

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.

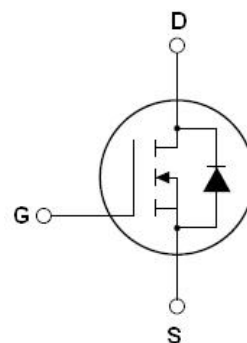
Features

- 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
$R_{DS(ON)TYP}$	620	mΩ
I_D	6.4	A
Q_g	9.6	nC



Schematic diagram

Package Marking And Ordering Information

Device	Device Package	Marking
NCE60N670F	TO-220F	NCE60N670F



TO-220F

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}	± 30	V
Gate-Source Voltage ($V_{DS}=0V$) DC	V_{GS}	± 20	V
Continuous Drain Current at $T_c=25^\circ\text{C}$	$I_D (DC)$	6.4	A
Continuous Drain Current at $T_c=100^\circ\text{C}$	$I_D (DC)$	4.48	A
Pulsed drain current (Note 1)	$I_{DM} (pulse)$	19.2	A
Maximum Power Dissipation ($T_c=25^\circ\text{C}$)	P_D	31.4	W
Derate above 25°C		0.21	W/ $^\circ\text{C}$
Avalanche current (Note 1)	I_{AR}	1.5	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}	$-55 \dots +175$	$^\circ\text{C}$

* limited by maximum junction temperature

Table 2. Thermal Characteristic

Parameter	Symbol	Value	Unit
Thermal Resistance, Junction-to-Case (Maximum)	R_{thJC}	4.78	$^{\circ}\text{C}/\text{W}$
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
On/off states						
Drain-Source Breakdown Voltage	BV _{DSS}	V _{GS} =0V I _D =250μA	600			V
Zero Gate Voltage Drain Current(Tc=25℃)	I _{DSS}	V _{DS} =600V,V _{GS} =0V			1	μA
Zero Gate Voltage Drain Current(Tc=125℃)	I _{DSS}	V _{DS} =600V,V _{GS} =0V			100	μA
Gate-Body Leakage Current	I _{GSS}	V _{GS} =±20V,V _{DS} =0V			±200	nA
Gate Threshold Voltage	V _{GS(th)}	V _{DS} =V _{GS} ,I _D =250μA	3	3.5	4	V
Drain-Source On-State Resistance	R _{DS(ON)}	V _{GS} =10V, I _D =3A		620	670	mΩ
Dynamic Characteristics						
Input Capacitance	C _{iss}	V _{DS} =50V,V _{GS} =0V, F=1.0MHz		250		pF
Output Capacitance	C _{oss}			21		pF
Reverse Transfer Capacitance	C _{rss}			4		pF
Total Gate Charge	Q _g	V _{DS} =450V,I _D =3.2A, V _{GS} =10V		9.6		nC
Gate-Source Charge	Q _{gs}			2.5		nC
Gate-Drain Charge	Q _{gd}			3.3		nC
Gate plateau voltage	V _{gp}			5.5		V
Intrinsic gate resistance	R _G	f = 1 MHz open drain		42		Ω
Switching times						
Turn-on Delay Time	t _{d(on)}	V _{DD} =380V,I _D =3A, R _G =1.7Ω,V _{GS} =10V		6		nS
Turn-on Rise Time	t _r			7		nS
Turn-Off Delay Time	t _{d(off)}			38		nS
Turn-Off Fall Time	t _f			6		nS
Source- Drain Diode Characteristics						
Source-drain current(Body Diode)	I _{SD}	T _C =25℃			6.4	A
Pulsed Source-drain current(Body Diode)	I _{SDM}				19.2	A
Forward On Voltage	V _{SD}	T _J =25℃,I _{SD} =6.4A,V _{GS} =0V		0.9	1.2	V
Reverse Recovery Time	t _{rr}	T _J =25℃,I _F =3A, di/dt=100A/μs		170		nS
Reverse Recovery Charge	Q _{rr}			0.93		uC
Peak Reverse Recovery Current	I _{rrm}			11		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

