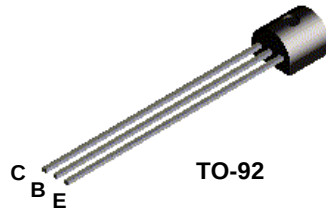
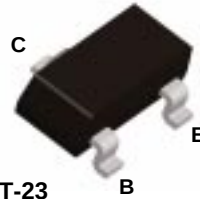


## 2N4403



TO-92

## MMBT4403



SOT-23  
Mark: 2T

### PNP General Purpose Amplifier

This device is designed for use as a general purpose amplifier and switch 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                           | 40          | V     |
| V <sub>EBO</sub>                  | Emitter-Base Voltage                             | 5.0         | 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 |
|------------------|-----------------------------------------|--------|-----------|-------|
|                  |                                         | 2N4403 | *MMBT4403 |       |
| P <sub>D</sub>   | Total Device Dissipation                | 625    | 350       | mW    |
|                  | Derate above 25°C                       | 5.0    | 2.8       | 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  |

\*Device mounted on FR-4 PCB 1.6" X 1.6" X 0.06."

# PNP General Purpose Amplifier

(continued)

2N4403 / MMBT4403

## 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     | $I_C = 0.1 \text{ mA}, I_E = 0$                 | 40  |     | V             |
| $V_{(BR)EBO}$ | Emitter-Base Breakdown Voltage       | $I_E = 0.1 \text{ A}, I_C = 0$                  | 5.0 |     | V             |
| $I_{BEX}$     | Base Cutoff Current                  | $V_{CE} = 35 \text{ V}, V_{EB} = 0.4 \text{ V}$ |     | 0.1 | $\mu\text{A}$ |
| $I_{CEX}$     | Collector Cutoff Current             | $V_{CE} = 35 \text{ V}, V_{BE} = 0.4 \text{ V}$ |     | 0.1 | $\mu\text{A}$ |

### ON CHARACTERISTICS

|               |                                       |                                                                                                                                                                                                                                                           |                              |             |        |
|---------------|---------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|-------------|--------|
| $h_{FE}$      | DC Current Gain                       | $I_C = 0.1 \text{ mA}, V_{CE} = 1.0 \text{ V}$<br>$I_C = 1.0 \text{ mA}, V_{CE} = 1.0 \text{ V}$<br>$I_C = 10 \text{ mA}, V_{CE} = 1.0 \text{ V}$<br>$I_C = 150 \text{ mA}, V_{CE} = 2.0 \text{ V}^*$<br>$I_C = 500 \text{ mA}, V_{CE} = 2.0 \text{ V}^*$ | 30<br>60<br>100<br>100<br>20 | 300         |        |
| $V_{CE(sat)}$ | Collector-Emitter Saturation Voltage* | $I_C = 150 \text{ mA}, I_B = 15 \text{ mA}$<br>$I_C = 500 \text{ mA}, I_B = 50 \text{ mA}$                                                                                                                                                                |                              | 0.4<br>0.75 | V<br>V |
| $V_{BE(sat)}$ | Base-Emitter Saturation Voltage       | $I_C = 150 \text{ mA}, I_B = 15 \text{ mA}^*$<br>$I_C = 500 \text{ mA}, I_B = 50 \text{ mA}$                                                                                                                                                              | 0.75                         | 0.95<br>1.3 | V<br>V |

