

650V 360mohm Super-Junction Power MOSFET  
AK2S65N3K6KM

Description:

This SJ device provides good FOM performance, better EMI for customer application.

Features:

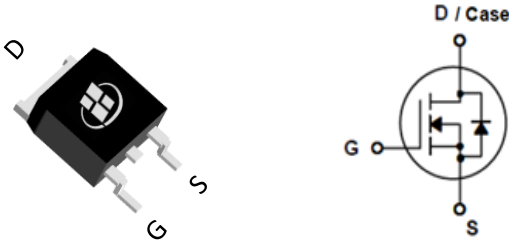
- EMI-Friendly
- RoHS compliant
- Halogen-free

Applications:

- High Frequency Switching
- Quick Charging and Adapter

Key Performance Parameters:

| Parameter                               | Value | Unit |
|-----------------------------------------|-------|------|
| $V_{DS}$                                | 650   | V    |
| $R_{DS(on), max} @V_{GS} = 10\text{ V}$ | 360   | mΩ   |
| $I_D$                                   | 11    | A    |



Ordering Information:

| Ordering Code | Package Type | Marking Code | Form      | Packing       |
|---------------|--------------|--------------|-----------|---------------|
| AK2S65N3K6KM  | TO-252       | 2S65N3K6KM   | Tape Reel | 2500 per reel |

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> | 11          | A     |
|                                   | Drain Current - Continuous (T <sub>C</sub> = 100°C)                    | 7           | A     |
| I <sub>DM</sub>                   | Drain Current - Pulsed <sup>(Note 2)</sup>                             | 33          | A     |
| V <sub>GS</sub>                   | Gate - Source Voltage                                                  | ± 30        | V     |
| E <sub>AS</sub>                   | Single Pulsed Avalanche Energy <sup>(Note 3)</sup>                     | 72          | mJ    |
| P <sub>D</sub>                    | Power Dissipation (T <sub>C</sub> = 25°C)                              | 113         | W     |
| dV/dT                             | MOSFET dv/dt ruggedness, V <sub>DS</sub> = 0...400 V                   | 40          | V/ns  |
|                                   | Reverse diode dv/dt, V <sub>DS</sub> = 0...400 V                       | 20          | 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                        | 1.1   | °C/W  |
| R <sub>θJA</sub> | Thermal Resistance, Junction - to - Ambient, Steady State <sup>(Note 4)</sup> | 60    | °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 = 23 mH, V<sub>DD</sub> = 100 V, I<sub>AS</sub> = 2.5 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         |
|-------------------------------|--------------------------------------|-----------------------------------------------------|-----|-----|-----------|---------------|
| <b>Static Characteristics</b> |                                      |                                                     |     |     |           |               |
| $V_{(BR)DSS}$                 | Drain - Source Breakdown Voltage     | $V_{GS} = 0\text{ V}, I_D = 250\text{ }\mu\text{A}$ | 650 |     |           | V             |
| $I_{DSS}$                     | Zero Gate Voltage Drain Current      | $V_{DS} = 650\text{ V}, V_{GS} = 0\text{ V}$        |     |     | 1         | $\mu\text{A}$ |
| $I_{GSS}$                     | Gate Leakage Current                 | $V_{GS} = \pm 30\text{ V}, V_{DS} = 0\text{ V}$     |     |     | $\pm 100$ | nA            |
| $V_{GS(th)}$                  | Gate Threshold voltage               | $V_{DS} = V_{GS}, I_D = 250\text{ }\mu\text{A}$     | 2   | 3.5 | 5         | V             |
| $R_{DS(ON)}$                  | Drain - Source on - state resistance | $V_{GS} = 10\text{ V}, I_D = 5\text{ A}$            |     | 310 | 360       | m $\Omega$    |

