

600V/12A Power MOSFET (N-Channel)

General Description

- MSU12N60 is a N-Channel enhancement mode power MOSFET with advanced technology. It is designed to have Better characteristics, such as fast switching time, low gate charge, minimized on-state resistance and withstanding high energy pulse in the avalanche and commutation modes. These devices are well suited for high efficiency switching mode power supply applications.
- MSU12N60 are available in TO-220, TO-220F packages.



TO-220

TO-220F

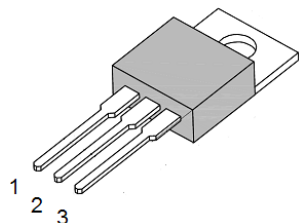


**HALOGEN
FREE**

Features

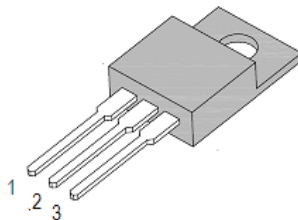
- $R_{DS(ON)} = 0.8\Omega @ V_{GS} = 10V$
- Ultra low gate charge (Typ. 42nC)
- Low reverse transfer capacitance ($C_{rss} = \text{Typ. } 25\text{pF}$)
- Fast switching capability
- Avalanche energy tested
- Improved dv/dt capability, high ruggedness
- RoHS Compliance and Halogen free

Pin Configuration and Symbol



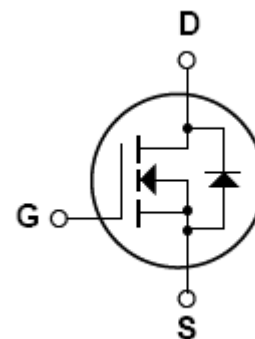
1: GATE 2: DRAIN 3: SOURCE

TO-220



1: GATE 2: DRAIN 3: SOURCE

TO-220F



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MSU12N60

Absolute Maximum Ratings ($T_C=25^\circ\text{C}$ unless otherwise specified, Note)

Symbol	Description	Ratings	Unit
V_{DSS}	Drain-Source Voltage	600	V
V_{GSS}	Gate-Source Voltage	± 30	V
I_D	Drain Current -Continuous	12	A
I_{DM}	Drain Current -Pulsed (note1)	48	A
E_{AS}	Avalanche Energy	Single Pulsed (Note2)	mJ
E_{AR}		Repetitive (Note1)	
I_{AR}	Avalanche Current (note1)	12	A
dv/dt	Peak Diode Recovery dv/dt (note3)	4.5	V/ns
P_D	Power Dissipation	TO-220	W
		TO-220F	
R_{θJA}	Thermal Resistance (Junction-to-Ambient)	62.5	°C/ W
R_{θJC}	Thermal Resistance (Junction-to-Case)	TO-220	°C/ W
		TO-220F	
T_J	Junction Temperature	+150	° C
T_{STG}	Storage Temperature Range	-55 to +150	° C

Note: Absolute maximum ratings indicate limits beyond which damage to the device may occur.
For guarantee specification and test conditions, see the Electrical Characteristics.
The guaranteed specification apply only for the test conditions listed.

Note1: Repetitive Rating: Pulse width limited by maximum junction temperature

2: L=10mH, I_{AS}=12A, V_{DD}=50V, R_G=25Ω, Starting T_J=25°C

3: I_{sd}≤12A, di/dt≤200A/s, V_{DD}≤V_{BR(DSS)}, Starting T_J=25°C

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Electrical Characteristics ($T_C=25^{\circ}\text{C}$ unless otherwise specified)

