

## N-Channel Super Junction Power MOSFET IV

### General Description

The series of devices use advanced trench gate super junction technology and design to provide excellent  $R_{DS(ON)}$  with low gate charge. This super junction MOSFET fits the industry's AC-DC SMPS requirements for PFC, AC/DC power conversion, and industrial power applications.

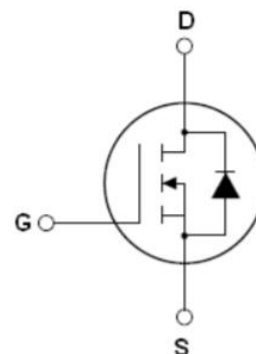
### Features

- Optimized body diode reverse recovery performance
- Low on-resistance and low conduction losses
- Small package
- Ultra Low Gate Charge cause lower driving requirements
- 100% Avalanche Tested
- ROHS compliant

### Application

- Power factor correction (PFC)
- Switched mode power supplies(SMPS)
- Uninterruptible Power Supply (UPS)
- LLC Half-bridge

$V_{DS \min @ T_{jmax}}$	550	V
$R_{DS(ON)TYP.}$	1050	mΩ
$I_D$	3	A
$Q_g$	4.2	nC



Schematic diagram

### Package Marking And Ordering Information

Device	Device Package	Marking
NCE50N1K2K	TO-252-2L	NCE50N1K2K



TO-252

Table 1. Absolute Maximum Ratings ( $T_c=25^\circ\text{C}$ )

Parameter	Symbol	Value	Unit
Drain-Source Voltage ( $V_{GS}=0V$ )	$V_{DS}$	500	V
Gate-Source Voltage ( $V_{DS}=0V$ ), AC ( $f>1\text{ Hz}$ )	$V_{GS}$	$\pm 30$	V
Gate-Source Voltage ( $V_{DS}=0V$ ), DC	$V_{GS}$	$\pm 20$	V
Continuous Drain Current at $T_c=25^\circ\text{C}$	$I_{D(DC)}$	3	A
Continuous Drain Current at $T_c=100^\circ\text{C}$	$I_{D(DC)}$	2.1	A
Pulsed drain current (Note 1)	$I_{DM(pluse)}$	9	A
Maximum Power Dissipation( $T_c=25^\circ\text{C}$ )	$P_D$	31	W
Derate above $25^\circ\text{C}$		0.21	W/ $^\circ\text{C}$
Single pulse avalanche current (Note 2)	$I_{AS}$	1	A
Reverse diode dv/dt, $V_{DS} \leq 480\text{ V}, I_{SD} < I_D$	dv/dt	15	V/ns
Drain Source voltage slope, $V_{DS} \leq 480\text{ V}$	dv/dt	50	V/ns
Operating Junction and Storage Temperature Range	$T_J, T_{STG}$	-55...+175	$^\circ\text{C}$

**Table 2. Thermal Characteristic**

Parameter	Symbol	Value	Unit
Thermal Resistance, Junction-to-Case (Maximum)	$R_{thJC}$	4.84	$^{\circ}\text{C}/\text{W}$
Thermal Resistance, Junction-to-Ambient (Maximum)	$R_{thJA}$	62	$^{\circ}\text{C}/\text{W}$

