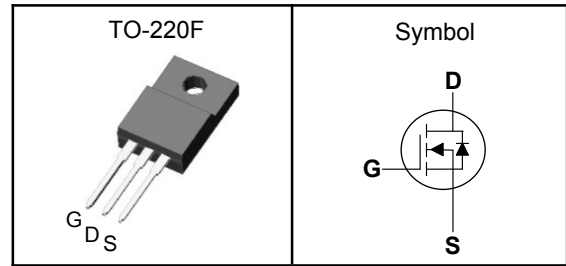


**650V Super Junction Power MOSFET**
**Features**

- Low drain-source on-resistance:  $R_{DS(ON)}=0.15\Omega(\text{typ})$
- Easy to control gate switching
- Enhancement mode:  $V_{th} = 2.5$  to  $4.5V$
- 100% avalanche tested
- RoHS compliant

**Applications**

- Switch Mode Power Supply (SMPS)
- Uninterruptible Power Supply (UPS)
- Power Factor Correction (PFC)
- Charger, Lighting

**Pin Description**


$V_{DSS}$	650	V
$R_{DS(ON)-Typ}$	150	m $\Omega$
$I_D$	20	A

**Absolute Maximum Ratings** ( $T_C=25^\circ C$ , 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	$^\circ C$
$T_{STG}$	Storage Temperature Range	-55 to 150	$^\circ C$
$E_{AS}$	Single Pulse Avalanche Energy <sup>3</sup>	655	mJ
$I_{DM}^{①}$	300 $\mu s$ Pulse Drain Current Tested	55	A
$I_D$	Continuous Drain Current	20	A
$P_D$	Maximum Power Dissipation	36	W
$I_{AS}$	Avalanche Current	3.9	A
dv/dt	MOSFET dv/dt ruggedness, $V_{DS} = 0 \dots 400V$	50	V/ns
	Reverse diode dv/dt <sup>3</sup> $V_{DS}=0 \dots 400V, I_{SD} \leq I_D$	100	

**Thermal Characteristics**

Symbol	Parameter	Rating	Unit
$R_{\theta JA}^{③}$	Thermal Resistance Junction-Ambient <sup>1</sup>	62.5	$^\circ C/W$
$R_{\theta JC}$	Thermal Resistance Junction-Case <sup>1</sup>	3.5	$^\circ C/W$

