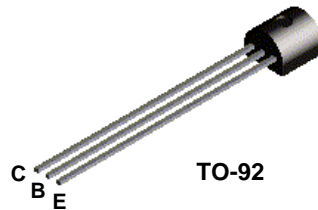


2N4401



MMBT4401



NPN General Purpose Amplifier

This device is designed for use as a medium power amplifier and switch requiring collector currents up to 500 mA. Sourced from Process 19. See PN2222A for characteristics.

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 | 60 | V |
| V _{EBO} | Emitter-Base Voltage | 6.0 | V |
| I _C | Collector Current - Continuous | 1.0 | A |
| 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 |
|------------------|---|--------|-----------|-------|
| | | 2N4401 | *MMBT4401 | |
| P _D | Total Device Dissipation Derate above 25°C | 625 | 350 | mW |
| | | 5.0 | 2.8 | mW/°C |
| R _{θJC} | Thermal Resistance, Junction to Case | 83.3 | | °C/W |
| R _{θJA} | Thermal Resistance, Junction to Ambient | 200 | 357 | °C/W |

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

NPN General Purpose Amplifier

(continued)

2N4401 / MMBT4401

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 | $I_C = 0.1 \text{ mA}, I_E = 0$ | 60 | | V |
| $V_{(BR)EBO}$ | Emitter-Base Breakdown Voltage | $I_E = 0.1 \text{ mA}, I_C = 0$ | 6.0 | | V |
| I_{BL} | Base Cutoff Current | $V_{CE} = 35 \text{ V}, V_{EB} = 0.4 \text{ V}$ | | 0.1 | μA |
| I_{CEX} | Collector Cutoff Current | $V_{CE} = 35 \text{ V}, V_{EB} = 0.4 \text{ V}$ | | 0.1 | μA |

ON CHARACTERISTICS*

| | | | | | |
|---------------|--------------------------------------|---|-----------------------------|-------------|---|
| h_{FE} | DC Current Gain | $I_C = 0.1 \text{ mA}, V_{CE} = 1.0 \text{ V}$ $I_C = 1.0 \text{ mA}, V_{CE} = 1.0 \text{ V}$ $I_C = 10 \text{ mA}, V_{CE} = 1.0 \text{ V}$ $I_C = 150 \text{ mA}, V_{CE} = 1.0 \text{ V}$ $I_C = 500 \text{ mA}, V_{CE} = 2.0 \text{ V}$ | 20 40 80 100 40 | 300 | |
| $V_{CE(sat)}$ | Collector-Emitter Saturation Voltage | $I_C = 150 \text{ mA}, I_B = 15 \text{ mA}$ $I_C = 500 \text{ mA}, I_B = 50 \text{ mA}$ | | 0.4 0.75 | 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 |

SMALL SIGNAL CHARACTERISTICS

| | | | | | |
|----------|----------------------------------|---|-----|-----|------------------|
| f_T | Current Gain - Bandwidth Product | $I_C = 20 \text{ mA}, V_{CE} = 10 \text{ V},$ $f = 100 \text{ MHz}$ | 250 | | MHz |
| C_{cb} | Collector-Base Capacitance | $V_{CB} = 5.0 \text{ V}, I_E = 0,$ $f = 140 \text{ kHz}$ | | 6.5 | pF |
| C_{eb} | Emitter-Base Capacitance | $V_{BE} = 0.5 \text{ V}, I_C = 0,$ $f = 140 \text{ kHz}$ | | 30 | pF |
| h_{ie} | Input Impedance | $I_C = 1.0 \text{ mA}, V_{CE} = 10 \text{ V},$ $f = 1.0 \text{ kHz}$ | 1.0 | 15 | $k\Omega$ |
| h_{re} | Voltage Feedback Ratio | $I_C = 1.0 \text{ mA}, V_{CE} = 10 \text{ V},$ $f = 1.0 \text{ kHz}$ | 0.1 | 8.0 | $\times 10^{-4}$ |
| h_{fe} | Small-Signal Current Gain | $I_C = 1.0 \text{ mA}, V_{CE} = 10 \text{ V},$ $f = 1.0 \text{ kHz}$ | 40 | 500 | |
| h_{oe} | Output Admittance | $I_C = 1.0 \text{ mA}, V_{CE} = 10 \text{ V},$ $f = 1.0 \text{ kHz}$ | 1.0 | 30 | μmhos |

SWITCHING CHARACTERISTICS

| | | | | | |
|-------|--------------|--|--|-----|----|
| t_d | Delay Time | $V_{CC} = 30 \text{ V}, V_{EB} = 0.2 \text{ V},$ | | 15 | ns |
| t_r | Rise Time | $I_C = 150 \text{ mA}, I_{B1} = 15 \text{ mA}$ | | 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 $\leq 2.0\%$