

N-Channel 650V (D-S) Super Junction Power MOSFET

| PRODUCT SUMMARY | | |
|------------------------------------|-----------------|------|
| V_{DS} (V) at T_J max. | 700 | |
| $R_{DS(on)}$ at 25 °C (Ω) | $V_{GS} = 10$ V | 0.23 |
| Q_g Typ. (nC) | 24 | |
| Q_{gs} (nC) | 6 | |
| Q_{gd} (nC) | 11 | |
| Configuration | Single | |

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)

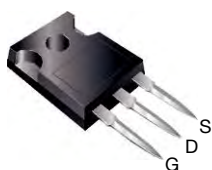


RoHS*
Available
HALOGEN
FREE
Available

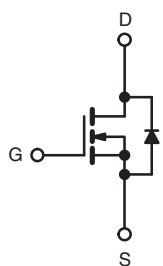
APPLICATIONS

- Server and telecom power supplies
- Switch mode power supplies (SMPS)
- Power factor correction power supplies (PFC)
- Lighting
 - High-intensity discharge (HID)
 - Fluorescent ballast lighting
- Industrial
 - Welding
 - Induction heating
 - Motor drives
 - Battery chargers
 - Renewable energy
 - Solar (PV inverters)

TO-247AC



Top View



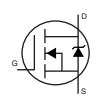
N-Channel MOSFET

| 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 | 15 |
| | | $T_C = 100$ °C | 10 |
| Pulsed Drain Current ^a | | I_{DM} | 45 |
| Linear Derating Factor | | | 1.4 |
| Single Pulse Avalanche Energy ^b | | E_{AS} | 286 |
| Maximum Power Dissipation | | P_D | 180 |
| Operating Junction and Storage Temperature Range | | T_J, T_{stg} | -55 to +150 |
| Drain-Source Voltage Slope | $T_J = 125$ °C | dV/dt | 37 |
| Reverse Diode dV/dt ^d | | | 23 |
| Soldering Recommendations (Peak Temperature) ^c | for 10 s | | 300 |
| | | | °C |

Notes

- Repetitive rating; pulse width limited by maximum junction temperature.
- $V_{DD} = 50$ V, starting $T_J = 25$ °C, $L = 28.2$ mH, $R_g = 25$ Ω , $I_{AS} = 4.5$ A.
- 1.6 mm from case.
- $I_{SD} \leq I_D$, $dI/dt = 100$ 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} | - | 0.7 | |

| 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 $25\text{ }^\circ\text{C}$, $I_D = 1\text{ mA}$ | | - | 0.75 | - | V/°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} | $V_{DS} = 650\text{ V}, V_{GS} = 0\text{ V}$ | | - | - | 1 | μA |
| | | $V_{DS} = 520\text{ V}, V_{GS} = 0\text{ V}, T_J = 125\text{ }^\circ\text{C}$ | | - | - | 10 | |
| Drain-Source On-State Resistance | $R_{DS(on)}$ | $V_{GS} = 10\text{ V}$ | $I_D = 8\text{ A}$ | - | 0.23 | - | Ω |
| Forward Transconductance | g_{fs} | $V_{DS} = 30\text{ V}, I_D = 8\text{ A}$ | | - | 5.6 | - | S |
| Dynamic | | | | | | | |
| Input Capacitance | C_{iss} | $V_{GS} = 0\text{ V}, V_{DS} = 100\text{ V}, f = 1\text{ MHz}$ | | - | 1640 | - | pF |
| Output Capacitance | C_{oss} | | | - | 80 | - | |
| Reverse Transfer Capacitance | C_{rss} | | | - | 4 | - | |
| Effective Output Capacitance, Energy Related ^a | $C_{o(er)}$ | $V_{DS} = 0\text{ V to } 520\text{ V}, V_{GS} = 0\text{ V}$ | | - | 63 | - | |
| Effective Output Capacitance, Time Related ^b | $C_{o(tr)}$ | | | - | 213 | - | |
| Total Gate Charge | Q_g | $V_{GS} = 10\text{ V}$ | $I_D = 8\text{ A}, V_{DS} = 520\text{ V}$ | - | 24 | 48 | nC |
| Gate-Source Charge | Q_{gs} | | | - | 6 | - | |
| Gate-Drain Charge | Q_{gd} | | | - | 11 | - | |
| Turn-On Delay Time | $t_{d(on)}$ | $V_{DD} = 520\text{ V}, I_D = 8\text{ A}, V_{GS} = 10\text{ V}, R_g = 9.1\text{ }\Omega$ | | - | 18 | 36 | ns |
| Rise Time | t_r | | | - | 24 | 48 | |
| Turn-Off Delay Time | $t_{d(off)}$ | | | - | 48 | 96 | |
| Fall Time | t_f | | | - | 25 | 50 | |
| Gate Input Resistance | R_g | $f = 1\text{ MHz}, \text{open drain}$ | | - | 0.8 | - | Ω |
| Drain-Source Body Diode Characteristics | | | | | | | |
| Continuous Source-Drain Diode Current | I_S | MOSFET symbol showing the integral reverse p - n junction diode  | | - | - | 15 | A |
| Pulsed Diode Forward Current | I_{SM} | | | - | - | 38 | |
| Diode Forward Voltage | V_{SD} | $T_J = 25\text{ }^\circ\text{C}, I_S = 8\text{ A}, V_{GS} = 0\text{ V}$ | | - | - | 1.2 | V |
| Reverse Recovery Time | t_{rr} | $T_J = 25\text{ }^\circ\text{C}, I_F = I_S = 8\text{ A}, di/dt = 100\text{ A}/\mu\text{s}, V_R = 400\text{ V}$ | | - | 325 | - | ns |
| Reverse Recovery Charge | Q_{rr} | | | - | 4.6 | - | μC |
| Reverse Recovery Current | I_{RRM} | | | - | 20 | - | 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

