

## N-Channel Super Junction Power MOSFET IV

### General Description

The series of devices use advanced trench gate super junction technology and design to provide ultra-low  $R_{DS(ON)}$  and low gate charge and With a rapid recovery body diode. This super junction MOSFET fits the industry's AC-DC SMPS requirements for PFC, AC/DC power conversion, industrial power applications, Fast charger, new energy vehicle charging pile, on-board OBC etc.

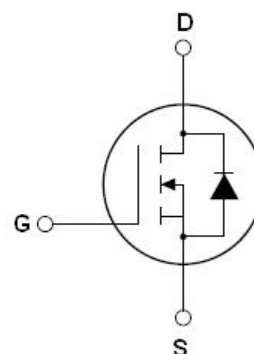
### Features

- New technology for high voltage device
- Ultra low on-resistance and ultra low conduction losses
- Ultra Low Gate Charge cause lower driving requirements
- Diode reverse recovery speed is super fast
- High reliability
- ROHS compliant

### Application

- Power factor correction (PFC)
- Switched mode power supplies (SMPS)
- Uninterruptible Power Supply (UPS)
- On-board charger (OBC)

$V_{DS\ min@T_{jmax}}$	710	V
$R_{DS(ON)TYP}$	85	mΩ
$I_D$	36	A
$Q_g$	55	nC



Schematic diagram

✧ Intrinsic fast-recovery body diode

### Package Marking And Ordering Information

Device	Device Package	Marking
NCE65NF099	TO-220	NCE65NF099

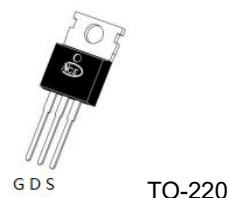


Table 1. Absolute Maximum Ratings ( $T_c=25^\circ\text{C}$ )

Parameter	Symbol	Value	Unit
Drain-Source Voltage ( $V_{GS}=0V$ )	$V_{DS}$	650	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 $T_c=25^\circ\text{C}$	$I_D (DC)$	36	A
Continuous Drain Current at $T_c=100^\circ\text{C}$	$I_D (DC)$	25.2	A
Pulsed drain current (Note 1)	$I_{DM (pluse)}$	108	A
Maximum Power Dissipation ( $T_c=25^\circ\text{C}$ )	$P_D$	346	W
Derate above $25^\circ\text{C}$		2.30	W/ $^\circ\text{C}$
Single pulse avalanche energy (Note 2)	$E_{AS}$	324	mJ
Avalanche current (Note 1)	$I_{AS}$	9	A
Repetitive Avalanche energy, $t_{AR}$ limited by $T_{jmax}$ (Note 1)	$E_{AR}$	3.9	mJ

Parameter	Symbol	Value	Unit
Drain Source voltage slope, $V_{DS} \leq 480V$ ,	dv/dt	50	V/ns
Reverse diode dv/dt, $V_{DS} \leq 480V, I_{SD} < I_D$	dv/dt	50	V/ns
Operating Junction and Storage Temperature Range	$T_J, T_{STG}$	-55...+175	°C

