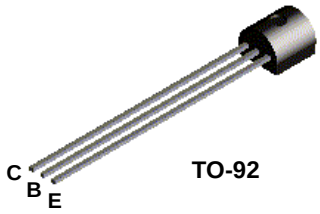
FAIRCHILD
SEMICONDUCTOR TM

# 2N4402




TO-92

## 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<br>Derate above 25°C | 625<br>5.0 | mW<br>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)

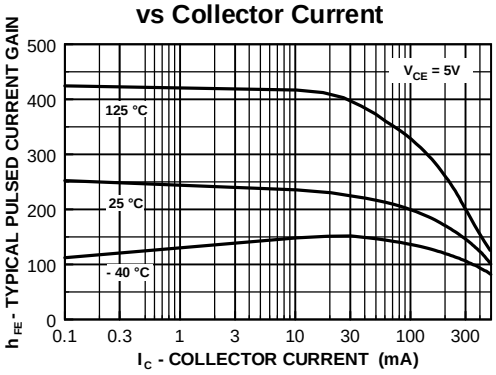
### Electrical Characteristics
TA = 25°C unless otherwise noted

| Symbol | Parameter | Test Conditions | Min | Max | Units |
|---|---|---|---|---|---|
| **OFF CHARACTERISTICS** | | | | | |
| $V_{(BR)CEO}$ | Collector-Emitter Breakdown Voltage* | $I_C$ = 1.0 mA, $I_B$ = 0 | 40 | | V |
| $V_{(BR)CBO}$ | Collector-Base Breakdown Voltage | $I_C$ = 100 µA, $I_E$ = 0 | 40 | | V |
| $V_{(BR)EBO}$ | Emitter-Base Breakdown Voltage | $I_E$ = 100 µA, $I_C$ = 0 | 5.0 | | V |
| $I_{CEX}$ | Collector Cutoff Current | $V_{CE}$ = 35 V, $V_{EB}$ = 0.4 V | | 0.1 | µA |
| $I_{BL}$ | Base Cutoff Current | $V_{CE}$ = 35 V, $V_{EB}$ = 0.4 V | | 0.1 | µA |
| **ON CHARACTERISTICS*** | | | | | |
| $h_{FE}$ | DC Current Gain | $V_{CE}$ = 1.0 V, $I_C$ = 1.0 mA<br>$V_{CE}$ = 1.0 V, $I_C$ = 10 mA<br>$V_{CE}$ = 2.0 V, $I_C$ = 150 mA<br>$V_{CE}$ = 2.0 V, $I_C$ = 500 mA | 30<br>50<br>50<br>20 | <br><br>150<br> | |
| $V_{CE(sat)}$ | Collector-Emitter Saturation Voltage | $I_C$ = 150 mA, $I_B$ = 15 mA<br>$I_C$ = 500 mA, $I_B$ = 50 mA | | 0.40<br>0.75 | V<br>V |
| $V_{BE(sat)}$ | Base-Emitter Saturation Voltage | $I_C$ = 150 mA, $I_B$ = 15 mA<br>$I_C$ = 500 mA, $I_B$ = 50 mA | 0.75 | 0.95<br>1.30 | V<br>V |
| **SMALL SIGNAL CHARACTERISTICS** | | | | | |
| $C_{ob}$ | Output Capacitance | $V_{CB}$ = 10 V, f = 140 kHz | | 8.5 | pF |
| $C_{ib}$ | Input Capacitance | $V_{EB}$ = 0.5 V, f = 140 kHz | | 30 | pF |
| $h_{fe}$ | Small-Signal Current Gain | $I_C$ = 20 mA, $V_{CE}$ = 10 V, f = 100 MHz | 1.5 | | |
| $h_{fe}$ | Small-Signal Current Gain | $I_C$ = 1.0 mA, $V_{CE}$ = 10 V, f = 1.0 kHz | 30 | 250 | |
| $h_{ie}$ | Input Impedance | | 0.75 | 7.5 | kΩ |
| $h_{re}$ | Voltage Feedback Ratio | | 0.10 | 8.0 | $x10^{-4}$ |
| $h_{oe}$ | Output Admittance | | 1.0 | 100 | µmhos |
| **SWITCHING CHARACTERISTICS** | | | | | |
| $t_d$ | Delay Time | $V_{CC}$ = 30 V, $I_C$ =150 mA, $I_{B1}$ = 15 mA, $V_{BE(off)}$ = 2.0 V | | 15 | ns |
| $t_r$ | Rise Time | | | 20 | ns |
| $t_s$ | Storage Time | $V_{CC}$ = 30 V, $I_C$ =150 mA, $I_{B1}$ = $I_{B2}$ = 15 mA | | 225 | ns |
| $t_f$ | Fall Time | | | 30 | ns |

