# 60V N&P-Channel Trench Power MOSFET

## General Description

The SJD60NP965 uses advanced trench technology to provide excellent $R_{DS(ON)}$, low gate charge and operation with gate voltages as low as 4.5V. This device is suitable for use as a wide variety of applications.

## Features

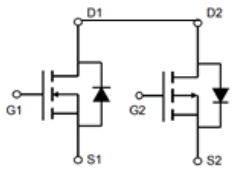
- Low Gate Charge
- 100% UIS Tested, 100% DVDS Tested
- High Power and current handing capability
- Lead free product is acquired

## Application

- DC/DC Converter
- Ideal for high-frequency switching and synchronous rectification

## Key Performance Parametes

| Parameter | Value | Value | Unit |
|---|---|---|---|
| $V_{DS}$ | 60 | -60 | V |
| $R_{DS(ON)_TYP}$ | 27.5 | 69.6 | mΩ |
| $I_D$ | 19.8 | -15 | A |
| $Q_G$ | 32.5 | 23.7 | nC |




Schematic Diagram

TO-252-4L top view

RoHS

## Package Marking and Ordering Information

| Device/Ordering Code | Marking | Package | Packing | Reel Size | Tape width | Quantity |
|---|---|---|---|---|---|---|
| SJD60NP965 | SJD60NP965 | TO-252-4L | Tape | \ | \ | 2500 Pcs |

## Table 1. Absolute Maximum Ratings ($T_C$=25℃ unless otherwise noted)

| Symbol | Parameter | N Limit | P Limit | Unit |
|---|---|---|---|---|
| $V_{DS}$ | Drain-Source Voltage ($V_{GS}$=0V) | 60 | -60 | V |
| $V_{GS}$ | Gate-Source Voltage ($V_{DS}$=0V) | ±20 | ±20 | V |
| $I_D$ | Drain Current-Continuous($T_C$=25℃) | 19.8 | -15 | A |
| | Drain Current-Continuous($T_C$=100℃) | 12.5 | -9.5 | A |
| $I_{DM\ (pluse)}$ | Drain Current-Continuous@ Current-Pulsed (Note 1) | 79.2 | -60 | A |
| $P_D$ | Maximum Power Dissipation($T_C$=25℃) | 29 | 34 | W |
| | Maximum Power Dissipation($T_C$=100℃) | 11.6 | 13.5 | W |
| $E_{AS}$ | Avalanche energy (Note 2) | 42 | 49 | mJ |
| $T_J$, $T_{STG}$ | Operating Junction and Storage Temperature Range | -55 To 150 | | ℃ |

## Table 2. Thermal Characteristic

| Symbol | Parameter | N Limit | P Limit | Unit |
|---|---|---|---|---|
| $R_{\theta JC}$ | Thermal Resistance, Junction-to- Case | 4.3 | 3.7 | ℃/W |

