

# 650V Super Junction Power MOSFET

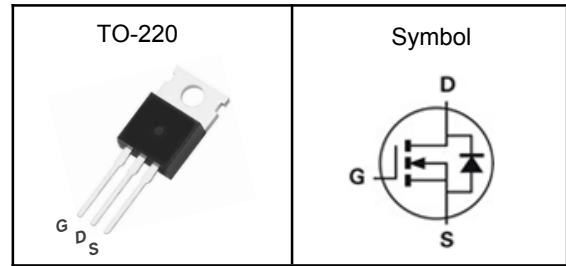
## Features

- Low drain-source on-resistance:  $R_{DS(ON)}=0.090\Omega(\text{typ})$
- Easy to control gate switching
- Enhancement mode:  $V_{th} = 2.5$  to  $4.2V$
- 100% avalanche tested
- RoHS compliant

## Applications

- Switch Mode Power Supply (SMPS)
- TV power & LED Lighting Power
- AC to DC Converters
- Telecom

## Pin Description



|                  |     |            |
|------------------|-----|------------|
| $V_{DSS}$        | 650 | V          |
| $R_{DS(ON)-Typ}$ | 90  | m $\Omega$ |
| $I_D$            | 30  | A          |

## Absolute Maximum Ratings ( $T_J=25^\circ\text{C}$ , Unless Otherwise Noted)

| Symbol       | Parameter                                  | N-Channel              | Unit             |
|--------------|--|------------------------|------------------|
| $V_{DSS}$    | Drain-Source Voltage                       | 650                    | V                |
| $V_{GSS}$    | Gate-Source Voltage                        | $\pm 20$               | V                |
| $T_J$        | Maximum Junction Temperature               | -55 to 150             | $^\circ\text{C}$ |
| $T_{STG}$    | Storage Temperature Range                  | -55 to 150             | $^\circ\text{C}$ |
| $E_{AS}$     | Single Pulse Avalanche Energy <sup>③</sup> | 720                    | mJ               |
| $I_{DM}^{①}$ | Pulse Drain Current Tested                 | 90                     | A                |
| $I_D$        | Continuous Drain Current                   | $T_C=25^\circ\text{C}$ | A                |
| $P_D$        | Maximum Power Dissipation                  | $T_C=25^\circ\text{C}$ | W                |

## Thermal Characteristics

| Symbol          | Parameter  | Rating | Unit                      |
|-----------------|--|--------|---------------------------|
| $R_{\theta JA}$ | Thermal Resistance Junction-Ambient <sup>①</sup> (Max) | 60     | $^\circ\text{C}/\text{W}$ |
| $R_{\theta JC}$ | Thermal Resistance Junction-Case <sup>①</sup>          | 0.85   | $^\circ\text{C}/\text{W}$ |

Note ① : Max. current is limited by bonding wire.

Note ② : UIS tested and pulse width are limited by maximum junction temperature  $150^\circ\text{C}$ .

