

## NCE N-Channel Super Trench Power MOSFET

### Description

The NCEP40T20A 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.

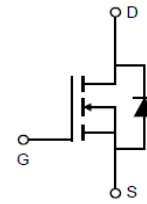
### General Features

- $V_{DS} = 40V, I_D = 200A$   
 $R_{DS(ON)} = 1.3m\Omega$  (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

### Application

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

**100% UIS TESTED!**  
**100% ΔVds TESTED!**



Schematic Diagram



Marking and pin assignment



TO-220-3L top view

### Package Marking and Ordering Information

| Device Marking | Device     | Device Package | Reel Size | Tape width | Quantity |
|----------------|------------|----------------|-----------|------------|----------|
| NCEP40T20A     | NCEP40T20A | TO-220         | -         | -          | -        |

### Absolute Maximum Ratings ( $T_C = 25^\circ C$ unless otherwise noted)

| Parameter   | Symbol             | Limit      | Unit |
|---|--------------------|------------|------|
| Drain-Source Voltage                              | $V_{DS}$           | 40         | V    |
| Gate-Source Voltage                               | $V_{GS}$           | $\pm 20$   | V    |
| Drain Current-Continuous                          | $I_D$              | 200        | A    |
| Drain Current-Continuous( $T_C = 100^\circ C$ )   | $I_D(100^\circ C)$ | 150        | A    |
| Pulsed Drain Current <sup>(Note 1)</sup>          | $I_{DM}$           | 800        | A    |
| Maximum Power Dissipation                         | $P_D$              | 270        | W    |
| Derating factor                                   |                    | 1.8        | W/°C |
| Single pulse avalanche energy <sup>(Note 5)</sup> | $E_{AS}$           | 1692       | mJ   |
| Operating Junction and Storage Temperature Range  | $T_J, T_{STG}$     | -55 To 175 | °C   |

### Thermal Characteristic

|  |                 |      |      |
|--|-----------------|------|------|
| Thermal Resistance, Junction-to-Case <sup>(Note 2)</sup> | $R_{\theta JC}$ | 0.56 | °C/W |
|--|-----------------|------|------|

## Electrical Characteristics ( $T_C=25^\circ\text{C}$ unless otherwise noted)

| Parameter                                 | Symbol       | Condition  | Min | Typ    | Max       | Unit       |
|---|--------------|--|-----|--------|-----------|------------|
| <b>Off Characteristics</b>                |              |  |     |        |           |            |
| Drain-Source Breakdown Voltage            | $BV_{DSS}$   | $V_{GS}=0V, I_D=250\mu A$  | 40  |        | -         | V          |
| Zero Gate Voltage Drain Current           | $I_{DSS}$    | $V_{DS}=40V, V_{GS}=0V$  | -   | -      | 1         | $\mu A$    |
| Gate-Body Leakage Current                 | $I_{GSS}$    | $V_{GS}=\pm 20V, V_{DS}=0V$  | -   | -      | $\pm 100$ | nA         |
| <b>On Characteristics</b> (Note 3)        |              |  |     |        |           |            |
| Gate Threshold Voltage                    | $V_{GS(th)}$ | $V_{DS}=V_{GS}, I_D=250\mu A$  | 2   |        | 3.8       | V          |
| Drain-Source On-State Resistance          | $R_{DS(ON)}$ | $V_{GS}=10V, I_D=100A$   | -   | 1.3    | 1.6       | m $\Omega$ |
| Gate resistance                           | $R_G$        | $F=1.0\text{MHz}$  | -   | 5      | -         | $\Omega$   |
| Forward Transconductance                  | $g_{FS}$     | $V_{DS}=5V, I_D=100A$  |     | 90     | -         | S          |
| <b>Dynamic Characteristics</b> (Note 4)   |              |  |     |        |           |            |
| Input Capacitance                         | $C_{iss}$    | $V_{DS}=20V, V_{GS}=0V,$<br>$F=1.0\text{MHz}$                        | -   | 5834.6 | -         | PF         |
| Output Capacitance                        | $C_{oss}$    |  | -   | 2320.5 | -         | PF         |
| Reverse Transfer Capacitance              | $C_{rss}$    |  | -   | 70     | -         | PF         |
| <b>Switching Characteristics</b> (Note 4) |              |  |     |        |           |            |
| Turn-on Delay Time                        | $t_{d(on)}$  | $V_{DD}=20V, I_D=100A$<br>$V_{GS}=10V, R_G=1.6\Omega$                | -   | 14.5   | -         | nS         |
| Turn-on Rise Time                         | $t_r$        |  | -   | 8      | -         | nS         |
| Turn-Off Delay Time                       | $t_{d(off)}$ |  | -   | 58     | -         | nS         |
| Turn-Off Fall Time                        | $t_f$        |  | -   | 10     | -         | nS         |
| Total Gate Charge                         | $Q_g$        | $V_{DS}=20V, I_D=100A,$<br>$V_{GS}=10V$                              | -   | 91     | -         | nC         |
| Gate-Source Charge                        | $Q_{gs}$     |  | -   | 29.4   |           | nC         |
| Gate-Drain Charge                         | $Q_{gd}$     |  | -   | 19     |           | nC         |
| <b>Drain-Source Diode Characteristics</b> |              |  |     |        |           |            |
| Diode Forward Voltage (Note 3)            | $V_{SD}$     | $V_{GS}=0V, I_S=100A$  | -   |        | 1.2       | V          |
| Diode Forward Current (Note 2)            | $I_S$        |  | -   | -      | 200       | A          |
| Reverse Recovery Time                     | $t_{rr}$     | $T_J = 25^\circ\text{C}, I_F = I_S$<br>$di/dt = 100A/\mu s$ (Note 3) | -   | -      | 38        | nS         |
| Reverse Recovery Charge                   | $Q_{rr}$     |  | -   | -      | 125       | nC         |

