

SCT4045DE-VB Datasheet

N-Channel 650V (D-S) SiC Power MOSFET

| PRODUCT SUMMARY | | |
|------------------------------------|-----------------|------|
| V_{DS} (V) | 650 | |
| $R_{DS(on)}$ at 25 °C (Ω) | $V_{GS} = 18$ V | 0.05 |
| Q_g (nC) | 90 | |

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

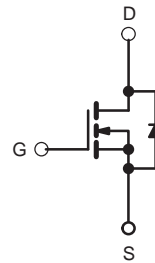
APPLICATIONS

- Server and telecom power supplies
- Switch mode power supplies (SMPS)
- Power factor correction power supplies (PFC)
- DC/DC converter

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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} | 650 | V | | |
| Gate-Source Voltage | V_{GS} | -10 / +22 | | | |
| Continuous Drain Current ($T_J = 150$ °C) | V_{GS} at 18 V | $T_C = 25$ °C | 40 | A | |
| | | $T_C = 100$ °C | 32 | | |
| Pulsed Drain Current ^a | | I_{DM} | 120 | | |
| Linear Derating Factor | | | 2.1 | W/°C | |
| Single Pulse Avalanche Energy ^b | | E_{AS} | 225 | mJ | |
| Maximum Power Dissipation | | P_D | 187 | W | |
| Operating Junction and Storage Temperature Range | | T_J, T_{stg} | -55 to +175 | °C | |
| Drain-Source Voltage Slope | | dV/dt | $T_J = 125$ °C | 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, $L = 0.5$ mH, $R_g = 25$ Ω , $I_{AS} = 30$ 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} | - | 40 | °C/W |
| Maximum Junction-to-Case (Drain) | R_{thJC} | - | 0.8 | |

| 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) | $V_{GS(th)}$ | $V_{DS} = V_{GS}, I_D = 10\text{ mA}$ | | 2 | - | 5 | V |
| Gate-Source Leakage | I_{GSS} | $V_{GS} = +22\text{ V}$ | | - | - | 100 | nA |
| | | $V_{GS} = -10\text{ V}$ | | - | - | 100 | μA |
| Zero Gate Voltage Drain Current | I_{DSS} | $V_{DS} = 650\text{ V}, V_{GS} = 0\text{ V}$ | | - | 10 | - | μA |
| | | $V_{DS} = 650\text{ V}, V_{GS} = 0\text{ V}, T_J = 125\text{ }^\circ\text{C}$ | | - | - | 100 | |
| Drain-Source On-State Resistance | $R_{DS(on)}$ | $V_{GS} = 18\text{ V}$ | $I_D = 20\text{ A}$ | - | 0.05 | - | Ω |
| Forward Transconductance | g_{fs} | $V_{DS} = 0\text{ V}, I_D = 30\text{ A}$ | | - | 12 | - | S |
| Dynamic | | | | | | | |
| Input Capacitance | C_{iss} | $V_{GS} = 0\text{ V},$ $V_{DS} = 600\text{ V},$ $f = 1\text{ MHz}$ | | - | 2000 | - | pF |
| Output Capacitance | C_{oss} | | | - | 175 | - | |
| Reverse Transfer Capacitance | C_{rss} | | | - | 9 | - | |
| Effective Output Capacitance, Energy Related ^a | $C_{o(er)}$ | $V_{DS} = 0\text{ V to } 400\text{ V}, V_{GS} = 0\text{ V}$ | | - | 156 | - | |
| Effective Output Capacitance, Time Related ^b | $C_{o(tr)}$ | | | - | 268 | - | |
| Total Gate Charge | Q_g | $V_{GS} = -5/18\text{ V}$ | $I_D = 20\text{ A}, V_{DS} = 400\text{ V}$ | - | 70 | - | nC |
| Gate-Source Charge | Q_{gs} | | | - | 20 | - | |
| Gate-Drain Charge | Q_{gd} | | | - | 23 | - | |
| Turn-On Delay Time | $t_{d(on)}$ | $V_{DD} = 400\text{ V}, I_D = 20\text{ A},$ $V_{GS} = -5/18\text{ V}, R_g = 2\text{ }\Omega$ | | - | 12 | 15 | ns |
| Rise Time | t_r | | | - | 10 | 13 | |
| Turn-Off Delay Time | $t_{d(off)}$ | | | - | 20 | - | |
| Fall Time | t_f | | | - | 10 | - | |
| Gate Input Resistance | R_g | $f = 1\text{ MHz}, \text{ open drain}$ | | - | 2.2 | - | Ω |
| Drain-Source Body Diode Characteristics | | | | | | | |
| Continuous Source-Drain Diode Current | I_S | MOSFET symbol showing the integral reverse p - n junction diode  | | - | - | 40 | A |
| Pulsed Diode Forward Current | I_{SM} | | | - | - | 120 | |
| Diode Forward Voltage | V_{SD} | $T_J = 25\text{ }^\circ\text{C}, I_S = 20\text{ A}, V_{GS} = 0$ | | - | - | 4.1 | V |
| Reverse Recovery Time | t_{rr} | $T_J = 25\text{ }^\circ\text{C}, I_F = I_S = 20\text{ A},$ $di/dt = 1000\text{ A}/\mu\text{s}, V_R = 400\text{ V}$ | | - | 20 | - | ns |
| Reverse Recovery Charge | Q_{rr} | | | - | 60 | - | μC |
| Reverse Recovery Current | I_{RRM} | | | - | 10 | - | 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 60 % 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 60 % V_{DSS} .

