

650V 190mohm Super-Junction Power MOSFET  
AKS65N1K9PMF

Description:

This SJ device integrated with fast-recovery diode provides good FOM factor, EMI friendly for customer application.

Features:

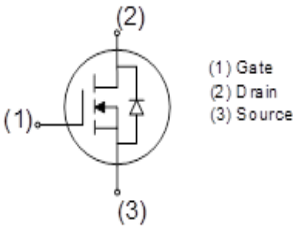
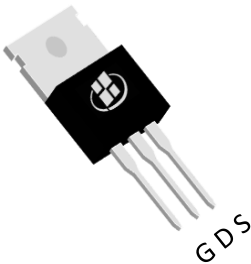
- EMI-Friendly
- RoHS compliant
- Halogen-free

Applications:

- Switch Mode Power Supply (SMPS)
- Uninterruptible Power Supply (UPS)
- Power Factor Correction (PFC)

Key Performance Parameters:

| Parameter                               | Value | Unit |
|-----------------------------------------|-------|------|
| $V_{DS}$                                | 650   | V    |
| $R_{DS(on), max} @V_{GS} = 10\text{ V}$ | 190   | mΩ   |
| $I_D$                                   | 20.5  | A    |



Ordering Information:

| Ordering Code | Package Type | Marking Code | Form | Packing      |
|---------------|--------------|--------------|------|--------------|
| AKS65N1K9PMF  | TO-220       | S65N1K9PMF   | Tube | 1000 per box |

Maximum Ratings (T<sub>A</sub> = 25°C unless otherwise noted)

| Symbol                            | Parameter                                                              | Value       | Units |
|-----------------------------------|------------------------------------------------------------------------|-------------|-------|
| V <sub>DS</sub>                   | Drain - Source Voltage                                                 | 650         | V     |
| I <sub>D</sub>                    | Drain Current - Continuous (T <sub>C</sub> = 25°C) <sup>(Note 1)</sup> | 20.5        | A     |
|                                   | Drain Current - Continuous (T <sub>C</sub> = 100°C)                    | 13          | A     |
| I <sub>DM</sub>                   | Drain Current - Pulsed <sup>(Note 2)</sup>                             | 61.5        | A     |
| V <sub>GS</sub>                   | Gate - Source Voltage                                                  | ± 30        | V     |
| E <sub>AS</sub>                   | Single Pulsed Avalanche Energy <sup>(Note 3)</sup>                     | 390         | mJ    |
| P <sub>D</sub>                    | Power Dissipation (T <sub>C</sub> = 25°C)                              | 208         | W     |
| dV/dT                             | MOSFET dv/dt ruggedness, V <sub>DS</sub> = 0...400 V                   | 50          | V/ns  |
|                                   | Reverse diode dv/dt, V <sub>DS</sub> = 0...400 V                       | 50          | V/ns  |
| T <sub>J</sub> , T <sub>STG</sub> | Operating and Storage Temperature Range                                | -55 to +150 | °C    |

Thermal Characteristics

| Symbol           | Parameter                                                                     | Value | Units |
|------------------|-------------------------------------------------------------------------------|-------|-------|
| R <sub>θJC</sub> | Thermal Resistance, Junction - to - Case, Steady State                        | 0.6   | °C/W  |
| R <sub>θJA</sub> | Thermal Resistance, Junction - to - Ambient, Steady State <sup>(Note 4)</sup> | 55    | °C/W  |

Notes:

- 1. The max drain current rating limited by maximum junction temperature
- 2. Repetitive Rating: Pulse width limited by maximum junction temperature
- 3. L = 10.8 mH, V<sub>DD</sub> = 150 V, I<sub>AS</sub> = 8.5 A, R<sub>G</sub> = 25 Ω, Starting T<sub>J</sub> = 25 °C
- 4. Mount on minimum PCB layout

