



**THE DATASHEET OF  
NCV303LSN20T1G**



# NCP302, NCP303

## Voltage Detector Series with Programmable Delay

The NCP302 and NCP303 series are second generation ultra-low current voltage detectors that contain a programmable time delay generator. These devices are specifically designed for use as reset controllers in portable microprocessor based systems where extended battery life is paramount.

Each series features a highly accurate undervoltage detector with hysteresis and an externally programmable time delay generator. This combination of features prevents erratic system reset operation.

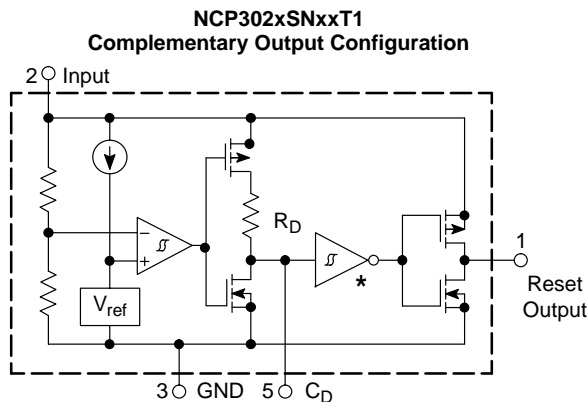
The NCP302 series consists of complementary output devices that are available with either an active high or active low reset. The NCP303 series has an open drain N-Channel output with an active low reset output.

### Features

- Quiescent Current of 0.5  $\mu$ A Typical
- High Accuracy Undervoltage Threshold of 2.0%
- Externally Programmable Time Delay Generator
- Wide Operating Voltage Range of 0.8 V to 10 V
- Complementary or Open Drain Output
- Active Low or Active High Reset
- Specified Over the  $-40^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$  Temperature Range (Except for Voltage Options from 0.9 to 1.1 V)
- NCV Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC-Q100 Qualified and PPAP Capable
- These Devices are Pb-Free and are RoHS Compliant

### Typical Applications

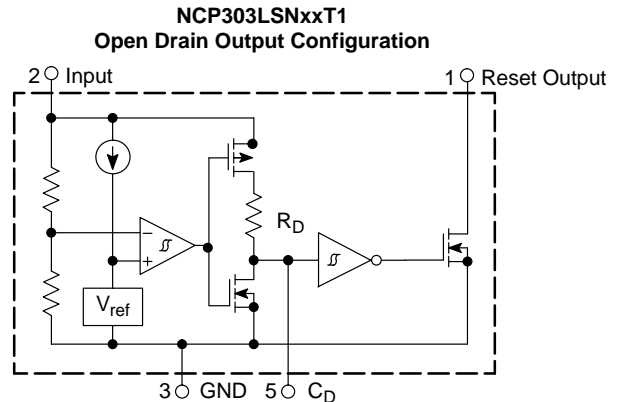
- Microprocessor Reset Controller
- Low Battery Detection
- Power Fail Indicator
- Battery Backup Detection



\* Inverter for active low devices.  
Buffer for active high devices.

This device contains 28 active transistors.

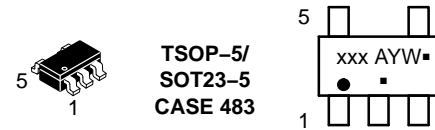
**Figure 1. Representative Block Diagrams**



**ON Semiconductor**<sup>®</sup>

<http://onsemi.com>

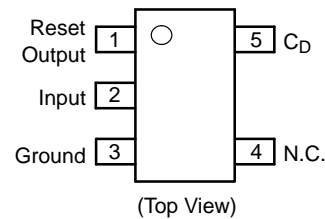
### MARKING DIAGRAM



xxx = Specific Device Code  
A = Assembly Location  
Y = Year  
W = Work Week  
▪ = Pb-Free Package

(Note: Microdot may be in either location)

### PIN CONNECTIONS



### ORDERING INFORMATION

See detailed ordering and shipping information in the ordering information section on page 22 of this data sheet.

## NCP302, NCP303

### MAXIMUM RATINGS

| Rating  | Symbol          | Value                                | Unit     |
|---|-----------------|--------------------------------------|----------|
| Input Power Supply Voltage (Pin 2)  | $V_{in}$        | 12                                   | V        |
| Delay Capacitor Pin Voltage (Pin 5)   | $V_{CD}$        | -0.3 to $V_{in} + 0.3$               | V        |
| Output Voltage (Pin 1)<br>Complementary, NCP302<br>N-Channel Open Drain, NCP303                                   | $V_{OUT}$       | -0.3 to $V_{in} + 0.3$<br>-0.3 to 12 | V        |
| Output Current (Pin 1) (Note 2)   | $I_{OUT}$       | 70                                   | mA       |
| Thermal Resistance Junction-to-Air  | $R_{\theta JA}$ | 250                                  | °C/W     |
| Maximum Junction Temperature  | $T_J$           | +150                                 | °C       |
| Operating Ambient Temperature Range<br>All Voltage Options: 0.9 V to 1.1 V<br>All Voltage Options: 1.2 V to 4.9 V | $T_A$<br>$T_A$  | -40 to +85<br>-40 to +125            | °C<br>°C |
| Storage Temperature Range   | $T_{stg}$       | -55 to +150                          | °C       |
| Moisture Sensitivity Level  | MSL             | 1                                    |          |
| Latchup Performance (Note 3)<br>Positive<br>Negative  | $I_{LATCHUP}$   | 200<br>200                           | mA       |

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

- This device series contains ESD protection and exceeds the following tests:  
Human Body Model 2000 V per MIL-STD-883, Method 3015.  
Machine Model Method 200 V.

- The maximum package power dissipation limit must not be exceeded.

$$P_D = \frac{T_{J(max)} - T_A}{R_{\theta JA}}$$

- Maximum ratings per JEDEC standard JESD78.

# NCP302, NCP303

## ELECTRICAL CHARACTERISTICS (For all values $T_A = -40^{\circ}\text{C}$ to $+125^{\circ}\text{C}$ , unless otherwise noted.)

| Characteristic   | Symbol        | Min                            | Typ                         | Max                 | Unit             |
|--|---------------|--------------------------------|-----------------------------|---------------------|------------------|
| <b>NCP302/3 – 0.9 (<math>T_A = 25^{\circ}\text{C}</math> for voltage options from 0.9 to 1.1 V)</b>  |               |                                |                             |                     |                  |
| Detector Threshold (Pin 2, $V_{in}$ Decreasing)  | $V_{DET-}$    | 0.882                          | 0.900                       | 0.918               | V                |
| Detector Threshold Hysteresis (Pin 2, $V_{in}$ Increasing)   | $V_{HYS}$     | 0.027                          | 0.045                       | 0.063               | V                |
| Supply Current (Pin 2)<br>( $V_{in} = 0.8\text{ V}$ )<br>( $V_{in} = 2.9\text{ V}$ )   | $I_{in}$      | –<br>–                         | 0.20<br>0.45                | 0.6<br>1.2          | $\mu\text{A}$    |
| Maximum Operating Voltage (Pin 2)  | $V_{in(max)}$ | –                              | –                           | 10                  | V                |
| Minimum Operating Voltage (Pin 2)<br>( $T_A = -40^{\circ}\text{C}$ to $85^{\circ}\text{C}$ )   | $V_{in(min)}$ | –<br>–                         | 0.55<br>0.65                | 0.70<br>0.80        | V                |
| Reset Output Current (Pin 1, Active Low 'L' Suffix Devices)<br><br>Nch Sink Current, NCP302, NCP303<br>( $V_{OUT} = 0.05\text{V}$ , $V_{in} = 0.70\text{V}$ )<br>( $V_{OUT} = 0.50\text{V}$ , $V_{in} = 0.85\text{V}$ )<br><br>Pch Source Current, NCP302<br>( $V_{OUT} = 2.4\text{V}$ , $V_{in} = 4.5\text{V}$ )  | $I_{OUT}$     | <br>0.01<br>0.05<br><br>1.0    | <br>0.05<br>0.50<br><br>6.0 | <br>–<br>–<br><br>– | mA               |
| Reset Output Current (Pin 1, Active High 'H' Suffix Devices)<br><br>Nch Sink Current, NCP302, NCP303<br>( $V_{OUT} = 0.5\text{ V}$ , $V_{in} = 1.5\text{ V}$ )<br><br>Pch Source Current, NCP302<br>( $V_{OUT} = 0.4\text{ V}$ , $V_{in} = 0.7\text{ V}$ )<br>( $V_{OUT} = \text{GND}$ , $V_{in} = 0.8\text{ V}$ ) | $I_{OUT}$     | <br>1.05<br><br>0.011<br>0.014 | <br>2.5<br><br>0.04<br>0.08 | <br>–<br><br>–<br>– | mA               |
| $C_D$ Delay Pin Threshold Voltage (Pin 5)<br>( $V_{in} = 0.99\text{ V}$ )  | $V_{TCD}$     | 0.50                           | 0.67                        | 0.84                | V                |
| Delay Capacitor Pin Sink Current (Pin 5)<br>( $V_{in} = 0.7\text{ V}$ , $V_{CD} = 0.1\text{V}$ )<br>( $V_{in} = 0.85\text{ V}$ , $V_{CD} = 0.5\text{V}$ )  | $I_{CD}$      | 2.0<br>10                      | 120<br>300                  | –<br>–              | $\mu\text{A}$    |
| Delay Pullup Resistance (Pin 5)  | $R_D$         | 0.5                            | 1.0                         | 2.0                 | $\text{M}\Omega$ |

