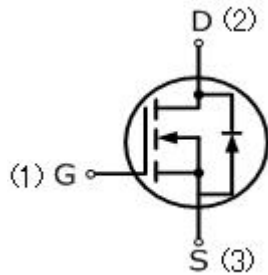


# 11N65TFS

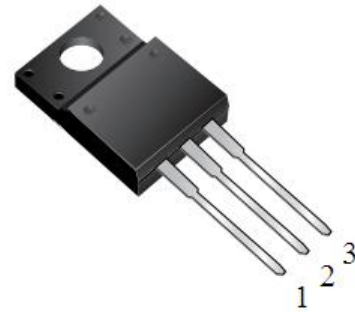
## 11 Amps,650 Volts N-Channel Super Junction Power MOSFET

### FEATURE

- 11A,650V, $R_{DS(ON)MAX}=0.36\ \Omega$  @ $V_{GS}=10V/5.5A$
- Low gate charge
- Low  $C_{iss}$
- Fast switching
- 100% avalanche tested



### TO-220TF



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

Parameter	Symbol	11N65TFS	UNIT
Drain-Source Voltage	$V_{DSS}$	650	V
Gate-Source Voltage	$V_{GSS}$	$\pm 30$	
Continuous Drain Current	$I_D$	11	A
Pulsed Drain Current(Note1)	$I_{DM}$	44	
Single Pulse Avalanche Energy (Note 2)	$E_{AS}$	120	mJ
Avalanche Current(Note1)	$I_{AR}$	5.0	A
Repetitive Avalanche Energy (Note1)	$E_{AR}$	0.5	mJ
Reverse Diode dV/dt (Note 3)	dV/dt	15	V/ns
Operating Junction and Storage Temperature Range	$T_J, T_{STG}$	-55 to +150	$^\circ\text{C}$
Maximum lead temperature for soldering purposes, 1/8" from case for 5 seconds	$T_L$	260	$^\circ\text{C}$
Mounting Torque	6-32 or M3 screw	10	lbf • in
		1.1	N • m

### Thermal Characteristics

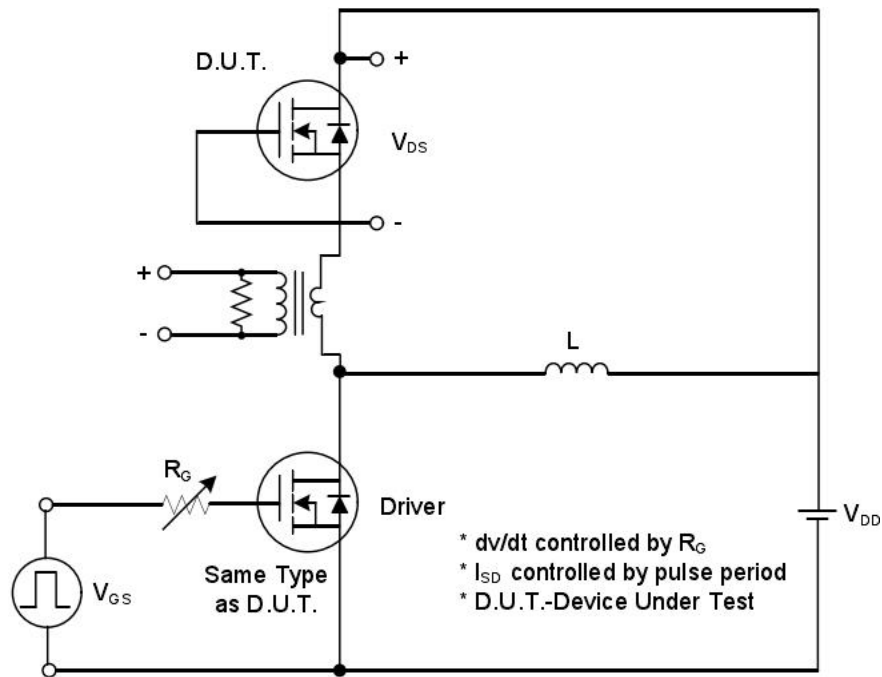
Parameter	Symbol	11N65TFS	Units
Maximum Junction-to-Case	$R_{thJC}$	4.15	$^\circ\text{C}/\text{W}$
Maximum Power Dissipation	$P_D$	30	W

