

## Features

- Uses PingWei advanced PerfectMOS4 technology
- Extremely low on-resistance  $R_{DS(on)}$
- Excellent  $Q_g \times R_{DS(on)}$  product(FOM)
- Excellent Low Ciss
- Qualified according to JEDEC criteria

## Benefits

- High robustness and reliability
- Increases maximum current capability
- Low power loss, high power density
- Easy paralleling

## Applications

- Synchronous Rectification for AC/DC Quick Charger
- Battery management
- UPS (Uninterruptible Power Supplies)

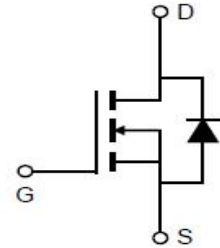
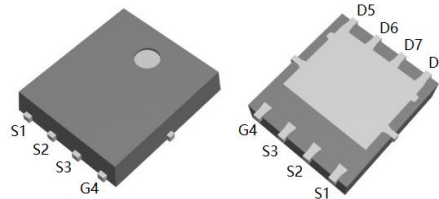


**100% DVDS Tested**  
**100% Avalanche Tested**

## Product Summary

$V_{DS}$	40V
$R_{DS(on)}@10V$ typ	1.1mΩ
$I_D$	246A

DFN5x6



## Package Marking and Ordering Information

Part #	Marking	Package	Packing	Reel Size	Tape Width	Qty
PWC013N04ES	C013N04ES	DFN5x6	Tape&Reel	13 inches	12mm	5000pcs

## Absolute Maximum Ratings

Parameter	Symbol	Value	Unit
Drain-source voltage	$V_{DS}$	40	V
Continuous drain current	$I_D$	246	A
$T_C = 25^\circ\text{C}$ (Silicon limit)		300	
$T_C = 25^\circ\text{C}$ (Package limit)		155	
$T_C = 100^\circ\text{C}$ (Silicon limit)		26	
$T_a = 25^\circ\text{C}$			
Pulsed drain current ( $T_C = 25^\circ\text{C}$ , $t_p = 100\mu\text{s}$ )	$I_{D\ pulse}$	983	A
Avalanche energy, single pulse ( $L=0.3\text{mH}$ , $V_{ds}=32\text{V}$ )	$E_{AS}$	240	mJ
Gate-Source voltage	$V_{GS}$	$\pm 20$	V
Power dissipation	$P_{tot}$	125	W
$T_C = 25^\circ\text{C}$		1.4	
$T_a = 25^\circ\text{C}$			
Operating junction and storage temperature	$T_j, T_{stg}$	-55...+150	$^\circ\text{C}$
Soldering temperature, wave soldering only allowed at leads (1.6mm from case for 10s)	$T_{sold}$	260	$^\circ\text{C}$

## Thermal Resistance

Parameter	Symbol	Value			Unit	Test Condition
		min.	typ.	max.		
Thermal resistance, junction – case.	RthJC	-	-	1.0	°C/W	-
Thermal resistance, junction - ambient(min. footprint)	RthJA	-	-	91	°C/W	-

## Electrical Characteristic (at Tj = 25 °C, unless otherwise specified)

Parameter	Symbol	Value			Unit	Test Condition
		min.	typ.	max.		

## Static Characteristic

Drain-source breakdown voltage	$BV_{DSS}$	40	-	-	V	$V_{GS}=0V, I_D=250\mu A$
Gate threshold voltage	$V_{GS(th)}$	2.0	-	4.0	V	$V_{DS}=V_{GS}, I_D=250\mu A$
Zero gate voltage drain current	$I_{DSS}$	-	0.05	1	$\mu A$	$V_{DS}=40V, V_{GS}=0V$ $T_j=25^\circ C$ $T_j=150^\circ C$
Gate-source leakage current	$I_{GSS}$	-	$\pm 10$	$\pm 100$	nA	$V_{GS}=\pm 20V, V_{DS}=0V$
Drain-source on-state resistance	$R_{DS(on)}$	-	1.1	1.3	mΩ	$V_{GS}=10V, I_D=50A$
Transconductance	$g_{fs}$	-	111	-	S	$V_{DS}=5V, I_D=50A$