### Notes:

1. Repetitive Rating: Pulse width limited by maximum junction temperature.
2. Surface Mounted on FR4 Board,  $t \leq 10$  sec.
3. Pulse Test: Pulse Width  $\leq 300\mu s$ , Duty Cycle  $\leq 2\%$ .
4. Guaranteed by design, not subject to production
5. EAS condition :  $T_J=25^\circ\text{C}, V_{DD}=20V, V_G=10V, L=0.5\text{mH}, R_g=25\Omega$

Typical Electrical and Thermal Characteristics

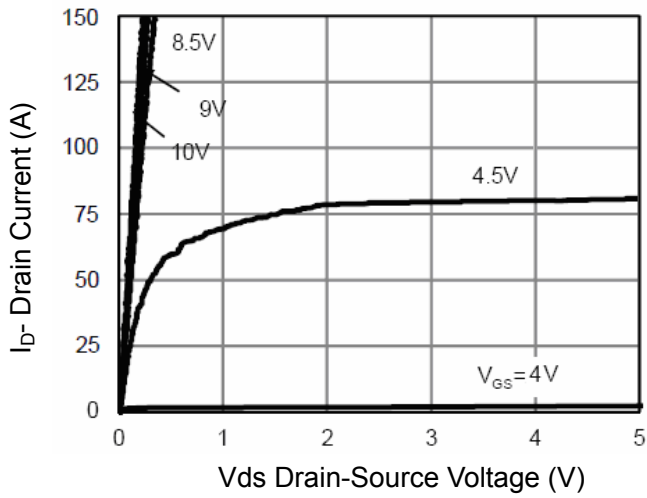


Figure 1 Output Characteristics

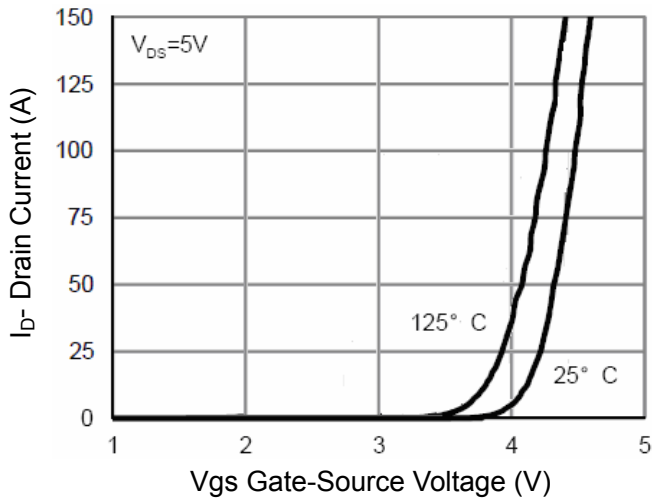


Figure 2 Transfer Characteristics

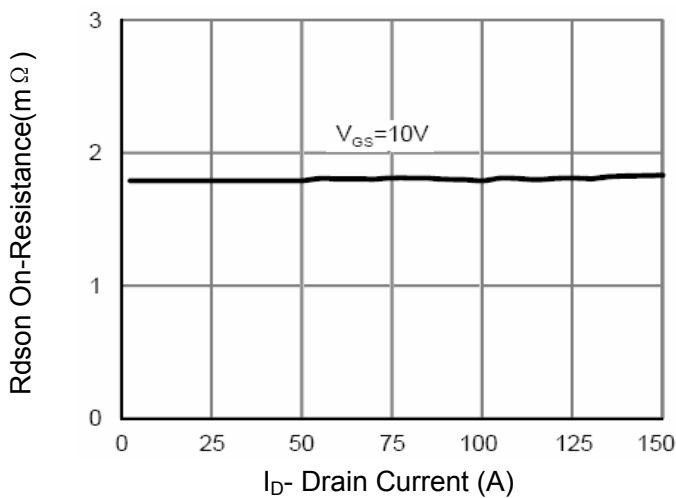


Figure 3 Rdson- Drain Current

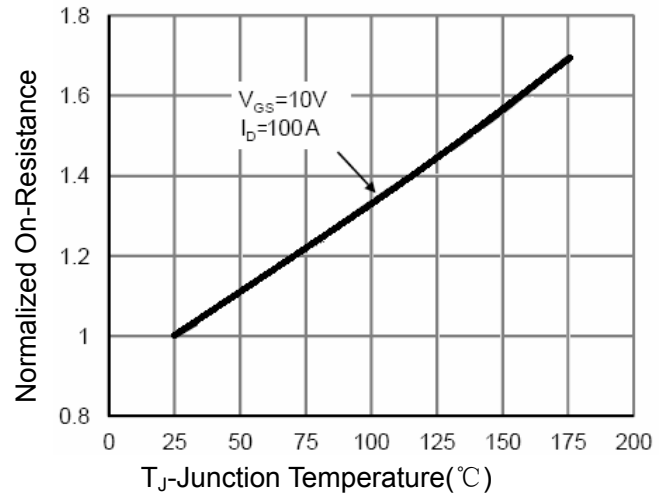


Figure 4 Rdson-Junction Temperature

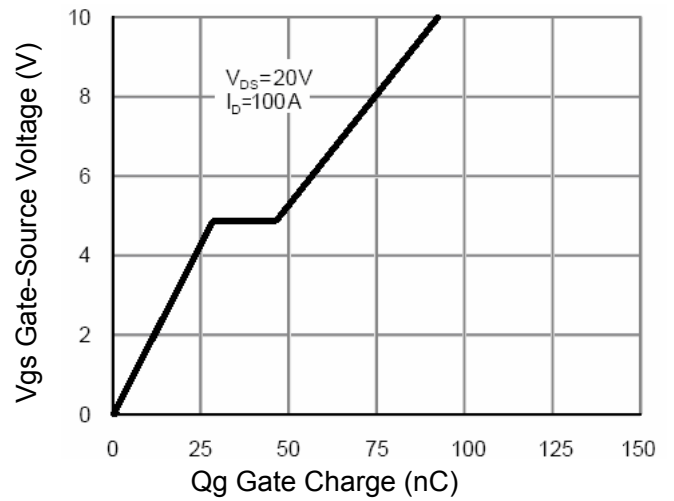


Figure 5 Gate Charge

