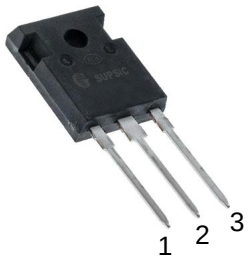
## Features

1) Low on-resistance
2) Fast switching speed
3) Fast reverse recovery
4) Easy to parallel
5) Simple to drive
6) Pb-free lead plating ; RoHS compliant

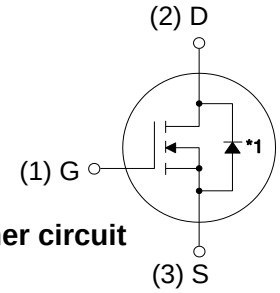
| Parameter | Rating | Units |
|---|---|---|
| $V_{DS}$ | **650** | V |
| $I_{D\ @\ 25^{\circ}C}$ | **38** | A |
| $R_{DS(on)}$ | **60** | m Ω |

## Applications

- Solar inverters
- DC/DC converters
- Switch mode power supplies
- Induction heating




TO-247-3
**Package**




**Inner circuit**

(1) Gate
(2) Drain
(3) Source

*1 Body Diode

## Maximum Ratings

| Symbol | Parameter | Value | Unit | Note |
|---|---|---|---|---|
| $V_{DSS}$ | Drain - Source Voltage, $T_C$ = 25 ˚C | 650 | V | |
| $V_{GS}$ | Gate - Source voltage (Under transient events < 100 ns) | -8/+19 | V | |
| $I_D$ | Continuous Drain Current, $V_{GS}$ = 15 V, $T_C$ = 25˚C | 38 | A | |
| | Continuous Drain Current, $V_{GS}$ = 15 V, $T_C$ = 100˚C | 28 | | |
| $I_{D(pulse)}$ | Pulsed Drain Current, Pulse width $t_P$ limited by $T_{jmax}$ | 99 | A | |
| $P_D$ | Power Dissipation, $T_C$=25˚C, $T_J$ = 175 ˚C | 150 | W | |
| $T_J$ , $T_{stg}$ | Operating Junction and Storage Temperature | -40 to +175 | ˚C | |
| $T_L$ | Solder Temperature, 1.6mm (0.063") from case for 10s | 260 | ˚C | |
| $M_d$ | Mounting Torque, (M3 or 6-32 screw) | 1<br>8.8 | Nm<br>lbf-in | |

Note (1): Die limits are 37A (25°C) and 27A (100°C)

