



**THE DATASHEET OF  
NCP304HSQ45T1G**



# NCP304, NCP305

## Voltage Detector Series

The NCP304 and NCP305 series are second generation ultra-low current voltage detectors. 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 which prevents erratic system reset operation as the comparator threshold is crossed.

The NCP304 series consists of complementary output devices that are available with either an active high or active low reset output. The NCP305 series has an open drain N-Channel output with an active low reset output.

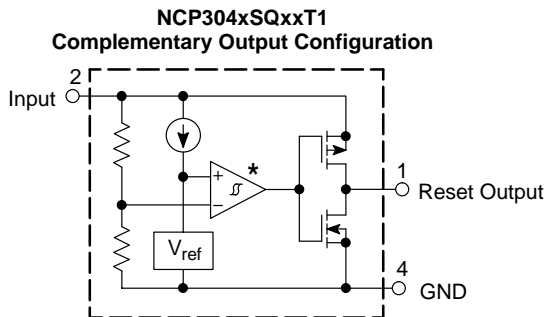
The NCP304 and NCP305 device series are available in the SC-82AB package with standard undervoltage thresholds. Additional thresholds that range from 0.9 V to 4.9 V in 100 mV steps can be manufactured.

### Features

- Quiescent Current of 1.0  $\mu$ A Typical
- High Accuracy Undervoltage Threshold of 2.0%
- Wide Operating Voltage Range of 0.8 V to 10 V
- Complementary or Open Drain Reset Output
- Active Low or Active High Reset Output
- 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

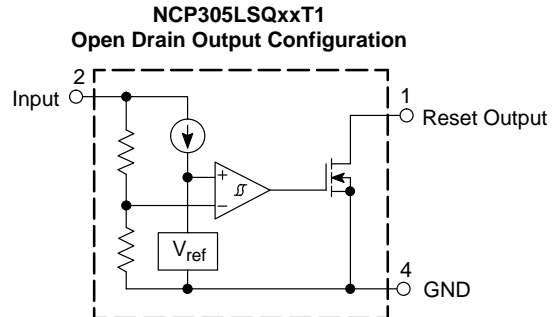
### Typical Applications

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



This device contains 38 active transistors.

\* The representative block diagram depicts active low reset output 'L' suffix devices. The comparator input is interchanged for the active high output 'H' suffix devices.



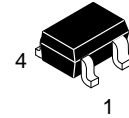
This device contains 37 active transistors.

Figure 1. Representative Block Diagrams



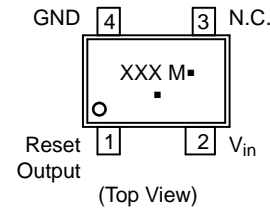
ON Semiconductor®

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SC-82AB  
SQ SUFFIX  
CASE 419C

### PIN CONNECTIONS AND MARKING DIAGRAM



XXX = Specific Device Code  
M = Date Code  
▪ = Pb-Free Package

(Note: Microdot may be in either location)

### ORDERING INFORMATION

See detailed ordering, marking and shipping information in the ordering information section on page 19 of this data sheet.

# NCP304, NCP305

## MAXIMUM RATINGS (Note 1)

| Rating  | Symbol          | Value                              | Unit |
|---|-----------------|------------------------------------|------|
| Input Power Supply Voltage (Pin 2)  | $V_{in}$        | 12                                 | V    |
| Output Voltage (Pin 1)<br>Complementary, NCP304<br>N-Channel Open Drain, NCP305 | $V_{OUT}$       | -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   | $R_{\theta JA}$ | 285                                | °C/W |
| Maximum Junction Temperature  | $T_J$           | +125                               | °C   |
| Storage Temperature Range   | $T_{stg}$       | -55 to +150                        | °C   |
| Latchup Performance (Note 3)<br>Positive<br>Negative                            | $I_{LATCHUP}$   | 500<br>170                         | 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.

## ELECTRICAL CHARACTERISTICS (For all values $T_A = 25^\circ\text{C}$ , unless otherwise noted.)

| Characteristic  | Symbol        | Min                        | Typ                     | Max             | Unit          |
|---|---------------|----------------------------|-------------------------|-----------------|---------------|
| <b>NCP304/5 – 0.9</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>-                     | 0.8<br>-                | 2.4<br>3.0      | $\mu\text{A}$ |
| 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>N-Channel Sink Current, NCP304, NCP305<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>P-Channel Source Current, NCP304<br>( $V_{OUT} = 2.4\text{ V}$ , $V_{in} = 4.5\text{ V}$ ) | $I_{OUT}$     | 0.01<br>0.05<br><br>1.0    | 0.05<br>0.50<br><br>2.0 | -<br>-<br><br>- | mA            |
| Reset Output Current (Pin 1, Active High 'H' Suffix Devices)<br><br>N-Channel Sink Current, NCP304, NCP305<br>( $V_{OUT} = 0.5\text{ V}$ , $V_{in} = 1.5\text{ V}$ )<br><br>P-Channel Source Current, NCP304<br>( $V_{OUT} = 0.4\text{ V}$ , $V_{in} = 0.7\text{ V}$ )<br>( $V_{OUT} = \text{GND}$ , $V_{in} = 0.8\text{ V}$ )      | $I_{OUT}$     | 1.05<br><br>0.011<br>0.014 | 2.5<br><br>0.04<br>0.08 | -<br><br>-<br>- | mA            |
| Propagation Delay Input to Output (Figure 2)  |               |                            |                         |                 | $\mu\text{s}$ |

- In the case of CMOS Output Type: The time interval between the rising edge of  $V_{DD}$  input pulse from 0.7 V to  $(+V_{DET}) + 2.0\text{ V}$  and output voltage level becoming to  $V_{DD}/2$ . In the case of N-Channel Open Drain Output Type: Output pin is pulled up with a resistance of 470 k $\Omega$  to 5.0 V, the time interval between the rising edge of  $V_{DD}$  input pulse from 0.7 V to  $(+V_{DET}) + 2.0\text{ V}$  and output voltage level becoming to 2.5 V.

# NCP304, NCP305

## ELECTRICAL CHARACTERISTICS (continued) (For all values $T_A = 25^\circ\text{C}$ , unless otherwise noted.)

| Characteristic   | Symbol   | Min                           | Typ                         | Max                         | Unit                              |
|--|--|-------------------------------|-----------------------------|-----------------------------|-----------------------------------|
| <b>NCP304/5 – 0.9</b>  |  |                               |                             |                             |                                   |
| Complementary Output NCP304 Series<br>Output Transition, High to Low (Note 4)  | $t_{pHL}$  | –                             | 18                          | –                           |                                   |
| Output Transition, Low to High (Note 4)  | $t_{pLH}$  | –                             | 6.0                         | 60                          |                                   |
| N-Channel Open Drain NCP305 Series<br>Output Transition, High to Low (Note 4)  | $t_{pHL}$  | –                             | 18                          | –                           |                                   |
| Output Transition, Low to High (Note 4)  | $t_{pLH}$  | –                             | –                           | 100                         |                                   |
| <b>NCP304/5 – 1.8</b>  |  |                               |                             |                             |                                   |
| Detector Threshold (Pin 2, $V_{in}$ Decreasing)  | $V_{DET-}$   | 1.764                         | 1.80                        | 1.836                       | 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>–                        | 0.8<br>1.0                  | 2.4<br>3.0                  | $\mu\text{A}$                     |
| 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>N-Channel Sink Current, NCP304, NCP305<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>P-Channel Source Current, NCP304<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>2.0  | <br>–<br>–<br><br>–         | <br><br><br><br><br>mA            |
| Reset Output Current (Pin 1, Active High 'H' Suffix Devices)<br><br>N-Channel Sink Current, NCP304, NCP305<br>( $V_{OUT} = 0.5\text{ V}$ , $V_{in} = 5.0\text{ V}$ )<br><br>P-Channel Source Current, NCP304<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>–         | <br><br><br><br><br>mA            |
| Propagation Delay Input to Output (Figure 2)<br><br>Complementary Output NCP304 Series<br>Output Transition, High to Low (Note 4)<br>Output Transition, Low to High (Note 4)<br><br>N-Channel Open Drain NCP305 Series<br>Output Transition, High to Low (Note 4)<br>Output Transition, Low to High (Note 4)                       | $t_{pHL}$<br>$t_{pLH}$<br><br>$t_{pHL}$<br>$t_{pLH}$ | <br>–<br>–<br><br>–<br>–      | <br>14<br>15<br><br>14<br>– | <br>–<br>60<br><br>–<br>100 | <br><br><br><br><br>$\mu\text{s}$ |
| <b>NCP304/5 – 2.0</b>  |  |                               |                             |                             |                                   |
| Detector Threshold (Pin 2, $V_{in}$ Decreasing)  | $V_{DET-}$   | 1.960                         | 2.00                        | 2.040                       | 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>–                        | 0.9<br>1.1                  | 2.7<br>3.3                  | $\mu\text{A}$                     |
| 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)  | $I_{OUT}$  |                               |                             |                             | mA                                |

4. In the case of CMOS Output Type: The time interval between the rising edge of  $V_{DD}$  input pulse from 0.7 V to  $(+V_{DET}) + 2.0\text{ V}$  and output voltage level becoming to  $V_{DD}/2$ . In the case of N-Channel Open Drain Output Type: Output pin is pulled up with a resistance of 470 k $\Omega$  to 5.0 V, the time interval between the rising edge of  $V_{DD}$  input pulse from 0.7 V to  $(+V_{DET}) + 2.0\text{ V}$  and output voltage level becoming to 2.5 V.

