

## 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

$V_{DS\ min@T_{jmax}}$	650	V
$R_{DS(ON)TYP}$	620	mΩ
ID	6.4	A
Qg	9.6	nC



Schematic diagram

### Package Marking And Ordering Information

Device	Device Package	Marking
NCE60N670K	TO-252	NCE60N670K



TO-252

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

Parameter	Symbol	Value	Unit
Drain-Source Voltage ( $V_{GS}=0V$ )	$V_{DS}$	600	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 $T_c=25^\circ\text{C}$	$I_{D(DC)}$	6.4	A
Continuous Drain Current at $T_c=100^\circ\text{C}$	$I_{D(DC)}$	4.48	A
Pulsed drain current (Note 1)	$I_{DM(pluse)}$	19.2	A
Maximum Power Dissipation( $T_c=25^\circ\text{C}$ )	$P_D$	72	W
Derate above $25^\circ\text{C}$		0.48	W/ $^\circ\text{C}$
Avalanche current (Note 1)	$I_{AR}$	1.5	A
Drain Source voltage slope, $V_{DS} \leq 480\text{ V}$ ,	$dv/dt$	50	V/ns
Reverse diode $dv/dt$ , $V_{DS} \leq 480\text{ V}, I_{SD} < I_D$	$dv/dt$	50	V/ns
Operating Junction and Storage Temperature Range	$T_J, T_{STG}$	-55...+175	$^\circ\text{C}$

\* limited by maximum junction temperature

**Table 2. Thermal Characteristic**

Parameter	Symbol	Value	Unit
Thermal Resistance, Junction-to-Case (Maximum)	$R_{thJC}$	2.08	$^{\circ}\text{C}/\text{W}$
Thermal Resistance, Junction-to-Ambient (Maximum)	$R_{thJA}$	62	$^{\circ}\text{C}/\text{W}$

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

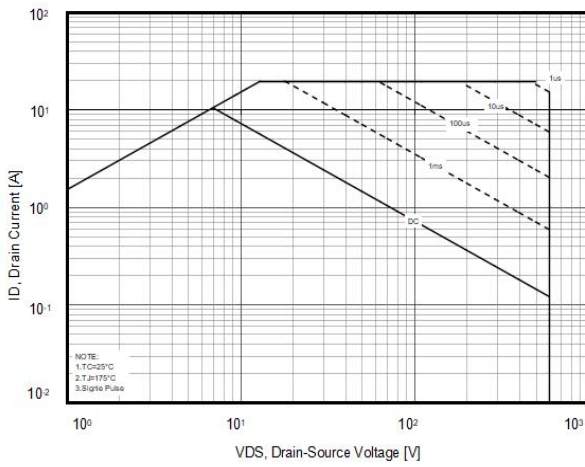
Parameter	Symbol	Condition	Min	Typ	Max	Unit
<b>On/off states</b>						
Drain-Source Breakdown Voltage	$BV_{DSS}$	$V_{GS}=0V, I_D=250\mu A$	600			V
Zero Gate Voltage Drain Current(Tc=25°C)	$I_{DSS}$	$V_{DS}=600V, V_{GS}=0V$			1	$\mu A$
Zero Gate Voltage Drain Current(Tc=125°C)	$I_{DSS}$	$V_{DS}=600V, V_{GS}=0V$			100	$\mu A$
Gate-Body Leakage Current	$I_{GSS}$	$V_{GS}=\pm 20V, V_{DS}=0V$			$\pm 200$	nA
Gate Threshold Voltage	$V_{GS(th)}$	$V_{DS}=V_{GS}, I_D=250\mu A$	3	3.5	4	V
Drain-Source On-State Resistance	$R_{DS(on)}$	$V_{GS}=10V, I_D=3A$		620	670	m $\Omega$
<b>Dynamic Characteristics</b>						
Input Capacitance	$C_{iss}$	$V_{DS}=50V, V_{GS}=0V,$ $F=1.0\text{MHz}$		250		pF
Output Capacitance	$C_{oss}$			21		pF
Reverse Transfer Capacitance	$C_{rss}$			4		pF
Total Gate Charge	$Q_g$	$V_{DS}=450V, I_D=3.2A,$ $V_{GS}=10V$		9.6		nC
Gate-Source Charge	$Q_{gs}$			2.5		nC
Gate-Drain Charge	$Q_{gd}$			3.3		nC
Gate plateau voltage	$V_{gp}$			5.5		V
Intrinsic gate resistance	$R_G$	$f = 1 \text{ MHz open drain}$		42		$\Omega$
<b>Switching times</b>						
Turn-on Delay Time	$t_{d(on)}$	$V_{DD}=380V, I_D=3A,$ $R_G=1.7\Omega, V_{GS}=10V$		6		nS
Turn-on Rise Time	$t_r$			7		nS
Turn-Off Delay Time	$t_{d(off)}$			38		nS
Turn-Off Fall Time	$t_f$			6		nS
<b>Source- Drain Diode Characteristics</b>						
Source-drain current(Body Diode)	$I_{SD}$	$T_C=25^{\circ}\text{C}$			6.4	A
Pulsed Source-drain current(Body Diode)	$I_{SDM}$				19.2	A
Forward On Voltage	$V_{SD}$	$T_j=25^{\circ}\text{C}, I_{SD}=6.4A, V_{GS}=0V$		0.9	1.2	V
Reverse Recovery Time	$t_{rr}$	$T_j=25^{\circ}\text{C}, I_F=3A,$ $di/dt=100A/\mu s$		170		nS
Reverse Recovery Charge	$Q_{rr}$			0.93		$\mu\text{C}$
Peak Reverse Recovery Current	$I_{rrm}$			11		A

