

## 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.

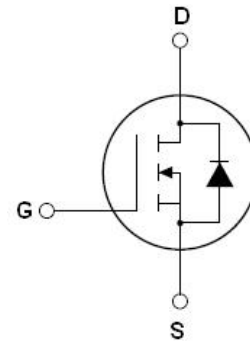
### Features

- 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
$R_{DS(ON)TYP}$	50	mΩ
ID	51	A
Qg	58	nC



Schematic diagram

✧ Intrinsic fast-recovery body diode

### Package Marking And Ordering Information

Device	Device Package	Marking
NCE60NF055	TO-220	NCE60NF055



GDS

TO-220

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 $T_c=25^\circ\text{C}$	$I_{D(DC)}$	51	A
Continuous Drain Current at $T_c=100^\circ\text{C}$	$I_{D(DC)}$	35.7	A
Pulsed drain current (Note 1)	$I_{DM(pluse)}$	153	A
Maximum Power Dissipation( $T_c=25^\circ\text{C}$ )	$P_D$	378	W
Derate above $25^\circ\text{C}$		2.52	W/ $^\circ\text{C}$
Single pulse avalanche energy (Note 2)	$E_{AS}$	576	mJ
Avalanche current (Note 1)	$I_{AR}$	12	A
Repetitive Avalanche energy, $t_{AR}$ limited by $T_{jmax}$ (Note 1)	$E_{AR}$	0.9	mJ
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)	$R_{thJC}$	0.39	$^{\circ}C/W$
Thermal Resistance, Junction-to-Ambient (Maximum)	$R_{thJA}$	62	$^{\circ}C/W$

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

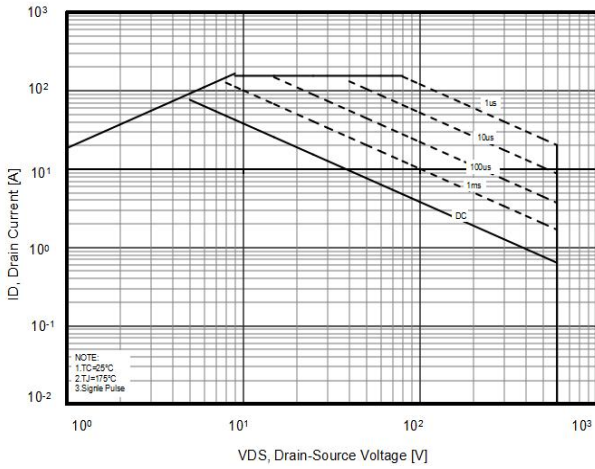
Parameter	Symbol	Condition	Min	Typ	Max	Unit
<b>On/off states</b>						
Drain-Source Breakdown Voltage	$BV_{DSS}$	$V_{GS}=0V, I_D=1mA$	600			V
Zero Gate Voltage Drain Current(Tc=25°C)	$I_{DSS}$	$V_{DS}=600V, V_{GS}=0V$			10	$\mu A$
Zero Gate Voltage Drain Current(Tc=125°C)	$I_{DSS}$	$V_{DS}=600V, V_{GS}=0V$			300	$\mu A$
Gate-Body Leakage Current	$I_{GSS}$	$V_{GS}=\pm 20V, V_{DS}=0V$			$\pm 100$	nA
Gate Threshold Voltage	$V_{GS(th)}$	$V_{DS}=V_{GS}, I_D=500\mu A$	3	4	5	V
Drain-Source On-State Resistance	$R_{DS(ON)}$	$V_{GS}=10V, I_D=25A$		50	55	m $\Omega$
<b>Dynamic Characteristics</b>						
Input Capacitance	$C_{iss}$	$V_{DS}=50V, V_{GS}=0V,$ $F=1.0MHz$		3836		pF
Output Capacitance	$C_{oss}$			155		pF
Reverse Transfer Capacitance	$C_{rss}$			5.1		pF
Total Gate Charge	$Q_g$	$V_{DS}=480V, I_D=25A,$ $V_{GS}=10V$		58		nC
Gate-Source Charge	$Q_{gs}$			22		nC
Gate-Drain Charge	$Q_{gd}$			15		nC
Gate plateau voltage	$V_{gp}$			6.6		V
Intrinsic gate resistance	$R_G$	$f = 1 MHz$ open drain		2		$\Omega$
<b>Switching times</b>						
Turn-on Delay Time	$t_{d(on)}$	$V_{DD}=380V, I_D=25A,$ $R_G=1.7\Omega, V_{GS}=10V$		32		nS
Turn-on Rise Time	$t_r$			14		nS
Turn-Off Delay Time	$t_{d(off)}$			90		nS
Turn-Off Fall Time	$t_f$			9		nS
<b>Source- Drain Diode Characteristics</b>						
Source-drain current(Body Diode)	$I_{SD}$	$T_C=25^{\circ}C$			51	A
Pulsed Source-drain current(Body Diode)	$I_{SDM}$				153	A
Forward On Voltage	$V_{SD}$	$T_J=25^{\circ}C, I_{SD}=51A, V_{GS}=0V$		1.0	1.2	V
Reverse Recovery Time	$t_{rr}$	$T_J=25^{\circ}C, I_F=25A,$ $di/dt=100A/\mu s$		140		nS
Reverse Recovery Charge	$Q_{rr}$			0.63		$\mu C$
Peak Reverse Recovery Current	$I_{rrm}$			9		A