**Table 3. Electrical Characteristics (TA=25°C unless otherwise noted)**

Parameter	Symbol	Condition	Min	Typ	Max	Unit
On/off states						
Drain-Source Breakdown Voltage	BV <sub>DSS</sub>	V <sub>GS</sub> =0V I <sub>D</sub> =250uA	500			V
Zero Gate Voltage Drain Current(Tc=25℃)	I <sub>DSS</sub>	V <sub>DS</sub> =500V,V <sub>GS</sub> =0V			1	μA
Zero Gate Voltage Drain Current(Tc=125℃)	I <sub>DSS</sub>	V <sub>DS</sub> =500V,V <sub>GS</sub> =0V			50	μA
Gate-Body Leakage Current	I <sub>GSS</sub>	V <sub>GS</sub> =±20V,V <sub>DS</sub> =0V			±100	nA
Gate Threshold Voltage	V <sub>GS(th)</sub>	V <sub>DS</sub> =V <sub>GS</sub> ,I <sub>D</sub> =250uA	3		4	V
Drain-Source On-State Resistance	R <sub>DS(ON)</sub>	V <sub>GS</sub> =10V, I <sub>D</sub> =1.5A		1050	1200	mΩ
Dynamic Characteristics						
Gate Resistance	R <sub>g</sub>	F=1MHZ, D-S short		3.1		Ω
Input Capacitance	C <sub>iss</sub>	V <sub>DS</sub> =50V,V <sub>GS</sub> =0V, F=1MHz		120		pF
Output Capacitance	C <sub>oss</sub>			10.5		pF
Reverse Transfer Capacitance	C <sub>rss</sub>			4		pF
Total Gate Charge	Q <sub>g</sub>	V <sub>DS</sub> =400V,I <sub>D</sub> =1.5A, V <sub>GS</sub> =10V		4.2	6	nC
Gate-Source Charge	Q <sub>gs</sub>			0.5		nC
Gate-Drain Charge	Q <sub>gd</sub>			1.1		nC
Gate plateau voltage	V <sub>gp</sub>			5.3		V
Switching times						
Turn-on Delay Time	t <sub>d(on)</sub>	V <sub>DD</sub> =380V,I <sub>D</sub> =1.5A, R <sub>G</sub> =4Ω,V <sub>GS</sub> =10V		8		nS
Turn-on Rise Time	t <sub>r</sub>			5.5		nS
Turn-Off Delay Time	t <sub>d(off)</sub>			20		nS
Turn-Off Fall Time	t <sub>f</sub>			22		nS
Source- Drain Diode Characteristics						
Source-drain current(Body Diode)	I <sub>SD</sub>	T <sub>c</sub> =25℃			3	A
Pulsed-Source-drain current(Body Diode)	I <sub>SDM</sub>				9	A
Forward on voltage	V <sub>SD</sub>	T <sub>j</sub> =25℃,I <sub>SD</sub> =3A,V <sub>GS</sub> =0V		0.9	1.1	V
Reverse Recovery Time	t <sub>rr</sub>	T <sub>j</sub> =25℃,I <sub>F</sub> =1.5A, di/dt=100A/μs		130		nS
Reverse Recovery Charge	Q <sub>rr</sub>			0.47		uC
Peak reverse recovery current	I <sub>rrm</sub>			7.2		A