Symbol	Description	Min.	Typ.	Max.	Unit	Conditions	
OFF CHARACTERISTICS							
$V_{(BR)DSS}$	Drain-Source Breakdown Voltage	600	-	-	V	$V_{GS}=0V, I_D=250\mu A$	
$\Delta V_{(BR)DSS} / \Delta T_J$	Breakdown Voltage Temperature Coefficient	-	0.7	-	V/ $^{\circ}\text{C}$	$I_D=250\mu A$	
I_{DSS}	Drain-Source leakage Current	-	-	1	μA	$V_{DS}=600V, V_{GS}=0V$	
I_{GSS}	Gate-Source leakage Current	Forward	-	-	100	nA	$V_{GS}=30V, V_{DS}=0V$
		Reverse	-	-	-100	nA	$V_{GS}=-30V, V_{DS}=0V$
ON CHARACTERISTICS							
$V_{GS(th)}$	Gate-Source Threshold Voltage	2.0	-	4.0	V	$V_{DS}=V_{GS}, I_D=250\mu A$	
$R_{DS(on)}$	Static Drain-Source On-State Resistance	-	0.6	0.8	Ω	$V_{GS}=10V, I_D=6.0A$	
DYNAMIC CHARACTERISTICS							
C_{iss}	Input Capacitance	-	1480	1900	pF	$V_{DS}=25V, V_{GS}=0V, f=1.0\text{MHz}$	
C_{oss}	Output Capacitance	-	200	270	pF		
C_{rss}	Reverse Transfer Capacitance	-	25	35	pF		
R_g	Gate Resistance	0.2	-	1.2	Ω	$V_{DS}=V_{GS}=0V, f=1\text{MHz}$	
SWITCHING CHARACTERISTICS							
$t_d(on)$	Turn-on Delay Time	-	30	70	nS	$V_{DD}=300V, I_D=12A, R_G=25\Omega$ (Note 4, 5)	
t_r	Turn-on Rise Time	-	115	240	nS		
$t_d(off)$	Turn-off Delay Time	-	95	200	nS		
t_f	Turn-off Fall Time	-	85	180	nS		
Q_g	Total Gate Charge	-	42	54	nC	$V_{DS}=480V, I_D=12A, V_{GS}=10V$ (Note 4, 5)	
Q_{gs}	Gate-Source Charge	-	8.6	-	nC		
Q_{gd}	Gate-Drain Charge	-	21	-	nC		
DRAIN-SOURCE DIODE CHARACTERISTICS AND MAXIMUM RATINGS							
V_{SD}	Drain-Source Diode Forward Voltage	-	-	1.4	V	$V_{GS}=0V, I_S=12A$	
I_S	Maximum Continuous Drain-Source Diode Forward Current	-	-	12	A	-	
I_{SM}	Maximum Pulse Drain-Source Diode Forward Current	-	-	48	A	-	
t_{rr}	Reverse Recovery Time	-	380	-	nS	$V_{GS}=0V, I_S=12A$	
Q_{rr}	Reverse Recovery Charge	-	3.5	-	μC	$dI_F/dt=100\text{A}/\mu\text{s}$ (Note4)	