\* limited by maximum junction temperature

**Table 2. Thermal Characteristic**

Parameter	Symbol	Value	Unit
Thermal Resistance, Junction-to-Case (Maximum)	$R_{thJC}$	0.43	°C /W
Thermal Resistance, Junction-to-Ambient (Maximum)	$R_{thJA}$	62	°C /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> =1mA	650			V
Zero Gate Voltage Drain Current(Tc=25℃)	I <sub>DSS</sub>	V <sub>DS</sub> =650V,V <sub>GS</sub> =0V			10	μA
Zero Gate Voltage Drain Current(Tc=125℃)	I <sub>DSS</sub>	V <sub>DS</sub> =650V,V <sub>GS</sub> =0V			400	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> =500uA	3.5	4.2	5.0	V
Drain-Source On-State Resistance	R <sub>DS(ON)</sub>	V <sub>GS</sub> =10V, I <sub>D</sub> =18A		85	99	mΩ
Dynamic Characteristics						
Input Capacitance	C <sub>iss</sub>	V <sub>DS</sub> =50V,V <sub>GS</sub> =0V, F=1.0MHz		2800	3200	pF
Output Capacitance	C <sub>oss</sub>			96		pF
Reverse Transfer Capacitance	C <sub>rss</sub>			6		pF
Total Gate Charge	Q <sub>g</sub>	V <sub>DS</sub> =480V,I <sub>D</sub> =18A, V <sub>GS</sub> =10V		55	60	nC
Gate-Source Charge	Q <sub>gs</sub>			16.5		nC
Gate-Drain Charge	Q <sub>gd</sub>			25.5		nC
Gate plateau voltage	V <sub>gp</sub>			7.3		V
Intrinsic gate resistance	R <sub>G</sub>	f = 1 MHz open drain		1.5		Ω
Switching times						
Turn-on Delay Time	t <sub>d(on)</sub>	V <sub>DD</sub> =380V,I <sub>D</sub> =18A, R <sub>G</sub> =1.7Ω,V <sub>GS</sub> =10V		15		nS
Turn-on Rise Time	t <sub>r</sub>			14		nS
Turn-Off Delay Time	t <sub>d(off)</sub>			72		nS
Turn-Off Fall Time	t <sub>f</sub>			14		nS
Source- Drain Diode Characteristics						
Source-drain current(Body Diode)	I <sub>SD</sub>	T <sub>C</sub> =25℃			36	A
Pulsed Source-drain current(Body Diode)	I <sub>SDM</sub>				108	A
Forward On Voltage	V <sub>SD</sub>	T <sub>J</sub> =25℃,I <sub>SD</sub> =36A,V <sub>GS</sub> =0V		1.0	1.2	V
Reverse Recovery Time	t <sub>rr</sub>	T <sub>J</sub> =25℃,I <sub>F</sub> =18A,di/dt=100A/μs		160		nS
Reverse Recovery Charge	Q <sub>rr</sub>			0.96		uC
Peak Reverse Recovery Current	I <sub>rrm</sub>			12		A

