

**12A, 650V N-CHANNEL  
POWER MOSFET**

TO-220F-3L

**DESCRIPTION**

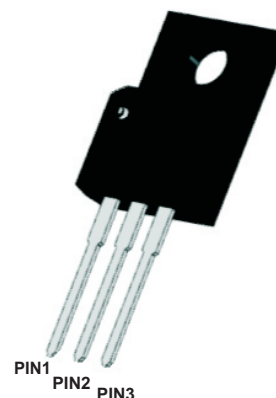
The F12N65L is a high voltage power MOSFET and is designed to have better characteristics, such as fast switching time, low gate charge, low on-state resistance and have a high rugged avalanche characteristics. This power MOSFET is usually used at high speed switching applications in switching power supplies and adaptors.

**Features**

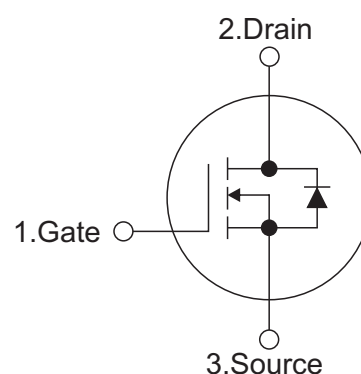
- $R_{DS(ON)} \leq 0.85 \Omega @ V_{GS}=10V, I_D=12A$
- Fast switching capability
- Avalanche energy tested
- Improved dv/dt capability, high ruggedness

**Mechanical data**

- Case: TO-220F-3L
- Approx. Weight: 2.1g ( 0.07oz)
- Lead free finish, RoHS compliant
- Case Material: "Green" molding compound, UL flammability classification 94V-0, "Halogen-free".



**SYMBOL**



**ABSOLUTE MAXIMUM RATINGS (TA=25°C, unless otherwise specified)**

PARAMETER		Symbols	RATINGS	Units
Drain-Source Voltage		$V_{DSS}$	650	V
Gate-Source Voltage		$V_{GSS}$	$\pm 30$	V
Continuous Drain Current	$T_c=25^\circ C$	$I_D$	12	A
	$T_c=100^\circ C$		7.8	A
Pulsed Drain Current (Note 2)		$I_{DM}$	48	A
Avalanche Energy	Single Pulsed (Note 3)	$E_{AS}$	790	mJ
Peak Diode Recovery dv/dt (Note 4)		dv/dt	50	V/ns
Power Dissipation		$P_D$	51	W
Operation Junction Temperature and Storage Temperature		$T_j, T_{stg}$	-55 ~ +150	$^\circ C$

Notes: 1. Absolute maximum ratings are those values beyond which the device could be permanently damaged.

Absolute maximum ratings are stress ratings only and functional device operation is not implied.

2. Repetitive Rating: Pulse width limited by maximum junction temperature.

3.  $L = 30mH, I_{AS} = 7.3A, V_{DD} = 50V, R_G = 25 \Omega, \text{Starting } T_J = 25^\circ C$

4.  $ISD \leq 12A, di/dt \leq 200A/\mu s, V_{DD} \leq BVDSS, \text{Starting } T_J = 25^\circ C$

**THERMAL DATA**

PARAMETER	Symbols	RATINGS	Units
Junction to Ambient	$R_{thJA}$	62.5	$^\circ C/W$
Junction to Case	$R_{thJC}$	2.44	$^\circ C/W$