### NCP302/3 – 1.8

|  |               |                               |                            |                     |               |
|--|---------------|-------------------------------|----------------------------|---------------------|---------------|
| Detector Threshold (Pin 2, $V_{in}$ Decreasing) ( $T_A = 25^{\circ}\text{C}$ )<br>( $T_A = -40^{\circ}\text{C}$ to $125^{\circ}\text{C}$ )   | $V_{DET-}$    | 1.764<br>1.746                | 1.800<br>–                 | 1.836<br>1.854      | V             |
| Detector Threshold Hysteresis (Pin 2, $V_{in}$ Increasing)   | $V_{HYS}$     | 0.054                         | 0.090                      | 0.126               | V             |
| Supply Current (Pin 2)<br>( $V_{in} = 1.7\text{ V}$ )<br>( $V_{in} = 3.8\text{ V}$ )   | $I_{in}$      | –<br>–                        | 0.23<br>0.48               | 0.7<br>1.3          | $\mu\text{A}$ |
| Maximum Operating Voltage (Pin 2)  | $V_{in(max)}$ | –                             | –                          | 10                  | V             |
| Minimum Operating Voltage (Pin 2) ( $T_A = 25^{\circ}\text{C}$ )<br>( $T_A = -40^{\circ}\text{C}$ to $125^{\circ}\text{C}$ )   | $V_{in(min)}$ | –<br>–                        | 0.55<br>0.65               | 0.70<br>0.80        | V             |
| Reset Output Current (Pin 1, Active Low 'L' Suffix Devices)<br><br>Nch Sink Current, NCP302, NCP303<br>( $V_{OUT} = 0.05\text{V}$ , $V_{in} = 0.70\text{V}$ )<br>( $V_{OUT} = 0.50\text{V}$ , $V_{in} = 1.5\text{V}$ )<br><br>Pch Source Current, NCP302<br>( $V_{OUT} = 2.4\text{V}$ , $V_{in} = 4.5\text{V}$ )   | $I_{OUT}$     | <br>0.01<br>1.0<br><br>1.0    | <br>0.05<br>2.0<br><br>6.0 | <br>–<br>–<br><br>– | mA            |
| Reset Output Current (Pin 1, Active High 'H' Suffix Devices)<br><br>Nch Sink Current, NCP302, NCP303<br>( $V_{OUT} = 0.5\text{ V}$ , $V_{in} = 5.0\text{ V}$ )<br><br>Pch Source Current, NCP302<br>( $V_{OUT} = 0.4\text{ V}$ , $V_{in} = 0.7\text{ V}$ )<br>( $V_{OUT} = \text{GND}$ , $V_{in} = 1.5\text{ V}$ ) | $I_{OUT}$     | <br>6.3<br><br>0.011<br>0.525 | <br>11<br><br>0.04<br>0.6  | <br>–<br><br>–<br>– | mA            |
| $C_D$ Delay Pin Threshold Voltage (Pin 5)<br>( $V_{in} = 1.98\text{ V}$ )  | $V_{TCD}$     | 0.99                          | 1.34                       | 1.68                | V             |

# NCP302, NCP303

**ELECTRICAL CHARACTERISTICS (continued)** (For all values  $T_A = -40^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$ , unless otherwise noted.)

| Characteristic   | Symbol        | Min                       | Typ                    | Max             | Unit             |
|--|---------------|---------------------------|------------------------|-----------------|------------------|
| <b>NCP302/3 – 1.8</b>  |               |                           |                        |                 |                  |
| Delay Capacitor Pin Sink Current (Pin 5)<br>( $V_{in} = 0.7\text{ V}$ , $V_{CD} = 0.1\text{V}$ )<br>( $V_{in} = 1.5\text{ V}$ , $V_{CD} = 0.5\text{V}$ )   | $I_{CD}$      | 2.0<br>200                | 120<br>1600            | –<br>–          | $\mu\text{A}$    |
| Delay Pullup Resistance (Pin 5)  | $R_D$         | 0.5                       | 1.0                    | 2.0             | $\text{M}\Omega$ |
| <b>NCP302/3 – 2.0</b>  |               |                           |                        |                 |                  |
| Detector Threshold (Pin 2, $V_{in}$ Decreasing) ( $T_A = 25^{\circ}\text{C}$ )<br>( $T_A = -40^{\circ}\text{C}$ to $125^{\circ}\text{C}$ )   | $V_{DET-}$    | 1.96<br>1.94              | 2.00<br>–              | 2.04<br>2.06    | V                |
| Detector Threshold Hysteresis (Pin 2, $V_{in}$ Increasing)   | $V_{HYS}$     | 0.06                      | 0.10                   | 0.14            | V                |
| Supply Current (Pin 2)<br>( $V_{in} = 1.9\text{ V}$ )<br>( $V_{in} = 4.0\text{ V}$ )   | $I_{in}$      | –<br>–                    | 0.23<br>0.48           | 0.8<br>1.3      | $\mu\text{A}$    |
| Maximum Operating Voltage (Pin 2)  | $V_{in(max)}$ | –                         | –                      | 10              | V                |
| Minimum Operating Voltage (Pin 2) ( $T_A = 25^{\circ}\text{C}$ )<br>( $T_A = -40^{\circ}\text{C}$ to $125^{\circ}\text{C}$ )   | $V_{in(min)}$ | –<br>–                    | 0.55<br>0.65           | 0.70<br>0.80    | V                |
| Reset Output Current (Pin 1, Active Low 'L' Suffix Devices)<br><br>Nch Sink Current, NCP302, NCP303<br>( $V_{OUT} = 0.05\text{V}$ , $V_{in} = 0.70\text{V}$ )<br>( $V_{OUT} = 0.50\text{V}$ , $V_{in} = 1.5\text{V}$ )<br><br>Pch Source Current, NCP302<br>( $V_{OUT} = 2.4\text{V}$ , $V_{in} = 4.5\text{V}$ )   | $I_{OUT}$     | 0.01<br>1.0<br><br>1.0    | 0.14<br>3.5<br><br>9.7 | –<br>–<br><br>– | mA               |
| Reset Output Current (Pin 1, Active High 'H' Suffix Devices)<br><br>Nch Sink Current, NCP302, NCP303<br>( $V_{OUT} = 0.5\text{ V}$ , $V_{in} = 5.0\text{ V}$ )<br><br>Pch Source Current, NCP302<br>( $V_{OUT} = 0.4\text{ V}$ , $V_{in} = 0.7\text{ V}$ )<br>( $V_{OUT} = \text{GND}$ , $V_{in} = 1.5\text{ V}$ ) | $I_{OUT}$     | 6.3<br><br>0.011<br>0.525 | 11<br><br>0.04<br>0.6  | –<br><br>–<br>– | mA               |
| $C_D$ Delay Pin Threshold Voltage (Pin 5)<br>( $V_{in} = 2.2\text{ V}$ )   | $V_{TCD}$     | 1.10                      | 1.49                   | 1.87            | V                |
| Delay Capacitor Pin Sink Current (Pin 5)<br>( $V_{in} = 0.7\text{ V}$ , $V_{CD} = 0.1\text{V}$ )<br>( $V_{in} = 1.5\text{ V}$ , $V_{CD} = 0.5\text{V}$ )   | $I_{CD}$      | 2.0<br>200                | 250<br>3600            | –<br>–          | $\mu\text{A}$    |
| Delay Pullup Resistance (Pin 5)  | $R_D$         | 0.5                       | 1.0                    | 2.0             | $\text{M}\Omega$ |
| <b>NCP302/3– 2.7</b>   |               |                           |                        |                 |                  |
| Detector Threshold (Pin 2, $V_{in}$ Decreasing) ( $T_A = 25^{\circ}\text{C}$ )<br>( $T_A = -40^{\circ}\text{C}$ to $125^{\circ}\text{C}$ )   | $V_{DET-}$    | 2.646<br>2.619            | 2.700<br>–             | 2.754<br>2.781  | V                |
| Detector Threshold Hysteresis (Pin 2, $V_{in}$ Increasing)   | $V_{HYS}$     | 0.081                     | 0.135                  | 0.189           | V                |
| Supply Current (Pin 2)<br>( $V_{in} = 2.6\text{ V}$ )<br>( $V_{in} = 4.7\text{ V}$ )   | $I_{in}$      | –<br>–                    | 0.25<br>0.50           | 0.8<br>1.3      | $\mu\text{A}$    |
| Maximum Operating Voltage (Pin 2)  | $V_{in(max)}$ | –                         | –                      | 10              | V                |
| Minimum Operating Voltage (Pin 2) ( $T_A = 25^{\circ}\text{C}$ )<br>( $T_A = -40^{\circ}\text{C}$ to $125^{\circ}\text{C}$ )   | $V_{in(min)}$ | –<br>–                    | 0.55<br>0.65           | 0.70<br>0.80    | V                |
| Reset Output Current (Pin 1, Active Low 'L' Suffix Devices)<br><br>Nch Sink Current, NCP302, NCP303<br>( $V_{OUT} = 0.05\text{V}$ , $V_{in} = 0.70\text{V}$ )<br>( $V_{OUT} = 0.50\text{V}$ , $V_{in} = 1.5\text{V}$ )<br><br>Pch Source Current, NCP302<br>( $V_{OUT} = 2.4\text{V}$ , $V_{in} = 4.5\text{V}$ )   | $I_{OUT}$     | 0.01<br>1.0<br><br>1.0    | 0.14<br>3.5<br><br>9.7 | –<br>–<br><br>– | mA               |
| Reset Output Current (Pin 1, Active High 'H' Suffix Devices)<br><br>Nch Sink Current, NCP302, NCP303<br>( $V_{OUT} = 0.5\text{ V}$ , $V_{in} = 5.0\text{ V}$ )   | $I_{OUT}$     | 6.3                       | 11                     | –               | mA               |

# NCP302, NCP303

**ELECTRICAL CHARACTERISTICS (continued)** (For all values  $T_A = -40^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$ , unless otherwise noted.)

| Characteristic   | Symbol    | Min            | Typ         | Max    | Unit             |
|--|-----------|----------------|-------------|--------|------------------|
| <b>NCP302/3– 2.7</b>   |           |                |             |        |                  |
| Pch Source Current, NCP302<br>( $V_{OUT} = 0.4\text{ V}$ , $V_{in} = 0.7\text{ V}$ )<br>( $V_{OUT} = \text{GND}$ , $V_{in} = 1.5\text{ V}$ )               |           | 0.011<br>0.525 | 0.04<br>0.6 | –<br>– |                  |
| $C_D$ Delay Pin Threshold Voltage (Pin 5)<br>( $V_{in} = 2.97\text{ V}$ )  | $V_{TCD}$ | 1.49           | 2.01        | 2.53   | V                |
| Delay Capacitor Pin Sink Current (Pin 5)<br>( $V_{in} = 0.7\text{ V}$ , $V_{CD} = 0.1\text{ V}$ )<br>( $V_{in} = 1.5\text{ V}$ , $V_{CD} = 0.5\text{ V}$ ) | $I_{CD}$  | 2.0<br>200     | 250<br>3600 | –<br>– | $\mu\text{A}$    |
| Delay Pullup Resistance (Pin 5)  | $R_D$     | 0.5            | 1.0         | 2.0    | $\text{M}\Omega$ |

