

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

| | | |
|------------------------|-----|----|
| $V_{DS\ min@T_{jmax}}$ | 710 | V |
| $R_{DS(ON)TYP}$ | 60 | mΩ |
| I_D | 45 | A |
| Q_g | 65 | nC |



Schematic diagram

✧ Intrinsic fast-recovery body diode

Package Marking And Ordering Information

| Device | Device Package | Marking |
|------------|----------------|------------|
| NCE65NF068 | TO-220-3L | NCE65NF068 |



Table 1. Absolute Maximum Ratings ($T_c=25^\circ\text{C}$)

TO-220

| Parameter | Symbol | Value | Unit |
|--|------------------|------------------|---------------------|
| Drain-Source Voltage ($V_{GS}=0V$) | V_{DS} | 650 | 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 $T_c=25^\circ\text{C}$ | $I_D (DC)$ | 45 | A |
| Continuous Drain Current at $T_c=100^\circ\text{C}$ | $I_D (DC)$ | 31.5 | A |
| Pulsed drain current (Note 1) | $I_{DM} (pluse)$ | 135 | A |
| Maximum Power Dissipation ($T_c=25^\circ\text{C}$) | P_D | 371 | W |
| Derate above 25°C | | 2.47 | W/ $^\circ\text{C}$ |
| Single pulse avalanche energy (Note 2) | E_{AS} | 400 | mJ |
| Avalanche current (Note 1) | I_{AS} | 10 | 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} | $-55 \dots +175$ | $^\circ\text{C}$ |

* limited by maximum junction temperature

Table 2. Thermal Characteristic

| Parameter | Symbol | Value | Unit |
|---|------------|-------|-------|
| Thermal Resistance, Junction-to-Case (Maximum) | R_{thJC} | 0.40 | °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 _{DSS} | V _{GS} =0V I _D =1mA | 650 | | | V |
| Zero Gate Voltage Drain Current(Tc=25℃) | I _{DSS} | V _{DS} =650V, V _{GS} =0V | | | 10 | μA |
| Zero Gate Voltage Drain Current(Tc=125℃) | I _{DSS} | V _{DS} =650V, V _{GS} =0V | | | 300 | μA |
| Gate-Body Leakage Current | I _{GSS} | V _{GS} =±20V, V _{DS} =0V | | | ±100 | nA |
| Gate Threshold Voltage | V _{GS(th)} | V _{DS} =V _{GS} , I _D =500μA | 3.5 | 4 | 5 | V |
| Drain-Source On-State Resistance | R _{DS(ON)} | V _{GS} =10V, I _D =23A | | 60 | 68 | mΩ |
| Dynamic Characteristics | | | | | | |
| Input Capacitance | C _{iss} | V _{DS} =50V, V _{GS} =0V, F=1.0MHz | | 3900 | 4400 | pF |
| Output Capacitance | C _{oss} | | | 132 | | pF |
| Reverse Transfer Capacitance | C _{rss} | | | 14 | | pF |
| Total Gate Charge | Q _g | V _{DS} =480V, I _D =23A, V _{GS} =10V | | 65 | 70 | nC |
| Gate-Source Charge | Q _{gs} | | | 21 | | nC |
| Gate-Drain Charge | Q _{gd} | | | 17 | | nC |
| Gate plateau voltage | V _{gp} | | | 6.5 | | V |
| Intrinsic gate resistance | R _G | f = 1 MHz open drain | | 3 | | Ω |
| Switching times | | | | | | |
| Turn-on Delay Time | t _{d(on)} | V _{DD} =380V, I _D =23A, R _G =1.7Ω, V _{GS} =10V | | 42 | | nS |
| Turn-on Rise Time | t _r | | | 14 | | nS |
| Turn-Off Delay Time | t _{d(off)} | | | 90 | | nS |
| Turn-Off Fall Time | t _f | | | 12 | | nS |
| Source- Drain Diode Characteristics | | | | | | |
| Source-drain current(Body Diode) | I _{SD} | T _C =25℃ | | | 45 | A |
| Pulsed Source-drain current(Body Diode) | I _{SDM} | | | | 135 | A |
| Forward On Voltage | V _{SD} | T _j =25℃, I _{SD} =45A, V _{GS} =0V | | 1.0 | 1.2 | V |
| Reverse Recovery Time | t _{rr} | T _j =25℃, I _F =23A, di/dt=100A/μs | | 173 | | nS |
| Reverse Recovery Charge | Q _{rr} | | | 1.13 | | uC |
| Peak Reverse Recovery Current | I _{rrm} | | | 13 | | 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

