

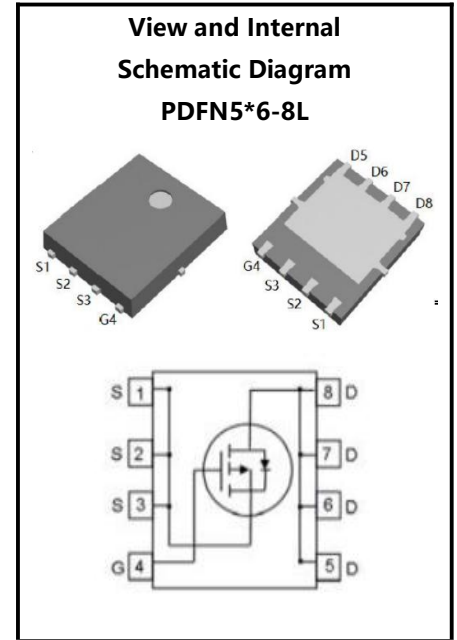
MOSFET

-40A, -60V, 20.5mΩ, P-CHANNEL MOSFET

Description and Applications

- ◆ Trench Power MOSFET technology
- ◆ Low R_{DS(on)} and Low Gate Charge
- ◆ RoHS and Halogen Free Complaint
- ◆ Synchronous Rectification
- ◆ Industrial and Motor Drive application

Parameter	Values	Unit
BV _{DSS}	-60	V
I _D	-40	A
R _{Dson} (max)	20.5	mΩ
V _{GS(th)} (Typ)	-1.6	V



Ordering Code	Marking	Package	Packaging
X409CVA	X409CVA	PDFN5*6-8L	Tape & Reel

Absolute Maximum Ratings(T_C=25°C,unless otherwise noted)

Parameter	Symbol	Values			Unit	Note/Test Conditions
		Min	Typ	Max		
Drain-Source Voltage	V _{DSS}	-	-	-60	V	V _{GS} =0V
Gate-Source Voltage	V _{GS}	-20	-	20	V	V _{DS} =0V
Continuous Drain Current(Note 1)	I _D	-	-	-40	A	T _C =25°C
		-	-	-25	A	T _C =100°C
Pulsed Drain Current(Note 2)	I _{DM}	-	-	-80	A	-
Avalanche Energy	E _{AS}	-	-	80	mJ	L=0.1mH
Maximum Power Dissipation	P _D	-	-	62.5	W	T _C =25°C
		-	-	25	W	T _C =100°C
Operating Junction and Storage Temperature Range	T _J , T _{STG}	-55	-	150	°C	-

Thermal Characteristics

Parameter	Symbol	Values			Unit	Note/Test Conditions
		Min	Typ	Max		
Thermal resistance , Junction to Case	R _{th(J-c)}	-	1.1	2	°C/W	-
Thermal resistance , Junction to Ambient	R _{th(J-a)}	-	39	50	°C/W	-

Electrical Characteristics ($T_j=25^{\circ}\text{C}$, unless otherwise noted)
Static characteristics

Parameter	Symbol	Values			Unit	Note/Test Conditions
		Min	Typ	Max		
Drain-Source Breakdown Voltage	BV_{DSS}	-60	-	-	V	$V_{GS}=0V, I_D=-250\mu A$
Zero Gate Voltage Drain Current	I_{DSS}	-	-	-1	μA	$V_{DS}=-60V, V_{GS}=0V$
Gate-Body Leakage Current, Forward	I_{GSSF}	-	-	100	nA	$V_{GS}=20V, V_{DS}=0V$
Gate-Body Leakage Current, Reverse	I_{GSSR}	-	-	-100	nA	$V_{GS}=-20V, V_{DS}=0V$
Gate-Source Threshold Voltage	$V_{GS(th)}$	-1.25	-	-2.05	V	$V_{DS}=V_{GS}, I_D=-250\mu A$
Drain-Source On-State Resistance	$R_{DS(on)}$	-	16.4	20.5	m Ω	$V_{GS}=-10V, I_D=-20A$
		-	18.3	23.5	m Ω	$V_{GS}=-4.5V, I_D=-20A$
Gate resistance	R_g	-	8.9	-	Ω	$V_{GS}=0V, V_{DS}=0V, f=1\text{MHz}$
Forward Transconductance	g_{fs}	-	61	-	S	$V_{DS}=-5V, I_D=-20A$