**Electrical Characteristics** ( $T_J = 25^\circ\text{C}$  unless otherwise noted)

| Symbol                                                 | Parameter                                       | Test Conditions                                                                                 | Min | Typ  | Max  | Units |
|--------------------------------------------------------|-------------------------------------------------|-------------------------------------------------------------------------------------------------|-----|------|------|-------|
| Static Characteristics                                 |                                                 |                                                                                                 |     |      |      |       |
| V <sub>(BR)DSS</sub>                                   | Drain - Source Breakdown Voltage                | V <sub>GS</sub> = 0 V, I <sub>D</sub> = 1 mA                                                    | 650 |      |      | V     |
| I <sub>DSS</sub>                                       | Zero Gate Voltage Drain Current                 | V <sub>DS</sub> = 650 V, V <sub>GS</sub> = 0 V                                                  |     |      | 10   | μA    |
| I <sub>GSS</sub>                                       | Gate Leakage Current                            | V <sub>GS</sub> = ± 30 V, V <sub>DS</sub> = 0 V                                                 |     |      | ±100 | nA    |
| V <sub>GS(th)</sub>                                    | Gate Threshold voltage                          | V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250 μA                                     | 3   | 3.8  | 4.5  | V     |
| R <sub>DS(ON)</sub>                                    | Drain - Source on - state resistance            | V <sub>GS</sub> = 10 V, I <sub>D</sub> = 10 A                                                   |     | 144  | 190  | mΩ    |
| Dynamic Characteristics                                |                                                 |                                                                                                 |     |      |      |       |
| C <sub>iss</sub>                                       | Input Capacitance                               | V <sub>DS</sub> = 100 V, V <sub>GS</sub> = 0 V, f = 1 MHz                                       |     | 1695 |      | pF    |
| C <sub>oss</sub>                                       | Output Capacitance                              |                                                                                                 |     | 74   |      | pF    |
| C <sub>rss</sub>                                       | Reverse Transfer Capacitance                    |                                                                                                 |     | 2    |      | pF    |
| C <sub>o(er)</sub>                                     | Effective output capacitance, energy related    | V <sub>DS</sub> = 0...400 V, V <sub>GS</sub> = 0 V                                              |     | 75   |      | pF    |
| C <sub>o(tr)</sub>                                     | Effective output capacitance, time related      | V <sub>DS</sub> = 0...400 V, V <sub>GS</sub> = 0 V, I <sub>D</sub> =constant                    |     | 348  |      | pF    |
| R <sub>g</sub>                                         | Gate Resistance                                 | f = 1 MHz                                                                                       |     | 21   |      | Ω     |
| Switching Characteristics                              |                                                 |                                                                                                 |     |      |      |       |
| t <sub>d(on)</sub>                                     | Turn On Delay Time                              | V <sub>DD</sub> = 400 V , I <sub>D</sub> = 10 A, V <sub>GS</sub> = 13 V, R <sub>G</sub> = 3.3 Ω |     | 73   |      | ns    |
| t <sub>r</sub>                                         | Rise Time                                       |                                                                                                 |     | 26   |      | ns    |
| t <sub>d(off)</sub>                                    | Turn Off Delay Time                             |                                                                                                 |     | 120  |      | ns    |
| t <sub>f</sub>                                         | Fall Time                                       |                                                                                                 |     | 11   |      | ns    |
| Q <sub>g</sub>                                         | Total Gate Charge                               | V <sub>DD</sub> = 480 V , I <sub>D</sub> = 11 A, V <sub>GS</sub> = 10 V                         |     | 46   |      | nC    |
| Q <sub>gs</sub>                                        | Gate - Source Charge                            |                                                                                                 |     | 11   |      | nC    |
| Q <sub>gd</sub>                                        | Gate - Drain Charge                             |                                                                                                 |     | 24   |      | nC    |
| Drain-Source Diode Characteristics and Maximum Ratings |                                                 |                                                                                                 |     |      |      |       |
| I <sub>S</sub>                                         | Maximum Continuous Body - Diode Forward Current |                                                                                                 |     |      | 20.5 | A     |
| I <sub>SM</sub>                                        | Maximum Pulsed Body - Diode Forward Current     |                                                                                                 |     |      | 61.5 | A     |
| V <sub>SD</sub>                                        | Diode Forward Voltage                           | V <sub>GS</sub> = 0 V, I <sub>S</sub> = 1 A                                                     |     | 0.7  |      | V     |
| t <sub>rr</sub>                                        | Reverse recovery time                           | V <sub>DD</sub> = 400 V, I <sub>D</sub> = 11 A, di/dt = 100 A/μs                                |     | 118  |      | ns    |
| Q <sub>rr</sub>                                        | Reverse recovery charge                         |                                                                                                 |     | 0.7  |      | μC    |
| I <sub>rrm</sub>                                       | Peak Reverse Recovery Current                   |                                                                                                 |     | 12   |      | A     |