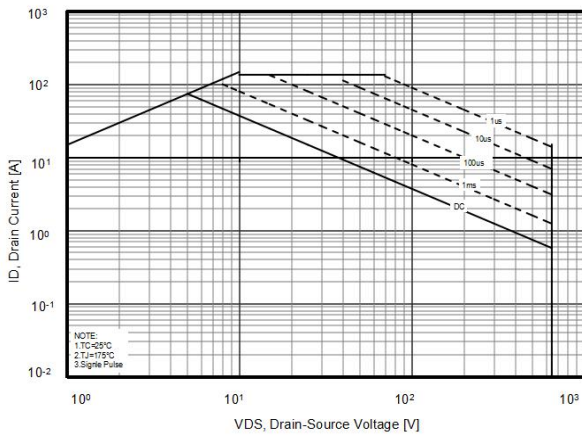


Figure2. Capacitance

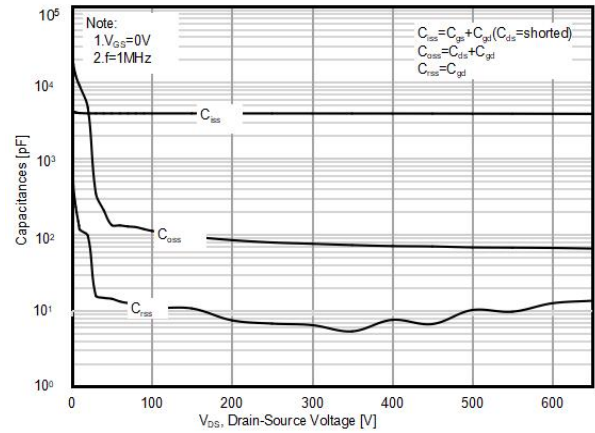


Figure3. Source-Drain Diode Forward Voltage

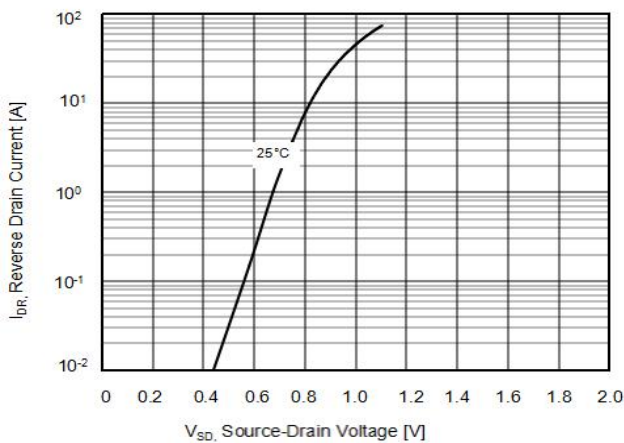


Figure4. Output characteristics

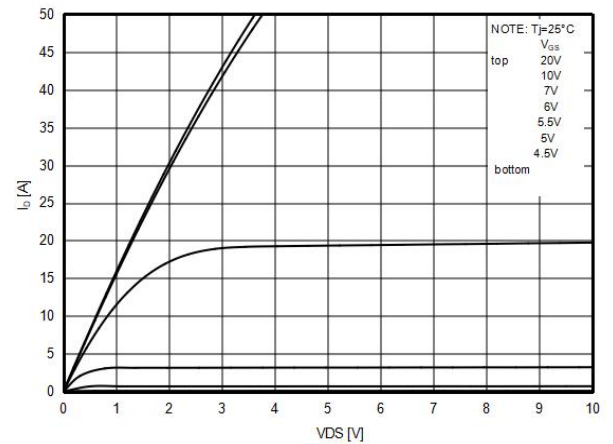


