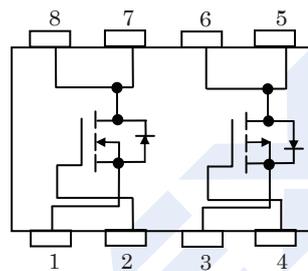
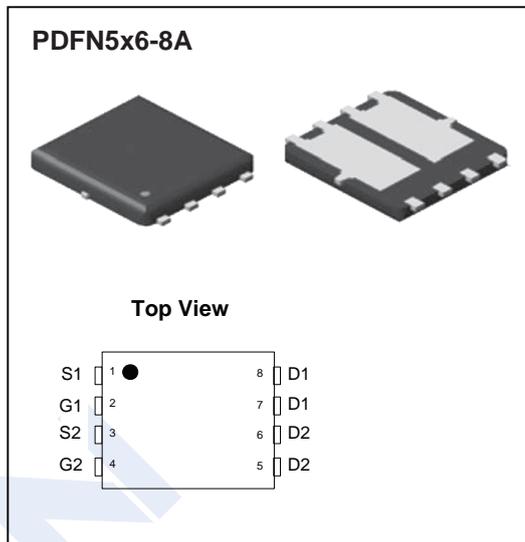


N-Ch and P-Ch MOSFET

2NP09

■ Features

- N-Channel
 - $V_{DS} = 40V$
 - $I_D = 32A$
 - $R_{DS(ON)} < 16m\Omega$
- P-Channel
 - $V_{DS} = -40V$
 - $I_D = -22A$
 - $R_{DS(ON)} < 30m\Omega$
- Advanced high cell density Trench technology
- Super Low Gate Charge
- Excellent CdV/dt effect decline
- 100% EAS Guaranteed

■ Absolute Maximum Ratings ($T_a = 25^\circ C$ Unless otherwise specified)

Parameter	Symbol	N-Channel	P-Channel	Unit	
Drain-Source Voltage	V_{DS}	40	-40	V	
Gate-Source Voltage	V_{GS}	± 20	± 20		
Continuous Drain Current (Note 1)	I_D	$T_C=25^\circ C$	32	-22	A
		$T_C=100^\circ C$	21	-17	
Pulsed Drain Current (Note 2)	I_{DM}	47	-41		
Single Pulse Avalanche Energy (Note 3)	EAS	18	20	mJ	
Maximum Power Dissipation (Note 4)	P_D	$T_C=25^\circ C$		25	W
Thermal Resistance, Junction- to-Ambient (Note 1)	$R_{\theta JA}$			62	$^\circ C/W$
Thermal Resistance, Junction- to-Case (Note 1)	$R_{\theta JC}$			5	
Junction Temperature	T_J			150	$^\circ C$
Storage Temperature Range	T_{stg}			-55 to 150	

Notes 1. The data tested by surface mounted on a 1 inch² FR-4 board with 2OZ copper.

2. The data tested by pulsed , pulse width $\leq 300\mu s$, duty cycle $\leq 2\%$.

3. The EAS data shows Max. rating . The test condition is $V_{BD}=25V, V_{GS}=10V, L=0.1mH, I_{AS}=17.8A$.

4. The power dissipation is limited by $150^\circ C$ junction temperature.

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■ Electrical Characteristics (Ta = 25°C Unless otherwise specified)