# NCP304, NCP305

## ELECTRICAL CHARACTERISTICS (continued) (For all values $T_A = 25^\circ\text{C}$ , unless otherwise noted.)

| Characteristic  | Symbol                 | Min            | Typ          | Max          | Unit          |
|---|------------------------|----------------|--------------|--------------|---------------|
| <b>NCP304/5 – 2.0</b>   |                        |                |              |              |               |
| N-Channel Sink Current, NCP304, NCP305<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>–       |               |
| P-Channel Source Current, NCP304<br>( $V_{OUT} = 2.4\text{ V}$ , $V_{in} = 4.5\text{ V}$ )  |                        | 1.0            | 2.0          | –            |               |
| Reset Output Current (Pin 1, Active High 'H' Suffix Devices)  | $I_{OUT}$              |                |              |              | mA            |
| N-Channel Sink Current, NCP304, NCP305<br>( $V_{OUT} = 0.5\text{ V}$ , $V_{in} = 5.0\text{ V}$ )  |                        | 6.3            | 11           | –            |               |
| P-Channel Source Current, NCP304<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>–       |               |
| Propagation Delay Input to Output (Figure 2)  |                        |                |              |              | $\mu\text{s}$ |
| Complementary Output NCP304 Series<br>Output Transition, High to Low (Note 4)<br>Output Transition, Low to High (Note 4)                                      | $t_{pHL}$<br>$t_{pLH}$ | –<br>–         | 13<br>15     | –<br>60      |               |
| N-Channel Open Drain NCP305 Series<br>Output Transition, High to Low (Note 4)<br>Output Transition, Low to High (Note 4)                                      | $t_{pHL}$<br>$t_{pLH}$ | –<br>–         | 13<br>–      | –<br>100     |               |
| <b>NCP304/5 – 2.7</b>   |                        |                |              |              |               |
| Detector Threshold (Pin 2, $V_{in}$ Decreasing)   | $V_{DET-}$             | 2.646          | 2.700        | 2.754        | 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>–         | 0.9<br>1.1   | 2.7<br>3.3   | $\mu\text{A}$ |
| 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)   | $I_{OUT}$              |                |              |              | mA            |
| N-Channel Sink Current, NCP304, NCP305<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>–       |               |
| P-Channel Source Current, NCP304<br>( $V_{OUT} = 2.4\text{ V}$ , $V_{in} = 4.5\text{ V}$ )  |                        | 1.0            | 2.0          | –            |               |
| Reset Output Current (Pin 1, Active High 'H' Suffix Devices)  | $I_{OUT}$              |                |              |              | mA            |
| N-Channel Sink Current, NCP304, NCP305<br>( $V_{OUT} = 0.5\text{ V}$ , $V_{in} = 5.0\text{ V}$ )  |                        | 6.3            | 11           | –            |               |
| P-Channel Source Current, NCP304<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>–       |               |
| Propagation Delay Input to Output (Figure 2)  |                        |                |              |              | $\mu\text{s}$ |
| Complementary Output NCP304 Series<br>Output Transition, High to Low (Note 4)<br>Output Transition, Low to High (Note 4)                                      | $t_{pHL}$<br>$t_{pLH}$ | –<br>–         | 12<br>19     | –<br>60      |               |
| N-Channel Open Drain NCP305 Series<br>Output Transition, High to Low (Note 4)<br>Output Transition, Low to High (Note 4)                                      | $t_{pHL}$<br>$t_{pLH}$ | –<br>–         | 12<br>–      | –<br>100     |               |

4. In the case of CMOS Output Type: The time interval between the rising edge of  $V_{DD}$  input pulse from 0.7 V to  $(+V_{DET}) + 2.0\text{ V}$  and output voltage level becoming to  $V_{DD}/2$ . In the case of N-Channel Open Drain Output Type: Output pin is pulled up with a resistance of 470 k $\Omega$  to 5.0 V, the time interval between the rising edge of  $V_{DD}$  input pulse from 0.7 V to  $(+V_{DET}) + 2.0\text{ V}$  and output voltage level becoming to 2.5 V.



# NCP304, NCP305

## ELECTRICAL CHARACTERISTICS (continued) (For all values $T_A = 25^\circ\text{C}$ , unless otherwise noted.)

| Characteristic   | Symbol                 | Min            | Typ         | Max      | Unit          |
|--|------------------------|----------------|-------------|----------|---------------|
| <b>NCP304/5 – 3.0</b>  |                        |                |             |          |               |
| P-Channel Source Current, NCP304<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>–   |               |
| Propagation Delay Input to Output (Figure 2)   |                        |                |             |          | $\mu\text{s}$ |
| Complementary Output NCP304 Series<br>Output Transition, High to Low (Note 4)<br>Output Transition, Low to High (Note 4)                           | $t_{pHL}$<br>$t_{pLH}$ | –<br>–         | 12<br>19    | –<br>60  |               |
| N-Channel Open Drain NCP305 Series<br>Output Transition, High to Low (Note 4)<br>Output Transition, Low to High (Note 4)                           | $t_{pHL}$<br>$t_{pLH}$ | –<br>–         | 12<br>–     | –<br>100 |               |

### NCP304/5 – 4.5

|  |                        |                       |                    |              |               |
|--|------------------------|-----------------------|--------------------|--------------|---------------|
| Detector Threshold (Pin 2, $V_{in}$ Decreasing)  | $V_{DET-}$             | 4.410                 | 4.500              | 4.590        | 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>–                | –<br>–             | 3.0<br>3.9   | $\mu\text{A}$ |
| 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>N-Channel Sink Current, NCP304, NCP305<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>P-Channel Source Current, NCP304<br>( $V_{OUT} = 5.9\text{ V}$ , $V_{in} = 8.0\text{ V}$ ) | $I_{OUT}$              | 0.01<br>1.0<br>1.5    | 0.05<br>2.0<br>3.0 | –<br>–<br>–  | mA            |
| Reset Output Current (Pin 1, Active High 'H' Suffix Devices)<br><br>N-Channel Sink Current, NCP304, NCP305<br>( $V_{OUT} = 0.5\text{ V}$ , $V_{in} = 5.0\text{ V}$ )<br><br>P-Channel Source Current, NCP304<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            |
| Propagation Delay Input to Output (Figure 2)   |                        |                       |                    |              | $\mu\text{s}$ |
| Complementary Output NCP304 Series<br>Output Transition, High to Low (Note 4)<br>Output Transition, Low to High (Note 4)   | $t_{pHL}$<br>$t_{pLH}$ | –<br>–                | 10<br>21           | –<br>60      |               |
| N-Channel Open Drain NCP305 Series<br>Output Transition, High to Low (Note 4)<br>Output Transition, Low to High (Note 4)   | $t_{pHL}$<br>$t_{pLH}$ | –<br>–                | 10<br>–            | –<br>100     |               |

### NCP304/5 – 4.7

|   |               |        |            |            |               |
|---|---------------|--------|------------|------------|---------------|
| Detector Threshold (Pin 2, $V_{in}$ Decreasing)                                       | $V_{DET-}$    | 4.606  | 4.70       | 4.794      | 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>– | 1.1<br>1.3 | 3.0<br>3.9 | $\mu\text{A}$ |
| Maximum Operating Voltage (Pin 2)   | $V_{in(max)}$ | –      | –          | 10         | V             |

4. In the case of CMOS Output Type: The time interval between the rising edge of  $V_{DD}$  input pulse from 0.7 V to  $(+V_{DET}) + 2.0\text{ V}$  and output voltage level becoming to  $V_{DD}/2$ . In the case of N-Channel Open Drain Output Type: Output pin is pulled up with a resistance of 470 k $\Omega$  to 5.0 V, the time interval between the rising edge of  $V_{DD}$  input pulse from 0.7 V to  $(+V_{DET}) + 2.0\text{ V}$  and output voltage level becoming to 2.5 V.

