

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.

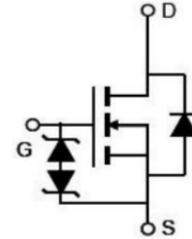
Features

- 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)

$V_{DS\ min@T_{jmax}}$	550	V
$R_{DS(ON)TYP.}$	180	m Ω
I_D	13.5	A
Q_g	19	nC



Schematic diagram

◇ Intrinsic fast-recovery body diode

Package Marking And Ordering Information

Device	Device Package	Marking
NCE50NF220	TO-220	NCE50NF220

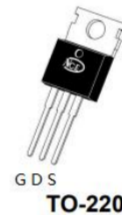


Table 1. Absolute Maximum Ratings ($T_c=25^\circ\text{C}$)

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}	± 30	V
Gate-Source Voltage ($V_{DS}=0V$), DC	V_{GS}	± 20	V
Continuous Drain Current at $T_c=25^\circ\text{C}$	$I_{D(DC)}$	13.5	A
Continuous Drain Current at $T_c=100^\circ\text{C}$	$I_{D(DC)}$	9.45	A
Pulsed drain current (Note 1)	$I_{DM(pluse)}$	40.5	A
Maximum Power Dissipation($T_c=25^\circ\text{C}$)	P_D	109	W
Derate above 25°C		0.72	W/ $^\circ\text{C}$
Single pulse avalanche current (Note 2)	I_{AS}	3	A
Reverse diode dv/dt , $V_{DS} \leq 480\text{ V}$, $I_{SD}<I_D$	dv/dt	50	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}	1.37	$^{\circ}\text{C}/\text{W}$
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_{DSS}	$V_{GS}=0V, I_D=250\mu A$	500			V
Zero Gate Voltage Drain Current(Tc=25°C)	I_{DSS}	$V_{DS}=500V, V_{GS}=0V$			10	μA
Zero Gate Voltage Drain Current(Tc=125°C)	I_{DSS}	$V_{DS}=500V, V_{GS}=0V$			400	μA
Gate-Body Leakage Current	I_{GSS}	$V_{GS}=\pm 20V, V_{DS}=0V$			± 200	nA
Gate Threshold Voltage	$V_{GS(th)}$	$V_{DS}=V_{GS}, I_D=250\mu A$	3.5	4.2	5.0	V
Drain-Source On-State Resistance	$R_{DS(on)}$	$V_{GS}=10V, I_D=6.5A$		180	220	m Ω
Dynamic Characteristics						
Gate Resistance	R_g	F=1MHZ, D-S short		15		Ω
Input Capacitance	C_{iss}	$V_{DS}=50V, V_{GS}=0V,$ F=1MHz		846		pF
Output Capacitance	C_{oss}			46		pF
Reverse Transfer Capacitance	C_{riss}			1.8		pF
Total Gate Charge	Q_g	$V_{DS}=380V, I_D=6.5A,$ $V_{GS}=10V$		19		nC
Gate-Source Charge	Q_{gs}			7.3		nC
Gate-Drain Charge	Q_{gd}			5.7		nC
Gate plateau voltage	V_{gp}			6.6		V
Switching times						
Turn-on Delay Time	$t_{d(on)}$	$V_{DD}=380V, I_D=6.5A,$ $R_G=4\Omega, V_{GS}=10V$		8		nS
Turn-on Rise Time	t_r			10		nS
Turn-Off Delay Time	$t_{d(off)}$			41		nS
Turn-Off Fall Time	t_f			10		nS
Source- Drain Diode Characteristics						
Source-drain current(Body Diode)	I_{SD}	$T_C=25^{\circ}\text{C}$			13.5	A
Pulsed-Source-drain current(Body Diode)	I_{SDM}				40.5	A
Forward on voltage	V_{SD}	$T_j=25^{\circ}\text{C}, I_{SD}=13.5A, V_{GS}=0V$		1.0	1.2	V
Reverse Recovery Time	t_{rr}	$T_j=25^{\circ}\text{C}, I_F=6.5A,$ $di/dt=100A/\mu s$		150		nS
Reverse Recovery Charge	Q_{rr}			0.34		μC
Peak reverse recovery current	I_{rm}			4.5		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. Output characteristics

