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 under voltage 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 μA Typical
- High Accuracy Under Voltage 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

Typical Applications

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

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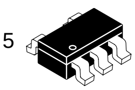
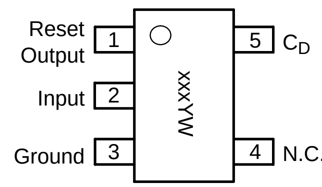


THIN SOT–23–5
SN SUFFIX
CASE 483

PIN CONNECTIONS AND MARKING DIAGRAM



xxx = 302 or 303
Y = Year
W = Work Week

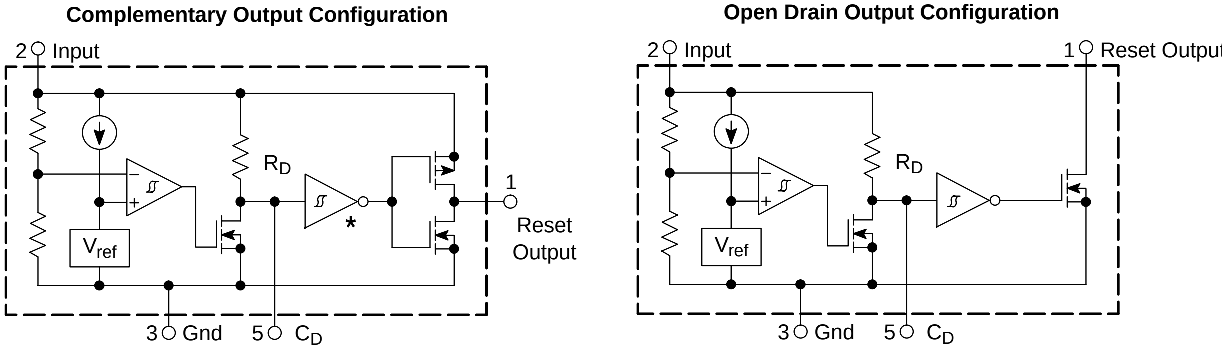
(Top View)

ORDERING INFORMATION

See detailed ordering and shipping information in the ordering information section on page 25 of this data sheet.

NCP302xSNxxT1
Complementary Output Configuration

NCP303LSNxxT1
Open Drain Output Configuration



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

This device contains 28 active transistors.

Figure 1. Representative Block Diagrams

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August, 2001 – Rev. 9

Publication Order Number:
NCP302/D

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) Complementary, NCP302 N–Channel Open Drain, NCP303	V_{OUT}	 –0.3 to V_{in} + 0.3 –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
Operating Junction Temperature Range	T_J	–40 to +125	°C
Storage Temperature Range	T_{stg}	–55 to +150	°C
Latch–up Performance Positive Negative	$I_{LATCH–UP}$	 200 200	mA

1. 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.
2. The maximum package power dissipation limit must not be exceeded.

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

ELECTRICAL CHARACTERISTICS (For all values T_A = 25°C, unless otherwise noted.)

Characteristic	Symbol	Min	Typ	Max	Unit
NCP302/3 – 0.9					
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) (V_{in} = 0.8 V) (V_{in} = 2.9 V)	I_{in}	 – –	 0.20 0.45	 0.6 1.2	μA
Maximum Operating Voltage (Pin 2)	$V_{in(max)}$	–	–	10	V
Minimum Operating Voltage (Pin 2) (T_A = –40°C to 85°C)	$V_{in(min)}$	– –	0.55 0.65	0.70 0.80	V
Reset Output Current (Pin 1, Active Low ‘L’ Suffix Devices) Nch Sink Current, NCP302, NCP303 (V_{OUT} = 0.05V, V_{in} = 0.70V) (V_{OUT} = 0.50V, V_{in} = 0.85V) Pch Source Current, NCP302 (V_{OUT} = 2.4V, V_{in} = 4.5V)	I_{OUT}	 0.01 0.05 1.0	 0.05 0.50 2.0	 – – –	mA
Reset Output Current (Pin 1, Active High ‘H’ Suffix Devices) Nch Sink Current, NCP302, NCP303 (V_{OUT} = 0.5 V, V_{in} = 1.5 V) Pch Source Current, NCP302 (V_{OUT} = 0.4 V, V_{in} = 0.7 V) (V_{OUT} = GND, V_{in} = 0.8 V)	I_{OUT}	 1.05 0.011 0.014	 2.5 0.04 0.08	 – – –	mA
C_D Delay Pin Threshold Voltage (Pin 5) (V_{in} = 0.99 V)	V_{TCD}	 0.50	 0.67	 0.84	V
Delay Capacitor Pin Sink Current (Pin 5) (V_{in} = 0.7 V, V_{CD} = 0.1V) (V_{in} = 1.5 V, V_{CD} = 0.5V)	I_{CD}	 2.0 10	 120 300	 – –	μA
Delay Pullup Resistance (Pin 5)	R_D	0.5	1.0	2.0	MΩ

ELECTRICAL CHARACTERISTICS (For all values T_A = 25°C, unless otherwise noted.)

Characteristic	Symbol	Min	Typ	Max	Unit
NCP302/3 – 1.8					
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) (V_{in} = 1.7 V) (V_{in} = 3.8 V)	I_{in}	 – –	 0.23 0.48	 0.7 1.3	µA
Maximum Operating Voltage (Pin 2)	$V_{in(max)}$	–	–	10	V
Minimum Operating Voltage (Pin 2) (T_A = –40°C to 85°C)	$V_{in(min)}$	– –	0.55 0.65	0.70 0.80	V
Reset Output Current (Pin 1, Active Low ‘L’ Suffix Devices) Nch Sink Current, NCP302, NCP303 (V_{OUT} = 0.05V, V_{in} = 0.70V) (V_{OUT} = 0.50V, V_{in} = 1.5V) Pch Source Current, NCP302 (V_{OUT} = 2.4V, V_{in} = 4.5V)	I_{OUT}	 0.01 1.0 1.0	 0.05 2.0 2.0	 – – –	mA
Reset Output Current (Pin 1, Active High ‘H’ Suffix Devices) Nch Sink Current, NCP302, NCP303 (V_{OUT} = 0.5 V, V_{in} = 5.0 V) Pch Source Current, NCP302 (V_{OUT} = 0.4 V, V_{in} = 0.7 V) (V_{OUT} = GND, V_{in} = 1.5 V)	I_{OUT}	 6.3 0.011 0.525	 11 0.04 0.6	 – – –	mA
C_D Delay Pin Threshold Voltage (Pin 5) (V_{in} = 1.98 V)	V_{TCD}	 0.99	 1.34	 1.68	V
Delay Capacitor Pin Sink Current (Pin 5) (V_{in} = 0.7 V, V_{CD} = 0.1V) (V_{in} = 1.5 V, V_{CD} = 0.5V)	I_{CD}	 2.0 200	 120 1600	 – –	µA
Delay Pullup Resistance (Pin 5)	R_D	0.5	1.0	2.0	MΩ

ELECTRICAL CHARACTERISTICS (For all values T_A = 25°C, unless otherwise noted.)

Characteristic	Symbol	Min	Typ	Max	Unit
NCP302/3 – 2.0					
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) (V_{in} = 1.9 V) (V_{in} = 4.0 V)	I_{in}	 – –	 0.23 0.48	 0.8 1.3	μA
Maximum Operating Voltage (Pin 2)	$V_{in(max)}$	–	–	10	V
Minimum Operating Voltage (Pin 2) (T_A = –40°C to 85°C)	$V_{in(min)}$	– –	0.55 0.65	0.70 0.80	V
Reset Output Current (Pin 1, Active Low ‘L’ Suffix Devices) Nch Sink Current, NCP302, NCP303 (V_{OUT} = 0.05V, V_{in} = 0.70V) (V_{OUT} = 0.50V, V_{in} = 1.5V) Pch Source Current, NCP302 (V_{OUT} = 2.4V, V_{in} = 4.5V)	I_{OUT}	 0.01 1.0 1.0	 0.05 2.0 2.0	 – – –	mA
Reset Output Current (Pin 1, Active High ‘H’ Suffix Devices) Nch Sink Current, NCP302, NCP303 (V_{OUT} = 0.5 V, V_{in} = 5.0 V) Pch Source Current, NCP302 (V_{OUT} = 0.4 V, V_{in} = 0.7 V) (V_{OUT} = GND, V_{in} = 1.5 V)	I_{OUT}	 6.3 0.011 0.525	 11 0.04 0.6	 – – –	mA
C_D Delay Pin Threshold Voltage (Pin 5) (V_{in} = 2.2 V)	V_{TCD}	 1.10	 1.49	 1.87	V
Delay Capacitor Pin Sink Current (Pin 5) (V_{in} = 0.7 V, V_{CD} = 0.1V) (V_{in} = 1.5 V, V_{CD} = 0.5V)	I_{CD}	 2.0 200	 120 1600	 – –	μA
Delay Pullup Resistance (Pin 5)	R_D	0.5	1.0	2.0	MΩ

ELECTRICAL CHARACTERISTICS (For all values T_A = 25°C, unless otherwise noted.)

Characteristic	Symbol	Min	Typ	Max	Unit
NCP302/3– 2.7					
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) (V_{in} = 2.6 V) (V_{in} = 4.7 V)	I_{in}	 – –	 0.26 0.46	 0.8 1.3	µA
Maximum Operating Voltage (Pin 2)	$V_{in(max)}$	–	–	10	V
Minimum Operating Voltage (Pin 2) (T_A = –40°C to 85°C)	$V_{in(min)}$	– –	0.55 0.65	0.70 0.80	V
Reset Output Current (Pin 1, Active Low ‘L’ Suffix Devices) Nch Sink Current, NCP302, NCP303 (V_{OUT} = 0.05V, V_{in} = 0.70V) (V_{OUT} = 0.50V, V_{in} = 1.5V) Pch Source Current, NCP302 (V_{OUT} = 2.4V, V_{in} = 4.5V)	I_{OUT}	 0.01 1.0 1.0	 0.05 2.0 2.0	 – – –	mA
Reset Output Current (Pin 1, Active High ‘H’ Suffix Devices) Nch Sink Current, NCP302, NCP303 (V_{OUT} = 0.5 V, V_{in} = 5.0 V) Pch Source Current, NCP302 (V_{OUT} = 0.4 V, V_{in} = 0.7 V) (V_{OUT} = GND, V_{in} = 1.5 V)	I_{OUT}	 6.3 0.011 0.525	 11 0.04 0.6	 – – –	mA
C_D Delay Pin Threshold Voltage (Pin 5) (V_{in} = 2.97 V)	V_{TCD}	 1.49	 2.01	 2.53	V
Delay Capacitor Pin Sink Current (Pin 5) (V_{in} = 0.7 V, V_{CD} = 0.1V) (V_{in} = 1.5 V, V_{CD} = 0.5V)	I_{CD}	 2.0 200	 120 1600	 – –	µA
Delay Pullup Resistance (Pin 5)	R_D	0.5	1.0	2.0	MΩ

ELECTRICAL CHARACTERISTICS (For all values T_A = 25°C, unless otherwise noted.)

