

# SCY305

## Voltage Detector Series

The SCY305 series is a 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.

The series features a highly accurate undervoltage detector with hysteresis which prevents erratic system reset operation as the comparator threshold is crossed.

The SCY305 series has an open drain N–Channel output with an active low reset output.

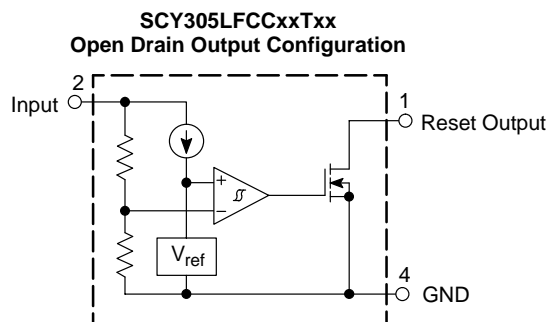
The SCY305 device series is available in a WLCSP package with standard undervoltage thresholds. Additional thresholds that range from 0.9 V to 4.9 V in 100 mV steps can be manufactured.

### Features

- Quiescent Current of 1.0  $\mu$ A Typical
- High UVLO Accuracy of 1.0% at Room Temperature  
1.5% Over Room Temperature
- Wide Operating Voltage Range of 0.8 V to 10 V
- Open Drain Reset Output
- Active Low Reset Output
- 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 37 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.

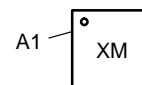
**Figure 1. Representative Block Diagram**

This document contains information on a product under development. ON Semiconductor reserves the right to change or discontinue this product without notice.



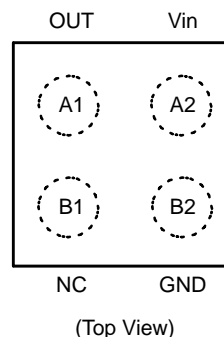
**WLCSP4  
FCC SUFFIX  
CASE TBD**

### MARKING DIAGRAM



X = Specific Device Code  
M = Month

### PIN CONNECTIONS



### ORDERING INFORMATION

See detailed ordering and shipping information on page 13 of this data sheet.

**This document contains information on a product under development. ON Semiconductor reserves the right to change or discontinue this product without notice.**

This document, and the information contained herein, is CONFIDENTIAL AND PROPRIETARY and the property of Semiconductor Components Industries, LLC., dba ON Semiconductor. It shall not be used, published, disclosed or disseminated outside of the Company, in whole or in part, without the written permission of ON Semiconductor. Reverse engineering of any or all of the information contained herein is strictly prohibited.

© 2019, SCILLC. All Rights Reserved.

**Table 1. MAXIMUM RATINGS** (Note 1)

Rating	Symbol	Value	Unit
Input Power Supply Voltage (Pin 2)	$V_{in}$	12	V
Output Voltage (Pin 1) N-Channel Open Drain, SCY305	$V_{OUT}$	-0.3 to 12	V
Output Current (Pin 1) (Note 2)	$I_{OUT}$	70	mA
Thermal Resistance, Junction-to-Air	$R_{\theta JA}$	TBD	°C/W
Maximum Junction Temperature	$T_J$	+125	°C
Storage Temperature Range	$T_{stg}$	-55 to +150	°C
Latchup Performance (Note 3) Positive Negative	$I_{LATCHUP}$	500 170	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.

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.

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

3. Maximum Ratings per JEDEC standard JESD78.

**Table 2. ELECTRICAL CHARACTERISTICS** (For all values  $T_A = 25^\circ\text{C}$ , unless otherwise noted.)

Characteristic	Symbol	Min	Typ	Max	Unit
<b>SCY305 – 2.7</b>					
Detector Threshold (Pin 2, $V_{in}$ Decreasing)	$V_{DET-}$	2.673	2.700	2.727	V
		2.660	2.700	2.741	
Detector Threshold Hysteresis (Pin 2, $V_{in}$ Increasing)	$V_{HYS}$	0.081	0.135	0.189	V
Supply Current (Pin 2) ( $V_{in} = 2.6\text{ V}$ ) ( $V_{in} = 4.7\text{ V}$ )	$I_{in}$	-	0.9	2.7	$\mu\text{A}$
		-	1.1	3.3	
Maximum Operating Voltage (Pin 2)	$V_{in(max)}$	-	-	10	V
Minimum Operating Voltage (Pin 2) ( $T_A = -40^\circ\text{C}$ to $85^\circ\text{C}$ )	$V_{in(min)}$	-	0.55	0.70	V
		-	0.65	0.80	
Reset Output Current (Pin 1, Active Low 'L' Suffix Devices)  N-Channel Sink Current, SCY305 ( $V_{OUT} = 0.05\text{ V}$ , $V_{in} = 0.70\text{ V}$ ) ( $V_{OUT} = 0.50\text{ V}$ , $V_{in} = 1.5\text{ V}$ )	$I_{OUT}$	0.01	0.05	-	mA
		1.0	2.0	-	
Reset Output Current (Pin 1, Active High 'H' Suffix Devices)  N-Channel Sink Current, SCY305 ( $V_{OUT} = 0.5\text{ V}$ , $V_{in} = 5.0\text{ V}$ )	$I_{OUT}$	6.3	11	-	mA
Propagation Delay Input to Output (Figure 2)  N-Channel Open Drain SCY305 Series Output Transition, High to Low (Note 4) Output Transition, Low to High (Note 4)	$t_{pHL}$ $t_{pLH}$	-	12	-	$\mu\text{s}$
		-	-	70	
<b>SCY305 – 2.9</b>					
Detector Threshold (Pin 2, $V_{in}$ Decreasing)	$V_{DET-}$	2.871	2.900	2.929	V
		2.857	2.900	2.944	

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.

