

## 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.

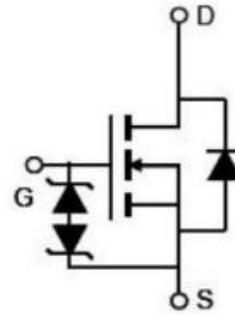
### Features

- 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
$R_{DS(ON)TYP.}$	230	m $\Omega$
$I_D$	14	A
$Q_g$	19	nC

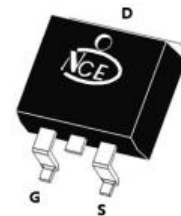


Schematic diagram

✧ Intrinsic fast-recovery body diode

### Package Marking And Ordering Information

Device	Device Package	Marking
NCE60NF260D	TO-263-2L	NCE60NF260D



TO-263

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 ( $f>1\text{ Hz}$ )	$V_{GS}$	$\pm 30$	V
Gate-Source Voltage ( $V_{DS}=0V$ ), DC	$V_{GS}$	$\pm 20$	V
Continuous Drain Current at $T_c=25^\circ\text{C}$	$I_{D(DC)}$	14	A
Continuous Drain Current at $T_c=100^\circ\text{C}$	$I_{D(DC)}$	9.8	A
Pulsed drain current (Note 1)	$I_{DM(pluse)}$	42	A
Maximum Power Dissipation( $T_c=25^\circ\text{C}$ )	$P_D$	128	W
Derate above $25^\circ\text{C}$		0.85	W/ $^\circ\text{C}$
Single pulse avalanche current (Note 2)	$I_{AS}$	2.5	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)	$R_{thJC}$	1.17	$^{\circ}\text{C}/\text{W}$
Thermal Resistance, Junction-to-Ambient (Maximum)	$R_{thJA}$	62	$^{\circ}\text{C}/\text{W}$

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

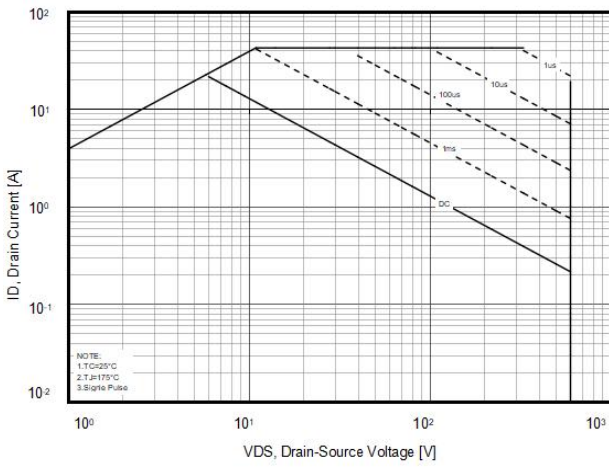
Parameter	Symbol	Condition	Min	Typ	Max	Unit
<b>On/off states</b>						
Drain-Source Breakdown Voltage	$BV_{DSS}$	$V_{GS}=0V, I_D=250\mu A$	600			V
Zero Gate Voltage Drain Current(Tc=25°C)	$I_{DSS}$	$V_{DS}=600V, V_{GS}=0V$			10	$\mu A$
Zero Gate Voltage Drain Current(Tc=125°C)	$I_{DSS}$	$V_{DS}=600V, V_{GS}=0V$			300	$\mu A$
Gate-Body Leakage Current	$I_{GSS}$	$V_{GS}=\pm 20V, V_{DS}=0V$			$\pm 200$	nA
Gate Threshold Voltage	$V_{GS(th)}$	$V_{DS}=V_{GS}, I_D=250\mu A$	3.5	4.2	5	V
Drain-Source On-State Resistance	$R_{DS(ON)}$	$V_{GS}=10V, I_D=7A$		230	260	m $\Omega$
<b>Dynamic Characteristics</b>						
Gate Resistance	$R_g$	F=1MHZ, D-S short		17.3		$\Omega$
Input Capacitance	$C_{iss}$	$V_{DS}=50V, V_{GS}=0V,$ F=1MHZ		946		pF
Output Capacitance	$C_{oss}$			50		pF
Reverse Transfer Capacitance	$C_{riss}$			1.6		pF
Total Gate Charge	$Q_g$	$V_{DS}=400V, I_D=7A,$ $V_{GS}=10V$		19	22	nC
Gate-Source Charge	$Q_{gs}$			9.8		nC
Gate-Drain Charge	$Q_{gd}$			3.1		nC
Gate plateau voltage	$V_{gp}$			6.8		V
<b>Switching times</b>						
Turn-on Delay Time	$t_{d(on)}$	$V_{DD}=380V, I_D=7A,$ $R_G=4\Omega, V_{GS}=10V$		18		nS
Turn-on Rise Time	$t_r$			13		nS
Turn-Off Delay Time	$t_{d(off)}$			52		nS
Turn-Off Fall Time	$t_f$			10		nS
<b>Source- Drain Diode Characteristics</b>						
Source-drain current(Body Diode)	$I_{SD}$	$T_c=25^{\circ}\text{C}$			14	A
Pulsed-Source-drain current(Body Diode)	$I_{SDM}$				42	A
Forward on voltage	$V_{SD}$	$T_j=25^{\circ}\text{C}, I_{SD}=14A, V_{GS}=0V$		1.0	1.2	V
Reverse Recovery Time	$t_{rr}$	$T_j=25^{\circ}\text{C}, I_F=7A,$ $di/dt=100A/\mu s$		85		nS
Reverse Recovery Charge	$Q_{rr}$			0.29		$\mu\text{C}$
Peak reverse recovery current	$I_{rrm}$			7		A

