

**NPS16N60F**

600V N-Channel Enhancement Mode Power MOSFET



<b>VOLTAGE:</b>	600 Volts	<b>CURRENT:</b>	16.0 Amperes	<b>TO-220F</b>	<b>Marking and Polarity</b>
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**FEATURES**

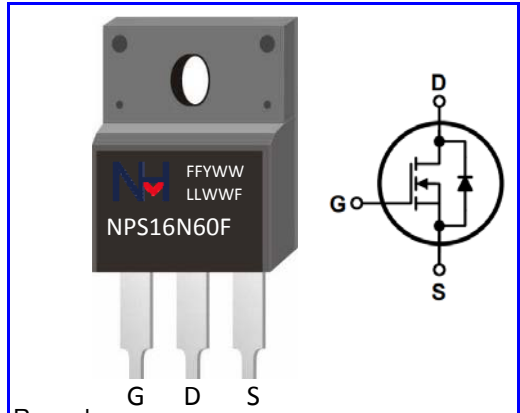
- Low RDS(ON)
- Ultra Low Gate Charge
- RoHS Compliant
- 100% UIS and RG Tested

**TYPICAL APPLICATIONS**

- Adapter,PC,PD,Charger,LED Driver
- Switched mode power supplies(SMPS)
- Uninterruptible Power Supply (UPS)

**PRODUCT SUMMARY**

VDS@T <sub>J</sub> MAX.	600	V
ID	16.0	A
RDS(ON) ,Typ.@10V	0.41	Ω



**Remark:**

- ①. NH=niuhang trademark;
- ②. FF=Product line code,According to actual changes  
YWW=Date code,According to actual changes  
LLWWF=Inernal code,According to actual changes
- ③. NPS16N60F=Mode.

**Absolute Maximum Ratings (Ratings at 25°C ambient temperature unless otherwise specified )**

Parameter	Test Conditions	Symbol	Ratings	Unit
Drain-Source Voltage		V <sub>DS</sub>	600	V
Gate-Source Voltage		V <sub>GS</sub>	±30	V
Continuous Drain Current (Note 1)	Ta= 25 °C Ta= 100 °C	I <sub>D</sub>	16 10.2	A
Drain Current-Pulsed (Note 1)	T <sub>J</sub> < 150 °C	I <sub>DM</sub>	64	A
Maximum Power Dissipation	Ta= 25 °C	P <sub>D</sub>	70	W
Power Dissipation Derating Factor above 25°C	Ta= 100 °C		28	
Derating Factor		D <sub>F</sub>	0.56	W/°C
Junction Temperature		T <sub>J</sub>	-55 to 150	°C
Storage temperature range		T <sub>STD</sub>	-55 to 150	°C
Avalanche Current,Single pulse	L= 10 mH	I <sub>AS</sub>	12.6	A
Single Pulse Avalanche Energy	L= 10 mH,VDD=50V IAS= 12.6 A, RG=25Ω Starting T <sub>J</sub> =25°C	E <sub>AS</sub>	794	mJ

**Thermal Characteristics (Ratings at 25°C ambient temperature unless otherwise specified )**

Parameter	Test Conditions	Symbol	Typ.	Unit
Thermal Resistance Junction to Ambient(Note 2)	1.still air environment with TA =25° C.	R <sub>θJA</sub>	100.0	°C/W
Thermal Resistance Junction-Case(Note 2)	2.device mounted on 1 in <sup>2</sup> FR-4 board with 2oz	R <sub>θJC</sub>	1.79	

Notes: 1. Repetitive Rating : Pulse width limited by maximum junction temperature ##  
2 The value of R<sub>θJA</sub> is measured with the device mounted on 1in2 FR-4 board with 2oz. Copper, in a still air environment with TA =25° C.  
The value in any given application depends on the user's specific board design.This transistor is sensitive to electrostatic discharge and should be handled with care.