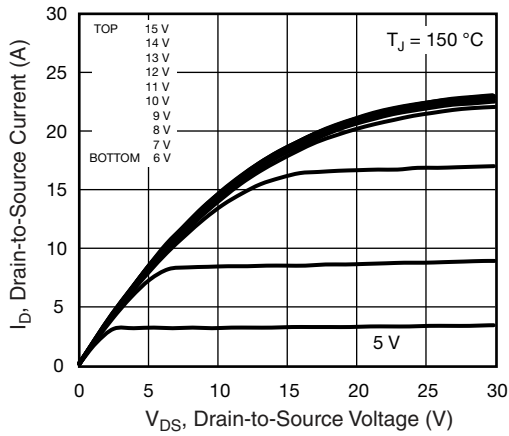


Fig. 2 - Typical Output Characteristics



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

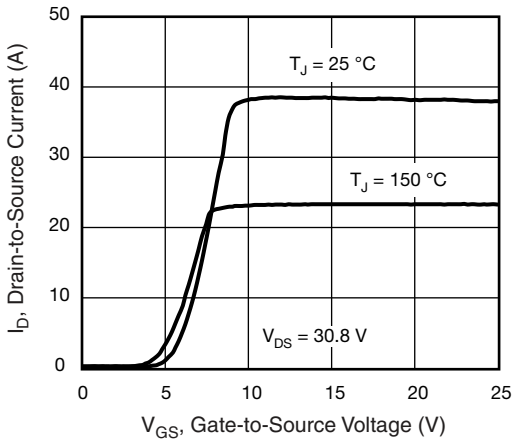


Fig. 3 - Typical Transfer Characteristics

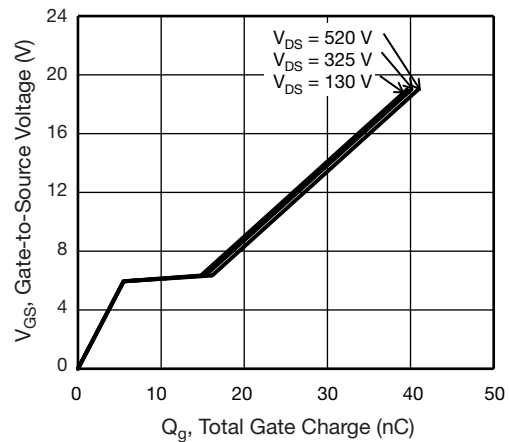


Fig. 6 - Typical Gate Charge vs. Gate-to-Source Voltage



Fig. 7 - Typical Source-Drain Diode Forward Voltage

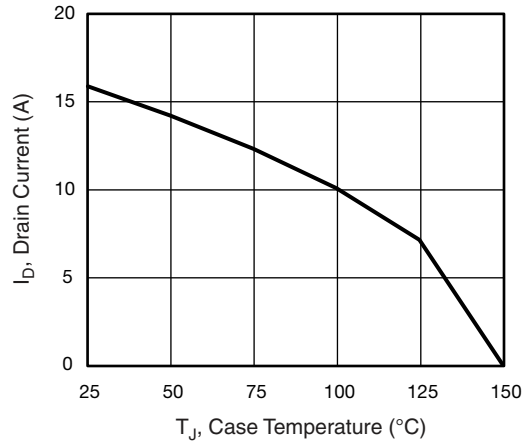


Fig. 9 - Maximum Drain Current vs. Case Temperature



Fig. 8 - Maximum Safe Operating Area



Fig. 10 - Temperature vs. Drain-to-Source Voltage