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

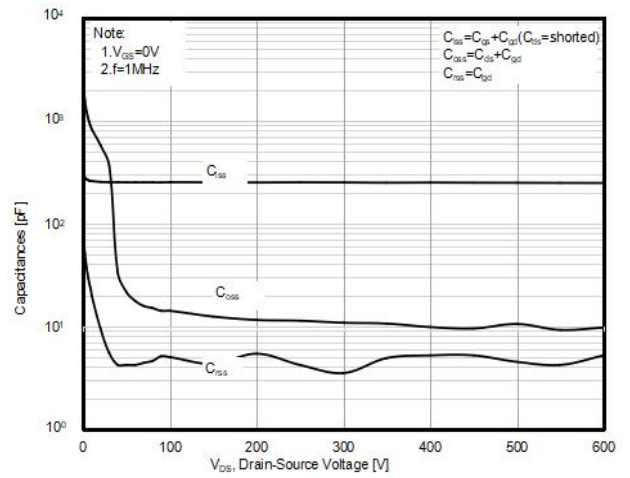
2.  $T_j=25^{\circ}\text{C}, V_{DD}=50V, V_G=10V, R_G=25\Omega$

## TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS (curves)

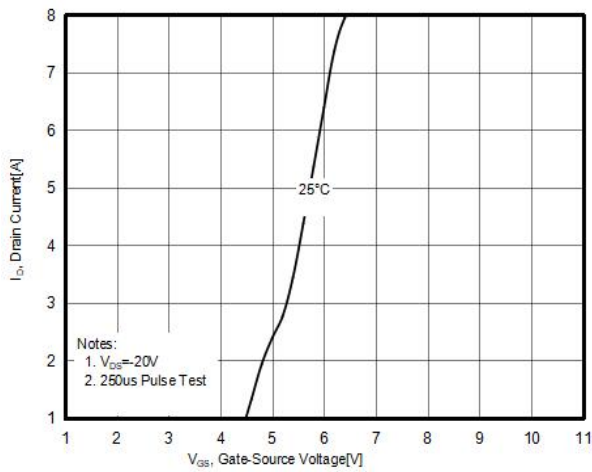
**Figure1. Safe operating area**



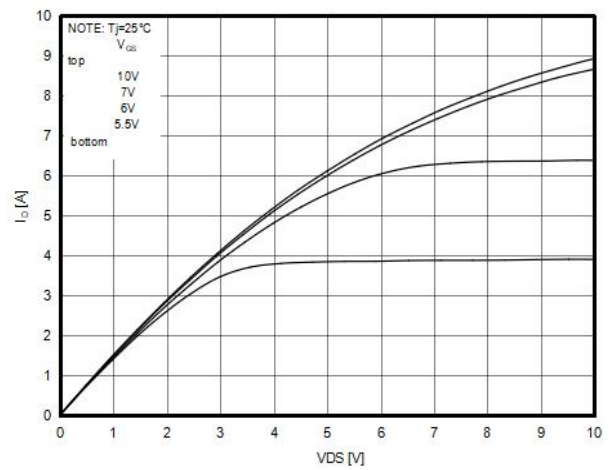