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Electrical Characteristics (Ratings at 25°C ambient temperature unless otherwise specified)						
Parameter	Test Conditions	Symbol	Min.	Typ.	Max.	Unit
<b>Static off Characteristics</b>						
Drain-Source Breakdown Voltage	VGS=0V, ID=250uA	$BV_{DSS}$	600	-	-	V
Bvdss Temperature Coefficient	ID=250uA, Reference 25°C	$\Delta BV_{DSS}/\Delta T_J$	-	0.65	-	V/°C
Drain-Source Leakage Current	VDS= 600 V, VGS=0V	$I_{DSS}$	-	-	1	uA
Gate-Body Leakage Current	VGS= ±30 V, VDS=0V	$I_{GSS}$	-	-	±100	nA
<b>Static on Characteristics</b>						
Gate Threshold Voltage	VGS= VDS ID=250uA	$V_{GS(TH)}$	2.0	3.0	4.0	V
Drain-Source On Resistance	ID= 8 A, VGS=10V	$R_{DS(ON)}$	-	0.41	0.50	Ω
<b>Dynamic Characteristics</b>						
Input Capacitance	VDS= 25 V	$C_{iss}$	-	2640	-	pF
Output Capacitance	VGS= 0 V	$C_{oss}$	-	230	-	pF
Reverse Transfer Capacitance	F= 1 MHz	$C_{rss}$	-	15.0	-	pF
<b>Switching Parameters</b>						
Turn-On Delay Time	VDS= 300 V	$t_{d(on)}$	-	14	-	ns
Turn-On Rise Time	ID= 16 A	$t_r$	-	19	-	ns
Turn-Off Delay Time	VGS= 15 V	$t_{d(off)}$	-	88	-	ns
Turn-Off Rise Time	RG= 10 Ω	$t_f$	-	16	-	ns
Total Gate Charge	VDS= 300 V	$Q_g$	-	54	-	nC
Gate-Source Charge	ID= 16 A	$Q_{gs}$	-	13	-	nC
Gate-Drain Charge	VGS= 10 V	$Q_{gd}$	-	18	-	nC
<b>Drain-Source Diode Characteristics and Maximum Ratings</b>						
Max. Diode Forward Current		$I_S$	-	-	16	A
Max. Pulsed Forward Current		$I_{SM}$	-	-	64	A
Diode Forward Voltage	ID= 16 A, VGS=0V	$V_{SD}$	-	0.85	1.4	V
Reverse Recovery Time	ID= 16 A, VGS=0V	$t_{rr}$	-	420	-	ns
Reverse Recovery Charge	di/dt= 100 A/us	$Q_{rr}$	-	4.8	-	μC

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Typical Characteristics Curves

