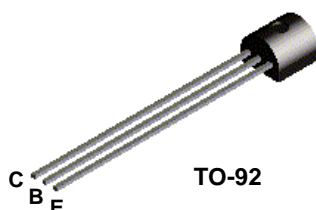


2N4402



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 _{θJC} | Thermal Resistance, Junction to Case | 83.3 | °C/W |
| R _{θJA} | 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* | $I_C = 1.0 \text{ mA}, I_B = 0$ | 40 | | V |
| $V_{(BR)CBO}$ | Collector-Base Breakdown Voltage | $I_C = 100 \text{ } \mu\text{A}, I_E = 0$ | 40 | | V |
| $V_{(BR)EBO}$ | Emitter-Base Breakdown Voltage | $I_E = 100 \text{ } \mu\text{A}, I_C = 0$ | 5.0 | | V |
| I_{CEX} | Collector Cutoff Current | $V_{CE} = 35 \text{ V}, V_{EB} = 0.4 \text{ V}$ | | 0.1 | μA |
| I_{BL} | Base Cutoff Current | $V_{CE} = 35 \text{ V}, V_{EB} = 0.4 \text{ V}$ | | 0.1 | μA |

ON CHARACTERISTICS*

| | | | | | |
|---------------|--------------------------------------|---|----------------------|--------------|--------|
| h_{FE} | DC Current Gain | $V_{CE} = 1.0 \text{ V}, I_C = 1.0 \text{ mA}$ $V_{CE} = 1.0 \text{ V}, I_C = 10 \text{ mA}$ $V_{CE} = 2.0 \text{ V}, I_C = 150 \text{ mA}$ $V_{CE} = 2.0 \text{ V}, I_C = 500 \text{ mA}$ | 30 50 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 1.30 | V V |

SMALL SIGNAL CHARACTERISTICS

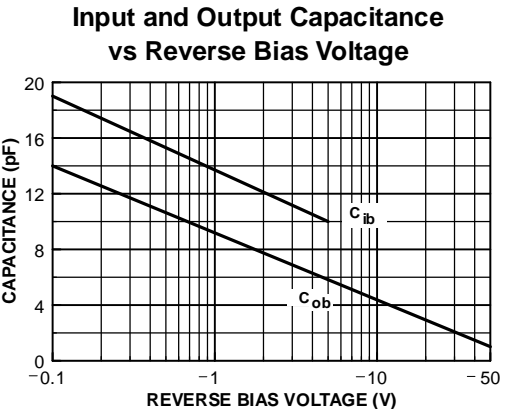
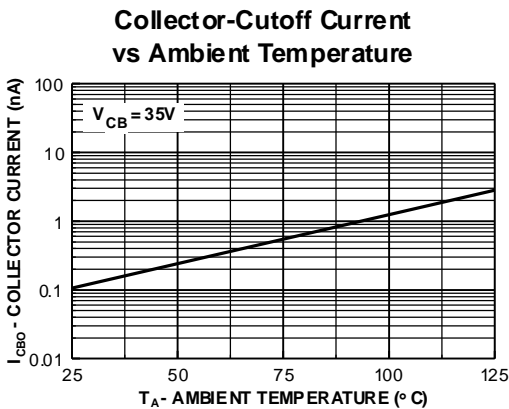
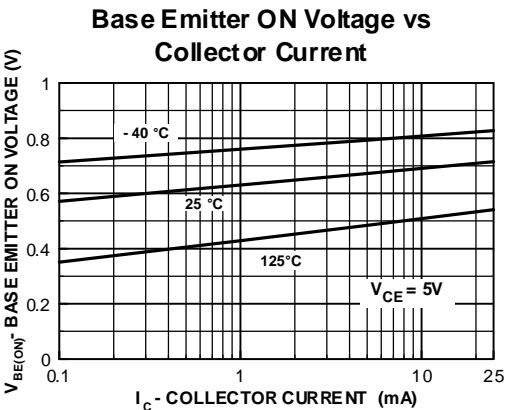
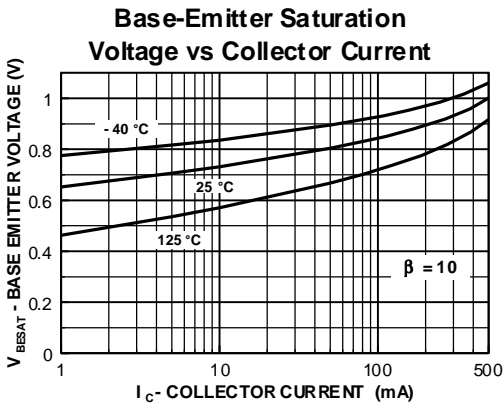
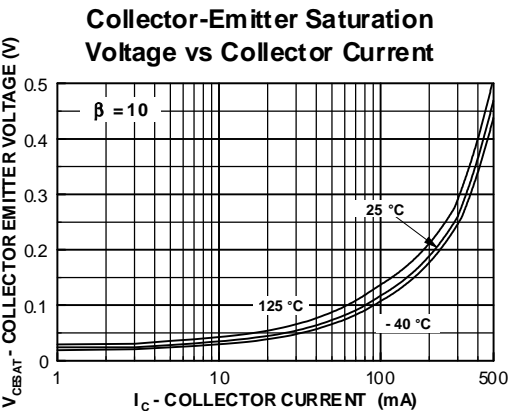
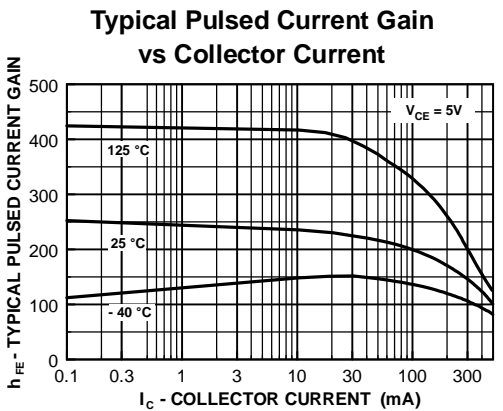
| | | | | | |
|----------|---------------------------|---|------|-----|------------------|
| C_{ob} | Output Capacitance | $V_{CB} = 10 \text{ V}, f = 140 \text{ kHz}$ | | 8.5 | pF |
| C_{ib} | Input Capacitance | $V_{EB} = 0.5 \text{ V}, f = 140 \text{ kHz}$ | | 30 | pF |
| h_{fe} | Small-Signal Current 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 | $f = 1.0 \text{ kHz}$ | 0.75 | 7.5 | k Ω |
| h_{re} | Voltage Feedback Ratio | | 0.10 | 8.0 | $\times 10^{-4}$ |
| h_{oe} | Output Admittance | | 1.0 | 100 | μmhos |