Parameter	Symbol	Test Conditions	Type	Min	Typ	Max	Unit	
Off Characteristics								
Drain-Source Breakdown Voltage	V _{DSS}	I _D =250μA, V _{GS} =0V	N-CH	40			V	
		I _D =-250μA, V _{GS} =0V	P-CH	-40				
Zero Gate Voltage Drain Current	I _{DSS}	V _{DS} =40V, V _{GS} =0V	N-CH			1	μA	
		V _{DS} =-40V, V _{GS} =0V	P-CH			-1		
Gate-Body Leakage Current	I _{GSS}	V _{DS} =0V, V _{GS} =±20V	N-CH			±100	nA	
		V _{DS} =0V, V _{GS} =±20V	P-CH			±100		
On Characteristics (Note 1)								
Gate Threshold Voltage	V _{GS(th)}	V _{DS} =V _{GS} , I _D =250μA	N-CH	1		2.5	V	
		V _{DS} =V _{GS} , I _D =-250μA	P-CH	-1		-2.5		
Static Drain-Source On-Resistance	R _{DS(on)}	V _{GS} =10V, I _D =12A	N-CH			21	mΩ	
		V _{GS} =4.5V, I _D =10A				25		
		V _{GS} =-10V, I _D =-7A	P-CH			38		
		V _{GS} =-4.5V, I _D =-4A				62		
Forward Transconductance	g _{FS}	V _{DS} =5V, I _D =12A	N-CH		8		S	
		V _{DS} =-5V, I _D =-8A	P-CH		12.6			
Dynamic Characteristics (Note 2)								
Input Capacitance	C _{iss}	N-Channel: V _{GS} =0V, V _{DS} =15V, f=1MHz P-Channel: V _{GS} =0V, V _{DS} =-15V, f=1MHz	N-CH		593		pF	
			P-CH		1004			
Output Capacitance	C _{oss}		N-CH		76			
			P-CH		108			
Reverse Transfer Capacitance	C _{rss}		N-CH		56			
			P-CH		80			
Switching Characteristics (Note 2)								
Total Gate Charge	Q _g	N-Channel: V _{GS} =4.5V, V _{DS} =20V, I _D =12A P-Channel: V _{GS} =-4.5V, V _{DS} =-20V, I _D =-12A	N-CH		5.5		nC	
			P-CH		9			
Gate Source Charge	Q _{gs}		N-CH		1.25			
			P-CH		2.54			
Gate Drain Charge	Q _{gd}		N-CH		2.5			
			P-CH		3.1			
Turn-On Delay Time	t _{d(on)}		N-Channel: V _{DD} =20V, I _D =1A V _{GS} =10V, R _G =3.3Ω P-Channel: V _{DD} =-15V, I _D =1A V _{GS} =-10V, R _G =3.3Ω	N-CH		8.9		ns
				P-CH		19.2		
Turn-On Rise Time	t _r	N-CH			2.2			
		P-CH			12.8			
Turn-Off Delay Time	t _{d(off)}	N-CH			41			
		P-CH			48.6			
Turn-Off Fall Time	t _f	N-CH			2.7			
		P-CH			4.6			
Drain-Source Diode Characteristics								
Diode Forward Voltage	V _{SD}	I _S =1A, V _{GS} =0V	N-CH			1.2	V	
		I _S =-1A, V _{GS} =0V	P-CH			-1.0		

Notes 1. Pulse Test: Pulse Width ≤ 300μs, Duty Cycle ≤ 2%.

2. Guaranteed by design, not subject to production

■ Marking

Marking	NP09 KA****
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2NP09

■ Typical Characteristics ($T_J = 25^\circ\text{C}$ unless otherwise specified)

