优尚

YOUSHANG SEMICONDUCTOR

# 设计研发新型功率器件

## 各类小信号开关

## 中低压及高压大电流等场效应管

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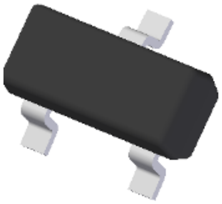
## Features

- Epitaxial Planar Die Construction
- Ideal for Medium Power Amplification and Switching
- Complementary PNP Type: NK-MMBT4403

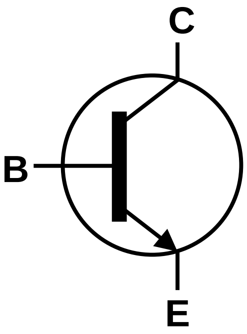
## Mechanical Data

- Package: SOT23
- Package Material: Molded Plastic “Green” Compound UL Flammability Rating 94V-0
- Moisture Sensitivity: Level 1 per J-STD-020
- Terminals: Finish - Matte Tin Plated Leads, Solderable per MIL-STD-202, Method 208 e3
- Weight: 0.008 grams (Approximate)

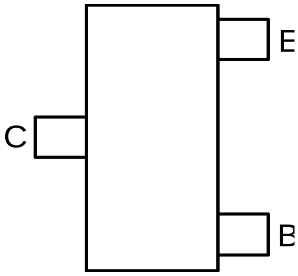
SOT23



Top View



Device Symbol



Top View
Pin-Out

## Absolute Maximum Ratings (@ $T_A$ = +25°C, unless otherwise specified.)

| Characteristic | Symbol | Value | Unit |
|---|---|---|---|
| Collector-Base Voltage | $V_{CBO}$ | 60 | V |
| Collector-Emitter Voltage | $V_{CEO}$ | 40 | V |
| Emitter-Base Voltage | $V_{EBO}$ | 6.0 | V |
| Collector Current | $I_C$ | 600 | mA |
| Peak Collector Current | $I_{CM}$ | 1 | A |
| Peak Base Current | $I_{BM}$ | 200 | mA |

## Thermal Characteristics (@$T_A$ = +25°C, unless otherwise specified.)

| Characteristic | | Symbol | Value | Unit |
|---|---|---|---|---|
| Power Dissipation | (Note 5) | $P_D$ | 310 | mW |
| | (Note 6) | | 350 | |
| Thermal Resistance, Junction to Ambient | (Note 5) | $R_{\theta JA}$ | 403 | °C/W |
| | (Note 6) | | 357 | |
| Thermal Resistance, Junction to Leads | (Note 7) | $R_{\theta JL}$ | 350 | °C/W |
| Thermal Resistance, Junction to Case | (Note 5) | $R_{\theta JC}$ | 120 | °C/W |
| Operating and Storage Temperature Range | | $T_J, T_{STG}$ | -55 to +150 | °C |

## ESD Ratings (Note 8)

| Characteristic | Symbol | Value | Unit | JEDEC Class |
|---|---|---|---|---|
| Electrostatic Discharge - Human Body Model | ESD HBM | 4,000 | V | 3A |
| Electrostatic Discharge - Machine Model | ESD MM | 400 | V | C |
| Electrostatic Discharge – Charged Device Model | ESD CDM | 1,000 | V | C3 |

Notes:

5. For a device mounted on minimum recommended pad layout 1oz copper that is on a single-sided FR4 PCB; device is measured under still air conditions whilst operating in a steady-state.
6. Same as note (5), except the device is mounted on 15mm x 15mm 1oz copper.
7. Thermal resistance from junction to solder-point (at the end of the leads).
8. Refer to JEDEC specification JESD22-A114, JESD22-A115 and JES-022-C101.

