

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.

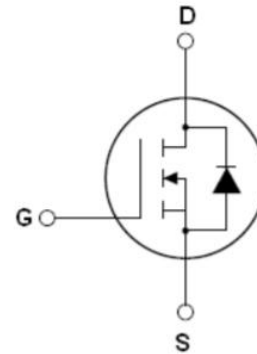
Features

- 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
$R_{DS(ON)TYP.}$	880	m Ω
I_D	4.3	A
Q_g	8.5	nC



Schematic diagram

Package Marking And Ordering Information

Device	Device Package	Marking
NCE60N1K0F	TO-220F-3L	NCE60N1K0F



TO-220F

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}	± 30	V
Gate-Source Voltage ($V_{DS}=0V$), DC	V_{GS}	± 20	V
Continuous Drain Current at $T_c=25^\circ\text{C}$	$I_{D(DC)}$	4.3	A
Continuous Drain Current at $T_c=100^\circ\text{C}$	$I_{D(DC)}$	3.0	A
Pulsed drain current (Note 1)	$I_{DM(pluse)}$	12.9	A
Maximum Power Dissipation($T_c=25^\circ\text{C}$)	P_D	30.7	W
Derate above 25°C		0.20	W/ $^\circ\text{C}$
Single pulse avalanche current (Note 2)	I_{AS}	1	A
Repetitive Avalanche energy, t_{AR} limited by T_{jmax} (Note 1)	E_{AR}	0.9	mJ
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}	4.89	$^{\circ}\text{C}/\text{W}$
Thermal Resistance, Junction-to-Ambient (Maximum)	R_{thJA}	62	$^{\circ}\text{C}/\text{W}$

Table 3. Electrical Characteristics (TA=25 $^{\circ}\text{C}$ unless otherwise noted)

Parameter	Symbol	Condition	Min	Typ	Max	Unit
On/off states						
Drain-Source Breakdown Voltage	BV_{DSS}	$V_{GS}=0V, I_D=250\mu A$	600			V
Zero Gate Voltage Drain Current(Tc=25 $^{\circ}\text{C}$)	I_{DSS}	$V_{DS}=600V, V_{GS}=0V$			1	μA
Zero Gate Voltage Drain Current(Tc=125 $^{\circ}\text{C}$)	I_{DSS}	$V_{DS}=600V, V_{GS}=0V$			50	μA
Gate-Body Leakage Current	I_{GSS}	$V_{GS}=\pm 20V, V_{DS}=0V$			± 200	nA
Gate Threshold Voltage	$V_{GS(th)}$	$V_{DS}=V_{GS}, I_D=250\mu A$	3		4	V
Drain-Source On-State Resistance	$R_{DS(ON)}$	$V_{GS}=10V, I_D=2A$		880	1000	m Ω
Dynamic Characteristics						
Gate Resistance	R_g	F=1MHZ, D-S short		40		Ω
Input Capacitance	C_{iss}	$V_{DS}=50V, V_{GS}=0V,$ F=1MHz		252		pF
Output Capacitance	C_{oss}			1.82		pF
Reverse Transfer Capacitance	C_{rss}			0.78		pF
Total Gate Charge	Q_g	$V_{DS}=400V, I_D=2A,$ $V_{GS}=10V$		8.5	10.5	nC
Gate-Source Charge	Q_{gs}			1.6		nC
Gate-Drain Charge	Q_{gd}			3		nC
Gate plateau voltage	V_{gp}			4.8		V
Switching times						
Turn-on Delay Time	$t_{d(on)}$	$V_{DD}=380V, I_D=2A,$ $R_G=4\Omega, V_{GS}=10V$		8		nS
Turn-on Rise Time	t_r			10		nS
Turn-Off Delay Time	$t_{d(off)}$			18		nS
Turn-Off Fall Time	t_f			15		nS
Source- Drain Diode Characteristics						
Source-drain current(Body Diode)	I_{SD}	$T_C=25^{\circ}\text{C}$			4.3	A
Pulsed-Source-drain current(Body Diode)	I_{SDM}				12.9	A
Forward on voltage	V_{SD}	$T_j=25^{\circ}\text{C}, I_{SD}=4.3A, V_{GS}=0V$		0.9	1.1	V
Reverse Recovery Time	t_{rr}	$T_j=25^{\circ}\text{C}, I_F=2A,$ $di/dt=100A/\mu s$		150		nS
Reverse Recovery Charge	Q_{rr}			0.87		μC
Peak reverse recovery current	I_{rrm}			11.6		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

