# P-Channel Trench Power MOSFET

## General Description

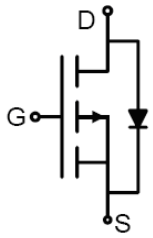
The HM2301B uses advanced trench technology to provide excellent $R_{DS(ON)}$, low gate charge and operation with gate voltages as low as -2.5V. This device is suitable for use as a battery protection or in other switching application.

## Features

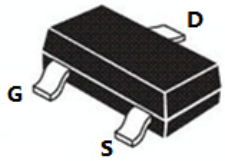
- $V_{DS}$ = -20V,ID =-2.5A
  $R_{DS(ON)}$ < 160mΩ @ $V_{GS}$ =-4.5V
  $R_{DS(ON)}$ < 230mΩ @ $V_{GS}$ =-2.5V
- High Power and current handing capability
- Lead free product is acquired
- Surface Mount Package

## Application

- Battery protection
- Load switch
- Power management




**Schematic Diagram**




**SOT-23 top view**

## Package Marking and Ordering Information

| Device Marking | Device | Device Package | Reel Size | Tape width | Quantity |
|---|---|---|---|---|---|
| A1SHB | HM2301B | SOT-23 | Ø180mm | 8mm | 3000units |

## Table 1. Absolute Maximum Ratings ($T_A$=25℃)

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| $V_{DS}$ | Drain-Source Voltage ($V_{GS}$=0V) | -20 | V |
| $V_{GS}$ | Gate-Source Voltage ($V_{DS}$=0V) | ±12 | V |
| $I_D$ | Drain Current-Continuous | -2.5 | A |
| $I_{DM\ (pluse)}$ | Drain Current-Continuous@ Current-Pulsed **(Note 1)** | -10 | A |
| $P_D$ | Maximum Power Dissipation | 1 | W |
| $T_J$,$T_{STG}$ | Operating Junction and Storage Temperature Range | -55 To 150 | ℃ |

Notes 1.Repetitive Rating: Pulse width limited by maximum junction temperature

## Table 2. Thermal Characteristic

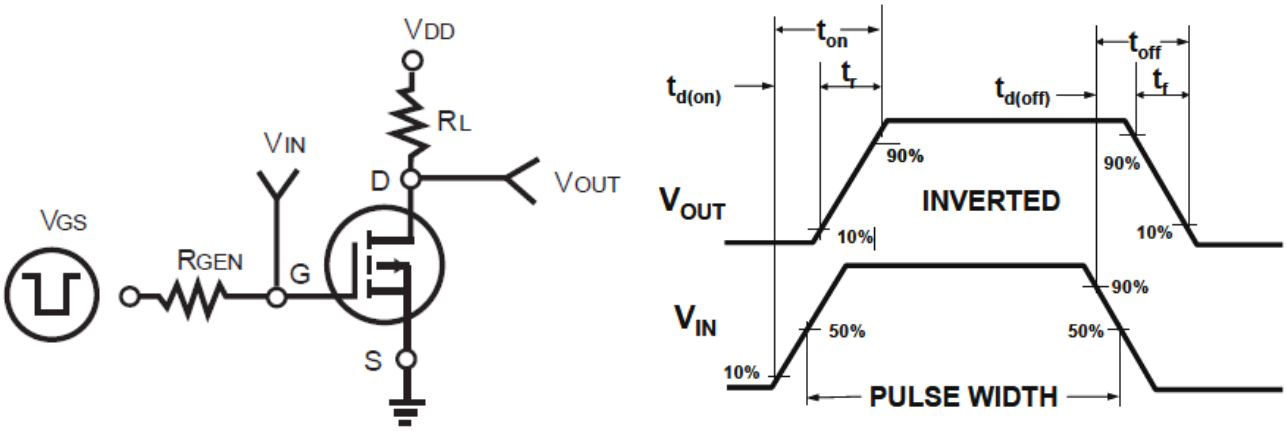
| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| $R_{\theta JA}$ | Thermal Resistance, Junction-to-Ambient | 125 | ℃/W |

