

NPB4N65F

N-Channel Enhancement Mode Power MOSFET



Voltage: 650 Volts

Current: 4.0 Amperes

Polarity And Marking

Package: TO-220F

Features

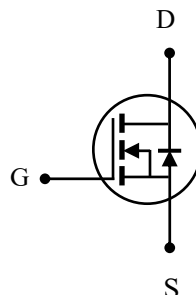
- NH'S Advanced Planar DMOS Technology
- Low Rds(on) For Low On-State Loss
- High EAS For High Reliability
- Qualified According To JEDEC Criteria

Typical Applications

- AC/DC Converter
- Adaptor And Charger
- PC Power
- LED Drives And LED Lighting
- Weight: App. 2.048 Grams (0.07224 Ounce)

Product Summary

VDS Min.@Tj	650	V
ID Min.@Ta	4.0	A
RDS(ON)Typ.@10V	2.3	Ω



Remark:

- ①. NH=Niuhang Trademark
- ②. FF=Product Line Code, According To Actual Changes
YWW=Date Code, According To Actual Changes
LLWWF=Internal Code, According To Actual Changes
- ③. NPB4N65F=Model

***100% UIS TESTED**

***100% ΔVDS TESTED**

Absolute Maximum Ratings (Ta=25°C Unless Otherwise Specified)

Parameter	Test Conditions	Symbol	Ratings	Unit
Drain-Source Voltage		V _{DS}	650	V
Gate-Source Voltage		V _{GS}	±30	V
Continuous Drain Current (Note 1)	Ta= 25 °C	I _D	4.0	A
	Ta= 100 °C		2.6	
Drain Current-Pulse (Note 1)	Tj< 150 °C	I _{DM}	16	A
Maximum Power Dissipation Power	Ta= 25 °C	P _D	30	W
	Ta= 100 °C		12	
Derating Factor		D _F	0.24	W/°C
Avalanche Current, Single Pulse (Note 1)	L= 10.0 mH	I _{AS}	6.3	A
Single Pulse Avalanche Energy (Note 1) Test Circuit & Waveform See Fig.16	L= 10.0 mH IAS= 6.3 A, RG= 10.0 Ω Starting Tj=25 °C, VG = 10.0 V	E _{AS}	198	mJ

Thermal Characteristics (Ta=25°C Unless Otherwise Specified)

Parameter	Test Conditions	Symbol	Typ.	Unit
Junction Temperature		T _J	-55 to 150	°C
Storage Temperature Range		T _{STD}	-55 to 150	°C
Thermal Resistance Junction To Ambient With Steady-State	Still Air Environment With Ta=25 °C	R _{θJA}	62.5	°C/W
Thermal Resistance Junction-Case With Steady-State	Device Mounted On 75mm x 45mm x 2.5mm Alu. Heat.	R _{θJC}	4.17	

Notes: 1. Pulse Width Limited By Max. Junction Temperature. (See Fig. 13).

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Electrical Characteristics (Ta=25°C Unless Otherwise Specified)

