# WSJM65R360X

## Super-Junction Power MOSFET

Rev.01 - 22 January 2024 Product data sheet

## 1. General description

WSJM65R360X is a high voltage N-channel MOSFET in TO220F package, which utilizes the advanced super-junction technology to provide superior FOM $R_{DS(on)}$ * $Q_g$ among silicon based MOSFETs. It is particularly suitable for applications require extreme high efficiency and power density.

## 2. Features and benefits

- Superior FOM $R_{DS(on)}$ * $Q_g$
- Extremely low switching loss
- 100% avalanche tested

## 3. Applications

- PFC stage and/or DC/DC converters in various high efficiency power suppliers, e.g. TV/sever/telecom/lighting power suppliers
- Inverters and motor drives

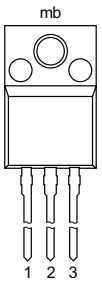
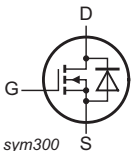
## 4. Quick reference data

**Table 1. Quick reference data**

| Symbol | Parameter | Conditions | Notes | Values | | | Unit |
|---|---|---|---|---|---|---|---|
| **Absolute maximum rating** | | | | | | | |
| $V_{DS}$ | drain-source voltage | | | 650 | | | V |
| $V_{GS}$ | gate-source voltage | | | ±30 | | | V |
| $I_D$ | continuous drain current | $T_h$ = 25 °C | [1] | 12 | | | A |
| $P_{tot}$ | power dissipation | $T_h$ = 25 °C | | 31 | | | W |
| $T_j$ | junction temperature | | | -55 to 150 | | | °C |
| **Symbol** | **Parameter** | **Conditions** | **Notes** | **Min** | **Typ** | **Max** | **Unit** |
| **Static characteristics** | | | | | | | |
| $R_{DS(on)}$ | drain-source on-state resistance | $V_{GS}$ = 10 V, $I_D$ = 5.5 A | | - | 335 | 360 | mΩ |
| **Dynamic characteristics** | | | | | | | |
| $Q_{G(tot)}$ | total gate charge | $I_D$ = 5.5 A; $V_{DS}$ = 400 V; $V_{GS}$ = 10 V | | - | 18 | - | nC |
| $E_{OSS}$ | coss stored erergy | $V_{GS}$ = 0 V; $V_{DS}$ = 0 to 400 V | | - | 2.6 | - | μJ |

## 5. Pinning information

**Table 2. Pinning information**

| Pin | Symbol | Description | Simplified outline | Graphic symbol |
|---|---|---|---|---|
| 1 | G | gate |   |   |
| 2 | D | drain | | |
| 3 | S | source | | |
| mb | n.c. | mounting base; isolated | | |

## 6. Ordering information

**Table 3. Ordering information**

| Type number | Package name | Orderable part number | Packing method | Small packing quantity | Package version | Package issue date |
|---|---|---|---|---|---|---|
| WSJM65R360X | TO220F | WSJM65R360XQ | Tube | 50 | SOT186A | 14-Nov-2013 |

## 7. Marking

**Table 4. Marking codes**

| Type number | Marking codes |
|---|---|
| WSJM65R360X | WSJM<br>65R360X |

# 8. Limiting values

**Table 5. Limiting values**

*In accordance with the Absolute Maximum Rating System (IEC 60134).*

| Symbol | Parameter | Conditions | Notes | Values | Unit |
|---|---|---|---|---|---|
| $V_{DS}$ | drain-source voltage | | | 650 | V |
| $V_{GS}$ | gate-source voltage | | | ±30 | V |
| $I_D$ | continuous drain current | $T_h$ = 25 °C | [1] | 12 | A |
| | | $T_h$ = 100 °C | [1] | 7.9 | A |
| $I_{DM}$ | pulsed drain current | $T_h$ = 25 °C | | 48 | A |
| $P_{tot}$ | power dissipation | $T_h$ = 25 °C | | 31 | W |
| $E_{AS}$ | single pulse drain−to-source avalanche | $I_{AS}$ = 3.3 A; $R_{GS}$ = 25 Ω; $V_{DD}$ = 50 V; $T_j$ = 25 °C | | 54 | mJ |
| $E_{AR}$ | repetitive avalanche energy | $I_{AS}$ = 3.3 A; $R_{GS}$ = 25 Ω; $V_{DD}$ = 50 V; $T_j$ = 25 °C | | 0.6 | mJ |
| $I_{AS}$ | avalanche current, single pulse | | | 3.3 | A |
| dv/dt | MOSFET dv/dt ruggedness | | | 50 | V/ns |
| dv/dt | reverse diode dv/dt | | | 15 | V/ns |
| $dI_F/dt$ | maximum diode commutation speed | | | 500 | A/µs |
| $T_{stg}$ | storage temperature | | | -55 to 150 | °C |
| $T_j$ | junction temperature | | | -55 to 150 | °C |