Note 4: Pulse test: Pulse width $\leq 300\mu\text{s}$, Duty cycle $\leq 2\%$

5: Essentially independent of operating temperature

Typical Characteristics Curves

Fig.1- On-Resign Characteristics

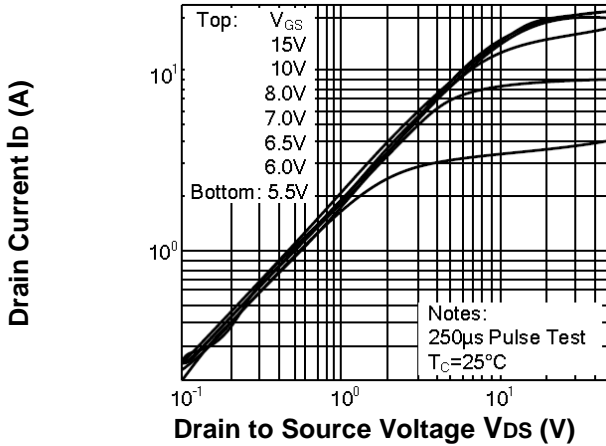


Fig.2- Transfer Characteristics

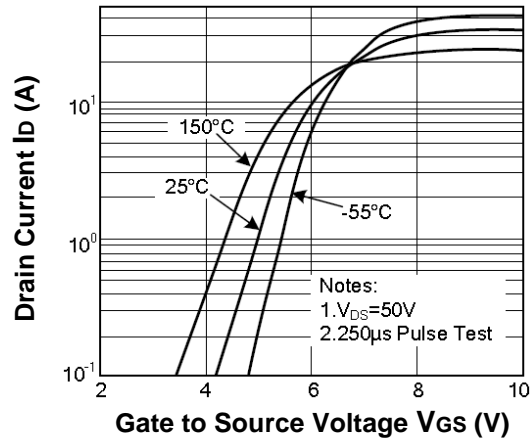


Fig.3- On-Resistance variation vs. Drain current and Gate Voltage

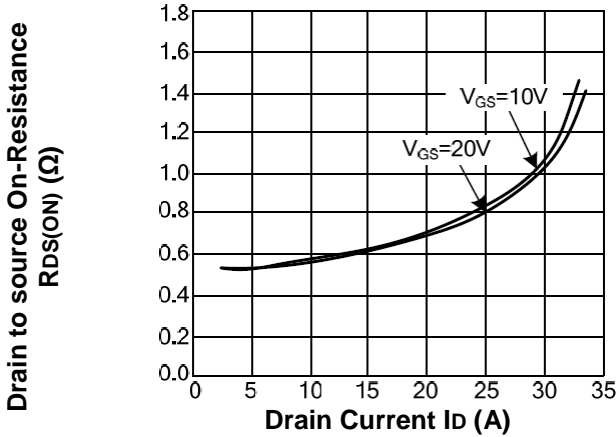


Fig.4- Body Diode Forward Voltage Variation vs. Source Current and Temperature

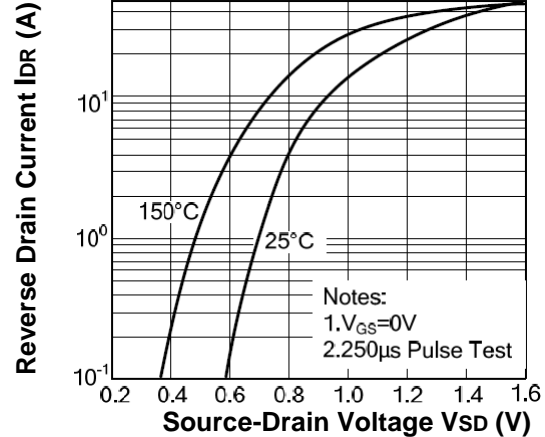


Fig.5- Capacitance Characteristics

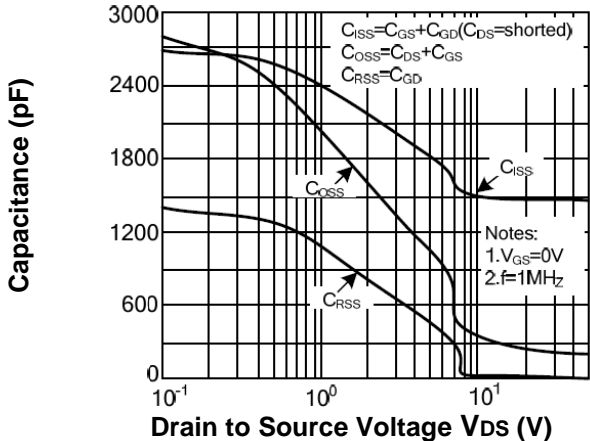


Fig.6- Gate Charge Characteristics

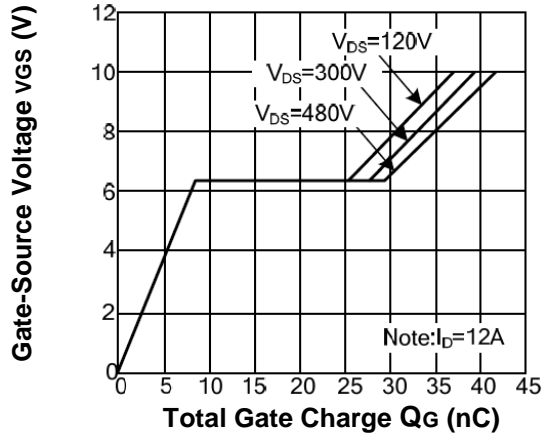


Fig.7- Maximum safe operating area

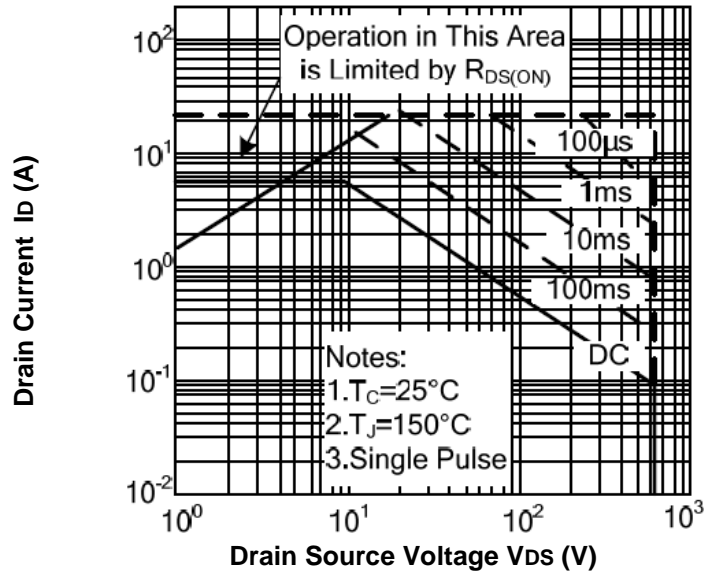
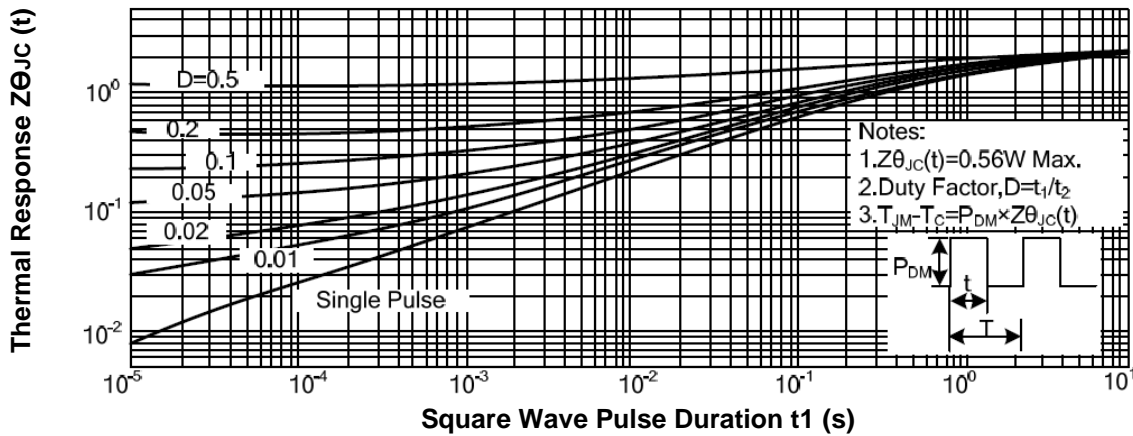