Electrical Characteristics Diagrams

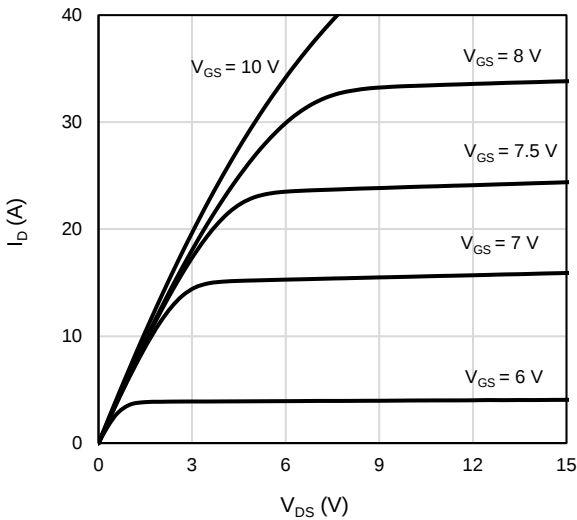


Figure 1: On-Region Characteristics

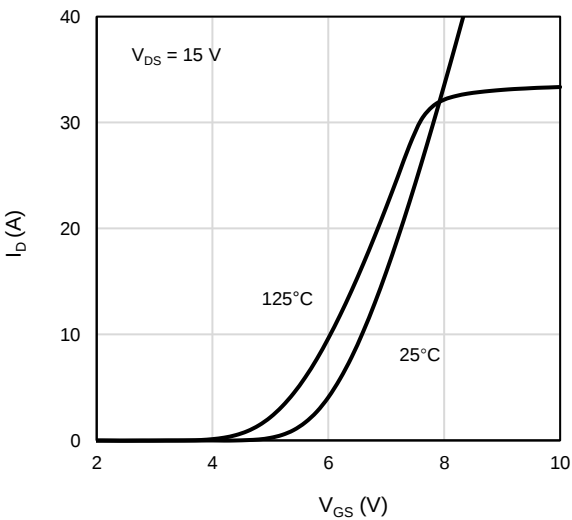


Figure 2: Transfer Characteristics

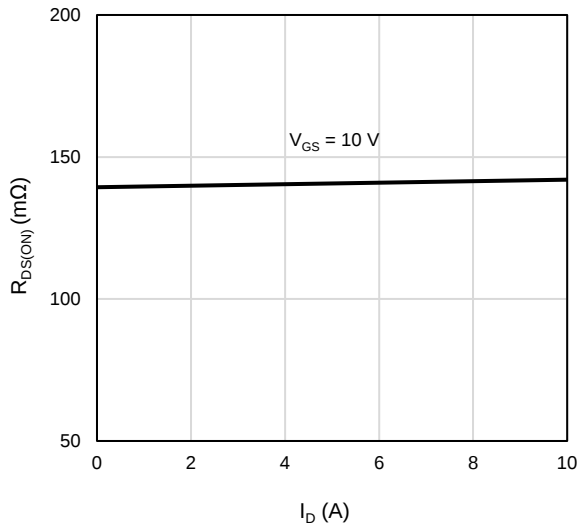


Figure 3: On-Resistance vs. Drain Current and Gate Voltage

