

STW13NK60Z-VB Datasheet

N-Channel 650 V (D-S) MOSFET

| PRODUCT SUMMARY | | |
|------------------------------------|-----------------|------|
| V_{DS} (V) at T_J max. | 650 | |
| $R_{DS(on)}$ (Ω) at 25 °C | $V_{GS} = 10$ V | 0.36 |
| Q_g max. (nC) | 106 | |
| Q_{gs} (nC) | 14 | |
| Q_{gd} (nC) | 33 | |
| Configuration | Single | |

FEATURES

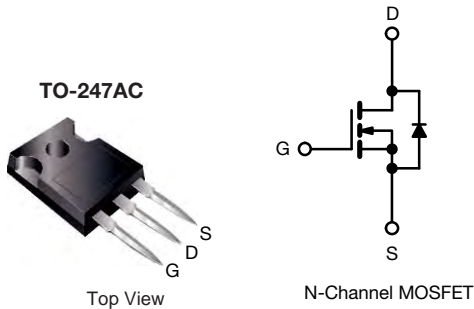
- Reduced t_{rr} , Q_{rr} , and I_{RRM}
- Low figure-of-merit (FOM) $R_{on} \times Q_g$
- Low input capacitance (C_{iss})
- Low switching losses due to reduced Q_{rr}
- Ultra low gate charge (Q_g)
- Avalanche energy rated (UIS)



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APPLICATIONS

- Telecommunications
 - Server and telecom power supplies
- Lighting
 - High-intensity discharge (HID)
 - Fluorescent ballast lighting
- Consumer and computing
 - ATX power supplies
- Industrial
 - Welding
 - Battery chargers
- Renewable energy
 - Solar (PV inverters)
- Switch mode power supplies (SMPS)



| ABSOLUTE MAXIMUM RATINGS (T _C = 25 °C, unless otherwise noted) | | | | | |
|---|-------------------------|-------------------------|-----------------------------------|-------------|------|
| PARAMETER | | | SYMBOL | LIMIT | UNIT |
| Drain-Source Voltage | | | V _{DS} | 650 | V |
| Gate-Source Voltage | | | V _{GS} | ± 30 | |
| Continuous Drain Current (T _J = 150 °C) | V _{GS} at 10 V | T _C = 25 °C | I _D | 18 | A |
| | | T _C = 100 °C | | 16 | |
| Pulsed Drain Current ^a | | | I _{DM} | 53 | |
| Linear Derating Factor | | | | 1.7 | W/°C |
| Single Pulse Avalanche Energy ^b | | | E _{AS} | 367 | mJ |
| Maximum Power Dissipation | | | P _D | 208 | W |
| Operating Junction and Storage Temperature Range | | | T _J , T _{stg} | -55 to +150 | °C |
| Drain-Source Voltage Slope | T _J = 125 °C | | dV/dt | 37 | V/ns |
| Reverse Diode dV/dt ^d | | 31 | | | |
| Soldering Recommendations (Peak Temperature) ^c | for 10 s | | | 300 | °C |


Notes

- a. Repetitive rating; pulse width limited by maximum junction temperature.
 b. $V_{DD} = 50$ V, starting $T_J = 25$ °C, $L = 28.2$ mH, $R_g = 25$ Ω , $I_{AS} = 5.1$ A.
 c. 1.6 mm from case.
 d. $I_{SD} \leq I_D$, $dI/dt = 100$ A/ μ 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} | - | 0.5 | |

SPECIFICATIONS ($T_J = 25\text{ }^{\circ}\text{C}$, unless otherwise noted)