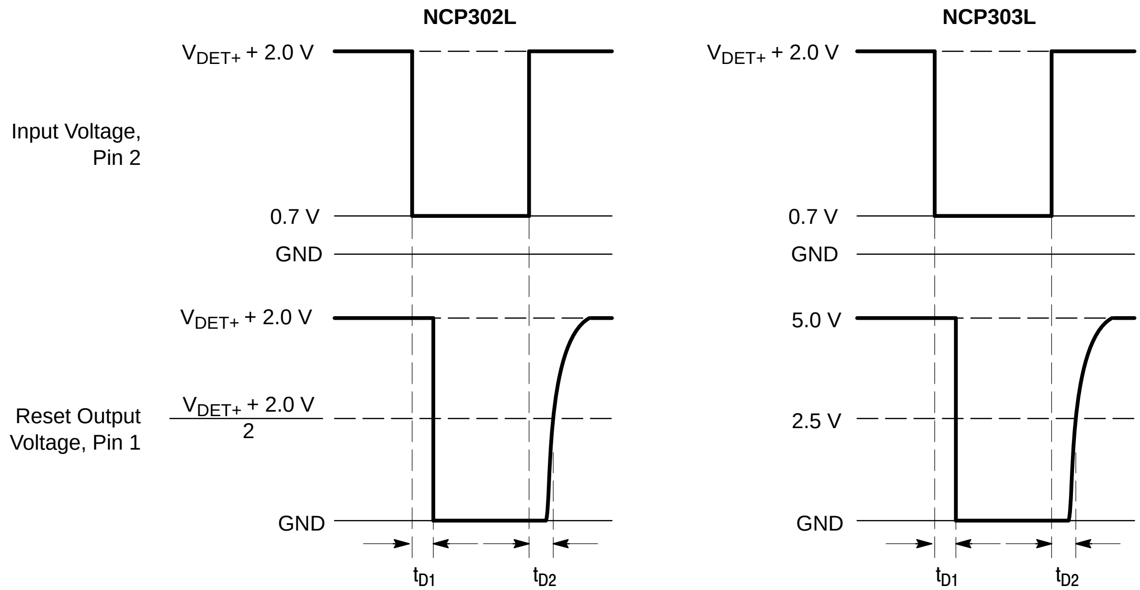
Characteristic	Symbol	Min	Typ	Max	Unit
NCP302/3 – 3.0					
Detector Threshold (Pin 2, V_{in} Decreasing)	V_{DET-}	2.94	3.00	3.06	V
Detector Threshold Hysteresis (Pin 2, V_{in} Increasing)	V_{HYS}	0.09	0.15	0.21	V
Supply Current (Pin 2) (V_{in} = 2.87 V) (V_{in} = 5.0 V)	I_{in}	 – –	 0.27 0.47	 0.9 1.3	μA
Maximum Operating Voltage (Pin 2)	$V_{in(max)}$	–	–	10	V
Minimum Operating Voltage (Pin 2) (T_A = –40°C to 85°C)	$V_{in(min)}$	– –	0.55 0.65	0.70 0.80	V
Reset Output Current (Pin 1, Active Low ‘L’ Suffix Devices) Nch Sink Current, NCP302, NCP303 (V_{OUT} = 0.05V, V_{in} = 0.70V) (V_{OUT} = 0.50V, V_{in} = 1.5V) Pch Source Current, NCP302 (V_{OUT} = 2.4V, V_{in} = 4.5V)	I_{OUT}	 0.01 1.0 1.0	 0.05 2.0 2.0	 – – –	mA
Reset Output Current (Pin 1, Active High ‘H’ Suffix Devices) Nch Sink Current, NCP302, NCP303 (V_{OUT} = 0.5 V, V_{in} = 5.0 V) Pch Source Current, NCP302 (V_{OUT} = 0.4 V, V_{in} = 0.7 V) (V_{OUT} = GND, V_{in} = 1.5 V)	I_{OUT}	 6.3 0.011 0.525	 11 0.04 0.6	 – – –	mA
C_D Delay Pin Threshold Voltage (Pin 5) (V_{in} = 3.3 V)	V_{TCD}	 1.65	 2.23	 2.81	V
Delay Capacitor Pin Sink Current (Pin 5) (V_{in} = 0.7 V, V_{CD} = 0.1V) (V_{in} = 1.5 V, V_{CD} = 0.5V)	I_{CD}	 2.0 200	 120 1600	 – –	μA
Delay Pullup Resistance (Pin 5)	R_D	0.5	1.0	2.0	MΩ

ELECTRICAL CHARACTERISTICS (For all values T_A = 25°C, unless otherwise noted.)

Characteristic	Symbol	Min	Typ	Max	Unit
NCP302/3 – 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) (V_{in} = 4.34 V) (V_{in} = 6.5 V)	I_{in}	 – –	 0.33 0.52	 1.0 1.4	µA
Maximum Operating Voltage (Pin 2)	$V_{in(max)}$	–	–	10	V
Minimum Operating Voltage (Pin 2) (T_A = –40°C to 85°C)	$V_{in(min)}$	– –	0.55 0.65	0.70 0.80	V
Reset Output Current (Pin 1, Active Low ‘L’ Suffix Devices) Nch Sink Current, NCP302, NCP303 (V_{OUT} = 0.05V, V_{in} = 0.70V) (V_{OUT} = 0.50V, V_{in} = 1.5V) Pch Source Current, NCP302 (V_{OUT} = 5.9V, V_{in} = 8.0V)	I_{OUT}	 0.01 1.0 1.5	 0.05 2.0 3.0	 – – –	mA
Reset Output Current (Pin 1, Active High ‘H’ Suffix Devices) Nch Sink Current, NCP302, NCP303 (V_{OUT} = 0.5 V, V_{in} = 5.0 V) Pch Source Current, NCP302 (V_{OUT} = 0.4 V, V_{in} = 0.7 V) (V_{OUT} = GND, V_{in} = 1.5 V)	I_{OUT}	 6.3 0.011 0.525	 11 0.04 0.6	 – – –	mA
C_D Delay Pin Threshold Voltage (Pin 5) (V_{in} = 4.95 V)	V_{TCD}	 2.25	 3.04	 3.83	V
Delay Capacitor Pin Sink Current (Pin 5) (V_{in} = 0.7 V, V_{CD} = 0.1V) (V_{in} = 1.5 V, V_{CD} = 0.5V)	I_{CD}	 2.0 200	 120 1600	 – –	µA
Delay Pullup Resistance (Pin 5)	R_D	0.5	1.0	2.0	MΩ

ELECTRICAL CHARACTERISTICS (For all values T_A = 25°C, unless otherwise noted.)

Characteristic	Symbol	Min	Typ	Max	Unit
NCP302/3 – 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) (V_{in} = 4.54 V) (V_{in} = 6.7 V)	I_{in}	 – –	 0.34 0.53	 1.0 1.4	µA
Maximum Operating Voltage (Pin 2)	$V_{in(max)}$	–	–	10	V
Minimum Operating Voltage (Pin 2) (T_A = –40°C to 85°C)	$V_{in(min)}$	– –	0.55 0.65	0.70 0.80	V
Reset Output Current (Pin 1, Active Low ‘L’ Suffix Devices) Nch Sink Current, NCP302, NCP303 (V_{OUT} = 0.05V, V_{in} = 0.70V) (V_{OUT} = 0.50V, V_{in} = 1.5V) Pch Source Current, NCP302 (V_{OUT} = 5.9V, V_{in} = 8.0V)	I_{OUT}	 0.01 1.0 1.5	 0.05 2.0 3.0	 – – –	mA
Reset Output Current (Pin 1, Active High ‘H’ Suffix Devices) Nch Sink Current, NCP302, NCP303 (V_{OUT} = 0.5 V, V_{in} = 5.0 V) Pch Source Current, NCP302 (V_{OUT} = 0.4 V, V_{in} = 0.7 V) (V_{OUT} = GND, V_{in} = 1.5 V)	I_{OUT}	 6.3 0.011 0.525	 11 0.04 0.6	 – – –	mA
C_D Delay Pin Threshold Voltage (Pin 5) (V_{in} = 5.17 V)	V_{TCD}	 2.59	 3.49	 4.40	V
Delay Capacitor Pin Sink Current (Pin 5) (V_{in} = 0.7 V, V_{CD} = 0.1V) (V_{in} = 1.5 V, V_{CD} = 0.5V)	I_{CD}	 2.0 200	 120 1600	 – –	µA
Delay Pullup Resistance (Pin 5)	R_D	0.5	1.0	2.0	MΩ



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 12, 13, and 14. 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}

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_{in} Low	V_{in} High	V_{in} Low	V_{in} High	
	V_{DET-} (V)			V_{HYS} (V)			I_{in} (µA) (1)	I_{in} (µA) (2)	I_{OUT} (mA) (3)	I_{OUT} (mA) (4)	I_{OUT} (mA) (5)
Part Number	Min	Typ	Max	Min	Typ	Max	Typ	Typ	Typ	Typ	Typ
NCP302LSN09T1	0.882	0.9	0.918	0.027	0.045	0.063	0.3	0.5	0.05	0.5	2.0
NCP302LSN10T1	0.980	1.0	1.020	0.030	0.050	0.070					
NCP302LSN11T1	1.078	1.1	1.122	0.033	0.055	0.077				1.0	
NCP302LSN12T1	1.176	1.2	1.224	0.036	0.060	0.084					
NCP302LSN13T1	1.274	1.3	1.326	0.039	0.065	0.091					
NCP302LSN14T1	1.372	1.4	1.428	0.042	0.070	0.098					
NCP302LSN15T1	1.470	1.5	1.530	0.045	0.075	0.105					
NCP302LSN16T1	1.568	1.6	1.632	0.048	0.080	0.112				2.0	
NCP302LSN17T1	1.666	1.7	1.734	0.051	0.085	0.119					
NCP302LSN18T1	1.764	1.8	1.836	0.054	0.090	0.126					
NCP302LSN19T1	1.862	1.9	1.938	0.057	0.095	0.133					
NCP302LSN20T1	1.960	2.0	2.040	0.060	0.100	0.140					
NCP302LSN21T1	2.058	2.1	2.142	0.063	0.105	0.147					
NCP302LSN22T1	2.156	2.2	2.244	0.066	0.110	0.154					
NCP302LSN23T1	2.254	2.3	2.346	0.069	0.115	0.161					
NCP302LSN24T1	2.352	2.4	2.448	0.072	0.120	0.168					
NCP302LSN25T1	2.450	2.5	2.550	0.075	0.125	0.175					
NCP302LSN26T1	2.548	2.6	2.652	0.078	0.130	0.182					
NCP302LSN27T1	2.646	2.7	2.754	0.081	0.135	0.189					
NCP302LSN28T1	2.744	2.8	2.856	0.084	0.140	0.196					
NCP302LSN29T1	2.842	2.9	2.958	0.087	0.145	0.203					
NCP302LSN30T1	2.940	3.0	3.060	0.090	0.150	0.210					
NCP302LSN31T1	3.038	3.1	3.162	0.093	0.155	0.217					
NCP302LSN32T1	3.136	3.2	3.264	0.096	0.160	0.224					
NCP302LSN33T1	3.234	3.3	3.366	0.099	0.165	0.231					
NCP302LSN34T1	3.332	3.4	3.468	0.102	0.170	0.238					
NCP302LSN35T1	3.430	3.5	3.570	0.105	0.175	0.245					
NCP302LSN36T1	3.528	3.6	3.672	0.108	0.180	0.252					
NCP302LSN37T1	3.626	3.7	3.774	0.111	0.185	0.259					
NCP302LSN38T1	3.724	3.8	3.876	0.114	0.190	0.266					
NCP302LSN39T1	3.822	3.9	3.978	0.117	0.195	0.273					
NCP302LSN40T1	3.920	4.0	4.080	0.120	0.200	0.280	0.4	0.6			3.0
NCP302LSN41T1	4.018	4.1	4.182	0.123	0.205	0.287					
NCP302LSN42T1	4.116	4.2	4.284	0.126	0.210	0.294					
NCP302LSN43T1	4.214	4.3	4.386	0.129	0.215	0.301					
NCP302LSN44T1	4.312	4.4	4.488	0.132	0.220	0.308					
NCP302LSN45T1	4.410	4.5	4.590	0.135	0.225	0.315					
NCP302LSN46T1	4.508	4.6	4.692	0.138	0.230	0.322					
NCP302LSN47T1	4.606	4.7	4.794	0.141	0.235	0.329					
NCP302LSN48T1	4.704	4.8	4.896	0.144	0.240	0.336					
NCP302LSN49T1	4.802	4.9	4.998	0.147	0.245	0.343					

