

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.

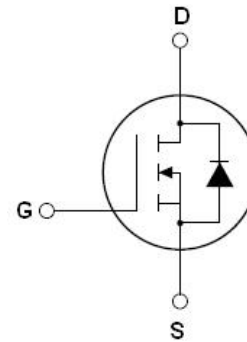
Features

- 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

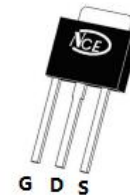
$V_{DS\ min@T_{jmax}}$	650	V
$R_{DS(ON)TYP}$	350	mΩ
ID	10	A
Qg	13	nC



Schematic diagram

Package Marking And Ordering Information

Device	Device Package	Marking
NCE60N390I	TO-251	NCE60N390I



TO-251

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 $T_c=25^\circ\text{C}$	$I_{D(DC)}$	10	A
Continuous Drain Current at $T_c=100^\circ\text{C}$	$I_{D(DC)}$	7	A
Pulsed drain current (Note 1)	$I_{DM(pluse)}$	30	A
Maximum Power Dissipation($T_c=25^\circ\text{C}$)	P_D	99	W
Derate above 25°C		0.66	W/ $^\circ\text{C}$
Avalanche current (Note 1)	I_{AS}	2	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	15	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}	1.51	$^{\circ}\text{C}/\text{W}$
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}	$V_{GS}=0V, I_D=250\mu A$	600			V
Zero Gate Voltage Drain Current(Tc=25°C)	I_{DSS}	$V_{DS}=600V, V_{GS}=0V$			1	μA
Zero Gate Voltage Drain Current(Tc=125°C)	I_{DSS}	$V_{DS}=600V, V_{GS}=0V$			100	μA
Gate-Body Leakage Current	I_{GSS}	$V_{GS}=\pm 20V, V_{DS}=0V$			± 200	nA
Gate Threshold Voltage	$V_{GS(th)}$	$V_{DS}=V_{GS}, I_D=250\mu A$	3	3.5	4	V
Drain-Source On-State Resistance	$R_{DS(on)}$	$V_{GS}=10V, I_D=5A$		350	390	m Ω
Dynamic Characteristics						
Input Capacitance	C_{iss}	$V_{DS}=50V, V_{GS}=0V,$ $F=1.0\text{MHz}$		440		pF
Output Capacitance	C_{oss}			32		pF
Reverse Transfer Capacitance	C_{rss}			6		pF
Total Gate Charge	Q_g	$V_{DS}=450V, I_D=5A,$ $V_{GS}=10V$		13		nC
Gate-Source Charge	Q_{gs}			4.5		nC
Gate-Drain Charge	Q_{gd}			3		nC
Gate plateau voltage	V_{gp}			5.5		V
Intrinsic gate resistance	R_G	$f = 1 \text{ MHz open drain}$		42		Ω
Switching times						
Turn-on Delay Time	$t_{d(on)}$	$V_{DD}=380V, I_D=5A,$ $R_G=1.7\Omega, V_{GS}=10V$		16		nS
Turn-on Rise Time	t_r			9		nS
Turn-Off Delay Time	$t_{d(off)}$			32		nS
Turn-Off Fall Time	t_f			16		nS
Source- Drain Diode Characteristics						
Source-drain current(Body Diode)	I_{SD}	$T_C=25^{\circ}\text{C}$			10	A
Pulsed Source-drain current(Body Diode)	I_{SDM}				30	A
Forward On Voltage	V_{SD}	$T_j=25^{\circ}\text{C}, I_{SD}=10A, V_{GS}=0V$		0.9	1.2	V
Reverse Recovery Time	t_{rr}	$T_j=25^{\circ}\text{C}, I_F=5A,$ $di/dt=100A/\mu s$		220		nS
Reverse Recovery Charge	Q_{rr}			1.9		μC
Peak Reverse Recovery Current	I_{rrm}			17		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