## NCP302/3 – 3.0

|  |               |                       |                    |              |                  |
|--|---------------|-----------------------|--------------------|--------------|------------------|
| Detector Threshold (Pin 2, $V_{in}$ Decreasing) ( $T_A = 25^{\circ}\text{C}$ )<br>( $T_A = -40^{\circ}\text{C}$ to $125^{\circ}\text{C}$ )   | $V_{DET-}$    | 2.94<br>2.91          | 3.00<br>–          | 3.06<br>3.09 | V                |
| Detector Threshold Hysteresis (Pin 2, $V_{in}$ Increasing)   | $V_{HYS}$     | 0.09                  | 0.15               | 0.21         | V                |
| Supply Current (Pin 2)<br>( $V_{in} = 2.87\text{ V}$ )<br>( $V_{in} = 5.0\text{ V}$ )  | $I_{in}$      | –<br>–                | 0.25<br>0.50       | 0.9<br>1.3   | $\mu\text{A}$    |
| Maximum Operating Voltage (Pin 2)  | $V_{in(max)}$ | –                     | –                  | 10           | V                |
| Minimum Operating Voltage (Pin 2) ( $T_A = 25^{\circ}\text{C}$ )<br>( $T_A = -40^{\circ}\text{C}$ to $125^{\circ}\text{C}$ )   | $V_{in(min)}$ | –<br>–                | 0.55<br>0.65       | 0.70<br>0.80 | V                |
| Reset Output Current (Pin 1, Active Low 'L' Suffix Devices)<br><br>Nch Sink Current, NCP302, NCP303<br>( $V_{OUT} = 0.05\text{ V}$ , $V_{in} = 0.70\text{ V}$ )<br>( $V_{OUT} = 0.50\text{ V}$ , $V_{in} = 1.5\text{ V}$ )<br><br>Pch Source Current, NCP302<br>( $V_{OUT} = 2.4\text{ V}$ , $V_{in} = 4.5\text{ V}$ ) | $I_{OUT}$     | 0.01<br>1.0<br>1.0    | 0.14<br>3.5<br>9.7 | –<br>–<br>–  | mA               |
| Reset Output Current (Pin 1, Active High 'H' Suffix Devices)<br><br>Nch Sink Current, NCP302, NCP303<br>( $V_{OUT} = 0.5\text{ V}$ , $V_{in} = 5.0\text{ V}$ )<br><br>Pch Source Current, NCP302<br>( $V_{OUT} = 0.4\text{ V}$ , $V_{in} = 0.7\text{ V}$ )<br>( $V_{OUT} = \text{GND}$ , $V_{in} = 1.5\text{ V}$ )     | $I_{OUT}$     | 6.3<br>0.011<br>0.525 | 11<br>0.04<br>0.6  | –<br>–<br>–  | mA               |
| $C_D$ Delay Pin Threshold Voltage (Pin 5)<br>( $V_{in} = 3.3\text{ V}$ )   | $V_{TCD}$     | 1.65                  | 2.23               | 2.81         | V                |
| Delay Capacitor Pin Sink Current (Pin 5)<br>( $V_{in} = 0.7\text{ V}$ , $V_{CD} = 0.1\text{ V}$ )<br>( $V_{in} = 1.5\text{ V}$ , $V_{CD} = 0.5\text{ V}$ )   | $I_{CD}$      | 2.0<br>200            | 250<br>3600        | –<br>–       | $\mu\text{A}$    |
| Delay Pullup Resistance (Pin 5)  | $R_D$         | 0.5                   | 1.0                | 2.0          | $\text{M}\Omega$ |

## NCP302/3 – 4.5

|  |               |                |              |                |               |
|--|---------------|----------------|--------------|----------------|---------------|
| Detector Threshold (Pin 2, $V_{in}$ Decreasing) ( $T_A = 25^{\circ}\text{C}$ )<br>( $T_A = -40^{\circ}\text{C}$ to $125^{\circ}\text{C}$ )   | $V_{DET-}$    | 4.410<br>4.365 | 4.500<br>–   | 4.590<br>4.635 | V             |
| Detector Threshold Hysteresis (Pin 2, $V_{in}$ Increasing)   | $V_{HYS}$     | 0.135          | 0.225        | 0.315          | V             |
| Supply Current (Pin 2)<br>( $V_{in} = 4.34\text{ V}$ )<br>( $V_{in} = 6.5\text{ V}$ )  | $I_{in}$      | –<br>–         | 0.33<br>0.52 | 1.0<br>1.4     | $\mu\text{A}$ |
| Maximum Operating Voltage (Pin 2)  | $V_{in(max)}$ | –              | –            | 10             | V             |
| Minimum Operating Voltage (Pin 2) ( $T_A = 25^{\circ}\text{C}$ )<br>( $T_A = -40^{\circ}\text{C}$ to $125^{\circ}\text{C}$ )   | $V_{in(min)}$ | –<br>–         | 0.55<br>0.65 | 0.70<br>0.80   | V             |
| Reset Output Current (Pin 1, Active Low 'L' Suffix Devices)<br><br>Nch Sink Current, NCP302, NCP303<br>( $V_{OUT} = 0.05\text{ V}$ , $V_{in} = 0.70\text{ V}$ )<br>( $V_{OUT} = 0.50\text{ V}$ , $V_{in} = 1.5\text{ V}$ ) | $I_{OUT}$     | 0.01<br>1.0    | 0.05<br>2.0  | –<br>–         | mA            |

## NCP302, NCP303

**ELECTRICAL CHARACTERISTICS (continued)** (For all values  $T_A = -40^\circ\text{C}$  to  $+125^\circ\text{C}$ , unless otherwise noted.)

| Characteristic   | Symbol    | Min            | Typ         | Max    | Unit             |
|--|-----------|----------------|-------------|--------|------------------|
| <b>NCP302/3 – 4.5</b>  |           |                |             |        |                  |
| Pch Source Current, NCP302<br>( $V_{OUT} = 5.9\text{V}$ , $V_{in} = 8.0\text{V}$ )   |           | 1.5            | 10.5        | –      |                  |
| Reset Output Current (Pin 1, Active High 'H' Suffix Devices)   | $I_{OUT}$ |                |             |        | mA               |
| Nch Sink Current, NCP302, NCP303<br>( $V_{OUT} = 0.5\text{V}$ , $V_{in} = 5.0\text{V}$ )   |           | 6.3            | 11          | –      |                  |
| Pch Source Current, NCP302<br>( $V_{OUT} = 0.4\text{V}$ , $V_{in} = 0.7\text{V}$ )<br>( $V_{OUT} = \text{GND}$ , $V_{in} = 1.5\text{V}$ )              |           | 0.011<br>0.525 | 0.04<br>0.6 | –<br>– |                  |
| $C_D$ Delay Pin Threshold Voltage (Pin 5)<br>( $V_{in} = 4.95\text{V}$ )   | $V_{TCD}$ | 2.25           | 3.04        | 3.83   | V                |
| Delay Capacitor Pin Sink Current (Pin 5)<br>( $V_{in} = 0.7\text{V}$ , $V_{CD} = 0.1\text{V}$ )<br>( $V_{in} = 1.5\text{V}$ , $V_{CD} = 0.5\text{V}$ ) | $I_{CD}$  | 2.0<br>200     | 120<br>1600 | –<br>– | $\mu\text{A}$    |
| Delay Pullup Resistance (Pin 5)  | $R_D$     | 0.5            | 1.0         | 2.0    | $\text{M}\Omega$ |

### NCP302/3 – 4.7

|  |               |                |              |                |                  |
|--|---------------|----------------|--------------|----------------|------------------|
| Detector Threshold (Pin 2, $V_{in}$ Decreasing) ( $T_A = 25^\circ\text{C}$ )<br>( $T_A = -40^\circ\text{C}$ to $125^\circ\text{C}$ )                   | $V_{DET-}$    | 4.606<br>4.559 | 4.700<br>–   | 4.794<br>4.841 | V                |
| Detector Threshold Hysteresis (Pin 2, $V_{in}$ Increasing)   | $V_{HYS}$     | 0.141          | 0.235        | 0.329          | V                |
| Supply Current (Pin 2)<br>( $V_{in} = 4.54\text{V}$ )<br>( $V_{in} = 6.7\text{V}$ )  | $I_{in}$      | –<br>–         | 0.34<br>0.53 | 1.0<br>1.4     | $\mu\text{A}$    |
| Maximum Operating Voltage (Pin 2)  | $V_{in(max)}$ | –              | –            | 10             | V                |
| Minimum Operating Voltage (Pin 2) ( $T_A = 25^\circ\text{C}$ )<br>( $T_A = -40^\circ\text{C}$ to $125^\circ\text{C}$ )                                 | $V_{in(min)}$ | –<br>–         | 0.55<br>0.65 | 0.70<br>0.80   | V                |
| Reset Output Current (Pin 1, Active Low 'L' Suffix Devices)  | $I_{OUT}$     |                |              |                | mA               |
| Nch Sink Current, NCP302, NCP303<br>( $V_{OUT} = 0.05\text{V}$ , $V_{in} = 0.70\text{V}$ )<br>( $V_{OUT} = 0.50\text{V}$ , $V_{in} = 1.5\text{V}$ )    |               | 0.01<br>1.0    | 0.05<br>2.0  | –<br>–         |                  |
| Pch Source Current, NCP302<br>( $V_{OUT} = 5.9\text{V}$ , $V_{in} = 8.0\text{V}$ )   |               | 1.5            | 10.5         | –              |                  |
| Reset Output Current (Pin 1, Active High 'H' Suffix Devices)   | $I_{OUT}$     |                |              |                | mA               |
| Nch Sink Current, NCP302, NCP303<br>( $V_{OUT} = 0.5\text{V}$ , $V_{in} = 5.0\text{V}$ )   |               | 6.3            | 11           | –              |                  |
| Pch Source Current, NCP302<br>( $V_{OUT} = 0.4\text{V}$ , $V_{in} = 0.7\text{V}$ )<br>( $V_{OUT} = \text{GND}$ , $V_{in} = 1.5\text{V}$ )              |               | 0.011<br>0.525 | 0.04<br>0.6  | –<br>–         |                  |
| $C_D$ Delay Pin Threshold Voltage (Pin 5)<br>( $V_{in} = 5.17\text{V}$ )   | $V_{TCD}$     | 2.59           | 3.49         | 4.40           | V                |
| Delay Capacitor Pin Sink Current (Pin 5)<br>( $V_{in} = 0.7\text{V}$ , $V_{CD} = 0.1\text{V}$ )<br>( $V_{in} = 1.5\text{V}$ , $V_{CD} = 0.5\text{V}$ ) | $I_{CD}$      | 2.0<br>200     | 120<br>1600  | –<br>–         | $\mu\text{A}$    |
| Delay Pullup Resistance (Pin 5)  | $R_D$         | 0.5            | 1.0          | 2.0            | $\text{M}\Omega$ |

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

# NCP302, NCP303



NCP302 and NCP303 series are measured with a 10 pF capacitive load. NCP303 has an additional 470 k pullup resistor connected from the reset output to +5.0 V. The reset output voltage waveforms are shown for the active low 'L' devices. Output time delay  $t_{D1}$  and  $t_{D2}$  are dependent upon the delay capacitance. Refer to Figures 30, 31, and 32. The upper detector threshold,  $V_{DET+}$  is the sum of the lower detector threshold,  $V_{DET-}$  plus the input hysteresis,  $V_{HYS}$ .