# NCP304, NCP305

## ELECTRICAL CHARACTERISTICS (continued) (For all values $T_A = 25^\circ\text{C}$ , unless otherwise noted.)

| Characteristic   | Symbol   | Min                   | Typ                 | Max                 | Unit          |
|--|--|-----------------------|---------------------|---------------------|---------------|
| <b>NCP304/5 – 4.7</b>  |  |                       |                     |                     |               |
| 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>N–Channel Sink Current, NCP304, NCP305<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>P–Channel Source Current, NCP304<br>( $V_{OUT} = 5.9\text{ V}$ , $V_{in} = 8.0\text{ V}$ ) | $I_{OUT}$  | 0.01<br>1.0<br>1.5    | 0.05<br>2.0<br>3.0  | –<br>–<br>–         | mA            |
| Reset Output Current (Pin 1, Active High ‘H’ Suffix Devices)<br><br>N–Channel Sink Current, NCP304, NCP305<br>( $V_{OUT} = 0.5\text{ V}$ , $V_{in} = 5.0\text{ V}$ )<br><br>P–Channel Source Current, NCP304<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            |
| Propagation Delay Input to Output (Figure 2)<br><br>Complementary Output NCP304 Series<br>Output Transition, High to Low (Note 4)<br>Output Transition, Low to High (Note 4)<br><br>N–Channel Open Drain NCP305 Series<br>Output Transition, High to Low (Note 4)<br>Output Transition, Low to High (Note 4)                       | $t_{pHL}$<br>$t_{pLH}$<br><br>$t_{pHL}$<br>$t_{pLH}$ | –<br>–<br>–<br>–      | 10<br>21<br>10<br>– | –<br>60<br>–<br>100 | $\mu\text{s}$ |

4. In the case of CMOS Output Type: The time interval between the rising edge of  $V_{DD}$  input pulse from 0.7 V to  $(+V_{DET}) + 2.0\text{ V}$  and output voltage level becoming to  $V_{DD}/2$ . In the case of N–Channel Open Drain Output Type: Output pin is pulled up with a resistance of 470 k $\Omega$  to 5.0 V, the time interval between the rising edge of  $V_{DD}$  input pulse from 0.7 V to  $(+V_{DET}) + 2.0\text{ V}$  and output voltage level becoming to 2.5 V.

## NCP304, NCP305



NCP304 and NCP305 series are measured with a 10 pF capacitive load. NCP305 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. The upper detector threshold,  $V_{DET+}$  is the sum of the lower detector threshold,  $V_{DET-}$  plus the input hysteresis,  $V_{HYS}$ .

**Figure 2. Propagation Delay Measurement Conditions**

# NCP304, NCP305

**Table 1. NCP304 SERIES ELECTRICAL CHARACTERISTIC TABLE FOR 0.9 – 4.9 V**

| Part Number   | Detector Threshold    |     |       | Detector Threshold Hysteresis |       |       | Supply Current                |                               | N-Channel Sink Current         |                                | P-Channel Source Current       |
|---------------|-----------------------|-----|-------|-------------------------------|-------|-------|-------------------------------|-------------------------------|--------------------------------|--------------------------------|--------------------------------|
|               |                       |     |       |                               |       |       | V <sub>in</sub> Low           | V <sub>in</sub> High          | V <sub>in</sub> Low            | V <sub>in</sub> High           |                                |
|               | V <sub>DET-</sub> (V) |     |       | 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                            |
| NCP304LSQ09T1 | 0.882                 | 0.9 | 0.918 | 0.027                         | 0.045 | 0.063 | 0.8                           | 0.9                           | 0.05                           | 0.5                            | 2.0                            |
| NCP304LSQ15T1 | 1.470                 | 1.5 | 1.530 | 0.045                         | 0.075 | 0.105 |                               |                               |                                |                                |                                |
| NCP304LSQ18T1 | 1.764                 | 1.8 | 1.836 | 0.054                         | 0.090 | 0.126 |                               |                               |                                |                                |                                |
| NCP304LSQ20T1 | 1.960                 | 2.0 | 2.040 | 0.060                         | 0.100 | 0.140 | 0.9                           | 1.1                           |                                |                                |                                |
| NCP304LSQ23T1 | 2.254                 | 2.3 | 2.346 | 0.069                         | 0.115 | 0.161 |                               |                               |                                |                                |                                |
| NCP304LSQ25T1 | 2.450                 | 2.5 | 2.550 | 0.075                         | 0.125 | 0.175 |                               |                               |                                |                                |                                |
| NCP304LSQ27T1 | 2.646                 | 2.7 | 2.754 | 0.081                         | 0.135 | 0.189 |                               |                               |                                |                                |                                |
| NCP304LSQ28T1 | 2.744                 | 2.8 | 2.856 | 0.084                         | 0.140 | 0.196 |                               |                               |                                |                                |                                |
| NCP304LSQ29T1 | 2.842                 | 2.9 | 2.958 | 0.087                         | 0.145 | 0.203 |                               |                               |                                |                                |                                |
| NCP304LSQ30T1 | 2.940                 | 3.0 | 3.060 | 0.090                         | 0.150 | 0.210 | 1.0                           | 1.2                           |                                |                                |                                |
| NCP304LSQ31T1 | 3.038                 | 3.1 | 3.162 | 0.093                         | 0.155 | 0.217 |                               |                               |                                |                                |                                |
| NCP304LSQ33T1 | 3.234                 | 3.3 | 3.366 | 0.099                         | 0.165 | 0.231 |                               |                               |                                |                                |                                |
| NCP304LSQ37T1 | 3.626                 | 3.7 | 3.774 | 0.111                         | 0.185 | 0.259 |                               |                               |                                |                                |                                |
| NCP304LSQ38T1 | 3.724                 | 3.8 | 3.876 | 0.114                         | 0.190 | 0.266 |                               |                               |                                |                                |                                |
| NCP304LSQ40T1 | 3.920                 | 4.0 | 4.080 | 0.120                         | 0.200 | 0.280 | 1.1                           | 1.3                           |                                |                                | 3.0                            |
| NCP304LSQ42T1 | 4.116                 | 4.2 | 4.284 | 0.126                         | 0.210 | 0.294 |                               |                               |                                |                                |                                |
| NCP304LSQ43T1 | 4.214                 | 4.3 | 4.386 | 0.129                         | 0.215 | 0.301 |                               |                               |                                |                                |                                |
| NCP304LSQ45T1 | 4.410                 | 4.5 | 4.590 | 0.135                         | 0.225 | 0.315 |                               |                               |                                |                                |                                |
| NCP304LSQ46T1 | 4.508                 | 4.6 | 4.692 | 0.138                         | 0.230 | 0.322 |                               |                               |                                |                                |                                |
| NCP304LSQ47T1 | 4.606                 | 4.7 | 4.794 | 0.141                         | 0.235 | 0.329 |                               |                               |                                |                                |                                |

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. NCP304 SERIES ELECTRICAL CHARACTERISTIC TABLE FOR 0.9 – 4.9 V**

| Part Number   | Detector Threshold    |     |       | Detector Threshold Hysteresis |       |       | Supply Current                 |                                | N-Channel Sink Current          | P-Channel Source Current        |                                 |
|---------------|-----------------------|-----|-------|-------------------------------|-------|-------|--------------------------------|--------------------------------|---------------------------------|---------------------------------|---------------------------------|
|               |                       |     |       |                               |       |       | V <sub>in</sub> Low            | V <sub>in</sub> High           |                                 | V <sub>in</sub> Low             | V <sub>in</sub> High            |
|               | V <sub>DET-</sub> (V) |     |       | V <sub>HYS</sub> (V)          |       |       | I <sub>in</sub> (μA) (Note 10) | I <sub>in</sub> (μA) (Note 11) | I <sub>OUT</sub> (mA) (Note 12) | I <sub>OUT</sub> (mA) (Note 13) | I <sub>OUT</sub> (mA) (Note 14) |
|               | Min                   | Typ | Max   | Min                           | Typ   | Max   | Typ                            | Typ                            | Typ                             | Typ                             | Typ                             |
| NCP304HSQ09T1 | 0.882                 | 0.9 | 0.918 | 0.027                         | 0.045 | 0.063 | 0.8                            | 0.9                            | 2.5                             | 0.04                            | 0.08                            |
| NCP304HSQ18T1 | 1.764                 | 1.8 | 1.836 | 0.054                         | 0.090 | 0.126 |                                |                                |                                 |                                 |                                 |
| NCP304HSQ20T1 | 1.960                 | 2.0 | 2.040 | 0.060                         | 0.100 | 0.140 | 0.9                            | 1.1                            |                                 |                                 |                                 |
| NCP304HSQ22T1 | 2.156                 | 2.2 | 2.244 | 0.066                         | 0.110 | 0.154 |                                |                                |                                 |                                 |                                 |
| NCP304HSQ27T1 | 2.646                 | 2.7 | 2.754 | 0.081                         | 0.135 | 0.189 |                                |                                |                                 |                                 |                                 |
| NCP304HSQ29T1 | 2.842                 | 2.9 | 2.958 | 0.087                         | 0.145 | 0.203 |                                |                                |                                 |                                 |                                 |
| NCP304HSQ30T1 | 2.940                 | 3.0 | 3.060 | 0.090                         | 0.150 | 0.210 | 1.0                            | 1.2                            |                                 |                                 |                                 |
| NCP304HSQ45T1 | 4.410                 | 4.5 | 4.590 | 0.135                         | 0.225 | 0.315 |                                |                                |                                 |                                 |                                 |
| NCP304HSQ47T1 | 4.606                 | 4.7 | 4.794 | 0.141                         | 0.235 | 0.329 |                                |                                |                                 |                                 |                                 |