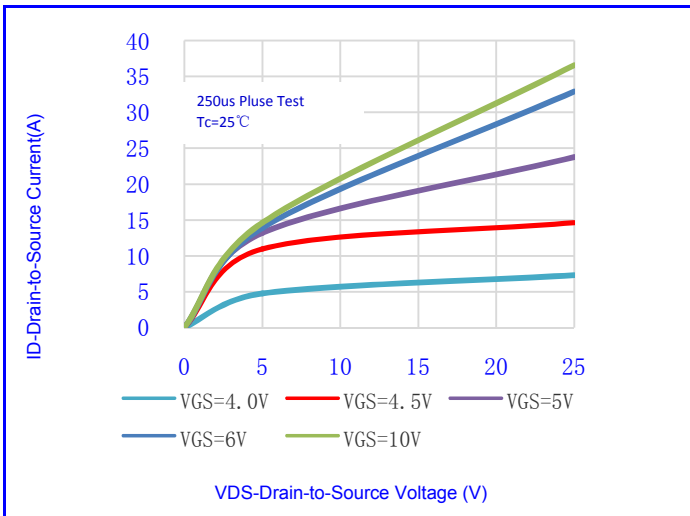


Fig.1-Output Characteristics

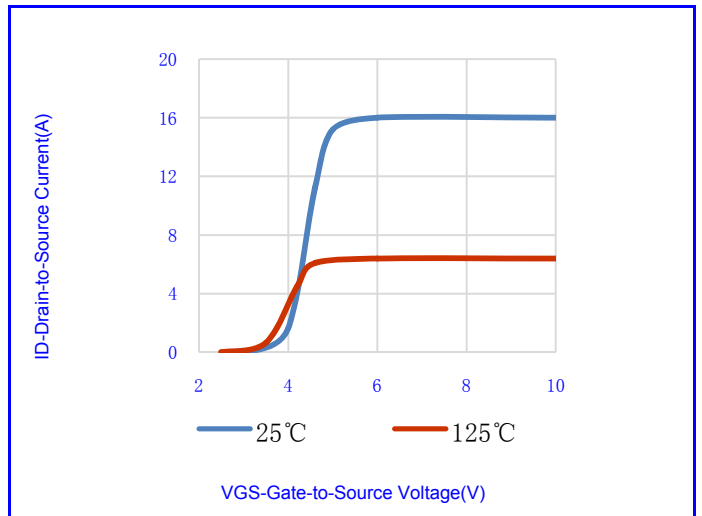


Fig.2- Transfer Characteristics

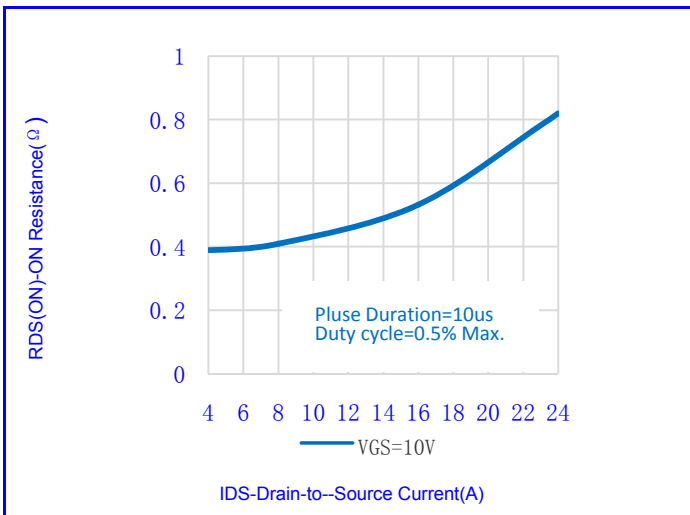


Fig.3- On Resistance vs. Drain Current

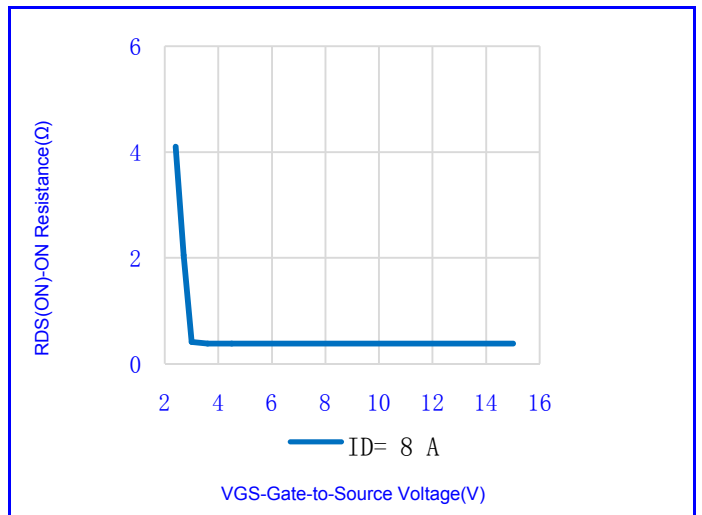