**Table 2. ELECTRICAL CHARACTERISTICS (continued)** (For all values  $T_A = 25^\circ\text{C}$ , unless otherwise noted.)

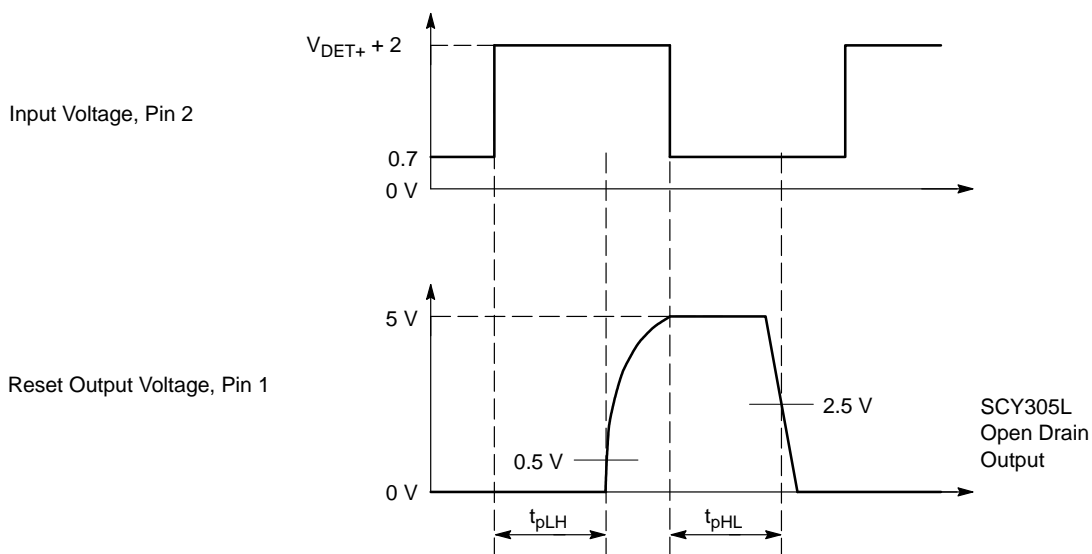
Characteristic	Symbol	Min	Typ	Max	Unit
<b>SCY305 – 2.9</b>					
Detector Threshold Hysteresis (Pin 2, $V_{in}$ Increasing)	$V_{HYS}$	0.087	0.145	0.203	V
Supply Current (Pin 2) ( $V_{in} = 2.8\text{ V}$ ) ( $V_{in} = 4.9\text{ V}$ )	$I_{in}$	– –	0.9 1.1	2.9 3.5	$\mu\text{A}$
Maximum Operating Voltage (Pin 2)	$V_{in(max)}$	–	–	10	V
Minimum Operating Voltage (Pin 2) ( $T_A = -40^\circ\text{C}$ to $85^\circ\text{C}$ )	$V_{in(min)}$	– –	0.55 0.65	0.70 0.80	V
Reset Output Current (Pin 1, Active Low 'L' Suffix Devices)  N-Channel Sink Current, SCY305 ( $V_{OUT} = 0.05\text{ V}$ , $V_{in} = 0.70\text{ V}$ ) ( $V_{OUT} = 0.50\text{ V}$ , $V_{in} = 1.5\text{ V}$ )	$I_{OUT}$	0.01 1.0	0.05 2.0	– –	mA
Reset Output Current (Pin 1, Active High 'H' Suffix Devices)  N-Channel Sink Current, SCY305 ( $V_{OUT} = 0.5\text{ V}$ , $V_{in} = 5.0\text{ V}$ )	$I_{OUT}$	6.3	11	–	mA
Propagation Delay Input to Output (Figure 2)  N-Channel Open Drain SCY305 Series Output Transition, High to Low (Note 4) Output Transition, Low to High (Note 4)	$t_{pHL}$ $t_{pLH}$	– –	12 –	– 70	$\mu\text{s}$

**SCY305 – 3.0**

Detector Threshold (Pin 2, $V_{in}$ Decreasing)	$V_{DET-}$	2.970	3.00	3.030	V
		2.955	3.00	3.045	
Detector Threshold Hysteresis (Pin 2, $V_{in}$ Increasing)	$V_{HYS}$	0.09	0.15	0.21	V
Supply Current (Pin 2) ( $V_{in} = 2.87\text{ V}$ ) ( $V_{in} = 5.0\text{ V}$ )	$I_{in}$	– –	1.0 1.2	3.0 3.6	$\mu\text{A}$
Maximum Operating Voltage (Pin 2)	$V_{in(max)}$	–	–	10	V
Minimum Operating Voltage (Pin 2) ( $T_A = -40^\circ\text{C}$ to $85^\circ\text{C}$ )	$V_{in(min)}$	– –	0.55 0.65	0.70 0.80	V
Reset Output Current (Pin 1, Active Low 'L' Suffix Devices)  N-Channel Sink Current, SCY305 ( $V_{OUT} = 0.05\text{ V}$ , $V_{in} = 0.70\text{ V}$ ) ( $V_{OUT} = 0.50\text{ V}$ , $V_{in} = 1.5\text{ V}$ )	$I_{OUT}$	0.01 1.0	0.05 2.0	– –	mA
Reset Output Current (Pin 1, Active High 'H' Suffix Devices)  N-Channel Sink Current, SCY305 ( $V_{OUT} = 0.5\text{ V}$ , $V_{in} = 5.0\text{ V}$ )	$I_{OUT}$	6.3	11	–	mA
Propagation Delay Input to Output (Figure 2)  N-Channel Open Drain SCY305 Series Output Transition, High to Low (Note 4) Output Transition, Low to High (Note 4)	$t_{pHL}$ $t_{pLH}$	– –	12 –	– 70	$\mu\text{s}$

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.

# SCY305



The SCY305 series is measured with a 10 pF capacitive load. The SCY305 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**

Table 3. SCY305 SERIES ELECTRICAL CHARACTERISTIC TABLE FOR 0.9 – 4.9 V, T<sub>A</sub> = 25°C

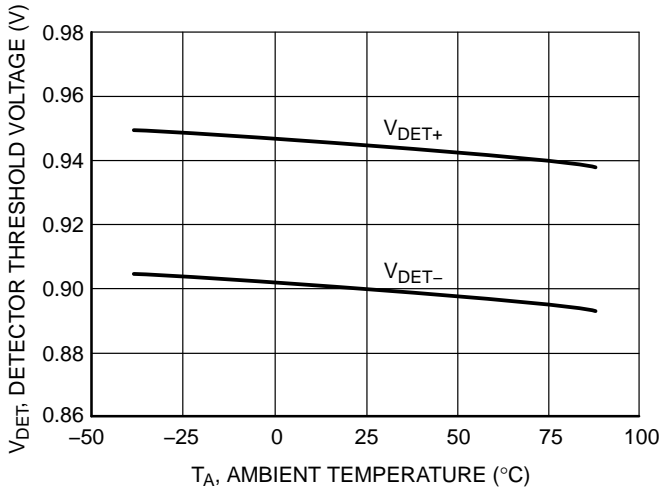
Part Number	Detector Threshold			Detector Threshold Hysteresis			Supply Current		N-Channel Sink Current	
							V <sub>in</sub> Low	V <sub>in</sub> High	V <sub>in</sub> Low	V <sub>in</sub> High
	V <sub>DET-</sub> (V)			V <sub>HYS</sub> (V)			I <sub>in</sub> (μA) (Note 5)	I <sub>in</sub> (μA) (Note 6)	I <sub>OUT</sub> (mA) (Note 7)	I <sub>OUT</sub> (mA) (Note 8)
	Min	Typ	Max	Min	Typ	Max	Typ	Typ	Typ	Typ
SCY305LFCC09TBG	0.891	0.9	0.909	0.027	0.045	0.063	0.8	0.9	0.05	0.5
SCY305LFCC15TBG	1.485	1.5	1.515	0.045	0.075	0.105				
SCY305LFCC16TBG	1.584	1.6	1.616	0.048	0.080	0.112				
SCY305LFCC17TBG	1.683	1.7	1.717	0.051	0.085	0.119				
SCY305LFCC18TBG	1.782	1.8	1.818	0.054	0.090	0.126				
SCY305LFCC20TBG	1.980	2.0	2.020	0.060	0.100	0.140	0.9	1.1	2.0	
SCY305LFCC22TBG	2.178	2.2	2.222	0.066	0.110	0.154				
SCY305LFCC23TBG	2.277	2.3	2.323	0.069	0.115	0.161				
SCY305LFCC24TBG	2.376	2.4	2.424	0.072	0.120	0.168				
SCY305LFCC25TBG	2.475	2.5	2.525	0.075	0.125	0.175				
SCY305LFCC26TBG	2.574	2.6	2.626	0.078	0.130	0.182				
SCY305LFCC27TBG	2.673	2.7	2.727	0.081	0.135	0.189				
SCY305LFCC28TBG	2.772	2.8	2.828	0.084	0.140	0.196				
SCY305LFCC29TBG	2.871	2.9	2.929	0.087	0.145	0.203				
SCY305LFCC30TBG	2.970	3.0	3.030	0.090	0.150	0.210				1.0
SCY305LFCC31TBG	3.069	3.1	3.131	0.093	0.155	0.217				
SCY305LFCC32TBG	3.168	3.2	3.232	0.096	0.160	0.224				
SCY305LFCC33TBG	3.267	3.3	3.333	0.099	0.165	0.231				
SCY305LFCC34TBG	3.366	3.4	3.434	0.102	0.170	0.238				
SCY305LFCC35TBG	3.465	3.5	3.535	0.105	0.175	0.245				
SCY305LFCC36TBG	3.564	3.6	3.636	0.108	0.180	0.252				
SCY305LFCC37TBG	3.663	3.7	3.737	0.111	0.185	0.259				
SCY305LFCC40TBG	3.960	4.0	4.040	0.120	0.200	0.280				
SCY305LFCC44TBG	4.356	4.4	4.444	0.132	0.220	0.308	1.1	1.3	2.0	
SCY305LFCC45TBG	4.455	4.5	4.545	0.135	0.225	0.315				
SCY305LFCC47TBG	4.653	4.7	4.747	0.141	0.235	0.329				
SCY305LFCC49TBG	4.851	4.9	4.949	0.147	0.245	0.343				

