



4A, 600V N-CHANNEL POWER MOSFET

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

Description

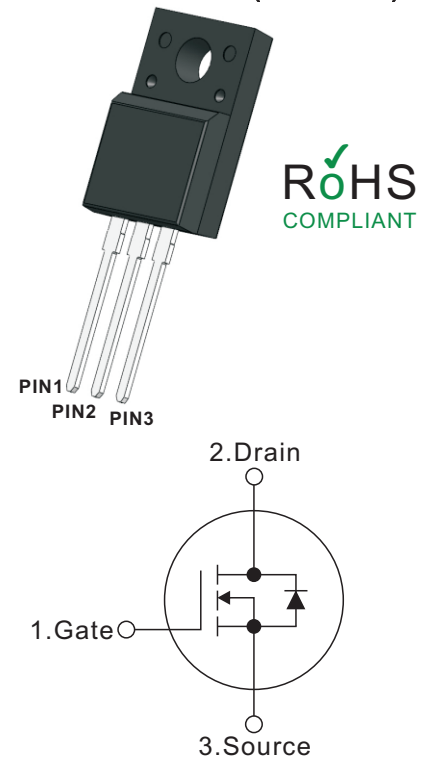
The F4N60L is a high voltage power MOSFET and is designed to have better characteristics, such as fast switching time, low gate charge, low on-state resistance and have a high rugged avalanche characteristics. This power MOSFET is usually used at high speed switching applications in switching power supplies and adaptors.

Features

- $R_{DS(ON)} < 2.5 \Omega$ @ $V_{GS}=10V$, $I_D=2.0A$
- Fast switching capability
- 100% Avalanche tested
- 100% ΔV_{DS} tested

Mechanical data

- Case: TO-220F-3L
- pprox. Weight: 1.77g (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	F4N60L	F4N60L	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_{DS}	600	V
Gate-Source Voltage	V_{GS}	± 30	V
Continuous Drain Current $T_c=25^\circ\text{C}$ $T_c=100^\circ\text{C}$	I_D	4.0 2.5	A
Pulsed Drain Current (Note 2)	I_{DM}	16	A
Avalanche Energy Single Pulsed (Note 3)	E_{AS}	173	mJ
Power Dissipation ($T_c = 25^\circ\text{C}$)	P_D	20	W
Operating junction and storage temperature	T_J, T_{STG}	-55 ~ +150	$^\circ\text{C}$

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 = 100mH, IAS = 4.1A, VDD = 50V, RG = 25 Ω , Starting $T_J = 25^\circ\text{C}$