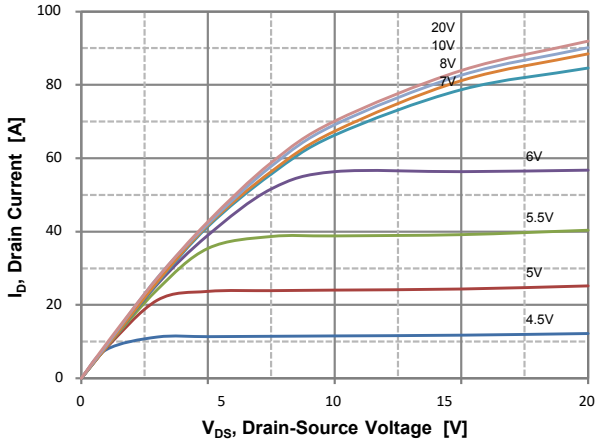
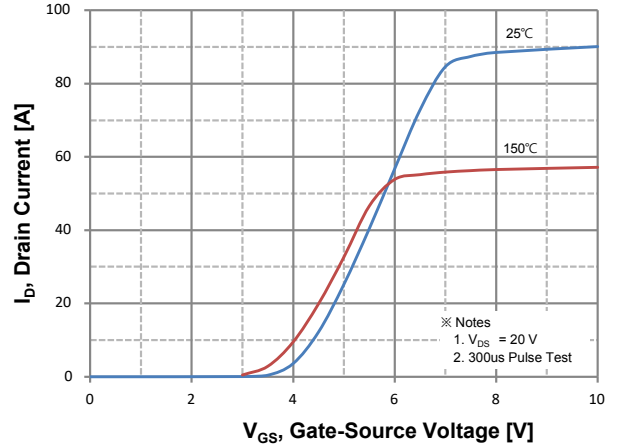
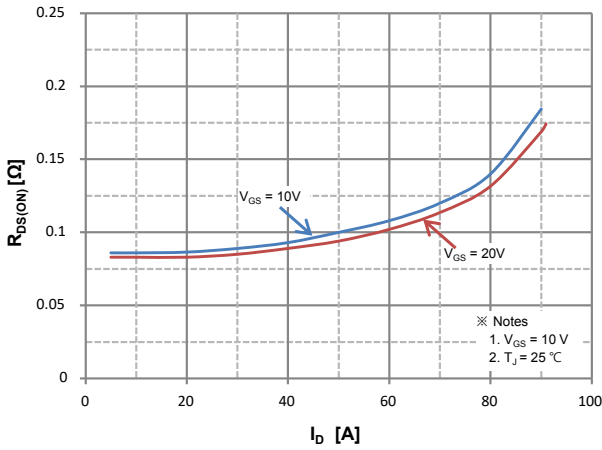
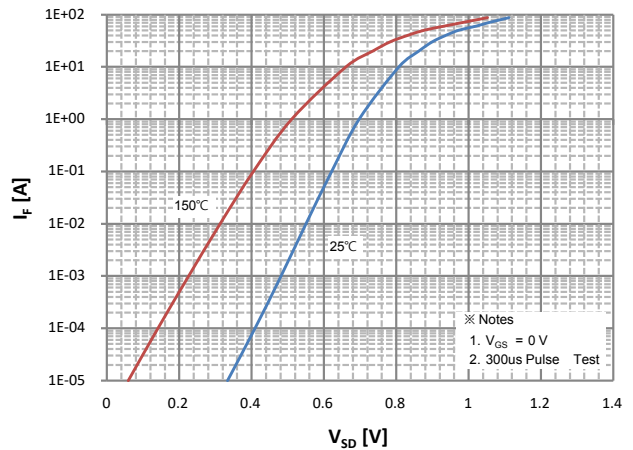
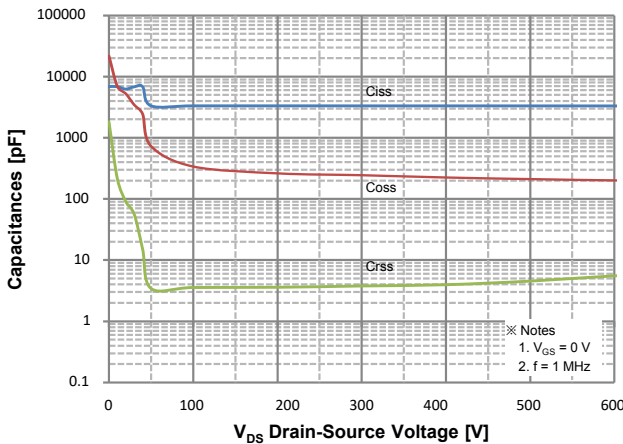
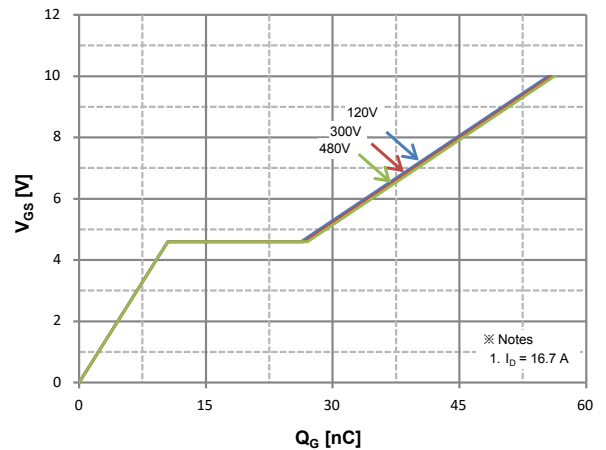
Note ③ : Surface Mounted on  $1\text{in}^2$  FR-4 board with 1oz.