## Electrical Characteristics ($T_C$ = 25˚C unless otherwise specified)

| Symbol | Parameter | Min. | Typ. | Max. | Unit | Test Conditions | Note |
|---|---|---|---|---|---|---|---|
| $V_{(BR)DSS}$ | Drain-Source Breakdown Voltage | 650 | | | V | $V_{GS}$ = 0 V, $I_D$ = 100 µA | |
| $V_{GSon}$ | Gate-Source Recommended Turn-On Voltage | | 15 | | V | Static | |
| $V_{GSoff}$ | Gate-Source Recommended Turn-Off Voltage | | -4 | | V | | |
| $V_{GS(th)}$ | Gate Threshold Voltage | 1.8 | 2.3 | 3.6 | V | $V_{DS}$ = $V_{GS}$, $I_D$ = 5 mA | |
| | | | 1.9 | | V | $V_{DS}$ = $V_{GS}$, $I_D$ = 5 mA, $T_J$ = 175ºC | |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | | 1 | 50 | µA | $V_{DS}$ = 650 V, $V_{GS}$ = 0 V | |
| $I_{GSS}$ | Gate-Source Leakage Current | | 10 | 250 | nA | $V_{GS}$ = 15 V, $V_{DS}$ = 0 V | |
| $R_{DS(on)}$ | Drain-Source On-State Resistance | 42 | 60 | 80 | mΩ | $V_{GS}$ = 15 V, $I_D$ = 13.2 A | |
| | | | 80 | | | $V_{GS}$ = 15 V, $I_D$ = 13.2 A, $T_J$ = 175ºC | |
| $g_{fs}$ | Transconductance | | 10 | | S | $V_{DS}$= 20 V, $I_{DS}$= 13.2 A | |
| | | | 9 | | | $V_{DS}$= 20 V, $I_{DS}$= 13.2 A, $T_J$ = 175ºC | |
| $C_{iss}$ | Input Capacitance | | 975 | | pF | $V_{GS}$ = 0 V, $V_{DS}$ = 600 V<br>f = 1 MHz<br>$V_{AC}$ = 25 mV | |
| $C_{oss}$ | Output Capacitance | | 80 | | | | |
| $C_{rss}$ | Reverse Transfer Capacitance | | 9 | | | | |
| $C_{o(er)}$ | Effective Output Capacitance (Energy Related) | | 99 | | pF | $V_{GS}$ = 0 V, $V_{DS}$ = 400 V | |
| $C_{o(tr)}$ | Effective Output Capacitance (Time Related) | | 132 | | | | |
| $E_{oss}$ | $C_{oss}$ Stored Energy | | 15 | | µJ | $V_{DS}$ = 600 V, 1 MHz | |
| $E_{ON}$ | Turn-On Switching Energy (Body Diode) | | 110 | | µJ | $V_{DS}$ = 400 V, $V_{GS}$ = -4 V/15 V, $I_D$ = 13.2 A,<br>$R_{G(ext)}$ = 2.5Ω, L= 135 µH, $T_J$ = 175ºC<br>FWD = Internal Body Diode of MOSFET | |
| $E_{OFF}$ | Turn Off Switching Energy (Body Diode) | | 22 | | | | |
| $E_{ON}$ | Turn-On Switching Energy (External SiC Diode) | | 64 | | µJ | $V_{DS}$ = 400 V, $V_{GS}$ = -4 V/15 V, $I_D$ = 13.2 A,<br>$R_{G(ext)}$ = 2.5Ω, L= 135 µH, $T_J$ = 175ºC<br>FWD = External SiC Diode | |
| $E_{OFF}$ | Turn Off Switching Energy (External SiC Diode) | | 28 | | | | |
| $t_{d(on)}$ | Turn-On Delay Time | | 10 | | ns | $V_{DD}$ = 400 V, $V_{GS}$ = -4 V/15 V<br>$I_D$ = 13.2 A, $R_{G(ext)}$ = 2.5 Ω, L= 135 µH<br>Timing relative to $V_{DS}$<br>Inductive load | |
| $t_r$ | Rise Time | | 20 | | | | |
| $t_{d(off)}$ | Turn-Off Delay Time | | 17 | | | | |
| $t_f$ | Fall Time | | 8 | | | | |
| $R_{G(int)}$ | Internal Gate Resistance | | 3 | | Ω | f = 1 MHz, $V_{AC}$ = 25 mV | |
| $Q_{gs}$ | Gate to Source Charge | | 13 | | nC | $V_{DS}$ = 400 V, $V_{GS}$ = -4 V/15 V<br>$I_D$ = 13.2 A<br>Per IEC60747-8-4 pg 21 | |
| $Q_{gd}$ | Gate to Drain Charge | | 14 | | | | |
| $Q_g$ | Total Gate Charge | | 43 | | | | |

Note (1): $C_{o(er)}$, a lumped capacitance that gives same stored energy as Coss while Vds is rising from 0 to 400V
$C_{o(tr)}$, a lumped capacitance that gives same charging time as Coss while Vds is rising from 0 to 400V

