

## N Channel MOSFET



Lead Free Package and Finish

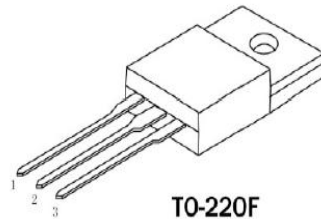
### Applications:

- Adapter & Charger
- SMPS Standby Power
- AC-DC Switching Power Supply
- LED driving power

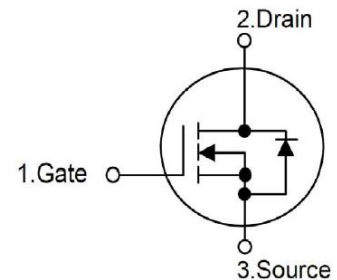
$I_D$	$R_{DS(ON)}(Typ.)$	$V_{DSS}$
13A	0.37Ω	500V

### Features:

- Low On Resistance
- Low Gate Charge
- Peak Current vs Pulse Width Curve
- RoHS Compliant



TO-220F



### Ordering Information

Not to Scale

Part Number	Package	Marking
RS13N50F	TO-220F	RS13N50F

### Absolute Maximum Ratings $T_c=25^\circ\text{C}$ unless otherwise specified

Symbol	Parameter	RS13N50F	Units	
$V_{DSS}$	Drain-to-Source Voltage (Note*1)	500	V	
$I_D$	Continuous Drain Current	13.0	A	
$I_{D@ 100^\circ\text{C}}$	Continuous Drain Current	7.5		
$I_{DM}$	Pulsed Drain Current (Note*2)	52.0		
$P_D$	Power Dissipation	65	W	
$V_{GS}$	Gate-to-Source Voltage	$\pm 30$	V	
EAS	Single Pulse Avalanche Energy L=10mH VDD=50V $R_G=25\Omega$ Starting $T_J=25^\circ\text{C}$	352	mJ	
IAS	(Note*2)	8.4	A	
$T_L$	Maximum Temperature for Soldering	300	$^\circ\text{C}$	
TPKG	Leads at 0.063in(1.6mm)from Case for 10 seconds			260
	Package Body for 10 seconds			
$T_J$ and $T_{STG}$	Operating Junction and Storage Temperature Range	-55 to 150		

\*Drain Current Limited by Maximum Junction Temperature

Caution:Stresses greater than those listed in the“Absolute Maximum Ratings”Table may cause permanent damage to the device.

### Thermal Resistance

Symbol	Parameter	RS13N50F	Units	Test Conditions
$R_{\theta JC}$	Junction-to-Case	1.92	$^\circ\text{C}/\text{W}$	Drain lead soldered to water cooled heatsink, $P_D$ adjusted for a peak junction temperature of $+150^\circ\text{C}$ .
$R_{\theta JA}$	Junction-to-Ambient	62.5		1 cubic foot chamber,free air.

### Static Characteristics $T_J=25^{\circ}\text{C}$ unless otherwise specified

Symbol	Parameter	Min.	Typ.	Max.	Units	Test Conditions
$BV_{DSS}$	Drain-to-source Breakdown Voltage	500	--	--	V	$V_{GS}=0V, I_D=250\mu A$
$I_{DSS}$	Drain-to-Source Leakage Current	--	--	1.0	$\mu A$	$V_{DS}=500V, V_{GS}=0V$
$I_{GSS}$	Gate-to-Source Forward Leakage	--	--	100	nA	$V_{GS}=+30V, V_{DS}=0V$
	Gate-to-Source Reverse Leakage	--	--	-100		$V_{GS}=-30V, V_{DS}=0V$

### Static Characteristics $T_J=25^{\circ}\text{C}$ unless otherwise specified

Symbol	Parameter	Min.	Typ.	Max.	Units	Test Conditions
$R_{DS(on)}$	Static Drain-to-Source On-Resistance (Note*3)	--	0.37	0.46	$\Omega$	$V_{GS}=10V, I_D=6.5A$
$V_{GS(TH)}$	Gate Threshold Voltage	3.0	--	4.0	V	$V_{GS}=V_{DS}, I_D=250\mu A$