## Dynamic Characteristic

Input Capacitance	$C_{iss}$	-	4829	-	pF	$V_{GS}=0V, V_{DS}=20V,$ $f=1MHz$
Output Capacitance	$C_{oss}$	-	1645	-		
Reverse Transfer Capacitance	$C_{rss}$	-	90	-		
Gate Total Charge	$Q_G$	-	68	-	nC	$V_{DS}=20V, I_D=50A,$ $V_{GS}=10V$
Gate-Source charge	$Q_{gs}$	-	29	-		
Gate-Drain charge	$Q_{gd}$	-	8	-		
Turn-on delay time	$t_{d(on)}$	-	17	-	ns	$V_{GS}=10V, V_{DD}=20V,$ $R_G=1.6\Omega, I_D=50A$
Rise time	$t_r$	-	43	-		
Turn-off delay time	$t_{d(off)}$	-	46	-		
Fall time	$t_f$	-	22	-		
Gate resistance	$R_G$	-	2.6	-	Ω	$V_{GS}=0V, V_{DS}=0V,$ $f=1MHz$



## Body Diode Characteristic

Parameter	Symbol	Value			Unit	Test Condition
		min.	typ.	max.		
Body Diode Forward Voltage	$V_{SD}$	-	-	1.2	V	$V_{GS}=0V, I_{SD}=50A$
Body Diode Continuous Forward Current	$I_S$	-	-	246	A	TC = 25°C
Body Diode Pulsed Current	$I_S$ pulse	-	-	983	A	TC = 25°C
Body Diode Reverse Recovery Time	$t_{rr}$	-	36	-	ns	$V_R=20V, I_F=50A,$ $dI/dt=100A/\mu s$
Body Diode Reverse Recovery Charge	$Q_{rr}$	-	20	-	nC	