10. 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  
 11. Condition 2: 0.9 – 4.9 V, V<sub>in</sub> = V<sub>DET-</sub> + 2.0 V  
 12. 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  
 13. 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  
 14. 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

# NCP304, NCP305

**Table 3. NCP305 SERIES ELECTRICAL CHARACTERISTIC TABLE FOR 0.9 – 4.9 V**

| Part Number   | Detector Threshold    |     |       | Detector Threshold Hysteresis |       |       | Supply Current                    |                                   | N-Channel Sink Current             |                                    |     |     |      |     |
|---------------|-----------------------|-----|-------|-------------------------------|-------|-------|-----------------------------------|-----------------------------------|------------------------------------|------------------------------------|-----|-----|------|-----|
|               |                       |     |       |                               |       |       | V <sub>in</sub> Low               | V <sub>in</sub> High              | V <sub>in</sub> Low                | V <sub>in</sub> High               |     |     |      |     |
|               | V <sub>DET-</sub> (V) |     |       | V <sub>HYS</sub> (V)          |       |       | I <sub>in</sub> (μA)<br>(Note 15) | I <sub>in</sub> (μA)<br>(Note 16) | I <sub>OUT</sub> (mA)<br>(Note 17) | I <sub>OUT</sub> (mA)<br>(Note 18) |     |     |      |     |
|               | Min                   | Typ | Max   | Min                           | Typ   | Max   | Typ                               | Typ                               | Typ                                | Typ                                |     |     |      |     |
| NCP305LSQ09T1 | 0.882                 | 0.9 | 0.918 | 0.027                         | 0.045 | 0.063 | 0.8                               | 0.9                               | 0.05                               | 0.5                                |     |     |      |     |
| NCP305LSQ15T1 | 1.470                 | 1.5 | 1.530 | 0.045                         | 0.075 | 0.105 |                                   |                                   |                                    |                                    |     |     |      |     |
| NCP305LSQ16T1 | 1.568                 | 1.6 | 1.632 | 0.048                         | 0.080 | 0.112 |                                   |                                   |                                    |                                    |     |     |      |     |
| NCP305LSQ17T1 | 1.666                 | 1.7 | 1.734 | 0.051                         | 0.085 | 0.119 |                                   |                                   |                                    |                                    |     |     |      |     |
| NCP305LSQ18T1 | 1.764                 | 1.8 | 1.836 | 0.054                         | 0.090 | 0.126 |                                   |                                   |                                    |                                    |     |     |      |     |
| NCP305LSQ20T1 | 1.960                 | 2.0 | 2.040 | 0.060                         | 0.100 | 0.140 | 0.9                               | 1.1                               | 0.05                               | 2.0                                |     |     |      |     |
| NCP305LSQ22T1 | 2.156                 | 2.2 | 2.244 | 0.066                         | 0.110 | 0.154 |                                   |                                   |                                    |                                    |     |     |      |     |
| NCP305LSQ23T1 | 2.254                 | 2.3 | 2.346 | 0.069                         | 0.115 | 0.161 |                                   |                                   |                                    |                                    |     |     |      |     |
| NCP305LSQ24T1 | 2.352                 | 2.4 | 2.448 | 0.072                         | 0.120 | 0.168 |                                   |                                   |                                    |                                    |     |     |      |     |
| NCP305LSQ25T1 | 2.450                 | 2.5 | 2.550 | 0.075                         | 0.125 | 0.175 |                                   |                                   |                                    |                                    |     |     |      |     |
| NCP305LSQ26T1 | 2.548                 | 2.6 | 2.652 | 0.078                         | 0.130 | 0.182 |                                   |                                   |                                    |                                    |     |     |      |     |
| NCP305LSQ27T1 | 2.646                 | 2.7 | 2.754 | 0.081                         | 0.135 | 0.189 |                                   |                                   |                                    |                                    |     |     |      |     |
| NCP305LSQ28T1 | 2.744                 | 2.8 | 2.856 | 0.084                         | 0.140 | 0.196 |                                   |                                   |                                    |                                    |     |     |      |     |
| NCP305LSQ29T1 | 2.842                 | 2.9 | 2.958 | 0.087                         | 0.145 | 0.203 |                                   |                                   |                                    |                                    |     |     |      |     |
| NCP305LSQ30T1 | 2.940                 | 3.0 | 3.060 | 0.090                         | 0.150 | 0.210 |                                   |                                   |                                    |                                    | 1.0 | 1.2 | 0.05 | 2.0 |
| NCP305LSQ31T1 | 3.038                 | 3.1 | 3.162 | 0.093                         | 0.155 | 0.217 |                                   |                                   |                                    |                                    |     |     |      |     |
| NCP305LSQ32T1 | 3.136                 | 3.2 | 3.264 | 0.096                         | 0.160 | 0.224 |                                   |                                   |                                    |                                    |     |     |      |     |
| NCP305LSQ33T1 | 3.234                 | 3.3 | 3.366 | 0.099                         | 0.165 | 0.231 |                                   |                                   |                                    |                                    |     |     |      |     |
| NCP305LSQ34T1 | 3.332                 | 3.4 | 3.468 | 0.102                         | 0.170 | 0.238 |                                   |                                   |                                    |                                    |     |     |      |     |
| NCP305LSQ35T1 | 3.430                 | 3.5 | 3.570 | 0.105                         | 0.175 | 0.245 |                                   |                                   |                                    |                                    |     |     |      |     |
| NCP305LSQ36T1 | 3.528                 | 3.6 | 3.672 | 0.108                         | 0.180 | 0.252 |                                   |                                   |                                    |                                    |     |     |      |     |
| NCP305LSQ37T1 | 3.626                 | 3.7 | 3.774 | 0.111                         | 0.185 | 0.259 |                                   |                                   |                                    |                                    |     |     |      |     |
| NCP305LSQ40T1 | 3.920                 | 4.0 | 4.080 | 0.120                         | 0.200 | 0.280 | 1.1                               | 1.3                               | 0.05                               | 2.0                                |     |     |      |     |
| NCP305LSQ44T1 | 4.312                 | 4.4 | 4.488 | 0.132                         | 0.220 | 0.308 |                                   |                                   |                                    |                                    |     |     |      |     |
| NCP305LSQ45T1 | 4.410                 | 4.5 | 4.590 | 0.135                         | 0.225 | 0.315 |                                   |                                   |                                    |                                    |     |     |      |     |
| NCP305LSQ47T1 | 4.606                 | 4.7 | 4.794 | 0.141                         | 0.235 | 0.329 |                                   |                                   |                                    |                                    |     |     |      |     |
| NCP305LSQ49T1 | 4.802                 | 4.9 | 4.998 | 0.147                         | 0.245 | 0.343 |                                   |                                   |                                    |                                    |     |     |      |     |

15. 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

16. Condition 2: 0.9 – 4.9 V, V<sub>in</sub> = V<sub>DET-</sub> + 2.0 V

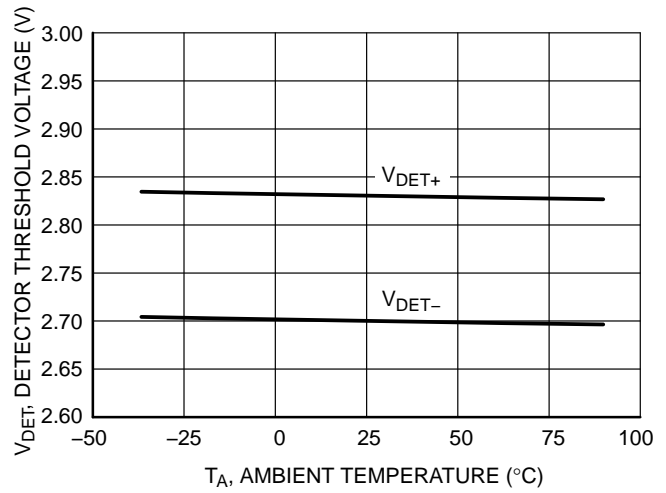
17. Condition 3: 0.9 – 4.9 V, V<sub>in</sub> = 0.7 V, V<sub>OUT</sub> = 0.05 V, Active Low 'L' Suffix Devices