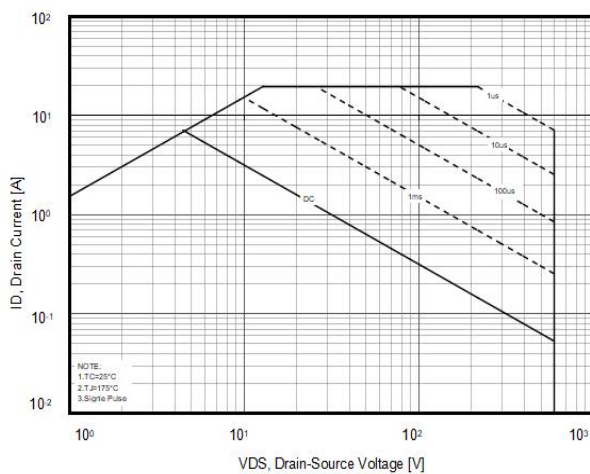


Figure2. Capacitance

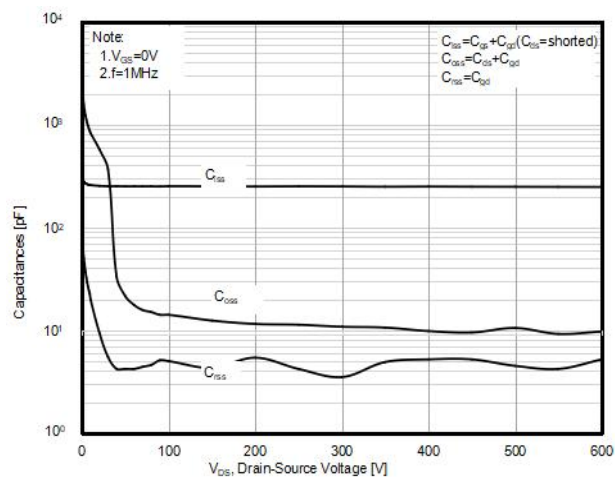


Figure3. Source-Drain Diode Forward Voltage

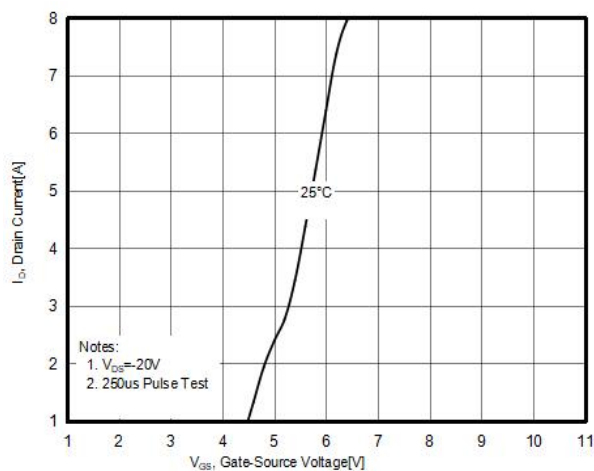


Figure4. Output characteristics

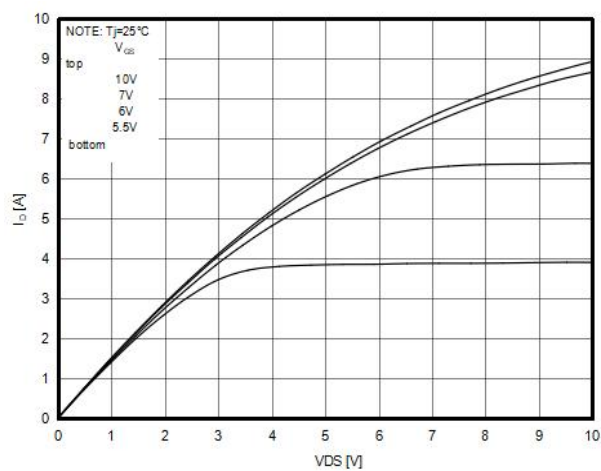


Figure5. $R_{DS(ON)}$ vs Junction Temperature