## Typical Performance Characteristics

Fig 1: Output Characteristics

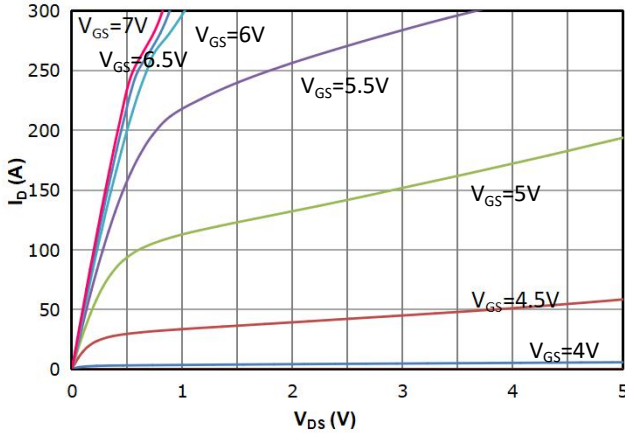


Fig 2: Transfer Characteristics

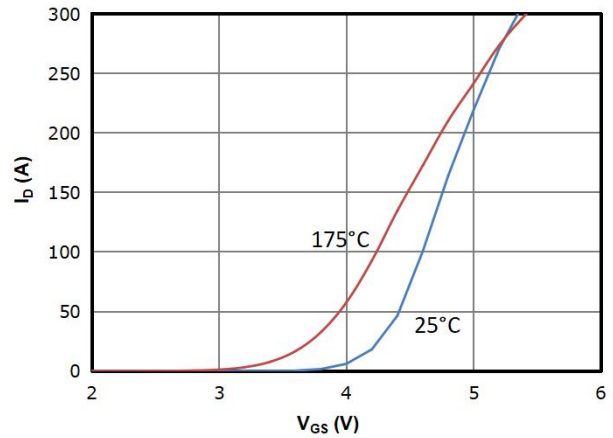


Fig 3:  $R_{DS(on)}$  vs Drain Current and Gate Voltage

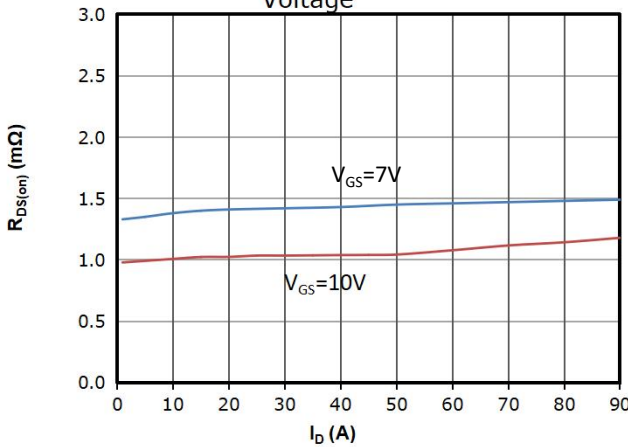


Fig 4:  $R_{DS(on)}$  vs Gate Voltage

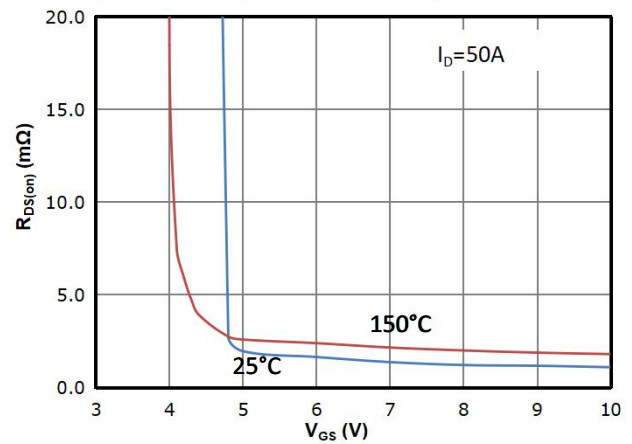


Fig 5:  $R_{DS(on)}$  vs. Temperature