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

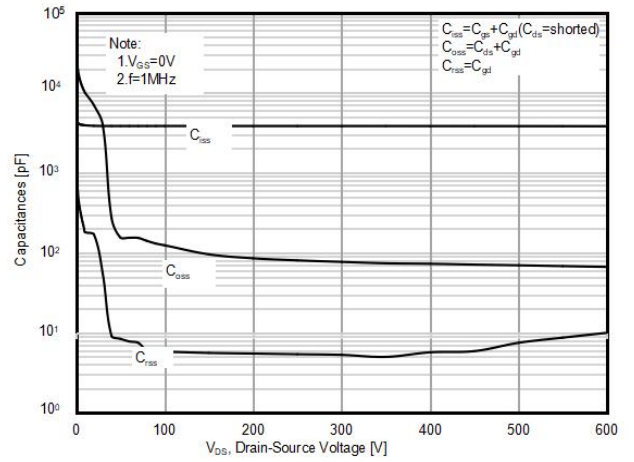
2.  $T_J=25^{\circ}C, V_{DD}=50V, V_G=10V, R_G=25\Omega$

## TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS (curves)

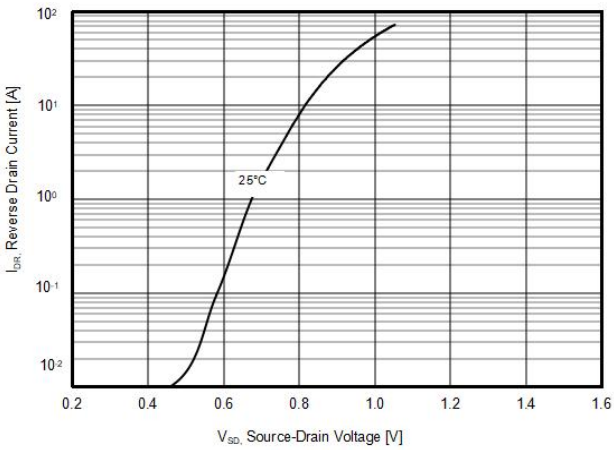
**Figure1. Safe operating area**



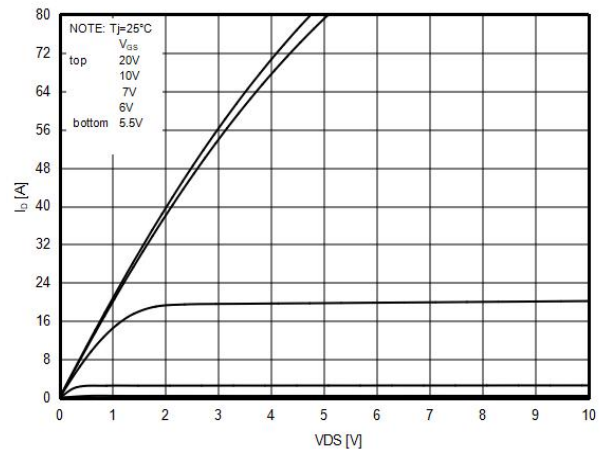
**Figure2. Capacitance**



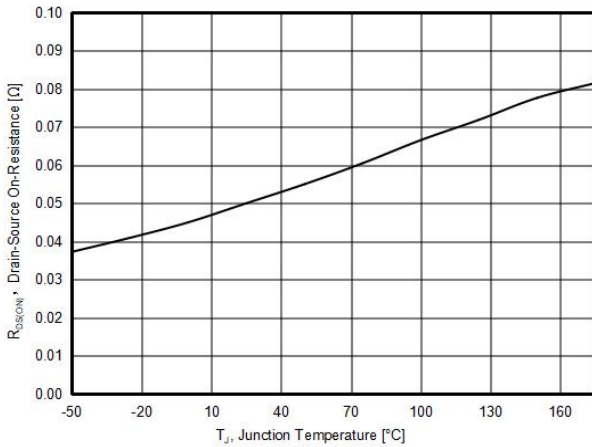
**Figure3. Source-Drain Diode Forward Voltage**



