# NCE Automotive N-Channel Super Trench Power MOSFET

## Description

The NCEAP60ND60G uses **Super Trench** technology that is uniquely optimized to provide the most efficient high frequency switching performance. Both conduction and switching power losses are minimized due to an extremely low combination of $R_{DS(ON)}$ and $Q_g$. This device is ideal for high-frequency switching and synchronous rectification.

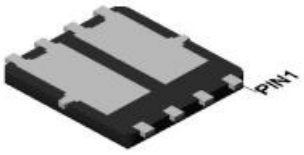
## Application

- Automotive application
- DC/DC Converter
- Ideal for high-frequency switching and synchronous rectification

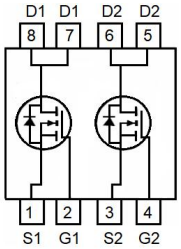
## General Features

- $V_{DS}$ =60V,$I_D$ =70A
  $R_{DS(ON)}$=7.8mΩ (typical) @ $V_{GS}$=10V
- Excellent gate charge x $R_{DS(on)}$ product(FOM)
- Very low on-resistance $R_{DS(on)}$
- 175 °C operating temperature
- Pb-free lead plating
- 100% UIS tested
- 100% ΔVds tested
- **AEC-Q101 qualified**

DFN 5X6




Top View




Schematic Diagram

## Package Marking and Ordering Information

| Device Marking | Device | Device Package | Reel Size | Tape width | Quantity |
|---|---|---|---|---|---|
| AP60ND60G | NCEAP60ND60G | DFN5X6-8L | - | - | - |

## Absolute Maximum Ratings ($T_C$=25℃unless otherwise noted)

| Parameter | Symbol | Limit | Unit |
|---|---|---|---|
| Drain-Source Voltage | $V_{DS}$ | 60 | V |
| Gate-Source Voltage | $V_{GS}$ | ±20 | V |
| Drain Current-Continuous | $I_D$ | 70 | A |
| Drain Current-Continuous | $I_D$ (100℃) | 50 | A |
| Pulsed Drain Current | $I_{DM}$ | 220 | A |
| Maximum Power Dissipation | $P_D$ | 84 | W |
| Derating factor | | 0.56 | W/℃ |
| Single pulse avalanche energy (Note 2) | $E_{AS}$ | 320 | mJ |
| Operating Junction and Storage Temperature Range | $T_J$,$T_{STG}$ | -55 To 175 | ℃ |

## Thermal Characteristic

| | | | |
|---|---|---|---|
| Thermal Resistance,Junction-to-Case | $R_{\theta JC}$ | 1.78 | ℃/W |

