# 650V N-Channel MOSFET

General Description

This Power MOSFET is produced using Slkor's advanced Superjunction MOSFET technology. This advanced technology has been especially tailored to minimize on-state resistance, provide superior switching performance, and withstand high energy pulse in the avalanche and commutation mode. These devices are well suited for high efficiency switched mode power supplies.

Features

- 22A, 650V, $R_{DS(on)}$ =170mΩ@V_{GS} = 10 V
- Low gate charge(typ. Qg = 30.2nC)
- High ruggedness
- Ultra fast switching
- 100% avalanche tested
- Improved dv/dt capability
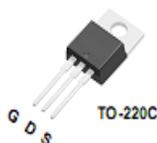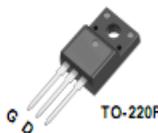
SL22N65C   SL22N65CF
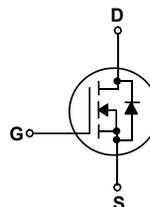
Absolute Maximum Ratings

T_C = 25°C unless otherwise noted

Symbol	Parameter		SL22N65C/SL22N65CF	Units
V_{DSS}	Drain-Source Voltage		650	V
I_D	Drain Current - Continuous (T_C = 25°C)		22 *	A
	- Continuous (T_C = 100°C)		12*	A
I_{DM}	Drain Current - Pulsed	(Note 1)	57 *	A
V_{GSS}	Gate-Source Voltage		±30	V
EAS	Single Pulsed Avalanche Energy	(Note 2)	985	mJ
I_{AR}	Avalanche Current	(Note 1)	4	A
E_{AR}	Repetitive Avalanche Energy	(Note 1)	1.62	mJ
dv/dt	Peak Diode Recovery dv/dt	(Note 3)	20	V/ns
	MOSFET dv/dt		100	
P_D	Power Dissipation (T_C = 25°C)		36	W
	- Derate above 25°C		0.29	W/°C
T_J, T_{STG}	Operating and Storage Temperature Range		-55 to +150	°C
T_L	Maximum lead temperature for soldering purposes, 1/8" from case for 5 seconds		260	°C

* Drain current limited by maximum junction temperature.

Thermal Characteristics

Symbol	Parameter	SL22N65C/SL22N65CF	Units
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case	3.5	°C/W
$R_{\theta JS}$	Thermal Resistance, Case-to-Sink Typ.	-	°C/W
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient	62.5	°C/W

Electrical Characteristics
$T_C = 25°C$ unless otherwise noted

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units

Off Characteristics

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
BV_{DSS}	Drain-Source Breakdown Voltage	$V_{GS} = 0$ V, $I_D = 1$mA	650	--	--	V
BV_{DSS}	Drain-Source Breakdown Voltage	$V_{GS} = 0$ V, $I_D = 1$mA, $T_J = 150°C$	650	--	--	V
I_{DSS}	Zero Gate Voltage Drain Current	$V_{DS} = 600$ V, $V_{GS} = 0$ V	--	--	1	uA
		$V_{DS} = 480$ V, $T_C = 125°C$	--	2	--	uA
I_{GSSF}	Gate-Body Leakage Current, Forward	$V_{GS} = 30$ V, $V_{DS} = 0$ V	--	--	100	nA
I_{GSSR}	Gate-Body Leakage Current, Reverse	$V_{GS} = -30$ V, $V_{DS} = 0$ V	--	--	-100	nA

On Characteristics

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS} = V_{GS}$, $I_D = 1.7$mA	2.5	--	4.5	V
$R_{DS(on)}$	Static Drain-Source On-Resistance	$V_{GS} = 10$ V, $I_D = 10$ A	--	150	170	mΩ

Dynamic Characteristics

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
C_{iss}	Input Capacitance	$V_{DS} = 400$ V, $V_{GS} = 0$ V, f = 250KHz	--	1240	--	pF
C_{oss}	Output Capacitance		--	34	--	pF
C_{rss}	Reverse Transfer Capacitance		--	3.2	--	pF

