

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.

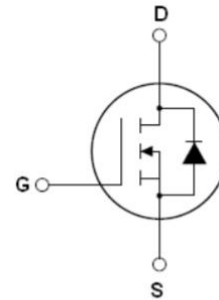
Features

- 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

| | | |
|------------------------|------|------------|
| $V_{DS\ min@T_{jmax}}$ | 550 | V |
| $R_{DS(ON)TYP.}$ | 110 | m Ω |
| I_D | 23.5 | A |
| Q_g | 24.5 | nC |



Schematic diagram

✧ **Intrinsic fast-recovery body diode**

Package Marking And Ordering Information

| Device | Device Package | Marking |
|-------------|----------------|-------------|
| NCE50NF130K | TO-252 | NCE50NF130K |



TO-252

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

| Parameter | Symbol | Value | Unit |
|--|-----------------|------------|---------------------|
| Drain-Source Voltage ($V_{GS}=0V$) | V_{DS} | 500 | 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 $T_c=25^\circ\text{C}$ | $I_{D(DC)}$ | 23.5 | A |
| Continuous Drain Current at $T_c=100^\circ\text{C}$ | $I_{D(DC)}$ | 16.45 | A |
| Pulsed drain current (Note 1) | $I_{DM(pulse)}$ | 70.5 | A |
| Maximum Power Dissipation($T_c=25^\circ\text{C}$) | P_D | 186 | W |
| Derate above 25°C | | 1.24 | W/ $^\circ\text{C}$ |
| Single pulse avalanche current (Note 2) | I_{AS} | 6 | A |
| Reverse diode dv/dt , $V_{DS} \leq 400\text{ V}, I_{SD} < I_D$ | dv/dt | 15 | V/ns |
| Drain Source voltage slope, $V_{DS} \leq 400\text{ V}$ | dv/dt | 50 | V/ns |
| Operating Junction and Storage Temperature Range | T_J, T_{STG} | -55...+175 | $^\circ\text{C}$ |

Table 2. Thermal Characteristic

| Parameter | Symbol | Value | Unit |
|---|------------|-------|-----------------------------|
| Thermal Resistance, Junction-to-Case (Maximum) | R_{thJC} | 0.80 | $^{\circ}\text{C}/\text{W}$ |
| 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} | $V_{GS}=0V, I_D=250\mu A$ | 500 | | | V |
| Zero Gate Voltage Drain Current(Tc=25°C) | I_{DSS} | $V_{DS}=500V, V_{GS}=0V$ | | | 10 | μA |
| Zero Gate Voltage Drain Current(Tc=125°C) | I_{DSS} | $V_{DS}=500V, V_{GS}=0V$ | | | 300 | 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 | | 5 | V |
| Drain-Source On-State Resistance | $R_{DS(ON)}$ | $V_{GS}=10V, I_D=12A$ | | 110 | 130 | m Ω |
| Dynamic Characteristics | | | | | | |
| Gate Resistance | R_g | F=1MHZ, D-S short | | 2 | | Ω |
| Input Capacitance | C_{iss} | $V_{DS}=50V, V_{GS}=0V,$ F=1MHZ | | 1544 | | pF |
| Output Capacitance | C_{oss} | | | 630 | | pF |
| Reverse Transfer Capacitance | C_{riss} | | | 6.1 | | pF |
| Total Gate Charge | Q_g | $V_{DS}=400V, I_D=12A,$ $V_{GS}=10V$ | | 24.5 | | nC |
| Gate-Source Charge | Q_{gs} | | | 11.5 | | nC |
| Gate-Drain Charge | Q_{gd} | | | 6.5 | | nC |
| Gate plateau voltage | V_{gp} | | | 7.7 | | V |
| Switching times | | | | | | |
| Turn-on Delay Time | $t_{d(on)}$ | $V_{DD}=400V, I_D=12A,$ $R_G=4\Omega, V_{GS}=10V$ | | 13 | | nS |
| Turn-on Rise Time | t_r | | | 10 | | nS |
| Turn-Off Delay Time | $t_{d(off)}$ | | | 58 | | nS |
| Turn-Off Fall Time | t_f | | | 9 | | nS |
| Source- Drain Diode Characteristics | | | | | | |
| Source-drain current(Body Diode) | I_{SD} | $T_c=25^{\circ}\text{C}$ | | | 23.5 | A |
| Pulsed-Source-drain current(Body Diode) | I_{SDM} | | | | 70.5 | A |
| Forward on voltage | V_{SD} | $T_j=25^{\circ}\text{C}, I_{SD}=23.5A, V_{GS}=0V$ | | 0.9 | 1.1 | V |
| Reverse Recovery Time | t_{rr} | $T_j=25^{\circ}\text{C}, I_F=12A,$ $di/dt=100A/\mu s$ | | 170 | | nS |
| Reverse Recovery Charge | Q_{rr} | | | 1.02 | | μC |
| Peak reverse recovery current | I_{rrm} | | | 12 | | 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