## Table 3. N-Channel Electrical Characteristics ($T_J$=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 | 60 | | | V |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | $V_{DS}$=60V, $V_{GS}$=0V $T_J$=25℃ | | | 1 | μA |
| | | $V_{DS}$=60V, $V_{GS}$=0V $T_J$=125℃ | | | 100 | μA |
| $I_{GSS}$ | Gate-Body Leakage Current | $V_{GS}$=±20V, $V_{DS}$=0V | | | ±100 | nA |
| $V_{GS(th)}$ | Gate Threshold Voltage | $V_{DS}$=$V_{GS}$, $I_D$=250μA | 1 | | 2.5 | V |
| $g_{FS}$ | Forward Transconductance | $V_{DS}$=5V, $I_D$=10A | | 14.8 | | S |
| $R_{DS(ON)}$ | Drain-Source On-State Resistance | $V_{GS}$=10V, $I_D$=10A $T_J$=25℃ | | 27.5 | 34.4 | mΩ |
| $R_{DS(ON)}$ | Drain-Source On-State Resistance | $V_{GS}$=4.5V, $I_D$=5A $T_J$=25℃ | | 32 | 42.6 | mΩ |
| **Dynamic Characteristics** | | | | | | |
| $C_{iss}$ | Input Capacitance | $V_{DS}$=30V,$V_{GS}$=0V, f=1.0MHz | | 903 | | pF |
| $C_{oss}$ | Output Capacitance | | | 55 | | pF |
| $C_{rss}$ | Reverse Transfer Capacitance | | | 47 | | pF |
| Rg | Gate resistance | $V_{GS}$=0V, $V_{DS}$=0V, f=1.0MHz | | 1 | | Ω |
| **Switching Parameters** | | | | | | |
| $t_{d(on)}$ | Turn-on Delay Time | $V_{GS}$=10V, $V_{DS}$=30V, $R_L$=15Ω, $R_{GEN}$=3Ω | | 12.7 | | nS |
| $t_r$ | Turn-on Rise Time | | | 2.6 | | nS |
| $t_{d(off)}$ | Turn-Off Delay Time | | | 27.2 | | nS |
| $t_f$ | Turn-Off Fall Time | | | 3.2 | | nS |
| $Q_g$ | Total Gate Charge | $V_{GS}$=10V, $V_{DS}$=30V, $I_D$=2A | | 32.5 | | nC |
| $Q_{gs}$ | Gate-Source Charge | | | 3.36 | | nC |
| $Q_{gd}$ | Gate-Drain Charge | | | 6.4 | | nC |
| **Source-Drain Diode Characteristics** | | | | | | |
| $I_{SD}$ | Source-Drain Current (Body Diode) | | | | 19.8 | A |
| $V_{SD}$ | Forward on Voltage (Note 3) | $V_{GS}$=0V, $I_S$=2A | | | 1.2 | V |
| $t_{rr}$ | Reverse Recovery Time | $I_F$=2A, dI/dt=100A/μs | | 19.5 | | ns |
| $Q_{rr}$ | Reverse Recovery Charge | $I_F$=2A, dI/dt=100A/μs | | 15.8 | | nC |

Notes 1.Repetitive Rating: Pulse width limited by maximum junction temperature.
Notes 2.$E_{AS}$ condition: $T_J$=25℃,$V_{DD}$=30V,$V_G$=10V, Rg=25Ω, L=0.5mH.
Notes 3.Repetitive Rating: Pulse width limited by maximum junction temperature.