[1] Limited by maximum junction temperature, equivalent to TO220.

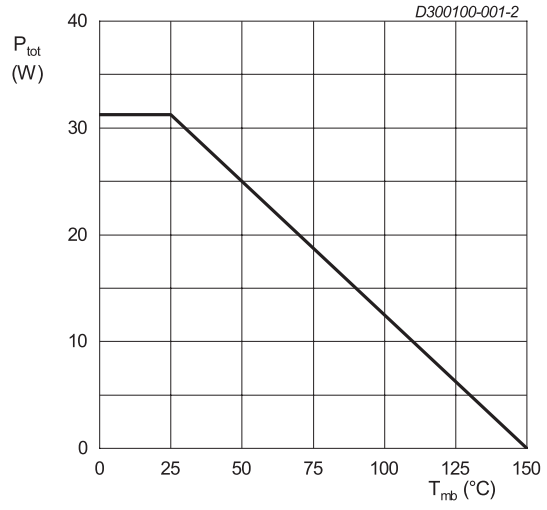



**Fig. 1. Total power dissipation as a function of heatsink temperature**

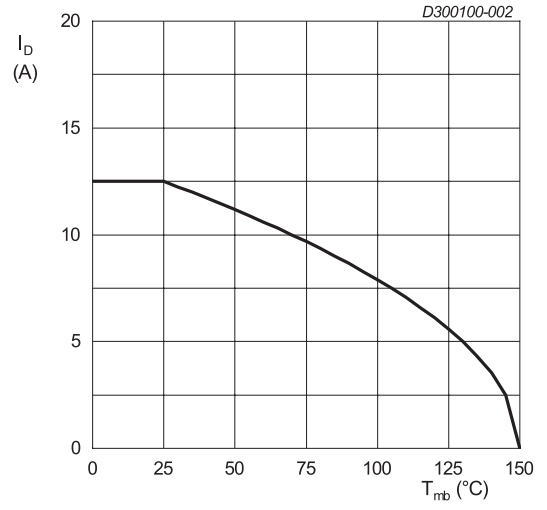



**Fig. 2. Continuous Drain Current as a function of heatsink temperature**

# 9. Thermal & Mechanical characteristics

**Table 6. Thermal & Mechanical characteristics**

| Symbol | Parameter | Conditions | Notes | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| $R_{th(j-h)}$ | thermal resistance from junction to heatsink | | | - | 3.4 | 4.0 | K/W |
| $R_{th(j-a)}$ | thermal resistance from junction to ambient | in free air | | - | 60 | - | K/W |

