# 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.

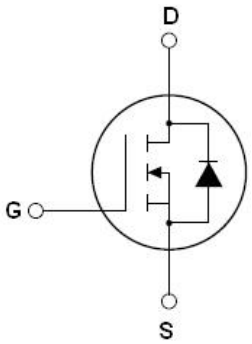
## Features

- 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

| | | |
|---|---|---|
| $V_{DS\ min@Tjmax}$ | 650 | V |
| $R_{DS(ON)TYP}$ | 70 | mΩ |
| ID | 41 | A |
| Qg | 53 | nC |




**Schematic diagram**

✧ **Intrinsic fast-recovery body diode**

## Package Marking And Ordering Information

| Device | Device Package | Marking |
|---|---|---|
| NCE60NF080D | TO-263 | NCE60NF080D |


**TO-263**

## Table 1. Absolute Maximum Ratings ($T_C$=25℃)

| Parameter | Symbol | Value | Unit |
|---|---|---|---|
| Drain-Source Voltage (VGS=0V） | $V_{DS}$ | 600 | V |
| Gate-Source Voltage (VDS=0V) AC (f>1 Hz) | $V_{GS}$ | ±30 | V |
| Gate-Source Voltage (VDS=0V) DC | $V_{GS}$ | ±20 | V |
| Continuous Drain Current at Tc=25°C | $I_{D\ (DC)}$ | 41 | A |
| Continuous Drain Current at Tc=100°C | $I_{D\ (DC)}$ | 28.7 | A |
| Pulsed drain current (Note 1) | $I_{DM\ (pluse)}$ | 123 | A |
| Maximum Power Dissipation(Tc=25°C)<br>Derate above 25°C | $P_D$ | 351<br>2.34 | W<br>W/°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) | $E_{AR}$ | 0.7 | mJ |
| Drain Source voltage slope, $V_{DS}$ ≤480 V, | dv/dt | 50 | V/ns |
| Reverse diode dv/dt， $V_{DS}$ ≤480 V,$I_{SD}$<$I_D$ | dv/dt | 50 | V/ns |
| Operating Junction and Storage Temperature Range | $T_J$,$T_{STG}$ | -55...+175 | °C |

* limited by maximum junction temperature

## Table 2. Thermal Characteristic

| Parameter | Symbol | Value | Unit |
|---|---|---|---|
| Thermal Resistance，Junction-to-Case（Maximum） | $R_{thJC}$ | 0.427 | °C /W |
| Thermal Resistance，Junction-to-Ambient （Maximum） | $R_{thJA}$ | 62 | °C /W |