**Figure2. Capacitance**



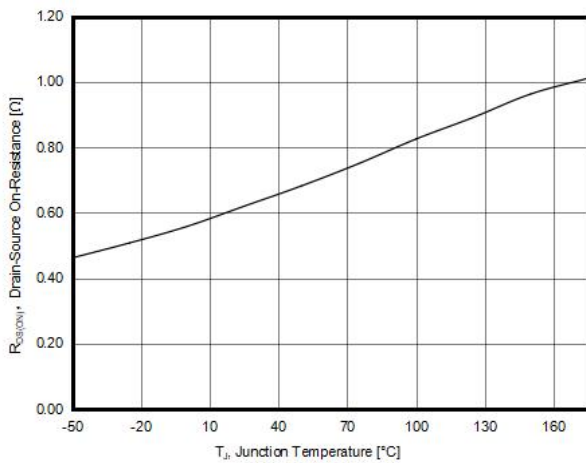
**Figure3. Source-Drain Diode Forward Voltage**



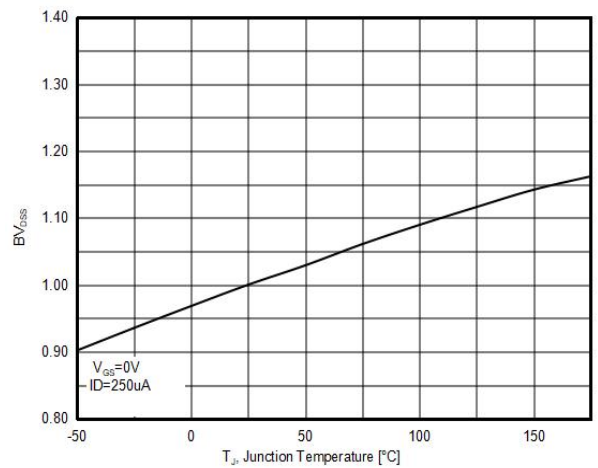
**Figure4. Output characteristics**



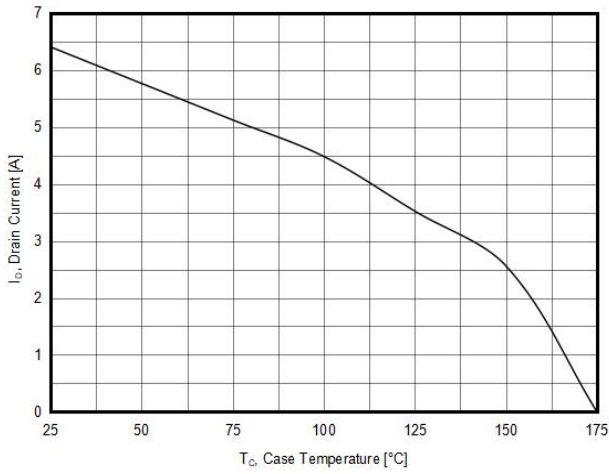
**Figure5.  $R_{DS(ON)}$  vs Junction Temperature**



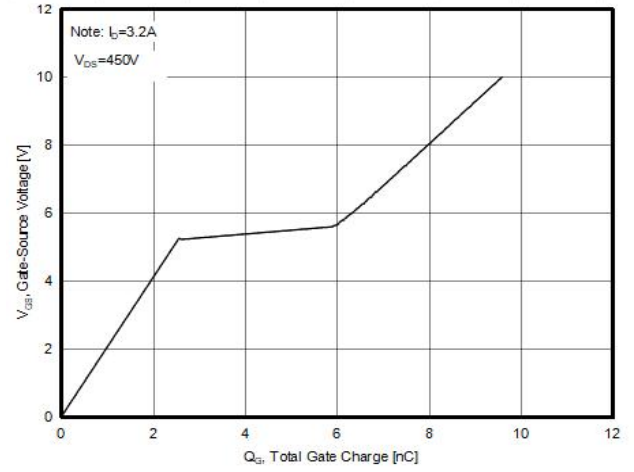
**Figure6.  $BV_{DSS}$  vs Junction Temperature**