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

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

## TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS (curves)

Figure1. Safe operating area

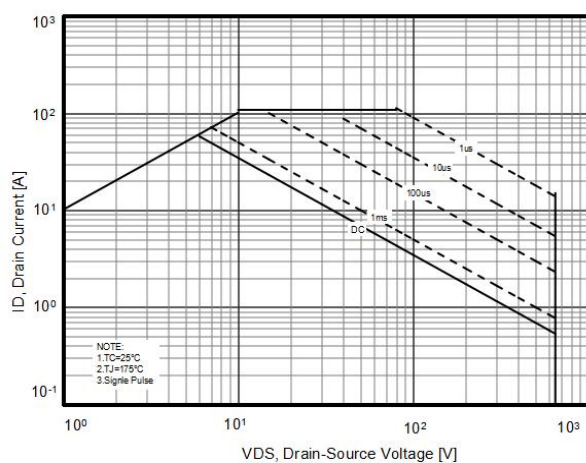


Figure2. Capacitance

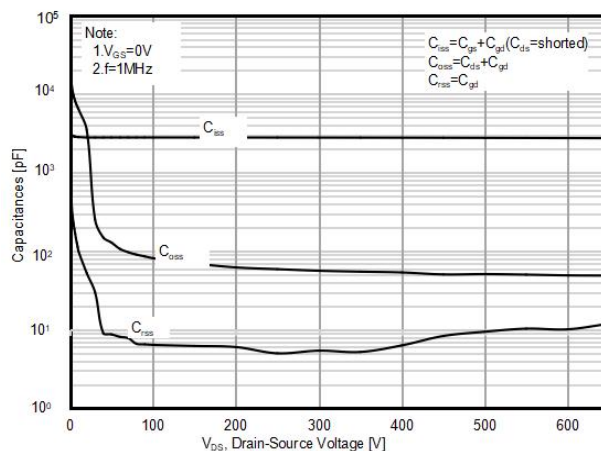


Figure3. Output characteristics

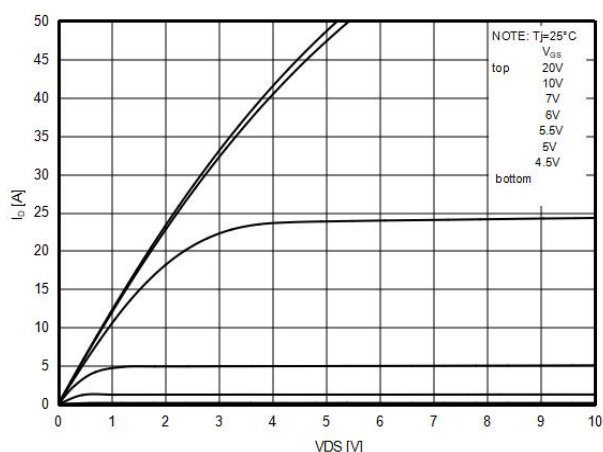


Figure4. Source-Drain Diode Forward Voltage

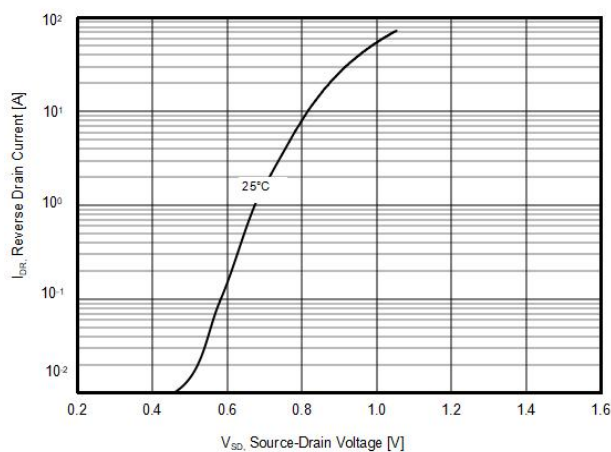


Figure5. Static drain-source on resistance

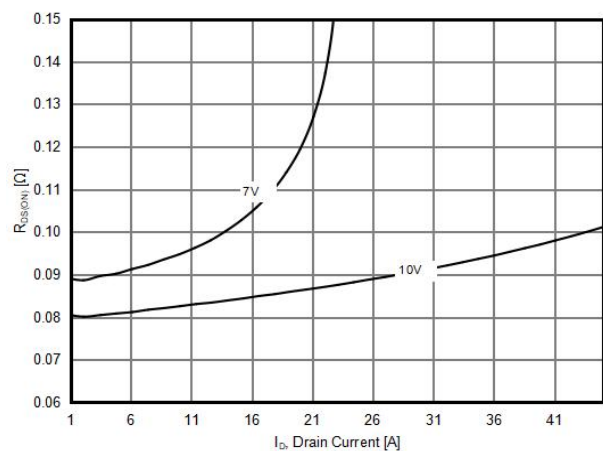
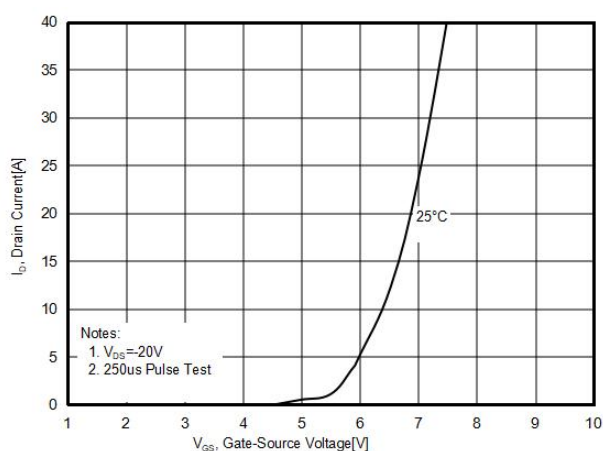
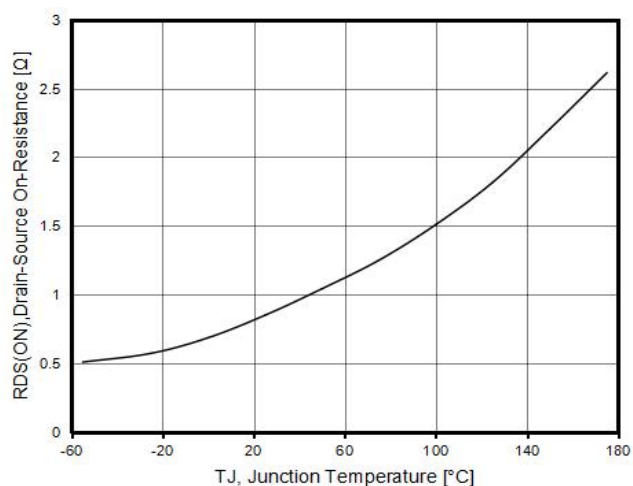


