

# NUS1204MN

## Overvoltage Protection IC with Integrated MOSFET

This device represents a new level of safety and integration by combining the NCP304 overvoltage protection circuit (OVP) with a -12 V P-Channel power MOSFET. It is specifically designed to protect sensitive electronic circuitry from overvoltage transients and power supply faults. During such hazardous events, the IC quickly disconnects the input supply from the load, thus protecting the load before any damage can occur.

The OVP IC is optimized for applications using an external AC-DC adapter or a car accessory charger to power a portable product or recharge its internal batteries. It has a nominal overvoltage threshold of 4.725 V which makes it ideal for single cell Li-Ion as well as 3/4 cell NiCD/NiMH applications.

### Features

- Overvoltage Turn-Off Time of Less Than 20  $\mu$ s
- Accurate Voltage Threshold of 4.725 V, Nominal
- High Accuracy Undervoltage Threshold of 2.0%
- -12 V Integrated P-Channel Power MOSFET
- Low  $R_{DS(on)}$  = 75 m $\Omega$  @ -4.725 V
- Low Profile 2.0 x 2.0 mm WDFN Package Suitable for Portable Applications
- Maximum Solder Reflow Temperature @ 260°C
- This device is manufactured with a Pb-Free external lead finish only.

### Benefits

- Provide Battery Protection
- Integrated Solution Offers Cost and Space Savings
- Integrated Solution Improves System Reliability

### Applications

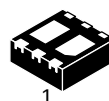
- Portable Computers and PDAs
- Cell Phones and Handheld Products
- Digital Cameras



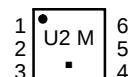
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### MARKING DIAGRAM

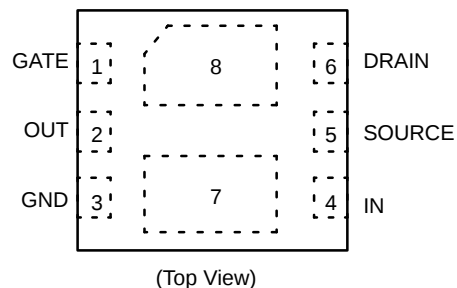


**WDFN6  
CASE 506AN**



U2 = Specific Device Code  
M = Date Code  
■ = Pb-Free Package

### PIN CONNECTIONS



### ORDERING INFORMATION

| Device       | Package            | Shipping <sup>†</sup> |
|--------------|--------------------|-----------------------|
| NUS1204MNT1G | WDFN6<br>(Pb-Free) | 3000 Tape & Reel      |

<sup>†</sup>For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specification Brochure, BRD8011/D.

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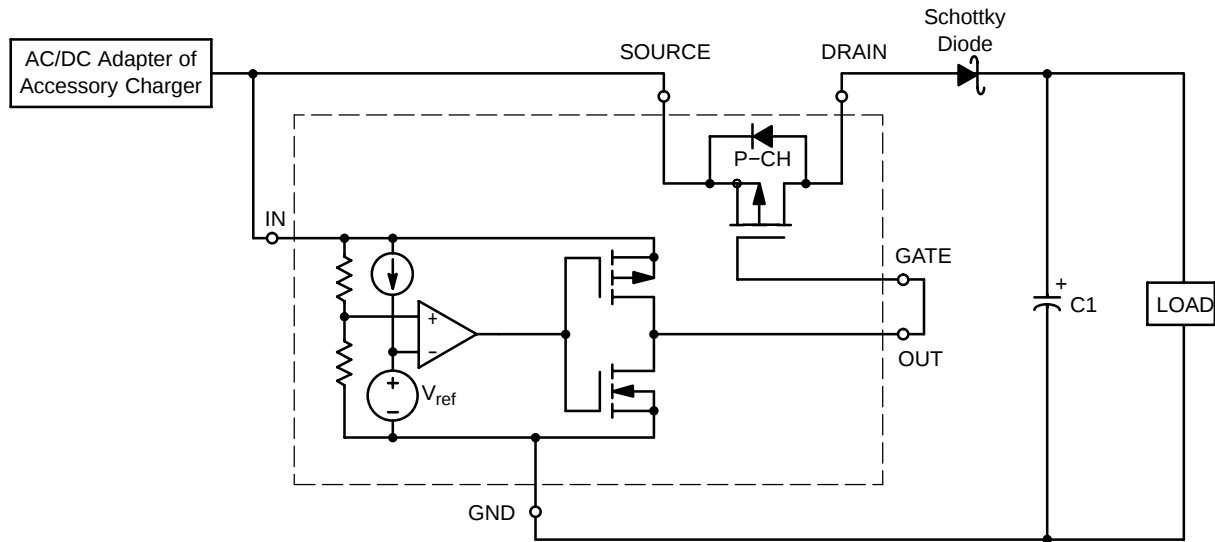