**Figure 2. Measurement Conditions for  $t_{D1}$  and  $t_{D2}$**

# NCP302, NCP303

**Table 1. ELECTRICAL CHARACTERISTIC TABLE FOR 0.9 – 4.9 V**

| NCP302 Series  | Detector Threshold             |     |       | Detector Threshold Hysteresis |       |       | Supply Current                |                               | Nch Sink Current               |                                | Pch Source Current             |
|----------------|--------------------------------|-----|-------|-------------------------------|-------|-------|-------------------------------|-------------------------------|--------------------------------|--------------------------------|--------------------------------|
|                |                                |     |       |                               |       |       | V <sub>in</sub> Low           | V <sub>in</sub> High          | V <sub>in</sub> Low            | V <sub>in</sub> High           | I <sub>OUT</sub> (mA)          |
| Part Number    | V <sub>DET-</sub> (V) (Note 4) |     |       | V <sub>HYS</sub> (V)          |       |       | I <sub>in</sub> (μA) (Note 5) | I <sub>in</sub> (μA) (Note 6) | I <sub>OUT</sub> (mA) (Note 7) | I <sub>OUT</sub> (mA) (Note 8) | I <sub>OUT</sub> (mA) (Note 9) |
|                | Min                            | Typ | Max   | Min                           | Typ   | Max   | Typ                           | Typ                           | Typ                            | Typ                            | Typ                            |
| NCP302LSN09T1  | 0.882                          | 0.9 | 0.918 | 0.027                         | 0.045 | 0.063 | 0.20                          | 0.45                          | 0.05                           | 0.5                            | 2.0                            |
| NCP302LSN15T1  | 1.470                          | 1.5 | 1.530 | 0.045                         | 0.075 | 0.105 |                               |                               |                                |                                |                                |
| NCP302LSN18T1  | 1.764                          | 1.8 | 1.836 | 0.054                         | 0.090 | 0.126 | 0.23                          | 0.48                          |                                |                                |                                |
| NCP302LSN20T1  | 1.960                          | 2.0 | 2.040 | 0.060                         | 0.100 | 0.140 |                               |                               |                                |                                |                                |
| NCP302LSN27T1  | 2.646                          | 2.7 | 2.754 | 0.081                         | 0.135 | 0.189 | 0.25                          | 0.50                          |                                |                                |                                |
| NCP302LSN30T1, | 2.940                          | 3.0 | 3.060 | 0.090                         | 0.150 | 0.210 |                               |                               |                                |                                |                                |
| NCV302LSN30T1, | 2.940                          | 3.0 | 3.060 | 0.090                         | 0.150 | 0.210 |                               |                               |                                |                                |                                |
| NCP302LSN33T1  | 3.234                          | 3.3 | 3.366 | 0.099                         | 0.165 | 0.231 |                               |                               |                                |                                |                                |
| NCP302LSN38T1  | 3.724                          | 3.8 | 3.876 | 0.114                         | 0.190 | 0.266 |                               |                               |                                |                                |                                |
| NCP302LSN40T1  | 3.920                          | 4.0 | 4.080 | 0.120                         | 0.200 | 0.280 | 0.33                          | 0.52                          |                                |                                |                                |
| NCP302LSN43T1  | 4.214                          | 4.3 | 4.386 | 0.129                         | 0.215 | 0.301 |                               |                               |                                |                                |                                |
| NCP302LSN45T1  | 4.410                          | 4.5 | 4.590 | 0.135                         | 0.225 | 0.315 | 0.34                          | 0.53                          |                                |                                |                                |
| NCP302LSN47T1  | 4.606                          | 4.7 | 4.794 | 0.141                         | 0.235 | 0.329 |                               |                               | 3.0                            |                                |                                |

4. Values shown apply at +25°C only. For voltage options greater than 1.1 V, V<sub>DET-</sub> limits over operating temperature range (-40°C to +125°C) are V<sub>NOM</sub> ±3%. For voltage options < 1.2 V, V<sub>DET-</sub> is guaranteed only at +25°C.
5. Condition 1: 0.9 – 2.9 V, V<sub>in</sub> = V<sub>DET-</sub> - 0.10 V; 3.0 – 3.9 V, V<sub>in</sub> = V<sub>DET-</sub> - 0.13 V; 4.0 – 4.9 V, V<sub>in</sub> = V<sub>DET-</sub> - 0.16 V
6. Condition 2: 0.9 – 4.9 V, V<sub>in</sub> = V<sub>DET-</sub> + 2.0 V
7. Condition 3: 0.9 – 4.9 V, V<sub>in</sub> = 0.7 V, V<sub>OUT</sub> = 0.05 V, Active Low 'L' Suffix Devices
8. Condition 4: 0.9 – 1.0 V, V<sub>in</sub> = 0.85 V, V<sub>OUT</sub> = 0.5 V; 1.1 – 1.5 V, V<sub>in</sub> = 1.0 V, V<sub>OUT</sub> = 0.5 V; 1.6 – 4.9 V, V<sub>in</sub> = 1.5 V, V<sub>OUT</sub> = 0.5 V, Active Low 'L' Suffix Devices
9. Condition 5: 0.9 – 3.9 V, V<sub>in</sub> = 4.5 V, V<sub>OUT</sub> = 2.4 V; 4.0 – 4.9 V, V<sub>in</sub> = 8.0 V, V<sub>OUT</sub> = 5.9 V, Active Low 'L' Suffix Devices

**Table 2. ELECTRICAL CHARACTERISTIC TABLE FOR 0.9 – 4.9 V**

| NCP302 Series | Detector Threshold              |     |       | Detector Threshold Hysteresis |       |       | Supply Current                 |                                | Nch Sink Current                | Pch Source Current              |                                 |
|---------------|---------------------------------|-----|-------|-------------------------------|-------|-------|--------------------------------|--------------------------------|---------------------------------|---------------------------------|---------------------------------|
|               |                                 |     |       |                               |       |       | V <sub>in</sub> Low            | V <sub>in</sub> High           |                                 | V <sub>in</sub> Low             | V <sub>in</sub> High            |
| Part Number   | V <sub>DET-</sub> (V) (Note 10) |     |       | V <sub>HYS</sub> (V)          |       |       | I <sub>in</sub> (μA) (Note 11) | I <sub>in</sub> (μA) (Note 12) | I <sub>OUT</sub> (mA) (Note 13) | I <sub>OUT</sub> (mA) (Note 14) | I <sub>OUT</sub> (mA) (Note 15) |
|               | Min                             | Typ | Max   | Min                           | Typ   | Max   | Typ                            | Typ                            | Typ                             | Typ                             | Typ                             |
| NCP302HSN09T1 | 0.882                           | 0.9 | 0.918 | 0.027                         | 0.045 | 0.063 | 0.20                           | 0.45                           | 2.5                             | 0.04                            | 0.08                            |
| NCP302HSN18T1 | 1.764                           | 1.8 | 1.836 | 0.054                         | 0.090 | 0.126 |                                |                                |                                 |                                 |                                 |
| NCP302HSN27T1 | 2.646                           | 2.7 | 2.754 | 0.081                         | 0.135 | 0.189 | 0.25                           | 0.50                           |                                 |                                 |                                 |
| NCP302HSN30T1 | 2.940                           | 3.0 | 3.060 | 0.090                         | 0.150 | 0.210 |                                |                                |                                 |                                 |                                 |
| NCP302HSN40T1 | 3.920                           | 4.0 | 4.080 | 0.120                         | 0.200 | 0.280 | 0.33                           | 0.52                           |                                 |                                 |                                 |
| NCP302HSN45T1 | 4.410                           | 4.5 | 4.590 | 0.135                         | 0.225 | 0.315 |                                |                                |                                 |                                 |                                 |

10. Values shown apply at +25°C only. For voltage options greater than 1.1 V, V<sub>DET-</sub> limits over operating temperature range (-40°C to +125°C) are V<sub>NOM</sub> ±3%. For voltage options < 1.2 V, V<sub>DET-</sub> is guaranteed only at +25°C.
11. Condition 1: 0.9 – 2.9 V, V<sub>in</sub> = V<sub>DET-</sub> - 0.10 V; 3.0 – 3.9 V, V<sub>in</sub> = V<sub>DET-</sub> - 0.13 V; 4.0 – 4.9 V, V<sub>in</sub> = V<sub>DET-</sub> - 0.16 V
12. Condition 2: 0.9 – 4.9 V, V<sub>in</sub> = V<sub>DET-</sub> + 2.0 V
13. Condition 3: 0.9 – 1.4 V, V<sub>in</sub> = 1.5 V, V<sub>OUT</sub> = 0.5 V; 1.5 – 4.9 V, V<sub>in</sub> = 5.0 V, V<sub>OUT</sub> = 0.5 V, Active High 'H' Suffix Devices
14. Condition 4: 0.9 – 4.9 V, V<sub>in</sub> = 0.7 V, V<sub>OUT</sub> = 0.4 V, Active High 'H' Suffix Devices
15. Condition 5: 0.9 – 1.0 V, V<sub>in</sub> = 0.8 V, V<sub>OUT</sub> = GND; 1.1 – 1.5 V, V<sub>in</sub> = 1.0 V, V<sub>OUT</sub> = GND; 1.6 – 4.9 V, V<sub>in</sub> = 1.5 V, V<sub>OUT</sub> = GND, Active High 'H' Suffix Devices