(1) Condition 1: 0.9 — 2.9 V, $V_{in} = V_{DET-} - 0.10$ V; 3.0 — 3.9 V, $V_{in} = V_{DET-} - 0.13$ V; 4.0 — 4.9 V, $V_{in} = V_{DET-} - 0.16$ V
(2) Condition 2: 0.9 — 4.9 V, $V_{in} = V_{DET-} + 2.0$ V
(3) Condition 3: 0.9 — 4.9 V, V_{in} = 0.7 V, V_{OUT} = 0.05 V, Active Low ‘L’ Suffix Devices
(4) Condition 4: 0.9 — 1.0 V, V_{in} = 0.85 V, V_{OUT} = 0.5 V; 1.1 — 1.5 V, V_{in} = 1.0 V, V_{OUT} = 0.5 V; 1.6 — 4.9 V, V_{in} = 1.5 V, V_{OUT} = 0.5 V, Active Low ‘L’ Suffix Devices
(5) Condition 5: 0.9 — 3.9 V, V_{in} = 4.5 V, V_{OUT} = 2.4 V; 4.0 — 4.9 V, V_{in} = 8.0 V, V_{OUT} = 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 V_{in} Low	Supply Current V_{in} High	Nch Sink Current	Pch Source Current V_{in} Low	Pch Source Current V_{in} High
	V_{DET-} (V)			V_{HYS} (V)			I_{in} (μA) (1)	I_{in} (μA) (2)	I_{OUT} (mA) (3)	I_{OUT} (mA) (4)	I_{OUT} (mA) (5)
Part Number	Min	Typ	Max	Min	Typ	Max	Typ	Typ	Typ	Typ	Typ
NCP302HSN09T1	0.882	0.9	0.918	0.027	0.045	0.063	0.3	0.5	2.5	0.04	0.08
NCP302HSN10T1	0.980	1.0	1.020	0.030	0.050	0.070					
NCP302HSN11T1	1.078	1.1	1.122	0.033	0.055	0.077					0.18
NCP302HSN12T1	1.176	1.2	1.224	0.036	0.060	0.084					
NCP302HSN13T1	1.274	1.3	1.326	0.039	0.065	0.091					
NCP302HSN14T1	1.372	1.4	1.428	0.042	0.070	0.098					
NCP302HSN15T1	1.470	1.5	1.530	0.045	0.075	0.105			11		
NCP302HSN16T1	1.568	1.6	1.632	0.048	0.080	0.112					0.6
NCP302HSN17T1	1.666	1.7	1.734	0.051	0.085	0.119					
NCP302HSN18T1	1.764	1.8	1.836	0.054	0.090	0.126					
NCP302HSN19T1	1.862	1.9	1.938	0.057	0.095	0.133					
NCP302HSN20T1	1.960	2.0	2.040	0.060	0.100	0.140					
NCP302HSN21T1	2.058	2.1	2.142	0.063	0.105	0.147					
NCP302HSN22T1	2.156	2.2	2.244	0.066	0.110	0.154					
NCP302HSN23T1	2.254	2.3	2.346	0.069	0.115	0.161					
NCP302HSN24T1	2.352	2.4	2.448	0.072	0.120	0.168					
NCP302HSN25T1	2.450	2.5	2.550	0.075	0.125	0.175					
NCP302HSN26T1	2.548	2.6	2.652	0.078	0.130	0.182					
NCP302HSN27T1	2.646	2.7	2.754	0.081	0.135	0.189					
NCP302HSN28T1	2.744	2.8	2.856	0.084	0.140	0.196					
NCP302HSN29T1	2.842	2.9	2.958	0.087	0.145	0.203					
NCP302HSN30T1	2.940	3.0	3.060	0.090	0.150	0.210					
NCP302HSN31T1	3.038	3.1	3.162	0.093	0.155	0.217					
NCP302HSN32T1	3.136	3.2	3.264	0.096	0.160	0.224					
NCP302HSN33T1	3.234	3.3	3.366	0.099	0.165	0.231					
NCP302HSN34T1	3.332	3.4	3.468	0.102	0.170	0.238					
NCP302HSN35T1	3.430	3.5	3.570	0.105	0.175	0.245					
NCP302HSN36T1	3.528	3.6	3.672	0.108	0.180	0.252					
NCP302HSN37T1	3.626	3.7	3.774	0.111	0.185	0.259					
NCP302HSN38T1	3.724	3.8	3.876	0.114	0.190	0.266					
NCP302HSN39T1	3.822	3.9	3.978	0.117	0.195	0.273					
NCP302HSN40T1	3.920	4.0	4.080	0.120	0.200	0.280	0.4	0.6			
NCP302HSN41T1	4.018	4.1	4.182	0.123	0.205	0.287					
NCP302HSN42T1	4.116	4.2	4.284	0.126	0.210	0.294					
NCP302HSN43T1	4.214	4.3	4.386	0.129	0.215	0.301					
NCP302HSN44T1	4.312	4.4	4.488	0.132	0.220	0.308					
NCP302HSN45T1	4.410	4.5	4.590	0.135	0.225	0.315					
NCP302HSN46T1	4.508	4.6	4.692	0.138	0.230	0.322					
NCP302HSN47T1	4.606	4.7	4.794	0.141	0.235	0.329					
NCP302HSN48T1	4.704	4.8	4.896	0.144	0.240	0.336					
NCP302HSN49T1	4.802	4.9	4.998	0.147	0.245	0.343					

(1) Condition 1: 0.9 — 2.9 V, $V_{in} = V_{DET-} - 0.10$ V; 3.0 — 3.9 V, $V_{in} = V_{DET-} - 0.13$ V; 4.0 — 4.9 V, $V_{in} = V_{DET-} - 0.16$ V
(2) Condition 2: 0.9 — 4.9 V, $V_{in} = V_{DET-} + 2.0$ V
(3) Condition 3: 0.9 — 1.4 V, V_{in} = 1.5 V, V_{OUT} = 0.5 V; 1.5 — 4.9 V, V_{in} = 5.0 V, V_{OUT} = 0.5 V, Active High ‘H’ Suffix Devices
(4) Condition 4: 0.9 — 4.9 V, V_{in} = 0.7 V, V_{OUT} = 0.4 V, Active High ‘H’ Suffix Devices
(5) Condition 5: 0.9 — 1.0 V, V_{in} = 0.8 V, V_{OUT} = GND; 1.1 — 1.5 V, V_{in} = 1.0 V, V_{OUT} = GND; 1.6 — 4.9 V, V_{in} = 1.5 V, V_{OUT} = GND, Active High ‘H’ Suffix Devices

Table 3. ELECTRICAL CHARACTERISTIC TABLE FOR 0.9 – 4.9 V

NCP303 Series	Detector Threshold			Detector Threshold Hysteresis			Supply Current		Nch Sink Current	
							V_{in} Low	V_{in} High	V_{in} Low	V_{in} High
	V_{DET-} (V)			V_{HYS} (V)			I_{in} (μA) (1)	I_{in} (μA) (2)	I_{OUT} (mA) (3)	I_{OUT} (mA) (4)
Part Number	**Min**	**Typ**	**Max**	**Min**	**Typ**	**Max**	**Typ**	**Typ**	**Typ**	**Typ**
NCP303LSN09T1	0.882	0.9	0.918	0.027	0.045	0.063	0.3	0.5	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				1.0
NCP303LSN12T1	1.176	1.2	1.224	0.036	0.060	0.084				
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				2.0
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				
NCP303LSN19T1	1.862	1.9	1.938	0.057	0.095	0.133				
NCP303LSN20T1	1.960	2.0	2.040	0.060	0.100	0.140				
NCP303LSN21T1	2.058	2.1	2.142	0.063	0.105	0.147				
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				
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				
NCP303LSN35T1	3.430	3.5	3.570	0.105	0.175	0.245				
NCP303LSN36T1	3.528	3.6	3.672	0.108	0.180	0.252				
NCP303LSN37T1	3.626	3.7	3.774	0.111	0.185	0.259				
NCP303LSN38T1	3.724	3.8	3.876	0.114	0.190	0.266				
NCP303LSN39T1	3.822	3.9	3.978	0.117	0.195	0.273				
NCP303LSN40T1	3.920	4.0	4.080	0.120	0.200	0.280	0.4	0.6		
NCP303LSN41T1	4.018	4.1	4.182	0.123	0.205	0.287				
NCP303LSN42T1	4.116	4.2	4.284	0.126	0.210	0.294				
NCP303LSN43T1	4.214	4.3	4.386	0.129	0.215	0.301				
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				
NCP303LSN48T1	4.704	4.8	4.896	0.144	0.240	0.336				
NCP303LSN49T1	4.802	4.9	4.998	0.147	0.245	0.343				

(1) Condition 1: 0.9 — 2.9 V, $V_{in} = V_{DET-} - 0.10$ V; 3.0 — 3.9 V, $V_{in} = V_{DET-} - 0.13$ V; 4.0 — 4.9 V, $V_{in} = V_{DET-} - 0.16$ V
(2) Condition 2: 0.9 — 4.9 V, $V_{in} = V_{DET-} + 2.0$ V
(3) Condition 3: 0.9 — 4.9 V, $V_{in} = 0.7$ V, $V_{OUT} = 0.05$ V, Active Low 'L' Suffix Devices
(4) Condition 4: 0.9 — 1.0 V, $V_{in} = 0.85$ V, $V_{OUT} = 0.5$ V; 1.1 — 1.5 V, $V_{in} = 1.0$ V, $V_{OUT} = 0.5$ V; 1.6 — 4.9 V, $V_{in} = 1.5$ V, $V_{OUT} = 0.5$ V, Active Low 'L' Suffix Devices