Fig. 11 - Normalized Thermal Transient Impedance, Junction-to-Case

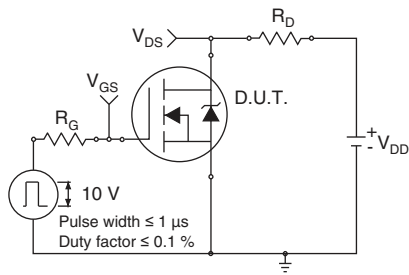


Fig. 12 - Switching Time Test Circuit

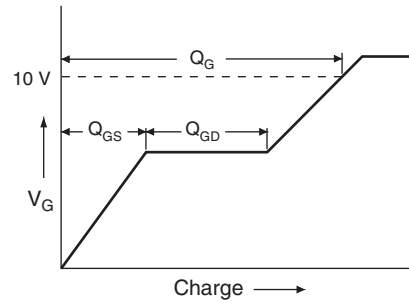


Fig. 16 - Basic Gate Charge Waveform

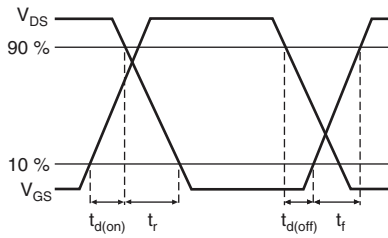


Fig. 13 - Switching Time Waveforms

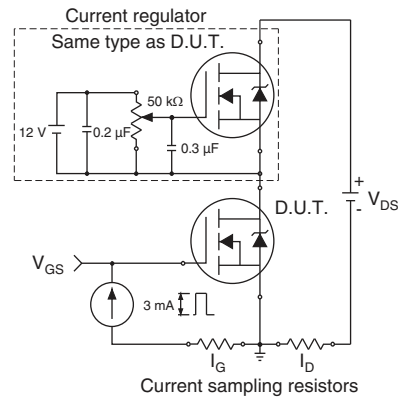


Fig. 17 - Gate Charge Test Circuit

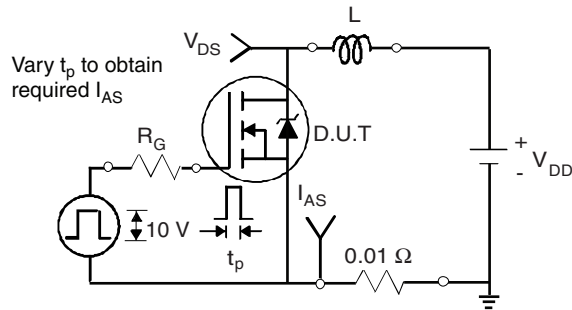


Fig. 14 - Unclamped Inductive Test Circuit

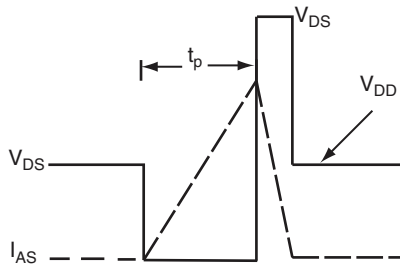
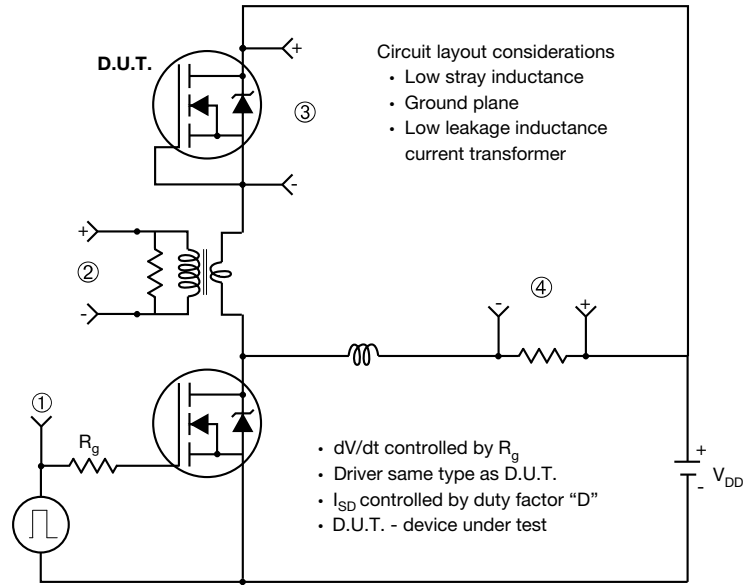