Dynamic characteristics

Parameter	Symbol	Values			Unit	Note/Test Conditions
		Min	Typ	Max		
Input Capacitance	C_{iss}	-	4967	-	pF	$V_{DS}=-30V, V_{GS}=0V, f=1.0\text{MHz}$
Output Capacitance	C_{oss}	-	234	-	pF	
Reverse Transfer Capacitance	C_{rss}	-	178	-	pF	
Turn-On Delay Time	$t_{d(on)}$	-	12	-	ns	$V_{DD}=-30V, R_G=3\Omega, V_{GS}=-10V, R_L=1.5\Omega$
Turn-On Rise Time	t_r	-	61	-	ns	
Turn-Off Delay Time	$t_{d(off)}$	-	160	-	ns	
Turn-Off Fall Time	t_f	-	137	-	ns	

Gate charge characteristics

Parameter	Symbol	Values			Unit	Note/Test Conditions
		Min	Typ	Max		
Total Gate Charge	Q_g	-	98	-	nC	$V_{DS}=-30V, I_D=-20A, V_{GS}=-10V$
Gate-Source Charge	Q_{gs}	-	19	-	nC	
Gate-Drain Charge	Q_{gd}	-	16	-	nC	

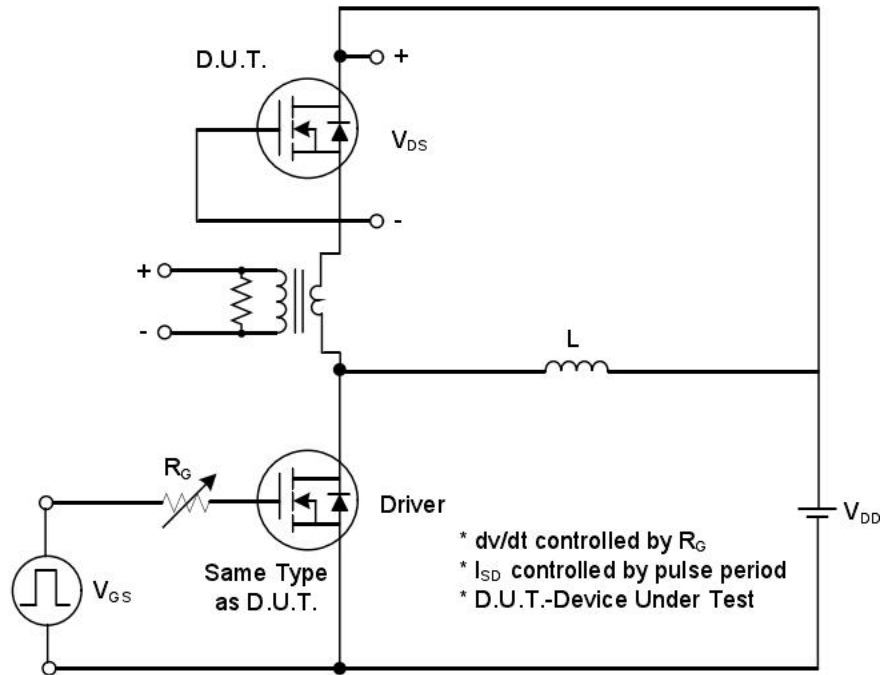
Reverse diode

Parameter	Symbol	Values			Unit	Note/Test Conditions
		Min	Typ	Max		
Continuous Diode Forward Current	I_S	-	-	-40	A	-
Diode Forward Voltage	V_{SD}	-	-	-1	V	$I_S=-1A, V_{GS}=0V$
Body Diode Reverse Recovery Time	t_{rr}	-	37	-	ns	$V_{GS}=0V, I_S=-20A, di/dt=-100\mu A/s$
Body Diode Reverse Recovery Charge	Q_{rr}	-	35	-	nC	

