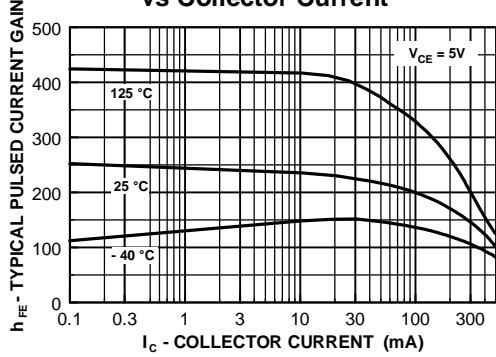
\*Pulse Test: Pulse Width  $\leq 300 \mu\text{s}$ , Duty Cycle  $\leq 2.0\%$

## PNP General Purpose Amplifier

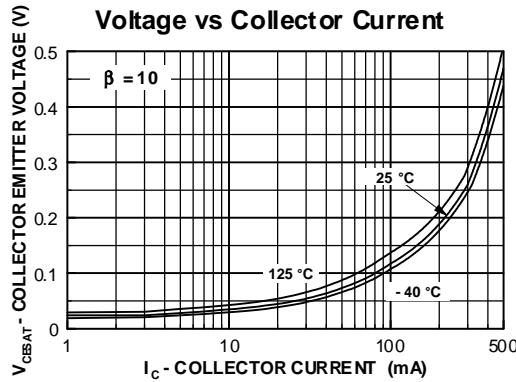
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### Typical Characteristics

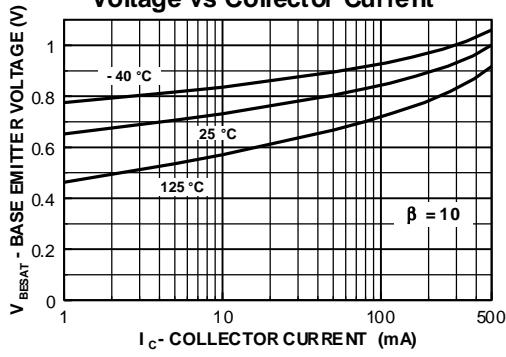
Typical Pulsed Current Gain  
vs Collector Current



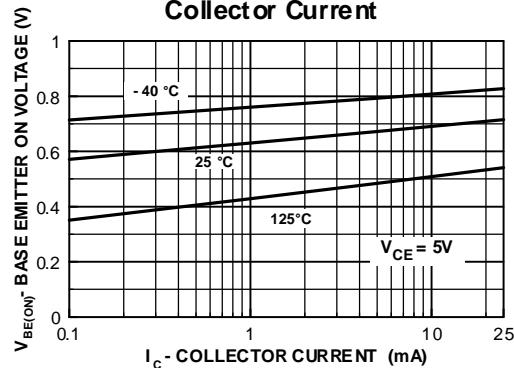
Collector-Emitter Saturation  
Voltage vs Collector Current



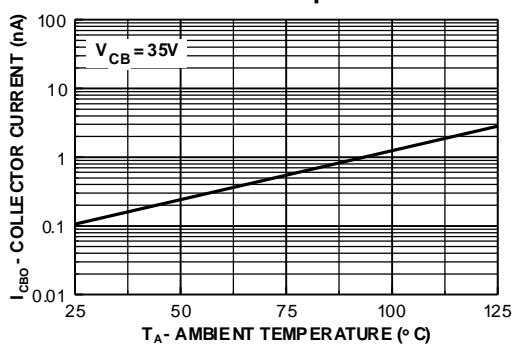
Base-Emitter Saturation  
Voltage vs Collector Current



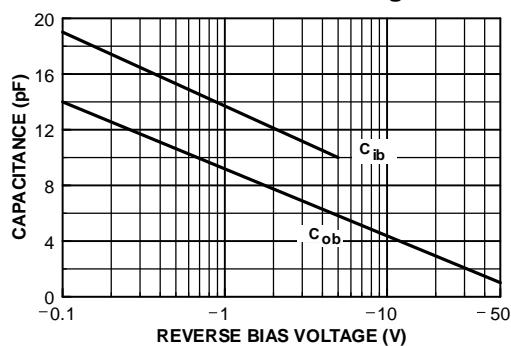
Base Emitter ON Voltage vs  
Collector Current



Collector-Cutoff Current  
vs Ambient Temperature



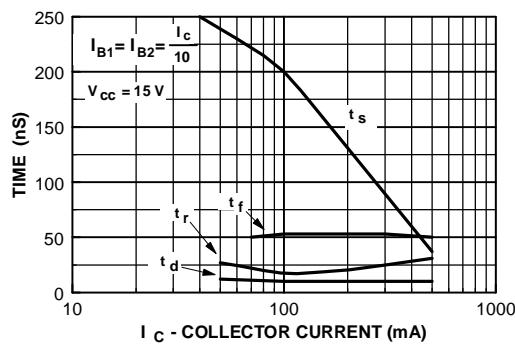
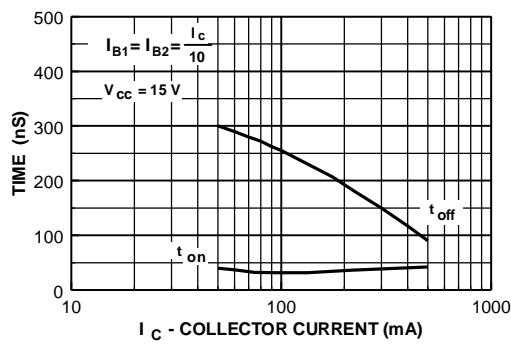
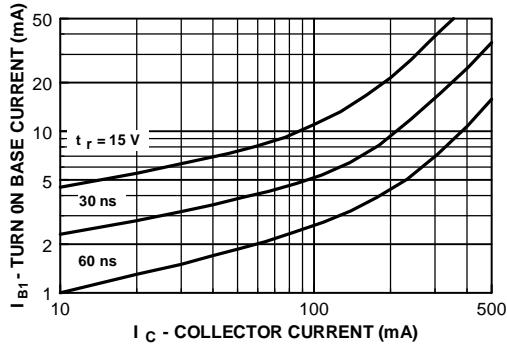
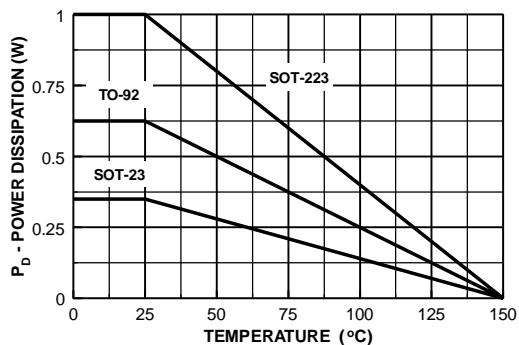
Input and Output Capacitance  
vs Reverse Bias Voltage