## N-Channel Typical Electrical And Thermal Characteristics (Curves)

**Figure 1. Output Characteristics**

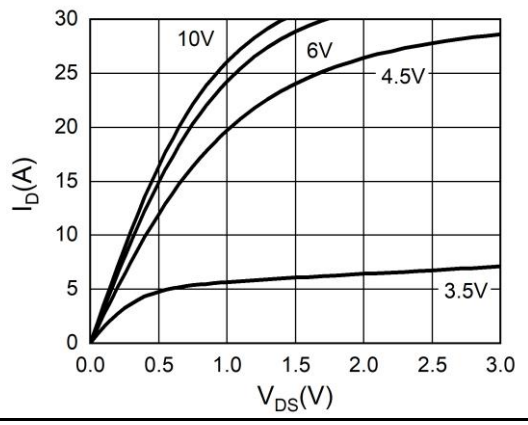



**Figure 2. Transfer Characteristics**

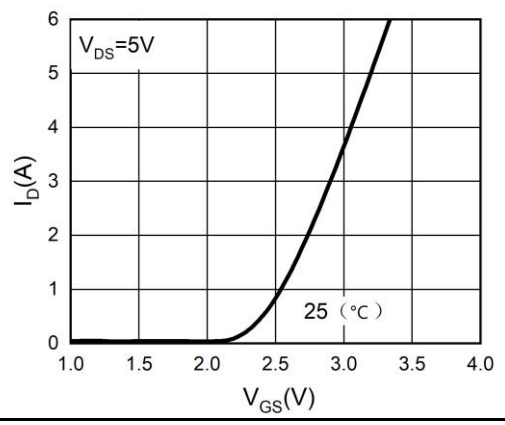



**Figure 3. Power Dissipation**

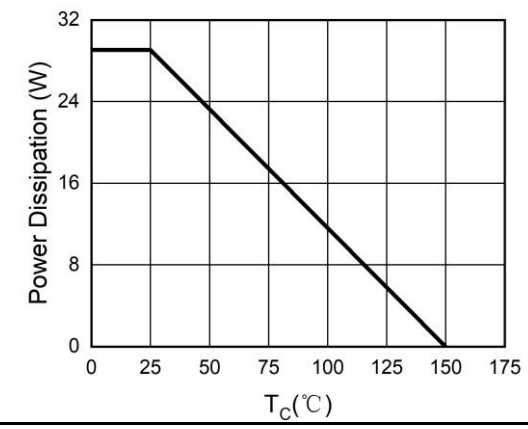



**Figure 4. Drain Current**

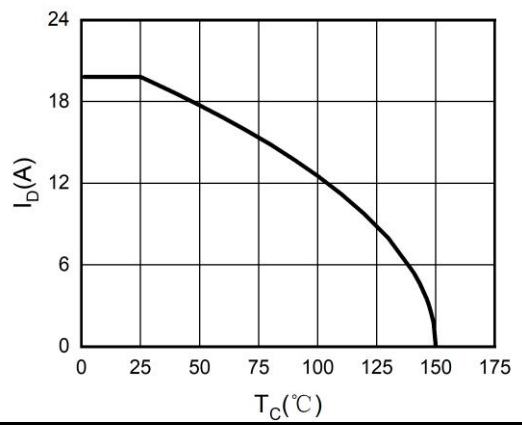



**Figure 5. $BV_{DSS}$ vs Junction Temperature**

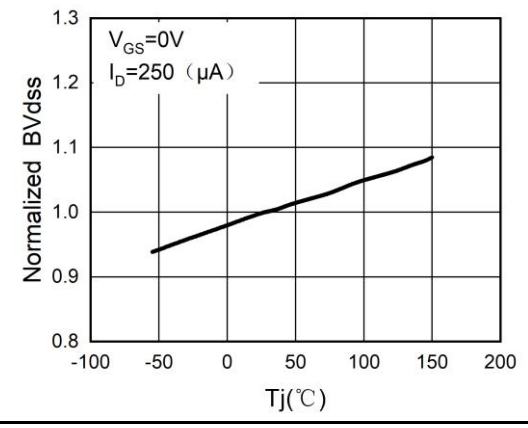
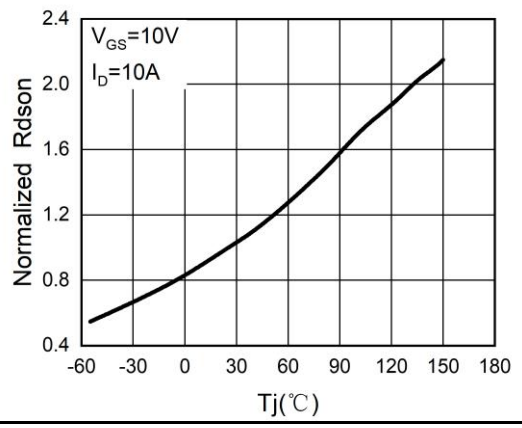