N-Channel Typical Characteristics

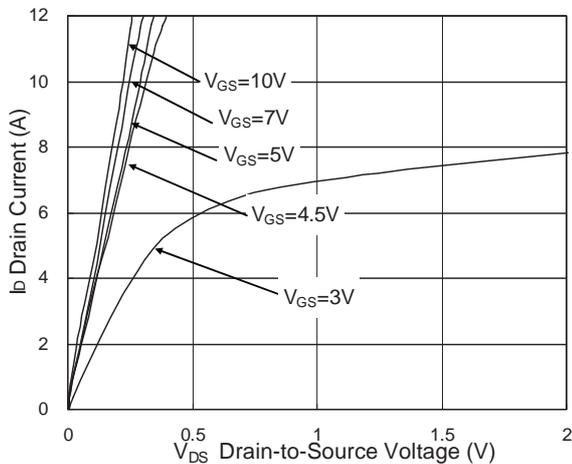


Fig.1 Typical Output Characteristics

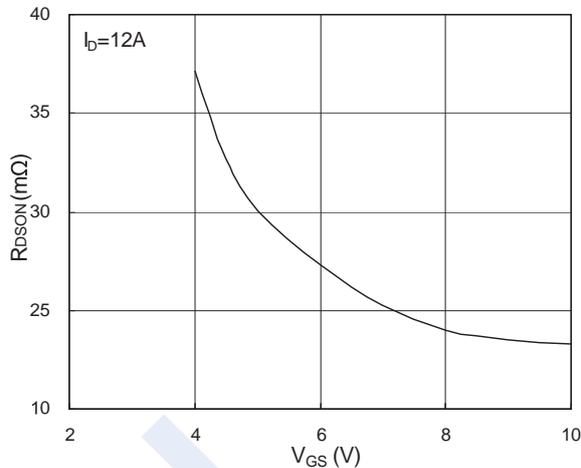


Fig.2 On-Resistance vs. G-S Voltage

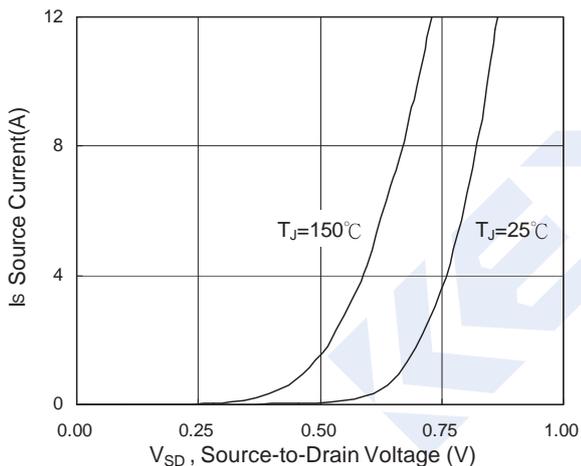


Fig.3 Forward Characteristics of Reverse

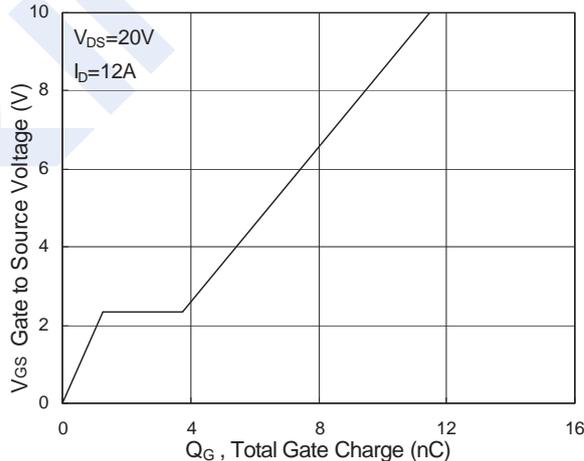


