

# SLF65R380E7

## 650V N-Channel Multi-EPI Super-JMOSFET

### General Description

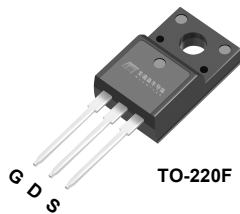
This Power MOSFET is produced using Msemitek's Advanced Super-Junction technology.

This advanced technology has been especially tailored to minimize conduction loss, provide superior switching performance, and withstand high energy pulse in the avalanche and commutation mode.

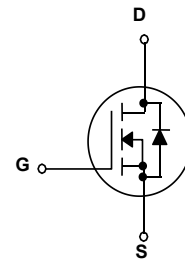
These devices are well suited for AC/DC power conversion in switching mode operation for higher efficiency.

### Features

- 11A, 650V,  $R_{DS(on)max} = 380m\Omega @ V_{GS} = 10V$
- Low gate charge ( typical 15.5nC)
- High ruggedness
- Fast switching
- 100% avalanche tested
- Improved dv/dt capability



TO-220F



### Absolute Maximum Ratings

$T_C = 25^\circ\text{C}$  unless otherwise noted

Symbol	Parameter	SLF65R380E7	Units
$V_{DSS}$	Drain-Source Voltage	650	V
$I_D$	Drain Current - Continuous ( $T_C = 25^\circ\text{C}$ ) - Continuous ( $T_C = 100^\circ\text{C}$ )	11	A
		7	A
$I_{DM}$	Drain Current - Pulsed (Note 1)	33	A
$V_{GSS}$	Gate-Source Voltage	$\pm 30$	V
EAS	Single Pulsed Avalanche Energy (Note 2)	483	mJ
$I_{AR}$	Avalanche Current (Note 1)	11	A
$E_{AR}$	Repetitive Avalanche Energy	6.25	mJ
dv/dt	Peak Diode Recovery dv/dt (Note 3)	20	V/ns
	MOSFET dv/dt	100	
$P_D$	Power Dissipation ( $T_C = 25^\circ\text{C}$ ) - Derate above $25^\circ\text{C}$	28	W
		0.22	W/ $^\circ\text{C}$
$T_J, T_{STG}$	Operating and Storage Temperature Range	-55 to +150	$^\circ\text{C}$
$T_L$	Maximum lead temperature for soldering purposes, 1/8" from case for 5 seconds	300	$^\circ\text{C}$

\* Drain current limited by maximum junction temperature.

### Thermal Characteristics

Symbol	Parameter	SLF65R380E7	Units
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case	4.5	$^\circ\text{C}/\text{W}$
$R_{\theta JS}$	Thermal Resistance, Case-to-Sink Typ.	--	$^\circ\text{C}/\text{W}$
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient	62.5	$^\circ\text{C}/\text{W}$

## Package Marking

Part Number	Top Marking	Package	Packing Method	MOQ	QTY
SLF65R380E7	SLF65R380E7	TO-220F	Tube	1000	5000

## Electrical Characteristics

$T_C = 25^\circ\text{C}$  unless otherwise noted

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
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### Off Characteristics

BV <sub>DSS</sub>	Drain-Source Breakdown Voltage	$V_{GS} = 0\text{ V}, I_D = 1\text{ mA}$	650	--	--	V
		$V_{GS} = 0\text{ V}, I_D = 1\text{ mA}, T_J = 150^\circ\text{C}$	650	--	--	
I <sub>DSS</sub>	Zero Gate Voltage Drain Current	$V_{DS} = 600\text{ V}, V_{GS} = 0\text{ V}$	--	--	1	uA
		$V_{DS} = 480\text{ V}, T_C = 125^\circ\text{C}$	--	2	--	uA
I <sub>GSSF</sub>	Gate-Body Leakage Current, Forward	$V_{GS} = 30\text{ V}, V_{DS} = 0\text{ V}$	--	--	100	nA
I <sub>GSSR</sub>	Gate-Body Leakage Current, Reverse	$V_{GS} = -30\text{ V}, V_{DS} = 0\text{ V}$	--	--	-100	nA

