# NCE N-Channel Enhancement Mode Power MOSFET

## Description

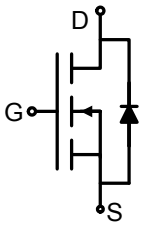
The NCE3402 uses advanced trench technology to provide excellent $R_{DS(ON)}$, low gate charge and operation with gate voltages as low as 2.5V. This device is suitable for use as a Battery protection or in other Switching application.

## General Features

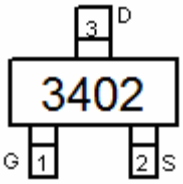
- $V_{DS}$ = 30V,$I_D$ = 3A
  $R_{DS(ON)}$ < 75mΩ @ $V_{GS}$=2.5V
  $R_{DS(ON)}$ < 65mΩ @ $V_{GS}$=4.5V
- High power and current handing capability
- Lead free product is acquired
- Surface mount package

## Application

- Battery protection
- Load switch
- Power management




**Schematic diagram**




**Marking and pin assignment**


**SOT-23 top view**

## Package Marking and Ordering Information

| Device Marking | Device | Device Package | Reel Size | Tape width | Quantity |
|---|---|---|---|---|---|
| 3402 | NCE3402 | SOT-23 | Ø180mm | 8 mm | 3000 units |

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

| Parameter | Symbol | Limit | Unit |
|---|---|---|---|
| Drain-Source Voltage | $V_{DS}$ | 30 | V |
| Gate-Source Voltage | $V_{GS}$ | ±20 | V |
| Drain Current-Continuous | $I_D$ | 3 | A |
| Drain Current-Pulsed (Note 1) | $I_{DM}$ | 20 | A |
| Maximum Power Dissipation | $P_D$ | 0.9 | W |
| Operating Junction and Storage Temperature Range | $T_J$,$T_{STG}$ | -55 To 150 | ℃ |

## Thermal Characteristic

| | | | |
|---|---|---|---|
| Thermal Resistance,Junction-to-Ambient (Note 2) | $R_{\theta JA}$ | 138 | ℃/W |

## Electrical Characteristics ($T_A$=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 | 30 | - | - | V |
| Zero Gate Voltage Drain Current | $I_{DSS}$ | $V_{DS}$=20V,$V_{GS}$=0V | - | - | 1 | μA |

| Parameter | Symbol | Condition | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| Gate-Body Leakage Current | $I_{GSS}$ | $V_{GS}$=±20V,$V_{DS}$=0V | - | - | ±100 | nA |
| **On Characteristics** (Note 3) | | | | | | |
| Gate Threshold Voltage | $V_{GS(th)}$ | $V_{DS}$=$V_{GS}$,$I_D$=250μA | 1 | 1.5 | 3.0 | V |
| Drain-Source On-State Resistance | $R_{DS(ON)}$ | $V_{GS}$=10V, $I_D$=3A | - | 50 | 65 | mΩ |
| | | $V_{GS}$=4.5V, $I_D$=3 A | - | 65 | 75 | mΩ |
| Forward Transconductance | $g_{FS}$ | $V_{DS}$=5V,$I_D$=3A | 14 | - | - | S |
| **Dynamic Characteristics** (Note4) | | | | | | |
| Input Capacitance | $C_{lss}$ | $V_{DS}$=10V,$V_{GS}$=0V, F=1.0MHz | - | 235 | - | PF |
| Output Capacitance | $C_{oss}$ | | - | 35 | - | PF |
| Reverse Transfer Capacitance | $C_{rss}$ | | - | 18 | - | PF |
| **Switching Characteristics** (Note 4) | | | | | | |
| Turn-on Delay Time | $t_{d(on)}$ | $V_{DD}$=15V,$I_D$=1A $V_{GS}$=10V,$R_{GEN}$=6Ω | - | 3.5 | - | nS |
| Turn-on Rise Time | $t_r$ | | - | 1.5 | - | nS |
| Turn-Off Delay Time | $t_{d(off)}$ | | - | 17.5 | - | nS |
| Turn-Off Fall Time | $t_f$ | | - | 2.5 | - | nS |
| Total Gate Charge | $Q_g$ | $V_{DS}$=15V,$I_D$=3A,$V_{GS}$=10V | - | 10 | - | nC |
| Gate-Source Charge | $Q_{gs}$ | | - | 0.95 | - | nC |
| Gate-Drain Charge | $Q_{gd}$ | | - | 1.6 | - | nC |
| **Drain-Source Diode Characteristics** | | | | | | |
| Diode Forward Voltage (Note 3) | $V_{SD}$ | $V_{GS}$=0V,$I_S$=3A | - | - | 1.2 | V |
| Diode Forward Current (Note 2) | $I_S$ | | - | - | 3 | A |

