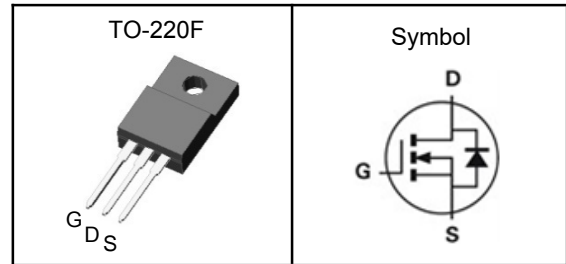


**650V Super Junction Power MOSFET**
**Features**

- Low drain-source on-resistance:  $R_{DS(on)}=0.09\Omega$ (typ)
- Very Low FOM ( $R_{DS(on)} \times Q_g$ )
- Extremely low switching loss
- 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 $\Omega$
$I_D$	38	A

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

Symbol	Parameter	Rating	Unit
$V_{DSS}$	Drain-Source Voltage	650	V
$V_{GSS}$	Gate-Source Voltage	$\pm 30$	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>	187	mJ
$I_{DM}^{①}$	300 $\mu\text{s}$ Pulse Drain Current Tested	110	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)	62	$^\circ\text{C}/\text{W}$
$R_{\theta JC}$	Thermal Resistance Junction-Case <sup>1</sup>	3.6	$^\circ\text{C}/\text{W}$

