



## 13A, 500V N-CHANNEL POWER MOSFET

TO-220F-3L(\*Prefix :F)

### Description

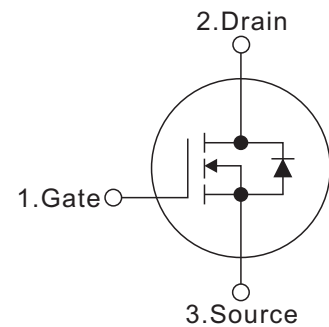
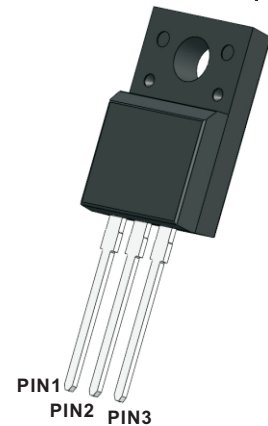
These N-channel enhanced vdmofets, is obtained by the self-aligned planar technology which reduce the conduction loss, improve switching performance and enhance the avalanche energy. Which accords with the RoHS standard.

### Features

- $R_{DS(ON)} < 0.48\Omega @ V_{GS}=10V, I_D=6.5A$
- Fast switching capability
- 100% Avalanche tested
- 100%  $\Delta V_{DS}$  tested

### Mechanical data

- Case: TO-220F-3L
- pprox. Weight: 1.767g ( 0.062oz)
- Lead free finish, RoHS compliant
- Case Material: "Green" molding compound, UL flammability classification 94V-0, "Halogen-free".



### Packing Marking And Ordering Information

Device Package	Device	Marking	Packing Type	QTY Per Tube	Inner box	Per Carton
TO-220F-3L	F13N50L	F13N50L	Tube	50 Pcs	2,500 Pcs	5,000 Pcs

### Absolute Maximum Ratings (Ta=25°C, Unless Otherwise Specified)

Parameter	Symbols	Ratings	Units
Drain-Source Voltage	$V_{DSS}$	500	V
Gate-Source Voltage	$V_{GSS}$	$\pm 30$	V
Continuous Drain Current	$I_D$	13 7.8	A
		$T_c=25^\circ C$ $T_c=100^\circ C$	
Pulsed Drain Current (Note 2)	$I_{DM}$	51	A
Avalanche Energy Single Pulsed (Note 3)	$E_{AS}$	576	mJ
Power Dissipation ( $T_c = 25^\circ C$ )	$P_D$	50	W
Operating junction 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.  $L = 10mH, I_{AS} = 6.2A, V_{DD} = 50V, R_G = 25\Omega$ , Starting  $T_J = 25^\circ C$

### Thermal Resistance

Parameter	Symbols	Ratings	Units
Thermal resistance, junction – case.	$R_{thJC}$	4	$^\circ C/W$
Thermal resistance, junction – ambient(min. footprint)	$R_{thJA}$	63	$^\circ C/W$



Electrical Characteristics (Ta=25°C, Unless Otherwise Specified)