Parameter	Test Conditions	Symbol	Min.	Typ.	Max.	Unit
Static Off Characteristics						
Drain-Source Breakdown Voltage	VGS=0V,ID=250uA	BV _{DSS}	650	--	--	V
Bvdss Temperature Coefficient	ID=250uA,Reference25℃	ΔBV _{DSS} /ΔT _J	--	0.77	--	V/℃
Drain-Source Leakage Current	VDS= 650 V,VGS=0V	I _{DSS}	--	--	1	uA
Gate-Body Leakage Current	VGS= ±30 V,VDS=0V	I _{GSS}	--	--	±100	nA
Forward Transconductance	ID= 2.0 A,VDS= 15 V	g _{fs}	--	3.5	--	S
Static On Characteristics						
Gate Threshold Voltage	VGS= VDS ID=250uA	V _{GS(TH)}	2.0	3.0	4.0	V
Drain-Source On Resistance	ID= 2.0 A,VGS= 10.0 V	R _{DS(ON)}	--	2.3	2.8	Ω
	ID= 2.0 A,VGS= 5.5 V		--	2.6	3.8	
Dynamic Characteristics						
Input Capacitance	VDS= 50 V	C _{iss}	--	600.0	--	pF
Output Capacitance	VGS= 0 V	C _{oss}	--	50.0	--	pF
Reverse Transfer Capacitance	F= 1 MHZ	C _{rss}	--	3.5	--	pF
Switching Paramters (Test Circuit & Waveform See Fig.14)						
Turn-On Delay Time	VDS= 325 V	t _{d(on)}	--	14.0	--	ns
Turn-On Rise Time	VGS= 10.0 V	t _r	--	16.0	--	ns
Turn-Off Delay Time	RG= 10.0 Ω	t _{d(off)}	--	32.0	--	ns
Turn-Off Rise Time		t _f	--	11.0	--	ns
Gate Charge Paramters (Test Circuit & Waveform See Fig.15)						
Total Gate Charge	VDS= 325 V	Q _g	--	15.0	--	nC
Gate-Source Charge	VGS= 10.0 V	Q _{gs}	--	3.0	--	nC
Gate-Drain Charge	ID= 2.0 A	Q _{gd}	--	6.5	--	nC
Drain-Source Diode Characteristics And Maximum Ratings (Test Circuit & Waveform See Fig.17)						
Max. Diode Forward Cuurent		I _s	--	--	4.0	A
Max. Pulsed Forward Cuurent		I _{SM}	--	--	16	A
Diode Forward Voltage	ID= 2.0 A,VGS=0V	V _{SD}	--	1.08	1.5	V
Reverse Recovery Time	ID= 2.0 A,di/dt= 100 A/us	t _{rr}	--	250	--	ns
Reverse Recovery Charge	VGS= 10.0 V,VDD= 325 V	Q _{rr}	--	1200	--	nC

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Typical Characteristics Curves