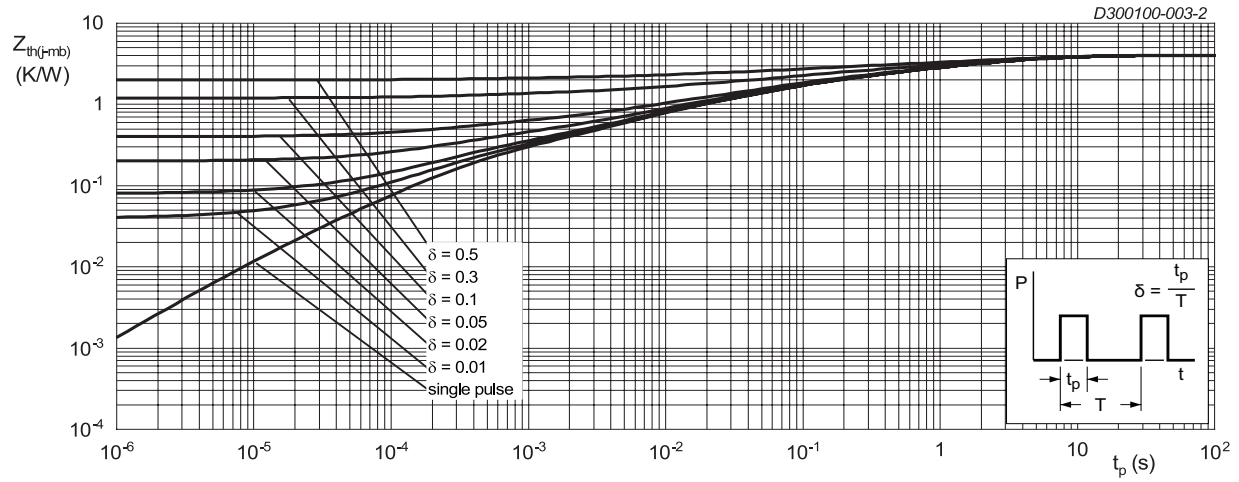



**Fig. 3. Transient thermal impedance from junction to heatsink as a function of pulse duration; maximum values**

# 10. Characteristics

**Table 7. Characteristics**

$T_j$ = 25 °C unless otherwise noted

| Symbol | Parameter | Conditions | Notes | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| **Static characteristics** | | | | | | | |
| $V_{(BR)DSS}$ | drain-source breakdown voltage | $I_D$ = 250 µA; $V_{GS}$ = 0 V | | 650 | - | - | V |
| $V_{GS(th)}$ | gate-source threshold voltage | $I_D$ = 250 µA; $V_{DS}$ = $V_{GS}$ | | 2.5 | - | 4.5 | V |
| $I_{DSS}$ | drain leakage current | $V_{DS}$ = 650 V; $V_{GS}$ = 0 V | | - | - | 1 | µA |
| | | $V_{DS}$ = 650 V; $V_{GS}$ = 0 V; $T_j$ = 125 °C | | - | - | 10 | µA |
| $I_{GSS}$ | gate leakage current | $V_{GS}$ = ±30 V; $V_{DS}$ = 0 V | | - | - | ±100 | nA |
| $R_{DS(on)}$ | drain-source on-state resistance | $V_{GS}$ = 10 V; $I_D$ = 5.5 A | | - | 335 | 360 | mΩ |
| $R_G$ | gate resistance | f = 1 MHz | | - | 18 | - | Ω |
| **Dynamic characteristics** | | | | | | | |
| $Q_{G(tot)}$ | total gate charge | $I_D$ = 5.5 A; $V_{DS}$ = 400 V; $V_{GS}$ = 10 V | | - | 18 | - | nC |
| $Q_{GS}$ | gate-source charge | | | - | 4.1 | - | nC |
| $Q_{GD}$ | gate-drain charge | | | - | 7.0 | - | nC |
| $C_{iss}$ | input capacitance | $V_{DS}$ = 400 V; $V_{GS}$ = 0 V; f = 1 MHz | | - | 808 | - | pF |
| $C_{oss}$ | output capacitance | | | - | 23 | - | pF |
| $C_{rss}$ | reverse transfer capacitance | | | - | 1.8 | - | pF |
| $C_{o(er)}$ | effective output capacitance, energy related | $V_{GS}$ = 0 V; $V_{DS}$ = 0 to 400 V | | - | 33 | - | pF |
| $C_{o(tr)}$ | effective output capacitance, time related | | | - | 148 | - | pF |
| $t_{d(on)}$ | turn-on delay time | $V_{DS}$ = 400 V; $V_{GS}$ = 10 V; $R_G$ = 2 Ω; $I_D$ = 5.5 A | | - | 30 | - | ns |
| $t_r$ | rise time | | | - | 9.6 | - | ns |
| $t_{d(off)}$ | turn-off delay time | | | - | 52 | - | ns |
| $t_f$ | fall time | | | - | 14 | - | ns |
| **Source-drain diode** | | | | | | | |
| $V_{SD}$ | source-drain voltage | $V_{GS}$ = 0 V; $I_S$ = 5.5 A | | - | 0.8 | 1.1 | V |
| $I_S$ | body-diode continuous current | $T_h$ = 25 °C | | - | - | 12 | A |
| $t_{rr}$ | reverse recovery time | $V_R$ = 400 V; $I_F$ = 5.5 A; $dI_F/dt$ = 100 A/µs | | - | 229 | - | ns |
| $Q_{rr}$ | reverse recovered charge | | | - | 2.3 | - | µC |
| $I_{rrm}$ | reverse recovery current | | | - | 20 | - | A |