SWITCHING CHARACTERISTICS

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

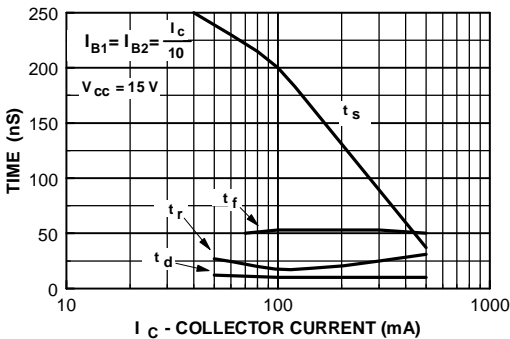
* Pulse Test: Pulse Width $\leq 300 \text{ } \mu\text{s}$, Duty Cycle $\leq 2.0\%$

Typical Characteristics

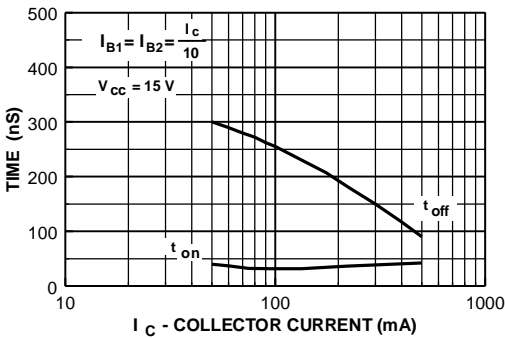


Typical Characteristics (continued)

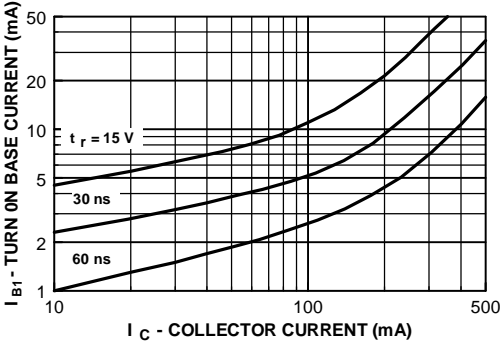
Switching Times
vs Collector Current



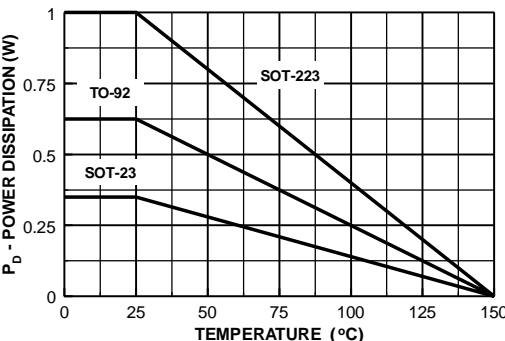
Turn On and Turn Off Times
vs Collector Current



