

## 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.

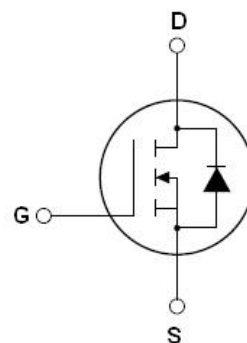
### Features

- 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
$I_D$	51	A
$Q_g$	58	nC



Schematic diagram

✧ Intrinsic fast-recovery body diode

### Package Marking And Ordering Information

Device	Device Package	Marking
NCE60NF055	TO-220	NCE60NF055



G D S

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	°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	600			V
Zero Gate Voltage Drain Current(Tc=25℃)	I <sub>DSS</sub>	V <sub>DS</sub> =600V, V <sub>GS</sub> =0V			10	μA
Zero Gate Voltage Drain Current(Tc=125℃)	I <sub>DSS</sub>	V <sub>DS</sub> =600V, V <sub>GS</sub> =0V			300	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> =500μA	3	4	5	V
Drain-Source On-State Resistance	R <sub>DS(ON)</sub>	V <sub>GS</sub> =10V, I <sub>D</sub> =25A		50	55	mΩ
Dynamic Characteristics						
Input Capacitance	C <sub>iss</sub>	V <sub>DS</sub> =50V, V <sub>GS</sub> =0V, F=1.0MHz		3836		pF
Output Capacitance	C <sub>oss</sub>			155		pF
Reverse Transfer Capacitance	C <sub>rss</sub>			5.1		pF
Total Gate Charge	Q <sub>g</sub>	V <sub>DS</sub> =480V, I <sub>D</sub> =25A, V <sub>GS</sub> =10V		58		nC
Gate-Source Charge	Q <sub>gs</sub>			22		nC
Gate-Drain Charge	Q <sub>gd</sub>			15		nC
Gate plateau voltage	V <sub>gp</sub>			6.6		V
Intrinsic gate resistance	R <sub>G</sub>	f = 1 MHz open drain		2		Ω
Switching times						
Turn-on Delay Time	t <sub>d(on)</sub>	V <sub>DD</sub> =380V, I <sub>D</sub> =25A, R <sub>G</sub> =1.7Ω, V <sub>GS</sub> =10V		32		nS
Turn-on Rise Time	t <sub>r</sub>			14		nS
Turn-Off Delay Time	t <sub>d(off)</sub>			90		nS
Turn-Off Fall Time	t <sub>f</sub>			9		nS
Source- Drain Diode Characteristics						
Source-drain current(Body Diode)	I <sub>SD</sub>	T <sub>C</sub> =25℃			51	A
Pulsed Source-drain current(Body Diode)	I <sub>SDM</sub>				153	A
Forward On Voltage	V <sub>SD</sub>	T <sub>j</sub> =25℃, I <sub>SD</sub> =51A, 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> =25A, di/dt=100A/μs		140		nS
Reverse Recovery Charge	Q <sub>rr</sub>			0.63		uC
Peak Reverse Recovery Current	I <sub>rrm</sub>			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