**Dynamic Characteristics**

|             |                                              |                                                                                  |  |     |  |          |
|-------------|----------------------------------------------|----------------------------------------------------------------------------------|--|-----|--|----------|
| $C_{iss}$   | Input Capacitance                            | $V_{DS} = 400\text{ V}, V_{GS} = 0\text{ V},$<br>$f = 1\text{ MHz}$              |  | 600 |  | pF       |
| $C_{oss}$   | Output Capacitance                           |                                                                                  |  | 20  |  | pF       |
| $C_{rss}$   | Reverse Transfer Capacitance                 |                                                                                  |  | 5.8 |  | pF       |
| $C_{o(er)}$ | Effective output capacitance, energy related | $V_{DS} = 0\ldots 400\text{ V}, V_{GS} = 0\text{ V}$                             |  | 30  |  | pF       |
| $C_{o(tr)}$ | Effective output capacitance, time related   | $V_{DS} = 0\ldots 400\text{ V}, V_{GS} = 0\text{ V},$<br>$I_D = \text{constant}$ |  | 170 |  | pF       |
| $R_g$       | Gate Resistance                              | $f = 1\text{ MHz}$                                                               |  | 3.5 |  | $\Omega$ |

**Switching Characteristics**

|              |                      |                                                                                              |  |    |  |    |
|--------------|----------------------|----------------------------------------------------------------------------------------------|--|----|--|----|
| $t_{d(on)}$  | Turn On Delay Time   | $V_{DD} = 400\text{ V}, I_D = 6\text{ A},$<br>$V_{GS} = 10\text{ V}, R_G = 50\text{ }\Omega$ |  | 90 |  | ns |
| $t_r$        | Rise Time            |                                                                                              |  | 33 |  | ns |
| $t_{d(off)}$ | Turn Off Delay Time  |                                                                                              |  | 64 |  | ns |
| $t_f$        | Fall Time            |                                                                                              |  | 12 |  | ns |
| $Q_g$        | Total Gate Charge    | $V_{DD} = 400\text{ V}, I_D = 5\text{ A},$<br>$V_{GS} = 10\text{ V}$                         |  | 22 |  | nC |
| $Q_{gs}$     | Gate - Source Charge |                                                                                              |  | 2  |  | nC |
| $Q_{gd}$     | Gate - Drain Charge  |                                                                                              |  | 11 |  | nC |

**Drain-Source Diode Characteristics and Maximum Ratings**

|           |                                                 |                                                                                  |  |      |  |               |
|-----------|-------------------------------------------------|----------------------------------------------------------------------------------|--|------|--|---------------|
| $I_S$     | Maximum Continuous Body - Diode Forward Current |                                                                                  |  | 11   |  | A             |
| $I_{SM}$  | Maximum Pulsed Body - Diode Forward Current     |                                                                                  |  | 33   |  | A             |
| $V_{SD}$  | Diode Forward Voltage                           | $V_{GS} = 0\text{ V}, I_S = 5\text{ A}$                                          |  | 0.82 |  | V             |
| $t_{rr}$  | Reverse recovery time                           | $V_{DD} = 400\text{ V}, I_D = 5\text{ A},$<br>$di/dt = 400\text{ A}/\mu\text{s}$ |  | 68   |  | ns            |
| $Q_{rr}$  | Reverse recovery charge                         |                                                                                  |  | 0.9  |  | $\mu\text{C}$ |
| $I_{rrm}$ | Peak Reverse Recovery Current                   |                                                                                  |  | 30   |  | A             |

