

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

| PRODUCT SUMMARY | | |
|--|------------------------|-------|
| V _{DS} (V) at T _J max. | 650 | |
| R _{DS(on)} at 25 °C (Ω) | V _{GS} = 10 V | 0.050 |

FEATURES

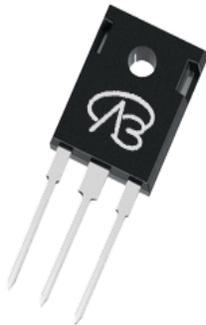
- Low figure-of-merit (FOM) R_{on} x Q_g
- Low input capacitance (C_{iss})
- Reduced switching and conduction losses
- Ultra low gate charge (Q_g)
- Avalanche energy rated (UIS)



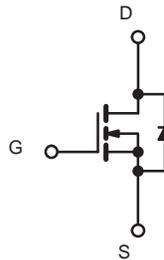
APPLICATIONS

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

TO-247



Top View



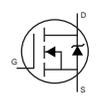
N-Channel MOSFET

| 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 | 47 |
| | | T _C = 100 °C | 28 |
| Pulsed Drain Current ^a | I _{DM} | 140 | A |
| Linear Derating Factor | | 1.67 | W/°C |
| Single Pulse Avalanche Energy ^b | E _{AS} | 840 | mJ |
| Maximum Power Dissipation | P _D | 320 | 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 ^d | | 15 | |
| Soldering Recommendations (Peak Temperature) ^c | 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 = 30mH, R_g = 25 Ω, I_{AS} = 15A.
- 1.6 mm from case.
- I_{SD} ≤ I_D, dI/dt = 100 A/μs, starting T_J = 25 °C.

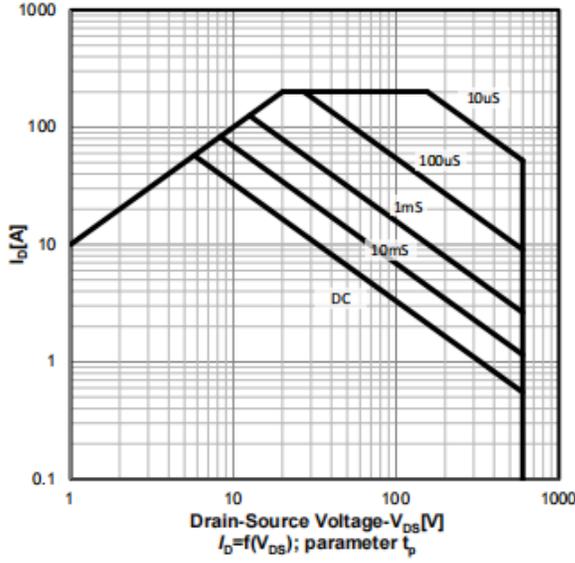
| THERMAL RESISTANCE RATINGS | | | | |
|----------------------------------|------------|------|------|------|
| PARAMETER | SYMBOL | TYP. | MAX. | UNIT |
| Maximum Junction-to-Ambient | R_{thJA} | - | 62 | °C/W |
| Maximum Junction-to-Case (Drain) | R_{thJC} | - | 0.38 | |

