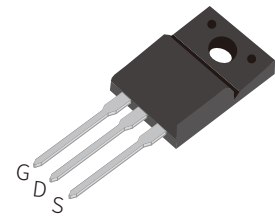


## FEATURES

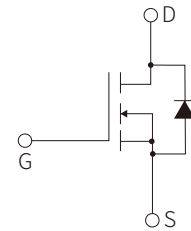
- | Low Gate Charge
- | Low Crss
- | Fast Switching
- | Improved dv/dt and ESD Capability
- | 100% Avalanche energy test



TO-220F

## APPLICATION

- | High Frequency Switched-Mode Power Supply
- | Electronic lamp ballasts
- | UPS



Schematic Symbol

## APPROVALS

- RoHS** | Compliance with 2011/65/EU
- HF** | Compliance with IEC61249-2-21:2003

## ABSOLUTE MAXIMUM RATINGS (T<sub>A</sub>=25°C)

Parameter	Symbol	Value	Unit
Drain-Source Voltage	V <sub>DSS</sub>	650	V
Continuous Drain Current	I <sub>D</sub>	T <sub>C</sub> =25°C	20 <sup>*</sup>
		T <sub>C</sub> =100°C	14 <sup>*</sup>
Plused Drain Current <sup>(note1)</sup>	I <sub>DM</sub>	80	A
Gate-Source Voltage	V <sub>GS</sub>	±30	V
Avalanche Current <sup>(note1)</sup>	I <sub>AR</sub>	20	A
Repetitive Avalanche Energy <sup>(note1)</sup>	E <sub>AR</sub>	81	mJ
Single Pulsed Avalanche Energy <sup>(note2)</sup>	E <sub>AS</sub>	720	mJ
Peak Diode Recovery <sup>(note3)</sup>	dv/dt	4.5	V/ns
Power Dissipation T <sub>C</sub> =25°C	P <sub>D</sub>	50	W
Power Dissipation Derating Factor Above 25°C	P <sub>D(DF)</sub>	0.4	W/°C
Maximum Temperature for Soldering	T <sub>L</sub>	300	°C
Operating Junction Temperature Range	T <sub>J</sub>	150	°C
Storage Temperature Range	T <sub>STG</sub>	-55 to +150	°C
Thermal Resistance, Junction to Case	R <sub>th(j-c)</sub>	2.5	°C/W
Thermal Resistance, Junction to Ambient	R <sub>th(j-a)</sub>	62.5	°C/W