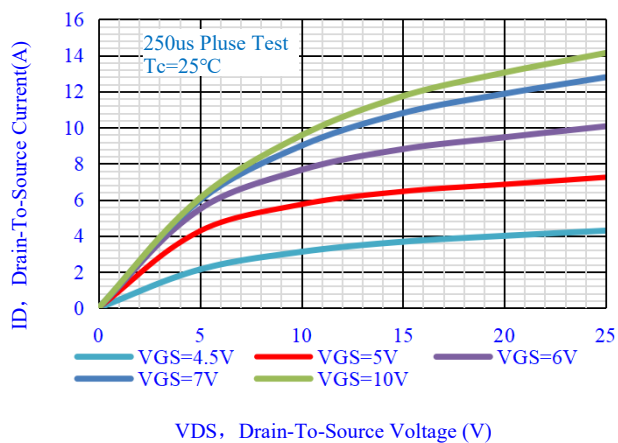


Fig.1-Output Characteristics

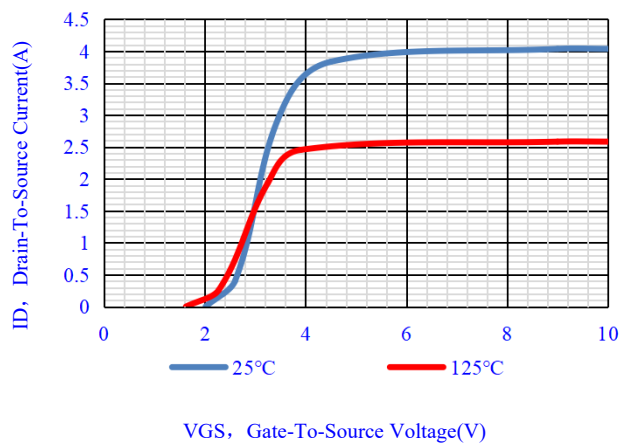


Fig.2- Transfer Characteristics

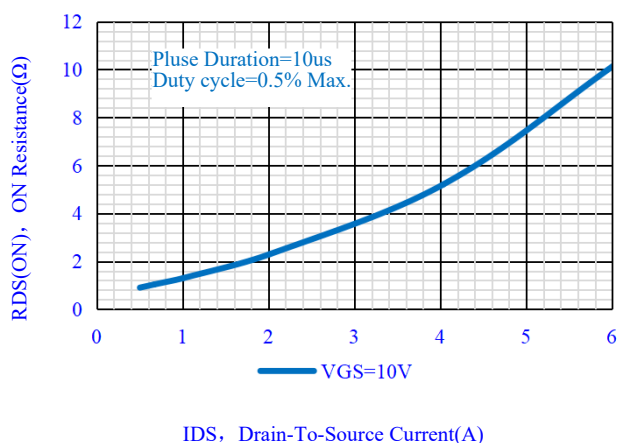


Fig.3- On Resistance vs. Drain Current

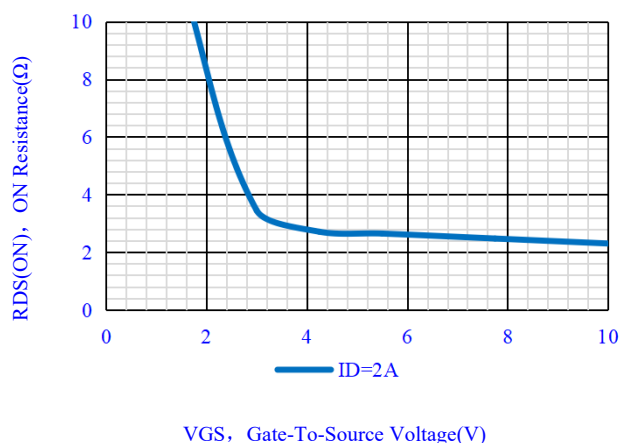


Fig.4- On Resistance vs. Gate Source Voltage

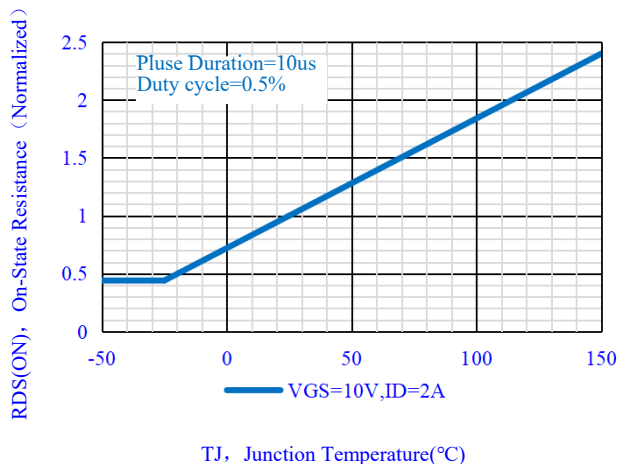


Fig.5- On Resistance vs. Junction Temperature

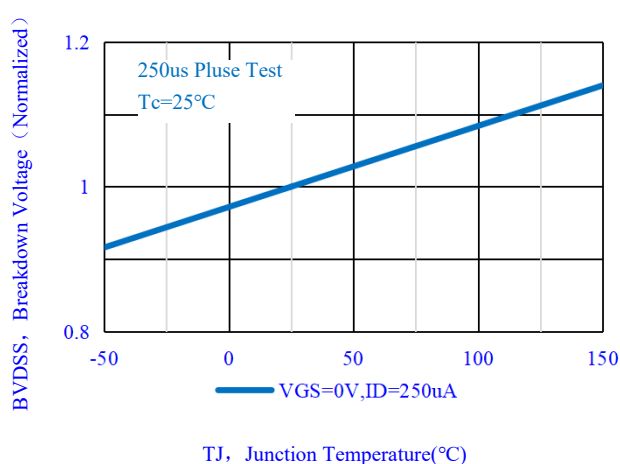


Fig.6- Breakdown Voltage vs. Junction Temperature

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Typical Characteristics Curves