### Resistive Switching Characteristics Essentially independent of operating temperature

Symbol	Parameter	Min.	Typ.	Max.	Units	Test Conditions
$t_{d(ON)}$	Turn-on Delay Time	--	43	--	nS	$V_{DS}=400V$ $I_D=13A$ $R_G=25\Omega$
$t_{rise}$	Rise Time	--	25	--		
$t_{d(OFF)}$	Turn-OFF Delay Time	--	136	--		
$t_{fall}$	Fall Time	--	43	--		

### Dynamic Characteristics Essentially independent of operating temperature

Symbol	Parameter	Min.	Typ.	Max.	Units	Test Conditions
$C_{iss}$	Input Capacitance	--	1569	--	pF	$V_{GS}=0V$ $V_{DS}=25V$ $f=1.0MHz$
$C_{oss}$	Output Capacitance	--	171	--		
$C_{rss}$	Reverse Transfer Capacitance	--	5	--		
$Q_g$	Total Gate Charge	--	30.9	--	nC	$V_{DS}=400V$ $I_D=13A$ $V_{GS}=10V$ (Note:3,4)
$Q_{gs}$	Gate-to-Source Charge	--	7.8	--		
$Q_{gd}$	Gate-to-Drain("Miller") Charge	--	10.6	--		

## Source-Drain Diode Characteristics

Symbol	Parameter	Min.	Typ.	Max.	Units	Test Conditions
I <sub>S</sub>	Continuous Source Current	--	--	13.0	A	Integral pn-diode in MOSFET
I <sub>SM</sub>	Maximum Pulsed Current	--	--	52.0	A	
V <sub>SD</sub>	Diode Forward Voltage	--	--	1.4	V	I <sub>S</sub> =6.5A, V <sub>GS</sub> =0V
t <sub>rr</sub>	Reverse Recovery Time	--	307	--	nS	V <sub>GS</sub> =0V I <sub>S</sub> =13A, di/dt=100A/μs
Q <sub>rr</sub>	Reverse Recovery Charge	--	3.5	--	μC	

### Notes:

- \*1. T<sub>J</sub>=±25°C to +150°C.
- \*2. Repetitive rating; pulse width limited by maximum junction temperature.
- \*3. Pulse width ≤ 300μs; duty cycle ≤ 1%.

### Typical Feature curve

T<sub>J</sub> = 25°C, unless otherwise noted

Figure 1. Output Characteristics (T<sub>J</sub> = 25°C)

