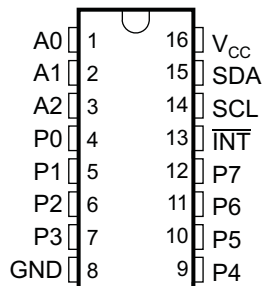
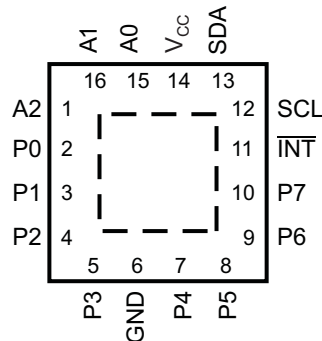
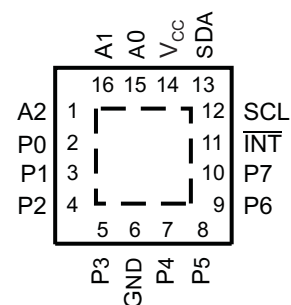


# REMOTE 8-BIT I<sup>2</sup>C AND SMBus LOW-POWER I/O EXPANDER WITH INTERRUPT OUTPUT AND CONFIGURATION REGISTERS

Check for Samples: [PCA9534A](#)

## FEATURES

- Low Standby Current Consumption of 1  $\mu$ A Max
- I<sup>2</sup>C to Parallel Port Expander
- Open-Drain Active-Low Interrupt Output
- Operating Power-Supply Voltage Range of 2.3 V to 5.5 V
- 5-V Tolerant I/O Ports
- 400-kHz Fast I<sup>2</sup>C Bus
- Three Hardware Address Pins Allow Up to Eight Devices on the I<sup>2</sup>C/SMBus
- Allows Up to 16 Devices on the I<sup>2</sup>C/SMBus When Used in Conjunction with the [PCA9534](#)  
See [Table 1](#) for I<sup>2</sup>C Expander offerings
- Input/Output Configuration Register
- Polarity Inversion Register
- Internal Power-On Reset
- Power-Up With All Channels Configured as Inputs
- No Glitch on Power-Up
- Noise Filter on SCL/SDA Inputs
- Latched Outputs With High-Current Drive  
Maximum Capability for Directly Driving LEDs
- Latch-Up Performance Exceeds 100 mA Per JESD 78, Class II
- ESD Protection Exceeds JESD 22
  - 2000-V Human-Body Model (A114-A)
  - 200-V Machine Model (A115-A)
  - 1000-V Charged-Device Model (C101)

DB, DBQ, DGV, DW, OR PW PACKAGE  
(TOP VIEW)

RGV PACKAGE  
(TOP VIEW)

RGT PACKAGE  
(TOP VIEW)


## DESCRIPTION

This 8-bit I/O expander for the two-line bidirectional bus (I<sup>2</sup>C) is designed for 2.3-V to 5.5-V  $V_{CC}$  operation. It provides general-purpose remote I/O expansion for most microcontroller families via the I<sup>2</sup>C interface [serial clock (SCL), serial data (SDA)].

The PCA9534A consists of one 8-bit configuration (input or output selection), input port, output port, and polarity inversion (active high or active low) register. At power on, the I/Os are configured as inputs. However, the system master can enable the I/Os as either inputs or outputs by writing to the I/O configuration bits. The data for each input or output is kept in the corresponding input or output register. The polarity of the input port register can be inverted with the polarity inversion register. All registers can be read by the system master.

The system master can reset the PCA9534A in the event of a timeout or other improper operation by utilizing the power-on reset feature, which puts the registers in their default state and initializes the I<sup>2</sup>C/SMBus state machine.

The PCA9534A open-drain interrupt ( $\overline{INT}$ ) output is activated when any input state differs from its corresponding input port register state and is used to indicate to the system master that an input state has changed.



Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

$\overline{\text{INT}}$  can be connected to the interrupt input of a microcontroller. By sending an interrupt signal on this line, the remote I/O can inform the microcontroller if there is incoming data on its ports without having to communicate via the I<sup>2</sup>C bus. Thus, the PCA9534A can remain a simple slave device.

The device's outputs (latched) have high-current drive capability for directly driving LEDs. It has low current consumption.

Three hardware pins (A0, A1, and A2) are used to program and vary the fixed I<sup>2</sup>C address and allow up to eight devices to share the same I<sup>2</sup>C bus or SMBus.

The PCA9534A is pin-to-pin and I<sup>2</sup>C address compatible with the PCF8574A. However, software changes are required due to the enhancements in the PCA9534A over the PCF8574A.

The PCA9534A is a low-power version of the PCA9554A. The only difference between the PCA9534A and PCA9554A is that the PCA9534A eliminates an internal I/O pullup resistor, which dramatically reduces power consumption in the standby mode when the I/Os are held low.

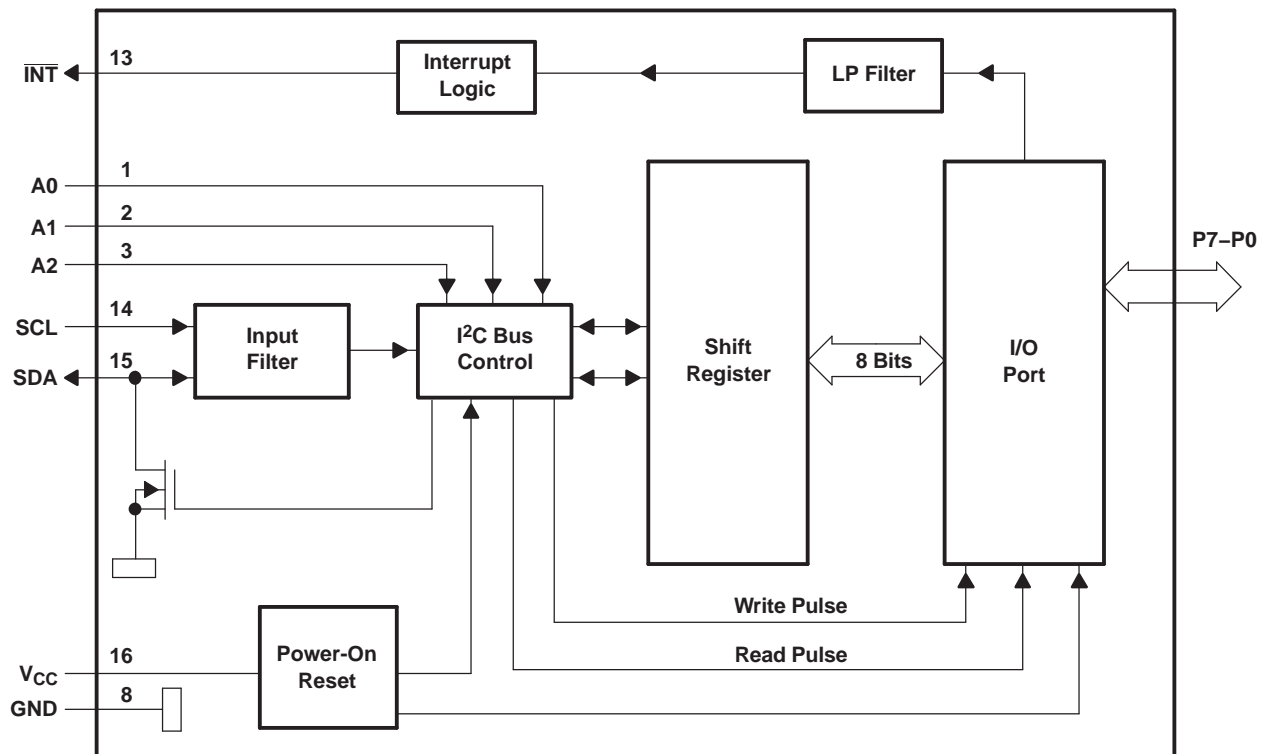
The PCA9534A and PCA9534 are identical, except for their fixed I<sup>2</sup>C address. This allows for up to 16 of these devices (8 of each) on the same I<sup>2</sup>C bus.

**Table 1. I<sup>2</sup>C Expander Offerings**

DEVICE	MAX FREQUENCY	I <sup>2</sup> C ADDRESS	V <sub>CC</sub> RANGE	NO. OF GPIOs	INTERRUPT OUTPUT	RESET INPUT	CONFIGURATION REGISTERS	5-V TOLERANT	PUSH-PULL I/O TYPE	OPEN-DRAIN I/O TYPE	COMMENT
<a href="#">TCA6408</a>	400	0100 00x	1.65 to 5.5	8	Yes	Yes	Yes	Yes	Yes	No	Power on reset, t <sub>r</sub> (fall time) > 100 ms and t <sub>r</sub> (ramp time) < 10 ms
<a href="#">TCA6408</a>	400	0100 00x	1.65 to 5.5	8	Yes	Yes	Yes	Yes	Yes	No	Unrestricted power on reset ramp/fall time. Both t <sub>r</sub> (fall time) and TRT (ramp time) can be between 0.1 ms and 2000 ms
<a href="#">TCA6416</a>	400	0100 00x	1.65 to 5.5	16	Yes	Yes	Yes	Yes	Yes	No	Power on reset, t <sub>r</sub> (fall time) > 100 ms and TRT (ramp time) < 10 ms
<a href="#">TCA6416A</a>	400	0100 00x	1.65 to 5.5	16	Yes	Yes	Yes	Yes	Yes	No	Unrestricted power on reset ramp/fall time. Both t <sub>r</sub> (fall time) and TRT (ramp time) can be between 0.1 ms and 2000ms
<a href="#">TCA6424</a>	400	0100 00x	1.65 to 5.5	24	Yes	Yes	Yes	Yes	Yes	No	Power on reset, t <sub>r</sub> (fall time) > 100 ms and TRT (ramp time) < 10 ms
<a href="#">TCA9535</a>	400	0100 xxx	1.65 to 5.5	16	Yes	No	Yes	Yes	Yes	No	
<a href="#">TCA9539</a>	400	1110 1xx	1.65 to 5.5	16	Yes	Yes	Yes	Yes	Yes	No	
<a href="#">TCA9555</a>	400	0100 xxx	1.65 to 5.5	16	Yes	No	Yes	Yes	Yes	No	
<a href="#">PCA6107</a>	400	0011 xxx	2.3 to 5.5	8	Yes	Yes	Yes	Yes	Yes P1—P7 bits	Yes P0 bit	One open drain output; eight push pull outputs
<a href="#">PCA9534</a>	400	0100 xxx	2.3 to 5.5	8	Yes	No	Yes	Yes	Yes	No	PCA9534 has a different slave address as the PCA9534A, allowing up to 16 devices '9534 type devices on the same I <sup>2</sup> C bus
<a href="#">PCA9534A</a>	400	0111 xxx	2.3 to 5.5	8	Yes	No	Yes	Yes	Yes	No	PCA9534A has a different slave address as the PCA9534, allowing up to 16 devices '9534 type devices on the same I <sup>2</sup> C bus
<a href="#">PCA9535</a>	400	0100 xxx	2.3 to 5.5	16	Yes	No	Yes	Yes	Yes	No	
<a href="#">PCA9536</a>	400	1000 001	2.3 to 5.5	4	No	No	Yes	Yes	Yes	No	
<a href="#">PCA9538</a>	400	1110 0xx	2.3 to 5.5	8	Yes	Yes	Yes	Yes	Yes	No	
<a href="#">PCA9539</a>	400	1110 1xx	2.3 to 5.5	16	Yes	Yes	Yes	Yes	Yes	No	
<a href="#">PCA9554</a>	400	0100 xxx	2.3 to 5.5	8	Yes	No	Yes	Yes	Yes	No	
<a href="#">PCA9554A</a>	400	0111 xxx	2.3 to 5.5	8	Yes	No	Yes	Yes	Yes	No	
<a href="#">PCA9555</a>	400	0100 xxx	2.3 to 5.5	16	Yes	No	Yes	Yes	Yes	No	
<a href="#">PCA9557</a>	400	0011 xxx	2.3 to 5.5	8	No	Yes	Yes	Yes	Yes	Yes	
<a href="#">PCF8574</a>	400	0100 xxx	2.5 to 6.0	8	Yes	No	No	Yes	Yes	No	PCA8574 has a different slave address as the PCA8574A, allowing up to 16 devices '9534 type devices on the same I <sup>2</sup> C bus
<a href="#">PCF8574A</a>	400	0111 xxx	2.5 to 6.0	8	Yes	No	No	Yes	Yes	No	PCA8574A has a different slave address as the PCA8574, allowing up to 16 devices '9534 type devices on the same I <sup>2</sup> C bus
<a href="#">PCF8575</a>	400	0100 xxx	2.5 to 5.5	16	Yes	No	No	Yes	Yes	No	
<a href="#">PCF8575C</a>	400	0100 xxx	4.5 to 5.5	16	Yes	No	No	Yes	No	Yes	

**Table 2. TERMINAL FUNCTIONS**

NO.			NAME	DESCRIPTION
	QSOP (DBQ), SOIC (DW), SSOP (DB), TSSOP (PW), AND TVSOP (DGV)	QFN (RGT) AND QFN (RGV)		
1		15	A0	Address input. Connect directly to V <sub>CC</sub> or ground.
2		16	A1	Address input. Connect directly to V <sub>CC</sub> or ground.
3		1	A2	Address input. Connect directly to V <sub>CC</sub> or ground.
4		2	P0	P-port input/output. Push-pull design structure.
5		3	P1	P-port input/output. Push-pull design structure.
6		4	P2	P-port input/output. Push-pull design structure.
7		5	P3	P-port input/output. Push-pull design structure.
8		6	GND	Ground
9		7	P4	P-port input/output. Push-pull design structure.
10		8	P5	P-port input/output. Push-pull design structure.
11		9	P6	P-port input/output. Push-pull design structure.
12		10	P7	P-port input/output. Push-pull design structure.
13		11	$\overline{\text{INT}}$	Interrupt output. Connect to V <sub>CC</sub> through a pullup resistor.
14		12	SCL	Serial clock bus. Connect to V <sub>CC</sub> through a pullup resistor.
15		13	SDA	Serial data bus. Connect to V <sub>CC</sub> through a pullup resistor.
16		14	V <sub>CC</sub>	Supply voltage

**Figure 1. LOGIC DIAGRAM (POSITIVE LOGIC)**

- A. Pin numbers shown are for DB, DBQ, DGV, DW, or PW package.  
 B. All I/Os are set to inputs at reset.

The diagram illustrates the internal logic of the output port of the 6805 microprocessor. It shows the following components and connections:

- Configuration Register:** A D-type flip-flop (FF) with inputs for "Data From Shift Register" (D), "Write Configuration Pulse" (Ck), and "Q". Its output (Q) is connected to the "Output Port Register" and the "Polarity Inversion Register".
- Output Port Register:** A D-type flip-flop (FF) with inputs for "Data From Shift Register" (D), "Write Pulse" (Ck), and "Q". Its output (Q) is connected to the "Input Port Register" and the "Polarity Inversion Register".
- Input Port Register:** A D-type flip-flop (FF) with inputs for "Read Pulse" (Ck), "Data From Shift Register" (D), and "Q". Its output (Q) is connected to the "Polarity Inversion Register".
- Polarity Inversion Register:** A D-type flip-flop (FF) with inputs for "Data From Shift Register" (D), "Write Polarity Pulse" (Ck), and "Q". Its output (Q) is connected to the "Polarity Register Data" output.
- Output Port:** The output of the "Output Port Register" (Q) is connected to the "Output Port Register Data" output. It is also connected to the "P0 to P7" pins, which are protected by an "ESD Protection Diode" connected to "GND".
- Transistor Q1:** A transistor connected to the "Output Port Register" (Q) and the "Polarity Inversion Register" (Q). Its gate is connected to the "Output Port Register" (Q) and the "Polarity Inversion Register" (Q). Its source is connected to "GND" and its drain is connected to "VCC".
- Logic Gates:** Two 3-input AND gates are used to combine signals from the "Configuration Register" (Q), "Output Port Register" (Q), and "Polarity Inversion Register" (Q) to drive the gates of transistors Q1 and Q2.

## I/O Port

If the I/O is configured as an output, Q1 or Q2 is enabled, depending on the state of the output port register. In this case, there are low-impedance paths between the I/O pin and either  $V_{CC}$  or GND. The external voltage applied to this I/O pin should not exceed the recommended levels for proper operation.

## I<sup>2</sup>C Interface

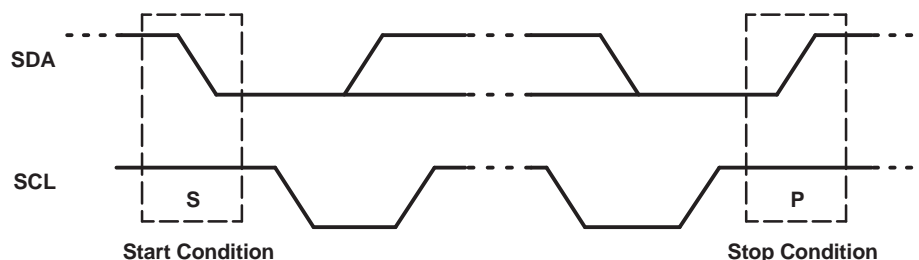
<sup>2</sup>I<sup>2</sup>C communication with this device is initiated by a master sending a start condition, a high-to-low transition on the SDA input/output while the SCL input is high (see [Figure 2](#)). After the start condition, the device address byte is sent, MSB first, including the data direction bit (R/W).