\* Drain current limited by maximum junction temperature

## ELECTRICAL CHARACTERISTICS (T<sub>A</sub>=25°C)

Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Unit	
<b>Off Characteristics</b>							
Drain-Source Breakdown Voltage	BV <sub>DSS</sub>	V <sub>GS</sub> =0V, I <sub>D</sub> =250μA	650			V	
Breakdown Voltage Temperature Coefficient	ΔBV <sub>DSS</sub> / ΔT <sub>J</sub>	I <sub>D</sub> =250μA, referenced to 25°C		0.7		V/°C	
Zero Gate Voltage Drain Current	I <sub>DSS</sub>	V <sub>DS</sub> =650V, V <sub>GS</sub> =0V, T <sub>C</sub> =25°C			1	μA	
		V <sub>DS</sub> =520V, T <sub>C</sub> =125°C			10	μA	
Gate-Body Leakage Current, Forward	I <sub>GSSF</sub>	V <sub>GS</sub> =30V, V <sub>DS</sub> =0V			100	nA	
Gate-Body Leakage Current, Reverse	I <sub>GSSR</sub>	V <sub>GS</sub> =-30V, V <sub>DS</sub> =0V			-100	nA	
<b>On Characteristics</b>							
Gate Threshold Voltage	V <sub>GS(th)</sub>	V <sub>DS</sub> =V <sub>GS</sub> , I <sub>D</sub> =250μA	2.0		4.0	V	
Drain-Source On-Resistance	R <sub>DS(on)</sub>	V <sub>GS</sub> =10V, I <sub>D</sub> =9A		0.36	0.45	Ω	
Forward Transconductance	g <sub>FS</sub>	V <sub>DS</sub> =40V, I <sub>D</sub> =9A (note 4)		11.0		S	
<b>Dynamic Characteristics</b>							
Input Capacitance	C <sub>iss</sub>	V <sub>DS</sub> = 25V, V <sub>GS</sub> = 0V, f=1.0MHz		2418		pF	
Output Capacitance	C <sub>oss</sub>				168		pF
Reverse Transfer Capacitance	C <sub>rss</sub>				20		pF
Turn-On Delay Time	t <sub>d(on)</sub>	V <sub>DD</sub> =350V, I <sub>D</sub> =18A, R <sub>G</sub> =25Ω (note 4,5)		48		ns	
Turn-On Rise Time	t <sub>r</sub>			27		ns	
Turn-Off Delay Time	t <sub>d(off)</sub>			133		ns	
Turn-Off Fall Time	t <sub>f</sub>			45		ns	
Total Gate Charge	Q <sub>G</sub>	V <sub>DS</sub> =560V, I <sub>D</sub> =18A, V <sub>GS</sub> =15V (note 4,5)		59		nC	
Gate-Source Charge	Q <sub>GS</sub>			10		nC	
Gate-Drain Charge	Q <sub>GD</sub>			20		nC	
Maximum Continuous Drain-Source Diode Forward Current	I <sub>S</sub>				20	A	
Maximum Pulsed Drain-Source Diode Forward Current	I <sub>SM</sub>				80	A	
Drain-Source Diode Forward Voltage	V <sub>SD</sub>	I <sub>S</sub> =18A, V <sub>GS</sub> =0V			1.4	V	
Reverse Recovery Time	t <sub>rr</sub>	I <sub>S</sub> =18A, V <sub>GS</sub> =0V, di <sub>F</sub> /dt=100A/μs(note 4)		450		ns	
Reverse Recovery Charge	Q <sub>rr</sub>				3.4		μC

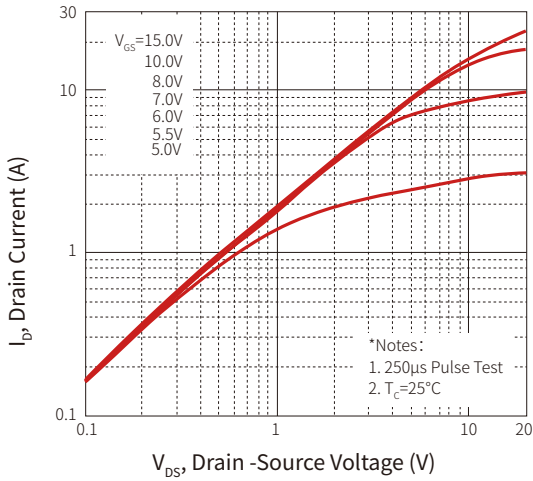
**Notes:**

1: Pulse width limited by maximum junction temperature  
 3: I<sub>SD</sub> ≤ 18A, di/dt ≤ 300A/μs, V<sub>DD</sub> ≤ BV<sub>DSS</sub>, Starting T<sub>J</sub>=25°C  
 5: Essentially independent of operating temperature

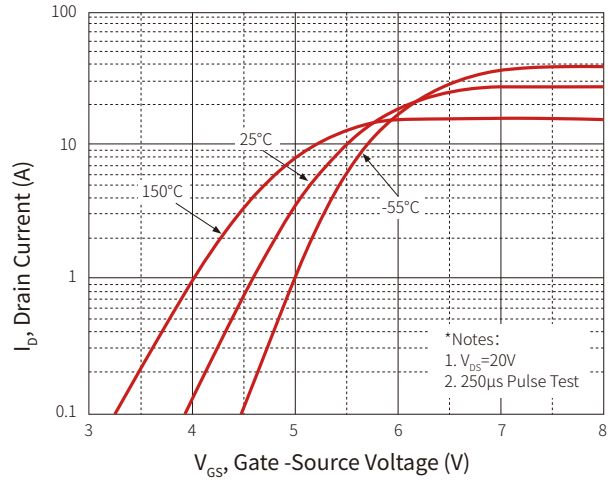
2: L=4.5mH, I<sub>AS</sub>=18A, V<sub>DD</sub>=50V, R<sub>G</sub>=25Ω, Starting T<sub>J</sub>=25°C  
 4: Pulse Test: Pulse Width ≤ 300μs, Duty Cycle ≤ 2%