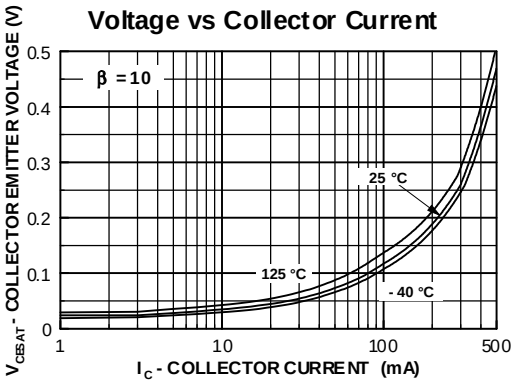
*Pulse Test: Pulse Width ≤ 300 µs, Duty Cycle ≤ 2.0%

## Typical Characteristics

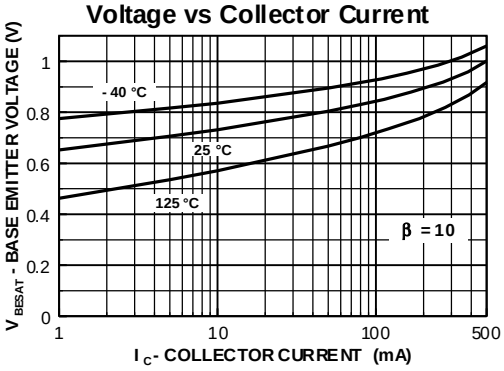
### Typical Pulsed Current Gain vs Collector Current