18. 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

# NCP304, NCP305



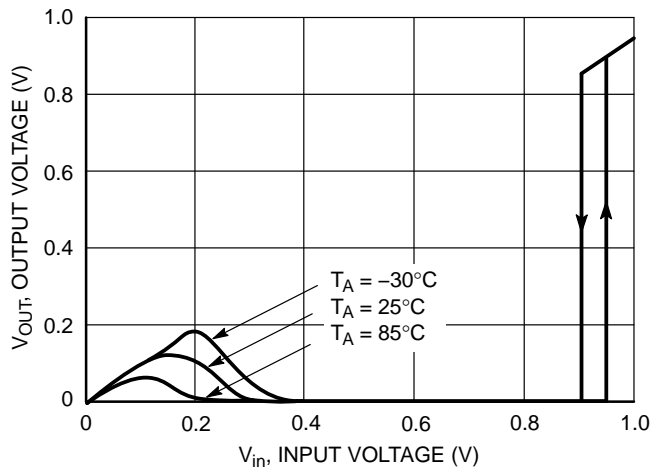
**Figure 3. NCP304/5 Series 0.9 V  
Detector Threshold Voltage vs. Temperature**



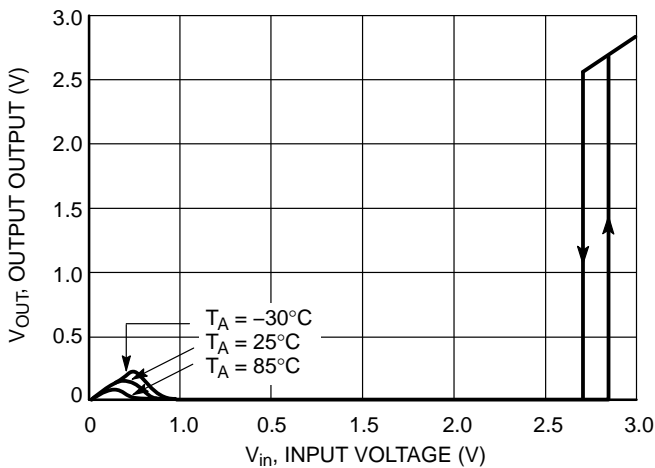
**Figure 4. NCP304/5 Series 2.7 V  
Detector Threshold Voltage vs. Temperature**



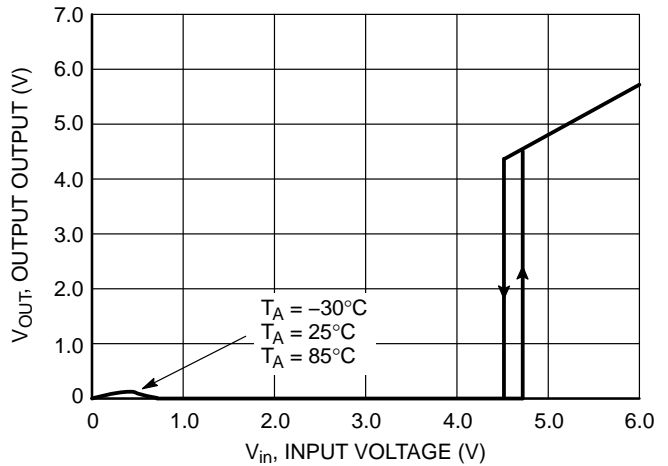
**Figure 5. NCP304/5 Series 4.5 V  
Detector Threshold Voltage vs. Temperature**



**Figure 6. NCP304L/5L Series 0.9 V  
Reset Output Voltage vs. Input Voltage**



**Figure 7. NCP304L/5L Series 2.7 V  
Reset Output Voltage vs. Input Voltage**



**Figure 8. NCP304L/5L Series 4.5 V  
Reset Output Voltage vs. Input Voltage**

# NCP304, NCP305



**Figure 9. NCP304H/5H Series 2.7 V Reset Output Voltage vs. Input Voltage**



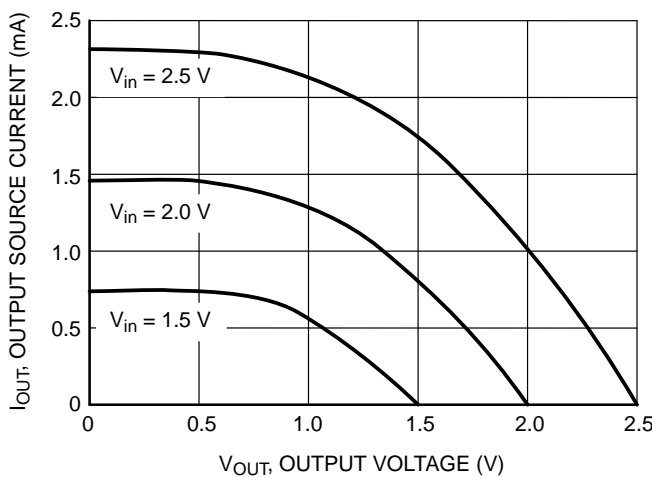
**Figure 10. NCP304H/5L Series 0.9 V Reset Output Sink Current vs. Output Voltage**



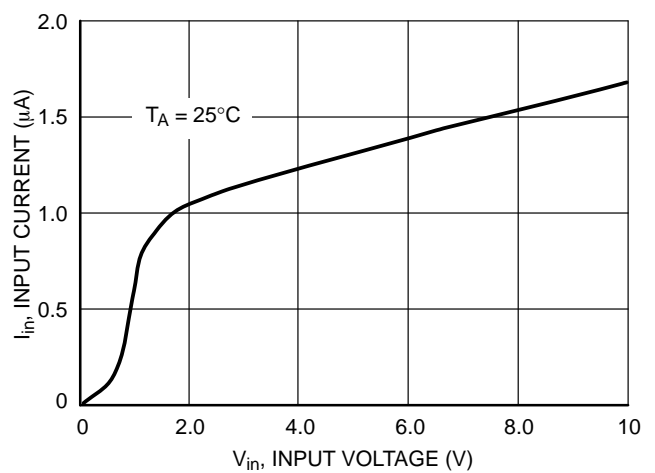
**Figure 11. NCP304H/5L Series 2.7 V Reset Output Sink Current vs. Output Voltage**



