

# TCA9617A Level-Translating FM+ I<sup>2</sup>C Bus Repeater

## 1 Features

- Two-channel bidirectional I<sup>2</sup>C buffer
- Support for standard mode, fast mode (400kHz), and fast mode+ (1MHz) I<sup>2</sup>C operation
- Operating supply voltage range of 0.8V to 5.5V on A-side
- Operating supply voltage range of 2.2V to 5.5V on B-side
- Voltage-level translation from 0.8V to 5.5V and 2.2V to 5.5V
- Footprint and function replacement for TCA9517
- Active-high repeater-enable input
- Open-drain I<sup>2</sup>C I/O
- 5.5V Tolerant I<sup>2</sup>C and enable input support
- Lockup-free operation
- Support for clock stretching and multiple controller arbitration across the device
- Latch-up performance exceeds 100mA Per JESD 78, class II
- ESD protection exceeds JESD 22
  - 4000V Human-body model
  - 1500V Charged-device model

## 2 Applications

- [Servers](#)
- [Routers](#) (Telecom Switching Equipment)
- [Industrial Equipment](#)
- Products with many I<sup>2</sup>C targets and/or long PCB traces

## 3 Description

The TCA9617A is a BiCMOS dual bidirectional buffer intended for I<sup>2</sup>C bus and SMBus systems. The device provides bidirectional voltage-level translation (up-translation and down-translation) between low voltages (down to 0.8V) and higher voltages (2.2V to 5.5V) in mixed-mode applications. This device enables I<sup>2</sup>C and similar bus systems to be extended, without degradation of performance even during level shifting.

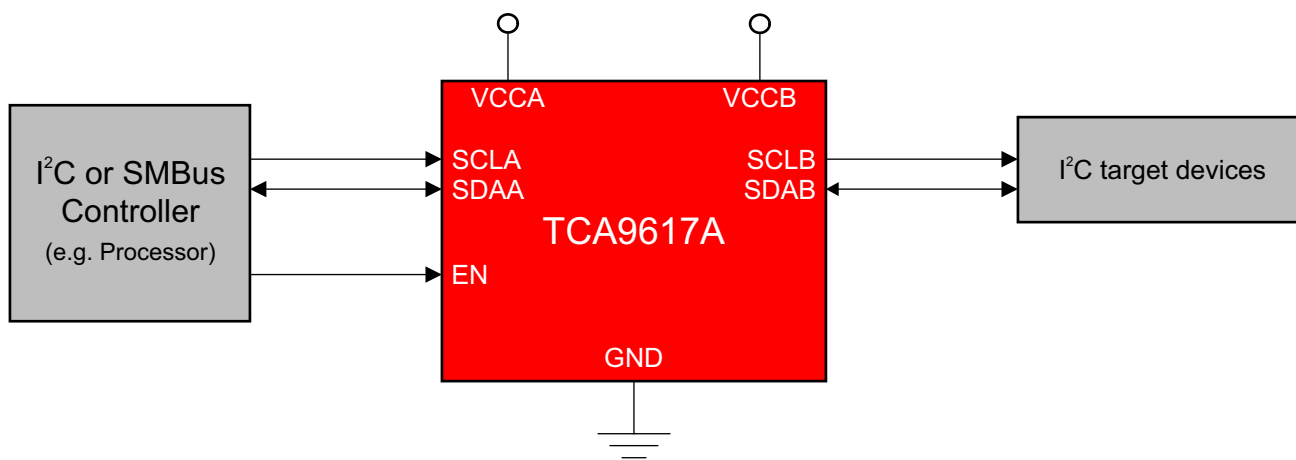
The TCA9617A buffers both the serial data (SDA) and the serial clock (SCL) signals on the I<sup>2</sup>C bus, allowing two buses of 550pF to be connected in an I<sup>2</sup>C application. This device can also be used to separate two halves of a bus for voltage and capacitance.

### Package Information

PART NUMBER	PACKAGE <sup>(1)</sup>	PACKAGE SIZE <sup>(2)</sup>
TCA9617A	VSSOP (8)	3mm × 3mm

(1) For more information, see [Section 10](#).

(2) The package size (length × width) is a nominal value and includes pins, where applicable.



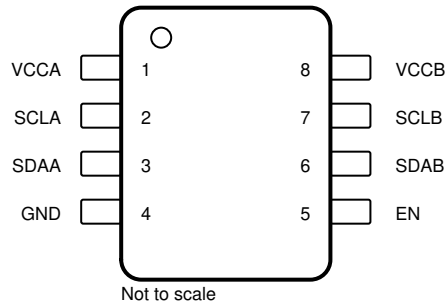
Simplified Schematic



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## 4 Pin Configuration and Functions



**Figure 4-1. DGK Package, 8-Pin VSSOP  
(Top View)**

**Table 4-1. Pin Functions**

PIN		DESCRIPTION
NAME	NO.	
VCCA	1	A-side supply voltage (0.8V to 5.5V)
SCLA	2	I <sup>2</sup> C SCL line, A side. Connect to V <sub>C</sub> CA through a pull-up resistor.
SDAA	3	I <sup>2</sup> C SDA line, A side. Connect to V <sub>C</sub> CA through a pull-up resistor.
GND	4	Supply ground
EN	5	Active-high repeater enable input. Internally connected to V <sub>C</sub> CB through a weak pull-up resistor.
SDAB	6	I <sup>2</sup> C SDA line, B side. Connect to V <sub>C</sub> CB through a pull-up resistor.
SCLB	7	I <sup>2</sup> C SCL line, B side. Connect to V <sub>C</sub> CB through a pull-up resistor.
VCCB	8	B-side and device supply voltage (2.2V to 5.5V)

## 5 Specifications

### 5.1 Absolute Maximum Ratings

Over operating free-air temperature range (unless otherwise noted)<sup>(1)</sup>

			MIN	MAX	UNIT
V <sub>CCB</sub>	Supply voltage range		-0.5	6.5	V
V <sub>CCA</sub>	Supply voltage range		-0.5	6.5	V
V <sub>I</sub>	Enable input voltage range <sup>(2)</sup>		-0.5	6.5	V
V <sub>IO</sub>	I <sup>2</sup> C bus voltage range <sup>(2)</sup>		-0.5	6.5	V
I <sub>IK</sub>	Input clamp current	V <sub>I</sub> < 0		-50	mA
I <sub>OK</sub>	Output clamp current	V <sub>O</sub> < 0		-50	mA
I <sub>O</sub>	Continuous output current			±50	mA
	Continuous current through V <sub>CC</sub> or GND			±100	mA
T <sub>stg</sub>	Storage temperature		-65	150	°C

- (1) Operation outside the *Absolute Maximum Ratings* may cause permanent device damage. Absolute Maximum Ratings do not imply functional operation of the device at these or any other conditions beyond those listed under *Recommended Operating Conditions*. If used outside the *Recommended Operating Conditions* but within the *Absolute Maximum Ratings*, the device may not be fully functional, and this may affect device reliability, functionality, performance, and shorten the device lifetime.
- (2) The input negative-voltage and output voltage ratings may be exceeded if the input and output current ratings are observed.