## Electrical Characteristics ($T_C$=25℃unless otherwise noted)

| Parameter | Symbol | Condition | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| **Off Characteristics** | | | | | | |
| Drain-Source Breakdown Voltage | $BV_{DSS}$ | $V_{GS}$=0V $I_D$=250μA | 60 | - | - | V |
| Zero Gate Voltage Drain Current | $I_{DSS}$ | $V_{DS}$=60V,$V_{GS}$=0V | - | - | 1 | μA |
| Gate-Body Leakage Current | $I_{GSS}$ | $V_{GS}$=±20V,$V_{DS}$=0V | - | - | ±100 | nA |
| **On Characteristics** | | | | | | |
| Gate Threshold Voltage | $V_{GS(th)}$ | $V_{DS}$=$V_{GS}$,$I_D$=250μA | 2 | 3 | 4 | V |
| Drain-Source On-State Resistance | $R_{DS(ON)}$ | $V_{GS}$=10V, $I_D$=20A | - | 7.8 | 8.5 | mΩ |
| Forward Transconductance | $g_{FS}$ | $V_{DS}$=5V,$I_D$=20A | 35 | - | - | S |
| **Dynamic Characteristics** | | | | | | |
| Input Capacitance | $C_{lss}$ | $V_{DS}$=30V,$V_{GS}$=0V, F=1.0MHz | - | 1700 | - | pF |
| Output Capacitance | $C_{oss}$ | | - | 345 | - | pF |
| Reverse Transfer Capacitance | $C_{rss}$ | | - | 8 | - | pF |
| **Switching Characteristics** (Note 3) | | | | | | |
| Turn-on Delay Time | $t_{d(on)}$ | $V_{DD}$=30V,$I_D$=20A $V_{GS}$=10V,$R_G$=4.7Ω | - | 8 | - | nS |
| Turn-on Rise Time | $t_r$ | | - | 2 | - | nS |
| Turn-Off Delay Time | $t_{d(off)}$ | | - | 29 | - | nS |
| Turn-Off Fall Time | $t_f$ | | - | 4 | - | nS |
| Total Gate Charge | $Q_g$ | $V_{DS}$=30V,$I_D$=20A, $V_{GS}$=10V | - | 26.9 | - | nC |
| Gate-Source Charge | $Q_{gs}$ | | - | 9.4 | - | nC |
| Gate-Drain Charge | $Q_{gd}$ | | - | 4.6 | - | nC |
| **Drain-Source Diode Characteristics** | | | | | | |
| Diode Forward Voltage | $V_{SD}$ | $V_{GS}$=0V,$I_S$=20A | - | - | 1.2 | V |
| Diode Forward Current | $I_S$ | | - | - | 55 | A |
| Reverse Recovery Time | $t_{rr}$ | $T_J$ = 25°C, $I_F$ = $I_S$ di/dt = 100A/μs | - | 38 | - | nS |
| Reverse Recovery Charge | Qrr | | - | 48 | - | nC |

## Notes:

1. Defined by design.Not Subject to production test
2. EAS condition : Tj=25℃,$V_{DD}$=30V,$V_G$=10V,L=0.5mH,Rg=25Ω
3. Guaranteed by design, not subject to production
4. These curves are based on the junction-to-case thermal impedance which is measured with the device mounted to a large heatsink, assuming a maximum junction temperature of TJ(MAX)=175°C. The SOA curve provides a single pulse rating.