Switching Characteristics

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
$t_{d(on)}$	Turn-On Delay Time	$V_{DS} = 400$ V, $I_D = 10$ A, $R_G = 10$ Ω, VGS = 10 V (Note 4, 5)	--	12	--	ns
t_r	Turn-On Rise Time		--	8	--	ns
$t_{d(off)}$	Turn-Off Delay Time		--	53	--	ns
t_f	Turn-Off Fall Time		--	10	--	ns
Q_g	Total Gate Charge	$V_{DS} = 400$ V, $I_D = 10$ A, $V_{GS} = 10$ V (Note 4, 5)	--	30.2	--	nC
Q_{gs}	Gate-Source Charge		--	5.8	--	nC
Q_{gd}	Gate-Drain Charge		--	15.4	--	nC
R_G	Gate Resistance	f = 1MHz		1.3		Ω

Drain-Source Diode Characteristics and Maximum Ratings

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
I_S	Maximum Continuous Drain-Source Diode Forward Current		--	--	22	A
I_{SM}	Maximum Pulsed Drain-Source Diode Forward Current		--	--	57	A
V_{SD}	Drain-Source Diode Forward Voltage	$V_{GS} = 0$ V, $I_S = 10$ A	--	--	1.2	V
t_{rr}	Reverse Recovery Time	$V_{DD} = 400$ V, $I_S = 10$A,	--	274	--	ns
Q_{rr}	Reverse Recovery Charge	$dI_F / dt = 100$ A/us (Note 4)	--	3.33	--	uC

Notes:
1. Repetitive Rating : Pulse width limited by maximum junction temperature
2. L=79mH $I_{AS} = I_D$, $V_{DD} = 50$V, $R_G = 25$Ω, Starting $T_J = 25°C$
3. $I_{SD} \leq I_D$ di/dt ≤ 200A/us, $V_{DD} \leq 400$ Starting $T_J = 25°C$
4. Pulse Test : Pulse width ≤ 300us, Duty cycle $\leq 2\%$
5. Essentially independent of operating temperature

Typical Characteristics
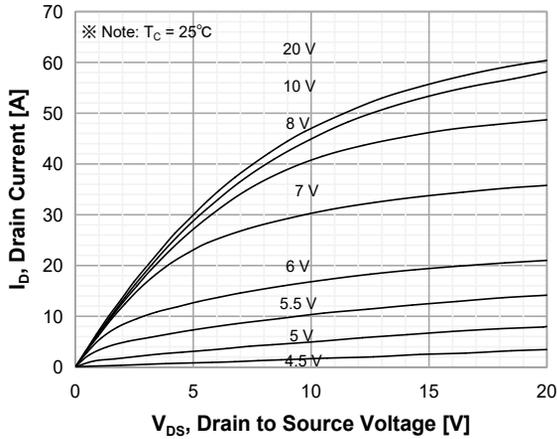
Figure 1. On-Region Characteristics
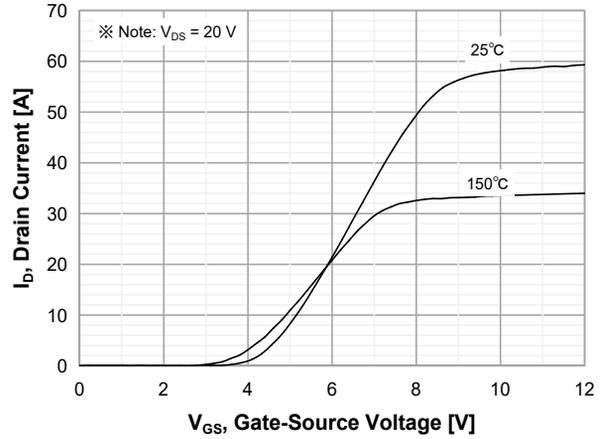