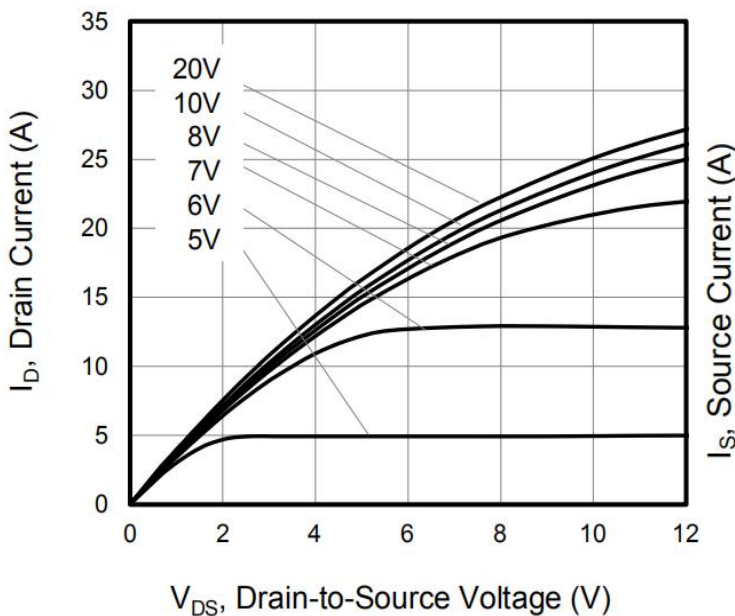
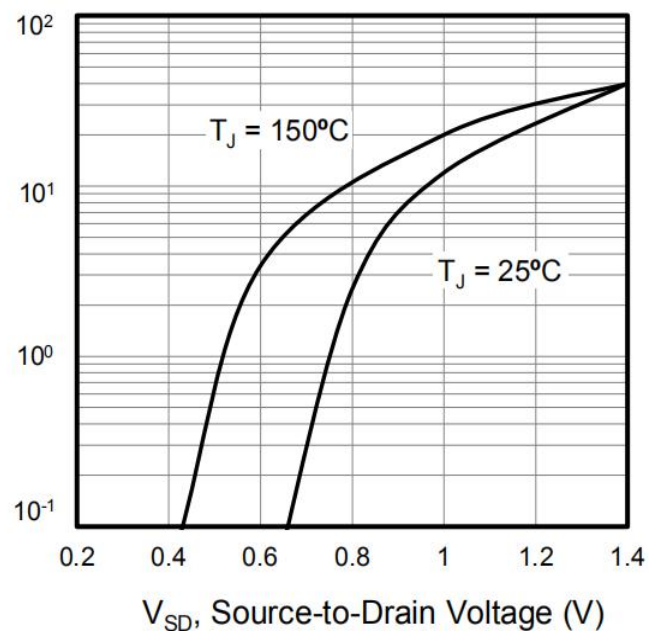
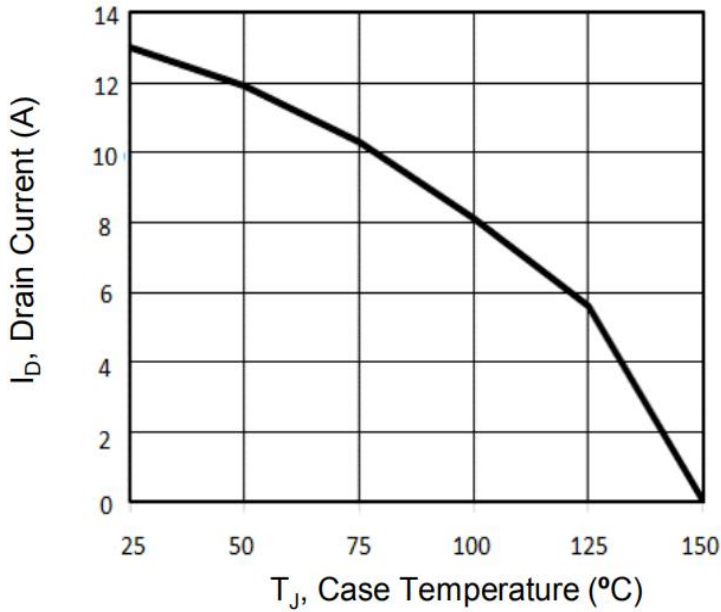


