

## 4A, 600V N-CHANNEL POWER MOSFET

ITO-220ABW

### DESCRIPTION

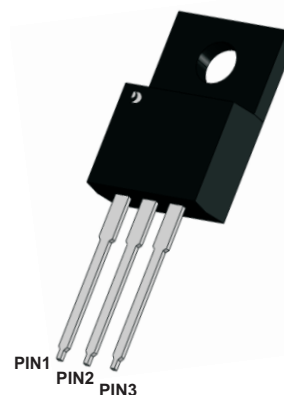
The F4N60 is a high voltage power MOSFET and is designed to have better characteristics, such as fast switching time, low gate charge, low on-state resistance and have a high rugged avalanche characteristics. This power MOSFET is usually used at high speed switching applications in switching power supplies and adaptors.

### Features

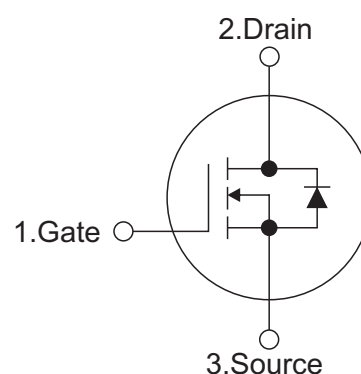
- $R_{DS(ON)} \leq 2.5 \Omega$  @  $V_{GS}=10V, I_D=2.0A$
- Fast switching capability
- Avalanche energy tested
- Improved dv/dt capability, high ruggedness

### Mechanical data

- Case: ITO-220ABW
- 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	$V_{DSS}$	600	V	
Gate-Source Voltage	$V_{GSS}$	$\pm 30$	V	
Continuous Drain Current	$I_D$	$T_c=25^\circ C$	4	A
		$T_c=100^\circ C$	2.5	A
Pulsed Drain Current (Note 2)	$I_{DM}$	16	A	
Avalanche Energy Single Pulsed (Note 3)	$E_{AS}$	173	mJ	
Peak Diode Recovery dv/dt (Note 4)	dv/dt	2.1	V/ns	
Power Dissipation	$P_D$	43	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 = 100mH, IAS = 4.1A, VDD = 50V, RG = 25  $\Omega$ , Starting TJ = 25 $^\circ C$

4. ISD  $\leq$  10A, di/dt  $\leq$  200A/ $\mu s$ , VDD  $\leq$  BVDSS, Starting TJ = 25 $^\circ C$

### THERMAL DATA

PARAMETER	Symbols	RATINGS	Units
Junction to Ambient	$R_{thJA}$	63	$^\circ C/W$
Junction to Case	$R_{thJC}$	2.9	$^\circ C/W$