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

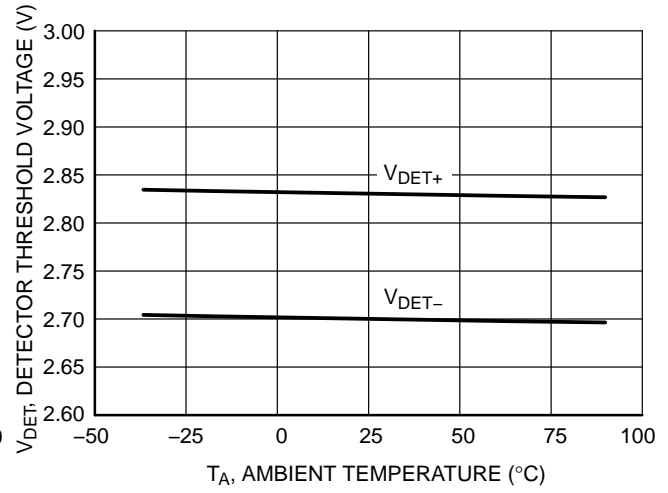
6. Condition 2: 0.9 – 4.9 V, V<sub>in</sub> = V<sub>DET-</sub> + 2.0 V

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

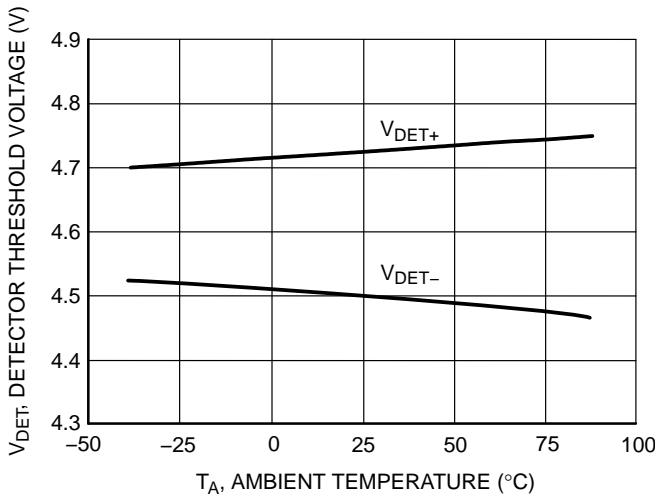
8. Condition 4: 0.9 – 1.0 V, V<sub>in</sub> = 0.85 V, V<sub>OUT</sub> = 0.5 V; 1.1 – 1.5 V, V<sub>in</sub> = 1.0 V, V<sub>OUT</sub> = 0.5 V; 1.6 – 4.9 V, V<sub>in</sub> = 1.5 V, V<sub>OUT</sub> = 0.5 V, Active Low 'L' Suffix Devices



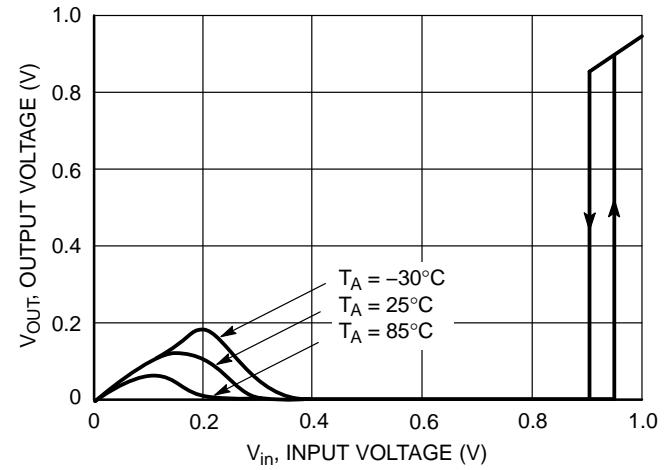
**Figure 3. SCY305 Series 0.9 V  
Detector Threshold Voltage vs. Temperature**



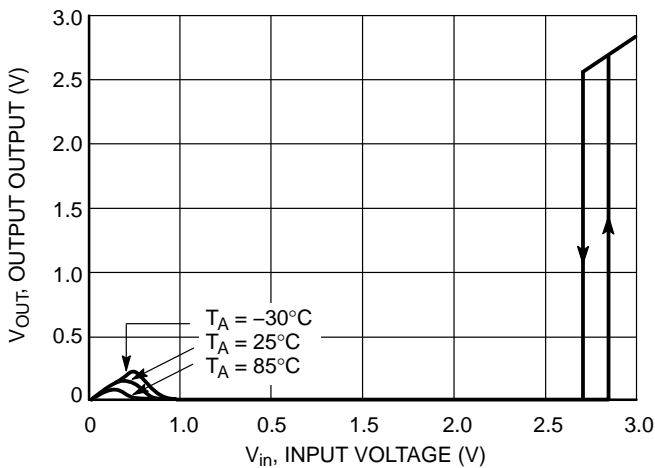
**Figure 4. SCY305 Series 2.7 V  
Detector Threshold Voltage vs. Temperature**