Notes: 1. Repetitive Rating: Pulse width limited by maximum junction temperature

2.  $T_j=25^{\circ}\text{C}, V_{DD}=50V, V_G=10V, R_G=25\Omega, L=30\text{mH}$

## TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS (curves)

Figure1. Safe operating area

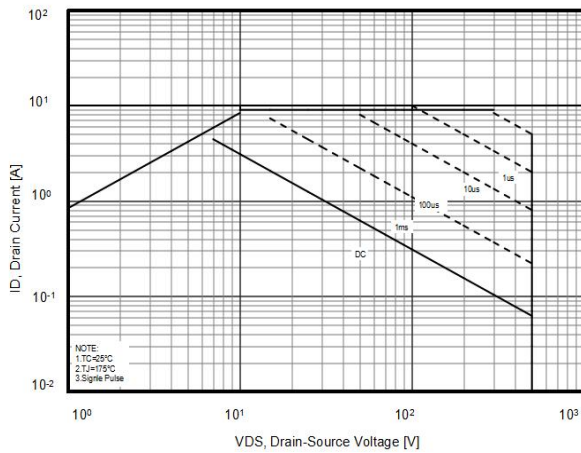


Figure2. Source-Drain Diode Forward Voltage

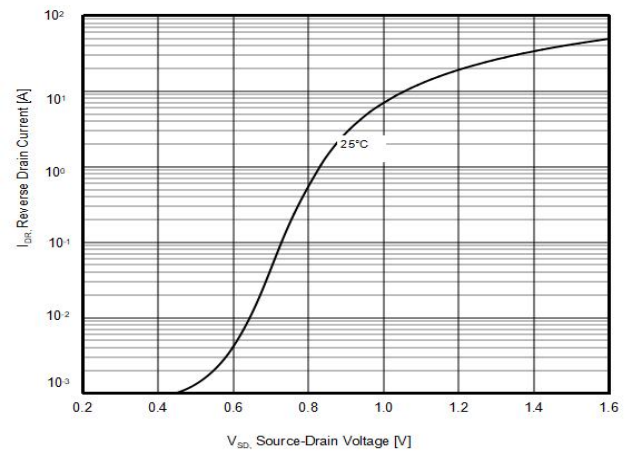


Figure3. Output characteristics

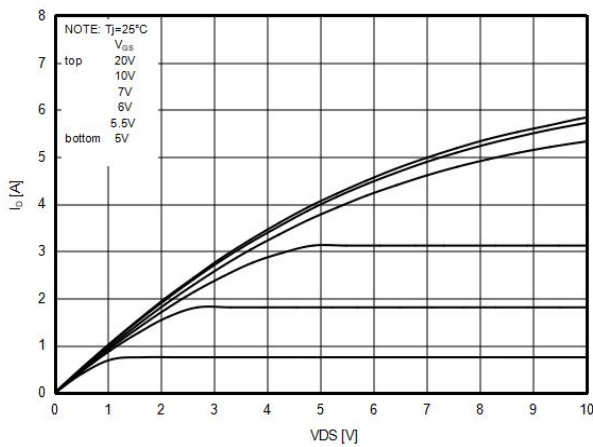


Figure4. Transfer characteristics

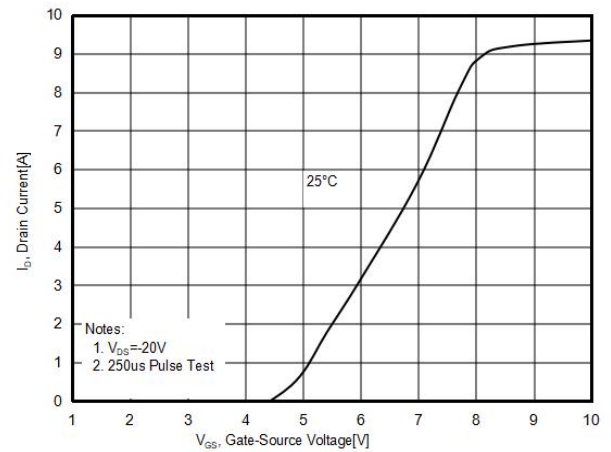


Figure5. Static drain-source on resistance

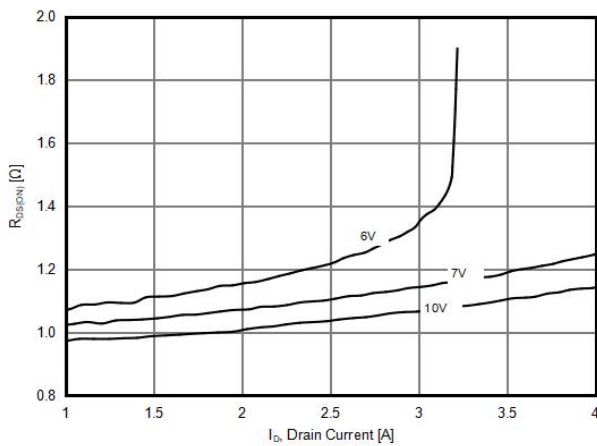
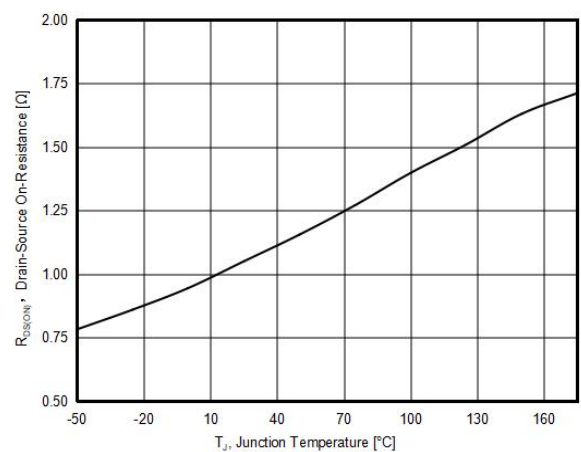
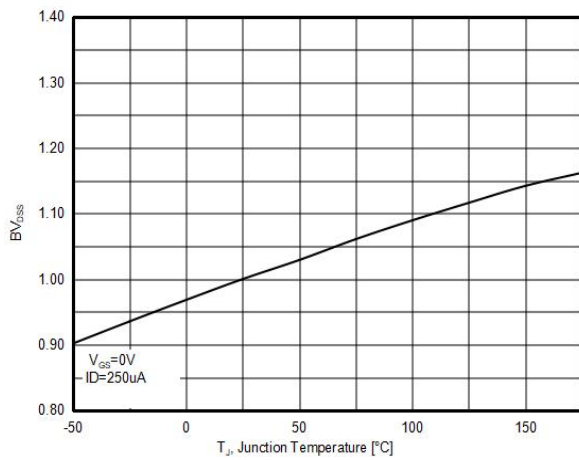