| SPECIFICATIONS ($T_J = 25\text{ }^\circ\text{C}$, unless otherwise noted) | | | | | | | |
|---|---------------------|---|--|------|-------|-----------|---------------|
| PARAMETER | SYMBOL | TEST CONDITIONS | | MIN. | TYP. | MAX. | UNIT |
| Static | | | | | | | |
| Drain-Source Breakdown Voltage | V_{DS} | $V_{GS} = 0\text{ V}, I_D = 1\text{ mA}$ | | 650 | - | - | 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} | $V_{GS} = \pm 20\text{ V}$ | | - | - | ± 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 |
| | | $V_{DS} = 520\text{ V}, V_{GS} = 0\text{ V}, T_J = 125\text{ }^\circ\text{C}$ | | - | - | 100 | |
| Drain-Source On-State Resistance | $R_{DS(on)}$ | $V_{GS} = 10\text{ V}$ | $I_D = 10\text{ A}$ | - | 0.050 | - | Ω |
| Forward Transconductance | g_{fs} | $V_{DS} = 30\text{ V}, I_D = 10\text{ A}$ | | - | 5.6 | - | S |
| Dynamic | | | | | | | |
| Input Capacitance | C_{iss} | $V_{GS} = 0\text{ V},$ $V_{DS} = 100\text{ V},$ $f = 1\text{ MHz}$ | | - | 5200 | - | pF |
| Output Capacitance | C_{oss} | | | - | 330 | - | |
| 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 | $V_{GS} = 10\text{ V}$ | $I_D = 20\text{ A}, V_{DS} = 520\text{ V}$ | - | 90 | - | nC |
| Gate-Source Charge | Q_{gs} | | | - | 3.9 | - | |
| Gate-Drain Charge | Q_{gd} | | | - | 4.7 | - | |
| Turn-On Delay Time | $t_{d(on)}$ | $V_{DD} = 520\text{ V}, I_D = 20\text{ A},$ $V_{GS} = 10\text{ V}, R_g = 9.1\text{ }\Omega$ | | - | 15 | 26 | ns |
| Rise Time | t_r | | | - | 23 | 57 | |
| Turn-Off Delay Time | $t_{d(off)}$ | | | - | 8.0 | - | |
| Fall Time | t_f | | | - | 1.2 | - | |
| 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  | | - | - | 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} | $T_J = 25\text{ }^\circ\text{C}, I_F = I_S = 8\text{ A},$ $dI/dt = 100\text{ A}/\mu\text{s}, V_R = 400\text{ V}$ | | - | 70 | - | ns |
| Reverse Recovery Charge | Q_{rr} | | | - | 5.8 | - | μC |
| Reverse Recovery Current | I_{RRM} | | | - | 4.5 | - | A |

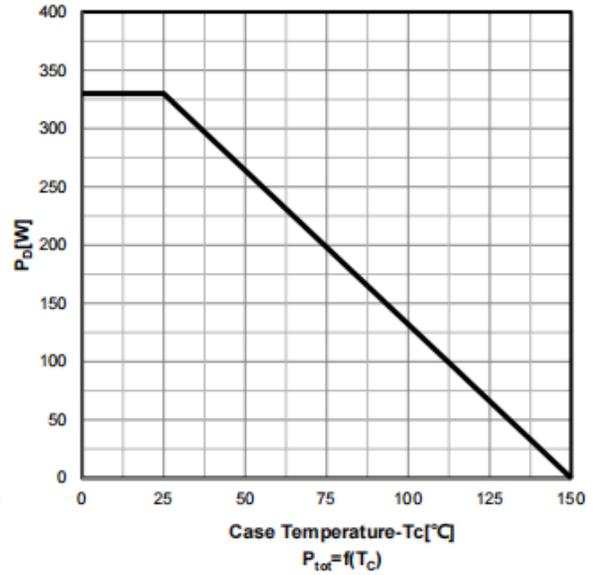
Notes

- 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} .