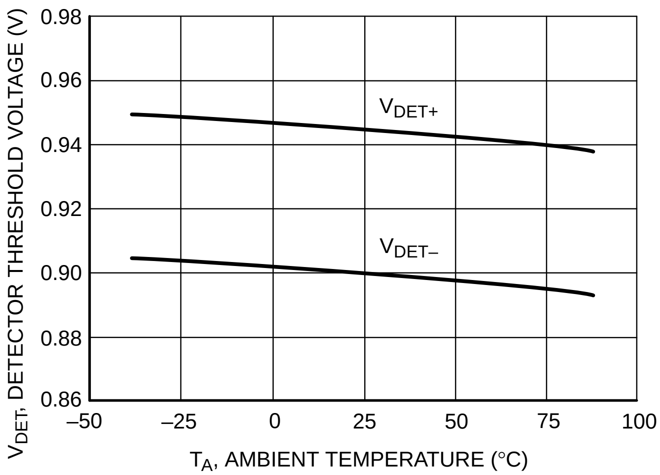


Figure 3. NCP302/3 Series 0.9 V Detector Threshold Voltage vs. Temperature

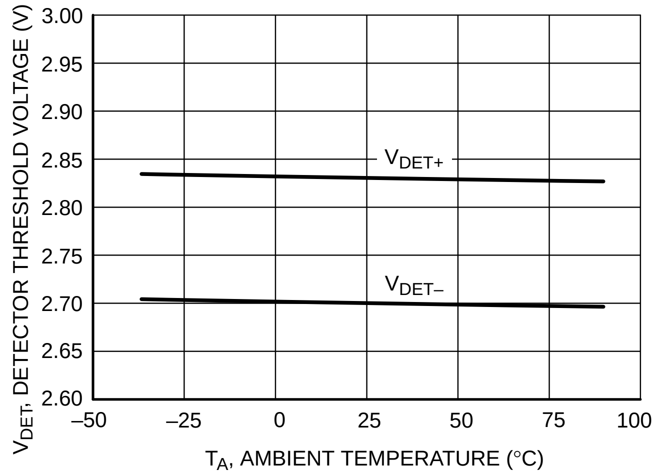


Figure 4. NCP302/3 Series 2.7 V Detector Threshold Voltage vs. Temperature

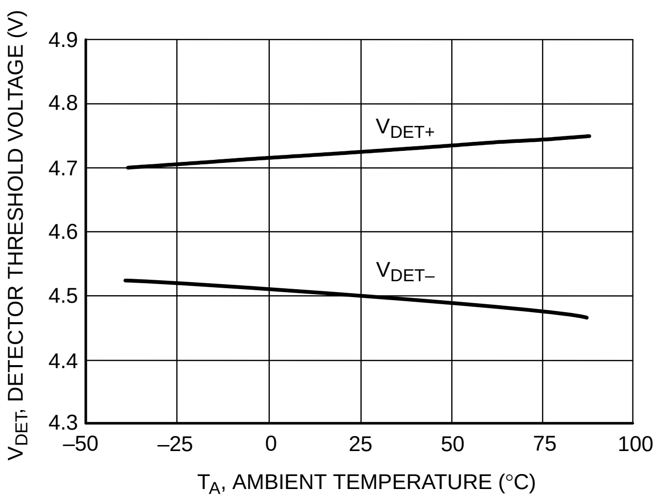


Figure 5. NCP302/3 Series 4.5 V Detector Threshold Voltage vs. Temperature

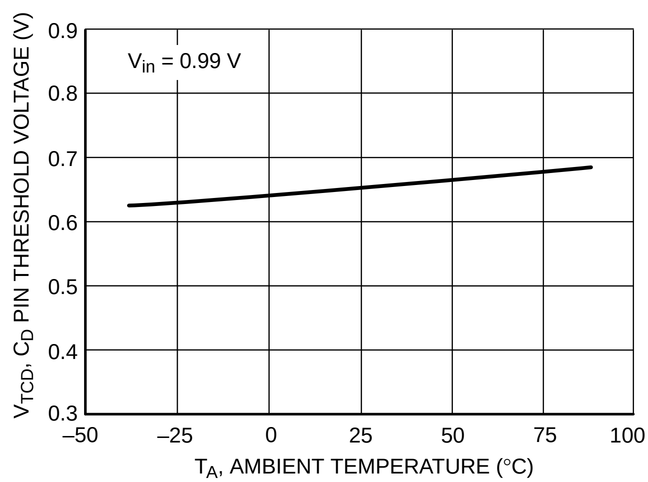


Figure 6. NCP302/3 Series 0.9 V C_D Delay Pin Threshold Voltage vs. Temperature

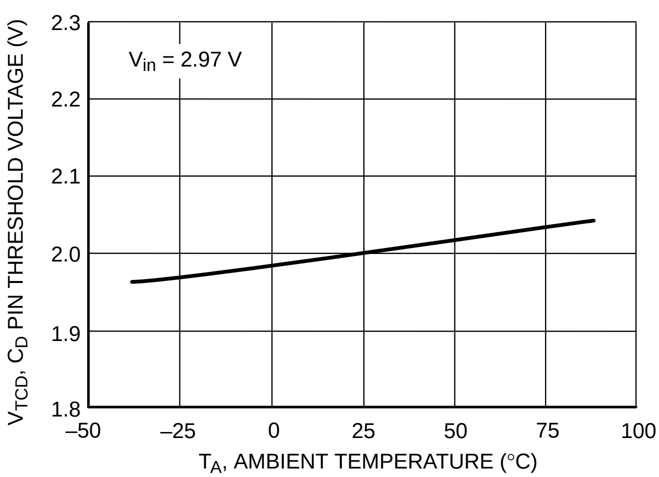


Figure 7. NCP302/3 Series 2.7 V C_D Delay Pin Threshold Voltage vs. Temperature

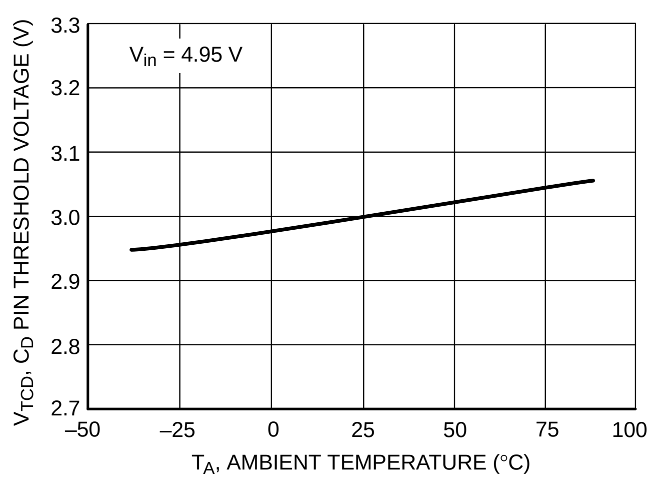


Figure 8. NCP302/3 Series 4.5 V C_D Delay Pin Threshold Voltage vs. Temperature

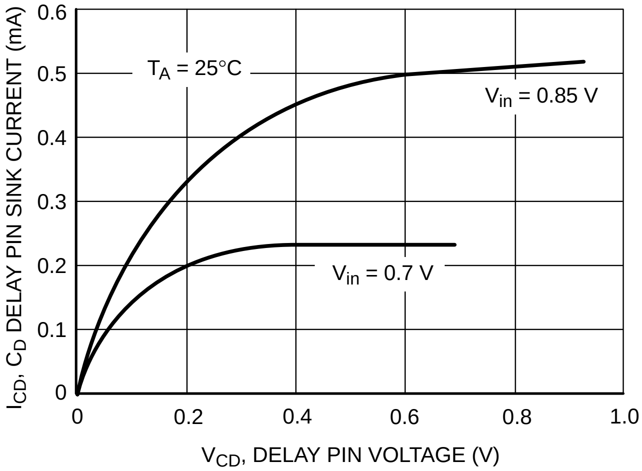


Figure 9. NCP302/3 Series 0.9 V
C_D Delay Pin Sink Current vs. Voltage

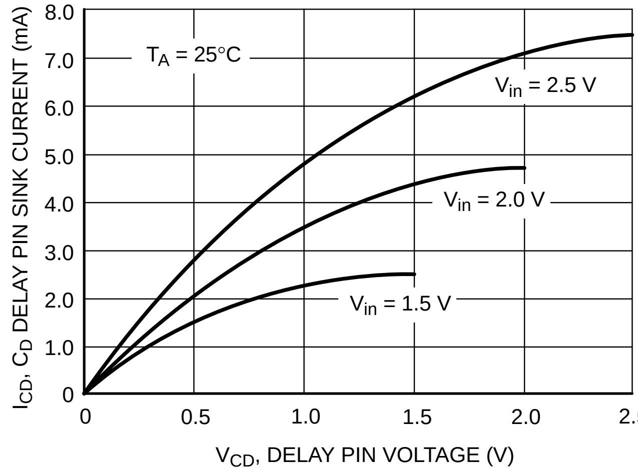


Figure 10. NCP302/3 Series 2.7 V
C_D Delay Pin Sink Current vs. Voltage

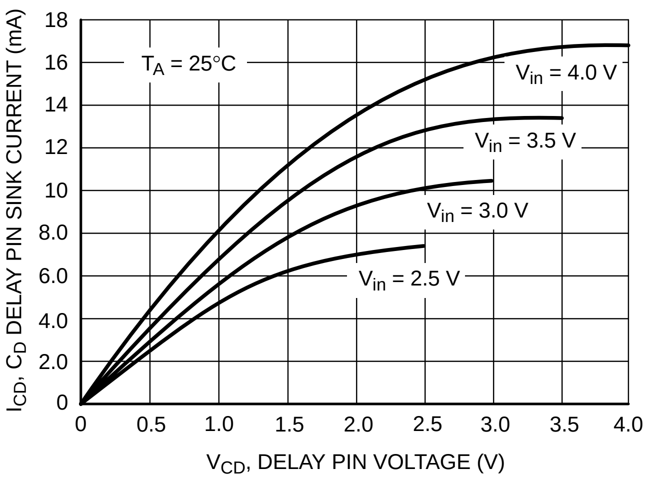


Figure 11. NCP302/3 Series 4.5 V
C_D Delay Pin Sink Current vs. Voltage

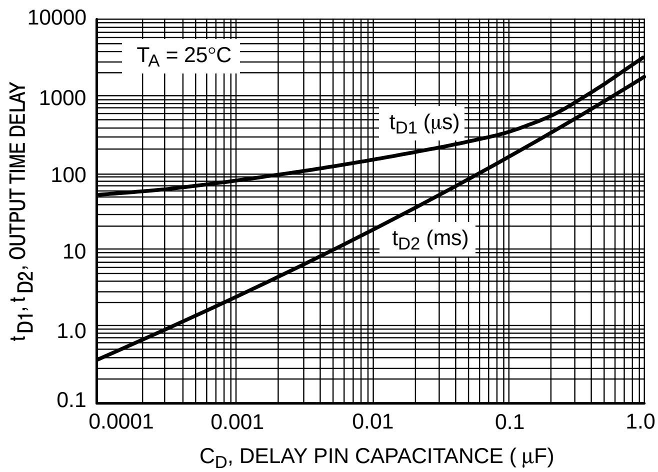


Figure 12. NCP302/3 Series 0.9 V
Output Time Delay vs. Capacitance

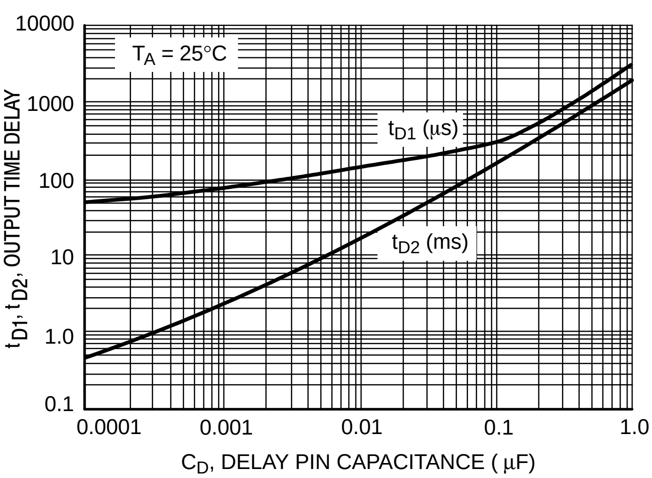


Figure 13. NCP302/3 Series 2.7 V
Output Time Delay vs. Capacitance

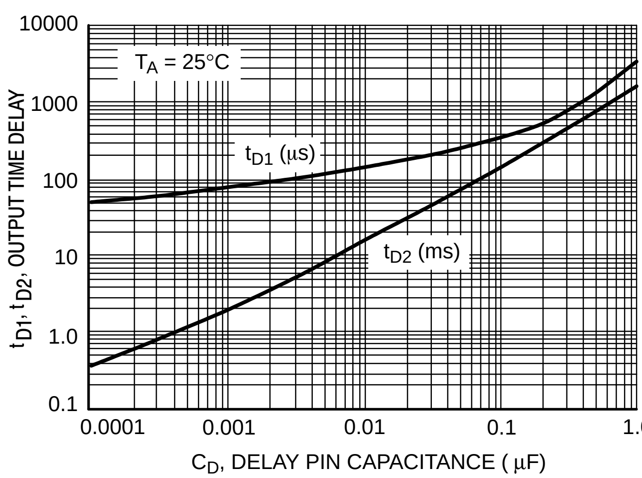


Figure 14. NCP302/3 Series 4.5 V
Output Time Delay vs. Capacitance

