

## 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.

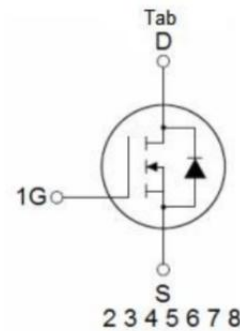
### Features

- 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

$V_{DS\ min@T_{jmax}}$	710	V
$R_{DS(ON)TYP}$	165	mΩ
ID	18	A
Qg	30	nC

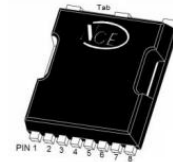


Schematic diagram

✧ Intrinsic fast-recovery body diode

### Package Marking And Ordering Information

Device	Device Package	Marking
NCE65NF190LL	TOLL-8L	NCE65NF190LL



TOLL-8L

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 $T_c=25^\circ\text{C}$	$I_{D(DC)}$	18	A
Continuous Drain Current at $T_c=100^\circ\text{C}$	$I_{D(DC)}$	12.6	A
Pulsed drain current (Note 1)	$I_{DM(pluse)}$	54	A
Maximum Power Dissipation( $T_c=25^\circ\text{C}$ )	$P_D$	194	W
Derate above $25^\circ\text{C}$		1.29	W/ $^\circ\text{C}$
Avalanche current(Note 1)	$I_{AS}$	4	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)	$R_{thJC}$	0.77	$^{\circ}\text{C}/\text{W}$
Thermal Resistance, Junction-to-Ambient (Maximum)	$R_{thJA}$	62	$^{\circ}\text{C}/\text{W}$

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

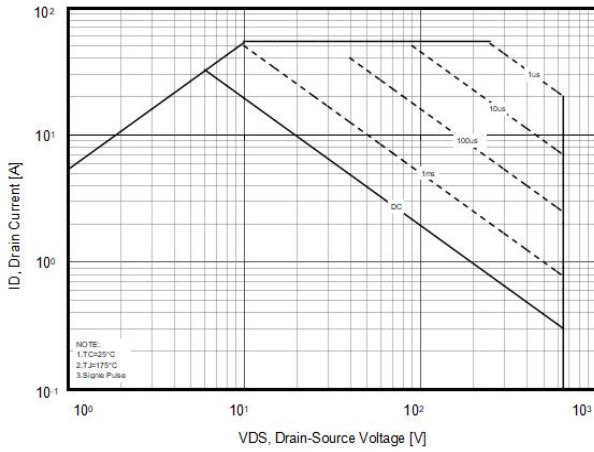
Parameter	Symbol	Condition	Min	Typ	Max	Unit
<b>On/off states</b>						
Drain-Source Breakdown Voltage	$BV_{DSS}$	$V_{GS}=0V, I_D=250\mu A$	650			V
Zero Gate Voltage Drain Current(Tc=25°C)	$I_{DSS}$	$V_{DS}=650V, V_{GS}=0V$			10	$\mu A$
Zero Gate Voltage Drain Current(Tc=125°C)	$I_{DSS}$	$V_{DS}=650V, V_{GS}=0V$			300	$\mu A$
Gate-Body Leakage Current	$I_{GSS}$	$V_{GS}=\pm 20V, V_{DS}=0V$			$\pm 100$	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	$R_{DS(on)}$	$V_{GS}=10V, I_D=9A$		165	190	m $\Omega$
<b>Dynamic Characteristics</b>						
Input Capacitance	$C_{iss}$	$V_{DS}=50V, V_{GS}=0V,$ $F=1.0\text{MHz}$		1550	1950	pF
Output Capacitance	$C_{oss}$			60		pF
Reverse Transfer Capacitance	$C_{rss}$			5		pF
Total Gate Charge	$Q_g$	$V_{DS}=480V, I_D=9A,$ $V_{GS}=10V$		30		nC
Gate-Source Charge	$Q_{gs}$			12.5		nC
Gate-Drain Charge	$Q_{gd}$			11		nC
Gate plateau voltage	$V_{gp}$			7.5		V
Intrinsic gate resistance	$R_G$	$f = 1 \text{ MHz open drain}$		1.5		$\Omega$
<b>Switching times</b>						
Turn-on Delay Time	$t_{d(on)}$	$V_{DD}=380V, I_D=9A,$ $R_G=1.7\Omega, V_{GS}=10V$		43		nS
Turn-on Rise Time	$t_r$			17		nS
Turn-Off Delay Time	$t_{d(off)}$			94		nS
Turn-Off Fall Time	$t_f$			26		nS
<b>Source- Drain Diode Characteristics</b>						
Source-drain current(Body Diode)	$I_{SD}$	$T_C=25^{\circ}\text{C}$			18	A
Pulsed Source-drain current(Body Diode)	$I_{SDM}$				54	A
Forward On Voltage	$V_{SD}$	$T_j=25^{\circ}\text{C}, I_{SD}=18A, V_{GS}=0V$		0.9	1.2	V
Reverse Recovery Time	$t_{rr}$	$T_j=25^{\circ}\text{C}, I_F=9A,$ $di/dt=100A/\mu s$		125		nS
Reverse Recovery Charge	$Q_{rr}$			0.51		$\mu\text{C}$
Peak Reverse Recovery Current	$I_{rrm}$			8.2		A

