

## 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.

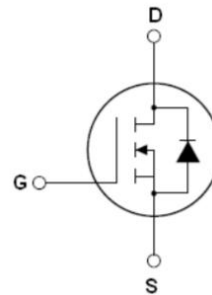
### Features

- 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
- 100% Avalanche Tested and 100%  $T_{rr}$  Tested
- High reliability
- RoHS&Halogen Free

### 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
$R_{DS(ON)TYP.}$	30	m $\Omega$
$I_D$	70	A
$Q_g$	125	nC



✧ **Intrinsic fast-recovery body diode**

**Schematic diagram**

### Package Marking And Ordering Information

Device	Device Package	Marking
NCE65NF036T4	TO-247-4L	NCE65NF036T4



TO-247-4L

**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 $T_c=25^\circ\text{C}$	$I_{D(DC)}$	70	A
Continuous Drain Current at $T_c=100^\circ\text{C}$	$I_{D(DC)}$	49	A
Pulsed drain current (Note 1)	$I_{DM (pluse)}$	210	A
Maximum Power Dissipation ( $T_c=25^\circ\text{C}$ )	$P_D$	488	W
Derate above $25^\circ\text{C}$		3.25	W/ $^\circ\text{C}$
Single pulse avalanche energy (Note 2)	$E_{AS}$	784	mJ
Single pulse avalanche current (Note 2)	$I_{AS}$	14	A
Repetitive Avalanche energy, $t_{AR}$ limited by $T_{jmax}$ (Note 1)	$E_{AR}$	0.8	mJ

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

**Table 2. Thermal Characteristic**

Parameter	Symbol	Value	Unit
Thermal Resistance, Junction-to-Case (Maximum)	$R_{thJC}$	0.31	°C /W
Thermal Resistance, Junction-to-Ambient (Maximum)	$R_{thJA}$	62	°C /W

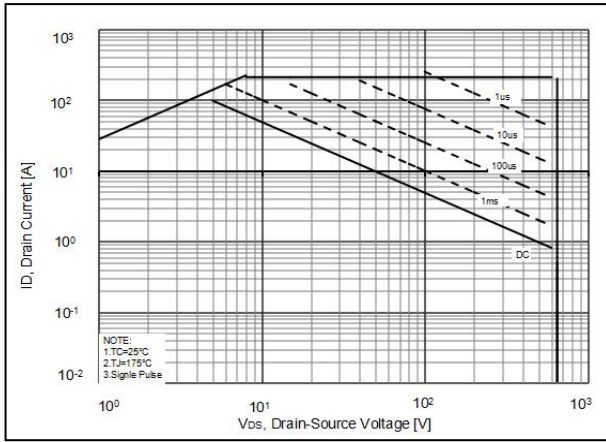
**Table 3. Electrical Characteristics (TA=25°C unless otherwise noted)**