# NCP302, NCP303

**Table 3. ELECTRICAL CHARACTERISTIC TABLE FOR 0.9 – 4.9 V**

| NCP303 Series | Detector Threshold              |     |       | Detector Threshold Hysteresis |       |       | Supply Current                 |                                | Nch Sink Current                |                                 |
|---------------|---------------------------------|-----|-------|-------------------------------|-------|-------|--------------------------------|--------------------------------|---------------------------------|---------------------------------|
|               |                                 |     |       |                               |       |       | V <sub>in</sub> Low            | V <sub>in</sub> High           | V <sub>in</sub> Low             | V <sub>in</sub> High            |
| Part Number   | V <sub>DET-</sub> (V) (Note 16) |     |       | V <sub>HYS</sub> (V)          |       |       | I <sub>in</sub> (μA) (Note 17) | I <sub>in</sub> (μA) (Note 18) | I <sub>OUT</sub> (mA) (Note 19) | I <sub>OUT</sub> (mA) (Note 20) |
|               | Min                             | Typ | Max   | Min                           | Typ   | Max   | Typ                            | Typ                            | Typ                             | Typ                             |
| NCP303LSN09T1 | 0.882                           | 0.9 | 0.918 | 0.027                         | 0.045 | 0.063 | 0.20                           | 0.45                           | 0.05                            | 0.5                             |
| NCP303LSN10T1 | 0.980                           | 1.0 | 1.020 | 0.030                         | 0.050 | 0.070 |                                |                                |                                 |                                 |
| NCP303LSN11T1 | 1.078                           | 1.1 | 1.122 | 0.033                         | 0.055 | 0.077 |                                |                                |                                 |                                 |
| NCP303LSN13T1 | 1.274                           | 1.3 | 1.326 | 0.039                         | 0.065 | 0.091 |                                |                                |                                 |                                 |
| NCP303LSN14T1 | 1.372                           | 1.4 | 1.428 | 0.042                         | 0.070 | 0.098 |                                |                                |                                 |                                 |
| NCP303LSN15T1 | 1.470                           | 1.5 | 1.530 | 0.045                         | 0.075 | 0.105 |                                |                                |                                 |                                 |
| NCP303LSN16T1 | 1.568                           | 1.6 | 1.632 | 0.048                         | 0.080 | 0.112 |                                |                                |                                 |                                 |
| NCP303LSN17T1 | 1.666                           | 1.7 | 1.734 | 0.051                         | 0.085 | 0.119 |                                |                                |                                 |                                 |
| NCP303LSN18T1 | 1.764                           | 1.8 | 1.836 | 0.054                         | 0.090 | 0.126 | 0.23                           | 0.48                           | 2.0                             |                                 |
| NCP303LSN20T1 | 1.960                           | 2.0 | 2.040 | 0.060                         | 0.100 | 0.140 |                                |                                |                                 |                                 |
| NCP303LSN22T1 | 2.156                           | 2.2 | 2.244 | 0.066                         | 0.110 | 0.154 |                                |                                |                                 |                                 |
| NCP303LSN23T1 | 2.254                           | 2.3 | 2.346 | 0.069                         | 0.115 | 0.161 |                                |                                |                                 |                                 |
| NCP303LSN24T1 | 2.352                           | 2.4 | 2.448 | 0.072                         | 0.120 | 0.168 |                                |                                |                                 |                                 |
| NCP303LSN25T1 | 2.450                           | 2.5 | 2.550 | 0.075                         | 0.125 | 0.175 |                                |                                |                                 |                                 |
| NCP303LSN26T1 | 2.548                           | 2.6 | 2.652 | 0.078                         | 0.130 | 0.182 |                                |                                |                                 |                                 |
| NCP303LSN27T1 | 2.646                           | 2.7 | 2.754 | 0.081                         | 0.135 | 0.189 |                                |                                |                                 |                                 |
| NCP303LSN28T1 | 2.744                           | 2.8 | 2.856 | 0.084                         | 0.140 | 0.196 | 0.25                           | 0.50                           |                                 |                                 |
| NCP303LSN29T1 | 2.842                           | 2.9 | 2.958 | 0.087                         | 0.145 | 0.203 |                                |                                |                                 |                                 |
| NCP303LSN30T1 | 2.940                           | 3.0 | 3.060 | 0.090                         | 0.150 | 0.210 |                                |                                |                                 |                                 |
| NCP303LSN31T1 | 3.038                           | 3.1 | 3.162 | 0.093                         | 0.155 | 0.217 |                                |                                |                                 |                                 |
| NCP303LSN32T1 | 3.136                           | 3.2 | 3.264 | 0.096                         | 0.160 | 0.224 |                                |                                |                                 |                                 |
| NCP303LSN33T1 | 3.234                           | 3.3 | 3.366 | 0.099                         | 0.165 | 0.231 |                                |                                |                                 |                                 |
| NCP303LSN34T1 | 3.332                           | 3.4 | 3.468 | 0.102                         | 0.170 | 0.238 |                                |                                |                                 |                                 |
| NCP303LSN36T1 | 3.528                           | 3.6 | 3.672 | 0.108                         | 0.180 | 0.252 |                                |                                |                                 |                                 |
| NCP303LSN38T1 | 3.724                           | 3.8 | 3.876 | 0.114                         | 0.190 | 0.266 | 0.33                           | 0.52                           |                                 |                                 |
| NCP303LSN40T1 | 3.920                           | 4.0 | 4.080 | 0.120                         | 0.200 | 0.280 |                                |                                |                                 |                                 |
| NCP303LSN42T1 | 4.116                           | 4.2 | 4.284 | 0.126                         | 0.210 | 0.294 |                                |                                |                                 |                                 |
| NCP303LSN44T1 | 4.312                           | 4.4 | 4.488 | 0.132                         | 0.220 | 0.308 |                                |                                |                                 |                                 |
| NCP303LSN45T1 | 4.410                           | 4.5 | 4.590 | 0.135                         | 0.225 | 0.315 |                                |                                |                                 |                                 |
| NCP303LSN46T1 | 4.508                           | 4.6 | 4.692 | 0.138                         | 0.230 | 0.322 |                                |                                |                                 |                                 |
| NCP303LSN47T1 | 4.606                           | 4.7 | 4.794 | 0.141                         | 0.235 | 0.329 |                                |                                |                                 |                                 |
| NCP303LSN49T1 | 4.802                           | 4.9 | 4.998 | 0.147                         | 0.245 | 0.343 |                                |                                |                                 |                                 |

16. Values shown apply at +25°C only. For voltage options greater than 1.1 V, V<sub>DET-</sub> limits over operating temperature range (-40°C to +125°C) are V<sub>NOM</sub> ±3%. For voltage options < 1.2 V, V<sub>DET-</sub> is guaranteed only at +25°C.
17. Condition 1: 0.9 – 2.9 V, V<sub>in</sub> = V<sub>DET-</sub> – 0.10 V; 3.0 – 3.9 V, V<sub>in</sub> = V<sub>DET-</sub> – 0.13 V; 4.0 – 4.9 V, V<sub>in</sub> = V<sub>DET-</sub> – 0.16 V
18. Condition 2: 0.9 – 4.9 V, V<sub>in</sub> = V<sub>DET-</sub> + 2.0 V
19. Condition 3: 0.9 – 4.9 V, V<sub>in</sub> = 0.7 V, V<sub>OUT</sub> = 0.05 V, Active Low 'L' Suffix Devices
20. Condition 4: 0.9 – 1.0 V, V<sub>in</sub> = 0.85 V, V<sub>OUT</sub> = 0.5 V; 1.1 – 1.5 V, V<sub>in</sub> = 1.0 V, V<sub>OUT</sub> = 0.5 V; 1.6 – 4.9 V, V<sub>in</sub> = 1.5 V, V<sub>OUT</sub> = 0.5 V, Active Low 'L' Suffix Devices

# NCP302, NCP303



**Figure 3. NCP302/3 Series 0.9 V Input Current vs. Input Voltage**



**Figure 4. NCP302/3 Series 2.7 V Input Current vs. Input Voltage**



**Figure 5. NCP302/3 Series 4.5 V Input Current vs. Input Voltage**



**Figure 6. NCP302/3 Series 0.9 V Detector Threshold Voltage vs. Temperature**



**Figure 7. NCP302/3 Series 2.7 V Detector Threshold Voltage vs. Temperature**

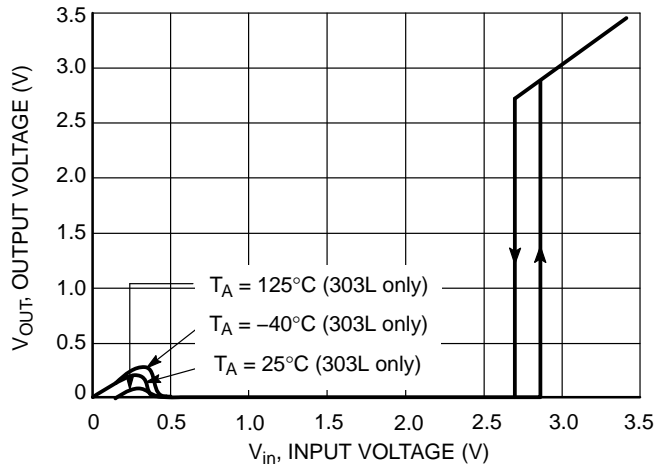


**Figure 8. NCP302/3 Series 4.5 V Detector Threshold Voltage vs. Temperature**

# NCP302, NCP303



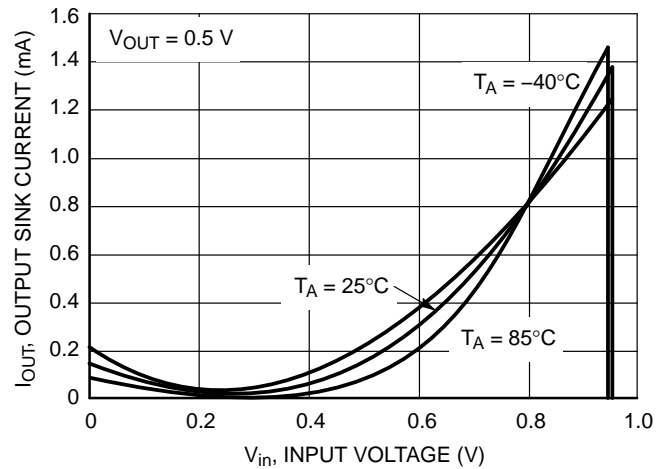
**Figure 9. NCP302L/3L Series 0.9 V Reset Output Voltage vs. Input Voltage**



**Figure 10. NCP302L/3L Series 2.7 V Reset Output Voltage vs. Input Voltage**



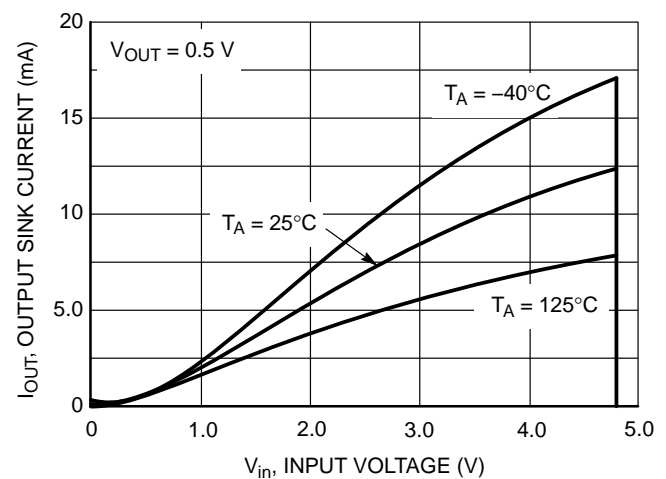
**Figure 11. NCP302L/3L Series 4.5 V Reset Output Voltage vs. Input Voltage**