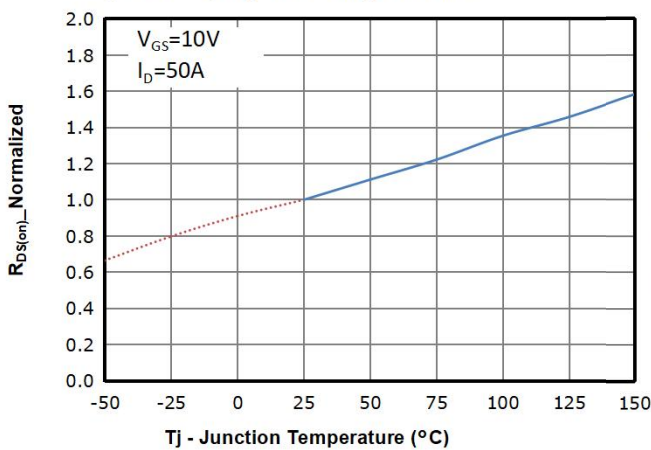


Fig 6:  $V_{GS(th)}$  vs. Temperature

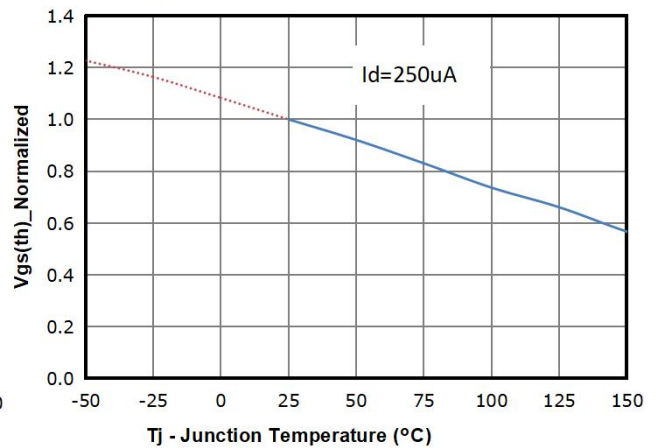




Fig 7: BVdss vs. Temperature

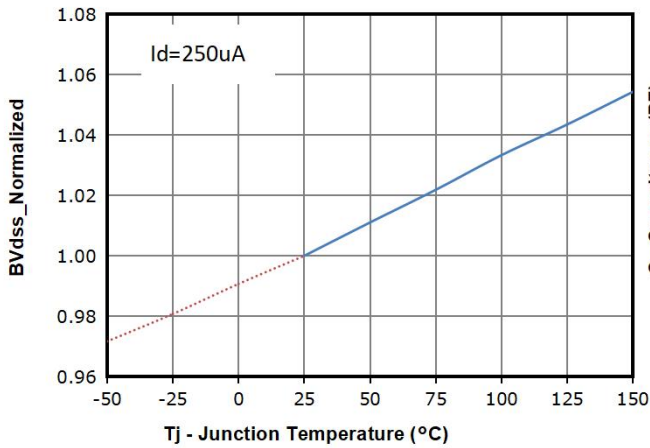


Fig 8: Capacitance Characteristics

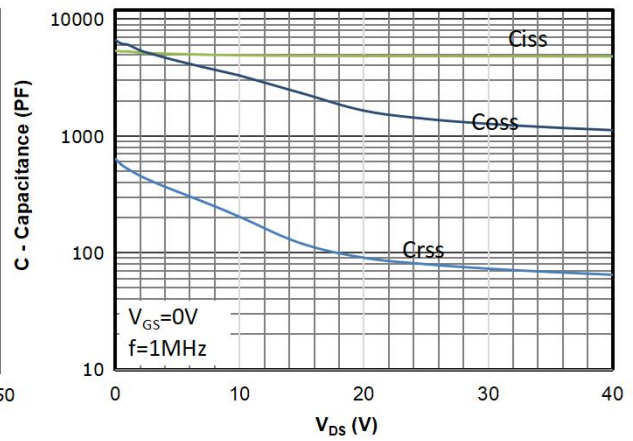


Fig 9: Gate Charge Characteristics

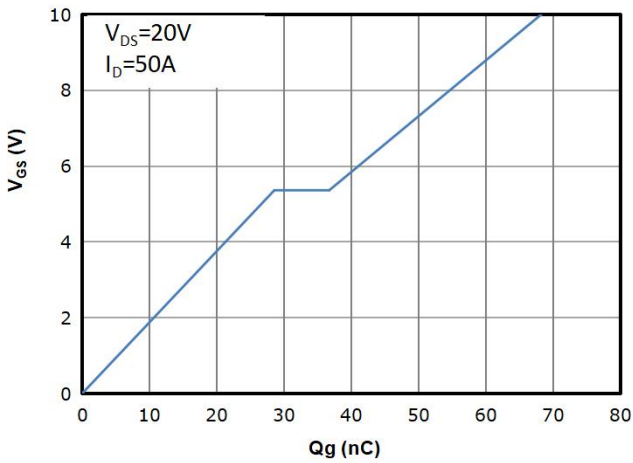


Fig 10: Body-diode Forward Characteristics