Figure 1. Simplified Schematic

## PIN FUNCTION DESCRIPTIONS

| Pin # | Symbol | Pin Description                                                                                                                                                                                                                                                                                                                                                                                    |
|-------|--------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1     | GATE   | Gate pin of the P-Channel Power MOSFET                                                                                                                                                                                                                                                                                                                                                             |
| 2     | OUT    | This signal drives the gate of a P-channel Power MOSFET. It is controlled by the voltage level on the IN pin. When an overvoltage event is detected, the OUT pin is driven to within 1.0 V of $V_{IN}$ in less than 20 $\mu$ sec provided that gate and stray capacitance is less than 12 nF.                                                                                                      |
| 3, 7  | GND    | Circuit Ground                                                                                                                                                                                                                                                                                                                                                                                     |
| 4     | IN     | This pin senses an external voltage point. If the voltage on this input rises above the overvoltage threshold ( $V_{TH}$ ), the OUT pin will be driven to within 1.0 V of $V_{IN}$ , thus disconnecting the P-Channel Power MOSFET. The nominal threshold level is 4.725 V and this threshold level can be increased with the addition of an external resistor between the IN pin and the adapter. |
| 5     | SOURCE | Source pin of the P-Channel Power MOSFET                                                                                                                                                                                                                                                                                                                                                           |
| 6, 8  | DRAIN  | Drain pin of the P-Channel Power MOSFET                                                                                                                                                                                                                                                                                                                                                            |

## OVERVOLTAGE PROTECTION CIRCUIT TRUTH TABLE

| IN        | OUT      |
|-----------|----------|
| $<V_{th}$ | GND      |
| $>V_{th}$ | $V_{IN}$ |

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## MAXIMUM RATINGS (T<sub>A</sub> = 25°C unless otherwise stated)

| Rating                                                                 | Pin   | Symbol             | Min  | Max        | Unit |
|------------------------------------------------------------------------|-------|--------------------|------|------------|------|
| OUT Voltage to GND                                                     | 2     | V <sub>O</sub>     | -0.3 | 12         | V    |
| Input Pin Voltage to GND                                               | 4     | V <sub>input</sub> | -0.3 | 12         | V    |
| Maximum Power Dissipation (Note 1)                                     | –     | P <sub>D</sub>     | –    | 0.96       | W    |
| Thermal Resistance Junction-to-Air (Note 1)<br>OVP IC<br>P-Channel FET | –     | R <sub>θJA</sub>   | –    | 130<br>130 | °C/W |
| Junction Temperature                                                   | –     | T <sub>J</sub>     | –    | 150        | °C   |
| Operating Ambient Temperature                                          | –     | T <sub>A</sub>     | -40  | 85         | °C   |
| Storage Temperature Range                                              | –     | T <sub>stg</sub>   | -65  | 150        | °C   |
| ESD Performance (HBM) (Note 2)                                         | 2,3,4 | –                  | 2.5  | –          | kV   |
| Drain-to-Source Voltage                                                |       | V <sub>DSS</sub>   |      | -12        | V    |
| Gate-to-Source Voltage                                                 |       | V <sub>GS</sub>    | -8   | 8          | V    |
| Continuous Drain Current, Steady State, T <sub>A</sub> = 25°C (Note 1) |       | I <sub>D</sub>     |      | -0.6       | A    |

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

1. Surface-mounted on FR4 board using 1 inch sq pad size (Cu area = 1.127 in sq [1 oz] including traces).
2. Human body model (HBM): MIL STD 883C Method 3015-7, (R = 1500 Ω, C = 100 pF, F = 3 pulses delay 1 s).