### 5.2 ESD Ratings

			VALUE	UNIT
V <sub>(ESD)</sub>	Electrostatic discharge	Human body model (HBM), per ANSI/ESDA/ JEDEC JS-001, all pins <sup>(1)</sup>	±4000	V
		Charged device model (CDM), per JEDEC specification JESD22-C101, all pins <sup>(2)</sup>	±1500	

- (1) JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process.
- (2) JEDEC document JEP157 states that 250-V CDM allows safe manufacturing with a standard ESD control process.

### 5.3 Recommended Operating Conditions

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

			MIN	MAX	UNIT
V <sub>CCA</sub>	Supply voltage, A-side bus		0.8	V <sub>CCB</sub>	V
V <sub>CCB</sub>	Supply voltage, B-side bus		2.2	5.5	V
I <sub>OLA</sub>	Low-level output current			30	mA
I <sub>OLB</sub>	Low-level output current		0.1	30	mA
T <sub>A</sub>	Ambient temperature		-40	85	°C

## 5.4 Thermal Information

THERMAL METRIC <sup>(1)</sup>		DGK	UNIT
		8 PINS	
$R_{\theta JA}$	Junction-to-ambient thermal resistance	171.5	°C/W
$R_{\theta JC(top)}$	Junction-to-case (top) thermal resistance	77.5	°C/W
$R_{\theta JB}$	Junction-to-board thermal resistance	107.1	°C/W
$\Psi_{JT}$	Junction-to-top characterization parameter	12.3	°C/W
$\Psi_{JB}$	Junction-to-board characterization parameter	105.3	°C/W

(1) For more information about traditional and new thermal metrics, see the [Semiconductor and IC Package Thermal Metrics](#) application report.

## 5.5 Electrical Characteristics

$V_{CCB} = 2.2V$  to  $5.5V$ ,  $GND = 0V$ ,  $T_A = -40^{\circ}C$  to  $85^{\circ}C$  (unless otherwise noted)

PARAMETER			TEST CONDITIONS	$V_{CCB}$	MIN	TYP <sup>(1)</sup>	MAX	UNIT	
$V_{IK}$	Input clamp voltage		$I_I = -18mA$	2.2V to 5.5V	-1.2		0	V	
$V_{OL}$	Low-level output voltage	SDAB, SCLB	$I_{OL} = 100\mu A$ or $30mA$ , $V_{ILA} = 0V$	2.2V to 5.5V	0.48	0.53	0.58	V	
		SDAA, SCLA	$I_{OL} = 30mA$				0.1		0.23
$V_{IH}$	High-level input voltage	SDAA, SCLA		2.2V to 5.5V	$0.7 \times V_{CCA}$		5.5	V	
		SDAB, SCLB					$0.7 \times V_{CCA}$		5.5
		EN					$0.7 \times V_{CCB}$		5.5
$V_{IL}$	Low-level input voltage	SDAA, SCLA		2.2V to 5.5V			$0.3 \times V_{CCA}$	V	
		SDAB, SCLB					0.4		
		EN					$0.3 \times V_{CCB}$		
$I_{CCA}$	Quiescent supply current for $V_{CCA}$		Both channels low, SDAA = SCLA = GND and $I_{OLB} = 100\mu A$ , or SDAA = SCLA = open and SDAB = SCLB = GND	2.2V to 5.5V			13	$\mu A$	
$I_{CCB}$	Quiescent supply current		Both Channels high, SDAA = SCLA = VCCA B-side pulled up to VCCB with pull-up resistors	2.2V to 5.5V		4.5	7	mA	
			Both channels low, SDAA = SCLA = GND, $I_{OLB} = 100\mu A$	5.5V		5.7	8.1		

## 5.5 Electrical Characteristics (continued)

$V_{CCB} = 2.2V$  to  $5.5V$ ,  $GND = 0V$ ,  $T_A = -40^{\circ}C$  to  $85^{\circ}C$  (unless otherwise noted)

PARAMETER			TEST CONDITIONS	$V_{CCB}$	MIN	TYP <sup>(1)</sup>	MAX	UNIT
$I_I$	Input leakage current	SDAB, SCLB	$V_I = V_{CCB}$	2.2V to 5.5V	-1		1	$\mu A$
			$V_I = 0.2V, EN = 0$		-10		10	
			$V_I = V_{CCB} - 0.2V$		-1		1	
			$V_I = 5.5V, V_{CCA} = 0V$	0V	-10		10	
		SDAA, SCLA	$V_I = V_{CCA}$	2.2V to 5.5V	-1		1	
			$V_I = 0.2V, EN = 0$		-10		10	
			$V_I = V_{CCA} - 0.2V$		-1		1	
			$V_I = 5.5V, V_{CCA} = 0V$	0V	-10		10	
EN	$V_I = V_{CCB}$		-1		1			
	$V_I = 0.2V$		-25					
$C_I$	Input capacitance	EN	$V_I = 3V$ or $0V$	3.3V			7	pF
$C_{IO}$	Input/output capacitance	SCLA, SDAA	$V_I = 3V$ or $0V$	3.3V			9	pF
				0V			9	
		SCLB, SDAB	$V_I = 3V$ or $0V$	3.3V			14	
				0V			14	

(1) All typical values are at  $T_A = 25^{\circ}C$ .

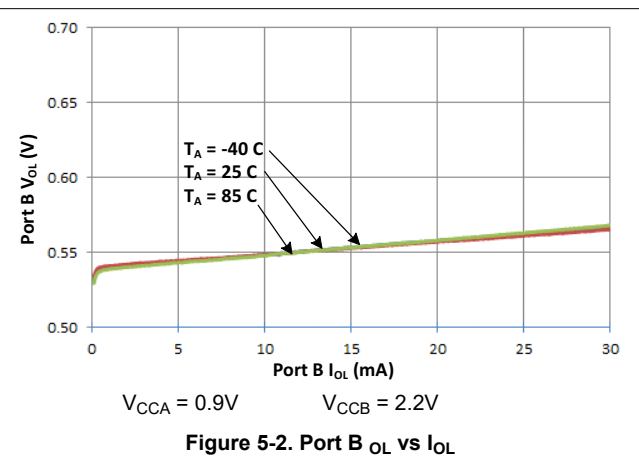
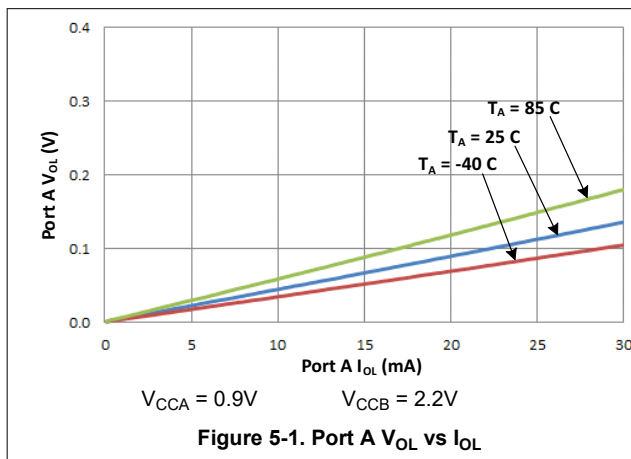
## 5.6 Timing Requirements