On the I<sup>2</sup>C bus, only one data bit is transferred during each clock pulse. The data on the SDA line must remain stable during the high pulse of the clock period, as changes in the data line at this time are interpreted as control commands (start or stop) (see [Figure 3](#)).

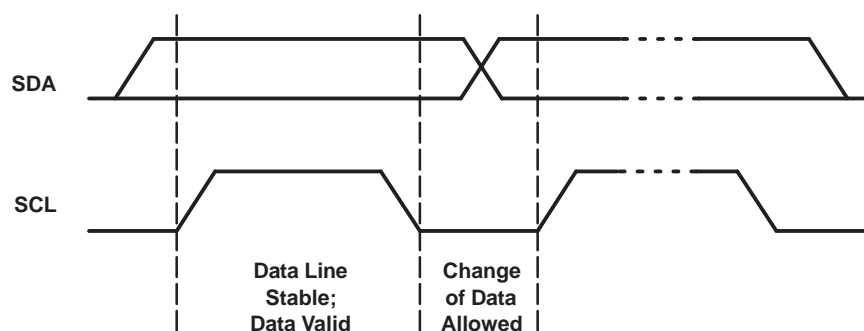
[Submit Documentation Feedback](#)

Any number of data bytes can be transferred from the transmitter to receiver between the start and the stop conditions. Each byte of eight bits is followed by one ACK bit. The transmitter must release the SDA line before the receiver can send an ACK bit. The device that acknowledges must pull down the SDA line during the ACK clock pulse so that the SDA line is stable low during the high pulse of the ACK-related clock period (see [Figure 4](#)). When a slave receiver is addressed, it must generate an ACK after each byte is received. Similarly, the master must generate an ACK after each byte that it receives from the slave transmitter. Setup and hold times must be met to ensure proper operation.

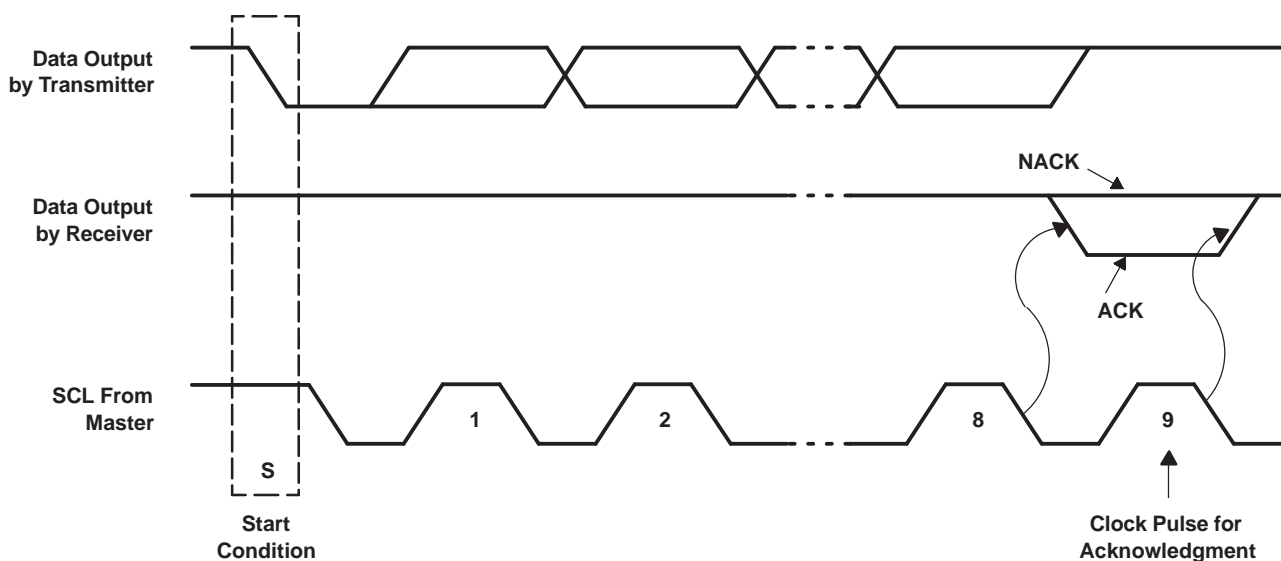
A master receiver will signal an end of data to the slave transmitter by not generating an acknowledge (NACK) after the last byte has been clocked out of the slave. This is done by the master receiver by holding the SDA line high. In this event, the transmitter must release the data line to enable the master to generate a stop condition.



**Figure 2. Definition of Start and Stop Conditions**



**Figure 3. Bit Transfer**



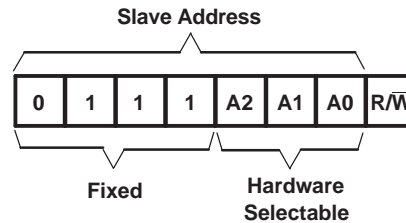
**Figure 4. Acknowledgment on I²C Bus**

**Table 3. Interface Definition**

BYTE	BIT							
	7 (MSB)	6	5	4	3	2	1	0 (LSB)
I <sup>2</sup> C slave address	L	H	H	H	A2	A1	A0	R/ $\overline{W}$
Px I/O data bus	P7	P6	P5	P4	P3	P2	P1	P0

## Device Address

Figure 5 shows the address byte of the PCA9534A.



**Figure 5. PCA9534A Address**

**Table 4. Address Reference**

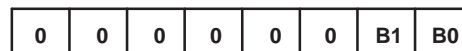
INPUTS			I <sup>2</sup> C BUS SLAVE ADDRESS
A2	A1	A0	
L	L	L	56 (decimal), 38 (hexadecimal)
L	L	H	57 (decimal), 39 (hexadecimal)
L	H	L	58 (decimal), 3A (hexadecimal)
L	H	H	59 (decimal), 3B (hexadecimal)
H	L	L	60 (decimal), 3C (hexadecimal)
H	L	H	61 (decimal), 3D (hexadecimal)
H	H	L	62 (decimal), 3E (hexadecimal)
H	H	H	63 (decimal), 3F (hexadecimal)

The last bit of the slave address defines the operation (read or write) to be performed. When it is high (1), a read is selected, while a low (0) selects a write operation.

## Control Register and Command Byte

Following the successful acknowledgment of the address byte, the bus master sends a command byte which is stored in the control register in the PCA9534A. Two bits of this command byte state the operation (read or write) and the internal register (input, output, polarity inversion or configuration) that will be affected. This register can be written or read through the I<sup>2</sup>C bus. The command byte is sent only during a write transmission.

Once a command byte has been sent, the register that was addressed continues to be accessed by reads until a new command byte has been sent.



**Figure 6. Control Register Bits**

**Table 5. Command Byte**

CONTROL REGISTER BITS		COMMAND BYTE (HEX)	REGISTER	PROTOCOL	POWER-UP DEFAULT
B1	B0				
0	0	0x00	Input Port	Read byte	xxxx xxxx
0	1	0x01	Output Port	Read/write byte	1111 1111
1	0	0x02	Polarity Inversion	Read/write byte	0000 0000
1	1	0x03	Configuration	Read/write byte	1111 1111

## Register Descriptions

The input port register (register 0) reflects the incoming logic levels of the pins, regardless of whether the pin is defined as an input or an output by the configuration register. It only acts on read operation. Writes to these registers have no effect. The default value, X, is determined by the externally applied logic level.

Before a read operation, a write transmission is sent with the command byte to let the I<sup>2</sup>C device know that the input port register will be accessed next.

**Table 6. Register 0 (Input Port Register)**

BIT	I7	I6	I5	I4	I3	I2	I1	I0
DEFAULT	X	X	X	X	X	X	X	X

The output port register (register 1) shows the outgoing logic levels of the pins defined as outputs by the configuration register. Bit values in this register have no effect on pins defined as inputs. In turn, reads from this register reflect the value that is in the flip-flop controlling the output selection, not the actual pin value.

**Table 7. Register 1 (Output Port Register)**

BIT	O7	O6	O5	O4	O3	O2	O1	O0
DEFAULT	1	1	1	1	1	1	1	1

The polarity inversion register (register 2) allows polarity inversion of pins defined as inputs by the configuration register. If a bit in this register is set (written with 1), the corresponding port pin polarity is inverted. If a bit in this register is cleared (written with a 0), the corresponding port pin original polarity is retained.

**Table 8. Register 2 (Polarity Inversion Register)**

BIT	N7	N6	N5	N4	N3	N2	N1	N0
DEFAULT	0	0	0	0	0	0	0	0

The configuration register (register 3) configures the directions of the I/O pins. If a bit in this register is set to 1, the corresponding port pin is enabled as an input with high-impedance output driver. If a bit in this register is cleared to 0, the corresponding port pin is enabled as an output.

**Table 9. Register 3 (Configuration Register)**

BIT	C7	C6	C5	C4	C3	C2	C1	C0
DEFAULT	1	1	1	1	1	1	1	1

## Power-On Reset

When power (from 0 V) is applied to  $V_{CC}$ , an internal power-on reset holds the PCA9534A in a reset condition until  $V_{CC}$  has reached  $V_{POR}$ . At that point, the reset condition is released and the PCA9534A registers and I<sup>2</sup>C/SMBus state machine initialize to their default states. After that,  $V_{CC}$  must be lowered to below 0.2 V and then back up to the operating voltage for a power-reset cycle.



## Interrupt Output ( $\overline{\text{INT}}$ )

An interrupt is generated by any rising or falling edge of the port inputs in the input mode. After time,  $t_{iv}$ , the signal  $\overline{\text{INT}}$  is valid. Resetting the interrupt circuit is achieved when data on the port is changed to the original setting, data is read from the port that generated the interrupt. Resetting occurs in the read mode at the acknowledge (ACK) or not acknowledge (NACK) bit after the rising edge of the SCL signal.

Interrupts that occur during the ACK or NACK clock pulse can be lost (or be very short) due to the resetting of the interrupt during this pulse. Each change of the I/Os after resetting is detected and is transmitted as  $\overline{\text{INT}}$ . Writing to another device does not affect the interrupt circuit, and a pin configured as an output cannot cause an interrupt. Changing an I/O from an output to an input may cause a false interrupt to occur, if the state of the pin does not match the contents of the Input Port register. Because each 8-pin port is read independently, the interrupt caused by port 0 is not cleared by a read of port 1 or vice versa.

The  $\overline{\text{INT}}$  output has an open-drain structure and requires pullup resistor to  $V_{CC}$ .

## Bus Transactions

Data is exchanged between the master and PCA9534A through write and read commands.

### Writes

Data is transmitted to the PCA9534A by sending the device address and setting the least-significant bit to a logic 0 (see Figure 5 for device address). The command byte is sent after the address and determines which register receives the data that follows the command byte (see Figure 7 and Figure 8). There is no limitation on the number of data bytes sent in one write transmission.

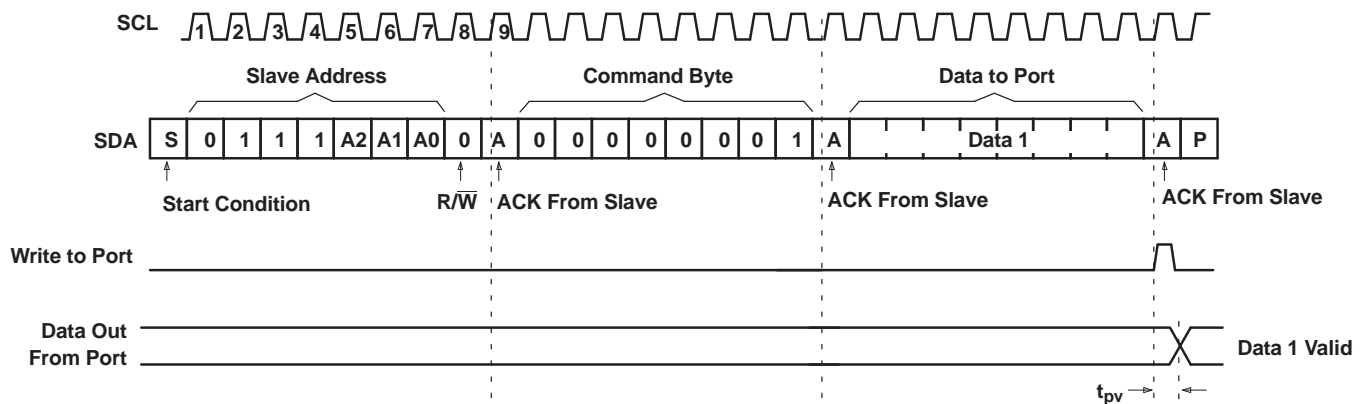


Figure 7. Write to Output Port Register

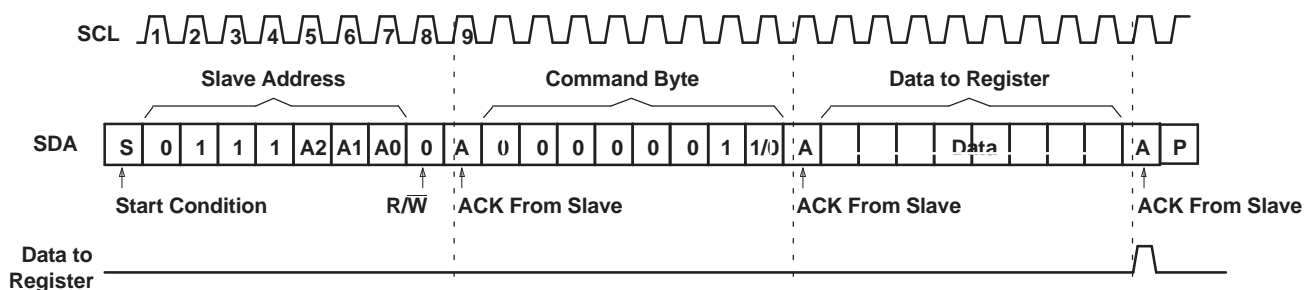


Figure 8. Write to Configuration or Polarity Inversion Registers

## Reads

The bus master first must send the PCA9534A address with the least-significant bit set to a logic 0 (see Figure 5 for device address). The command byte is sent after the address and determines which register is accessed. After a restart, the device address is sent again but, this time, the least-significant bit is set to a logic 1. Data from the register defined by the command byte then is sent by the PCA9534A (see Figure 9 and Figure 10). After a restart, the value of the register defined by the command byte matches the register being accessed when the restart occurred. Data is clocked into the register on the rising edge of the ACK clock pulse. There is no limitation on the number of data bytes received in one read transmission, but when the final byte is received, the bus master must not acknowledge the data.

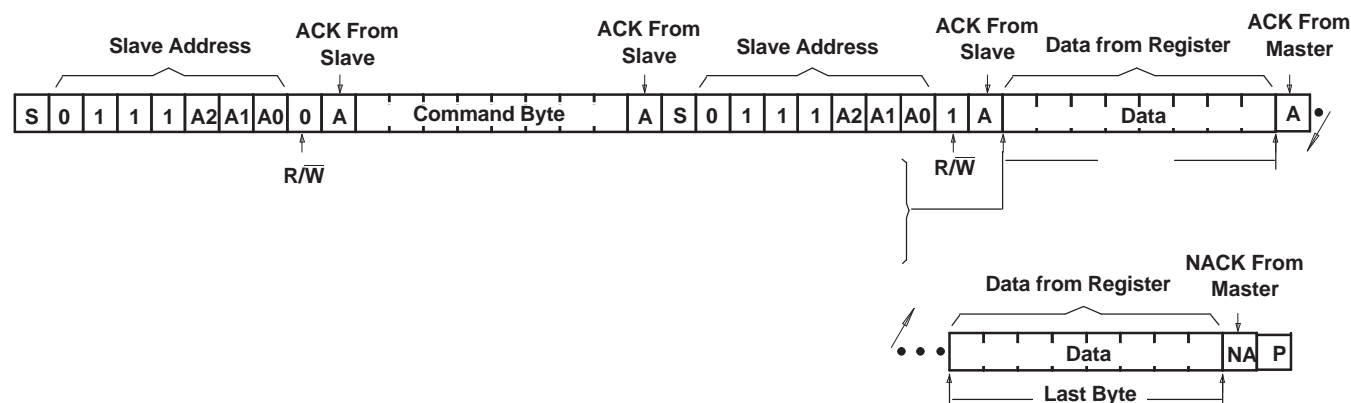
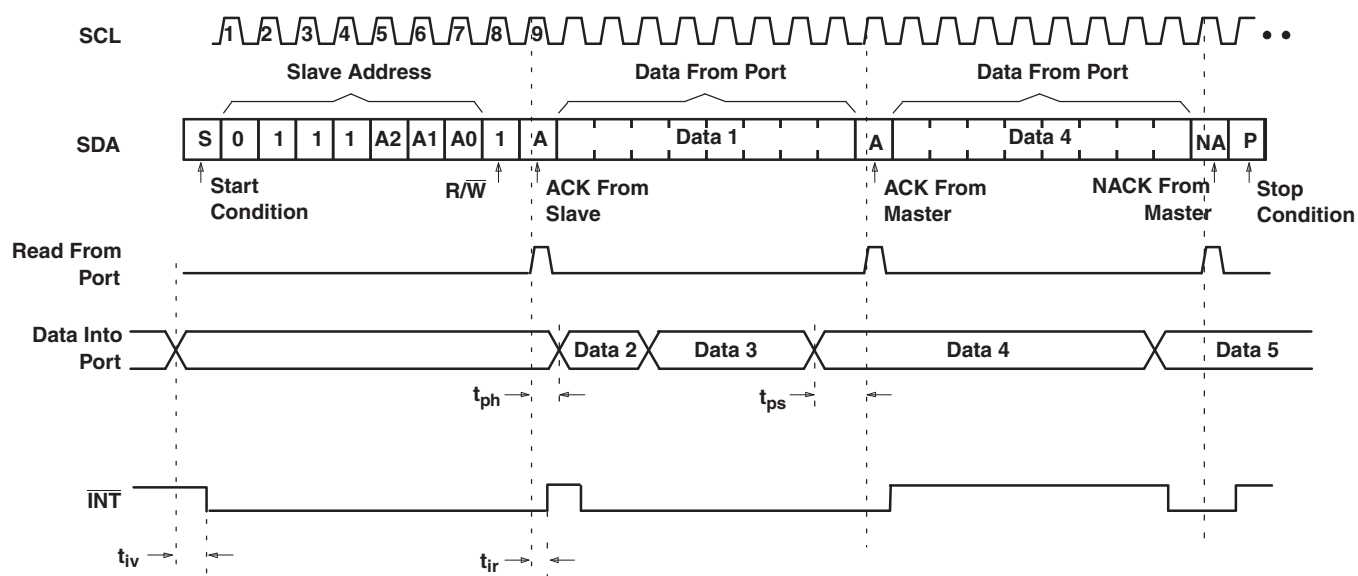


Figure 9. Read From Register



- This figure assumes that the command byte has previously been programmed with 00h.
- Transfer of data can be stopped at any moment by a stop condition.
- This figure eliminates the command byte transfer, a restart and slave address call between the initial slave address call and the actual data transfer from the P Port. See Figure 9 for these details.