Parameter	Symbol	Condition	Min	Typ	Max	Unit
<b>On/off states</b>						
Drain-Source Breakdown Voltage	$BV_{DSS}$	$V_{GS}=0V, I_D=1mA$	650			V
Zero Gate Voltage Drain Current( $T_c=25^\circ C$ )	$I_{DSS}$	$V_{DS}=650V, V_{GS}=0V$			10	$\mu A$
Zero Gate Voltage Drain Current( $T_c=125^\circ C$ )	$I_{DSS}$	$V_{DS}=650V, V_{GS}=0V$			600	$\mu A$
Gate-Body Leakage Current	$I_{GSS}$	$V_{GS}=\pm 20V, V_{DS}=0V$			$\pm 200$	nA
Gate Threshold Voltage	$V_{GS(th)}$	$V_{DS}=V_{GS}, I_D=3mA$	3.5	4.2	5	V
Drain-Source On-State Resistance	$R_{DS(on)}$	$V_{GS}=10V, I_D=35A$		30	36	m $\Omega$
<b>Dynamic Characteristics</b>						
Gate Resistance	$R_g$	F=1MHZ, D-S short		4		$\Omega$
Input Capacitance	$C_{iss}$	$V_{DS}=50V, V_{GS}=0V,$ F=1MHZ		7727		pF
Output Capacitance	$C_{oss}$			263		pF
Reverse Transfer Capacitance	$C_{riss}$			25.1		pF
Total Gate Charge	$Q_g$	$V_{DS}=400V, I_D=40A, V_{GS}=10V$		125	135	nC
Gate-Source Charge	$Q_{gs}$			57		nC
Gate-Drain Charge	$Q_{gd}$			34		nC
Gate plateau voltage	$V_{gp}$			6.5		V
<b>Switching times</b>						
Turn-on Delay Time	$t_{d(on)}$	$V_{DD}=380V, I_D=40A,$ $R_G=4\Omega, V_{GS}=10V$		54		nS
Turn-on Rise Time	$t_r$			37		nS
Turn-Off Delay Time	$t_{d(off)}$			127		nS
Turn-Off Fall Time	$t_f$			5		nS
<b>Source- Drain Diode Characteristics</b>						
Source-drain current(Body Diode)	$I_{SD}$	$T_c=25^\circ C$			70	A
Pulsed-Source-drain current(Body Diode)	$I_{SDM}$				210	A
Forward on voltage	$V_{SD}$	$T_j=25^\circ C, I_{SD}=70A, V_{GS}=0V$		1.0	1.2	V
Reverse Recovery Time	$t_{rr}$	$T_j=25^\circ C, I_F=40A,$ $di/dt=100A/\mu s$		185		nS
Reverse Recovery Charge	$Q_{rr}$			1.6		$\mu C$
Peak reverse recovery current	$I_{rrm}$			16		A

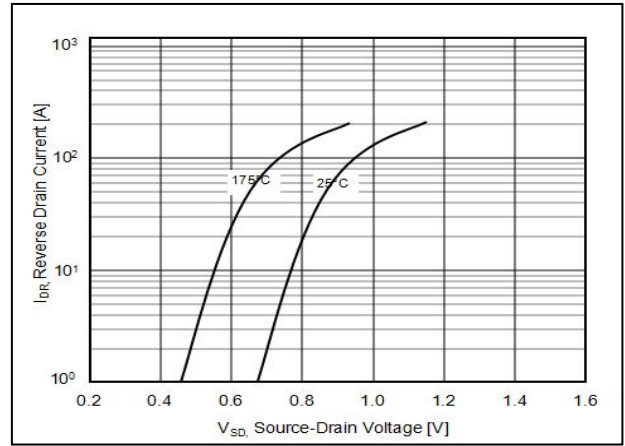
Notes: 1. Repetitive Rating: Pulse width limited by maximum junction temperature  
 2.  $T_j=25^\circ C, V_{DD}=50V, V_G=10V, R_G=25\Omega$

## TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS (curves)

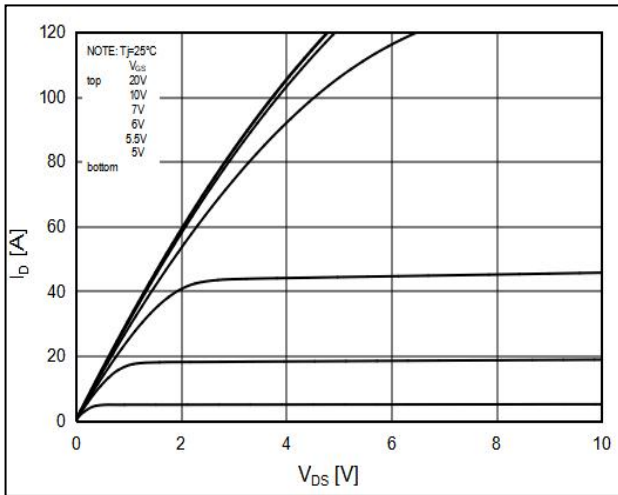
**Figure1. Safe operating area**



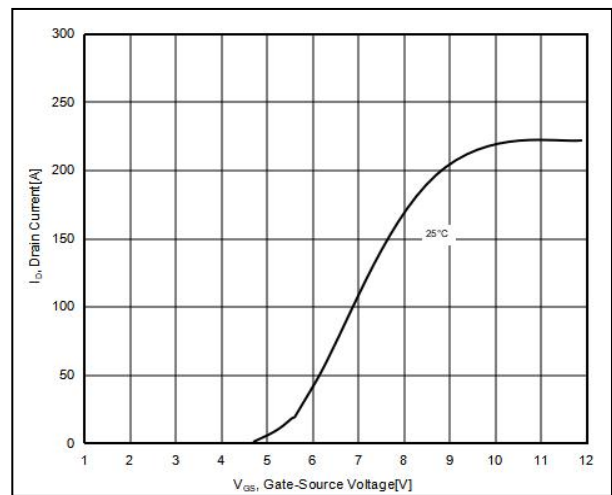
**Figure2. Source-Drain Diode Forward Voltage**



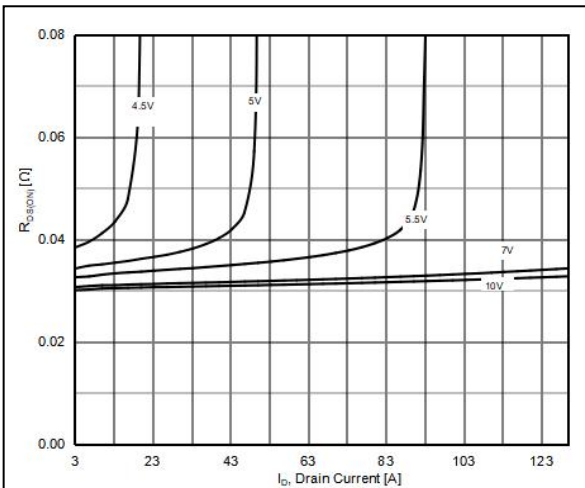
**Figure3. Output characteristics (25°C)**



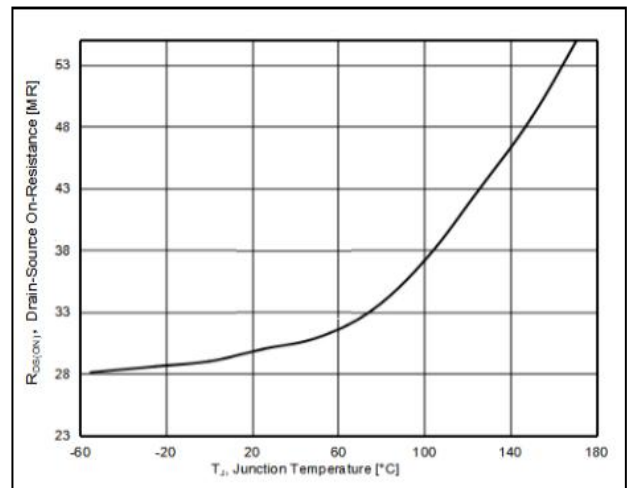
**Figure4. Transfer characteristics**



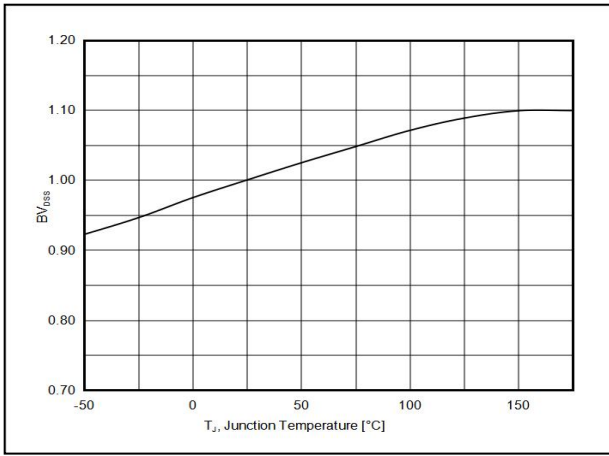
**Figure5. Static drain-source on resistance**