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

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

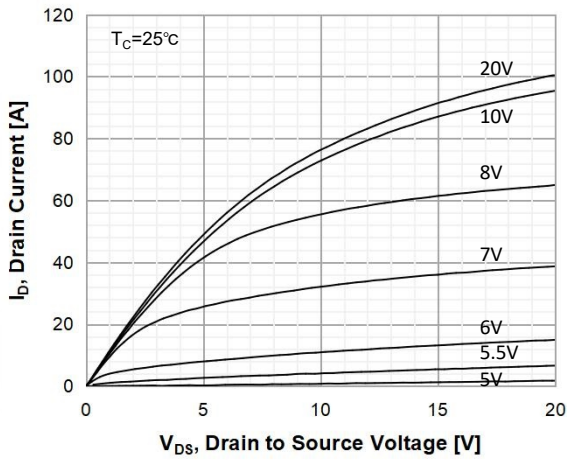
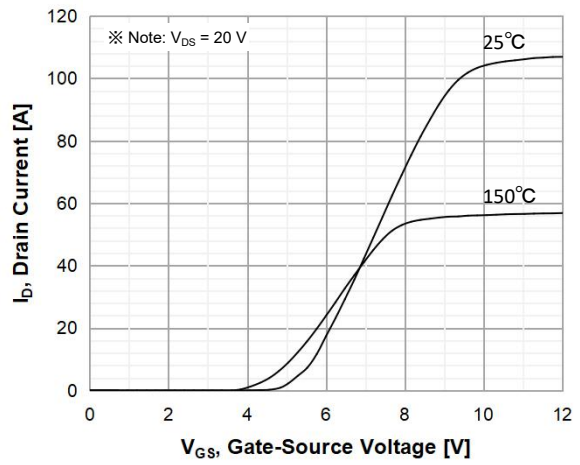
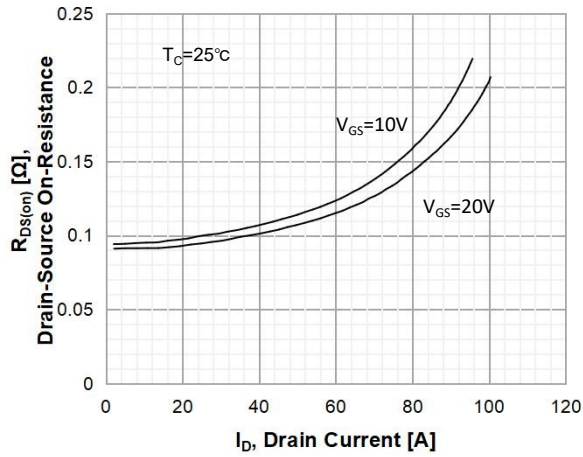
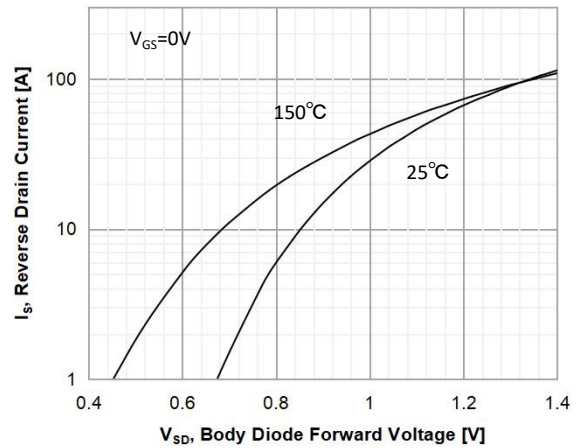
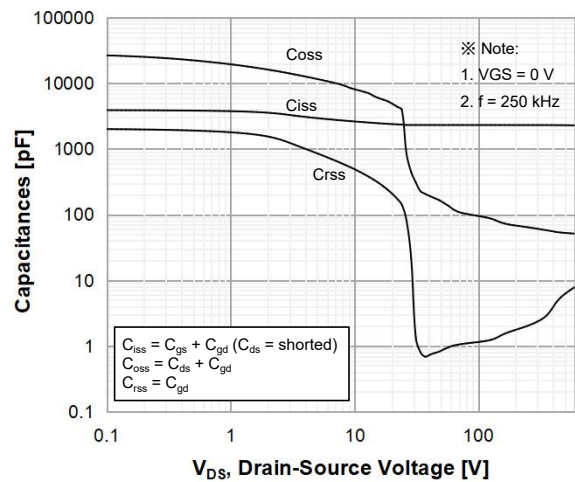
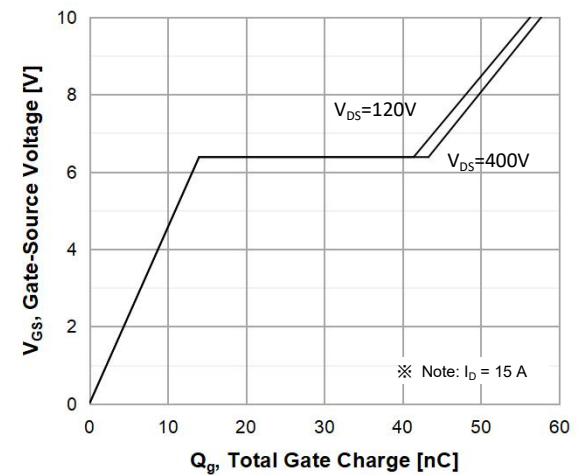
Note ③ : Surface Mounted on 1in<sup>2</sup> FR-4 board with 1oz.