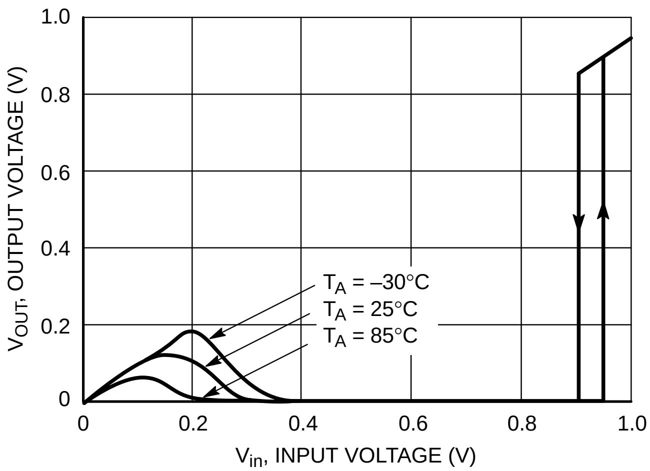


Figure 15. NCP302H/3L Series 0.9 V Reset Output Voltage vs. Input Voltage

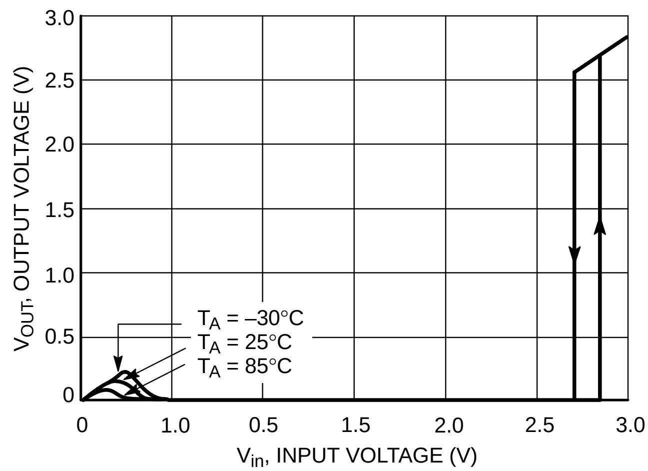


Figure 16. NCP302H/3L Series 2.7 V Reset Output Voltage vs. Input Voltage

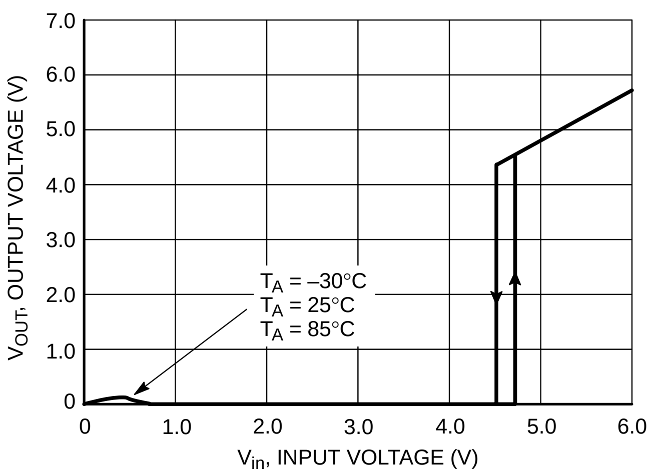


Figure 17. NCP302H/3L Series 4.5 V Reset Output Voltage vs. Input Voltage

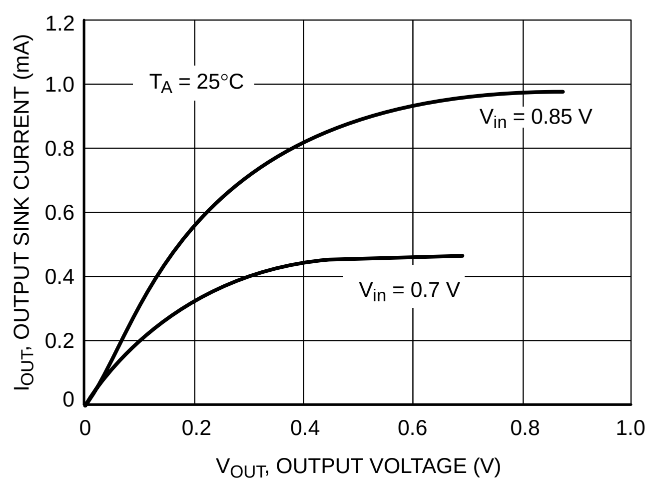


Figure 18. NCP302H/3L Series 0.9 V Reset Output Sink Current vs. Output Voltage

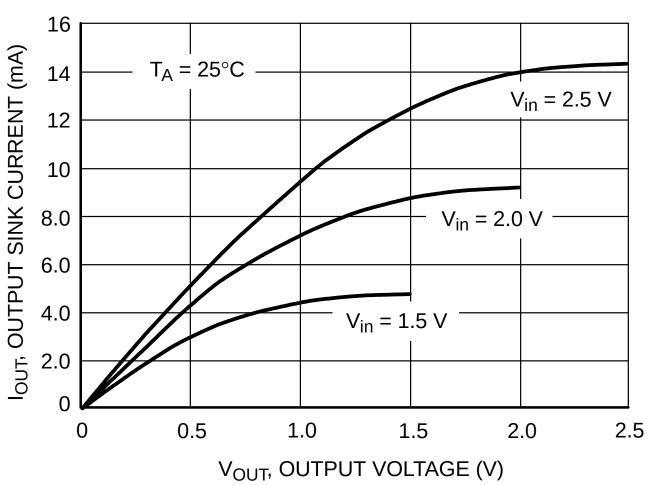


Figure 19. NCP302H/3L Series 2.7 V Reset Output Sink Current vs. Output Voltage

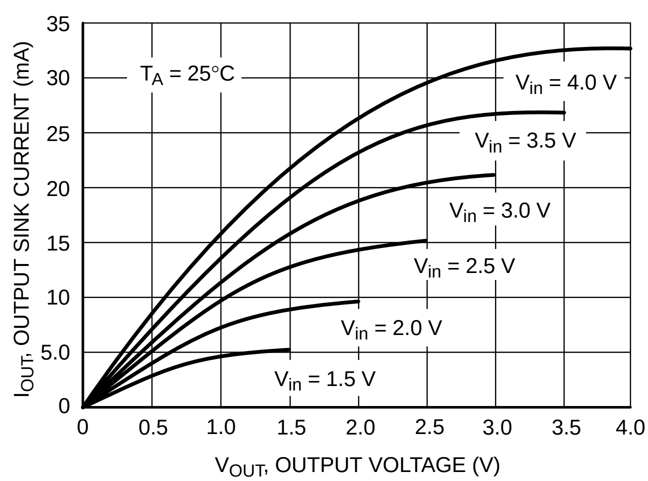


Figure 20. NCP302H/3L Series 4.5 V Reset Output Sink Current vs. Output Voltage

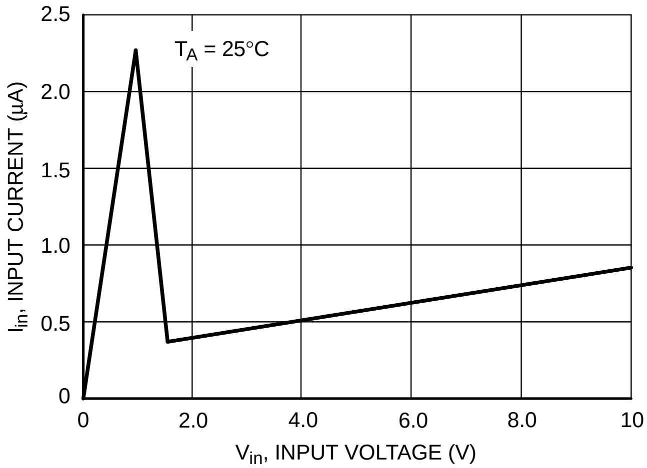


Figure 21. NCP302/3 Series 0.9 V Input Current vs. Input Voltage

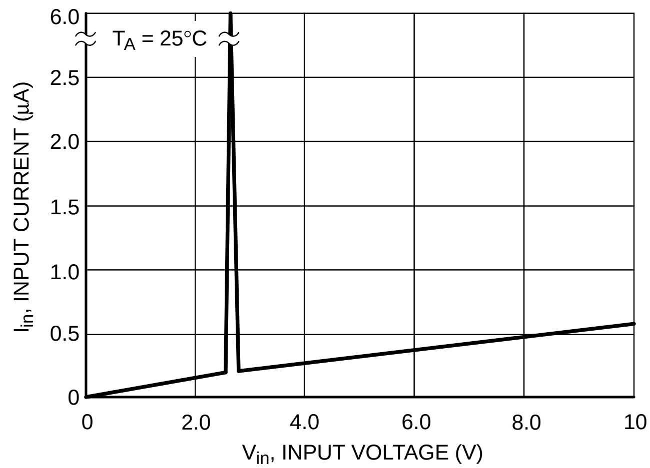


Figure 22. NCP302/3 Series 2.7 V Input Current vs. Input Voltage

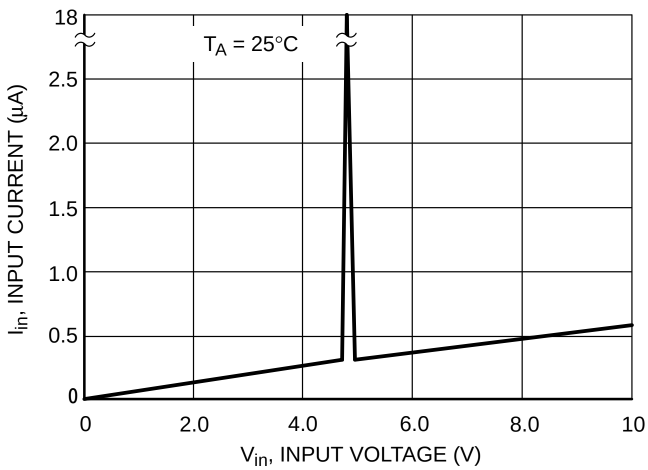


Figure 23. NCP302/3 Series 4.5 V Input Current vs. Input Voltage

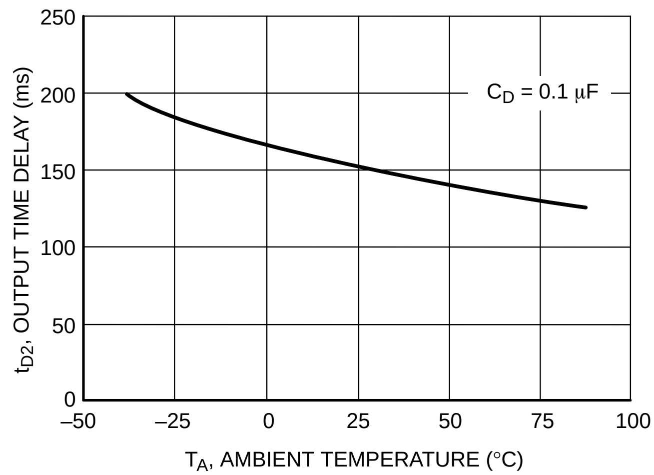


Figure 24. NCP302/3 Series 0.9 V Reset Output Time Delay vs. Temperature

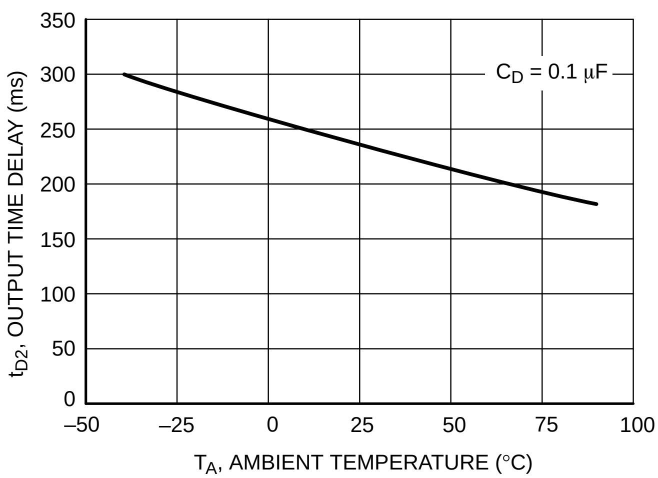


Figure 25. NCP302/3 Series 2.7 V Reset Output Time Delay vs. Temperature

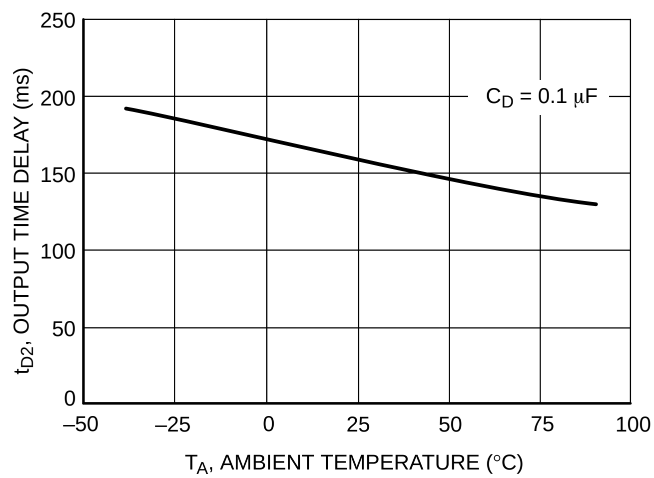


Figure 26. NCP302/3 Series 4.5 V Reset Output Time Delay vs. Temperature