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

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

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



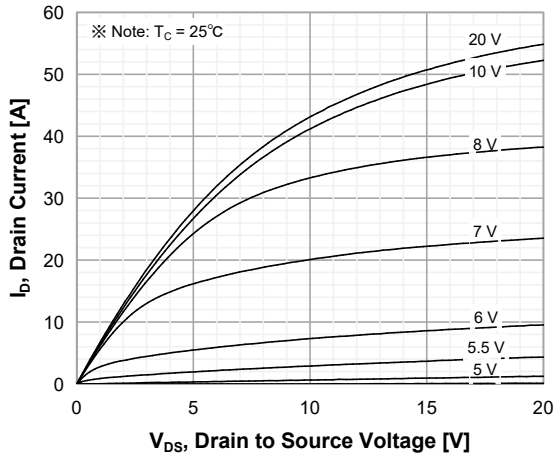
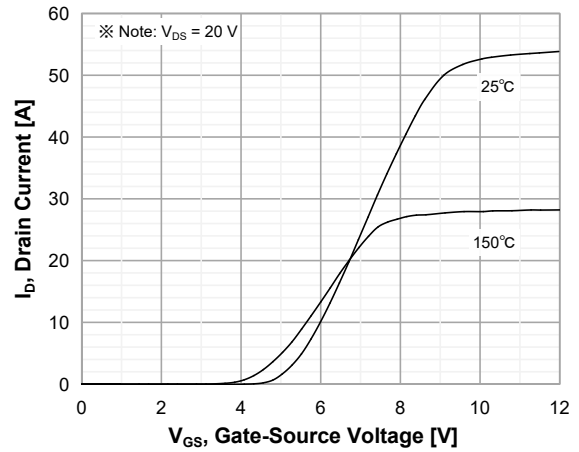
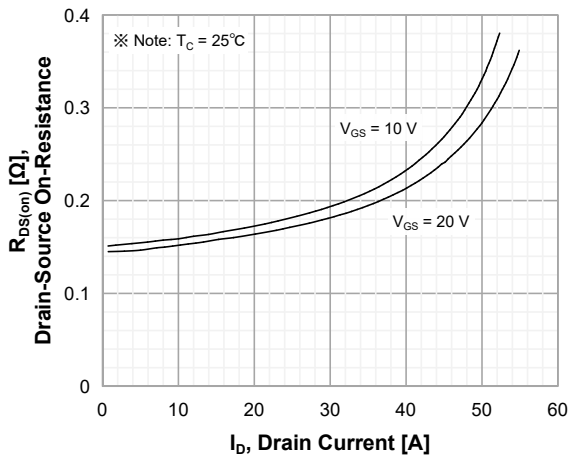
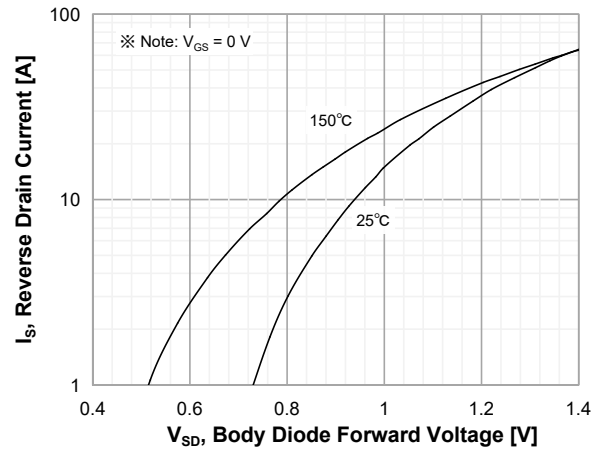
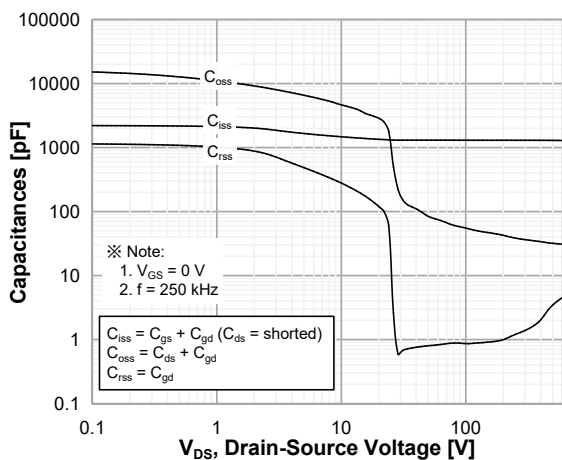
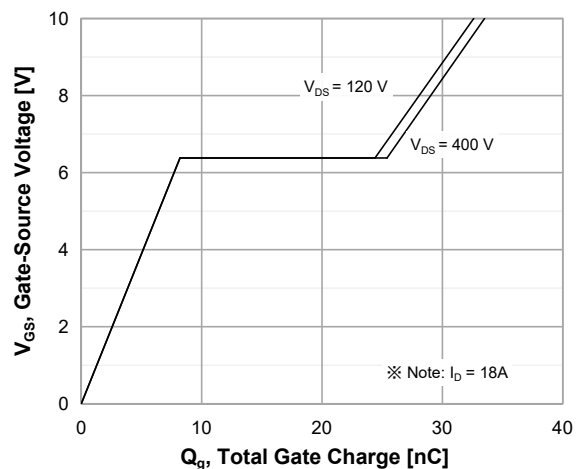
**650V Super Junction Power MOSFET**