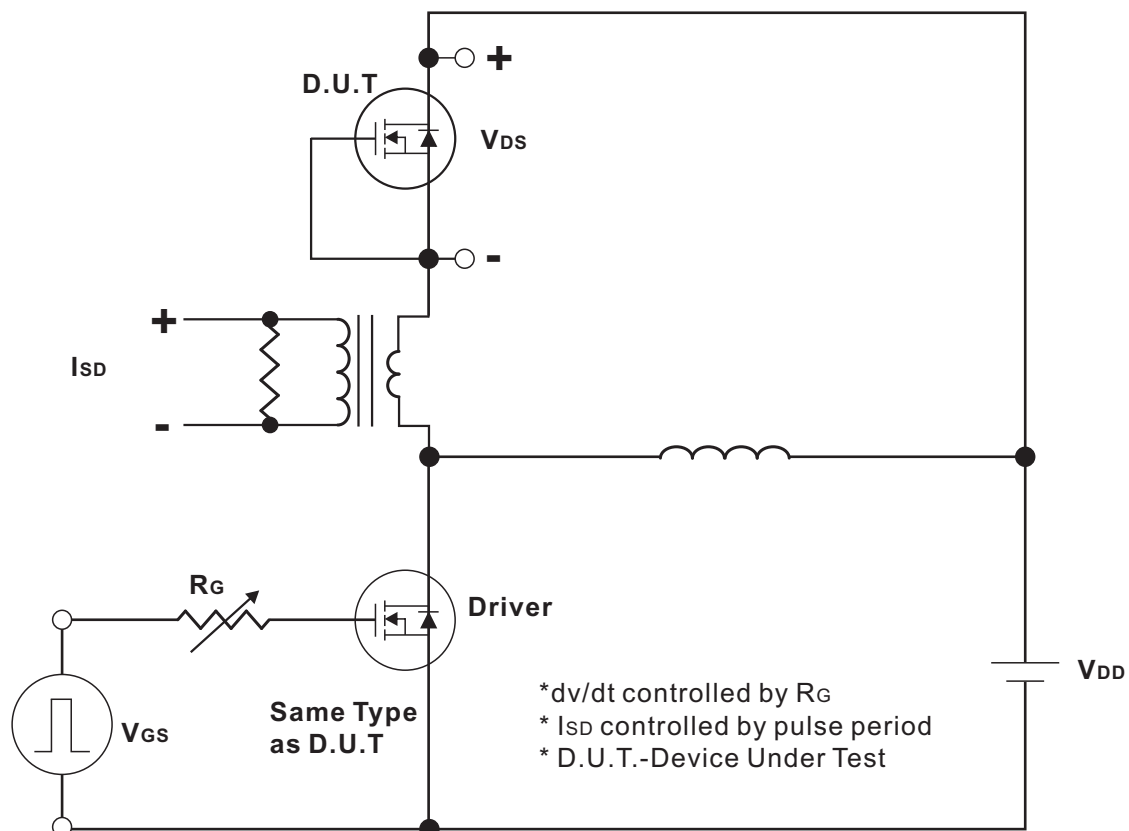
Parameter	Symbols	Test Conditions	Min	Typ	Max	Units
<b>Off Characteristics</b>						
Drain-Source Breakdown Voltage	$BV_{DSS}$	$V_{DS}=0V, I_D=250\mu A$	500			V
Drain-Source Leakage Current	$I_{DSS}$	$V_{DS}=500V, V_{GS}=0V$			1	$\mu A$
Gate- Source Leakage Current	Forward	$I_{GSS}$			100	nA
	Reverse				-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	$R_{DS(ON)}$	$V_{GS}=10V, I_D=6.5A$		0.37	0.48	$\Omega$
Forward Transfer Conductance	$g_{fs}$	$V_{DS}=40V, I_D=6.5A$		8		S
<b>Dynamic Characteristics</b>						
Input Capacitance	$C_{ISS}$	$V_{DS}=25V,$ $V_{GS}=0V,$ $f=1.0MHz$		2014		pF
Output Capacitance	$C_{OSS}$			160		pF
Reverse Transfer Capacitance	$C_{RSS}$			20		pF
Gate resistance	$R_G$			1.2		$\Omega$
<b>Switching Characteristics</b>						
Total Gate Charge (Note 1)	$Q_G$	$V_{DD}=400V, V_{GS}=10V,$ $I_D=13A, I_G=1mA$ (NOTE1,2)		37		nC
Gate-Source Charge	$Q_{GS}$			11		nC
Gate-Drain Charge	$Q_{GD}$			17		nC
Turn-On Delay Time (Note 1)	$t_{D(ON)}$	$V_{DD}=250V, V_{GS}=10V,$ $I_D=13A, R_G=25\Omega$ (NOTE1,2)		90		ns
Turn-On Rise Time	$t_R$			160		ns
Turn-Off Delay Time	$t_{D(OFF)}$			150		ns
Turn-Off Fall Time	$t_F$			60		ns
<b>Drain-source Diode Characteristics And Maximum Ratings</b>						
Maximum Body-Diode Continuous Current	$I_S$				13	A
Drain-Source Diode Forward Voltage (Note 1)	$V_{SD}$	$I_S=13A, V_{GS}=0V$			1.4	V
Reverse Recovery Time (Note 1)	$t_{rr}$	$I_S=13A, V_{GS}=0V,$ $di/dt=100A/\mu s$		470		ns
Reverse Recovery Charge	$Q_{rr}$			4.5		$\mu C$

Notes:

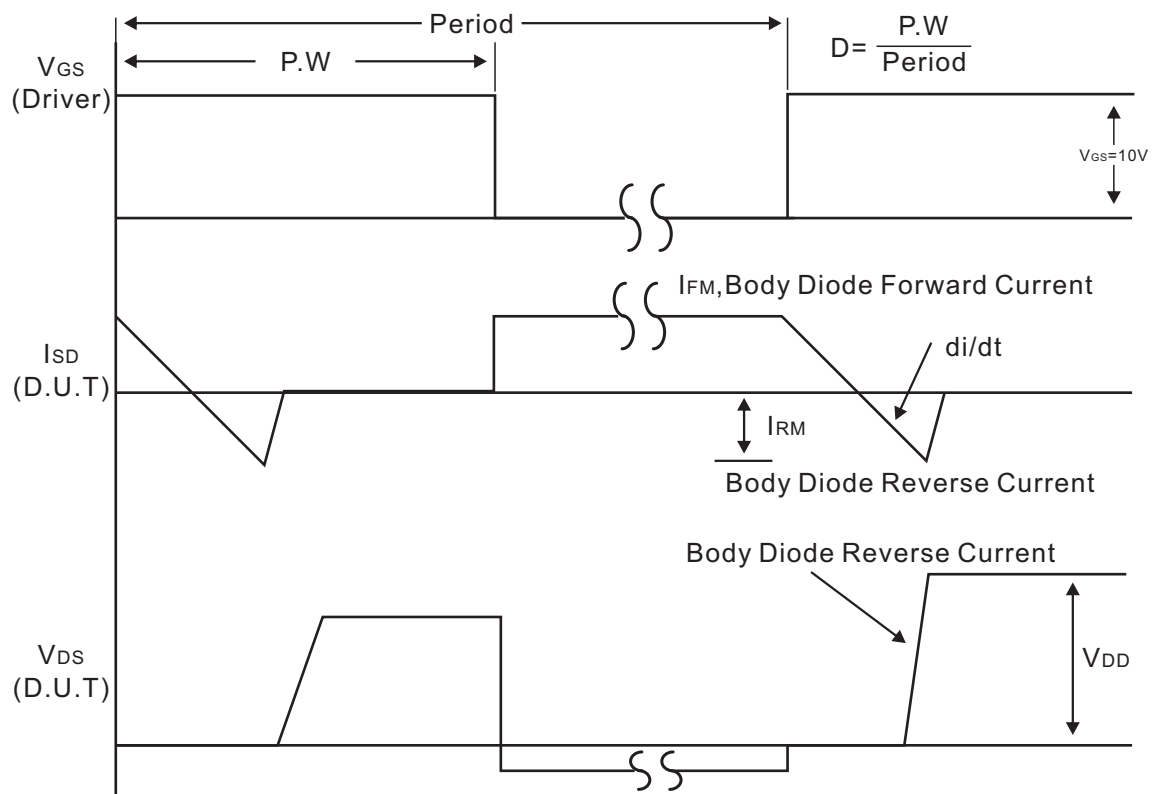
1. Pulse Test: Pulse width  $\leq 300\mu s$ , Duty cycle  $\leq 2\%$ .
2. Essentially independent of operating temperature.



### Test Circuits and waveforms



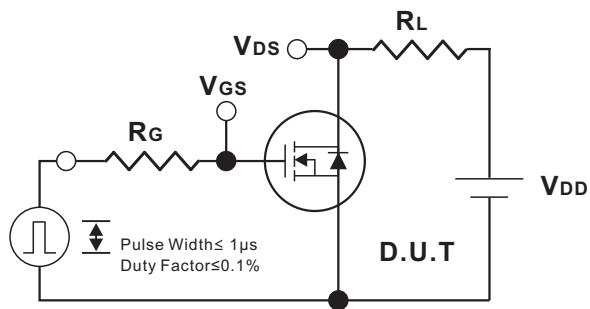
Peak Diode Recovery dv/dt Test Circuit



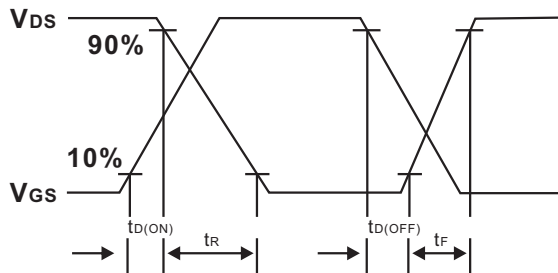
Body Diode Forward Voltage Drop  
Peak Diode Recovery dv/dt Waveforms