Fig.8- Transient Thermal Response Curve



TEST CIRCUIT AND WAVEFORMS

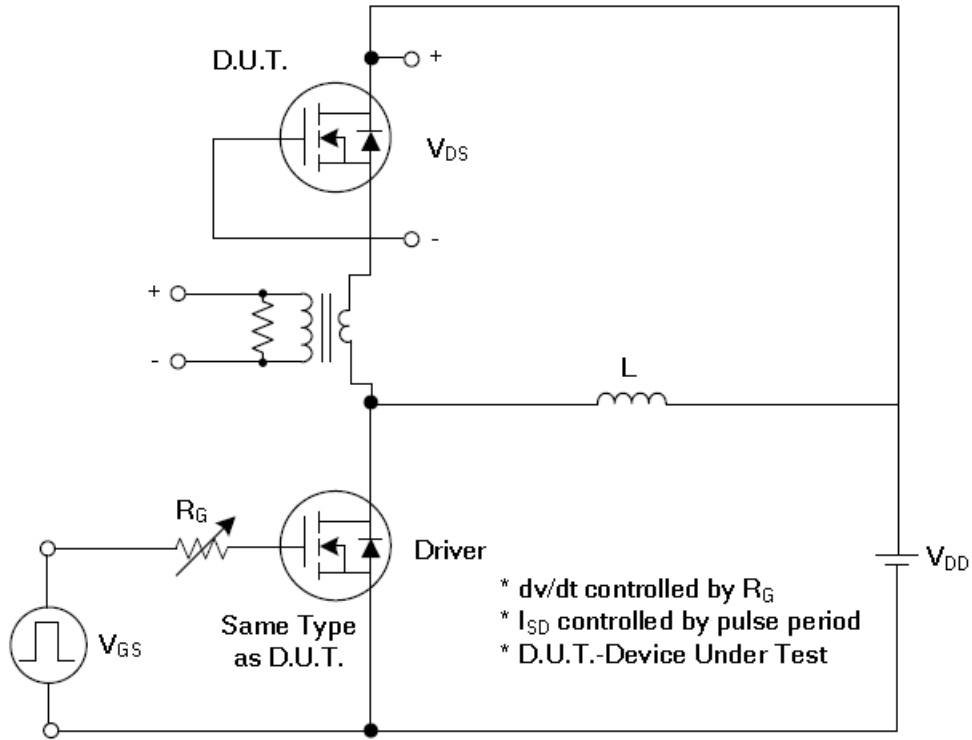


Fig.9- Peak Diode Recovery dv/dt Test Circuit

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MSU12N60

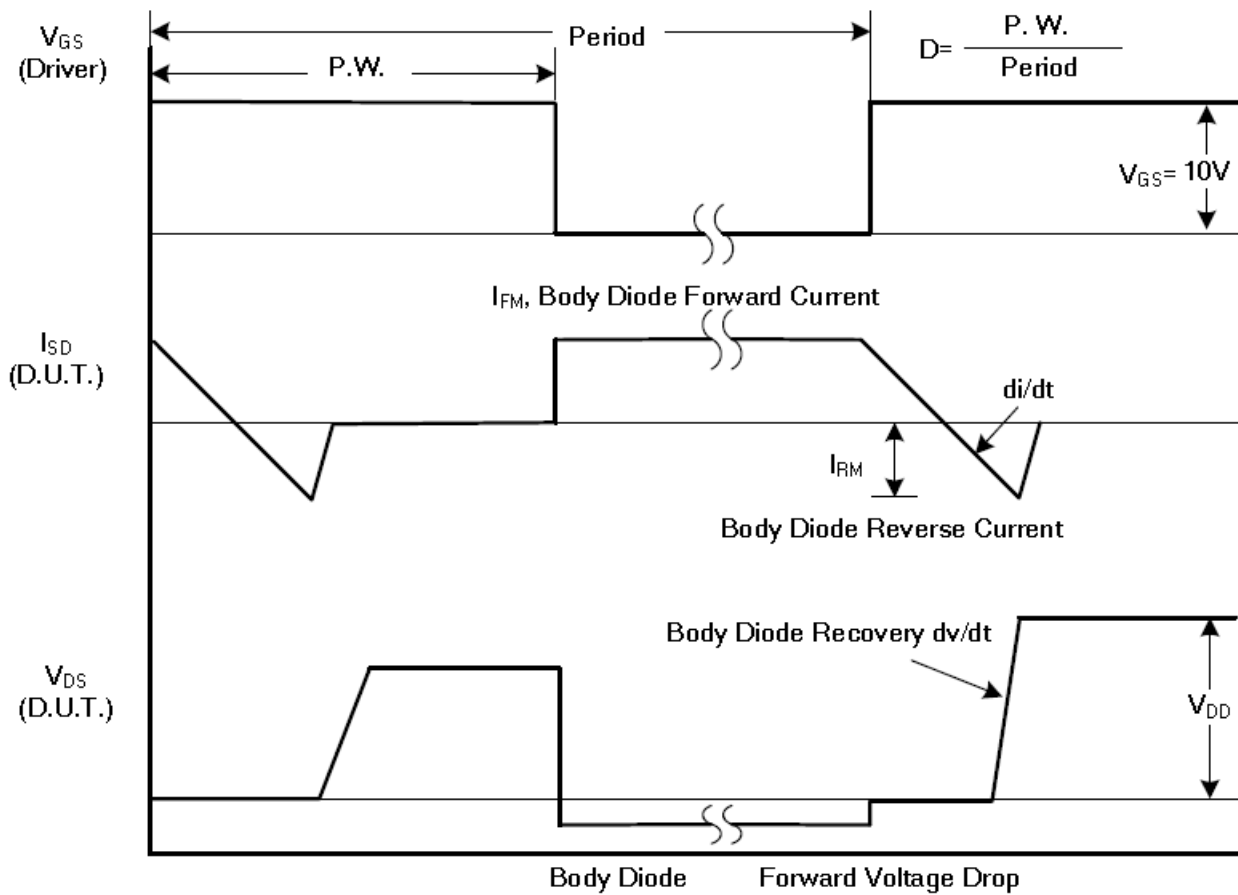


