



N-Channel Super Junction Power MOSFET III

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.

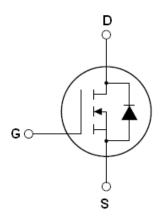
Features

- New technology for high voltage device
- 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)

V_{DS}	700	V
R _{DS(ON)TYP.}	1100	mΩ
I_D	4	A



Schematic diagram

Package Marking And Ordering Information

Device	Device Package	Marking
NCE70T1K2I	TO-251	NCE70T1K2I
NCE70T1K2K	TO-252	NCE70T1K2K





TO-252

TO-251

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

Parameter	Symbol	Value	Unit
Drain-Source Voltage (V _{GS} =0V)	V _{DS}	700	V
Gate-Source Voltage (VDS=0V) ,AC (f>1 Hz)	V _{GS}	±30	V
Continuous Drain Current at Tc=25°C	I _{D (DC)}	4	Α
Continuous Drain Current at Tc=100°C	I _{D (DC)}	2.5	Α
Pulsed drain current (Note 1)	I _{DM (pluse)}	16	А
Maximum Power Dissipation(Tc=25℃)	P_{D}	41	W
Derate above 25°C		0.328	w/°C
Single pulse avalanche energy (Note2)	Eas	27	mJ
Avalanche current ^(Note 1)	I _{AR}	0.7	Α
Repetitive Avalanche energy , t_{AR} limited by T_{jmax} (Note 1)	E _{AR}	0.1	mJ

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Parameter	Symbol	Value	Unit
Drain Source voltage slope, V _{DS} ≤480 V,	dv/dt	50	V/ns
Reverse diode dv/dt, $V_{DS} \le 480 \text{ V}, I_{SD} \le I_D$	dv/dt	15	V/ns
Operating Junction and Storage Temperature Range	T_{J}, T_{STG}	-55+150	°C

Table 2. Thermal Characteristic

Parameter	Symbol	Value	Unit
Thermal Resistance, Junction-to-Case (Maximum)	R _{thJC}	3.0	°C /W
Thermal Resistance, Junction-to-Ambient (Maximum)	R _{thJA}	62	°C /W

Table 3. Electrical Characteristics (TA=25°Cunless otherwise noted)