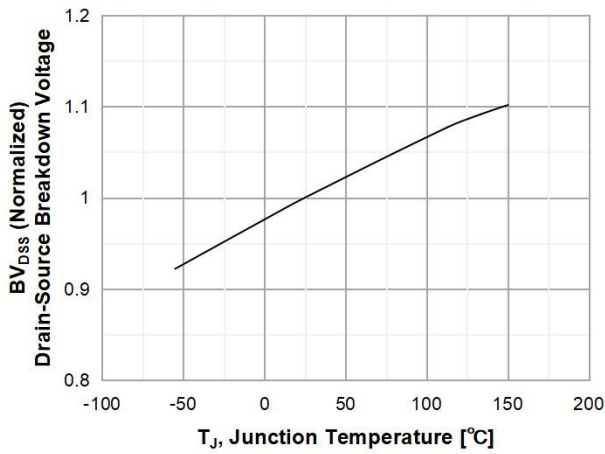
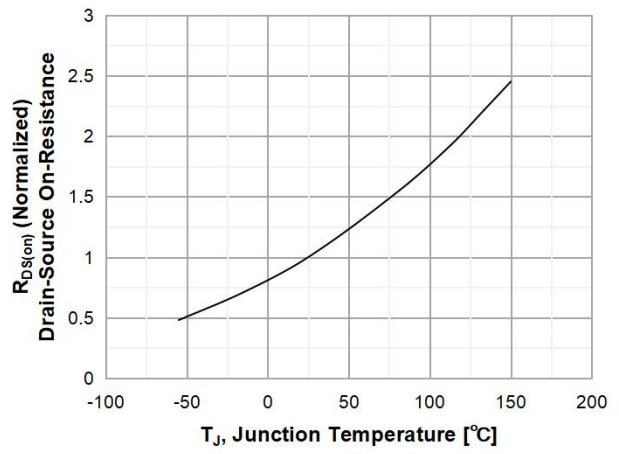
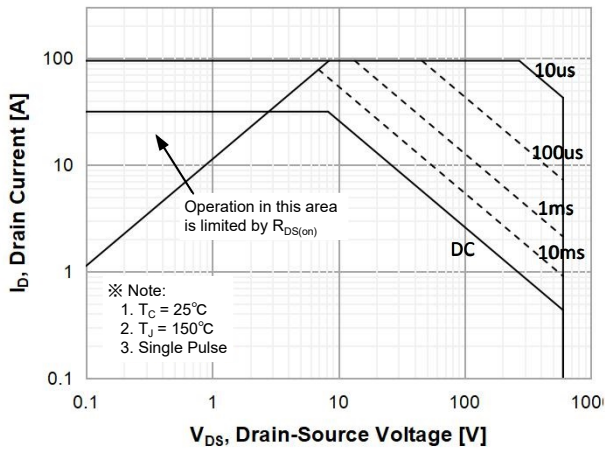
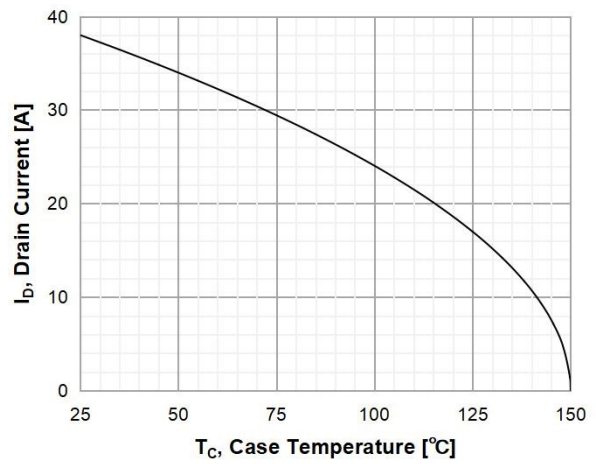
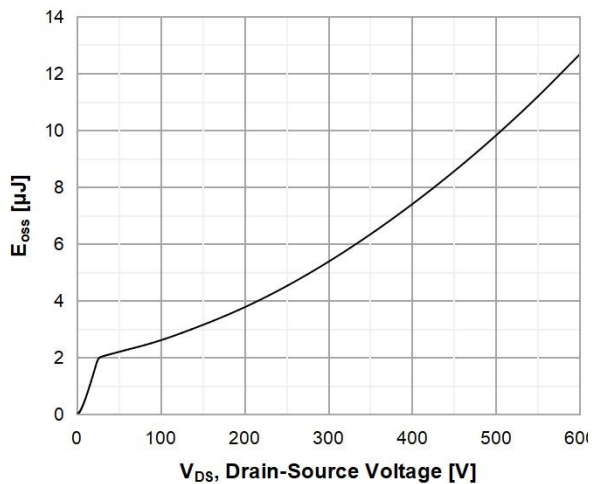
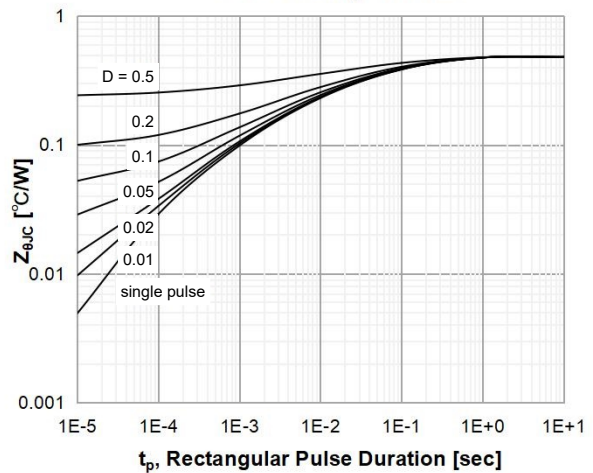
**650V Super Junction Power MOSFET****Electrical Characteristics** ( $T_J=25^\circ\text{C}$ , Unless Otherwise Noted)