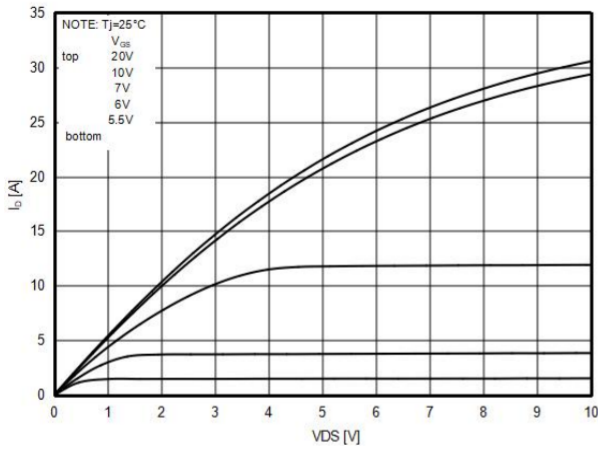


Figure2. Transfer characteristics

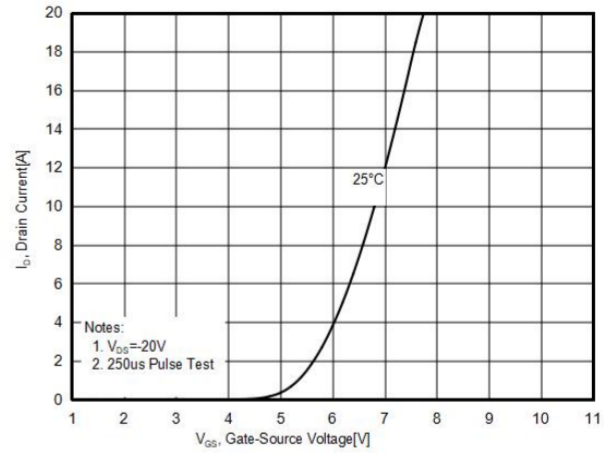


Figure3. $R_{DS(ON)}$ vs Junction Temperature

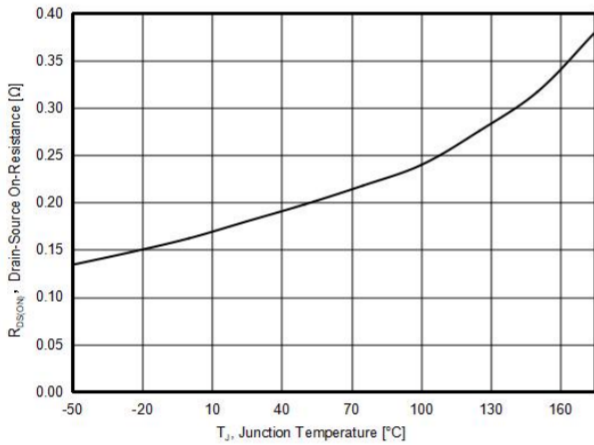


Figure4. BV_{DSS} vs Junction Temperature

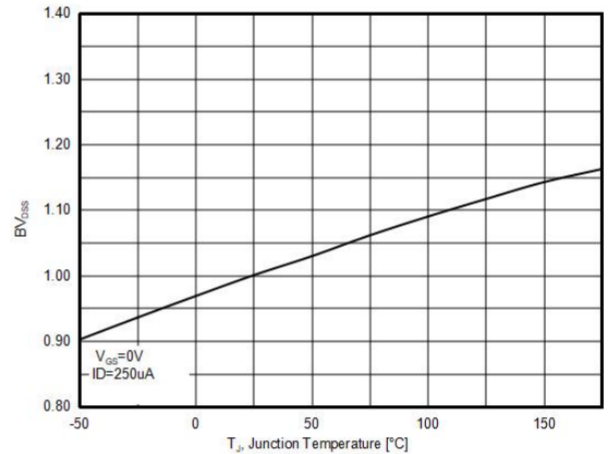