**Figure 12. NCP302H/3L Series 0.9 V Reset Output Sink Current vs. Input Voltage**



**Figure 13. NCP302H/3L Series 2.7 V Reset Output Sink Current vs. Input Voltage**



**Figure 14. NCP302H/3L Series 4.5 V Reset Output Sink Current vs. Input Voltage**

# NCP302, NCP303



**Figure 15. NCP302L Series 0.9 V**  
Reset Output Source Current vs. Input Voltage



**Figure 16. NCP302L Series 2.7 V**  
Reset Output Source Current vs. Input Voltage



**Figure 17. NCP302L Series 4.5 V**  
Reset Output Source Current vs. Input Voltage



**Figure 18. NCP302H/3L Series 0.9 V**  
Reset Output Sink Current vs. Output Voltage



**Figure 19. NCP302H/3L Series 2.7 V**  
Reset Output Sink Current vs. Output Voltage



**Figure 20. NCP302H/3L Series 4.5 V**  
Reset Output Sink Current vs. Output Voltage

# NCP302, NCP303



**Figure 21. NCP302/3 Series 0.9 V**  
C<sub>D</sub> Delay Pin Sink Current vs. Input Voltage



**Figure 22. NCP302/3 Series 2.7 V**  
C<sub>D</sub> Delay Pin Sink Current vs. Input Voltage



**Figure 23. NCP302/3 Series 4.5 V**  
C<sub>D</sub> Delay Pin Sink Current vs. Input Voltage



**Figure 24. NCP302/3 Series 0.9 V**  
C<sub>D</sub> Delay Pin Sink Current vs. Voltage



**Figure 25. NCP302/3 Series 2.7 V**  
C<sub>D</sub> Delay Pin Sink Current vs. Voltage



**Figure 26. NCP302/3 Series 4.5 V**  
C<sub>D</sub> Delay Pin Sink Current vs. Voltage

# NCP302, NCP303



**Figure 27. NCP302/3 Series 0.9 V**  
**C<sub>D</sub> Delay Pin Threshold Voltage vs. Temperature**



**Figure 28. NCP302/3 Series 2.7 V**  
**C<sub>D</sub> Delay Pin Threshold Voltage vs. Temperature**



**Figure 29. NCP302/3 Series 4.5 V**  
**C<sub>D</sub> Delay Pin Threshold Voltage vs. Temperature**



**Figure 30. NCP302/3 Series 0.9 V**  
**Output Time Delay vs. Capacitance**

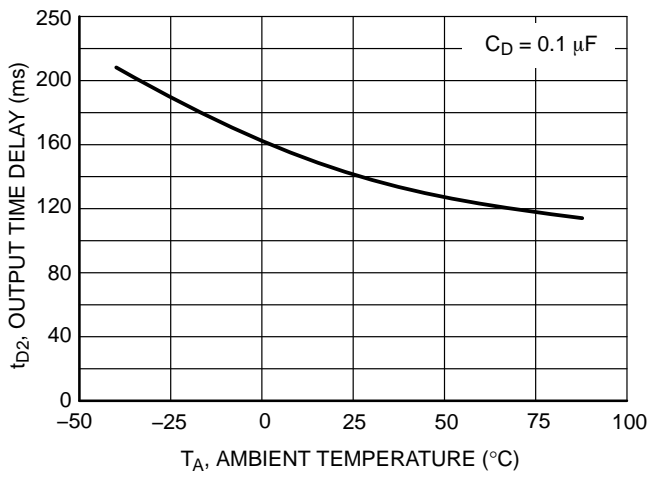


**Figure 31. NCP302/3 Series 2.7 V**  
**Output Time Delay vs. Capacitance**

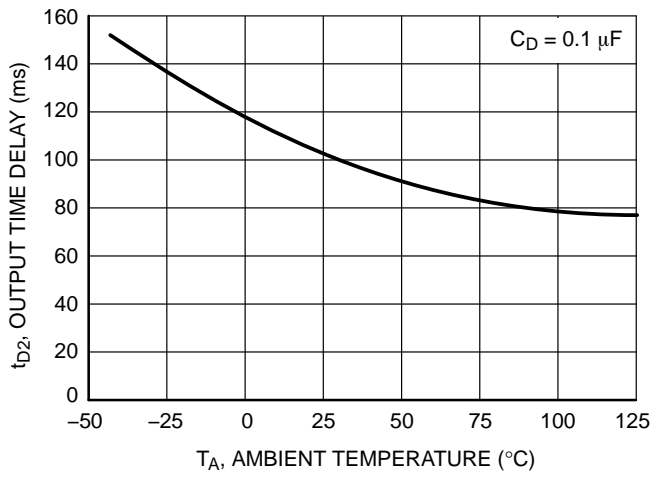


**Figure 32. NCP302/3 Series 4.5 V**  
**Output Time Delay vs. Capacitance**

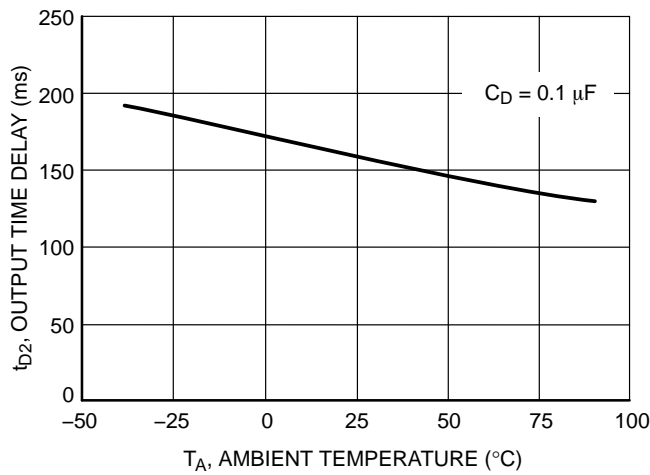
# NCP302, NCP303



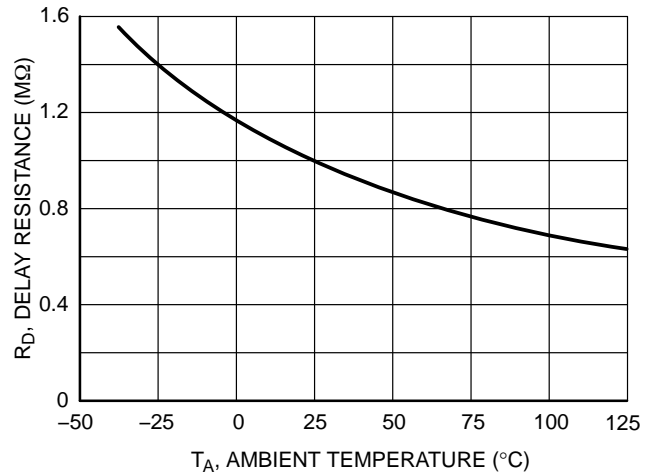
**Figure 33. NCP302/3 Series 0.9 V Reset Output Time Delay vs. Temperature**



**Figure 34. NCP302/3 Series 2.7 V Reset Output Time Delay vs. Temperature**



**Figure 35. NCP302/3 Series 4.5 V Reset Output Time Delay vs. Temperature**



**Figure 36. NCP302/3 Series Delay Resistance vs. Temperature**

**OPERATING DESCRIPTION**

The NCP302 and NCP303 series devices consist of a precision voltage detector that drives a time delay generator. Figures 37 and 38 show a timing diagram and a typical application. Initially consider that input voltage  $V_{in}$  is at a nominal level and it is greater than the voltage detector upper threshold ( $V_{DET+}$ ). The voltage at Pin 5 and capacitor  $C_D$  will be at the same level as  $V_{in}$ , and the reset output (Pin 1) will be in the high state for active low devices, or in the low state for active high devices. If there is a power interruption and  $V_{in}$  becomes significantly deficient, it will fall below the lower detector threshold ( $V_{DET-}$ ) and the external time delay capacitor  $C_D$  will be immediately discharged by an internal N-Channel MOSFET that connects to Pin 5. This sequence of events causes the Reset output to be in the low state for active low devices, or in the high state for active high devices. After completion of the power interruption,

$V_{in}$  will again return to its nominal level and become greater than the  $V_{DET+}$ . The voltage detector will turn off the N-Channel MOSFET and allow pullup resistor  $R_D$  to charge external capacitor  $C_D$ , thus creating a programmable delay for releasing the reset signal. When the voltage at Pin 5 exceeds the inverter/buffer threshold, typically  $0.675 V_{in}$ , the reset output will revert back to its original state. The reset output time delay versus capacitance is shown in Figures 30 through 32. The voltage detector and inverter/buffer have built-in hysteresis to prevent erratic reset operation.

Although these device series are specifically designed for use as reset controllers in portable microprocessor based systems, they offer a cost-effective solution in numerous applications where precise voltage monitoring and time delay are required. Figures 38 through 46 show various application examples.



**Figure 37. Timing Waveforms**

# NCP302, NCP303

## APPLICATION CIRCUIT INFORMATION



Figure 38. Microprocessor Reset Circuit



Figure 39. Battery Charge Indicator



Figure 40. Missing Pulse Detector or Frequency Detector

## NCP302, NCP303



**Figure 41. Microprocessor Reset Circuit with Additional Hysteresis**

Comparator hysteresis can be increased with the addition of resistor  $R_H$ . The hysteresis equations have been simplified and do not account for the change of input current  $I_{in}$  as  $V_{in}$  crosses the comparator threshold. The internal resistance,  $R_{in}$  is simply calculated using  $I_{in} = 0.26 \mu A$  at 2.6 V.