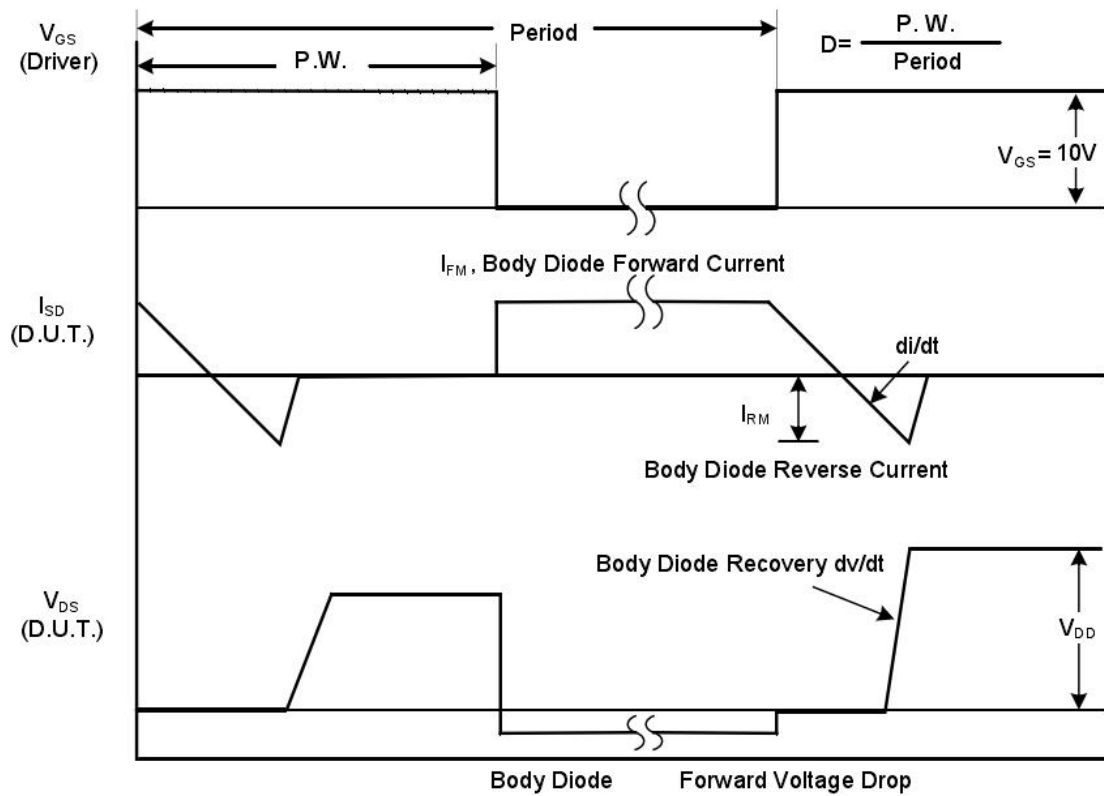
Notes

1. Computed continuous current assumes the condition of T_{j_Max} while the actual continuous current depends on the thermal & electro-mechanical application board design.
2. This single-pulse measurement was taken under $T_{j_Max} = 150^{\circ}\text{C}$.