Thermal Resistance

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



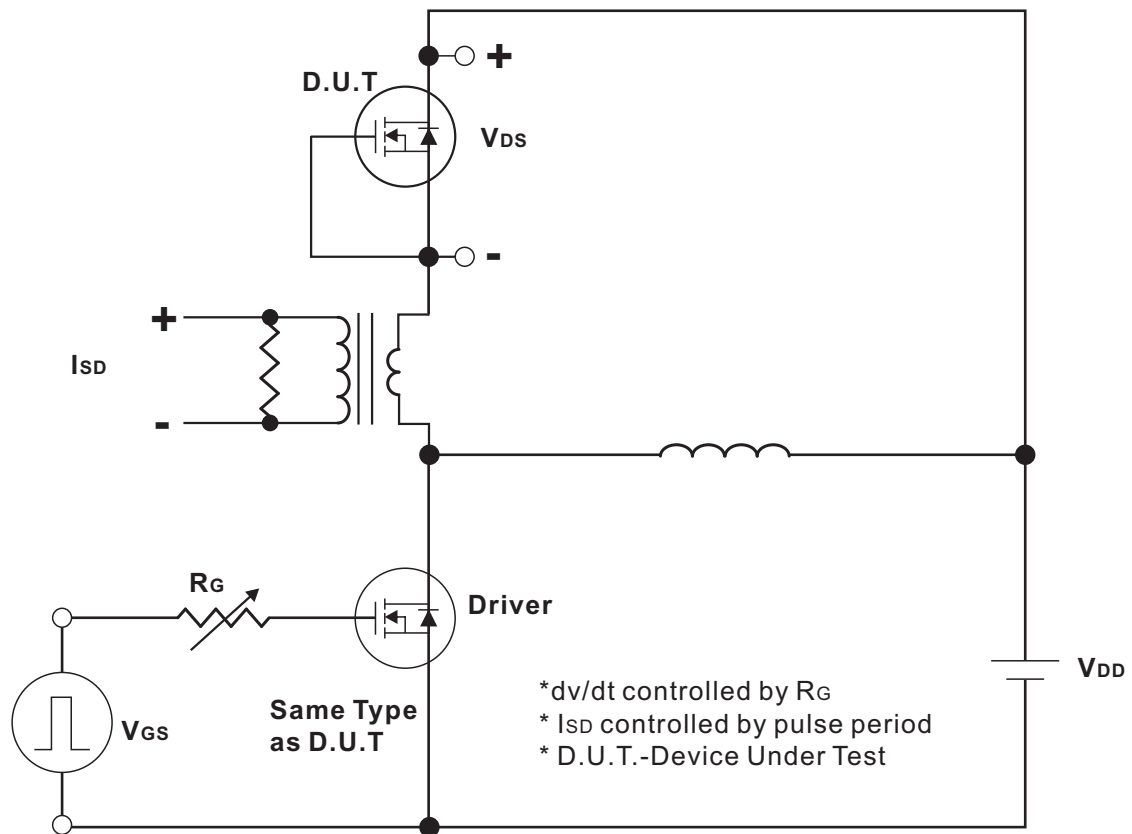
Electrical Characteristics (Ta=25°C, Unless Otherwise Specified)

Parameter		Symbols	Test Conditions	Min	Typ	Max	Units
Off Characteristics							
Drain-Source Breakdown Voltage		BV _{DSS}	V _{GS} =0V,I _D =250uA	600			V
Drain-Source Leakage Current		I _{DSS}	V _{DS} =600V,V _{GS} =0V			1.0	uA
Gate- Source Leakage Current	Forward	I _{GSS}	V _{GS} =30V,V _{DS} =0V			100	nA
	Reverse		V _{GS} =-30V,V _{DS} =0V			-100	
On Characteristics							
Gate Threshold Voltage		V _{GS(TH)}	V _{DS} =V _{GS} ,I _D =250uA	2.0		4.0	V
Static Drain-Source On-State Resistance		R _{DS(ON)}	V _{GS} =10V,I _D =2.0A		2.1	2.5	Ω
Transconductance		g _{fs}	V _{DS} =25V,I _D =5A		4.3		S
Dynamic Characteristics							
Input Capacitance		C _{ISS}	V _{DS} =25V, V _{GS} =0V, f=1.0MHz		564		pF
Output Capacitance		C _{OSS}			66		pF
Reverse Transfer Capacitance		C _{RSS}			12		pF
Gate resistance		R _G			1.1		Ω
Switching Characteristics							
Total Gate Charge (Note 1)		Q _G	V _{DS} =480V,V _{GS} =10V, I _D =4A (NOTE1,2)		12		nC
Gate-Source Charge		Q _{GS}			4.0		nC
Gate-Drain Charge		Q _{GD}			4.8		nC
Turn-On Delay Time (Note 1)		t _{D(ON)}	V _{DS} =300V,I _D =4A R _G =25Ω (NOTE1,2)		30		ns
Turn-On Rise Time		t _R			75		ns
Turn-Off Delay Time		t _{D(OFF)}			60		ns
Turn-Off Fall Time		t _F			55		ns
Drain-Source Diode Characteristics And Maximum Ratings							
Maximum Body-Diode Continuous Current		I _S				4	A
Drain-Source Diode Forward Voltage (Note 1)		V _{SD}	I _{SD} =4A,V _{GS} =0V			1.4	V
Reverse Recovery Time (Note 1)		t _{rr}	I _F =4A		250		ns
Reverse Recovery Charge		Q _{rr}	di/dt=100A/us		4.5		uC