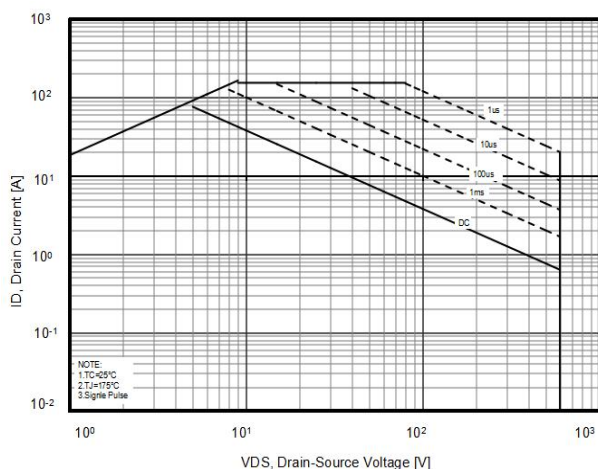


Figure2. Capacitance

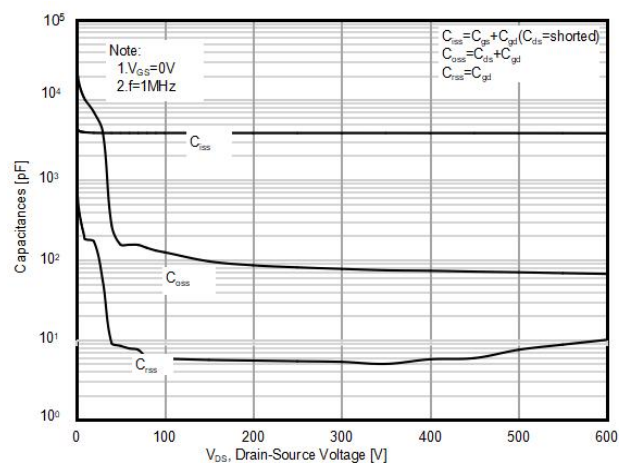


Figure3. Source-Drain Diode Forward Voltage

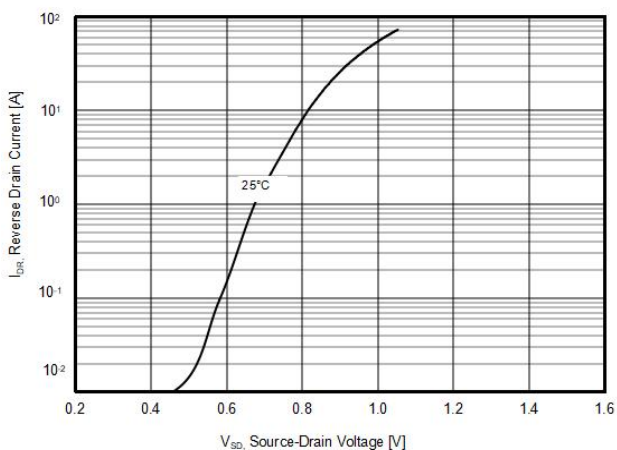


Figure4. Output characteristics

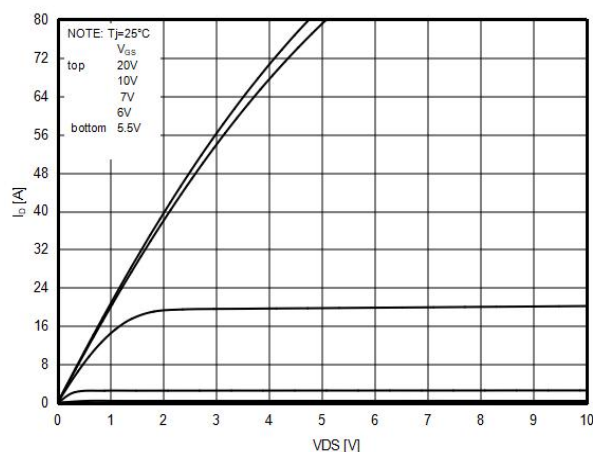


Figure5.  $R_{DS(ON)}$  vs Junction Temperature