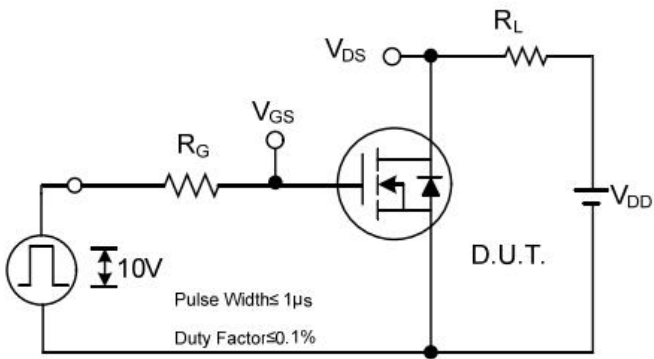
RATING AND CHARACTERISTIC CURVES



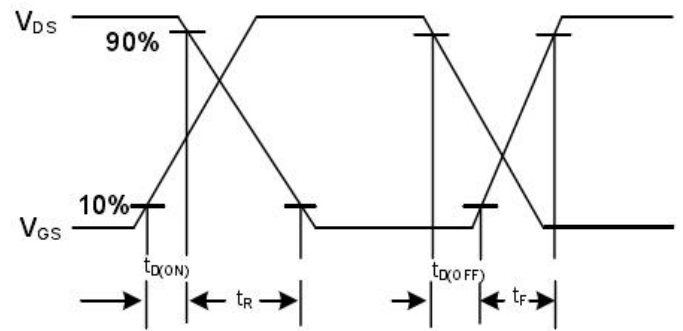
Peak Diode Recovery dv/dt Test Circuit



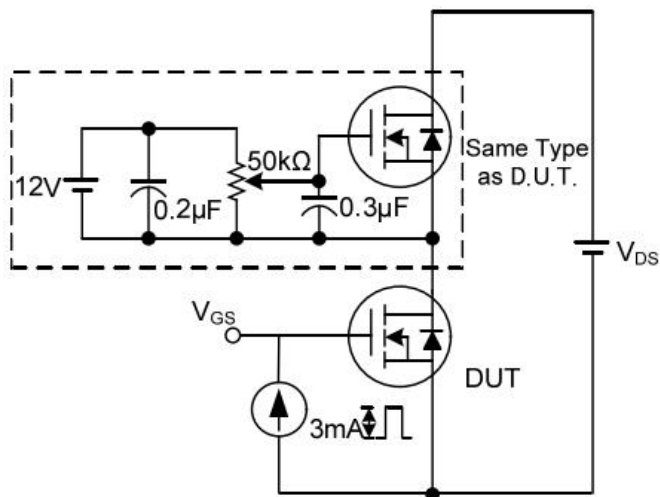
Peak Diode Recovery dv/dt Waveforms



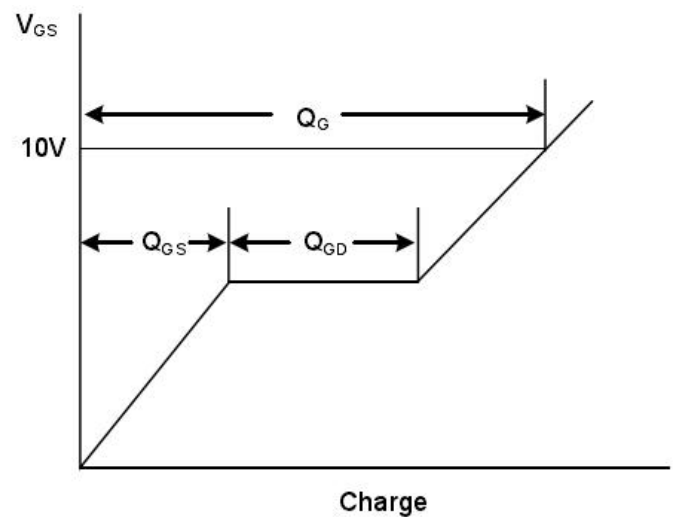
Switching Test Circuit



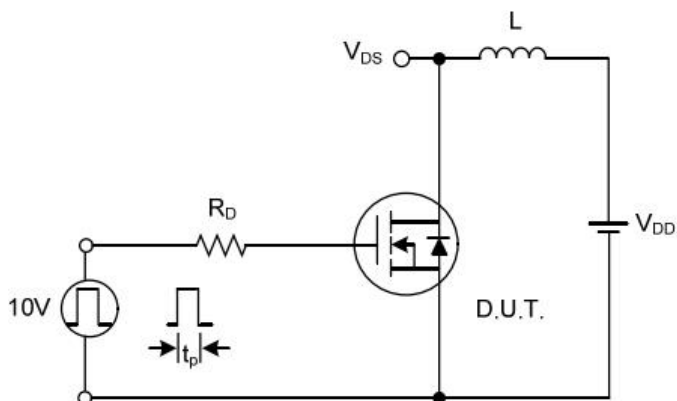
Switching Waveforms



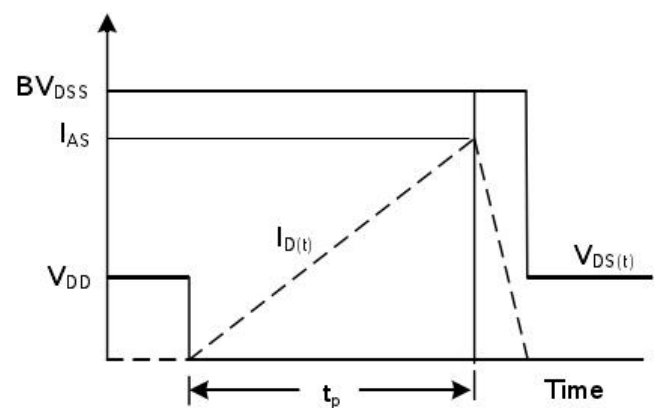