Figure 10. Read Input Port Register

## ABSOLUTE MAXIMUM RATINGS<sup>(1)</sup>

over operating free-air temperature range (unless otherwise noted)

			MIN	MAX	UNIT
V <sub>CC</sub>	Supply voltage range		–0.5	6	V
V <sub>I</sub>	Input voltage range <sup>(2)</sup>		–0.5	6	V
V <sub>O</sub>	Output voltage range <sup>(2)</sup>		–0.5	6	V
I <sub>IK</sub>	Input clamp current	V <sub>I</sub> < 0		–20	mA
I <sub>OK</sub>	Output clamp current	V <sub>O</sub> < 0		–20	mA
I <sub>IOK</sub>	Input/output clamp current	V <sub>O</sub> < 0 or V <sub>O</sub> > V <sub>CC</sub>		±20	mA
I <sub>OL</sub>	Continuous output low current	V <sub>O</sub> = 0 to V <sub>CC</sub>		50	mA
I <sub>OH</sub>	Continuous output high current	V <sub>O</sub> = 0 to V <sub>CC</sub>		–50	mA
I <sub>CC</sub>	Continuous current through GND			–250	mA
	Continuous current through V <sub>CC</sub>			160	
θ <sub>JA</sub>	Package thermal impedance <sup>(3)</sup>	DB package		82	°C/W
		DBQ package		90	
		DGV package		86	
		DW package		46	
		N package		67	
		PW package		88	
		RGT package		TBD	
		RGV package		51	
T <sub>stg</sub>	Storage temperature range		–65	150	°C

- (1) Stresses beyond those listed under "absolute maximum ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
- (2) The input negative-voltage and output voltage ratings may be exceeded if the input and output current ratings are observed.
- (3) The package thermal impedance is calculated in accordance with JESD 51-7.

## RECOMMENDED OPERATING CONDITIONS

			MIN	MAX	UNIT
V <sub>CC</sub>	Supply voltage		2.3	5.5	V
V <sub>IH</sub>	High-level input voltage	SCL, SDA	0.7 × V <sub>CC</sub>	5.5	V
		A2–A0, P7–P0	2	5.5	
V <sub>IL</sub>	Low-level input voltage	SCL, SDA	–0.5	0.3 × V <sub>CC</sub>	V
		A2–A0, P7–P0	–0.5	0.8	
I <sub>OH</sub>	High-level output current	P7–P0		–10	mA
I <sub>OL</sub>	Low-level output current	P7–P0		25	mA
T <sub>A</sub>	Operating free-air temperature		–40	85	°C

## ELECTRICAL CHARACTERISTICS

over operating free-air temperature range (unless otherwise noted)

PARAMETER		TEST CONDITIONS	V <sub>CC</sub>	MIN	TYP <sup>(1)</sup>	MAX	UNIT
V <sub>IK</sub>	Input diode clamp voltage	I <sub>I</sub> = –18 mA	2.3 V to 5.5 V	–1.2			V
V <sub>POR</sub>	Power-on reset voltage	V <sub>I</sub> = V <sub>CC</sub> or GND, I <sub>O</sub> = 0	V <sub>POR</sub>		1.5	1.65	V
V <sub>OH</sub>	P-port high-level output voltage <sup>(2)</sup>	I <sub>OH</sub> = –8 mA	2.3 V	1.8			V
			3 V	2.6			
			4.5 V	4.1			
			4.75 V	4.1			
		I <sub>OH</sub> = –10 mA	2.3 V	1.7			
			3 V	2.5			
			4.5 V	4			
			4.75 V	4			
I <sub>OL</sub>	SDA	V <sub>OL</sub> = 0.4 V	2.3 V to 5.5 V	3	8		mA
	P port <sup>(3)</sup>	V <sub>OL</sub> = 0.5 V	2.3 V	8	10		
			3 V	8	14		
			4.5 V	8	17		
			4.75 V	8	35		
		V <sub>OL</sub> = 0.7 V	2.3 V	10	13		
			3 V	10	19		
			4.5 V	10	24		
			4.75 V	10	45		
	$\overline{\text{INT}}$	V <sub>OL</sub> = 0.4 V	2.3 V to 5.5 V	3	10		
I <sub>I</sub>	SCL, SDA	V <sub>I</sub> = V <sub>CC</sub> or GND	2.3 V to 5.5 V			±1	μA
	A2–A0					±1	
I <sub>IH</sub>	P port	V <sub>I</sub> = V <sub>CC</sub>	2.3 V to 5.5 V			1	μA
I <sub>IL</sub>	P port	V <sub>I</sub> = GND	2.3 V to 5.5 V			–1	μA
I <sub>CC</sub>	Operating mode	V <sub>I</sub> = V <sub>CC</sub> or GND, I <sub>O</sub> = 0, I/O = inputs, f <sub>scl</sub> = 400 kHz	5.5 V		104	175	μA
			3.6 V		50	90	
			2.7 V		20	65	
		V <sub>I</sub> = V <sub>CC</sub> or GND, I <sub>O</sub> = 0, I/O = inputs, f <sub>scl</sub> = 100 kHz	5.5 V		60	150	
			3.6 V		15	40	
			2.7 V		8	20	
	Standby mode	V <sub>I</sub> = GND, I <sub>O</sub> = 0, I/O = inputs, f <sub>scl</sub> = 0 kHz	5.5 V		0.25	1	
			3.6 V		0.2	0.9	
			2.7 V		0.1	0.8	
ΔI <sub>CC</sub>	Additional current in standby mode	One input at V <sub>CC</sub> – 0.6 V, Other inputs at V <sub>CC</sub> or GND	2.3 V to 5.5 V			1.5	mA
		All LED I/Os at V <sub>I</sub> = 4.3 V, f <sub>scl</sub> = 0 kHz	5.5 V			1	
C <sub>I</sub>	SCL	V <sub>I</sub> = V <sub>CC</sub> or GND	2.3 V to 5.5 V		4	5	pF
C <sub>io</sub>	SDA	V <sub>IO</sub> = V <sub>CC</sub> or GND	2.3 V to 5.5 V		5.5	6.5	pF
	P port				8	9.5	

(1) All typical values are at nominal supply voltage (2.5-V, 3.3-V, or 5-V V<sub>CC</sub>) and T<sub>A</sub> = 25°C.

(2) The total current sourced by all I/Os must be limited to 85 mA.

(3) Each I/O must be externally limited to a maximum of 25 mA, and the P port (P7–P0) must be limited to a maximum current of 200 mA.

## I<sup>2</sup>C INTERFACE TIMING REQUIREMENTS

over operating free-air temperature range (unless otherwise noted) (see [Figure 11](#))

			STANDARD MODE I <sup>2</sup> C BUS		FAST MODE I <sup>2</sup> C BUS		UNIT
			MIN	MAX	MIN	MAX	
t <sub>scl</sub>	I <sup>2</sup> C clock frequency		0	100	0	400	kHz
t <sub>sch</sub>	I <sup>2</sup> C clock high time		4		0.6		μs
t <sub>scl</sub>	I <sup>2</sup> C clock low time		4.7		1.3		μs
t <sub>sp</sub>	I <sup>2</sup> C spike time			50		50	ns
t <sub>sds</sub>	I <sup>2</sup> C serial-data setup time		250		100		ns
t <sub>sdh</sub>	I <sup>2</sup> C serial-data hold time		0		0		ns
t <sub>icr</sub>	I <sup>2</sup> C input rise time			1000	20 + 0.1C <sub>b</sub> <sup>(1)</sup>	300	ns
t <sub>icf</sub>	I <sup>2</sup> C input fall time			300	20 + 0.1C <sub>b</sub> <sup>(1)</sup>	300	ns
t <sub>ocf</sub>	I <sup>2</sup> C output fall time	10-pF to 400-pF bus		300	20 + 0.1C <sub>b</sub> <sup>(1)</sup>	300	ns
t <sub>buf</sub>	I <sup>2</sup> C bus free time between stop and start		4.7		1.3		μs
t <sub>sts</sub>	I <sup>2</sup> C start or repeated start condition setup		4.7		0.6		μs
t <sub>sth</sub>	I <sup>2</sup> C start or repeated start condition hold		4		0.6		μs
t <sub>sps</sub>	I <sup>2</sup> C stop condition setup		4		0.6		μs
t <sub>vd(data)</sub>	Valid data time	SCL low to SDA output valid	300		50		ns
t <sub>vd(ack)</sub>	Valid data time of ACK condition	ACK signal from SCL low to SDA (out) low	0.3	3.45	0.1	0.9	μs
C <sub>b</sub>	I <sup>2</sup> C bus capacitive load			400		400	ns

(1) C<sub>b</sub> = total capacitive of one bus in pF

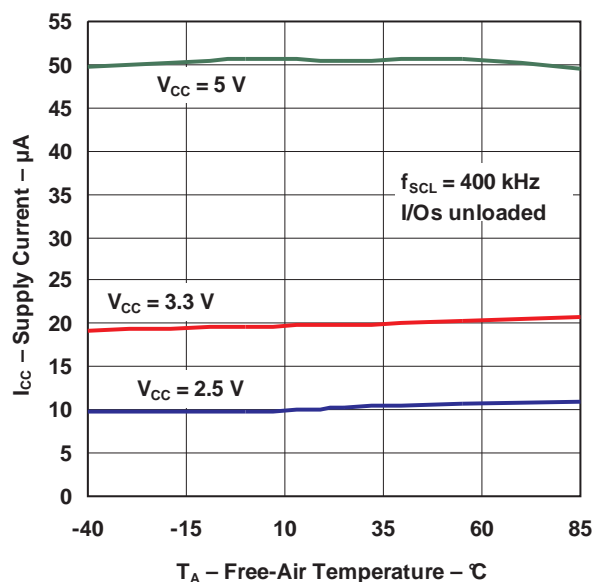
## SWITCHING CHARACTERISTICS

over operating free-air temperature range (unless otherwise noted) (see [Figure 12](#) and [Figure 13](#))

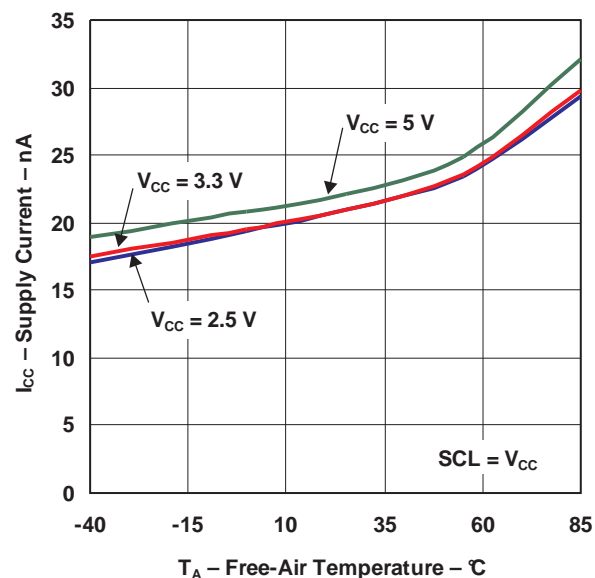
PARAMETER		FROM (INPUT)	TO (OUTPUT)	STANDARD MODE I <sup>2</sup> C BUS		FAST MODE I <sup>2</sup> C BUS		UNIT
				MIN	MAX	MIN	MAX	
t <sub>iv</sub>	Interrupt valid time	P port	$\overline{\text{INT}}$		4		4	μs
t <sub>ir</sub>	Interrupt reset delay time	SCL	$\overline{\text{INT}}$		4		4	μs
t <sub>pV</sub>	Output data valid	SCL	P7–P0		200		200	ns
t <sub>ps</sub>	Input data setup time	P port	SCL	100		100		ns
t <sub>ph</sub>	Input data hold time	P port	SCL	1		1		μs

## TYPICAL CHARACTERISTICS

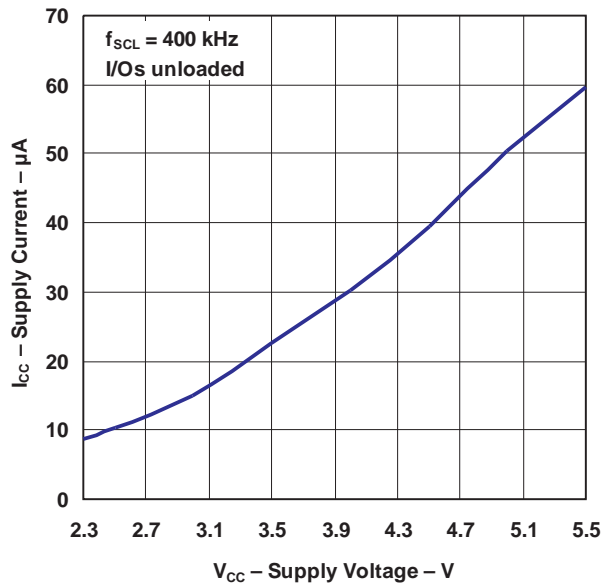
**SUPPLY CURRENT  
vs  
TEMPERATURE**



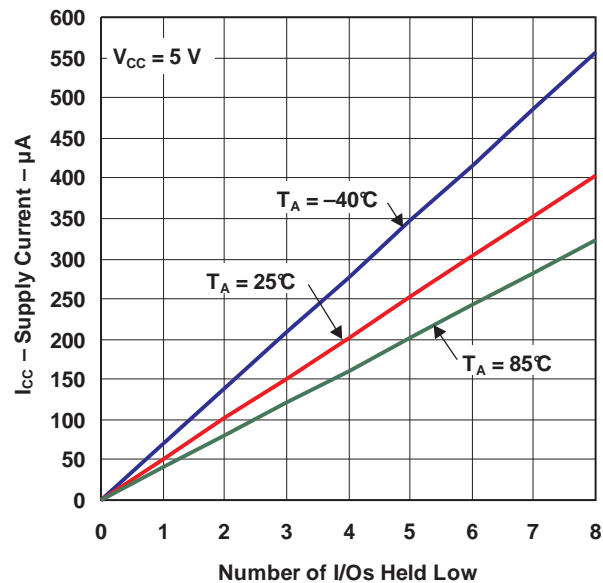
**QUIESCENT SUPPLY CURRENT  
vs  
TEMPERATURE**



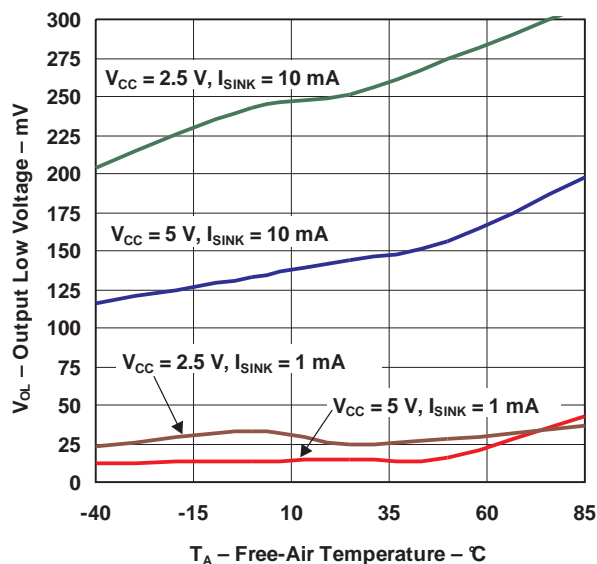
**SUPPLY CURRENT  
vs  
SUPPLY VOLTAGE**