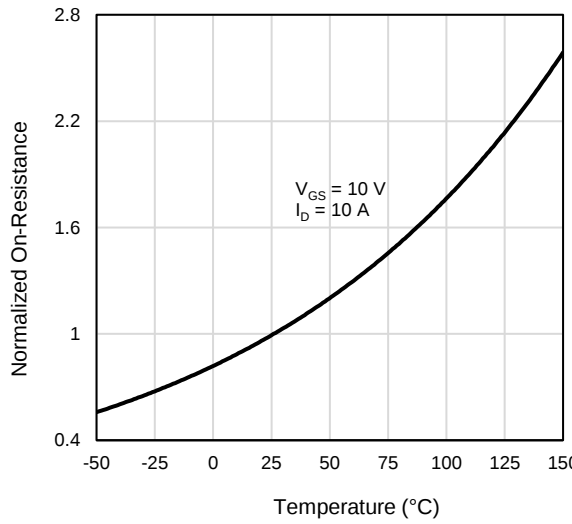


Figure 4: On-Resistance vs. Junction Temperature

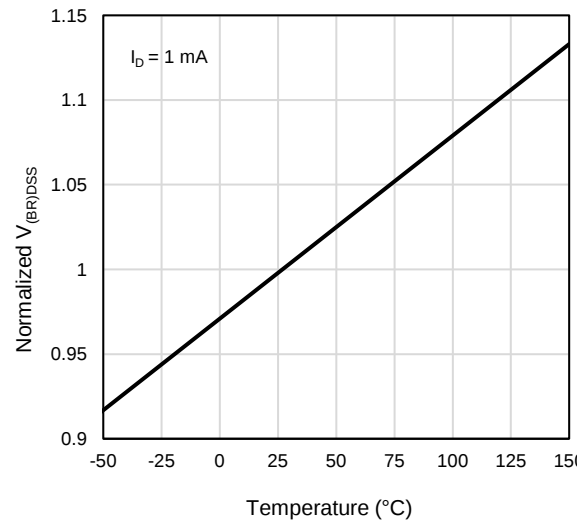


Figure 5: Breakdown Voltage vs. Junction Temperature

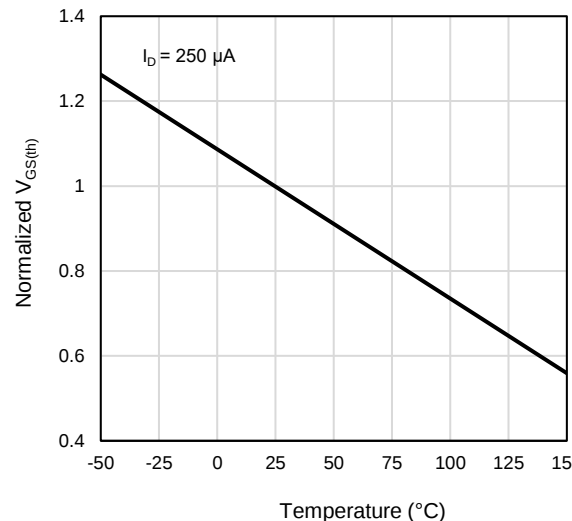


Figure 6: Threshold Voltage vs. Junction Temperature

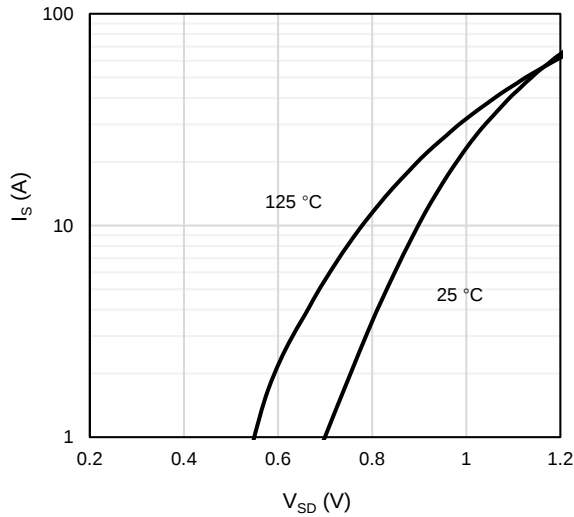