## Thermal Characteristics and Derating Information

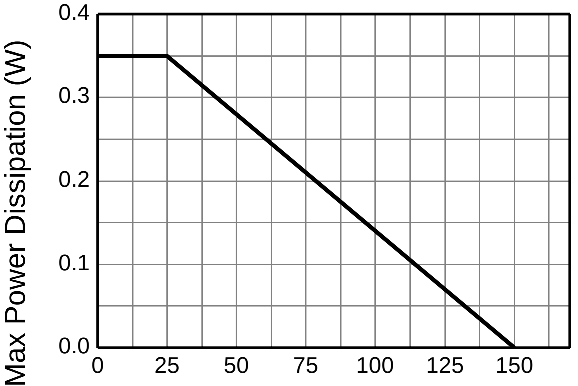


**Figure 1. Derating Curve**

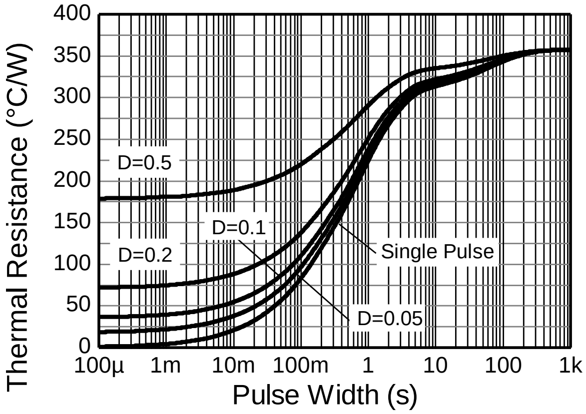


**Figure 2. Transient Thermal Impedance**

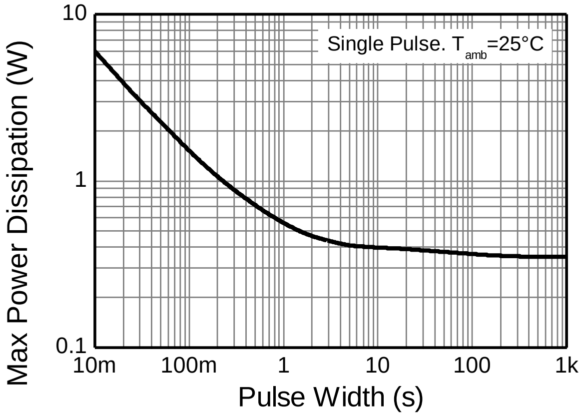


**Figure 3. Pulse Power Dissipation**

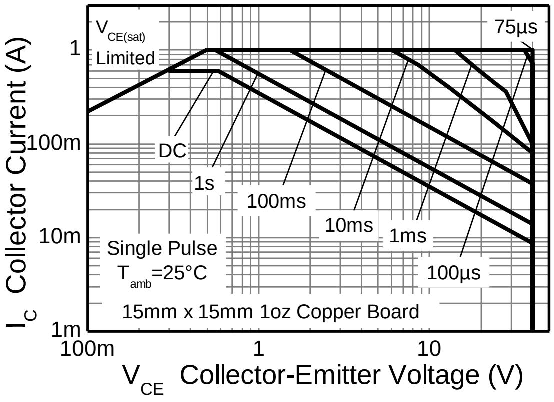


**Figure 4. Safe Operating Area**

## Electrical Characteristics (@ $T_A$ = +25°C, unless otherwise specified.)

| Characteristic | Symbol | Min | Max | Unit | Test Condition |
|---|---|---|---|---|---|
| **OFF CHARACTERISTICS** | | | | | |
| Collector-Base Breakdown Voltage | $BV_{CBO}$ | 60 | — | V | $I_C$ = 100µA |
| Collector-Emitter Breakdown Voltage (Note 9) | $BV_{CEO}$ | 40 | — | V | $I_C$ = 10mA |
| Emitter-Base Breakdown Voltage | $BV_{EBO}$ | 6 | — | V | $I_E$ = 100µA |
| Collector Cutoff Current | $I_{CEX}$ | — | 100 | nA | $V_{CE}$ = 35V, $V_{EB(off)}$ = 0.4V |
| Base Cutoff Current | $I_{BL}$ | — | 100 | nA | $V_{CE}$ = 35V, $V_{EB(off)}$ = 0.4V |
| **ON CHARACTERISTICS (Note 9)** | | | | | |
| DC Current Gain | $h_{FE}$ | 20<br>40<br>80<br>100<br>40 | —<br>—<br>—<br>300<br>— | — | $I_C$ = 100µA, $V_{CE}$ = 1V<br>$I_C$ = 1mA, $V_{CE}$ = 1V<br>$I_C$ = 10mA, $V_{CE}$ = 1V<br>$I_C$ = 150mA, $V_{CE}$ = 1V<br>$I_C$ = 500mA, $V_{CE}$ = 2V |