## Table 3. Electrical Characteristics (TA=25℃unless otherwise noted)

| Parameter | Symbol | Condition | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| **On/off states** | | | | | | |
| Drain-Source Breakdown Voltage | $BV_{DSS}$ | $V_{GS}$=0V $I_D$=500uA | 600 | | | V |
| Zero Gate Voltage Drain Current(Tc=25℃) | $I_{DSS}$ | $V_{DS}$=600V,$V_{GS}$=0V | | | 10 | μA |
| Zero Gate Voltage Drain Current(Tc=125℃) | $I_{DSS}$ | $V_{DS}$=600V,$V_{GS}$=0V | | | 300 | μA |
| Gate-Body Leakage Current | $I_{GSS}$ | $V_{GS}$=±20V,$V_{DS}$=0V | | | ±100 | nA |
| Gate Threshold Voltage | $V_{GS(th)}$ | $V_{DS}$=$V_{GS}$,$I_D$=250μA | 3 | 4 | 5 | V |
| Drain-Source On-State Resistance | $R_{DS(ON)}$ | $V_{GS}$=10V, $I_D$=20A | | 70 | 80 | mΩ |
| **Dynamic Characteristics** | | | | | | |
| Input Capacitance | $C_{lss}$ | $V_{DS}$=50V,$V_{GS}$=0V, F=1.0MHz | | 2920 | | pF |
| Output Capacitance | $C_{oss}$ | | | 123 | | pF |
| Reverse Transfer Capacitance | $C_{rss}$ | | | 5.4 | | pF |
| Total Gate Charge | $Q_g$ | $V_{DS}$=480V,$I_D$=20A, $V_{GS}$=10V | | 53 | | nC |
| Gate-Source Charge | $Q_{gs}$ | | | 17 | | nC |
| Gate-Drain Charge | $Q_{gd}$ | | | 13 | | nC |
| Gate plateau voltage | Vgp | | | 6.8 | | V |
| Intrinsic gate resistance | $R_G$ | f = 1 MHz open drain | | 1.0 | | Ω |
| **Switching times** | | | | | | |
| Turn-on Delay Time | $t_{d(on)}$ | $V_{DD}$=380V,$I_D$=20A, $R_G$=1.7Ω,$V_{GS}$=10V | | 31 | | nS |
| Turn-on Rise Time | $t_r$ | | | 13 | | nS |
| Turn-Off Delay Time | $t_{d(off)}$ | | | 89 | | nS |
| Turn-Off Fall Time | $t_f$ | | | 8 | | nS |
| **Source- Drain Diode Characteristics** | | | | | | |
| Source-drain current(Body Diode) | $I_{SD}$ | $T_C$=25°C | | | 41 | A |
| Pulsed Source-drain current(Body Diode) | $I_{SDM}$ | | | | 123 | A |
| Forward On Voltage | $V_{SD}$ | Tj=25°C,$I_{SD}$=41A,$V_{GS}$=0V | | 1.0 | 1.2 | V |
| Reverse Recovery Time | $t_{rr}$ | Tj=25°C,$I_F$=20A, di/dt=100A/μs | | 120 | | nS |
| Reverse Recovery Charge | $Q_{rr}$ | | | 0.48 | | uC |
| Peak Reverse Recovery Current | $I_{rrm}$ | | | 8 | | A |