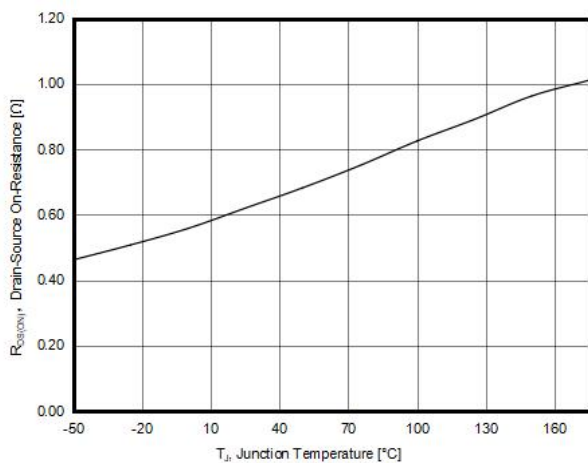


Figure6. BV_{DSS} vs Junction Temperature

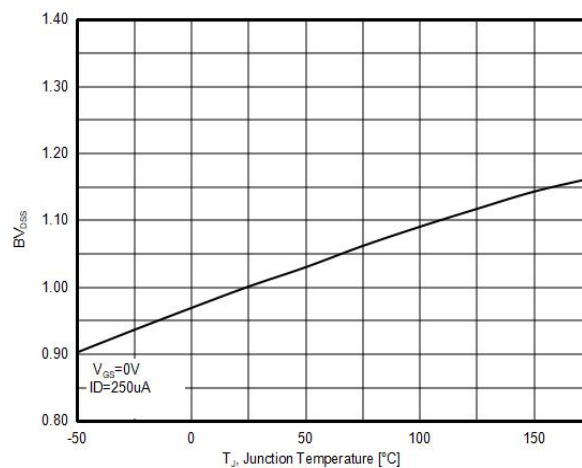


Figure7. Maximum I_D vs Junction Temperature

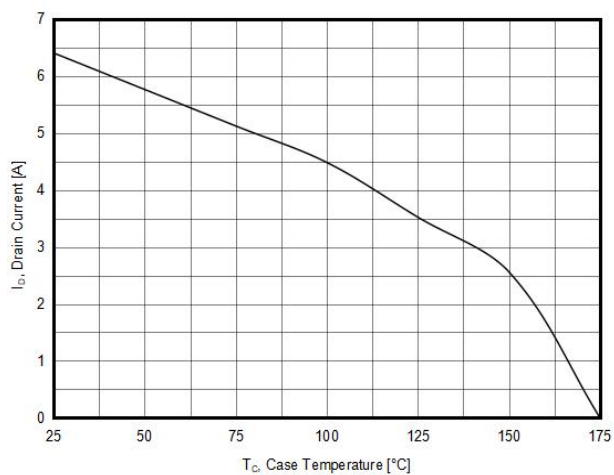


Figure8. Gate charge waveforms

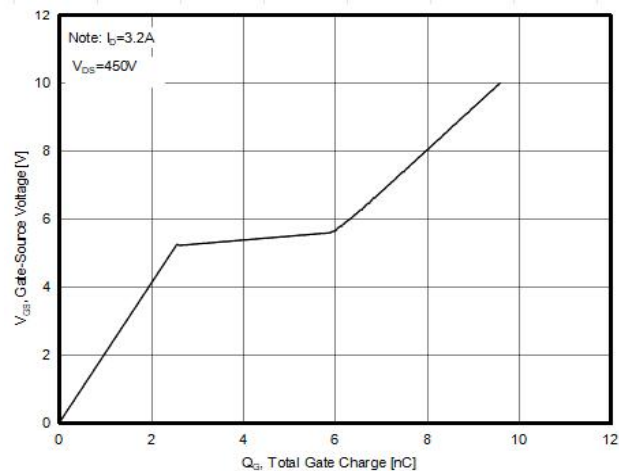


Figure9. Static drain-source on resistance