$V_{in}$  Decreasing:

$$V_{th} = \left( \frac{R_H}{R_{in}} + 1 \right) (V_{DET-})$$

$V_{in}$  Increasing:

$$V_{th} = \left( \frac{R_H}{R_{in} \parallel R_L} + 1 \right) (V_{DET-} + V_{HYS})$$

$$V_{HYS} = V_{in \text{ Increasing}} - V_{in \text{ Decreasing}}$$

| Test Data               |                         |               |                    |                     |
|-------------------------|-------------------------|---------------|--------------------|---------------------|
| $V_{th}$ Decreasing (V) | $V_{th}$ Increasing (V) | $V_{HYS}$ (V) | $R_H$ ( $\Omega$ ) | $R_L$ (k $\Omega$ ) |
| 2.70                    | 2.84                    | 0.135         | 0                  | –                   |
| 2.70                    | 2.87                    | 0.17          | 100                | 10                  |
| 2.70                    | 2.88                    | 0.19          | 100                | 6.8                 |
| 2.70                    | 2.91                    | 0.21          | 100                | 4.3                 |
| 2.70                    | 2.90                    | 0.20          | 220                | 10                  |
| 2.70                    | 2.94                    | 0.24          | 220                | 6.8                 |
| 2.70                    | 2.98                    | 0.28          | 220                | 4.3                 |
| 2.70                    | 2.70                    | 0.27          | 470                | 10                  |
| 2.70                    | 3.04                    | 0.34          | 470                | 6.8                 |
| 2.70                    | 3.15                    | 0.35          | 470                | 4.3                 |



| Test Data     |                 |                   |
|---------------|-----------------|-------------------|
| C ( $\mu F$ ) | $f_{osc}$ (kHz) | $I_Q$ ( $\mu A$ ) |
| 0.01          | 2590            | 21.77             |
| 0.1           | 490             | 21.97             |
| 1.0           | 52              | 22.07             |

**Figure 42. Simple Clock Oscillator**

## NCP302, NCP303



This circuit monitors the current at the load. As current flows through the load, a voltage drop with respect to ground appears across  $R_{sense}$  where  $V_{sense} = I_{load} * R_{sense}$ . The following conditions apply:

If:  
 $I_{Load} < V_{DET-} / R_{sense}$   
 $I_{Load} \geq (V_{DET-} + V_{HYS}) / R_{sense}$

Then:  
 Reset Output = 0 V  
 Reset Output =  $V_{DD}$

Figure 43. Microcontroller Systems Load Sensing



A simple voltage monitor can be constructed by connecting several voltage detectors as shown above. Each LED will sequentially turn on when the respective voltage detector threshold ( $V_{DET-} + V_{HYS}$ ) is exceeded. Note that detector thresholds ( $V_{DET-}$ ) that range from 0.9 V to 4.9 V in 100 mV steps can be manufactured.

Figure 44. LED Bar Graph Voltage Monitor

## NCP302, NCP303

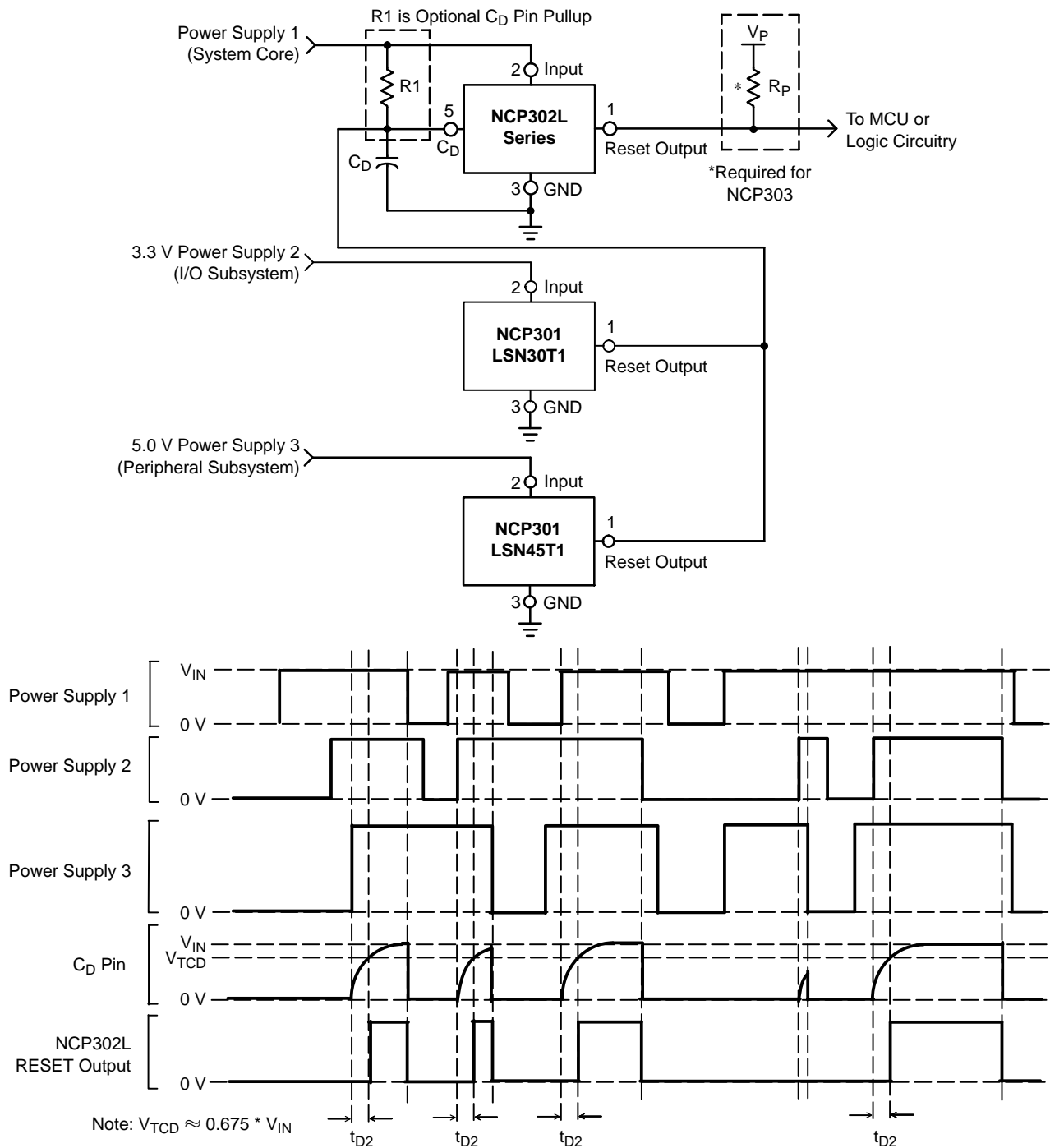


**Figure 45. Undervoltage Detection with Independent Reset Signal Control**

This circuit monitors  $V_{DD}$  for undervoltage. If the  $V_{DD}$  input falls below the detector threshold ( $V_{DET-}$ ), then the capacitor on the  $C_D$  pin will be immediately discharged resulting in the reset output changing to its active state indicating that an undervoltage event has been detected. The addition of a logic gate (Logic 1) provides for reset output control which is independent of  $V_{DD}$ . If the output of the

logic gate is tristated the undervoltage detector will behave normally. If the tristate is de-asserted, the logic gate will pull the  $C_D$  pin low resulting in the Reset Output pin changing to an active state. This independent control is useful in power supply sequencing applications when the Reset Output is tied to the enable input of an LDO or DC-DC converter.

## NCP302, NCP303



**Figure 46. Multi-Rail Supply Undervoltage Monitor with Power Good**

This circuit monitors multiple power supply rails for undervoltage conditions. If any of the three power supplies are in an undervoltage condition, the NCP302 reset output will be immediately set to an active low level. All three power supplies must be above their minimum voltage levels for the NCP302 reset output to generate a “Power Good” level (Reset Output = Power Supply 1 or  $V_P$ ).

Optionally, R1 may be added to provide a smaller effective  $C_D$  pin pullup resistance, ( $R_D'$ ), where  $R_D' = R1 \parallel R_D$ , with  $R_D$  (internal  $C_D$  pin pullup resistance)

approximately equal to 1.0 M $\Omega$ , and  $R1 > 5 \text{ k}\Omega$ . If  $R1 \ll R_D$ , then R1 also can decrease the reset output delay time ( $t_{D2}$ ) variance over the operating temperature range.

The Power Good signal time delay ( $t_{D2}$ ) can be estimated by:  $t_{D2} \approx R_D * C_D$ , with  $R_D$  in Ohms, and  $C_D$  in Farads. If R1 is installed, then  $R_D'$  is substituted for  $R_D$ .  $R_P$  is added only if using the NCP303 to replace the NCP302. This allows the Reset Output to be pulled up to  $V_P$  which can be the Power Supply 1 or an independent power supply rail.

# NCP302, NCP303

## ORDERING INFORMATION

| Device          | Threshold Voltage | Output Type | Reset            | Marking     | Package          | Shipping†                        |                  |
|-----------------|-------------------|-------------|------------------|-------------|------------------|----------------------------------|------------------|
| NCP302LSN09T1G  | 0.9               | CMOS        | Active Low       | SBO         | TSOP-5 (Pb-Free) | 3000 / Tape & Reel (7 inch Reel) |                  |
| NCP302LSN15T1G  | 1.5               |             |                  | SBI         | TSOP-5 (Pb-Free) |                                  |                  |
| NCP302LSN18T1G  | 1.8               |             |                  | SBF         | TSOP-5 (Pb-Free) |                                  |                  |
| NCP302LSN20T1G  | 2.0               |             |                  | SBD         | TSOP-5 (Pb-Free) |                                  |                  |
| NCV302LSN20T1G* |                   |             |                  | AHH         |                  |                                  |                  |
| NCP302LSN27T1G  | 2.7               |             |                  | SAW         | TSOP-5 (Pb-Free) |                                  |                  |
| NCP302LSN28T1G  | 2.8               |             |                  | ALA         | TSOP-5 (Pb-Free) |                                  |                  |
| NCP302LSN30T1G  | 3.0               |             |                  | SAT         | TSOP-5 (Pb-Free) |                                  |                  |
| NCV302LSN30T1G* |                   |             |                  | ACJ         |                  |                                  |                  |
| NCP302LSN33T1G  | 3.3               |             |                  | SAQ         | TSOP-5 (Pb-Free) |                                  |                  |
| NCP302LSN38T1G  | 3.8               |             |                  | SAK         | TSOP-5 (Pb-Free) |                                  |                  |
| NCP302LSN40T1G  | 4.0               |             |                  | SAI         | TSOP-5 (Pb-Free) |                                  |                  |
| NCP302LSN43T1G  | 4.3               |             |                  | SAF         | TSOP-5 (Pb-Free) |                                  |                  |
| NCP302LSN45T1G  | 4.5               |             |                  | SAL         | TSOP-5 (Pb-Free) |                                  |                  |
| NCP302LSN47T1G  | 4.7               |             |                  | SAC         | TSOP-5 (Pb-Free) |                                  |                  |
| NCP302HSN09T1G  | 0.9               |             |                  | Active High | SDO              |                                  | TSOP-5 (Pb-Free) |
| NCP302HSN18T1G  | 1.8               |             |                  |             | SFH              |                                  | TSOP-5 (Pb-Free) |
| NCP302HSN27T1G  | 2.7               |             |                  |             | SDK              |                                  | TSOP-5 (Pb-Free) |
| NCP302HSN30T1G  | 3.0               | SDI         | TSOP-5 (Pb-Free) |             |                  |                                  |                  |
| NCP302HSN40T1G  | 4.0               | SJH         | TSOP-5 (Pb-Free) |             |                  |                                  |                  |
| NCP302HSN45T1G  | 4.5               | SDG         | TSOP-5 (Pb-Free) |             |                  |                                  |                  |

NOTE: The ordering information lists standard undervoltage thresholds with active low outputs. Additional active low threshold devices, ranging from 0.9 V to 4.9 V in 100 mV increments and NCP302 active high output devices, ranging from 0.9 V to 4.9 V in 100 mV increments can be manufactured. Contact your ON Semiconductor representative for availability. The electrical characteristics of these additional devices are shown in Tables 1 and 2.