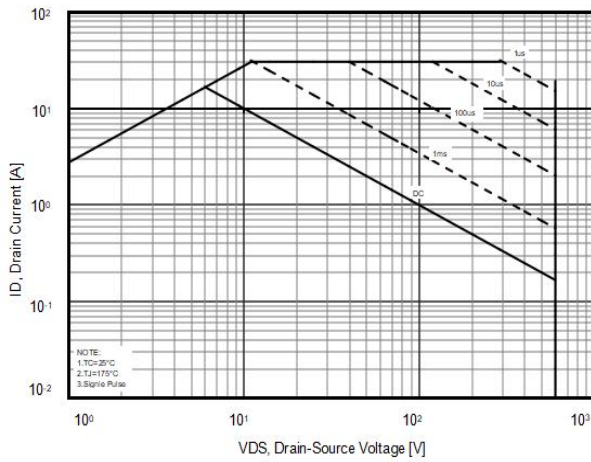


Figure2. Capacitance

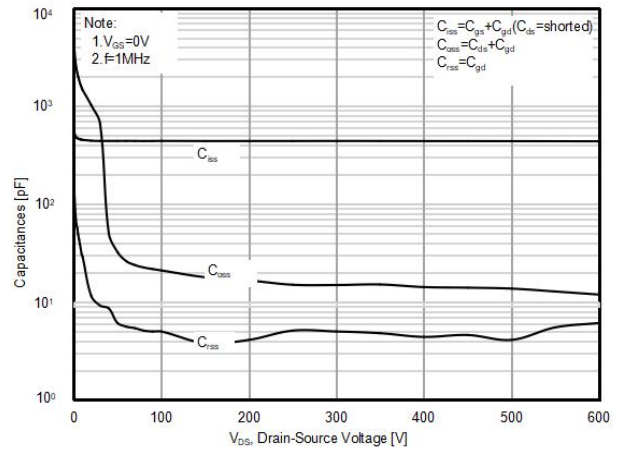


Figure3. Transfer characteristics

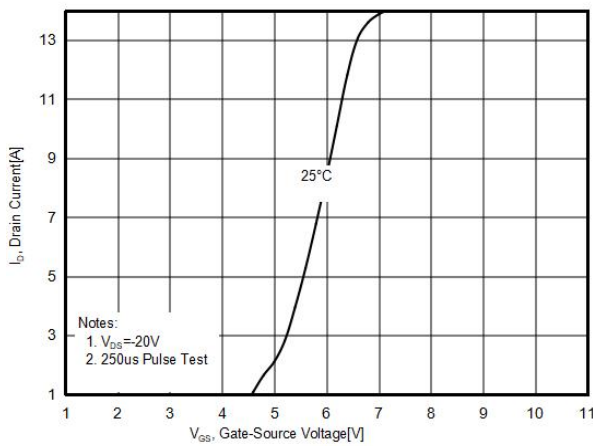


Figure4. Output characteristics

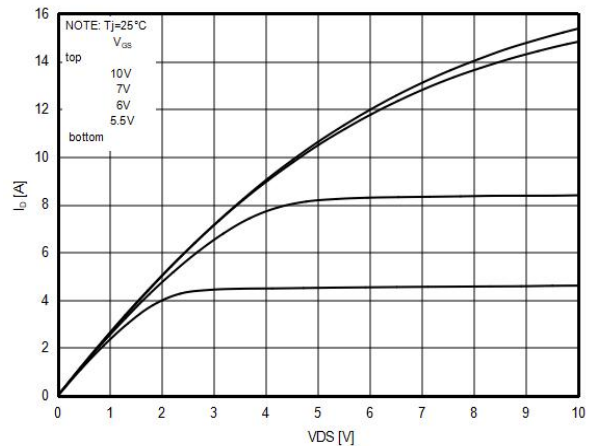


Figure5. $R_{DS(ON)}$ vs Junction Temperature