Electrical Characteristics Diagrams

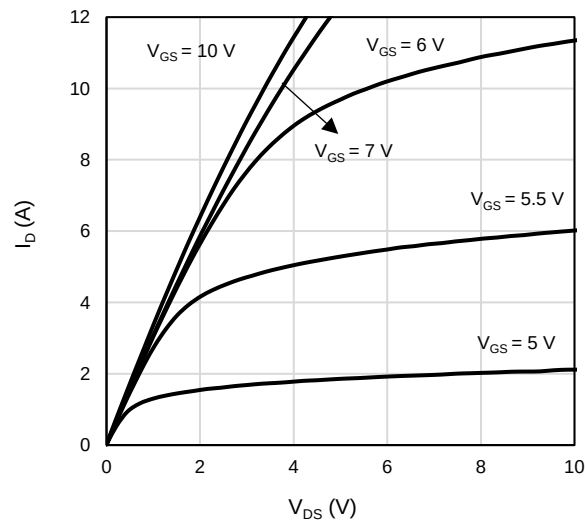


Figure 1: On-Region Characteristics

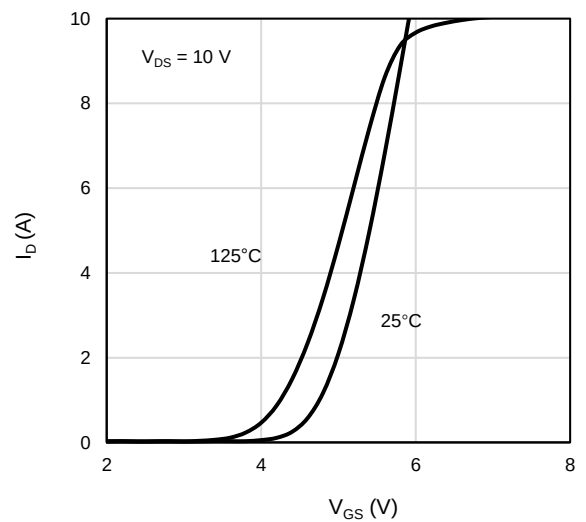


Figure 2: Transfer Characteristics

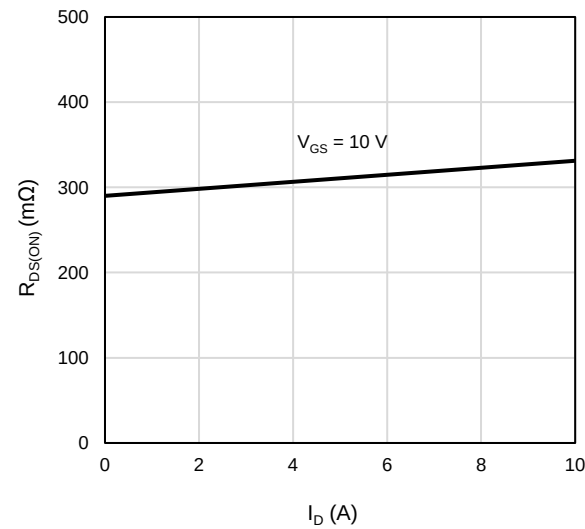


Figure 3: On-Resistance vs. Drain Current and Gate Voltage

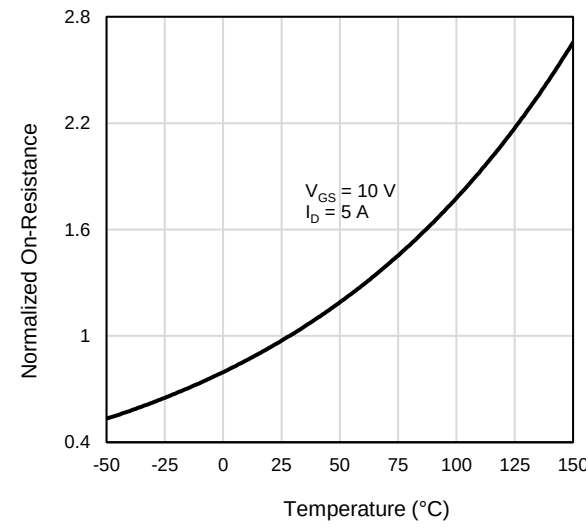