Figure 7: Body-Diode Characteristics

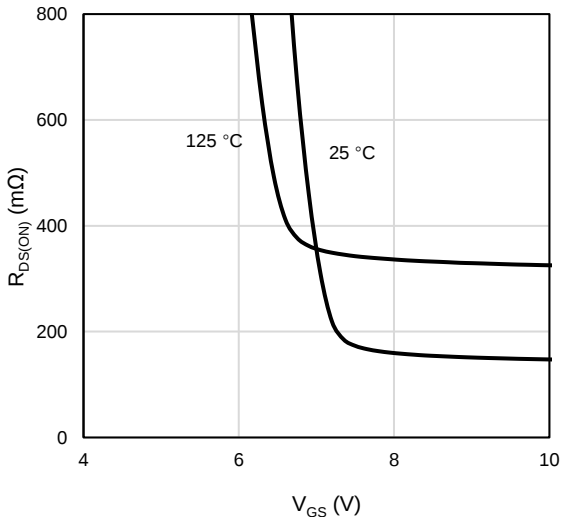


Figure 8: On-Resistance vs. Gate-Source Voltage

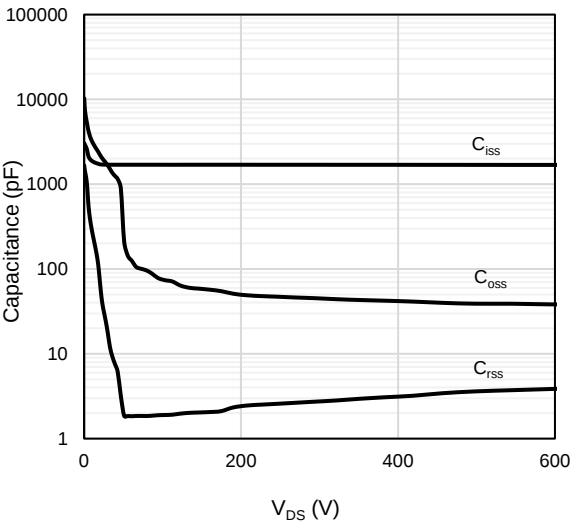


Figure 9: Capacitance Characteristics

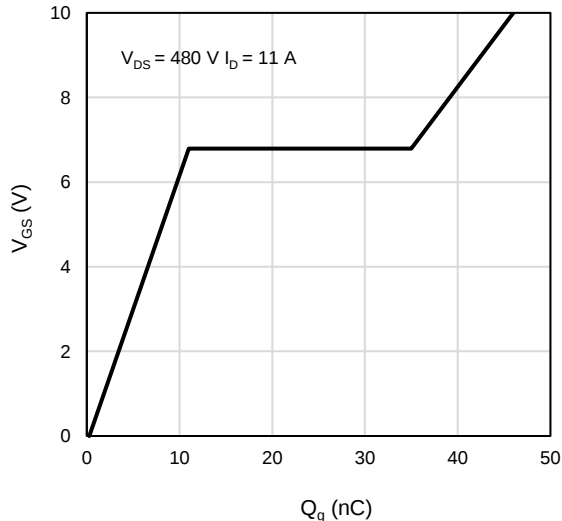


Figure 10: Gate-Charge Characteristics