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

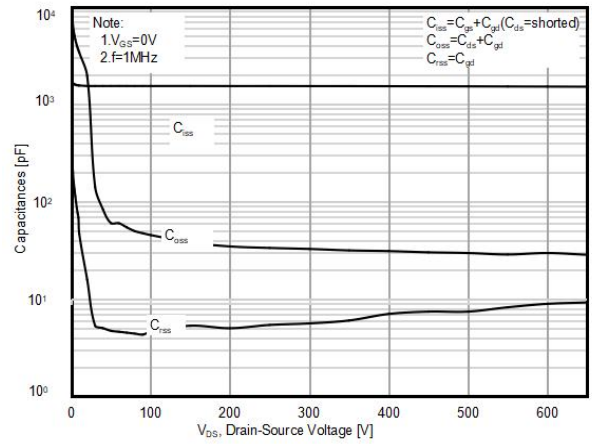
2.  $T_j=25^{\circ}\text{C}, V_{DD}=50V, V_G=10V, R_G=25\Omega$

## TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS (curves)

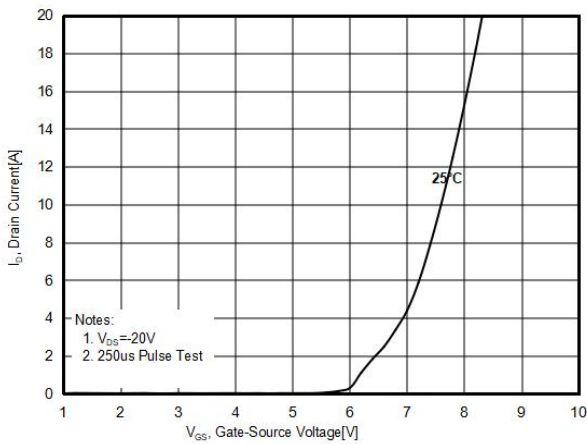
**Figure1. Safe operating area**



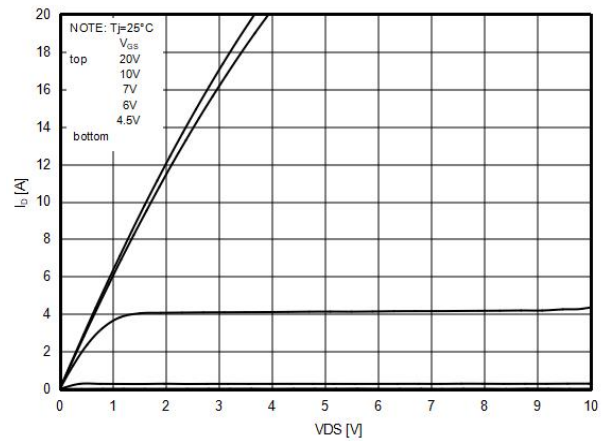
**Figure2. Capacitance**



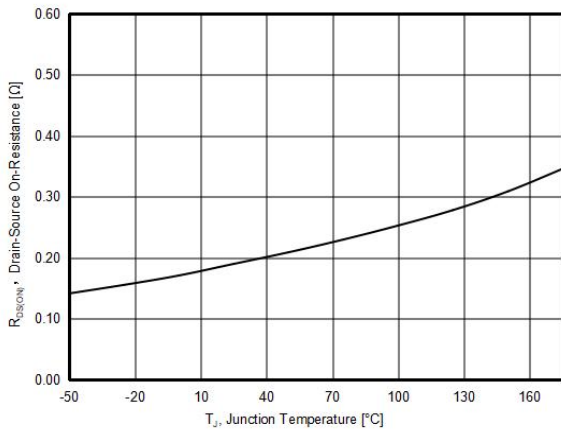