Figure 2. Transfer Characteristics
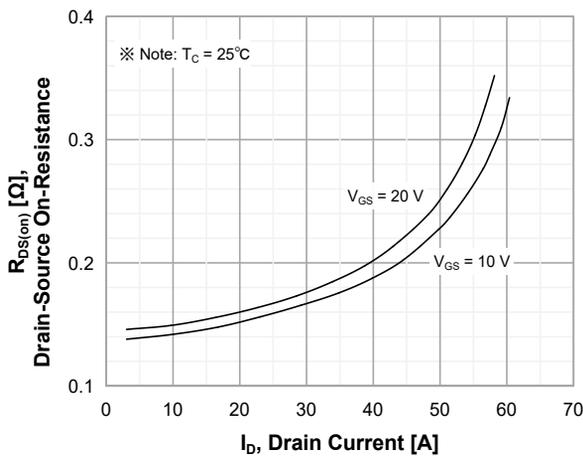
Figure 3. On-Resistance Variation vs Drain Current and Gate Voltage
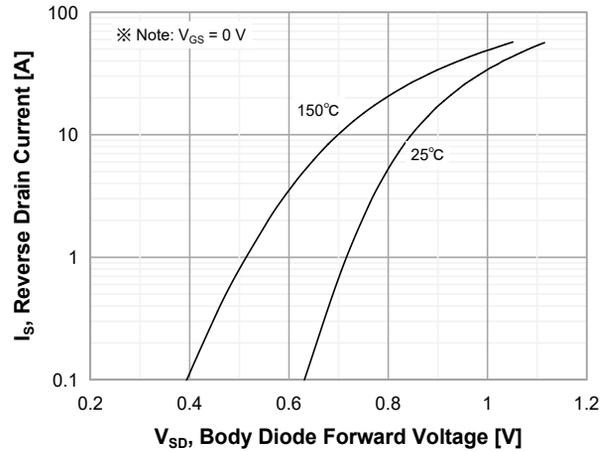
Figure 4. Body Diode Forward Voltage Variation with Source Current and Temperature
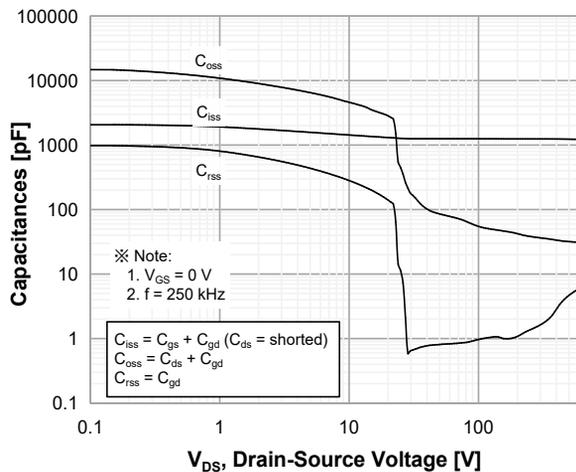

Figure 5. Capacitance Characteristics
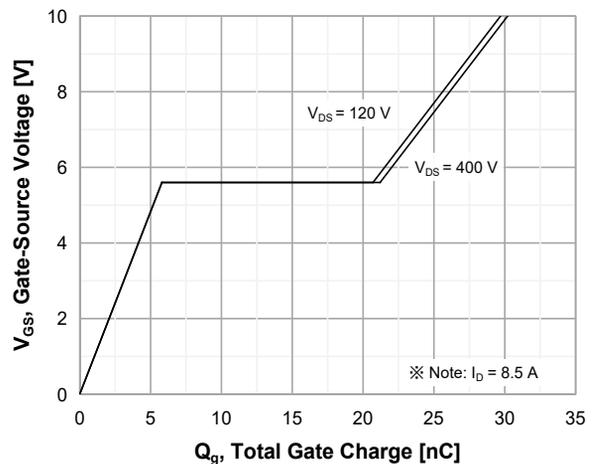
Figure 6. Gate Charge Characteristics

Typical Characteristics (Continued)
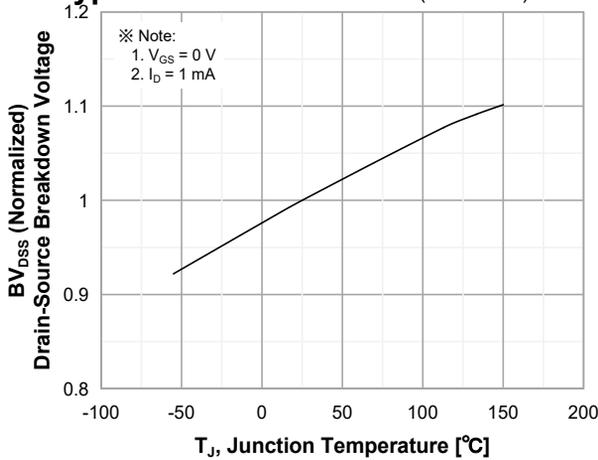
Figure 7. Breakdown Voltage Variation vs Temperature