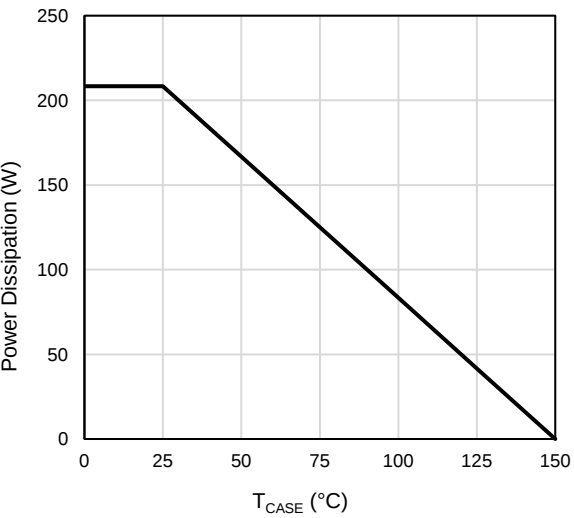


Figure 11: Power De-rating

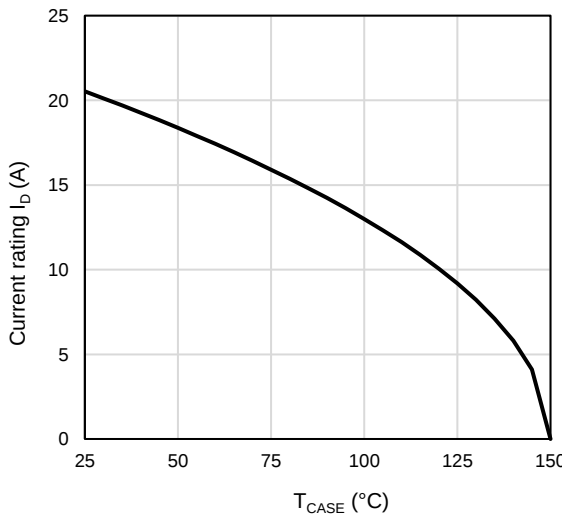


Figure 12: Current De-rating

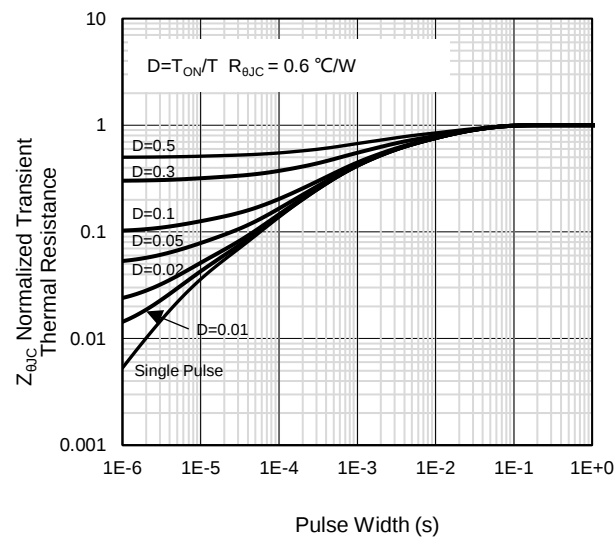


Figure 13: Normalized Maximum Transient Thermal Impedance

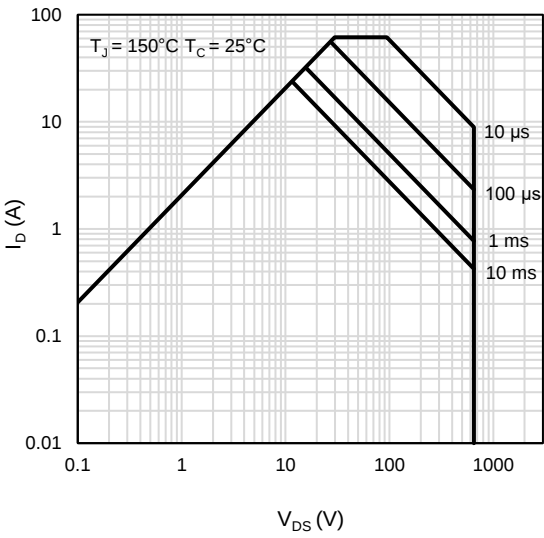
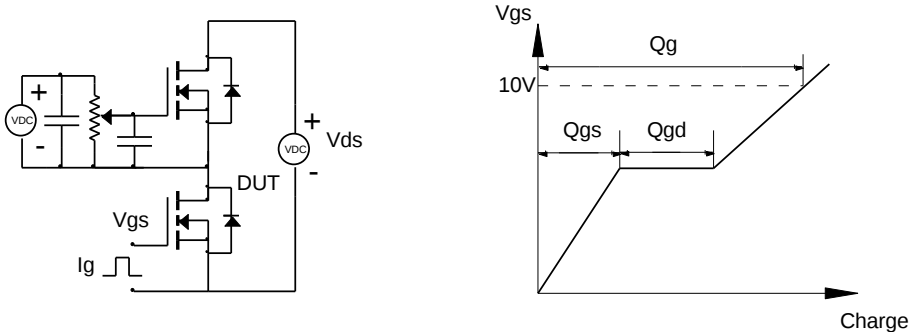