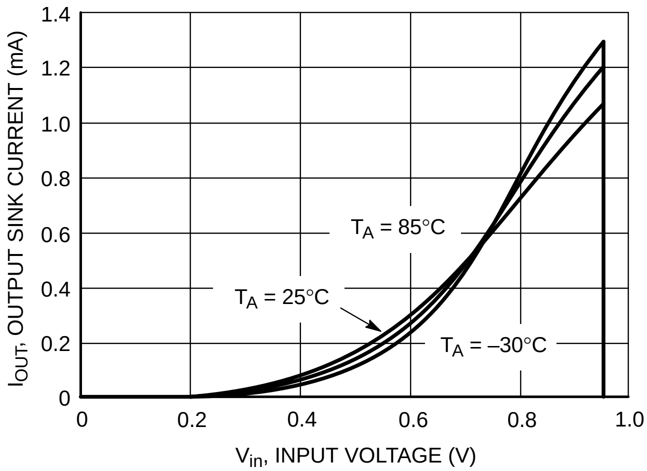


Figure 27. NCP302H/3L Series 0.9 V Reset Output Sink Current vs. Input Voltage

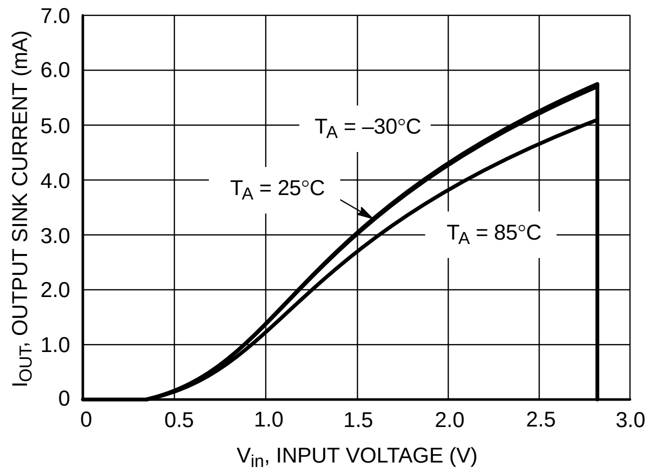


Figure 28. NCP302H/3L Series 2.7 V Reset Output Sink Current vs. Input Voltage

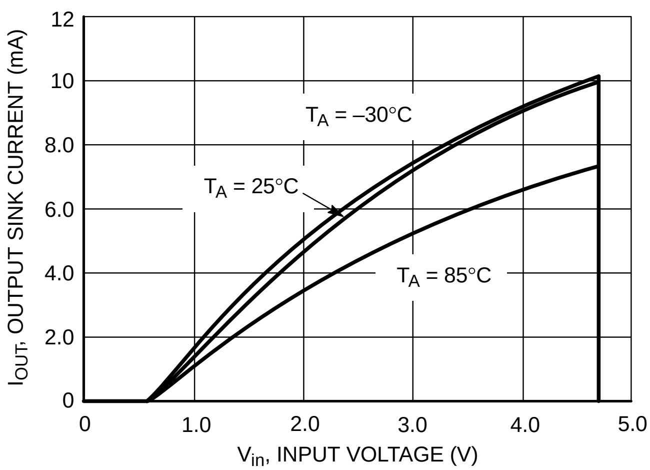


Figure 29. NCP302H/3L Series 4.5 V Reset Output Sink Current vs. Input Voltage

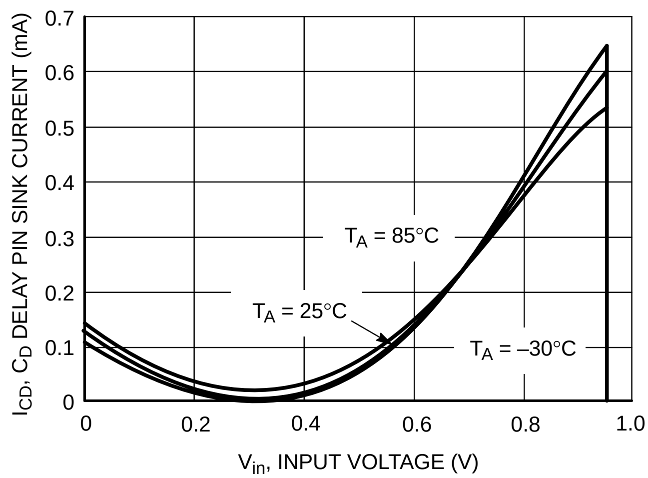


Figure 30. NCP302/3 Series 0.9 V C_D Delay Pin Sink Current vs. Input Voltage

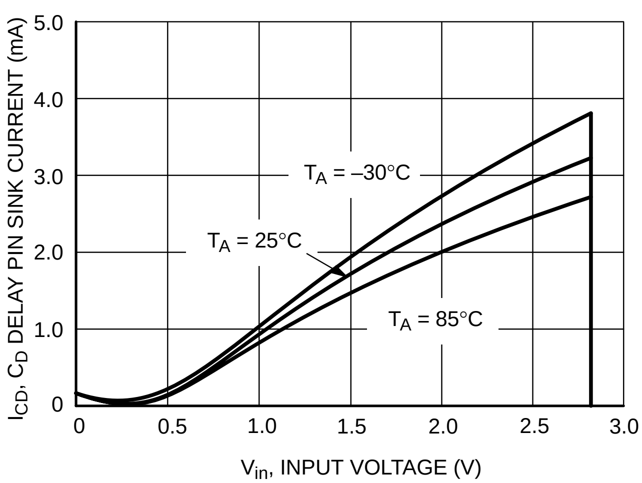


Figure 31. NCP302/3 Series 2.7 V C_D Delay Pin Sink Current vs. Input Voltage

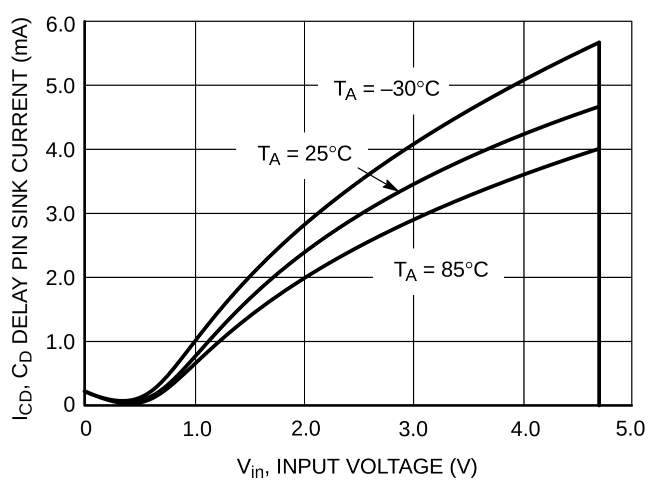


Figure 32. NCP302/3 Series 4.5 V C_D Delay Pin Sink Current vs. Input Voltage

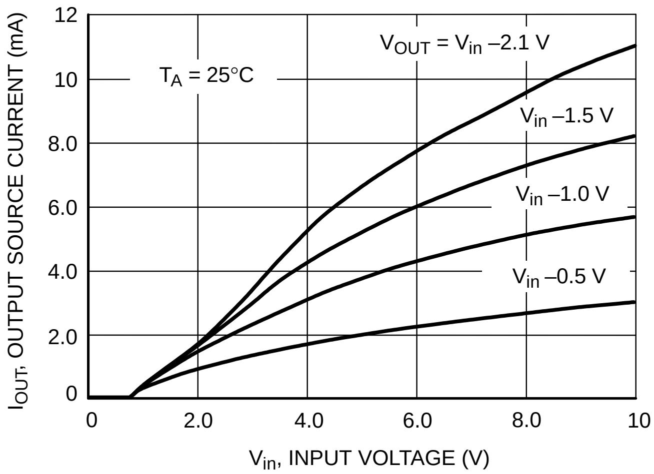


Figure 33. NCP302H Series 0.9 V Reset Output Source Current vs. Input Voltage

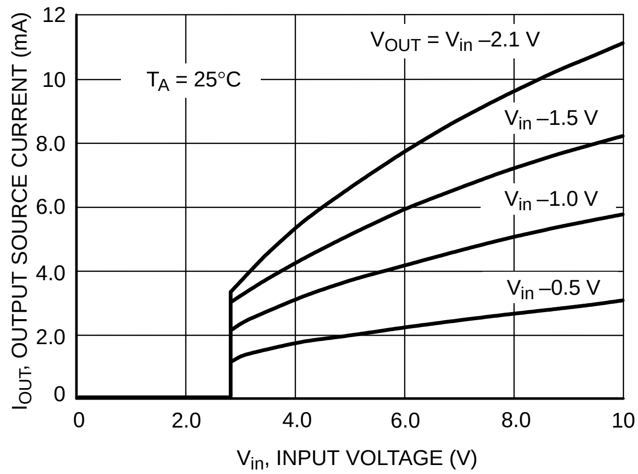


Figure 34. NCP302H Series 2.7 V Reset Output Source Current vs. Input Voltage

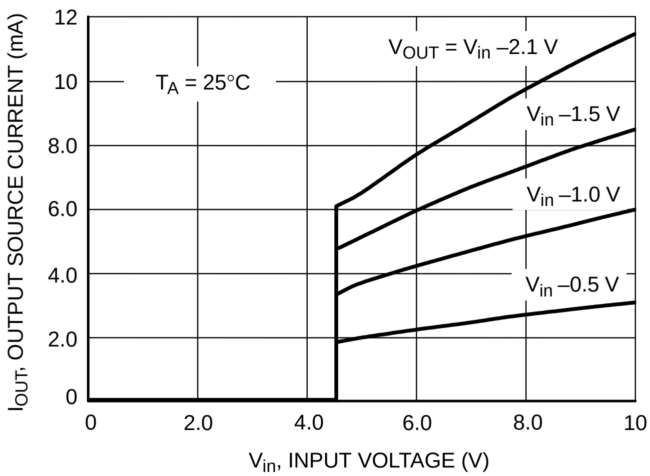


Figure 35. NCP302H Series 4.5 V Reset Output Source Current vs. Input Voltage

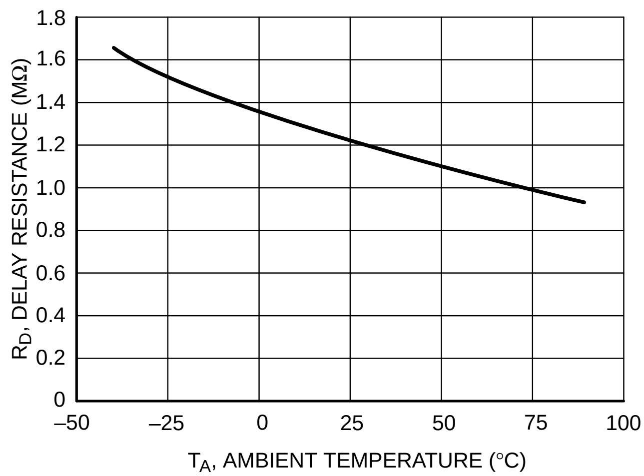


Figure 36. NCP302/3 Series Delay Resistance vs. Temperature

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 12 through 14. 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 45 show various application examples.