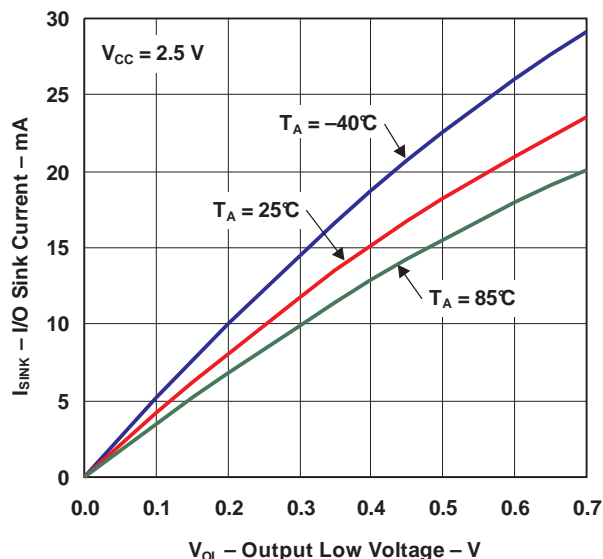
**SUPPLY CURRENT  
vs  
NUMBER OF I/Os HELD LOW**



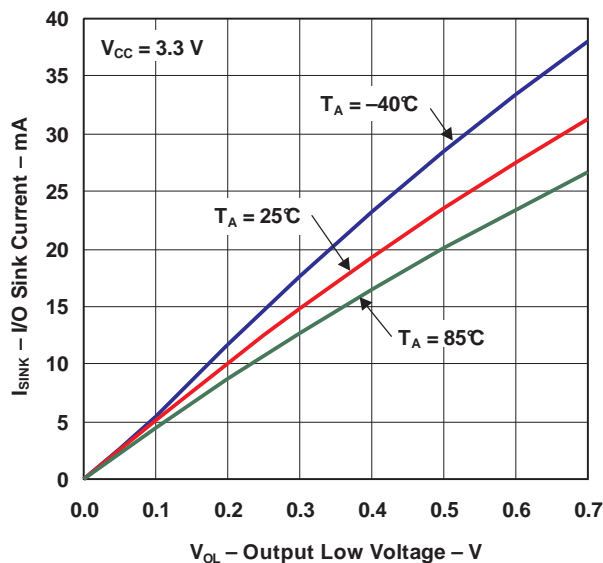
# **TYPICAL CHARACTERISTICS (continued)** **I/O OUTPUT LOW VOLTAGE** **vs** **TEMPERATURE**



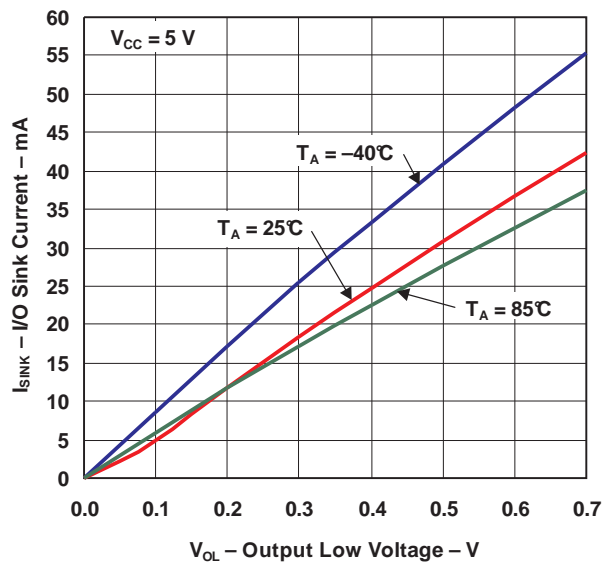
# **I/O SINK CURRENT** **vs** **OUTPUT LOW VOLTAGE**



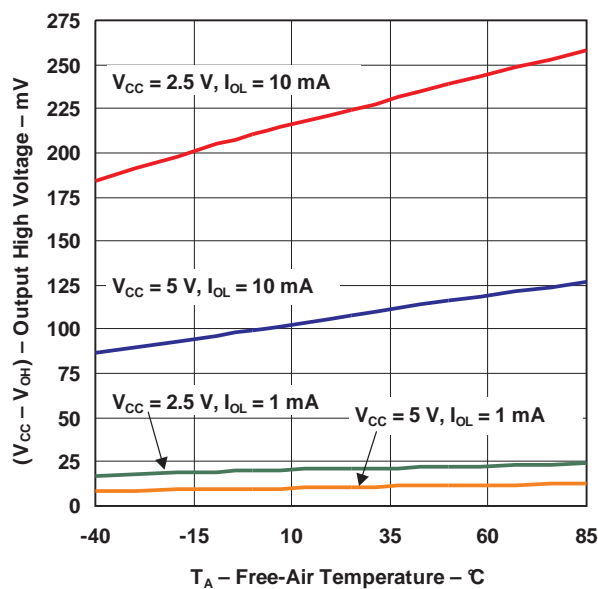
# **I/O SINK CURRENT** **vs** **OUTPUT LOW VOLTAGE**



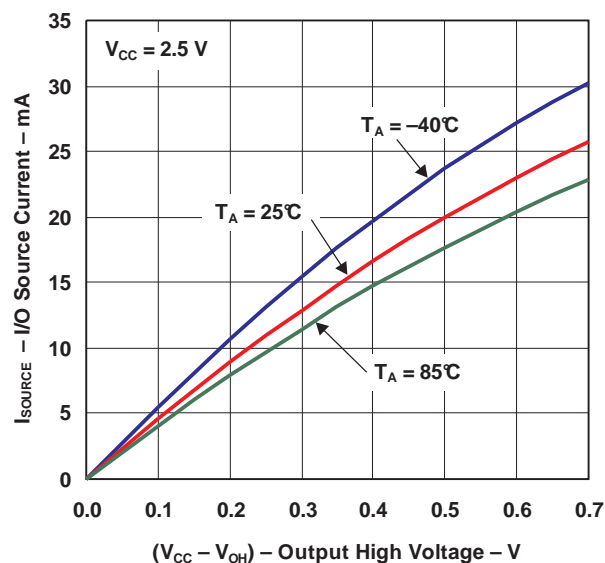
# **I/O SINK CURRENT** **vs** **OUTPUT LOW VOLTAGE**



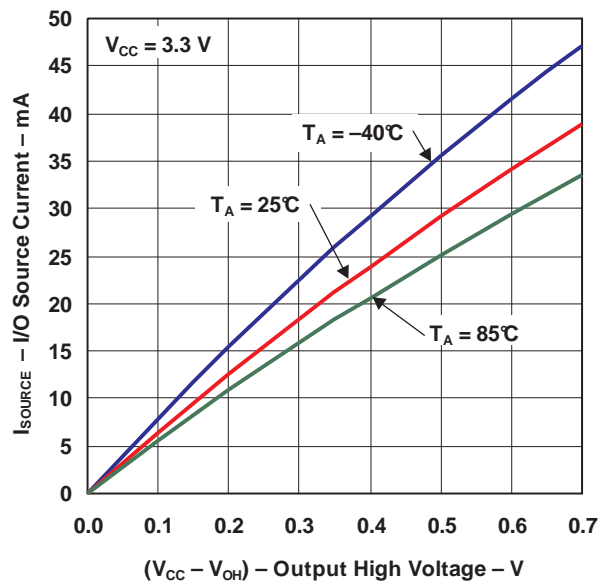
# **TYPICAL CHARACTERISTICS (continued)** **I/O OUTPUT HIGH VOLTAGE** **VS** **TEMPERATURE**



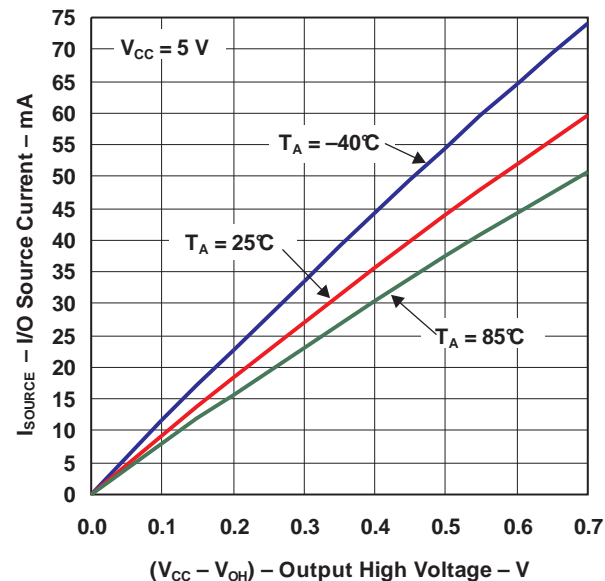
# **I/O SOURCE CURRENT** **VS** **OUTPUT HIGH VOLTAGE**



# **I/O SOURCE CURRENT** **VS** **OUTPUT HIGH VOLTAGE**

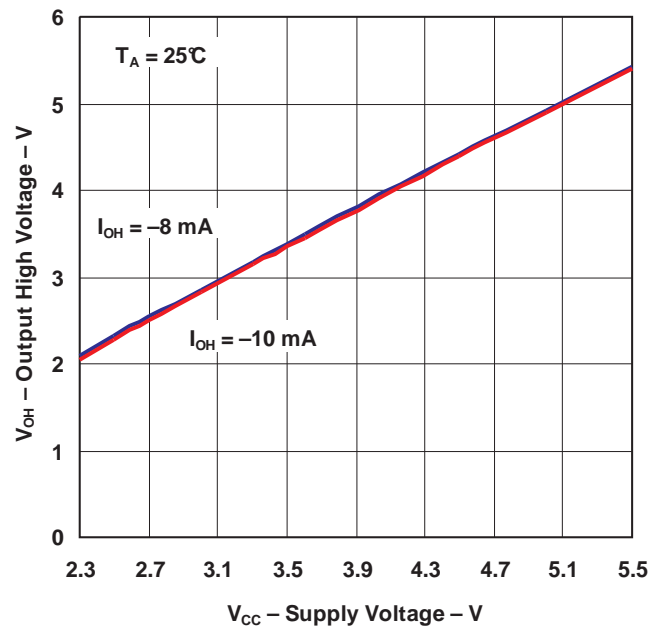


# **I/O SOURCE CURRENT** **VS** **OUTPUT HIGH VOLTAGE**

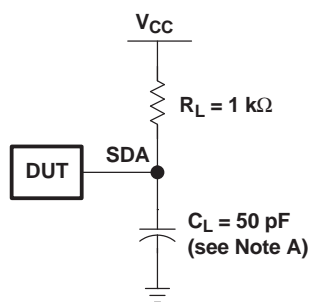




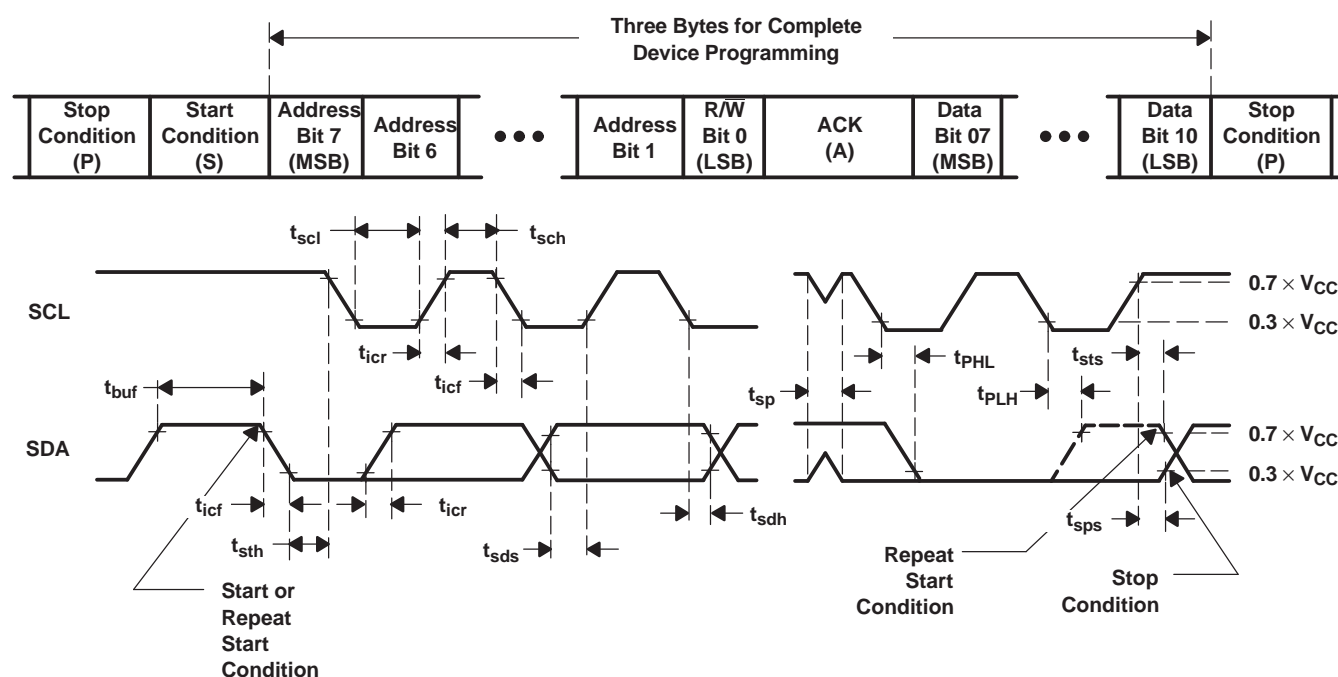
**TYPICAL CHARACTERISTICS (continued)**  
**OUTPUT HIGH VOLTAGE**  
**vs**  
**SUPPLY VOLTAGE**



## PARAMETER MEASUREMENT INFORMATION



SDA LOAD CONFIGURATION



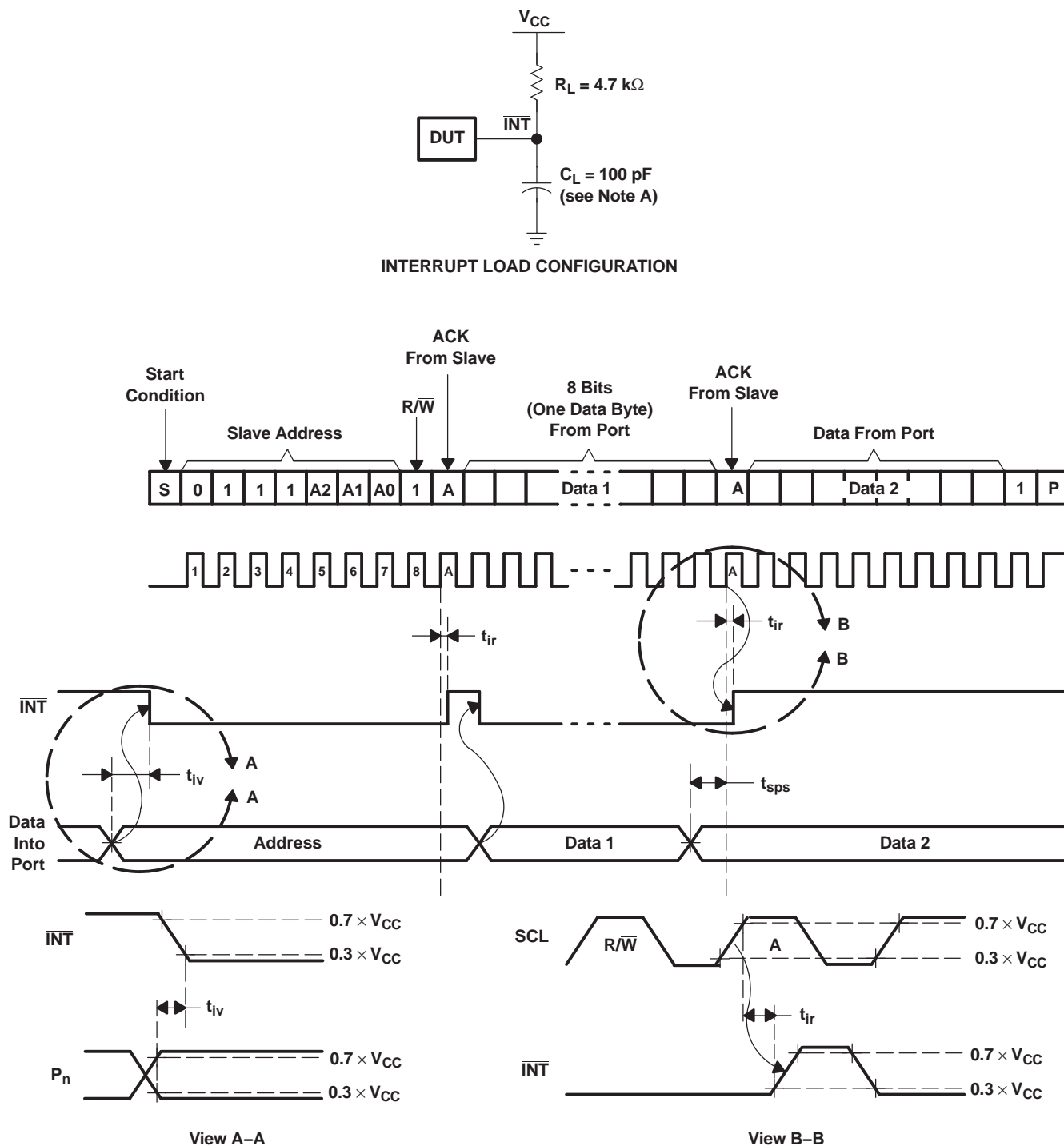
VOLTAGE WAVEFORMS

BYTE	DESCRIPTION
1	I <sup>2</sup> C address
2, 3	P-port data

- A.  $C_L$  includes probe and jig capacitance.
- B. All inputs are supplied by generators having the following characteristics:  $PRR \leq 10\text{ MHz}$ ,  $Z_O = 50\ \Omega$ ,  $t_r/t_f \leq 30\text{ ns}$ .
- C. All parameters and waveforms are not applicable to all devices.