## Notes:

**1.** Repetitive Rating: Pulse width limited by maximum junction temperature.
**2.** Surface Mounted on FR4 Board, t ≤ 10 sec.
**3.** Pulse Test: Pulse Width ≤ 300μs, Duty Cycle ≤ 2%.
**4.** Guaranteed by design, not subject to production

## Typical Electrical and Thermal Characteristics

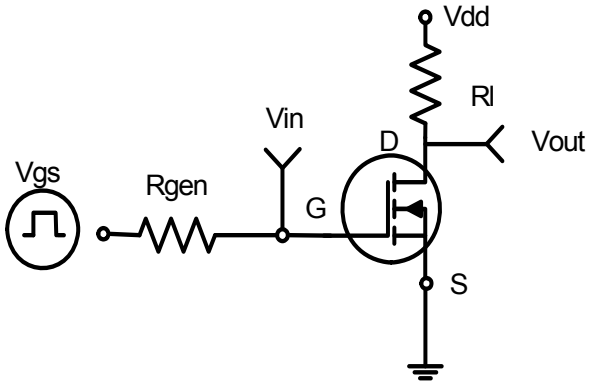



**Figure 1:Switching Test Circuit**

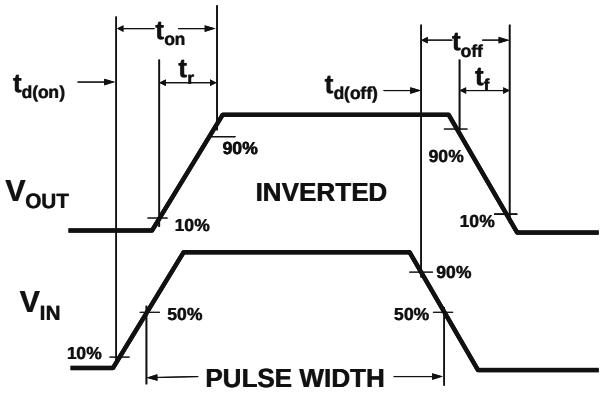