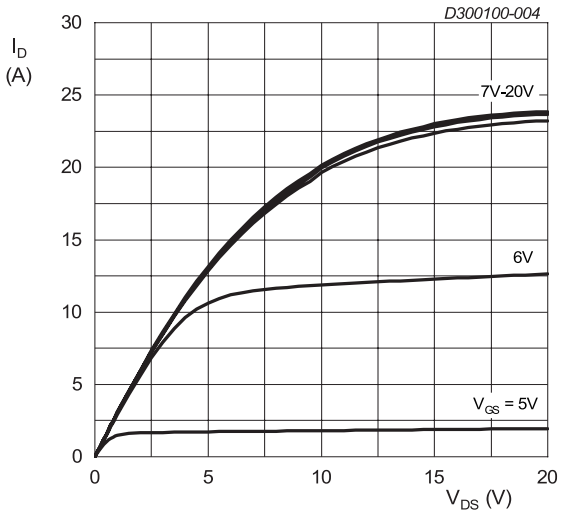
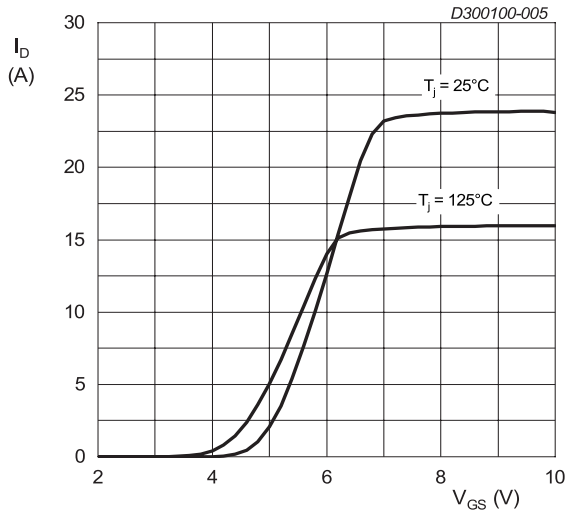
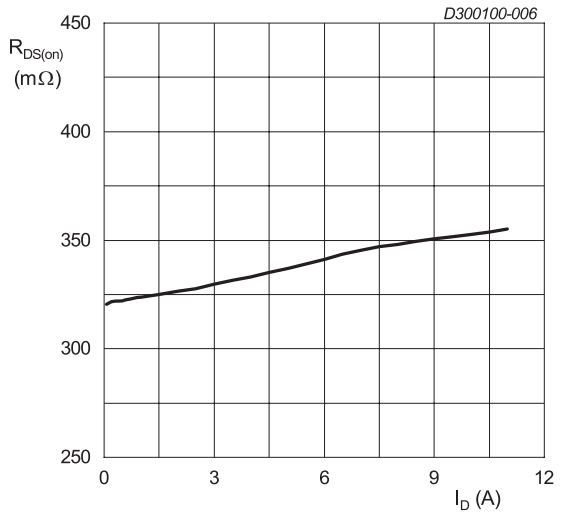