Note:
1. V_{GS} = 0 V
2. I_D = 1 mA
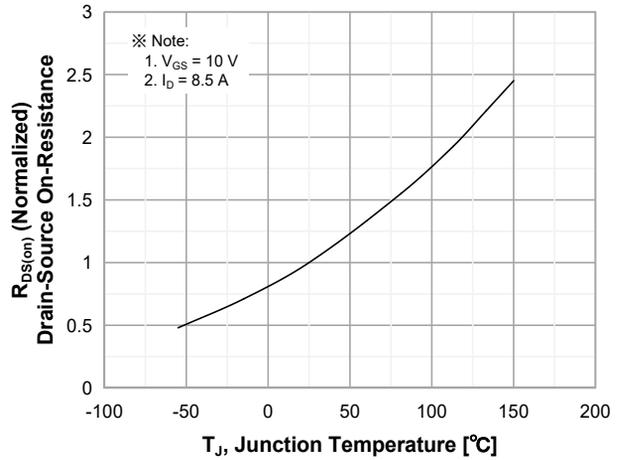
Figure 8. On-Resistance Variation vs Temperature

Note:
1. V_{GS} = 10 V
2. I_D = 8.5 A
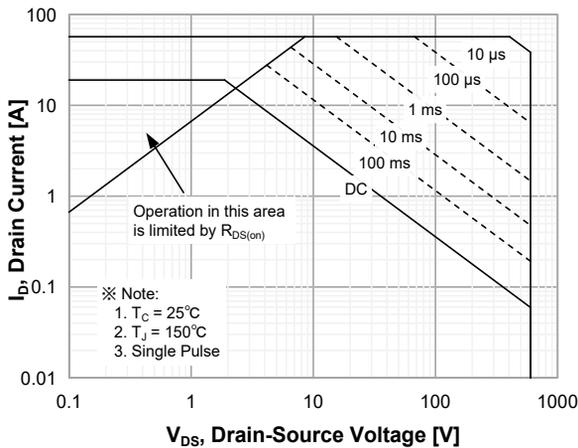
Figure 9. Maximum Safe Operating Area

Operation in this area is limited by $R_{DS(on)}$

Note:
1. T_C = 25℃
2. T_J = 150℃
3. Single Pulse
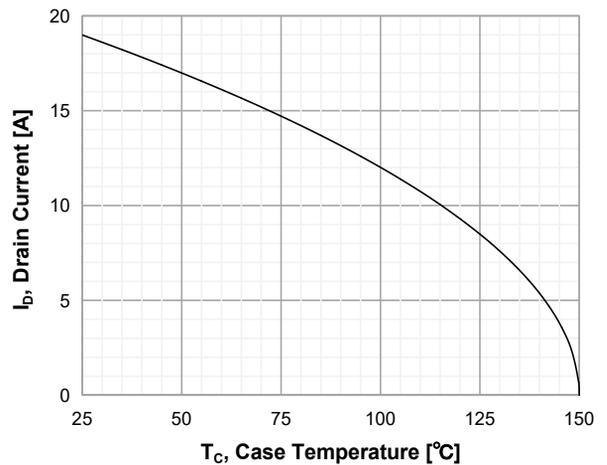
Figure 10. Maximum Drain Current vs. Case Temperature
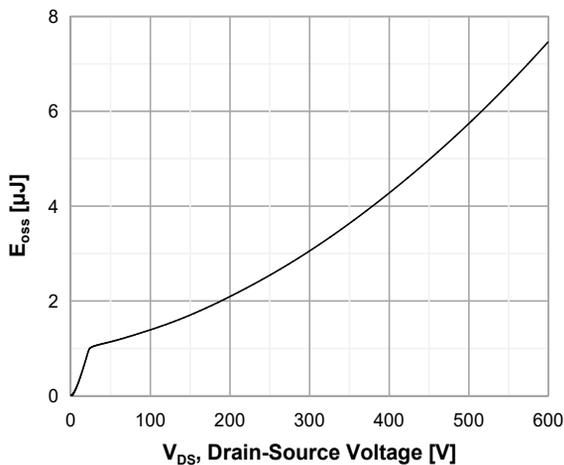
Figure 11.E_{oss} vs. Drain to Source Voltage
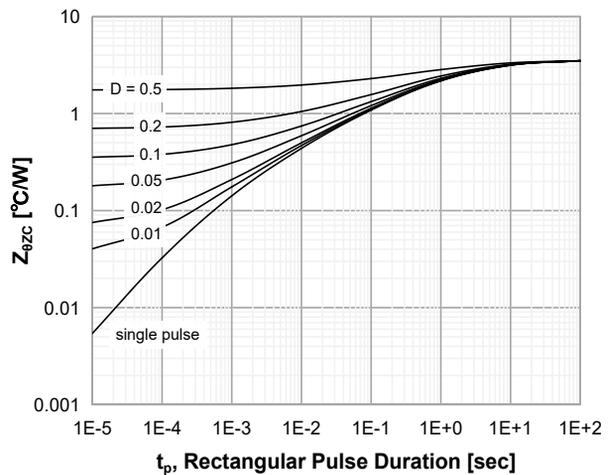
Figure 12.Transient Thermal Response Curve