**Figure 2:Switching Waveforms**

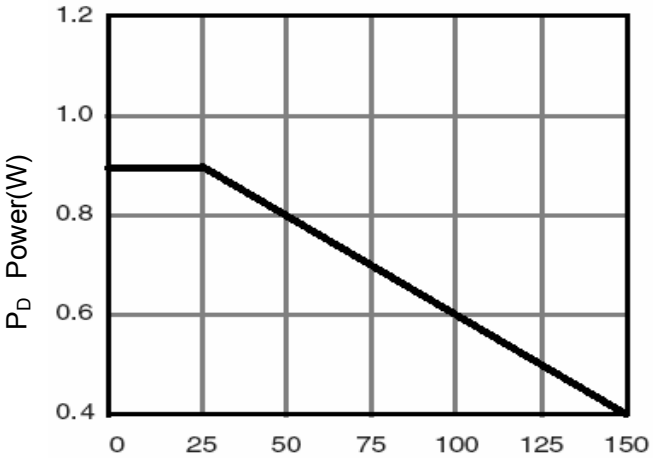



**Figure 3 Power Dissipation**

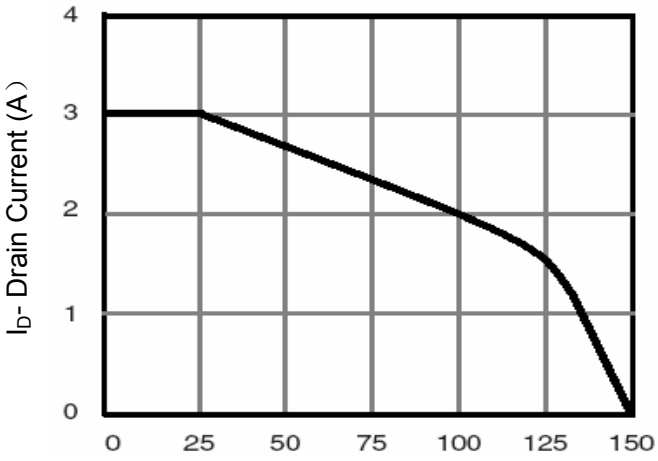



**Figure 4 Drain Current**

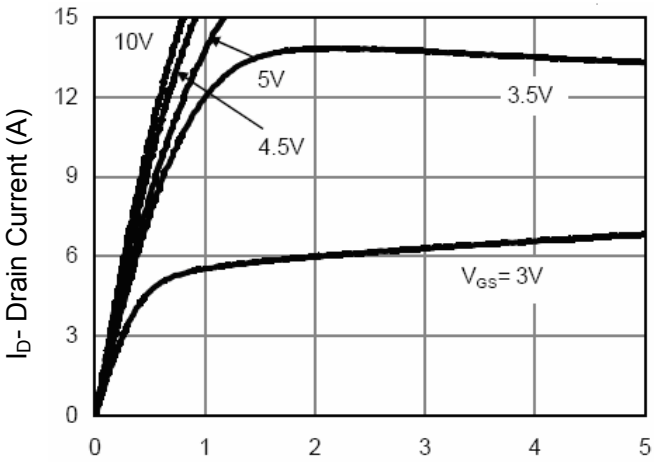



**Figure 5 Output Characteristics**

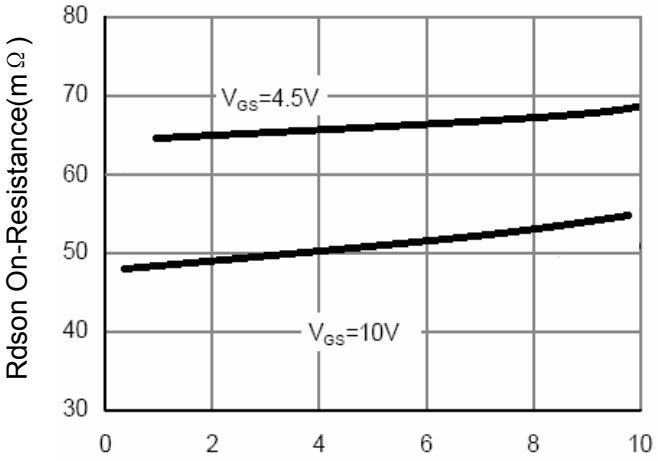



**Figure 6 Drain-Source On-Resistance**

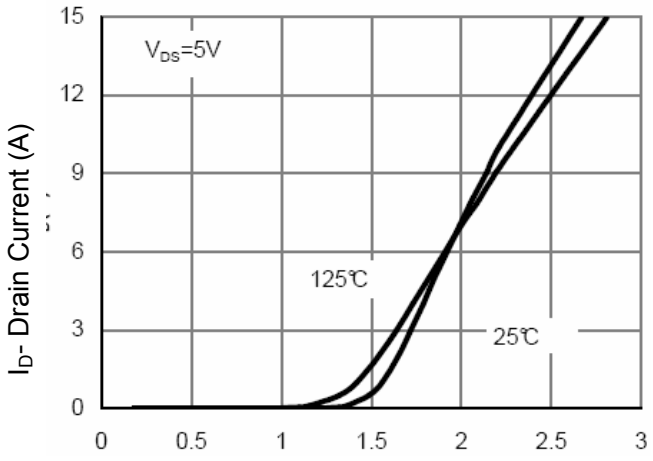



**Figure 7 Transfer Characteristics**

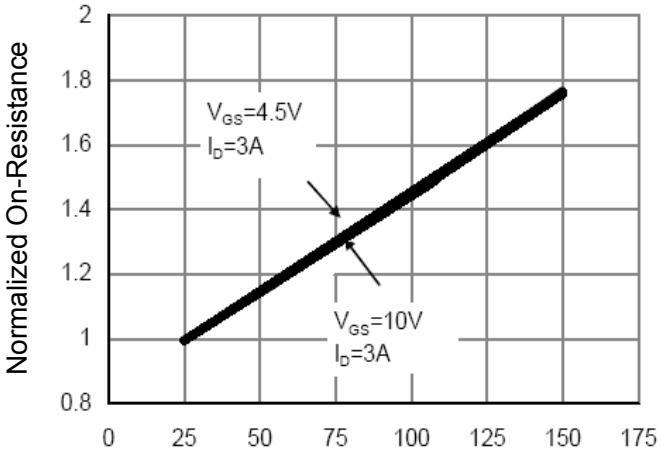