### On Characteristics

V <sub>GS(th)</sub>	Gate Threshold Voltage	$V_{DS} = V_{GS}, I_D = 0.8\text{ mA}$	2.5	--	4.5	V
R <sub>DS(on)</sub>	Static Drain-Source On-Resistance	$V_{GS} = 10\text{ V}, I_D = 4.0\text{ A}$	--	318	380	mΩ
R <sub>G</sub>	Gate resistance	F=1MHZ	--	1.0	--	Ω

### Dynamic Characteristics

C <sub>iss</sub>	Input Capacitance	$V_{DS} = 400\text{ V}, V_{GS} = 0\text{ V},$ $f = 250\text{ KHz}$	--	628	--	pF
C <sub>oss</sub>	Output Capacitance		--	20	--	pF
C <sub>o(tr)</sub>	Time Related Output Capacitance	$V_{DS} = 0\text{ V to } 400\text{ V}, V_{GS} = 0\text{ V}$	--	239	--	pF
C <sub>o(er)</sub>	Energy Related Output Capacitance		--	30	--	pF

### Switching Characteristics

t <sub>d(on)</sub>	Turn-On Delay Time	$V_{DD} = 400\text{ V}, I_D = 4.0\text{ A},$ $R_G = 10\ \Omega$  (Note 4, 5)	--	8	--	ns
t <sub>r</sub>	Turn-On Rise Time		--	7	--	ns
t <sub>d(off)</sub>	Turn-Off Delay Time		--	30	--	ns
t <sub>f</sub>	Turn-Off Fall Time		--	8	--	ns
Q <sub>g</sub>	Total Gate Charge	$V_{DS} = 400\text{ V}, I_D = 4.0\text{ A},$ $V_{GS} = 10\text{ V}$  (Note 4, 5)	--	15.5	--	nC
Q <sub>gs</sub>	Gate-Source Charge		--	3.0	--	nC
Q <sub>gd</sub>	Gate-Drain Charge		--	7.9	--	nC

### Drain-Source Diode Characteristics and Maximum Ratings

I <sub>S</sub>	Maximum Continuous Drain-Source Diode Forward Current	--	--	11	A	
I <sub>SM</sub>	Maximum Pulsed Drain-Source Diode Forward Current	--	--	33	A	
V <sub>SD</sub>	Drain-Source Diode Forward Voltage	$V_{GS} = 0\text{ V}, I_S = 4.0\text{ A}$	--	--	1.2	V
t <sub>rr</sub>	Reverse Recovery Time	$V_{DD} = 400\text{ V}, I_S = 4.0\text{ A},$ $dI_F / dt = 100\text{ A/us}$ (Note 4)	--	221	--	ns
Q <sub>rr</sub>	Reverse Recovery Charge		--	1.8	--	uC

#### Notes:

1. Repetitive Rating : Pulse width limited by maximum junction temperature
2. L = 79 mH, I<sub>AS</sub> = 2.5A, V<sub>DD</sub> = 100V, R<sub>G</sub> = 25Ω, Starting T<sub>J</sub> = 25°C
3. I<sub>SD</sub> ≤ 4A, di/dt ≤ 100A/us, V<sub>DD</sub> ≤ BV<sub>DSS</sub>, Starting T<sub>J</sub> = 25°C
4. Pulse Test : Pulse width ≤ 300us, Duty cycle ≤ 2%
5. Essentially independent of operating temperature