Gate Charge Test Circuit & Waveform

Current Regulator

12V

200nF

50KΩ

300nF

Same Type
as DUT

V_{GS}

DUT

3mA

R_1

R_2

V_{DS}

Current Sampling (I_G)
Resistor

Current Sampling (I_D)
Resistor

V_{GS}

10V

Q_g

Q_{gs}

Q_{gd}

Charge

Resistive Switching Test Circuit & Waveforms

V_{out}

V_{in}

R_G

R_L

V_{DD}
(0.5 rated V_{DS})

DUT

10V

V_{out}

90%

V_{in}

10%

$t_{d(on)}$ t_r

t_{on}

$t_{d(off)}$ t_f

t_{off}
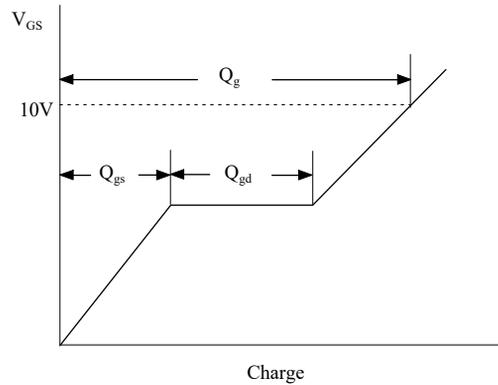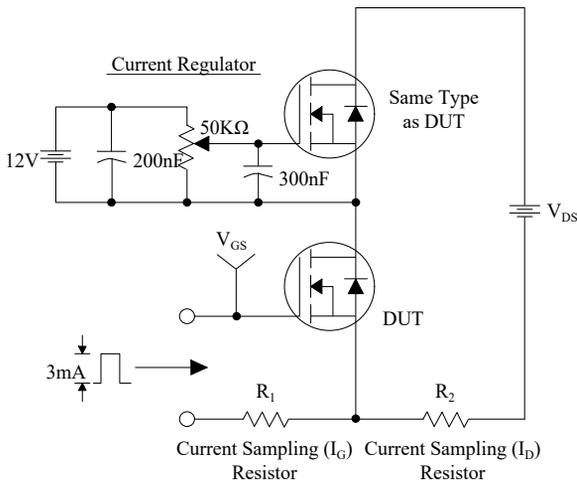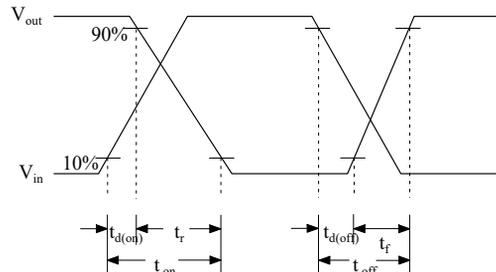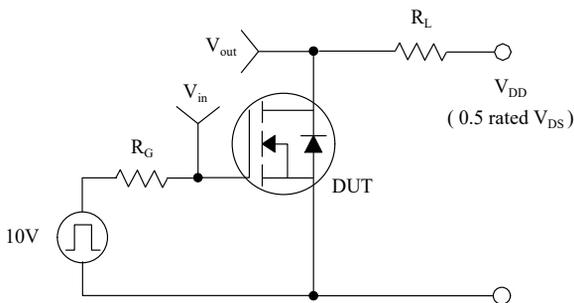
Unclamped Inductive Switching Test Circuit & Waveforms