**Figure 8 Drain-Source On-Resistance**

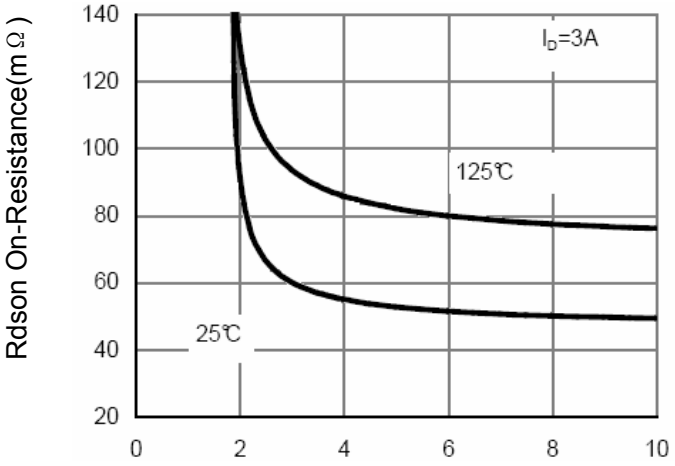



**Figure 9 Rdson vs Vgs**

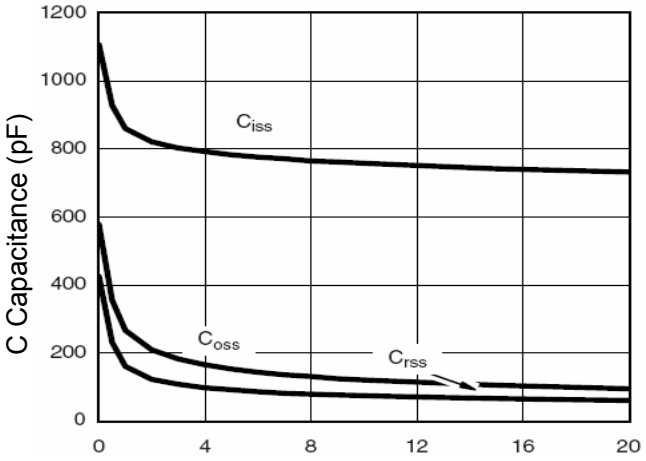



**Figure 10 Capacitance vs Vds**

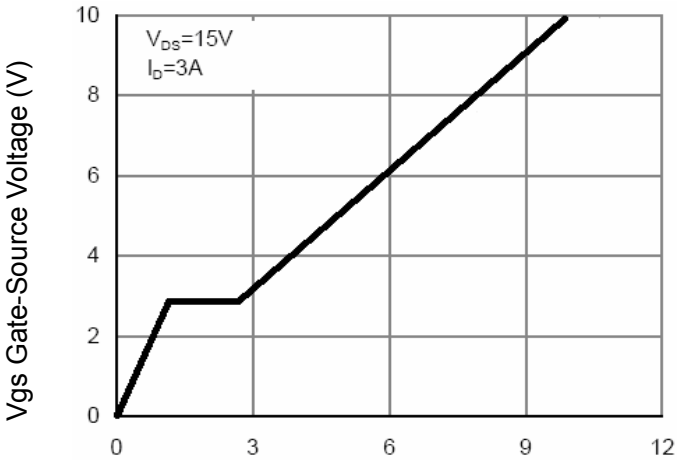



**Figure 11 Gate Charge**

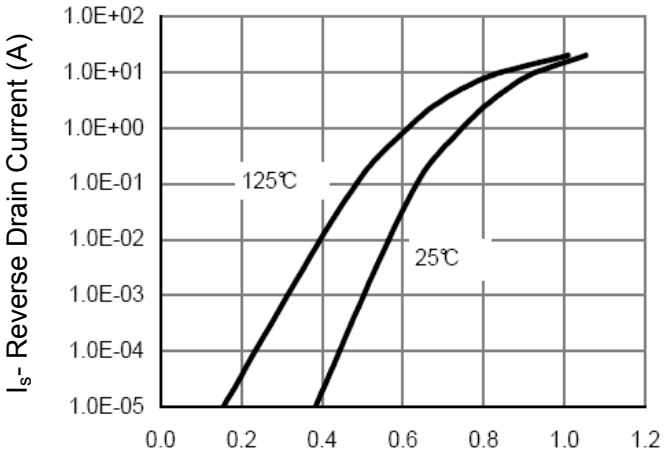



**Figure 12 Source- Drain Diode Forward**

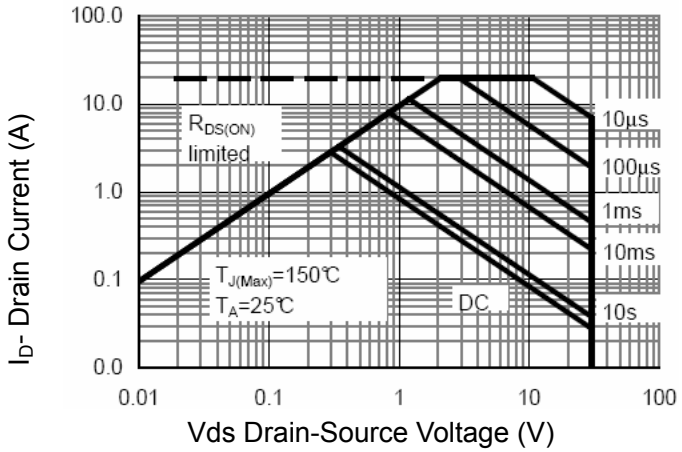



**Figure 13 Safe Operation Area**

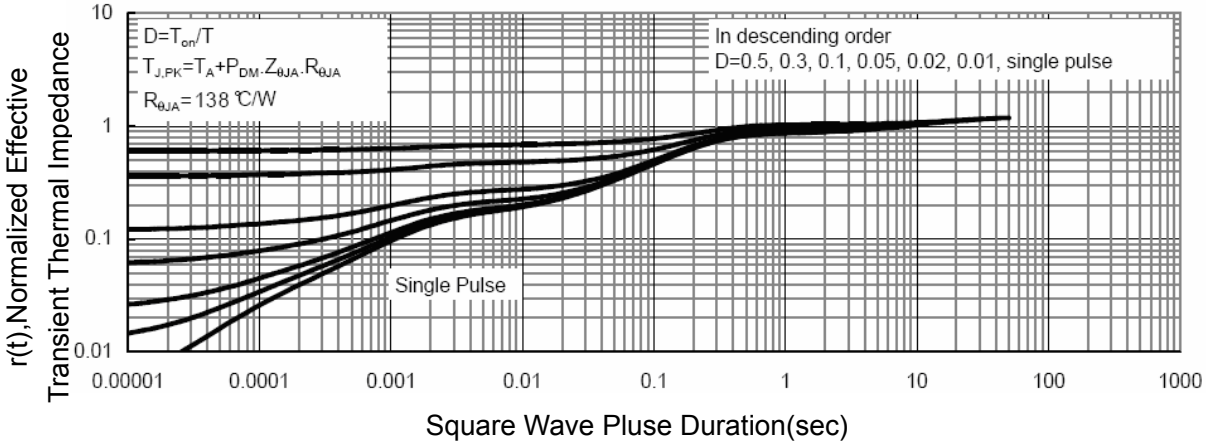