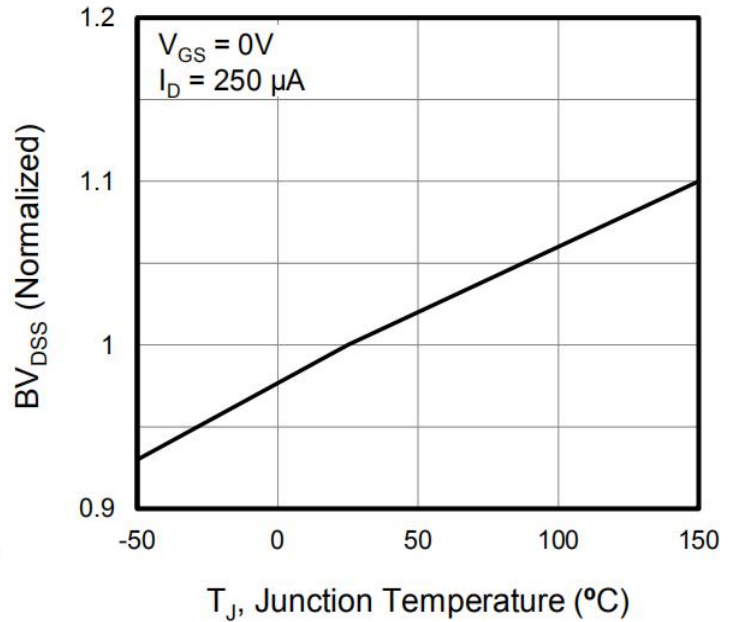
Figure 2. Body Diode Forward Voltage



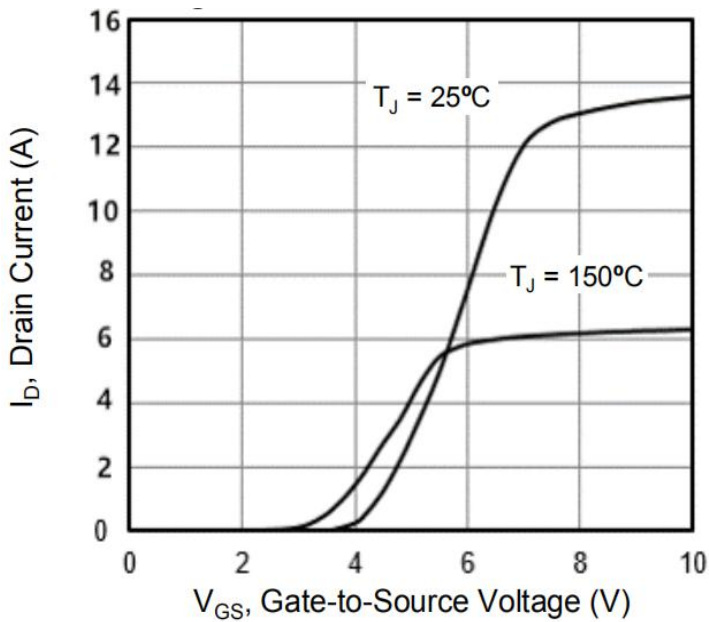
**Figure 3. Drain Current vs. Temperature**