Parameter Symbol Condition Min Typ Max Unit On/off states	Table 5. Liectifical Characteristics	5 (TA-23 Culliess Otherwise Hoteu)					
Drain-Source Breakdown Voltage BV _{DSS} V _{GS} =0V I _D =250µA 700 V Zero Gate Voltage Drain Current(Tc=25°C) I _{DSS} V _{DS} =700V,V _{GS} =0V 1 µA Zero Gate Voltage Drain Current(Tc=125°C) I _{DSS} V _{DS} =700V,V _{GS} =0V 50 µA Gate-Body Leakage Current I _{GSS} V _{GS} =±20V,V _{DS} =0V ±100 nA Gate Threshold Voltage V _{GS(III)} V _{DS} =V _{GS,ID} =250µA 3 4 V V Drain-Source On-State Resistance R _{DS(ON)} V _{GS} =10V, I _D =2A 1100 1300 mΩ Dynamic Characteristics V _{DS} =10V,V _{GS} =0V, V _{GS} =10V, I _D =2A 1100 1300 mΩ V _{GS} =10MHz 177 PF PF Reverse Transfer Capacitance C _{GSS} V _{DS} =50V,V _{GS} =0V, V _{GS} =0V, V _{GS} =0V, V _{GS} =10V 177 PF PF Total Gate Charge Q _g V _{DS} =480V,I _D =4A, V _{GS} =10V 4 nC Reverse Transfer Capacitance Q _g V _{DS} =480V,I _D =4A, V _{GS} =10V 4 nC Reverse Transfer Capacitance C _{GSS} Reverse Transfer Capacitance Roseovery Time C _{GSSS} Reverse Transfer Capacitance Roseovery Time	Parameter	Symbol Condition		Min	Тур	Max	Unit
Zero Gate Voltage Drain Current(Tc=25°C) IDSS VDS=700V,VGS=0V 1	On/off states						
Zero Gate Voltage Drain Current(Tc=125°C) Ibss Vbs=700V,Vgs=0V 50 μA Gate-Body Leakage Current Icss Vgs=±20V,Vbs=0V ±100 nA Gate Threshold Voltage Vgs(m) Vbs=Vgs,Ib=250μA 3 4 V Drain-Source On-State Resistance Rbs(oN) Vgs=10V, Vgs=20V, Vgs=20V, Vgs=20V, Vgs=0V, Vgs=20V, Vgs=20V, Vgs=20V, Vgs=20V, Vgs=20V, Vgs=20V, Vgs=20V, Vgs=10V 177 PF Output Capacitance Cgs Vgs=480V,Ib=4A, Vgs=10V 2.3 nC Gate-Source Charge Qgs Vgs=480V,Ib=4A, Vgs=10V 2.3 nC Gate-Drain Charge Qgs Vgs=10V 8 12 nC Switching times Turn-on Delay Time tg(on) Vgs=380V,Ib=2.5A, Rg=5Ω,Vgs=10V 8 nS nS Turn-Off Delay Time tg(off) Tg=25°C 9 18 nS Source- Drain Diode Characteristics Igs Tc=25°C 0.9 1.2 V Reverse Recovery Time Vgs Tj=25°C,Isp=4A,Vgs=0V 0.9 1.2 V	Drain-Source Breakdown Voltage	BV _{DSS}	V _{GS} =0V I _D =250μA	700			V
Cate-Body Leakage Current IGSS VGS=±20V,VDS=0V ±100 nA	Zero Gate Voltage Drain Current(Tc=25℃)	I _{DSS}	V _{DS} =700V,V _{GS} =0V			1	μA
Sate Threshold Voltage V _{GS(th)} V _{DS} =V _{GS} , I _D =250μA 3 4 V Drain-Source On-State Resistance R _{DS(ON)} V _{GS} =10V, I _D =2A 1100 1300 mΩ Dynamic Characteristics Input Capacitance C _{ISS} V _{DS} =50V, V _{GS} =0V, F=1.0MHz 17 PF Reverse Transfer Capacitance C _{rss} C _{TSS} V _{DS} =480V, I _D =4A, V _{GS} =10V 4 n.C Gate-Drain Charge Q _g Q _g V _{DS} =380V, I _D =25A, A 4 n.C Switching times t _r V _{DD} =380V, I _D =25A, A 4 n.S Turn-On Delay Time t _{d(off)} R _G =5Ω, V _{GS} =10V 52 70 n.S Turn-Off Fall Time t _r V _{DD} =380V, I _D =2.5A, A 4 n.S Turn-Off Fall Time t _r T _C =25°C 16 A A Pulsed Source-drain current(Body Diode) I _{SDM} T _C =25°C, I _{SD} =4A, V _{GS} =0V 0.9 1.2 V Reverse Recovery Time t _r 200 n.S Reverse Recovery Time t _r 200	Zero Gate Voltage Drain Current(Tc=125℃)	I _{DSS}	V _{DS} =700V,V _{GS} =0V			50	μΑ
