

## TK39N60W-VB Datasheet

## N-Channel 600V (D-S) Super Junction Power MOSFET

**PRODUCT SUMMARY**

|                                    |                 |       |
|------------------------------------|-----------------|-------|
| $V_{DS}$ (V) at $T_J$ max.         | 600             |       |
| $R_{DS(on)}$ at 25 °C ( $\Omega$ ) | $V_{GS} = 10$ V | 0.060 |

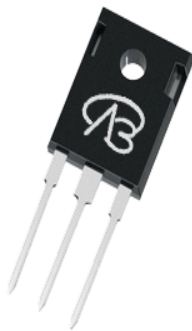
**FEATURES**

- Low figure-of-merit (FOM)  $R_{on} \times Q_g$
- Low input capacitance ( $C_{iss}$ )
- Reduced switching and conduction losses
- Ultra low gate charge ( $Q_g$ )
- Avalanche energy rated (UIS)

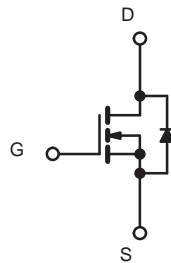
**APPLICATIONS**

- Server and telecom power supplies
- Switch mode power supplies (SMPS)
- Power factor correction power supplies (PFC)
- Lighting
  - High-intensity discharge (HID)
  - Fluorescent ballast lighting

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Top View



N-Channel MOSFET

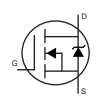
**ABSOLUTE MAXIMUM RATINGS** ( $T_C = 25$  °C, unless otherwise noted)

| PARAMETER   | SYMBOL           | LIMIT          | UNIT |    |
|---|------------------|----------------|------|----|
| Drain-Source Voltage                                      | $V_{DS}$         | 600            | V    |    |
| Gate-Source Voltage                                       | $V_{GS}$         | $\pm 30$       |      |    |
| Continuous Drain Current ( $T_J = 150$ °C)                | $V_{GS}$ at 10 V | $T_C = 25$ °C  | 47   | A  |
|   |                  | $T_C = 100$ °C | 29   |    |
| Pulsed Drain Current <sup>a</sup>                         | $I_{DM}$         | 140            |      |    |
| Linear Derating Factor                                    |                  | 1.67           | W/°C |    |
| Single Pulse Avalanche Energy <sup>b</sup>                | $E_{AS}$         | 850            | mJ   |    |
| Maximum Power Dissipation                                 | $P_D$            | 510            | W    |    |
| Operating Junction and Storage Temperature Range          | $T_J, T_{stg}$   | -55 to +150    | °C   |    |
| Drain-Source Voltage Slope                                | $dV/dt$          | 50             | V/ns |    |
| Reverse Diode $dV/dt$ <sup>d</sup>                        |                  |                |      | 15 |
| Soldering Recommendations (Peak Temperature) <sup>c</sup> | for 10 s         | 260            | °C   |    |

**Notes**

- Repetitive rating; pulse width limited by maximum junction temperature.
- $V_{DD} = 100$  V, starting  $T_J = 25$  °C,  $L = 30$  mH,  $R_g = 25$   $\Omega$ ,  $I_{AS} = 24$  A.
- 1.6 mm from case.
- $I_{SD} \leq I_D$ ,  $dI/dt = 100$  A/ $\mu$ s, starting  $T_J = 25$  °C.