**Figure 4. BVDSS Variation vs. Temperature**



**Figure 5. Transfer Characteristics**



**Figure 6. On-Resistance vs. Temperature**

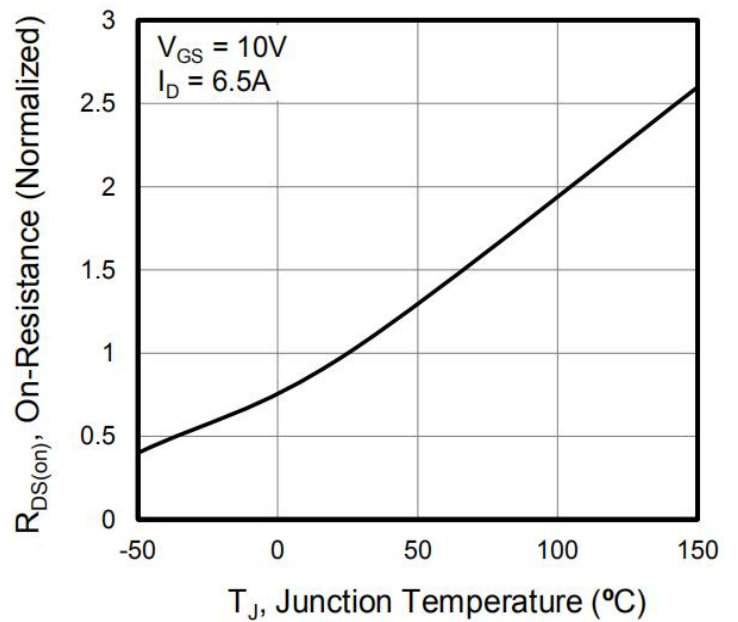


Figure 7. Capacitance

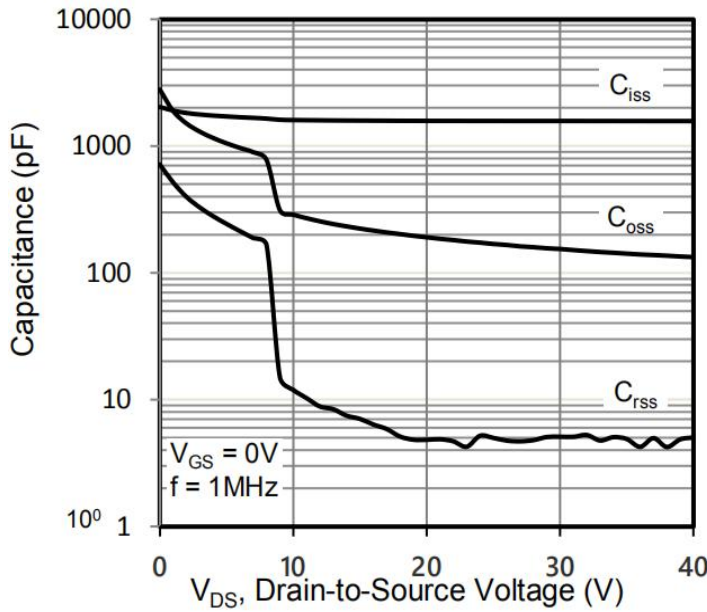


Figure 8. Gate Charge

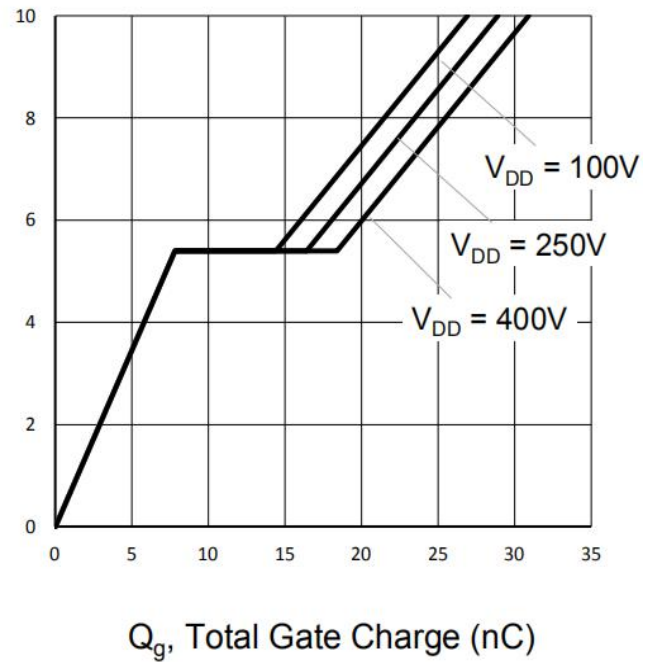
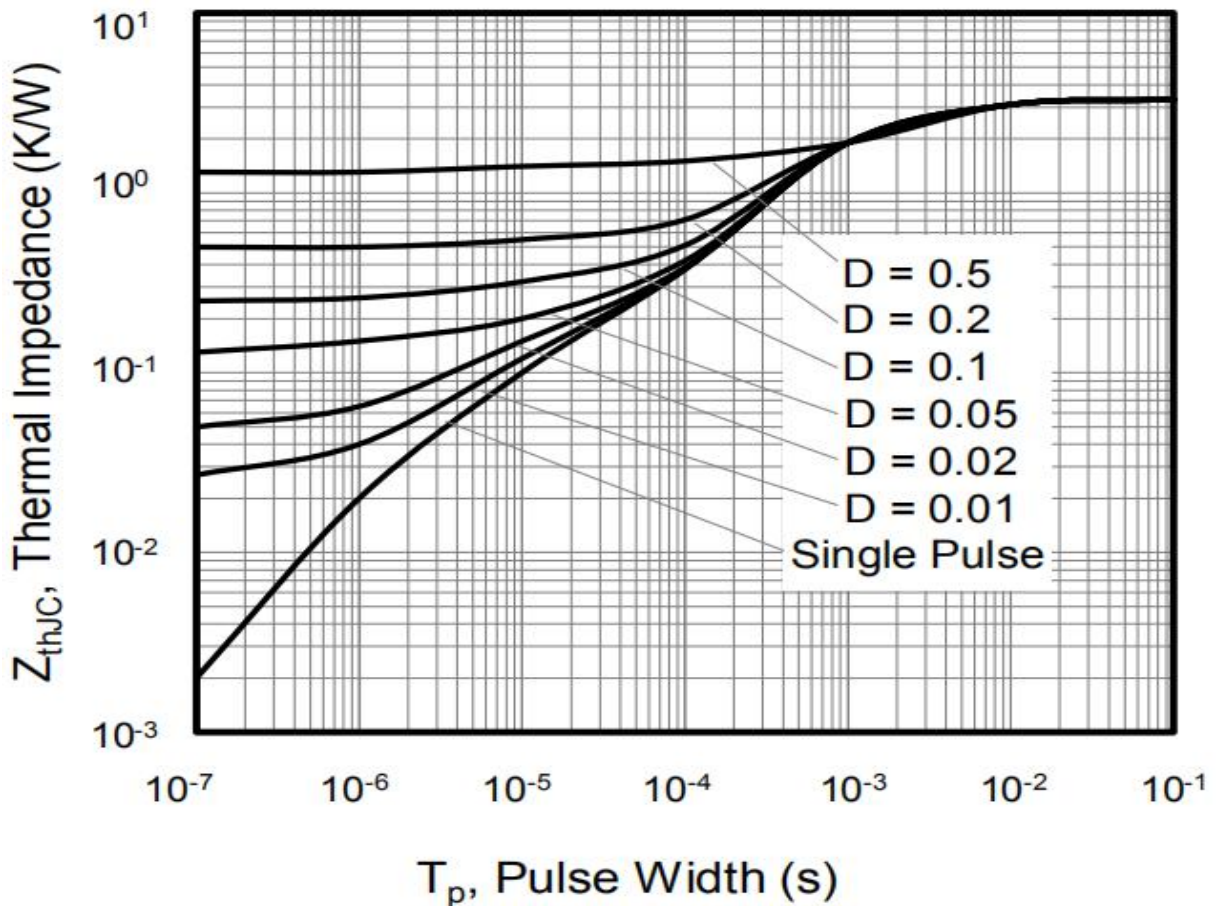