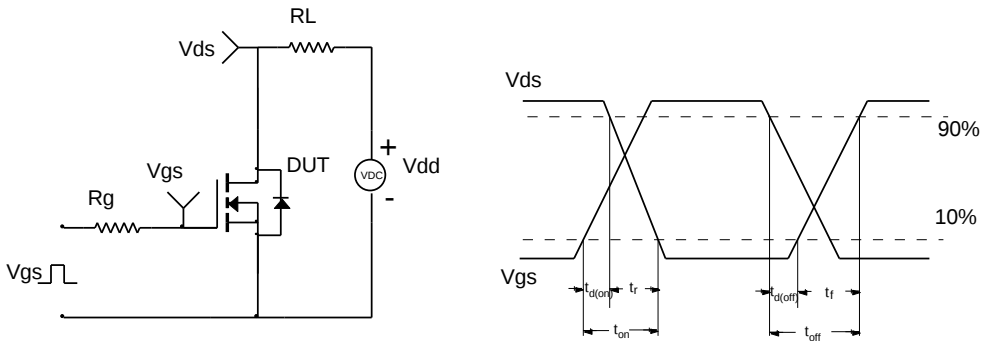
Figure 14: Maximum Forward Biased Safe Operating Area

Test Circuit and Waveform

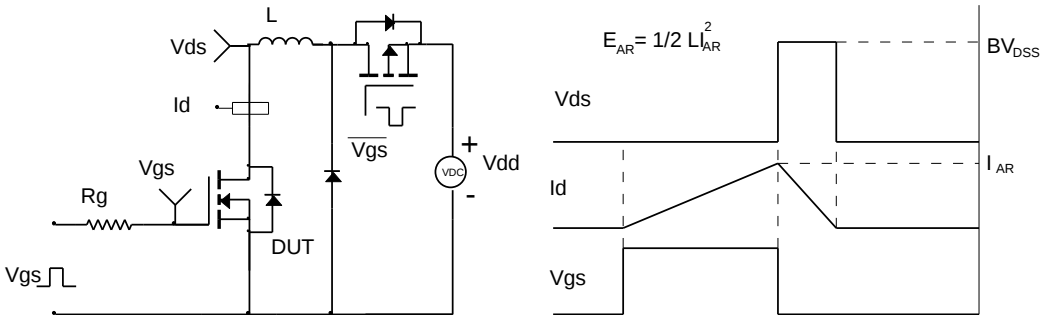
Gate Charge Test Circuit & Waveform



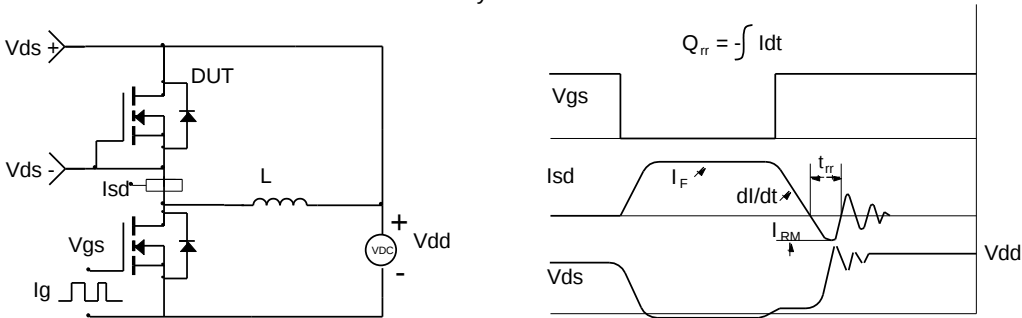
Resistive Switching Test Circuit & Waveforms