Fig.4 Gate-Charge Characteristics

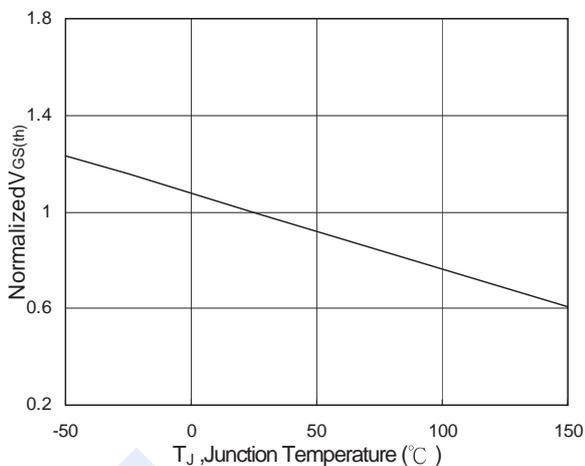


Fig.5 Normalized $V_{GS(th)}$ vs. T_J

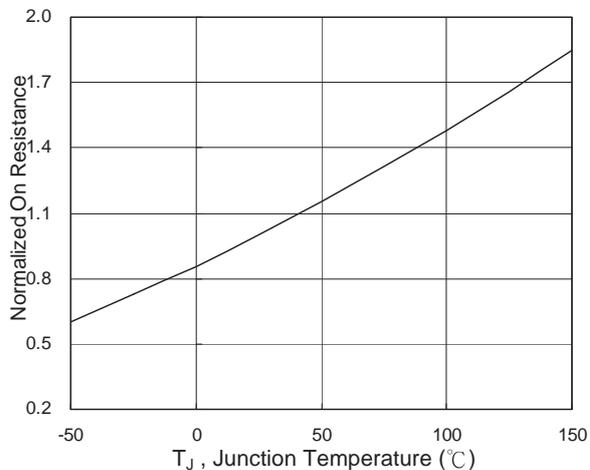


Fig.6 Normalized $R_{DS(on)}$ vs. T_J

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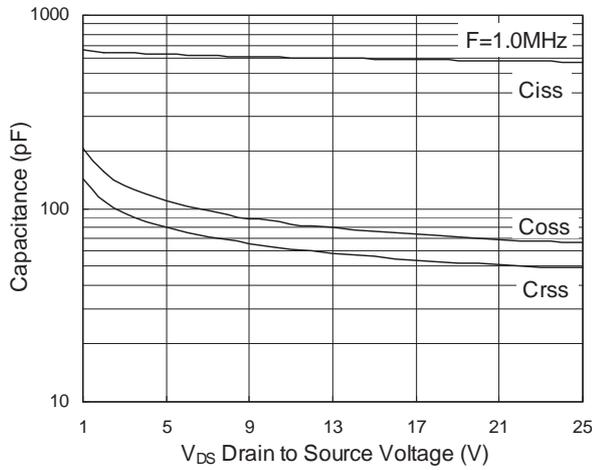