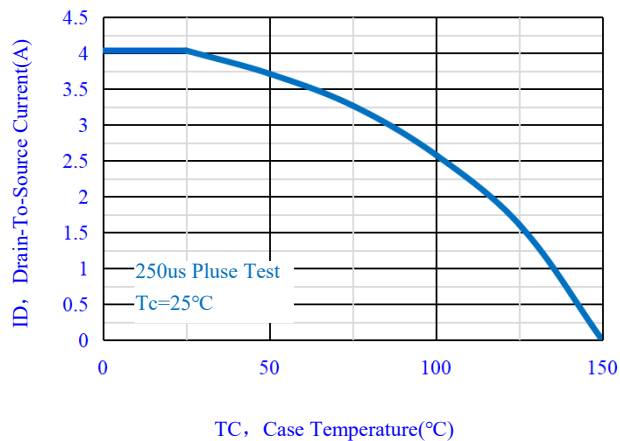


Fig.7-Maximum Continuous Drain Current vs. Case Temperature

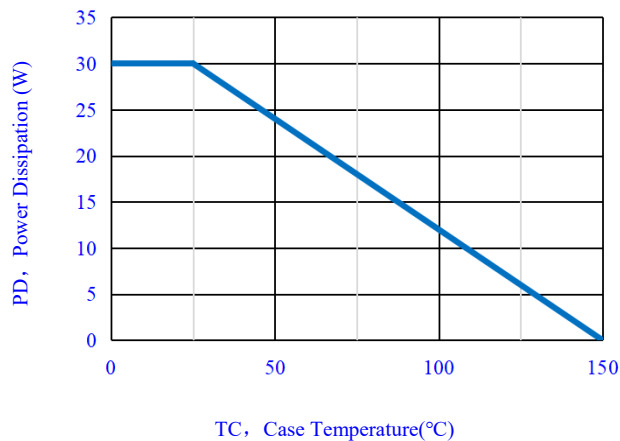


Fig.8-Maximum Power Dissipation vs. Case Temperature

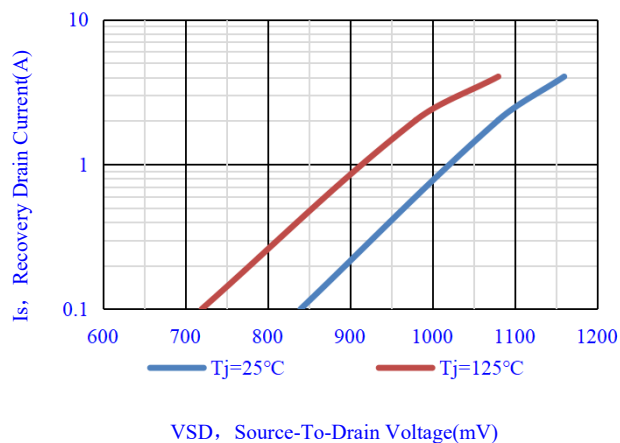


Fig.9- Source-To-Drain Diode Forward Voltage

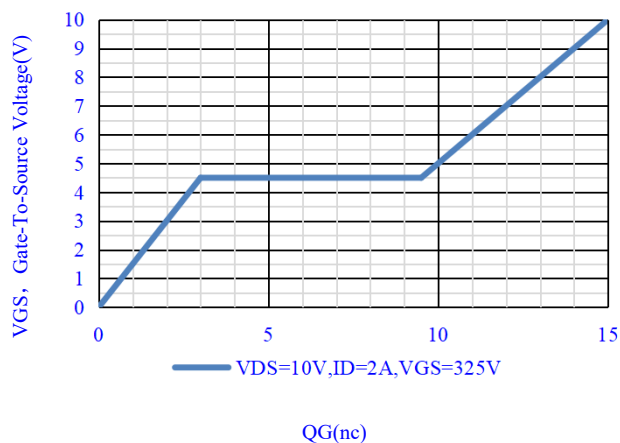


Fig.10-Gate Charge Waveform

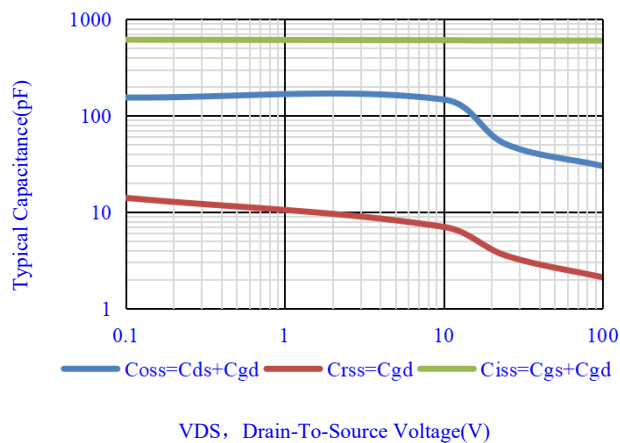


Fig.11-Typical Capacitance vs. Drain-To-Source Voltage

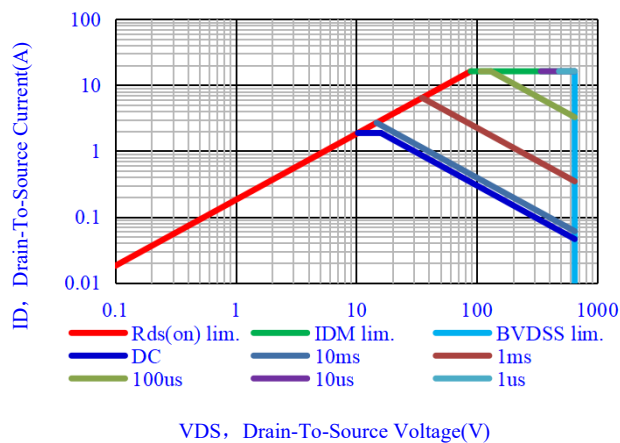


Fig.12-Maximum Safe Operating Area(SOA)