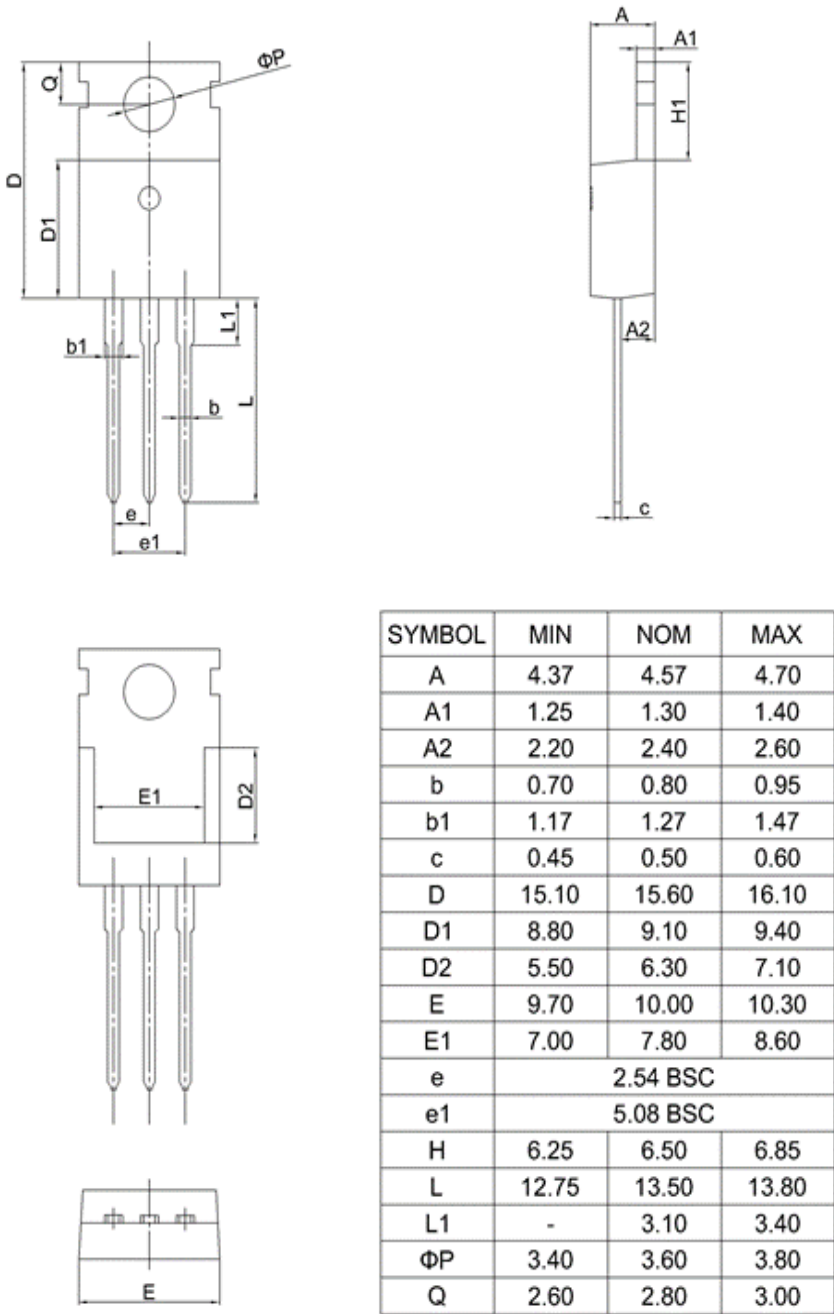
Unclamped Inductive Switching (UIS) Test Circuit & Waveforms



Diode Recovery Test Circuit & Waveforms



Package Outlines



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## Marking Information



S65N1K9PMF

XXXXXXX

Note:

S65N1K9PMF = Product Name Code

XXXXXXX = Date code

Contact ALKAIDSEMI sales for detail information

Revision History

| Revision | Released | Remark          |
|----------|----------|-----------------|
| Rev.1.0  | 2024     | Initial Release |

Disclaimer

The information given in this document describes the independent performance of the product, but similar performance is not guaranteed under other working conditions, and cannot be guaranteed when installed with other products or equipment. To achieve the required performance of the product in actual scenarios, the customer should conduct a complete application test to assess the functionality of the product.

Alkaidsemi assumes no responsibility for equipment failures result from using products at values that exceed the ratings, operating conditions, or other parameters listed in the product specifications.

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