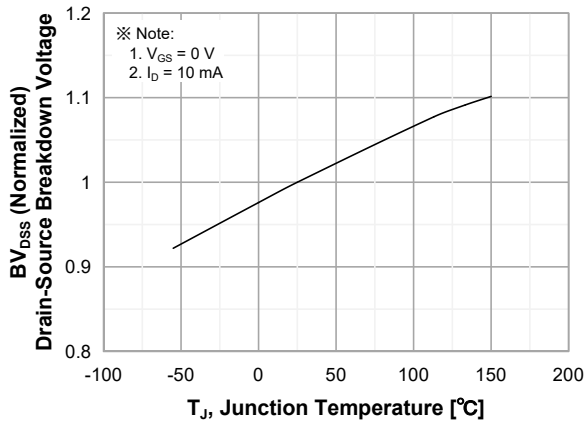
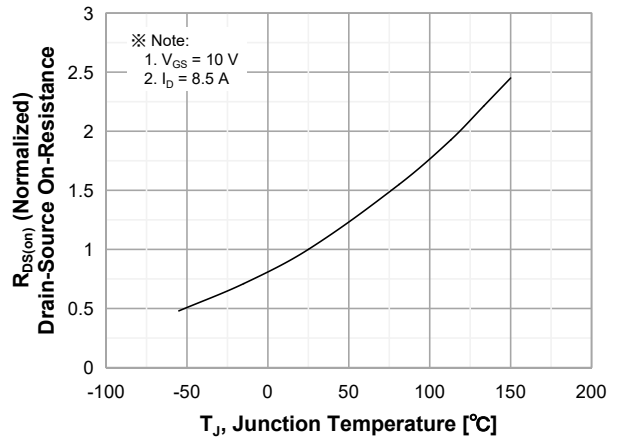
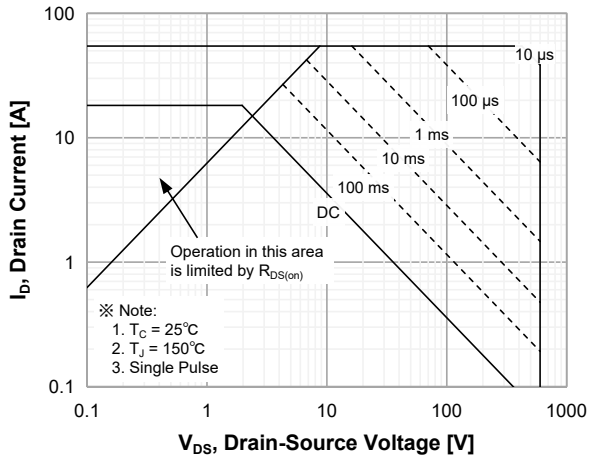
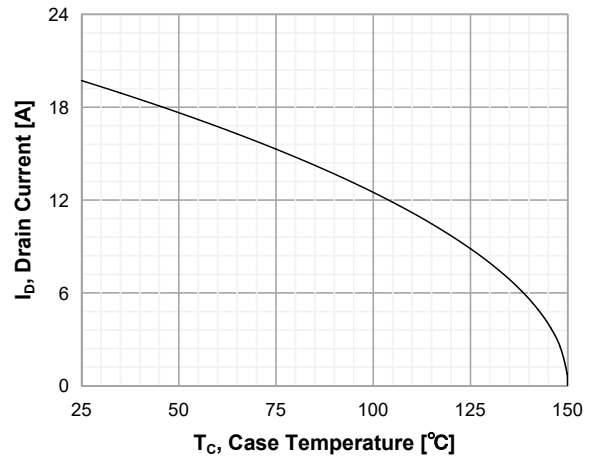
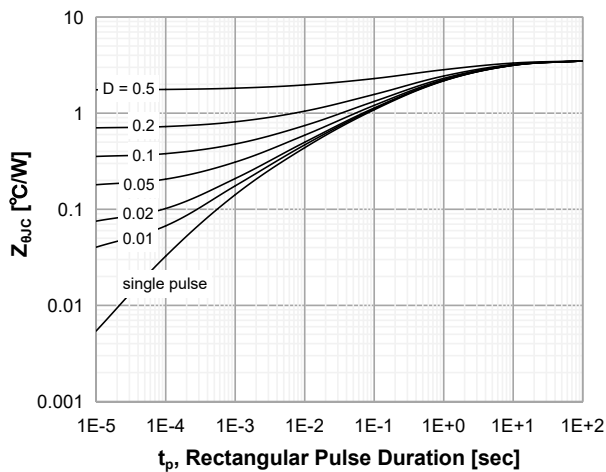
**Electrical Characteristics** ( $T_J=25^{\circ}\text{C}$ , Unless Otherwise Noted)