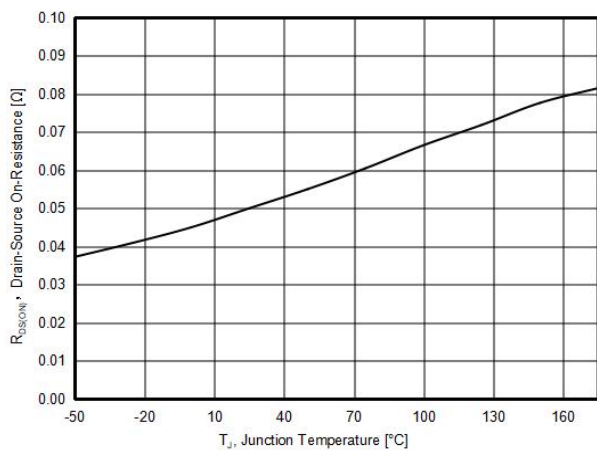
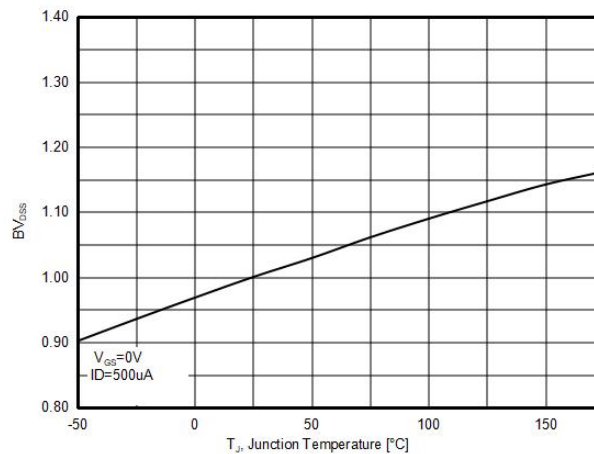
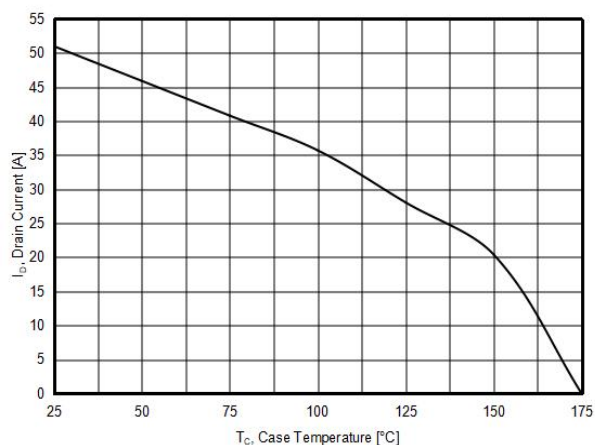


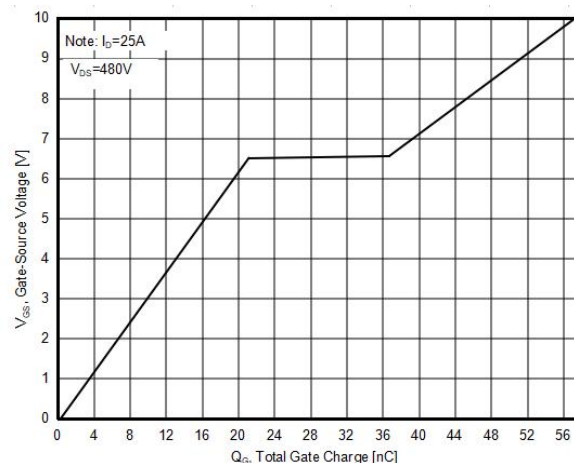
Figure6.  $BV_{DSS}$  vs Junction Temperature



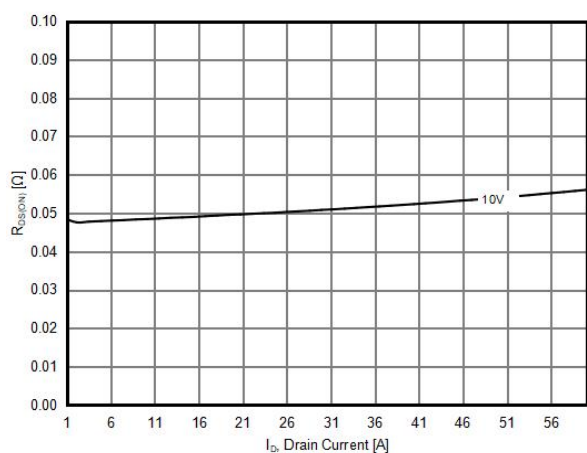
**Figure7. Maximum  $I_D$  vs Junction Temperature**