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

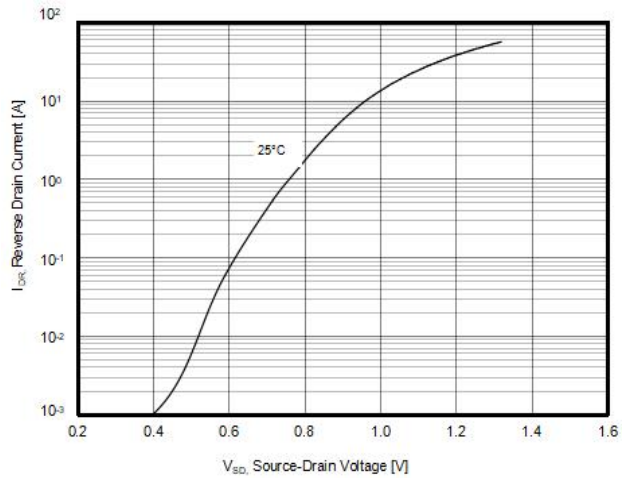
2.  $T_j=25^{\circ}\text{C}, V_{DD}=50V, V_G=10V, R_G=25\Omega$

## TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS (curves)

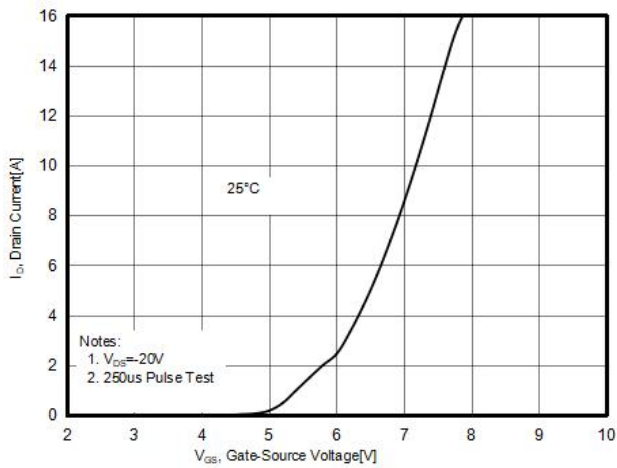
**Figure1. Safe operating area**



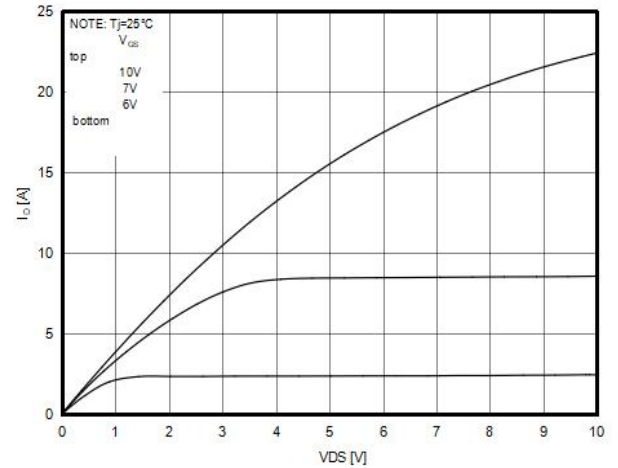
**Figure2. Source-Drain Diode Forward Voltage**