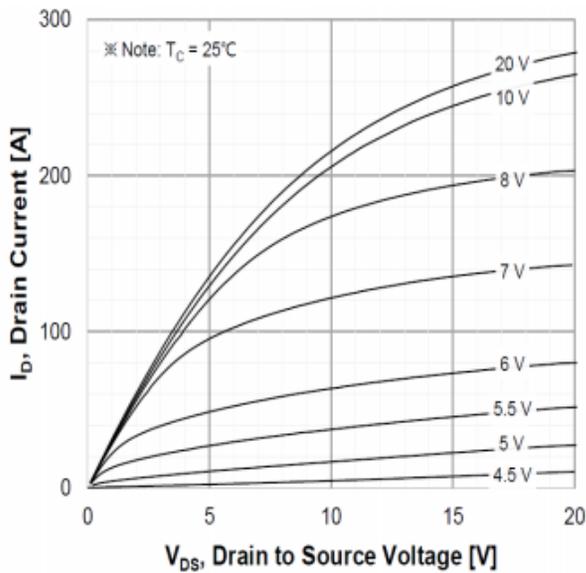
Safe operating area TC=25 °C
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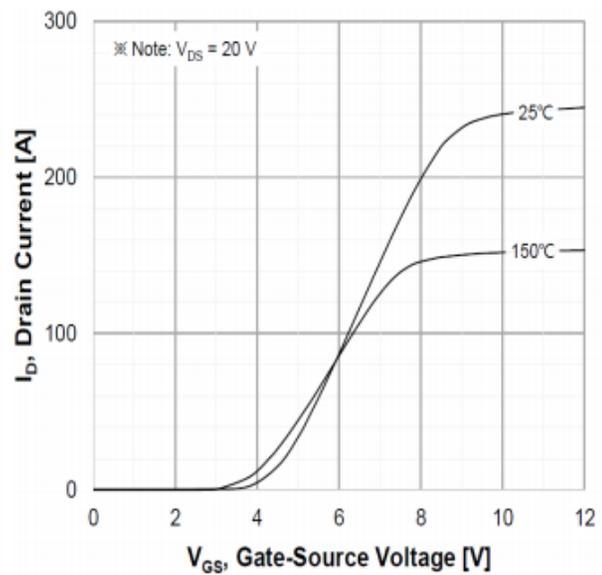
Power dissipation



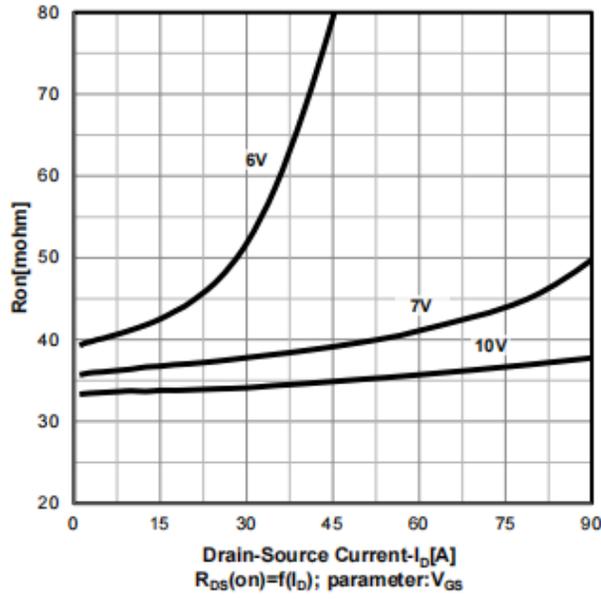
Typ. output characteristics $T_J=25\text{ °C}$