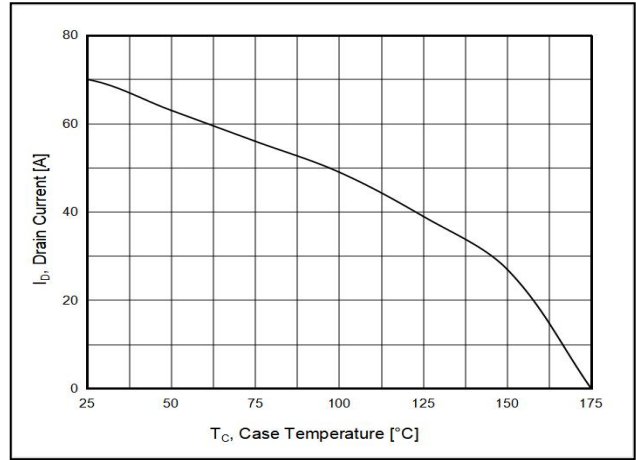
**Figure6.  $R_{DS(ON)}$  vs Junction Temperature**



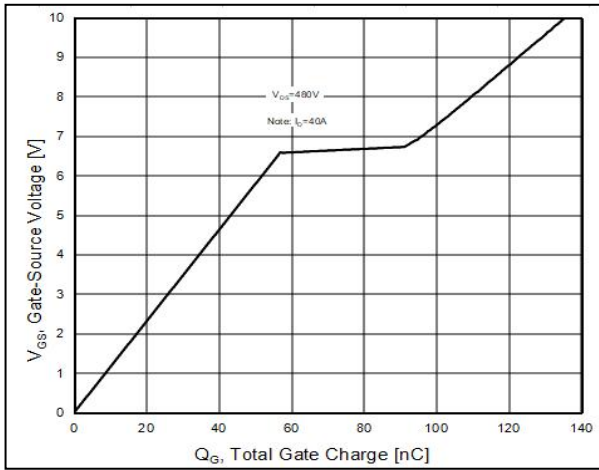
**Figure7.  $BV_{DSS}$  vs Junction Temperature**



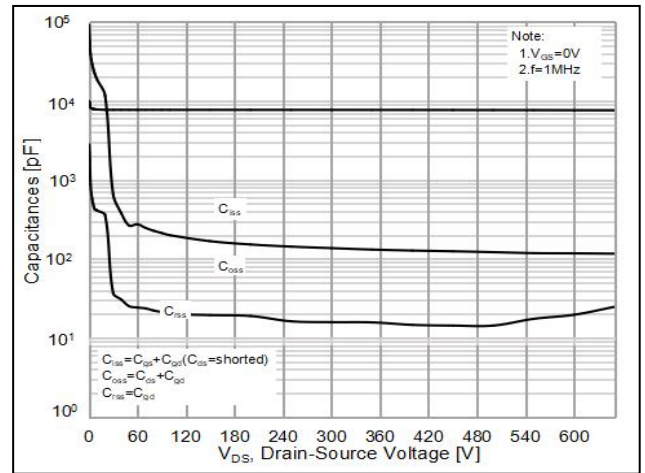
**Figure8. Maximum  $I_D$  vs Junction Temperature**