Fig.10- Peak diode Recovery dv/dt Waveform

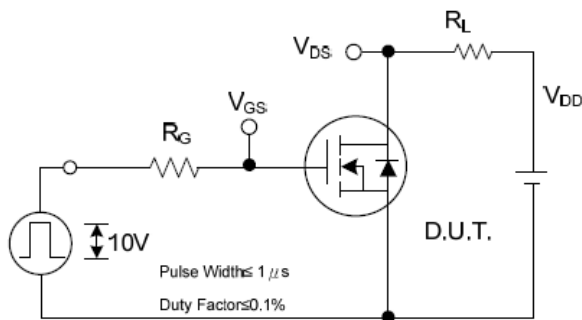


Fig.11- Switching Test Circuit

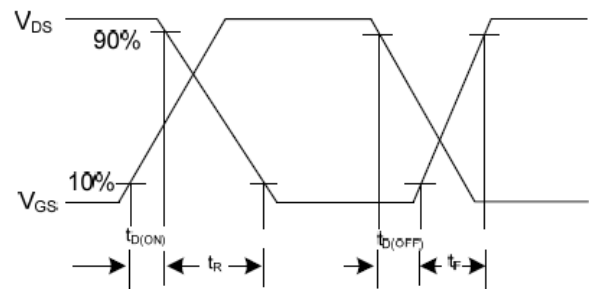


Fig.12- Switching Waveform

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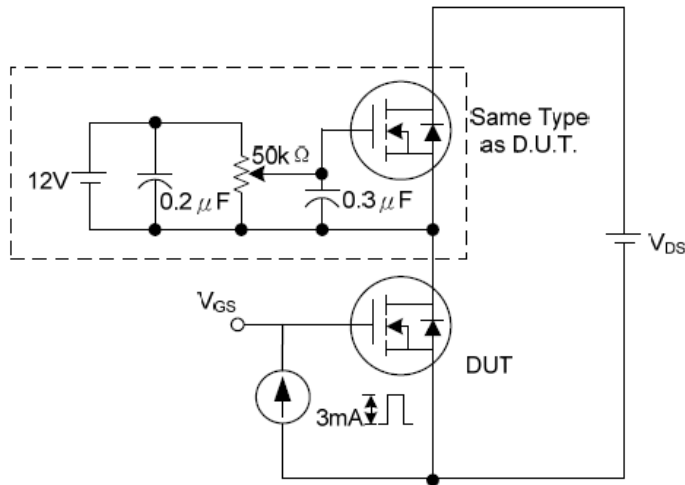