Rise Time vs Collector
and Turn On Base Currents

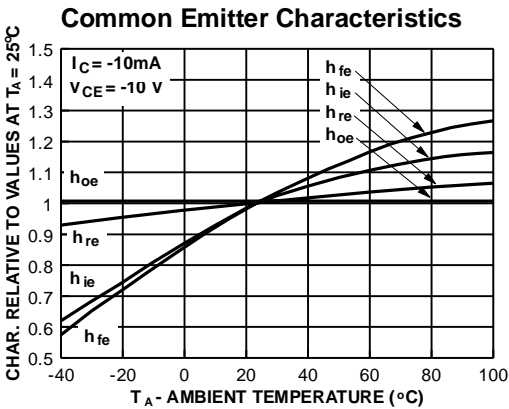
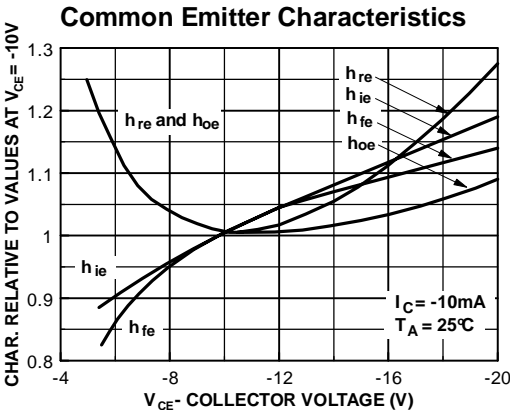
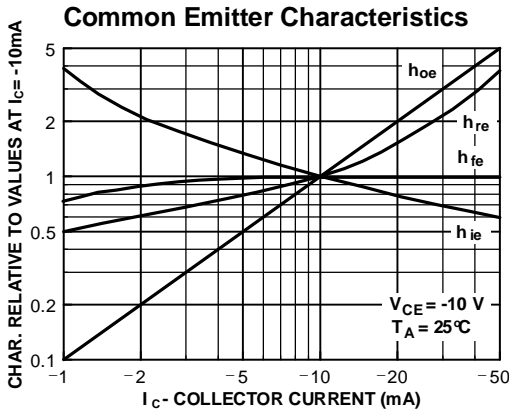


Power Dissipation vs
Ambient Temperature



PNP General Purpose Amplifier
(continued)

Typical Common Emitter Characteristics (f = 1.0kHz)



Test Circuits

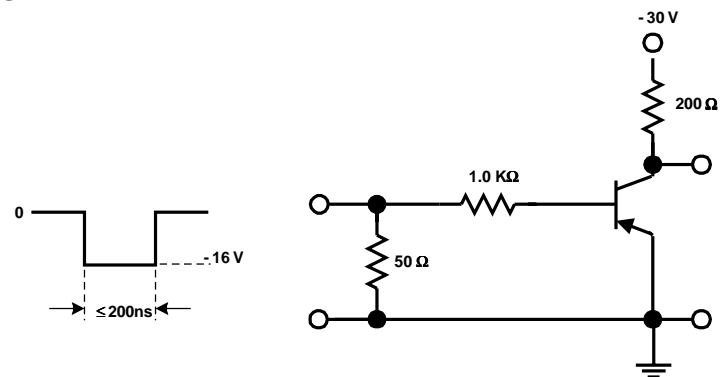


FIGURE 1: Saturated Turn-On Switching Time Test Circuit

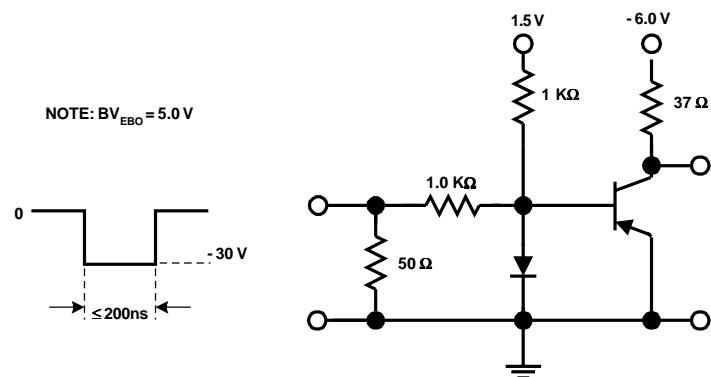


FIGURE 2: Saturated Turn-Off Switching Time Test Circuit

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| DOME™ | ISOPLANAR™ | Quiet Series™ | |
| E ² CMOS™ | MICROWIRE™ | SILENT SWITCHER® | |
| EnSigna™ | OPTOLOGIC™ | SMART START™ | |
| FACT™ | OPTOPLANAR™ | SuperSOT™-3 | |
| FACT Quiet Series™ | PACMAN™ | SuperSOT™-6 | |
| FAST® | POP™ | SuperSOT™-8 | |

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