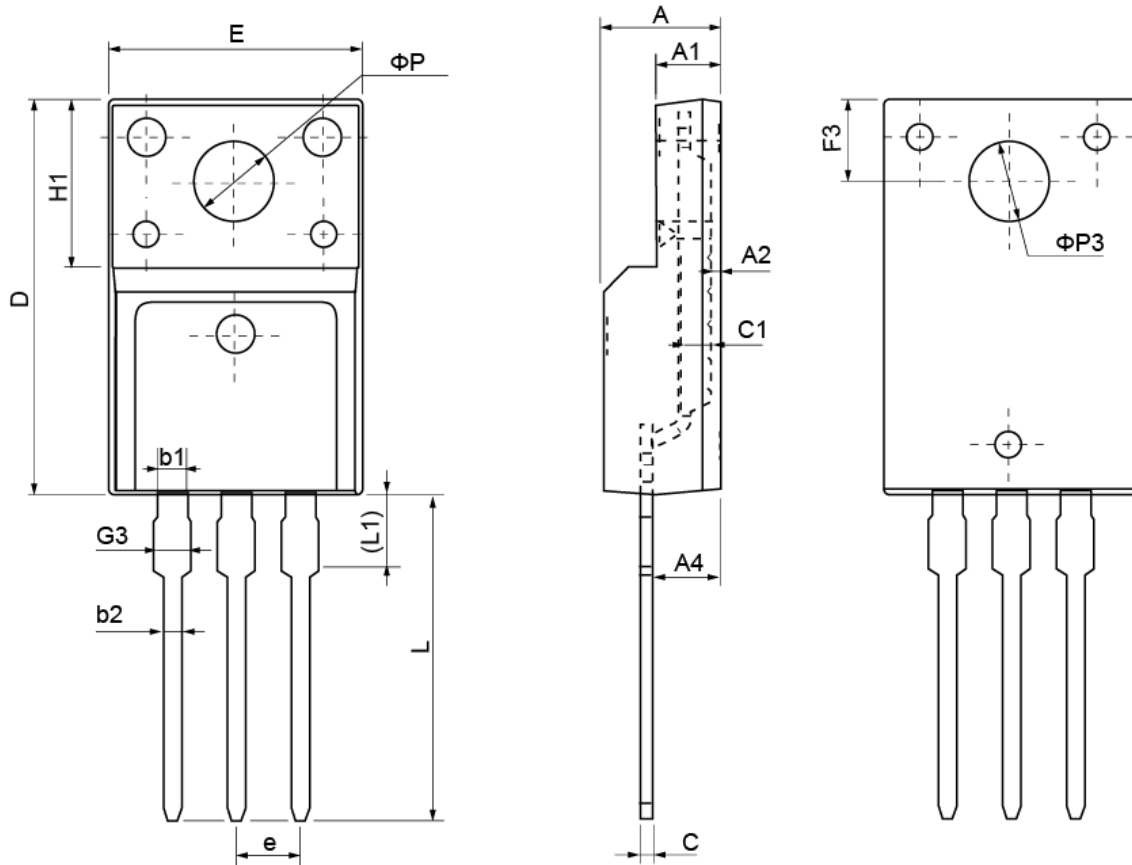
Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
<b>Static Electrical Characteristics</b>						
$BV_{DSS}$	Drain-Source Breakdown Voltage	$V_{GS}=0V, I_D=1mA$	650	---	---	V
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS}=600V, V_{GS}=0V$	---	---	10	$\mu A$
$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS}=V_{GS}, I_D=250\mu A$	3.0	---	5.0	V
$I_{GSS}$	Gate Leakage Current	$V_{GS}=\pm 30V, V_{DS}=0V$	---	---	$\pm 100$	nA
$R_{DS(ON)}$	Drain-Source On-state Resistance	$V_{GS}=10V, I_D=15A$	---	90	105	$m\Omega$
<b>Dynamic Characteristics</b> <sup>⑤</sup>						
$C_{iss}$	Input Capacitance	$V_{GS}=0V,$ $V_{DS}=400V,$ $Freq.=1MHz$	---	2305	---	pF
$C_{oss}$	Output Capacitance		---	55	---	
$C_{rss}$	Reverse Transfer Capacitance		---	9	---	
$T_{d(on)}$	Turn-on Delay Time	$V_{DD}=400V,$ $R_G=10\Omega,$ $I_D=15A$	---	23	---	nS
$T_r$	Turn-on Rise Time		---	12	---	
$T_{d(off)}$	Turn-off Delay Time		---	80	---	
$T_f$	Turn-off Fall Time		---	9	---	
$Q_g$	Total Gate Charge	$V_{DS}=400V,$ $V_{GS}=10V,$ $I_D=15A$	---	57.7	---	nC
$Q_{gs}$	Gate-Source Charge		---	14	---	
$Q_{gd}$	Gate-Drain Charge		---	29.3	---	
<b>Source-Drain Characteristics</b> ( $T_J=25^\circ\text{C}$ )						
$V_{SD}$ <sup>④</sup>	Diode Forward Voltage	$I_F=15A, V_{GS}=0V$	---	---	1.2	V
$t_{rr}$	Reverse Recovery Time	$V_R=400V, I_F=15A,$	---	140	---	nS
$Q_{rr}$	Reverse Recovery Charge	$di/dt=100A/\mu s, T_J=25^\circ\text{C}$	---	0.91	---	nC