Safe operating area Tc=25 °C
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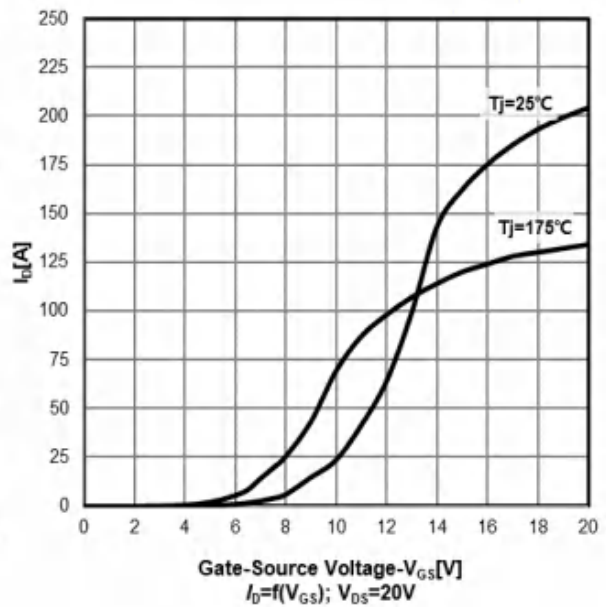
On-Region characteristics Tj=25 °C