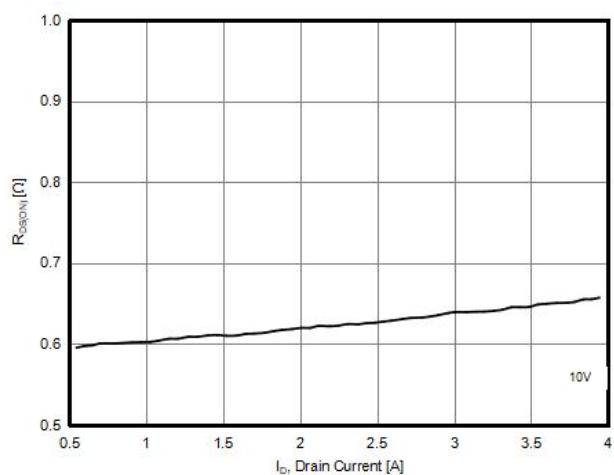
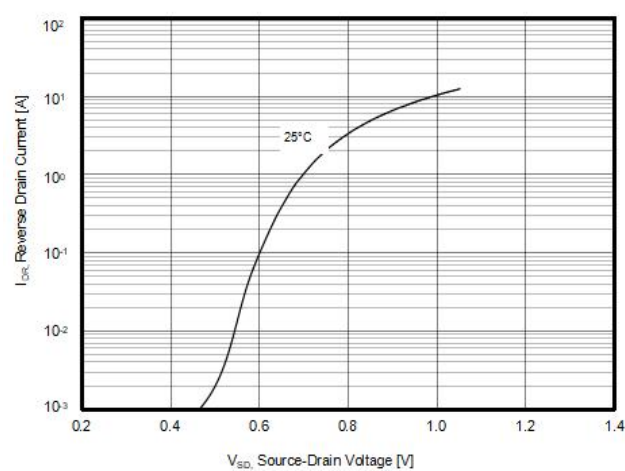
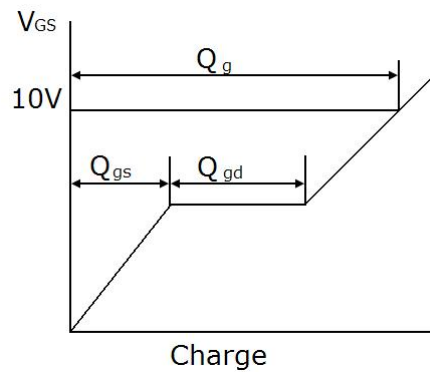
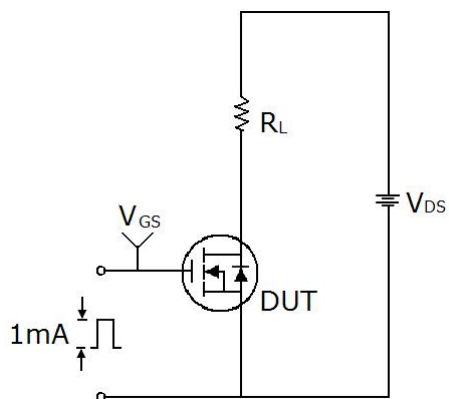


Figure10. Source-Drain Diode Forward Voltage

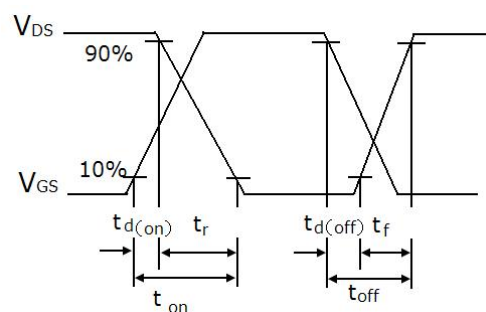
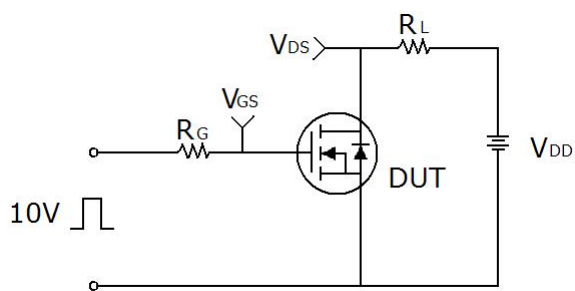