Notes 1.Repetitive Rating: Pulse width limited by maximum junction temperature

2. Tj=25℃,VDD=50V,VG=10V, $R_G$=25Ω

## TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS (curves)

**Figure1. Safe operating area**

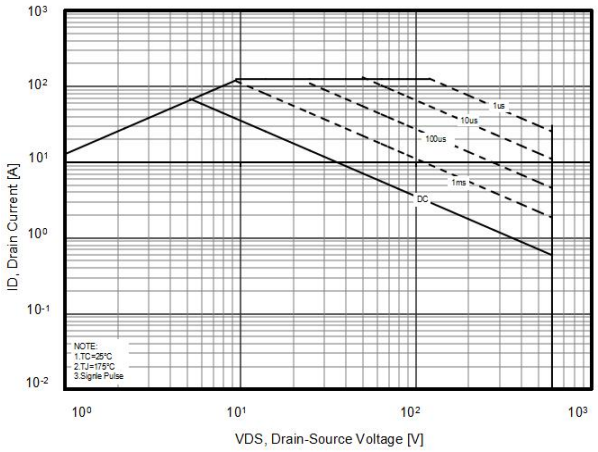



**Figure2. Capacitance**

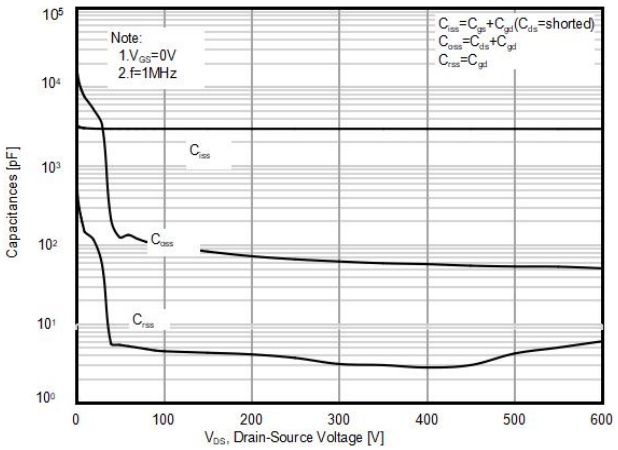



**Figure3. Source-Drain Diode Forward Voltage**

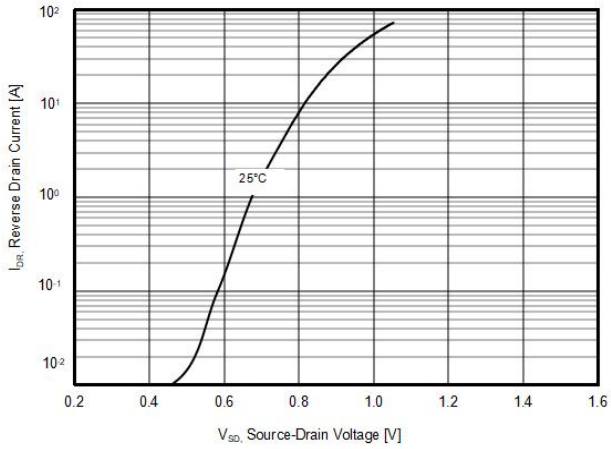



**Figure4. Output characteristics**

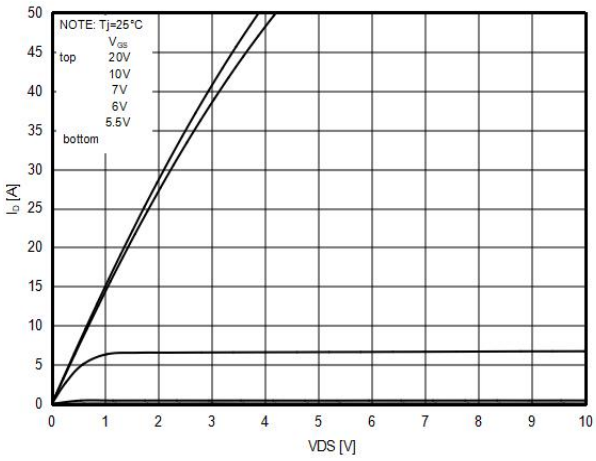