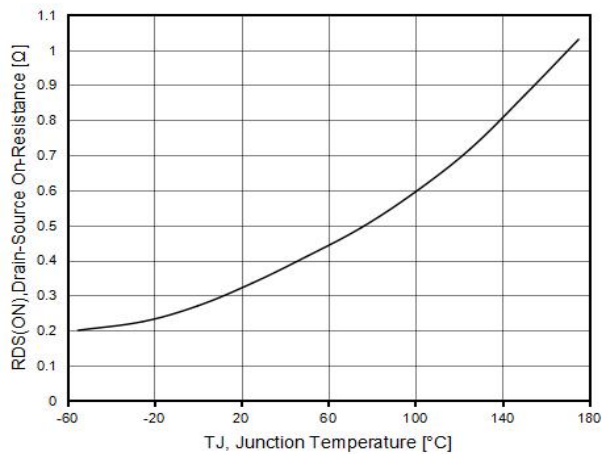


Figure6. BV_{DSS} vs Junction Temperature

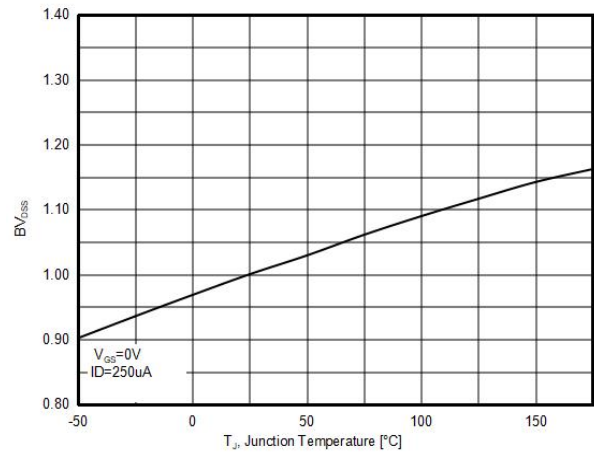


Figure7. Maximum I_D vs Junction Temperature

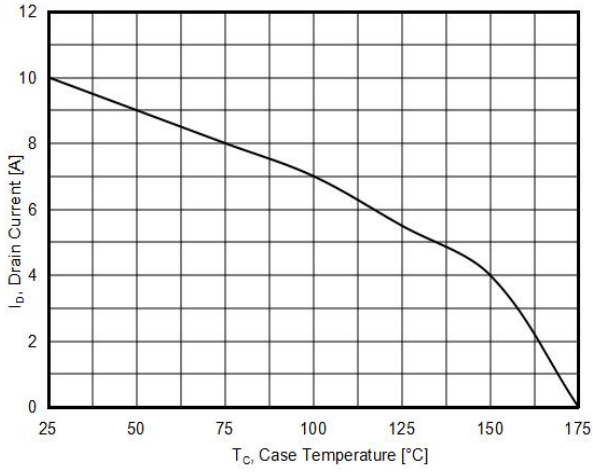


Figure8. Gate charge waveforms

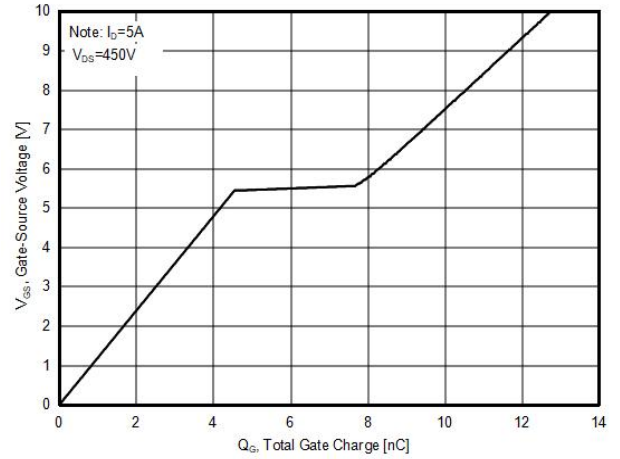


Figure9. Static drain-source on resistance