On-Region characteristics Tj=175 °C



Transfer characteristics



Drain current vs temperature



Power dissipation



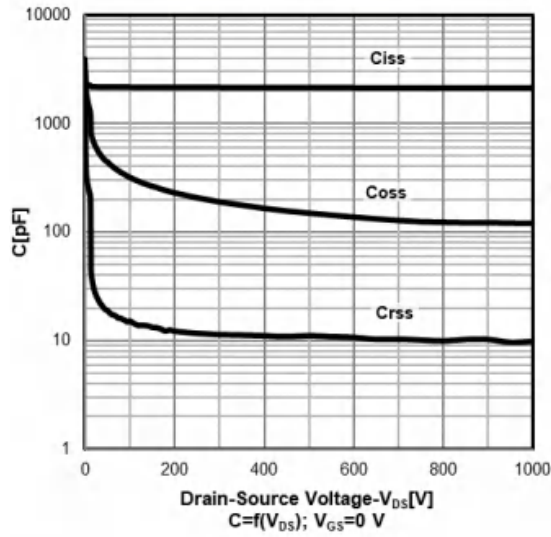
Threshold voltage vs temperature



Normalized On-resistance vs temperature



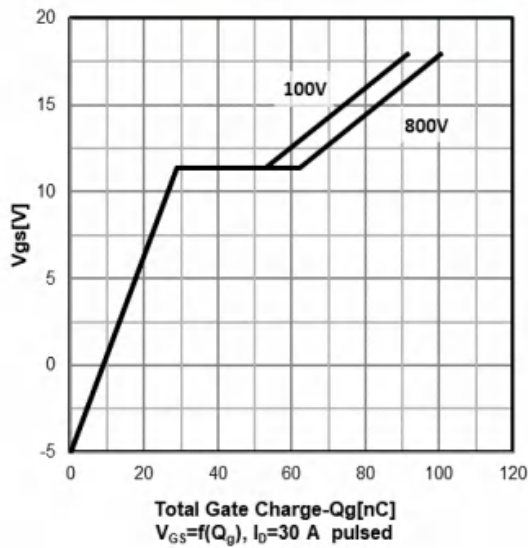
Typ. capacitances



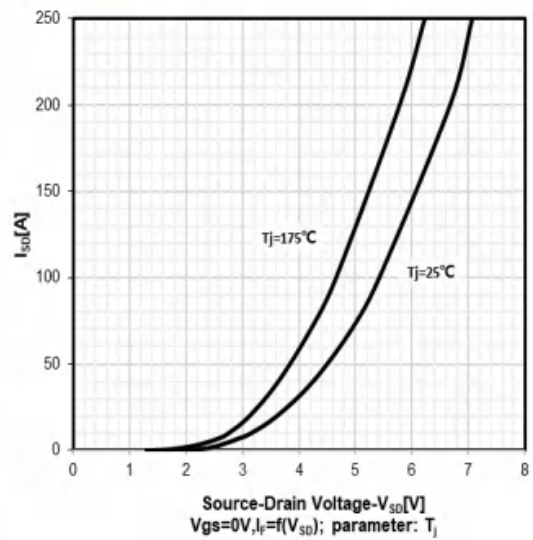
C_{oss} stored energy



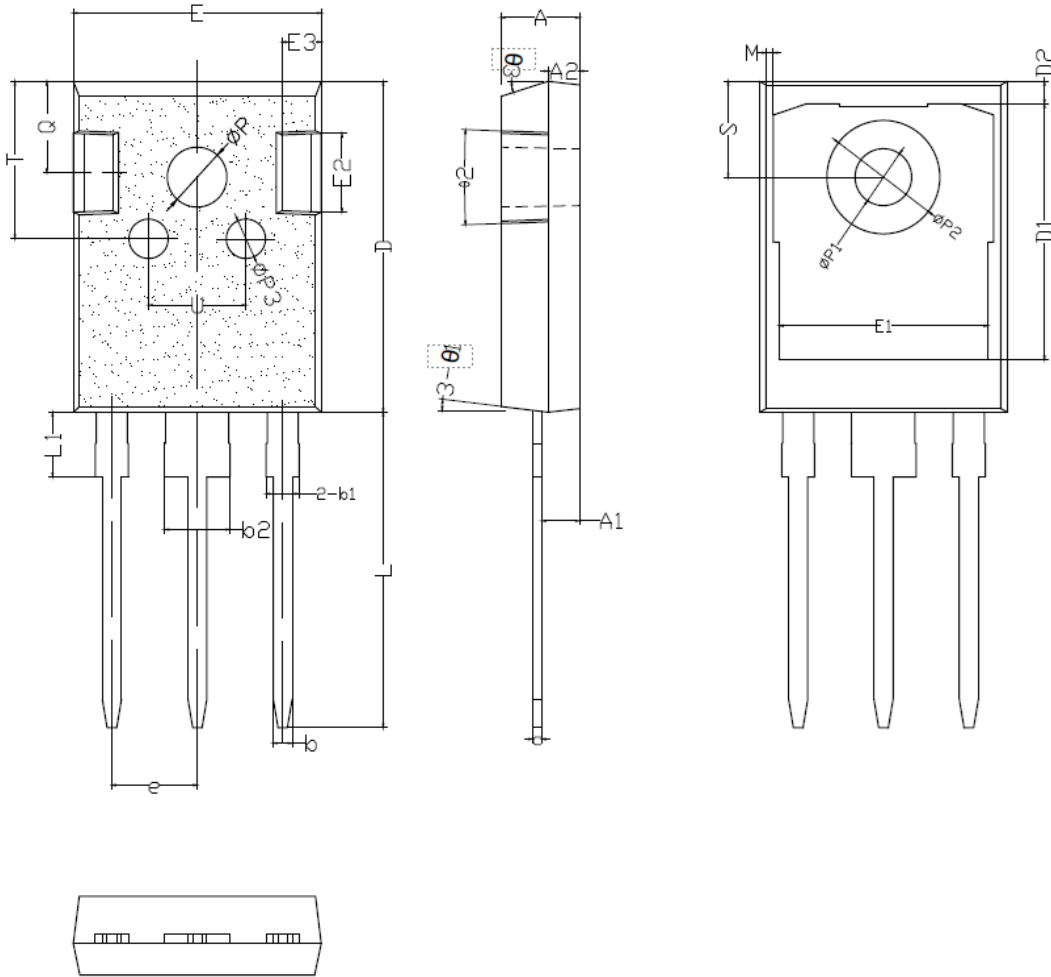
Typ. gate charge characteristics



Diode forward voltage characteristics
 $T_j=25^\circ C/175^\circ C$



TO-247 PACKAGE OUTLINE DIMENSIONS



| SYMBOL | mm | | |
|--------|-------|-------|-------|
| | MIN | NOM | MAX |
| *A | 4.90 | 5.00 | 5.10 |
| *A1 | 2.31 | 2.41 | 2.51 |
| A2 | 1.90 | 2.00 | 2.10 |
| *b | 1.15 | 1.20 | 1.25 |
| *b1 | 1.95 | 2.10 | 2.25 |
| *b2 | 2.95 | 3.10 | 3.25 |
| *c | 0.55 | 0.60 | 0.65 |
| *D | 20.90 | 21.00 | 21.10 |
| D1 | 16.35 | 16.55 | 16.75 |
| D2 | 1.05 | 1.20 | 1.35 |

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