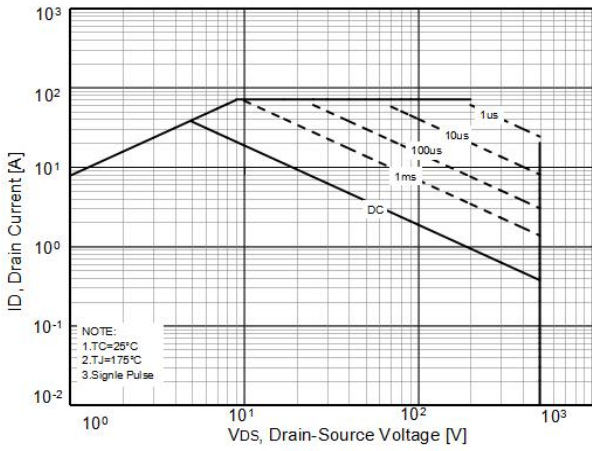


Figure2. Source-Drain Diode Forward Voltage

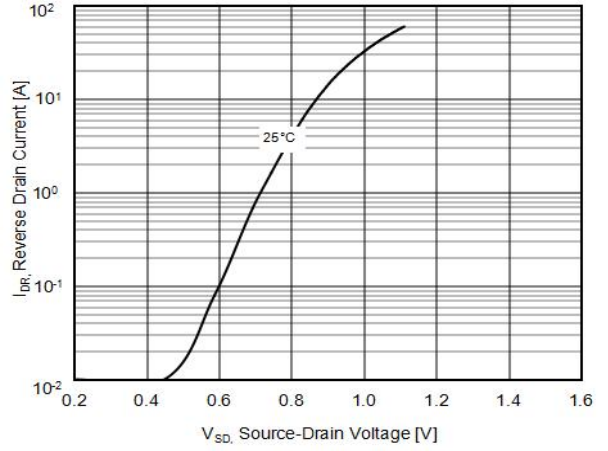


Figure3. Output characteristics

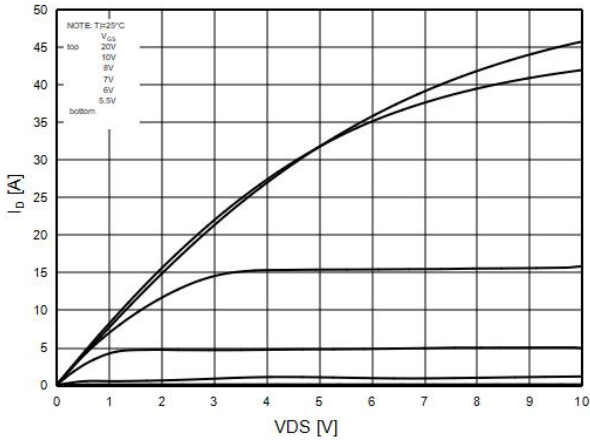


Figure4. Transfer characteristics

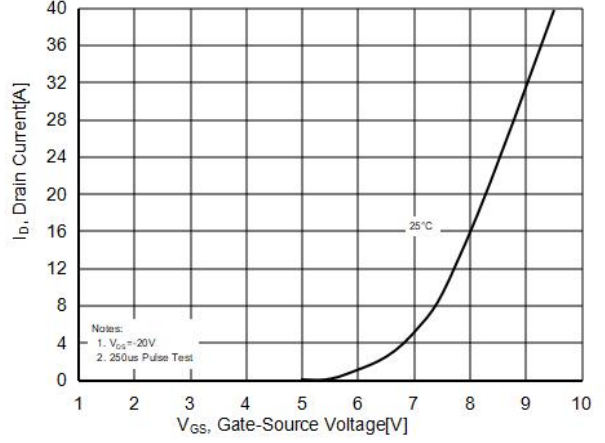


Figure5. Static drain-source on resistance

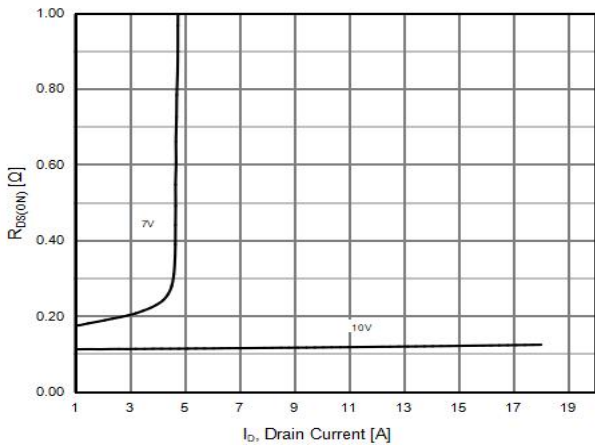


Figure6. RDS(ON) vs Junction Temperature

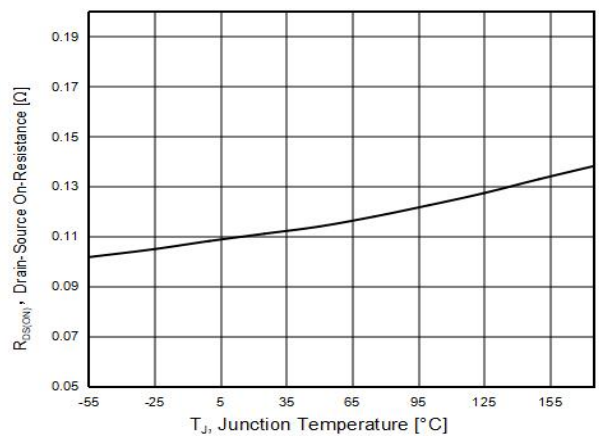


Figure7. BV_{DSS} vs Junction Temperature