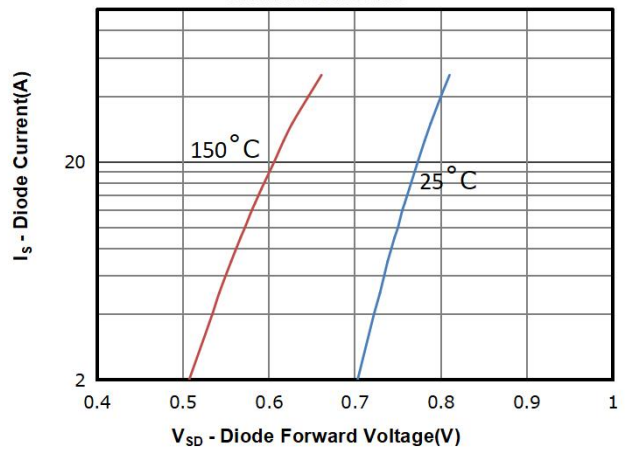


Fig 11: Power Dissipation

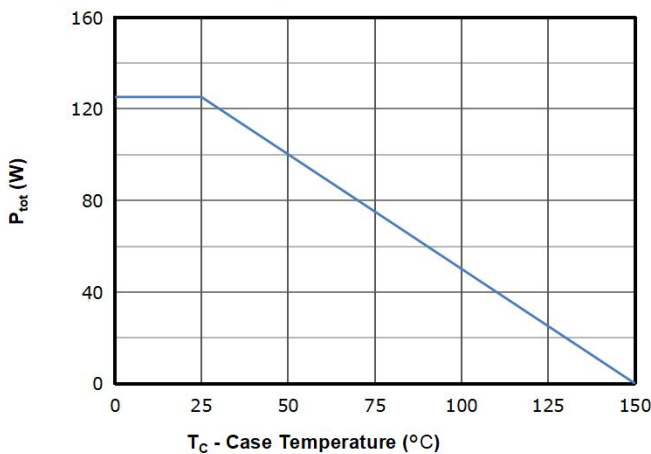


Fig 12: Drain Current Derating

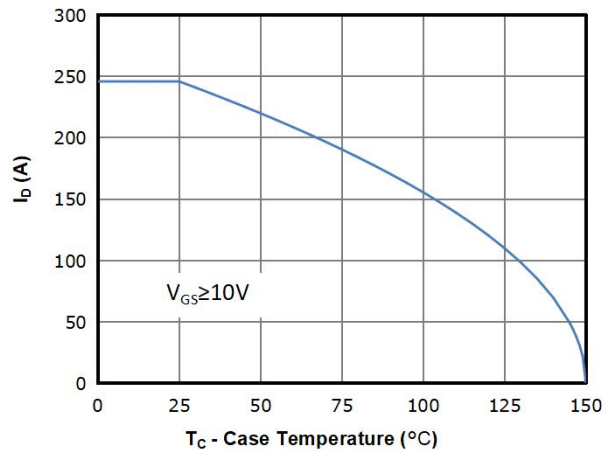




Fig 13: Safe Operating Area

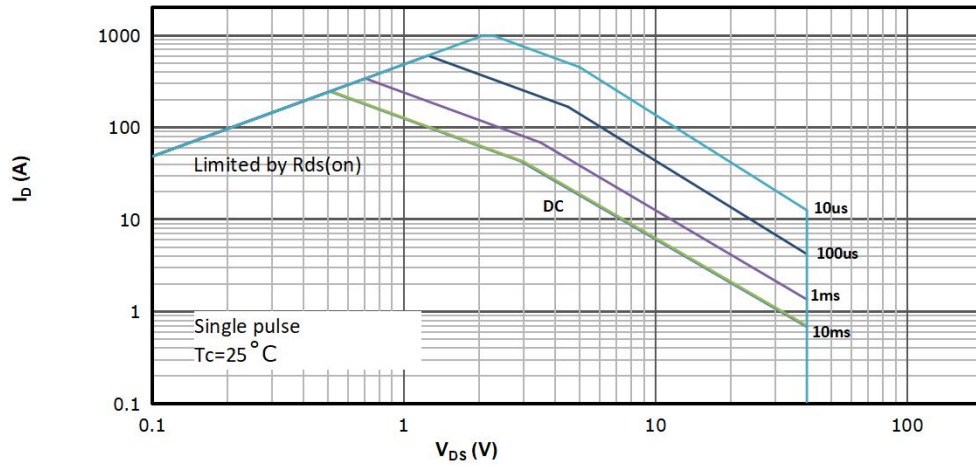
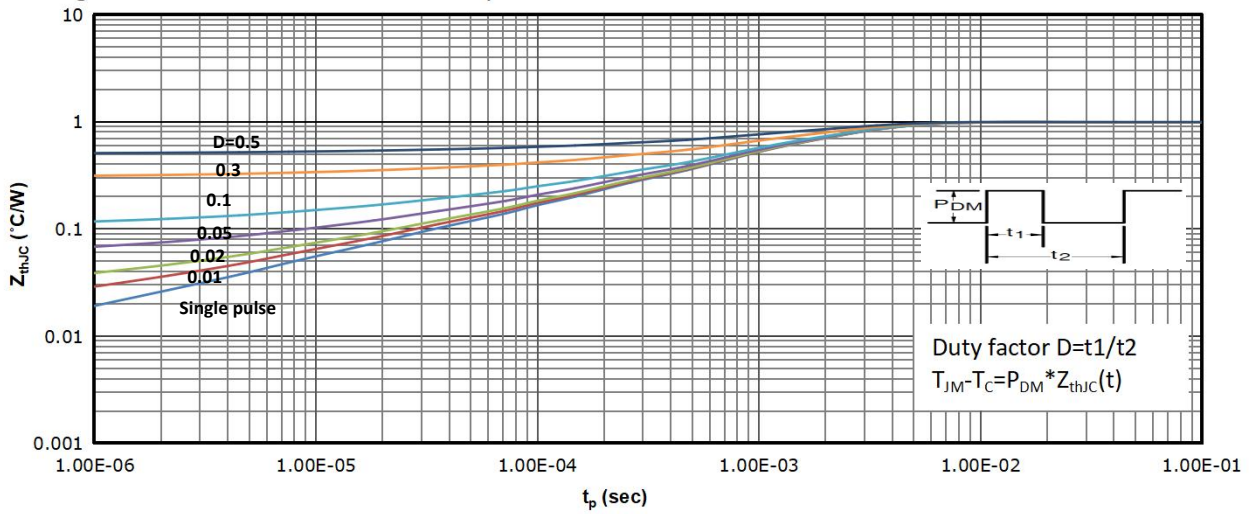
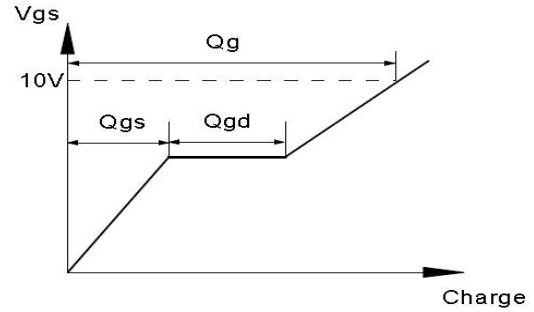
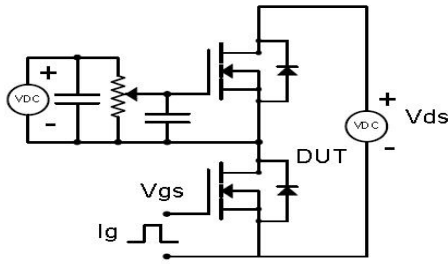