Fig.4- On Resistance vs. Gate Source Voltage

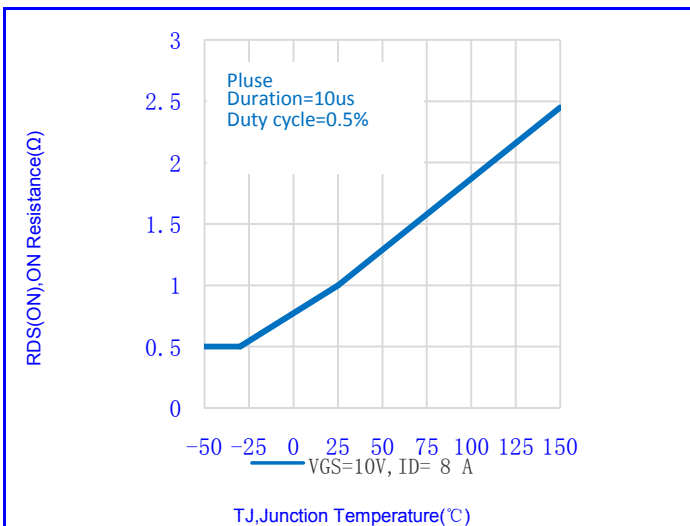


Fig.5- On Resistance vs. Junction Temperature

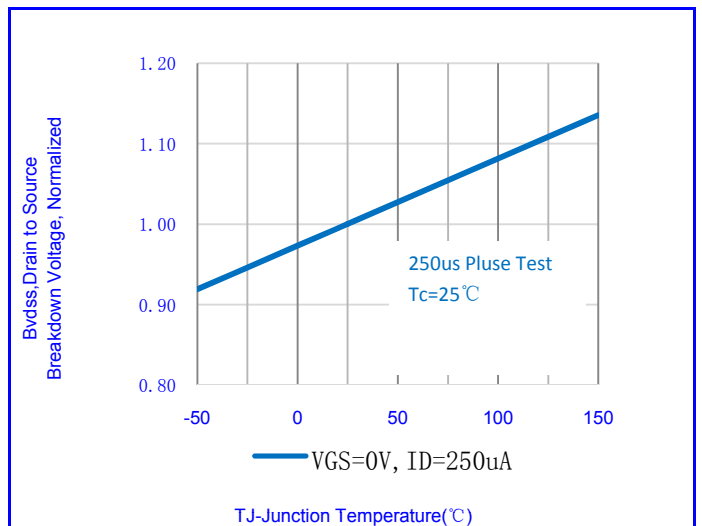


Fig.6- Breakdown Voltage vs. Junction Temperature

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Typical Characteristics Curves