<b>Electrical Characteristics</b> ( $T_c=25^\circ\text{C}$ , unless otherwise noted)						
Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
<b>Off Characteristics</b>						
Drain-Source Breakdown Voltage	$BV_{DSS}$	$V_{GS}=0V, I_D=250\mu A$	650	—	—	V
Breakdown Temperature Coefficient	$\Delta BV_{DSS} / \Delta T_J$	Reference to $25^\circ\text{C}$ , $I_D=250\mu A$	—	0.6	—	$V/^\circ\text{C}$
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{DS}=650V, V_{GS}=0V$	—	—	1	$\mu A$
Gate-Body Leakage Current, Forward	$I_{GSSF}$	$V_{GS}=30V, V_{DS}=0V$	—	—	1	$\mu A$
Gate-Body Leakage Current, Reverse	$I_{GSSR}$	$V_{GS}=-30V, V_{DS}=0V$	—	—	-1	$\mu A$
<b>On Characteristics</b>						
Gate-Source Threshold Voltage	$V_{GS(th)}$	$V_{DS}=V_{GS}, I_D=250\mu A$	2.0	—	4.0	V
Drain-Source On-State Resistance	$R_{DS(on)}$	$V_{GS}=10V, I_D=5.5A$	—	0.32	0.36	$\Omega$
<b>Dynamic Characteristics</b>						
Input Capacitance	$C_{iss}$	$V_{DS}=50V, V_{GS}=0V,$ $f=1.0\text{MHz}$	—	1030	—	pF
Output Capacitance	$C_{oss}$		—	87	—	pF
Reverse Transfer Capacitance	$C_{rss}$		—	4.5	—	pF
<b>Switching Characteristics</b>						
Turn-On Delay Time	$t_{d(on)}$	$V_{DD}=380V, I_D=5.0A,$ $R_G=6.8\Omega$ (Note3,4)	—	9	—	ns
Turn-On Rise Time	$t_r$		—	4	—	ns
Turn-Off Delay Time	$t_{d(off)}$		—	40	—	ns
Turn-Off Fall Time	$t_f$		—	4.5	—	ns
Total Gate Charge	$Q_g$	$V_{DS}=480V, I_D=10A,$ $V_{GS}=10V,$ (Note3,4)	—	23	—	nC
Gate-Source Charge	$Q_{gs}$		—	5.7	—	nC
Gate-Drain Charge	$Q_{gd}$		—	8.0	—	nC
<b>Drain-Source Body Diode Characteristics and Maximum Ratings</b>						
Diode Forward Voltage	$V_{SD}$	$I_S=10A, V_{GS}=0V$	—	—	1.3	V
Reverse Recovery Time	$t_{rr}$	$V_{GS}=0V, I_S=10A,$ $dI/dt=100A/\mu s,$ (Note3)	—	245	—	ns
Reverse Recovery Charge	$Q_{rr}$		—	2.4	—	$\mu C$