Fig 14: Max. Transient Thermal Impedance

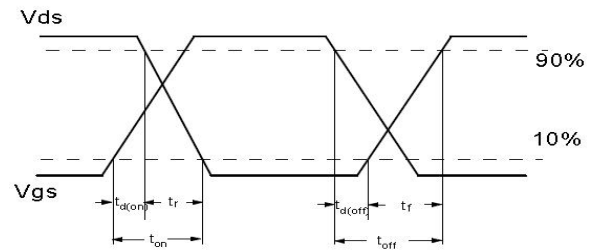
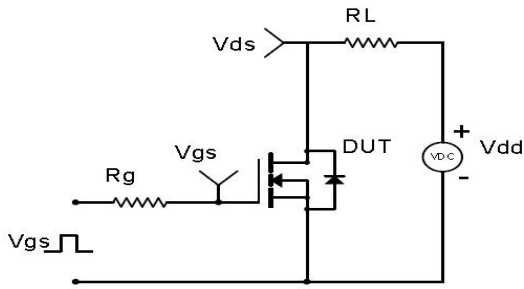


## Test Circuit & Waveform

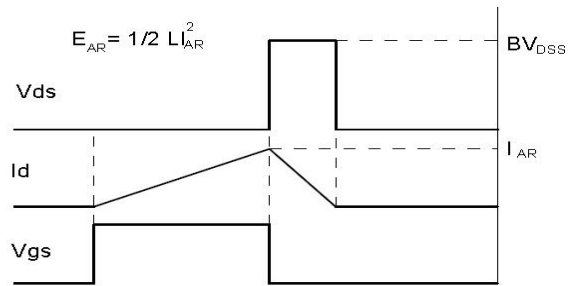
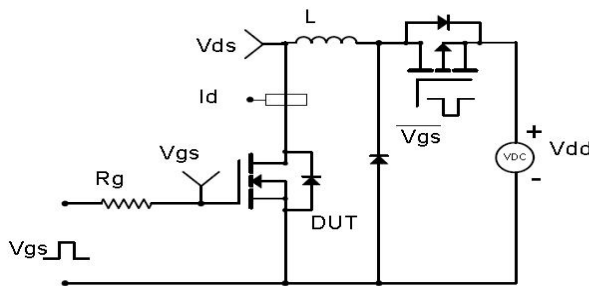
Gate Charge Test Circuit & Waveform