Drain-Source On-State Resistance R _{DS(ON)} V _{GS} =10V, I _D =2A 1100 1300 mΩ Dynamic Characteristics Input Capacitance C _{Iss} V _{DS} =50V,V _{GS} =0V, F=1.0MHz 304 PF Output Capacitance C _{oss} F=1.0MHz 17 PF Reverse Transfer Capacitance C _{rss} F=1.0MHz 8.8 12 nC Gate-Source Charge Q _g V _{DS} =480V,I _D =4A, V _{GS} =10V 2.3 nC nC Gate-Drain Charge Q _g V _{DS} =480V,I _D =4A, V _{GS} =10V 4 nC Switching times Turn-on Delay Time t _Q V _{DD} =380V,I _D =2.5A, R _G =10V 4 nS Turn-Off Delay Time t _Q R _G =5Ω,V _{GS} =10V 52 70 nS Turn-Off Fall Time t _f R _G =5Ω,V _{GS} =10V 52 70 nS Source- Drain Diode Characteristics T _C =25°C 4 A A Source-drain current(Body Diode) I _{SDM} T _C =25°C 0.9 1.2 V Reverse Recovery Time t	Gate-Body Leakage Current	I _{GSS}	V _{GS} =±20V,V _{DS} =0V			±100	nA
Dynamic Characteristics	Gate Threshold Voltage	$V_{GS(th)}$	$V_{DS}=V_{GS}$, $I_{D}=250\mu A$	3		4	V
Input Capacitance	Drain-Source On-State Resistance	R _{DS(ON)}	V _{GS} =10V, I _D =2A		1100	1300	mΩ
Output Capacitance Coss (Coss Reverse Transfer Capacitance) Coss (Coss Reverse Transfer Capacitance) V _{DS} =50V,V _{GS} =0V, F=1.0MHz 17 PF PF Total Gate Charge Qg V _{DS} =480V,I _D =4A, V _{GS} =10V 8.8 12 nC 2.3 nC nC Gate-Source Charge Qgs V _{DS} =480V,I _D =4A, V _{GS} =10V 4 nC nC Switching times Turn-on Delay Time t _d (on) V _{DD} =380V,I _D =2.5A, R _G =5Ω,V _{GS} =10V 4 nS nS Turn-Off Delay Time t _d (off) R _G =5Ω,V _{GS} =10V 52 70 nS nS Source- Drain Diode Characteristics T _C =25°C 4 A A Source-drain current(Body Diode) I _{SDM} T _C =25°C, I _{SD} =4A,V _{GS} =0V 0.9 1.2 V Reverse Recovery Time t _{tr} 200 nS	Dynamic Characteristics						
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	Input Capacitance	C _{Iss}	\/ -50\/\/ -0\/		304		PF
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	Output Capacitance	Coss			17		PF
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	Reverse Transfer Capacitance	C _{rss}	Γ-1.UIVIΠZ		0.5		PF
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	Total Gate Charge	Qg	\/ -400\/ -40		8.8	12	nC
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	Gate-Source Charge	Q _{gs}			2.3		nC
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	Gate-Drain Charge	Q_{gd}	V _{GS} -10V		4		nC
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	Switching times			•			
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	Turn-on Delay Time	t _{d(on)}			8		nS
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	Turn-on Rise Time	t _r	V_{DD} =380V, I_{D} =2.5A,		4		nS
	Turn-Off Delay Time	t _{d(off)}	$R_G=5\Omega,V_{GS}=10V$		52	70	nS
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	Turn-Off Fall Time	t _f			9	18	nS
Pulsed Source-drain current(Body Diode) I_{SDM} $T_{C}=25^{\circ}C$ 16 A Forward On Voltage V_{SD} $T_{J}=25^{\circ}C,I_{SD}=4A,V_{GS}=0V$ 0.9 1.2 V Reverse Recovery Time t_{rr} 200 nS	Source- Drain Diode Characteristics						
Pulsed Source-drain current(Body Diode) I _{SDM} 16 A Forward On Voltage V _{SD} Tj=25°C,I _{SD} =4A,V _{GS} =0V 0.9 1.2 V Reverse Recovery Time t _{rr} 200 nS	Source-drain current(Body Diode)	I _{SD}	T -25°C			4	Α
Reverse Recovery Time t _{rr} 200 nS	Pulsed Source-drain current(Body Diode)	I _{SDM}	1 _C =25 C			16	Α
	Forward On Voltage	V _{SD}	Tj=25°C,I _{SD} =4A,V _{GS} =0V		0.9	1.2	V
Reverse Recovery Charge Q _{rr} Tj=25°C,I _F =2A,di/dt=100A/µs 0.6 uC	Reverse Recovery Time	t _{rr}			200		nS
	Reverse Recovery Charge	Q _{rr}	Tj=25°C,I _F =2A,di/dt=100A/µs		0.6		uC
Peak reverse recovery current I _{rrm} 6 A	Peak reverse recovery current	I _{rrm}			6		Α