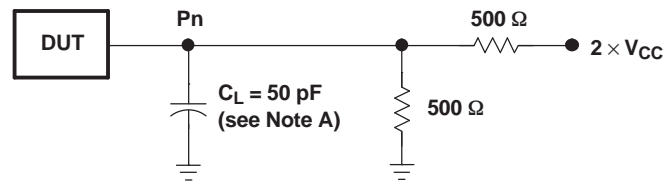
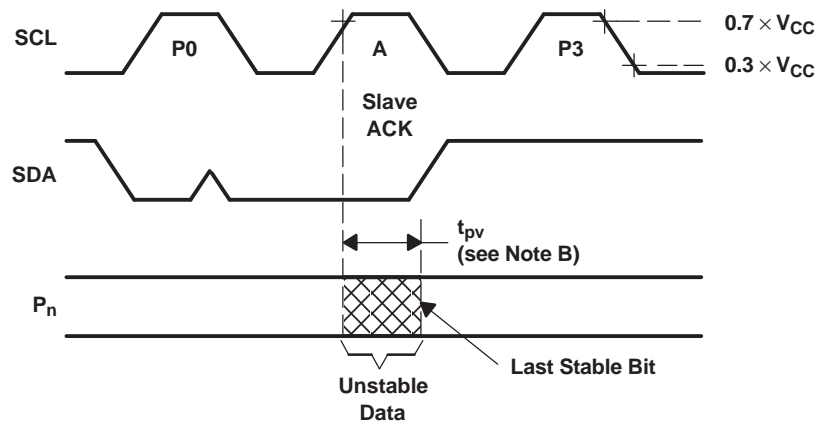
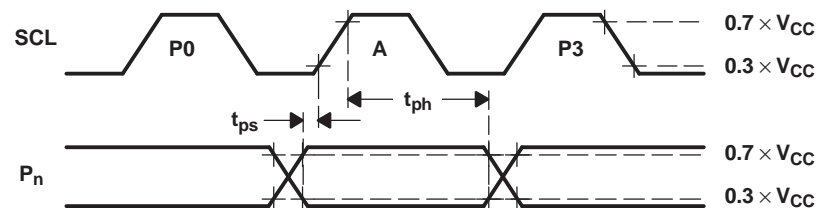
**Figure 11. I<sup>2</sup>C Interface Load Circuit and Voltage Waveforms**

## PARAMETER MEASUREMENT INFORMATION (continued)



- A.  $C_L$  includes probe and jig capacitance.
- B. All inputs are supplied by generators having the following characteristics:  $PRR \leq 10$  MHz,  $Z_O = 50 \Omega$ ,  $t_r/t_f \leq 30$  ns.
- C. All parameters and waveforms are not applicable to all devices.

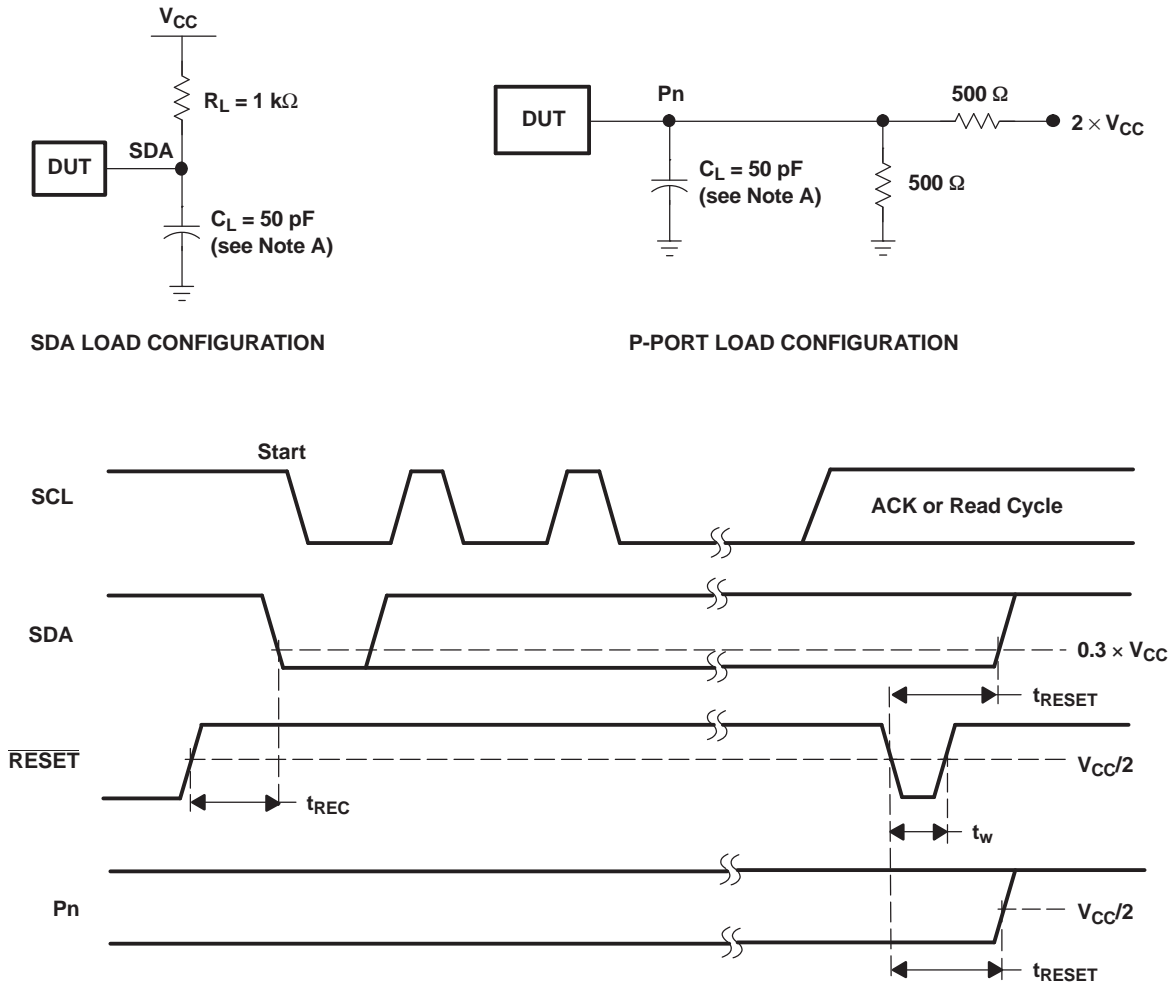
**Figure 12. Interrupt Load Circuit and Voltage Waveforms**

**PARAMETER MEASUREMENT INFORMATION (continued)****P-PORT LOAD CONFIGURATION****WRITE MODE ( $R/\overline{W} = 0$ )****READ MODE ( $R/\overline{W} = 1$ )**

- A.  $C_L$  includes probe and jig capacitance.
- B.  $t_{pv}$  is measured from  $0.7 \times V_{CC}$  on SCL to 50% I/O ( $P_n$ ) output.
- C. All inputs are supplied by generators having the following characteristics: PRR  $\leq 10$  MHz,  $Z_O = 50 \Omega$ ,  $t_r/t_f \leq 30$  ns.
- D. The outputs are measured one at a time, with one transition per measurement.
- E. All parameters and waveforms are not applicable to all devices.

**Figure 13. P-Port Load Circuit and Voltage Waveforms**

## PARAMETER MEASUREMENT INFORMATION (continued)

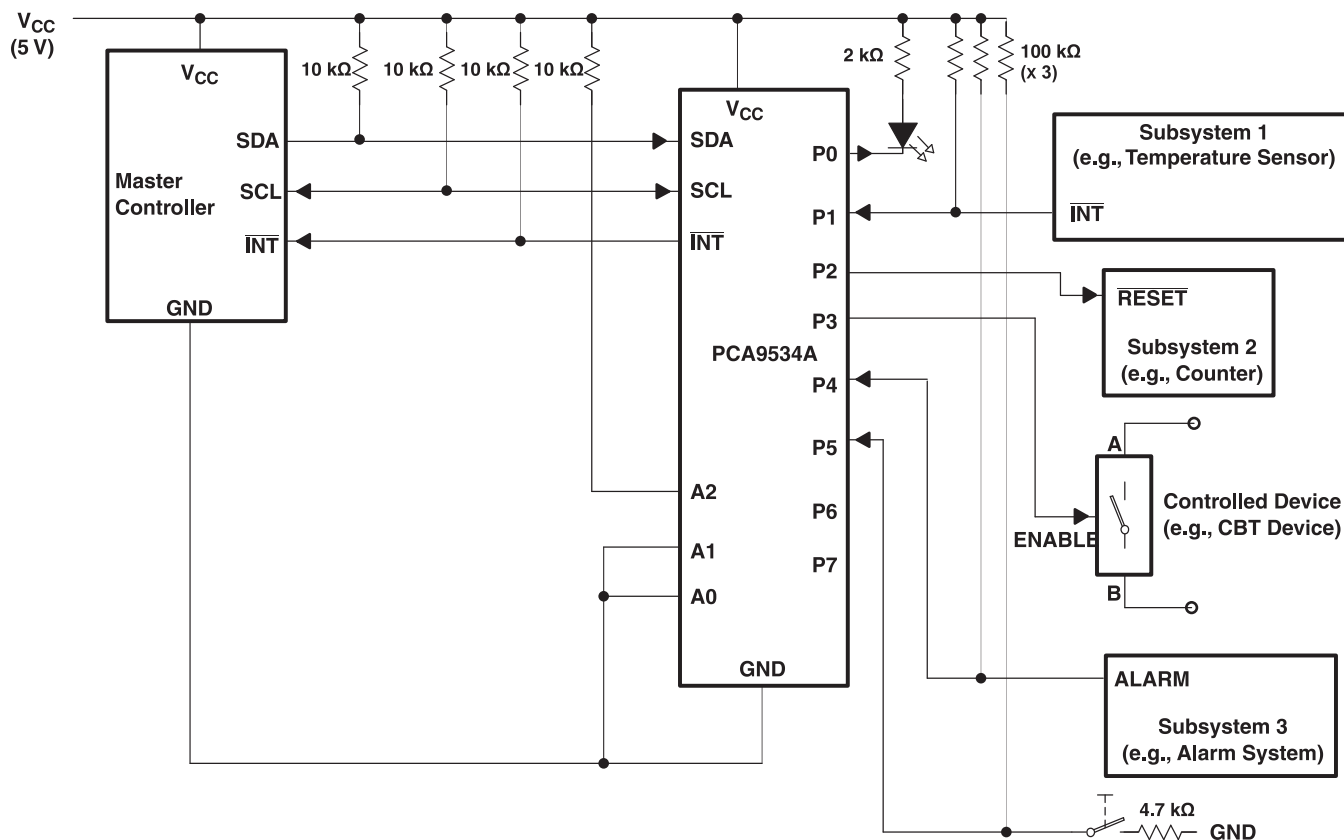


- A.  $C_L$  includes probe and jig capacitance.
- B. All inputs are supplied by generators having the following characteristics:  $PRR \leq 10 \text{ MHz}$ ,  $Z_O = 50 \Omega$ ,  $t_r/t_f \leq 30 \text{ ns}$ .
- C. I/Os are configured as inputs.
- D. All parameters and waveforms are not applicable to all devices.

**Figure 14. Reset Load Circuits and Voltage Waveforms**

## APPLICATION INFORMATION

Figure 15 shows an application in which the PCA9534A can be used.



- A. Device address is configured as 0111100 for this example.
- B. P0, P2, and P3 are configured as outputs.
- C. P1, P4, and P5 are configured as inputs.
- D. P6 and P7 are not used and must be configured as outputs.

**Figure 15. Typical Application**

## Minimizing $I_{CC}$ When the I/O Controls LEDs

When the I/Os are used to control LEDs, they normally are connected to  $V_{CC}$  through a resistor as shown in Figure 15. Because the LED acts as a diode, when the LED is off, the I/O  $V_{IN}$  is about 1.2 V less than  $V_{CC}$ . The supply current,  $I_{CC}$ , increases as  $V_{IN}$  becomes lower than  $V_{CC}$  and is specified as  $\Delta I_{CC}$  in *Electrical Characteristics*.

For battery-powered applications, it is essential that the voltage of the I/O pins is greater than or equal to  $V_{CC}$  when the LED is off to minimize current consumption. Figure 16 shows a high-value resistor in parallel with the LED. Figure 17 shows  $V_{CC}$  less than the LED supply voltage by at least 1.2 V. Both of these methods maintain the I/O  $V_{IN}$  at or above  $V_{CC}$  and prevents additional supply-current consumption when the LED is off.

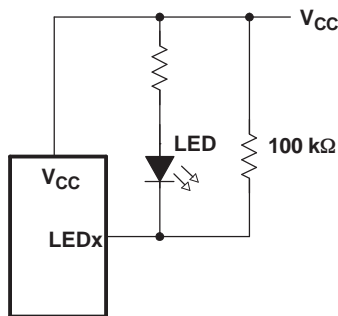


Figure 16. High-Value Resistor in Parallel With the LED

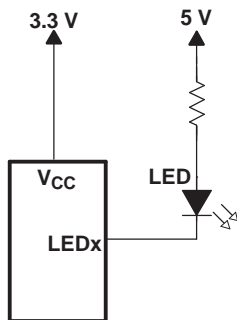


Figure 17. Device Supplied by a Lower Voltage

## Power-On Reset Requirements

In the event of a glitch or data corruption, PCA9534A can be reset to its default conditions by using the power-on reset feature. Power-on reset requires that the device go through a power cycle to be completely reset. This reset also happens when the device is powered on for the first time in an application.

The two types of power-on reset are shown in Figure 18 and Figure 19.

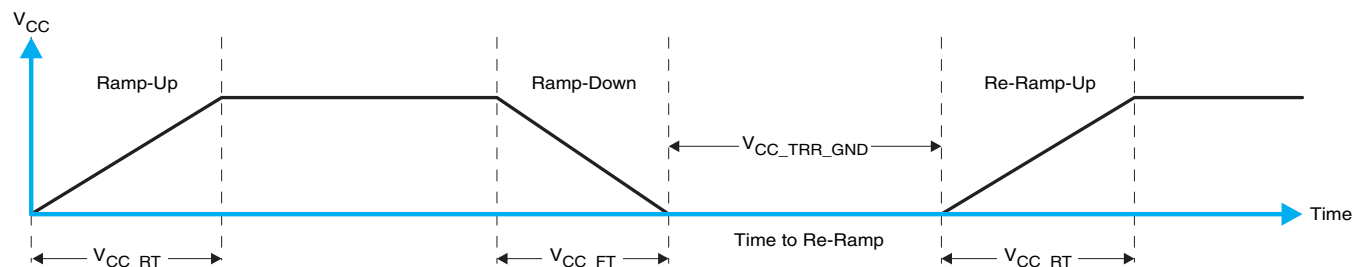
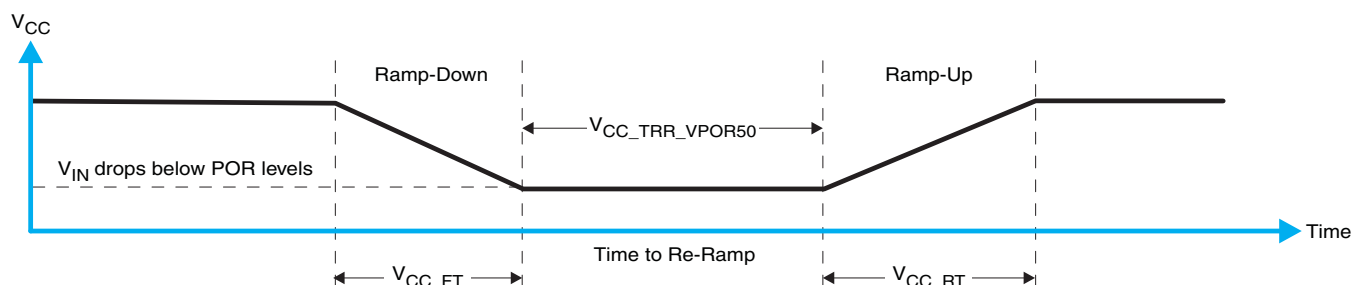


Figure 18.  $V_{CC}$  is Lowered Below 0.2 V or 0 V and Then Ramped Up to  $V_{CC}$



**Figure 19.  $V_{CC}$  is Lowered Below the POR Threshold, Then Ramped Back Up to  $V_{CC}$**

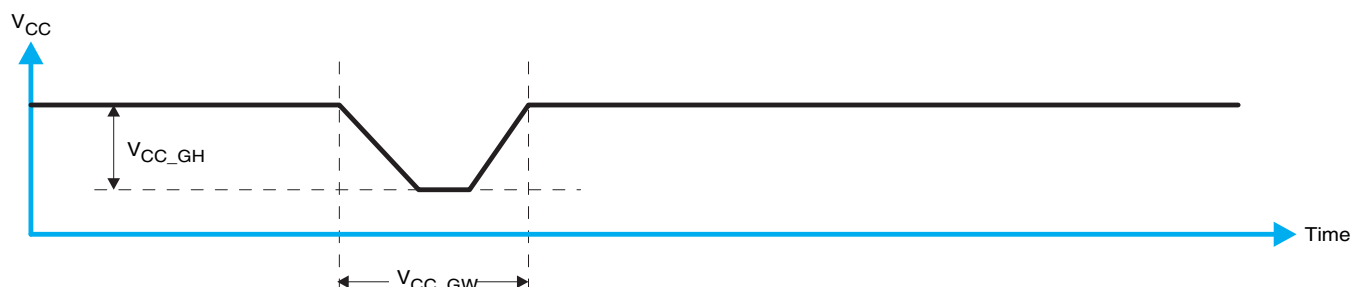
Table 10 specifies the performance of the power-on reset feature for PCA9534A for both types of power-on reset.