**Figure5. $R_{DS(ON)}$ vs Junction Temperature**

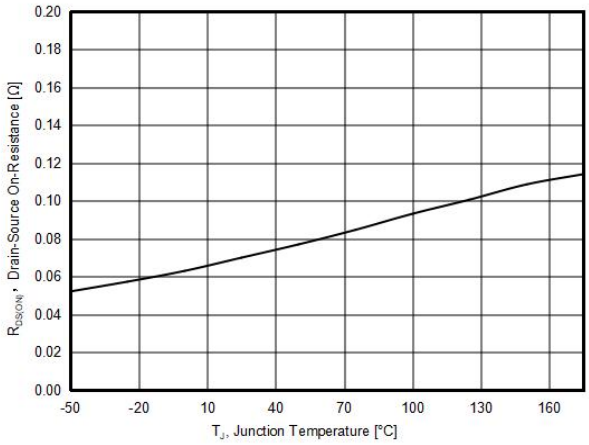



**Figure6. $BV_{DSS}$ vs Junction Temperature**

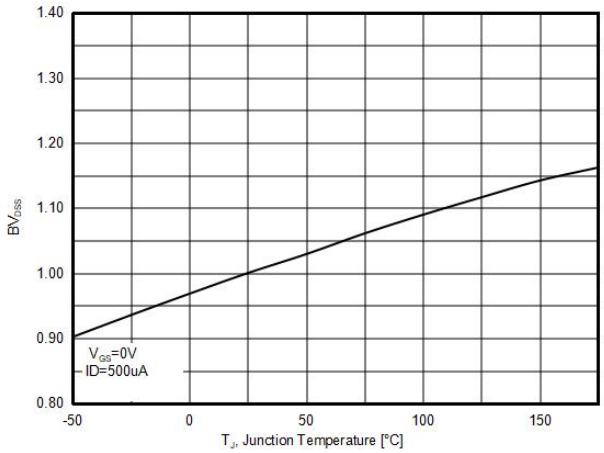


**Figure7. Maximum $I_D$ vs Junction Temperature**

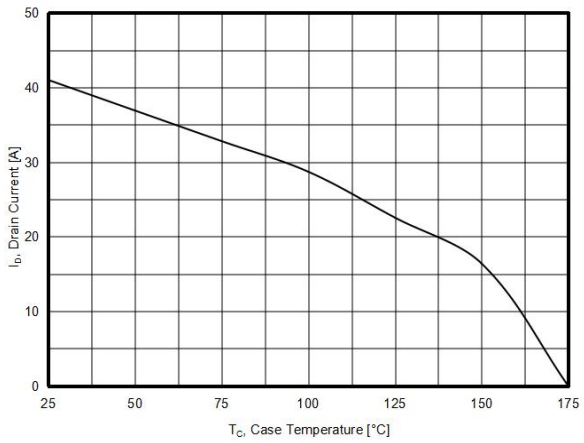



**Figure8. Gate charge waveforms**

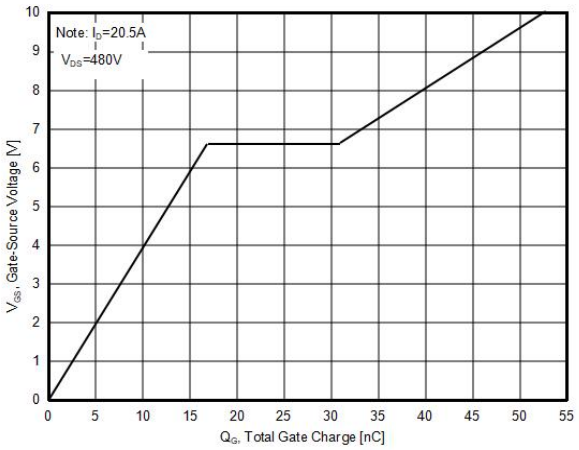



**Figure9. Static drain-source on resistance**

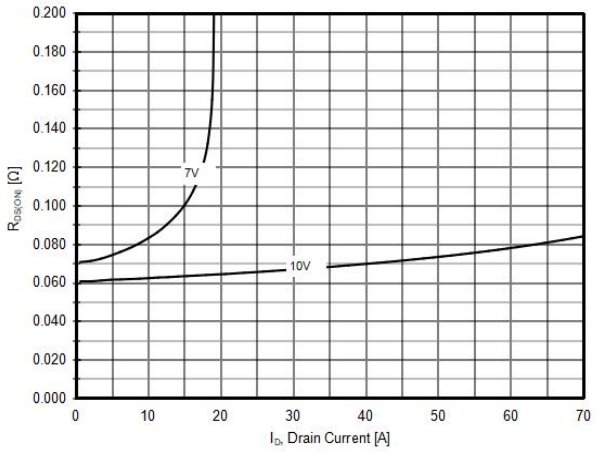
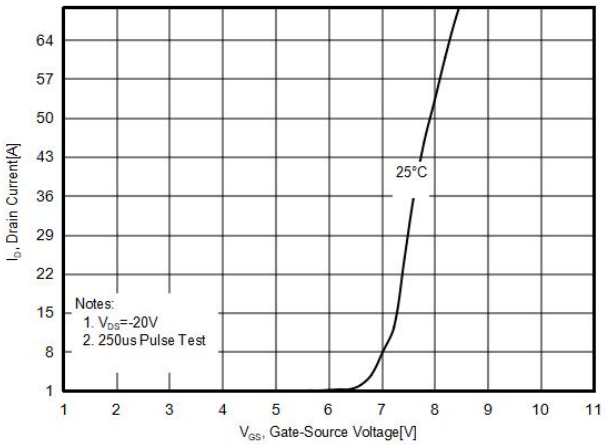
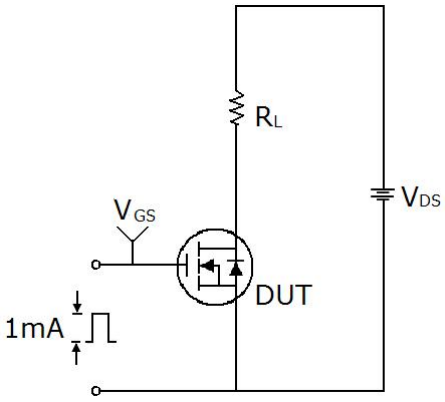