| Collector-Emitter Saturation Voltage | $V_{CE(sat)}$ | — | 0.4<br>0.75 | V | $I_C$ = 150mA, $I_B$ = 15mA<br>$I_C$ = 500mA, $I_B$ = 50mA |
| Base-Emitter Saturation Voltage | $V_{BE(sat)}$ | 0.75<br>— | 0.95<br>1.2 | V | $I_C$ = 150mA, $I_B$ = 15mA<br>$I_C$ = 500mA, $I_B$ = 50mA |
| **SMALL SIGNAL CHARACTERISTICS** | | | | | |
| Output Capacitance | $C_{cb}$ | — | 6.5 | pF | $V_{CB}$ = 5V, f = 1MHz |
| Input Capacitance | $C_{eb}$ | — | 30 | pF | $V_{EB}$ = 0.5V, f = 1MHz |
| Input Impedance | $h_{ie}$ | 1 | 15 | kΩ | $V_{CE}$ = 10V, $I_C$ = 1mA, f = 1kHz |
| Voltage Feedback Ratio | $h_{re}$ | 0.1 | 8 | x $10^{-4}$ | |
| Small Signal Current Gain | $h_{fe}$ | 40 | 500 | — | |
| Output Admittance | $h_{oe}$ | 1 | 30 | µS | |
| Current Gain-Bandwidth Product | $f_T$ | 250 | — | MHz | $V_{CE}$ = 10V, $I_C$ = 20mA, f = 100MHz |
| **SWITCHING CHARACTERISTICS** | | | | | |
| Delay Time | $t_d$ | — | 15 | ns | $V_{CC}$ = 30V, $I_C$ = 150mA, $V_{BE(off)}$ = 2V, $I_{B1}$ = 15mA |
| Rise Time | $t_r$ | — | 20 | ns | |
| Storage Time | $t_s$ | — | 225 | ns | $V_{CC}$ = 30V, $I_C$ = 150mA, $I_{B1}$ = $-I_{B2}$ = 15mA |
| Fall Time | $t_f$ | — | 30 | ns | |

Note: 9. Measured under pulsed conditions. Pulse width ≤ 300µs. Duty cycle ≤ 2%.