Figure5. $R_{DS(ON)}$ vs Junction Temperature

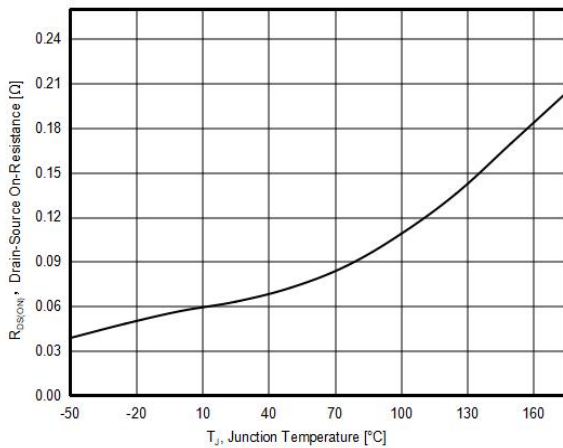


Figure6. BV_{DSS} vs Junction Temperature

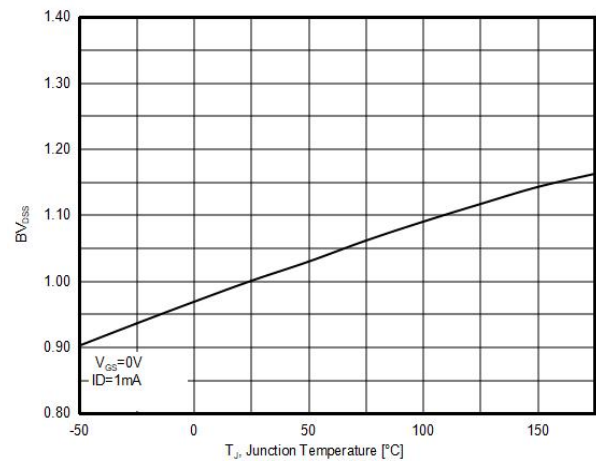


Figure7. Maximum I_D vs Junction Temperature

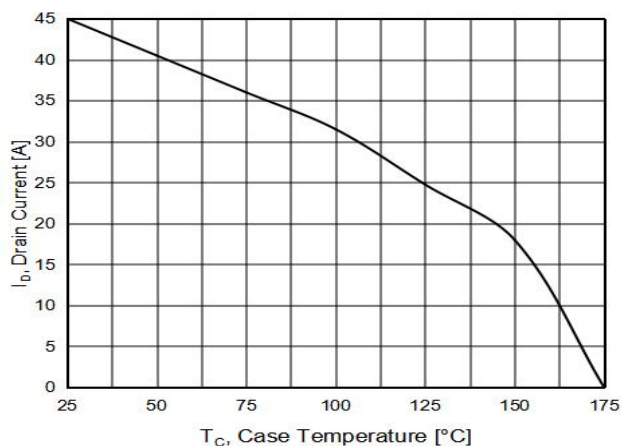


Figure8. Gate charge waveforms