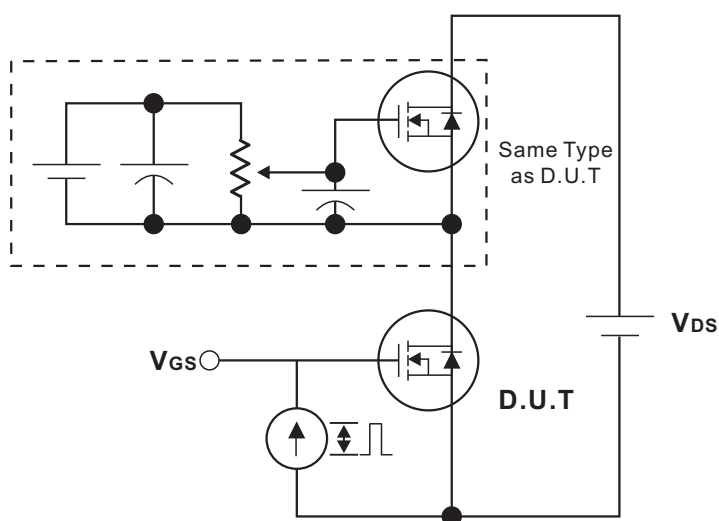
Test Circuits and waveforms



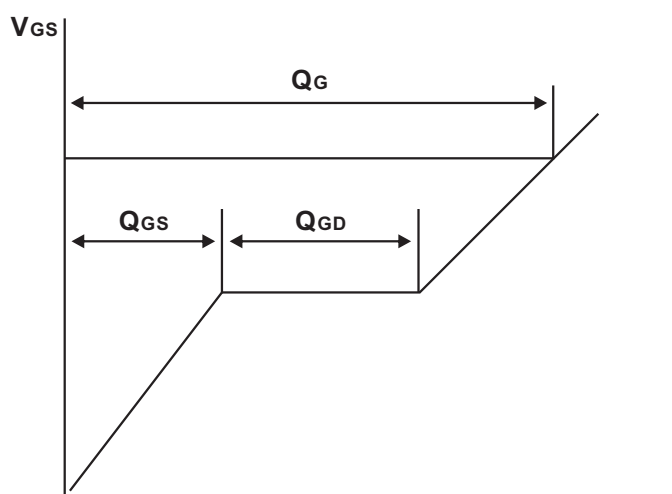
Switching Test Circuit



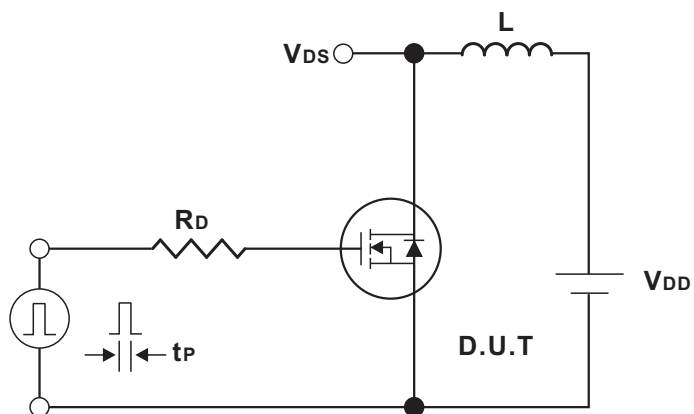
Switching Waveforms



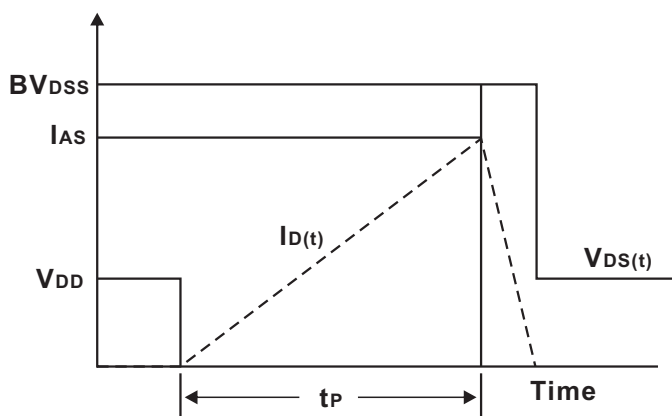
Gate Charge Test Circuit



Charge  
Gate Charge Waveform



Unclamped Inductive Switching Test Circuit



Unclamped Inductive Switching Waveforms



### Typical Characteristics

Fig.1 Typical Output Characteristics