**Fig. 4. Drain current as a function of drain-source voltage; typical values**



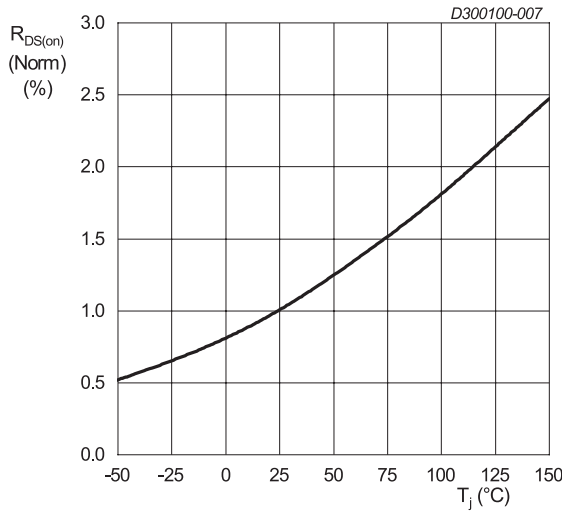

$V_{DS}$ = 20 V

**Fig. 5. Drain current as a function of gate-source voltage; typical values**



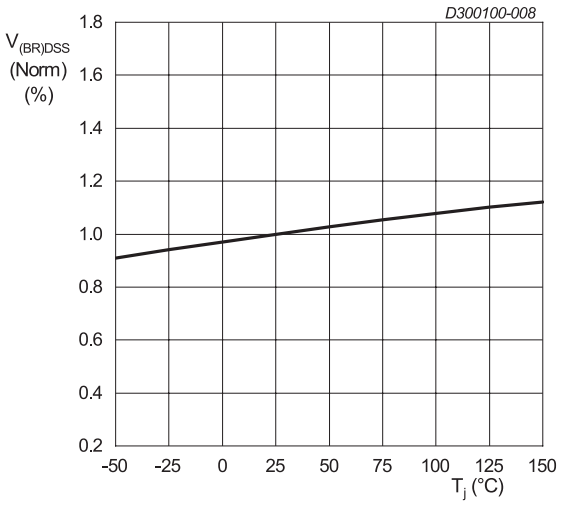

$V_{GS}$ = 10 V

**Fig. 6. Drain-source on-state resistance as a function of drain current; typical values**



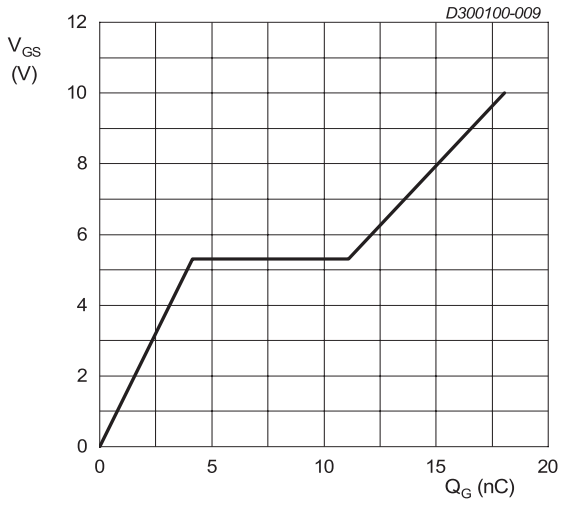

$V_{GS}$ = 10 V; $I_D$ = 5.5 A

**Fig. 7. Normalized drain-source on-state resistance as a function of junction temperature**



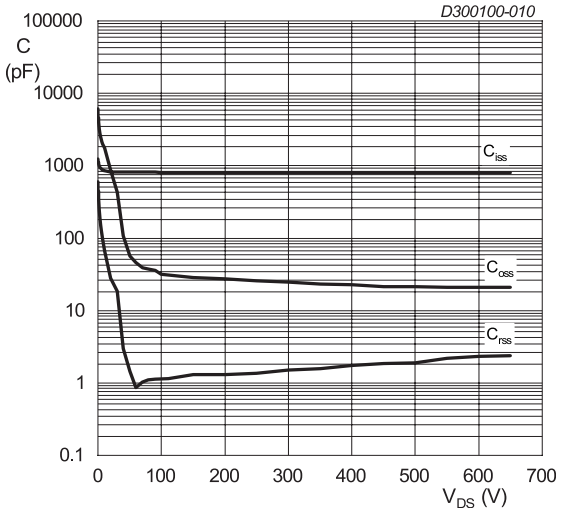