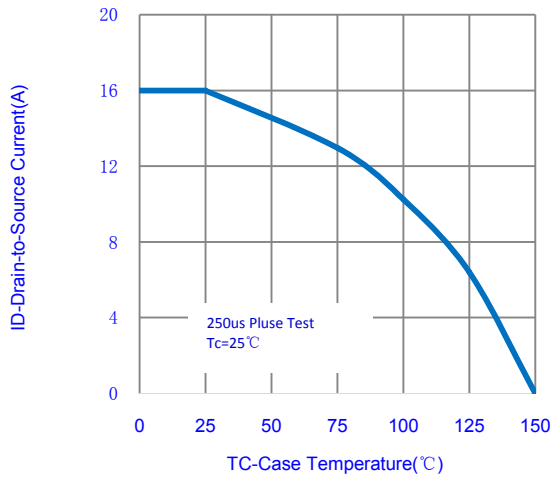


Fig.7-Maximum Continuous Drain Current vs. Case Temperature

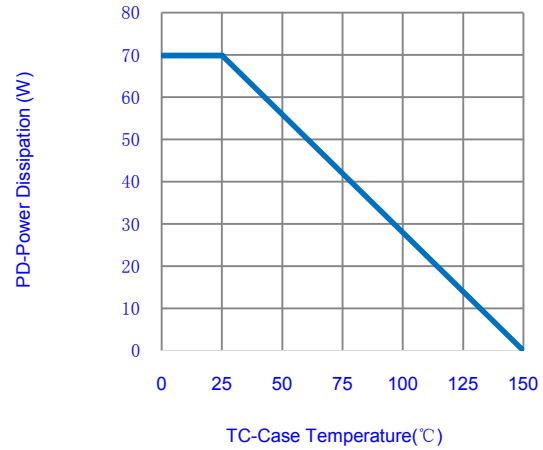


Fig.8-Maximum Power Dissipation vs. Case Temperature

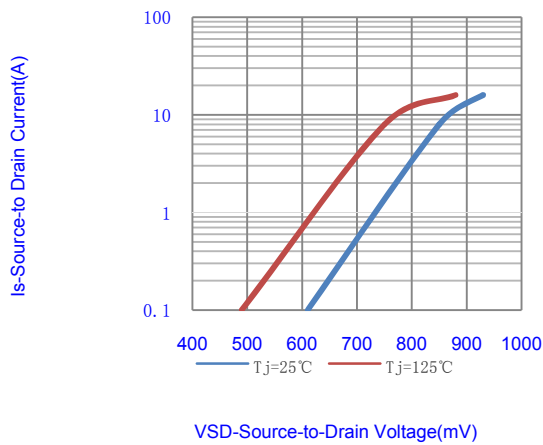


Fig.9- Source-Drain Diode Forward Voltage

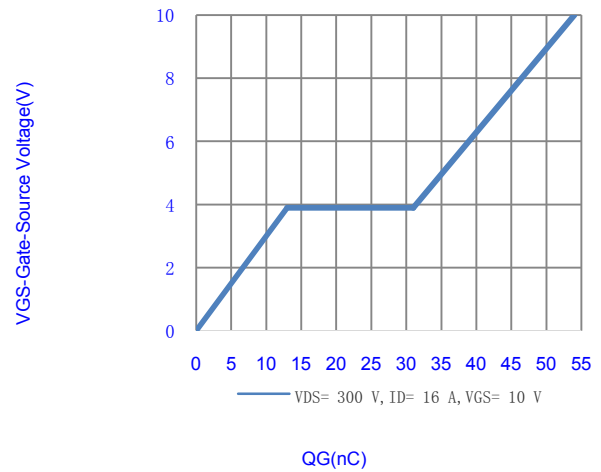


Fig.10-Gate Charge Waveform

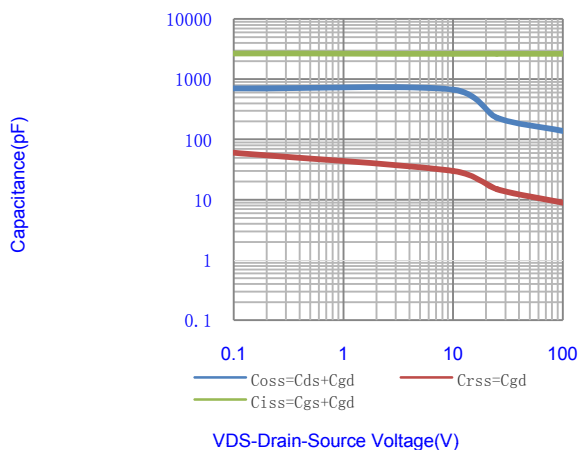


Fig.11- Gate-Source Voltage-VGS(V)

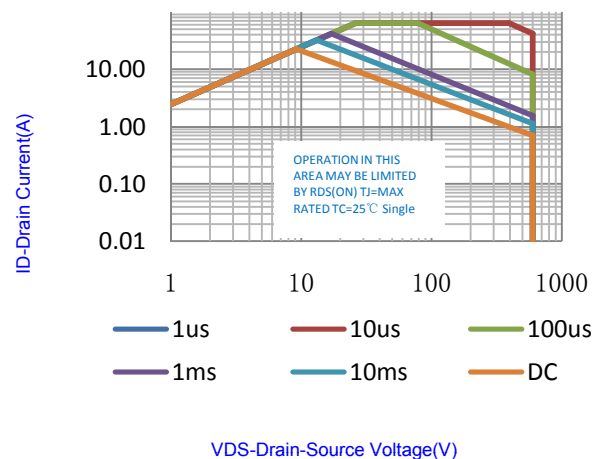


Fig.12-Maximum Safe Operating Area(SOA)

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Typical Characteristics Curves