Figure 4: On-Resistance vs. Junction Temperature

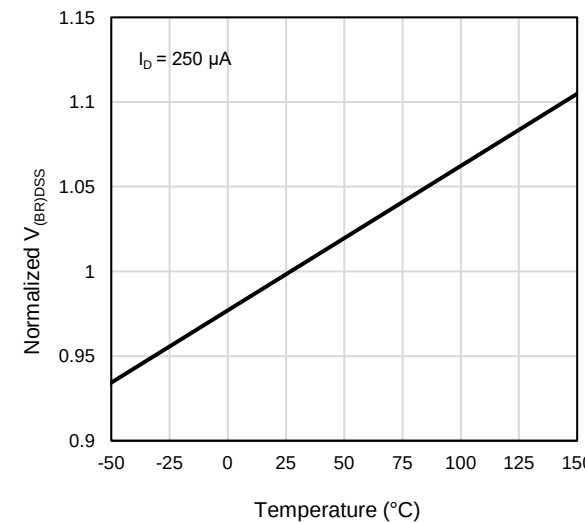


Figure 5: Breakdown Voltage vs. Junction Temperature

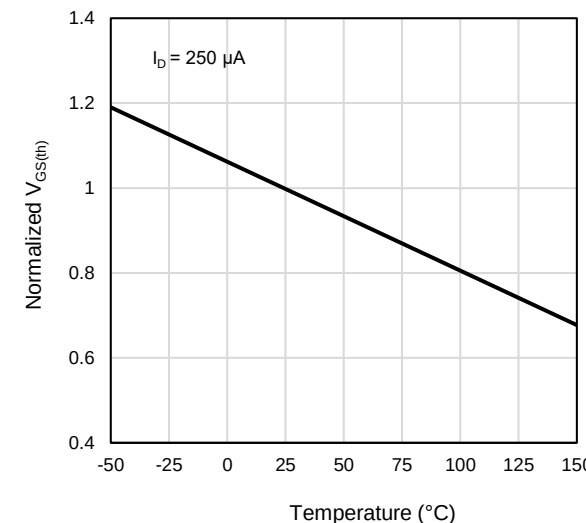


Figure 6: Threshold Voltage vs. Junction Temperature

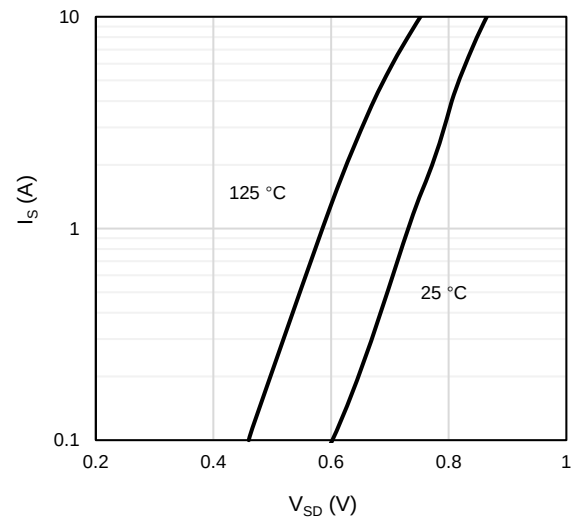


Figure 7: Body-Diode Characteristics