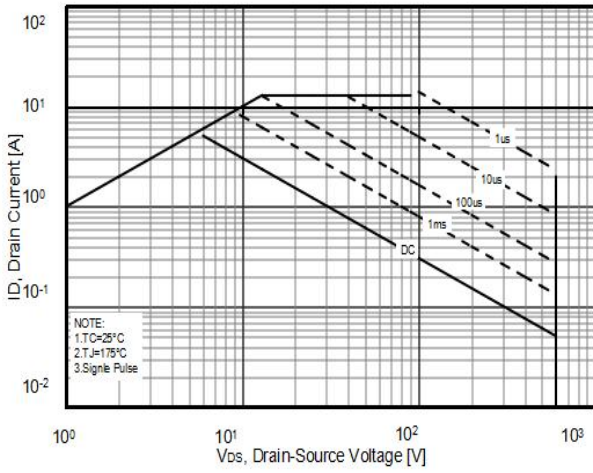


Figure2. Source-Drain Diode Forward Voltage

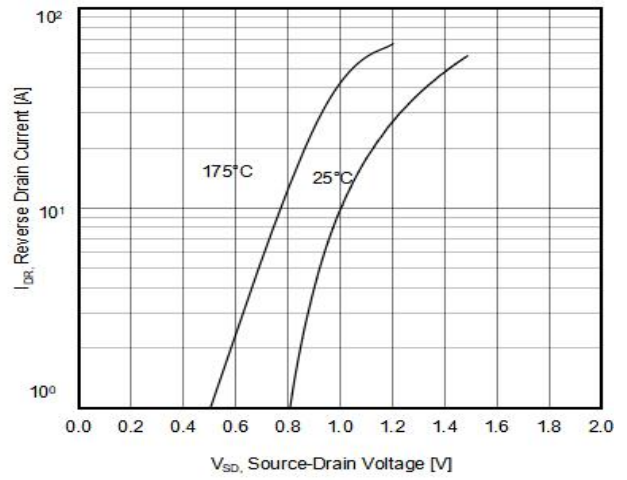


Figure3. Transfer characteristics

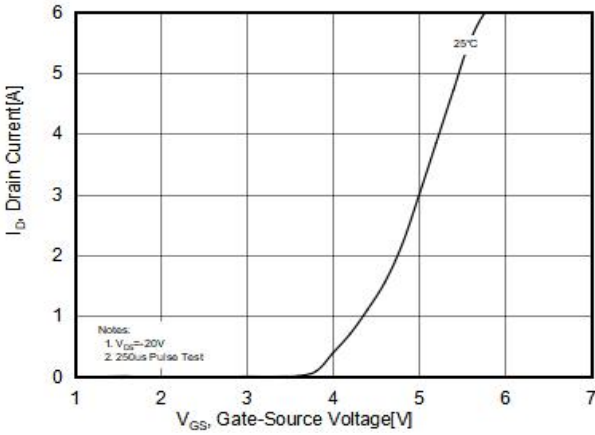


Figure4. Output characteristics

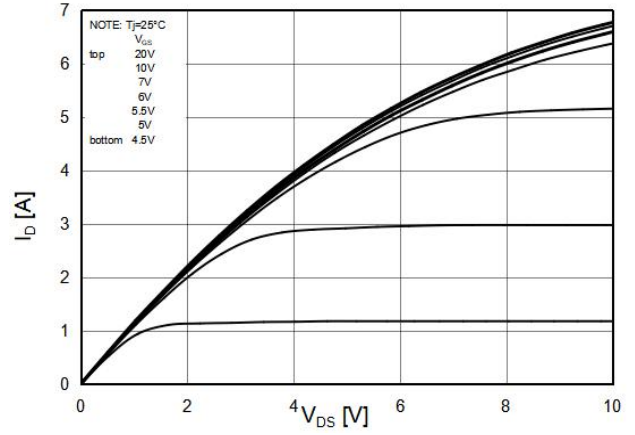


Figure5. Static drain-source on resistance

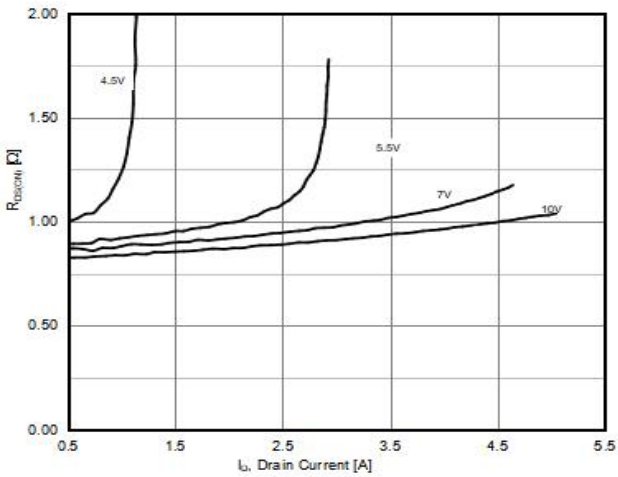


Figure6. $R_{DS(ON)}$ vs Junction Temperature

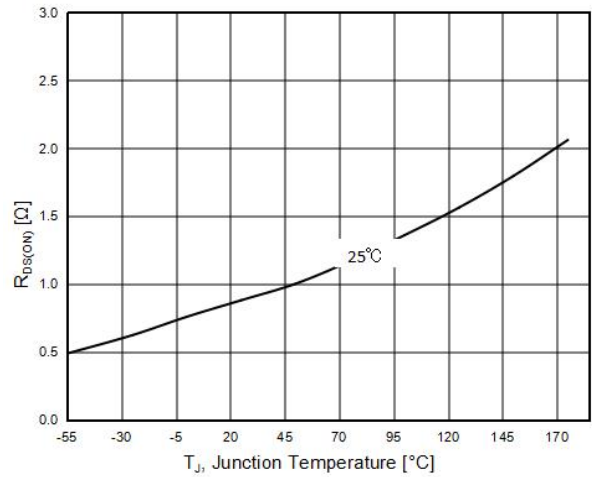


Figure7. BV_{DSS} vs Junction Temperature

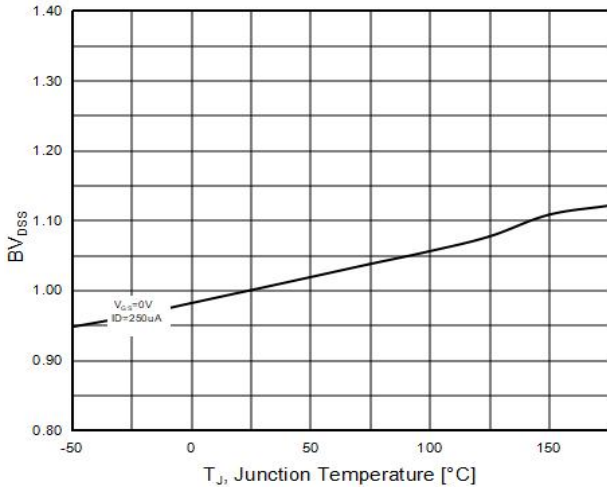