# CHARACTERISTIC CURVES

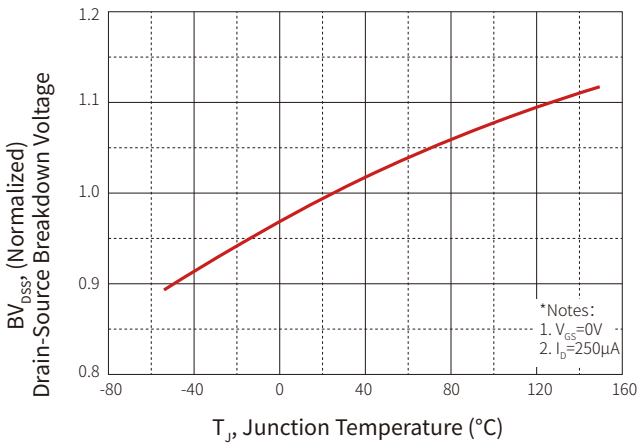
**Fig.1 On-State Characteristics**



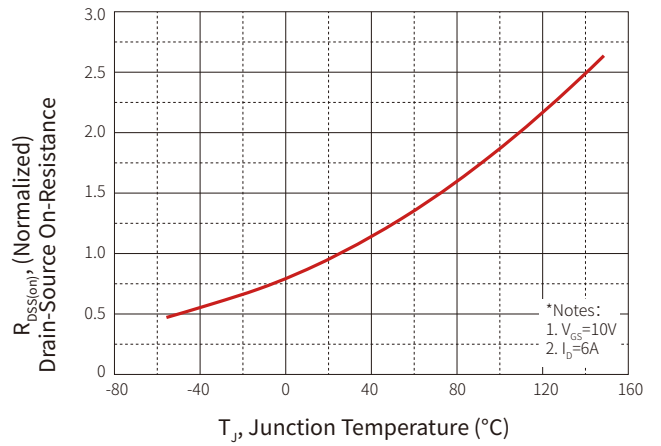
**Fig.2 Transfer Characteristics**



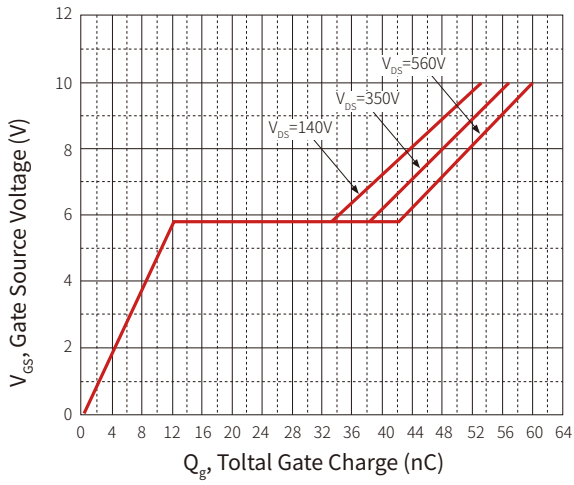
**Fig.3 Breakdown Voltage Variation vs Temperature**