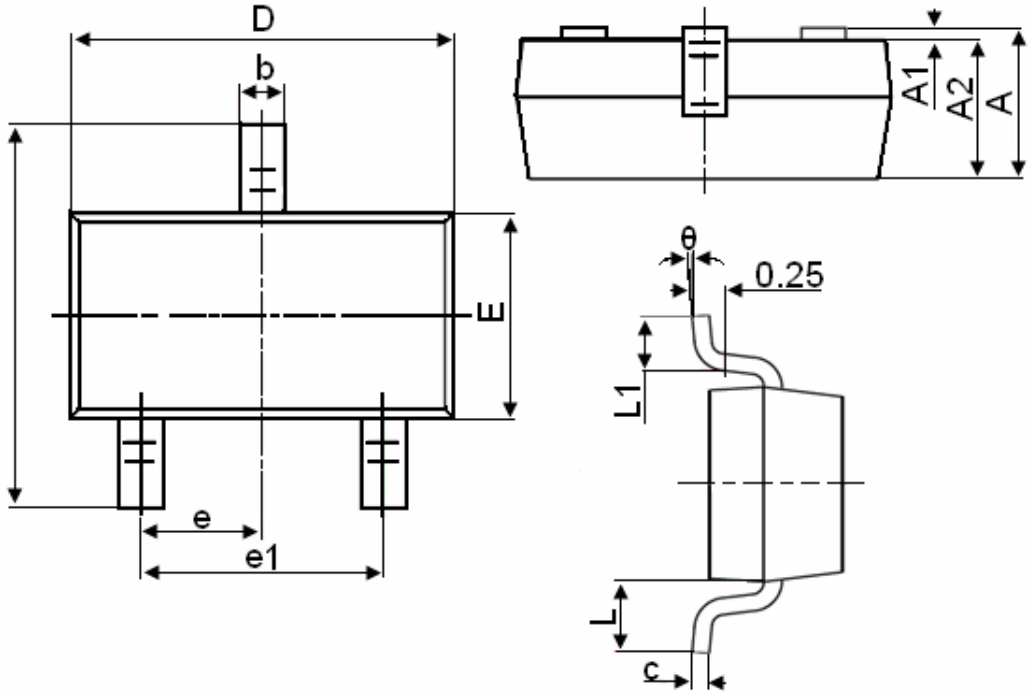



**Figure 14 Normalized Maximum Transient Thermal Impedance**

## SOT-23 Package Information




| Symbol | Dimensions in Millimeters | |
|---|---|---|
| | MIN. | MAX. |
| A | 0.900 | 1.150 |
| A1 | 0.000 | 0.100 |
| A2 | 0.900 | 1.050 |
| b | 0.300 | 0.500 |
| c | 0.080 | 0.150 |
| D | 2.800 | 3.000 |
| E | 1.200 | 1.400 |
| E1 | 2.250 | 2.550 |
| e | 0.950TYP | |
| e1 | 1.800 | 2.000 |
| L | 0.550REF | |
| L1 | 0.300 | 0.500 |
| θ | 0° | 8° |

## Notes

1. All dimensions are in millimeters.
2. Tolerance ±0.10mm (4 mil) unless otherwise specified
3. Package body sizes exclude mold flash and gate burrs. Mold flash at the non-lead sides should be less than 5 mils.
4. Dimension L is measured in gauge plane.
5. Controlling dimension is millimeter, converted inch dimensions are not necessarily exact.

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