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

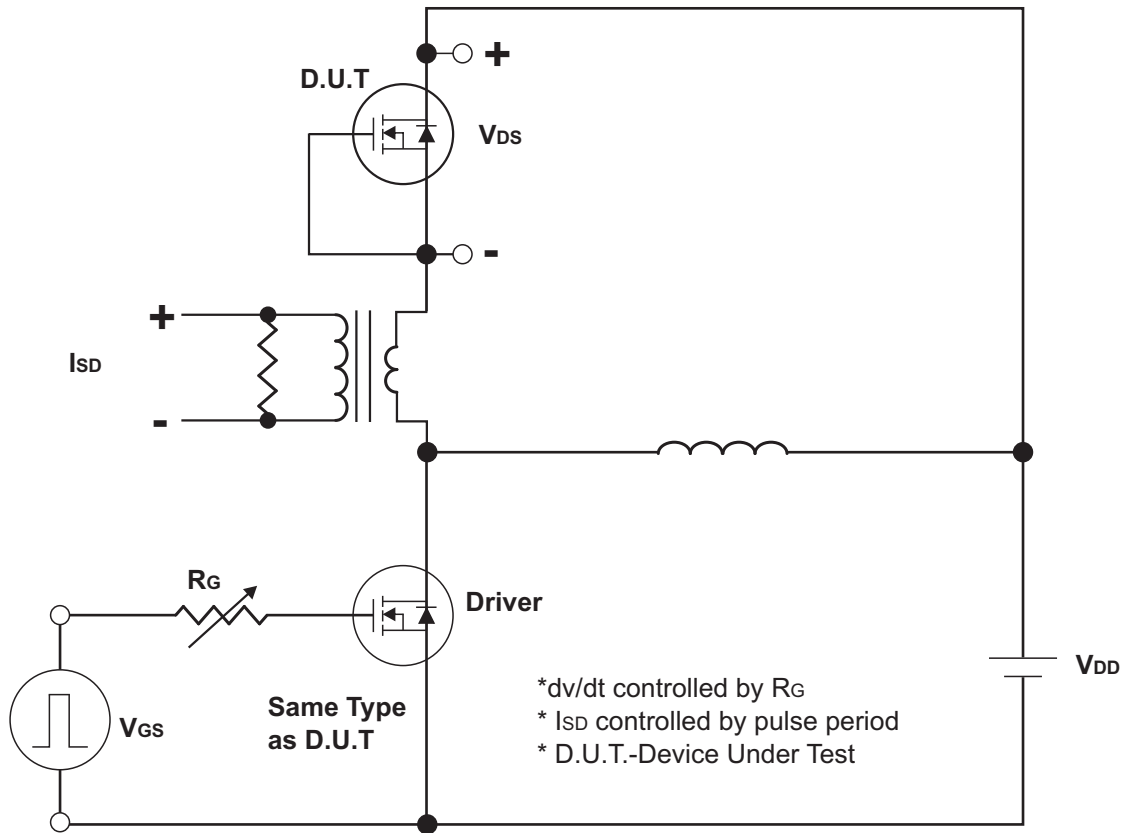
PARAMETER		Symbols	TEST CONDITIONS	Min	Typ	Max	Units	
<b>OFF CHARACTERISTICS</b>								
Drain-Source Breakdown Voltage		$BV_{DSS}$	$V_{GS}=0V, I_D=250\mu A$	600			V	
Drain-Source Leakage Current		$I_{DSS}$	$V_{DS}=600V, V_{GS}=0V$			1	$\mu A$	
Gate- Source Leakage Current	Forward	$I_{GSS}$	$V_{GS}=30V, V_{DS}=0V$			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		$R_{DS(ON)}$	$V_{GS}=10V, I_D=2.0A$		2.04	2.5	$\Omega$	
<b>DYNAMIC CHARACTERISTICS</b>								
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
<b>SWITCHING CHARACTERISTICS</b>								
Total Gate Charge (Note 1)		$Q_G$	$V_{DS}=480V, V_{GS}=10V,$ $I_D=4A, I_G=1mA$ (NOTE1,2)		13		nC	
Gate-Source Charge		$Q_{GS}$				4		nC
Gate-Drain Charge		$Q_{GD}$				2.2		nC
Turn-On Delay Time (Note 1)		$t_{D(ON)}$	$V_{DS}=100V, V_{GS}=10V,$ $I_D=4A, R_G=25\Omega$ (NOTE1,2)		7		ns	
Turn-On Rise Time		$t_R$				16		ns
Turn-Off Delay Time		$t_{D(OFF)}$				36		ns
Turn-Off Fall Time		$t_F$				22		ns
<b>DRAIN-SOURCE DIODE CHARACTERISTICS AND MAXIMUM RATINGS</b>								
Maximum Body-Diode Continuous Current		$I_S$				4	A	
Maximum Body-Diode Pulsed Current		$I_{SM}$				16	A	
Drain-Source Diode Forward Voltage (Note 1)		$V_{SD}$	$I_S=4A, V_{GS}=0V$			1.4	V	
Reverse Recovery Time (Note 1)		$t_{rr}$	$I_S=4A, V_{GS}=0V,$		250		ns	
Reverse Recovery Charge		$Q_{rr}$	$di/dt=100A/\mu s$		4.5		$\mu C$	

Notes:

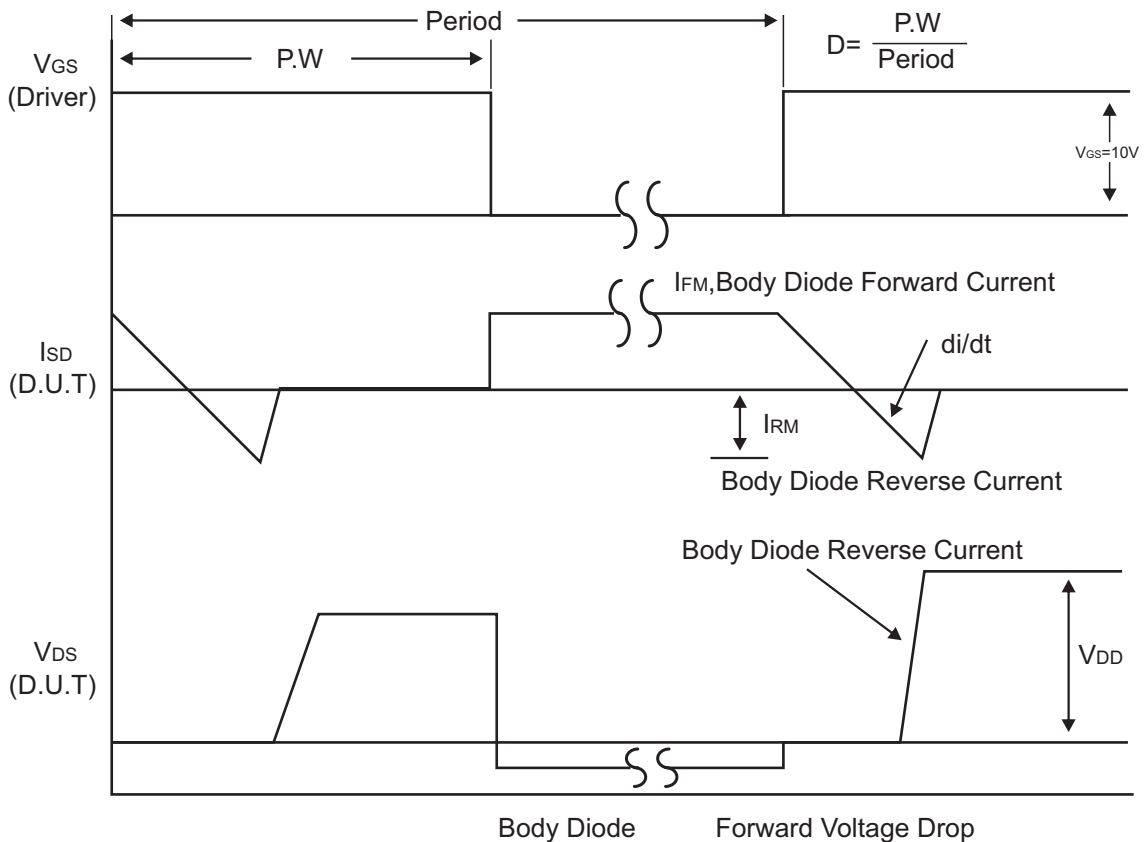
1. Pulse Test: Pulse width  $\leq 300\mu s$ , Duty cycle  $\leq 2\%$ .
2. Essentially independent of operating temperature.