**Table 3. Electrical Characteristics ($T_A$=25℃ unless otherwise noted)**

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| **On/Off States** | | | | | | |
| $BV_{DSS}$ | Drain-Source Breakdown Voltage | $V_{GS}$=0V $I_D$=-250μA | -20 | -23 | | V |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | $V_{DS}$=-20V,$V_{GS}$=0V | | | -1 | μA |
| $I_{GSS}$ | Gate-Body Leakage Current | $V_{GS}$=±12V,$V_{DS}$=0V | | | ±100 | nA |
| $V_{GS(th)}$ | Gate Threshold Voltage | $V_{DS}$=$V_{GS}$,$I_D$=-250μA | -0.4 | -0.7 | -1 | V |
| $g_{FS}$ | Forward Transconductance | $V_{DS}$=-5V,$I_D$=-2A | 4 | | | S |
| $R_{DS(ON)}$ | Drain-Source On-State Resistance | $V_{GS}$=-4.5V, $I_D$=-2.5A | | 118 | 160 | mΩ |
| | | $V_{GS}$=-2.5V, $I_D$=-2A | | 175 | 230 | mΩ |
| | | $V_{GS}$=-1.8V, $I_D$=-2A | | 310 | 390 | mΩ |
| **Dynamic Characteristics** | | | | | | |
| $C_{iss}$ | Input Capacitance | $V_{DS}$=-10V,$V_{GS}$=0V, f=1.0MHz | | 290 | | pF |
| $C_{oss}$ | Output Capacitance | | | 55 | | pF |
| $C_{rss}$ | Reverse Transfer Capacitance | | | 29 | | pF |
| **Switching Times** | | | | | | |
| $t_{d(on)}$ | Turn-on Delay Time | $V_{DD}$=-10V,$I_D$=-1A,$R_L$=2.8Ω $V_{GS}$=-4.5V,$R_G$=6Ω | | 8 | | nS |
| $t_r$ | Turn-on Rise Time | | | 13 | | nS |
| $t_{d(off)}$ | Turn-Off Delay Time | | | 13 | | nS |
| $t_f$ | Turn-Off Fall Time | | | 18 | | nS |
| $Q_g$ | Total Gate Charge | $V_{DS}$=-10V,$I_D$=-2.5A, $V_{GS}$=-4.5V | | 3 | | nC |
| $Q_{gs}$ | Gate-Source Charge | | | 0.7 | | nC |
| $Q_{gd}$ | Gate-Drain Charge | | | 0.8 | | nC |
| **Source-Drain Diode Characteristics** | | | | | | |
| $I_{SD}$ | Source-Drain Current(Body Diode) | | | | -2.5 | A |
| $V_{SD}$ | Forward on Voltage **(Note 1)** | $V_{GS}$=0V,$I_S$=-2.5A | | | -1.2 | V |

Notes 1. Repetitive Rating: Pulse width limited by maximum junction temperature.