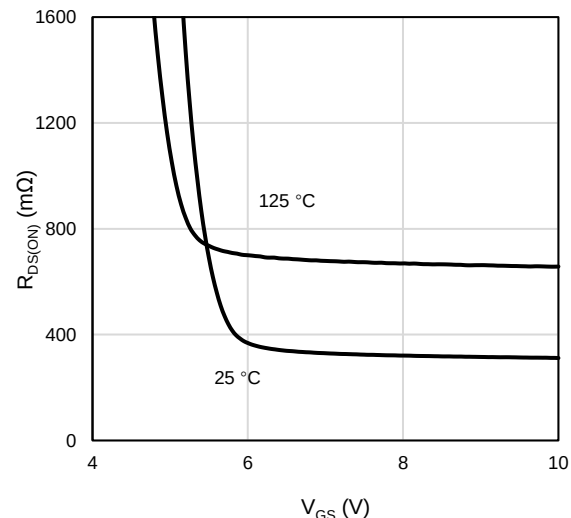


Figure 8: On-Resistance vs. Gate-Source Voltage

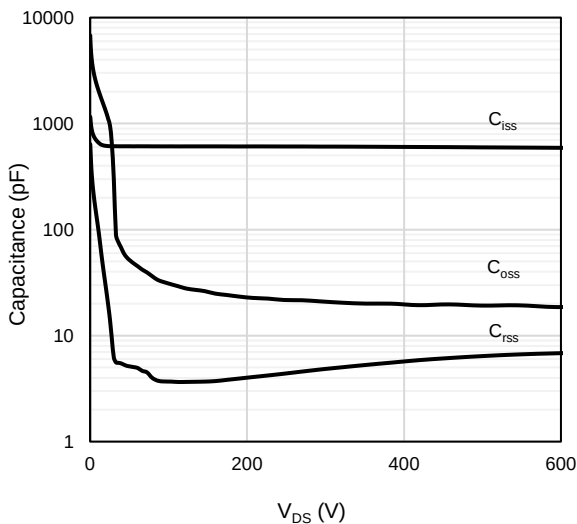


Figure 9: Capacitance Characteristics

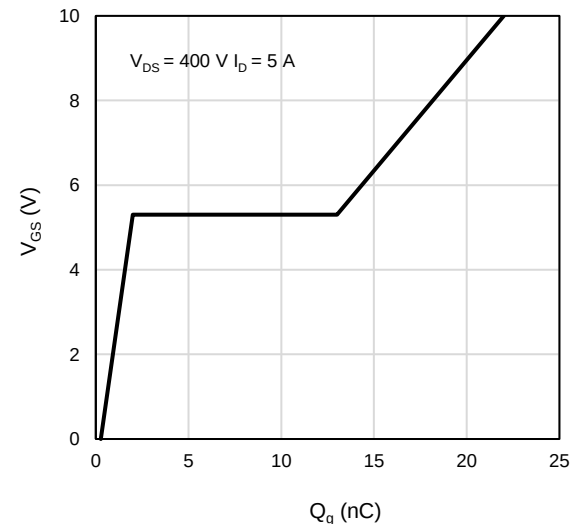


Figure 10: Gate-Charge Characteristics

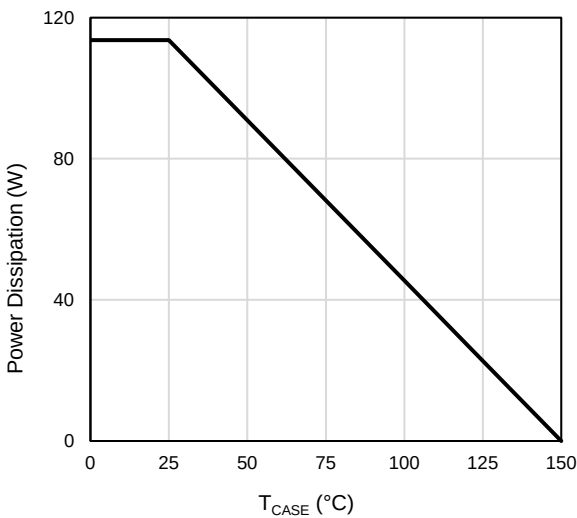


Figure 11: Power De-rating