Figure8. Maximum I_D vs Junction Temperature

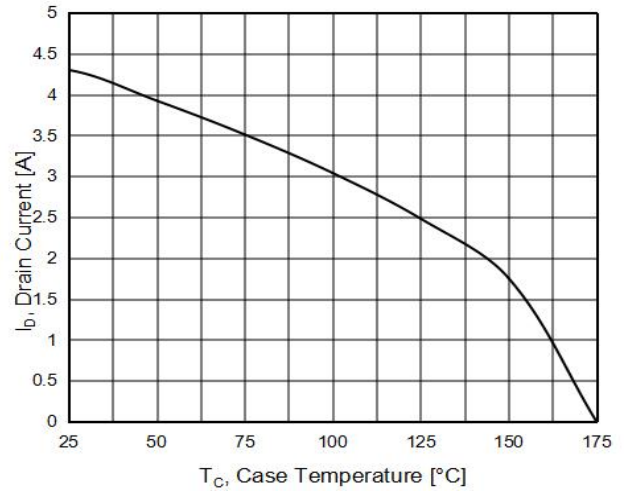


Figure9. Gate charge waveforms

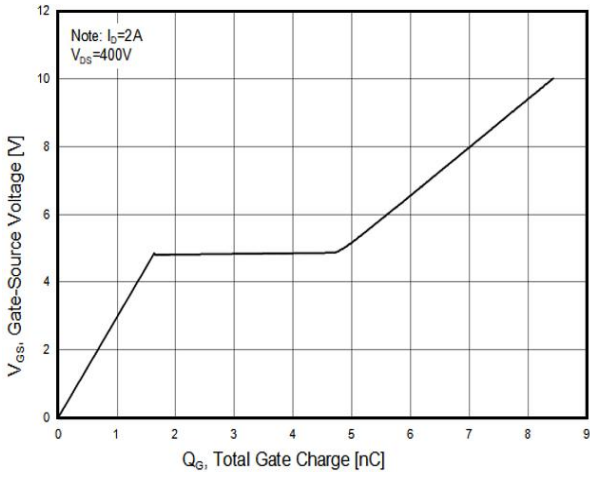
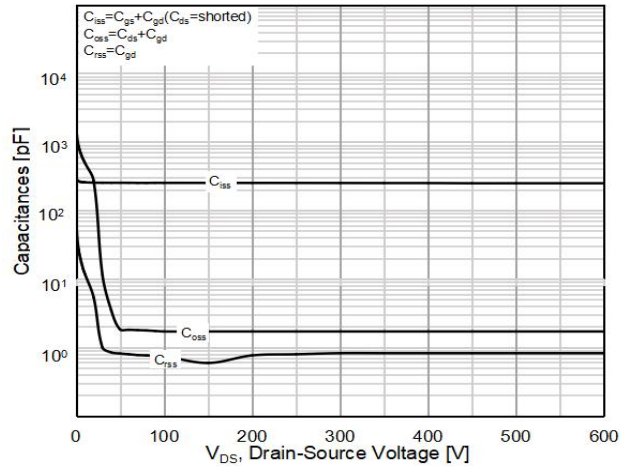


Figure10. Capacitance

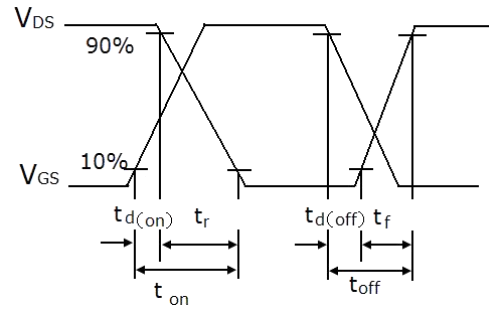


Test circuit

1) Gate charge test circuit & Waveform



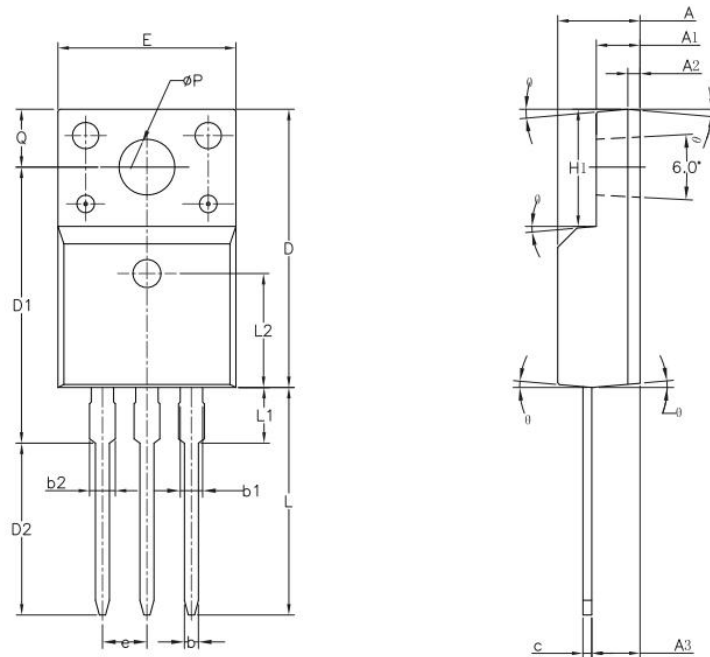
2) Switch Time Test Circuit:



3) Unclamped Inductive Switching Test Circuit & Waveforms



TO-220F-P Package Information



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	4.50	4.83	0.177	0.190
A1	2.34	2.74	0.092	0.108
A2	0.70 REF		0.028 REF	
A3	2.56	2.93	0.101	0.115
b	0.70	0.90	0.028	0.035
b1	1.18	1.38	0.046	0.054
b2	--	1.47	--	0.058
c	0.45	0.60	0.018	0.024
D	15.67	16.07	0.616	0.631
D1	15.55	15.95	0.611	0.627
D2	9.60	10.00	0.377	0.393
E	9.96	10.36	0.391	0.407
e	2.54 BSC		0.100 BSC	
H1	6.48	6.88	0.255	0.270
L	12.68	13.28	0.498	0.522
L1	--	3.50	--	0.138
L2	6.50 REF		0.255 REF	
ø P	3.08	3.28	0.121	0.129
Q	3.20	3.40	0.126	0.134
θ1	1.0°	5.0°	1.00°	5.00°

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