$V_{CCA} = 0.8V$  to  $5.5V$ ,  $V_{CCB} = 2.2V$  to  $5.5V$ ,  $GND = 0V$ ,  $T_A = -40^{\circ}C$  to  $85^{\circ}C$  (unless otherwise noted)<sup>(1) (2) (3)</sup>

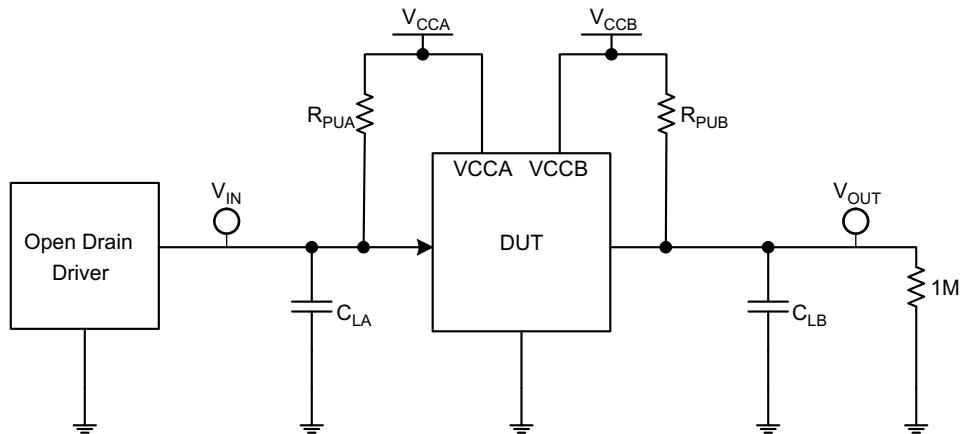
PARAMETER		FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	MIN	TYP	MAX	UNIT
$t_{PLH}$	Propagation delay	SDAB, SCLB	SDAA, SCLA		35		90	ns
$t_{PLH}$	Propagation delay	SDAA, SCLA	SDAB, SCLB	$V_{CCB} \leq 3V$	50		137	ns
$t_{PLH}$	Propagation delay	SDAA, SCLA	SDAB, SCLB	$V_{CCB} > 3V$	59		250	ns
$t_{PHL}$	Propagation delay	SDAB, SCLB	SDAA, SCLA		32		144	ns
$t_{PHL}$	Propagation delay	SDAA, SCLA	SDAB, SCLB		28		140	ns
$t_{TLH}^{(4)}$	Transition time	B side	30%	70%	88		ns	
		A side			37			
$t_{THL}$	Transition time	B side	70%	30%	5.40		32	ns
		A side			1.40		40	
$t_{su,en}^{(5)}$	Setup time, EN high before Start condition				100			ns

- Times are specified with loads of  $240\ \Omega \pm 1\%$  and  $400\ pF \pm 10\%$  on B-side and  $240\ \Omega \pm 1\%$  and  $200\ pF \pm 10\%$  on A-side. Different load resistance and capacitance alter the rise time, thereby changing the propagation delay and transition times.
- Times are specified with A-side signals pulled up to  $V_{CCA}$  and B-side signals pulled up to  $V_{CCB}$ .
- Typical values were measured with  $V_{CCA} = 0.9\ V$  and  $V_{CCB} = 2.5\ V$  at  $T_A = 25^{\circ}C$ , unless otherwise noted.
- $T_{TLH}$  is determined by the pull-up resistance and load capacitance
- EN should change state only when the global bus and the repeater port are in an idle state

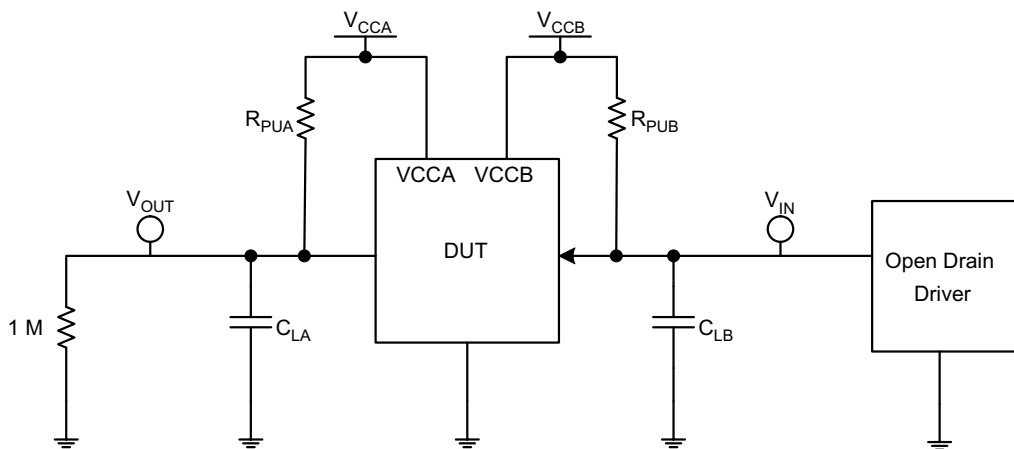
## 5.7 Typical Characteristics



## Parameter Measurement Information



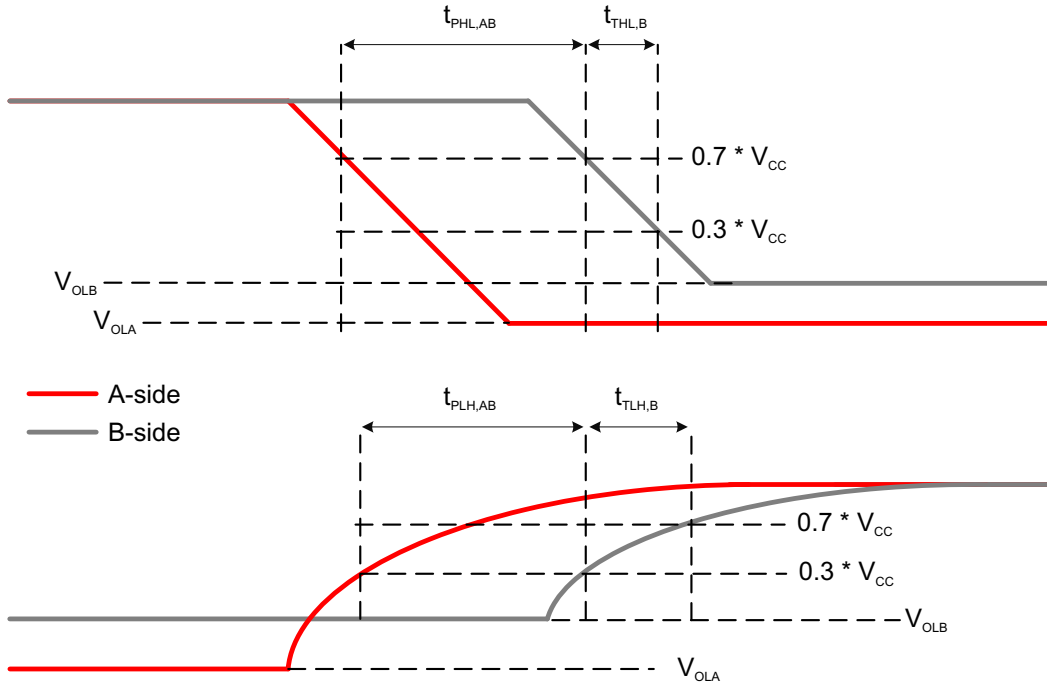
**Figure 6-1. Test Circuit for Open-Drain Output from A to B**