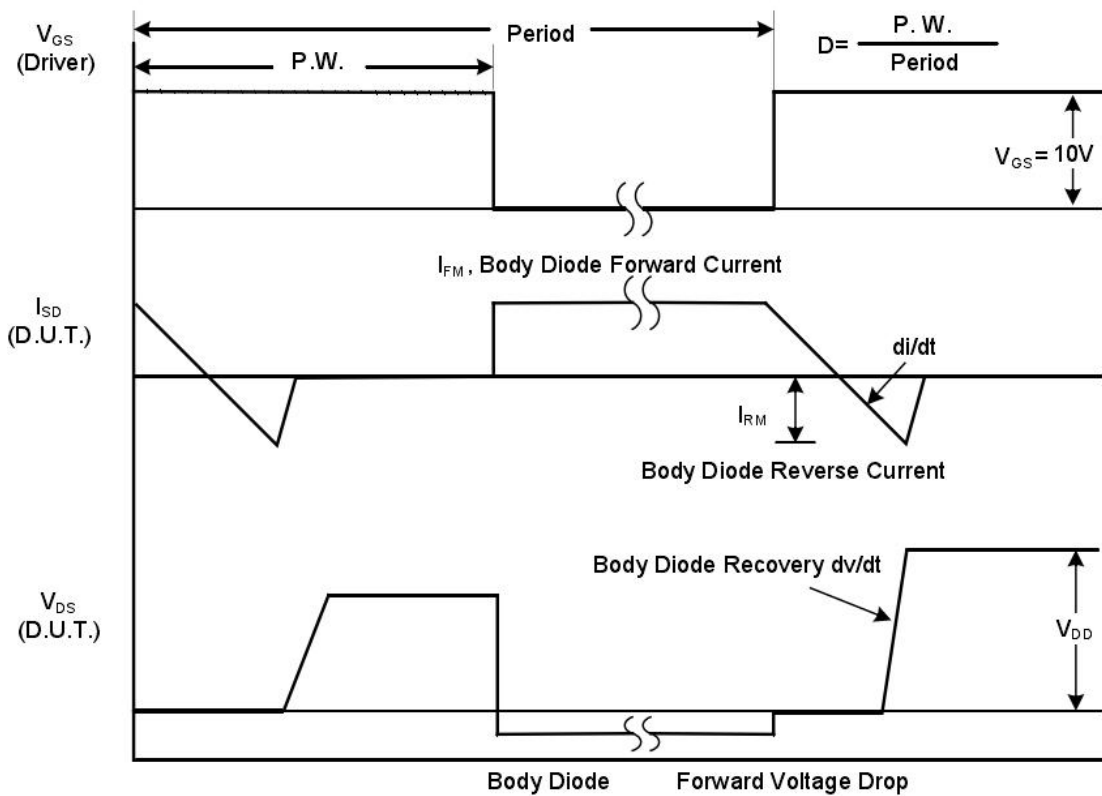
**Notes**

1. Repetitive Rating: pulse width limited by maximum junction temperature.
2.  $L=10\text{mH}, R_g=25\Omega, I_{AS}=5.0A$ , starting  $T_J=25^\circ\text{C}$ .
3.  $dI/dt=200A/\mu s$ , starting  $T_J=25^\circ\text{C}$ . Pulse width  $\leq 300\mu s$ ; duty cycle  $\leq 2\%$ .
4. Repetitive rating; pulse width limited by maximum junction temperature.

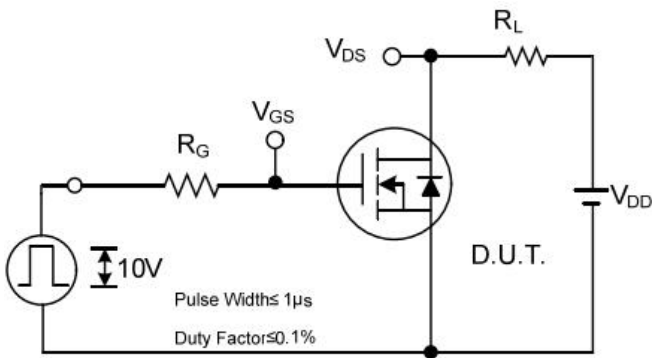
TEST CIRCUIT AND WAVEFORM



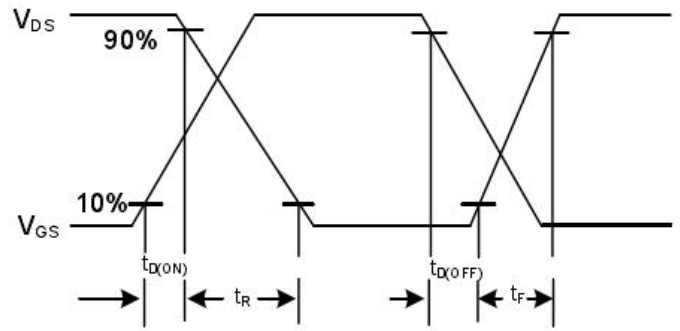
Peak Diode Recovery  $dv/dt$  Test Circuit