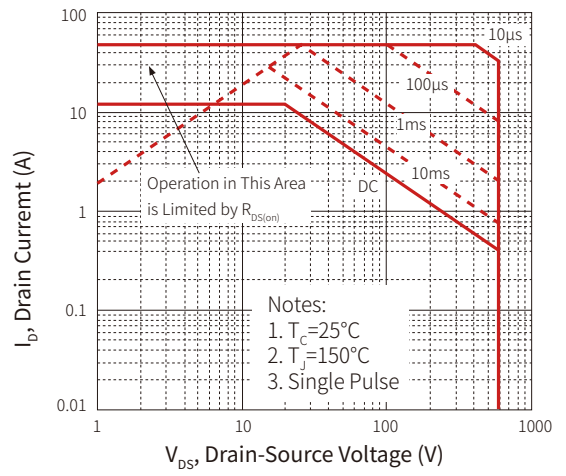
**Fig. 4 On-Resistance Variation vs Temperature**



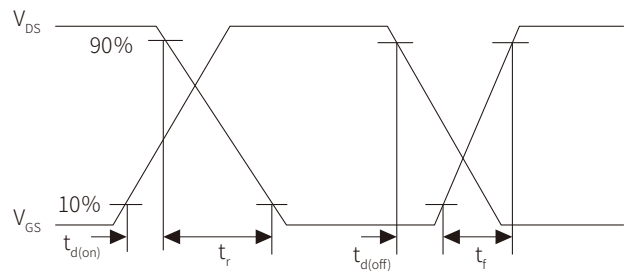
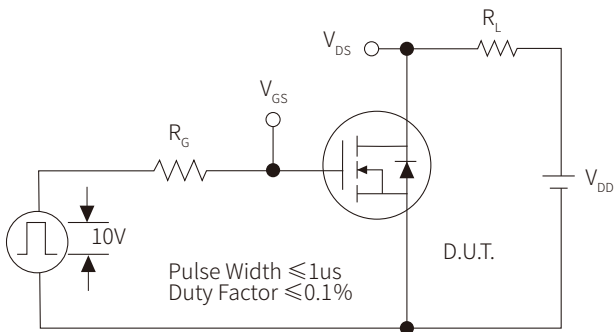
**Fig.5 Gate Charge Characteristics**



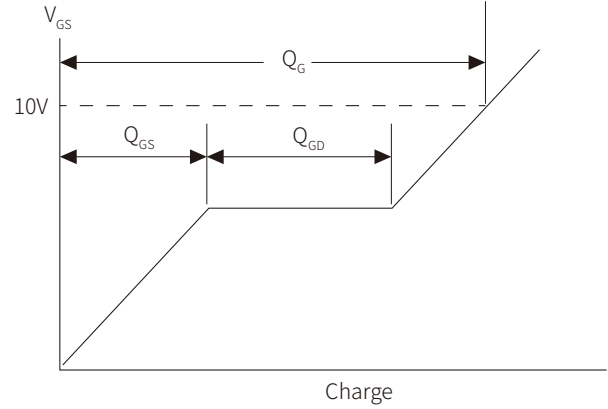
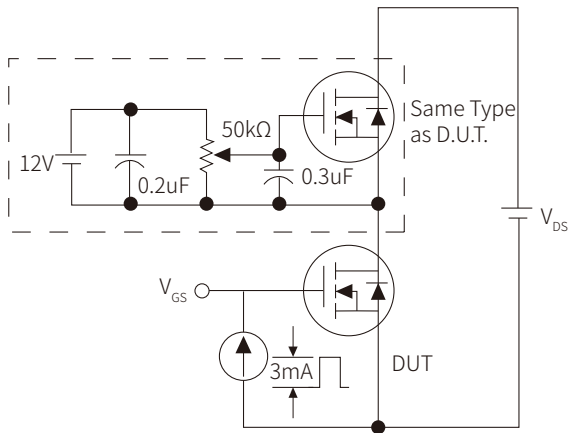
**Fig.6 Maximum Safe Operating Area**