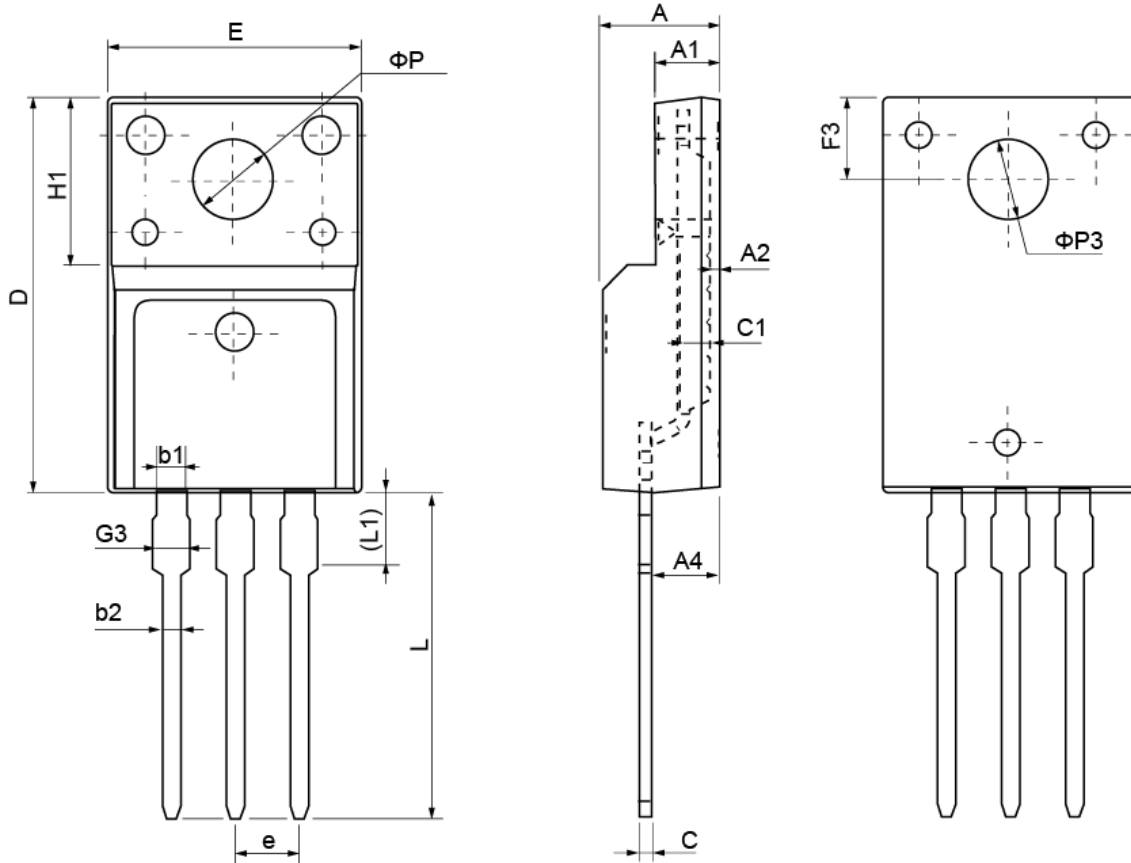
Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
<b>Static Electrical Characteristics</b>						
$BV_{DSS}$	Drain-Source Breakdown Voltage	$V_{GS}=0V, I_D=250\mu A$	650	---	---	V
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS}=600V, V_{GS}=0V$	---	---	1	$\mu A$
$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS}=V_{GS}, I_D=250\mu A$	2.5	---	4.5	V
$I_{GSS}$	Gate Leakage Current	$V_{GS}=\pm 30V, V_{DS}=0V$	---	---	$\pm 100$	nA
$R_{DS(ON)}$	Drain-Source On-state Resistance	$V_{GS}=10V, I_D=8.5A$	---	150	180	m $\Omega$
<b>Dynamic Characteristics</b> <sup>⑤</sup>						
$C_{iss}$	Input Capacitance	$V_{GS}=0V,$ $V_{DS}=400V,$ Freq.=1MHz	---	1290	---	pF
$C_{oss}$	Output Capacitance		---	34	---	
$C_{rss}$	Reverse Transfer Capacitance		---	6	---	
$T_{d(on)}$	Turn-on Delay Time	$V_{DD}=400V, V_{GS}=10V,$ $R_G=10\Omega, I_D=8.5A$	---	15	---	nS
$T_r$	Turn-on Rise Time		---	9	---	
$T_{d(off)}$	Turn-off Delay Time		---	50	---	
$T_f$	Turn-off Fall Time		---	7	---	
$R_g$	Gate Resistance	$f = 1.0\text{MHz}, \text{open drain}$	---	1.3	---	$\Omega$
$Q_g$	Total Gate Charge	$V_{DS}=400V, V_{GS}=10V,$ $I_D=8.5A$	---	33	---	nC
$Q_{gs}$	Gate-Source Charge		---	8.2	---	
$Q_{gd}$	Gate-Drain Charge		---	17.2	---	
<b>Source-Drain Characteristics</b> ( $T_J=25^{\circ}\text{C}$ )						
$V_{SD}$ <sup>④</sup>	Diode Forward Voltage	$I_S=8.5A, V_{GS}=0V$	---	0.9	1.2	V
$t_{rr}$	Reverse Recovery Time	$V_R=400V, I_F=8.5A,$ $di/dt=100A/\mu s, T_J=25^{\circ}\text{C}$	---	119	---	nS
$Q_{rr}$	Reverse Recovery Charge		---	0.7	---	nC

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

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

**650V Super Junction Power MOSFET**
**Typical Characteristics**

**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-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><math>\phi P</math></b>	3.03	3.20	3.50
<b>c</b>	0.30	0.50	0.70	<b><math>\phi P3</math></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