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

\*NCV Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC-Q100 Qualified and PPAP Capable.

NCVxxx:  $T_{low} = -40^{\circ}\text{C}$ ,  $T_{high} = +125^{\circ}\text{C}$ . Guaranteed by design.

## NCP302, NCP303

### ORDERING INFORMATION

| Device          | Threshold Voltage | Output Type | Reset      | Marking | Package             | Shipping†                           |
|-----------------|-------------------|-------------|------------|---------|---------------------|-------------------------------------|
| NCP303LSN09T1G  | 0.9               | Open Drain  | Active Low | SDE     | TSOP-5<br>(Pb-Free) | 3000 / Tape & Reel<br>(7 inch Reel) |
| NCV303LSN09T1G* |                   |             |            | AMU     |                     |                                     |
| NCP303LSN10T1G  | 1.0               |             |            | SDD     | TSOP-5<br>(Pb-Free) |                                     |
| NCV303LSN10T1G* |                   |             |            | SSM     |                     |                                     |
| NCP303LSN11T1G  | 1.1               |             |            | SDC     | TSOP-5<br>(Pb-Free) |                                     |
| NCV303LSN11T1G* |                   |             |            | ADC     |                     |                                     |
| NCV303LSN12T1G* | 1.2               |             |            | SDB     | TSOP-5<br>(Pb-Free) |                                     |
| NCP303LSN13T1G  | 1.3               |             |            | SDA     | TSOP-5<br>(Pb-Free) |                                     |
| NCV303LSN13T1G* |                   |             |            | SRS     |                     |                                     |
| NCP303LSN14T1G  | 1.4               |             |            | SCZ     | TSOP-5<br>(Pb-Free) |                                     |
| NCV303LSN14T1G* |                   |             |            | SRT     |                     |                                     |
| NCP303LSN15T1G  | 1.5               |             |            | SCY     | TSOP-5<br>(Pb-Free) |                                     |
| NCV303LSN15T1G* |                   |             |            | SRU     |                     |                                     |
| NCP303LSN16T1G  | 1.6               |             |            | SCX     | TSOP-5<br>(Pb-Free) |                                     |
| NCV303LSN16T1G* |                   |             |            | SRV     |                     |                                     |
| NCP303LSN17T1G  | 1.7               |             |            | SCW     | TSOP-5              |                                     |
| NCP303LSN18T1G  | 1.8               |             |            | SCV     | TSOP-5<br>(Pb-Free) |                                     |
| NCP303LSN20T1G  | 2.0               |             |            | SCT     | TSOP-5<br>(Pb-Free) |                                     |
| NCV303LSN20T1G* |                   | SRW         |            |         |                     |                                     |

NOTE: The ordering information lists standard undervoltage thresholds with active low outputs. Additional active low threshold devices, ranging from 0.9 V to 4.9 V in 100 mV increments and NCP302 active high output devices, ranging from 0.9 V to 4.9 V in 100 mV increments can be manufactured. Contact your ON Semiconductor representative for availability. The electrical characteristics of these additional devices are shown in Tables 1 and 2.

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## NCP302, NCP303

### ORDERING INFORMATION

| Device          | Threshold Voltage | Output Type | Reset               | Marking | Package             | Shipping†                           |
|-----------------|-------------------|-------------|---------------------|---------|---------------------|-------------------------------------|
| NCP303LSN22T1G  | 2.2               | Open Drain  | Active Low          | SCR     | TSOP-5<br>(Pb-Free) | 3000 / Tape & Reel<br>(7 inch Reel) |
| NCV303LSN22T1G* |                   |             |                     | ADD     |                     |                                     |
| NCP303LSN23T1G  | 2.3               |             |                     | SCQ     | TSOP-5<br>(Pb-Free) |                                     |
| NCV303LSN23T1G* |                   |             |                     | SRX     |                     |                                     |
| NCP303LSN24T1G  | 2.4               |             |                     | SCP     | TSOP-5<br>(Pb-Free) |                                     |
| NCV303LSN24T1G* |                   |             |                     | SRY     |                     |                                     |
| NCP303LSN25T1G  | 2.5               |             |                     | SCO     | TSOP-5<br>(Pb-Free) |                                     |
| NCV303LSN25T1G* |                   |             |                     | AHA     |                     |                                     |
| NCP303LSN26T1G  | 2.6               |             |                     | SCN     | TSOP-5<br>(Pb-Free) |                                     |
| NCP303LSN27T1G  | 2.7               |             |                     | SCM     | TSOP-5<br>(Pb-Free) |                                     |
| NCV303LSN27T1G* |                   |             |                     | CAP     |                     |                                     |
| NCP303LSN28T1G  | 2.8               |             |                     | SCL     | TSOP-5<br>(Pb-Free) |                                     |
| NCV303LSN28T1G* |                   |             |                     | TAA     |                     |                                     |
| NCP303LSN29T1G  | 2.9               |             |                     | SCK     | TSOP-5<br>(Pb-Free) |                                     |
| NCV303LSN29T1G* |                   |             |                     | SSK     |                     |                                     |
| NCP303LSN30T1G  | 3.0               |             |                     | SCJ     | TSOP-5<br>(Pb-Free) |                                     |
| NCV303LSN30T1G* |                   |             |                     | SSA     |                     |                                     |
| NCP303LSN31T1G  | 3.1               |             |                     | SCI     | TSOP-5<br>(Pb-Free) |                                     |
| NCV303LSN31T1G* |                   | CAR         |                     |         |                     |                                     |
| NCP303LSN32T1G  | 3.2               | SCH         | TSOP-5<br>(Pb-Free) |         |                     |                                     |

NOTE: The ordering information lists standard undervoltage thresholds with active low outputs. Additional active low threshold devices, ranging from 0.9 V to 4.9 V in 100 mV increments and NCP302 active high output devices, ranging from 0.9 V to 4.9 V in 100 mV increments can be manufactured. Contact your ON Semiconductor representative for availability. The electrical characteristics of these additional devices are shown in Tables 1 and 2.

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# NCP302, NCP303

## ORDERING INFORMATION

| Device          | Threshold Voltage | Output Type      | Reset      | Marking | Package          | Shipping†                        |
|-----------------|-------------------|------------------|------------|---------|------------------|----------------------------------|
| NCP303LSN33T1G  | 3.3               | Open Drain       | Active Low | SCG     | TSOP-5 (Pb-Free) | 3000 / Tape & Reel (7 inch Reel) |
| NCP303LSN34T1G  | 3.4               |                  |            | SCF     | TSOP-5 (Pb-Free) |                                  |
| NCV303LSN34T1G* |                   |                  |            | CAT     |                  |                                  |
| NCP303LSN36T1G  | 3.6               |                  |            | SCD     | TSOP-5 (Pb-Free) |                                  |
| NCV303LSN36T1G* |                   |                  |            | SSC     |                  |                                  |
| NCP303LSN38T1G  | 3.8               |                  |            | SCA     | TSOP-5 (Pb-Free) |                                  |
| NCP303LSN40T1G  | 4.0               |                  |            | SBY     | TSOP-5 (Pb-Free) |                                  |
| NCV303LSN40T1G* |                   |                  |            | SSD     |                  |                                  |
| NCP303LSN42T1G  | 4.2               |                  |            | SBW     | TSOP-5 (Pb-Free) |                                  |
| NCV303LSN42T1G* |                   |                  |            | SSE     |                  |                                  |
| NCV303LSN43T1G* | 4.3               |                  |            | SBV     | TSOP-5 (Pb-Free) |                                  |
| NCP303LSN44T1G  | 4.4               |                  |            | SBU     | TSOP-5 (Pb-Free) |                                  |
| NCV303LSN44T1*  |                   |                  |            | SSF     | TSOP-5           |                                  |
| NCV303LSN44T1G* |                   |                  |            |         | TSOP-5 (Pb-Free) |                                  |
| NCP303LSN45T1G  | 4.5               |                  |            | SBT     | TSOP-5 (Pb-Free) |                                  |
| NCV303LSN45T1G* |                   |                  |            | SSG     |                  |                                  |
| NCP303LSN46T1G  | 4.6               |                  |            | SBS     | TSOP-5 (Pb-Free) |                                  |
| NCV303LSN46T1*  |                   |                  |            | SSH     | TSOP-5           |                                  |
| NCV303LSN46T1G* |                   |                  |            |         | TSOP-5 (Pb-Free) |                                  |
| NCP303LSN47T1G  | 4.7               |                  |            | SBR     | TSOP-5 (Pb-Free) |                                  |
| NCV303LSN47T1*  |                   |                  |            | SSJ     | TSOP-5           |                                  |
| NCV303LSN47T1G* |                   |                  |            |         | TSOP-5 (Pb-Free) |                                  |
| NCP303LSN49T1G  | 4.9               |                  |            | SBP     | TSOP-5 (Pb-Free) |                                  |
| NCV303LSN49T1*  |                   |                  |            | SSI     | TSOP-5           |                                  |
| NCV303LSN49T1G* |                   | TSOP-5 (Pb-Free) |            |         |                  |                                  |

NOTE: The ordering information lists standard undervoltage thresholds with active low outputs. Additional active low threshold devices, ranging from 0.9 V to 4.9 V in 100 mV increments and NCP302 active high output devices, ranging from 0.9 V to 4.9 V in 100 mV increments can be manufactured. Contact your ON Semiconductor representative for availability. The electrical characteristics of these additional devices are shown in Tables 1 and 2.

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# NCP302, NCP303

## PACKAGE DIMENSIONS

### TSOP-5 (SOT-23-5/SC59-5) CASE 483-02 ISSUE K



**NOTES:**

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH THICKNESS. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIAL.
4. DIMENSIONS A AND B DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS. MOLD FLASH, PROTRUSIONS, OR GATE BURRS SHALL NOT EXCEED 0.15 PER SIDE. DIMENSION A.
5. OPTIONAL CONSTRUCTION: AN ADDITIONAL TRIMMED LEAD IS ALLOWED IN THIS LOCATION. TRIMMED LEAD NOT TO EXTEND MORE THAN 0.2 FROM BODY.

### SOLDERING FOOTPRINT\*



\*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

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