V_{DS}

L_L

I_D

Vary t_p to obtain
required peak I_D

R_G

DUT

C

V_{DD}

10V

t_p

$$E_{AS} = \frac{1}{2} L_L I_{AS}^2$$

BV_{DSS}

I_{AS}

$I_D(t)$

V_{DD}

$V_{DS}(t)$

t_p

Time
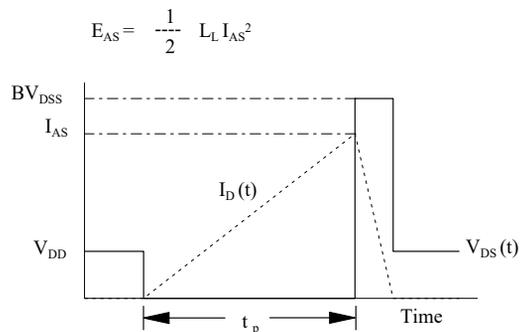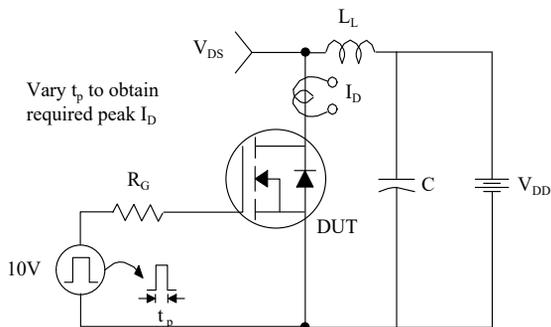
Peak Diode Recovery dv/dt Test Circuit & Waveforms