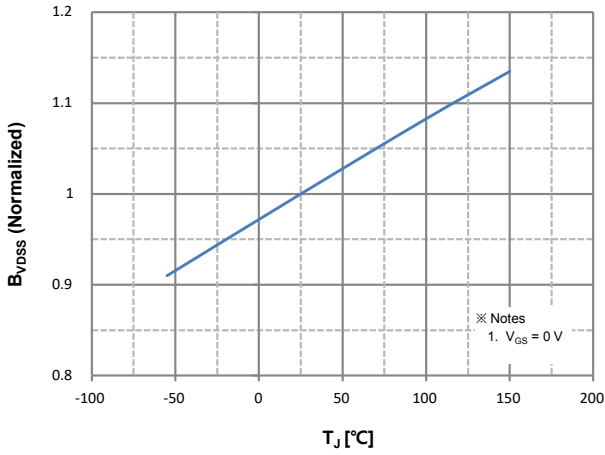
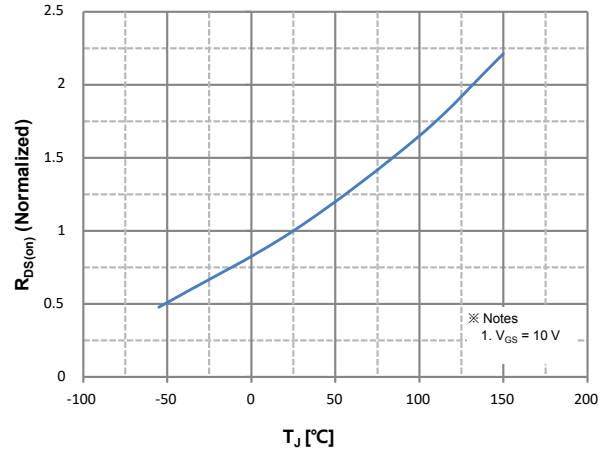
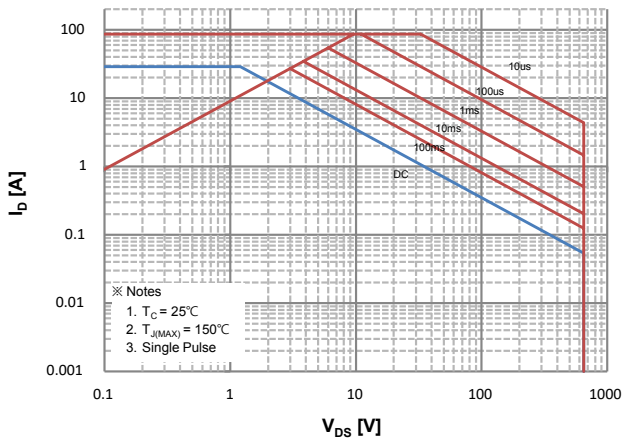
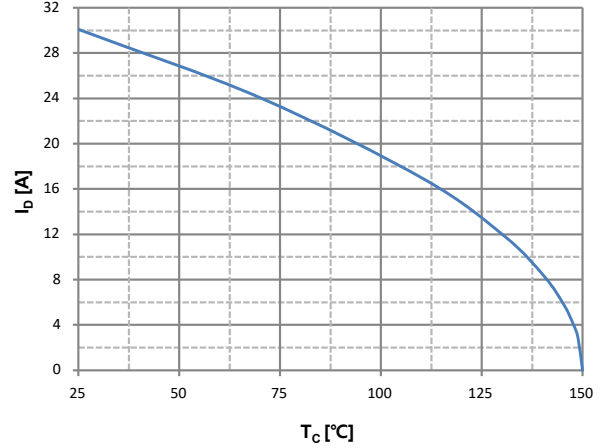
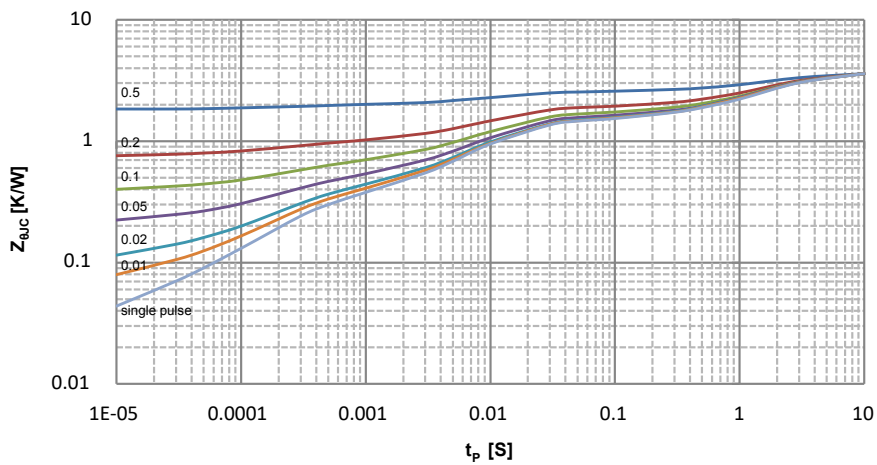
**650V Super Junction Power MOSFET****Electrical Characteristics** ( $T_J=25^\circ\text{C}$ , Unless Otherwise Noted)