Test Circuits and waveforms



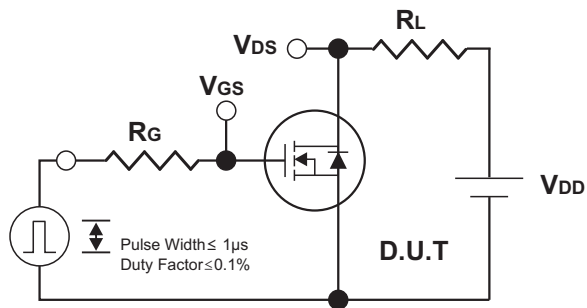
Peak Diode Recovery dv/dt Test Circuit



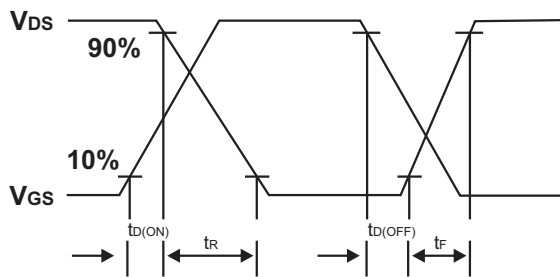
Peak Diode Recovery dv/dt Waveforms



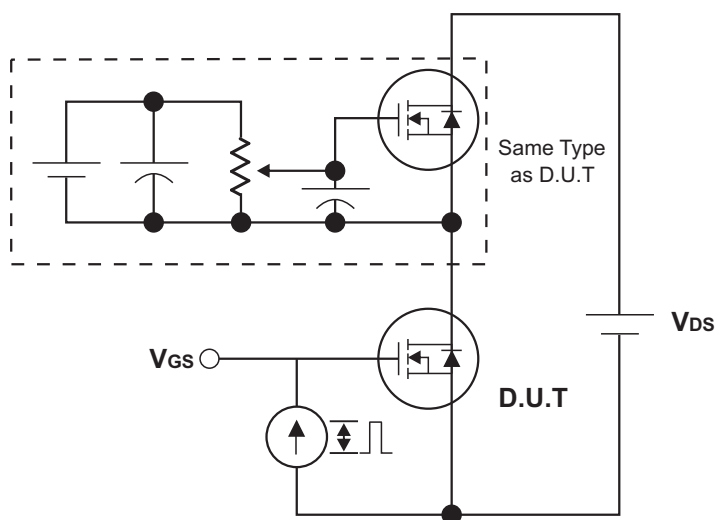
### Test Circuits and waveforms



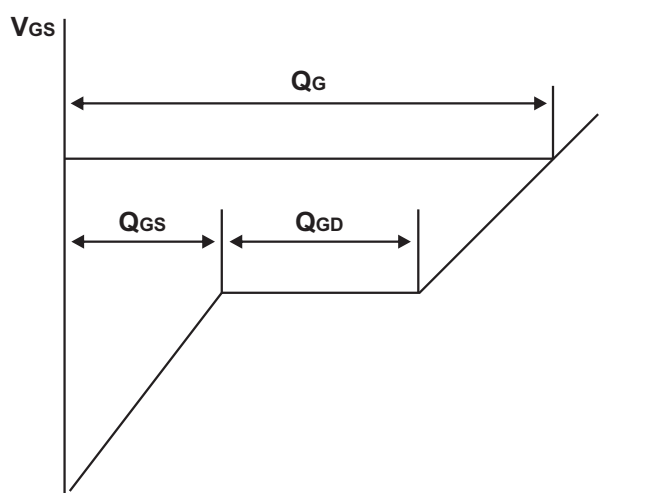
Switching Test Circuit



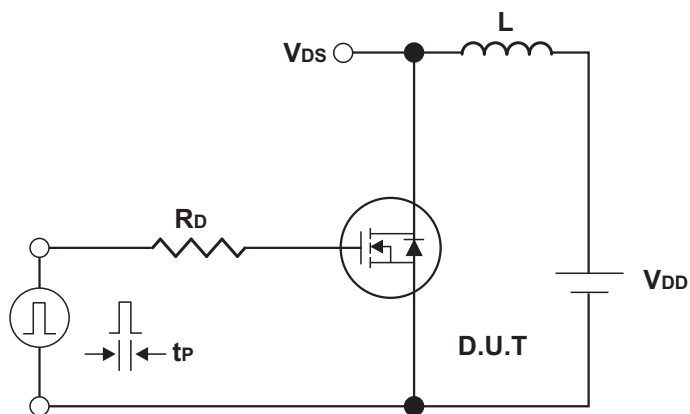
Switching Waveforms



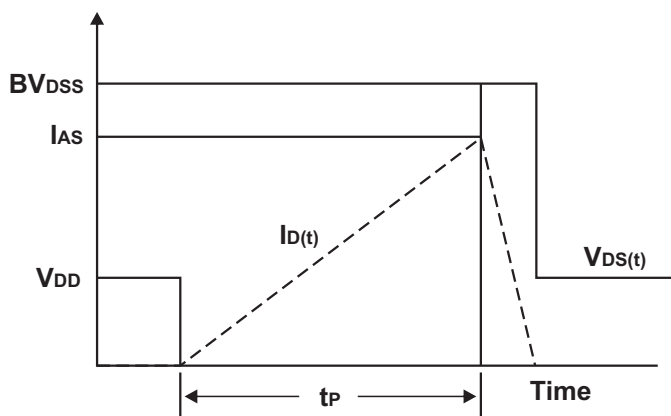