$$D = \frac{\text{Gate Pulse Width}}{\text{Gate Pulse Period}}$$
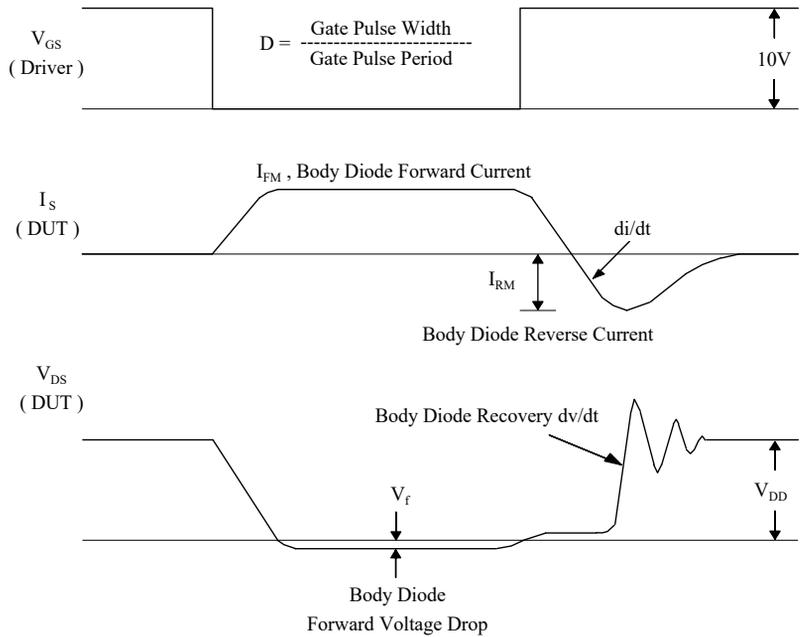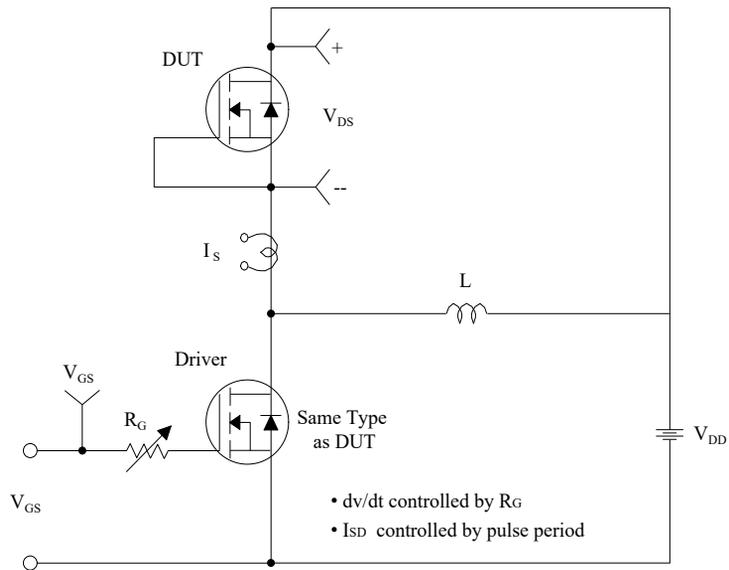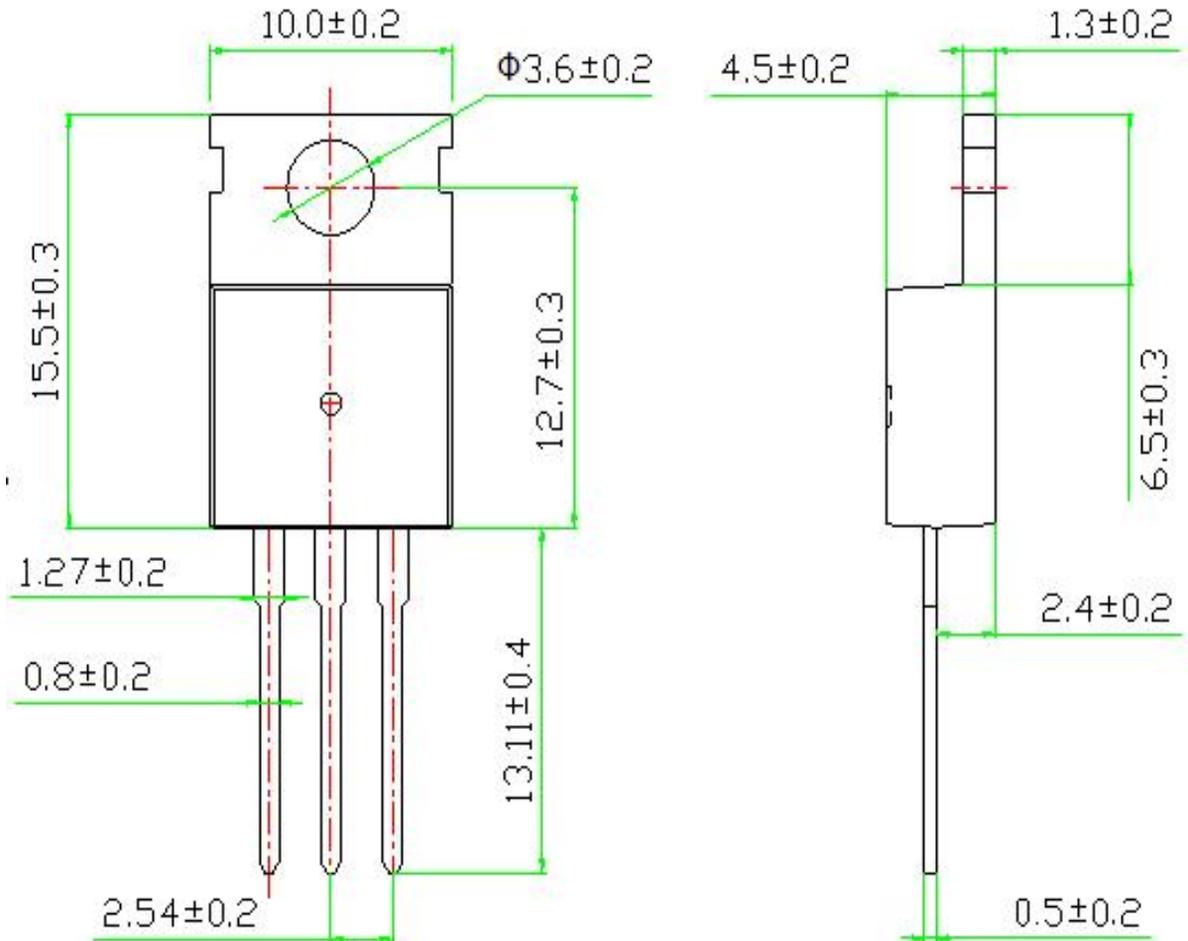
TO-220C OUTLINE

NAME	TO-220C OUTLINE	UNIT	mm	DESIGNED	Shawn Chen	THIRD ANGLE SYSTEM
DWGNO		PAGE	1 OF 1	CHECKED		
VERSION	Ver1.0	ISSUE DATE		APPROVED		