## Reverse Diode Characteristics ($T_C$ = 25˚C unless otherwise specified)

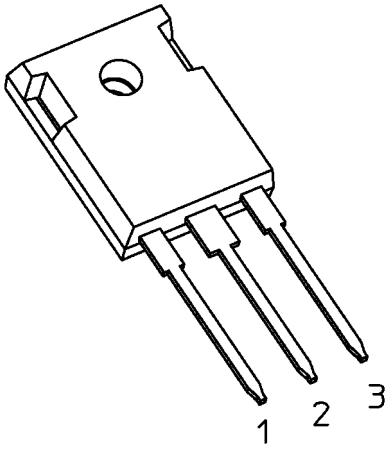
| Symbol | Parameter | Typ. | Max. | Unit | Test Conditions | Note |
|---|---|---|---|---|---|---|
| $V_{SD}$ | Diode Forward Voltage | 5.1 | | V | $V_{GS}$ = -4 V, $I_{SD}$ = 6.6 A, $T_J$ = 25 °C | |
| | | 4.8 | | V | $V_{GS}$ = -4 V, $I_{SD}$ = 6.6 A, $T_J$ = 175 °C | |
| $I_S$ | Continuous Diode Forward Current | | 23 | A | $V_{GS}$ = -4 V, $T_C$ = 25˚C | |
| $I_{S,\ pulse}$ | Diode pulse Current | | 99 | A | $V_{GS}$ = -4 V, pulse width $t_P$ limited by $T_{jmax}$ | |
| $t_{rr}$ | Reverse Recover time | 20 | | ns | $V_{GS}$ = -4 V, $I_{SD}$ = 13.2 A, $V_R$ = 400 V<br>dif/dt = 1200 A/µs, $T_J$ = 175 °C | |
| $Q_{rr}$ | Reverse Recovery Charge | 195 | | nC | | |
| $I_{rrm}$ | Peak Reverse Recovery Current | 16 | | A | | |
| $t_{rr}$ | Reverse Recover time | 29 | | ns | $V_{GS}$ = -4 V, $I_{SD}$ = 13.2 A, $V_R$ = 400 V<br>dif/dt = 750 A/µs, $T_J$ = 175 °C | |
| $Q_{rr}$ | Reverse Recovery Charge | 185 | | nC | | |
| $I_{rrm}$ | Peak Reverse Recovery Current | 9 | | A | | |

## Thermal Characteristics

| Symbol | Parameter | Typ. | Unit | Test Conditions | Note |
|---|---|---|---|---|---|
| $R_{\theta JC}$ | Thermal Resistance from Junction to Case | 0.99 | °C/W | | |
| $R_{\theta JA}$ | Thermal Resistance From Junction to Ambient | 40 | | | |

## Package Dimensions

Unit: mm

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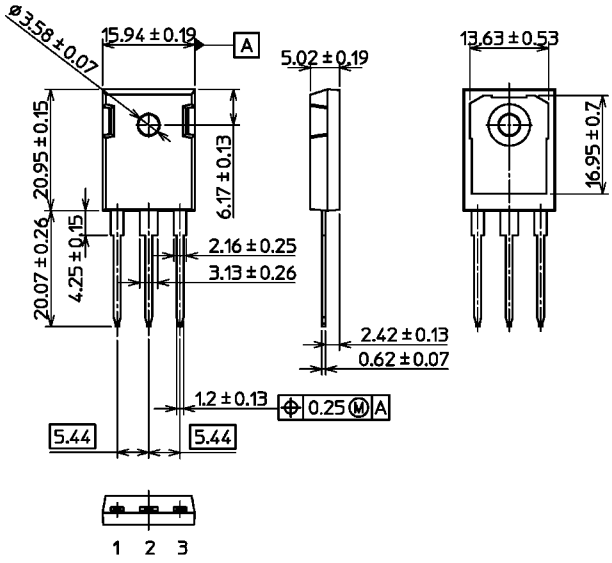
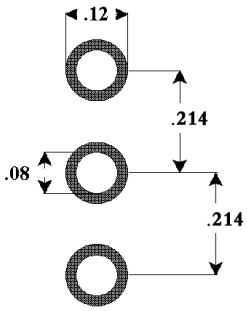



## Recommended Solder Pad Layout

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