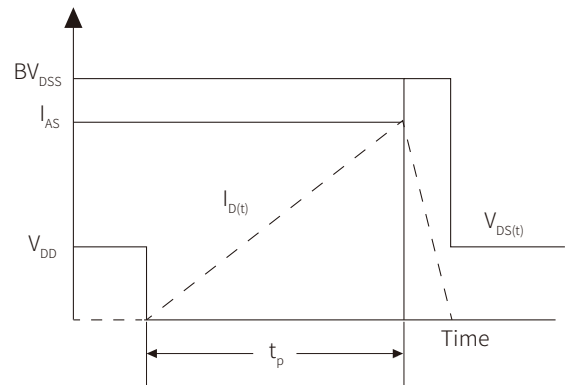
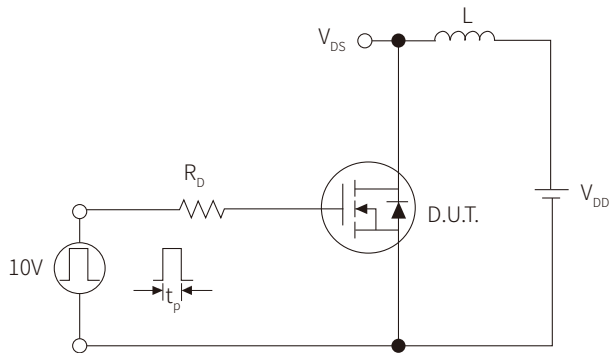
**Fig.7 Resistive Switching Test Circuit & Waveforms**



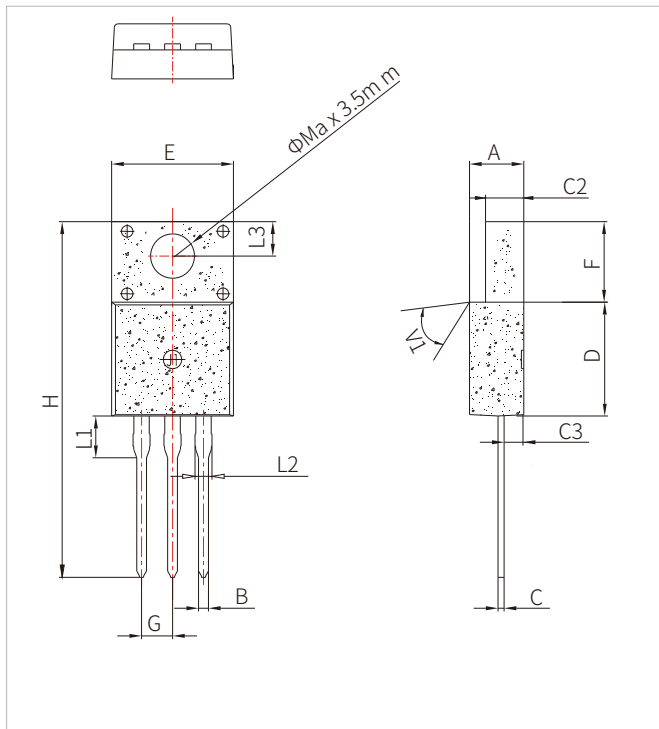
**Fig.8 Gate Charge Test Circuit & Waveform**



**Fig.9 Unclamped Inductive Switching Test Circuit & Waveforms**




## TO-220F PACKAGE MECHANICAL DATA



Ref.	Dimensions					
	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A	4.40		4.90	0.173		0.193
B	0.74	0.80	0.83	0.029		0.033
C	0.45		0.75	0.018		0.030
C2	2.40		2.70	0.094		0.106
C3	2.60		3.00	0.102		0.118
D	8.80		9.30	0.346		0.366
E	9.70		10.4	0.382		0.409
F	6.40		7.00	0.252		0.276
G		2.54			0.1	
H	28.0		30.0	1.102		1.181
L1		3.55			0.140	
L2	1.14		1.70	0.045		0.067
L3		3.30			0.130	
V1		45°			45°	

## ORDERING INFORMATION

Part Number	Component Package	Marking	QTY/Tube	Box	Carton
SNM20N65F	TO-220F	 20N65 XXXX	50PCS	1000PCS	5000PCS

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