**Figure3. Transfer characteristics**



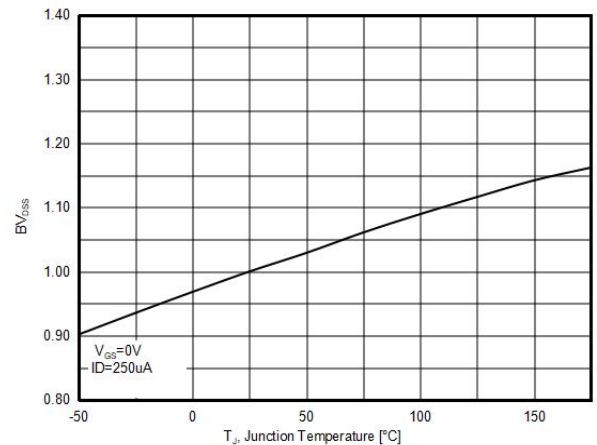
**Figure4. Output characteristics**



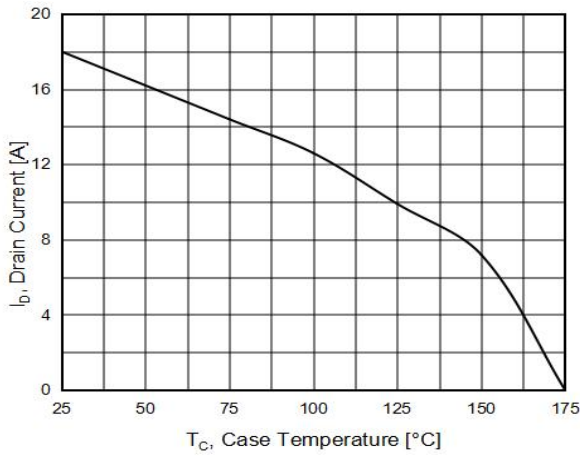
**Figure5.  $R_{DS(ON)}$  vs Junction Temperature**



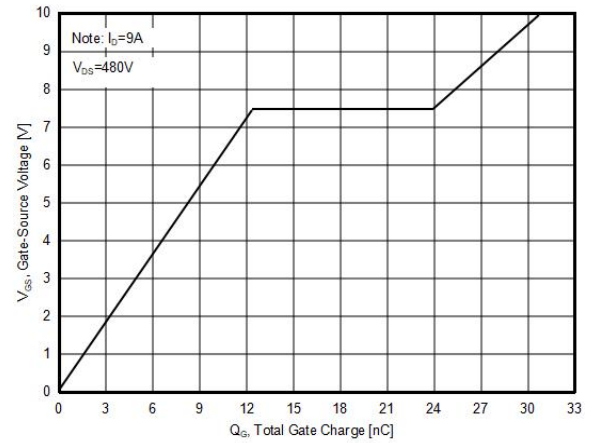
**Figure6.  $BV_{DSS}$  vs Junction Temperature**



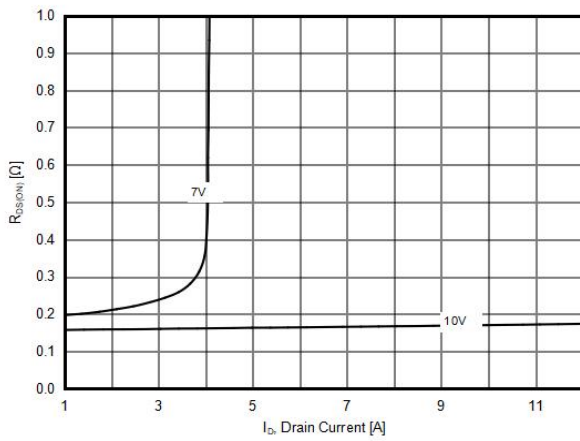
**Figure7. Maximum  $I_D$  vs Junction Temperature**