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Typical Characteristics Curves

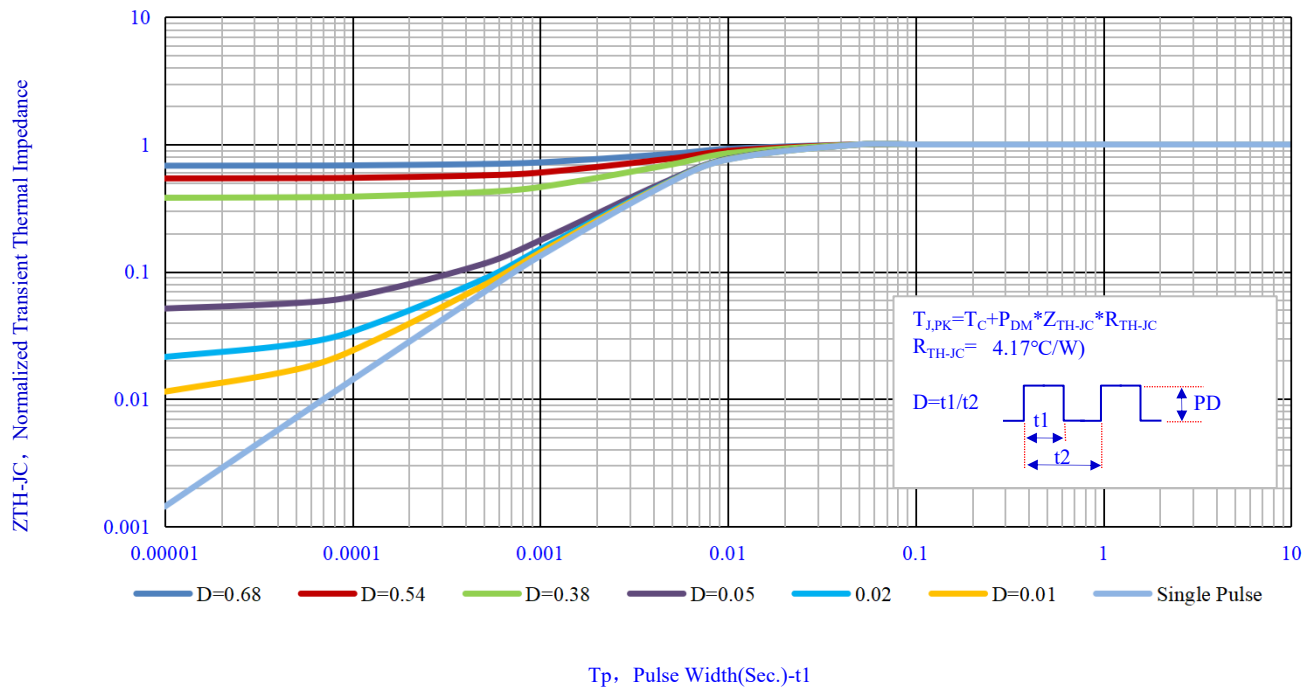


Fig.13- Normalized Maximum Transient Thermal Impedance vs.Pulse Width

Test Circuit & Waveform

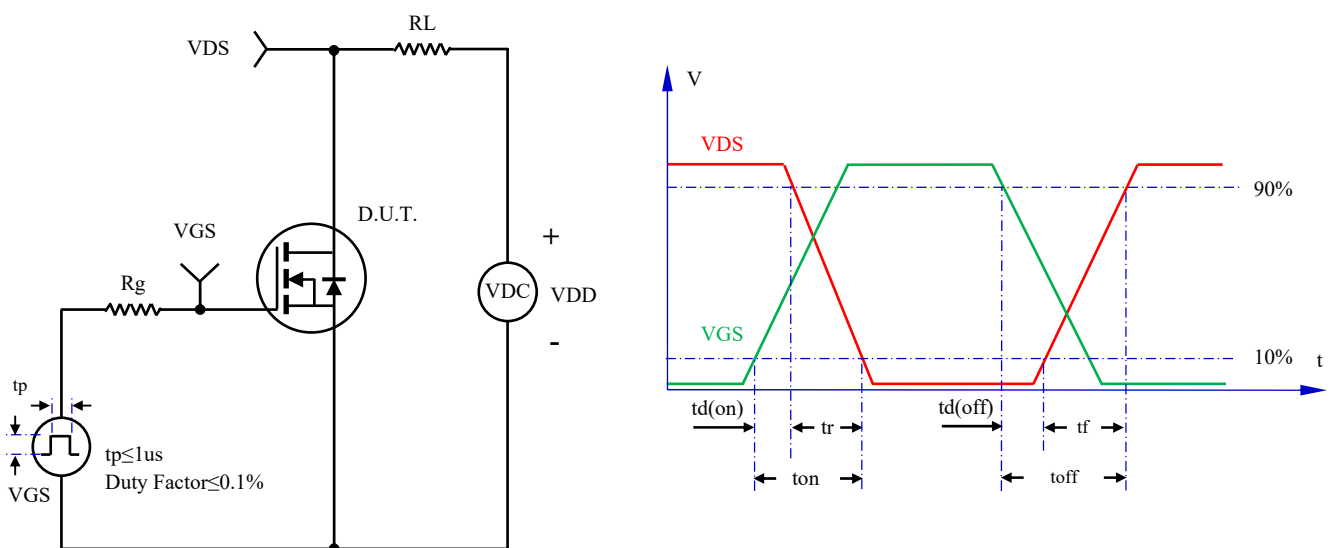