Fig.13- Gate Charge Test Circuit

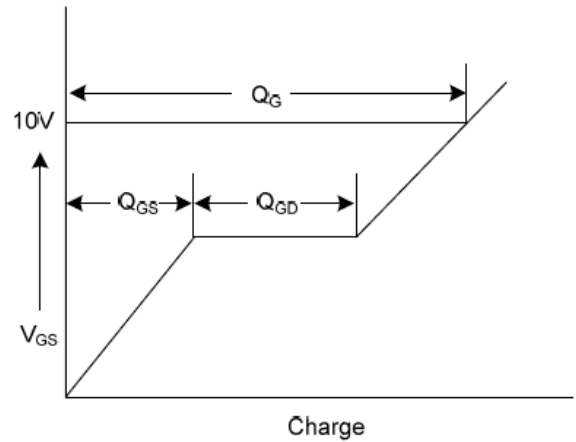


Fig.14- Gate Charge Waveform

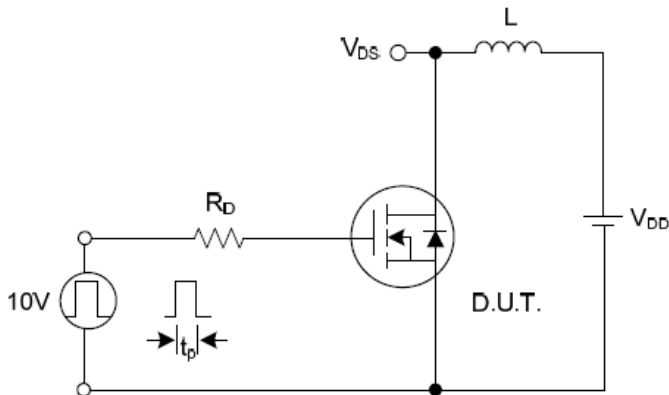


Fig.11- Unclamped Inductive Switching Test Circuit

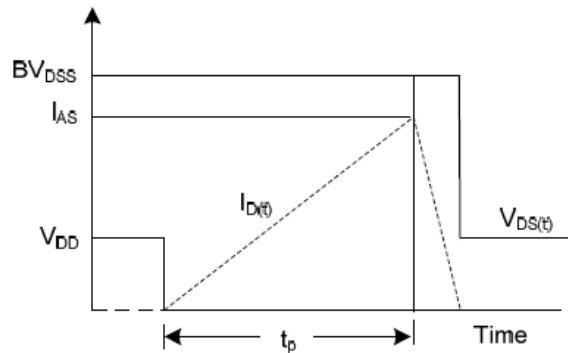