### Typical Characteristics

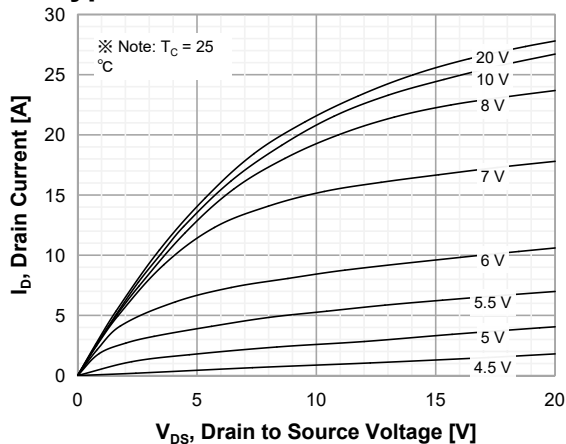


Figure 1. On-Region Characteristics

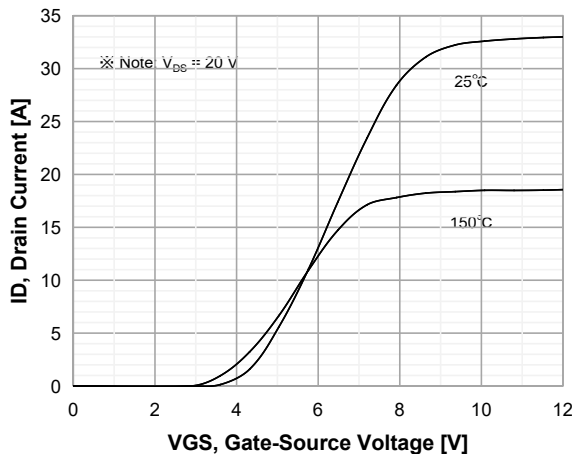


Figure 2. Transfer Characteristics

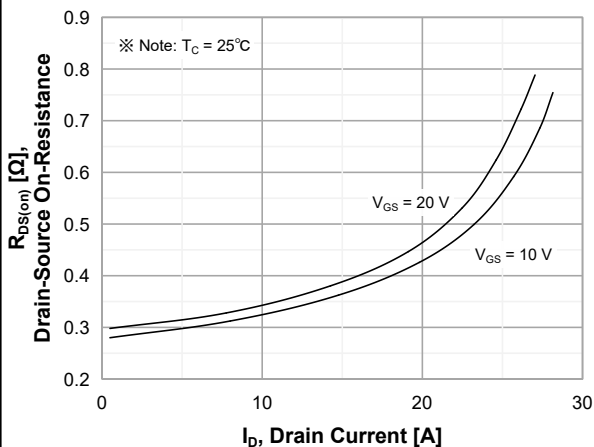


Figure 3. On-Resistance Variation vs Drain Current and Gate Voltage

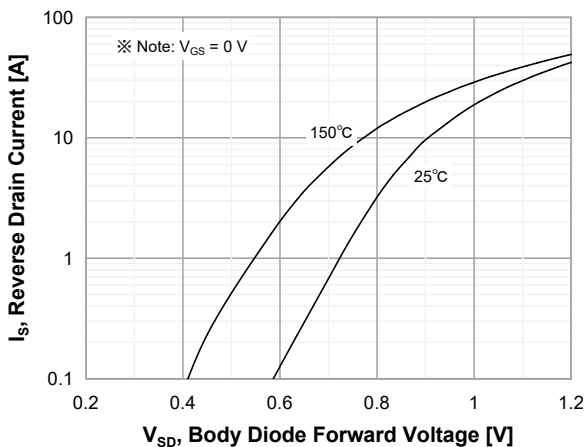


Figure 4. Body Diode Forward Voltage Variation with Source Current and Temperature