**Figure 6. $R_{DS(ON)}$ vs Junction Temperature**



## N-Channel Typical Electrical And Thermal Characteristics (Curves)

**Figure 7. Gate Charge Waveforms**

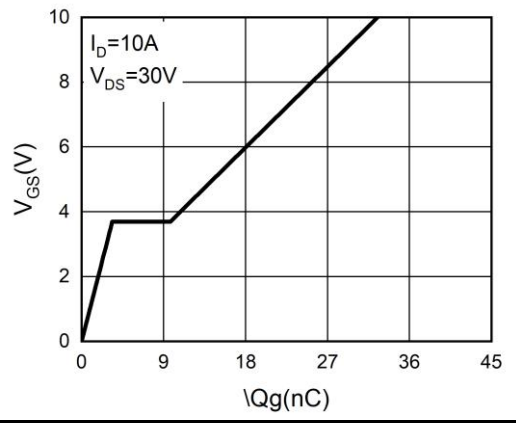



**Figure 8. Capacitance**

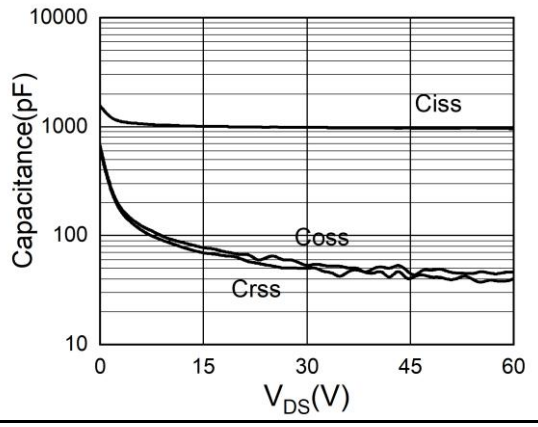



**Figure 9. Body-Diode Characteristics**

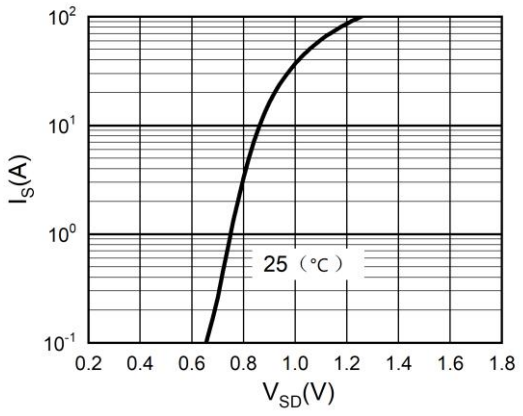
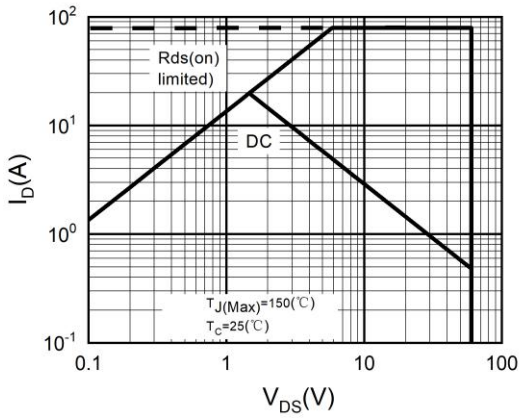



**Figure 10. Maximum Safe Operating Area**



## Table 4. P-Channel Electrical Characteristics ($T_J$=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 | -60 | | | V |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | $V_{DS}$=-60V, $V_{GS}$=0V $T_J$=25℃ | | | -1 | μA |
| | | $V_{DS}$=-60V, $V_{GS}$=0V $T_J$=125℃ | | | -100 | μA |
| $I_{GSS}$ | Gate-Body Leakage Current | $V_{GS}$=±20V, $V_{DS}$=0V | | | ±100 | nA |
| $V_{GS(th)}$ | Gate Threshold Voltage | $V_{DS}$=$V_{GS}$, $I_D$=-250μA | -1 | | -2.5 | V |
| $g_{FS}$ | Forward Transconductance | $V_{DS}$=-5V, $I_D$=-7A | | 12 | | S |
| $R_{DS(ON)}$ | Drain-Source On-State Resistance | $V_{GS}$=-10V, $I_D$=-7A $T_J$=25℃ | | 69.6 | 87 | mΩ |
| $R_{DS(ON)}$ | Drain-Source On-State Resistance | $V_{GS}$=-4.5V, $I_D$=-5A $T_J$=25℃ | | 84.2 | 112 | mΩ |
| **Dynamic Characteristics** | | | | | | |
| $C_{iss}$ | Input Capacitance | $V_{DS}$=-30V,$V_{GS}$=0V, f=1.0MHz | | 1120 | | pF |
| $C_{oss}$ | Output Capacitance | | | 53 | | pF |
| $C_{rss}$ | Reverse Transfer Capacitance | | | 44 | | pF |
| Rg | Gate resistance | $V_{GS}$=0V, $V_{DS}$=0V, f=1.0MHz | | 5.2 | | Ω |
| **Switching Parameters** | | | | | | |
| $t_{d(on)}$ | Turn-on Delay Time | $V_{GS}$=-10V, $V_{DS}$=-30V, $R_L$=4.3Ω, $R_{GEN}$=3Ω | | 10 | | nS |
| $t_r$ | Turn-on Rise Time | | | 5.5 | | nS |
| $t_{d(off)}$ | Turn-Off Delay Time | | | 29 | | nS |
| $t_f$ | Turn-Off Fall Time | | | 6 | | nS |
| $Q_g$ | Total Gate Charge | $V_{GS}$=-10V, $V_{DS}$=-30V, $I_D$=-7A | | 23.7 | | nC |
| $Q_{gs}$ | Gate-Source Charge | | | 2.1 | | nC |
| $Q_{gd}$ | Gate-Drain Charge | | | 7.2 | | nC |
| **Source-Drain Diode Characteristics** | | | | | | |
| $I_{SD}$ | Source-Drain Current (Body Diode) | | | | -15 | A |
| $V_{SD}$ | Forward on Voltage (Note 3) | $V_{GS}$=0V, $I_S$=-7A | | | -1.2 | V |
| $t_{rr}$ | Reverse Recovery Time | $I_F$=-7A, dI/dt=-100A/μs | | 34 | | ns |
| $Q_{rr}$ | Reverse Recovery Charge | $I_F$=-7A, dI/dt=-100A/μs | | 37 | | nC |