Gate Charge Test Circuit



Gate Charge Waveform



Unclamped Inductive Switching Test Circuit



Unclamped Inductive Switching Waveforms

RATING AND CHARACTERISTIC CURVES

Figure.1 On-Region Characteristics

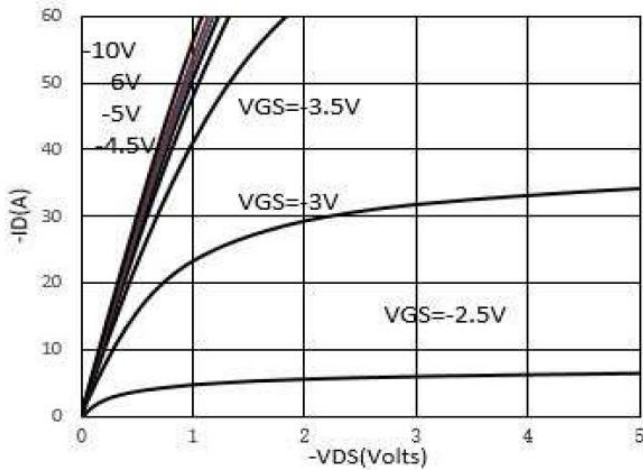


Figure.2 Transfer Characteristics

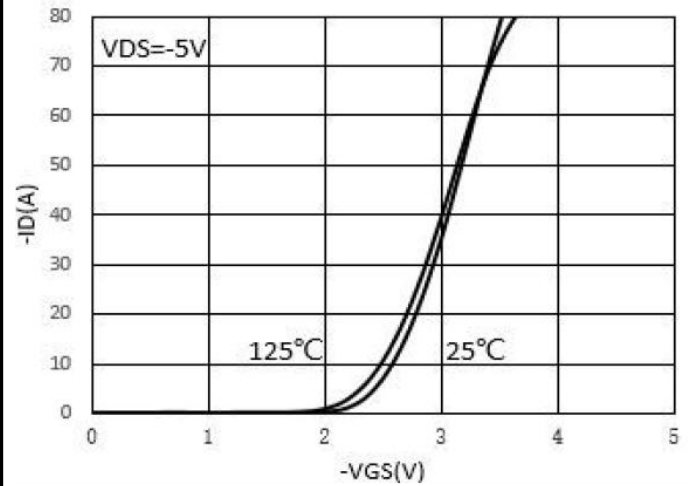


Figure.3 On-Resistance vs. Drain Current and Gate Voltage

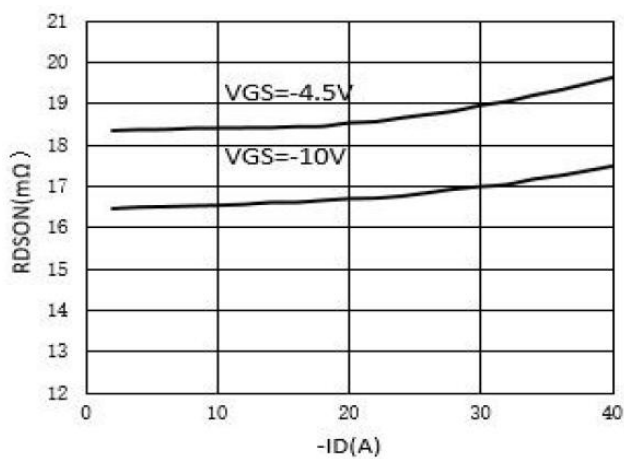