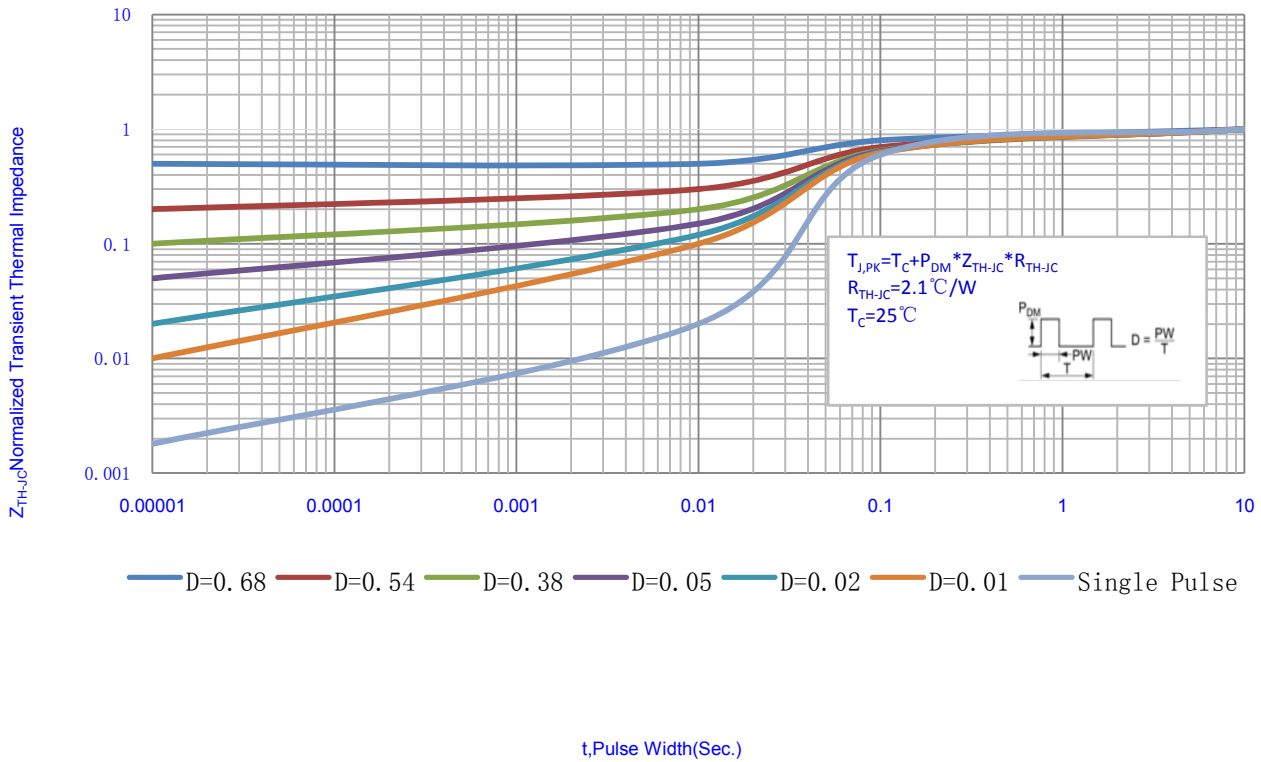


Fig.13- Normalized Transient Thermal Impedance vs.Pulse Width

Test Circuit & Waveform

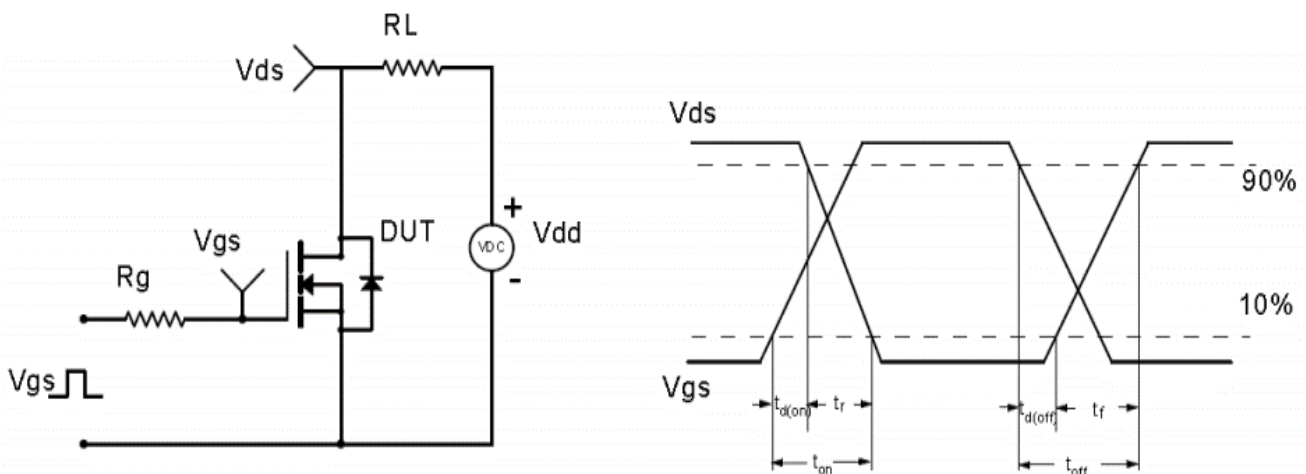


Fig.14- Resistive Switching Test Circuit & Waveform

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Test Circuit & Waveform

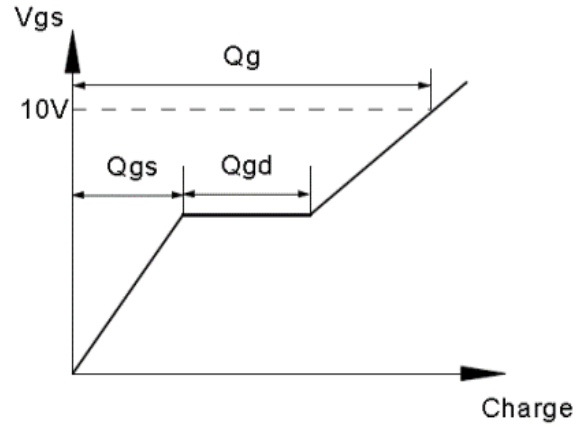
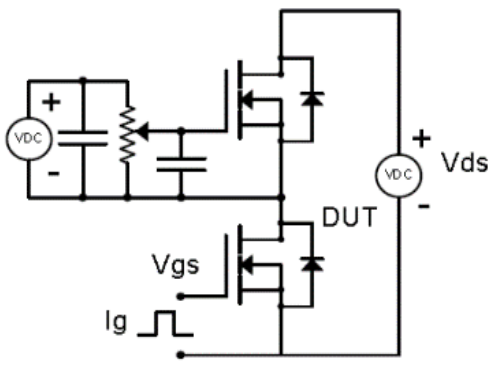