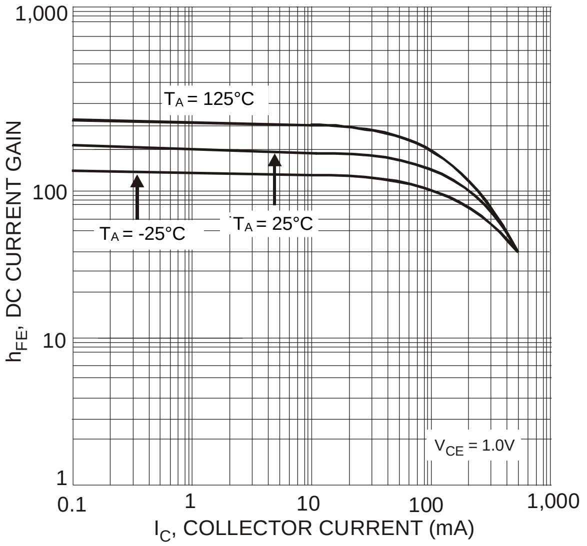


Figure 5 Typical DC Current Gain vs. Collector Current

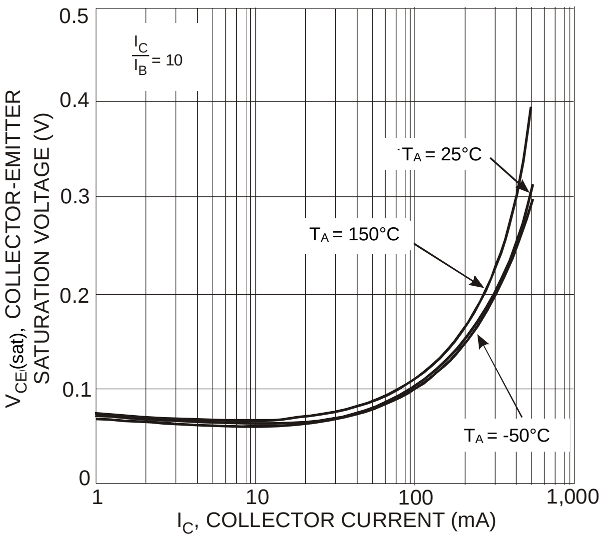


Figure 6 Collector-Emitter Saturation Voltage vs. Collector Current

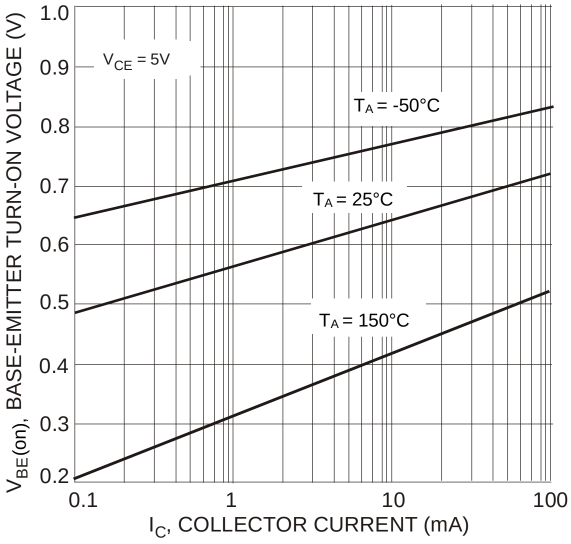


Figure 7 Typical Base-Emitter Turn-On Voltage vs. Collector Current

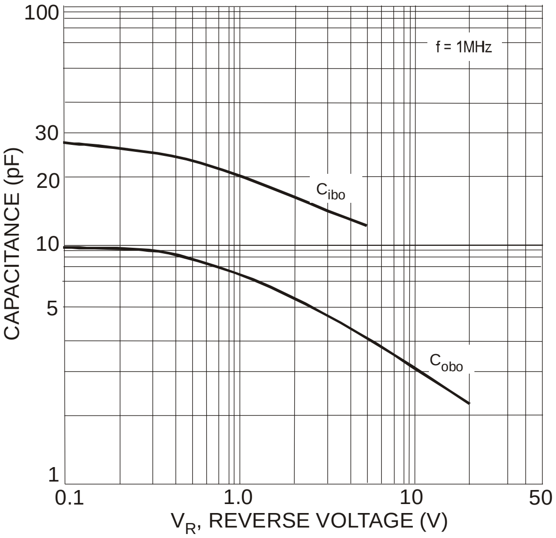


Figure 8 Typical Capacitance Characteristics

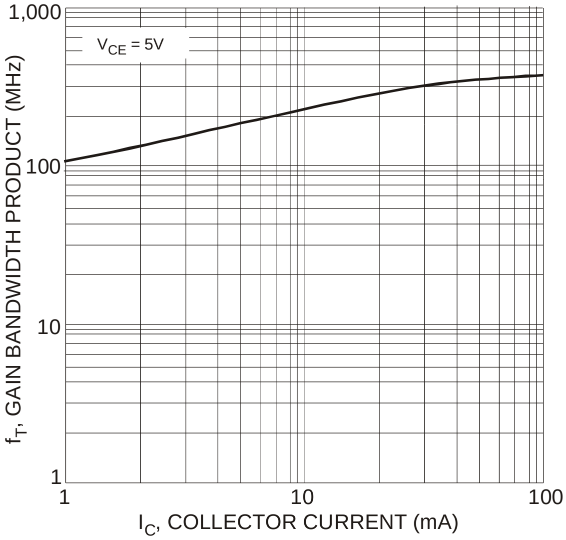


Figure 9 Typical Gain Bandwidth Product vs. Collector Current

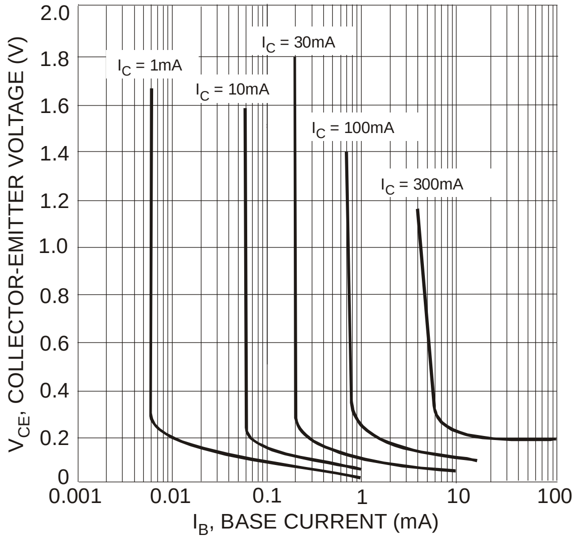
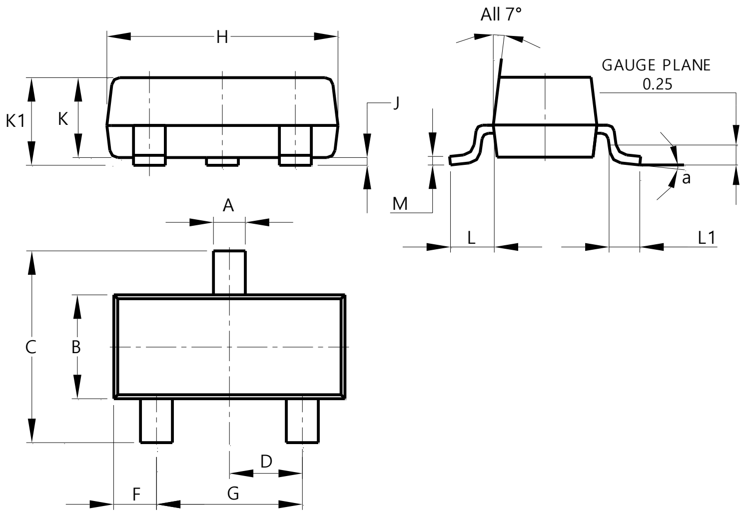


Figure 10 Typical Collector Saturation Region

## Package Outline Dimensions

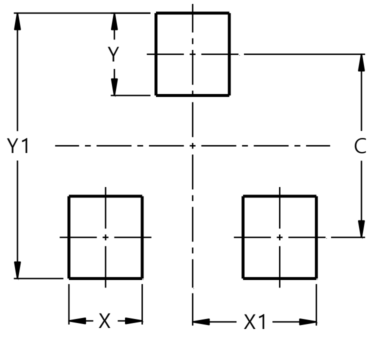
**SOT23**



| SOT23 | | | |
|---|---|---|---|
| **Dim** | **Min** | **Max** | **Typ** |
| **A** | 0.37 | 0.51 | 0.40 |
| **B** | 1.20 | 1.40 | 1.30 |
| **C** | 2.30 | 2.50 | 2.40 |
| **D** | 0.89 | 1.03 | 0.915 |
| **F** | 0.45 | 0.60 | 0.535 |
| **G** | 1.78 | 2.05 | 1.83 |
| **H** | 2.80 | 3.00 | 2.90 |
| **J** | 0.013 | 0.10 | 0.05 |
| **K** | 0.890 | 1.00 | 0.975 |
| **K1** | 0.903 | 1.10 | 1.025 |
| **L** | 0.45 | 0.61 | 0.55 |
| **L1** | 0.25 | 0.55 | 0.40 |
| **M** | 0.085 | 0.150 | 0.110 |
| **a** | 0° | 8° | -- |
| **All Dimensions in mm** | | | |

## Suggested Pad Layout

**SOT23**



| **Dimensions** | **Value (in mm)** |
|---|---|
| **C** | 2.0 |
| **X** | 0.8 |
| **X1** | 1.35 |
| **Y** | 0.9 |
| **Y1** | 2.9 |