Figure.4 On-Resistance vs. Junction Temperature

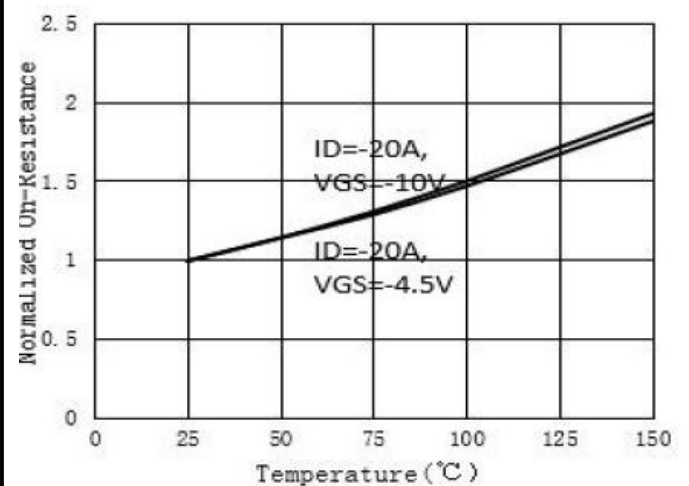


Figure.5 On-Resistance vs. Gate-Source Voltage

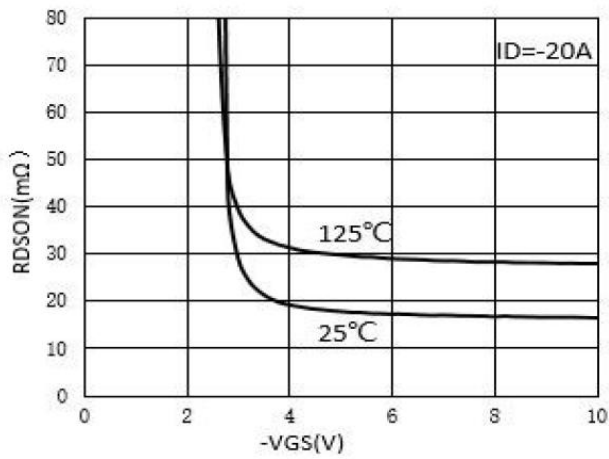


Figure.6 Body-Diode Characteristics

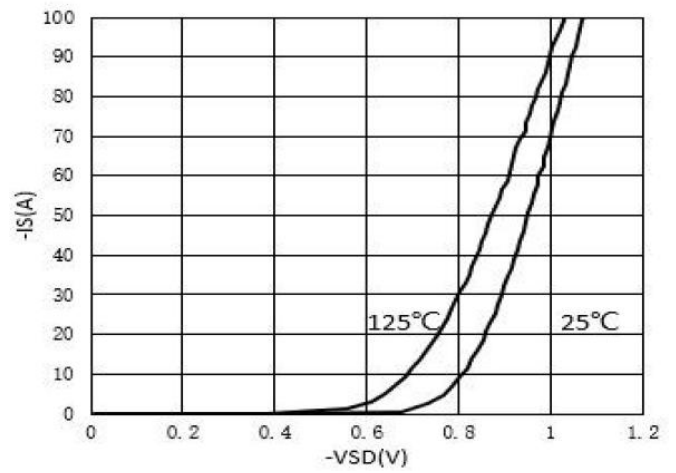


Figure.7 Gate-Charge Characteristics

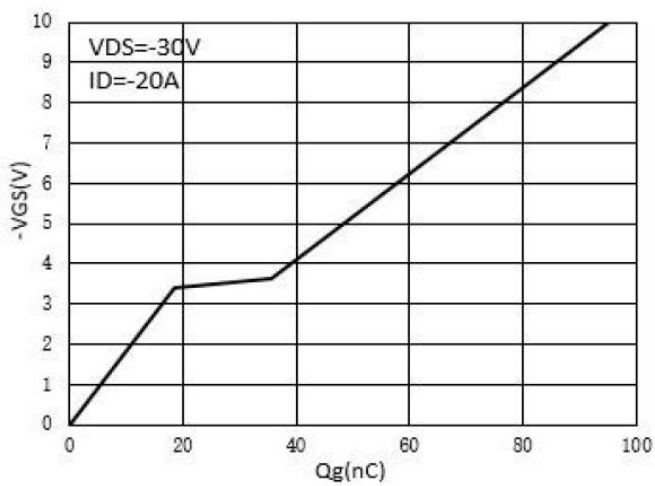


Figure.8 Capacitance Characteristics

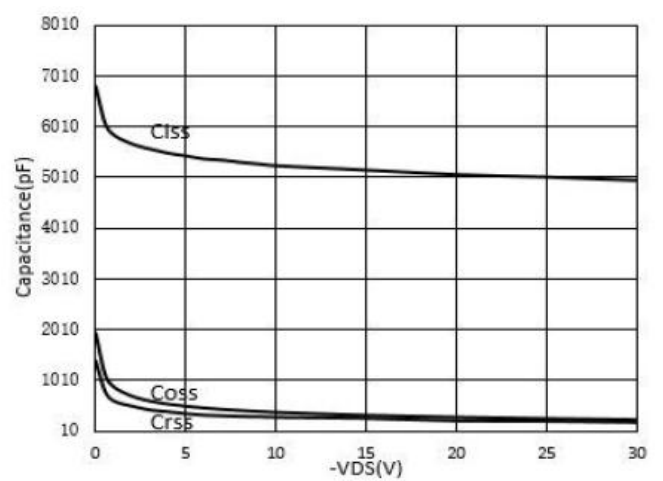