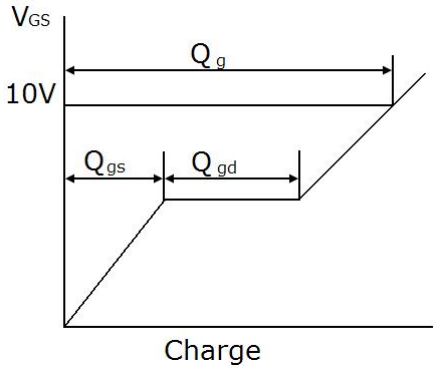

**Figure10. Transfer characteristics**



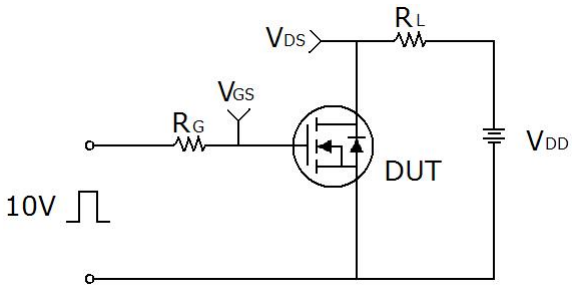
# Test circuit

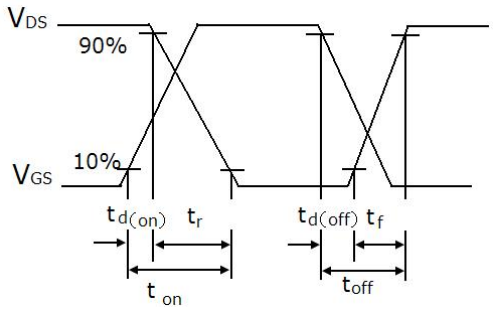
**1）Gate charge test circuit & Waveform**