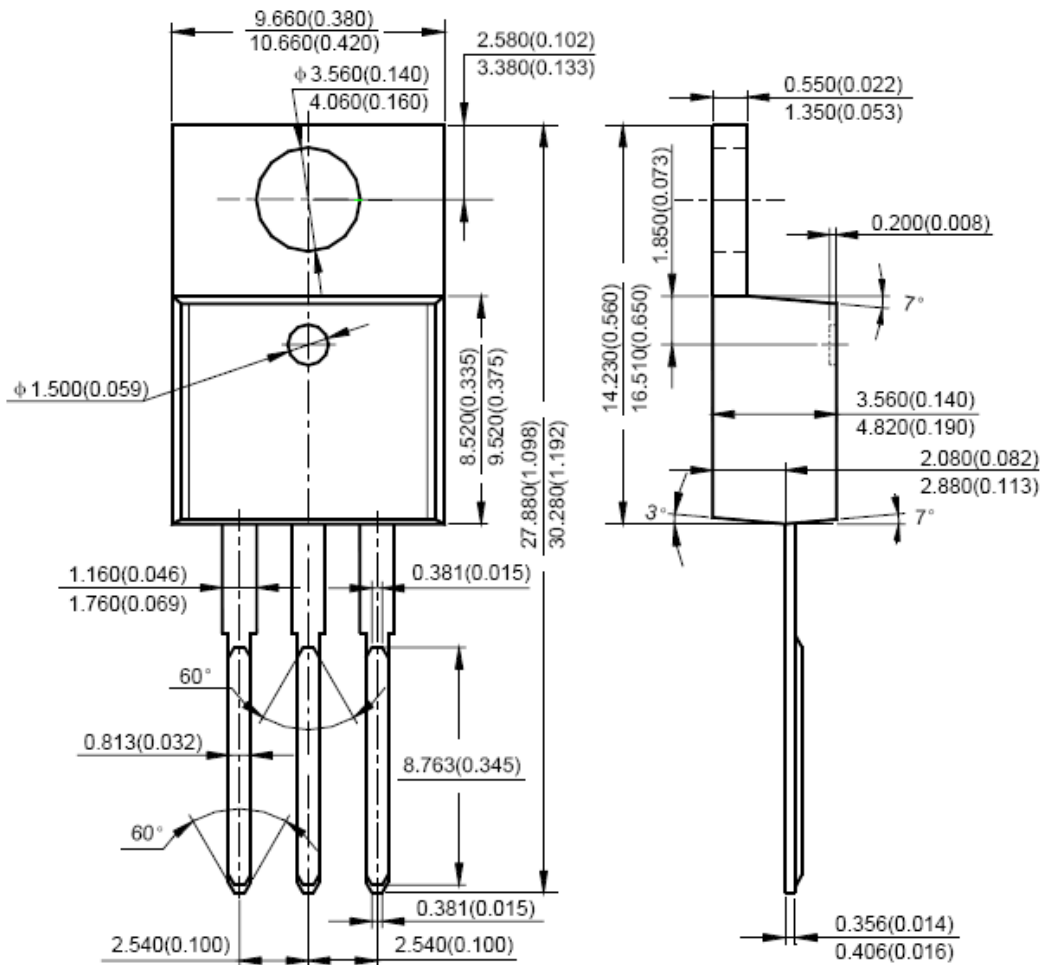


Fig.12 Unclamped Inductive Switching Waveform

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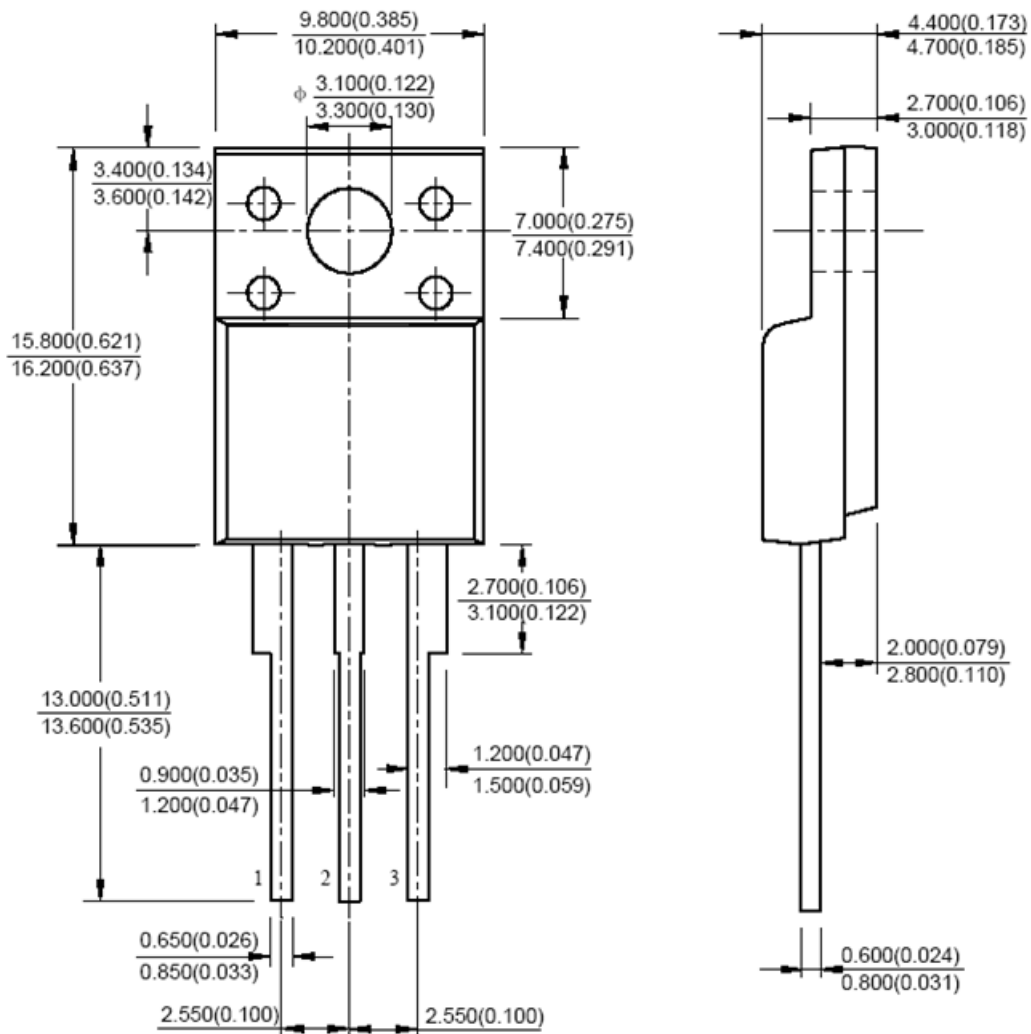
Dimensions in mm (inch)