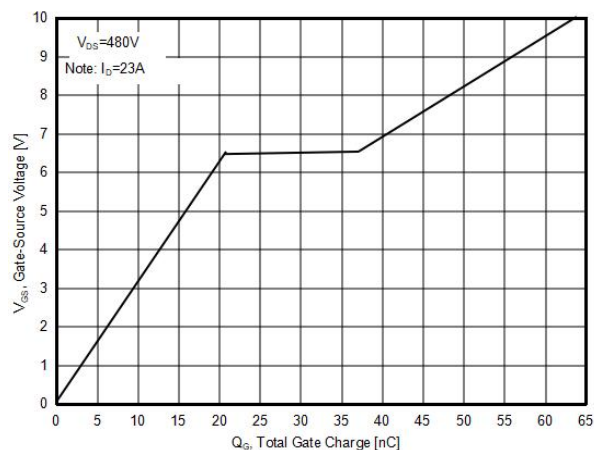


Figure9. Static drain-source on resistance

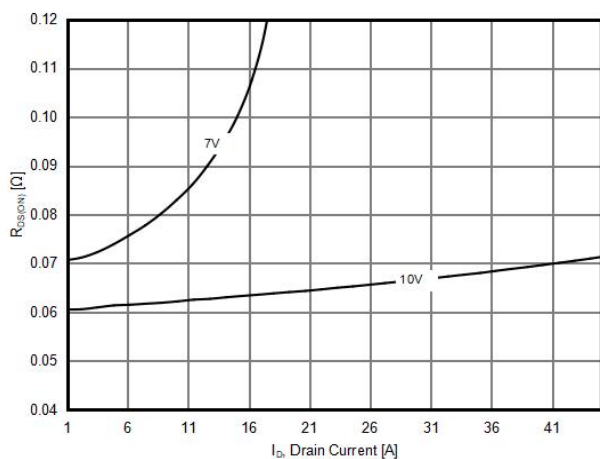
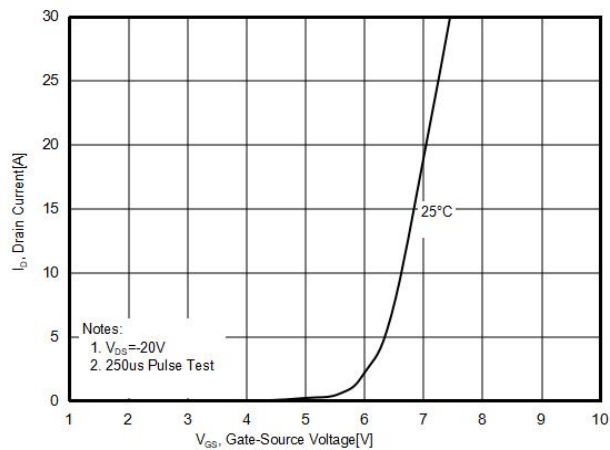


Figure10. Transfer characteristics

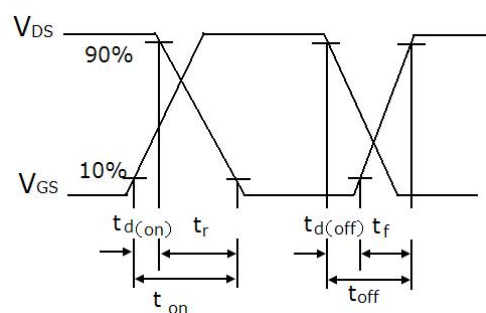
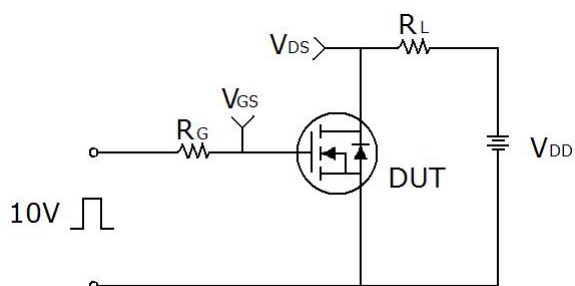