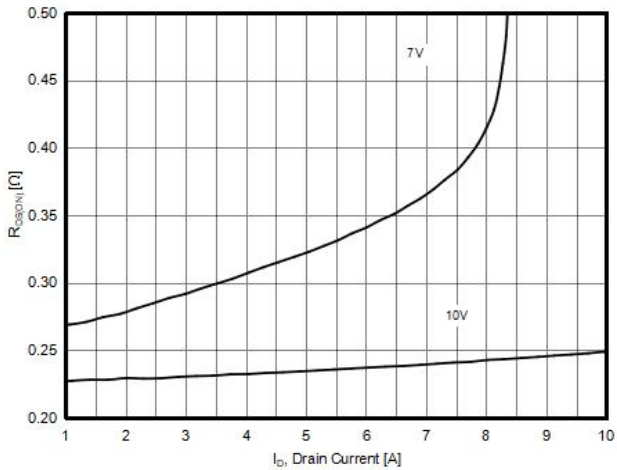
**Figure3. Transfer characteristics**



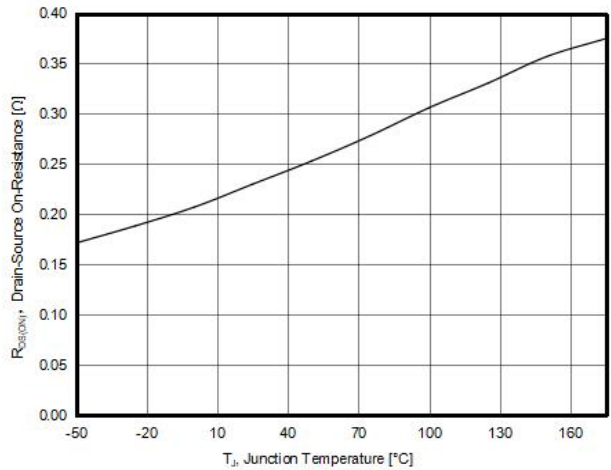
**Figure4. Output characteristics**



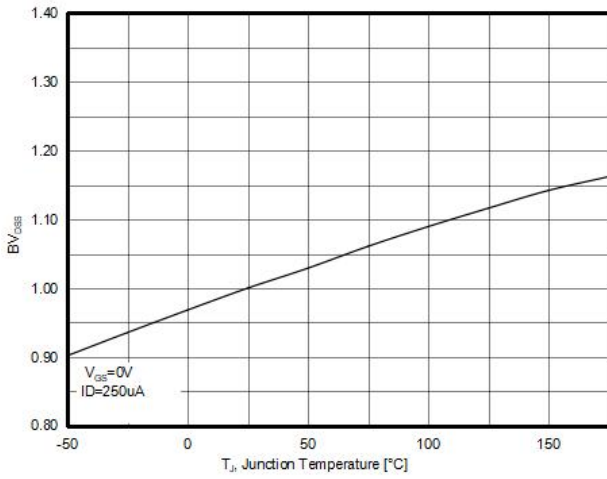
**Figure5. Static drain-source on resistance**



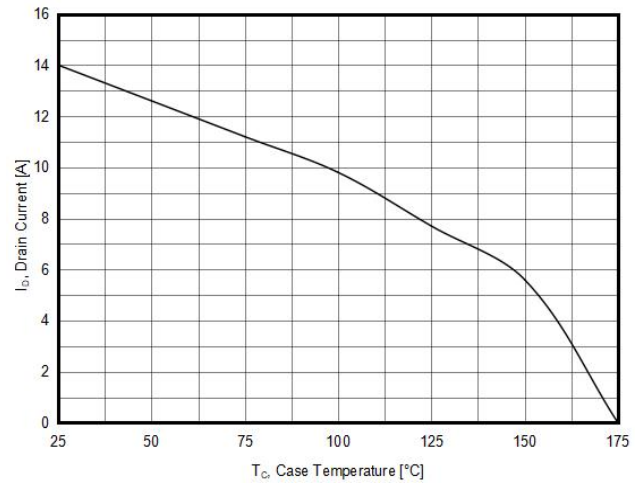
**Figure6.  $R_{DS(ON)}$  vs Junction Temperature**