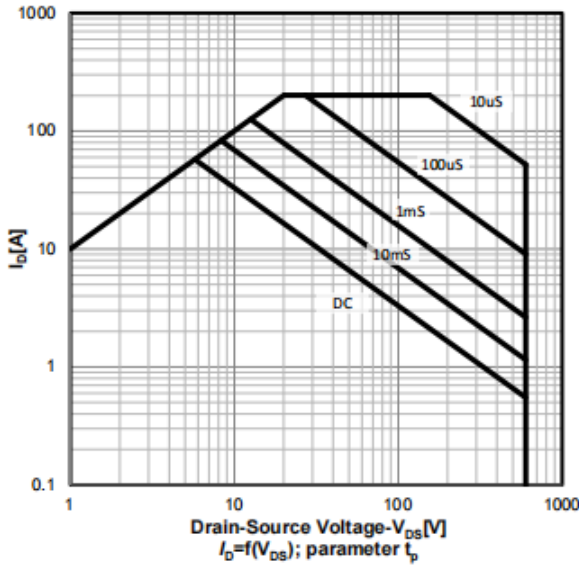
| THERMAL RESISTANCE RATINGS       |            |      |      |      |
|----------------------------------|------------|------|------|------|
| PARAMETER                        | SYMBOL     | TYP. | MAX. | UNIT |
| Maximum Junction-to-Ambient      | $R_{thJA}$ | -    | 62   | °C/W |
| Maximum Junction-to-Case (Drain) | $R_{thJC}$ | -    | 0.38 |      |

| SPECIFICATIONS ( $T_J = 25\text{ }^\circ\text{C}$ , unless otherwise noted) |                     |  |  |  |       |           |               |
|---|---------------------|--|--|--|-------|-----------|---------------|
| PARAMETER   | SYMBOL              | TEST CONDITIONS  |  | MIN.                                   | TYP.  | MAX.      | UNIT          |
| <b>Static</b>   |                     |  |  |  |       |           |               |
| Drain-Source Breakdown Voltage  | $V_{DS}$            | $V_{GS} = 0\text{ V}, I_D = 1\text{ mA}$   |  | 600                                    | -     | -         | V             |
| $V_{DS}$ Temperature Coefficient  | $\Delta V_{DS}/T_J$ | Reference to $25\text{ }^\circ\text{C}$ , $I_D = 1\text{ mA}$  |  | -                                      | 0.70  | -         | V/°C          |
| Gate-Source Threshold Voltage (N)   | $V_{GS(th)}$        | $V_{DS} = V_{GS}, I_D = 250\text{ }\mu\text{A}$  |  | 2.5                                    | -     | 4.5       | V             |
| Gate-Source Leakage   | $I_{GSS}$           | $V_{GS} = \pm 20\text{ V}$   |  | -                                      | -     | $\pm 100$ | nA            |
|   |                     | $V_{GS} = \pm 30\text{ V}$   |  | -                                      | -     | $\pm 1$   | $\mu\text{A}$ |
| Zero Gate Voltage Drain Current   | $I_{DSS}$           | $V_{DS} = 600\text{ V}, V_{GS} = 0\text{ V}$   |  | -                                      | -     | 1         | $\mu\text{A}$ |
|   |                     | $V_{DS} = 480\text{ V}, V_{GS} = 0\text{ V}, T_J = 125\text{ }^\circ\text{C}$  |  | -                                      | -     | 100       |               |
| Drain-Source On-State Resistance  | $R_{DS(on)}$        | $V_{GS} = 10\text{ V}$   | $I_D = 16\text{ A}$                        | -                                      | 0.060 | -         | $\Omega$      |
| Forward Transconductance  | $g_{fs}$            | $V_{DS} = 30\text{ V}, I_D = 16\text{ A}$  |  | -                                      | 5.6   | -         | S             |
| <b>Dynamic</b>  |                     |  |  |  |       |           |               |
| Input Capacitance   | $C_{iss}$           | $V_{GS} = 0\text{ V},$<br>$V_{DS} = 100\text{ V},$<br>$f = 1\text{ MHz}$   |  | -                                      | 4900  | -         | pF            |
| Output Capacitance  | $C_{oss}$           |  |  | -                                      | 330   | -         |               |
| Reverse Transfer Capacitance  | $C_{rss}$           |  |  | -                                      | 4     | -         |               |
| Effective Output Capacitance, Energy Related <sup>a</sup>                   | $C_{o(er)}$         | $V_{DS} = 0\text{ V to } 520\text{ V}, V_{GS} = 0\text{ V}$  |  | -                                      | 63    | -         |               |
| Effective Output Capacitance, Time Related <sup>b</sup>                     | $C_{o(tr)}$         |  |  | -                                      | 213   | -         |               |
| Total Gate Charge   | $Q_g$               | $V_{GS} = 10\text{ V}$   | $I_D = 20\text{ A}, V_{DS} = 520\text{ V}$ | -                                      | 370   | -         | nC            |
| Gate-Source Charge  | $Q_{gs}$            |  |  | -                                      | 39    | -         |               |
| Gate-Drain Charge   | $Q_{gd}$            |  |  | -                                      | 47    | -         |               |
| Turn-On Delay Time  | $t_{d(on)}$         | $V_{DD} = 520\text{ V}, I_D = 20\text{ A},$<br>$V_{GS} = 10\text{ V}, R_g = 9.1\text{ }\Omega$   |  | -                                      | 18    | 25        | ns            |
| Rise Time   | $t_r$               |  |  | -                                      | 24    | 55        |               |
| Turn-Off Delay Time   | $t_{d(off)}$        |  |  | -                                      | 80    | -         |               |
| Fall Time   | $t_f$               |  |  | -                                      | 12    | -         |               |
| Gate Input Resistance   | $R_g$               |  |  | $f = 1\text{ MHz}, \text{ open drain}$ |       | -         |               |
| <b>Drain-Source Body Diode Characteristics</b>                              |                     |  |  |  |       |           |               |
| Continuous Source-Drain Diode Current                                       | $I_S$               | MOSFET symbol showing the integral reverse p-n junction diode<br> |  | -                                      | -     | 47        | A             |
| Pulsed Diode Forward Current  | $I_{SM}$            |  |  | -                                      | -     | 140       |               |
| Diode Forward Voltage   | $V_{SD}$            | $T_J = 25\text{ }^\circ\text{C}, I_S = 8\text{ A}, V_{GS} = 0\text{ V}$  |  | -                                      | -     | 1.5       | V             |
| Reverse Recovery Time   | $t_{rr}$            | $T_J = 25\text{ }^\circ\text{C}, I_F = I_S = 8\text{ A},$<br>$di/dt = 100\text{ A}/\mu\text{s}, V_R = 400\text{ V}$                                    |  | -                                      | 520   | -         | ns            |
| Reverse Recovery Charge   | $Q_{rr}$            |  |  | -                                      | 5.8   | -         | $\mu\text{C}$ |
| Reverse Recovery Current  | $I_{RRM}$           |  |  | -                                      | 4.5   | -         | A             |