Fig.14- Resistive Switching Test Circuit & Waveform

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Test Circuit & Waveform

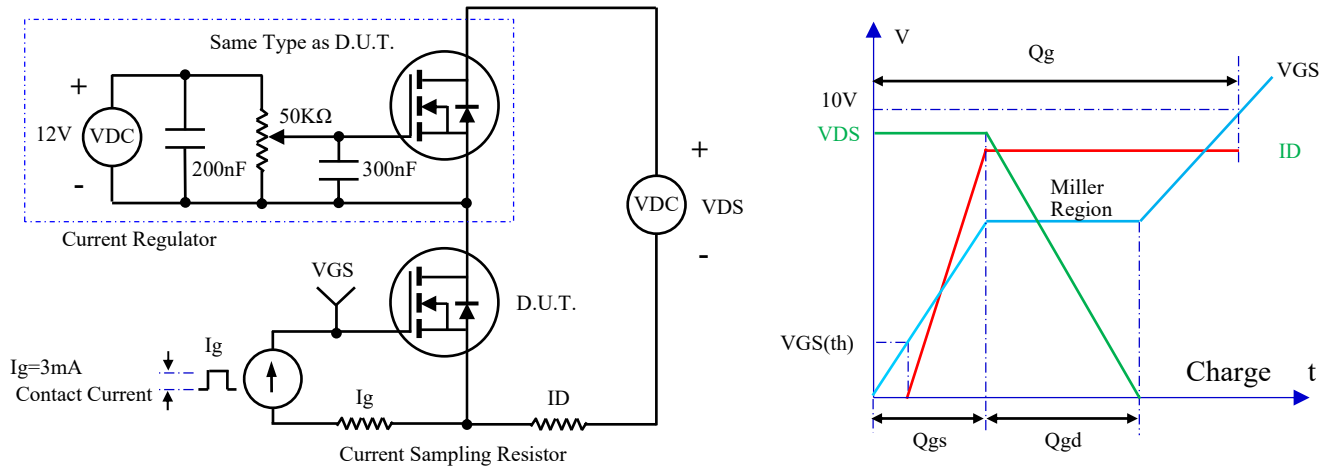


Fig.15- Gate Charge Test Circuit & Waveform

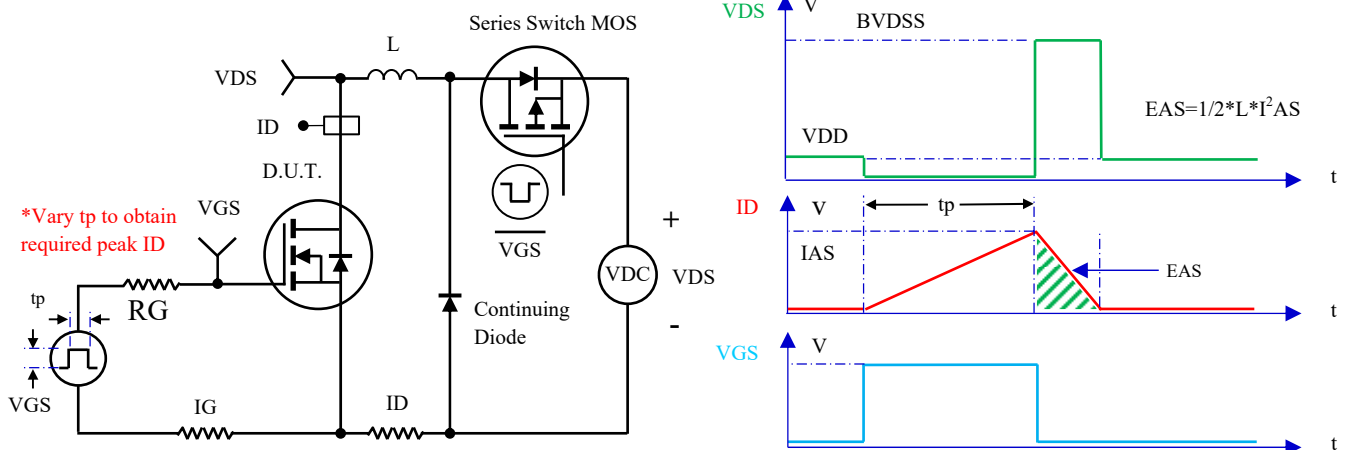