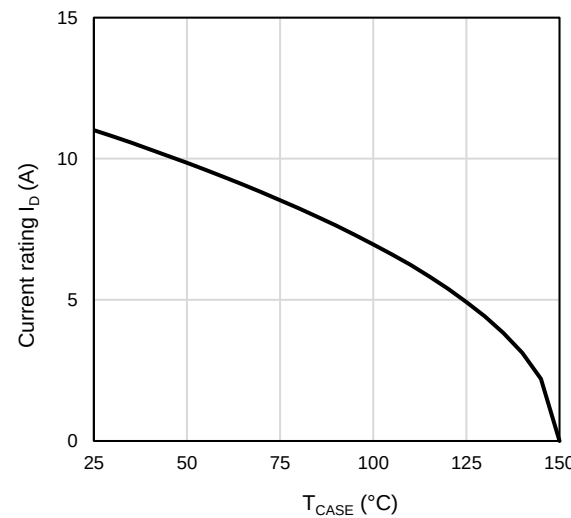


Figure 12: Current De-rating

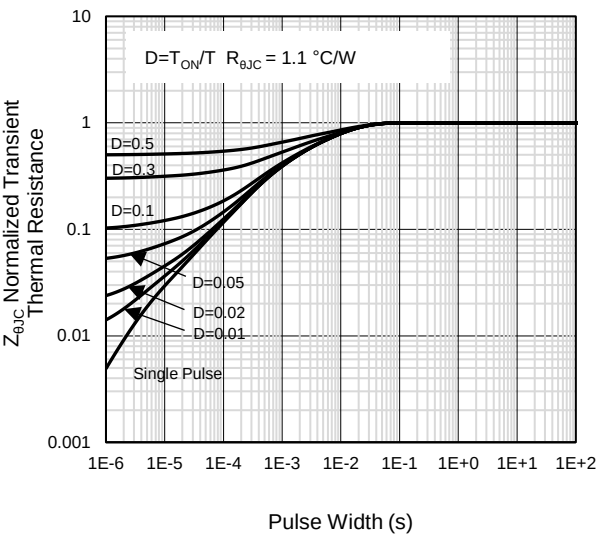


Figure 13: Normalized Maximum Transient Thermal Impedance

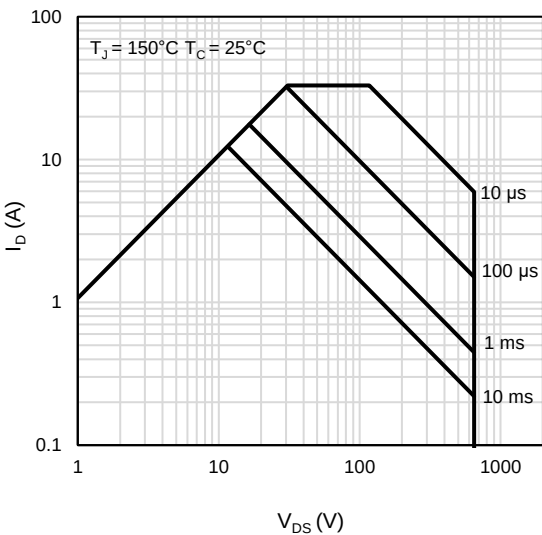
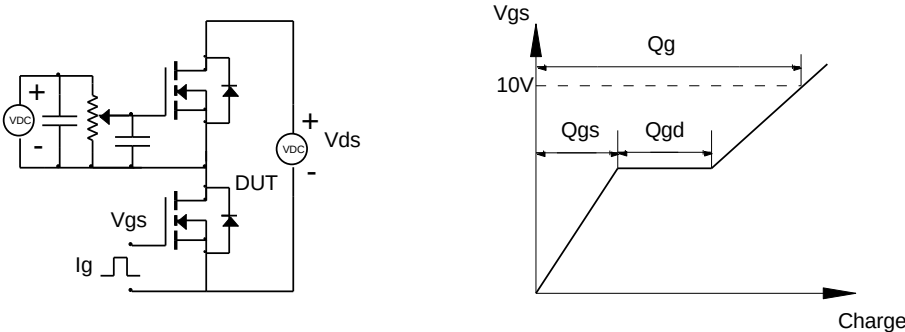


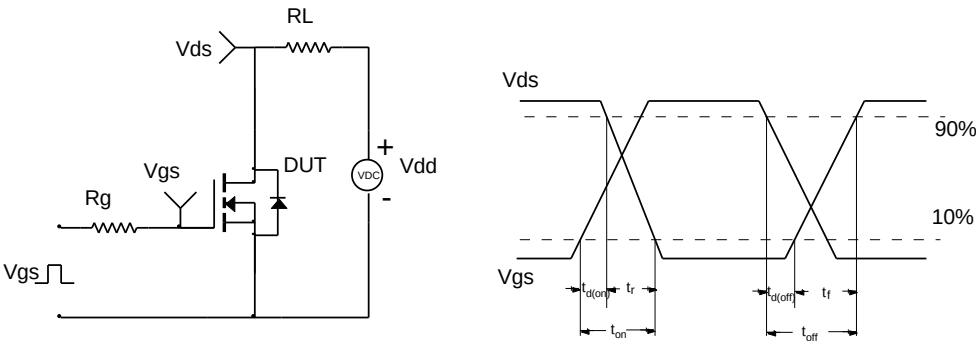
Figure 14: Maximum Forward Biased Safe Operating Area