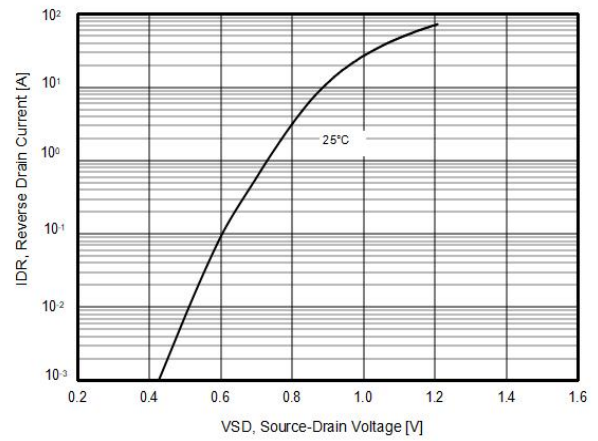
**Figure8. Gate charge waveforms**



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



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

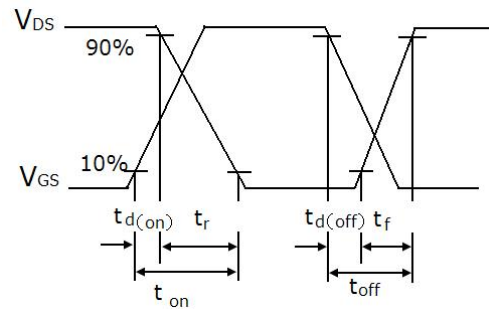


## Test circuit

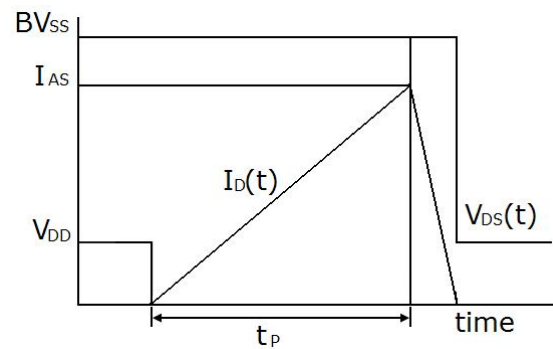
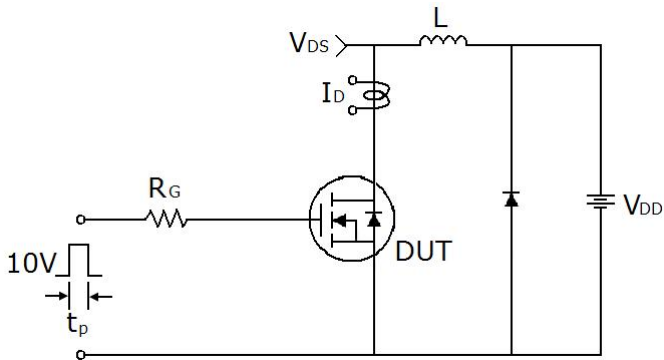
### 1) Gate charge test circuit & Waveform



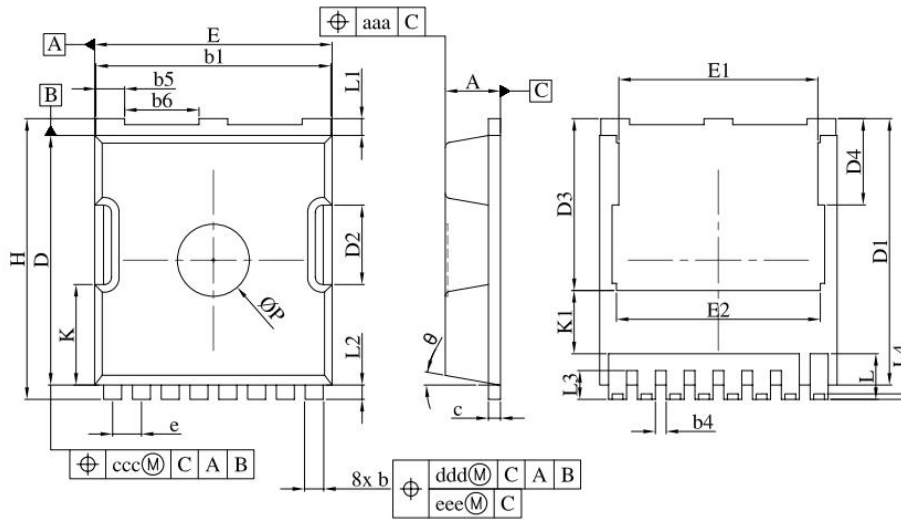
### 2) Switch Time Test Circuit:



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



## TOLL-8L Package Information



SYMBOL	Dimensions In Millimeters			Dimensions In Inches		
	Min	Typ	Max	Min	Typ	Max
A	2.20	2.30	2.40	0.087	0.091	0.094
b	0.70	0.80	0.90	0.028	0.031	0.035
b1	9.70	9.80	9.90	0.382	0.386	0.390
b4	0.30	0.40	0.50	0.012	0.016	0.020
b5	1.10	1.20	1.30	0.043	0.047	0.051
b6	3.00	3.10	3.20	0.118	0.122	0.126
c	0.40	0.50	0.60	0.016	0.020	0.024
D	10.28	10.38	10.55	0.405	0.409	0.415
D1	10.98	11.08	11.18	0.432	0.436	0.440
D2	3.20	3.30	3.40	0.126	0.130	0.134
D3	7.00	7.15	7.30	0.276	0.281	0.287
D4	3.44	3.59	3.74	0.135	0.141	0.147
e	1.10	1.20	1.30	0.043	0.047	0.051
E	9.80	9.90	10.00	0.386	0.390	0.394
E1	8.20	8.30	8.40	0.323	0.327	0.331
E2	8.35	8.50	8.65	0.329	0.335	0.341
H	11.50	11.68	11.85	0.453	0.460	0.467
K	4.08	4.18	4.28	0.161	0.165	0.169
K1	2.45	--	--	0.096	--	--
L	1.60	1.90	2.10	0.063	0.075	0.083
L1	0.50	0.70	0.90	0.020	0.028	0.035
L2	0.50	0.60	0.70	0.020	0.024	0.028
L3	1.00	1.20	1.30	0.039	0.047	0.051
L4	0.13	0.23	0.33	0.005	0.009	0.013
P	2.85	3.00	3.15	0.112	0.118	0.124

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