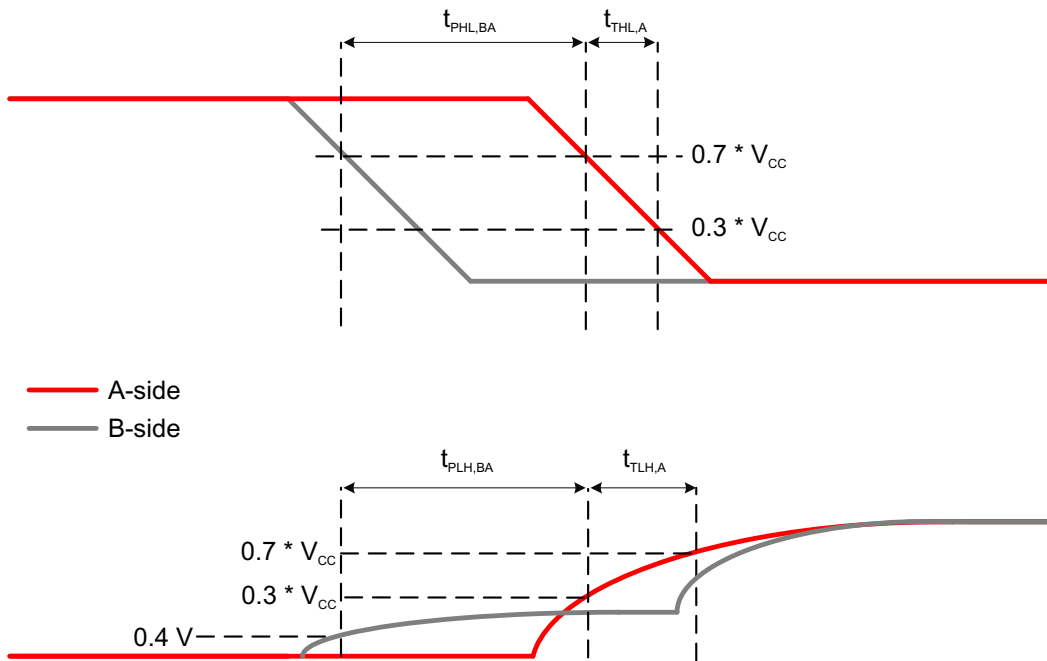
- A.  $V_{CCA} = 0.9V$
- B.  $V_{CCB} = 2.5V$
- C.  $R_{PUA} = R_{PUB} = 240\Omega$  on the A-side and the B-side
- D.  $C_{LA} = 200pF$  on A-side and  $C_{LB} = 400pF$  on B-side (includes probe and jig capacitance)
- E. All input pulses are supplied by generators having the following characteristics:  $PRR \leq 10MHz$ ,  $Z_O = 50\Omega$ , slew rate  $\geq 1V/ns$
- F. The outputs are measured one at a time, with one transition per measurement.

**Figure 6-2. Test Circuit for Open-Drain Output from B to A**





**Figure 6-3. Propagation Delay And Transition Times (A to B)**



**Figure 6-4. Propagation Delay And Transition Times (B to A)**

## 6 Detailed Description

### 6.1 Overview

The TCA9617A is a BiCMOS dual bidirectional buffer intended for I<sup>2</sup>C bus and SMBus systems. As with the standard I<sup>2</sup>C system, pull-up resistors are required to provide the logic high levels on the buffered bus. The TCA9617A has standard open-drain configuration of the I<sup>2</sup>C bus. The size of these pull-up resistors depends on the system, but each side of the repeater must have a pull-up resistor. The device is designed to work with Standard mode, Fast mode and Fast Mode+ I<sup>2</sup>C devices.

The TCA9617A B-side drivers operate from 2.2V to 5.5V. The output low level for this internal buffer is approximately 0.5V, but the input voltage must be below  $V_{IL}$  when the output is externally driven low. The higher-voltage low signal is called a buffered low. When the B-side I/O is driven low internally, the low is not recognized as a low by the input. This feature prevents a lockup condition from occurring when the input low condition is released. This type of design on the B side prevents TCA9617A from being used in series with another TCA9617A B-side or other buffers that incorporate a static or dynamic offset voltage. This is because these devices do not recognize buffered low signals as a valid low and do not propagate the signal as a buffered low again.

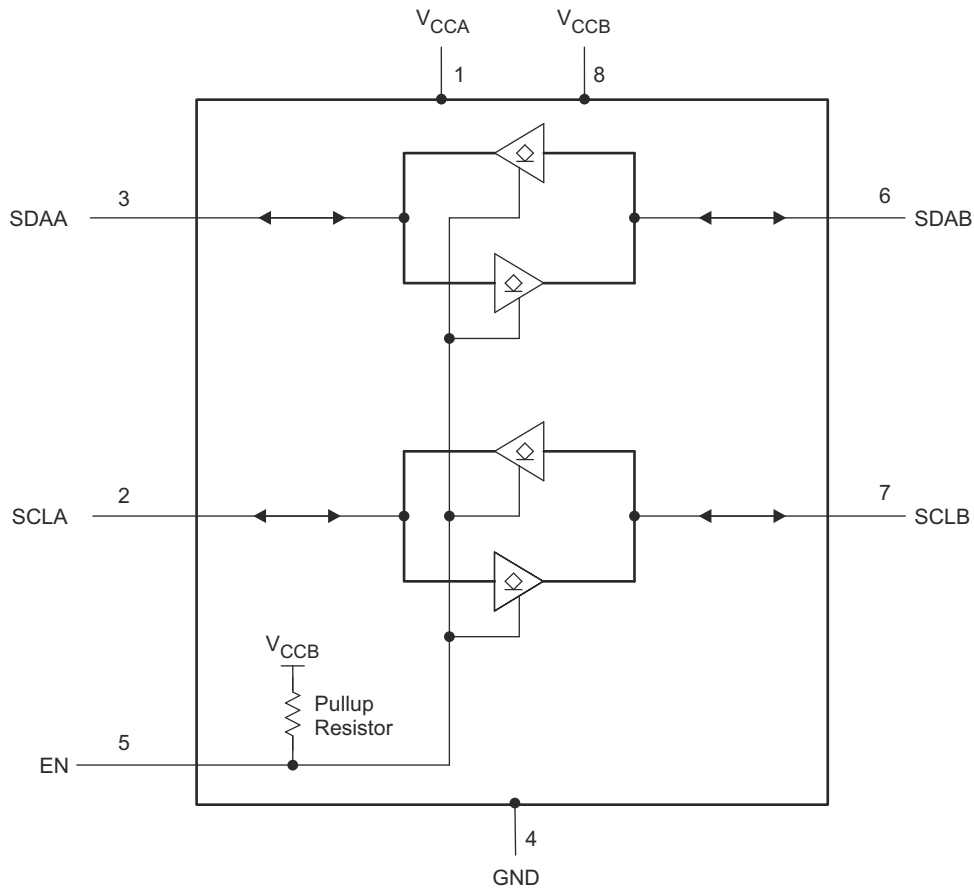
The TCA9617A A-side drivers operate from 0.8V to 5.5V and do not have the buffered low feature (or the static offset voltage). This means that a low signal on the B side translates to a nearly 0V low on the A side, which accommodates smaller voltage swings of low-voltage logic. The output pull-down on the A side drives a hard low, and the input level is set to 30% of  $V_{CCA}$  to accommodate the need for a lower low level in systems where the low-voltage-side supply voltage is as low as 0.8V.