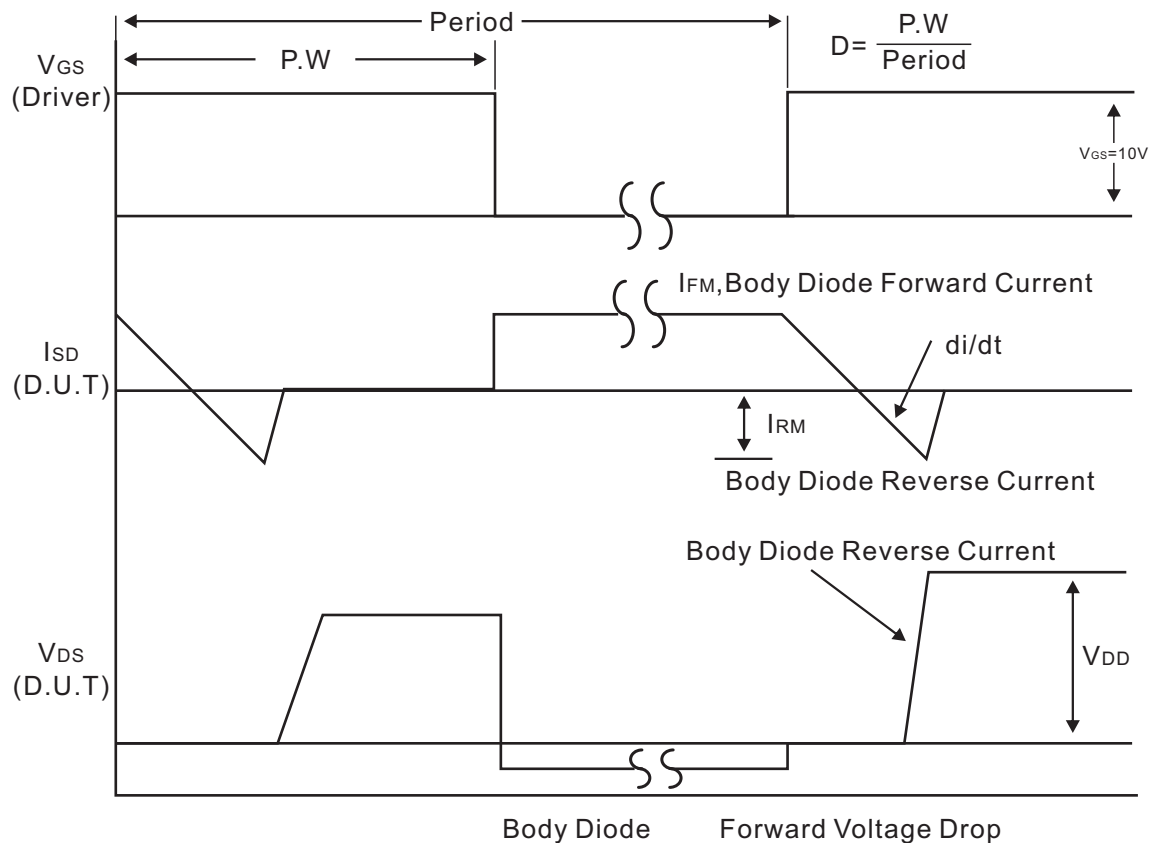
Notes:

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

Test Circuits and waveforms



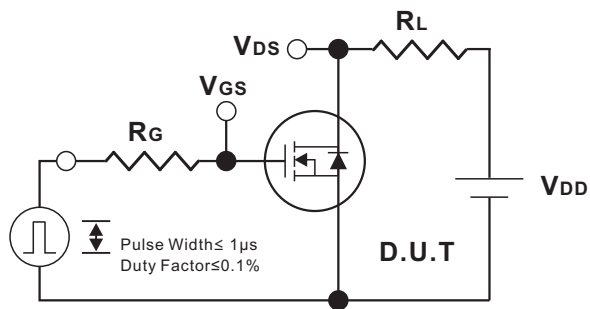
Peak Diode Recovery dv/dt Test Circuit



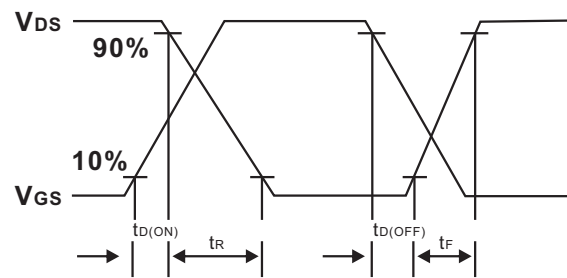
Peak Diode Recovery dv/dt Waveforms



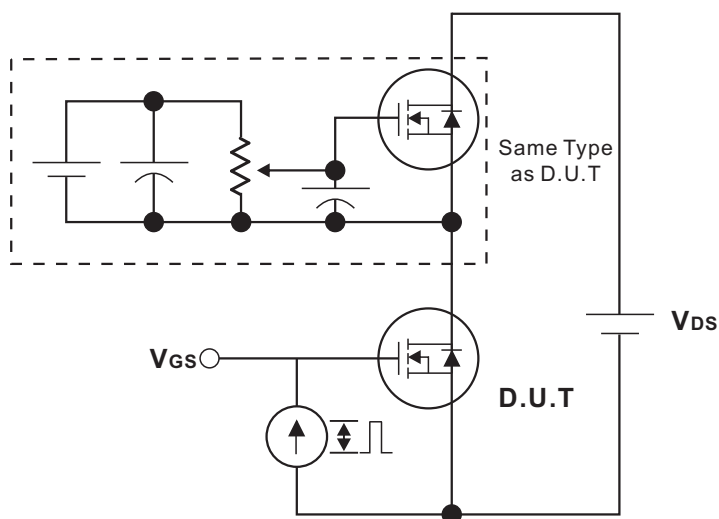
Test Circuits and waveforms



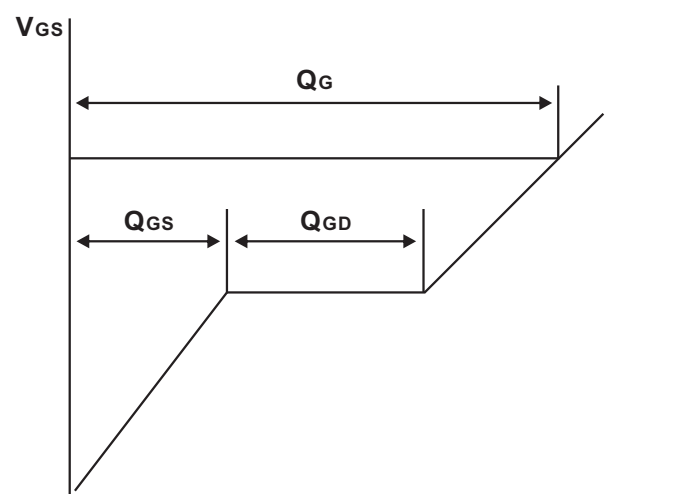
Switching Test Circuit



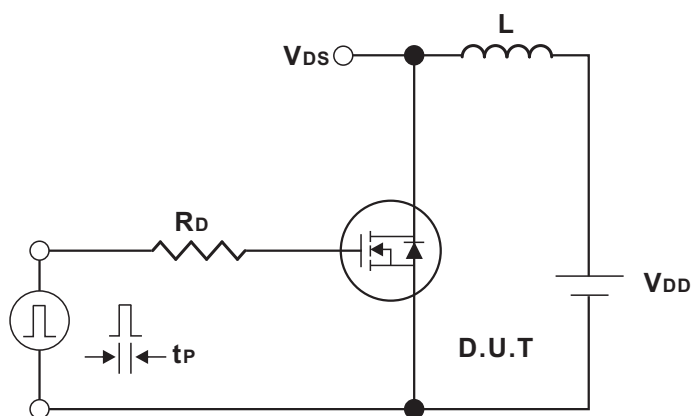