## Typical Electrical and Thermal Characteristics

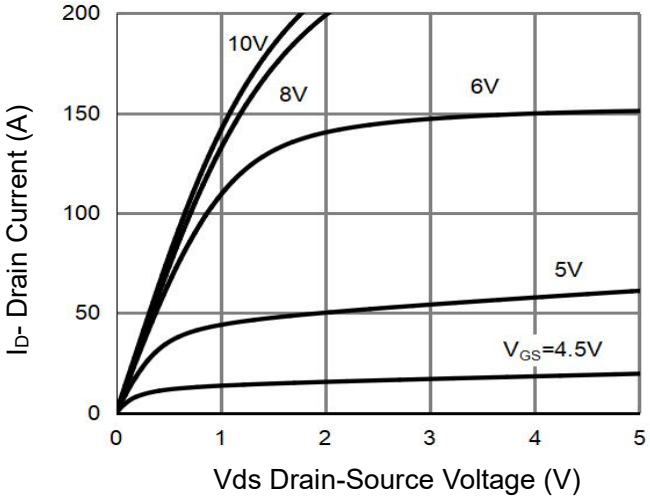



**Figure 1 Output Characteristics**

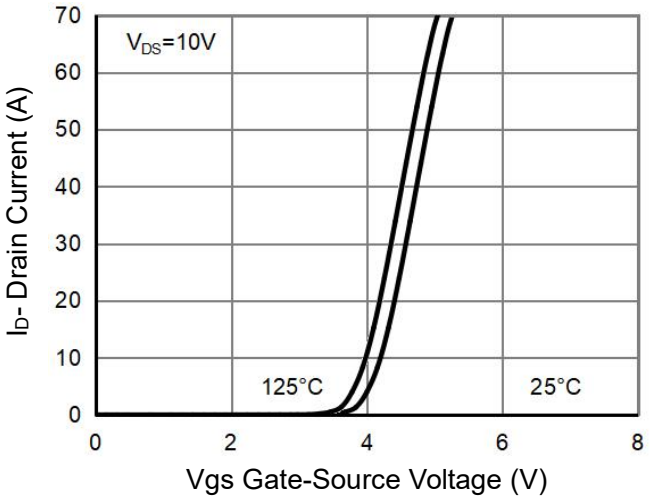



**Figure 2 Transfer Characteristics**

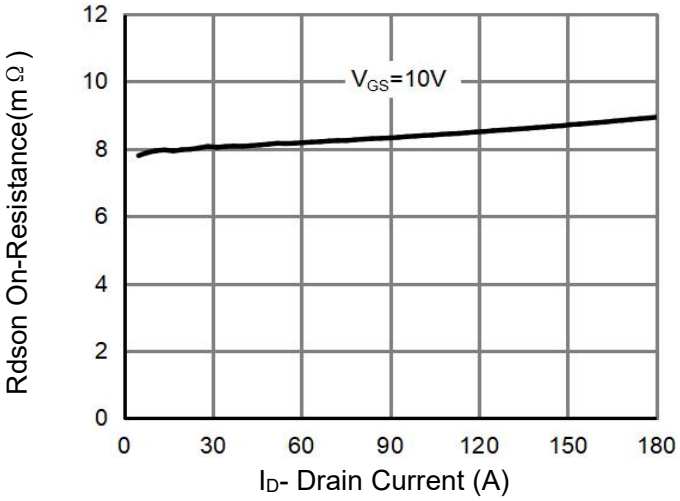



**Figure 3 Rdson- Drain Current**

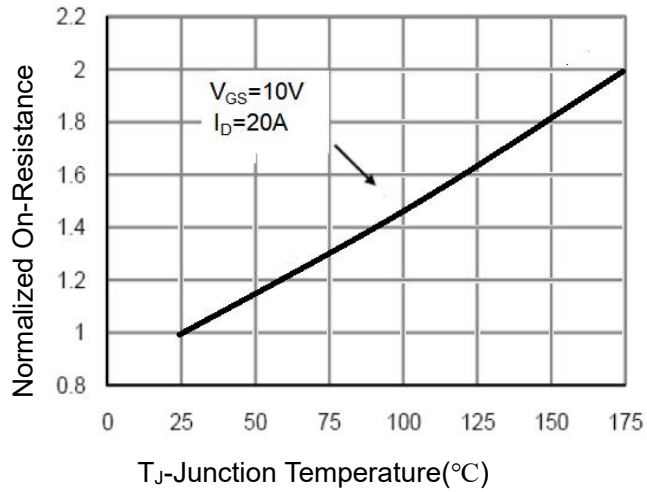