TO-220F OUTLINE

10.16±0.2

Φ3.18±0.2

15.87±0.3

12.57±0.2

1.3±0.2

0.8±0.2

12.95±0.4

2.54±0.2

4.70±0.2

2.54±0.2

6.68±0.3

2.76±0.2

0.5±0.1
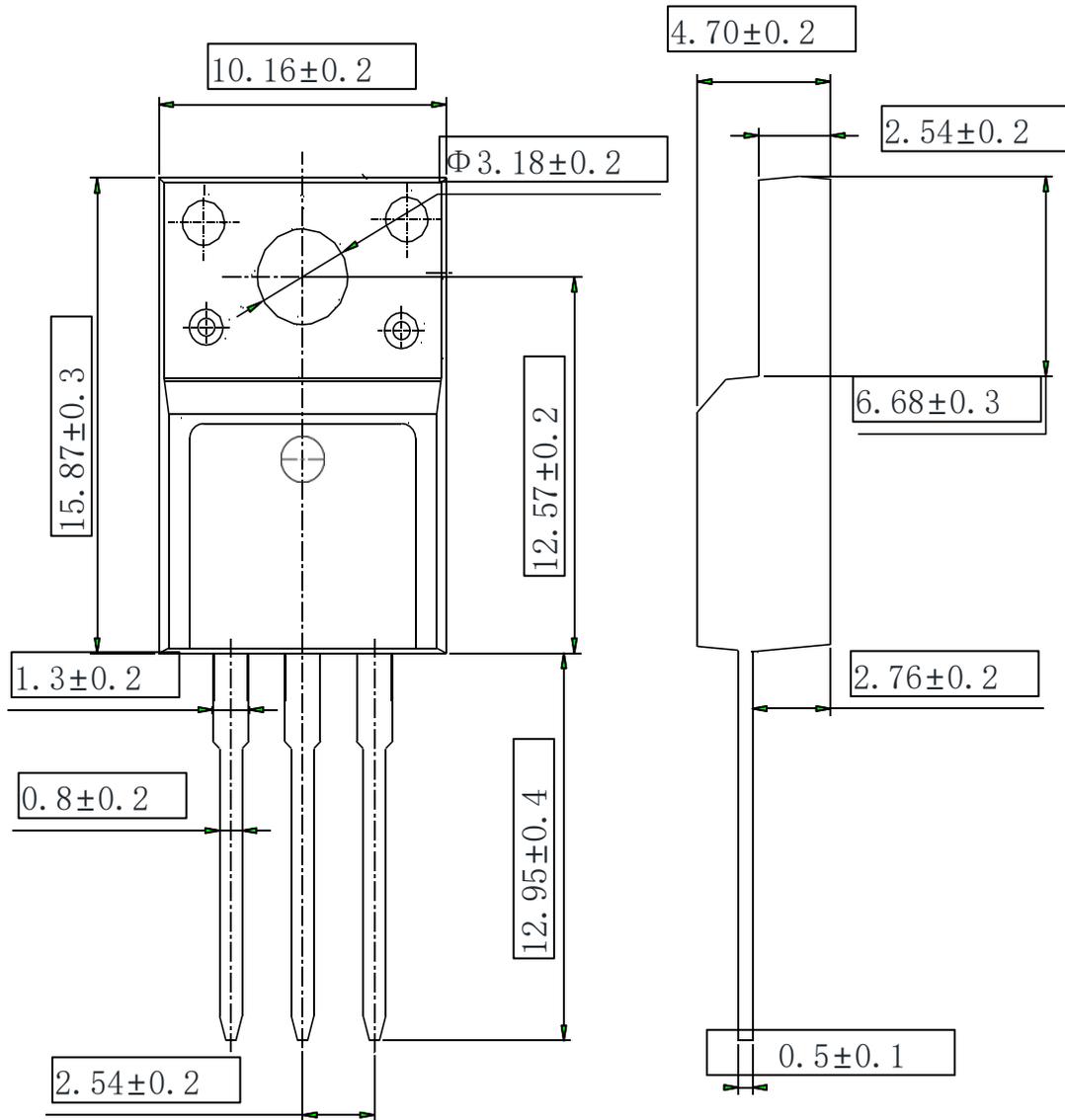
NOTE：
1The plastic package is not marked as smooth surfaceRa=0.1;Subglossy surfaceRa=0.8
2.Undeclared tolerance±0.15,Unmarked filletRmax=0.25