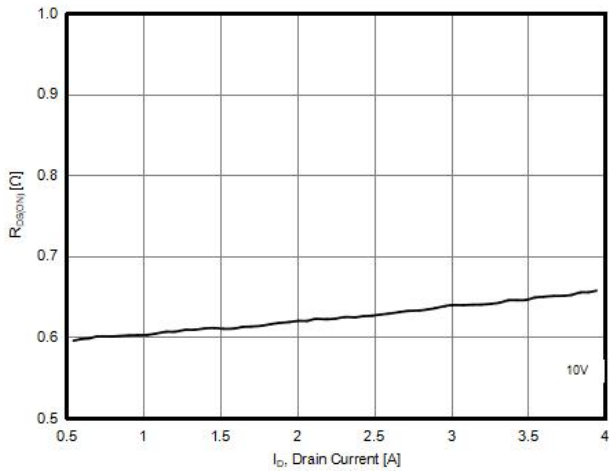
**Figure7. Maximum  $I_D$  vs Junction Temperature**



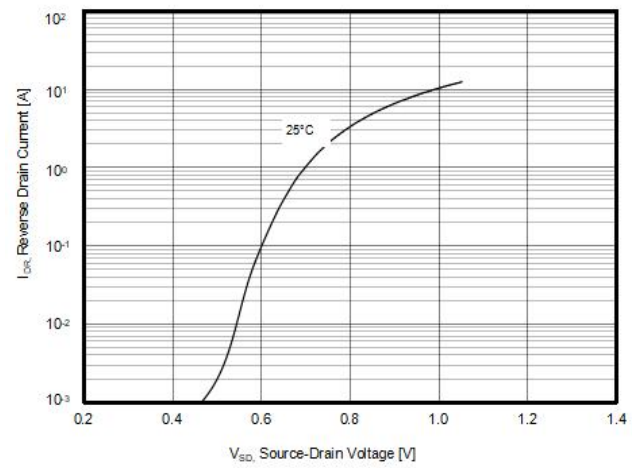
**Figure8. Gate charge waveforms**



**Figure9. Static drain-source on resistance**

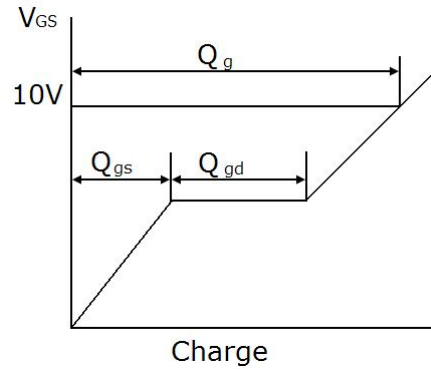
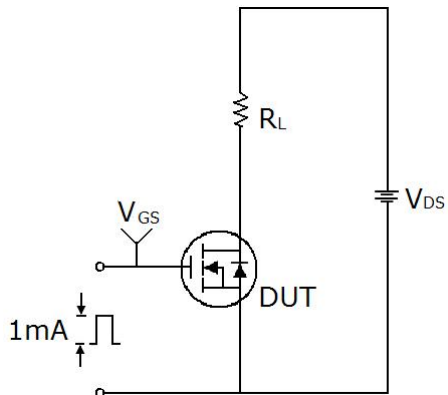


**Figure10. Source-Drain Diode Forward Voltage**

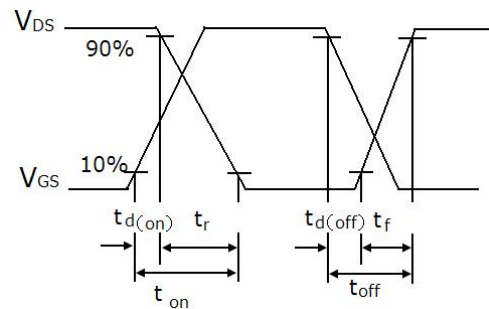
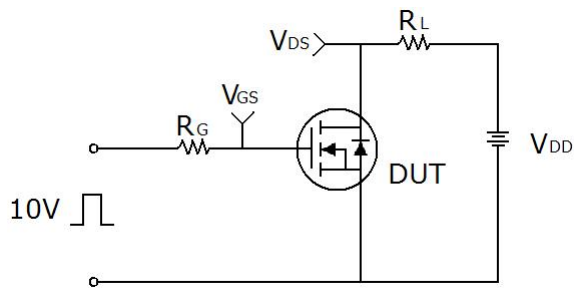