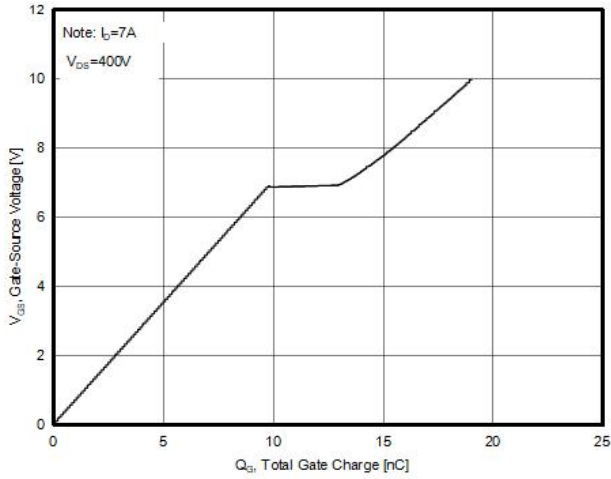
**Figure7.  $BV_{DSS}$  vs Junction Temperature**



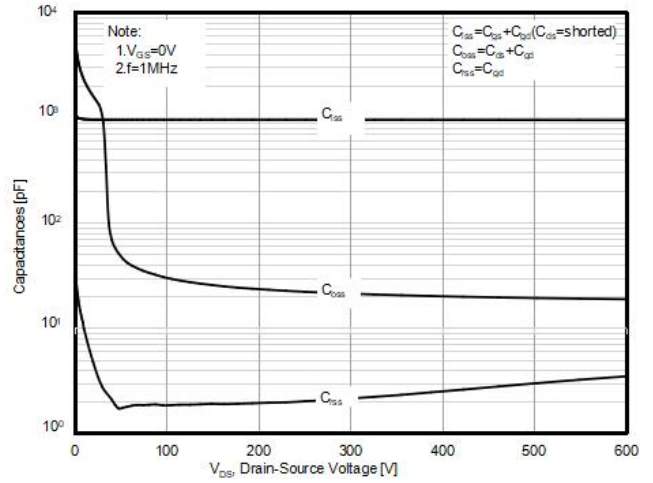
**Figure8. Maximum  $I_D$  vs Junction Temperature**



**Figure9. Gate charge waveforms**



**Figure10. Capacitance**



## Test circuit

### 1) Gate charge test circuit & Waveform



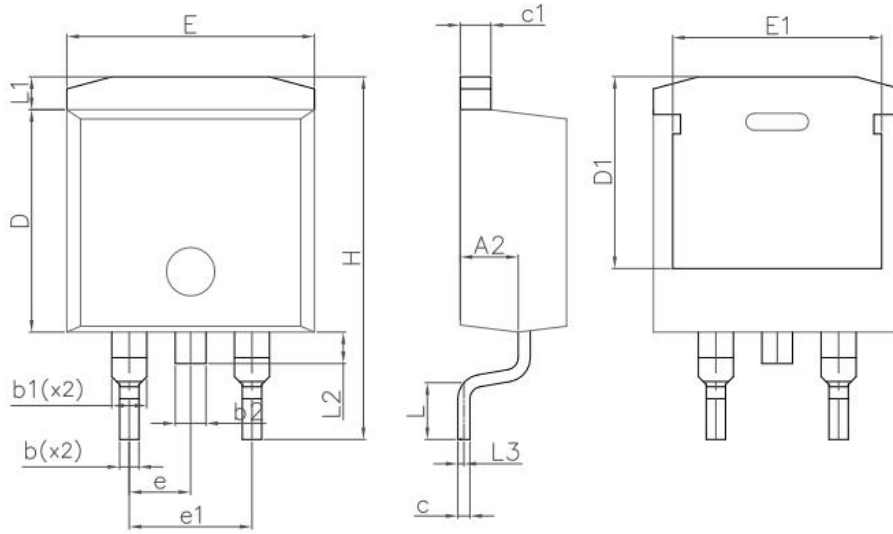
### 2) Switch Time Test Circuit:



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



## TO-263-E Package Information



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	4.20	4.60	0.165	0.181
A1	-	0.25	-	0.010
A2	2.20	2.60	0.087	0.102
b	0.70	0.90	0.028	0.035
b2	1.17	1.37	0.046	0.054
c	0.40	0.60	0.016	0.024
c1	1.15	1.40	0.045	0.055
D	9.10	9.30	0.358	0.366
D1	7.63	8.23	0.300	0.324
E	10.05	10.45	0.396	0.411
E1	8.35	8.95	0.329	0.352
e	2.54 BSC		0.100 BSC	
H	14.61	15.88	0.575	0.625
L	1.78	2.79	0.070	0.110
L1	1.36REF		0.053REF	
L2	1.3REF		0.051REF	
L3	0.25REF		0.009REF	

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