Test Circuit and Waveform

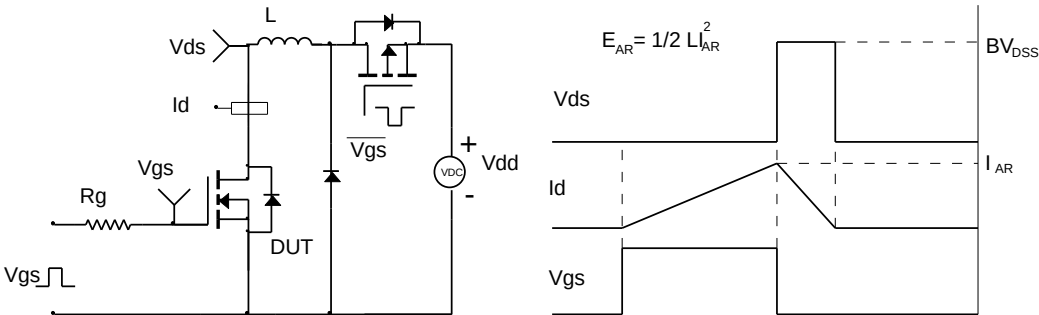
Gate Charge Test Circuit & Waveform



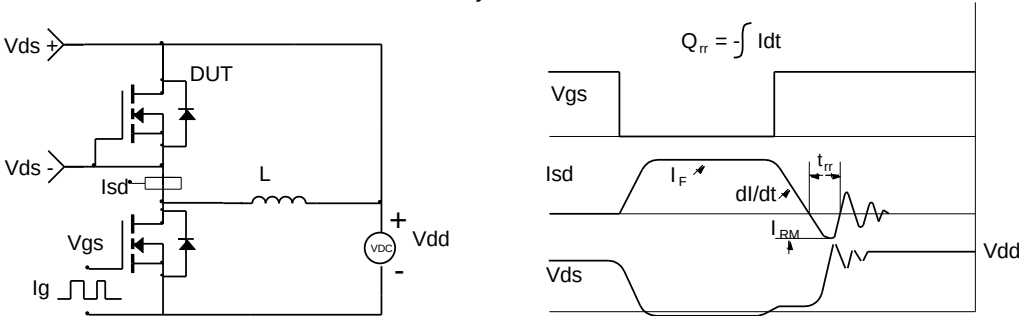
Resistive Switching Test Circuit & Waveforms



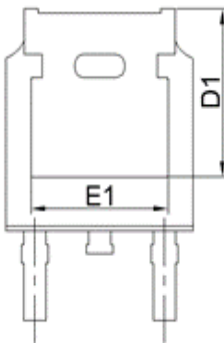
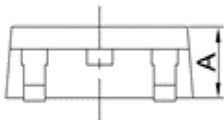
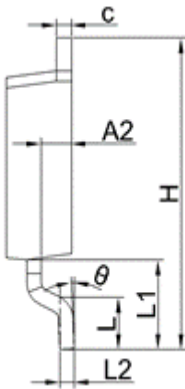
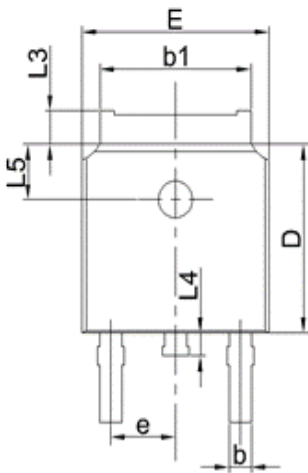
Unclamped Inductive Switching (UIS) Test Circuit & Waveforms