**ELECTRICAL CHARACTERISTICS (TA=25°C, unless otherwise specified)**

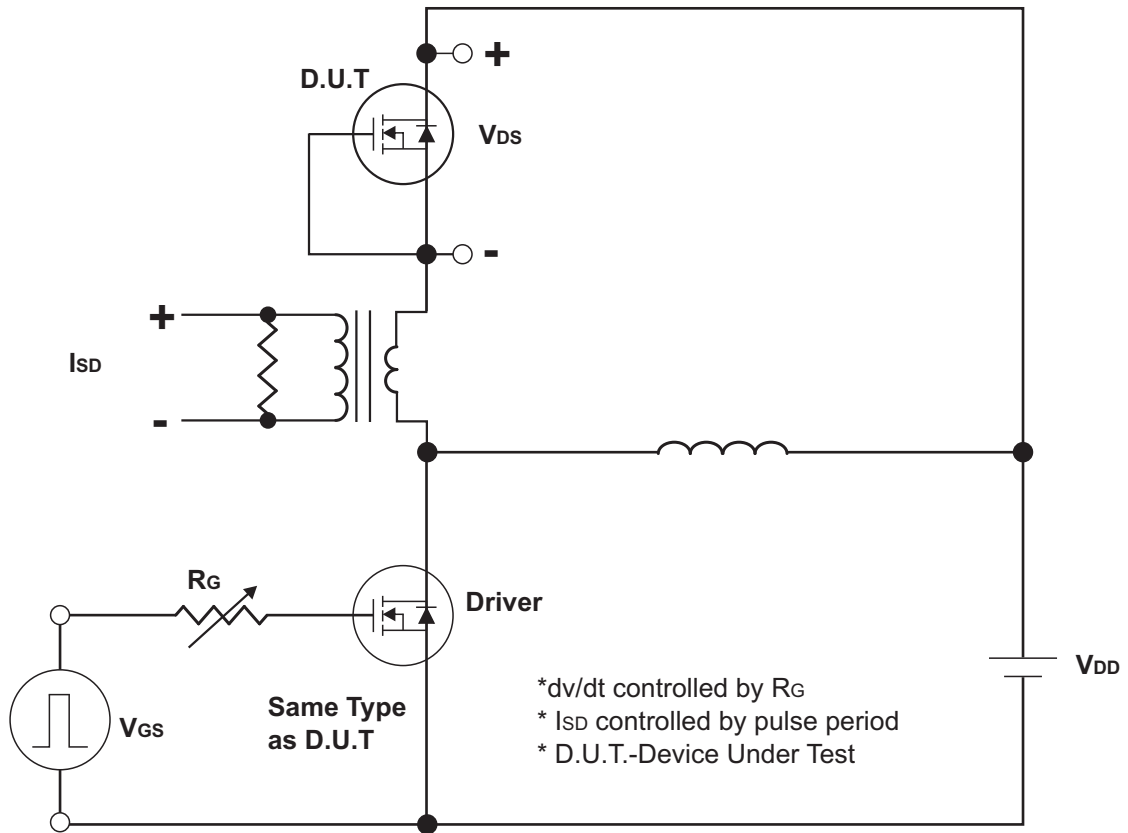
PARAMETER		Symbols	TEST CONDITIONS	Min	Typ	Max	Units	
<b>OFF CHARACTERISTICS</b>								
Drain-Source Breakdown Voltage		$BV_{DSS}$	$V_{GS}=0V, I_D=250\mu A$	650			V	
Drain-Source Leakage Current		$I_{DSS}$	$V_{DS}=650V, V_{GS}=0V$			1	$\mu A$	
Gate- Source Leakage Current	Forward	$I_{GSS}$	$V_{GS}=30V, V_{DS}=0V$			100	nA	
	Reverse		$V_{GS}=-30V, V_{DS}=0V$			-100		
<b>ON CHARACTERISTICS</b>								
Gate Threshold Voltage		$V_{GS(TH)}$	$V_{DS}=V_{GS}, I_D=250\mu A$	2.0		4.0	V	
Static Drain-Source On-State Resistance		$R_{DS(ON)}$	$V_{GS}=10V, I_D=6.0A$		0.62	0.85	$\Omega$	
<b>DYNAMIC CHARACTERISTICS</b>								
Input Capacitance		$C_{ISS}$	$V_{DS}=25V,$ $V_{GS}=0V,$ $f=1.0MHz$		2000		pF	
Output Capacitance		$C_{OSS}$				160		pF
Reverse Transfer Capacitance		$C_{RSS}$				5		pF
<b>SWITCHING CHARACTERISTICS</b>								
Total Gate Charge (Note 1)		$Q_G$	$V_{DS}=520V, V_{GS}=10V,$ $I_D=12A, I_G=1mA$ (NOTE1,2)		36		nC	
Gate-Source Charge		$Q_{GS}$				8.6		nC
Gate-Drain Charge		$Q_{GD}$				10		nC
Turn-On Delay Time (Note 1)		$t_{D(ON)}$	$V_{DS}=325V, V_{GS}=10V,$ $I_D=12A, R_G=25\Omega$ (NOTE1,2)		22		ns	
Turn-On Rise Time		$t_R$				23		ns
Turn-Off Delay Time		$t_{D(OFF)}$				115		ns
Turn-Off Fall Time		$t_F$				32		ns
<b>DRAIN-SOURCE DIODE CHARACTERISTICS AND MAXIMUM RATINGS</b>								
Maximum Body-Diode Continuous Current		$I_S$				12	A	
Maximum Body-Diode Pulsed Current		$I_{SM}$				48	A	
Drain-Source Diode Forward Voltage (Note 1)		$V_{SD}$	$I_S=12A, V_{GS}=0V$			1.4	V	
Reverse Recovery Time (Note 1)		$t_{rr}$	$I_S=12A, V_{GS}=0V,$			470	ns	
Reverse Recovery Charge		$Q_{rr}$	$di/dt=100A/\mu s$			12	$\mu C$	