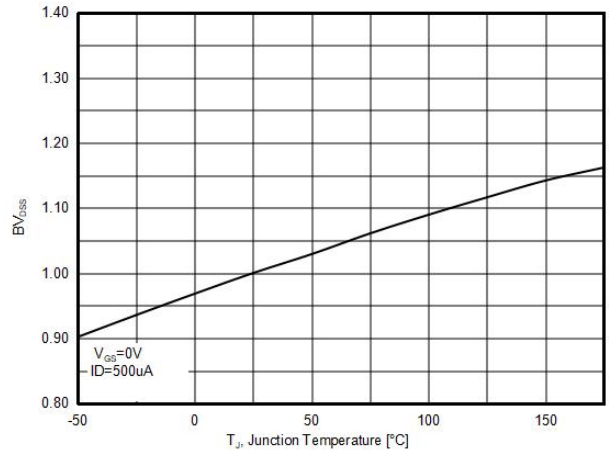
**Figure4. Output characteristics**



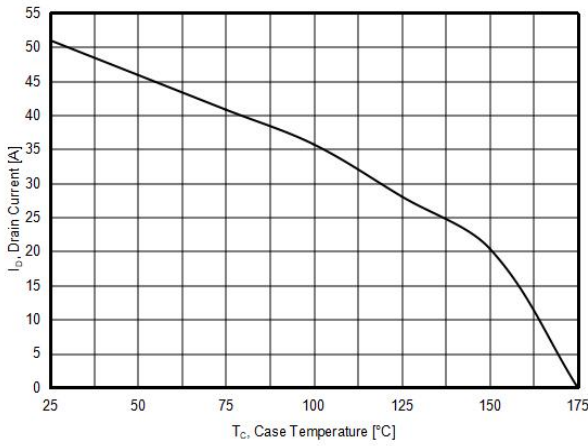
**Figure5.  $R_{DS(ON)}$  vs Junction Temperature**



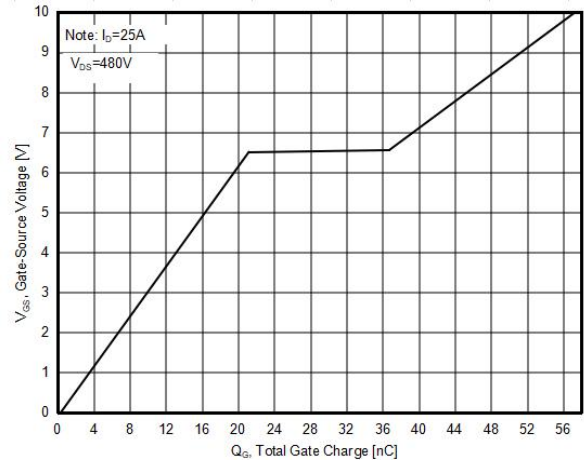
**Figure6.  $BV_{DSS}$  vs Junction Temperature**



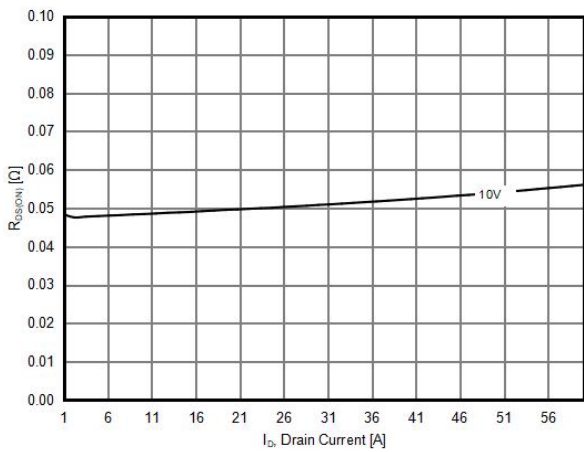
**Figure7. Maximum  $I_D$  vs Junction Temperature**