**Figure 12. NCP304H/5L Series 4.5 V Reset Output Sink Current vs. Output Voltage**

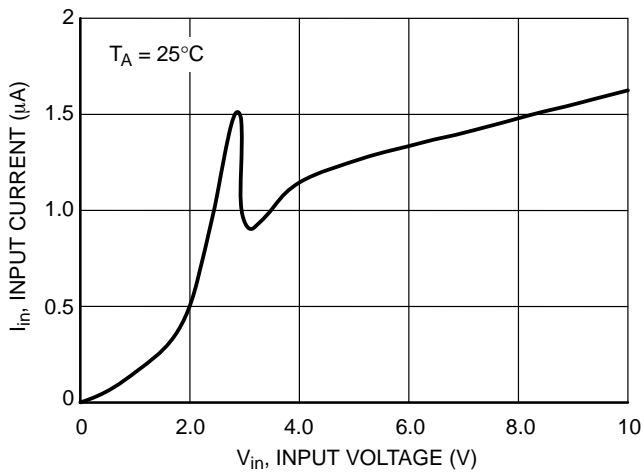


**Figure 13. NCP304H Series 2.7 V Reset Output Source Current vs. Output Voltage**

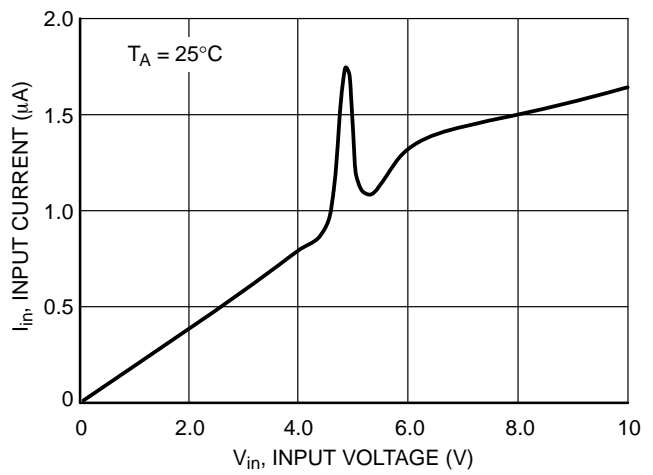


**Figure 14. NCP304/5 Series 0.9 V Input Current vs. Input Voltage**

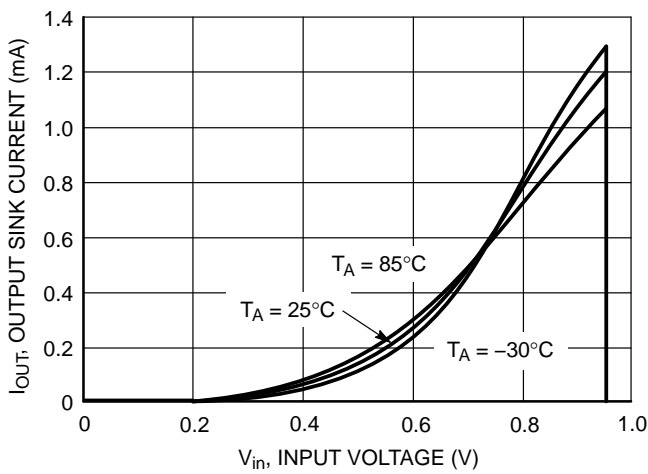
# NCP304, NCP305



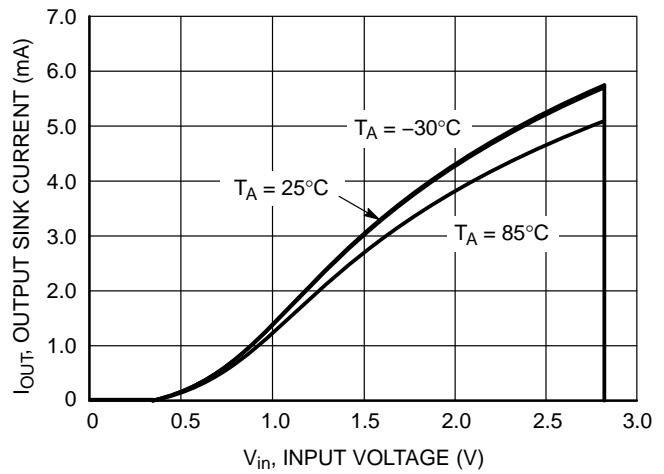
**Figure 15. NCP304/5 Series 2.7 V Input Current vs. Input Voltage**



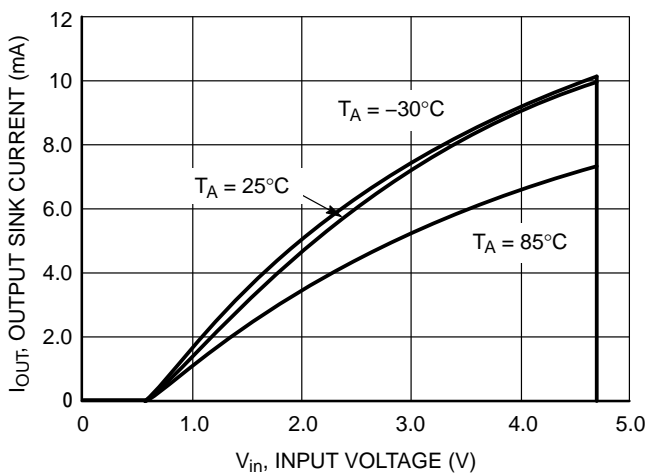
**Figure 16. NCP304/5 Series 4.5 V Input Current vs. Input Voltage**



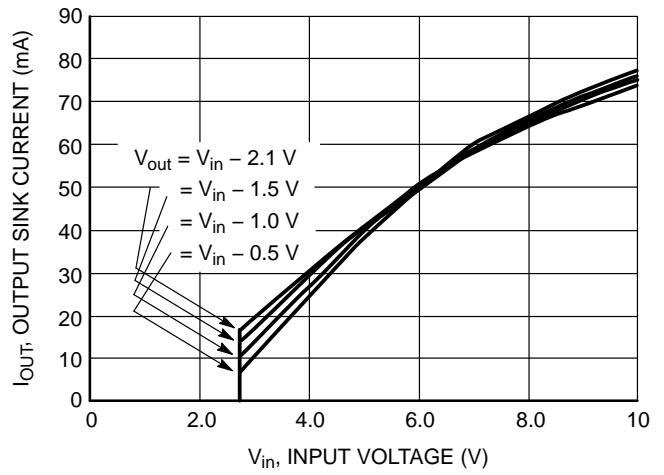
**Figure 17. NCP304H/5L Series 0.9 V Reset Output Sink Current vs. Input Voltage**



**Figure 18. NCP304H/5L Series 2.7 V Reset Output Sink Current vs. Input Voltage**

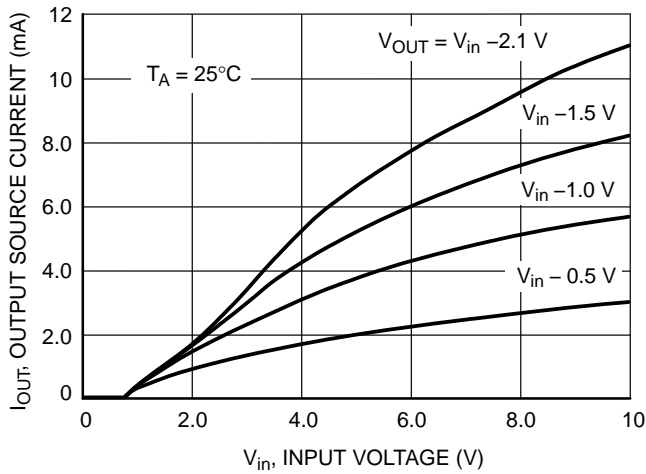


**Figure 19. NCP304H/5L Series 4.5 V Reset Output Sink Current vs. Input Voltage**

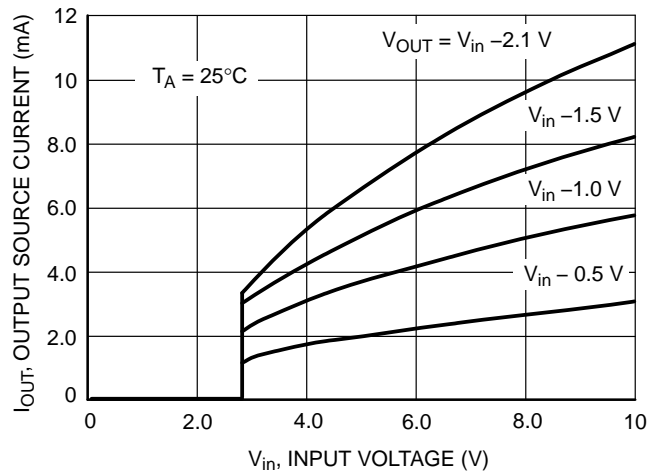


**Figure 20. NCP304H/5H Series 2.7 V Reset Output Sink Current vs. Input Voltage**

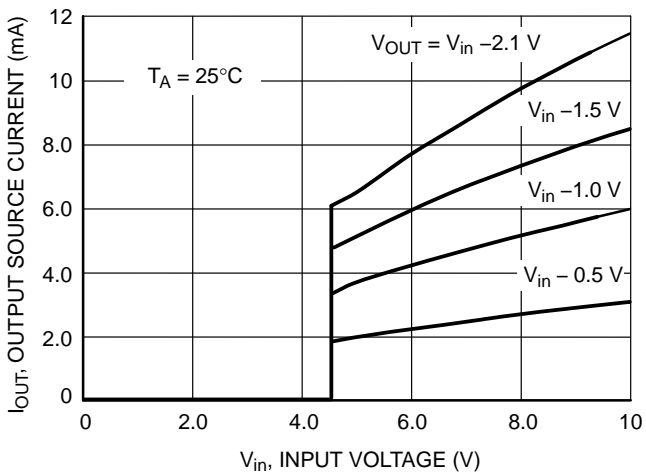
# NCP304, NCP305



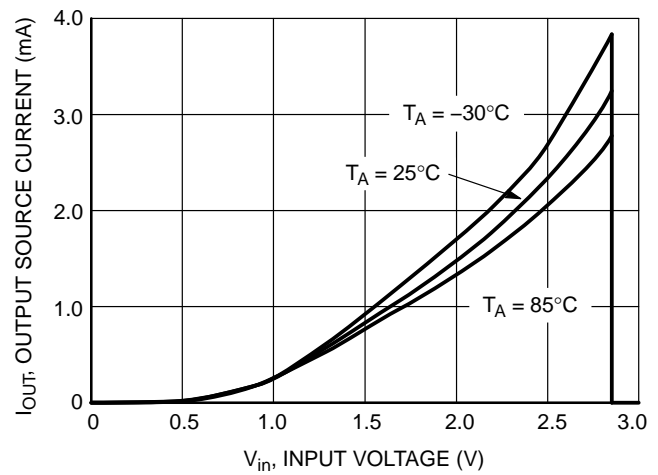
**Figure 21. NCP304H Series 0.9 V**  
Reset Output Source Current vs. Input Voltage



**Figure 22. NCP304H Series 2.7 V**  
Reset Output Source Current vs. Input Voltage



**Figure 23. NCP304H Series 4.5 V**  
Reset Output Source Current vs. Input Voltage



**Figure 24. NCP304H Series 2.7 V**  
Reset Output Source Current vs. Input Voltage

# NCP304, NCP305

## OPERATING DESCRIPTION

The NCP304 and NCP305 series devices are second generation ultra-low current voltage detectors. Figures 25 and 26 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 ( $V_{DET+}$ ), 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 ( $V_{DET-}$ ). 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 has built-in hysteresis to prevent erratic reset operation as the comparator threshold is crossed.