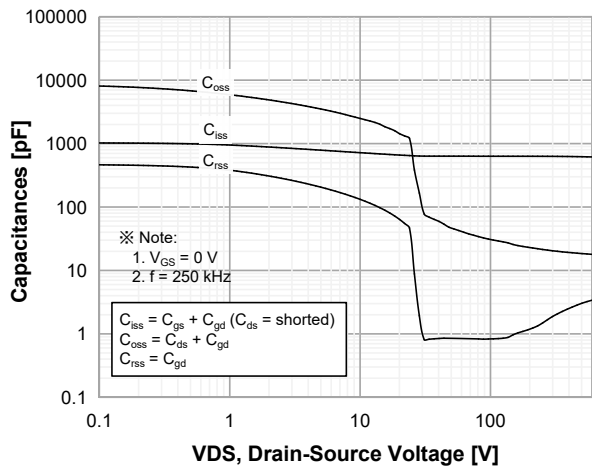


Figure 5. Capacitance Characteristics

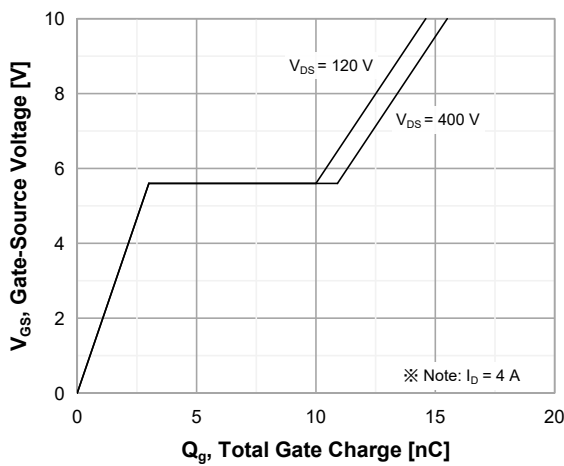


Figure 6. Gate Charge Characteristics

Typical Characteristics (Continued)