Figure5. Maximum I_D vs Junction Temperature

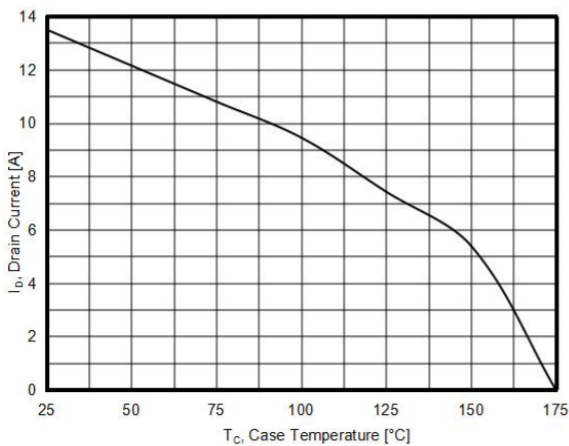


Figure6. Gate charge waveforms

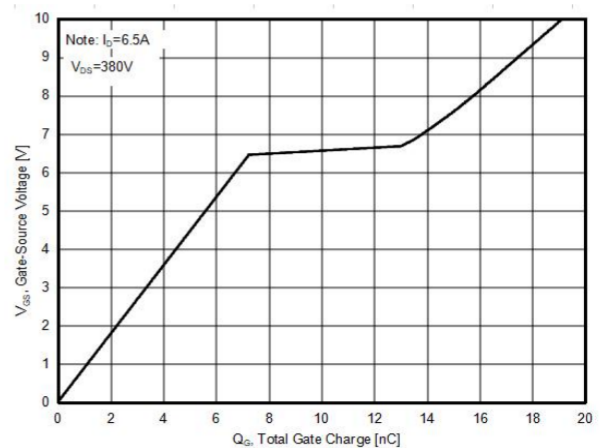


Figure7. Static drain-source on resistance

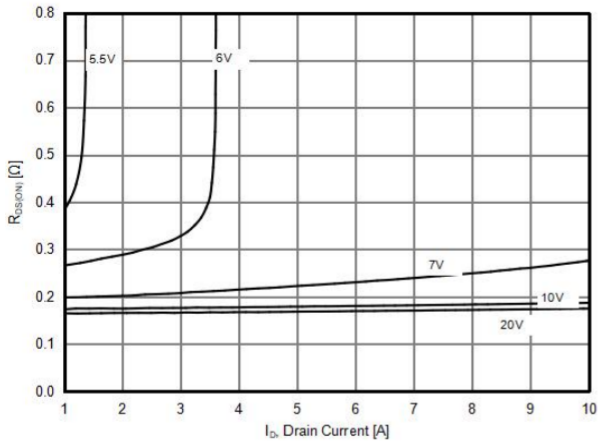


Figure8. Source-Drain Diode Forward Voltage

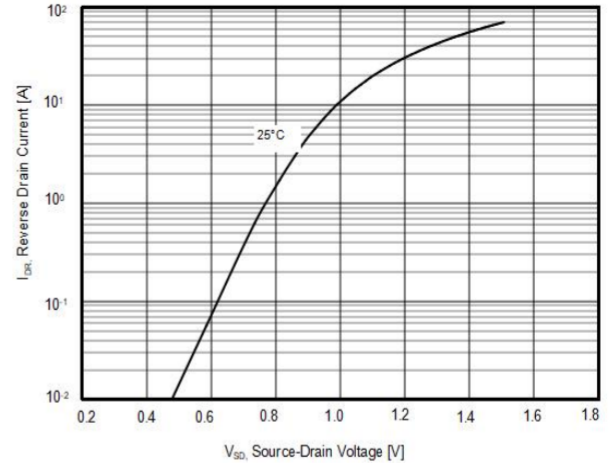