Note ④ : Pulse test (pulse width $\leq 300\mu s$ , duty cycles $\leq 2\%$ ).

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

**650V Super Junction Power MOSFET**
**Handbook 7 \ UFWYf]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. E<sub>oss</sub> vs. Drain to Source Voltage**

**Figure 12. Transient Thermal Response Curve**

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


Symbol	Dimensions (unit:mm)			Symbol	Dimensions (unit:mm)		
	Min	Typ	Max		Min	Typ	Max
<b>A</b>	4.40	4.70	5.00	<b>H1</b>	6.70 REF		
<b>A1</b>	2.30	2.55	2.80	<b>L</b>	12.30	12.98	13.30
<b>A2</b>	0.30	0.50	0.70	<b>L1</b>	2.95	3.10	3.50
<b>A4</b>	2.45	2.80	3.05	<b>φ P</b>	3.03	3.20	3.50
<b>c</b>	0.30	0.50	0.70	<b>φ P3</b>	3.15	3.45	3.65
<b>c1</b>	1.20	1.30	1.40	<b>b1</b>	1.10	1.30	1.45
<b>D</b>	15.40	15.90	16.40	<b>b2</b>	0.60	0.80	1.00
<b>E</b>	9.86	10.16	10.46	<b>F3</b>	3.05	3.30	3.55
<b>e</b>	2.54 BSC			<b>G3</b>	1.15	1.35	1.55