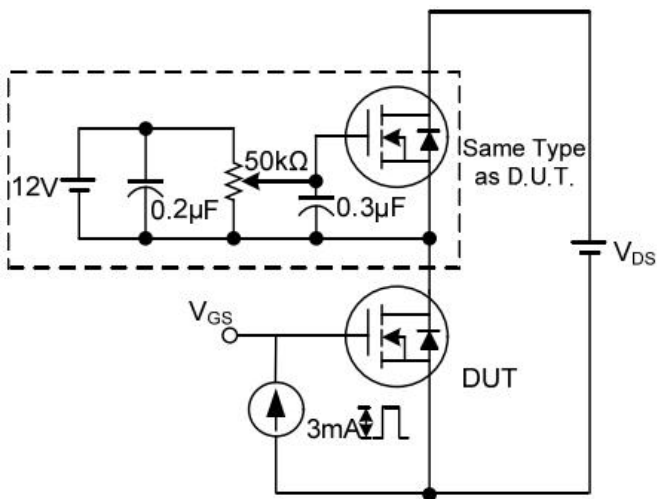
Peak Diode Recovery  $dv/dt$  Waveforms



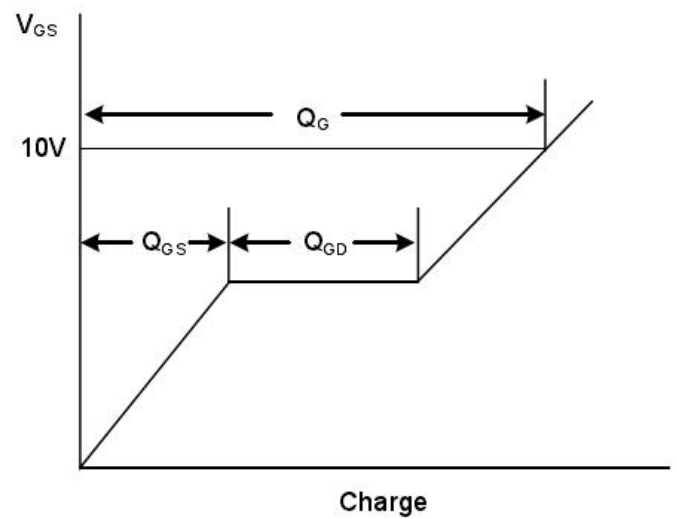
Switching Test Circuit



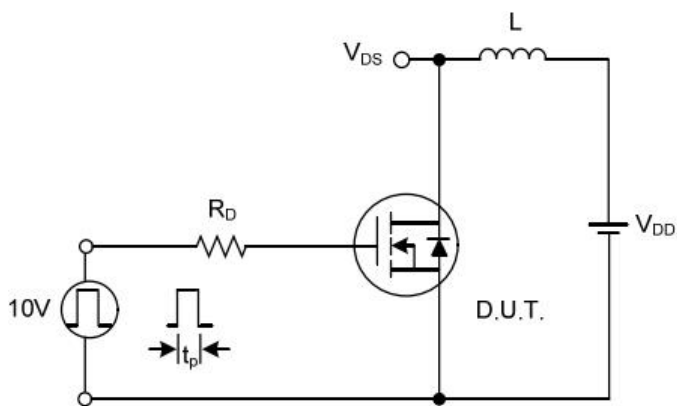
