

## NCE N-Channel Enhancement Mode Power MOSFET

### Description

The NCE6050KA uses advanced trench technology and design to provide excellent  $R_{DS(ON)}$  with low gate charge. It can be used in a wide variety of applications.

### General Features

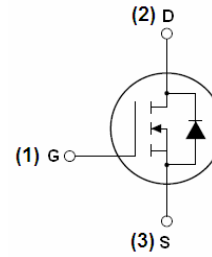
- $V_{DS} = 60V, I_D = 50A$   
 $R_{DS(ON)} < 20m\Omega @ V_{GS} = 10V$
- High density cell design for ultra low  $R_{dson}$
- Fully characterized avalanche voltage and current
- Good stability and uniformity with high  $E_{AS}$
- Excellent package for good heat dissipation
- Special process technology for high ESD capability

### Application

- Power switching application
- Hard switched and high frequency circuits
- Uninterruptible power supply

**100% UIS TESTED!**

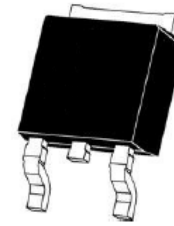
**100%  $\Delta V_{ds}$  TESTED!**



Schematic diagram



Marking and pin assignment



TO-252-2L top view

### Package Marking and Ordering Information

| Device Marking | Device    | Device Package | Reel Size | Tape width | Quantity |
|----------------|-----------|----------------|-----------|------------|----------|
| NCE6050KA      | NCE6050KA | TO-252-2L      | -         | -          | -        |

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

| Parameter   | Symbol              | Limit      | Unit          |
|---|---------------------|------------|---------------|
| Drain-Source Voltage                              | $V_{DS}$            | 60         | V             |
| Gate-Source Voltage                               | $V_{GS}$            | $\pm 20$   | V             |
| Drain Current-Continuous                          | $I_D$               | 50         | A             |
| Drain Current-Continuous ( $T_C = 100^\circ C$ )  | $I_D (100^\circ C)$ | 35.4       | A             |
| Pulsed Drain Current                              | $I_{DM}$            | 200        | A             |
| Maximum Power Dissipation                         | $P_D$               | 85         | W             |
| Derating factor                                   |                     | 0.57       | W/ $^\circ C$ |
| Single pulse avalanche energy <sup>(Note 5)</sup> | $E_{AS}$            | 300        | mJ            |
| Operating Junction and Storage Temperature Range  | $T_J, T_{STG}$      | -55 To 175 | $^\circ C$    |

## Thermal Characteristic

|  |                 |     |      |
|--|-----------------|-----|------|
| Thermal Resistance, Junction-to-Case <sup>(Note 2)</sup> | $R_{\theta JC}$ | 1.8 | °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                       | $BV_{DSS}$   | $V_{GS}=0V, I_D=250\mu A$   | 60  | -    | -         | V          |
| Zero Gate Voltage Drain Current                      | $I_{DSS}$    | $V_{DS}=60V, V_{GS}=0V$   | -   | -    | 1         | $\mu A$    |
| Gate-Body Leakage Current                            | $I_{GSS}$    | $V_{GS}=\pm 20V, V_{DS}=0V$   | -   | -    | $\pm 100$ | nA         |
| <b>On Characteristics</b> <sup>(Note 3)</sup>        |              |   |     |      |           |            |
| Gate Threshold Voltage                               | $V_{GS(th)}$ | $V_{DS}=V_{GS}, I_D=250\mu A$   | 1.4 | 1.9  | 2.5       | V          |
| Drain-Source On-State Resistance                     | $R_{DS(ON)}$ | $V_{GS}=10V, I_D=20A$   | -   | 14   | 20        | m $\Omega$ |
| Forward Transconductance                             | $g_{FS}$     | $V_{DS}=5V, I_D=20A$  | 18  | -    | -         | S          |
| <b>Dynamic Characteristics</b> <sup>(Note 4)</sup>   |              |   |     |      |           |            |
| Input Capacitance                                    | $C_{iss}$    | $V_{DS}=30V, V_{GS}=0V,$<br>$F=1.0\text{MHz}$   | -   | 2050 | -         | PF         |
| Output Capacitance                                   | $C_{oss}$    |   | -   | 158  | -         | PF         |
| Reverse Transfer Capacitance                         | $C_{rss}$    |   | -   | 120  | -         | PF         |
| <b>Switching Characteristics</b> <sup>(Note 4)</sup> |              |   |     |      |           |            |
| Turn-on Delay Time                                   | $t_{d(on)}$  | $V_{DD}=30V, R_L=6.7\Omega$<br>$V_{GS}=10V, R_G=3\Omega$                              | -   | 7.4  | -         | nS         |
| Turn-on Rise Time                                    | $t_r$        |   | -   | 5.1  | -         | nS         |
| Turn-Off Delay Time                                  | $t_{d(off)}$ |   | -   | 28.2 | -         | nS         |
| Turn-Off Fall Time                                   | $t_f$        |   | -   | 5.5  | -         | nS         |
| Total Gate Charge                                    | $Q_g$        | $V_{DS}=30V, I_D=20A,$<br>$V_{GS}=10V$  | -   | 50   | -         | nC         |
| Gate-Source Charge                                   | $Q_{gs}$     |   | -   | 6    | -         | nC         |
| Gate-Drain Charge                                    | $Q_{gd}$     |   | -   | 15   | -         | nC         |
| <b>Drain-Source Diode Characteristics</b>            |              |   |     |      |           |            |
| Diode Forward Voltage <sup>(Note 3)</sup>            | $V_{SD}$     | $V_{GS}=0V, I_S=20A$  | -   | -    | 1.2       | V          |
| Diode Forward Current <sup>(Note 2)</sup>            | $I_S$        |   | -   | -    | 50        | A          |
| Reverse Recovery Time                                | $t_{rr}$     | $T_J = 25^\circ\text{C}, I_F = 20A$<br>$di/dt = 100A/\mu\text{s}$ <sup>(Note 3)</sup> | -   | 28   | -         | nS         |
| Reverse Recovery Charge                              | $Q_{rr}$     |   | -   | 40   | -         | nC         |
| Forward Turn-On Time                                 | $t_{on}$     | Intrinsic turn-on time is negligible (turn-on is dominated by LS+LD)                  |     |      |           |            |