**Table 10. RECOMMENDED SUPPLY SEQUENCING AND RAMP RATES<sup>(1)</sup>**

PARAMETER			MIN	TYP	MAX	UNIT
$V_{CC\_FT}$	Fall rate	See Figure 18	1		100	ms
$V_{CC\_RT}$	Rise rate	See Figure 18	0.01		100	ms
$V_{CC\_TRR\_GND}$	Time to re-ramp (when $V_{CC}$ drops to GND)	See Figure 18	0.001			ms
$V_{CC\_TRR\_POR50}$	Time to re-ramp (when $V_{CC}$ drops to $V_{POR\_MIN} - 50$ mV)	See Figure 19	0.001			ms
$V_{CC\_GH}$	Level that $V_{CCP}$ can glitch down to, but not cause a functional disruption when $V_{CCX\_GW} = 1$ $\mu$ s	See Figure 20			1.2	V
$V_{CC\_GW}$	Glitch width that will not cause a functional disruption when $V_{CCX\_GH} = 0.5 \times V_{CCX}$	See Figure 20				$\mu$ s
$V_{PORF}$	Voltage trip point of POR on falling $V_{CC}$		0.767		1.144	V
$V_{PORR}$	Voltage trip point of POR on rising $V_{CC}$		1.033		1.428	V

(1)  $T_A = -40^{\circ}\text{C}$  to  $85^{\circ}\text{C}$  (unless otherwise noted)

Glitches in the power supply can also affect the power-on reset performance of this device. The glitch width ( $V_{CC\_GW}$ ) and height ( $V_{CC\_GH}$ ) are dependent on each other. The bypass capacitance, source impedance, and device impedance are factors that affect power-on reset performance. Figure 20 and Table 10 provide more information on how to measure these specifications.



**Figure 20. Glitch Width and Glitch Height**

$V_{POR}$  is critical to the power-on reset.  $V_{POR}$  is the voltage level at which the reset condition is released and all the registers and the I<sup>2</sup>C/SMBus state machine are initialized to their default states. The value of  $V_{POR}$  differs based on the  $V_{CC}$  being lowered to or from 0. Figure 21 and Table 10 provide more details on this specification.



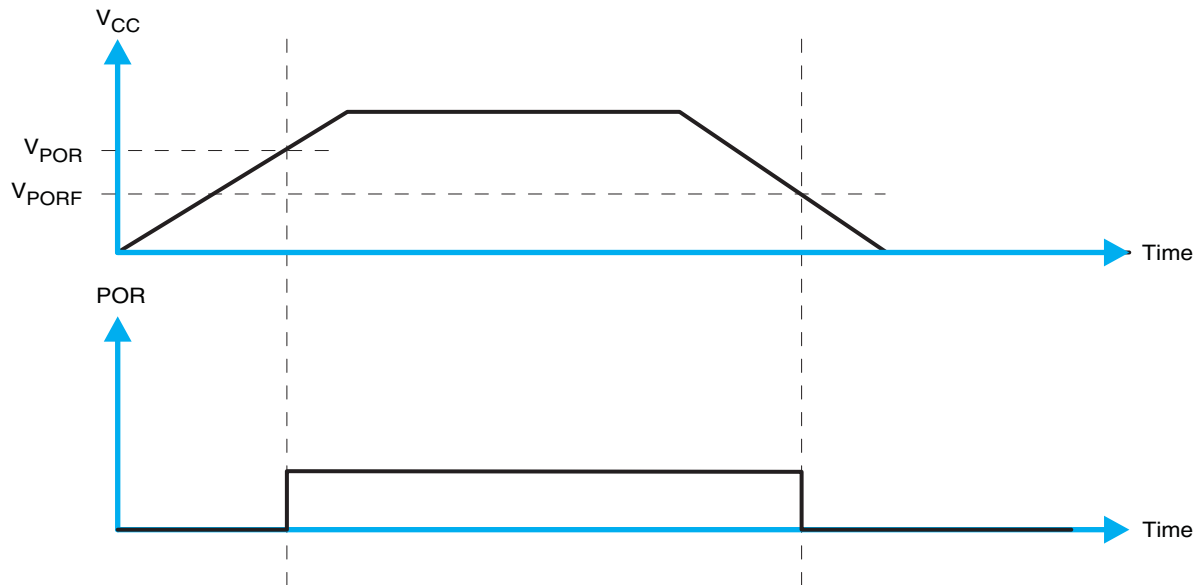


Figure 21.  $V_{POR}$

## Interrupt Requirements

The expected performance of the interrupt feature is that  $\overline{INT}$  is to be cleared (de-asserted) when the input register is read or all inputs return to the last read values.  $\overline{INT}$  is also de-asserted when both of the following occur:

- The last I<sup>2</sup>C command byte (register pointer) written was 00h. This generally means the last operation with the device was a read of the input register, but the command byte may have been written with 00h without ever going on to read the Input register.
- Any other slave device on the I<sup>2</sup>C bus acknowledges an address byte with the R/ $\overline{W}$  bit set high. This occurs when reading any other valid device on the bus.

In order to prevent  $\overline{INT}$  from de-asserting when another device is read on the I<sup>2</sup>C bus, the user needs to change the command byte to something other than 00 (hex) after a read operation to the device.

REVISION HISTORY

Changes from Revision G (June 2010) to Revision H	Page
• Removed Ordering Information Table. ....	<a href="#">2</a>
• Deleted the 100 kΩ resistor at V <sub>CC</sub> .....	<a href="#">22</a>

**PACKAGING INFORMATION**

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
PCA9534ADB	ACTIVE	SSOP	DB	16	80	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	PD534A	<a href="#">Samples</a>
PCA9534ADBG4	ACTIVE	SSOP	DB	16	80	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	PD534A	<a href="#">Samples</a>
PCA9534ADBR	ACTIVE	SSOP	DB	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	PD534A	<a href="#">Samples</a>
PCA9534ADBRG4	ACTIVE	SSOP	DB	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	PD534A	<a href="#">Samples</a>
PCA9534ADGVR	ACTIVE	TVSOP	DGV	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	PD534A	<a href="#">Samples</a>
PCA9534ADGVRG4	ACTIVE	TVSOP	DGV	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	PD534A	<a href="#">Samples</a>
PCA9534ADW	ACTIVE	SOIC	DW	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	PCA9534A	<a href="#">Samples</a>
PCA9534ADWG4	ACTIVE	SOIC	DW	16	40	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	PCA9534A	<a href="#">Samples</a>
PCA9534ADWR	ACTIVE	SOIC	DW	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	PCA9534A	<a href="#">Samples</a>
PCA9534ADWRG4	ACTIVE	SOIC	DW	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	PCA9534A	<a href="#">Samples</a>
PCA9534APW	ACTIVE	TSSOP	PW	16	90	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	PD534A	<a href="#">Samples</a>
PCA9534APWG4	ACTIVE	TSSOP	PW	16	90	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	PD534A	<a href="#">Samples</a>
PCA9534APWR	ACTIVE	TSSOP	PW	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	PD534A	<a href="#">Samples</a>
PCA9534APWRG4	ACTIVE	TSSOP	PW	16	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	PD534A	<a href="#">Samples</a>
PCA9534ARGTR	ACTIVE	QFN	RGT	16	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-40 to 85	ZVJ	<a href="#">Samples</a>
PCA9534ARGTRG4	ACTIVE	QFN	RGT	16	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-40 to 85	ZVJ	<a href="#">Samples</a>
PCA9534ARGVR	ACTIVE	VQFN	RGV	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-40 to 85	PD534A	<a href="#">Samples</a>

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
PCA9534ARGVRG4	ACTIVE	VQFN	RGV	16	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-40 to 85	PD534A	<a href="#">Samples</a>

(1) The marketing status values are defined as follows:

**ACTIVE:** Product device recommended for new designs.

**LIFEBUY:** TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

**NRND:** Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

**PREVIEW:** Device has been announced but is not in production. Samples may or may not be available.

**OBSOLETE:** TI has discontinued the production of the device.

(2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

**TBD:** The Pb-Free/Green conversion plan has not been defined.

**Pb-Free (RoHS):** TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

**Pb-Free (RoHS Exempt):** This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

**Green (RoHS & no Sb/Br):** TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

(3) MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

**Important Information and Disclaimer:** The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

**TAPE AND REEL INFORMATION**


\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
PCA9534ADBR	SSOP	DB	16	2000	330.0	16.4	8.2	6.6	2.5	12.0	16.0	Q1
PCA9534ADGVR	TVSOP	DGV	16	2000	330.0	12.4	6.8	4.0	1.6	8.0	12.0	Q1
PCA9534ADWR	SOIC	DW	16	2000	330.0	16.4	10.75	10.7	2.7	12.0	16.0	Q1
PCA9534APWR	TSSOP	PW	16	2000	330.0	12.4	6.9	5.6	1.6	8.0	12.0	Q1
PCA9534ARGTR	QFN	RGT	16	3000	330.0	12.4	3.3	3.3	1.1	8.0	12.0	Q2
PCA9534ARGVR	VQFN	RGV	16	2500	330.0	12.4	4.25	4.25	1.15	8.0	12.0	Q2

## TAPE AND REEL BOX DIMENSIONS



\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
PCA9534ADBR	SSOP	DB	16	2000	367.0	367.0	38.0
PCA9534ADGVR	TVSOP	DGV	16	2000	367.0	367.0	35.0
PCA9534ADWR	SOIC	DW	16	2000	367.0	367.0	38.0
PCA9534APWR	TSSOP	PW	16	2000	367.0	367.0	35.0
PCA9534ARGTR	QFN	RGT	16	3000	367.0	367.0	35.0
PCA9534ARGVR	VQFN	RGV	16	2500	367.0	367.0	35.0

PW (R-PDSO-G16)

PLASTIC SMALL OUTLINE

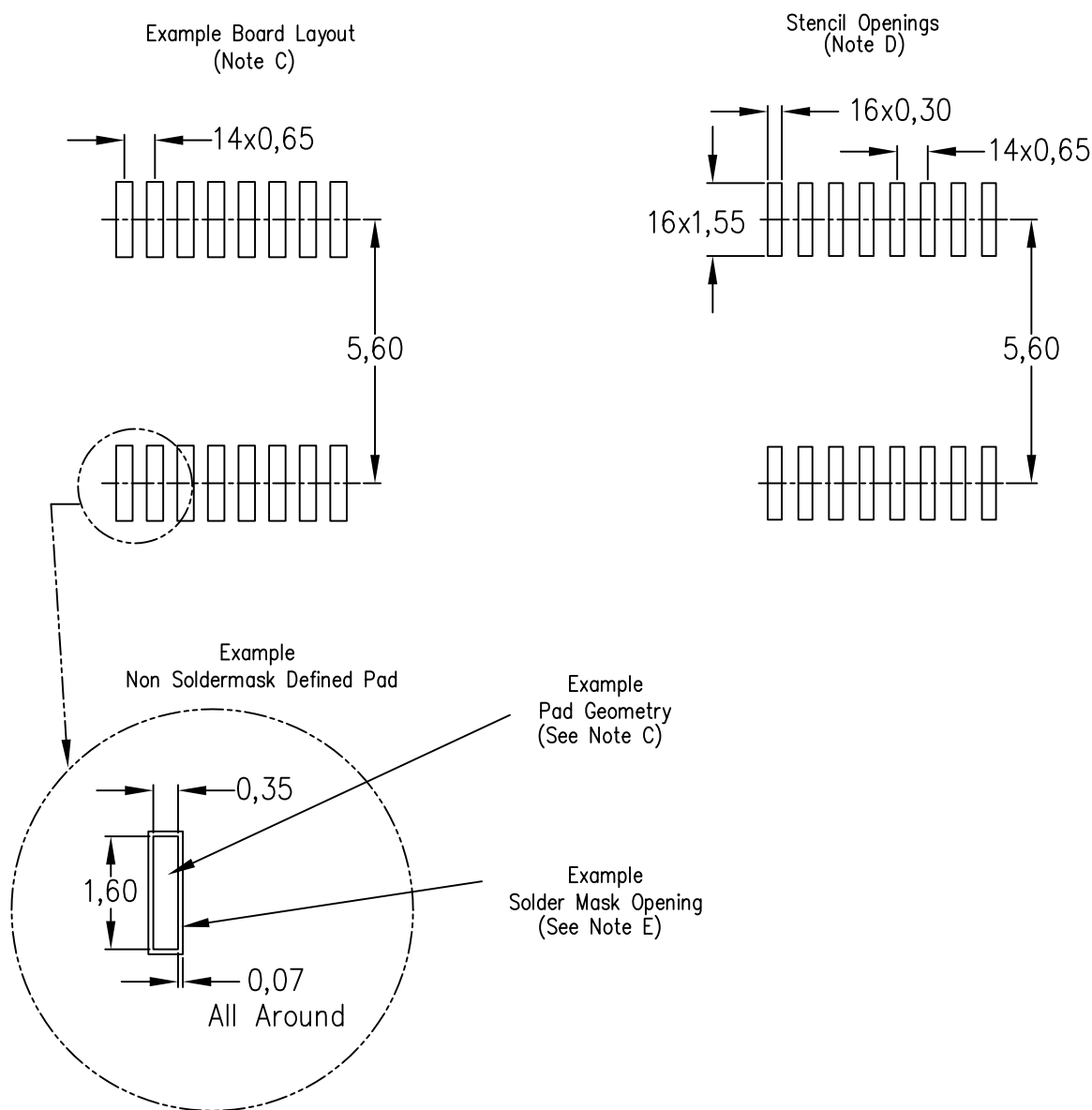


4040064-4/G 02/11

- NOTES:
- A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.
  - B. This drawing is subject to change without notice.
  - C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0,15 each side.
  - D. Body width does not include interlead flash. Interlead flash shall not exceed 0,25 each side.
  - E. Falls within JEDEC MO-153

PW (R-PDSO-G16)

PLASTIC SMALL OUTLINE



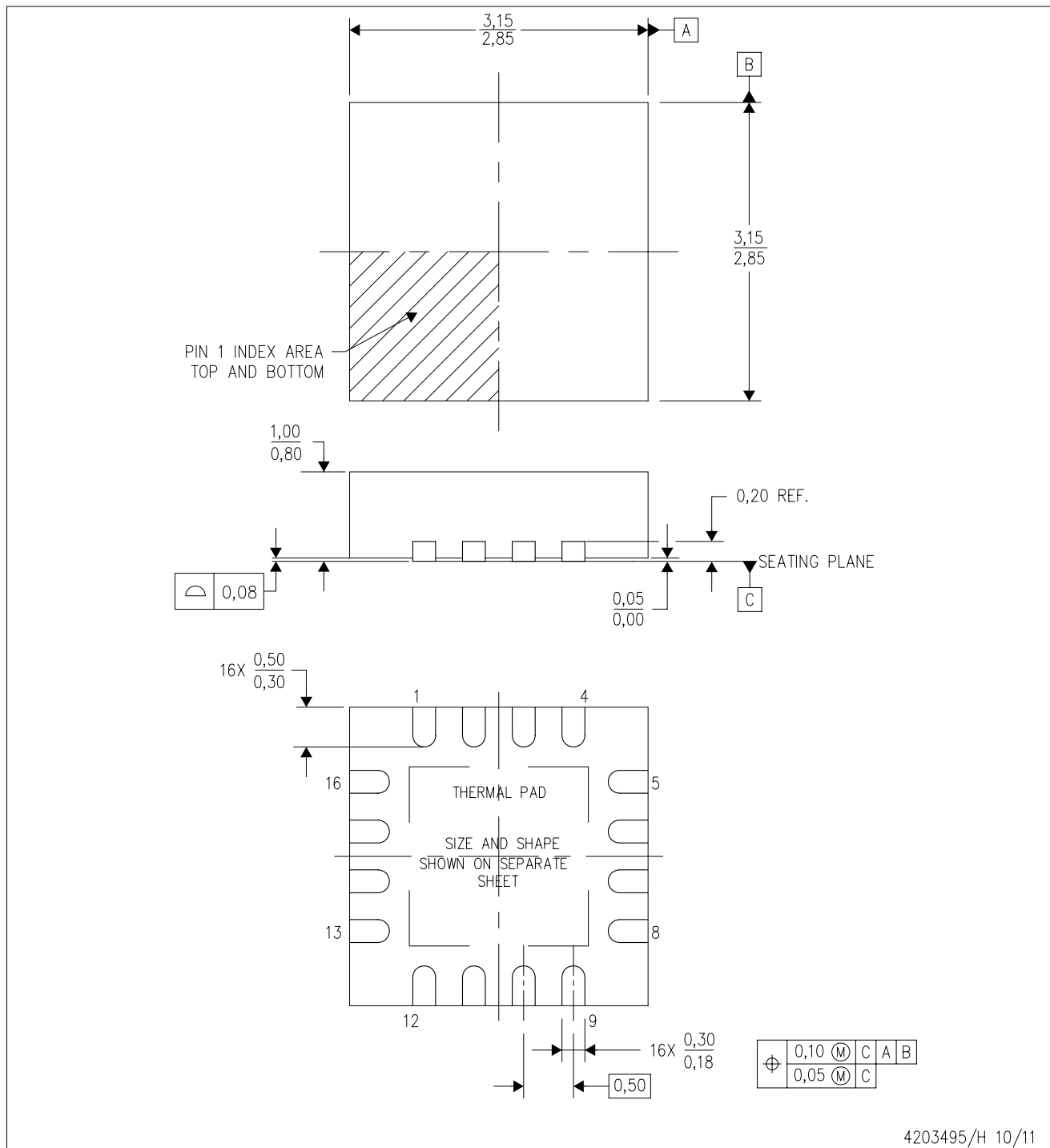
4211284-3/F 12/12

- NOTES:
- All linear dimensions are in millimeters.
  - This drawing is subject to change without notice.
  - Publication IPC-7351 is recommended for alternate designs.
  - Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC-7525 for other stencil recommendations.
  - Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.