Notes 1.Repetitive Rating: Pulse width limited by maximum junction temperature.
Notes 2.$E_{AS}$ condition: $T_J$=25℃,$V_{DD}$=-40V,$V_G$=-10V, Rg=25Ω, L=0.5mH.
Notes 3.Repetitive Rating: Pulse width limited by maximum junction temperature.

## P-Channel Typical Electrical And Thermal Characteristics (Curves)

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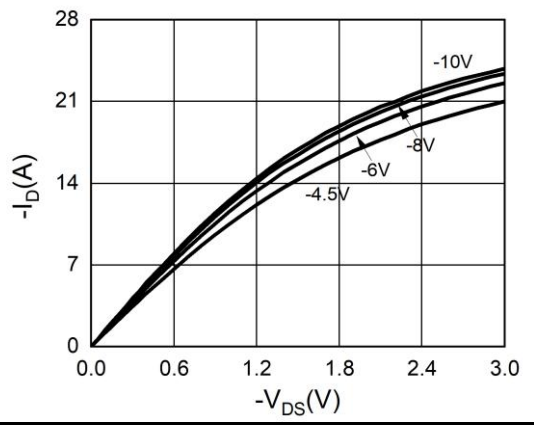



**Figure 2. Transfer Characteristics**

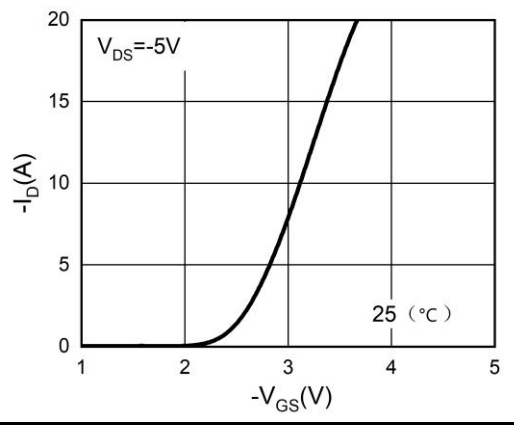



**Figure 3. Power Dissipation**

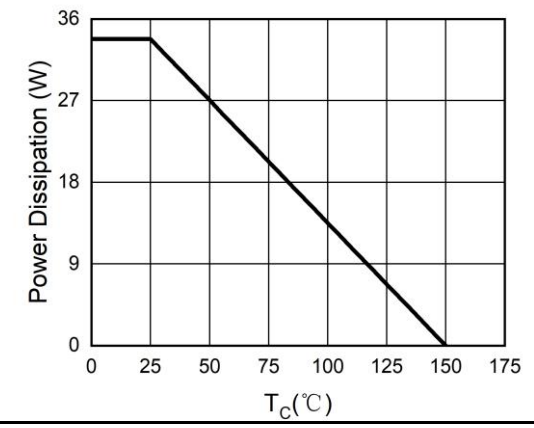



**Figure 4. Drain Current**

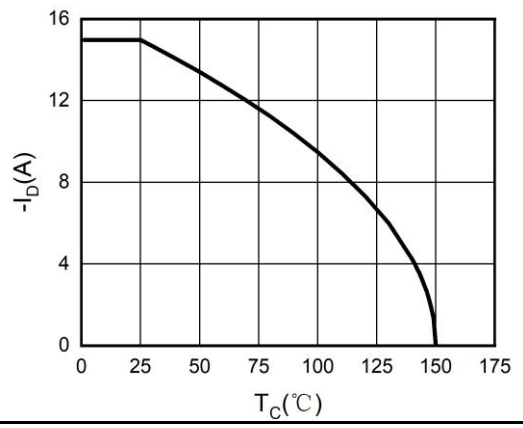



**Figure 5. $BV_{DSS}$ vs Junction Temperature**

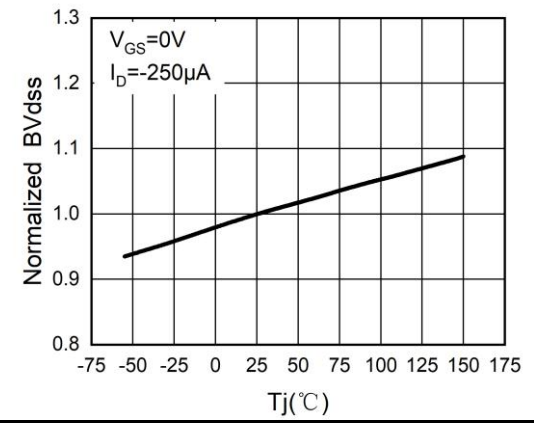
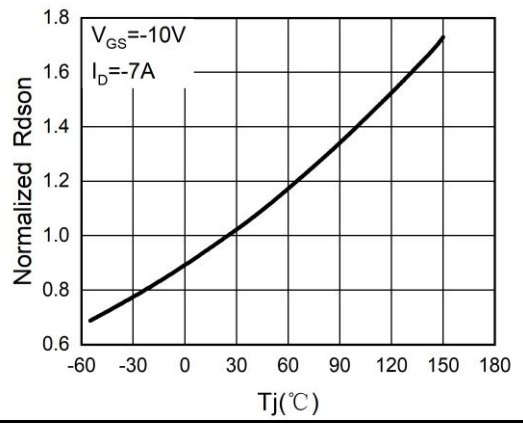