### SMALL SIGNAL CHARACTERISTICS

|          |                                  |                                                                         |     |     |                  |
|----------|----------------------------------|-------------------------------------------------------------------------|-----|-----|------------------|
| $f_T$    | Current Gain - Bandwidth Product | $I_C = 20 \text{ mA}, V_{CE} = 10 \text{ V},$<br>$f = 100 \text{ MHz}$  | 200 |     | MHz              |
| $C_{cb}$ | Collector-Base Capacitance       | $V_{CB} = 10 \text{ V}, I_E = 0,$<br>$f = 140 \text{ kHz}$              |     | 8.5 | pF               |
| $C_{eb}$ | Emitter-Base Capacitance         | $V_{BE} = 0.5 \text{ V}, I_C = 0,$<br>$f = 140 \text{ kHz}$             |     | 30  | pF               |
| $h_{ie}$ | Input Impedance                  | $I_C = 1.0 \text{ mA}, V_{CE} = 10 \text{ V},$<br>$f = 1.0 \text{ kHz}$ | 1.5 | 15  | k $\Omega$       |
| $h_{re}$ | Voltage Feedback Ratio           | $I_C = 1.0 \text{ mA}, V_{CE} = 10 \text{ V},$<br>$f = 1.0 \text{ kHz}$ | 0.1 | 8.0 | $\times 10^{-4}$ |
| $h_{fe}$ | Small-Signal Current Gain        | $I_C = 1.0 \text{ mA}, V_{CE} = 10 \text{ V},$<br>$f = 1.0 \text{ kHz}$ | 60  | 500 |                  |
| $h_{oe}$ | Output Admittance                | $I_C = 1.0 \text{ mA}, V_{CE} = 10 \text{ V},$<br>$f = 1.0 \text{ kHz}$ | 1.0 | 100 | $\mu\text{mhos}$ |

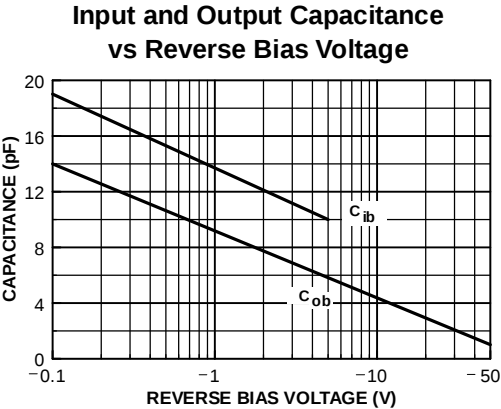
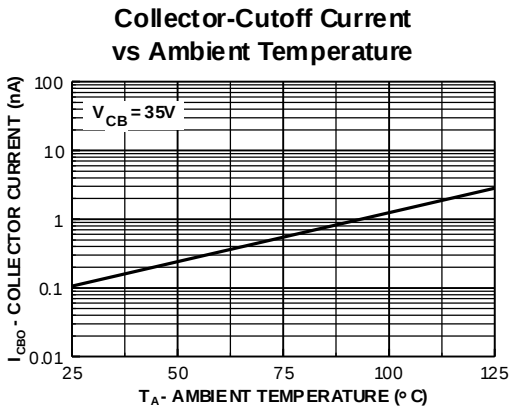
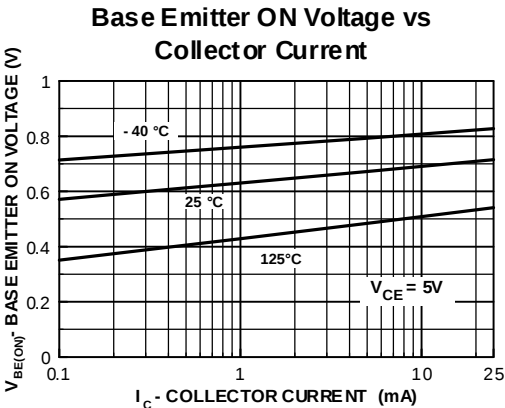
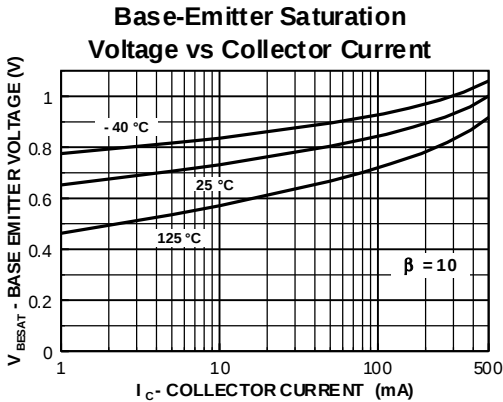
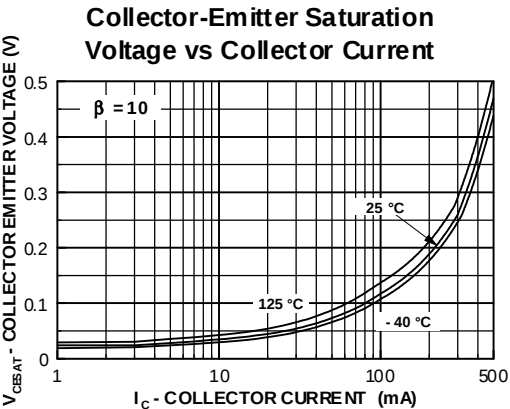
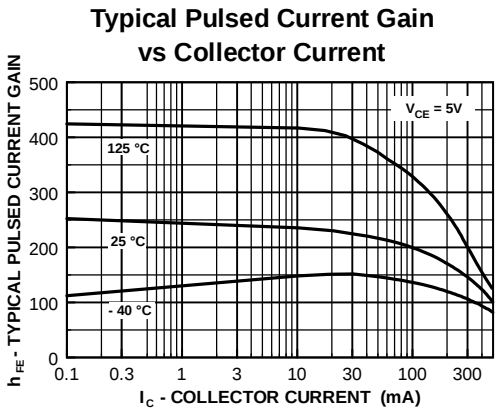
### SWITCHING CHARACTERISTICS