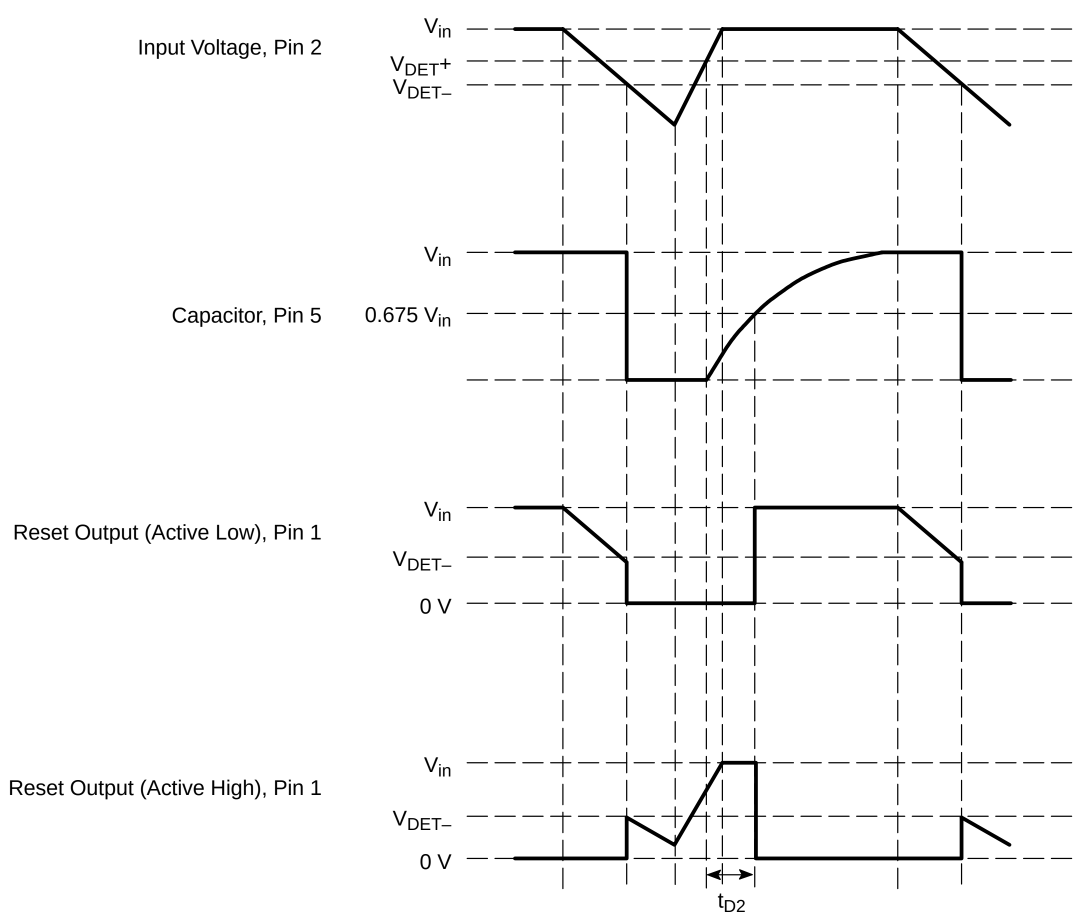


Figure 37. Timing Waveforms

APPLICATION CIRCUIT INFORMATION

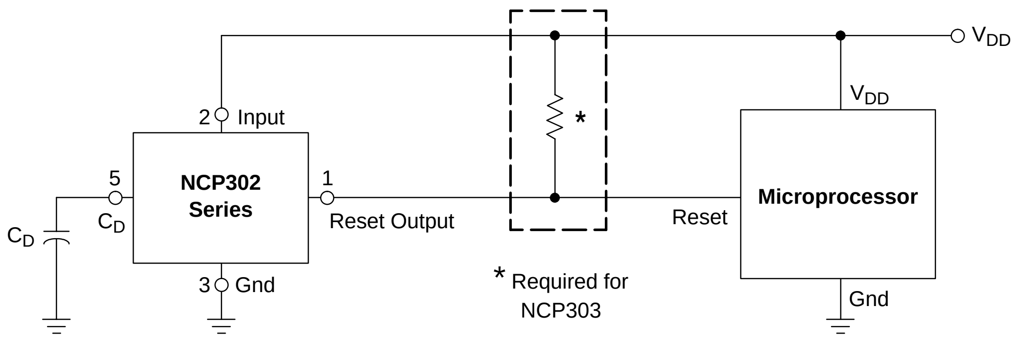


Figure 38. Microprocessor Reset Circuit

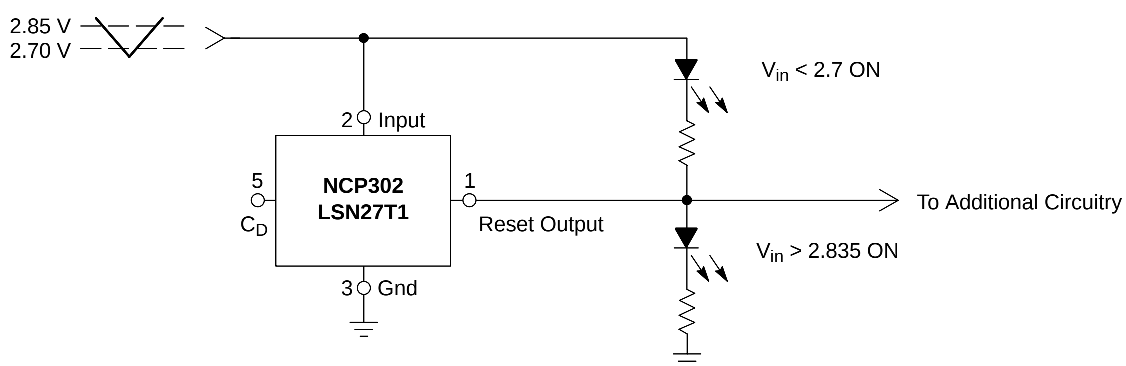


Figure 39. Battery Charge Indicator

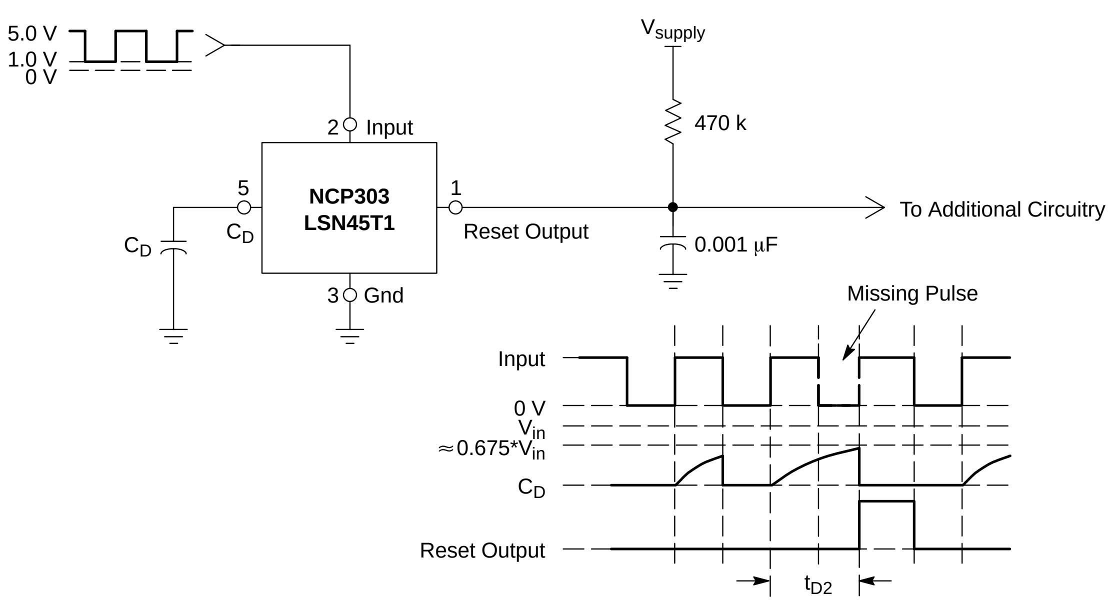


Figure 40. Missing Pulse Detector or Frequency Detector

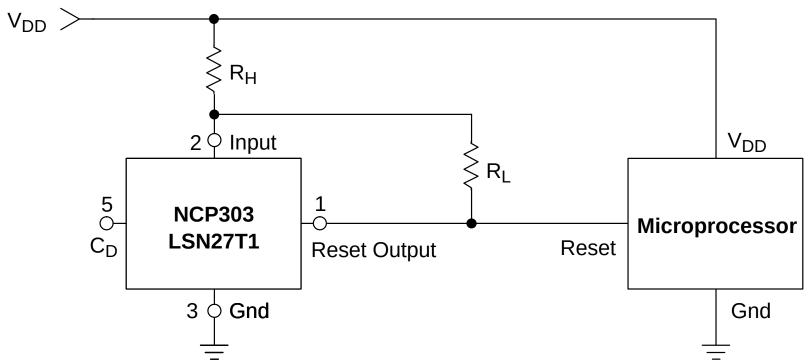


Figure 41. Microprocessor Reset Circuit with Additional Hysteresis

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 μA at 2.6 V.

V_{in} Decreasing:

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

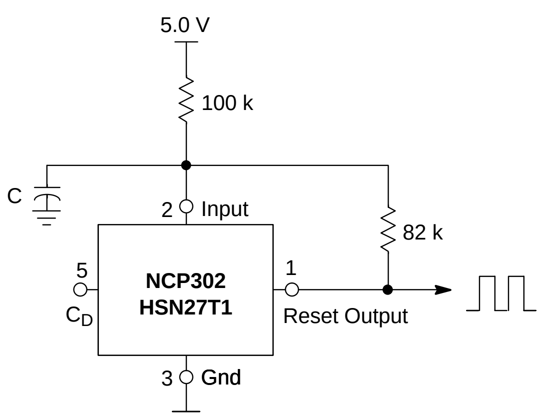
V_{in} Increasing:

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

$V_{HYS} = V_{in}$ Increasing – V_{in} Decreasing

Test Data

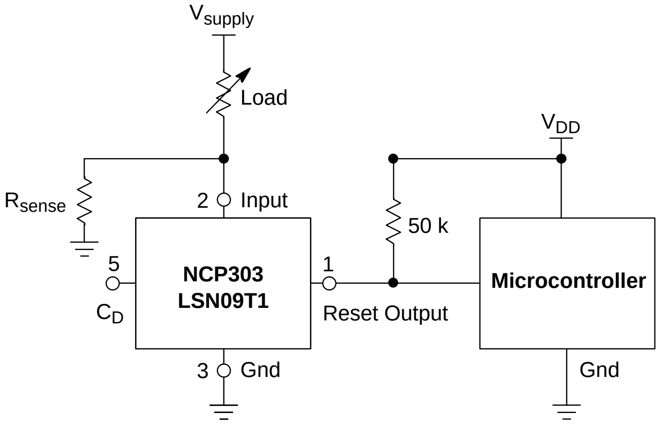
V_{th} Decreasing (mV)	V_{th} Increasing (mV)	V_{HYS} (mV)	R_H (Ω)	R_L (kΩ)
2.70	2.84	0.135	0	–
2.70	2.87	0.17	100	10
2.70	2.88	0.19	100	6.8
2.70	2.91	0.21	100	4.3
2.70	2.90	0.20	220	10
2.70	2.94	0.24	220	6.8
2.70	2.98	0.28	220	4.3
2.70	2.70	0.27	470	10
2.70	3.04	0.34	470	6.8
2.70	3.15	0.35	470	4.3