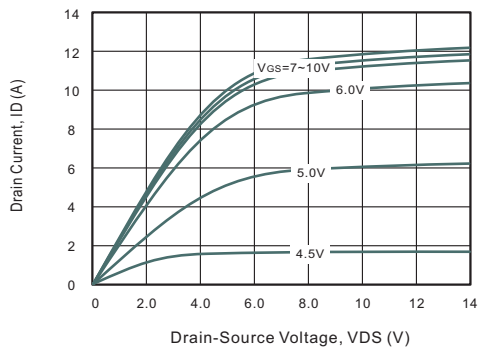


Fig.2 Power Dissipation

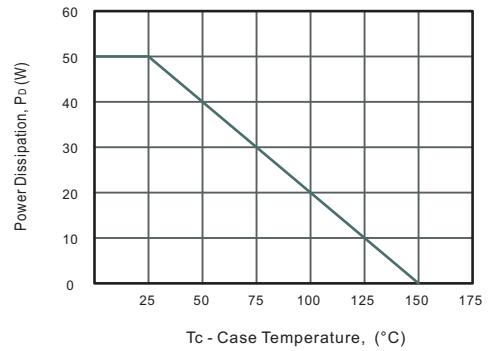


Fig.3 Drain Current Derating

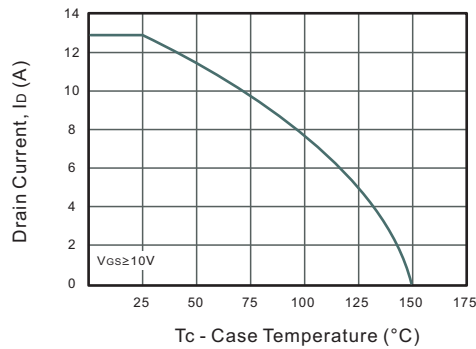


Fig.4 Drain-Source On-Resistance vs. Drain Current

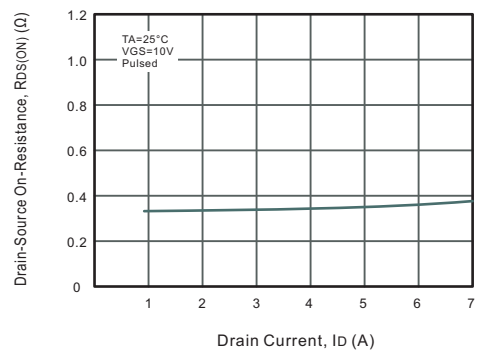


Fig.5 Gate Threshold Voltage vs. Junction Temperature

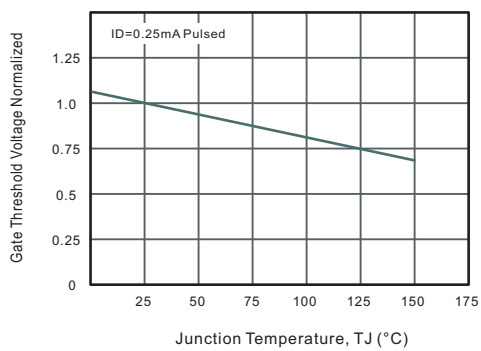


Fig.6 Body-diode Forward Characteristics

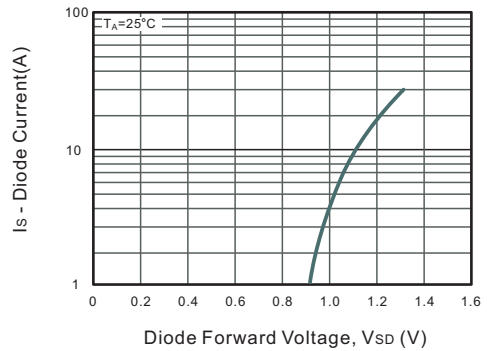