Fig.16- Unclamped Inductive Switching (UIS) Test Circuit & Waveform

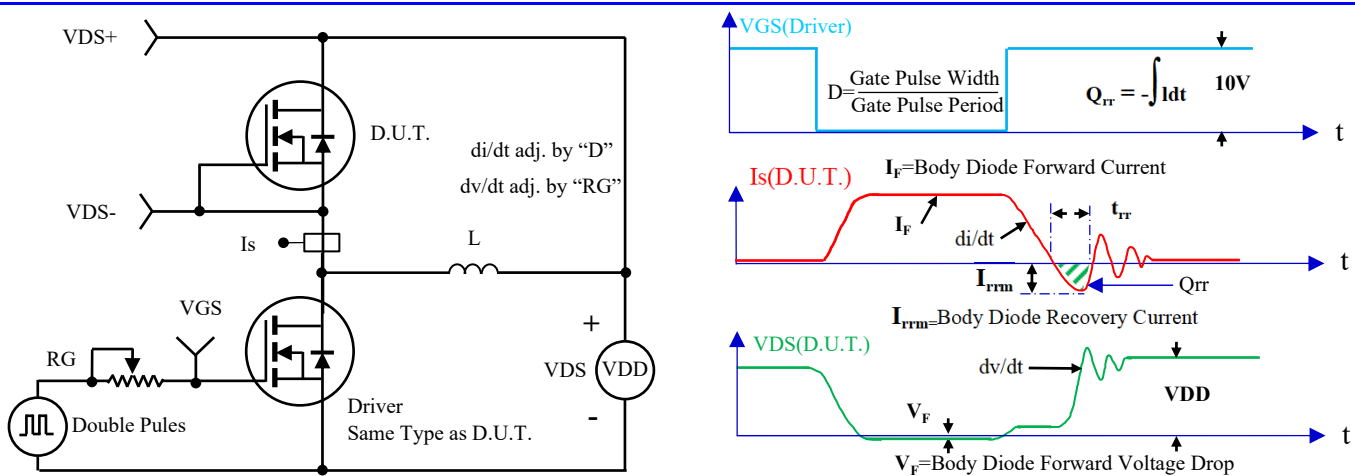


Fig.17- Diode Recovery Test Circuit & Waveform

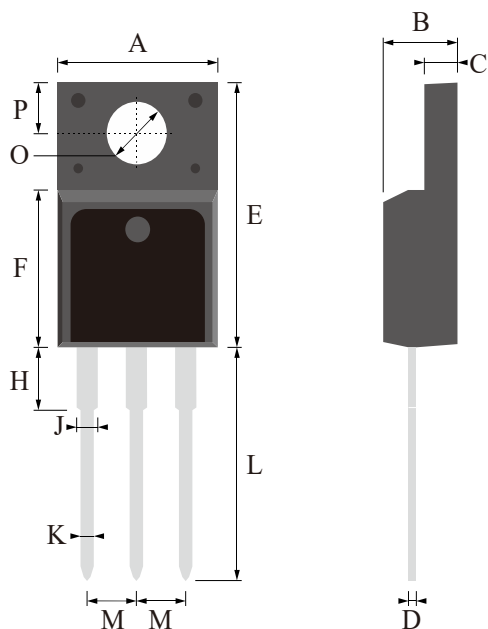
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OUTLINE DRAWINGS