Test Data

C (μF)	f_{OSC} (kHz)	I_Q (μA)
0.01	2590	21.77
0.1	490	21.97
1.0	52	22.07

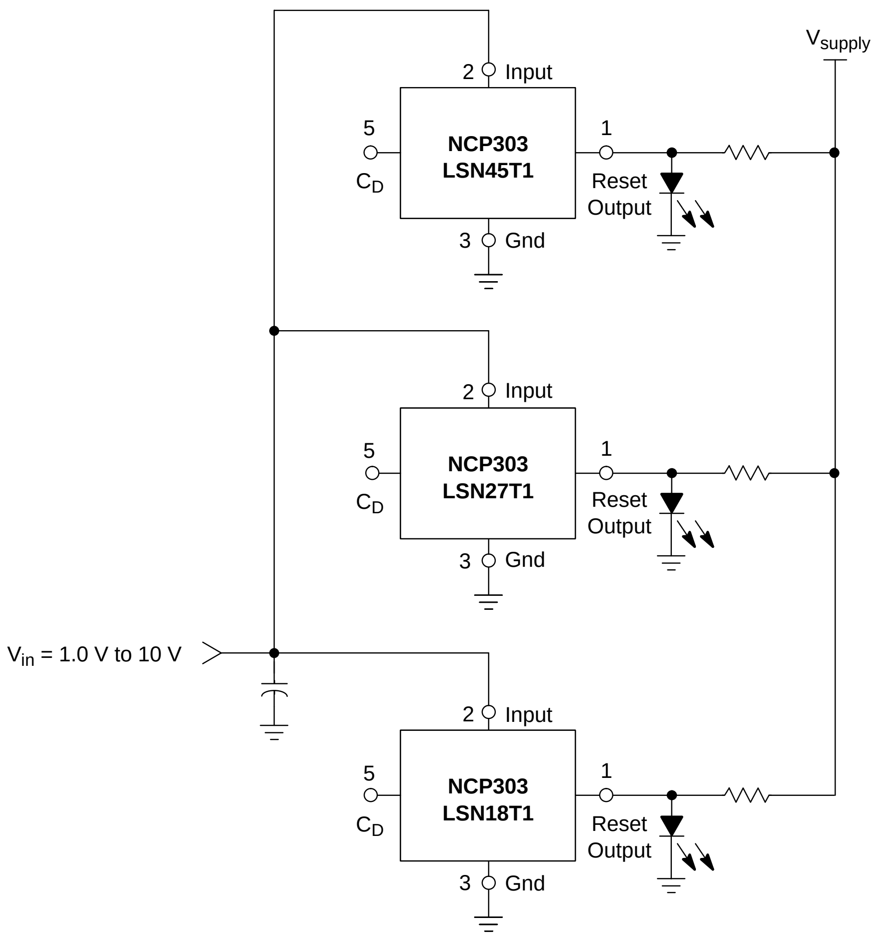
Figure 42. Simple Clock Oscillator



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:

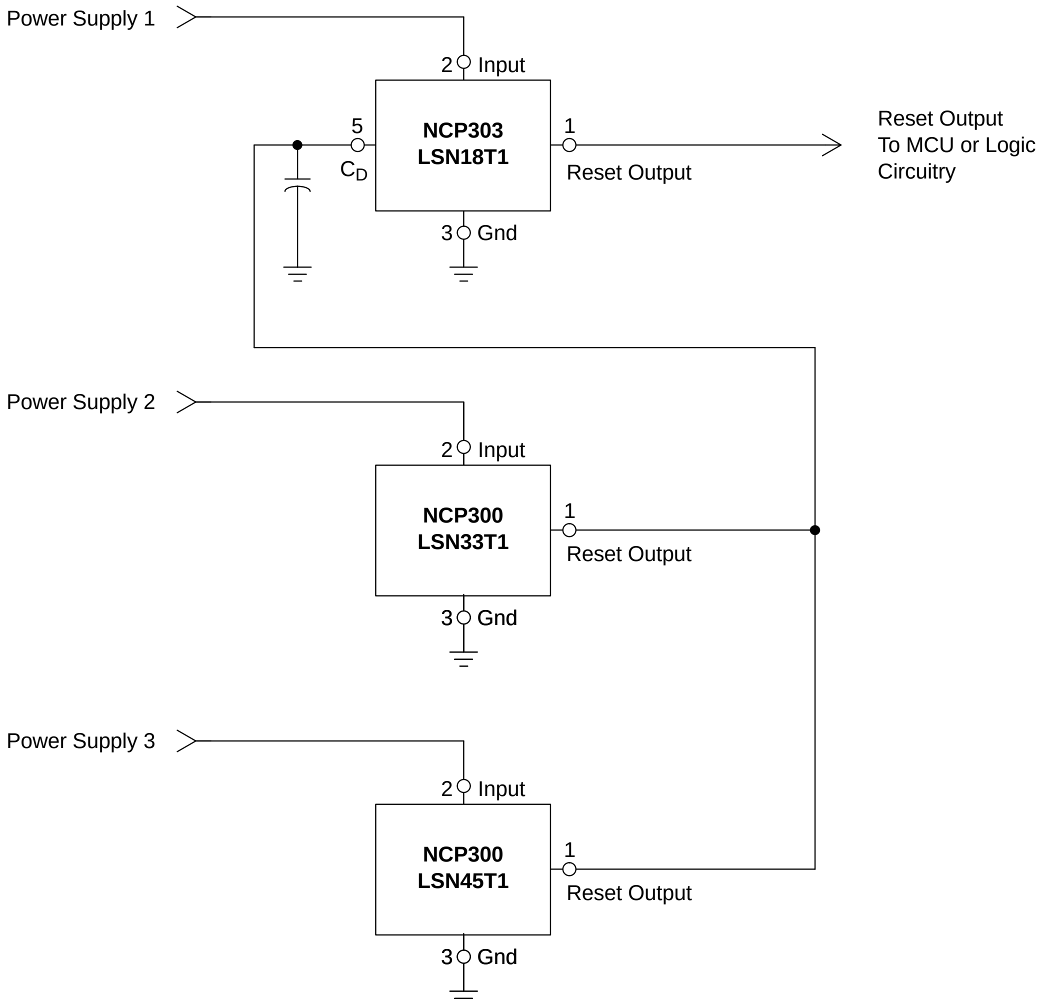
If:	Then:
$I_{Load} < V_{DET-} / R_{sense}$	Reset Output = 0 V
$I_{Load} \geq (V_{DET-} + V_{HYS}) / R_{sense}$	Reset Output = V_{DD}

Figure 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

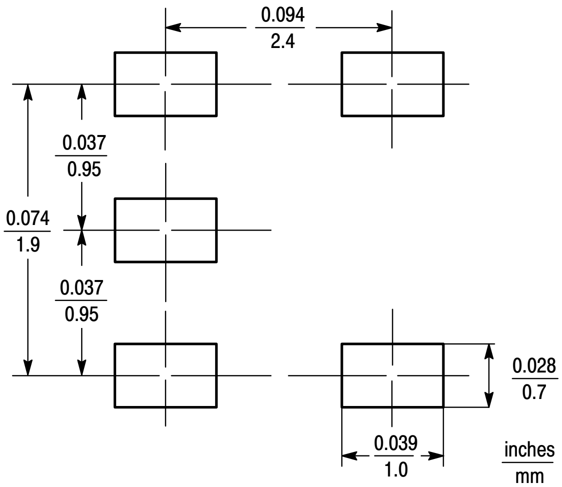


For monitoring power supplies with a time delay reset, only a single NCP303 with delay capacitor is required.

Figure 45. Multiple Power Supply Undervoltage Supervision with Time Delay Reset

MINIMUM RECOMMENDED FOOTPRINT FOR SURFACE MOUNTED APPLICATIONS

Surface mount board layout is a critical portion of the total design. The footprint for the semiconductor packages must be the correct size to insure proper solder connection interface between the board and the package. With the correct pad geometry, the packages will self align when subjected to a solder reflow process.



THIN SOT–23–5

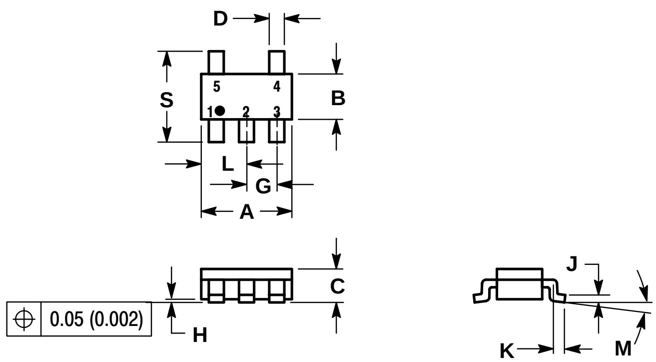
ORDERING INFORMATION

Device	Threshold Voltage	Output Type	Reset	Marking	Package (Qty/Reel)
NCP302LSN09T1	0.9	CMOS	Active Low	SBO	3000 Units on 7 inch Reel
NCP302LSN15T1	1.5			SBI	
NCP302LSN18T1	1.8			SBF	
NCP302LSN20T1	2.0			SBD	
NCP302LSN27T1	2.7			SAW	
NCP302LSN30T1	3.0			SAT	
NCP302LSN33T1	3.3			SAQ	
NCP302LSN38T1	3.8			SAK	
NCP302LSN40T1	4.0			SAI	
NCP302LSN43T1	4.3			SAF	
NCP302LSN45T1	4.5			SAL	
NCP302LSN47T1	4.7			SAC	
NCP302HSN09T1	0.9		Active High	SDO	
NCP302HSN18T1	1.8			SFH	
NCP302HSN27T1	2.7			SDK	
NCP302HSN30T1	3.0			SDI	
NCP302HSN45T1	4.5			SDG	
NCP303LSN09T1	0.9	Open Drain	Active Low	SDE	
NCP303LSN16T1	1.6			SCX	
NCP303LSN18T1	1.8			SCV	
NCP303LSN20T1	2.0			SCT	
NCP303LSN22T1	2.2			SCR	
NCP303LSN24T1	2.4			SCP	
NCP303LSN25T1	2.5			SCO	
NCP303LSN26T1	2.6			SCN	
NCP303LSN27T1	2.7			SCM	
NCP303LSN28T1	2.8			SCL	
NCP303LSN29T1	2.9			SCK	
NCP303LSN30T1	3.0			SCJ	
NCP303LSN31T1	3.1			SCI	
NCP303LSN32T1	3.2			SCH	
NCP303LSN33T1	3.3			SCG	
NCP303LSN34T1	3.4			SCF	
NCP303LSN38T1	3.8			SCA	
NCP303LSN40T1	4.0			SBY	
NCP303LSN42T1	4.2			SBW	
NCP303LSN44T1	4.4			SBU	
NCP303LSN45T1	4.5			SBT	
NCP303LSN46T1	4.6			SBS	
NCP303LSN47T1	4.7			SBR	

NOTE: The ordering information lists seven standard under voltage 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.

PACKAGE DIMENSIONS

THIN SOT–23–5
SN SUFFIX
PLASTIC PACKAGE
CASE 483–01
ISSUE B



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH THICKNESS. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIAL.

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	2.90	3.10	0.1142	0.1220
B	1.30	1.70	0.0512	0.0669
C	0.90	1.10	0.0354	0.0433
D	0.25	0.50	0.0098	0.0197
G	0.85	1.05	0.0335	0.0413
H	0.013	0.100	0.0005	0.0040
J	0.10	0.26	0.0040	0.0102
K	0.20	0.60	0.0079	0.0236
L	1.25	1.55	0.0493	0.0610
M	0 °	10 °	0 °	10 °
S	2.50	3.00	0.0985	0.1181

Notes

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