Switching Waveforms



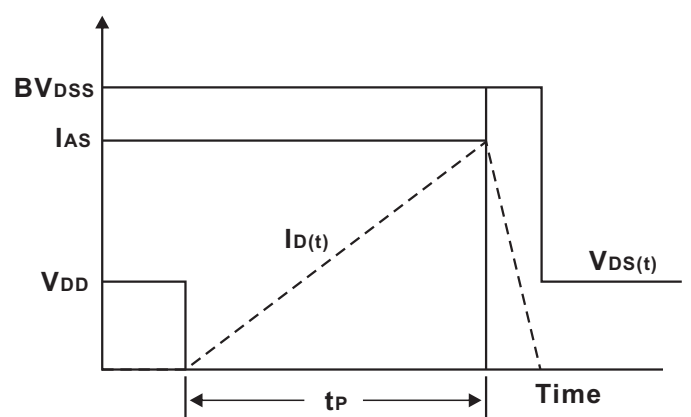
Gate Charge Test Circuit



Charge
Gate Charge Waveform



Unclamped Inductive Switching Test Circuit



Unclamped Inductive Switching Waveforms



Typical Characteristics

Fig.1 Output characteristics

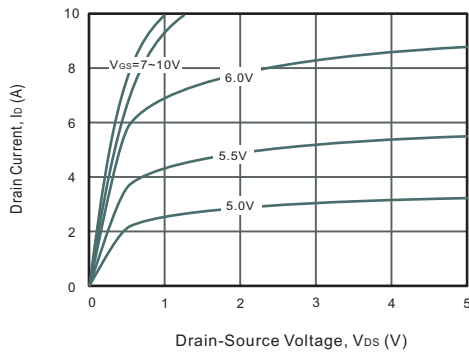


Fig.2 Power Dissipation

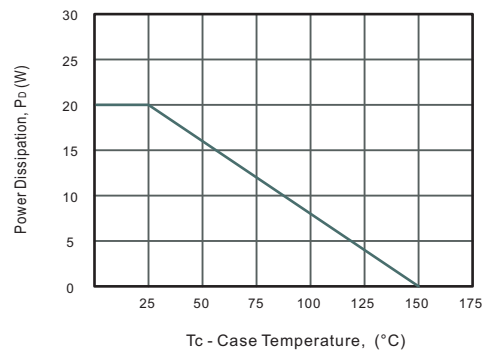


Fig.3 Drain Current Derating

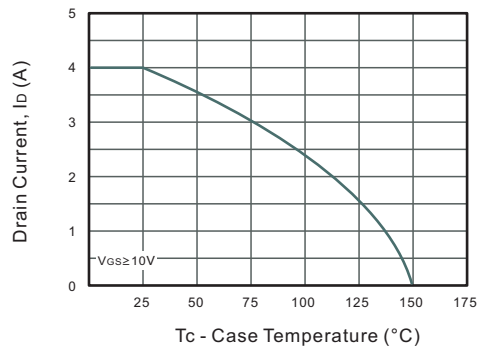