## 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  $\leq 300\mu\text{s}$ , Duty Cycle  $\leq 2\%$ .
4. Guaranteed by design, not subject to production
5. EAS condition :  $T_J=25^\circ\text{C}, V_{DD}=30V, V_G=10V, L=0.5\text{mH}, R_g=25\Omega$

**Test Circuit**

**1) E<sub>AS</sub> test Circuit**



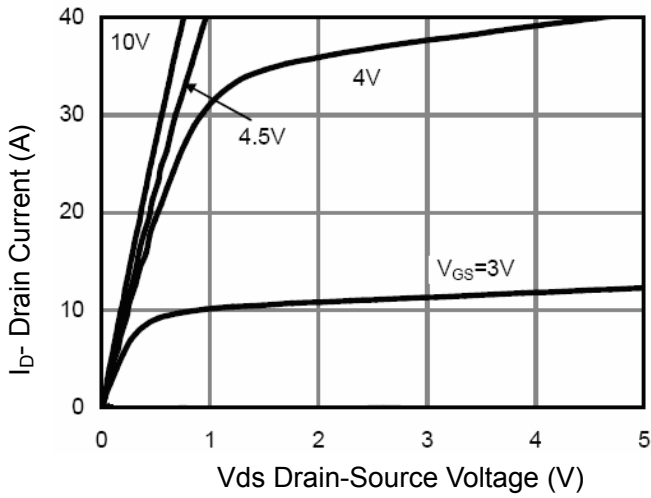
**2) Gate charge test Circuit**



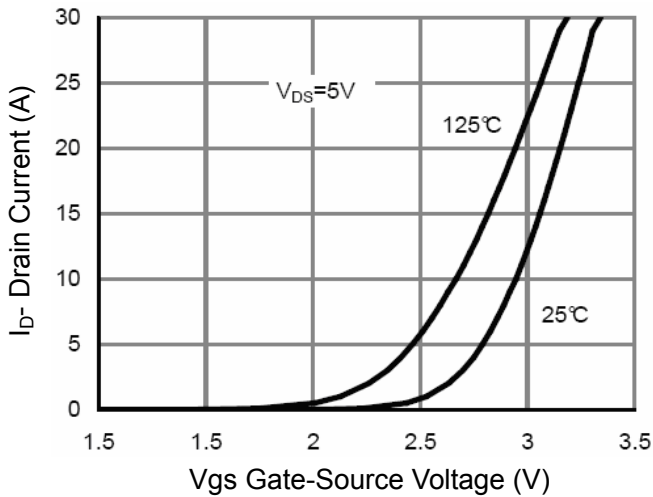
**3) Switch Time Test Circuit**



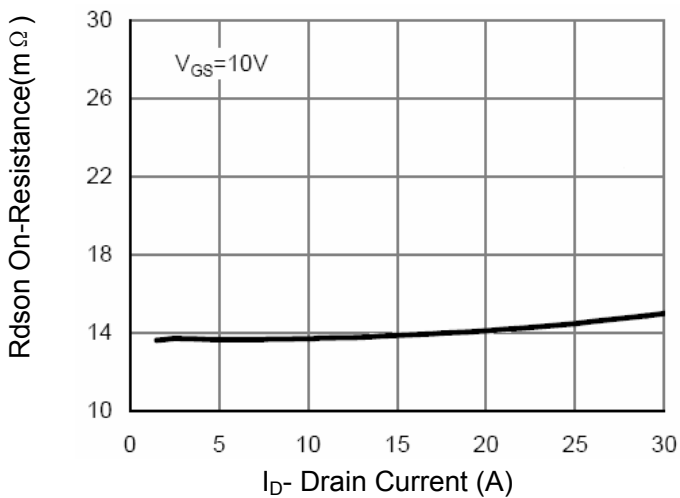
## Typical Electrical and Thermal Characteristics (Curves)