Switching Waveforms



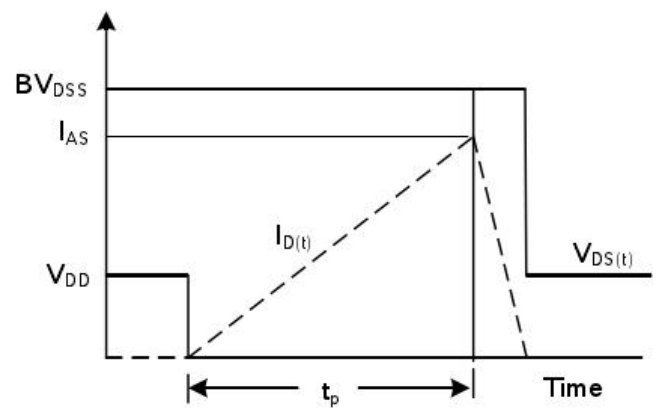
Gate Charge Test Circuit



Gate Charge Waveform

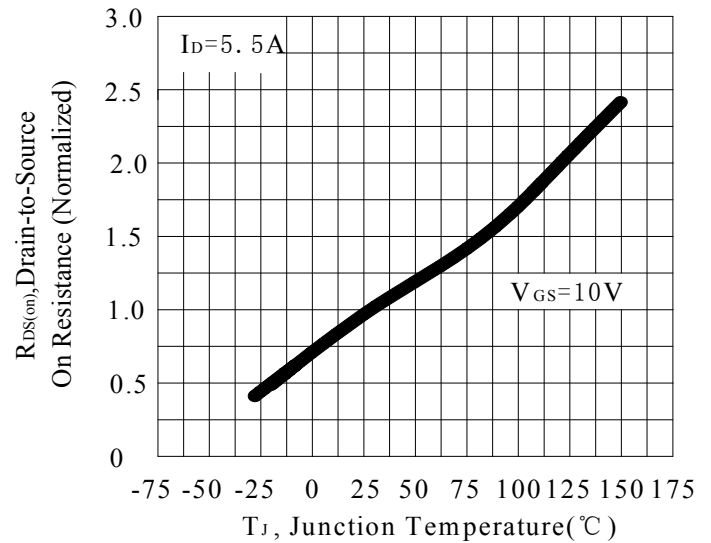
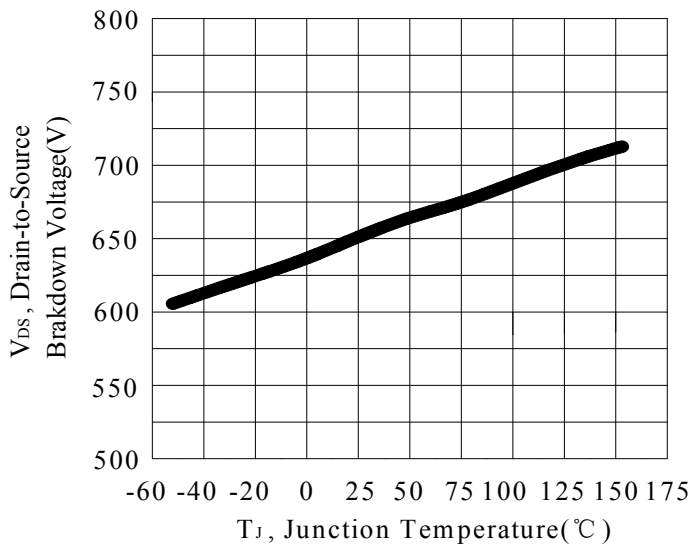