**Figure 4 Rdson-JunctionTemperature**

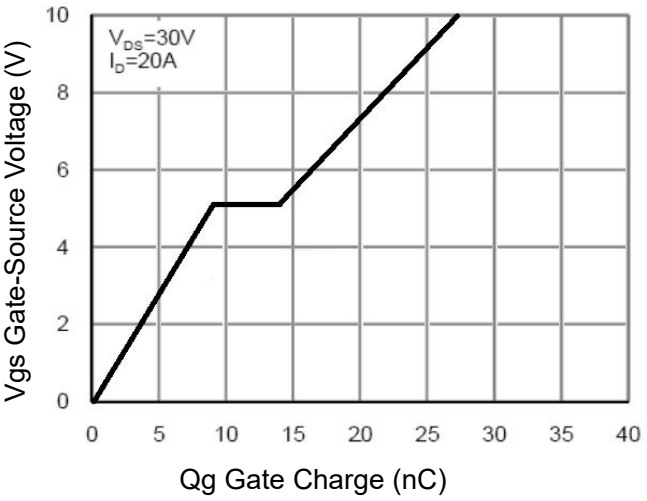



**Figure 5 Gate Charge**

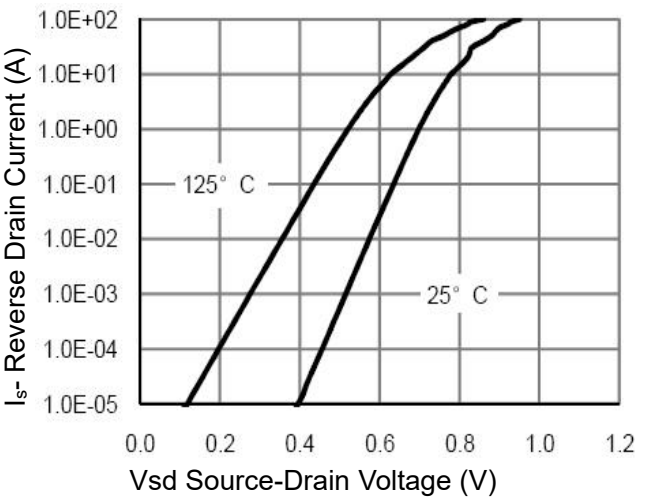



**Figure 6 Source- Drain Diode Forward**

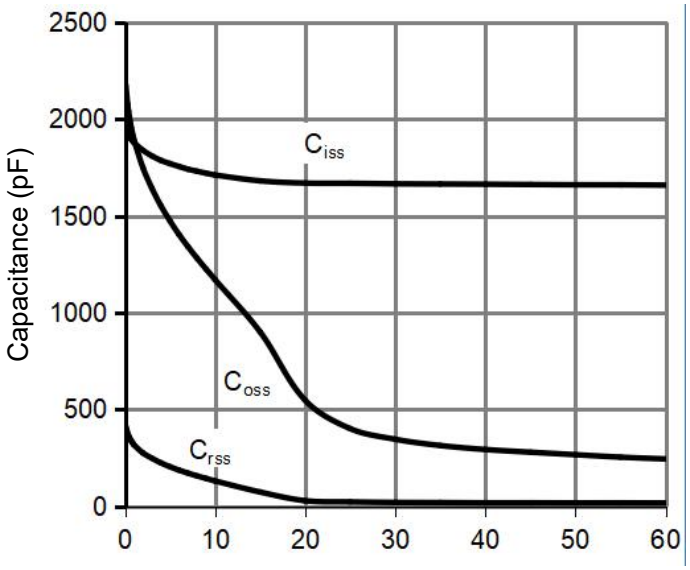



**Figure 7 Capacitance vs Vds**

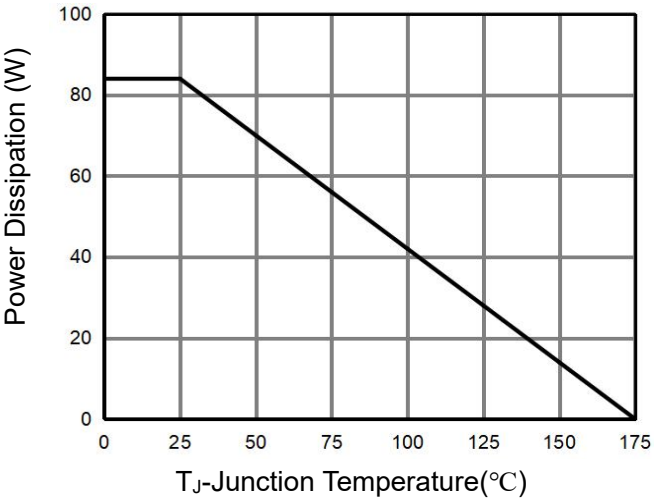