Notes:

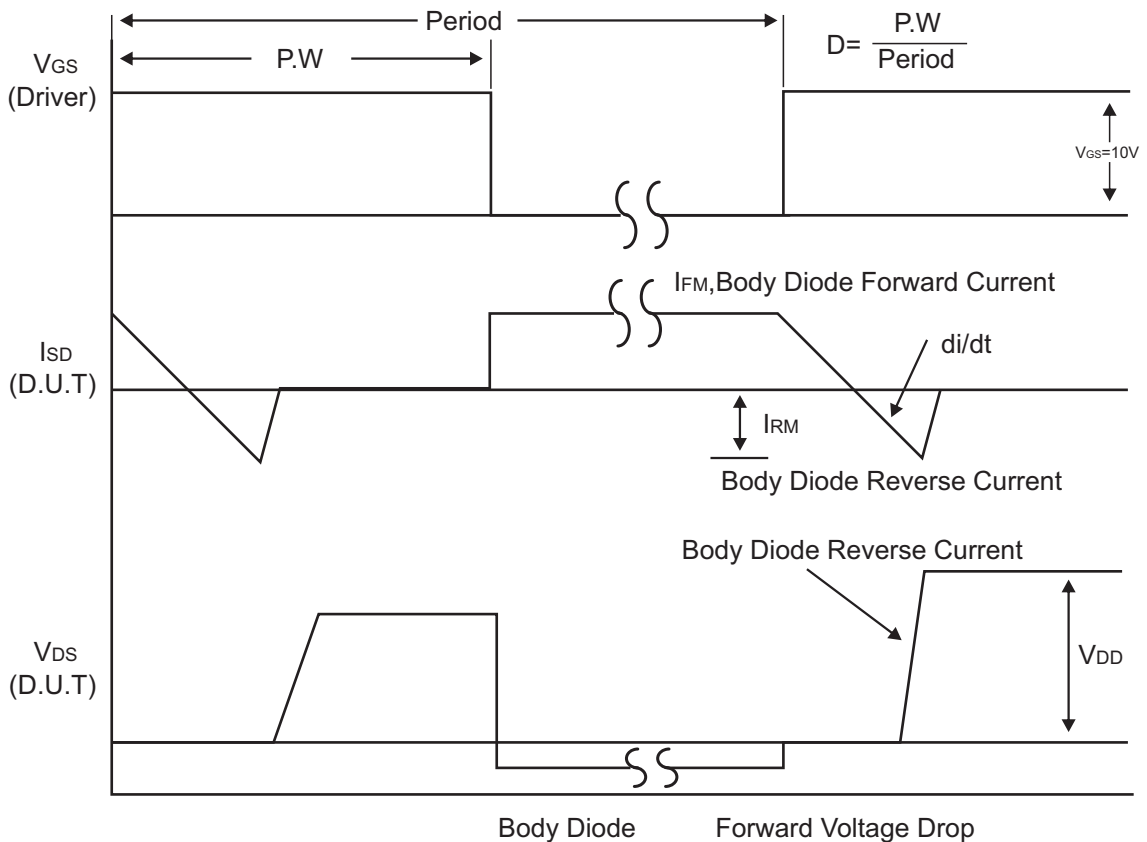
1. Pulse Test: Pulse width  $\leq 300\mu s$ , Duty cycle  $\leq 2\%$ .
2. Essentially independent of operating temperature.