| Symbol   | Parameter                          | Test Conditions  | Min | Typ  | Max       | Unit      |
|--|------------------------------------|--|-----|------|-----------|-----------|
| <b>Static Electrical Characteristics</b>                       |                                    |  |     |      |           |           |
| $BV_{DSS}$   | Drain-Source Breakdown Voltage     | $V_{GS}=0V, I_D=250\mu A$  | 650 | ---  | ---       | V         |
| $I_{DSS}$  | Zero Gate Voltage Drain Current    | $V_{DS}=650V, V_{GS}=0V$   | --- | ---  | 1         | $\mu A$   |
| $V_{GS(th)}$   | Gate Threshold Voltage             | $V_{DS}=V_{GS}, I_D=250\mu A$                                      | 2.5 | ---  | 4.2       | V         |
| $I_{GSS}$  | Gate Leakage Current               | $V_{GS}=\pm 20V, V_{DS}=0V$  | --- | ---  | $\pm 100$ | nA        |
| $R_{DS(ON)}$   | Drain-Source On-state Resistance   | $V_{GS}=10V, I_D=14A$  | --- | 90   | 100       | $m\Omega$ |
| <b>Dynamic Characteristics</b> <sup>⑤</sup>                    |                                    |  |     |      |           |           |
| $C_{iss}$  | Input Capacitance                  | $V_{GS}=0V,$<br>$V_{DS}=400V,$<br>Freq.=1MHz                       | --- | 2480 | ---       | pF        |
| $C_{oss}$  | Output Capacitance                 |  | --- | 220  | ---       |           |
| $C_{rss}$  | Reverse Transfer Capacitance       |  | --- | 6.7  | ---       |           |
| $T_{d(on)}$  | Turn-on Delay Time                 | $V_{DD}=325V, R_G=25\Omega,$<br>$I_D=16.7A$                        | --- | 23   | ---       | nS        |
| $T_r$  | Turn-on Rise Time                  |  | --- | 28   | ---       |           |
| $T_{d(off)}$   | Turn-off Delay Time                |  | --- | 110  | ---       |           |
| $T_f$  | Turn-off Fall Time                 |  | --- | 22   | ---       |           |
| $Q_g$  | Total Gate Charge                  | $V_{DD}=520V, V_{GS}=10V,$<br>$I_D=16.7A$                          | --- | 52   | ---       | nC        |
| $Q_{gs}$   | Gate-Source Charge                 |  | --- | 10   | ---       |           |
| $Q_{gd}$   | Gate-Drain Charge                  |  | --- | 20   | ---       |           |
| <b>Source-Drain Characteristics</b> ( $T_J=25^\circ\text{C}$ ) |                                    |  |     |      |           |           |
| $V_{SD}$   | Diode Forward Voltage <sub>z</sub> | $V_{GS}=0V,$<br>$I_S=16.7A, T_J=25^\circ\text{C}$                  | --- | ---  | 1.3       | V         |
| $t_{rr}$   | Reverse Recovery Time              | $V_R=400V, I_S=16.7A,$<br>$di/dt=100A/\mu s, T_J=25^\circ\text{C}$ | --- | 195  | ---       | nS        |
| $Q_{rr}$   | Reverse Recovery Charge            |  | --- | 3.1  | ---       | nC        |

Note ④ : Pulse test (pulse width $\leq$ 300us, duty cycle $\leq$ 2%).

Note ⑤ : Guaranteed by design, not subject to production testing.

**650V Super Junction Power MOSFET**
**Handbook 7 \ UFUWYf]gh]Vg**

**Figure 1. On Region Characteristics**

**Figure 2. Transfer Characteristics**

**Figure 3. On Resistance Variation vs Drain Current and Gate Voltage**

**Figure 4. Body Diode Forward Voltage Variation with Source Current and Temperature**

**Figure 5. Capacitance Characteristics**

**Figure 6. Gate Charge Characteristics**

**650V Super Junction Power MOSFET**

**Figure 7. Breakdown Voltage Variation vs. Temperature**

**Figure 8. On-Resistance Variation vs. Temperature**

**Figure 9. Maximum Safe Operating Area**

**Figure 10. Maximum Drain Current vs. Case Temperature**

**Figure 11. Transient Thermal Response Curve**

**650V Super Junction Power MOSFET**
**TO-220 Package Outline Data**


| Symbol | Dimensions In Millimeters |        |
|--------|---------------------------|--------|
|        | Min.                      | Max.   |
| A      | 4.350                     | 4.650  |
| A1     | 2.250                     | 2.550  |
| b      | 0.710                     | 0.910  |
| b1     | 1.170                     | 1.400  |
| c      | 0.330                     | 0.650  |
| c1     | 1.200                     | 1.400  |
| D      | 9.910                     | 10.250 |
| E      | 8.9500                    | 9.750  |
| E1     | 12.650                    | 12.950 |
| e      | 2.540 TYP.                |        |
| e1     | 4.980                     | 5.180  |
| F      | 2.650                     | 2.950  |
| H      | 7.900                     | 8.100  |
| h      | 0.000                     | 0.300  |
| L      | 12.700                    | 13.500 |
| L1     | 2.850                     | 3.250  |
| V      | 7.500 REF.                |        |
| Φ      | 3.400                     | 3.800  |