Fig.4 Drain-Source On-Resistance vs. Drain Current

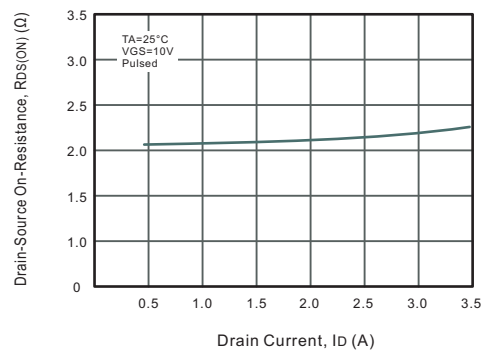


Fig.5 Gate Threshold Voltage vs. Junction Temperature

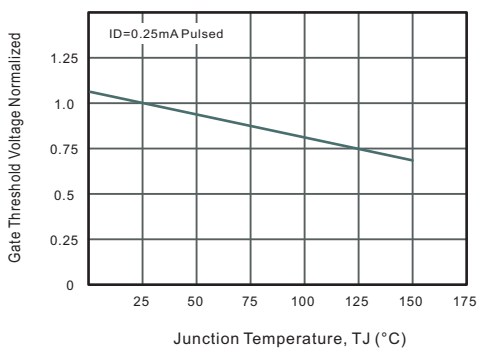


Fig.6 Body-diode Forward Characteristics

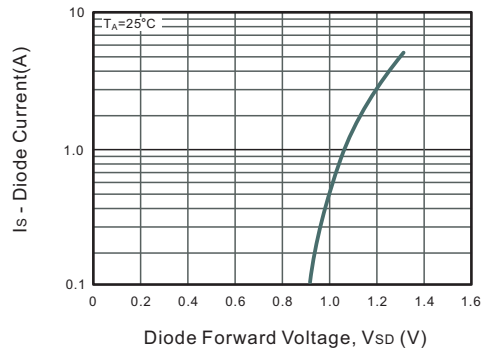


Fig.7 Drain-Source On-Resistance vs. Junction Temperature

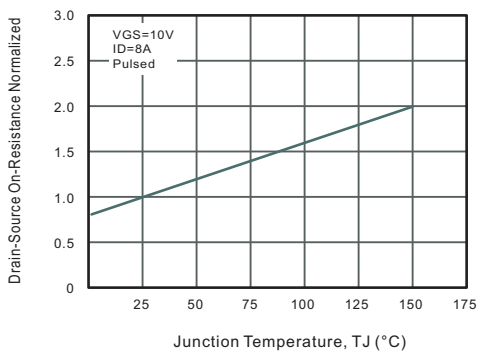
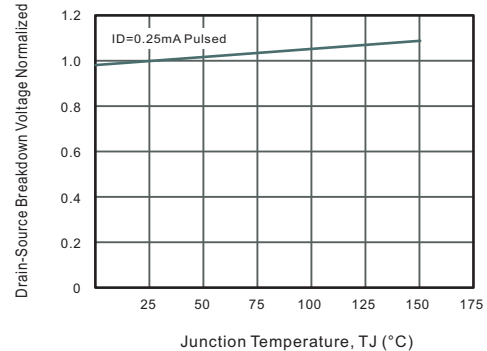