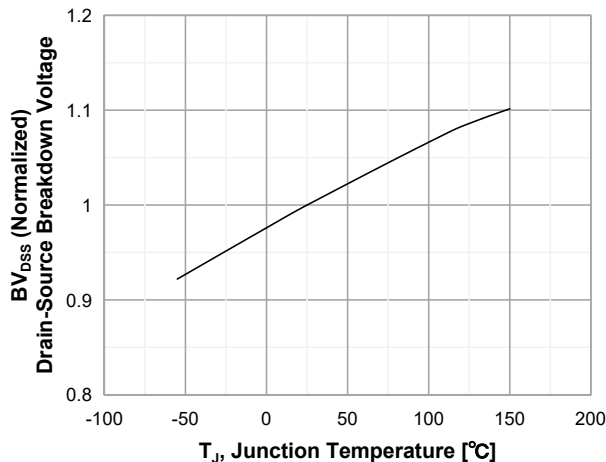


Figure 7. Breakdown Voltage Variation vs Temperature

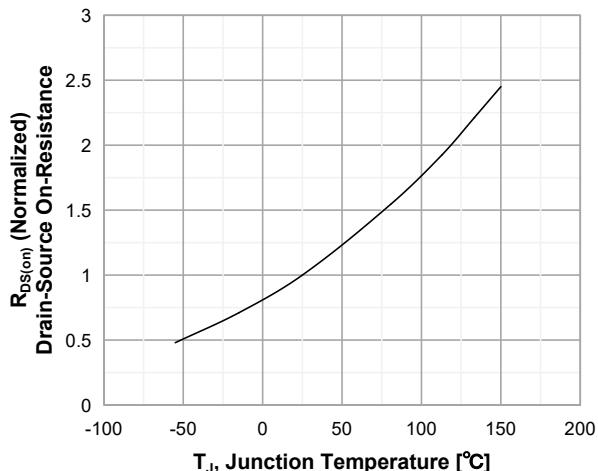


Figure 8. On-Resistance Variation vs Temperature

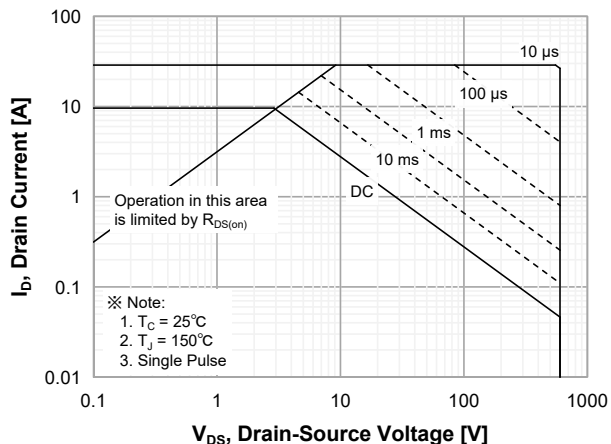


Figure 9. Maximum Safe Operating Area

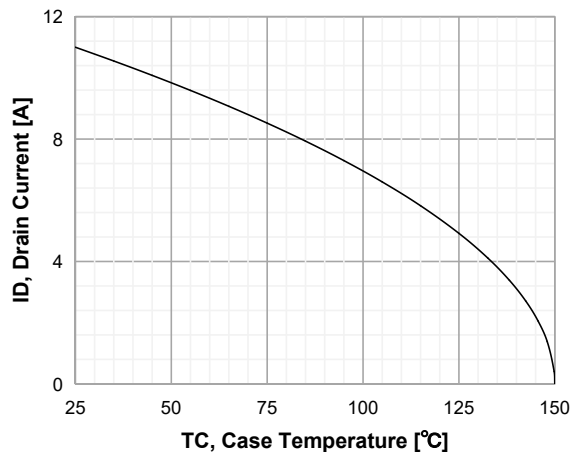


Figure 10. Maximum Drain Current vs Case Temperature

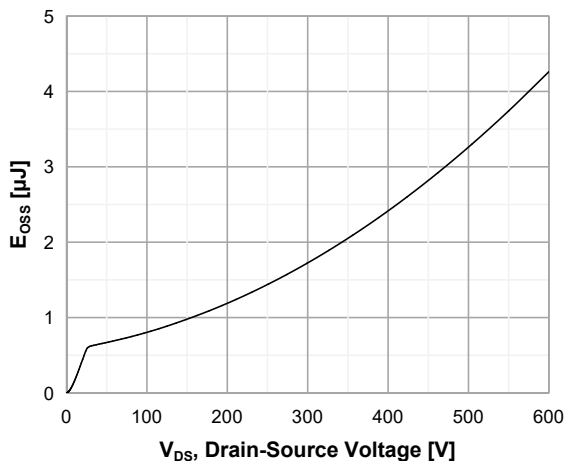


Figure 11.  $E_{OSS}$  vs. Drain to Source Voltage

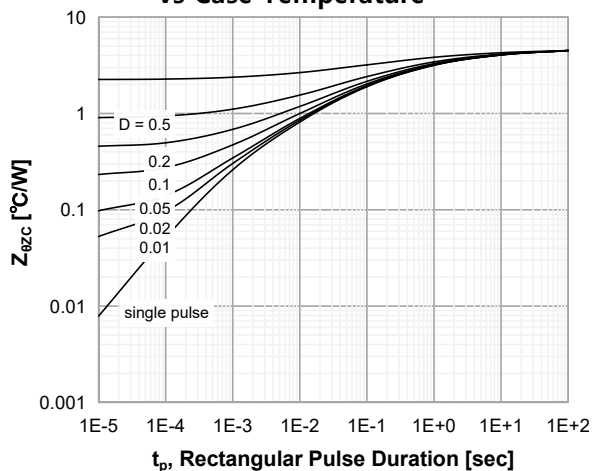
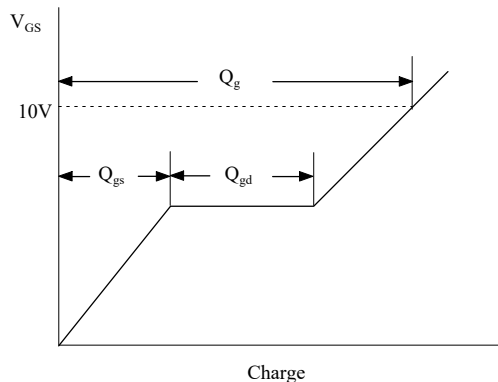
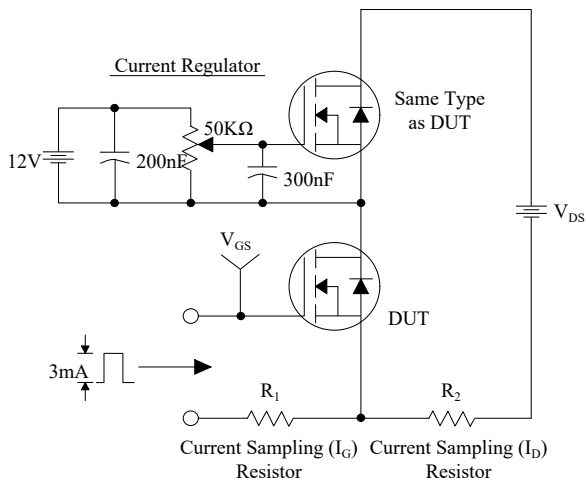
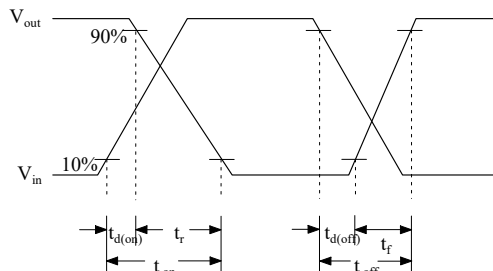