## Test circuit

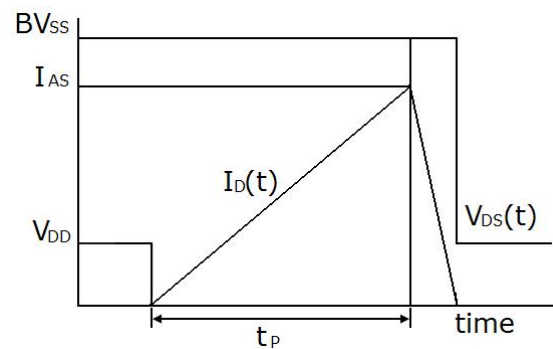
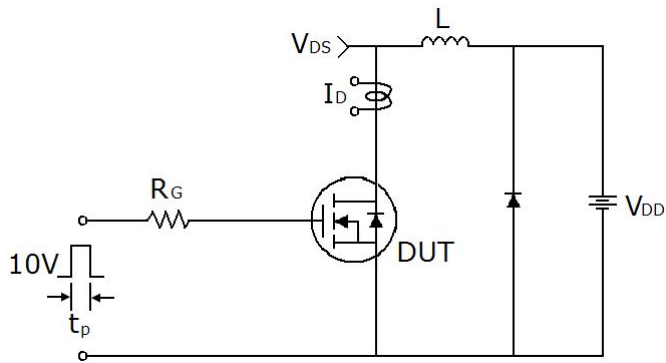
### 1) Gate charge test circuit & Waveform



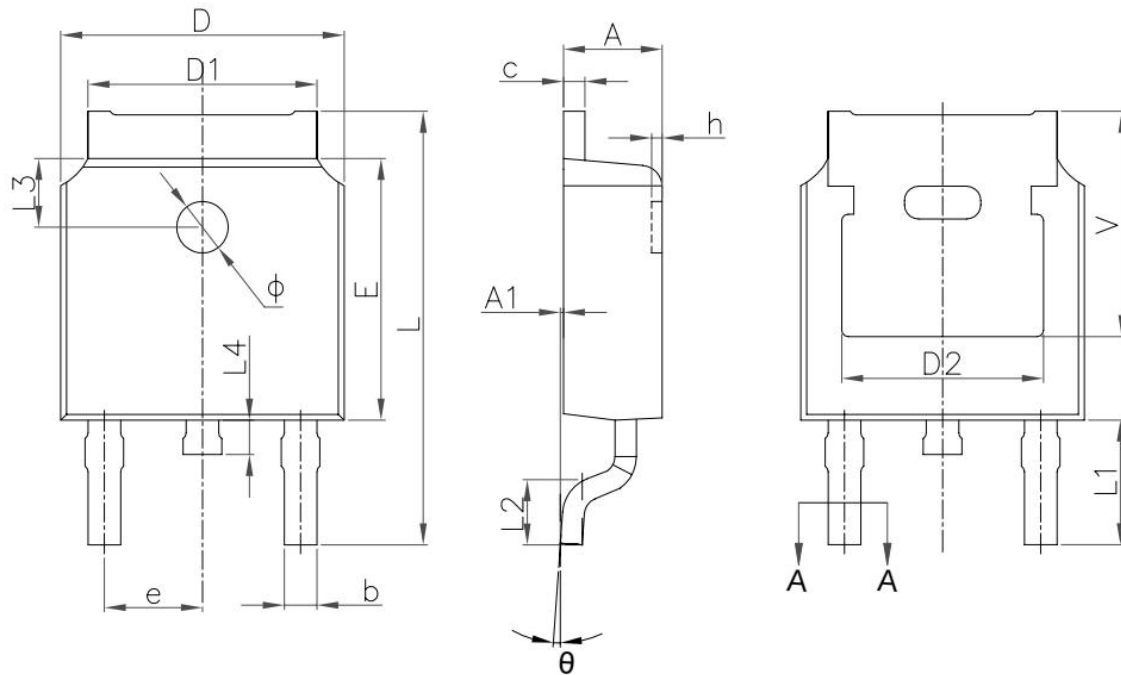
### 2) Switch Time Test Circuit:



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



## TO-252-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	0.83	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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