Gate Charge Test Circuit



Charge  
Gate Charge Waveform



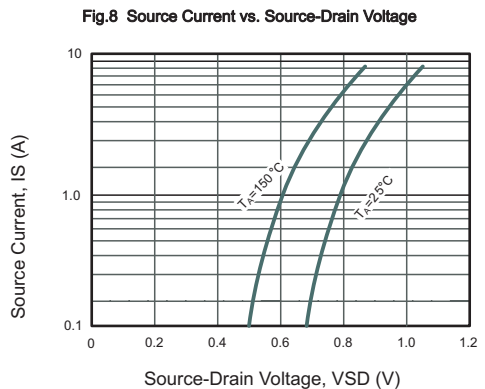
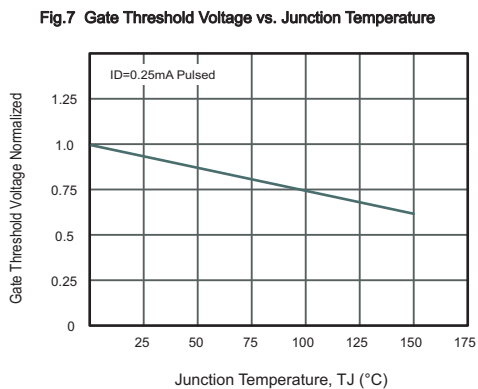
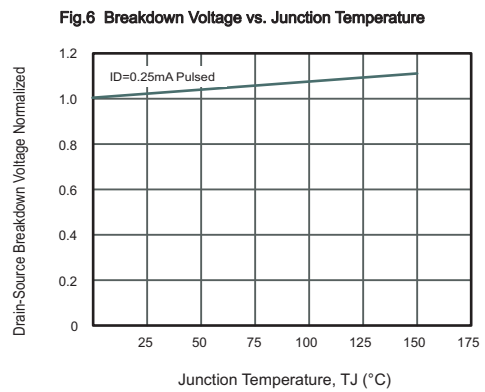
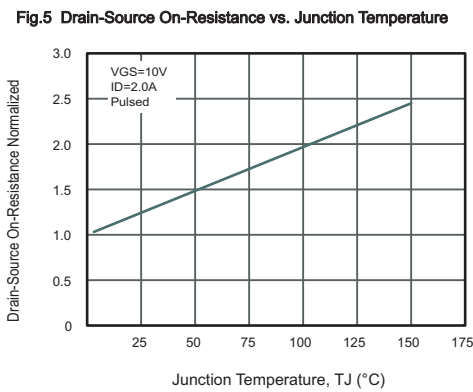
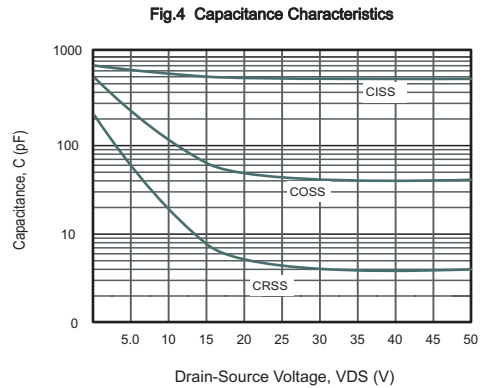
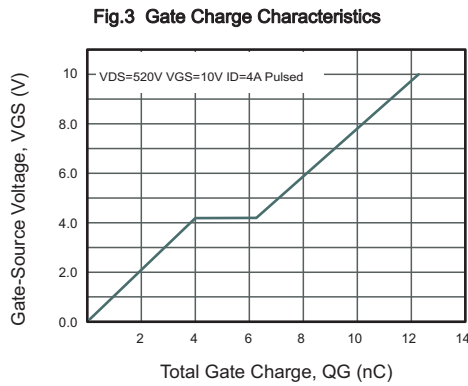
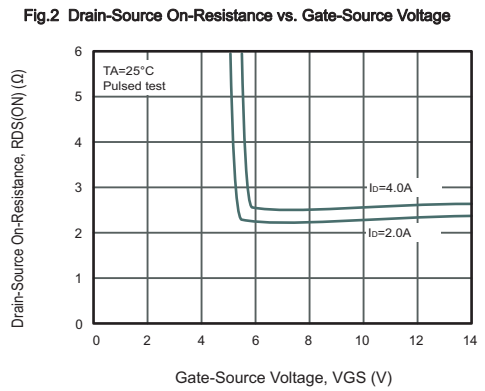
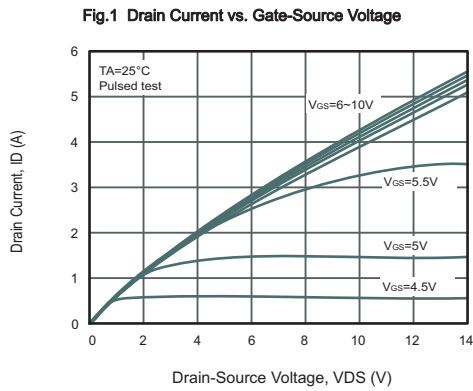
Unclamped Inductive Switching Test Circuit