| PARAMETER | SYMBOL | TEST CONDITIONS | | MIN. | TYP. | MAX. | UNIT |
|---|---------------------|--|---|------|------|-----------|-----------------------|
| Static | | | | | | | |
| Drain-Source Breakdown Voltage | V_{DS} | $V_{GS} = 0\text{ V}$, $I_D = 250\text{ }\mu\text{A}$ | | 650 | - | - | V |
| V_{DS} Temperature Coefficient | $\Delta V_{DS}/T_J$ | Reference to $25\text{ }^{\circ}\text{C}$, $I_D = 1\text{ mA}$ | | - | 0.67 | - | V/ $^{\circ}\text{C}$ |
| Gate-Source Threshold Voltage (N) | $V_{GS(th)}$ | $V_{DS} = V_{GS}$, $I_D = 250\text{ }\mu\text{A}$ | | 2 | - | 4 | V |
| Gate-Source Leakage | I_{GSS} | $V_{GS} = \pm 20\text{ V}$ | | - | - | ± 100 | nA |
| | | $V_{GS} = \pm 30\text{ V}$ | | - | - | ± 1 | μA |
| Zero Gate Voltage Drain Current | I_{DSS} | $V_{DS} = 520\text{ V}$, $V_{GS} = 0\text{ V}$ | | - | - | 1 | μA |
| | | $V_{DS} = 520\text{ V}$, $V_{GS} = 0\text{ V}$, $T_J = 125\text{ }^{\circ}\text{C}$ | | - | - | 500 | |
| Drain-Source On-State Resistance | $R_{DS(on)}$ | $V_{GS} = 10\text{ V}$ | $I_D = 11\text{ A}$ | - | 0.36 | - | Ω |
| Forward Transconductance | g_{fs} | $V_{DS} = 30\text{ V}$, $I_D = 11\text{ A}$ | | - | 7.0 | - | S |
| Dynamic | | | | | | | |
| Input Capacitance | C_{iss} | $V_{GS} = 0\text{ V}$, $V_{DS} = 100\text{ V}$, $f = 1\text{ MHz}$ | | - | 2322 | - | pF |
| Output Capacitance | C_{oss} | | | - | 105 | - | |
| Reverse Transfer Capacitance | C_{rss} | | | - | 4 | - | |
| Effective Output Capacitance, Energy Related ^a | $C_{o(er)}$ | $V_{DS} = 0\text{ V to } 520\text{ V}$, $V_{GS} = 0\text{ V}$ | | - | 84 | - | |
| Effective Output Capacitance, Time Related ^b | $C_{o(tr)}$ | | | - | 293 | - | |
| Total Gate Charge | Q_g | $V_{GS} = 10\text{ V}$ | $I_D = 11\text{ A}$, $V_{DS} = 520\text{ V}$ | - | 71 | 106 | nC |
| Gate-Source Charge | Q_{gs} | | | - | 14 | - | |
| Gate-Drain Charge | Q_{gd} | | | - | 33 | - | |
| Turn-On Delay Time | $t_{d(on)}$ | $V_{DD} = 520\text{ V}$, $I_D = 11\text{ A}$, $V_{GS} = 10\text{ V}$, $R_g = 9.1\text{ }\Omega$ | | - | 22 | 44 | ns |
| Rise Time | t_r | | | - | 34 | 68 | |
| Turn-Off Delay Time | $t_{d(off)}$ | | | - | 68 | 102 | |
| Fall Time | t_f | | | - | 42 | 84 | |
| Gate Input Resistance | R_g | $f = 1\text{ MHz}$, open drain | | - | 0.78 | - | Ω |
| Drain-Source Body Diode Characteristics | | | | | | | |
| Continuous Source-Drain Diode Current | I_S | MOSFET symbol showing the integral reverse p - n junction diode  | | - | - | 21 | A |
| Pulsed Diode Forward Current | I_{SM} | | | - | - | 53 | |
| Diode Forward Voltage | V_{SD} | $T_J = 25\text{ }^{\circ}\text{C}$, $I_S = 11\text{ A}$, $V_{GS} = 0\text{ V}$ | | - | 0.9 | 1.2 | V |
| Reverse Recovery Time | t_{rr} | $T_J = 25\text{ }^{\circ}\text{C}$, $I_F = I_S = 11\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$, $V_R = 25\text{ V}$ | | - | 160 | - | ns |
| Reverse Recovery Charge | Q_{rr} | | | - | 1.2 | - | μC |
| Reverse Recovery Current | I_{RRM} | | | - | 14 | - | 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} .

TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)

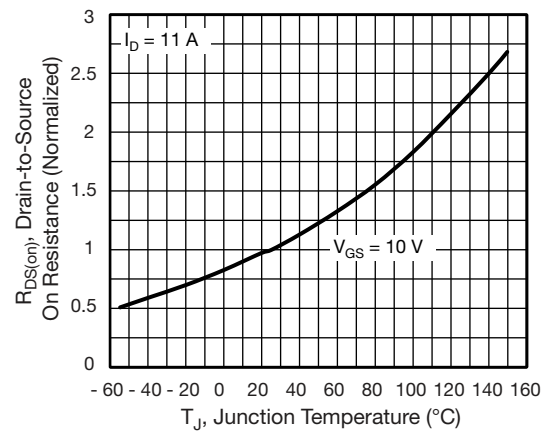
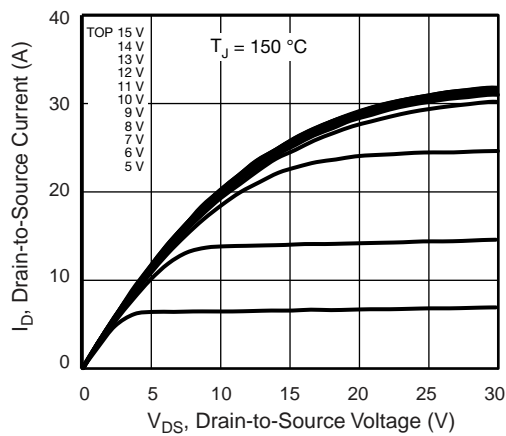
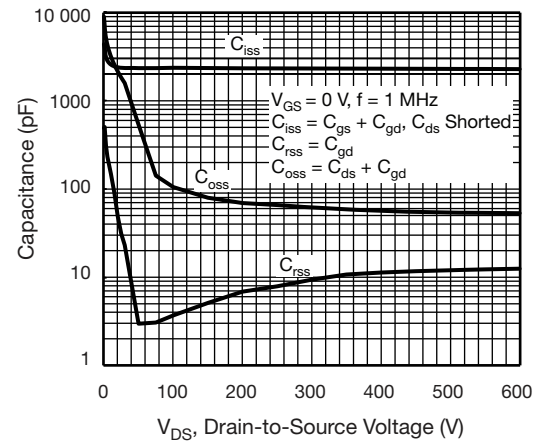
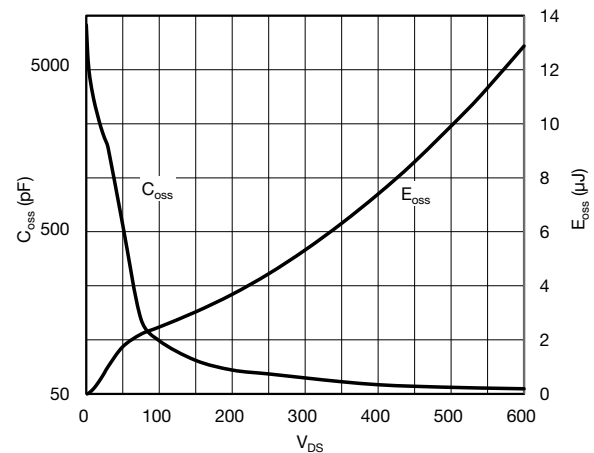
Fig. 1 - Typical Output Characteristics