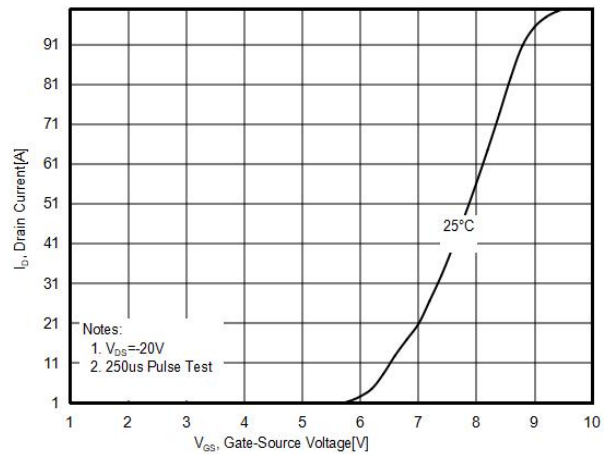
**Figure8. Gate charge waveforms**



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



**Figure10. Transfer characteristics**

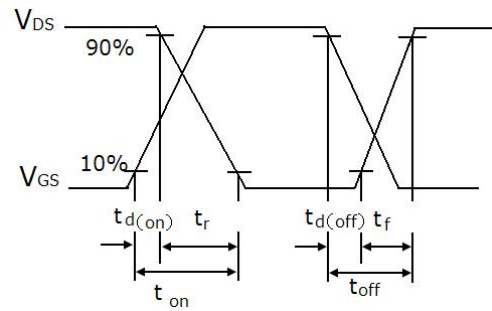


## Test circuit

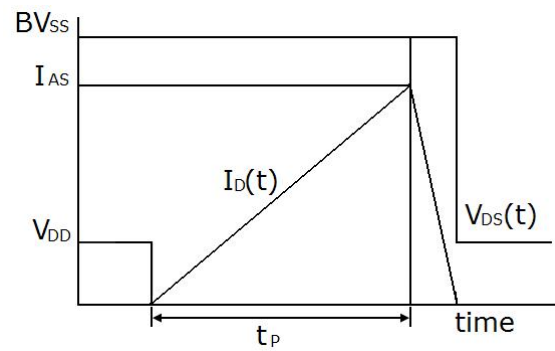
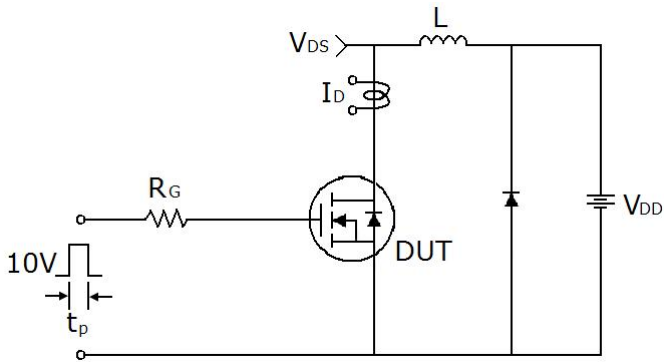
### 1) Gate charge test circuit & Waveform



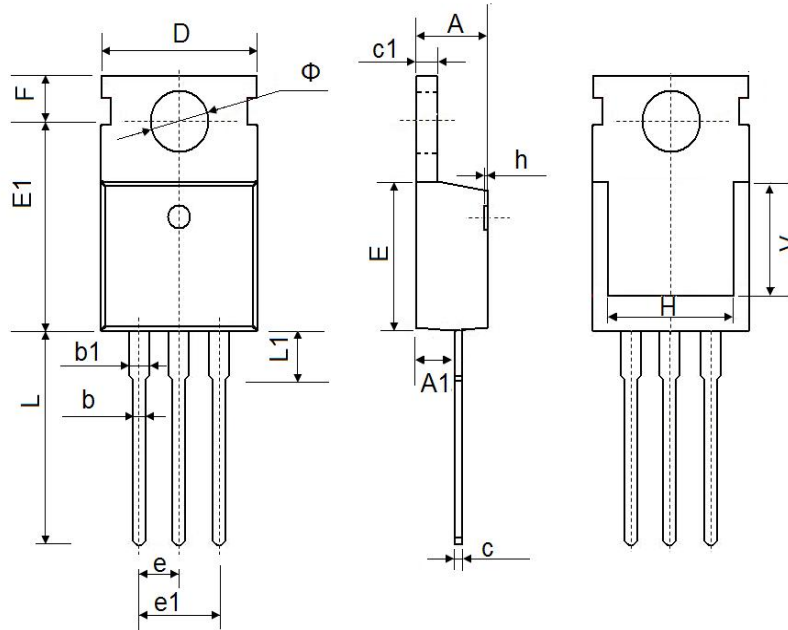
### 2) Switch Time Test Circuit:



### 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	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

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