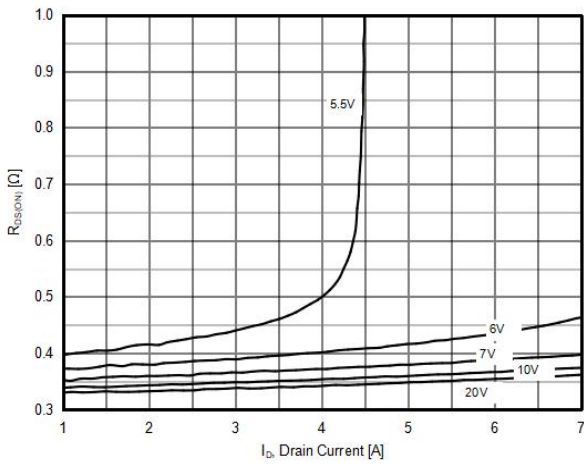
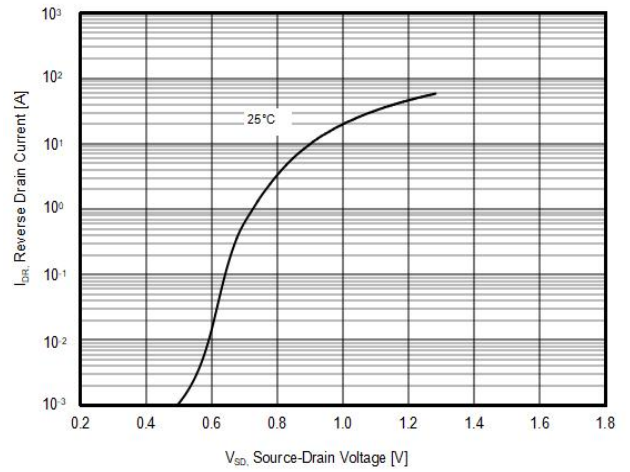


Figure10. Source-Drain Diode Forward Voltage

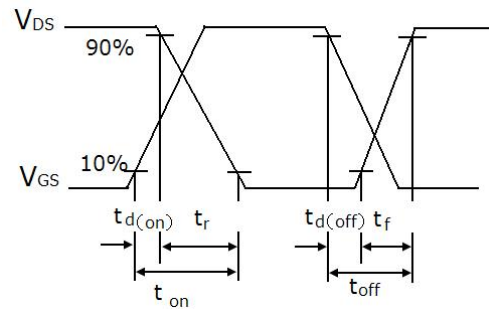


Test circuit

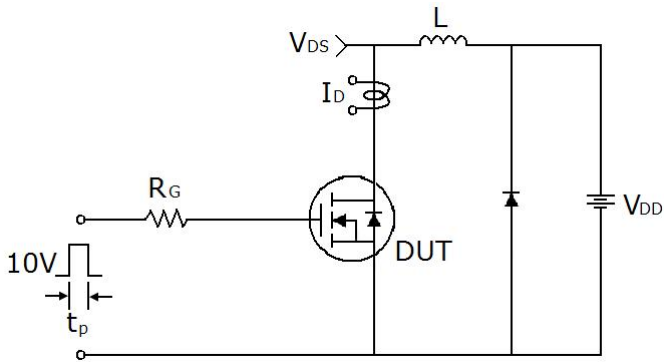
1) Gate charge test circuit & Waveform



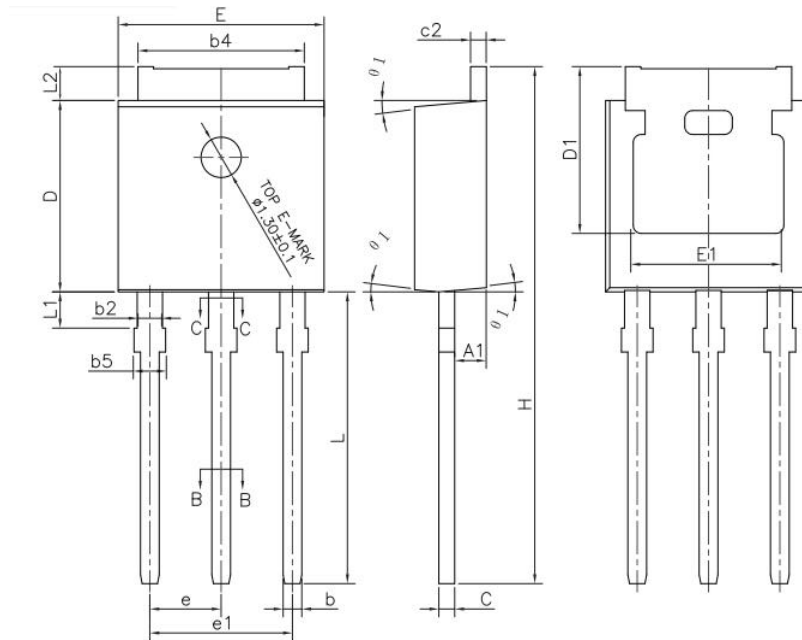
2) Switch Time Test Circuit:



3) Unclamped Inductive Switching Test Circuit & Waveforms

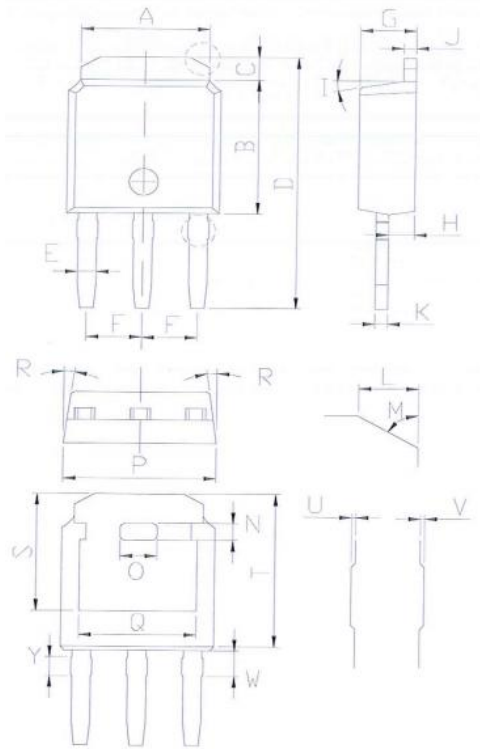


TO-251-3L-P Package Information



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	2.20	2.35	0.087	0.093
A1	0.90	1.10	0.035	0.043
b	0.56	0.69	0.022	0.027
b1	0.55	0.65	0.022	0.026
b2	0.77	0.90	0.030	0.035
b3	0.76	0.86	0.030	0.034
b4	5.23	5.43	0.206	0.214
b5		1.05		0.041
c	0.46	0.59	0.018	0.023
c1	0.45	0.55	0.018	0.022
c2	0.46	0.59	0.018	0.023
D	6.00	6.20	0.236	0.244
D1	5.20		0.205	
E	6.50	6.70	0.256	0.264
E1	4.60	5.00	0.181	0.197
e	2.24	2.34	0.088	0.092
e1	4.47	4.67	0.176	0.184
H	16.18	16.78	0.637	0.661
L	9.00	9.60	0.354	0.378
L1	0.95	1.35	0.037	0.053
L2	0.90	1.25	0.035	0.049

TO-251-3L-L Package Information



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	5.04	5.64	0.198	0.222
B	5.70	6.30	0.224	0.248
C	0.75	1.35	0.030	0.053
D	11.01	11.61	0.433	0.457
E	0.61	0.91	0.024	0.036
F	2.13	2.43	0.084	0.096
G	2.00	2.60	0.079	0.102
H	0.76	1.36	0.030	0.054
J	0.36	0.66	0.014	0.026
K	0.37	0.67	0.015	0.026
L	0.50	1.10	0.020	0.043
N	0.45	1.05	0.018	0.041
O	1.50	2.10	0.059	0.083
P	6.30	6.90	0.248	0.272
Q	4.55	5.15	0.179	0.203
S	5.00	5.60	0.197	0.220
T	6.60	7.20	0.260	0.283
W	0.90	1.40	0.035	0.055
Y	0.60	1.10	0.024	0.043

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