Fig. 4 - Normalized On-Resistance vs. Temperature

Fig. 2 - Typical Output Characteristics

Fig. 5 - Typical Capacitance vs. Drain-to-Source Voltage

Fig. 3 - Typical Transfer Characteristics

Fig. 6 - C_{oss} and E_{oss} vs. V_{DS}

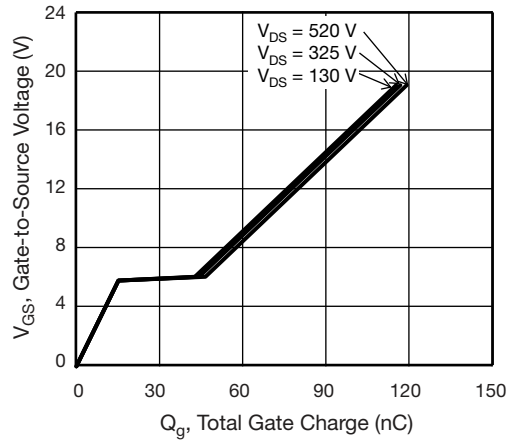


Fig. 7 - Typical Gate Charge vs. Gate-to-Source Voltage

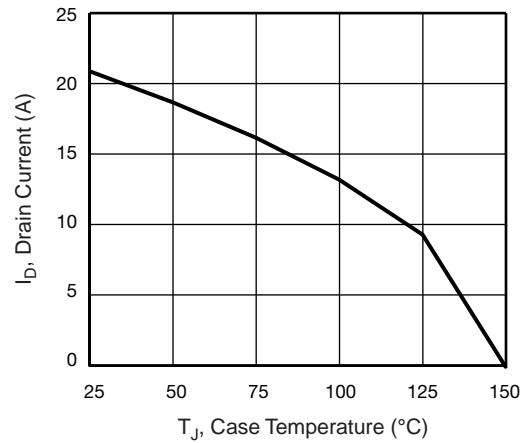


Fig. 10 - Maximum Drain Current vs. Case Temperature



Fig. 8 - Typical Source-Drain Diode Forward Voltage



Fig. 11 - Temperature vs. Drain-to-Source Voltage



Fig. 9 - Maximum Safe Operating Area



Fig. 12 - Normalized Thermal Transient Impedance, Junction-to-Case



Fig. 13 - Switching Time Test Circuit



Fig. 16 - Unclamped Inductive Waveforms



Fig. 14 - Switching Time Waveforms

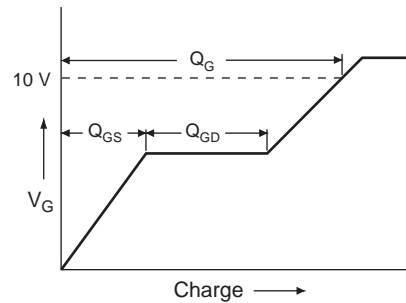


Fig. 17 - Basic Gate Charge Waveform



Fig. 15 - Unclamped Inductive Test Circuit

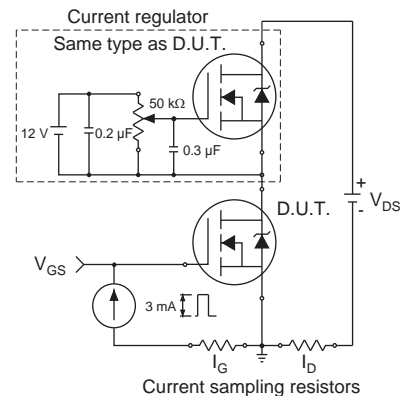


Fig. 18 - Gate Charge Test Circuit

**Note**

a. $V_{GS} = 5\text{ V}$ for logic level devices

Fig. 19 - For N-Channel

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