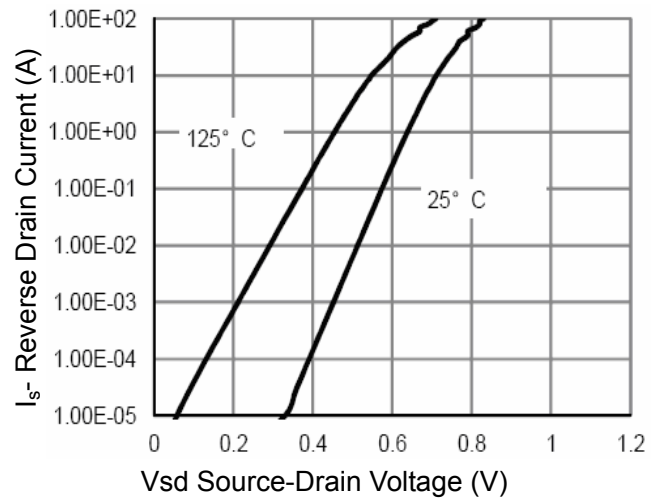


Figure 6 Source- Drain Diode Forward

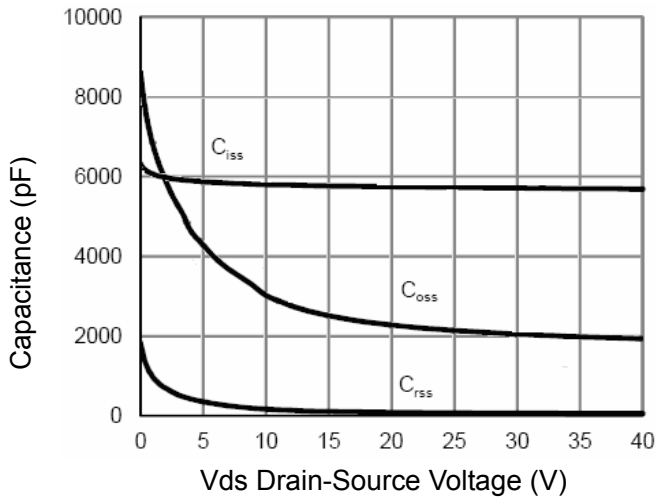


Figure 7 Capacitance vs Vds

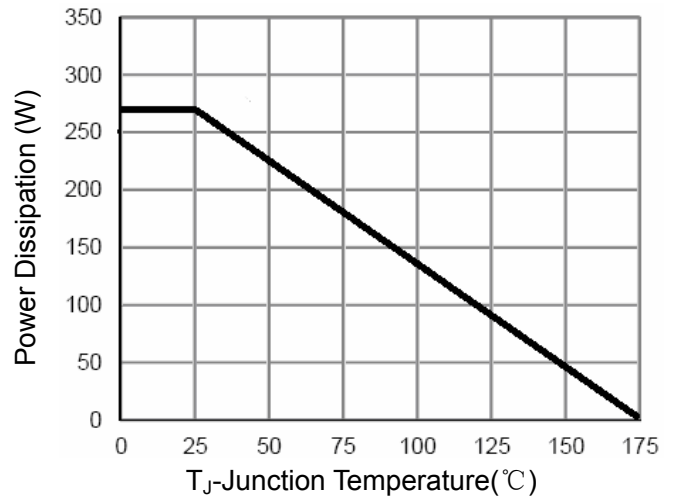


Figure 9 Power De-rating

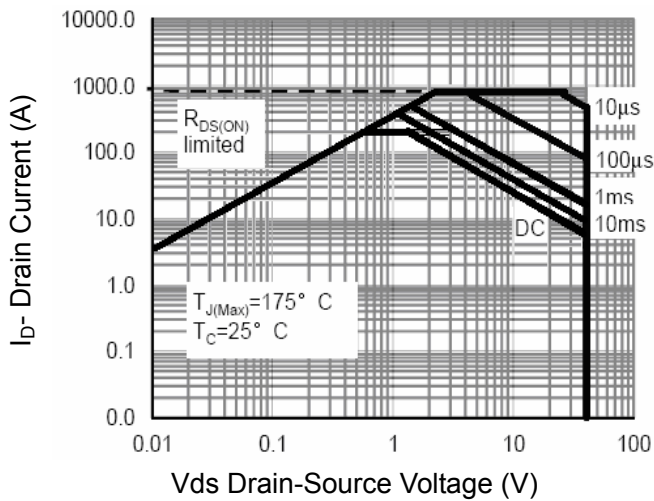


Figure 8 Safe Operation Area

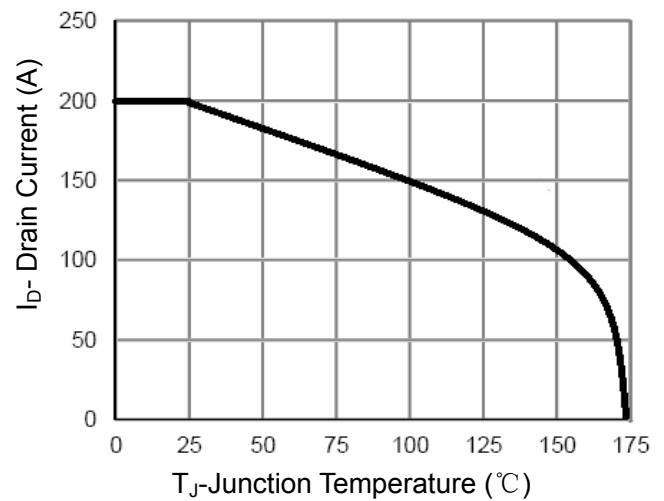


Figure 10 Current De-rating