Fig.7 Capacitance

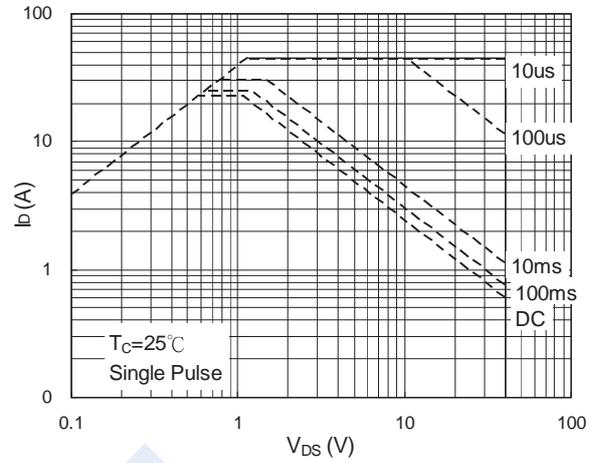


Fig.8 Safe Operating Area

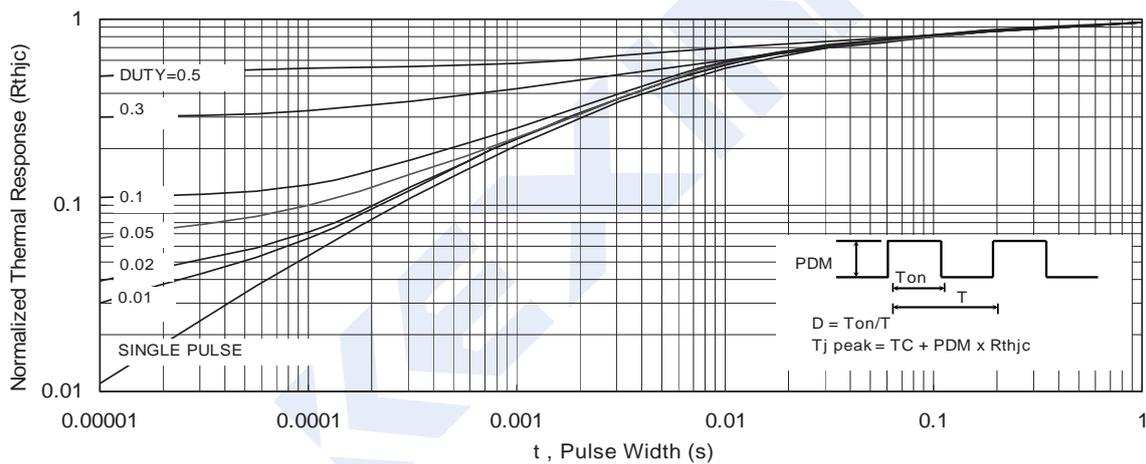


Fig.9 Normalized Maximum Transient Thermal Impedance

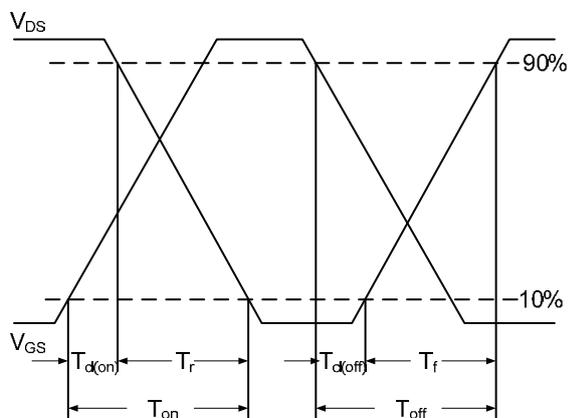


Fig.10 Switching Time Waveform

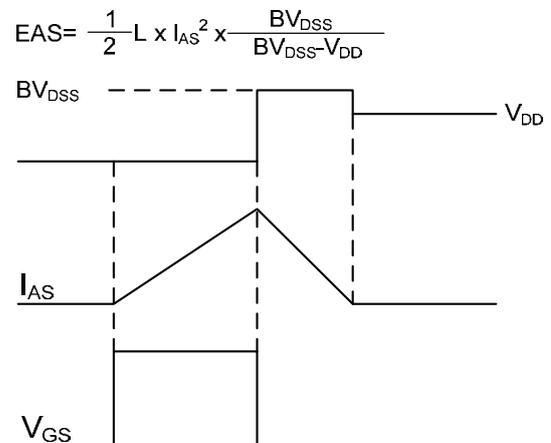


Fig.11 Unclamped Inductive Switching Wave

2NP09

P-Channel Typical Characteristics

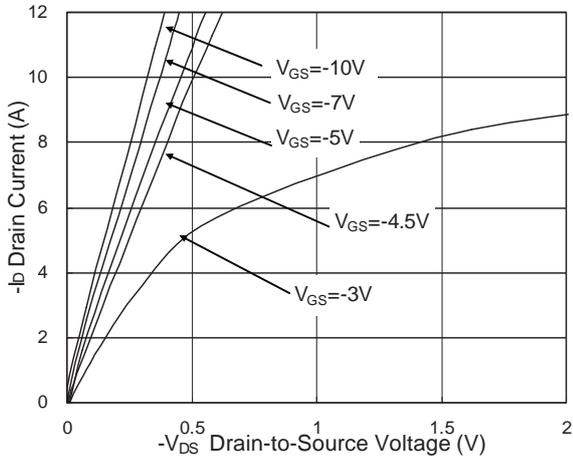


Fig.1 Typical Output Characteristics