Test Circuits and waveforms



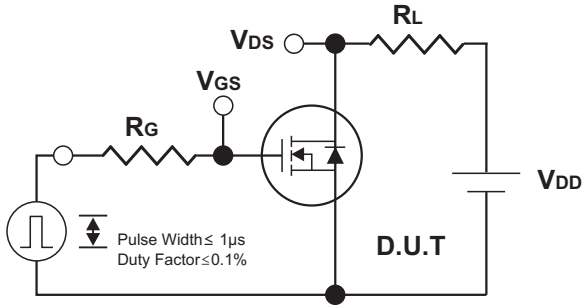
Peak Diode Recovery dv/dt Test Circuit



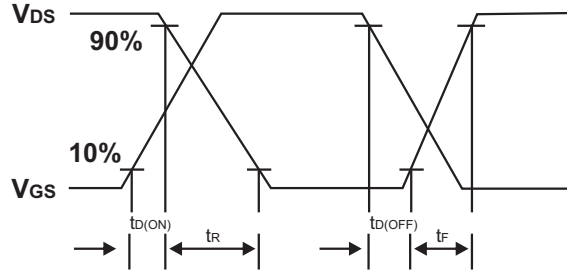
Peak Diode Recovery dv/dt Waveforms



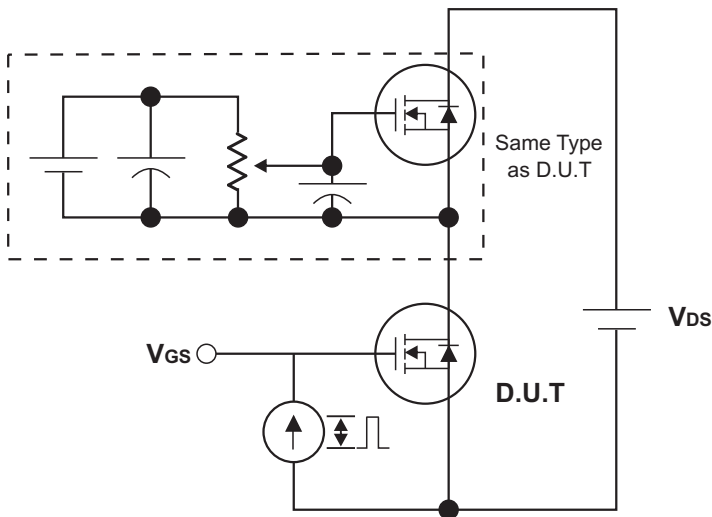
Test Circuits and waveforms



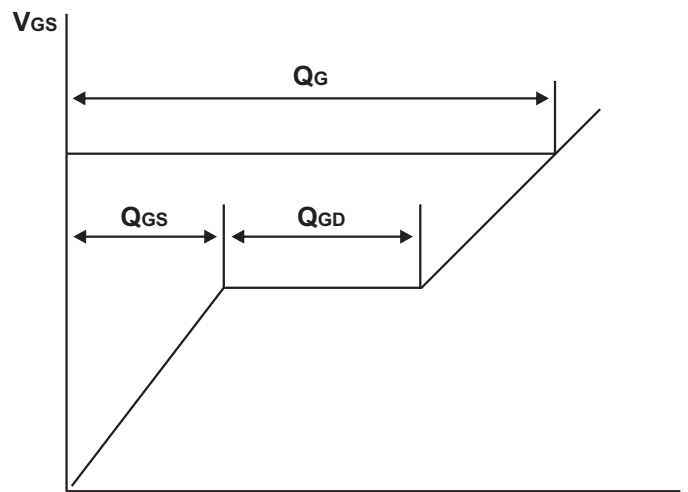
Switching Test Circuit



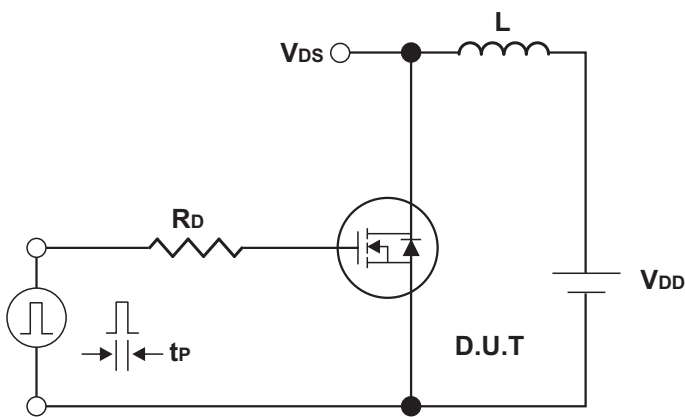
Switching Waveforms



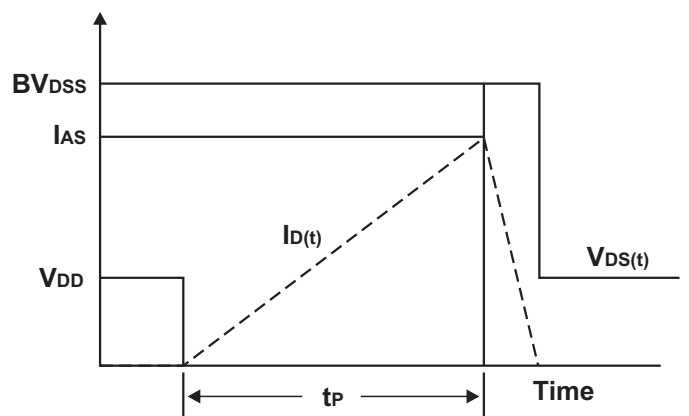