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 is required. Figure 26 through Figure 32 shows various application examples.

| "L" in Part Name                          | "H" in Part Name                          |
|---|---|
| Function: active Low Reset Output         | Function: active High Reset Output        |
| Input < $V_{det-}$ , Reset Output is Low  | Input < $V_{det-}$ , Reset Output is High |
| Input > $V_{det+}$ , Reset Output is High | Input > $V_{det+}$ , Reset Output is Low  |

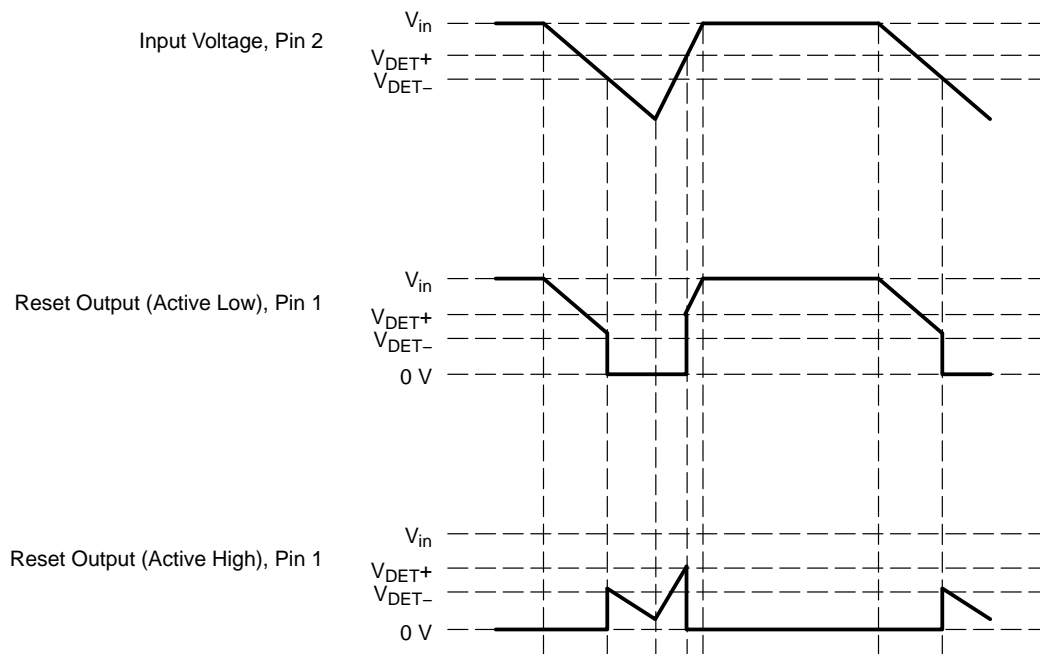


Figure 25. Timing Waveforms

# NCP304, NCP305

## APPLICATION CIRCUIT INFORMATION



Figure 26. Microprocessor Reset Circuit

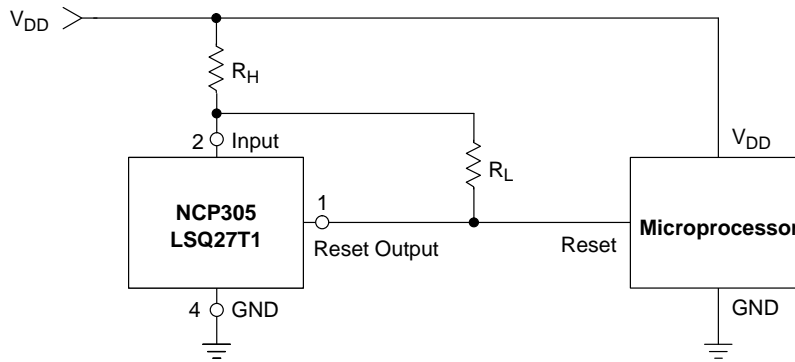


Figure 27. Battery Charge Indicator



Figure 28. Dual Power Supply Undervoltage Supervision

## NCP304, NCP305



**Figure 29. 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  $I_{in} = 0.26 \mu\text{A}$  at 2.6 V.

$V_{in}$  Decreasing:

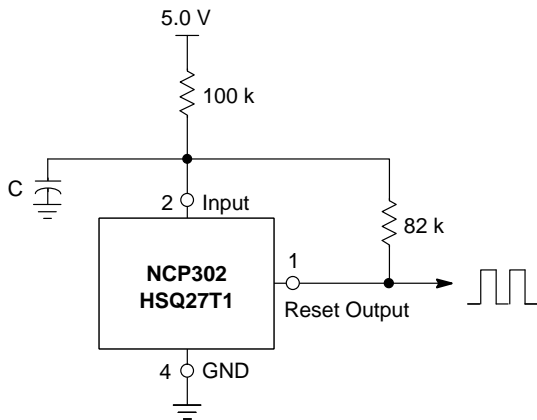
$$V_{th} = \left( \frac{R_H}{R_{in}} + 1 \right) (V_{DET-})$$

$V_{in}$  Increasing:

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

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

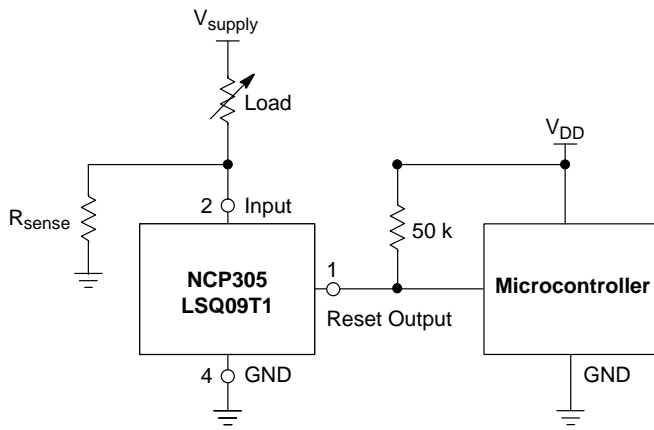
| Test Data                |                          |                |                    |                     |
|--------------------------|--------------------------|----------------|--------------------|---------------------|
| $V_{th}$ Decreasing (mV) | $V_{th}$ Increasing (mV) | $V_{HYS}$ (mV) | $R_H$ ( $\Omega$ ) | $R_L$ (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 ( $\mu\text{F}$ ) | $f_{OSC}$ (kHz) | $I_Q$ ( $\mu\text{A}$ ) |
| 0.01                | 2590            | 21.77                   |
| 0.1                 | 490             | 21.97                   |
| 1.0                 | 52              | 22.07                   |

**Figure 30. Simple Clock Oscillator**

## NCP304, NCP305



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:  | Then:                   |
| $I_{Load} < V_{DET-} / R_{sense}$                | Reset Output = 0 V      |
| $I_{Load} \geq (V_{DET-} + V_{HYS}) / R_{sense}$ | Reset Output = $V_{DD}$ |

Figure 31. 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 32. LED Bar Graph