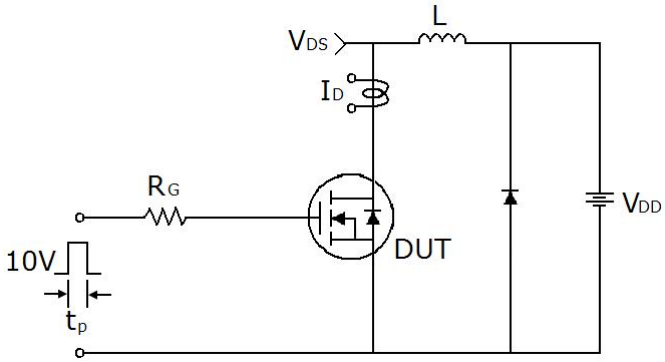



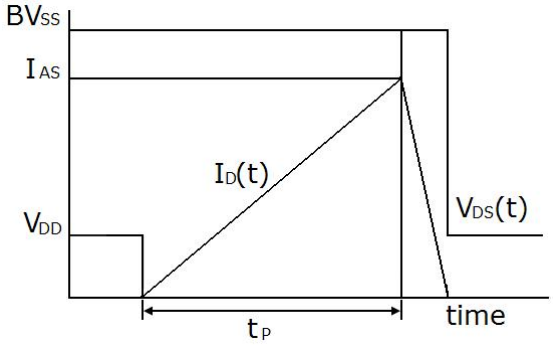

**2）Switch Time Test Circuit：**



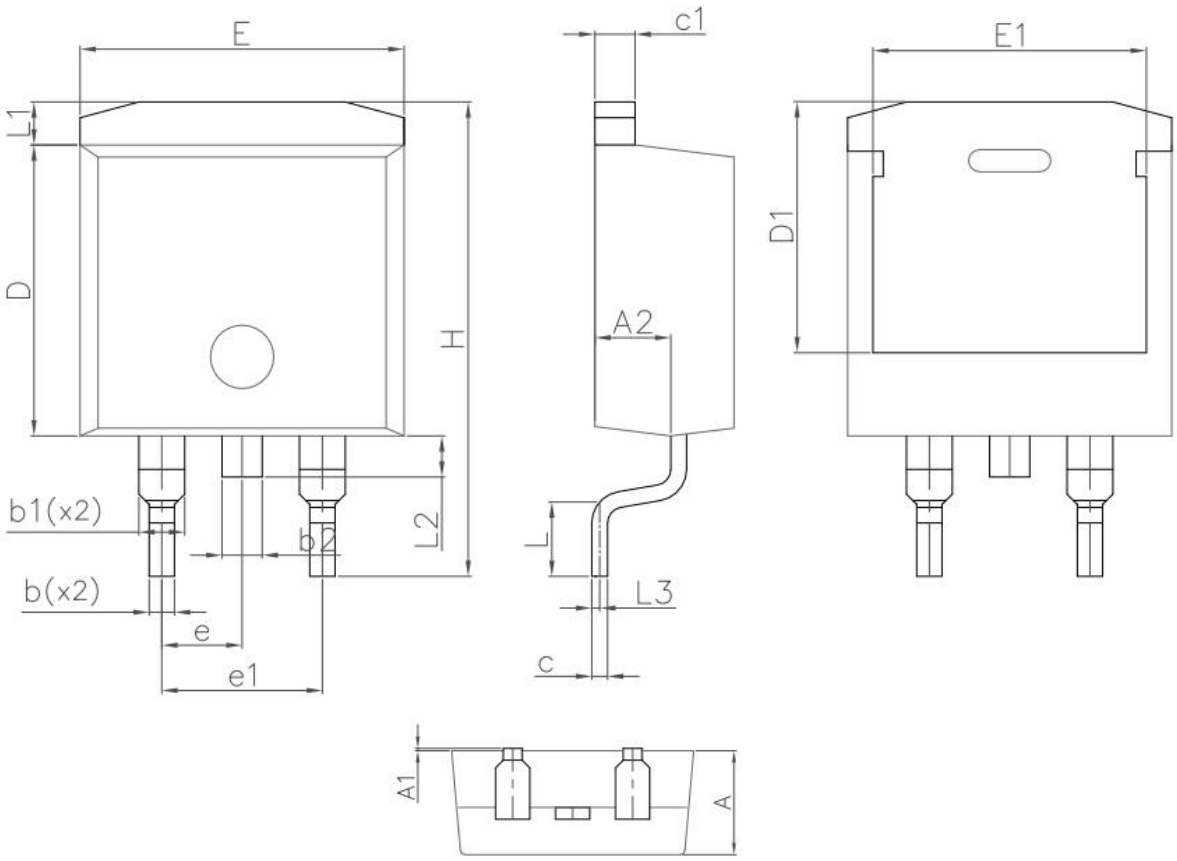




**3）Unclamped Inductive Switching Test Circuit & Waveforms**



# TO-263-E Package Information




| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|---|---|---|---|---|
| | Min. | Max. | Min. | Max. |
| A | 4.20 | 4.60 | 0.165 | 0.181 |
| A1 | 0.00 | 0.25 | 0.00 | 0.010 |
| A2 | 2.20 | 2.60 | 0.087 | 0.102 |
| b | 0.70 | 0.90 | 0.028 | 0.035 |
| b1 | 1.20 | 1.75 | 0.047 | 0.069 |
| b2 | 1.17 | 1.37 | 0.046 | 0.054 |
| c | 0.40 | 0.60 | 0.016 | 0.024 |
| c1 | 1.15 | 1.40 | 0.045 | 0.055 |
| D | 9.10 | 9.30 | 0.358 | 0.366 |
| D1 | 7.63 | 8.23 | 0.300 | 0.324 |
| E | 10.05 | 10.45 | 0.396 | 0.411 |
| E1 | 8.35 | 8.95 | 0.329 | 0.352 |
| e | 2.54BSC | | 0.100BSC | |
| e1 | 5.08BSC | | 0.200BSC | |
| H | 14.61 | 15.88 | 0.575 | 0.625 |
| L | 1.78 | 2.79 | 0.070 | 0.110 |
| L1 | 1.36REF | | 0.054REF | |
| L2 | 1.30REF | | 0.051REF | |

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