Fig.7 Drain-Source On-Resistance vs. Junction Temperature

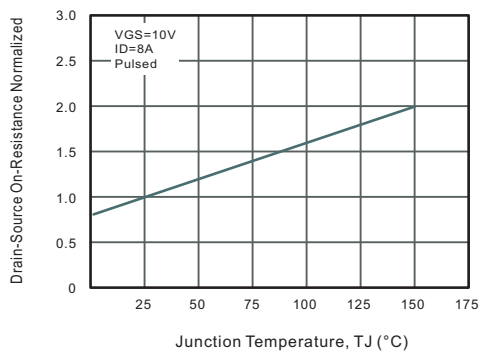
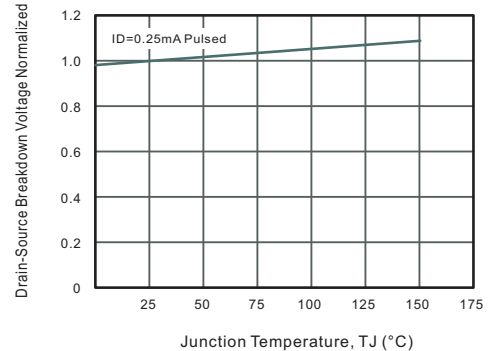


Fig.8 Breakdown Voltage vs. Junction Temperature





### Typical Characteristics

Fig.9 Capacitance Characteristics

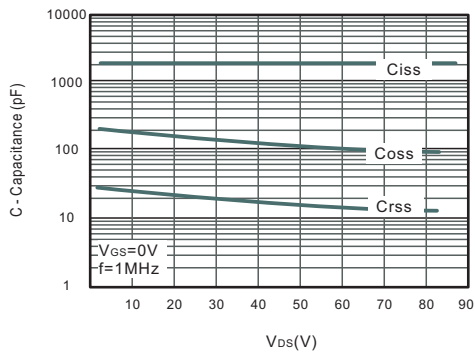


Fig.10 Gate Charge Characteristics

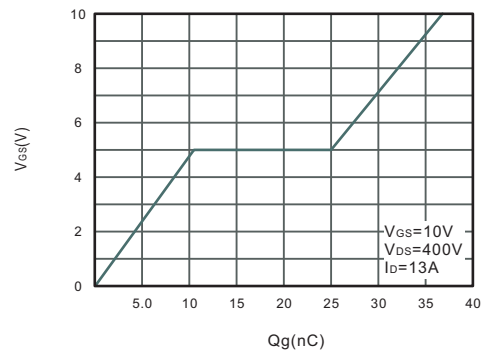


Fig.11 Safe Operating Area

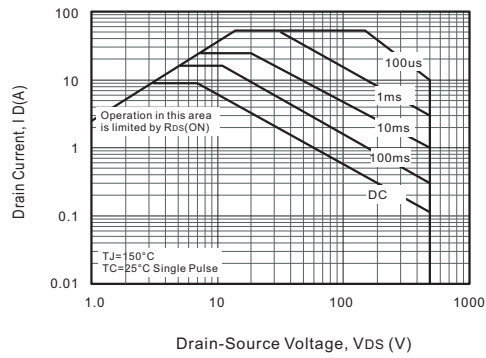
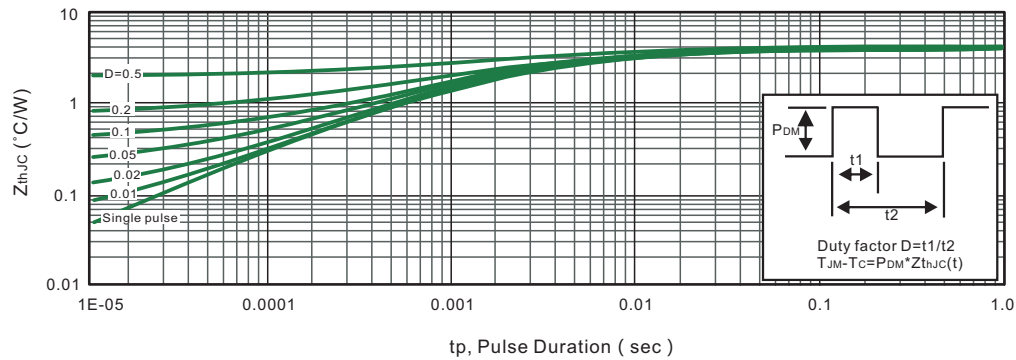