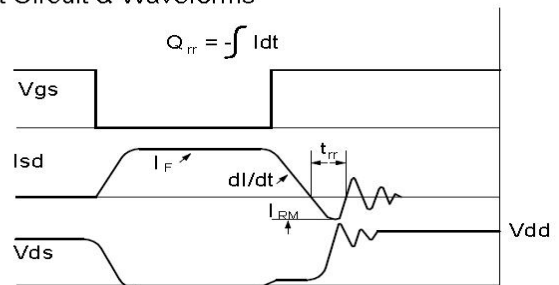
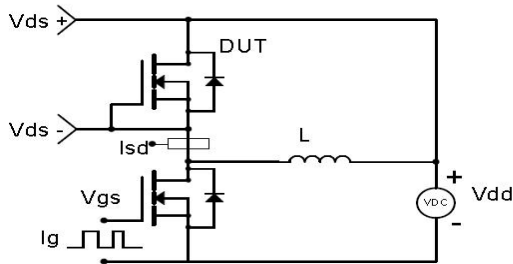
Resistive Switching Test Circuit & Waveforms



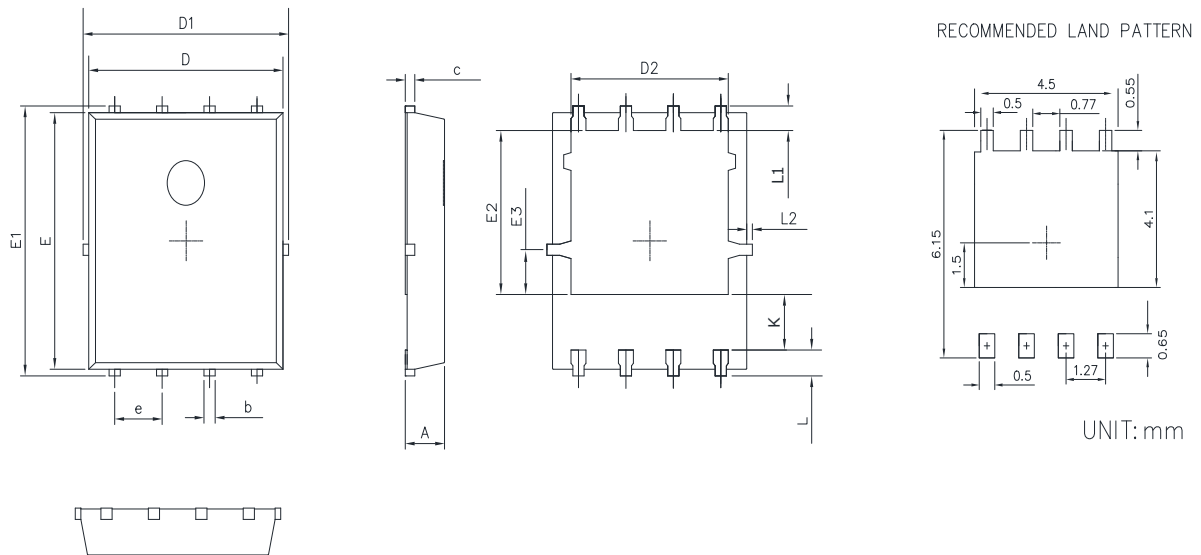
Unclamped Inductive Switching (UIS) Test Circuit & Waveforms



Diode Recovery Test Circuit & Waveforms



## Package Outline: DFN5X6



SYMBOL	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	0.90	1.10	0.035	0.043
b	0.25	0.50	0.010	0.020
c	0.10	0.30	0.004	0.012
D	4.80	5.30	0.189	0.209
D1	4.90	5.50	0.193	0.217
D2	3.92	4.20	0.154	0.165
E	5.65	5.85	0.222	0.230
E1	5.90	6.20	0.232	0.244
E2	3.33	3.78	0.131	0.149
E3	0.80	1.00	0.031	0.039
e	1.27		0.050	
L	0.40	0.70	0.016	0.028
L1	0.65		0.026	
L2	0.00	0.15	0.000	0.006
K	1.00	1.50	0.039	0.059





## Revision History

Revision	Date	Major changes
1.0	2023/3/19	Release of Formal Version.

## Disclaimer

Any and all semiconductor products have certain probability to fail or malfunction, which may result in personal injury, death or property damage. Customer are solely responsible for providing adequate safe measures when design their systems.

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