Test circuit

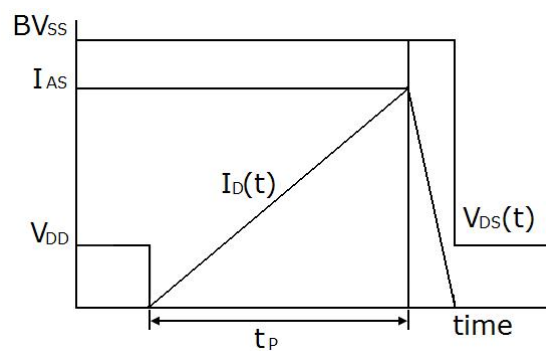
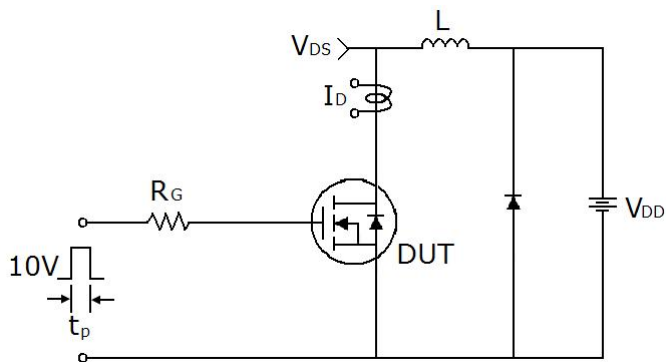
1) Gate charge test circuit & Waveform



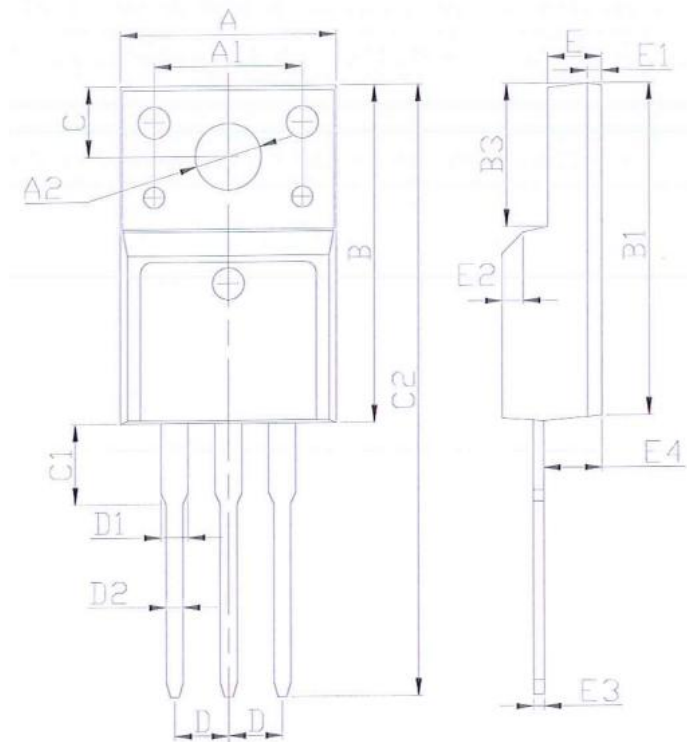
2) Switch Time Test Circuit:



3) Unclamped Inductive Switching Test Circuit & Waveforms



TO-220F-L Package Information



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	9.86	10.46	0.387	0.411
A1	6.80	7.20	0.267	0.283
A2	2.92	3.32	0.115	0.130
A3	9.40	10.00	0.369	0.393
B	15.40	16.40	0.605	0.644
B1	15.10	16.10	0.593	0.633
B2	4.40	5.00	0.173	0.196
B3	6.40	7.00	0.251	0.275
C	3.05	3.55	0.120	0.139
C1	2.95	3.55	0.116	0.139
C2	28.20	29.20	1.108	1.147
D	2.54 BSC		0.100 BSC	
D1	--	1.47	--	0.058
D2	0.60	1.00	0.024	0.039
E	2.30	2.80	0.090	0.110
E1	0.45	0.95	0.018	0.037
E2	45.0°		45.00°	
E3	0.30	0.70	0.012	0.028
E4	2.45	3.05	0.096	0.120

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