



ON Semiconductor®

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## Powering-Up and Resetting the 16-Bit PCA I<sup>2</sup>C-Bus I/O Expanders

### APPLICATION NOTE

#### Introduction

ON Semiconductor's new PCA family of 16-Bit I<sup>2</sup>C-Bus General Purpose I/O expanders are available with various combinations of I/O types. The PCA9535E device has push-pull I/Os. The PCA9535EC device has open-drain I/Os. The PCA9655E device also has push-pull I/Os with each I/O being pulled up to V<sub>DD</sub> by an internal 100 kΩ resistor.

For these devices to operate properly, the internal I<sup>2</sup>C/SMBus control block, and the internal registers and I/Os have to be reset and initialized properly during power-on or during a power-reset cycle.

#### Powering-On

When power is applied to V<sub>DD</sub>, an internal Power-On Reset (POR) holds the device in a reset condition. When V<sub>DD</sub> has reached the power-on-reset voltage, V<sub>POR</sub>, the reset condition is released. Upon release of the reset condition, the POR will then initialize the internal registers and I<sup>2</sup>C control block to their default states. The reset and initialization of the internal circuit blocks requires a certain amount of time to complete. The device should operate normally afterwards.

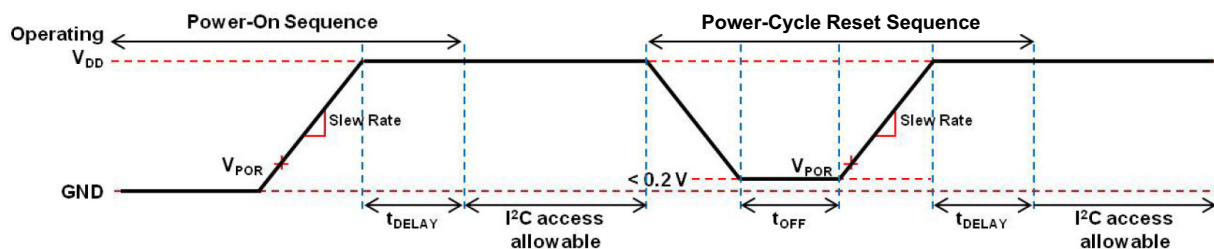
#### Power-Cycling Reset

In the event of a lockout or when the application requires it, the master may reset the device to have the device operate normally again.

Without the benefit of an external reset pin, the recommended method is to power-cycle reset the device. The power-cycle reset method works by pulling down the V<sub>DD</sub> line lower than 0.2 V for a certain amount of time, and then powering-up the device to operating V<sub>DD</sub> voltage level.

#### Recommended Power-Up and Power-Cycle Reset Profile

Proper reset and initialization of the devices is key to normal operation of the devices. Figure 1 shows the recommended power-up and power-cycle reset profile. Table 1 defines the recommended values for the slew rate, t<sub>DELAY</sub> and t<sub>OFF</sub> defined in Figure 1.



- V<sub>POR</sub> : Power-On-Reset Voltage, voltage level when initialization of I<sup>2</sup>C block and registers starts
- Slew Rate : Rate at which the V<sub>DD</sub> line rises up to operating level
- t<sub>DELAY</sub> : Wait time before starting I<sup>2</sup>C port access
- t<sub>OFF</sub> : Time for maintaining V<sub>DD</sub> below 0.2 V during a power-cycle reset

Figure 1. Recommended Power-Up and Power-Cycle Reset Profile

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**Table 1. RECOMMENDED VALUES FOR SLEW RATE** ( $t_{\text{DELAY}}$  and  $t_{\text{OFF}}$  at  $T_A = 25^\circ\text{C}$ )

Operating $V_{\text{DD}}$ (V)	Slew Rate ( $\mu\text{s/V}$ )	$t_{\text{DELAY}}$ (ms)	$t_{\text{OFF}}$ (ms)
1.65 to 1.95	120 to 1500	> 7000	> 100
2.3 to 2.7	120 to 1500	> 1400	> 50
3.0 to 3.6	120 to 1500	> 300	> 40
4.5 to 5.5	120 to 1500	> 100	> 30

NOTE: The values indicated in Table 1 are recommendations only. The values may need to be tuned for actual applications and for actual application conditions.

**Table 2. ORDERING INFORMATION FOR FEATURED DEVICES**

Device	I/O Type	Package	Shipping <sup>†</sup>
PCA9535EDWR2G	Push-Pull	SOIC-24 (Pb-Free)	1000 / Tape & Reel
PCA9535EDTR2G, NLVPCA9535EDTR2G*	Push-Pull	TSSOP-24 (Pb-Free)	2500 / Tape & Reel
PCA9535EMTTXG	Push-Pull	WQFN24 (Pb-Free)	3000 / Tape & Reel
PCA9535ECDWR2G	Open Drain	SOIC-24 (Pb-Free)	1000 / Tape & Reel
PCA9535ECDTR2G	Open Drain	TSSOP-24 (Pb-Free)	2500 / Tape & Reel
PCA9535ECMTTXG	Open Drain	WQFN24 (Pb-Free)	3000 / Tape & Reel
PCA9655EDWR2G	Push-Pull with Pullup	SOIC-24 (Pb-Free)	1000 / Tape & Reel
PCA9655EDTR2G	Push-Pull with Pullup	TSSOP-24 (Pb-Free)	2500 / Tape & Reel
PCA9655EMTTXG	Push-Pull with Pullup	WQFN24 (Pb-Free)	3000 / Tape & Reel

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


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

### Additional Information

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