TO-220F

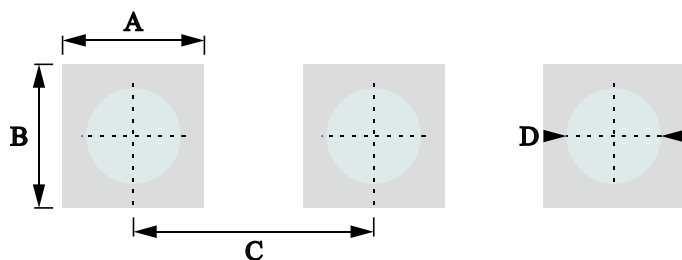


OUTLINE DIMENSIONS

Dim.	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A	9.25	-	10.75	0.3642	-	0.4232
B	2.30	-	2.90	0.0906	-	0.1142
C	4.20	-	5.20	0.1654	-	0.2047
D	0.35	-	0.75	0.0138	-	0.0295
E	14.80	-	16.80	0.5827	-	0.6614
F	8.25	-	9.75	0.3248	-	0.3839
L	12.15	-	14.15	0.4783	-	0.5571
H	2.40	-	3.00	0.0945	-	0.1181
J	1.10	-	1.50	0.0433	-	0.0591
K	0.60	-	1.00	0.0236	-	0.0394
M	2.20	-	3.00	0.0866	-	0.1181
O	2.70	-	3.50	0.1063	-	0.1378
P	2.25	-	2.85	0.0886	-	0.1122

RECOMMEDND LAYOUT DRAWINGS

TO-220F



OUTLINE DIMENSIONS

Dim.	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A	-	1.60	-	-	0.0630	-
B	-	1.60	-	-	0.0630	-
C	-	2.54	-	-	0.1000	-
D	-	1.00	-	-	0.0394	-

PACKING INFORMATION

Package Code	Package Method	Min. Pack. Size (mm)	Quantity (Pcs/Min. Pack.)	Inner Box Size L×W×H(mm)	Quantity (Pcs/Inner Box)	Outer Carton Size L×W×H(mm)	Quantity (Pcs/Carton)
TO-220F	T/P	545x35x7	50	570x155x40	1000	585x235x185	5000

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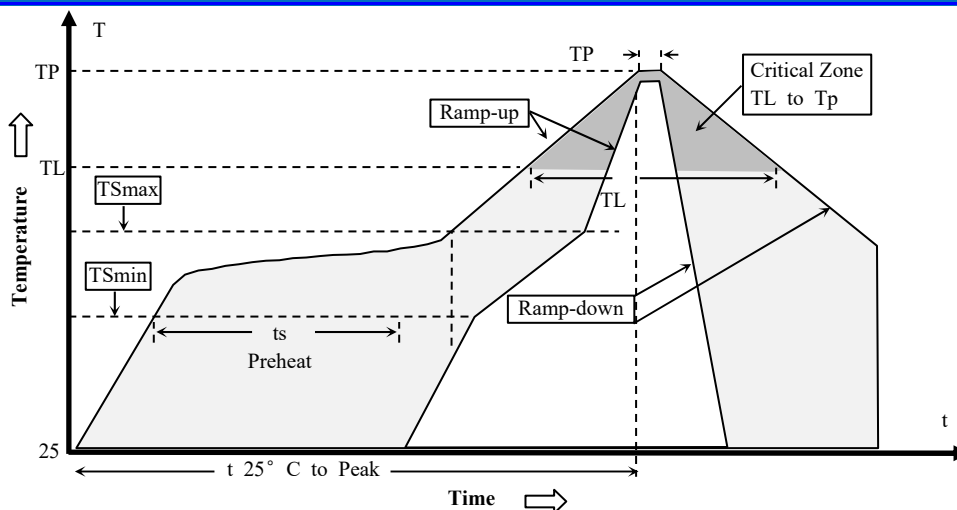
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Recommended wave soldering condition

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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