Figure 9. Transient Thermal Impedance TO-220F



## Test Circuits and Waveforms

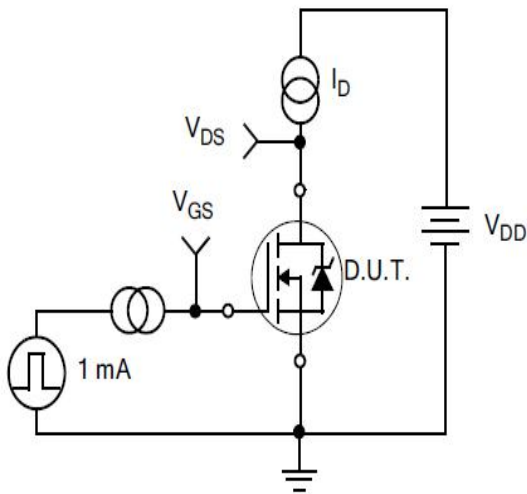


Figure 10.  
Gate Charge Test Circuit

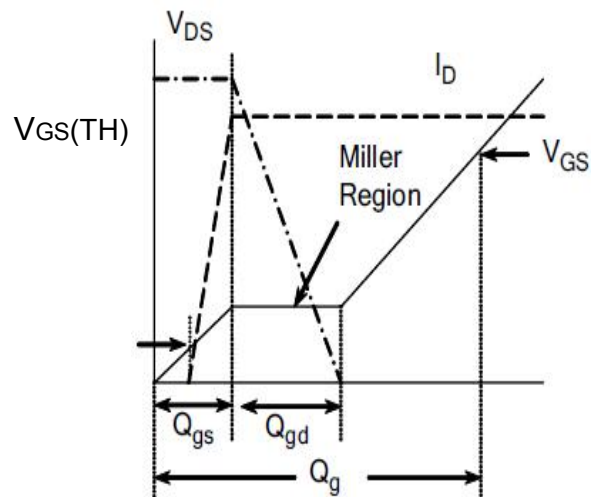


Figure 11.  
Gate Charge Waveform

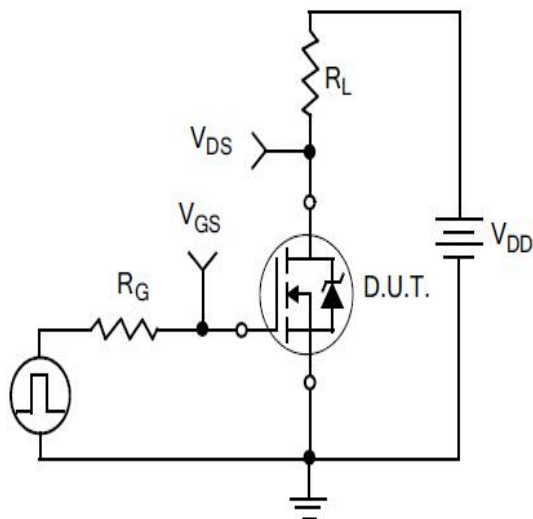


Figure 12.  
Resistive Switching Test Circuit

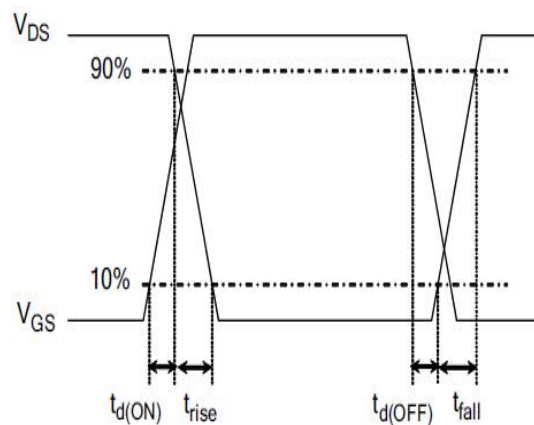