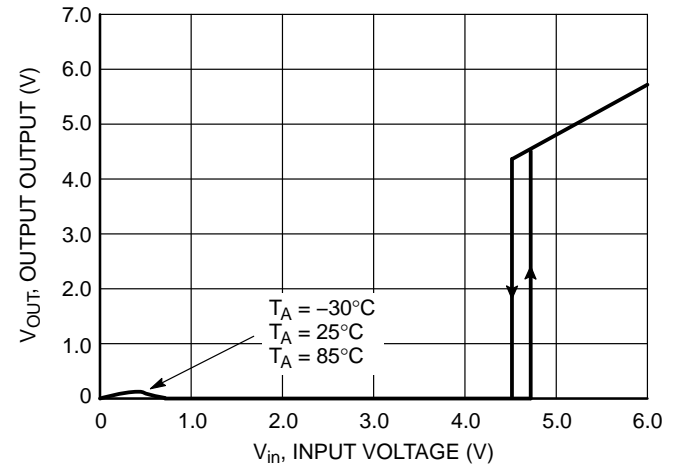
**Figure 5. SCY305L Series 4.5 V  
Detector Threshold Voltage vs. Temperature**



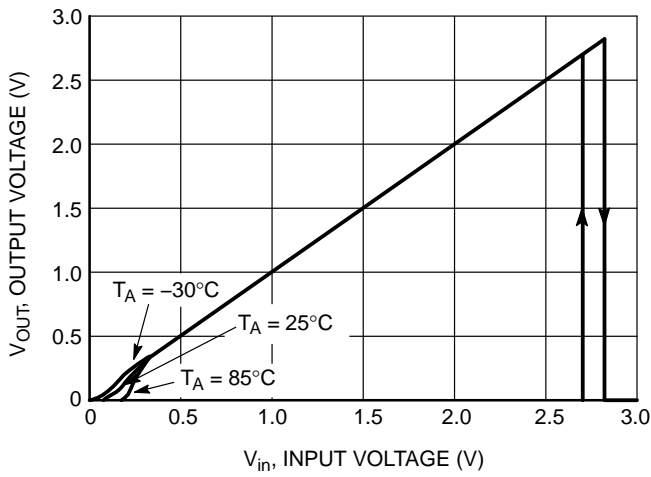
**Figure 6. SCY305L Series 0.9 V  
Reset Output Voltage vs. Input Voltage**



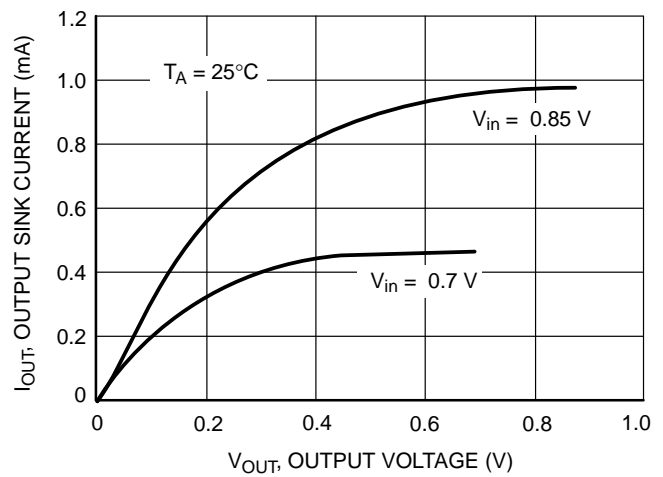
**Figure 7. SCY305L Series 2.7 V  
Reset Output Voltage vs. Input Voltage**



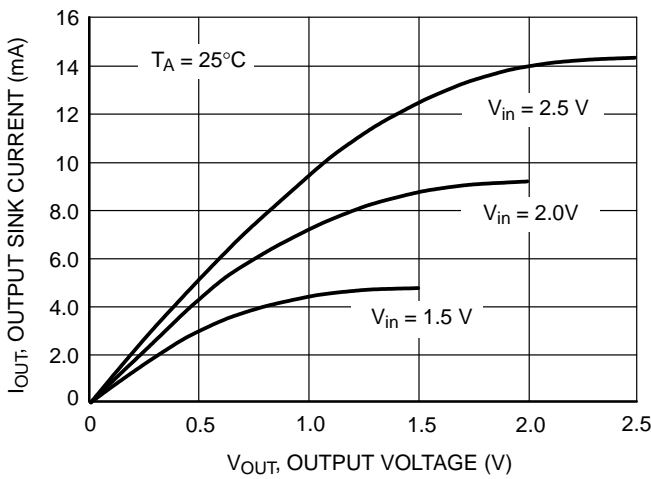
**Figure 8. SCY305L Series 4.5 V  
Reset Output Voltage vs. Input Voltage**



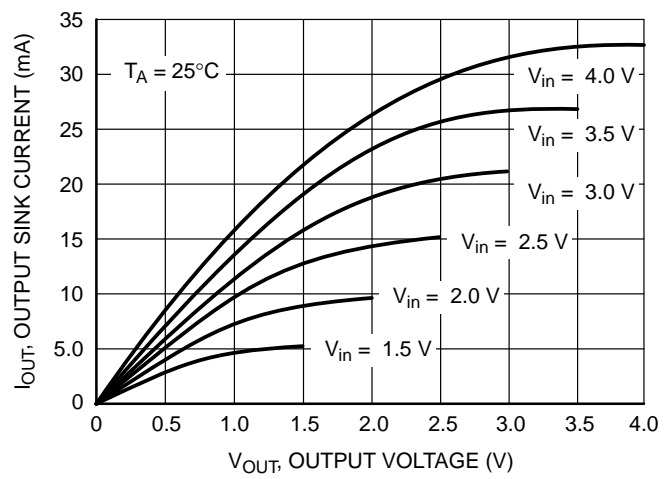
**Figure 9. SCY305H Series 2.7 V  
Reset Output Voltage vs. Input Voltage**



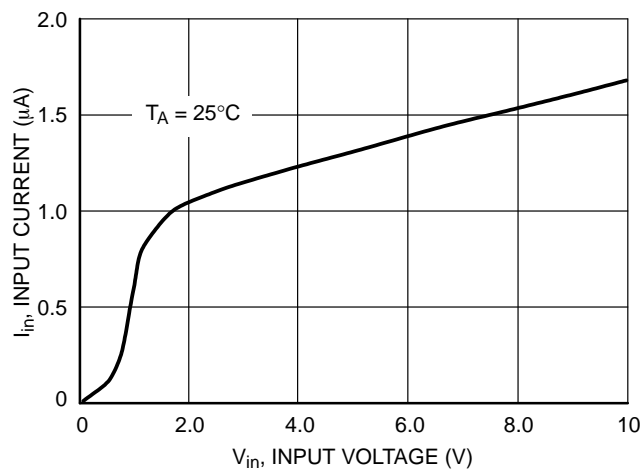
**Figure 10. SCY305L Series 0.9 V  
Reset Output Sink Current vs. Output Voltage**