Fig.8 Breakdown Voltage vs. Junction Temperature





Typical Characteristics

Fig.9 Capacitance Characteristics

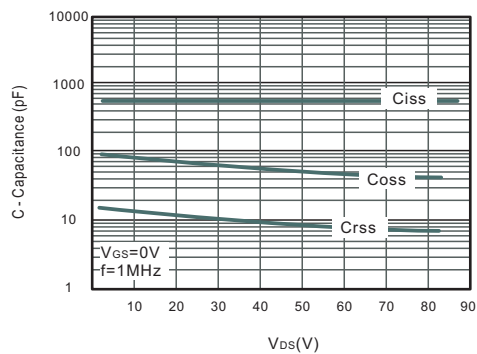


Fig.10 Gate Charge Characteristics

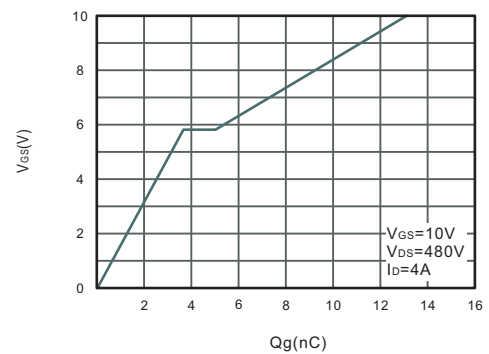


Fig.11 Safe Operating Area

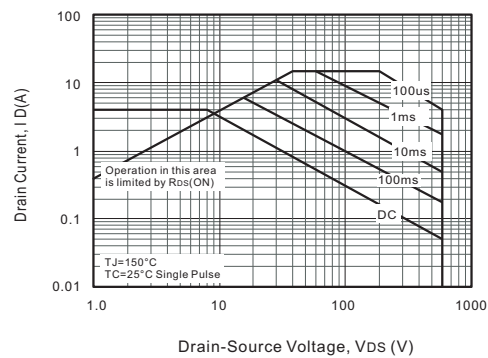
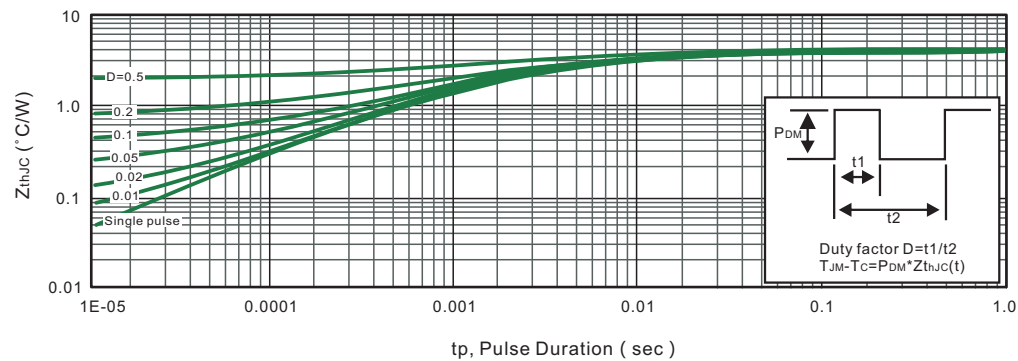


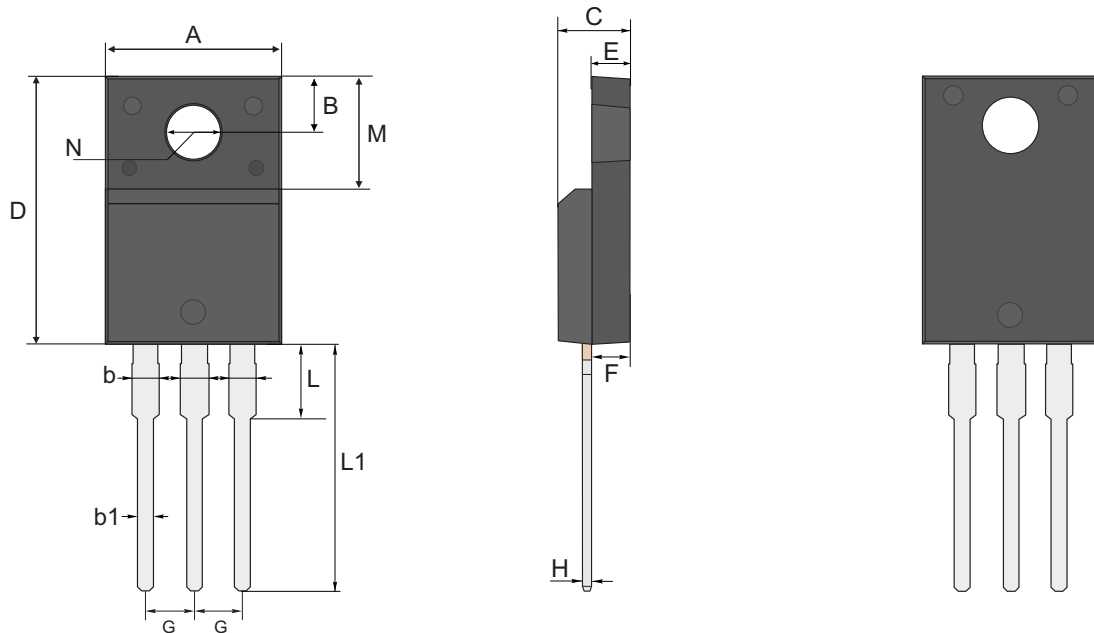
Fig.12 Max. Transient Thermal Impedance





Package Outline
Through Hole Package ; 3 leads

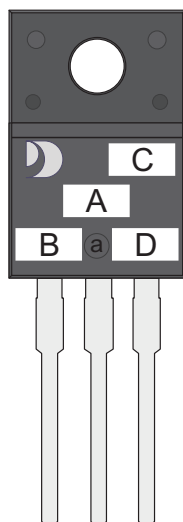
TO-220F-3L



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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