Unclamped Inductive Switching Waveforms



### Typical Characteristics





## Typical Characteristics

Fig.9 Drain Current vs. Gate-Source Voltage

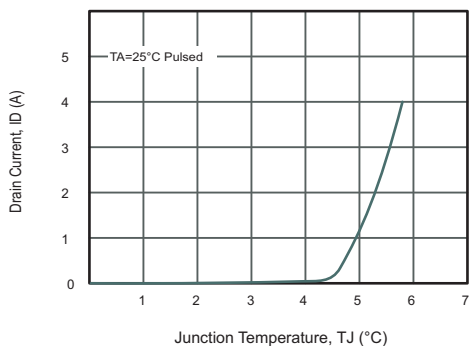


Fig.10 Drain-Source On-Resistance vs. Drain Current

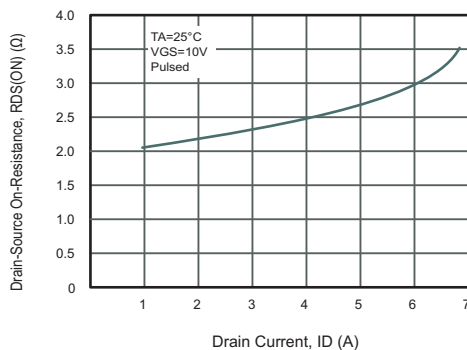


Fig.11 Drain Current vs. Junction Temperature

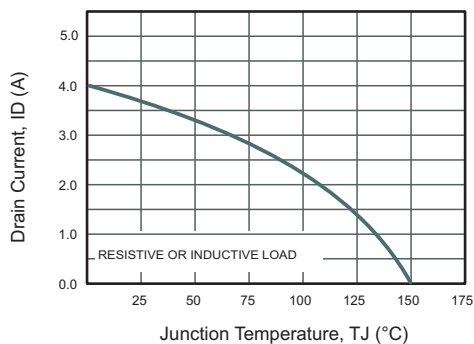


Fig.12 Power Dissipation vs. Junction Temperature

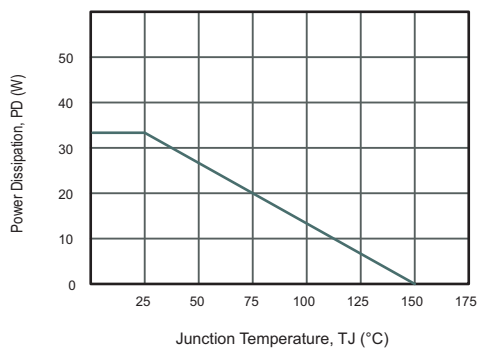
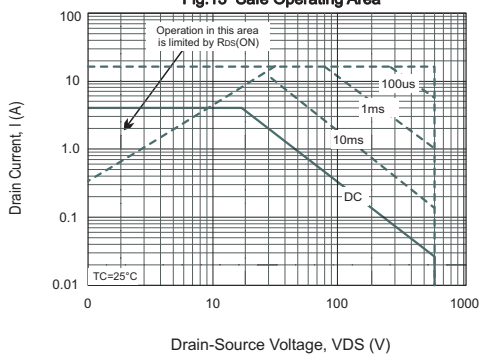