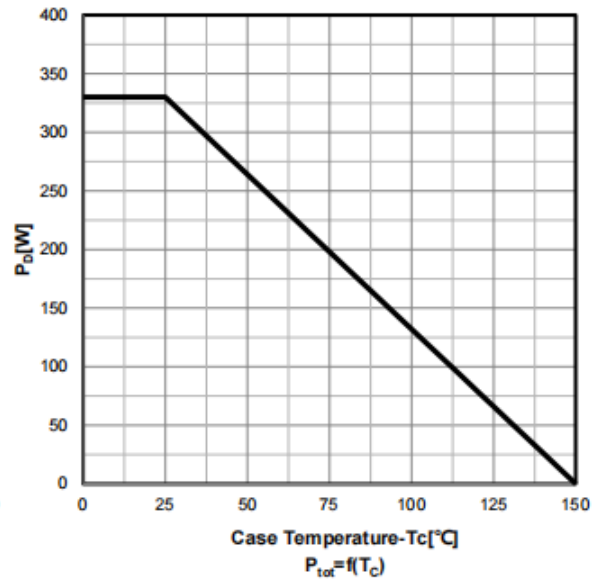
**Notes**

- a.  $C_{oss(er)}$  is a fixed capacitance that gives the same energy as  $C_{oss}$  while  $V_{DS}$  is rising from 0 % to 80 %  $V_{DSS}$ .  
 b.  $C_{oss(tr)}$  is a fixed capacitance that gives the same charging time as  $C_{oss}$  while  $V_{DS}$  is rising from 0 % to 80 %  $V_{DSS}$ .