The A side of two or more TCA9617As can be connected together to allow a star topology, with the A side on the common bus. Also, the A side can be connected directly to any other buffer with static or dynamic offset voltage. Multiple TCA9617As can be connected in series, A side to B side, with no buildup in offset voltage with only time-of-flight delays to consider.

The TCA9617A includes a power-up circuit that keeps the output drivers turned off until  $V_{CCB}$  is above 2V and  $V_{CCA}$  is above 0.7V.  $V_{CCA}$  is only used to provide references for the A-side input comparators and the power-good-detect circuit. The TCA9617A internal circuitry and all I/Os are powered by the  $V_{CCB}$  pin; however, due to ESD protection requirements on the SCLA and SDAA,  $V_{CCB}$  is required to power-up prior to  $V_{CCA}$ . If SDA and SCL (on A-side or B-side) are pulled up to a positive voltage before  $V_{CCB}$  is powered, there can be significant current leakage into the SCA and SCL pins that can cause them to be pulled down. The SDA and SCL lines shall not be pulled up to a voltage higher than  $V_{CCB}$ , even when the device is powered down.

After power up and with the EN high, the A side falling below 30% of  $V_{CCA}$  turns on the corresponding B-side driver (either SDA or SCL) and drives the B-side down momentarily to 0V before settling to approximately 0.5V. When the A-side rises above 30% of  $V_{CCA}$ , the B-side pull-down driver is turned off and the external pull-up resistor pulls the pin high. If the B side falls first and goes below 0.4V, the A-side driver is turned on and drives the A-side to 0V. When the B-side rises above 0.45V, the A-side pull-down driver is turned off and the external pull-up resistor pulls the pin high.

## 6.2 Functional Block Diagram



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## 6.3 Feature Description

### 6.3.1 Bidirectional Level Translation

The TCA9617A can provide bidirectional voltage level translation (up-translation and down-translation) between low voltages (down to 0.8V) and higher voltages (2.2V to 5.5V) in mixed-mode applications.

### 6.3.2 $V_{OL}$ B-side Offset Voltage

Figure 6-2 depicts the offset voltage on the B side of the device. As shown in Figure 6-2 the target releases and the B-side rises, and rises to 0.5V and stays there until the A-side rises above 30% of  $V_{CCA}$ . This effect can cause the low level signal to have a *pedestal*. Once the voltage on the A-side crosses 30% of  $V_{CCA}$ , the B-side begins to rise to  $V_{CCB}$ .

Due to nature of the B-side pedestal and the static offset voltage, there is a slight overshoot as the B-side rises from being externally driven low to the 0.5V offset. The TCA9617A is designed to control this behavior provided the system is designed with rise times greater than 20ns. Therefore, care must be taken to limit the pullup strength when devices with rise time accelerators are present on the B side. Excessive overshoot on the B-side pedestal can cause devices with rise time accelerators to trip prematurely if the accelerator thresholds are below 30% of  $V_{CCB}$ .

### 6.3.3 High to Low Transition Characteristics

When the A side of the bus is driven to 30% of  $V_{CCA}$ , the B side driver turns on. This drives the B-side to 0V for a short period (see Figure 6-2) and then the B-side rises to the static offset voltage of 0.5V ( $V_{OL}$  of TCA9617A). This effect, called an inverted pedestal, allows the B-side to drive to logic low much faster than driving to the static offset. Driving to the static offset voltage requires that the fall time be slowed to prevent ringing.

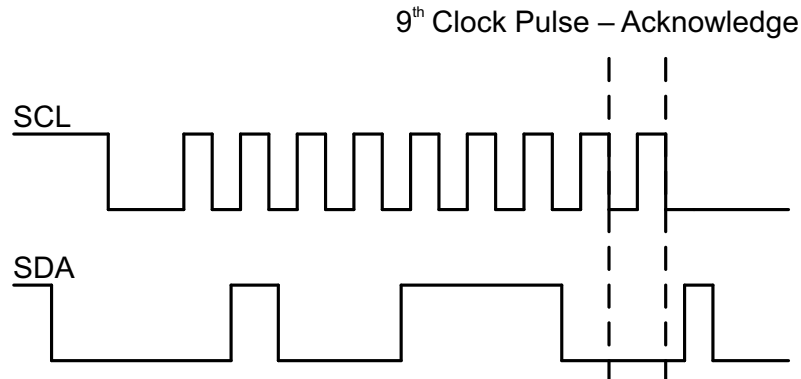


Figure 6-1. Bus A (0.8V to 5.5V Bus) Waveform

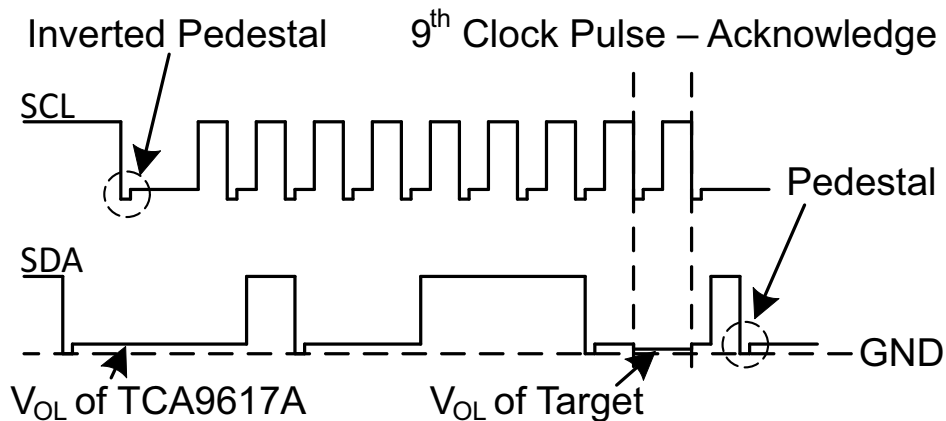


Figure 6-2. Bus B (2.2V to 5.5V Bus) Waveform

## 6.4 Device Functional Modes

The TCA9617A has an active-high enable (EN) input with an internal pull-up to  $V_{CCB}$ , which allows the user to select when the repeater is active. This can be used to separate a misbehaving target on power-up reset. The EN must never change state during an I<sup>2</sup>C operation. Disabling during a bus operation can hang the bus. Enabling part way through the bus cycles can confuse the I<sup>2</sup>C parts being enabled. The EN input must change state only when the global bus and repeater port are in the idle state to prevent system failures.