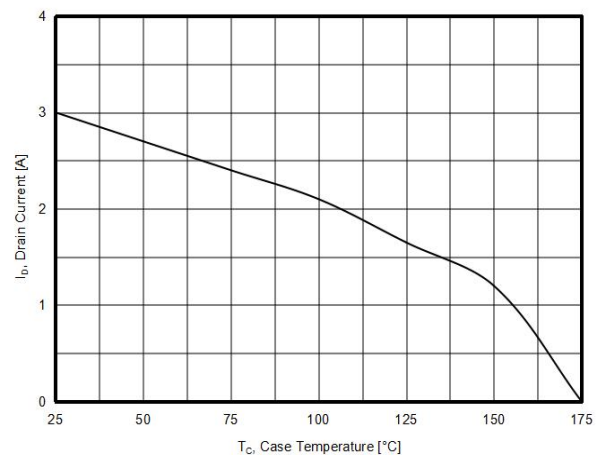
Figure6.  $R_{DS(ON)}$  vs Junction Temperature



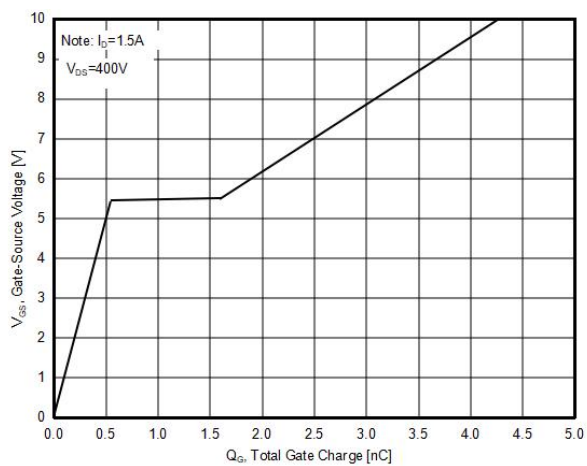
**Figure7.  $BV_{DSS}$  vs Junction Temperature**



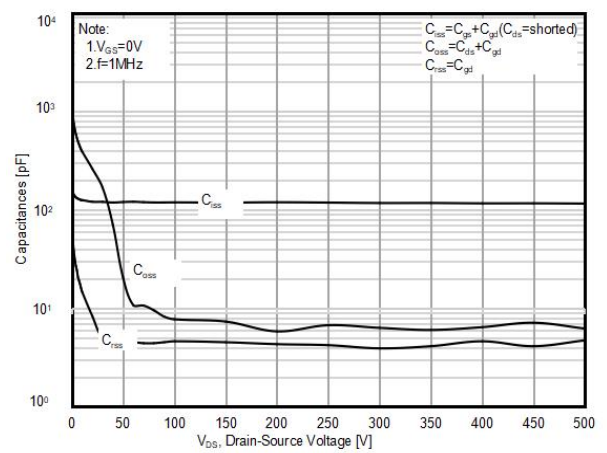
**Figure8. Maximum  $I_D$  vs Junction Temperature**