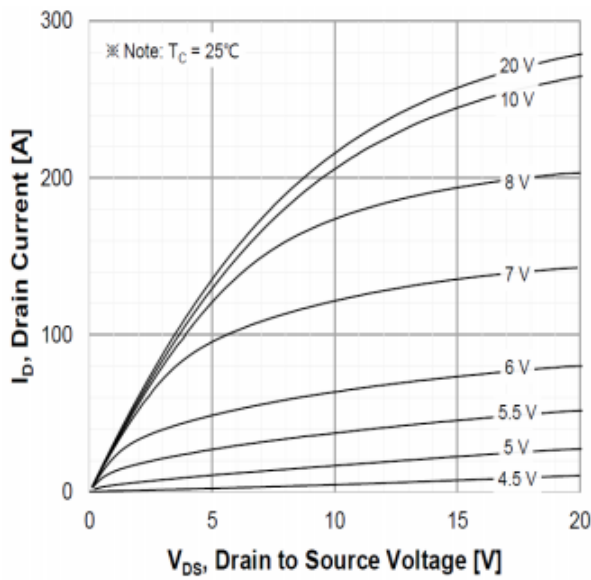
Safe operating area TC=25 °C  
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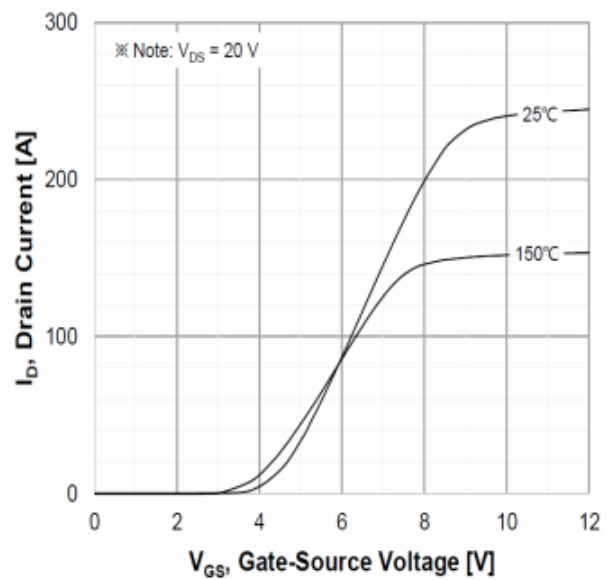
Power dissipation



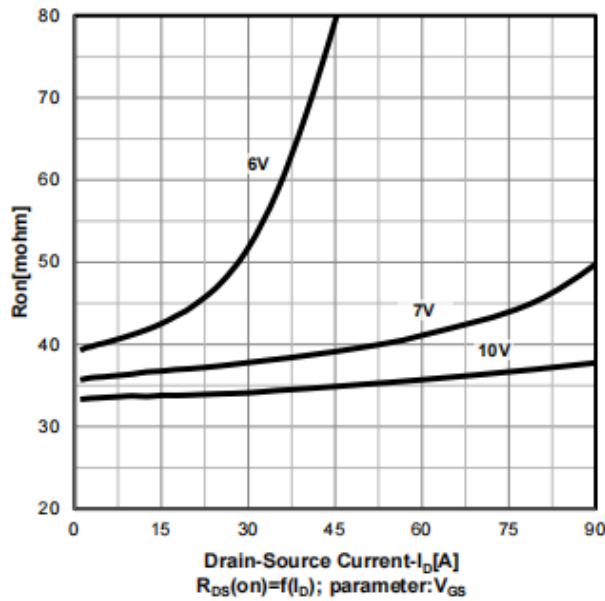
Typ. output characteristics  $T_J=25\text{ °C}$