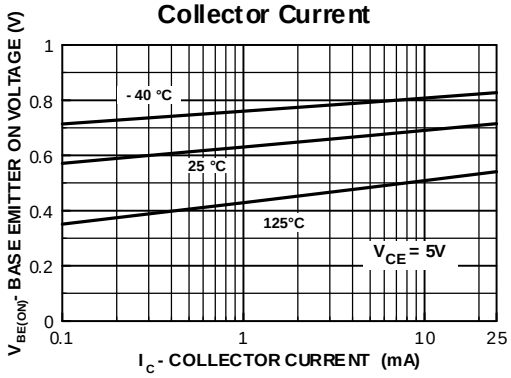

### Collector-Emitter Saturation Voltage vs Collector Current



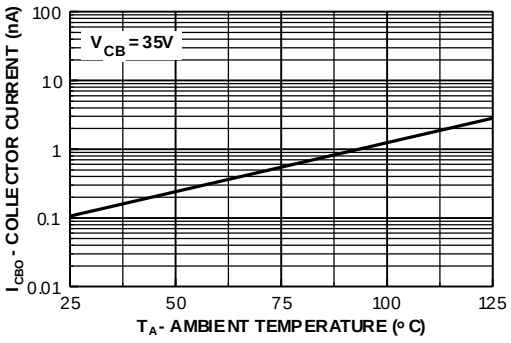

### Base-Emitter Saturation Voltage vs Collector Current



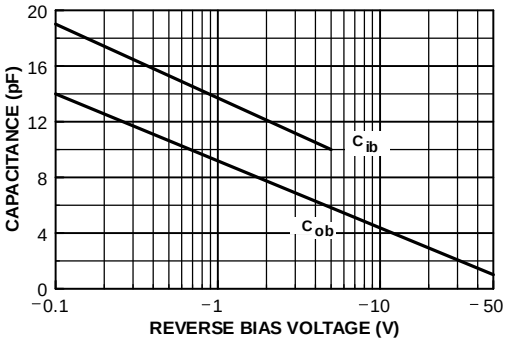

### Base Emitter ON Voltage vs Collector Current




### Collector-Cutoff Current vs Ambient Temperature

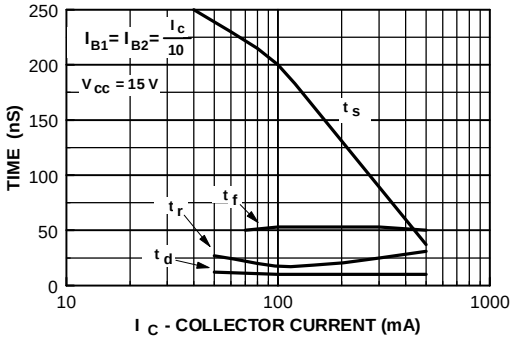



### Input and Output Capacitance vs Reverse Bias Voltage

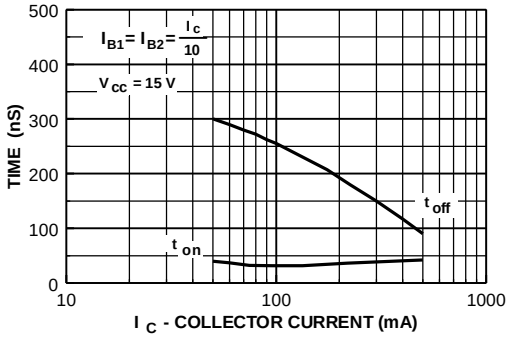


## Typical Characteristics (continued)

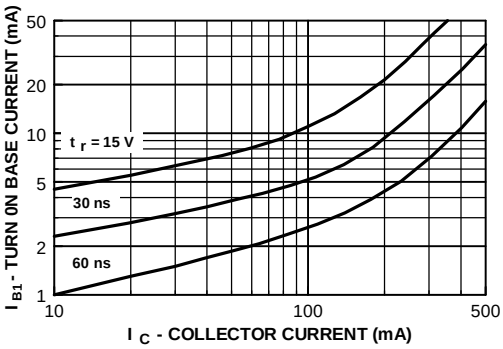
### Switching Times vs Collector Current