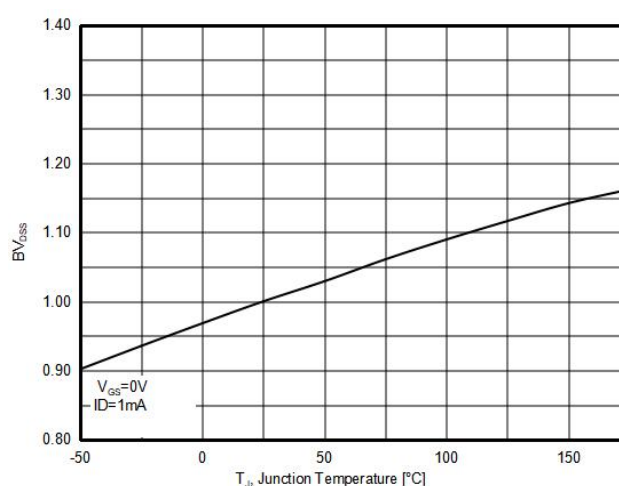
Figure6. Transfer characteristics



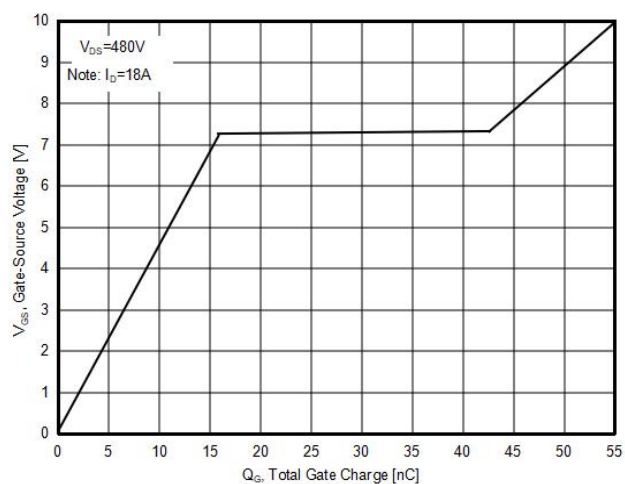
**Figure7.  $R_{DS(ON)}$  vs Junction Temperature**



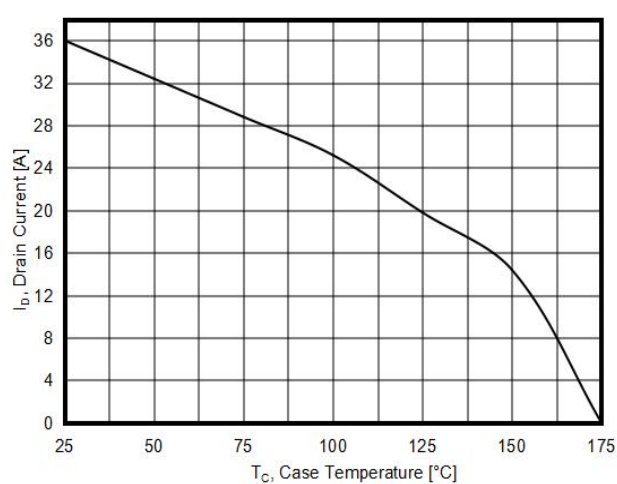
**Figure8.  $BV_{DSS}$  vs Junction Temperature**