# NCP304, NCP305

## ORDERING INFORMATION

| Device          | Threshold Voltage | Output Type | Reset       | Marking | Package              | Shipping <sup>†</sup> |
|-----------------|-------------------|-------------|-------------|---------|----------------------|-----------------------|
| NCP304LSQ09T1G  | 0.9               | CMOS        | Active Low  | SHG     | SC-82AB<br>(Pb-Free) | 3000 / Tape & Reel    |
| NCP304LSQ18T1G  | 1.8               |             |             | SGX     |                      |                       |
| NCP304LSQ20T1G  | 2.0               |             |             | SGV     |                      |                       |
| NCP304LSQ23T1G  | 2.3               |             |             | SGR     |                      |                       |
| NCP304LSQ25T1G  | 2.5               |             |             | SGP     |                      |                       |
| NCP304LSQ27T1G  | 2.7               |             |             | SGN     |                      |                       |
| NCP304LSQ280T1G | 2.8               |             |             | CAT     |                      |                       |
| NCP304LSQ29T1G  | 2.9               |             |             | SGK     |                      |                       |
| NCP304LSQ30T1G  | 3.0               |             |             | SGJ     |                      |                       |
| NCV304LSQ30T1G* | 3.0               |             |             | ACT     |                      |                       |
| NCP304LSQ33T1G  | 3.3               |             |             | SGG     |                      |                       |
| NCV304LSQ33T1G* | 3.3               |             |             | AGA     |                      |                       |
| NCP304LSQ37T1G  | 3.7               |             |             | SGB     |                      |                       |
| NCP304LSQ38T1G  | 3.8               |             |             | SGA     |                      |                       |
| NCP304LSQ40T1G  | 4.0               |             |             | SFY     |                      |                       |
| NCP304LSQ42T1G  | 4.2               |             |             | SFU     |                      |                       |
| NCP304LSQ43T1G  | 4.3               |             |             | SFV     |                      |                       |
| NCP304LSQ45T1G  | 4.5               |             |             | SFS     |                      |                       |
| NCP304LSQ46T1G  | 4.6               |             |             | SFR     |                      |                       |
| NCP304LSQ47T1G  | 4.7               |             |             | SFQ     |                      |                       |
| NCP304HSQ09T1G  | 0.9               | CMOS        | Active High | SNQ     |                      |                       |
| NCP304HSQ18T1G  | 1.8               |             |             | SNZ     |                      |                       |
| NCP304HSQ20T1G  | 2.0               |             |             | SOB     |                      |                       |
| NCP304HSQ22T1G  | 2.2               |             |             | SOD     |                      |                       |
| NCP304HSQ27T1G  | 2.7               |             |             | SOI     |                      |                       |
| NCP304HSQ29T1G  | 2.9               |             |             | SOK     |                      |                       |
| NCP304HSQ30T1G  | 3.0               |             |             | SOL     |                      |                       |
| NCP304HSQ45T1G  | 4.5               |             |             | SPA     |                      |                       |
| NCP304HSQ47T1G  | 4.7               |             |             | SPC     |                      |                       |

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 NCP304 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.

<sup>†</sup>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<sub>low</sub> = -40°C, T<sub>high</sub> = +125°C. Guaranteed by design.

# NCP304, NCP305

## ORDERING INFORMATION

| Device          | Threshold Voltage | Output Type | Reset      | Marking | Package           | Shipping†            |
|-----------------|-------------------|-------------|------------|---------|-------------------|----------------------|
| NCP305LSQ09T1G  | 0.9               | Open Drain  | Active Low | SIZ     | SC-82AB (Pb-Free) | 3000 / Tape & Reel   |
| NCP305LSQ11T1G  | 1.1               |             |            | SIX     |                   |                      |
| NCV305LSQ11T1G* | 1.1               |             |            | TAP     |                   |                      |
| NCP305LSQ15T1G  | 1.5               |             |            | SIS     |                   |                      |
| NCP305LSQ16T1G  | 1.6               |             |            | SIR     |                   |                      |
| NCP305LSQ17T1G  | 1.7               |             |            | SIQ     |                   |                      |
| NCP305LSQ18T1G  | 1.8               |             |            | SIP     |                   |                      |
| NCP305LSQ20T1G  | 2.0               |             |            | SIN     |                   |                      |
| NCV305LSQ20T1G* | 2.0               |             |            | AAJ     |                   |                      |
| NCP305LSQ22T1G  | 2.2               |             |            | SIK     |                   |                      |
| NCP305LSQ23T1G  | 2.3               |             |            | SIJ     |                   |                      |
| NCV305LSQ23T1G* | 2.3               |             |            | AUT     |                   |                      |
| NCP305LSQ24T1G  | 2.4               |             |            | SII     |                   |                      |
| NCP305LSQ25T1G  | 2.5               |             |            | SIH     |                   |                      |
| NCP305LSQ26T1G  | 2.6               |             |            | SIG     |                   |                      |
| NCP305LSQ27T1G  | 2.7               |             |            | SIF     |                   |                      |
| NCP305LSQ28T1G  | 2.8               |             |            | SIE     |                   |                      |
| NCP305LSQ29T1G  | 2.9               |             |            | SID     |                   |                      |
| NCP305LSQ30T1G  | 3.0               |             |            | SIC     |                   |                      |
| NCP305LSQ30T3G  | 3.0               |             |            | SIC     |                   | 10,000 / Tape & Reel |
| NCP305LSQ31T1G  | 3.1               |             |            | SIB     |                   | 3000 / Tape & Reel   |
| NCP305LSQ32T1G  | 3.2               |             |            | SIA     |                   |                      |
| NCP305LSQ33T1G  | 3.3               |             |            | SHZ     |                   |                      |
| NCP305LSQ34T1G  | 3.4               |             |            | SHY     |                   |                      |
| NCP305LSQ35T1G  | 3.5               |             |            | SHX     |                   |                      |
| NCP305LSQ36T1G  | 3.6               |             |            | SHU     |                   |                      |
| NCP305LSQ37T1G  | 3.7               |             |            | SHV     |                   |                      |
| NCP305LSQ40T1G  | 4.0               |             |            | SHR     |                   |                      |
| NCP305LSQ44T1G  | 4.4               |             |            | SHN     |                   |                      |
| NCV305LSQ44T1G* | 4.4               |             |            | AAH     |                   |                      |
| NCP305LSQ45T1G  | 4.5               | SHL         |            |         |                   |                      |
| NCP305LSQ47T1G  | 4.7               | SHJ         |            |         |                   |                      |
| NCP305LSQ49T1G  | 4.9               | SHH         |            |         |                   |                      |

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 NCP304 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.

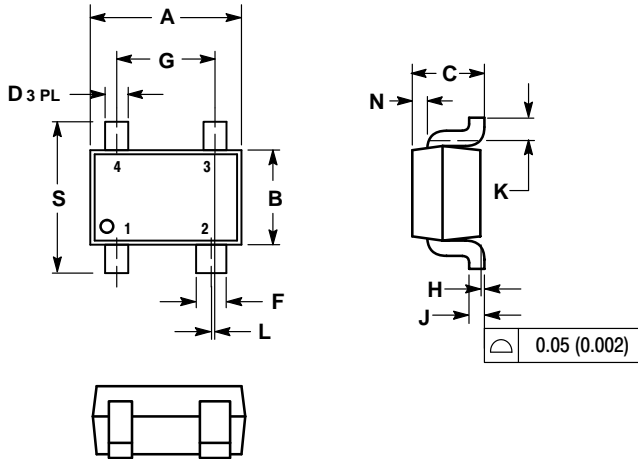
\*NCV Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC-Q100 Qualified and PPAP Capable.

NCVxxx: T<sub>low</sub> = -40°C, T<sub>high</sub> = +125°C. Guaranteed by design.

# NCP304, NCP305

## PACKAGE DIMENSIONS

**SC-82AB**  
**SQ SUFFIX**  
 CASE 419C-02  
 ISSUE F

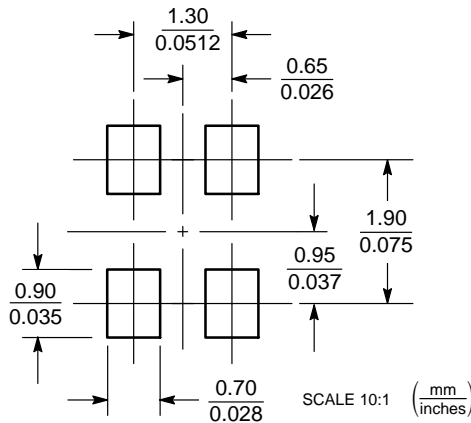


**NOTES:**

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. 419C-01 OBSOLETE. NEW STANDARD IS 419C-02.
4. DIMENSIONS A AND B DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS.

| DIM | MILLIMETERS |      | INCHES    |       |
|-----|-------------|------|-----------|-------|
|     | MIN         | MAX  | MIN       | MAX   |
| A   | 1.80        | 2.20 | 0.071     | 0.087 |
| B   | 1.15        | 1.35 | 0.045     | 0.053 |
| C   | 0.80        | 1.10 | 0.031     | 0.043 |
| D   | 0.20        | 0.40 | 0.008     | 0.016 |
| F   | 0.30        | 0.50 | 0.012     | 0.020 |
| G   | 1.10        | 1.50 | 0.043     | 0.059 |
| H   | 0.00        | 0.10 | 0.000     | 0.004 |
| J   | 0.10        | 0.26 | 0.004     | 0.010 |
| K   | 0.10        | —    | 0.004     | —     |
| L   | 0.05 BSC    |      | 0.002 BSC |       |
| N   | 0.20 REF    |      | 0.008 REF |       |
| S   | 1.80        | 2.40 | 0.07      | 0.09  |

### 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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