Fig.15-Gate Charge Test Circuit & Waveform

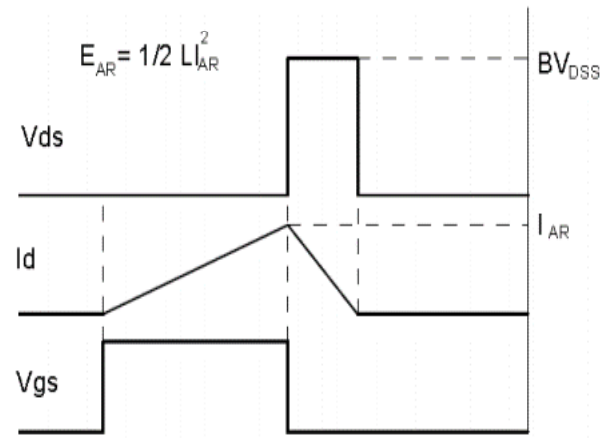
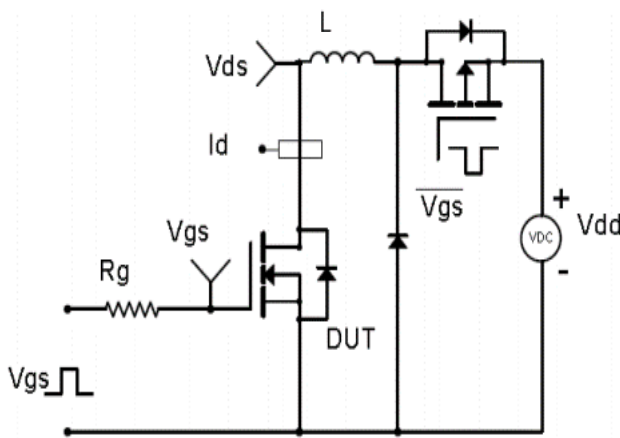


Fig.16- EAS Test Circuit & Waveform

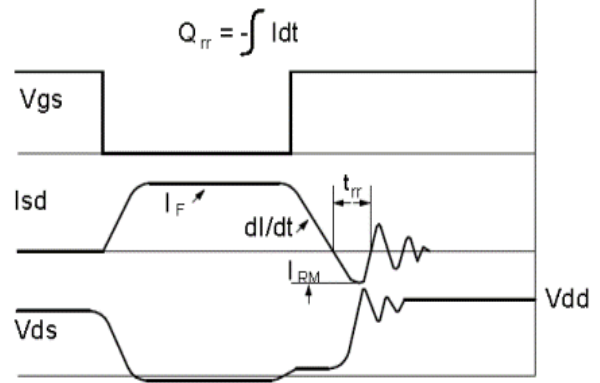
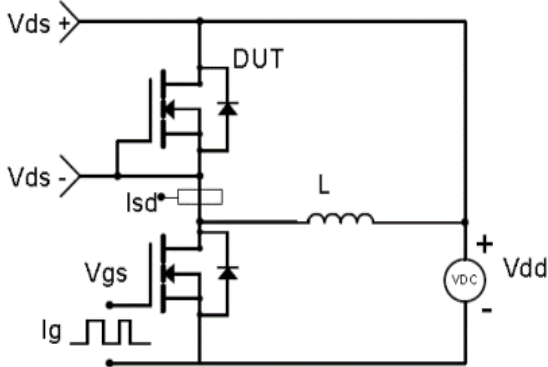


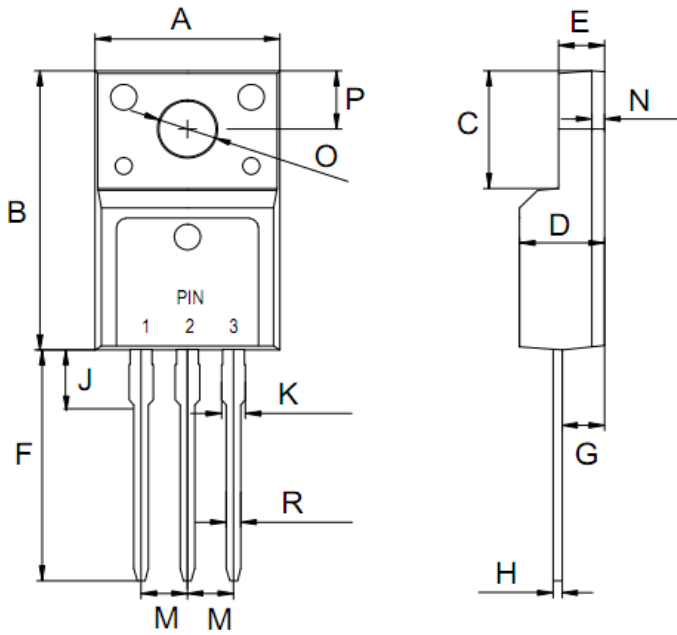
Fig.16- Diode Recovery Test Circuit & Waveform