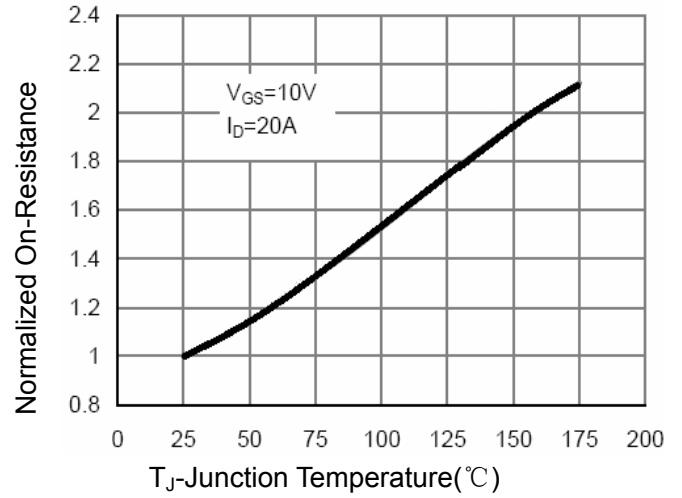
**Figure 1 Output Characteristics**



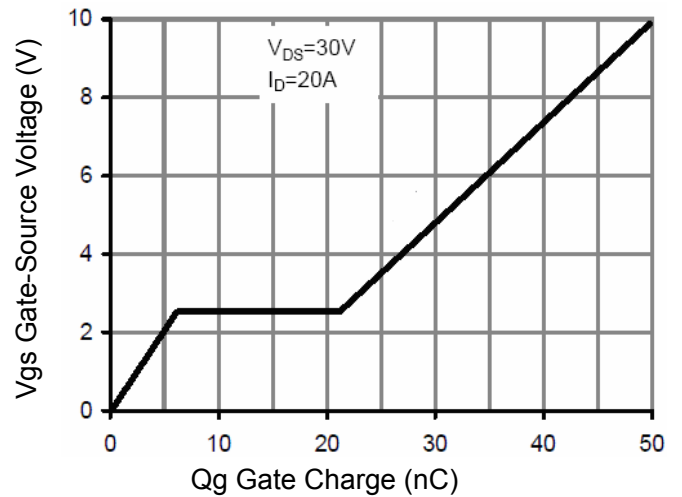
**Figure 2 Transfer Characteristics**



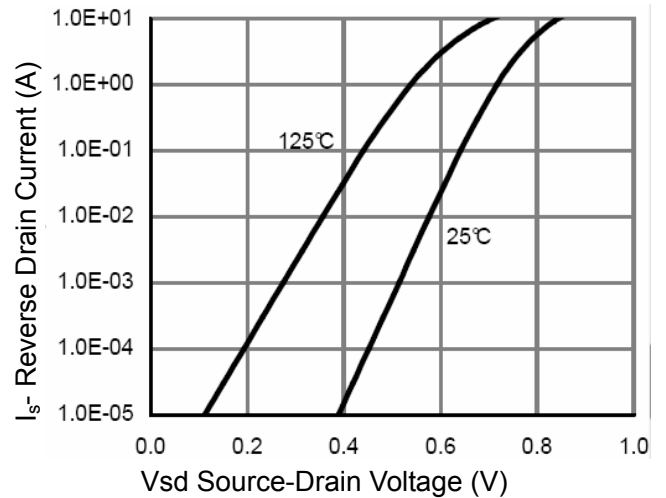
**Figure 3 Rdson- Drain Current**



**Figure 4 Rdson-Junction Temperature**



**Figure 5 Gate Charge**



**Figure 6 Source- Drain Diode Forward**

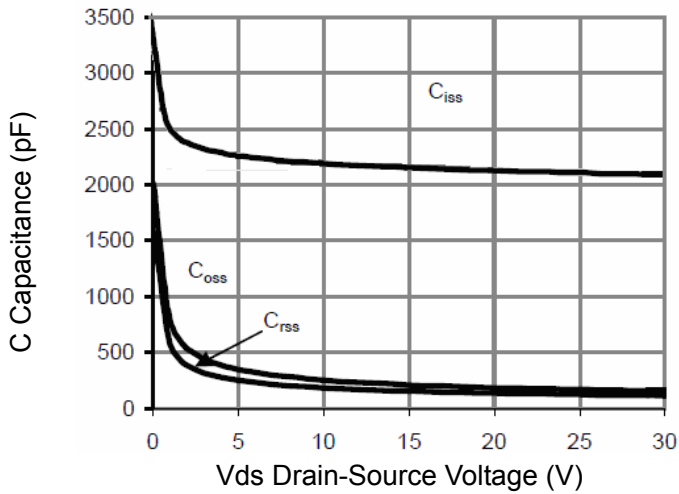


Figure 7 Capacitance vs Vds

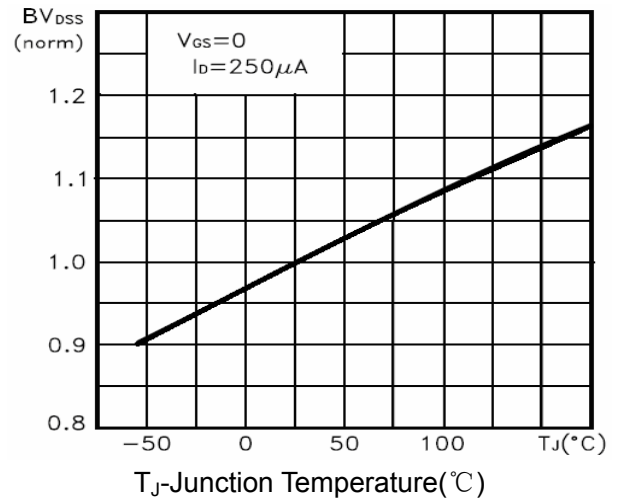


Figure 9  $BV_{DSS}$  vs Junction Temperature

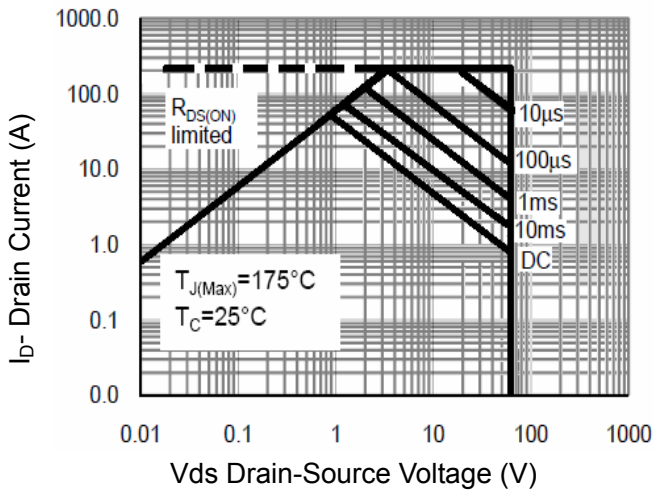


Figure 8 Safe Operation Area

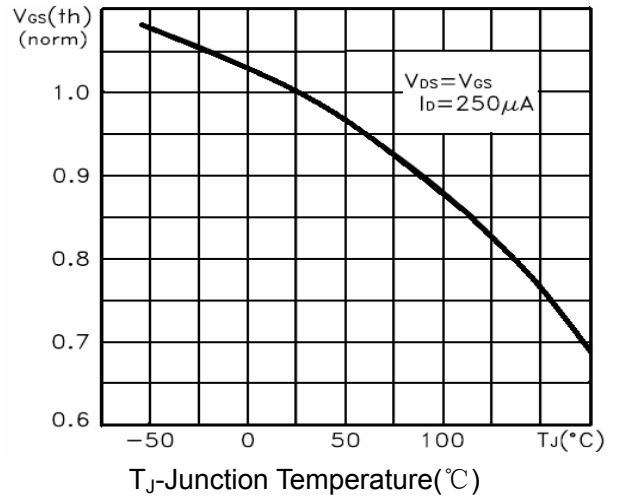


Figure 10  $V_{GS(th)}$  vs Junction Temperature

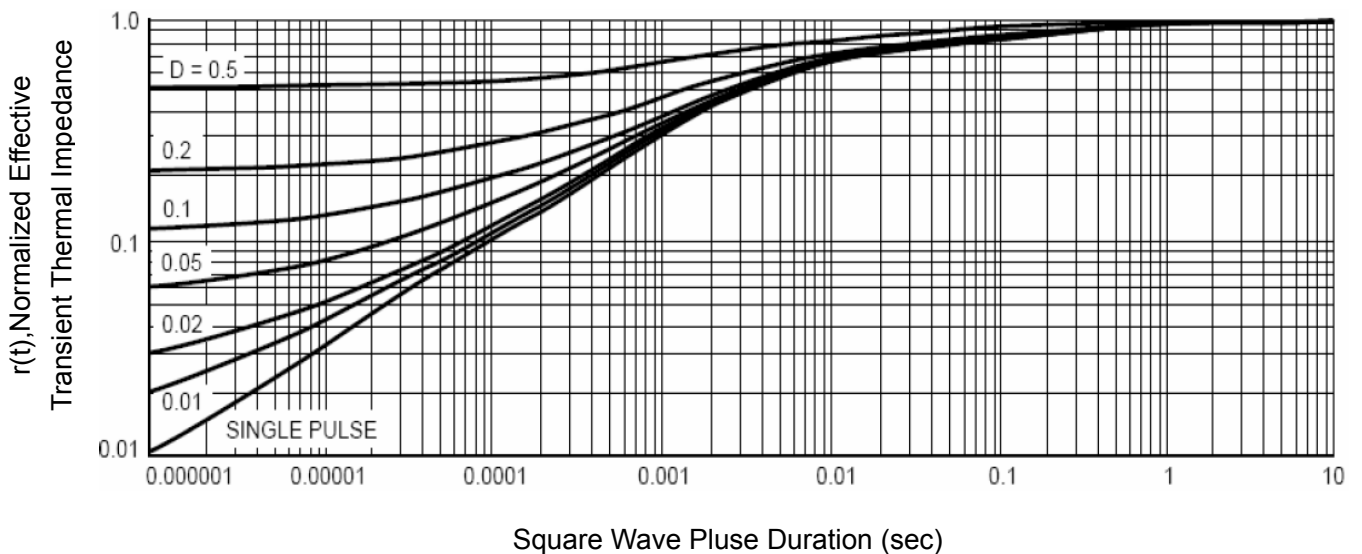


Figure 11 Normalized Maximum Transient Thermal Impedance

**TO-252 Package Information**


| Symbol | Dimensions In Millimeters |        | Dimensions In Inches |       |