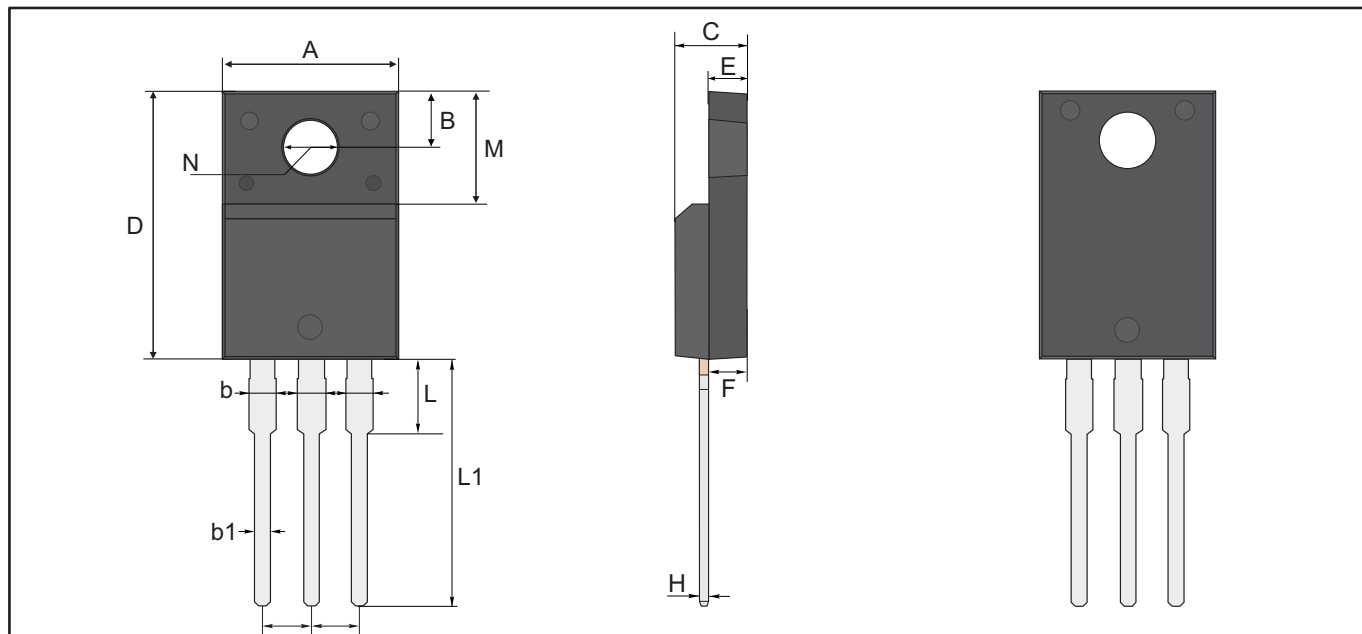
Fig.12 Max. Transient Thermal Impedance





Package Outline  
Through Hole Package ; 3 leads

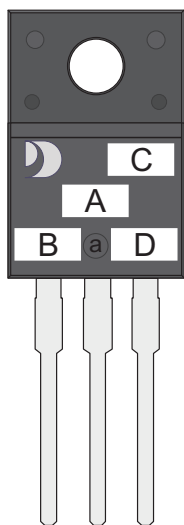
TO-220F-3L



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	1.44	0.9	4.9	16.07	2.74	2.74	2.64	0.6	3.38	13.7	6.98	3.18 typ.
	typ	10.18	3.27	1.34	0.8	4.7	15.87	2.54	2.54	2.54	0.5	3.18	13.5	6.68	
	min	10.08	3.17	1.24	0.7	4.5	15.67	2.34	2.34	2.44	0.4	2.98	13.3	6.38	
mil	max	405	133	57	35	193	633	108	108	104	24	133	539	275	125 typ.
	typ	401	129	53	31	185	625	100	100	100	20	125	531	263	
	min	397	125	49	28	177	617	92	92	96	16	117	524	251	

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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