**Figure 11. SCY305L Series 2.7 V  
Reset Output Sink Current vs. Output Voltage**



**Figure 12. SCY305L Series 4.5 V  
Reset Output Sink Current vs. Output Voltage**



**Figure 13. SCY305 Series 0.9 V  
Input Current vs. Input Voltage**

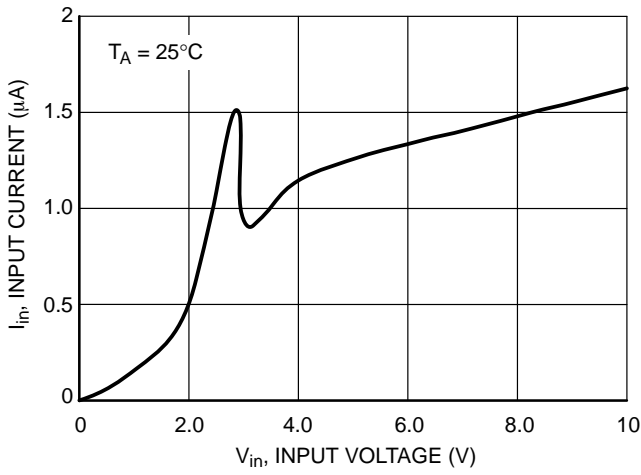


Figure 14. SCY305 Series 2.7 V Input Current vs. Input Voltage

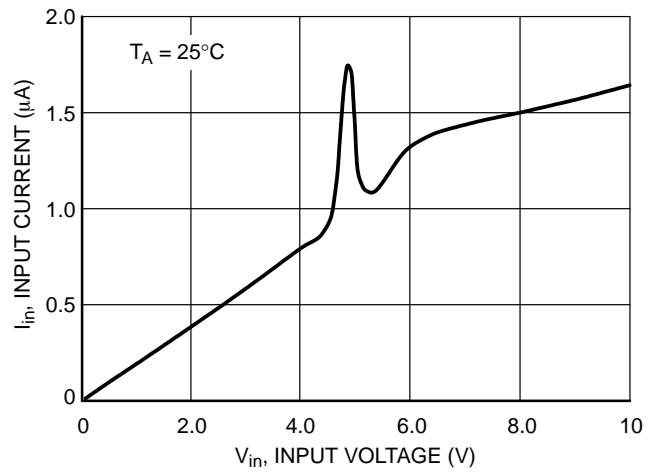


Figure 15. SCY305 Series 4.5 V Input Current vs. Input Voltage

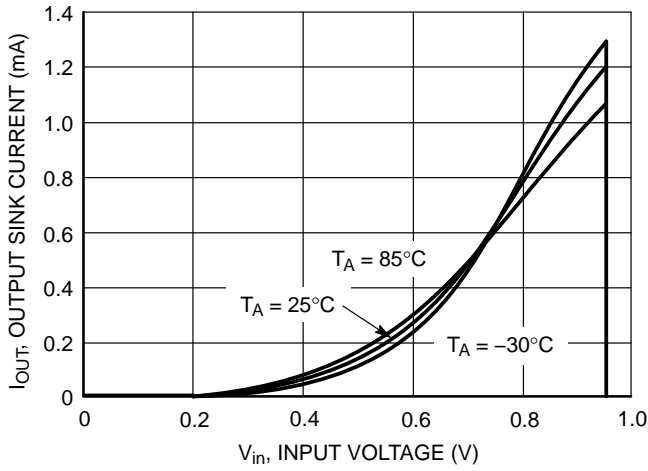


Figure 16. SCY305L Series 0.9 V Reset Output Sink Current vs. Input Voltage

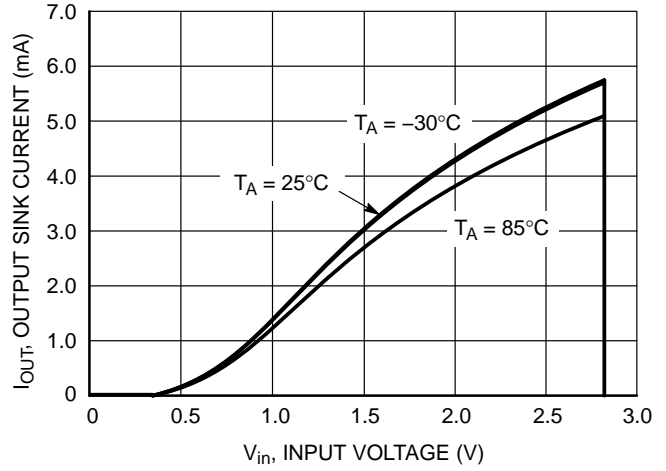


Figure 17. SCY305L Series 2.7 V Reset Output Sink Current vs. Input Voltage

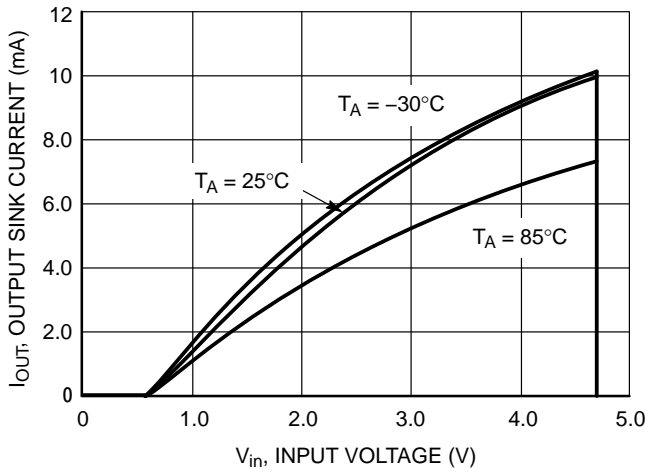


Figure 18. SCY305L Series 4.5 V Reset Output Sink Current vs. Input Voltage

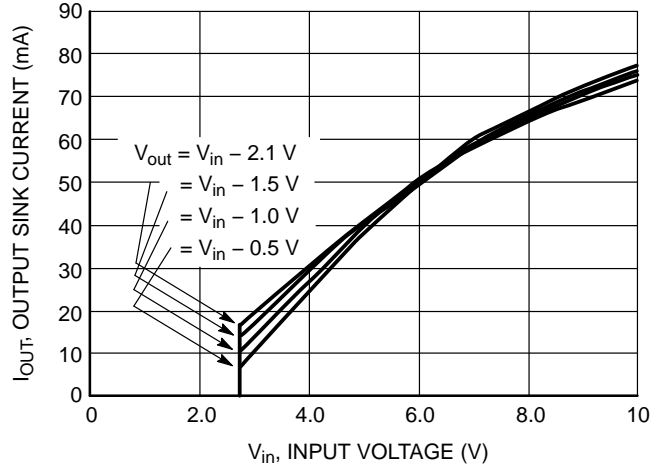


Figure 19. SCY305H Series 2.7 V Reset Output Sink Current vs. Input Voltage



OPERATING DESCRIPTION

The SCY305 series devices are second generation ultra-low current voltage detectors. Figures 20 and 21 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 21 through Figure 27 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