**Switch Time Test Circuit and Switching Waveforms：**




**TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS (Curves)**

**Figure1. Power Dissipation**

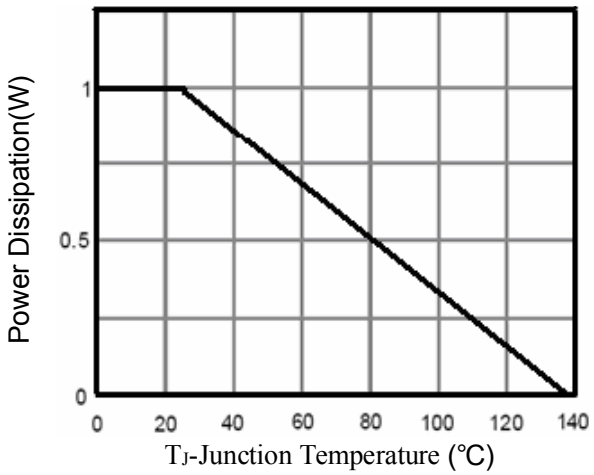



**Figure2. Drain Current**

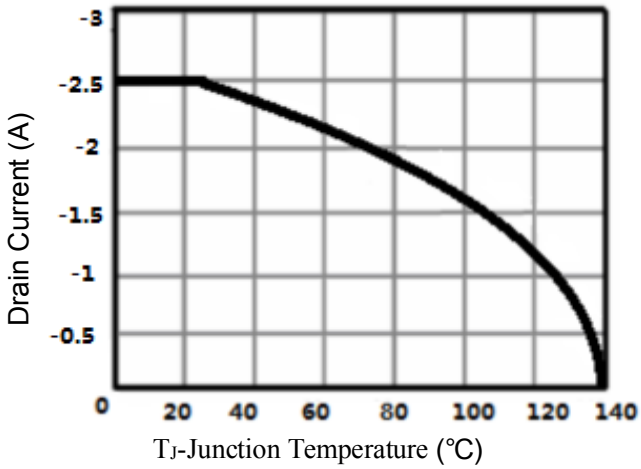



**Figure3. Output Characteristics**

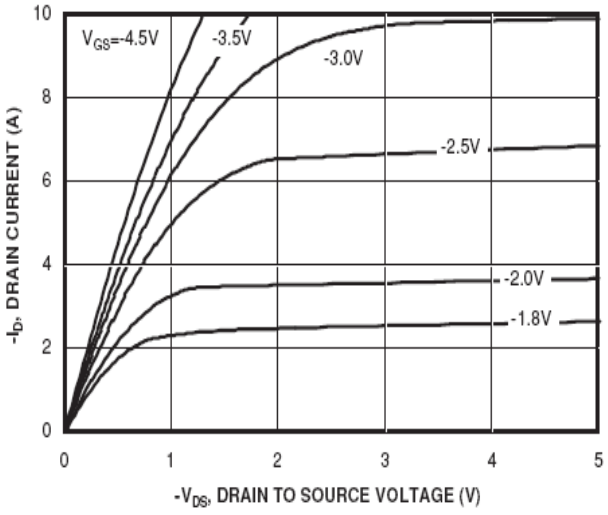



**Figure4. Transfer Characteristics**

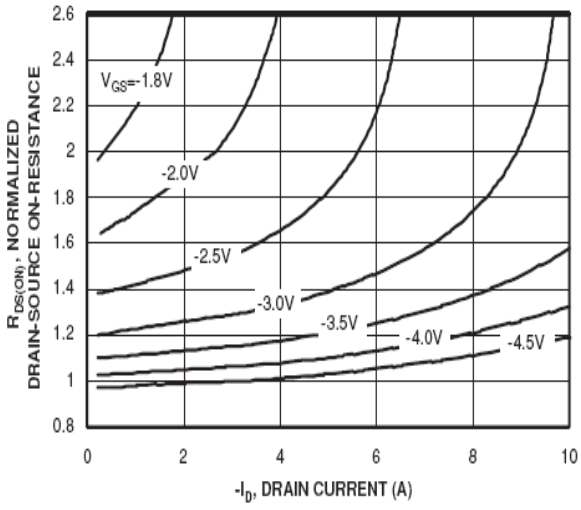


**Figure5. Capacitance**

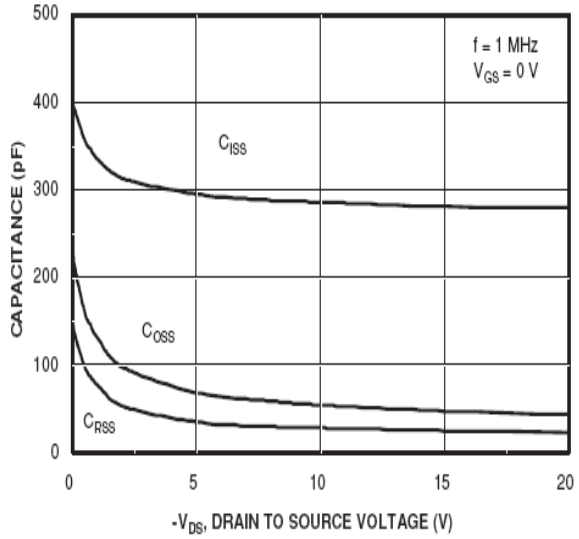



**Figure6. $R_{DS(ON)}$ vs Junction Temperature**

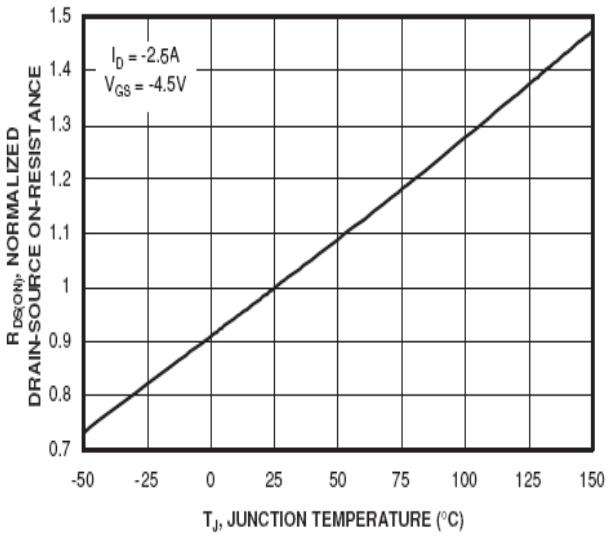