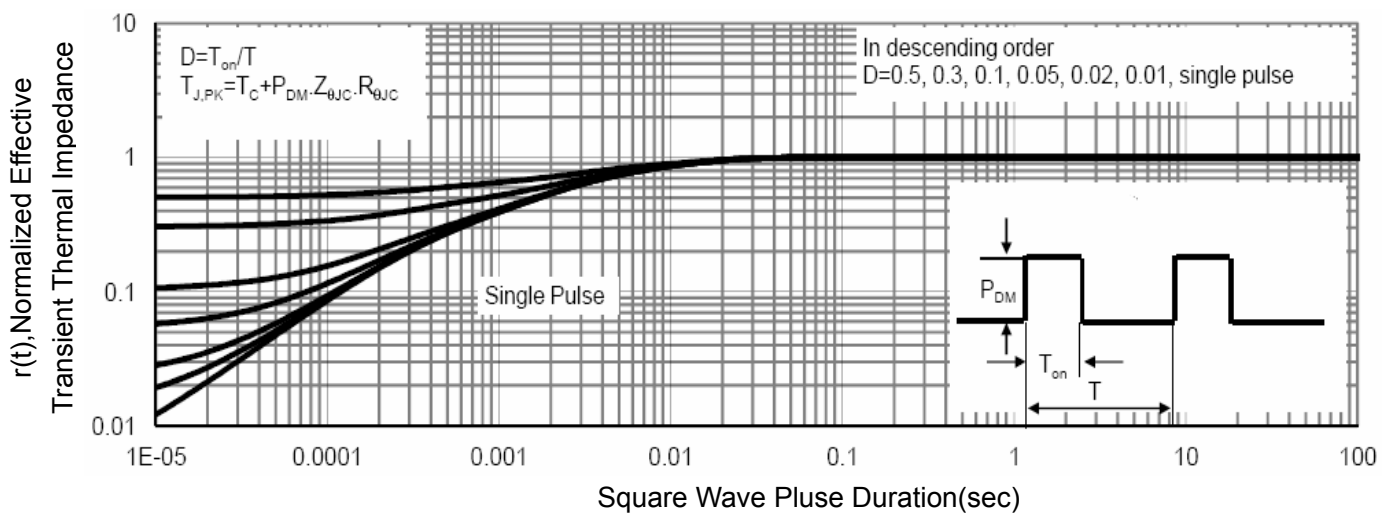
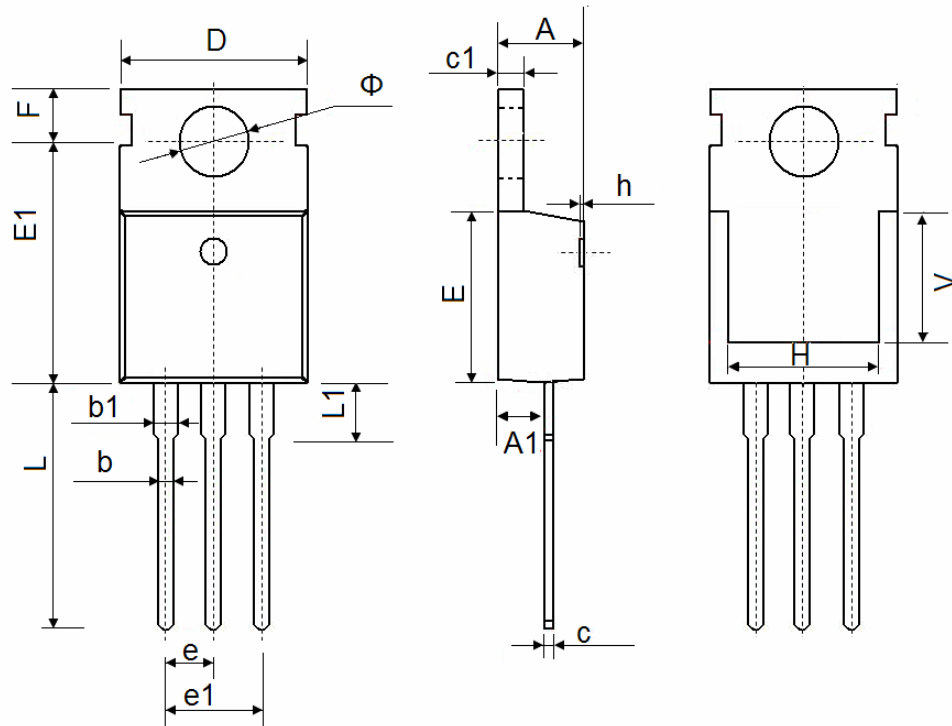


Figure 11 Normalized Maximum Transient Thermal Impedance

## 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      | 6.900 REF.                |        | 0.276 REF.           |       |
| Φ      | 3.400                     | 3.800  | 0.134                | 0.150 |

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