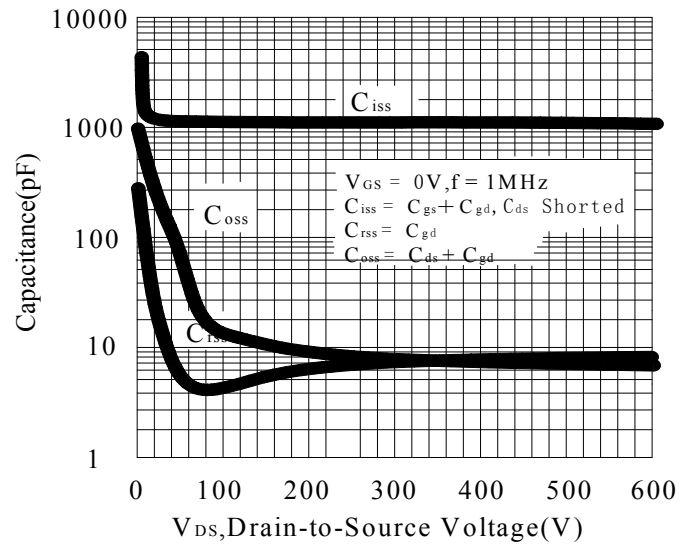
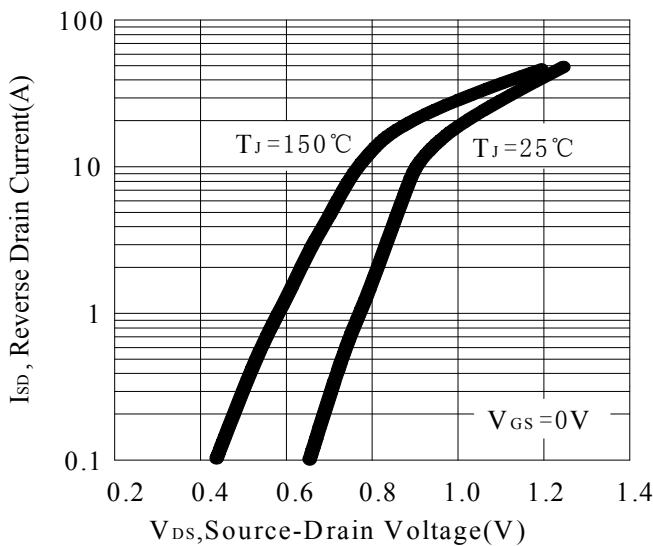
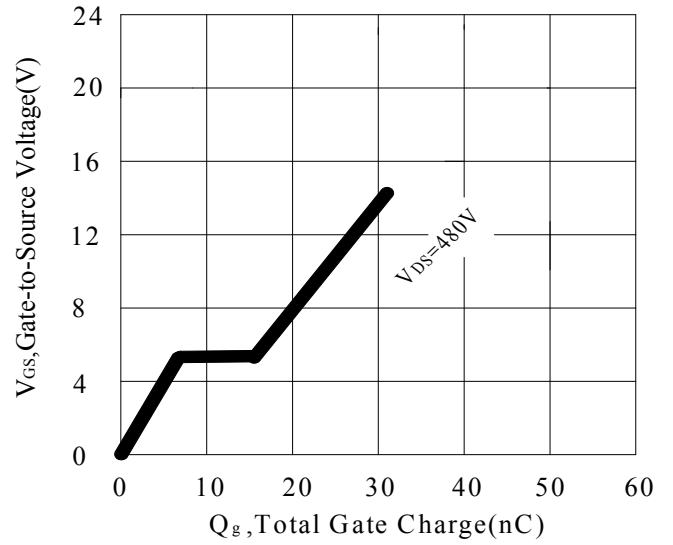
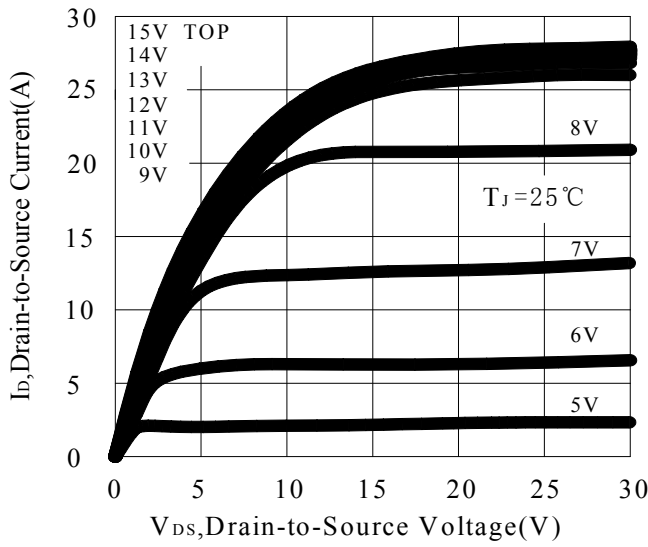