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

PNP General Purpose Amplifier  
(continued)

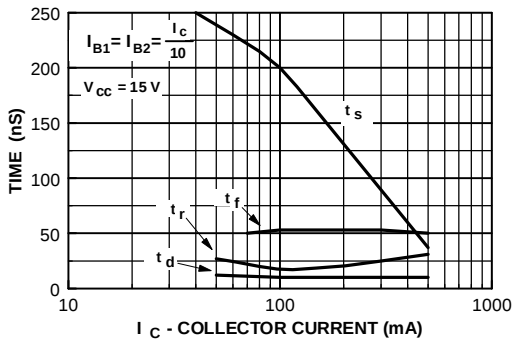
Typical Characteristics



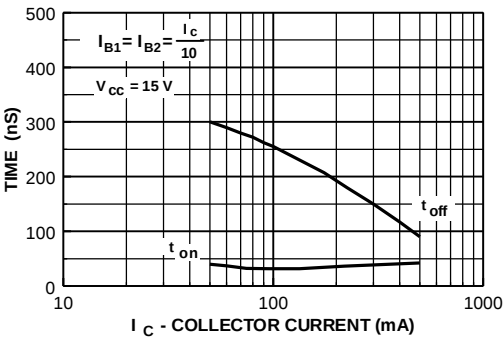
PNP General Purpose Amplifier  
(continued)

Typical Characteristics (continued)

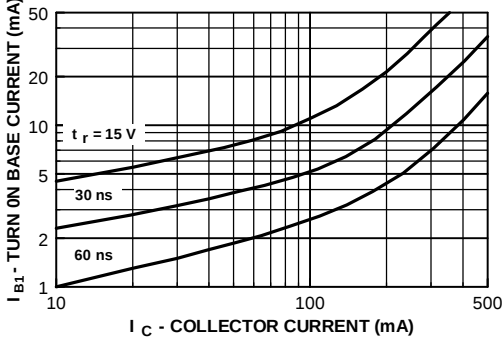
Switching Times  
vs Collector Current



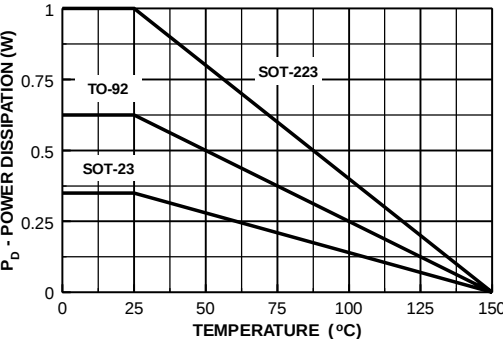
Turn On and Turn Off Times  
vs Collector Current