Fig. 15 - Unclamped Inductive Waveforms

Peak Diode Recovery dV/dt Test Circuit

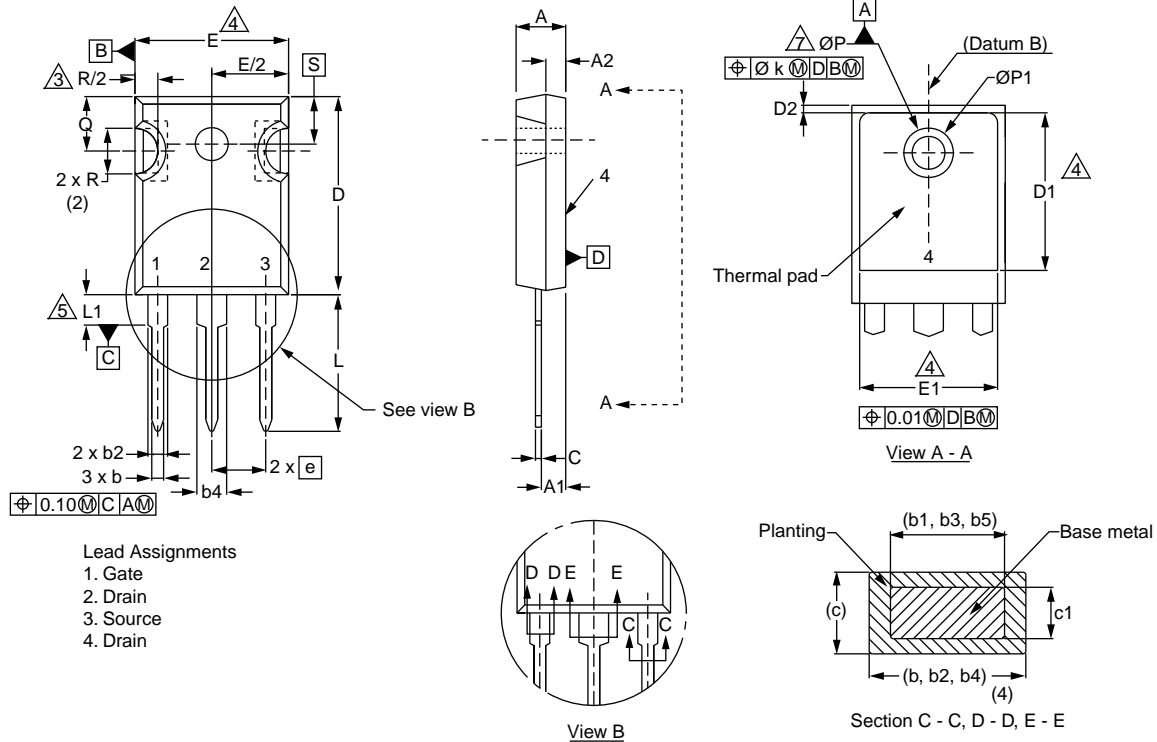


Note

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

Fig. 18 - For N-Channel

TO-247AC (High Voltage)



| DIM. | MILLIMETERS | | INCHES | |
|------|-------------|-------|--------|-------|
| | MIN. | MAX. | MIN. | MAX. |
| A | 4.58 | 5.31 | 0.180 | 0.209 |
| A1 | 2.21 | 2.59 | 0.087 | 0.102 |
| A2 | 1.17 | 2.49 | 0.046 | 0.098 |
| b | 0.99 | 1.40 | 0.039 | 0.055 |
| b1 | 0.99 | 1.35 | 0.039 | 0.053 |
| b2 | 1.53 | 2.39 | 0.060 | 0.094 |
| b3 | 1.65 | 2.37 | 0.065 | 0.093 |
| b4 | 2.42 | 3.43 | 0.095 | 0.135 |
| b5 | 2.59 | 3.38 | 0.102 | 0.133 |
| c | 0.38 | 0.86 | 0.015 | 0.034 |
| c1 | 0.38 | 0.76 | 0.015 | 0.030 |
| D | 19.71 | 20.82 | 0.776 | 0.820 |
| D1 | 13.08 | - | 0.515 | - |

| DIM. | MILLIMETERS | | INCHES | |
|-----------|-------------|-------|-----------|-------|
| | MIN. | MAX. | MIN. | MAX. |
| D2 | 0.51 | 1.30 | 0.020 | 0.051 |
| E | 15.29 | 15.87 | 0.602 | 0.625 |
| E1 | 13.72 | - | 0.540 | - |
| e | 5.46 BSC | | 0.215 BSC | |
| ϕk | 0.254 | | 0.010 | |
| L | 14.20 | 16.25 | 0.559 | 0.640 |
| L1 | 3.71 | 4.29 | 0.146 | 0.169 |
| N | 7.62 BSC | | 0.300 BSC | |
| ϕP | 3.51 | 3.66 | 0.138 | 0.144 |
| $\phi P1$ | - | 7.39 | - | 0.291 |
| Q | 5.31 | 5.69 | 0.209 | 0.224 |
| R | 4.52 | 5.49 | 0.178 | 0.216 |
| S | 5.51 BSC | | 0.217 BSC | |

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