Table 6-1. Function Table

INPUT EN	FUNCTION
L	Outputs disabled
H	SDAA = SDAB SCLA = SCLB

## 7 Application and Implementation

### Note

Information in the following applications sections is not part of the TI component specification, and TI does not warrant its accuracy or completeness. TI's customers are responsible for determining suitability of components for their purposes, as well as validating and testing their design implementation to confirm system functionality.

### 7.1 Application Information

A typical application is shown in [Figure 7-1](#). In this example, the system controller is running on a 0.9V I<sup>2</sup>C bus, and the target is connected to a 2.5V bus. Both buses are running at 400kHz. Decoupling capacitors are required but are not shown in [Figure 7-6](#) for simplicity.

The TCA9617A is 5V tolerant so no additional circuits are required to translate between 0.8V to 5.5V bus voltages and 2.7V to 5.5V bus voltages.

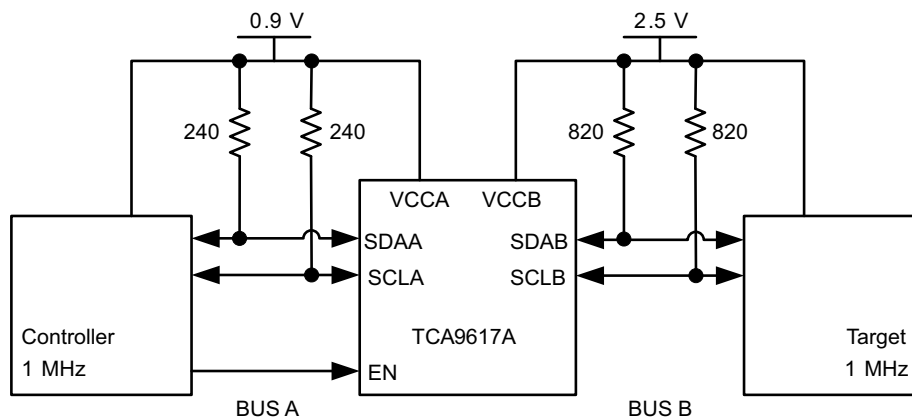
When the A side of the TCA9617A is pulled low by a driver on the I<sup>2</sup>C bus, a comparator detects the falling edge when the signal level goes below 30% of V<sub>CCA</sub> and cause the internal driver on the B side to turn on. The B-side is first pull down to 0V and then settle to 0.5V. When the B side of the TCA9617A falls below 0.4V, the TCA9617A detects the falling edge, turn on the internal driver on the A side and pull the A-side pin down to ground. To illustrate what can be seen for an A to B transition refer to [Figure 7-3](#), and for a B to A transition see [Figure 7-2](#).

On the B-side bus of the TCA9617A, the clock and data lines have a positive offset from ground equal to the V<sub>OL</sub> of the TCA9617A. After the eighth clock pulse, the data line is pulled to the V<sub>OL</sub> of the target device, which is close to ground in this example. At the end of the acknowledge, the level rises only to the low level set by the driver of the TCA9617A for a short delay (approximately 0.5V), while the A-side bus rises above 30% of V<sub>CCA</sub> and then continues high.

Although the TCA9617A has a single application, the device can exist in multiple configurations. [Figure 7-1](#) shows the standard configuration for the TCA9617A. Multiple TCA9617As can be connected either in star configuration ([Figure 7-4](#)) or in series configuration ([Figure 7-5](#)). The design requirements, detailed design procedure, and application curves in [Section 7.2.1](#) are valid for all three configurations.

### 7.2 Typical Application

#### 7.2.1 Standard Application



**Figure 7-1. Bidirectional Voltage Level Translator**

### 7.2.1.1 Design Requirements

For the level-translating application, the following must be true:

- $V_{CCA} = 0.8V$  to  $5.5V$
- $V_{CCB} = 2.2V$  to  $5.5V$
- $I_{OL} > I_O$

### 7.2.1.2 Detailed Design Procedure

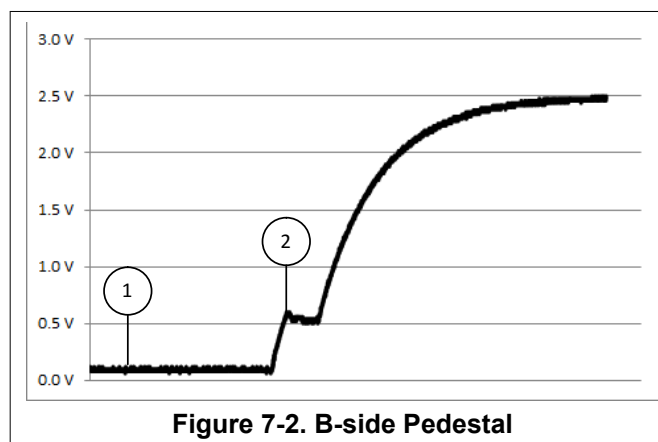
#### 7.2.1.2.1 Pullup Resistor Sizing

For the TCA9617A to function correctly, all devices on the B-side must be able to pull the B-side below the voltage input low contention level ( $0.4V$ ). This means that the  $V_{OL}$  of any device on the B-side must be below  $0.4V$  for proper operation.

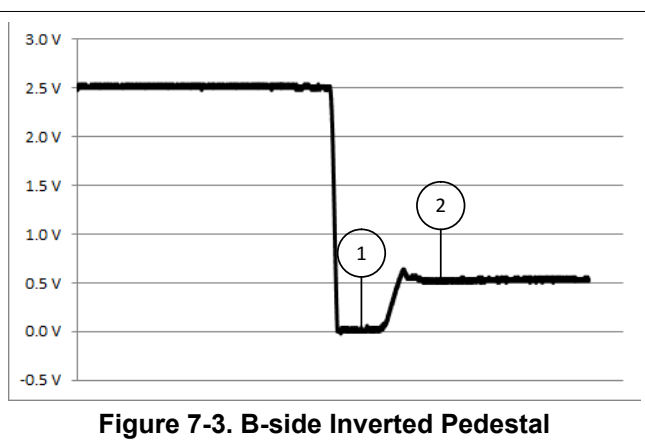
The  $V_{OL}$  of a device can be adjusted by changing the  $I_{OL}$  through the device which is set by the pull-up resistor value. The pull-up resistor on the B-side must be carefully selected to make sure the logic levels is transferred correctly to the A-side.

The B-side pull-up resistor sizing must also make sure that the rise time is greater than  $20ns$ . Shorter rise times increase the pedestal overshoot shown in [Figure 7-2](#).