Figure 13.  
Resistive Switching Waveforms

## Test Circuits and Waveforms

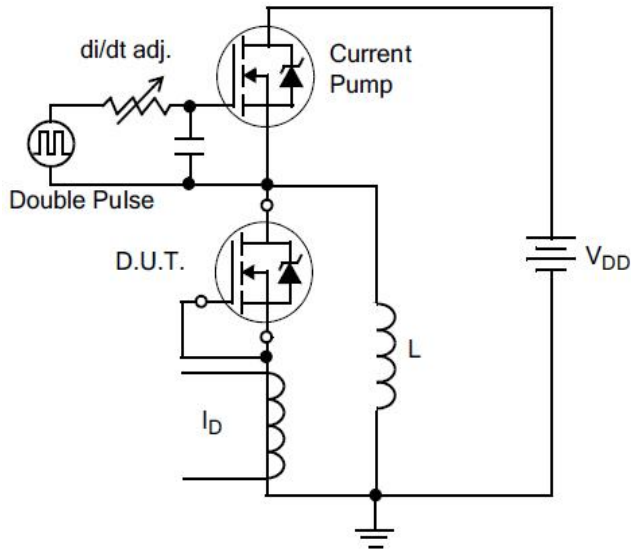


Figure14.Diode Reverse Recovery Test Circuit

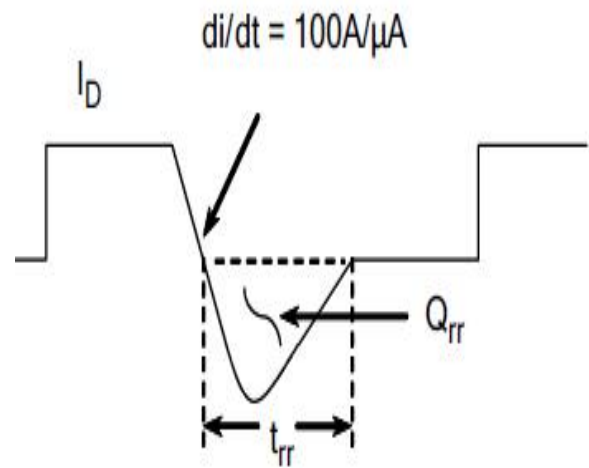


Figure15.Diode Reverse Recovery Waveform

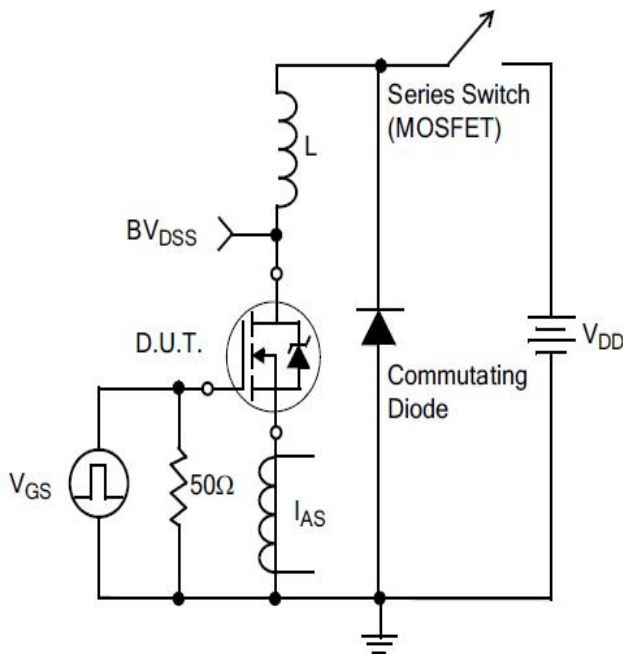
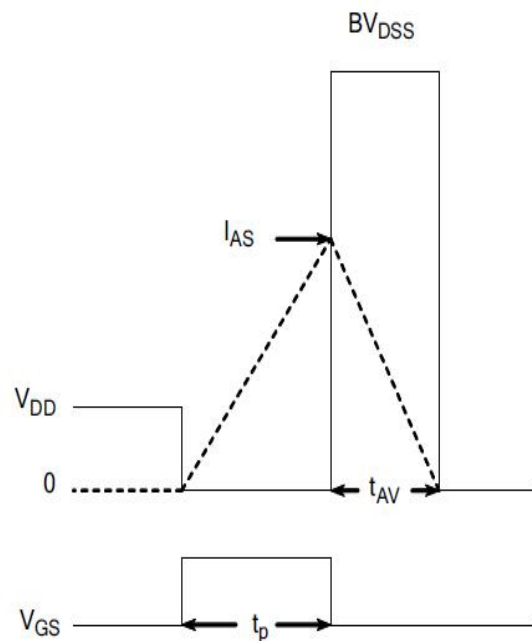