$I_D$ = 250 µA

**Fig. 8. Normalized drain-source breakdown voltage as a function of junction temperature**



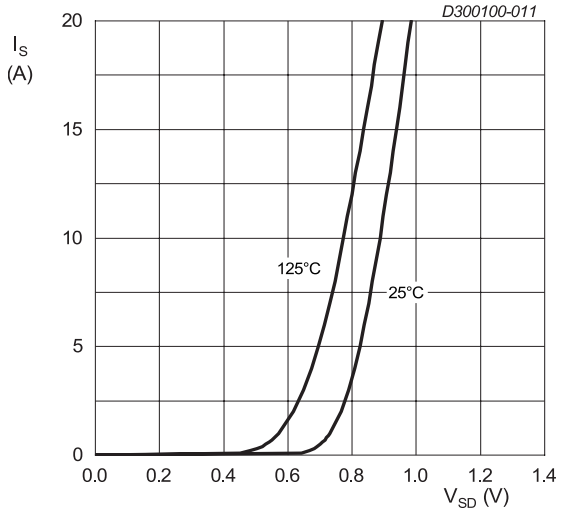

$I_D$ = 5.5 A; $V_{DS}$ = 400 V

**Fig. 9. Gate-source voltage as a function of gate charge; typical values**




$V_{GS}$ = 0 V; f = 1 MHz

**Fig 10. Capacitances as a function of drain-source voltage; typical values**




$V_{GS}$ = 0 V

**Fig 11. Source current as a function of source-drain voltage; typical values**

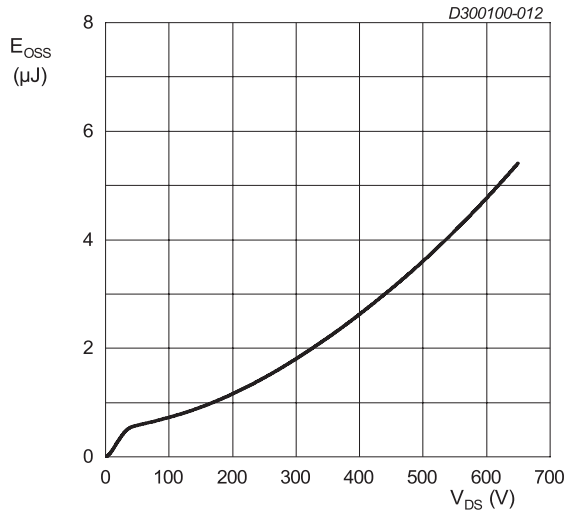
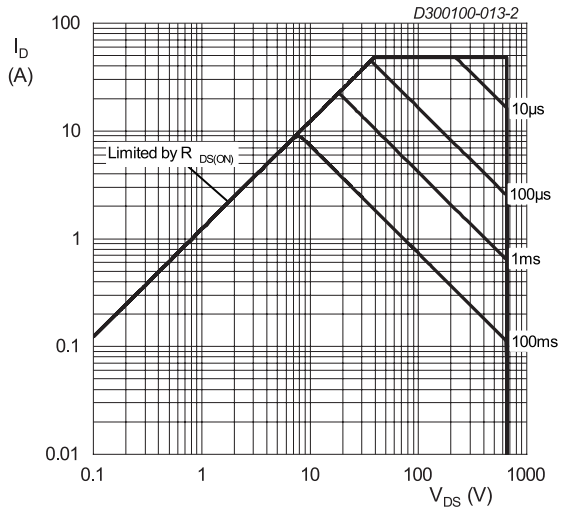