**Figure 6. $R_{DS(ON)}$ vs Junction Temperature**



## P-Channel Typical Electrical And Thermal Characteristics (Curves)

**Figure 7. Gate Charge Waveforms**

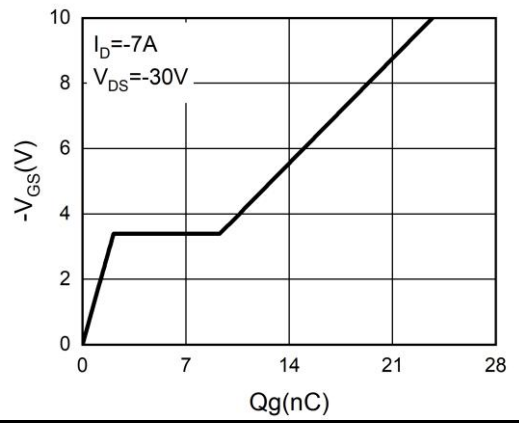



**Figure 8. Capacitance**

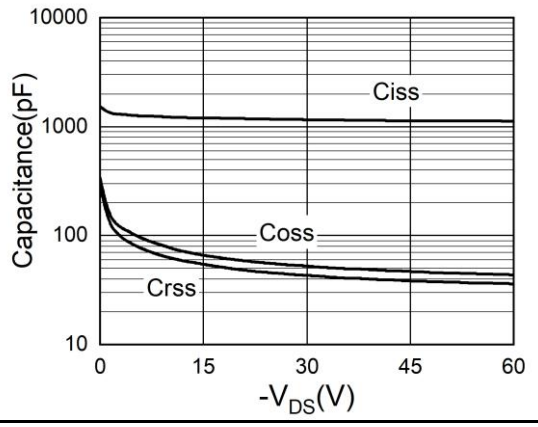



**Figure 9. Body-Diode Characteristics**

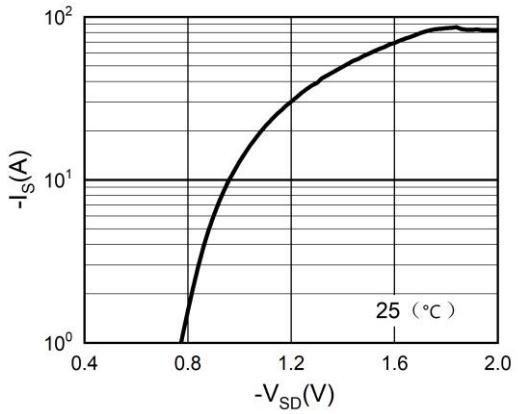
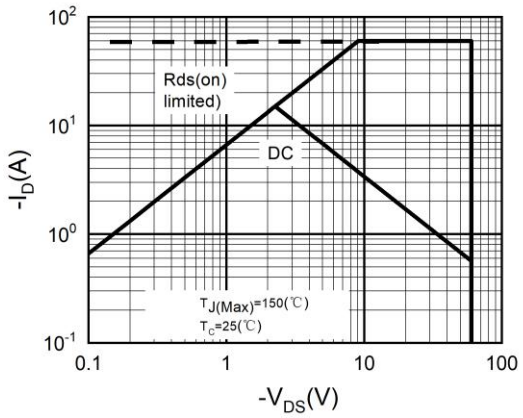
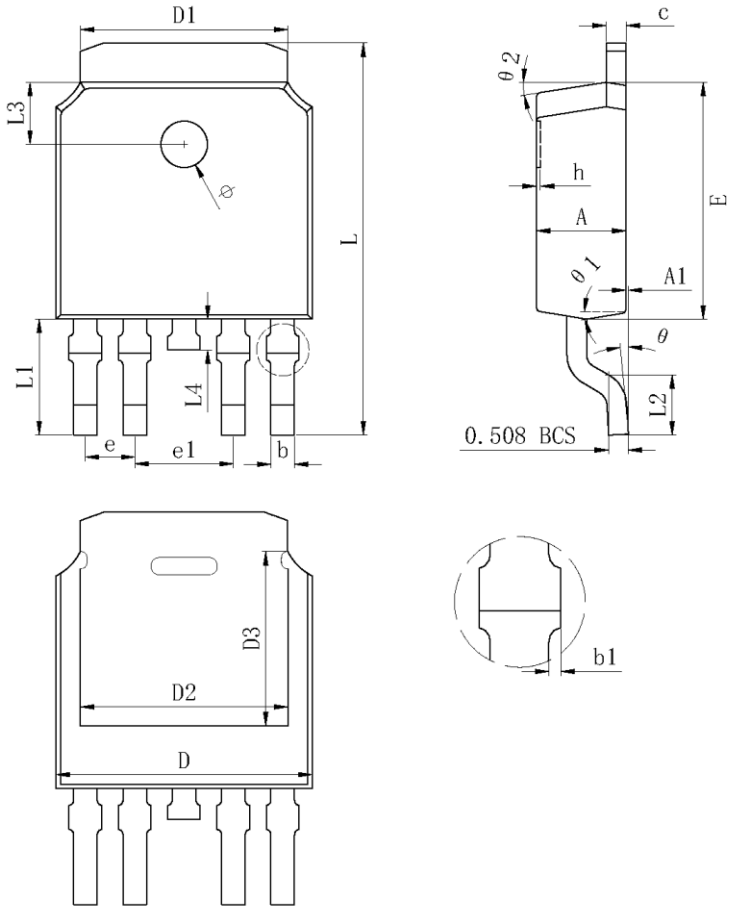



**Figure 10. Maximum Safe Operating Area**



## TO-252-4L Package Information




| SYMBOL | MILLIMETER | | |
|---|---|---|---|
| | MIN | Typ. | MAX |
| A | 2.200 | 2.300 | 2.400 |
| A1 | 0.000 | | 0.127 |
| b | 0.550 | 0.600 | 0.650 |
| b1 | 0.000 | | 0.120 |
| c(电镀后) | 0.460 | 0.520 | 0.580 |
| D | 6.500 | 6.600 | 6.700 |
| D1 | 5.334 REF | | |
| D2 | 5.346 REF | | |
| D3 | 4.490 REF | | |
| E | 6.000 | 6.100 | 6.200 |
| e | 1.270 TYP | | |
| e1 | 2.540 TYP | | |
| h | 0.000 | 0.100 | 0.200 |
| L | 9.900 | 10.100 | 10.300 |
| L1 | 2.988 REF | | |
| L2 | 1.400 | 1.550 | 1.700 |
| L3 | 1.600 REF | | |
| L4 | 0.700 | 0.800 | 0.900 |
| Φ | 1.100 | 1.200 | 1.300 |
| θ | 0° | | 8° |
| θ1 | 9° TYP | | |
| θ2 | 9° TYP | | |

## Attention

This product described in this document can not be used in life support devices or systems, aircraft's control systems, and other applications whose failure can be reasonably expected to result in serious physical and/or material damage，apart from that when an application agreement is signed between customer and Wuxi Shangjia Semiconductor.

The performances and characteristics of this product in the independent testing state are displayed in this document. Wuxi Shangjia Semiconductor can't guarantee of the performances and characteristics of this described product that mounted in the customer's products or equipments as same as that in the independent testing state. So the customer should evaluate and test devices mounted in the customer's products or equipments.

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