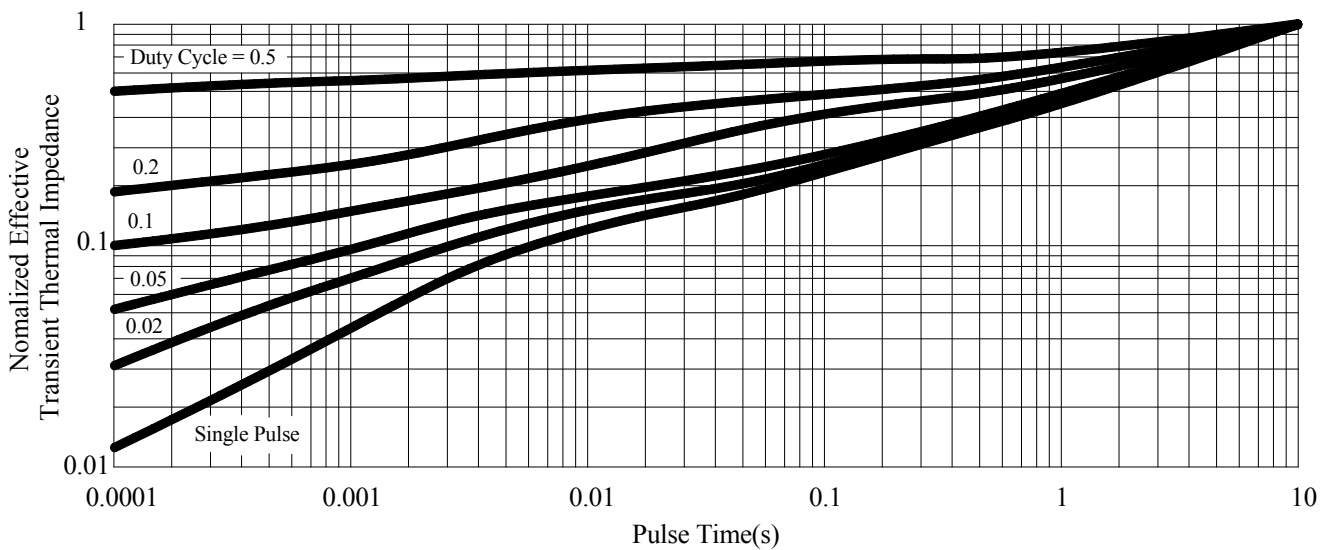
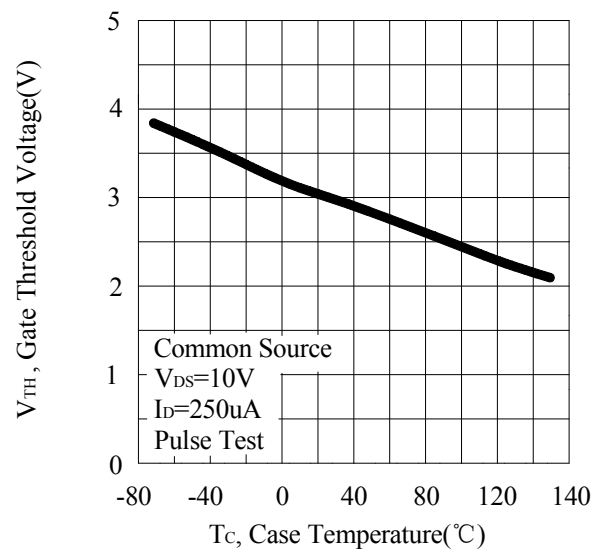
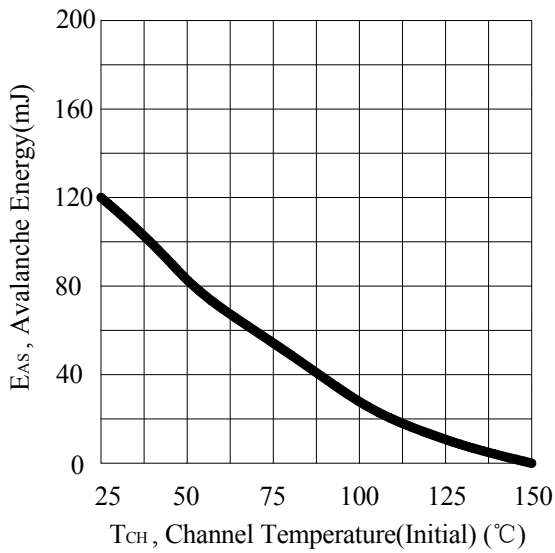
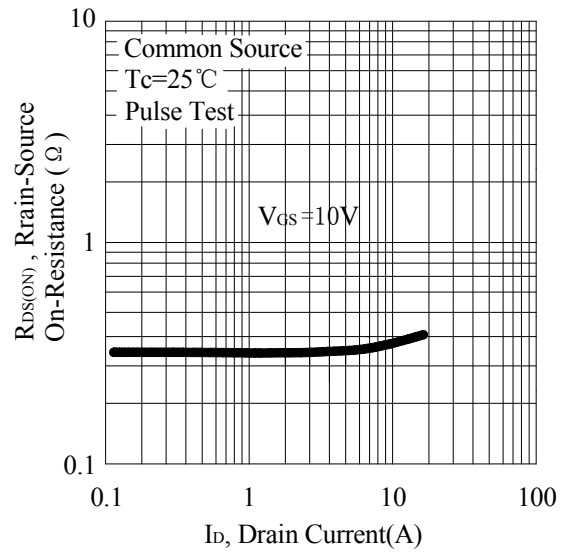
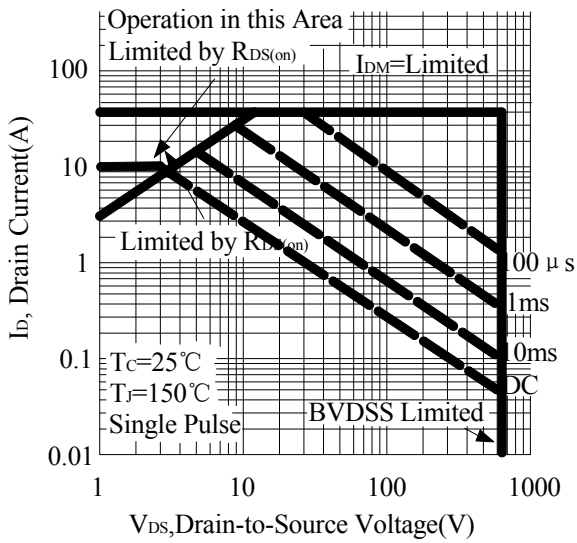
Unclamped Inductive Switching Test Circuit