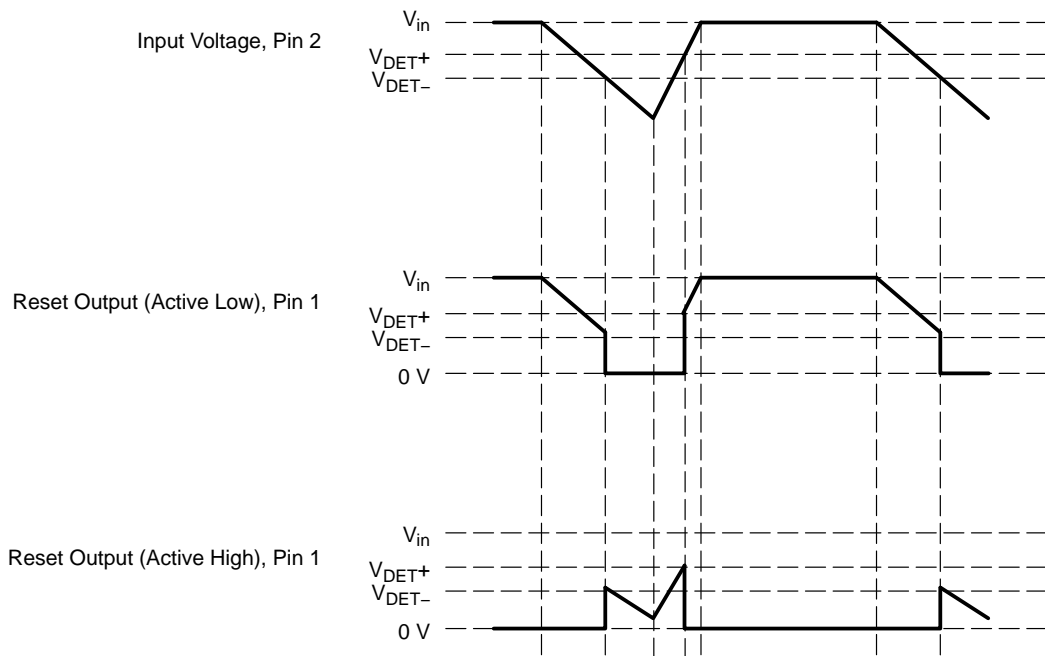


Figure 20. Timing Waveforms

APPLICATION CIRCUIT INFORMATION

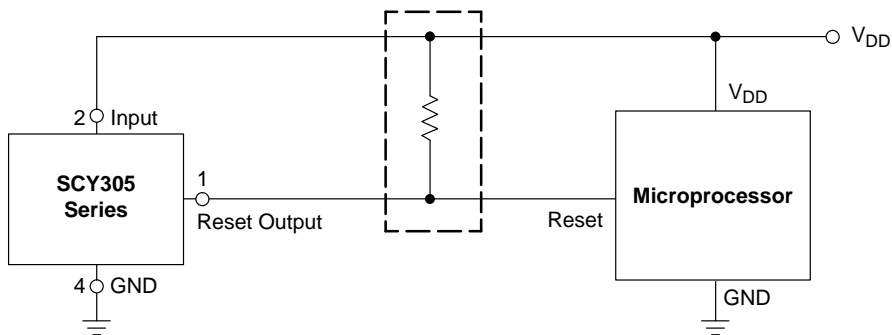


Figure 21. Microprocessor Reset Circuit

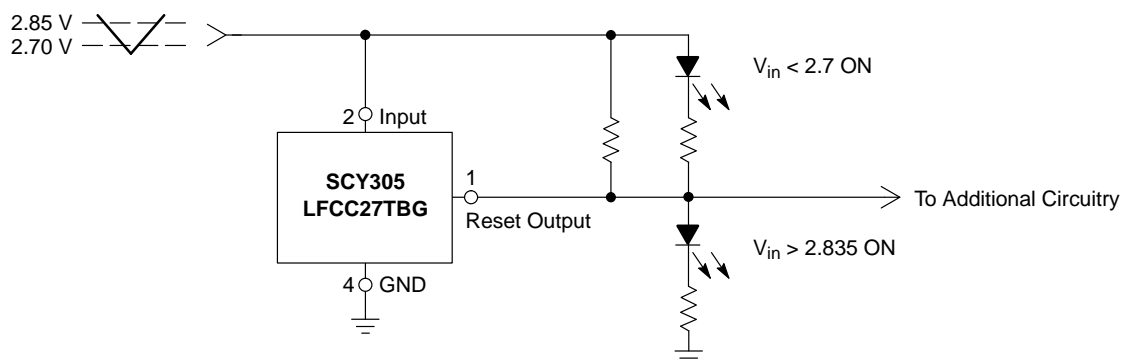


Figure 22. Battery Charge Indicator

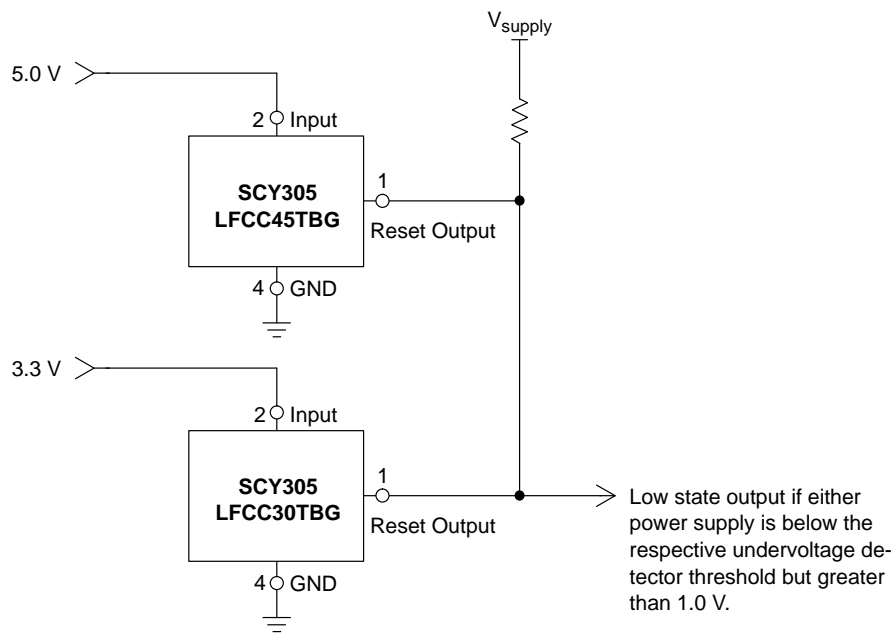


Figure 23. Dual Power Supply Undervoltage Supervision

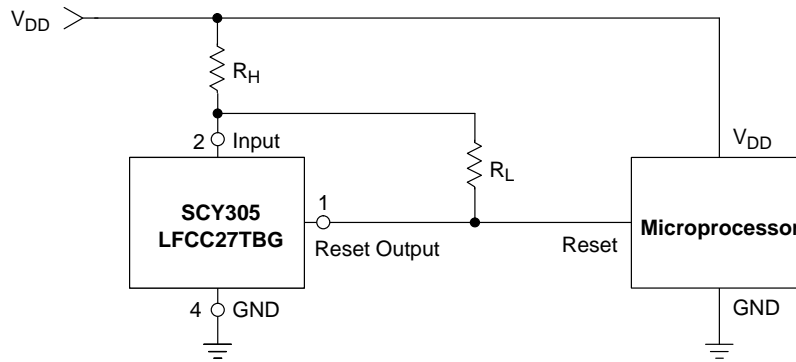


Figure 24. Microprocessor Reset Circuit with Additional Hysteresis

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

$V_{in}$  Decreasing:

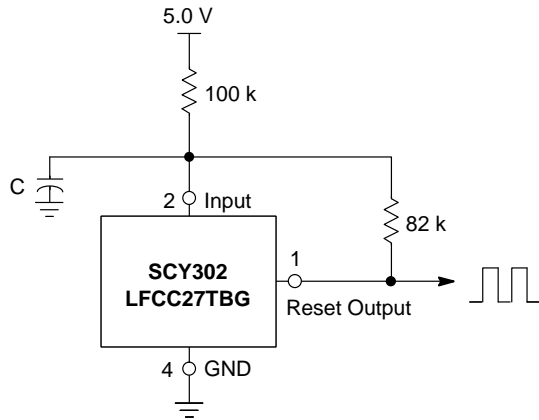
$$V_{th} = \left( \frac{R_H}{R_{in}} + 1 \right) (V_{DET-})$$

$V_{in}$  Increasing:

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

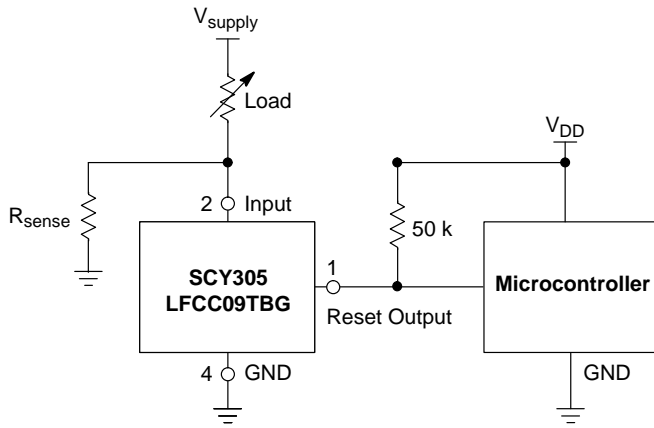
$$V_{HYS} = V_{in \text{ Increasing}} - V_{in \text{ Decreasing}}$$

Test Data				
$V_{th}$ Decreasing (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 ( $\mu F$ )	$f_{OSC}$ (kHz)	$I_Q$ ( $\mu A$ )
0.01	2590	21.77
0.1	490	21.97
1.0	52	22.07

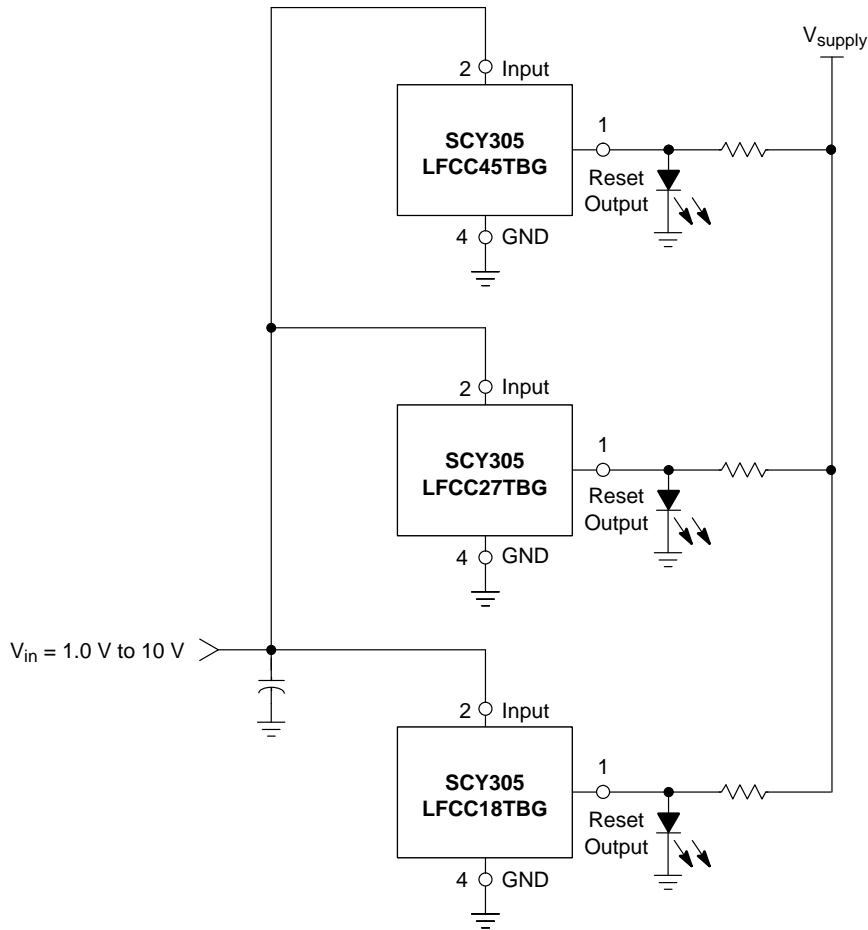
Figure 25. Simple Clock Oscillator



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 26. 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 27. LED Bar Graph