Gate Charge Test Circuit



Charge  
Gate Charge Waveform



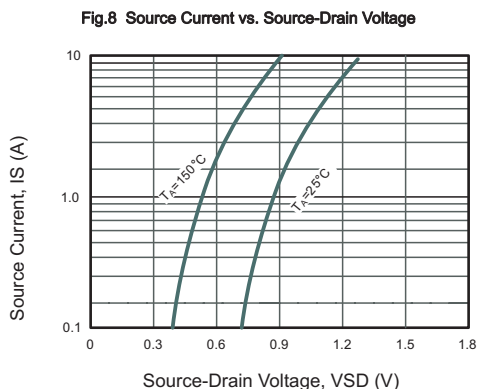
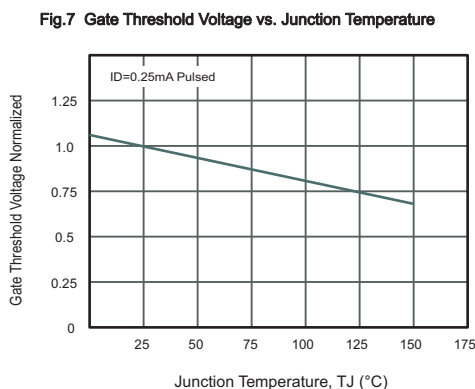
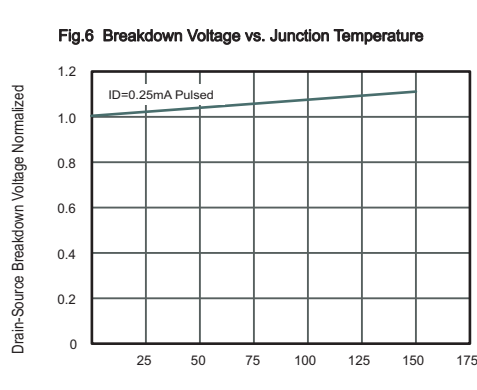
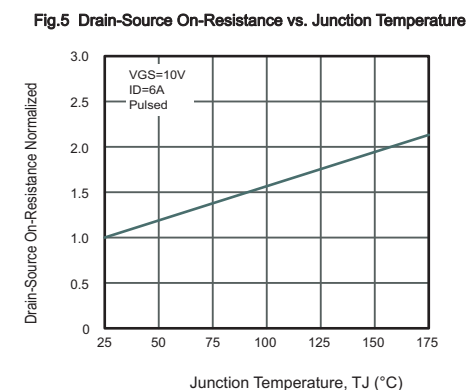
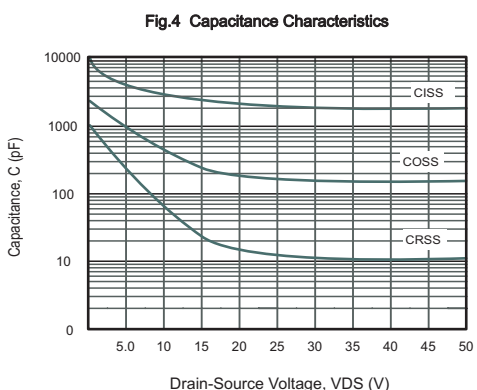
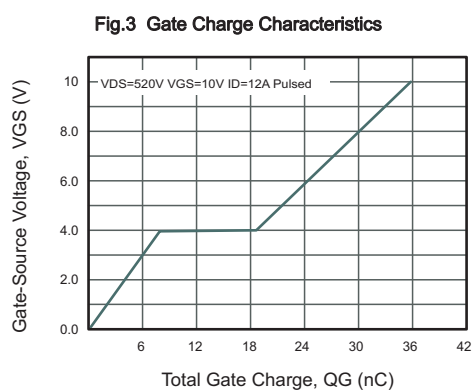
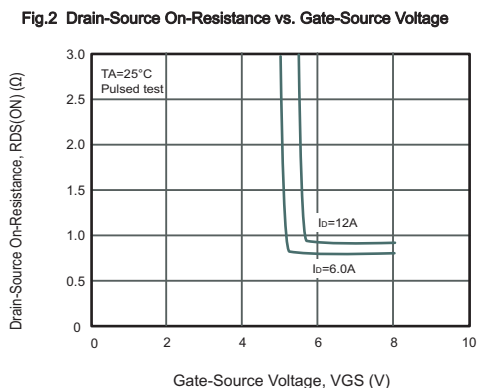
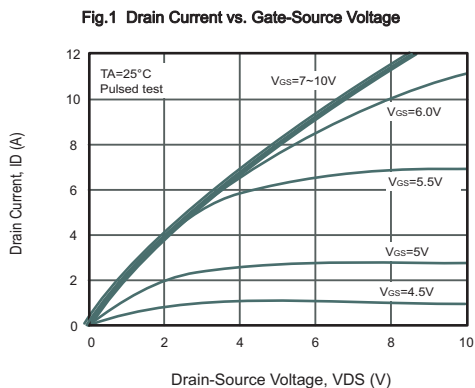
Unclamped Inductive Switching Test Circuit