Figure9. Capacitance

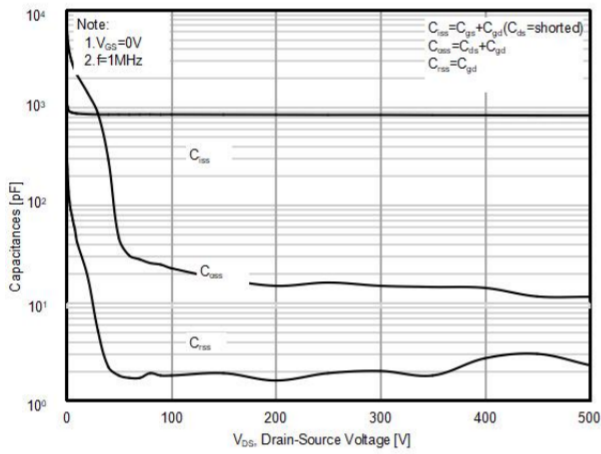
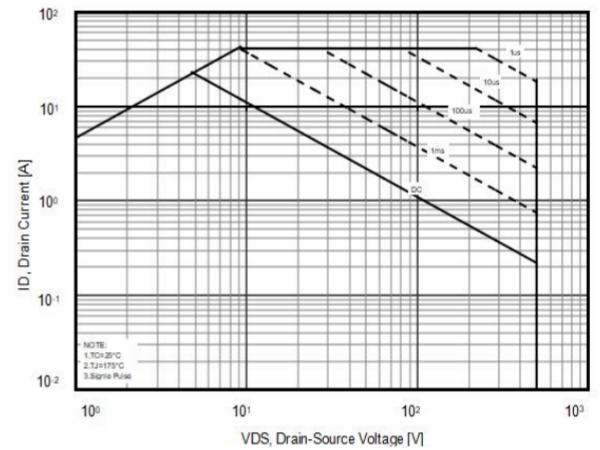
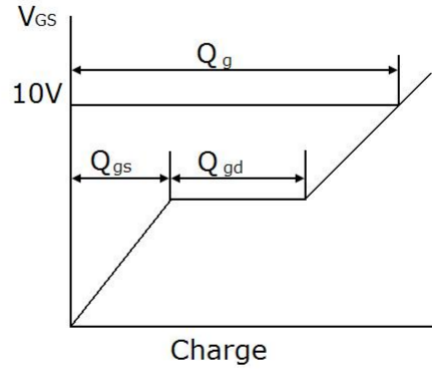
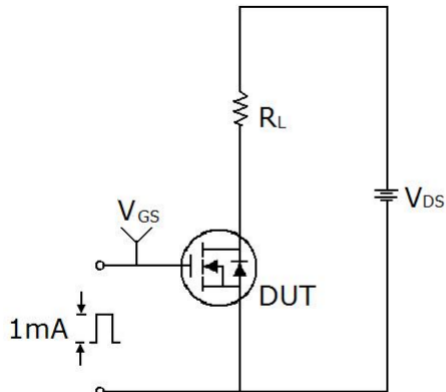


Figure10. Safe operating area

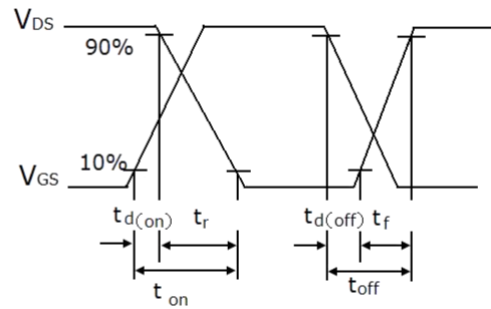
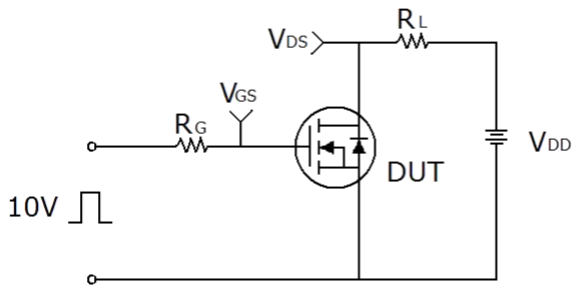