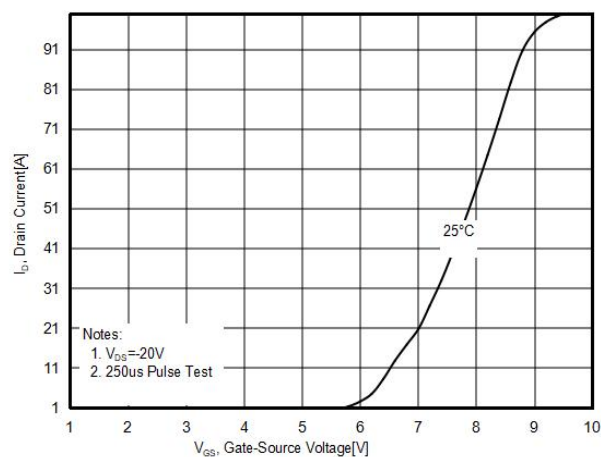
**Figure8. Gate charge waveforms**



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



**Figure10. Transfer characteristics**

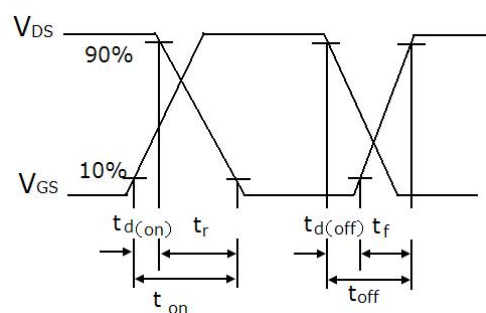
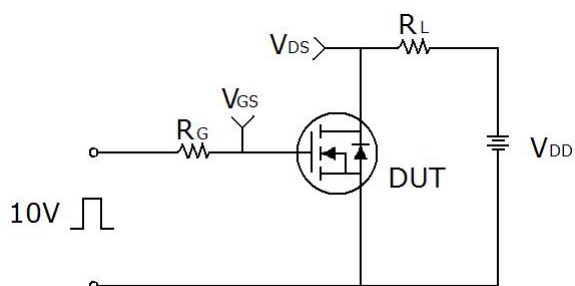


## Test circuit

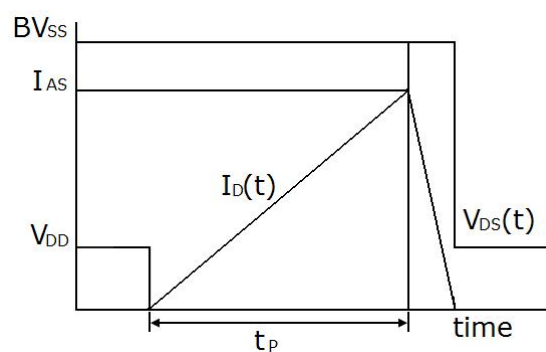
### 1) Gate charge test circuit & Waveform



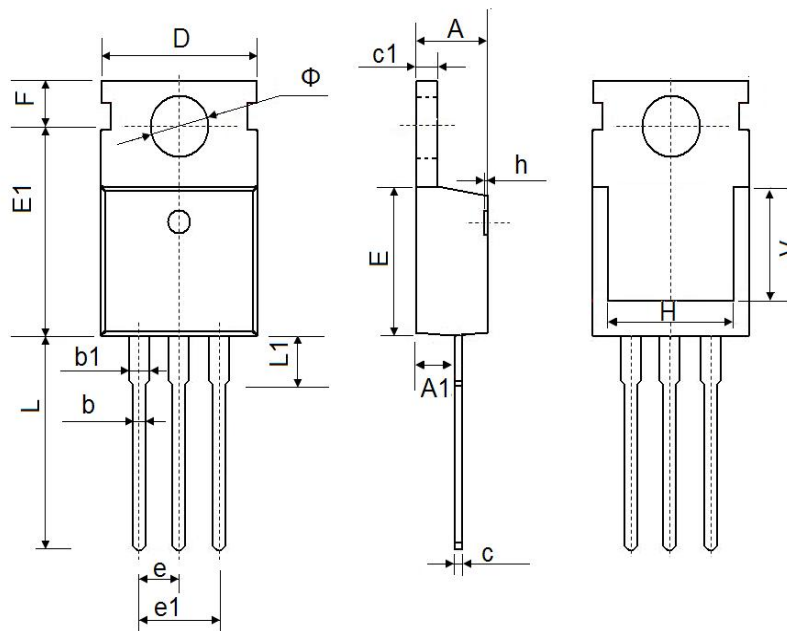
### 2) Switch Time Test Circuit:



### 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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