Unclamped Inductive Switching Waveforms

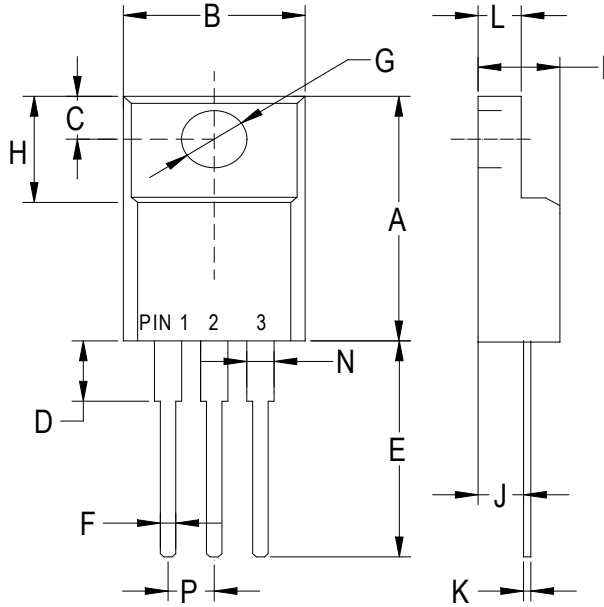
**RATING AND CHARACTERISTIC CURVES**





**PACKAGE OUTLINE DIMENSIONS**

**TO-220TF**



TO-220TF		
Dim	Min	Max
A	.590 (15.0)	.650 (16.5)
B	.393 (10.0)	.414 (10.5)
C	.118 (3.00)	.138 (3.50)
D	.118 (3.00)	.146 (3.70)
E	.512 (13.0)	.551 (14.0)
F	.028 (0.70)	.035 (0.90)
G	.114 (2.90)	.138 (3.50)
H	.255 (6.50)	.280 (7.10)
I	.173 (4.40)	.197 (5.00)
J	.102 (2.60)	.110 (2.80)
K	.018 (0.45)	.026 (0.65)
L	.092 (2.35)	.109 (2.75)
P	.890 (2.25)	.113 (2.85)
N	.049 (1.25)	.059 (1.50)

Dimensions in inches and (millimeters)