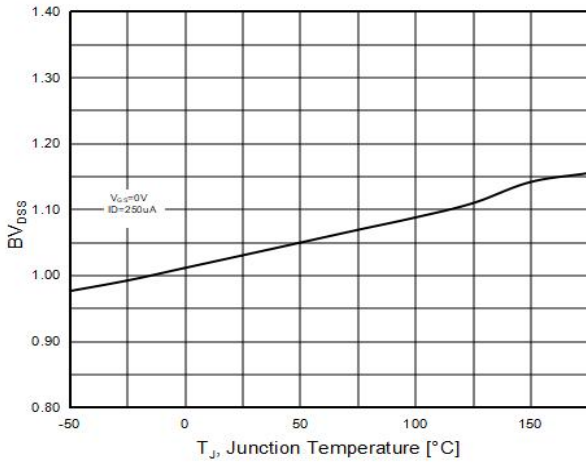


Figure8. Maximum I_D vs Junction Temperature

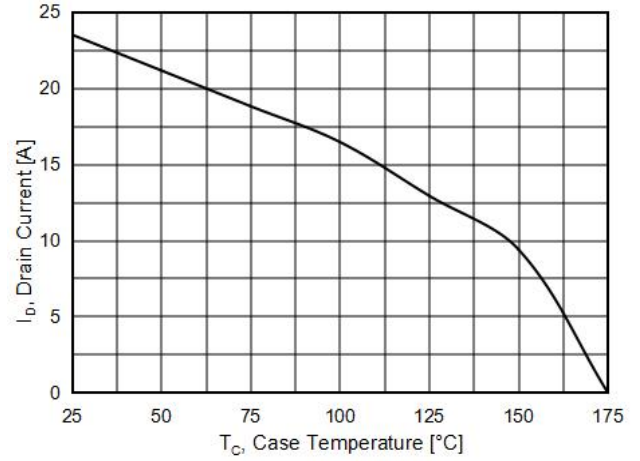


Figure9. Gate charge waveforms

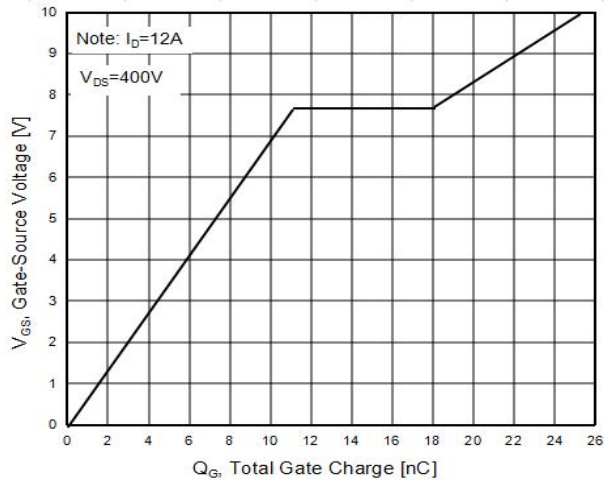
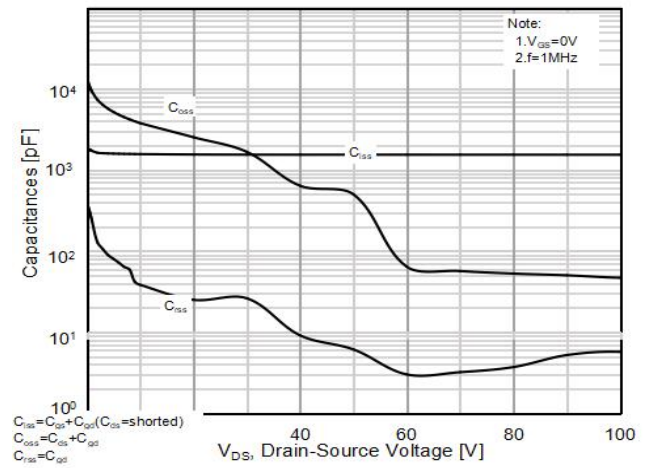


Figure10. Capacitance



Test circuit

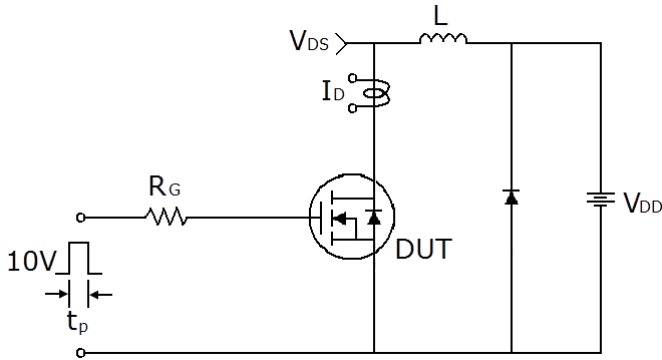
1) Gate charge test circuit & Waveform



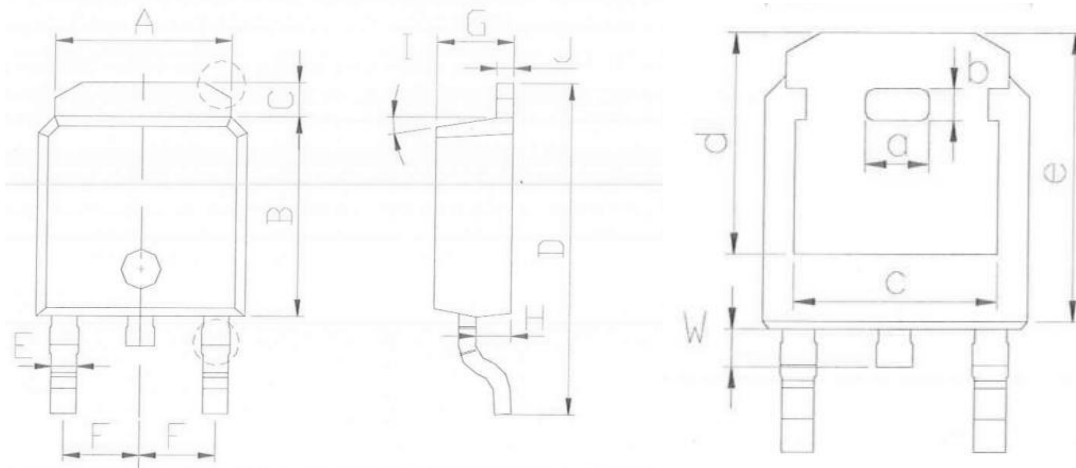
2) Switch Time Test Circuit:



3) Unclamped Inductive Switching Test Circuit & Waveforms



TO-252 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 | 6.03 | 0.224 | 0.237 |
| C | 0.75 | 1.35 | 0.030 | 0.053 |
| D | 9.65 | 10.25 | 0.380 | 0.404 |
| 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 |
| W | 0.60 | 1.20 | 0.024 | 0.047 |
| a | 1.50 | 2.10 | 0.059 | 0.083 |
| b | 0.45 | 1.05 | 0.018 | 0.041 |
| c | 4.55 | 5.15 | 0.179 | 0.203 |
| d | 5.00 | 5.60 | 0.197 | 0.220 |
| e | 6.60 | 7.20 | 0.260 | 0.283 |

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