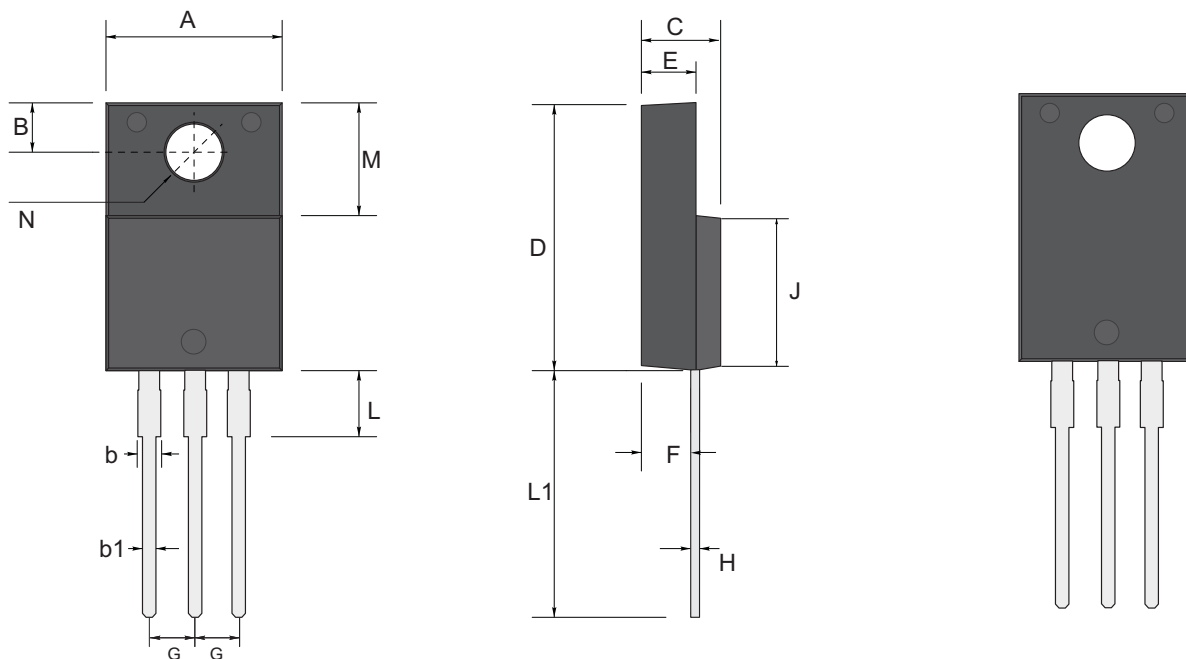
Fig.13 Safe Operating Area





PACKAGE OUTLINE  
Plastic surface mounted package; 3 leads

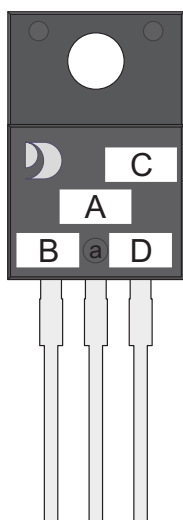
ITO-220ABW



ITO-220ABW mechanical data

UNIT		A	B	b	b1	C	D	E	F	G	H	L	L1	M	N
mm	max	10.5	2.85	1.4	0.8	4.7	16.0	2.9	2.8	2.54 TYPICAL	0.70	2.9	14.3	7.0	3.4 TYPICAL
	typ	10.0	2.70	1.2	0.6	4.5	15.0	2.7	2.7		0.55	2.5	13.5	6.8	
	min	9.85	2.54	1.1	0.5	4.4	14.7	2.5	2.5		0.41	2.3	13.0	6.3	
mil	max	413	112	55	31	185	630	114	110	100 TYPICAL	27	114	563	276	133 TYPICAL
	typ	394	106	47	24	177	590	106	106		22	98	531	267	
	min	388	100	43	20	173	580	98	98		16	91	512	248	

**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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