**Figure 9 Power De-rating**

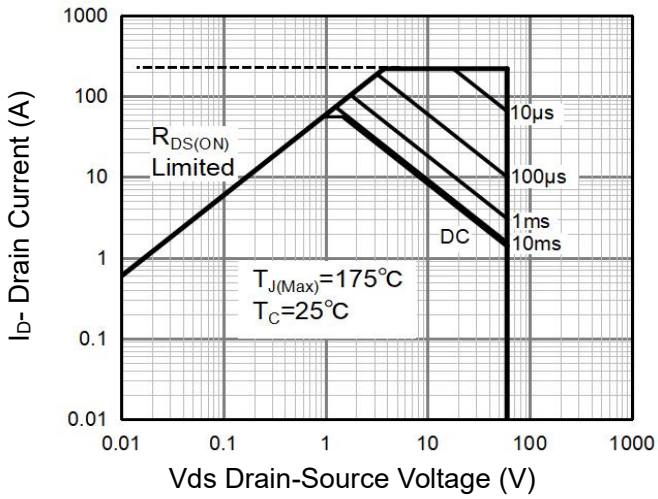



**Figure 8 Safe Operation Area** (Note4)

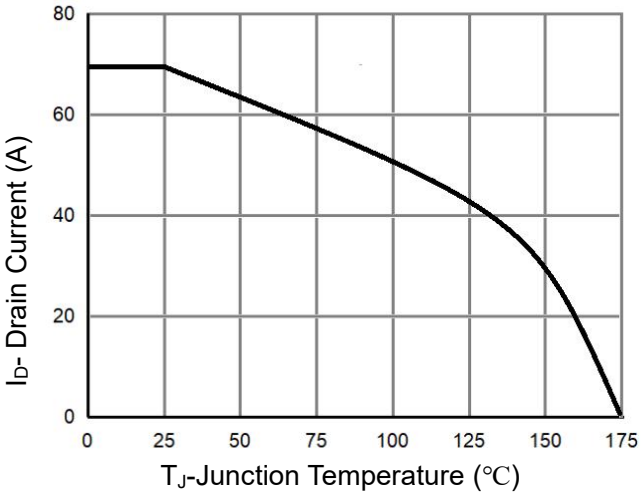



**Figure 10 Current De-rating**

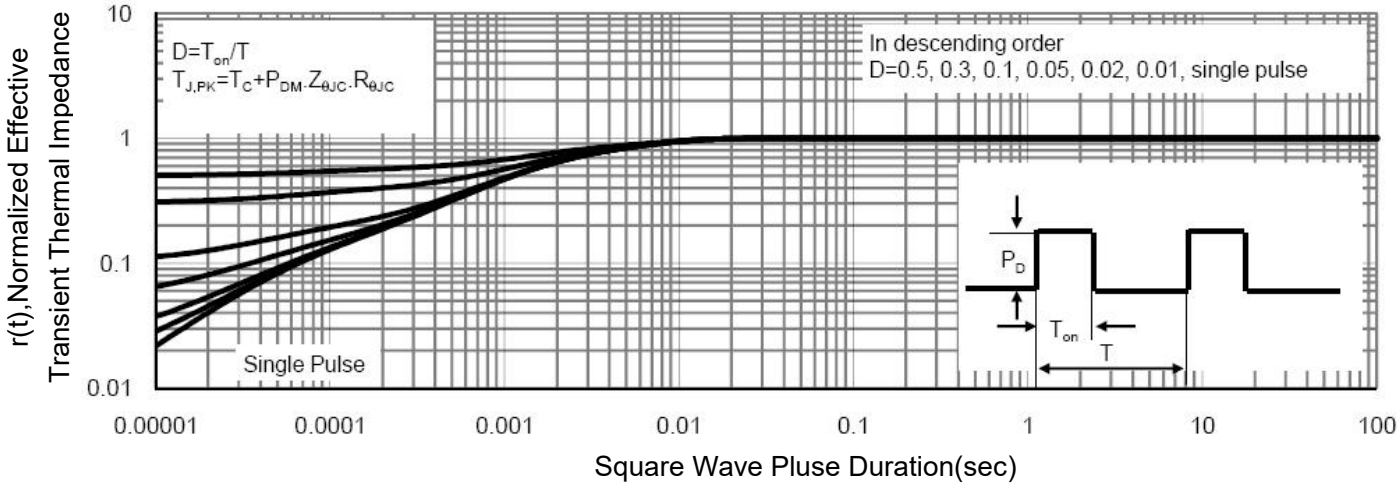
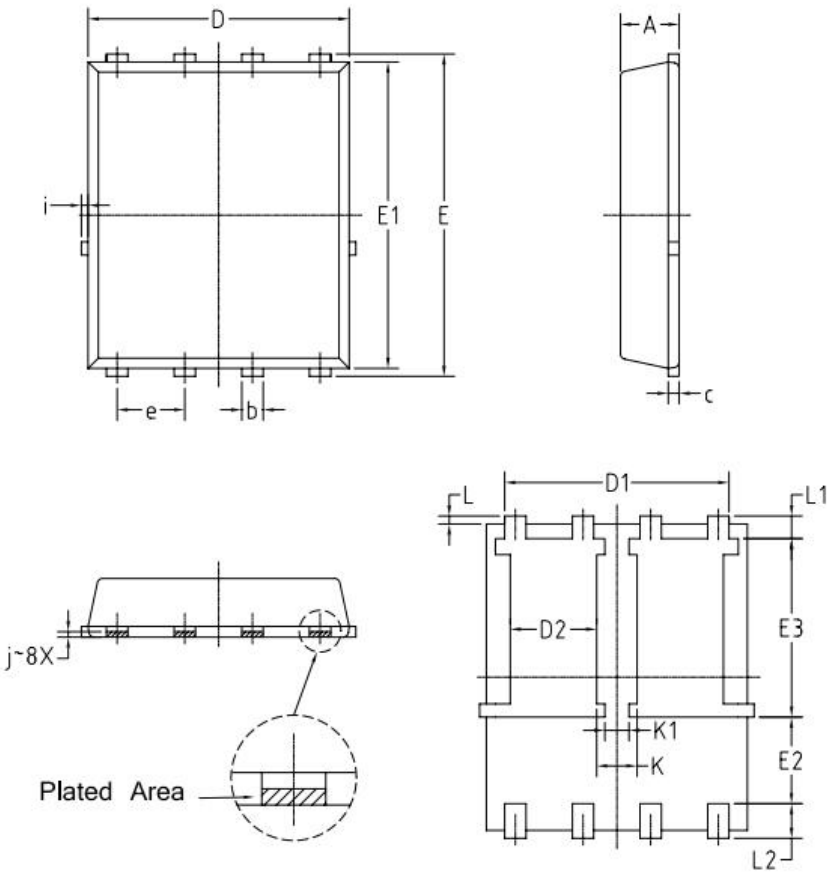