## ELECTRICAL CHARACTERISTICS (T<sub>A</sub> = 25°C, V<sub>CC</sub> = 6.0 V, unless otherwise specified)

| Characteristic                                                                                                                                                                                                                           | Symbol                               | Min                                                                   | Typ          | Max          | Unit |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------|-----------------------------------------------------------------------|--------------|--------------|------|
| Input Threshold (Pin 4, V <sub>in</sub> Increasing)                                                                                                                                                                                      | V <sub>TH</sub>                      | 4.630                                                                 | 4.725        | 4.820        | V    |
| Input Threshold Hysteresis (Pin 4, V <sub>in</sub> Decreasing)                                                                                                                                                                           | V <sub>HYS</sub>                     | 0.135                                                                 | 0.225        | 0.315        | V    |
| Supply Current (Pin 4)<br>(V <sub>in</sub> = 4.34 V)<br>(V <sub>in</sub> = 6.5 V)                                                                                                                                                        | I <sub>in</sub>                      | –<br>–                                                                | –<br>–       | 3.0<br>3.9   | μA   |
| Minimum Operating Voltage (Pin 4) (Note 3)<br>(T <sub>A</sub> = 25°C)<br>(T <sub>A</sub> = -40°C to 85°C)                                                                                                                                | V <sub>in(min)</sub>                 | –<br>–                                                                | 0.55<br>0.65 | 0.70<br>0.80 | V    |
| Output Voltage High (V <sub>in</sub> = 8.0 V; I <sub>Source</sub> = 1.0 mA)<br>Output Voltage High (V <sub>in</sub> = 8.0 V; I <sub>Source</sub> = 0.25 mA)<br>Output Voltage High (V <sub>in</sub> = 8.0 V; I <sub>Source</sub> = 0 mA) | V <sub>oh</sub>                      | V <sub>in</sub> -1.0<br>V <sub>in</sub> -0.25<br>V <sub>in</sub> -0.1 | –            | –            | V    |
| Output Voltage Low<br>(Input < 4.5 V; I <sub>Sink</sub> = 0 mA; CNTRL = 0 V)                                                                                                                                                             | V <sub>ol</sub>                      | –                                                                     | –            | 0.1          | V    |
| Propagation Delay Input to Output<br>Complementary Output NCP304 Series<br>Output Transition, High to Low<br>Output Transition, Low to High                                                                                              | t <sub>pHL</sub><br>t <sub>pLH</sub> | –<br>–                                                                | 10<br>21     | –<br>60      | μs   |

3. Guaranteed by design.

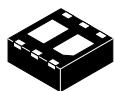
# NUS1204MN

**P-CHANNEL MOSFET** ( $T_A = 25^\circ\text{C}$ , unless otherwise specified)

| Parameter                                                                                                                            | Symbol        | Min  | Typ      | Max        | Units            |
|--------------------------------------------------------------------------------------------------------------------------------------|---------------|------|----------|------------|------------------|
| Drain to Source On Resistance<br>$V_{GS} = -4.5\text{ V}$ , $I_D = 600\text{ mA}$<br>$V_{GS} = -4.5\text{ V}$ , $I_D = 1.0\text{ A}$ | $R_{DS(on)}$  |      | 75<br>75 | 100<br>100 | $\text{m}\Omega$ |
| Zero Gate Voltage Drain Current<br>$V_{GS} = -4.5\text{ V}$ , $V_{GS} = 0\text{ V}$ , $V_{DS} = -10\text{ V}$                        | $I_{DSS}$     |      |          | -1.0       | $\mu\text{A}$    |
| Turn On Delay (Note 4)<br>$V_{GS} = -4.5\text{ V}$                                                                                   | $t_{on}$      |      | 5.5      |            | ns               |
| Turn Off Delay (Note 4)<br>$V_{GS} = -4.5\text{ V}$                                                                                  | $t_{off}$     |      | 20       |            | ns               |
| Input Capacitance<br>$V_{GS} = 0\text{ V}$ , $f = 1.0\text{ MHz}$ , $V_{DS} = -10\text{ V}$                                          | $C_{in}$      |      | 531      |            | pF               |
| Gate to Source Leakage Current<br>$V_{GS} = 8.0\text{ V}$ , $V_{DS} = 0\text{ V}$                                                    | $I_{GSS}$     |      | $\pm 10$ |            | nA               |
| Drain to Source Breakdown Voltage<br>$V_{GS} = 0\text{ V}$ , $I_D = -250\text{ }\mu\text{A}$                                         | $V_{(BR)DSS}$ | -12  |          |            | V                |
| Gate Threshold Voltage<br>$V_{GS} = V_{DS}$ , $I_D = -250\text{ }\mu\text{A}$                                                        | $V_{(GS)th}$  | -0.4 | -0.7     | -1.0       | V                |