|--------|---------------------------|--------|----------------------|-------|
|        | Min.                      | Max.   | Min.                 | Max.  |
| A      | 2.200                     | 2.400  | 0.087                | 0.094 |
| A1     | 0.000                     | 0.127  | 0.000                | 0.005 |
| b      | 0.660                     | 0.860  | 0.026                | 0.034 |
| c      | 0.460                     | 0.580  | 0.018                | 0.023 |
| D      | 6.500                     | 6.700  | 0.256                | 0.264 |
| D1     | 5.100                     | 5.460  | 0.201                | 0.215 |
| D2     | 4.830 TYP.                |        | 0.190 TYP.           |       |
| E      | 6.000                     | 6.200  | 0.236                | 0.244 |
| e      | 2.186                     | 2.386  | 0.086                | 0.094 |
| L      | 9.800                     | 10.400 | 0.386                | 0.409 |
| L1     | 2.900 TYP.                |        | 0.114 TYP.           |       |
| L2     | 1.400                     | 1.700  | 0.055                | 0.067 |
| L3     | 1.600 TYP.                |        | 0.063 TYP.           |       |
| L4     | 0.600                     | 1.000  | 0.024                | 0.039 |
| Φ      | 1.100                     | 1.300  | 0.043                | 0.051 |
| θ      | 0°                        | 8°     | 0°                   | 8°    |
| h      | 0.000                     | 0.300  | 0.000                | 0.012 |
| V      | 5.350 TYP.                |        | 0.211 TYP.           |       |

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