**Figure7. Max $BV_{DSS}$ vs Junction Temperature**

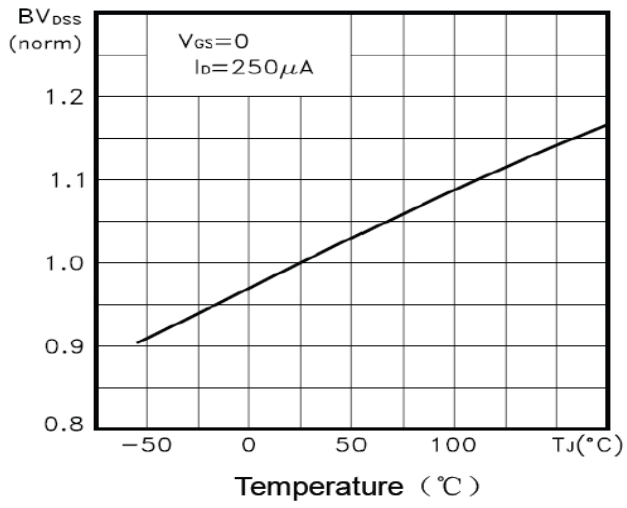



**Figure8. $V_{GS(th)}$ vs Junction Temperature**

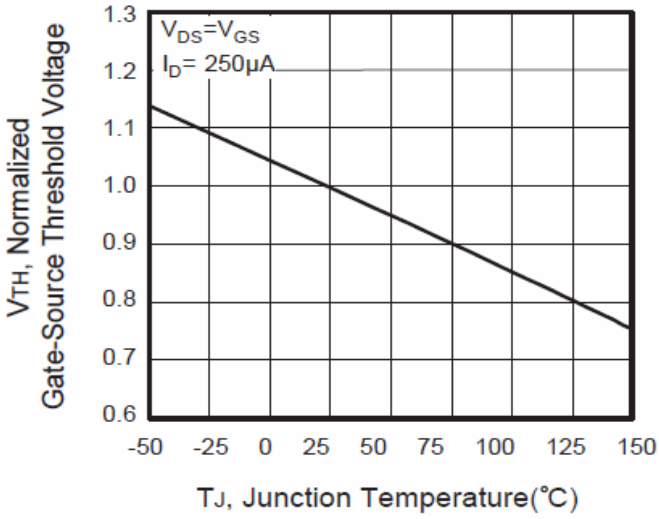



**Figure9. Gate Charge Waveforms**

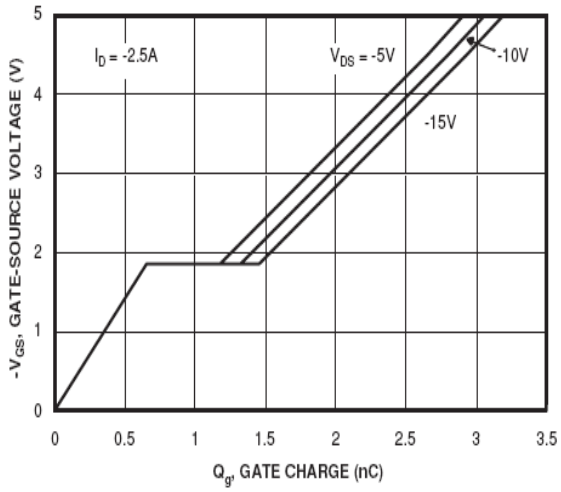



**Figure10. Maximum Safe Operating Area**

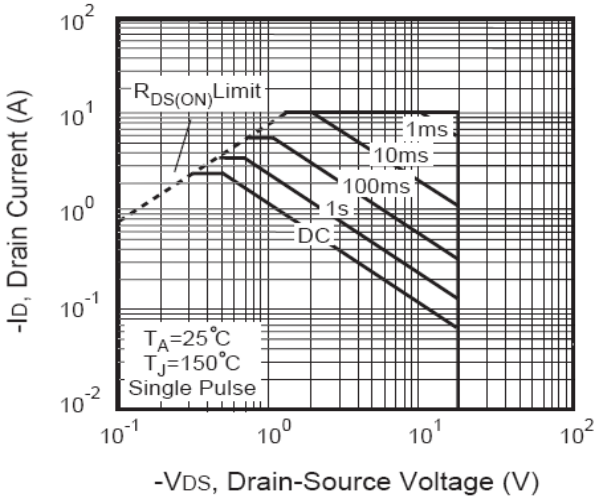
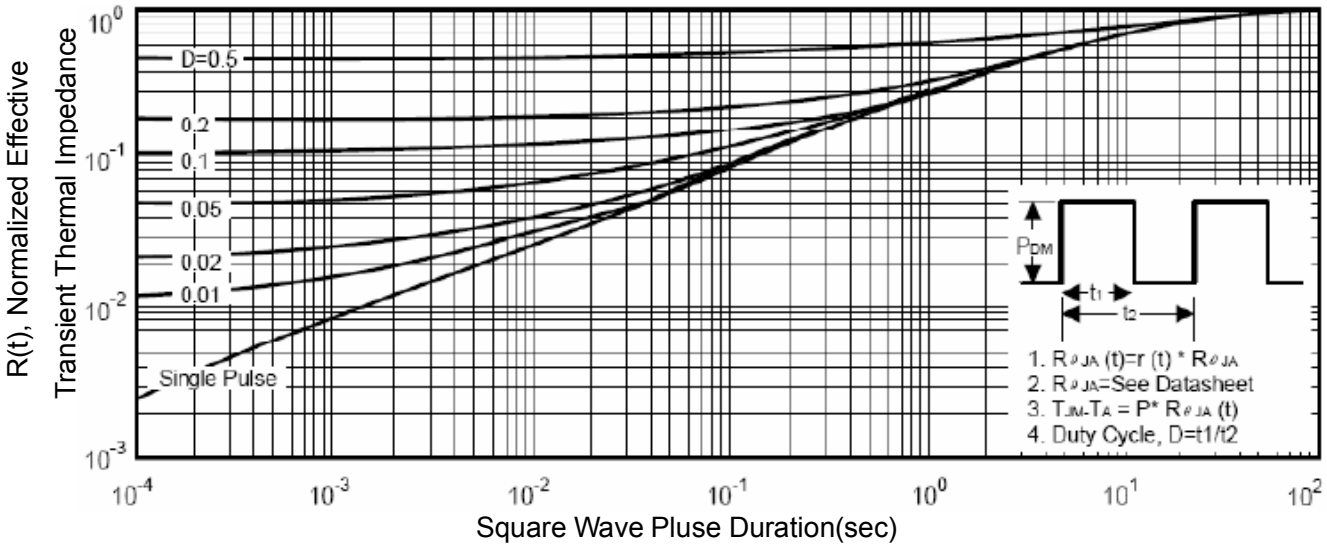
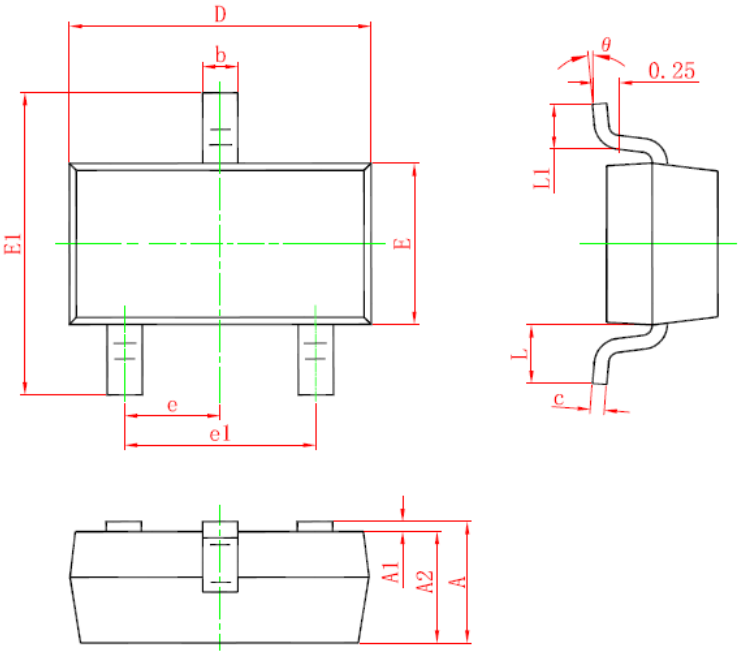


**Figure11. Normalized Maximum Transient Thermal Impedance**




# SOT-23 Package Information




| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|---|---|---|---|---|
| | Min. | Max. | Min. | Max. |
| A | 0.900 | 1.150 | 0.035 | 0.045 |
| A1 | 0.000 | 0.100 | 0.000 | 0.004 |
| A2 | 0.900 | 1.050 | 0.035 | 0.041 |
| b | 0.300 | 0.500 | 0.012 | 0.020 |
| c | 0.080 | 0.150 | 0.003 | 0.006 |
| D | 2.800 | 3.000 | 0.110 | 0.118 |
| E | 1.200 | 1.400 | 0.047 | 0.055 |
| E1 | 2.250 | 2.550 | 0.089 | 0.100 |
| e | 0.950 TYP. | | 0.037 TYP. | |
| e1 | 1.800 | 2.000 | 0.071 | 0.079 |
| L | 0.550 REF. | | 0.022 REF. | |
| L1 | 0.300 | 0.500 | 0.012 | 0.020 |
| θ | 0° | 8° | 0° | 8° |