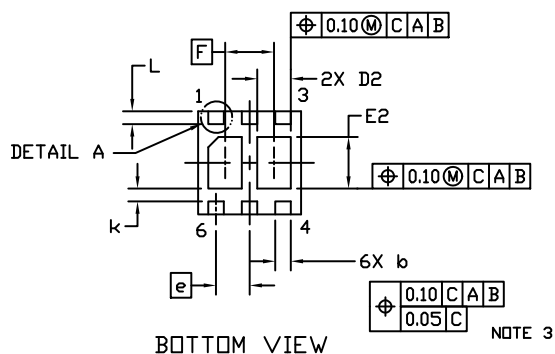
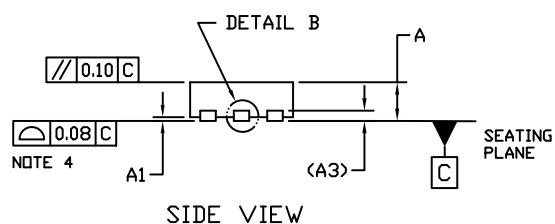
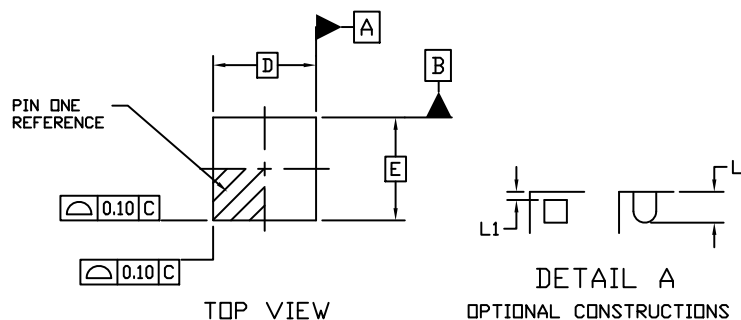
4. Switching characteristics are independent of operating junction temperature.

# MECHANICAL CASE OUTLINE PACKAGE DIMENSIONS



**WDFN6 2x2, 0.65P**  
CASE 506AN  
ISSUE H

DATE 25 JAN 2022



## GENERIC MARKING DIAGRAM\*



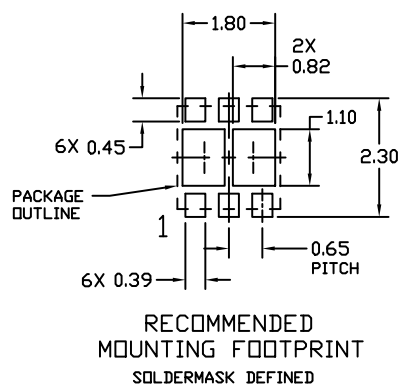
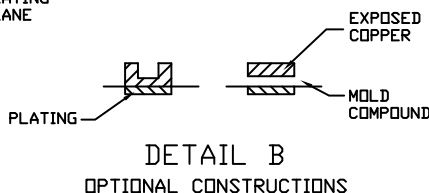
XX = Specific Device Code  
M = Date Code

\*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "▪", may or may not be present. Some products may not follow the Generic Marking.

## NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS
3. DIMENSION **b** APPLIES TO PLATED TERMINAL AND IS MEASURED BETWEEN 0.15 AND 0.30 MM FROM THE TERMINAL TIP.
4. COPLANARITY APPLIES TO THE EXPOSED PADS AS WELL AS THE TERMINALS.

| DIM | MILLIMETERS |      |
|-----|-------------|------|
|     | MIN.        | MAX. |
| A   | 0.70        | 0.80 |
| A1  | 0.00        | 0.05 |
| A3  | 0.20 REF    |      |
| b   | 0.25        | 0.35 |
| D   | 2.00 BSC    |      |
| D2  | 0.57        | 0.77 |
| E   | 2.00 BSC    |      |
| E2  | 0.90        | 1.10 |
| e   | 0.65 BSC    |      |
| F   | 0.95 BSC    |      |
| k   | 0.25 REF    |      |
| L   | 0.20        | 0.30 |
| L1  | ---         | 0.10 |



|                         |                         |                                                                                                                                                                                  |
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