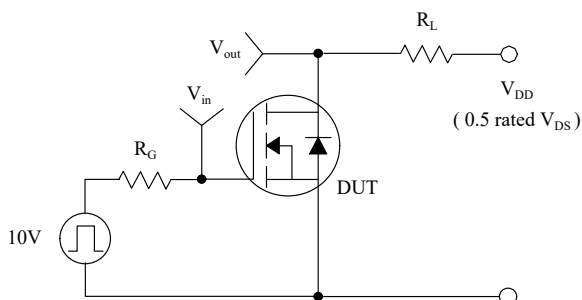


Figure 12. Transient Thermal Response Curve

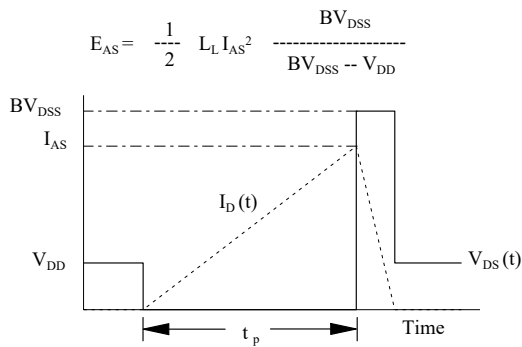
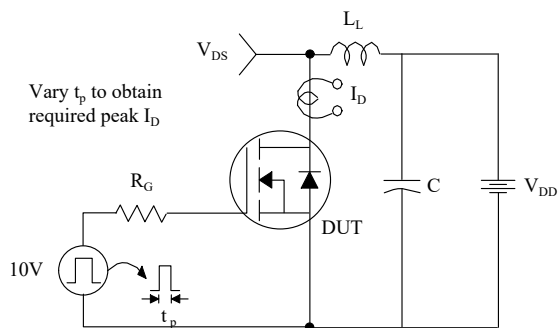
### Gate Charge Test Circuit & Waveform



### Resistive Switching Test Circuit & Waveforms



### Unclamped Inductive Switching Test Circuit & Waveforms



# Peak Diode Recovery dv/dt Test Circuit & Waveforms



## Electrical Characteristics

$T_C = 25^\circ\text{C}$  unless otherwise noted

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
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### Off Characteristics