**Fig. 12. Output capacitance stored energy as a function of drain-source voltage**

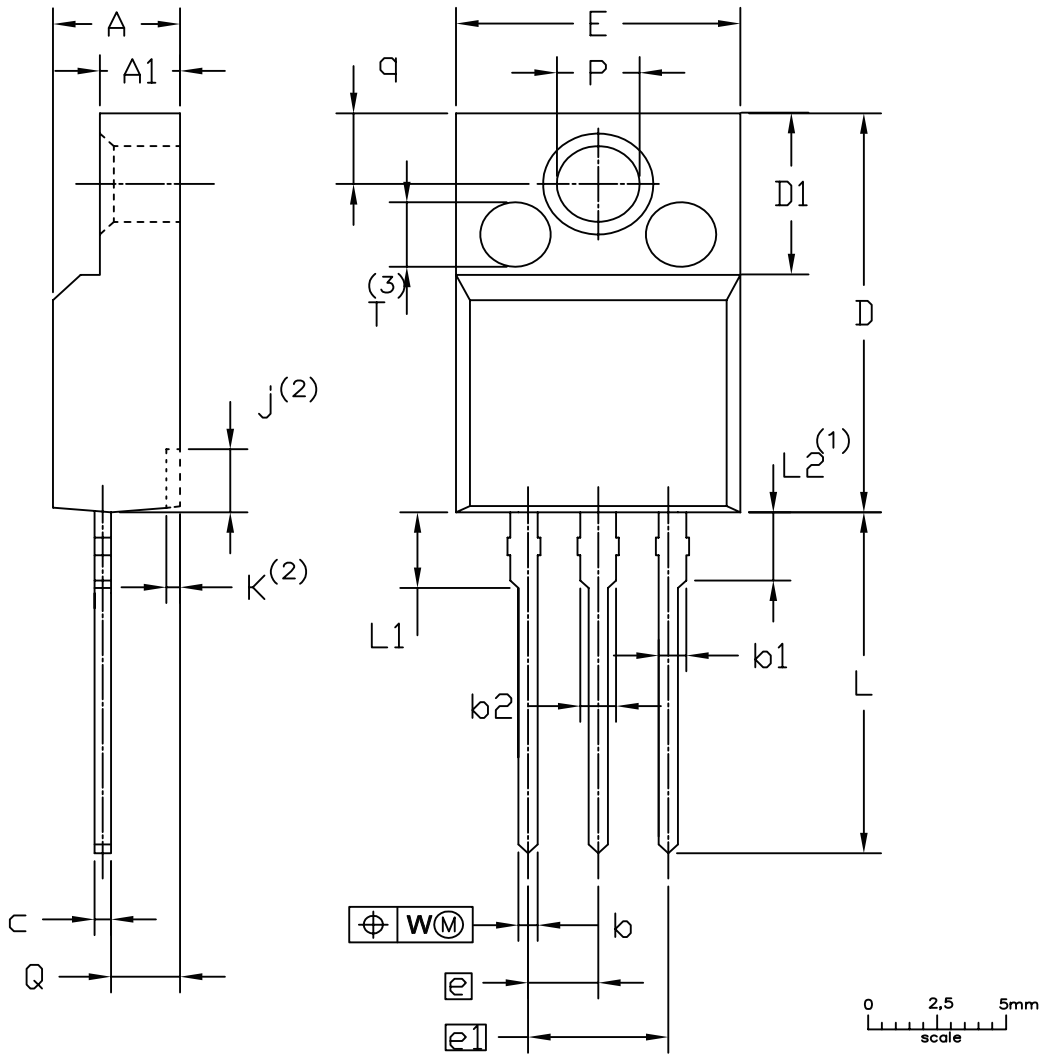



$T_h$ = 25 °C

**Fig. 13. Safe operating area**

## 11. Package outline

Plastic single-ended package; isolated heatsink mounted; 1 mounting hole; 3-lead TO-220 "full pack" SOT186A




| UNIT | A | $A_1$ | b | $b_1$ | $b_2$ | c | D | $D_1$ | E | e | $e_1$ | j(2) | K(2) | L | $L_1$ | $L_2$(1) max. | P | Q | q | W | T(3) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | 4.6 | 2.9 | 0.9 | 1.1 | 1.4 | 0.7 | 15.8 | 6.5 | 10.3 | 2.54 | 5.08 | 2.7 | 0.6 | 14.4 | 3.30 | 3 | 3.2 | 2.6 | 3.0 | 0.4 | 2.5 |
| | 4.0 | 2.5 | 0.7 | 0.9 | 1.0 | 0.4 | 15.2 | 6.3 | 9.7 | | | 1.7 | 0.4 | 13.5 | 2.79 | | 3.0 | 2.3 | 2.6 | | |

Notes
1. Terminal dimensions within this zone are uncotrolled
2. Dot lines area designs may vary
3. Eject pin mark is for reference only

| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|---|---|---|---|---|---|---|
| | IEC | JEDEC | JEITA | | | |
| SOT186A | | 3 LEADS TO220F | | | | 2013-11-14 |

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|---|---|---|
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**Date of release: 22 January 2024**

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