Figure16.Unclamped Inductive Switching Test Circuit



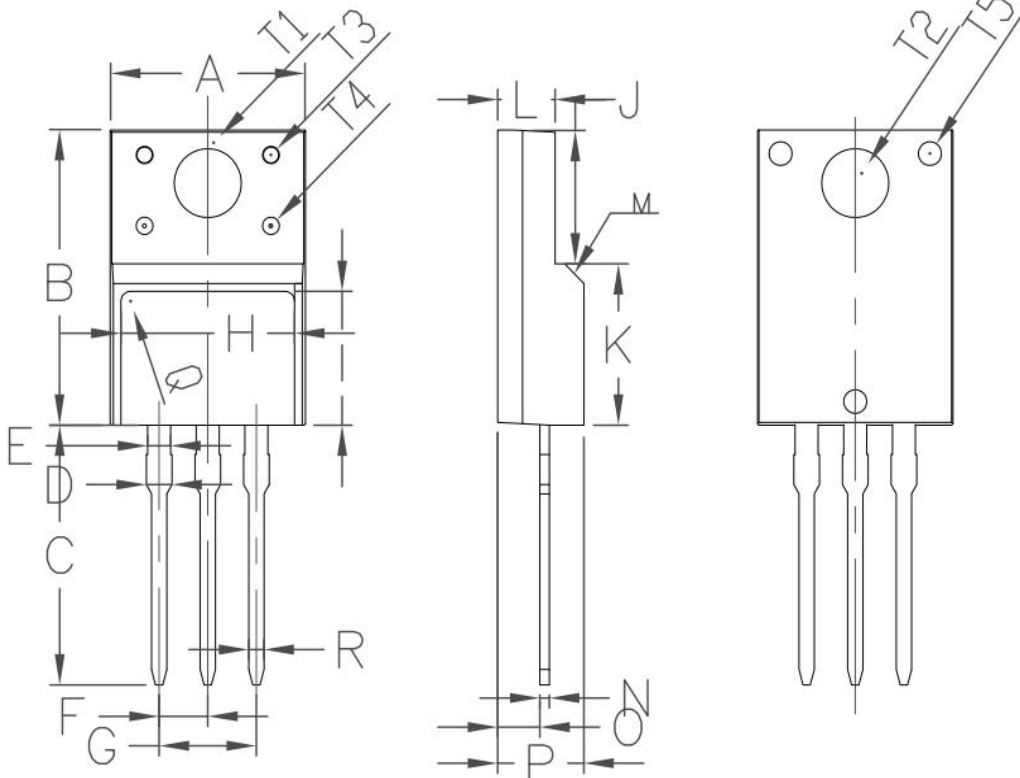
$$E_{AS} = \frac{I_{AS}^2 L}{2}$$

Figure17.Unclamped Inductive Switching Waveforms

## Package outline drawing

TO-220F

Unit: mm



Symbol	Min	Non	Max
A	9.96	10.16	10.36
B	15.67	15.87	16.07
C	13.14	13.34	13.54
D	1.20	1.30	1.40
E		1.20	
F		2.54	
G		5.08	
H	7.60	7.80	8.00
I	7.10	7.30	7.50
J	6.48	6.68	6.88
K	8.99	9.19	9.39
L	2.34	2.54	2.74
M		45°	
N	0.49	0.50	0.52
O	2.15	2.35	2.55
P	4.50	4.70	4.90
Q		0.50	
S	4°	4.5°	5°
T1		3.45	
T2		3.18	
T3		1.50	
T4		1.20	
T5		1.50	
R	0.77	0.8	0.83



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