$BV_{DSS}$	Drain-Source Breakdown Voltage	$V_{GS} = 0\text{ V}, I_D = 250\text{ }\mu\text{A}$	500	--	--	V
$\Delta BV_{DSS} / \Delta T_J$	Breakdown Voltage Temperature Coefficient	$I_D = 250\text{ }\mu\text{A}$ , Referenced to $25^\circ\text{C}$	--	0.59	--	$V/^\circ\text{C}$
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS} = 500\text{ V}, V_{GS} = 0\text{ V}$	--	--	1	$\mu\text{A}$
		$V_{DS} = 400\text{ V}, T_C = 125^\circ\text{C}$	--	--	10	$\mu\text{A}$
$I_{GSSF}$	Gate-Body Leakage Current, Forward	$V_{GS} = 30\text{ V}, V_{DS} = 0\text{ V}$	--	--	100	nA
$I_{GSSR}$	Gate-Body Leakage Current, Reverse	$V_{GS} = -30\text{ V}, V_{DS} = 0\text{ V}$	--	--	-100	nA

### On Characteristics

$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS} = V_{GS}, I_D = 250\text{ }\mu\text{A}$	3.0	--	5.0	V
$R_{DS(on)}$	Static Drain-Source On-Resistance	$V_{GS} = 10\text{ V}, I_D = 9\text{ A}$	--	212	265	m $\Omega$
$g_{FS}$	Forward Transconductance	$V_{DS} = 40\text{ V}, I_D = 9\text{ A}$	--	12	--	S

### Dynamic Characteristics

$C_{iss}$	Input Capacitance	$V_{DS} = 25\text{ V}, V_{GS} = 0\text{ V}, f = 1.0\text{ MHz}$	--	3110	--	pF
$C_{oss}$	Output Capacitance		--	328	--	pF
$C_{riss}$	Reverse Transfer Capacitance		--	32	--	pF

### Switching Characteristics

$t_{d(on)}$	Turn-On Delay Time	$V_{DD} = 250\text{ V}, I_D = 18\text{ A}, R_G = 25\text{ }\Omega$ (Note 4, 5)	--	65	--	ns
$t_r$	Turn-On Rise Time		--	40	--	ns
$t_{d(off)}$	Turn-Off Delay Time		--	245	--	ns
$t_f$	Turn-Off Fall Time		--	68	--	ns
$Q_g$	Total Gate Charge	$V_{DS} = 250\text{ V}, I_D = 18\text{ A}, V_{GS} = 10\text{ V}$ (Note 4, 5)	--	116	--	nC
$Q_{gs}$	Gate-Source Charge		--	16	--	nC
$Q_{gd}$	Gate-Drain Charge		--	38	--	nC