RGT (S-PVQFN-N16)

PLASTIC QUAD FLATPACK NO-LEAD



4203495/H 10/11

- NOTES:
- A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.
  - B. This drawing is subject to change without notice.
  - C. Quad Flatpack, No-leads (QFN) package configuration.
  - D. The package thermal pad must be soldered to the board for thermal and mechanical performance.
  - E. See the additional figure in the Product Data Sheet for details regarding the exposed thermal pad features and dimensions.
  - F. Falls within JEDEC MO-220.

## THERMAL PAD MECHANICAL DATA

RGT (S-PVQFN-N16)

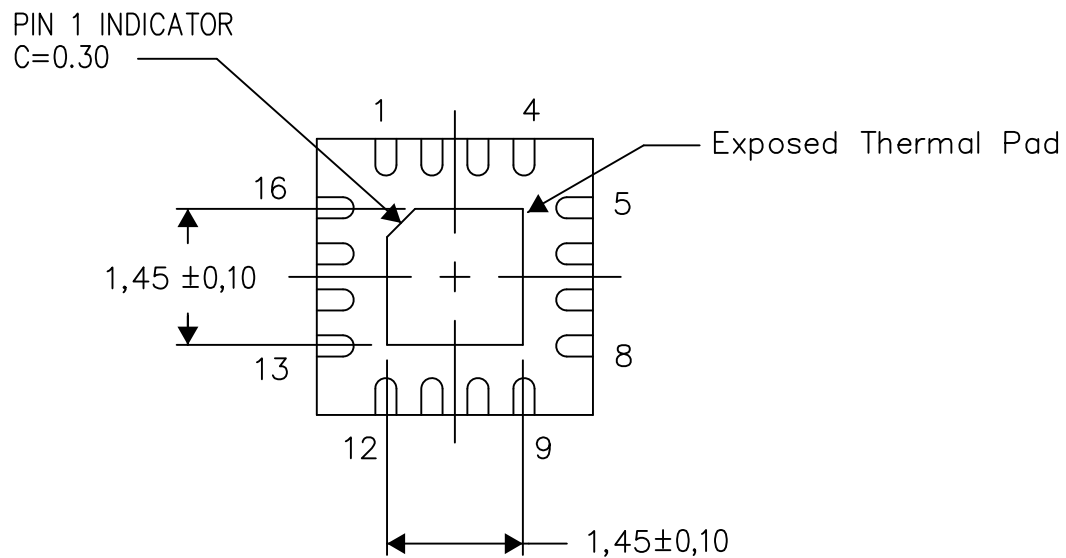
PLASTIC QUAD FLATPACK NO-LEAD

### THERMAL INFORMATION

This package incorporates an exposed thermal pad that is designed to be attached directly to an external heatsink. The thermal pad must be soldered directly to the printed circuit board (PCB). After soldering, the PCB can be used as a heatsink. In addition, through the use of thermal vias, the thermal pad can be attached directly to the appropriate copper plane shown in the electrical schematic for the device, or alternatively, can be attached to a special heatsink structure designed into the PCB. This design optimizes the heat transfer from the integrated circuit (IC).

For information on the Quad Flatpack No-Lead (QFN) package and its advantages, refer to Application Report, QFN/SON PCB Attachment, Texas Instruments Literature No. SLUA271. This document is available at [www.ti.com](http://www.ti.com).

The exposed thermal pad dimensions for this package are shown in the following illustration.



Bottom View

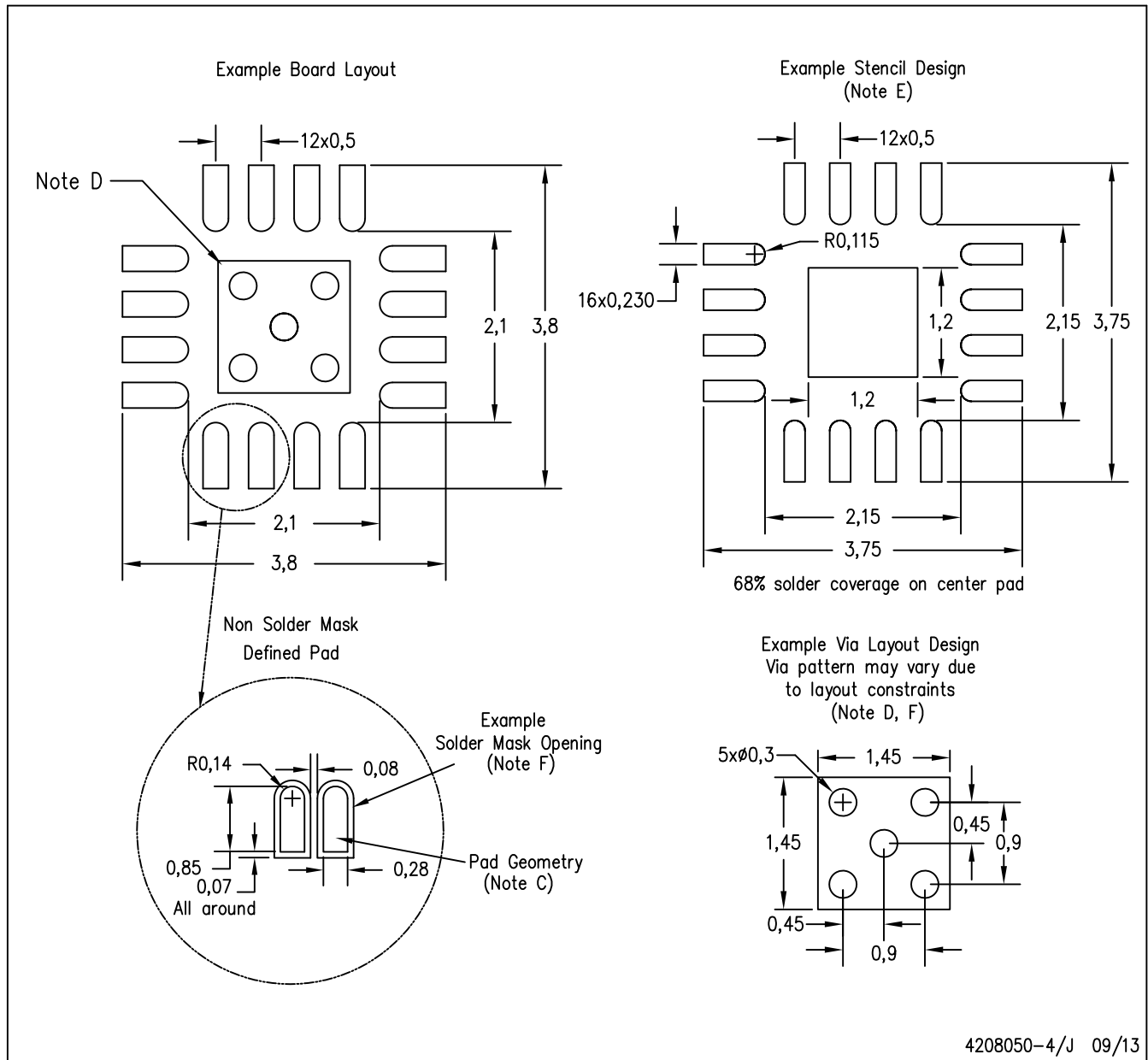
Exposed Thermal Pad Dimensions

4206349-2/U 09/13

NOTE: All linear dimensions are in millimeters

RGT (S-PVQFN-N16)

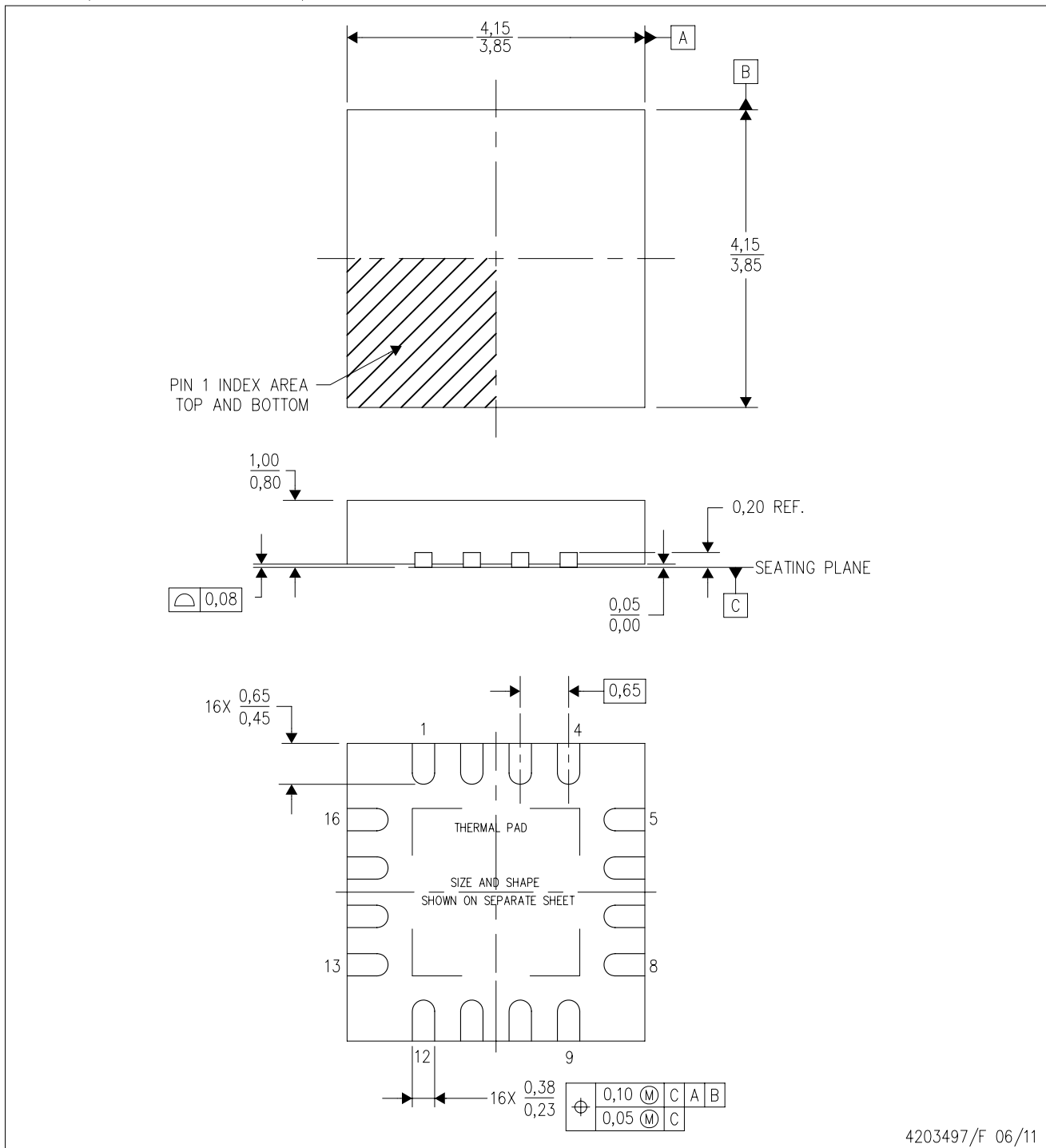
PLASTIC QUAD FLATPACK NO-LEAD



- NOTES:
- All linear dimensions are in millimeters.
  - This drawing is subject to change without notice.
  - Publication IPC-7351 is recommended for alternate designs.
  - This package is designed to be soldered to a thermal pad on the board. Refer to Application Note, QFN/SON PCB Attachment, Texas Instruments Literature No. SLUA271, and also the Product Data Sheets for specific thermal information, via requirements, and recommended board layout. These documents are available at [www.ti.com](http://www.ti.com) <<http://www.ti.com>>.
  - Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC 7525 for stencil design considerations.
  - Customers should contact their board fabrication site for minimum solder mask web tolerances between signal pads.

RGV (S-PVQFN-N16)

PLASTIC QUAD FLATPACK NO-LEAD



4203497/F 06/11

- NOTES:
- All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.
  - This drawing is subject to change without notice.
  - Quad Flatpack, No-leads (QFN) package configuration.
  - The package thermal pad must be soldered to the board for thermal and mechanical performance.
  - See the additional figure in the Product Data Sheet for details regarding the exposed thermal pad features and dimensions.
  - Falls within JEDEC MO-220.

RGV (S-PVQFN-N16)

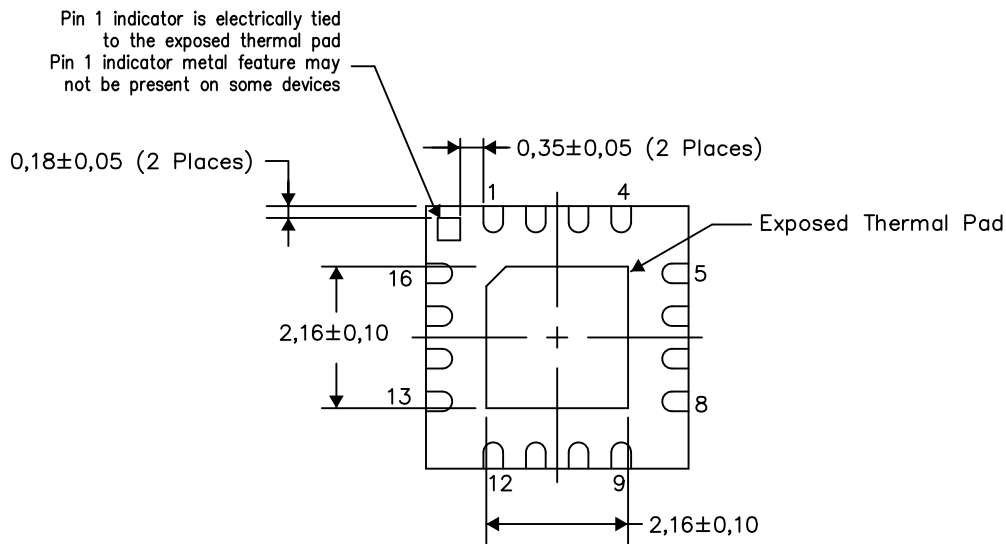
PLASTIC QUAD FLATPACK NO-LEAD

## THERMAL INFORMATION

This package incorporates an exposed thermal pad that is designed to be attached directly to an external heatsink. The thermal pad must be soldered directly to the printed circuit board (PCB). After soldering, the PCB can be used as a heatsink. In addition, through the use of thermal vias, the thermal pad can be attached directly to the appropriate copper plane shown in the electrical schematic for the device, or alternatively, can be attached to a special heatsink structure designed into the PCB. This design optimizes the heat transfer from the integrated circuit (IC).

For information on the Quad Flatpack No-Lead (QFN) package and its advantages, refer to Application Report, QFN/SON PCB Attachment, Texas Instruments Literature No. SLUA271. This document is available at [www.ti.com](http://www.ti.com).

The exposed thermal pad dimensions for this package are shown in the following illustration.