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**OUTLINE DRAWINGS**



**TO-220F**

OUTLINE DIMENSIONS						
Dim.	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A	10.00	-	10.50	0.39	-	0.41
B	15.40	-	16.20	0.61	-	0.64
C	6.48	-	6.88	0.26	-	0.27
D	4.50	-	4.90	0.18	-	0.19
E	2.35	-	2.75	0.09	-	0.11
F	12.50	-	-	0.49	-	-
G	2.40	-	3.00	0.09	-	0.12
H	0.40	-	0.60	0.02	-	0.02
J	2.20	-	4.20	0.09	-	0.17
M	2.40	-	2.70	0.09	-	0.11
N	0.80	-	1.10	0.03	-	0.04
K	1.20	-	1.50	0.05	-	0.06
R	0.60	-	1.00	0.02	-	0.04
O	3.10	-	3.70	0.12	-	0.15
P	3.00	-	4.00	0.12	-	0.16

**PACKING INFORMATION**

**TO-220F**

Package Method	Inner Box Size L×W×H(mm)	Quantity (pcs/box)	Carton Size L×W×H(mm)	Quantity (box/carton)
Box Package	570×153×47	1000	580×250×180	5000

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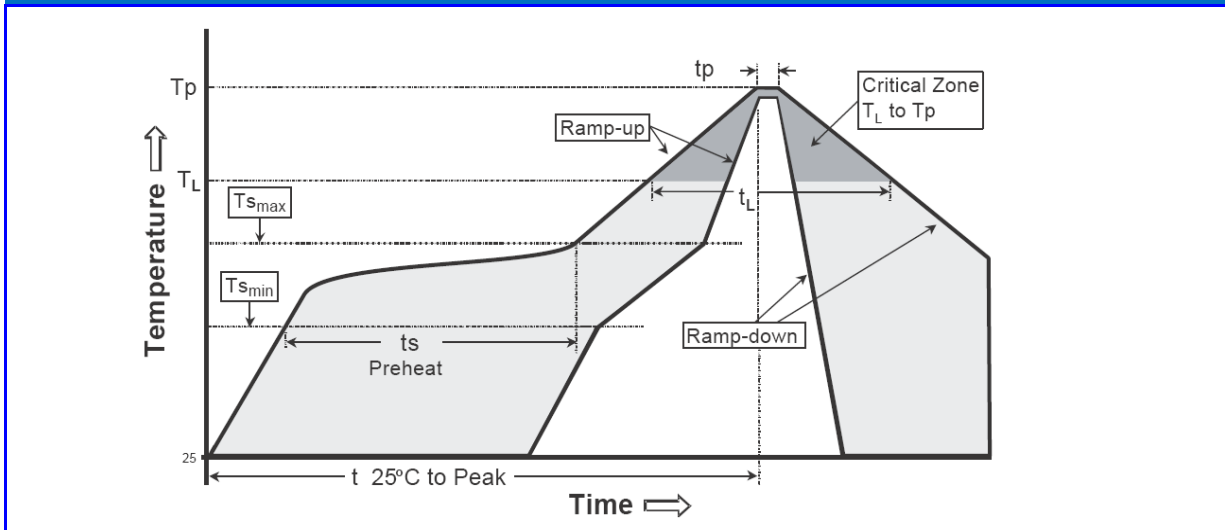
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**Recommended wave soldering condition**

Product	Peak Temperature	Soldering Time
Pb-free devices	260 +0/-5 °C	5 +1/-1 seconds

**Recommended temperature profile for IR reflow**



Profile feature	Sn-Pb eutectic Assembly	Pb-free Assembly
Average ramp-up rate (Tsmax to Tp)	3°C/second max.	3°C/second max.
Preheat -Temperature Min(TS min) -Temperature Max(TS max) -Time(ts min to ts max)	100°C 150°C 60-120 seconds	150°C 200°C 60-180 seconds
Time maintained above: -Temperature (TL) - Time (tL)	183°C 60-150 seconds	217°C 60-150 seconds
Peak Temperature(TP)	240 +0/-5 °C	260 +0/-5 °C
Time within 5°C of actual peak temperature(tp)	10-30 seconds	20-40 seconds
Ramp down rate	6°C/second max.	6°C/second max.
Time 25 °C to peak temperature	6 minutes max.	8 minutes max.

Note : All temperatures refer to topside of the package, measured on the package body surface.



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