TO-220

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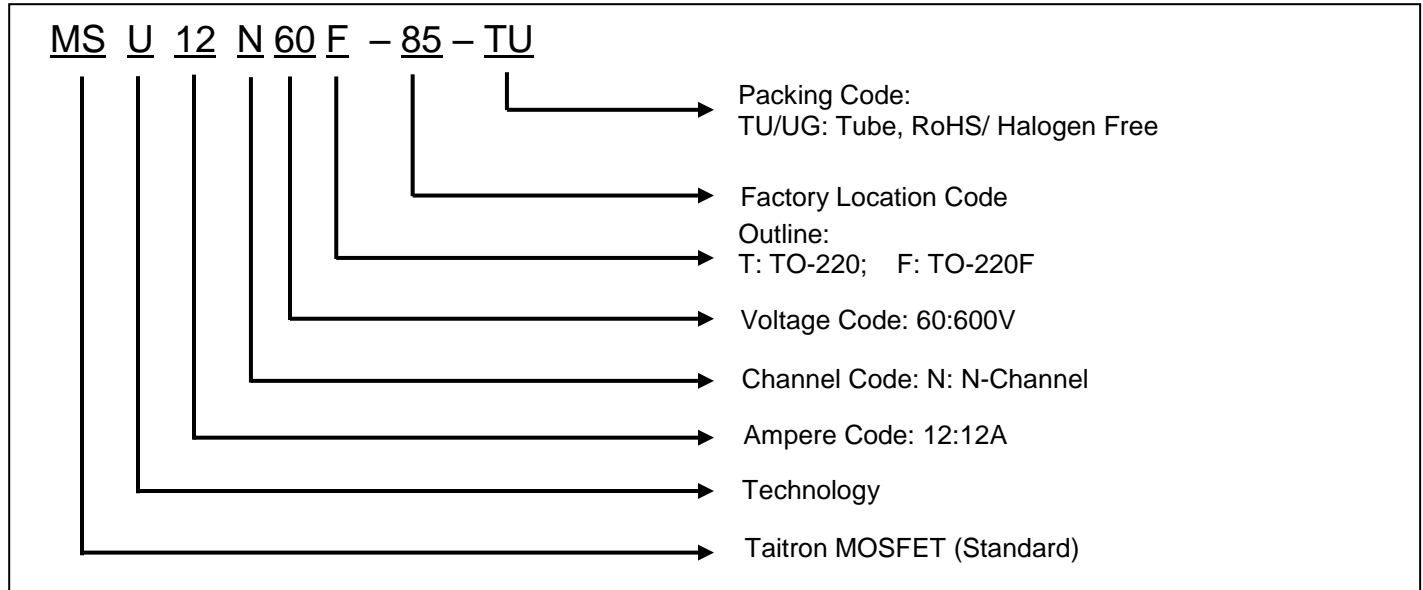


TO-220F

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MSU12N60

Ordering Information



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