Figure.9 Maximum Forward Biased Safe Operating Area

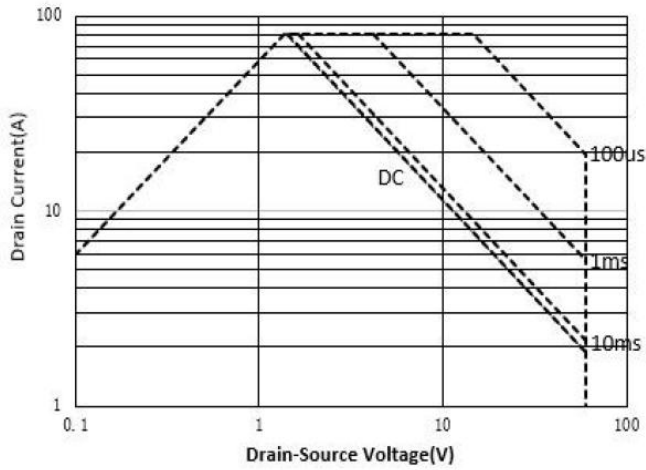


Figure.10 Single Pulse Power Rating Junction-to-Ambient

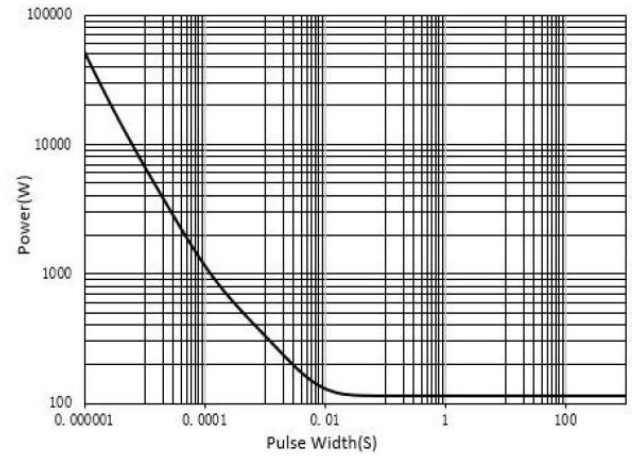
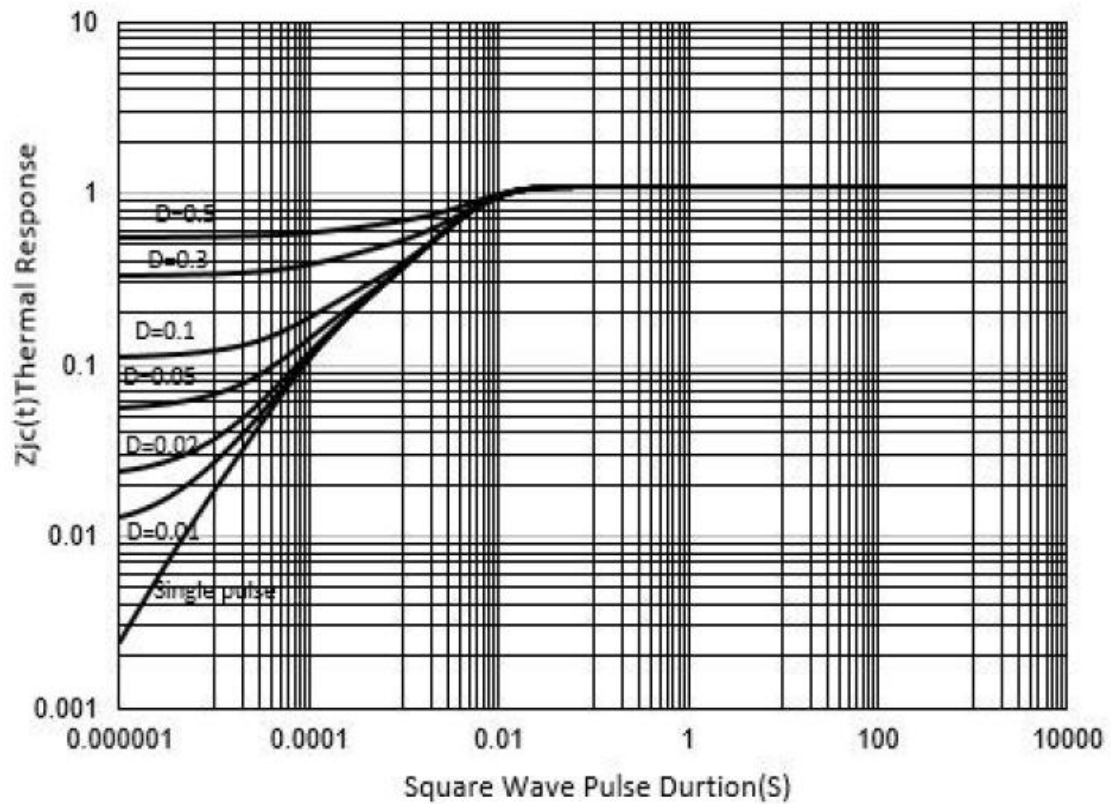
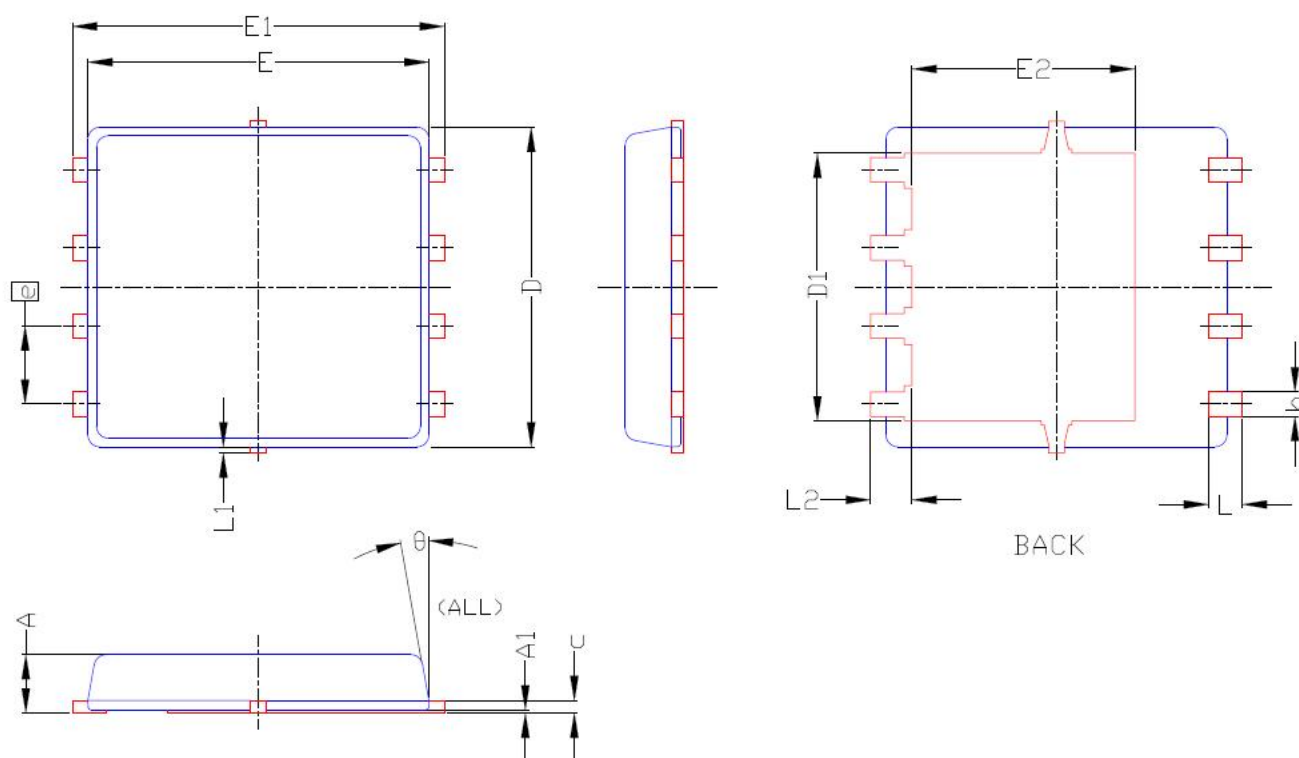


Figure 11: Normalized Maximum Transient Thermal Impedance



Package Outline: PDFN5*6-8L



SYMBOLS	DIMENSIONS IN MILLIMETERS			DIMENSIONS IN INCHES		
	MIN	NOM	MAX	MIN	NOM	MAX
A	0.85	0.95	1.00	0.033	0.037	0.039
A1	0.00	-	0.05	0.000	-	0.002
b	0.30	0.40	0.50	0.012	0.016	0.020
c	0.15	0.20	0.25	0.006	0.008	0.010
D	5.20BSC			0.205BSC		
D1	4.35BSC			0.171BSC		
E	5.55BSC			0.219BSC		
E1	6.05BSC			0.238BSC		
E2	3.62BSC			0.143BSC		
e	1.27BSC			0.050BSC		
L	0.45	0.55	0.65	0.018	0.022	0.026
L1	0	-	0.15	0	-	0.006
L2	0.68REF			0.027REF		
θ	0°	-	10°	0°	-	10°