Test circuit

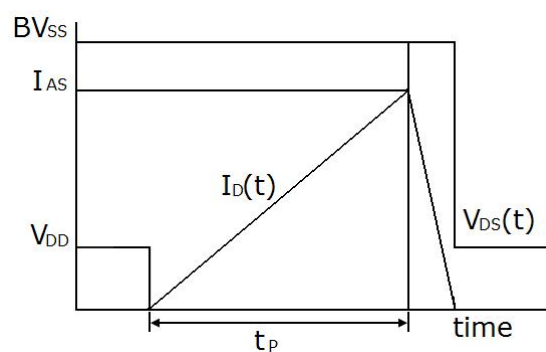
1) Gate charge test circuit & Waveform



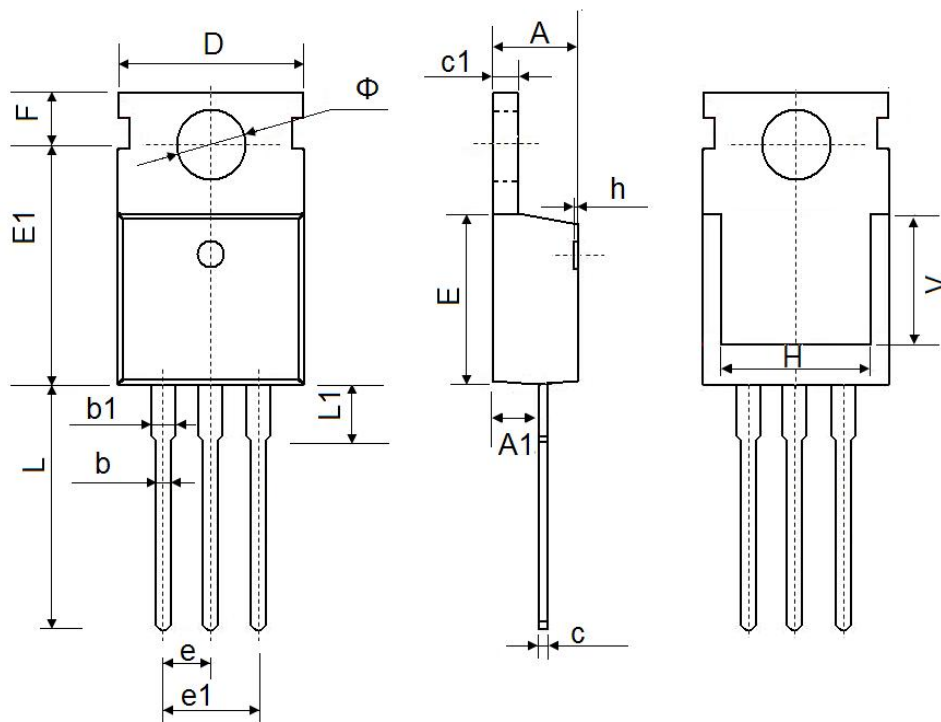
2) Switch Time Test Circuit:



3) Unclamped Inductive Switching Test Circuit & Waveforms



TO-220-3L Package Information



| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|--------|---------------------------|--------|----------------------|-------|
| | Min. | Max. | Min. | Max. |
| A | 4.400 | 4.600 | 0.173 | 0.181 |
| A1 | 2.250 | 2.550 | 0.089 | 0.100 |
| b | 0.710 | 0.910 | 0.028 | 0.036 |
| b1 | 1.170 | 1.370 | 0.046 | 0.054 |
| c | 0.330 | 0.650 | 0.013 | 0.026 |
| c1 | 1.200 | 1.400 | 0.047 | 0.055 |
| D | 9.910 | 10.250 | 0.390 | 0.404 |
| E | 8.9500 | 9.750 | 0.352 | 0.384 |
| E1 | 12.650 | 12.950 | 0.498 | 0.510 |
| e | 2.540 TYP. | | 0.100 TYP. | |
| e1 | 4.980 | 5.180 | 0.196 | 0.204 |
| F | 2.650 | 2.950 | 0.104 | 0.116 |
| H | 7.900 | 8.100 | 0.311 | 0.319 |
| h | 0.000 | 0.300 | 0.000 | 0.012 |
| L | 12.900 | 13.400 | 0.508 | 0.528 |
| L1 | 2.850 | 3.250 | 0.112 | 0.128 |
| V | 7.500 REF. | | 0.295 REF. | |
| Φ | 3.400 | 3.800 | 0.134 | 0.150 |

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