Test circuit

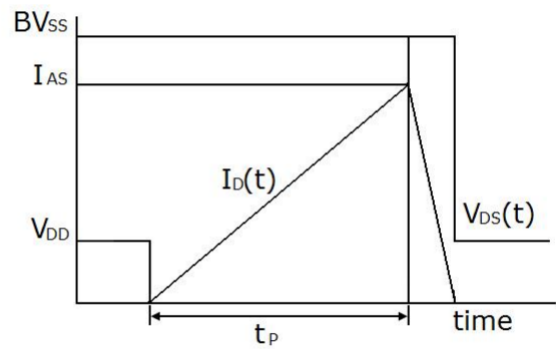
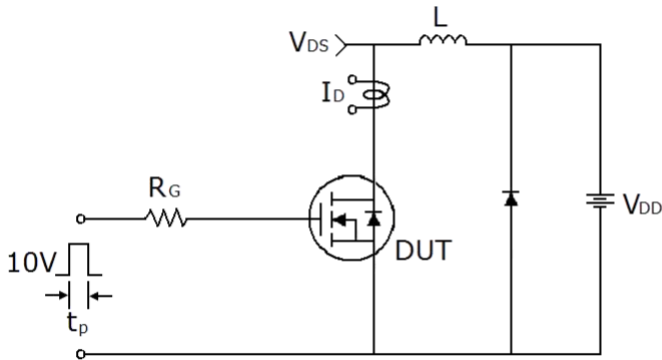
1) Gate charge test circuit & Waveform



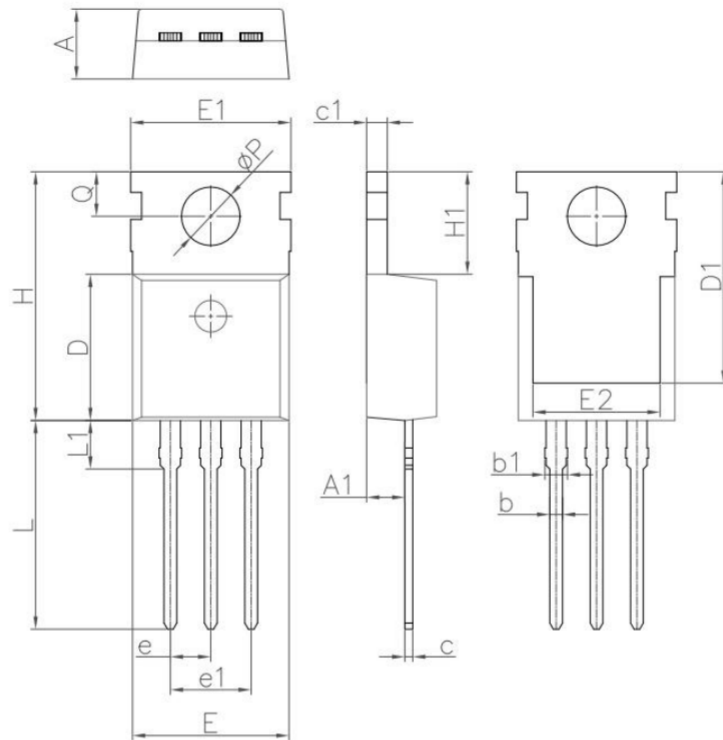
2) Switch Time Test Circuit:



3) Unclamped Inductive Switching Test Circuit & Waveforms



TO-220-E Package Information



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	4.20	4.60	0.165	0.181
A1	2.25	2.55	0.089	0.100
b	0.70	0.90	0.028	0.035
b1	1.17	1.37	0.046	0.054
c	0.33	0.65	0.013	0.026
c1	1.20	1.40	0.047	0.055
D	8.95	9.75	3.524	3.839
D1	13.10	13.50	5.157	5.315
E	9.74	10.04	3.835	3.953
E1	9.91	10.25	3.902	4.035
E2	7.90	8.10	3.110	3.189
e	2.54BSC		0.100BSC	
e1	5.08BSC		0.200BSC	
H	15.45	15.85	6.083	6.240
H1	6.30	6.60	2.480	2.598
L	12.90	13.40	5.079	5.276
L1	2.85	3.25	1.122	1.280
Q	2.65	2.95	1.043	1.161
ΦP	3.40	3.80	1.339	1.496

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