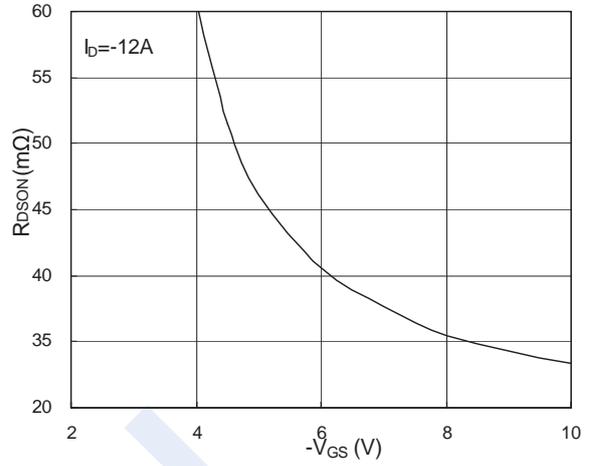


Fig.2 On-Resistance v.s Gate-Source

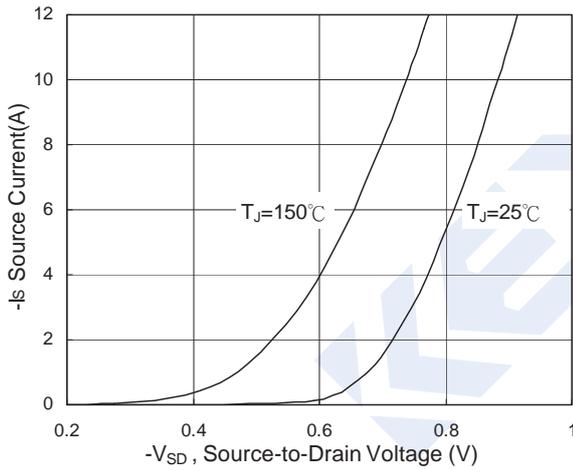


Fig.3 Forward Characteristics of Reverse

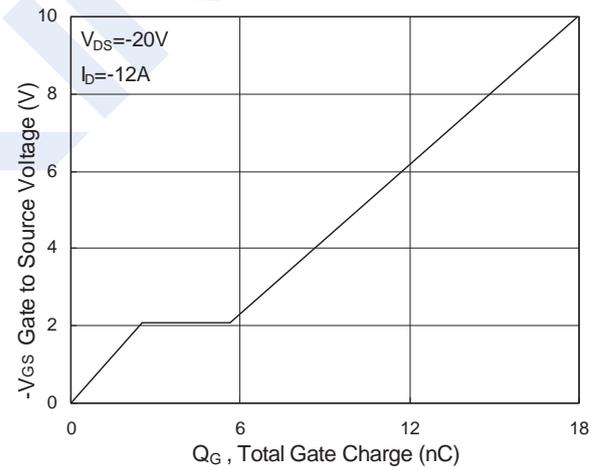


Fig.4 Gate-Charge Characteristics

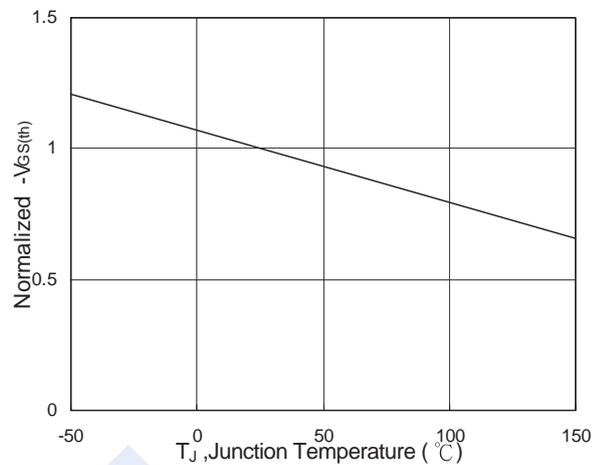


Fig.5 Normalized $V_{GS(th)}$ v.s T_J

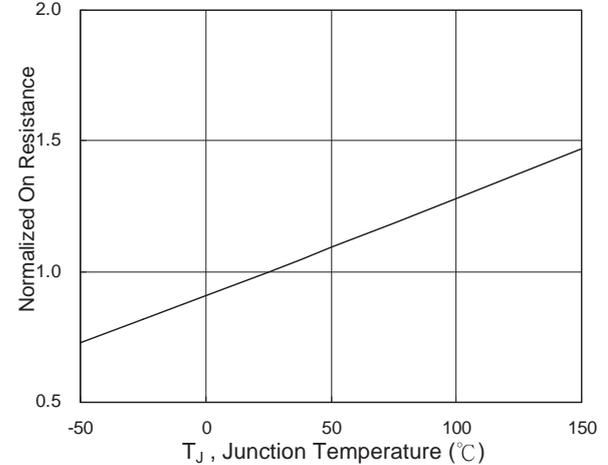


Fig.6 Normalized $R_{DS(on)}$ v.s T_J

2NP09

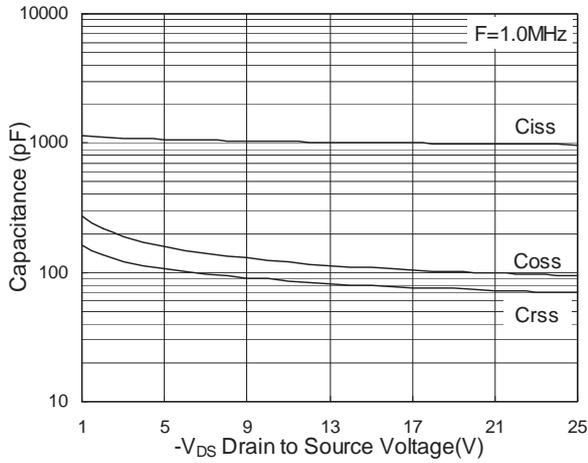