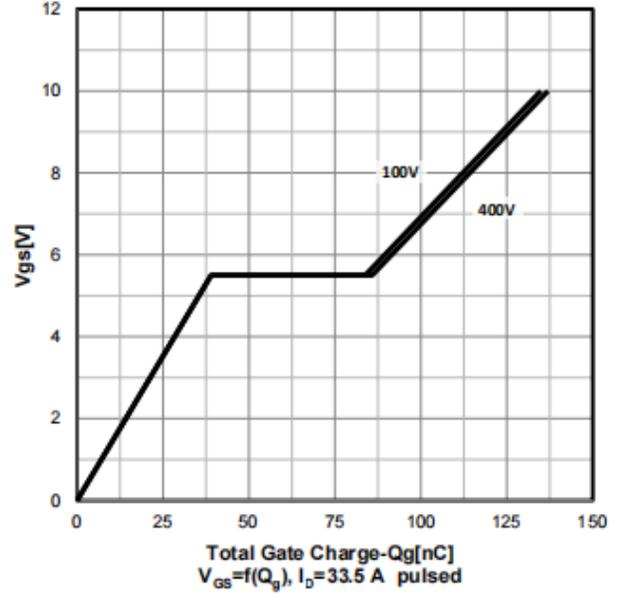
Transfer characteristics



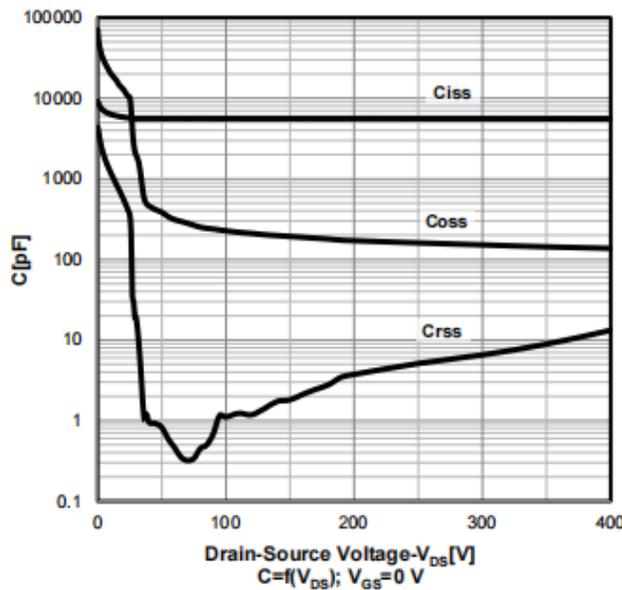
Typ. drain-source on-state resistance



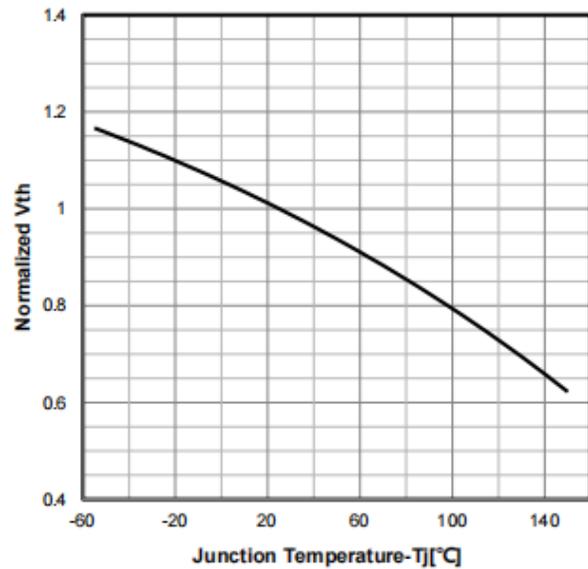
Typ. gate charge characteristics



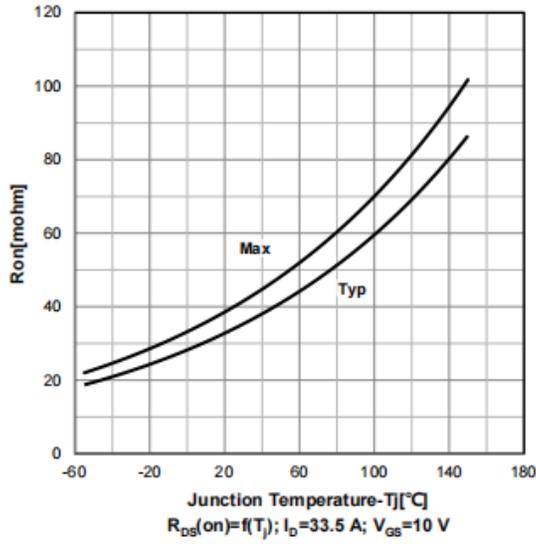
Typ. capacitances



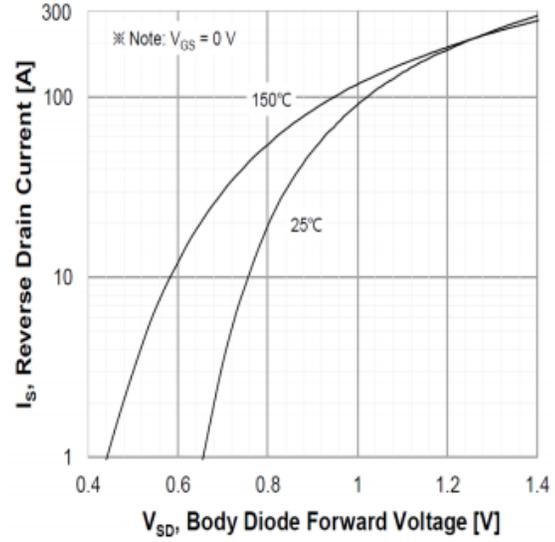
Normalized $V_{GS(th)}$ characteristics