**Figure9. Gate charge waveforms**



**Figure10. Capacitance**



## Test circuit

### 1) Gate charge test circuit & Waveform



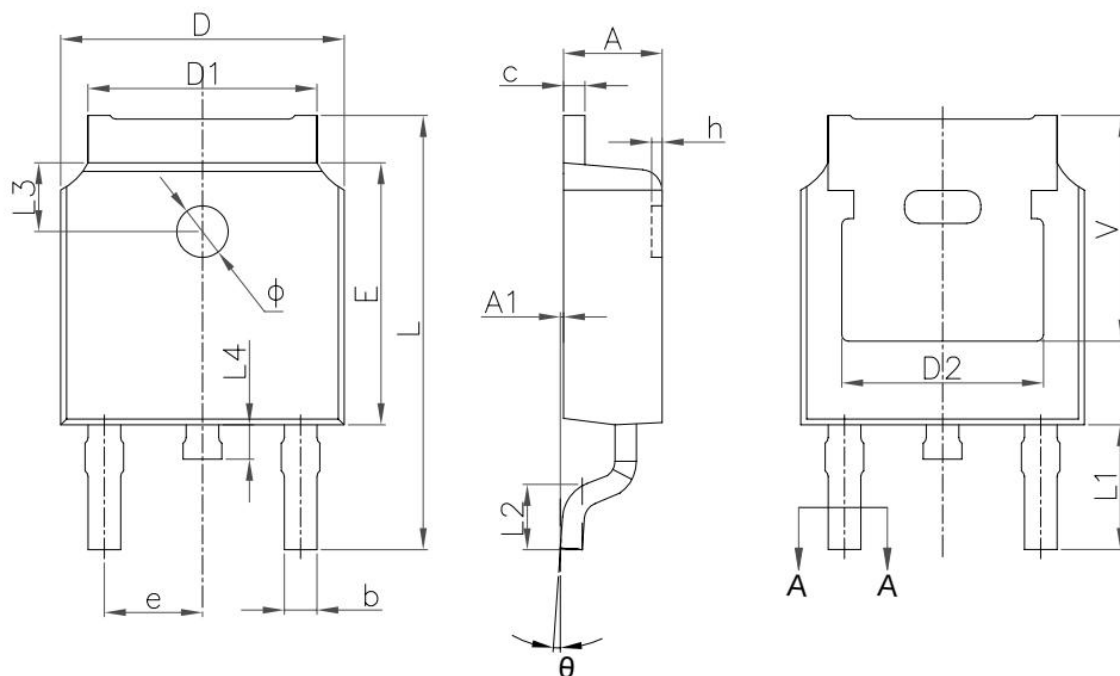
### 2) Switch Time Test Circuit:



### 3) Unclamped Inductive Switching Test Circuit & Waveforms



## TO-252-2L-E Package Information



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	2.20	2.40	0.087	0.094
A1	0.00	0.13	0.000	0.005
b	0.66	0.86	0.026	0.033
b1	0.73	0.79	0.029	0.031
c	0.46	0.58	0.018	0.023
c1	0.50	0.52	0.020	0.020
D	6.50	6.70	0.256	0.264
D1	5.10	5.46	0.201	0.215
D2	4.83 REF		0.19REF	
E	6.00	6.20	0.236	0.244
e	2.19	2.39	0.086	0.094
L	9.80	10.40	0.386	0.409
L1	2.90 REF		0.11REF	
L2	1.40	1.70	0.055	
L3	1.60 REF		0.06REF	
L4	0.60	1.00	0.024	0.039
φ	1.10	1.30	0.043	0.051
θ	0°	8°	0°	8°
h	0.00	0.30	0.000	0.012

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