#### 7.2.1.3 Application Curves



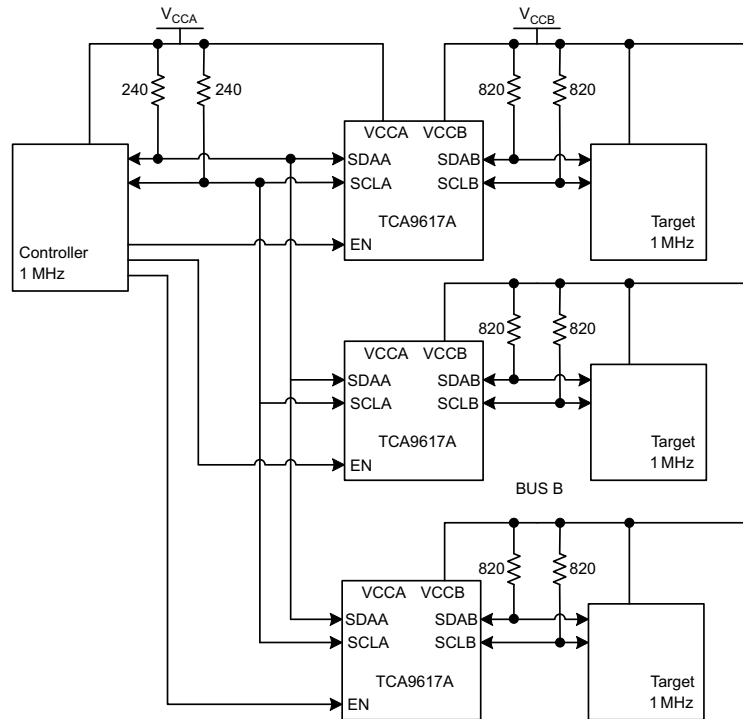
**Figure 7-2. B-side Pedestal**



**Figure 7-3. B-side Inverted Pedestal**

## 7.2.2 Star Application

Multiple TCA9617A A sides can be connected in a star configuration, allowing all nodes to communicate with each other.



**Figure 7-4. Typical Star Application**

### 7.2.2.1 Design Requirements

Refer to [Section 7.2.1.1](#).

### 7.2.2.2 Detailed Design Procedure

Refer to [Section 7.2.1.2](#).

### 7.2.2.3 Application Curves

Refer to [Section 7.2.1.3](#).

### 7.2.3 Series Application

Multiple TCA9617As can be connected in series as long as the A side is connected to the B side. I<sup>2</sup>C bus target devices can be connected to any of the bus segments. The number of devices that can be connected in series is limited by repeater delay/time-of-flight considerations on the maximum bus speed requirements.

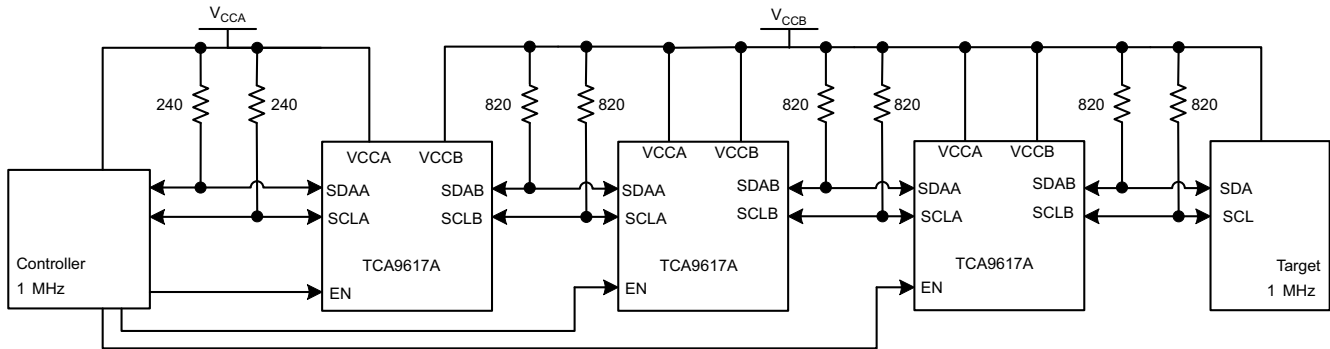


Figure 7-5. Typical Series Application

#### 7.2.3.1 Design Requirements

Refer to [Section 7.2.1.1](#).

#### 7.2.3.2 Detailed Design Procedure

Refer to [Section 7.2.1.2](#).

#### 7.2.3.3 Application Curves

Refer to [Section 7.2.1.3](#).

### 7.3 Power Supply Recommendations

For VCCA, an 0.8V to 5.5V power supply is required. For VCCB, a 2.2V to 5.5V power supply is required.

VCCB can always be higher than VCCA. VCCB cannot be lower than VCCA even when the device is disabled. During power-up, VCCB must rise before VCCA.

Standard decoupling capacitors are recommended. These capacitors typically range from 0.1μF to 1μF, but the value of the capacitance depends on the frequencies of noise from the power supply.

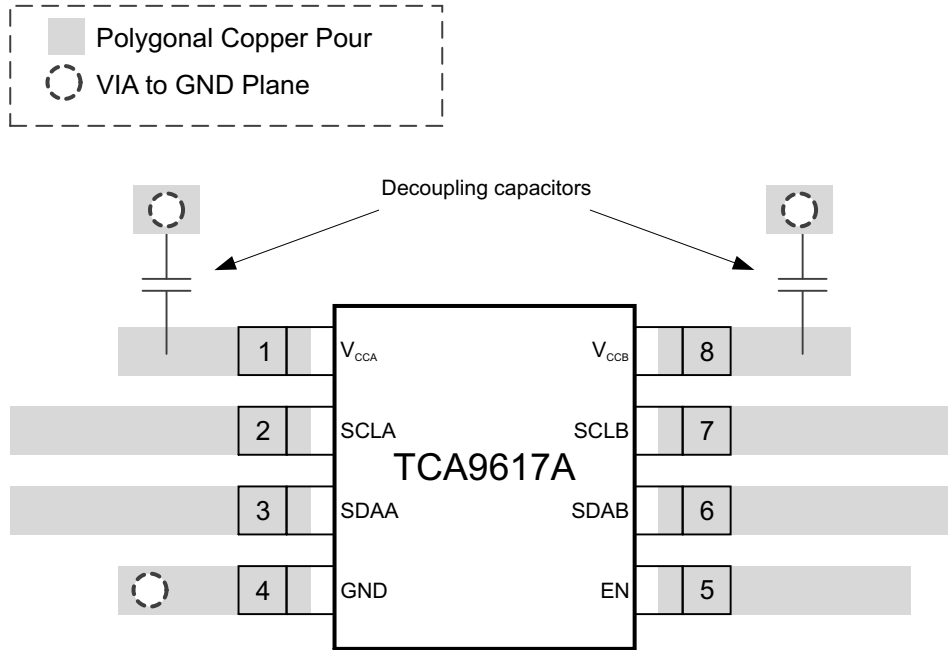


## 7.4 Layout

### 7.4.1 Layout Guidelines

The recommended decoupling capacitors must be placed as close to the VCCA and VCCB pins of the TCA9617A as possible.

### 7.4.2 Layout Example



**Figure 7-6. Layout Schematic**

## 8 Device and Documentation Support

### 8.1 Receiving Notification of Documentation Updates

To receive notification of documentation updates, navigate to the device product folder on ti.com. In the upper right corner, click on *Alert* me to register and receive a weekly digest of any product information that has changed. For change details, review the revision history included in any revised document.

### 8.2 Support Resources

TI E2E™ [support forums](#) are an engineer's go-to source for fast, verified answers and design help — straight from the experts. Search existing answers or ask your own question to get the quick design help you need.

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### 8.3 Trademarks

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### 8.4 Electrostatic Discharge Caution



This integrated circuit can be damaged by ESD. Texas Instruments recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

### 8.5 Glossary

[TI Glossary](#)

This glossary lists and explains terms, acronyms, and definitions.