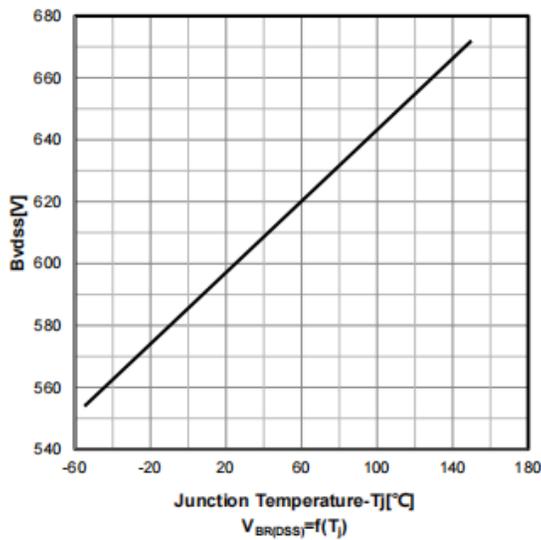
On-resistance vs temperature



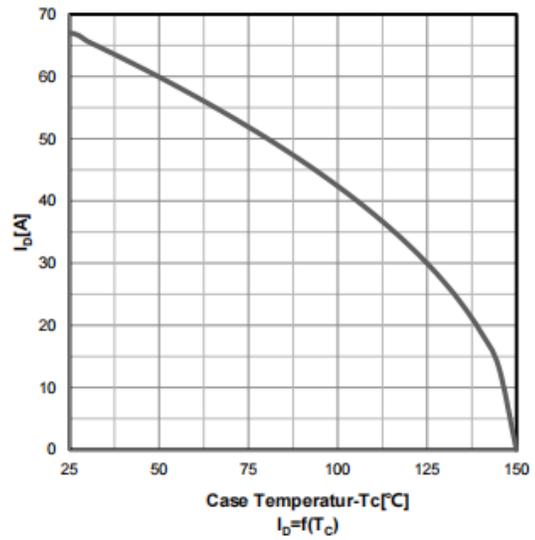
Forward characteristics of reverse diode



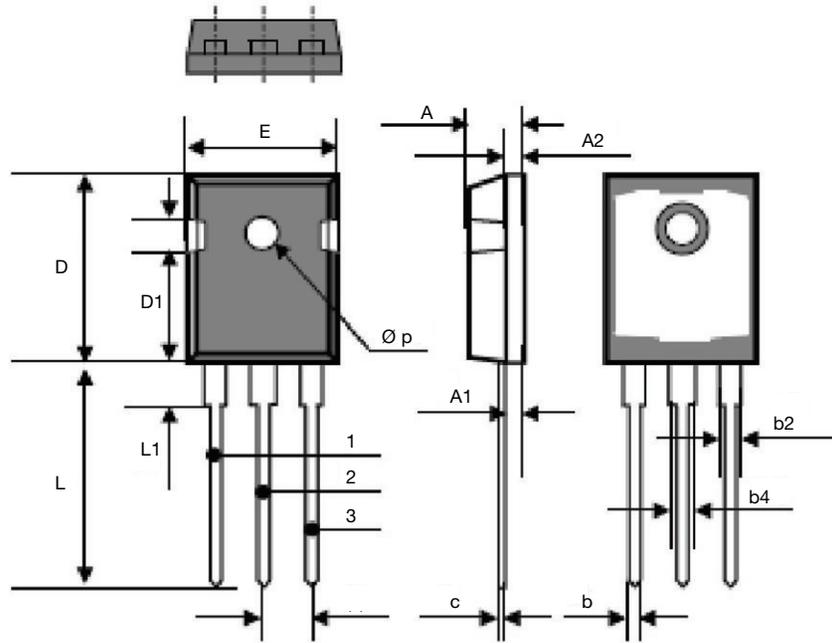
Drain-source breakdown voltage



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 |
| $\varnothing p$ | 3.51 | 3.66 | 0.138 | 0.144 |

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