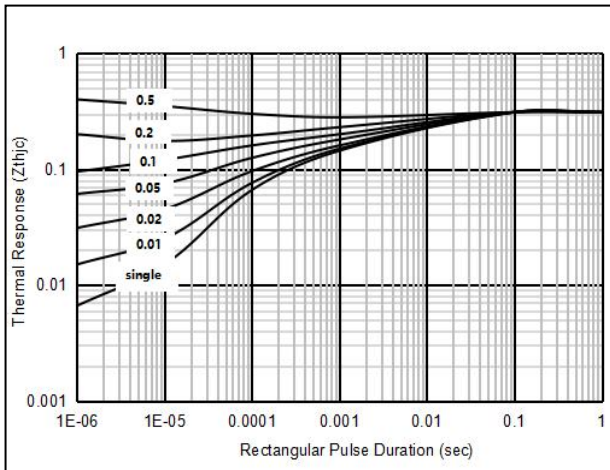
**Figure9. Gate charge waveforms**



**Figure10. Capacitance**



**Figure11. Transient Thermal Impedance**



## Test circuit

### 1) Gate charge test circuit & Waveform



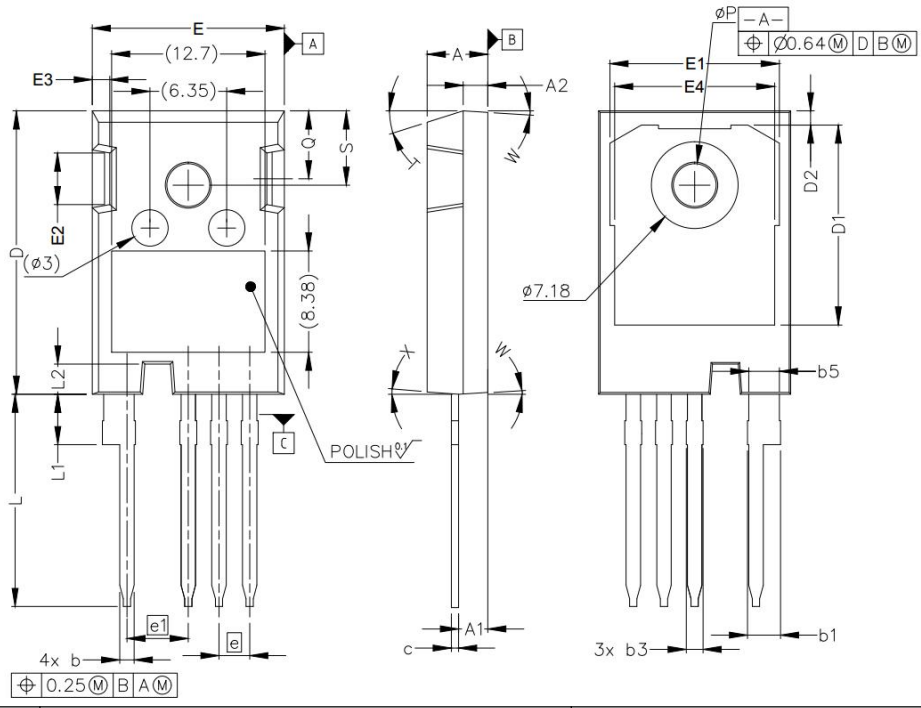
### 2) Switch Time Test Circuit:



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



# TO-247-4L Package Information



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	4.83	5.21	0.19	0.21
A1	2.29	2.54	0.09	0.10
A2	1.91	2.16	0.08	0.09
b	1.07	1.33	0.04	0.05
b1	2.39	2.94	0.09	0.12
b3	1.07	1.60	0.04	0.06
b5	2.39	2.69	0.09	0.11
c	0.55	0.68	0.02	0.03
D	23.30	23.60	0.92	0.93
D1	16.25	17.65	0.64	0.69
D2	0.95	1.25	0.04	0.05
E	15.75	16.13	0.62	0.64
E1	13.10	14.15	0.52	0.56
E2	3.68	5.10	0.14	0.20
E3	1.00	1.90	0.04	0.07
E4	12.38	13.43	0.49	0.53
e	2.54 BSC		0.1 BSC	
e1	5.08 BSC		0.2 BSC	
L	17.31	17.82	0.68	0.70
L1	3.97	4.37	0.16	0.17
L2	2.35	2.65	0.09	0.10
$\phi P$	3.51	3.65	0.14	0.14
Q	5.49	6.00	0.22	0.24
S	6.04	6.30	0.24	0.25
T	17.5° REF.			
W	3.5° REF.			
X	4.0° REF.			

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