Diode Recovery Test Circuit & Waveforms



Package Outlines



| SYMBOL | MIN       | NOM   | MAX   |
|--------|-----------|-------|-------|
| A      | 2.20      | 2.30  | 2.38  |
| A1     | 0.00      | 0.06  | 0.12  |
| A2     | 0.97      | 1.07  | 1.17  |
| b      | 0.68      | 0.78  | 0.90  |
| b1     | 5.20      | 5.33  | 5.46  |
| c      | 0.43      | 0.53  | 0.61  |
| D      | 5.98      | 6.10  | 6.22  |
| D1     | 5.30 REF  |       |       |
| E      | 6.40      | 6.60  | 6.73  |
| E1     | 4.63      | -     | -     |
| e      | 2.286 BSC |       |       |
| H      | 9.40      | 10.10 | 10.50 |
| L      | 1.38      | 1.50  | 1.75  |
| L1     | 2.90 REF  |       |       |
| L2     | 0.51 BSC  |       |       |
| L3     | 0.88      | 1.08  | 1.28  |
| L4     | 0.50      | 0.75  | 1.00  |
| L5     | 1.65      | 1.80  | 1.95  |
| θ      | 0°        | 4°    | 8°    |

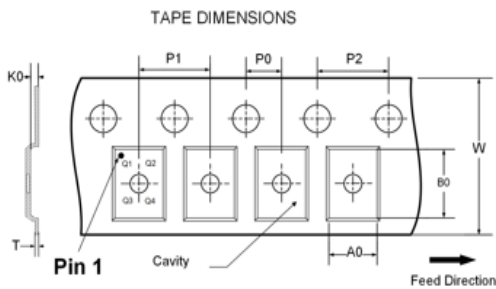
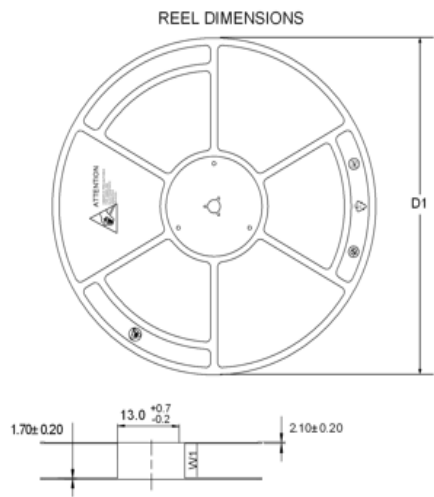


Marking Information



Note:  
2S65N3K6KM = Product Name Code  
XXXXXXX = Date code  
Contact ALKAIDSEMI sales for detail information

Tape & Reel Information



A0: Dimension designed to accommodate the component width  
B0: Dimension designed to accommodate the component length  
K0: Dimension designed to accommodate the component thickness  
W: Overall width of the carrier tape  
P0: Pitch between successive cavity centers and sprocket hole  
P1: Pitch between successive cavity centers  
P2: Pitch between sprocket hole  
T: Tape material thickness  
D1: Reel Diameter  
W1: Reel Width

| DIMENSIONS(Unit:mm)        |     |      |    |    |     |      |     |     |                |          |
|----------------------------|-----|------|----|----|-----|------|-----|-----|----------------|----------|
| Reel                       | D1  | W1   |    |    |     |      |     |     |                | Material |
|                            | 330 | 16.4 |    |    |     |      |     |     |                | Hips     |
| Tape                       | P0  | P1   | P2 | W  | A0  | B0   | K0  | T   | Pin 1 Quadrant | Material |
|                            | 2   | 8    | 4  | 16 | 6.9 | 10.5 | 2.7 | 0.3 | Q1             | PC       |
| All dimensions are nominal |     |      |    |    |     |      |     |     |                |          |

Revision History

| Revision | Released | Remark |
|----------|----------|--------|
| Rev.1.1  | 2024     |        |

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.

The product described in this specification is not applicable for aerospace or other applications which requires high reliability. Customers using or selling these products for use in medical, life-saving, or life-sustaining applications do so at their own risk and agree to fully indemnify.

Due to product or technical improvements, the information described or contained herein may be changed without prior notice.