Unclamped Inductive Switching Waveforms



### Typical Characteristics





### Typical Characteristics

Fig.9 Drain Current vs. Gate-Source Voltage

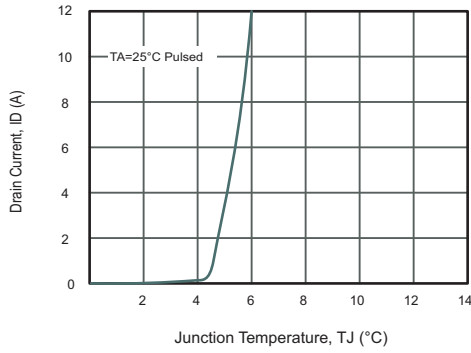


Fig.10 Drain-Source On-Resistance vs. Drain Current

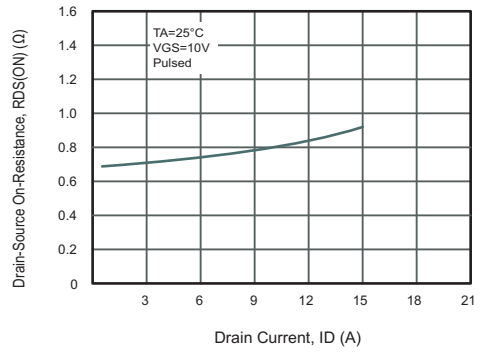


Fig.11 Power Dissipation vs. Junction Temperature

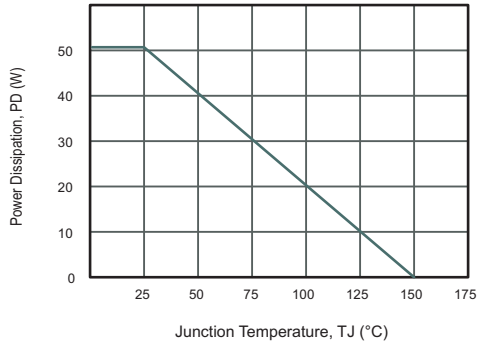


Fig.12 Drain Current vs. Junction Temperature

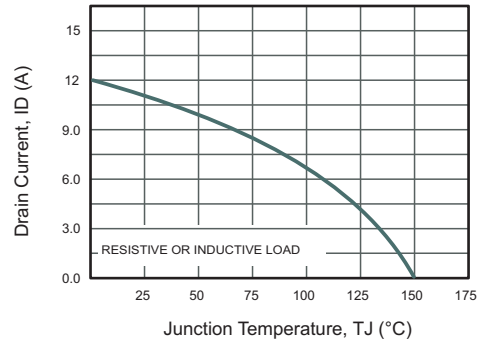
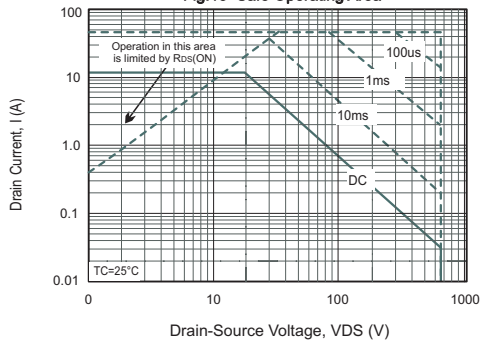