Fig.7 Capacitance

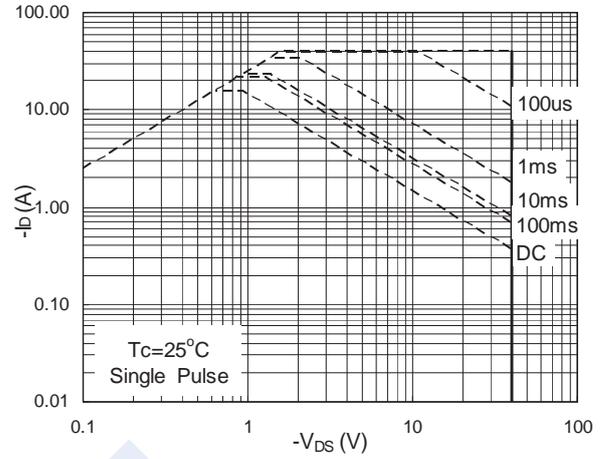


Fig.8 Safe Operating Area

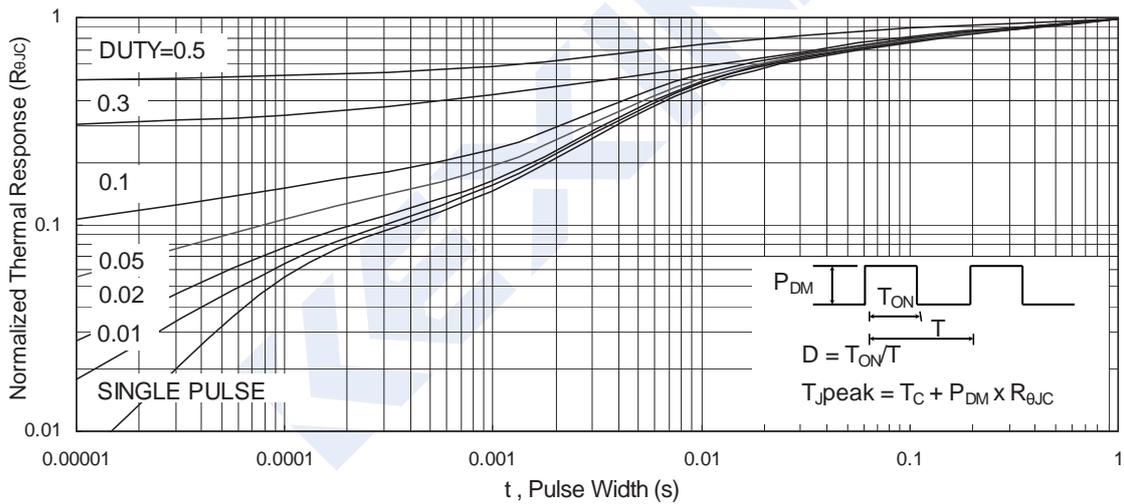


Fig.9 Normalized Maximum Transient Thermal Impedance

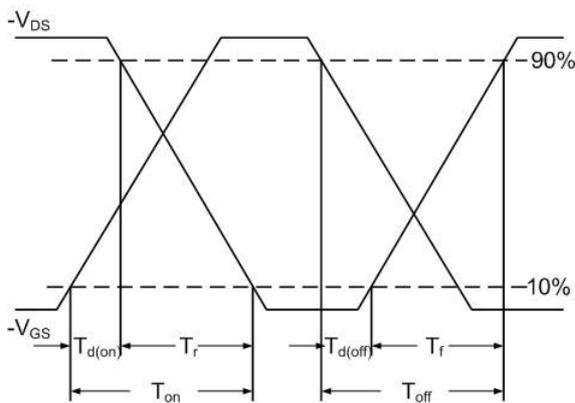


Fig.10 Switching Time Waveform

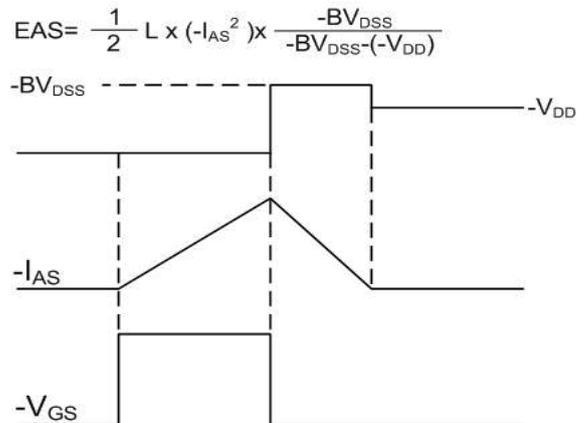
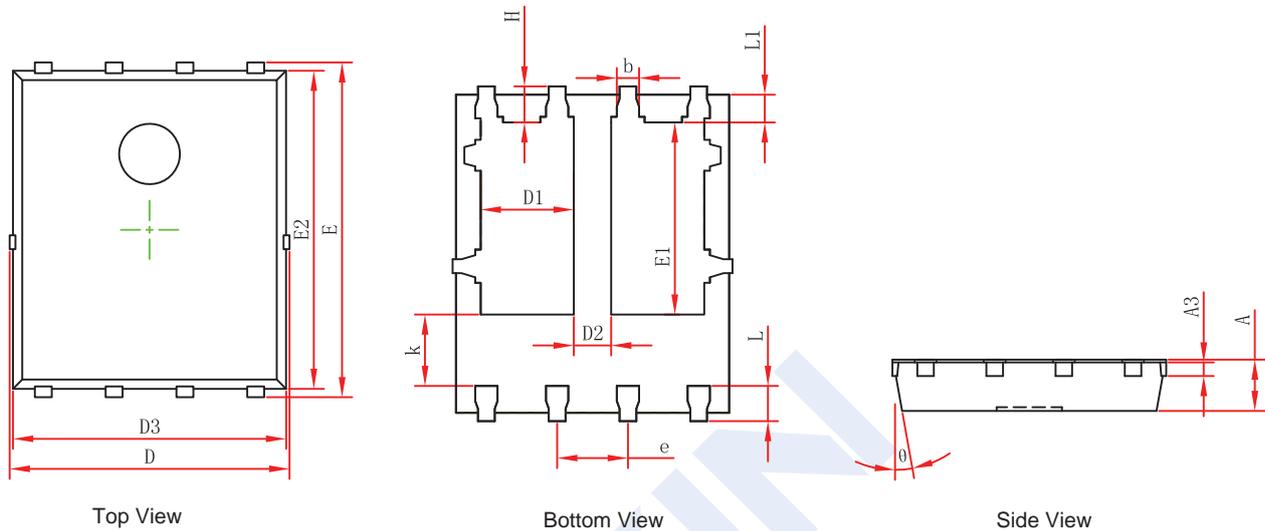


Fig.11 Unclamped Inductive Waveform

2NP09

■ PDFN5x6-8A Package Outline Dimensions



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	0.900	1.000	0.035	0.039
A3	0.254 REF.		0.010REF.	
D	4.944	5.096	0.195	0.201
E	5.974	6.126	0.235	0.241
D1	1.470	1.870	0.058	0.074
D2	0.470	0.870	0.019	0.034
E1	3.375	3.575	0.133	0.141
D3	4.824	4.976	0.190	0.196
E2	5.674	5.826	0.223	0.229
k	1.190	1.390	0.047	0.055
b	0.350	0.450	0.014	0.018
e	1.270TYP.		0.050TYP.	
L	0.559	0.711	0.022	0.028
L1	0.424	0.576	0.017	0.023
H	0.574	0.726	0.023	0.029
θ	10°	12°	10°	12°