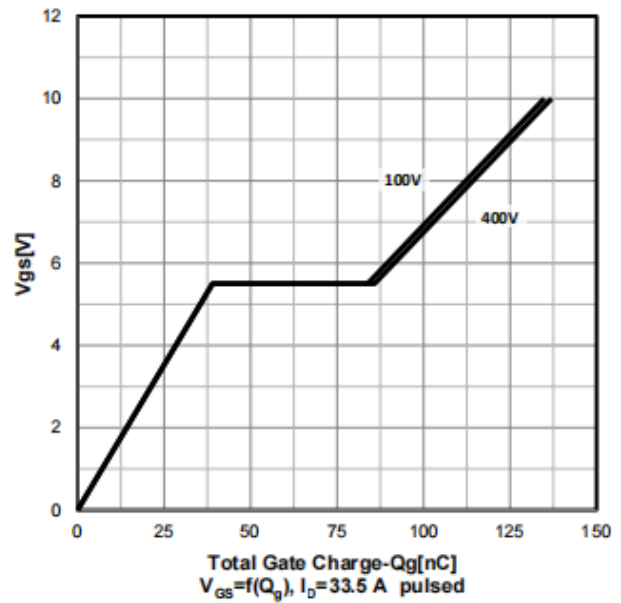
Transfer characteristics



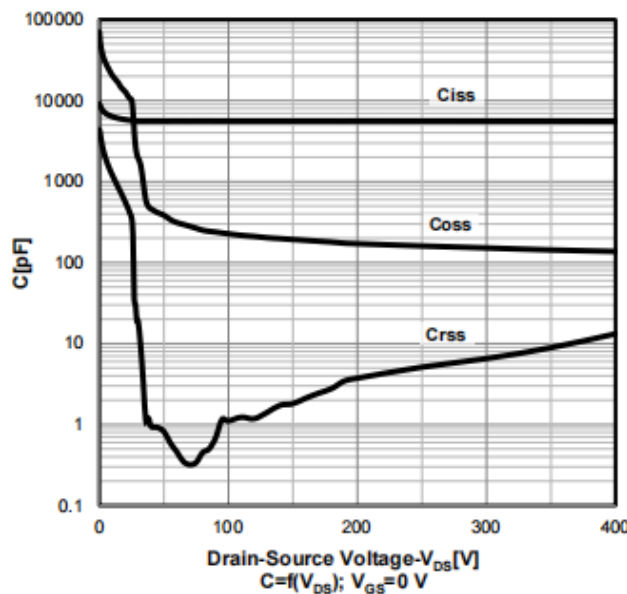
Typ. drain-source on-state resistance



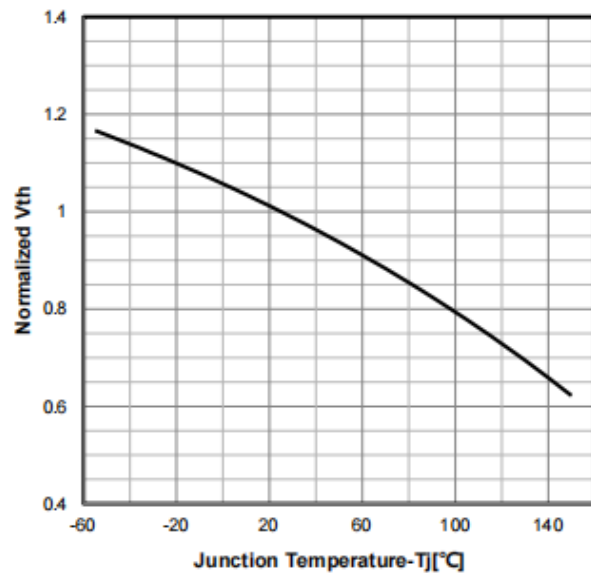
Typ. gate charge characteristics



Typ. capacitances



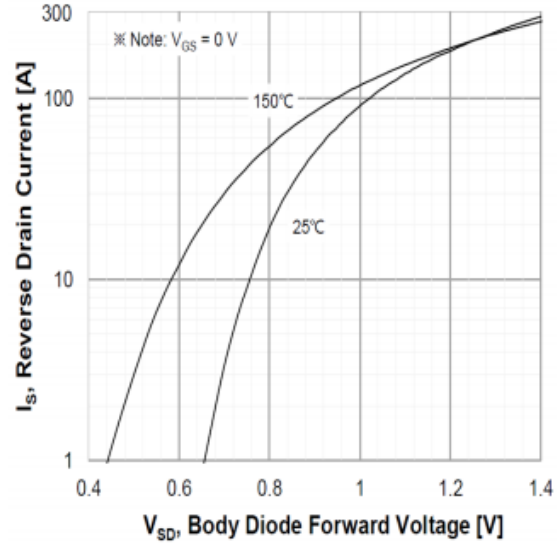
Normalized  $V_{GS(th)}$  characteristics



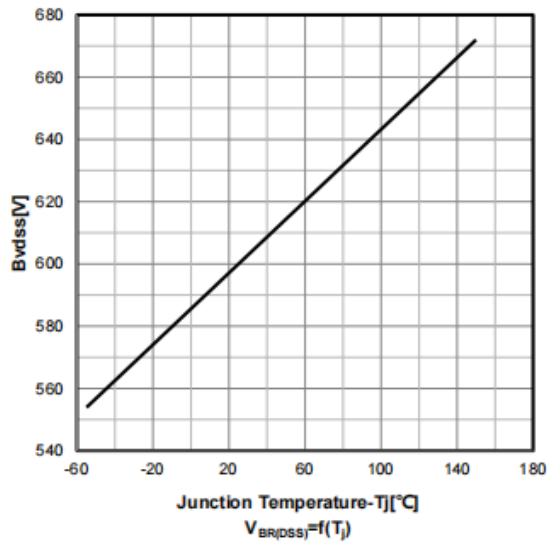
On-resistance vs temperature



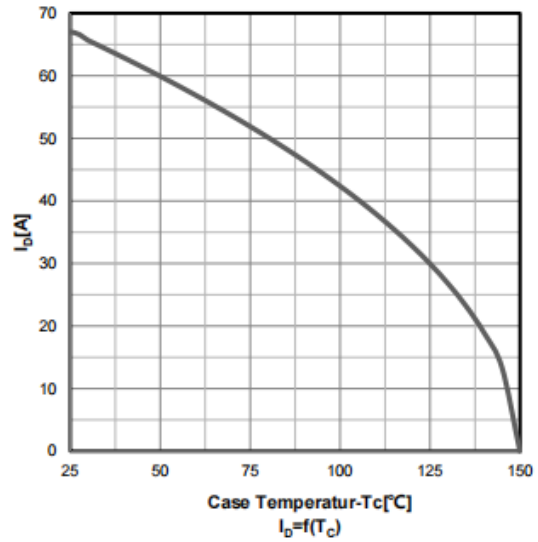
Forward characteristics of reverse diode



Drain-source breakdown voltage



Drain current vs temperature



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| DIM. | MILLIMETERS |       | INCHES    |       |
|------|-------------|-------|-----------|-------|
|      | MIN.        | MAX.  | MIN.      | MAX.  |
| A    | 4.70        | 5.31  | 0.185     | 0.209 |
| A1   | 2.21        | 2.59  | 0.087     | 0.102 |
| A2   | 1.50        | 2.49  | 0.059     | 0.098 |
| b    | 0.99        | 1.40  | 0.039     | 0.055 |
| b2   | 1.65        | 2.41  | 0.065     | 0.095 |
| b4   | 2.59        | 3.43  | 0.102     | 0.135 |
| c    | 0.61 BSC    |       | 0.024 BSC |       |
| D    | 20.80       | 21.46 | 0.819     | 0.845 |
| D1   | 3.68        | 5.49  | 0.145     | 0.216 |
| (e)  | 5.46 BSC    |       | 0.215 BSC |       |
| E    | 15.49       | 16.26 | 0.610     | 0.640 |
| L    | 19.81       | 20.32 | 0.780     | 0.800 |
| L1   | 4.06        | 4.50  | 0.160     | 0.177 |
| Øp   | 3.51        | 3.66  | 0.138     | 0.144 |

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