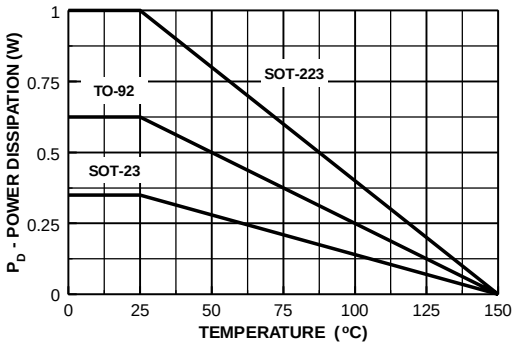

### Turn On and Turn Off Times vs Collector Current



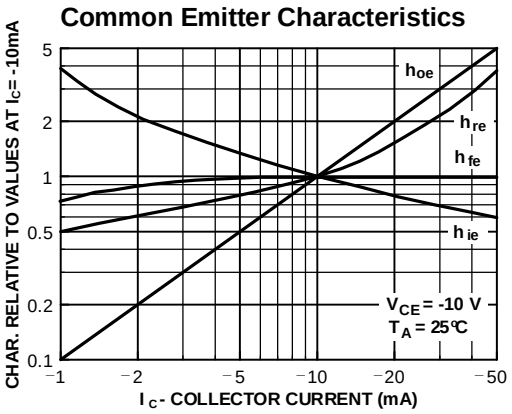

### Rise Time vs Collector and Turn On Base Currents

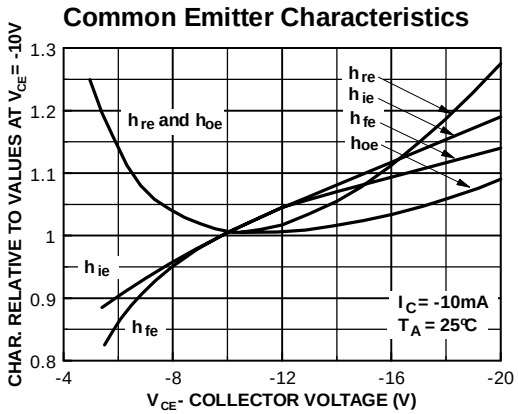


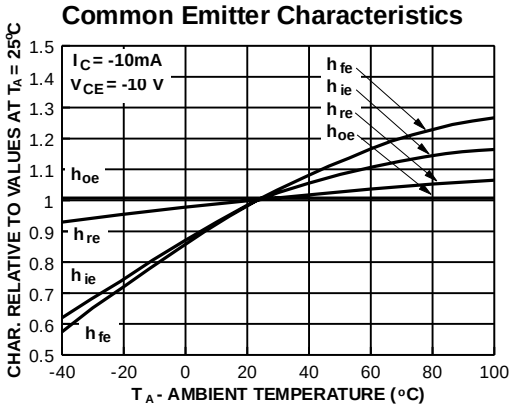

### Power Dissipation vs Ambient Temperature



## Typical Common Emitter Characteristics (f = 1.0kHz)



## Test Circuits

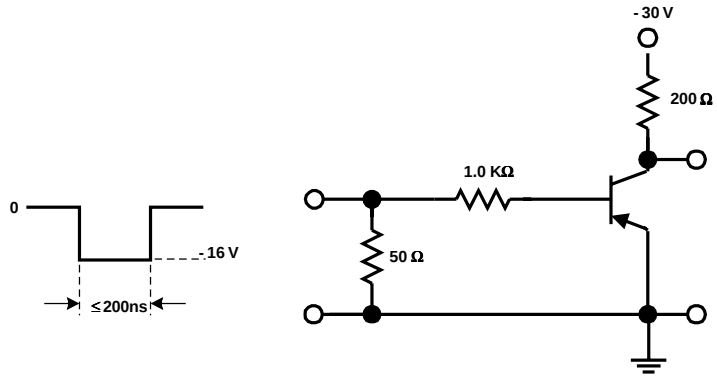



**FIGURE 1: Saturated Turn-On Switching Time Test Circuit**

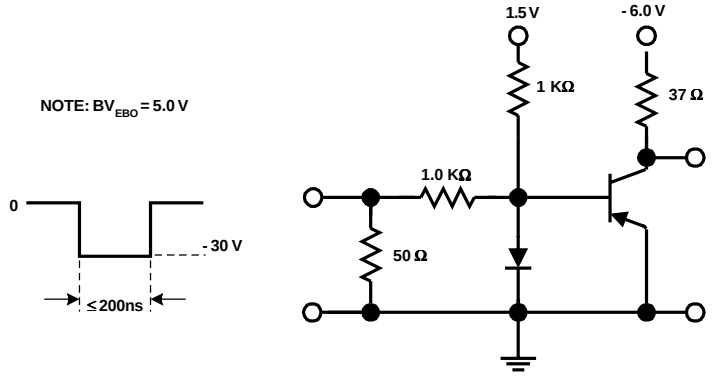



**FIGURE 2: Saturated Turn-Off Switching Time Test Circuit**

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