**Figure 11 Normalized Maximum Transient Thermal Impedance**

## DFN5X6-8L Package Information




| SYMBOL | COMMON | | | |
|---|---|---|---|---|
| | MM | | INCH | |
| | MIN. | MAX. | MIN. | MAX. |
| A | 1.00 | 1.20 | 0.039 | 0.047 |
| b | 0.30 | 0.50 | 0.012 | 0.020 |
| c | 0.203 BSC | | 0.008 BSC | |
| D | 4.80 | 5.00 | 0.189 | 0.197 |
| D1 | 4.06 | 4.36 | 0.160 | 0.172 |
| D2 | 1.47 | 1.77 | 0.058 | 0.070 |
| E | 5.90 | 6.20 | 0.232 | 0.244 |
| E1 | 5.65 | 5.85 | 0.222 | 0.230 |
| E2 | 1.45 | — | 0.057 | — |
| E3 | 3.20 | 3.50 | 0.126 | 0.138 |
| e | 1.27 BSC | | 0.05 BSC | |
| L | 0.05 | 0.25 | 0.002 | 0.010 |
| L1 | 0.325 | 0.525 | 0.013 | 0.021 |
| L2 | 0.500 | 0.800 | 0.020 | 0.031 |
| i | — | 0.20 | — | 0.008 |
| K | 0.61 | 0.91 | 0.024 | 0.036 |
| K1 | 0.31 | 0.60 | 0.012 | 0.024 |
| j | 0.1015 BSC | | 0.004BSC | |

## Revision History

| Revision | Date | Subjects |
|---|---|---|
| V1.0 | 2022.12.15 | Product data sheet |
| V2.0 | 2023.06.19 | Capacitance vs Vds Curve |

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