**Figure9. Gate charge waveforms**

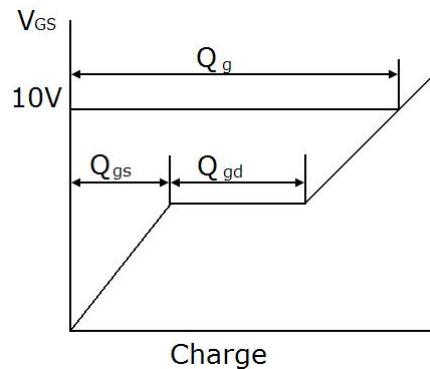


**Figure10. Maximum  $I_D$  vs Junction Temperature**



## Test circuit

### 1) Gate charge test circuit & Waveform



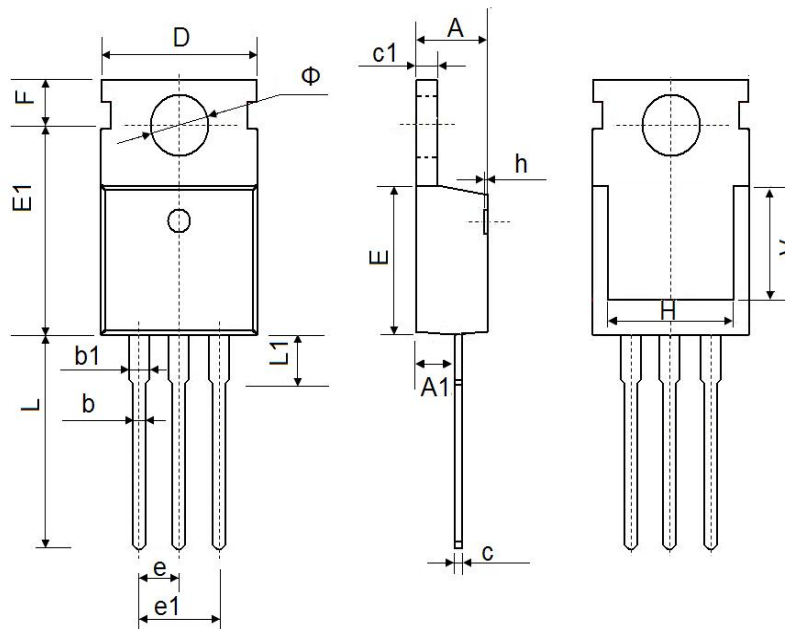
### 2) Switch Time Test Circuit:



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

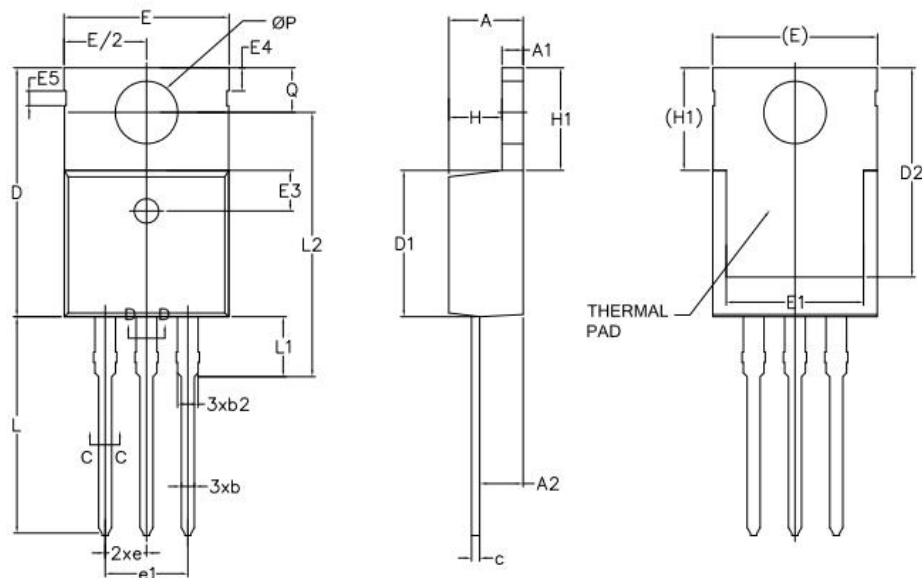


## TO-220-3L-E Package Information



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	9.91	10.25	0.390	0.404
E	8.95	9.75	0.352	0.384
E1	12.80	12.90	0.504	0.508
e	2.54BSC		0.100BSC	
e1	5.08BSC		0.200BSC	
F	2.65	2.95	0.104	0.116
H	7.90	8.10	0.311	0.319
L	12.90	13.40	0.508	0.528
L1	2.85	3.25	0.112	0.128
Φ	3.40	3.80	0.134	0.150

## TO-220-3L-J Package Information



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	4.47	4.67	0.176	0.184
A1	1.20	1.40	0.047	0.055
A2	2.35	2.90	0.093	0.114
b	0.71	0.91	0.028	0.036
b1	0.71	0.86	0.028	0.034
b2	1.22	1.36	0.048	0.054
c	0.47	0.60	0.019	0.024
c1	0.47	0.55	0.019	0.022
D	14.70	15.80	0.579	0.622
D1	8.90	9.47	0.350	0.373
D2	11.75	13.60	0.463	0.535
E	9.70	10.37	0.382	0.408
E1	7.00	8.89	0.276	0.350
E2	9.80	10.20	0.386	0.402
E3	2.40	2.60	0.094	0.102
E4	1.27	1.57	0.050	0.062
e	2.54BSC		0.100BSC	
e1	5.08BSC		0.200BSC	
H	3.00	3.40	0.118	0.134
L	12.90	14.80	0.508	0.583
L1	2.54	3.84	0.100	0.151
L2	12.13	16.50	0.478	0.650
ØP	3.60	3.90	0.142	0.154
Q	4.60	4.90	0.181	0.193

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