Bottom View

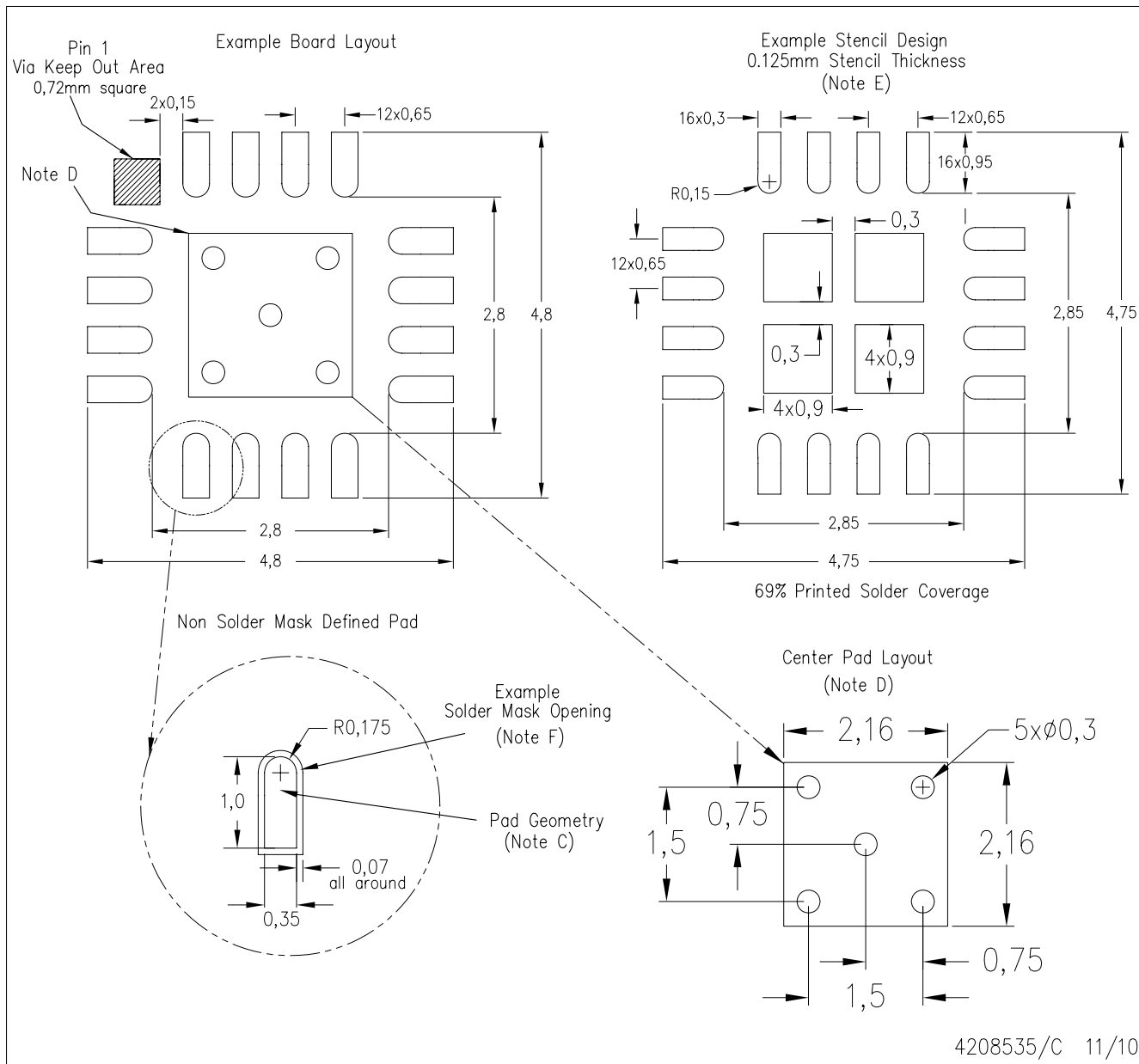
Exposed Thermal Pad Dimensions

4206351-2/L 05/13

NOTE: All linear dimensions are in millimeters

RGV (S-PVQFN-N16)

PLASTIC QUAD FLATPACK NO-LEAD

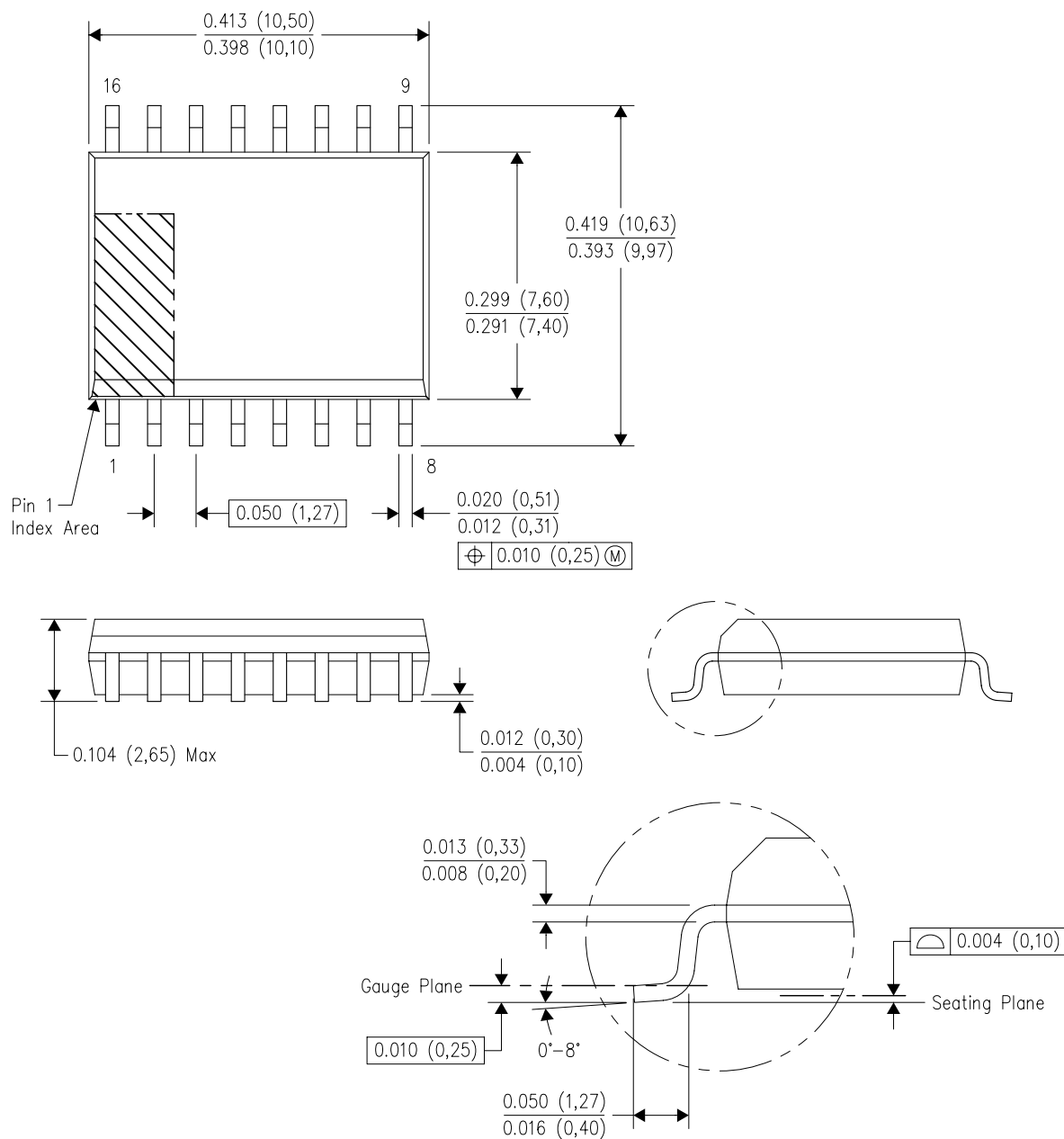


4208535/C 11/10

- NOTES:
- All linear dimensions are in millimeters.
  - This drawing is subject to change without notice.
  - Publication IPC-7351 is recommended for alternate designs.
  - This package is designed to be soldered to a thermal pad on the board. Refer to Application Note, QFN Packages, Texas Instruments Literature No. SLUA271, and also the Product Data Sheets for specific thermal information, via requirements, and recommended board layout. These documents are available at [www.ti.com](http://www.ti.com) <<http://www.ti.com>>.
  - Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC 7525 for stencil design considerations.
  - Customers should contact their board fabrication site for solder mask tolerances.

DW (R-PDSO-G16)

# PLASTIC SMALL OUTLINE

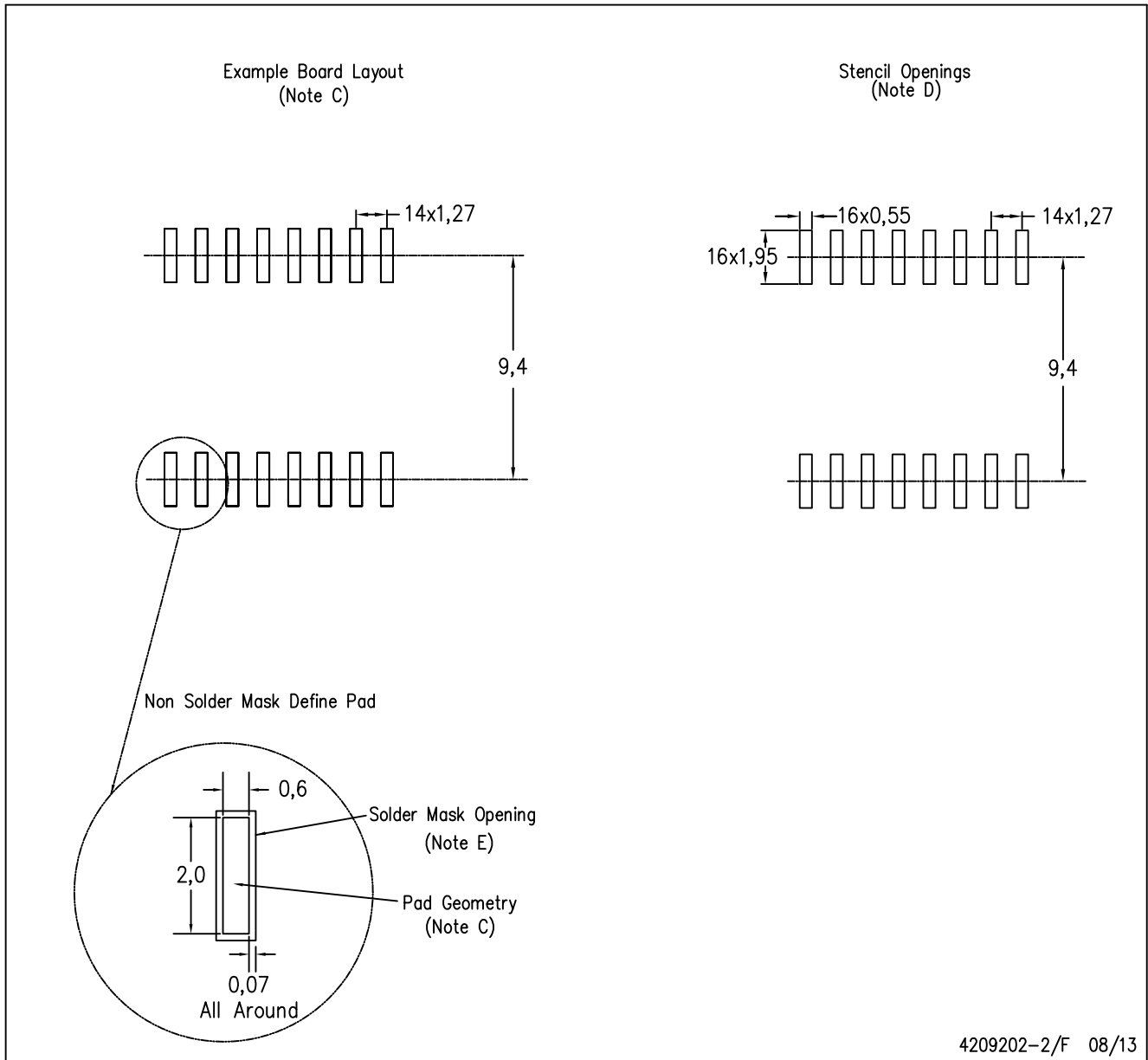


4040000-2/G 01/11

- NOTES: A. All linear dimensions are in inches (millimeters). Dimensioning and tolerancing per ASME Y14.5M-1994.  
B. This drawing is subject to change without notice.  
C. Body dimensions do not include mold flash or protrusion not to exceed 0.006 (0,15).  
D. Falls within JEDEC MS-013 variation AA.

DW (R-PDSO-G16)

PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in millimeters.
  - B. This drawing is subject to change without notice.
  - C. Refer to IPC7351 for alternate board design.
  - D. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC-7525
  - E. Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.



## DB (R-PDSO-G\*\*)

## PLASTIC SMALL-OUTLINE

28 PINS SHOWN



- NOTES: A. All linear dimensions are in millimeters.  
 B. This drawing is subject to change without notice.  
 C. Body dimensions do not include mold flash or protrusion not to exceed 0,15.  
 D. Falls within JEDEC MO-150

## IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, enhancements, improvements and other changes to its semiconductor products and services per JESD46, latest issue, and to discontinue any product or service per JESD48, latest issue. Buyers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All semiconductor products (also referred to herein as "components") are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its components to the specifications applicable at the time of sale, in accordance with the warranty in TI's terms and conditions of sale of semiconductor products. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by applicable law, testing of all parameters of each component is not necessarily performed.

TI assumes no liability for applications assistance or the design of Buyers' products. Buyers are responsible for their products and applications using TI components. To minimize the risks associated with Buyers' products and applications, Buyers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI components or services are used. Information published by TI regarding third-party products or services does not constitute a license to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of significant portions of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI components or services with statements different from or beyond the parameters stated by TI for that component or service voids all express and any implied warranties for the associated TI component or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Buyer acknowledges and agrees that it is solely responsible for compliance with all legal, regulatory and safety-related requirements concerning its products, and any use of TI components in its applications, notwithstanding any applications-related information or support that may be provided by TI. Buyer represents and agrees that it has all the necessary expertise to create and implement safeguards which anticipate dangerous consequences of failures, monitor failures and their consequences, lessen the likelihood of failures that might cause harm and take appropriate remedial actions. Buyer will fully indemnify TI and its representatives against any damages arising out of the use of any TI components in safety-critical applications.

In some cases, TI components may be promoted specifically to facilitate safety-related applications. With such components, TI's goal is to help enable customers to design and create their own end-product solutions that meet applicable functional safety standards and requirements. Nonetheless, such components are subject to these terms.

No TI components are authorized for use in FDA Class III (or similar life-critical medical equipment) unless authorized officers of the parties have executed a special agreement specifically governing such use.

Only those TI components which TI has specifically designated as military grade or "enhanced plastic" are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components which have **not** been so designated is solely at the Buyer's risk, and that Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI has specifically designated certain components as meeting ISO/TS16949 requirements, mainly for automotive use. In any case of use of non-designated products, TI will not be responsible for any failure to meet ISO/TS16949.

### Products

Audio	<a href="http://www.ti.com/audio">www.ti.com/audio</a>
Amplifiers	<a href="http://amplifier.ti.com">amplifier.ti.com</a>
Data Converters	<a href="http://dataconverter.ti.com">dataconverter.ti.com</a>
DLP® Products	<a href="http://www.dlp.com">www.dlp.com</a>
DSP	<a href="http://dsp.ti.com">dsp.ti.com</a>
Clocks and Timers	<a href="http://www.ti.com/clocks">www.ti.com/clocks</a>
Interface	<a href="http://interface.ti.com">interface.ti.com</a>
Logic	<a href="http://logic.ti.com">logic.ti.com</a>
Power Mgmt	<a href="http://power.ti.com">power.ti.com</a>
Microcontrollers	<a href="http://microcontroller.ti.com">microcontroller.ti.com</a>
RFID	<a href="http://www.ti-rfid.com">www.ti-rfid.com</a>
OMAP Applications Processors	<a href="http://www.ti.com/omap">www.ti.com/omap</a>
Wireless Connectivity	<a href="http://www.ti.com/wirelessconnectivity">www.ti.com/wirelessconnectivity</a>

### Applications

Automotive and Transportation	<a href="http://www.ti.com/automotive">www.ti.com/automotive</a>
Communications and Telecom	<a href="http://www.ti.com/communications">www.ti.com/communications</a>
Computers and Peripherals	<a href="http://www.ti.com/computers">www.ti.com/computers</a>
Consumer Electronics	<a href="http://www.ti.com/consumer-apps">www.ti.com/consumer-apps</a>
Energy and Lighting	<a href="http://www.ti.com/energy">www.ti.com/energy</a>
Industrial	<a href="http://www.ti.com/industrial">www.ti.com/industrial</a>
Medical	<a href="http://www.ti.com/medical">www.ti.com/medical</a>
Security	<a href="http://www.ti.com/security">www.ti.com/security</a>
Space, Avionics and Defense	<a href="http://www.ti.com/space-avionics-defense">www.ti.com/space-avionics-defense</a>
Video and Imaging	<a href="http://www.ti.com/video">www.ti.com/video</a>

### TI E2E Community

[e2e.ti.com](http://e2e.ti.com)