## 9 Revision History

<b>Changes from Revision B (December 2018) to Revision C (January 2024)</b>	<b>Page</b>
• Changed all instances of legacy terminology to controller and target where mentioned.....	1
• Changed the Device Information table to <i>Package Information</i> table.....	1
• Changed <i>isolate</i> to <i>separate</i> in the <i>Description</i> .....	1
• Deleted "or greater bus capacitance".....	1
• Added internal pull-up resistor information on EN pin.....	3
• Changed abs max voltages from 7V to 6.5V.....	4
• Changed the Thermal Information for 8 DGK.....	5
• Changed $V_{IK}$ MAX value of -1.2V to a MIN value.....	5
• Changed $T_{PLH}$ (B to A) by removing typical value.....	7
• Changed $T_{PLH}$ (A to B) for $V_{CCB} \leq 3V$ by changing min value from 59ns to 50ns and removing typical value.....	7
• Changed $T_{PLH}$ (A to B) for $V_{CCB} > 3V$ by removing typical value.....	7
• Changed $T_{PHL}$ (B to A) by changing min value from 69ns to 32ns and removing typical value.....	7
• Changed $T_{PHL}$ (A to B) by changing min value from 68ns to 28ns and removing typical value.....	7
• Changed $T_{THL}$ (B side) by changing max value from 13.8ns to 32ns and removing typical value.....	7
• Changed $T_{THL}$ (B side) by changing max value from 11.3ns to 40ns and removing typical value.....	7
• Changed $0.3V_{CCA}$ to: <i>30% of <math>V_{CCA}</math></i> in the <i>Overview</i> .....	10
• Changed A side falling below $0.7V_{CCA}$ to: <i>A side falling below 30% of <math>V_{CCA}</math></i> .....	10
• Changed goes below $0.7V_{CCB}$ to: <i>goes below 0.4V</i> .....	10
• Changed "70mV or more below the output low level" to: <i>goes below <math>V_{IL}</math></i> .....	10
• Changed $0.3V_{CCA}$ to: <i>30% of <math>V_{CCA}</math></i> in the <i>Low to High Transition Characteristics</i> .....	11
• Changed "accelerator thresholds are below 30% of $V_{CCB}$ " to: "overshoot is more than accelerator thresholds".....	11
• Deleted <i>Since the A-side does not have a static offset low voltage, no pedestal is seen on the A-side as shown in Bus A (0.8V to 5.5V Bus) Waveform</i> .....	11
• Changed $0.7V_{CCA}$ to <i>30% of <math>V_{CCA}</math></i> in the <i>High-to-Low Transition Characteristics</i> .....	12
• Changed <i>isolate a badly behaved</i> to <i>separate a misbehaving</i> in the <i>Device Functional Modes</i> .....	12
• Changed $0.7V_{CCA}$ to <i>30% of <math>V_{CCA}</math></i> in the <i>Application Information</i> .....	13
• Changed falls below 0.45V to: <i>falls below 0.4V</i> .....	13
• Changed (0.45V) to: <i>(0.4V)</i> in the <i>Pullup Resistor Sizing</i> .....	14
<hr/>	
<b>Changes from Revision A (July 2014) to Revision B (December 2018)</b>	<b>Page</b>
• Changed the appearance of the DGK pin out image .....	3
• Deleted $V_{CCA} < V_{CCB}$ from the Design Requirements list.....	14
<hr/>	
<b>Changes from Revision * (June 2013) to Revision A (July 2014)</b>	<b>Page</b>
• Deleted " Powered-Off High-Impedance I <sup>2</sup> C Pins" from Features list.....	1
• Added Applications. ....	1
• Added Typical Characteristics section. ....	7
• Added Application and Implementation section. ....	13
• Added Power Supply Recommendations section. ....	16

## 10 Mechanical, Packaging, and Orderable Information

The following pages include mechanical, packaging, and orderable information. This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser-based versions of this data sheet, refer to the left-hand navigation.

**PACKAGING INFORMATION**

Orderable part number	Status (1)	Material type (2)	Package   Pins	Package qty   Carrier	RoHS (3)	Lead finish/ Ball material (4)	MSL rating/ Peak reflow (5)	Op temp (°C)	Part marking (6)
<a href="#">TCA9617ADGKR</a>	Active	Production	VSSOP (DGK)   8	2500   LARGE T&R	Yes	NIPDAU   SN   NIPDAUAG	Level-1-260C-UNLIM	-40 to 85	(7EA, DWK)
TCA9617ADGKR.Z	Active	Production	VSSOP (DGK)   8	2500   LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 85	(7EA, DWK)

(1) **Status:** For more details on status, see our [product life cycle](#).

(2) **Material type:** When designated, preproduction parts are prototypes/experimental devices, and are not yet approved or released for full production. Testing and final process, including without limitation quality assurance, reliability performance testing, and/or process qualification, may not yet be complete, and this item is subject to further changes or possible discontinuation. If available for ordering, purchases will be subject to an additional waiver at checkout, and are intended for early internal evaluation purposes only. These items are sold without warranties of any kind.

(3) **RoHS values:** Yes, No, RoHS Exempt. See the [TI RoHS Statement](#) for additional information and value definition.

(4) **Lead finish/Ball material:** Parts may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

(5) **MSL rating/Peak reflow:** The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will be used to mount the part to the printed circuit board.

(6) **Part marking:** There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "~" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

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**TAPE AND REEL INFORMATION**

**QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE**


\*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
TCA9617ADGKR	VSSOP	DGK	8	2500	330.0	12.4	5.3	3.4	1.4	8.0	12.0	Q1

## TAPE AND REEL BOX DIMENSIONS



\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
TCA9617ADGKR	VSSOP	DGK	8	2500	353.0	353.0	32.0

DGK0008A



# PACKAGE OUTLINE

VSSOP - 1.1 mm max height

SMALL OUTLINE PACKAGE



NOTES:

PowerPAD is a trademark of Texas Instruments.

1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. This dimension does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.15 mm per side.
4. This dimension does not include interlead flash. Interlead flash shall not exceed 0.25 mm per side.
5. Reference JEDEC registration MO-187.

# EXAMPLE BOARD LAYOUT

DGK0008A

™ VSSOP - 1.1 mm max height

SMALL OUTLINE PACKAGE



LAND PATTERN EXAMPLE  
EXPOSED METAL SHOWN  
SCALE: 15X



SOLDER MASK DETAILS

4214862/A 04/2023

NOTES: (continued)

6. Publication IPC-7351 may have alternate designs.
7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.
8. Vias are optional depending on application, refer to device data sheet. If any vias are implemented, refer to their locations shown on this view. It is recommended that vias under paste be filled, plugged or tented.
9. Size of metal pad may vary due to creepage requirement.



# EXAMPLE STENCIL DESIGN

DGK0008A

™ VSSOP - 1.1 mm max height

SMALL OUTLINE PACKAGE



SOLDER PASTE EXAMPLE  
SCALE: 15X

4214862/A 04/2023

NOTES: (continued)

11. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
12. Board assembly site may have different recommendations for stencil design.

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