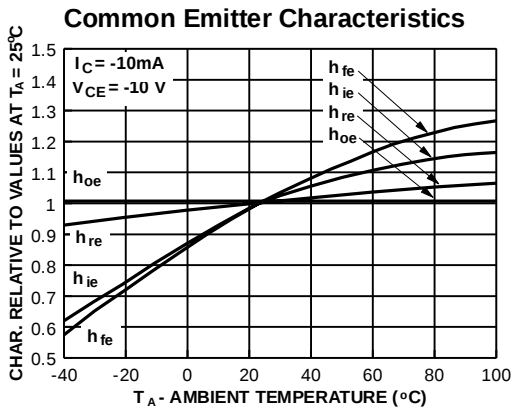
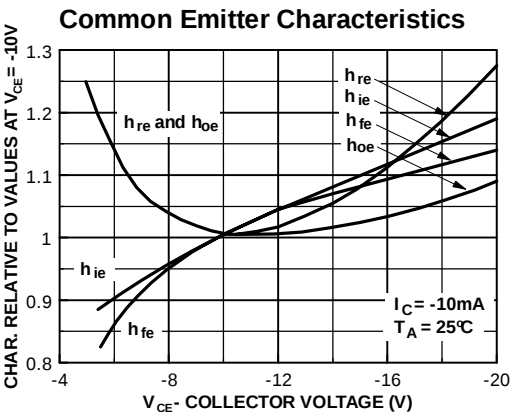
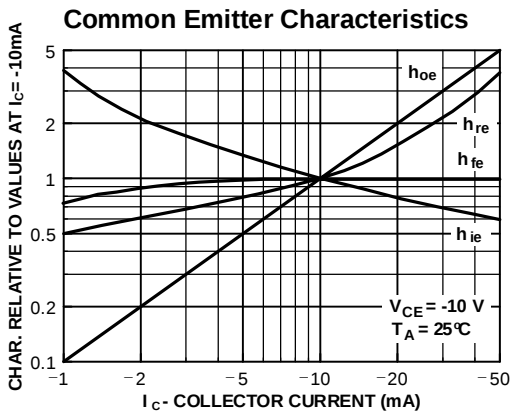
Rise Time vs Collector  
and Turn On Base Currents



Power Dissipation vs  
Ambient Temperature



Typical Common Emitter Characteristics (f = 1.0kHz)



## Test Circuits

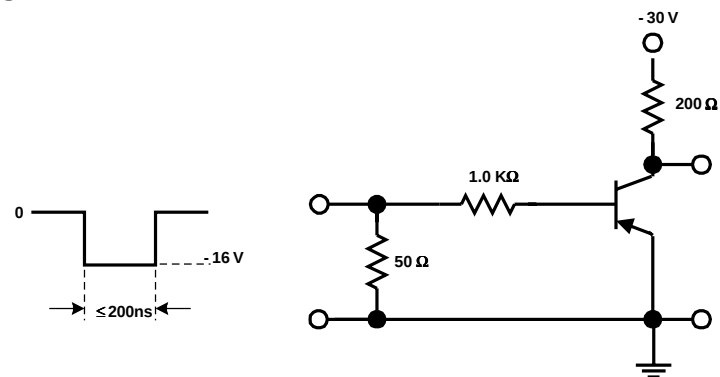


FIGURE 1: Saturated Turn-On Switching Time Test Circuit

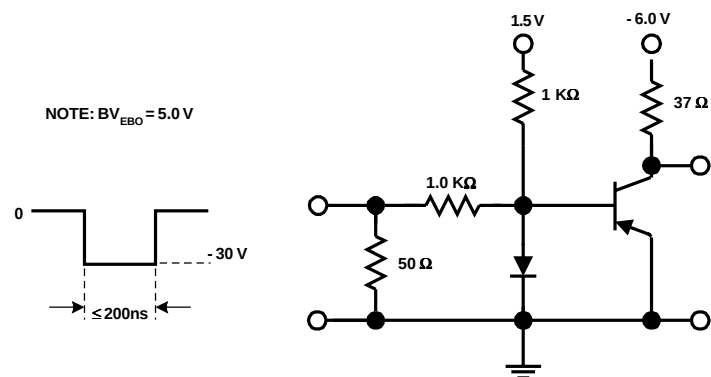


FIGURE 2: Saturated Turn-Off Switching Time Test Circuit

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