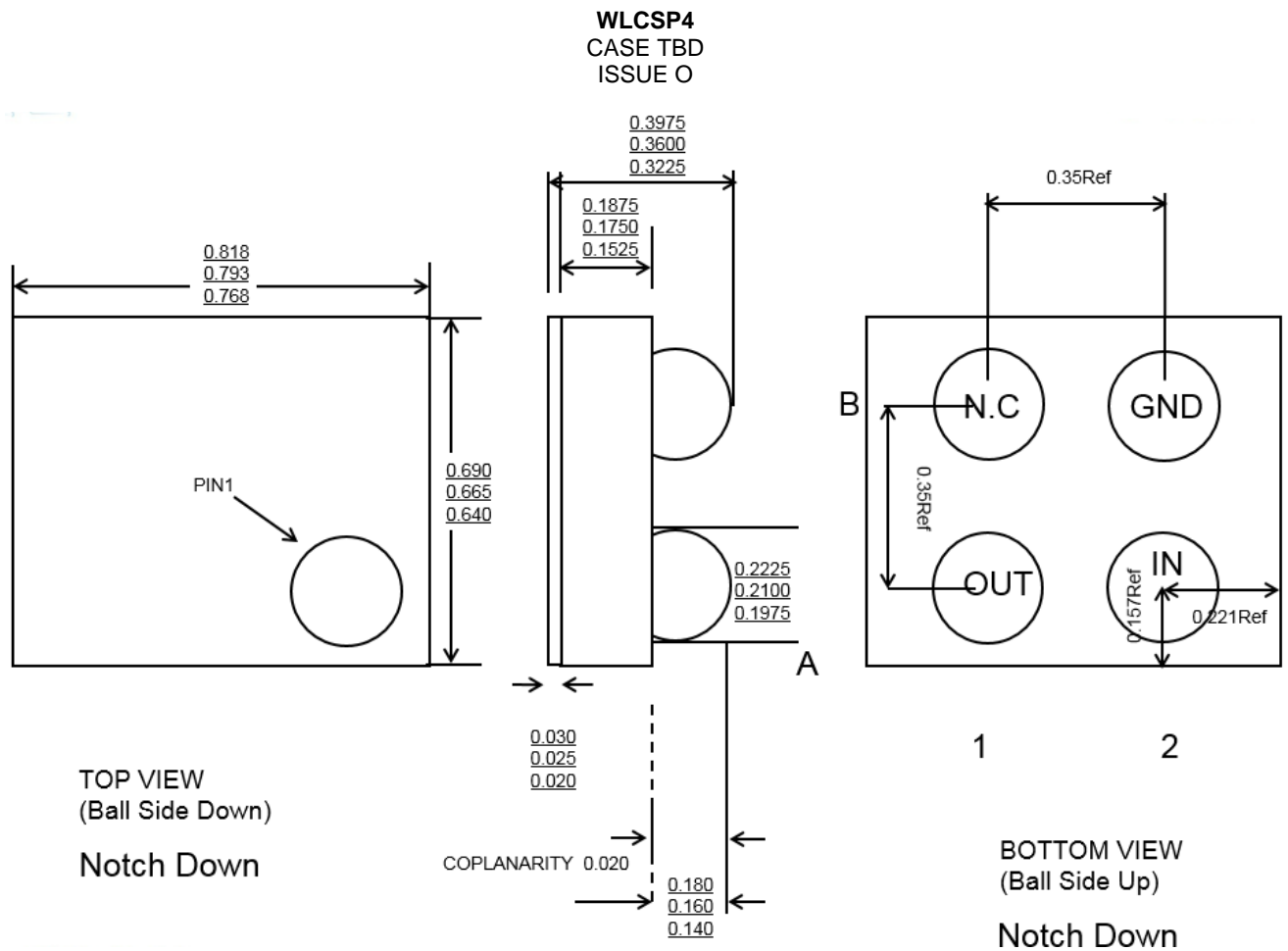
**ORDERING INFORMATION**

Device	Threshold Voltage	Output Type	Reset	Marking	Package	Shipping†	T&R Orientation
SCY305LFCC32TBG	3.2	Open Drain	Active Low	TBD	WLCSP	3000 / Tape & Reel	Pin 1 Upper Right Quadrant toward sprocket hole

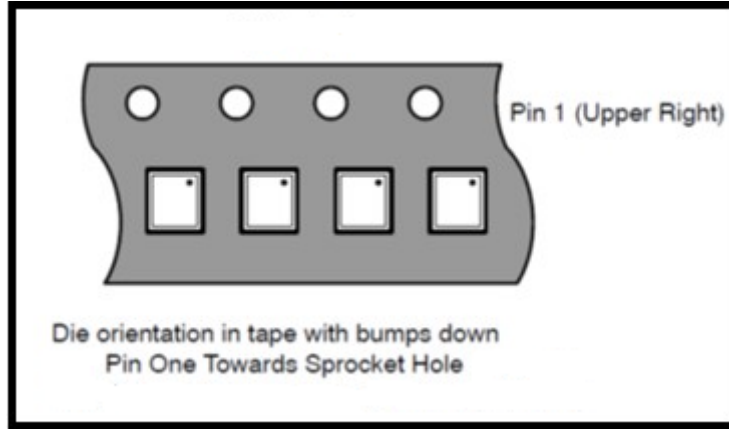
NOTE: The ordering information lists standard undervoltage thresholds with active low outputs. Additional active low threshold devices, ranging from 0.9 V to 4.9 V in 100 mV increments can be manufactured. Contact your ON Semiconductor representative for availability. The electrical characteristics of these additional devices are shown in Tables 2 and 3.

†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.

**PACKAGE DIMENSIONS**



WLCSP Tape and Reel Orientation



Package	Tape Width mm	Pitch mm (Dimension P1) (inch)	Reel Size		Devices Per Reel & Min Order Quantity	T&R Suffix
			(mm)	(in)		
WLCSP 4-Bump 0.69x0.82mm	8	2.0+/-0.05 (0.079+/-0.002)	178	7	3000	TB

ON Semiconductor and are trademarks of Semiconductor Components Industries, LLC dba ON Semiconductor or its subsidiaries in the United States and/or other countries. ON Semiconductor owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of ON Semiconductor's product/patent coverage may be accessed at [www.onsemi.com/site/pdf/Patent-Marking.pdf](http://www.onsemi.com/site/pdf/Patent-Marking.pdf). ON Semiconductor reserves the right to make changes without further notice to any products herein. ON Semiconductor makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does ON Semiconductor assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. Buyer is responsible for its products and applications using ON Semiconductor products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by ON Semiconductor. "Typical" parameters which may be provided in ON Semiconductor data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. ON Semiconductor does not convey any license under its patent rights nor the rights of others. ON Semiconductor products are not designed, intended, or authorized for use as a critical component in life support systems or any FDA Class 3 medical devices or medical devices with a same or similar classification in a foreign jurisdiction or any devices intended for implantation in the human body. Should Buyer purchase or use ON Semiconductor products for any such unintended or unauthorized application, Buyer shall indemnify and hold ON Semiconductor and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that ON Semiconductor was negligent regarding the design or manufacture of the part. ON Semiconductor is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

**PUBLICATION ORDERING INFORMATION**

**LITERATURE FULFILLMENT:**  
Literature Distribution Center for ON Semiconductor  
19521 E. 32nd Pkwy, Aurora, Colorado 80011 USA  
**Phone:** 303-675-2175 or 800-344-3860 Toll Free USA/Canada  
**Fax:** 303-675-2176 or 800-344-3867 Toll Free USA/Canada  
**Email:** [orderlit@onsemi.com](mailto:orderlit@onsemi.com)

**N. American Technical Support:** 800-282-9855 Toll Free  
USA/Canada  
**Europe, Middle East and Africa Technical Support:**  
Phone: 421 33 790 2910

**ON Semiconductor Website:** [www.onsemi.com](http://www.onsemi.com)  
**Order Literature:** <http://www.onsemi.com/orderlit>

For additional information, please contact your local Sales Representative