## PNP General Purpose Amplifier

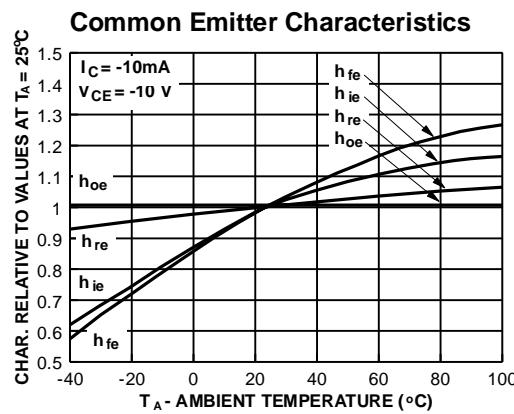
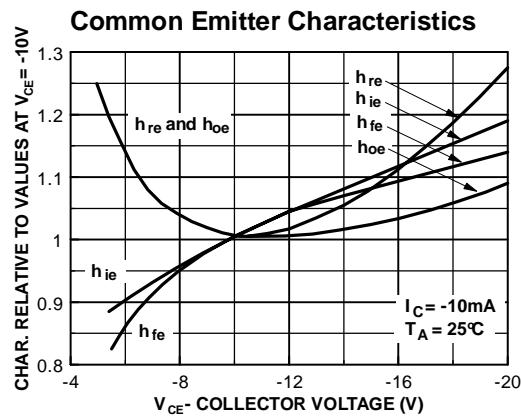
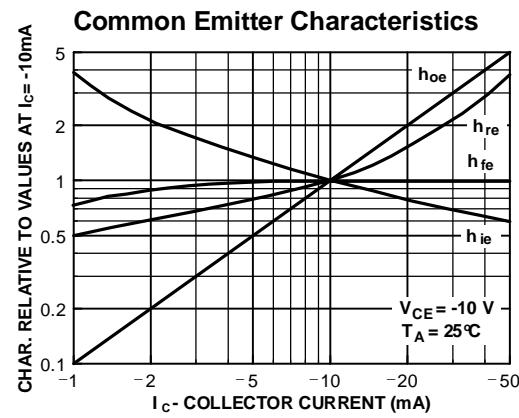
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## Typical Characteristics (continued)

Switching Times  
vs Collector CurrentTurn On and Turn Off Times  
vs Collector CurrentRise Time vs Collector  
and Turn On Base CurrentsPower Dissipation vs  
Ambient Temperature

## PNP General Purpose Amplifier

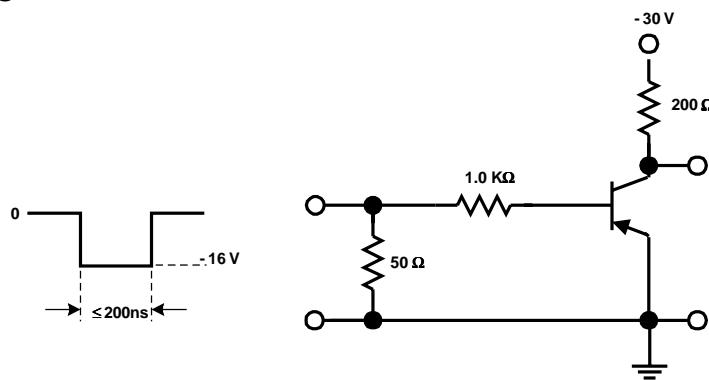
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Typical Common Emitter Characteristics ( $f = 1.0\text{kHz}$ )

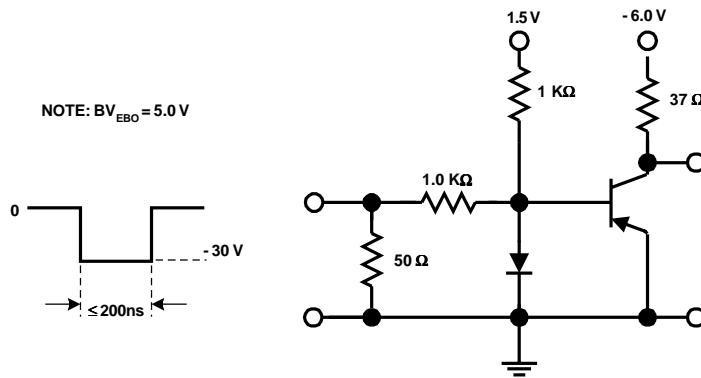
## PNP General Purpose Amplifier

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## Test Circuits



**FIGURE 1: Saturated Turn-On Switching Time Test Circuit**



**FIGURE 2: Saturated Turn-Off Switching Time Test Circuit**

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