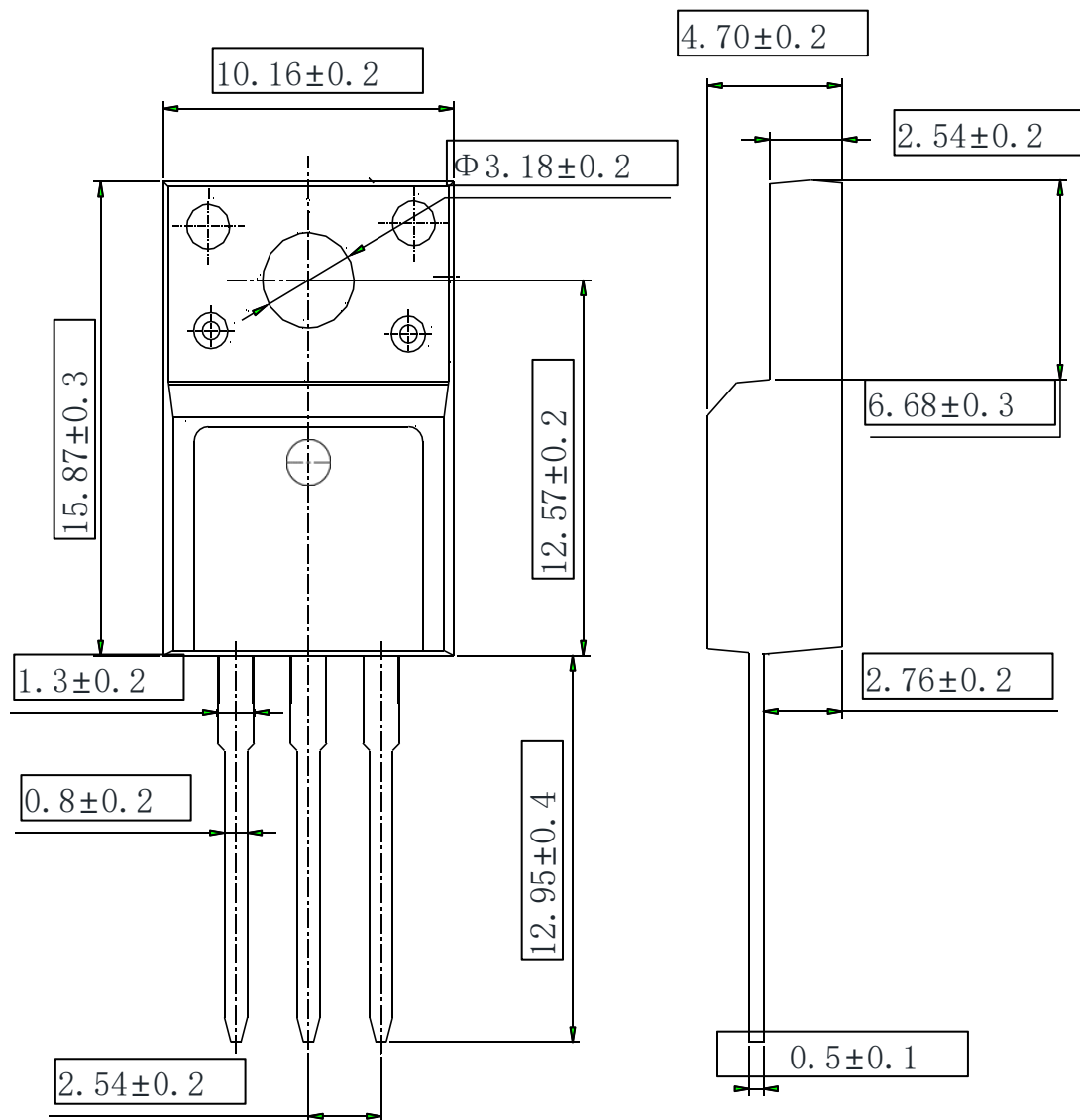
### Drain-Source Diode Characteristics and Maximum Ratings

$I_S$	Maximum Continuous Drain-Source Diode Forward Current	--	--	18	A	
$I_{SM}$	Maximum Pulsed Drain-Source Diode Forward Current	--	--	72	A	
$V_{SD}$	Drain-Source Diode Forward Voltage	$V_{GS} = 0\text{ V}, I_S = 9\text{ A}$	--	--	1.4	V
$t_{rr}$	Reverse Recovery Time	$V_{GS} = 0\text{ V}, I_S = 18\text{ A},$	--	525	--	ns
$Q_{rr}$	Reverse Recovery Charge	$di_F / dt = 100\text{ A}/\mu\text{s}$ (Note 4)	--	6.2	--	$\mu\text{C}$

#### Notes:

1. Repetitive Rating : Pulse width limited by maximum junction temperature
2.  $L = 0.5\text{ mH}, V_G = 10\text{ V}, V_{DD} = 50\text{ V}$ , Starting  $T_J = 25^\circ\text{C}$
3.  $I_{SD} \leq 20\text{ A}, di/dt \leq 200\text{ A}/\mu\text{s}, V_{DD} \leq BV_{DSS}$ , Starting  $T_J = 25^\circ\text{C}$
4. Pulse Test : Pulse width  $\leq 300\mu\text{s}$ , Duty cycle  $\leq 2\%$
5. Essentially independent of operating temperature

## TO-220F OUTLINE



## NOTE:

- 1The plastic package is not marked as smooth surface  $Ra=0.1$ ; Subglossy surface  $Ra=0.8$
2. Undeclared tolerance  $\pm 0.15$ , Unmarked fillet  $R_{max}=0.25$



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