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

2. Tj=25°C,VDD=50V,VG=10V, R_G =25 Ω



TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS (curves)

Figure 1. Safe operating area

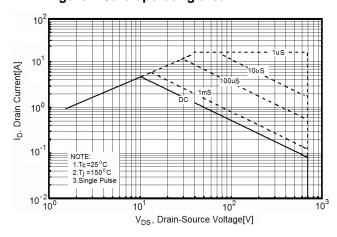


Figure 2. Source-Drain Diode Forward Voltage

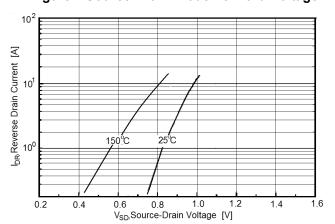


Figure 3. Output characteristics

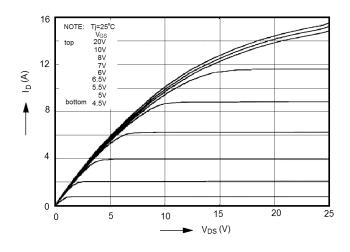


Figure 4. Transfer characteristics

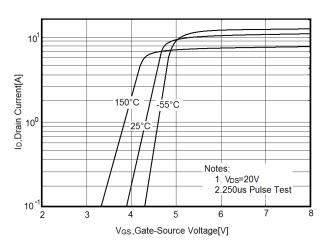


Figure 5. Static drain-source on resistance

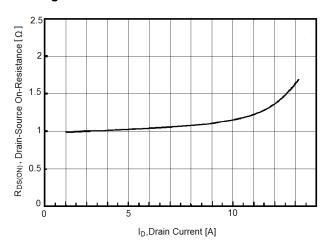
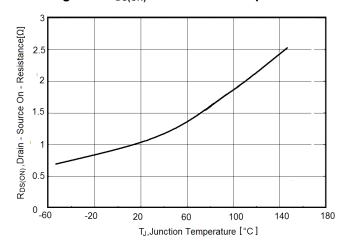


Figure 6. R_{DS(ON)} vs Junction Temperature



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Figure 7. BV_{DSS} vs Junction Temperature

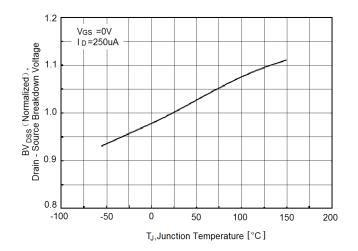


Figure 8. Maximum I_D vs Junction Temperature

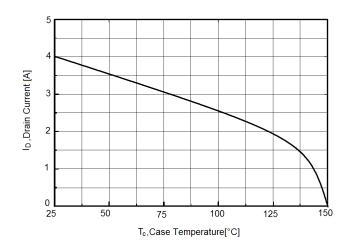


Figure 9. Gate charge waveforms

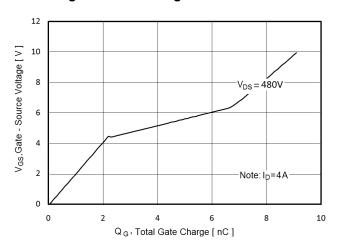


Figure 10. Capacitance

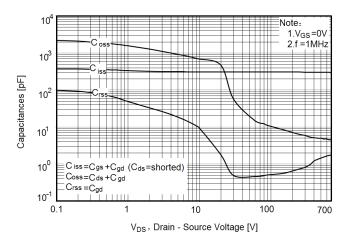
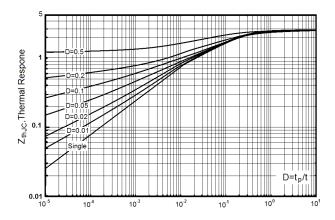


Figure 11. Transient Thermal Impedance

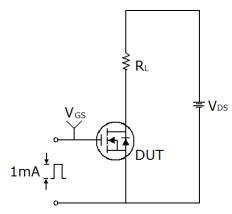


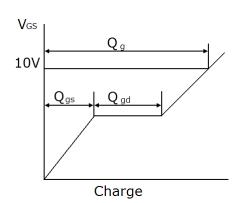




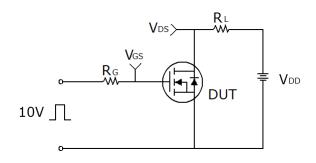
Test circuit

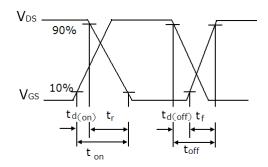
1) Gate charge test circuit & Waveform



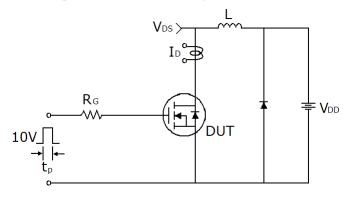


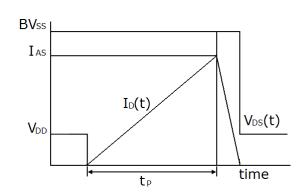
2) Switch Time Test Circuit:





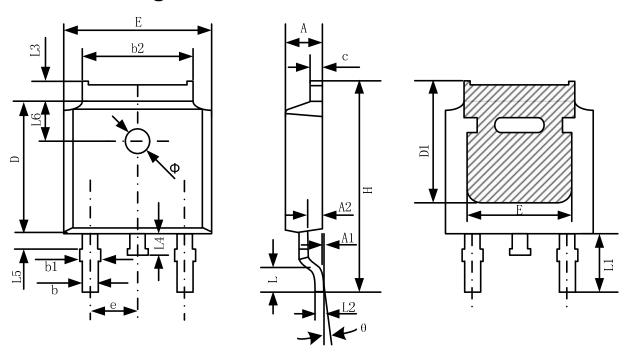
3) Unclamped Inductive Switching Test Circuit & Waveforms







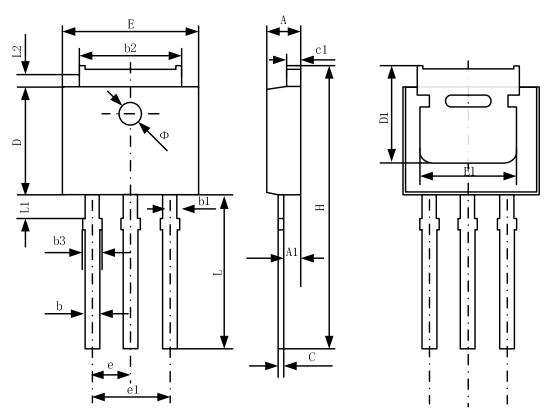
TO-252-2 Package Information



Symbol	Dimension	s In Millimeters	Dimensions In Inches		
Symbol	Min.	Max.	Min.	Max.	
A	2.20	2.38	0.087	0.094	
A1	0.00	0.10	0.000	0.004	
A2	0.90	1.10	0.035	0.043	
b	0.72	0.85	0.028	0.033	
b1	0.72	0.90	0.028	0.035	
b2	5.13	5.46	0.202	0.215	
С	0.47	0.60	0.019	0.024	
D	6.00	6.20	0.236	0.244	
D1	5.25		0.207		
E	6.50	6.70	0.256	0.264	
E1	4.70		0.185		
e	2.19	2.39	0.086	0.094	
Н	9.80	10.40	0.386	0.409	
L	1.40	1.70	0.055	0.067	
L1	2.9	90 REF	0.114	1 REF	
L2	0.5	08 BSC	0.020) BSC	
L3	0.90	1.25	0.035	0.049	
L4	0.60	1.00	0.024	0.039	
L5	0.15	0.75	0.006	0.030	
L6	1.8	BO REF	0.07	1 REF	
Ф	1.20	1.40	0.047	0.055	
θ	0°	8°	0°	8°	



TO-251 Package Information



Complete al	Dimensions	In Millimeters	Dimensions In Inches		
Symbol	Min.	Max.	Min.	Max.	
Α	2.20	2.35	0.087	0.093	
A1	0.90	1.10	0.035	0.043	
b	0.56	0.69	0.022	0.027	
b1	0.77	0.90	0.030	0.035	
b2	5.23	5.43	0.206	0.214	
b3		1.05	0.000	0.041	
С	0.46	0.59	0.018	0.023	
c1	0.46	0.59	0.018	0.023	
D	6.00	6.20	0.236	0.244	
D1	5.20		0.205		
E	6.50	6.70	0.256	0.264	
E1	4.60	5.00	0.181		
e	2.24	2.34	0.088	0.092	
e1	4.47	4.67	0.176	0.184	
Н	16.18	16.78	0.637	0.661	
L	9.00	9.60	0.354	0.378	
L1	0.95	1.35	0.037	0.053	
L2	0.90	1.25	0.035	0.049	



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