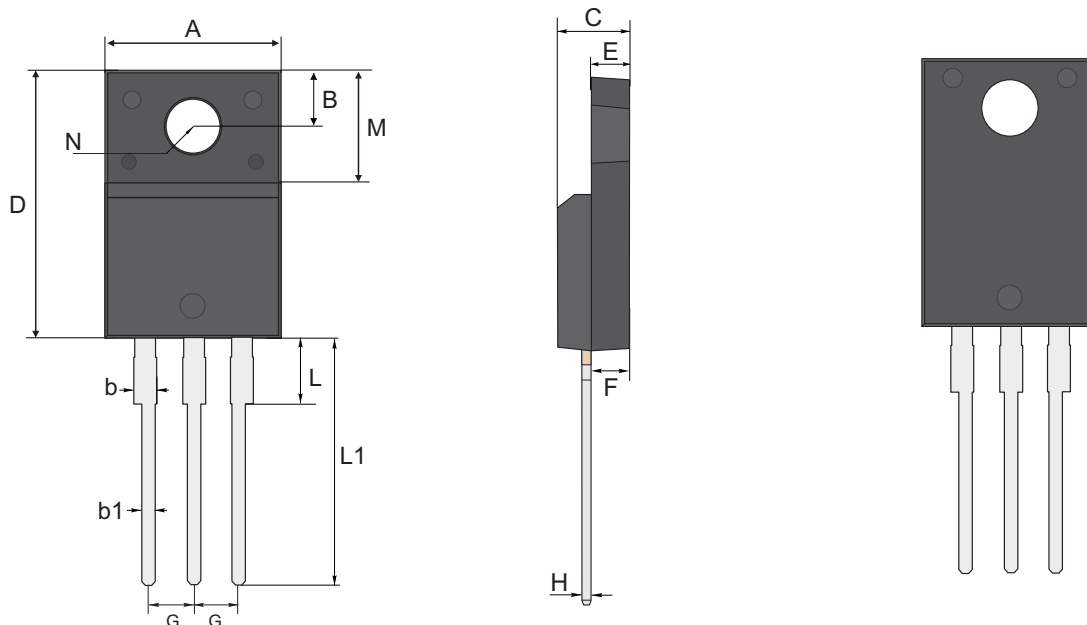
Fig.13 Safe Operating Area





PACKAGE OUTLINE  
Plastic Through hole package; 3 leads

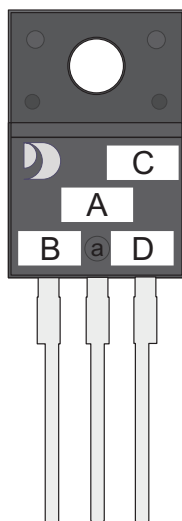
TO-220F-3L



TO-220F-3L mechanical data

UNIT		A	B	b	b1	C	D	E	F	G	H	L	L1	M	N
mm	max	10.28	3.37	1.34	0.9	4.9	16.07	2.74	2.74	2.64	0.60	2.85	13.7	6.88	3.18 TYPICAL
	typ	10.18	3.27	1.24	0.8	4.7	15.87	2.54	2.54	2.54	0.50	2.65	13.5	6.68	
	min	10.08	3.17	1.14	0.7	4.5	15.67	2.34	2.34	2.44	0.40	2.45	13.3	6.48	
mil	max	405	133	53	35	193	630	108	108	104	27	112	539	271	125 TYPICAL
	typ	401	129	49	31	185	590	100	100	100	20	104	531	267	
	min	397	125	45	28	177	580	92	92	96	16	96	524	255	

**MARKING DIAGRAM**



- Unmarkable Surfacea
- Marking Composition Field
- a:Ejector Pin Mark
- A:Marking Area
- B: Lot Code
- C: Additional Information
- D:Date Code (YWW)
- Y:Years(0~9)
- WW:Week



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